INSTRUCTION MANUAL

for

Model 3050

AUDIO SINE/SQUARE WAVE GENERATOR

B & K DIVISION OF DYNASCAN CORPORATION
1801 W. Belle Plaine Avenue
Chicago, Illinois 60613

CONTENTS

GENERAL DESCRIPTION AND FEATURES

The B & K Model 3050 is an audio frequency generator employing the Wien bridge circuit. It provides a sine wave output voltage of 10V RMS over the frequency range of 20Hz to 200kHz. It generates both sine and square waves, as selected by the WAVE FORM switch. This makes the 3050 a versatile signal source for phase and time measurements and for characteristic measurements using square waves, as well as a low-distortion sine wave signal source for audio frequency measurements.

Its main features include:

- All solid state circuitry for extremely high stability, minimum warm-up time and low power consumption.
- Meter-type frequency dial scale calibrated with single-scale graduations for frequency range of 20Hz to 200kHz, with a 4-position range selector.
- 40dB, 20dB and 0dB attenuator and output level control provide for adjusting output voltage from a maximum of 10V RMS down to zero.
- Low output impedance of 600 ohms.
- Sine and square-wave outputs.
- Synchronizing input terminal.
- Extremely high stability, with ±10% variation of line voltage.

SPECIFICATIONS

FREQUENCY:	
Frequency Range:	X1 range: 20Hz–200Hz X10 range: 200Hz–2kHz X100 range: 2kHz–20kHz X1000 range: 20kHz–200kHz
Frequency Accuracy:	±(3% + 2Hz)
SINE-WAVE OUTPUT:	
Output Voltage:	10V RMS, ± 10% at 1kHz
Output vs. Frequency Characteristics (With respect to the level at 1kHz):	± 1dB or less from 20Hz to 100kHz ± 1.5dB or less from 20Hz to 200kHz
Distortion:	0.5% or less from 50Hz to 100kHz 1% or less from 20Hz to 200kHz
SQUARE-WAVE OUTPUT:	
Output Voltage:	10V p-p or more
Tilt:	10% or less (at 20Hz)
Rise and Fall Times:	0.5μ SEC or less
Overshoot:	3% or less
Symmetry:	Within ± 5% (as measured at 1kHz max. output).

OUTPUT (SINE AND SQUARE-WAVE):	
Output Impedance:	Approx. 600Ω.
Output Attenuator:	0dB, 20dB, 40dB (3 steps).
Output Vernier:	Continuously variable output adjustment (OUTPUT LEVEL); adjusts output from zero to maximum level selected by OUTPUT ATT switch.
EXTERNAL SYNCHRONIZATION:	
Synchronizing Range:	Approx. 1%/1.5V or more
Max. Input Voltage:	10V RMS.
Input Impedance:	Approx. 20 000 ohms
EFFECT OF ± 10% LINE VOLTAGE CHANGES:	
Frequency Drift:	Less than ± 0.5%.
Output Level Variation:	Less than ± 0.5dB.
OPERATING TEMPERATURE:	0–50°C at relative humidity of 90% or less.
POWER REQUIREMENTS:	117V AC, 50/60Hz (can be converted to 230V and 100V, 50/60Hz operation).
Power Consumption:	Approx. 7 watts.
DIMENSIONS (overall):	7-3/4" W x 9-5/8" D x 6" H.
WEIGHT:	6¼ pounds.
ACCESSORIES INCLUDED:	(1) One red test cord with basket clip and banana plug. (2) One black test cord with basket clip and banana plug. (3) One 0.1 A fuse. (4) One copy of instruction manual.

OPERATING CONTROLS

FRONT PANEL CONTROLS AND FACILITIES

All panel controls and connectors are described below and shown in Fig. 1.

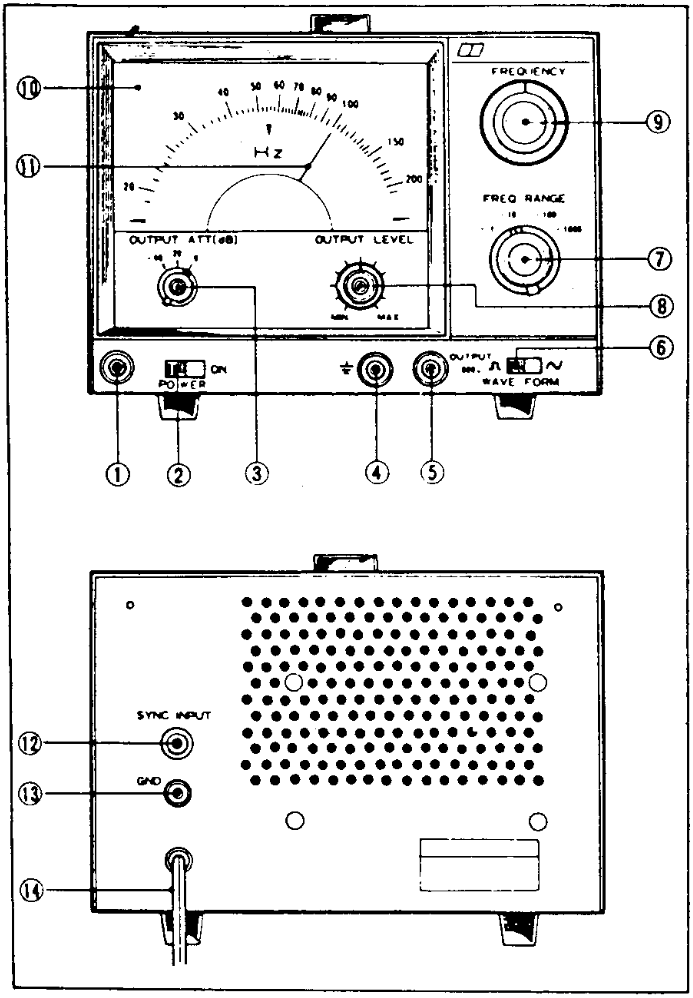

Fig. 1. External view.

