

HIGH STABILITY  
**AG-202A**  
CR OSCILLATOR

**INSTRUCTION MANUAL**





FEATURES

- All solid state circuitry insures extremely high stability, minimum warm-up time and less power consumption.
- Meter type frequency dial scale calibrated with single-scale graduations for frequency range of 20 Hz ~ 200 kHz with a 4-position range selector.
- -20 dB (1/10), -40 dB (1/100) attenuator with fine output level control provide for adjusting output voltage 10 V r.m.s. down to 0.
- Low output impedance of 600Ω.
- Sine and square waves easily available.
- Synchronizing input terminal.
- Extremely high stability provided against variation of power source voltage.

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## SPECIFICATIONS

<b>Frequency range</b>	X 1 range: 20 Hz ~ 200 Hz
	X 10 range: 200 Hz ~ 2 kHz
	X 100 range: 2 kHz ~ 20 kHz
	X 1000 range: 20 kHz ~ 200 kHz
<b>Frequency accuracy</b>	$\pm (3\% + 2 \text{ Hz})$ [at max. output]

## SINE-WAVE CHARACTERISTICS

<b>Output voltage</b>	10V r.m.s. $\pm 10\%$ (As measured at 1 kHz under max. output)
<b>Frequency characteristic</b> (With respect to the level at 1 kHz)	$\pm 1 \text{ dB}$ or less from 20 Hz to 100 kHz
	$\pm 1.5 \text{ dB}$ or less from 20 Hz to 200 kHz
<b>Distortion factor</b>	0.5% or less from 50 Hz to 100 kHz 1% or less from 20 Hz to 200 kHz

## SQUARE-WAVE CHARACTERISTICS

<b>Output voltage</b>	10 V <sub>pp</sub> or more
<b>Sag</b>	10% or less (at 20 Hz)
<b>Rise and fall times</b>	0.5 $\mu\text{s}$ or less
<b>Overshoot</b>	3% or less
<b>Duty ratio</b>	50% $\pm 5\%$ (as measured at 1 kHz under max. output)

## EXTERNAL SYNCHRONIZATION CHARACTERISTICS

<b>Synchronizing range</b>	Approx. 1% for 1.5V or more
<b>Max. allowable input voltage</b>	10V r.m.s.
<b>Input Impedance</b>	Approx. 20 k $\Omega$

<b>Output impedance</b>	Approx. 600 $\Omega$
<b>Output attenuator</b>	Approx. 0dB, -20dB and -40dB in 3 steps

<b>Stability against power source voltage variation</b>	(With respect to a variation of 100/117/230 volts $\pm 10\%$ )
<b>Frequency drift</b>	Within $\pm 0.5\%$
<b>Output voltage variation</b>	Within $\pm 0.5 \text{ dB}$

<b>Operating temperature</b>	0 ~ 50°C under a relative humidity of 90% or less
<b>Power requirement</b>	AC 230/117/100V, 50/60 Hz
<b>Power consumption</b>	Approx. 4.7W

## Dimensions

<b>Width:</b>	186mm (190 mm)
<b>Height:</b>	131mm (154mm)
<b>Depth:</b>	220mm (245mm)

Maximum dimensions are indicated in brackets ( ).

## Weight

2.8 kg (6.2 lbs.)

## Accessories

<b>Input cord:</b>	One red and black test cord with basket clip and banana plug
<b>Fuse:</b>	0.1A ..... 2 pcs. 0.2A ..... 2 pcs.
<b>Instruction manual:</b>	One copy

## CIRCUIT DESCRIPTION

### SUMMARY

When reading the following descriptions, please refer to the block diagram and the schematic diagram (Attached the 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  $\surd$  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  $\perp$  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 with a better rise time.

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 did 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 approx.  $600\Omega$ . The output attenuator provides selectable attenuations of approximately  $-20$  dB (1/10) and  $-40$  dB (1/100).

### WIEN BRIDGE OSCILLATOR CIRCUIT

The Wien bridge oscillator circuit elements consist of the resistance elements (FREQ. RANGE), which may be switched over for 4 ranges, and a variable capacitance element using a variable capacitor (FREQUENCY dial). These resistance and variable capacitance elements provide means to vary the oscillating frequency continuously over 10 times its frequency or more, thereby determining any desired frequency within the entire frequency range from 20 Hz to 200 kHz.

The amplifier circuit for the oscillator circuit is a

high input impedance circuit which employing an FET (2SK30A-Y). Transistor Q1 is the above-mentioned FET forming the initial stage. Transistors Q2 (2SA561-Y) and Q3 (2SC734-Y) serves as the 2nd and 3rd amplifiers. While, transistors Q4 (2SC734-Y) and Q5(2SA561-Y) 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 Wien bridge to sustain the oscillation.

While, another part of the output voltage is fed back with negative polarity through resistor R6 to the emitter of transistor Q2 in order to have amplifier circuit deliver the sine wave signal with less waveform distortion.

The lamp inserted in the abovementioned negative feedback loop stabilizes the amplitude of feedback voltage with its non-linear characteristics.

### SQUARE WAVE SHAPING CIRCUIT

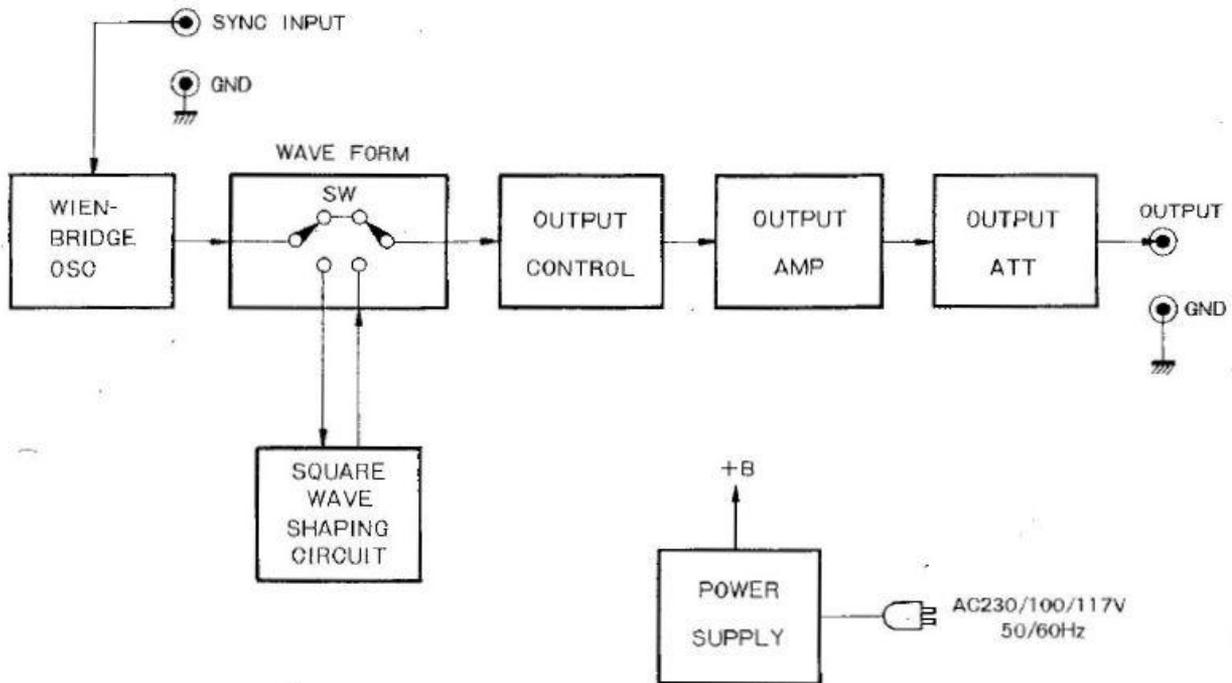
The square wave shaping circuit is essentially a Schmitt circuit which, comprising transistors Q6 and Q7 shapes the sine wave signal from the oscillator circuit into the proper square wave.

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

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

### OUTPUT CIRCUIT

The output circuit is essentially an impedance converter formed into a complementary output circuit comprising transistors Q8 and Q9 with a low impedance.



BLOCK DIAGRAM OF AG-202A

## OUTPUT ATTENUATOR

The output attenuator selects three attenuations of 0 dB, -20 dB or -40 dB (1/1, 1/10 or 1/100). When turned in the 0 dB position with the output attenuator, turned fully clockwise, the attenuator passes an output voltage of approximately 10V r.m.s. (sine wave) to the output terminal (600Ω output impedance).

## POWER SUPPLY

Power transformer T1 transforms AC230V (or 100V, 117V) input into necessary AC voltage, which is rectified by voltage doubler silicon rectifiers D1 and D2 and capacitors C19 and C20 into a DC voltage. This DC voltage is supplied through the smoothing circuit to the all of circuits as +B supply (48 V).

