PEG PROTECTION ENGINEERS GROUP

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Trends in Lightning Protection
Protection of Smart Structures

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Sponsored by: DEHN, HARGER

Session 2: *Power & Lightning (Surge) Protection*

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Lightning Protection System Trends and Technology

What's Changed in Recent Years?

The use of electronics and automation has become common place in construction.

NFPA 780 Annex J provide guidance on protection of smart structures.

What is a smart structure?

Within the context of NFPA 780, a **smart structure** is defined as a structure that has a high degree of interconnected automatic systems for lighting, temperature control, multimedia systems, telecommunications, security, windows and door operations, and other functions.

History of the smart structure

In 1933, The Homes of Tomorrow are displayed at the Chicago World's Fair.

In 1946, The Electronic Numerical Integrator and Computer (ENIAC) is created.

In 1975, the X10 Home Automation Project is started.

In 1984, the term "Smart Home" is first used by the American Association of Home Builders.

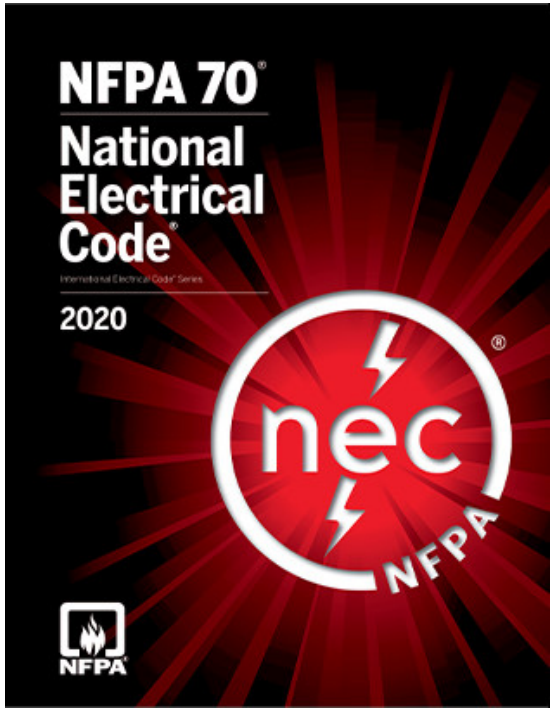
In 1990, the Internet of Things (IoT) is developed when a toaster is connected and controlled via the Internet.

In 2011, the Nest Learning Thermostat is released.

In 2014, Amazon introduces the Echo Dot which included Alexa.

In 2018, the number of IoT devices in existence exceeds the population of the world.

