HEWLETT PACKARD

PCInstruments

Owner's Guide

HP 61015A Universal Counter

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PC Instruments Universal Counter (61015-90001)

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■ Are the concepts and wording easy to understand?	Yes	No
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Notice

Printing History

New editions of this manual will incorporate all material since the previous edition. Update packages, which may be issued between editions, contain replacement and additional pages to be merged into the manual by the user.

The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.)

The instrument prefix number alongside the date refers to the first part of the serial number on the bottom of the instrument. This number indicates the version of the instrument that was available at the time that this manual was issued. However, note that, many instrument updates do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one to one correspondence between instrument changes and manual updates.

Edition 1....April 1985....Instrument Prefix 2506A

Safety Summary

The following safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard assumes no liability for the customer's failure to comply with these requirements.

Ground the Instrument

To avoid potentially hazardous electrical shock, establish a safety ground before connecting user's circuits. Connect the output cable from the Power Pack to the Universal Counter, and then connect the line cord from the Power Pack to the ac line. Detailed instructions are in the HP PC Instruments System Owner's Manual.

Safety Symbols

Instruction manual symbol: the product will be marked with this symbol when it is necessary for you to refer to the manual (see What's in this Manual?)

Indicates measuring earth (ground) terminal.

WARNING

The WARNING sign calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

What's in this Manual

This manual is a supplement to the PC Instruments System Owner's Manual. It contains specific information for your Hewlett-Packard Universal Counter, Model 61015A. **You must read the System Owner's Manual before you read this manual!** Warranty and service information is included in the Support Guide supplied with your System Owner's Manual.

The System Owner's Manual discusses information that is common to all PC Instruments. It also contains specific information about your computer and PC Instruments system. If you are a first-time user, refer to Table 3 in your System Owner's manual for the proper reading sequence of your computer and PC Instruments manuals. Experienced users who already have an installed PC Instruments System need only read this manual to learn how to operate and program the Universal Counter.

Please insert this manual in the same hardcover binder as your System Owner's Manual. Here is a brief description of the contents of each chapter in this manual:

Chapter 1- Product Description
Briefly describes the Universal Counter, gives its specifications, and lists the items that you receive with it.

Chapter 2 - Trying Out Your Instrument
Gives simple step-by-step instructions that let you *quickly* perform some operations with nothing connected to the front panel.

Chapter 3 - Manual Instrument Control
Gives detailed operating information not covered in the simplified instructions of Chapter 2.

Chapter 4 - Front Panel Connections

Explains how to connect the Universal Counter to your application.

Chapter 5 - Programming with BASIC

Describes how to control the Universal Counter with a program. All program statements for the Universal Counter are described. A simple programming example is also included.

Appendix A - Programming Statement Summary

Lists all programming statements that apply to the Universal Counter.

Appendix B - Verification and Calibration

Describes verification and calibration procedures that you can use to verify the proper operation of the Universal Counter if you suspect an instrument malfunction.

Appendix C - Error Messages

Lists all error messages that apply to the Universal Counter.

1 Product Description

Introducing The HP PC Instruments Universal Counter

The HP PC Instruments Universal Counter is an Instrument that measures common time-dependent characteristics of input waveforms. The instrument is controlled by a computer equipped with PC Instruments software and an interface card. The System Owner's Manual tells you all you need to know about the required software and interface card for your computer. Chapters 2 and 3 of this manual explain how to operate the Universal Counter "manually" using the Soft Front Panel (computer display) while Chapter 5 describes programming statements you can use to control it from BASIC.

Figure 1-1 is a block diagram of the basic functions of the Universal Counter. The Universal Counter decodes commands from your computer, measures the input waveform, and then returns the 8-digit measurement value back to the computer. The Counter has seven measurement functions:

Frequency · measures the frequency of a repetitive input signal using the selected range.

Auto-Frequency · measures the frequency of a repetitive input signal by automatically selecting the range.*

Period · measures repetitive waveforms using a selected number of cycles.

Auto-Period · measures the period of the input signal by automatically selecting the number of cycles to sample.*

Interval · measures the time interval between two events.

Ratio · measures the ratio between the two input frequencies (INPUT A/INPUT B).

Totalize counts up to 99,999,999 events.

* The AUTO functions require a repetitive waveform of at least 1.5 second duration. The measurement is taken using a reciprocal counting technique.

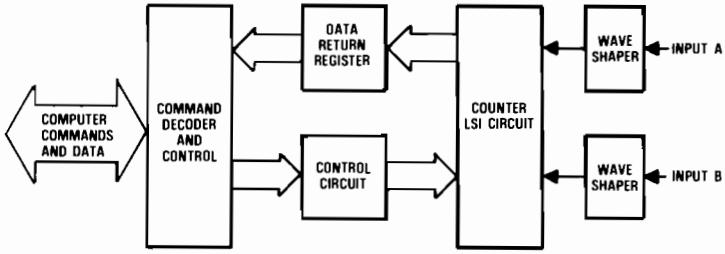

Figure 1-1. Block Diagram Of The Universal Counter

The Counter has two AC coupled inputs called INPUT A and INPUT B. The primary input is INPUT A because it is used for all measurements and has 100 MHz bandwidth. INPUT B is used only for time interval and ratio measurements. For each input, you can select the slope (positive or negative) that will trigger the Counter. Selecting positive slope will cause the Counter to trigger on the low-to-high transition of the input waveform. Selecting negative slope causes the Counter to trigger on the high-to-low transition. When performing interval measurements, the input source can be selected (common or separate). Selecting "common" allows you to measure the time interval between two transitions of INPUT A. Selecting "separate" allows measurement of the interval between one transition on INPUT A and another transition on INPUT B.

Unlike the operation of most other electronic measurement instruments, use of a counter presupposes that you know something about its input signal characteristics before you try to measure it. For this reason, it is preferable to inspect the signal with an oscilloscope before connecting it to the Counter. Important characteristics to look for are: amplitude, frequency, distortion, and slope to use for counting. These characteristics must all be within the specifications of the Counter in order to take an accurate measurement. Signal distortion is of particular interest because distorted input signals can cause unexpected results. For example, referring to Figure 1-2 you can see how aberrations at points 1 and 2 will cause the Counter

to count twice instead of once. If the Counter were measuring frequency, the measurement would be twice as large as the actual signal frequency. Likewise, if the Counter were measuring some other function (period, interval, etc.) the result would also be incorrect.

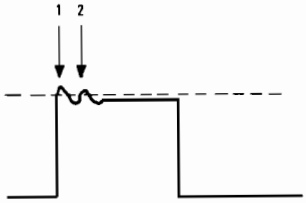

Figure 1-2. Signal Aberrations

When using the Counter, also keep in mind that the input signal only has to be repetitive for the duration of the measurement. (This duration is called the gatetime.) Figure 1-3 shows an example of a "good" measurement and a "bad" measurement. The principle is the same whether you are measuring frequency, period, or time interval.

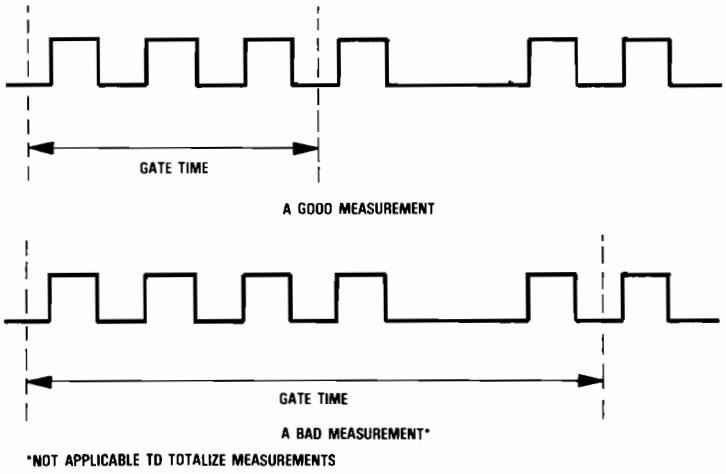

Figure 1-3. Frequency, Period, and Interval Measurements

Items Supplied

In addition to this manual, check that you have received the following items with your Universal Counter:

Power Pack - an ac power transformer with an attached one metre cable. The transformer type you received was determined by the available ac voltage in your country. Chapter 2 of the System Owner's Manual lists the different types and their part numbers.

Power Cord - connects the Power Pack to an ac source. Plug type was determined by the country of destination. Chapter 2 of the System Owner's manual lists types and part numbers.

Instrument Interconnect Cable ( ) - connects your instrument to the system interface. Refer to the System Owner's Manual for its installation.

Owner's Manual Update Pages - if applicable, updated pages are included. Replace the obsolete pages with the new ones before you use this manual.

Table 1-1. Specifications

Sensitivity:

INPUT A:

35 mV rms 10 Hz to 100 MHz

75 mV p-p, min. pulse width 5 ns (10 Hz to 100 MHz Range)

75 mV p-p, min. pulse width 50 ns (10 Hz to 10 MHz Range)

INPUT B:

35 mV rms 10 Hz to 2.5 MHz

75 mV p-p, min. pulse width 200 ns

Input Coupling:

ac on both Inputs.

Table 1-1. Specifications (Continued)

Input Impedence:
1M (nominal) shunted by 30 pf

Recommended Input Voltage Level:
10 Hz to 850 kHz ≤ 42.5 volts (AC peak + DC):

850 kHz to 5 MHz: $\frac{2.5 \times 10^7 \text{ Vrms Hz}}{\text{Input Frequency}}$

5 MHz to 100 MHz: 5 Vrms

Input Damage Voltage:
INPUT A or INPUT B to ground:
10 Hz to 100 kHz: 350 volts (AC peak + DC)

100 kHz to 5 MHz: $\frac{2.5 \times 10^7 \text{ Vrms Hz}}{\text{Input Frequency}}$

Greater than 5 MHz: 5 volts rms.

Frequency (INPUT A):
Ranges:
10 Hz to 10 MHz (LSD=10 Hz with 0.1 sec gate time)
10 Hz to 10 MHz (LSD=1 Hz with 1 sec. gate time)
10 Hz to 10 MHz (LSD=0.1 HZ with 10 sec. gate time)
10 Hz to 100 MHz (LSD=100 Hz with 0.1 sec. gate time)
10 Hz to 100 MHz (LSD=10 Hz with 1 sec. gate time)
Resolution: ± LSD
Accuracy: ± LSD ± (timebase error in ppm) × frequency

Auto-Frequency (INPUT A):
Range:
10 Hz to 100 MHz
0.1 mHz to 10 Hz depending on input frequency.
Resolution: ± LSD
Accuracy: ± LSD ± (timebase error in ppm) × frequency

Table 1-1. Specifications (continued)

Period (INPUT A):
Range:
400 ns to 0.1 sec.
Number of cycles of averaging (N) can be selected from 1 to 1000.
LSD = 100 ns when 1 cycle is sampled
LSD = 10 ns when 10 cycles are sampled
LSD = 1 ns when 100 cycles are sampled
LSD = 0.1 ns when 1000 cycles are sampled
Resolution: ± LSD
Accuracy: ± LSD ± 1.4 × [(trigger error)/N]
± (timebase error in ppm) × period

Auto-Period (INPUT A):
Range:
10 ns to 0.1 sec.
LSD = 0.1 picoseconds to 10 nanoseconds depending on period of input signal.
Resolution: ± LSD
Accuracy: ± LSD ± 1.4 × [(trigger error)/N]
± (timebase error in ppm) × period

Time Interval (INPUT A and INPUT B):
Range:
250 ns to 10 sec
LSD = 100 ns
Resolution: ± 100 ns
Accuracy: ± 100 ns ± (''start'' trigger error)
± (''stop'' trigger error)
± (timebase error in ppm) × (actual time interval)

Frequency Ratio:
Range (INPUT A):
10 Hz to 10 MHz (LSD = 1 part in (A/B) × N)
10 Hz to 100 MHz (LSD = 1 part in (A/B) × N × 0.1)
Range (INPUT B):
10 Hz to 2.5 MHz
Resolution: ± 1 LSD

Frequency Ratio (Cont'd):

Accuracy: ± (one count of A)
± [(B trigger error) × (frequency of A)] / N
where N is the number of cycles of averaging for INPUT B. N may be selected in 1 to 1000 in decade steps.

