INSTRUCTION MANUAL

FREQUENCY RESPONSE CHECKER

MODEL 681A

KIKUSUI ELECTRONICS CORPORATION

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____A, _____VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

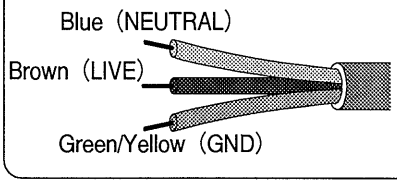
☐ AC power cable

The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

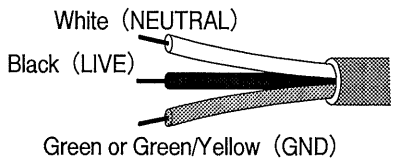
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

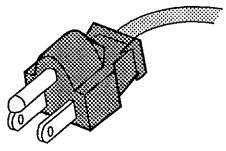
☐ Without a power plug



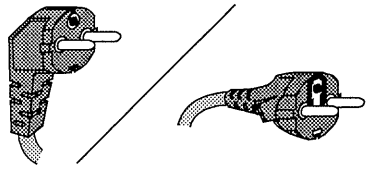
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

TABLE OF CONTENTS

1. GENERAL

Model 681A Frequency Response Checker has been designed for rapid test of frequency response characteristics of tape recorders, stereophonic amplifiers, and other audio equipment. The check operation (the test to find whether the frequency response of audio equipment is within a specified range or not) can be instantaneously done with respect to any reference frequency (1 kHz, normally) without being affected by gain variation of the tested equipment.

The Checker has seven check spot frequencies, ranging from 31.5 Hz to 20 kHz. Frequencies can be changed by replacing plug-in units.

2. CONSTRUCTION

The Checker consists of two major blocks -- transmitter and receiver. At the transmitter, the outputs of oscillators are mixed at equal voltage levels, the resultant compound signal is conditioned to a certain voltage level with an attenuator and then the signal is fed to the output terminal.

The output terminal of the Checker is to be connected to the input terminal of the tested equipment and its output terminal is to be connected to the input terminal of the Checker.

The receiver can be operated either in a manual or an AGC mode of measurement. For manual measurement, the input signal is manually adjusted to an appropriate voltage by the input potentiometer and then the signal is applied to the input circuit and individual band pass filters (BPF's).

The BPF output voltage is compared with a preset voltage, by a voltage comparator. The compared result is indicated with the GO lamp (within specification -- green) or the NO GO lamp (out of specification -- red). At the same time the BPF output is applied to an indicator circuit and is indicated by an indicating meter (edge-width meter).

In the case the measured equipment has very large variation characteristics with respect to the reference frequency (such as a tone control circuit or an equalizer circuit of a stereo amplifier), the gain of the indicating meter circuit can be switched to -10 dB, +10 dB, or +20 dB, thereby expanding the effective measuring range of the indicating meter.

When in AGC measurement, gain of the AGC circuit is varied so that the BPF output of the reference frequency (1 kHz, normally) is maintained constant. The output voltage of the reference-frequency BPF is used as the control signal of the AGC circuit.

A block diagram of the Checker is shown in Figure 1.

