AG-203

CR Oscillator

INSTRUCTION MANUAL

CONTENTS

Features

* All solid state circuitry insures extreme high stability, minimum warm-up time and less power consumption.
* High reliability with adoption of direct coupled circuits throughout the entire stage.
* Compact styling with vertical type panel for easy operation.
* Frequency dial scale calibrated with single-scale graduations for frequency range of 10Hz to 1MHz selectable in 5 ranges.
* High output design; more than 7V rms at no load and more than 3.5V rms at 600Ω. Output level is fully adjustable with a 10dB-step, 6 range attenuator and a level adjuster.
* Low output impedance of 600Ω. The attenuator provides accuracy of ± 1.0dB at 600Ω load.
* Sine and square waves easily available.
* Synchronizing input terminal.
* Extremely high stability against variation of power source voltage.

Specifications

Frequency range:	x 1 range; 10Hz – 100Hz x 10 range; 100Hz – 1kHz x 100 range; 1kHz – 10kHz x 1k range; 10kHz – 100kHz x 10k range; 100kHz – 1MHz
Frequency accuracy:	±(3% + 1Hz)

[Sine Wave Characteristics]

Output voltages (no load):	7V rms or more
Frequency characteristic: (reference freq: 1kHz)	10Hz – 1 MHz, ± 0.5dB
Distortion factor:	400Hz – 20kHz, 0.1% or less 100Hz – 100kHz, 0.3% or less (x 10 range for 100Hz) 50Hz – 200kHz, 0.5% or less 20Hz – 500kHz, 1% or less 10Hz – 1MHz, 1.5% or less

[Square Wave Characteristics]

Output voltage (no load):	10V p-p or more
Sag:	5% or less (at 50Hz)
Rise and fall times:	200ns or less
Overshoot:	2% or less (at 1kHz, max. output)
Duty ratio:	50% ± 5% (at 1kHz, max. output)

[External Synchronization Characteristics]

Synchronizing range:	±1%/V
Max. allowable input voltage:	10V rms
Input impedance:	Approx. 10kΩ
Output impedance:	600Ω ±10%
Output attenuator:	0dB, –10dB, –20dB, –30dB, –40dB and –50dB in 6 steps (accuracy: ±1dB at 600Ω load)

[Stability against power source voltage variation (with respect to variation of 100V ± 10%)]

Frequency drift:	Within ±0.5%
Output voltage variation:	Within ±0.5dB
Operating temperature:	0 – 50°C (relative humidity: Less than 90%)
Power requirement:	AC 100V (120V, 220V or 240V), 50 – 60Hz
Power consumption:	5 watts
External view:	See Fig. 2 on page 9
Dimensions:	Casing; 128(W) x 238(D) x 190(H) mm Overall (including knobs); 130(W)x268(D)x 215(H) mm

Weight:	2.9 kg
Accessories:	Power cord (1)
	Output cord: one red and black test cord with basket clip and banana plug
	Banana plug; red (1) and black (1)
	Fuse; 0.125 A (2) and 0.2A (2)
	Instruction manual (1)

Circuit Description

1. Summary

When reading the following descriptions, refer to the block diagram (Fig. 1) and the schematic diagram.

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 switch is in the "⎍" position, the sine-wave signal is shaped into the square wave and the voltage is also adjusted by the OUTPUT control.

The signal voltage thus adjusted is applied to the output circuit, where its impedance is appropriately converted, and then delivered through an output attenuator to the output terminal. The attenuator provides selectable attenuations of 0dB through −50dB in 10dB steps at 600Ω of output impedance.

2. Wien Bridge Oscillator Circuit

The Wien bridge oscillator circuit elements consist of the resistance elements, which may be switched over for 5 ranges by the FREQ. RANGE switch, and the variable capacitor controlled by the FREQUENCY dial.

These elements provide means to vary the oscillating frequency continuously over 10 times its frequency on one range, thus determining any desired frequency within the entire frequency range from 10Hz to 1MHz.

The amplifier circuit for the oscillator circuit is composed of a 2-stage differential amplifier and an output stage, employing an DC amplifier circuit. The first stage is a high input impedance circuit with FET while the driver stage is a wide band, high amplification type circuit with PNP transistors featuring high cut-off frequency. The output stage is a SEPP circuit using complementary transistors.

The output voltage is fed back with positive polarity through the oscillator elements to form an oscillating circuit, while it is also fed back with negative polarity through the non-linear thermistor to stabilize the amplitude.

3. Square Wave Shaping Circuit

The square wave shaping circuit is a Schmidt-trigger circuit in which the sine wave signal from the oscillator circuit is shaped into a square wave. It is composed of an emitter coupled Schmidt-trigger circuit and a buffer amplifier, thus providing sufficient rising and falling characteristics.

4. Output Circuit

The output circuit converts the impedance of signal from the OUTPUT control and feeds the signal to the output attenuator at a low impedance. It is a SEPP-OCL circuit employing complementary transistors to provide sufficiently low output impedance characteristics over the range from DC to 1MHz.