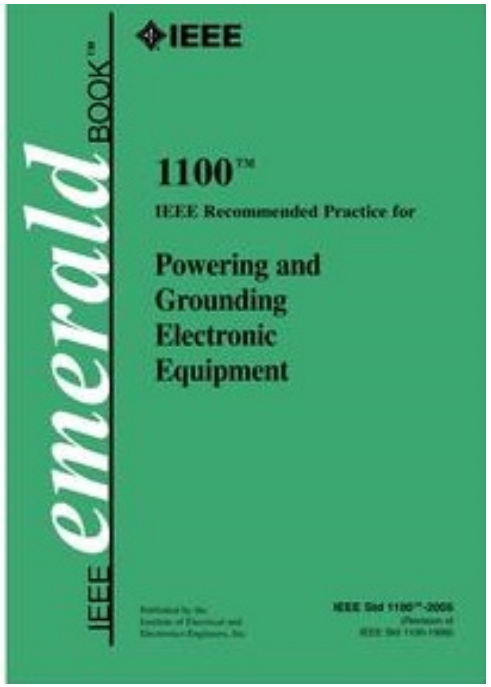
Applicable standards



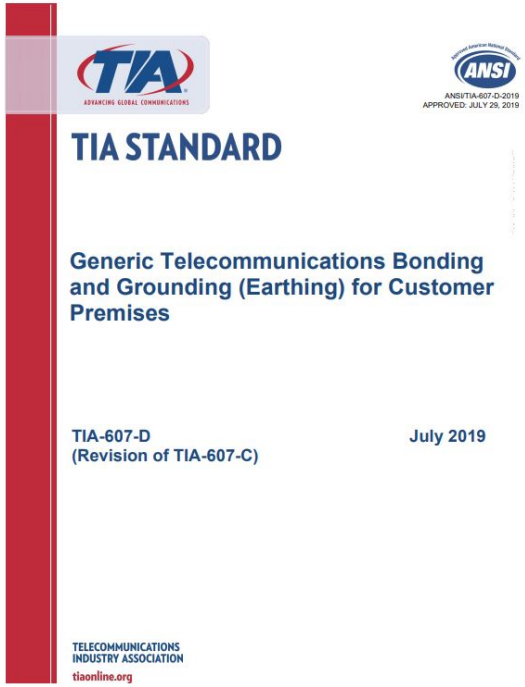
NFPA 70, *National Electrical Code*

NFPA 780, *Standard for the Installation of Lightning Protection Systems*

Applicable standards



