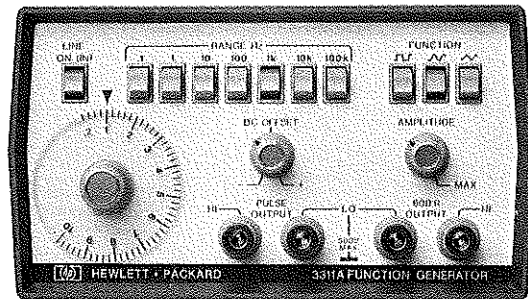


P45.8

OPERATING AND SERVICE MANUAL

FUNCTION GENERATOR 3311A



HEWLETT  PACKARD



OPERATING AND SERVICE MANUAL

Manual Part No. 03311-90001

Microfiche Part No. 03311-90051

MODEL 3311A FUNCTION GENERATOR

Serial Number Prefixed: 1244A

IMPORTANT NOTICE

This instruction manual requires no change sheet. Any change information has already been integrated into the manual by page revisions. Revised pages have a letter which can be found on the lower corner of the page. Reference is also made to Section VIII where backdating information for earlier instruments can be found.

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains general information about the -hp- Model 3311A. Included is a paragraph regarding specifications, a description of the instrument and instrument identification information. Throughout this manual the instrument will be referred to as the "Model 3311A" or the "3311A".

1-3. SPECIFICATIONS.

1-4. Table 1-1 contains specifications for the Model 3311A. Table 1-2 contains general operating characteristics of the instrument. The information in Table 1-2 is provided for your convenience. It indicates how the instrument operates under typical operating conditions and should not be considered specifications.

1-5. DESCRIPTION.

1-6. The -hp- 3311A is a versatile Function Generator having sine, triangle, square and pulse outputs. The pulse output is a 0 to +5 V transition with a 10 to 20% duty cycle and is compatible with TTL circuits. The sine, square

and triangle functions have a maximum output voltage of 10 V peak open circuit or 5 V peak into 600 ohms. The signal may be offset by ± 10 V dc into open circuit or ± 5 V dc into 600 ohms.

1-7. The frequency range of the Model 3311A is .1 Hz to 1 MHz in 7 ranges. The frequency may be externally controlled in a 10:1 range by application of an external voltage to the VCO terminals.

1-8. INSTRUMENT AND MANUAL IDENTIFICATION.

1-9. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments. The last section (suffix) identifies a particular instrument within the series. If a letter is included with the serial number, it identifies the country where the instrument was manufactured. This manual is kept up-to-date with the instrument at all times with revised pages. If the serial prefix of your instrument differs from the one on the title page of this manual, refer to Section VIII for backdating information that will adapt this manual to your instrument. All correspondence with Hewlett-Packard should include the complete serial number.

Table 1-1. Specifications.

<p>600 OHM OUTPUT</p> <p>Dial Accuracy: $\pm 5\%$ of full scale.</p> <p>Maximum Output Amplitude: 20 V p-p open circuit; 10 V p-p into 600 Ω.</p> <p>Amplitude Control: continuously variable, > 30 dB range.</p> <p>D.C. Offset: Continuously adjustable over a range from $\geq +10$ V to ≤ -10 V open circuit (range from $\geq +5$ V to ≤ -5 V into 600 Ω, and independent of amplitude control).</p> <p>Output Impedance: 600 $\Omega \pm 10\%$.</p> <p>Sine Wave Amplitude Flatness: within $\pm 3\%$ of 10 kHz reference (maximum output amplitude) to 100 kHz, $\pm 6\%$ to 1 MHz.</p> <p>Triangle Linearity: < 1% deviation from best straight line at 100 Hz (10 V peak).</p> <p>Sine Wave Total Harmonic Distortion: < 3% at maximum output amplitude, 10 Hz to 1 MHz.</p>	<p>Square Wave Time Axis Symmetry: Error $\pm 2\%$ error maximum to 100 kHz.</p> <p>Square Wave Transition Time: < 100 nsec (10 to 90% points)</p> <p>PULSE OUTPUT</p> <p>Output Amplitude: > 3 V positive (open circuit) TTL compatible.</p> <p>Duty Cycle: 10.0% to 20.0% of the total period.</p> <p>Transition Times: < 25 nsec (10 and 90% points).</p> <p>EXTERNAL FREQUENCY CONTROL</p> <p>VCO Range: > 10:1 on any frequency range.</p> <p>Input Requirement: With frequency dial set to 1.0, a linear ramp of 0 V to -10 V ± 2 V will linearly increase frequency > 10:1.</p>
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Table 1-2. General Information.

<p>Waveforms: Sinusoid, square, triangle, positive pulse.</p> <p>Frequency Range: 0.1 Hz to 1 MHz in seven decade ranges.</p> <p>Isolation: using an external supply, the outputs may be floated as much as ± 500 V relative to the instrument case (outer chassis ground).</p> <p>Recommended Calibration Interval: 6 months.</p>	<p>VCO Input Impedance: 10 k$\Omega \pm 10\%$ shunted by < 60 pF.</p> <p>Power: 100/120/220/240 V - 10% +5%, switchable, 48 to 440 Hz, ≤ 12 VA.</p> <p>Operating Temperature Range: 0°C to 55°C. Specifications apply from +15°C to +35°C.</p> <p>Storage Temperature Range: -40°C to 75°C.</p>
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SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains installation and shipping information for the Model 3311A.

2-3. INITIAL INSPECTION.

