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# Data Bulletin

# Enhancing Short Circuit Selective Coordination with Low Voltage Circuit Breakers

**Retain for future use.**

## Introduction

**The purpose of this data bulletin** is to present techniques for improving the short circuit selective coordination of low voltage circuit breakers used in electrical distribution systems.

**It is a myth** that only fuse based low voltage systems can be selectively coordinated. Modern molded case, insulated case and low voltage power circuit breakers provide the performance necessary to deliver higher levels of coordination than some have previously thought possible. This data bulletin demonstrates this fact.

**The scope of this data bulletin** encompasses only breaker to breaker short circuit selective coordination. Coordination with fuses and the protection of motors, transformers and other devices, as well as coordinated ground fault protection, is not discussed. See the Reference section, **on page 10**, for other data bulletins.

## Definitions

See the Glossary in **Appendix B on page 21**, for a list of terms used in this data bulletin.

## Assumptions

A few assumptions have been made in the writing of this data bulletin:

**Circuit Breaker Contact Position**

It is assumed that all circuit breakers in the system, with the possible exception of the branch breaker nearest to the fault, are in the closed (ON) position when the fault occurs. Some circuit breakers, notably insulated case and low voltage power circuit breakers, may incorporate a making current release (MCR) trip function set slightly below the circuit breaker's close and latch rating. The MCR trip level may be below that of the adjustable instantaneous or instantaneous override trip functions.

**Instantaneous Trip Setting**

In order to maximize selective coordination, it is assumed that the instantaneous trip setting on all main and feeder breakers in the system, if adjustable, will be set to the highest position. It is also assumed that if the instantaneous trip function on electronic trip mains and feeders can be turned off it will be.

Turning off the instantaneous trip function does not mean that the circuit breaker loses its ability to protect against short circuits. Square D® electronic trip circuit breakers that have an OFF position on the instantaneous switch are also equipped with a short time pick-up and delay function, and may also be equipped with an instantaneous override function if necessary for the proper functioning of the circuit breaker.

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## Circuit Breaker Basics

Before embarking on improving the design of a low voltage distribution system using circuit breakers so as to improve short circuit selective coordination, it would be helpful to know a few simple facts about circuit breakers that relate to selective coordination.

**What a Circuit Breaker Must Protect**

The primary function of a circuit breaker is to protect the downstream conductors connected to it. That is why virtually all circuit breakers are tested with a length of wire. However, the trip system inside the circuit breaker must also be able to protect the circuit breaker itself, as excessive current levels could damage the circuit breaker, rendering it unable to perform it's intended function. For this reason, circuit breakers with electronic trip systems may incorporate a making current release and/or an instantaneous selective override. When conducting a short circuit coordination study, the instantaneous override level needs to be considered.

This is not to say, of course, that circuit breakers are never applied in load protection applications as opposed to conductor protection applications. Certainly they are, but special protection studies must be conducted in such instances utilizing the circuit breaker trip curves and are not within the scope of this guide.

**Continuous Current Rating Overlap**

Circuit breaker manufacturers typically provide some overlap in the continuous current (handle) ratings of progressively larger frame size circuit breakers. For example, current ratings for 150, 250 and 400 A circuit breaker frames might be 15–150 A, 150–250 A, and 250–400 A respectively.

**Electronic Trip Systems**

The advantages of being able to adjust the trip curve of a circuit breaker equipped with an electronic trip system are obvious. But there are other advantages, such as being able to turn the instantaneous trip function off on some circuit breakers and models of trip units and the ability to select lower rated current sensors.

**Adjustable Trip Settings**

It should be noted that all adjustable trip settings on Square D® low voltage circuit breakers, with the exception of the ampere rating switch (also known as Ir or long time pick-up), are set to their lowest position in the factory prior to shipment. Thus, in order to realize the selective coordination planned, these settings may need to be adjusted in the field.

**Series Ratings**

The adjustment of trip settings does not affect any series rating that may be employed as UL® requires series ratings tests to be conducted with the instantaneous trip adjustment set to its highest position.

## Basic Information Needed

**System One-line Diagram**

A one-line diagram of the system to be studied is absolutely necessary in order to determine the level of system coordination.

**System Voltage**

While the system voltage, in and of itself, has no impact on selective coordination, it does impact circuit breaker selection, which in turn impacts coordination; thus the system voltage needs to be known.

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### Circuit Ampacity

The instantaneous trip characteristics of a circuit breaker are more often a function of the frame or current sensor rating rather than the current rating of the circuit breaker. However, the current rating required to meet the ampacity of the circuit drives the circuit breaker selection, thus it needs to be known. (See NEC® Articles 210, 215, 220, 225 and 230.)

### Available Short Circuit Current

The available short circuit current at each point in the system should be determined in order to select circuit breakers with the proper interrupting rating and in turn to determine the level of selective coordination.

## Determining the Selective Coordination Level

Based on the system one-line diagram, select the circuit breakers required throughout the system using catalog information or selection tools provided by the manufacturer. This will yield what will hence be referred to as the “standard” circuit breaker selection.

### Determine Selective Coordination Levels

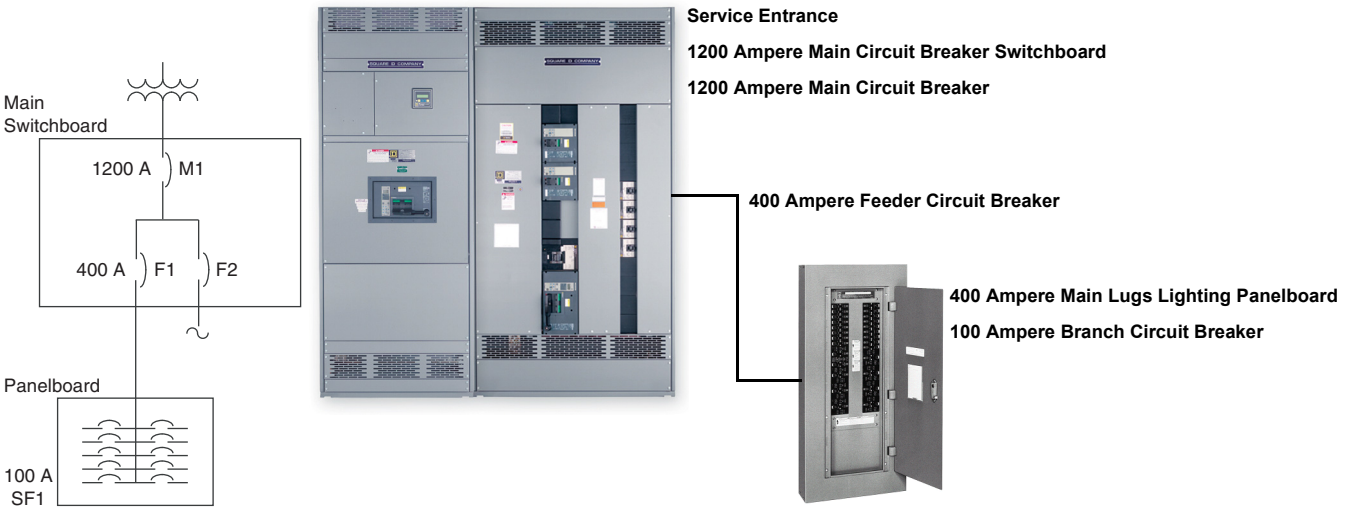
Determine the selective coordination of the standard circuit breaker selection by using trip curves, selective coordination software tools provided by the manufacturer or third parties, or the data presented in **Appendix A on page 11**.

