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MODEL 30 INSTRUCTION MANUAL

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DESCRIPTION

Your Wavetek Model 30 is a battery operated, self-sweeping audio function generator of unusual value and small size. There are three frequency ranges which give an overall frequency range of 2 Hz to 200 kHz. In each range, the frequency may be varied from the maximum range value to one-thousandth of that value.

The operating modes are dial control of frequency, external voltage control of generator frequency (VCG) and fast, medium and slow frequency sweep rate modes. The response to any of these modes of control is selectable to be either linear or logarithmic.

A sine wave output can be varied from 0 to over 1 V rms from a 600 ohm source at the front panel and is available at a rear auxiliary terminal but reduced by 40 dB.

A square wave output at the front panel is for oscilloscope synchronizing or driving logic circuits.

Rear panel terminals give sine wave, triangle wave, sweep sync, generator sync, horizontal drive (linear ramp and log ramp) signals and allow connection of external timing capacitors for the main generator and the ramp generator, control voltage input (VCG) and a battery charger input.

The battery supplied with the generator will power it for the equivalent of approximately one 8-hour day. As an option, a battery charger and a rechargeable battery are available for unrestricted line operation as well as battery charging. Overnight charge gives 3 hours of generator operation.

SPECIFICATIONS

These specifications apply when the battery is fresh, recharged or with the battery charger connected. (First indications of a weak battery are poor waveform symmetry at the low end of the frequency ranges and poor frequency calibration at the top end of the log scale.)

Frequency Ranges

2 Hz to 2 kHz
20 Hz to 20 kHz
200 Hz to 200 kHz

All ranges can be controlled in either linear or logarithmic response. For added frequency range, connections are provided for adding an external capacitor for unlimited down ranging.

Dial Accuracy

$\pm 2\%$ of range to 20 kHz (linear calibration only, log not specified).

Variable Outputs

High Level Sine Wave: This output is variable up to 1 V rms open circuit from 600Ω source. Distortion is less than 2% from 20 Hz to 20 kHz.

Low Level Sine Wave: Varies with the high level sine wave, and is approximately 1% of high level output.

Fixed Outputs

Pulse: This front panel output provides a 50% duty cycle pulse output with nominal TTL levels of 0 V to +0.5 V (low) and +3 V to +5 V (high).

Triangle Wave: A rear panel output of approximately 1 V p-p, less than 2 mA peak current.

Generator Sync Out: Rear panel output in parallel with the front panel pulse output.

Dial Mode

The generator operates as a conventional oscillator with frequency selected by the front panel controls.

VCG Mode

The generator operates as a Voltage Controlled Generator. The frequency is determined by the voltage applied to the rear panel VCG input and front panel selected range. Full scale frequency change requires approximately 1.8 volt input. Response is either linear or logarithmic selectable.

Sweep Mode

The generator sweeps the full frequency range. The sweep function is either linear or logarithmic. Approximate sweep times are:

Fast	2.5 ms
Medium	250 ms
Slow	25 s

For further sweep versatility, external capacitors can be connected for unlimited increase of the sweep period.

Power Source

The generator is supplied with an alkaline 9 V transistor battery (Mallory MN 1604 or equivalent). This will operate the generator for approximately a full eight hour day at maximum output.

INITIAL CHECKOUT

1. Remove the instrument and battery from the shipping package.
2. At the back of the instrument, squeeze the sides of the battery case and remove it. Place the battery in the case and snap the battery to the connector. Reinstall the battery and case.
3. Connect the \sim terminal and the \perp terminal to the inputs of an oscilloscope. The oscilloscope sync may be set to internal or connected externally to the \square terminal of the generator.

NOTE

An ac voltmeter may be substituted for the oscilloscope, in which case, there is no need for the sync connections; however, the sweep feature will not be obvious.

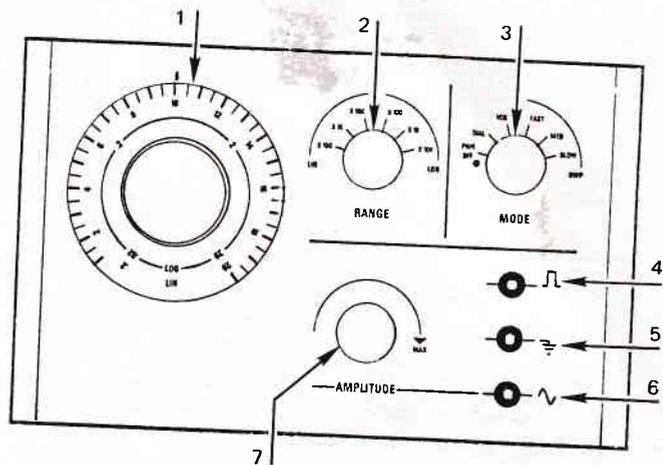
4. Turn the MODE switch to DIAL and rotate the dial from one end of the scale to the other in each RANGE switch position and see that a sine wave is produced at all switch settings and numbered dial marks.
5. Vary the AMPLITUDE control and observe that the sine wave amplitude varies accordingly.
6. Connect the external sync of the oscilloscope to the SWEEP SYNC OUT terminal at the back of the generator, and turn the MODE switch to FAST sweep. A swept sine wave should be displayed.

The existence of other signals may be verified by going to the appropriate terminals and switch positions.

CONTROLS AND CONNECTORS

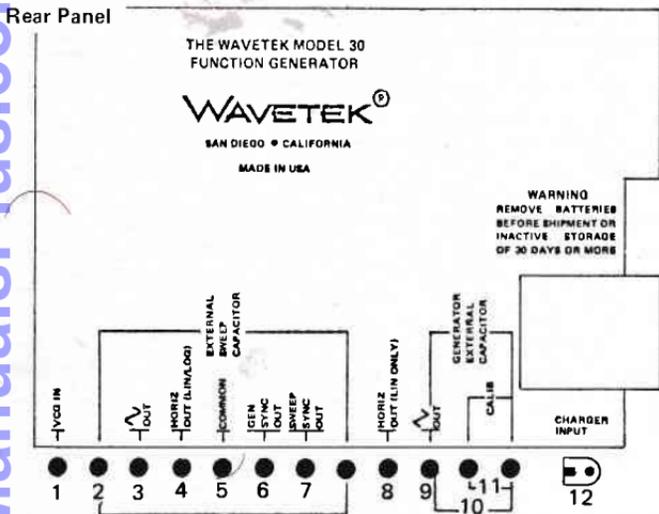
Front Panel

- Dial** – Controls the frequency continuously from the top of the selected range down to one-thousandth of the top value. There are two scales on the dial. The outer one has a linear distribution of frequencies and the inner scale has a logarithmic distribution. The proper scale depends upon the RANGE switch setting of LOG or LIN.
- NOTE**
- The dial is operative only if the MODE switch is in the DIAL position.*
- RANGE Switch** – Selects one of the three frequency ranges and either linear or logarithmic control. Frequency ranges are 2 Hz to 2 kHz (X 100 setting), 20 Hz to 20 kHz (X 1K setting) and 200 Hz to 200 kHz (X 10K setting).
 - MODE Switch** – Selects generator operating mode: a DIAL controlled generator, a voltage controlled generator (VCG) or a self swept generator covering the chosen range in a period of 2.5 ms (FAST), 250 ms (MED) or 25 s (SLOW). The off-on control is also on this switch. The on condition is indicated by the appearance of a red spot below the word OFF.
 - Jack** – Gives a square wave with a 50% duty cycle. The low side or common for this signal is on the \perp jack. The amplitude is fixed with the low state between 0 and +0.5 V, and the high state between +3 V and +5 V, depending on battery charge condition.