2-4. Each 3311A has been carefully inspected prior to shipment and should be in perfect electrical order and free of marks or scratches. To confirm this, the instrument should be inspected upon receipt for damage that might have occurred in transit, or for other deficiencies. If there is damage due to shipping, file a claim with the carrier; if there are electrical or mechanical deficiencies not attributable to shipping, then refer to the statement of Warranty on the back of the title page. Use the procedures of Section V to check the instrument's performance.

2-5. POWER REQUIREMENTS.

2-6. The Model 3311A may be operated from the four line voltages 100 V, 120 V, 220 V and 240 V rms + 5% - 10%, of 48 Hz to 440 Hz frequency. The two switches on the rear panel are positioned to select one of the four voltages. The power requirement is 12 VA maximum.



TO AVOID INSTRUMENT DAMAGE, THE REAR PANEL LINE VOLTAGE SWITCHES MUST BE IN THE CORRECT POSITION BEFORE THE POWER CORD IS PLUGGED IN.

2-7. GROUNDING REQUIREMENTS.

2-8. For the safety of operating personnel, a provision for grounding the instrument case has been provided as recommended by the National Electrical Manufacturer's Association (NEMA). The offset pin of the power cable grounds the instrument when plugged into the appropriate receptacle. If only a two-contact receptacle is available, then use a three-prong-to-two-prong adapter and connect the adapter ground lead to earth ground.

2-9. INSTRUMENT MOUNTING.

2-10. Bench Use.

2-11. The front of the 3311A may be elevated for operating convenience by lowering the tilt stand on the bottom shell of the instrument.

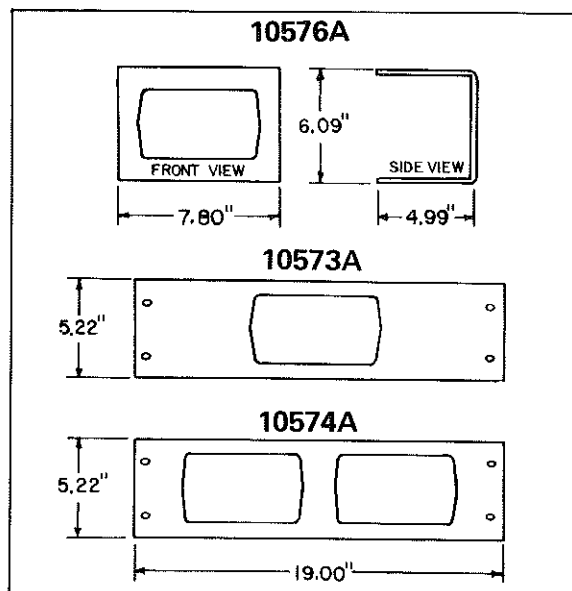


Figure 2-1. Rack Mount Kits.

2-12. Rack Mounting.

2-13. Figure 2-1 shows the available kits for rack mounting the 3311A.

2-14. REPACKAGING FOR SHIPMENT.

2-15. If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument describing the work to be accomplished and identifying the owner and instrument. Identify the instrument by serial number, model number, and name in any correspondence. If you have any questions, contact your local Hewlett-Packard Sales and Service Office. See Appendix B for office locations.

2-16. If the original shipping container is to be used, place the instrument in the container with appropriate packing material and seal the container well with strong tape or metal bands.

2-17. If an -hp- container is not to be used, then use a heavy carton or wooden box with an inner container. Wrap the instrument with heavy paper or plastic and place cardboard strips across the face for protection before placing the instrument in the inner container. Use packing material around all sides of the inner container, and seal the outer container well with strong tape or metal bands. Mark the container with "DELICATE INSTRUMENT", or "FRAGILE".

SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains information necessary for proper operation of the Model 3311A Function Generator. Identification of controls, indicators, and connectors (i.e., panel features), turn-on procedures, and general operating information are included in this section. Information pertaining to operating considerations is also provided.

3-3. PANEL FEATURES.

3-4. Panel features for the Model 3311A are described in Figure 3-1. Each operating control, indicator and connector is identified by an associated number and described by a paragraph with the corresponding number.

3-5. GENERAL OPERATING INFORMATION.



Before connecting the Model 3311A to primary power ensure that the proper line voltage and fuse have been selected. The switches and fuse holder are located on the rear panel.

3-6. Apply primary power to the instrument by pressing the LINE switch.

3-7. Selecting the Desired Output.

NOTE

When using a cable on the 600 Ω OUTPUT terminals which has a characteristic impedance other than 600 ohms, the output signal will be distorted. The output cable should always be terminated in its characteristic impedance.

3-8. Select the function desired (⑥ of Figure 3-1). Set the RANGE switch (⑦) and the frequency dial (①) to the desired settings. The output frequency of the 3311A equals the RANGE setting times the dial setting. Turn the AMPLITUDE control (④) to minimum and connect the load to the OUTPUT terminals (③). Connect an oscilloscope to the OUTPUT terminals (③), and adjust the AMPLITUDE control for the desired output level. If DC OFFSET is desired set the offset (⑤) to the desired level using a dc coupled oscilloscope. DC offset can be obtained on sine, square or triangle functions. The pulse cannot be dc offset.

NOTE

At frequencies below 1 Hz it may be desirable to use an X - Y plotter or similar device in place of the oscilloscope.

To use the PULSE OUTPUT connect the desired load across the pulse terminals.

3-9. Using the VCO Input.