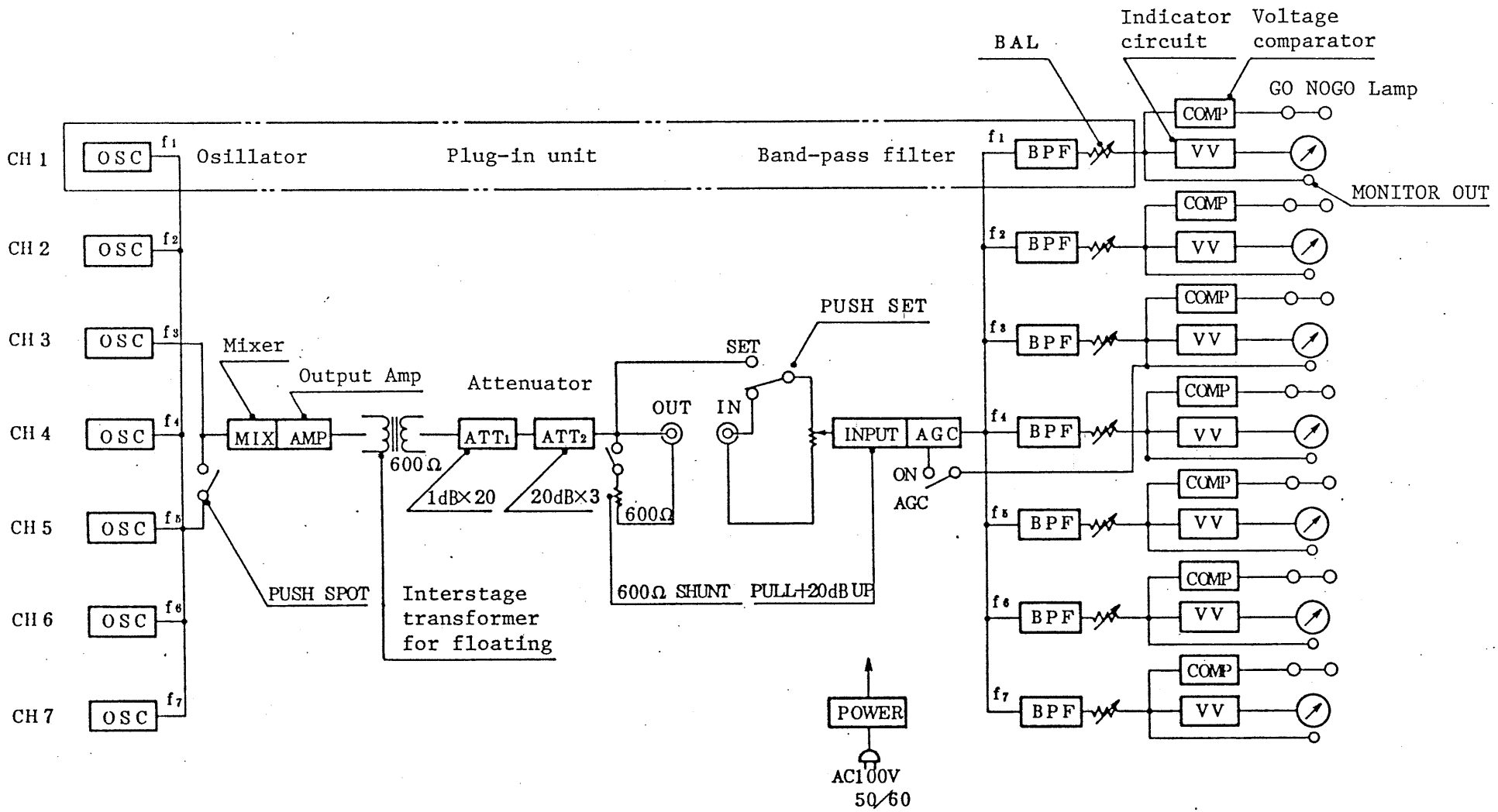


Figure 1. Block diagram of Model 681A Frequency Response Checker

3. SPECIFICATIONS

Transmitter

Oscillation frequencies: 31.5 Hz - 20 kHz, frequency selection of up to seven points in plug-in system (For frequencies selectable with plug-in system, see table in Subsection 6-5.)

Accuracy: ±3% or better

Stability: ±2% or better

Mixing ratio (1 kHz as reference): Within ±1 dB (for each frequency)

Output voltage (maximum): $0.245 \times \sqrt{n}$ Vrms/600-ohms
(n: the number of plug-in units)

Impedance: 600Ω ±20%, single-ended, floating

Stability: ±0.5 dB or better

Attenuator: 0 dB to -80 dB, 1-dB steps
(-1 dB × 20) + (-20 dB × 3)

Terminals: Binding posts and BNC connector

Receiver

Maximum allowable input voltage: ±50 V (DC + AC peak)

Measuring input voltage range: 2 mVrms - 4 Vrms
(per one frequency)

Impedance: 100 kΩ ±20%, single-ended

AGC operation range: ±10 dB or over
(level shift: not larger than ±0.5 dB)

Band pass filter characteristics

Center frequency:	The same with oscillator frequency
Selectivity:	Within ±1 dB at ±5% of nominal frequency. -35 dB or over at one-octave-deviated frequency
Frequency stability:	±2% or better

Indicating meter:	Edgewise meter (JIS CLASS 2.5)
Indication range:	+5 dB to -15 dB (meter scale)
Indication level change:	Indication level (meter scale 0 dB) can be changed to +20 dB, +10 dB, and -10 dB, except at reference frequency (1 kHz, normally)
Measurable range:	+25 dB to -25 dB
Accuracy:	±3% or better

GO/NO-GO indication (for each frequency)

Indication setting range:	Full meter scale range for both UPPER and LOWER setting
Indication:	GO — green lamp; NO GO -- red lamp

Input terminals:	Binding posts and BNC connector
Power requirements:	100 V AC, 50/60 Hz, approx. 27 VA
Stability:	The above specifications are satisfied at 100 V ±10%, 50/60 Hz AC.
Ambient temperature and humidity:	5°C to 35°C (41°F to 95°F), 85% RH

Dimensions:	430 (W) × 160 (H) × 275 (D) mm
	(16.93 (W) × 6.30 (H) × 10.83 (D) in.
At maximum sections:	445 (W) × 175 (H) × 305 (D) mm
	(17.52 (W) × 6.89 (H) × 12.01 (D) in.
Weight:	Approx. 10 kg (22 lbs)
Accessories:	Instruction manual ..... 1 copy
	Fuses (1 A) 2