- \perp Jack** – Provides a common for external connections.
- \sim Jack** – Gives a sine wave output of up to 1 V rms with 600Ω source impedance. This is the main generator output. The low side or common for this signal is on the \perp jack. (Internal jumpers may be rearranged to make the full output amplitude at these jacks about 10 mV rms; see page 6.)
- AMPLITUDE Control** – Varies the sine wave output (at the front panel) amplitude continuously from zero to over 1 V rms.

The AMPLITUDE control is for the sine wave only.



- VCG IN Terminal** – For the connection of external voltage control of generator frequency (VCG). It is inoperative unless the MODE switch is in the VCG position. Zero to approximately 1.8 volts varies the frequency just as the frequency dial can in DIAL mode. Input impedance is $> 1 \text{ k}\Omega$. **Caution:** *Voltage in excess of 2.5 V will damage the input circuit.*
- EXTERNAL SWEEP CAPACITOR Terminals** – Two terminals for the connection of an external timing capacitor which extends the sweep periods.

A quality low leakage capacitor should be used for linear performance. If a polarized capacitor is used, it should be a low

leakage tantalum capacitor with at least a six-volt rating and connected positive-side to the terminal adjacent to the VCG terminal. The external capacitor will be connected in parallel with the internal timing capacitor, which is selected by the MODE switch. The relationship of the timing capacitor to the sweep time is such that for SLOW SWP an external $33 \mu\text{F}$ capacitor will be in parallel with the internal $33 \mu\text{F}$ timing capacitor, doubling the sweep period to 50 s. As a guide, the following formula may be used:

$$\text{Additional Sweep Time in ms} = 750 \times \text{Capacitance in } \mu\text{F}$$

- OUT Terminal** – Output for a sine wave that is 1% of the front panel sine wave amplitude. The 600Ω output impedance may be loaded to common for any lower full scale amplitude that may be desired. (The internal jumpers may be rearranged to bring the larger sine wave up to 1 V rms to the rear connector; see Page 6.)
- HORIZ OUT (LIN/LOG) Terminal** – An output voltage indicating the percent of frequency range at which the generator is operating. The voltage out is proportional to frequency and is about 2 V when the generator is running at 100% of the selected frequency range. Also see Index 8, HORIZ OUT (LIN ONLY).
- COMMON Terminal** – Electrically connected to the low side of all signals and \perp jack on the front panel.
- GEN SYNC OUT Terminal** – Connected in parallel with the front panel \perp jack. It is for driving an oscilloscope sync or logic.

7. **SWP SYNC OUT Terminal** — Output of a narrow positive pulse coincident with the flyback time of the ramp generator. If the MODE switch does not call for a sweep, there will be no signal. This signal is intended to drive an oscilloscope sync for use with the ramp or swept waveforms.
8. **HORIZ OUT (LIN ONLY) Terminal** — Output for a signal proportional to the control voltage, which may be dial voltage, VCG, or ramp generator voltage. Any one of these voltages may be selected for the main generator control voltage.

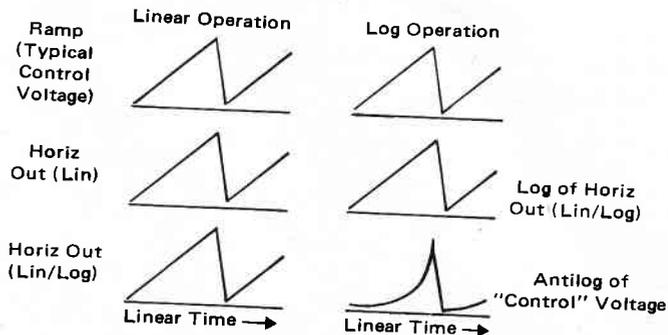
NOTE

During linear operation, the voltages at the two HORIZ OUT terminals will be proportional. However, during "log" operation, the control voltage is processed to derive its antilog (see figure), and this antilog is fed to the main generator. HORIZ OUT (LIN/LOG) is directly proportional to this processed voltage. HORIZ OUT (LIN ONLY) voltage is always linear in its distribution, and therefore, during log operation, is the log of HORIZ OUT (LIN/LOG). In log mode:

$$\overset{\text{log}}{\uparrow} \text{HORIZ OUT (LIN ONLY)} = \text{HORIZ OUT (LIN/LOG)} \overset{\text{antilog}}{\uparrow}$$

When in a log mode, HORIZ OUT (LIN ONLY) can be used for oscilloscope X-axis drive where logarithmic distribution on the display is desired. (Each one-third

of HORIZ OUT (LIN ONLY) voltage excursion represents a decade of frequency change in the generator, as it is on the dial's LOG scale).



9. **∇ OUT Terminal** — For triangle waveforms of 0.8 V p-p about a 0 V level. The positive slope of the triangle is synchronous with the low level portion of the square wave. Load current must be less than 2 mA peak.
10. **GENERATOR EXTERNAL CAPACITOR Terminals** — For connecting capacitors which will extend the generator frequency range downward. The external capacitors should be of high quality with low leakage. A 1 μF capacitor will change the top of the 2 kHz range (X 100 RANGE switch setting) to 200 Hz and a 10 μF capacitor in parallel with that will change the range down to 20 Hz at the top and 20 MHz at the bottom. Nonpolarized capacitors are necessary because the charge alternates polarity. The following table may be used as a guide for capacitor selection.

RANGE Switch Settings

X 100 X 1K X 10K
Top-Bottom of Freq Range (Hz)

Added
External
Capacitance

0 μ F

2k	20k	200k
2	20	200

1 μ F

200	220	222
0.2	0.22	0.222

1 μ F + 10 μ F

20	20.2	20
20 m	20.2 m	20.2 m

1 μ F + 10 μ F + 100 μ F

2	2	2
2 m	2 m	2 m

As can be seen from the table, the X 1K and X 10K settings lose significance with the addition of external capacitors.