3-10. Connect a negative voltage source to the VCO INPUT terminals. A 0 V to -10 V waveform applied to the VCO INPUT will sweep the 3311A over a 10:1 frequency range when the frequency dial is set to "1". This waveform can be obtained from another 3311A by adjusting its DC OFFSET and AMPLITUDE controls. A smaller VCO drive voltage may be used to obtain smaller frequency deviations. When the frequency dial is set above "1" a smaller VCO drive voltage is required. The VCO drive voltage should always be negative. Frequency can be swept up from the dial setting; it cannot be swept below the dial setting.

3-11. OPERATING CONSIDERATIONS.

3-12. Using Internal DC OFFSET.

3-13. The \pm DC OFFSET may be used to provide an output signal superimposed on a dc level. A maximum open circuit offset voltage of ± 10 V can be obtained. The peak voltage of the signal, including any dc offset, cannot exceed ± 10 V into an open circuit. Voltages in excess of this will be clipped. When operating into a 600 ohm load the above mentioned voltages are halved. This means that the peak voltage, including dc offset, is ± 5 V.



DO NOT APPLY AN EXTERNAL VOLTAGE SOURCE > 30 V PEAK TO THE 600 Ω OUTPUT. TO DO SO MAY DAMAGE THE INSTRUMENT.

3-14. Floating Using External Sources.

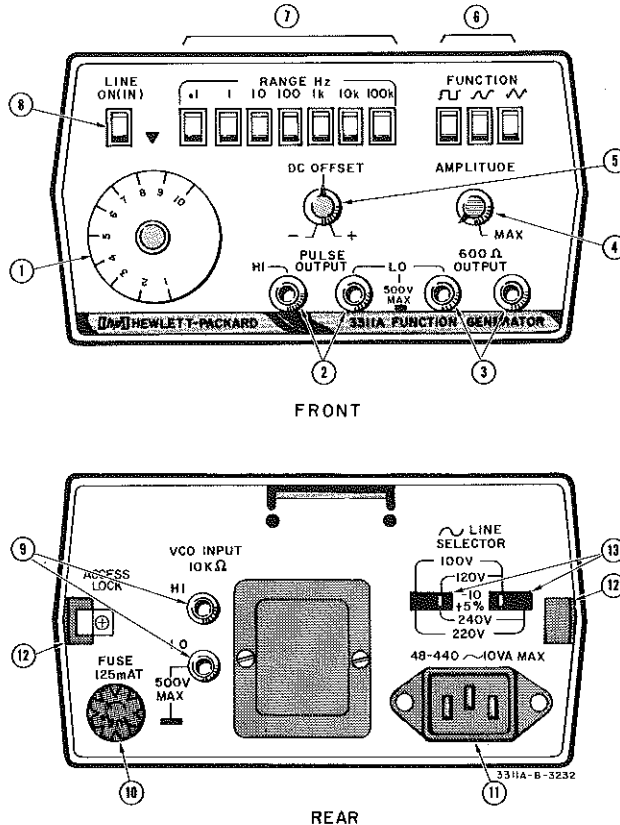
3-15. The low terminal of the 3311A output can be referenced up to ± 500 V dc above chassis (outer frame) ground.

3-16. If an external source is connected to the 3311A output it will add to the current flowing in the output. This will ordinarily not damage the instrument unless the source is connected directly across the output terminals. The maximum current which can be obtained from the 3311A output without clipping is 16.67 mA peak. This includes any current which may be contributed as a result of a source being connected in series with the output.

3-17. Using the Pulse Output.

3-18. When using the pulse output it is recommended that the interconnecting cable, between the source and the load, be terminated at the load in its characteristic impedance; i.e., if 50 ohm cable is used it should be terminated in

50 ohms. This is necessary since the pulse output is designed to be TTL compatible and has a very low output impedance. *Reflection from a load not matched to the interconnecting cable will result in ringing.* Leads of any measuring instrument connected to the pulse output should be as short as possible to prevent rounding of the pulse.



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| <p>① FREQUENCY DIAL - Selects the desired frequency within the range set by ⑦</p> <p>② PULSE OUTPUT - A 0 to > 3 V pulse can be obtained from these terminals when operating into an open circuit. The pulse output is TTL compatible and capable of driving in excess of 20 TTL loads. This output is not affected by the dc offset control or the amplitude and function switches.</p> <p>③ OUTPUT - Output terminal for sine, square and triangle functions. A maximum voltage of 10 V p-p can be obtained when operating into a 600 ohm load.</p> <p>④ AMPLITUDE CONTROL - Adjusts the output level of the sine, square and triangle functions. Output can be varied from approximately 250 mV p-p to 20 V p-p open circuit, or 125 mV p-p to 10 V p-p into 600 ohms.</p> <p>⑤ DC OFFSET CONTROL - Adjusts positive or negative dc offset voltage in a range of 0 to 10 V open circuit, or 0 V to 5 V into 600 ohms.</p> <p>⑥ FUNCTION SELECTOR - Selects the output waveform. Three functions, sine, square and triangle are available.</p> | <p>⑦ RANGE SELECTOR - Selects the tuning range of the 3311A (Hz). The frequency range setting times the dial setting determines the output frequency.</p> <p>⑧ LINE SWITCH - Applies primary power to the instrument when set to LINE position.</p> <p>⑨ Voltage Controlled Oscillator (VCO) INPUT - Input for an external frequency control voltage. A 0 to -10 V ramp will sweep the instrument upward a full decade with the frequency dial set to 1. (See Paragraph 3-10.)</p> <p>⑩ FUSE - Protects internal circuits of the instrument from overload due to short circuits within the instrument.</p> <p>⑪ PRIMARY POWER RECEPTACLE - Primary power should be applied here after selecting the proper line voltage at the LINE SELECTOR switches.</p> <p>⑫ SIDE LOCK LEVERS - Pull out these two levers to separate the top and bottom of the case.</p> <p>⑬ LINE SELECTOR SWITCHES - Position these two switches to select the desired line voltage before connecting the power cord.</p> |
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Figure 3-1. 3311A Front and Rear Panel Features.

