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ELECTROTECHNICAL VOCABULARY

PART XLVII DIGITAL ELECTRONIC EQUIPMENT

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ELECTROTECHNICAL VOCABULARY

PART XLVII DIGITAL ELECTRONIC EQUIPMENT

0. FOREWORD

0.1 This Indian Standard (Part XLVII) was adopted by the Indian Standards Institution on 19 September 1977, after the draft finalized by the Basic Standards on Electronics and Telecommunication Sectional Committee in consultation with Electronic Measuring Equipment Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 With progressive formulation of Indian Standards on various types of digital electronic equipment, the need for uniform definitions of terms relating to these types of equipment was felt. With a view to ensuring this and avoiding repetition of these terms and definitions in individual standards, this standard has been prepared.

0.3 This standard is one of a series of Indian Standards on electrotechnical vocabulary. A list of the standards so far brought out in this series related to Electronics and Telecommunication is given on page 34.

0.4 Where the term ' apparatus ' is used without any special reference in this standard, it covers both measuring instruments and convertors.

Where the term ' conversion ' is used in a general sense without any special reference in this standard, it covers the overall action performed by measuring instruments or convertors.

Throughout, this standard, wherever, ' output information ' is mentioned, the indication (for example the output information in visual form) is also implied.

0.5 While preparing this standard attempt has been made to follow as far as possible, the definitions proposed by International Electrotechnical Commission in their publication No. 485 (1974) ' Digital electronic dc voltmeters and dc electronic analogue-to-digital convertors. '

1. SCOPE

1.1 This standard (Part XLVII) covers terms and definitions relating to digital electronic equipment.

2. GENERAL

2.1 Electrical Signal — An electrical quantity one or more parameters of which convey information.

2.2 Information Parameter of an Electrical Signal — A parameter of an electrical signal conveying information.

2.3 Analogue Representation of a Physical Quantity — The representation of one physical quantity by another physical quantity in which the representing quantity may continuously assume any value between specified limits, when the physical quantity to be represented is varied between corresponding limits.

2.4 Digital Representation of a Physical Quantity — The representation of a physical quantity by discrete numerals or digital signals or both when the physical quantity to be represented is varied between specified limits.

2.5 Analogue Signal — A signal having one or more continuous ranges of values of the signal parameters, different information being associated with each of these values.

For a quantity, the analogue signal is the analogue representation of that quantity.

2.6 Digital Signal — A signal having a discrete number of ranges of values of the signal parameter, different information being associated with each of ranges.

For a quantity, the digital signal is the digital representation of that quantity.

2.7 Quantization — A process in which the range of a variable is divided into a finite number of distinct sub-ranges (called quanta), not necessarily equal, each of which is represented by an assigned or ‘ quantized ’ value within the sub-range.

2.7.1 *Quantization Unit* — The width of sub-ranges when these are nominally equal.

NOTE — When the quantization units become unequal, linearity errors will result.

2.7.2 *Quantization Step* — The widths of sub-ranges when they are intentionally not equal.

NOTE — The quanta of these steps in such a case will have to be taken into consideration during encoding.

2.8 Code — An agreed set of unambiguous rules to specify the way in which data may be represented by the characters of a character set.

2.9 Encode (to) — To convert by applying a code.

NOTE — In digital voltmeters, the visual output is usually coded in decimal digits and the electrical output in BCD form. Analogue-to-digital convertors usually have output codes such as two's complement binary, excess three, biquinary, BCD, etc.

2.10 Binary Element (Binary Digit or Bit) — The information in digital electrical form is represented by a group of statement each being realized by a digital signal. The meaning of each statement is determined by the code of the system and is represented by the position in time (or space) of the corresponding signal values.

Each statement consists of either a logical 'one' or a logical 'zero', corresponding to the 'one' level state or the 'zero' level state of the representing signal. Each of these two values constitutes a binary element, and is represented by a binary digit or bit.

2.11 Character — A member of a set of elements intended for use in conveying information, either when arranged together in an agreed fashion (in general sequentially), or when isolated.

2.12 Word — A character string (or a binary element string) that is convenient for some purpose to consider as an entity.

NOTE — Figure 1 illustrates the application of the terms 'character', 'word' 'binary digit' and 'bit', to particular representation methods.

2.13 Analogue-to-Digital Conversion — The transformation of an analogue quantity into a digital representation by means of sampling, quantization and encoding, and the necessary auxiliary operations.

2.14 Electronic Analogue-to-Digital Convertor — An electronic device for performing the analogue-to-digital conversion of electrical signals, and for supplying the converted values in digital electrical form.

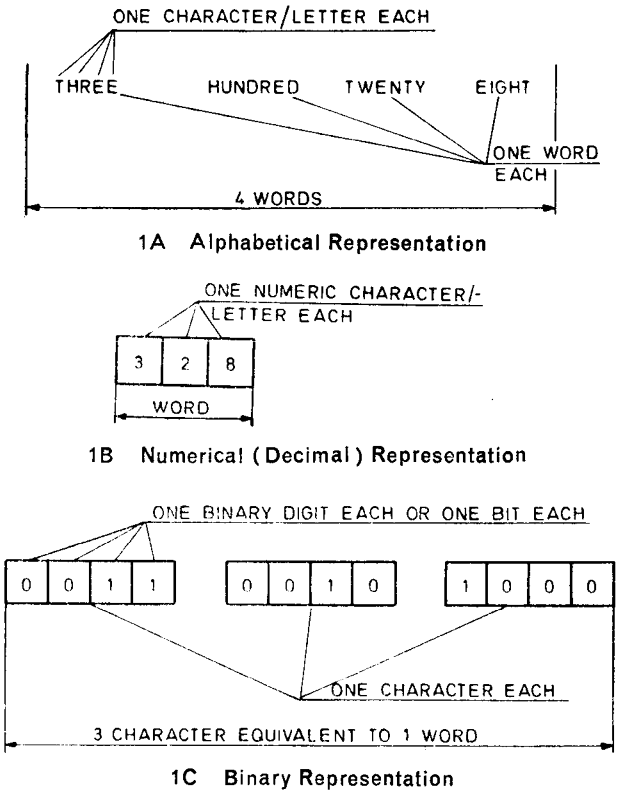
NOTE — Some types of analogue-to-digital convertors are also provided with a visual digital display.

2.15 Digital Electronic Voltmeter — An instrument containing an analogue-to-digital convertor and visually indicating the value of measured voltage in the form of decimal numerals.

NOTE — Some types of digital electronic voltmeters are also provided with digital electrical output facilities.

2.16 Accessory — Circuit element or elements (probes, cables, etc) which is, or which are, associated with the apparatus, either permanently and essential for its operation, or non-permanently and required for the purpose of modifying its characteristics in a prescribed manner.