5. Output Attenuator

The 6-position output attenuator selects attenuations of 0dB to −50dB in 10dB steps. At the 0dB position with the OUTPUT control turned fully clockwise, the output voltage (sine wave at no-load time) is more than 7V rms.

The output impedance is rated for 600Ω and the attenuation accuracy is as high as ±1.0dB at a 600Ω load.

6. Power Supply

The power supply circuit is powered by AC 100V, 120V or 220V) and delivers DC±22V sufficiently stabilized by large capacity smoothing capacitors (2200μF x 2) and a voltage stabilizer.

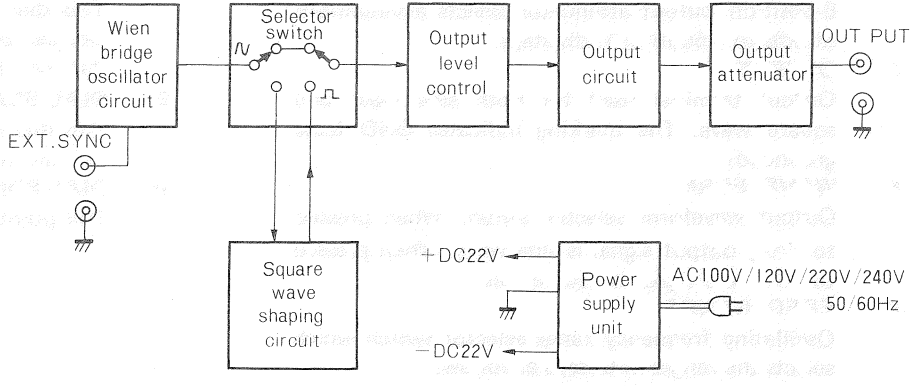


Fig. 1 Block Diagram

Panel Controls and Their Functions

The table below describes the functions of panel controls. Refer to the panel diagram on page 9.

FRONT PANEL

1. This lamp (light emitting diode) lights when POWER switch (2) is ON.
2. **POWER**
   Pushbutton type switch turns on the power when pressed.
3. **ATTENUATOR**
   6-position output attenuator selects attenuations of 0dB to –50dB in 10dB steps.
4. **OUTPUT**
   Output terminal used for both sine wave and square wave. The marking indicates GND (case grounded).
5. **WAVE FORM**
   Output waveform selector switch. When pressed to "∿", output signal is sine wave. When pressed to "⎍" the signal is square wave.
6. **FREQ. RANGE**
   Oscillating frequency range selector switch which selects the ranges in 5 steps as follows:
   x 1 10Hz – 100Hz
   x 10 100Hz – 1kHz
   x 100 1 kHz – 10kHz
   x 1k 10kHz – 100kHz
   x 10k 100kHz – 1MHz
7. **AMPLITUDE**
   Amplitude adjuster to continuously vary the amplitude of output voltage.
8. **FREQUENCY DIAL**
   This dial adjusts oscillating frequencies. Frequencies can be read by multiplying the reading on the dial scale by magnification of FREQ.RANGE.
9. **DIAL SCALE**
   This dial is calibrated with graduations of 10–100 to indicate oscillating frequencies.
10. **DIAL POINTER**
    This pointer indicates frequencies on the dial scale.

REAR PANEL

11. **SYNC**
    External synchronizing signal input terminals for GND for connection of synchronizing signal to AG-203.
12. **FUSE**
    Fuse for power supply.
13. **AC CONNECTOR**
    For connection of the supplied AC connector.
14. **POWER VOLTAGE SELECTOR**
    This selector is preset to 240V position. AC power of 100V, 120V or 220V may be used by changing the position of the selector.

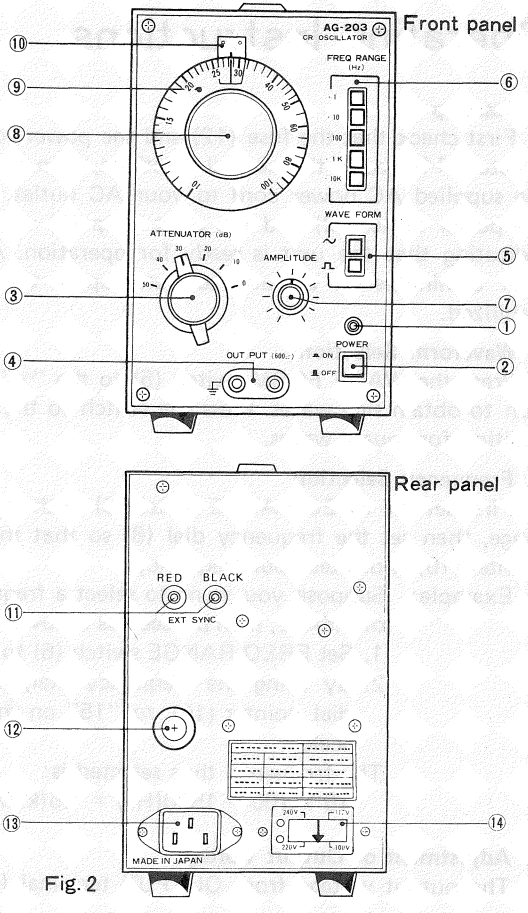


Fig. 2

Operating Instructions

1. Start-up

First check that the fuse (12) and the power voltage selector (14) are in the normal positions, then connect the supplied AC power cord to your AC outlet. Press the power switch (2) and the pilot lamp (1) will light indicating that the unit is ready for operation. Allow 2 or 3 minutes for the unit to warm up so that it is stabilized.

