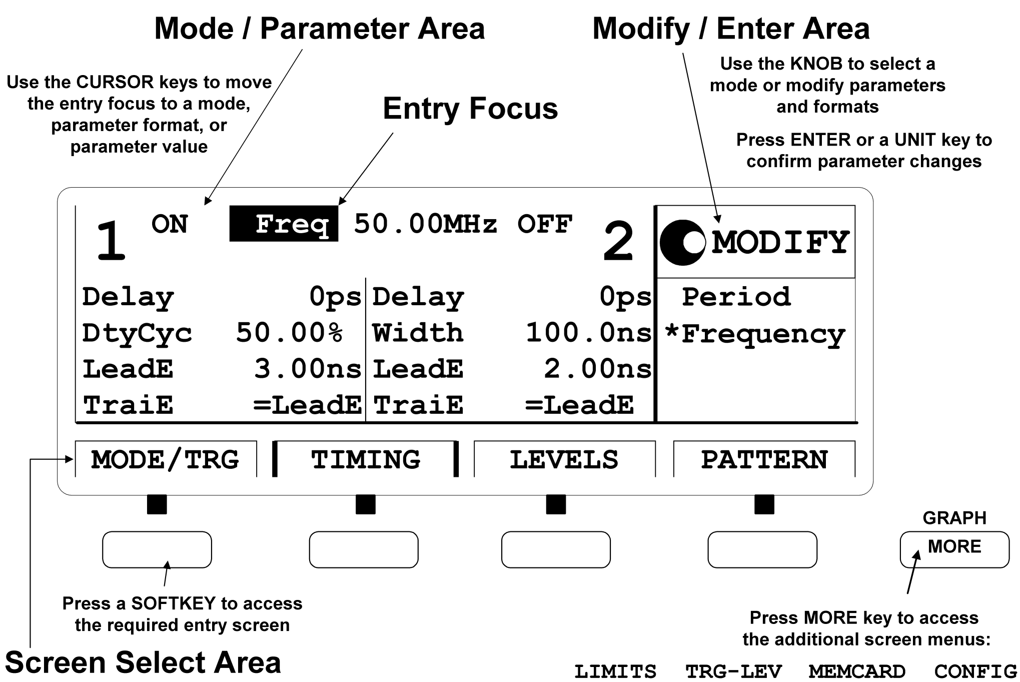
HEWLETT® PACKARD

Reference Guide

HP 81110A 165/330 MHz,
HP 81104A 80 MHz
Pulse/Pattern Generators

Front Panel Display and Softkeys



Reference Guide

HP 81110A 165/330 MHz, HP 81104A 80 MHz Pulse/Pattern Generators

HP Part No. 81110-91010
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NOTICE

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Safety

For safety information, please refer to the Installation and Safety Requirements chapter in the HP 81110A and HP 81104A Quick Start Guide.

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The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States Institute of Standards and Technology, to the extent allowed by the Institute's calibrating facility, and to the calibration facilities of other International Standards Organization members.

About this book

This reference guide gives you in-depth operating hints and a list of the device commands to program the instrument with all possible modules installed. In addition in the specification chapter the valid instrument specification are provided.
The information is valid for HP 81104A and HP 81110A. Where required the differences are explicitly mentioned. Possible configurations are:

Output Module for HP 81104A Mainframe:

Module	Description	Max Quantity
HP 81105A	10V/ max.80 MHz Output Channel	2

Output Modules for HP 81110A Mainframe:

Module	Description	Max Quantity
HP 81111A	10V/ max. 165 MHz Output Channel	2

Module	Description	Max Quantity
HP 81112A	3.8V/ max. 330 MHz Output Channel	2

As standard the instruments are equipped with one output channel, so, some of the described features will not be available.

Installing

Please refer to the Quick Start Guide, p/n 81110-91010.

Introduction

Please refer to the Quick Start Guide, p/n 81110-91010.

Getting Started

Please refer to the Quick Start Guide, p/n 81110-91010.

Operating Reference

A reference for using the front panel parameter screens to operate the instrument with diagrams of signal outputs in different operating modes.

Programming Reference

A SCPI reference for programming the instrument via HI-IB.

Specifications

The valid specifications of the HP 81110A and HP 81104A.

Table of Contents

Chapter 3 Specifications

Chapter 1

Operating Reference

Introduction

This chapter is a reference guide for operating the instrument using the frontpanel controls. It contains information on using the **HELP** key and the main frontpanel controls, followed by a reference section for each of the parameter screens selected by the softkeys under the display:

Using Help

Parameter Help **|ON FIELD|**

If there are no Warnings or Errors (Refer to "Warnings and Errors" on page 97.) press the **HELP** key at any time to obtain information about the current location of the parameter cursor. The help information gives a short description of the parameter or setting options and the SCPI command(s) syntax for programming the parameter or setting. Use the MODIFY knob or the CURSOR keys to scroll through the help information if there is more than one screen available.

Press **|EXIT HELP|** or **HELP** again to return to normal operation.

Concept Help **|CONCEPT|**

If there are no Warnings or Errors (Refer to "Warnings and Errors" on page 97.) press the **HELP** key followed by the **|CONCEPT|** softkey to view a short description of the instrument.

Serial Numbers and Software Revision **|SERIAL #|**

If there are no Warnings or Errors (Refer to "Warnings and Errors" on page 97.) press the **HELP** key followed by the **|SERIAL #|** softkey to see a list of the installed boards and their serial numbers followed by the software revision code of the instrument's firmware.

Warning Help `|WARNINGS|`

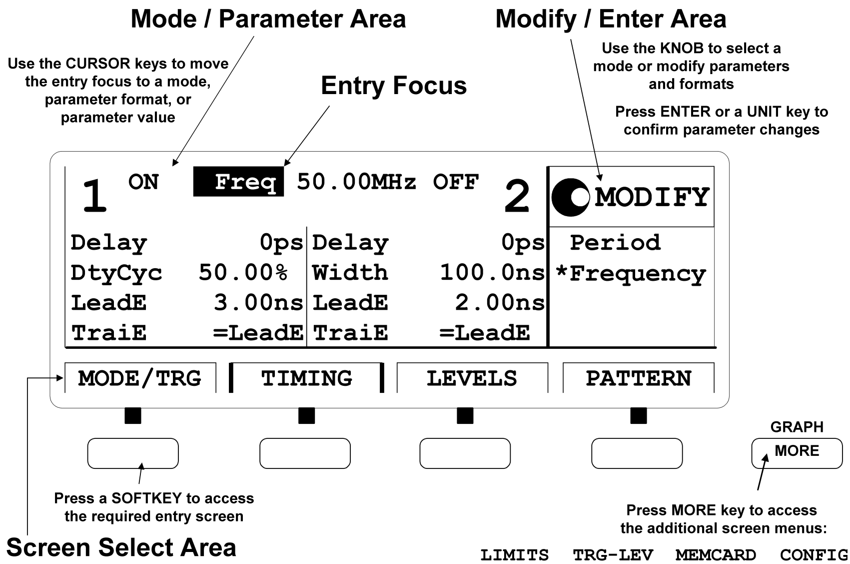
If a Warning condition occurs, indicated by a flashing **`W`**, press **HELP** to see a list of the current warning messages.

Error Queue `|ERROR QU|`

If an Error condition occurs, indicated by a flashing **`E`**, press **HELP** to see a list of the current error messages.

Front Panel Controls

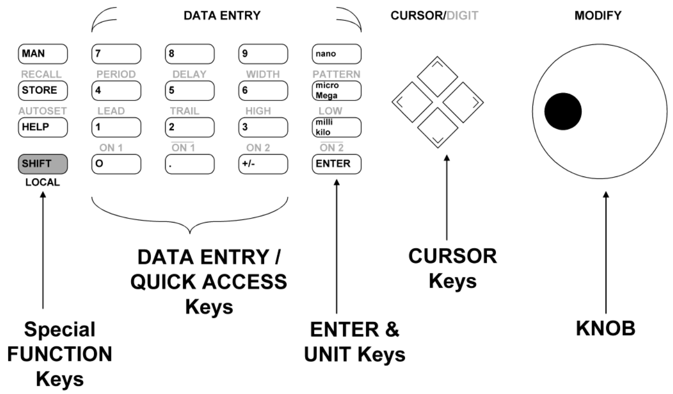
Figure 1 Front Panel Display and Softkeys



Softkeys and MORE

There are four softkeys underneath the display. Use the softkeys to select the parameter screens. The names of the parameter screens are displayed above the softkeys. Press MORE to display alternative parameter screens.

Figure 2 Front Panel Controls



SHIFT / LOCAL Key

Press SHIFT to enter SHIFT-mode. A flashing **S** indicates that you are in SHIFT-mode. The extra functions available in SHIFT-mode are shown in blue *above* the keys.

NOTE: Note that when using the DIGIT keys (CURSOR keys in SHIFT-mode) you must press SHIFT again to exit from SHIFT-mode.

When the instrument is programmed via the HP-IB it enters remote mode and disables the frontpanel controls. Press the SHIFT key to return to LOCAL operating mode.

AUTOSET HELP Key

Press HELP to obtain help on the currently selected parameter/setting.

Press AUTOSET (SHIFT HELP) to set the instrument to a valid setting based on the actual period setting.

RECALL STORE Key

Press STORE to store the current instrument setting in one of 9 memories.

Press RECALL(SHIFT STORE) to recall a complete instrument setting from one of the 9 memories, or to **recall the default instrument settings from memory 0.**

MAN Key

Use the MAN key to generate a manual trigger or gate signal when the instrument is running in **`TRIGGERED`** or **`GATED`** trigger mode with the **`MAN`** key as the selected trigger/gate source.

DATA ENTRY

Use the DATA ENTRY keys to quickly enter a parameter value into the Modify Window. Enter the numeric value followed by the appropriate unit key, or press **ENTER** where appropriate.

During the data entry you can press CANCEL (**SHIFT** **ENTER**) to cancel the entry or use the cursor left < to backspace the digit-cursor.

Use the **SHIFT** DATA ENTRY functions indicated in blue above the keys to quickly select a particular parameter.

CURSOR/DIGIT

Use the CURSOR keys to move the entry field on the parameter screens. The entry field highlights the currently selected parameter, parameter format or mode which is then displayed in the Modify Window at the right hand side of the display.

In SHIFT-mode the CURSOR keys move the digit-cursor within the Modify Window and vernier the value of the selected digit.

MODIFY knob

Use the knob to modify the selected parameter in the Modify Window, or to select a setting from the list displayed in the Modify window.

On the **|PATTERN|** screen when the cursor is located in the bit-editing window you can use the knob to scroll through the pattern data. Modify the data with the DATA ENTRY keys.

When **+ENTER** is displayed, make the selection and press the **ENTER** key to start a function.

Connectors

EXT INPUT

You can use an external signal connected to the EXT INPUT to trigger the instrument by selecting **`TRIGGERED`** mode and **`Triggered by EXT-IN`** on the **`|MODE/TRG|`** screen.

You can use an external signal connected to the EXT INPUT to gate (enable/disable) the instrument by selecting **`GATED`** mode and **`Gated by`***:* **`EXT-IN`** on the **`|MODE/TRG|`** screen.

You can use an external signal connected to the EXT INPUT to generate leading and trailing edges by selecting **`EXT_WIDTH`** mode and **`Width: EXT-IN`** on the **`|MODE/TRG|`** screen.

TRIGGER OUT

The TRIGGER OUT signal generates an output pulse for each pulse-period generated by the instrument.

You can set the output levels to TTL or ECL on the **`|TRG-LEV|`** screen.

STROBE OUT

In **`PULSES`** mode, the STROBE OUT signal is not used.

In **`BURST`** mode, the STROBE OUT signal marks the start and end of each burst of pulses generated. The rising edge of the STROBE signal is synchronized to the start of the first pulse-period in a burst, the falling edge is synchronized to the start of the last pulse-period in the burst. (see Figure 5 on page 38 for example)

In **`PATTERN`** mode, the STROBE OUT signal is bit-programmable on the **`|PATTERN|`** page. The pulse-width is not programmable, only NRZ pulses are generated. (Figure 6 on page 39 for example)

Table 1: Trigger and Strobe Availability

	Pulse Mode	Burst Mode	Pattern Mode
Continuous	T[1]	T, S[2]	T, S
Triggered	T	T, S	T, S
Gated	T	T, S	T, S
Ext. Width	T	n/a	n/a

[1] T = Trigger Out
[2] S = Strobe Out

You can set the output level to TTL or ECL on the **`|TRG/LEV|`** screen.

Regular User Interface Tasks

Switching Outputs ON/OFF

Switch the OUTPUT signal on and off in the **|LEVELS|** and **|TIMING|** screens.

NOTE: You can use the short-cut keys SHIFT 0 (ON/OFF 1) for output 1 or SHIFT +/- (ON/OFF 2) for output 2 to quickly toggle the OUTPUTS on and off.

Modifying the Value of a Parameter

You can adjust a parameter value in graphics or text mode. Example screens are shown in the following subsections for graphics mode only.

1 Move the parameter cursor onto the value you want to modify using the CURSOR keys.

2 Modify the value with the knob.

NOTE: Note that when you use the knob, the parameter range can be restricted to prevent any warnings or errors occurring (refer to “Warnings and Errors” on page 97.). Overprogramming - If you want to set a value outside this temporary range, use the DATA

ENTRY keys or press **SHIFT** and turn the knob. If you try to set a value outside the absolute maximum or minimum limits, the maximum or minimum limit will be set.

Modifying the Format of a Parameter

NOTE: You can only modify the format of a parameter in text mode

Many parameters can be displayed in different formats, for example the pulse period can be displayed as a period or frequency. To modify the format of a parameter:

1. If you are in GRAPHics mode, select TEXT mode with **SHIFT** **MORE**
2. Move the cursor onto the parameter name.
3. Use the MODIFY knob to select a parameter format from the list in the MODIFY window.

Toggling Graphics and Text Mode

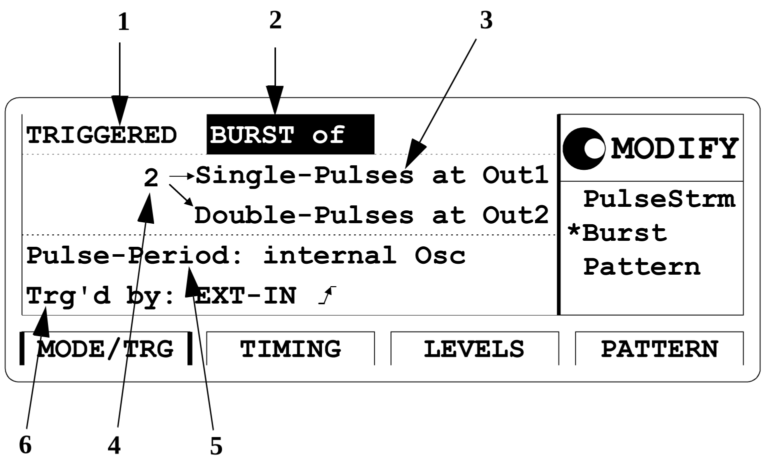
The TIMING, LEVELS and PATTERN screens can be toggled between graphic and text mode by pressing the corresponding softkey or the

SHIFT **GRAPH MORE** keys.

NOTE: Note that in graphics mode you can only adjust the values of each parameter, not the parameter format. If you want to change the format of a parameter, for example **`Offset/Amplit`** to **`High/Low`**, you must be in text mode to select the parameter name with the cursor.

|MODE/TRG| Screen

Figure 3 **Typical `|MODE/TRG|` screen**



Use the **`|MODE/TRG|`** page to set up the overall operating modes of the instrument. For summaries of main settings available on screen see Table 2. The numbers in Figure 2 relate to the numbers in Table 1.

Table 2: `|MODE/TRG|` Summary of modes

1 Trigger Mode	**CONTINUOUS**			**TRIGGERED**			**GATED**			**EXT WIDTH**
2 Pulse Mode	**PULSES**	**BURST**	**PATTERN**	**PULSES**	**BURST**	**PATTERN**	**PULSES**	**BURST**	**PATTERN**	
3 Pulse Type	Single/Double		RZ/NRZ	Single/Double		RZ/NRZ	Single/Double		RZ/NRZ	
4 Length		2-65536	2-16384[1]		2-65536	2-16384[1]		2-65536	2-16384[1]	
5 Period Source	int Osc int PLL CLK-IN				int Osc int PLL CLK-IN		int Osc int PLL CLK-IN			
6 Arming Source				MAN-Key EXT INPUT	MAN-Key EXT INPUT PLL[2]		MAN-Key EXT INPUT			MAN-Key EXT INPUT
TRIGGER OUT	Marks each pulse-period generated									
STROBE OUT	Not Used	↑on 1st ↓on last	Program-mable	Not Used	↑on1st ↓on last	Program mable	Not Used	↑on 1st ↓on last	Program mable	Not Used

[1] Set `Last` on `|PATTERN|` screen
[2] PLL cannot be used as Pulse and Arming source at the same time

To change a setting, move the entry field onto the setting using the CURSOR keys and modify the setting with the MODIFY knob.

The following sections explain the mode combinations in more detail.

General Information

NOTE: For intrinsic fixed delays refer to Chapter 3, Specifications, for typical values

`Single-Pulses` Single pulse per period, delay parameter sets delay to leading-edge from start of period.

`Double-Pulses` Double pulse per period, double-delay parameter sets delay between leading-edges of pulses.

- Select pulse-period source (See **5** in Figure 3 on page 34)
- As the PLL clock is fitted, select the pulse-period source (See **5** in Figure 3 on page 34):
  - **`internal Osc`** `(VFO)`
  - **`internal PLL`** (Higher accuracy)
  - **`ext CLK-IN`** (External signal), synchronize to rising or falling edge.

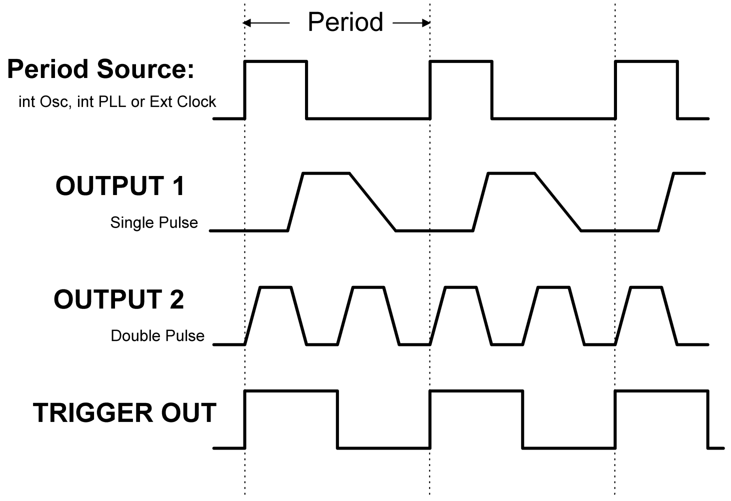
Data Output Formats

`RZ` A single pulse is generated in each pulse-period with data value 1, no pulse is generated for data value 0.

`NRZ` A leading-edge is generated for a 0→1 data transition, a trailing-edge is generated for a 1→0 data transition.

`CONTINUOUS PULSES` Mode

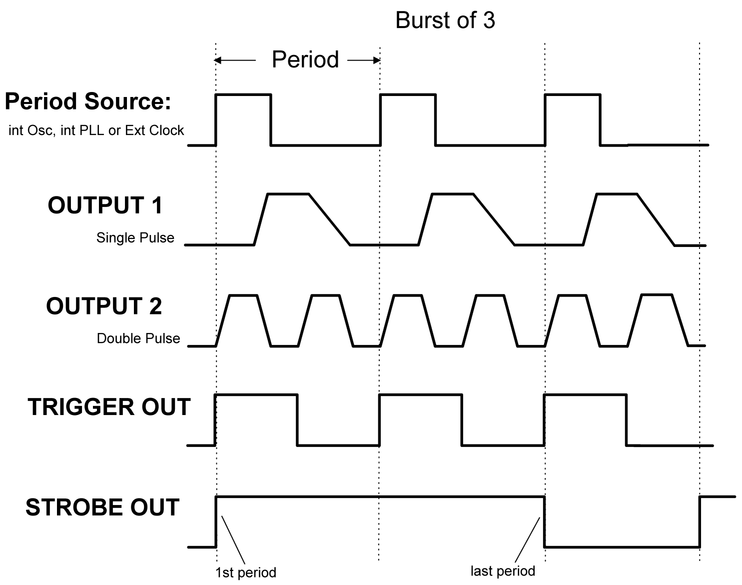
Figure 4 Timing Diagram: `CONTINUOUS PULSES`



- Pulse-periods are generated continuously
- Select between Single and Double-pulses per pulse-period for each OUTPUT (See **3** in Figure 3 on page 34)
- As the PLL clock is fitted, select the pulse-period source (See **5** in Figure 3 on page 34)
  - **`internal Osc`** `(VFO)`
  - **`internal PLL`** (Higher accuracy)
  - **`ext CLK-IN`** (External signal), synchronize to rising or falling edge.
- TRIGGER OUT marks each pulse period.
- STROBE OUT not used in continuous pulse mode.

`CONTINUOUS BURST` Mode

Figure 5 Timing Diagram:`CONTINUOUS BURST`

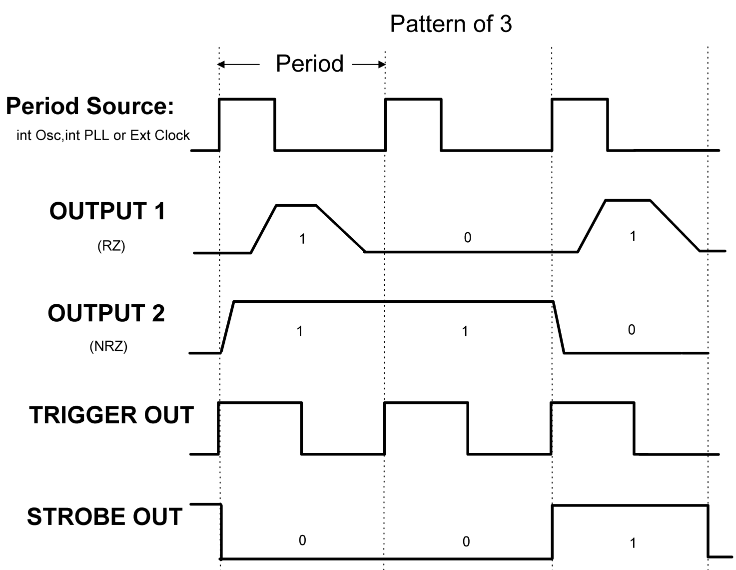


- A burst of pulse-periods is repeated continuously. The OUTPUT signal is the same as **`PULSES`** mode, but the STROBE OUT now marks the beginning and end of each burst.
- Select the number of pulse-periods per burst in the range 2 - 65536 (See **4** in Figure 3 on page 34).
- Select between Single and Double-pulses per pulse-period for each OUTPUT (See **3** in Figure 3 on page 34).
- Select pulse-period source (see **5** in Figure 3 on page 34)
- TRIGGER OUT marks each pulse period.
- STROBE OUT rises at the start of the first pulse-period in a burst and

falls at the start of the last pulse-period.

`CONTINUOUS PATTERN` Mode

Figure 6 Timing Diagram: `CONTINUOUS PATTERN`



- A pattern of pulses is repeated continuously.
- Select between RZ and NRZ data pulses for each OUTPUT (See **3** in Figure 3 on page 34):

`RZ` A single pulse is generated in each pulse-period with data value 1, no pulse is generated for data value 0.

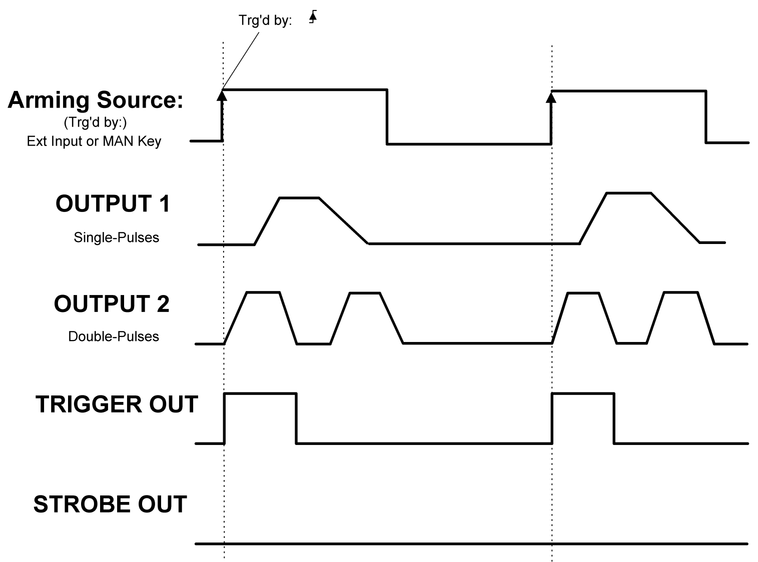
`NRZ` A leading-edge is generated for a 0 →1 data transition, a trailing-edge is generated for a 1→0 data transition.

- Select the pulse-period source (See **5** in Figure 3 on page 34)

- Select the **|PATTERN|** screen to set the pattern length in the range 2-16 384.
- Select the **|PATTERN|** screen to program the data values for each OUTPUT.
- TRIGGER OUT marks each pulse period.
- STROBE OUT is bit-programmable, like the OUTPUTS, in NRZ format on the **|PATTERN|** screen.

`TRIGGERED PULSES` Mode

Figure 7 Timing Diagram: TRIGGERED PULSES

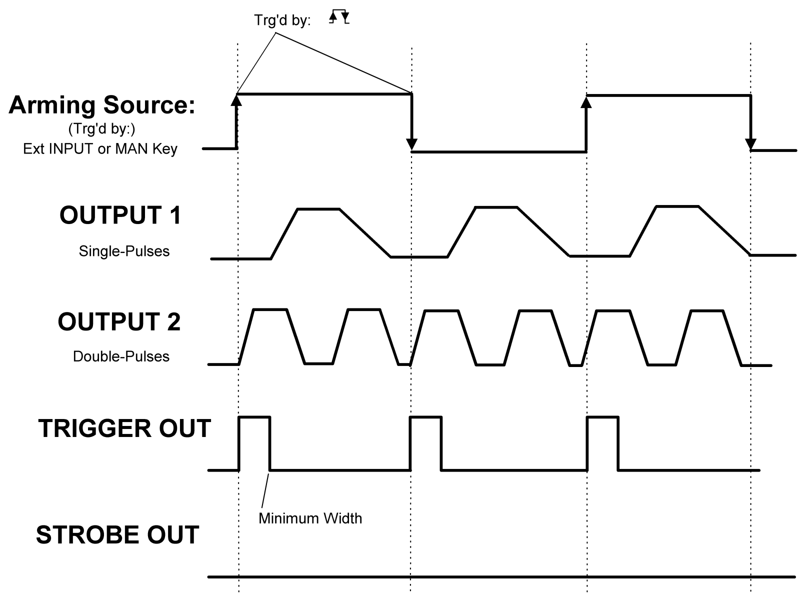


- Single pulse-periods are triggered by (**`Trg’d by`**) an active edge at the selected arming source (See **6** in Figure 3 on page 34)

  - MAN Key **MAN** on frontpanel, triggered by press or release or both.
  - EXT INPUT (External signal) triggered by rising or falling or both edges (Figure 8 on page 42).

NOTE: The PLL cannot be selected as the arming source. Select **`CONTINUOUS PULSES`** mode with the PLL as **`Period source`** to achieve the same result.

