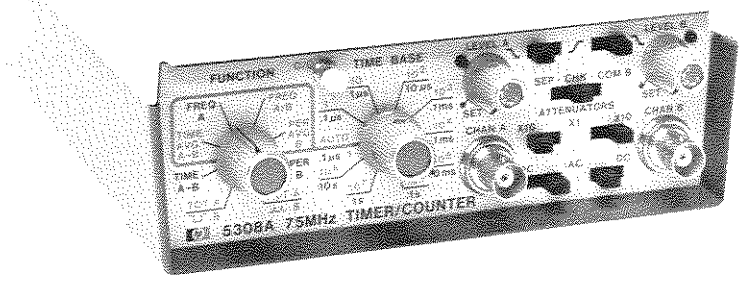
OPERATING AND SERVICE MANUAL

75 MHz TIMER/COUNTER

5308A



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CERTIFICATION

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

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

If this product is sold as part of a Hewlett-Packard integrated instrument system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SECTION IX H

75 MHz TIMER/COUNTER

5308A

OPERATING AND SERVICE MANUAL

SERIAL PREFIX: 1528A

This section applies directly to Model 5308A 75 MHz Timer/Counters having Serial Prefix 1528A. The section is provided in loose-leaf form for incorporation into the 5300B Measuring System Manual.

NEWER INSTRUMENTS

This section with enclosed "Manual Changes" sheet applies directly to HP Model 5308A 75 MHz Timer/Counters having Serial Prefix numbers above 1528A.

OLDER INSTRUMENTS

Subsection VII of this document contains information pertinent to all older instruments with Serial Prefix 1440A or 1524A.

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SECTION IX H
5308A 75 MHz TIMER/COUNTER

SUBSECTION I
GENERAL INFORMATION

9H-1-1. PURPOSE AND USE OF SECTION IX H

9H-1-2. Section IX H contains the information necessary to install, operate, and maintain the HP 5308A Timer/Counter. Theory of operation, parts lists, component locator illustrations, and a schematic diagram are included. Insert this document in the HP 5300B Measuring System manual as part of Section IX.

9H-1-3. INSTRUMENT DESCRIPTION

9H-1-4. When plugged onto a 5300B mainframe, the 5308A can measure frequency, frequency ratio, period, period average, time interval, and time interval average. A single-channel or a two-channel totalize function is provided. The two-channel function totalizes pulses on Channel A during pulses on Channel B or between pulses on Channel B.

9H-1-5. Front panel controls are provided for function and time base selection and for signal conditioning (slope, level, and attenuation). Automatic selection of maximum resolution is provided for the four functions of frequency, frequency ratio, period average, and time interval average measurements. Trigger indicator lamps are provided to indicate when internal amplifier triggering occurs.

9H-1-6. Rear panel connectors provide a gate output for Z axis modulation of an oscilloscope, trigger level outputs for monitoring the voltage level at which each channel triggers, and a time base output for use in totalizing, period, and time interval measurements.

9H-1-7. The electrical and mechanical specifications are listed in Table 9H-1-1.

9H-1-8. INSTRUMENT IDENTIFICATION

9H-1-9. Hewlett-Packard uses a two-section, nine-digit serial number (0000A00000) mounted on the rear panel to identify the instrument. The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix on your instrument differs from that listed on the title page of this section, there are differences between the manual and your instrument. Lower serial prefixes are covered by a manual change sheet included with the manual.

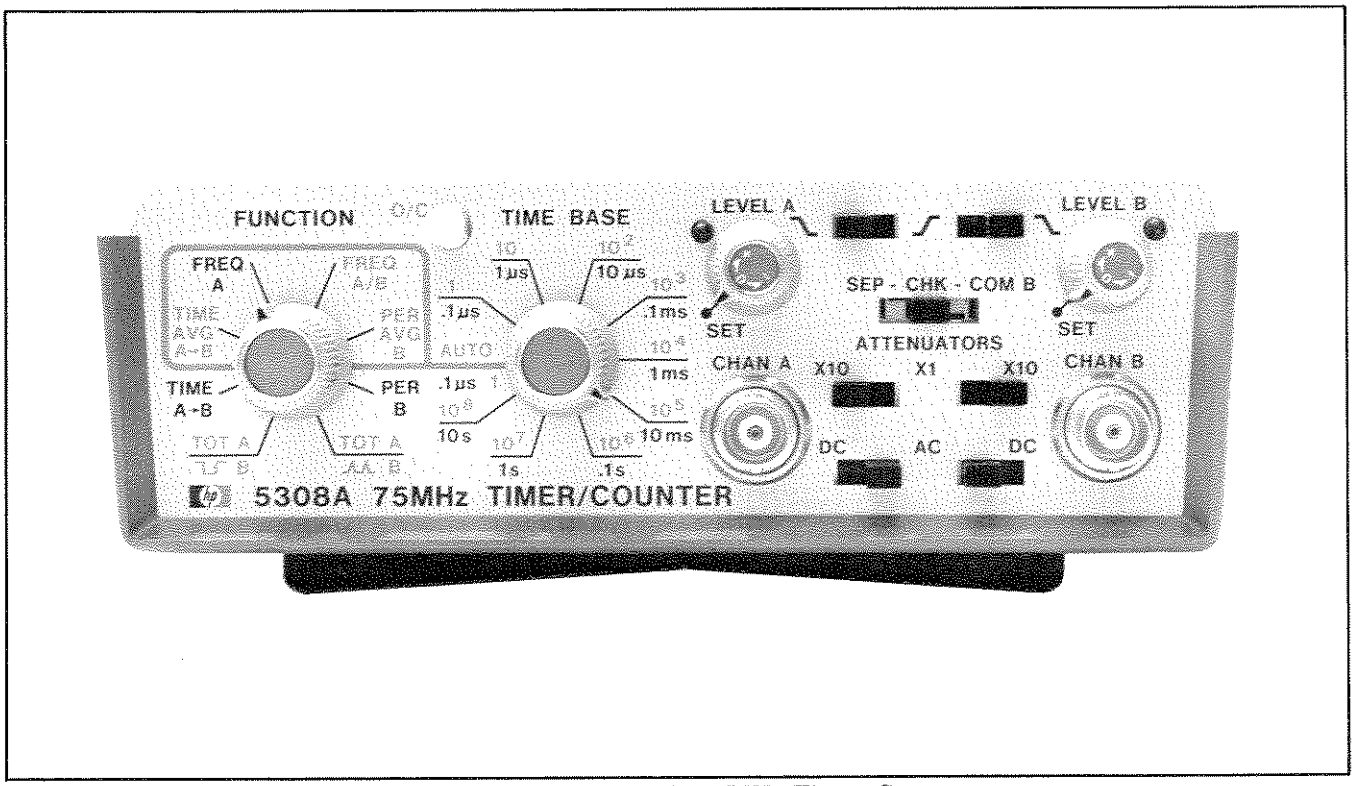


Figure 9H-1-1. 5308A 75 MHz Timer/Counter

9H-1-10. The printed circuit board within the instrument is identified by a two-section, 10-digit part number (e.g., 05308-60001) and a four-digit series number (e.g., "SERIES 1440A"). The series number identifies the electrical characteristics of the complete printed-circuit assembly. A replacement circuit-board assembly may have a different series number than the assembly originally supplied with the instrument. Therefore, when troubleshooting a circuit-board assembly, ensure that the series number on the schematic diagram matches the series number on the board assembly. If the series number on the assembly is lower than the number on the schematic diagram in Subsection VIII, refer to Subsection VII of this document for change information. If the series number on the assembly is higher than the number on the schematic diagram in Subsection VIII, the change information is provided in a manual change sheet which is available from the nearest Hewlett-Packard Sales and Service Office.

9H-1-11. Manual Changes and Options

9H-1-12. The title page lists the serial prefix number to which this manual directly applies. If the serial prefix is different from the one listed, a change sheet is included describing the required changes. If this change sheet is missing, the information can be supplied by any Hewlett-Packard Sales and Service office listed in Section VIII of the 5300B Measuring System manual. Options are listed in Section IX H, Subsection VII.

Table 9H-1-1. Specifications

INPUT CHANNELS A AND B

RANGE: DC Coupled; 0 to 75 MHz
AC Coupled; 20 Hz to 75 MHz

SENSITIVITY: (Min) 25 mV rms sine wave to 10 MHz. 50 mV rms sine wave to 75 MHz. 150 mV p-p pulse at minimum pulse width of 10 ns. Input must be less than 1V rms from 50 to 75 MHz with Attenuator switch in X1 position. Sensitivity can be decreased by 10 using Attenuator switch.

IMPEDANCE: 1 MΩ shunted by less than 48 pF.

OVERLOAD PROTECTION: †

DC Range:

X1:	DC to 400 kHz	125V rms
	400 kHz to 5 MHz	Vrms = $(5 \times 10^7) \div (Hz)$
	5 MHz to 75 MHz	10V rms
X10:	DC to 4 MHz	250V rms
	4 MHz to 75 MHz	Vrms = $(1 \times 10^9) \div (Hz)$

AC Ranges:

DC to 10 Hz	200V peak in addition to above ratings.

TRIGGER LEVEL: Set position centers triggering at 0 volts, or continuously variable over the range of ±2.0V with Attenuator in X1 position or ±20V with Attenuator in X10 position. Trigger level available on rear panel BNC connectors for DVM monitoring.

SLOPE: Independent selection of triggering on positive or negative slope.

CHANNEL INPUTS: Separate or Common B

GATE OUTPUT: Rear panel BNC. TTL low level while gate is open may be used to intensity modulate an HP oscilloscope.

TIME BASE/SCALING OUTPUT: Available at rear panel BNC.

FREQUENCY

RANGE: 0 to 75 MHz, Channel A or Channel B.

GATE TIMES: 8 manually selectable times from 1 μs to 10 seconds. AUTO position selects gate time for maximum resolution within a 1.1 second measurement time.

ACCURACY: ±1 count ± time base accuracy.

DISPLAY: Hz, kHz, and MHz with positioned decimal point.