**Example**

One manufacturer has published an example of a three tiered system consisting of a 1200 A molded case circuit breaker over a 400 A circuit breaker over a 100 A circuit breaker. The selective coordination analysis based on published trip curves showed the main breaker selectively coordinated up to 7,200 A. System voltage, available short circuit currents, and the type of equipment housing each circuit breaker, were not specified.

**Figure 1**, below, proposes what such an arrangement might look like in the real world, namely a 1200 A main breaker switchboard with a 400 A feeder breaker feeding a 400 A main lugs lighting panelboard with a 100 A branch breaker. Based on this configuration, a selective coordination study was conducted utilizing the method outlined above at 208 Y / 120 Vac and a 480 Y / 277 Vac with an assumed available short circuit current at the service entrance of 65 kA. Square D® circuit breakers and equipment were used in the analysis.

**Figure 1: A Typical Three-tiered System**



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As can be seen in **Table 1** below, with no short circuit study and a standard circuit breaker selection, the system is selectively coordinated up to 21,600 A at the main and up to 3,000 A at the feeder on the 208 Y / 120 Vac system. On the 480 Y / 277 Vac system the circuit breakers are selectively coordinated up to 9,000 A at the main and up to 2,400 A at the feeder. These levels are “worst case,” taking into account the tolerances of the instantaneous trip functions.

**Table 1: Selective Coordination with a Standard Circuit Breaker Selection**

| One-line Diagram | Available Short Circuit Current (kA) | Circuit Breaker Ampacity (A) | Square D® Equipment | Square D® Circuit Breaker | Instantaneous Trip[1] (Amperes) | Instantaneous Override Trip[2] (Amperes) | Maximum Selective Coordination Level[3] (Amperes) |
|---|---|---|---|---|---|---|---|
| **208 Y / 120 Vac 65 kA Available Short Circuit Current** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | PGA36120U33A | OFF | 21,600–26,400 | 21,600 |
| | 65 | 400 | I-Line® Switchboard | LH36400 | 3,000–4,800 | None | 3,000 |
| | 65 | 100 | NF Panelboard | EGB34100 | 1,725–2,760 | None | — |
| | **Fault** | | | | | | |
| **480 Y / 277 Vac 65 kA Available Short Circuit Current** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | PJA36120U44A | OFF | 9,000–11,000 | 9,000 |
| | 65 | 400 | I-Line® Switchboard | LC36400 | 2,400–3,840 | None | 2,400 |
| | 65 | 100 | NF Panelboard | EJB34100 | 1,725–2,760 | None | — |
| | **Fault** | | | | | | |

1 Range shown is UL® 489 maximum allowable.

2 Range shown is from published literature.

3 Value shown takes into account the minimum tolerance of the upstream circuit breaker and the maximum tolerance of the downstream circuit breaker.

One might argue that “in the real world” a 500 kVA transformer might feed a 1200 A 208 Y / 120 Vac system. Assuming a standard impedance of 5.0%, unlimited short circuit kVA available on the primary and 50% motor load, the secondary short circuit current would be only 30,600 A. Similarly, a 1000 kVA transformer might feed a 1200 A 480 Y / 277 Vac system. Assuming a standard impedance of 5.75%, unlimited short circuit kVA available on the primary and 100% motor load, the secondary short circuit current would be only 25,700 A. But for the purposes of illustrating how selective coordination can be improved to even higher levels than these, the assumed 65 kA available short circuit current level will continue to be used.

## Optimizing the Selective Coordination Level

Here are some suggestions on how to optimize selective coordination of a circuit breaker based low voltage system. **Appendix A on page 11**, lists the instantaneous trip levels of various Square D® low voltage circuit breakers and other pertinent information necessary to employ the suggestions listed below. The sample system illustrated in **Figure 1, on page 3**, is used to illustrate these techniques.

**Conduct A Short Circuit Study**

Conducting a short circuit study may reveal that lower interrupting rated circuit breakers can be selected at the feeder and branch levels, possibly resulting in higher withstand ratings.

Tables 2, 3 and 4 show standard rated branch breakers (10 kAIR for the 208 Y / 120 Vac system and 18 kAIR for the 480 Y / 277 Vac system). Is this assumption reasonable? Yes it is, as only 125 feet of #2 THHN in the 208 Vac system and 53 feet in the 480 Vac system would drop the available short circuit current at the branch to 10,000 A or 18,000 A respectively.

A Square D® PowerPact® PG circuit breaker has an instantaneous override set at 24,000 A nominal while the higher interrupting rated PJ circuit breaker has an instantaneous override set at 10,000 A nominal. Thus, had the lighting panel feeder breaker been located some distance from the service entrance, a lower interrupting rated PG circuit breaker might have been selected, increasing the maximum level of selective coordination.

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### Increase Frame Size

As can be seen in **Table 2** below, by increasing the frame size of the main, the selective coordination at that level in the system can be increased from 21,600 A to 51,300 A and from 9,000 A to 40,800 A on the 208 Vac and 480 Vac systems respectively. This is possible because a 1200 A rating is available on the 2500 A PowerPact® R-frame unit mount circuit breaker. (Note that in a Square D® I-Line® switchboard, a 1200A PowerPact® R-frame I-Line® circuit breaker could also be selected as a back-fed main.)

