Model 1200A

Linear Sweep/Function Generator
0.2Hz to 3MHz

Serial No. _____

Operating Manual

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Figure 1. Model 1200A Linear Sweep/Function Generator

Section 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

The Krohn-Hite Model 1200A, illustrated in Figure 1, combines a function generator and ramp generator in one instrument. An exclusive feature of the 1200A is WAVEGUARDä, a unique output protection circuit that protects the generator's MAIN (HI) OUTPUT from damage, if a voltage is accidentally placed across the output terminals. The WAVEGUARD circuit recovers automatically when the external voltage is removed.

The main generator provides sine, triangle and square waveforms from 0.2Hz to 3MHz. Frequency is controlled by the tuning dial, calibrated in Hertz from .2 to 30 (1500:1) plus a 3 band, decade multiplier. A fine-tune vernier provides ±2.5% adjustment of the dial setting. Frequency may be also controlled externally by an AC or DC voltage applied to the external voltage control (VC) input.

The auxiliary ramp generator amplitude is continuously adjustable from 5mV p-p to 20 volts p-p, open-circuit. Output impedance is a constant 50 ohms. A simultaneous LO (-20dB) output is also provided.

Additional features include: ±10V variable DC offset, auxiliary TTL output and a calibrated CV (control voltage) output, proportional to the main generator frequency.

A Rack-Mounting Kit, part No. RK-39, is also available.

The generator is carefully inspected, aged and adjusted before shipment, and should ready for operation when it is unpacked. If it appears to have been damaged in shipment, file a claim with the freight carrier, and notify Krohn-Hite or its nearest sales office immediately.

1.2 SPECIFICATIONS

1.2.1 Waveforms

Sine, triangle, TTL, ramp.

1.2.2 Frequency Range

0.2Hz to 3MHz.

1.2.3 Frequency Control

Single turn dial calibrated logarithmically from 0.2 to 300 in Hertz, and a 3 position multiplier providing a 1500:1 coverage in each multiplier position. Separate fine-tune vernier provides 5% adjustment.

BAND	MULTIPLIER	FREQUENCY RANGE (Hz)
1	1	0.2 – 300
2	100	20 – 30k
3	10K	2k – 3M

1.2.4 Frequency Accuracy

±5% at three dial calibration settings of 10, 100 and 300; ±20% maximum at other settings.

1.2.5 Main Output

1.2.5.1 Waveforms

Sine, square, triangle.

1.2.5.2 Output

HI LEVEL (0dB): 20 volts p-p open-circuit, 10 volts p-p across 50 ohms.

LO LEVEL (-20dB): 20 volts p-p open-circuit, 1 volt p-p across 50 ohms.

1.2.5.3 Isolation

Can be floated up to ±200 volts peak between output and instrument case.

1.2.5.4 Amplitude Stability (Maximum Amplitude)

10 minutes, 0.02%; 24 hours, 0.1%

1.2.5.5 Amplitude Control

Infinite resolution vernier. Minimum output less than 5 millivolts.

1.2.5.6 Frequency Response

Sine wave, less than 0.1dB from 0.2Hz to 300kHz; 1.0dB to 3MHz.

1.2.5.7 Sine Wave Distortion

Less than 0.5% from 2Hz to 300kHz; 3% to 3MHz.

1.2.5.8 Square Wave

Rise and fall time, less than 40ns; tal abberations less than 5% with 50 ohm termination.

1.2.5.9 DC Components

All waveforms are normally symmetrical about ground with nominal zero DC volts. At maximum output, drift is less than 5 millivolts per degree C.

1.2.5.10 Triangle Linearity

Greater than 99% from 0.2Hz to 300kHz; 95% to 3MHz.

1.2.5.11 Time Symmetry

Sine, square, tirangle 99% from 0.2Hz to 300kHz.

1.2.6 Operational Modes

Continuous or linear sweep.

1.2.7 Sweep Characteristics

1.2.7.1 Sweep Range:

Maximum 1500:1 up or down; upper and lower limits set by tuning dial and START FREQUENCY control.

1.2.7.2 Sweep Duration

1000s – 1ms in two ranges; 1000s – 1s, 1s – 1ms.