IEEE 1100, *Powering and Grounding Electronic Equipment* (Emerald Book)



TIA-607-D, *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*

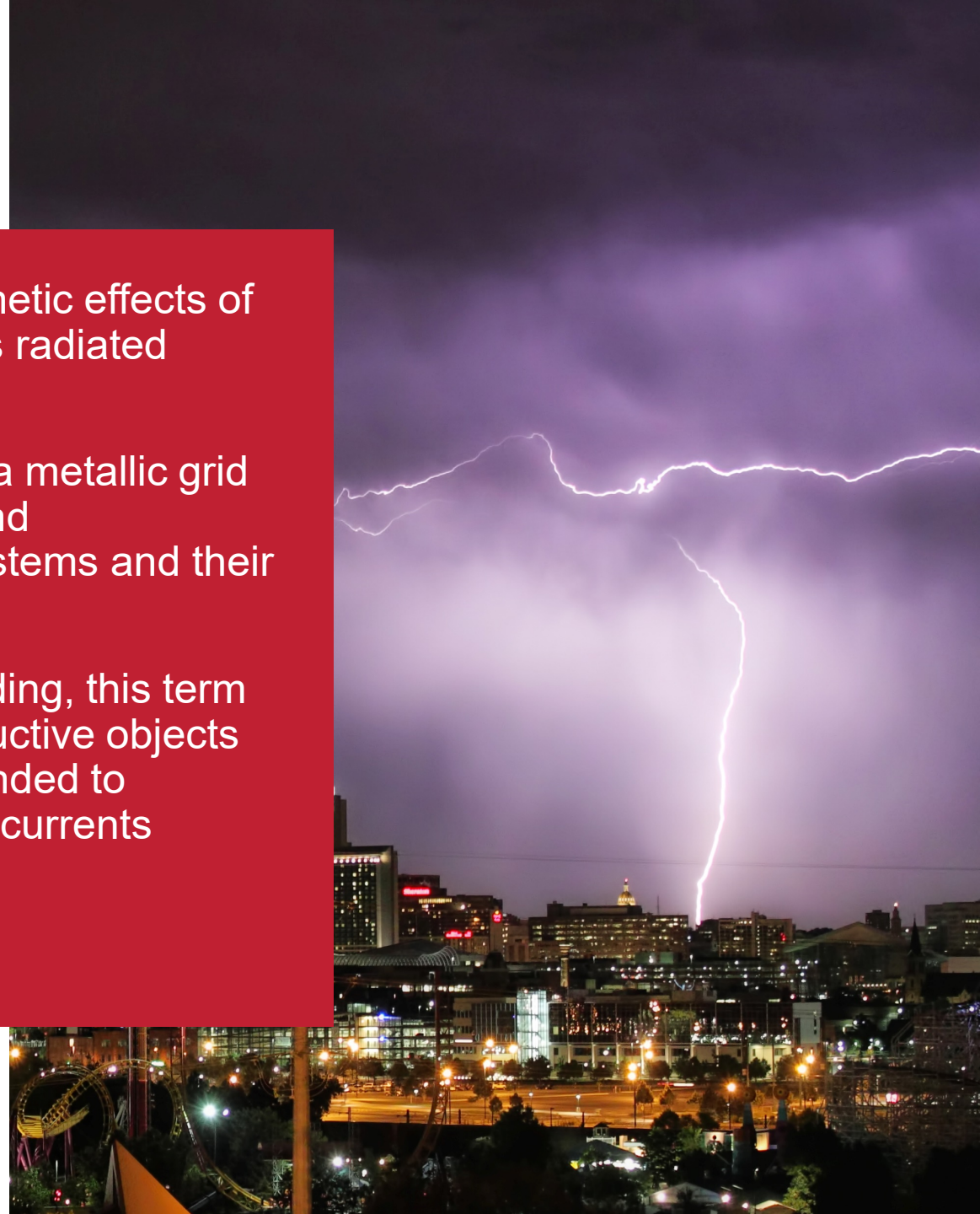
Motorola Publication R56, *Standards and Guidelines for Communication Sites*

