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IEEE C63.14

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ANSI C63.14-1998
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American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD)

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IEEE

Published by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017, USA.

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

Accredited Standards Committee on Electromagnetic Compatibility, C63

Accredited by the
American National Standards Institute

Secretariat
Institute of Electrical and Electronics Engineers, Inc.

Approved 28 October 1998
American National Standards Institute

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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345 East 47th Street, New York, NY 10017-2394, USA

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ISBN 0-7381-0257-1

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Introduction

[This introduction is not part of ANSI C63.14-1998, American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD).]

This document defines 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).

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.

Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
USA

Participants

At the time that this standard was developed, the C63 Subcommittee 2 Working Group (S/C-2) had the following active membership:

J.L. Norman Violette, *Project Chair*

Richard B. Schulz, *S/C-2 Co-Chairman* **Ralph M. Showers,** *C63 Committee Chair*

Edwin L. Bronaugh
Joseph Butler
Ross A. Hansen
Donald N. Heirman
H. Robert Hofmann
Arthur H. Light
Herbert K. Mertel

At the time that the Accredited Standards Committee on Electromagnetic Compatibility, C63, approved this standard, it had the following membership:

Ralph M. Showers, *Chair* **Edwin L. Bronaugh,** *Vice Chair*

Patricia Gerdon, *Secretariat*

Organization Represented	*Name of Representative*
Aeronautical Radio, Inc. (ARINC)	Dan Martinec
	Paul Prisaznuk *(Alt.)*
Alliance for Telecom. Industry Solutions	John F. Lichtig
American Automobile Manufacturers Association	Terry Rybak
	Barbara Wendling *(Alt.)*
American Council of Independent Laboratories	Ross A. Hansen
	Walter Poggi *(Alt.)*
American Radio Relay League	Hugh Turnbull
	Edward F. Hare *(Alt.)*
Association of American Railroads	Chris Allman
Association of Telecommunications Attorneys	Glen Dash
	Jon Curtis *(Alt.)*
AT&T	Keith Peavler
ESD Association	Douglas C. Smith
Federal Communications Commission	L. Art Wall
	Thomas Phillips *(Alt.)*

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Food and Drug Administration	Jon Casamento
	Jeffrey L. Silberberg *(Alt.)*
Hewlett-Packard	Ray Magnuson
Information Technology Industry Council (ITI)	William T. Rhoades
	John Godfrey *(Alt.)*
Institute of Electrical and Electronics Engineers, Inc.	Edwin L. Bronaugh
	Donald N. Heirman
	Nestor Kolcio
Lucent Technologies—Bell Labs	H. Robert Hofmann
	Steven M. Crosby *(Alt.)*
National Association of Broadcasters	Kelly Williams
National Electrical Manufacturers Association	William J. Murphy
	Kenneth Gettman *(Alt.)*
National Institute of Standards and Technology	Motohisa Kanda
Oklahoma University Center for the Study of Wireless EMC	Hank Grant
	Donald Heirman *(Alt.)*
Radio Shack Engineering	Dwayne Campbel
	Joel Guskin *(Alt.)*
Siemens ROLM Communications	H. Stephen Berger
Society of Automotive Engineers (Aerospace)	Herbert K. Mertel
Society of Automotive Engineers (Land Vehicle)	Poul Andersen
Southwest Research Institute	James J. Polonis
	William E. Cory *(Alt.)*
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TUV Product Service	Daniel D. Hoolihan
	Tim O'Shea *(Alt.)*
Underwriters Laboratories	Willard Tuthill
	Corey Hyatt *(Alt.)*
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US Air Force	John Zentner
	Dennis Baseley *(Alt.)*
US Dept. of Energy—Oak Ridge National Laboratory	Paul Ewing
	Richard A. Hess *(Alt.)*
US Dept. of Energy—Western Area Power Administration	Scott E. Johnson
US Dept. of the Navy, Space and Naval Warfare Systems Command	Marcus Shellman
US Dept. of Transportation —Federal Aviation Administration	Robert Frazier
Violette Engineering	J. L. Norman Violette
	Michael F. Violette *(Alt.)*
WIN Forum AT&T Systems	Anatoly Tsaliovich
Members-at-Large	Ralph Calcavecchio
	Vernon L. Chartier
	Arthur Heath Light
	John D. Osburn
	Werner Schaefer
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Catherine K.N. Berger
IEEE Standards Project Editor

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

1. Scope

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

2. References

This standard shall be used in conjunction with the following publications. If the following publications are superseded by an approved revision, the revision shall apply.

ANSI C63.4-1992, 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]

ANSI C63.7-1992, American National Standard Guide for Construction of Open-Area Test Sites for Performing Radiated Emission Measurements.

ESD-ADV 1.0-1994 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, Radio Frequency Devices (1990).[3]

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[1]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

[2]ESD publications are available from the Sales Department, ElectroStatic Discharge Association, P.O. Box 913, Rome, NY 13442-0913, USA.

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

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IEC 60050-161 (1990-09), International Electrotechnical Vocabulary. Chapter 161: Electromagnetic compatibility. [4]

IEC 60050-604 (1987-03), International Electrotechnical Vocabulary. Chapter 604: Generation, transmission, and distribution of electricity—Operation.

IEC 60050-826 (1982-01), International Electrotechnical Vocabulary. Chapter 826: Electrical installations of buildings.

IEEE/ASTM SI 10-1997, Standard for Use of the International System of Units (SI)—The Modern Metric System.[5]

IEEE Std 100-1996, IEEE Standard Dictionary of Electrical and Electronics Terms.

IEEE Std 260.1-1993, American National Standard Letter Symbols for Units of Measurement (SI Units, Customary Inch-Point units, and Certain Other Units).

International vocabulary of basic and general terms in metrology [VIM], second edition, 1993. Edited in common by BIPM, IEC, ISO, and OIML.[6]

ISO/IEC Guide 2: 1996, Standardization and related activities—General vocabulary. [7]

ISO/IEC Guide 25: 1990, General requirements for the competence of calibration and testing laboratories.

ITU, International Telecommunication Union Radio Regulations, 1990 ed.[8]

MIL-HDBK-419A-1987, Grounding, Bonding, and Shielding for Electronic Equipments and Facilities. Volumes I (Basic Theory) and II (Applications).[9]

MIL-STD-464, Electromagnetic Environmental Effects—Requirements for Systems, 18 March 1997.

National Telecommunication and Information Administration (NTIA) Manual: Manual of Regulations and Procedures for Federal Radio Frequency Management. May, 1989, with Revisions dated January, 1991.[10]

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).[11]

SAE ARD 50040, (draft) High Intensity Radiated Field (HIRF) Advisory Circular, June 1992.[12]

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[4]IEC publications are available from IEC Sales Department, Case Postale 131, 3, rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse. 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.

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[8]ITU publications are available from the International Telecommunications Union, Place des Nations, CH-1211, Geneva 20, Switzerland.

[9]MIL publications are available from Customer Service, Defense Printing Service, 700 Robbins Ave., Bldg. 4D, Philadelphia, PA 19111-5094.

[10]This publication is available from the Superintendent of Documents, US Government Printing Office.

[11]Information on the availability of NATO STANAGs can be obtained from Headquarters United States Air Force/XOXX-ISO, Washington, DC 20330-5058.

[12]SAE publications are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA.

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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.) In case of variance, this standard takes precedence.

Table 1—Units of quantity

Quantity	SI Unit	Symbol of SI Unit
Capacitance	farad	F
Electric current	ampere	A
Electric filed 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
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 time (T_w)	second	s
Time	second	s
Wavelength	meter	m

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3.2 Multiplying factors and symbols

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

Table 2—Symbols of 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})	—
Nano (10^{-9})	n
Pico (10^{-12})	p
Femto (10^{-15})	f
Atto (10^{-18})	a

3.3 Frequency spectrum designations and symbols

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

Table 3—Symbols of frequency spectrum

Frequency subdivision	Frequency range
ELF (extremely low)	30 Hz–300 Hz
VF (voice)	300 Hz–3 kHz
VLF (very low)	3 kHz–30 kHz
LF (low)	30 kHz– 300kHz
MF (medium)	300 kHz–3000 kHz (3MHz)
HF (high)	3 MHz–30MHz
VHF (very high)	30 MHz–300MHz
UHF (ultra high)	300 MHZ–3000 MHz (3 GHz)
SHF (super high)	3 GHz–30 GHz
EHF (extremely high)	30 GHz–300 GHz
(Undesignated)	300 GHZ–3000 GHz (3 THz)

—From NTIA

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3.4 Abbreviations and acronyms

AMN	Artificial Mains Network (See LISN)
ANSI	American National Standards Institute
BER	bit-error-rate
C-E	communication-electronic
CE	conducted emission
CI	conducted immunity
CISPR	International Special Committee on Radio Interference
CS	conducted susceptibility
dB	decibel
dB(A)	decibels referenced to 1 ampere
dBm	decibels reference to 1 milliwatt
dB(mV)	decibels referenced to 1 microvolt
dB(mV/m)	decibels referenced to 1 microvolt per meter
ECCM	electronic counter-countermeasure
ECM	electronic countermeasure
EFS	electric field strength
EIA	Electrical Industries Association
EIRP	equivalent isotropic radiated power
EM	electromagnetic
EMC	electromagnetic compatibility
EMCP	electromagnetic compatibility program
EMCS	electromagnetic compatibility standardization
EMI	electromagnetic interference
EMCM	electromagnetic compatibility margin
EMP	electromagnetic pulse
EMS	electromagnetic susceptibility
EMV	electromagnetic vulnerability
ERP	effective radiated power
ESD	electrostatic discharge
EUT	equipment under test
EW	electronic warfare
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FIM	field-intensity meter
FSM	field-strength meter
FSVM	frequency-selective voltmeter
GHz	gigahertz
GTEM	gigahertz transverse electromagnetic cell
HERF	hazards of electromagnetic radiation to fuel
HERO	hazards of electromagnetic radiation to ordnance
HERP	hazards of electromagnetic radiation to personnel
HIRF	high intensity radiated field(s)
Hz	hertz
IBW	impulse bandwidth
IEEE	Institute of Electrical and Electronics Engineers
IF	intermediate frequency
IG	impulse generator
IEC	International Electrotechnical Commission
ISM	industrial, scientific, medical
ISO	International Organization for Standardization
kHz	kilohertz
l_e	antenna effective length for electric-field antennas

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l_{em}	antenna effective length for magnetic-field antennas
LAN	local area network
LISN	line impedance stabilization network
MDS	minimum discernible signal
MFS	magnetic field strength
MHz	megahertz
MOV	metal oxide varistor
mW	milliwatt
ms	millisecond
NTIA	National Telecommunications and Information Administration
OATS	open area test site
P	power
PCS	personal communications services
POE	point of entry
ppm	parts per million
PSD	power spectral density
RADHAZ	radiation hazard
RBW	resolution bandwidth
RE	radiated emission
RF	radio frequency
RFI	radio-frequency interference
RI	radio immunity
rms	root mean square
RS	radiated susceptibility
Rx	receiver
TEM	transverse electromagnetic
Tx	transmitter
UPCS	unlicensed personal communications services
ms	microsecond
W	watt
WBTEM	wideband TEM

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. [See IEEE Std 100-1996, and IEC 60050-161 (1990-09), or latest editions thereof.] In case of variance, this standard takes precedence.

4.1 above deck. An area that is generally in the open air on a naval vessel. (NATO STANAG)

4.2 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. *See also:* **fire safety absorber.**

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 power emitted by the appliance or device. [IEC 60050-161 (1990-09)]

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4.5 absorption (radio-wave propagation). The irreversible conversion of the energy of an electromagnetic wave into another form of energy as a result of wave interaction with matter. (IEEE Std 100-1996)

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 accreditation. Procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks. (ISO/IEC Guide 2: 1986)

4.8 accuracy. **(1)** The quality of freedom from mistake or error, that is, of conformity to truth or to a rule. (IEEE Std 100-1996) **(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.