Totalize(INPUT A):
Range: 10 Hz to 10 MHz (LSD = 1 count)
10 Hz to 100 MHz (LSD = 10 count)
Resolution: ± LSD

Time Base:
Frequency: 10 MHz
Error: ± 10 ppm
Aging: ± 3 ppm (1st year)
± 2 ppm (after 1st year)

Speed:
0.1 to 10 readings per second (System limit with MEASURE statement)

General:
Trigger Error:

$$\frac{(80\ \mu V)^2 + e_n^2}{\text{input slew rate at trigger point } (\mu V/s)}$$

where e_n is the rms noise of the input for a 100 MHz bandwidth in INPUT A and 10 MHz bandwidth in INPUT B.

Operating Temperature Range:
0 °C to +40 °C

Storage Temperature Range:
−40 °C to +80 °C

Table 1-1. Specifications (continued)

Instrument Dimensions (length × width × height):
295 mm × 212 mm × 64 mm
(11.62 in. × 8.35 in × 2.54 in)

Factory Default Labels and Settings:
Label for first Universal Counter in the system:
COUNTER.01
Label for second Universal Counter in the system:
COUNTER.02
Function: Auto-frequency

In addition, each function has the following factory defaults:

Frequency:
Range: 10 Hz to 100 MHz
Gatetime: 1 sec.
Trigger mode: Internal
Slope: Positive

Auto-frequency:
Trigger mode: Internal
Slope: Positive

Period:
Samples: 10
Trigger mode: Internal
Slope: Positive

Auto-period:
Trigger mode: Internal
Slope: Positive

Time Interval:
Input Source: Common
Trigger mode: Internal
Slope A: Positive
Slope B: Positive

Frequency Ratio:

Range: 10 Hz to 10 MHz
Samples: 10
Trigger mode: Internal
Slope A: Positive
Slope B: Positive

Totalize:

Range: 10 Hz to 10 MHz
Trigger mode: Internal
Slope: Positive

2 Trying Out Your Instrument

Introduction

The following step-by-step procedure allows you to quickly perform some simple instrument operations using the frequency function. This procedure is especially suitable for first-time users who want to quickly become familiar with the basic operation of the Universal Counter. Chapter 3 contains additional detailed operating information about other Counter functions that you can use once you have learned the basics in this chapter.

The Procedure

Trying out your instrument consists of pointing to and selecting various interactive fields on the Soft Front Panel. Before you try out your Universal Counter, you should have: connected it to the interface, applied power, loaded the computer's operating system, renamed (or erased) HPSTATE.HPC to return the instrument to its factory default settings, and run PANELS as explained in Chapters 2 and 3 of your System Owner's Manual.

NOTE

If you have an application connected to your Universal Counter, be aware that following these instructions will measure the signal applied to INPUT A. While the actual measured value is unimportant for these exercises, you may want to apply a signal within the range you select. Out of range signals are displayed as OVERFLOW and are not harmful to the Counter. You ***must*** *be careful not to exceed the input voltage ratings given in Table 1-1.*

Step 1 · If COUNTER.01 is not already in the Interactive Instrument Window, point to and select it from the labels listed in the System View window. The ACTIVE indicator on the front of the Universal Counter will light to let you know that you have selected the Counter. If you have many instruments in your system, you can use the ROLL UP SYS VIEW and the ROLL DOWN SYS VIEW softkeys to view them all.

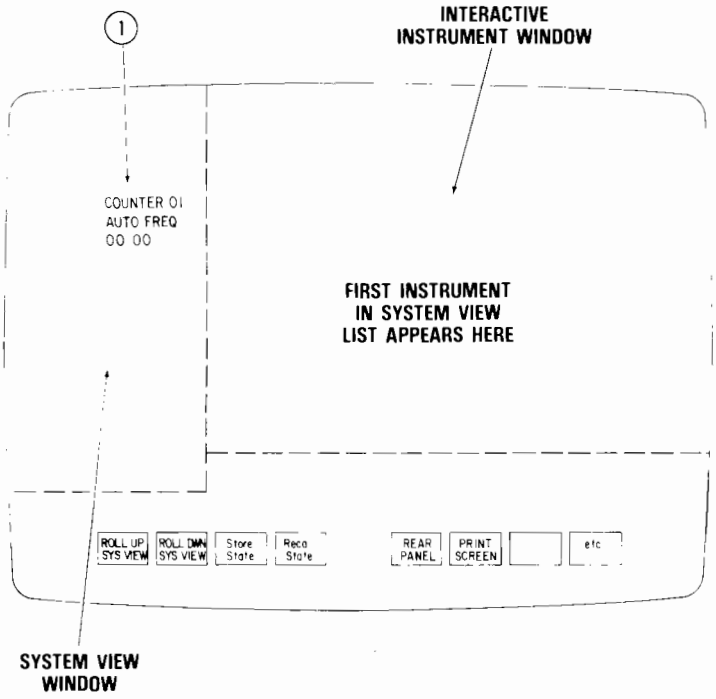

Figure 2-1. Select COUNTER.01

As Figure 2-1 shows, the Universal Counter places one label in the System View window. The line below the label shows that the Counter is now in the auto-frequency function. The present measurement value is displayed on the third line.

The factory assigned default label for the Universal Counter is COUNTER.01 for the first Counter in your system. If you have more than one Universal Counter in the system, the default label for the second Universal Counter is COUNTER.02. Each additional Universal Counter in the system will be assigned a default label that is sequentially numbered; i.e., COUNTER.03, COUNTER.04, etc.

Step 2 · When you complete Step 1, COUNTER.01 appears in the interactive instrument window as shown in Figure 2-2. Notice that the System View window turns bright where the label was previously. The bright box in the center of the FUNCTION switch shows that the Counter is now in the Auto-Frequency function. Point to and select the ▼ arrow to choose the FREQUENCY function as shown in Figure 2-2.

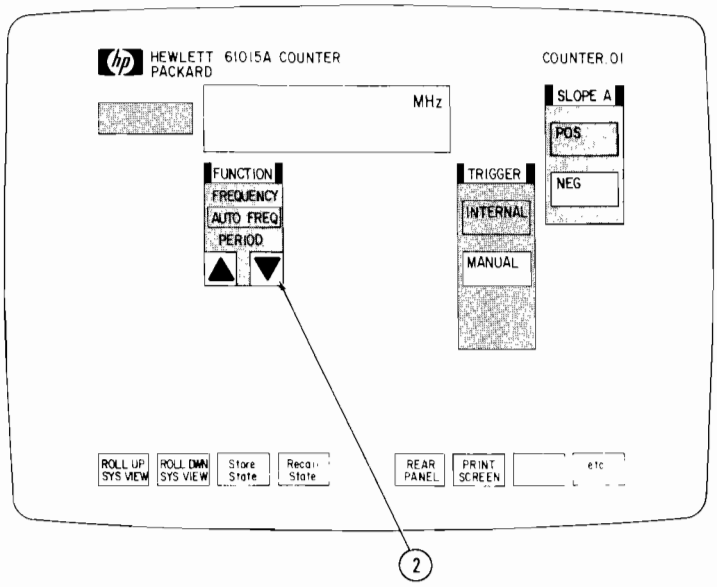

Figure 2-2. Select The Frequency Function

Step 3 · The word FREQUENCY now appears in the center box but the Counter is still in the auto-frequency function as shown by the bright box around AUTO FREQ. To activate the frequency function, point to and select FREQUENCY as shown in Figure 2-3.

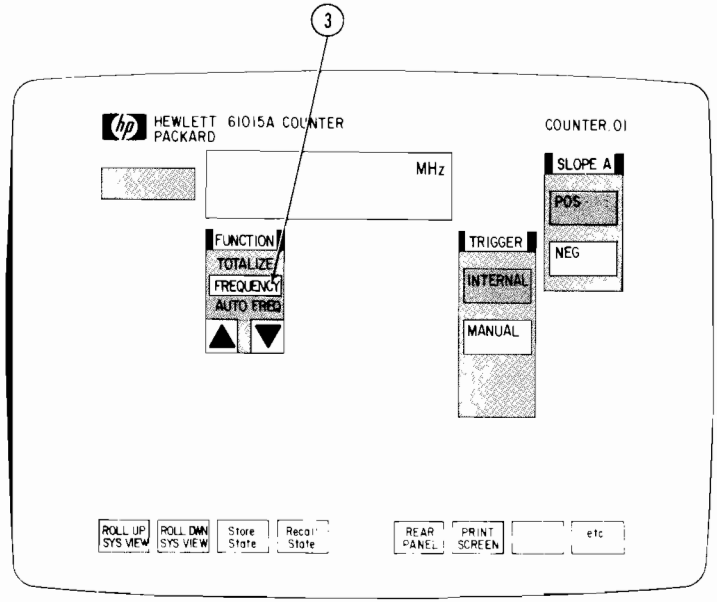

Figure 2-3. Activating The Frequency Function

Step 4 - The Counter is now measuring the frequency of the signal on INPUT A. The default settings for range, gatetime, triggering, and slope are displayed in the light boxes. Input frequencies less than 10 MHz can be measured with greater resolution using a different range. Change the range by pointing to and selecting the 10 Hz to 10 MHz field below the RANGE switch. See Figure 2-4.

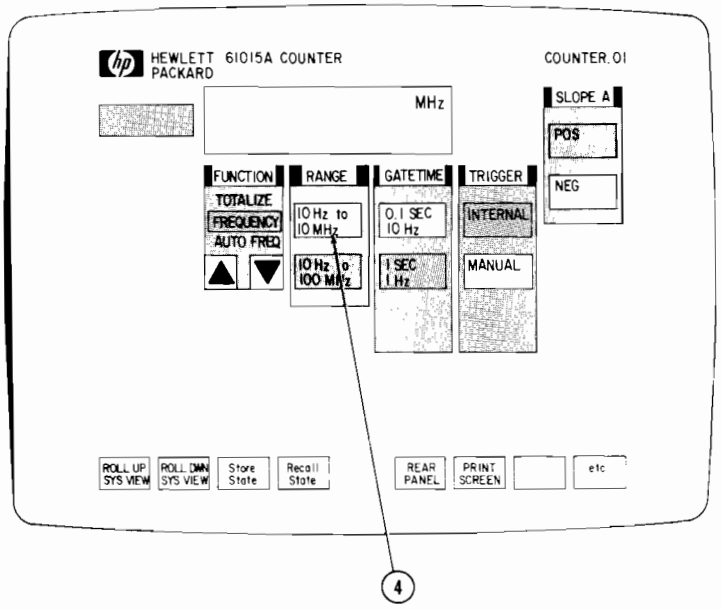

Figure 2-4. Change The Range

Step 5 - As Figure 2-5 shows, completing Step 4 causes the 10 second gatetime choice to appear. The resolution of the displayed measurement value depends on the setting of the GATETIME switch. Selecting a longer gatetime yields greater resolution but takes longer to make the measurement. Change the gatetime by pointing to and selecting the 10 SEC gatetime.