2. Waveform Selection

Press the WAVE FORM switch (5) to the "∿" position to obtain sine waves. Press the switch to the "⎍" position for square waves.

3. Frequency Selection

First set the FREQ.RANGE switch (6) to the desired range, then set the frequency dial (8) so that the dial pointer (10) indicates your frequency.

Example: Suppose you want to select a frequency of 1.5kHz, then proceed as follows:

1. Set FREQ RANGE switch (6) to x 100.
2. By using the frequency dial, set the dial pointer (10) ro "15" on the dial scale.

The frequency thus selected is:

15 x 100 = 1500(Hz) = 1.5(kHz)

4. Adjustment of Output Voltage

The output voltage from OUTPUT terminal (4), be it sine wave or square wave, can be continuously varied by AMPLITUDE (7) and stepped down by ATTENUATOR (3).

Example: To adjust output voltage to 10mV rms, proceed as follows:

1. Connect a voltmeter capable of measuring AC 1 V rms to OUTPUT terminal (4).
2. Set ATTENUATOR (3) to 0dB and then adjust AMPLITUDE (7) until the voltmeter indicates 1V rms. A voltage of 1V rms will appear at OUTPUT terminal (4).
3. Set ATTENUATOR (3) to −40dB. The voltmeter indicates about 0V, while a voltage of 10mV rms appears at OUTPUT terminal (4).

5. Use of Synchronizing Input Terminal

By applying an external sine wave signal to SYNC terminal (11), the oscillating frequency of AG-203 can be synchronized to the external signal. The synchronizing range is increased in proportion as the input voltage is increased as shown in Fig. 3, indicating that the synchronizing range is about ±1% per input voltage of 1V.

Example: Suppose that the input signal voltage is 1V rms and the oscillating frequency of AG-203 is between 990Hz and 1010Hz

(1kHz±1kHz x 1%/V x 1V =
1kHz±1kHz x 0.01),
the frequency can be synchronized with 1kHz of the input signal.

Note that too high a synchronizing signal voltage will affect the amplitude and distortion factor, and care must therefore be taken when the signal voltage is higher than 3V rms. Also, note that if the synchronizing signal is largely deviated from the frequency of AG-203, the synchronization is pulled out which affects the distortion factor. It is therefore advisable that the oscillating frequency be first synchronized with a low input signal voltage (less than 1V rms) and then the voltage be increased.

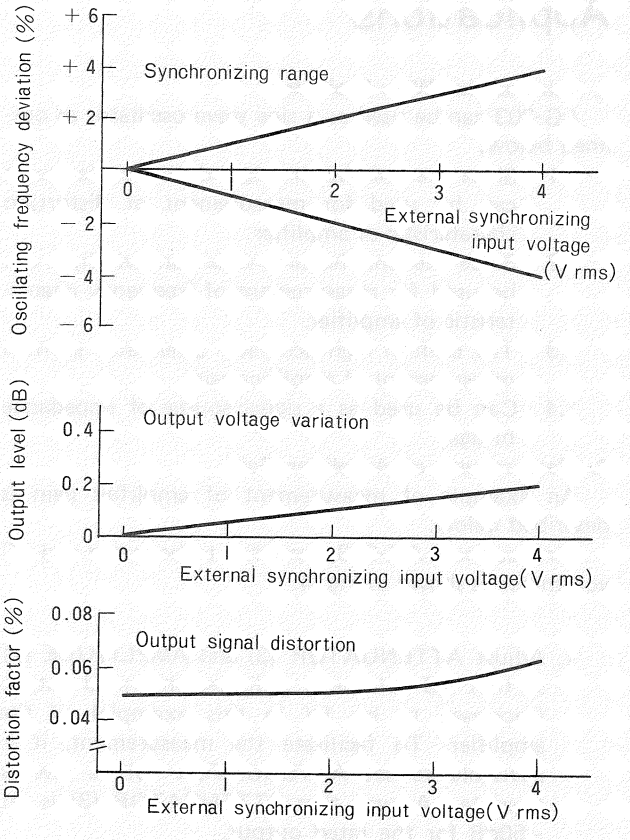


Fig. 3

Applications

1. Using as Sine Wave Oscillator

AG-203 can be used as a sine wave oscillator as outlined below.

1.1 Since the unit features low distortion factor, it can be used for measurement of distortion charateristic of amplifier.

1.2 Since the unit features wide bandwidth, it can be used for measurement of frequency characteristic of amplifier.

1.3 The built-in high accuracy attenuator permits measurement of amplifier gain.

1.4 Can be used as a signal source of impedance bridge.

2. Measurement of Amplifier Gain

An example of measurement of amplifier gain is described below.

First connect AG-203, amplifier to be tested and AC volt-meter as shown in Fig. 4.

