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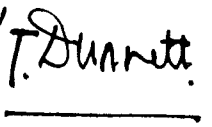
AIR PUBLICATION
117D-1003-1A

ELECTRONIC COUNTERS
(HEWLETT PACKARD 5245L AND J12-5245L)

OPERATING MANUAL

BY COMMAND OF THE DEFENCE COUNCIL



Ministry of Defence

FOR USE IN

ROYAL AIR FORCE

(Prepared by the Ministry of Technology)

SKYNET TELEMETRY AND COMMAND STATION FGR1 26062/1

THIS BINDER CONTAINS THE FOLLOWING AIR PUBLICATIONS:-

117D-1003-1A	Electronic counters (Hewlett Packard 5245L and J12-5245L) - operating manual
117D-1003-1C	Frequency converter 6625-99-972-3960 (Hewlett Packard 5253B)
117D-1003-1F	Pre-scaler (Hewlett Packard 5252A modified to Spec. H11-5252A)

Each separate publication has its own record of amendments.

A complete list of publications for the Telemetry and Command Station is to be found in the preliminaries of System Manual-A.P 116S-0206-1A.

Also filed in this binder are the following books (not A.P.s):-

Attention is drawn to the following associated publications:-

A.P.117D-1003-1B	Electronic counters (Hewlett Packard 5245L and J12-5245L) - service manual

HEWLETT hp PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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OPERATING AND SERVICE MANUAL

MODIFICATIONS

Electrical modifications made in this special instrument are described in detail on pages inserted in the front of the Service Manual.

The added Service Manual pages provide complete data on all electrical changes and provide any special instructions for instrument operation.

Mechanical modifications in a special instrument are not included in the added Service Manual pages unless the changes affect instrument specifications or operating procedures.

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OPERATING MANUAL

MODEL 5245L
ELECTR NIC OUNTER

SERIALS PREFIXED: 628- & ABOVE

This manual applies to all 5245L Counters having serial prefix 628- and above.

The 5245L Operating Manual may be used with 5245L instruments serial prefixed 544- and below. Delete reference to LEVEL control in counter operating procedures. All other procedures apply.

SERIALS PREFIXED: 335- & BELOW

Model 5245L instruments with serial prefix 335 and below must be modified to operate with the following plug-in units: 5252A Prescaler, 5255A Frequency Converter, 5256A Frequency Converter, 5258A Sensitive Prescaler, 5264A Preset Unit, and 5265A Digital Voltmeter. A Modification Kit (HP Part No. 05243-6030) is available from your Hewlett-Packard Sales and Service Office complete with instructions for modification.

For complete service information, refer to Section VI of the Model 5245L Service Manual.

02347-3

Printed: JULY 1967

MANUAL CONTENT

This is an Operating Manual only. Service instructions are outlined in a separate Service Manual. This Operating Manual is supplied to help you make the best use of your HP Model 5245L Electronic Counter. Four sections of information are included as follows:

Section I is an introduction to the Counter. This includes a table of technical specifications.

Section II contains information for installation and shipment.

Section III explains operation of the Counter and all available plug-ins.

Section IV gives basic maintenance information.

HOW TO ORDER

To order an Operating or Service Manual for your Electronic Counter, contact your nearest Hewlett-Packard Sales and Service Office. Lists are provided at the back of this manual. Give complete 8-digit serial number and name of instrument. Comments and suggestions concerning this manual are welcome at any Sales and Service Office.

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. DESCRIPTION.

1-3. The Model 5245L Electronic Counter is a high-frequency general-purpose electronic counter. The Model 5245L measures frequencies from 0 to 50 MHz, periods from 1 μsec to 10 seconds, period averages from 10 to 100, 000 periods, the ratio of two frequencies, and the multiplied ratio of two frequencies.

1-4. The Model 5245L provides these additional features:

a. Decade scaling to 10^9 for any frequency to 50 MHz.

b. Standard output frequencies from 0.1 cps to 10 MHz in decade steps.

c. Four-line, binary-coded-decimal output to drive digital recorder (Model 562A), digital to analog converter (Model 580A/581A), remote readout, or data processing equipment (1-2-2-4 code; 1-2-4-8 code available at extra cost as Option 02).

d. Remote control by external contact closure.

e. Display storage which permits reading to be displayed while new count is made.

f. Eight-digit display using rectangular (narrow) digital display tubes; decimal point position and measurement units displayed automatically.

g. Operation with plug-in units which extend the basic range and performance of the counter.

1-5. The Model 5245L features solid state design, low power consumption, small size (5-1/4 inch panel height), light weight (32 lb), easy conversion for rack mounting, and modular plug-in circuit boards for simplified maintenance.

1-6. IDENTIFICATION.

1-7. Hewlett-Packard uses a two-section, eight-digit serial number (on instrument rear panel) to identify instruments (000-00000). The first three digits are a serial prefix number, and the last five digits refer to a specific instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there may be differences between the manual and your instrument. If there are differences, they will be described in a change sheet included with the manual.

1-8. AVAILABLE PLUG-IN UNITS.

1-9. MODEL 5251A.

1-10. The Model 5251A Frequency Converter extends the frequency range of the Model 5245L to 100 MHz. The Model 5251A mixes a selected 10 MHz harmonic (between 20 and 90 Mc) with the input signal. The resulting difference-frequency signal is amplified and provided to the basic counter for counting and display. Because the selected 10-MHz harmonic is derived from a harmonic generator driven by a 10-MHz output from the basic counter, the stability and accuracy of the basic counter are retained.

1-11. MODEL 5252A.

1-12. The Model 5252A Prescaler Unit is a plug-in unit which converts the Model 5245L Electronic Counter into a direct reading counter from DC to 350 MHz. Prescaling is accomplished, without tuning, by transistor binary dividers, operating over the frequency range DC to 350 MHz. Multiple scaling factors (2, 4, or 8) are provided to shorten scaling time at the lower frequencies.

NOTE

A Sensitive Prescaler, Model 5258A, is described on pages 1-7 and 3-42.

1-13. MODEL 5253B.

1-14. The Model 5253B Frequency Converter extends the frequency range of the Model 5245L to 512 MHz. The stability and basic accuracy are retained by multiplying a 10 MHz signal, derived from the counter's internal time base, to a known harmonic frequency. When this harmonic frequency is selected and mixed with the input signal frequency, the difference frequency produced is within the range of the basic counter and is displayed by the counter.

1-15. MODEL 5254B.

1-16. The Model 5254B Frequency Converter provides the Model 5245L with a frequency range from 200 to 3000 MHz. The stability and accuracy of the basic counter are retained by using a 50 MHz multiple of the crystal oscillator signal from the counter to beat with the signal being measured. The difference frequency produced is within the range of the basic counter and is displayed by the counter. The converter has an indicator which aids in frequency selection and indicates the output level to the counter. The required input signal level is 50 mV rms to 1 V rms. The input connector is a type N female. The output of the video amplifier (1 to 50 MHz) is available at the AUX OUT jack on the front panel.

1-17. MODEL 5255A.

1-18. The Model 5255A Frequency Converter provides the Model 5245L with a frequency range from 3 to 12.4 GHz. The stability and accuracy of the counter is retained by the use of a heterodyne signal frequency (a selected harmonic from a 200 MHz comb spectrum) which is derived from the 5245L time base. The 5245L displays the converter's difference frequency to the nearest cycle with the counter TIME

Table 1-1. Specifications

FREQUENCY MEASUREMENTS

Range: 0 to 50 MHz (dc input). 25 Hz to 50 MHz (ac input, maximum sensitivity).

Gate Time: 1 μsec to 10 seconds in decade steps.

Accuracy: ±1 count ± time base accuracy

Reads In: kHz or MHz with positioned decimal point; units annunciator in line with digital display.

Self Check: counts 10 MHz for the gate time chosen by the time base selector switch.

SCALING

Frequency Range: 0 to 50 MHz.

Factor: by decades up to 10^9, switch selected on rear panel.

Input: front panel, Signal Input.

Output: in place of time base output frequencies.

PERIOD AVERAGE MEASUREMENTS

Range:

Single Period	0 to 1 MHz
Multiple Period	0 to 300 kHz

Periods Averaged: 1 period to 10^5 periods in decade steps.

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

Frequency Counted:

1 and 10 period	1 Hz to 10 MHz in decade steps
100 period	10 Hz to 10 MHz
1,000 period	100 Hz to 10 MHz
10,000 period	1 kHz to 10 MHz
100,000 period	10 kHz to 10 MHz

Reads In: sec, ms, μs, with positioned decimal point; units annunciator in line with digital display.

Self Check: Gate time is 10 μs to 1 sec (periods averaged of 100 kHz); counts 100 kHz from the time base.

RATIO MEASUREMENTS

Displays: (f_1/f_2) times period multiplier.

Range: f_1 - 0 to 50 MHz. f_2 - 0 to 1 MHz in single period. 0 to 300 kHz in multiple period; periods averaged 1 to 10^5 in decade steps.

Sensitivity: 0.1 v rms, each input.

Accuracy: ±1 count of f_1 ± trigger error* of f_2. f_1 is frequency applied to the decimal counters (enters Time Base Ext. jack on front panel); f_2 is frequency applied to decade dividers (enters Signal Input jack).

Reads In: Dimensionless; positioned decimal point for number of periods averaged.

Self Check: Period Average Self Check applies.

TIME BASE

Frequency (internal): 1 MHz.

Stability: Aging Rate - less than 3 parts in 10^9 per 24 hours. ** As a Function of Temperature: less than ±2 parts in 10^{10}/°C -20°C to +55°C. As a Function of Line Voltage: less than ±5 parts in 10^{10} for ±10% change in line voltage from 115v or 230 v rms.

Short Term - less than 2 parts in 10^{10} rms with measurement averaging time of one second under constant environmental and line voltage conditions.

Adjustment: Fine frequency adjustment (range approximately 4 parts in 10^8) and medium frequency adjustment (range approximately 1 part in 10^6) are available from the front panel through the plug-in hole. Coarse frequency adjustment (range approximately 1 part in 10^5) is available at the rear of the instrument.

Output Frequencies:

Rear Panel: 0.1 Hz to 10 MHz in decade steps; switch selected on rear panel; all frequencies available in manual function without interruption at reset except 100 Hz, 10 Hz, 1 Hz, and 0.1 Hz which are interrupted by manual reset; 10 kHz to 10 MHz available continuously in all functions; 1 kHz available continuously for all functions except 100K period average; stability same as internal time base; 5 volts p-p rectangular wave with 1000 ohm source impedance at 1 MHz and lower; 1 volt rms sine wave with 1000 ohm source impedance only at 10 MHz.

Front Panel: 0.1 Hz to 1 MHz in decade steps; selected by Time Base switch; availability as defined under Output Frequencies above; stability same as internal time base; 1 v p-to-p.

External Standard Frequency: 1 MHz, 1 volt, rms, into 1000 ohms required at rear panel BNC connector.

GENERAL

Registration: 8 digits in-line with rectangular Nixie® tubes and display storage; 99,999,999 maximum display; total width of 8 digit display including illuminated units annunciator and auto-positioned decimal point indication does not exceed 7 inches.

®Burroughs Corporation

*Trigger error is less than ±0.3% of one period ÷ periods averaged for signals with 40db or better signal-to-noise ratio.

** After 72 hours of continuous operation.

Table 1-1. Specifications (cont'd)

GENERAL (continued)

Display Storage: Holds reading between samples; switch overrides storage.

Sample Rate: Time following a gate closing during which the gate may not be reopened is continuously variable from less than 0.2 sec to 5 seconds in frequency mode, independent of gate time; display can be held indefinitely.

Operating Temperature Range: -20°C to +65°C.

Connectors: BNC type except for BCD output and power cable.

Signal Input:
Maximum Sensitivity - 100 mv rms.
Attenuation - Step attenuator provides ranges of 0.1, 1, and 10 volts rms.
Trigger Level Adjustment - Front panel control has ± 0.3 volt trigger level range on 0.1 volt position, ± 3 volt range on 1 volt position, and ± 30 volt range on 10 volt position. A preset position automatically centers trigger level at zero volts for all positions of attenuator.
Impedance - 1 megohm in parallel with approximately 25 pf, all ranges.
Coupling - ac or dc, separate BNC connectors. AC coupling has 600 vdc, 0.022 μf capacitor (-3 dB at approximately 7 Hz).
Overload Protection - Diode clamps protect input circuit for up to 120 volts rms on 0.1 volt range, 250 volts rms on 1 volt range, and 500 volts rms on 10 volt range. Input resistance under overload conditions (approximately ten times minimum sensitivity) will be greater than 100K ohms on 0.1 volt range, and approximately 1 megohm on other ranges.

Time Base External Input (Front Panel):
Maximum Sensitivity - 100 mv, rms.
Impedance - 1 M ohm, approximately 20 pf. DC coupled.
Overload - Diode clamps protect input circuit for up to 120 volts, rms.

Output:
4-line BCD 1-2-2-4, "1" state positive. 4-line BCD 1-2-4-8, available as Option 02 ("1" state positive) and Option 03 ("1" state negative).
"0" State Level: -8v.
"1" State Level: +18v.
Impedance - 100K, each line.
Reference Levels:
Approximately +17v, 350 ohm source.
Approximately -6.5v, 1000 ohm source.
Output is suitable for systems use or output devices such as Ⓗ Model 580A and 581A Digital-to-Analog Converters and includes the decimal point and measurement unit for Ⓗ 562A Digital Recorder.
Print Command - +13v to 0v step, dc-coupled.
Cable Connector - Amphenol 50-pin 57-30500, 1 required.

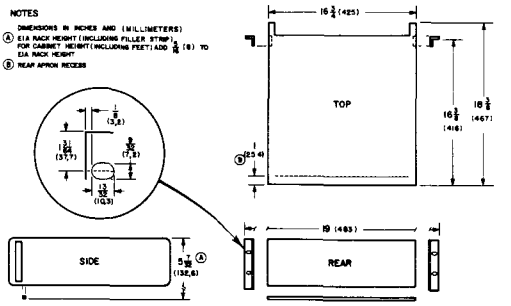
Hold-off Requirement - +15v min., +25v max. from chassis ground (1000 ohm source).

Weight - Net 32 lbs (14,4 kg) with blank plug-in; shipping, 40 lbs (18,2 kg).

Power Supply - 115 or 230 volts ± 10%, 50 to 60 Hz; 95 watts (50 to 1000 Hz operation, special order).

Accessories Furnished - Ⓗ 10503A Cable, 4 feet long, male BNC connectors. Detachable power cord, 7-1/2 ft (2040 mm) long, NEMA plug. Circuit Board Extender.

Dimensions:



OPTIONAL AND SPECIAL FEATURES

Option 02: 4-line BCD 1-2-4-8, "1" state positive in lieu of 1-2-2-4 (identical in other respects to above Output data) for digits only.

Option 03: 4-line BCD 1-2-4-8, "1" state negative in lieu of 1-2-2-4 (identical in other respects to above Output data) for digits only.

Remote Operation: All functions which may be programmed from the front panel controls (in normal use) may be programmed from a remote location except for the "Sample Rate" (as defined above) and the sensitivity control setting. The instrument provides (through rear panel connectors) all voltages necessary for remote control. The programming voltages for Time Base and Function control are low level, -15 volts dc at 5 ma per gate. Control may also be achieved by using an external -15 volt dc supply. The position of the decimal point and measurements unit may be correctly illuminated from the remote location, using +170 volts dc from the internal or an external supply.

Cable Connector: Amphenol 36-pin 57-30360, 2 required.

BASE switch set to 1 sec. Adding this reading to the 5255A dial reading (3 to 12.4 GHz) gives the input frequency value with a resolution of up to 1 Hz.

1-19. MODEL 5261A.

1-20. The hp Model 5261A Video Amplifier Unit extends the sensitivity of the Model 5245L to 1.0 millivolt over the frequency range of 10 Hz to 50 MHz. Input impedance is increased to 1 megohm and can be further increased to 10 megohms by use of an accessory 10:1 divider probe (hp 10003A) for signals greater than 10 mv. A 50-ohm output is provided for oscilloscope monitoring of the amplified signal.

1-21. MODEL 5262A.

1-22. The hp Model 5262A Time Interval Unit provides start and stop pulses, initiated by electrical inputs, to the main count gate in the Model 5245L enabling it to make time interval measurements. Time intervals from 1 microsecond to 10^8 seconds are measured with a resolution of 0.1 microsecond. Basic counter accuracy is retained when the signal counted is derived from the internal oscillator.

1-23. MODEL 5264A.

1-24. The hp Model 5264A Preset Unit converts the 5245L to a preset time base counter while retaining its basic measurement functions and range. The hp 5264A permits the 5245L to:

measure normalized frequency rate
measure normalized ratio
measure normalized period
count N events
divide an input frequency by N

In these measurements N may be any integer from 1 to 100,000 (N = 100,000 when all N switches are set to 0).

1-25. Such versatility is achieved by using a set of decade dividers in the 5264A to control the gate of the counter. These decade dividers, which may be preset to any integer from 1 to 100,000, open the counter's gate when the first pulse is received and close the gate when the Nth pulse is received. Separate output signals from the counter are available to operate other equipment whenever the gate opens or closes.

1-26. MODEL 5265A.

1-27. The hp Model 5265A Digital Voltmeter converts the 5245L to an accurate DC digital voltmeter. DC voltages as high as 1000 volts can be measured with six-digit presentation. Accuracy of the Digital Voltmeter is ±0.1% of the displayed reading or 0.01% of the full-range value for operating temperatures between +15°C and +40°C. Accuracy is maintained for over-range voltages of 5% on all ranges. The LOCAL-REMOTE switch permits remote selection of the digital voltmeter mode or operation from the plug-in controls. Polarity of the input DC voltage is automatically sensed and displayed.

1-28. APPLICATIONS.

1-29. GENERAL.

1-30. The Model 5245L can measure frequencies from 0 to 50 MHz directly, to 12.4 GHz when used with available plug-in units, and to 18,000 MHz when used with the hp Model 540B Transfer Oscillator and hp Model P932A Harmonic Mixer. It can measure speed, rpm, acceleration, vibration, and other phenomena when they are converted to sine waves or pulses. It can simplify the design, test, and calibration of filters, oscillators, scalers, and other devices which require critical frequency or time interval measurements in their manufacture or maintenance. Remote control and BCD output make the Model 5245L ideal for systems use.

1-31. HIGH RESOLUTION ANALOG PLOT.

1-32. The Model 5245L (with Model 5253B, 5254A, and 5255A Frequency Converters) when used with the hp Model 581A Digital to Analog Converter and the Moseley Model 680 Strip Chart Recorder provides an analog plot of frequency stability for frequencies as high as 12.4 GHz. This combination provides full scale chart resolution of 100 Hz (4 parts in 10^8 at 2500 MHz) with 1 second gate time and 10 Hz (4 parts in 10^9 at 3000 MHz) with 10 second gate time.

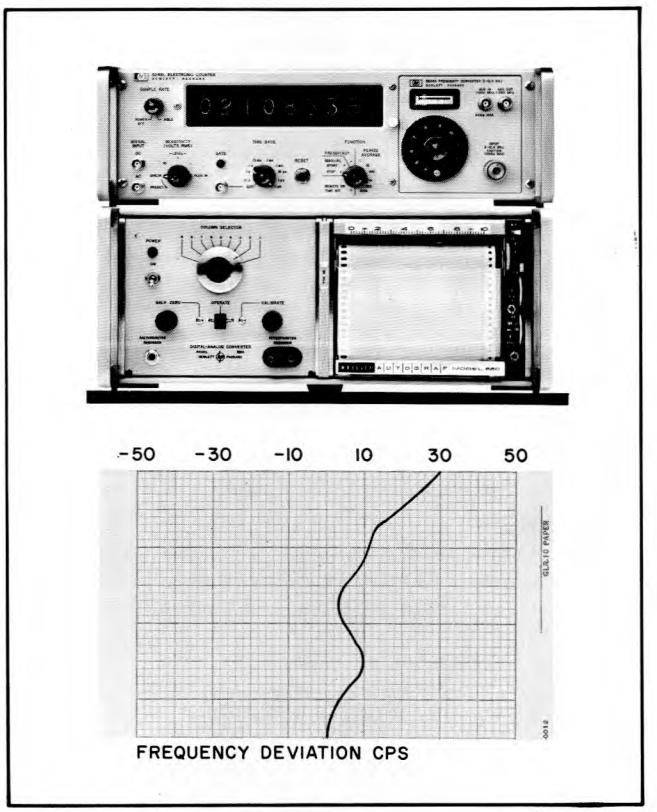


Figure 1-2. Frequency Stability Plot

1-33. In Figure 1-2 the Model 5245L with plug-in unit measures and displays the input frequency with 1 Hz resolution (counter set for 1 second gate time). The Model 581A converts the BCD output from the

last two decimal counting assemblies in the Counter (outputs for any three consecutive digits or the two least significant digits may be selected for conversion in the Model 581A) to drive the Recorder. A change of 10 Hz in the input frequency will drive the recorder pen one major division on the chart.

1-34. Any phenomena which can be measured by the Model 5245L can be plotted in this way with resolution determined by counter gate time and Model 581A column selection.

1-35. TERMINOLOGY.

1-36. The definitions of the following terms apply to those terms as they will be used throughout the manual.

a. BINARY. A bistable multivibrator (flip-flop) used to count or store binary information. The output of each binary is a "bit" or binary digit.

b. DECIMAL WEIGHT. Numerical value assigned to the output of each binary. In a 1224 code, decimal weights are assigned as follows: A binary; 1; B binary, 2; C binary, 2; D binary, 4.

c. "1" STATE. One transistor in binary conducting, output of binary indicates decimal weight present.

d. "0" STATE. Opposite transistor in binary conducting, output of binary indicates decimal weight absent.

e. 4-LINE BCD. Four-line binary-coded-decimal; decimal information coded in such a way that each decimal digit may be represented by a unique combination of 1 and 0 states of four binaries.

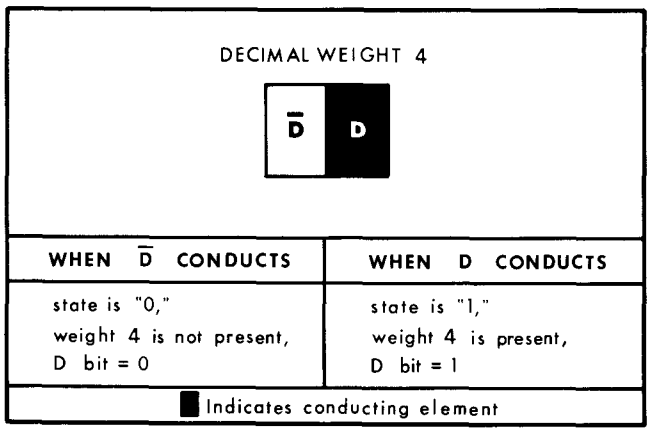


Figure 1-3. Binary Symbol

f. TRUTH TABLE. A table which lists the allowable 1 or 0 states of a system of binaries for each decimal digit to be represented. These states are listed in an order which presents the most significant digit first. Example: In a 1224 code, binaries D, C, B, and A are assigned decimal weights of 4, 2, 2, and 1 respectively. The decimal numeral 5 is represented by state 0111 and weights of 2, 2, and 1 are present. The allowable combination (0111) is listed in the truth table (Table 1-2).

Table 1-2. Four-Line Code Truth Table

Digit	4-Line Code, 1-2-2-4 0 -, 1 +			
	D = 4	C = 2	B = 2	A = 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	1	0
5	0	1	1	1
6	1	1	0	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1

1-37. OPTIONAL BCD OUTPUT

1-38. OPTION 02. The counter is available with 1-2-4-8 "1" state positive BCD output. Option 02 decimal counter assemblies with "1" state positive output have been substituted for the standard assemblies. These substitutions have been made: A10 through A14; substitute hp Part No. 05212-6002, A15/A16; substitute hp Part No. 05232-6002, and A18; substitute hp Part No. 05245-6001. The counter with Option 02 is identical in all respects to the standard counter except for the BCD code.

1-39. OPTION 03. The counter is available with 1-2-4-8 "1" state negative BCD output. Option 03 decimal counter assemblies with "1" state negative output have been substituted for the standard assemblies. These substitutions have been made: A10 through A14; substitute hp Part No. 05212-6003, A15/A16; substitute hp Part No. 05232-6003, and A18; substitute 05245-6003. The counter with Option 03 is identical in all respects to the standard counter except for the BCD code.

1-40. Table 1-3 is a truth table for the 1-2-4-8 BCD code.

1-41. Decimal point and measurement units assemblies that provide a 1-2-4-8 BCD output code are available by special order. They are not included as part of Option 02 and 03.

Table 1-3. 1-2-4-8 Code Truth Table

Digit	Option 02 0 = - 8V, 1 = +18V Option 03 0 = +18V, 1 = -8V			
	D = 8	C = 4	B = 2	A = 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Table 1-4. Plug-In Specifications

5251A 20 to 100 MHz Frequency Converter *†	**5253B** 50 to 512 MHz Frequency Converter* †
Range: 20 MHz to 100 MHz, using mixing frequencies of 20 MHz to 90 MHz in 10 MHz steps. **Accuracy:** Retains accuracy of basic counter. **Input Voltage Range:** 50 mV to 1 V rms. **Maximum Input:** 2 V rms or ± 100 Vdc will not damage the instrument. **Input Impedance:** Approximately 50 ohms. **Level Indicator:** Meter aids mixing frequency selection; indicates output voltage level to counter. **Registration:** Counter Display is added to the converter dial reading. **Weight:** Net 3 lbs (1, 5 kg); shipping 7 lbs (3 kg).	**Range:** 50 MHz to 512 MHz, using mixing frequencies of 50 MHz to 500 MHz in 10 MHz steps. **Accuracy:** Retains accuracy of basic counter. **Input Voltage Range:** 50 mV rms (-13 dBm in 50 ohms) to 1V rms (+13 dBm in 50 ohms). **Maximum Input:** 2V rms or 250 Vdc will not damage instrument. **Input Impedance:** Approximately 50 ohms. **Level Indicator:** Meter aids frequency selection; indicates output voltage level to counter. **Registration:** Counter display is added to the converter dial reading. **Weight:** Net 5 lbs (2, 3 kg); shipping 9 lbs (4, 1 kg).
5252A Prescaler* †	**5254A/5254B** Frequency Converter *
Operating Frequency Range: Dc to 350 MHz. **Accuracy:** Same as the basic counter. **Input Sensitivity:** 100 mV rms. **Maximum Input:** 2 volts rms, ± 20 dBm, or 100 mW. **Input Impedance:** 50 ohm (nominal). **Operating Temperature Range:** 0°C to +55°C. **Scaled Output:** 100 mV rms into 50Ω is available at the AUX A output BNC connector of the basic counter. **Double Pulse Resolution:** 2.8 ns **Minimum Pulse Amplitude:** 280 mV. **Weight:** Net 2.2 lbs (1 kg); shipping 6-3/4 lbs (3, 1 kg).	**Range:** 5254A: 300 to 3000 MHz. 5254B: 200 to 3000 MHz. **Accuracy:** Same as the basic counter. **Input Signal Level:** 50 mV rms (-13 dBm in 50 ohms) to 1V rms (+13 dBm in 50 ohms). **Input Overload:** Input power in excess of 100 mW (+2 dBm or 2.2V rms) may damage the converter. **Input Impedance:** Approximately 50 ohms. **Input Connector:** Type N female. **Level Indicator:** Meter aids frequency selection; indicates output voltage level to counter. **Registration:** Counter display in MHz is added to the converter dial reading. **Weight:** Net, 5 lbs (2, 5 kg); shipping 9 lbs (4 kg)

*When installed in the Model 5245L Electronic Counter.