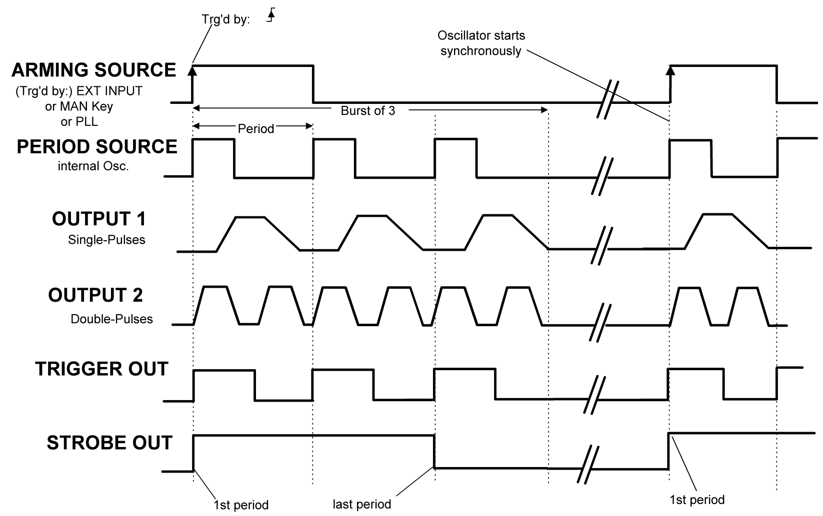
Figure 8 Timing Diagram: `TRIGGERED PULSES Trg'd by Both`



- Select between Single and Double-pulses per pulse-period for each OUTPUT (See **3** in Figure 3 on page 34)
- TRIGGER OUT marks each pulse period.
- STROBE OUT not used in triggered pulses mode.

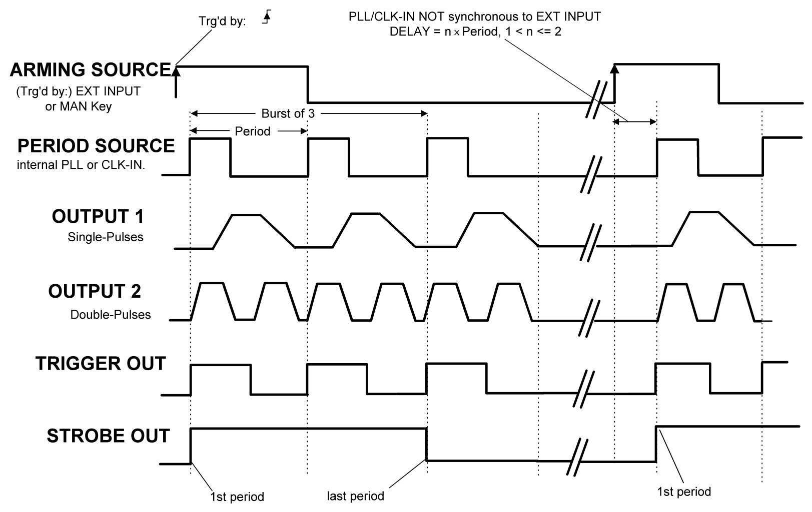
`TRIGGERED BURST` Mode

Figure 9 Timing Diagram: TRIGGERED BURST Pulse-Period: internal Osc



- A burst of pulse-periods is triggered by (Trg'd by) an active edge at the selected arming source (See **6** in Figure 3 on page 34)
  - **`MAN Key`** MAN on frontpanel, triggered by press or release or both.
  - **`EXT INPUT`** (External signal) triggered by rising or falling or both edges.
  - **`PLL`** (Internally triggered bursts), select the triggering period.
- Select the number of pulse-periods per burst in the range 2 - 65536 (See **4** in Figure 3 on page 34).
- Select between Single and Double-pulses per pulse-period for each OUTPUT (See **3** in Figure 3 on page 34).

Figure 10 Timing Diagram: `TRIGGERED BURST` `Pulse-Period:` `internal PLL` or `CLK-IN`



Select the pulse-period source. (See **5** in Figure 3 on page 34)

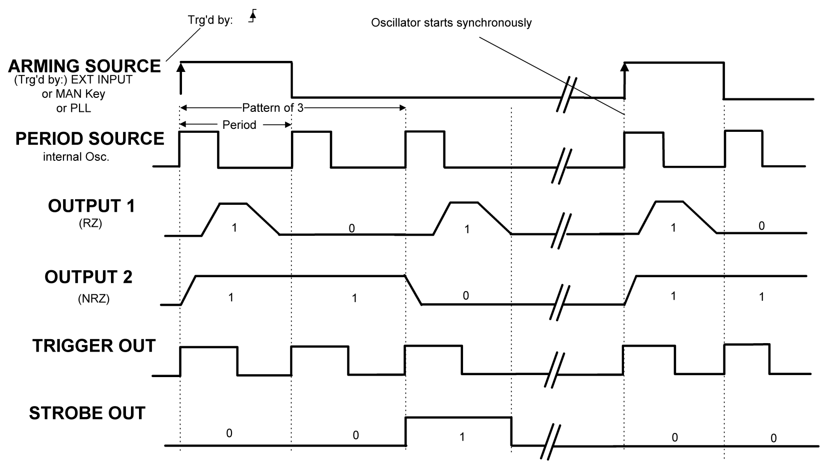
- **`internal Osc`** (start of burst synchronized to trigger, see Figure 9 on page 43)
- **`internal PLL`** (Higher accuracy, start of burst not synchronized to trigger, see Figure 10 on page 44)
- **`ext CLK-IN`** (External signal), pulse-period synchronized to rising or falling edge.

NOTE: You cannot use the PLL as both Pulse-Period source and Trg'd by (arming) source at the same time.

- TRIGGER OUT marks each pulse period.
- STROBE OUT rises at the start of the first pulse-period in a burst and falls at the start of the last pulse-period.

`TRIGGERED PATTERN` Mode

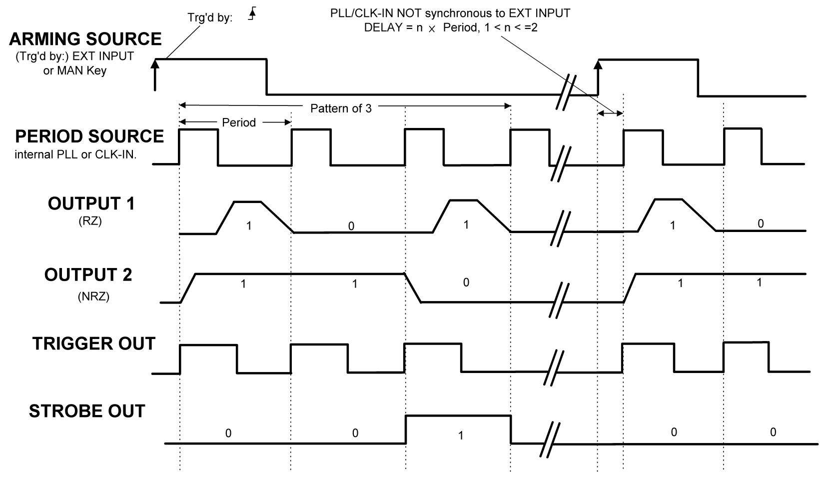
Figure 11 Timing Diagram: `TRIGGERED PATTERN Pulse-Period: internal Osc`



NOTE: For intrinsic fixed delays refer to Chapter 3 for typical values.

- A pattern of pulses is triggered by (**`Trg'd by`**) an active edge from the selected arming source (See **6** in Figure 3 on page 34)
  - **`MAN Key`** MAN on frontpanel, triggered by press, release or both.
  - **`EXT INPUT`** (External signal) triggered by rising, falling or both edges.
  - **`PLL`** (Internally triggered patterns), select the triggering period.
- Select between RZ and NRZ data pulses for each OUTPUT (See **3** in Figure 3 on page 34).

Figure 12 **Timing Diagram: `TRIGGERED PATTERN Pulse-Period: internal PLL or CLK-IN`**



Select the pulse-period source. (See **5** in Figure 3 on page 34)

- **`internal Osc`** (start of burst synchronized to trigger, see Figure 9 on page 43)
- **`internal PLL`** (Higher accuracy, start of burst not synchronized to trigger, see Figure 10 on page 44)
- **`ext CLK-IN`** (External signal), pulse-period synchronized to rising or falling edge.

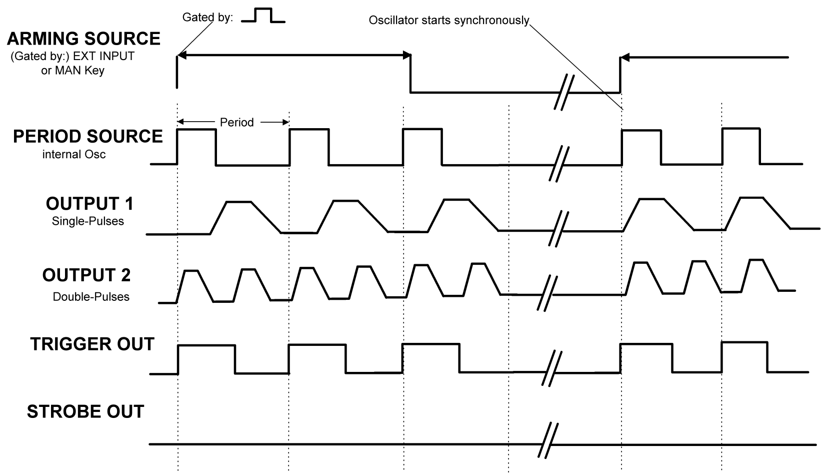
NOTE: You cannot use the PLL as both Pulse-Period source and **`Trg'd`** by (arming) source at the same time.

- Select the **`|PATTERN|`** screen to set the pattern length in the range 2 - 16384.
- Select the **`|PATTERN|`** screen to program the data values for each OUTPUT.

- TRIGGER OUT marks each pulse period.
- STROBE OUT is bit-programmable, like the OUTPUTS, in NRZ format on the **|PATTERN|** screen.

`GATED PULSES` Mode

Figure 13 Timing Diagram: **`GATED PULSES, Pulse-Period: internal Osc`**

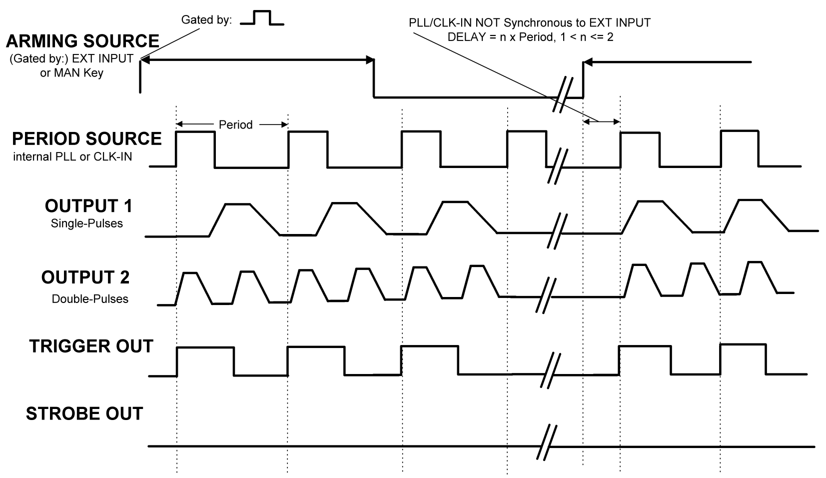


- Pulse-periods are **`Gated by`** (enabled by) an active level at the selected arming source (See **`6`** in Figure 3 on page 34)

  - **`MAN Key`** MAN on frontpanel, gated while pressed or released or both.
  - **`EXT INPUT`** (External signal) gated by high, low or both levels.

- Select between Single and Double-pulses per pulse-period for each OUTPUT (See **3** in Figure 3 on page 34).

Figure 14 Timing Diagram: GATED PULSES, Pulse-Period: PLL or CLK-IN



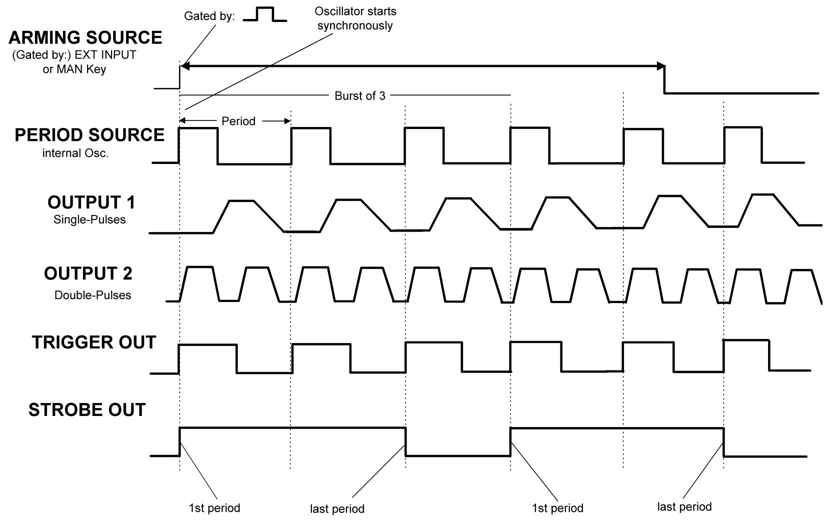
Select the pulse-period source. (See **5** in Figure 3 on page 34)

- `internal Osc` (start of burst synchronized to trigger, see Figure 9 on page 43)
- `internal PLL` (Higher accuracy, start of burst not synchronized to trigger, see Figure 10 on page 44)
- `ext CLK-IN` (External signal), pulse-period synchronized to rising or falling edge.

- TRIGGER OUT marks each pulse period.
- STROBE OUT not used in gated pulse mode.

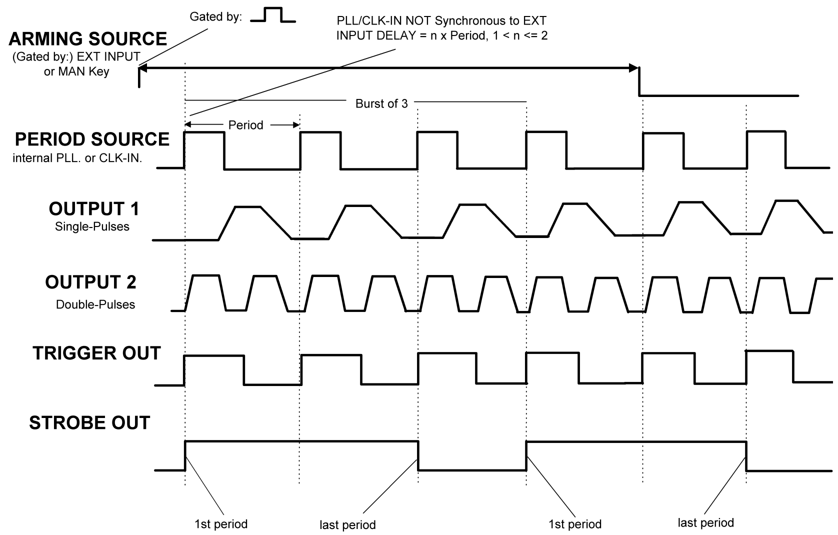
`GATED BURST` Mode

Figure 15 Timing Diagram: GATED BURST, Pulse-Period: internal Osc



- Bursts of pulse-periods are **`Gated by`** (enabled by) an active level at the selected arming source (See **6** in Figure 3 on page 34):
  - **`MAN Key`** MAN on frontpanel, gated while pressed or released or both.
  - **`EXT INPUT`** (External signal) gated while high or low or both.
- Select the number of pulse-periods per burst in the range 2-65536 (See **4** in Figure 3 on page 34).
- Select between Single and Double-pulses per pulse-period for each OUTPUT (See **3** in Figure 3 on page 34).

Figure 16 Timing Diagram: GATED BURST Pulse-Period: internal PLL or CLK-IN



Select the pulse-period source. (See **5** in Figure 3 on page 34)

- `internal Osc` (start of burst synchronized to trigger, see Figure 9 on page 43)
- `internal PLL` (Higher accuracy, start of burst not synchronized to trigger, see Figure 10 on page 44)
- `ext CLK-IN` (External signal), pulse-period synchronized to rising or falling edge.

- TRIGGER OUT marks each pulse period.
- STROBE OUT rises at the start of the first pulse-period in a burst and falls at the start of the last pulse-period.

`GATED PATTERN` Mode

- A pattern of pulses is Gated by (enabled by) an active level at the selected arming source (See **6** in Figure 3 on page 34).
  - **`MAN Key`** **MAN** on frontpanel, gated while pressed, released or both.
  - **`EXT INPUT`** (External signal) gated while high or low or both.
- Select between RZ and NRZ data pulses for each OUTPUT (See **3** in Figure 3 on page 34).

`RZ`	A single pulse is generated in each pulse-period with data value 1, no pulse is generated for data value 0.
`NRZ`	A leading-edge is generated for a 0→1 data transition, a trailing-edge is generated for a 1→0 data transition.

Select the pulse-period source. (See **5** in Figure 3 on page 34)

- **`internal Osc`** (start of burst synchronized to gate, see Figure 9 on page 43)
- **`internal PLL`** (Higher accuracy, start of burst not synchronized to gate, see Figure 10 on page 44)
- **`ext CLK-IN`** (External signal), pulse-period synchronized to rising or falling edge.

- Select the **`|PATTERN|`** screen to set the pattern length in the range 2 - 16384.
- Select the **`|PATTERN|`** screen to program the data values for each OUTPUT.

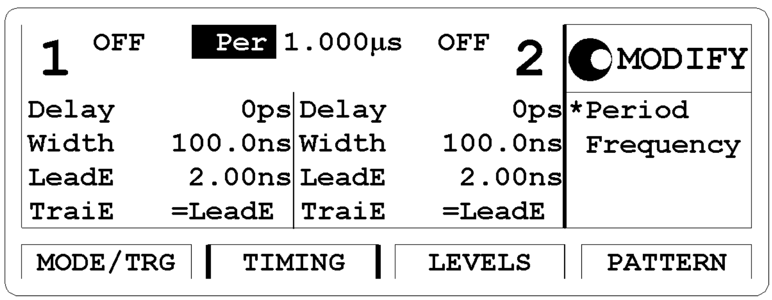
- TRIGGER OUT marks each pulse period.
- STROBE OUT is bit-programmable, like the OUTPUTS, in NRZ format on the **`|PATTERN|`** screen.

`EXT WIDTH` Mode

- The pulse-width is determined by an external signal:
  - **`MAN`** Key Pressing the **MAN** key generates a leading-edge, releasing the **MAN** key generates a trailing-edge.
  - **`EXT-IN`** A rising-edge at the EXT INPUT generates a leading-edge, a falling-edge at the EXT INPUT generates a trailing-edge.
- Set the threshold and impedance of the EXT INPUT on the **`|TRG-LEV|`** screen.
- The period, delay, and width of the output pulse are not programmable in this mode as they are determined by the external signal.

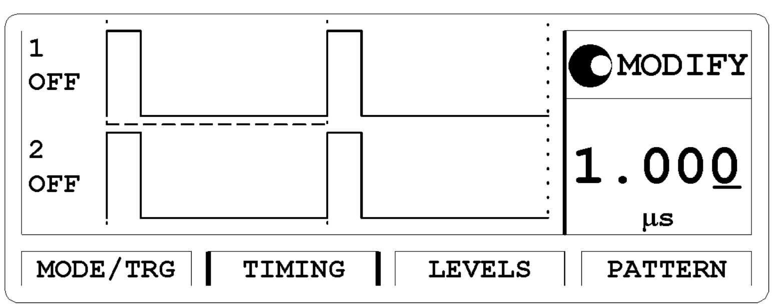
|TIMING| screen

The **`|TIMING|`** screen is only available if you have two channels fitted to your HP 81110A or HP 81104A mainframe *and* you have selected **`Group Params by: TIMING/LEVELS`** on the **`|CONFIG|`** screen. **`|TIMING|`** screen, text mode



NOTE: On screens of the HP 81110A with HP 81112A 3.8V/330 Mhz Outputs the second status output is displayed for differential outputs. The trailing edge is always coupled to the leading edge. The leading edge has selectable values of 0.8 ns or 1.6 ns.

Figure 17 `|TIMING|` screen, graphics mode



Use the **`|TIMING|`** screen to view and control the pulse-timing parameters for both channels on one screen. If you have a single channel instrument both the timing and level parameters are on the **`|OUTPUT|`** screen, see page 68.

NOTE: Note that in graphics mode you can only adjust the values of each parameter, not the parameter format. If you want to change the format of a parameter, for example **`Width to DutyCycle`**, you must be in text mode to select the parameter name with the cursor.

Pulse-period Parameter

Set the pulse-period as either **`Period`** or **`Frequency`**.

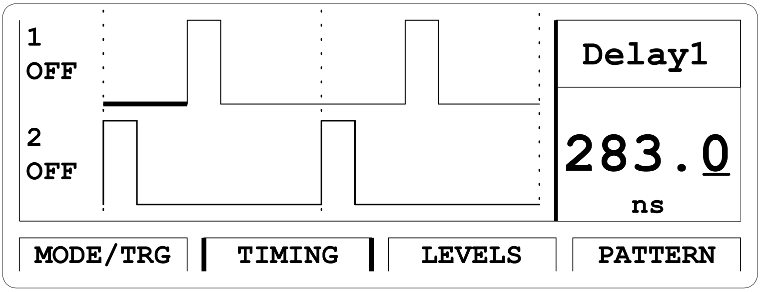
NOTE: You can select the pulse-period source on the **`|MODE/TRG|`** screen.

If you select the CLK IN connector as the pulse-period source, the pulse-period/frequency is determined from the signal applied to CLK IN:

`Meas Once`	The external signal is measured once, Press ENTER to measure again
`Meas Cont`	The external signal is continuously measured.

Pulse Delay Parameter

Figure 18 **|TIMING/OUTPUT| Timing parameter graphics,Delay**



Delay the leading edge of the pulse within the pulse-period. There are three delay formats available, selectable in text mode:

Delay

Delay is the absolute delay from the start of a pulse-period to the start of the leading edge of the pulse. The absolute delay is independent of the pulse period so the leading-edge does not move relative to the start of the period if you change the period.

Delay%

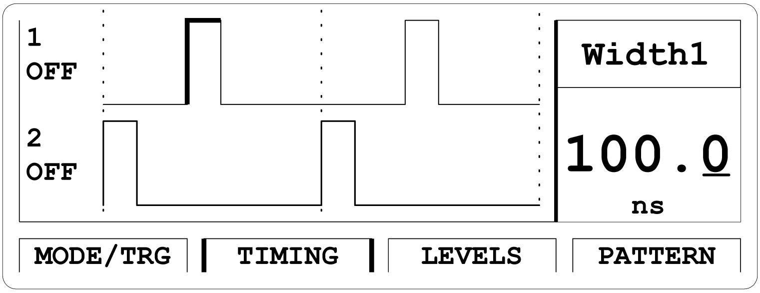
Delay% is the delay from the start of the pulse-period to the start of the leading edge expressed as a percentage of the pulse period. In this format if you change the period, the leading-edge moves relative to the start of the period in order to maintain the percentage delay.

Phase

Phase is the phase delay in degrees from the start of the pulse-period to the start of the leading edge. (360° = 1 pulse-period). In this format if you change the period, the leading-edge moves relative to the start of the period in order to maintain the phase delay.

Pulse Width Parameter

Figure 19 **`|TIMING/OUTPUT TIMING|` parameter graphics,Width**



Set the width of the output pulse. There are three width formats available, selectable in text mode.

`Width`

`Width` is the absolute pulse-width measured from start of the leading edge to start of the trailing edge. In this format the pulse-width is independent of changes in pulse period and delay.

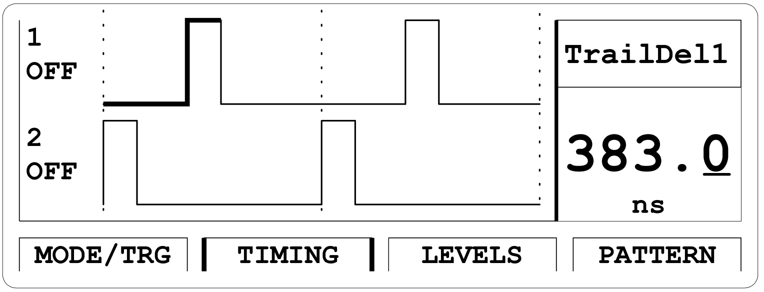
`DutyCyc`

`DutyCycle` is the pulse-width measured from start of the leading edge to start of the trailing edge expressed as a percentage of the period. In this format if you adjust the period, the absolute width is adjusted to maintain the dutycycle.

NOTE: You cannot have the width format set to **`DutyCyc`** and the leading/trailing-edge format set to percentage of width (**`LeadEd%/TrailE%`**) at the same time.

`TraDel`

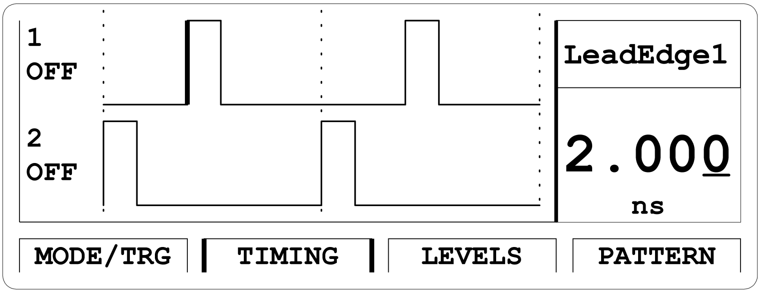
Figure 20 TIMING/OUTPUT Timing parameter graphics, Trailing Delay



`TrailingDelay` is the absolute delay from the start of the pulse-period to the start of the trailing-edge. In this format the trailing-edge remains fixed relative to the start of the pulse-period if you adjust the pulse-delay (leading-edge delay) or the pulse period.

Pulse Leading-edge Parameter

Figure 21 `|TIMING/OUTPUT|` **Timing parameter graphics, Leading-edge**



Set the leading-edge transition-time of the pulse, measured from 10% to 90% of pulse amplitude.

NOTE: The leading and trailing-edges are independently programmable within certain ranges only, see Figure 48 on page 295. There are two formats available, selectable in text mode:

`LeadEd`

The absolute transition-time measured from 10% to 90% of pulse amplitude. In this format the leading-edge is independent of the pulse-width.

`LeadEd%`

The absolute transition-time expressed as a percentage of pulse-width. In this format if you adjust the pulse-width, the transition-time is adjusted to maintain the edge-time as a percentage of the width.

NOTE: You cannot have the width format set to **`DutyCyc`** and the leading/ trailing-edge format set to percentage of width (**`LeadED%/ TrailE%`**) at the same time.

NOTE: The leading edge of a HP 81110A with HP 81112A 3.8 V/330 MHz outputs can be selected from 0.8 ns or 1.6 ns.

Pulse Trailing-edge Parameter

Set the trailing-edge transition-time of the pulse, measured from 10% to 90% of pulse amplitude.

NOTE: The leading and trailing-edges are independently programmable within certain ranges only, see Figure 48 on page 295. There are three formats available, selectable in text mode:

`=LeadE`

The trailing-edge transition-time is coupled directly to the leading edge to maintain a symmetrical pulse.

`TrailEd`

The absolute transition-time measured from 10% to 90% of pulse amplitude. In this format the trailing-edge is independent of the leading-edge and pulse-width.

`TrailE%`

The trailing-edge transition-time expressed as a percentage of pulse-width. In this format if you adjust the pulse-width, the transition-time is adjusted to maintain the edge-time as a percentage of the width.

NOTE: Note that you cannot have the width format set to **`DutyCyc`** and the leading/trailing-edge format set to percentage of width(**`LeadEd%/TrailE%`**) at the same time.

NOTE: The trailing edge of HP 81110A with HP 81112A 3.8 V/330 MHz outputs is always coupled to the leading edge.

|LEVELS| screen

The **`|LEVELS|`** screen is only available if you have two channels fitted to your HP 81110A or HP 81104A mainframe *and* you have selected **`Group Params by: TIMING/LEVELS`** on the **`|CONFIG|`** screen.