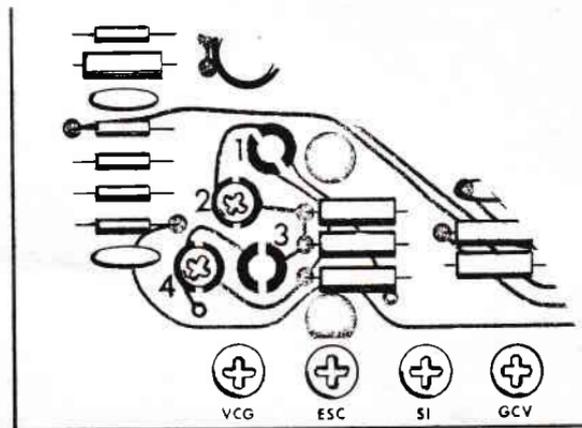
11. **CALIB Terminals** — For main generator calibration. (See Page 13 for calibration procedure.)

12. **BATTERY CHARGER INPUT Connector** — For connection of the optional battery charger. The charger may be connected indefinitely without harm to the generator, and the generator may be used with the charger connected. For line power operation, connect the battery charger and *keep a battery installed* in the generator.

SINE WAVE OUTPUT EXCHANGE

The two sine wave outputs, approximately 1 V rms maximum and 10 mV rms maximum, are routed one to the front panel jack and the other to the rear terminal. Two jumper screws on the printed circuit board, near the VCG terminal, determine the routing; they may be set in any combination, such as:

	Screws in Holes
1 V rms to Front Jack and 10 mV rms to Rear Terminal	2
10 mV rms to Front Jack and 1 V rms to Rear Terminal	4
	1
	3

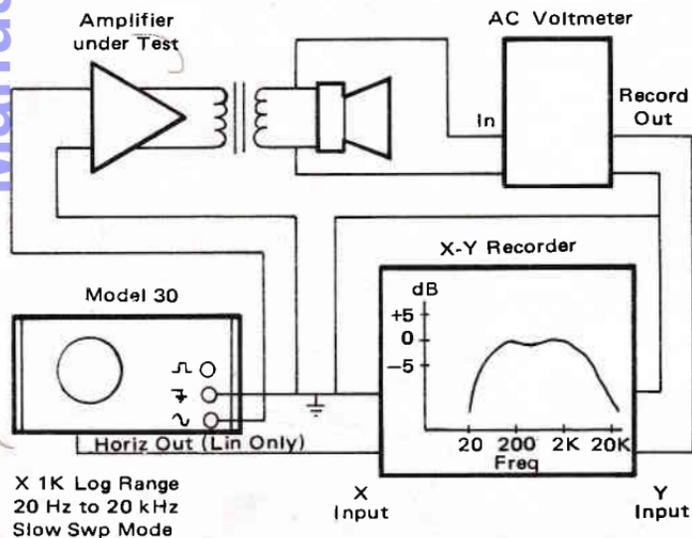


APPLICATIONS

A. Use of Sine Wave, Sweep, and Horizontal Drive Signals

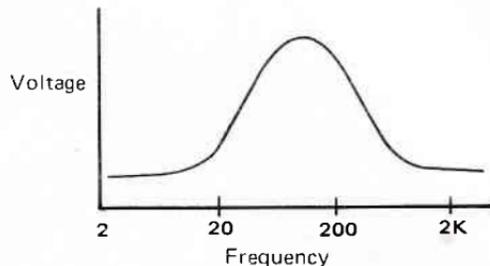
1. Frequency Response and Tone Control Curve Testing

Here the generator is used to supply a swept audio input signal with flat amplitude. The output response is plotted automatically so that changes can be made, as in tone controls, and more plots easily run. The connections are shown below. Note that the plot will be logarithmic if HORIZ OUT (LIN ONLY) is used. For a linear distribution, use HORIZ OUT (LIN/LOG).



2. Speaker Resonance

The setup is similar to No. 1 except that the speaker is driven directly with the generator and the generator is on the X 100 range. Since at resonance the impedance of the speaker will be higher than normal, the voltage across it will rise and be plotted as a peak.



3. Speaker Enclosure Tuning

The speaker resonance setup is used but the speaker will be in an enclosure. The resonant curve can be plotted and the baffles, ports, and spaces of the enclosure can be adjusted for another readily made plot. When the enclosure is properly tuned, there will be two small peaks in the curve, one above and one below the speaker-alone resonance. Ideally, the curve will be maximally flat.

4. Audio Signal Tracing by Sound

The principle here is to inject an audio signal from the Model 30 into the audio circuit, first starting near the output, and then moving toward the audio circuit input, stage by stage, until the

signal can no longer be heard in the speaker. The stage where the signal is lost is presumed to be bad. A precaution should be taken here not to change the dc bias on the stages under test or to damage the Model 30 with the dc bias of the stage under test. For precaution, use a coupling capacitor to block the bias voltage, or "float" the Model 30 on the bias of the stage under test by connecting the Model 30 so it does not provide a dc path to alter the bias of the stage under test.

The Model 30 has a special capability which may be of value in some signal tracing applications. If the equipment under test is handling one or more audible signals that can be confused with the test signal, a number of signals with unique sounds may be produced for testing purposes by using the sweep modes and various frequency ranges.

5. Audio Signal Tracing by Oscilloscope

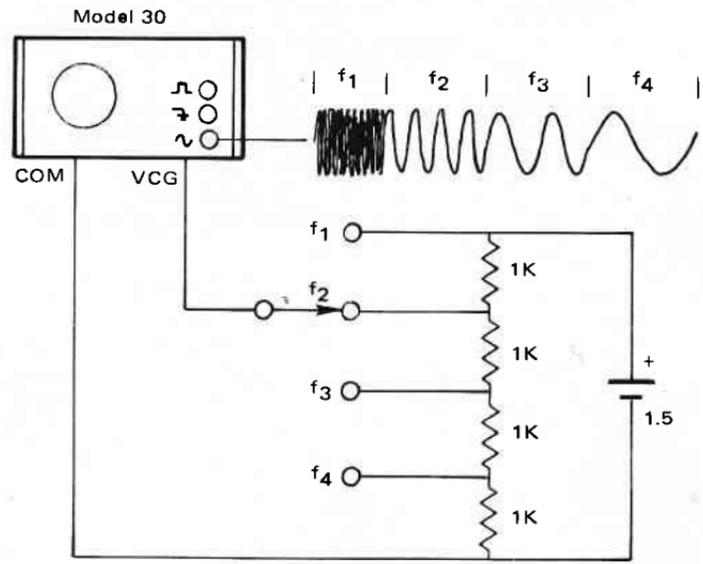
This method is similar to the previous one except the signal need not come out of the circuit output to be detected. It may be injected at any audio stage and detected at many places by probing with the oscilloscope.