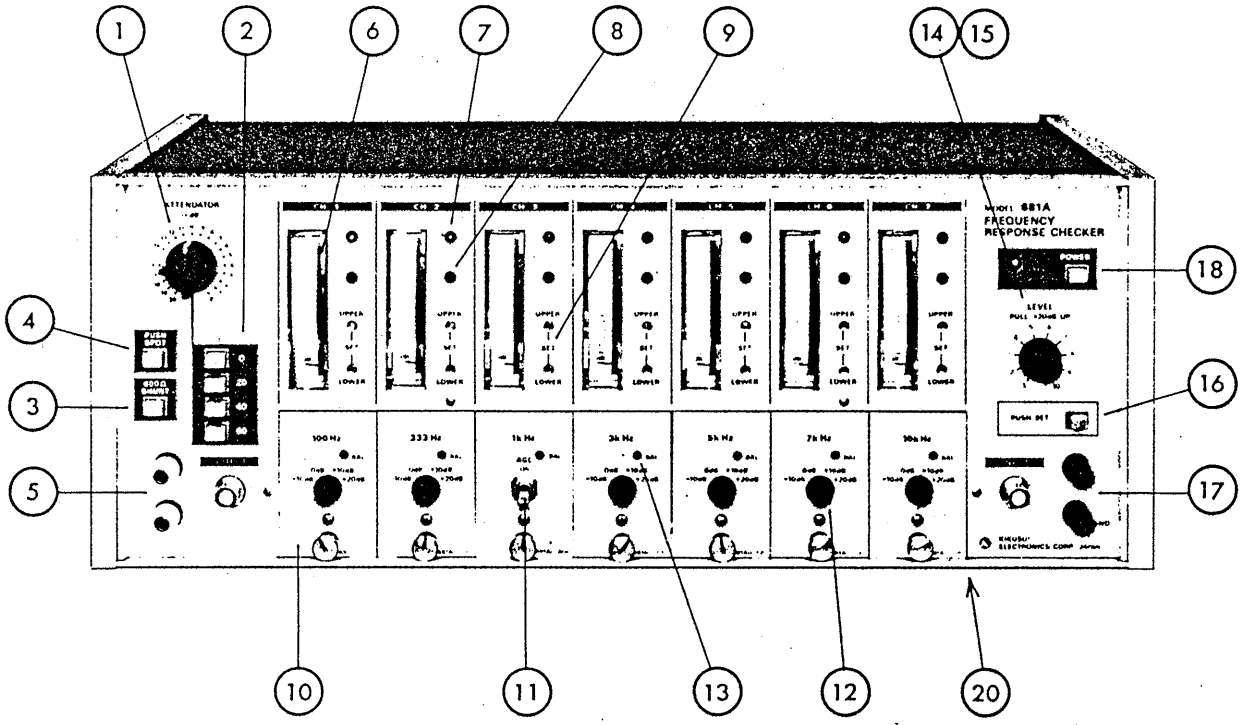


Figure 2. Front panel

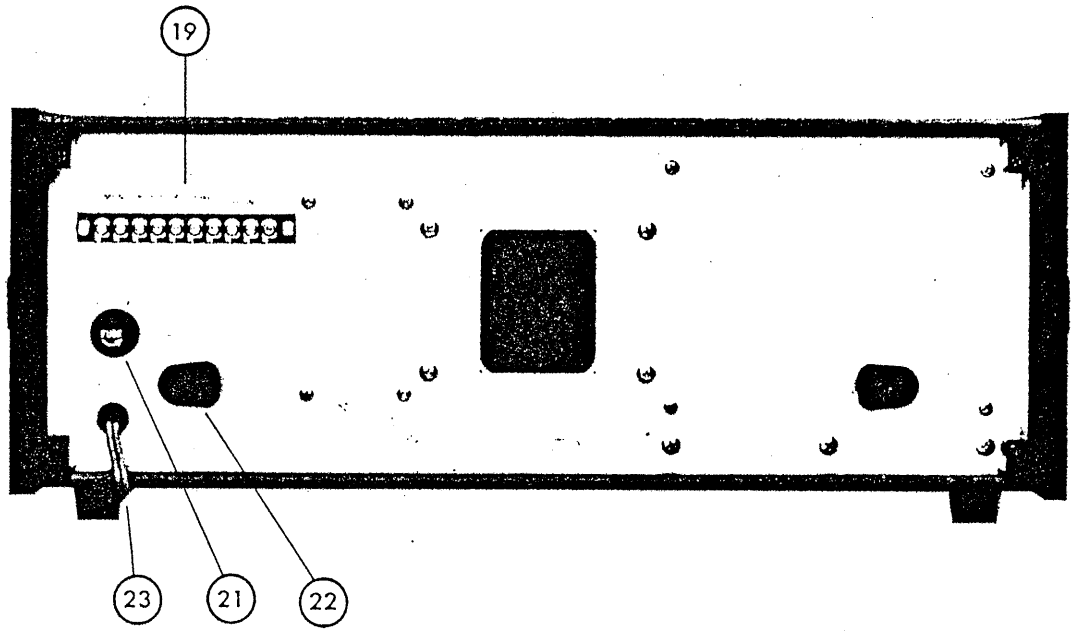


Figure 3. Rear panel

4. EXPLANATION OF PANEL ITEMS

See Figure 2.