Figure 22 `|LEVELS|` screen, text mode

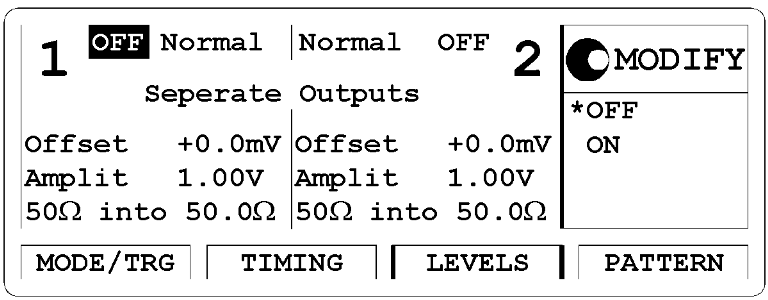
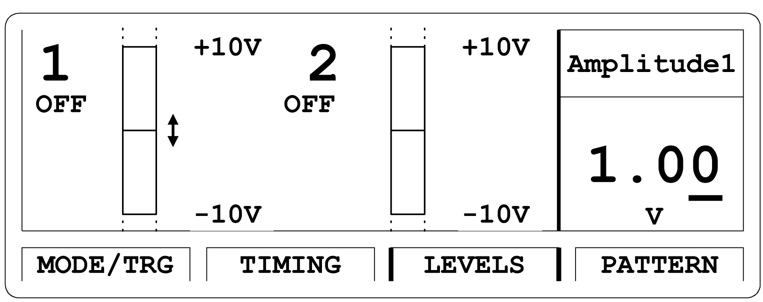


Figure 23 `|LEVELS|` screen, graphics mode



Use the **`|LEVELS|`** screen to view and control the pulse-level parameter for both channels on one screen. If you have a single channel instrument both the timing and level parameters are on the **`|OUTPUT|`** screen, see page 68.

`Normal/Complmnt` Parameter

NOTE: This parameter is only available in text mode.

Switch the OUTPUT between **`Normal`** and **`Complement`** modes.

`Normal` Pulse Leading-edge rises from low to high-level, trailing- edge falls from high to low-level.

`Complmnt` Pulse leading-edge falls from high to low level, trailing-edge rises from low to high-level

`Seperate/Added` Outputs Parameter

NOTE: The channel add option is not available for the HP 81110A with HP 81112A 3.8 V 330 MHz outputs installed. This parameter is only available in text mode, and if you have two output channels fitted.

Switch **`Added`** output mode on and off.

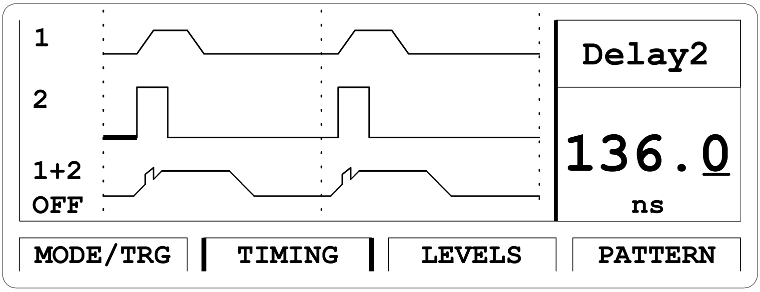
`Separate Outputs`

OUTPUT 1 and OUTPUT 2 operate as entirely separate output channels.

`Added at Output 1`

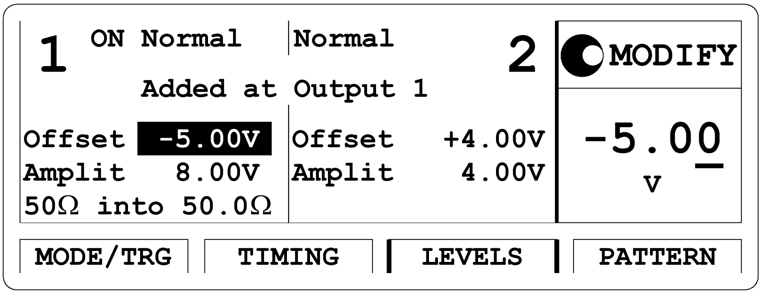
OUTPUT 1 and OUTPUT 2 signals are added together at the OUTPUT 1 connector. The OUTPUT 2 connector is no longer used. You can use this mode to create complex pulse waveforms as shown, see Figure 24.

Figure 24 |TIMING| screen, Added Outputs



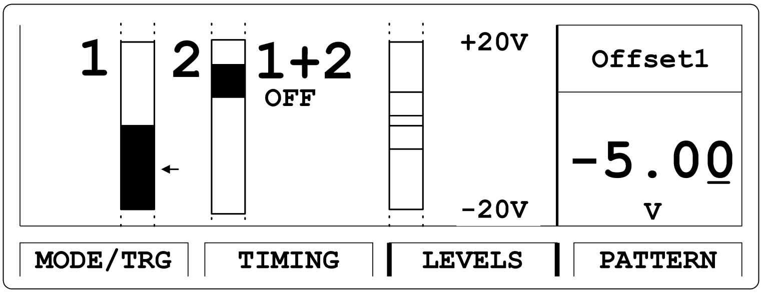
NOTE: Note that by using **|PATTERN|** mode you can code 3 or 4-level codes, or place spike pulses from OUTPUT CH2 on particular data pulses on OUTPUT CH1 for example. Since OUTPUT 2 is no longer used, its Impedance parameters are no longer available, see Figure 25.

Figure 25 |LEVELS| screen, Added Outputs text mode



The **|LEVELS|** graphic page is also modified to indicate the multiple levels formed by OUTPUT 1 + 2:

Figure 26 **|LEVELS| screen, Added Outputs graphics mode**



`Offset, Amplit, High, Low` Level Parameters

Set and display the pulse levels in terms of either Offset and Amplitude, or High- and Low-level. You can quickly set TTL or ECL output levels using the **`Set TTL`** and **`Set ECL`** formats.

`Set TTL`

Select High and Low-level formats and automatically set the levels to the default TTL levels:

```
TTL-HI  +2.50 V
TTL-LOW +0.0 mV
```

The default levels are set once and can be adjusted afterwards by moving the cursor onto the values as normal.

`High-Low`

Select High and Low-level format for the pulse levels.

`Offs-Ampl`

Select Offset and Amplitude format for the pulse levels. Offset is measured from 0V to the middle of the pulse amplitude. Pulse-amplitude is the difference between the High- and Low-levels of the pulse.

`Set ECL`

Select High and Low-level format and automatically set the levels to the default ECL levels:

```
ECL-HI    -850mV
ECL-LOW   -1.80V
```

These default levels are set once and can be adjusted afterwards by moving the cursor onto the value as normal.

`mV V mA A` Voltage/Current Mode

NOTE: This parameter is only available in text mode.

Move the entry field onto the level units to select between setting the pulse-levels **`in Volts`** or **`in Amperes`**.

`50 Ω into` Output Source Impedance Parameter

NOTE: This parameter is only available in text mode

An impedance of 50 Ω or 1 kΩ is selectable. There is no selection for the HP 81110A when fitted with HP 81112A 3.8 V / 330 MHz output channels.

`50.0Ω` Load Impedance Parameter

Adjust the load impedance value expected at the OUTPUT to compensate for non-50Ω loads. The displayed level-parameters are then calculated using this value and therefore represent the levels at a non-50Ω static load.

Output Voltage and Power Protection

NOTE: When an OUTPUT is switched on, the instrument monitors the actual voltage and current levels at the OUTPUT. The OUTPUT is automatically switched off if voltage levels or power dissipation reach levels which could damage the OUTPUT circuits.

The available output levels for an OUTPUT could therefore be limited by external voltages, loads and the level settings of the *other* OUTPUT if you are using a dual channel instrument with Outputs added at OUTPUT 1. Refer to Specifications Chapter 3, Outputs Table 73 on page 344.

NOTE: On the screen of the HP 81110A with HP 81112A 3.8 V/330 MHz outputs installed the second status output is displayed for differential outputs. The instrument also assumes 50 Ω load impedance and there is no added outputs option available.

|OUTPUT| Screens

The **|OUTPUT|** screen is available if you have only one channel fitted to your HP 81110A or HP 81104A mainframe. **|OUTPUT 1|** and **|OUTPUT 2|** screens are available on a two channel instrument if you have selected **Group Params by:OUTPUT 1/2** on the **|CONFIG|** screen. The **|OUTPUT|** screen on a single channel instrument is identical to the **|OUTPUT 1|** screen shown in this section.

Figure 27 |OUTPUT| screen, text mode

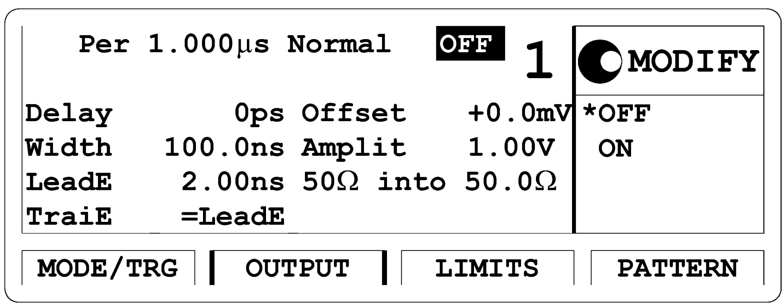
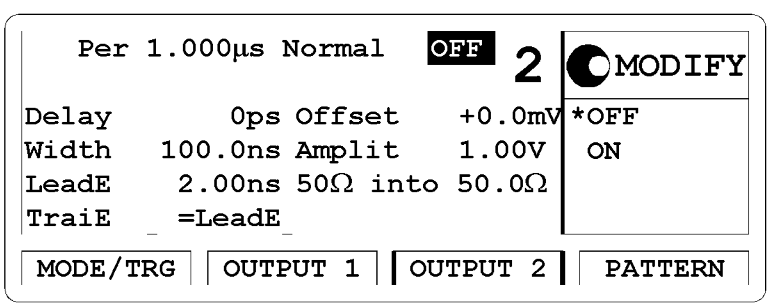


Figure 28 |OUTPUT 2| screen, text mode



The **|OUTPUT|** screen mode can be toggled between textual and graphical displays

Pulse-period Parameter

To set the Pulse Period Parameter please refer to **TIMING,** "Pulse-period Parameter" on page 55.

`Normal/Complmnt` Parameter

For details of the normal/complmnt Parameter please refer to **LEVELS,** "Normal/Complmnt Parameter" on page 63.

Pulse Delay Parameter

For details of the Pulse Delay Parameter please refer to **TIMING,** "Pulse Delay Parameter" on page 56.

Pulse Width Parameter

For details of the Pulse Width parameter please refer to **TIMING,** "Pulse Width Parameter" on page 57.

Pulse Leading-edge Parameter

For details of the Pulse Leading-edge Parameter please refer to **TIMING,** "Pulse Leading-edge Parameter" on page 59.

Pulse Trailing-edge Parameter

For details of the Pulse Trailing Edge Parameter please refer to **TIMING,** “Pulse Trailing-edge Parameter” on page 60.

`Separate/Added` Outputs Parameter

For details of the Separate/Added Outputs Parameter please refer to **LEVELS,** “Seperate/Added Outputs Parameter” on page 63.

`Offset, Amplit, High, Low` Level Parameters

For details on the Offset, Amplit, High and low parameters please refer to **LEVELS,** “Offset, Amplit, High, Low Level Parameters” on page 65.

`mv, V, mA, A` Voltage/Current Mode

For details on the mv, V, mA, A Voltage/Current Mode please refer to **LEVELS**, “mv V mA A Voltage/Current Mode” on page 66.

`50Ω into` OUTPUT Source Impedance Parameter

For details on the 50Ω into OUTPUT Source Impedance Parameter please refer to **LEVELS,** “50 W into Output Source Impedance Parameter” on page 66.

`50.0`Ω Load Impedance Parameter

For details on the 50.0Ω Load Impedance Parameter please refer to **LEVELS**, "50.0W Load Impedance Parameter" on page 66.

Output Voltage and Power Protection

For details on Output Voltage and Power Protection please refer to **LEVELS,** "Output Voltage and Power Protection" on page 67.

|PATTERN| Screen

Figure 29 **|PATTERN| screen, text mode**

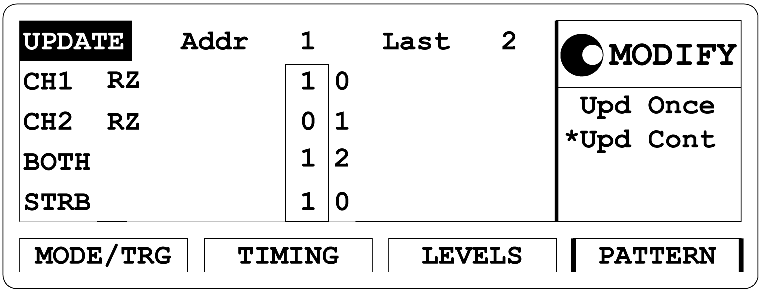
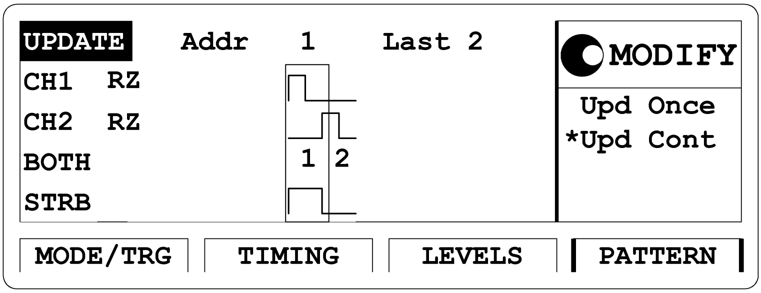


Figure 30 **|PATTERN| screen, graphics mode**



Use the **|PATTERN|** screen to edit the pattern data which is generated when you select the pattern mode on the **|MODE/TRG|** screen.

You can toggle between graphics and text mode by pressing the **|PATTERN|** softkey or **SHIFT** **GRAPH MORE**.

`UPDATE` Parameter

`UPDATE (Upd Cont)`

The pattern data at the outputs are updated continuously as you edit the data on the screen.

`NO UPD (Upd Once)`

The pattern data at the outputs are not updated automatically from the screen. You can therefore modify the data patterns on the screen without affecting the pattern which is currently being generated at the Outputs.

Press **ENTER** to update the pattern once.

`Addr` Parameter

Adjust the address of the bit-editing window to scroll through the data. Figure 31 shows the bit-editing window located at the third bit in the pattern.

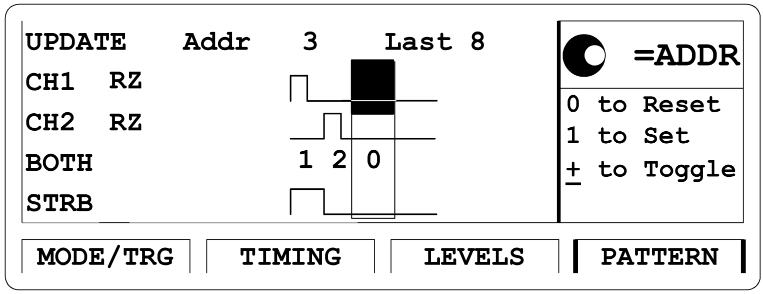
`Last` Parameter

Adjust the last bit number to set the length of the pattern in the range 2 to 16384.

Bit-Editing Window

Move the entry field into the bit-editing window to edit individual data bits. The bit-editing window moves automatically one location to the right for each pattern entered.

Figure 31 `|PATTERN|` screen, Bit-editing window



While the entry field is in the bit-edit window you can use the knob to scroll through the data.

RZ/NRZ Data Format

The data output format RZ or NRZ can be selected for the channels if not already done in the `|MODE/TRG|` screen

OUTPUTS (`CH1,CH2`) and STROBE OUT (STRB)

Use the DATA ENTRY keys to edit the data bit at the cursor:

0 Set bit to 0, and move the bit-editing window to the next bit.

1 Set bit to 1, and move the bit-editing window to the next bit.

+/- Toggle bit without moving the bit-editing window.

You can edit both output channels together in the BOTH pattern. This makes it easy to enter data for 3 or 4-level codes.

Figure 32 **|PATTERN| screen, Bit-editing window BOTH**

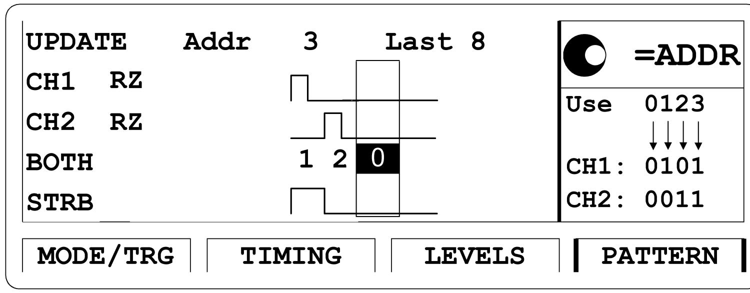


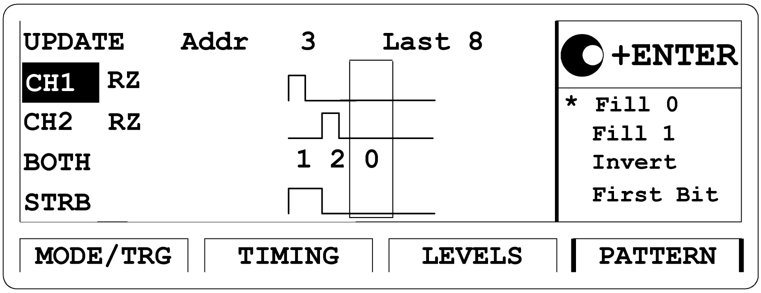
Table 3: Conversion Table

BOTH	DATA ENTRY	CH2	CH1
0	0	0	0
1	1	0	1
2	2	1	0
3	3	1	1

`CH1 CH2 BOTH STRB` Block Editing Functions

Move the entry field onto the **`CH1`**, **`CH2`**, **`BOTH`** or **`STRB`** at the left hand side of the screen to use the block editing functions.

Figure 33 **|PATTERN| screen, Block editing functions**



Select the function using the MODIFY knob. Press **ENTER** to carry out the edit.

NOTE: Most of the block editing functions apply from (or at) the current Addr of the bit-editing window to the Last bit in the pattern.

The data memory is 16384 bits long. Bits beyond the Last bit are not affected by the editing functions except when you insert or delete bits.

`Fill 0`

Set all bits from Addr to Last inclusive to 0.

`Fill 1`

Set all bits from Addr to Last inclusive to 1.

`Invert`

Invert all bits from Addr to Last inclusive.

`First Bit`

Set the first bit to 1, and bits 2 to Last to 0.

`Last Bit`

Set the last bit to 1, and all preceding bits to 0.

`Ins Bit`

Insert a bit at **`Addr`**. The bit value is copied from the current bit at **`Addr`**, and bits **`Addr`** to 16384 are shifted right. Bit 16384 is lost.

NOTE: The **`Last`** parameter is *not* automatically incremented, so the length of the generated pattern is not increased unless you adjust the **`Last`** parameter yourself.

`Del Bit`

Delete the bit at Addr. Bits (Addr + 1) to 16 384 are shifted left and bit 16 384 is copied.

NOTE: The **`Last`** parameter is *not* automatically decremented, so the length of the generated pattern is not decreased unless you adjust the **`Last`** parameter yourself.

`Clock÷N`

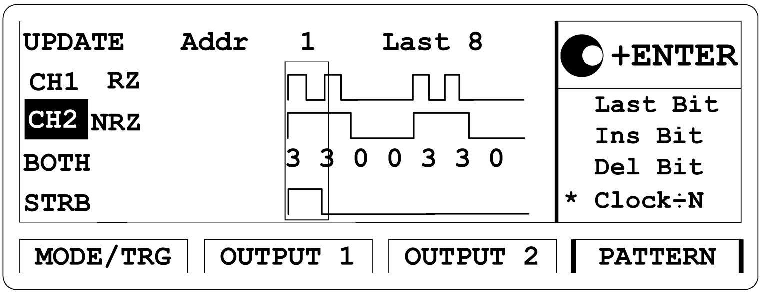
Fill bits **`Addr to Last`** with a divided clock pattern. After pressing **ENTER** you can adjust the dividing factor from 2 to 16384 and press **ENTER** again to implement.

For example:

n=2 Sequence = 101010101010101....
n=3 Sequence = 100100100100100....
n=4 Sequence = 110011001100110....
n=5 Sequence = 110001100011000....
n=6 Sequence = 111000111000111....
n=7 Sequence = 111000011100001....
n=8 Sequence = 111100001111000....

NOTE: Note that the output signal is only a squarewave if you are using NRZ data. You can see this best in graphics mode:

Figure 34 **`|PATTERN| Clock÷4`, CH1=RZ, CH2=NRZ**



`PRBS 2`^{n}`-1`

Fill bits **`Addr`** to **`Last`** with a 2^n-1 Pseudo-random Binary Sequence.

After pressing **ENTER** you can adjust n in the range 7 to 14 and press **ENTER** again to implement.

Some Hints on Editing Pattern Data

The block editing functions, apart from Insert and Delete, do not affect data bits beyond the current **`Last`** bit. Therefore you can use the **`Addr`** and **`Last`** parameters to define the block of bits you want to edit. Remember, however, that the **`Last`** parameter also defines the length of the pattern generated at the outputs.

Example

You are currently generating a 48 bit pattern on OUTPUT 1 and now want to fill bits 10 to 20 with data value 1. On the **`|PATTERN|`** screen:

1 If necessary, move the cursor to **`UPDATE`** and select **`Upd Once`** to prevent the data edits from affecting the pattern currently being generated at the OUTPUT.

If **`NO UPD`** is already shown, or it isn't important if the pattern is disturbed during the editing you can ignore this step.

2 Adjust **`Addr`** to 10.

3 Adjust **`Last`** to 20
If **`UPDATE`** is still active, the pattern at the OUTPUT will now be automatically reduced to 20 bits in length.

4 Move the cursor to **`CH1`** to access the block editing functions for OUTPUT 1.

5 Use the MODIFY knob to select **`Fill 1`** from the list of functions.

6 Press **ENTER** to fill bits 10 to 20 with data value 1.

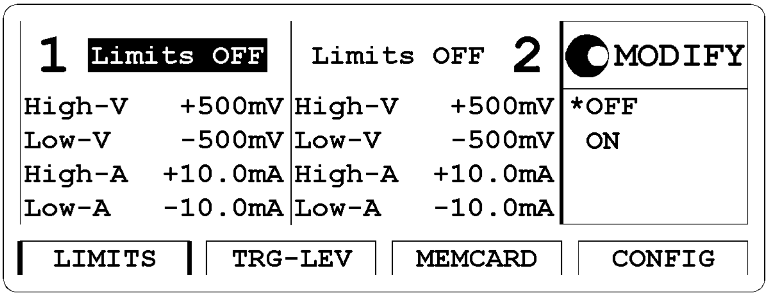
If **`UPDATE`** is still active, the pattern at the OUTPUT will now change automatically.

7 Adjust **`Last`** back to 48 to return the pattern length to 48.
If **`UPDATE`** is still active, the pattern at the OUTPUT will now return to 48 bits in length.

8 If necessary, move the cursor to **`NO UPD`** and press **ENTER** to update the pattern being generated at the OUTPUT (or select **`Upd Cont`**)

|LIMITS| screen

Figure 35 **`|LIMITS|` screen**

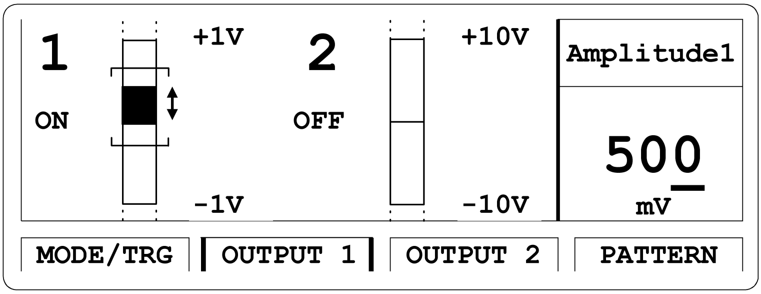


Use the **`|LIMITS|`** screen to set up voltage and current limits for the pulse level parameters to prevent accidental damage of the device under test.

After you switch on the limits, the pulse level parameters on the **`|LEVELS|`**/**`|OUTPUT|`** screens cannot be adjusted outside the ranges on the **`|LIMITS|`** page if the OUTPUT is switched on. Note that because current and voltage limits apply, the available ranges of the impedance parameters are also affected.

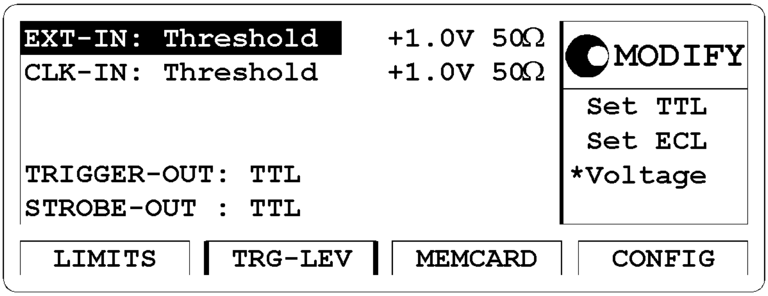
When output limits are on, the limits are indicated on the **`|LEVELS|`**/ **`|OUTPUT|`** pages in graphics mode and the level bar is scaled accordingly:

Figure 36 Level graphics with `Limits ON` on OUTPUT 1 `|TRG-LEV|` screen



|TRG-LEV|

Figure 37 **`|TRG-LEV|` screen**



Use the **`|TRG-LEV|`** screen to:

- Set the triggering threshold and input impedance for the EXT INPUT connector.
- Set the triggering threshold and input impedance for the HP 81106A CLK IN connector, if fitted.
- Set the output levels for the STROBE OUT and TRIGGER OUT connectors.

`EXT-IN` Parameter

Move the entry field onto **`EXT-IN`** to quickly set the triggering threshold of the EXT INPUT to a TTL or ECL compatible level.

`Set TTL`

`Set the EXT INPUT threshold to +2.5V.`
You can adjust the threshold by moving the entry field onto the value.

`Set ECL`

`Set the EXT INPUT threshold to -1.3V.`
You can adjust the threshold by moving the entry field onto the value.

`Voltage`

Set any threshold level in the range -10.0 V to +10.0 V. Move the entry field onto the value to adjust it.

50Ω/10kΩ EXT INPUT Impedance Parameter

Toggle the input impedance of the EXT INPUT connector between 50Ω and 10 kΩ.

`CLK-IN` Parameter

Move the entry field onto **`CLK-IN`** to quickly set the triggering threshold of the CLK IN to a TTL or ECL compatible level.

Levels can be selected in the same way as for EXT-IN, see page 86.

50Ω/10kΩ CLK IN Impedance Parameter

Toggle the input impedance of the CLK IN connector between 50 Ω and 10 kΩ.

`TRIGGER-OUT` TRIGGER OUT Level Parameter

Set the output levels into 50 Ω for the TRIGGER OUT connector.

TTL

High-level +2.50 V Low-level 0V

ECL

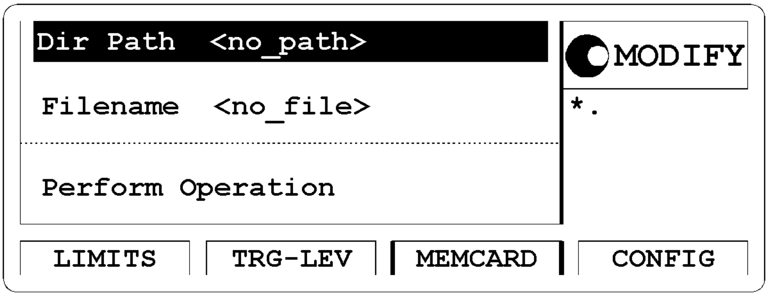
High-level -0.85V Low-level -1.8V

STROBE-OUT STROBE OUT Level Parameter

Set the output levels into 50 Ω for the STROBE OUT connector. Select TTL or ECL levels as for TRIGGER OUT.

|MEMCARD| Screen

Figure 38 **|MEMCARD| screen, No card present.**



Use the **|MEMCARD|** screen to:

- Store instrument settings to the memory-card.
- Recall instrument settings from the memory-card.
- Delete files from the memory-card.
- Format a memory card.

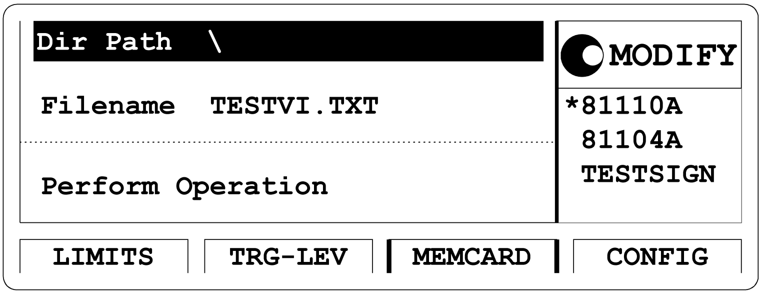
NOTE: Note that the HP 81110A and the HP 81104A use DOS formatted memory-cards and you cannot create or delete directories using the instrument.