PANEL CONTROLS AND THEIR FUNCTIONS

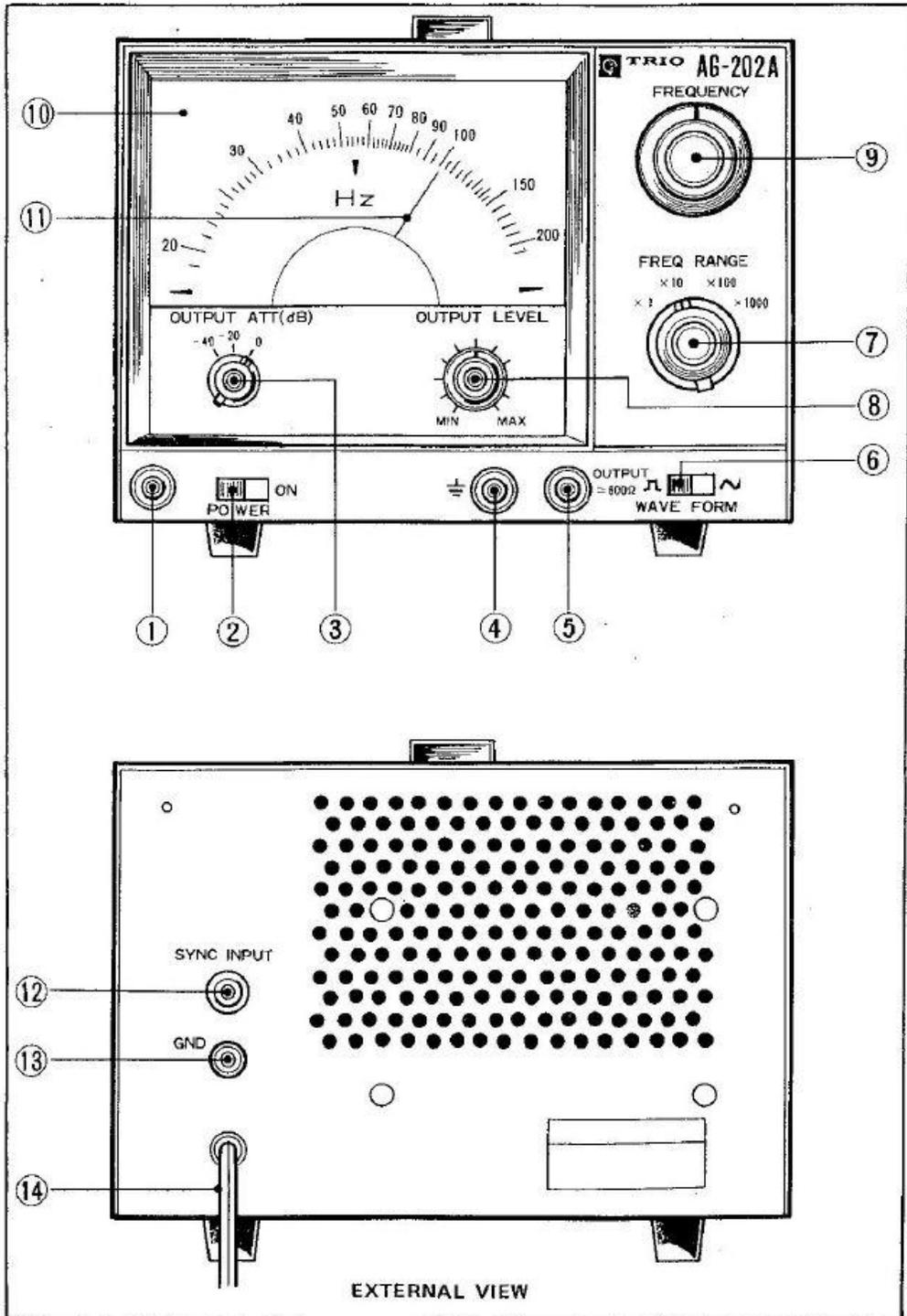
**FRONT PANEL**

- (1) **NEON LAMP**  
Neon pilot lamp which lights when POWER switch (2) is turned to ON.
- (2) **POWER**  
Power slide switch which, when slided into right-hand position ON, turns on the set.
- (3) **OUTPUT ATT (dB)**  
Output attenuator.  
Used in conjunction with OUTPUT LEVEL (8) control, the output attenuator selects an attenuation of approximately 0 dB, -20 dB or -40 dB (3 steps).
- (4) **GND**  
Grounding terminal.
- (5) **OUTPUT  $\approx 600\Omega$**   
Output terminals with output impedance of approx.  $600\Omega$ .
- (6) **WAVE FORM**  
Output signal waveform selector switch.  
Sine wave output available when slided into right hand position. Square wave output available when slided into left hand position.
- (7) **FREQ RANGE**  
Oscillating frequency range selector switch which, serving as a multiplier for a frequency setting indicated by pointer (11) and dial scale (10), provides means to directly read an oscillating frequency.  
X 1 . . . . . Range from 20 Hz to 200 Hz  
X 10 . . . . . Range from 200 Hz to 2 kHz  
X 100 . . . . . Range from 2 kHz to 20 kHz  
X 1000 . . . . . Range from 20 kHz to 200 kHz

- (8) **OUTPUT LEVEL**  
This control provides means to continuously vary the output voltage from 0 to 10V r.m.s. (sine wave).
- (9) **FREQUENCY**  
Frequency adjustment dial which, driving pointer (11) ganged with a variable capacitor, provides means to determine an oscillating frequency.
- (10) **(SCALE PLATE)**  
Dial scale plate with graduations 20 ~ 200 for oscillating frequencies.
- (11) **(POINTER)**  
Pointer which provide means for indicating dial scale setting.

**REAR PANEL**

- (12) **SYNC INPUT**  
External synchronizing signal input terminal, which provides means for connection of CR oscillator AG-202A to an external synchronizing signal source.
- (13) **GND**  
Grounding terminal for external synchronizing signal input terminal
- (14) **(POWER CORD)**  
AC line cord.



## OPERATING INSTRUCTIONS

With power cord (14) connected to a power source, turn power switch (2) to ON. This turns neon lamp (1) on and places the CR oscillator set in the running condition. Allow 3 minutes for the set to warm up in order to stabilize the operation.

## SELECTION OF DESIRED FREQUENCY

To select a desired frequency, operate FREQUENCY dial with FREQ. RANGE selector switch set at appropriate position until pointer (11) ganged with the variable capacitor is positioned to the desired frequency setting on the frequency dial scale. Therefore, oscillating frequency is a product of the figure on the frequency dial scale and frequency range factor.

**(Example)** Suppose that you want to select a frequency of 10 kHz and proceed as follows:

Set FREQ RANGE selector switch (7) to position X 100. Turn FREQUENCY dial until POINTER (11) is set to graduation 100 on frequency dial scale

And the frequency is selected:

$$100 \times 100 = 10,000 \text{ Hz} = 10 \text{ kHz}$$

## ADJUSTMENT OF OUTPUT VOLTAGE

The output voltage may be continuously taken out from output terminal (5), as adjusted by OUTPUT control (8), to any desired voltage within a voltage range of 0 to 10 V r.m.s.

Turning the OUTPUT control (8) clockwise, increases the output voltage. When the control is set to the fully clockwise position with the OUTPUT ATT (3) in the 0 dB position, the output voltage becomes 10 V r.m.s. If the attenuator is set to -20 dB, the output voltage decreases to 1 V (approximately 1/10) and if it is set to -40 dB the output further decreases to approximately 100 mV (1/100). This makes it possible to obtain a minute voltage smoothly.

Turning WAVE FORM selector switch (3) to the  $\square$

position allows the square wave to appear at the output terminal. The square wave output (More than 10 Vpp, maximum) may also be adjusted by means of OUTPUT control (8) and output attenuator (3) in the same manner as mentioned above.

## USE OF SYNCHRONIZING INPUT TERMINAL

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. 1, which indicates a ratio of synchronization of approx.  $\pm 1.5\%$  (compared with the rated ratio of  $\pm 1\%$  or more) per input voltage of 1.5 V.

**(Example)** Suppose that the external input signal voltage is 3 V r.m.s. at 1 kHz and the AG-202A oscillating frequency can be synchronized with the external signal voltage as follows:

Set up the AG-202A so that the oscillating frequency is set to within 1 kHz  $\pm (1.5\% \times 2)$ , i.e. 970~1030 Hz. And, the output signal can be taken out at 1 kHz.

Note, however, the 1.5% shown above is the typical value for synchronizing range.

Also, the synchronizing range is increased approx. 1.5% per voltage.

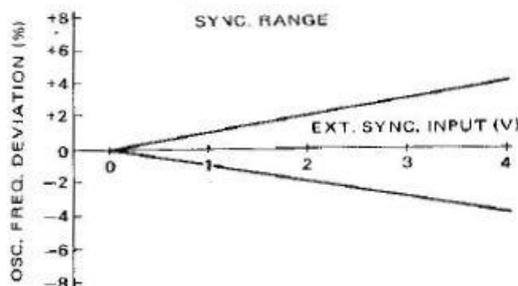


Fig. 1 Sync. Range of Ext. Sync. Input

## APPLICATIONS

The followings are the examples of the uses of this CR oscillator operated for measurements of the characteristics of a wide band amplifier.

### MEASUREMENT USING SINE WAVE SIGNAL

Set up the test circuit shown in Fig. 2 with WAVE FORM selector switch of model AG-202A set at position  $\sim$  so as to provide the sine wave signal.

### INPUT-OUTPUT CHARACTERISTIC MEASUREMENT

Set the oscillating frequency to 1 kHz by turning FREQUENCY dial until pointer (11) is set to graduation 100 on the frequency dial scale with FREQ RANGE selector switch placed in X 10 position.

Using OUTPUT LEVEL control (8) and OUTPUT ATT switch (3) raise the input voltage (i.e. the output voltage of AG-202A) of the amplifier under starting with 0V and take readings of the output voltages appearing across the fixed load connected to the output circuit.

If the amplifier under test provides an input impedance which is high enough compared with an impedance of  $600\Omega$ , there is no trouble about the output voltage measured. If the input impedance is

lower than  $600\Omega$ , on the contrary, the output voltage is lowered depending on the ratio of the output impedance to the load impedance.

Plot the above output voltage readings on a system of rectangular coordinates marked on a graph paper with the axes of its ordinates and abscissas calibrated in volt for the output and input voltages respectively and connect the plotted points to obtain an input voltage vs. output characteristic curve. Fig. 3 shows an example of the characteristic curve thus obtained.