† A 50-ohm coaxial cable, 48 inches long (HP Part No. 10503A) male BNC to male BNC, is furnished with all of the above instruments.

Table 1-4. Plug-In Specifications Cont'd.

5255A 3 to 12.4 GHz Frequency Converter*	**5258A** 1 to 200 MHz Sensitive Prescaler *†
Range: 3 to 12.4 GHz using mixing frequencies of 2.8 12.4 GHz in 200 MHz steps. As a prescaler, 1 MHz to 200 MHz. **Accuracy:** Retains accuracy of basic counter. **Input Sensitivity:** 100 mV rms (-7 dBm) as a converter. 5 mV rms as a prescaler. **Input Impedance:** 50 ohms nominal (vswr 2 up to 12.4 GHz). **Maximum Input:** +10 dBm. **Level Indicator:** Meter aids frequency selection; indicates usable signal level. **Auxiliary Output:** 1 MHz to 200 MHz difference signal from video amplifier. **Registration:** Counter display in MHz is added to converter dial reading. **Installation:** Plugs into front panel plug-in compartment of HP 5246L Electronic Counter. **Input Connector:** Precision Type N female. GPC-7 connector optional. **Weight:** Net 8.25 lbs (3,8 kg) Shipping 13 lbs (5,5 kg). *When installed in the HP Model 5245L Electronic Counter.	**Range:** 1 MHz to 200 MHz **Accuracy:** Same as basic counter. **Input Sensitivity:** 1 mV/10 mV/.2V rms as selected by front panel switch. **Resolution:** 1 Hz in 4 sec, 10 Hz in 0.4 sec, etc. **Input Impedance:** 50 ohms **Input Scaling Factor:** ÷ 4 **Operating Temperature Range:** -20°C to +65°C **Scaled Output:** 100 mV rms into 50 ohms (available at the AUX A jack on rear of counter). **As a Video Amplifier:** 30 dB maximum gain on 1 mV range. **Weight:** Net 4.75 lb (2,16 kg) Shipping 9.25 lb (4,2 kg) *When installed in the HP Model 5245L Electronic Counter. † A 50-ohm, coaxial cable, 48 inches long (HP Part No. 10503A) male BNC to male BNC is supplied with the 5258A.

5256A

8 to 18 GHz Frequency Converter

Range
As a converter for HP 50 MHz plug-in electronic counters, 8 to 18 GHz using mixing frequencies of 8 to 18 GHz in 200 MHz steps. As a prescaler, 1 MHz to 200 MHz.

Accuracy: Retains counter accuracy.

Input Sensitivity:
100 mV rms (-7 dBm) as a converter, 5 mV rms as a prescaler.

Input Impedance: 50 ohm nominal.

Maximum Input: ,10 dBm; 0 dBm on AUX IN.

Level Indicator:
Meter aids frequency selection; indicates usable signal level.

Auxiliary Output:
1 MHz to 200 MHz difference signal from video amplifier.

Registration:
Counter display in MHz is added to converter dial reading.

Installation:
Plugs into front panel plug-in compartment of HP 50 MHz plug-in electronic counter.

Input Connector: Precision Type APC-7 connector.

Weight:
Net, 8-1/4 lbs. (3,8 kg). Shipping, 12 lbs. (5,5 kg).

Table 1-4. Plug-In Specifications Cont'd.

5261A

VIDEO AMPLIFIER †*

Bandwidth:
10 Hz to 50 MHz with 5245L.

Input Sensitivity:
1 mV to 300 mV rms.

Input Impedance:
Approximately 1 megohm, 15 pf shunt; HP 10003A Probe increases impedance to 10 megohms, 10 pf shunt.

Attenuator Ranges:
1, 3, 10, 30 and 100 mV rms.

Maximum Input:
100 volts dc, 5 volts rms (ranges: 1, 3, 10, 30, 100 mV).

Monitor:
Meter shows when the signal level is acceptable to the counter.

Accuracy:
Retains accuracy of basic counter.

50-Ohm Output:
Separate BNC front panel output for oscilloscope monitoring or for driving external equipment; 50-ohm source impedance. On amplifier's most sensitive attenuator range, 1 mV rms at input results in at least 100 mV rms at auxiliary output into 50-ohm load. Maximum undistorted output is 300 mV rms into 50-ohm load.

Weight:
Net 2 lb (0, 90 kg); shipping 8 lbs (3, 8 kg).

†A 50Ω, low microphonic cable (10507A) male BNC to male BNC is supplied with the 5261A.

5262A

TIME INTERVAL UNIT*

Range:
1 μsec to 10^8 sec (start and stop pulses must be separated by 1 μsec to give useful readings).

Accuracy:
± 1 period of standard frequency counted ± time base accuracy.

Registration:
On Model 5245L Electronic Counter.

Input Voltage:
0.3 volt, peak-to-peak, minimum, direct coupled input.

Input Impedance:
10K ohms, less than 80 pf, on X.1 and X.2 multiplier positions; constant up to ± 40 volts peak times multiplier position.

100K ohms times multiplier position on X.3 to X100 positions, less than 40 pf on X.3, and less than 20 pf on X1 to X100; constant up to ± 40 volts times multiplier position.

Overload:
50 volts rms, or ± 150 volts peak on X.1, .2, and .3 multiplier positions is tolerable; 150 volts rms, or ± 250 volts peak, on X1 and X3; 250 volts rms or ± 250 volts peak, on X10, 30, and 100.

Start Stop:
Independent or common channels.

Trigger Slope:
Positive or negative on Start and Stop channels, independently selected.

Trigger Amplitude:
Both channels continuously adjustable from -250 volts to +250 volts.

Frequency Range:
(When used as an input signal discriminator): 0 to 2 MHz.

Standard Frequency Counted:
10^7 to 1 Hz in decades from 5245L, or externally applied frequency.

Markers:
Separate output voltage steps, 0.5 volts peak-to-peak from source impedance of approximately 7K ohms, 100 pf; available at rear panel of the 5245L with negative step coincident with trigger points on input waveforms for positive slope and positive step coincident for negative slope.

Reads In:
μs, ms, sec with measurement units indicated and decimal point positioned.

Accessory Supplied:
50-ohm coaxial cable, 48" long (HP Part No. 10503A) male BNC to male BNC.

Weight:
Net 2 lb (0, 90 kg); shipping 7 lbs (3, 2 kg)

*When installed in the HP Model 5245L Electronic Counter

Table 1-4. Plug-In Specifications (cont'd)

5264A
PRESET UNIT *†

N x FREQ (counter input):
Range: 5245L: 0 to 50 MHz

Gate Time: (set by counter Time Base and "N" switches):

10 μsec to 1 sec in 10-μsec steps
100 μsec to 10 sec in 100-μsec steps
1 msec to 100 sec in 1-msec steps
10 msec to 10^3 sec in 10-msec steps
0.1 sec to 10^4 sec in 0.1-sec steps
1 sec to 10^5 sec in 1-sec steps
10 sec to 10^6 sec in 10-sec steps

Accuracy: ±1 count ± time base accuracy

Maximum Counter Sensitivity: 0.1 volt rms

Counter Attenuator: 3-position, 0.1, 1 and 10V

Counter Input Impedance:
100K ohms/volt, 40 pf on 0.1 V range, 15 pf on 1 and 10 V ranges.

PRESET (AUX INPUT on Preset Unit)
Input Frequency Range: 20 Hz to 100 kHz

Maximum Sensitivity: 0.1 volt rms

Input Impedance: 1 M ohm; 50 pf shunt

Preset Range: 1 to 99,999 in steps of one

N x PERIOD (counter input):
Input Frequency Range: 0 Hz to 100 kHz

Maximum Sensitivity: 0.1 volt rms

Attenuator: 3-position, 0.1, 1 and 10V

Input Impedance: 100K ohms/volt; 40 pf on 0.1V range, 15 pf on 1 and 10V ranges

Reads: N x PERIOD

Time Units: 0.1 μs to 10 sec in decade steps

Accuracy: ±1 count ± time base accuracy ± trigger error ‡

N x RATIO:
f_1 (counter Ext. Time Base Input)

Frequency Range: 5245L, 0 to 50 MHz

Sensitivity: 0.1 volt rms

Input Impedance: 10K ohms, 40 pf shunt

f_2 (counter signal input)

Frequency Range: 0 Hz to 100 kHz

Maximum Sensitivity: 0.1 volt

Attenuator: 3-position, 0.1, 1, and 10V

Input Impedance: 100K ohms/volt; 40 pf on 0.1V range, 15 pf on 1 and 10V ranges

Reads: $N \times f_1/f_2$

Accuracy: ±1 count of f_1

DIVIDE BY N (AUX input on Preset Unit):

Frequency Range: 20 Hz to 100 kHz sinusoidal

Prescaling: In decade steps to 10^9 to maximum rate of counter (scaled output frequency 100 kHz)

Output: Pulses, .2 volt peak-to-peak centered at 0 volts into a high impedance load, less than 1 μsec rise time, approximately 5 μsec duration

Sensitivity: 0.1 volt rms

Input Impedance: 1 M ohm, 50 pf shunt

Weight:
Net 3 lbs, 2 oz (1,4 kg), shipping 9 lbs (4 kg)

---

† Trigger error (sine wave) $< \pm \frac{0.3\% \text{ of one period}}{N}$ for 40 dB signal-to-noise ratio on input signal. Trigger error decreases with increased signal amplitude and slope

*When installed in HP 5245 L Electronic Counter

†A 50-ohm coaxial cable, 48 inches long (HP Part No. 10503A) male BNC to male BNC, is furnished with the 5264A.

Table 1-4. Plug-In Specifications Cont'd.

5265A

DIGITAL VOLTMETER*†

Voltage Range:
Six-digit presentation of 10.0000, 100.000, and 1000.00 volts full scale with 5% over-range capability. (Common terminal is INSTRUMENT GROUND.)

Registration:
On Model 5245L.

Reads In:
Dc volts with decimal point positioned by range switch; automatic polarity indicator.

Accuracy: (0 to 50°C):
±0.1% of reading, ±0.01% of full scale.

Range Selection:
Manual

Input Resistance:
10.2 megohms to DC on all ranges

Input Filter AC Rejection:
30 dB at 60 Hz, increasing at 12 dB per octave.

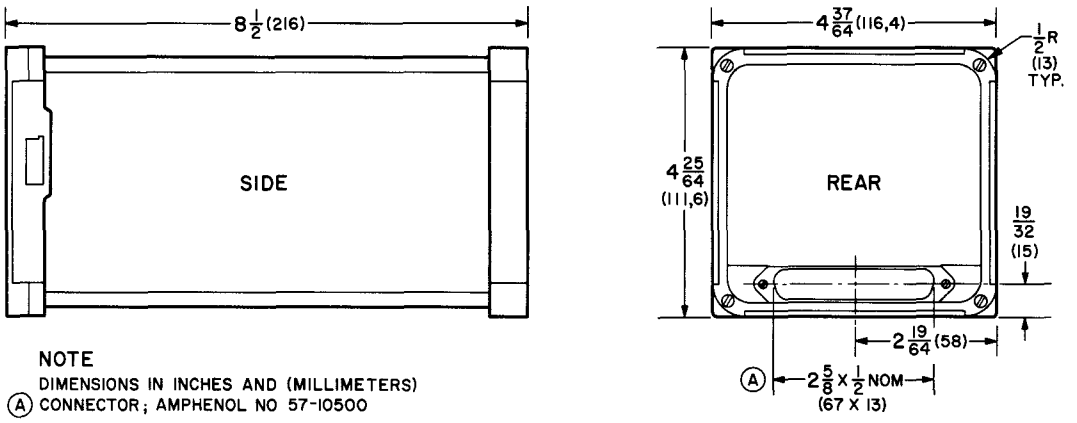
Input Filter Response Time:
Less than 450 msec to a step function to within 99.95% of final value.

Weight:
Net 2-1/2 lbs (1,1 kg); shipping 7 lbs (3,2 kg).

*When used with 5245L Electronic Counter.

†22-pin extender board is supplied with the Model 5265A.

PLUG-IN DIMENSIONS:



NOTE
DIMENSIONS IN INCHES AND (MILLIMETERS)
(A) CONNECTOR; AMPHENOL NO 57-10500

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, storage, and installation.

2-3. UNPACKING AND INSPECTION.

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc). If the instrument is damaged or fails to self check (Self Check Procedure, Figure 3-4), notify the carrier and the nearest Hewlett-Packard field office immediately (field offices are listed at the back of this manual). Retain the shipping carton and the padding material for the carrier's inspection. The field office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT.

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are a few recommended packaging methods:

a. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.

b. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq in. bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of the instrument.

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

a. Maximum altitude, 20,000 feet.

b. Minimum temperature -40°F (-40°C).

c. Maximum temperature 167°F (75°C).

2-8. RACK INSTALLATION.

2-9. The Model 5245L is ready for bench operation as shipped from the factory. Additional parts necessary for rack mounting are packaged with the instrument. To convert for rack installation, refer to Figure 2-1 and proceed as follows:

a. Remove tilt stand.

b. Remove feet (press the foot-release button, slide foot toward center of instrument, and lift off).

c. Remove adhesive-backed trim strips at front end of sides.

d. Attach filler strip along bottom edge of front panel.

e. Attach flanges to front end of sides (larger corner-notch toward bottom of instrument). Instrument is now ready to mount in standard rack.

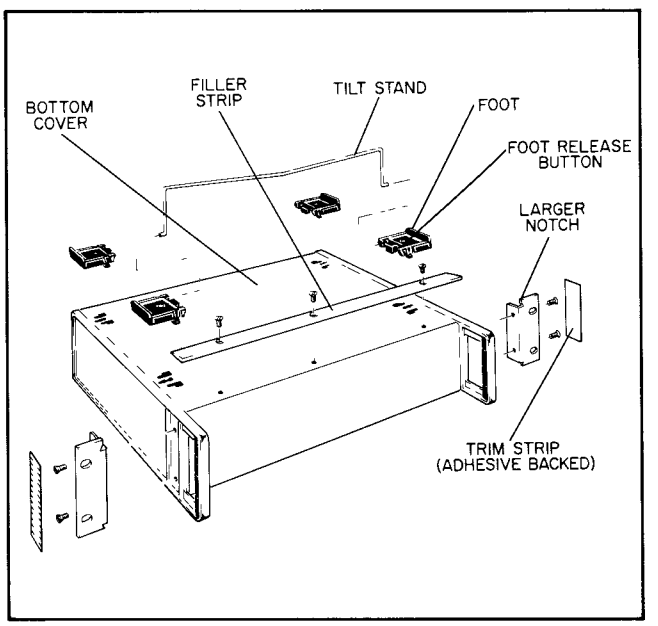


Figure 2-1. Conversion for Rack Mounting

CAUTION

Ambient temperature in rack during operation should not exceed a maximum of 131°F (55°C). Be sure instrument position in rack permits air circulation to intake in center area of rear panel and that nearby instruments do not discharge hot air near intake.

2-10. POWER CONNECTION.

2-11. LINE VOLTAGE. The Model 5245L may be operated from either 115- or 230-volt (±10%) power lines. A slide switch on the rear panel permits quick conversion for operation from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the switch to the right for 230-volt operation ("230" marking exposed) or to the left for 115-volt operation ("115" marking exposed). The Model 5245L is supplied with 115-volt fuse; be sure to replace this fuse for 230-volt operation; see Table 2-1.

CAUTION

Before plugging instrument into AC power line be sure slide switch is properly positioned.

Table 2-1. 115/230 Volt Conversion

Conversion	115 Volt	230 Volt
Slide switch	Left ("115")	Right ("230")
AC LINE FUSE	2 ampere slow-blow (2110-0006)	1 ampere slow-blow (2110-0007)

2-12. POWER CABLE. The Model 5245L is equipped with a detachable 3-wire power cable. Proceed as follows for installation.

a. Connect flat plug (3-socket connector) to AC line jack at rear of instrument.

b. Connect plug (2-blade with round grounding pin) to 3-wire (grounded) power outlet. Exposed portions of instrument are grounded through the round pin on the plug for safety; when only 2-blade outlet is available, use connector adapter (stock no. 1251-0048), then connect short wire from side of adapter to ground.

Note

To maintain oscillator stability, crystal oven circuits are energized continuously when the Model 5245L is connected to power line.

2-13. COOLING.

2-14. The Model 5245L uses forced air cooling. The air intake and filter are located on the rear panel of the instrument. Inspect the filter regularly; clean the filter before it becomes dirty enough to restrict air flow (see Paragraph 5-3 for instructions on filter care).

Note

Do not apply coating compounds to non-metal filters.

2-15. PLUG-IN INSTALLATION.

2-16. The plug-in units are installed into the rectangular compartment at the right hand side of the front panel of the Model 5245L. To install the plug-in unit in the counter, turn counter off and remove blank panel from counter by turning the retaining latch knob counterclockwise. Insert plug-in unit into counter and push unit firmly into compartment until front panel of plug-in is flush with the front panel of the counter. Turn the retaining latch knob clockwise until it is tight.

2-17. To remove unit from counter, turn counter off and turn the retaining latch knob counterclockwise to its stop. Then grasp switch knob and pull unit from counter. If any difficulty is encountered with installation or removal, check that the retaining latch is fully counterclockwise.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. The Model 5245L measures frequency, period average, ratio of two frequencies, and total events. A FUNCTION selector switch selects measurement function, and a TIME BASE selector switch selects time base or multiplier. A SAMPLE RATE control selects the sampling rate, and a SENSITIVITY control adjusts instrument sensitivity. Figures 3-4 through 3-9 provide step-by-step operating procedures for each measurement function. Figures 3-11 through 3-36 provide operating procedures for measurements made with available plug-in units. The number or numbers associated with each control indicate the step in which that control is used.

3-3. INTERPRETING DISPLAY.

3-4. Direct readout is provided in both PERIOD and FREQUENCY functions with measurement units displayed and with decimal point automatically positioned. In the MANUAL function the display is read directly; the decimal point is not lighted. Note that the only difference between ratio and period measurements is the use of an external frequency instead of the internal 1-MHz oscillator.

3-5. ACCURACY.

3-6. FREQUENCY MEASUREMENTS. The basic counter accuracy is determined by two factors. One factor is the aging rate of the 1 MHz crystal standard in the time base, which is less than 2 parts in 10^8 per week. A second factor is the inherent error of ±1 count present in all counters of this type. This error is due to phasing between the timing pulse that operates the electronic gate and the pulses that pass through the gate to the counters. The chart in Figure 3-1 shows the errors possible for frequency or period measurements.

3-7. PERIOD MEASUREMENTS. There are three factors contributing to the accuracy of period measurements:

a. The aging rate of the 1 MHz standard, which is less than 2 parts in 10^8 per week.

b. The ambiguity of the ±1 count.

c. ± trigger error (for one period, assuming signal to noise ratio of 40 dB, this trigger error is 0.3% at rated sensitivity). A general formula for finding the percentage error to be expected under various conditions is as follows:

$$A = 100 \left(\pm \frac{f_2}{nf_1} \pm \frac{e}{n} \pm E\right)$$

A = accuracy in %

f_1 = time base frequency counted (Hz)

f_2 = frequency whose period is being measured (Hz)

n = number of periods averaged

e = 3×10^{-3} (trigger error for one period, 40 db S/N)

E = time base accuracy (weekly maximum drift rate) E depends on the drift rate of the individual time base, absolute value of off-set at standardization and the time since standardization. A plot of this formula for the 5245L is shown in Figure 3-1.

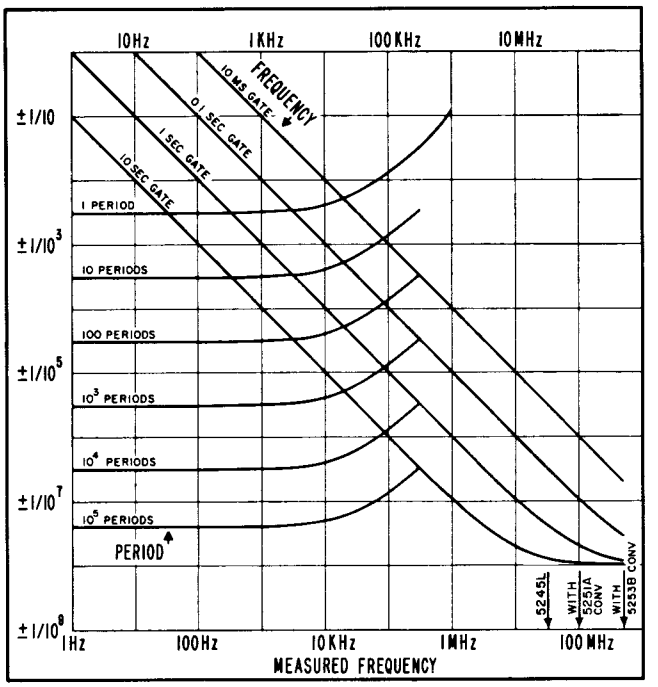


Figure 3-1. Measurement Accuracy

3-8. STANDARD FREQUENCY OUTPUT.

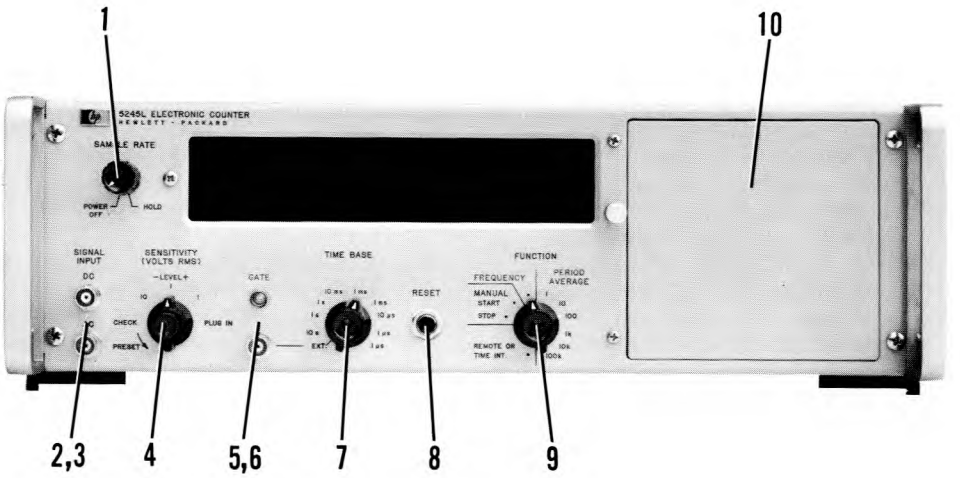
3-9. FRONT PANEL. Frequencies of 0.1 Hz to 1 MHz are available in decade steps at the TIME BASE EXT connector as selected by the TIME BASE switch. This output is subject to the restrictions given below in Paragraph 3-11.

3-10. REAR PANEL. Frequencies of 0.1 Hz through 10 MHz are available in decade steps at the rear-panel OUTPUT connector as selected by the rear-panel OUTPUT switch. This output is subject to the restrictions listed below.

3-11. RESTRICTIONS. All frequencies are available one at a time in the MANUAL function without interruption; 1 kHz is continuously available for all functions except 100K PERIOD AVERAGE; 10 kHz to 10 MHz continuously available in all functions.

Note

Accuracy and stability of these outputs is the same as that of the time base oscillator.



1. SAMPLE RATE
   a. Controls power to all circuits except crystal oven heater; max ccw turns POWER OFF.
   b. Controls time between measurements from 0.2 sec to 5 sec.
   c. Causes display to HOLD indefinitely when maximum cw.

2. DC SIGNAL INPUT provides direct coupling to internal amplifier for most measurements.

3. AC SIGNAL INPUT provides coupling to internal amplifier through .022 μf (600 vdc maximum).

4. SIGNAL INPUT SENSITIVITY & LEVEL control.
   a. Controls input attenuator; set to highest position which includes signal amplitude (max overload; 120 V rms in position 0.1, 250 V rms in position 1; 500 V rms in position 10).
   b. Maximum CCW (CHECK position) gives internal self check; counts 10 MHz with selected TIME-BASE gate for FREQUENCY; 100 kHz for number of periods averaged (10 μsec to 1 sec) for PERIOD AVERAGE, or continuously at selected TIME BASE frequency (0.1 Hz to 10 MHz) for MANUAL START.
   c. Maximum CW (PLUG-IN position) connects output of plug-in unit directly to input amplifier.
   d. The LEVEL control adjusts the input trigger level from -0.3V dc to +0.3V dc when attenuator is set at 0.1V rms, from -3.0V dc to +3.0V dc when attenuator is set at 1V rms, and -30V dc to +30V dc when attenuator is set at 10V rms.
   e. Maximum counterclockwise position (PRESET) sets trigger level at zero volts.

5. GATE lamp glows during counting (main gate open).

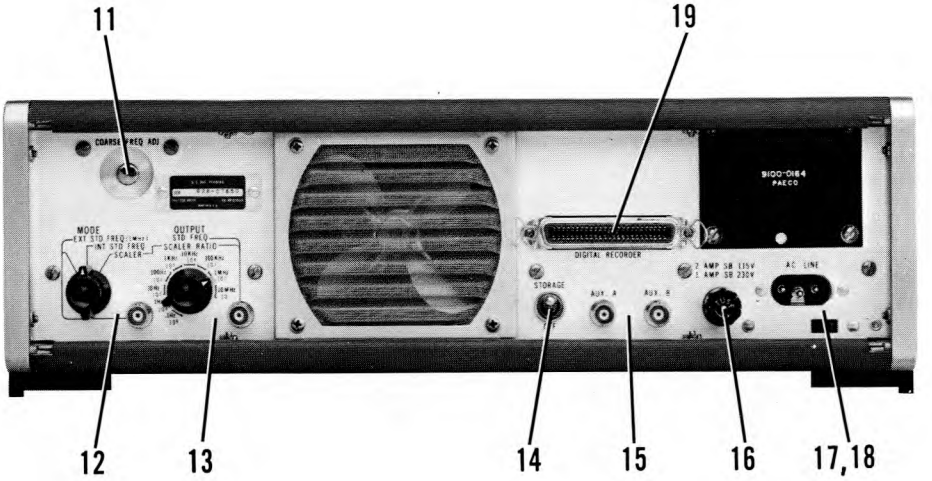
6. EXT connector
   a. Provides input for higher of two frequencies for ratio measurement (lower frequency to SIGNAL INPUT) when TIME BASE set to EXT.
   b. Provides output frequency 0.1 Hz to 1 MHz as selected by TIME-BASE switch (see text for restrictions).