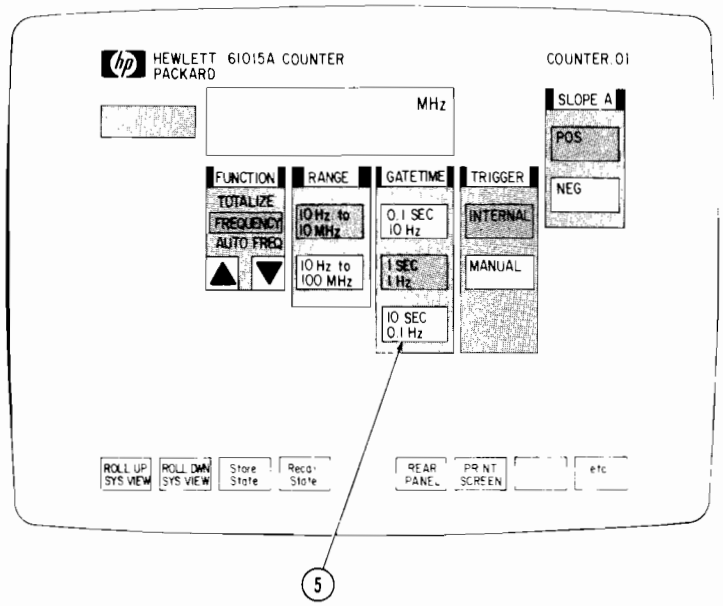

Figure 2-5. Change The Gate Time

Step 6 - Completing Step 5 causes the Counter to take 10 seconds for every measurement. The Counter is continuously taking frequency measurements and updating the display because INTERNAL trigger is the default setting for the TRIGGER switch. To make the Counter take a measurement on command, you have to put it in manual trigger mode by pointing to and selecting MANUAL. See Figure 2-6.

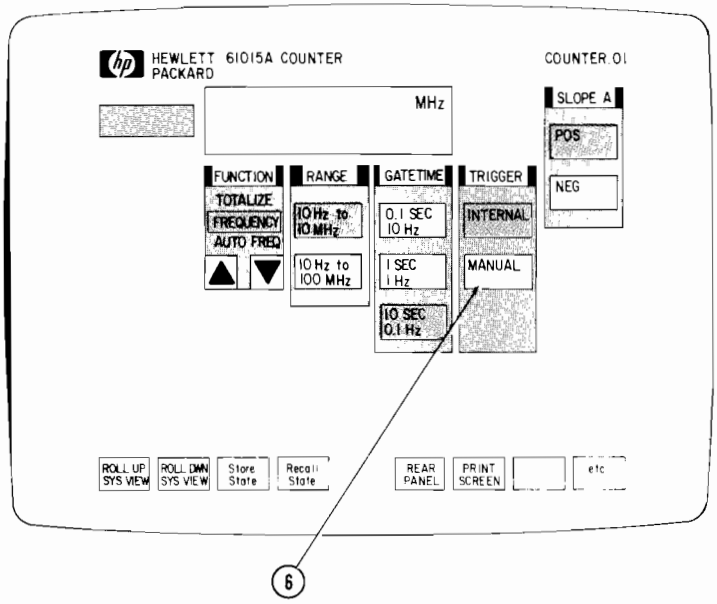

Figure 2-6. Select Manual Trigger Mode

Step 7 · Selecting MANUAL trigger mode clears the displayed measurement value and causes a START button to appear in the TRIGGER switch. To command the Counter to take a single measurement and display the value, point to and select the START button. See Figure 2-7.

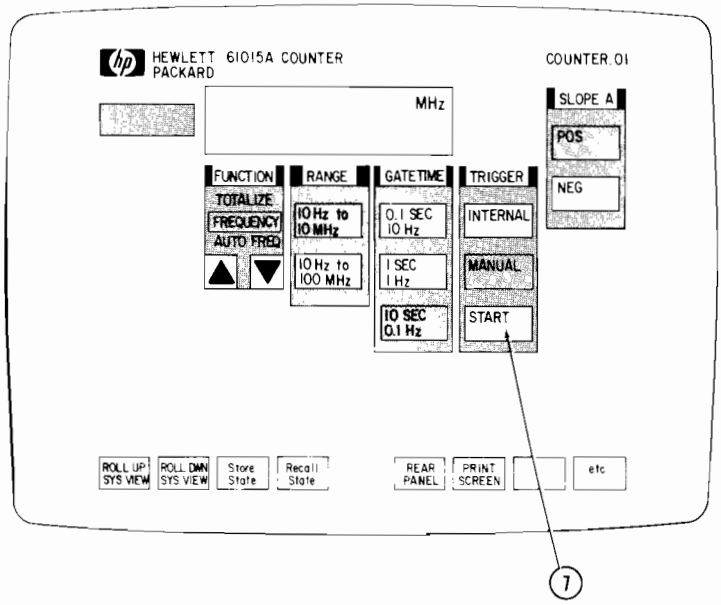

Figure 2-7. Take A Single Measurement

Step 8 · You can take another measurement by pointing to and selecting the START button again. Since the START button is only available when the Counter is in the Interactive Instrument Window, you should never leave the Counter in the manual trigger mode if you want the System View Window display to continuously update. To return the Counter to the internal trigger mode, point to and select INTERNAL. See Figure 2-8.

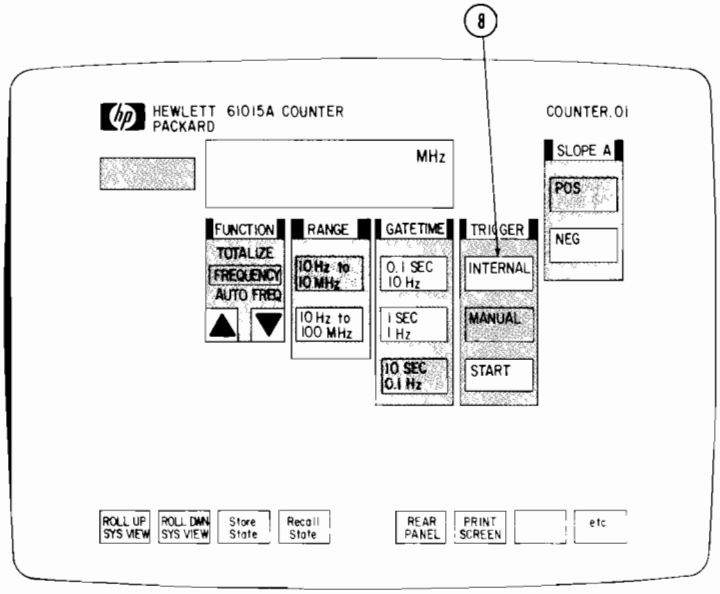

Figure 2-8. Return The Counter To Internal Trigger Mode

If you fail to do step 8, and then select another instrument, the System View Window will show the letter "M" next to the Counter's displayed measurement. This is to warn you that the Counter is not updating the display because it is in Manual trigger mode.

The Result

The Counter is now measuring the frequency of INPUT A. You have changed the range, gatetime, and trigger mode settings. Other Counter functions can now be selected as described in Chapter 3. Your display looks like this:

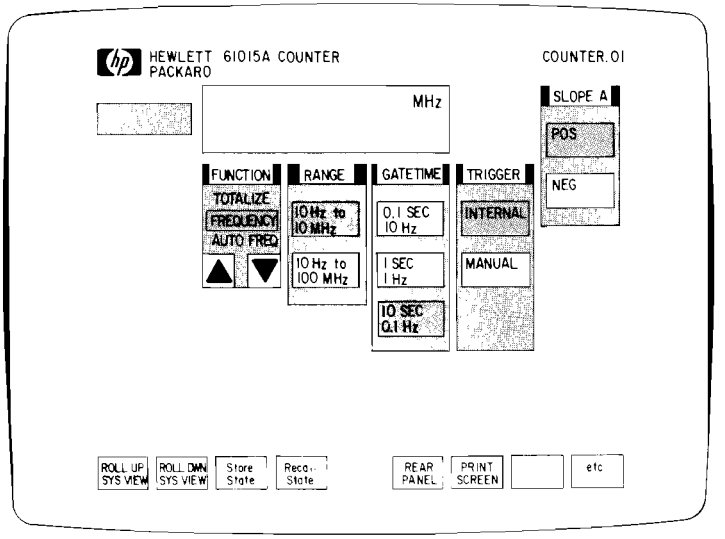

Figure 2-9. The Front Panel Display Of The Universal Counter

If you would like to try out a different instrument now, go to Chapter 2 of its manual; otherwise, press the **Etc** softkey and then the **EXIT** softkey.

What To Do Next

Now that you have finished trying out your instrument, the next thing you do depends upon the type of user you are. If you are an experienced PC Instruments user and are already familiar with the System Owner's Manual, read the remaining chapters in this manual. If you are a first-time PC Instruments System user, read Chapter 4 in the System Owner's Manual and then Chapter 3 of this manual to learn about controlling your Counter "manually". Table 3 in the System Owner's Manual specifies the reading sequence of these manuals for first time users.

3 Manual Instrument Control

Introduction

You may have some idea of how to manually control the Universal Counter from the procedure given in Chapter 2. However, that chapter only gave you some ways to measure frequency. This chapter gives you more detailed information for measuring frequency and other signal characteristics. Chapter 4 of the System Owner's Manual describes the Soft Front Panel features (including softkeys) that are common to manual control of all instruments.

Selecting The Universal Counter

The Universal Counter must be displayed in the Interactive Instrument window before you can manually operate it. If its name is not already displayed in the Interactive Instrument window, point to and select its label in the System View window.

Figure 3-1 shows the factory default settings that appear when the first Universal Counter in the system is selected. All of the default settings are listed in Table 1-1. If your computer's display does not look like this, it means that a previous user has changed the default settings or instrument label.

The Interactive Instrument Window can display either the front panel or rear panel of your instrument. If the rear panel is displayed, press the **FRONT PANEL** softkey (f5) to display the front panel. This is the display that lets you control the Universal Counter's functions and settings as explained by the following pages.

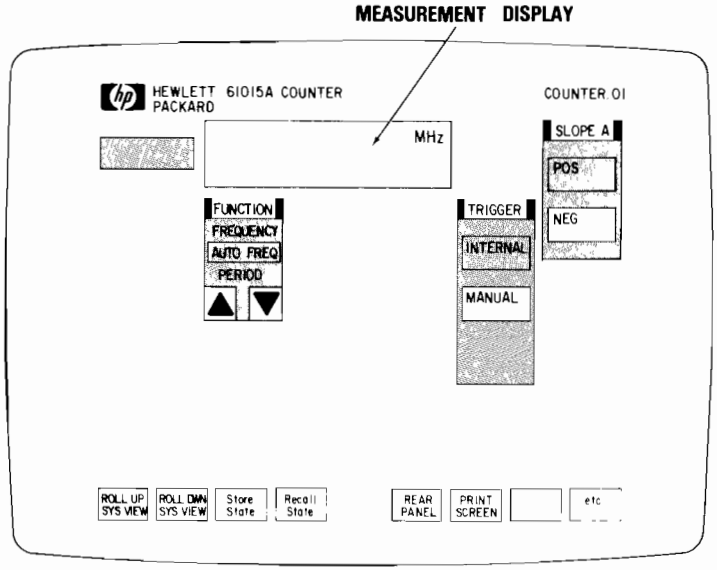

Figure 3-1. Universal Counter Default Settings

Operating The Universal Counter

The present Counter measurement is displayed in the large field at the top of the Interactive Instrument window, as shown in Figure 3-1. Below the measurement field are up to five graphical representations of switches. You use these switches to control function, range, gatetime, and other settings just as you would use knobs and switches on a conventional counter. Since there are no knobs to turn, on the computer display, the way to select different settings is explained in the following paragraphs under the type of measurement you want to perform.