FREQUENCY RATIO

DISPLAY: Fa/Fb, measured over N periods of Fb. N=1 to 10^8, selectable in decade steps with automatic decimal position and annunciators. AUTO position selects N automatically for maximum resolution within a 1.1 second measurement time.

RANGE: Channel A; 0 to 75 MHz. Channel B; 0 to 5 MHz.

ACCURACY: ±1 count of Fa ± trigger error of Fb*.

PERIOD

RANGE: 0 Hz to 5 MHz, Channel B

RESOLUTION: 100 ns to 10 s in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error*.

DISPLAY: μs, or s with positioned decimal point.

PERIOD AVERAGE

RANGE: 0 to 5 MHz; (100 ns to 10 s), Channel B.

PERIODS AVERAGED: 1 to 10^8 manually selectable in decade steps. AUTO position automatically selects number of periods for maximum resolution within a 1.1 second measurement time.

FREQUENCY COUNTED: 10 MHz.

ACCURACY: ±1 count ± time base accuracy ± trigger error*.

DISPLAY: mμs (ns), μs, with positioned decimal points. (In the 10^8 position of the TIME BASE switch, the display will be ps with no annunciator shown.)

TIME INTERVAL

RANGE: 200 ns to 10^9 s. 25 ms minimum pulse width. Separate or Common B.

RESOLUTION: 100 ns to 10 s in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error*.

DISPLAY: μs, s, or ks with positioned decimal point.

TIME INTERVAL AVERAGE

RANGE: 1 ns to 10 s. 200 ns dead time between intervals. Channels A and B separate or Common B.

INTERVALS AVERAGED: 1 to 10^8 selectable in decade steps. AUTO position selects number of intervals to give maximum resolution within a measurement time of 1.1 second.

DISPLAY: mμs (ns), μs, or s with positioned decimal point. (In the 10^8 position of the TIME BASE switch, the display will be in ps with no annunciator shown.)

ACCURACY: ± time base accuracy ±5 ns

$$\frac{\pm\,[\text{Trigger Error}^* \pm 100\text{ ns}]}{\sqrt{\text{Intervals Averaged}}}$$

TOTALIZE

Totalizes Channel A during pulses on Channel B.
Totalizes Channel A between pulses on Channel B.

RANGE: 75 MHz on Channel A in position 1 of TIME BASE switch, 5 MHz in other positions of TIME BASE switch.

ACCURACY: ±1 count ± trigger error on Channel B*.

DISPLAY: Displays count. Can scale display with annunciator by use of TIME BASE switch to increase count capacity.

GENERAL

NOTE: 5308A is compatible with 8 digit 5300B mainframe only.

CHECK: Inserts internal 10 MHz reference frequency into counting decades. Displays 10^N counts for TIME BASE switch positions 10 through 10^8 with proper decimal position and annunciator.

OPERATING TEMPERATURE: 0° to 50°C.

POWER REQUIREMENTS: Including 5300B mainframe, nominally 15 watts.

WEIGHT: Net, 0.9 kg (2 lb). Shipping, 1.5 kg (3¼ lb).

DIMENSIONS: With mainframe 89 mm H (3½″) x 760 mm W (6¼″) x 248 mm L (9¾″).

†SEE WARNING ON PAGE 9H-3-11.

*For any waveshape, trigger error (μs) is less than ±

$$\frac{0.005}{\text{Signal Slope (V/}\mu\text{s)}}$$

For period average, this is less than ±0.3% of one period ÷ periods averaged for signals with 40 dB or better signal-to-noise ratio.

SECTION IX H
5308A 75 MHz TIMER/COUNTER

SUBSECTION II
INSTALLATION

9H-2-1. INTRODUCTION

9H-2-2. This section contains information on unpacking and inspection, storage and shipment, installation and removal of plug-on, and portable operation.

9H-2-3. UNPACKING AND INSPECTION

9H-2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inpsect the instrument for damage such as scratches, dents, broken knobs, etc. If the instrument is damaged or fails to meet performance tests when used with the 5300B mainframe, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. Performance check procedures are located in Subsection V, and Sales and Service Offices are listed in Section VI of the 5300B portion of the manual. Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service Office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

9H-2-5. STORAGE AND SHIPMENT

9H-2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packaging material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. The unit was originally packaged as follows:

> The original container is a corrugated cardboard box with 200 lbs. burst test (HP 9211-1620). The instrument is secured and protected in the box by a top and bottom molded frame of polystyrene foam (HP No. 9220-1545).

9H-2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 feet.
b. Minimum temperature: -40°F (-40°C).
c. Maximum temperature: +167°F (+75°C).

9H-2-8. INSTALLATION AND REMOVAL OF PLUG-ON

9H-2-9. The counter must be used with a 5300B mainframe to make measurements. Mate the counter and the mainframe according to the instructions given in Paragraph 2-11 and Figure 2-1 in the 5300B mainframe documentation.

9H-2-10. PORTABLE OPERATION

9H-2-11. Use of the HP Model 5310A Battery Pack enables the 5300B mainframe and the counter to be used in areas removed from ac power sources. The battery pack provides a minimum of 3 hours operation (typically 5 hours) at 20° to 30°C operating and charging temperature. Tables 1-2 and 1-4 of the 5300B portion of the manual lists the battery pack as an available accessory. Documentation for the battery pack is also included in Section IV through VIII of the 5300B portion of the manual. To prepare the 5300B/5308A for portable operation, refer to Paragraph 2-13 and Figure 2-2, of the 5300B portion of the manual.

SECTION IX H
5308A 75 MHz TIMER/COUNTER

SUBSECTION III
OPERATION

9H-3-1. INTRODUCTION

9H-3-2. This section provides operating information and describes modes of operation and operating procedures. The 5308A plug-on may be used to measure frequency or frequency ratio up to 75 MHz, period to 5 MHz, period average to 5 MHz, time interval from 200 nanoseconds to 10 seconds and time interval average from 1 nanosecond to 10^9 seconds. Signals up to 75 MHz may be totalized on Channel A in the single-channel totalize function. In the two-channel totalize function, signals up to 75 MHz may be totalized on Channel A during pulses on Channel B or between pulses on Channel B.

9H-3-3. OPERATING INFORMATION

9H-3-4. The front panel contains a FUNCTION selector, a TIME BASE selector and signal conditioning controls for use with the Channel A and Channel B input connectors. The signal conditioning controls are labeled LEVEL A and LEVEL B, ATTENUATORS and AC-DC. An O/C (open/close) switch is provided for Channel B and a SEP-CHK-COM B switch is provided for selecting channel inputs and self check function. The purpose and use of these controls is described in the following paragraphs.

9H-3-5. Function Selector

9H-3-6. The FUNCTION selector selects one of the eight operating modes listed in paragraph 9H-3-2.

9H-3-7. Time Base Selector

9H-3-8. The TIME BASE selector provides gate time control for frequency measurements, resolution settings for period or time interval mode, selection of number of cycles averaged during frequency ratio, period average, or time interval average modes, and provides a scaling factor of 1 to 10^8 in the totalize mode. The AUTO position automatically sets the TIME BASE selection (for maximum resolution within 1.1 second measurement time) for frequency gate time, and for number of cycles averaged in ratio, period average and time interval average measurements.

9H-3-9. Signal Conditioning Controls

9H-3-10. Four types of signal conditioning controls are provided for each channel (A and B) input. These controls allow adjustment of trigger level and selection of attenuation, slope and ac or dc coupling. The effect of these controls is to minimize inaccuracies in measurements (refer to Figure 9H-3-1).

9H-3-11. ATTENUATORS. X1 and X10 positions (both channels). The X10 position of the attenuator switch is used to attenuate large amplitude signals. The X1 position represents no attenuation. The switch setting X10 increases the trigger levels and hysteresis voltages by a factor of 10. If input signal levels are unknown, the initial measurements should be made with the attenuator switches set to X10. The setting may then be changed to X1 if necessary to obtain a stable, usable measurement.

9H-3-12. SLOPE SWITCHES (both channels). The slope switches allow triggering on the positive slope or the negative slope of the input signals (see Figure 9H-3-1).

9H-3-13. LEVEL A and LEVEL B. The level controls allow adjustment of the triggering point on the input signal waveform. With the LEVEL controls set to the "0" position (or to the SET position when the rear panel 'SET' TRIG LEVELS switch is in the .0V position as described in Figure 9H-3-3) triggering is centered around zero volts. The voltage range over which triggering may be set is ±2 volts with the attenuators in the X1 position or ±20 volts with the attenuator switch in the X10 position.

9H-3-14. AC-DC SWITCHES (both channels). The AC-DC switches select ac or dc coupling. In AC position with the LEVEL control set for triggering centered around zero ac volts, the dc components on the signal have no effect. In DC position with the LEVEL control in SET (as described in the preceding paragraph) triggering is centered around zero volts dc.

9H-3-15. O/C (open/close) Switch

9H-3-16. This pushbutton switch controls totalizing of Channel A input signals as described in paragraph 9H-3-34. This switch also controls the stopwatch function as described in paragraph 9H-3-40.

9H-3-17. SEP-CHK-COM B Switch

9H-3-18. This switch provides selection of separate Channel A and Channel B inputs in the SEP position. The CHK position enables the self check function as described in paragraph 9H-3-39 and the stopwatch function as described in paragraph 9H-3-41. The COM B position connects the CHAN B connector on the front panel to the Channel A and Channel B amplifier circuits in parallel.

