

DIGITAL
FUNCTION GENERATOR
FG-2102AD

Operation
Manual

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1. SPECIFICATIONS

- A) Basic Outputs: Since Wave, Triangle Wave, Square Wave, TTL Pulse, and CMOS PULSE.
- B) FREQUENCY RANGE: 0.2Hz to 2MHz (7 ranges). Four digit frequency counter display.
- C) Frequency Control: Separate coarse and fine tuning controls.
- D) Maximum Amplitude: 20Vp-p (open circuit).
10Vp-p (into 50 ohm load).
- E) Amplitude Control: Continuously variable, 20dB range typical.
- F) Attenuator: -20dB+1dB.
- G) Output Impedance: 50 ohm+6%
- H) DC Offset: Continuously variable, from -10V to +10V (open circuit), -5V to +5V into 50 ohm.
- I) Duty Cycle Control: Continuously variable from 1:1 to 10:1.
- J) Since Wave Function:

Distortion: 0.2Hz to 20KHz; 1%
20KHz to 200KHz; 2%
Frequency Response: 0.2Hz to 100KHz, 0.2dB,
100KHz to 2MHz; 1dB.

K) Square Wave Function:

Symmetry: 0.2Hz to 100KHz; 2%.
Rise Time: 120ns.

L) Triangle Wave Linearity: 0.2Hz to 100KHz; 98%,
100KHz to 2MHz; 95%.

M) TTL Output:

Level: 3Vp-p.
Rise Time: 30ns.

N) COMS Output:

Level: Continuously adjustable from 4Vp-p (± 1 Vp-p) to 14.5 Vp-p
(± 0.5 Vp-p).

O) Rise Time: 120ns.

P) VCF (Voltage Controlled Frequency) Input:

Input Voltage: Approximately +10V (± 1 V) causes 10:1 frequency
change.

Impedance: Approximately 10kohm.

Q) Frequency Counter (Internal Only):

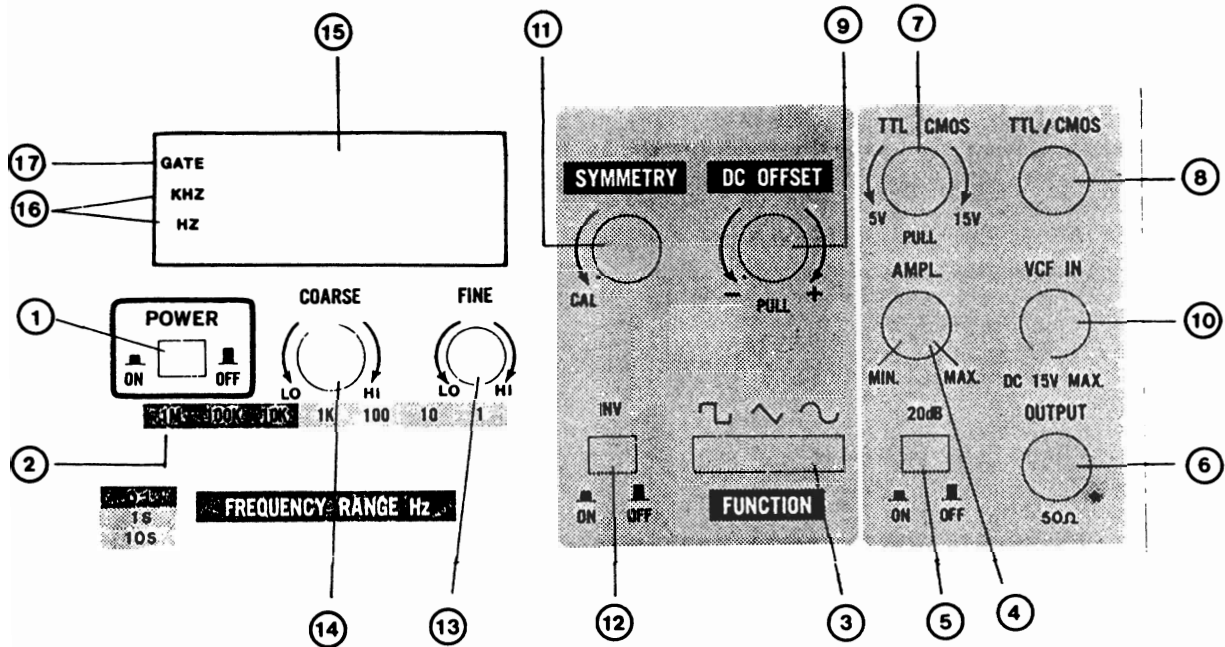
Accuracy: +Time Base Accuracy +1 Count.