By increasing the frame size of the feeder breaker, selective coordination at the feeder can be increased from 3,000 A to 21,600 A and from 2,400 to 9,000 A on the 208 Vac and 480 Vac systems respectively. This is possible because a 400 A rating is available on the 1200 A PowerPact® P-frame I-Line® circuit breaker.

**Table 2: Improving Selective Coordination by Increasing the Frame Size of the Main and Feeder Circuit Breakers**

| One-line Diagram | Available Short Circuit Current (kA) | Circuit Breaker Ampacity (A) | Square D® Equipment | Square D® Circuit Breaker | Instantaneous Trip[1] (Amperes) | Instantaneous Override Trip[2] (Amperes) | Maximum Selective Coordination Level[3] (Amperes) |
|---|---|---|---|---|---|---|---|
| **208 Y / 120 Vac 65 kA Available Short Circuit Current at Service Entrance** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | RGF36120U33A | OFF | 43,200–52,800 | 43,200 |
| | 65 | 400 | I-Line® Switchboard | PGA36040U33A | OFF | 21,600–26,400 | 21,600 |
| | 10 | 100 | NQOD Panelboard | QOB3100 | 1,125–1,800 | None | — |
| | **Fault** | | | | | | |
| **480 Y / 277 Vac 65 kA Available Short Circuit Current at Service Entrance** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | RJF36120U44A | OFF | 40,800–56,200 | 40,800 |
| | 65 | 400 | I-Line® Switchboard | PJA36040U33A | OFF | 9,000–11,000 | 9,000 |
| | 18 | 100 | NF Panelboard | EDB34100 | 1,725–2,760 | None | — |
| | **Fault** | | | | | | |

1 Range shown is UL® 489 maximum allowable.

2 Range shown is from published literature.

3 Value shown takes into account the minimum tolerance of the upstream circuit breaker and the maximum tolerance of the downstream circuit breaker.

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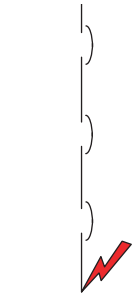
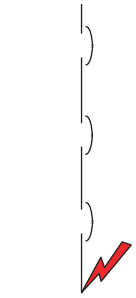
**Table 3**, below, illustrates what would result if the feeder breaker was a PowerPact® R-frame circuit breaker. In this case, the selective coordination level would be 51,300 A at 208 Vac and 40,800 A at 480 Vac. This is possible because PowerPact® R-frame I-Line® circuit breaker is available with a 600 A sensor and an adjustable rating plug that can be set to 0.75.

**Table 3: Improving Selective Coordination by Increasing the Frame Size of the Feeder Circuit Breaker**

| One-line Diagram | Available Short Circuit Current (kA) | Circuit Breaker Ampacity (A) | Square D® Equipment | Square D® Circuit Breaker | Instantaneous Trip[1] (Amperes) | Instantaneous Override Trip[2] (Amperes) | Maximum Selective Coordination Level[3] (Amperes) |
|---|---|---|---|---|---|---|---|
| **208 Y / 120 Vac 65 kA Available Short Circuit Current at Service Entrance** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | RGF36120U33A | OFF | 43,200–52,800 | 43,200 |
| | 65 | 400 | I-Line® Switchboard | RGA36040CU33A | OFF | 43,200–52,800 | 43,200 |
| | 10 | 100 | NQOD Panelboard | QOB3100 | 1,125–1,800 | None | — |
| | **Fault** | | | | | | |
| **480 Y / 277 Vac 65 kA Available Short Circuit Current at Service Entrance** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | RJF36120U44A | OFF | 40,800–55,200 | 40,800 |
| | 65 | 400 | I-Line® Switchboard | RJA36040CU33A | OFF | 40,800–55,200 | 40,800 |
| | 18 | 100 | NF Panelboard | EDB34100 | 1,725–2,760 | None | — |
| | **Fault** | | | | | | |

1 Range shown is UL® 489 maximum allowable.

2 Range shown is from published literature.

3 Value shown takes into account the minimum tolerance of the upstream circuit breaker and the maximum tolerance of the downstream circuit breaker.

### Change Circuit Breaker Type

As can be seen in **Table 4** below, by changing the main from a molded case to an insulated case circuit breaker, the selective coordination at that level in the system can be increased from 21,600 A to 58,500 A and from 9,000 A to 58,500 A on the 208 Vac and 480 Vac systems respectively. Once again, note that these levels are “worst case,” taking into account the tolerances of the instantaneous trip functions. But if the nominal instantaneous override trip level of 65,000 A was considered instead, the main breaker could be considered to be fully selective!

**Table 4: Improving Selective Coordination by Changing the Main Circuit Breaker Type**

| One-line Diagram | Available Short Circuit Current (kA) | Circuit Breaker Ampacity (A) | Square D® Equipment | Square D® Circuit Breaker | Instantaneous Trip[1] (Amperes) | Instantaneous Override Trip[2] (Amperes) | Maximum Selective Coordination Level[3] (Amperes) |
|---|---|---|---|---|---|---|---|
| **208 Y / 120 Vac 65 kA Available Short Circuit Current** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | NW1200H | OFF | 58,500–71,500 | 58,500 |
| | 65 | 400 | I-Line® Switchboard | RGA36040CU33A | OFF | 51,300–62,700 | 51,300 |
| | 10 | 100 | NQOD Panelboard | QOB3100 | 1,125–1,800 | None | — |
| | **Fault** | | | | | | |
| **480 Y / 277 Vac 65 kA Available Short Circuit Current** | | | | | | | |
|  | 65 | 1200 | I-Line® Switchboard | NW1200H | OFF | 58,500–71,500 | 58,500 |
| | 65 | 400 | I-Line® Switchboard | RJA36040CU33A | OFF | 40,800–55,200 | 40,800 |
| | 18 | 100 | NF Panelboard | EDB34100 | 1,725–2,760 | None | — |
| | **Fault** | | | | | | |

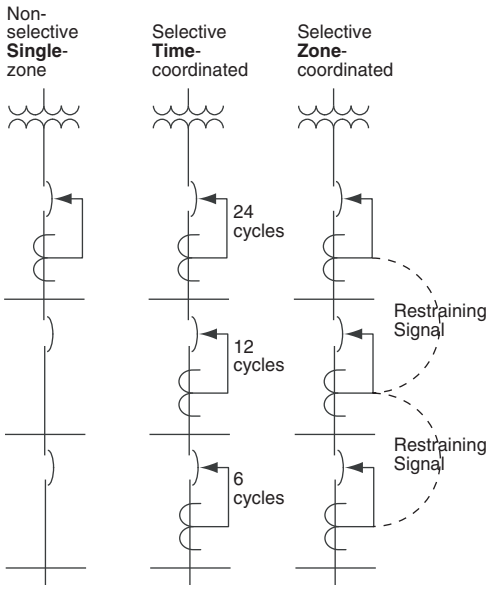
1 Range shown is UL® 489 maximum allowable.