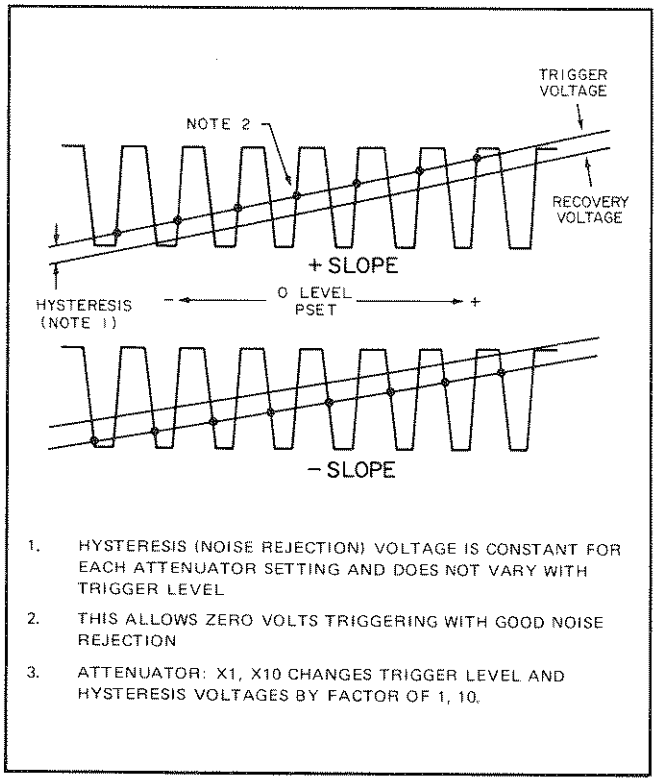


Figure 9H-3-1. Signal Conditioning Using Attenuator, Level and Slope Controls

9H-3-19. MODES OF OPERATION

9H-3-20. The 5308A provides seven modes of operation in addition to a self-check function and a stopwatch function. Some modes of operation are available on both channels (A or B) while other modes are available on only one channel. In all cases, the modes are selected by the FUNCTION switch. The modes and functions are:

a. Frequency Mode (Channel A or B).

b. Frequency Ratio Mode (Channel A/B).

c. Period Mode (Channel B only).

d. Period Average Mode (Channel B only).

e. Time Interval Mode (Channel A to B or Channel B only).

f. Time Interval Average Mode (Channel A to B or Channel B only).

g. Totalize Mode (Single or two channel).

h. Self Check Function.

i. Stopwatch Function.

9H-3-21. Frequency Mode (Channel A or B)

9H-3-22. Frequency measurements may be made on Channel A or B from 0 to 75 MHz. Front panel controls are set to the same relative positions for measurements on either channel with the exception that the SEP-CHK-COM B switch is set to SEP for Channel A and to COM B for Channel B measurements. The LEVEL A control adjusts the triggering point on the input signal for Channel A or Channel B in the frequency mode. Accuracy is ±1 count ± time base accuracy.

9H-3-23. Frequency Ratio Mode (Channel A/B)

9H-3-24. The frequency ratio of Channel A signals (from 0 to 75 MHz) to Channel B signals (0 to 5 MHz) can be measured. The TIME BASE switch setting (1 to 10^8) selects the number of cycles of the Channel B signal over which the ratio A/B is averaged. Accuracy is ±1 count of Frequency A ± trigger error of Frequency B. Increasing the number of cycles of Frequency B (higher setting of TIME BASE switch) results in increased accuracy.

9H-3-25. Period Mode (Channel B)

9H-3-26. The period mode allows single period measurements to be made with frequencies of 0 to 5 MHz into Channel B. The resolution is selectable from 100 nanoseconds to 10 seconds by the TIME BASE switch. Accuracy is ±1 count ± time base accuracy ± trigger error.

9H-3-27. Period Average Mode (Channel B)

9H-3-28. The period average mode allows multiple period averages to be made with frequencies of 0 to 5 MHz into Channel B. The number of periods to be averaged is selected by the TIME BASE switch (1 to 10^8). Accuracy is ±1 count ± time base accuracy ± trigger error. The ± 1 count and trigger error is reduced in proportion to the number of periods averaged.

9H-3-29. Time Interval Mode (Channel A to B or Channel B only)

9H-3-30. The time interval mode allows time measurements to be made between points on one waveform or between two waveforms. The range of measurements is 200 nanoseconds to 10^9 seconds (minimum pulse width of 25 nanoseconds) with resolution of 100 nanoseconds to 10 seconds in decade steps. A Start signal (Channel A) opens the main gate and a Stop signal (Channel B) closes it. (For Start and Stop signals from a common source, the CHAN B input is used and the SEP-CHK-COM B switch is set to COM B.) A TTL low output is available at the GATE OUT connector on the rear panel while the gate is open. This output is

used to intensity modulate an oscilloscope for display of the time interval measured. Accuracy is ± 1 count ± time base accuracy ± trigger error. For more precise measurement of trigger level, connectors are provided on the rear panel for DVM monitoring of the trigger level voltage.

9H-3-31. Time Interval Average Mode (Channel A to B or Channel B Only)

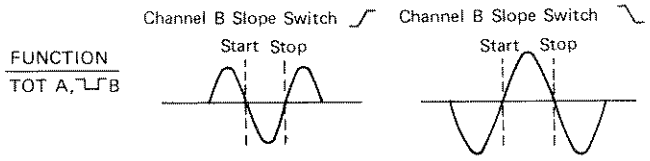
9H-3-32. The time interval average mode provides greater resolution of time interval measurements than the time interval mode provides. The ± 1 count error can be reduced by averaging a number of measurements. In the time interval average mode, the main gate is open for the number of time intervals selected by the TIME BASE switch. Up to 10^8 time intervals may be averaged in this mode. Since the measurement accuracy is increased by $\frac{1}{\sqrt{N}}$ (instead of $\frac{1}{N}$ as shown on the display) the displayed measurement should be evaluated by computing the true resolution which is $\frac{\pm 100\ ns}{\sqrt{N}}$ where N is equal to the number of time intervals selected by the TIME BASE switch. For detailed information on time interval averaging, refer to HP Application Note 162-1.

9H-3-33. Totalize Mode (Single or Two Channel)

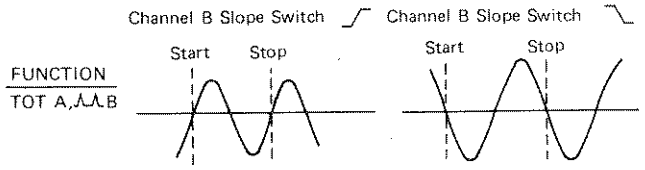
H-3-34. Input signals up to 75 MHz applied to Channel A can be totalized with the TIME BASE switch in position 1. In all other positions of the TIME BASE switch input signals up to 5 MHz can be totalized. The input frequency is scaled by a factor equal to the setting of the TIME BASE switch (10^N).

9H-3-35. For single-channel totalizing, the Channel A signal is totalized under control of the O/C switch when the FUNCTION switch is in the TOT A, ⎍⎍ B position. Totalizing is initiated by pressing the O/C switch and terminated by pressing the O/C switch a second time.

9H-3-36. For two-channel totalizing, the Channel A signal is totalized under control of the Channel B signal. When the FUNCTION switch is in the TOT A, ⎍⎍ B position (totalize Channel A during pulses on Channel B) the Start and Stop signals on Channel B occur between two successive trigger level crossings in the opposite direction, as follows:



9H-3-37. When the FUNCTION switch is in the TOT A, ⎍⎍ B position (totalize Channel A between pulses on Channel B) the Start and Stop signals on Channel B occur between two successive trigger level crossings in the same direction as follows:



9H-3-38. Self Check Function

9H-3-39. The CHK position of the SEP-CHK-COM B switch on the front panel provides a position where proper operation of the majority of the logic circuits in the 5308A and 5300B is verified. When circuits are functioning properly, the 10^N counts are displayed for positions 10 through 10^8 of the TIME BASE switch with the proper decimal position and annunciator.

9H-3-40. Stopwatch Function

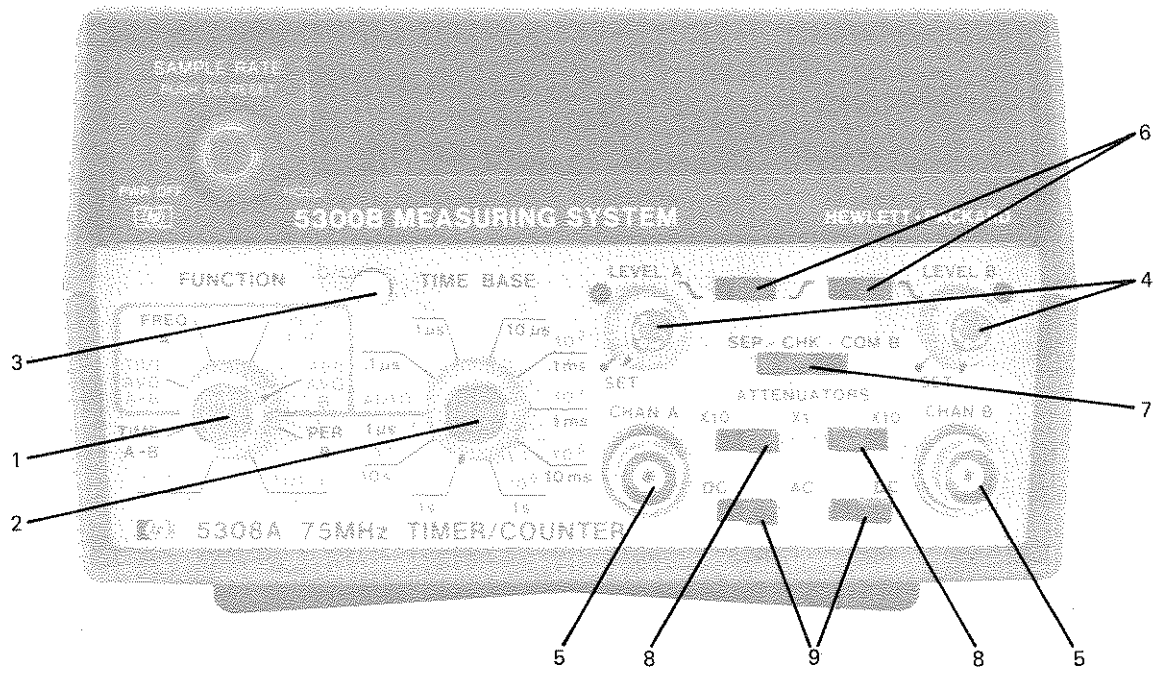
9H-3-41. The CHK position of the SEP-CHK-COM B switch also provides an electronic stopwatch function when the FUNCTION switch is set to TOT A, ⎍⎍ B. After the RESET switch is pressed, the stopwatch count is started by pressing the O/C switch. The count is terminated by pressing the O/C switch a second time. To initiate a new measurement, the RESET switch must be pressed.