2.16.1 *Interchangeable Accessory* — An accessory having its own properties and accuracy, these being independent of those of the apparatus with which it may be associated.



As an example, a 1-2-4-8 BCD-code has been chosen

FIG. 1 ILLUSTRATION OF PARTICULAR REPRESENTATION METHODS

2.16.2 *Non-interchangeable Accessory* — An accessory which has been adjusted to take into account the electrical characteristics of one particular apparatus.

2.17 Scaling — An analogue operation, generally preceding analogue-to-digital conversion, of either amplification or attenuation to modify the measurement (conversion) range of the apparatus.

2.18 Distortion Factor — The ratio of the rms value of the harmonic content to the rms value of the total of a non-sinusoidal quantity.

2.19 Warm-Up Time — The time interval after switching on the apparatus under specified conditions, necessary for it to comply with all performance requirements.

2.20 Preliminary Adjustment — The preliminary operation by means of which certain adjusting parts, are set according to the manufacturer's instructions so as to cause the apparatus to perform with the specified accuracy.

2.21 Calibration — Application of a calibrating voltage (*see* **2.22**) to the input of the apparatus under operating conditions in order to compare the corresponding output value with the calibration value (*see* **2.23**), and possibly making them equal with the aid of a special control called a calibration adjuster.

NOTE — Calibration is always a part of the preliminary adjustment, but calibration in itself may also be performed from time to time during operation.

2.22 Calibrating Voltage — A voltage of an accurately known and stable value, internally or externally applied from a reference source to the apparatus and intended to serve as the basis for comparison during calibration.

2.23 Calibration Value — Visually indicated number or output information signal value which should appear as a result of calibration.

2.24 Electrical Zero — The output information value obtained when the apparatus is connected to a supply voltage, and switched on but with no input quantity intentionally applied between its input terminals which are protected from external fields, and only connected to an external circuit when this is specifically indicated by the manufacturer.

NOTE — This definition does not apply to apparatus which is not intended to deliver output information of zero value when no input quantity is applied, for example, apparatus with displaced zero or those intended to deliver "$-\infty$" (negative overflow).

2.25 Electrical Zero Adjuster — The means by which it is possible to shift the electrical zero to zero indication or to the appropriate value.

2.26 Supply — The source of power required for operation of the apparatus.

2.27 Type Tests — Tests carried out to prove conformity with the requirements of the standard. These are intended to prove the general quality and design of a given type of equipment.

2.28 Routine Tests — Tests carried out on each equipment to check the requirements which are likely to vary during production.

2.29 Acceptance Tests — Tests carried out on the samples selected from a lot for the purpose of acceptance of the lot.

2.29.1 *Lot* — All equipment of the same category and rating, manufactured by the same factory and during the same period.

3. INPUT CHARACTERISTICS

3.1 Input Terminals — Connection points at which the electrical quantity to be measured (converted) is applied to the apparatus.

NOTE — Almost all combinations of the arrangements described in **3.1.1** to **3.1.7** are possible (for example symmetrical plus grounded, floating plus guarded).

3.1.1 *Asymmetrical Input* — A three-terminal input circuit where the nominal values of the impedances between the common terminal and each of the other two terminals are different.

3.1.2 *Symmetrical (Balanced) Input* — A three-terminal input circuit where the nominal values of the impedances between the common terminal and each of the other two terminals are equal.

3.1.3 *Difference Input* — An input circuit with two input terminals, having a high impedance to the common point, intended to measure the electrical quantity between these terminals.

NOTE — The result of the measurement is intended to be largely independent of their respective voltages with reference to a common point.

3.1.4 *Grounded Input (Single Ended Input)* — An input circuit in which one input terminal is directly connected to measuring earth. This is often the common point terminal.

3.1.5 *Floating Input*— An input circuit which is isolated from the frame, from the mains and from any of the output circuit terminals.

3.1.6 *Input with Isolated Common Point* — An input circuit having one input terminal connected to one output terminal but being isolated from the frame and from the mains.

3.1.7 *Guarded Input* — A screened (shielded) input circuit where the screen (shield) is isolated from earth and the common point terminal, being arranged so that the screen may nominally be at the same potential as one of the signal-carrying conductors.

3.2 Quantities at the Input

3.2.1 *Input Quantity (Input Signal)* — The analogue quantity (signal) applied to the input terminals.

NOTE — Where there is no possibility of ambiguity, the value of the input quantity may be referred as ' input value '.

3.2.2 *Rate of Change of the Input Voltage* — The derivative of the input voltage with respect to time.

3.2.3 *Common Mode Voltage* — That part of the input voltage which exists, equal in amplitude and phase, between both measuring terminals and the common terminal, the common terminal may be the frame terminal or the measuring earth terminal.

3.2.4 *Series Mode Voltage* — An unwanted part of the input voltage which is superimposed on the voltage to be measured.

NOTE — Typical examples of a series mode voltage are thermopotentials or induced voltages, for example, an ac ripple on a dc signal.

3.2.5 *Spurious Feedback Appearing at the Input Terminals* — Internally generated disturbance fed back to the source through the input terminals of the apparatus, or between one input terminal and the measuring earth or the screen terminal.

3.2.6 *Overload* — An input signal exceeding the measurement (conversion) range referring to the voltage limit of the input circuits of the apparatus.

3.2.7 *Maximum Permissible Input/Output Voltage* — The highest value of the voltage between two terminals or relative to frame which may be applied to the input/output terminals when connected to an external circuit in rated operating conditions.

3.3 Impedances at the Input

3.3.1 *Source Impedance* — The impedance of the output circuit of the source connected to the input terminals of the apparatus.

3.3.2 *Input Impedance* — The impedance of the input circuit measured between the input terminals of the apparatus under operating conditions.

NOTE — In general, the impedance before and during measuring time may be different from that at the end of the measuring time.

3.3.3 *Equivalent Input Impedance* — When the input circuit of an apparatus is such that the instantaneous value of the current flowing into the input terminals is a non-linear function of the instantaneous value of the input voltage under given conditions of frequency and voltage, the equivalent input impedance is the impedance of a combination of a resistance and a reactance that absorbs the same active power at the input circuit, mentioned above and into which flows a reactive current equal to the component at the fundamental frequency that is flowing into the non-linear input circuit of the apparatus.

3.3.4 *Other Impedances* — Impedances measured under operating conditions of the apparatus between any pairs of the following terminals

(excluding pairs of the input and output terminals): each input terminal, each output terminal, input earth terminal, frame, screen and protective earth.

NOTE — Terms such as leakage ' capacitance ' or ' insulation resistance ' are used to describe such impedances.