2 Range shown is from published literature.

3 Value shown takes into account the minimum tolerance of the upstream circuit breaker and the maximum tolerance of the downstream circuit breaker.

Although not illustrated, selective coordination on the 208 Vac system at the feeder can also be improved by changing from the standard Square D® LH circuit breaker to the LH-MC Mission Critical circuit breaker that has a higher withstand, and hence instantaneous trip level. Doing this would increase selective coordination at the feeder from 3,000 A to 5,400 A

## Ground Fault Protection




### Requirements and Use

Ground faults are one of the most common low voltage electrical system failures; thus ground fault protection is a good idea at any voltage. But on solidly grounded wye systems of more than 150 Vac to ground but not exceeding 600 Vac phase-to-phase, the National Electrical Code® (Article 230.95) requires the use of ground fault protection on service disconnects rated 1000 A or more. And, in health care facilities, the NEC® requires two levels of ground fault protection (Article 517.17), and requires them to be selectively coordinated.

Employing ground fault protection on feeder and branch circuits can not only minimize system damage but can interrupt the flow of fault current when it is still at a low level, thus preventing the possibility that upstream circuit breakers may trip. It is better to interrupt a fault current early when it is a low level ground fault rather than later when it has escalated into a high level phase-to-phase fault. Thus adding ground fault protection on feeder and branch breakers can improve selective coordination.

### Zone Selective Interlocking

Selective ground fault protection coordination can be achieved by setting progressively higher pick-ups and time delays on upstream devices. But in order to minimize system damage should a ground fault occur somewhere in the “middle” of the system, such as in between the main and feeder, ZSI should be employed. Note that ZSI, in and of itself, does not provide selective coordination. Proper pick-up and time delay settings are required for coordination, with or without ZSI.

## Conclusion

**Consider the functions and characteristics** of circuit breakers in order to enhance the design of selectively coordinated low voltage systems. As previously discussed, these include:

- **Instantaneous Trip Setting**—Some electronic trip units provide an OFF position on the instantaneous trip adjustment. This position can be used to enhance selective coordination without sacrificing the interrupting rating of the circuit breaker or any series ratings that may be available on the equipment in which the breaker is installed.
- **Continuous Current Rating Overlap**—The availability of lower continuous current ratings on higher amp frame circuit breakers can be used to enhance selective coordination as higher amp frame circuit breakers often have higher instantaneous trip levels.
- **Field Adjustment**—Do not neglect to properly adjust circuit breakers in the field as they are often shipped from the factory with all but the ampere-rating switch in the lowest position.

**The methodology for evaluating** the level of selective coordination between low voltage circuit breakers, is as follows:

- **Obtain a one-line diagram** of the system to be studied.
- **Determine the system** voltage and circuit ampacities.
- **Make initial circuit breaker selections.**
- **Determine the selective coordination levels** between adjacent pairs of circuit breakers in the system.

**Several optimizing techniques** for enhancing the level of short circuit selective coordination in a low voltage circuit breaker system include:

- **Conduct a study** to determine the level of short circuit current available at various points in the system. This may allow the selection of circuit breakers with a lower interrupting rating and a higher instantaneous trip level.
- **Increase the frame size** of main or feeder breakers, thus increasing the instantaneous trip level of these breakers.
- **Change the type** of main or feeder breakers from molded case to insulated case or low voltage power, thus increasing the instantaneous trip level of these breakers.
- **Incorporate ground fault protection** into feeder and branch circuits so that low level ground faults will be cleared before they escalate into high level phase-to-phase faults.

**Significant improvements** in the selective coordination of low voltage circuit breaker based electrical distribution systems can be achieved by changing the circuit breaker selection. And as the examples have shown, very high levels of selectivity can be achieved.

## Reference

***Overcurrent Protection***
Document Number: 0600DB0301

***Reducing Fault Stress with Zone-selective Interlocking***
Document Number: 0600DB0001

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# Appendices

## Appendix A

### Instantaneous Trip Data for Square D® Low Voltage Circuit Breakers

**Table 5: 240 Volt Circuit Breakers**

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| **Molded Case Circuit Breakers: UL® 489 Standard** | | | | | | | | |
| 240 | 100 | 25 | FA | T-M | 15–30 | 275–600 | Fixed | None |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | | 65 | FH | | 15–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | | 100 | GJL | | 15–40 | 600–1200 | | |
| | | | | | 50–100 | 800–1400 | | |
| | | 200 | FI | | 20–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | 125 | 25 | ED | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | | 65 | EG | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | | 100 | EJ | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | 150 | 25 | HD | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 65 | HG | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 100 | HJ | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 125 | HL | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |

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**Table 5: 240 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 240 | 250 | 25 | JD | T-M | 150–250 | 5–10 x CCR | Adjustable | None |
| | | 65 | JG | | | | | |
| | | 100 | JJ | | | | | |
| | | 125 | JL | | | | | |
| | | 200 | KI | | 110–250 | | | |
| | | 10 | QB | | 70–90 | 1000–1800 | Fixed | |
| | | | | | 100–250 | 1200–2400 | | |
| | | 25 | QD | | 70–90 | 1000–1800 | | |
| | | | | | 100–250 | 1200–2400 | | |
| | | 65 | QG | | 70–90 | 1000–1800 | | |
| | | | | | 100–250 | 1200–2400 | | |
| | | 100 | QJ[3] | | 70–90 | 1000–1800 | | |
| | | | | | 100–250 | 1200–2400 | | |
| | 400 | 25 | Q4 | | 250–400 | 5–10 x CCR | Adjustable | |
| | | 42 | LA | | 125–400 | | | |
| | | | LA-MC | | 200–250 | 17–20 x CCR | Fixed | |
| | | | | | 400 | 15–18 x CCR | | |
| | | 65 | LH | | 250–400 | 5–10 x CCR | Adjustable | |
| | | | LH-MC | | 200–250 | 17–20 x CCR | Fixed | |
| | | | | | 400 | 15–18 x CCR | | |
| | 600 | 65 | DG | STR23SP | 150–600 | 9 x In | Fixed | 6,000 |
| | | | | STR53UP | | 1.5–7 x In | Adjustable | |
| | | 100 | DJ | STR23SP | | 9 x In | Fixed | |
| | | | | STR53UP | | 1.5–7 x In | Adjustable | |
| | | | LC | T-M | 300–400 | 5 x CCR–3,200 | Adjustable | None |
| | | | | | 450–600 | 5 x CCR–4,200 | | |
| | | | LE | Micrologic® Series B | 100–600 | OFF[4] | | 9 x P–11 x P |
| | | | LX | | | 2.5–8 x P | | |
| | | 125 | DL | STR23SP | 150–600 | 9 x In | Fixed | 6,000 |
| | | | | STR53UP | | 1.5–7 x In | Adjustable | |
| | | 200 | LI | T-M | 300–400 | 5 x CCR–3,200 | Adjustable | None |
| | | | | | 450–600 | 5 x CCR–4,200 | | |
| | | | LXI | Micrologic Series B | 100–600 | 2.5–8 x P | | 9 x P–11 x P |
| | 800 | 65 | MG | ET1.01 | 300–800 | 5–10 x CCR | | None |
| | | 100 | MJ | | | | | |
| | 1200 | 65 | PG, PK | ET1.01 | 600–1200 | 5–10 x CCR | | 21,600–26,400 |
| | | | | Micrologic® | 100–1200 | OFF[4] | | |
| | | 100 | PJ | ET1.01 | 600–1200 | 5–10 x CCR | | 9,000–11,000 |
| | | | | Micrologic® | 100–250 | OFF[4] | | 6,300–7,700 |
| | | | | | 400–1200 | | | 9,000–11,000 |
| | | 125 | PL | ET1.01 | 600–1200 | 5–10 x CCR | | 9,000–11,000 |
| | | | | Micrologic® | 100–250 | OFF[4] | | 6,300–7,700 |
| | | | | | 400–1200 | | | 9,000–11,000 |
| | 2500 | 65 | RG, RK[5] | ET1.01 | 1200–2500 | 5–10 x CCR | | 51,300–62,700 |
| | | | | Micrologic® | 240–2500 | OFF[4] | | |
| | | 100 | RJ[5] | ET1.01 | 1200–2500 | 5–10 x CCR | | 40,800–55,200 |
| | | | | Micrologic® | 240–2500 | OFF[4] | | |
| | | 125 | RL[5] | ET1.01 | 1200–2500 | 5–10 x CCR | | |
| | | | | Micrologic® | 240–2500 | OFF[4] | | |

*Continued on next paget*

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**Table 5: 240 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| **Insulated Case Circuit Breakers (Masterpact®): UL® 489 Standard** | | | | | | | | |
| 240 | 800–1200 | 50 | NT-N | Micrologic® | 100–250 | OFF[4] | Adjustable | 21,600–26,400 |
| | | | | | 400–1200 | | | 36,000–44,000 |
| | | 65 | NT-H | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–1200 | | | 36,000–44,000 |
| | | 100 | NT-L1 | | 100–1200 | | | 9,000–11,000 |
| | | 200 | NT-L | | | | | |
| | | | NT-LF | | | | | |
| | 800–2000 | 65 | NW-N | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–2000 | | | 36,000–44,000 |
| | | 100 | NW-H | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–2000 | | | 36,000–44,000 |
| | | 200 | NW-L | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–1600 | | | 31,500–38,500 |
| | | | | | 2000 | | | 58,500–71,500 |
| | | | NW-LF | | 100–2000 | | | 21,600–26,400 |
| | 2500–3000 | 100 | NW-H | | 1200–3000 | | | 58,500–71,500 |
| | | 200 | NW-L | | | | | |
| | 4000–6000 | 100 | NW-H | | 2000–6000 | | | 67,500–82,500 |
| | | 200 | NW-L | | | | | |
| **Low Voltage Power Circuit Breakers (Masterpact®): UL® 1066 / ANSI C37 Standards** | | | | | | | | |
| 254 | 800 | 42 | NT-N1 | Micrologic® | 100–250 | OFF[4] | Adjustable | 21,600–26,400 |
| | | | | | 400–800 | | | None[6] |
| | | | NW-N1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[6] |
| | | 65 | NW-H1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[6] |
| | | 85 | NW-H2 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[6] |
| | | 100 | NW-H3 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | 76,500–93,500 |
| | | 200 | NW-L1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | 31,500–38,500 |
| | | | NW-L1F | | 100–800 | | | 21,600–26,400 |
| | 1600 | 42 | NW-N1 | | 800–1600 | | | None[6] |
| | | 65 | NW-H1 | | | | | |
| | | 85 | NW-H2 | | | | | |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 31,500–38,500 |
| | | | NW-L1F | | | | | 21,600–26,400 |
| | 2000 | 65 | NW-H1 | | 1000–2000 | | | None[6] |
| | | 85 | NW-H2 | | | | | |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 31,500–38,500 |
| | | | NW-L1F | | | | | 21,600–26,400 |

*Continued on next page*

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**Table 5: 240 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 254 | 3200 | 65 | NW-H1 | Micrologic® | 1600–3200 | OFF[4] | Adjustable | None[6] |
| | | 85 | NW-H2 | | | | | |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 105,300–128,700 |
| | 4000–5000 | 85 | NW-H2 | | 2000–5000 | | | None[6] |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 105,300–128,700 |

1 For thermal-magnetic circuit breakers with fixed instantaneous trip, the lower number is the “must hold” and the higher number the “must trip” value. For thermal-magnetic circuit breakers with adjustable instantaneous trip, the adjustment range shown is a function of the continuous current rating (CCR, aka ampere or handle rating) of the circuit breaker. The allowable UL tolerances are -20% (low) and +30% (high) from the nominal values shown. For electronic trip circuit breakers, the adjustment range shown is a function of the rating plug (P) or the sensor (In). Tolerances are +/-10% on both the low and high end of the range.

2 The range shown reflects manufacturing tolerances.

3 Rated 208 Y / 120 Vac.

4 Turning the instantaneous setting to OFF on Micrologic® electronic trip units will maximize short circuit selective coordination. An OFF setting is available on Micrologic® trip units with LSI or LSIG protection.

5 1200 amperes maximum in I-Line®.

6 This circuit breaker, with the instantaneous set to OFF, is fully selective up to the interrupting rating of the circuit breaker.