1. Adjust ATTENUATOR (3) and AMPLITUDE (7) so that AC volt-meter indicates the rated output (supposed to be 1V in this example) of the amplifier. To facilitate the measurement, it is advisable to set ATTENUATOR (3) as low as possible. Assume that ATTENUATOR (3) is set −50dB for the rated output.
2. Disconnect the amplifier and connect the AC volt-meter to AG-203 to measure the output voltage. Note that the use of ATTENUATOR (3) eliminates the need for connecting a high sensitivity voltmeter. If ATTENUATOR (3) is set to 0dB and the voltmeter indicates 2V, it means that the input voltage of the amplifier is 50dB below 2V. Therefore, the gain obtained is as follows:

$$50\text{dB} + 20 \log_{10} \frac{1\text{V}}{2\text{V}} \text{ dB}$$

$$= 50\text{dB} - 6\text{dB}$$

$$= 44\text{dB}$$

3. Measurement of Phase Characteristic

Connect AG-203 and an oscilloscope to the amplifier to be tested as shown in Fig. 5. If there is no phase shift about the output signal of the amplifier, the oscilloscope will display a straight line as shown in Fig. 5A. If the

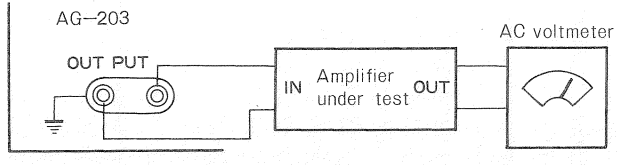


Fig. 4

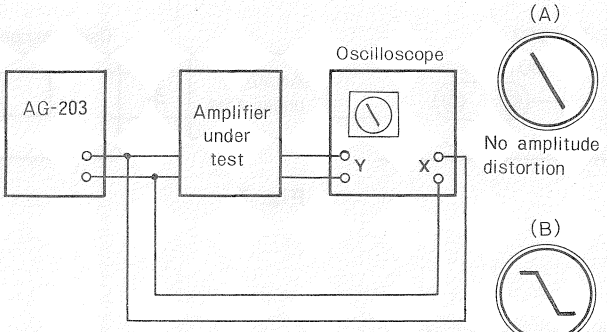


Fig. 5 Measurement of Phase Characteristic

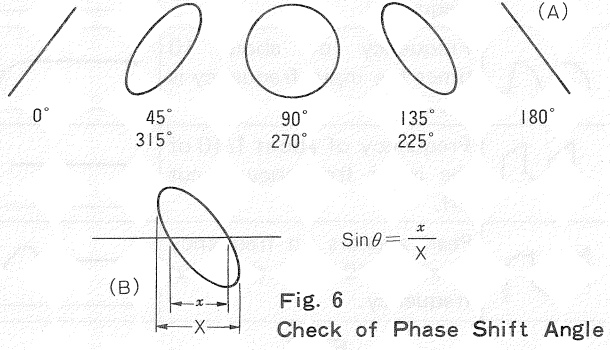


Fig. 6
Check of Phase Shift Angle

straight line on the oscilloscope is curved at its top and bottom sections as shown in Fig. 5B, it indicates that the output signal of amplifier is suffering from an amplitude distortion. In this case, reduce the output level of AG -203 a little to vary the frequency. This causes the straight line on the 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 and suppose that this deflection is "X" and that the section at which the ellipse crosses the horizontal axis is "x", as shown in Fig. 6. And, the phase shift angle θ is given by the following.

$$\text{Sin } \theta = \frac{x}{X}$$

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

4. Using as Square Wave Oscillator

AG-203 features excellent rising and falling characteristics (120 ns as standard characteristic). It has no coupling capacitors in the output stage, so the sag (deflection of top section) is as low as 5% at 50Hz. By applying such a good square wave to an amplifier input, various characteristics of amplifier can be observed on an oscilloscope. To test an amplifier, proceed as follows:

1. Connect AG-203, an amplifier to be tested and an oscilloscope as shown in Fig. 7.
2. Press WAVE FORM (5) to the "⎍" position to obtain square waves of appropriate frequency and amplitude.
3. During the test, change the frequency as necessary. The relationship between waveforms and amplifier characteristics is shown in Fig. 8.

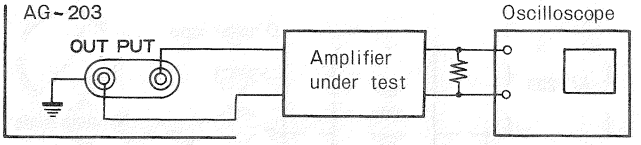


Fig. 7

Output Waveform	Amplifier Characteristic	
⎍⎍⎍	Flat frequency characteristic over 10 times the input frequency.	
∩∩	Frequency of about 10 times the input frequency is cut off.	
⩘⩘	Frequency of about 1/10 of the input frequency is cut off.	
⩘⩘	Peak appears on frequency of about 10 times the input frequency.	

Fig. 8

Maintenance

1. Removal of Case

Remove 2 screws each on the left, right and top sides with a Phillips head screwdriver. Lift the case at the underside until the case is fully removed (see Fig. 9).

