User's Guide

HP LogicDart
Advanced Logic Probe
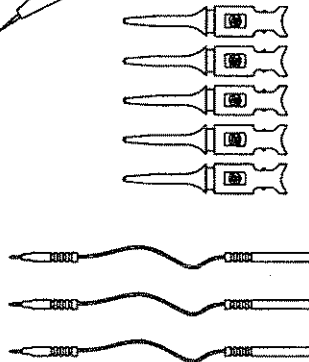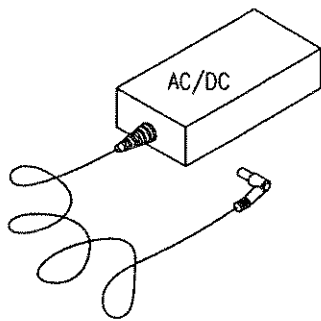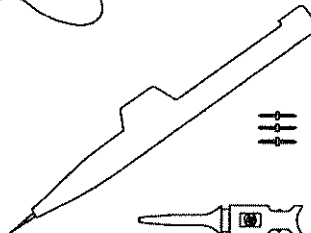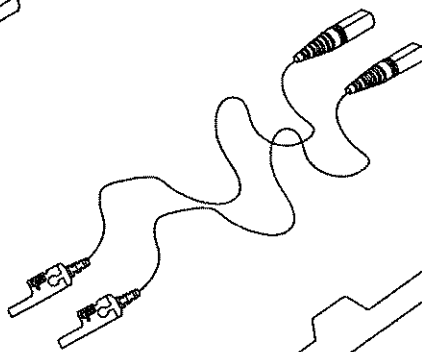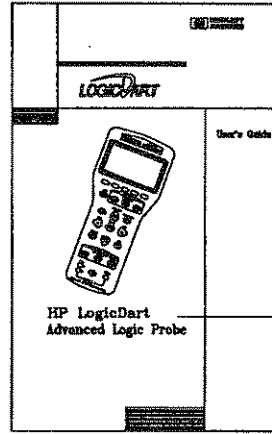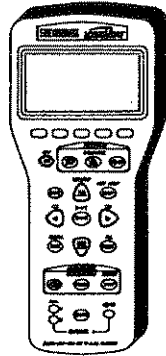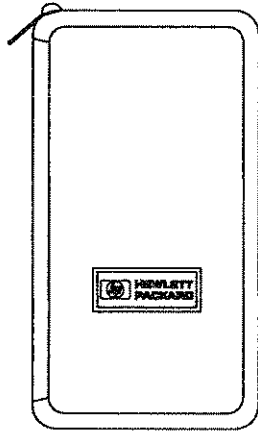
English

日本語

Korean

中文

汉语

English

日本語

한글

中 文

Chinese

Table of Contents and Overview
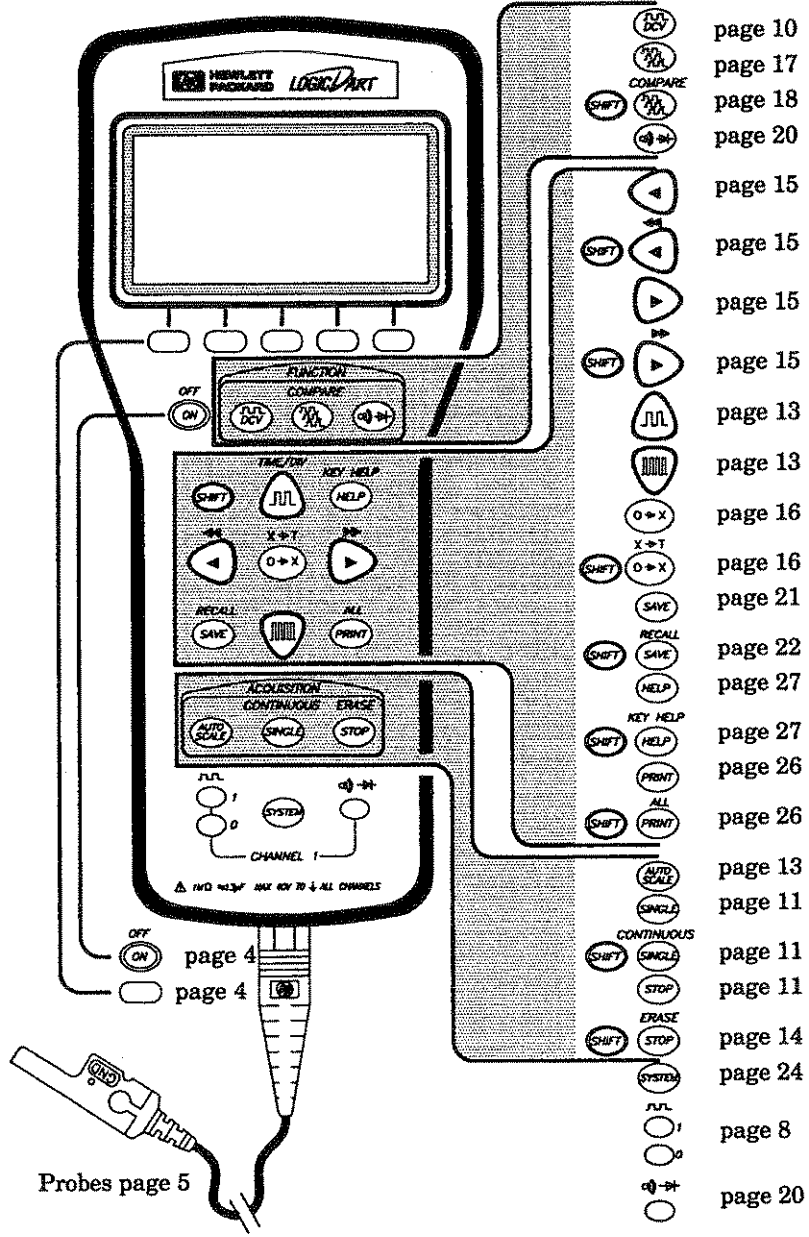
English
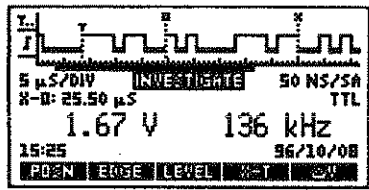
Use Investigate to view voltages, frequencies, and waveforms on Channel 1.
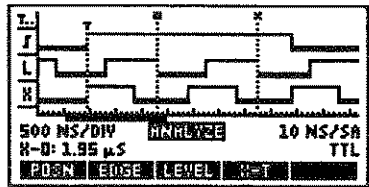
Use analyze to capture waveforms on Channels 1, 2, and 3.
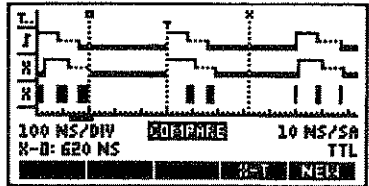
COMPARE

Use Compare to view the differences between two successive Channel 1 waveforms.

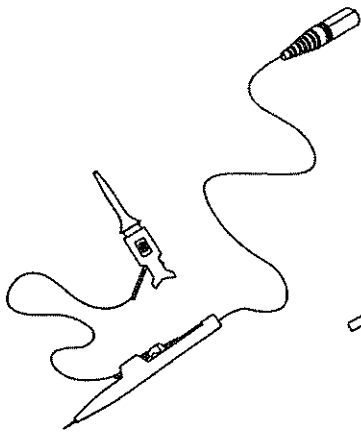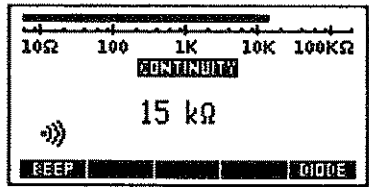Use Continuity to check for opens or shorts, measure resistance, and check diodes on Channel 1.
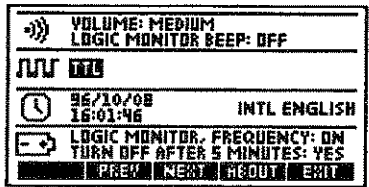
Use System Setup to define the global conditions for HP LogicDart.

Other Topics

English

Turn *LogicDart* On (ON)

Press (ON) once to turn on HP LogicDart.

Press (SHIFT) and then (ON) to turn off HP LogicDart.

All your settings and any waveforms are saved when you turn HP LogicDart off. The settings, applications, and waveforms are restored when you turn HP LogicDart back on.

Adjust the Display Contrast

You can adjust the contrast of the display to suit your viewing angle and ambient light conditions.

- (ON) and (ON) change the display contrast.

  Hold down the (ON) key while pressing either (⬆) or (⬇) until the display is the most readable.

A Word About Menu Keys

There are five unlabeled keys just below the display. These keys are the menu keys and their function changes to suit the task at hand.