Time Base Accuracy: ± 10 ppm ($23^{\circ}\text{C} \pm 5^{\circ}\text{C}$).

R) Power Source: 120/220/240V AC $\pm 10\%$, 50/60Hz.

Remarks: AH specifications apply with coarse frequency dial between 0.2 and 2 times range.

CONTROLS AND INDICATORS



2. PANEL CONTROLS

- 1) PWR Switch. Turns power on and off.
- 2) Range Selectors. Selects frequency range. Decade frequency type, seven ranges from 1Hz to 1MHz. Frequency can be adjusted from 0.2 to 2 times the range selected. For example, if the 100K range is selected, frequency can be adjusted (see Frequency Control) from 20KHz to 200KHz. Numbers under pushbuttons indicate gate time (see GATE LED).
- 3) Function. Selects square, triangle, or sine waveform at OUTPUT jack.
- 4) AMPL Control. Controls amplitude of signal at OUTPUT jack.
- 5) ATTENUATOR 20dB. Push in "ON" attenuated -20dB and pull out "OFF" release attenuated +20dB.
- 6) output jack. Waveform selected by FUNCTION switches as well as the superimposed DC OFFSET voltage is available at this jack.
- 7) TTL/CMOS. When control is pushed in, a TTL signal is present at the TTL/CMOS jack. Level is fixed at 3Vp-p and turning control has no effect. When the control is pulled out (PULL COMS), a CMOS signal is present at the TTL/CMOS jack. Turning the control clockwise increases the amplitude and turning the control counterclockwise decreases amplitude (amplitude is adjustable from approximately 4Vp-p to 14.5Vp-p).
- 8) TTL/CMOS Jack. Square wave selected by TTL/CMOS control (either TTL or

CMOS) is available at this jack. The output is independent of the AMPL and OFFSET controls.

- 9) OFFSET Control. When control is pushed in, DC offset is set at zero. When control is pulled out (PULL ADJ), clockwise rotation changes DC offset in a positive direction and counterclockwise rotation changes DC offset in a negative direction. Full clockwise rotation gives approximately +5V into 50 ohm load (+10V open circuited). Full counterclockwise rotation gives approximately -5V into 50 ohm load (-10V open circuit).
- 10) VCF IN Jack. Voltage Controlled Frequency input. Permits external sweep or frequency control. Positive voltage decreases the output frequency.
- 11) SYMMETRY. Rotation adjusts the duty cycle of both the main OUTPUT signal and the TTL/CMOS signal. Fully counterclockwise rotation is the CAL position (normal duty cycle). Duty cycle changes when control is rotated away from CAL position.
- 12) INV (INVERT) Switch: Push in "ON" the square wave at the main output and the TTL or CMOS signal are inverted. Pull out "OFF" is released INVERT function.
- 13) FINE Frequency Control. Coarse adjustment of output frequency for ease of setting to a precise frequency.

- 14) COARSE Frequency Control. Coarse adjustment of output frequency (main output and TTL/CMOS output) from 0.2 to 2 times the selected range.
- 15) FREQUENCY Counter Display. Display frequency of internally generated frequency.
- 16) Hz and KHz LED. Indicates whether display is showing Hz or KHz.
- 17) GATE LED. Indicates when frequency counter display is updated. When the 10K through 1M frequency switches are selected, the LED will flash 10 times per second (every 0.1 second). When the 10 through 1K switches are selected, the LED will flash once each second and when the 1 switch is selected. As the LED turns off, the display is updated.

3. OPERATION

A) FREQUENCY AND WAVEFORM SELECTION

- a. With the unit plugged into a power source, depress the PWR switch.
- b. Select the desired frequency range by depressing the appropriate range switch. The output frequency is displayed, with the appropriate decimal point, on the LED display. The Hz or KHz indicator is also lit.
- c. Rotation of the COARSE frequency control will quickly set the output frequency to the approximate desired value. The FINE frequency control should then be used to easily set the output to the specific desired value. The frequency selected is available at both the TTL/CMOS jack

and the OUTPUT jack.

- d. Select the waveform desired (square, triangle, or sine) by depressing the appropriate FUNCTION switch. The phase relationships of the waveforms available are shown in Fig. 1. Be sure that the DUTY control is set to CAL.

