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IS 11212 (1985): Direct current resistive volt ratio boxes  
[ETD 12: Measuring Equipment for Basic Electrical  
Quantities]



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*Indian Standard*  
SPECIFICATION FOR  
DIRECT CURRENT RESISTIVE  
VOLT RATIO BOXES

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**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# *Indian Standard*

## SPECIFICATION FOR DIRECT CURRENT RESISTIVE VOLT RATIO BOXES

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# *Indian Standard*

## SPECIFICATION FOR DIRECT CURRENT RESISTIVE VOLT RATIO BOXES

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 30 January 1985, after the draft finalized by the Electrical Measuring Instruments Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** Volt ratio box is essentially a high resistance voltage divider which is connected across the source to be measured and the potentiometer is connected across the known fraction of this resistance to measure this fraction of the total voltage drop. By the use of volt ratio box and standard resistors very precise measurement of direct voltages and currents can be made on any general purpose potentiometers. This standard relates to the general requirements and tests of volt ratio box with fixed ratios and having voltage up to 1.5 kV dc.

**0.3** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS: 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard specifies the requirements of dc resistive volt ratio boxes with fixed ratios and having input voltage up to 1.5 kV dc. The class index of these shall be 0.1 or better. This standard shall also apply to the equipment which form the essential parts of the volt ratio box, prepared or supplied by the manufacturers.

### 2. TERMINOLOGY

**2.1** For the purpose of this standard, the following definitions, in addition to those given in IS: 1885 (Part 11)-1966†, shall apply.

\*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary: Part 11 Electrical measurements.

**2.1.1 Volt Ratio Box** — Volt ratio box is a device made up of a network of resistances with fixed ratios to provide an output voltage, equal to a known fixed fraction of an input voltage. Output and input voltage lie respectively between pairs of terminals, which are marked +Ve and -Ve with red and black respectively.

A volt ratio box having many ratios will be provided with as many input terminals properly marked having one common terminal. Output pair of terminals will be fixed irrespective of input voltages. In that case it acts as a range multiplier to be used in the working of dc potentiometers.

**2.1.2 Nominal Voltage Ratio** — It is defined as the ratio between the rated input and output voltages.

**2.1.3 Actual Voltage Ratio** — The ratio of the input voltage applied to the output voltage.

**2.1.4 Influence Quantity** — A quantity which is likely to produce undesired variation in the voltage ratio of a volt ratio box.

**2.1.5 Reference Condition** — The specified conditions under which the volt ratio box meets the requirements of intrinsic error.

**2.1.6 Limiting Values of an Influence Quantity** — Maximum value of an influence quantity corresponding to which the accuracy of volt ratio box is affected.

**2.1.7 Error** — Difference between the true voltage ratio and the nominal voltage ratio.

**2.1.8 Parasitic Voltage** — There may be present some voltage at the output terminals in the absence of or immediately after the removal of input voltage. This undesirable voltage is called parasitic voltage which may be dc or ac.

### 3. CLASSIFICATION

**3.1** The volt ratio box are classified as under according to their accuracy classes:

- a) Class index expressed in percentage — ·0005, ·001, ·002, ·005, ·01, ·02, ·05 and 0·1,
- b) Expressed in ppm (parts per million) — 5 ppm, 10 ppm, 20 ppm, 50 ppm, 100 ppm, 200 ppm, 500 ppm and 1 000 ppm.



#### 4. TEST CONDITIONS FOR THE DETERMINATION OF VOLTAGE RATIO

4.1 The volt ratio box should be given sufficient time for attaining stability of equilibrium with respect to the various values of influence quantities which are liable to cause variation in the voltage ratio of volt ratio box. Table 1 gives reference conditions and tolerance of the influence quantity.

**TABLE 1 REFERENCE CONDITIONS AND TOLERANCE OF THE INFLUENCE QUANTITY**

INFLUENCE QUANTITY	REFERENCE CONDITION	CLASS INDEX		TOLERANCE PERMITTED
		ppm	PERCENT	
(1)	(2)	(3)	(4)	(5)
Surrounding temperature	27°C	.000 1 to .001 .002 - .01 .02 - 0.1	1 - 10 20 - 100 200 - 1000	±0.1°C ±1°C ±2°C
Relative humidity	40 to 60 percent			
Position (orientation)	Any			
Input voltage	Rated value	.000 1 to 0.1	1 to 1000	±1 percent
Ripple content of input voltage	Less than 0.01 percent			
Common mode voltage	Zero	.000 1 to .01	1 to 1000	10 percent of maximum dc common mode voltage

4.2 The manufacturer shall clarify the time for which input voltage is to be applied before measurement. In the absence of such clarification, this time shall be taken as zero.