4.9 accuracy of measurement. Closeness of agreement between the result of a measurement and a true value of the measurand. *Notes*—(1) Accuracy is a qualitative concept, the accuracy of a measurement is indeterminate [because the true value is unknowable]. (2) The term "precision" should not be used for "accuracy." (VIM-1993)

4.10 allowable deviation from normal. Changes in indication that are acceptable during a susceptibility test, provided they do not deviate beyond the tolerance given in the individual equipment specification.

4.11 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 100-1996) For example, atmospheric noise, and signals from man-made and other natural sources all contribute to the "ambient level."

4.12 anechoic enclosure [radio frequency (RF)]. An enclosure with internal walls that have low reflection characteristics. (IEEE Std-100 1996)

4.13 antenna. A device designed for radiation or reception of electromagnetic wave energy. (NATO STANAG)

4.14 antenna beamwidth. In a radiation pattern cut in a specific radiation plane 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 100-1996) *See also:* **half-power beamwidth.**

4.15 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 for a given polarization, polarized coincident with the polarization that the antenna would radiate. (IEEE Std 100-1996)

4.16 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 100-1996)

4.17 antenna factor. *See:* **receive antenna factor; transmit antenna factor.**

4.18 antenna gain. The ratio of the radiated field strength, in a given direction, produced by a given antenna, to the radiated field strength that would be obtained if the power accepted by the antenna were radiated isotropically. *Note*—Gain does not include losses arising from impedance and polarization mismatches. When not otherwise specified, the gain figure for an antenna refers to the gain in the direction of the radiation main lobe. In applications using scattering modes of propagation, the full gain of an antenna may not be realizable in practice, and the apparent gain may vary with time. *See also:* **gain** in IEEE Std 100-1996.

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4.19 antenna induced voltage. The voltage that is measured at, or calculated to exist across, the open-circuited antenna terminals.

4.20 antenna pattern. A graphical representation of the radiation properties of the antenna as a function of space coordinates. *Note*—In the usual case the radiation pattern is determined in the far-field region and is represented as a function of directional coordinates. Radiation properties include power flux density, electric or magnetic field strength, phase, and polarization. (IEEE-Std 100-1996). *See also:* **radiation pattern** in IEEE Std 100-1996.

4.21 antenna terminal conducted interference (disturbance). Any undesired conducted voltage or current, generated within a receiver, transmitter, or its associated equipment, appearing at the antenna terminals. *See also:* IEEE Std 100-1996.

4.22 antenna transfer switch. A device used to alternate between the reception of over-the-air RF signals via connection to an antenna and the reception of RF signals received by any other method.

4.23 aperture. An opening, or discontinuity, in an electromagnetic (EM) barrier or shield through which EM fields can penetrate.

4.24 architectural effects. The impact of building architectural construction (e.g., solid metal screens, metal walls, steel reinforcing rods in concrete, window reflection/glare treatments, and metallic cabinets) on the propagation of electromagnetic waves.

4.25 artificial hand. An electric network simulating the impedance of the human body, under average operational conditions, between a hand-held electrical appliance and earth. [IEC 60050-161 (1990-09)]

4.26 assigned frequency band. The frequency band within which the emission of a station is authorized; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance. Where space stations are concerned, the assigned frequency band includes twice the maximum doppler shift that may occur in relation to any point of the earth's surface. (NTIA) (ITU Radio Regulations, 1982 Edition)

4.27 attenuation. The reduction in magnitude (as a result of absorption and scattering) of an electric or magnetic field or a current or a voltage—usually expressed in dB.

4.28 average detector. A detector with an output voltage that is the average value of the envelope of an applied signal. *Note*—The average value must be taken over a specified time interval. [IEC 60050-161 (1990-09)]

4.29 balanced line. A transmission line, consisting of two conductors in the presence of ground, that is capable of being operated in such a way so that the voltages and currents on the two conductors at all transverse planes are equal in magnitude and opposite in phase. (IEEE Std 100-1996)

4.30 balanced voltages (on a balanced line). Voltages relative to ground on the two conductors of a balanced line which, at every point along the line, are equal in magnitude and opposite in polarity. (IEEE Std 100-1996)

4.31 balun. A device for transforming an unbalanced voltage to a balanced voltage or vice-versa. [IEC 60050-161 (1990-09)]

4.32 bandwidth (of a receiver, amplifier or network). The extent of a continuous range of frequencies over which the gain does not differ from its maximum value by more than a specified amount. (NATO STANAG)

4.33 barrier. *See:* **electromagnetic barrier.**

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4.34 baseband. The band of frequencies occupied by the signal before it modulates the carrier (or subcarrier) frequency to form the transmitted line or radio signal. (IEEE Std 100-1996)

4.35 baseband modulation techniques. *See also:* **modulation types.**

a) *Baseband:* The band of frequencies occupied by the signal before it modulates the carrier (or subcarrier) frequency to form the transmitted line or radio signal. (IEEE Std 100-1996)

b) *Composite modulation:* Applying more than one baseband process to a single carrier for the transmission of digital information. It is possible to superimpose pulse-amplitude modulation (PAM) on frequency-shift keying (FSK) or phase-shift keying (PSK) signals as a means of increasing the information throughput rate without significantly increasing the system bandwidth. Likewise, pulse-position modulation (PPM) and pulse-duration modulation (PDM) or PAM and PPM may co-exist in the same channel.

c) *Frequency-shift keying (FSK):* The form of frequency modulation in which the modulating signal shifts the output frequency between predetermined values, and the output wave has no phase discontinuity. (IEEE Std 100-1996)

d) *Phase-shift keying (PSK):* The form of phase modulation in which the modulating function shifts the instantaneous phase of the modulated wave between predetermined discrete values. (IEEE Std 100-1996)

e) *Pulse-amplitude modulation (PAM):*

—Modulation in which the modulating wave is caused to amplitude-modulate a pulse carrier. (IEEE Std 100-1996)

—A baseband modulation technique where an analog waveform is converted to a digital or discrete waveform by successive samples of pulses having amplitudes that are derived from the input waveform.

f) *Pulse-code modulation (PCM):* The type of pulse modulation where the magnitude of the signal is sampled and each sample is approximated to a nearest reference level (this process is called quantizing). Then a code, which represents the reference level, is transmitted to the distant location. The main advantage of PCM is the fact that at the receiving end only the presence or absence of a pulse must be detected. (IEEE Std 100-1996)

g) *Pulse-duration modulation (PDM) or pulse-width modulation (PWM):* Pulse-time modulation in which the value of each instantaneous sample of the modulating wave is caused to modulate the duration of a pulse. *Note*—In PDM, the modulating wave may vary the time of occurrence of the leading edge, the trailing edge, or both edges of the pulse. (IEEE Std 100-1996)

h) *Pulse-position modulation (PPM):* Pulse-time modulation in which the value of each instantaneous sample of a modulating wave is caused to modulate the position in time of a pulse. (IEEE Std 100-1996)

i) *Pulse-time modulation (PTM):* Modulation in which the value of instantaneous samples of the modulating wave are caused to modulate the time of occurrence of some characteristics of a pulse carrier. *Note*—Pulse-duration modulation, pulse-position modulation, and pulse-interval modulation are particular forms of pulse-time modulation. (IEEE Std 100-1996)

4.36 below deck. An area that is generally bounded by metallic walls, or an area that provides an equivalent attenuation to electromagnetic radiation, such as the metal hull or superstructure of a naval vessel. (NATO STANAG)

4.37 bit error rate (BER). The number of erroneous bits divided by the total number of bits over some stipulated period of time. Transmission BER is the number of erroneous bits received versus the total number of bits transmitted. Information BER is the number of erroneous decoded (corrected) bits versus total number of decoded (corrected) bits. The BER is usually expressed in scientific notation, e.g. 2×10^{-5}, etc.

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4.38 bond (noun). The electrical connection between two metallic surfaces established to provide a low resistance (impedance) path between them. (MIL-HDBK-419A-1987)

4.39 bonding. The process of establishing the required degree of electrical continuity between the conductive surfaces of members to be joined. (MIL-HDBK-419A-1987) *See also*: **earthing.**

4.40 bonding jumper. (1) A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected. **(2)** A braided wire or metal strap that provides the necessary electrical conductivity between the unit and structure, which would otherwise not be in sufficient electrical contact.

4.41 broadband emission (EMC). An emission that has a bandwidth greater than that of a particular measuring apparatus or receiver. [IEC 60050-161 (1990-09)]

4.42 broadband interference (disturbance). An undesired emission that has a spectral energy distribution sufficiently broad so that the response of the measuring receiver in use does not vary more than 3 dB when tuned over the frequency range of plus or minus two impulse bandwidths. *See also:* **broadband emission.**

4.43 broadband radio noise. Radio noise having a frequency spectrum broad in width as compared to the nominal bandwidth of the measuring instrument, and having spectral components that are sufficiently close together and uniform so that the measuring instrument cannot resolve them.

4.44 bulk current injection (BCI). A test system in which current is injected on to a cable or cable harness to evaluate system or component immunity.

4.45 burst. A sequence of a limited number of distinct pulses or an oscillation of limited duration. [IEC 60050-161 (1990-09)]

4.46 cable. A lead assembly (wire assembly) of two or more wires, e.g., a power cable has two or more power leads.

4.47 calibration. (1) The comparison of measuring and test equipment (M&TE) or measurement standard of unknown accuracy to a measurement standard of known accuracy in order to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the instrument being compared. **(2)** The set of operations that establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurand. (ISO/IEC Guide 25: 1990)

4.48 calibration laboratory. Laboratory that performs calibrations. (ISO/IEC Guide 25: 1990)

4.49 calibration method. A test or defined technical procedure for performing a calibration. (ISO/IEC Guide 25: 1990)

4.50 carrier power. The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle under conditions of no modulation. This definition does not apply to pulse modulated emissions. (NTIA)

4.51 certification. (1) The procedure by which written assurance is given that a product or service conforms to a standard or specification. **(2)** Procedure by which a third party gives written assurance (certificate of conformity) that a product, process, or service conforms to specified requirement. (ISO/IEC Guide 2: 1986) *See also:* **third party certification.**

4.52 certification mark. The sign or symbol owned or controlled by the certification body that is used exclusively by the third party certification program to identify products or services as being certified. It is

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registered as a certification mark with the U.S. Patent and Trademark Office under the Trade Mark Act of 1946. *Synonym:* mark of conformity.

4.53 certified reference material (CRM). A material that has one or more of its property values certified by a technically valid procedure, and is accompanied by or traceable to a certificate or other documentation that is issued by a certifying body. (ISO/IEC Guide 25: 1990)

4.54 characteristic frequency. A frequency that can be easily identified and measured in a given emission. (NTIA)

4.55 click. (1) A disturbance of a duration less than a specified value when measured under specified conditions. *Note*—For the specified values and conditions, see CISPR publications [B1], [B2], and [B3].[13] **(2)** An electromagnetic disturbance that, when measured in a specified way, has a duration not exceeding a specified value. [IEC 60050-161 (1990-09)]

4.56 click rate. The number of clicks per unit of time, generally per minute, that exceeds a specified level. [IEC 60050-161 (1990-09)]

4.57 commercial off-the-shelf equipment (COTS). Equipment that has been designed and manufactured for commercial applications.

4.58 common-mode (CM) circuit. (sometimes called asymmetric mode) The full current loop or closed circuit for the CM current, including the cable, the apparatus, and the nearby parts of the earthing system.

