



NECA • BICSI
SUMMIT 2023

Intro to Class 4 Fault Managed Power Systems

Quick Review of Circuit Classes

- Class 1, Class 2, and Class 3 circuits are differentiated from each other by power limitations
 - Class 2 considers safety from a fire initiation standpoint and provides acceptable protection from electric shock
 - Class 3 considers safety only from a fire initiation standpoint
- Article 725
 - Allows for special wiring methods, different wire sizes and insulations, and distinct rules about such things as overcurrent protection and derating factors

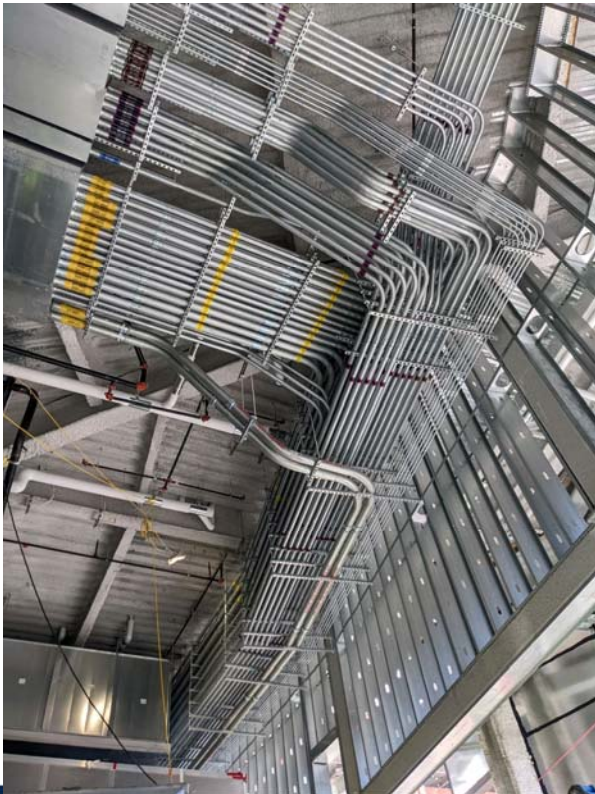
**Class 1 and Class 2/3 circuits hfssty
share the same cable, enclosure, or raceway.**

Class 2 and 3 Circuits are *Limited Energy Circuits*

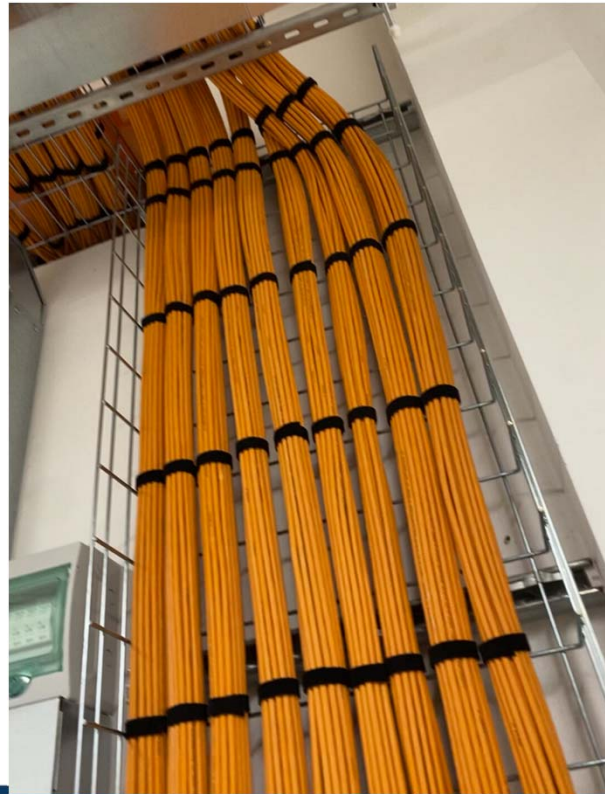
- Limits possibilities of ignition or ventricular fibrillation
- Devices and systems must be LISTED as a Limited Power Source (LPS)
- Power over Ethernet (PoE) is a well-known example of Class 2

