

CEA Bulletin

Recommended Practice for the Installation of Smart Grid Devices

CEA/CEDIA-CEB29

March 2012



CEA[®]
Consumer Electronics Association

www.CEAdocs.org
Documents
Document Sharing Hub

NOTICE

Consumer Electronics Association (CEA®)/Custom Electronic Design and Installation Association (CEDIA®) Standards, Bulletins and other technical publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards, Bulletins and other technical publications shall not in any respect preclude any member or nonmember of CEA/CEDIA from manufacturing or selling products not conforming to such Standards, Bulletins or other technical publications, nor shall the existence of such Standards, Bulletins and other technical publications preclude their voluntary use by those other than CEA/CEDIA members, whether the standard is to be used either domestically or internationally.

Standards, Bulletins and other technical publications are adopted by CEA/CEDIA in accordance with the American National Standards Institute (ANSI) patent policy. By such action, CEA/CEDIA does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the Standard, Bulletin or other technical publication.

This document does not purport to address all safety problems associated with its use or all applicable regulatory requirements. It is the responsibility of the user of this Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before its use.

This document is copyrighted by the Consumer Electronics Association (CEA®)/Custom Electronic Design and Installation Association (CEDIA®) and may not be reproduced, in whole or part, without written permission. Federal copyright law prohibits unauthorized reproduction of this document by any means. Organizations may obtain permission to reproduce a limited number of copies by entering into a license agreement. Requests to reproduce text, data, charts, figures or other material should be made to CEA/CEDIA.

(Formulated under the cognizance of the CEA/CEDIA **R10 Residential Systems Committee.**)

Published by

©CONSUMER ELECTRONICS ASSOCIATION/ CUSTOM ELECTRONIC DESIGN AND
INSTALLATION ASSOCIATION 2012

www.CE.org
www.CEDIA.org

All rights reserved

The following members of the CEA/CEDIA R10 WG9 Smart Grid Installation Working Group contributed to the development of this document:

David Cassano, Apple Computer, Inc.
 Derek Flickinger, Interactive Homes, Inc.
 Ron Hotchkiss, Surge Suppression Inc.
 Gary Langille, EchoStar Satellite, LLC
 Charles Smith, GE Appliances
 Jay McLellan, Home Automation Inc. (HAI)
 Thomas Pickral, Home Automation Inc. (HAI)
 Kenneth Wacks, Home Systems
 Joel Silver, Imaging Sciences Foundation
 Neal Mellen, Imation Corporation
 Derek Flickinger, Interactive Homes, Inc.
 Kevin Cressa, Linear LLC
 Jeremy Roberts, LonMark International
 Galen Koepke, National Institute of Standards & Technology
 Paul Schomburg, Panasonic Corporation
 Walt Zerbe, Russound
 Carey Mossop, Schneider Electric SA
 James Allen, STMicroelectronics Inc.
 Peter Kaars, Technicolor
 William Rose, WJR Consulting

FOREWARD

This joint bulletin was developed by the Consumer Electronics Association/Custom Electronics Design & Installation Association R10 Residential Systems Committee.

.....

Contents

1. Background.....	4
2. References.....	4
2.1 Informative Reference List.....	4
2.2 Informative Reference Acquisition	5
3. Compliance Notation	6
4. Purpose	6
5. Acronyms.....	6
7. Building Protection – Lightning	8
7.1.1 Recommendations/Requirements	10
7.2.1 Recommendations/Requirements	11
7.3.1 Recommendations/Requirements (See UL 96A, 12 th Edition)	11
7.5 Multiple Buildings.....	13
8. Wiring	13
8.4 Whole-home audio systems (See TIA 570B-1 section 6.1.4.3)	15
9. Surge Protection Devices (SPDs)	16
9.1 Types of SPDs.....	17
9.1.2 Type 2 SPDs	18
9.1.4 Phone/DATA/CATV/Control Bus Surge Suppression	18
9.2 Installation of SPDs	18
9.2.1 Installing Type 1 and Type 2 SPDs	19
9.2.2 Installing Type 3 SPDs	19
9.3 Summary of National Electric Code Requirements for SPDs.....	20
10. Wireless Networks	21
10.1 Causes of Interference to wLANs.....	21
10.1.1 Co-channel Interference	21
10.1.2 Out of Band Interference	22
10.1.5 Improving the Signal	23
11. Powerline Carrier Networks.....	23
11.1 Wideband PLC	23
11.1.1 Problems with Your PLC Network	23
11.1.2 Issues Related to PLC Networks	25
11.2 Narrowband PLC.....	25
11.3 Broadband Powerline Carrier Networks (BPL).....	25