4.59 common-mode radio noise. Conducted radio noise that appears between a common reference plane (ground) and all wires of a transmission line causing their potentials to be changed simultaneously and by the same amount relative to the common reference plane (ground). (IEEE Std 100-1996)

4.60 communication-electronic (C-E) equipment. Any item intentionally generating, transmitting, conveying, acquiring, storing, processing, or utilizing electronic and electromagnetic information in the broadest sense. Such devices are used to meet a variety of operational requirements such as communications, surveillance, identification, navigation, guided missile control, SONAR, countermeasures, and space operations.

4.61 computing device. *See:* **digital device; information technology equipment (ITE).**

4.62 conducted emission. (1) Electromagnetic energy that is propagated along a conductor. (NATO STANAG) **(2)** Electromagnetic emissions propagated along a metallic conductor, which could be a power line, signal line, and/or an unintentional or fortuitous conductor such as a metallic pipe, etc.

4.63 conducted emission test site. A site that meets specified requirements suitable for measuring radio interference voltages and currents emitted by an equipment under test (EUT).

4.64 conducted interference (disturbance). Undesired electromagnetic energy that is propagated along a conductor, usually defined in terms of a voltage and/or current level.

4.65 conducted radio noise. Radio noise produced by equipment operation that exists on the powerline and interconnecting cables of the equipment, and is measurable under specified conditions as a voltage or current. (Based on IEEE Std 100-1996) *Note*—Radio noise can also be induced by natural sources, such as lightning.

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[13]The numbers in brackets preceded by the letter B correspond to those of the bibliography in Annex A.

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4.66 conducted susceptibility. A measure of the interference signal current and/or voltage required on power, control, and/or signal leads to cause an undesirable response or degradation of performance.

4.67 consensus standard. An object, process, or criterion that is used as a de facto standard by agreement of the vendor and purchaser when no formal, recognized U.S. national standard is available.

4.68 counterpoise (antenna). A system of conductors, elevated above and insulated from the ground, forming a lower system of conductors of an antenna. (IEEE Std 100-1996)

4.69 Crawford cell. A transverse electromagnetic (TEM) cell used as a combination antenna and shielded enclosure based on the concept of an expanded transmission line operating in a TEM mode. TEM cells are better than standard antennas in terms of bandwidth, linear phase response, and accuracy. *See also:* **transverse electromagnetic (TEM) cell.**

4.70 critical point. A point in a system or subsystem considered most susceptible to interference due to sensitivity, inherent susceptibility, importance to mission objectives, or exposure to the electromagnetic environment. The critical point is electrical in nature and normally precedes the subsystem output stage.

4.71 cross coupling (transmission medium). (1) A measure of the undesired power transferred from one channel to another. *See also:* **coupling; transmission line** in IEEE Std 100-1996. **(2)** The undesired coupling between two or more different communication channels, circuit components, or parts.

4.72 cross-modulation. (1) A type of intermodulation due to the modulation of the carrier of the desired signal by an undesired signal wave. (IEEE Std 100-1996) **(2)** Modulation of the carrier of a wanted signal by an unwanted signal, produced by interaction of the signals in non-linear equipment, electrical networks, or transmission media. [IEC 60050-161 (1990-09)]

4.73 crosstalk. An undesired signal disturbance introduced in a transmission circuit by mutual electric (capacitive) or magnetic (inductive) field coupling with other transmission circuits.

4.74 cumulative amplitude probability distribution. A cumulative distribution showing the probability that all amplitudes equal to, or above, a stated value are exceeded as a function of that value. (IEEE Std 100-1996)

4.75 current probe. A device for measuring the current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits. [IEC 60050-161 (1990-09)]

4.76 damage. Permanent malfunction or degradation to a system from electromagnetic interference (EMI) stress, affecting operational effectiveness or suitability to such a degree that critical mission objectives are disrupted until operability restitution and repair are completed.

4.77 damped sinusoidal (DS) waveform. A time-varying, voltage [$v(t)$] or current [$i(t)$] waveform, characterized by a frequency of oscillation (f), exponential damping factor (a), peak amplitude A_0, and phase angle b, as follows:

$$v(t) \text{ or } i(t) = A_0 e^{-at} \sin (2\pi ft + b)$$

4.78 decade. (1) A range of values for which the upper limit is a power of ten above the lower limit. Synonymous with the power of ten. (IEEE Std 100-1996)

4.79 decibel (dB). (general) (1) Ten times the logarithm to base 10 of a ration of two powers. **(2)** One-tenth of a bel, the number of decibels denoting the ratio of the two amounts of power being ten times the logarithm to the base 10 of this ratio. In the following equation, P_1 and P_2 designate two amounts of power, and n

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designates the number of decibels denoting their ratio. P_2 is the reference power level, and P_1 is the calculated or measured power in units referenced to the units of P_2,

$$n = 10 \log_{10}(P_1/P_2) \text{ dB}$$

When the conditions are such that ratios of currents or ratios of voltages (or analogous quantities in other fields) are the square roots of the corresponding power ratios, the number of decibels by which the corresponding powers differ is expressed by the following equations:

$$n = 20 \log_{10}(I_1/I_2) \text{ dB}$$

$$n = 20 \log_{10}(V_1/V_2) \text{ dB}$$

where I_1/I_2 and V_1/V_2 are the given current and voltage ratios, respectively. By extension, these relations between numbers of decibels and ratios of currents or voltages are sometimes applied where these ratios are not the square roots of the corresponding power ratios; to avoid confusion, such usage should be accompanied by a specific statement of the application in question. (Such extensions of the term described should preferably be avoided.) (Based on IEEE Std 100-1996)

4.80 decibels (broadband voltage) referred to one microvolt per megahertz bandwidth [dB(μV/MHz)]. Broadband voltage level expressed in decibels referred to one microvolt per megahertz bandwidth (μV/MHz).

4.81 decibels (current) referred to one microampere [dB(μA)]. Narrowband current level expressed in decibels referred to one microampere (μA).

4.82 decibels (electric field) referred to one microvolt per meter [dB(μV/m)]. Narrowband electric field level expressed in decibels referred to one microvolt per meter (μV/m).

4.83 decibels (impedance) referred to one ohm [dB(ohm)]. Impedance level expressed in decibels referred to one ohm (Ω).

4.84 decibels (magnetic B-field flux density) referred to one picotesla [dB(pT)]. Narrowband magnetic flux density expressed in decibels referred to one picotesla (pT).

4.85 decibels (magnetic H-field intensity) referred to one microampere per meter [dB(μA/m)]. Narrowband magnetic field intensity expressed in decibels referred to one microampere per meter (μA/m).

4.86 decibels (power) referred to one milliwatt [dBm, or dB(mW)]. Narrowband power level expressed in decibels referred to one milliwatt (mW).

4.87 decibels (radiated power density) relative to one milliwatt per square meter [dB(mW/m^2)]. A measure of radiated power density of a narrowband signal referred to one milliwatt per square meter (mW/m^2). *Note*—The power density units shall not be used whenever the power distribution is not uniform across the area measured, such as in the near-field of an antenna.

4.88 decibels (voltage) referred to one microvolt [dB(μV)]. Narrowband voltage level expressed in decibels referred to one microvolt (μV).

4.89 degradation. Any specified condition or parameter that is out-of-tolerance during electromagnetic compatibility (EMC) or other testing.

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4.90 degradation criteria. A military requirement used to define and evaluate malfunctions, unacceptable and undesired responses.

4.91 degradation of performance. An undesired departure in the operational performance of any device, equipment, or system from its intended performance. *Note*—The term "degradation" can apply to temporary or permanent failure. [IEC 60050-161 (1990-09)]

4.92 desensitization. A reduction of the wanted output of a receiver due to an unwanted signal. [IEC 60050-161 (1990-09)]

4.93 differential-mode (DM) circuit. (sometimes called symmetric mode) The full current loop or closed circuit for the intended signal or power, including a cable and the apparatus connected to it at both ends.

4.94 differential-mode radio noise. Conducted radio noise that causes the potential of one side of the signal transmission path to be changed relative to another side. (IEEE Std 100-1996)

4.95 digital device (EMC). (previously defined as a computing device) **(1) (general)** An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer. *Note*—Computer terminals and peripherals that are intended to be connected to a computer are digital devices. (FCC Rules and Regulations Part 15) **(2) (control equipment)** A device that operates on the basis of discrete numerical techniques in which the variables are represented by coded pulses or states. (IEEE Std 100-1996)

4.96 disturbance. *See:* **electromagnetic disturbance.**

4.97 disturbance level. The strength of a given electromagnetic disturbance, measured in a specified way.

4.98 disturbance suppression. Action that reduces or eliminates the electromagnetic disturbance. [IEC 60050-161 (1990-09)]

4.99 double exponential (DE) waveform. A mathematical term or function typically containing two exponential expressions of the form:

$$A(t) = A_o[e^{-at} - e^{-bt}]$$

The above equation is typically used in analysis or simulation to represent or approximate voltage, current, electric field, and magnetic field unipolar transient waveforms as a function of the time parameter, t. The waveform represented is characterized by the values of the amplitude, A_o, and the parameters a and b. Typically, the waveform has a value of zero at $t = 0$, rises relatively sharply to a peak value, and exponentially decays relatively slowly towards zero as t increases indefinitely.

4.100 duplex operation. The operation of transmitting and receiving apparatus at one location in conjunction with associated transmitting and receiving equipment at another location, the processes of transmission and reception being concurrent. *See also:* IEEE Std 100-1996.

4.101 duty cycle. (1) (general) The time interval occupied by a device on intermittent duty in starting, running, stopping, and idling. **(2) (pulse techniques)** The ratio of the pulse duration to the pulse period, of a period pulse train. (IEEE Std 100-1996)

4.102 earth. *See:* **ground.**

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4.103 earth electrode. *See:* **ground electrode.**

4.104 earthing. The process of making a satisfactory electrical connection between the structure (including the metal skin of an object or vehicle) and the mass of the earth, to ensure a common potential with the earth. *See also*: **bonding; grounding**. (NATO)

4.105 earthing conductor. *See:* **grounding conductor.**

4.106 earthing network. *See:* **grounding network.**

4.107 effective radiated power (ERP). **(1)** The product in a given direction of the effective gain of the antenna in that direction over a half-wave dipole antenna, and the antenna power input. *See also:* IEEE Std 100-1996. **(2)** The power supplied to the antenna multiplied by the relative gain of the antenna in a given direction.

4.108 effective isotropically radiated power. *See:* **equivalent isotropically radiated power (EIRP).**

4.109 electroexplosive sub-system. All components required to control, monitor, and initiate an electrically-initiated ordnance/pyrotechnic function. (NATO)

4.110 electromagnetic barrier. A closed, conducting surface, enclosing a volume of space, that has a degree of shielding effectiveness usually measured in decibels (dB) of impenetrability to impinging electromagnetic fields whether by diffusion, radiation, or conductive means. The so-called completely enclosed "Faraday shield" is the ideal case.

