

BF de fonction Hewlett Packard  
3312A1133  
38-30C  
38.297

ENS LYON

## SECTION I

## GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. This manual contains installation procedures, operating instructions and maintenance information for the Model 3312A Function Generator. Instrument specifications and procedures for adjusting the instrument to those specifications, schematic diagrams, theory of operation, and troubleshooting information are provided for use in maintaining the instrument.

1-3. This section of the manual contains a description of the Model 3312A, the performance specifications and characteristics, and instrument identification information.

## 1-4. DESCRIPTION.

1-5. The Hewlett-Packard Model 3312A Function Generator is a compact, wide range, dual function generator consisting of a main generator and a modulation generator. The main generator provides sine, square, or triangle wave outputs over the frequency range of 0.1 Hz to 13 MHz. The modulation generator produces sine, square and triangle waveforms with a frequency range of 0.01 Hz to 10 kHz. The modulation generator can be used to Amplitude Modulate (AM) or Frequency Modulate (FM) the output signal of the main generator. The AM envelope can be adjusted from 0% to 100%; FM can change the carrier frequency up to  $\pm 5\%$ .

## 1-6. SWEEP OUTPUT.

1-7. For added versatility, the 3312A has a built-in sweep generator which can be used to sweep the frequency of the main generator. The frequency of the main generator can be swept as much as 100:1 on any range.

## 1-8. OUTPUT LEVEL.

1-9. The output voltage of the 3312A can be varied from 0 V to 10 V peak-to-peak into 50 ohms in four voltage ranges. A front panel control permits continuous adjustment within each voltage range. The dc level of the main generator output can be adjusted within the range of  $\pm 10$  volts using the front panel offset control. With the OFFSET in the CAL position the dc offset is eliminated.

## 1-10. BURST.

1-11. The burst is either a single pulse or a series of pulses which are rear panel selectable by a slide switch labeled SINGLE and MULTIPLE. The TRIGGER PHASE control adjusts the phase of the signal. FREE RUN disables the burst.

## 1-12. SYMMETRY.

1-13. The main and the modulation generators have separate front panel symmetry adjustments which will vary the symmetry of the output waveforms. The CAL position of each SYM knob will produce symmetrical waveforms. In the SWEEP mode, the SYM adjusts the sweep rate, and CAL selects a 90:10 ramp.

## 1-14. SPECIFICATIONS.

1-15. Table 1-1 is a complete list of the Model 3312A critical specifications. These specifications are the performance standards or limits against which the instrument can be tested. Table 1-2 lists some supplemental performance characteristics which are not specifications, but are typical characteristics included as additional information for the user.

1-16. Any changes in specifications due to manufacturing, design or traceability to the U.S. National Bureau of Standards are included in Table 1-1 of this manual. Specifications listed in this manual supersede all previous specifications for the Model 3312A.

## 1-17. INSTRUMENT AND MANUAL IDENTIFICATION.

1-18. The instrument serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix. A letter between the suffix and prefix identifies the country in which the instrument was manufactured (A = USA, G = West Germany, J = Japan, U = United Kingdom). All correspondence with Hewlett-Packard should include the complete serial number.

1-19. If the serial number of your instrument is lower than the one on the title page of this manual, refer to Section VIII for backdating information that will adapt this manual to your instrument.

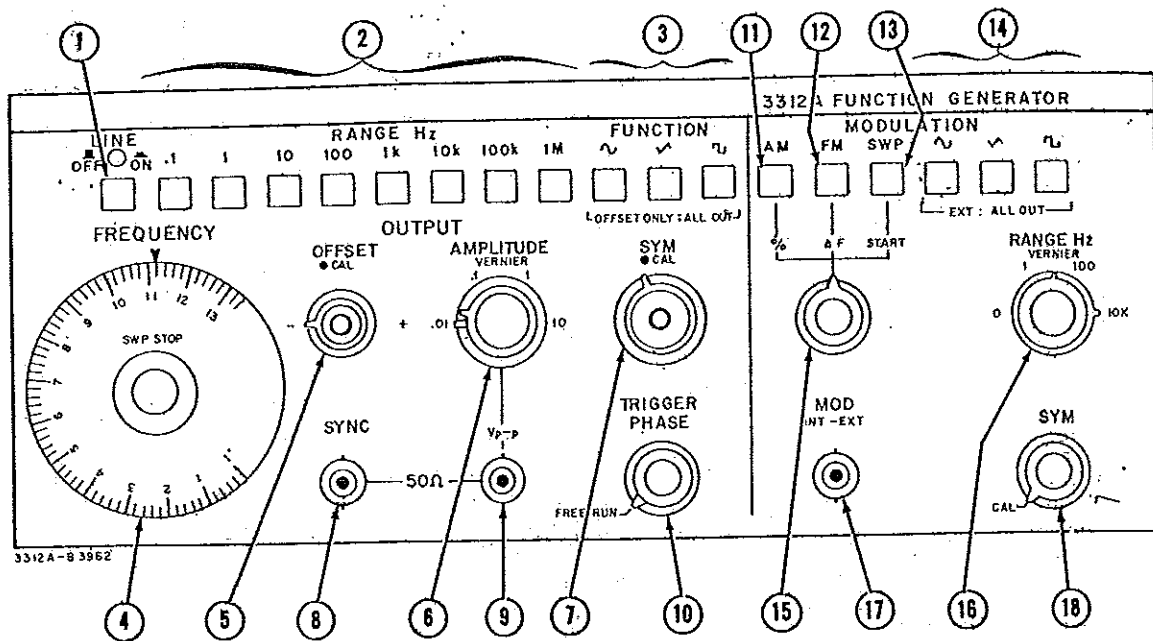
DÉPARTEMENT DES SCIENCES DE LA MATIÈRE  
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Table 1-1. Specifications.