1. Background

The development of the Smart Grid (SG) may entail the interconnection of numerous consumer electronic devices and appliances to each other and to the outside world. As devices become more interconnected the importance of proper installation practices with respect to electromagnetic compatibility (EMC) and electromagnetic interference (EMI) grows. The most destructive phenomena associated with EMI is lightning strikes, which can result in high energy surges and ring wave transients on a building's power and communications wiring and its grounding system; electrostatic discharge, which is a form of ring wave transient that is exacerbated by low humidity; and conducted and radiated radio frequency (RF) energy from equipment power supplies, florescent ballasts, welders, switching, wireless communications devices, dimmers, and other sources.

The traditional first line of defense is to reduce the noise potential at the source. Not all EMI is controllable or accessible so good installation practices are critical, including:

- Proper lightning protection outside the building
- An understanding of proper grounding practices
- Surge protection on all wires entering or leaving the building
- Local surge and ring wave transient protection for sensitive equipment on both power and communications connections to a device
- Proper wiring installation practices
- An understanding of electromagnetic interference issues relating to wired, wireless and powerline carrier networks

2. References

2.1 Informative Reference List

1. National Fire Protection Association (NFPA): NFPA 70 National Electric Code (NEC), 2011
http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=70&cookie_test=1
2. NFPA 780: Standard for the Installation of Lightning Protection Systems, 2011
<http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=780>
3. TIA-570-B Residential Telecommunications Infrastructure Standard, August 2003
http://www.tiaonline.org/standards/catalog/search.cfm?standards_criteria=TIA-570-B
4. IEEE: How to Protect Your House and Its Contents from Lightning, April 2005
http://www.lightningsafety.com/nlsi_lhm/IEEE_Guide.pdf
5. Transient Protection of the SMART Grid: An AC Power Perspective, October 2010
http://emersonnetworkpower.com/en-US/Brands/SurgeProtection/Documents/White%20Papers/WP-30018_SmartGridSPDs_rev0_10-10.pdf

6. National Weather Service Lightning Map of the US
http://www.lightningsafety.noaa.gov/lightning_map.htm
7. Portland General (Utility): Understanding Surges & Spikes
http://www.portlandgeneral.com/safety_outages/surge_protection/understanding_surges_spikes.aspx
8. Choosing the right Surge Protector, February 2011
http://www.statefarm.com/learning/loss_prevent/surge_protection.asp
9. National Electrical Manufacturers Association (NEMA): Surge Protection FAQs
<http://www.nemasurge.com/help.html>
10. Florida Light and Power (Utility): Installation Recommendations for Surge Protectors
http://www.fpl.com/residential/power_quality/installation_recommendations_for_surge_protectors.shtml
11. Cisco: 20 Myths of Wi-Fi Interference, December 2007
http://www.cisco.com/en/US/prod/collateral/wireless/ps9391/ps9393/ps9394/prod_white_paper_0900aecd807395a9_ns736_Networking_Solutions_White_Paper.htm
12. [UL 96A](#): Standard for Safety Installation Requirements for Lightning Protection Systems, May 2007
http://www.comm-2000.com/productdetails.aspx?sendingPageType=BigBrowser&CatalogID=Standards&ProductID=UL96A_12_S_20070523%28ULStandards%29
13. [BICSI Telecommunications Distribution Methods Manual, 12th Edition](#)
http://www.techstreet.com/standards/bicsi/tdmm?product_id=1646187

2.2 Informative Reference Acquisition

- National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169; Phone: 617-770-3000; Internet: <http://www.nfpa.org>
- Telecommunications Industry Association, 2500 Wilson Boulevard, Suite 300, Arlington, VA 22201; Phone: 703-907-7700; Internet; <http://www.tiaonline.org>.
- Institute of Electrical and Electronic Engineers, 3 Park Avenue, 17th Floor, New York, NY 10016; Phone: 212-419-7900; Internet: <http://www.ieee.org>.
- Emerson Network Power; 1050 Dearborn Drive, Columbus, OH 43085; Phone: 614-888-0246; Internet: <http://www.emersonnetworkpower.com>.
- National Oceanic and Atmospheric Administration; 1401 Constitution Avenue NW, Room 5128, Washington, DC 20230; Phone: add number; Internet: <http://www.noaa.gov>.