The FUNCTION switch setting is the most important of all. If the displayed function is not the one you want, you should change it before you change any other settings that appear to the right of the FUNCTION switch. Unless you change them again, these settings will always be associated with the selected function. From then on, whenever the particular function is selected, these settings will be automatically recalled. For example, if you select a positive slope while the frequency function is active and then switch to the period function, the slope will also switch to the way it was the last time you performed a period measurement. Likewise, if you now make the slope setting negative and again select the frequency function, the slope will switch back to positive because that is the way it was set the last time you used the frequency function.

Frequency Measurements

All frequency measurements are made through INPUT A. Connect the signal to be measured to the BNC connector on the front of the Counter by INPUT A. The switch on the left side of the Interactive Instrument window selects the function (frequency, period, etc). Figure 3-2 shows the FUNCTION switch when the Counter is measuring frequency.

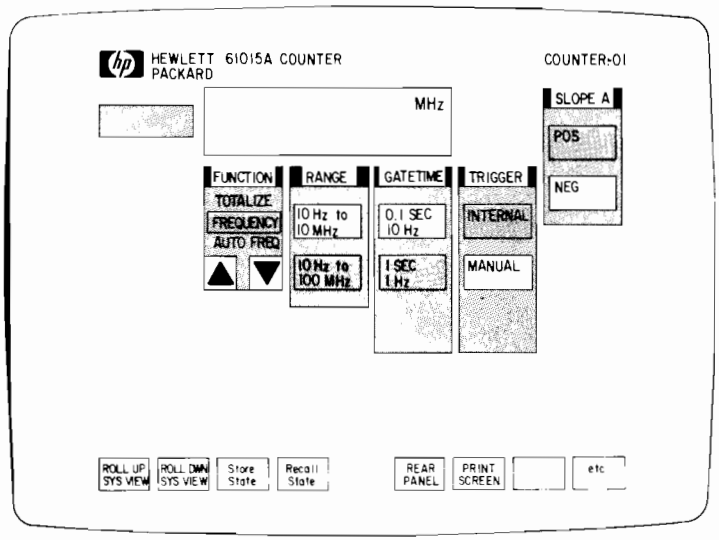

Figure 3-2. Measuring Frequencies Less Than 100 MHz

To measure frequency you must make sure the word "FREQUENCY" is in the bright field in the center of the Function Select switch. You must point to and select either arrow at the bottom of the switch until the boxed in word in the middle of the list indicates FREQUENCY. (You may have to select the arrow several times to scroll the list to the desired position.) Now that the FUNCTION switch is displaying the desired function (FREQUENCY) in the center box, you must point to and select that word to set the Counter to that function. The newly selected function will then become brightly highlighted.

NOTE

If OVERFLOW is displayed, your input signal is not within the displayed frequency range. You must change the range as described below.

The resolution of the frequency measurement depends on the positions of the RANGE and GATETIME switches. These resolutions are listed in the Specifications of Chapter 1. The 10 Hz-100 MHz range must be used for input frequencies greater than 10 MHz. Greater resolution can be obtained by using the 10 Hz to 10 MHz range for input frequencies less than 10 MHz. To change the range, you simply point to and select the desired range as shown in Figure 3-3.

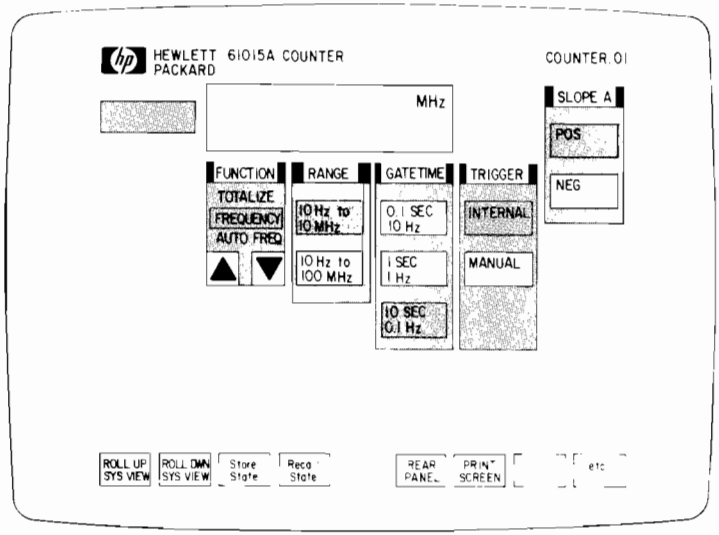

Figure 3-3. Measuring Frequencies Less Than 10 MHz

Gate time is how long it takes the Counter to perform a measurement. Longer gatetimes will yield greater resolution. To change the gatetime, point to and select the desired GATETIME. Note that the 10 second choice for gatetime is not avaliable if the 10 Hz to 100 MHz range is in effect.

The TRIGGER switch offers two choices for initiating a measurement: INTERNAL and MANUAL. To set the Counter to either of these trigger modes, point to and select the desired choice. When INTERNAL is selected, the Counter continuously takes measurements and the display is updated with each measurement. When MANUAL is selected, a measurement is taken only when the START ''button'' is selected. The START button only appears when MANUAL is selected. It is a momentary contact type switch that will temporaraly turn from dark to bright when it is selected. A new measurement is taken and displayed each time you point to and select the START switch.

NOTE

When the Counter display is in the System View window it will not be updated if MANUAL TRIGGER is selected. The letter ''M'' appears next to the Counter's label in the System View Window to remind you that it is in manual mode. You must select INTERNAL TRIGGER if you want the System View window display to update when the Counter is not in the Interactive Instrument window.

The SLOPE switch determines whether the low-to-high (POS) or the high-to-low (NEG) transition of the input signal triggers the Counter. The slope is changed by pointing to and selecting the desired slope.

Auto Frequency Measurements

The AUTO-FREQUENCY function is similar to the frequency function just described but, the range and gatetime are automatically selected by the Counter. In addition, a period measurement may be made to improve the measurement resolution. If a period measurement is made, the reciprocal value is returned so that the frequency value is still displayed. Connect your input signal to INPUT A. You use the FUNCTION switch the same way as described for frequency measurements except that "AUTO FREQ" should be moved to the middle box of the switch. Figure 3-4 shows the Soft Front Panel once the auto-frequency function is selected.

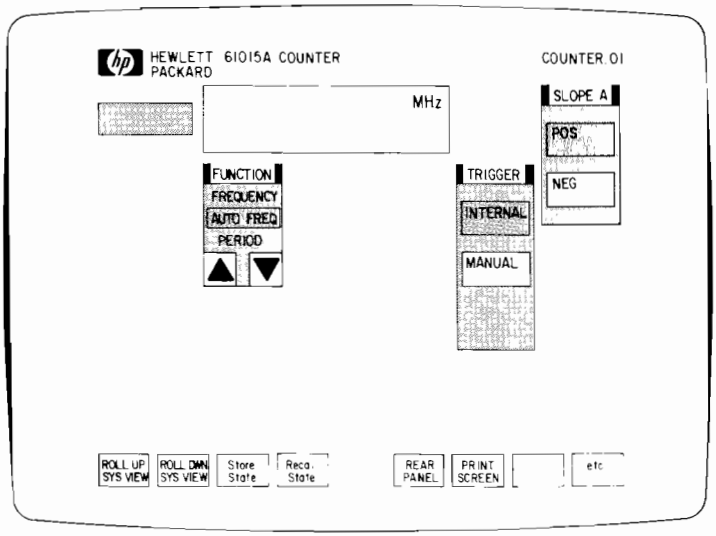

Figure 3-4. Measuring frequency with the Auto-Frequency function.

The AUTO-FREQUENCY function lets the Counter take the most accurate measurement possible within a 1.5 second limit by using a reciprocal counting technique. This

method automatically choses optimum settings for most measurements. Special applications may require greater resolution or faster measurements. The FREQUENCY function can be used for these applications so you can set the range and gatetime yourself.

The Trigger and Slope switches function as described for frequency measurements.

Period Measurements

The PERIOD function measures the period of any periodic waveform connected to INPUT A. You use the Function switch to select PERIOD the same way as you select frequency except the word "PERIOD" must be moved into the middle box of the FUNCTION switch. Figure 3-5 shows the Soft Front Panel when the period function is selected.

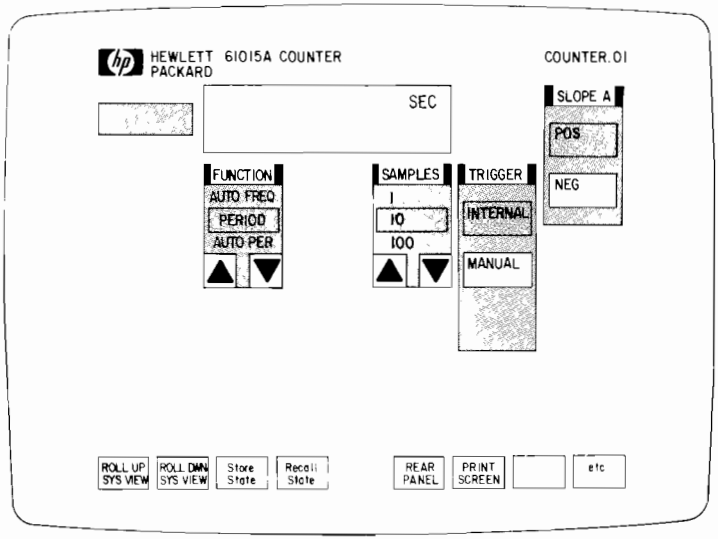

Figure 3-5. Measuring Period

The resolution of the measurement depends on the setting of the SAMPLES switch (Refer to Specifications in Chapter 1). The SAMPLES switch tells the Counter how many

cycles of the input signal to sample, before it displays the average value of period. To change the number of samples used, point to and select either arrow below the SAMPLES switch until the desired number (1, 10, 100, or 1000) appears in the middle box. Then point to and select the box.

The TRIGGER and SLOPE switches both function the same as described for frequency measurements.

Auto Period

The AUTO-PERIOD function is similar to the period function just described, but the Counter automatically selects the number of cycles to sample for the most accurate measurement possible in 1.5 seconds, or less. Connect your input signal to INPUT A. You use the FUNCTION switch the same way as described for frequency measurements except "AUTO PER" should be moved into the middle box of the switch. Figure 3-6 shows the Soft Front Panel for the AUTO-PERIOD function.

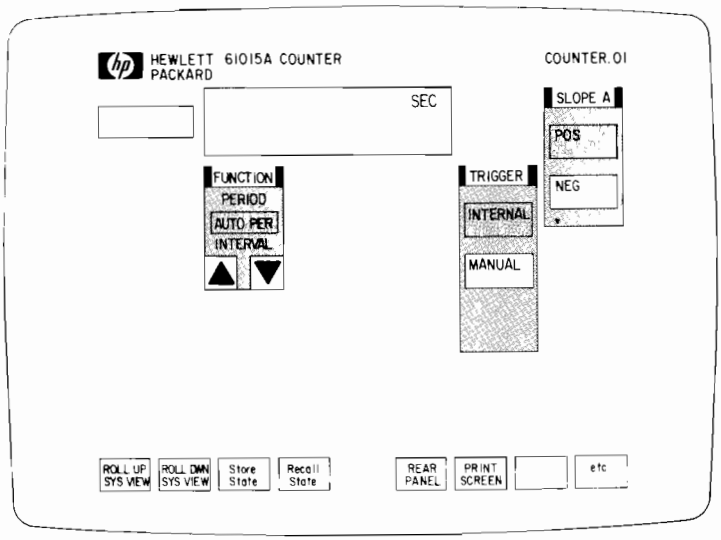

Figure 3-6. Measuring Period with the AUTO-PERIOD function

The AUTO-PERIOD function lets the Counter take the most accurate measurement possible within a 1.5 second limit by using a reciprocal counting technique. This method automatically choses optimum settings for most measurements. Special applications may require greater resolution or faster measurements. The PERIOD function can be used for these applications so you can select the number of SAMPLES yourself.