2. Mounting the Case

Place the case so that the underside of it is left open a little. Tighten 6 screws uniformly. Do not use excessive force when tightening, as it will damage the screws and the vinyl leather on the case.

3. Replacement of Fuse

Open the fuse holder with a Phillips head screwdriver. Replace the fuse with one having the same rating.

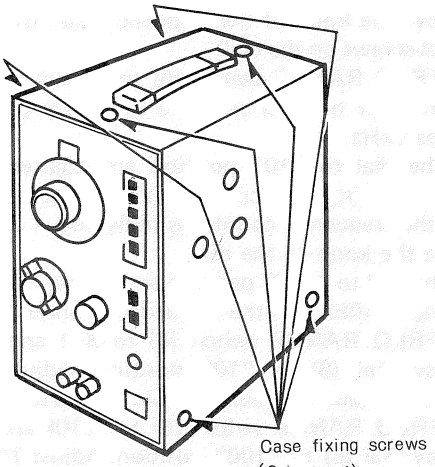


Fig. 9

Adjustments

All the circuits of AG-203 are factory adjusted prior to shipment and no further adjustments are required, except for the frequency dial which may need readjustment for proper tracking. Although this dial is also pre-adjusted at the factory. If readjustment is required, proceed to the adjusting work using an accurate test equipment. Note that the power supply voltage must be calibrated before making adjustment (see Fig. 10).

1. Connect a frequency counter to OUTPUT terminal (4).
2. Remove the knob of the frequency dial, then loosen the set-screws on the dial.
3. Set FREQ. RANGE switch (6) to X 100 and adjust the shaft of the dial until the frequency counter indicates 1kHz.
4. Set the dial to "10" position and tighten the set-screws, making sure that the shaft stays as it is. Check that the frequency counter is indicating 1 kHz, then secure the knob to the dial.
5. Set the dial to "100" position and adjust TC101 for a reading of 10kHz on the frequency counter.
6. Set FREQ. RANGE switch (6) to X 1 and the frequency dial (8) to "10" position. Adjust VR101 until the frequency counter indicates 10Hz.
7. Set FREQ. RANGE switch (6) to X 10k and the frequency dial (8) to "100" position. Adjust TC102 for 1 MHz on the frequency counter.

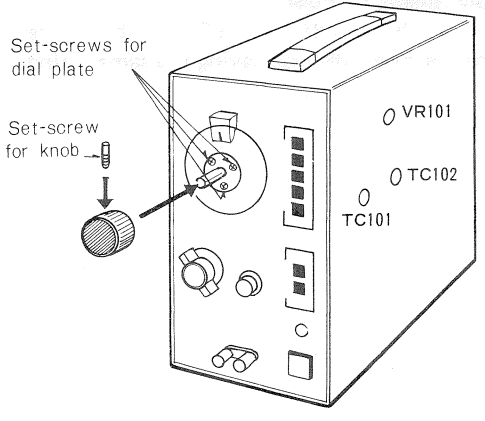


Fig. 10

Caution

1. Do not apply voltage of more than 10V rms to OUTPUT terminal and SYNC terminal. If a DC voltage is to be used, it should be applied through a capacitor.
2. Connecting leads should be as short as possible. Use of a long shield cable will affect high frequency amplitude characteristics because of its own line capacitance. Also, use of a long unshielded lead will introduce noise and cause other troubles.
3. Power supply voltage:
   AG-203 is preset to operate on AC 240V, however, this should be checked before connecting AC power cord. If your local AC voltage is other than 240V, change the position of the power voltage selector according to the instructions on the rear panel. Note that operating voltage is within ± 10% of the rated voltage.
4. Output waveform after switching on:
   Because of the use of direct coupled circuits throughout the entire stage, a DC voltage will appear at OUTPUT terminal for a while when the power is on. This DC voltage will disappear about 20 to 30 seconds later when normal output waveform is obtained.
5. Output voltage variation due to ambient temperature:
   A thermistor is used to control the oscillating voltage. Care should be used when operating AG-203 in atmosphere of excessive temperature variation because the thermistor is normally affected by ambient temperature variation.
6. Be sure to press only one FREQ RANGE switch. If two switches are pressed at the same time or all the switches are in released positions, your AG-203 will not work properly.
7. Impedance matching:
   Any related equipment to be connected to OUTPUT terminal should be checked to see that its input impedance matches the output impedance (600 Ω) of AG-203.
8. Effect of external noise:
   Excessive noise from an outside source may affect the external synchronizing input terminal. If such a noise is evident, short this terminal (output voltage amplitude will somewhat deviate in this case).