The function of each menu key is shown in the display. For example, in Investigate, five keys are active. From left to right they are: ███ ███ ███ ███ ███
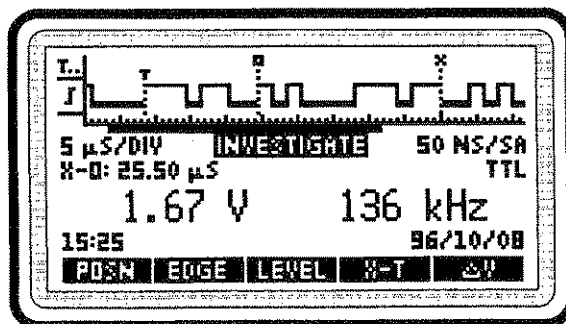
Press the menu key below the label to perform that action. In the display above, pressing the right hand menu key, labeled ██████, turns on or off the ΔV measurement (described on page 10).

Using the Probes

Install the probes on HP LogicDart as shown. Be sure to note the channel number (Channel 1 is the center connector).

Key

One Channel Connections

Ground Lead

Browser

Grabber

Ground Lead
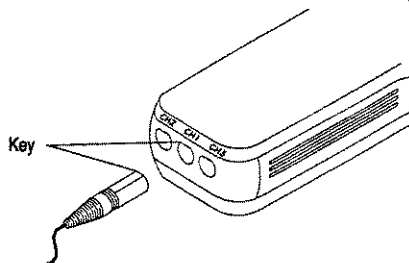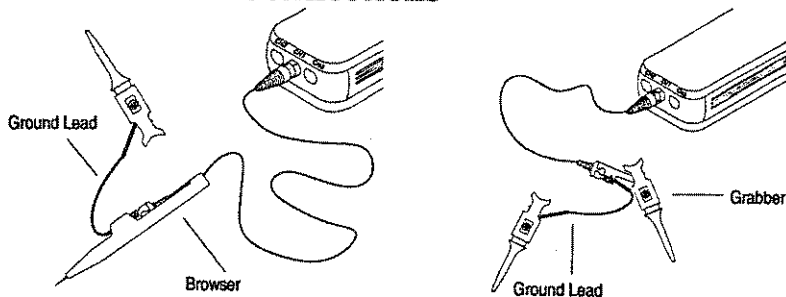
Alternate Grounding Techniques

Ground
Lead

Browser used as
a Ground Lead
(see page 6)

Browser used as
a Signal Lead
(see page 6)
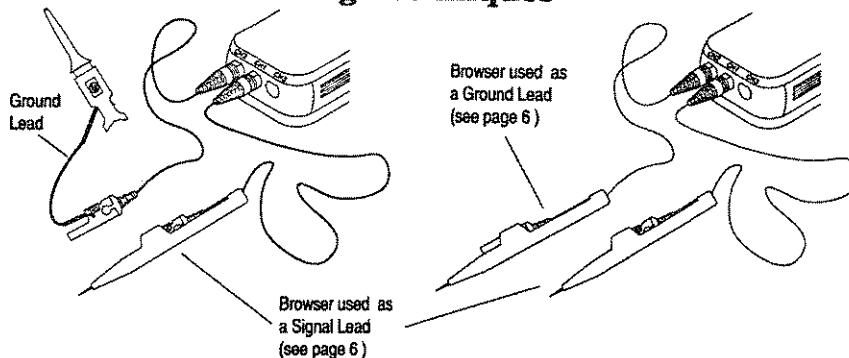
You can use the ground connection from either Channel 2 or Channel 3 for low frequency Channel 1 operations. All ground connections are common (not isolated) to all channels.

⚠ **CAUTION** *Do not exceed the maximum rated input voltage of ±40 V. Do not exceed ±40 V to earth ground on any input signal or ground leads.*

High Frequencies (above 1 MHz)

For frequencies above 1 MHz and for two- or three-channel operations, use minimum-length ground leads and grabbers. Ground each channel separately. Do not use a single ground for two- or three-channel operations.

Multiple Channel Connections

Using the Browser

Ground Lead

Probe

Browser as a Signal Lead

Browser

Strain Relief

Browser as a Ground Lead
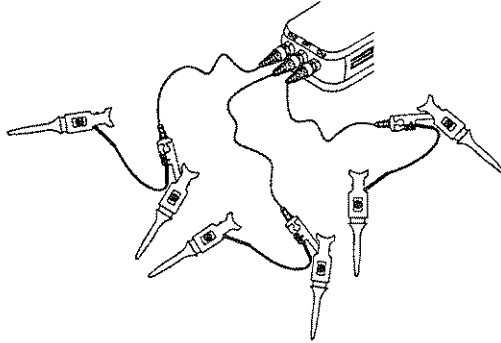
Using the Probes
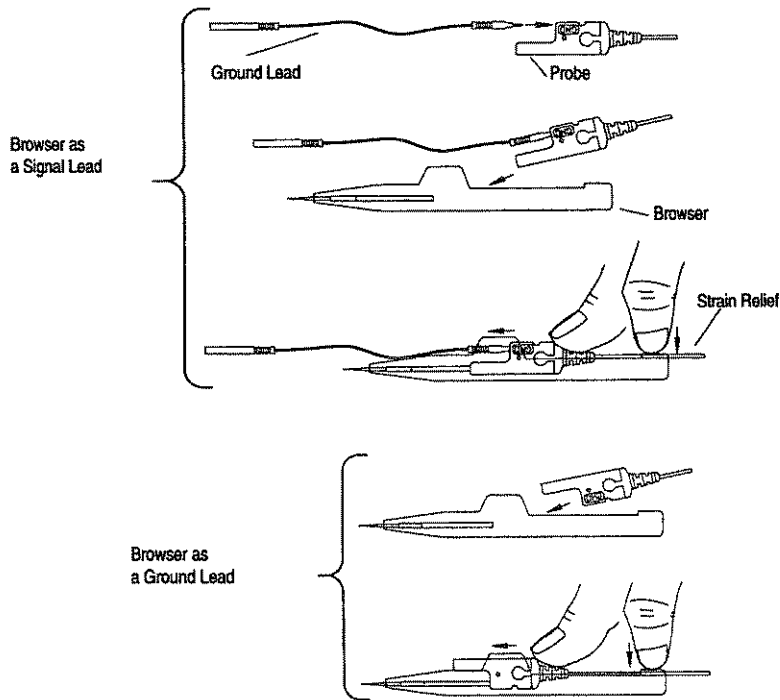
Probe Accessories and Parts

Probe
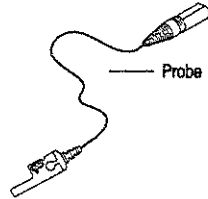
Contact Pin

Contact pin used for probing

Contact Pin

Probe
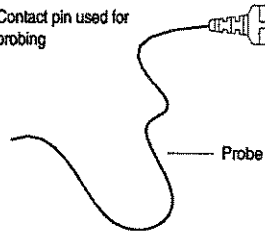
To short an input for calibration

Contact Pin

Contact Pin

Probe

Ground Lead
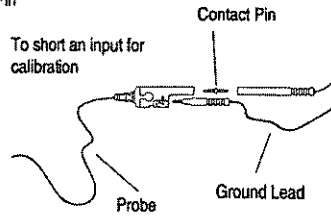
Ground Extenders
(supplied in E2322A Accessory Kit)

Probe

Ground Extender
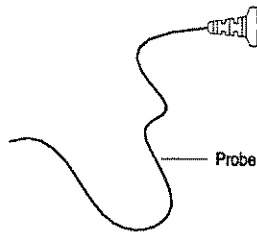
Probe with Ground Extender
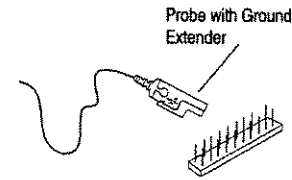
Browser Replacement Pins
(supplied in E2322A Accessory Kit)

Browser Replacement Pin
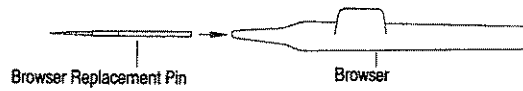
Browser

Logic Monitor

The Logic Monitor gives a visual (and, optionally, audible) indication of the logic levels at the Channel 1 probe tip. The Logic Monitor runs continuously unless turned off (see page 25).