1. NEON LAMP: Lights up when POWER switch is turned ON.
2. POWER: Slide switch–turns unit ON and OFF.
3. OUTPUT ATT (dB): Output attenuator:

0dB	In this position, attenuator allows signal to be delivered to the output terminal without any attenuation.
20 or 40dB	In either of these positions, output signal is attenuated 20dB or 40dB.

4. GND: Grounding terminal.

5. OUTPUT ≈600 Ω: Output terminal; approximately 600 ohms impedance.
6. WAVE FORM: Output signal wave form selector.
   ∿ Sine wave output.
   ⎍ Square wave output.
7. FREQ RANGE: Range selector switch; serves as multiplier for frequency setting indicated on dial scale **10**.

X1	20Hz to 200Hz
X10	200Hz to 2kHz
X100	2kHz to 20kHz
X1000	20kHz to 200kHz

8. OUTPUT LEVEL: Used to continuously vary output voltage from 0-10 volts RMS (sine wave). With OUTPUT ATT switch in 0dB position.
9. FREQUENCY: Vernier frequency adjustment dial.
10. SCALE PLATE: Dial scale; has graduations of 20-200.
11. POINTER: Indicates frequency setting.

REAR PANEL CONTROLS AND FACILITIES

12. SYNC INPUT: External sync signal input terminal, for connection to an external synchronizing signal source.
13. GND: Grounding terminal for external sync signal input.
14. POWER CORD: AC line cord.

OPERATING THE MODEL 3050

1. TURNING UNIT ON:
   a. With power cord 14 connected to a power source, turn power switch 2 to ON. This turns on the signal generator and neon lamp 1 lights. Allow 3 minutes for warm-up stabilization.
2. SELECTION OF DESIRED FREQUENCY:
   a. To select a desired frequency, operate FREQUENCY dial with FREQ RANGE selector switch set at appropriate position until pointer 11 is positioned to the desired frequency setting on the frequency dial scale. The frequency is a product of the frequency dial scale reading and frequency range factor.
   b. Example: Suppose you want to select a frequency of 10kHz. Set FREQ RANGE selector switch 7 to position X100. Turn FREQUENCY dial until POINTER 11 is set to graduation 100 on frequency dial scale. The selected frequency is 100 x 100 = 10,000Hz = 10kHz.
3. ADJUSTMENT OF OUTPUT VOLTAGE:
   a. The output voltage is continuously adjustable with OUTPUT LEVEL control 8 to any desired voltage within a voltage range of 0 to 10V RMS. Turning the OUTPUT LEVEL control clockwise increases the output voltage. When the

control is set to the fully clockwise position with the OUTPUT ATT 3 in the 10dB position, the output voltage becomes 10V RMS. If the attenuator is set to the -20dB position, the voltage becomes approximately 1V, and if the attenuator is set to the -40dB position, the voltage becomes approximately 100mV, i.e., one hundredth (-40dB) of the rated 10V output. This makes it possible to obtain smooth adjustment of a very low voltage.

b. Turning WAVE FORM selector switch 6 to the ⎍ position allows the square wave to appear at the output terminal. The square wave output (more than 10V p-p, maximum) may also be adjusted by means of the OUTPUT LEVEL control and OUTPUT ATT in the same manner as mentioned above.

4. USE OF SYNCHRONIZING INPUT TERMINAL:

a. When an external synchronizing signal source is available, connect the sine wave signal from the external signal source to the SYNC INPUT terminal and the oscillating frequency can be synchronized with the external sine wave signal within a synchronizing range shown in Fig. 2, which indicates a ratio of synchronization of 1% per volt of synchronizing signal.

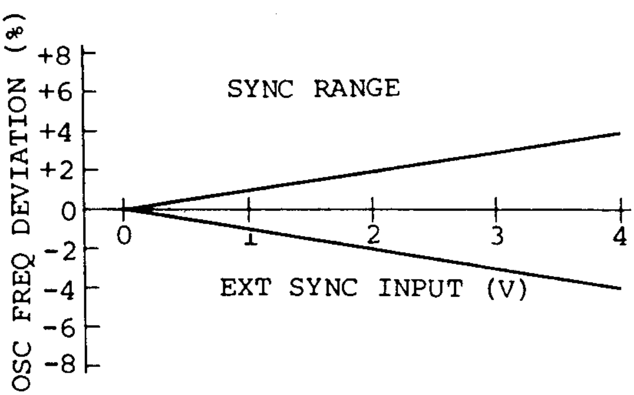

Fig. 2. Sync range.

b. **Example**: Suppose that the external input signal voltage is 2V RMS at 1kHz. The 3050 oscillating frequency can be synchronized with the external signal voltage, as follows:

Set up the 3050 without a synchronizing input signal so that the oscillating frequency is set at 1kHz, ± 2%, i.e., 980 to 1020Hz. With a synchronizing input signal of 2 volts RMS, at 1.0kHz, the 3050 output frequency will be pulled to 1.0kHz.

APPLICATIONS

The following are examples of the uses of this signal generator for measurement of the characteristics of a wide-band amplifer.

A. MEASUREMENTS USING SINE WAVE SIGNAL

Set up the test circuit shown in Fig. 3 with WAVE FORM selector switch of model 3050 set at position ∿ so as to provide sine wave output.

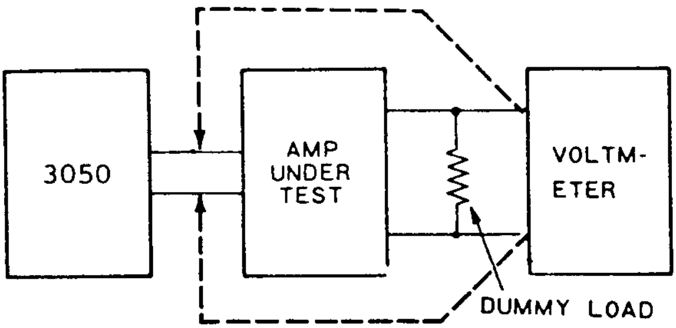

Fig. 3. Test circuit.