SECTION IV THEORY OF OPERATION

4-1. GENERAL DESCRIPTION.

NOTE

The discussion in Paragraph 4-2 through 4-5 refers to Figure 4-1.

4-2. The Model 3311A generates a linear ramp by charging a capacitor from a constant current source. The capacitor is then discharged through another constant current source to generate a triangle waveform. The output frequency is determined by the charge time plus the discharge time of the integrator capacitor (C_i).

4-3. Output level of the Tuning Amplifier is controlled by the frequency dial setting. The Tuning Amplifier and the Range Multiplier control the magnitude of current from the current sources. The charge/discharge rate of C_i is directly proportional to the magnitude of this current. The diode gates are controlled by the Square Wave Generator and determine when C_i is charging and when it is discharging.

4-4. The Triangle Amplifier output is the signal source for the Sine Shaper, the Square Wave Generator, and the Pulse Generator. The Square Wave Generator and the Pulse Generator employ a level comparison technique similar to that of a Schmitt Trigger, to create the square wave and pulse outputs.

4-5. The Function Selector selects sine, square, or triangle function and connects the selected function to the Output Amplifier.

4-6. DETAILED THEORY OF OPERATION.

4-7. Triangle Generator (See Figure 7-1).

4-8. Feedback from the emitter of current source Q11 causes the voltage at TP8 to equal the voltage at the + input of the tuning amplifier. Transistor Q9 biases Q5 and Q11 so that they have equal collector currents (R_a is always equal to R_b). Current I_1 flows through CR9 and into C_i and C_6 during time interval T1 of the Square Wave Generator output. This causes the voltage of TP13 to rise. Also during T1 current I_2 flows through CR1 from the output of the Square Wave Generator. When the level of the voltage at TP13 becomes +2 V, the output of the Square Wave Generator switches to -7 V initiating time interval T2. Current I_2 is supplied by C_i and C_6 through CR5 during T2. This causes the voltage at TP2 to decrease. During T2 current I_1 flows through CR3 to the output of the Square Wave Generator. When the voltage at TP13 reaches -2 V, the output of the Square Wave Generator switches back to +7 V.

4-9. VCO Input.

4-10. The voltage at the input to the Tuning Amplifier is determined by the setting of the frequency dial (R_2), and any negative voltage applied to the VCO INPUT. To sweep

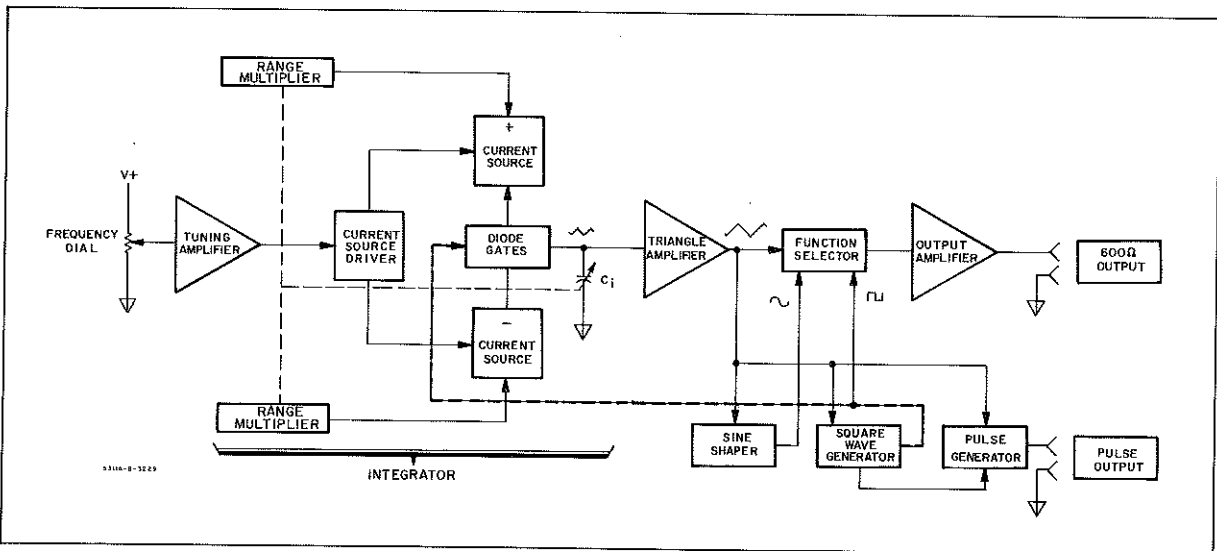


Figure 4-1. Basic Block Diagram.

the 3311A upward one full decade (10:1), the voltage at the + input of Tuning Amplifier must vary from approximately +18 V to +7 V. With no voltage applied to the VCO INPUT this voltage is controlled only by the frequency dial. When the frequency dial is set to 1 (full CW), a 0 to -10 V ramp applied to the VCO INPUT will sweep the 3311A upward in a 10:1 range.

4-11. Triangle Amplifier.

4-12. The Triangle Amplifier provides a voltage gain of 2. Current flowing into the amplifier input is minimized by its FET input stage. This prevents non-linearity of the ramp at low frequencies.