9H-3-42. CONTROLS AND CONNECTORS

9H-3-43. The front panel controls and connectors are described in Figure 9H-3-2 and the rear panel switch and connectors are described in Figure 9H-3-3.

9H-3-44. OPERATING PROCEDURES

9H-3-45. The operating procedures for making measurements in the various modes are listed in Figures 9H-3-4 through 9H-3-12.



1. FUNCTION. Eight position switch selects mode of operation, as follows (blue lettering matches corresponding blue lettering on TIME BASE switch):

   a. FREQ A. Enables frequency measurements of 0 to 75 MHz to be made using Channel A.

   b. FREQ A/B. Enables the frequency ratio of Channel A signals to Channel B signals to be taken. The ratio of Channel A input signals (from 0 to 75 MHz) to the Channel B input signals (0 to 5 MHz) can be measured. The ratio is averaged over N cycles of the Channel B signal. N is selectable from 1 to 10^8 by the TIME BASE switch. Accuracy is ±1 count of frequency A, ± trigger error of Frequency B.

   c. TIME AVG A→B. Sets counter to measure average time interval, A to B. Channel A starts the interval and Channel B stops the interval. The TIME BASE switch (blue lettering) sets the number of time intervals to be averaged. Time interval input range is 1 ns to 10 s; there must be a 200 ns deadtime between intervals.

   d. TIME A→B. Sets counter to measure time interval A to B. Channel A starts the measurement and Channel B stops the measurement. Time interval input range is 200 ns to 10^9 s (25 ns minimum pulse width). The TIME BASE switch (black lettering) selects resolution of 100 ns to 10 s.

   e. PER AVG B. Enables multiple period averages to be made from Channel B with frequencies of 0 to 5 MHz (range of 200 ns to 10 s). Use TIME BASE switch (blue lettering) to select number of periods to be averaged (1 to 10^8).

   f. PER B. Enables single period measurements to be made from Channel B with frequencies of 0 to 5 MHz. The TIME BASE switch (black lettering) selects resolution of 100 ns to 10 s.

   g. TOT A, ⊓⊔ B. Totalizes signals on Channel A during pulses on Channel B. (Refer to paragraph 9H-3-33.) Totalizes signals up to 75 MHz with TIME BASE switch in position 1 (blue lettering), up to 5 MHz with TIME BASE switch in any other position (10^N).

Figure 9H-3-2. Front Panel Controls and Connectors

h. TOT A, ⎍⎍ B. Totalizes Channel A between pulses on Channel B. (Refer to paragraph 9H-3-33.) Totalizes signals up to 75 MHz with TIME BASE switch in position 1 (blue lettering), up to 5 MHz with TIME BASE switch in any other position (10^N).

2. TIME BASE. Ten position switch performs the following functions:

   a. 1 μs, 10 μs, .1 ms, 1 ms, 10 ms, .1 s, 1 s, 10 s (black lettering). Provides eight selectable times as gate time controls for frequency (FREQ A) measurements.

   b. .1 μs, 1 μs, 10 μs, .1 ms, 1 ms, 10 ms, .1 s, 1 s, 10 s (black lettering). Provides resolution of 100 ns to 10 s when FUNCTION switch selects period (PER B) or time interval (TIME A→B) mode of operation.

   c. 1, 10, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, (blue lettering). Provides selection of number of cycles or events averaged when FUNCTION switch selects frequency ratio (FREQ A/B), period average (PER AVG B), or time interval average (TIME AVG A→B).

   d. 1, 10, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, (blue lettering). Provides scaling factor when FUNCTION switch selects totalize (TOT A, ⎍⎍ B/TOT A, ⎍⎍ B) modes of operation.

   e. AUTO/.1 μs 1. The AUTO position provides four function auto-ranging (pertains to gray-bordered FUNCTION switch positions) including frequency (FREQ A), frequency ratio (FREQ A/B), period average (PER AVG B) and time interval average (TIME AVG A→B). Provides maximum resolution that can be obtained in each function within a maximum of 1.1 second measurement time.

   f. AUTO/.1 μs 1. The .1 μs 1 position pertains to the FUNCTION switch lower-half positions (corresponding letter colors). The .1 μs position (black lettering) pertains to TIME A→B and to PER B. The 1 position (blue lettering) pertains to TOT A, ⎍⎍ B and to TOT A, ⎍⎍ B.

3. O/C (open/close). Pushbutton switch enables input signals to Channel A to be totalized when the FUNCTION switch selects TOT A, ⎍⎍ B. Totalizing is initiated by pressing the O/C switch and is terminated by pressing the switch a second time. To reinitiate the totalize function the reset switch on the front panel of the 5300B mainframe must be pressed. An additional function of the O/C switch is to operate the display as a stopwatch (see Figure 9H-3-12).

4. LEVEL A and LEVEL B. Used in conjunction with ATTENUATORS switch to determine voltage at which triggering occurs for Channel A or Channel B. In SET position, triggering is centered around 0 volts when the rear panel 'SET' TRIG LEVELS switch is in the .0V position. Trigger level is continuously variable over the range of ±2V (ATTENUATORS IN X1) or ±20V (ATTENUATORS in X10). Adjacent lamp indicates when amplifier triggering occurs.

5. CHAN A and CHAN B. Input connectors for Channel A and Channel B. Input impedance is 1MΩ shunted by less than 48 pF. By using a 10 to 1 divider probe, input impedance can be increased to 10 MΩ.

6. Slope Switch. Selects the triggering on positive or negative slope of the input signals to Channel A (switch on left side) or Channel B (switch on right side).

7. SEP-CHK-COM B. (Separate-Check-Common B).

   a. SEP. Channel A and Channel B are connected for separate source inputs (1 MΩ input impedance).

   b. CHK. Self check verifies that the majority of the 5300B mainframe logic circuits and the 5308A logic circuits are functioning properly.

   c. COM B. Disconnects front panel input connector CHAN A and connects CHAN B to the amplifiers for Channel A and Channel B in parallel (1MΩ input impedance).

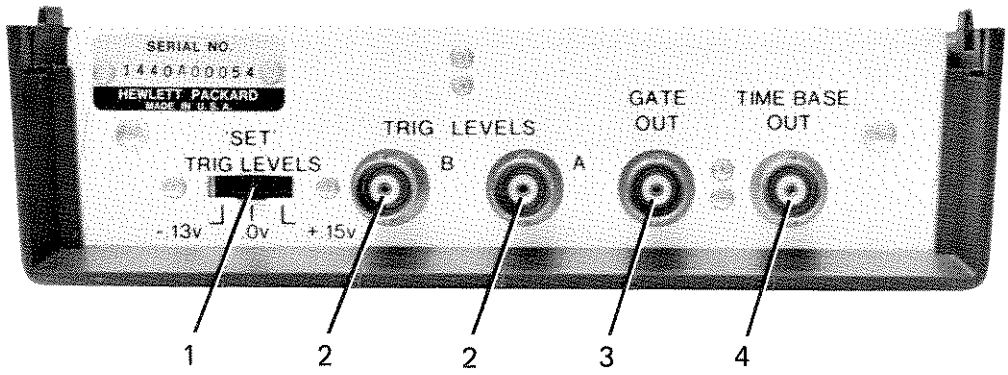
8. ATTENUATORS. Selects attenuation of the input signals to Channel A (switch on left side) and to Channel B (switch on right side).

   a. X1 connects input signals directly to input amplifiers.

   b. X10 attenuates input signals by a factor of 10.

9. AC-DC. Selects ac coupling or dc coupling of the input signals to Channel A (switch on left side) or Channel B (switch on right side).

Figure 9H-3-2. Front Panel Controls and Connectors (Cont'd)



1. 'SET' TRIG LEVELS. Three position switch presets the trigger level to the indicated voltage (-.13V, .0V, +.15V) when the LEVEL control on the front panel is in the SET position. With a 10:1 divider probe connected to the CHAN A or CHAN B connector on the front panel, the -.13V position is used when checking ECL logic circuits and the +.15V position is used when checking TTL logic circuits. The .0V position is used when measuring a symmetrical waveform such as a sine wave.

2. TRIG LEVELS A and B. Connectors provide for measurement of Channel A or Channel B trigger levels by a monitoring DVM. The trigger level voltage is measured at the midpoint of the hysteresis band.