1. Input-Output Characteristic Measurement
   a. Set the oscillating frequency to 1kHz by turning FREQUENCY dial until pointer 11 is set to graduation 100 on the frequency dial scale with FREQ RANGE selector switch placed in X10 position.
   b. Using OUTPUT LEVEL control 8 and OUTPUT ATT switch 3 , raise the input voltage (i.e. the *output* voltage of 3050) of the amplifier, starting with minimum voltage, and take readings of the output voltage appearing across the fixed load connected to the output circuit. The AC voltmeter also can be used to monitor the amplifier input voltage.
   c. Plot the above output voltage readings on a system of rectangular coordinates marked on a graph paper with the axes of its ordinates and abcissas calibrated in volts for the output and input voltages respectively and connect the plotted points to obtain an input voltage vs. output characteristic curve. Fig. 4 shows an example of the characteristic curve thus obtained.
   d. The output power W out of an amplifier is given in watts by the formula:

   $$W\ out = E^2 out/R\ \text{Watts},$$

   where E denotes the output voltage and R the dummy load.
   e. In the example of the amplifier having the characteristic shown in Fig. 4, the maximum distortionless output may be calculated as:

   $$13^2/16 = 10.6\ \text{Watts},$$

   since the output characteristic starts to become non-linear at about 13V and dummy load R is 16 Ω as indicated in the diagram.

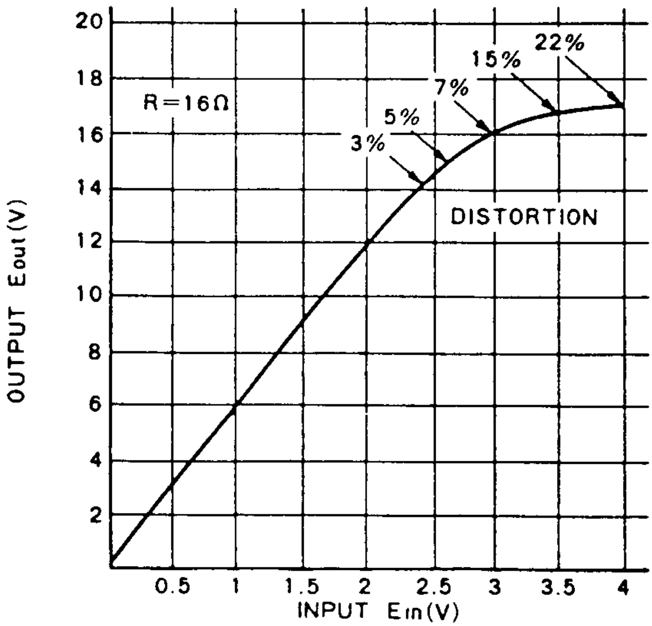

Fig. 4. Output characteristic.

f. Note that the distortion factor of the amplifier with the characteristic curve shown in Fig. 4 cannot be known directly from this measurement, but may be roughly estimated from the degree of the curvature represented by the characteristic curve.

g. The gain G of the above amplifier, expressed as a voltage ratio, is given by the following formula:

$$G = 20 \log_{10} \frac{E\ out}{E\ in} \quad (dB)$$

h. Accordingly, gain G of the amplifier may be calculated as follows, assuming that E_{in} is 1V for E_{out} of 6V:

$$G = 20 \log_{10} 6$$
$$= 20 \times 0.778$$
$$15.6\ (dB)$$

i. For true power gain, however, the impedances of input and output must be included. Assume the amplifier input impedance is 100,000 ohms and the output impedance is 16 ohms as indicated:

$$G = 10 \log_{10} \frac{\frac{E^2 out}{Z\ out}}{\frac{E^2 in}{Z\ in}}$$

$$= 10 \log_{10} \frac{\frac{36}{16}}{\frac{1}{100,000}}$$

$$= 10 \log_{10} 2.25 \times 10^5$$

$$= 10 (5.35)$$
$$= 53.5 \text{ dB}$$

2. Output Versus Frequency Measurements
   a. Set model 3050 output voltage of 1V at 1kHz and apply the output of model 3050 to the amplifier under test. This will provide an output voltage of 6V as shown in Fig. 5.

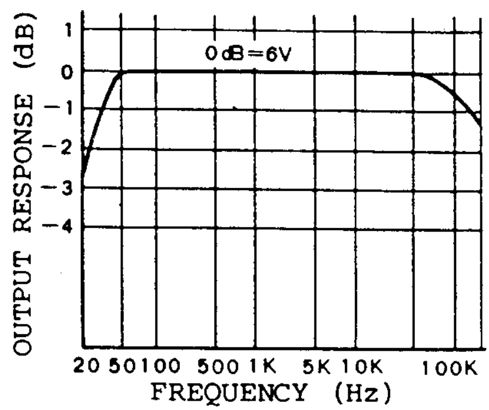

Fig. 5. Frequency characteristic.

   Change the frequency from 20Hz to 200kHz with the output voltage of model 3050 constant, while taking the corresponding output voltage readings on the voltmeter.

   b. Plot the above output voltage readings on a system of coordinates marked on a graph paper with axes of its ordinates and abscissas, calibrated in linear dB and logarithmic frequency scales respectively for the output voltages and their corresponding frequencies and connect the plotted points to obtain an output versus frequency characteristic.
   c. In the above output voltage measurement, it is a general practice to employ the logarithmic dB scale provided on an electronic voltmeter. In this case the zero dB output reference is 6 volts at 1kHz.
   d. Figure 5 shows an example of the output versus frequency characteristic of an amplifier obtained as mentioned above.
   e. As seen from the characteristic curve, the above amplifier provides a completely flat characteristic from 50Hz to 50kHz, with a -3dB bandwidth of 20Hz to beyond 200kHz.

f. The attenuation at the lower frequencies may be attributed to the increasing impedance of the coupling capacitors in the RC-coupled stages, or the increased impedance of emitter bypass capacitors. The attenuation in the higher frequency region, on the contrary, may be due to the stray capacitances of the circuit.