4.111 electromagnetic compatibility (EMC). **(1)** The capability of electrical and electronic systems, equipments, and devices to operate in their intended electromagnetic environment within a defined margin of safety, and at design levels of performance without suffering or causing unacceptable degradation as a result of electromagnetic interference. (NATO) **(2)** The ability of a device, equipment, or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment. (IEEE Std 100-1996)

4.112 electromagnetic compatibility analysis. The compilation and interpretation of electromagnetic compatibility data to determine the degree of electromagnetic interference. (NATO)

4.113 electromagnetic compatibility margin (EMCM). The difference between the immunity level of a device, equipment, or system and the emission limit from a disturbing source. [IEC 60050-161 (1990-09)]

4.114 electromagnetic compatibility program (programme). Systematic activities for ensuring the electromagnetic compatibility of a system or equipment. (NATO)

4.115 electromagnetic compatibility program (programme) plan. Description of all organizational and technical activities to achieve electromagnetic compatibility. The plan includes a schedule and a specification of aims and of decision criteria. (NATO)

4.116 electromagnetic compatibility test plan. Description of the tests required in each phase of the electromagnetic compatibility program (programme). (NATO)

4.117 electromagnetic disturbance. Any electromagnetic phenomenon that may degrade the performance of a device, equipment, or system, or adversely affect living or inert matter. [IEC 60050-161 (1990-09)] *Note*—An electromagnetic disturbance may be a noise, an unwanted signal, or a change in the propagation medium itself. (ANSI C63.4-1992)

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4.118 electromagnetic environment (EME). (1) The time distribution of the levels of power, voltage(s), current(s), electric and magnetic field(s), within various frequency ranges of the conducted and radiated electromagnetic emissions that may be encountered in the environment of a system or subsystem when performing its assigned mission. (2) The totality of electromagnetic phenomena existing at a given location. [IEC 60050-161 (1990-09)] (NATO)

4.119 electromagnetic environment effects (E3). The impact of the electromagnetic environment upon the operational capability of electronic or electrical systems, equipments, or devices. It encompasses all electromagnetic disciplines, including the following:

a) Electromagnetic compatibility;
b) Electromagnetic interference;
c) Electromagnetic vulnerability;
d) Electromagnetic pulse;
e) Electronic countermeasures;
f) Hazards of electromagnetic radiation to ordnance and volatile materials;
g) Natural phenomena effects of lightning and precipitation static (p-static). (NATO)

4.120 electromagnetic interference (disturbance). Any conducted or radiated electromagnetic energy that interrupts, obstructs, or otherwise degrades or limits the effective performance of telecommunications or other electrical and electronic equipment.

4.121 electromagnetic interference (EMI). (1) Any electromagnetic disturbance, whether intentional or not, that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronic or electrical equipment. (NATO) (2) Degradation of the performance of an equipment, transmission channel, or system caused by an electromagnetic disturbance. [IEC 60050-161 (1990-09)]

4.122 electromagnetic interference (EMI) control. The control of radiated and conducted energy such that the emissions unnecessary for system, sub-system, or equipment operation are minimized or reduced. Electromagnetic radiated and conducted emissions, regardless of their origin within the equipment, subsystem, or system, are therefore controlled such that they do not cause unacceptable system degradation. Successful EMI control, along with susceptibility control, leads to electromagnetic compatibility (EMC).

4.123 electromagnetic interference emission. Any conducted or radiated emission that may cause system or subsystem degradation.

4.124 electromagnetic pulse (EMP). The electromagnetic radiation caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium as a result of a nuclear explosion or lightning. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges. *See also:* **nuclear electromagnetic pulse.**

4.125 electromagnetic radiation. (1) The emission of electromagnetic energy from a finite region in the form of unguided waves. (IEEE Std 100-1996) (2) The phenomenon by which energy in the form of electromagnetic waves emanates from a source into space. (3) Energy transferred through space in the form of electromagnetic waves. *Note*—By extension, the term "electromagnetic radiation" is sometimes used to include induction phenomena. [IEC 60050-161 (1990-09)]

4.126 electromagnetic radiation hazard (EMRADHAZ). A condition that would expose personnel, equipment, munitions, or fuel to a dangerous level of electromagnetic radiation. The electromagnetic energy is of sufficient intensity to cause sparking, ignition of volatile combustibles, harmful biological effects on humans, inadvertent operation of electro-explosive devices, or failures or progressive degradation in safety critical circuits. (NATO)

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4.127 electromagnetic susceptibility. The inability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance. *Note*—Susceptibility is a lack of immunity. [IEC 60050-161 (1990-09)]

4.128 electromagnetic vulnerability (EMV). The characteristics of a system, equipment, or device that cause it to suffer degradation in performance of, or inability to perform, its specified task as a result of electromagnetic interference. (NATO)

4.129 electromagnetic waves. A propagating energy phenomenon resulting when there are two forms of energy, specifically in electric and magnetic field components, whereby the time rate of change of one component leads to a time change of the other—specifically, change in magnetic flux density as a function of time produces a time-change in the associated electric field, and vice versa.

4.130 electrostatic discharge (ESD). **(1)** A transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact. [IEC 60050-161 (1990-09)] **(2)** The rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field. *Note*—Usually, the charge flows through a spark between two bodies at different electrostatic potentials as they approach one another. Details of such processes, such as the rate of the charge transfer, are described in specific electrostatic discharge models. *See also:* Glossary—ESD-ADV 1.0-1994.

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

4.132 EMC assurance. Those inspection, test, and evaluation procedures and activities performed during design, development, production, and installation that confirm the efficacy and suitability of the EMC hardening of products, and technical documentation. A consistent subset of quality assurance.

4.133 emission. Electromagnetic energy propagated from a source by radiation or conduction. (The phenomenon by which electromagnetic energy emanates from a source.)

4.134 emission bandwidth (B). The width in Hertz of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. It is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth (RBW) approximately equal to 1.0 percent of the emission bandwidth of the device under measurement. (FCC)

4.135 emission control. Selective control of emitted electromagnetic or acoustic energy. The aim can be twofold:

a) To minimize the enemy's detection of emissions and exploitation of the information so gained, or
b) To improve the performance of friendly sensors. (NATO)

4.136 emission spectrum. The distribution of the amplitude (and sometimes phase) of the components of an emission as a function of frequency.

4.137 equipment. Any electrical, electronic, or electromechanical device, or collection of items intended to operate as an integral unit to perform a singular function.

4.138 equipment arrangement. Equipment locations used during the maximization process. (ANSI C63.4-1992)

4.139 equipment configuration. Equipment units chosen to be the equipment under test (EUT). (ANSI C63.4-1992)

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4.140 equipment under test (EUT). (1) The device, equipment, subsystem, or system to be tested or under test. (2) A device or system used for evaluation that is representative of a product to be marketed.

4.141 equipotential bonding. Electrical connection putting various exposed conductive parts and extraneous conductive parts at an equal potential.

4.142 equipotential bonding conductor. A protective conductor for ensuring equipotential bonding. *See also:* **bonding jumper.**

4.143 equipotential ground plane. (1) A ground reference scheme used for high frequencies to minimize common impedance coupling. (2) A grid, sheet, mass, or masses of conducting material that, when bonded together, offer a negligible impedance to current flow. (MIL-HDBK-419A-1987)

4.144 equivalent isotropically radiated power (EIRP). (1) In a given direction, the gain of a transmitting antenna multiplied by the net power accepted by the antenna from the connected transmitter. (IEEE Std 100-1996) (2) The product of the power of an emission as supplied to an antenna and the antenna gain in a given direction relative to an isotropic antenna. *Synonym:* effective isotropically radiated power.

4.145 error rate (bit, block, character, element). The ratio of the number of characters of a message incorrectly received to the number of characters of the message received. *See also:* **bit error rate (BER).**

4.146 facility ground system. The electrically interconnected system of conductors and conductive elements that provides multiple current paths to earth. The facility ground system includes the earth electrode subsystem, lightning protection subsystem, signal reference subsystem, fault protection subsystem, as well as the building structure, equipment racks, cabinets, conduit, junction boxes, raceways, ductwork, pipes, and other normally noncurrent-carrying metal elements. (MIL-HDBK-419A-1987)

4.147 facsimile. (1) A process, or the result of the process, by which fixed graphic material, including text, pictures and/or images, is scanned and the information converted to signal waves that are used either locally or remotely to produce, in record form, a likeness (facsimile) of the subject copy. (2) A system of telecommunication for the transmission of fixed images, with or without half-tones, with a view to their reproduction in permanent form.

4.148 Faraday shield. An electrostatic shield, ideally a continuous electrical conductor, enclosing a circuit or a system.

4.149 far-field. The distance between two directional antennas equal to D^2/λ or 3λ, whichever is larger, where D is the maximum aperture dimension of the largest antenna, and λ is the wavelength at the fundamental frequency. If the test antenna aperture (D_2) is larger than one-tenth of the aperture (D_1) of the antenna being measured, then the minimum test site distance is $(D_1 + D_2)^2/\lambda$. This is the minimum range that will yield a satisfactory approximation of the far-field pattern. For directional antennas—these formulas apply primarily to the on-axis distance required to be in the far-field of the main beam. Generally, the required distance decreases as a function of the angle off the main beam axis.

4.150 far-field region. For land-mobile communications transmitters, the region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. *Notes*—(1) If the antenna has a maximum overall dimension, D, that is large compared to the wavelength, the far-field region is commonly taken to exist at distances greater than $2D^2/\lambda$ from the antenna, λ being the wavelength. For directional antennas, these formulas apply primarily to the on-axis distance required to be in the far-field of the main beam. Generally, the required distance decreases as a function of the angle off the main beam axis. (2) For an antenna focused at infinity, the far-field region is sometimes referred to as the Fraunhofer region. *See also:* IEEE Std 100-1996.

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4.151 field disturbance sensor. A device that employs a point source of RF energy to detect motion in the vicinity of the source, and in which the emitter and the receiver (or detector) are essentially at the same point, that is, a space protected system. (ANSI C63.4-1992)

4.152 field strength. A general term that usually means the magnitude of the electric field vector, commonly expressed in volts per meter, but may also mean the magnitude of the magnetic H-field vector, commonly expressed in amperes per meter (or ampere turns per meter). *See also:* IEEE Std 100-1996.

4.153 field strength meter. A calibrated radio receiver for measuring field strength. *See also:* IEEE Std 100-1996.

4.154 fire safety absorber. Absorber material that corresponds to Fire Safety Specifications.

4.155 fixed elevation antenna. An antenna used at a single selected elevation angle and/or antenna height with respect to an elevation angle and/or height reference.

4.156 flicker. Impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time. [IEC 60050-161 (1990-09)]

4.157 frequency allocation. Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more (terrestrial or space) radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned. (NTIA revised 1/90) (ITU Radio Regulations, 1982 Edition)

4.158 frequency assignment. (1) Assignment of a radio frequency or radio frequency channel. **(2)** Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions. (NTIA revised 1/90) (ITU Radio Regulations, 1982 Edition)

4.159 frequency-selective voltmeter (FSVM). A (frequency) selective radio receiver, with provisions for output indication. (Based on IEEE Std 100-1996)

4.160 frequency tolerance. The maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned frequency, or by the characteristic frequency of an emission from the reference frequency. The frequency tolerance is usually expressed in parts per million (parts in 106) or in hertz (Hz). (NTIA)

4.161 gasket (RF). A flexible component made of electrically conductive material, used to form a low impedance connection between two pieces of electrically conductive materials to seal an aperture in a conductive enclosure.

4.162 gigahertz transverse electromagnetic (GTEM) cell. A tapered TEM cell/anechoic chamber hybrid intended for general radiated emissions and susceptibility testing. It is designed to be useful over the entire range of typical electromagnetic compatibility (EMC) test frequencies; exhibit a precise, uniform field over the recommended test volume; provide high sensitivity with minimal background noise; and provide good correlation to standard type ground screen measurements. *See also:* **wideband TEM device.**

4.163 ground. (1) The conductive mass of the earth, which has an electric potential at any point that is conventionally taken as equal to zero. [IEC 60050-161 (1990-09)] **(2)** A conducting connection, whether intentional or accidental between an electrical circuit and the earth, or to some conducting body that serves in place of earth. **(3)** The position or portion of an electrical circuit at zero potential with respect to the earth. **(4)** A conduction body, such as the earth or the hull of a steel ship, used as a return path for electric currents and as an arbitrary zero reference point. (ESD-ADV 2.0-1994) *Synonym:* earth.

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4.164 ground electrode. A conductive part or a group of conductive parts in intimate contact with and providing an electrical connection with earth (ground). [IEC 60050-161 (1990-09)] *Synonym:* earth electrode.