The TRIGGER and SLOPE switches function the same as for frequency measurements.

Time Interval Measurements

The time interval function measures the time between a transition of a signal on INPUT A and a transition of a signal on INPUT B when SEPARATE INPUT SOURCE is selected. The interval between two transitions of the same signal on INPUT A can be measured by setting the INPUT SOURCE switch to COMMON.

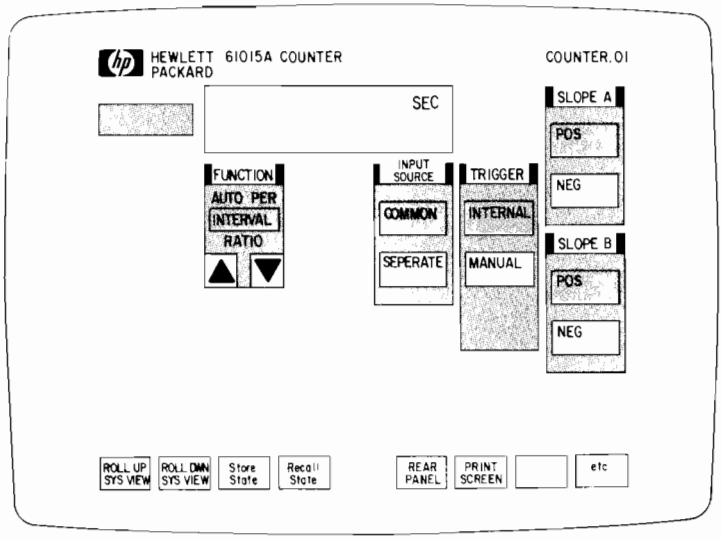

Figure 3-7. Measuring Time Interval

You select the time interval function the same way as you select frequency, except the word "INTERVAL" must appear in the box in the middle of the FUNCTION switch. Figure 3-7 shows the Soft Front Panel when the time interval function is selected.

The transitions that start and stop the measurement interval can be selected using the SLOPE switch. Use the INPUT A SLOPE switch to determine the polarity of the "start" edge (the one that starts the time interval). Use INPUT B SLOPE switch to determine the polarity of the "stop" edge (the one that stops the interval measurement). For either input, POS selects the rising edge and NEG selects the falling edge.

Selecting INTERNAL TRIGGER causes the Counter to continuously measure the interval between the "start" and "stop" transitions and then update the display. Every interval is measured and displayed; they are not averaged. The Counter has to be "primed" once after selecting the INTERVAL function or after making any change to INPUT SOURCE, TRIGGER, or SLOPE. Signals with transitions of opposite slope to the start and stop transitions prime the Counter. INPUT A must be primed before INPUT B. When using INTERNAL TRIGGER the Counter is automatically primed by the transitions of the waveform.

Selecting MANUAL TRIGGER halts the measurement process and displays the START button. Point to and select the START button to reset the Counter and take another measurement. When using MANUAL TRIGGER you must ensure that the Counter is primed by the appropriate transitions as shown in Figure 3-8. The Counter must be primed once for every measurement done in manual mode.

Figure 3-8 also shows how INPUT SOURCE and SLOPE determine when the measurement interval starts and stops. Note how the pulse width of a signal can be measured using COMMON INPUT SOURCE.

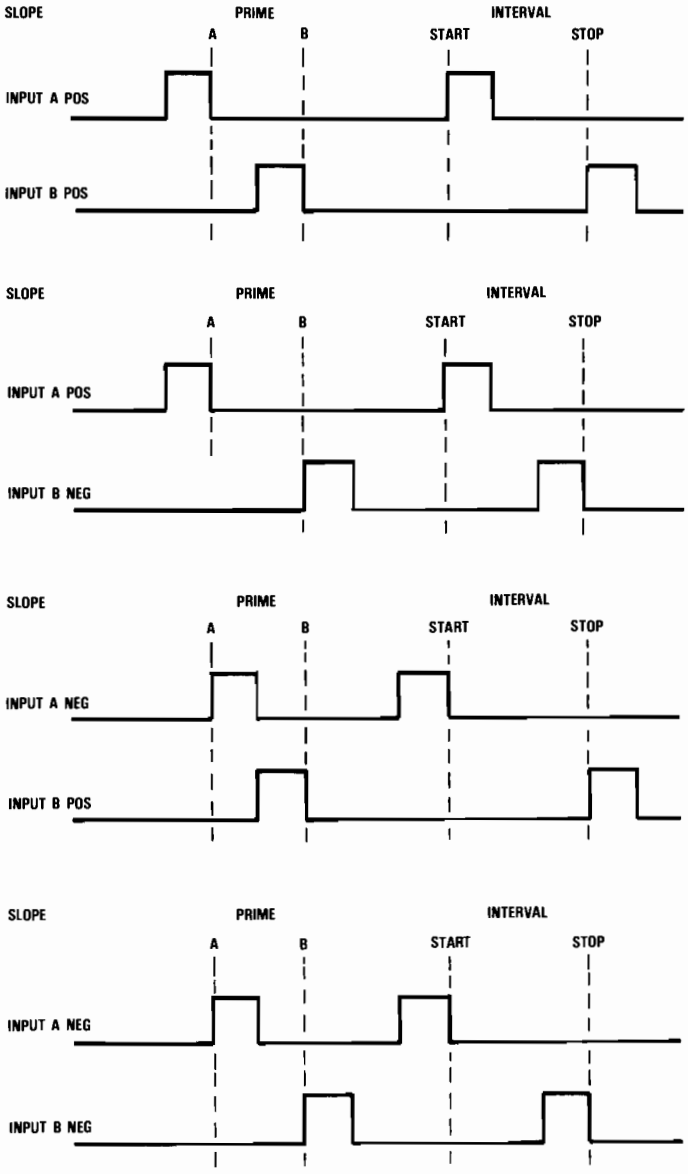

Figure 3-8a. Interval Measurements Using SEPARATE Input Signals

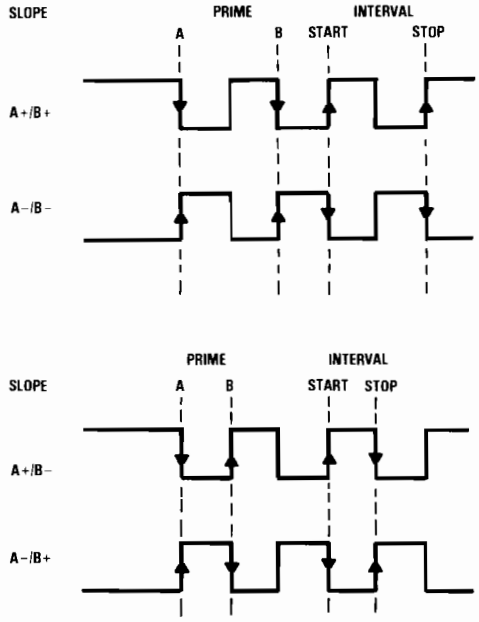

Figure 3-8b. Interval Measurements Using One COMMON Input Signal

Ratio A to B Measurements

The RATIO function measures the ratio of the two input frequencies (INPUT A/INPUT B). You use the Function switch to select RATIO the same way as for frequency except the word "RATIO" must be moved to the middle box. Figure 3-9 shows the Soft Front Panel when the ratio function is selected.

The resolution of the measurement depends on the settings of the RANGE switch and SAMPLES switch. These resolutions are listed in Table 1-1. The 10 Hz-100 MHz range must be used for INPUT A frequencies greater than 10 MHz. To change the range simply point to and select the desired range.

The SAMPLES switch sets the number of "INPUT B cycles" that are sampled. Using more samples will take

longer but will yield greater measurement resolution and allow measuring ratios less than 1. To change the number of samples used, point to and select either arrow below the SAMPLES switch until the desired number (1, 10, 100, or 1000) appears in the middle box. Then point to and select the box. Note that the 1 SAMPLE choice is not available when the 10 Hz-100 MHz range is selected.

The TRIGGER and SLOPE switches work the same as for frequency measurements except that now the slope of INPUT B can also be selected.

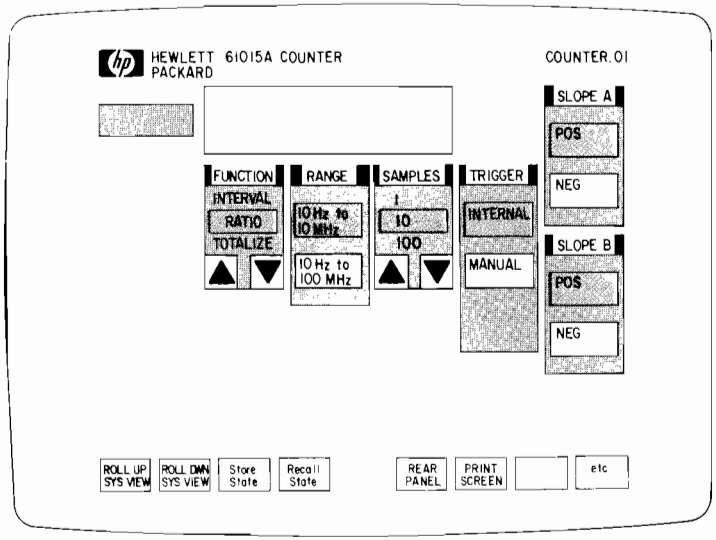

Figure 3-9. Measuring Frequency Ratio

Totalize Measurements

The Totalize function counts transitions of the signal connected to INPUT A. The transitions must have a repetition between 10 Hz and 100 MHz. You use the Function switch to select TOTALIZE the same way as you do for frequency measurements except the word "TOTALIZE" must be moved to the middle box. Figure 3-10 shows the Soft Front Panel when the totalize function is selected.

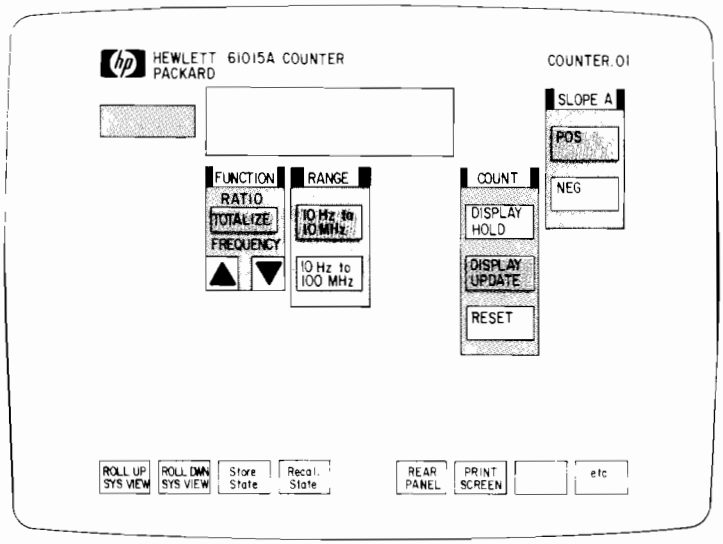

Figure 3-10. Totalize Measurements

The measurement resolution depends on the RANGE switch setting. The 10 Hz-10 MHz range gives you 1 count resolution; the 10 Hz-100 MHz range gives you 10 count resolution. You must select the 10 Hz-100 MHz range if the event frequency is greater than 10 MHz. To change the range, point to and select the desired range.