3. Measurement of Negative Feedback Value

To determine the amount of negative feedback of an amplifier circuit, proceed as follows:

a. First apply the output of Model 3050 to the input terminals of the set under test with Model 3050 set up to deliver a sine wave output of 1000 Hz.

b. Connect an output meter across the voice coil of the speaker or dummy load, as shown in Fig. 6, and adjust the 3050 so that the amplifier delivers rated output. Set the gain control on the amplifier, if provided, in the fully clockwise position. Note the amplifier input voltage required.

c. Disconnect the negative feedback circuit and lower the output of 3050 slowly until the output meter reads the same value as the previous reading. Once again note the amplifier input level.

d. Let E1 and E2 denote the output voltages of 3050 under the conditions where the 3050 is operated with and without the negative feedback, respectively, and the value of negative feedback is given by:

$$\text{Negative Feedback} = 20 \log \frac{E1}{E2} \text{ (dB)}$$

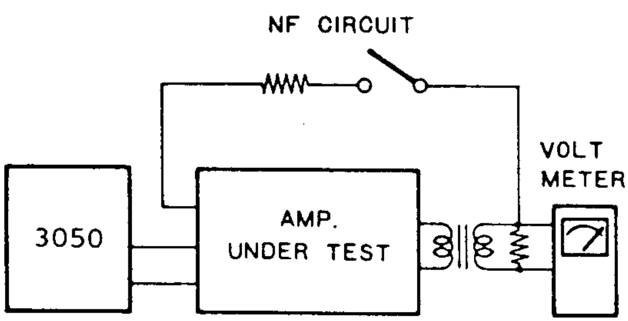

Fig. 6. Measurement of NF (negative feedback) value.

4. Phase Characteristic Measurement

a. Phase characteristics of high fidelity amplifiers are important and must be taken into account when designing amplifiers using large amounts of negative feedback. If the phase shift is severe at the extremes of the frequency response, the feedback phase may shift from negative to positive, causing high or low frequency instability.

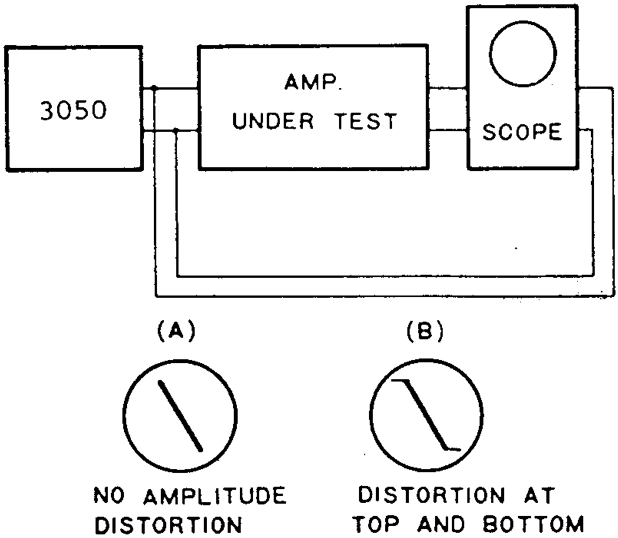

Fig. 7. Phase characteristic measurement.

b. To determine phase shift, connect the 3050 and an oscilloscope to the amplifier under test as shown in Fig. 7. If there is no phase shift of the output with respect to the input signal of amplifier under the above condition, the oscilloscope waveform will be a straight line similar to that shown in Fig. 7(A). If the straight line displayed is curved at its top and bottom sections as shown in Fig. 7(B), it indicates that the output signal of amplifier contains amplitude distortion. If this occurs, reduce the output level of the 3050.

c. Changing the frequency of the 3050 under the above condition causes the straight line on the oscilloscope to expand gradually into an ellipse. By utilizing the configuration of this ellipse, the phase shift can be calculated as follows (see Fig. 8):

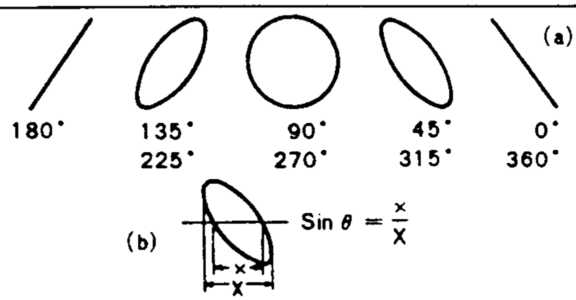

Fig. 8. Method for calculating phase angle.

d. First, measure the maximum horizontal deflection of the ellipse. Suppose that the deflection is Xmm as shown in Fig. 8. Here, let us suppose that the horizontal axis section, which is cut off by the ellipse, has a length of x mm. And, the phase shift angle θ is given by

$$\sin \theta = \frac{x}{X}$$

e. Find θ from a table of trigonometric functions and the value obtained gives the angle of phase shift.

B. TEST OF AMPLIFIERS USING SQUARE WAVES

1. This method is used to measure the dynamic frequency characteristic of an amplifier. In this case, the 3050 is used as the signal source with its WAVE FORM selector switch 6 set to position ⎍. The test circuit of Fig. 3 may be used, with the electronic voltmeter replaced by, or connected in parallel with, an oscilloscope.
2. Fig. 9 shows an example of the amplifier output waveforms and frequency characteristics obtained with the square wave input under various conditions. During these tests, the input to the amplifier must be adjusted to prevent saturation caused by excessive signal input.