① OUTPUT ATTEN (-dB)

This is a 600-ohm attenuator for attenuation of the output signal with 1-dB step × 20. As used in conjunction with ② ATTENUATOR, a 600 ohm attenuator for 80 dB in 1-dB steps can be obtained.

② ATTENUATOR

This is a 600-ohm attenuator which attenuates the output signal with 20-dB step × 3.

③ 600Ω SHUNT

As you depress this button, the output is terminated with a resistor of 600 ohms, 1%, 1/2 W.

④ PUSH SPOT

When this button is OFF (⊓), the compound signal of the signals of the plug-in units is delivered to the OUTPUT terminal. When this button is ON (⊓), the signal of CH3 alone is delivered.

⑤ OUTPUT

This is the output terminal of the Checker. A set of 3/4-inch pair plugs or a BNC connector can be connected to this terminal. The BNC connector and the pair plugs are connected in parallel.

⑥ METER

This is an edgewise meter which indicates frequency response for a range of +5 dB to -10 dB.

⑦ GO LAMP (GREEN)

This lamp light when the meter pointer is within the range which has been set at Item ⑨ below, to indicate that the condition is GO.

⑧ NO-GO LAMP (RED)

This lamp lights when the meter pointer is out of the range which has been set as Item ⑦ below, to indicate that the condition is NO-GO.

⑨ SET (UPPER, LOWER)

This potentiometer sets the upper limit or lower limit for GO/NO/GO limit level. The GO range can be made narrower starting from and upper position of the meter with the UPPER potentiometer and it can be made narrower starting from a lower position of the meter with the LOWER potentiometer.

⑩ PLUG-IN UNIT

This unit comprises a spot frequency oscillator and a band pass filter. The oscillating frequency of the oscillator and the center frequency of the band pass filter are the same for each plug-in unit.

⑪ AGC (ON-OFF) SWITCH

This switch is for on-off control of the AGC function. The AGC function covers ±10 dB with respect to the 0 dB position of the meter.

⑫ LEVEL SHIFT

This switch is for meter level shift. When it is thrown to the +10 dB position, the 0 dB position of the meter becomes a value of +10 dB.

⑬ BAL

This potentiometer is for adjustment of meter sensitivity for a range of approximately ±3 dB.

⑭ INPUT LEVEL

This control is for continuously variable attenuation of the input. The scale indicates a relative quantity of the input signal.

⑮ PULL +20 dB UP

As you pull up this switch, the input sensitivity becomes higher by approximately +20 dB (10 times).

⑯ PUSH SET

This switch is used to connect the output directly to the input. (This switch is used for GO/NO-GO preset.)

⑰ INPUT

These are the input terminals of the Checker. The BNC connector and the pair plugs are connected parallel.

⑱ POWER

This is the main power switch of the Checker.

⑲ MONITOR OUTPUT

These terminals provide output voltages which may be monitored with an oscilloscope, AC voltmeter, etc. The output voltages are proportional to the indicating meter deflection, with a voltage of approximately 0.4 Vrms when meter indication is 0 dB. The output impedance is approximately 10 kΩ, balanced.

⑳ STAND

The stand may be used to get a better viewing angle of the meter.

㉑ FUSE

The fuse holder, which contains 1-ampere fuse, is connected in the AC input circuit.

㉒ CORD TAKE-UP

The power cord can be wound and taken up on a pair of hooks.

㉓ POWER CORD

To be connected to a receptacle of 100 V, 50/60 Hz power line.

5. OPERATING PROCEDURE

1. Before starting operating the Checker, set the controls as below. Allow approximately 10 minutes of stabilization period after turning on the instrument power.

OUTPUT ATTEN:	0 dB
PUSH 600Ω:	ON (▄)
PUSH SPOT:	OFF (▯)
INPUT VR:	Scale "5" (depressed state)
PUSH SET:	ON (▄)
AGC:	OFF
LEVEL SHIFT:	0 dB

2. After the stabilization period has elapsed, turn the INPUT VR and check that the level is variable for a range of from +5 dB to -10 dB. Then, adjust that the meter indicates 0 dB with 14 INPUT VR and 13 BAL. Perform this operation for all meters.

3. Set the OUTPUT ATTEN in the 10 dB position. (Each meter will indicate the -10 dB position.)

4. Turn on the AGC switch. (Each meter will indicate 0 dB again.)

5. Turn the AGC switch to the OFF position and the OUTPUT ATTEN to the 0 dB position.

6. Set the range for GO and NO-GO. (For example, a range of +3 to -3 dB may be set as the GO range and all other ranges as the NO-GO range.

7. By turning the INPUT VR, move the meter pointer to the upper limit point (in the above example, to the +3 dB scale position).