Key definitions

Lightning Electromagnetic Impulse (LEMP) – Electromagnetic effects of lightning current, which includes conducted surges as well as radiated impulse electromagnetic field effects

Magnetically shielded – All or part of an object enclosed in a metallic grid or continuous screen that reduces the effects of the LEMP and consequences relating to the failure or upset of electronic systems and their components

Equipotential bonding – Also commonly referred to as bonding, this term means an electrical connection between an electrically conductive objects and a component of a lightning protection system that is intended to significantly reduce potential differences created by lightning currents

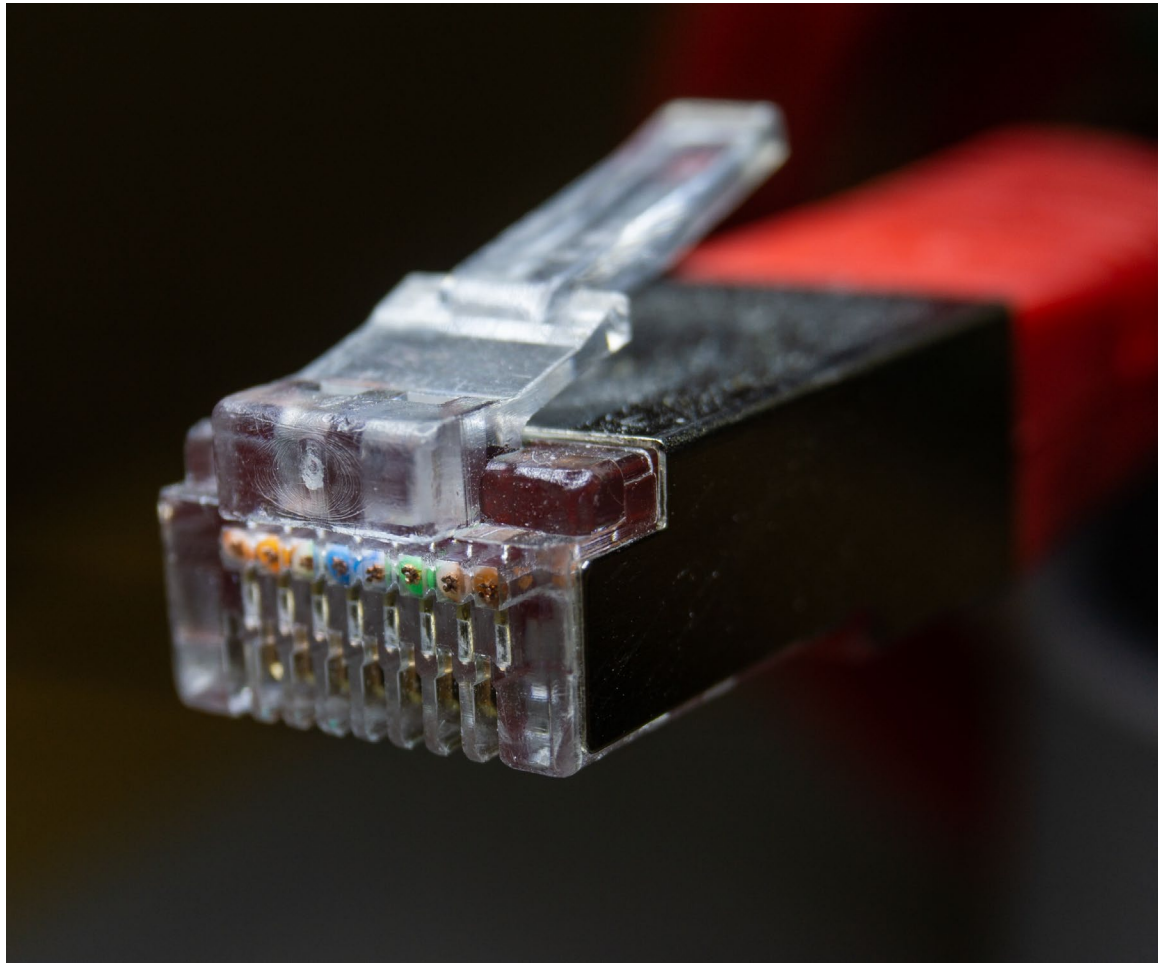


Preventing mutual inductance on communication cables

- NFPA 70, 800.53 requires a minimum separation of **6 feet** between lightning conductors and all communication wires and cables and CATV type coaxial cables.
- Where it is not practicable to maintain this separation, the conductor should cross perpendicular to minimize the effect of mutual inductance

Shielded communication lines

- Shielding protects the data being communicated from external electromagnetic interference (EMI)
- The shielding does not block EMI but rather provides a path of least impedance
- The drain wire **must** be connected to a shielded coupler or shielded jack that is bonded to the communication system's bonding and grounding system
- Failure to terminate properly will cause EMI to build and degrade the quality of the signal