4-13. Sine Shaper (See Figure 4-2).

4-14. The Sine Shaper is composed of two sections. The first section shapes the waveform near its crest. This is accomplished by diodes CR59 and CR61 which alternately conduct, providing a low dynamic impedance to ground. The point on the waveform at which the diodes conduct is set by R165 for the positive half of the waveform and by R163 for the negative half. The signal is then coupled through R149 to the second section of the Sine Shaper. The diodes in this section are selected to ensure a smooth sine shaped curve. This accounts for the good distortion characteristics of the Model 3311A.

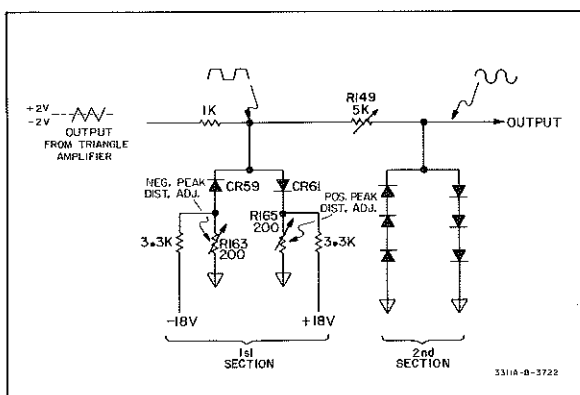


Figure 4-2. Sine Shaper.

4-15. Square Wave Generator (See Figure 4-3).

4-16. The Square Wave Generator output is switched between +7 V and -7 V. Operation of this circuit will be explained by following the circuit through one complete cycle of operation:

At t_0 the voltage at (1) is -1 V and increasing with time. The voltage at (2) is +7 V, and the voltage at (3) is +1 V. The output of U7 is +2 V which causes Q31 and Q21 to be turned off and Q33 and Q19 to be active. Current flows through Q33 to ground. Current also flows through CR27, CR17, and Q19 to the +18 V supply causing the voltage at point (2) to be +7 V.

At T_1 the voltage at (1) has increased and is slightly larger than the voltage at (3). This causes the output of U7 to change from +2 V to -5 V which turns off Q33 and Q19 and allows Q31 and Q21 to become active. Current flows through Q31 to ground. Current also flows through CR29, CR19, and Q21 to the -18 V supply causing the voltage at point (2) to be -7 V. The voltage at point (3) now becomes -1 V. The change in output level at point (2) switches the current sources in the integrator. This causes the triangle waveform to start in the negative direction.

At T_2 the voltage at (1) becomes slightly more negative than the voltage at (3). This causes the output of U7 to switch, changing the states of Q33, Q31, Q21, and Q19. Accordingly, the integrator waveform changes directions becoming more positive with time.

4-17. Pulse Generator (See Figure 7-5).

4-18. The Pulse Generator compares the outputs of the Triangle Amplifier (2) and the Square Wave Generator (4). When the proper comparison level is reached, a 0 to +5 V pulse is generated. Diodes CR2, CR4, and CR6 protect the Pulse Generator against external voltages which may be applied to the output.

CAUTION

This circuit will not protect against continuous application of currents exceeding 1 ampere.

4-19. Output Amplifier (See Figure 7-5).

4-20. The Output Amplifier provides a gain of 20 for the signals from the Function Selector. Diodes CR31, CR33, CR35, and CR37 are output protection diodes which conduct if excessive voltage is applied to the output.

CAUTION

Do not apply an external source of >30 V peak to the output. To do so may damage the instrument.