7. TIME BASE selects either time that main gate is on for frequency or time unit per count for period measurement.

8. RESET pushbutton returns both displayed and internal count to zero when pressed.

9. FUNCTION
   a. Permits totalizing of pulses applied to SIGNAL INPUT when set to MANUAL START; holds accumulated count when switched to MANUAL stop.
   b. Permits measurement of frequency applied to SIGNAL INPUT during interval selected by TIME-BASE switch when in FREQUENCY.
   c. Permits period measurement of waveforms applied to SIGNAL INPUT averaged over 1 to 100,000 periods when set to PERIOD AVERAGE.
   d. Removes control of TIME-BASE and FUNCTION switches when set to REMOTE or TIME INT; remote control is provided through rear connector or plug-in unit.

Figure 3-2. Operating Controls (Front Panel)



10. Plug-in compartment
    a. Receives plug-in unit to extend basic counter capabilities. To install plug-in (1) turn power off, (2) loosen knurled screw at side of compartment, (3) remove blank panel or plug-in unit, (4) slide desired plug-in unit into place and tighten knurled screw.
    b. Permits access to fine and medium frequency controls through panel at rear of compartment; FINE FREQ ADJ has range of about 5×10^{-8}; MED FREQ ADJ has range of about 1×10^{-6}.

11. COARSE FREQ ADJ permits adjustment of oscillator over a range of about 1×10^{-5}.

12. MODE
    a. Permits use of external 1-Mc frequency standard for time-base control when set to EXT STD FREQ (1 MHz).
    b. Permits normal operation of counter using internal oscillator when set to INT STD FREQ.
    c. Permits scaling of input signal by factors of 10 when set to SCALER.

13. OUTPUT
    a. Supplies selected frequency when MODE is set to INT STD FREQ (see text for restrictions).
    b. Supplies scaled input frequency when MODE is set to SCALER.

14. STORAGE switch provides display storage when up; continuous display of internal count when OFF (down).

15. AUX A/AUX B (TIME INTERVAL TRIGGER OUT - START/STOP). Auxiliary plug-in outputs. See appropriate plug-in manual.

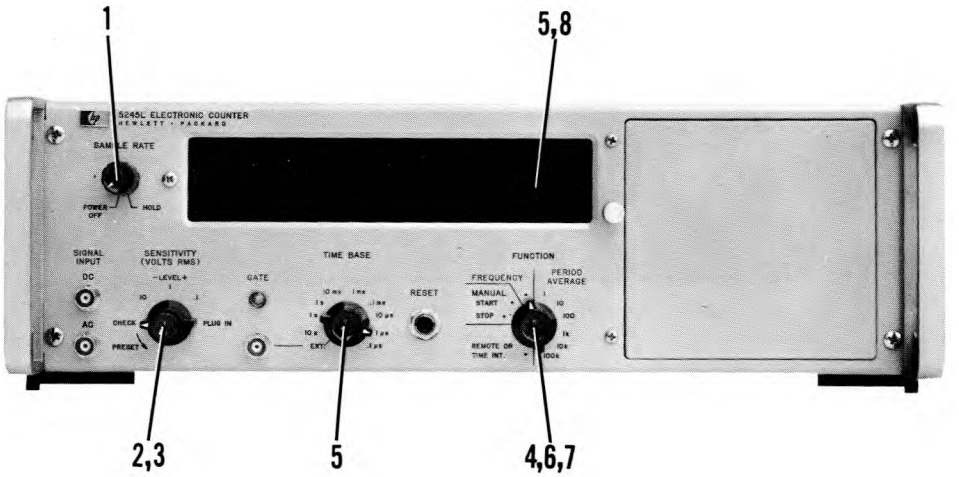
16. Fuse provides overload protection; should be 2 ampere slow-blow for 115-volt operation; 1 ampere slow-blow for 230-volt operation.

17. Line-voltage switch permits selection of either 115- or 230-vac line; insert narrow blade and slide to left for 115 v, slide to right for 230v.

18. AC LINE connector connects to flat plug on power cable.

19. DIGITAL RECORDER connector supplies BCD information to recorder, analog converter, or data processing equipment.

Figure 3-3. Operating Controls (Rear Panel)



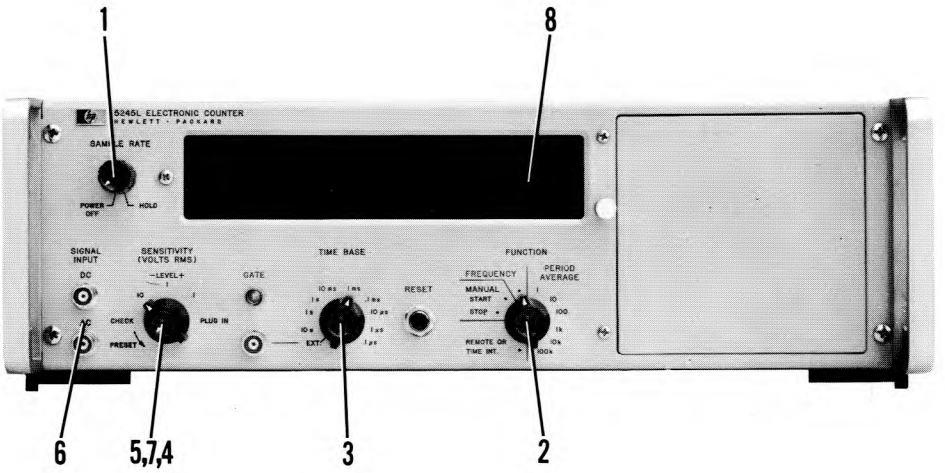
1. Turn SAMPLE RATE control clockwise from POWER OFF position to turn counter on.
2. Set SENSITIVITY switch to CHECK.
3. Set LEVEL control to PRESET.
4. Set FUNCTION switch to FREQUENCY.
5. See table below for proper display (± 1 count) for each position of TIME BASE switch.

TIME BASE	DISPLAY
1 μs	00000010. MHz
10 μs	0000010. 0 MHz
.1 ms	000010. 00 MHz
1 ms	00010000. kHz
10 ms	0010000. 0 kHz
.1 s	010000. 00 kHz
1 s	10000. 000 kHz
10 s	0000. 0000 kHz

6. Set FUNCTION switch to MANUAL START. Counter should count continuously at frequency selected on TIME BASE switch.
7. Set FUNCTION switch to 1 PERIOD AVERAGE.
8. See table below for proper display (±1 count) for each PERIOD AVERAGE position of the FUNCTION switch.

PERIOD AVERAGE	DISPLAY
1	00000001
10	00000010
100	00000100
1K	00001000
10K	00010000
100K	00100000

Figure 3-4. Self Check



1. Turn SAMPLE RATE control clockwise from POWER OFF position to turn counter on.

2. Set FUNCTION switch to FREQUENCY.

3. Set TIME BASE switch for desired count (gate) time.

   Note

   Asterisk (*) will light at right end of display for switch positions which do not permit legitimate measurement (in this case EXT and .1 μs).

4. Set LEVEL control to PRESET.

5. Set SENSITIVITY switch to CHECK to verify proper counter operation (see Figure 3-4).

6. Connect unknown signal to AC or DC SIGNAL INPUT jack.

7. Change SENSITIVITY switch to "10". If there is no count, or if count is uncertain, progressively switch SENSITIVITY to lower ranges†

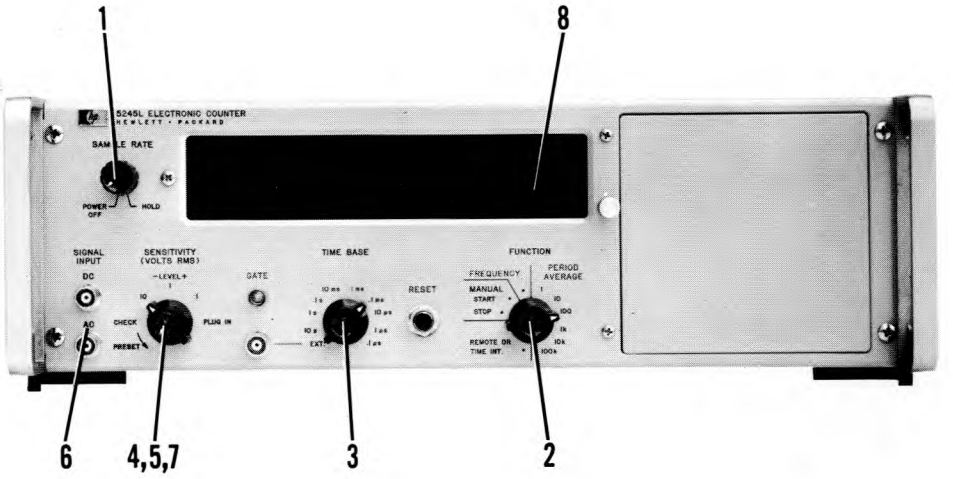
   CAUTION

   Maximum overload is 120 volts in position 0.1, 250 volts in position 1, 500 volts in position 10. Maximum input level for correct count is 2 volts in position 0.1, 20 volts in position 1, 200 volts in position 10.

8. Read frequency from display. Decimal point is correctly positioned and correct measurement unit (kHz or MHz) is displayed.

† For pulse input signals, adjust -LEVEL+ control for consistent count.

Figure 3-5. Frequency Measurements



1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to desired PERIOD AVERAGE position.
3. Set TIME BASE switch to desired time unit per count.

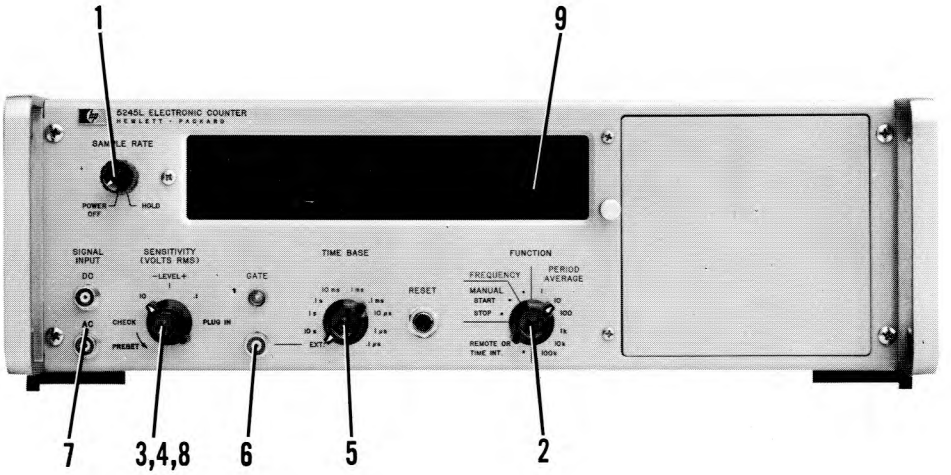
   Note

   Asterisk (*) will light at right end of display for switch positions which do not permit legitimate measurement (in this case may be any position between 1 millisecond and 10 seconds, depending on number of periods averaged as selected on FUNCTION switch).

4. Set LEVEL control to PRESET.
5. Set SENSITIVITY switch to CHECK to verify proper counter operation (see Figure 3-4).
6. Connect unknown signal to AC or DC SIGNAL INPUT jack.
7. Turn SENSITIVITY switch clockwise to first position which gives steady count.† (See CAUTION, Figure 3-5.)
8. Read period from display. Decimal point is correctly positioned and measurement unit (μs, ms, sec) is displayed.

† For pulse input signals, adjust -LEVEL+ control for consistent count.

Figure 3-6. Period Measurements



Proceed as follows to measure the ratio between two frequencies (f_1/f_2). The higher frequency (f_1) may be between 0 and 50 MHz the lower frequency (f_2) must be less than 1 MHz for single period measurement and less than 300 kHz for multiple-period measurement.

1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to desired PERIOD AVERAGE position.
3. Set LEVEL control to PRESET.
4. Set SENSITIVITY switch to CHECK to verify proper counter operation (see Figure 3-4).
5. Set TIME BASE switch to EXT.
6. Connect f_1 (the higher frequency) to the TIME BASE EXT connector.

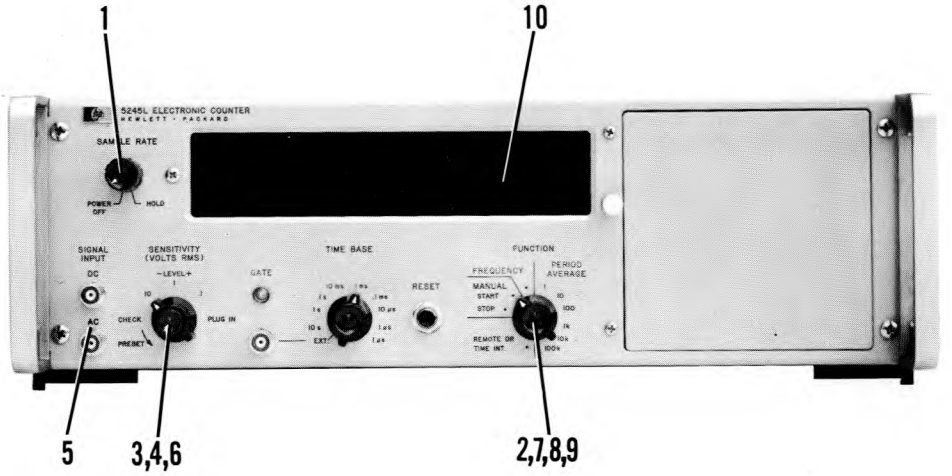
   CAUTION

   Input f_1 must not exceed 2V rms for correct count. Maximum input 120V rms. Use external blocking capacitor if a DC component is on f_1 signal.

7. Connect f_2 (the lower frequency) to the AC or DC SIGNAL INPUT jack.
8. Turn SENSITIVITY switch clockwise to first position which gives steady count.† (See CAUTION, Figure 3-5.)
9. Read ratio f_1/f_2 from display. Decimal point is correctly positioned, but no measurement unit is given since ratio is dimensionless.

† For pulse input signals, adjust -LEVEL+ control for consistent count.

Figure 3-7. Ratio Measurements



1. Turn counter on at SAMPLE RATE control.
2. Set FUNCTION switch to MANUAL START.
3. Set LEVEL control to PRESET.
4. To verify correct counter operation, set SENSITIVITY switch to CHECK. Counter should count continuously at frequency selected on TIME BASE switch.
5. Connect signal to AC or DC SIGNAL INPUT jack.
6. Change SENSITIVITY switch to "10". If there is no count, or if count is uncertain, progressively switch SENSITIVITY to lower ranges.† (See CAUTION, Figure 3-5.)

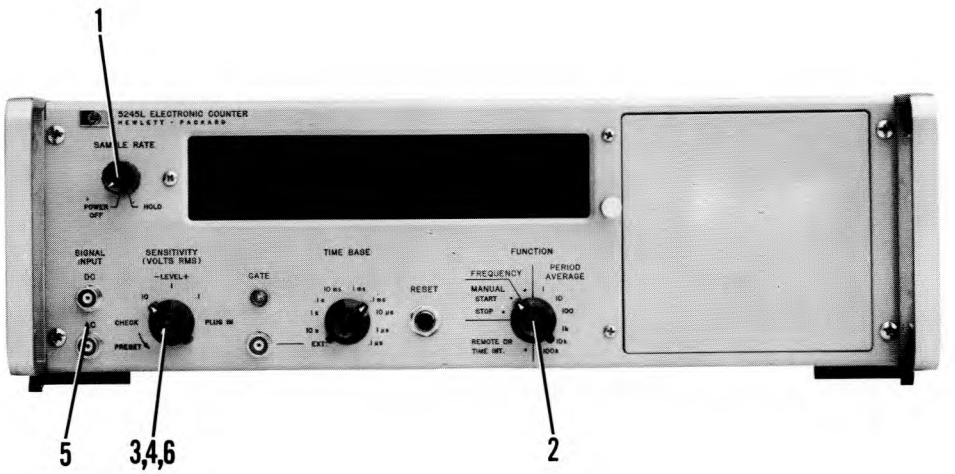
CAUTION

Maximum overload is 120 volts in position 0.1, 150 volts in position 1, 500 volts in position 10.

7. Set FUNCTION switch to MANUAL STOP.
8. At desired time to begin count, set FUNCTION switch to MANUAL START.
9. At desired time to end count, set FUNCTION switch to MANUAL STOP.
10. Read accumulated count from display.

† For pulse input signals, adjust -LEVEL+ control for consistent count.

Figure 3-8. Totalizing Operation



Any signal from 0 to 50 MHz can be scaled by decade factors from 10 to 10^9. Proceed as follows:

1. Turn counter on at SAMPLE RATE control.
2. Set FUNCTION switch to MANUAL START.
3. Set LEVEL control to PRESET.
4. Set SENSITIVITY switch to CHECK. Counter should count continuously at frequency selected on TIME BASE switch.
5. Connect signal to AC or DC SIGNAL INPUT jack.
6. Turn SENSITIVITY switch clockwise to first position which gives steady count.† (See CAUTION, Figure 3-5.)
7. Set OUTPUT switch (rear panel) to desired scaler ratio (10 to 10^9).
8. Take scaled output from OUTPUT connector located below the OUTPUT switch.

† For pulse input signals, adjust -LEVEL+ control for consistent count.

Figure 3-9. Scaler Operation

3-12. DIGITAL RECORDER OUTPUT.

3-13. To supply counter display information (including all digits, decimal point position, and measurement unit) to the ℏ Model 562A Digital Recorder or ℏ Model 580A/581A Digital-to-Analog Converter, connect 50-wire cable (ℏ stock no. 562A-16C) between rear-panel DIGITAL RECORDER jack on counter and input connector of recorder or converter. Cable can be fabricated for connection to other equipment using an Amphenol 57-30500 connector to mate with the counter DIGITAL RECORDER jack. Signals available and external signals required are given in Table 3-1. Tables 3-2 and 3-3 provide output information for decimal point and measurement units recording.

Table 3-1. Summary of Connections to Digital Recorder Jack

Function		J11 Pin No.
Display	Weight	
(Right End) 10^0 Units	1 2 2 4	1 2 26 27
10^1 Tens	1 2 2 4	3 4 28 29
10^2 Hundreds	1 2 2 4	5 6 30 31
10^3 Thousands	1 2 2 4	7 8 32 33
10^4 Ten Thousands	1 2 2 4	9 10 34 35
10^5 Hundred Thousands	1 2 2 4	11 12 36 37
10^6 Millions	1 2 2 4	13 14 38 39
(Left End) 10^7 Ten Millions	1 2 2 4	15 16 40 41

Function		J11 Pin No.
Display	Weight	
Measurement Units	1 2 2 4	17 18 42 43
Decimal Point Position	1 2 2 4	19 20 44 45
Inhibit signal input; +15v min, +25 v max supplied from external source to prevent reset; causes count to hold		22
Print command output; +13 v to 0 v step, DC-coupled, signals that completed count is available for readout		48
Neg reference output; about -6.5 vdc indicates "0" level for BCD output		24
Pos reference output; about +17 vdc indicates "1" level for BCD output		25
Ground		50
No connection		21 23 46 47 49

Table 3-2. Decimal Point BCD Out

DISPLAY	J11 Output (Volts)				Printed Digit
	Pin 45	Pin 44	Pin 20	Pin 19	
0 0 0 0 0 0 0 0	- 8	- 8	- 8	- 8	0
0 0 0 0 0 0 0 0.	- 8	- 8	- 8	- 8	0
0 0 0 0 0 0 0 0.0	- 8	- 8	- 8	+18	1
0 0 0 0 0 0 0.0 0	- 8	- 8	+18	- 8	2
0 0 0 0 0 0.0 0 0	- 8	- 8	+18	+18	3
0 0 0 0 0.0 0 0 0	- 8	+18	+18	- 8	4
0 0 0 0.0 0 0 0 0	- 8	+18	+18	+18	5
0 0 0.0 0 0 0 0 0	+18	+18	- 8	- 8	6
0 0.0 0 0 0 0 0 0	+18	+18	- 8	+18	7

Table 3-3. Measurement Units BCD Out

DISPLAY	J11 Output (Volts)				Printed Digit
	Pin 43	Pin 42	Pin 18	Pin 17	
*	- 8	- 8	- 8	- 8	0
MC (MHz)	- 8	- 8	- 8	+18	1
KC (KHz)	- 8	- 8	+18	- 8	2
SEC	- 8	- 8	+18	+18	3
MS	- 8	+18	+18	- 8	4
μS	- 8	+18	+18	+18	5

3-14. REMOTE CONTROL. (SPECIAL)

3-15. OPERATION. Front-panel controls at the counter should normally be set as follows to allow remote control.

a. FUNCTION: REMOTE OR TIME INTERVAL.

b. TIME BASE: EXT.

c. SENSITIVITY: Not CHECK, set to proper range for input signal amplitude.

d. SAMPLE RATE: as desired.

Note

To permit normal front-panel control, all remote control circuit connections must be interrupted.

3-16. GENERAL. Two rear-panel connectors permit connection for complete control of the basic instrument from a remote location. All front-panel switching operations can be controlled except for SAMPLE RATE and SENSITIVITY.

3-17. PROGRAMMING. The following procedure describes how to provide counter control from a remote location. All that is required is contact closure between appropriate terminals of J9 (upper) and J10 (lower) on the rear panel. Mating connector for J9 or J10 is Amphenol 57-30360.

a. Program desired FUNCTION by connecting -15 volts to J9 pins listed in Table 3-4. When counter is on, -15 volts is continuously available at pin 30 of J9; -15 volts is also available at pin 32 of J10 only when FUNCTION switch is set to REMOTE OR TIME INT.

Table 3-4. Function Program

Equivalent Switch Position	Pins on J9 Requiring -15V
MANUAL START	2, 15
MANUAL STOP	2, 14
FREQUENCY	2, 3, 12
1 PERIOD AVERAGE	1, 5, 12
10 PERIOD AVERAGE	1, 11, 13, 5
100 PERIOD AVERAGE	1, 10, 13, 5
1K PERIOD AVERAGE	1, 9, 13, 5
10K PERIOD AVERAGE	1, 8, 13, 5
100K PERIOD AVERAGE	1, 7, 13, 5

b. Program desired TIME BASE by connecting -15 volts to J9 pins listed in Table 3-5.

Table 3-5. Time-Base Program

Equivalent Switch Position	Pins on J9 Requiring -15V
10 s	21
1 s	22
.1 s	23
10 ms	24
1 ms	25
.1 ms	26
10 μs	27
1 μs	28
.1 μs	29

Table 3-7. Pins on J10 Requiring +170 V for Decimal Point and Measurement Units Program

Function	Time Base									
	0.1 μs	1 μs	10 μs	0.1 ms	1 ms	10 ms	0.1 ms	1 s	10 s	EXT
MANUAL START	-	-	-	-	-	-	-	-	-	-
MANUAL STOP	-	-	-	-	-	-	-	-	-	-
FREQUENCY	11	10, 13	1, 13	2, 13	10, 12	1, 12	2, 12	3, 12	4, 12	11
1 PERIOD AVERAGE	1, 16	10, 16	2, 15	1, 15	10, 15	2, 14	1, 14	10, 14	11	10
10 PERIOD AVERAGE	2, 16	1, 16	10, 16	2, 15	1, 15	10, 15	2, 14	1, 14	11	1
100 PERIOD AVERAGE	3, 16	2, 16	1, 16	10, 16	2, 15	1, 15	10, 15	11	11	2
1K PERIOD AVERAGE	4, 16	3, 16	2, 16	1, 16	10, 16	2, 15	11	11	11	3
10K PERIOD AVERAGE	5, 16	4, 16	3, 16	2, 16	1, 16	11	11	11	11	4
100K PERIOD AVERAGE	6, 16	5, 16	4, 16	3, 16	11	11	11	11	11	5

Table 3-6. Check Program

Check Function	Pins on J9 Requiring -15V
MANUAL	1, 15, any 21-29
FREQUENCY	3, 6, 12, any 21-28
1 PERIOD AVERAGE	1, 3, 12, 27
10 PERIOD AVERAGE	1, 3, 11, 13, 27
100 PERIOD AVERAGE	1, 3, 10, 13, 27
1K PERIOD AVERAGE	1, 3, 9, 13, 27
10K PERIOD AVERAGE	1, 3, 8, 13, 27
100K PERIOD AVERAGE	1, 3, 7, 13, 27

c. Counter operation may be programmed for CHECK, if desired, by connecting -15 volts to the J9 pins listed in Table 3-6.

d. Program appropriate decimal point and measurement unit for the selected FUNCTION and TIME BASE by connecting +170 V to J10 pins as given in Table 3-7. When counter is on, +170 volts is continuously available at pin 20 of J10; +170 volts is also available at pins 21 and 22 of J10 when FUNCTION switch is set to REMOTE OR TIME INTERVAL.

3-18. 5251A FREQUENCY CONVERTER.

3-19. The following paragraphs contain information for operating the HP Model 5251A Frequency Converter plug-in when installed in the HP Model 5245L Electronic Counter.

3-20. FRONT PANEL.

3-21. GENERAL. The functions of the front panel control, meter, and input connector are described in Paragraphs 3-22 through 3-24.

3-22. INPUT CONNECTOR. Signal input 50 mV rms (-13 dBm) to 1 V rms (+13 dBm) into type "N" female connector.

3-23. MIXING FREQUENCY SELECTOR. Calibrated in megacycles, this control selects a 10-Mc harmonic to be heterodyned with INPUT signal.

3-24. LEVEL INDICATOR METER. The meter circuit continuously monitors the level of the difference-frequency signal fed from the converter to the counter. When the meter reads in green portion of the scale, the INPUT signal level is adequate for accurate frequency measurement.

3-25. MAXIMUM INPUT VOLTAGES.