3.4 Input Interferences

3.4.1 *Common Mode Interference* — The change in the output information caused by the application of a common mode voltage (*see* **3.2.3**).

3.4.2 *Series Mode Interference* — The change in output information caused by the application of a series mode voltage (*see* **3.2.4**).

3.4.3 *Common Mode Rejection Factor* — Term used to designate the sensitivity of the apparatus to common mode interference. It is expressed as the ratio of the peak value of the signal applied between the common point and the two terminals connected by specified circuit to the signal required between the input terminals to produce the same output information value.

3.4.4 *Series Mode Rejection Factor* — Term used to designate the sensitivity of the apparatus to series mode interference. It is expressed as the ratio of the peak value of the interfering voltage to the increment of the input signal required to produce the same change in the output information value.

NOTE — The common mode rejection factor and the series mode rejection factor are often expressed in decibels (or as a percentage) and may be given for different frequencies.

4. METHOD OF OPERATION

4.1 Conversion

4.1.1 *Linear Conversion* — Conversion having a nominally constant ratio for each change in the output value to the corresponding change in the input value.

4.1.2 *Non-linear Conversion* — Conversion having a ratio of changes in the output value corresponding to changes in the input value, which is a function of the input value.

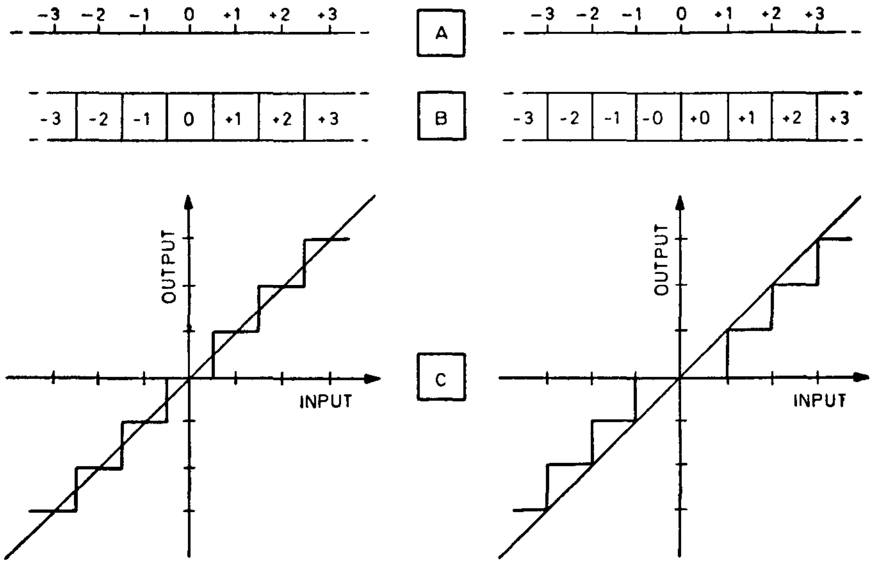
NOTE — A typical kind of non-linear conversion is logarithmic conversion.

4.1.3 *Transition Point (Commutation Point)* — The point within each representation unit (*see* **5.2.2.3**) which the output signal (indication) jumps from one value to the adjacent one when the value of the input quantity is varied.

NOTE — According to the position of the commutation point, distinction should be made between:

a) apparatus having the commutation point at the centre of each representation unit (*see* Fig. 2A);

b) apparatus having the commutation point at the end of each representation unit (*see* Fig. 2B).



2A Communication Point at the Centre of Each Representation Unit

2B Commutation Point at the End of Each Representation Unit

A = Analogue input

B = Digital output

C = Conversion characteristic

FIG. 2 COMMUTATION POINT

4.1.4 *Conversion Command* — The pulse or voltage level which initiates a conversion cycle.

NOTE — The conversion command may initiate either a conversion cycle from zero or a follow-up operation.

4.2 Basic Modes of Operation

NOTE 1 — Depending on the origin of the conversion command, the following modes of operation are the most typical:

a) Triggered,

b) repetitive, and

c) tracking.

NOTE 2 — Other modes of operation are, for example, maximum seeking and minimum seeking.

4.2.1 *Triggered Mode of Operation* — In this mode, the conversion command is of external origin (manual or electrical).

4.2.2 *Repetitive (Cyclic) Mode of Operation* — In this mode, the conversion command is initiated by an internal clock.

4.2.3 *Tracking Mode of Operation* — In this mode, the conversion command is initiated by internal circuits sensing a change of the quantity to be measured/converted.

4.3 Operating Principles

4.3.1 *Instantaneous Value Conversion* — Conversion resulting in a digital representation of the instantaneous value existing during the conversion time of the input quantity.

NOTE — Typical principles of operation of apparatus for measuring/converting the instantaneous values of the input quantity are given in **4.3.1.1** to **4.3.1.4**.

4.3.1.1 *Successive approximation type* — An operating principle in which a feedback voltage generator provides a set of regulated voltages, the values of which correspond to binary or decimal digits. Comparison of these voltages with the scaled input voltage is made in a prescribed sequence by steps of decreasing magnitude.

4.3.1.2 *Servo-balancing type* — An operating principle in which the feedback generator consists of servo-controlled feedback element coupled to a numerical indicator.

The feedback voltage is continuously compared with the scaled input voltage. A difference between them causes the servo-element to re-establish the balanced state and to change simultaneously the numerical indication.

4.3.1.3 *Linear ramp type* — An operating principle in which a voltage generator periodically or upon command produces a voltage which changes linearly with time (ramp signal) and is compared with the scaled input voltage by an error detector.

Synchronized with the initiation of the ramp or with the coincidence of a value of the ramp with a reference voltage, a gate on a clock oscillator is opened and kept open for the time interval required for the ramp to become equal to the scaled input value at which instant the gate is closed. During this interval, the number of clock pulses gated out is counted by a counter circuit. By relating the slope of the ramp to the clock frequency, the value of the output information is made numerically equal to the value of the input quantity.

4.3.1.4 *Stepped ramp type* — In operating principle similar to the linear ramp type, except that the ramp is made up of equal voltage steps, the number of which is counted.

4.3.2 *Integrating Conversion* — Conversion resulting in a digital representation of the integral of the input signal over a specified time interval.

NOTE — Typical principles of operation of apparatus which are used for measuring or converting the integral or the average value of the input quantity are given in **4.3.2.1** and **4.3.2.2**.

4.3.2.1 *Input quantity to frequency conversion type* — An operating principle according to which the apparatus generates a frequency directly proportional to the value of the input quantity. A count of the number of cycles occurring in a fixed time interval gives the measure of the average value of the input quantity during this interval.