#### 5. SELF HEATING

5.1 The effect of self heating shall be calculated from the difference in voltage ratios found thirty minutes after operation of rated voltage. This difference should not be greater than the corresponding value in respect of half of the class index.

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NOTE — High resistance volt ratio box consumes less power and, therefore, has less self-heating than a low resistance in it for the same input voltage. However, the practical limitations for use of high resistance are as follows:

- a) high resistances are expensive to make and adjust;
- b) high resistances are inherently less stable than low resistances;
- c) for a given insulation resistance, shunting effect of leakage current is greater for high resistance than for low resistance; and
- d) if volt ratio box contributes a large resistance to the measuring circuit, the sensitivity of measurement may be reduced.

### 6. CONDITION FOR STORAGE

6.1 The volt ratio boxes should be able to withstand, without any damage, the variation of surrounding temperature from  $-10$  to  $+50^{\circ}\text{C}$ . After attaining the normal conditions, the volt ratio boxes should meet all the requirements of this standard.

6.1.1 When stored in racks care should be taken for proper ventilation.

### 7. INFORMATION

7.1 The manufacturer shall provide the following information to the consumer:

- a) Name of the manufacturer,
- b) Serial No. of the volt ratio box supplied,
- c) Class index,
- d) Nominal voltage ratio,
- e) Rated voltage,
- f) Test voltage,
- g) Reference position,
- h) Essential parameters of extra equipment,
- j) Circuit diagram with value of components and list of span, and
- k) Time for which input voltage to be applied before measurement.

### 8. MARKING

8.1 Following terminals shall be marked for identification:

- a) Input and output terminals;
- b) Terminals for use with the extra equipment; and
- c) Earth terminal, if any.

**8.2** The volt ratio boxes may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

## 9. TESTS

**9.1 Insulation Resistance Test** — Insulation resistance between terminal and enclosure shall be not less than 100 megohm at  $500 \pm 50$  V dc.

**9.2 High Voltage Test** — No breakdown, arcing or sparking shall occur when an ac voltage equal to '2 × rated voltage + 1000 V ac' or '2000 volts rms', whichever is higher, is applied between terminals and enclosure for a period of one minute.

**9.3 Accuracy Test** — The test shall be carried out as given in IS: 1248 (Part 8)-1984\* at reference condition and shall satisfy the requirements as given in IS: 1248 (Part 1)-1983†.

**9.4 Temperature Variation Test** — The value of the resistance measured shall be remeasured at temperature of 10°C higher and 10°C lower than the specified temperature and the variation of resistance for this change shall be within the variation given by a temperature coefficient of 0.000 02 for 1°C in case of accuracy class 0.005 to 0.01 and 0.000 05 for 1°C for other accuracy class. Resistance values as measured in this range shall be within the limits of error.

**9.5 Thermo-emf with Copper Test** — (For the volt ratio boxes of 0.005 and 0.01 percent accuracy) Thermo-emf of the resistance material used in the resistance shall be measured against copper and shall not be greater than 2 microvolt per degree celsius of temperature difference between the cold and hot junction.

**9.6 Temperature Cycle Test** — The volt ratio box shall operate without

\*Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 8 Accessories.

†Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 1 General requirements.

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incurring permanent damage and also satisfy the requirements of 6.1 when subjected to the temperature cycle as given in 6.5.3 of IS:1248 (Part 1)-1983\* for the temperature cycle limits  $-10$  to  $+55^{\circ}\text{C}$ .

**9.7 Damp Heat (Cyclic) Test** — The test shall be carried out as given in IS:9000 (Part 5/Sec 1)-1981† with number of cycles 2 and recovery period of 24 hours.

**9.8 Vibration and Shock Test**— Provisions of 7.6 of IS:1248 (Part 1)-1983\* shall apply.

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\*Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 1 General requirements.

†Basic environmental testing procedures for electronic and electrical items: Part 5 Damp heat (cyclic) test, Section 1.