Parts List

Ref. No.	Parts No.	Description
	MISCELLANEOUS	
—	A01-0809-22	Case
—	A10-1409-23	Chassis
—	A13-0702-13	Frame
—	A20-2708-03	Panel
—	A21-0811-13	Ornament panel
—	A23-1606-13	Rear Panel
—	A40-0703-13	Bottom plate
—	B07-0189-04	Push escutcheon
—	B07-0190-04	Push escutcheon
—	B20-0904-14	Graticule
—	B23-0601-04	Pointer
—	B30-0902-15	LED Lamp
—	B40-2703-14	Serial plate
—	B41-0754-14	Voltage indication label
—	B50-2818-10	Instruction manual
VC1a, b	C01-0154-15	Variable capacitor
—	D13-0501-04	Bevel gear (1)
—	D13-0502-04	Bevel gear (2)
—	D21-0901-14	Shaft
—	D23-0061-04	Bearing
—	E18-0351-05	Power connector
—	E08-1081-05	Voltage selector (jack)
—	E09-0681-05	Voltage selector (plug)

Ref. No.	Part No.	Description
—	E18-0106-05	Terminal, type banana
—	E18-0107-05	Terminal, type banana (black)
—	E21-0209-13	Pair terminal
—	E30-0095-05	Cord (Black)
—	E30-0096-05	Cord (Red)
—	E91-0003-05	Mini-gator clip with black insulator
—	E91-0004-05	Mini-gator clip with red insulator
—	E91-0016-05	Banana tip (Black)
—	E91-0015-05	Banana tip (Red)
—	F05-2012-05	Fuse (0.2A) x 2
—	F05-1218-05	Fuse (0.125A) x 3
—	F10-1511-04	Shield plate
—	G01-0901-14	Spring
—	H01-2812-14	Packing case (individual packing)
—	H10-2802-02	Packing material, foamed styrene
—	H20-1703-04	Protection cover
—	H25-0029-04	Polyethylene bag
—	J03-0003-04	Rubber leg
—	J13-0033-15	Fuse holder
—	J21-2820-04	Variable capacitor mounting hardware
—	J21-2877-04	Switch mounting hardwear
	J42-0038-04	bushing
—	K01-0058-25	Grip
—	K21-0282-14	Knob (push)
—	K21-0289-14	Knob
—	K21-0292-14	Knob (push) (Orange)
—	K21-0306-04	Knob

Ref. No.	Parts No.	Description
—	K21-0803-14	Dial knob
—	K21-0807-04	Knob (push) (Blue)
—	L01-9026-05	Power transformer
—	S40-2506-05	Push switch
—	X65-1160-00	Main unit (Printed circuit board)

PARTS LIST OF X65-1160-00

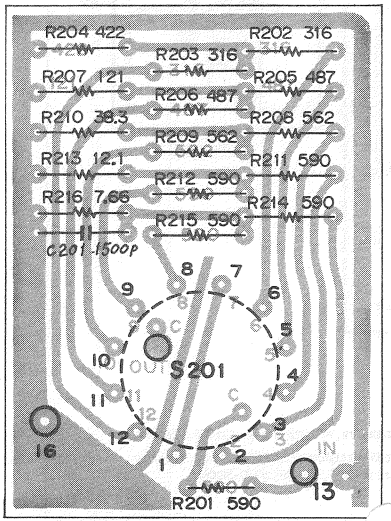
Ref. No.	Parts No.	Description
	CAPACITOR	
C101	CM93BD2A120J	Mica 12pF
C102	CM93BD2A080D	Mica 8pF
C103	CM93BD2A100D	Mica 10pF
C104	CM93BD2A100D	Mica 10pF
C105	CM93BD2A510J	Mica 51pF
C106	CE04W1H471M	Electrolytic 470μF 50V
C107,108	CE02W1V222	Electrolytic 2200μF 35V
C109,110	CQ93M1H104K	Mylar 0.1μF
C111,112	CE04W1V101M	Electrolytic 100μF 35V
C113	CH93BD2A040D	Mica 4pF
C114	CC45SL1H330J	Ceramic 33pF
C116	CC45SL1H101J	Ceramic 100pF
C117	CC45CH1H470J	Ceramic 47pF
C201	CK45B1H152K	Ceramic 1500pF ±10%
	RESISTOR	
R101,102	RN14BK2E3601F	Metal 3.6kΩ ±1% 1/4W
R103,104	RN14BK2E3602F	Metal 36kΩ ±1% 1/4W
R105,106	RN14BK2E3603F	Metal 360kΩ ±1% 1/4W