3-26. Damage to the converter may result if an AC signal greater than 2 volts rms or a DC voltage greater then ±100 volts DC is applied to converter INPUT connector.

3-27. OPERATING PROCEDURE.

3-28. Figure 3-11 provides a step-by-step operating procedure to be used for measurement of frequencies from 20 MHz to 100 MHz with INPUT signal amplitudes from 50 mv to 1 v rms.

3-29. When the difference frequency (produced by the heterodyning of the INPUT signal frequency and the selected MIXING FREQUENCY) is less than 100 kHz or more than 12 MHz, change the MIXING FREQUENCY so that the difference frequency is between 100 kHz and 12 MHz (bandwidth of amplifier within the converter). Table 3-8 lists counter displays when INPUT signal frequency is within 100 kHz of a MIXING FREQUENCY.

3-30. TYPICAL FREQUENCY MEASUREMENTS.

3-31. Figure 3-11 shows counter and plug-in indications during three typical frequency measurements.

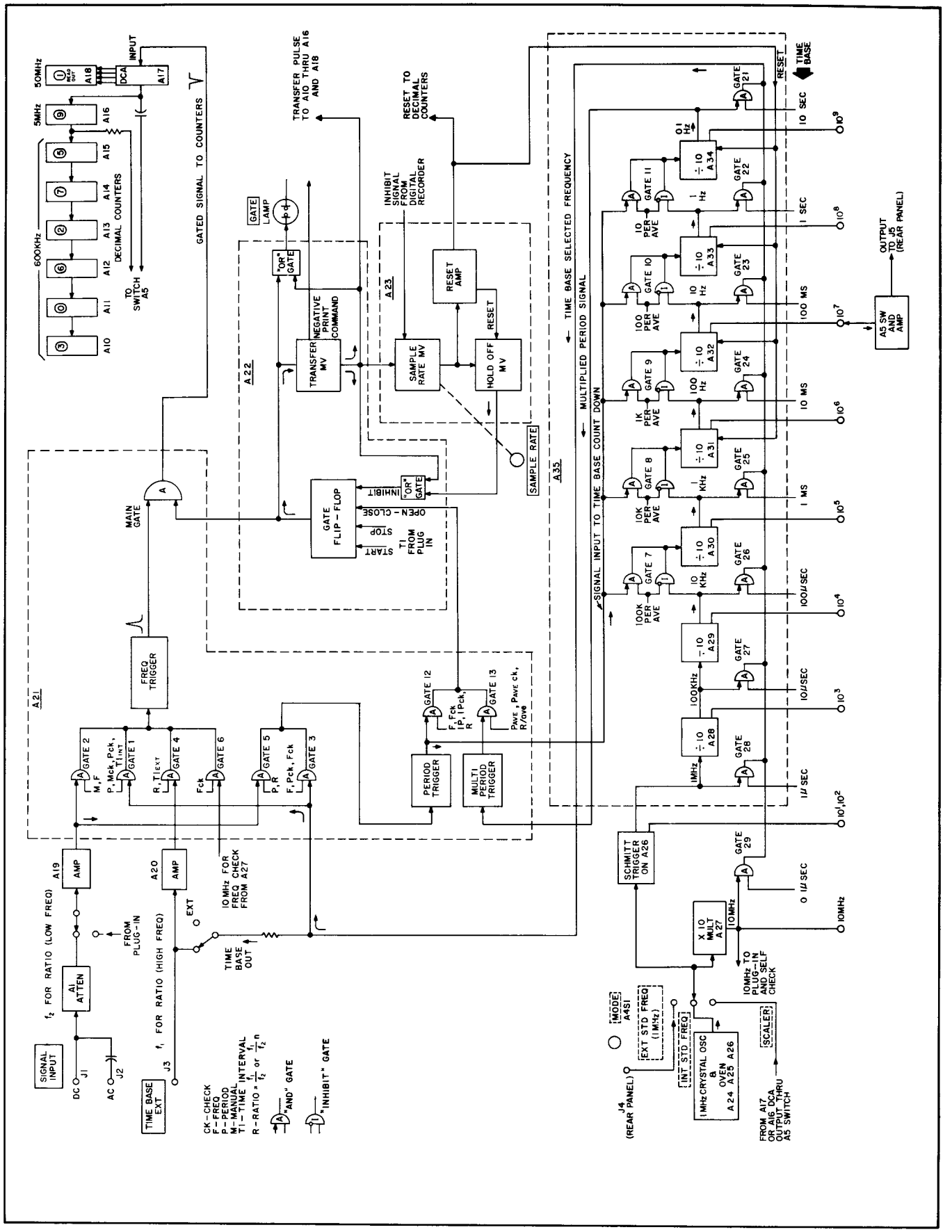
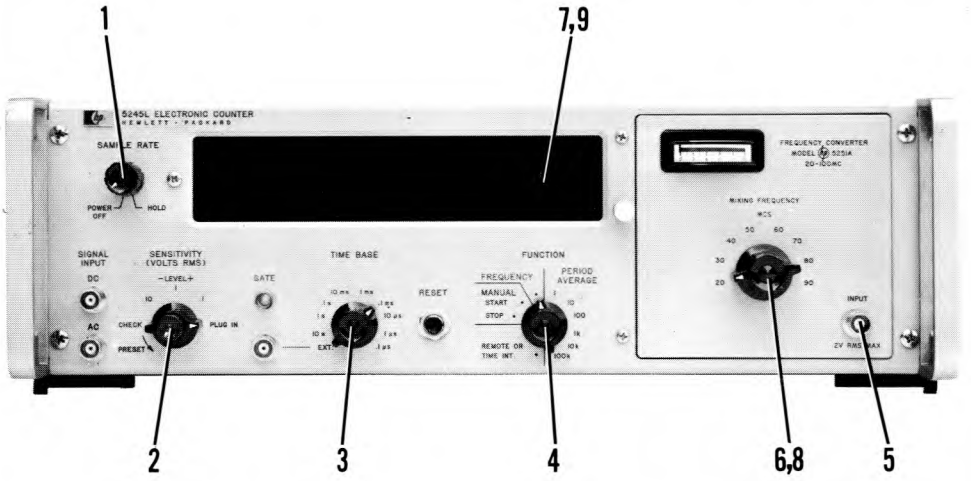


Figure 3-10. Model 5245L Logic Block Diagram



1. Turn SAMPLE RATE control slightly clockwise out of POWER OFF position.
2. Set SENSITIVITY to PLUG-IN.
3. Set TIME BASE to . 1 ms*.
4. Set FUNCTION to FREQUENCY.
5. Connect signal whose frequency is to be measured to converter INPUT. DO NOT EXCEED 2 VOLTS RMS.
6. Set MIXING FREQUENCY to 20 MHz. If meter indicates in green area and counter reading is less than 10 MHz, proceed with step 7 below. If meter does not indicate in green area or if counter reading is greater than 10 MHz, increase MIXING FREQUENCY in 10-MHz steps until meter indicates in green area and counter reading is less than 10 MHz.
7. Add counter reading to MIXING FREQUENCY for frequency of INPUT signal.
8. Increase MIXING FREQUENCY by 10 MHz.
9. Subtract counter reading from MIXING FREQUENCY; result should agree with frequency obtained in step 7 above.

Note

Meter may indicate in red area and proper counter reading may not be displayed when MIXING FREQUENCY differs from frequency of INPUT signal by less than 100 kHz. See Table 3-9 when counter reading is between 9. 9 MHz and 10. 1 MHz.

*TIME BASE setting may vary depending upon desired resolution of INPUT signal frequency. (See Table 3-8.)

Input Freq.	Display	Dial	Meter	
	EXAMPLE OF ONE RESPONSE			
	00000.000 MHz	70 MHz	Red	Difference frequency of 30 MHz is above pass band of video amplifier assembly.
100.000 MHz	00000.000 MHz	80 MHz	Red	Difference frequency of 20 MHz is above pass band of video amplifier assembly.
	00010.000 MHz	90 MHz	Green	90.000 MHz + 10.000 MHz = 100. 000 MHz
	EXAMPLE OF TWO RESPONSES			
	00010.030 MHz	70 MHz	Green	70. 000 MHz + 10. 030 MHz = 80. 030 MHz
80.030 MHz	00000.000 MHz	80 MHz	Red	Difference frequency of 30 kHz is below pass band of video amplifier assembly.
	00009.970 MHz	90 MHz	Green	90. 000 MHz - 9. 970 MHz = 80. 030 MHz
	EXAMPLE OF TWO RESPONSES			
	00000.000 MHz	60 MHz	Red	Difference frequency of 15 MHz is above pass band of video amplifier assembly
75.000 MHz	00005.000 MHz	70 MHz	Green	70. 000 MHz + 5. 000 MHz = 75. 000 MHz
	00005.000 MHz	80 MHz	Green	80. 000 MHz - 5. 000 MHz = 75. 000 MHz

Figure 3-11. Model 5251A Operating Procedure

Table 3-8. Frequency Resolution

TIME BASE SETTING	COUNTER DISPLAY	MEASUREMENT RESOLUTION
.1 μS	(No Display)	
1.0 μS	1 1 . MHz	7 1 . MHz
10.0 μS	1 1 . 1 MHz	7 1 . 1 MHz
.1 MS	1 1 . 1 2 MHz	7 1 . 1 2 MHz
1.0 MS	1 1 1 2 2 . KHz	7 1 . 1 2 2 MHz
10.0 MS	1 1 1 2 2 . 3 KHz	7 1 . 1 2 2 3 MHz
.1 S	1 1 1 2 2 . 3 3 KHz	7 1 . 1 2 2 3 3 MHz
1.0 S	1 1 1 2 2 . 3 3 4 KHz	7 1 . 1 2 2 3 3 4 MHz
10.0 S	1 1 2 2 . 3 3 4 4 KHz	7 1 . 1 2 2 3 3 4 4 MHz
INPUT SIGNAL FREQUENCY 71.1223344 MHz MIXER-FREQUENCY DIAL SET TO 60 MHz		

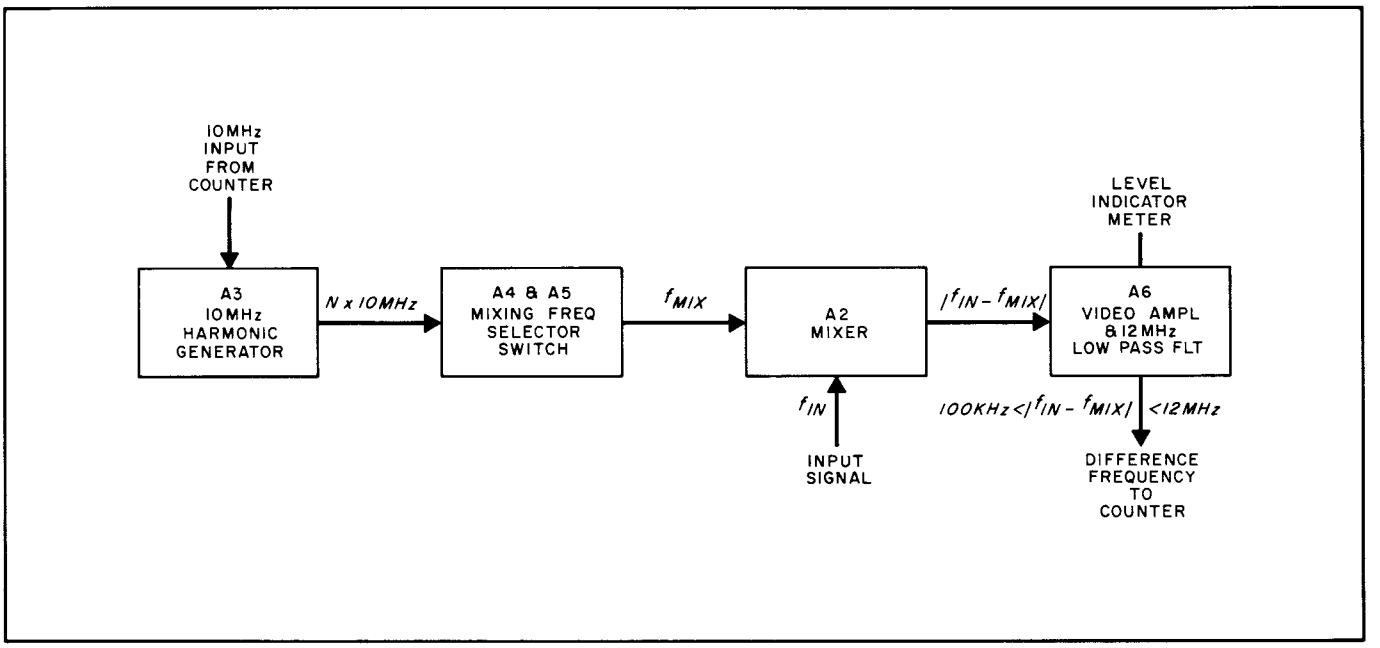


Figure 3-12. Model 5251A Block Diagram

Table 3-9. Special Counter Display

Mixer Frequency MHz	Input Frequency MHz								
	2.0 to 20.1	29.9 to 30.1	39.9 to 40.1	49.9 to 50.1	59.9 to 60.1	69.9 to 70.1	79.9 to 80.1	89.9 to 90.1	99.9 to 100
20	*	9.9 to 10.1							
30	9.9 to 10	*	9.9 to 10.1						
40		9.9 to 10.1	*	9.9 to 10.1					
50			9.9 to 10.1	*	9.9 to 10.1				
60				9.9 to 10.1	*	9.9 to 10.1			
70					9.9 to 10.1	*	9.9 to 10.1		
80						9.9 to 10.1	*	9.9 to 10.1	
90							9.9 to 10.1	*	9.9 to 10
*Meter may indicate in red area; counter reading is valid only if meter indication is in green area.									

3-32. 5252A PRESCALER.

3-33. The following paragraphs contain information for operating the Model 5252A Prescaler plug-in when installed in the Model 5245L Electronic Counter.

3-34. CONTROLS AND INPUT.

3-35. GENERAL. The function of the front panel switch, connector, and control are described in Paragraphs 3-36 through 3-38.

3-36. MAX COUNT RATE SWITCH. The switch selects scaling factor for the unknown frequencies. The following are the switch positions and their corresponding scaling factors.

MAX COUNT RATE	SCALE FACTOR
100 MHz	2
200 MHz	4
350 MHz	8

3-37. INPUT CONNECTOR. The signal input is DC coupled into 50 ohms. Damage to the plug-in will result if a dc voltage or ac signal greater than 2 v rms, +20 dBm, or 100 mw is applied to the plug-in INPUT connector.

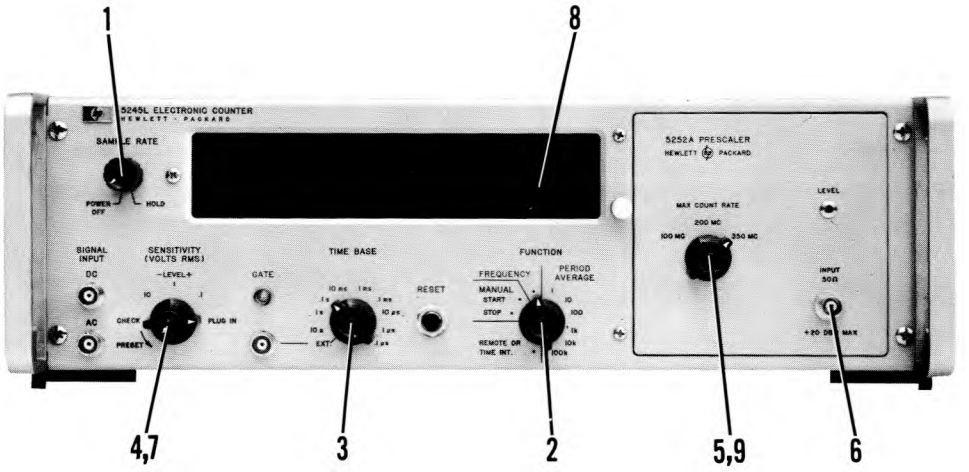
3-38. LEVEL CONTROL. Provides adjustment for counting either positive or negative pulses.

3-39. OPERATING PROCEDURE.

3-40. Figure 3-13 provides a step-by-step procedure for operating the 5252A plug-in.

3-41. SCALED OUTPUT.

3-42. A scaled output of greater than 100 mv RMS into 50 ohms is available at the AUX A jack on the rear panel of the counter.



1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to FREQUENCY.
3. Set TIME BASE switch to desired gate time*.
4. Set SENSITIVITY switch to CHECK to verify proper counter operation.
5. Set plug-in MAX COUNT RATE switch to 350 MHz.
6. Connect unknown signal to plug-in INPUT jack.

CAUTION

Input signal must not exceed 2 volts rms, +20 dBm, 100 mw, or ±1 V dc.

7. Set SENSITIVITY switch to PLUG-IN.
8. Display is unknown frequency.
9. For faster gate times, the MAX COUNT RATE switch may be set to lower frequency range which includes unknown frequency.

* Gate time is extended by 2:1 when count rate is on 100 MHz; 4:1 when count rate is on 200 MHz, and 8:1 when count rate is on 350 MHz.

Figure 3-13. Model 5252A Operating Procedure

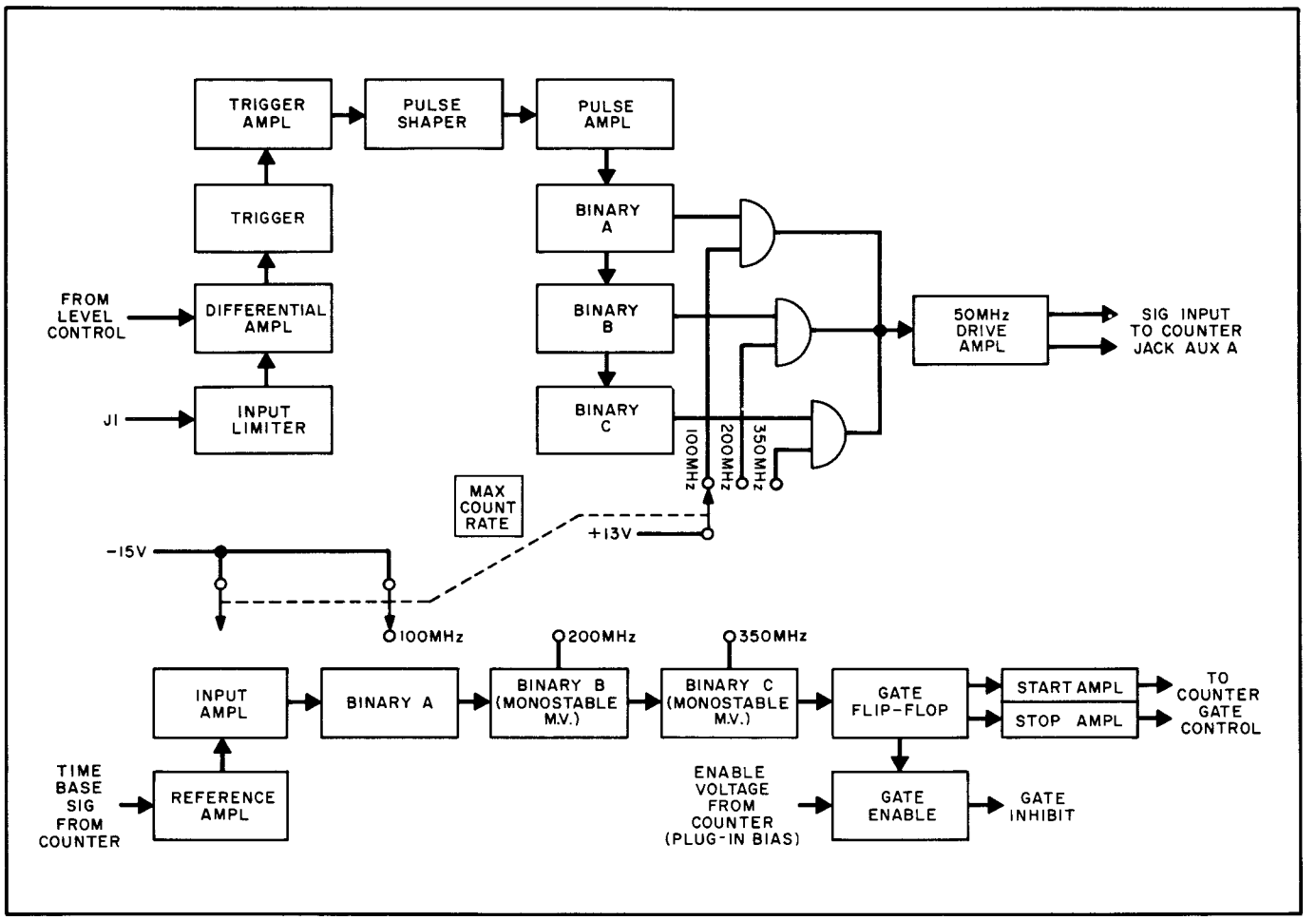


Figure 3-14. Model 5252A Block Diagram

3-43. 5253B FREQUENCY CONVERTER.

3-44. The following paragraphs contain information for operating the ℗ Model 5253B Frequency Converter plug-in when installed in the ℗ Model 5245L Electronic Counter.

3-45. FRONT PANEL.

3-46. GENERAL. The functions of the front panel control, meter, and input connector are described in Paragraphs 3-47 through 3-49.

3-47. INPUT CONNECTOR. Signal input, 50 mV (-13 dBm) to 1 V (+13 dBm) into a BNC connector.

3-48. MIXING FREQUENCY SELECTOR. Calibrated in megacycles, this control tunes the internal cavity to select a harmonic of 10 MHz to be heterodyned with the INPUT signal.

3-49. LEVEL INDICATOR METER. The meter circuit continuously monitors the level of the difference-frequency output of the converter to counter. When meter reads in green portion of its scale, INPUT signal amplitude is adequate for accurate frequency measurements.

3-50. MAXIMUM INPUT VOLTAGES.

3-51. Damage to the converter may result if an AC signal greater than 2 v RMS or a DC voltage greater than 100 v is applied to converter INPUT connector.

3-52. OPERATING PROCEDURES.

3-53. NORMAL RANGE MEASUREMENTS. Figure 3-15 is the procedure to be used for measurement of frequencies from 50.1 to 512 MHz with INPUT signal amplitudes from 50 mv to 1 v RMS.

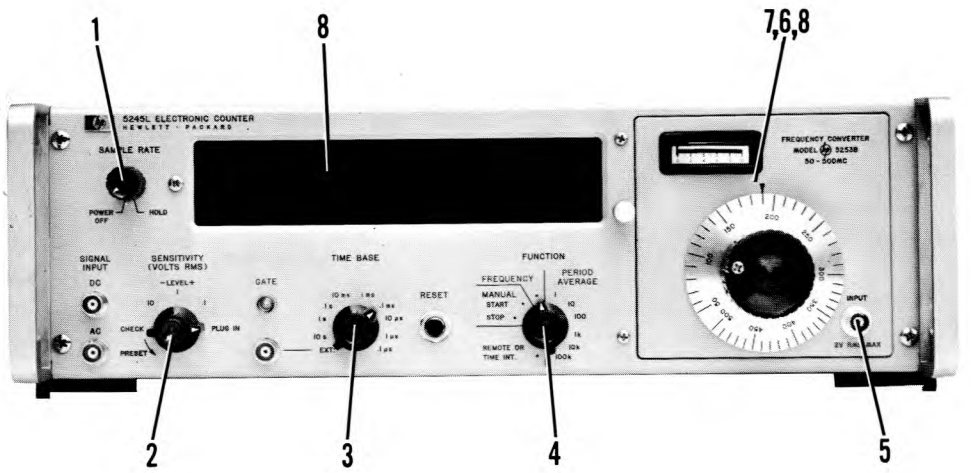
3-54. EXTENDED RANGE MEASUREMENTS. The frequency of signals not within the normal range of 50.1 to 512 MHz, 50 mv to 1 v RMS, may be measured using the following procedures:

3-55. 50 TO 50.1 MHz, 50 MV TO 1 V RMS. Perform steps 1 through 5 of Figure 3-15. Then:

a. Set mixing frequency control to slightly more than 60 MHz.

b. Turn mixing frequency control slowly clockwise until level indicator meter first reaches a maximum reading in the green portion of its scale.

c. Subtract counter display (in MHz) from reading of mixing frequency control (in MHz) for frequency of INPUT signal.



1. Turn SAMPLE RATE control slightly out of POWER OFF position.
2. Set SENSITIVITY to PLUG-IN.
3. Set TIME BASE to . 1 ms*.
4. Set FUNCTION to FREQUENCY.
5. Connect signal whose frequency is to be measured to INPUT of converter.
6. Set mixing frequency control to read slightly less than 50 MHz.
7. Slowly turn mixing frequency control counterclockwise until level indicator meter first reaches a maximum reading in the green portion of its scale.
8. Add counter display (in MHz) to mixing frequency control reading (in MHz) for frequency of INPUT signal.

* TIME BASE setting may vary, depending on desired resolution of INPUT signal frequency. See Table 3-10.

Input Frequency	Display	Dial	Meter	
	EXAMPLE OF ONE RESPONSE			
512.000 MHz	00000000 MHz	480 MHz	Red	Difference frequency of 32 MHz is above pass band of video amplifier assembly
	00000000 MHz	490 MHz	Red	Difference frequency of 22 MHz is above pass band of video amplifier assembly
	00012000 MHz	500 MHz	Green	500.000 MHz + 12.000 MHz = 512.000 MHz
	EXAMPLE OF TWO RESPONSES			
150.030 MHz	00010030 MHz	140 MHz	Green	140.000 MHz + 10.030 MHz = 150.030 MHz
	00000000 MHz	150 MHz	Red	Difference frequency of 30 kHz is below passband of video amplifier assembly
	00009970 MHz	160 MHz	Green	160.000 MHz - 9.970 MHz = 150.030 MHz
	EXAMPLE OF TWO RESPONSES			
155.000 MHz	00000000 MHz	140 MHz	Red	Difference frequency of 15 MHz is above pass band of video amplifier assembly
	00005000 MHz	150 MHz	Green	150.000 MHz + 5.000 MHz = 155.000 MHz
	00005000 MHz	160 MHz	Green	160.000 MHz - 5.000 MHz = 155.000 MHz

Figure 3-15. Model 5253B Operating Procedure

3-56. 50 TO 512 MHz, AMPLITUDE LESS THAN 50 MV RMS. The front panel level indicator meter indicates in the green portion of its scale only when converter is properly tuned and amplitude of INPUT signal is adequate for accurate frequency measurement. However, because of conservative specifications of both the converter and counter, frequencies may often be accurately measured when meter reads in the red portion of its scale. To make these extended range measurements:

a. Follow normal procedure (Figure 3-15 or Paragraph 3-54, depending upon frequency range) except that mixing frequency control should be tuned for first maximum reading on the level indicator meter, regardless of the color of region maximum.

b. Check frequency measurement result as described in Paragraph 3-58, or

c. Insert an external variable attenuator (such as Hewlett-Packard Model 355A or 355C) in the transmission line between the converter and the source of INPUT signal. Vary attenuation from 0 to 1 dB during final step of frequency measurement procedure. If counter display does not change more than momentarily (during switching of attenuator), INPUT signal is above noise threshold and frequency measurement result is valid.