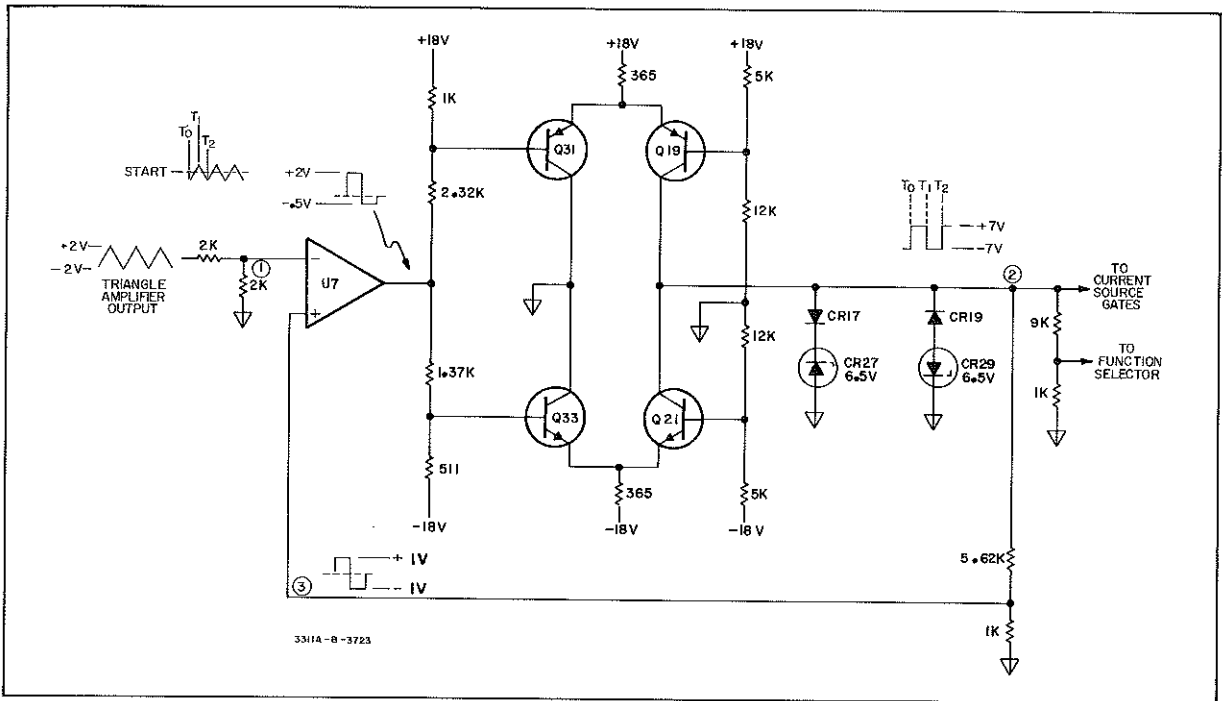


Figure 4-3. Square Wave Generator.

SECTION V MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information necessary for proper maintenance of the Model 3311A. Included are Performance Tests and Adjustment Procedures. The Performance Tests may be used for incoming inspection and prior to using the Adjustment Procedures. Specifications are given in Table 1-1. If your instrument does not meet its required specifications, refer to the Adjustment Procedures.

5-3. RECOMMENDED TEST EQUIPMENT.

5-4. The test equipment that is recommended for main-

taining the Model 3311A is listed in Table 5-1. If the recommended Model is not available, use an instrument that has specifications equal to or exceeding those listed.

5-5. TEST RECORD.

5-6. A Performance Test Record form is provided at the end of this section to record the results of the Performance Tests and their acceptable limits. The form may be removed from your manual and retained as a permanent record of the incoming inspection or routine maintenance performed on the instrument. It may be reproduced without written permission from Hewlett-Packard.

Table 5-1. Recommended Test Equipment.

Instrument Type	Required Specifications	Recommended Model
Electronic Counter	.1 Hz to 1 MHz with time interval capability	-hp- Model 5245L with a Model 5262A Time Interval Plug-In
Oscilloscope	1 MHz bandwidth with dual channel (-hp- Model 1805A) and delay (-hp- Model 1821A) plug-ins	-hp- Model 180C/1805A/1821A with 10004A oscilloscope probe (an -hp- Model 1801A vertical amplifier may be used if a Model 1805A is not available.)
Divider Probe	10 M Ω , 10:1 divider \leq 10 pF shunt cap.	-hp- 10004B
Distortion Analyzer	Distortion measurement range: 5 Hz to 600 kHz \pm 0.1%	-hp- Model 333A/334A
Power Supply	Voltage Regulation: \pm 4 mV Voltage Adjustment Range: 0 to - 12 V	-hp- Model 6215A
Resistors	R: fxd, 604 Ω \pm 1% R: fxd, 51 Ω \pm 1% R: fxd, 10 k Ω \pm 1%	-hp- Part No. 0757-0161 -hp- Part No. 0683-5105 -hp- Part No. 0757-0442
Feedthru Terminating Resistance	Resistance: 50 Ω \pm 1% Frequency Range: dc to 10 MHz	-hp- Model 11048C
Feedthru Terminating Resistance	Resistance: 600 Ω \pm 1% Frequency Range: dc to 1 MHz	-hp- Model 11095A
Notch Filter (1 MHz)	C: fxd, 820 pF, 1 ea C: fxd, 300 pF, 2 ea L: fxd, 22 μ H, 1 ea R: fxd, 1200 Ω \pm 10% R: var, 1 k Ω \pm 10%	0160-2009 0140-0225 9140-0179 0684-1221 2100-2291
AC Voltmeter	Frequency Range: 20 Hz to 4 MHz Voltage Range: 100 μ V to 10 V	-hp- Model 400F/FL
Digital Voltmeter	10 mV sensitivity, 3 digits resolution, with sample-and-hold option, and dc measuring capability	-hp- Model 3480C/D/3484A with option 001 (sample-and-hold)
Function Generator	Output Frequency: 20 kHz Function: Square Wave, with triggering capability	-hp- Model 3300A/3302A
Function Generator	\pm 7 V peak square wave output 50 Ω output impedance	-hp- Model 3310A (recommended for troubleshooting)

5-7. PERFORMANCE TESTS.

5-8. The following tests verify that the Model 3311A is operating properly and meets the specifications listed in Table 1-1 of this manual. These tests should be completed before attempting to adjust the instrument.

5-9. Sine Wave Amplitude Flatness Test.

DESCRIPTION:

This test verifies the ability of the Model 3311A to maintain constant output amplitude within $\pm 3\%$ from 0.1 Hz to 100 kHz, and $\pm 6\%$ from 100 kHz to 1 MHz.

SPECIFICATION:

Sine Wave Frequency Response: $\pm 3\%$, 0.1 Hz to 100 kHz; $\pm 6\%$, 100 kHz to 1 MHz; 10 kHz reference (600 Ω termination).

NOTE

In the following procedure all interconnecting wires should be as short as possible.

RECOMMENDED TEST EQUIPMENT:

Oscilloscope, -hp- Model 180C with 1805A/1821A plug-ins
604 Ω resistor, -hp- Part Number 0757-0161

TEST PROCEDURE:

- Connect the equipment as shown in Figure 5-1.
- Set the Model 3311A controls for a 10 kHz sine wave. Set the AMPLITUDE control to the fully clockwise position. DC OFFSET should be set to minimum (control centered).
- Using the oscilloscope, measure the peak to peak amplitude of the 3311A output. Multiply this value by 0.015 to determine maximum permissible deviation (Vdev) in volts.