8. Turn the SET--UPPER VR to the position where the GO/NO-GO lamps are switched, using a slim screwdriver (-). (upper limit setting)

9. By turning the INPUT VR, move the meter pointer to the lower limit point (in the above example, to the -3 dB scale position).

10. Turn the SET--LOWER VR to the position where the GO/NO-GO lamps are switched, using a slim screwdriver (-). (lower limit setting)

    Note: Setting for GO/NO-GO judgement can be made for a range of approximately -20 dB from the meter full-scale. When the below condition is not met, the red lamp alone lights. When the meter pointer is lower than -20 dB, both red lamp and green lamp go off.

    UPPER setpoint > LOWER setpoint > -20 dB

11. Set the PUSH SET button in the unpressed state and adjust the OUTPUT ATTEN at 80 dB. (Set the 1-dB-step attenuator at 20 dB and the 20-dB-step attenuator at 60 dB.)

12. Set the INPUT VR at scale "1" position.

13. Connect the output of the Checker to the input of the measured equipment.

14. Connect the input of the Checker to the output of the measured equipment.

15. By adjusting the OUTPUT ATTENUATOR, apply an appropriate input signal to the measured equipment.

16. Gradually turn the INPUT VR until the level is made 0 dB at a certain frequency (arbitrary one of the seven spot frequencies). Read on each meter the relative level difference at each frequency.

17. Turn on the AGC. Read relative level difference at each frequency, with respect to 0 dB of the frequency of the plug-in unit which has the AGC function.

18. If the frequency response characteristics of the measured equipment is flat for a range of 31.5 Hz to 20 kHz, all blue lamps will light indicating that the state is GO.

If there are peaks higher than +3 dB or dips lower than -3 dB, the red lamp of the corresponding frequency will light indicating that the state is NO-GO.

6. PRECAUTIONS FOR OPERATING THE CHECKER

6-1. Some stabilization time is required before the instrument is warmed up and the signal levels become stabilized after turning on the instrument power. Be sure to allow a stabilization time before starting measurement.

6-2. Do not insert or remove the plug-in unit while the power switch is kept turned on.

6-3. Output voltage:

The output voltage of the Checker is -10 dBm (= 0.245 Vrms) as terminated with 600 Ω (the attenuator is at 0 dB). When an "n" number of plug-in units are used, the rms-value output voltage can be expressed as follows:

$$Vo\ rms = 0.245 \times \sqrt{n}\ V\ rms\ (600\ \Omega\ load)$$

The output voltages of all plug-in units are mixed at equal levels. Therefore, the peak-to-peak output voltage can be expressed as follows:

$$Vo\ p\text{-}p = 0.693 \times n\ Vp\text{-}p\ (600\ \Omega\ load)$$

Note: Note that, in the case the output levels are of two or more waves, indication errors may result if a mean-value-indication effective-value-scale voltmeter is used.

6-4. Recording Level of Tape Recorder

Measurement of frequency response characteristics of a regular type recorders is done, due to non-linearity of recording media (magnetic tape), at a level lower by 10 to 20 dB lower than the standard level (0 V) of the tape recorder (as per JIS). When this checker is used for measurement, it is recommended to lower further the level by 5 to 10 dB.

Note that the output voltage of the checker per wave is -10 dBm when the attenuator is set at 0 dB. When sevel signals are mixed together, the output voltage in effective value is as follows:

$$0.245 \times \sqrt{7}\ \text{Vrms} = 0.648\ \text{Vrms} = -15\ \text{dBm}\ (600\ \Omega\ \text{load})$$

The output voltage in peak-to-peak value is expressed as follows:

$$0.693 \times 7\ \text{Vp-p} = 4.85\ \text{Vp-p}\ (600\ \Omega\ \text{load})$$

Pay attention to the above especially when tape recorders which have a noise reduction system (Dorby system etc.) or an automatic level control (ALC) function or etc. are tested.

6-5. Selecting of Plug-in Frequencies

(1) Select plug-in frequencies from within a range of 31.5 Hz to 20 kHz. The frequencies shown in Table 1 are available for the plug-in units. Select up to seven units (including ones with AGC feature) from the table.

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31.5 Hz	150 Hz	1 kHz	6.3 kHz	13 kHz
40 Hz	200 Hz	2 kHz	7 kHz	14 kHz
60 Hz	250 Hz	3 kHz	7.2 kHz	15 kHz
63 Hz	300 Hz	4 kHz	7.5 kHz	16 kHz
80 Hz	333 Hz	5 kHz	8 kHz	18 kHz
100 Hz	400 Hz	5.3 kHz	10 kHz	20 kHz
120 Hz	500 Hz	5.8 kHz	12 kHz	
125 Hz	800 Hz	6 kHz	12.5 kHz	

