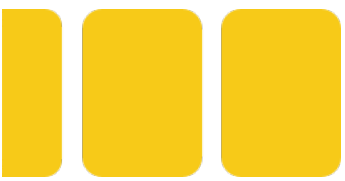




Solutions



UL 1400-1 and 2023 NEC Updates for Fault-Managed Equipment

Ken McKinney

Principal Engineer

UL Solutions



Fault-Managed Power Systems

Agenda

- Quick overview of what a Fault-Managed Power System is
- Standards Development Update
- Installation and Use – 2023 Code Updates



Fault-Managed Power Systems

- What is a Fault-Managed Power System (FMPS)?

Fault-Managed power systems consist of a Fault-managed power transmitter and a Fault-managed power receiver connected by a cabling system. These systems are characterized by **monitoring the circuit for faults** and controlling the power transmitted to ensure the **energy and power delivered into any fault is limited**. Fault-managed systems differ from Class 2, Class 3 and Power over Ethernet systems in that they are not limited for power delivered to an appropriate load. They are power limited with respect to the risk of shock and fire between the transmitter and receiver.

Fault-Managed Power Systems

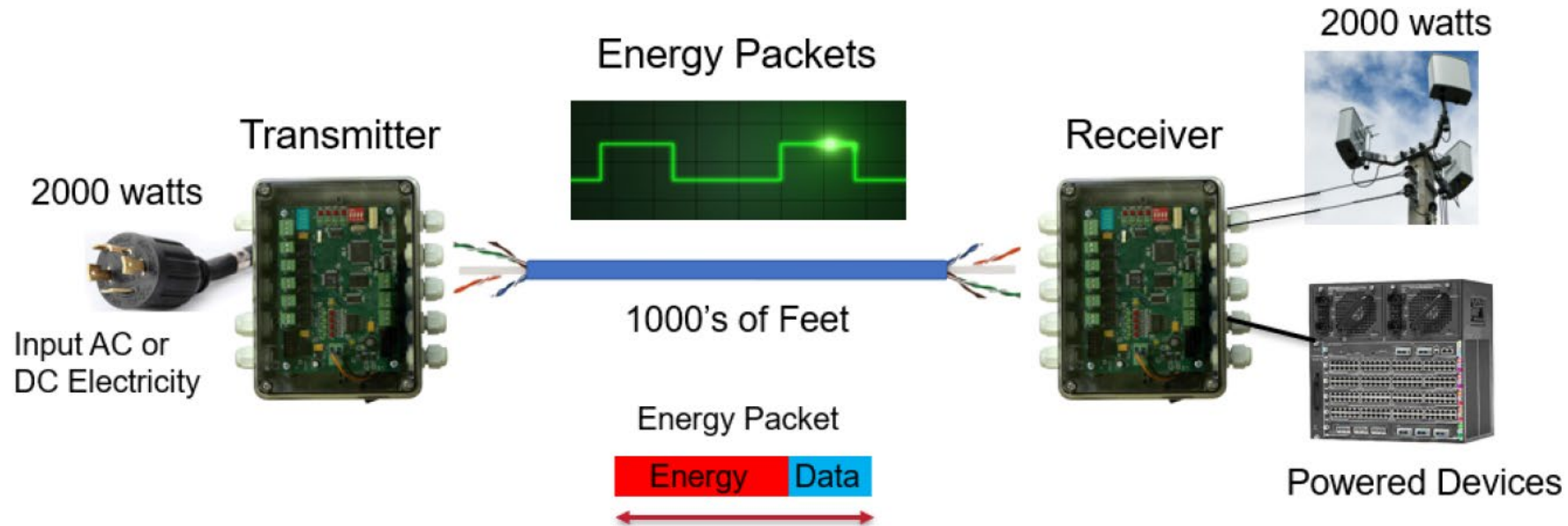
Advantages of a Fault-Managed Power System

- Power levels significantly higher than Class 2 or Power over Ethernet (1,000-2,000 watts)
- Ability to transfer power over significant distances (1,000s of feet)
- Less intensive wiring methods/ease of installation (usually no conduit required, smaller conductor sizes)
- Circuits that are continuously monitored for faults (i.e., short circuit, ground-faults, arcing faults, touch-faults, and faulty wiring)

Fault-Managed Power Systems



Example of one type of Fault-Managed Power System.