- Portland General Electric; 121 SW Salmon Street, Portland, OR 97204; Phone: 503-464-8000; Internet: <http://www.portlandgeneral.com>.
- State Farm, One State Farm Plaza, Bloomington, IL 61710; Phone: 800-782-8332; Internet: <http://www.statefarm.com>.
- National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1752, Rosslyn, VA 22209; Phone: 703-841-3200; Internet: <http://www.nema.org>.
- Florida Light and Power, P.O. Box 025576, Miami, FL 33102; Phone: add number; Internet; <http://www.fpl.com>.
- Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 94134; Phone: 408-526-4000; Internet: <http://www.cisco.com>.
- Underwriters Laboratories, 2600 N.W. Lake Road, Camas, WA 98607; Phone: 877-854-3477; Internet: <http://www.ul.com>.
- BICSI; 8610 Hidden River Parkway, Tampa, FL 33637-1000 USA; Phone: 1 813.979.1991 or 800.242.7405 (USA/Canada toll free); Internet: www.bicsi.org

3. Compliance Notation

As used in this document “should” denotes a provision that is recommended but not mandatory. “May” denotes a feature whose presence does not preclude compliance, and implementation of which is optional. “Optional” denotes items that may or may not be present in a compliant device.

4. Purpose

This Installation Guide was developed to provide the reader with a basic understanding many of the issues related to the proper installation and protection of Smart Grid devices and systems they connect to. It is not intended to be a complete source of solutions for all situations, nor as a replacement for an understanding of, and compliance to the laws and regulations as defined by the FCC, the National Electric Code (NEC) and other federal, state and local codes and regulations. It should be seen as a starting point for consumers, installers, and companies involved in buying, developing, or installing smart grid technologies and devices. References are included in an appendix for those interested in learning more about this important subject.

5. Acronyms

AWG	American Wire Gauge
BPL	Broadband Powerline Carrier
CATV	Cable Television (originally Community Antenna Television)
CEA	Consumer Electronics Association
DSL	Digital Subscriber Line
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
FCC	Federal Communications Commission
GFCI	Ground Fault Circuit Interrupter
IEEE	Institute of Electrical and Electronic Engineers

ISM	Industrial, Scientific and Medical [radio bands]
ISP	Inter System Protocol
LAN	Local Area Network
MIMO	Multiple-Input Multiple-Output [antennas]
MOV	Metal Oxide Varistor
NEC	National Electric Code (see NFPA 70)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
PAN	Personal Area Network
PLC	Powerline Carrier
RF	Radio Frequency
SCCR	Short-Circuit Current Rating
SG	Smart Grid
SGIP	Smart Grid Interoperability Panel
SPD	Surge Protective Device
TIA	Telecommunications Industry Association
TVSS	Transient Voltage Surge Suppressor
UTP	Unshielded Twisted Pair (e.g. CAT5, CAT5e, CAT6 UTP)
WLAN	Wireless Local Area Network

6. Definitions

Bluetooth – A proprietary open wireless technology standard for exchanging data over short distances (using short wavelength radio transmissions in the ISM band from 2400-2480 MHz) from fixed and mobile devices, creating personal area networks (PANs).

Capture Device – The building protection system such as one or more lightning rods, a mesh system, or taut overhead wire (s) used to capture a lightning strike.

Down conductor – The conductor connecting the air terminal or overhead ground wire to the earth electrode subsystem.

Electrical Surge (Transient) – A high current impulse (hundreds to thousands of amps), with a duration of less than one-half cycle and a rise time in microseconds. A transient may be common or differential mode and coupled directly or induced onto cabling as a result of lightning, switching of high current power systems, short circuits and other high current disturbances.

Electrostatic Discharge (ESD) – A rapid discharge (tens of nanoseconds), either conducted or through the air, of built-up electrical charge from one unit to another, often from a person to a device.

Grounding conductor – See Down conductor.

Grounding electrode – A conductor that is firmly embedded in the earth thereby serving to maintain ground potential on the conductors connected to it.

Line voltage – As used in this document: 120v-240v AC.

Low voltage – As used in this document: <50v AC or DC.