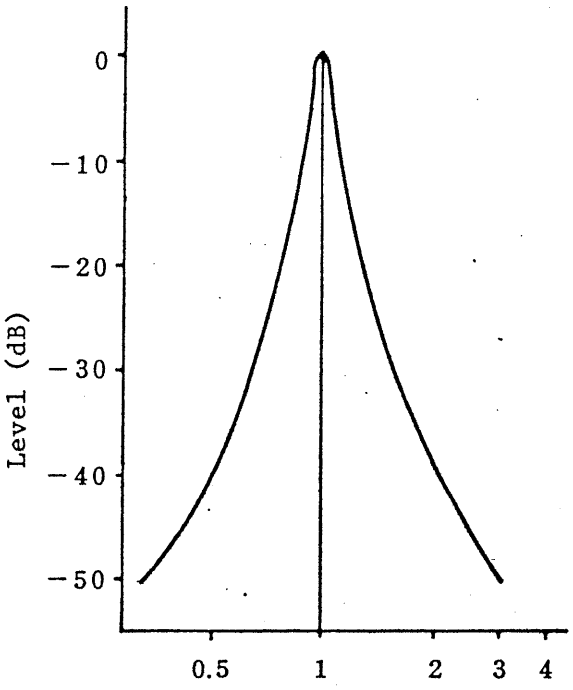
Table 1

(2) Avoid, whenever avoidable, selecting frequencies of harmonic relationships (frequencies in relationships of multiplication by integers), especially of 2nd and 3rd harmonic frequencies (frequencies in relationships of multiplication by 2 and 3). If frequencies which may result in large harmonic distortion are applied to the equipment to be tested, larger indication errors may be caused. Especially at low frequencies (such as frequencies lower than 1 kHz), beat may be caused and the meter pointer may deflect oscillatingly.

Examples of undesirable frequency relationships:

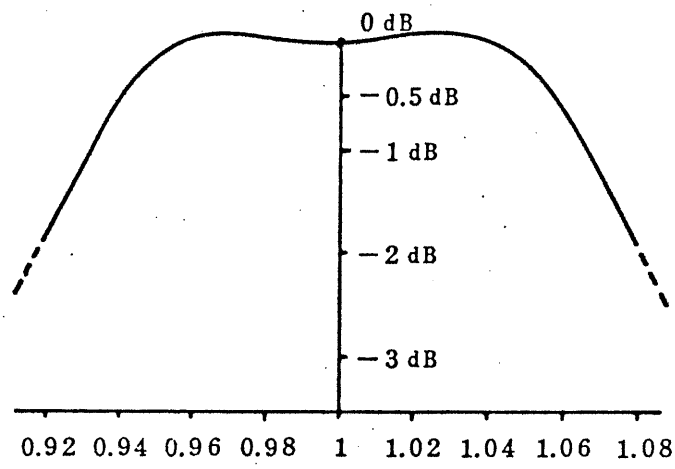
40 Hz ↔ 80 Hz, 100 Hz ↔ 200 Hz

(3) Select mutually adjoining frequencies as apart as possible. The characteristics of the band pass filters (BPF) of the receiver are as shown in Figures 4 and 5. If frequencies which are not sufficiently apart are selected, a band pass filter may add up components of an adjoining frequency and indication errors may result. Such errors will be explained in more detail with examples in subsequent paragraphs.



BPF characteristics (1)

Figure 4



BPF characteristics (2)

Figure 5

Example: When seven measuring spot frequencies are selected at 40 Hz, 100 Hz, 400 Hz, 1 kHz (AGC), 10 kHz, 16 kHz, and 20 kHz

Let us discuss the interference between 16 kHz and 20 kHz (frequency ratio = 0.25). (See Figure 6.)

(A) When frequency response between 16 kHz and 20 kHz is flat and there is no level difference between them

(a) The meter indication for the 16 kHz signal is the sum of the component (A) of the 16 kHz signal itself and the component (B) of the 20 kHz signal, as having passed through the 16 kHz BPF. Errors caused by the component of the 20 kHz signal is negligibly small (approximately 0.04 dB*).

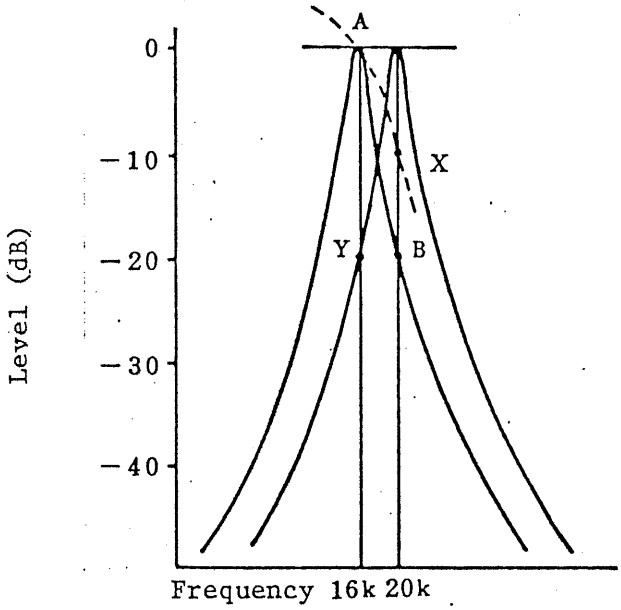


Figure 6

* Calculation for the case of (A), (a):