`Dir Path` Current Directory Parameter

Move the entry field onto **`Dir Path`** to change directory on the memory-card or to view the subdirectories in the current directory (The current directory name is displayed next to **`Dir Path`**).

All the sub-directories in the current directory are listed in the MODIFY window.

Figure 39 `|MEMCARD|` screen, `Dir Path` Example



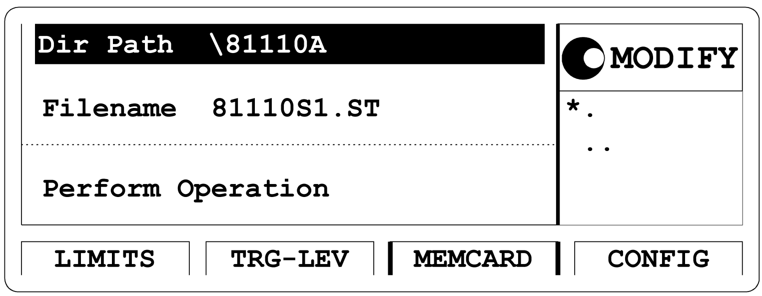
NOTE: Settings from HP 81104A can not be used in the HP 81110A or vice versa.

To change directory

1 Use the MODIFY knob to select the directory name from the list of files and directories in the MODIFY window.

2 Press ENTER.

Figure 40 |MEMCARD| screen, Subdirectory Example

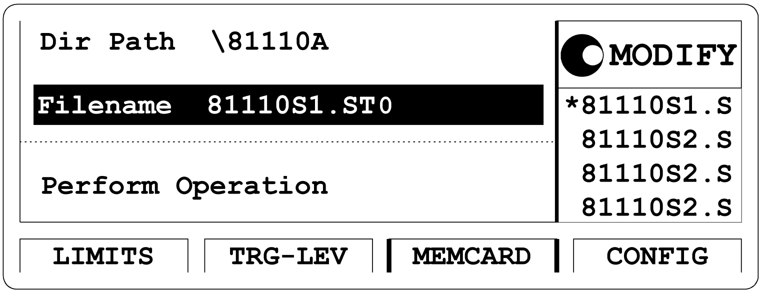


NOTE: Note that when you are in a sub-directory you can return to the parent-directory by selecting .. from the directory list in the MODIFY window.

`Filename` Parameter

Move the entry field onto the **`Filename`** parameter to view and select a file from the current directory. Use the MODIFY knob to scroll through the filenames listed in the MODIFY window.

Figure 41 `|MEMCARD|` screen, `Filename` Example



Memory Card Operations

Move the entry field onto **`Perform Operation`** and use the knob to select the operation:

`ReadCard`

Read the DOS file-system information from the memory-card after inserting a new card. Press **ENTER** to carry out the operation.

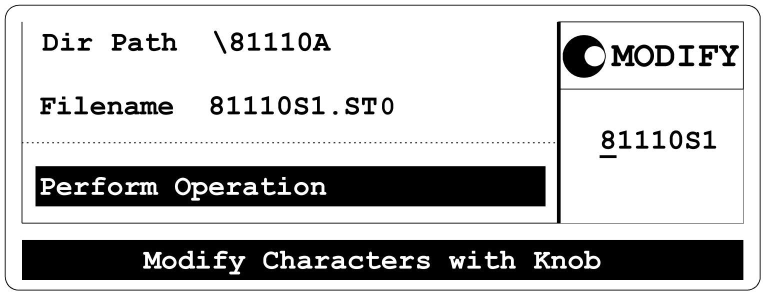
`Recall`

Recall the selected file as the current-instrument setting. Press **ENTER** to carry out the operation.

Store

Store the current instrument-setting to the memory-card.

Figure 42 |MEMCARD| screen, Store Operation



Press ENTER once to start editing the filename for the setting in the MODIFY window. The currently selected filename is used as default.

CAUTION: If you do not modify the filename, the existing file will be overwritten when you press ENTER.

Press SHIFT ENTER to CANCEL the store operation at any time.

To modify the filename

1. Move the character cursor with the CURSOR keys.
   The filename can be up to 8 characters long.
2. Modify a character using the knob.

   When you have finished, press ENTER to store the setting.

NOTE: Note that the DOS filename suffix **`.ST0(STx)`** is added automatically to the filename when you store the current settings.

`Store All`

Store the current instrument-setting and the instrument-setting memories 1 to 9 to the memory-card. Each setting is stored in a separate file with the same name but different suffixes:

Setting	**Filename Suffix**
Current Setting	.ST0
Memory 1	.ST1
Memory 2	.ST2
.	.
.	.
Memory 9	.ST9

Press **ENTER** once to start editing the filename for the setting in the MODIFY window. The currently selected filename is used as default.

CAUTION: If you do not modify the filename, the existing file will be overwritten when you press **ENTER**.

Press **SHIFT** **ENTER** to CANCEL the store operation at any time.

To modify the filename

Same procedure as for the Store Operation, see page 90.

`Delete`

Delete the selected file from the memory-card. Press **ENTER** to carry out the operation.

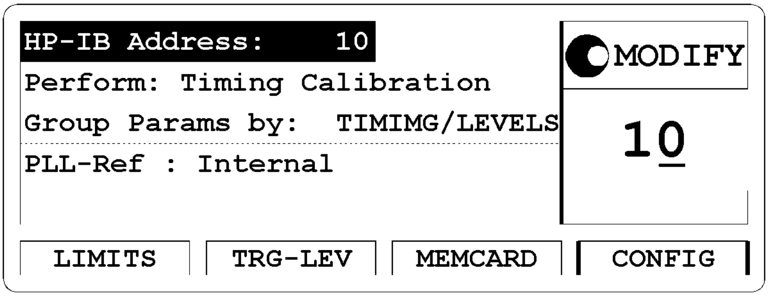
`Format`

CAUTION: Formatting a memory-card destroys any existing files on the card.

Format the memory-card. Press **ENTER** to carry out the operation.

|CONFIG| Screen

Figure 43 **`|CONFIG|` screen**



Use the **`|CONFIG|`** screen to:

- Set the HP-IB address of the HP 81110A.
- Perform a selftest.
- Group the pulse parameters by **`TIMING/LEVELS`** or **`OUTPUT1 OUTPUT2`** on a two channel instrument.
- Select the frequency reference source and frequency for the PLL.

`HP-IB Address`

Set the HP 81110A or HP 81104A HP-IB address in the range 0 to 30. The default address of HP 81110A and HP 81104A is 10.

Perform Operation `Selftest`

Select **`Selftest`** in the MODIFY area.

Perform a selftest by pressing **ENTER**. If the selftest fails, a flashing **`E`** is displayed. Press **HELP** to see the list of error messages.

Perform Operation `Calibrate`

Select Calibrate in the MODIFY area. Perform a timing calibration for the VFO-period, delay and width circuitries by pressing **ENTER**.

If the calibration fails, a flashing **`E`** is displayed. Press **HELP** to see the list of error messages.

NOTE: Timing Calibration is available for HP 81110A only.

Parameter Grouping `Group Params by`

NOTE: This option is only available if you have two Output modules fitted to your HP 81110A or HP 81104A mainframe.

Configure the grouping of the pulse-parameters on the user interface:

`TIMING/LEVELS`

The pulse-timing parameters for OUTPUTS 1 and 2 are grouped together on the **`|TIMING|`** parameter screen.

The pulse-level parameters for OUTPUTS 1 and 2 are grouped together on the **|LEVELS|** parameter screen.

OUTPUT 1/2

All timing and level parameters for OUTPUT 1 are grouped together on the **|OUTPUT 1|** parameter screen.

All timing and level parameters for OUTPUTS 2 are grouped together on the **|OUTPUT 2|** parameter screen.

PLL Reference

Set the frequency reference source for the PLL:

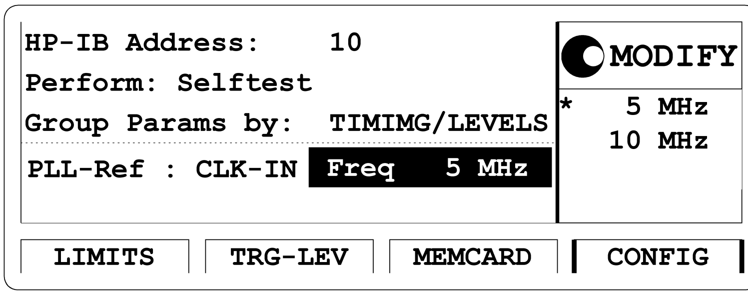
Internal

The internal 5 MHz reference.

`CLK-IN`

An external reference signal at the CLK IN (PLL REF) connector. You can set the expected frequency of the external reference to 5 MHz or 10 MHz:

Figure 44 **`|CONFIG|` screen, External PLL Reference frequency**



Warnings and Errors

The HP 81110A and HP 81104A have two levels of error reporting called warnings and errors. On a single channel instrument, or a two channel instrument with outputs **`Added at Output 1`**, error and warning checking is always enabled unless you switch it off via the HP-IB using the :**`SYSTem:CHECk`** command.

NOTE: On a two channel instrument with **`Separate Outputs`**, error and warning checking is *automatically* disabled for a channel which is switched off. This allows you to ignore the settings of a channel you are not using. You can also switch off error and warning checking via the HP-IB.

<table>
<tr><td colspan="5">←---------------------Maximum programmable range of selected parameter-------------------→</td></tr>
<tr><td>Probably invalid</td><td>Probably valid</td><td>ALL signal parameters in specification</td><td>Probably valid</td><td>Probably invalid</td></tr>
<tr><td>ERROR</td><td>WARNING</td><td></td><td>WARNING</td><td>ERROR</td></tr>
<tr><td>Setting not implemented</td><td colspan="3">←---------------- Setting implemented in hardware-------------→</td><td>Setting not implemented</td></tr>
</table>

Warnings

A warning is generated when the output signal *could* be invalid due to a combination of worst case uncertainties at the current settings of all relevant parameters. For example, when adjusting the pulse-width, the leading edge, trailing edge, and pulse period settings and their uncertainties have to be considered in order to check if the width setting will fit within the pulse period. Refer to "An Example of Warning and Error Reporting". Note that the warning limits are therefore not fixed for a particular parameter, but vary with the settings of the related parameters. It is also possible that the error and warning limits are the same, that is, a warning does not occur before the error limit is reached.

If a warning occurs, the settings are still implemented in the hardware since the worst case conditions used to evaluate the warning limits are very unlikely to occur in practice.
A blinking **W** indicates that one or more warnings have occurred. Press **HELP** to view the warning list. Multiple warnings can exist together.

Errors

An error is generated when an invalid mode is chosen, or the required parameter settings cannot be implemented in the output hardware. Multiple errors can occur, but only the first error detected is displayed.
An error is indicated by a blinking error message at the bottom of the screen.

NOTE: If you are using the knob to adjust parameters it is normally not possible to generate warnings or errors. All parameters are automatically limited to settings which guarantee specified operation.

If you do want to use the knob to adjust a parameter beyond its warning limits:

1. Adjust to the limit with the knob
2. Press **SHIFT** and adjust beyond the limit with the knob.

AUTOSET

You can press **SHIFT** **HELP** (**AUTOSET**) to carry out an AUTOSET.

The instrument resets all parameters, based on the current period setting, to remove all warning and error conditions.

An Example of Warning and Error Reporting

1 Switch on instrument and recall standard settings with

SHIFT **STORE** (**RECALL**) **0** .

The period is now set to 1 µs.

2 Switch on OUTPUT 1 with **SHIFT** **0** (**ON/OFF 1**) .

3 On the **`|TIMING|`** or **`|OUTPUT 1|`** screen, move the parameter cursor onto the value of the Width parameter (**`100ns`**).

4 Use the knob to make the **`Width`** as large as possible (approximately **`940ns`**).
This limit is intended to guarantee that the actual output pulse is within specifications, for the actual period.
The limit is calculated taking into account a worst case combination of minimum period from the period setting (**`1 µs`**) and maximum width from the width setting (**`940 ns`**) together with minimum leading and trailing edge settings (e.g. **`2.00 ns`**).

NOTE: Note that if you now try and adjust the Leading Edge from its current setting of e.g. 2.00 ns with the knob, it cannot be adjusted. This is because the upper and lower warning limits are currently 2.00 ns. The width is at its maximum value and width+leading edge+trailing edge ≤ period.

5 Press **SHIFT** and adjust the Width above its warning limit. A flashing `W` appears to indicate that a warning condition has occurred.

NOTE: Note that as long as no errors occur, the output hardware is set up and attempts to generate the required output.

6 Press **HELP** to see the warning message:

`Trailing edge 1 may cut next pulse`

7 Press **HELP** again to return to the Width parameter.

8 Increase the **`Width`** further to approximately 980 ns and press **HELP** to see the current warnings:

`Width 1 too close to period`

`Trailing edge 1 may cut next pulse`

9 Press **HELP** again to return to the **`Width`** parameter.

10 Increase the **`Width`** further until a flashing error message appears (approximately 1.10 µs):

`OUTPUT 1: Width > Period`
You have reached the current upper error-limit of the **`Width`** parameter.

The setting is not implemented in the output hardware.

11 Press **SHIFT** **HELP** to carry out an AUTOSET.

Chapter 2

Programming Reference

Introduction

This chapter has the following sections:

Programming Recommendations

Here are some recommendations for programming the instrument:

a Start programming from the default setting. The common command for setting the default setting is:

***RST**

b Switch off the automatic update of the display to increase the programming speed. The device command for switching off the display is:

:DISPlay OFF

c The SCPI standard defines a long and a short form of the commands. For fast programming speed it is recommended to use the short forms. The short forms of the commands are represented by upper case letters. For example the short form of the command to set 100 ns double pulse delay is:

:PULS:DOUB:DEL 100NS

d To improve programming speed it is also allowed to skip optional subsystem command parts. Optional subsystem command parts are depicted in square brackets, e.g.: enable double pulse mode by [SOURce]:PULSe:DOUBle[1|2][:STATe]   ON|OFF. Sufficient to use:

:PULS:DOUB ON	**# enables double pulse mode for # output 1**

e The commands to set the timing and level parameters, except of period/frequency, have to be specified for output 1 and output 2. If there is no output specified the command will set the default output 1. So, for setting a high level of 3 Volts for output 1 and output 2 the commands are:

:VOLT:HIGH 3V	**# sets high level of 3 V at out 1**
:VOLT1:HIGH 3V	**# sets high level of 3 V at out 1**
:VOLT2:HIGH 3V	**# sets high level of 3 V at out 2**

f It is recommended to test the new setting which will be programmed on the instrument by setting it up manually. Enable the outputs so that the instruments error check system is on and possible parameter conflicts are immediately displayed. When you have found the correct setting, then use this to create the program. In the program it is recommended to send the command for enabling outputs (e.g. **:OUTPut1 ON**) as the last command. With this procedure it is possible to switch off the error check system (**:SYSTem:CHECk OFF**) to increase programming speed. The error check is enabled again by sending *RST.

***RST**	**# set default settings**
:DISP OFF	**# switch off display update**
:SYST:CHEC OFF	**# switch off error check**
...	**# other commands to set modes**
...	**# and parameters**
:OUTP1 ON	**# enable the output 1**

g Selftest of the instrument can be invoked by the common command

***TST**

h The HP 81110A offers auto calibration for the period (VFO), delay and width circuitry by the device command **:CALibration**. It is recommended to query whether the calibration is passed by sending **:CALibration?**.

i If it is important to know whether the last command is completed then send the common command

***OPC?**

Common Command Summary

Table 1: Common Command Summary IEEE 488.2

Command	Parameter	Description
*CLS	-	Clear the status structure
*ESE	<0-255>	Set the Standard Event Status register mask
*ESE?	-	Read the state of the Standard Event Status enable register
*ESR?	-	Read the state of the Standard Event Status event register
*IDN?	-	Read the Instrument's Identification string
*LRN?	-	Read the complete Instrument Setting
*OPC	-	Set the Operation Complete bit when all pending actions are complete
*OPC?	-	Read the status of the Operation Complete bit
*OPT?	-	Read the installed options
*RCL	<0-9>	Recall a complete Instrument Setting from memory
*RST[1]	-	Reset the instrument to standard settings
*SAV	<1-9>	Save the complete Instrument Setting to memory
*SRE	<0-255>	Set the Service Request Enable Mask
*SRE?	-	Read the Service Request Enable Mask
*STB?	-	Read the Status Byte
*TRG	-	Trigger
*TST?	-	Execute instrument's self-test
*WAI	-	Wait until all pending actions are complete

1 See the default settings in Table 3 on page 114, at the end of this section

SCPI Command Summary

Table 2: Instrument SCPI Command Summary

Command	Parameter	Description	see page
:ARM		(Trigger mode and source)	
[:SEQuence[1]] | :STARt			
[:LAYer[1]]			
:EWIDTh			
[:STATe]	ON|OFF|1|0	Set/read External Width mode	126
:FREQuency	<value>	Set/read trigger frequency, when PLL(INT2) used as source	127
:IMPedance	<value>	Set/read impedance at EXT INPUT	129
:LEVel	<value>	Set/read threshold level at EXT INPUT	131
:PERiod	<value>	Set/read trigger period,when PLL(INT2) used as source	133
:SENSe	EDGE|LEVel	Set/read trigger on edge or gate on level	135
:SLOPe	POS|NEG|EITH	Set/read trigger slope at EXT INPUT	136
:SOURce	IMM|INT2|EXT|MAN	Set/read trigger source (VCO|PLL|EXT INPUT|MAN key)	137
:CHANnel			
:MATH	OFF|PLUS	Set/read addition of channels of channels 1 & 2 at output 1	138
:CALibration[:ALL]		Set/read calibration of period (VFO), delay and width circuitries	140

Table 2: Instrument SCPI Command Summary, continued

Command	Parameter	Description	see page
:DIGital			
[:STIMulus]			
:PATTern			
:DATA[1|2|3]	[<start>,]<data>	Set/read pattern data [from Bit<start>]	141
:PRBS[1|2|3]	[<n>,]<length>	Set PRBS 2n-1 data (n = 7 to 12)	145
:PRESet[1|2|3]	[<n>,]<length>	Set preset pattern with frequency CLOCK÷ n (n = 2 to 16384)	147
[:STATe]	OFF|ON|0|1	Switch PATTERN mode on or off	149
:UPDate	OFF|ON|ONCE	Update the hardware with pattern data	150
:SIGNal[1|2]			
:FORMat	RZ|NRZ	Set/read data format of Output channel	151
:DISPlay			
[:WINDow]			
[:STATe]	ON|OFF|1|0	Set/read frontpanel display state	153
:MMEMory			
:CATalog?	[A:]	Read directory of memory card	154
:CDIRectory	[<name>]	Change directory on memory card	155
:COPY	<source>[,A:],<dest>[,A:]	Copy a file on memory card	157
:DELete	<name>[,A:]	Delete a file from memory card	158
:INITialize	[A:[DOS]]	Initialize memory card to DOS format	159
:LOAD			
:STATe	<n>,<name>	Load file from memory card to memory n	160
:STORe			
:STATe	<n>,<name>	Store memory n to memory card	161

Table 2: Instrument SCPI Command Summary, continued

Command	Parameter	Description	see page
:OUTPut[1|2]			
[:NORMal]			
[:STATe]	OFF|ON|1|0	Set/read normal output state	163
:COMPlement			
[:STATe]	OFF|ON|1|0	Set/read complement output state	164
:IMPedance			
[:INTernal]	<value>	Set/read internal source impedance of output	165
:EXTernal	<value>	Set/read expected external load impedance at output	167
:POLarity	NORM|INV	Set/read output polarity	169
[:SOURce]			
:CURRent[1|2]			
[:LEVel]			
[:IMMediate]			
[:AMPLitude]	<value>	Set/read channel amplitude current	170
:OFFSet	<value>	Set/read channel offset current	172
:HIGH	<value>	Set/read channel high-level current	174
:LOW	<value>	Set/read channel low-level current	176
:LIMit			
[:HIGH]		Set/read maximum current limits	178
:LOW		Set/read minimum current limits	180
:STATe	ON|OFF|1|0	Enable/Disable the current limits	182
:FREQency			
[:CW | :FIXed]	<value>	Set/read frequency of pulses	184
:AUTO	ONCE	Measure frequency at CLK IN	186
:HOLD[1|2]	VOLT|CURR	Switch between VOLtage and CURRent command subtrees	187

Table 2: Instrument SCPI Command Summary, continued

Command	Parameter	Description	see page
[:SOURce]		(Continued from previous page)	
:PHASe[1|2]			
[:ADJust]	<value>	Set/read channel phase	188
:PULSe			
:DCYCLe[1|2]	<value>	Set/read channel dutycycle	190
:DELay[1|2]	<value>	Set/read channel delay (to leading edge)	192
:HOLD	TIME|PRATio	Hold absolute delay|delay as period fixed with varying frequency	194
:UNIT	S|SEC|PCT|DEG|RAD	Set/read delay units	196
:DOUBle[1|2]			
[:STATe]	OFF|ON	Enable/disable double pulses per pulse-period	197
:DELay	<value>	Set/read delay between double pulses	198
:HOLD	TIME|PRATio	Hold absolute delay|delay as period fixed with varying frequency	200
:UNIT	S|SEC|PCT	Set/read delay units	202
:HOLD[1|2]	WIDTh|DCYCLe|TDELay	Hold Width|Dutycycle|Trailing edge delay fixed with varying frequency	203
:PERiod	<value>	Set/read pulse-period	204
:AUTO	ONCE	Measure pulse-period at CLK IN	206
:TDELay[1|2]	<value>	Set/read trailing edge delay	207
:TRANsition[1|2]			
:HOLD	TIME|WRATio	Hold absolute transitions|transitions as width ratio fixed with varying width per period	209
:UNIT	S|SEC|PCT	Set/read transition-time units	211
[:LEADing]	<value>	Set/read leading-edge transition	212
:TRAiling	<value>	Set/read trailing-edge transition	214
:AUTO	OFF|ON|ONCE	Couple trailing-edge to leading-edge	216
:TRIGger[1|2]			
:VOLTage	TTL|ECL	Set/read TRIGGER|STROBE OUTput levels	218
:WIDTh[1|2]	<value>	Set/read channel pulse-width	219

Table 2: Instrument SCPI Command Summary, continued

Command	Parameter	Description	see page
[:SOURce]		(Continued from previous page)	
:ROSCillator			
:SOURce	INTernal|EXTernal	Set/read PLL reference source	221
:EXTernal			
:FREQuency	<value>	Set/read frequency of external PLL reference	223
:VOLTage[1|2]			
[:LEVel]			
[:IMMediate]			
[:AMPlitude]	<value>	Set/read channel amplitude voltage	225
:OFFset	<value>	Set/read channel offset voltage	227
:HIGH	<value>	Set/read channel high-level voltage	230
:LOW	<value>	Set/read channel low-level voltage	232
:LIMit			
[:HIGH]		Set/read maximum voltage limit	234
:LOW		Set/read minimum voltage limit	236
:STATe	ON|OFF|1|0	Enable|Disable the voltage limits	238
:STATus			
:OPERation			
[:EVENt]?		Read Operation event register	240
:CONDition		Read Operation condition register	
:ENABle	Numeric	Set/Read Operation enable register	
:NTRansition	Numeric	Set/Read Operation negative-transition register	
:PTRansition	Numeric	Set/Read positive-transition register	
:PREset		Clear and preset status groups	241
:QUEStionable			242
[:EVENt]?		Read Questionable event register	
:CONDition?		Read Questionable condition register	
:ENABLe	Numeric	Set/Read Questionable enable register	
:NTRansition	Numeric	Set/Read Questionable negative-transition register	
:PTRansition	Numeric	Set/Read Questionable positive-transition register	

Table 2: Instrument SCPI Command Summary, continued

Command	Parameter	Description	see page
:SYSTem			
:CHECk			
[:ALL]			
[:STATe]	OFF	Switch error checking off	244
:ERRor?		Read error queue	245
:KEY	Numeric	Simulate key press or read last key pressed	247
:PRESet		no function	251
:SECurity			
[:STATe]	ON|OFF	Switch security on and off	252
:SET	Block data	Set/read complete instrument setting	254
:VERSion?		Read SCPI compliance setting	255
:WARNing			
[:COUNt]?		Read number of active warnings	256
:STRing?		Read active warnings as concatenated string	257
:BUFFer?		Read maximum possible length of concatenated string	258
:TRIGger		(Pulse mode and period source)	
[:SEQuence [1] | :STARt]			
:COUNt	<value>	Set/read number of triggered periods to be generated per ARM event	259
:IMPedance	<value>	Set/read impedance at CLK IN	262
:LEVel	<value>	Set/read threshold level at CLK IN	264
:SLOPe	POS|NEG	Set/read trigger slope at CLK IN	266
:SOURce	IMM | INT[1] | INT2 |EXT	Set/read trigger source (IMM | VFO | PLL | CLK IN)	267

Default Values, standard settings

Table 3: Default Values, standard settings

Parameter				*RST,Default Values
:ARM :	EWIDth	:STATe		OFF
	:FREQuency			100kHz
	:IMPedance			50Ω
	:LEVel			+1.00V
	:PERiod			10.00µs
	:SENSe			EDGE
	:SLOPe			POS
	:SOURce			IMMediate
:CHANnel	:MATH			OFF
:DIG	[:STIMulus:]	:PATTern	:DATA[1|2|3]	Ch1 Bit1=1, Bit2 to 16384=0
				Ch2 Bit1=0, Bit2=1, Bit3 to 16384=0
				Strobe Bit1=1, Bit2 to 16384=0
			:PRBS[1|2|3]	not applicable
			:PRESet[1|2|3]	not applicable
			[:STATe]	OFF
			:UPDate	ON
		:SIGNal[1|2]	:FORMat	RZ

Table 3: Default Values, standard settings, continued

Parameter			*RST,Default Values
:DISPlay	[:WINDow]	[:STATe]	ON
:CALibration[:ALL]			not applicable
:MMEMory	:CATalog?		not applicable
	:CDIRectory		not applicable
	:COPY		not applicable
	:DELete		not applicable
	:INITialize		not applicable
	:LOAD	:STATe	not applicable
	:STORe	:STATe	not applicable
:OUTPut[1|2]	[:NORMal]	[:STATe]	OFF
	:COMPlement	[:STATe]	OFF
	:IMPedance	[:INTernal]	50Ω
		:EXTernal	50.0Ω
	:POLarity		NORMal

Table 3: Default Values, standard settings, continued

Parameter					*RST,Default Values
[:SOURce]	:CURRent[1|2][:LEVel]		[:IMM]	[:AMPL]	20.0mA (from 50Ω into 50Ω)
				:OFFset	0.0mA (from 50Ω into 50Ω)
				:HIGH	+10.0mA (from 50Ω into 50Ω)
				:LOW	-10.0mA (from 50Ω into 50Ω)
		:LIMit	[:HIGH]		+10.0mA
			:LOW		-10.0mA
			:STATe		OFF
	:FREQ	[:CW|:FIXed]			1.00MHz
			:AUTO		not applicable
	:HOLD				VOLT
	:PHASe[1|2]	[:ADJust]			0.0
	:PULSe:	:DCYCle[1|2]			10.0% (derived from Width and Period)
		:DELay[1|2]			0.0
			:HOLD		TIME
			:UNIT		S
		:DOUBle[1|2][:STATe]			OFF
			:DELay		250 ns
				:HOLD	TIME
				:UNIT	S
		:HOLD[1|2]			WIDTh

Table 3: Default Values, standard settings, continued

Parameter					*RST,Default Values
[:SOURce]	:PULSe	:PERiod			1µs
			:AUTO		not applicable
		:TDELay[1|2]			100ns
		:TRANsition[1|2]:HOLD			TIME
			:UNIT		S
			[:LEADing]		HP 81111A 10V/165 MHz Output: 2.0 ns HP 81112A 3.8V/330 MHz Output: 0.8 ns HP 81105A 10V/80 MHz Output: 3.0 ns
			:TRAiling		HP 81111A 10V/165 MHz Output: 2.0 ns HP 81112A 3.8V/330 MHz Output: 0.8 ns HP 81105A 10V/80 MHz Output: 3.0 ns
				:AUTO	ON
		:TRIGger[1|2] :VOLTage			TTL
		:WIDTh[1|2]			100ns
		:ROSCillator:SOURce			INTernal
			:EXTernal :FREQ		5MHz

Table 3: Default Values, standard settings, continued

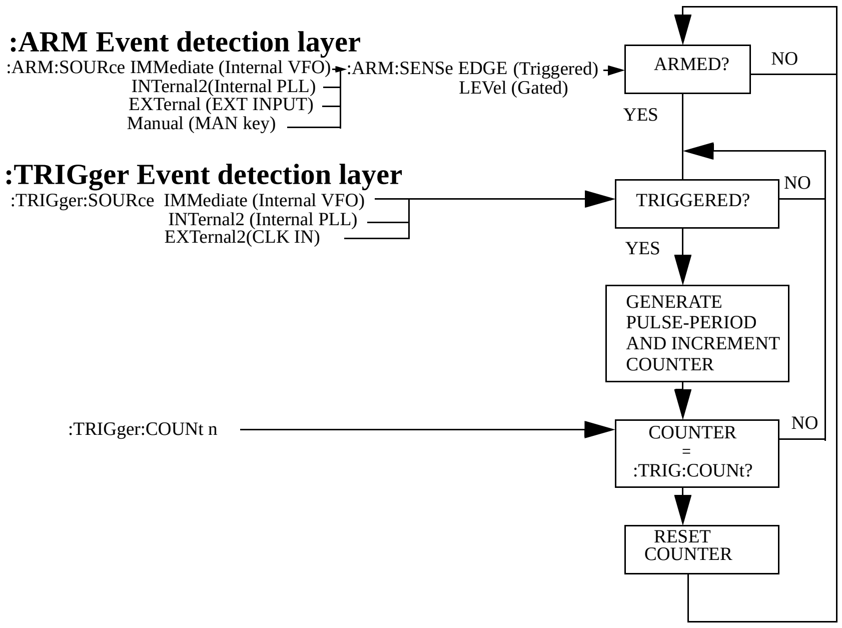
Parameter	*RST,Default Values
[:SOURce] :VOLTage[1|2] :LEVel] [IMMediate] [:AMPLitude]	1.0V
:OFFSet	0.0mV
:HIGH	500mV
:LOW	-500mV
:LIMIt [:High]	+ 500V
:LOW	-500V
:STATe	OFF
:STATus: :OPERation	not applicable
:PRESet	not applicable
:QUEStionable[:EVENt]?	not applicable
:CONDition?	not applicable
:ENABle	not affected
:NTRansition	not applicable
:PTRansition	not applicable

Table 3: Default Values, standard settings, continued

Parameter				*RST,Default Values
:SYSTem	:CHECk	[:ALL]	[:STATe]	OFF
	:ERRor?			not applicable
	:KEY			+255
	:PRESet			not applicable
	:SECurity	[:STATe]		OFF
	:SET			not applicable
	:VERSion			"1992.0"
	:WARNing	[:COUNt]?		not applicable
		:STRing?		not applicable
		:BUFFer?		not applicable
:TRIGger	:COUNt			1
	:IMPedance			50Ω
	:LEVel			1.0V
	:SLOPe			POSitive
	:SOURce			IMMediate

Programming the Instrument Trigger Modes

Figure 45 **Instrument ARM-TRIGGER model**



You program the comprehensive triggering capabilities of the instrument using the SCPI :ARM and :TRIGger subsystems. Using these two command subsystems you can program the operating modes of the instrument which are set up using the [**`MODE/TRG`**] screen on the frontpanel.