The output power  $W$  out of an amplifier is given in watt by

$$W_{out} = E^2_{out}/R \text{ (W)}$$

where  $E$  denotes the output voltage and  $R$  the dummy load.

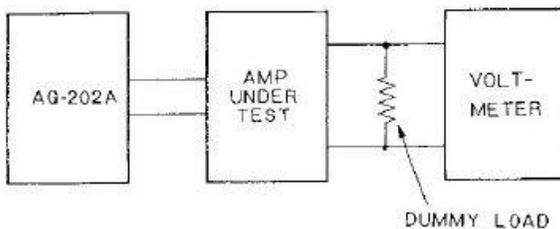


Fig. 2 Test Circuit

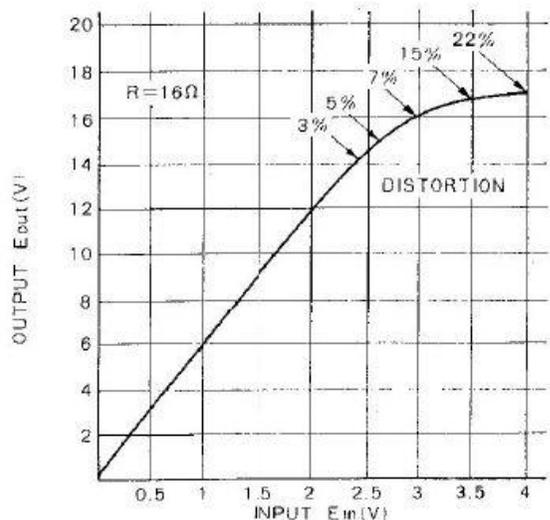


Fig. 3 Output Characteristic

In case of the amplifier having the characteristic shown in Fig. 3, the maximum distortionless output may be calculated as

$$13^2/16 = 10.6 \text{ (W)}$$

since  $E_{\text{out}} = 13 \text{ V}$  because the characteristic starts to curve around 13 V and dummy load  $R$  is  $16\Omega$  as indicated in the diagram.

Note here that the distortion factor of the amplifier with the characteristic curve shown in Fig. 3 cannot be known directly from this measurement, but may be roughly estimated from the degree of the curvature represented by the characteristic curve.

While, gain  $G$  of the above amplifier is given by the following formula within the linear region of the characteristic shown in Fig. 3:

$$G = 20 \log_{10} \frac{E_{\text{out}}}{E_{\text{in}}} \text{ (dB)}$$

Accordingly, gain  $G$  of the amplifier may be calculated easily as follows provided that  $E_{\text{in}}$  is selected as 1 V for  $E_{\text{out}}$  of 6 V:

$$\begin{aligned} G &= 20 \log_{10} 6 \\ &= 20 \times 0.778 \\ &\doteq 15.6 \text{ (dB)} \end{aligned}$$

## FREQUENCY TO OUTPUT CHARACTERISTIC MEASUREMENT

Set up model AG-202A for an output voltage of 1 V and for an oscillating frequency of 1 kHz and apply the output of model AG-202A to the amplifier under test. This will cause the amplifier provides an output voltage of 6 V as shown in Fig. 4.

Then, change the oscillating frequency from 20 Hz to 200 kHz with the output voltage of model AG-202A constant, while taking the corresponding output voltage readings on the voltmeter.

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 uniform dB and logarithmic kHz scales respectively for the output voltages and their corresponding frequencies and connect the plotted points to obtain a frequency to output characteristic.

In the above output voltage measurement, it is a general practice to employ the logarithmic scale

provided on an electronic voltmeter. In this case, proceed to the measurement with the output voltage set at a reference level of 0 dB even if it is necessary for the tester to vary the input and output voltages of the amplifier more or less for easier measurement.

Fig. 4 shows an example of the frequency to output characteristic of an amplifier obtained as mentioned above.

As seen from the characteristic curve, the above amplifier provides a complete flat characteristic from 70 Hz to 50 kHz with its output tolerance of  $-3 \text{ dB}$  covered by the entirely operating frequency range of 20 Hz~200 kHz. Then, it follows that the amplifier tested is an excellent amplifier.

The attenuation at the lower frequency region may be attributed to the insufficient capacity of coupling capacitor in the RC coupling stage, the insufficient resistance value of a collector load, or the insufficient capacity of an emitter bypass capacitor. As to the attenuation at the higher frequency region, on the contrary, the stray capacitances of circuit may be responsible.

## TEST OF AMPLIFIER USING SQUARE WAVE

This method of measuring the amplifier is used for measuring the frequency characteristic. In this case, model AG-202A is used as the signal source with its

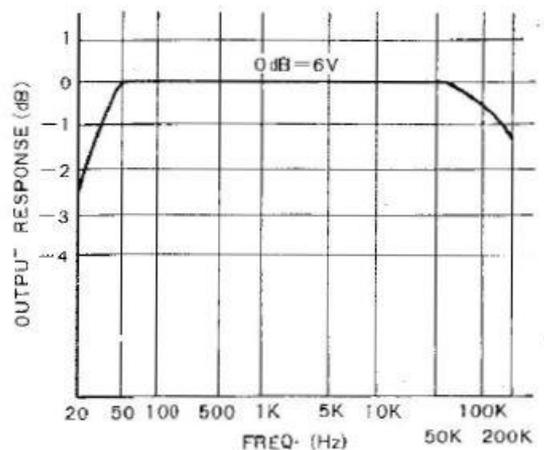


Fig. 4 Frequency Characteristic

WAVE FORM selector switch (6) is set to position  $\square$ . As the test circuit, the one shown in Fig. 2 may be used with the electronic voltmeter replaced with an oscilloscope.

Fig. 5 shows an example of the output waveforms and frequency characteristics of an amplifier obtained for the square waves inputted to the amplifier under various conditions.

Note, however, that the input signal to the amplifier should be reduced appropriately without fail under the square wave test lest the amplifier should be saturated by the signal.

The square wave test is also useful to know the transient and phase characteristics of an amplifier, not to speak of the frequency characteristic.

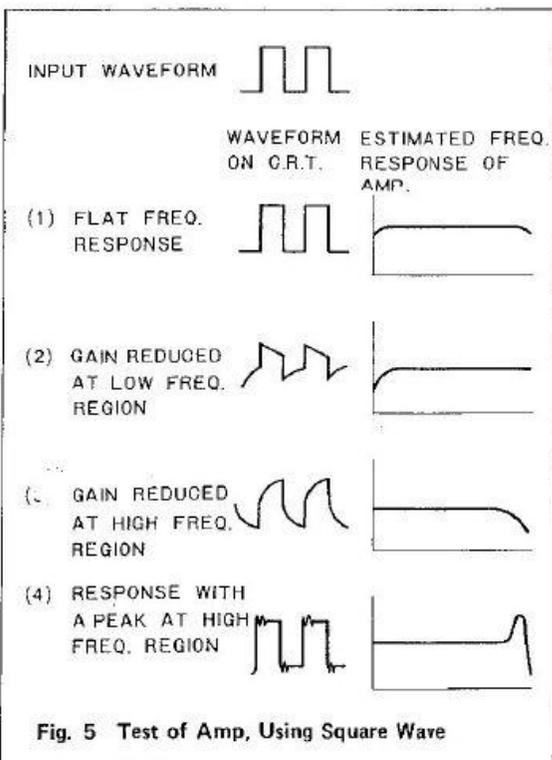


Fig. 5 Test of Amp, Using Square Wave

## MEASUREMENT OF NEGATIVE FEEDBACK VALUE

For instance, suppose that you want to know amount of negative feedback voltage of the circuit proceed as follows:

First apply the output of model AG-202A to the input terminal (pick-up terminal) of the set under test with model AG-202A set up so as to deliver an output of 400 Hz sine wave signal.

Connect an output meter across the voice coil of the speaker or dummy load as shown in Fig. 6 and adjust the AG-202A so that the amplifier delivers the rated output. Note in this case that the volume control on the amplifier and set under test should be placed in the fully clockwise position if it is provided.

Put the output voltage of the AG-202A under the above condition on record.

With the negative feedback circuit disconnected, then, lower the output of AG-202A bit by bit until the output meter read the same value as the previous reading. Put the output voltage of the AG-202A in this case on record.

Let E1 and E2 denote the output voltages of AG-202A under the conditions where the AG-202A is operated with and without the negative feedback, respectively, and the value of negative feedback is given by

$$\text{Value of NF} = 20 \log_{10} \frac{E1}{E2} \text{ (dB)}$$

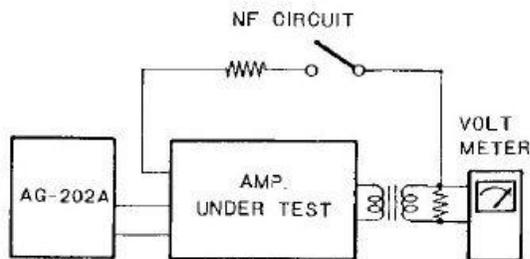


Fig. 6 Measurement of NF Value

### PHASE CHARACTERISTIC MEASUREMENT

The phase characteristic of an amplifier and other is not handled hitherto so much as an important problem.

As for an Hi-Fi amplifier, however, the phase characteristic has come to the front because the amplifier handles the signals located over a wider frequency range and further is operated with negative feedback without fail. If the phase shifts greatly, therefore, the negative feedback intended may actually result in the positive feedback, which will sometimes cause the amplifier to start in oscillation when it operates with a frequency in the higher or lower frequency region.