Examples of circuits in buildings

Class 1



Class 2 (PoE)

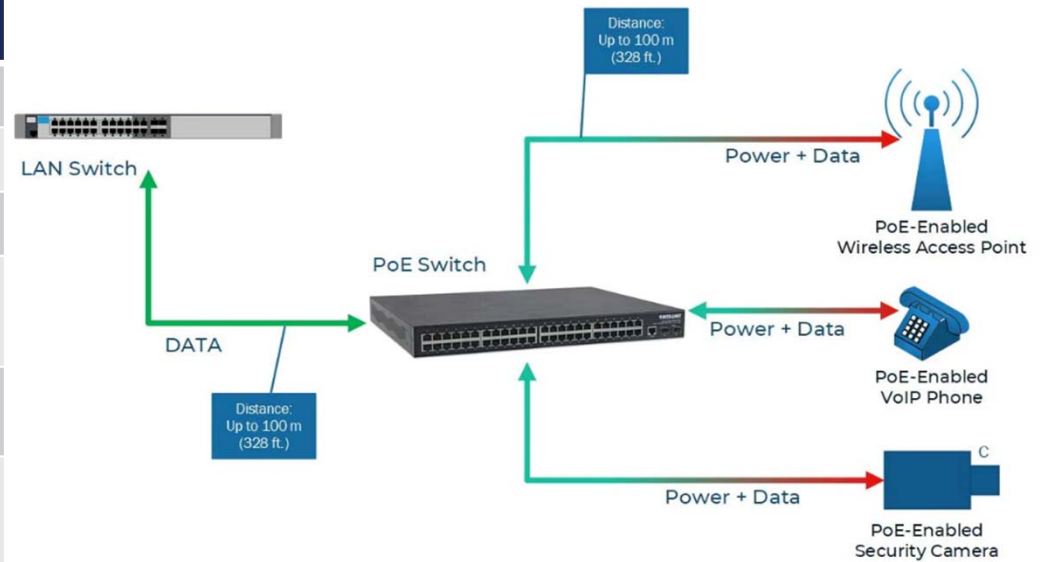


Class 2 (DE)



Power over ethernet (PoE)

Parameter	PoE
Standard	IEEE 802.3
Wiring	NFPA 70 Art. 725 Class 2
Standards	UL 62368-1
Max Power at source	90W
Max distance	100m (330ft)
Max power at Max distance	71W (with Cat6A)



VoltServer: The Pioneer of Fault Managed Power

- The only company with a fault managed power system
 - Eight years of commercial deployments under NEC and CEC Article 725
- Participated in industry groups to develop UL 1400-1 and 1400-2
 - Resulted in the codification of Class 4 in the 2023 version of NFPA 70 Article 726