1.2.7.3 Ramp Output

+5V peak sawtooth, frequency adjustable with DURATION control, .002Hz – 1kHz. Ramp retrace, less than 75ms. Output impedance, constant 600 ohms.

1.2.8 External Frequency Control (VC)

1.2.8.1 Range

1500:1.

1.2.8.2 Voltage Control Range

Zero to ±3volts. (A maximum of ±25 volts may be applied to the VC input without damage to the circuitry).

1.2.8.3 Input Impedance

10k ohms.

1.2.9 Variable DC Offset

±10 volts open-circuit, ±5 volts across 50 ohms. Push-button ON-OFF Control with separate vernier. (Reduced by –20dB on LO output).

1.2.10 TTL Output

TTL pulse at generator fre quency, drives up to 10 TTL loads; rise and fall times less than 15ns.

1.2.11 Control Voltage (CV) Output

+2mV to 3 volts, proportional generatorfrequency.
Ac cu racy, better than 5%. Out put im ped ance, 600 ohms.

1.2.12 Operating Ambient Temperature Range

-10°C to 45°C.

1.2.13 Controls

Front panel contains FREQUENCY dial, frequency VER Nier, START FRE Quency, DU RA TION, AM PLI TUDE, DC OFF SET and push-but ton con trols for fre quency range MUL Ti plier, MAIN OUT-put wave form se lec tor, SWP on, sweep range mul ti plier, and POWER switch. Rear panel con tains LINE switches, SYMmetry ADJust, DC LEVEL AD Just ment and GROUND switch.

1.2.14 Terminals

Front panel only, BNC con nec tors for HI and LO out puts, TTL out put, CV out put, RAMP out put, and VC input.

1.2.15 Power Requirements

Switch selectable, 90-110, 108-132, 180-220, or 216-264 volts, sin gle phase, 50-400Hz, 13 watts.

1.2.16 Dimensions and Weights

Cabinet Size/Weight	H	W	D	Net	Gross
U.S.	3-1/2”	9”	8-1/2”	5 lb.	7 lb.
Metric	9cm	23cm	21.7cm	2.3kg	3.2kg

1.2.17 Optional Rack Mounting Kit (see Figure 2)

Part No. RK-39; permits installation of the Model 1200A into a standard, 19” rack spacing.

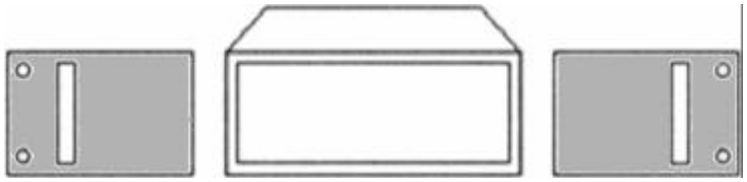

Figure 2. Optional Rack Mounting Kit

Specifications apply at 25°C, ±5°C at maximum output voltage, and dial set between 2 and 300, unless otherwise noted.

Specifications subject to change without notice.