Use the :ARM subsystem to select the overall triggering mode of the instrument **`(CONTINUOUS,TRIGGERED,GATED,EXT WIDTH)`**, and the

:TRIGger subsystem to select the pulse-period source, triggering and number of pulse-periods per :ARM event **(BURST or PATTERN** length).

CONTINUOUS

Set **CONTINUOUS** mode by ARMing the instrument from its internal oscillator:

:ARM : SOURce IMMediate	Arm from internal osc.

TRIGGERED

Set **TRIGGERED** mode by ARMing the instrument on edges from the EXT INPUT:

:ARM:SOURce EXTernal1	Arm from EXT INPUT
:ARM:SENSe EDGE	Arm on edge
:ARM:SLOPe POSitive	Arm on positive edge
:ARM:LEVel 1V	Set EXT INPUT threshold

As you have the PLL/External Clock fitted, you can also ARM the instrument from the PLL and set the frequency (or period) of the PLL to the required triggering rate:

:ARM:SOURce INTernal2	Arm from PLL
:ARM:SENSe EDGE	Arm on edge
:ARM:SLOPe POSitive	Arm on positive edge
:ARM:FREQuency <value>	Set PLL frequency

NOTE: The PLL (INTernal2) *cannot* be used as:ARM:SOURce (triggering rate) if it is already being used as :TRIGger:SOURce (pulse-period source).

GATED

Set **GATED** mode by ARMing the instrument on levels from the EXT INPUT:

:ARM:SOURce EXTernal1	Arm from EXT INPUT
:ARM:SENSe LEVel	Arm on signal level
:ARM:SLOPe POSitive	Arm on positive level

EXT WIDTH

Set **EXT WIDTH** mode using the :EWIDth[:STATe] command:

:ARM:EWIDth ON	Switch on EXT WIDTH mode

This command disables the ARM-TRIGger system. The ARM-TRIGger system is re-enabled by switching OFF EWIDth mode.

PULSES

Set **PULSES** mode by setting the :TRIGger:COUNt to 1 so that a single triggered pulse-period is generated for every ARM event. The trigger source sets the pulse-period:

:TRIGger:COUNt 1	Single pulse-period per arm event
:TRIGger:SOURce INTernal 1	Pulse period from internal osc.
:DIGital :PATTern OFF	Disable pattern data.

Pulse-period Source	:TRIGger SOURce
internal OSC. **internal PLL** **CLK IN**	INTernal[1] INTernal2 EXTernal2

NOTE: The **internal PLL** (INTernal2) *cannot* be used as :TRIGger:SOURce (pulse-period source) if it is already being used as ARM:SOURce (triggering rate).

Note that in **TRIGGERED PULSES** mode the pulse-period source is not relevant because a single pulse is generated for each ARM event.

BURST of

Set **BURST of** mode by setting the :TRIGger:COUNt to the burst count required. The trigger source sets the pulse-period for the pulses within the burst **(See Table 21)**

:TRIGger:COUNt 16	Burst of 16 pulse periods
:TRIGger:SOURce INTernal1	Pulse-period from internal osc.
:DIGital:PATTern OFF	Disable pattern data

PATTERN

Set **PATTERN** mode by setting the :TRIGger:COUNt to the pattern length required, and switching on digital pattern data. The trigger source sets the pulse-period for the data pulses (**See Table 21**):

:TRIGger:COUNt 512	Pattern length 512
:TRIGger:SOURce INTernal1	Pulse period from internal osc.
:DIGital:PATTern ON	Enable pattern data
:DIGital:SIGNal1:FORMat NRZ	Set OUTPUT 1 data to NRZ

SCPI Instrument Command List

The following reference sections list the instrument commands in alphabetical order. In addition to a command description, the attributes of each command are described under the following headings. Not all of these attributes are applicable to all commands. The commands are conform to the IEEE 488.2 SCPI standard.

Subsection Header

The subsection header shows the short form of the command.

Long

Shows the long form of the command.

Form

Set	The command can be used to program the instrument
Query	The command can be used to interrogate the instrument. Add a ? to the command if necessary.
Event	The command performs a one-off action.

Parameter

The type of parameter, if any, accepted by the command. The minimum and maximum value of numeric parameters can be accessed by the option MINimum or MAXimum.

Parameter Suffix

The suffixes which may follow the parameter.

Functional Coupling

Any other commands which are implicitly executed by the command.

Value Coupling

Any other parameter which is also changed by the command.

Range Coupling

Any other parameters whose valid ranges may be changed by the command.

*RST value

The value/state following a *RST command.

Specified Limits

The specified limits of a parameter.

Absolute Limits

Some parameters can be programmed beyond their specified limits.

Example

Example programming statements which assume:

- HP BASIC 6.1 or higher
- HP-IB Interface Select Code = 7
- Instrument HP-IB Address = 10

:ARM:EWID

Long

:ARM[:SEQuence[1]][:LAYer]:EWIDth[:STATe]

Form

Set & Query

Parameter

ON | OFF | 1 | 0

*RST value

OFF

Description

This command enables the **EXT WIDTH** trigger mode available on the [**MODE/TRG**] screen using the frontpanel. When EXT WIDTH mode is switched on, the rest of the :ARM and :TRIG system is disabled.

In EXT WIDTH mode a signal applied to the EXT INPUT determines the width and period of the output signal(s) from the instrument. You can still control the edge transition-times and levels of the output signal(s).

:ARM:FREQ

Long

:ARM[:SEQuence[1]][:LAYer]:FREQuency[:CW][:FIXed]

Form

Set & Query

Parameter

Numeric

Parameter Suffix

HZ with engineering prefixes, e.g.: MHZ is Megahertz.

*RST value

100 kHz

Specified Limits

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
1 mHz to 80 MHz	1 mHz to 165 MHz	1mHz to 330 MHz	VCO: 1 Hz to 150 MHz PLL: 1 mHz to 150 MHz

Description

Use this command to program the frequency of the PLL (INTernal2) when it is used as the **`:ARM:SOURce`** for internal triggering of pulses, bursts or patterns.

If you are using the PLL as **`:TRIGger:SOURce`** to set the pulse frequency, use the **`[:SOURce]:FREQuency[:CW|:FIXed]`** command

Example

To set up bursts of four 100 MHz pulses occurring at a burst-rate of 10 MHz:

`OUTPUT 710;":TRIG:SOUR INT"`	Select internal osc. as pulse period source
`OUTPUT 710;":FREQ 100MHZ"`	Set pulse frequency to 100MHz
`OUTPUT 710;":ARM:SOUR INT2"`	Select PLL as triggering source
`OUTPUT 710;":ARM:SENS EDGE"`	Sense edge of PLL signal
`OUTPUT 710;":ARM:FREQ 10 MHZ"`	Set triggering frequency to 10 MHZ
`OUTPUT 710;":TRIG:COUNT 4"`	Set burst length to 4

:ARM:IMP

Long

:ARM[:SEQuence[1]][:LAYer]:IMPedance

Form

Set & Query

Parameter

Numeric

Parameter Suffix

OHM with engineering prefixes, e.g.: MOHM is Megaohms.

*RST value

50 Ω

Specified Limits

50 Ω or 10 kΩ

Description

Use this command to program the input impedance of the EXT INPUT connector. Note that only two settings are available. If you try to program any other value, it will be rounded to one of the specified values.

Example

`OUTPUT 710;":ARM:IMP 50OHM"`	Set EXT INPUT impedance to 50 Ω
`OUTPUT 710;":ARM:LEV 2.5V"`	Set EXT INPUT threshold to 2.5 V

:ARM:LEV

Long

:ARM[:SEQuence[1]][:LAYer]:LEVel

Form

Set & Query

Parameter

Numeric

Parameter Suffix

V with engineering prefixes.

*RST value

+1.0 V

Specified Limits

-10 V to +10 V

Description

Use this command to program the triggering threshold of the EXT INPUT connector.

Example

`OUTPUT 710;":ARM:IMP 50OHM"`	Set EXT INPUT impedance to 50 Ω
`OUTPUT 710;":ARM:LEV 2.5V"`	Set EXT INPUT threshold to 2.5 V

:ARM:PER

Long

:ARM[:SEQuence[1]][:LAYer]:PERiod

Form

Set & Query

Parameter

Numeric

Parameter Suffix

S or SEC with engineering prefixes.

*RST value

10.00 µs

Specified Limits

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
12.5 ns to 999.5 s	6.06 ns to 999.5 s	3.03 ns to 999.5 s	VCO: 6.65 ns to 999 ms PLL: 6.650 ns to 999.0 s

Description

Use this command to program the period of the PLL (INTernal2) when it is used as the `:ARM:SOURce` for internal triggering of pulses, bursts or patterns.

If you are using the PLL as :**`TRIGger:SOURce`** use the **`[:SOURce]:PULSe:PERiod`** command to set the pulse period,

Example

To set up bursts of four 10 ns pulses occurring every 100 ns:

`OUTPUT 710;":TRIG:SOUR INT"`	Select internal osc.as pulse period source
`OUTPUT 710;":PER 10 NS"`	Set pulse period to 10ns
`OUTPUT 710;":ARM:SOUR INT2"`	Select PLL as triggering source
`OUTPUT 710;":ARM:SENS EDGE"`	Sense edge of PLL signal
`OUTPUT 710;":ARM:PER 100ns"`	Set triggering period to 100ns
`OUTPUT 710;":ARM:TRIG:COUNT 4"`	Set burst length to 4

:ARM:SENS

Long

:ARM[:SEQuence[1]][:LAYer]:SENSe

Form

Set & Query

Parameter

EDGE | LEVel

*RST value

EDGE

Description

Use this command to select **TRIGGERED** or **GATED** mode by choosing whether the instrument arms on the edge(s) or level of the arming signal. When sensing edges, the instrument triggers when the arming signal crosses the selected threshold level (**:ARM:LEV**) in the selected direction (:**ARM:SLOP**). This corresponds to the **TRIGGERED** mode selected on the [**MODE/TRG**] screen when using the frontpanel.
When sensing levels, the instrument triggers as long as the arming signal is above (**:ARM:SLOP POS**), or below (**:ARM:SLOP NEG**) the selected threshold level (**:ARM:LEV**). This corresponds to the **GATED** mode selected on the [**MODE/TRG**] screen when using the frontpanel.

:ARM:SLOP

Long

:ARM[:SEQuence[1]][:LAYer]:SLOPe

Form

Set & Query

Parameter

POSitive | NEGative | EITHer

*RST value

POS

Description

Use this command to select the trigger slope for the arming signal when triggering on edges. Use EITHer to trigger on both the positive and negative edges of the arming signal. This allows you to trigger at twice the frequency of the arming signal.
If you are arming on levels, use this command to select whether the instrument triggers during the positive or negative cycle of the arming signal.

:ARM:SOUR

Long

:ARM[:SEQuence[1]][:LAYer]:SOURce

Form

Set & Query

Parameter

IMMediate | INTernal[1] | INTernal2 | EXTernal[1] | MANual

*RST value

IMM

Description

Use this command to select the triggering mode of the instrument by selecting the source of the arming signal:

Table 4:

Triggering source	:ARM:SOURce	Mode
internal osc.	IMMediate|INTernal[1]	**CONTINUOUS**
PLL	INTernal2	[1]**TRIGGERED| GATED by PLL**
EXT INPUT	EXTernal1	[1]**TRIGGERED|GATED by:EXT IN**
MAN key	MANual	[1]**TRIGGERED|GATED by:MANKey**

[1] Use :ARM:SENSe EDGE | LEVel to choose between **TRIGGERED** and **GATED**

:CHAN:MATH

Long

:CHANnel:MATH

Form

Set & Query

Parameter

OFF | PLUS

*RST value

OFF

Description

Use this command to enable or disable channel addition in an instrument with two Output channels installed. With :CHAN:MATH PLUS the signals from both channels are added at OUTPUT 1. OUTPUT 2 is not used.
This allows you to for example

- Generate 3 and 4 level waveforms
- Simulate single or repeated glitches
- Generate pulse transitions with a step-change in slew-rate
- Simulate overshoot and undershoot

For levels and amplitude values which can be added in the channel addition mode, refer to chapter 3, Specifications, “Levels in Channel Addition” on page 297.

NOTE: This functionality is not available for HP 81110A with HP 81112A 3.8V/330 MHz outputs installed.

:CALibration

Long

:CALibration[:ALL]

Form

Set & Query

Parameter

none

*RST value

none

Description

Use this command to perform a timing calibration of the HP 81110A. The timing circuitries for VCO-period, delay and width are calibrated in reference to the internal PLL reference.

The return values for the query command :CALibration[:ALL]? are as follows:

0	calibration passed
>0	calibration failed

When the HP 81110A is switched off and on again, the factory calibration data are activated again.

:DIG:PATT:DATA[1|2|3]

Long

:DIGital[:STIMulus]:PATTern:DATA[1|2|3]

Form

Set & Query

Parameter

[<start>,] <data>

*RST value

Table 5:

Channel		Default		
[1|2|3]	Description	Bit 1	Bit 2	Bits 3 to 16384 (HP 8110A: 4096)
1	CH1 (OUTPUT 1)	1	0	0
2	CH2 (OUTPUT 2)	0	1	0
3	STRB(STROBE OUT)	1	0	0

Description

Use this command to set or read the pattern data of one or all channels starting from Bit 1. The <data> is an arbitrary block of program data as defined in IEEE 488.2 7.7.6.2, for example:

NOTE: Note that the optional<start> parameter is ignored by the instrument if you use it

#1541213

Start of block
1 Length of the length of the data
5 Length of the data
41213 5 bytes of data

#2161000100010001000

Start of block
2 Length of the length of the data
16 Length of the data
10...00 16 bytes of data

Examples

:DIG:PATT:DATA #1541213
The instrument uses each byte of data set one Bit in the pattern memory. If you don't specify a particular channel, the lowest three bits of each byte are used to set all three channels, and the top five bits are ignored. Note that you can therefore use the ASCII characters ‘0’,‘1’,‘2’ and ‘3’, to program Outputs 1 and 2 in binary with STROBE=0 (or ‘4’,’5’,’6’, and ‘7’ for STROBE=1):

DATA			STRB STROBE OUT	CH2 OUTPUT2	CH1 OUTPUT 1
ASCII	IGNORED	USED			
	D7 D6 D5 D4 D3	D2 D1 D0			
4	0 1 1 1 0	1 0 0	1	0	0
1	0 1 1 1 0	0 0 1	0	0	1
2	0 1 1 1 0	0 1 0	0	1	0
1	0 1 1 1 0	0 0 1	0	0	1
3	0 1 1 1 0	0 1 1	0	1	1

:DIG:PATT:DATA2 #1501011

If you specify a particular channel, the least significant bit of each byte is used to set the selected channel, and the top seven bits are ignored. Note that you can therefore use the ASCII characters ‘1’ and ‘0’ to set individual bits to 1 and 0:

DATA									STRB STROBE OUT[1]	CH2 OUTPUT2	CH1 OUTPUT [1]
ASCII	IGNORED							LSB			
	D7	D6	D5	D4	D3	D2	D1	D0			
0	0	1	1	1	0	0	0	0	X	0	X
1	0	1	1	1	0	0	0	1	X	0	X
0	0	1	1	1	0	1	0	0	X	1	X
1	0	1	1	1	0	0	0	1	X	0	X
1	0	1	1	1	0	0	0	1	X	1	X

1 X indicates that the bit remains unchanged

Example

`OUTPUT 710;":ARM:SOUR IMM"`	Set continuous mode
`OUTPUT 710;":DIG:PATT:DATA3 #1501011"`	Set up pattern data for- STROBE channel
`OUTPUT 710;":TRIG:COUN 5"`	Set pattern length (last- bit) to 5
`OUTPUT 710;":DIG:PATT ON"`	Switch on PATTERN mode

:DIG:PATT:PRBS[1|2|3]

Long

:DIGital[:STIMulus]:PATTern:PRBS[1|2|3]

Form

Set

Parameter

<n>,<length>

*RST value

Not applicable

Specified Limits

<n>	7 to 14 (integer) (HP 8110A: 7-12)
<length>	2 to 16384 (integer) (HP 8110A: 1- 4096)

Description

Use this command to set up PRBS data starting from bit 1. The parameter <n> is used as the basis to generate a 2^n-1 PRBS. The parameter <length> determines how many bits of the PRBS sequence are used. If <length> is longer than the PRBS, the PRBS is repeated as necessary to achieve the required length.

Example

To set up a repeating $2^{10-}1$ PRBS on OUTPUT 1:

`OUTPUT 710;":ARM:SOUR IMM"`	Set continuous mode
`OUTPUT 710;":TRIG:COUN 1023"`	Set pattern length (last bit) to 1023
`OUTPUT710; ":DIG:PATT:PRBS1 10,1023"`	Set up PRBS on OUTPUT 1
`OUTPUT 710;":DIG:PATT ON"`	Switch on PATTERN mode

:DIG:PATT:PRES[1|2|3]

Long

:DIGital[:STIMulus]:PATTern:PRESet[1|2|3]

Form

Set

Parameter

<n>,<length>

*RST value

Not applicable

Specified Limits

<n>	2 to 16384 (integer)
<length>	2 to 16384 (integer)

Description

Use this command to set up clock data starting from bit 1 with value 1. The parameter <n> is used as the divider to generate a CLOCK÷n sequence (squarewave if NRZ data is selected). The parameter <length> determines the length of the sequence.

n=2 Sequence = 101010101010101....
n=3 Sequence = 100100100100100....
n=4 Sequence = 110011001100110....
n=5 Sequence = 110001100011000....
n=6 Sequence = 111000111000111....

n=7 Sequence = 111000011100001....
n=8 Sequence = 111100001111000....
and so on.
Special Case: <n> = 0, <n> = 1,
If <n> = 0 then the sequence defined by <length> is filled with zeros. If <n> = 1, then the sequence is filled with ones.

Example

To set up a CLOCK ÷ 4 squarewave on STROBE OUT:

`OUTPUT 710;":TRIG:COUN 4096"`	Set pattern length (last bit) to 4096
`OUTPUT 710;":DIG:PATT:PRES3 4,4096"`	Set up CLOCK÷4 on STRB
`OUTPUT 710;":DIG:PATT ON"`	Switch on PATTERN mode

NOTE: To produce a CONTINUOUS squarewave the pattern length must be a multiple of the selected divider, in this case a multiple of 4.

:DIG:PATT

Long

:DIGital[:STIMulus]:PATTern[:STATe]

Form

Set & query

Parameter

ON | OFF

*RST

OFF

Description

Use this command to enable and disable **`PATTERN`** mode. Use **`:TRIG:COUN`** to program the length of the pattern.

:DIG:PATT:UPD

Long

:DIGital[:STIMulus]:PATTern:UPDate

Form

Set & query

Parameter

ON | OFF | ONCE

*RST

ON

Description

Use this command to enable and disable the automatic updating of the pattern generating hardware following a **`:DIG:PATT:DATA`** command. Disable the automatic updating if you want to set up new pattern data in the instrument without affecting the pattern which is currently being generated. You can then update the hardware with the new pattern data by sending a **`:DIG:PATT:UPD ONCE`** command.

:DIG:SIGN[1|2]:FORM

Long

:DIGital[:STIMulus]:SIGNal[1|2]:FORMat

Format

Set & Query

Parameter

RZ | NRZ

Range Coupling

Period, Frequency

*RST value

RZ

Description

Use this command to set and read the data format of channels 1 and 2 when using **PATTERN** mode. If you don't specify a channel number in the command, channel 1 is assumed.

RZ	Return to Zero. An RZ pulse is generated for each '1' in the data. You can vary the width, edges and levels of the pulse.
NRZ	Non Return to Zero.A pulse of 100% duty-cycle is generated for each '1'in the data. You can vary the edges and levels of the pulse.

Example

`OUTPUT 710;":DIG:SIGN:FORM NRZ"`	Set channel 1 data format to NRZ

:DISP

Long

:DISPlay[:WINDow][:STATe]

Form

Set & Query

Parameter

ON | OFF | 1 | 0

*RST value

ON

Description

This command is used to turn the frontpanel display on and off. Switching off the display improves the programming speed of the instrument.

NOTE: *RST switches the display back on. Use **`:SYSTem:PRESet`** to perform an *RST without switching the display back on.

Example

`OUTPUT 710;"DISP OFF"`	Switch off the frontpanel display

:MMEM:CAT?

Long

:MMEMory:CATalog?

Form

Query

Parameter

["A:"]

*RST value

Not applicable

Description

Use this command to get a listing of the contents of the currently selected directory on the memory card. As there is only one memory card slot, the parameter A: is optional. The information returned is:
<bytes_used>,<bytes_free>{,<file_entry>}

<bytes_used>	The total number of bytes used on the memory card.
<bytes_free>	The total number of bytes still available on the memory card.
<file_entry>	String containing the name, type and size of one file: "<file_name>,<file_type>,<file_size>"

NOTE: The <file_type> is always blank.
A directory name has <file_size> = 0

:MMEM:CDIR

Long

:MMEMory:CDIRectory

Form

Event

Parameter

["directory_name"]

*RST value

Not applicable

Description

Use this command to change the current directory on the memory card. If you don't specify a directory name parameter, the root directory is selected.

NOTE: Note that you cannot use DOS pathnames as directory names, you can only select a directory name within the current directory.

Use the directory name ".." to move back to the parent directory of the current directory, unless you are already in the root directory "\".

Examples

OUTPUT 710;":MMEM:CDIR"	Select root directory
OUTPUT 710;":MMEM:CDIR ""PER-FORM"""	Select directory "PERFORM"
OUTPUT 710;":MMEM:CDIR ""..""""	Select parent directory

:MMEM:COPY

Long

:MMEMory:COPY

Form

Event

Parameter

"filename"[,"A:"],"copyname"[,"A:"]

*RST

Not applicable

Description

Use this command to copy an existing file *filename* in the current directory to a new file *copyname*. If *copyname* is the name of a sub-directory in the current directory, a copy of the file *filename* is made in the sub-directory. Use ".." as *copyname* to copy a file into the parent directory of the current directory.

Examples

`OUTPUT 710;":MMEM:COPY ""test1"",""test2"""`	Copy test1 to test2
`OUTPUT 710;":MMEM:COPY ""test1"","".."""`	Copy test1 into parent directory

:MMEM:DEL

Long

:MMEMory:DELete

Form

Event

Parameter

"filename"

*RST

Not applicable

Description

Use this command to delete file *filename* from the currently selected directory.

:MMEM:INIT

Long

:MMEMory:INITialize

Form

Event

Parameter

["A:"[,"DOS"]]

*RST

Not applicable

Description

CAUTION: Initializing a memory card destroys any existing data on the card.

Use this command to initialize a memory card to DOS format.

:MMEM:LOAD:STAT

Long

:MMEMory:LOAD:STATe

Form

Event

Parameter

<n>,"filename"[,"A:"]

*RST

Not applicable

Specified Limits

<n> = 0 to 9 (integer)

Description

Use this command to load a complete instrument setting from file *file-name* in the current directory into memory <n> in the instrument. Memories 1 to 9 are the internal memories. Use memory 0 to load a default setting as the current instrument setting.

Examples

See next command

:MMEM:STOR:STAT

Long

:MMEMory:STORe:STATe

Form

Event

Parameter

<n>,"filename"[,"A:"]

*RST

Not applicable

Specified Limits

<n> = 0 to 9 (integer)

Description

Use this command to store a complete instrument setting from memory <n> to file *filename* in the current directory on the memory card. Memories 1 to 9 are the internal memories. Use memory 0 to store the current instrument setting to a file.

Examples

`OUTPUT 710;":MMEM:LOAD:STAT 1,""FREQPERF"""`	Load FREQPERF into memory 1
`OUTPUT 710;":MMEM:LOAD:STAT 0,""AMPTEST"""`	Load AMPTEST as current setting
`OUTPUT 710;":*SAV 2"`	Save current setting in memory 2
`OUTPUT 710;":*RCL 3"`	Recall memory 3 as current setting

:OUTP[1|2]

Long

:OUTPut[1|2][:NORMal][:STATe]

Form

Set & Query

Parameter

ON | OFF | 1 | 0

*RST value

OFF

Description

Use this command to switch the normal OUTPUTs on or off.

Example

`OUTPUT 710;":OUTP1 ON"`	Switch on OUTPUT 1
`OUTPUT 710;":OUTP2 OFF"`	Switch off OUTPUT 2

:OUTP[1|2]:COMP

Long

:OUTPut[1|2]:COMPlement[:STATe]

Form

Set & Query

Parameter

ON | OFF | 1 | 0

*RST value

OFF

Description

Use this command to switch the complement/differential OUTPUTs on or off. (Available with HP 81112A 3.8 V / 330 MHz output channels)

Example

`OUTPUT 710;":OUTP1:COMP ON"`	Switch on complement OUTPUT 1
`OUTPUT 710;":OUTP2:COMP OFF"`	Switch off complement OUTPUT 2

:OUTP[1|2]:IMP

Long

:OUTPut[1|2]:IMPedance[:INTernal]

Form

Set & Query

Parameter

Numeric

Parameter Suffix

OHM with engineering prefixes, e.g.: **MOHM** is Megaohms.