3-57. DOUBLE-CHECKING FREQUENCY MEASUREMENT RESULT.

3-58. Because of the heterodyne action of the converter, frequency measurement results obtained at any one setting of the mixing frequency control may be checked at other settings. See Figure 3-15 for examples.

3-59. AID TO RAPID TUNING.

3-60. To easily obtain an indication of the proper MIXING FREQUENCY when rapidly tuning the Model 5253B through its frequency range in search of an unknown INPUT frequency, set counter FUNCTION control to MANUAL START. This allows the counter to totalize each cycle of any difference frequency produced during rapid tuning. When counter display changes, indicating that the MIXING FREQUENCY is heterodyning with the INPUT frequency and producing a difference frequency within the frequency range of the basic counter, set counter FUNCTION control to FREQUENCY and proceed with measurement.

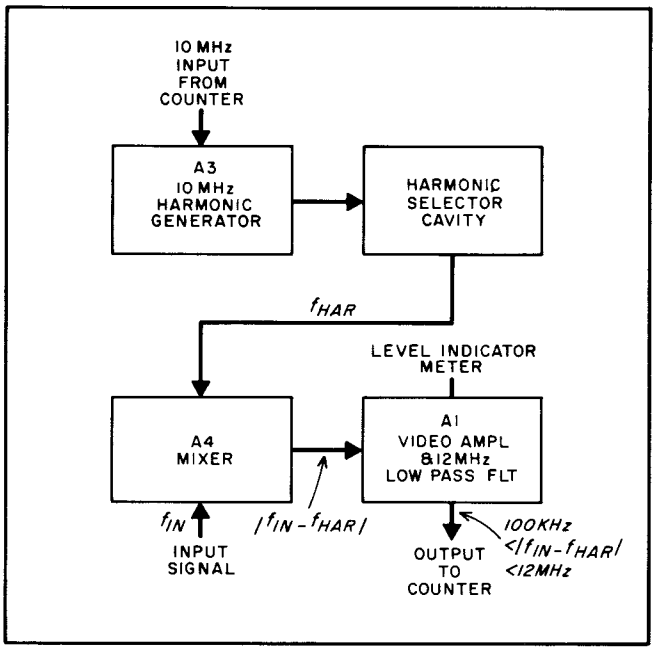


Figure 3-16. Model 5253B Block Diagram

Table 3-10. Frequency Resolution

INPUT SIGNAL FREQUENCY = 151.1223344 MHz MIXING FREQUENCY CONTROL set to 140 MHz		
TIME BASE SETTING	COUNTER DISPLAY	MEASUREMENT RESOLUTION
.1 μs	*(no display)	
1 μs	11. MHz	151. MHz
10 μs	11.1 MHz	151.1 MHz
.1 ms	11.12 MHz	151.12 MHz
1 ms	111122. MHz	151.122 MHz
10 ms	111122.3 MHz	151.1223 MHz
.1 s	111122.33 MHz	151.12233 MHz
1 s	111122.334 MHz	151.122334 MHz
10 s	11122.3344 MHz	151.1223344 MHz

3-61. 5254B FREQUENCY CONVERTER.

3-62. The following paragraphs contain information for operating the Model 5254B Frequency Converter plug-in when installed in the Model 5245L Electronic Counter.

3-63. The Model 5254B Frequency Converter increases the range of the 5245L Electronic Counter to .2 through 3.0 GHz (200 through 3000 MHz). As a general rule to measure frequency, always start with the Mixing Frequency control below .2 GHz and tune upward in frequency to obtain first response and tune for a maximum reading in the green portion of the meter scale. The input frequency is the sum of the counter reading and the dial frequency reading. This procedure will be valid whether there are responses in 1, 2, or 3 consecutive harmonic reference frequencies; see Figure 3-17. If the input signal level to the converter is high, the second, third and other harmonics of this signal may be generated. Therefore, tuning Mixing Frequency control from the low end upward will enable the input fundamental frequency to be detected before its harmonics. In the 5254B harmonics of the reference-frequency signals are held to such a low level that regardless of input signal level, their mixing effects are not observable, avoiding possible ambiguity. Figure 3-17 provides a step-by-step procedure to be used for measurement of frequencies from .2 to 3.0 GHz (200 MHz to 3000 MHz). The only exception is if the first response occurs at .2 GHz or .25 GHz. To avoid possible ambiguity in these cases, start from above .35 GHz and tune downward in frequency for the first response and subtract the counter reading from the dial frequency for the frequency of the input signal.

Note

If the input frequency is known approximately, the Mixing Frequency Control can be set a hundred megacycles below the input signal. Tune up for the first response and add the counter reading to the dial frequency.

3-64. CONTROLS AND INPUT.

3-65. GENERAL. The functions of the front panel control, meter, and input connector are described in Paragraphs 3-66 through 3-68.

3-66. INPUT CONNECTOR. Signal input, 50 ohms input impedance, 50 mv (-13 dBm in 50 ohms) to 1 v rms (+13 dBm in 50 ohms) into type "N" female connector.

3-67. MIXING FREQUENCY SELECTOR. Calibrated from .3 to 3.0 GHz (300 MHz to 3000 MHz), this control tunes the internal cavity to select a harmonic of 50 MHz to be heterodyned with the INPUT signal.

3-68. LEVEL INDICATOR METER. The meter circuit continuously monitors the level of the difference-frequency output of the converter to the counter. When meter reads in the green portion of its scale, INPUT signal amplitude is adequate for accurate frequency measurement.

3-69. MAXIMUM INPUT VOLTAGES.

3-70. Damage to the converter may result if an AC signal greater than +20 dBm in 50 ohms (2.2 v rms) or a DC voltage greater than 100 v is applied to converter INPUT connector.

3-71. FREQUENCY MEASUREMENT WITH AMPLITUDE LESS THAN 50 MV RMS.

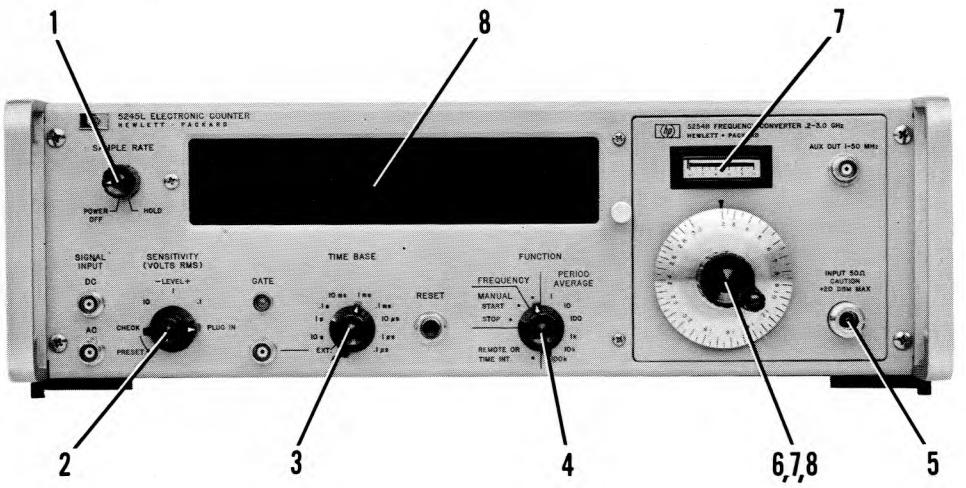
3-72. The front panel level indicator meter indicates in the green portion of its scale only when converter is properly tuned and amplitude of INPUT signal is adequate for accurate frequency measurement. However, because of conservative specifications of both the converter and counter, frequencies may often be accurately measured when meter reads in the red portion of its scale. To make these extended range measurements:

a. Follow normal procedure (Figure 3-17) except that mixing frequency control should be tuned for first maximum reading on the level indicator meter, regardless of the color of region.

b. Check frequency measurement result as described in Paragraph 3-73.

Table 3-11. Frequency Resolution

INPUT SIGNAL FREQUENCY = 2.4911223344 GHz MIXING FREQUENCY CONTROL set to 2.45 GHz		
TIME BASE SETTING	COUNTER DISPLAY	MEASUREMENT RESOLUTION
.1 μs	*(no display)	
1 μs	41. MHz	2.4911 GHz
10 μs	4.11 MHz	2.49111 GHz
.1 ms	41.12 MHz	2.491112 GHz
1 ms	41122 KHz	2.4911122 GHz
10 ms	41122.3 KHz	2.49111223 GHz
.1 s	41122.33 KHz	2.491112233 GHz
1 s	41122.334 KHz	2.4911122334 GHz
10 s	1122.3344 KHz	2.49111223344 GHz



1. Turn SAMPLE RATE control slightly out of POWER OFF position.
2. Set SENSITIVITY to PLUG IN.
3. Set TIME BASE to .1 ms*.
4. Set FUNCTION to FREQUENCY.

*TIME BASE setting may vary, depending on desired resolution of INPUT signal frequency, (see Table 3-11).

5. Connect signal whose frequency is to be measured to INPUT of converter.
6. Set Mixing Frequency Control to read slightly less than .2 GHz.
7. Slowly turn Mixing Frequency Control counterclockwise to obtain the first response, and tune for a maximum reading in the green portion of the Level Indicator Meter scale.
8. Add Counter display (in MHz) to Mixing Frequency Control reading (in MHz) for frequency of INPUT signal.

Input Freq	Display	Meter	Dial	Response
	EXAMPLE OF ONE RESPONSE			
3020 MHz	000000.00 MHz	Red	2.95 GHz (2950 MHz)	No response, difference frequency greater than 1 MHz to 53 MHz pass band of video ampl.
	000020.00 MHz	Green	3.0 GHz (3000 MHz)	First response 3000 MHz + 20 MHz = 3020 MHz
	EXAMPLES OF TWO RESPONSES			
1020 MHz	000020.00 MHz	Green	1.0 GHz (1000 MHz)	First response 1000 MHz + 20 MHz = 1020 MHz
	000030.00 MHz	Green	1.05 GHz (1050 MHz)	Second response 1050 MHz - 30 MHz = 1020 MHz
900 MHz	000050.00 MHz	Green	.85 GHz (850 MHz)	First response 850 MHz + 50 MHz = 900 MHz
	000000.00 MHz	Red	.90 GHz (900 MHz)	No response, difference frequency less than 1 MHz to 53 MHz pass band of video amplifier
	000050.00 MHz	Green	.95 GHz (950 MHz)	Second response 950 MHz - 50 MHz = 900 MHz
	EXAMPLE OF THREE RESPONSES			
851 MHz	000051.00 MHz	Green	.8 GHz (800 MHz)	First response 800 MHz + 51 MHz = 851 MHz
	000001.00 MHz	Green	.85 GHz (850 MHz)	Second response 850 MHz + 1 MHz = 851 MHz
	000049.00 MHz	Green	.9 GHz (900 MHz)	Third response 900 MHz - 49 MHz = 851 MHz

* Note: Counter in .1 ms Gate to give reading in Megahertz in all examples.

Figure 3-17. Model 5254B Operating Procedure

3-73. DOUBLE-CHECKING FREQUENCY MEASUREMENT RESULT.

3-74. Because of the heterodyne action of the converter, frequency measurement results obtained at any one setting of the Mixing Frequency Control may be checked at other settings. In most cases these will be two consecutive responses: tune in the first response and add the counter display to dial frequency reading; then tune up in frequency to the second response and subtract the counter display from the dial frequency reading (see Table 3-12). In some cases there will be three consecutive responses (see Figure 3-17); in these cases the third response will be the one in which you subtract the counter display from the dial frequency reading.

3-75. AID TO RAPID TUNING.

3-76. To easily obtain an indication of the proper MIXING FREQUENCY when rapidly tuning the Model 5254A through its frequency range in search of an unknown INPUT frequency, set 5245L FUNCTION control to MANUAL START. This allows the counter to totalize each cycle of any difference frequency produced during rapid tuning. When 5245L display changes, indicating that the MIXING FREQUENCY is heterodyning with the INPUT frequency and producing a difference frequency within the frequency range of the basic counter, set counter FUNCTION control to FREQUENCY and proceed with measurement.

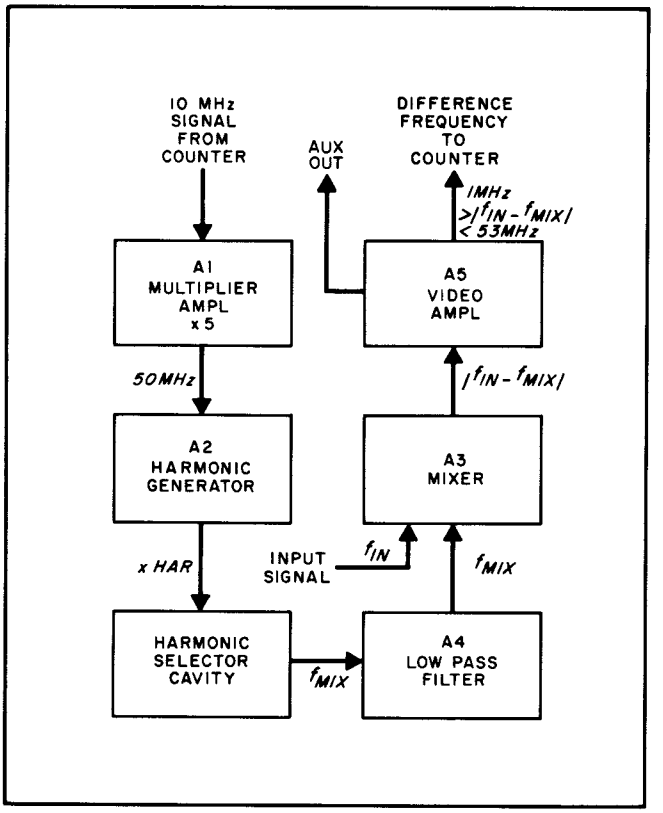


Figure 3-18. Model 5254B Block Diagram

Table 3-12. Typical Double-Check Frequency Measurement

Input Frequency	Counter Reading*	Mixing Frequency	Meter Indication	
1.2345678 GHz	34567.8 kHz	1.2 GHz	Peak	First Response: 1.2000000 GHz + 345678 kHz 1.2345678 GHz
	15432.2 kHz	1.25 GHz	Peak	Second Response: 1.2500000 GHz - 154322 kHz 1.2345678 GHz
*Note Counter in 10 ms Gate to give reading in kHz				

3-77. 5255A FREQUENCY CONVERTER.

3-78. The following paragraphs contain information for operating the Model 5255A Frequency Converter plug-in when installed in the Model 5245L Electronic Counter.

3-79. The Model 5255A Frequency Converter increases the range of the 5245L Electronic Counter to 3 thru 12.4 GHz (3000 to 12,400 MHz). As a general rule to measure frequency, always start with the Mixing Frequency Control below 3 GHz and tune upward in frequency to obtain first response and tune for a maximum reading in the green portion of the meter scale. This procedure will be valid whether there are responses in 1, 2, or 3 consecutive harmonic reference frequencies; see Table 3-14.. If the input signal level to the converter is high, the second, third, and other harmonics of this signal may be generated. Therefore, tuning Mixing Frequency Control from the low end upward will enable the input fundamental frequency to be detected before its harmonics. In the 5255A harmonics of the reference-frequency signals are held to such a low level that regardless of input signal level, their mixing effects are not observable, avoiding possible ambiguity. Figure 3-19 provides a step-by-step procedure to be used for measurement of frequencies from 3 to 12.4 GHz (3000 to 12,400 Mc). The only exception is if the first response occurs at 2.8 GHz or 3.0 GHz. To avoid possible ambiguity in these cases, start from above 3.4 GHz and tune downward in frequency for the first response and subtract the counter reading from the dial frequency for the frequency of the input signal.

3-80. CONTROLS AND INPUTS.

3-81. GENERAL. The function of the front panel tuning control, input connector, meter, AUX input, and AUX output connectors are described in Paragraphs 3-82 through 3-86.

3-82. INPUT CONNECTOR. Signal input, 50 ohms input impedance, 100 mV (-7 dBm in 50 ohms) to 707 mV (+10 dBm in 50 ohms) into precision type "N" female connector (GPC-7 connector is optional). ("N" type male optional.)

3-83. MIXING FREQUENCY SELECTOR. Calibrated from 2.8 GHz to 12.4 GHz (2800 MHz to 12,400 MHz), this control tunes the internal cavity to select a harmonic of 200 MHz to be mixed with the INPUT signal.

3-84. LEVEL INDICATOR METER. The meter circuit continuously monitors the level of the difference-frequency output of the converter to the counter. When meter reads in the green portion of its scale, INPUT signal amplitude is adequate for accurate frequency measurement.

3-85. AUX IN. Signals connected to this input of -33 dBm (5 mv) up to 0 dBm (224 mv) and 1 to 200 MHz at the AUX IN jack will be counted and displayed directly.

3-86. AUX OUT. The output from the AUX OUT jack is the 1 to 200 MHz difference signal from the video amplifier.

Note

If any difficulty occurs while making measurements, check all cables and connectors for resonant points.

3-87. MAXIMUM INPUT VOLTAGES.

3-88. Damage to the converter may result if an AC signal greater than +10 dBm (.707 V rms) or a DC voltage greater than 5 V is applied to converter INPUT connector.

3-89. FREQUENCY MEASUREMENT WITH AMPLITUDE LESS THAN 100 MV RMS.

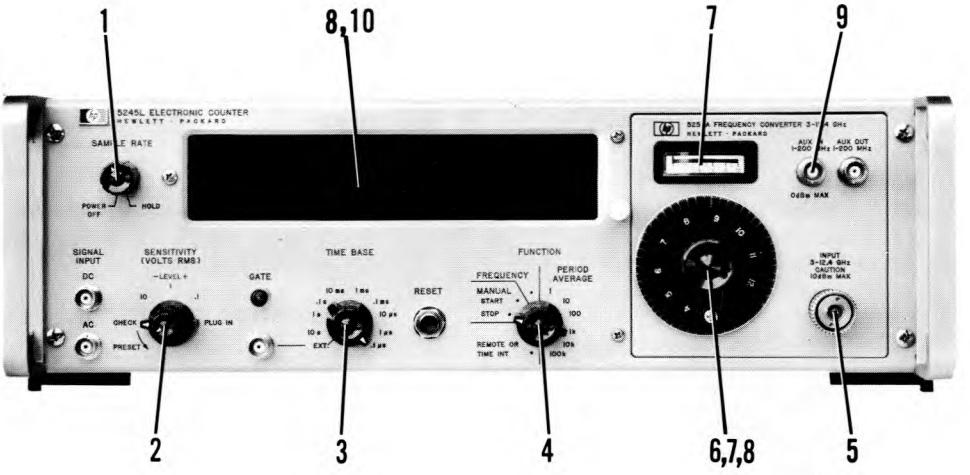
3-90. The front panel level indicator meter indicates in the green portion of its scale only when converter is properly tuned and amplitude of INPUT signal is adequate for accurate frequency measurement. (Because of conservative specifications of the converter this will often occur with an input signal less than 100 mv.)

3-91. DOUBLE-CHECKING FREQUENCY MEASUREMENT RESULTS.

3-92. Because of the heterodyne action of the converter, frequency measurement results obtained at any one setting of the Mixing Frequency Control may be checked at other settings. In most cases these will be consecutive responses: tune in the first response and add the counter display to dial frequency reading; then tune up in frequency to the second response and subtract the counter display from the dial frequency reading (see Table 3-13). In some cases there will be three consecutive responses (see Figure 3-19); in these cases the third response will be the one in which you subtract the counter display from the dial frequency reading.

Table 3-13. Typical Double-Check Frequency Measurement (5255A)

Input Frequency	Counter Reading*	Mixing Frequency	Meter Indication	
8.1234567 GHz	123456.7 kHz	8.0 GHz	Peak	First Response: 8.0000000 GHz + 1234567 kHz 8.1234567 GHz
	76543.3 kHz	8.2 GHz	Peak	Second Response: 8.2000000 GHz - 765433 kHz 8.1234567 GHz
*Note: Counter in 10 ms Gate to give readings in kHz.				



FREQUENCY MEASUREMENTS

1. Turn SAMPLE RATE slightly out of POWER OFF position.
2. Set SENSITIVITY to PLUG IN.
3. Set TIME BASE to 10 ms. *
4. Set FUNCTION to FREQUENCY.
5. Connect input signal to INPUT of converter.
6. Set Mixing Frequency control to read slightly less than 2.8 GHz.
7. Slowly turn Mixing Frequency control counter-clockwise to obtain the first response, and tune for a maximum reading in the green portion of the Level Indicator Meter scale.
8. Add counter display (in kHz) to Mixing Frequency control reading (in GHz) for frequency of INPUT signal.

USE OF AUX IN

9. To use prescaler portion of plug-in connect the 1 to 200 MHz input signal to the AUX IN jack (0 dBm max).
10. The counter will display frequency of input signal. (During this measurement the main input to the converter should be disconnected, or, if a microwave signal is present at the main input, the converter should be detuned so that there is no counter reading from that source).

*TIME BASE setting may vary, depending on desired resolution of INPUT signal frequency.

Figure 3-19. Model 5255A Operating Procedure

Table 3-14. Model 5255A Typical Frequency Measurements

Input Frequency	Display	Meter	Dial	Response
	EXAMPLE OF ONE RESPONSE			
2600 MHz	000000.00 MHz	Red	3.0 GHz	No response; frequency difference greater than passband of video amplifier
	000200.00 MHz	Green	2.8 GHz	First Response: * 2800 MHz - 200 MHz 2600 MHz
12,600 MHz	000000.00 MHz	Red	12.2 GHz	No response; frequency difference greater than passband of video amplifier
	000200.00 MHz	Green	12.4 GHz	First Response: 12,400 MHz + 200 MHz 12,600 MHz
	EXAMPLE OF TWO RESPONSES			
10,050 MHz	000050.00 MHz	Green	10.0 GHz	First Response: 10,000 MHz + 50 MHz 10,050 MHz
	000150.00 MHz	Green	10.2 GHz	Second Response 10,200 MHz - 150 MHz 10,050 MHz
4,000 MHz	000200.00 MHz	Green	3.8 GHz	First Response 3,800 MHz + 200 MHz 4,000 MHz
	000000.00 MHz	Red	4.0 GHz	No response; difference frequency less than passband of video amplifier
	000200.00 MHz	Green	4.2 GHz	Second Response: 4,200 MHz - 200 MHz 4,000 MHz
	EXAMPLE OF THREE RESPONSES			
11,005 MHz	000205.00 MHz	Green	10.8 GHz	First Response: 10,800 MHz + 205 MHz 11,005 MHz
	000005.00 MHz	Green	11.0 GHz	Second Response: 11,000 MHz + 5 MHz 11,005 MHz
	000195.00 MHz	Green	11.2 GHz	Third Response: 11,200 MHz - 195 MHz 11,005 MHz

*When response present at 2.8 or 3.0 GHz, tune from above and subtract first reading, (See Paragraph 3-79).

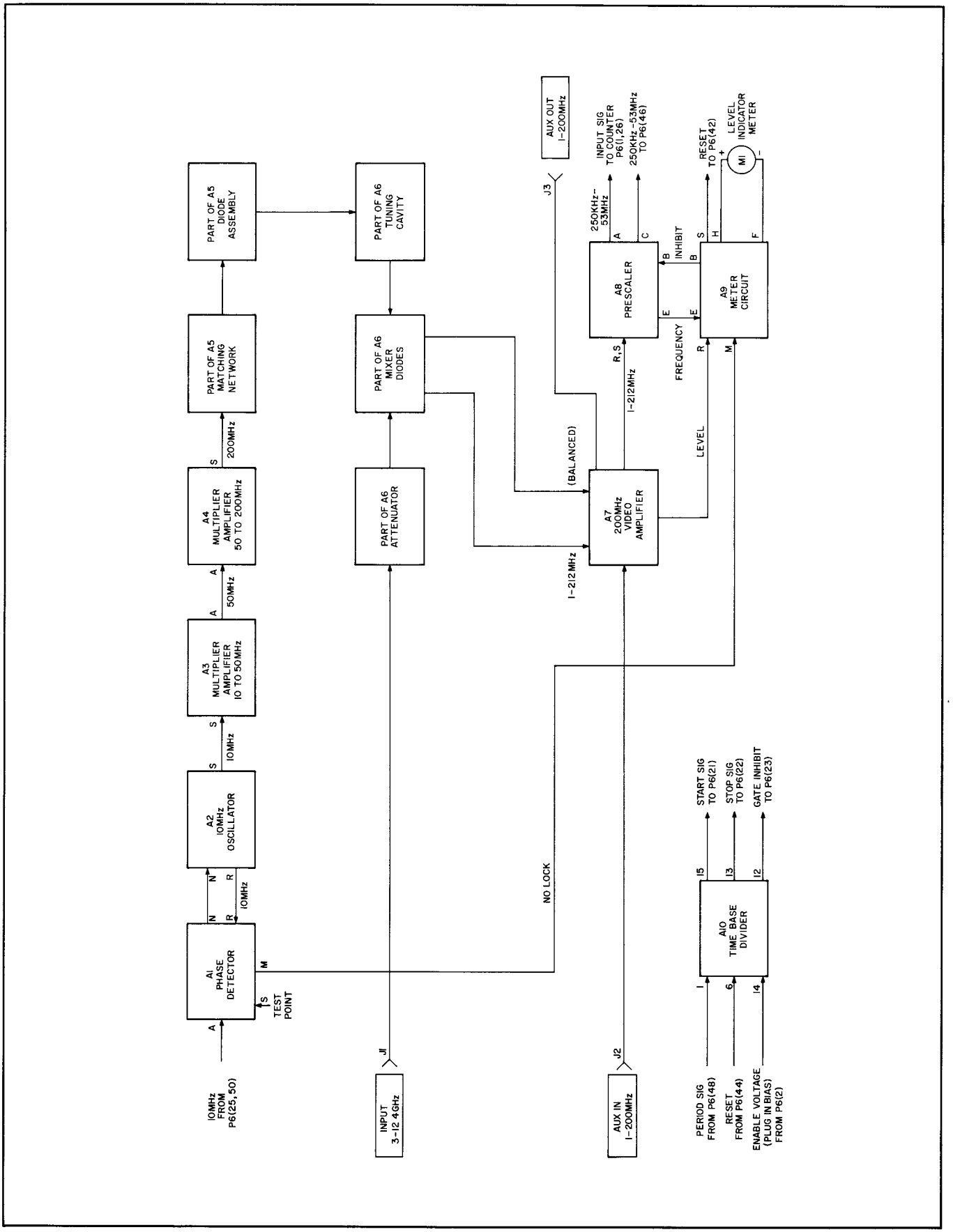


Figure 3-20. Model 5255A Block Diagram

3-93. 5261A VIDEO AMPLIFIER.