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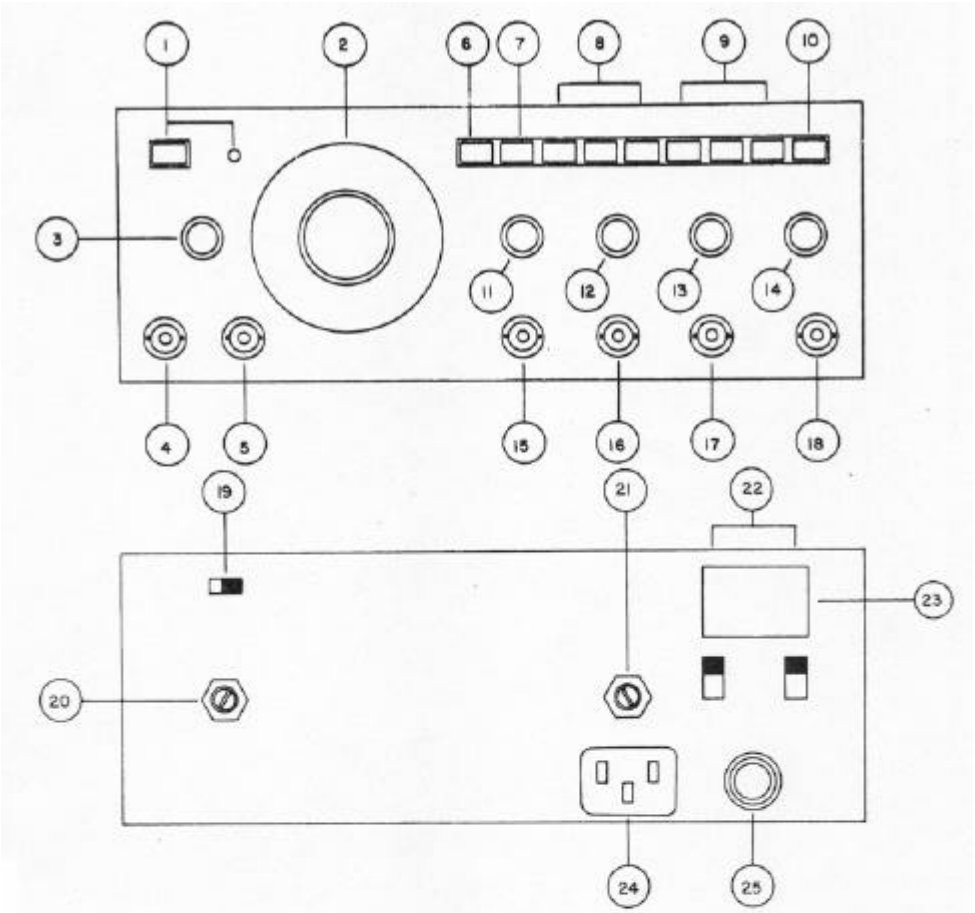
Section 2
OPERATION

2.1 POWER REQUIREMENTS

The Model 1200A is de signed to op er ate from a sin gle phase, 50-400Hz AC power source of 90-110, 108-132, 180-220 or 216-264 volts. Complementary LINE switches on the rear panel allow the 1200A to be pow ered from one of the above 4 voltage ranges. The AC power receptacle located on the rear panel, is a stan dard 3-pin con nec tor. A de tach able 3 wire line cord is pro vided with the instrument.

The fuse re cep ta cle con tains ei ther a 1/8 am pere slow blow fuse (90-132 volt op er a tion) or a 1/16 ampere slow blow fuse (180-264 volt operation).

To turn the instrument on; a) set the LINE switches for the correct AC line voltage range; b) check for or in sert the prop erly rated fuse into the fuse re cep ta cle and se cure; c) make sure the front panel POWER switch is off (out) before you connect the line cord to the AC power source; d) depress the POWER switch and allow the generator to warm up for several minutes.



1 POWER SWITCH AND INDICATOR
2 FREQUENCY Hz – STOP FREQUENCY DIAL
3 FREQUENCY VERNIER
4 VC INPUT
5 CV OUTPUT
6 SWEEP ON SELECTOR
7 SWEEP DURATION MULTIPLIER
8 FREQUENCY MUTIPLIER
9 WAVEFORM SELECTOR
10 DC OFFSET ON – SELECTOR
11 START – FREQUENCY CONTROL
12 SWEEP DURATION CONTROL
13 AMPLITUDE CONTROL
14 VARIABLE DC OFFSET CONTROL
15 TTL OUTPUT
16 RAMP OUTPUT
17 LO OUTPUT
18 HI OUTPUT
19 GROUND SWITCH
20 DC LEVEL ADJ.
21 SYMMETRY ADJ.
22 AC LINE SELECTOR SWITCHES
23 AC LINE VOLTAGE CHART
24 LINE CORD RECEPTACLE
25 LINE FUSE RECEPTACLE

Figure 3. Operating Controls and Connectors

CAUTION!

The cover of this instrument should not be removed when the instrument is connected to an AC power source, because of the potentially dangerous voltages that exist within the unit.

2.2 OPERATING CONTROLS AND CONNECTORS (see Figure 3)

2.2.1 Front Panel

2.2.1.1 Power:

Push-button ON-OFF switch and power ON indicator light.

