

American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD)

(Dictionary of EMC/EMP/ESD Terms and Definitions)

Accredited Standards Committee On Electromagnetic Compatibility, C63

accredited by the

American National Standards Institute

Secretariat

Institute of Electrical and Electronics Engineers, Inc.

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Abstract: Terms associated with electromagnetic compatibility (EMC), electromagnetic pulse (EMP), and electrostatic discharge (ESD) are defined. Quantities, units, multiplying factors, symbols, and abbreviations are covered.

Keywords: electromagnetic compatibility (EMC), terms and definitions; electromagnetic pulse (EMP), terms and definitions; electrostatic discharge (ESD), terms and definitions

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Foreword

[This foreword is not a part of American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD) (Dictionary of EMC/EMP/ESD Terms and Definitions).]

This document is intended to serve as a Standard Dictionary of Terms and Definitions commonly used and related by usage to activities pertaining to electromagnetic compatibility (EMC), electromagnetic pulse (EMP), and electrostatic discharge (ESD).

In developing the definitions for these terms, international usage, as reflected in Chapter 161 of IEC 50(161)(1990), International Electrotechnical Vocabulary, has been adopted wherever possible. In addition, military usage has been incorporated.

Terms that may be considered to have special meaning in specific applications are recognized by a parenthetical note identifying the originating organization or specific application.

Suggestions for improvement of this standard are welcome. They should be sent to:

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Contents

SECTION	PAGE
1. Scope	1
2. References	1
3. Quantities, Units, Multiplying Factors, Symbols, and Abbreviations	2
3.1 Quantities	2
3.2 Multiplying Factors and Symbols	3
3.3 Frequency Spectrum Designations and Symbols	3
3.4 Abbreviations	4
4. Definitions and Terminology	4

American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD)

(Dictionary of EMC/EMP/ESD Terms and Definitions)

1. Scope

This document provides definitions of terms associated with electromagnetic compatibility (EMC), electromagnetic pulse (EMP), and electrostatic discharge (ESD). In addition to definitions, it includes symbols and abbreviations.

2. References

[1] ANSI C63.4-1991, American National Standard Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.¹

[2] ANSI C63.7-1988, American National Standard Guide for Construction of Open Area Test Sites for Performing Radiated Emission Measurements.

[3] IEEE Std 100-1988, IEEE Standard Dictionary of Electrical and Electronics Terms—4th ed. (ANSI).²

[4] MIL-STD-463A-1977, Military Standard, Definitions and System of Units, Electromagnetic Interference and Electromagnetic Compatibility Technology.³

[5] Collin, Robert E., *Field Theory of Guided Waves*, 2nd ed., New York: IEEE Press, 1991.

[6] FCC 47 CFR Part 15, Radio Frequency Devices (1990).⁴

[7] IEC 50(161)(1990), International Electrotechnical Vocabulary, Chapter 161: Electromagnetic compatibility. Also: parts of Chapters 604 and 826.⁵

¹ANSI C63 publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08855-1331, USA, or from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

²IEEE publications are available from the Institute of Electrical and Electronics Engineers.

³Military publications are available through appropriate channels within respective US Army, Navy, and Air Force project program offices. Information on military document availability also can be obtained from the Director, US Navy Publications and Printing Service, Eastern Division, 700 Robbins Avenue, Philadelphia, PA 19111, USA.

⁴This document is available from the Superintendent of Documents, US Government Printing Office, Document Control Branch, Washington, DC 20402, USA.

⁵IEC publications are available from the International Electrotechnical Commission, 3 rue de Varembe, Case Postale 131, CH-1211, Geneva 20, Switzerland/Suisse. In the United States, IEC publications are available from the American National Standards Institute.

