



American National Standard Dictionary of Electromagnetic Compatibility (EMC) including Electromagnetic Environmental Effects (E3)

C63[®]

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Accredited Standards Committee C63[®] —Electromagnetic Compatibility

Accredited by the American National Standards Institute

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Accredited Standards Committee C63®—Electromagnetic Compatibility

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Secretariat

Institute of Electrical and Electronic Engineers, Inc.

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Abstract: Terms associated with electromagnetic compatibility (EMC) and electromagnetic environmental effects (E3) are defined including electromagnetic pulse (EMP), and electrostatic discharge (ESD) terms. Quantities, units, multiplying factors, symbols, and abbreviations are covered.

Keywords: electromagnetic compatibility (EMC), electromagnetic environmental effects (E3), terms and definitions; electromagnetic pulse (EMP), terms and definitions; electrostatic discharge (ESD), terms and definitions

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Introduction

This introduction is not part of ANSI C63.14-2009, American National Standard Dictionary of Electromagnetic Compatibility (EMC) including Electromagnetic Environmental Effects (E3).

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), including electromagnetic environmental effects (E3).

The title of this document was changed to reflect the common usage of the term “electromagnetic environmental effects” used by the U.S. Department of Defense and industry to represent the broad category of engineering disciplines that had been commonly included under the term “electromagnetic compatibility.” Because some people still think of EMC as a term representing many related categories, the term was retained in the title to provide continuity for title searches. The other terms in the previous title, “electromagnetic pulse” (EMP) and “electrostatic discharge” (ESD), were just two of many categories of supporting disciplines with specific terms that were included within the scope of E3 and so were removed from the title. The other categories of E3, as listed in the definition herein, include electromagnetic interference; electromagnetic vulnerability; electromagnetic pulse; electronic protect; electrostatic discharge; hazards of electromagnetic radiation to personnel, ordnance, and fuels (volatile materials); and natural phenomena effects of lightning and precipitation static.

Since the time this document was introduced in 1998, the landscape of terms related to the broad category of E3 and EMC has increased or changed by the design and evaluation activities of the U.S. Department of Defense and industry. Terms that were considered common and not specifically related to the E3 and EMC fields and are defined by *The IEEE Standards Dictionary: Glossary of Terms & Definitions*^a were removed from this document. New or modified terms defined by ANSI C63[®] documents and U.S. Military Standards are introduced in this document. As an example, the term “above deck” was modified by MIL-STD-464A, and the updated definition is included in this document. An example of a term removed was “accreditation,” which is not specifically and directly related to E3 and EMC and is defined in *The IEEE Standards Dictionary: Glossary of Terms & Definitions*.

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^a *The IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at <http://shop.ieee.org/>.

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1. Scope

This standard provides definitions of terms associated with electromagnetic environmental effects including electromagnetic compatibility (EMC), electromagnetic pulse (EMP), and electrostatic discharge (ESD). In addition to definitions, several symbols and abbreviations are included.

2. References

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

2.1 Commercial

ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.¹

ANSI C63.5-2006, American National Standard for Electromagnetic Compatibility—Radiated Emission Measurements in Electromagnetic Interference (EMI) Control—Calibration of Antennas (9 kHz to 40 GHz).

ANSI C63.7-2005, American National Standard Guide for Construction of Open-Area Test Sites for Performing Radiated Emission Measurements.

ANSI C63.011-2000, American National Standard for Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific, and Medical (ISM) Radio-Frequency Equipment.

ANSI C63.12-1999, American National Standard Recommended Practice for Electromagnetic Compatibility Limits.

ANSI C63.13-1991, American National Standard Guide on the Application and Evaluation of EMI Power-Line Filters for Commercial Use.

ANSI C63.16-1993, American National Standard Guide for Electrostatic Discharge Test Methodologies and Criteria for Electronic Equipment.

ANSI C63.17-2006, American National Standard Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (UPCS) Devices.

ANSI C63.19-2007, American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

ANSI C63.22-2004, American National Standard Guide for Automated Electromagnetic Interference Measurements.

ESD ADV 1.0-1994, ESD Association Advisory for Electrostatic Discharge Terminology, Glossary.²

ESD ADV 2.0-1994, ESD Association Advisory for Protection and Sensitivity Testing of Electrostatic Discharge Susceptible Items.

