

# NEC Class 2 circuits: power supply and circuit requirements

May 2023

Written by: Jack Coghlan, Lead Product Support Engineer

Industrial automation and process control equipment, along with other low energy-consuming devices that were once routinely energized with 120 V AC power systems, are increasingly migrating to designs that operate on low-wattage, limited-power resources. As a result, industrial workplaces are becoming safer.

The lower voltage and current components of power-limited electrical circuits reduce electrical shock hazards, and the resulting reduced VA power limitations enhance the fire safety integrity of physical structures. The NFPA 70 National Electrical Code (NEC) specifies special conditions required to provide safe low-voltage/low-current power circuits for electrical distributions installed in buildings and structures throughout the United States. The NEC defines power supply and circuit wiring requirements that must be achieved from their power sources to their connected downstream equipment loads. To qualify as Class 2 circuits, the NEC requires limited-power circuits meeting those conditions to be tested by Underwriters Laboratories (UL) - or another approved Nationally Recognized Testing Laboratories (NRTL) - in their ability to preserve the system during short-circuit events and electrical faults before they can be approved for Class 2 certification.

While Class 2 circuits can be energized with 24 V AC (or DC voltage values up to 60 V DC), many industries power these circuits with 24 V DC sources. Nevertheless, the limiting factor of any Class 2 circuit is its ability to limit the circuit's current conduction to values that maintain the maximum circuit power capacity to 100 VA, in reference to any allowable source voltage value. Class 2 Certified power supplies and over-current circuit protectors that achieve and uphold that requisite must do so throughout their power source's full nominal operating ranges. For example, if a 24 V DC power supply's specifications state that its maximum output voltage range can extend up to 28 V DC, then it must be designed to limit the circuit's current capacity to 3.57 A (100 VA/28) at that 28 V DC threshold to maintain its Class 2 circuit's 100 VA power-limitation requirements.

Phoenix Contact offers several Underwriters Laboratories (UL) 1310 Approved UNO and QUINT 4 low-

wattage 24 V DC output power supplies that meet NEC's Class 2 source power requirements and are MARKED accordingly. Any of those Class 2 certified power supply models can be used to directly power individual Class 2 circuits whose load requirements fall within the power supplies' rated power output capacities. Larger systems with several circuits that have low wattage requirements, are better served in sourcing their 24 V DC power from higher amperage output power supplies used in conjunction with Electronic Circuit Protectors (ECPs). The DC outputs provided by high-capacity power supplies, regardless of their input voltage configurations, can be easily arrayed into 24 V DC power distributions that support multiple 24 V DC circuits. Protecting those circuits individually with Class 2 Approved ECPs qualifies them as Class 2 circuits and precludes the need for the power supply to be Class 2 certified as well.

It is important to emphasize that only Class 2 Approved ECPs are permitted to originate and protect Class 2 limited-power circuits. Conventional fuses and circuit breakers CANNOT be used for that purpose because they do not perform at the efficiency levels required to maintain the 100 VA power-limiting integrity required by Class 2 circuits. ECPs, on the other hand, differ from common circuit interrupters in that they are highly efficient, intelligent devices with precise tripping characteristics. They are more sensitive to over-current events than their conventional counterparts and activate faster and more reliably than fuses and circuit breakers. ECPs are designed to rapidly open their protected circuit(s) when called upon to conduct over-current values at just 20% over their nominal current ratings. Their operating characteristics ideally suit them to protect Class 2 circuit applications.

Conversely, standard thermal-magnetic circuit breakers must conduct much higher over-current values than their ECP counterparts to open their protected circuits immediately. Depending on their time-current curve (trip curve) characteristics, they must conduct from 3 to 20 times their nominal current ratings before they activate and open their protected circuits. This delayed reaction can be problematic because low-voltage power-limited power supplies may not be capable of supplying current at those values to activate mechanical circuit protectors or may respond too slowly. These technology limitations can be extrapolated to the trip characteristics of fuses and their inability to maintain a Class 2 circuit's 100 VA power-limiting integrity.

Class 2 circuits are a growing conversation for many industries as they can bring many benefits for automation systems. Phoenix Contact offers numerous ECP product options with our UL 1310 Approved PTCB, CBMC, and CAPAROC

## NEC Class 2 circuits: power supply and circuit requirements

May 2023

product lines to meet most NEC Class 2 circuit needs. Equipment users and circuit designers can quickly select application specific ECPs with versatile option sets to uniquely satisfy most Class 2 circuit monitoring, expansion, and remote interfacing requirements.