B. Use of VCG

1. Fixed-Frequency Signals

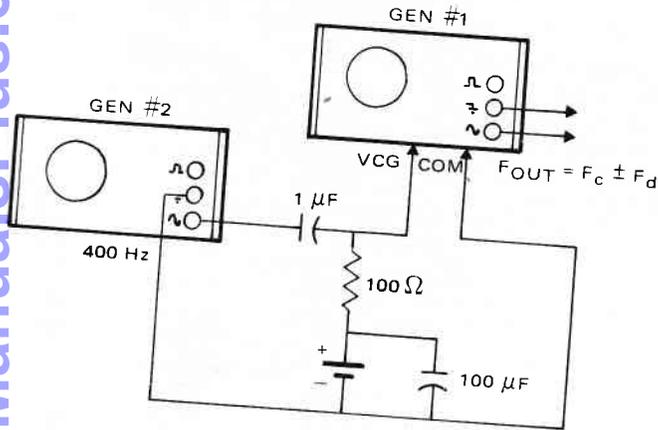
Rapid manual switching among four discrete frequencies with absolute accuracy and repeatability is accomplished by using the VCG input. A 1.5 volt cell, switch and divider network are con-

nected to the generator as shown. Resistor values determine VCG voltage and, hence, generator frequency.



2. Frequency Modulation

The sine wave output of generator #1 is modulated with another sine wave from generator #2 by connecting the output of the latter to the VCG terminal of generator #1. When switched to VCG MODE, the frequency of generator #1 is proportional to the voltage applied to its VCG terminal.



In this example, the steady state VCG voltage, and the center frequency (F_C) is determined by the battery and resistor. The center frequency is changed at a 400 Hz rate by the 400 Hz signal coming from generator #2. The extent of frequency change, or frequency deviation (F_D) from the center frequency depends upon the peak-to-peak voltage of the 400 Hz signal.

$$F_D \text{ of Gen \#1} \sim V_{p-p} \text{ of Gen \#2}$$

The value of C should be increased if a lower modulating frequency is used.

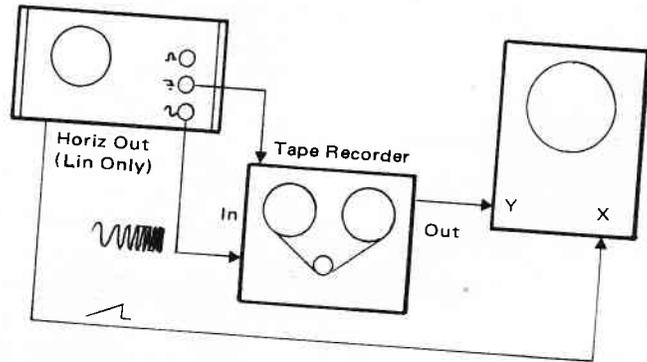
C. Use of Sweeper

1. Tape Recorder Head Alignment

The sweep mode can be used in conjunction with an oscilloscope in the X-Y mode to align tape recorder heads.

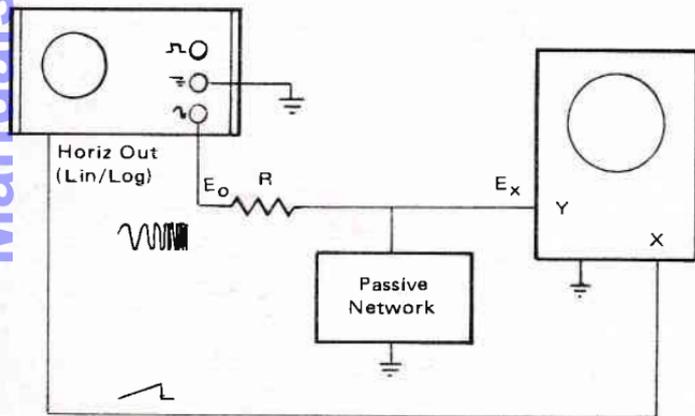
Connect the equipment as shown, set the RANGE switch to X 1K LOG and the MODE switch to FAST SWP.

The swept sine wave is fed into the tape input and the tape output is fed to the vertical input of the oscilloscope. The horizontal input of the oscilloscope is driven by the HORIZ OUT (LIN ONLY) for a logarithmic distribution of frequency on the oscilloscope. The screen then displays the 20 Hz to 20 kHz frequency response of the recorder, and the tape recorder head can be aligned for optimum response.



2. Determination of Passive Network Characteristics

The impedance characteristics of a passive network are easily determined by using the setup shown here. Besides your Model 30, an oscilloscope with X-Y capability is required. In this particular example, a linear distribution of frequency is obtained on the oscilloscope display.



The Model 30 is set to drive the network with a constant amplitude sine wave whose frequency varies logarithmically over the range of interest. The swept sine wave voltage (E_x) is the vertical component of the oscilloscope display while the log ramp voltage is the horizontal component. The curve displayed on the oscilloscope represents the characteristics of the passive network at the frequencies of interest.

Breaking resistor R is used to calibrate the network impedance; i.e., when $E_x = \frac{1}{2} E_0$, the network impedance equals $R + 600$ where 600 is the 600 ohm output impedance of the Model 30. To determine E_0 , disconnect the passive network and measure E_x . Because the oscilloscope input is a very high impedance compared to the Model 30's 600 ohm output impedance and R , this E_x value is E_0 .

CIRCUIT DESCRIPTION

Refer to the schematic (Page 20) during the following descriptions.

NOTE

The terminal designations agree with those on the printed circuit rather than those on the back cover.

A. Ramp Generator

This circuit produces the ramp waveform for the slow, medium and fast sweep modes of the main generator. In addition, the ramp generator produces a sweep sync signal comprised of a pulse that is high when the ramp is in the flyback segment of its cycle and near ground for the remainder of the time. Two Norton amplifiers*, half of the quad array IC1, are used here for the ramp integrator and hysteresis switch. The transistors are used to switch and steer the operating currents.