FCC 47 CFR Part 15, U.S. Code of Federal Regulations, Title 47—Telecommunication, Chapter I—Federal Communications Commission, Part 15—Radio Frequency Devices.³

IEC 60050-161:1990-09 (Amendment 1 1997-10; Amendment 2 1998-04), International Electrotechnical Vocabulary. Chapter 161: Electromagnetic Compatibility.⁴

NOTE—IEC has a website for the IEV at (<http://www.electropedia.org>), which may be useful; however, if there are any conflicts in definitions, then this document shall take precedent.⁵

¹ ANSI C63® publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>), or from the Sales Department, American National Standards Institute, 11 West 42nd St., 13 Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

² ESD publications are available from the Sales Department, ElectroStatic Discharge Association, 7900 Turin Road, Bldg 3, P.O. Box 913, Rome, NY 13440-2069 USA. ESD standards are available from the Internet at (<http://www.esda.org/standards.html>).

³ FCC publications are available from U. S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954 USA (<http://www.gpoaccess.gov/>).

⁴ IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iec.ch/>). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (<http://standards.ieee.org/>).

IEEE/ASTM SI 10-1997, Standard for Use of the International System of Units (SI)—The Modern Metric System.⁶

IEEE Std 260.1™-1993, American National Standard Letter Symbols for Units of Measurement.⁷

International vocabulary of basic and general terms in metrology (VIM), 2nd ed., 1993. (Edited in common by BIPM, IEC, ISO, and OIML.)⁸

ISO/IEC Guide 2:1996, Standardization and Related Activities—General Vocabulary.⁹

ISO/IEC 17025:2005, General Requirements for the Competence of Testing and Calibration Laboratories.

ITU, International Telecommunication Union Radio Regulations, 2004 ed.¹⁰

SAE ARD 50040, 1992 (draft), High Intensity Radiated Field (HIRF) Advisory Circular.¹¹

2.2 Military

Joint Publication 1-02, 2004, “Department of Defense Dictionary Of Military and Associated Terms.”

MIL-HDBK-240, 2002, Hazards of Electromagnetic Radiation to Ordnance (HERO) Test Guide.¹²

MIL-HDBK-419A, 1987, Grounding, Bonding, and Shielding for Electronic Equipments and Facilities. Volumes I (Basic Theory) and II (Applications).

MIL-STD-461F, 2007, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.

MIL-STD-464A, 2002, Electromagnetic Environmental Effects—Requirements for Systems.

MIL-STD-469B, 1996, Department of Defense Interface Standard for Radar Engineering Interface Requirements, Electromagnetic Compatibility.

National Telecommunication and Information Administration (NTIA) Manual: Manual of Regulations and Procedures for Federal Radio Frequency Management. May 1989, with Revisions dated January, 2007.¹³

NATO STANAG No. 3968-1999, NATO Glossary of Electromagnetic Terminology (Edition 3) (Amendment 1).¹⁴

⁵ Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

⁶ IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA (<http://standards.ieee.org/>). ASTM publications are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA (<http://www.astm.org/>).

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⁸ This publication is available from Global Engineering, 15 Inverness Way East, Englewood, CO 80112-5704, USA.

⁹ ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembe, CH-1211, Genève 20, Switzerland/ Suisse (<http://www.iso.ch/>). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

¹⁰ ITU-T publications are available from the International Telecommunications Union, Place des Nations, CH-1211, Geneva 20, Switzerland/Suisse (<http://www.itu.int/>).

¹¹ SAE publications are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA (<http://www.sae.org/>).

¹² MIL publications are available from Customer Service, Defense Printing Service, 700 Robbins Ave., Bldg. 4D, Philadelphia, PA 19111-5094 (<http://assist.daps.dla.mil/quicksearch/>).

¹³ This publication is available from the Superintendent of Documents, U.S. Government Printing Office.

3. Quantities, units, multiplying factors, symbols, and abbreviations

3.1 Quantities

The units and symbols listed in Table 1 shall be used to indicate the applicable quantity. The quantities, units, and unit symbols presented comply with the International System of Units (SI). (See IEEE Std 260.1™-1993 and IEEE/ASTM SI 10-1997.¹⁵) In case of variance, this standard takes precedence.

Table 1—Units of a quantity

Quantity	SI unit	Symbol of SI unit
Capacitance	Farad	F
Electric current	Ampere	A
Electric field strength (<i>E</i> -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
Length	Meter	m
Magnetic field strength (<i>H</i> -vector)	Ampere per meter	A/m
Magnetic flux	Weber	Wb
Magnetic flux density (<i>B</i> -vector)	Tesla	T
Power	Watt	W
Pulse rise time (<i>t_r</i>)	Second	s
Pulse fall time (<i>t_f</i>)	Second	s
Pulse width time (<i>t_w</i>)	Second	s
Time	Second	s
Wavelength	Meter	m

3.2 Multiplying factors and symbols

The symbols listed in Table 2 shall be used to indicate the applicable multiplier.