- [8] International Telecommunication Union (ITU) Radio Regulations, 1990 ed.⁶
- [9] Jordan, E. C. *Reference Data for Engineers: Radio, Electronics, Computer, and Communications*, 7th ed. Howard W. Sams & Co., Inc. 1985.
- [10] MIL-B-5087B(ASG)-1964, Military Specification, Bonding, Electrical, and Lightning Protection, for Aerospace Systems.⁷
- [11] MIL-E-6051D-1967, Military Specification, Electromagnetic Compatibility Requirements, Systems.
- [12] MIL-HDBK-419A-1987, Grounding, Bonding, and Shielding for Electronic Equipments and Facilities. Volumes I (Basic Theory) and II (Applications).
- [13] National Institute of Standards and Technology (NIST) Special Publication 330, International System of Units (SI), July 1986.⁸
- [14] National Telecommunication and Information Administration (NTIA) Manual: Manual of Regulations and Procedures for Federal Radio Frequency Management. May, 1989, with revisions dated January, 1991.⁹
- [15] NATO STANAG No. 3968-1988, NATO Glossary of Electromagnetic Terminology (Edition 2) (First Draft) (Undated); NATO AAP-6, NATO Glossary of Terms and Definitions (English and French).¹⁰

3. Quantities, Units, Multiplying Factors, Symbols, and Abbreviations

3.1 Quantities. The following units and symbols shall be used to indicate the applicable quantity. The quantities, units, and unit symbols presented comply with the International System of Units (SI). See NIST [13]¹¹.

Quantity	SI Unit	Symbol of SI Unit
Capacitance	farad	F
Electric current	ampere	A
Electric field strength (E-vector)	volt per meter	V/m
Electric potential (potential difference, electromotive force)	volt	V
Electric resistance	ohm	Ω
Energy	joule	J
Frequency	hertz	Hz
Inductance	henry	H

⁶Copies of the Radio Regulations are available from the Secretary General, International Telecommunications Union, Place des Nations, CH-1211, Geneva 20, Switzerland/Suisse.

⁷See footnote 3.

⁸This document is available from the Superintendent of Documents, US Government Printing Office.

⁹This publication is available from the Superintendent of Documents, US Government Printing Office.

¹⁰Information on the availability of NATO STANAGS can be obtained from Headquarters, US Air Force/XOXX-ISO, Washington, DC 20330-5058, USA.

¹¹The numbers in brackets correspond to those of the references in Section 2.

Quantity	SI Unit	Symbol of SI Unit
Length	meter	m
Magnetic field strength (H-vector)	ampere per meter	A/m
Magnetic flux	weber	Wb
Magnetic flux density (B-vector)	tesla	T
Power	watt	W
Pulse Rise Time (T_r)	second	s
Pulse Fall Time (T_f)	second	s
Pulse width (T_w)	second	s
Time	second	s
Wavelength	meter	m

3.2 Multiplying Factors and Symbols. The following symbols shall be used to indicate the applicable multiplier:

Multiplier	Symbol
Tera (10^{12})	T
Giga (10^9)	G
Mega (10^6)	M
Kilo (10^3)	k
Hecto (10^2)	h
Deka (10^1)	da
Deci (10^{-1})	d
Centi (10^{-2})	c
Milli (10^{-3})	m
Micro (10^{-6})	μ
Nano (10^{-9})	n
Pico (10^{-12})	p
Femto (10^{-15})	f
Atto (10^{-18})	a

3.3 Frequency Spectrum Designations and Symbols. The following symbols shall be used to indicate the applicable portion of the frequency spectrum. (NTIA [14])

Frequency Subdivision	Frequency Range
ELF (extremely low)	30 Hz to 300 Hz
VF (voice)	300 Hz to 3 kHz
VLF (very low)	3 kHz to 30 kHz
LF (low)	30 kHz to 300 kHz
MF (medium)	300 kHz to 3000 kHz (3 MHz)
HF (high)	3 MHz to 30 MHz
VHF (very high)	30 MHz to 300 MHz
UHF (ultra high)	300 MHz to 3000 MHz (3 GHz)
SHF (super high)	3 GHz to 30 GHz
EHF (extremely high)	30 GHz to 300 GHz
(undesignated)	300 GHz to 3000 GHz (3 THz)

