Electronic Trip Circuit Breaker Basics

Circuit Breaker Application Guide
When it comes to circuit breakers, no one knows more than Square D. This Circuit Breaker Application Guide is one of a series designed to provide answers to the most commonly asked questions about selecting and applying circuit breakers.

Along with a large network of Square D field offices and authorized distributors, this series of application guides helps provide technical support unsurpassed in the industry. So, when you need to know more about circuit breakers, turn to Square D.
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PART 1 – ELECTRONIC TRIP CIRCUIT BREAKERS

WHAT IS A CIRCUIT BREAKER?

A circuit breaker has two primary functions:

1. to provide a nonautomatic means to energize and de-energize the circuit

and

2. to open automatically to protect the circuit from damage due to an overcurrent condition.

In other words, a circuit breaker must be able to be switched on and off, and it must open automatically during an overcurrent condition.

In order to open automatically, circuit breakers are equipped with some type of tripping mechanism. Some circuit breakers employ electro-mechanical tripping mechanisms, some use hydromechanical tripping mechanisms, and some use electronic tripping mechanisms.

Electronic trip circuit breakers from Square D Company use the MICROLOGIC® tripping system, which includes current sensors, a microprocessor-based trip unit and a tripping solenoid.

Electronic trip molded case circuit breakers are designed to meet UL489, Underwriters Laboratories Standard for Safety for Molded-Case Circuit Breakers and Circuit Breaker Enclosures.

WHY USE ELECTRONIC TRIP CIRCUIT BREAKERS?

In most cases, the basic overcurrent protection provided by standard thermal-magnetic circuit breakers will meet the requirements of the electrical system design. In some cases, however, basic overcurrent protection might not be enough.

Electronic trip circuit breakers can provide the additional features needed in those cases. Reasons to use electronic trip circuit breakers include

- enhanced coordination capabilities
- integral ground-fault detection
- communication capabilities
- future growth potential

Enhanced Coordination Capabilities

In electrical systems where downtime could have critical consequences, electronic trip circuit breakers provide more versatility to achieve coordination. For instance, certain installations serving continuous processes may be required to continue operating during a fault condition because shutting the system down would be more costly than the damage done by the fault itself. Or, in critical care facilities, a loss of power could result in the loss of life.

These situations require that coordination be optimized at all costs. In order to maximize coordination, downstream branch devices should operate very fast – with no intentional delay – and main devices should delay operation so that the downstream devices have time to clear the fault.
MICROLOGIC electronic trip circuit breakers can help optimize coordination:

- **Independent adjustments** allow one dial setting to be changed without affecting the rest of the pickup and delay levels. This allows the designer to better define the tripping characteristics needed on the system.

- **Interchangeable rating plugs** allow the designer to shift the entire trip characteristic curve (except for ground fault) to improve coordination with other devices. MICROLOGIC rating plugs define the circuit breaker's maximum current rating based on a percentage of the circuit breaker sensor size, and can be used on any frame size of circuit breaker within the MICROLOGIC family of circuit breakers.

- **Withstand ratings** give the designer a larger window of coordination potential. The withstand rating is the level of rms symmetrical current that a circuit breaker can carry with the contacts in the closed position for a certain period of time. At current levels above the withstand rating (and less than or equal to the interrupting rating), the circuit breaker will trip instantaneously. In other words, the withstand rating is the highest current level at which delay can be introduced to maintain coordination with downstream devices. Withstand ratings are available only on full-function trip systems ordered with the adjustable short-time function.

- **Inverse time delay characteristics** allow for better coordination with fusible switches or thermal-magnetic circuit breakers downstream. Devices that respond to heat generated by current flow (such as fuses and thermal-magnetic circuit breakers) have inverse time tripping characteristics. This means that as current increases, the time that it takes the device to trip will decrease.

In order to coordinate better with these types of downstream devices, MICROLOGIC circuit breakers offer inverse time delay characteristics on the long-time, short-time and ground-fault functions.