The COUNT switch controls the displayed measurement. Normally the display will update continuously. Since this may make it difficult to read rapidly changing values, you can point to and select the DISPLAY HOLD switch to stop updating the display. When selected, the DISPLAY HOLD switch becomes bright to indicate that the display updating has halted but the events are still being counted. Point to and select DISPLAY UPDATE to resume display updating with the present count. Selecting DISPLAY UPDATE also darkens the DISPLAY HOLD button. Selecting RESET clears the count to zero and counting resumes immediately.

The SLOPE switch is used to select the type of transition that is counted. Point to and select POS to count low-to-high transitions on INPUT A or, point to and select NEG to count high-to-low transitions.

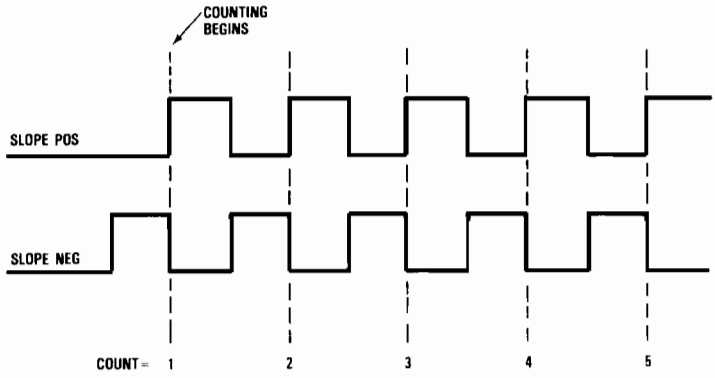

Figure 3-11. How Slope Affects Totalize Measurements

4 Front Panel Connections

Introduction

The following paragraphs describe how to make connections to the front panel of your Universal Counter. You should become familiar with the operation of the instrument as explained in the two preceding chapters before you connect anything to its front panel. You may also want to read about programming your instrument in Chapter 5 before you make front panel connections.

WARNING

Before making any front panel connections establish a safety ground connection to your Universal Counter by installing the Power Pack as described in the System Owner's Manual.

Figure 4-1 shows a single-stage schematic diagram of the input circuit for either input of the Universal Counter. The full specifications are given in Table 1-1.

CAUTION

To avoid possible damage to the Universal Counter, do not exceed maximum input voltage ratings given in Table 1-1.

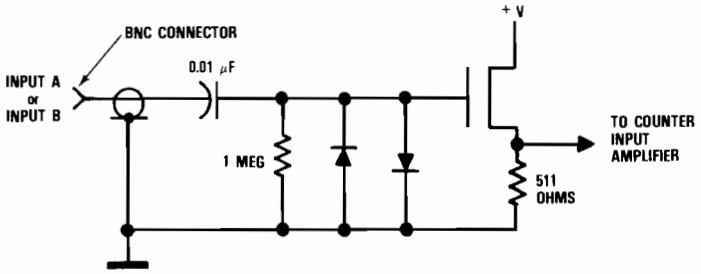

Figure 4-1. Simplified Input Schematic Diagram

Each Counter input is connected to your application by a user-supplied coaxial cable with BNC connectors. Plug each connector into its mating socket located on the front of the Counter. We recommend using a 50 ohm termination at the Counter end of your cable when measuring signals greater than 10 MHz.

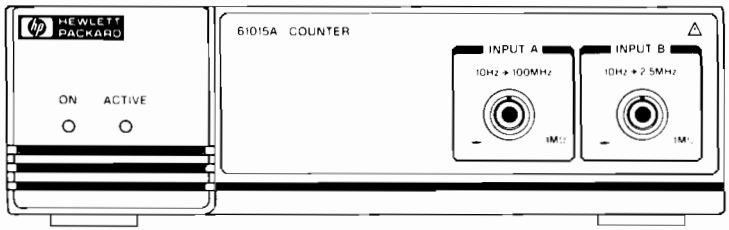

Figure 4-2. Front View Of The Universal Counter

5 Programming with BASIC

General Information

You can write a BASIC program to control the function and settings of the Counter. Before you attempt this, you should familiarize yourself with controlling the instrument in manual mode (Refer to Chapters 2 and 3). Also, you must already know how to write programs in BASIC before you can write your own application program. Chapter 5 of the System Owner's Manual gives information about how to develop and run your program. Before writing your program, you must first run the Soft Front Panel to generate a program shell. You can also use the Soft Front Panel to assign a label to the Universal Counter and create one or more State files.

This chapter describes all the statements that you can use in your program to control the Universal Counter. These statements fall into two categories: system and instrument. System statements affect other instruments in your system as well as the Universal Counter. Instrument statements will affect only the specified Universal Counter.

NOTE

If the programming statements in this chapter fail to execute, you may have a programming error. Refer to Chapter 5 in the System Owner's Manual which discusses error handling methods. Appendix C of this manual lists the error messages that apply to the Universal Counter.

How Statements Control The Universal Counter

Before using any of the statements in this chapter, take some time to review Figure 5-1. This block diagram illustrates the relationship between the instrument programming statements and the functions of the Counter. Since most of the major functions of the Counter are performed by a single integrated circuit, they are shown as one large block (LSI Counter Circuit).

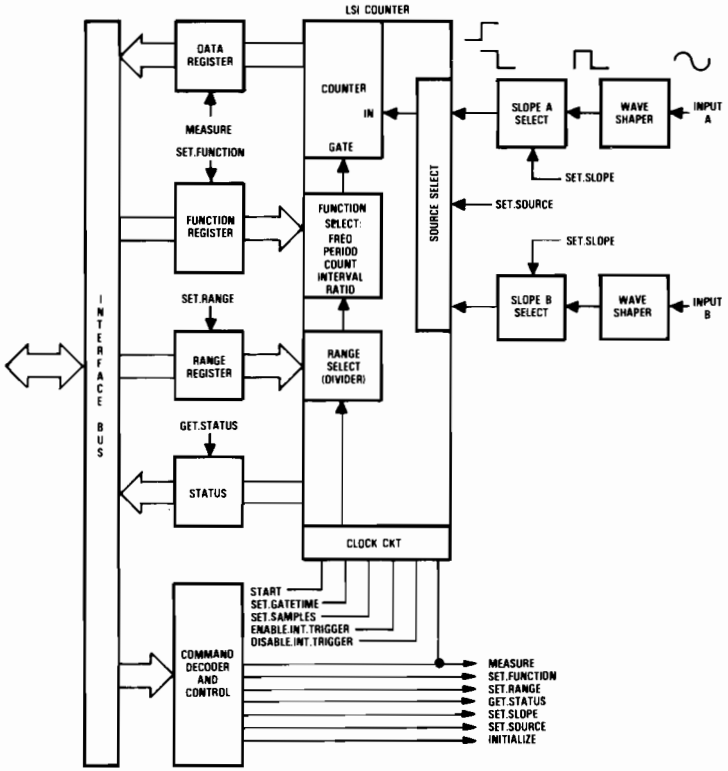

Figure 5-1. How Statements Control The Universal Counter

From the diagram, you can see that the function and range of the Counter are programmed with different statements (SET.FUNCTION and SET.RANGE). The Function Select circuit determines the desired function

from the data stored in the Function Register by the SET.FUNCTION statement. The Range Select circuit determines the range from the digital value stored in the Range Register by the SET.RANGE statement. The MEASURE statement returns data from the LSI Counter circuit to the computer via the Data Register where it is saved in digital format. The LSI Circuit is also responsible for returning status information to the computer whenever the GET.STATUS statement is executed. The INITIALIZE statement simultaneously controls the LSI Counter, function, range, and slope.

System Programming Statements

All of the system programming statements are covered in Chapter 5 of the System Owner's Manual. Only one of them affects the Universal Counter:

INITIALIZE.SYSTEM (*statefile*) - where statefile is a string variable that is equal to a State filename that you assigned using the Soft Front Panel. This statement causes the Counter's function and settings to be set to the values specified in the State file. All other instruments in the system are also initialized. The INITIALIZE.SYSTEM statement should be used carefully because it affects all the settings of the Universal Counter. Wherever it is used in your program, it will override the results of any previously issued instrument statements. Programming the Universal Counter without using an INITIALIZE statement sets your instrument to the factory default settings listed in Table 1-1.

NOTE

The Rear Panel information contained in the State file must agree with your present hardware set-up. The Rear Panel mode is explained in Chapter 4 of the System Owner's Manual.

Instrument Programming Statements

In the following statement descriptions, the *label* parameter is the label of the Counter that you want to program. This label must be the same one that was assigned to the Counter when you saved the program shell using the Soft Front Panel. If you did not assign a new label, you must use the factory default label; e.g., COUNTER.01.

INITIALIZE (*label,statefile*). This statement is the same as INITIALIZE.SYSTEM except it causes only the named Counter to be initialized to the values contained in the *statefile*. Although this file may contain information about other instruments in your system, only the information that applies to the named Counter will be retrieved.

Example:

```
1010 FILE$="STARTUP"
1020 CALL INITIALIZE (COUNTER.01,FILE$)
```

This example sets the Counter with the label COUNTER.01 to the settings contained in the State file STARTUP. You must have previously saved this State file using the Soft Front Panel.

SET.FUNCTION (*label,function*) · sets the Counter to the specified function. The *function* parameter must be one of the following reserved variables: FREQUENCY, AUTO.FREQ, PERIOD, AUTO.PER, INTERVAL, RATIO, TOTALIZE. All functions are fully described in Chapter 3. Note that programming a function may retrieve default or previously programmed settings as described in Chapter 3.

Example:

```
1010 CALL SET.FUNCTION (COUNTER.01,FREQUENCY)
```

ENABLE.INT.TRIGGER (*label*) - sets the Counter to the internal trigger mode. In this mode, the Counter will repeatedly take measurements and make them available for the MEASURE statement (described later). The ENABLE.INT.TRIGGER statement cannot be programmed when the Counter is in the totalize function; doing so will cause an error.

Example:

```
1010 CALL ENABLE.INT.TRIGGER (COUNTER.01)
```

DISABLE.INT.TRIGGER (*label*) - sets the Counter to the manual trigger mode. In this mode, the Counter will not take a measurement until the START statement is programmed. Refer to the START and GET.STATUS statements described later. Programming the DISABLE.INT.TRIGGER statement when the Counter is in the totalize mode causes an error.

Example:

```
1010 CALL DISABLE.INT.TRIGGER
```

SET.SLOPE (*label,channel,slope*) - sets the slope of the specified input channel where *channel* must be one of the two reserved variables, CHAN.A or CHAN.B and *slope* must be one of the reserved variables, POSITIVE or NEGATIVE. Note that CHAN.B can only be specified if the Counter is in either the interval or ratio function; otherwise an error is generated.

Example:

```
1010 CALL SET.SLOPE(COUNTER.01,CHAN.A,POSITIVE)
```

This example sets INPUT A of COUNTER.01 to positive slope.

SET.RANGE (*label,range*) · sets the Counter's range when the Counter is in either the frequency or ratio function; an error is generated if it is in any other function. *Range* must be one of the following reserved variables: R10MEGA or R100MEGA where,

R10MEGA selects the 10 Hz to 10 MHz range
R100MEGA selects the 10 Hz to 100 MHz range

NOTE

The 100 MHz range must be used for input signals greater than 10 MHz.

