SECTION 27 6310 – Class 4 Fault Managed Power System

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:

1. XX

1.2 SUMMARY

A. Section Includes:

1. Class 4 Fault-Managed Power Systems (FMPS).
    a. Transmitter chassis.
    b. Transmitter power supply unit (PSU)
    c. Transmitter module
    d. Receiver

2. The testing, documentation, and instructions for completing the Class 4 Fault-Managed Power System (FMPS)

B. Examine the contract documents in their entirety (including drawings and AC/DC power requirements for the equipment rooms (ERs) required for a functional system.

C. Contractor shall provide and install
1. Power system circuits as defined in FMPS design documents
2. Class 4 Transmitter(s)
3. Class 4 cabling infrastructure compliant with UL 1400-2
4. Class 4 Receivers
5. Any passive panels for power transmission jumpers
6. Any passive jumpers or power buses from receivers to active equipment
7. Any labeling on panels and equipment for administration

D. Errors or Omissions in Drawings or Documentation
1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
2. Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.

1.1 DEFINITIONS

A. AWG – American Wire Gauge

B. Class 4 power system: A power system that uses class 4 circuit to deliver power to remote equipment over standard copper cable.

C. Receiver: A device that converts class 4 circuit into +/-48 VDC power, which can power multiple end devices.

D. EMI: Electromagnetic interference that is generated by fault managed power systems.

E. ER – Equipment Room – An environmentally-controlled, centralized space for telecommunications equipment that serves the occupants of the building, considered distinct from a Telecommunications Room (TR) because of the nature or complexity of the equipment.

F. LED: Light-emitting diode.

G. Class 4 Circuit: A Class 4 circuit is an energy limited circuit in a fault condition and has a voltage limit of 450 volts. It must comprise of a listed Class 4 transmitter connected to a listed Class 4 receiver using listed Class 4 cable. Defined in UL 1400.

H. Class 4 Transmitter: A listed Class 4 transmitter takes power from a power source, converts it to a Class 4 circuit

I. Class 4 (FMPS) Fault Managed Power System: A system that meets the UL 1400 standard for transmitting class 4 power.

J. SPD: Surge protection device.

K. UPS: Uninterruptible power supply.

1.2 PRODUCT SUBMITTALS

A. Product Data: For each type of Class 4 Fault-Managed Power System:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the system components, including the Pulse Power Source, Receiver, distribution wiring, and end devices.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for the system.
3. Cabling media recommended for the system including details on jacket rating, AWG wire sizes and counts, cable construction (solid or stranded), and color.

B. Shop Drawings: For Class 4 Fault-Managed Power System:

1. Include plans, elevations, sections, and mounting/attachment details for the system components, including the Pulse Power Source, Receiver, distribution wiring, and end devices.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads,

required clearances, method of field assembly, components, and location and size of each field connection.
3. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
4. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **[power quality specialist] [testing agency]**.

B. Product Certificates: For each product, from manufacturer.

C. Factory Test Reports: Comply with specified requirements.

D. Product Test Reports: Indicate test results compared with specified performance requirements and provide justification and resolution of differences if values do not agree.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Certified by NETA (National Electrical Testing Association) to perform electrical testing of fault managed power systems.
2. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing of fault managed power systems.
3. System shall comply with UL 1400-1 class 4 power delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Panduit
2. VoltServer
3. JMA Wireless

2.2 SYSTEM REQUIREMENTS

A. Introduction: The Class 4 Fault-Managed Power System (FMPS) is an innovative design to revolutionize remote power delivery for System Integrators. Class 4 FMPS is intended to

remotely power a wide range of electrical devices, including but not limited to switches, controllers, and edge devices. This system offers a centralized power solution for large venues and complex installations.

B. System Overview

1. The Class 4 Fault-Managed Power System shall:

   a. Remotely power electrical devices over long distances.
   b. Comply with the latest UL-1400 standard for safety.
   c. Be scalable and allow multiple configurations.
   d. Support three hot-swappable power supplies.
   e. Accommodate nine hot-swappable transmitter modules.
   f. Provide power up to 4.8 kW to remote receivers located up to 2 km away.
   g. Accept power feeds from multiple sources.
   h. Deliver up to 1.6 kW of power to an unlimited number of end devices.
   i. Be compatible with devices requiring ±48 VDC power.
   j. Offer a user-friendly graphical user interface for configuration, monitoring, and control.
   k. Minimize rack space with its 1 RU design.
   l. Allow for an additional RU for cable management if needed.