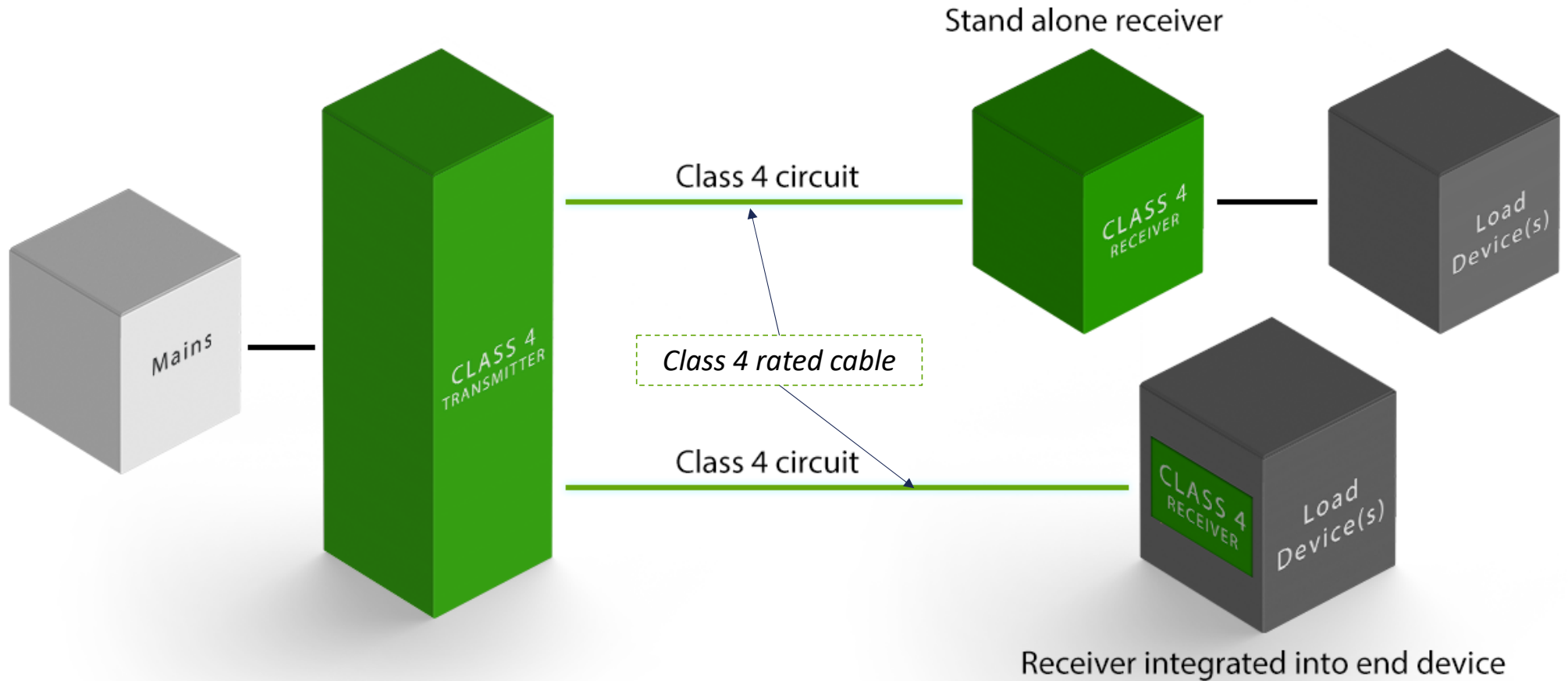
Leverage VoltServer's unmatched expertise for your project.

- Thousands of venues, an tens of thousands of systems deployed worldwide
 - Over 50MW of power delivered
- Customers include the top 3 mobile network operators in the US
- Deployments include
 - Stadiums and Arenas
 - International airports
 - Class A Offices
 - High-tech hotels and resorts