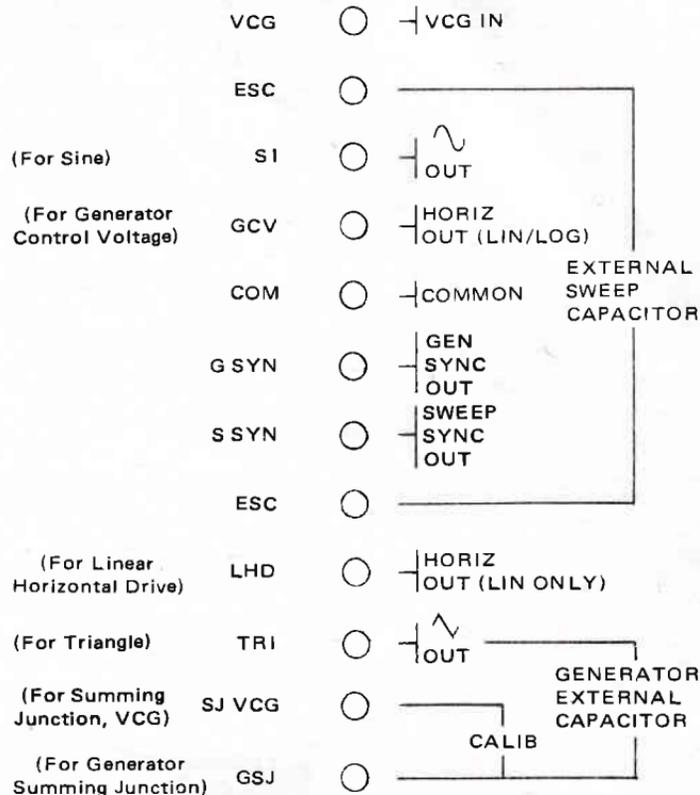
B. Log Converter

On linear ranges this circuit behaves as a gain-of-one buffer so that the signals at the LHD terminal and the GCV terminal are both copies of the frequency control signal, be it dial output, VCG signal or ramp generator.

* A current-differencing op-amp as opposed to the conventional differential voltage amplifier.

Schematic and Printed Circuit

Back Cover



In the log ranges the logarithmic characteristics of the base-emitter junction of Q10 cause the output of IC2 to be logarithmic. The GCV signal will be the antilog of the frequency control signal and the LHD signal in these ranges.

$$\text{GCV} = e^{\text{LHD}}$$

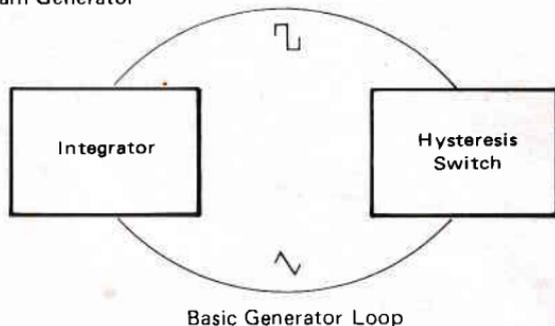
C. Voltage Regulator

Q4 and Q5 are emitter followers which buffer the outputs of the regulator Zener CR2.

D. Battery Splitter

Q6, Q7 and one section of IC1 behave as a conventional operational amplifier arranged so that the midpoint between the regulated supplies is sensed, buffered to a low impedance and called the common point of the circuit.

E. Main Generator



In the basic generator loop, the integrator and hysteresis switch operate upon each other to produce the square and triangle waveforms. The sine waveform is produced by shaping the triangle wave with a nonlinear diode network.

VCG Mirror. This is an inverting operational amplifier which produces a voltage which is the negative image (plus one diode drop) of the GCV signal. Both positive and negative control voltages are needed to control the generator loop.

Integrating Current Switch. A diode (pins 3 and 4 of diode array DA1) and the transistor Q11 switch the net integrating current alternately positive and negative to produce the negative and positive slopes of a triangle waveform.

Hysteresis Switch. The positive and negative peaks of the triangle signal trip the self-resetting comparator circuit comprised of IC5, IC6, Q12 and Q13.

Square Wave Signal Conditioner. Q14 and Q15 are driven by the low level square wave information and present a square wave signal to the output terminal.

Sine Converter. Diode arrays DA2 and DA3 with their resistors make up the nonlinear network which converts the triangle voltage wave into a sinusoidal current wave at pin 2 of IC7.

Output Amplifier. IC7 changes the sinusoidal current wave to a sinusoidal output voltage of controllable amplitude.

CALIBRATION**A. Recommended Equipment**

1. High-input impedance, low-level voltmeter with 20 μV resolution: Fluke 845A or equivalent.
2. Notch filter circuit (see Page 15) or HP334A distortion analyzer or equivalent.
3. Frequency counter: Monsanto 101A or equivalent.
4. Oscilloscope: Tektronix 545 with 1A1 plug-in or equivalent.

To perform calibration, remove the rear cover. Refer to the assembly drawing (Page 17) for component location.

NOTE

Printed circuit board terminal designations are given here for operations with the cover off. Schematic and back cover designations are given in parentheses where applicable.

Start with a fully charged battery or with a charger connected.

B. Voltage Symmetry Setting for Instruments with VBAL Potentiometer (R34)**NOTE**

The connection points in Step 1 are summing junctions and may be disturbed by probe cable capacities. It is helpful to put 10K resistors in series with each line of the probe cable. Place the resistors between the circuit board and each line.

1. Connect the high input impedance voltmeter to the SJ VCG and GSJ (CALIB) terminals.

2. Control Settings:

RANGE Switch	X 100, LOG
MODE Switch	DIAL
Dial	2, LOG Scale

3. Set the VBAL potentiometer (R34) for a minimum indication on the voltmeter: less than 20 μV .
4. Remove the voltmeter connections from the generator.

C. Minimizing Distortion at 200 Hz

1. Connect the generator G SYN (GEN SYNC OUT) terminal to an oscilloscope external sync.
2. Connect the generator  jack to the notch filter input (or distortion analyzer input) and the oscilloscope channel one.
3. Connect the notch filter output (or distortion analyzer residue output) to channel two of the oscilloscope.
4. Control Settings:

RANGE Switch	X 100, LOG
MODE Switch	DIAL
Dial	2, LOG Scale
AMPLITUDE Control	MAX

5. Observe the two-channel display and adjust the generator frequency dial until the channel 2 signal is nulled.
6. Increase the oscilloscope sensitivity until the channel 2 signal becomes apparent.
7. Set the SINE DIST potentiometer (R52) for minimum channel 2 amplitude.

NOTE

The SYM potentiometer (R48) can also be set to help minimize amplitude at this point, although R48 will be set accurately in Step 10.

8. Control Settings:

RANGE Switch	X 10K, LOG
Dial	.02, LOG Scale

9. Again, null the channel 2 signal and increase oscilloscope sensitivity.
10. Set the SYM potentiometer (R48) for minimum channel 2 amplitude.
11. Remove the notch filter circuit or distortion analyzer and the oscilloscope connections.