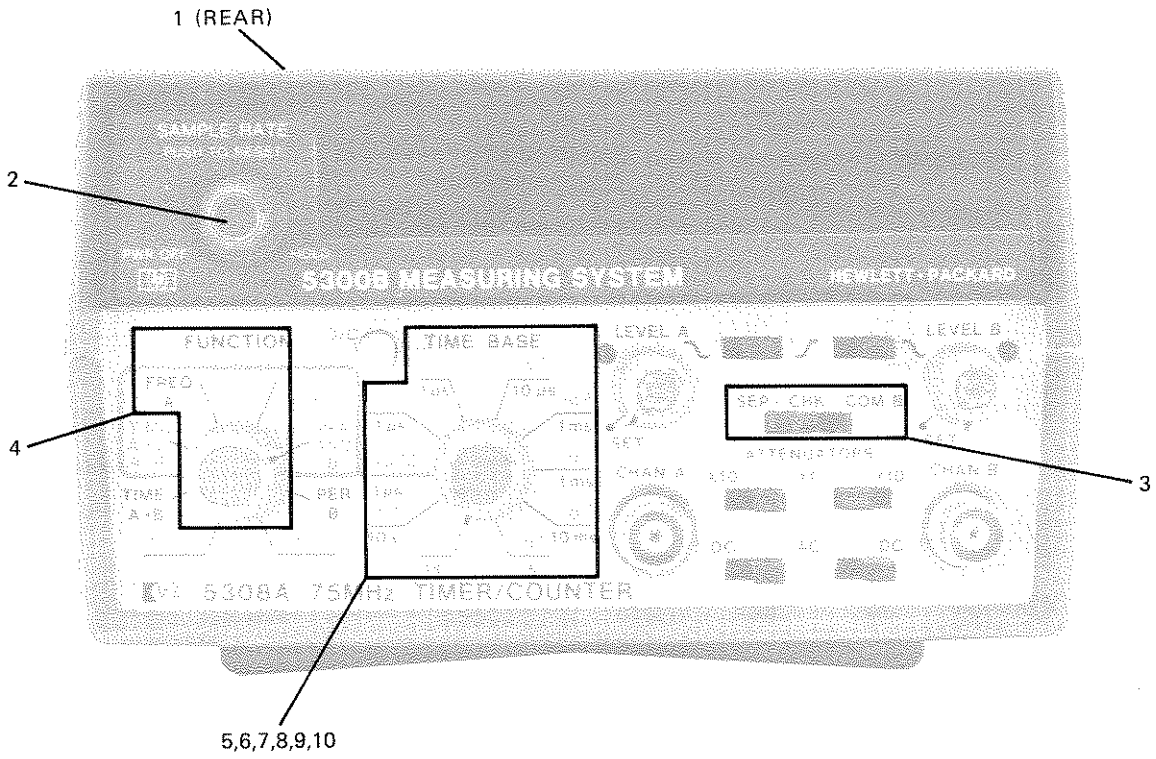
3. GATE OUT. Provides a TTL level signal (LOW) while the 5300B main gate is open. Used for time interval measurements to intensity modulate an oscilloscope to indicate the interval being measured.

4. TIME BASE OUT. This connector provides two different outputs, selectable by the position of the FUNCTION switch, as follows:

   a. In the TOT A, ⌐└┌ B and TOT A, ⌒⌒ B positions of the FUNCTION switch, the TIME BASE OUT connector provides a scaled (divided) output of the input signal frequency applied to Channel A. The output is scaled by a factor of from 10 to 10^8 as set on the TIME BASE control.

   b. In the PER B and TIME A→B positions of the FUNCTION switch, the TIME BASE OUT connector provides a scaled output of the internal 10 MHz oscillator frequency. The output is scaled by a factor of from 10 to 10^8 as set on the TIME BASE control. The period of this output is indicated by the black lettering on the TIME BASE control. The same output is provided when the FUNCTION switch is in TOT A, ⌐└┌ B or TOT A, ⌒⌒ B position and the SEP-CHK-COM B switch is in the CHK position.

Figure 9H-3-3. Rear Panel Control and Connectors



NOTE

If proper indications are not received during the self check, refer to the trouble-shooting procedures in Section V.

1. Connect ac power to 5300B ac receptacle.
2. Turn ac power on with 5300B SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.
3. Set the SEP-CHK-COM B switch to CHK

NOTE

All display indications are ±1 count. In the 10^8 position of the TIME BASE switch, wait 10 seconds for the count display.

4. Set the FUNCTION switch to FREQ A.
5. Set the TIME BASE switch to the positions listed below and observe the display.

Frequency A Self Check

TIME BASE	DISPLAY	ANNUNCIATOR
AUTO	10000.000	kHz
.1 μs	10000.000	kHz
1 μs	00000010	MHz
10 μs	0000010.0	MHz
.1 ms	000010.00	MHz
1 ms	00010.000	MHz
10 ms	0010000.0	kHz
.1 s	010000.00	kHz
1 s	10000.000	kHz
10 s	•0000000.0	Hz

• = OVERFLOW

Figure 9H-3-4. Making Self Check Measurements

Ratio Self Check

6. Set the FUNCTION switch to FREQ A/B. Set the TIME BASE switch as shown below and observe the display.

TIME BASE	DISPLAY	ANNUNCIATOR
AUTO	1000000.0	μ
1	10000000	
10	0000001.0	
10^2	000001.00	
10^3	00001.000	
10^4	0001.0000	
10^5	001.00000	
10^6	01000000	μ
10^7	1000000.0	μ
10^8	•000000.00	μ

• = Overflow

Period Average Self Check

7. Set the FUNCTION switch to PER AVG B. Set the TIME BASE switch as shown below and observe the display.

TIME BASE	DISPLAY	ANNUNCIATOR
AUTO	100.00000	Mμs
1	1000000.0	μs
10	000000.10	μs
10^2	00000.100	μs
10^3	0000.1000	μs
10^4	000.10000	μs
10^5	00100.000	Mμs
10^6	0100.0000	Mμs
10^7	100.00000	Mμs
10^8	•00000.000	

• = Overflow

Mμs = Nanoseconds

Period Self Check

8. Set the FUNCTION switch to PER B. Set the TIME BASE switch as shown below and observe the display.

TIME BASE	DISPLAY	ANNUNCIATOR
AUTO	1000000.0	μs
.1 μs	1000000.0	μs
1 μs	00000010	μs
10 μs	000.00100	s
.1 ms	0000.1000	s
1 ms	00010.000	s
10 ms	001000.00	s
.1 s	0100000.0	s
1 s	10000000	s
10 s	•000000.00	ks

• = Overflow

Time Interval Self Check

9. Set the FUNCTION switch to TIME A→B. Set the TIME BASE switch as shown below and observe the display.

TIME BASE	DISPLAY	ANNUNCIATOR
AUTO	1000000.5	μs
.1 μs	1000000.5	μs
1 μs	00000015	μs
10 μs	000.00105	s
.1 ms	0000.1005	s
1 ms	00010.005	s
10 ms	001000.05	s
.1 s	0100000.5	s
1 s	10000005	s
10 s	•000000.05	Ks

• = Overflow

Time Interval Average Self Check

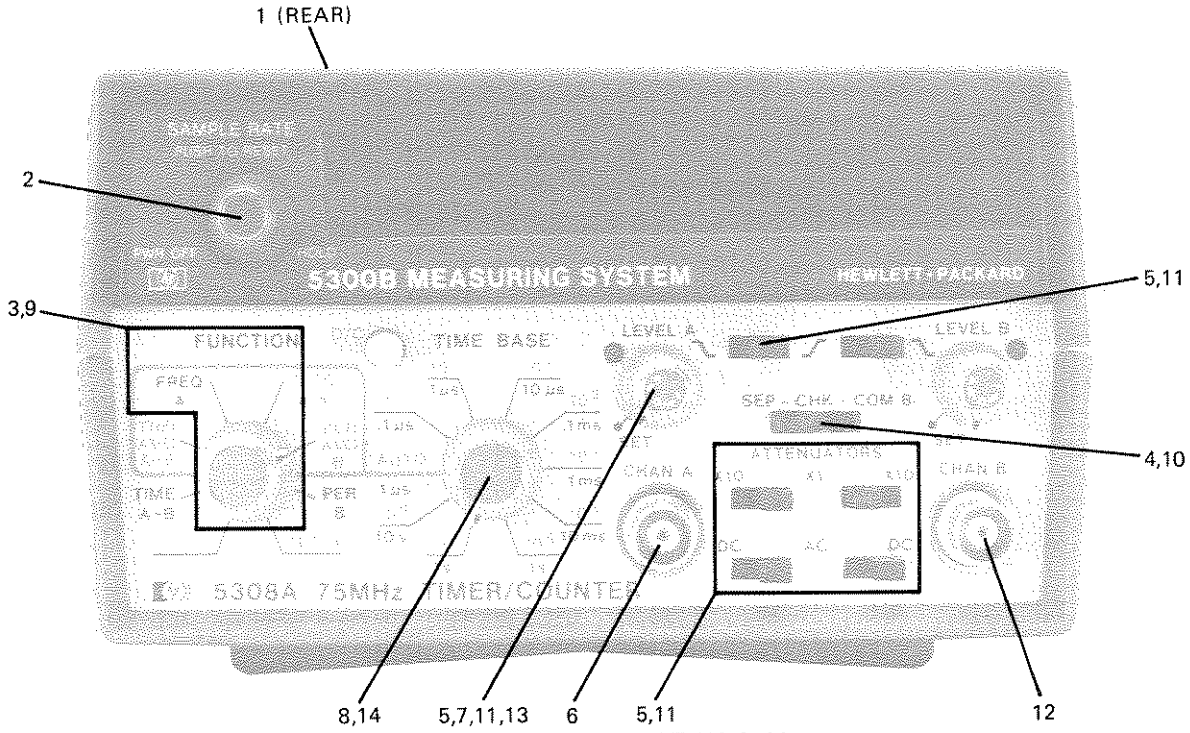
10. Set the FUNCTION switch to TIME AVG A→B. Set the TIME BASE switch as shown below and observe the display.

TIME BASE	DISPLAY	ANNUNCIATOR
AUTO	100.00000	Mμs
1	1000000.0	μs
10	000000.10	μs
10^2	00000.100	μs
10^3	0000.1000	μs
10^4	000.10000	μs
10^5	00100.000	Mμs
10^6	0100.0000	Mμs
10^7	100.00000	Mμs
10^8	•00000.000	

• = Overflow

Mμs = Nanoseconds

Figure 9H-3-4. Making Self Check Measurements (Cont'd)



SEE WARNING ON PAGE 9H-3-11

1. Connect ac power to 5300B ac receptacle.
2. Turn ac power on with the 5300B SAMPLE RATE control.

Channel A

3. Set FUNCTION to FREQ A and adjust SAMPLE RATE for desired display time.
4. Set SEP-CHK-COM B to SEP.
5. Set ATTENUATORS to X10; AC-DC to AC and Channel A slope switch to polarity desired. Set LEVEL A to SET.

NOTE

Ensure that the 'SET' TRIG LEVELS switch on the rear panel is in the .0V position when the LEVEL control is in the SET position.