<p><b>MODULATION CHARACTERISTICS.</b></p> <p><b>Internal Modulation Source</b>  Output Level: &gt; 1.0 V p-p into 10 k<math>\Omega</math>.  Spectral Purity: Sine Wave Distortion: &lt; 2% THD from 10 Hz to 10 kHz.</p> <p><b>Amplitude Modulation</b>  Carrier 3 dB Bandwidth: &lt; 100 Hz to &gt; 5 MHz.  Carrier Envelope Distortion: &lt; 2% at 70% sine wave modulation with <math>f_c = 1</math> MHz, <math>f_m = 1</math> kHz.  External Sensitivity: &lt; 10 V p-p for 100% modulation.</p> <p><b>Frequency Modulation: <math>\pm 5\%</math>.</b>  Deviation: 0 to 5% (internal).  Modulation Frequency:  Internal: 0.01 Hz to 10 kHz.  External: DC to &gt; 50 kHz.  Distortion: &lt; -35 dB at <math>f_c = 10</math> MHz, <math>f_m = 1</math> kHz, 10% modulation.</p> <p><b>Sweep</b>  Ramp Linearity Error: &lt; 1% at 100 Hz.</p> <p><b>EXTERNAL FREQUENCY CONTROL.</b></p> <p>Input Requirement: With dial set to 10, 0 to -2 V <math>\pm 20\%</math> will linearly decrease frequency &gt; 1000:1. An ac voltage will FM the frequency about a dial setting with the limits (1 &lt; f &lt; 10)</p>	<p>x range setting.  Linearity: Ratio of output frequency to input voltage <math>\frac{\Delta f}{\Delta V}</math> will be linear within 0.5% over a 100:1 frequency range.</p> <p><b>FREQUENCY CHARACTERISTICS.</b></p> <p>Dial Accuracy: <math>\pm 5\%</math> of full scale.  Square Wave Rise or Fall Time (10% to 90%): &lt; 18 nsec at full rated output.  Aberrations: &lt; 10%.  Triangle Linearity Error: &lt; 1% at 100 Hz.  Variable Symmetry: 80:20 to 20:80 to 1 MHz.</p> <p><b>Spectral Purity:</b>  Sine Wave Distortion: &lt; 0.5% THD from 10 Hz to 50 kHz,  &gt; 30 dB below fundamental from 50 kHz to 13 MHz.</p> <p><b>OUTPUT CHARACTERISTICS.</b></p> <p>Impedance: 50 <math>\Omega \pm 10\%</math>.  Level: 20 V p-p into open circuit, 10 V p-p into 50 <math>\Omega</math>.  Level Flatness (Sine Wave): &lt; <math>\pm 3\%</math> from 10 Hz to 100 kHz at full rated output (1 kHz reference). &lt; <math>\pm 10\%</math> from 100 kHz to 10 MHz at full rated output.  Step Attenuator Accuracy: &lt; 5%.  Sync Output: Impedance: 50 <math>\Omega \pm 10\%</math>, &gt; 1 V p-p square wave into open circuit.  Rise or Fall Time (10% to 90%): &lt; 10 nsec.  DC Offset: <math>\pm 10</math> volts.</p>
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Table 1-2. General-Information.

<p><b>MAIN GENERATOR CHARACTERISTICS.</b></p> <p><b>General:</b>  Sine, Square, triangle, ramp, and pulse.</p> <p><b>Variable Symmetry.</b>  Range is 80:20 to 20:80.</p> <p><b>Frequency Characteristics</b>  Range: 0.1 Hz to 13 MHz in 8 decade ranges.</p> <p><b>Output Characteristics</b>  Attenuator: 1:1, 10:1, 100:1, 1000:1 and &gt; 10:1 continuous control.</p> <p><b>MODULATION CHARACTERISTICS.</b></p> <p><b>General:</b>  Types: Internal AM, FM, Sweep, Trigger, Gate or Burst.  External AM, FM, Sweep, Trigger, Gate or Burst.</p> <p><b>Amplitude Modulation:</b>  Depth: 0 to 100%.  Modulation Frequency: 0.01 Hz to 10 kHz (internal),  DC to &gt; 1 MHz (external).</p>	<p><b>Frequency Modulation:</b>  Modulation Frequency: 0.01 Hz to 10 kHz (internal).  DC to &gt; 50 kHz (external).</p> <p><b>Sweep Characteristics</b>  Sweep Width: &lt; Range: 100:1 on any range.  Sweep Rate: 90:10 ramp, (0 Hz provides manual setting of "Sweep Start" without Modulation Generator oscillating).  Sweep Mode: Repetitive linear sweep between start and stop frequency settings. Retrace time can be increased with symmetry control.</p> <p><b>Gate Characteristics</b>  Frequency Range: 0.1 Hz to 1 MHz (useful to 10 MHz).  Start/Stop Phase Range: +90<math>^\circ</math> to -80<math>^\circ</math>.  Gating Signal Frequency Range (External): DC to 1 MHz.  (TTL compatible input level.)</p> <p><b>External Frequency Control</b>  Range: 1000:1 on any range.</p> <p><b>General:</b>  Operating Temperature: 0<math>^\circ</math> C to +55<math>^\circ</math> C; specifications apply from 0<math>^\circ</math> C to 40<math>^\circ</math> C.  Storage Temperature: -40<math>^\circ</math> C to +75<math>^\circ</math> C.  Power: 100/120/220/240 V <math>\pm 5\%</math>, -10%, switchable; 48 Hz to 440 Hz; <math>\leq 25</math> VA.</p>
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- ① **LINE:** switch applies or removes ac power. The green LED is lit when ON.
- ② **RANGE Hz:** pushbuttons select frequency range. RANGE selection times the reading on the FREQUENCY dial determines the output frequency of the main generator.
- ③ **FUNCTION:** interlocked buttons select one of three functions. When they are all out, the dc level may be set accurately.
- ④ **FREQUENCY:** Sets the desired frequency within the range of any of the RANGE pushbuttons.
- ⑤ **OFFSET:** Sets the dc operating point of any function. CAL position removes the dc offset.  $E_{ac} + E_{dc}$  must be less than 10 V or clipping of the waveform will occur.
- ⑥ **AMPLITUDE:** Adjusts the peak-to-peak amplitude of the waveform. It is attenuated in steps of 1:1, 10:1, 100:1, 1000:1; the VERNIER adjusts from zero to maximum output volts for the particular range selected.
- ⑦ **SYM:** Varies the symmetry of output waveforms and the SYNC output. CAL is symmetrical.
- ⑧ **SYNC:** A square wave in phase with the main generator. Useful for synchronizing external instruments or driving a counter.
- ⑨ **OUTPUT:** Terminal for all main generator functions. 20 V p-p into open circuit or 10 V p-p into 50 ohms, in the 1:1 attenuator position.
- ⑩ **TRIGGER PHASE:** Sets the starting phase of the output signal in the burst mode. FREE RUN disables the burst.
- ⑪ **AM:** Selects amplitude modulation. Functional for internal or external modulation.
- ⑫ **FM:** Selects frequency modulation. Functional for internal or external modulation.
- ⑬ **SWP:** Selects sweep mode. This function overrides AM and FM.
- ⑭ **~ ∇ □ :** Select the modulating function. External modulation is possible when all buttons are out, and the modulating signal is applied to the MOD INT-EXT jack.
- ⑮ **%ΔF START:** Selects the percent of AM, the deviation in FM, or the start frequency of the SWP.
- ⑯ **RANGE Hz:** Selects one of three ranges of modulating frequencies with continuous control within each range via the VERNIER. The 0 position is used to set the start sweep frequency.
- ⑰ **MOD INT-EXT:** Input for external AM or FM. Waveforms of the modulation generator are also available at this output when internal modulation is used.
- ⑱ **SYM:** varies the symmetry of the modulation output waveform. CAL selects a 90:10 ramp for SWP and symmetrical for all other functions.

