

Application of multi-wire terminals for molded case circuit breakers

Abstract

Multi-wire terminals for molded case circuit breakers are a means to provide more than one load side termination while maintaining the circuit breaker's UL® listing. This paper examines the application of multi-wire terminals in conjunction with UL Standard 508A as well as with the National Electrical Code®, NFPA® 70-2014 (NEC®). The paper addresses multi-wire terminals used with circuit breakers in industrial control panels as defined in NEC Section 409 and UL Standard 508A.

Multi-wire terminals

The tables below list field-installed, multi-wire terminals for Eaton breakers. These are UL listed for installation on the load side (only) of the corresponding circuit breaker. It is important to note that each load conductor must be sized in order to provide the proper ampacity to meet the circuit breaker's handle rating, or be protected by a properly sized individual overcurrent device. Under these conditions, the installed multi-wire terminal will maintain the marked short-circuit current rating of the breaker.

Circuit breakers equipped with multi-wire terminals function as feeder breakers, as opposed to branch breakers. Feeder circuits can be tapped, while branch circuits cannot.

Table 1. Power Defense breakers

Frame	Max. amperes	Wires per terminal	Wire size range AWG	Wire class	Kit catalog number
PD1	125	3	14–2	B & C	PDG1X3TA1253W
PD1	125	6	14–6	B & C	PDG1X3TA1256W
PD2	225	3	14–2	B & C	PDG2X3TA2253W
PD2	225	6	14–6	B & C	PDG2X3TA2256W
PD3	400	3	12–2/0	B & C	PDG3X3TA4003W
PD3	400	6	14–3	B & C	PDG3X3TA4006W
PD3	600	6	14–1/0	B & C	PDG3X3TA6006W
PD3	600	6	12–2/0	B & C	PDG3X3TA6006WSW
PD3	600	6	8–1/0	D, G, H, I, K, M	PDG3X3TA6006WSW

Table 2. Series C® breakers

Frame	Max. amperes	Wires per terminal	Wire size range AWG	Kit catalog Number
G	100	3	14–2	3TA100G3K
G	100	6	14–6	3TA100G6K
F	225	3	14–2	3TA150F3K
F	225	6	14–6	3TA150F6K
J	250	3	14–2	3TA250J3K
J	250	6	14–6	3TA250J6K
K	400	3	12–2/0	3TA400K3K
K	400	6	14–3	3TA400K6K

Table 3. Series G® breakers

Frame	Max. amperes	Wires per terminal	Wire size range AWG	Kit catalog Number
EG	125	3	14–2	3TA125E3K
EG	125	6	14–6	3TA125E6K
JG	250	3	14–2	3TA250FJ3
JG	250	6	14–6	3TA250FJ6
LG	600	6	14–1/0	3TA600L6K



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Codes and standards requirements

NEC requirements

NEC Section 430.28 addresses the topic of feeder taps.

430.28 Feeder Taps—Feeder tap conductors shall have an ampacity not less than that required by Part II (Part II addresses the sizing of conductors for specific loads; consult the NEC for details), shall terminate in a branch-circuit protective device, and, in addition, shall meet one of the following requirements:

1. Be enclosed either by an enclosed controller or by a raceway, be not more than 10 feet (3 m) in length, and, for field installation, be protected by an overcurrent device on the line side of the tap conductor, the rating or setting of which shall not exceed 1000 percent of the tap conductor ampacity.
2. Have an ampacity of at least 1/3 that of the feeder conductors, be suitably protected from physical damage or enclosed in a raceway, and be not more than 25 feet (7.5 m) in length.
3. Have an ampacity not less than the feeder conductors [Reference 1].

UL 508A requirements

UL 508A Section 31.4 addresses the issue using similar language.