3-94. The following paragraphs contain information for operating the Model 5261A Video Amplifier plug-in when installed in the Model 5245L Electronic Counter.

3-95. FRONT PANEL.

3-96. GENERAL. The functions of the front panel control, meter, and connectors are described in Paragraphs 3-97 through 3-100.

3-97. INPUT CONNECTOR. Input signal 1 to 100 mV rms from 10 Hz to 50 MHz.

3-98. SENSITIVITY CONTROL. Calibrated in millivolts, this control determines the sensitivity of the Video Amplifier and is adjusted to keep the signal output to the Counter within limits acceptable to the Counter input circuit as indicated on the OUTPUT LEVEL meter.

3-99. OUTPUT LEVEL METER. The meter monitors the level of the Video Amplifier output to the counter. When meter indicates in green portion of scale, Video Amplifier output to counter is satisfactory.

3-100. OUTPUT 50Ω CONNECTOR. When terminated in 50 ohms, the signal at this connector is identical in frequency and amplitude to the Video Amplifier output to the counter.

3-101. OPERATING PROCEDURE.

3-102. The Video Amplifier plug-in unit is ac-coupled but does not change any functions of the counter in which it is installed. Using the plug-in, period, multi-

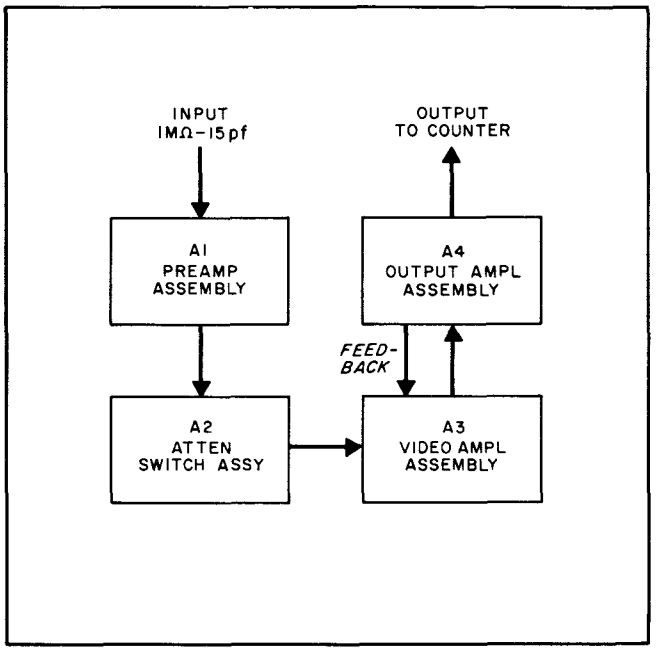


Figure 3-21. Model 5261A Block Diagram

period, frequency, totalizing, and ratio measurements can be performed with input signals as low as one millivolt. Since the measurements can be made with or without the Video Amplifier installed, only frequency measurement is illustrated in Figure 3-22. For other measurement procedures, see the Operating Procedures (Figures 3-5 through 3-8) for Counter. Table 3-15 lists the frequency resolution for all settings of the counter TIME BASE control (Figure 3-22, item 4).

3-103. OPERATION WITH PULSE INPUT SIGNALS.

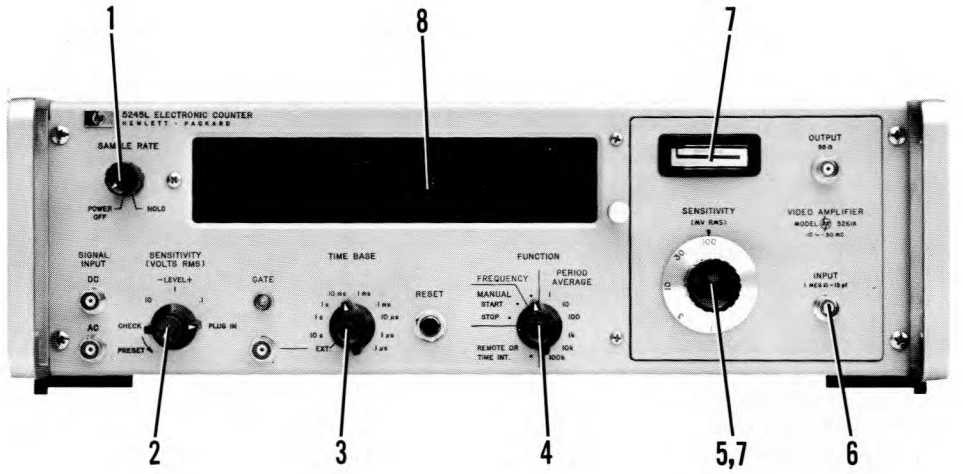
3-104. The Video Amplifier is designed to amplify sinusoidal input signals. However, pulse input signals can be amplified if the output signal is monitored to ensure a satisfactory output to the counter. Monitor the signal at the OUTPUT 50Ω connector with an oscilloscope and set the Video Amplifier SENSITIVITY control for a level which results in satisfactory counter operation. Because the output level meter is an average-responding device, it will read low with a pulse input signal. Do not use the meter as an output level indicator when amplifying pulses.

3-105. OPERATION WITH HIGH IMPEDANCE PROBE.

3-106. The 10003A 10:1 divider probe can be used with the Video Amplifier. The 10:1 divider probe serves to decrease the effects of resistive loading on the external circuit at low frequencies. When using the probe, Video Amplifier sensitivity is decreased by 1/10. As a result, the maximum sensitivity of the Video Amplifier is 10 mv.

Table 3-15. Frequency Resolution

INPUT FREQUENCY = 11.1223344 MHz	
TIME BASE Setting	Counter Display and Resolution
.1 μs	no display
1 μs	11. MHz
10 μs	11.1 MHz
.1 ms	11.12 MHz
1 ms	11122. kHz
10 ms	11122.3 kHz
.1 s	11122.33 kHz
1 s	11122.334 kHz
10 s	11122.3344 kHz



1. Apply power to Counter and Video Amplifier by turning SAMPLE RATE control slightly clockwise from POWER OFF position.

2. Set Counter SENSITIVITY to PLUG-IN.

3. Set TIME BASE to 10 ms*.

---

* TIME BASE setting may vary depending upon desired resolution of INPUT signal frequency (Table 3-15).

4. Set FUNCTION to FREQUENCY.

5. Set Video Amplifier SENSITIVITY to 100 MV.

6. Connect signal to be measured to INPUT connector on Video Amplfiier. DO NOT EXCEED 5 VOLTS RMS.

7. Vary SENSITIVITY control until OUTPUT LEVEL meter reads in green portion of scale.

8. Observe frequency of INPUT signal as displayed by Counter.

Figure 3-22. Model 5261A Operating Procedure

3-107. VIDEO AMPLIFIER INPUT IMPEDANCE.

3-108. As illustrated in Figure 3-23, Video Amplifier input impedance decreases at higher frequencies. This decrease is due to the capacitive loading effect of the amplifier input. Thus when a signal source of fixed impedance is connected to the Video Amplifier INPUT, a meter at the signal source will not indicate the correct input level at the Video Amplifier. To avoid this error, monitor the input level at the Video Amplifier input with an RF Voltmeter such as the hp Model 411A to ensure a satisfactory input level. The Video Amplifier input can also be terminated in the signal source characteristic impedance but at frequencies near 50 MHz capacitive loading reduces the input impedance, the signal source is no longer terminated in its characteristic impedance, and a meter at the signal source is incorrect. Thus, the simplest method of ensuring a satisfactory input to the Video Amplifier is to monitor the signal level at the Video Amplifier input.

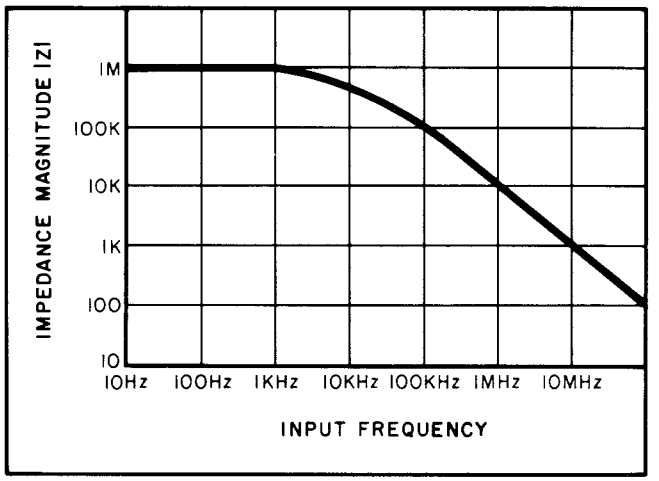


Figure 3-23. Model 5261A Input Impedance

3-109. 5262A TIME INTERVAL UNIT.

3-110. The following paragraphs contain information for operating the hp Model 5262A Time Interval Unit plug-in when installed in the hp Model 5245L Electronic Counter.

3-111. The Model 5262A has two independent channels which determine the beginning and the end of a time interval. Each channel has its own TRIGGER SLOPE, TRIGGER LEVEL, and MULTIPLIER controls. Figures 3-27 and 3-28 show procedures for making a time interval measurement and a phase measurement. The following paragraphs describe the function of each control.

3-112. CONTROLS.

3-113. FUNCTION SWITCH. The function switch provides the operator with three modes of operation: common, separate, and remote.

a. With the function switch in the COMMON position START and STOP input connectors are connected together internally. Thus, if start and stop signals come from the same source, set function switch to COMMON and apply the signal to either input connector. Adjust MULTIPLIER and TRIGGER LEVEL controls for each channel separately.

b. With the function switch in the REMOTE position, the time interval function becomes one of the remote programming operations of the counter.

c. With the function switch in the SEPARATE position the start signal must be applied to START input connector and stop signal must be applied to STOP input connector.

3-114. TRIGGER SLOPE. The TRIGGER SLOPE controls determine the slope a signal must have as it crosses the voltage level set by the MULTIPLIER and TRIGGER LEVEL controls to start or stop a measurement.

3-115. MULTIPLIER AND TRIGGER LEVEL. These controls work together to determine the voltage level a signal must cross to start or stop a measurement. For example with the TRIGGER LEVEL dial set at +2 and the MULTIPLIER set at .3 the Model 5262A will trigger as the input crosses the +0.6 volt level. Suppose you have a pulse as shown in Figure 3-24A, there will be little difference whether measurement begins at V_a or V_b. However, to measure interval "y" of Figure 3-24B, you must be more careful. Set TRIGGER LEVEL dial reading near 0 as a preliminary adjustment. Adjust the start and then the stop TRIGGER LEVEL controls. Watch for definite changes in measured time. Thus you know that start and stop voltage levels are above the step and that the indicated time interval is actually "y".

3-116. MULTIPLIER AND TRIGGER LEVEL USING OSCILLOSCOPE. This is an easier method because you can see where the pulses are occurring with respect to the signal. Connectors at the rear of the

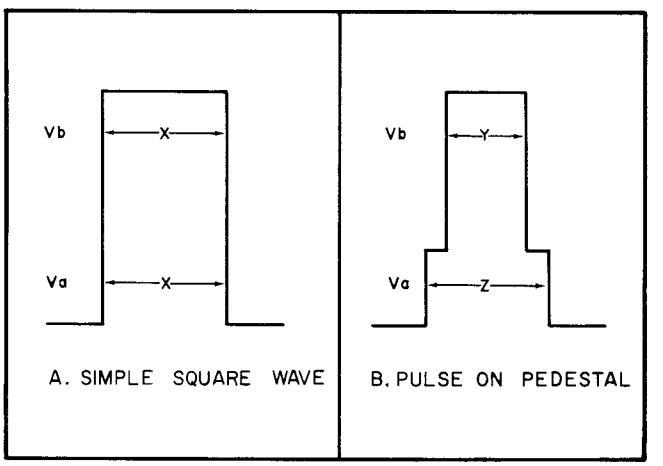


Figure 3-24. Model 5262A Trigger Level Settings

Model 5245L Electronic Counter provide separate voltage steps which occur at the same time as the trigger pulses. Use the following procedure:

a. Connect BNC-to-BNC cable between START input connector on front panel of Model 5262A and EXT AC SYNC input of oscilloscope; use the connector UG-274A/U at Model 5262A.

b. Connect the AUX A output connector at the rear of the Model 5245L and one input channel of the oscilloscope.

c. Set Model 5262A function switch to COM.

d. Connect a cable from an oscillator to the START input connector of the Model 5262A; frequency is not important if it is a sine wave and the range is between 0 and 2 MHz.

e. Connect the STOP input connector of the hp 5262A and the other channel of the oscilloscope.

f. Set VERTICAL SENSITIVITY controls to .2 volts/cm.

g. Set the VERTICAL PRESENTATION selector of the oscilloscope to CHOPPED or ALTERNATE.

h. Display on the oscilloscope will be similar to that shown in Figure 3-25.

3-117. ELIMINATING DC COMPONENT FROM SINE WAVE INPUT.

3-118. As the input circuits of the Model 5262A are dc coupled it is sometimes easier to set the MULTIPLIER and TRIGGER LEVEL controls when any dc component from the start and/or stop sine wave input signals is eliminated with blocking capacitors. With the aid of Figure 3-26 you can select the proper value of blocking capacitor for no readout error. For example, on the .1 MULTIPLIER range, at 400 Hz and with a source impedance of 10,000 ohms the proper value of blocking capacitor is 25 μf.

3-119. However, if the right value of capacitor is not available, use the following approximate formula to determine what the error per channel in seconds will be (for phase shifts less than 10^0 and signals less than ±40 volts peak times multiplier position):

$$\text{Error in seconds} = \frac{-1}{Cs\,(R_S + R\,(2\pi f)^2} + \frac{R_S\,(RC)}{R_S + R}$$

C_S = Blocking capacitor

R_S = Signal source impedance

RC = 6×10^{-7} for 0.1 and 0.2 MULTIPLIER settings,
9×10^{-7} for 0.3, 1.5×10^{-6} for 1,
3.3×10^{-6} for 3, 1×10^{-5} for 10,
3×10^{-5} for 30, 1×10^{-4} for 100.

3-120. For example, on the .1 MULTIPLIER range, the use of a 10 μf blocking capacitor at 400 Hz and with a source impedance of 600 ohms results in an error of 1.5 microseconds.

3-121. PHASE MEASUREMENT.

3-122. Phase measurement is a special application of time interval measurement. You measure the time interval between like points on two similar waveforms and relate the reading to phase angle. The measurement is made between the points where the signals cross 0 volt going in the same direction. The zero-crossing is the reference point for two reasons: first, it is the easiest point to determine accurately on the counter; and second, for sinewaves it is in the region of maximum slope, allowing maximum resolution.

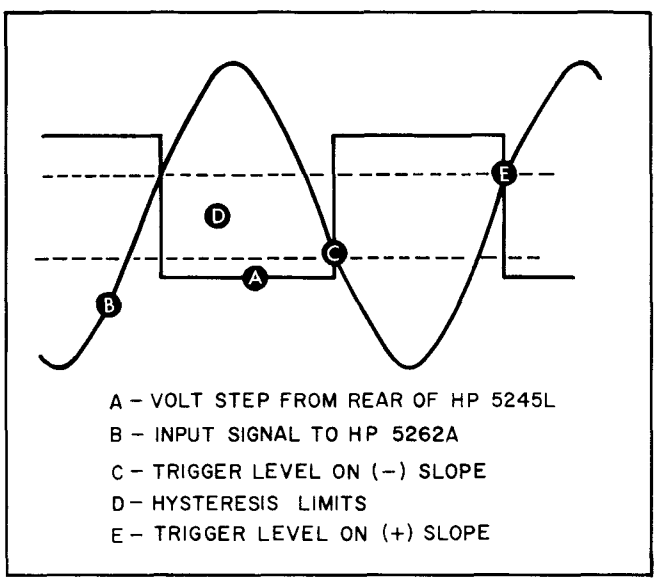
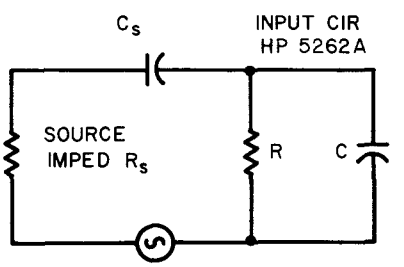


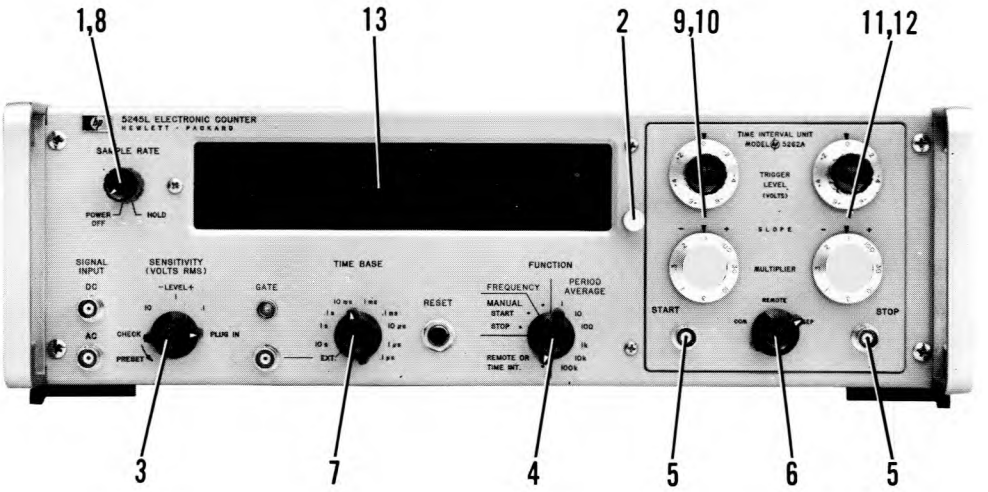
Figure 3-25. Oscilloscope Display of Trigger Levels

$C_S = \frac{1}{KR_S f2}$ $\quad K = 4\pi 2RC$



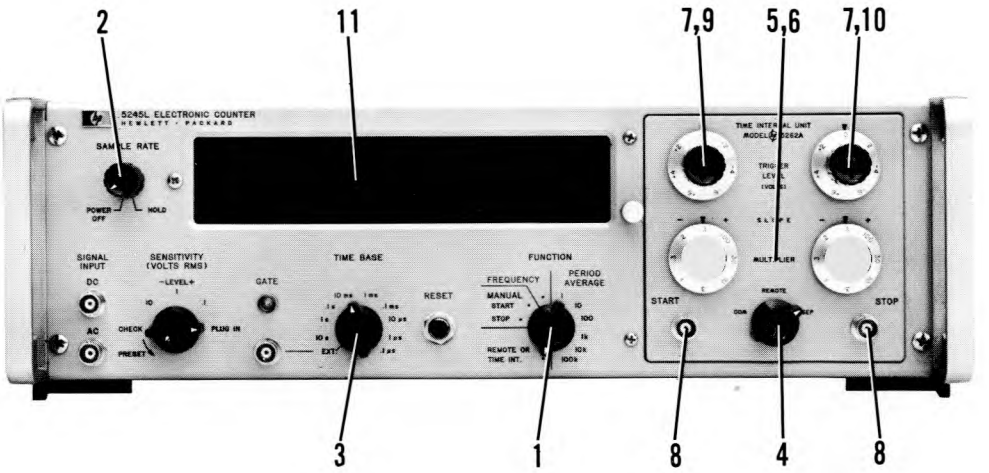
MULTIPLIER SETTING	0.1	0.2	0.3	1	3	10	30	100
K (10-4)	.237	.237	.355	.592	1.30	.039	.118	.39

Figure 3-26. Remove DC from Sine Wave Input



1. Turn SAMPLE RATE control to POWER OFF.
2. Plug in Model 5262A, turning knurled knob clockwise until tight.
3. Set SENSITIVITY to PLUG-IN.
4. Set FUNCTION switch to REMOTE OR TIME INT.
5. Connect signal to START or STOP with selector at common, to START and STOP at other positions of selector switch.
6. Set COM-REMOTE-SEP to:
   a. COM if start and stop signals are from same source.
   b. REMOTE if the Model 5245L is being operated from a remote control box.
   c. SEP if start and stop signals are from different sources.
7. Set TIME BASE switch to obtain greatest possible count, or to EXT if an external time unit is to be used.
8. Set SAMPLE RATE control for desired operating rate.
9. Set start channel SLOPE control to "+" if you want measurement to start on positive slope. Set to "-" if you want to start count on negative slope.
10. Adjust start MULTIPLIER and TRIGGER LEVEL controls to set measurement start point at desired voltage level.
11. Set stop channel SLOPE control to "+" if you want measurement to stop on positive-going part of signal. Set to "-" if you want to stop count on negative slope.
12. Adjust stop MULTIPLIER and TRIGGER LEVEL controls to set measurement stop points at desired voltage level.
13. Read time interval units.

Figure 3-27. Model 5262A Operating Procedure



1. Set FUNCTION to REMOTE OR TIME INT.
2. Set SAMPLE RATE to position just before POWER OFF. (MAX SAMPLE RATE.)
3. Set TIME BASE switch to obtain greatest possible count, or to EXT if an External Freq is counted to give an answer in degrees.
4. Set COM-REMOTE-SEP to SEP.
5. Set start and stop TRIGGER SLOPE to same polarity.
6. Set both START and STOP MULTIPLIER controls to 0.1 position.
7. Set both start and stop TRIGGER LEVEL controls to 0 position.
8. Connect signals whose phase difference is to be measured to START and STOP inputs. (Note: For specified accuracy, do not exceed ±40 volts peak times multiplier setting.)
9. Set start TRIGGER LEVEL control for no difference in counter reading as state MULTIPLIER is switched between the 0.1 and 0.2 positions. Procedure:
   a. Note counter reading with MULTIPLIER set to 0.1 position.
   b. Note counter reading with MULTIPLIER set to 0.2 position.
   c. Subtract the smaller reading from the larger reading.
   d. If reading in step b is less than reading in step a, add result of step c to reading step a and adjust TRIGGER LEVEL for result.
   e. If reading in step b is greater than reading in step a, subtract result of step c from reading of step a and adjust TRIGGER LEVEL for result.

   Note

   The procedure may have to be repeated to obtain exact zero crossing.
10. Repeat step 9 for stop TRIGGER LEVEL control.
11. Read phase difference in units selected by TIME BASE switch.

Figure 3-28. Model 5262A Operating Procedure Phase Measurements

3-123. Phase difference is measured in time units if one of the internal standard frequencies is counted. The following formula converts time interval (t) to phase (Ø) in degrees:

$$Ø = \frac{360t}{\text{period of either signal}}$$

3-124. If the two signals are not equal in amplitude, use the larger for the period measurement. You can measure phase directly in degrees if you apply the appropriate external frequency (360 x frequency of signals whose phase you are measuring) to the counters in place of an internal standard frequency. However, the external frequency cannot exceed the maximum counting rate of the instrument. Procedure for phase measurement is given in Figure 3-28.

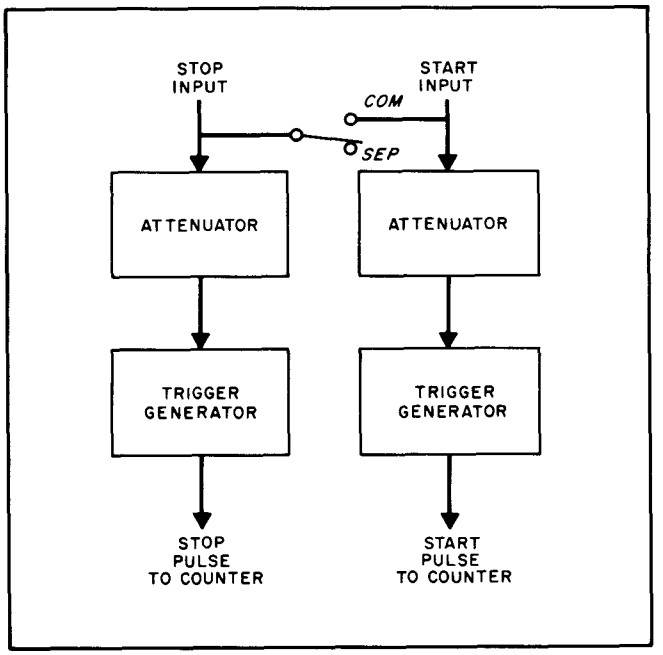


Figure 3-29. Model 5262A Block Diagram

3-125. 5264A PRESET UNIT.

3-126. The following paragraphs contain information for operating the Ⓗ Model 5264A Preset Unit plug-in when installed in Ⓗ Model 5245L Electronic Counter.

3-127. FRONT PANEL.

3-128. The functions of the front panel switches and connectors are as follows:

a. N switches permit selection of gate times.

b. MODE SELECTOR.

1. N x PERIOD permits measurement of time for N events to occur at the counter input.

2. N x FREQ permits direct or normalized measurement of the input signals, whereby normalization may be accomplished by adjusting the number of signals to be counted or by counting signals for a predetermined time. The display may then be read out in desired units.

3. N x RATIO permits measurements with a choice of normalizing factors from 1 to 100,000. The signal (f_1) connected to the counter's Ext Time Base input goes to the decimal counter; the signal (f_2) connected to the counter's signal input goes through the preset decades and controls the gate. Thus f_1 is counted for N periods of f_2 so that the counter displays Nf_1/f_2.

4. PRESET permits counting N events when N is set on thumbwheel switches.

5. f/N permits division of any input frequency up to 100 kHz by N.

6. REMOTE permits operation of counter and plug-in (except N switches) from a REMOTE position.

c. AUX INPUT is used for PRESET and f/N functions.

d. f/N OUTPUT provides a means of using the divided signal with external equipment.

3-129. ACCURACY.

3-130. N x FREQ accuracy is ±1 count ± time base accuracy. N x PERIOD accuracy is ±1 count ± time base accuracy ± trigger error.* N x RATIO accuracy is ±1 count of f (counter external time base input).