**Table 6: 480 Volt Circuit Breakers**

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| **Molded Case Circuit Breakers: UL® 489 Standard** | | | | | | | | |
| 480 Y / 277 Vac | 125 | 18 | ED | T-M | 15–30 | 270–875 | Fixed | None |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | | 35 | EG | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | | 65 | EJ | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| 480 | 100 | 18 | FA | | 15–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | | 25 | FH | | 15–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | | 65 | GJL | | 15–40 | 600–1200 | | |
| | | | | | 50–100 | 800–1400 | | |
| | | 200 | FI | | 20–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |

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**Table 6: 480 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 480 | 150 | 18 | HD | T-M | 15–30 | 350–750 | Fixed | None |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 35 | HG | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 65 | HJ | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 100 | HL | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | 250 | 18 | JD | | 150–250 | 5–10 x CCR | Adjustable | |
| | | 35 | JG | | | | | |
| | | 65 | JJ | | | | | |
| | | 100 | JL | | | | | |
| | | 200 | KI | | 110–250 | | | |
| | 400 | 30 | LA | | 125–400 | 5–10 x CCR | Adjustable | |
| | | | LA-MC | | 200–250 | 17–20 x CCR | Fixed | |
| | | | | | 400 | 15–18 x CCR | | |
| | | 35 | LH | | 250–400 | 5–10 x CCR | Adjustable | |
| | | | LH-MC | | 200–250 | 17–20 x CCR | Fixed | |
| | | | | | 400 | 15–18 x CCR | | |
| | 600 | 35 | DG | STR23SP | 150–600 | 9 x In | Fixed | 6,000 |
| | | | | STR53SP | | 1.5–7 x In | Adjustable | |
| | | 65 | DJ | STR23SP | | 9 x In | Fixed | |
| | | | | STR53SP | | 1.5–7 x In | Adjustable | |
| | | | LC | T-M | 300–400 | 5 x CCR–3,200 | Adjustable | None |
| | | | | | 450–600 | 5 x CCR–4,200 | | |
| | | | LE | Micrologic® Series B | 100–600 | OFF[3] | | 9 x P–11 x P |
| | | | LX | | | 2.5–8 x P | | |
| | | 100 | DL | STR23SP | 150–600 | 9 x In | Fixed | 6,000 |
| | | | | STR53SP | | 1.5–7 x In | Adjustable | |
| | | 200 | LI | T-M | 300–400 | 5 x CCR–3,200 | Adjustable | None |
| | | | | | 450–600 | 5 x CCR–4,200 | | |
| | | | LXI | Micrologic® Series B | 100–600 | 2.5–8 x P | | 9 x P–11 x P |
| | 800 | 35 | MG | ET1.01 | 300–800 | 5–10 x CCR | Adjustable | None |
| | | 65 | MJ | | | | | |

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**Table 6: 480 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 480 | 1200 | 35 | PG | ET1.01 | 600–1200 | 5–10 x CCR | Adjustable | 21,600–26,400 |
| | | | | Micrologic® | 100–1200 | OFF[3] | | |
| | | 50 | PK | ET1.01 | 600–1200 | 5–10 x CCR | | |
| | | | | Micrologic® | 100–1200 | OFF[3] | | |
| | | 65 | PJ | ET1.01 | 600–1200 | 5–10 x CCR | | 9,000–11,000 |
| | | | | Micrologic® | 100–250 | OFF[3] | | 6,300–7,700 |
| | | | | | 400–1200 | | | 9,000–11,000 |
| | | 100 | PL | ET1.01 | 600–1200 | 5–10 x CCR | | 9,000–11,000 |
| | | | | Micrologic® | 100–250 | OFF[3] | | 6,300–7,700 |
| | | | | | 400–1200 | | | 9,000–11,000 |
| | 2500 | 35 | RG[4] | ET1.01 | 1200–2500 | 5–10 x CCR | | 51,300–62,700 |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| | | 50 | RK[4] | ET1.01 | 1200–2500 | 5-10 x CCR | | |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| | | 65 | RJ[4] | ET1.01 | 1200–500 | 5–10 x CCR | | 40,800–55,200 |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| | | 100 | RL[4] | ET1.01 | 1200–2500 | 5–10 x CCR | | |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| **Insulated Case Circuit Breakers (Masterpact®): UL® 489 Standard** | | | | | | | | |
| 480 | 800–1200 | 50 | NT-N | Micrologic® | 100–250 | OFF[3] | Adjustable | 21,600–26,400 |
| | | | | | 400–1200 | | | 36,000–44,000 |
| | | 50 | NT-H | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–1200 | | | 36,000–44,000 |
| | | 65 | NT-L1 | | 100–1200 | | | 9,000–11,000 |
| | | 100 | NT-L | | | | | |
| | | | NT-LF | | | | | |
| | 800–2000 | 65 | NW-N | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–2000 | | | 36,000–44,000 |
| | | 100 | NW-H | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–2000 | | | 36,000–44,000 |
| | | 150 | NW-L | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–1600 | | | 31,500–38,500 |
| | | | | | 2000 | | | 58,500–71,500 |
| | | | NW-LF | | 100–2000 | | | 21,600–26,400 |
| | 2500–3000 | 100 | NW-H | | 1200–3000 | | | 58,500–71,500 |
| | | 150 | NW-L | | | | | |
| | 4000–6000 | 100 | NW-H | | 2000–6000 | | | 67,500–82,500 |
| | | 150 | NW-L | | | | | |
| **Low Voltage Power Circuit Breakers (Masterpact®): UL® 1066 / ANSI C37 Standards** | | | | | | | | |
| 508 | 800 | 42 | NT-N1 | Micrologic® | 100–250 | OFF[3] | Adjustable | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | | NW-N1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | 65 | NW-H1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | 85 | NW-H2 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | 100 | NW-H3 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | 76,500–93,500 |
| | | 200 | NW-L1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | 31,500–38,500 |
| | | | NW-L1F | | 100–800 | | | 21,600–26,400 |

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**Table 6: 480 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 508 | 1600 | 42 | NW-N1 | Micrologic® | 800–1600 | OFF[3] | Adjustable | None[5] |
| | | 65 | NW-H1 | | | | | |
| | | 85 | NW-H2 | | | | | |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 31,500–38,500 |
| | | | NW-L1F | | | | | 21,600–26,400 |
| | 2000 | 65 | NW-H1 | | 1000–2000 | | | None[5] |
| | | 85 | NW-H2 | | | | | |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 31,500–38,500 |
| | | | NW-L1F | | | | | 21,600–26,400 |
| | 3200 | 65 | NWH1 | | 1600–3200 | | | None[5] |
| | | 85 | NWH2 | | | | | |
| | | 100 | NWH3 | | | | | 76,500–93,500 |
| | | 200 | NWL1 | | | | | 105,300–128,700 |
| | 4000–5000 | 85 | NW-H2 | | 2000–5000 | | | None[5] |
| | | 100 | NW-H3 | | | | | 76,500–93,500 |
| | | 200 | NW-L1 | | | | | 105,300–128,700 |