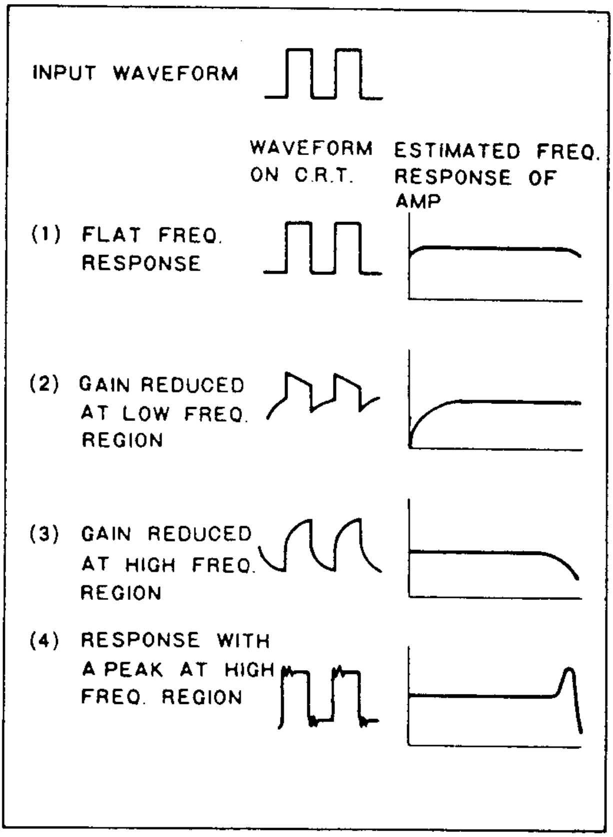

Fig. 9. Test of amplifier, using square wave.

3. The square wave test is also useful to determine the transient and phase characteristics of an amplifier, in addition to the frequency characteristic.

CIRCUIT DESCRIPTION

1. SUMMARY

When reading the following descriptions, please refer to the circuit diagram at end of this manual.

The sine wave signal generated by the Wien bridge oscillator circuit is fed through the WAVE FORM selector switch, set at the ∿ position, to the OUTPUT control, by means of which it is adjusted to any desired voltage.

If the WAVE FORM selector switch is in the ⎍ position, the sine wave signal output is fed from the switch to a square wave shaping circuit, where it is shaped into the square wave.

The square wave output signal from the square wave shaping circuit is then fed to the OUTPUT control, by means of which it is adjusted to any desired voltage in the same manner as for the sine wave signal.

The adjusted signal voltage is applied to the output circuit, where its impedance is appropriately converted, and then delivered through an output attenuator to the output terminal. This terminal provides an output impedance of approximately, 600 ohms, while the attenuator provides attenuation steps of 0dB, 20dB and 40dB.

2. WIEN BRIDGE OSCILLATOR CIRCUIT

The Wien bridge oscillator circuit elements consist of the resistance elements (FREQ RANGE), which may be switched over 4 ranges, and a variable capacitor (FREQUENCY dial). Each of the 4 selected ranges has a 10 to 1 adjustable frequency range to provide continuous overlapping coverage of the entire frequency range from 20Hz to 200kHz.

The amplifier circuit for the oscillator circuit is a high input impedance circuit employing an FET (Q1). Transistors Q2 and Q3 serve as the 2nd and 3rd amplifiers, while transistors Q4 and Q5 form a complementary output circuit.

Part of the output voltage is fed back with positive polarity through variable resistor VR1 to the oscillator elements of the Wien bridge to sustain the oscillation.

Another part of the output voltage is fed back with negative polarity through resistor R6 to the emitter of transistor Q2 to minimize waveform distortion.

The lamp inserted in the above-mentioned negative feedback loop stabilizes the amplitude of feedback voltage with its non-linear characteristic.

3. SQUARE WAVE SHAPING CIRCUIT

The square wave shaping circuit is essentially a Schmitt circuit consisting of transistors Q6 and Q7, which shapes the sine wave signal from the oscillator circuit into the proper square wave.

When there is no signal input, transistors Q6 and Q7 remain OFF and ON respectively in the Schmitt circuit. If a signal is applied to the input of this circuit, transistors Q6 and Q7 invert their operating conditions at the input signal rate, and generate a square wave at the output of the shaping circuit.

The symmetry of this circuit is factory adjusted to the proper value by means of variable resistor VR2.

4. OUTPUT CIRCUIT

The output circuit is essentially an impedance converter formed into a complementary output circuit comprised of transistors Q8 and Q9 with low output impedance. Operating with resistor R33 inserted in series, it provides 600 ohms output.

5. OUTPUT ATTENUATOR

When placed in the 0dB position, the OUTPUT ATTENUATOR allows the output signal to pass directly to the OUTPUT terminal. The OUTPUT LEVEL control can be used to vary the output from zero to maximum (10V RMS for sine wave output, or 10V p-p for square wave output).

In the 20dB position, it allows the signal to pass through an inverted L-attenuator with an attenuation of 20dB (1/10); the maximum output available using the OUTPUT LEVEL control is reduced to one-tenth.

In the 40dB position, it allows the signal to pass through an inverted L-attenuator with an attenuation of 40dB (1/100); the maximum output available using the OUTPUT LEVEL control is reduced to one-hundredth.

6. POWER SUPPLY

The secondary voltage of Transformer T1 is rectified by voltage doubler silicon rectifier D1 and D2 and capacitors C19 and C20 into a DC voltage. This DC voltage is supplied through the smoothing circuit to all of the circuits as +B supply (48V).

1. REMOVAL OF CASE (See Fig. 10)

Remove 3 screws each on left and right side plates. Using handle on top of case, lift up until case is removed from chassis.

