TEXIO
Test and Measurement Solutions

# INSTRUCTION MANUAL

## RESISTANCE ATTENUATOR

# RA-920B

B71-0170-00

# CONTENTS



You are now the owner of our new product RA-920B.
This unit has been carefully engineered and manufactured under our rigid quality control and should give you satisfactory and dependable operation for many years. If trouble is encountered or the unit is damaged in transit, please contact your dealer or our distributor.

# USING THE PRODUCT SAFELY

## ■ Preface

To use the product safely, read this instruction manual to the end. Before using this product, understand how to correctly use it.
If you read this manual but you do not understand how to use it, ask us or your local dealer. After you read this manual, save it so that you can read it anytime as required.

## ■ Notes on reading this instruction manual

◆ The contents of this instruction manual include technical terms in part of their explanation. If you do not understand those terms, do not hesitate to ask us or your local dealer.

## ■ Pictorial indication and warning character indication

This instruction manual and product show the warning and caution items required to safely use the product. The following pictorial indication and warning character indication are provided.

| | |
|---|---|
| <Pictorial indication>  | Some part of this product or the instruction manual may show this pictorial indication. In this case, if the product is incorrectly used in that part, a serious danger may be brought about on the user's body or the product.<br>To use the part with this pictorial indication, be sure to refer to this instruction manual. |
| <Warning character Indication><br>  **WARNING** | If you use the product, ignoring this indication, you may get killed or seriously injured. This indication shows that the warning item to avoid the danger is provided. |
|  **CAUTION** | If you incorrectly use the product, ignoring this indication, you may get slightly injured or the product may be damaged. This indication shows that the caution item to avoid the danger is provided. |

# USING THE PRODUCT SAFELY

## WARNING

### ■ Do not remove the product's covers and panels

Never remove the product's covers and panels for any purpose. Otherwise, the user's electric shock or a fire may be incurred.

### ■ Warning on using the product

The warning items given below are to avoid danger to the user's body and life and avoid the damage and deterioration of the product.
Use the product, observing the following warning and caution items.

### ■ Warning item on installation environment

- Operating temperature
  Use the product within the operating temperature indicated in the rating column. If the product is used with the vents of the product blocked or in high ambient temperatures, a fire may occur.
- Operating humidity
  Use the product within the operating humidity indicated in the rating column. Watch out for condensation by a sharp humidity change such as transfer to a room with a different humidity. Also, do not operate the product with wet hands. Otherwise, an electric shock or fire may occur.
- Use in a gas
  Use in and around a place where an inflammable or explosive gas or steam is generated or stored may result in an explosion and fire. Do not operate the product in such an environment.
  Also, use in and around a place where a corrosive gas is generated or spreading causes a serious damage to the product. Do not use the product in such an environment.

# USING THE PRODUCT SAFELY

## WARNING

### ■ Warning item on grounding

The product has the GND terminal on the panel surface to protect the user from electric shock and protect the product. Be sure to ground the product to safely use it.

### ■ Warning item on abnormality while in use

If smoke or fire is generated from the product while in use, stop using the product. After confirming that no other devices catch fire, ask us or your local dealer.

# USING THE PRODUCT SAFELY

## CAUTION

### ■ Input/output terminal

Maximum input to the input terminals is specified to prevent the product from being damaged. Do not supply input, exceeding the specifications that are indicated in the "Rating" or "Caution on use" column in the instruction manual of the product. Otherwise, a product failure is caused. Also, do not supply power to the output terminals from the outside. Otherwise, a product failure is caused.

(Calibration)

Although the performance and specifications of the product are checked under strict quality control during shipment from the factory, they may aging rate because of aging rate in its parts. It is recommended to periodically calibrate the product so that it is used with its performance and specifications stable. For consultation about the product calibration, call the dealer or the company or each sales office where you bought the product.

(Daily maintenance)

When you clean off the dirt of the product covers, panels, and knobs, avoid solvents such as thinner and benzene. Otherwise, paint may peel off or the resin surface may be affected.

To wipe off the covers, panels, and knobs, use a soft cloth with neutral detergent in it. During cleaning, be careful that water, detergents, and other foreign matters do not get into the product.