4.3.2.2 *Linear dual slope type* — An operating principle in which the sealed input quantity is converted to a proportional current. A capacitor is charged by this current over a defined period of time and subsequently discharged linearly by a current having a defined value.

The period of time required to remove the charge produced by the input quantity is directly proportional to the integral of the input quantity. It is usually measured by gating a clock into a counter.

4.4 Time Functions

NOTE — The presence and sequence of the time intervals listed in this clause and their delay or overlap depend on the operation process of the apparatus.

The magnitude of the time intervals, and in some cases even their occurrence, may be either internally fixed or dependent on the characteristics of the input quantity and/or of the source impedance.

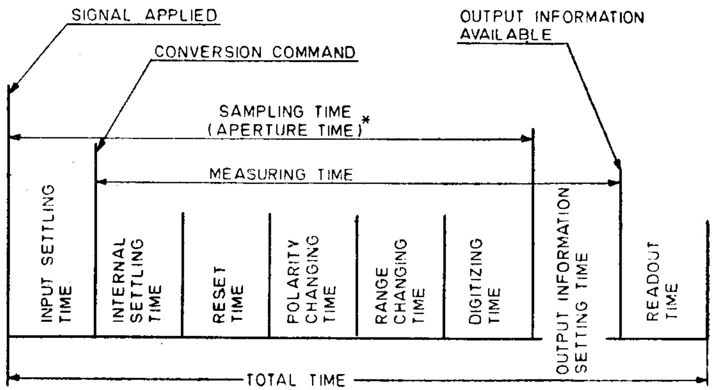
Unlike the internal time intervals defined in **4.4.3** to **4.4.14** which may by useful when stated for information purposes, the response times of **4.4.16.1** to **4.4.16.3** are defined for testing purposes.

4.4.1 *Conversion Rate* — Number of the complete conversions within the stated accuracy limits, obtained, per unit time.

4.4.2 *Total Time* — Time interval during which one complete measurement (conversion) takes place.

NOTE 1 — Explanations as to total time and its typical components are given in Fig. 3 and 4.

NOTE 2 — The reciprocal of the conversion rate is not equal to the total time when the operation includes delay or overlap.



*For apparatus without sample and hold facility

FIG. 3 EXAMPLE OF THE COMPONENTS WHICH MAY BE INCLUDED IN THE TOTAL TIME

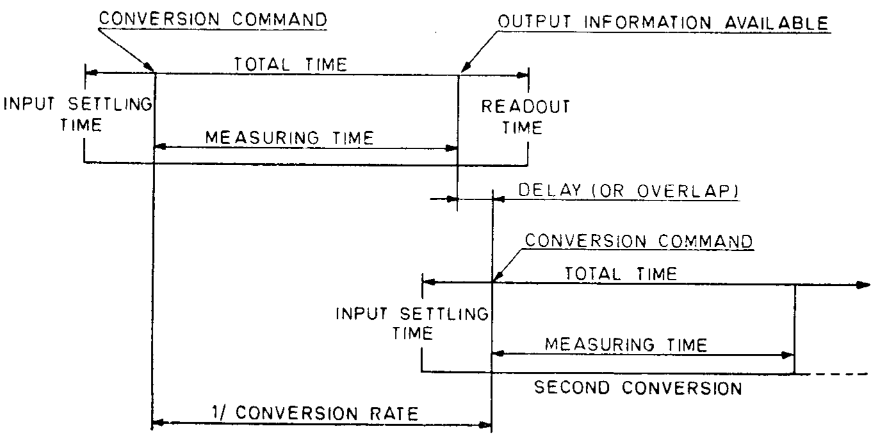


FIG. 4 EXAMPLE OF THE SEQUENCE OF TWO SUBSEQUENT MEASURING TIMES AS WELL AS THE RECIPROCAL OF THE CONVERSION RATE

4.4.3 *Measuring Time* — Time interval between the moment at which the conversion command is applied and the moment at which the complete digital information is available at the output.

4.4.4 *Sampling Time* (*Aperture Time*) — Time interval during which the input quantity is sensed by the conversion circuits.

4.4.5 *Input Settling Time* — After an input step has been applied, the time interval required before a conversion may be started within the stated accuracy limits.

NOTE — The input settling time is in general affected by the source impedance connected to the input.

4.4.6 *Internal Settling Time* — The time interval, after a conversion command, provided internally by the apparatus necessary for it to start conversion within the given accuracy limits.

4.4.7 *Reset Time* — Time interval provided internally by the apparatus, necessary to reset the conversion circuits to starting conditions.

4.4.8 *Polarity Changing Time* — For apparatus with automatic polarity sensing the time interval required for determining the polarity and/or a change of polarity, as well as for making the apparatus ready for conversion of the input quantity with the given polarity.

For apparatus with external polarity setting, the time interva required for making the apparatus ready for conversion of the input quantity with the given polarity.

4.4.9 *Range Changing Time* — For apparatus with automatic range changing, the time interval for determining the range and, if necessary, a change of range.

4.4.10 *Digitizing Time* — The time interval required to perform sampling, quantization and encoding.

4.4.11 *Integration Time* — With integrating conversion, the time interval between the limits of which the integral of the input value is formed.

4.4.12 *Output Information Setting Time* — Time needed for setting the visual display corresponding to the converted value and/or for delivering the total output signal to the output terminals.

NOTE — Depending on the construction of the apparatus, this time interval may overlap the digitizing time (for example, with some apparatus with series output system), or the time of the next measuring process (for example, apparatus with buffer store, etc.)

4.4.13 *Read-Out Time* — Time interval during which the output signal is available for reading under continuous operation at maximum conversion rate.

4.4.14 *Overload Recovery Time* — Time interval required after removal of a specified overload input value before a measurement (conversion) may be made within the stated accuracy limits.

4.4.15 *Response Time* — The time interval between an abrupt (step) change of the input signal and the steady-state indication of its new value within the stated accuracy limits.

4.4.15.1 *Step response time* — Response time resulting from a step change of specified magnitude of the input signal within a range without polarity change.

4.4.15.2 *Polarity response time* — Response time resulting from a step change of specified magnitude of the input signal that causes a change in the indicated polarity.

4.4.15.3 *Range response time* — Response time resulting from a step change of specified magnitude of the input signal, without a polarity change, that causes switching to an adjacent range.

5. OUTPUT CHARACTERISTICS

5.1 Output Terminals — Connection points of the apparatus across which the output information signals are available in the form of specified voltage (current) levels or are represented by specified impedance states (for example, short of circuit and open circuit).

5.1.1 *Auxiliary Terminals* — Terminals other than input and output terminals which supply or receive auxiliary analogue or digital signals.

5.2 Quantities at the Output

5.2.1 *Output Signal* — The signal which results from conversion.