Figure 3-1. Front Panel.

## SECTION III

### OPERATING INSTRUCTIONS

#### 3-1. INTRODUCTION.

3-2. This section contains complete operating instructions for the Model 3312A Function Generator. Included is a brief description of the instrument, a description of controls and connectors, general operating information, and a basic operating procedure.

#### 3-3. DESCRIPTION.

3-4. The 3312A Function Generator combines two separate function generators in one instrument—a main generator and a modulation generator. The frequency range of the main generator is 0.1 Hz to 13 MHz in eight decade ranges. The modulation generator frequency range is 0.01 Hz to 10 kHz. Both the main generator and the modulation generator provide sine, triangle, square, pulse and ramp outputs. The symmetry of all waveforms can be varied over a range of 80:20 to 20:80 on the main generator and 90:10 to 10:90 on the modulation generator.

3-5. The main generator can be modulated or triggered by the modulation generator to provide AM, FM, sweep or burst. The main generator can also be modulated by an external source connected to the MOD connector on the modulation generator. The frequency of the main generator can be externally controlled by applying an ac or dc voltage to the VCO input.

3-6. The output attenuator has a range of more than 1000:1 so that output levels ranging from 1 mV p-p to 10 V p-p into 50 ohms can be obtained.

3-7. The 3312A has a dc offset capability which allows the dc operating point of the main generator output to be adjusted from -10 V to +10 V dc. The dc offset can be adjusted using the front panel OFFSET control or set to 0 V by pushing the associated CAL button.

#### 3-8. CONTROLS AND INDICATORS.

3-9. Figures 3-1 and 3-2 illustrate and describe the function of all front and rear panel controls, connectors and indicators. The description of each item is keyed to the drawing within the figure.

#### 3-10. GENERAL OPERATING INFORMATION.

#### 3-11. Grounding.

3-12. To protect operating personnel, the 3312A chassis must be grounded. All Hewlett-Packard instruments are equipped with a three-conductor power cord, which, when

plugged into the proper receptical, grounds the instrument. The offset pin of the power plug is the ground connection. All input and output commons are connected directly to outer chassis (frame) ground through the offset pin on the power cord.

#### WARNING

*The outer shells of all input and output BNC jacks are connected to the chassis. To protect the operator from electrical shock, DO NOT float this instrument.*

#### 3-13. Main Generator Outputs.

3-14. The main generator has two outputs, a main signal output and a sync output. The main signal output (labeled V p-p) provides the sine, square and triangle outputs. The sync output (Paragraph 3-19) provides a pulse which can be used for external timing purposes. Both outputs are BNC connectors located on the front panel of the instrument.

#### 3-15. Main Signal Output.

3-16. The output of the main generator is dc coupled to supply both ac and dc components of the output waveform. The main generator output level is 10 V p-p into 50 ohms. The SYNC output level is .25 V p-p into 50 ohms. Output impedance of both outputs is 50 ohms nominal.

3-17. Connections to this output should be made using shielded cables equipped with BNC connectors. Table 3-1 is a list of recommended -hp- cables. In order for the 3312A to meet the specifications listed in Table 1-1, the main signal output must be terminated into 50 ohms. The -hp- Model 11048C 50 ohm Feedthru Termination is recommended. Always place the termination at the load end of the transmission line.

Table 3-1. Cable Assemblies.