To view the above-mentioned phase shift, connect the AG-202A and an oscilloscope to the amplifier under test as shown in Fig. 7.

If there is no phase shift about the output signal of amplifier under the above condition, the oscilloscope will represent as the waveform 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 is suffering from an amplitude distortion. In this case, therefore, reduce the output level of AG-202A a little.

Changing the frequency of AG-202A under the above condition causes the straight line on the

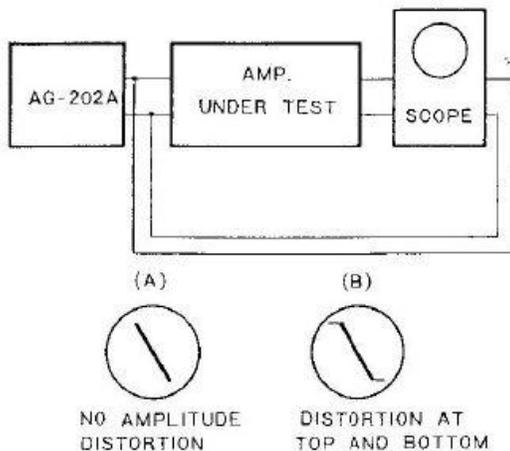


Fig. 7 Phase Characteristic Measurement

oscilloscope to expand gradually to turn into an ellipse. By utilizing the configuration of this ellipse, the phase shift can be calculated as follows:

First, measure the maximum horizontal deflection of the ellipse with a measure and suppose that the deflection is X mm 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  $\theta$  is given by

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

Find  $\theta$  from the table of trigonometric functions and the value obtained gives the angle of phase shift.

### AUDIO TRANSFORMER MEASUREMENT

The AG-202A CR oscillator may also be utilized as an effective tool for testing various characteristics of an audio transformer placed in the input circuit of an audio amplifier or radio transmitter modulator output.

One requirement of such an audio transformer is that its DC resistance must be low to ensure low loss or high efficiency. In practice, however, the audio transformer may be classified as a good transformer if its DC resistance is as low as 1/20 of the rated impedance. Another requirement, if the transformer is used in the input or output of a push-pull circuit, is balance in the DC resistance values of the pair windings, which should be accurate to a maximum of 10% deviation.

One of the ohm ranges of a multimeter will be satisfactory to measure the DC resistance or unbalance in the resistances of the transformer. Characteristics of an audio transformer which we are going to measure with the AG-202A in the following are its inductance and impedance.

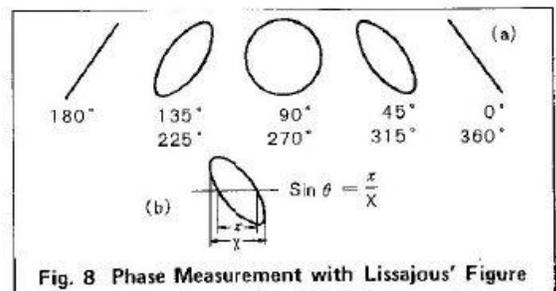


Fig. 8 Phase Measurement with Lissajous' Figure

## MEASUREMENT OF INDUCTANCE

Accurate measurement should be made with a bridge. Approximation, however, can be done in a simplified method as shown in Fig. 9.

With an output of about 8 volts supplied from the AG-202A to the transformer under test, adjust potentiometer VR until the electronic voltmeter gives an identical deflection for both positions A and B of the switch. In this measurement, if the resistance of the potentiometer is R ohms and the signal frequency of the AG-202A is (f) Hz, the inductance (L) H of the transformer under test is given by,

$$L = \frac{R}{6.28 \times f}$$

This method involves some error caused by the DC resistance of the measured transformer but there will be no problem in practice. The above same method is also applicable to measurement of the inductance of choke coils. Precautions for measurement of transformers and choke coils should include limiting the output of the AG-202A to below 5 volts because a higher measuring voltage will cause so great a current to flow in the transformer or choke coil as to increase the flux density of the transformer core, thus affecting the test result of characteristics.

Also, a voltmeter to be used in this measurement should be an electronic voltmeter having a high input impedance. A regular multimeter set to an AC volt range will involve an increased error.

It was suspected that a small inductance value could possibly be measured with accuracy. But, in an attempt, result was 23.9 mH when measured with a 10 kHz output from the AG-202A while it should be 25 mH. This error is approximately 4.5% and we may say it practical unless a very high accuracy is required.

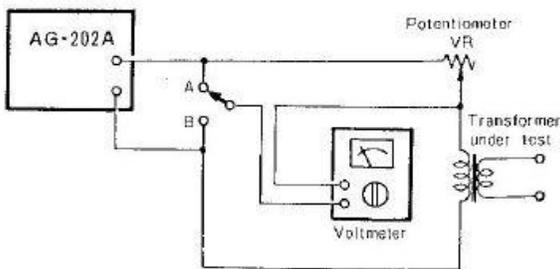


Fig. 9 Inductance Measurement

## MEASUREMENT OF IMPEDANCE

The impedance characteristics of an output transformer or modulating transformer are determined in a series substitution method as shown in Fig. 10. This test set-up differs from the foregoing inductance measurement circuit in that a resistor having a value equal to the rated impedance of the transformer under test is used across the secondary winding of the transformer. As an example, the 16 ohms voice coil is replaced with a 16 ohms winding resistor, or the 10 k ohms impedance of a modulating transformer with a 10 k ohms resistor. In this set-up, potentiometer VR is adjusted, similarly to the case of inductance measurement, until the electronic voltmeter gives an identical deflection for both positions A and B of the switch. Thus, the resistance value of the potentiometer adjusted indicates the absolute impedance of the transformer at a particular frequency. A series of such impedance values are traced on the semi-logarithmic graph of Fig. 11 with the frequency graduated on the abscissa and the impedance on the ordinate. This graph is the measurement result of the impedance characteristics of a transformer available on the market. The result, traced by dots, well agrees with the manufacturer-declared curve. Although result will vary depending on the measuring voltage applied, use of the maximum output of the AG-202A will give an accurate result close to the usually employed 18 dB level.

Since the transformer used as a test piece was traced up to only 50 kHz of characteristic, we tried to extend the curve up to 80 kHz as seen in Fig. 11, and found that there was a dip at this high frequency. Such an irregularity often appears as oscillation in the high frequency region. In this manner, the AG-202A can effectively be used in finding the characteristics of transformers, even wider than those published by the manufacturer.

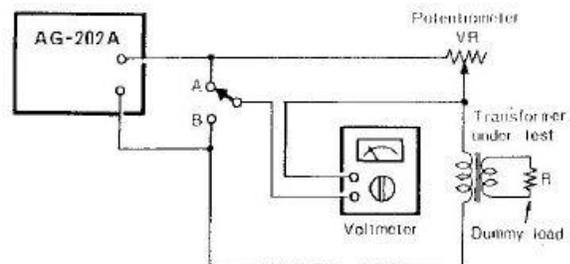


Fig. 10 Impedance Measurement

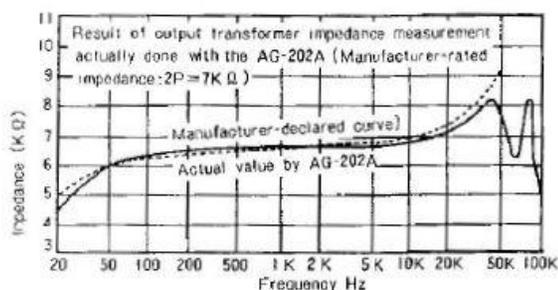


Fig. 11 Example Characteristic of a Market-Available Output Transformer

### USE OF AG-202A FOR RECEIVER ALIGNMENT

Radio receivers often have a trouble that its audio amplifier stages do not operate at all or do not produce a sufficient volume of sound. In determining which stage or part is suspected for such trouble, the AG-202A may be effectively utilized, by supplying its output first to the speaker terminals, then down to the younger stages one after another. In this tracing, the trouble may appear as the absence at one point or reduction of volume of sound at another and can easily be localized.

There may be a case the AG-202A must be connected to a live or DC-imposed circuit such as a plate or collector circuit. In this case, it is necessary to block the output from the AG-202A by inserting a capacitor (about  $0.01 \mu\text{F}$ ) between the CR oscillator and the circuit under test. One of the generator's output leads should be grounded to the chassis of the receiver.

Alignment of an LF receiver of double super-heterodyne receiver whose intermediate frequency fails at 50 kHz or 80 kHz cannot be done with a regular test oscillator, since it does not usually have frequencies below 100 kHz. If this is the case, the AG-202A will be quite useful.

MAINTENANCE

REMOVAL OF CASE

Remove 3 setscrews each on the left and right side plates with a Phillips head screwdriver.

Hold the handle provided on the top of the case with hand and lift it up until the case is removed from the chassis.

ATTACHMENT OF CASE

To attach the case to the chassis, proceed as follows:

Loosely screw two setscrews onto the chassis at the holes provided on the rear left and right sides. (marked \*)

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

Then, fix the left and side plates of the case to the chassis by screwing 2 setscrews into the holes provided

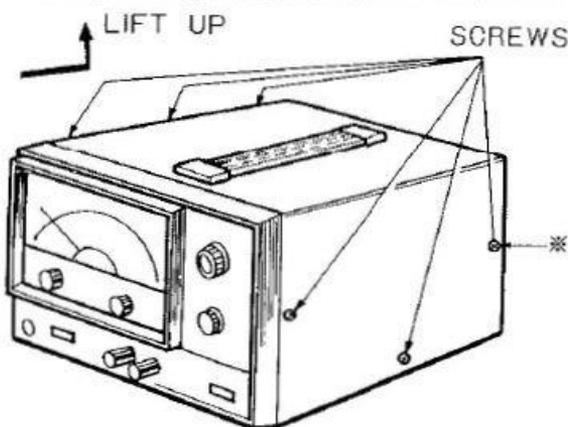


Fig. 12 Removal of Case

on the front and bottom edges of the side plates. Also, tighten the screws at the middle rear edges of the side plates.