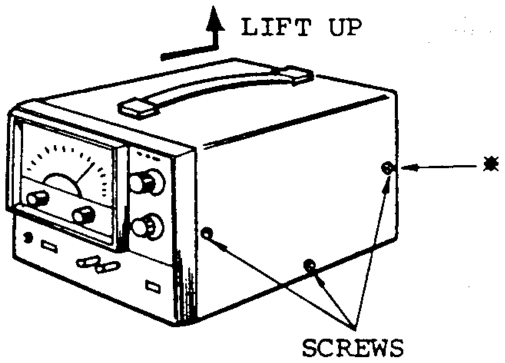

Fig. 10. How to remove case.

2. REPLACING THE CASE (See Fig. 11)

To attach case to chassis, proceed as follows:

a. Loosely screw 2 screws onto chassis at holes provided on rear left and right sides (marked with *).

b. Place case onto chassis starting with rear side and fit the slots provided at middle rear edges of left and right side plates onto the setscrews attached beforehand (marked wtih *). Press case down over chassis while pushing it rearward, until case is placed on chassis properly. In the above operation, be careful not to allow front ends of case to strike the panel and damage it.

c. Then, fix left and right side plates of case to chassis by screwing 2 screws into holes provided on front and bottom edges of side plates. Also, tighten screws at middle rear edges of side plates.

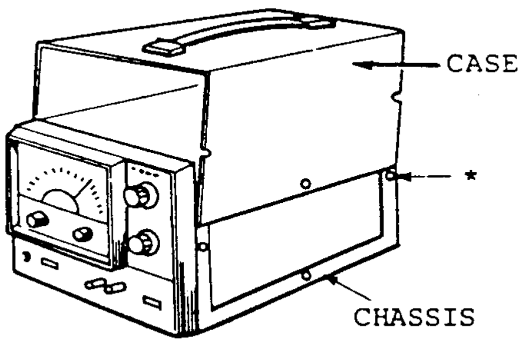

Fig. 11. Replacing the case.

CAUTION

ALWAYS unplug the 3050 power cord when assembling or disassembling the unit. Also, when removing case from chassis, take care not to damage the internal printed circuit board or other components.

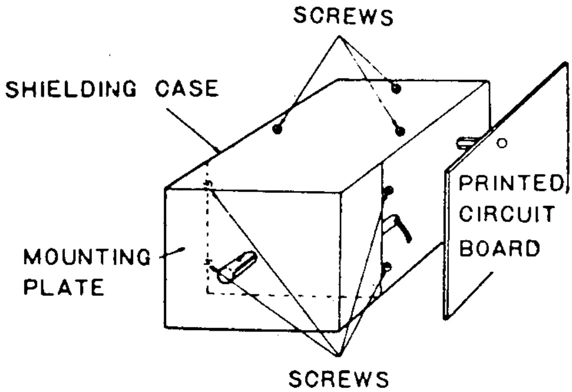

Fig. 12. Removing the shielding case.

3. REMOVAL OF SHIELDING CASE (See Fig. 12)
   a. When checking the variable capacitor, remove top plate of shielding case after unscrewing 3 setscrews, using a Phillips-head screwdriver (+).
   b. The shielding case covering the variable capacitor may be removed easily when 2 screws are removed from left and right side plates.

NOTE

In performing the above operation, be careful never to allow the variable capacitor mounting plate to move.

   c. To mount the shielding case to the chassis, perform the steps for removing the case, in reverse order.

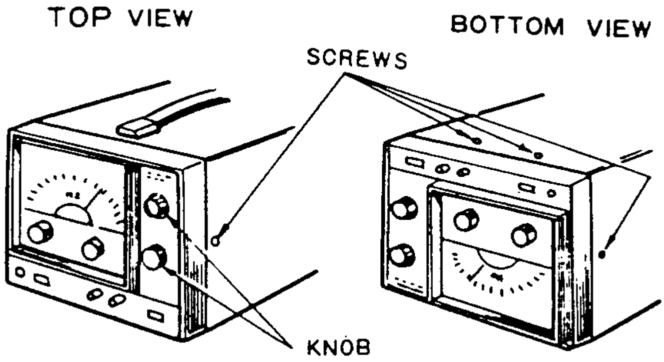

Fig. 13. Removing front panel.

4. REMOVAL OF FRONT PANEL (See Fig. 13)

To remove front panel, proceed as follows:

a. Loosen the setscrews for 3 knobs on the panel and remove the knobs. Then, remove the left and right screws provided on the case directly behind the panel to fix both the case and panel in position. Further, remove 2 screws provided on the bottom side of the panel.

b. Then, hold the panel with both hands and pull it toward you. The panel will come off the chassis.

c. When removing the panel, pull it forward slowly, taking care that the terminals, slide switches, neon lamp, etc. are clear.

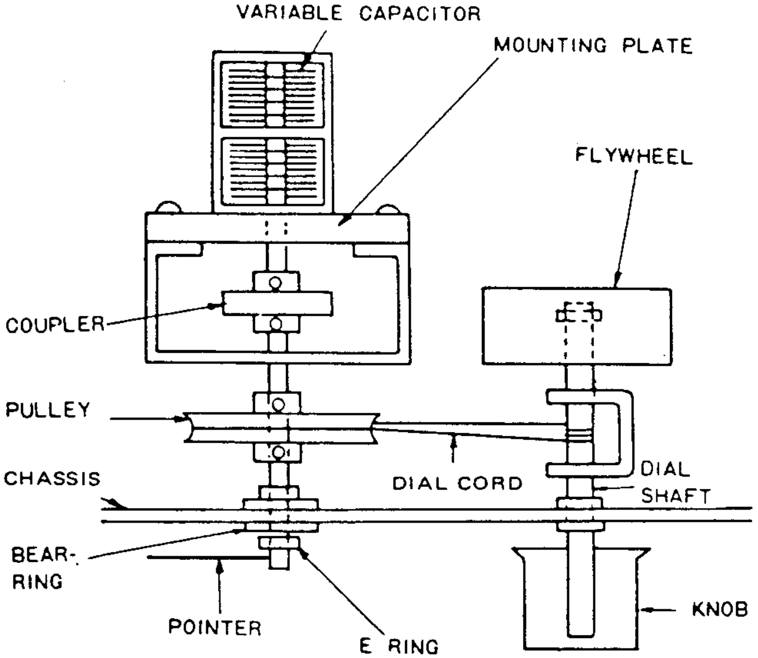

Fig. 14. Removal of dial mechanism.