C. Operational Requirements:

1. Safety: The Fault-Managed Power System shall adhere to the latest UL-1400 standard to ensure the safety of users and connected devices. It shall include safeguards against electrical hazards, overheating, and other potential risks.

2. Installation: The Fault-Managed Power System shall be designed for straightforward installation. It must include clear and comprehensive installation instructions to facilitate System Integrators in setting up the system quickly and efficiently.

3. Ease of Management and Upgrades: The Fault-Managed Power System shall offer intuitive management tools to allow for easy configuration, monitoring, and control. Furthermore, it shall support future upgrades and enhancements, ensuring longevity and adaptability.

4. Power Delivery Range: The Fault-Managed Power System shall reliably deliver power to remote receivers located up to 2 km away, offering consistent performance even at maximum range.

5. Scalability: The system's scalability shall enable System Integrators to configure multiple combinations of power supplies and transmitter modules, ensuring it can meet the power requirements of various installations.

6. Compatibility: The Fault-Managed Power System shall be compatible with a wide range of electrical devices requiring ±48 VDC power to maximize its usability across different applications.

7. Rack Space Efficiency: The system's 1 RU design should effectively minimize the space required within equipment racks, making it suitable for installations with limited

space. Additionally, it should offer the option of an extra RU for cable management to maintain a neat and organized installation.

8. Structured cabling support: The system shall support either direct connect or patch panel with jumpers (recommended). Connections at the Transmitter and the Receiver shall use push-on Euro-style connectors (Phoenix) with screws that connect to the Transmitter and Receiver for a more secure and reliable connection.

2.3 Class 4 Transmitter Chassis

A. Input Voltage - Source accepts up to 3 Power Supply Units (PSU). See specifications for details.
B. Output Voltage - Source accepts up to 9 Transmitter Modules. See specifications for details.
C. Output Power - 4800 W (Based on fully loaded Transmitter Chassis).
D. Alarm Output - 80mA AC or DC, 30 Ω max, 5kV RMS isolation, <1 µA leakage at 350 V, Contacts rated for 30 V, Maximum wire size: 16 AWG (1mm2)
E. Dimensions - 22"L x 17.5"W x 1.7"H, (553.9mm x 445.8mm x 43.8mm) 1 RU
F. Weight - Base Configuration: 12.75 lbs., (5.78 kg)
G. Mounting - Horizontal or Vertical Mounting L Brackets for 2-post racks
H. Connections - Inlet: IEC 60320 C-19, Transmitter module Outlet: Screw terminal plug (12-30 AWG), Alarm Outlet: 2-pin spring loaded terminal (16-26 AWG), Network: RJ45 connector.
I. Operating Temperature - (-10°C to 50°C)
J. Storage Temperature - (-10°C to 60°C)
K. Humidity - (0% to 85%, non-condensing)
L. Pollution Degree - 3
M. Altitude - 6500' (2000m), Above 2000m, de-rate operating ambient temperature 5°C per 1000m.
N. Split chassis design that support input power supply on one side (rear) and output power via transmitter module on the other side (front).

2.4 Power Supply Unit (PSU)

A. Input Voltage - 115 to 230 VAC, single phase, 50-60 Hz (Output power de- rates at <180 VAC)
B. Input Current - 15.2 Amps @ 115 VAC nom, 7.6 Amps @ 230 VAC nom
C. Inrush Current - 50 Amps cold start
D. Leakage Current - <1.1 mA at 230 VAC
E. Output Voltage - ±187.5 VDC ±12.5 VDC, ±1%, 300 mV pk, -pk ripple
F. Output Current - 5 Amps
G. Output Power - 1600 W(Based on 208 VAC input)
H. Efficiency - >92%
I. Power Factor - >0.9 at 230 VAC at Full Load
J. Isolation - 3kV input to output, 2kV input to ground, 0.5kV output to ground
K. Insulation - 100 MΩ minimum at 500 VDC 25°C 70% Relative Humidity
L. Recommended Breaker Size - 2 pole 20 Amps feed
M. Dimensions - 11.1"L x 5.63"W x 1.61"H, (282mm x 143mm x 41mm)
N. Weight - 3.7 lbs. (1.68 kg)
O. Mounting - Hot-swappable via quick release mount
P. Connection - Inlet: IEC 60320 C-19