Fault-Managed Power Systems



Solutions

Fault-Managed Power Systems were introduced into the market:

- Without specific product certification standards
- Without specific Code requirements to address their installation

Fault-Managed Power Systems



- UL 1400-1 for Fault-Managed Equipment IS PUBLISHED (Dec. 2022)!!
- Currently, this is an Outline of Investigation – used to certify (list) products, but they are not developed by a UL Standards Technical Panel (STP) and are not ANSI approved.
- Application for ANSI approval will begin soon.

Fault-Managed Power Systems

- The standard was created as part of a working group
- The working group included representatives from the following organizations:

- | | | |
|-----------------------|--------------------------|----------------------|
| 1. ATIS | 6. Corning Cable Systems | 11. <u>Commscope</u> |
| 2. Belden | 7. Leviton | 12. Daikin America |
| 3. Cisco | 8. Hubbell | 13. Southwire |
| 4. Alpha Technologies | 9. <u>Voltserver</u> | |
| 5. Chemours | 10. Schneider Electric | |

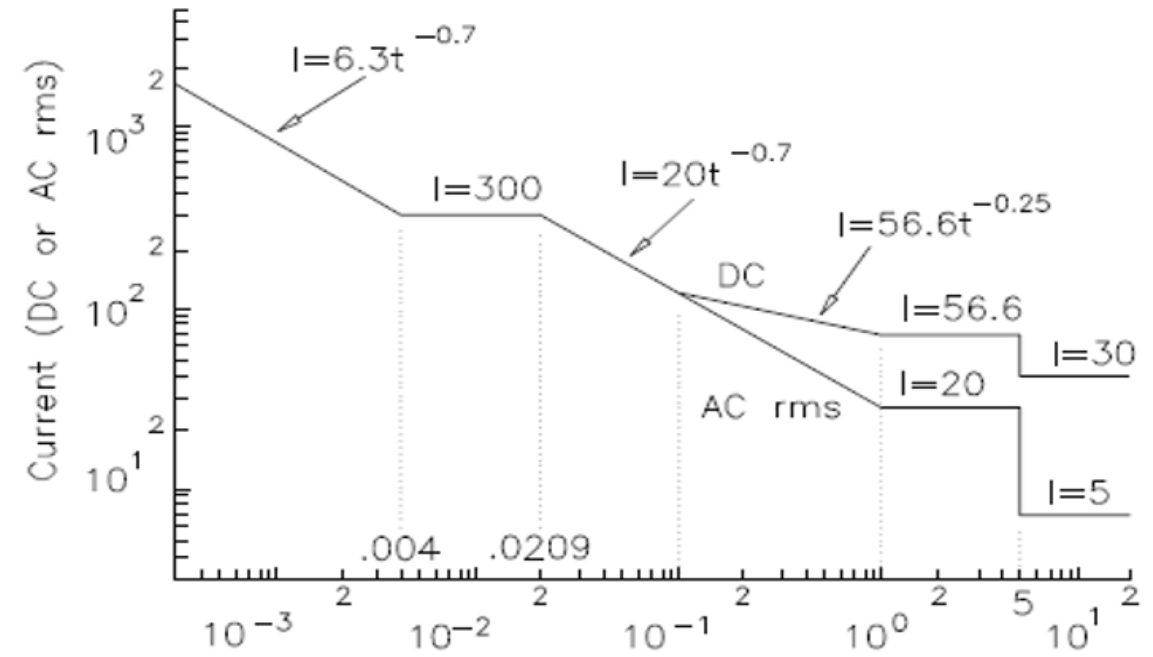
Fault-Managed Power Systems



- The standard was written to be technology agnostic and to account for many different waveforms (on the output of the transmitter):
 - Continuous DC
 - Pulsed DC
 - Sinusoidal AC
 - AC + DC
 - Pulsed DC + DC

Fault-Managed Power Systems

- The standard covers both Ventricular Fibrillation and Let-Go. It does not cover perception or startle reaction.