*RST value

50 Ω

Specified Limits

50 Ω or 1 kΩ

Description

Use this command to program the source impedance of the OUTPUT connectors. Note that only two settings are available. If you try to program any other value, it will be rounded to one of the specified values. The HP 81112A 3.8V/330 MHz output has a fixed 50 Ω Source impedance.

Example

`OUTPUT 710;":OUTP1:IMP 50OHM"`	Set OUTPUT 1 impedance to 50 Ω
`OUTPUT 710;":OUTP2:IMP 1000OHM"`	Set OUTPUT 2 impedance to 1 kΩ

:OUTP[1|2]:IMP:EXT

Long

:OUTPut[1|2]:IMPedance:EXTernal

Form

Set & Query

Parameter

Numeric

Parameter Suffix

`OHM` with engineering prefixes, e.g.: `MOHM` is Megaohms.

*RST value

50.0 Ω

Specified Limits

0.1 Ω to 1 MΩ

Description

Use this command to set the expected load impedance of the device-under-test at the OUTPUT connectors. If you have a non-50 Ω load, the output levels at the device-under-test will not be the levels you program or set via the frontpanel *unless* you set the expected load using this command. With the HP 81112A 3.8V/330MHz output channels it is not possible to set load impedance, it expects 50 Ω loads.

Example

`OUTPUT 710;":OUTP1:IMP:EXT 47.6OHM"`	Set load impedance at OUTPUT 1 to 47.6 Ω
`OUTPUT 710;":OUTP2:IMP:EXT 1M OHMS`	Set load impedance at OUTPUT 2 to 1 MΩ

:OUTP[1|2]:POL

Long

:OUTPut[1|2]:POLarity

Form

Set & Query

Parameter

NORMal | INVerted

*RST value

NORM

Description

Use this command to invert the signal at the OUTPUTs.

Example

`OUTPUT 710;":OUTP1:POL INV"`	Inverted signal at OUTPUT1
`OUTPUT 710;":OUTP1:POL NORM"`	Normal signal at OUTPUT 1

:CURR[1|2]

Long

[:SOURce]:CURRent[1|2][:LEVel][:IMMediate][:AMPLitude]

Form

Set & Query

Parameter

Numeric

Parameter suffix

A with engineering prefixes.

*RST value

20 mA (50 Ω into 50 Ω)

Specified Limits

10 V Outputs (from high Z into short) :max 400 mA typical
3.8V Outputs (50 Ω into short): max 152 mA typical

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling

Offset

Description

This command programs the amplitude current of the OUTPUT signal. Note that to set the OUTPUT levels in terms of current, you first have to execute the `[:SOURce]:HOLD CURRent` command to enable the `[:SOURce]:CURRent subsystem.`

The available current range is limited by the combination of:

- Specified Voltage limits
- Actual OUTPUT Impedance setting :`OUTPut:IMPedance`
- Actual Expected Load impedance setting`:` `:OUTPut:IMPedance:EXTernal`

Example

`OUTPUT 710;":HOLD CURR"`	Enable CURRENT subsystem
`OUTPUT 710;":CURR1 75MA"`	Set OUTPUT 1 amplitude to 75 mA

:CURR[1|2]:OFFSet

Long

[:SOURce]:CURRent[1|2][:LEVel][:IMMediate]:OFFSet

Form

Set & Query

Parameter

Numeric

Parameter suffix

A with engineering prefixes.

*RST value

0.0 µA (50 Ω into 50 Ω)

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling

Amplitude

Description

This command programs the offset current of the OUTPUT signal. Note that to set the OUTPUT levels in terms of current, you first have to execute
the **`[:SOURce]:HOLD CURRent`** command to enable the **`[:SOURce]:CURRent`** subsystem.

The available current range is limited by the combination of:

- Specified Voltage limits
- Actual OUTPUT Impedance setting **`:OUTPut:IMPedance`**
- Actual Expected Load impedance setting

Example

`OUTPUT 710;":HOLD CURR"`	Enable CURRENT subsystem
`OUTPUT 710;":CURR1:OFF 50MA"`	Set OUTPUT 1 offset to 50 mA

:CURR[1|2]:HIGH

Long

[:SOURce]:CURRent[1|2][:LEVel][:IMMediate]:HIGH

Form

Set & Query

Parameter

Numeric

Parameter suffix

A with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling

Low-level

*RST value

+10 mA (50 Ω into 50 Ω)

Specified Limits

10 V Output (from high Z into short): -396 mA to 400 mA typical
3.8 V (from 50 Ω into short): -82 mA to 152 mA typical

Description

This command programs the High-level current of the OUTPUT signal. Note that to set the OUTPUT levels in terms of current, you first have to execute `[:SOURCE]:HOLD CURRent` command to enable the `[:SOURCE]:CURRent` subsystem.

The available current range is limited by the combination of:

- Specified Voltage limits
- Actual OUTPUT Impedance setting `:OUTPut:IMPedance`
- Actual Expected Load impedance setting: `:OUTPut:IMPedance:EXTernal`

Example

`OUTPUT 710;":HOLD CURR"`	Enable CURRENT subsystem
`OUTPUT 710;":CURR1:HIGH 150MA"`	Set OUTPUT 1 High-level to 150 mA

:CURR[1|2]:LOW

Long

[:SOURce]:CURRent[1|2][:LEVel][:IMMediate]:LOW

Form

Set & Query

Parameter

Numeric

Parameter suffix

A with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling

High-level

*RST value

-10 mA (50 Ω into 50 Ω)

Specified Limits

10 V Outputs (from high Z into short): -400 mA to 396 mA typical
3.8 V Outputs (from 50 Ω into short): -84 mA to 150 mA typical

Description

This command programs the Low-level current of the OUTPUT signal. Note that to set the OUTPUT levels in terms of current, you first have to execute the **`[:SOURce]:HOLD CURRent`** command to enable the **`[:SOURce] :CURRent`** subsystem.

The available current range is limited by the combination of:

- Specified Voltage limits
- Actual OUTPUT Impedance setting **`:OUTPut:IMPedance`**
- Actual Expected Load impedance setting: **`:OUTPUT:IMPedance:EXTernal`**

Example

`OUTPUT 710;":HOLD CURR"`	Enable CURRENT subsystem
`OUTPUT 710;":CURR1:LOW 50 MA"`	Set OUTPUT 1 Low-level to 50 mA

:CURR[1|2]:LIM

Long

[:SOURce]:CURRent[1|2]:LIMit[:HIGH]

Form

Set & Query

Parameter

Numeric

Parameter suffix

A with engineering prefixes.

*RST value

+10.0 mA

Description

Use this command to set/read the High-level current limit. If you switch on current limiting, the High-level current cannot be set above the programmed limit.

NOTE: The current is *NOT* limited by the OUTPUT hardware, this is a software limit.

Example

OUTPUT 710;":HOLD CURR"	Enable CURRENT subsystem
OUTPUT 710;":CURR1:LIM 50 MA"	Set OUTPUT 1 High-levelcurrent limit to 50 mA
OUTPUT 710;":CURR1:LIM:STAT ON"	Switch on OUTPUT 1 limits

:CURR[1|2]:LIM:LOW

Long

[:SOURce]:CURRent[1|2]:LIMit:LOW

Form

Set & Query

Parameter

Numeric

Parameter suffix

A with engineering prefixes.

*RST value

-10.0 mA

Description

Use this command to set/read the Low-level current limit. If you switch on current limiting, the Low-level current cannot be set below the programmed limit.

NOTE: The current is *NOT* limited by the OUTPUT hardware, this is a software limit.

Example

`OUTPUT 710;":HOLD CURR"`	Enable CURRENT subsystem
`OUTPUT 710;":CURR1:LIM:LOW -50MA"`	Set OUTPUT 1 Low-level current limit to -50 mA
`OUTPUT 710;":CURR1:LIM:STAT ON"`	Switch on OUTPUT 1 limits

:CURR[1|2]:LIM:STAT

Long

[:SOURce]:CURRent[1|2]:LIMit:STATe

Form

Set & Query

Parameter

ON | OFF | 1 | 0

*RST value

OFF

Description

This command switches the output limits on or off. When you switch on the output limits cannot program the output-levels beyond the programmed limits, until you switch off the output-limits. The limits apply whether you program High/Low levels or Amplitude/Offset levels.

NOTE: You can switch the limits on and off in both the **`[:SOURce]:CURRent`** and the [**`:SOURce`**]**`:VOLTage`** subsystems *but the current and voltage limits are not enabled/disabled independently*. The voltage and current limits are always enabled/disabled together.

Example

OUTPUT 710;":HOLD CURR"	Enable CURRENT subsystem
OUTPUT 710;":CURR1:LIM 50MA"	Set OUTPUT 1 High-level current limit to 50 mA
OUTPUT 710;":CURR1:LIM:LOW -50MA"	Set OUTPUT 1 LOW-level current limit to -50mA
OUTPUT 710;":CURR1:LIM:STAT ON"	Switch on OUTPUT 1 limits

:FREQ

Long

[:SOURce]:FREQuency[:CW|:FIXed]

Form

Set & Query

Parameter

Numeric

Parameter Suffix

`Hz` with engineering prefixes, or `MHZ` for Megahertz.

Value coupling

$$Period = \frac{1}{Frequency}$$

*RST value

1.00 MHz

Specified limits

HP 81111A	HP 81112A	HP 81105A	HP 8110A
1 MHz to 165 MHz	1 MHz to 330 MHz	1 MHz to 80 MHz	VCO 1Hz to 150 MHz PLL 1 MHz to 150 MHz

Description

Use this command to set/read the pulse frequency. Select the frequency source for the pulse frequency using **`:TRIGger:SOURce`**. The currently selected source is programmed by this command. Note that the specified limits and available resolution depend on the selected source.

You cannot set the pulse frequency if you have selected the CLK IN connector as the frequency source **`(:TRIG:SOUR EXT).`**

Example

`OUTPUT 710;":TRIG:SOUR INT"`	Select internal osc. as pulse trigger
`OUTPUT 710;":FREQ 75MHz`	Set pulse frequency to 75 MHz

:FREQ:AUTO

Long

[:SOURce]:FREQuency[:CW|:FIXed]:AUTO

Form

Event

Parameter

ONCE

*RST value

Not applicable

Description

Use this command to measure the frequency at the CLK IN connector. If the CLK IN connector is the selected pulse frequency source, you can then read the measured value with **:FREQ?**

Example

`OUTPUT 710;":TRIG:SOUR EXT"`	Select ext CLK IN as pulse trigger
`OUTPUT 710;":FREQ:AUTO ONCE"`	Measure frequency at CLK IN
`OUTPUT 710;":FREQ?"`	Query pulse frequency
`ENTER 710;F$`	Allocate the frequency value to variable F$

:HOLD

Long

[:SOURce]:HOLD

Form

Set & Query

Parameter

VOLTage | CURRent

*RST value

VOLT

Description

Use this command to enable either of the `[:SOURce]:VOLTage` or `[:SOURce]:CURRent` subsystems.

You can control the signal levels of the instrument OUTPUTs in terms of voltage or current.

:PHAS[1|2]

Long

[:SOURce]:PHASe[1|2][:ADJust]

Form

Set & Query

Parameter

Numeric

Parameter suffix

`DEG or RAD`. A parameter without a suffix is interpreted as **`RAD`**.

Functional coupling

Programming the pulse phase also executes **`[:SOURce]:PULSe:HOLD PHASe`** so that the pulse phase is held constant when the signal frequency is changed.

Value coupling

$$Delay = \frac{Phase}{360} \times Period$$

*RST value

0.0

Specified limits

0 to 360° constrained by delay and period limits.

Description

Use this command to set/read the relative phase-delay of the output signal. This is equivalent to setting an absolute or percentage pulse-delay with **`[:SOURce]:PULSe:DELay`**.

If you want the phase delay to remain constant when the pulse-period is varied (rather than the absolute pulse delay) use **`[:SOURce]:PULSe:DELay[1|2]:HOLD PRATio.`**

Example

`OUTPUT 710;":PULS:DEL1 500NS"`	Set OUTPUT 1 delay to 500ns
`OUTPUT 710;":PHAS2 180 DEG"`	Set OUTPUT 2 phase to 180°
`OUTPUT 710;":PULS:DEL1:HOLD TIM"`	Hold OUTPUT 1 delay constant with varying period
`OUTPUT 710;":PULS:DEL2:HOLD PRAT"`	Hold OUTPUT 2 phase constant with varying period

:PULS:DCYC[1|2]

Long

[:SOURce]:PULSe:DCYCle[1|2]

Form

Set & Query

Parameter

Numeric

Value coupling

$$Width = \frac{Dutycycle}{100} \times \mathtt{Period}$$

*RST value

10.0% (derived from Width and Period)

Specified limits

0.001% - 99.9%, depends on width, transition & period.

Description

Use this command to program the dutycycle of the pulse signal. If you want to set an absolute pulse-width use **`[:SOURce]:PULSe:WIDTh[1|2]`**.

If you want the pulse dutycycle to remain constant when the pulse-period is varied (rather than the absolute pulse width use)
`[:SOURce]:PULSe:HOLD[1|2] DCYCle`

Example

`OUTPUT 710;":PULS:DCYC1 25PCT"`	Set OUTPUT 1 dutycycle to 25%
`OUTPUT 710;":PULS:HOLD1 DCYC"`	Hold dutycycle constant with varying period

:PULS:DEL[1|2]

Long

[:SOURce]:PULSe:DELay[1|2]

Form

Set & Query

Parameter

Numeric

Parameter suffix

`S` with engineering prefixes. You can change the default unit using **`[:SOURce]:PULSe:DELay[1|2]:UNIT`**.

Value coupling

$$Phase = \frac{Delay}{Period} \times 360$$

$$Delay\% = \frac{Delay}{Period} \times 100$$

*RST value

0.0

Specified limits

0.00 ns to 999 s (limited by period - min width)

HP 81111A	HP 81112A	HP 81105A	HP 8110A
3.03 ns	3.03 ns	12.5 ns	6.65 ns

Description

Use this command to set/read the pulse-delay. Delay is the time between the start of the pulse-period and the start of the leading-edge of the pulse.

If you want the pulse-delay to remain constant when the pulse-period is varied (rather than the phase-delay) use
`[:SOURce]:PULSe:DELay[1|2]:HOLD TIME.`

Example

`OUTPUT 710;":PULS:DEL1 500NS"`	Set OUTPUT1 delay to500 ns
`OUTPUT 710;":PHAS2 180 DEG"`	Set OUTPUT 2 phase to180°
`OUTPUT 710;":PULS:DEL1:HOLD TIME"`	Hold OUTPUT 1 delay constant with varying period
`OUTPUT 710;":PULS:DEL2:HOLD PRAT"`	Hold OUTPUT 2 phase constant with varying period

:PULS:DEL[1|2]:HOLD

Long

[:SOURce]:PULSe:DELay[1|2]:HOLD

Form

Set & Query

Parameter

TIME | PRATio

*RST value

TIME

Description

Use this command to set/read the coupling between the pulse-period and the pulse-delay:

TIME	The absolute pulse-delay is held fixed when the pulse-period is varied (Pulse phase varies).
PRATio	The pulse phase-delay (delay as ratio of period) is held fixed when the pulse-period is varied (Pulse-delay varies.

Example

`OUTPUT 710;":PULS:DEL1 500ns"`	Set OUTPUT 1 delay to 500ns
`OUTPUT 710;":PHAS2 180DEG"`	Set OUTPUT 2 phase to 180°
`OUTPUT 710;":PULS:DEL1:HOLD TIME"`	Hold OUTPUT 1 delay constant with varying period
`OUTPUT 710;":PULS:DEL2:HOLD PRAT"`	Hold OUTPUT 2 phase constant with varying period

:PULS:DEL[1|2]:UNIT

Long

[:SOURce]:PULSe:DELay[1|2]:UNIT

Form

Set & Query

Parameter

S | SEC | PCT | DEG | RAD

*RST value

S

Description

Use this command to set/read the default units for the pulse-delay parameter. The default unit of a parameter is the unit used when the parameter is programmed to a value without a unit suffix.

Example

`OUTPUT 710;":PULS:DEL1:UNIT PCT"`	Set OUTPUT 1 delay unit to %
`OUTPUT 710;":PULS:DEL1 50"`	Set OUTPUT 1 delay to 50% of period

:PULS:DOUB[1|2]

Long

[:SOURce]:PULSe:DOUBle[1|2][:STATe]

Form

Set & Query

Parameter

OFF | ON

*RST value

OFF

Description

Use this command to switch double-pulse mode on or off. In double-pulsemode two pulses are generated per pulse-period and the delay between the leading edges of the first and second pulse can be adjusted.

:PULS:DOUB[1|2]:DEL

Long

[:SOURce]:PULSe:DOUBle[1|2]:DELay

Form

Set & Query

Parameter

Numeric

Parameter suffix

`S` with engineering prefixes. You can change the default unit using **`[:SOURce]:PULSe:DOUBle:DELay[1|2]:UNIT`**.

Value coupling

$$DblDel\% = \frac{DblDel}{Period} \times 100$$

*RST value

0.0

Specified limits

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
12.5 ns to 999.5 s (period - width - 6.25 ns)	6.06 ns to 999.5 s (period - width - 3.03 ns)	3.03 ns to 999.5 s (period - width- 1.5 ns)	6.65 ns to 999 ms (limited by period- width - 6.65 ns)
min period 25 ns	min period 12.2 ns	min period 6.06 ns	min period 13.3 ns

Description

Use this command to set/read the delay between the leading edges of the two pulses in double-pulse mode. The first pulse always starts at the start of the pulse-period.

If you want the double-delay to remain constant when the pulse-period is varied (rather than the double-delay as percentage of period) use **`[:SOURce]:PULSe:DOUBle[1|2]:DELay:HOLD TIME.`**

Example

`OUTPUT 710;":PULS:DOUB1 ON"`	Switch on Double pulses on OUTPUT 1
`OUTPUT 710;":PULS:DOUB1:DEL 500NS"`	Set inter-pulse delay to 500ns
`OUTPUT 710;":PULS:DOUB1:DEL:HOLD TIME"`	Hold inter-pulse delay fixed with varying pulse-period

:PULS:DOUB[1|2]:DEL:HOLD

Long

[:SOURce]:PULSe:DOUBle[1|2]:DELay:HOLD

Form

Set & Query

Parameter

TIME|PRATio

*RST value

TIME

Description

Use this command to set/read the coupling between the pulse-period and the Double-pulse delay:

TIME	The absolute double-pulse delay is held fixed when the pulse-period is varied.
PRATio	The double-pulse delay as percentage of period is held fixed when the pulse-period is varied.

Example

`OUTPUT 710;":PULS:DOUB1 ON"`	Switch on Double pulses on OUTPUT 1
`OUTPUT 710;":PULS:DOUB1:DEL 50 PCT"`	Set inter-pulse delay to 50% of pulse-period
`OUTPUT 710;":PULS:DOUB1:DEL:HOLD PRAT"`	Hold inter-pulse delay as fixed percentage of pulse-period

:PULS:DOUB[1|2]:DEL:UNIT

Long

[:SOURce]:PULSe:DOUBle[1|2]:DELay:UNIT

Form

Set & Query

Parameter

S | SEC | PCT

*RST value

S

Description

Use this command to set/read the default units for the double-delay parameter. The default unit of a parameter is the unit used when the parameter is programmed to a value without a unit suffix.

Example

`OUTPUT 710:":PULS:DOUB1:DEL:UNIT PCT"`	Set OUTPUT 1 double-delay unit to %
`OUTPUT 710:":PULS:DOUB1:DEL 50"`	Set OUTPUT 1 inter-pulse delay to 50% of period

:PULS:HOLD[1|2]

Long

[:SOURce]:PULSe:HOLD[1|2]

Form

Set & Query

Parameter

WIDTh | DCYCle | TDELay

*RST value

WIDTh

Description

Use this command to set whether the pulse-width,the pulse-dutycycle or the pulse trailing-edge delay is held constant when the pulse-period is changed.

Example

`OUTPUT 710;":PULS:DEL:HOLD1 TIME"`	Hold OUTPUT 1 delay fixed when frequency varies
`OUTPUT 710;":PULS:DEL 20NS"`	Set OUTPUT 1 delay to 20ns
`OUTPUT 710;":PULS:HOLD1 DCYC"`	Hold OUTPUT 1 Dutycycle fixed when frequency varies
`OUTPUT 710;":PULS:DCYC 25PCT"`	Set OUTPUT 1 Dutycycle to 25%

:PULS:PER

Long

[:SOURce]:PULSe:PERiod

Form

Set & Query

Parameter

Numeric

Parameter Suffix

S with engineering prefixes.

Value coupling

$$Frequency = \frac{1}{Period}$$

*RST value

1 µs

Specified limits

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
12.5 ns to 999.5 s	6.06 ns to 999.5 s	3.03 ns to 999.5 s	VCO: 6.65 ns to 999 ms PLL: 6.650 ns to 999.0 s

Description

Use this command to set/read the pulse-period. Select the pulse-period-source using **`:TRIGger:SOURce.`** The currently selected source is programmed by this command. Note that the specified limits and available resolution depend on the selected source.

You cannot set the pulse-period if you have selected the CLK IN connector as the frequency source **`(:TRIG:SOUR EXT)`**.

Example

`OUTPUT 710;":TRIG:SOUR INT"`	Select internal osc. as pulse trigger
`OUTPUT 710;":PULS:PER 25NS"`	Set pulse frequency to 25 ns

:PULS:PER:AUTO

Long

[:SOURce]:PULSe:PERiod:AUTO

Form

Event

Parameter

ONCE

*RST value

Not applicable

Description

Use this command to measure the period at the CLK IN connector. If the CLK IN connector is the selected pulse-period source, you can then read the measured value with **:PULS:PER?**

Example

`OUTPUT 710;":TRIG:SOUR EXT"`	Select ext CLK IN as pulse trigger
`OUTPUT 710;":PULS:PER:AUTO ONCE"`	Measure period at CLK IN
`OUTPUT 710;":PULS:PER?"`	Query pulse period
`ENTER 710;P$`	Allocate the period value to variable P$

:PULS:TDEL[1|2]

Long

[:SOURce]:PULSe:TDELay[1|2]

Form

Set & Query

Parameter

Numeric

Parameter Suffix

S with engineering prefixes.

*RST value

100 ns

Specified Limits

HP 81104A with HP 81105A	HP 81110A with HP 81110A	HP 81110A with HP 81112A	HP 8110A
6.25 ns to 999.5 s (period - 6.25ns)	3.03 ns to 999.5 s (period - 3.03 ns)	1.5 ns to 999.5 s (period - 1.5 ns)	3.30 ns to 999 ms (Maximum = Period - 3.3 ns)

Description

Use this command to program the delay of the trailing-edge of the pulse relative to the start of the pulse-period. This is an alternative method of programming the pulse-width.

Example

`OUTPUT 710;":PULS:DEL1 500NS"`	Set OUTPUT 1 delay to 500 ns
`OUTPUT 710;":PULS:DEL1:HOLD TIME"`	Hold OUTPUT 1 delay constant with varying period
`OUTPUT 710;":PULS:TDEL1 750NS"`	Set OUTPUT 1 trailing delay to 750 ns

:PULS:TRAN[1|2]:HOLD

Long

[:SOURce]:PULSe:TRANsition[1|2]:HOLD

Form

Set & Query

Parameter

TIME | WRATio

*RST value

TIME

Description

Use this command to set the coupling between transition-times and the pulse-width:

TIME	The absolute transition-times are held when the pulse-width is varied.
WRATio	The ratio of transition-time to pulse-width is held when the pulse-width is varied.

Example

`OUTPUT 710;":PULS:TRAN1:HOLD TIME"`	Hold OUTPUT 1 transitions fixed when pulse-width varies
`OUTPUT 710;":PULS:TRAN2:HOLD WRAT"`	Hold OUTPUT 2 transition:width ratio when pulse-width varies

:PULS:TRAN[1|2]:UNIT

Long

[:SOURce]:PULSe:TRANsition[1|2]:UNIT

Form

Set & Query

Parameter

S | SEC | PCT

*RST value

S

Description

Use this command to set the default units for the pulse transition-times. The default unit is used when the parameter is programmed to a value without a unit suffix.

:PULS:TRAN[1|2]

Long

[:SOURce]:PULSe:TRANsition[1|2][:LEADing

Form

Set & Query

Parameter

Numeric

Parameter suffix

S with engineering prefixes, or PCT

*RST value

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A
3 ns	2 ns	0.8 ns

Specified limits

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
3 ns to 200 ms	2 ns to 200 ms	0.8 ns/1.6 ns fixed	2 ns to 200 ms

Parameter coupling

Trailing-edge = Leading-edge with **`:PULS:TRAN:TRA:AUTO ON`**. This is the default condition.

Use :PULS:TRAN:TRA:AUTO OFF to enable independent programming of the trailing-edge within a 1:20 ratio for the ranges.

NOTE: HP 81110A with HP 81112A 3.8V/330 MHz Output has coupled transitions.

Description

Use this command to set/read the transition-time of the pulse leading-edge. Note that the leading and trailing edges of the pulse have to fit within the defined pulse-width

Example

`OUTPUT 710;":PULS:TRAN1 3NS"`	Set OUTPUT 1 leading edge to 3 ns
`OUTPUT 710;":PULS:TRAN1:TRA:AUTO OFF"`	Enable independent setting of trailing edge
`OUTPUT 710;":PULS:TRAN1:TRA 15 NS”`	Set OUTPUT 1 trailingedge to 15ns

:PULS:TRAN[1|2]:TRA

Long

[:SOURce]:PULSe:TRANsition[1|2]:TRAiling

Form

Set & Query

Parameter

Numeric

Parameter suffix

`S` with engineering prefixes, or `PCT`

*RST value

HP 81111A	HP 81105A	HP 81112
2.00 ns	3 ns	0.8 ns

Specified limits

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
3 ns to 200 ms	2 ns 200 ms	0.8 ns/1.6 ns fixed	2.00 ns to 200 ms

Parameter coupling

Trailing-edge = Leading-edge with **`:PULS:TRAN:TRA:AUTO ON`**. This is the default condition.

Use **`:PULS:TRAN:TRA:AUTO OFF`** to enable independent programming of the trailing-edge within a 1:20 ratio for the ranges.

NOTE: HP 81110A with HP 81112A 3.8V/330 MHz Output has coupled transitions.

Description

Use this command to set/read the transition-time of the pulse trailing-edge. Note that the leading and trailing edges of the pulse have to fit within the defined pulse-width.

Example

`OUTPUT 710;":PULS:TRAN1 3NS"`	Set OUTPUT 1 leading edge to 3ns
`OUTPUT 710;":PULS:TRAN1:TRA:AUTO OFF"`	Enable independent setting of trailing edge
`OUTPUT 710;":PULS:TRAN1:TRA: 15NS"`	Set OUTPUT 1 trailing edge to 15 ns

:PULS:TRAN[1|2]:TRA:AUTO

Long

:[SOURce]:PULSe:TRANsition[1|2]:TRAiling:AUTO

Form

Set & Query

Parameter

ON|OFF|ONCE

*RST value

ON

Description

Use this command to set/read the automatic coupling of the pulse trailing-edge transition-time to the leading-edge transition-time.

ON	The trailing-edge transition time is automatically set to the same value as the leading-edge, and is updated automatically each time the leading-edge transition-time changes.
OFF	The trailing-edge transition time is independently programmable.
ONCE	The trailing-edge transition time is set ONCE to the same value as the leading-edge.

NOTE: HP 81110A with HP 81112A 3.8V/330 MHz Output has coupled transitions.

Example

`OUTPUT 710;":PULS:TRAN1 3NS"`	Set OUTPUT 1 leading edge to 3 n
`OUTPUT 710;":PULS:TRAN1:TRA:AUTO OFF"`	Enable independent setting of trailing edge
`OUTPUT 710;":PULS:TRAN1:TRA 15NS"`	Set OUTPUT 1 trailing edge to 15 ns

:PULS:TRIG[1|2]:VOLT

Long

[:SOURce]:PULSe:TRIGger[1|2]:VOLTage[:LEVel][:IMMediate][:AMPlitude]

Form

Set & Query

Parameter

TTL | ECL

*RST value

TTL

Description

Use this command to set/read the output levels at the TRIGGER OUT connector.