5. REMOVAL OF DIAL MECHANISM (See Fig. 14)

When the front panel is removed and the top cover is removed from the shielding case, the dial drive mechanism is exposed, as shown in Fig. 14. Proceed as follows:

a. Loosen but do not remove setscrew for the pulley. This allows the pulley to idle when it is driven by means of the knob.

b. Disconnect dial cord from the spring; this removes tension from dial cord.

c. Loosen the setscrew for the coupler. This completely separates the variable capacitor from the pointer shaft and the shaft may be removed by withdrawing it toward you.

The foregoing steps allow you to disassemble the dial mechanism. To assemble the parts into the dial mechanism, follow the above steps in reverse sequence.

ADJUSTMENTS

The test equipment to be used for the calibration should be calibrated beforehand and line voltage should be set at nominal.

1. PRELIMINARY ADJUSTMENTS

   Set controls as follows unless otherwise specified:

   a. WAVE FORM 6 at position∿.

   b. OUTPUT ATT 3 at position 0dB

   c. FREQ RANGE 7 at position X10.

   d. OUTPUT LEVEL 8 at fully clockwise.

   e. FREQUENCY dial 9 at graduation 100.

   Prior to performing any adjustments, make DC voltage checks in all circuits to make sure that all circuits are operating normally. Refer to the circuit diagram for typical readings.

2. ADJUSTMENT OF OUTPUT VOLTAGE:

   a. Connect an AC voltmeter to output terminals 5 and 4.

   b. Adjust semi-fixed variable resistor VR1 until the AC voltmeter gives an indication of 10V RMS.

   Do not adjust the signal generator so that it provides an output voltage *higher* than the rated value of 10V RMS. Otherwise, the distortion will be excessive.

3. ADJUSTMENT OF SYMMETRY OF SQUARE WAVE (See Fig. 15)

   a. Place WAVE FORM switch 6 in position ⎍.

   b. Connect an oscilloscope to output terminals.

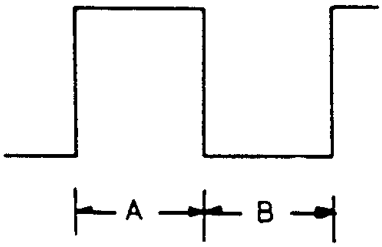

Fig. 15. Adjusting duty ratio of square wave.

Adjust VR2 until the square wave form appearing on the oscilloscope screen provides the same durations for its half cycles A and B shown in Figure 15.

4. ZERO SETTING OF POINTER

   a. Set the variable capacitor so that it provides the maximum capacity (fully meshed).

   b. Adjust coupler and pulley setscrew under the above condition so that pointer is set to position (1) in the diagram.

c. Move pointer clockwise and check to see that it is set precisely to the index at positions (2) and (3). If pointer fails to set to the index, loosen screws for the dial scale plate and adjust scale plate until pointer is set to the index as mentioned above.

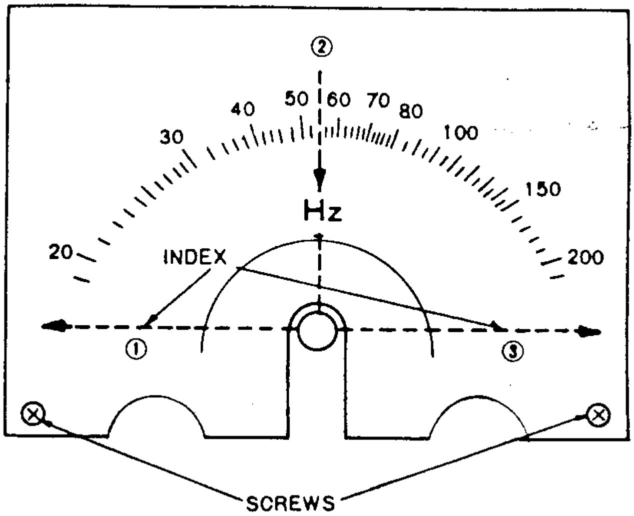

Fig. 16. Zero setting of pointer.

5. ADJUSTMENT OF OSCILLATOR FREQUENCY

a. Connect an AC voltmeter and frequency counter to the output terminals.

CAUTION

If voltmeter and/or frequency counter input impedance is less than 500kΩ, insert a suitable resistor in series with the counter to minimize loading.

b. Set pointer to graduation 20 and FREQ RANGE switch to X10. Check that the frequency is 200Hz ±(3% + 2Hz) under the above condition. Also, note the output level.

c. Set the pointer to graduation 200, and adjust TC101a and TC101b until the frequency is 2kHz ±(3% + 2Hz). The final frequency setting is made while observing the output level of the generator. It should equal that obtained in the preceding step.

d. Note that TC101a and TC101b (trimmers) are mounted on the variable capacitor at the left side.

e. After the above adjustments, the calibration between 20–200 is complete.

f. With FREQ RANGE switch set at the X1 position, and the pointer at 20, adjust VR3 until the output frequency is 20Hz ±2Hz, and the oscillator level is set as mentioned above.

6. PRECAUTIONS

a. When changing the primary voltage, change the power circuit connections as follows (see Fig. 17):

SOURCE	CONNECTIONS AT TERMINALS
100VAC	Wire between P.C. board terminals (22) and (21). Fuse size, 0.1 A.
117VAC	Wire between P.C. board terminals (22) and (17). Fuse size, 0.1A.
230VAC	Wire between P.C. board terminals (22) and (16). Fuse size, 1/16 A.