10502A 9" Cable Assembly
11086A 24" Cable Assembly
10519A 72" Cable Assembly

#### 3-18. SYNC Output.

3-19. The SYNC output supplies a pulse that is in phase with the main generator output signal. The leading edge and the trailing edge of the SYNC pulse occur at the zero crossing point of the output waveform. The frequency and duty cycle of this pulse vary with the main output signal.

## Section III

## 3-27. Sine Wave Output.

3-28. The Total Harmonic Distortion (THD) of the main sine wave, including spurious and harmonics, is less than 0.5% from 10 Hz to 50 kHz and greater than 30 dB below fundamental from 50 kHz to 13 MHz. The modulation sine wave distortion is less than 2% THD from 10 Hz to 10 kHz.

## 3-29. Square Wave Output.

3-30. The RMS value of a symmetrical (50% duty cycle) square waveform is equal to its peak value. The rise or fall time is less than 18 nanoseconds between the 10% and 90% points of the p-p output square wave. The aberrations, or deviations from the final settling amplitude of the square wave after overshoot, will not vary more than  $\pm 10\%$  of the final value.

## 3-31. Triangle Output.

3-32. The RMS value of the triangle waveform is 0.557 times the peak value. The triangle ramp will not deviate from a straight line any more than 1% of the total peak-to-peak value of the ramp. Non-linearity is, therefore, negligible.

## 3-33. Ramp.

3-34. A ramp output can be obtained from the main generator by selecting the triangle waveform and adjusting the symmetry control knob. The ramp output of the main generator can be varied in amplitude with the AMPLITUDE knob. The ramp output of the modulation generator has a fixed amplitude, however, the slope or retrace time can be varied with the SYM knob on the modulation generator.

## 3-35. Pulse.

3-36. A pulse with a variable amplitude from 0 V to 20 V p-p into an open circuit, is possible with the main generator. This involves selecting single cycle burst set to start at the zero point with the TRIGGER PHASE knob, and determining the pulse width with the FREQUENCY dial. The SYNC output can deliver a very fast pulse by changing the symmetry of the main generator.

## 3-37. Gate or Burst.

3-38. The usable frequency range of the burst function is from 0.1 Hz to 10 MHz. The trigger phase can be started anywhere from  $-80^\circ$  to  $+90^\circ$ . The stop will be at that point at the termination of the burst (see Figure 3-3).

## 3-39. AM.

3-40. The Main Generator output can be amplitude modulated up to 100%. The modulation frequency ranges from 0.01 Hz to 10 kHz. Any of the modulation generator's functions can be used to AM.

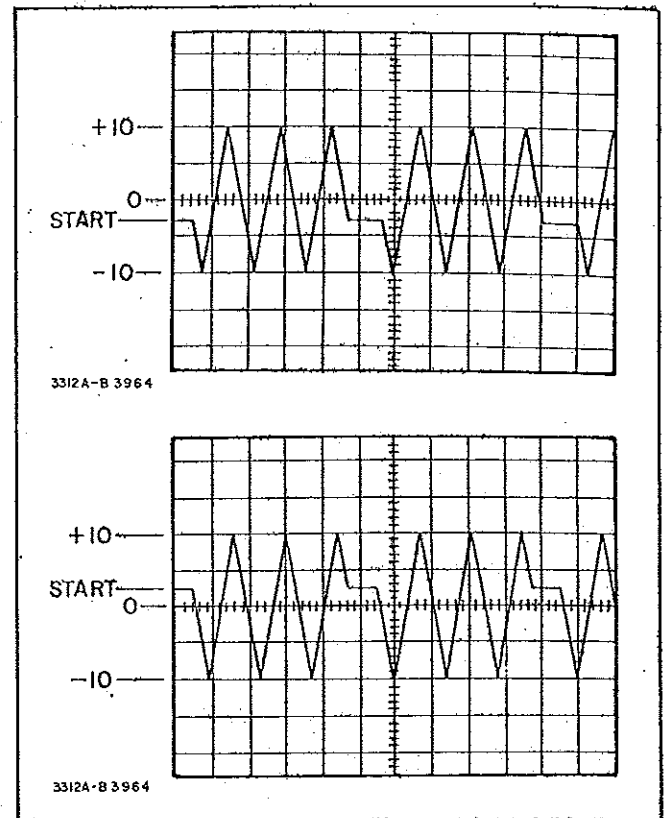


Figure 3-3. Phase Control of Burst.

## NOTE

*The 3312A is capable of > 100% modulation, i.e., the strength of the modulating signal can be greater than needed to just bring the carrier level to zero. Overmodulation may cause distortion of the modulating information.*

3-41. The extent of the amplitude variation is expressed as the percentage of modulation. The following formula defines the relationship between  $F_c$  and  $F_m$  (see Figure 3-4).

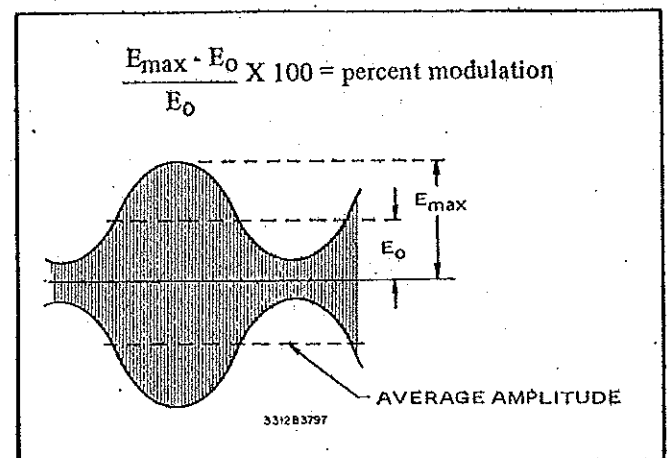


Figure 3-4. Percent Modulation.