NOTE — Where there is no possibility of ambiguity, the value of the output signal may be referred as the ' output value '.

5.2.1.1 *Output signal ' one ' level* — The value of the electrical signal occurring between a pair of output terminals so as to represent a binary ' one '.

5.2.1.2 *Output signal ' zero ' level* — The value of the electrical signal occurring between a pair of output terminals so as to represent a binary ' zero '.

5.2.1.3 *Auxiliary output signals* — Output signals, in general appearing across auxiliary terminals, intended to facilitate the evaluation of the output information signals.

NOTE — Typical auxiliary output signals are: clock pulses, gate signals, start, stop and other command signals for the associated apparatus.

5.2.1.4 *Overflow* — Condition which occurs when the output information exceeds the set of the digital representation.

5.2.1.5 *Overflow indication* — A warning signal indicating that overflow occurs.

5.2.1.6 *Uninterrupted stepwise progression* — The sequence of output information (*see* **5.2.2.1**) in which all possible output states appear in correct order of succession.

NOTE — When checking uninterrupted stepwise progression, the value of the input quantity shall be changed sufficiently slowly.

5.2.1.7 *Monotonicity* — The output value is monotonic, if the difference between successive output values always has the same sign or is equal to zero, when the input value is varied in one direction.

5.2.2 *Representation Form of Output Information*

5.2.2.1 *Output information* — The digital (electrical and/or visual) representation of the measured (converted) quantity resulting from the conversion process.

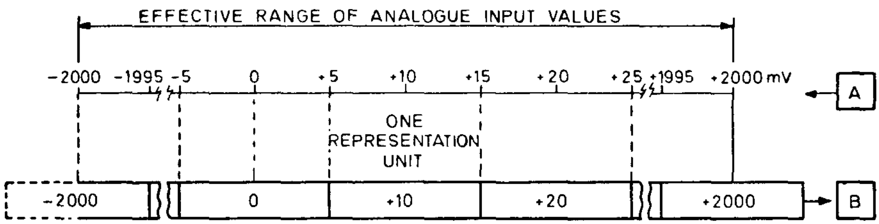
5.2.2.2 *Output state* — The output state is a dimensionless discrete condition of the output information during read-out time.

5.2.2.3 *Representation unit* — The representation unit is the minimum increment between two successive output states (*see* Fig. 5).

NOTE 1 — Illustrations of different magnitudes of the representation unit in decimal notation is given in Table 1.

NOTE 2 — In decimal output representation, it is possible that not every digit is displayed in all decades. For the least significant digit, examples are given in col 2 and 3 of Table 1. In some apparatus, the most significant digit may only assume ' 0 ' or ' 1 '.

NOTE 3 — The resolution of an apparatus is determined by its output range together with the total number of possible output states within that range.



Commutation point is at the centre of each representation unit (*see* Figure 2A)

A = Effective range of analogue input values : — 2 000...0 +2 000 mV

B = Set of representation units comprising 2 × 200 representation units of 10, equivalent to 10 mV each

FIG. 5 ILLUSTRATION OF THE SET OF REPRESENTATION UNITS

TABLE 1 EXAMPLES OF OUTPUT STATES

(*Clause* 5.2.2.3)

REPRESENTATION UNIT = 1	REPRESENTATION UNIT = 2	REPRESENTATION UNIT = 5
(1)	(2)	(3)
12 340	12 340	12 340
12 341	—	—
12 342	12 342	—
12 343	—	—
12 344	12 344	—
12 345	—	12 345
12 346	12 346	—

5.2.3 *Systems for Supplying Output Information*

5.2.3.1 *Series output system* — Output system arrangement in which the output signal consists of a series of consecutive binary digits appearing between a single pair of output terminals.

5.2.3.2 *Parallel output system* — Output system arrangement in which all binary digits appear simultaneously across a group of output terminal pairs.

5.2.3.3 *Series-parallel output system* — Combined output system arrangement comprising more than one pair of output terminals across which binary digits may appear simultaneously, and across all of which a number of consecutive binary digits may appear (for example, characters in series, elementary binary digits in parallel).

NOTE — In some types of apparatus, for example, the elementary-parallel binary digits correspond to an encoded decimal figure, and the consecutive binary digit groups correspond to consecutive decimal figures.

5.2.4 *Read-Out Clock Rate* — In a series or in a series-parallel output system, the number of binary digits supplied between each pair of output terminals per unit time.

5.3 Relations Between Input and Output

5.3.1 *Sensitivity* — Ratio of the change in the output value to the corresponding change in the input value. It is expressed in representation units per unit input quantity.

NOTE 1 — In graphical representation of the relationship between input and output values, the slope of that curve represents the sensitivity.

NOTE 2 — For apparatus with intentionally non-linear conversion characteristics, the sensitivity is a function of the input value.

5.3.2 *Conversion Coefficient* — The reciprocal of sensitivity.

5.3.3 *Resolution* — Resolution is expressed in one of the following ways:

a) By the equivalent of the representation unit in terms of the measured (converted) quantity.

b) By the number of representation units (for example 14 bits).

NOTE 1 — The resolution is a theoretical value assigned to the apparatus, and does not consider the effects during operation such as dead zone, lack of monotonicity or hysteresis.

NOTE 2 — The resolution contributes to the error in conversion; however, a high resolution will not necessarily result in a small error.

5.4 Impedances and Switching Conditions at the Output

5.4.1 *Output Impedance* — The impedance measured looking into a pair of output terminals of the apparatus under operating conditions.

5.4.2 *Permissible Load* — The lowest impedance that may be connected across the output pairs of terminals.

5.4.3 *Permissible Switching Conditions* — The maximum permissible current and voltage that may be applied across the passive output terminals, taking into account polarity, if necessary.

6. CONSTRUCTIONAL PARTS

6.1 Voltage Divider — A device comprising resistors, capacitors or inductors, by means of which it is possible to obtain between two points a voltage proportional to the voltage to be measured. This device will provide the wanted proportion of voltage with the required accuracy for a specified load impedance.

6.2 Series (Parallel) Resistor (Inductor, Capacitor) — A resistor (inductor, capacitor) connected in series (parallel) with an apparatus for the purpose of modifying its characteristics (for example, voltage range).

6.3 Input Filter — Part of the input circuit intended to reduce the series mode ac interference and/or intended to integrate a fluctuating dc input quantity.

6.4 Probe — An input device of an apparatus made as a separate small unit (accessory) and connected to it by means of a flexible cable which transmits in a suitable manner the signal to be measured.

6.5 Range-Changing Device — Device for changing the measurement (conversion) range. It may be operated manually, remotely or by automatic control.

6.5.1 *Range-Changing Hysteresis* — For apparatus with an automatic range changing device, range-changing hysteresis is the difference between the input values at which range-changing takes place when the input value is first increased and then decreased.