Voltage above
high threshold
(green LED on)

Voltage between
high and low
thresholds
(both LED's off)

Voltage below
low threshold
(red LED on)
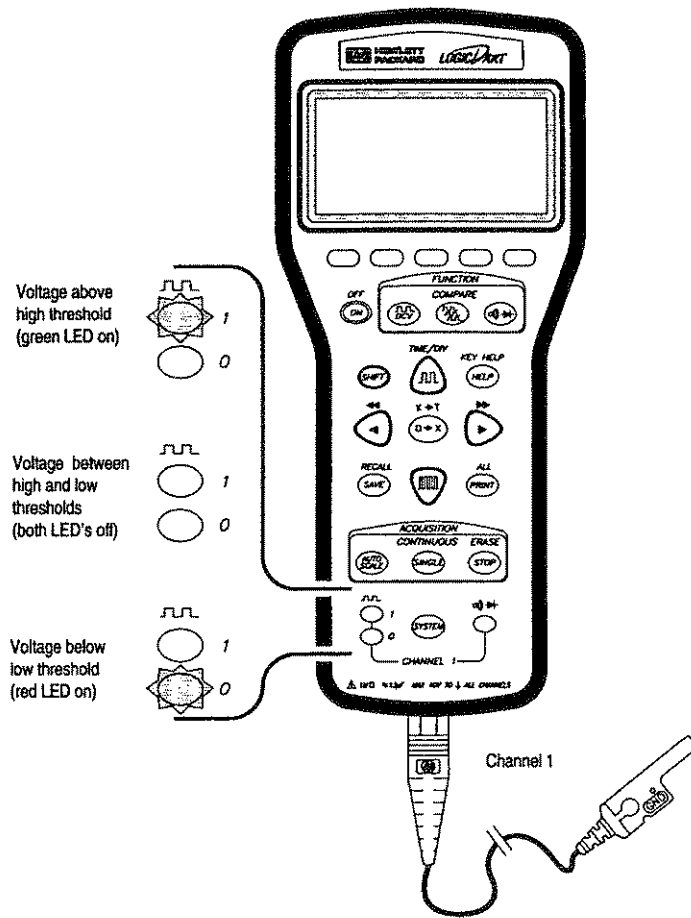
Channel 1

- Use the logic monitor with the browser to quickly locate active or stuck nodes, power supplies, and grounds. Page 5 shows how to use the probes.

- The green LED and a high-tone beep are on when the voltage at the Channel 1 probe tip is above the high threshold.

  The red LED and a low-tone beep are on when the voltage at the Channel 1 probe tip is below the low threshold.

  Both LEDs and the beep are off when the voltage at the Channel 1 probe tip is between the low threshold and the high threshold (tristate).

  Alternating red and green LEDs indicate a signal varying between high and low. The LEDs indicate signal activity but do not indicate either the frequency or the duty cycle of the input signal.

- A tolerance band exists below the high threshold and above the low threshold. The width of the tolerance band depends upon the logic family used and is defined in the specifications on page 35. An input signal value in a tolerance band is ambiguous. For example, if an input signal level is in the high tolerance band, the logic level reported by the logic monitor can be either a high level or a tristate level.

High threshold   }- Tolerance Band

                           Tristate

Low threshold   }-Tolerance Band

- You can turn the Logic Monitor beep on or off in System Setup (see page 25). The beep is turned off by default.

- The high and low logic threshold levels reported by the Logic Monitor are set in System Setup (see page 25).

- You can turn off the Logic Monitor (beeps and LED display) to save battery power (see page 25).

Investigate

Use Investigate to view voltages, frequencies, and waveforms at the Channel 1 probe tip. The waveform may be captured once and displayed or can be continuously updating.

Voltage   Frequency
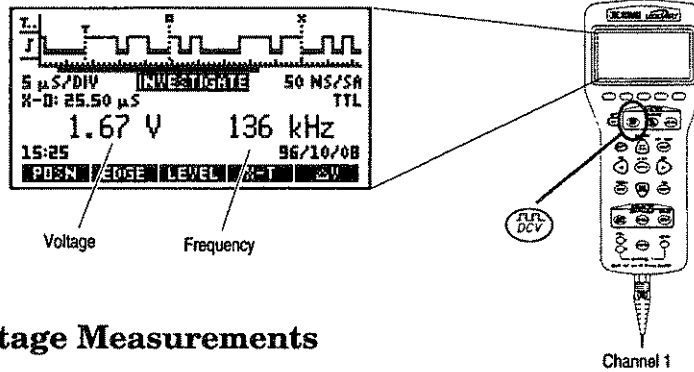
Voltage Measurements

Channel 1

- The voltage shown is the voltage at the Channel 1 probe tip (not the average of the displayed waveform). The voltage shown is updated approximately 20 times per second. Measured voltages are in the range of – 35.00 V to + 35.00 V. Voltages outside this range are shown as < – 35 V or > 35 V.

- If the probe tip is not in contact with a circuit, the OPEN message is shown in the display. ECL logic thresholds or user-defined logic thresholds set closer to each other than 1 V may not generate the OPEN message.

- You can also make ΔV measurements. ΔV shows the *difference* between a reference voltage and the Channel 1 probe tip voltage.

  Press ▄▄▄▄▄ to capture a reference voltage and begin displaying the difference. The actual voltage and the difference voltage are shown in the display (the reference voltage is not shown). Once turned on, ΔV is shown in the display until you press ▄▄▄▄▄ again or turn HP LogicDart off and back on.

ΔV

Voltage measurement

Investigate
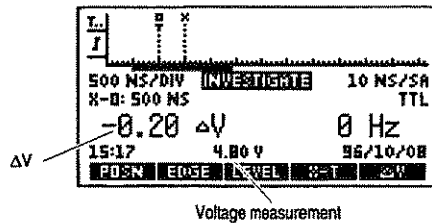
Frequency Measurements

- The frequency shown in the display is the frequency of the signal at the Channel 1 probe tip (not necessarily the frequency of the displayed waveform). The frequency is updated approximately twice per second. The frequency display is turned off while HP LogicDart is acquiring a waveform.

- The frequency is measured by counting falling edges. The frequency measurement is primarily useful for regular, periodic signals such as clocks.

- Frequencies less than 1 Hz are shown as < 1 Hz. The frequency is shown as 0 Hz if the input signal is a dc voltage or if the Channel 1 probe tip is not in contact with an active circuit.

- The frequency display may be turned off to prolong battery life (see page 25).

Capturing Waveforms

There are three methods you can use to capture a waveform. All waveform captures rely upon *trigger conditions* to control how and when the waveform is captured (setting the trigger conditions is described on page 12). The waveform is captured using the time/div you set and the corresponding sample period (described on page 13).

Once the trigger conditions are set, and the Channel 1 probe tip is in contact with a circuit, use one of these three methods to capture and display a waveform.

- (AUTO SCALE) automatically determines the time/div and sample period and then captures a waveform. The time/div is set such that 5 to 12 transitions are shown in the display. This method is most useful if you don't know the signal frequency.

- (SINGLE) captures and displays one waveform using your trigger position, trigger type, and time/div settings.
  (STOP) halts a single run in progress. The frequency is not shown while the waveform capture is in progress.

- CONTINUOUS
  (SHIFT) (SINGLE) captures waveforms continuously (while the trigger conditions are met). This method is useful when you are probing a circuit and looking for activity.
  (STOP) stops continuous waveform captures. The frequency is not shown during continuous waveform captures.

Setting Trigger Conditions for Channel 1
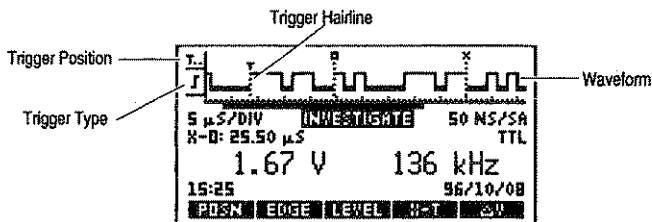
- Press **POSN** to set the trigger position. Use one of the following menu keys to set the trigger positions:

  L Use the *left trigger position* if you are interested in an area of the waveform following the trigger point.

  T Use the *center trigger position* if you are interested in an area of the waveform around the trigger point.

  R Use the *right trigger position* if you are interested in an area of the waveform before the trigger point.

- Press **EDGE** to set an edge trigger type. Use one of the following menu keys to set the edge trigger types:

  ↑ Sets the *rising* edge trigger type.

  ↓ Sets the *falling* edge trigger type.

  ↕ Sets either *rising or falling* edge trigger type.

- Press **LEVEL** to set a level trigger type. Use one of the following menu keys to set the level trigger types:

  H Sets *high* level trigger type.

  L Sets *low* level trigger type.

  X Sets a *don't care* trigger type (a trigger is not required for a waveform capture).

- When you start a waveform capture (as described on page 11) the trigger conditions are checked. If the trigger conditions are not met, the trigger type blinks and the message WAITING FOR TRIGGER is shown in the display.

- Trigger conditions are checked every 10 ns, regardless of the sample period (described on page 13). When the sample period is longer than 10 ns, the trigger conditions may be met, but may not be shown in the captured waveform. The trigger hairline, normally a dashed line, appears as a solid line when the trigger conditions occurred within a sample. To see the conditions causing the trigger, zoom in on the trigger hairline and capture another waveform. Zooming is described on page 13.

Investigate

■ Setting the Time/Div and Sample Period

HP LogicDart measures (samples) the input signal at specific
time intervals. This time interval is referred to as the sample
period. The sample period can range from 10 ns to 100 ms. The
sample period is set by changing the time/div setting before
capturing a waveform.

HP LogicDart captures 2048 samples per waveform. The sample
period used, therefore, determines both the resolution of the
waveform and the amount of time a waveform capture requires.

- At a 10 ns sample period (the shortest sample period), 20 μs
  of the input signal is captured and pulses as narrow as 10 ns
  may be captured.

- At a 100 ms sample period (the longest sample period),
  205 seconds of the input signal are captured, but pulses less
  than 50 ms wide may not be captured.