1 For thermal-magnetic circuit breakers with fixed instantaneous trip, the lower number is the “must hold” and the higher number the “must trip” value. For thermal-magnetic circuit breakers with adjustable instantaneous trip, the adjustment range shown is a function of the continuous current rating (CCR, aka ampere or handle rating) of the circuit breaker. The allowable UL tolerances are -20% (low) and +30% (high) from the nominal values shown. For electronic trip circuit breakers, the adjustment range shown is a function of the rating plug (P) or the sensor (In). Tolerances are +/-10% on both the low and high end of the range.

2 The range shown reflects manufacturing tolerances.

3 Turning the instantaneous setting to OFF on Micrologic® electronic trip units will maximize short circuit selective coordination. An OFF setting is available on Micrologic® trip units with LSI or LSIG protection.

4 1200 amperes maximum in I-Line®.

5 This circuit breaker, with the instantaneous set to OFF, is fully selective up to the interrupting rating of the circuit breaker.

**Table 7: 600 Volt Circuit Breakers**

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| **Molded Case Circuit Breakers: UL® 489 Standard** | | | | | | | | |
| 600 Y / 347 Vac | 100 | 18 | GJL | T-M | 15–40 | 600–1200 | Fixed | None |
| | | | | | 50–100 | 800–1400 | | |
| | 110 | 14 | ED | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | | 18 | EG | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |
| | | 25 | EJ | | 15–30 | 270–875 | | |
| | | | | | 35–70 | 630–1800 | | |
| | | | | | 80–125 | 1000–2300 | | |

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**Table 7: 600 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 600 | 100 | 14 | FA | T-M | 15–30 | 275–600 | Fixed | None |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | | 18 | FH | | 15–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | | 100 | FI | | 20–30 | 275–600 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–80 | 800–1450 | | |
| | | | | | 90–100 | 900–1700 | | |
| | 150 | 14 | HD | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 18 | HG | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 25 | HJ | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | | 50 | HL | | 15–30 | 350–750 | | |
| | | | | | 35–50 | 400–850 | | |
| | | | | | 60–90 | 800–1450 | | |
| | | | | | 100–150 | 900–1700 | | |
| | 250 | 14 | JD | | 150–250 | 5–10 x CCR | Adjustable | |
| | | 18 | JG | | | | | |
| | | 25 | JJ | | | | | |
| | | 50 | JL | | | | | |
| | | 100 | KI | | 110–250 | | | |
| | 400 | 22 | LA | | 125–400 | 5–10 x CCR | Adjustable | |
| | | | LA-MC | | 200–250 | 17–20 x CCR | Fixed | |
| | | | | | 400 | 15–18 x CCR | | |
| | | 25 | LH | | 250–400 | 5–10 x CCR | Adjustable | |
| | | | LH-MC | | 200–250 | 17–20 x CCR | Fixed | |
| | | | | | 400 | 15–18 x CCR | | |

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**Table 7: 600 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| 600 | 600 | 18 | DG | STR23SP | 150–600 | 9 x In | Fixed | 6,000 |
| | | | | STR53UP | | 1.5–7 x In | Adjustable | |
| | | 35 | DJ | STR23SP | | 9 x In | Fixed | |
| | | | | STR53UP | | 1.5–7 x In | Adjustable | |
| | | | LC | T-M | 300–400 | 5 x CCR–3,200 | Adjustable | None |
| | | | | | 450–600 | 5 x CCR–4,200 | | |
| | | | LE | Micrologic® Series B | 100–600 | OFF[3] | | 9 x P–11 x P |
| | | | LX | | | 2.5–8 x P | | |
| | | 100 | LI | T-M | 300–400 | 5 x CCR–3,200 | | None |
| | | | | | 450–600 | 5 x CCR–4,200 | | |
| | | | LXI | Micrologic® Series B | 100–600 | 2.5–8 x P | | 9 x P–11 x P |
| | 800 | 18 | MG | ET1.01 | 300–800 | 5–10 x CCR | | None |
| | | 25 | MJ | | | | | |
| | 1200 | 18 | PG | ET1.01 | 600–1200 | 5–10 x CCR | | 21,600–26,400 |
| | | | | Micrologic® | 100–1200 | OFF | | |
| | | 25 | PJ | ET1.01 | 600–1200 | 5–10 x CCR | | 9,000–11,000 |
| | | | | Micrologic® | 100–250 | OFF[3] | | 6,300–7,700 |
| | | | | | 400–1200 | | | 9,000–11,000 |
| | | 50 | PK | ET1.01 | 600–1200 | 5–10 x CCR | | 21,600–26,400 |
| | | | | Micrologic® | 100–1200 | OFF[3] | | |
| | 2500 | 18 | RG[4] | ET1.01 | 1200–2500 | 5–10 x CCR | | 51,300–62,700 |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| | | 25 | RJ[4] | ET1.01 | 1200–2500 | 5–10 x CCR | | 40,800–55,200 |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| | | 50 | RL[4] | ET1.01 | 1200–2500 | 5–10 x CCR | | |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| | | 65 | RK[4] | ET1.01 | 1200–2500 | 5–10 x CCR | | 51,300–62,700 |
| | | | | Micrologic® | 240–2500 | OFF[3] | | |
| **Insulated Case Circuit Breakers (Masterpact®): UL® 489 Standard** | | | | | | | | |
| 600 | 800-1200 | 35 | NT-N | Micrologic® | 100–250 | OFF[3] | Adjustable | 21,600–26,400 |
| | | | | | 400–1200 | | | 36,000–44,000 |
| | | 50 | NT-H | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–1200 | | | 36,000–44,000 |
| | 800-2000 | 50 | NW-N | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–2000 | | | 36,000–44,000 |
| | | 85 | NW-H | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–2000 | | | 36,000–44,000 |
| | | 100 | NW-L | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–1600 | | | 31,500–38,500 |
| | | | | | 2000 | | | 58,500–71,500 |
| | | | NW-LF | | 100–2000 | | | 21,600–26,400 |
| | 2500-3000 | 85 | NW-H | | 1200–3000 | | | 58,500–71,500 |
| | | 100 | NW-L | | | | | |
| | 4000-6000 | 85 | NW-H | | 2000–6000 | | | 67,500–82,500 |
| | | 100 | NW-L | | | | | |