Example:

```
1010 CALL SET.RANGE(COUNTER.01,R10MEGA)
```

This example sets the 10 MHz range for COUNTER.01.

SET.GATETIME (*label,gatetime*) · sets the gatetime of the Counter when in the frequency function. If the Counter is not in the frequency function an error is generated. The reserved variables for *gatetime* are: R10, R1, R100MILLI where,

R10 selects 10 second gatetime
R1 selects 1 second gatetime
R100 MILLI selects 0.1 second gatetime

Example:

```
1010 CALL SET.GATETIME(COUNTER.01,R10)
```

This example sets the frequency gatetime of COUNTER.01 to 10 seconds.

SET.SAMPLES(*label,samples*) · Sets the number of INPUT A samples that will be averaged for period measurements or the number of INPUT B samples that will be averaged for ratio measurements. An error is generated if the Counter is not in either the period or ratio functions. The reserved variables for *samples* are: R1, R10, R100, R1KILO where,

R1 selects one sample
R10 selects 10 samples
R100 selects 100 samples
R1KILO selects 1000 samples

Example:

```
1010 CALL SET.SAMPLES(COUNTER.01,R100)
```

This example sets the number of samples to 100.

SET.SOURCE(*label,source*) · used only for time interval measurements. An error is generated if the Counter is not in the interval function. The reserved variables for *source* are COMN or SEPARATE. COMN allows measurements using only INPUT A. SEPARATE is for measuring the interval from an event on INPUT A to an event on INPUT B.

Example:

```
1010 CALL SET.SOURCE(COUNTER.01,COMN)
```

START(*label*) · is used in conjunction with the DISABLE.INT.TRIGGER and MEASURE statements. The START statement can only be used if the Counter is in manual trigger mode. START initiates a measurement but does not wait for the Counter to finish. The GET.STATUS statement can be used to determine if the measurement is complete. Once the measurement is complete the value can be read using the MEASURE statement.

Example:

```
1010 CALL START(COUNTER.01)
```

GET.STATUS(*label,status*) · This statement returns the present status of the Counter by setting the variable *status* equal to a binary coded value as follows:

1 = Counter has a measurement value ready to be read.
2 = Counter is busy taking a measurement.
4 = An overflow or self-test error has occurred.
8 = Timeout; no input signal detected.

Any combination of these coded values can occur at the same time. For example a *status* value of 3 means the counter has one reading available and is busy taking another one.

Example:

```
1010 CALL DISABLE.INT.TRIGGER (COUNTER.01)
1020 CALL START (COUNTER.01)
1030 CALL GET.STATUS (COUNTER.01,S)
1040 IF S < > 1 GOTO 1030
1050 CALL MEASURE (COUNTER.01,VALUE)
1060 PRINT ''Measurement is: '';VALUE
```

In this example, line 1010 enables the manual trigger mode and line 1020 initiates a measurement. The statement in line 1030 returns the status of Counter.01 in the variable S, which is checked by line 1040. When COUNTER.01 has a measurement ready, line 1050 reads the measurement value and line 1060 prints it.

MEASURE (*label,value*) · Causes the named Counter to return the present measurement in the variable *value*. Since a real variable is used in this statement, you can perform calculations on measurement values in your BASIC program. The units for the variable depend on the function that is in effect: frequency is measured in Hz, period and interval in seconds. Ratio and totalize measurements are unitless. How the MEASURE statement works depends on the ENABLE.INT.TRIGGER and DISABLE.INT.TRIGGER statements. When the Counter is in internal trigger mode, the MEASURE statement simply

returns the most recently completed measurement. When the Counter is in the manual trigger mode, the MEASURE statement works one of two ways:

1. If the START statement has not been used to start the Counter, the MEASURE statement will start it and wait for the measurement to complete before it returns the *value*.

2. If the Counter has been started with a START statement, the MEASURE statement waits until the measurement is complete before it returns the *value*.

Example:

```
40 CALL MEASURE(COUNTER.01,VALUE)
```

In this example, line 40 assigns the present measurement value to the real variable, VALUE.

Sample Program

The following is a sample program using some statements described in this chapter. Before you can try out this program you have to use the Soft Front Panel to store a program shell and a State file. Be sure to store the State file under the name MYTEST. Exit the Soft Front Panel and run PCIBAS. Load the program shell and type in the following program lines. When entering the program statements, remember to use the same labels that you assigned to the Universal Counter when using the Soft Front Panel. This sample program uses the default label COUNTER.01. Once you have finished typing in the sample program, save it and run it.

```
1010 FILE$="MYTEST"
```

"MYTEST" is the State file that you saved when you ran the Soft Front Panel.

```
1020 CALL INITIALIZE(COUNTER.01,FILE$)
```

Counter .01 is the default name for the Counter.

```
1030 CALL MEASURE(COUNTER .01,VALUE1)
1040 CALL SET.FUNCTION(COUNTER.01,PERIOD)
```

Line 1040 selects the period function.

```
1050 CALL SET.SAMPLES(COUNTER.01,R10)
```

This statement sets the Counter to sample 10 cycles.

```
1060 CALL MEASURE(COUNTER.01,VALUE2)
```

This statement performs the measurement.

```
1070 PRINT VALUE1,VALUE2
1080 END
```

When you run the program, two things will happen. First, the Universal Counter will be initialized to the settings you saved in your State file and a measurement is taken. Second, the function is programmed to measure a period by sampling 10 cycles.

A Programming Statement Summary

The following is a summary of the programming statements that can be used to control the Universal Counter. You can use this summary as a reference guide for spelling and syntax of the available statements.

System Statements

INITIALIZE.SYSTEM(*statefile*)

Instrument Statements

DISABLE.INT.TRIGGER(*label*)
ENABLE.INT.TRIGGER(*label*)
GET.STATUS(*label,status*)
INITIALIZE(*label,statefile*)
MEASURE(*label,value*)
SET.FUNCTION(*label,function*)
Reserved *function* Variables:
FREQUENCY
AUTO.FREQ
PERIOD
AUTO.PER
INTERVAL
RATIO
TOTALIZE

SET.GATETIME(*label,gatetime*)
Reserved *gatetime* Variables:
R100MILLI
R1
R10

SET.RANGE(*label,range*)
Reserved *range* Variables:
R10MEGA
R100MEGA

SET.SAMPLES(*label,sample*)
Reserved *sample* Variables:
R1
R10
R100
R1KILO

SET.SLOPE(*label,*CHAN.A,*slope*)
Reserved *slope* Variables:
POSITIVE
NEGATIVE

SET.SLOPE(*label,*CHAN.B,*slope*)
Reserved *slope* Variables:
POSITIVE
NEGATIVE

SET.SOURCE(*label,source*)
Reserved *source* Variables:
COMN
SEPARATE

START(*label*)

B Instrument Verification and Calibration Procedures

Introduction

The Universal Counter should be checked for proper calibration at least once a year. The Universal Counter Verification should be performed only if you suspect a malfunction. Verification and calibration procedures for your Universal Counter are included with your PC Instruments System software. Instructions on how to load and run these procedures are given in Appendix B of your System Owner's Manual. When you run the verification program, step-by-step instructions appear on your computer's display to guide you through each procedure. It will usually not be necessary to refer to any other documentationn while you are running the program. This appendix specifies the required test equipment and briefly describes the tests performed on the Counter.

Equipment Required

You must have an installed PC Instruments Interface Card and a PC Instruments Universal Counter. Since the Counter measures the time-dependent parameters of repetetive waveforms, a function generator or test oscillator is required to supply stimuli to the Counter during testing. To calibrate your Counter you also need either an oscilloscope and frequency standard or a high precision counter. Refer to Table B-1 for equipment specifications. If you have a PC Instruments Function Generator in your system, you can use it to test your Counter automatically. The Function Generator must be connected to the same interface card as the Counter. Using the PC Instruments Function Generator makes the procedure faster and more convenient than when using non-PC Instruments equipment. Remember that no verification is performed on the PC Instruments Function

Generator by this test and it is assumed that it is functioning correctly. You will also need co-axial cables to connect the selected signal source to both channel inputs (INPUT A and INPUT B) of the Counter.

Table B-1. Test and Calibration Equipment

Equipment	Specifications	Use
Oscillator	9 MHz to 10.5 MHz, 0.25 ppm @ 100 mv to 5 volts p-p.	V
Frequency Standard	10 MHz ±2.5 Hz @ 0-40°C	C1
Oscilloscope	100 MHz bandwidth, externally triggered timebase	C1
High Precision Counter	10 MHz range, 1 Hz resolution, 0.25 ppm @ 10 MHz. E.g., HP 5335A or 5384A with a high stability "oven" timebase.	C2
BNC Cables	50 ohm; two required	V,C1, C2
Tee Type Connector	50 ohm	V

Note: V = Used for verification
C1 = Used for calibration method 1.
C2 = Used for calibration method 2.

What The Verification Test Does

When you first run the verification program, it does a system level verification that partially tests all the instruments in your system. This part of the test is described in Appendix B of your System Owner's Manual. After your Counter passes these preliminary tests, it will appear in a menu along with the other instruments in your system that passed the test. This menu is the starting point for the instrument-specific verification tests for all of your instruments. To continue testing your Counter, you must select it from this menu and press f7 (TEST). When you select an instrument from the menu, the ACTIVE indicator on the front of the instrument lights up.

The instrument-specific Verification of the Counter is performed in two steps: Control tests and Measurement tests.

1. Control tests. This first step tests the operation of the control circuits of the Counter. Several of the important control and status signals of the Counter are stimulated with programmed commands to verify that they respond properly. Once these signals have been verified, the trigger modes (Manual and Internal) of the Counter are checked.

2. Measurement tests. This second step tests the measurement performance of the Counter for each of its functions. Connect the signal source or Function Generator as instructed by the program. If you are not using the PC Instruments Function Generator you must type in the frequency of the signal source to within ±5%. If you are using the PC Instrumetns Function Generator the frequency is automatically programmed.

   The Counter is programmed to perform measurements using the following functions: Frequency, Period, Ratio, Totalize, Interval (using common and separate sources). The program

compares the measured value to an expected value. The expected value is based on the frequency you input (if using non-PC Instruments equipment) or the value programmed to the Function generator (when using PC Instruments test equipment). When the test completes, a message is printed on the screen that tells you the Counter has either passed or failed.

Test Results

It is important that you complete all verification tests on both the system and the instrument level. If your Counter does not pass the Control Test, repeat the tests. If it fails again, consult your Support Guide for information on the PC Instruments exchange program. If your Counter fails the Measurement tests, calibrate the Counter by following the procedures below and repeat all the tests. If the Counter still fails, consult your Support Guide for information on the PC Instruments exchange program.

Instrument Calibration

Please read the following procedure before attempting to calibrate the Universal Counter. You only have to make one adjustment to calibrate the Counter. You can calibrate it using either of the two methods described in this appendix. The equipment you have available determines the method you should use. The first method requires an oscilloscope and frequency standard. The second method requires a high precision counter. Consult Table B-1 for complete specifications for this equipment. Regardless of which method you choose, you must follow the preliminary instructions given below.

Preliminary Instructions

The calibration procedure requires that the Universal Counter be disconnected from the PC Instruments Interface Bus.

CAUTION

When you remove the instrument from the bus you cannot resume programming the instrument without re-initializing the system. To re-initialize the system, you must re-run the entire program or load and run another program.

Disconnect the power from the Universal Counter. Make sure that power is off by checking that the ON indicator is not lit. Now disconnect the interface bus cable from the instrument. The next step is to remove the top cover of the instrument in order to gain access to the component side of the printed circuit board to make the necessary adjustment.

