Indian Standard

ELECTROTECHNICAL VOCABULARY

PART XLI NON-RECIPROCAL ELECTROMAGNETIC COMPONENTS

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(*Continued on page* 2)

(*Continued from page* 1)

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(*Continued on page* 6)

Indian Standard

ELECTROTECHNICAL VOCABULARY

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0. FOREWORD

0.1 This Indian Standard (Part XLI) was adopted by the Indian Standards Institution on 21 March 1975, after the draft finalized by the Electrotechnical Standards Sectional Committee in consultation with the Magnetic Components and Ferrite Materials Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The terms and definitions contained in this Standard have been drawn up with the object of striking a correct balance between absolute precision and simplicity. The principal object of the standard is to provide definitions which are sufficiently clear so that each term is understood with the same meaning.

0.3 This standard is one of a series of Indian Standards on electrotechnical vocabulary. A list of standards so far published in this series is given on pages 7 and 8.

0.4 This standard is based on the draft IEC Recommendations contained in Doc:51 (Central Office) 112 Terms and definitions relating to non-reciprocal electromagnetic components, issued by the International Electrotechnical Commission.

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1. SCOPE

1.1 This standard (Part XLI) covers definitions of terms applicable to passive, non-reciprocal components for circuits and transmission lines, that is multiport devices in which the propagation properties depend upon the direction of propagation of electromagnetic energy through the device.

NOTE — Passive, non-reciprocal components usually utilize the gyromagnetic effect in a medium, for example, a ferrite, whose magnetic properties are expressed by a tensor permeability. Therefore, the term 'gyromagnetic device' may also be used for such components. On the other hand, not all gyromagnetic devices are non-reciprocal, since the wave propagation properties depend upon the spatial arrangement of the high-frequency and biasing magnetic fields.

The biasing magnetic field, which may sometimes be due to remanent magnetization only, may be either static or dynamic. Components in which pulsed external fields are used to change the state of remanence (and thereby the biasing field) are sometimes called 'latching devices'.

2. TERMS AND DEFINITIONS

2.1 Gyromagnetic Effect — The phenomenon by which the magnetization of a material or medium subjected to a magnetostatic field upon disturbance relaxes back to equilibrium by damped precessional motion about the direction of that field.

2.2 Gyromagnetic Material (Medium) — A material (medium) capable of displaying the gyromagnetic effect.

NOTE — Due to the gyromagnetic effect the electromagnetic wave propagation properties of a gyromagnetic material (medium) exhibit a characteristic behaviour related to tensor permeability.

2.3 Gyromagnetic Device — A device that utilizes a gyromagnetic material or medium.

2.4 Gyromagnetic Resonator — A gyromagnetic material or medium of a given geometry.

NOTE — Due to the gyromagnetic effect, resonance may occur when the angular frequency, ω, the effective internal magnetic field strength, H, and the gyromagnetic ratio, γ, satisfy the condition:

$$\omega = \gamma \mu_0 H$$

where

μ_0 is the magnetic constant.

2.5 Non-reciprocal Phase-Shifter — A two-port device whose propagation medium provides different phase-shifts for the two directions or propagation.

NOTE — The amount of phase-shift may be changed continuously (analogue phase-shifter) or stepwise (digital phase-shifter).

2.6 Non-reciprocal Polarization Rotator (Non-reciprocal Wave Rotator) — A waveguide structure, usually of circular cross section, whose propagation medium provides that the direction of polarization, that is, that of the electric field vector, for a linearly polarized wave is rotated clockwise in one direction of propagation and counter-clockwise in the other direction.

2.7 Gyrator — A non-reciprocal phase-shifter having a differential phase shift of $\pi/4$ radians.

NOTE — The use of the word gyrator to denote gyromagnetic devices in general is deprecated.

2.8 Circulator — A multiport device in which the power to any port is transmitted to the next port according to a given order of sequence.

NOTE — By reversing the biasing field the order of sequence is reversed. This property may be used to switch electromagnetic energy.

2.8.1 *Phase-Shift Circulator* — A circulator containing at least one non-reciprocal phase-shifter.

2.8.2 *Rotation Circulator* (*Wave Rotation Circulator*) — A circulator containing at least one non-reciprocal polarization rotator.

2.8.3 *Junction Circulator* — A circulator in which the multiport structure consists of a junction between transmission lines.

NOTE — Junction circulators may be built in several ways, characterized by the symmetry of the junction. To denote these circulator types the word 'junction' is usually omitted and a qualifying prefix used instead. Examples of this practice are the terms 'Y-circulator' and 'T-circulator', where the capitals are used to describe the type of junction employed.

In the cases of waveguide junction circulators further qualification may be needed, for example, as illustrated by the term 'H-plane Y-circulator'. Such qualifying prefixes shall conform with normal waveguide terminology.

