ELECTRICAL MEASURING INSTRUMENTS

INSTRUCTION FOR

PORTABLE WHEATSTONE BRIDGE

TYPE L - 3C

YOKOGAWA ELECTRIC WORKS, LTD.

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INSTRUCTION FOR

PORTABLE WHEATSTONE BRIDGE

TYPE L - 3C

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1. GENERAL

Type L-3C Bridge is a portable wheatston bridge equipped with dry cell and galvanometer and is quite convenient for general resistance measurement.

Sepcifications

1) Measurement range : 1Ω ~ 10MΩ (notice)
   Measuring arm : 1Ω x 10 + 10Ω x 10 ± 100Ω x 10 + 1000Ω x 10
   11,110Ω 4 dials
   Ratio arm : x0.001, x0.01, x0.1, x1, x10, x100, x1000
2) Accuracy
   100Ω ~ 100kΩ ± 0.1%
   10Ω ~ 1MΩ ± 0.3%
   1Ω ~ 10MΩ ± 0.6%
3) Temperature coefficient of resistor less than $1 \times 10^{-5}/°C$
4) Galvanometer (Type G-2B)
   External damping resistance : 650Ω ± 20%
   Period : Within 3 sec.
   Sensitivity : Less than 0.7 μA/div.
5) Power supply (Internally equipped)
   Dry cell (three) Type UM-1
6) External view
   Molded black plastic panel and case
7) Dimensions and weight
   182 x 226 x 126mm
   approx. 2kg

Notice ; In resistance measurement higher than 100 Kilochm, it is necessary to apply external galvanometer of high-sensitivity to the bridge for want of sensitivity of equipped galavnometer itself.

2. PERFORMANCE

External view and circuit diagram are shown in annexed chart 1 and 2. Main parts of this bridge are one ratio arm, four measuring dials and galvanometer. Dry cell mounted in the bottom of the bridge can be easily taken out of it for replacement by removing bottom cover.

When galvanometer whose sensitivity is higher than that of equipped galvanometer is necessary, move short circuitting bar across

EXT.GA terminals to INT. GA terminals and to connect galvanometer to EXT. GA terminals. In addition, change of power supply voltage is required, remove bottom battery cover to take out equipped battery. Apply battery to screws locating right and left corners with the polarity of it being coincident with their polarity.

B key and GA key are used for connecting power supply and galvanometer during measurement. They can be clamped by being turned a little to either direction, left or right.

3. OPERATING PRECEDURE

Assure than EXT. GA terminals are perfectly short circuitted with short circuitting bar. Then, set the pointer of galvanometer to "0". This adjustment is performed by turning the knob on the top of galvanometer smoothly with pushing key B but key GA being made free.

Apply unknown resistor (Rx) to Rx terminals and adjust resistors A, B and R so that no current flows in galvanometer during keys B and GA closed. Then, the following equation hold.

$$Rx = \frac{A}{B} R$$

Where A/B may be directly read from MULTIPLY dial, and R is expressed by the sum of indications of four dials in measuring arm, galvanometer has been designed to deflect.

to + side when $Rx > \frac{A}{B} R$ of

to - side when $Rx < \frac{A}{B} R$

First of all, approximate value of Rx should be known in measurement. Set MULTIPLY dial to "1" and measuring arm dial to 1000 ohm. Pushing battery key B, then lightly pushing galvanometer key GA to check which direction, + or -, it deflects. When the pointer deflects to + side, Rx is higher than 1000 ohm. Hence, increase MULTI dial to "10" and press B and GA keys again.