4.165 grounding. (1) The bonding of an equipment case, frame, or chassis to an object or a vehicle structure to ensure a common potential. (NAT0) (2) The connecting of an electric circuit or equipment to earth or to some conducting body of relatively large extent, which serves in place of earth. *See also:* **earthing.**

4.166 grounding conductor. A protective conductor connecting the main earthing (grounding) terminal or bar to the earth (ground) electrode. [IEC 60050-161 (1990-09)] *Synonym:* earthing conductor.

4.167 grounding network. The part of an earthing (grounding) installation that is restricted to the earth (ground) electrodes and their interconnections. [IEC 60050-161 (1990-09)] *Synonym:* earthing network.

4.168 ground plane. A conducting surface or plate used for equipment as a common reference for circuit returns and electric or signal potentials, and that reflects electromagnetic waves. Specifically: ground (reference) plane. A flat conductive surface having a potential that is used as a common reference. [IEC 60050-161 (1990-09)]

4.169 GTEM cell. *See* **gigahertz transverse electromagnetic (GTEM) cell; wideband TEM device.**

4.170 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 100-1996)

4.171 harden (EMC). To reduce the susceptibility of an equipment, system, or facility to electromagnetic environmental effects. The reduction in susceptibility is normally measured in dB.

4.172 harmonic emission. Electromagnetic radiation from a transmitter or local oscillator that is not part of the information signal, but has a frequency that is an integral multiple of the carrier frequency.

4.173 hazards of electromagnetic radiation to fuel (HERF). Potential for electromagnetic radiation to cause spark ignition of volatile combustibles, such as aircraft fuel.

4.174 hazards of electromagnetic radiation to ordnance (HERO). Potential for munitions or electroexplosive devices to be adversely affected by electromagnetic radiation.

4.175 hazards of electromagnetic radiation to personnel (HERP). Potential for electromagnetic radiation to produce harmful biological effects in humans.

4.176 hertz. The unit of frequency equal to one cycle per second. (IEEE Std 100-1996)

4.177 high altitude electromagnetic pulse (HEMP). The electromagnetic pulse produced by an exoatmospheric nuclear explosion.

4.178 high intensity radiated fields (HIRF). The electromagnetic environment that exists due to the transmission of very strong electromagnetic energy into free space. The HIRF envelope is the characterization of this electromagnetic environment in airspace in which civil aircraft are permitted to operate. (SAE ARD50040 and NATO STANAG)

4.179 horizontal polarization. An electromagnetic wave is horizontally polarized if the magnetic field vector is in the incidence plane and the electric field vector is perpendicular to the incidence plane; thus, parallel to the ground plane (usually the earth's surface).

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4.180 host. A device to which other devices (peripherals) are connected and that generally controls those devices.

4.181 ideal site. A test site on which the reflective surface is perfectly flat and has infinite conductivity and size.

4.182 image frequency. This applies to heterodyne frequency converters, in which one of the two sidebands produced by beating is selected. Also refers to an undesired input frequency capable of producing the selected frequency by the same process. *Note*—The word image implies the mirror-like symmetry of signal and image frequencies about the beating oscillator frequency or the intermediate frequency, whichever is the higher. *See also:* **radio receiver.** *See also:* **frequency, image** in IEEE Std 100-1996.

4.183 image rejection. Response of a superheterodyne receiver to the image frequency, as compared to the response to the desired frequency. *See also* **image response**.

4.184 image response. The response of a superheterodyne receiver to the image frequency, as compared to the response of the desired frequency. This is often expressed in dB. *See also:* IEEE Std 100-1996.

4.185 immunity (to a disturbance). The ability of a device, equipment, or system to perform without degradation in the presence of an electromagnetic disturbance. [IEC 60050-161 (1990-09)]

4.186 impedance control point (ICP). The physical point along a power lead at which the impedance is controlled. The impedance is measured between this point and the ground plane.

4.187 impulse. (1) An electrical pulse of short duration relative to a cycle at the highest frequency being considered. Mathematically, it is a pulse of infinite amplitude, infinitesimal duration, and finite area. Its spectral energy density is proportional to its volt-time area, and is uniformly and continuously distributed through the spectrum up to the highest frequency at which it may be considered an impulse. Regularly repeated impulses of uniform level will generate a uniform spectrum of discrete frequencies (Fourier components) separated in frequency by an amount equal to the repetition frequency. **(2)** A pulse that, for a given application, approximates a unit pulse or a Dirac delta function. [IEC 60050-161 (1990-09)]

4.188 impulse bandwidth. The ratio of the maximum value of the voltage at the output of a network (when properly corrected for network sinewave gain at the stated reference frequency) to the spectrum amplitude of the pulse applied at the input. In networks with a single-humped response, the reference frequency is taken as that at which the gain is maximum. *Note*—For a spectrum analyzer, the peak value of the time response envelope divided by the spectrum amplitude (assumed flat within the bandpass) of an applied pulse. *See also:* IEEE Std 100-1996.

4.189 impulse emission. An emission characterized by transient disturbances separated in time by quiescent intervals. *Synonym:* impulsive noise.

4.190 impulse generator. A standard reference source of broadband impulse energy. (IEEE Std 100-1996)

4.191 impulse strength or spectrum amplitude. (1) The root mean square (rms) unmodulated sine wave voltage, at the tuned frequency, required to produce in a circuit a peak response equal to that produced by the impulse in question, divided by the impulse bandwidth of the circuit. For the purpose of this standard, it is expressed in terms of microvolts per megahertz (V/MHz) or dB microvolts per megahertz (dB V/MHz). **(2)** The area under the amplitude-time relation for the impulse. (IEEE Std 100-1996)

4.192 impulsive noise. Noise that, when incident on a particular equipment, manifests itself as a succession of distinct pulses or transients. [IEC 60050-161 (1990-09)] *See also:* **impulse emission.**

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4.193 incidental radiation device. A device that generates radio frequency energy during the course of its operation, even though the device is not intentionally designed to emit or radiate this energy.

4.194 industrial radio frequency (RF) heating equipment. Any apparatus that generates and uses radio frequency energy for, or in connection with, industrial heating operations in a manufacturing or production process.

4.195 industrial, scientific, and medical (ISM) equipment. Apparatus intended for generating radio-frequency energy for industrial, scientific, or medical purposes. (IEEE Std 100-1996)

4.196 industrial, scientific, medical (ISM) qualifier. Qualifies equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic, or similar purposes, excluding applications in the field of telecommunications. [IEC 60050-161 (1990-09)]

4.197 information technology equipment (ITE). Equipment designed for the purpose of:

a) Receiving data from an external source (such as data input line or via a keyboard);

b) Performing some processing functions on the received data (such as computation, data transformation or recording, filing, sorting, storage, or transfer of data); and

c) Providing a data output either to other equipment or by the reproduction of data or images).

Note—This definition includes electrical or electronic units or systems that predominantly generate a multiplicity of periodic binary pulsed electrical or electronic waveforms and are designed to perform data processing functions such as word processing, electronic computation, data transformation, recording, filing, sorting, storage, retrieval and transfer, and reproduction of data as images. [IEC 60050-161 (1990-09)]

4.198 insertion loss. Resulting from the insertion of a transducer in a transmission system, the ratio of (A) the power delivered to that part of the system following the transducer, before insertion of the transducer, to (B) the power delivered to that same part of the system after insertion of the transducer. It is generally expressed as a ratio in decibels (dB). *Note*—If the input or output power, or both, consist of more than one component, such as multifrequency signal or noise, then the particular components used and their weighting are specified. (IEEE Std 100-1996)

4.199 in-situ testing. The process of performing electromagnetic interference (EMI) testing in an area where the equipment to be evaluated is normally installed or operated. This type of testing necessarily includes the effects of the environment as well as electromagnetic wave reflections due to structures and other objects.

4.200 interconnecting cable. Any lead assembly external to subsystems or equipment enclosures that provide functions other than power distribution. Subsets are:

a) *Power cable.* Any lead assembly providing primary power.

b) *Signal cable.* Any lead assembly interconnecting functions other than power.

4.201 intermodulation. The mixing of two or more signals in a nonlinear element to produce signals at new frequencies that are sums and differences of the input signals or their harmonics. The nonlinear element(s) may be internal to the system, subsystem, or equipment, or may be some external device(s).

4.202 intersystem electromagnetic compatibility. The condition that enables a system to function without perceptible degradation due to electromagnetic sources from another system, while preventing interference to other systems.

4.203 intrasystem electromagnetic compatibility. The condition that enables the various portions of a system to function without perceptible degradation due to electromagnetic sources in other portions of the same system, while preventing interference to other portions of the system.

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4.204 ionospheric scatter. The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the ionosphere. (NTIA)

4.205 isotropic antenna. A hypothetical, lossless antenna that radiates or receives energy of all polarizations equally well in all directions. An isotropic antenna is a lossless, point-source used as the theoretical reference to describe the absolute gain of a real antenna. *See also:* **isotropic radiator** in IEEE Std 100-1996.

4.206 jitter. (1) Short time instability of a signal. The instability may be in either amplitude or phase, or both. **(2)** A random departure from regular repetition. *See also:* **phase jitter; time jitter.**

4.207 laboratory. Body that calibrates and/or tests. (ISO/IEC Guide 25: 1990)

4.208 lead. One wire of a cable, cord, or bundle.

4.209 lightning electromagnetic pulse (LEMP). The electromagnetic radiation associated with a lightning discharge. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges. (NATO)

4.210 lightning surge. A transient electric disturbance in an electrical/electronic circuit caused by a lightning discharge.

4.211 line impedance stabilization network (LISN). A network inserted in the supply mains lead of apparatus to be tested that provides, in a given frequency range, a specified load impedance for the measurement of disturbance voltages, and that may isolate the apparatus from the supply mains in that frequency range.

4.212 low-power communication device. A restricted radiation device, exclusive of those employing conducted or guided radio frequency techniques, used for the transmission of signs, signals (including control signals), writing, images and sounds of intelligence of any nature by radiation of electromagnetic energy. Examples of such devices include cordless telephones, wireless microphones, phonograph oscillators, radio-controlled garage door openers, and radio-controlled models. (NTIA)

4.213 low-voltage electrical and electronic equipment. Electrical and electronic equipment with operating input voltages of up to 600 Vdc or 600 V root-mean-square (rms) ac. (ANSI C63.4-1992)

4.214 main earthing terminal. *See:* **main grounding terminal.**

4.215 main grounding terminal. A terminal or bar provided for the connection of protective conductors, including equipotential bonding conductors and conductors for functional earthing (grounding), if any, to the means of earthing (grounding). [IEC 60050-161 (1990-09)] *Synonym:* main earthing terminal.

4.216 malfunction (EMC). A failure of a system or associated subsystem/equipment due to electromagnetic interference or susceptibility that results in system damage, personal injury, permanent unacceptable reduction in system effectiveness, or degradation of performance.

4.217 malfunction level response. A deviation from the standard reference output that could cause (or indicate) a malfunction.

4.218 margin (EMC). The difference between the electromagnetic level in the environment wherein a system operates and the maximum electromagnetic (EM) level that will not result in an undesirable response in that system. Margins are usually expressed in dB and shall be provided based on system operational performance requirements, tolerances in system hardware, and uncertainties involved in verification of system-level design requirements. (MIL-STD-464, 1997.) *See also:* **safety margin.**

4.219 mark of conformity. *See:* **certification mark.**

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4.220 mean power. (1) The magnitude of power averaged over a specified interval of time. (2) The power supplied to the antenna transmission line by a transmitter during normal operation, averaged over a time sufficiently long compared with the period of the lowest frequency encountered in the modulation. A time of 0.1 second during which the mean power is greatest will be selected normally. (NTIA)

4.221 measurement standards. Those devices used to calibrate measuring and test equipment (M&TE) or other measurement standards and provide traceability to NIST standards.

4.222 measuring and test equipment (M&TE). Any device used to measure, gauge, test, inspect, or otherwise determine compliance of electric or electronic devices with prescribed technical requirements.