2.2.1.2 Frequency:

Hz/STOP FREQ: Single turn dial, calibrated in Hertz from .2 to 300, with a separate, fine-tune VERNier, plus a 3 position, push-button MULTiplier switch, X1, X100 and X10K. Effective dial turning range 1500:1. The output frequency is the dial setting, in Hz, times the MULTiplier setting, with the VERNier in its (0) position. In the sweep mode of operation the DIAL and MULTiplier determine the sweep frequency STOP limit, while the START FREQ control determines the start of the sweep frequency.

2.2.1.3 SWP:

Push-button switch that converts the generator to continuous sweep operation. When the SWP button is depressed the frequency sweep will always begin at the START FREQ setting.

2.2.1.4 Start Freq:

Single turn potentiometer for adjusting the start of the frequency sweep.

2.2.1.5 Duration:

Single turn potentiometerthat determines the weep duration (rate). Sweep duration is continuously adjustable from 1000 seconds to 1 second, or 1 second to 1 millisecond.

2.2.1.6 X1K:

Push-button control that selects a sweep duration range of (duration) 1000s – 1s (depressed) or 1s – 1ms (out).

2.2.1.7 Waveform:

3 position, push-button switch for selecting sine, square and triangle output waveforms.

2.2.1.8 Amplitude:

Single turn, infinite resolution control for adjustment of he output amplitude from 5mV p-p to 20 volts p-p, open circuit.

2.2.1.9 DC Offset:

Push-button ON-OFF switch, plus sep a rate sin gle turn ver nier, for off set ting the DC level of the out-put wave form be tween ±10 volts, open-cir cuit. The com bined DC off set plus AC sig nal should not exceed ±10 volts, open-circuit, or clip ping of the wave form may oc cur.

2.2.1.10 Main Out:

HI - The se lected wave form ap pears at this out put.
Impedance, 50 ohms.

LO - The selected wave form ap pears at this out put, at ten u ated by –20dB with re spect to the HI out put.
Impedance, 50 ohms.

2.2.1.11 VC In:

Provides for external volt age con trol of fre quency. A max i mum con trol volt age of zero to 3 volts will vary the gen er a tor fre quency to the max i mum range of 1500:1. In put im ped ance, 10k ohms.

2.2.1.12 CV Out:

DC volt age, pro por tional to the dial fre quency set ting, +2mV to +3 volts. In SWP mode, used in con-junction with START FREQ con trol to set the start ing point of the fre quency sweep. Out put imped-ance, 600 ohms.

2.2.1.13 TTL Out:

TTL pulse, coincident with generator fre quency, in phase with the main out put square wave. Will drive up to 10 TTL loads. Rise and fall times, less than 15ns.

2.2.1.14 Ramp Out:

Fixed zero to +5 volt lin ear ramp, rate co in ci dent with sweep DU RA TION con trol. Ramp re trace, less than 75ms. Out put im ped ance, 600 ohms.

2.2.2 Rear Panel

2.2.2.1 Line:

Complimentary slide switches for selecting 120 or 240 volt operation, and NORMal or Low line con-di tions. The 120/240V LINE switch de ter mine the proper volt age range (90-132V or 180-264V) while the NORM/LO LINE switch selects NORMal (108-132, 216-264) or Low (90-110, 180-220) line volt age.

2.2.2.2 SYM ADJ:

Potentiometer for pe ri odic ad just ment of the wave form sym me try.

2.2.2.3 DC Output Level:

Potentiometer for pe ri odic ad just ment of the MAIN OUT PUT DC.

2.3 OPERATION

2.3.1 Frequency Hz/Stop Freq Dial and Multiplier

The generator frequency is controlled by the main tuning (FREQUENCY Hz/STOP FREQ) dial and MULTiplier. The tuning dial is calibrated in Hertz, from 0.2 to 300, for an overall tuning rage of 1:1500. The 3 position, push-button MULTiplier multiplies the dial setting by a factor of 1, 100, or 10K (10,000). A separate, single-turn VERNier provides additional fine adjustment of ±2.5% of the dial setting. With the VERNier in the calibrated (0) position, the generator frequency is the dial setting, in Hertz times the MULTiplier.