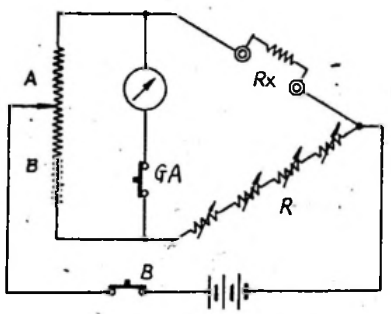


Fig. 1 Resistance measuring circuit Galvanometer

Table 1

Rx value	Indication value of MULTI dial
less than 10Ω	0.001
10 ~ 100Ω	0.01
100 ~ 1000Ω	0.1 0.1
1 ~ 10kΩ	1
10 ~ 100kΩ	10
100kΩ~1MΩ	100
1 ~ 10MΩ	1000

If the galvanometer still deflects to +side, turn MULTI dial to "100". Suppose than the pointer deflects - side by this adjustment, Rx is in the range between 10 Kiloohm. On the other hand, when the galvanometer deflects to - side by the first settings, Rx is lower than 1000 ohm. In this case, decrease the MULTI dial to "0.1" or "0.01" so as to find a position where deflection of the pointer becomes + side. Approximate value of Rx can be obtained by the above process.

After approximate value of Rx being obtained, select MULTI dial position according to Table 1 and adjust four measuring dials in succession to take balance of galvanometer. Then Rx is obtained from

Rx = (Sum of indications of dials in measuring arms) x (Indication of MULTI dial) ohm.

There might exist a case where perfect balance of galvanometer can not be taken even by adjustment to minimum figure (x1 dial). Read, in such case, an amount of unbalance from scale of the galvanometer and you can measure lower value by one figure by dividing the amount proportionally.

For higher Rx than 100 Kiloohm, measurement of minimum figure (x1 dial) becomes difficult for want of sensitivity of equipped galvanometer. In such measurement, apply high sensitive galvanometer to EXT. GA terminals. Employ Yokogawa's Type D-2L (5×10^{-8}A) or the equivalent for resistance measurements up to 1 Megohm or so, but galvanometer of higher sensitivity for higher ones than 1 Megohm.

4. CAUTION IN OPERATION AND MAINTENANCE

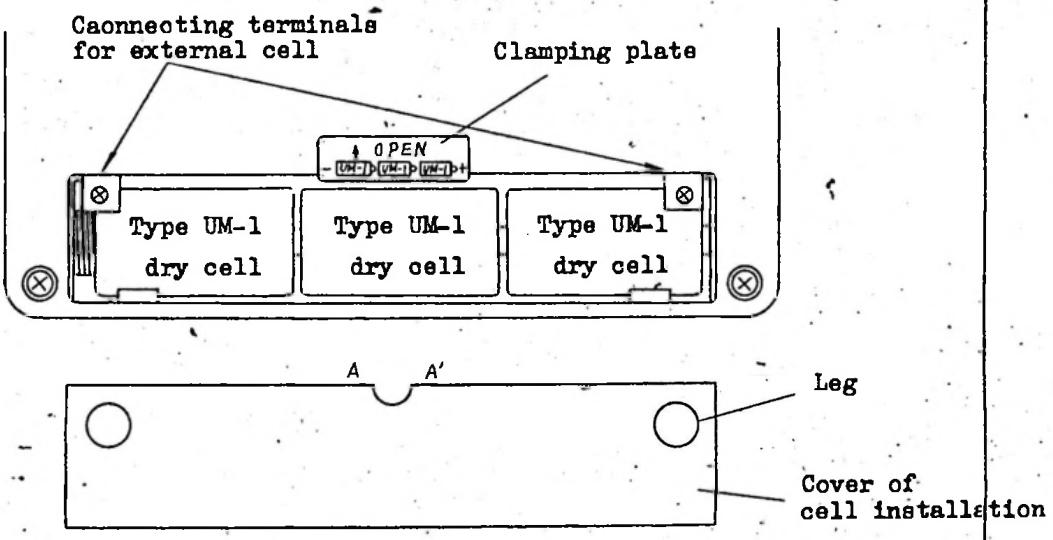
1) B key and GA key should be in OFF state after measurement.
2) In measurement, B key must be pressed prior to GA key. Pushing of GA key first will produce an error in measurement, if there is any inductance in measuring object. This is because current flows in galvanometer due to inverse electromotive force of self inductance which is produced in instance of B key pressing.
3) When external cell is employed for increase of sensitivity, full caution must be taken to avoid excess current flow that might cause burning, since all elements employed in this bridge can endure up to 1 watt.

That is, maximum cell voltage is 30V for unknown resistance from 100 Kiloohm to 1 Megohm or so and less than 50V

even for higher resistance than 3 Megohm . When such high voltage is applied, take rough balance of bridge with applied voltage lowered, then gradually increase the voltage. Above all, care must be taken no to make x1000 dial to 0.