D. Linear Dial

1. Connect the  output to a counter input.

2. Control Settings:

RANGE Switch	X 100, LIN
Dial	20, LIN Scale

3. Set the FS LIN potentiometer (R17) for 2 kHz on the counter.

4. Control Setting:

Dial	2, LIN Scale
------	--------------

5. Set the BOT LIN potentiometer (R20) for 200 Hz on the counter.

6. Repeat this sequence until no improvement is gained.

E. Log Dial

1. Connect the VCG terminal to the COM terminal.

2. Control Settings:

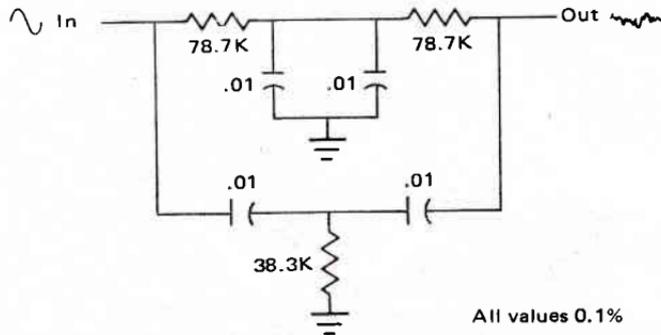
RANGE Switch	X 100, LOG
MODE	DIAL
Dial	20, LOG Scale

3. Set the FS LOG potentiometer (R24) for 2 kHz on the counter.
4. Control Settings:

RANGE Switch	X 10K, LOG
MODE Switch	DIAL
5. Set dial for minimum frequency on counter.
6. Set the BOT LOG potentiometer (R29) for 200 Hz on the counter.
7. Repeat this sequence until no improvement is gained.

200 HZ NOTCH FILTER CIRCUIT

This circuit may be used in lieu of a distortion analyzer for sine wave distortion calibration. The filter removes the first 200 Hz harmonic from the generator output, leaving the residue, which consists of the other 200 Hz harmonics. During calibration this residue is regulated to a minimum.



TROUBLESHOOTING

Refer to Circuit Description for component functions.

A. No Output On Any Terminal

If the generator fails to run and there is no alternating signal on any terminal, the problem may be:

1. Dead battery – Replace or charge.
2. Failure of IC1, Q6 or Q7 – Replace bad component and calibrate.
3. Failure of MODE switch – Replace.

B. No Sweep But Main Generator OK

If the main generator runs but the ramp generator does not, the problem may be:

1. Failure of IC1, Q3 or Q4 – Replace bad component.
2. Failure of the MODE switch – Replace.

C. Main Generator Not Working But SWP SYNC OUT Signal Present

If the ramp generator runs but the main generator does not, the problem may be:

1. Dial at the bottom on a linear range – Set at a higher frequency.

2. Failure of IC3, IC4, IC5, IC6, DA1, Q11, Q12, or Q13 – Replace bad component.

D. No Response To Any Mode Of Frequency Control

If the main generator runs but does not respond properly to any mode of frequency control, the problem may be failure of IC1, IC2, Q8, or Q9 – Replace bad component.

E. No Square Wave

If everything works except the square wave, the problem may be failure of Q14 or Q15 – Replace bad component.

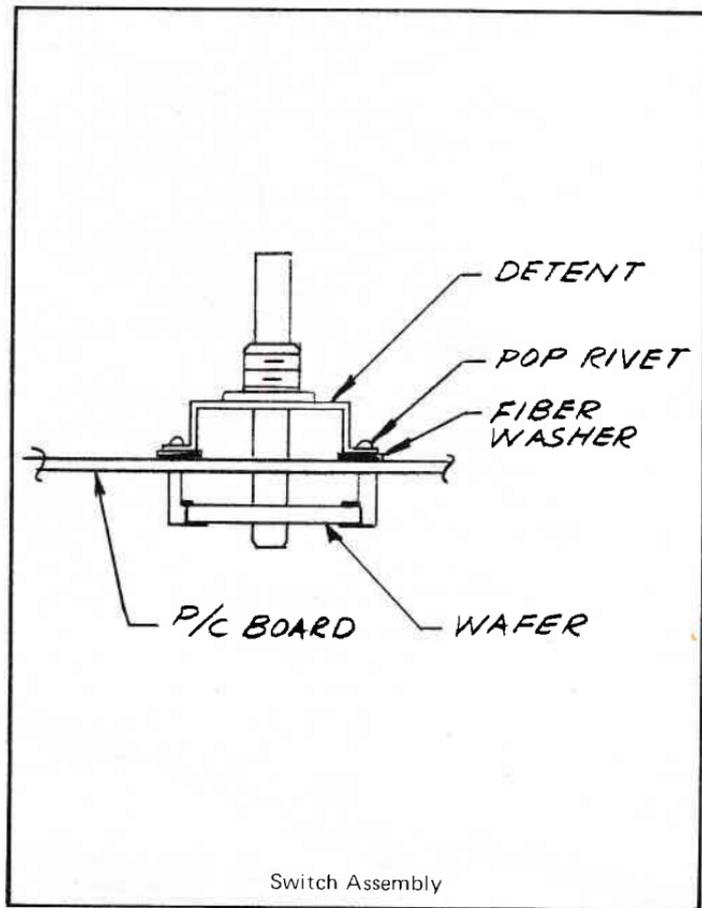
F. Clipped Sine Wave

If the sine wave is clipped on the negative peak at high amplitude only, the problem may be a low battery – Charge or replace.