6. Connect input signal (up to 75 MHz) to be measured to CHAN A connector.
7. Observe display. If display is not stable, rotate LEVEL A control until trigger light illuminates. If necessary, set ATTENUATORS switch for Channel A to X1.
8. Set TIME BASE to desired gate time or to AUTO.

Channel B

9. Set FUNCTION to FREQ A and adjust SAMPLE RATE for desired time.
10. Set SEP-CHK-COM B to COM B.

NOTE

In the Frequency mode of operation, the CHAN B input is processed by the Channel A amplifier circuit. Consequently, the slope and LEVEL controls for Channel A are effective as listed below. The Channel B ATTENUATORS and AC-DC switches are effective (see Figure 9H-8-1).

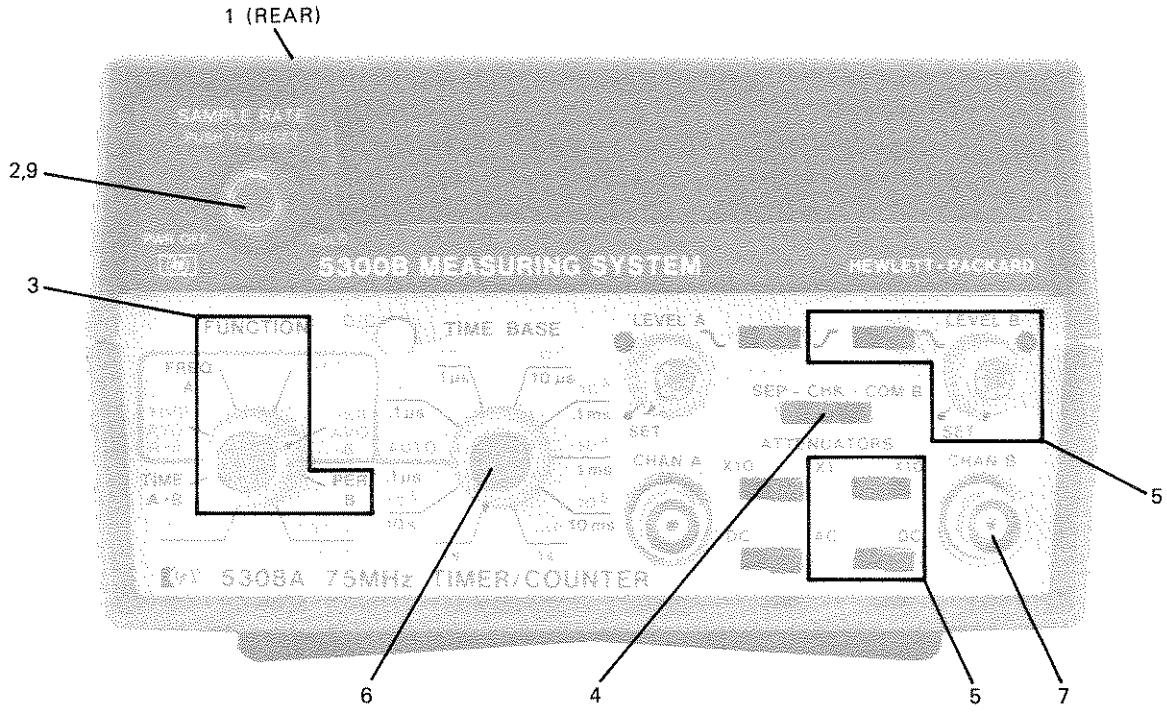
11. Set ATTENUATORS (Channel B) to X10; AC-DC (Channel B) to AC and Channel A slope switch to polarity desired. Set LEVEL A to SET.

NOTE

Ensure that the 'SET' TRIG LEVELS switch on the rear panel is in the .0V position when the LEVEL control is in the SET position.

12. Connect input signal (up to 75 MHz) to be measured to CHAN B connector.
13. Observe display. If display is not stable, rotate LEVEL A control until trigger light illuminates. If necessary, set ATTENUATORS switch for Channel A to X1.
14. Set TIME BASE to desired gate time or to AUTO.

Figure 9H-3-5. Making Channel A and Channel B Frequency Measurements



SEE WARNING ON NEXT PAGE

1. Connect ac power to 5300B ac receptacle.
2. Turn ac power on with 5300B SAMPLE RATE control.
3. Set FUNCTION switch to PER B.
4. Set SEP-CHK-COM B to SEP.

NOTE

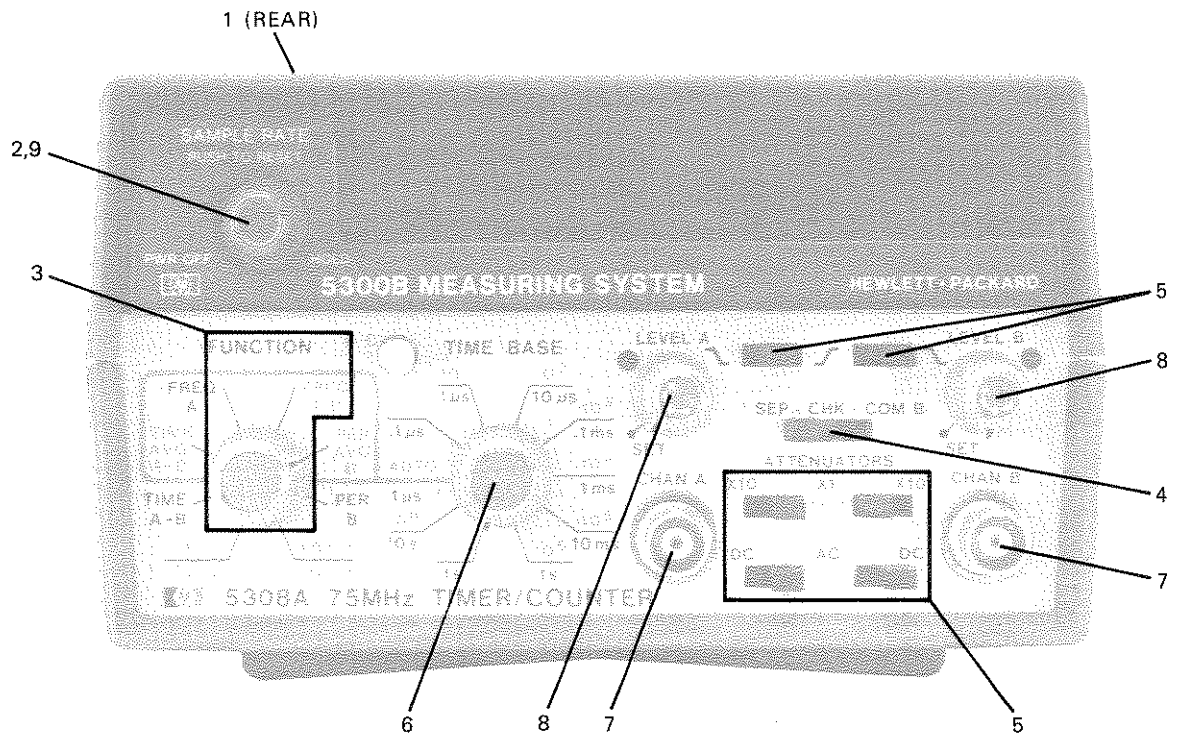
Ensure that the 'SET' TRIG LEVELS switch on the rear panel is in the .0V position when the LEVEL control is in the SET position.

5. Set LEVEL B to SET. Set ATTENUATORS to X10; AC-DC to AC and slope switch to polarity desired.
6. Set TIME BASE to desired resolution or to AUTO.
7. Connect input signal (0 to 5 MHz) to CHAN B connector.
8. Observe display. If display is not stable, rotate LEVEL B control until trigger light illuminates. If necessary, set ATTENUATORS switch for Channel B to X1.
9. Adjust SAMPLE RATE for desired display time.

NOTE

For greater resolution of period measurements, refer to Figure 9H-3-8 for period average measurements.

Figure 9H-3-6. Making Period Measurements

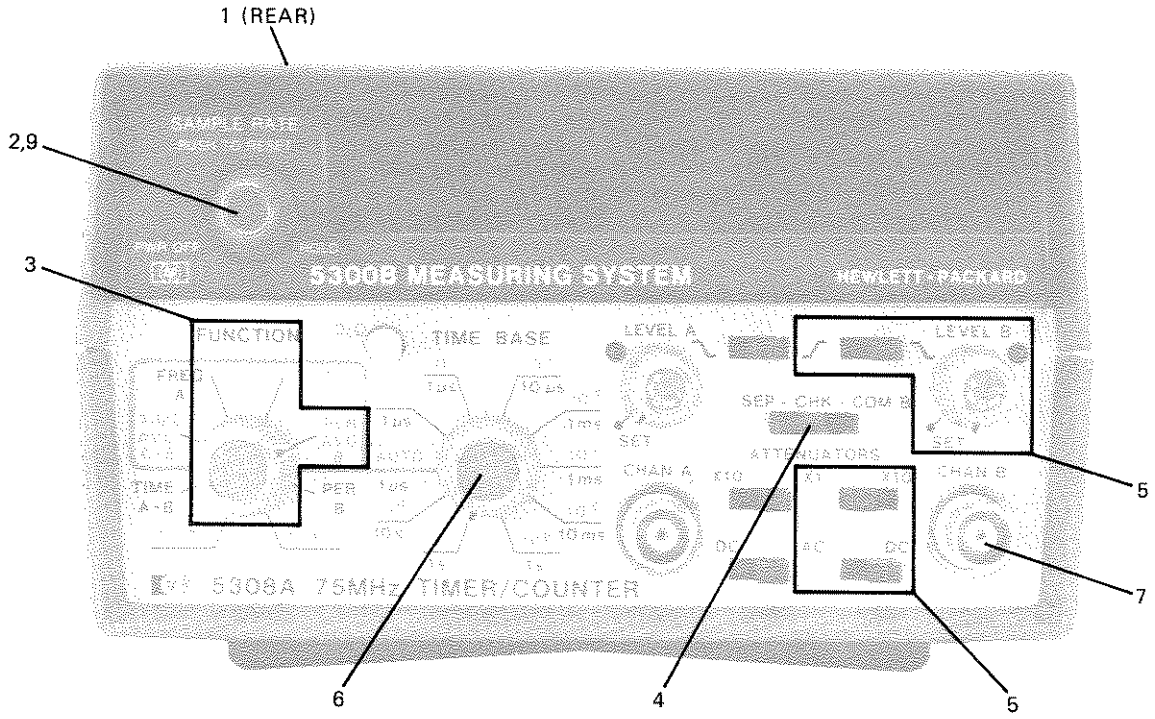


1. Connect ac power to 5300B ac receptacle.
2. Turn ac power on with 5300B SAMPLE RATE control.
3. Set FUNCTION switch to FREQ A/B.
4. Set SEP-CHK-COM B to SEP.
5. Set ATTENUATORS to X1; AC-DC and slope switch as desired.
6. Set TIME BASE to desired setting (1 to 10^8) or AUTO.
7. Connect lower frequency signal (0 to 5 MHz) to CHAN B connector; connect higher frequency signal (0 to 75 MHz) to CHAN A connector.
8. Set the LEVEL A and LEVEL B controls to the middle of the range in which the trigger light illuminates. If necessary, set ATTENUATORS switches to X1.
9. Adjust SAMPLE RATE control for desired display time.