2.8.4 *Lumped-Element Circulator* — A junction circulator in which the ports are connected to a network of lumped impedance elements.

2.9 Isolator (One-Way Attenuator) — A two-port device having much greater attenuation in one direction of propagation than in the other.

2.9.1 *Rotation Isolator* (*Wave Rotation Isolator*) — An isolator containing at least one non-reciprocal polarization rotator.

2.9.2 *Resonance Isolator* (*Resonance Absorption Isolator*) — An isolator whose operation depends upon resonance absorption in a gyromagnetic material or medium.

2.9.3 *Field-Displacement Isolator* — An isolator whose operation depends upon field-displacement caused by a gyromagnetic material or medium.

2.9.4 *Lumped-Element Isolator* — An isolator in which the two ports are connected by a network of lumped impedance elements.

2.10 Gyromagnetic Filter — A filter containing at least one gyromagnetic resonator.

NOTE — The use of terms like 'YIG filter' or 'garnet filter' for such devices is deprecated.

2.11 Gyromagnetic Power Limiter — A power limiter containing at least one gyromagnetic resonator and whose operation depends upon non-linear saturation effects in that resonator.

2.12 Differential Phase-Shift — The difference in phase-shift between the two directions of propagation in a non-reciprocal phase-shifter.

NOTE — The use of this term for other types of phase difference such as between states in a digital phase-shifter is deprecated.

2.13 Forward Direction (of an Isolator or a Circulator) — That direction of a transmission path in which energy propagates with much lower attenuation than in the opposite (the reverse direction).

2.14 Reverse Direction (of an Isolator or a Circulator) — That direction of a transmission path in which energy propagates with much higher attenuation than in the opposite (the forward direction).

2.15 Forward Loss — The insertion loss in the forward direction of an isolator or a circulator.

2.16 Reverse Loss — The insertion loss in the reverse direction of an isolator or a circulator.

2.17 Cross Coupling (of a Circulator Having Four or More Ports) — The attenuation between input port and any other port that is not adjacent to the input port according to the order of sequence.

NOTE — The cross coupling shall not be confused with the reverse loss occurring between adjacent ports.

2.18 Loss Ratio — The quotient of reverse and forward loss, expressed in dB, along a transmission path in an isolator or a circulator.

(*Continued from page* 2)

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IS : 1885 Electrotechnical vocabulary:

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(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 under-water acoustics

(Part III/Sec 5)-1966 Acoustics, Section 5 Speech and hearing

(Part III/Sec 6)-1967 Acoustics, Section 6 Acoustical instruments

(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 Quartz crystals

(Part VI)-1965 Printed circuits

(Part VII)-1965 Semiconductor devices

(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 microelectronics

(Part VIII)-1965 Secondary cells and batteries

(Part IX)-1966 Electrical relays

(Part X)-1968 Electrical power system protection

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(Part XII)-1966 Ferromagnetic oxide materials

(Part XIII/Sec 1)-1968 Telecommunication transmission lines and waveguides, Section 1 General transmission lines

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(Part XIV)-1967 Nuclear power plants

(Part XV)-1967 Primary cells and batteries

(Part XVI/Sec 1)-1968 Lighting, Section 1 General aspects

(Part XVI/Sec 2)-1968 Lighting, Section 2 General illumination, lighting fittings and lighting for traffic and signalling

(Part XVI/Sec 3)-1967 Lighting, Section 3 Lamps and auxiliary apparatus

(Part XVII)-1969 Switchgear and controlgear

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(Part XIX)-1967 Radiocommunication circuits
(Part XX)-1967 Radiowave propagation
(Part XXI)-1967 Aerials
(Part XXII)-1967 Equipments for radiocommunications, transmitting and receiving
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(Part XXIV)-1967 Broadcasting, sound and television
(Part XXV)-1967 Radiolocation and radio-navigation
(Part XXVI)-1968 Telecommunication relays
(Part XXVII)-1969 Static power convertors
(Part XXVIII)-1972 Instrument transformers
(Part XXIX)-1971 Mining terms
(Part XXX)-1971 Overhead transmission and distribution of electrical energy
(Part XXXI)-1971 Magnetism
(Part XXXII)-1971 Cables, conductors and accessories for electricity supply
(Part XXXIII)-1972 Piezo-electric filters
(Part XXXIV)-1972 Cinematography
(Part XXXV)-1973 Rotating machines
(Part XXXVI)-1972 Radio interference
(Part XXXVII)-1973 Tariff for electricity
(Part XXXVIII)-1973 Transformers
(Part XXXIX)-1974 Reliability of electronic and electrical items
(Part XL)-1974 Connectors