The time/div and sample period are shown in the display.
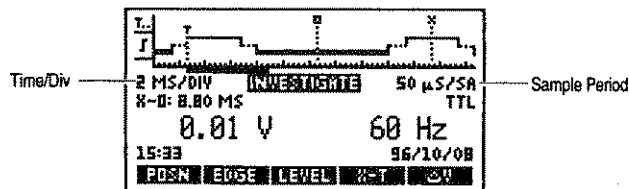
- The sample period used is based upon the time/div setting
  when the waveform is captured. To change the time/div and
  sample period:

  🔘 zooms in, sets a shorter time/div and a faster sample period.

  🔘 zooms out, sets a longer time/div and a slower sample period.
  If a waveform has been captured and displayed, these keys
  zoom in and out on the waveform but do not change the
  sample period until a new waveform is captured.

- You can use 🔘 to automatically determine the time/div and
  corresponding sample period and then capture a waveform. You
  must have the Channel 1 probe tip in contact with the circuit of
  interest. The time/div is set such that 5 to 12 transitions are
  shown in the display.

Viewing Waveforms

To capture a waveform, HP LogicDart makes a series of voltage measurements at the Channel 1 probe tip and compares the values obtained to the logic thresholds in use. The comparison is divided into one of three logic levels; high, tristate, or low. The waveform in the display is, therefore, a timing diagram of the input signal. The voltage comparisons are made at the sample rate.

- In the displayed waveform, the low logic level is shown as a thick line, the tristate is shown as a dashed line, and the high is shown as a thin line.

Voltage at or above high threshold

Voltage between high and low thresholds (tristate)

Voltage at or below low threshold
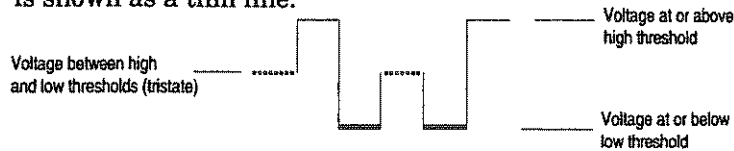
- The waveform shows dual threshold levels. Input voltages at or above the high threshold are shown as high levels and voltages at or below the low threshold are shown as low levels. The tristate level is indicated when the input signal is between the high and low thresholds. A voltage must be at the tristate level for more than one sample period to be shown as a tristate level.

High Threshold

Low Threshold

Input Signal

Samples

Displayed Waveform
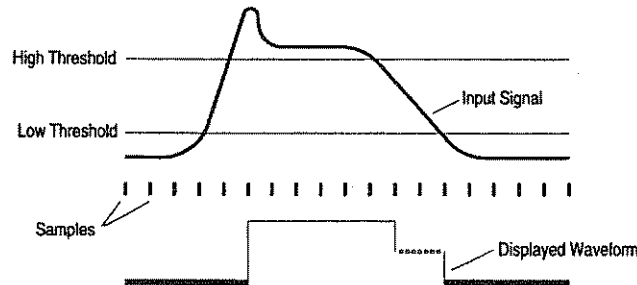
- A tolerance band exists below the high threshold and above the low threshold. An input signal value within a tolerance band can be displayed as either a logic level or a tristate level. For example, if an input signal level is in the high tolerance band, the logic level in the waveform can be either a high level or a tristate level. The width of the tolerance band depends upon the logic family used and is defined in the specifications on page 35.

High threshold — Tolerance Band

Tristate

Low threshold — Tolerance Band
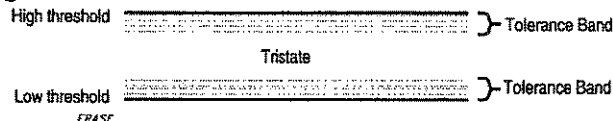
- Press (SHIFT) (STOP) [ERASE] to erase the waveform in the display and reset the X-cursor, O-marker, and trigger point hairline positions.

- A complete waveform may have many more points than are shown. To scroll the displayed waveform, change the position of the X-cursor. The X-cursor is always displayed (when the waveform is scrolled, the O-marker and trigger point may scroll out of the display). The following keys move the X-cursor and scroll the displayed waveform:

  ◁ and ▷ move the X-cursor left or right. When the X-cursor reaches the left or right edge of the display, the waveform scrolls.

  (SHIFT) ◁ and (SHIFT) ▷ move the X-cursor one screen to the left or right. When the X-cursor reaches the left or right edge of the display, the waveform scrolls.
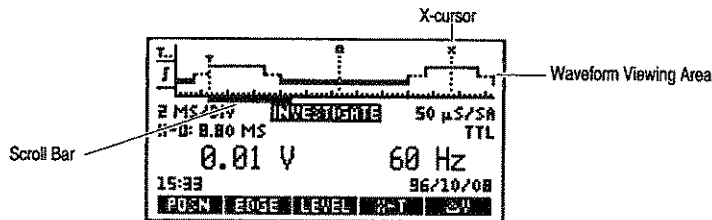
- The display contains a scroll bar to indicate what portion and how much of the waveform is shown in the display.

  The scroll bar width gives a visual indication of how many waveform points are being shown out of all waveform points captured. A small (narrow) scroll bar indicates that only a small portion of the captured waveform is being shown. When the scroll bar is as wide as the waveform viewing area, all of the captured waveform is being shown.

  The location of the scroll bar gives a visual indication of what portion of the captured waveform is being shown out of the entire waveform. The scroll bar changes position as the waveform is scrolled.

Measuring Time Along the Waveform

You may estimate the time between points along a waveform by using the scale below the waveform. The time/div shown in the display is the time span of the major division in the scale. Setting the time/div is described on page 13.

Alternately, you can make a more accurate time measurement using the X-cursor, O-marker, and trigger point.
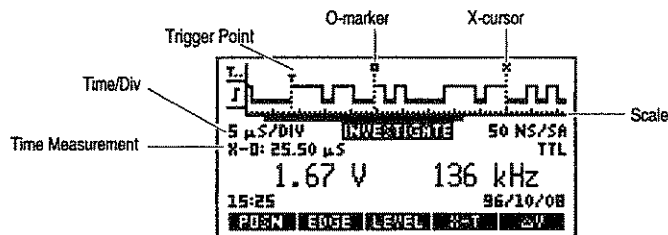
- Use three steps to measure time. First, move the X-cursor to a point of interest using ◁ and ▷. Then, move the O-marker to the X-cursor position with ☺. Finally, move the X-cursor to the next point of interest and read the time in the display. Use 🔍 to zoom in for a more precise measurement.

- The time measurement shown in the display indicates either the time from the X-cursor to the O-marker (X–O, *X minus O*) or the time from the X-cursor to the trigger point (X–T, *X minus T*).

    Press ▨▨▨ to change the time measurement to X-T. The menu key label changes to ▨▨▨.

- Use the following keys to move the X-cursor and O-marker:

    ◁ and ▷ move the X-cursor left or right (and scrolls the display).

    (SHIFT) ◁ and (SHIFT) ▷ move the X-cursor left or right one screen at a time (and scrolls the display).

    ☺ moves the O-marker to the X-cursor position.

    (SHIFT) ☺ moves the X-cursor to the trigger position.

- When you zoom in on a waveform, ◁ and ▷ move the X-cursor one sample at a time. When you zoom out on a waveform, ◁ and ▷ may move the X-cursor more than one sample at a time.

Analyze ⌖

Use Analyze to capture and view three waveforms simultaneously.
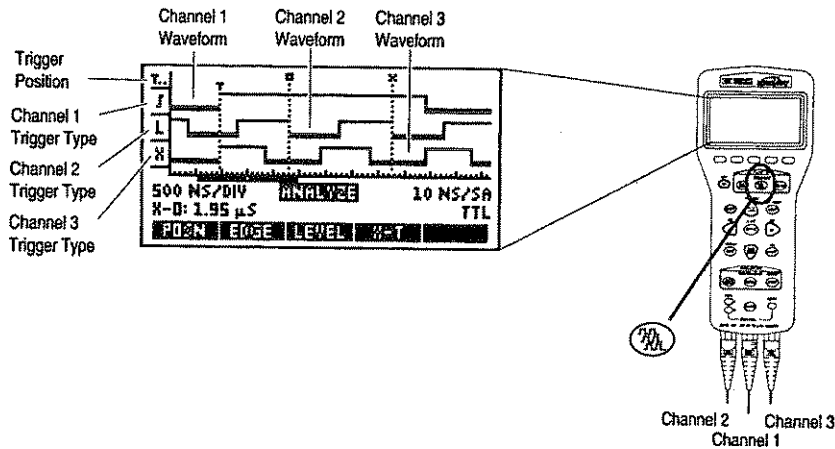
- In Analyze, you have more control over waveform triggering. You can set the trigger conditions for all three channels. Press **EDGE** or **LEVEL** to choose the trigger types, then select the channel for the trigger type using one of the **CH1**, **CH2**, or **CH3** menu keys. The trigger position and trigger types are described on page 12.

  You may set any combination of trigger types for all three channels, but *only one channel may use an edge trigger*. The trigger occurs when all three trigger types are met simultaneously. When you set a channel for edge trigger, any other channel set to edge trigger is automatically set to the don't care trigger type.