**Caution:** When removing the case from the chassis, pay attention not to touch the internal printed circuit board and others. Also, never fail to disconnect the power cord from the CR oscillator set because an AC voltage of 230 V or 117 V presents at the printed circuit board.

REMOVAL OF SHIELDING CASE

When checking the variable capacitor, remove the top plate of the shielding case after unscrewing 3 setscrews by means of a Phillips head screwdriver.

The shielding case covering the variable capacitor may be removed easily when 2 setscrews are removed from the left and right side plates.

In doing the above operations, pay attention so as to never allow the mounting plate for the variable capacitor to move.

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

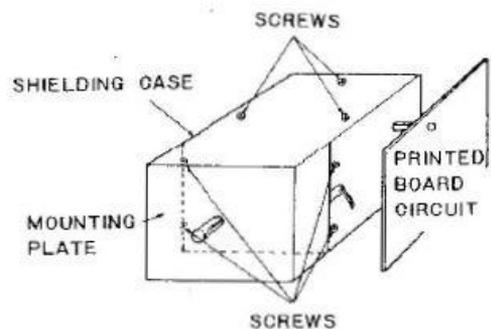


Fig. 13 Removal of Shielding Case

**REMOVAL OF FRONT PANEL**

To remove the front panel from this oscillator set, proceed as follows:

Loosen the setscrews for 4 knobs on the panel and remove the knobs. Then, remove the left and right setscrews provided on the case directly behind the panel to fix both the case and panel in position. Further, remove 2 setscrews provided on the bottom side of the panel.

Then, hold the panel with both hands and pull it toward you. And the panel comes off the chassis.

When removing the panel, pull it slowly while taking care not to make the terminals, slide switches, neon lamp and etc. being caught by it.

**REMOVAL OF DIAL MECHANISM**

When the front panel is removed as mentioned above after the top cover is removed from the shielding case, this oscillator set, reveals its interior as shown in Fig. 15. Then, proceed as follows:

- (1) Loosen the setscrew for the pulley. This allows the pulley to idle when it is driven by means of the knob.
- (2) Disconnect the dial thread from the spring and the thread is loosened.
- (3) 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.

These steps allows you to disassemble the dial mechanism into separator parts.

To assemble the separated parts into the dial mechanism, follow the above steps in the reverse sequence.

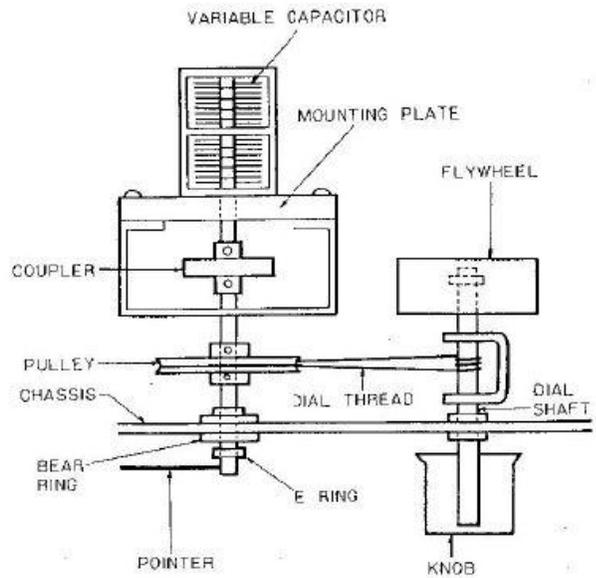


Fig. 15 The View of Dial Mechanism

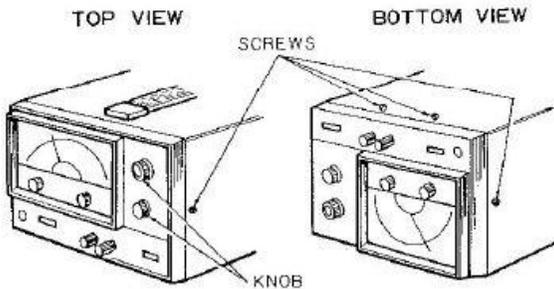


Fig. 14 Removal of Front Panel

## ADJUSTMENTS

(Model AG-202A is shipped after it is factory adjusted about the following matters. When it is to be re-adjusted, however, proceed to the adjusting work only after the power source voltage is calibrated.)

The test equipment to be used for the calibration should be those calibrated beforehand.

When proceeding to the adjustment, set the controls as follows unless otherwise specified:

- (1) OUTPUT ATT (3) at 0 dB position.
- (2) WAVE FORM (6) at position  $\square$ .
- (3) FREQ RANGE (7) at position  $\times 10$ .
- (4) OUTPUT LEVEL (8) at fully clockwise.
- (5) FREQUENCY dial (9) at graduation 100.

Prior to proceed in the adjustment, make DC voltage checks to all circuits of this set to make sure that all circuits are operating normally. In this case, refer to the schematic diagram.

## ADJUSTMENT OF OUTPUT VOLTAGE

- (1) Connect an AC voltmeter to output terminals (5) and (4).
- (2) Adjust semi-fixed variable resistor VR1 until the AC voltmeter gives an indication of 10 V r.m.s.

Be careful not to adjust the CR oscillator so that it provides an output voltage higher than the rated value. Otherwise, the distortion factor is deteriorated.

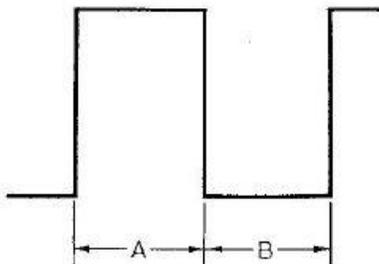


Fig. 16 Adjustment of Duty Ratio

## ADJUSTMENT OF DUTY RATIO OF SQUARE WAVE

- (1) Place WAVE FORM switch (6) in position  $\square$ .
- (2) Connect an oscilloscope to output terminals.
- (3) Adjust VR2 until the square wave form appearing on the oscilloscope screen provide the same durations for its half cycles A and B shown in Fig. 16.

## ZERO SETTING OF POINTER

- (1) Fix the variable capacitor in such manner that it provides the maximum capacity.
- (2) Adjust the coupler and the setscrew for pulley under the above condition so that the pointer is set to position ① in Fig. 17.
- (3) Move the pointer clockwise and check to see that the pointer is set completely to the index during at position ② and ③. If the pointer fails to set to the index, loosen the setscrews for the dial scale plate and adjust the scale plate until the pointer is set to the index as mentioned above.

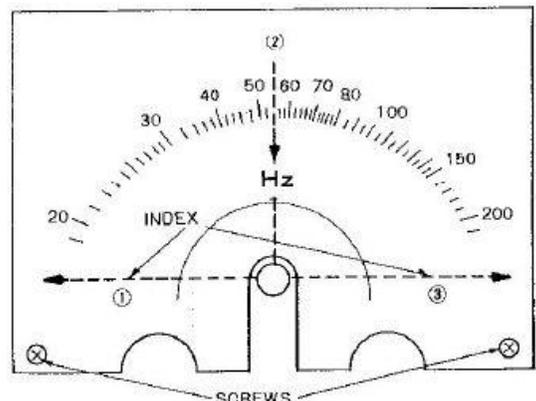


Fig. 17 Zero Setting of Pointer

## ADJUSTMENT OF OSCILLATOR FREQUENCY

- (1) Connect an AC voltmeter and frequency counter to the output terminals of oscillator set.

In this case, there is no trouble if the load has an impedance of more than 500 k $\Omega$ . If the load has an impedance of less than 500 k $\Omega$  (especially in case of the input impedance of frequency counter), insert a resistor in series with the counter or don't load the counter during a level check.

- (2) Set the pointer to graduation 20. Check that the oscillating frequency is within 200 Hz  $\pm$  (3% + 2Hz) under the above condition. Also, check the level at the time.

With the pointer set to graduation 200, adjust TC101a and TC101b until the oscillating frequency is set to within 2 kHz  $\pm$  (3% + 2Hz). But, adjust the set so that it provides the same level as that checked in the above step.

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

- (4) After the above adjustments, the adjustment for graduation between 20~200 is performed already.
- (5) With FREQ RANGE (7) set at position  $\times 1$ , adjust VR3 until the oscillating frequency and oscillation level are set as mentioned above when the pointer is set to graduation 20.

## CAUTIONS

- (1) When changing the primary voltage, change the power circuit connections as follows:

- AC 100V Wire between print circuit board terminals source 22 and 21. (Fuse ..... 0.2A)
- AC 117V Wire between printed circuit board terminals source 22 and 17. (Fuse ..... 0.2A)
- AC 230V Wire between printed circuit board terminals source 22 and 16. (Fuse ..... 0.1A)

- (2) This set is placed in its running condition as soon as the power switch is turned ON. In order to perform a precise measurement, however, allow about 3 minutes for the set to warm up before proceeding to the measurement.

- (3) Don't try to apply a DC voltage to the output terminals of the set.

If it becomes necessary to connect the output terminals to a circuit carrying DC voltage super-

posed on the AC signal, never fail to insert a capacitor between the terminals and the circuit to reject the DC component.

- (4) Don't connect the cable or other load to the external synchronizing input terminal unless absolutely necessary.

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 10 V r.m.s. to the terminal.