- Set the oscilloscope vertical sensitivity to .2 V/div. Set the sweep time to .2 ms/Div.

NOTE

The following procedure requires the oscilloscope display to be offset in order to view the top of the displayed waveform. This is accomplished with the vertical position and DC OFFSET controls of the Model 1805A Vertical Amplifier. If you have a Model 1801A Vertical Amplifier the DC Bal Control can be used to offset the waveform. The Model 1801A should be readjusted after this test is completed.

- Using the vertical position and DC Offset controls of the oscilloscope, position the display so that the positive peaks of the signal just touch the horizontal center line of the graticule.

- Check several frequencies from 0.1 Hz to 100 kHz. The positive peaks of the oscilloscope display should vary no more than the value of Vdev calculated in step c.

- Check several frequencies between 100 kHz and 1 MHz. Maximum allowable deviation for these frequencies is twice Vdev.

5-10. Square Wave Time Axis Symmetry Error Test.

DESCRIPTION:

This test verifies that the positive and negative halves of the 3311A square wave output have equal periods within $\pm 2\%$ of each other.

SPECIFICATION:

Square Wave Time Axis Symmetry Error: $<2\%$ to 100 kHz.

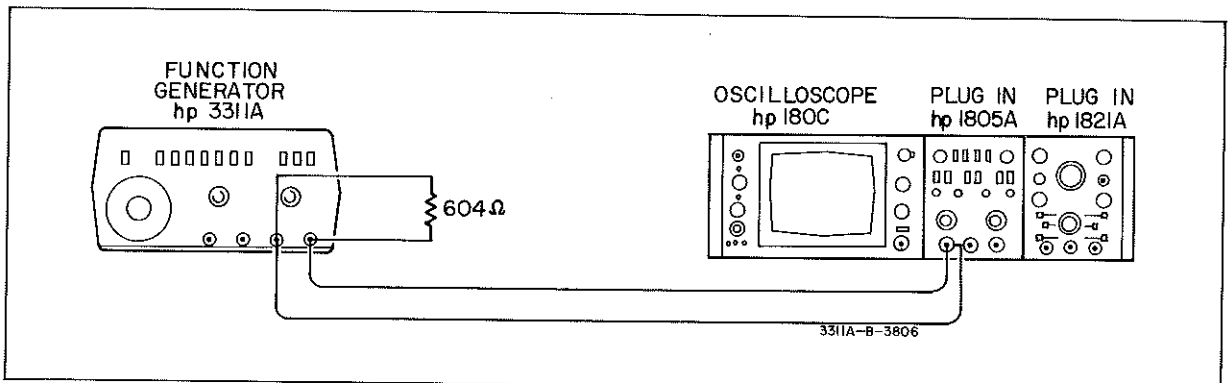


Figure 5-1. Amplitude Flatness.

RECOMMENDED TEST EQUIPMENT:

Electronic counter, -hp- Model 5245L with 5262A Plug-In

a. Set the 3311A to square wave function and connect the output to the time interval input of an electronic counter as shown in Figure 5-2 (symmetry).

b. Set the 3311A frequency to 100 kHz and adjust the AMPLITUDE control to maximum.

c. Measure the period of the positive portion of the square wave and then the period of the negative portion.

d. Calculate symmetry error using the following formula:

$$E_s (\%) = \frac{T_1 - T_2}{T_1 + T_2} \times 100$$

Where:

T_1 = Period of the positive portion of the waveform.

T_2 = Period of the negative portion of the waveform.

The value of E_s should not exceed 2%.

e. Measure the period of the positive and negative portion of the square wave at several other frequencies between 0.1 Hz and 100 kHz. Symmetry error should not exceed 2% for any frequency.

5-11. Pulse Duty Cycle Test.

DESCRIPTION:

This test verifies that the width of the pulse generated by Model 3311A is between 10 and 20% of the total period of one cycle.

SPECIFICATION:

Duty Cycle: 10.0% to 20.0% of the total period.

RECOMMENDED TEST EQUIPMENT:

Electronic counter, -hp- Model 5245L/5262A Plug-In

TEST PROCEDURE:

a. Connect the equipment as shown in Figure 5-2 for the symmetry test except connect the counter to the 3311A PULSE OUTPUT.

b. Set the 3311A frequency to 10 kHz and adjust the amplitude control to maximum.

c. Measure the period of the pulse and then the period of one cycle.

d. Divide the period of the pulse by the period measured for one cycle. This value should be between 0.1 and 0.2, i.e. 10% to 20%.

5-12. Dial Accuracy Test.

DESCRIPTION:

This test verifies that the dial setting of the Model 3311A coincides with the output frequency to within $\pm 5\%$ of maximum dial setting.

SPECIFICATION:

Dial Accuracy: $\pm 5\%$ of full scale

RECOMMENDED TEST EQUIPMENT:

Electronic counter, -hp- Model 5245L/5262A
Feed-Thru Termination (600 Ω), -hp- 11095A

TEST PROCEDURE:

a. Connect the equipment as shown in Figure 5-2 for the dial accuracy check.

b. Set the 3311A FUNCTION to square wave. Set the AMPLITUDE control Maximum.