- All three waveforms use the same time/div. Setting the time/div is described on page 13.

  ⌖ automatically determines the time/div and sample period and captures the waveforms. The time/div value used is based upon the channel with the fastest signal. The time base is set such that 5 to 12 transitions of that channel are shown in the display.

Compare (SHIFT) (🔊)

English

Use Compare to view the differences between two Channel 1 waveforms. Compare a waveform captured from a known good circuit to other circuits under test.

A Channel 1 reference waveform is captured and held. Subsequent Channel 1 waveforms are compared to the reference waveform and any differences are shown as vertical lines or blocks.
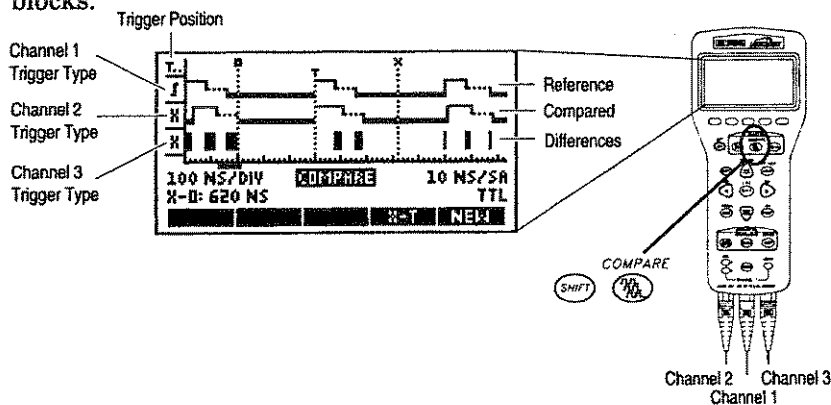
- The reference waveform is either the first waveform captured, or a previously saved waveform. Capturing waveforms is described on page 11. Saving and recalling waveforms are described on pages 21 and 22.

- You may use (🔊) to capture the reference waveform. Once the reference waveform is captured, pressing (🔊) will set only the time/div (and not the sample period) to a value that will show 5 to 12 transitions of the signal at the Channel 1 probe tip and then capture a compared waveform.

- To erase the reference waveform, press ▓▓▓. You can then capture a new reference waveform.

- To change the trigger position or trigger types, you must erase the reference waveform by pressing ▓▓▓. Change the trigger position or trigger types and then capture a new reference waveform.

- The reference and compared waveforms are captured at the Channel 1 probe tip. The Channel 2 and Channel 3 probe inputs are used for triggering only.

- Press **EDGE** or **LEVEL** to set the trigger types, then select the channel for the trigger type using one of the **CH1**, **CH2**, or **CH3** menu keys. The trigger position and trigger types are described on page 12.

  You may set any combination of trigger types for all three channels, but *only one channel may use an edge trigger*. The trigger occurs when all three trigger types are met simultaneously. When you set a channel for edge trigger, any other channel set to edge trigger is automatically set to the don't care trigger type.

- You can check a waveform's behavior over time using Compare. Capture a reference waveform and set continuous runs. The differences are updated for each waveform captured.

Continuity ⦿⊣⊢

Use Continuity to check circuits for opens and shorts. The circuit resistance is also shown.

Bar Graph

```
10Ω   100   1K   10K  100KΩ
        CONTINUITY
        15 kΩ
  ⦿))
  BEEP                    DIODE
```

Resistance

⦿))⊣⊢

Continuity LED ———— ◯
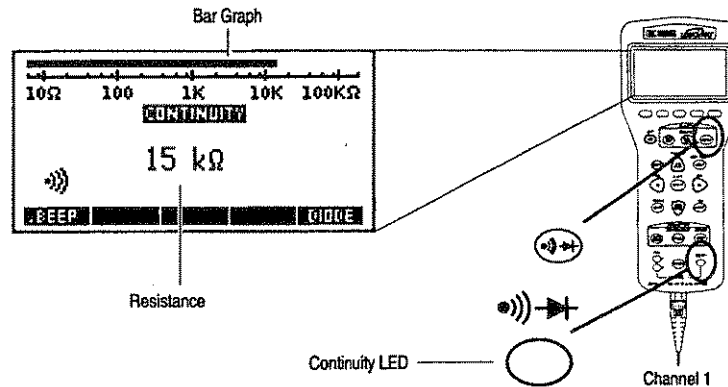
Channel 1

- Continuity is measured between the Channel 1 probe tip and ground. Channels 2 or 3 may be used to connect the ground (see page 5).

- The continuity LED is on and the beeper sounds whenever the measured resistance is below the continuity threshold (minimum 80 Ω).

- Press **BEEP** to turn the audio on or off. The symbol in the display changes to indicate the status of the audio.

- The measured resistance is shown on the bar graph and resistance scale. The resistance scale is logarithmic. Major tick marks are decades and minor tick marks are two units within the decade. The bar graph indicates resistance values between 6 Ω and 200 kΩ.

- Press **DIODE** to change the display to the diode check function. When a diode voltage drop (between 0.3 and 0.8 V) is detected at the channel 1 probe tip, the diode symbol is highlighted, the continuity LED is on, and the beeper sounds.

```
10Ω   100   1K   10K  100KΩ
          DIODE
  ⦿))     0.57 V
  BEEP                    CONT
```
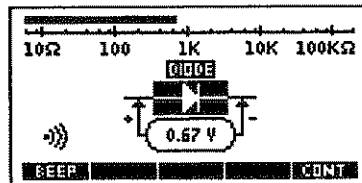
- Press **CONT** to return to the continuity check function.

Saving Waveforms ⟨SAVE⟩

You can save waveforms captured in Investigate, Analyze, or Compare. The trigger position, trigger type, and logic family used to capture the waveform are also saved.
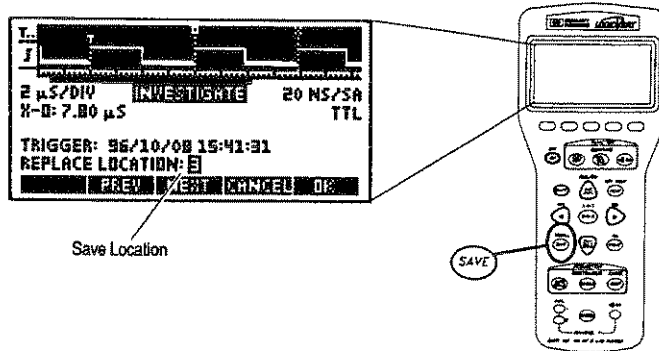
Save Location

- There are 10 waveform storage locations, numbered from 1 to 10. Press **NEXT** or **PREV** to select a storage location. When the desired location is selected, press **OK** to save the waveform and setup.

  Press **CANCEL** to leave the waveform save operation without making any changes. You will return to the application that was active when you began the save operation.

- If no waveform has been stored in the location selected, the message SAVE IN LOCATION: is shown. If a waveform has been stored in the location selected, the message REPLACE LOCATION: is shown and the waveform in that location is shown in inverse video.

- The trigger time and date are shown in the display to help you identify saved waveforms. If the saved waveform did not have a trigger, the time and date of the end of the waveform are shown.

- You can zoom and scroll previously saved waveforms to review or identify them (see pages 13 and 15).

- You can save a setup even if you have not captured a waveform. The trigger position, trigger types, and logic family can be saved with or without a waveform. You can recall these setups to use later.

- Press ⟨SHIFT⟩ ⟨STOP⟩ to clear a storage location.
  ERASE

Recalling Waveforms (SHIFT) (SAVE) *RECALL*

Once a waveform is saved (or a setup without a waveform), it can be recalled for use or for comparison.
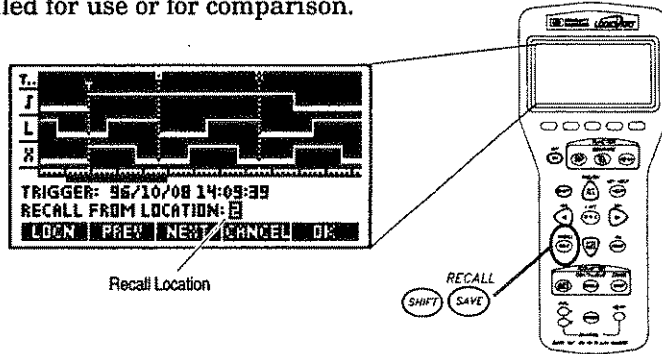
Recall Location

RECALL (SHIFT) (SAVE)

- There are 10 waveform storage locations, numbered from 1 to 10. Press **NEXT** or **PREV** to select a storage location. When the desired location is selected, press **OK** to recall the waveform and setup.

  Press **CANCEL** to leave the waveform recall operation without making any changes.

- The trigger time and date are shown in the display to help you identify saved waveforms. If the saved waveform did not have a trigger, the time and date of the end of the waveform are shown. If the saved waveform was saved from either Analyze or Compare, press **LOCN** to show the saved waveform time/div, sample period, time measurement, and logic family. Press **LOCN** again to return to the display of the trigger time and date and the location.