2.5 Class 4 Transmitter Module

A. Input Voltage - ±180 VDC nominal Meets high impedance requirement by UL-1400
B. Output Voltage - ±180 V Pulses 2 mS ON, max. duty cycle of 66%
C. Output Current - 5 Amps pk max. current, limited on each pulse.
D. Output Power - 600 W
E. Peak Efficiency 99%
F. Dimensions - 8.78"L x 1.66"W x 1.61"H, (223mm x 42.1mm x 41mm)
G. Weight - 1 lb. (0.45 kg)
H. Mounting - Hot-swappable via quick release mount
I. Connections - Outlet: Screw terminal plug (12-30 AWG)

2.6 Class 4 Receiver

A. Input Voltage - ±180 V Pulses, 2 mS ON with a max duty cycle of 66%
B. Input Current - 3.0A pk max.
C. Output Voltage - 48 VDC ±2% @ 25°C
D. Output Current - Receiver accepts up to 3 inputs from Transmitter Modules., Per input channel: ±12.5 Amps ±5% @ 25°C
E. Output Power - Per input channel: 530W Maximum per receiver: 1600 W
F. Efficiency - Peak efficiency 97%
G. Dimensions - 9.45"L x 9.4"W x 4.2"H, (240mm x 239mm x 107mm)
H. Weight - 15.45 lbs. (7 kg)
I. Mounting - Wall-mountable
J. Connections - Inlet: 3 Screw terminal plugs per channel, (12-30 AWG), Outlet: 3 Screw terminal plugs (8-24 AWG)
K. Operating Temperature – (-10°C to 60°C).

2.1 CONTROLS AND INDICATIONS

A. The Class 4 Fault-Managed Power System shall have hardware-based fault detection.

B. The Class 4 Fault-Managed Power System shall have an Ethernet interface for system management. This interface shall support the following protocols:
    1. DHCP – Dynamic Host Configuration Protocol
    2. SNMP V3/V2c
    3. HTTP/HTTPS
    4. DNS
       LDAP
    5. SSH – terminal access
    6. RADUIS
    7. SMTP – for outbound mail notifications

C. Each Transmitter module shall have LED indicators that show the following status of power and the other LED shall show the status of the communication channel to the remote.
    1. LED 1- Communications
        a. Red – Error
        b. Yellow – Receiver not detected
        c. Blue – Normal, Transmitter detects receiver, output power disabled
        d. Green Normal, Transmitter detects receiver, output power enabled
    2. LED 2 – Transmitter status
        a. Red – Error

b. Red flashing – Safety fault
c. Yellow – Over/Under temperature range
d. Orange – Input or Output voltage not in range
e. Blue – Normal output disabled
f. Green – Normal output enabled

D. Each Receiver shall have one LED indicator per input channel that shows the following state:
1. Red – Fault Detected
2. Yellow – Either no load detected or out of temperature range
3. Orange – Input or output voltage out of range
4. Blue – Normal, output disabled
5. Green – Normal, output enabled
6. Off – No Input Power

E. Each Transmitter Chassis shall have a network management card with three LED indicators
1. LED 1 (System Status)
a. Green – Normal
b. Yellow – At capacity threshold
c. Various colors duplicated from remote with highest error condition
d. Red – Capacity overload
2. LED 2 (Power Supply Status)
a. Duplicate condition of worst-case power supply (on rear)
b. Green is normal
3. LED 3 (Network Management Card Status)
a. Green – Normal
b. Red – Fault or system change
c. Yellow – temperature issue
d. Orange – SD card missing

F. System shall support event logging by:
1. On device non-volatile memory
2. SNMP alerts to centralized SNMP manager
3. SYSLOG alters to centralized SYSLOG server (UDP 514)
4. E-Mail notification (SNMP)

G. The system shall have an embedded web server that supports monitoring, control, configuration, and firmware updates. This interface shall also allow viewing of system log data. Key functions supported by this web GUI include:
1. Virtual LED representation mirroring transmitter and receiver LEDs on components
2. Ability to remotely disable/enable transmitter module
3. Ability to remotely disable/enable receiver module.
4. Ability to remotely disable/enable power supply units (PSU)
5. Ability to see current load, input voltage, output voltage, and temperature on transmitter
6. Ability to see current load, input voltage, output voltage, and temperature on receiver
7. Support both mobile and standard compute devices
8. Visually see the entire power chain status and current state
9. See system configuration settings and modify user-defined fields

H. Security: Remote access to the unit shall be provided by utilizing HTTPS, strong password requirements, and optional integration with LDAP and RADIUS services. The system also supports different user roles that limit what actions users assigned to that role can perform. The device BIOS has a secure boot function that validates authenticity of the firmware before said firmware is activated.