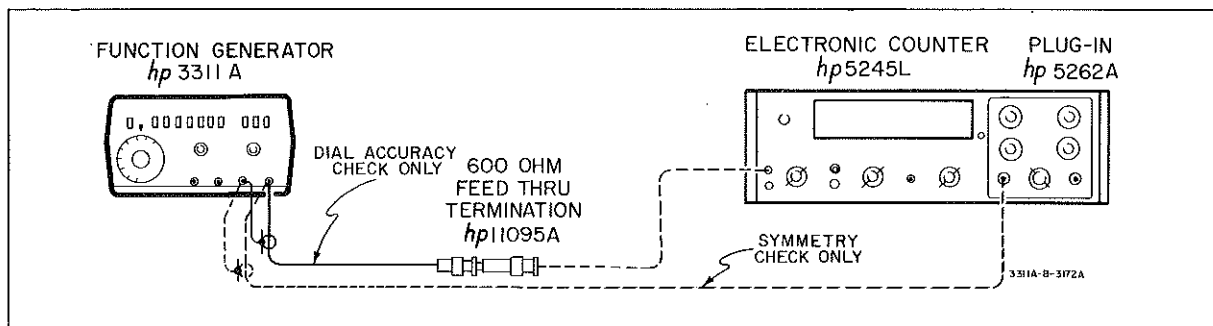


Figure 5-2. Dial Accuracy/Time Axis Symmetry Check.

c. Check the dial accuracy at the settings listed in Table 5-2. All readings should fall within the limits listed under "Counter Indication" in the Table.

Table 5-2. Dial Accuracy Check.

3311A Control Settings		
Dial	Range	Counter Indication
1	.1	6670 ms to 20000 ms
5	.1	1820 ms to 2220 ms
10	.1	950 ms to 1050 ms
1	1	667 ms to 2000 ms
5	1	182 ms to 222 ms
10	1	96 ms to 105 ms
1	10	66.7 ms to 200 ms
5	10	18.2 ms to 22.2 ms
10	10	9.5 ms to 10.5 ms
1	100	50 Hz to 150 Hz
5	100	450 Hz to 550 Hz
10	100	950 Hz to 1050 Hz
1	1 K	500 Hz to 1500 Hz
5	1 K	4500 Hz to 5500 Hz
10	1 K	9500 Hz to 10.5 kHz
1	10 K	5 kHz to 15 kHz
5	10 K	45 kHz to 55 kHz
10	10 K	95 kHz to 105 kHz
1	100 K	50 kHz to 150 kHz
5	100 K	450 kHz to 550 kHz
10	100 K	950 kHz to 1050 kHz

RECOMMENDED TEST EQUIPMENT:

Resistor (50 Ω), -hp- Part Number 0683-5105
Distortion Analyzer, -hp- Model 333A or 334A
Notch Filter, 1 MHz (See Table 5-1 for a list of components)

TEST PROCEDURE:

- Connect the equipment as shown in Figure 5-3.
- Set the 3311A FUNCTION to sine at a frequency of 10 Hz and measure the distortion. It should be more than 30 dB below the fundamental.
- Measure distortion at several other frequencies from 10 Hz through 600 kHz. Distortion should be more than 30 dB below the fundamental for each frequency checked.
- Connect the equipment as shown in Figure 5-4. *The components for the 1 MHz notch filter are listed in Table 5-1.*
- Set the 3311A frequency dial to the fully clockwise position on the 100 K RANGE. Adjust the AMPLITUDE control for a 0 dB indication on the voltmeter. This is the reference level.
- Readjust the 3311A frequency to 1 MHz.
- While monitoring the voltmeter, adjust the potentiometer in the 1 MHz filter and the 3311A frequency dial for the best null. This reading should be ≥ 30 dB below the reference level noted in step e.

5-14. Square Wave and Pulse Response Test.

DESCRIPTION:

This test verifies that the square wave and pulse transition times (10 and 90% points) meet the specifications listed below.

5-13. Sine Wave Distortion Test.

DESCRIPTION:

This test verifies that the sine wave distortion of the Model 3311A is less than 3%; i.e. greater than 30 dB below the fundamental.

SPECIFICATION:

Distortion: <3% at maximum output amplitude, 10 Hz to 1 MHz.

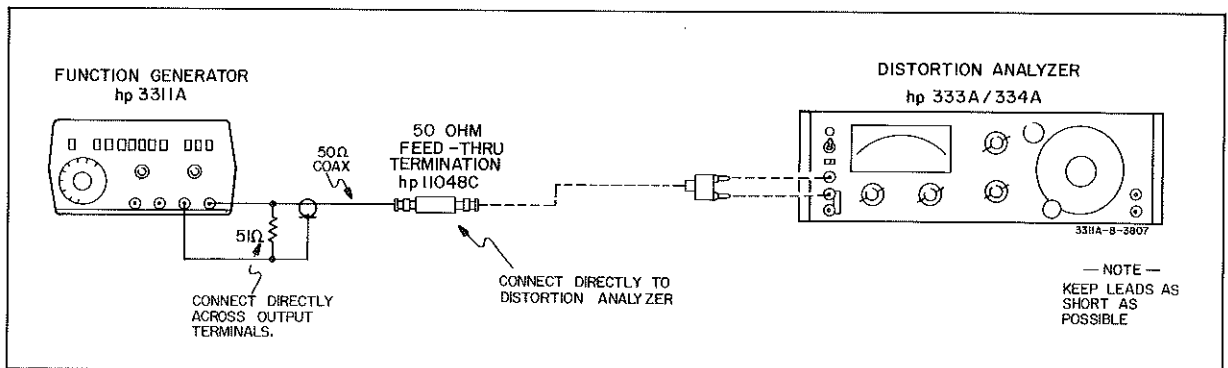


Figure 5-3. Distortion Test.