- Press (SHIFT) (STOP) to clear a storage location. *ERASE*

- If you recall a waveform while in Compare, the recalled waveform becomes the reference waveform. See the description on Compare beginning on page 18.

- When you recall a waveform in Investigate or Analyze, the trigger position, trigger types, and logic family are all recalled. Waveforms saved in Investigate are recalled to Investigate and waveforms saved in Analyze are recalled to Analyze (the application will change if necessary).

- If the saved waveform logic family is different than the one in use, you will be asked if you wish to erase the Investigate, Analyze, and Compare waveforms and change to the logic family of the recalled waveform.

System Setup ⊚

System Setup allows you to define global conditions for HP LogicDart. Settings are non-volatile (that is, settings remain in effect when the power is turned off and on).

```
·))) VOLUME: MEDIUM
     LOGIC MONITOR BEEP: OFF

JLU  TTL

 ⊙   96/10/08
     16:01:46           INTL ENGLISH

 ⊏⊐  LOGIC MONITOR. FREQUENCY: ON
     TURN OFF AFTER 5 MINUTES: YES
         PREV  NEXT  ABOUT  EXIT
```
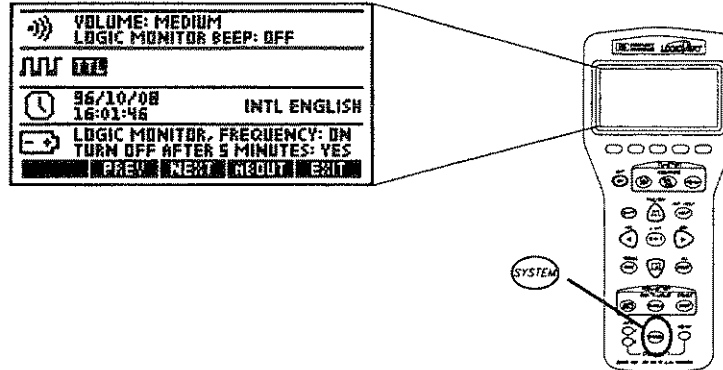
To use System Setup, move the highlight (white text on a black background) to the area of interest and then change the values for that setting. The Logic Family setting, TTL, is highlighted in the screen above.

- The following keys move the highlight:

  Ⓤ or Ⓓ move the highlight up or down one line.

  ◁ or ▷ move the highlight left or right.

- When a setting is highlighted, use the menu keys to change the setting. For example, with the Logic Family field highlighted, press **NEXT** or **PREV** to change the Logic Family. When you have made your choice, either move the highlight or leave System Setup.

- When you leave System Setup, HP LogicDart saves any changes you made. Press **EXIT** to leave System Setup.

Setting	Use to ...	Choices (bold indicates default)
Volume	Set the volume for all beeps.	OFF SOFT **MEDIUM** LOUD
Logic Monitor Beep	Turn on or off the logic monitor beeps.	**ON** OFF
Logic Family	Set the logic thresholds in use. Logic thresholds are fixed for defined logic families. [1] USER 1 and USER 2 logic families allow you to set your own thresholds.	**TTL** 5V CMOS 3.3V CMOS ECL USER 1 USER 2
Logic Thresholds [2]	Set your own logic thresholds when the logic family is set to either USER 1 or USER 2.	+8.20 V to – 8.20 V
Time	Set the system time. The time is shown in the display, saved with waveforms and included on printed waveforms.	0 to 23 (Hour) 0 to 59 (Minute) 0 to 59 (Second)
Date [3]	Set the system date. The date is shown in the display, saved with waveforms and included on printed waveforms.	1 to 31 (Day) 1 to 12 (Month) 96 to 95 (Year) (1996 to 2095)
Language	Set the language in all displays and the help system. This also sets how the date format and numbers are displayed.	**ENGLISH** INTL ENGLISH DEUTSCH FRANCAIS ESPAÑOL ITALIANO
Logic Monitor, Frequency	Turn on or off the logic monitor and frequency display. Set to OFF to prolong battery life.	**ON** OFF
Turn Off After 5 Minutes	Control the automatic turn-off feature (battery operation only). Set to YES to prolong battery life.	**YES** NO

[1] Predefined logic thresholds:
  5V CMOS (H = 4.50 V, L = 0.50 V), ECL (H = –1.00 V, L = –1.60 V)
  3.3V CMOS (H = 2.40 V, L = 0.40 V), TTL (H = 2.40 V, L = 0.40 V)

[2] USER 1 and USER 2 logic thresholds have the following characteristics:
  The high threshold must be greater than the low threshold by 0.50 V.
  The tristate voltage is the average of the high and low threshold values
  and must be between –3.50 V and +6.80 V.

[3] The order of the date settings change with the language selected.

Printing (PRINT)

You can print portions of a waveform or entire waveforms using the infrared LED port. Use an HP 82240B Thermal Printer.
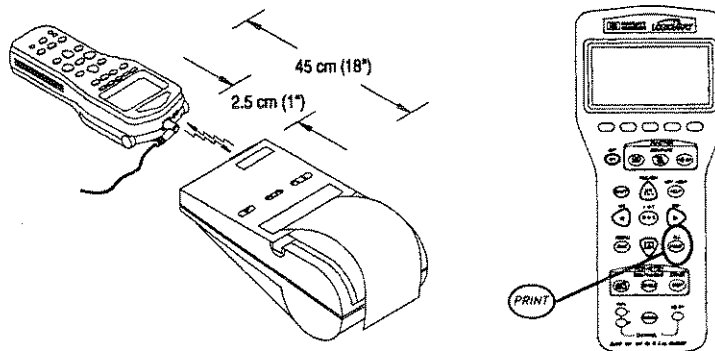
- Use the following keys for printing:

  (PRINT) prints the waveform or waveforms as shown in the display.

  (SHIFT) (PRINT) prints the entire waveform or waveforms.

  (STOP) stops a print in progress.

- Printing the entire waveform may take several minutes. You should use an ac adapter when printing entire waveforms.
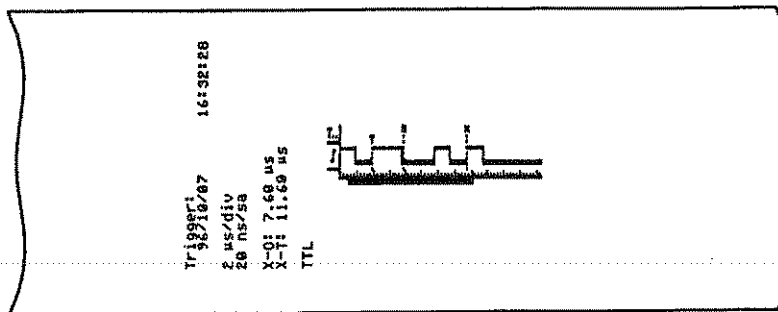
LED Safety   CLASS 1 LED Product
Do not attempt to make any adjustment to the unit.
Avoid direct eye exposure to the infrared LED beam.
Be aware that the LED beam is invisible and cannot be seen.
Do not attempt to view the infrared LED beam with any type
of optical device.

On-line Help (HELP)

You can obtain help on all messages, settings, keys, and menu keys.

YOU CAN USE ᴢᴏᴍᴇᴅᴀᴀᴛ's CHANNEL 1
INPUT TO SEE DC VOLTAGE, FREQUENCY,
LOGIC ACTIVITY, AND THE WAVEFORM.

ᴢᴏᴍᴇᴅᴀᴀᴛ SHOWS "OPEN" WHEN YOU
ARE NOT PROBING A CIRCUIT.
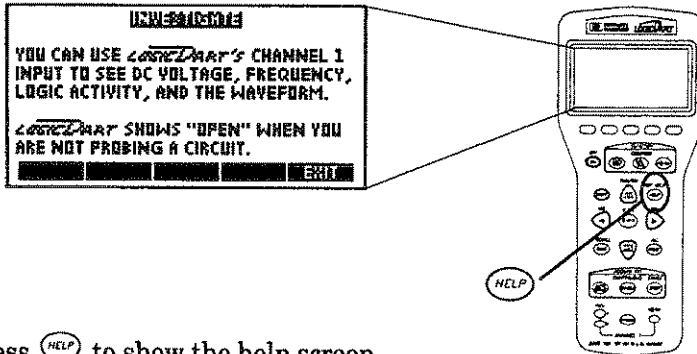
- Press (HELP) to show the help screen.

  In an application (Investigate, Analyze, Compare, or System Setup), help for the application is shown.

  If a message is in the display when you press (HELP), help for the message is shown.

  If a setting is highlighted when you press (HELP), help for that setting is shown.

- Press (SHIFT) (HELP) to show help for keyboard keys.

- Press **EXIT** to leave the help system and return to the application.

Power Supplies

Batteries contain toxic and harmful chemicals. Use properly marked containers and approved collection procedures to dispose of used batteries

Battery Replacement

When the batteries are getting low, the message

THE BATTERIES ARE LOW !

is shown in the display and the battery symbol will blink. Replace the batteries using the following procedure.