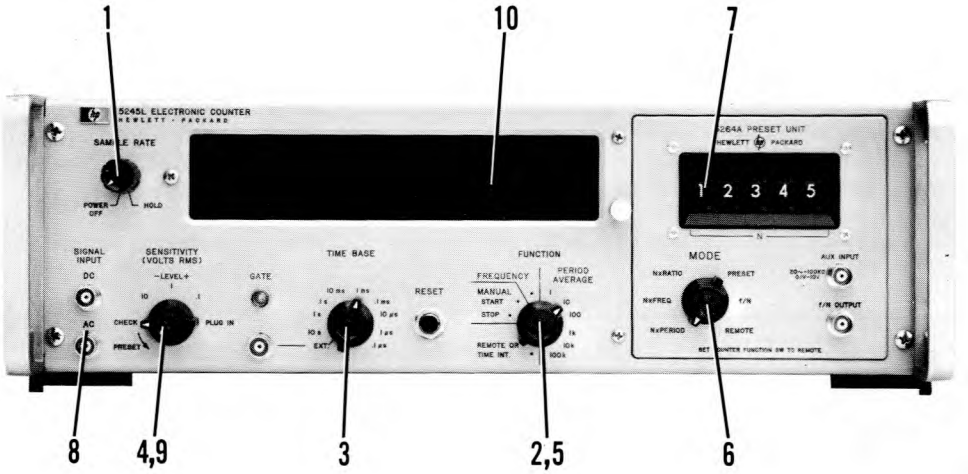
3-131. OPERATING PROCEDURE.

3-132. Figures 3-30 through 3-34 provide step-by-step operating procedures to be used for the different functions of the Model 5264A plug-in.

3-133. OUTPUT VOLTAGE.

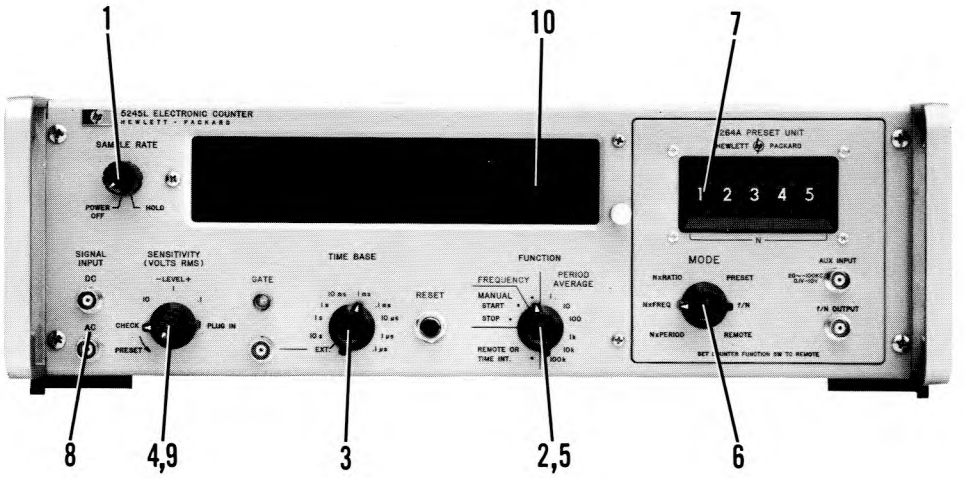
3-134. The output voltage at the f/N output is normally negative 0.2 volts p/p pulse with an internal impedance of approximately 50 ohms. The minimum load resistance should not be less than 100 ohms and/or maximum shunt capacity be greater than 0.01 μf. A -5 volt peak pulse with an internal impedance of approximately 600 ohms is available by changing the

*Trigger error (sine wave) $< \frac{0.3\% \text{ of one period}}{N}$ for ≥40 dB signal-to-noise ratio on input signal. Trigger error decreases with increased signal amplitude and slope.



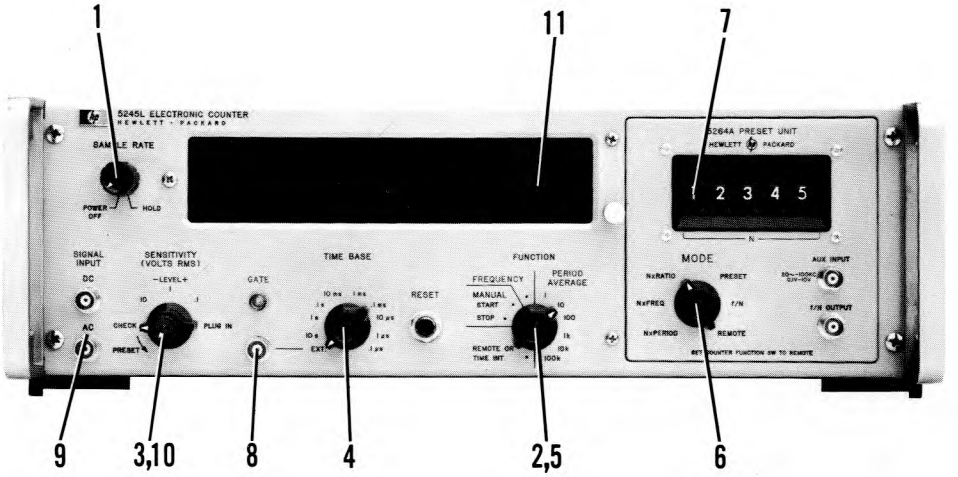
1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to desired PERIOD AVERAGE position.
3. Set TIME BASE switch to desired time unit per count.
4. Set SENSITIVITY switch to CHECK to verify proper Counter operation.
5. Set counter FUNCTION switch to REMOTE OR TIME INTERVAL.
6. Set plug-in MODE switch to N x PERIOD.
7. Set N switches for number of events to be counted.
8. Connect unknown signal to AC or DC SIGNAL INPUT jack.
9. Turn SENSITIVITY switch clockwise to first position which gives steady count.
10. Display is time for N periods to occur.

Figure 3-30. Model 5264A Operating Procedure N X PERIOD



1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to FREQUENCY.
3. Set TIME BASE switch to desired time unit per count.
4. Set SENSITIVITY switch to CHECK to verify proper counter operation.
5. Set counter FUNCTION switch to REMOTE OR TIME INTERVAL.
6. Set plug-in MODE switch to N x FREQ.
7. Set N switch for number of time base units to be counted. Time base units are now time base increments. Gate length will be N increments of time.
8. Connect unknown signal to AC or DC SIGNAL INPUT jack.
9. Turn SENSITIVITY switch clockwise to first position which gives steady count.
10. Display is number of events in count time.

Figure 3-31. Model 5264A Operating Procedure N X FREQ



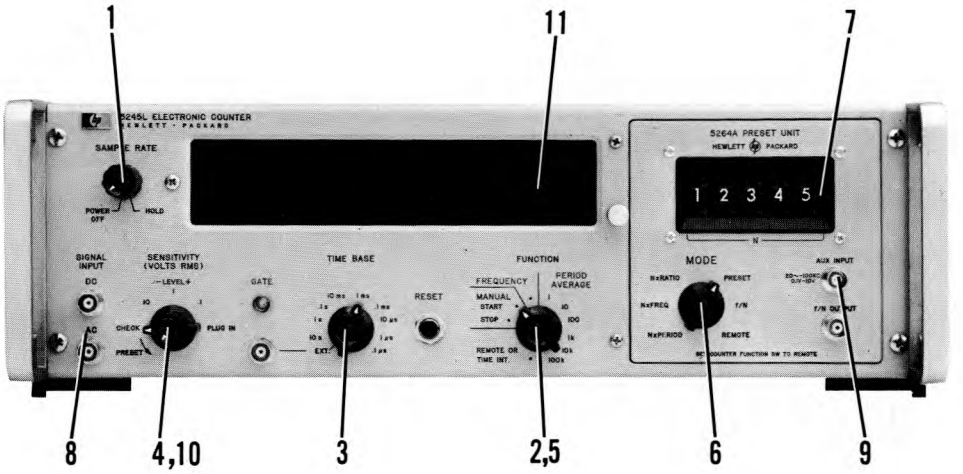
1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to desired PERIOD AVERAGE position.
3. Set SENSITIVITY switch to CHECK to verify proper Counter operation.
4. Set TIME BASE switch to EXT.
5. Set counter FUNCTION switch to REMOTE OR TIME INTERVAL.
6. Set plug-in MODE switch to N x RATIO.
7. Set N switches for Multiplier desired.
8. Connect f_1 (the higher frequency) to the TIME BASE EXT connector.

CAUTION

Input f_1 must not exceed 2 volts for correct count. Maximum input 50 volts rms.

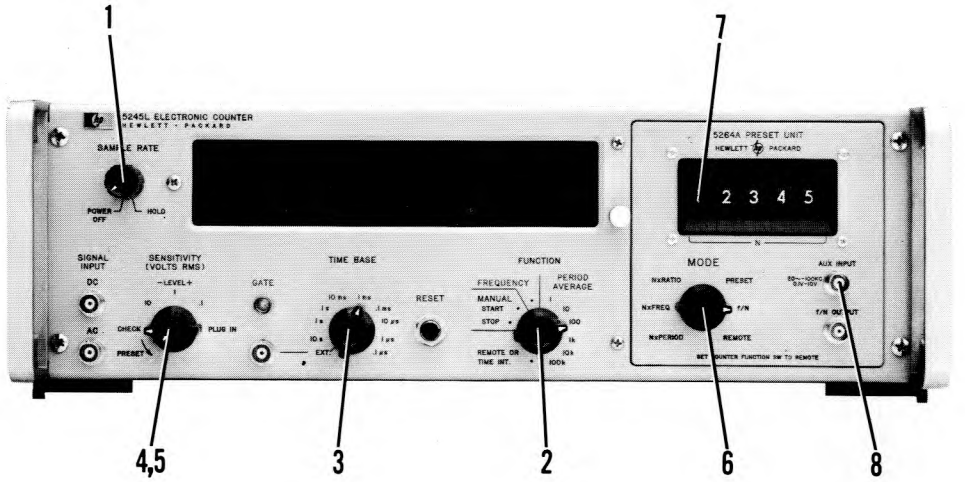
9. Connect f_2 (the lower frequency) to the AC or DC SIGNAL INPUT jack.
10. Turn SENSITIVITY switch clockwise to first position which gives steady count.
11. Counter reads N times Ratio f_1/f_2.

Figure 3-32. Model 5264A Operating Procedure N X RATIO



1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to MANUAL START.
3. Set TIME BASE switch to desired time unit per count.
4. Set SENSITIVITY switch to CHECK to verify proper Counter operation.
5. Set Counter FUNCTION switch to REMOTE OR TIME INTERVAL.
6. Set plug-in MODE switch to PRESET.
7. Set N switch for number of counts desired.
8. Connect output of counter AUX B jack on rear panel to DC INPUT jack on the front panel to monitor N.
9. Connect signal to plug-in AUX INPUT jack (10 volts max).
10. Set SENSITIVITY switch to first position that gives constant count.
11. Readout is N. (00000 = 0 in this function only. N = 1 to 99,999.)

Figure 3-33. Model 5264A Operating Procedure PRESET



1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to desired PERIOD AVERAGE position.
3. Set TIME BASE switch to desired time unit per count.
4. Set SENSITIVITY switch to CHECK to verify proper counter operation.
5. Set SENSITIVITY switch to PLUG-IN if f/N output is to be monitored.
6. Set plug-in MODE switch to f/N.
7. Set N switches as divisor for f input.
8. Connect input signal to plug-in AUX INPUT (10 volts max).
9. If the f/N output is not monitored, frequency and period measurements may be made in the normal way. The f/N OUTPUT supplies the divided signal for use with external equipment.

Figure 3-34. Model 5264A Operating Procedure f/N

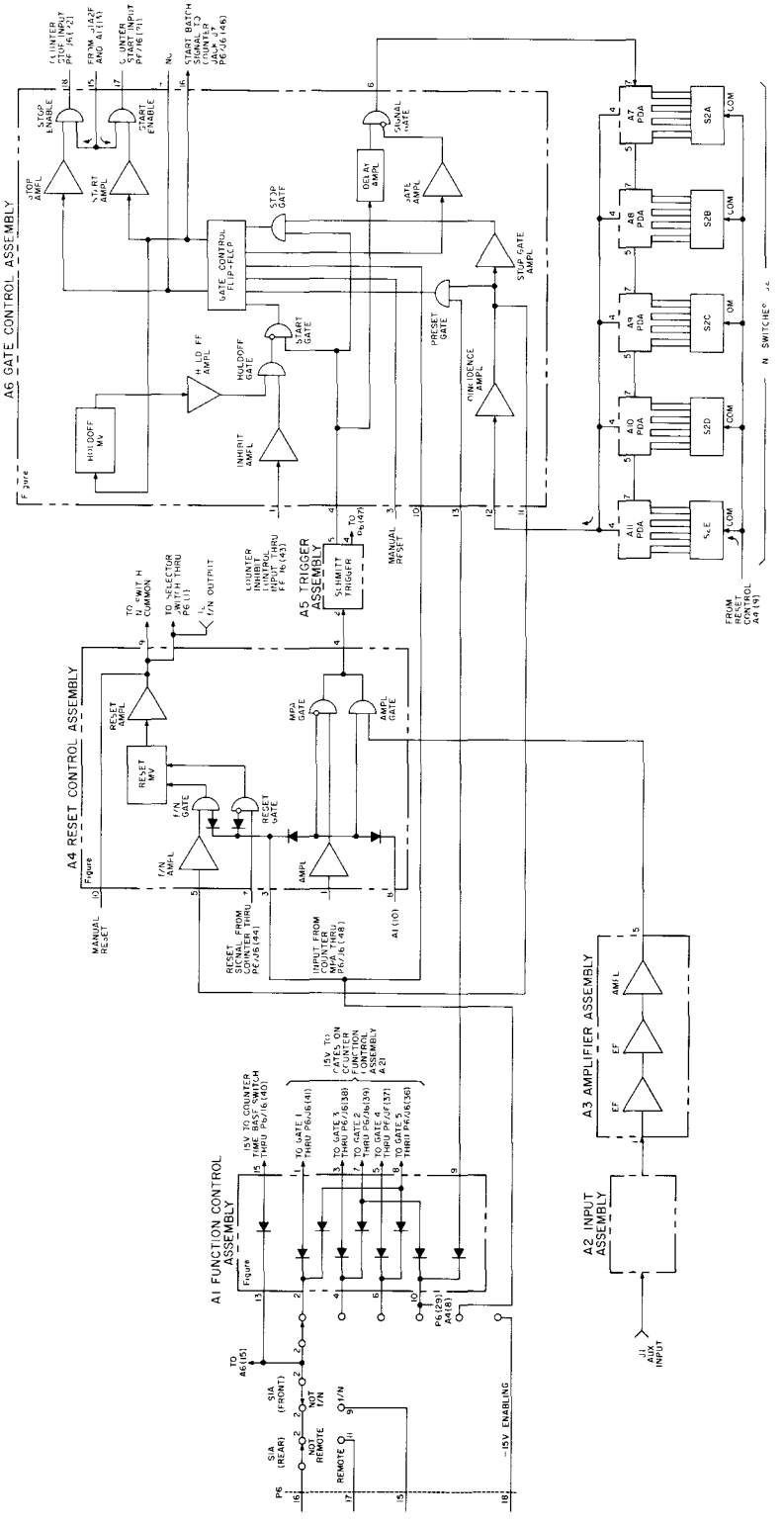


Figure 3-35. Model 5264A Block Diagram

wire from J2 at XA4 Pin 13 to XA4 Pin 14. If the -5 volt pulse is used, the minimum load resistance should not be less than 10K ohms and/or maximum shunt capacity be greater than 1000 pf.

Note

If the -5 volt pulse is used, care should be taken not to short out the f/N signal as this will cause the counter to stop working until the short is removed.

3-135. REMOTE CONTROL.

3-136. OPERATION. Counter front-panel controls should normally be set as follows to allow remote control:

FUNCTION . . . . . REMOTE OR TIME INTERVAL
TIME BASE . . . . . EXT
SENSITIVITY. .Not CHECK, set to proper range for input signal amplitude
SAMPLE RATE . . . . . As desired
PLUG-IN . . . . . REMOTE

Note

To permit normal front-panel control, all remote control circuit connections must be interrupted.

3-137. GENERAL. Two rear-panel connectors on special counters permit connection for complete control of the basic instrument from a remote location. All front-panel switching operations can be controlled except for SAMPLE RATE and SENSITIVITY on the counter and the N switch on the Plug-In.

3-138. PROGRAMMING. The following procedure describes how to provide counter control from a remote location. All that is required is contact closure between appropriate terminals of J9 and J10 on the rear panel. Mating connector for J9 or J10 is Amphenol 57-40360. (See pages 3-11 through 3-12 for counter programming.)

3-139. The functions of the plug-in are selected by enabling the diode steering gates by connecting -15 volts to the J9 pins listed in Table 3-16. The N switches cannot be remotely programmed and must be set at the plug-in.

Note

If a low frequency is used as the time base frequency, some counting cycles will take a long time to complete. A reset signal may be missed at the beginning of the input signal count. The divider chain will then count to 100,000 rather than the N number set on the N switches. If the combination of the low frequency and the N switch setting create a gate time longer than 15 seconds, the count may be started by using the manual reset button.

Table 3-16. Plug-In Function Program

Equivalent Switch Position	Pins on J9 Requiring -15 V
N x PERIOD	1, 5
N x FREQ	2, 3
N x RATIO	4, 5
PRESET	2, 5, 29
f/N	31

3-140. 5265A DIGITAL VOLTMETER.

3-141. The following paragraphs contain information for operating the Model 5265A Digital Voltmeter plug-in when installed in the Model 5245L Electronic Counter.

3-142. The Model 5265A Digital Voltmeter provides DC voltage measurement capabilities for the Model 5245L Electronic Counter. DC voltages as high as 1000 volts can be measured on one of three ranges (10, 100, 1000). The plug-in unit VOLTS FULL SCALE switch selects the range. LOCAL or REMOTE operation is selected with the center red knob on the VOLTS FULL SCALE switch. Input DC voltage polarity is automatically indicated by the + or - neon. Over-range capability of the Voltmeter is +5% of the full-range voltage. Figure 3-36 shows the Model 5265A front-panel controls and indicators.

3-143. FRONT PANEL.

3-144. INPUT DC VOLTAGE CONNECTOR. Apply DC voltage of 0 to 1000 volts.

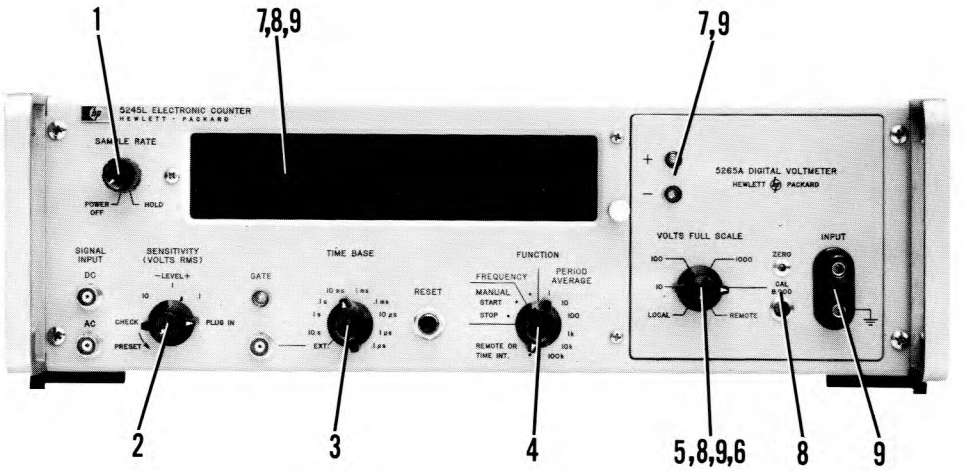
3-145. VOLTS FULL SCALE SWITCH. Selects correct range for the input DC voltage. Over-range capability is 5%.

3-146. LOCAL REMOTE SWITCH. Set to LOCAL for operation from instrument or REMOTE for remote programming of voltmeter function.

3-147. ZERO ADJUST. Set VOLTS FULL SCALE switch to 1000 and adjust to 000000.00 on counter display.

3-148. CAL 8.000 ADJUSTMENT. Set VOLTS FULL SCALE switch to CAL 8.000 and adjust for 0008.0000 ±5 counts on counter display.

3-149. POLARITY INDICATORS. Neons automatically indicate polarity of input DC voltage.



1. Apply power to Counter and Voltmeter by turning SAMPLE RATE control clockwise to mid-position. Allow ten-minute warmup.

2. Set SENSITIVITY switch to a position other than CHECK.

3. Set TIME BASE to a position other than EXT.

4. Set FUNCTION switch to REMOTE OR TIME INTERVAL.

5. Set VOLTS FULL SCALE switch to 1000.

6. Set LOCAL-REMOTE switch to LOCAL.

7. Adjust ZERO control for display of 000000.00 and observe that polarity indicators alternately flash. Short INPUT terminals.

8. Set VOLTS FULL SCALE switch to CAL 8.000, and adjust CAL 8.000 control for 0008.0000 display, ± 5 counts. Remove short.

9. Set VOLTS FULL SCALE switch to 1000 and apply DC voltage at INPUT terminals. (If display indicates between 100 volts and 10 volts, switch Voltmeter to 100 range. If less than 10 volts, switch to 10 range.) Observe voltage magnitude on Counter display and voltage polarity as indicated by Voltmeter polarity neon.

Figure 3-36. Model 5265A Operating Procedure

3-150. DIGITAL VOLTMETER CALIBRATION.

3-151. For maximum operating accuracy, check ZERO and CAL 8.000 and set, if necessary. Set VOLTS FULL SCALE switch to 1000 and adjust ZERO control for 000000.00 and alternately flashing polarity neons. Set VOLTS FULL SCALE switch to CAL 8.000 position and adjust front panel screwdriver adjustment for 0008.0000, ±5 counts on the Counter display.

3-152. OPERATING PROCEDURE.

3-153. Figure 3-36 indicates an operating procedure for a dc voltage measurement with the Digital Voltmeter. Do not exceed the 5% over-range specification.

3-154. REMOTE OPERATION (SPECIAL).

3-155. For those counters with the remote feature: with the Counter and Voltmeter in the remote condition, the Voltmeter can be turned on by connecting pin 25 to pin 26 and connecting pin 30 to pin 31 at the lower 36 pin connector on the rear panel of the Counter.

NOTE

Do not measure floating voltage. Common connector is chassis ground.

3-156. 5258A SENSITIVE PRESCALER.

3-157. The following paragraphs contain information for operating the Model 5258A Sensitive Prescaler plug-in when installed in the Model 5245L Electronic Counter.

3-158. The Model 5258A Sensitive Prescaler plug-in increases the range of the 5245L Electronic Counter to 200 MHz. It also increases the sensitivity of the counter to 1 mV from 1 MHz to 200 MHz. Input frequency prescaling (dividing) is accomplished by transistor binary dividers operating over the frequency range from 1 MHz to 200 MHz. At the same time, the prescaler adjusts the counter's time base an equal amount to provide direct readout in frequency.

3-159. The input signal is applied to a broadband amplifier and tunnel diode trigger prior to reaching the transistor binary dividers. The circuitry is stable and independent of frequency, so no adjustments are needed over the entire frequency range. An attenuator switch on the front panel enables the prescaler to be used with inputs over the range of 1 mV to 1 V. The output of the video amplifier is available at the video output connector located on the front panel of the plug-in. An oscilloscope may be used to monitor the unknown signal being measured. A front panel meter indicates a deflection in the green area when adequate voltage is present at the input. The counter is inhibited if the unknown signal is not adequate to operate the counter.

3-160. FRONT PANEL.

3-161. GENERAL. The function of the front panel switch, meter, and connectors are described in Paragraphs 3-162 through 3-165.

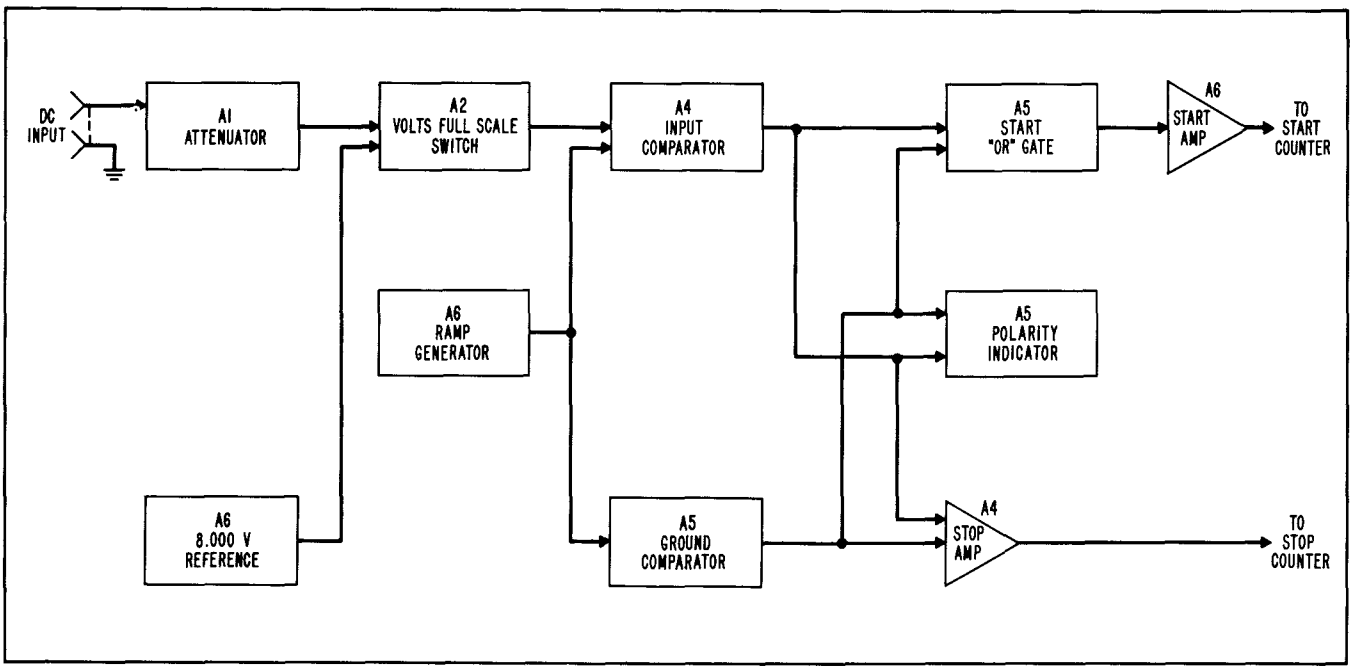


Figure 3-37. Model 5265A Block Diagram

3-162. INPUT LEVEL SWITCH. The input level switch provides three ranges of input sensitivity to the prescaler. They are 1-10 mV, 10-200 mV, and 0.2-1.0 volts.