WARNING

TO AVOID POSSIBILITY OF BODILY INJURY AND/OR EQUIPMENT DAMAGE, BE SURE TO OBSERVE POLARITY REQUIREMENTS WHEN CONNECTING TEST LEADS. (HEWLETT-PACKARD RECOMMENDS USING AN ISOLATION TRANSFORMER WHEN MEASURING AC LINE FREQUENCIES.) ADDITIONALLY, DO NOT EXCEED THE INPUT VOLTAGE LIMITATIONS AS SPECIFIED IN TABLE 9H-1-1.

Figure 9H-3-7. Making Ratio Measurements



SEE WARNING ON PAGE 9H-3-11

1. Connect ac power to 5300B ac receptacle.
2. Turn ac power on with 5300B SAMPLE RATE control.
3. Set FUNCTION to PER AVG B.
4. Set SEP-CHK-COM B to SEP.

NOTE

Ensure that the 'SET' TRIG LEVELS switch on the rear panel is in the .0V position when the LEVEL control is in the SET position.

5. Set LEVEL B to SET. Set ATTENUATORS to X10; AC-DC to AC and slope switch to polarity desired.

NOTE

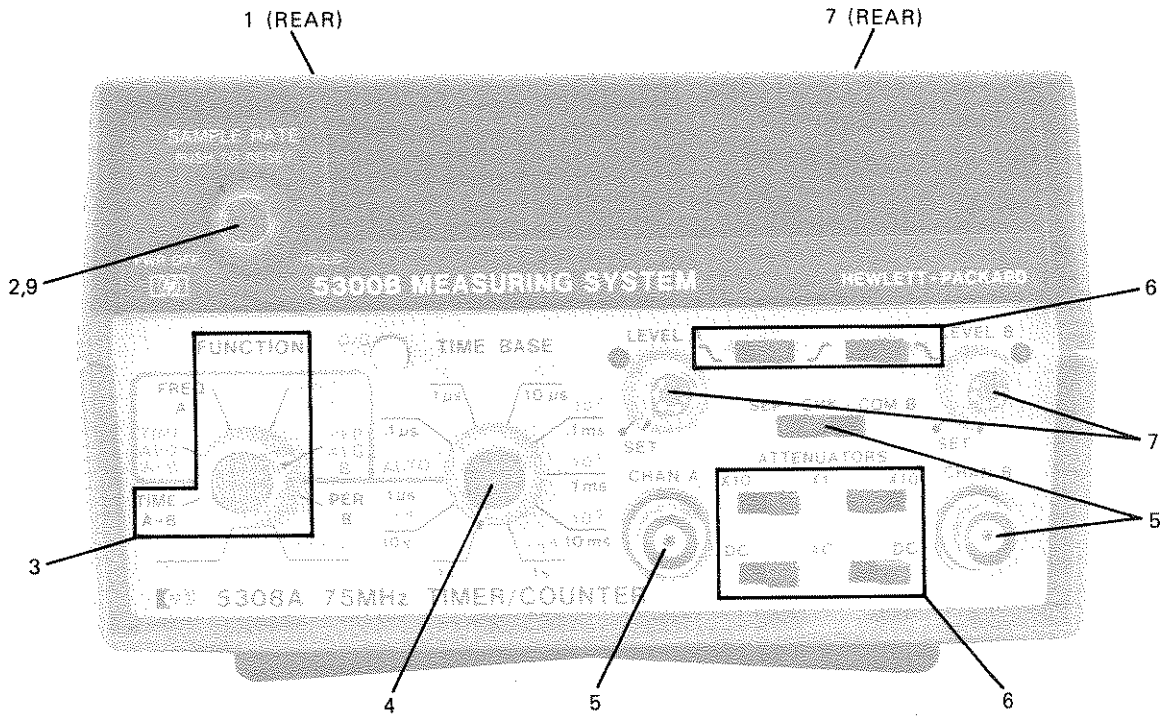
In the 10^8 position of the TIME BASE switch, the display will be in picoseconds with no annunciator shown.

6. Set TIME BASE to desired resolution or to AUTO.
7. Connect input signal (0 to 5 MHz) to CHAN B connector.
8. Observe display. If display is not stable, rotate LEVEL B control until trigger light illuminates. If necessary, set ATTENUATORS switch for Channel B to X1.
9. Adjust SAMPLE RATE for desired display time.

NOTE

For periods greater than 10 seconds, refer to Figure 9H-3-6 for period measurements.

Figure 9H-3-8. Making Period Average Measurements



SEE WARNING ON PAGE 9H-3-11

1. Connect ac power to 5300B ac receptacle.

2. Turn ac power on with 5300B SAMPLE RATE control.

NOTE

There must be at least 200 ns between the STOP pulse and the next START pulse. When measuring the time interval between the same polarity slope of two pulses from a single source, the PER B mode should be used.

3. Set FUNCTION switch to TIME A→B.

4. Set TIME BASE to desired resolution or to AUTO.

5. If the Start and Stop signals are from separate sources connect the Start signal to CHAN A connector. Connect the Stop signal to CHAN B connector and set the SEP-CHK-COM B to SEP. If the Start and Stop signals are from a common source connect to CHAN B connector and set the SEP-CHK-COM B to COM B.

NOTE

When the SEP-CHK-COM B switch is set to COM B, only the CHAN B ATTENUATORS and AC-DC switches are effective. However, both of the LEVEL controls and slope switches are effective.

6. Set ATTENUATORS to X10; AC-DC switches and slope control switches to settings desired.

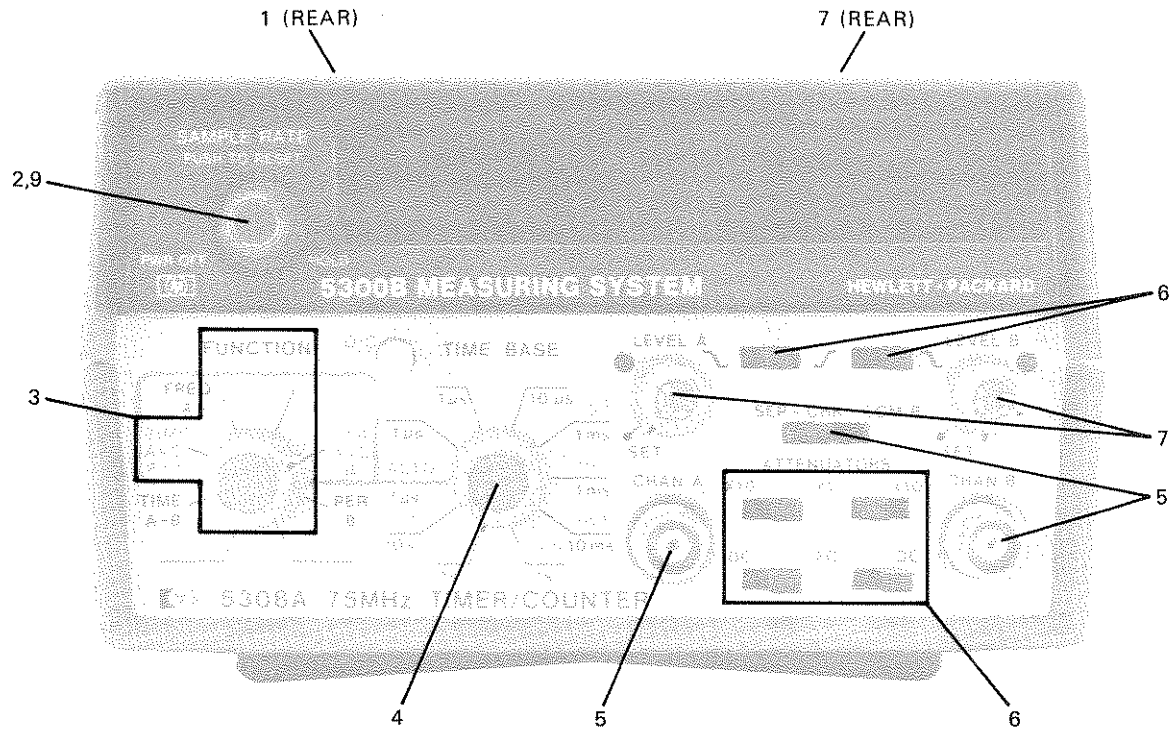
7. If the desired trigger level is not known, set the LEVEL A and LEVEL B controls to the middle of the range in which the trigger light illuminates. If the desired trigger level is known, connect a DVM to the TRIG LEVEL connector for each channel on the rear panel and set the LEVEL A and LEVEL B controls for the desired trigger level. If necessary, set the ATTENUATORS switches to X1.

8. Adjust SAMPLE RATE for desired display time.

NOTE

For greater resolution of time interval measurements refer to Figure 9H-3-10 for time interval average measurements.