:PULS:WIDT[1|2]

Long

[:SOURce]:PULSe:WIDTh[1|2]

Form

Set & Query

Parameter

Numeric

Parameter suffix

S with engineering prefixes

*RST value

100 ns

Specified limits

HP 81104A with HP 81105A	HP 81110A with HP 81110A	HP 81110A with HP 81112A	HP 8110A
6.25 ns to 999.0 s (period - 6.25ns)	3.03 ns to 999.0 s (period - 3.03 ns)	1.5 ns to 999.0 s (period - 1.5 ns)	3.30 ns to 999 ms (Maximum = Period - 3.3 ns)

(PLL: 999 s)

Description

Use this command to program the width of the pulse signal. If you want to set width as dutycycle use **`[:SOURce]:PULSe:DCYCle[1|2]`**.

If you want the pulse-width to remain constant when the pulse-period is varied (rather than the dutycycle) use
`[:SOURce]:PULSe:HOLD[1|2] WIDTh`.

Example

`OUTPUT 710;":PULS:WIDT1 50NS"`	Set OUTPUT 1 pulse width to 50 ns
`OUTPUT 710;":PULS:HOLD1 WIDTH"`	Hold pulse-width constant with varying period

:ROSC:SOUR

Long

[:SOURce]:ROSCillator:SOURce

Form

Set & Query

Parameter

INTernal | EXTernal

*RST value

INT

Description

Use this command to set/read the reference source for the PLL. If you select the external reference (CLK IN connector) you can choose to use a 5 MHz or 10 MHz reference signal using **`:ROSC:EXT:FREQ`.**

INTernal	Lock the PLL to its internal reference
EXTernal	Lock the PLL to a reference signal at the CLK IN connector. The external reference signal can be 5 or 10 MHz.

Example

`OUTPUT 710;":ROSC:SOUR EXT”`	Set external PLL reference (CLK IN)
`OUTPUT 710;":ROSC:EXT:FREQ 10 MHZ"`	Set expected PLL reference frequency to 10 MHz

:ROSC:EXT:FREQ

Long

[:SOURce]:ROSCillator:EXTernal:FREQuency

Form

Set & Query

Parameter

Numeric

*RST value

5 MHz

Specified limits

5 MHz or 10 MHz

Description

Use this command to set/read the expected reference frequency for the PLL at the CLK IN connector. The external reference can be a 5 or 10 MHz signal. Note that if you program any value other than the two specified values, the value will be set to the nearest of the two specified values.

Example

`OUTPUT 710;":ROSC:SOUR EXT"`	Set external PLL reference (CLK IN)
`OUTPUT 710;":ROSC:EXT:FREQ 10MHZ"`	Set expected PLL reference frequency to 10 MHz

:VOLT[1|2]

Long

[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate][:AMPLitude]

Form

Set & Query

Parameter

Numeric

Parameter suffix

V with engineering prefixes.

Value coupling

$$High = Offset + \frac{Amplitude}{2}$$

$$Low = Offset - \frac{Amplitude}{2}$$

Range coupling

With Offset, see page 227

*RST value

1.00 V

Specified limits

Values are valid from 50 Ω into 50 Ω

HP 81104A with HP 81105A	HP 81110A with HP 81111A	HP 81110A with HP 81112A	HP 8110A
100 mVpp to 10.0 Vpp	100 mVpp to 10.0 Vpp	100 mVpp to 3.8 Vpp	100 mVpp to 10.0 Vpp

Description

This command programs the amplitude voltage of the OUTPUT signal. Note that to set the OUTPUT levels in terms of voltage, you first have to execute the **`[:SOURce]:HOLD VOLTage`** command to enable the **`[:SOURce]:VOLTage`** subsystem.

The available voltage range is limited by the combination of:

- Specified Current limits
- Actual OUTPUT Impedance setting **`:OUTPut:IMPedance`**
- Actual Expected Load impedance setting: **`:OUTput:IMPedance:EXTernal`**

Example

`OUTPUT 710;":HOLD VOLT"`	Enable VOLTAGE subsystem
`OUTPUT 710;":VOLT1 5V"`	Set OUTPUT 1 amplitude to 5 V

:VOLT[1|2]:OFFSet

Long

[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate]:OFFSet

Form

Set & Query

Parameter

Numeric

Parameter suffix

V with engineering prefixes.

Value coupling

$$High = Offset + \frac{Amplitude}{2}$$

$$Low = Offset - \frac{Amplitude}{2}$$

Range coupling

With Amplitude, see page 225

*RST value

0.0 mV

Specified Limits

Table 6: Level Window

HP 81111A & HP 81105A	HP 81112A
-10 V to + 10 V	-2 V to +3.8 V

NOTE: When using the Level Window the amplitude has to be taken into account.

Description

This command programs the offset voltage of the OUTPUT signal. Note that to set the OUTPUT levels in terms of voltage, you first have to execute the **`[:SOURce]:HOLD VOLTage`** command to enable the **`[:SOURce]:VOLtage subsystem.`**

The available voltage range is limited by the combination of:

- Specified current limits
- Actual OUTPUT Impedance setting :OUTPut:IMPedance
- Actual Expected Load impedance setting **`:OUTput:IMPedance:EXTernal`**

Example

`OUTPUT 710;":HOLD VOLT"`	`Enable VOLTAGE subsystem`
`OUTPUT 710;":VOLT1:OFF -800MV"`	`Set OUTPUT 1 offset to -800mV`

:VOLT[1|2]:HIGH

Long

[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate]:HIGH

Form

Set & Query

Parameter

Numeric

Parameter suffix

V with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling

With Low-level

*RST value

500 mV

Specified limits

(50 Ω into 50 Ω)

HP 81111A & HP 81105 A	HP 81112A	HP 8110A
-9.90 V to 10.0 V	-1.9 V to +3.8 V	-9.90 V to 10.0 V

Description

This command programs the High-level voltage of the OUTPUT signal. Note that to set the OUTPUT levels in terms of voltage, you first have to execute the **`[:SOURce]:HOLD VOLTage`** command to enable the **`[:SOURce]:VOLTage subsystem.`**

The available voltage range is limited by the combination of:

- Specified current limits
- Actual OUTPUT Impedance setting :OUTPut:IMPedance"
- Actual Expected Load impedance setting **`:OUTPut:IMPedance:EXTernal`**

Example

`OUTPUT 710;":HOLD VOLT"`	`Enable VOLTAGE subsystem`
`OUTPUT 710;":VOLT1:HIGH 4.8V"`	`Set OUTPUT 1 high level voltage to 4.8V`

:VOLT[1|2]:LOW

Long

[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate]:LOW

Form

Set & Query

Parameter

Numeric

Parameter suffix

V with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High\text{-}Low}{2}$$

Range coupling

With High-level

*RST value

-500 mV

Specified limits

(50 Ω into 50 Ω)

HP 81111A & HP 81105A	**HP 81112A**	**HP 8110A**
-10.0 V to 9.90 V	-2.0 V to 3.7 V	-10.0 V to 9.90 V

Description

This command programs the Low-level voltage of the OUTPUT signal. Note that to set the OUTPUT levels in terms of voltage, you first have to execute the **`[:SOURce]:HOLD VOLTage`** command to enable the **`[:SOURce]:VOLTage subsystem.`**

The available voltage range is limited by the combination of:

- Specified current limits
- Actual OUTPUT Impedance setting **`:OUTPut:IMPedance`**
- Actual Expected Load impedance setting **`:OUTPut:IMPedance:EXTernal`**

Example

`OUTPUT 710;":HOLD VOLT"`	Enable VOLTAGE subsystem
`OUTPUT 710;":VOLT1:LOW 500MV"`	Set OUTPUT 1 low-level to 500mV

:VOLT[1|2]:LIM

Long

[:SOURce]:VOLTage[1|2]:LIMit[:HIGH]

Form

Set & Query

Parameter

Numeric

Parameter suffix

V with engineering prefixes.

*RST value

+500 mV

Description

Use this command to set/read the High-level voltage limit. If you switch on voltage limiting, the High-level voltage cannot be set above the programmed limit. Note that the voltage is *NOT* limited by the OUTPUT hardware, this is a software limit.

Example

`OUTPUT 710;":HOLD VOLT"`	Enable VOLTAGE subsystem
`OUTPUT 710;":VOLT1:LIM 3V"`	Set OUTPUT 1 High-level limit to 3 V
`OUTPUT 710;":VOLT1:LIM:STAT ON"`	Switch on OUTPUT 1 limits

:VOLT[1|2]:LIM:LOW

Long

[:SOURce]:VOLTage[1|2]:LIMit:LOW

Form

Set & Query

Parameter

Numeric

Parameter suffix

V with engineering prefixes.

*RST value

-500 mV

Description

Use this command to set/read the Low-level voltage limit. If you switch on voltage limiting, the Low-level voltage cannot be set below the programmed limit. Note that the voltage is *NOT* limited by the OUTPUT hardware, this is a software limit.

Example

`OUTPUT 710;":HOLD VOLT"`	Enable VOLTAGE subsystem
`OUTPUT 710;":VOLT1:LIM:LOW 0V"`	Set OUTPUT 1 Low-level voltage
`OUTPUT 710;":VOLT1:LIM:STAT ON"`	Switch on OUTPUT 1 limits

:VOLT[1|2]:LIM:STAT

Long

[:SOURce]:VOLTage[1|2]:LIMit:STATe

Form

Set & Query

Parameter

ON | OFF | 1 | 0

*RST value

OFF

Description

This command switches the output limits on or off. When you switch on the output limits cannot program the output-levels beyond the programmed limits, until you switch off the voltage-limits. The limits apply whether you program High/Low levels or Amplitude/Offset levels.

NOTE: You can switch the limits on and off in both the **`[:SOURce]:CURRent`** and the **`[:SOURce]:VOLTage`** subsystems *but the current and voltage limits are not enabled/ disabled independently*. The voltage and current limits are always enabled/disabled together.

Example

`OUTPUT 710;":HOLD VOLT"`	Enable VOLTAGE subsystem
`OUTPUT 710;":VOLT1:LIM 3V`	Set OUTPUT 1 High level voltage limit to 3 V
`OUTPUT 710;":VOLT1:LIM:LOW 0V"`	Set OUTPUT 1 Low-level voltage limit to 0V
`OUTPUT 710;":VOLT1:LIM:STAT ON"`	Switch on OUTPUT 1 limits

:STATus:OPERation

This command tree accesses the **`OPERation`** status group. *The* **`OPERation`** s*tatus group is not used by the* instrument *therefore this command tree is redundant.*

:STATus:OPERation[:EVENt]?

:STATus:OPERation:CONDition?

:STATus:OPERation:ENABle

:STATus:OPERation:NTRansition

:STATus:OPERation:PTRansition

:STATus:PRESet

Long

:STATus:PRESet

Form

Event

*RST value

Not Applicable

Description

This command

- Clears all status group event-registers
- Clears the error queue
- Presets the status group enable-, PTR-, and NTR-registers as follows:

Status Group	Register	Preset value
OPERation	ENABle	0000000000000000
	PTR	0111111111111111
	NTR	0000000000000000
QUEStionable	ENABle	0000000000000000
	PTR	0111111111111111
	NTR	0000000000000000

:STATus:QUEStionable

This command tree accesses the QUEStionable status group. The QUEStionable status group contains warning bits for voltage, current, time and frequency parameters. A warning occurs when the output signal *could* be out of specification due to the combined specification uncertainties of many parameters, although all parameters are set within their individually specified limits. If a parameter is set outside its specified limits an error is generated.

The following commands are used to access the registers within the statusgroup:

:STATus:QUEStionable[:EVENt]?

Form	Query
*RST value	Not Applicable
Description	This command reads the event register in the QUEStionable staus group.

:STATus:QUEStionable:CONDition?

Form	Query
*RST value	Not Applicable
Description	This command reads the condition register in the QUEStionable status group.

:STATus:QUEStionable:ENABle

Form	Set & Query
Parameter	Numeric
*RST value	Not affected by *RST”
Specified limits	0 - 32767
Description	This command sets or queries the enable register in the QUEStionable status group.

:STATus:QUEStionable:NTRansition

Form	Set & Query
Parameter	Numeric
*RST value	Not Applicable
Specified limits	0-32767
Description	This command sets or queries the negative-transition regisiter in the QUEStionable status group.

:STATus:QUEStionable:PTRansition

Form	Set & Query
Parameter	Numeric
*RST value	Not Applicable
Specified limits	0- 32767
Description	This command sets or queries the positive-transition register in the QUEStionable status group.

:SYST:CHEC

Long

:SYSTem:CHECk[:ALL][:STATe]

Form

Set & Query

Parameter

OFF

*RST value

OFF

Description

Use this command to switch the instrument’s error checking on or off. Switch off the error checking if you want to improve the programming speed of the instrument, but remember that no invalid parameter or mode settings will be detected and reported. Error checking is switched off by the *RST command, or when default setting is invoked.

CAUTION: Error checking cannot be switched on from the frontpanel. Error checking is *not* automatically re-enabled if you switch the instrument off and on again. Therefore your test programs should send either *RST or set default setting before ending.

:SYST:ERR?

Long

:SYSTem:ERRor?

Form

Query

*RST value

Not Applicable

Description

Use this command to read the instrument error queue. The instrument error queue can store up to 30 error codes on a first-in-first-out basis. When you read the error queue, the error number and associated message are put into the instrument's output buffer.

If the queue is empty, the value 0 is returned, meaning **`No Error`**. If the queue overflows at any time, the last error code is discarded and replaced with **`-350`** meaning **`Queue overflow`**.

Example

`OUTPUT 710;":SYS:ERR?"`	Query for errors
`ENTER 710; Systerr$`	Allocate errors to variable Systerr$
`PRINT Systerr$`	Print content of Systerr$ to a printer

Printer output example: **-222 "Data out of range" overlap at output 1: Width>Double Delay**

The above message is an example of a customized description. Generic descriptions are available in the SCPI 1995 Command Reference,items 21.8.4 to 21.8.11.

For more detailed information in the 81110A error.
Send **":SYST:WAEN:STR?".** Alternatively, the HELP key shows the current errors and warnings and their description on the instruments display.

:SYST:KEY

Long

:SYSTem:KEY

Form

Set & Query

Parameter

Numeric

Parameter suffix

No suffix allowed

*RST value

-1

Specified limit

Table 7:

No.	Key Description
-1	No key pressed (Query only)
0	DATA ENTRY 0
1	DATA ENTRY 1
2	DATA ENTRY 2
3	DATA ENTRY 3
4	DATA ENTRY 4
5	DATA ENTRY 5
6	DATA ENTRY 6
7	DATA ENTRY 7
8	DATA ENTRY 8
9	DATA ENTRY 9
10	DATA ENTRY .
11	DATA ENTRY +/-
12	
13	

Table 7:

No.	**Key Description**
14	
15	
16	MAN
17	STORE
18	HELP
19	SHIFT
20	MORE
21	Softkey 1
22	Softkey 2
23	Sofkey 3
24	Softkey 4
25	nano
26	micro Mega
27	milli kilo
28	ENTER
29	MODIFY Knob left (anticlockwise)
30	MODIFY Knob right (clockwise)

Description

In query form, this command reads the last key pressed. The buffer is emptied by *RST and returns the value -1 when empty.

In set form, the command simulates pressing a key on the frontpanel. Simulated key-press are also recorded as the last key pressed.

NOTE: :SYST:KEY 19 sets the instrument to LOCAL mode.

1. In remote mode *only* the softkeys under the display and the SHIFT (LOCAL) key are active. Since the instrument normally switches to remote mode when any command is received, including **`:SYSTem:KEY`**, simulating one of the other disabled keys has no effect.
2. If you want to simulate full frontpanel operation, you must prevent the instrument from entering remote mode by using the REN line of the HP-IB to maintain local mode (LOCAL 7 in BASIC).

   If you do this, the **`:SYSTem:KEY`** command is the only command which works. Any other commands will be buffered in the instrument blocking any further **`:SYSTem:KEY`** commands, until remote mode is enable.

:SYST:PRES

Long

:SYSTem:PRESet

Form

No function.

:SYST:SEC

Long

:SYSTem:SECurity[:STATe]

Form

Set & Query

Parameter

ON|OFF

*RST value

OFF

Description

CAUTION: Do not switch on system security unless you are willing to erase the instrument settings stored in the instrument. All instrument memories, including the current setting, will be overwritten with the default settings if you
a) Switch off system security
b) Switch the instrument off and on again
c) If you accidentally switch on system security, and want to rescue the settings stored in the instrument, store the settings on a memory card. You can then recall them from the memory card later.

Use this command to switch on system security mode. Switch on system security if you need to make sure that all instrument settings stored in the instrument are erased automatically when the instrument is switched off, or when security mode is switched off.

The instrument settings are erased by overwriting them with the default settings.

System security mode is not available via the frontpanel. If you want to erase all settings by hand:

1. **SHIFT** **STORE** (RECALL) **0** to recall the default settings from memory location 0.
2. **STORE** **1**, **STORE** **2** ,... **STORE** **9** to store the defaults in memory locations 1 to 9.

:SYST:SET

Long

:SYSTem:SET

Form

Set & Query

Parameter

Block data

*RST value

Not applicable

Description

In query form, the command reads a block of data containing the instrument's complete set-up. The set-up information includes all parameter and mode settings, but does not include the contents of the instrument setting memories, the status group registers or the **`:DISPlay[:WINDow][:STATe]`** The data is in a binary format, not ASCII, and cannot be edited.

In set form, the block data must be a complete instrument set-up read using the query form of the command.

:SYST:VERS?

Long

:SYSTem:VERSion?

Form

Query

*RST value

"1992.0"

Description

This command reads the SCPI revision to which the instrument complies.

:SYST:WARN?

Long

:SYSTem:WARNing[:COUNt]?

Form

Query

*RST value

Not applicable

Description

Use this command to read the number of warnings which are currently active. Note that the warning status of voltage, current, time and frequency are also summarised by bits in the QUEStionable Status register.

:SYST:WARN:STR?

Long

:SYSTem:WARNing:STRing?

Form

Query

*RST value

Not applicable

Description

Use this command to read all the currently active warning messages. The warning messages are concatenated to form a single string with a ; as seperator between the messages.

:SYST:WARN:BUFF?

Long

:SYSTem:WARNing:BUFFer?

Form

Query

*RST value

Not applicable

Description

Use this command to read the maximum possible number of characters which could be returned by :**`SYST:WARN:STR?`** if all warnings were active.

:TRIG:COUNt

Long

:TRIGger[:SEQuence[1]]:COUNt

Form

Set & Query

Parameter

Numeric

*RST value

1

Specified limits

:DIG:PATT OFF:	1 to 65536
:DIG:PATT ON:	2 to 16384 (HP 8110 A limit is 2 to 4096)

Description

Use this command to set/read the number of trigger events (pulse-periods) to be generated for each arming event. This corresponds to selecting the event mode on the |**MODE/TRG**| screen:

`PULSES`	Set a **trigger count of 1** so that a single pulse-period is generated for each arming event.- instrument is in pulse (stream) mode
`BURST of`	Set a **trigger count of 2 to 65536** so that a burst of 2 to 65536 pulse periods is generated for each arming event. Switch off pattern mode so that a pulse (or double-pulse) is generated in each pulse-period. (`:DIG:PATT OFF`)- instrument is in burst mode
`PATTERN of`	Set a **trigger count of 2 to 16384** so that a burst of 2 to 16384 pulse-periods is generated for each arming event. Switch on pattern mode so that the pattern memory is used to generate the pulses. (`:DIG:PATT ON`)- instrument is in pattern mode

Examples

To set **`CONTINUOUS PATTERN of NRZ--Pulses at Out1`**, with a 512 bit pattern length:

`OUTPUT 710:":ARM:SOUR IMM"`	Set CONTINUOUS arming
`OUTPUT 710:":TRIG:COUN 512"`	Pattern length 512
`OUTPUT 710:":TRIG:SOUR INT1`	Pulse-period trigger from internal osc
`OUTPUT 710:":DIG:PATT ON`	Enable pattern operating mode
`OUTPUT 710:":DIG:SIGN1:FORM NRZ`	Set OUTPUT 1 data to NRZ

To set **`TRIGGERED BURST of 16 Single-Pulses at Out1`**, each burst triggered by a positive edge at the EXT INPUT:

`OUTPUT 710:":ARM:SOUR EXT1"`	Set arming from EXT INPUT
`OUTPUT 710:":ARM:SENS EDGE"`	Set arming on edges
`OUTPUT 710:":ARM:SLOP POS"`	Set arming on positive edges
`OUTPUT 710:":TRIG:COUN 16"`	Burst length 16
`OUTPUT 710:":TRIG:SOUR INT1"`	Pulse-period trigger from internal osc.
`OUTPUT 710:":DIG:PATT OFF"`	Disable pattern operating mode
`OUTPUT 710:":PULS:DOUB1 OFF"`	Ensure single pulses at OUTPUT 1

To set **`GATED PULSES Single-Pulses at Out1`**, gated by a positive level at the EXT INPUT:

`OUTPUT 710:":ARM:SOUR EXT1"`	Set arming from EXT INPUT
`OUTPUT 710:":ARM: SENS LEV”`	Set arming on levels
`OUTPUT 710:":ARM:SLOP POS”`	Set arming on positive level 1 pulse-period
`OUTPUT 710:":TRIG:COUN 1"`	Single pulse output mode
`OUTPUT 710:":TRIG:SOUR INT1"`	Pulse-period trigger from internal osc.
`OUTPUT 710:":DIG:PATT OFF"`	Disable pattern data
`OUTPUT 710:":PULS:DOUB1 OFF"`	Ensure single pulses at OUTPUT 1

:TRIG:IMP

Long

:TRIGger:IMPedance

Form

Set & Query

Parameter

Numeric

Parameter Suffix

`OHM` with engineering prefixes, e.g.: **`MOHM`** is Megaohms.

*RST value

50 Ω

Specified Limits

50 Ω or 10 kΩ

Description

Use this command to program the input impedance of the CLK IN connector. Note that only two settings are available. If you try to program any other value, it will be rounded to one of the specified values.

Example

`OUTPUT 710;":TRIG:IMP 50OHM"`	Set CLK IN impedance to 50 Ω
`OUTPUT 710;":TRIG:LEV 2.5V"`	Set CLK IN threshold to 2.5V
`OUTPUT 710;":TRIG:SOUR EXT2"`	Pulse-period trigger from CLK IN

:TRIG:LEV

Long

:TRIGger:LEVel

Form

Set & Query

Parameter

Numeric

Parameter Suffix

V with engineering prefixes.

*RST value

1.0 V

Specified Limits

-10 V to +10 V

Description

Use this command to program the triggering threshold of the CLK IN connector.

Example

`OUTPUT 710;":TRIG:IMP 50OHM"`	Set CLK IN impedance to 50 Ω
`OUTPUT 710;":TRIG:LEV 2.5V"`	Set CLK IN threshold to 2.5 V

:TRIG:SLOP

Long

:TRIGger:SLOPe

Form

Set & Query

Parameter

POSitive | NEGative

*RST value

POS

Description

Use this command to select the trigger slope for the pulse-period triggering signal applied to the CLK IN connector.

:TRIG:SOUR

Long

:TRIGger:SOURce

Form

Set & Query

Parameter

IMMediate | INTernal[1] | INTernal2 | EXTernal2

*RST value

IMM

Description

Use this command to select the pulse-period source of the HP81110A by selecting the source of the pulse-period trigger signal:

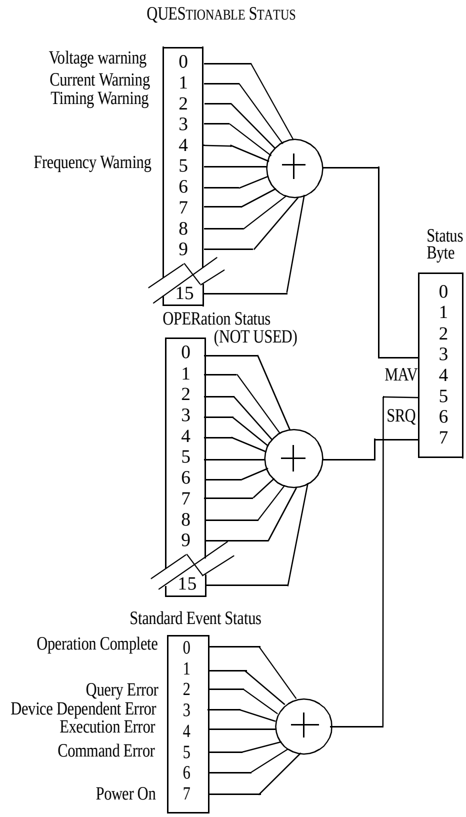
Pulse-period sources set by :TRIG:SOUR

Pulse-period source	:TRIG:SOURce
internal osc **internal PLL** **CLK IN**	IMMediate INTernal[1] INTernal2 EXTernal2

Status Model

Overview

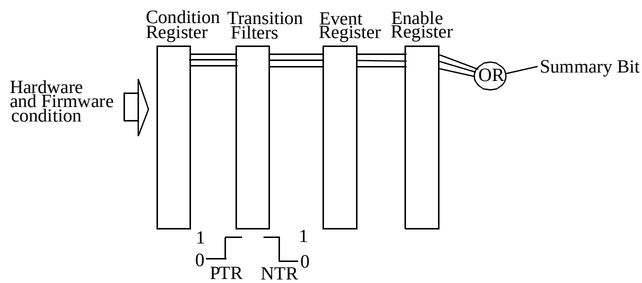
Figure 46 HP 81110A Status Groups



The instrument has a status reporting system conforming to IEEE 488.2 and SCPI. Figure 46 shows the status groups available in the instrument.Each status group is made up of component registers, as shown in

Figure 47.

Figure 47 Component registers in a Status Group



Condition Register

A condition register contains the current status of the hardware and firmware. It is continuously updated and is not latched or buffered. You can only read condition registers. If there is no command to read the condition register of a particular status group, then it is simply invisible to you.

Transition Filters

Transition filters are used to detect changes of state in the condition register and set the corresponding bit in the event register. You can set transition filter bits to detect positive transitions (**PTR**), negative transitions (**NTR**) or both. Transition filters are therefore read-write registers. They are unaffected by ***CLS**.

Event Register

An event register latches transition events from the condition register as specified by the transition filters or records status events. Querying (reading) the event register clears it, as does the ***CLS** command. There is no buffering, so while a bit is set, subsequent transition events are not recorded. Event registers are read-only.

Enable register

The enable register defines which bits in an event register are included in the logical OR into the summary bit. The enable register is logically ANDed with the event register and the resulting bits ORed into the summary bit. Enable registers are read-write, and are not affected by ***CLS** or querying.

Although all status groups have all of these registers, not all status groups actually use all of the registers. Table 16 summarizes the registers used in the instrument status groups.

Table 8:

Status Group	Registers in Group				
	CONDition	NTR	PTR	EVENt	ENABLe
QUEStionable	√	÷√	√	√	√
OPERation[1]	x	x	x	x	x
Standard Event Status	x	x	x	√[2]	√[3]
Status Byte	x	x	x	√[4]	√[5]

1 Present, but not used. COND and EVEN always 0.
2 Use ***ESR?** to query.
3 Use ***ESE** to set, ***ESE?** to query
4 Use ***STB?** to query
5 Use ***SRE** to set, ***SRE?** to query

Status Byte

The status byte summarizes the information from all other status groups. The summary bit for the status byte actually appears in bit 6 (RQS) of the status byte. When RQS is set it generates an SRQ interrupt to the controller indicating that at least one instrument on the bus requires attention. You can read the status byte using a serial poll or *STB?

Table 9:

Bit	Description
0	Unused, always 0
1	Unused, always 0
2	Unused, always 0
3	QUESTionable Status Summary Bit
4	MAV - Message AVailable in output buffer
5	Standard Event Status summary bit
6	RQS; ReQuest Service
7	OPERation Status summary Bit, unused

Standard Event Status Group

Table 10:

Bit	Description
0	Operation Complete, set by *OPC
1	Unused, always 0
2	Query Error
3	Device Dependant Error
4	Execution Error
5	Command Error
6	Unused, always 0
7	Power On

OPERation Status Group

This Status Group is not used in the instrument.