4) In cell replacement, remove cell cover of bottom and apply three dry cells in series. When the bridge is not in use for long time, cells must be removed.

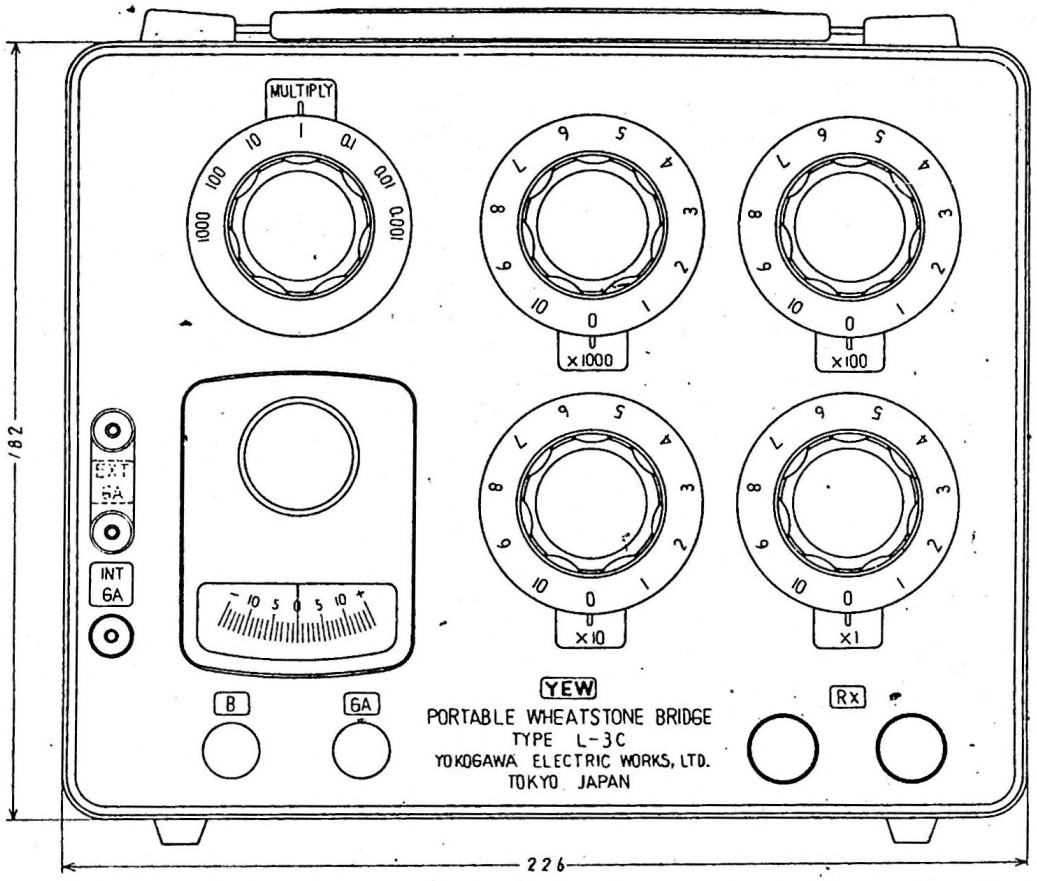
5) Although panel and case of this bridge are mechanically so tough owing to plastic made, caution is necessary, since they are influenced by heat and some chemicals. Especially, use of cynner for panel cleaning must be avoided.