*Continued on next page*

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**Table 7: 600 Volt Circuit Breakers** *(continued)*

| Voltage Rating | Frame Size (Amperes) | Interrupting Rating (kA) 60 Hz | Circuit Breaker | Trip Unit Type | Continuous Current Range (Amperes) | Instantaneous Trip | | Instantaneous Override |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Range (Amperes)[1] | Type | Trip Range (Amperes)[2] |
| **Low Voltage Power Circuit Breakers (Masterpact®): UL® 1066 / ANSI C37 Standards** | | | | | | | | |
| 635 | 800 | 42 | NW-N1 | Micrologic® | 100–250 | OFF[3] | Adjustable | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | 65 | NW-H1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | 85 | NW-H2 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | None[5] |
| | | | NW-H3 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | 76,500–93,500 |
| | | 130 | NW-L1 | | 100–250 | | | 21,600–26,400 |
| | | | | | 400–800 | | | 31,500–38,500 |
| | | | NW-L1F | | 100–800 | | | 21,600–26,400 |
| | 1600 | 42 | NW-N1 | | 800–1600 | | | None[5] |
| | | 65 | NW-H1 | | | | | |
| | | 85 | NW-H2 | | | | | |
| | | | NW-H3 | | | | | 76,500–93,500 |
| | | 130 | NW-L1 | | | | | 31,500–38,500 |
| | | | NW-L1F | | | | | 21,600-26,400 |
| | 2000 | 65 | NW-H1 | | 1000–2000 | | | None[5] |
| | | 85 | NW-H2 | | | | | |
| | | | NW-H3 | | | | | 76,500–93,500 |
| | | 130 | NW-L1 | | | | | 31,500–38,500 |
| | | | NW-L1F | | | | | 21,600-26,400 |
| | 3200 | 65 | NW-H1 | | 1600–3200 | | | None[5] |
| | | 85 | NW-H2 | | | | | |
| | | | NW-H3 | | | | | 76,500–93,500 |
| | | 130 | NW-L1 | | | | | 105,300–128,700 |
| | 4000–5000 | 85 | NW-H2 | | 2000–5000 | | | None[5] |
| | | | NW-H3 | | | | | 76,500–93,500 |
| | | 130 | NW-L1 | | | | | 105,300–128,700 |

1 For thermal-magnetic circuit breakers with fixed instantaneous trip, the lower number is the “must hold” and the higher number the “must trip” value. For thermal-magnetic circuit breakers with adjustable instantaneous trip, the adjustment range shown is a function of the continuous current rating (CCR, aka ampere or handle rating) of the circuit breaker. The allowable UL tolerances are -20% (low) and +30% (high) from the nominal values shown. For electronic trip circuit breakers, the adjustment range shown is a function of the rating plug (P) or the sensor (In). Tolerances are +/-10% on both the low and high end of the range.

2 The range shown reflects manufacturing tolerances.

3 Turning the instantaneous setting to OFF on Micrologic® electronic trip units will maximize short circuit selective coordination. An OFF setting is available on Micrologic® trip units with LSI or LSIG protection.

4 1200 amperes maximum in I-Line®.

5 This circuit breaker, with the instantaneous set to OFF, is fully selective up to the interrupting rating of the circuit breaker.

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# Appendix B

## Glossary

**ampacity** The RMS current, in amperes, that a conductor or circuit breaker can carry continuously under the conditions of use without exceeding its temperature rating.

**ampere rating** See continuous current rating.

**branch circuit** The circuit between the final overcurrent device protecting the circuit and the outlet(s) or loads.

**circuit breaker** A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on an overcurrent without damage to itself when properly applied within its rating.

**circuit breaker frame** (1) The circuit breaker housing which contains the current carrying components, the current sensing components, and the tripping and operating mechanism. (2) That portion of an interchangeable trip molded case circuit breaker remaining when the interchangeable trip unit is removed.

**close and latch rating** The maximum level of current a circuit breaker can be closed on and still have the mechanism latch in the fully closed position.

**continuous current rating** The designated RMS alternating or direct current in amperes which a device or assembly will carry continuously in free air without tripping or exceeding temperature limits.

**current sensor** A component which is able to sense the level of current flowing in a circuit breaker conductor and input a proportional signal into the trip unit of the circuit breaker.

**feeder circuit** A circuit between the main overcurrent-protecting device and the final branch circuit overcurrent protective devices.

**frame size** The largest ampere rating available in a group of circuit breakers of similar physical configuration.

**ground fault** An unintentional current path, through a grounded conductor, enclosure, raceway or the earth, back to the source.

**handle rating** See continuous current rating.

**instantaneous selective override** A fixed, non-adjustable, instantaneous trip function set just below a circuit breakers withstand capability.

**instantaneous trip** A qualifying term indicating that no delay is purposely introduced in the tripping action of the circuit breaker during short-circuit conditions.

**insulated case circuit breaker (ICCB)** UL Standard 489 Listed non-fused molded case circuit breakers which utilize a two-step stored energy closing mechanism, electronic trip system and optional draw-out construction.

**interrupting rating** The highest current at rated voltage that the circuit breaker is rated to interrupt in RMS symmetrical amperes. When the circuit breaker can be used at more than one voltage, the interrupting rating will be shown on the circuit breaker for each voltage level. The interrupting rating of a circuit breaker must be equal to or greater than the available short-circuit current at the point at which the circuit breaker is applied to the system.

**making current release** A fixed, non-adjustable, instantaneous trip function set just below a circuit breakers close and latch rating.

**molded case circuit breaker (MCCB)** A circuit breaker which is assembled as an integral unit in a supportive and enclosed housing of insulating material, generally 20 to 3000 A in size and used in systems up to 600 Vac and 500 Vdc.

**selective coordination** Localization of an overcurrent condition to restrict an outage to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.
(NEC 100 – Definitions)

**zone-selective interlocking (ZSI)** A communication capability between electronic trip systems and ground-fault relays which permits a short circuit or ground fault to be isolated and cleared by the nearest upstream device with no intentional time delay.

**Schneider Electric**
3700 Sixth St SW
Cedar Rapids IA 52404
1-888-SquareD (1-888-778-2733)
www.us.SquareD.com