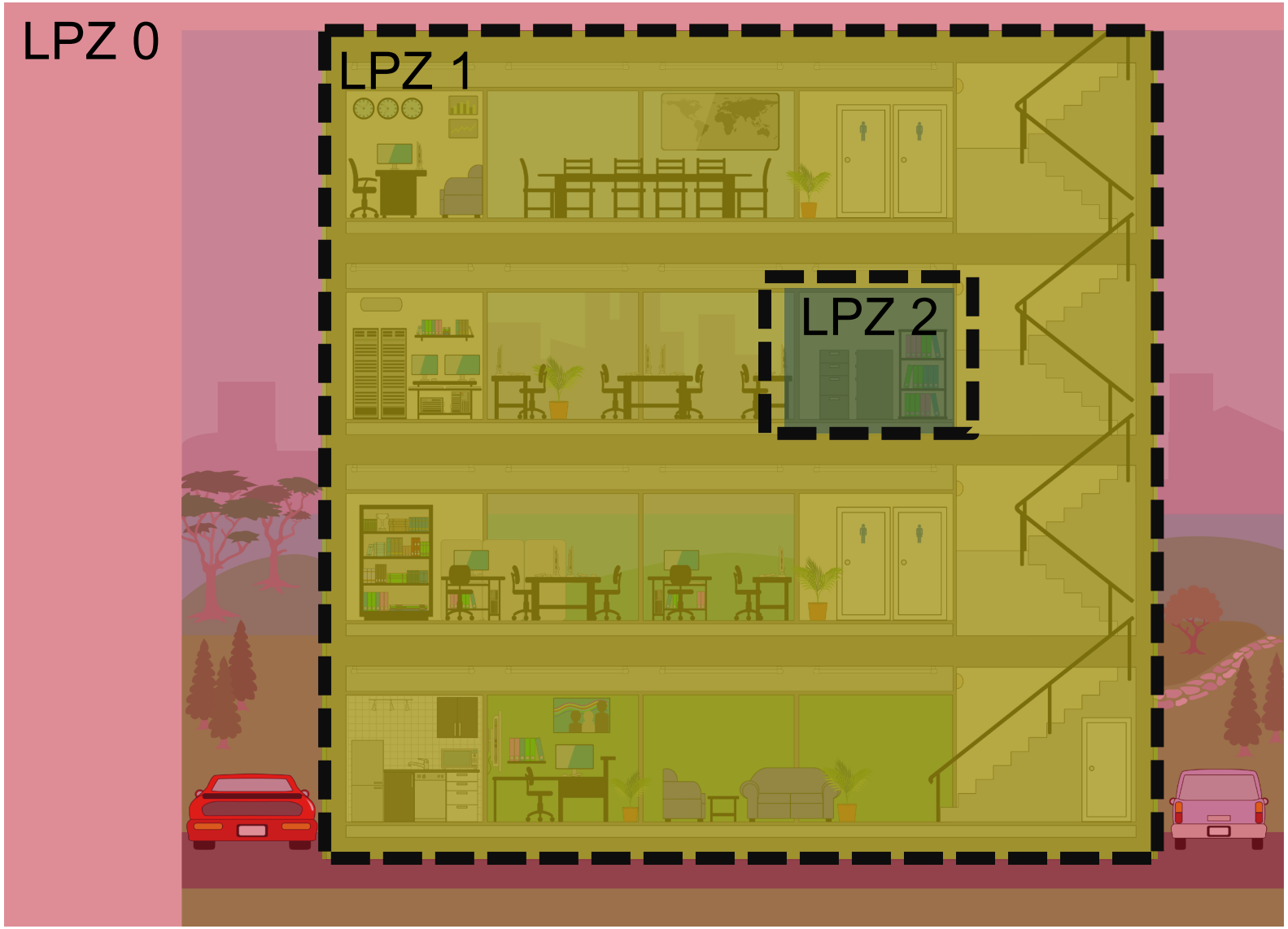


Point of use surge-protective devices (SPDs)

- Understanding that surge current is bi-directional, a minimum of two surge protective devices should be installed on all external antennas or communication circuits.
- When exterior conductors are used, surge protective devices should be installed as near as practicable to the antenna or device and at the point the conductor enters the building.
- SPDs must be bonded to the communications grounding system to effectively operate

Surge protection within the LPZs

- An all-encompassing surge protection schema should include SPDs at the boundary of each LPZ
- The dashed lines to the right show where SPDs should be installed
- This includes all building electrical and conductive communication circuits



Exposed Lightning Protection System Installation

- Exposed lightning protection down conductors subject to damage

Structural Steel Lightning Protection System Installation

- The use of structural steel and concealed lightning protection down conductors
- Involves other trades and pre-construction planning

Grounding Systems for Lightning Protection System Installation

- Lightning protection system ground ring electrode

Additional best practices

- Lightning is vibration, utilize exothermically welded connections or two-hole lugs to prevent loosening of the connection
- Proper hardware selection and torque is paramount for long term reliability *(Note: wire connector shown is not Listed for lightning protection)*
- Wire lengths for an SPD is a delay in functionality. All conductors should be as short as practicable. Each inch of conductor allows an additional 15 – 25V

Inspection and maintenance

- All grounding and bonding schemas require routine inspection and maintenance.
- External grounding should be verified with a clamp-on meter or the 3 point fall-of-potential method.
- Internal bonding should be verified by a visual inspection and a calibrated ohmmeter.
- SPDs should be inspected frequently. Commonly referred to as “idiot lights”, all listed SPDs should have a light indicating operational status.

Conclusion

Thank you for your time