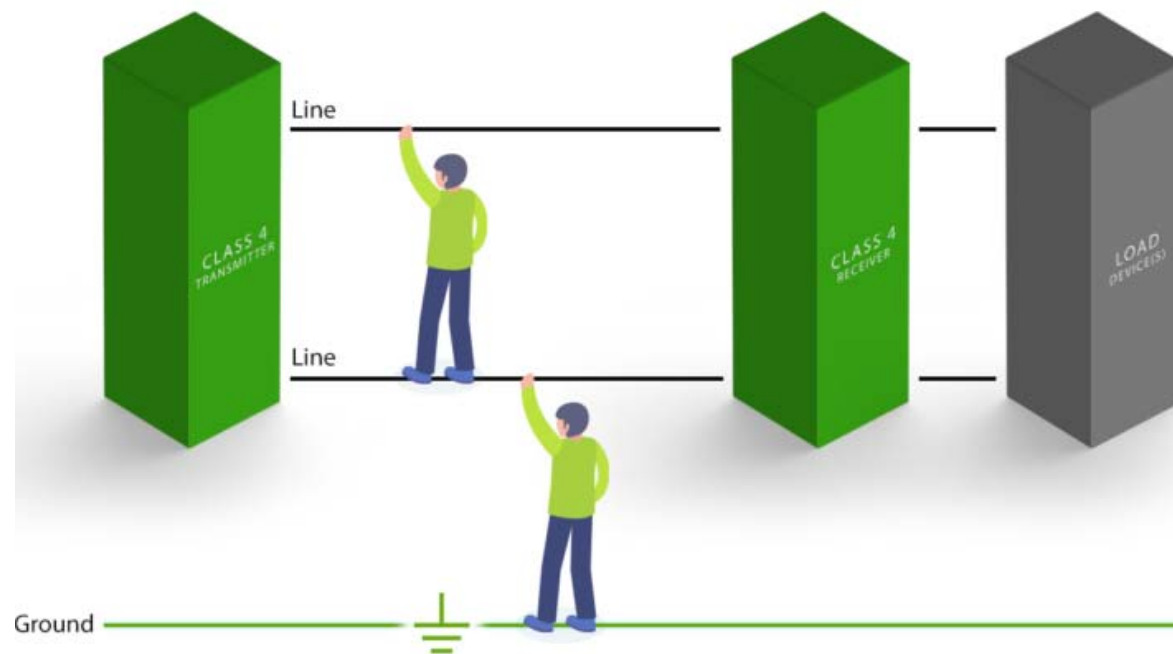
Benefits of FMPS

- **Safe** – NRTL certified for same wiring practices as Ethernet/PoE
- **Significant Power** – hundreds of Watts per pair of conductors
- **Significant Distance** – thousands of feet
- **Skinny Conductors** – 16-18AWG Typically
- **System Monitoring and Control** – remotely manage your power distribution, take actions upon external events
- **Speed to Deployment** – can be run in same pathway or Class2 or Class3 circuits, fiber or hybrid cables.....many jurisdictions do not require permits
- **Sustainable** – smaller cable gauges, no conduit, intelligent control over power use

FMP System Diagram

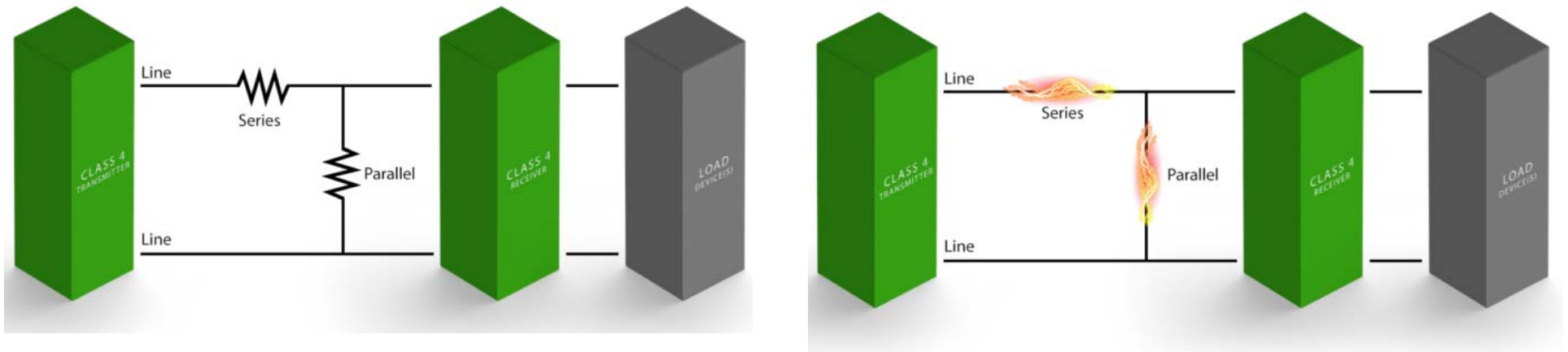


FMPS Shock Faults



- FMPS not only limit fault energy for shocks that occur between the line conductor and earth, but they also limit the fault energy for line-to-line faults.
- This means if someone accidentally touches both lines, the system will react to the fault and limit the energy into the person.
- Traditional power systems employing GFIs cannot react to line-to-line faults because GFIs cannot tell the difference between a person in contact with the wires and the load.
- FMPS can tell the difference between the load and a person in contact with the lines.