Section 31.4.3—The ampacity of the tap conductors, the internal conductors to the individual loads, shall be:

- A. Not less than 1/3 the ampacity of the branch circuit conductor, calculated as in 28.3.3 (28.3.3 addresses the sizing of field-wiring conductors for specific loads. Consult UL 508A for details.); or
- B. Not less than 1/10 the ampere rating of the branch circuit protection for the group for each motor circuit provided with a manual motor controller marked “Suitable as tap conductor protection in group installations” and complies with the Standard for Industrial Control Equipment, UL 508. The conductors on the load side of the manual motor controller shall have an ampacity not less than calculated in 28.3.2 (28.3.2 addresses the sizing of field-wiring conductors for motor loads; consult UL 508A for details) [Reference 2].

NEC 430.28 (1) and UL 508A 31.4.3 (b) state the same requirement in different terms. Both agree, however, that a tap conductor no more than 10 feet (3 m) long, emanating from a multi-wire terminal (tap), must have an ampacity equal to at least 10 percent of the ampacity of the feeder breaker’s trip current. Some term this the 10-foot tap rule.

Likewise, NEC 430.28 (2) and UL 508A 31.4.3 (a) state the same requirement for tap conductors up to 25 feet (7.5 m) long, sometimes termed the 25-foot tap rule. A tap conductor up to 25 feet (7.5 m) long must have an ampacity equal to at least 1/3 the ampacity of the feeder breaker’s trip current.

Sizing conductors

Application complying with UL 508A

10-foot tap rule

The ampacity for a tap conductor applied to a 200 A circuit breaker must be equal to 20 A or greater. Referring to Table 28.1 in UL 508A, the conductor would have to be at least 12 AWG. The conductor must terminate in an appropriately sized overcurrent protective device, for example, a circuit breaker or fuse.

25-foot tap rule

The ampacity for a conductor not exceeding 25 feet (7.5 m) in length must be at least 1/3 the ampacity of the circuit breaker’s trip rating. The ampacity for a tap conductor applied to a 300 A circuit breaker must be equal to 100 A or greater. Referring to Table 28.1 in UL 508A, the conductor would have to be at least 3 AWG. The conductor must terminate in an appropriately sized overcurrent protective device, for example, a circuit breaker or fuse.

Size range of conductors

While a wide range of conductors is listed for a particular multi-wire terminal, the entire range may not apply to every breaker frame to which a terminal is affixed. A K-frame breaker, for example, can have trip ranges from 70 A to 40 A. While a 14 AWG conductor may be applied to a 70 A trip unit, it may not be applied to a 400 A trip unit. Proper selection must be made as noted in the rules elucidated in the application sections above.

Conductor temperature ratings

Circuit breaker terminals are rated for a maximum temperature of 75 °C. Attention must be paid to conductor temperature ratings and the corresponding ampacities tabulated in the appropriate standard. Table 28.1, UL 508A, contains columns for conductor temperatures of 60 °C and 75 °C. Either is within the range of the multi-wire terminal temperature rating.

While NEC Table 310.15 (b) (16) contains like ratings, it also contains columns for 90 °C and higher. Conductors having higher temperature ratings, such as 90 °C, may be used; however, the ampacity must be de-rated to that in the 75 °C column.

Conclusion

Multi-wire terminals can offer significant advantages in the construction of industrial control panels.

1. While a combination of a circuit breaker and a power terminal block must be tested for a combined short-circuit current rating, a multi-wire terminal is a listed circuit breaker accessory, carrying the same short-circuit current rating as the breaker.
2. A multi-wire terminal is mounted on the circuit breaker’s load-side terminals, saving expensive panel space, mounting time, and wiring time.
3. A circuit breaker can have a multi-wire terminal factory-mounted, saving labor for the panel manufacturer.

References

1. NFPA 70, the National Electrical Code (2014). Quincy, MA: National Fire Protection Association.
2. UL 508A (2013). Northbrook, IL: Underwriters Laboratories.

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Printed in USA
Publication No. AP01200004E / Z1919
November 2018