When the generator is used in the SWP mode, the FREQUENCY dial determines the stopping point of the frequency sweep.

2.3.2 Internal Sweep Operation

When the front panel SWP button is depressed the generator frequency will continuously sweep between the limits set by the START FREQ control and the FREQUENCY Hz/STOP FREQ dial, at a rate determined by the SWP DURATION control. The generator frequency may be either swept up or down, up to a maximum of 1500:1, over the calibrated portion of the tuning dial. To operate the Model 1200A as a sweep generatorproceed as follows:

1) Depress the SWP-on button.

2) Select the frequency range within which you wish to sweep by selecting the appropriate frequency MULTiplier range.

SWEEP RANGE	MULTiplier
0.2Hz-300Hz	X1
20Hz-30kHz	X100
2kHz-3MHz	X10k

3) Set the FREQUENCY Hz/STOP FREQ dial to the beginning (start) frequency of the desired sweep range.

4) Connect an oscilloscope to the MAIN OUT connector and adjust the START FREQ control until the frequency stops sweeping. This sets the start frequency at the dial setting.

5) Tune the FREQUENCY Hz/STOP FREQ dial to where you want the frequency sweep to stop.

Once the start frequency is set by the START FREQ control, the stop frequency can be varied over any portion of the FREQUENCY dial, without affecting the start frequency. The generator frequency will sweep linearly over the limits set by the START FREQ control and STOP FREQ dial.

To set the sweep duration, connect a counter to the RAMP OUT and adjust the DURATION control to the desired sweep rate. The DURATION control is a single turn potentiometer that will adjust the sweep duration continuously from 1 second to 1 millisecond. When the DURATION X1K multiplier is in the recessed position, the sweep duration range will be multiplied by a factor of 1,000 (1k). The sweep duration will then cover a range of 1000 seconds to 1 second.

When the generator is used in the non-sweep mode, the RAMP OUT, consisting of a fixed, zero to +5V linear ramp, may be used independently of the main generator, with frequency controlled by the DURATION control.

2.3.3 External Frequency Control (VC)

The generator frequency may also be controlled by an external voltage applied to the VC (voltage control) input. A maximum control voltage of zero to 3 volts will vary the generator frequency up to a ratio of 1500:1 within the range of the tuning dial. The VC voltage will vary the frequency as the ratio of:

$$\Delta F = \frac{100Hz}{Volt} \times MULTiplier \times VC - Voltage$$

The VC control is used as follows:

1) With the FREQUENCY dial set to it low (.2) end, a zero to positive-going ramp voltage applied to the VC input will sweep the generator frequency upwards, by as much as 1:1500.

2) If the dial is set to its high (300) end, and a zero to negative-going ramp voltage is applied, the generator frequency will be swept down by 1500:1.

3) A sinusoidal waveform applied to the VC input will modulate (FM) the main output frequency about the dial setting.

As a further example of (3) above, suppose you wish to modulate the generator frequency ± 20% of the dial setting. Let us select arbitrary numbers, e.g., dial set at 10kHz (100 x 100), frequency of modulation, 10Hz. From the frequency to VC voltage expression,

$$\text{Given: } \Delta F = \frac{100Hz}{Volts} \times MULTiplier \times VCVoltage$$

$$\text{Where: } \Delta F = \pm 20\% \times 10kHz = \pm 2kHz$$

$$\text{Therefore, VC Voltage} = \frac{\Delta F}{MULTipleir} \times \frac{1Volt}{100Hz}$$

$$= \frac{\pm 0.2 \times 103Hz \times 1Volt}{100 \times 100Hz}$$

$$= \pm 0.2Volts$$

A sinusoidal voltage of ±.2 volts at a rate of 10Hz is required.

2.3.4 Variable DC Offset

The vari able DC OFF SET Con trol con sist of a push-but ton ON-OFF switch plus a sin gle turn po ten ti-ometer. It is used to vary the DC level of the output wave-form. The OFFSET potentiometer will vary this level from mi nus (-) 0 volts to plus (+) 10 volts. The combined peak AC plus DC offset should not ex ceed ±10 volts peak, oth er wise clip ping of the wave form may oc cur.