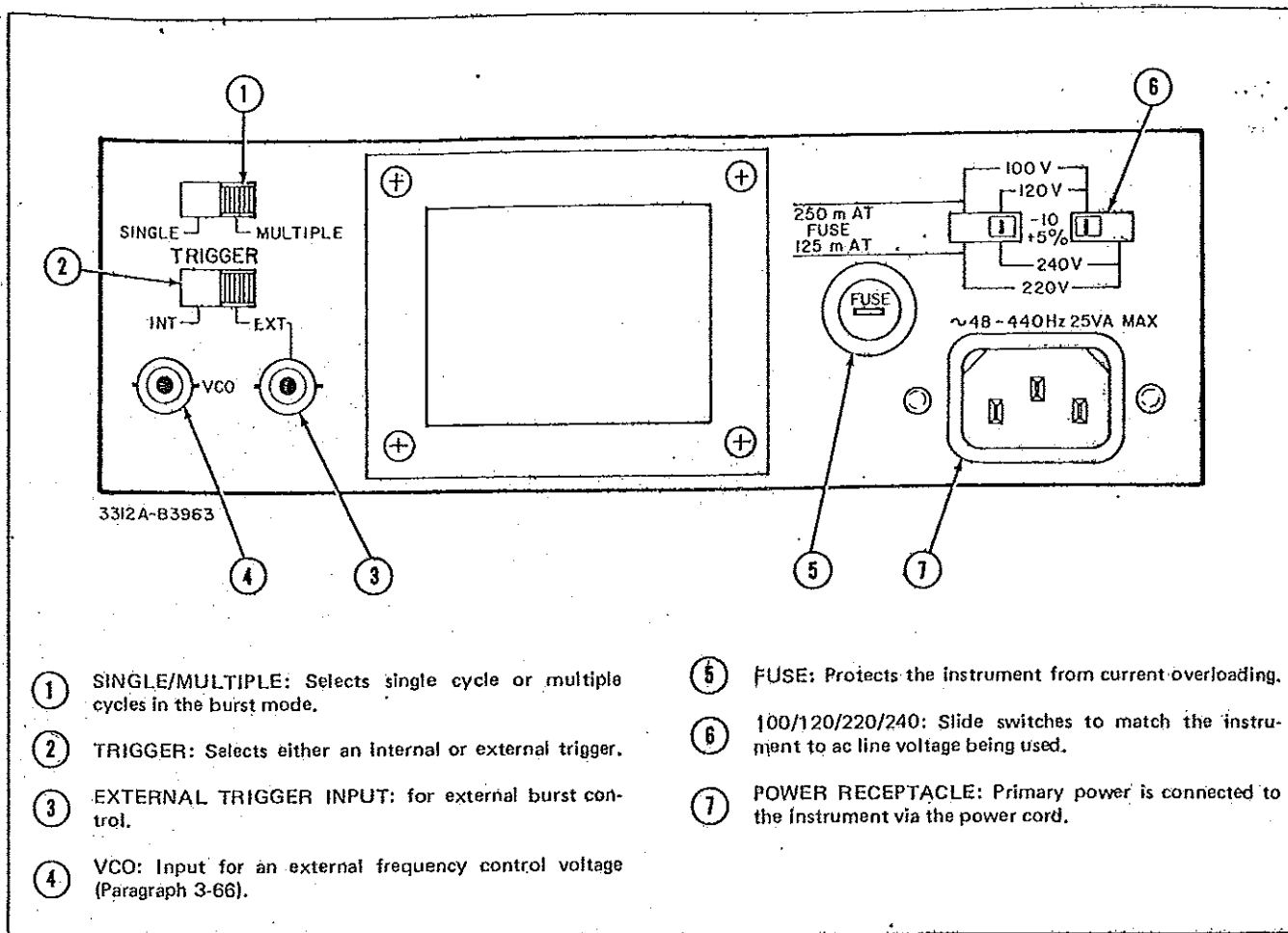


Figure 3-2. Rear Panel.

By connecting the SYNC output to the input of an appropriate frequency measuring device, the output frequency can be set with greater accuracy and resolution. The SYNC output can also be used to trigger an oscilloscope or synchronize an external oscillator.

### 3-20. Input Constraints.

3-21. The 3312A inputs and outputs are dc coupled. The maximum voltages which can be safely applied to the inputs are 10 V peak ac or  $\pm 10$  V dc. In some applications it may be necessary to connect one of the 3312A outputs to an ac or dc source node in a circuit. In these cases, the external signal level applied to the 3312A outputs must not exceed 10 V peak ac or  $\pm 10$  V dc.



*Exceeding input or output voltages of 10 V peak ac or  $\pm 10$  V dc can cause damage to the input or output circuitry of the 3312A.*

### 3-22. Modulation Generator Input/Output.

3-23. The BNC connector of the modulation generator

(labeled MOD) serves as both an input and an output. The waveforms from the internal modulation generator (sine, square or triangle) are available at the MOD connector and are useful for synchronizing an oscilloscope when using the AM, FM, or sweep modes. When none of the modulation generator's function buttons is pressed, an external modulation source can be applied through the MOD connector. Refer to Paragraph 3-46 for information concerning external operation.

3-24. The modulation generator input/output is dc coupled and the impedance is a nominal 8 kilohms. Refer to Table 3-1 for recommended cable assemblies to use with the modulation generator.

### 3-25. Output Characteristics.

3-26. The main generator and the modulation generator supply five different output waveforms.