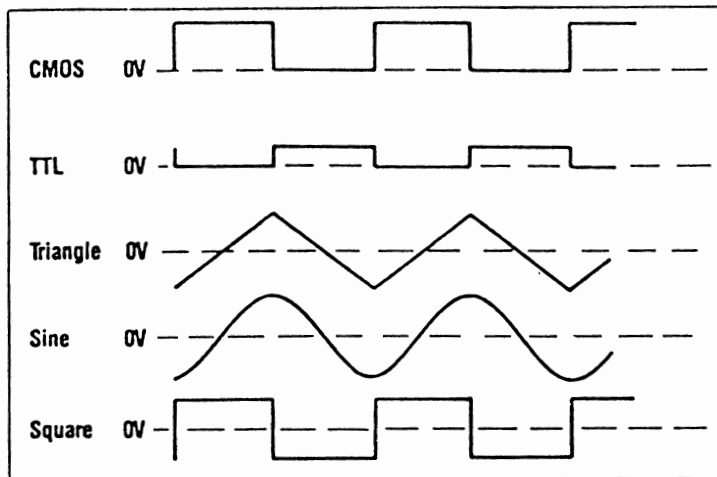


Fig. 1. Output Waveform And Phase Relationship.

- e. The amplitude fo the selected output signal at the main OUTPUT jack is adjusted with the AMPL control. Maximum signal level is 10V_{p-p} (into 50 ohm), and signal level can be decreased by turning the control counterclockwise.
- f. For information on the TTL and CMOS signals, see the "TTL/CMOS OUTPUT" section of this manual.
- g. A DC component can be added to the signal at the main OUTPUT jack by use of the OFFSET control. The DC component introduced is independent of the AMPL control and does not apply to the TTL/CMOS jack. The level of DC can be varied by +10 volts open circuited or +5 volts into 50 ohm.

B) CONSIDERATIONS

- a. The COARSE frequency control adjusts from approximately two-tenths to two times the indicated range value. For example, if the 10K range is selected and the COARSE frequency control is set to the most counter-clockwise major line, the output frequency is approximately 2KHz. When the COARSE frequency control is set to the most clockwise major line, the output frequency is approximately 20KHz.
- b. It is best not to set the COARSE frequency control beyond either the 0.2 or position. Instead, select the next lower or higher range. When thke COARSE control is set to such a position, erratic operation could occur.
- c. It is advisable to set the FINE frequency control to the approximately

center of its range before setting the control will not reach its limit of rotation while trying to finalize the frequency setting.

- d. The FINE frequency control spans about 10% of the range. This gives a fine tuning capability so that it is easy to set the frequency to a precise value.
- e. When the 1Hz range is selected, the gate time is 10 seconds. This means that the display is updated once every 10 seconds, and that the resolution is 0.1 second. However, the result of a frequency change may not be displayed until 10 seconds later. Keep adjusting the frequency in progressively smaller steps and waiting for the display update until the desired frequency is obtained.
- f. When using the higher output frequencies and when using the square wave output, terminate the cable into 50 ohm to minimize ringing. Also, keep cables as short as possible.
- g. Remember that the output signal swing of the generator is limited to ± 10 volts open circuited or ± 5 volts into 50 ohm. This applies to the combined signal and DC offset. Clipping occurs slightly above these levels. Fig. 2, illustrates the various operating conditions encountered when using the DC offset. If the desired output signal is large or a large DC offset is required, an oscilloscope should be used to make sure that the desired combination is obtained without undesirable clipping.

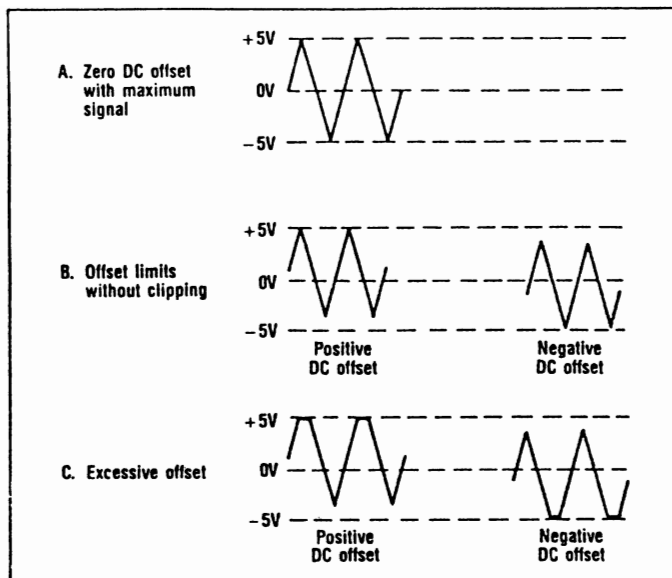


Fig. 2. Use of DC OFF Control.