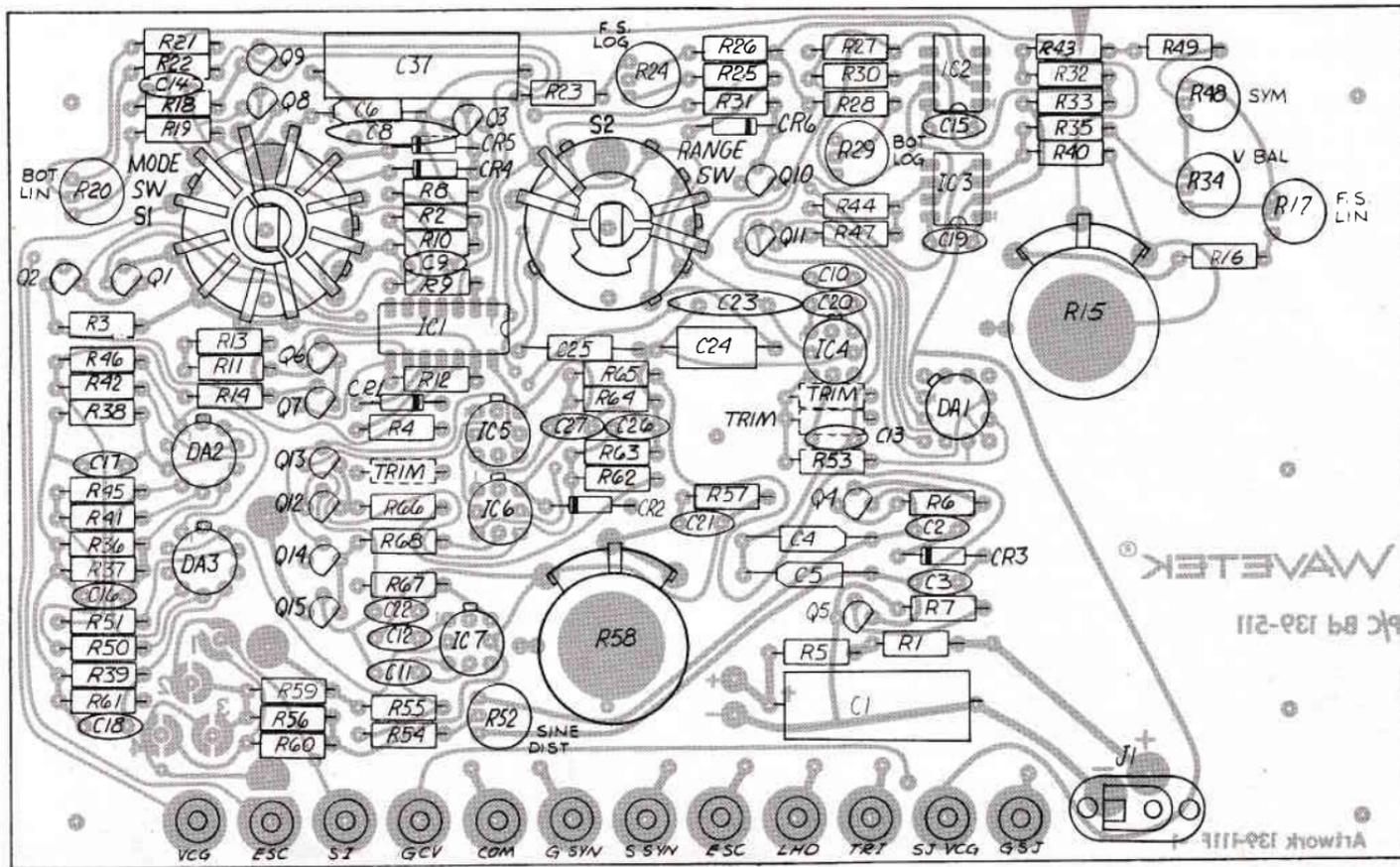
G. Distorted Or No Sine Wave

If the triangle and square look good but the sine wave is distorted or absent, the problem may be:

1. AMPLITUDE control full ccw – Increase amplitude.
2. Failure of DA2, DA3, or IC7 – Replace bad component.



Switch Assembly



REPLACEMENT PARTS

Most replacement parts are standard and in stock at local electronic parts stores. However, the parts listed as Wavetek manufactured will only be available from Wavetek or your Wavetek representative.

They may be purchased directly by ordering from:

Wavetek
P. O. Box 651
San Diego, CA 92112

NOTE

Resistor and capacitor values may be on the schematic only; their reference designation appears in both the parts list and schematic.

DESCRIPTION	MFGR	PART NO. OR TYPE
Top Cover Assy	Wavetek	139-017
Bottom Cover	Wavetek	139-302
Battery Holder	Wavetek	139-303
On/Off Disc Assy	Wavetek	139-019
Dial Knob Assy	Wavetek	139-022
Standard Knob	Wavetek	130-314A
Circuit Board Assy	Wavetek	139-011E
Range or Mode Switch Detent Mechanism	Wavetek	139-400
Range Switch Wafer	Wavetek	139-401
Mode Switch Wafer	Wavetek	139-402

DESCRIPTION	MFGR	PART NO. OR TYPE
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Capacitors

Ceramic Disc (C2, 3, 9, 14-22, 26, 27)	Centralab	DD
Ceramic Disc, 0.1 μ F, 10 V (C10-13)	Centralab	UK10-104
Silver Mica, 1100 pF, 1% (C23)	Arco	DM19-112F
Silver Mica, 3300 pF, 5% (C8)	Arco	DM19-332J
Mylar, 0.01 μ F, 1% (C25)	Elpac	Z1A103F
Mylar, 0.1 μ F, 1% (C24)	Elpac	Z1A104F
Mylar, 0.33 μ F, 10% (C7)	Cornell-Dubilier	WMF1P33
Tantalum, 33 μ F, 6 V (C4-6)	Kemet	T32B336K006A5
Electrolytic, 50 μ F, 50 V (C1)	Sprague	500D506G050DD7

Diodes (also see Integrated Circuits)

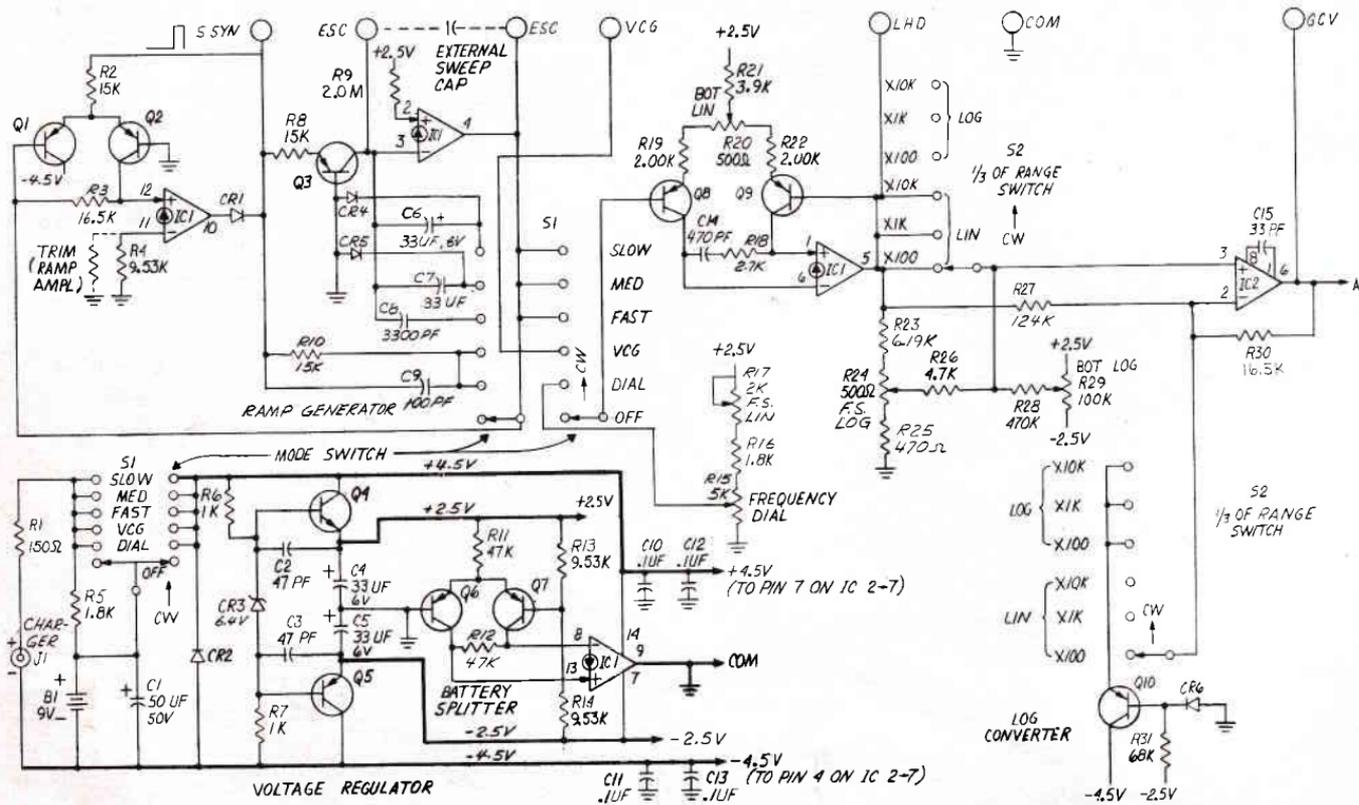
Silicon (CR1, 2, 4, 5, 6)	Fairchild	FD6666
Zener, 6.4 V (CR3)	Commercial	1N4581