- a. Sine
- b. Square
- c. Triangle
- d. Ramp
- e. Pulse

## Section III

## 3-58. Main Generator Operation.

3-59. The sine triangle and square waveforms, selected with interlocking pushbuttons, are available at the BNC output jack. The RANGE Hz pushbuttons and frequency dial select frequencies from 0.1 Hz to 13 MHz in eight overlapping ranges. The frequency dial scale must be multiplied by the RANGE Hz setting to obtain the frequency.

3-60. With the AMPLITUDE knob in the 10 position and no load, a 10 volt peak signal is selected. The VERNIER control adjusts the voltage from greater than 10 volts to 1 volt at that setting. In the 1 position the voltage is adjustable from 1 volt to .1 volts; in the .1 position the voltage is adjustable from .1 volts to .01 volts; and in the .01 position from .01 volts to 0.

3-61. The symmetry of any waveform can be varied with the SYM knob. The square waveform can be varied from symmetrical to a ratio of 80:20 to 20:80 up to 1 MHz.

3-62. OFFSET changes the dc level of the waveform. The CAL button eliminates dc offset. The peak ac voltage plus the dc offset should not exceed 10 V to avoid clipping of the output waveform.

## 3-63. Burst.

3-64. With the rear panel TRIGGER switch (2) set to INT, the upper slide switch (1) set to either SINGLE or MULTIPLE, and TRIGGER PHASE (10) out of the FREE RUN position, internal burst is initiated. The TRIGGER PHASE knob controls the starting and stopping phase of the output waveform. The SINGLE-MULTIPLE switch selects a single cycle or multiple cycles respectively. Pulses are obtained only when the square wave function is pushed. The pulse width is set by the main generator's FREQUENCY dial and the modulation generator's RANGE Hz knob sets the repetition rate. The TRIGGER PHASE knob in the FREE RUN position disables the burst (see Figure 3-11 for burst operation).

3-65. With the rear panel slide switch (2) set to EXT, an external burst may be applied in either single or multiple cycles. TRIGGER PHASE is still operational. The external gating signal frequency range is from dc to 1 MHz. The input voltages must be TTL compatible.

## 3-66. VCO.

3-67. A dc voltage from 0 V to -2 V applied to the rear panel VCO connector is sufficient to vary the frequency of the main generator over three decades. Since some dc power supplies induce some noise, a supply similar to the one in Figure 3-7 works well.

## 3-68. Modulation Generator Operation.

3-69. Figures 3-8 through 3-10 are operating illustrations containing step-by-step operating procedures indexed to the

illustrations. The figures describe the operations to be accomplished in achieving the different modes of operation.

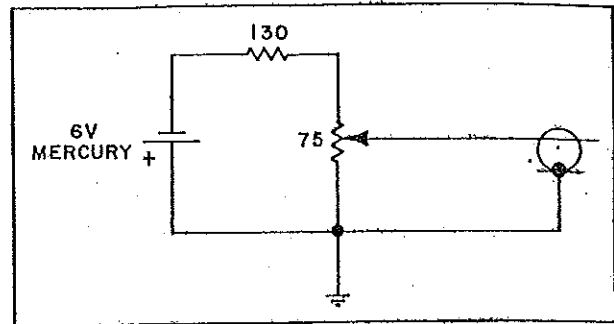


Figure 3-7. External VCO.

3-70. The operating procedure must be performed in the sequence given, as succeeding steps may depend on control settings and results of previous steps. In all cases, it is assumed that the main generator is set to the frequency and amplitude desired and that all modulation generator function pushbuttons are in the OUT position.

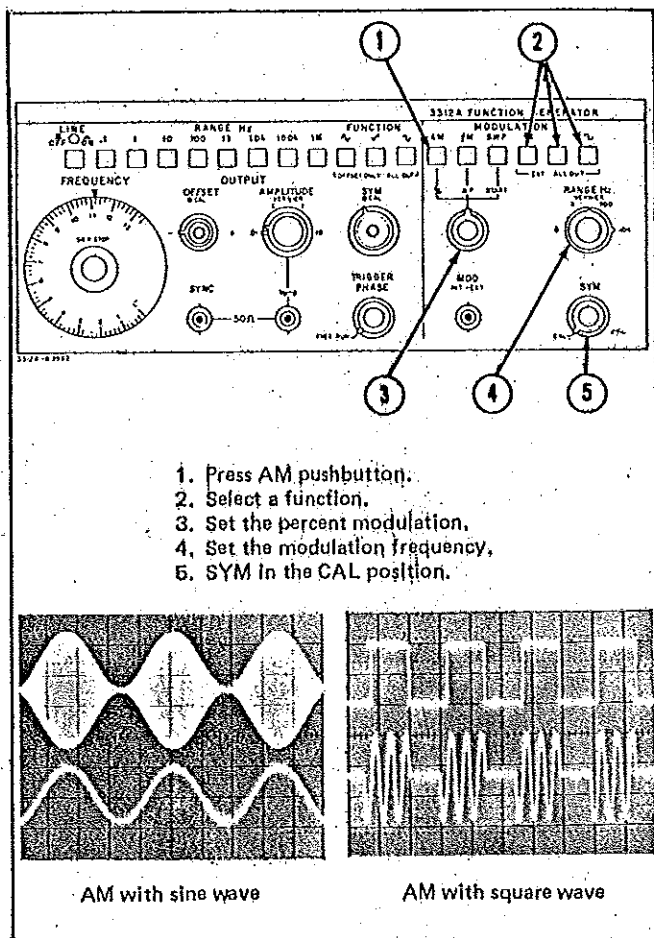


Figure 3-8. AM Operation.

Model 3312A

**3-42. FM.**

3-43. The frequency of the main generator can be varied up to  $\pm 5\%$  by the modulation generator. The modulation frequency can be set from 0.01 Hz to 10 kHz, and any of the modulation waveforms can be used to FM.