Assume that the component (A) of the 16 kHz signal is 1 Vrms. Since the component (B) of the 20 kHz signal which has passed the 16 kHz BPF is attenuated by -20 dB due to the characteristics shown in Figure 6, the voltage caused by the component (A) is 0.1 Vrms. The compound signal of (A) plus (B) becomes as follows:

$$\sqrt{A^2 + B^2} = \sqrt{1^2 + 0.1^2} = \sqrt{0.01} \fallingdotseq 1.005$$

The rate of increase of the 16 kHz signal caused by the component (B) of the 20 kHz signal is as follows:

$$\frac{1.005\ V}{1\ V} = 1.005$$

In terms of decibels, the increase is expressed as follows:

$$20 \times \log_{10} 1.005 = 0.04 \text{ (dB)}$$

(b) Errors caused on the 20 kHz signal indication also is negligible.

(B) When frequency response is low at higher frequencies and the component of 20 kHz is attenuated by 10 dB as compared with that of 16 kHz

(a) The meter indication for the 16 kHz signal is the sum of the component (A) of the 16 kHz signal itself plus the component (B) of the 20 kHz signal which has passed the 16 kHz BPF. As the component of the 20 kHz signal is attenuated by 10 dB than that of the 16 kHz signal, the effect of the component of the 20 kHz signal on the 16 kHz signal is still smaller than that in the case of Item (A) and it is quite negligible.

(b) The meter indication for the 20 kHz signal is the sum of the component (X) of the 20 kHz signal itself plus the component (Y) of the 16 kHz signal which has passed through the 20 kHz BPF. As the component of the 20 kHz signal is relatively small as compared with that of the 16 kHz signal, the effect caused by the 16 kHz signal is larger than the case of the above item (b). The level of error is an 0.41 dB increase in level over the case no 16-kHz plug-in unit is used.

The above relationships are shown in Figure 7.

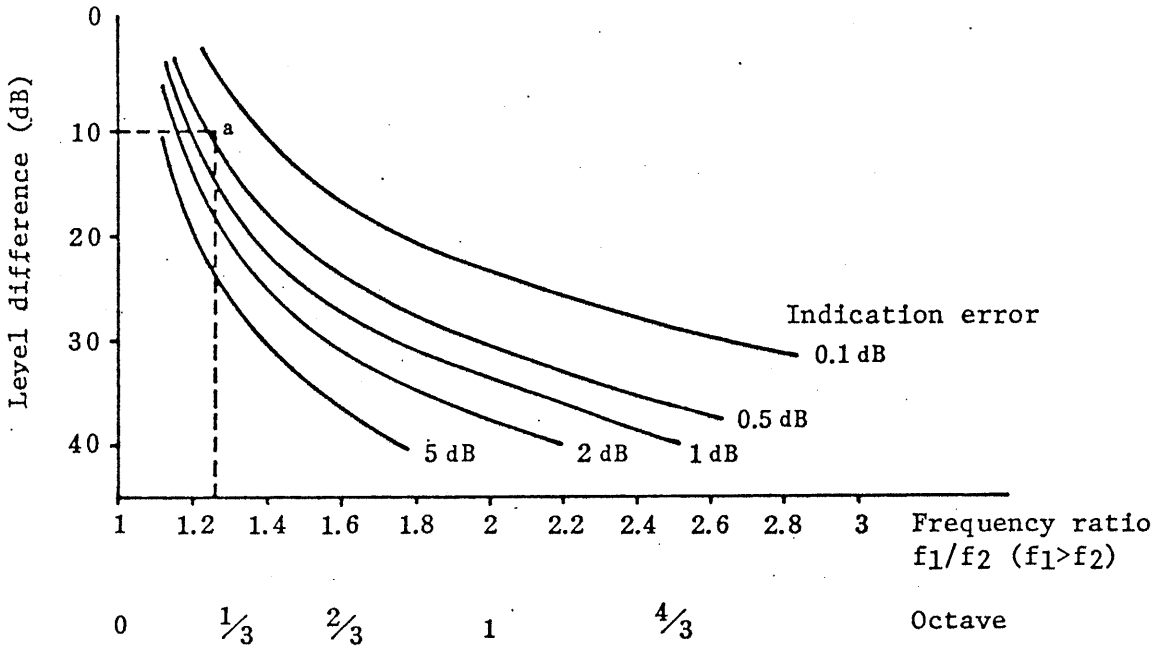


Figure 7

On the curves of Figure 7, error for the case of (B) (b) can be found as follows.

Level difference: 10 dB

Frequency ratio: f_1/f_2 ($f_1>f_2$)

20 kHz/16 kHz = 1.25

Error: Approximately 0.4 dB (value indicated by crossing point "a")

The above is for a case of two frequencies located closely. When three or more frequencies are located closely, errors larger than those of the above cases will be introduced.