FMPS Resistive and Arc Faults



- FMPS also limit the risk of fire.
- This is accomplished by limiting the amount of energy into an arc fault as well as managing resistive faults
- FMPS detect or prevent dangerous arcs that can lead to fire, both line-to-line as well as in-line.
- Resistive faults are limited to 100W for line-to-line faults which limits the amount of heat that can be generated to the same amount of heat allowed in a traditional Class 2 circuit.

Summary of FMPS Fault Protections

Hazard	Fault Type	GFCI	AFCI	FMPS
Shock	Line-to-Earth	✓	✓	✓
	Line-to-Line	✗	✗	✓
Fire	Series Arc	✗	✓	✓
	Parallel Arc	✗	✓	✓
	Line-to-Line Resistive	✗	✗	✓
	Series Resistive	✗	✗	✓



FMPS Summary

Fault Managed Power Systems (FMPS) provide the power capability of a ***power circuit*** with the hazard levels of a ***power-limited circuit*** enabling new ways of distributing power

Class 2 and Class 4 circuits CAN share the same cable, enclosure, or raceway.



Class 4 – Fault Managed Power (FMP)

- 2023 Edition of NFPA 70 has a *new* Article 726
- Limits the fault power in the circuit by monitoring for faults and controlling the power transmitted into the fault
- Based upon risks associated with electric shock and fire hazards
- Defines current limits in terms of duration based on the human body model, **limit energy and power available during a fault event**
- Also requires Functional Safety – Analysis and mitigation of safety-related component failures and behavior under fault conditions
 - Restart, over-voltage, over-current, etc.



PoE vs. DE FMPS vs. Class4 FMPS

Parameter	PoE	DE™ FMPS	Class4 FMPS
Standard	IEEE 802.3	Proprietary	None (yet)
Wiring	NFPA 70 Article 725 Class 2	NFPA 70 Art. 725 Class 2 NFPA 70 Art. 726 Class 4	NFPA 70 Article 726 Class 4
Safety	UL 62368-1 (previously 60950)	UL 62368-1 (LPS) UL 1400-1 (FMPS)	UL 1400-1 (systems) UL 1400-2 (cables)
Max Power at source	90W	600W / pair	System dependent
Max distance	100m (330ft)	2km (6,500ft)	System and cable dependent
Max power at Max distance	71W (with Cat6A)	300W @ 2km (4 pair, 16AWG)	System and cable dependent

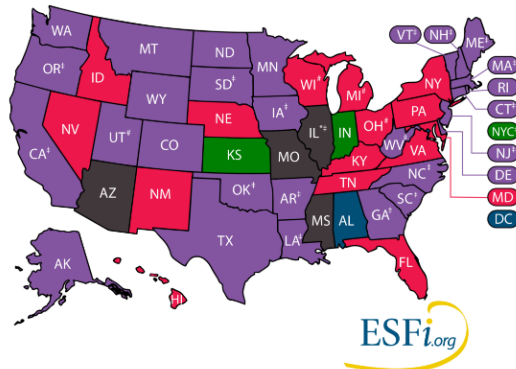
Status of FMPS

Item	Description	Status
<u>2023 NFPA 70 (Article 726)</u>	National Electrical Code	Released
<u>UL 1400-1</u>	Outline of Investigation for Fault-Managed Power System Requirements	Released
<u>UL 1400-2</u>	Outline of Investigation for Fault-Managed Power Cable Requirements	Released