If a liquid or metal gets into the product, an electric shock and fire are caused.

Use the product correctly and safely, observing the above warning and caution items. Because the instruction manual indicates caution items even in individual items, observe those caution items to correctly use the product.

If you have questions or comments about the content of the instruction manual, ask us or E-Mail us.

# 1. FEATURES

- Accurate attenuation over a wide range from DC to 1 MHz.
- Metallic film resistors are used throughout the circuitry to provide excellent temperature characteristic and accurate attenuation accuracy.
- Adoption of phase compensation eliminates phase deviation in high frequencies, permitting attenuation of pulse signals.
- Since the case is of the floating ground system, the unit can be readily connected to an electronic device having a different case potential. By grounding the case, the measurement accuracy is further improved.
- Rotary switches are used for easy dial setting.

## 2. SPECIFICATIONS

| | |
|---|---|
| Frequency Range | DC ～ 1MHz |
| Attenuation Range | 0dB to 121dB (0.1dB step) |
| Input/Output Impedance | 600ohm,±10ohm |
| Maximum Input Level | ＋27dBm or 0.5W or 17Vrms |
| Attenuation Accuracy (1kHz) | Less than ±0.2dB<br>Less than ±0.1dB for 1dB step range<br>Less than ±0.01dB for 0.1dB step range |
| Frequency Characteristic (reference freq. 1kHz) | DC ～ 80kHz : ±0.2dB (0dB to 121dB)<br>DC ～ 100kHz : ±0.2dB (0dB to 100dB)<br>DC ～ 150kHz : ±0.5dB (0dB to 100dB)<br>DC ～ 150kHz : ±1dB (0dB to 121dB)<br>DC ～ 1MHz : ±1.5dB (0dB to 60dB) |
| Maximum Floating Voltage | (DC ＋ ACpeak) : ±600V |
| Ambient Temperature | 23℃ ± 10℃ |
| Operating Temperature | 0℃ to 50℃ |
| Dimensions | 105(H)mm × 335(W)mm × 87(D)mm |
| Weight | 2kg |
| Accessories | Instruction manual ; 1 |

# 3. CIRCUIT DESCRIPTION

## 3-1. Outline of Circuit

Fig.3-1 shows the block diagram of the circuit. The large attenuation ranges use “T” or double “T” network and the small attenuation ranges use Bridge “T” networks.

Each step has 600ohm impedance and is provided with capacitors for phase compensation.

## 3-2. “T”, Double “T” and Bridge “T” Networks

The “T” network is used in the circuit where the attenuation per step is large, while the double “T” network is used where the attenuation per step exceeds 40dB so that the effect of stray capacitance is minimized and the accuracy is further improved.

Accordingly, when the attenuation per step is 60dB, the error caused by a single stage “T” network is $\pm 60\varepsilon$ dB, but can be reduced to $\pm 42\varepsilon$ dB (see NOTE below) if it is divided into two stages.

NOTE: $\pm\sqrt{(30\varepsilon)^2+(30\varepsilon)^2} \fallingdotseq \pm 42\varepsilon$ dB

where the accuracy of resistors is $\pm\varepsilon$ (%)

The bridge “T” network is used in the circuit from which small attenuations are obtained. The reason for the use of this network is to reduce the number of resistors.

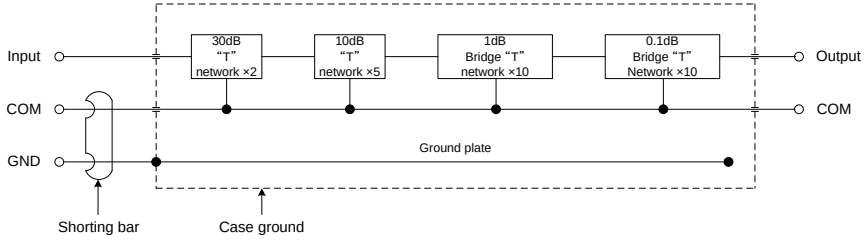
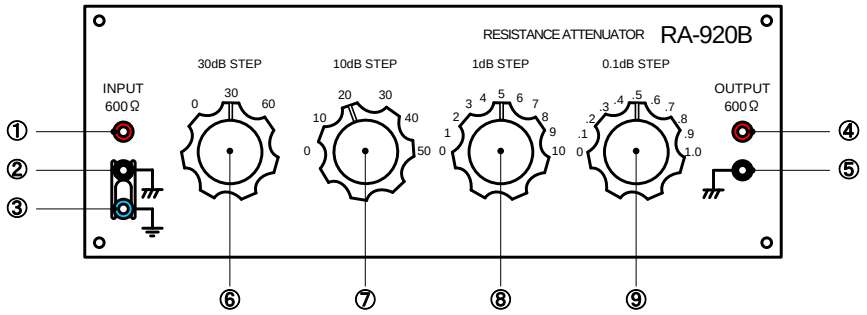