NOTE — This effect is usually applied intentionally for the elimination of output jitter which might for example, result from a small ac signal superposed on a dc input signal when the latter is very near to the upper limit of the effective range.

6.6 Polarity Sensing/Setting Device — Device which senses the polarity of the input quantity.

NOTE — Polarity indication may demand an operation by hand, or remote control, alternatively automatic polarity setting may be available.

6.7 Output (Buffer) Store — Circuit arrangement which stores the result of one measurement (conversion) during a period ending in general when the next conversion is completed, and makes it available in an encoded (for example, visually displayed) form during that period.

6.8 Maximum/Minimum Determining Device — Device which determines maximum and/or minimum input values from a sequence of measurement (conversion) and makes them available in an encoded (for example, visually displayed) form.

6.9 Ratio-Determining Device — Device which determines the ratio of the input value to one specified value or the ratio between the values of two independent input signals.

NOTE — The specified value may, for example, be introduced by replacing the internal reference source by an external one.

6.10 Level Comparator (Threshold Detector) — Device which compares the input value with a specified (preset) value and provides information on whether the input value is larger or smaller than the specified (preset) value.

6.11 Code Convertor — Device which provides for conversion from an internal code to one or more output codes.

6.12 Overflow Indicator — Device which provides an indication when the output information exceeds the upper limit of the digital representation.

6.13 Overload Protection Device — Device which protects the conversion circuits from damage when the input value exceeds a specified limit.

6.14 Remote Control Facility — A circuit arrangement by which one or more performance characteristics of the apparatus may be controlled from a distance.

6.15 Sample and Hold Facility — A device which senses and stores the input value within specified tolerances independent of the actual conversion and holds this value available until its conversion has been completed.

7. SPECIFICATION OF THE APPARATUS AND ITS ACCESSORIES

7.1 Performance Characteristic — One of the quantities assigned to an apparatus in order to define by values, tolerances, ranges, etc, the performance of the apparatus.

NOTE — The term 'performance characteristics' does not include influence quantities (*see* **7.2**).

7.2 Influence Quantity — Any quantity, generally external to an apparatus, which may affect the performance of the apparatus.

NOTE — Where a change of a performance characteristic affects another performance characteristic, it is referred to as an influencing characteristics (*see* **7.4.10**).

7.3 Values Related to Quantities

7.3.1 *Rated Value* — The value (or one of the values) of a quantity to be measured or converted which the manufacturer has assigned to the apparatus.

7.3.2 *Rated Range* — The range of a quantity to be measured or converted which the manufacturer has assigned to the apparatus.

7.3.3 *Measurement (Conversion) Range* — Range of values of the input quantity for which measurement (conversion) may be obtained.

7.3.4 *Effective Range* — That part of the measurement (conversion) range where measurements (conversion) may be made within the stated limits of error.

7.3.5 *Maximum Value of the Effective Range (MVER)* — The value of the output information signal (of the visual indication) to which reference is made when expressing a part of the error of the apparatus:

a) when the zero is at the lower end of the output range, the MVER is equal to the upper limit of the effective range; and

b) when the zero is outside the output range, the MVER is equal to the difference between the values corresponding to the upper and lower limits of the effective range.

For explanation, *see* the table below:

	Input Range	*Maximum Value of the Effective Range*
a)	0 V to 100 V	100 V
b)	100 V to 200 V	100 V

7.4 Specification of Performance

7.4.1 *Performance* — The degree to which the intended functions of an equipment are accomplished.

7.4.2 *Error*

7.4.2.1 *Absolute error* — The indicated value of a quantity minus its true value, expressed algebraically.

NOTE — The true value of a quantity is the ideal value that would be measured by a measuring process having no error. In practice, since this true value may not be determined by measurement, a conventionally true value, approaching the true value as closely as necessary (having regard to the error to be determined), is used in place of the true value. This value may be traced to standards agreed upon by the manufacturer and the user, or to national standards. In both cases, the uncertainty of the conventionally true value shall be stated.

7.4.2.2 *Relative error* — The ratio of the absolute error to a stated value.

7.4.2.3 *Percentage error* — The relative error expressed as a percentage, such as percent of full-scale (the maximum value of the effective range), percent of the indicated or preset value or of the rated value.

7.4.2.4 *Fiducial value* — A value to which reference is made in order to specify the percentage error, for example the upper limit of the effective range, or another clearly stated value.

7.4.3 *Digitization Error* (*Digitalization Error*) — The error composed of the components which occur during the digitization process.

NOTE 1 — Some of these error components may also occur with analogue measuring instruments.

NOTE 2 — The components of digitization error are in general: resolution error (quantization error), commutation error, dead zone error, hysteresis error.

NOTE 3 — Components of the digitization error are illustrated in Fig. 6. The examples refer to an apparatus having its commutation point at the centre of each quantization unit, and the errors are referred to the input value.

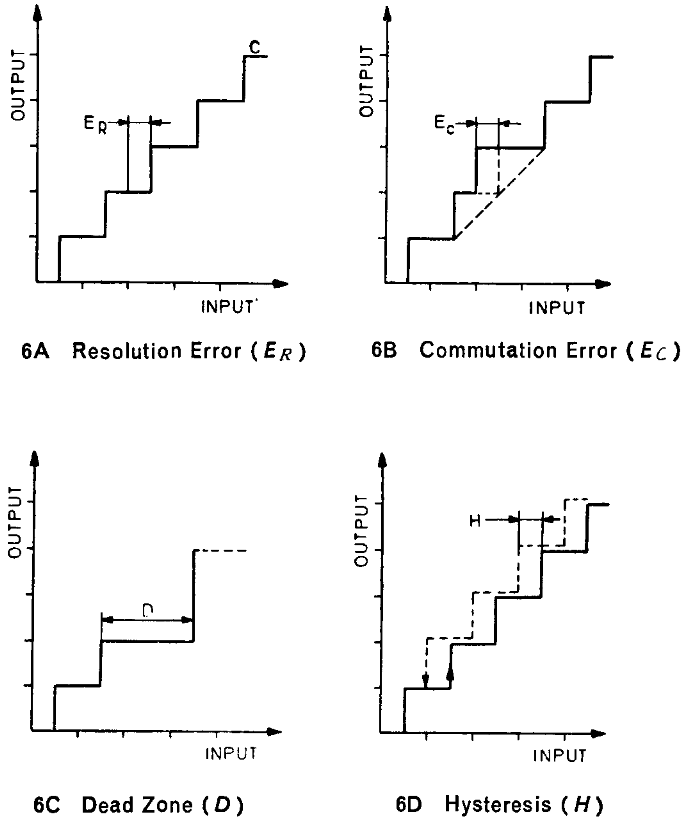
7.4.3.1 *Resolution error* (*quantization error*) — That part of the digitization error which is related to resolution.