C) VOLTAGE CONTROLLED FREQUENCY OPERATION

The Model FG-2102AD can be operated as a voltage-controlled oscillator (VCO) by using an external control voltage applied to the VCF IN jack. The externally applied voltage will vary the frequency which is pre-selected by the range switches and the frequency control controls.

Applying approximately +10V will cause the frequency to decrease by about 10 times (a 10:1 ratio).

CAUTION

Do not apply more than ±15 volts (dc or dc + ac peak) to the VCF IN jack. Inputs of more than 15 volts will not cause any further shift in the frequency and could cause damage to the Function Generator.

- a. Select the desired frequency range and function.
- b. Set the DC offset, if required.
- c. Set the starting frequency and amplitude to the desired level.

NOTE

Keep the (starting) COARSE frequency control between the 0.2 and 2 positions (see Fig. 3).

- d. To operate the function generator as a sweep generator, apply a positive going ramp signal to the VCF IN jack. As the voltage increases, the frequency decreases. A ramp that goes from 0 to +10 V will cause the frequency to decrease by a factor of 10 (i.e., if the starting frequency is 10KHz, when the ramp reaches +10V, the output frequency will be 1KHz). The rate of sweep can be adjusted by varying the frequency of the ramp signal.

- e. Specific frequencies can be selected by applying a fixed dc voltage to the VCF IN jack or the frequencies can be stepped by applying a stepped dc voltage.

D) TTL/CMOS OUTPUT

The TTL/CMOS output jack provides a fast rise time square wave output (no triangle or sine output available). Either a fixed 3Vp-p TTL or a variable (approximately 4Vp-p to 14.5Vp-p) CMOS output are available. The output pulses always go positive with respect to ground. This signal can be used as an external sync pulse for oscilloscopes or as a variable frequency signal source for exercising logic circuits.

NOTE

Because of the fast rise time of this output, cable length should be minimized to limit ringing and overshoot.

- a. Select the desired frequency range and adjust the frequency controls as required. The AMPL and OFFSET controls have no effect on the signal at the TTL/CMOS jack.
 - b. Select a TTL signal by pushing in the TTL/CMOS control. Select a CMOS signal by pulling out the TTL/CMOS control (PULL CMOS) and adjust the level of the CMOS signal by rotating the control (the TTL level is fixed)
- #### E) DUTY CYCLE CONTROL

The Model FG-2102AD Function Generator has a variable duty cycle control

to provide ramps (sawtooth) or pulses. The duty cycle control affects both the main OUTPUT and the TTL/CMOS output. If a standard square, triangle, or sine waveform are desired (normal duty cycle) the DUTY control should be set to CAL (fully counterclockwise). Fig. 3, illustrates the function of the DUTY control.

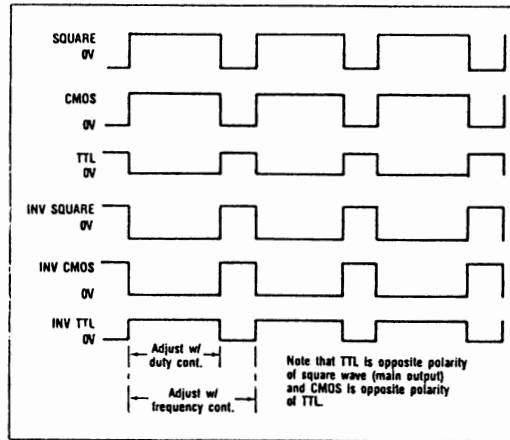


Fig. 3. Effect Of DUTY Control On Square Wave, TTL, and CMOS Signal.

NOTE

As the DUTY cycle is changed, the frequency will decrease. Be sure to set the desired frequency after the DUTY cycle has been adjusted.

- a. Select the desired function (either square or triangle wave if the main

OUTPUT is to be used or TTL or CMOS if the TTL/CMOS output is to be used) and frequency range.

- b. Adjust the amplitude and DC offset if the main OUTPUT is to be used or adjust the CMOS level if a CMOS signal is to be used (the TTL has a fixed level).
- c. Adjust the DUTY control so that the desired duty cycle is obtained (display on an oscilloscope for set-up if desired).
- d. Adjust the frequency of the signal using the COARSE and FINE frequency controls. The DUTY control can be pulled out to cause a negative going pulse (PULL INV) at either the main OUTPUT jack (for square wave only) or the TTL/CMOS jack (the triangle and sine wave cannot be inverted).