Fig. 3-1 Block Diagram

# 4. CONTROL PANEL




① INPUT

Input terminal: Connect a shielded cable or coaxial cable between the signal source and this terminal. The cable length should not exceed 1m.

② ⏚

Circuit common terminal: Connect this terminal to the case ground using the shorting bar.

③ GND

Case ground: This is connected to the common terminal 2. It is advisable to ground the case for improved accuracy.

④ OUTPUT

Output terminal: The load impedance should be 600ohm. If this terminal is to be connected to a circuit having an impedance very higher than 600ohm, insert a 600ohm resistor between the common terminal 5 and the terminal 4.

⑤ ⏚

Common terminal for output side.

⑥ 30dB STEP

Dial for 0-30-60dB attenuation.

⑦ 10dB STEP

Dial for 0-10-20-30-40-50dB attenuation.

⑧ 1dB STEP

Dial for setting attenuations of 0 to 10dB in 1dB step.

⑨ 0.1dB STEP

Dial for setting attenuations of 0 to 1.0dB in 0.1dB step.

## 5. CAUTIONS

1. The signal voltage applied to INPUT should be lower than 17Vrms.
2. To avoid leakage of signal and minimize the effect of phase deviation, be sure to use shielded cables on the input and output of the unit. These cables should be as short as possible. This is particularly important when pulse signals are used as a signal source.
3. When the unit is used with the case ground floated from the circuit ground, the potential difference (DC ＋ACpeak) between these two points should not exceed ±600V.
4. Dial setting

   Select appropriate dials for the desired attenuation at any frequency. Note that the markings on each dial indicate approximate settings of attenuation including error. A typical example of attenuation error and frequency characteristic error is shown in Table 5-1, where 100kHz signal is attenuated to 100dB, $\varepsilon$ a is the error at 1kHz of each dial end $\varepsilon$ f is the error of frequency characteristic. The overall error depends on the number of dials to be used as explained below.

   (Ⅰ) When the dials are set to 30dB × 2=60dB, 10dB × 3=30dB, 1dB × 9=9dB, 0.1dB × 10=1dB, then the overall error ($\varepsilon$) caused by each dial and frequency characteristic is obtained from the following equation:

$$\varepsilon = \pm\sqrt{(0.15^2+0.1^2)+(0.1^2+0.1^2)+(0.1^2+0.05^2)+(0.01^2+0.05^2)} \fallingdotseq \pm 0.28\text{dB}$$

   (Ⅱ) When the dials are set to 30dB × 2=60dB、 10dB × 4=40dB then:

$$\varepsilon = \pm\sqrt{(0.15^2+0.1^2)+(0.1^2+0.1^2)} \fallingdotseq \pm 0.23\text{dB}$$

   As will be understood from the above equations, the less the number of dials, the higher the accuracy.

Table 5-1 Typical Example of Attenuation Error and Frequency Characteristic Error

| Error | 30dB step | 10dB step | 1dB step | 0.1dB step |
|---|---|---|---|---|
| $\varepsilon$ a | ±0.15dB | ±0.1dB | ±0.1dB | ±0.01dB |
| $\varepsilon$ f | ±0.1dB | ±0.1dB | ±0.05dB | ±0.05dB |

# 6. APPLICATIONS

## 6-1. Measurement of amplifier gain

Example: Audio frequencies, 455kHz IF frequency, pulse amplifier, etc.