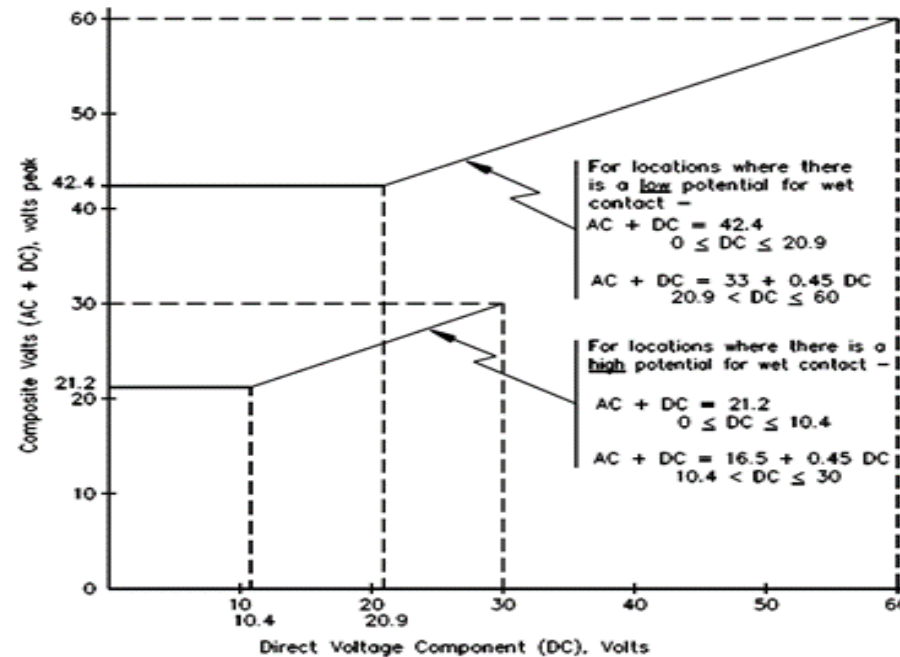




Fault-Managed Power Systems

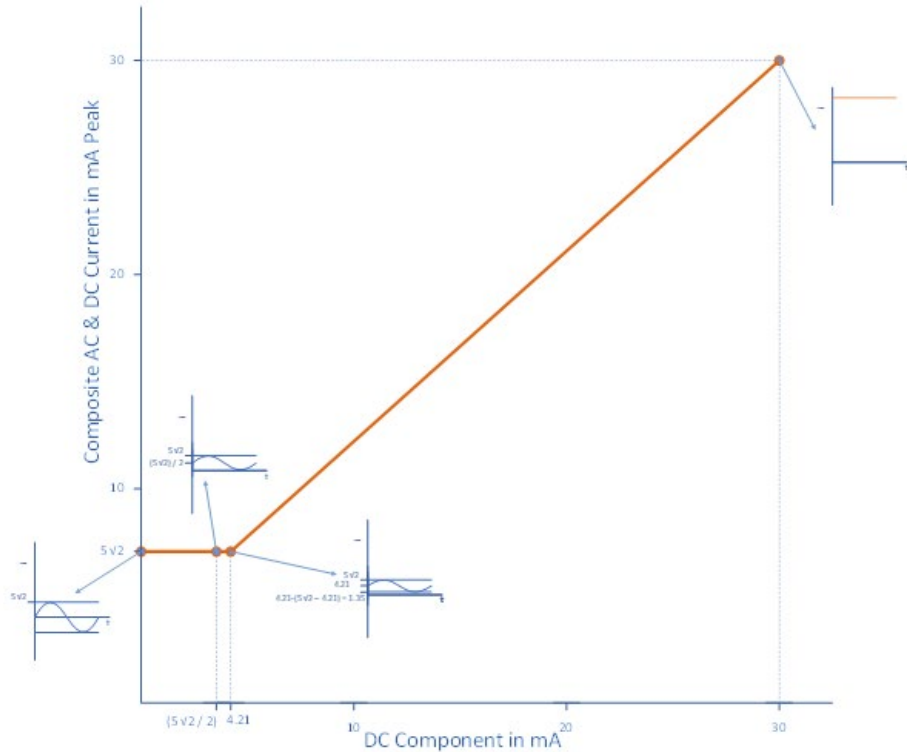
- The standard needed to account for Voltage and Current Limits for combined AC and DC waveforms:

Voltage Limit for combined AC + DC



Fault-Managed Power Systems

- The standard needed to account for Voltage and Current Limits for combined AC and DC waveforms:



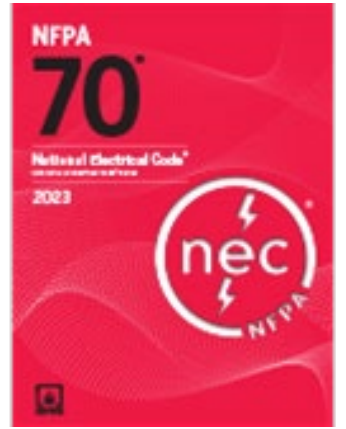
$$AC + DC = \begin{cases} 5\sqrt{2}, & 0 \leq DC \leq 4.21 \\ 3.33 + 0.89 \times DC, & 4.21 < DC \leq 30 \end{cases}$$

Current Limit for combined AC + DC



Fault-Managed Power Systems

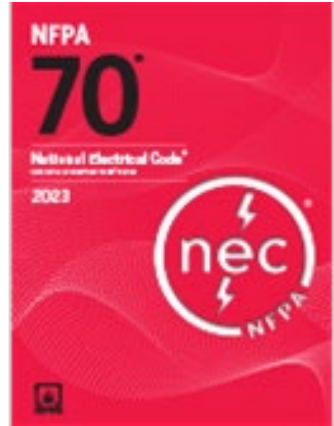
- New UL Category for this type of equipment: DLQC
- No certifications yet, but the process has started with several companies
- It's a complicated process:
 - General requirements per UL 62368-1
 - Systems evaluation for the transmitter, Class 4 Cable and receiver
 - Functional Safety Evaluation



Fault-Managed Power Systems

Additions for the 2023 National Electrical Code

Fault-Managed Power Systems

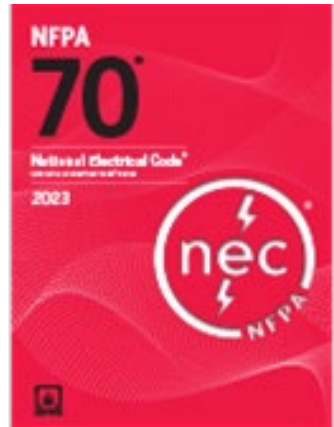


Article 726 – Class 4 FMP Systems (example of requirements):

- Covers installation of wiring and equipment of Class 4 FMP systems, including utilization equipment incorporating parts of these systems
- Excludes installation in dwelling units
- Transmitter output voltage limited to not more than 450 V peak
- Requires components of Class 4 system to be listed
 - UL 1400-1, Outline of Investigation for FMP Systems, Part 1 – General Requirements.*
- Requires connecting hardware to be listed
- Limits placement of Class 4 circuits with Class 1 circuits unless separated by a barrier
- Permits Class 4 cables to be in the same cable assembly as Class 2, Class 3 and communications circuits, provided their insulation is rated with the same (or greater) voltage as the Class 4 circuits

*Outline referenced in the Article and Informative Annex A for product standards

Fault-Managed Power Systems



Article 726 – Class 4 FMP Systems (example of requirements – continued):

A Class 4 FMP System transmitter must be able to interrupt an energized circuit under any of the following conditions:

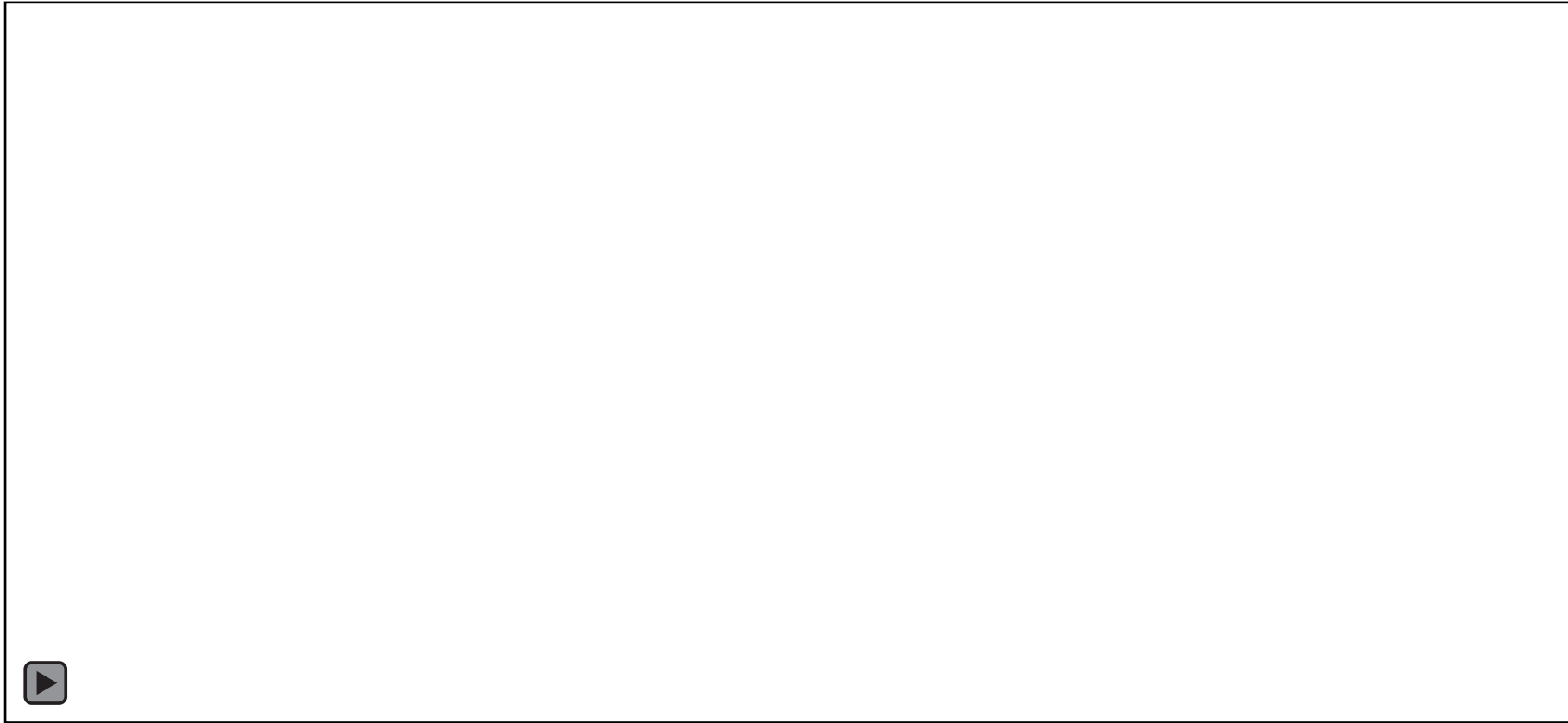
- A short circuit
- A line-to-line fault condition that presents an unacceptable risk of fire or electric shock
- A ground-fault condition that presents an unacceptable risk of fire or electric shock
- An overcurrent condition
- A malfunction of the monitoring or control system presents an unacceptable risk of fire or electric shock
- Any other condition that presents an unacceptable risk of fire or electric shock



Fault-Managed Power Systems



Solutions





Fault-Managed Power Systems



Solutions

Questions?