2.3.5 Calibrated CV (Control Voltage) Output

The cal i brated, CV out put is a DC volt age pro por tional to the FRE QUENCY dial set ting, and c overs a range of +2 mil li volts to +3 volts. The CV out put volt age is ac cu rate to

within 5% of the generator's out put fre quency, over the cal i brated range of the dial. It may be con-nected to a dig i tal volt me ter for mon i tor ing of fre quency, or it may be used to drive an x-y plotter. Output impedance is 600 ohms.

It may also be used as an independent ramp out put in the SWP mode; its start level and peak ampli-tude are con trolled by the gen er a tor's START FREQ and FRE QUENCY Hz/STOP FREQ con trols, re-spectively.

2.3.6 Waveguard Circuit

The ex clu sive WAVEGUARD out put pro tec tion cir cuit is con nected across the gen er a tor's HI output ter mi nals. The cir cuit pre vents dam age to the gen er a tor's out put am pli fier stage, if a volt age greater than ±12 volts is accidentally placed across the HI output terminal.

WARNING!

When the WAVEGUARD cir cuit is ac ti vated, it will short-cir cuit the ap plied volt age to ground. A low-ohm resistor is in ter ested in se ries with the WAVEGUARD cir cuit and the HI out put terminal, to protect the WAVEGUARD circuit from exceeding its maximum, continuous, continuous current rating.

A low fre quen cies, the cir cuit will re cover au to mat i cally when the ex ter nal volt age is re moved; at higher fre quen cies, it may be nec es sary to turn the am pli tude down or shut the power off mo men tarily to re set the cir cuit af ter the ex ter nal volt age is re moved.

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SECTION 3
INCOMING INSPECTION AND CHECKOUT

3.1 INTRODUCTION

The following procedure should be used to verify that the generator is operating within specifications, both for incoming inspection and for routine servicing. Tests should be made with the cover in place, and the procedure given below should be followed in sequence. Familiarize yourself with the initial setup and operating procedures outlined in Section 2, Operation.

CAUTION!
The cover of this instrument should not be removed when the instrument is connected to an AC power source, because of the potentially dangerous voltages that exist within the unit.

3.2 EQUIPMENT REQUIRED

1. Oscilloscope, bandwidth from DC to 30MHz, vertical sensitivity 5mV/cm, AC/DC coupled.
2. Frequency counter, capable of frequency measurements between 0.2Hz and 3MHz, 0.1% accuracy. (General Radio Model 1192-B, or equivalent).
3. AC Differential Voltmeter (ACVM), 3MHz bandwidth, capable of measuring AC voltages from zero to 20 volts, and voltage variations less than .1db (1%). (Fluke Model 931A or equivalent).
4. DC Voltmeter (DCVM), for DC voltage measurements from zero to ±50 volts. (Fluke Model 8000A or equivalent).
5. Calibrated DC voltage source, zero to ±3 volts. (Analogic Model AN-3100 or equivalent).
6. Distortion Analyzer. (Krohn-Hite Model 6800 or equivalent).

3.3 PROCEDURE

After allowing the instrument to warm up for at least 30 minutes, set the controls to the following positions:

FREQUENCY Hz/STOP FREQ	30
MULTiplier	X100
SWP	Off
AMPLITUDE	Max CW
Waveform	Sinewave
DC OFFSET	Off
CHASSI/FLOATING	Chasis

3.3.1 Waveforms

Connect the oscilloscope to the generator's MAIN OUT, (HI Level). Operate the Waveform switch in each of its positions; the waveforms should be present and at least 20 volts peak to peak. Connect the scope to the LO Level output; waveform amplitude should be at least 2 volts peak to peak.

3.3.2 Amplitude Control

Reconnect the scope to the HI Level output. Vary the Amplitude control from maximum to minimum; the waveform amplitude should diminish by more than 60db. Return the AM PLITUDE control to its maximum CW position. Connect a 50 ohm load across the generator's HI OUTPUT; the amplitude should diminish by one-half. Repeat this for the LO OUTPUT. Remove the 50 ohm load.