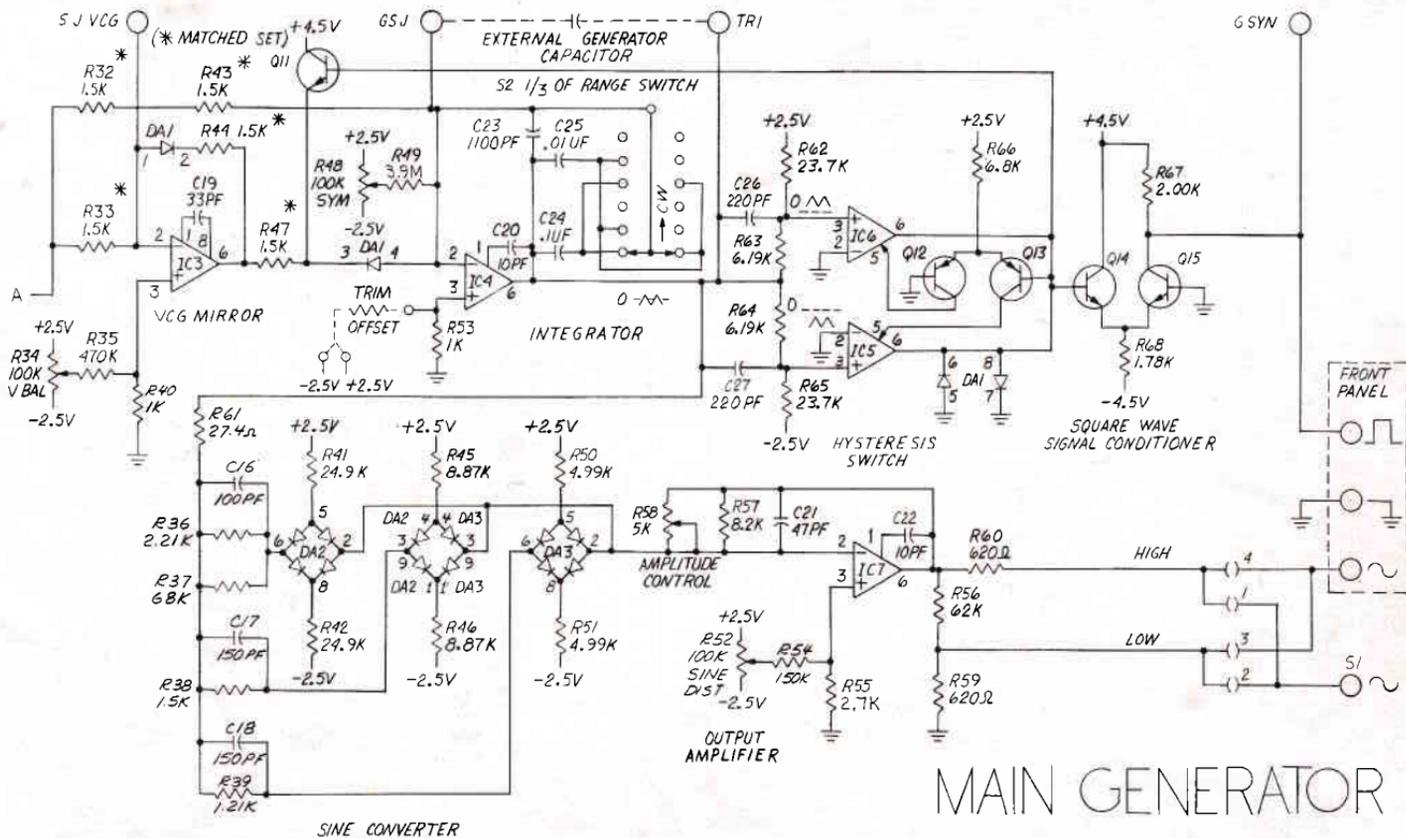
Integrated Circuits

Operational Amplifiers

(IC2, 3)	National	LM301
(IC4, 7)	National	LM318
(IC1)	National	LM3900

DESCRIPTION	MFGR	PART NO. OR TYPE	DESCRIPTION	MFGR	PART NO. OR TYPE
Integrated Circuits (Continued)			Transistors		
(IC5, 6)	RCA	CA3080	NPN (Q4)	Commercial	2N3565
Diode Array			NPN (Q11, 14, 15)	Commercial	2N3646
(DA2, 3)	RCA	CA3019	PNP (Q5-10)	Commercial	2N4248
(DA1)	RCA	CA3039	PNP (Q1-3, 12, 13)	Commercial	2N5139
Potentiometers			Miscellaneous		
Amplitude Control (R58)	Wavetek	139-500	Banana Jacks	H.H. Smith	1509
Dial (R15)	Wavetek	139-501A	Battery, 9 V	Mallory	MN-1604
Trim, 1/8 W (R17, 20, 24, 29, 48, 52)	Beckman	91AR	Battery Charger Jack	Shigoto	MJ-180
Resistors			Battery Connector	Keystone	72
Carbon, 1/2 W, 10% (R1, 2, 5, 8-12, 16, 18, 21, 25, 26, 30, 31, 37, 40, 49, 53-55, 57, 66)	Commercial	RC20GF	Battery Charger	Wavetek	139-020
Carbon, 1/2 W, 5% (R56, 59, 60)	Commercial	RC20GF	NiCad Battery	Eveready	N88
Metal Film, 1/8 W, 1% (R3, 4, 6, 7, 13, 14, 17, 19, 20, 22, 23, 27, 28, 36, 39, 41, 42, 45, 46, 50, 51, 61-65, 67, 68)	Commercial	RN55D	Faston Connector	Amp	42799-2
Matched Set (R32, 33, 43, 44, 47)	Wavetek	139-503-92	Fiber Washer	Commercial	#4





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