Connect an oscillator, RA-920B, amplifier to be tested and AC voltmeter (DC voltmeter for DC amplifier) using switches sufficiently durable against frequencies and currents, as shown in Fig. 6-1. Set the load impedance of RA-920B to 600ohm.

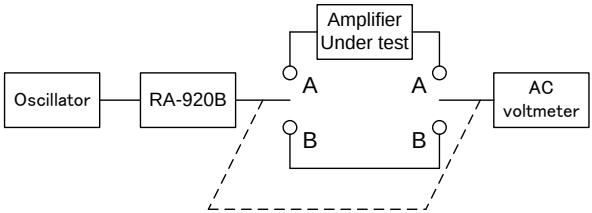



Fig. 6-1

① Set RA-920B to 0dB (may be attenuated to a certain level depending on the condition of oscillator).

② Set the switches to the B position and read the indication of the voltmeter.

③ Next, set the switches to the A position. Adjust RA-920B so that the reading on the voltmeter is the same as at the B position.
The reading obtained is the gain of the amplifier.

When a DC amplifier is to be tested, be sure that the input level does not exceed the maximum input voltage of the amplifier. Note that if the input impedance of DC amplifier etc. is lower than 600ohm, the error becomes larger.

## 6-2. Measurement of pulse circuit threshold level (Fig. 6-2)

① Adjust the voltage of pulse circuit to a proper level (5 to 10v for CMOS). then set RA-920B to 0dB.

② Adjust RA-920B so that the output disappears from the oscilloscope.

③ Where the reading of RA-920B is $\delta$、 the threshold level is $e_{0,}$ and the pulse generator output is $e_{i,}$

$$e_0 = e_i \times LOG^{-1} \frac{\delta}{20}$$

In measurement, be sure that the pulses frequency is below 100kHz, the signal is properly shielded and the load impedance is adequate.

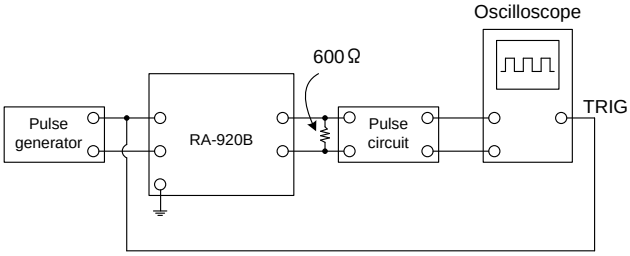



Fig. 6-2

## 6-3. Audio mixing (Fig. 6-3)

By using two RA-920B, it is possible to attenuate two individual signals for audio mixing.

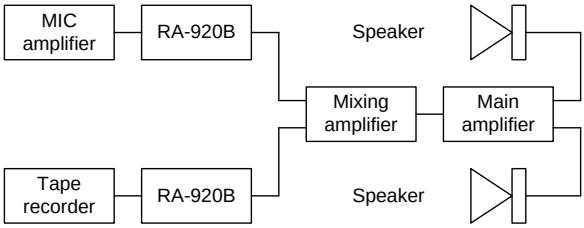



Fig. 6-3

## 6-4. Measurement of noise (Fig. 6-4)

If the noise figure of A and B are expressed by $F_1$ and $F_2$ respectively, the amount of attenuation is expressed by L, and the gain G of A is sufficiently large.

$$F_1 \fallingdotseq \frac{Ft_1L'' - Ft_2L'}{L'' - L'} \quad (F_1 >> \frac{1}{G})$$

$Ft_1$、and $Ft_2$ are Ft(overall noise figure) where L is L' and L".
Measurement of noise should be performed after checking the circuit system.

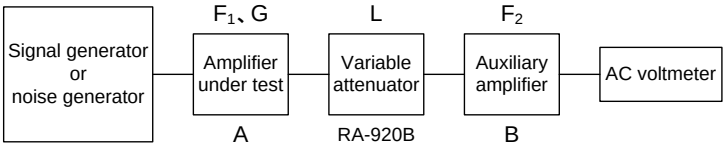



Fig. 6-4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