Table 11:

Bit	Description
0	Unused, always 0
1	Unused, always 0
2	Unused, always 0
3	Unused, always 0
4	Unused, always 0
5	Unused, always 0
6	Unused, always 0
7	Unused, always 0
8	Unused, always 0
9	Unused, always 0
10	Unused, always 0
11	Unused, always 0
12	Unused, always 0
13	Unused, always 0
14	Unused, always 0
15	Always 0

QUEStionable Status Group

Table 12:

Bit	QUEStionable
0	Voltage warning
1	Current warning
2	Time warning
3	Unused, always 0
4	Unused, always 0
5	Frequency warning
6	Unused, always 0
7	Unused, always 0
8	Unused, always 0
9	Unused, always 0
10	Unused, always 0
11	Unused, always 0
12	Unused, always
13	Unused, always 0
14	Unused, always 0
15	Always 0

The QUEStionable Status group is used to report warning conditions amongst the voltage, current, pulse timing and frequency parameters. For more information on warning conditions refer to "Warnings and Errors" in Chapter 4. Warnings occur when a parameter, although not outside its maximum limits, could be causing an invalid signal at the output bececause of the actual settings and uncertainties of related parameters.

Chapter 3

Specifications

Introduction

In this chapter you will find the **Specifications** of the HP 81110A and the HP 81104A.

If you want to read parameter definitions please refer to **Pulse Parameter Definitions, see page 298.**

Specifications

Specifications describe the instrument’s warranted performance. Non-warranted values are described as typical. All specifications apply after a 30 minute warm-up phase with 50 Ohm source, a 50 Ohm load resistance and separate channels. They are valid from 0 °C to 55 °C ambient temperature.

General

Environmental Conditions

Operating temperature:	0 °C to +55 °C
Storage temperature:	-40 °C to +70 °C
Humidity:	95% r.h. up to 40 °C ambient temperature
Altitude:	up to 2000 m
Installation:	Category II
Pollution:	Degree 2
EMC:	conforms to EN50082-1, EN55011, Class A
Battery:	Lithium, type CR2477-N (HP part number 1420-0557)

Safety

IEC1010, CSA1010

Power requirements

100-240 Vac, ±10%, 50-60 Hz;
100-120 Vac, ±10%, 400 Hz
Power consumption: 300 VA max.

Maximum Dimensions (H x W x D)

89 mm x 426 mm x 521 mm

Weight

Net
8.5 kg Single Channel
9.2 kg Dual Channel
Shipping
13.8 kg   Dual Channel

Recalibration period

1 year recommended

Warranty

3 years standard

Acoustic Noise Emission

Acoustic Noise Emission
For ambient temperature up to 30°C,
under normal operation and at the typical operator position:

LpA = 52 dB (5.9 bel) typical

Measured in accordance with ISO 7779/EN 27779.

Geraeuschemissionswerte
Bei einer Umgebungstemperatur bis 30°C

LpA = 52 dB (5,9 bel) typisch

am Arbeitsplatz, normaler Betrieb.

Angabe ist das Ergebnis einer Typpruefung nach ISO 7779/
EN 27779.

Declaration of Conformity

Manufacturer:	Hewlett-Packard GmbH Boeblingen Verification Solutions Herrenberger Str. 130 71034 Boeblingen Germany

We declare that the system

HP 81100 Family of Pulse/Pattern Generators
HP 81110A 165/330 MHz Pulse/Pattern Generator
HP 81104A 80 MHz Pulse/Pattern Generator

conforms to the following standards:

Safety:	IEC 1010-1:1990 + A1:1992 EN61010-1:1993
EMC:	EN 55011:1991/CISPR 11 Group 1, Class B
	EN 61000-4-2:1995 ESD: 4kV cd, 8kV ad, 4kV cp
	EN 61000-4-3:1995 Radiated Immunity: 3V/m, 80% AM
	ENV 50204:1995 Radiated Immunity: 3V/m, 50% Dty
	EN 61000-4-4:1995 Fast Transients/Bursts: 0.5kV, 1kV
	EN 61000-4-5:1995 Surges: 1 kVdiff, 2 KV com. mode
	EN 61000-4-6:1995 Conducted Immunity
	EN 61000-4-8:1993 Power freq. mang. field 3A/m, 50 Hz
	IEC 1000-4-11:1994 Voltage Dips and Interruptions

Supplementary Information

The product herewith complies with the requirements of the
*) Low Voltage Directive (72/23/EEC) and the
*) EMC Directive (89/336/EEC).

During the measurement against EN 55011, the I/O ports were terminated with their normal impedance, the HP-IB connector was terminated with the cable HP 10833B. When the product is connected to other devices, the user must ensure that the connecting cables and the other devices are adequately shielded to prevent radiation.

Boeblingen, June 9th 1998

Wolfgang Fenske
Regulation Consultant

HP 81110A and HP 81104A Pulse Generator Mainframes

Timing

Period

Period can also be entered as frequency.

Period	**HP 81110A with HP 81112A installed**	**HP 81110A with HP 81111A installed**	**HP 81104A with HP 81105A installed**
Range:	3.030 ns to 999.5 s	6.060 ns to 999.5 s	12.50 ns to 999.5 s
Resolution:	3.5 digits, 5 ps best case for VFO 4 digits, 1 ps best case for PLL		
Accuracy:	PLL: 0.01% VFO: 0.5% after selftest 3% w/o selftest		PLL: 0.01% VFO: ± 5%
RMS-jitter:	PLL: 0.001% + 15 ps VFO: 0.01% + 15 ps		
Frequency range:	1.00 mHz to 330 MHz	1.00 mHz to 165 MHz	1.00 mHz to 80 MHz

There are 2 period generation sources available:
a) startable oscillator (VFO)
b) high-accuracy frequency generator (PLL)

PLL Ref In/CLK In

It is possible to select between two clock sources, either the startable oscillator (VFO), or the PLL/External Clock. In Triggered Mode the PLL can be used as the trigger source for the VFO, without the need of an additional source.

Clock Input/ PLL Reference Input

Input impedance:	50Ω or 10kΩ selectable
Threshold:	-10 V to +10 V
Maximum input voltage:	±15 V
Input transitions:	<100 ns
Input Frequency:	dc to max 330 MHz, depends on the output module
Minimum pulse width:	1.5 ns
Input sensitivity:	≤ 300 mVpp typical
Delay from Clock Input to TRIGGER OUT:	12.5 ns typical

Rear panel BNC connector used as:
- External system clock input: pulse frequency = input frequency
- or 5 MHz or 10 MHz frequency reference input for internal PLL.

The input frequency can be measured.

Phase Locked Loop (PLL)

- Locks either to an external frequency reference at the PLL Ref Input Clk In (5 MHz or 10 MHz selectable) or to its internal reference.
- High accuracy period (frequency) source. When locked to the internal reference, period accuracy, range, resolution, and jitter are improved:

Period Accuracy:	0.01%
Period Range:	3.03 ns to 999.5 s, (min depends on output module type)
Period Resolution:	4 digits, best case 1 ps
Period RMS-jitter:	0.001% +15 ps

When locked to an external frequency reference, the external frequency affects these accuracies.

- Internal triggering of bursts and patterns: the internal PLL can replace an external trigger source, while the output period is determined by the normal internal oscillator.

External Clock

- The output period is determined by the signal at clock input. Frequency accuracy can be increased by using a precise external clock.
- Trigger synchronously to external clock: the output period is synchronous to the signal at clock input. The signal at the External Input is used for arming.

Configuration

The HP 81110A mainframe and the HP 81104A mainframe can be configured with either one or two output modules of the same type

Channel Addition

With two output channels fitted, 2-, 3- and 4-level complex signals can be generated by adding channel 2 to channel 1 at the OUTPUT 1 connector. OUTPUT 2 is disabled. For further information, please see also “Levels in Channel Addition” on page 297.

Output Modes

Pulses Mode

The output signal consists of single or double pulses, controlled by the Trigger mode.

Burst Mode

The output signal consists of bursts of single or double pulses, controlled by the Trigger mode.

Burst count:	2 to 65536
Format:	single or double pulses

Pattern Mode

The output signal consists of patterns of RZ or NRZ pulses, controlled by the Trigger mode.

Pattern Length	16,384 bits/channel including STROBE OUT
Format:	RZ (return-to-zero)
	NRZ (non-return-to-zero)
	DNRZ (delayed non-return-to-zero)
Random pattern:	PRBS 2^n -1, n = 7 to 14
	Compliance CCITT 0.151 standard

Trigger Modes

Continuous

Generate continuous pulses, double pulses, bursts or patterns.

External Triggered

Each active input transition (rising, falling or both) triggers a single or double pulse, a burst or a pattern.

The trigger source can be selected from:

- External Input
- **MAN** Manual Trigger key
- internal PLL.

External Gated

The active input level (high or low) enables pulses, double pulses, bursts or patterns. The last pulse, double pulse, burst or pattern is always completed. The gate source can be selected from:

- External Input
- **MAN** Manual Trigger key

External Width

To recover a pulse shape of an external signal, applied to the External Input, the period and width are maintained, levels, delay and transitions can be set.

External Input

Input impedance:	50 Ω or 10 kΩ selectable
Threshold:	-10 V to +10 V
Maximum input voltage:	±15 Vpp
Input transitions:	<100 ns
Input frequency:	dc to max 330 MHz, depends on the output module
Minimum pulse width:	1.5 ns
Input sensitivity:	≤300 mV_{pp} typical

Strobe Output

Level:	TTL or ECL selectable
Output impedance:	50 Ω typical
Maximum external voltage:	-2 V/+7 V
Transition times:	1 ns typical for TTL, 600 ps typical for ECL
Pattern:	16,384 bits NRZ in pattern mode.

Trigger Output

Level:	TTL or ECL selectable
Output impedance:	50 Ω typical
Trigger pulse width:	typically 50% of period
Maximum external voltage:	-2 V/+7 V
Transition times:	1 ns typical for TTL, 600 ps typical for ECL

Typical Delays

Mode	from	to	typ.value
external width	Ext Input	Strobe/Trigger Out OUT 1/OUT 2	8.5 ns 19.5 ns
Trigger Gated	Ext Input	Strobe/Trigger Out OUT 1/OUT 2	12.0 ns 26.0 ns
Continuous	Strobe/ Trigger Out	OUT 1/OUT 2	14.0 ns
Ext. clock signal as pulse period	CLK IN	Strobe/Trigger Out OUT 1/OUT 2	12.0 ns 26.0 ns

Human Interface

Overprogramming

Parameter values can be entered exceeding the specified range.

Warnings and Errors

Warning messages indicate potentially conflicting parameters due to accuracy tolerances.

Error messages indicate conflicting parameters.

HELP key

Displays a context-sensitive message about the selected parameter. Concept help for getting started is also available. If warnings or errors occur, the HELP key displays the warning/error list accordingly.

Memory

Non-volatile memory

Actual setting is saved on power- down. 9 user and 1 default setting are also stored in instrument.

Memory-card

99 settings can be stored per 1 MB (MS-DOS, PCMCIA) memory card. Also used for convenient firmware updates.

Remote Control

Operates according to IEEE standard 488.2, 1987 and SCPI 1992.0.

Function Code:

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1,C0.

Programming times:

all checks and display off.

Command	**Typical execution time**
One parameter or mode	30 ms typ.
Recall Setting	250 ms typ
16,384 bit pattern transfer	600 ms typ

Specifications for Output Channel Types

One or two output channels can be installed in one HP 81110A or HP 81104A mainframes. The second output channel can be retrofitted without recalibration. All timing parameters are measured at 50% of amplitude at fastest transitions in continuous mode with 50 Ω source and load impedance.

With HP 81110A it is possible to select between a 10 V output channel, HP 81111A and a 3.8 V output channel, HP 81112A.
With HP 81104A there is a 10 V output channel, HP 81105A, available.
The HP 81110A has a self-calibration feature for the timing circuitry, VFO-period, delay, width.

Timing Parameters

Common specifications

Repeatability:	4 times better than accuracy
Resolution:	3.5 digits, best case 5 ps VFO, 1 ps best case PLL
RMS Jitter:	0.01% + 15 ps

Width

Can be entered as absolute width, duty cycle or trailing-edge delay.

	HP 81112A	HP 81111A	HP 81105A
Range:	1.515 ns to 999.5 s (max value: period -1.5 ns)	3.030 ns to 999.5 s (max value: period -3.03 ns)	6.250 ns to 999.5 s (max value: period -6.25 ns)
Accuracy:	± 0.5% ± 250 ps after selfcal ± 3.0% ± 250 ps w/o selfcal		±5% ±250 ps
Duty cycle:	0.1% to 95% (depends on period and width; overprogrammable to 99%)		

Duty Cycle values from 0.1% to 95% can be entered directly. For values >95% press shift and use the Modify knob. The reason for this is that accuracy deteriorates above 95%. Hence for large values, it’s better to select complement and enter 100 minus the required duty cycle value.

Delay

Measured between trigger output and main output. Can be entered as absolute delay, phase ° or % of period.

	HP 81112A	HP 81111A	HP 81105A
Fixed delay from TRIGGER OUT:	14.0 ns typical		
Additional variable range:	0.00 ns to 999.5 ms (max value: period -3.03 ns)		0.000 ns to 999.5 s (max value: period -12.5 ns)
Accuracy:	± 0.5% ± 0.5 ns after self cal ± 3.0% ± 0.5 ns w/o self cal		± 5% ± 0.5 ns

Double Pulse Delay

Double pulse delay and delay are mutually exclusive. Double Pulse delay is the delay between the two pulses in Double Pulse mode.

	HP 81112A	HP 81111A	HP 81105A
Double Pulse Delay range:	3.030 ns to 999.5 ms (max value: period - width - 1.5 ns)	6.060 ns to 999.5 s (max value: period - width - 3.03 ns)	12.50 ns to 999.5 s (max value: period - width - 6.25 ns)
Accuracy:	± 0.5% ± 150 ps after selfcal ± 3.0% ± 150 ps w/o selfcal		±5% ±250 ps
Min. period:	6.06 ns (165 MHz)	12.2 ns (82 MHz)	25 ns (40 MHz)

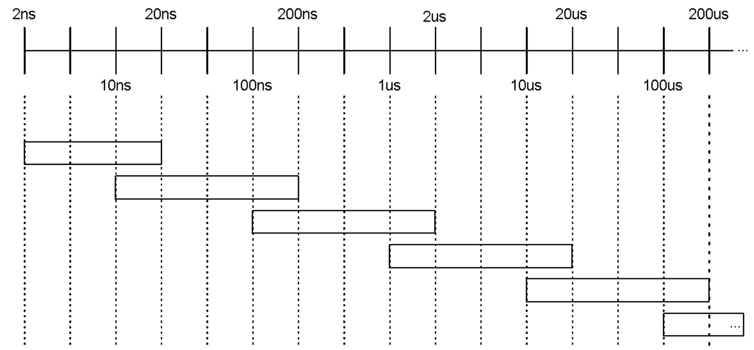
Transition Times

Measured between 10% and 90% of amplitude. Can be entered as leading/trailing edge or % of width.

	HP 81112A	HP 81111A	HP 81105A
Range:	800 ps or 1.6 ns, fixed	2.00 ns to 200 ms	3.00 ns to 200 ms
Min. transition:	≤600 ps for Vpp < 1V ≤900 ps for Vpp > 1V	≤2.0 ns	≤3.0 ns
	450 ps typical for Vpp<1v levels (20% to 80% of amplitude)	1.4 ns typical for ECL levels (20% to 80% of amplitude)	3 ns typical
	n/a	5 ns typical for 1 kΩ source impedance	
Accuracy:	±10% ±200 ps		
Linearity:	3% typical for transitions >100 ns		

Leading and trailing edges can be programmed independently within the following ranges (Maximum ratio 1:20):

Figure 48 Leading/Trailing Edge ranges



Level Parameters

	HP 81112A	HP 81111A	HP 81105A
Source impedance:	50 Ω	selectable 50 Ω or 1 kΩ ± 1% typical	
	n/a	(48 Ω or 500 Ω with Added Channels)	
Maximum external voltage:	-2.2 V to + 5.5 V	±24 V	
Short circuit current:	-84 mA to 152 mA	±400 mA (double for channel addition)	
Normal/complement:	selectable		
ON/OFF:	relays connect/disconnect output (HiZ).		
Limits:	high and low levels can be limited to protect the DUT.		

External Load compensation

For loads ≠ to 50Ω, the actual load impedance can be entered to correct the output values into a static load with HP 81111A and HP 81105A output modules.

Level Specifications

Level parameters can be entered as voltage or current, as high/low-level or offset/amplitude in terms of voltage or current.

	For HP 81111A and for HP 81105A	
	(50Ω into 50Ω)	**(1kΩ into 50Ω)**
Amplitude:	100 mVpp to 10.0 Vpp	200 mVpp to 20.0 Vpp
Level Window	-10.0 V to +10.0 V	-20.0 V to + 20.0 V
Level Accuracy: **HP 81111A** **HP 81105A**	 ±(1% Amplitude + 50 mV) ±(3% Amplitude + 75 mV)	n/a ±(1% Amplitude + 100 mV) ±(5% Amplitude + 150 mV)
Resolution:	10 mV	20 mV
Short Circuit Current	±400 mA max (doubles for channel addition)	

	For HP 81112A
	(50Ω into 50Ω)
Level Window	-2 V to + 3.80 V
Amplitude	100 mV to 3.8 V
Level Accuracy: **HP 81112A**	 ±(3% Amplitude + 50 mV)
Resolution:	10 mV
Short Circuit Current	-84 mA to +152 mA

Levels in Channel Addition

If two HP 81111A output channels are installed in an HP 81110A, or two HP 81105A output channels are installed in an HP 81104A, then the channel addition feature can be used.
Channel addition is not available with HP 81112A output channels.

The following parameters differ from previous specifications if channels are added:

	For HP 81111A and for HP 81105A	
	(50Ω into 50Ω)	**(1kΩ into 50Ω)**
Amplitude:	100 mVpp to 20.0 Vpp	200 mVpp to 20.0 Vpp
Level window:	-20.0 V to +20.0 V	
Maximum frequency:	60 MHz typical	15 MHz typical
Minimum transitions:	2 ns typical on first channel 5 ns typical on second channel	20 ns typical on both channels
Add fixed delay of second channel	2.5 ns	

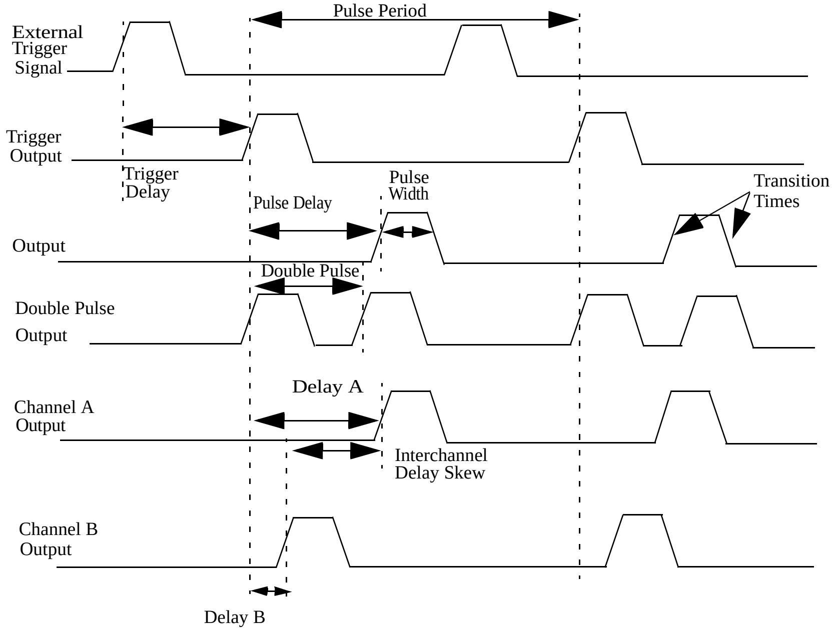
Pulse Performance

	HP 81112A	**HP 81111A**	**HP 81105A**
Overshoot, Preshoot, Ringing:	±5% of amplitude ±50 mV	±5% of amplitude ±20 mV	
Settling time:	5 ns typical	30 ns typical	
Baseline noise:	4 mV RMS typical	4 mV RMS typical	
Dynamic Crosstalk	< 0.1% typical		

Pulse Parameter Definitions

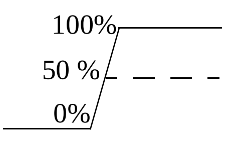
Here you find the pulse parameter definitions of terms used in the instrument specifications. In the following figure a graphical overview of the pulse parameters is provided:

Figure 49 Pulse Parameters



Time Reference Point:

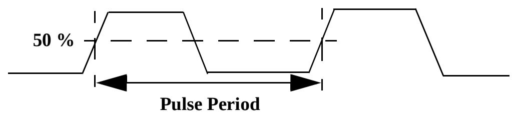
Median (50% amplitude point on pulse edge)



Pulse Period:

The time interval between the leading edge medians of consecutive out-

put pulses



Trigger Delay

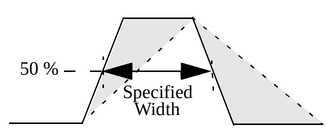
Interval between trigger point of the external trigger input signal and the trigger output pulse's leading-edge median.

Pulse Width:

Interval between leading- and trailing-edge medians. 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 stays unchanged* when transition times are varied. This is more convenient for programming and the width display is easy to interpret.

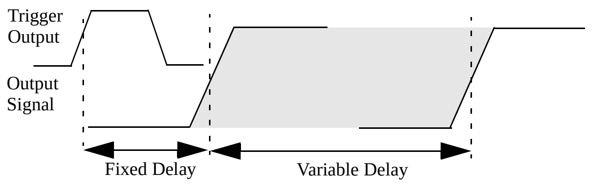
* in practice, start points may shift with changes in transition time

Figure 50 Pulse Width



Pulse Delay:

Interval between leading edge medians of trigger output pulse and output pulse. The specified and displayed value is that obtained with the fastest leading edge. Pulse delay has two components, a fixed delay from trigger output to output signal and a variable delay with respect to the trigger output.



Double Pulse Delay:

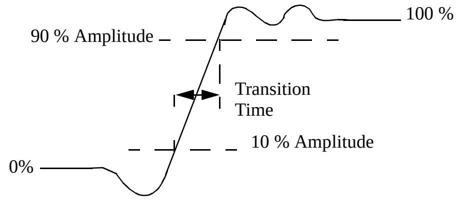
Interval between leading edge medians of the double pulses.

Interchannel Delay (Skew)

Interval between corresponding leading-edge medians of the output signals.

Transition Time:

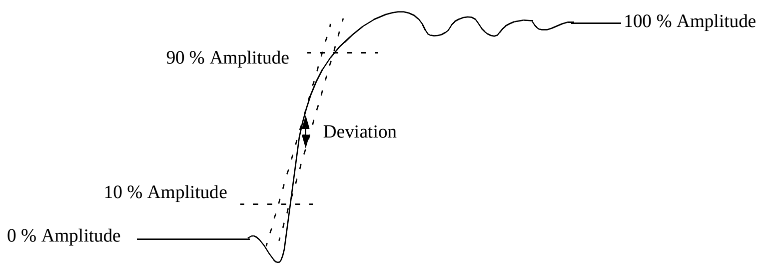
Interval between the 10%- and 90%- amplitude points on the leading/ trailing edge.



Linearity:

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

Figure 51 Linearity



Jitter:

Short-term instability of one edge relative to a reference edge. Usually specified as rms value, which is one standard deviation or “sigma”. If distribution is assumed Gaussian, six sigma represents 99.74% of the peak-peak jitter.
The reference edge for period jitter is the previous leading edge. That for delay jitter is the leading edge of the trigger output. Width jitter is the stability of the trailing edge with regard to the leading edge.

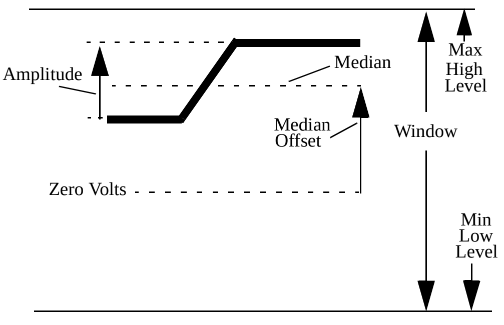
Stability:

Long-term average instability over a specific time, for example, hour, year. Jitter is excluded.

Pulse Levels:

Pulse output is specified as pulse top and pulse base (usually referred to as high level and low level), or as peak to peak amplitude and median offset. A “window” specification shows the limits within which the pulse can be positioned.

Figure 52 Pulse Amplitude

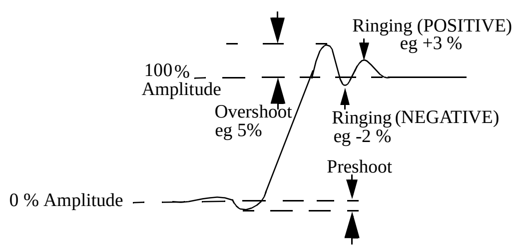


Preshoot, Overshoot, Ringing:

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

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

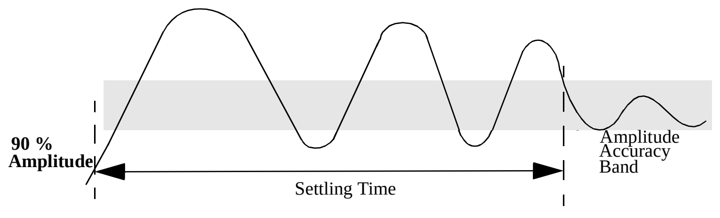
Figure 53 Preshoot, Overshoot, Ringing



Settling Time:

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

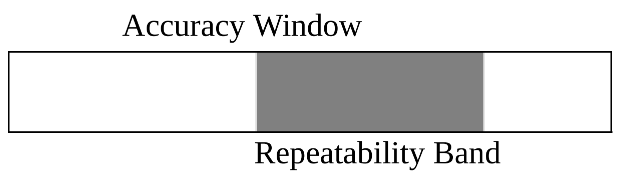
Figure 54 Settling Time



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.

Figure 55 Repeatability



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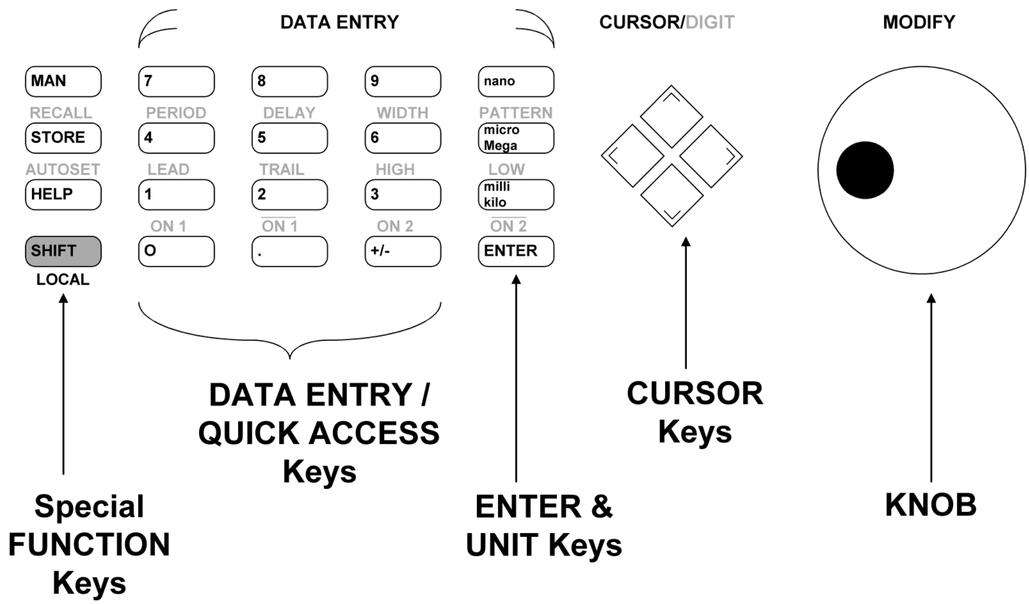
Front Panel Controls



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