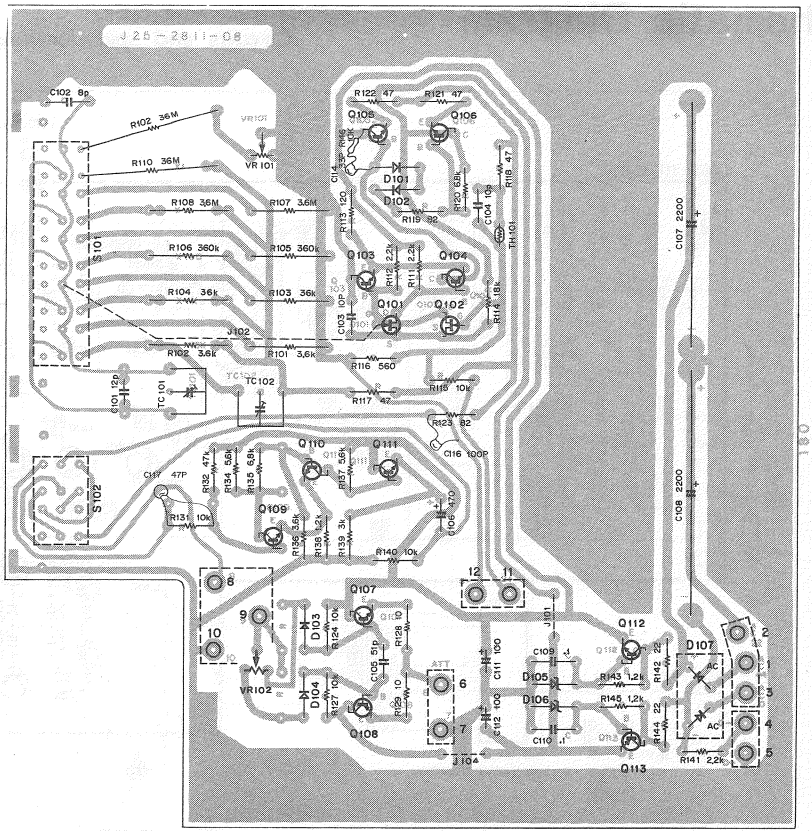
Ref. No.		Description			
R107,108	R92-0796-05	Metal	3.6MΩ	±1%	1/2W
R109,110	R92-0797-05	Metal	36MΩ	±1%	1/2W
R111,112	RD14BB2E 222J	Carbon	2.2kΩ	±5%	1/4W
R113	RD14BB2E 121J	Carbon	120Ω	±5%	1/4W
R114	RD14BB2E 183J	Carbon	18kΩ	±5%	1/4W
R115	RD14BB2E 103J	Carbon	10kΩ	±5%	1/4W
R116	RD14BB2E 561J	Carbon	560Ω	±5%	1/4W
R117,118	RD14BB2E 470J	Carbon	47Ω	±5%	1/4W
R119	RD14BB2E 820J	Carbon	82Ω	±5%	1/4W
R120	RD14BB2E 682J	Carbon	6.8kΩ	±5%	1/4W
R121,122	RD14BB2E 470J	Carbon	47Ω	±5%	1/4W
R123	RD14BB2E 820J	Carbon	82Ω	±5%	1/4W
R124	RD14BB2E 103J	Carbon	10kΩ	±5%	1/4W
R125,126					
R127, 146	RD14BB2E 103J	Carbon	10kΩ	±5%	1/4W
R128,129	RD14BB2E 100J	Carbon	10Ω	±5%	1/4W
R131	RD14BB2E 103J	Carbon	10kΩ	±5%	1/4W
R132	RD14BB2E 473J	Carbon	47kΩ	±5%	1/4W
R134	RD14BB2E 562J	Carbon	5.6kΩ	±5%	1/4W
R135	RD14BB2E 682J	Carbon	6.8kΩ	±5%	1/4W
R136	RD14BB2E 362J	Carobn	3.6kΩ	±5%	1/4W
R137	RD14BB2E 562J	Carbon	5.6kΩ	±5%	1/4W
R138	RD14BB2E 122J	Carbon	1.2kΩ	±5%	1/4W
R139	RD14BB2E 302J	Carbon	3.0kΩ	±5%	1/4W
R140	RD14BB2E 103J	Carbon	10kΩ	±5%	1/4W
R141	RD14BB2E 222J	Carbon	2.2kΩ	±5%	1/4W
R142	RD14BY2H 220J	Carbon	22Ω	±5%	1/2W
R143	RD14BB2E 122J	Carbon	1.2kΩ	±5%	1/4W
R144	RD14BY2H 220J	Carbon	22Ω	±5%	1/2W
R145	RD14BB2E 122J	Carbon	1.2kΩ	±5%	1/4W
R146	RD14BB2E103J	Carbon	10kΩ	±5%	1/4W
J101~103	R92-0150-05	Jamper	wire		

Ref. No.	Parts No.	Description
SEMICONDUCTOR		
Q101,102	2SK381D	Field Effect Transistor
Q103,104	2SA838(C)	Transistor
Q105	2SC1845	Transistor
Q106	2SA992	Transistor
Q107	2SC495 (Y)	Transistor
Q108	2SA505 (Y)	Transistor
Q109	2SC2274 (D E)	Transistor
Q110,111	2SC1845	Transistor
Q112	2SD882	Transistor
Q113	2SB772	Transistor
D101~104	1S1588	Diode
D105,106	MTZ24JC	Diode
D107	W02	Diode Bridge
TH101	STT-300H	Thermistor
MISCELLANEOUS		
VR101	R12-8001-05	Semi-fixed resistor 2.2MΩB
VR102	R12-0056-05	Semi-fixed resistor 100ΩB
TC101,102	C05-0415-05	Trimmer 15pF
C101a~e	S42-5501-05	Push switch
S102a,b	S42-2501-05	Push switch
S201a,b	S01-2502-05	Rotary Switch