4.223 medical diathermy equipment. Any apparatus (other than surgical diathermy apparatus designed for intermittent medical operation with low power) that generates and uses radio frequency energy for therapeutic purposes.

4.224 midpulse minimum visible signal (MPMVS). The minimum input pulse signal power level that permits visibility of the center of the output pulse. This level is obtained in the same manner as the minimum visible discernible signal (MVS).

4.225 minimum discernible signal (MDS). *See:* **susceptibility threshold.**

4.226 mode stirred chamber. (1) An electromagnetic reverberation chamber (e.g., a non-anechoic shielded chamber) used to generate an average, uniformly homogeneous electromagnetic field that is achieved by rotating an irregularly-shaped mode stirrer or tuner. (2) A shielded enclosure in which the internal resonance's are utilized to enhance immunity and emission testing. *Synonym:* reverberation chamber.

4.227 modulation types.

a) *Amplitude modulation (AM):* The process by which a continuous wave (carrier) is caused to vary in amplitude by the action of another wave containing information. (IEEE Std 100-1996)

b) *Continuous wave (CW):* Waves, the successive oscillations of which are identical under steady-state conditions. (IEEE Std 100-1996)

c) *Digital modulation (DM):* The process by which the characteristics of a carrier wave are varied among a set of predetermined discrete values in accordance with a digital modulating function.

d) *Double sideband (DSB):* AM transmission accompanied by both sidebands. The carrier may or may not be suppressed.

e) *Frequency modulation (FM):* The cyclic or random dynamic variation, or both, of instantaneous frequency about a mean frequency during steady-state electric system operation. (IEEE Std 100-1996)

f) *Independent sideband (ISB):* AM with the carrier either suppressed or reinserted, accompanied by both sidebands, each of which contains separate information.

g) *Phase modulation (PM):* Angle modulation in which the angle of a carrier is caused to depart from its reference value by an amount proportional to the instantaneous value of the modulating function. (IEEE Std 100-1996)

h) *Single sideband (SSB):*

—AM in which one sideband is transmitted and the other sideband is suppressed. The carrier wave may be either transmitted or suppressed.

—Modulation whereby the spectrum of the modulating function is translated in frequency by a specified amount either with or without inversion. (IEEE Std 100-1996)

4.228 monitor point. Describes one or more points in a system or subsystem used to observe or measure responses of the system or subsystem. Monitor points for determining unacceptable response shall be at the system or subsystem output and need not be electrical in nature. Monitor points used in conjunction with

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critical points to determine that no inadvertent response exists may be located at either internal system points or at the system or subsystem output. If monitor points are chosen at internal subsystem locations, particular caution must be exercised to insure that the monitoring instrumentation does not influence the test results.

4.229 multipoint ground. A scheme of circuit/shield/enclosure grounding at various points to an equipotential ground reference (such as a ground plane) used for high frequencies so as to minimize common impedance coupling.

4.230 narrowband emission (EMC). An emission that has a bandwidth less than that of a particular measuring apparatus or receiver. *Synonym:* narrowband interference.

4.231 narrowband interference. *See:* **narrowband emission.**

4.232 National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NAVLAP). An accreditation of laboratories by NIST based upon their ability to perform specific testing methods. This includes an evaluation of proper test equipment and calibration, qualifications of test personnel, procedures for handling test samples, record keeping, test report preparation, and proficiency testing as applicable in certain areas.

4.233 National Institute of Standards and Technology (NIST) traceability. The process by which the determined value of a measurement is compared, directly or indirectly, through a series of analytical and/or laboratory calibrations, including a comprehensive analysis and determination of the cumulative error of each successive comparison, to the value that would be obtained if the measurement had been determined by using the primary national standard established by NIST for that type of measurement. (ANSI) *Note*—Ascertaining NIST traceability using antenna calibration as an example: The requirement to show traceability of all antenna calibrations to NIST does not necessarily mean that all antennas must be individually calibrated by NIST. In fact, there are several ways to demonstrate the required traceability to NIST. For example, an antenna could be calibrated by the owner or an independent agency using a technique that is recognized to be reliable and theoretically correct, such as the well-known three-antenna method. If one can show traceability of the instrumentation used in this procedure (such as signal generators and RF voltage standards) to primary voltage standards at NIST, then one can establish traceability of the antenna calibration to NIST. It is also possible for a user to calibrate an antenna by comparing its performance with a "check standard" that has been calibrated by NIST, if it can be demonstrated that this check standard is stable and repeatable. However, it is desirable that the standard technique and equipment employed be specifically traceable to NIST standards.

4.234 near-field regions.

a) *Radiating:* That portion of the near-field region, wherein the angular field distribution is dependent upon distance from the antenna. *Notes*—(1) If the antenna has a maximum overall dimension that is not large compared to the wavelength, this field region may not exist. (2) For an antenna focused at infinity, the radiating near-field region is sometimes referred to as the Fresnel region on the basis of analogy to optical terminology. (IEEE Std 100-1996)

b) *Reactive:* That portion of the near-field region immediately surrounding the antenna, wherein the reactive field predominates. *Note*—For a very short dipole, or equivalent radiator, the outer boundary is commonly taken to exist at a distance l/2p from the antenna surface, where l is the wavelength. (IEEE Std 100-1996)

4.235 necessary bandwidth. For a given class of emission, the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed under specified conditions. Emissions useful for the good functioning of the receiving equipment as, for example, the emission corresponding to the carrier of reduced carrier systems, shall be included in the necessary bandwidth. (NTIA) The necessary bandwidth can be narrower or wider than the occupied bandwidth. *See also:* **emission bandwidth.**

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4.236 neutral conductor (N). A conductor connected to the neutral point of a system and capable of contributing to the transmission of electrical energy.

4.237 normalized site attenuation (NSA). Site attenuation divided by the antenna factors of the radiating and receiving antennas (all in linear units).

4.238 nuclear electromagnetic pulse (NEMP). The electromagnetic radiation caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium as a result of a nuclear explosion. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges. (NATO)

4.239 occupied bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission. In some cases, for example multichannel frequency division systems, the percentage of 0.5 may lead to certain difficulties in the practical application of the definition of occupied bandwidth; in such cases a different percentage may prove useful. (NTIA) *See also:* **occupied bandwidth (radio noise emissions)** in IEEE Std 100-1996.

4.240 octave. In electric communication, the interval between two frequencies having a ratio of 2 to 1. (IEEE Std 100-1996)

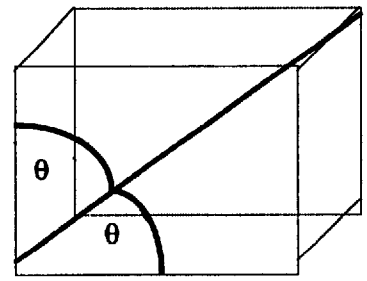
4.241 open-area test site (OATS). A site for electromagnetic measurements that has a reflective ground plane, and is open, flat terrain at a distance far enough away from buildings, electric lines, fences, trees, underground cables, pipelines, and other potential reflective objects, so that the effects due to such objects are negligible. *See also:* ANSI C63.7-1992 for guidance on the construction of open area test sites.

4.242 operate. The ability of an equipment, subsystem, or system to perform its intended function, without unacceptable degradation, while exposed to the electromagnetic environment.

4.243 operational environment. The aggregate of all conditions and influences that may affect the operation of a system.

4.244 ortho-angle. The angle that the diagonal of a cube makes to each side at the trihedral corners of the cube. This angle is widely used in transverse electromagnetic (TEM) device testing because its coefficients give a vector sum of unity when three orthogonal readings are made and summed.

When applied to a TEM device, the ortho-angle may alternately be described as the angle of a ray passing through the center of the test volume of the cell, such as that its azimuth is 45° to the centerline of the TEM device and its elevation is 45° above the horizontal plane of the TEM device. Thus, it is 54.7° to the edges of each face of a cube centered in the test volume. This assumes that the cube in question is aligned with the Cartesian coordinate system of the TEM device. *Note*—When associated with the equipment under test (EUT), this angle is usually referred to as the ortho-axis.



Ortho Angle (θ)
54.7 degrees

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4.245 out-of band emission. (1) Emission of a frequency or frequencies outside a specified frequency range. (2) Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions. (ITU)

4.246 parasitic emission. Electromagnetic radiation from a transmitter that is not part of the information signal or harmonically related to the carrier, but is caused by undesired oscillations due to parasitic resonances in the circuitry.

4.247 parasitic oscillation. An unwanted oscillation produced in equipment at a frequency independent both of the operating frequencies and of frequencies related to the generation of desired oscillations. [IEC 60050-161 (1990-09)]

4.248 peak detector. A detector, the output voltage of which is the true peak value of an applied signal or noise. *See also:* IEEE Std 100-1996.

4.249 peak envelope power. The average power delivered to the antenna transmission line by a transmitter during one radio frequency cycle at the highest crest of the modulation envelope, taken under conditions of normal operations. (NTIA)

4.250 peripheral device. A digital accessory that feeds data into or receives data from another device (host) that, in turn, controls its operation. (ANSI C63.4-1992)

4.251 phase jitter. The phenomenon, from causes known or unknown, that results in a relative shifting in the phase of the signal. The shifting in phase may appear to be random, cyclic, or both. The amount of phase jitter may be expressed in degrees with any cyclic component expressed in hertz.

4.252 phase lock loop. (1) A circuit that, normally, automatically controls an oscillator so that it remains in a fixed phase relationship with a reference signal. The phase lock loop is used in a variety of applications such as tracking filters and frequency discriminators. (2) A circuit for synchronizing a variable local oscillator with the phase of a transmitted signal. (IEEE Std 100-1996)

4.253 photon noise. (fiber optics) Noise attributable to the discrete or particle nature of light. *See also:* **quantum noise** in IEEE Std 100-1996.

4.254 plane wave. (1) A wave with equiphase surfaces that form a family of infinite parallel planes normal to the direction of propagation. (2) A wave in which the only spatial dependence of the field vectors is through a common exponential factor having an exponent that is a linear function of position. (IEEE Std 100-1996) (3) A wave in which the wave fronts are everywhere parallel planes normal to the direction of propagation.

4.255 point of entry (or exit) (POE). A localized critical point of a system resulting in appreciable propagation of energy to, or from, the system, subsystem, or equipment.

4.256 port. A place of access to a device or network where energy may be supplied or withdrawn, or where the device or network variables may be observed or measured.

4.257 power. The rate of generating, transferring, or using energy. (IEEE Std 100-1996) The basic unit is the watt, or joule per second.

4.258 power density. (1) Of a traveling wave, the time-average value of the Poynting vector. (2) Emitted power per unit cross-sectional area normal to the direction of propagation. (IEEE Std 100-1996)

4.259 precipitation static (P-static). (1) Electromagnetic interference effects primarily on antenna-connected receivers caused by corona discharge at sharp edges or points of structure, arcing across non-conduc-

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tive surfaces, and arcing between conductive joints or panels which are not electrically bonded. (NATO) **(2)** Electromagnetic disturbance caused by the (random) electrostatic discharge created as a result of the potential buildup caused by the charge (electron) transfer between air, moisture, and airborne particles and the structure of a vehicle moving in the atmosphere such as an aircraft or spacecraft.

4.260 probability density function. The first derivative of the probability distribution function; it represents the probability of obtaining a given value. (IEEE Std 100-1996) *Note*—The function in question is assumed to satisfy proper mathematical conditions such that the derivative can be defined.

4.261 proficiency testing. Determination of the laboratory or testing performance by means of interlaboratory comparisons.

4.262 pulse. An abrupt variation of short duration of a physical quantity followed by a rapid return to the initial value. [IEC 60050-161 (1990-09)]

4.263 pulsed current injection (PCI). A test method for measuring performance of a point of entry of a protective device on a penetrating conductor. A threat-relatable transient is injected on the penetrating conductor at a point outside of an electromagnetic barrier, and the residual internal transient stress is measured inside the barrier.