¹⁴ NATO STANAGs publications and other documents are available from the Headquarters of the United States Air Force/XOXX-ISO, Washington, DC 20330-5058 (<http://www.nato.int/docu/standard.htm>).

¹⁵ Information on references can be found in Clause 2.

Table 2—Symbols for multiplying factors

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

The designations in Table 3 shall be used to indicate the applicable portion of the frequency spectrum.

Table 3—Designations of frequency spectrum^a

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)

^aFrom the National Telecommunication and Information Administration (NTIA) Manual.

3.4 Abbreviations and acronyms

AM	amplitude modulation
AMN	Artificial Mains Network (see LISN)
ANSI	American National Standards Institute
ARD	Aerospace Resource Document (SAE)
BBN	broadband noise
BCI	bulk current injection
BER	bit error rate
BW	bandwidth
C-E	communication-electronic
CE	conducted emission
CI	conducted immunity
CISPR	International Special Committee on Radio Interference
CM	common mode
COTS	commercial off the shelf

CS	conducted susceptibility
CW	continuous wave
dB	decibel
dB(A)	decibels referenced to 1 ampere
dBm	decibels reference to 1 milliwatt
dB (μ V)	decibels referenced to 1 microvolt
dB (μ V/m)	decibels referenced to 1 microvolt per meter
DM	differential mode
DS	damped sinusoidal
DSB	double sideband
E3	electromagnetic environmental effects
EFS	electric field strength
EID	electrically initiated device
EIRP	equivalent isotropic radiated power
EM	electromagnetic
EMC	electromagnetic compatibility
EMCP	electromagnetic compatibility program
EME	electromagnetic environment
EMI	electromagnetic interference
EMRADHAZ	electromagnetic radiation hazard
EMP	electromagnetic pulse
EMV	electromagnetic vulnerability
EP	electronic protection
ERP	effective radiated power
ESC	equipment spectrum certification
ESD	electrostatic discharge
EUT	equipment under test
FCC	Federal Communications Commission
FIM	field-intensity meter
FM	frequency modulation
FSAF	free-space antenna factor
FSK	frequency-shift keying
FSVM	frequency-selective voltmeter
GCSF	geometry-specific correction factor
GTEM	gigahertz transverse electromagnetic cell
HEMP	high-altitude electromagnetic pulse
HERF	hazards of electromagnetic radiation to fuel (volatile materials)
HERO	hazards of electromagnetic radiation to ordnance
HERP	hazards of electromagnetic radiation to personnel
HIRF	high intensity radiated field(s)
IBW	impulse bandwidth
ICP	impedance control point
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electrotechnical Commission
IMI	intermodulation interference
ISB	independent sideband
ISM	industrial, scientific, medical
ISO	International Organization for Standardization
ITE	information technology equipment
l_e	antenna effective length for electric-field antennas
l_{em}	antenna effective length for magnetic-field antennas
LEMP	lightning electromagnetic pulse
LISN	line impedance stabilization network
MAE	maximum allowable environment
MDS	minimum discernible signal

MNFC	maximum no-fire current
MOV	metal oxide varistor
M&TE	measuring and test equipment
NATO	North Atlantic Treaty Organization
NDI	non-developmental item
NEMP	nuclear electromagnetic pulse
NTIA	National Telecommunications and Information Administration
NIST	National Institute of Standards and Technology
NSA	normalized site attenuation
NVLAP	National Voluntary Laboratory Accreditation Program
OATS	open area test site
P	power
PAM	pulse-amplitude modulation
PCI	pulsed current injection
PCM	pulse-code modulation
PDM	pulse-duration modulation
POE	point of entry
PPM	pulse-position modulation
PSD	power spectral density
PSK	phase-shift keying
P-static	precipitation static
PTM	pulse-time modulation
PWM	pulse-width modulation
PWM	pulse-width modulation
RADHAZ	radiation hazard
RAM	radar absorbing material
RBW	resolution bandwidth
RCS	radar cross section
RE	radiated emission
RF	radio frequency
RFI	radio-frequency interference
RI	radiated immunity
RS	radiated susceptibility
Rx	receiver
SAE	Society of Automotive Engineers
SSB	single sideband
SM	spectrum management
SS	spectrum supportability
TDR	time-domain reflectometry
TEM	transverse electromagnetic
Tx	transmitter
TPD	terminal protection device
TPL	tri-plate line
UPCS	unlicensed personal communications services
UPS	uninterruptible power systems
Z_t	transfer impedance

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 environmental effects (e.g., electromagnetic compatibility), and the fields related to the phenomena associated with electromagnetic pulse and electrostatic discharge. For the purposes of this document, the following terms and definitions apply.