3-163. LEVEL INDICATOR METER. The meter circuit continuously monitors the level of the input signal to the prescaler. When meter reads in green portion of its scale, input signal amplitude is adequate for accurate frequency measurements.

3-164. INPUT CONNECTOR. Signal input, 1 mV (-47 dBm) to 1 volt (+13 dBm) into a BNC connector.

3-165. VIDEO AMPLIFIER OUTPUT. The video amplifier has a maximum gain of 30 dB when the input level switch is on the 1 mV level setting. This provides an output of approximately 30 mV.

3-166. MAXIMUM INPUT VOLTAGES.

3-167. Damage to the plug-in may result if an AC signal greater than 2 volts rms or a DC voltage greater than 100 volts is applied to the plug-in input connector.

3-168. OPERATING PROCEDURE.

3-169. Figure 3-39 provides a step-by-step procedure for operating the 5258A plug-in.

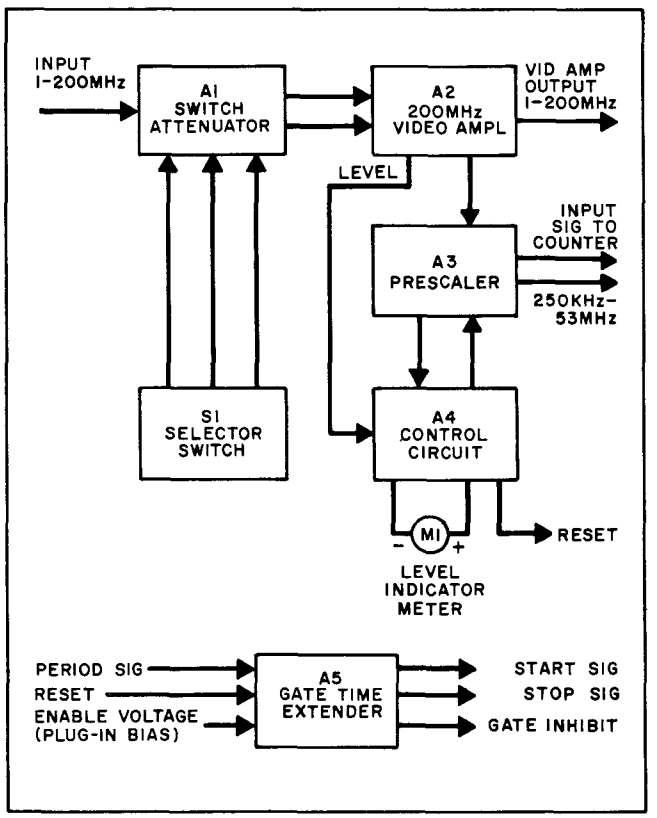


Figure 3-38. Model 5258A Block Diagram

3-170. 5256A FREQUENCY CONVERTER.

3-171. The following paragraphs contain information for operating the HP Model 5256A Frequency Converter plug-in when installed in the Model 5245L Electronic Counter.

3-172. The Model 5256A Frequency Converter increases the range of the 5245L Electronic Counter to 8 thru 18 GHz (8000 to 18,000 MHz).

3-173. FREQUENCY MEASUREMENT. As a general rule to measure frequency, always start with the mixing frequency control below 8 GHz and tune upward in frequency to obtain first response and tune for a maximum reading in the green portion of the meter scale. If the input signal level to the converter is high, the second, third and other harmonics of this signal may be generated. Therefore, tuning mixing frequency control from the low end upward will enable the input fundamental frequency to be detected before its harmonics. In the 5256A harmonic of the reference frequency signals are held to a low level. The effect of their mixing with the input signal is not observable. Figure 3-40 provides a step-by-step procedure to be used for measurement of frequencies from 8 to 18 GHz. The only exception is if the first response occurs at 8 GHz or 8.2 GHz. To avoid possible ambiguity in these cases, start from above 8.6 GHz and tune downward in frequency for the first response and subtract the counter reading from the dial frequency for the frequency of the input signal.

3-174. CONTROLS AND INPUTS.

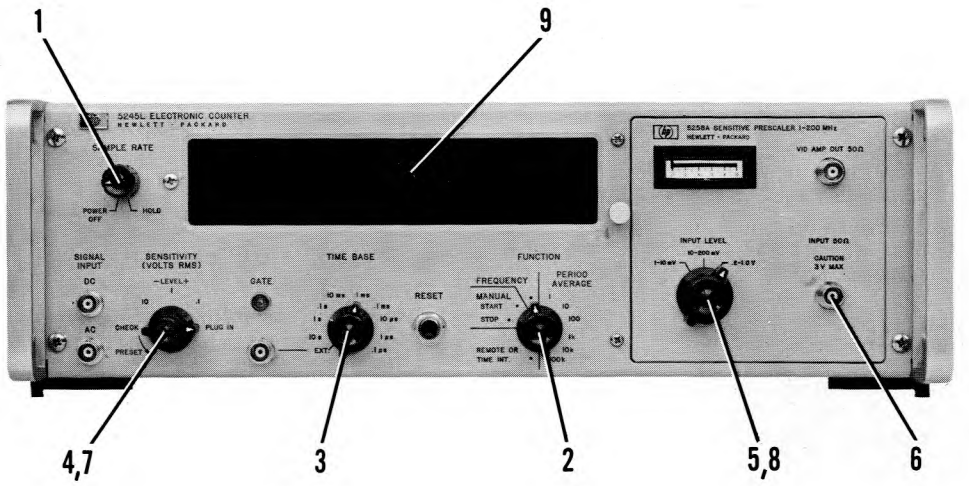
3-175. GENERAL. The function of the front panel tuning control, input connector, meter, AUX input, and AUX output connectors are described in Paragraphs 3-176 through 3-180.

3-176. INPUT CONNECTOR. Signal input, 50 ohms input impedance, 100 mV (-7 dBm) to 707 mV (+10 dBm) into precision (APC-7) connector.

3-177. MIXING FREQUENCY SELECTOR. Calibrated from 8 GHz to 18 GHz this control tunes the internal cavity to select a harmonic of 200 MHz to be mixed with the input signal.

3-178. LEVEL METER. The meter circuit continuously monitors the level of the difference frequency output of the converter to the counter. When the meter reads in the green portion of its scale, input signal amplitude is adequate for accurate frequency measurement.

3-179. AUX IN. Signals connected to this input of 5 mV (-33 dBm) up to 224 mV (0 dBm) and 1 to 200 MHz at the AUX IN jack will be counted and displayed directly.



1. Turn counter on with SAMPLE RATE control.
2. Set FUNCTION switch to FREQUENCY.
3. Set TIME BASE switch to desired gate time*.
4. Set SIGNAL INPUT switch to CHECK to verify proper counter operation.
5. Set plug-in INPUT LEVEL switch to 1 volt range.
6. Connect unknown signal to plug-in INPUT jack.
7. Set SIGNAL INPUT switch to PLUG-IN.
8. Adjust INPUT LEVEL switch until consistant count appears.
9. Display is unknown frequency.

* When using HP Model 5258A Sensitive Prescaler, the gate time of the counter is extended by a factor of four.

Figure 3-39. Model 5258A Operating Procedure

3-180. AUX OUT. The output from the AUX OUT jack is the 1 to 200 MHz difference signal from the video amplifier.

Note

If any difficulty occurs while making measurements, check all cables and connectors for reasonance. Since most coaxial cables exhibit considerable attenuation at microwave frequencies, waveguide is perferred for connecting the signal input to the 5256A INPUT.

3-181. MAXIMUM INPUT VOLTAGE.

3-182. Damage to the converter may result if an ac signal greater than .707V rms (+10 dBm) or a dc voltage greater than 5V is applied to converter INPUT connector.

3-183. FREQUENCY MEASUREMENT WITH AMPLITUDE LESS THAN 100 MV RMS. The front panel meter indicates in the green portion of its scale only when converter is properly tuned and amplitude in input signal is adequate for accurate frequency measurement. (Because of conservative specifications of the converter this will often occur with an input signal less than 100 mV).

3-185. DOUBLE-CHECKING FREQUENCY MEASUREMENT RESULTS.

3-186. Because of the heterodyne action of the converter, frequency measurement results obtained at any one setting of the mixing frequency control may be checked at other settings. In most cases these will be consecutive responses: tune in the first response and add the counter display to dial frequency reading; then tune up in frequency to the second response and subtract the counter display from the dial frequency reading (see Table 3-17). In some cases there will be three consecutive responses (see Table 3-18); in these cases the third response will be the one in whicy you subtract the counter display from the dial frequency reading.

Table 3-17. Typical Double-Check Frequency Measurement (5256A)

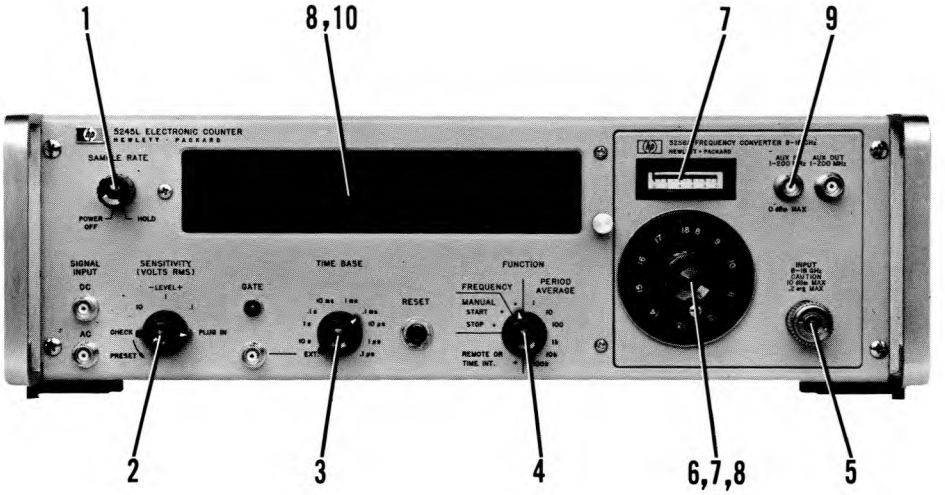
Input Frequency	Counter Reading	Mixing Frequency	Meter Indication	Response
10.1234567 GHz	123456.7 kHz	10.0 GHz	Peak	10.0000000 GHz +.1234567 GHz 10.1234567 GHz
	076543.3 kHz	10.2 GHz	Peak	10.2000000 GHz -.0765433 GHz 10.1234567 GHz
*Note: Counter in 10 ms Gate to give readings in kHz.				

Table 3-18. Model 5256A Typical Frequency Measurements

Input Frequency	Display	Meter	Dial	Response
	EXAMPLE OF ONE RESPONSE			
7800 MHz	000000.00 MHz	Red	8.2 GHz	No response; frequency difference greater than passband of video amplifier
	000200.00 MHz	Green	8.0 GHz	First Response: * 8000 MHz - 200 MHz 7800 MHz
18,200 MHz	000000.00 MHz	Red	17.8 GHz	No response; frequency difference greater than passband of video amplifier
	000200.00 MHz	Green	18.0 GHz	First Response: 18,000 MHz + 200 MHz 18,200 MHz
	EXAMPLE OF TWO RESPONSES			
16,050 MHz	000050.00 MHz	Green	16.0 GHz	First Response: 16,000 MHz + 50 MHz 16,050 MHz
	000150.00 MHz	Green	16.2 GHz	Second Response 16,200 MHz -150 MHz 16,050 MHz
9,200 MHz	000200.00 MHz	Green	9.0 GHz	First Response 9,000 MHz + 200 MHz 9,200 MHz
	000000.00 MHz	Red	9.2 GHz	No response; difference frequency less than passband of video amplifier
	000200.00 MHz	Green	9.4 GHz	Second Response: 9,400 MHz - 200 MHz 9,200 MHz
	EXAMPLE OF THREE RESPONSES			
17,005 MHz	000205.00 MHz	Green	16.8 GHz	First Response: 16,800 MHz + 205 MHz 17,005 MHz
	000005.00 MHz	Green	17.0 GHz	Second Response: 17,000 MHz + 5 MHz 17,005 MHz
	000195.00 MHz	Green	17.2 GHz	Third Response: 17,200 MHz - 195 MHz 17,005 MHz

*When response present at 7.8 or 8.0 GHz, tune from above and subtract first reading, (See Paragraph 3-69).

NOTE: Counter in .1 ms gate to give readings in MHz.



FREQUENCY MEASUREMENTS

1. Turn SAMPLE RATE slightly out of POWER OFF position.
2. Set SENSITIVITY to PLUG IN.
3. Set TIME BASE to 10 ms. *
4. Set FUNCTION to FREQUENCY.
5. Connect input signal to INPUT of converter.
6. Set Mixing Frequency control to read slightly less than 8.0 GHz.
7. Slowly turn Mixing Frequency control counterclockwise to obtain the first response, and tune for a maximum reading in the green portion of the Level Indicator Meter scale.
8. Add counter display (in kHz) to Mixing Frequency control reading (in GHz) for frequency of INPUT signal.

USE OF AUX IN

9. To use prescaler portion of plug-in connect the 1 to 200 MHz input signal to the AUX IN jack (0 dBm max).
10. The counter will display frequency of input signal. (During this measurement the main input to the converter should be disconnected, or, if a microwave signal is present at the main input, the converter should be detuned so that there is no counter reading from that source).

*TIME BASE setting may vary, depending on desired resolution of INPUT signal frequency.

Figure 3-40. Model 5256A Operating Procedure

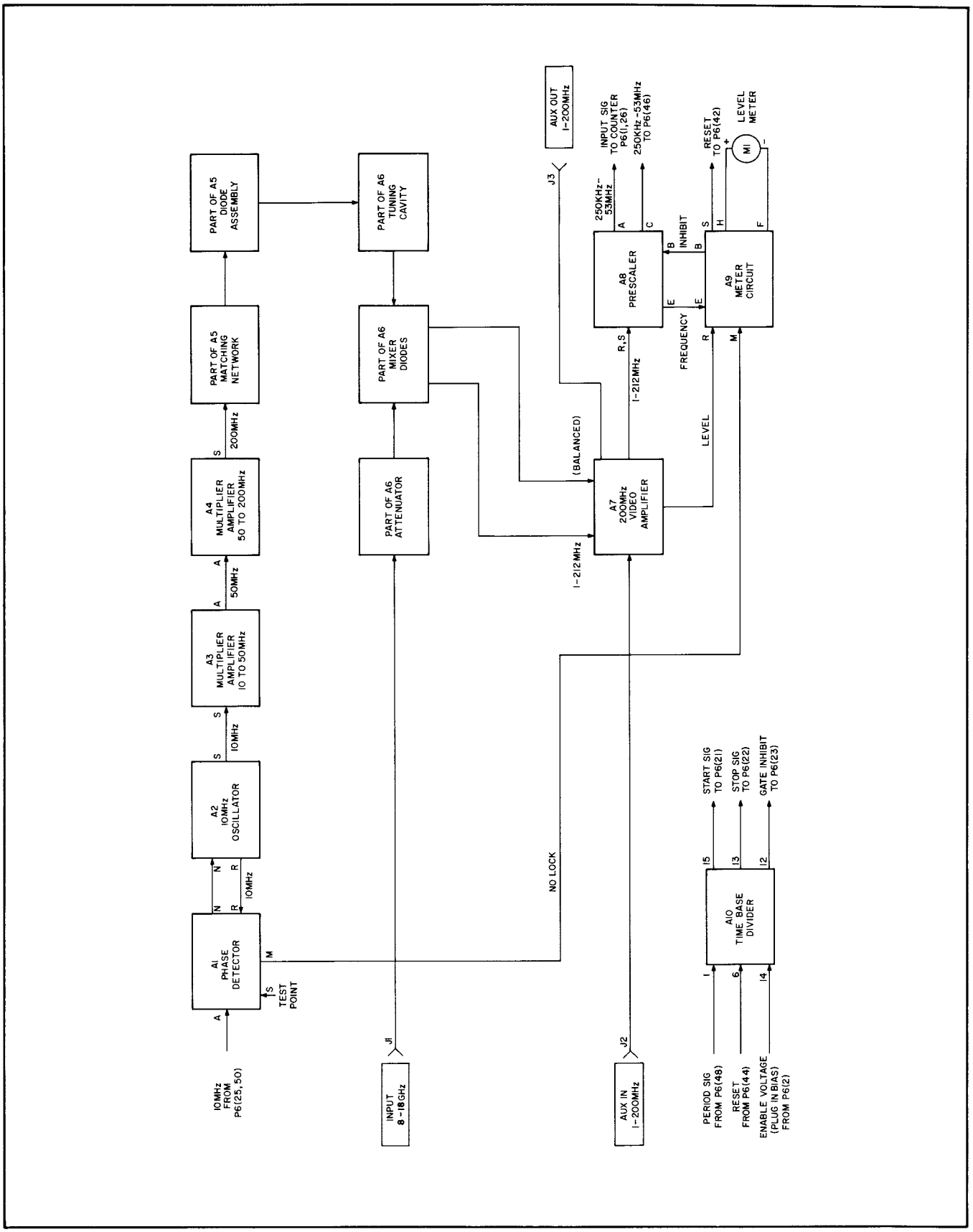


Figure 3-41. Model 5256A Block Diagram

SECTION IV
MAINTENANCE

4-1. INTRODUCTION.

4-2. This section contains information for air filter care, fuse replacement, oscillator frequency check, and a self-check table.

4-3. AIR FILTER.

4-4. Inspect the air filter (center of rear panel) regularly and clean it before it becomes dirty enough to restrict air flow. Proceed as follows:

a. Remove top cover (unlock the two quarter turn fasteners and slide cover to the rear).

b. Remove four screws holding filter in place.

c. Wash filter in warm water and detergent.

d. Allow filter to dry completely.

e. DO NOT APPLY ANY COATING COMPOUND TO NON-METAL FILTERS. Coat metal filters with light film of filter oil. We recommend No. 3 Filter Coat from Research Products Company. This adhesive is available in "Handi-Koter" sprayer cans at most heating supply stores or from your Hewlett-Packard field office.

4-5. FUSE REPLACEMENT.

4-6. Table 4-1 lists the fuse rating and ℔ Part No. for proper operation with either 115Vac or 230 Vac.

Table 4-1. Fuse Replacement

Conversion	115 Volt	230 Volt
Slide switch	Left ("115")	Right ("230")
AC LINE FUSE	2 ampere slow-blow (℔ 2110-0006)	1 ampere slow-blow (℔ 2110-0007)

4-7. OSCILLATOR FREQUENCY CHECK.

4-8. TIME-BASE OSCILLATOR FREQUENCY.

4-9. GENERAL. The frequency accuracy of the oscillator may be determined by observing the rate of drift of the oscilloscope pattern (Figure 4-1). If the pattern moves to the right, counter oscillator frequency is lower than the standard frequency being used to trigger the oscilloscope. If the pattern moves to the left, oscillator frequency is high. The reciprocal of the time in seconds for the oscilloscope pattern to move the width of one cycle equals the frequency difference in parts in 10^6 with 1-MHz inputs (or parts in 10^5 with 100-kHz inputs). For example, if the oscilloscope pattern drifts to the left a rate of one cycle's width every 10 seconds with 1-MHz inputs, the oscillator frequency is 1 part in 10^7 high. If the pattern moves the width of one cycle in 100 seconds, frequency error is 1 part in 10^9 with 10-MHz inputs. If the pattern moves the width of one cycle in 10 seconds with a 10-MHz input, the frequency error is 1 part in 10^8. Movement of the pattern may be accurately checked using an oscilloscope with calibrated sweeps by timing the movement of the point at which the oscilloscope trace crosses the base line when horizontal sweep is expanded and vertical gain is increased.

4-10. To check oscillator frequency, proceed as follows:

a. Connect oscilloscope to OUTPUT STD FREQ BNC and set MODE switch to INT STD FREQ.

b. Trigger oscilloscope externally with a 1-MHz signal from a standard frequency source.

c. Set oscilloscope sweep time to .1 μs/cm. Adjust oscilloscope controls to obtain a presentation of a 5 v peak-to-peak nonsinuoidal waveform.

d. Horizontal drift of oscilloscope display in cm/sec is difference between standard frequency and counter time-base frequency in parts in 10^7.

e. Determine frequency difference in parts in 10^7 and record.

f. If frequency difference is excessive for the desired application of counter, see Paragraph 4-11 for time-base oscillator frequency adjustment procedure.

g. Note and record environmental temperature.

h. Repeat above steps a through g at daily intervals. Change in frequency difference between standard frequency and time-base oscillator frequency per day is frequency drift of time-base oscillator. Drift should not exceed ± 3 parts in 10^9 per day under reasonably constant environmental conditions (see Table 1-1).

4-11. OSCILLATOR CALIBRATION.

a. Connect 100 kHz output of Quartz Oscillator to EXT SYNC input on Oscilloscope.

b. Connect 1 MHz signal from OUTPUT STD FREQ BNC on rear panel of the 5245L to VERT INPUT on Oscilloscope.

c. Adjust COARSE FREQUENCY capacitor from rear panel until pattern on the oscilloscope stops drifting.

d. If necessary adjust MED or FINE FREQ ADJ (at rear of plug-in compartment) until average drift of oscilloscope pattern is zero.

Table 4-2. Assembly Designations

A1	INPUT SWITCH ASSEMBLY (SENSITIVITY)
A2	TIME BASE SWITCH ASSEMBLY
A3	FUNCTION SWITCH ASSEMBLY
A4	MODE SWITCH ASSEMBLY
A5	OUTPUT SWITCH ASSEMBLY
A6	RECTIFIER ASSEMBLY
A7	REGULATOR ASSEMBLY
A8	DECIMAL POINT ASSEMBLY
A9	MEASUREMENT UNITS ASSEMBLY
A10-A14	LOW FREQUENCY DECIMAL COUNTERS
A15-A16	MEDIUM FREQUENCY DECIMAL COUNTER
A17	HIGH FREQUENCY DECIMAL COUNTER
A18	HIGH FREQUENCY READOUT
A19-A20	INPUT AMPLIFIER ASSEMBLIES
A21	FUNCTION CONTROL ASSEMBLY
A22	GATE CONTROL ASSEMBLY
A23	SAMPLING CONTROL ASSEMBLY
A24	CRYSTAL OVEN ASSEMBLY
A25	OVEN CONTROL ASSEMBLY
A26	OSCILLATOR ASSEMBLY
A27	MULTIPLIER ASSEMBLY
A28	MEDIUM FREQUENCY DECADE DIVIDER
A29-A34	LOW FREQUENCY DECADE DIVIDERS
A35	TIME BASE CONTROL ASSEMBLY

Table 4-3. Self Check

FUNCTION	TIME BASE	DISPLAYS	ASSEMBLIES CHECKED																GATES CHECKED
			2	3	10	11	12	13	14	15	16	27	28	29	30	31	32	33	34	
Frequency	1 μs	00000010. Mc	x								x	x								3, 6, 28
	10 μs	0000010. 0 Mc	x							x	x	x	x							3, 6, 27
	.1 ms	000010. 00 Mc	x						x	x	x	x	x	x						3, 6, 26
	1 ms	00010000. kc	x					x	x	x	x	x	x	x	x					3, 6, 25
	10 ms	0010000. 0 kc	x				x	x	x	x	x	x	x	x	x	x				3, 6, 24
	.1 s	010000. 00 kc	x			x	x	x	x	x	x	x	x	x	x	x	x			3, 6, 23
	1 s	10000. 000 kc	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		3, 6, 22
	10 s	0000. 0000 kc	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	3, 6, 21
Period Average	1	00000001		x									x	x						12, 27
	10	00000010		x							x		x	x	x					11, 13, 27
	100	00000100		x						x	x		x	x	x	x				10, 13, 27
	1K	00001000		x					x	x	x		x	x	x	x	x			9, 13, 27
	10K	00010000		x				x	x	x	x		x	x	x	x	x	x		8, 13, 27
	100K	00100000		x			x	x	x	x	x		x	x	x	x	x	x	x	7, 13, 27

The following assemblies are checked in all positions used in the Self-Check Table:

6, 7, 17, 18, 21, 22, 23, 24, 25, 26, and 35.

Assemblies 8 and 9 are checked in all Frequency Self-Checks.

The SENSITIVITY switch (A1) is in the check position for all Self Check functions.

Assemblies 4, 5, 19, 20, are not checked in Self Check functions.

Assembly A26 is checked for operation, but not for accuracy or stability.

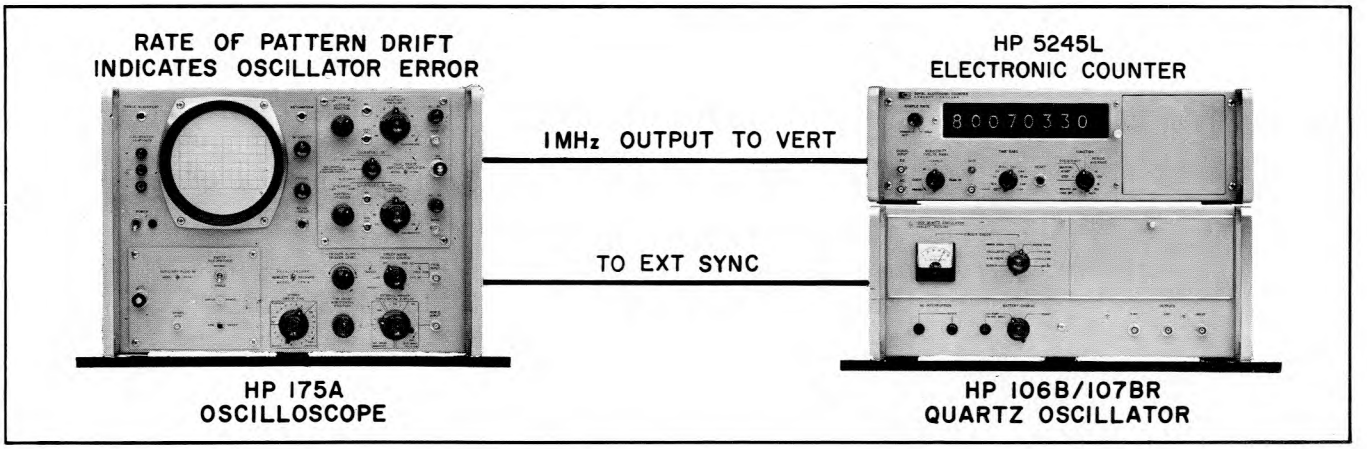


Figure 4-1. Test Setups for Checking Oscillator Frequency