Instrument Disassembly

1. Turn the Universal Counter upside down.

2. Remove the nuts from the two BNC connectors on the front of the unit.

3. Insert a small, strong, screwdriver into one of the rear latch holes at a 45° angle as shown in Figure B-1. Pay particular attention to the screwdriver placement shown in the detail drawing of the latch hole.

4. Firmly move the screwdriver handle toward the side of, and away from, the unit to release the latch and partly separate the top of the unit from its bottom.

5. Repeat steps 3 and 4 for the other side and remove the top of the unit. When you separate the top from the bottom, two plastic spacers inside the instrument may fall; put them in a safe place so you don't lose them.

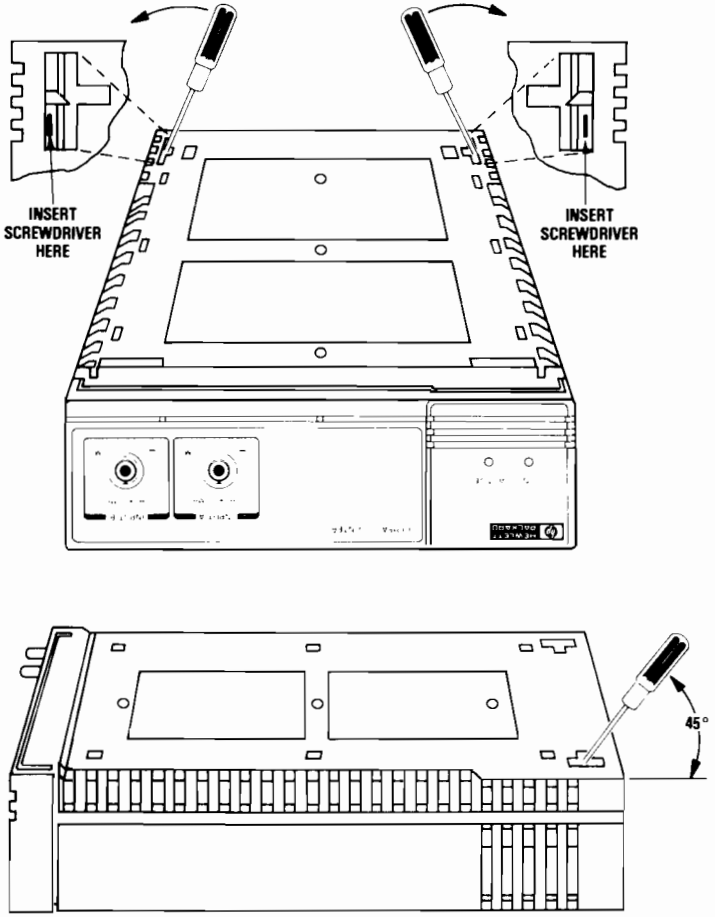

Figure B-1. Cover Removal

Calibration Method 1

Once the top cover has been removed from the Universal Counter, connect the oscilloscope input probe between U11 pin 33 and ground (ground can be found opposite the + side of C34). See Figure B-2 for the location of these components.

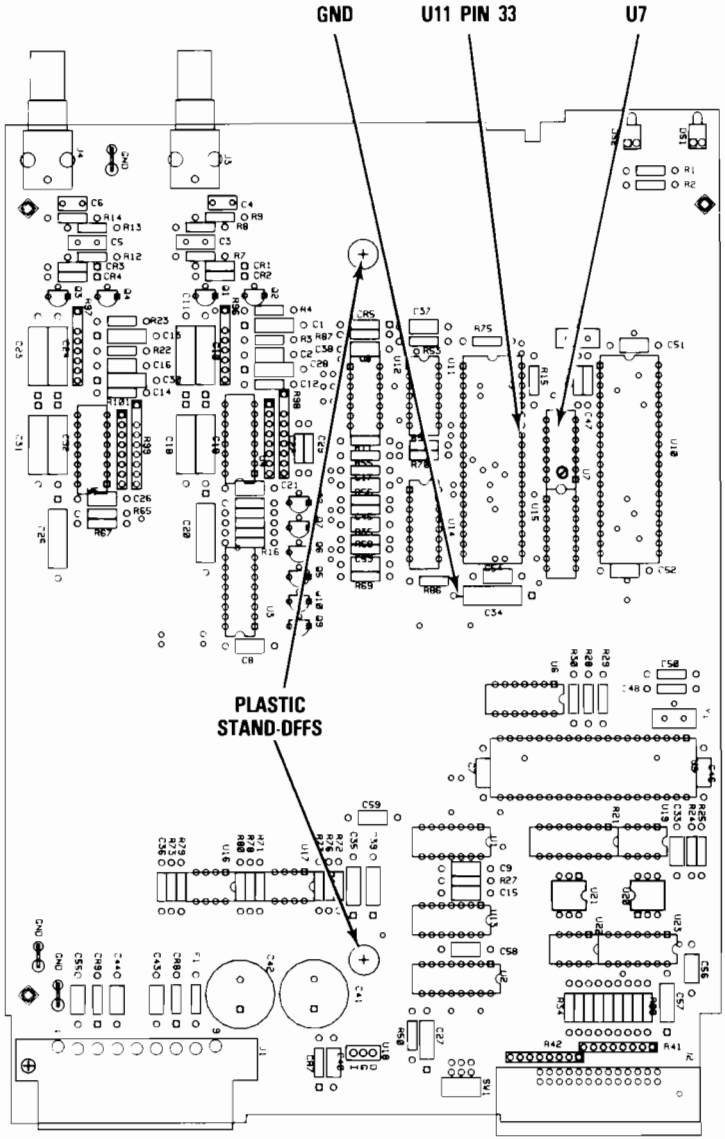

Figure B-2. Component Locations

Set the oscilloscope timebase to 0.1 microsecond/div and the selected input channel to AC coupling. Connect the frequency standard to the external trigger input of the oscilloscope. Set the oscilloscope for external triggering on the positive edge of the input signal supplied by the frequency standard. Your set-up should now look like Figure B-3.

Re-connect the power to the Counter and verify that the ON indicator is lit. Now adjust the trigger level on the oscilloscope so the waveform from U11 of the Universal Counter is displayed on the oscilloscope. The displayed waveform will be drifting rapidly across the screen if the Counter requires calibration. Use a small nonferromagnetic adjustment tool to rotate the screw adjustment on U7 until the waveform displayed on the oscilloscope is as steady as possible. Once this adjustment is complete, disconnect the power input to the instrument, remove the test equipment, and reassemble the instrument case as explained on the following page.

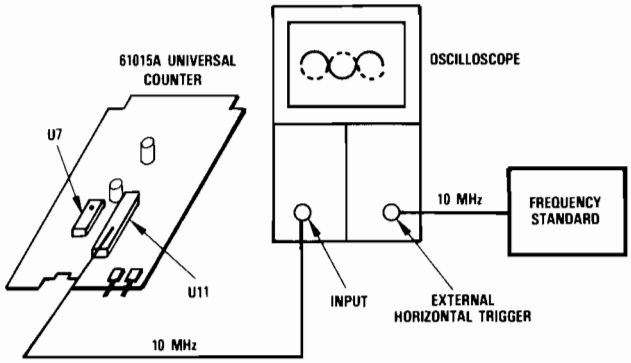

Figure B-3. Calibration Set-up

Calibration Method 2

Once you have removed the top cover of the Universal Counter, connect pin 33 of U11 to the input of the test counter listed in Table B-1. Set the test counter to measure a frequency of 10 MHz with a minimum of 1 Hz resolution. Re-connect the power to the Universal Counter and verify that the ON indicator is lit.

Rotate the screw adjustment on U7 with a small non-ferromagnetic adjustment tool until the test counter reading is within 25 Hz of 10 MHz. Once this adjustment is complete, disconnect the power input to the instrument, remove the test counter, and reassemble the instrument case as described below.

Instrument Re-assembly

1. Place the bottom of the unit on a table top with the circuit board facing up. Replace the plastic spacers over the two plastic stand-offs illustrated in Figure B-2.

2. Replace the top cover by sliding the two BNC connectors through the front until their threads show. To lock the two latches at the rear of the unit requires two steps. First, slightly spread the top cover sides out near the rear of the unit and lightly press down to *partially* close the cover (on some units nothing may appear to happen during this step because the top and bottom covers may be already lined up). Next (near the rear of the unit again) firmly press the top down, and the sides in, until the two latches snap into place. Check that both latches lock into place by inspecting them through the latch holes located on the bottom of the unit as shown by the expanded view in Figure B-1.

3. Snap the back under the tab on the top cover.

4. Replace the nuts on the two BNC connectors.

C Error Messages

The following error messages apply to the Universal Counter. When programming your instrument from BASIC, these messages are only returned when you use the error handling routine described in Chapter 5 of the System Owner's Manual.

101 Action disallowed with present function
102 RANGE must be R10MEGA or R100 MEGA
103 FUNCTION invalid
104 GATETIME must be R100MILLI, R1, or R10
105 START invalid with internal triggering
106 SAMPLES must be R1, R10, R100, R1KILO
107 SLOPE must be POSITIVE or NEGATIVE
108 Channel must be CHAN.A or CHAN. B
109 SOURCE must be COMN or SEPARATE
110 Counter failed self-test
111 Input signal timeout detected
199 System error

HEWLETT PACKARD

PCInstruments

CUSTOMER REPAIR CARD

THIS CARD **MUST** BE FILLED OUT AND RETURNED WITH THE DEFECTIVE MODULE

MODEL#_____ SERIAL#_____

SHIP TO:

COMPANY _____

ATTN. OF_____

BLDG./ROOM_____MAIL STOP_____

STREET ADDRESS_____

CITY _____ STATE _____ ZIP_____

* Did the trouble appear when you ran the verification procedures?

  YES _____ NO _____

  HARD FAILURE ☐ INTERMITTENT ☐

* Which PC was this unit interfaced to?

  MAKE _____ MODEL# _____

* Were all functions bad or just some?

PLEASE EXPLAIN _____

_____

_____

_____

5957-6312

YOUR NAME_____ DATE_____

PHONE ( )_____ YOUR P.O. REFERENCE_____

FOR NON-WARRANTY UNITS ONLY

Fill in all requested customer and payment information. (Credit card or check are the ONLY accepted payment method. DO NOT SEND CURRENCY, COIN, STAMPS or PURCHASE ORDERS.)

PAYMENT METHOD

- ☐ Check Enclosed (payable to Hewlett-Packard)
- ☐ Credit Card (check one, provide all information, and sign)

☐ MasterCard ☐ VISA

ACCOUNT NO.

EXPIRATION DATE MO. YR.

ALL ORDERS SUBJECT TO CREDIT APPROVAL

NAME ON CARD_____

ADDRESS_____

SIGNATURE _____

Include state/local taxes (H.P. is required to collect these; their omission will delay your order.

TAX EXEMPT? ☐ NO ☐ YES

TAX EXEMPT NO.

WARRANTY AND NON-WARRANTY

*** PLEASE RETURN YOUR DEFECTIVE UNIT ALONG WITH THIS CARD**

IN USA SEND UNIT TO:

HEWLETT-PACKARD COMPANY
Mail Order Department
333 Logue Ave.
Mountain View, CA 94039-7220
Phone: (415) 960-5820
(415) 960-5823

*SPECIAL SHIPPING INSTRUCTIONS _____

STANDARD SHIPMENT METHOD IS UPS
If other than UPS is specified above, please phone (415)960-5820 or (415)960-5823 for charges.

*** IN ALL OTHER AREAS, PLEASE CONSULT YOUR P.C. INSTRUMENTS SUPPORT GUIDE.**

Please complete both sides