4.264 pulse duration (pulse width, pulse length). The duration between the 50% amplitude points on the leading edge and the trailing edge of the pulse, unless otherwise specified. (The 10% amplitude points are also often used.)

4.265 pulse rise time. The interval between the instant at which the instantaneous amplitude first reaches specified lower and upper limits, namely, 10% and 90% of the peak pulse amplitude, unless otherwise stated. (IEEE Std 100-1996)

4.266 quality manual. A document stating the quality policy, quality system, and quality practices of an organization. (ISO/IEC Guide 25: 1990)

4.267 quality system. The organizational structure, responsibilities, procedures, processes, and resources for implementing quality management. (ISO/IEC Guide 25: 1990)

4.268 quasi-peak detector. A detector having specified electrical time constants that, when regularly repeated pulses of constant amplitude are applied to it, delivers an output voltage that is a fraction of the peak value of the pulses, the fraction increasing towards unity as the pulse repetition rate is increased. [IEC 60050-161 (1990-09)] *See also:* IEEE Std 100-1996.

4.269 quiet zone. The region in an anechoic shielded enclosure where the reflectivity is controlled to a design level.

4.270 RF gasket. A flexible electrically conductive material used to seal an aperture of an enclosure. *See also:* **gasket.**

4.271 radar. A system that detects targets by radiating electromagnetic energy and detecting the echo of the radiated wave returned as a reflection from the target. (The nature of the echo signal provides information about the target.)

4.272 radar absorbing material (RAM). *See:* **absorber.**

4.273 radar altimeter. *See:* **radio altimeter.**

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4.274 radar cross section (RCS). A measure of the reflective strength of a radar target; usually represented by the symbol s measured in square meters, and defined as 4p times the ratio of the power per unit solid angle scattered in a specified direction to the power per unit area in a plane wave incident on the scatterer from a specified direction. (IEEE Std 100-1996)

4.275 radiated emission. Desired or undesired electromagnetic energy, in the form of electric and magnetic fields, that is propagated through space.

4.276 radiated interference. Undesired electromagnetic energy, in the form of electric and/or magnetic fields, that is radiated from an electrical source associated with or part of any unit, antenna, cable, or interconnecting wiring, and causes performance degradation.

4.277 radiated susceptibility. A measure of the radiated electric or magnetic interference field level required to cause equipment, subsystem, or system performance degradation.

4.278 radiation. The emission of energy in the form of electromagnetic waves. (IEEE Std 100-1996)

4.279 radiation device (restricted). A device in which the generation of radio frequency energy is intentionally incorporated into the design, and in which the radio frequency energy is conducted along wires or is radiated, exclusive of transmitters for which provisions are made under those parts of Chapter 7 of the NTIA Manual (excluding non-licensed devices and industrial, scientific, and medical (ISM) equipment). (NTIA) *See also:* **low power communication device.**

4.280 radio. A general term applied to the use of electromagnetic waves in the radio frequency (RF) region of the spectrum.

4.281 radio altimeter. An altimeter using radar principles for height measurement. Height is determined by measurement of propagation time of a radio signal transmitted from an airborne or spacecraft vehicle and reflected back to the vehicle from the terrain below. (IEEE Std 100-1996) *Synonym:* radar altimeter.

4.282 radio astronomy. The branch of astronomy dealing with the passive reception and analysis of electromagnetic radiations of radio wavelength from extraterrestrial sources. (IEEE Std 100-1996)

4.283 radiocommunication. Telecommunication by means of electromagnetic (radio) waves.

4.284 radio frequency (RF). **(1)** A frequency in the portion of the electromagnetic spectrum that is between the audio-frequency portion and the infrared portion. **(2)** A frequency useful for radio transmission. *Note*—The present practical limits of radio frequency are roughly 10 kHz to 100,000 MHz (IEEE Std 100-1996) or 9 kHz to 3 THz (3,000 GHz) (FCC).

4.285 radio frequency (RF) stabilized arc welder. Any welding equipment that utilizes RF energy to initiate and stabilize the arc. An RF stabilized arc welder includes the source of the RF and welding current, the welding torch, and all interconnecting cables.

4.286 radio frequency (RF) systems, wired. *See:* **wired radio frequency (RF) systems.**

4.287 radio noise. An electromagnetic noise that may be superimposed upon a wanted signal and is within the radio-frequency range. An electromagnetic disturbance of a sinusoidal character is also considered radio noise.

4.288 radio noise meter. A device for measuring any unwanted disturbance within the radio frequency band, such as undesired electromagnetic waves in any transmission channel or device. (Based on IEEE Std 100-1996)

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4.289 radio waves (or Hertzian waves). Electromagnetic waves of radio frequencies. Current usage includes frequencies up to 1 THz (1,000 GHz). (IEEE Std 100-1996)

4.290 random noise. **(1)** Noise that comprises transient disturbances occurring at random. *Note*—The part of the noise that is unpredictable except in a statistical sense. *See also:* IEEE Std 100-1996. **(2)** Noise, having values at given instants that are not predictable. [IEC 60050-161 (1990-09)]

4.291 receive antenna factor. Quantity relating the strength of the field in which the antenna is immersed to the output voltage across the load connected to the antenna. (Antenna factor is independent of measurement geometry. Antenna is aligned with field polarization.) This factor does not normally include cable losses. (NATO STANAG)

4.292 receive free space antenna factor. Antenna factor when all influences from adjacent objects have been removed.

4.293 reference antenna. A designated measurement antenna having preferred measurement data that take precedence in the case of a discrepancy, such as between signal strength levels measured with the reference antenna and those measured with any other antenna.

4.294 reference frequency. A frequency having a fixed and specified position with respect to the assigned frequency. (NTIA)

4.295 reference material. A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO/IEC Guide 25: 1990)

4.296 reference standard. A standard generally of the highest metrological quality, available at a given location, from which measurements made at that location are derived. (ISO/IEC Guide 25: 1990)

4.297 reference test site. A test site for electromagnetic radiation measurements that is an open, flat area (open area test site), characteristic of cleared, level terrain. Essentially, such a site shall be void of buildings, electric lines, fences, trees, underground cables, pipelines, etc., except as required to perform the test. Such a site shall meet the test site acceptability criterion.

4.298 reflection coefficient. At a given frequency, at a given point, and for a given mode of propagation, the ratio of some quantity associated with the reflected wave to the corresponding quantity in the incident wave.

4.299 reflectivity. The ratio of the level of reflected or spurious energy to the level of the direct energy at the specified test region.

4.300 registration. Procedure by which a body indicates relevant characteristics of a product, process or service, or particulars of a body or person in an appropriate publicly available list. (ISO/IEC Guide 2: 1986)

4.301 required acceptance bandwidth. The receiver bandwidth that includes the fundamental frequency response and extends from the lowest to the highest frequencies on the selectivity outside of which the image response and all other responses are at specified levels below the response at the fundamental frequency.

4.302 requirement. A translation of needs into a set of individual quantified or descriptive specifications for the characteristics of an entity in order to enable its realization on examination. (ISO/IEC Guide 25: 1990)

4.303 research testing. The process of research testing in the medical equipment field is defined as ad hoc radiated immunity testing in which the transmitter operator brings the transmitter closer than the recommended test distance in order to determine how the medical device might react if users did not observe the transmitter separation distance recommendations.

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4.304 reverberation chamber. *See:* **mode stirred chamber.**

4.305 root-mean-square (rms) detector. A detector, the output voltage of which approximates the root-mean-square value of an applied signal or noise. *See also:* **root-mean-square detector** in IEEE Std 100-1996. *Note*— The rms value must be taken over a specified time interval [IEC 60050-161 (1990-09)].

4.306 rotatable antenna. An antenna that is rotated in the azimuth plane during measurements.

4.307 safety margin. The difference expressed in dB between the interference susceptibility threshold and the actual/expected interference level that exists at the place of influence. (NATO)

4.308 selectivity. The ability or a measure of the ability of a receiver to discriminate between a given wanted signal and unwanted signals. [IEC 60050-161 (1990-09)]

4.309 self compatibility. A requirement that the operational performance of an equipment or subsystem shall not be degraded, nor shall it malfunction when all of the units or devices in the equipment or subsystem are operating together at their designed levels of efficiency or their nominal design capability.

4.310 semi-anechoic chamber. *See:* **anechoic enclosure [radio frequency(RF)].**

4.311 shield. (electromagnetic) A housing, screen, or other object (usually conducting) that substantially reduces the effect of electric or magnetic fields on one side thereof, and on devices or circuits on the other side. (IEEE Std 100-1996)

4.312 shielded enclosure. (1) A housing or other type of enclosure, constructed of conducting material, that reduces the effects of electric and/or magnetic fields on one side thereof, and on devices, circuits, or systems located on the other side. **(2)** For measurements, a specially designed enclosure that affords attenuation to outside radio frequency (RF) ambients thereby permitting measurements of electromagnetic emissions from the test sample to be measured without interference from undesired external electromagnetic radiators. **(3)** A mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and the external environment. *Synonym:* shielded room. [IEC 60050-161 (1990-09)]

4.313 shielded room. *See:* **shielded enclosure.**

4.314 shielding effectiveness. A measure of the ability of a shield to exclude or confine electromagnetic waves. For a given external source, the ratio of electric or magnetic field strength at a point and after the placement of the shield in question. Usually expressed as the ratio (in the frequency domain) of the incident to the penetrating signal amplitudes in dB. (IEEE Std 100-1996)

4.315 signal reference subsystem. A subsystem that establishes a common reference for communication-electronics (C-E) equipments, thereby minimizing voltage differences between equipments. The signal reference subsystem can be a multiple point or equipotential ground plane, or a single point system.

4.316 signal-to-noise ratio. The ratio of the wanted signal level to the electromagnetic noise level as measured under specified conditions. [IEC 60050-161 (1990-09)] *Note*—Other types of noise are usually present, such as shot noise, etc., but are not considered as part of electromagnetic compatibility (EMC) considerations.

4.317 simplex operation. A method of operation in which communication between two stations takes place in one direction at a time. *Note*—This includes ordinary transmit-receive operation, press-to-talk operation, voice-operated carrier, and other forms of manual or automatic switching from transmit to receive. *See also:* IEEE Std 100-1996.

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4.318 single-point ground. A scheme of circuit/shield grounding in which each circuit/shield has only one physical connection to ground, ideally at the same point, for a given system or subsystem. This technique prevents undesirable voltage potentials from developing between circuit ground and system ground due to currents flowing through ground impedance(s).

4.319 site attenuation. The ratio of the power input to a matched, balanced, lossless tuned dipole radiator to that at the output of a similar matched, balanced, lossless tuned dipole receiving antenna for specified polarization, separation, and height above a flat, reflecting surface.

4.320 specification. (1) A statement of requirements to be satisfied by a product, material, service, or process. (2) A statement of a set of requirements to be satisfied by a product, a material or process indicating, wherever appropriate, the procedure by means of which it may be determined whether the requirements given are satisfied.

4.321 spectral power density. The power density per unit bandwidth.

4.322 spectrum amplitude. The amplitude vs. frequency characterization of a waveform.

4.323 specular region. Areas of chamber surfaces that could reflect energy from the radiating surface directly into the quiet zone with one bounce.

4.324 spike. A unidirectional pulse of short duration. [IEC 60050-161 (1990-09)]

4.325 spurious emission. Any electromagnetic emission at a frequency or frequencies that are outside the range of the necessary emission bandwidth, the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include parasitic emissions and intermodulation products, but exclude emissions in the immediate vicinity of the necessary emission bandwidth that are a result of the modulation process and are necessary for the transmission of information. Harmonic emissions are considered to be spurious emissions.

4.326 spurious response. Any response, other than the desired response, of an electric transducer or device. *See also:* IEEE Std 100-1996.