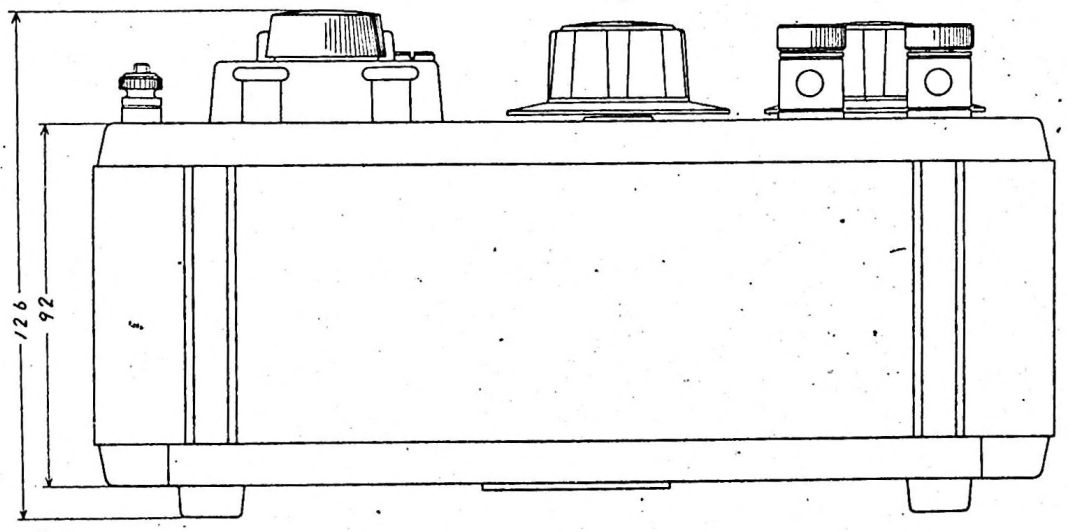


Cover of cell installation can be removed by pulling leg of the cover with pushing the clamping plate towards arrowed direction to extream end.

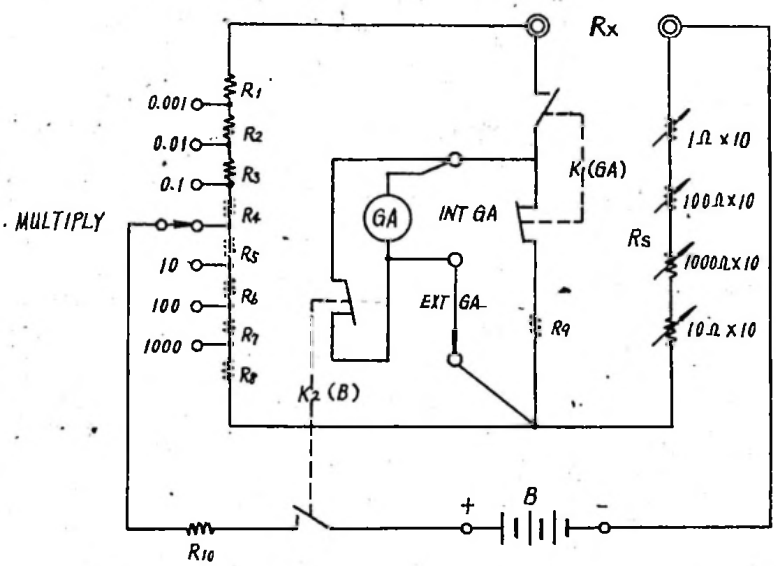
While the cover may be restored by applying A-A' edge of it to that of clampling plate and pushing it towards arrowed direction.

Outside View





Annexed chart 1 Circuit diagram



R1, R8	Mn wire wounded resistor	0.999 Ω
R2, R7	"	8.902 Ω
R3, R6	"	81.009 Ω
R4, R5	"	409.09 Ω
R9	"	650 Ω
R10	RD 2 LY 10 Ω J	

Rs

x 1 :	Mn wire wounded resistor	1, 2, 3, 4 Ω
x 10 :	"	10, 20, 30, 40 Ω
x 100 :	"	100, 200, 300, 400 Ω
x 1000 :	"	1000, 2000, 3000, 4000 Ω

GA : Galvanometer Type G-3 (B) 0.7 μA/div.
K1 : Key for galvanometer
K2 : Key for cell
B : Type UM-1 dry cell (1.5V x 3)

MAIN PRODUCTS

Ammeter, Voltmeter, Wattmeter, Frequency-meter, Insulation tester. Circuit tester, Galvanometer. Wheatstone-bridge, Potentiometer, Standard-resistor, Standard-capacitor, Standard-inductor, High frequency measuring instrument, Oscillogragh, Pyrometer, Flow-meter, Tachometer, Gas-analyzer etc.