- (5) Avoid installing the AG-202A where strong magnetic or electric field or high temperature and humidity prevail.

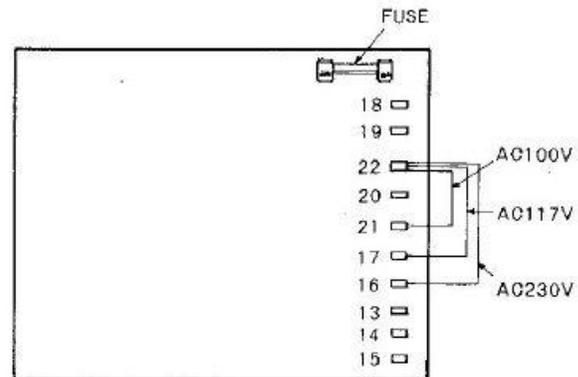
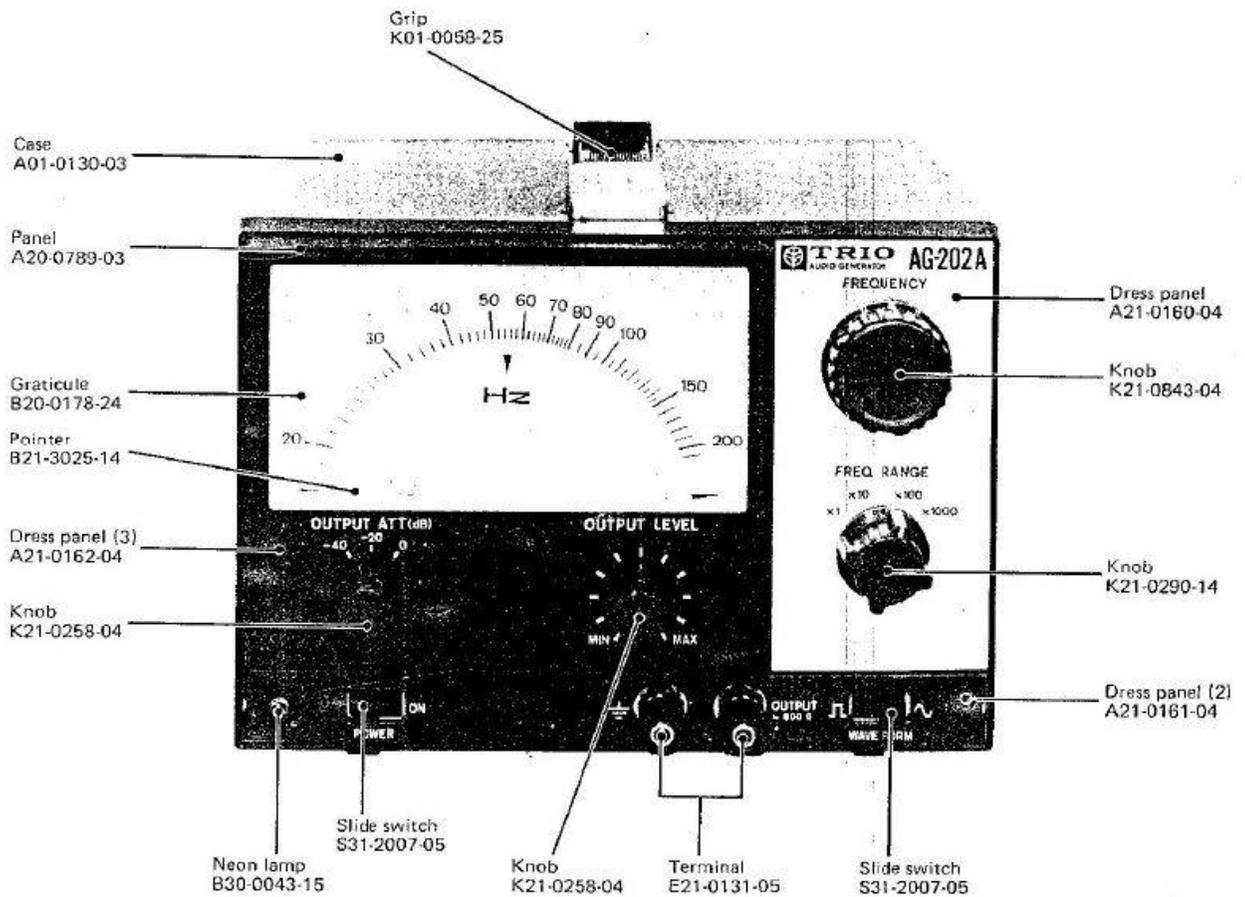
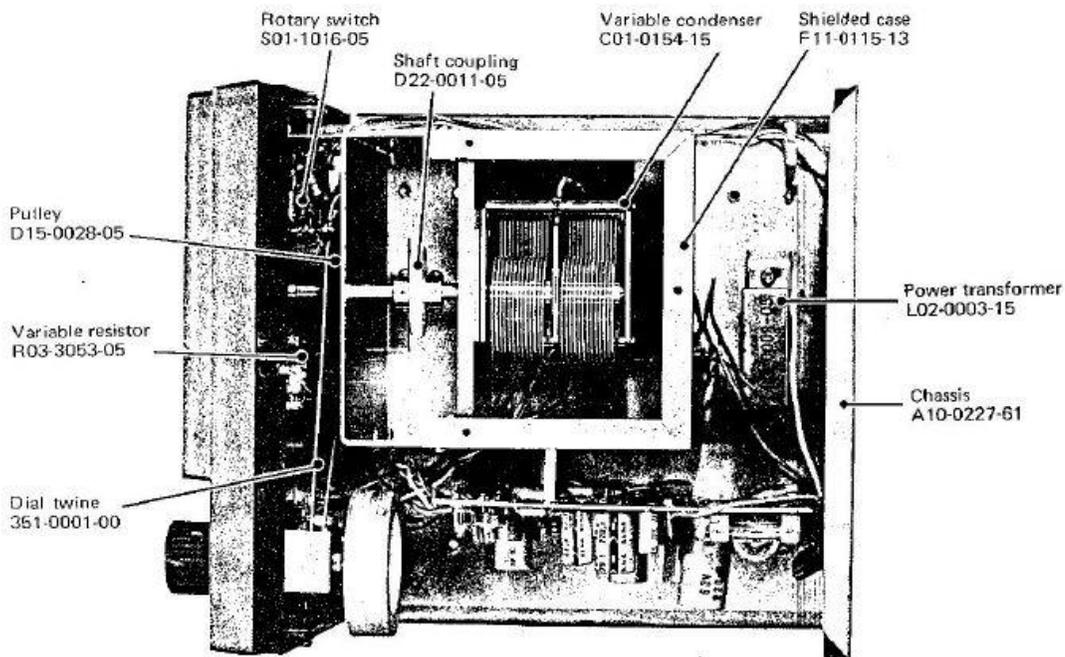


Fig. 18 Rewiring of Power Source Voltage

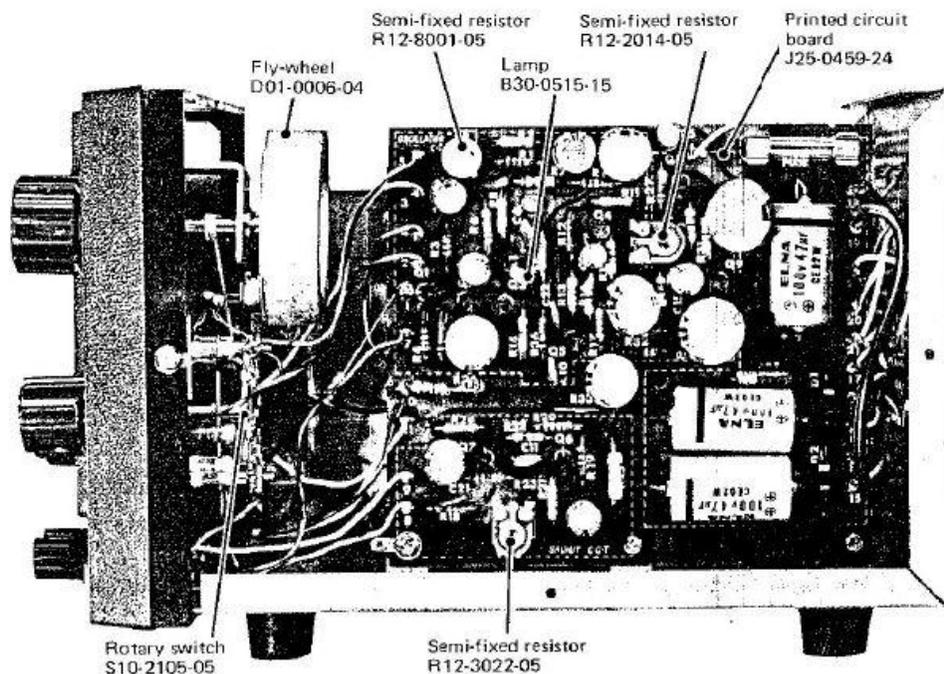
## PARTS LAYOUT (FRONT VIEW)