NOTE — The value of resolution error is equal to :

a) the resolution in the case of apparatus according to (b) in Note under **4.1.3**, and
b) half the resolution in the case of apparatus according to (a) in Note under **4.1.3**.

7.4.3.2 *Commutation error* — That part of the digitization error which is caused by deviations of the commutation point from its intended position within each quantization unit when the input value is changed in one direction.

NOTE — Commutation error results in further errors, for example linearity error.



6A Resolution Error (E_R)

6B Commutation Error (E_C)

6C Dead Zone (D)

6D Hysteresis (H)

C = Correct characteristic

FIG. 6 COMPONENTS OF THE DIGITALIZATION ERROR

7.4.3.3 *Dead zone error* — That part of the digitization error which produces an uncertainty of the output signal at the start or at the end of the conversion. It may be introduced intentionally.

7.4.3.4 *Hysteresis error* — That part of the digitization error which results from difference in the positions of the commutation point when the input value is first increased and then decreased, or vice versa.

NOTE — For apparatus in which dead zone and/or hysteresis are used intentionally, such as to facilitate a stationary display, it should be pointed out that both effects always contribute to the error of the apparatus independently of whether they are intentional or not.

7.4.4 *Error of the Conversion Coefficient* (*Error of the Slope*) — The measured value of the conversion coefficient minus its rated value.

NOTE 1 — An order of the conversion coefficient leads to an error in the output information which is proportional to the reading.

NOTE 2 — In order to be compatible with statements on linearity error, test specifications will specify the value of the input quantity at which, and the span across which the coefficient error is to be measured.

7.4.5 *Linearity Error* — The deviation of the conversion curve from a straight line. The following definitions are applicable only to apparatus in which linear conversion takes place.

NOTE — Deviation of the conversion curve from the straight line may be expressed by one or more of the means given below. In each case, the conversion curve should be fitted on the calibration point and on to the other reference point, generally the zero point.

7.4.5.1 *Reference line* — The straight line drawn through the zero point and the actual value of the calibration point (*see* Fig. 7).

NOTE 1 — The slope of this line is used for reference purposes.

NOTE 2 — For apparatus not intended to deliver output information of zero value when no input quantity is applied (*see* Note under **2.24**) the reference line is the straight line drawn through the actual position of the calibration point and another reference point specified by the manufacturer.

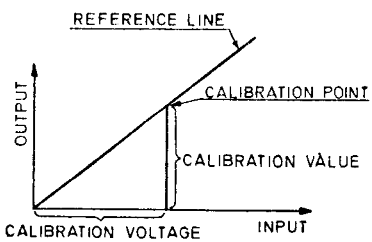
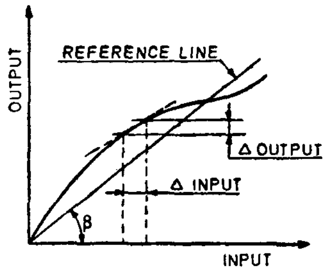


FIG. 7 REFERENCE LINE

7.4.5.2 *Differential error of the slope* — The difference between the sensitivity at a specified point within the effective range and the slope of the reference line (*see* Fig. 8).



Differential error of the slope in percent is :

$$\frac{\frac{\Delta\ \text{OUTPUT}}{\Delta\ \text{INPUT}} - \text{tg}\ \beta}{\text{tg}\ \beta} \times 100$$

Fig. 8 Differential Error of the Slope

7.4.5.3 *Deviation from linearity* — The difference between the output value and the value determined by the reference line, both corresponding to the same value of the input quantity (*see* Fig. 9).

Note — The deviation from linearity is given either by drawing the conversion curve or by a table listing a sufficient number of deviation values throughout the effective range.

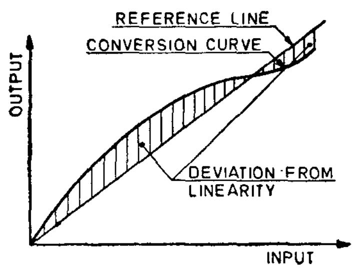
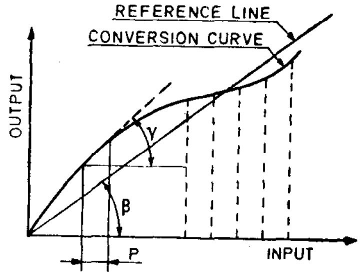


Fig. 9 Deviations from Linearity (Hatched)

7.4.5.4 *Slope over 10 percent* — The slope of the straight line spanning a part of the conversion curve corresponding to any 10 percent portion of the effective range (*see* Fig. 10).

7.4.5.5 *Slope error over 10 percent* — The difference between the ' slope over 10 percent ' and the slope of the reference line (*see* Fig. 10).



P = Any 10% of the effective range slope over 10% is tan γ

FIG. 10 SLOPE OVER 10% AND SLOPE ERROR OVER 10%

The percentage slope error over 10 percent is:

$$\frac{\tan \gamma - \tan \beta}{\tan \beta} \cdot 100$$

where

β = the angle of the reference line with the axis of the abscissae, and

γ = the angle of the '10 percent' with the axis of the abscissae.

7.4.6 *Zero Indication Error* — The deviation of output information from zero obtained when the input quantity has the value intended for zero indication.

7.4.7 *Ambiguity Error* — A transient gross error which may occur in reading the digital representation of a quantity when it is changing, due to lack of precise synchronism of the changes in different digit positions (such as in a multi-digit analogue-to-digital convertor) for example in passing from 199 to 200, 299 or 209 might be indicated.

NOTE — Ambiguity error may be avoided by the use of a unit-distance code or by a guard signal.

7.4.8 *Intrinsic Error* — The error determined under reference conditions.

7.4.9 *Operating Error* — The error determined under rated operating conditions (*see* **7.5.3**).

7.4.10 *Influence Error* — The error determined when one influence quantity assumes any value within its rated range of use (or an influencing characteristic assumes any value within its effective range), all others being at reference conditions.

NOTE — When over the whole rated range of use a substantially linear relationship exists between the influence error and the effect causing it, the relationship may be conveniently expressed in coefficient form.

7.4.11 *Stability Error* — The error in the output information or in the zero indication of an apparatus during a specified time, other condition remaining constant.

7.4.11.1 *Stability error in the output information* — Stability error manifesting itself by changes of the output information over a specified period of time, the value of the input signal being held constant at a specified value which is significantly different from zero.

NOTE — According to the time interval considered, a distinction is drawn between short-term and long-term stability error.