1. Turn HP LogicDart off.

2. Disconnect the input probes.

3. Connect the ac adapter (see page 29).

4. Replace the batteries, as shown below.

You can replace the batteries without using the ac adapter if you perform the replacement within about 45 seconds. If your batteries are completely dead, or if you take longer than 45 seconds to replace the batteries, you will have to reconfigure your system setup and will lose all displayed and saved waveforms. System setup is described on page 24.

3 x 1.5 V AA
Alkaline or Lithium
(R6/LR6/FR6/15LF)
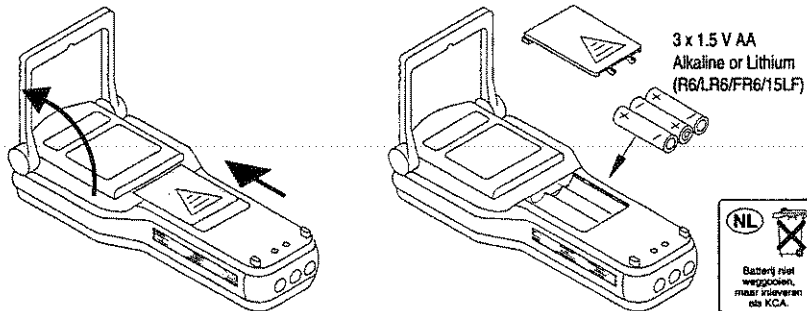
HP LogicDart calibration is not affected by dead batteries or the battery replacement procedure.

Maximizing Battery Life

The battery life depends upon a number of factors.
Maximum battery life can be obtained through the following:

- Use the ac adapter for continuous waveform captures whenever possible.

- Set the LOGIC MONITOR, FREQUENCY setting to OFF. This turns off the logic monitor and frequency display (see page 25).

- Set the TURN OFF AFTER 5 MINUTES setting to YES. If no waveform or keyboard activity is detected after 5 minutes, HP LogicDart will turn off to preserve batteries (see page 25).

- Use the ac adapter for printing operations. In particular, do not print ALL when using the batteries (see page 26).

- Remove the batteries before prolonged storage (all waveforms and setups will be lost).

Using the AC Adapter

The provided ac adapter provides enough power to run HP LogicDart, but does not recharge the batteries. When the ac adapter is connected to HP LogicDart and supplying power, the batteries are not used. Additionally, when operating with the ac adapter, HP LogicDart will *not* automatically turn off after 5 minutes, even if the TURN OFF AFTER 5 MINUTES field is set to YES (see page 25).

AC Adapter

HP Part Number	Country
9100-5557	U.S. (120 Vac, 60 Hz)
9100-5558	Europe (230 Vac, 50 Hz)
9100-5559	UK (230 Vac, 50 Hz)
9100-5560	Japan (100 Vac, 50–60 Hz)
9100-5561	Australia (240 Vac, 50 Hz)
9100-5562	South Africa (230 Vac, 50 Hz)
9100-5181	Taiwan (ROC) (120 Vac, 60 Hz)
9100-5182	China (PRC) (240Vac, 50Hz)
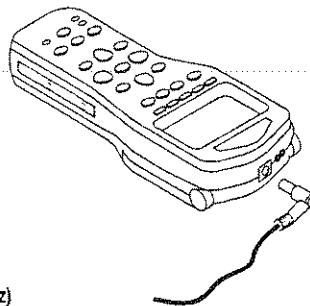
Calibration

Calibration Procedure

Periodic calibration and adjustment is required to maintain the accuracy of HP LogicDart. Calibration and adjustment should be performed at least once per year. To maintain the specifications listed on page 35, Hewlett-Packard recommends that calibration and adjustment be performed at 23 °C ± 5 °C at < 80% RH, non-condensing.

Use the ac adapter while performing these tests.

Use the following procedure:

1. Perform the Functional Verification Tests (see page 31).

2. Perform the Performance Verification Tests (see page 32) to characterize HP LogicDart relative to the specifications on page 35.

3. Perform the Adjustment (see page 33) if needed.

4. Perform the Performance Verification Tests (see page 32) to verify any adjustments made.

Equipment Required

Equipment	Used for ...	Required Specifications
Voltage Reference	Self-Test Performance Verification Adjustment	6 V to 7 V 10 V to 35 V ± 0.01%
Resistance Reference	Performance Verification Adjustment	Short, 10 kΩ, 100 kΩ ± 0.1%
Signal Source	Performance Verification	33 MHz Square Wave 4 V p-p, + 2.5 V offset < 3 ns transition time, ± 1% voltage accuracy ± 0.01% frequency accuracy
Probe Kit	Self-Test Performance Verification Adjustment	
AC Adapter	Self-Test Performance Verification Adjustment	See page 29

Functional Verification (Self-Test)

Functional Verification consists of a series of built-in self-tests. You can run one or more specific self-tests if you suspect HP LogicDart is not working properly. To perform a complete Functional Verification, perform all the self-tests.

- (ON)(SYSTEM) shows the self-test display. Hold down the (ON) key and press (SYSTEM).

```
RUN 9 TESTS      EEPROM
ROM              CH RAM
RAM              CH 123
CLOCK            VOLTMETER
IR               CONTINUITY
LCD              KEYBOARD
LED              AC ADAPTER
BEEP             CALIBRATION

                          EXIT
```
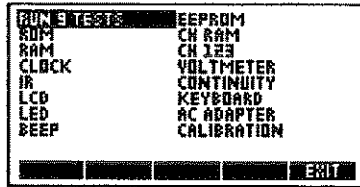
- Use (▣), (▣), (◁), and (▷) to select a test to run. The first test, RUN 9 TESTS, will perform the first 9 self-test procedures (ROM to CH RAM). The first 9 tests do not require user inputs.

  (SINGLE) begins the selected test procedure.

  (SHIFT) (SINGLE) repeats a test procedure indefinitely.

  (STOP) stops a continuous self-test.

- Observe HP LogicDart as the following tests are performed: LCD (all columns and rows in the display turn on), LED (all LEDs light), and BEEP (different frequencies and volumes). These tests report DONE when complete.

- Tests 10 through 14 require user input. Follow the instructions in the display.

- Self-test results are shown in the display as each test is completed. Some self-test procedures can take several seconds to complete.

- Press **EXIT** to leave the self-test display.

Note: The CH 123 self-test checks the measurement hardware and the Channel 1 probe. All three probes must be connected during the CH 123 test. To perform a complete functional test, run the CH 123 test with each probe connected to the Channel 1 input. If the CH 123 self-test reports FAIL 1, change the Channel 1 probe and try the test again. If the test passes, replace the probe that failed the test.

For assistance with failing self-test results, call 1-800-452-4844 in the United States, or contact your nearest Hewlett-Packard Sales Office.

Performance Verification

Performance verification gives a high degree of confidence that
HP LogicDart is operating correctly and meets specifications.

For steps 14 through 17, be sure to use good high-frequency connection
techniques (i.e., minimum-length ground leads and proper signal source
termination). You may need to construct a test fixture to connect all
three probes in parallel to the reference voltage and signal source.

Performance Verification Procedure

Step	Input	HP LogicDart Setup	Logic Family	Trigger Conditions	Verify
1	Short Channel 1	Continuity ⊲⊶			0.00 kΩ to 0.01 kΩ
2	10 kΩ Channel 1				9.7 kΩ to 10.3 kΩ
3	100 kΩ Channel 1				91 kΩ to 109 kΩ
4	Short Channel 1	Investigate	ECL		–0.02 V to 0.02 V
5			5V CMOS		–0.02 V to 0.02 V
6			TTL		–0.02 V to 0.02 V
7	+ 30 Vdc Channel 1				29.86 V to 30.14 V
8	+ 0.4 Vdc Channel 1 Channel 2 Channel 3	Analyze Time/div = 1 µs Press CONTINUOUS SHIFT SINGLE		T..	All three waveforms show a low level
9	+ 2.4 Vdc Channel 1 Channel 2 Channel 3				All three waveforms show a high level
10	–1.6 Vdc Channel 1 Channel 2 Channel 3		ECL		All three waveforms show a low level
11	–1.0 Vdc Channel 1 Channel 2 Channel 3				All three waveforms show a high level
12	+ 0.5 Vdc Channel 1 Channel 2 Channel 3		5V CMOS		All three waveforms show a low level
13	+ 4.5 Vdc Channel 1 Channel 2 Channel 3				All three waveforms show a high level

Step	Input	HP LogicDart Setup	Logic Family	Trigger Conditions	Verify
14	33 MHz square wave 4 V p-p	Analyze (ഇ) Time/div = 10 ns	5V CMOS	T.. X	All three waveforms show high and low levels
15	+ 2.5 V offset Channel 1 Channel 2 Channel 3	Investigate (ഇ) Press (STOP)		X X	32.9 MHz to 33.1 MHz
16		Analyze (ഇ) Press CONTINUOUS (SHIFT) (SINGLE)		For each trigger type shown below...	Trigger found immediately ("WAITING FOR TRIGGER" message does not occur)

Trigger Types	Step 16														
Channel 1	∫	1	∏	H	L	X	X	X	X	X	X	X	X	X	X
Channel 2	X	X	X	X	X	∫	1	∏	H	L	X	X	X	X	X
Channel 3	X	X	X	X	X	X	X	X	X	X	∫	1	∏	H	L

Step	Input	HP LogicDart Setup	Logic Family	Trigger Conditions	Verify
17	Open Channel 1 Channel 2 Channel 3	Analyze (ഇ) Press CONTINUOUS (SHIFT) (SINGLE)	5V CMOS	T.. X X X	All three waveforms show a tristate level

Adjustment

You should verify any adjustments made using the performance verification procedure (see page 32).