3.3.3 DC Offset

The variable DC OFFSET Control allows the waveform DC level to be varied ±10 volts peak. Turn the AMPLITUDE control to its maximum CCW position, and connect the scope or DCVM to the HI Level Output. Push the variable OFFSET Control "ON" and vary the control through its range; you should be able to vary the main output DC level by ±10 volts. Push the OFFSET Control to "OFF".

3.3.4 Frequency Controls and Accuracy

Rotate the FREQUENCY dial through its range to insure that it turns smoothly; observe the output waveform on the scope and check to see that the frequency increases as the dial is rotated from its low end (.2) to its high end (300). Operate the MULTiplier in each of its positions and check that the output frequency increases by x100 steps. Connect the frequency counter to the MAIN OUT, (HI Level, Waveform switch) and check the accuracy of the FREQUENCY dial in each position of the MULTiplier. Frequency accuracy is specified as within ±5% at dial settings of 10, 100 and 300 and ±20% maximum at all other settings [vernier in 0 (calibrated) position].

3.3.5 External Voltage Control (VC)

An external voltage applied to the VC input will vary the frequency of the generator about the frequency setting of the FREQUENCY dial and MULTiplier. Reconnect the frequency counter to the MAIN OUT. Connect the calibrated DC source to the VC input. Vary the DC source and observe the

change in the generator's frequency; a change of ±0.1 volt on the VC input will correspond to a frequency change of approximately 10Hz times the MULTiplier setting.

Disconnect the DC voltage source from the VC input.

3.3.6 CV Output

The CV Output is a DC voltage proportional to the generator frequency. Connect the DCVM to the CV output and check to see that is value is within 5% of the frequency reading observed on the frequency counter. Disconnect the frequency counter and DCVM.

3.3.7 Sweep Operation

To check the sweep operation, set the sweep controls to the following positions:

SWP	On (recessed)
START FREQ	Max CCW
DURATION	1s
DURATION x 1K	Off (Out)

Connect the oscilloscope to the RAMP OUT and check to see that the RAMP is present and its amplitude is zero to +5V. Turn the DURATION Control Max CW; the duration should decrease to approximately 1ms. Depress the duration x1K button; the ramp duration should increase to approximately 1 second.

Connect the oscilloscope to the MAIN OUTPUT. The start of the frequency sweep is adjusted by first setting the FREQUENCY Hz/STOP FREQ dial to the desired frequency, and then by adjusting the STRAT FREQ Control until the frequency stops sweeping. The FREQUENCY Hz/STOP FREQ dial is then tuned to the desired stop frequency. Observe that the frequency sweep range varies as you vary the FRQUENCY Hz/STOP FREQ setting. Return the SWP Control to the off (extended) position.

3.3.8 Frequency Response

The frequency response of the generator is defined as the variations in the amplitude of the output waveform, as the frequency of the generator is varied through its specified range. The response specifications apply to sinewave output, only. The response of the generator may be checked by 1 of 2 methods. If the ACVM is used, connect it to the generator's MAIN OUT and observe the variations in amplitude as the frequency is tuned through its range.

The alternative, and perhaps more convenient method is to sweep the generator frequency using the internal sweep, and observe the swept response on the scope. To use this method, set the FREQUENCY Hz/STOP FREQ dial to 300 x 10k; depress the SWP button and adjust the duration control for 1ms. Adjust the START FREQ control until the frequency stops sweeping, then tune the dial to .2; this will sweep the generator frequency down from approximately 3MHz to 2kHz.

For either method, the variations in output amplitude are specified as less than 0.1db (aprox. 1%) up to 300kHz, and less than 1.0db to 3MHz. Return the SWP button to the off (extended) position.

3.3.9 Sinewave Distortion

Connect the distortion analyzer to the generator's MAINOUT. Set the Waveform switch to . Check the distortion of the output sinewave at the various frequencies. Distortion should be less than 0.5% from 2Hz to 300kHz.

For distortion measurements between 300kHz – 3MHz, the use of a Wave or Spectrum Analyzer is recommended. Distortion is specified as less than 3% to 3MHz.

3.3.10 TTL Output

Connect the oscilloscope to the TTL output, and set the generator frequency to between 1-10kHzz. Check to see that the waveform amplitude is between approximately +.3V to +3.0V.