3.4 Abbreviations

BER	bit-error rate
C-E	communication-electronic
CE	conducted emission
CS	conducted susceptibility
ECCM	electronic counter-countermeasure
ECM	electronic countermeasure
EFS	electric field strength
EIRP	equivalent isotropic radiated power
EM	electromagnetic
EMC	electromagnetic compatibility
EMCP	electromagnetic compatibility program
EMCS	electromagnetic compatibility standardization
EMI	electromagnetic interference
EMIM	electromagnetic immunity
EMISM	electromagnetic interference safety margin
EMP	electromagnetic pulse
EMS	electromagnetic susceptibility
EMV	electromagnetic vulnerability
ERP	effective radiated power
EUT	equipment under test
EW	electronic warfare
FIM	field-intensity meter
FSM	field-strength meter
FSVM	frequency-selective voltmeter
HERF	hazards of electromagnetic radiation to fuel
HERO	hazards of electromagnetic radiation to ordnance
HERP	hazards of electromagnetic radiation to personnel
Hz	hertz
IBW	impulse bandwidth
IG	impulse generator
ISM	industrial, scientific, and medical
kHz	kilohertz
l_e	antenna effective length for electric-field antennas
l_{em}	antenna effective length for magnetic-field antennas
MDS	minimum discernible signal
MFS	magnetic field strength
MHz	megahertz
MPMVS	midpulse minimum visible signal
MVS	minimum visible signal
POE	point of entry
RADHAZ	radiation hazard
RE	radiated emission
RFI	radio-frequency interference
RS	radiated susceptibility

4. Definitions and Terminology

The following definitions and terms are given for use in applicable situations and documents. They are intended to be applied to the general field of electromagnetic compatibility, and the fields related to the phenomena associated with electromagnetic pulse and electrostatic discharge.

4.1 absorber. A material that causes the irreversible conversion of the energy of an electromagnetic wave into another form of energy (normally heat) as a result of its interaction with the absorber material.

4.2 absorber, fire safety. Absorber material that corresponds to fire safety specifications.

4.3 absorber performance. The ratio of absorbed energy to incident radiated energy impinging upon an absorber surface.

4.4 absorbing clamp. A measuring device, movable along the mains leads (or interface cables) of an appliance or similar device, intended to assess the maximum radio-frequency (RF) power emitted by the appliance or device. (IEC 50(161)(1990) [7])

4.5 absorption. The irreversible conversion of the energy of an electromagnetic wave into another form of energy as a result of its interaction with matter. (IEEE Std 100-1988 [3])

4.6 absorption loss. That part of a transmission loss due to the dissipation or conversion of either sound or electromagnetic energy into other forms of energy, either within the transmission medium or attendant upon a reflection and interaction with matter.

4.7 accuracy. (1) The quality of freedom from mistake or error, that is, of conformity to truth or to a rule. (IEEE Std 100-1988 [3]) (2) The specification of the maximum plus-or-minus error deviation from the true value for a unit or system level measurement. The accuracy may be specified in terms of peak or rms deviation.

4.8 ambient level (electromagnetic). The values of radiated and conducted signal and noise existing at a specified test location and time when the test sample is not activated. (IEEE Std 100-1988 [3]) For example, atmospheric noise, and signals from man-made and other natural sources all contribute to the “ambient level.”

4.9 anechoic enclosure [radio frequency (RF)]. An enclosure whose internal walls have low reflection characteristics. (IEEE Std 100-1988 [3])

4.10 antenna beamwidth (half-power beamwidth). In a radiation pattern cut containing the direction of the maximum of the lobe, the angle between the two directions in which the radiation power intensity is one half the maximum value. (IEEE Std 100-1988 [3])

4.11 antenna effective area (in a given direction). The ratio of the power available at the terminals of an antenna to the incident power density of a plane wave from a given direction, polarized coincident with the polarization that the antenna would radiate. (IEEE Std 100-1988 [3])

4.12 antenna effective length (l_e or l_{em}) (linearly polarized antenna). The ratio of the magnitude of the open-circuit voltage developed at the terminals of the antenna to the magnitude of the electric field strength in the direction of the antenna polarization. (IEEE Std 100-1988 [3])

4.13 antenna, elevatable. An antenna adjusted either automatically, semiautomatically, or manually, through differing elevation angles or antenna heights with respect to an elevation angle and/or height reference.

4.14 antenna factor, receive. The ratio of the strength of the field in which the antenna is immersed to the output voltage across the load connected to the antenna.

4.15 antenna factor, transmit. The ratio of the strength of the field produced by the antenna at a specified distance to the driving input voltage across the antenna input terminals.