The following table shows the adjustments, the required input/reference, and the acceptable measurement limits.

Adjustment Procedure	Reference Needed	Limits After Adjustment
Zero Adjustment	Short	± 0.004 V
Logic Threshold Gain	6 V to 7 V	Input ± 0.02 V
DC Voltage Gain	10 V to 35 V	Input ± 0.01 V
Resistance Gain	9 kΩ to 11 kΩ	Input ± 0.1 kΩ

Adjustment Procedure

You should verify LogicDart's performance before and after performing the adjustment procedures. Verification procedures begin on page 32.

1. (ON)(SYSTEM) shows the self-test display. Hold down the (ON) key and press (SYSTEM) (see page 31).

2. Press (⟲) to highlight CALIBRATION. Press (SINGLE) to begin.

```
THESE ADJUSTMENTS WILL CHANGE
LogicDart's ACCURACY.

FOR PROPER CALIBRATION, YOU SHOULD
VERIFY LogicDart's PERFORMANCE
AGAINST ITS SPECIFICATIONS BEFORE
AND AFTER THESE ADJUSTMENTS. SEE
THE USER'S GUIDE FOR DETAILS.
                           CANCEL
```

Note: Press CANCEL to return to the self-test screen.

3. To begin the adjustment procedure, press (ON)(◀▶)(AUTO SCALE) (press all three keys at the same time).

4. The first adjustment procedure is the Zero Adjustment. Make the connections shown in the display and press OK. A message in the display indicates when HP LogicDart has completed its internal adjustment. Press OK. The Zero Adjustment will take approximately 20 seconds to complete.

5. Once the Zero Adjustment is complete, the Logic Threshold Gain, DC Voltage Gain, and Resistance ∞ and Gain procedures are available. Use (⟲) and (⟳) to select each procedure and (SINGLE) to begin the selected procedure. Make the connections shown in the display. Use the menu keys to enter the reference input value that is highlighted in the display (not required for Resistance ∞). Press OK to make the adjustment. A message in the display indicates when the adjustment has completed. Verify the adjusted value against the limits shown in the table on page 33. Press OK. Some adjustment procedures can take up to 20 seconds to complete.

After any adjustment procedure, you may press BACK to perform the adjustment again.

Press CANCEL to quit the adjustment procedure.

The acceptable limits for any adjustment are shown in the table on page 33. If an adjustment does not produce results within the limits shown, or if the message "ADJUSTMENT OUT OF RANGE" is shown, HP LogicDart may need repair.

When all adjustment procedures have been completed, press EXIT to return to the self-test display and EXIT again to leave the self-test display and return to normal operation.

Calibration

Specifications (One Year)

Input Characteristics (all channels)

1 MΩ, ≈13 pF, maximum 40 V to ground

DC Voltage (3½ digit)

Accuracy:	± (0.5% of reading + 2 counts)§ at 23 °C ± 5 °C
Range:	± 35.00 V
Temperature Coefficient:	Accuracy x 0.1/°C (for DC Voltage and Resistance) (0 °C to 18 °C, 28 °C to 55 °C)

Resistance

Accuracy:	0.00 kΩ to 1.19 kΩ: ± (1.5% of reading + 1 count)
	1.2 kΩ to 11.9 kΩ: ± (2.0% of reading + 1 count)
	12 kΩ to 120 kΩ: ± (7.9% of reading + 1 count)

Continuity

Threshold:	80 Ω minimum, 140 Ω typical

Frequency

Accuracy:	± (0.1% of reading + 1 count)
Display:	1 Hz to 9 Hz: one digit
	10 Hz to 99 Hz: two digits
	100 Hz to 33.0 MHz: three digits

Logic Monitor

Sample Rate:	100 MSa/s
States:	high, low and tristate indicators†
Glitch Detect:	≥15 ns

Timing Analyzer

Maximum Sample Rate:	100 MSa/s
Number of Channels:	3
Number of Samples:	2048 per channel
Triggering Modes:	Edge, pattern, edge/pattern combination
Trigger Glitch Detect:	≥15 ns
Minimum Input:	0.50 V p-p
Time Base Range:	10 ns/div to 20 s/div
Cursor Accuracy:	± (1 sample period + 2 ns + 0.1% of reading)
Dual Threshold Range:	± 8.20 V
Dual Threshold Accuracy:	

	High		Low	
Logic Family	Min	Max	Min	Max
TTL, 3.3V CMOS	1.65 V	2.40 V	0.40 V	1.52 V
5V CMOS	3.23 V	4.50 V	0.50 V	1.84 V
ECL†	−1.50 V	−1.00 V	−1.60 V	−1.11 V
USER 1, USER 2	High − e‡	High	Low	Low + e‡

† tristate is not defined for the ECL logic family.
‡ e = 0.2 x (High − Low) + 0.43
(high and low threshold will never overlap for the same channel)
§ For USER 1 and USER 2: ± (0.5% of reading + 5 counts).

English

Specifications (continued)

Power Supply

Battery:	3 x 1.5 V AA alkaline (R6/LR6) or AA lithium batteries (FR6/15LF)
Battery Life:	15 to 20 hours typical for alkaline batteries (depending on use)
AC Adapter	Included (see page 29)

Physical

|	
Dimensions:	8.9 cm x 19.8 cm x 3.8 cm (3.5 in x 7.8 in x 1.5 in)
Weight:	0.4 kg (12 oz)

Operating Environment

Full accuracy from 0 °C to 55 °C
Full accuracy to 80% RH (non-condensing) at 30 °C

Storage Environment

-40 °C to 65 °C

System Reset

Occasionally, you may wish to return
HP LogicDart to a known starting condition.
Reset does not affect calibration, language,
time or date settings. Reset does erase all
saved and displayed waveforms and returns
HP LogicDart to the conditions indicated in
bold in the table on page 25.
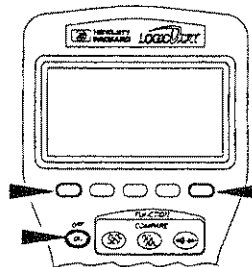
- Press the three keys shown at the same time to reset HP LogicDart.

Accessories

The following accessories are available for use with HP LogicDart.
In the U.S., contact HP DIRECT at 1-800-452-4844 to order.

	HP Order Number	Description
Probe Kits	E2320A	Assembled probe with browser. Includes: 1 probe, 1 browser, 1—30.5 cm (12 in) ground lead, and 1 grabber
	E2321A	Replacement probe (one)
	E2322A	Probe accessory kit. Includes: 1 browser, 3—30.5 cm (12 in) ground leads, 6—10.2 cm (4 in) ground leads, 4 grabbers, 6 contact pins, 6 ground extenders, and 3 browser replacement pins
Printer	HP 82240B	Thermal printer
	HP 82175A	Thermal printer paper (6 rolls)

Limited Three Year Warranty

What Is Covered
HP LogicDart is warranted to you, the original purchaser, by Hewlett-Packard against defects in materials and workmanship for three years from the date of original purchase. If you sell your unit or give your unit as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original three year period. During the warranty period, we will repair, or, at our option, replace your unit at no charge, a product that proves to be defective, provided you return the product, shipping prepaid, to a Hewlett-Packard service center.

What Is Not Covered
This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than an authorized Hewlett-Packard service center.

No other express warranty is given. The repair or replacement of a product is your exclusive remedy. ANY OTHER IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE THREE YEAR DURATION OF THIS WRITTEN WARRANTY. Some states, provinces, or countries do not allow the exclusion or limitation or incidental or consequential damages, so the above limitation or exclusion may not apply to you.

The warranty gives you specific legal rights, and you may also have other rights which vary from state to state, province to province, or country to country.

Service

Hewlett-Packard maintains service centers in many countries throughout the world. You may have your unit repaired at a Hewlett-Packard service center any time it needs service, whether the unit is under warranty or not. There is a charge for repairs after the warranty period. Repair or replacement during the first 30 days after purchase will be provided by the sales channel. After 30 days, contact the nearest service office.

Express Exchange Service (U.S. only)
You can receive a replacement HP LogicDart via overnight shipment for a short downtime. Before you call, have ready: your shipping address, a credit card number, and the serial number of the failing HP LogicDart. Call 1-800-258-5165 and ask for "Express Exchange".

Mail-In Exchange
You may also have your HP LogicDart repaired or replaced by sending your unit to:
> Hewlett-Packard Company
> Instrument Repair Coordinator
> 815 14th Street S.W.
> Loveland, CO 80537
> Telephone: (970) 679-2881

Service