Adoption of Class 4 by AHJ

**National Electrical Code Adoption
Effective March 2023**

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Effective March 2023**

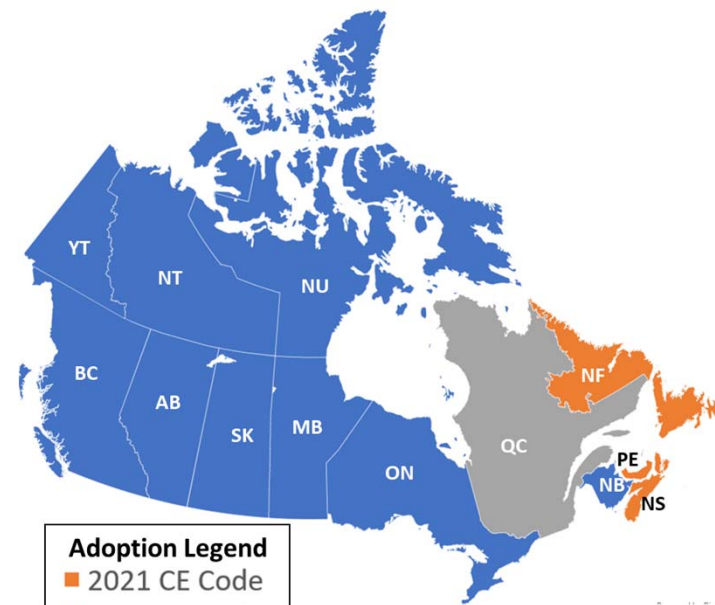


U.S. Territory Adoption
 American Samoa - 2020 NEC*
 Guam - 2008 NEC
 Puerto Rico - 2017 NEC
 Northern Mariana - 2008 NEC
 U.S. Virgin Islands - 2017 NEC

State Adoption Legend
 ■ 2020 National Electrical Code
 ■ 2017 National Electrical Code
 ■ 2014 National Electrical Code
 ■ 2011 National Electrical Code
 ■ 2008 National Electrical Code
 ■ No Statewide Adoption

*Also subject to local adoption
 †With state or city amendments
 *Commercial adoption, residential dwellings on older code

**Canadian Electrical Code Adoption
Effective December 2021**



Adoption Legend
 ■ 2021 CE Code
 ■ 2018 CE Code
 ■ 2015 CE Code

Sources
[Electrical Safety Foundation](#)
[Canadian Electrical Contractors Association](#)

Class 4 Deployments

Class 4 circuits will **not** be an enforceable method of installation within a given authority having jurisdiction (AHJ) until that AHJ has adopted the 2023 code.

It is expected to take several years before Class 4 circuits are allowed by code within a majority of AHJ.

FMPS Case Study – Circa Resort & Casino



- 1.25 million square feet
- 777 rooms and suites
- Powered, controlled, and backed up from a central, environmentally controlled location
- Bulk power delivered to guest rooms with Digital Electricity™
- LVDC distribution within rooms
- Digital Electricity™ also powers the DAS and Wi-Fi

Note:

Digital Electricity™ is a **Limited Power Source** per UL 62368-1 suitable for supplying a **Class 2 circuit** under **NEC Article 725**.

FMPS Case Study – Hard Rock Stadium

- Digital Electricity powers all the 4G and 5G radios and Wi-Fi access points
- 700,000ft of total cable
- Cable lengths from 500-2500 feet
- Centralized power plant for backup power



Note:

Digital Electricity™ is a **Limited Power Source** per UL 62368-1 suitable for supplying a **Class 2 circuit** under **NEC Article 725**.

FMPS Case Study – Hardee Fresh Vertical Farm



- 5 varieties of lettuce
- 50,000 sq ft
- 8 or 9 levels of plants
 - equal to 9 acres of field
- 1.1MW solar facility
- 22 miles of Digital Electricity (DE) cable
- DE
 - Powers the lights
 - Controls on/off cycles
 - Controls dimming
 - Only 2 conductors per fixture vs. 5 for AC power and control

Note:

Digital Electricity™ is a **Limited Power Source** per UL 62368-1 suitable for supplying a **Class 2 circuit** under **NEC Article 725**.

Thank You

Learn more at VoltServer.com/Class4