## PARTS LAYOUT (TOP VIEW)



## PARTS LAYOUT (BOTTOM VIEW)



## PARTS LIST OF AG-202A

Circuit No.	Parts No.	Description	Remarks
<b>CAPACITOR</b>			
C102	CC45SL1H020C	Ceramic 2pF $\pm 0.25\text{pF}$	
C103	CC45SL2H150J	Ceramic 15pF $\pm 20\%$	
C104, 105	CC45SL1H020C	Ceramic 2pF $\pm 0.25\text{pF}$	
VC101a, b	C01-0154-15	Variable capacitor / ECV-2HA43	
<b>RESISTOR</b>			
R101	RN14BK2H1992G	Metal film 19.9k $\Omega$ $\pm 2\%$ 1/2W	
R102	RN14BK2H2003G	Metal film 200k $\Omega$ $\pm 2\%$ 1/2W	
R103	RN14BK2H1954G	Metal film 1.95M $\Omega$ $\pm 2\%$ 1/2W	
R104	RD14AY2H196J	HT resistor 19M $\Omega$ $\pm 5\%$ 1/2W	
R105	RN14BK2H2002G	Metal film 20k $\Omega$ $\pm 2\%$ 1/2W	
R106	RN14BK2H2003G	Metal film 200k $\Omega$ $\pm 2\%$ 1/2W	
R107	RN14BK2H2004G	Metal film 2M $\Omega$ $\pm 2\%$ 1/2W	
R108	RD14AY2H208J	HT resistor 20M $\Omega$ $\pm 5\%$ 1/2W	
R109	RD14BB2E102J	Carbon 1k $\Omega$ $\pm 5\%$ 1/4W	
R110	RD14BB2E561J	Carbon 560 $\Omega$ $\pm 5\%$ 1/4W	
R111	RD14BB2E562J	Carbon 5.6k $\Omega$ $\pm 5\%$ 1/4W	
R112	RD14BB2E681J	Carbon 680 $\Omega$ $\pm 5\%$ 1/4W	
R113	RD14BB2E104J	Carbon 100k $\Omega$ $\pm 5\%$ 1/4W	
R114	RD14BB2E681J	Carbon 680 $\Omega$ $\pm 5\%$ 1/4W	
R115	RD14BB2E822J	Carbon 8.2k $\Omega$ $\pm 5\%$ 1/4W	
R116	RD14BB2E562J	Carbon 5.6k $\Omega$ $\pm 5\%$ 1/4W	
VR101	R03-3053-05	Variable resistor	
<b>SWITCH</b>			
S101	S10-2105-15	Rotary switch	34mm
S102	S31-2007-05	Slide switch	
S103	S01-1016-05	Rotary switch	22mm
S104	S31-2007-05	Slide switch	
<b>MISCELLANEOUS</b>			
-	A01-0130-03	Case	
-	A10-0227-71	Chassis	
-	A20-0351-12	Panel	
-	A20-0735-03	Panel assembly	
-	A21-0160-04	Dress panel (1)	
-	A21-0161-04	Dress panel (2)	
-	A21-0162-04	Dress panel (3)	
-	B20-0178-24	Graticule	
-	B21-3025-14	Pointer	
-	B30-0043-15	Neon lamp	
-	B40-1329-04	Name plate	
-	B41-0094-04	Caution label	220V-240V
-	B41-0111-04	Caution label	110V-120V
-	B50-1105-00	Instruction manual	
-	D01-0006-04	Fly-wheel	
-	D15-0028-05	Pulley	
-	D20-0002-23	Dial axis	

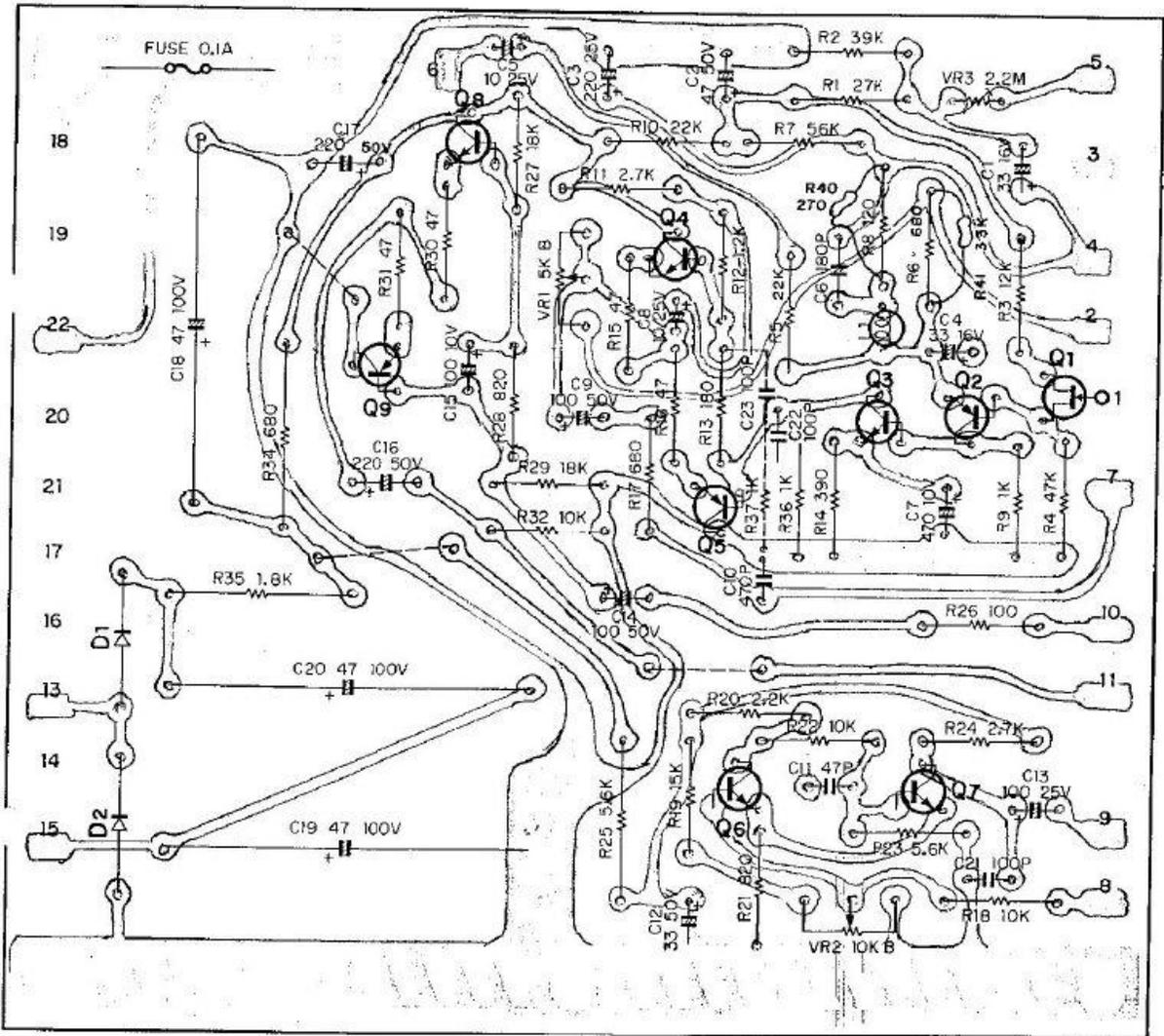
Circuit No.	Parts No.	Description	Remarks
-	D22-0011-05	Shaft coupling	
-	D23-0048-04	Bearing	
-	E18-0106-05	Terminal, type banana	black
-	E18-0107-05	Terminal, type banana	black
-	E21-0131-25	Terminal	
-	E22-0207-05	Lug board	
-	E23-0015-04	Earth lug	black
-	E30-0095-05	Tester cord	
-	E30-0096-05	Tester cord	
-	E30-0545-05	AC cord with plug	
-	E91-0003-05	Insulated alligator clip	black
-	E91-0004-05	Insulated alligator clip	red
-	E91-0016-05	Banana tip	black
-	E91-0015-05	Banana tip	red
-	F05-1012-05	Fuse	0.1A
-	F05-2012-05	Fuse	0.2A
-	F10-0191-14	Shielded plate	
-	F11-0115-13	Shielded case	
-	F31-0054-23	Bracket for reinforcement (3)	
-	F31-0098-04	Bracket for reinforcement (2)	
-	G01-0045-24	Dial spring	
-	G13-0042-04	Cushion	
-	H01-1065-24	Packing case (individual packing)	
-	H10-0364-22	Packing material, foamed styrene	
-	H10-0495-12	Packing material, foamed styrene	
-	H20-0274-13	Protection cover	
-	H25-0016-00	Polyethylene bag	
-	J03-0003-04	Rubber leg	
-	J20-0153-14	Mounting plate for variable condenser	
-	J32-0087-04	Boss	17.5mm
-	J41-0006-00	Cord bushing	
-	J42-0002-05	Rubber bushing	
-	J61-0014-05	Free up belt	
-	J61-0039-05	Wire clip	
-	K01-0058-25	Grip	
-	K21-0290-14	Knob	23.5φ
-	K21-0843-04	Knob	32φ
-	K21-0258-04	Knob	17φ
-	K21-0278-04	Knob	17φ
-	L02-0003-15	Power transformer	
-	X65-0011-00	Unit block	