Figure 9H-3-9. Making Time Interval Measurements



SEE WARNING ON PAGE 9H-3-11

1. Connect ac power to 5300B ac receptacle.

2. Turn ac power on with 5300B SAMPLE RATE control.

   NOTE

   There must be at least 200 ns between the STOP pulse and the next START pulse. When measuring the time interval average between the same polarity of two pulses from a single source, the PER AVG B mode should be used.

3. Set FUNCTION switch to TIME AVG A−B.

4. Set TIME BASE to desired resolution or to AUTO.

   NOTE

   In the 10^8 position of the TIME BASE switch, the display will be in picoseconds with no annunciator shown.

5. If the Start and Stop signals are from separate sources connect the Start signal to CHAN A connector. Connect the Stop signal to CHAN B connector and set the SEP-CHK-COM B to SEP. If the Start and Stop signals are from a common source connect to CHAN B connector and set the SEP-CHK-COM B to COM B.

   NOTE

   When the SEP-CHK-COM B switch is set to COM B, only the CHAN B ATTENUATORS and AC-DC switches are effective. However, both of the LEVEL controls and slope switches are effective.

6. Set ATTENUATORS to X10; AC-DC switches and slope control switches to settings desired.

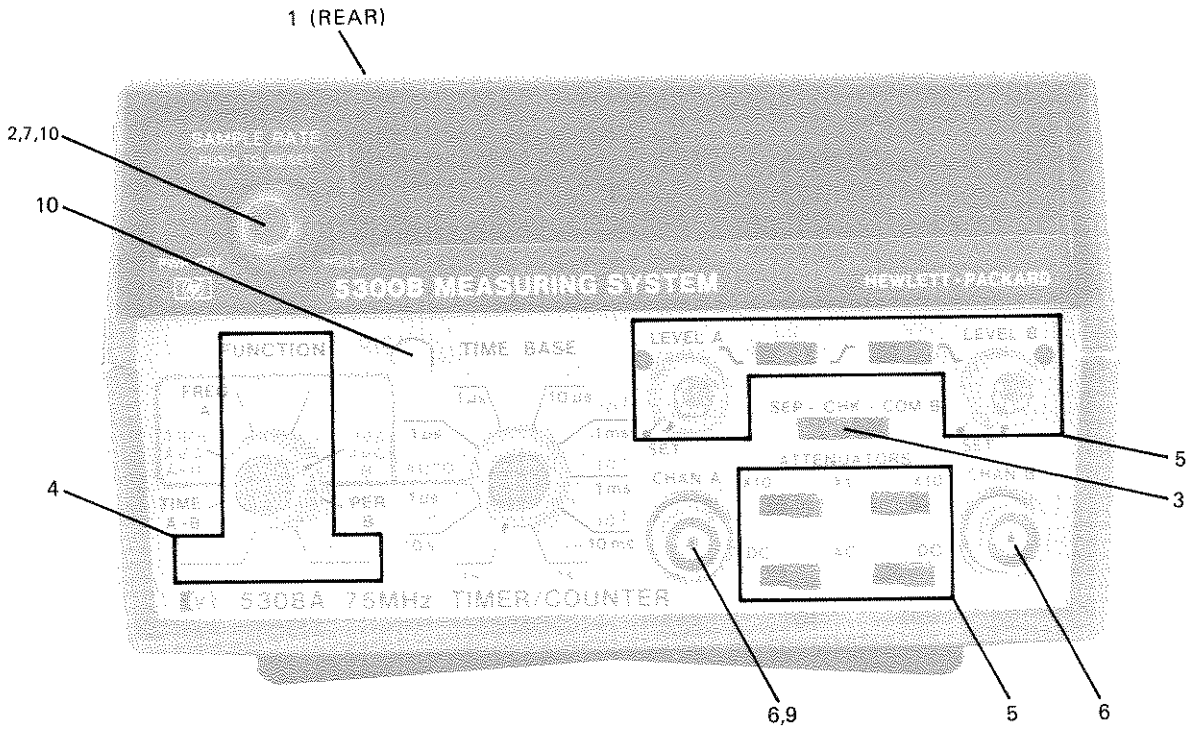
7. If the desired trigger level is not known, set the LEVEL A and LEVEL B controls to the middle of the range in which the trigger light illuminates. If the desired trigger level is known, connect a DVM to the TRIG LEVEL connector for each channel on the rear panel and set the LEVEL A and LEVEL B controls for the desired trigger level. If necessary, set the ATTENUATORS switches to X1.

8. Adjust SAMPLE RATE for desired display time.

   NOTE

   For time intervals in the range of 10 seconds to 10^9 seconds, refer to Figure 9H-3-9 for time interval measurements.

Figure 9H-3-10. Making Time Interval Average Measurements



SEE WARNING ON PAGE 9H-3-11

1. Connect ac power to 5300B ac receptacle.

2. Turn ac power on with 5300B SAMPLE RATE control and adjust SAMPLE RATE for desired display time.

3. Set SEP-CHK-COM B to SEP.

Two-Channel Totalizing

4. To totalize pulses input to Channel A between two pulses input to Channel B, set FUNCTION to TOT A, ⎍⎍ B. To totalize pulses input to Channel A while Channel B is low, set FUNCTION to TOT A, ⎍⎍ B.

NOTE

The position of the Channel B slope switch determines the Channel B trigger level polarity as described in paragraphs 9H-3-36 and 9H-3-37.

5. Set ATTENUATORS to X10; AC-DC switches and slope switches as desired. Set LEVEL A and LEVEL B to SET.

NOTE

Ensure that the 'SET' TRIG LEVELS switch on the rear panel is in the .0V position when the LEVEL control is in the SET position.

6. Connect Channel A input signal to CHAN A connector and Channel B input signal to CHAN B connector.

7. Press RESET. Display will accumulate the number of counts that occur on Channel A per switch settings of step 4. If trigger lights are not illuminated, rotate each LEVEL control until trigger light illuminates. If necessary, set ATTENUATORS switches to X1.

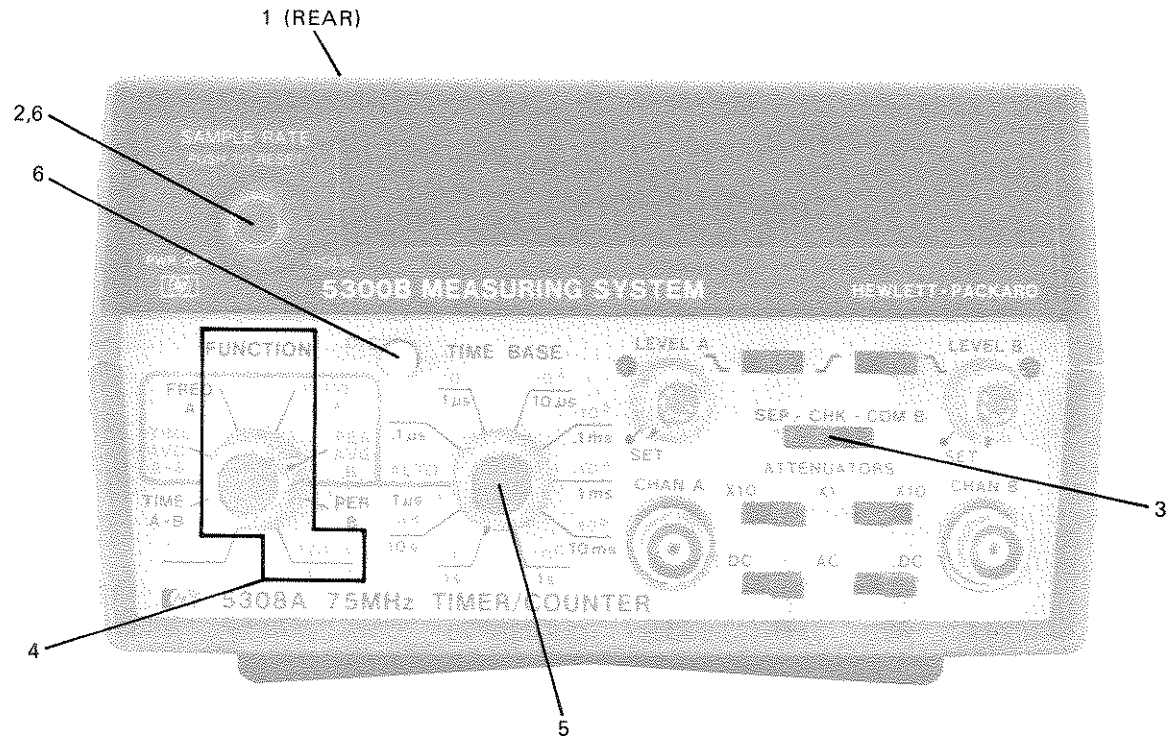
Single-Channel Totalizing

8. To totalize on one channel, perform steps 1, 2, 3 and 5. Set FUNCTION switch to TOT A ⎍⎍B.

9. Connect input signal to CHAN A connector.

10. Press RESET. Press OPEN/CLOSE switch to initiate totalizing. Display will accumulate at a rate dependent on input signal frequency. When display has accumulated the desired number of counts, press OPEN/CLOSE switch to stop totalizing. If trigger lights are not illuminated, rotate LEVEL A control until trigger light illuminates. If necessary, set ATTENUATORS switch to X1.

Figure 9H-3-11. Making Totalizing Measurements



SEE WARNING ON PAGE 9H-3-11

1. Connect ac power to 5300B ac receptacle.
2. Turn ac power on with 5300B SAMPLE RATE control.
3. Set SEP-CHK-COM B to CHK.
4. Set FUNCTION to TOT A, ⎍ B.
5. Set TIME BASE to desired resolution.

NOTE

Do not connect an input signal to CHAN B during this measurement.

6. Press RESET. Press O/C switch to start, press again to stop stopwatch.
7. Repeat step 6 for each measurement to be taken.

Figure 9H-3-12. Making Stopwatch Measurements