**3-44. SWP.**

3-45. When the SWP button is pressed, the modulation generator produces a linear ramp which sweeps the frequency of the main generator. With the RANGE Hz knob in the 0 Hz position, the "Sweep Start" frequency can be set. The stop frequency, or the frequency at which the sweep terminates, is set with the main frequency dial. The rate of sweep is governed by the SYM knob.

**3-46. External Control.**

3-47. The front panel MOD INT-EXT input/output connector is to be used for external amplitude modulating or frequency modulating the main generator. For AM operation, an external input of less than 10 V p-p will give 100% modulation. For FM operation, the external frequency may be varied from dc to greater than 50 kHz. The AM and FM pushbuttons must still be used.

3-48. The frequency of the main generator can be tuned remotely by applying 0 V to -2 V dc to the VCO connector on the rear panel. With the dial set to 10, any range can be varied over the entire dial range within the limit set by the range pushbuttons. Frequency modulation can also be accomplished by applying an ac voltage to the VCO terminal. Simultaneous AM and FM is possible with the VCO input used to vary frequency and the MOD input used for the AM signal.

**3-49. Frequency.**

3-50. The frequency range of the main generator is 0.1 Hz to 13 MHz in eight overlapping ranges. The dial accuracy is  $\pm 5\%$  of full scale which means that the greatest accuracy will be obtained at the high end of the dial. For instance, if the dial were set to "1" on the 1 kHz range, the output frequency would be 1 kHz  $\pm 50$  Hz. If, on the other hand, the dial were set to "10" on the 100 Hz range, the output frequency would be 1 kHz  $\pm 5$  Hz.

3-51. The frequency range of the modulation generator is 0.01 Hz to 10 kHz. The RANGE Hz knob selects the upper frequency limit and the VERNIER is used to select frequencies within the selected range.

**3-52. Amplitude.**

3-53. The amplitude of the main generator can be adjusted from 0 to 20 V p-p into an open circuit or from 0 to 10 V p-p into 50 ohms. Amplitude of the modulation generator is fixed at 1 V p-p into an open circuit, except in AM operation (Paragraph 3-40).

**3-54. BASIC OPERATING PROCEDURES.****3-55. Instrument Turn-On.**

- Check the line voltage at the point of installation.
- Refer to Figure 3-5. Set the rear panel Line Selector switches to the setting that corresponds with the line voltage to be used. Line voltage must be within -10% to +5% of the selected voltage setting. Line frequency must be within the range of 48 Hz to 440 Hz.

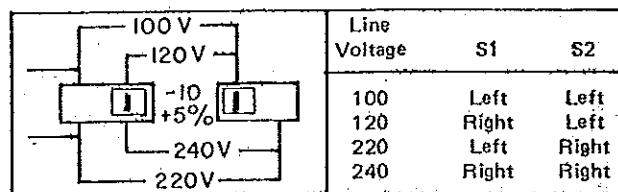


Figure 3-5. Line Selector Switches.

- Verify that the proper fuse is installed in the rear panel fuse holder.

Line Setting	Fuse Type	-hp- Part No.
100 V/120 V	.25 A 250 V Slo Blow	2110-0201
220 V/240 V	.125 V 250 V Slo Blow	2110-0318

- Connect the detachable ac power cord to the rear panel power receptacle.

- Set the LINE switch to the ON position. The green light will illuminate.

**3-56. Fuse Replacement.**

3-57. The main ac line fuse is located on the rear panel next to the line power receptacle. Remove the line power cord before attempting to remove the fuse. Figure 3-6 shows how to replace the fuse.

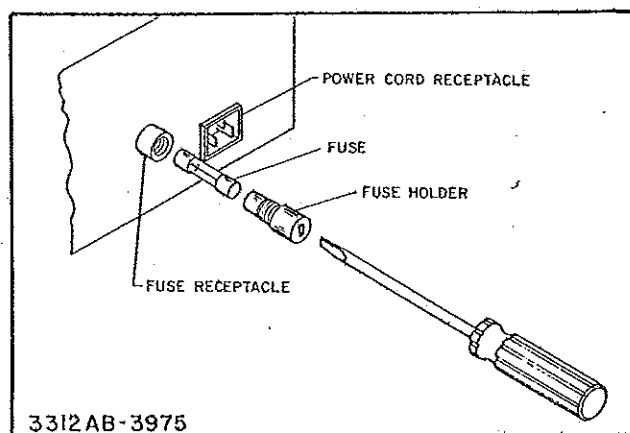


Figure 3-6. Fuse Replacement.



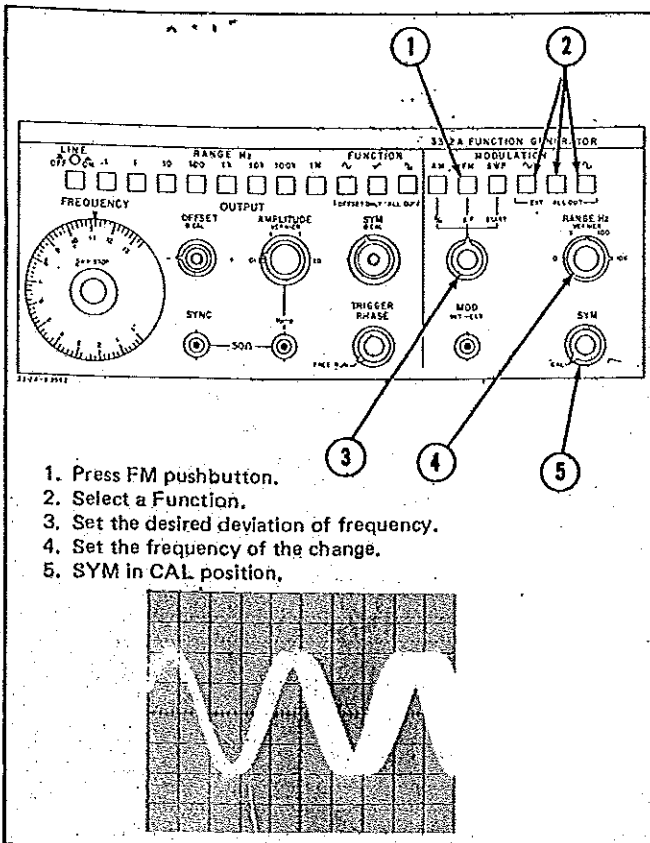


Figure 3-9. FM Operation.