I. Local control: The system shall be completely automated with no local switches or buttons other than recessed reset switch location on each transmitter and the network management card.

J. Load management: The system shall calculate the load (number of PSU installed and delivering power versus transmitters consuming power) and compares this to the user defined threshold. When exceeded an alarm is generated.

2.2 Class 4 FMPS Wiring:

A. System shall support 12-18 AWG wiring (twisted pairs) at the Transmitter module output and Receiver input. System shall support 8-24 AWG wiring at the Receiver output.
B. Standard wiring shall be certified to UL 1400-2 and Class 4 listed.
C. Outer jacket shall be PVC for indoor applications.
D. Operating temperature shall be -20 degrees C to +75 degrees C.

PART 3 – EXECUTION

3.1 EXAMINATION

A. A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the fault managed power system.

B. B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. C. Verify installation conditions are representative of the conditions used in the coordination studies for the fault managed power system.

3.2 INSTALLATION

A. Comply with NECA 2023 Class 4 and latest UL-1400 standards.

B. Wiring Method: Install cables in raceways or on j-hooks per manufacturer's recommendations

C. Equipment Mounting:

1. Transmitter Chassis shall be rack mounted per manufacturer's recommendations
2. Receiver shall be wall or ceiling mounted per manufacturer's recommendations

3.1 GROUNDING

A. Ground Equipment according to Section 26 0526 "Ground and Bonding for Electrical Systems"
B. Transmitter chassis shall be grounded via green grounding screw through mounting bracket to a grounded and bonded rack.
C. Receiver chassis shall be grounded via two- hole lug to local bus bar or building steel

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

1. Identify each component individually that make up the fault managed power system.

3.3 FIELD QUALITY CONTROL

A. Installation:
   1. Ensure that the Class 4 Fault-Managed Power System is installed correctly and in accordance with the manufacturer's instructions. This includes checking the following:

      a. All wiring is properly connected and insulated.
      b. All components are properly grounded.
      c. The system is installed in a clean and dry environment.
      d. The system is properly ventilated to prevent overheating.
      e. The required AC circuits for the transmitter chassis are installed
      f. The required PDU's are installed
      g. Appropriate cooling is present at headend

B. Testing:

   1. Once the system is installed, test it to ensure that it is operating properly. This includes the following tests:

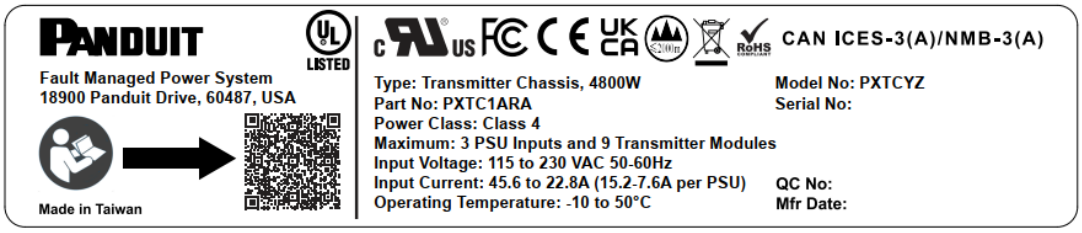
      a. Power quality testing to verify that the voltage, current, and frequency are within acceptable limits.
      b. Grounding resistance testing to verify that the system is properly grounded.
      c. Insulation resistance testing to verify that the wiring is properly insulated.
      d. Functional testing to verify that the system can provide power to the desired devices.

C. Documentation:

   1. Keep accurate records of all installation and testing activities. This documentation should be used to verify that the system was installed and tested correctly.

   2. Labeling:
      a. All Class 4 Fault-Managed Power System components should be clearly labeled by manufacturer. Labels should include the following information:

         1) Manufacturer
         2) Model number
         3) Serial number
         4) Voltage
         5) Current
         6) Power
         7) Class 4 with UL stamp (see below)



D. Security: The Class 4 Fault-Managed Power System should be installed in a secure location to protect it from unauthorized access and tampering.

E. Redundancy: If redundancy is required, the Class 4 Fault-Managed Power System should be installed in a way that provides the required level of redundancy.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fault managed power system.

END OF SECTION 27 6310