## PARTS LIST OF X65-0011-00

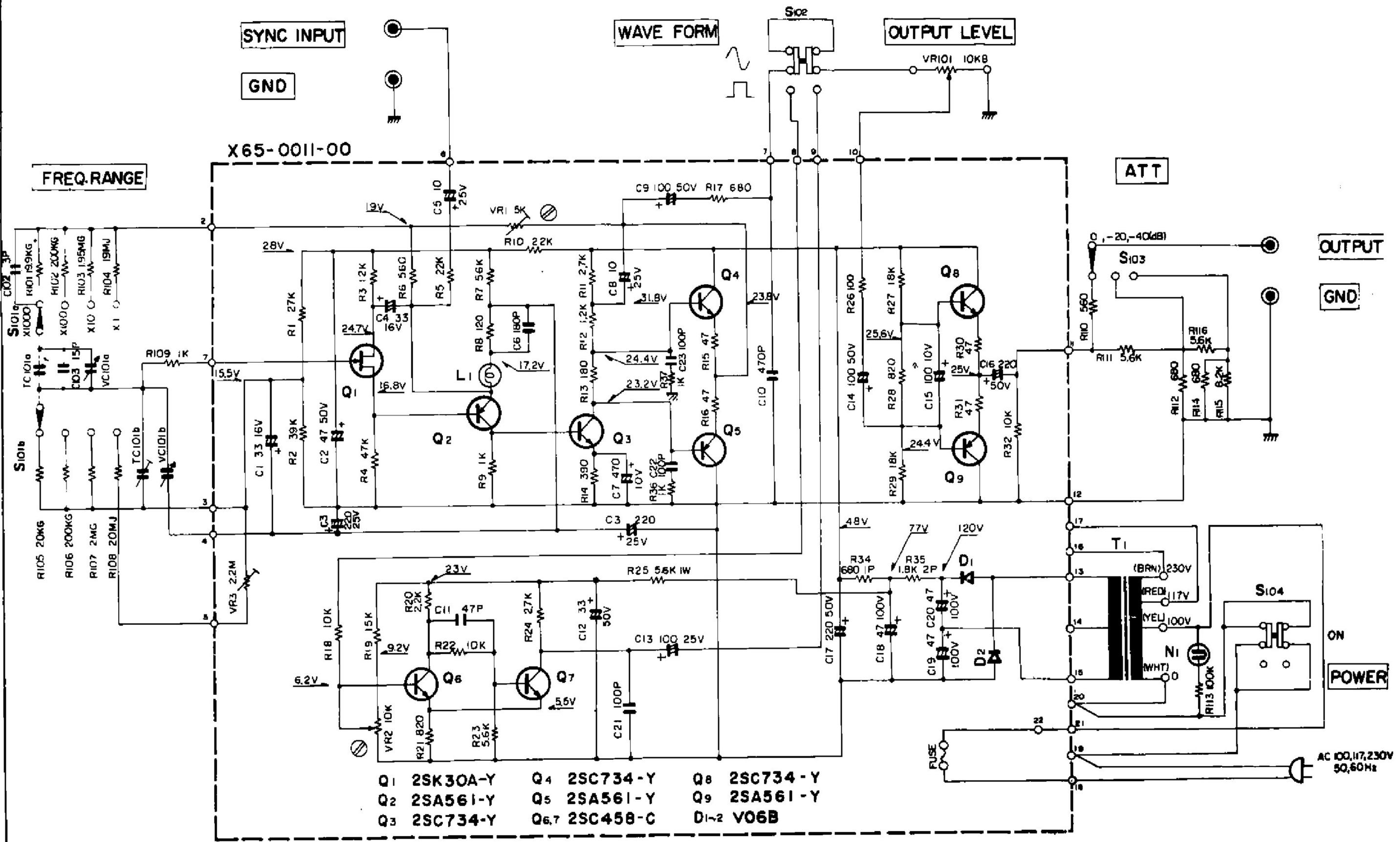
Circuit No.	Parts No.	Description			Remarks
<b>CAPACITOR</b>					
C1	CE04W1C330	Electrolytic	33 $\mu$ F		16WV
C2	CE04W1H470	Electrolytic	47 $\mu$ F		50WV
C3	CE04W1E221	Electrolytic	220 $\mu$ F		25WV
C4	CE04W1C330	Electrolytic	33 $\mu$ F		16WV
C5	CE04W1E100	Electrolytic	10 $\mu$ F		25WV
C6	CC45SL2H181J	Ceramic	180pF	$\pm 5\%$	
C7	CE04W1A471	Electrolytic	470 $\mu$ F		10WV
C8	CE04W1E100	Electrolytic	10 $\mu$ F		25WV
C9	CE04W1H101	Electrolytic	100 $\mu$ F		50WV
C10	CK45D2H471M	Ceramic	470pF	$\pm 20\%$	
C11	CC45SL2H470J	Ceramic	47pF	$\pm 5\%$	
C12	CE04W1H330	Electrolytic	33 $\mu$ F		50WV
C13	CE04W1E101	Electrolytic	100 $\mu$ F		25WV
C14	CE04W1H101	Electrolytic	100 $\mu$ F		50WV
C15	CE04W1A101	Electrolytic	100 $\mu$ F		10WV
C16	CE04W1H221	Electrolytic	220 $\mu$ F		50WV
C17	CE04W1H221	Electrolytic	220 $\mu$ F		50WV
C18~20	CE02W2A470	Electrolytic	47 $\mu$ F		100WV
C21~23	CC45SL2H101J	Ceramic	100pF	$\pm 5\%$	
<b>RESISTOR</b>					
R1	RD14BB2E273J	Carbon	27k $\Omega$	$\pm 5\%$	1/4W
R2	RD14BB2E393J	Carbon	39k $\Omega$	$\pm 5\%$	1/4W
R3	RD14BB2E123J	Carbon	12k $\Omega$	$\pm 5\%$	1/4W
R4	RD14BB2E473J	Carbon	47k $\Omega$	$\pm 5\%$	1/4W
R5	RD14BB2E223J	Carbon	22k $\Omega$	$\pm 5\%$	1/4W
R6	RD14BB2E681J	Carbon	680 $\Omega$	$\pm 5\%$	1/4W
R7	RD14BB2E563J	Carbon	56k $\Omega$	$\pm 5\%$	1/4W
R8	RD14BB2E121J	Carbon	120 $\Omega$	$\pm 5\%$	1/4W
R9	RD14BB2E102J	Carbon	1k $\Omega$	$\pm 5\%$	1/4W
R10	RD14BB2E223J	Carbon	22k $\Omega$	$\pm 5\%$	1/4W
R11	RD14BB2E272J	Carbon	2.7k $\Omega$	$\pm 5\%$	1/4W
R12	RD14BB2E122J	Carbon	1.2k $\Omega$	$\pm 5\%$	1/4W
R13	RD14BB2E181J	Carbon	180 $\Omega$	$\pm 5\%$	1/4W
R14	RD14BB2E391J	Carbon	390 $\Omega$	$\pm 5\%$	1/4W
R15	RD14BB2E470J	Carbon	47k $\Omega$	$\pm 5\%$	1/4W
R16	RD14BB2E470J	Carbon	47 $\Omega$	$\pm 5\%$	1/4W
R17	RD14BB2E681J	Carbon	680 $\Omega$	$\pm 5\%$	1/4W
R18	RD14BB2E103J	Carbon	10k $\Omega$	$\pm 5\%$	1/4W
R19	RD14BB2E153J	Carbon	15k $\Omega$	$\pm 5\%$	1/4W
R20	RD14BB2E222J	Carbon	2.2k $\Omega$	$\pm 5\%$	1/4W
R21	RD14RR2F821J	Carbon	820 $\Omega$	$\pm 5\%$	1/4W
R22	RD14BB2E103J	Carbon	10k $\Omega$	$\pm 5\%$	1/4W
R23	RD14BB2E562J	Carbon	5.6k $\Omega$	$\pm 5\%$	1/4W
R24	RD14BB2E272J	Carbon	2.7k $\Omega$	$\pm 5\%$	1/4W
R25	RS14AB3A562J	Metal film	5.6k $\Omega$	$\pm 5\%$	1W
R26	RD14BB2E101J	Carbon	100 $\Omega$	$\pm 5\%$	1/4W
R27	RD14BB2E183J	Carbon	18k $\Omega$	$\pm 5\%$	1/4W
R28	RD14BB2E821J	Carbon	820 $\Omega$	$\pm 5\%$	1/4W
R29	RD14BB2E183J	Carbon	18k $\Omega$	$\pm 5\%$	1/4W
R30, 31	RD14BB2E470J	Carbon	47 $\Omega$	$\pm 5\%$	1/4W
R32	RD14BB2E103J	Carbon	10k $\Omega$	$\pm 5\%$	1/4W

Circuit No.	Parts No.	Description	Remarks
R34	RS14AB3A681J	Metal film 680 $\Omega$ $\pm 5\%$ 1W	
R35	RS14AB3D182J	Metal film 1.8k $\Omega$ $\pm 5\%$ 2W	
R36, 37	RD14BY2E102J	Carbon 1k $\Omega$ $\pm 5\%$ 1/4W	
R40	RD14BB2E271J	Carbon 270 $\Omega$ $\pm 5\%$ 1/4W	
R41	RD14BB2E332J	Carbon 3.3k $\Omega$ $\pm 5\%$ 1/4W	
<b>SEMICONDUCTOR</b>			
Q1		2SK30A-Y	
Q2		2SA561-Y	
Q3, 4		2SC734-Y	
Q5		2SA561-Y	
Q6, 7		2SC458-C	
Q8		2SC734-Y	
Q9		2SA561-Y	
D1, 2		VO6B	
<b>POTENTIOMETER</b>			
VR1	R12-2014-05	B 5k $\Omega$	
VR2	R12-3022-05	B 10k $\Omega$	
VR3	R12-8001-05	2.2M $\Omega$	
<b>MISCELLANEOUS</b>			
L1	B30-0515-15	Lamp	
-	E23-0004-04	Terminal	
-	E23-0045-05	Relaying terminal	
-	F05-1012-05	Fuse	0.1A
-	F05-2012-05	Fuse	0.2A
-	J13-0020-05	Fuse holder	
-	J25-0459-24	Printed circuit board	

PC BOARD (X65-0011-00)



Q1 : 2SK30A (Y), Q3, 4, 8 : 2SC734 (Y), D1, 2 : VO6B  
 Q2, 5, 9 : 2SA561 (Y), O6, 7 : 2S0458 (C),



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**TRIO-KENWOOD CORPORATION**

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