The sensitivities of the meters of the 681A Checker are calibrated with a compound signal of different-frequency signals of the same level. Even when meter indication should be varied due to interference as in the case of example A, the meter indication remains flat as the meter sensitivity has been adjusted to such effect.

When close frequencies are selected or when the equipment to be tested has sharp frequency response characteristics, see the curves of Figure 7.

6-6. When two or more plug-in which have the AGC feature are installed, note that the checker will not correctly operate if two or more AGC switches are turned on at the same time.

6-7. Viewing Direction for Meters

To read the edgewise meters, observe the meters from the direction perpendicular to the front panel of the 681A Checker.

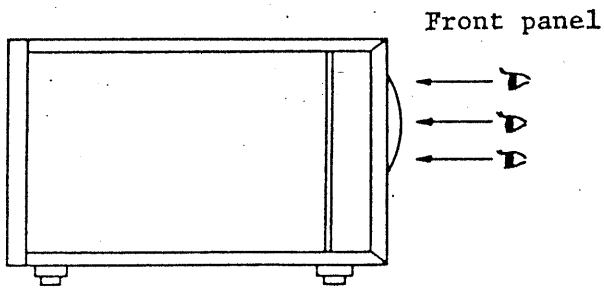


Figure 8

6-8. Interchangeability of Plug-in Units

The plug-in units of Model 681A Checker are interchangeable with those (681UA, 681U-CP) of Model 681 Checker. Note, however, that meter sensitivity is needed to be calibrated when interchanging plug-in units.

7. MAINTENANCE

7-1. Inspection of Checker Inside

To gain access to the inside of the instrument, remove the clamping-screws of the two black studs at right and left of the instrument rear and, then, remove the side, top, and bottom panels.

7-2. Adjustment of Output Voltage

The output voltage is adjustable with potentiometer VR201 on printed board A-2 (the output amplifier which is located close to the left-hand panel and has a connector). For adjustment, set at first the items as follows.

PUSH 600 : ON (⊓)
PUSH SPOT: ON (⊓)
Attenuator: 0 dB

Connect a millivoltmeter to the output terminal. So adjust VR201 that the meter reads 0.245 Vrms (= -10 dBm)

7-3. Adjustment of Input Level

The input level is adjustable with potentiometer VR302 on the printed board A-3 (INPUT AGC = located close to the righthand panel and has a connector).

7-4. Adjustment of AGC Level

The AGC level is adjustable with potentiometer VR301 on printed board A-3.

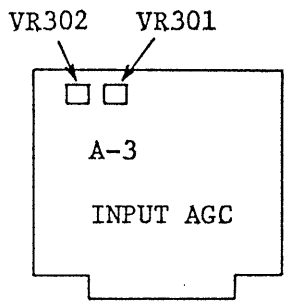
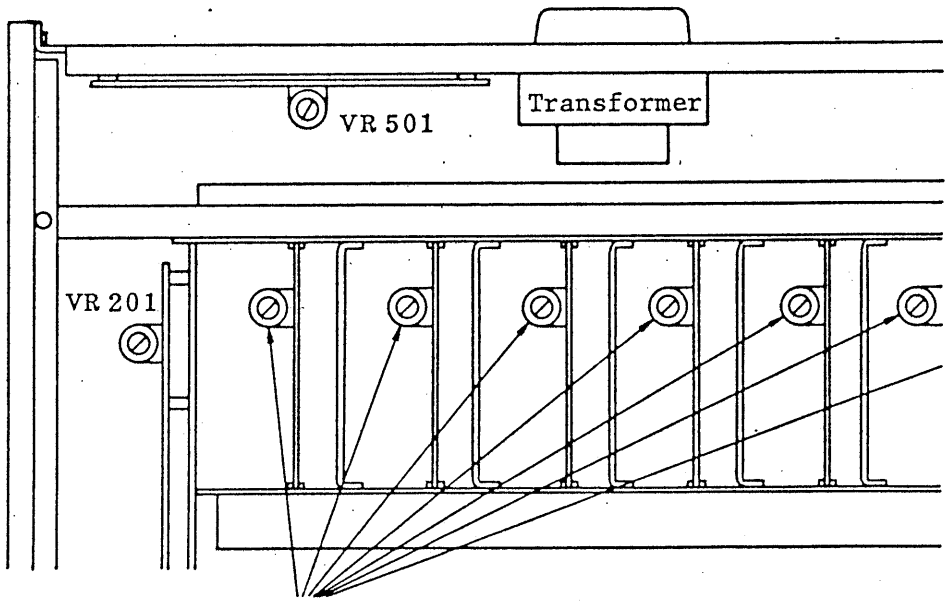


Figure 9

7-5. Making Equal the Levels of All Meters

Set (12) BAL potentiometer in a mid-position, remove the top panel and adjust the seven potentiometers (VR401) of the V. V. COMP circuits.



All of seven potentiometers are VR401

Figure 10