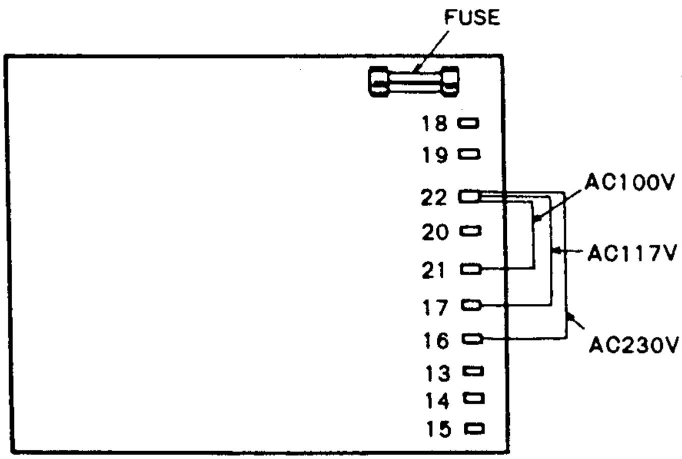

Fig. 17. Altering power transformer primary voltage.

b. The 3050 operates as soon as the power switch is turned to ON. In order to obtain precise measurements, however, allow about 3 minutes for the unit to warm up before proceeding to make your measurements.

c. Do not apply a DC voltage to the output terminals. If it becomes necessary to connect the output terminals to a circuit carrying DC voltage, always insert a capacitor between the terminals and the circuit to reject the DC component.

d. Don't connect the cable or other load to the external synchronizing input terminal unless absolutely necessary.

e. When connecting the external synchronizing signal carrying the DC signal component, insert a capacitor in series with the terminal to reject the DC signal component.

Also, be careful not to apply an AC voltage of more than 10V RMS to the terminal.

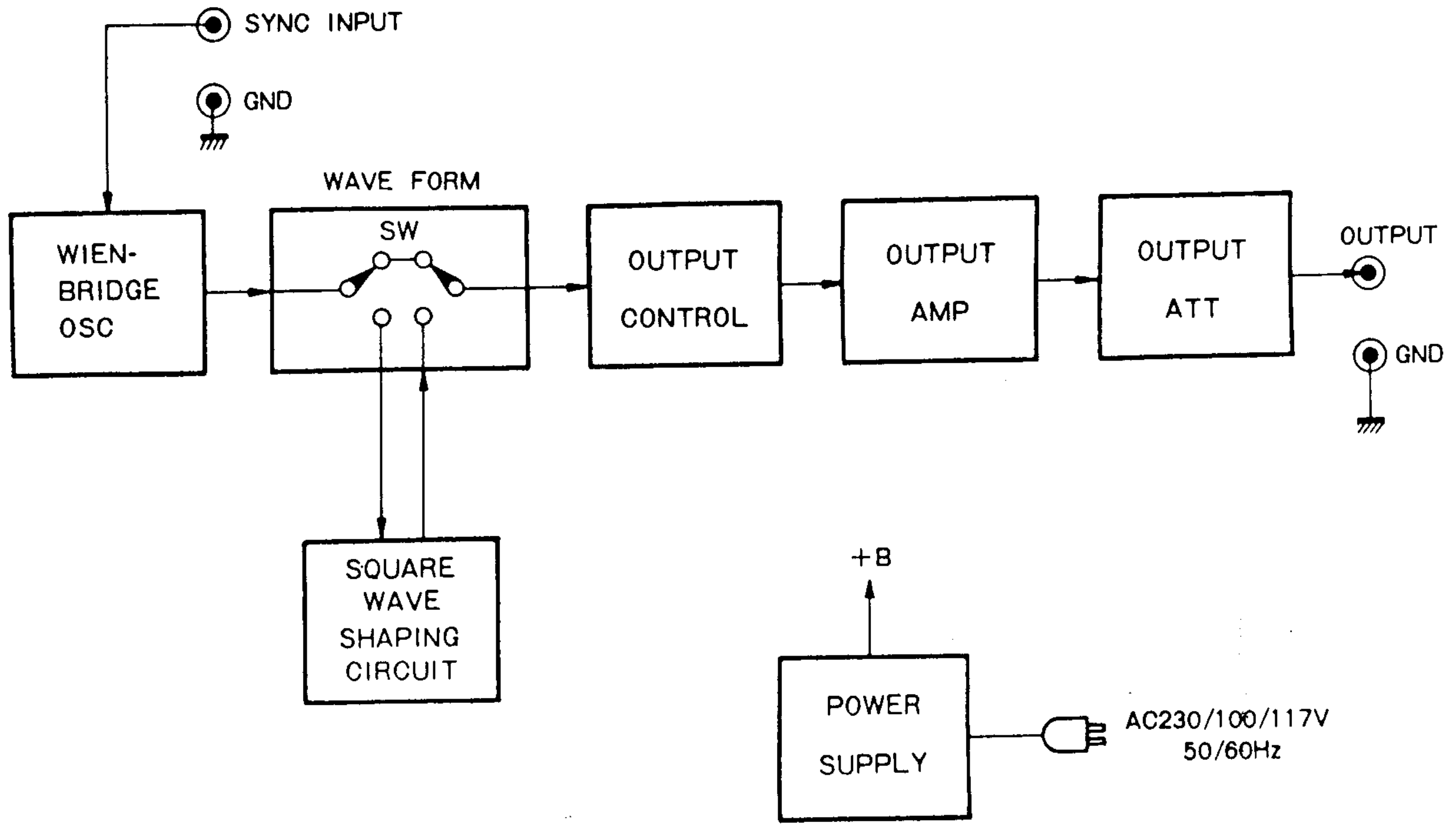

Fig. 18. Block diagram.