7.4.11.2 *Stability error of the electrical zero* — Stability error manifesting itself by changes of the zero indication over a specified period of time, the input being connected to a specified passive network.

7.4.11.3 *Components of the stability error* — The stability error is divided into fluctuation and drift. Above a frequency limit specified by the manufacturer, this stability error is considered as fluctuation, while below the limit it is considered as drift.

7.4.11.4 *Fluctuation (PARD — Periodic and random deviations)* — Periodic and/or random deviations from the average of the output information or of the electrical zero.

7.4.11.5 *Drift* — The generally slow and continuous but not necessarily unidirectional deviation of the output information or of the electrical zero as a function of time.

NOTE — According to the time interval considered, a distinction is drawn between short-term and long-term drift.

7.4.12 *Limits of Error* — The maximum values of error assigned by the manufacturer to a measured (converted) quantity of an apparatus operating under specified conditions.

7.4.13 *Zero Shift* — The difference between two values of the electrical zero when one influence quantity assumes successively two specified values within its rated range of use, all other quantities being at constant values within the rated operating conditions.

7.4.14 *Variation (In Output Information)* —may be expressed according to one of the following definitions:

a) The difference between the output information signal values (indications) for a constant input value when one influence quantity assumes successively two specified values within its rated range of use, all other quantities being at reference conditions.

b) The difference between the required input signal values for a constant output information signal (indication) when one influence quantity assumes successively two specified values, all other quantities being at reference conditions.

7.4.15 *Repeatability* — The ability of the apparatus to give identical results when measurements (conversions) are performed successively but nevertheless under constant conditions. In general, repeatability is expressed in statistical terms, that is, by the consistency and the related confidence level.

NOTE — The period of elapsed time over which the successive measurements (conversions) are taken should be short with respect to the period over which short-term drift is determined in order to separate these effects.

7.5 Conditions of Operation, Transport and Storage

7.5.1 *Reference Conditions* — A set of values with tolerances, or of restricted ranges of influence quantities, and if necessary of influencing characteristics, specified for making comparison and calibration tests.

7.5.2 *Rated Range of Use* — The range of values for an influence quantity within which the requirements concerning operating error are satisfied.

7.5.3 *Rated Operating Conditions* — The whole of the effective ranges for performance characteristics and rated ranges of use for influence quantities within which the performance of the apparatus is specified.

7.5.4 *Limit Conditions of Operation* — The whole of the ranges of values for influence quantities and performance characteristics (beyond the rated ranges of use and effective ranges respectively) within which an apparatus may function without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions.

NOTE — The limit conditions will, in general, include overload.

7.5.5 *Storage and Transport Conditions* — The whole of the conditions of temperature, humidity, air pressure, vibration, shock, etc, within which the apparatus may be stored in or transported in an inoperative conditions, without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions.

INDEX

NOTE — This index has been prepared in accordance with IS : 1275-1958*. Index numbers are clause numbers.

*Rules for making alphabetical indexes.

INDIAN STANDARDS

ON

ELECTROTECHNICAL VOCABULARY

IS:

1885 Electrotechnical vocabulary

(Part III/Sec 1)-1965 Acoustics, Section 1 Physical acoustics
(Part III/Sec 2)-1966 Acoustics, Section 2 Acoustical and electro-acoustical systems
(Part III/Sec 3)-1967 Acoustics, Section 3 Sound recording and reproduction
(Part III/Sec 4)-1966 Acoustics, Section 4 Sonics, ultrasonics and underwater acoustics
(Part III/Sec 5)-1966 Acoustics, Section 5 Speech and hearing
(Part III/Sec 6)-1967 Acoustics, Section 6 Acoustical instruments
(Part III/Sec 7)-1978 Acoustics, Section 7 Music
(Part III/Sec 8)-1974 Acoustics, Section 8 Architectural acoustics
(Part IV/Sec 1)-1973 Electron tubes, Section 1 Common terms (*first revision*)
(Part IV/Sec 2)-1973 Electron tubes, Section 2 X-ray tubes (*first revision*)
(Part IV/Sec 3)-1970 Electron tubes, Section 3 Microwave tubes
(Part IV/Sec 4)-1970 Electron tubes, Section 4 Cathode-ray tubes
(Part IV/Sec 5)-1972 Electron tubes, Section 5 Pulse terms
(Part IV/Sec 6)-1972 Electron tubes, Section 6 Noise in Microwave tubes
(Part IV/Sec 7)-1973 Electron tubes, Section 7 Camera tubes
(Part IV/Sec 8)-1973 Electron tubes, Section 8 Photosensitive devices
(Part V)-1965 Electrotechnical vocabulary: Part V Quartz crystals
(Part VI)-1965 Printed circuits
(Part VII/Sec 1)-1970 Semiconductor devices, Section 1 General
(Part VII/Sec 2)-1970 Semiconductor devices, Section 2 Diodes
(Part VII/Sec 3)-1970 Semiconductor devices, Section 3 Transistors
(Part VII/Sec 4)-1969 Semiconductor devices, Section 4 Thyristors
(Part VII/Sec 5)-1971 Semiconductor devices, Section 5 Integrated circuits and micro-electronics
(Part XII)-1966 Ferromagnetic oxide materials
(Part XIII/Sec 1)-1968 Telecommunication transmission lines and waveguides, Section 1 General transmission lines
(Part XIII/Sec 2)-1967 Telecommunication transmission lines and waveguides, Section 2 Microwave transmission lines and waveguides
(Part XVIII)-1967 General terms on radio communications
(Part XIX)-1967 Radio communication circuits
(Part XX)-1967 Radio wave propagation
(Part XXI)-1967 Aerials
(Part XXII)-1967 Equipments for radio-communications, transmitting and receiving
(Part XXIII) -1967 Radio telegraphy and mobile radio
(Part XXIV)-1967 Part XXIV Broadcasting, sound and television
(Part XXV)-1967 Radio location and radio-navigation
(Part XXVI)-1968 Telecommunication relays
(Part XXXVI)-1972 Radio interference
(Part XXXI)-1971 Magnetism
(Part XXXIII)-1972 Piezoelectric filters
(Part XXXIX)-1974 Reliability of electronic and electrical items
(Part XL)-1974 Connectors
(Part XLI)-1975 Non-reciprocal electromagnetic components
(Part XLV)-1977 Capacitors
(Part XLVI)-1977 Resistors
(Part XLVII)-1977 Digital electronic equipment

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Conversion*
Force	newton	N	1 N = 0·101 972 kgf
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m²
Frequency	hertz	Hz	1 Hz = 1 c/s (s⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m²

INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephone : 27 01 31 (20 lines) **Telegrams : Manaksanstha**

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