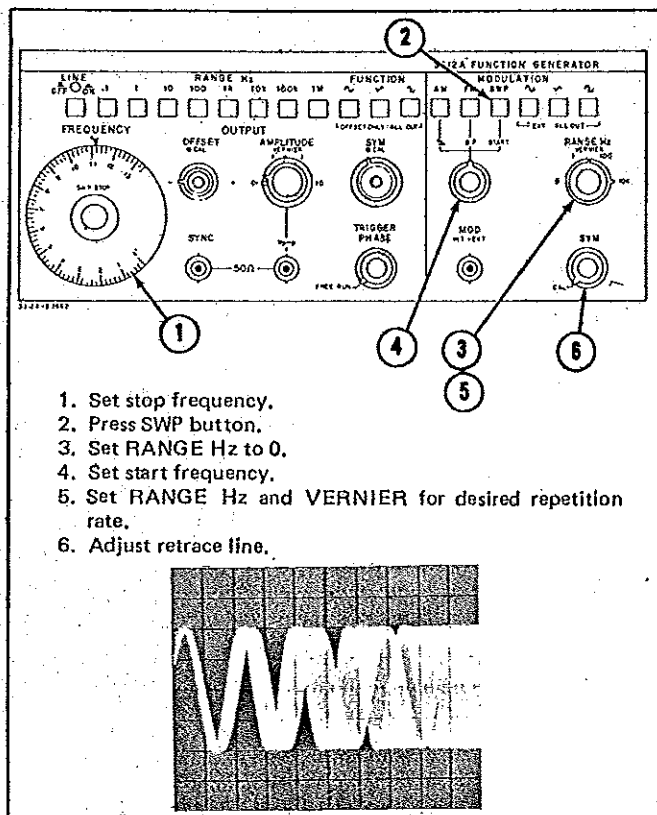
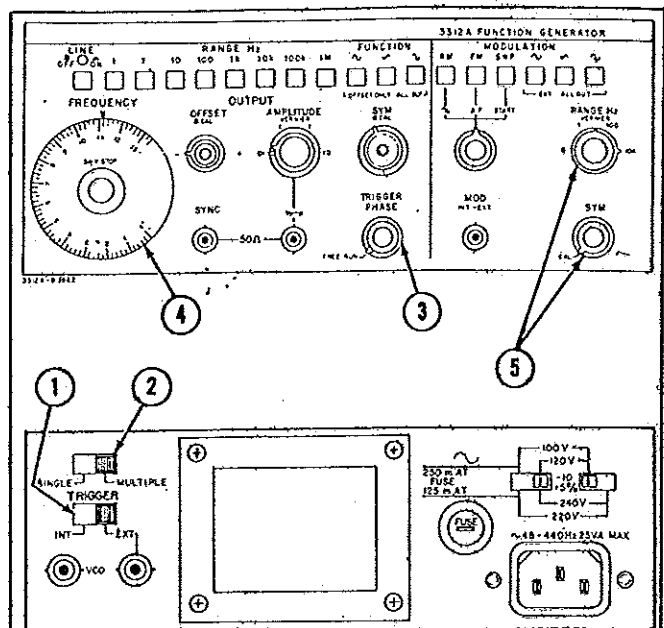
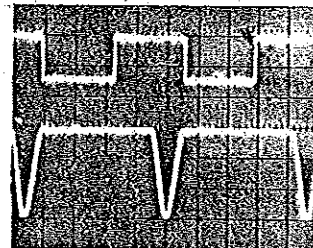


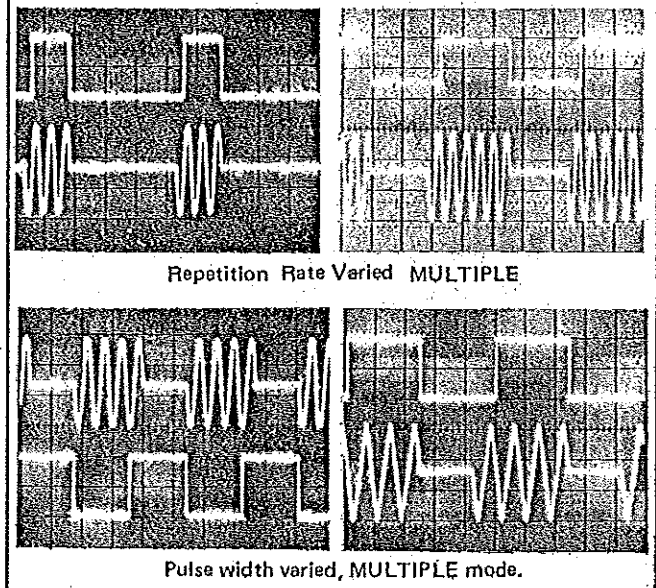
Figure 3-10. Sweep Operation.



NOTE The phase of the square function is unaffected by TRIGGER PHASE.



TRIGGER PHASE fully CW, SINGLE mode.



Repetition Rate Varied MULTIPLE

Pulse width varied, MULTIPLE mode.

Figure 3-11. Burst Operation.