Ref. No.	Parts No.	Description
R201	RN14BK2H5900F	Metal 590Ω
R202,203	RN14BK2H3160F	Metal 316Ω
R204	RN14BK2H4220F	Metal 422Ω
R205,206	RN14BK2H4870F	Metal 487Ω
R207	RN14BK2H1210F	Metal 121Ω
R208,209	RN14BK2H5620F	Metal 562Ω
R210	RN14BK2H38R3F	Metal 38.3Ω
R211,212	RN14BK2H5900F	Metal 590Ω
R213	RN14BK2H12R1F	Metal 12.1Ω
R214,215	RN14BK2H5900F	Metal 590Ω
R216	RN14BK2H3R83F	Metal 3.83Ω
MISCELLANEOUS		
–		Printed circuit board

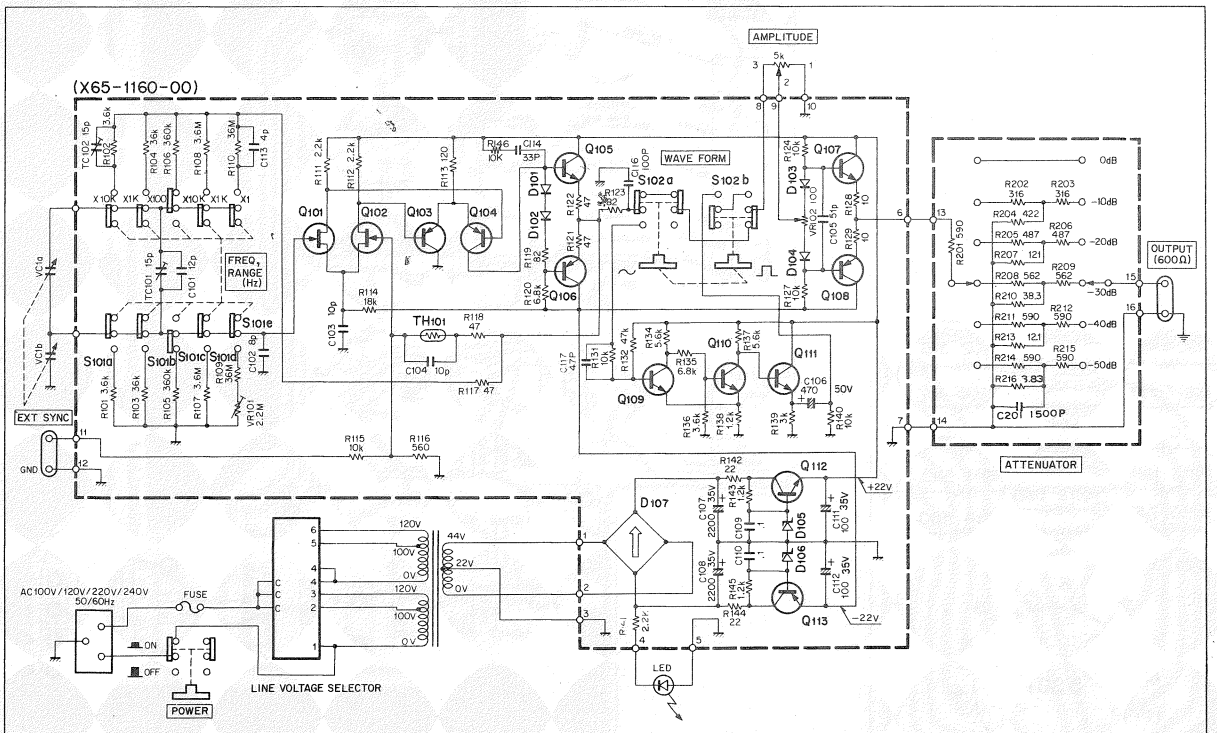
PC Board


R204 422
R202 316
R203 316
R207 121
R205 487
R206 487
R210 38.3
R208 562
R209 562
R213 12.1
R211 590
R212 590
R216 7.66
R214 590
R215 590
C201 1500P
S201
R201 590
16
13
IN
OUT


J25-2811-08
S101
S102
S201
J101
J102
J104
VR101
VR102
TC101
TC102
Q101
Q102
Q103
Q104
Q106
Q107
Q108
Q109
Q110
Q111
Q112
Q113
D101
D102
D103
D104
D105
D106
D107
TH101
C102 8p
R102 36M
R110 36M
R108 36M
R107 36M
R106 360k
R105 360k
R104 36k
R103 36k
R102 3.6k
R101 3.6k
R116 560
R117 47
R110 10k
R123 82
C116 100P
R122 47
R121 47
R120 68k
R119 39
R118 47
C104 10p
C107 2200
C108 2200
R112 2.2k
R111 2.2k
R114 18k
C103 10P
R113 120
C114 33P
R132 47k
R134 6.8k
R135 6.8k
R137 5.6k
C117 47P
R131 10k
R136 12k
R139 3k
R140 10k
C106 470
R124 10k
R128 10
C105 51P
R129 10
C111 100
C112 100
C109
C110
R143 1.2k
R145 1.2k
R142 22
R144 22
R141 2.2k
C201 1500P

Schematic Diagram

Circuits and specifications are subject to change for improvement.



A product of
KENWOOD CORPORATION
17-5, 2-chome, Shibuya, Shibuya-ku, Tokyo 150, Japan

 PRINTED IN JAPAN B50-2818-10 (K)