4.327 standard. A prescribed set of conditions and requirements, established by authority or agreement, for continuous application. A standard takes the form of a document containing a set of conditions to be fulfilled, or an object of comparison. For the purposes of this document, the provisions of a standard as defined and utilized shall be suitable to and capable of certification.

4.328 standard antenna calibration site. A site comprised of a flat, open-area devoid of nearby scatterers (e.g., trees, power lines, and fences) that has a large metallic ground plane. The ground plane encloses the first Fresnel ellipse and meets the Raleigh criterion. The clear area (sometimes referred to as the obstruction-free area) encloses the third Fresnel ellipse. *See also:* ANSI C63.7-1992.

4.329 standard reference output. The output level of a particular test sample for a given input level that defines normal operational performance, and is used as a reference level when relating any deviation from normal operational performance that occurs during susceptibility testing (e.g., signal-plus-noise ratio in the receiver for a specified input signal). The standard reference output should be defined in the individual equipment specification.

4.330 standard response. A device response, to a stimulus or signal, that falls within the specified limits or standard(s) for a given equipment or system.

4.331 standard test frequencies. That group of frequencies to which transmitters and/or receivers are tuned during a specified test procedure.

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4.332 station. One or more transmitters or receivers, or a combination of transmitters and receivers, including the accessory equipment necessary at one location for providing a telecommunications service.

4.333 stripline. A class of planar transmission line characterized by one or more thin conducting strips of finite width parallel to and approximately midway between two extended conducting ground planes. The space between the strips and the ground planes is filled by a homogeneous insulating medium. (IEEE Std 100-1996)

4.334 subsystem. A portion of a system containing two or more integrated components that, while not completely performing the specific function of a system, may be isolated for design, test, or maintenance. For the purpose of establishing electromagnetic compatibility (EMC) requirements, either of the following shall be considered as subsystems. In either case, the devices or equipments may be physically separated when in operation and will be installed in fixed or mobile stations, vehicles, or systems.

a) A collection of devices or equipments designed and integrated to function as a single entity but wherein no device or equipment is required to function as an individual device or equipment.

b) A collection of equipments and subsystems as defined in item a), designed and integrated to function as a major subdivision of a system and to perform an operational function or functions. Some activities consider these collections as systems, however, as noted above, they will be considered as subsystems.

4.335 suppression. The reduction or elimination of undesired emissions by such techniques as filtering, bonding, shielding, absorption, and grounding, or any combination thereof.

4.336 survive. The ability of equipment, subsystem, or system to resume functioning without evidence of degradation following temporary exposure to an adverse electromagnetic environment. This implies that the system performance will be degraded during exposure to the environment, but the system will not experience any damage, such as component burnout, that will prevent it from operating when the adverse electromagnetic effects are removed or reduced below allowable susceptibility levels.

4.337 susceptibility threshold. The minimum input signal power level that permits visibility of the output signal on a display unit. This level is obtained by initially setting the input signal level above the detection threshold and then slowly decreasing the amplitude. *Synonym:* minimum discernible signal (MDS).

4.338 system. A composite of equipment, subsystems, skilled personnel, and techniques capable of performing or supporting a defined operational role. A complete system includes related facilities, equipment, subsystems, materials, services, and personnel required for its operation to the degree that it can be considered self-sufficient within its operational or support environment.

4.339 tabletop device. A device designed to be placed and normally operated on the surface of a table, typically 80 cm in height. (ANSI C63.4-1992)

4.340 tailoring. The process by which the requirements of a standard are adapted (that is, modified, deleted, or supplemented) to accommodate the peculiarities, characteristics, or operational requirements of a specific equipment, system, or subsystem specification. The tailoring process does not constitute a waiver or deviation from the requirements of a standard.

4.341 telecommunication. Any transmission, emission, or reception of signs, signals, writings, images, digital data, and sounds or intelligence of any nature by wire, radio, visual, or other electromagnetic techniques.

4.342 telecommunications equipment. Any equipment that transmits, emits, or receives signs, signals, images, sound, or information of any nature by wire, radio, visual, or other electromagnetic means.

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4.343 telegraphy. A system of telecommunication that is concerned in any process providing transmission and reproduction at a distance of documentary matter, such as written or printed matter or fixed images, or the reproduction at a distance of any kind of information in such a form.

4.344 telemetering (remote metering). (1) Measurement with the aid of intermediate means that permit the measurement to be interpreted at a distance from the primary detector. (IEEE Std 100-1996) **(2)** The use of telecommunication for automatically indicating or recording measurements at a distance from the sensing or measuring instrument. *Synonym:* remote metering.

4.345 telephony. A system of telecommunication set up for the transmission of speech, other sounds, or digital data.

4.346 TEM cell. *See:* **transverse electromagnetic (TEM) cell.**

4.347 test. A technical operation that consists of the determination of one or more characteristics of performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. (ISO/IEC Guide 25: 1990)

4.348 test antenna. An antenna, of known performance characteristics, associated with measurement equipment.antenna transfer switch.

4.349 testing laboratory. Laboratory that performs tests. (ISO/IEC Guide 25: 1990)

4.350 test method. Defined technical procedure for performing a test. (ISO/IEC Guide 25: 1990)

4.351 test sample. The device, equipment, subsystem, or system to be tested or under test. *See also:* **equipment under test (EUT).**

4.352 test site acceptability criterion. A measurement site shall be considered acceptable for electromagnetic radiation measurements if the measured site attenuation is within ± 4 dB of the calculated normalized site attenuation for an ideal site. This criterion includes instrumentation calibration errors, measurement technique errors, and site performance errors.

4.353 test volume. The volume that has been validated to give acceptable accuracy for a particular test, such as radiated emission or radiated immunity. Typically with transverse electromagnetic (TEM) devices, the test volume is described as a cone that is centered between the cell septum and floor, and between the two cell side walls. Its base is truncated at a sufficient distance before the absorbers to avoid loading effects from the absorbers. The dimensions from the cell center line are dictated by the accuracy required for the intended test. (ANSI C63.4-1992)

4.354 text-only capability. A system that displays and processes only alphanumeric symbols, without graphics and specialized mathematical operations capability.

4.355 third party certification. A form of certification in which the producer's claim of conformity is validated, as part of a third party certification program, by a technically and otherwise competent body other than one controlled by the producer or the buyer.

4.356 third party program certification. An organized system **(1)** under which similar products or services of any number of producers may be certified as conforming to the referenced standards or specifications on a uniform and equitable basis, **(2)** that uses or is operated by a third party inspection/testing body, and **(3)** that authorizes the use of controlled certification marks or certificates of conformity as evidence of conformity.

4.357 time jitter. A measure of the uncertainty of the repetitive position of a time mark. Time-related, abrupt, spurious variations in the duration of any specified, related time interval.

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4.358 time urgent (HEMP). A system having a time of degradation from high altitude electromagnetic pulse (HEMP) stress, either from damage or upset, that must be limited and controlled. The criteria for time urgency measures are determined by the specified functions and missions of the system or link.

4.359 traceability. The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (ISO/IEC Guide 25: 1990)

4.360 transfer impedance (Zt). The ratio of the voltage coupled into one circuit to the current appearing in another circuit or another part of the same circuit.

4.361 transient. (1) A single electromagnetic event, or single-shot voltage, current, electric or magnetic field impulse or pulse, such as generated by lightning, electromagnetic pulse (EMP), or switching action. (2) Such an event with a low, and often random, repetition rate, generated by switching action, relay closure, or other low-repetition, cyclic operation. (3) (adjective or noun) Pertaining to or designating a phenomenon or a quantity that varies between two consecutive steady states during a time interval that is short when compared with the time-scale of interest. [IEC 60050-161 (1990-09)]

4.362 transient protection (suppression/attenuation) device (TPD). Provides protection to a conductive point of entry or exit (POE). It may, for example, consist of one or more of the following: a spark gap, a metal oxide varistor (MOV), or a filter. These devices are used to reduce the electrical stress that penetrates an electromagnetic barrier.

4.363 transmission line. Typically, a uniform conductor pair, forming a continuous path from an electrical energy source to a receptor, for directing (conducting) the transmission of electromagnetic energy along this path. In practice, typical transmission line configurations include telephone lines, power cables, coaxial cables, and computer cables.

4.364 transmit antenna factor. 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.

4.365 transverse electromagnetic (TEM) cell. An enclosed system, often a rectangular coaxial line, in which a wave is propagated in the transverse electromagnetic mode to produce a specified field level for testing purposes. [IEC 60050-161 (1990-09)]

4.366 tri-plate-line (TPL). An immunity test system consisting of a three parallel plate transmission line similar to the transverse electromagnetic (TEM) but without the side panels.

4.367 tropospheric scatter. The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the troposphere. (NTIA)

4.368 TV interface device. An unintentional radiator that produces or translates in frequency a radio carrier modulated by a video signal derived from an external or internal signal source, and that feeds the modulated radio frequency (RF) energy by conduction to the antenna terminals or to other nonbaseband input connections of a television broadcast receiver

4.369 undesirable response. A deviation from the standard reference output that exceeds the tolerances as defined in the equipment specification.

4.370 unintentional antenna. Any conducting structure (not designed to be an antenna) that can interact with electromagnetic (EM) fields, particularly outside a facility, to develop voltages on, or currents in, the structure.

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4.371 unintentional radiator. A device that generates radio frequency (RF) energy for use within the device, or sends RF signals by radiation to other devices nearby or by conduction to associated equipment via connecting wiring, despite the fact that it is not intended to emit RF energy by radiation or induction.

4.372 unwanted emissions. Emissions that consist of spurious and out-of-band emissions. (ITU)

4.373 unwanted signal. A signal that may impair the reception of a wanted signal. *Note*—Sometimes the term "undesired signal" is used.

4.374 upset. A spurious response not caused by normal operating signals or commands, and usually not immediately producing physical damage to the system. Frequently the inadvertent changing of the logic state of a digital device.

4.375 verification. Confirmation by examination and provision of objective evidence that specified requirements have been met.

4.376 vertical polarization. An electromagnetic wave is vertically polarized if the electric field vector is in the incidence plane and the magnetic field vector is perpendicular to the incidence plane; thus, parallel to the ground plane (usually the earth's surface.)

4.377 waveguide-below-cutoff filter. A waveguide that has a primary purpose of attenuating electromagnetic waves at frequencies below its cutoff frequency (rather than propagating waves at frequencies above the cutoff). The cutoff frequency is determined by the transverse dimensions and geometry of the waveguide and the properties of the dielectric material (if present) in the waveguide.

4.378 wave impedance. The ratio of electric field strength to magnetic field strength at the point of observation (expressed in Ω). *Note*—In the near field, the phase angle between the two must be considered.

4.379 waveguide cutoff frequency. For a given transmission mode in a nondissipative (ideal) waveguide, the frequency at which the propagation constant is zero. (IEEE Std 100-1996) *Note*—For ideal waveguides with walls of infinite conductivity, propagation along the guide ceases abruptly for frequencies below the cutoff frequency. For practical waveguides with dissipation, (i.e., with waveguide walls of finite conductivity) propagation along the waveguide does not stop abruptly at a "cutoff" frequency. Instead a transition range of frequencies exists over which transition occurs from propagation to rapidly increased attenuation of modes as frequency decreases. *See also:* Collin, pgs 340-342 [B4].

4.380 wideband TEM device. A transverse electromagnetic (TEM) device which has been altered to extend the usable frequency range. Often this is achieved by replacing one port of a two port TEM device with a non-tapered, wideband load. *See also:* **gigahertz transverse electromagnetic (GTEM) cell.**

4.381 wired radio frequency (RF) systems. Systems employing restricted radiation devices in which the RF energy is conducted or guided along wires or in cables, including electric power and telephone lines.

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Annex A

(informative)

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ISBN 0-7381-0257-1

9 780738 102573 90000

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