- The ammeter/trip indicator displays the level of ground-fault leakage current associated with the circuit. The ground-fault pickup level on the circuit breaker may then be adjusted somewhat higher than the amount of leakage current displayed on the ammeter.

This assumes that ground-fault detection testing was done before the system was energized and no ground-fault problems were found. In retrofit situations the magnitude of leakage current may be significant due to the deteriorating effects of moisture, dirt, rodents, etc., over time. New installations will also show some magnitude of leakage current at start-up.

There are no hard and fast rules for selecting the proper level of ground-fault protection because the level of leakage current on each system is different. The system engineer should provide information on the proper levels of protection.

**Integral Ground-fault Detection**

Electronic trip circuit breakers simplify the installation of equipment ground-fault detection into the electrical system.

Externally-mounted ground-fault detection systems require the specifying of five different parts – a circuit breaker, a ground-fault relay, a ground-fault sensor, a shunt trip for the circuit breaker, and testing means. Additional wiring is also required to install the system.

Electronic trip circuit breakers include most of the detection equipment within the circuit breaker housing. The phase current sensors, summing toroid, pickup and delay adjustments, tripping solenoid, and a push-to-test feature are all enclosed within the molded case.
The only part that is not within the circuit breaker case is the optional neutral sensor required for a four-wire system. That means that ground-fault detection plus overcurrent protection is as easy as specifying and mounting one device (except four-wire systems which require an additional neutral sensor).

MICROLOGIC circuit breakers are available with two different ground-fault detection options:

- ground-fault protection for equipment
- ground-fault alarm

The ground-fault protection for equipment option is available on circuit breakers with either the MICROLOGIC standard-function or full-function trip system, and will trip the circuit breaker in the event of a ground fault.

The ground-fault alarm option is available on circuit breakers with the MICROLOGIC full-function trip system only. This function will signal a remote POWERLOGIC® station, but will not trip due to a ground fault – maintaining system continuity.

**Communications Capabilities**

MICROLOGIC circuit breakers can communicate with each other and with the POWERLOGIC power monitoring systems.

Communication between circuit breakers at different levels in the system allows the downstream circuit breaker closest to the fault to ignore its preset delay time and trip without any intentional time delay on a short circuit or ground fault. This form of communication is known as zone-selective interlocking (ZSI).

Coordination assures that continuity of service is maximized during any type of overcurrent. However, coordination does not eliminate the stress on the system caused by the energy dissipated during a fault. ZSI actually reduces the stress on the system resulting from a fault while maximizing continuity of service.

MICROLOGIC full-function circuit breakers are equipped with ZSI communication capabilities as a standard feature. For more information on ZSI, see Circuit Breaker Application Guide 0600SC9102R6/95, Reducing Fault Stress With Zone-selective Interlocking.

Communication between circuit breakers and the POWERLOGIC power monitoring system allows the user to monitor each circuit and record energy usage, power surges, normal operating modes, harmonic contribution, etc. In addition, the MICROLOGIC full-function trip system can communicate the following information through the POWERLOGIC system:

- history of last trip
- trip unit pickup and delay levels
- impending trip conditions
- operating currents for each phase
- ground-fault leakage current associated with the circuit
- ground-fault alarm signal

The ground-fault alarm signal allows a ground fault to be reported without interrupting power to the system. It is especially useful when continuity of service must be maintained at all costs and where the maintenance staff is trained to locate and correct any fault problems before an unplanned outage takes place.

For more information on POWERLOGIC systems, see publication 3050SM9101R11/91, POWERLOGIC Product Interface for MICROLOGIC Circuit Breakers.
Future Growth Potential

Many of the adjustable features that enhance coordination also provide means for increasing the ampere rating of an electronic trip circuit breaker to meet future growth needs. The adjustability of a MICROLOGIC circuit breaker enables a designer to plan for future growth. A circuit breaker can be chosen based on projected growth, and by changing the rating plug and/or changing the long-time pickup, its ampacity can be reduced down to 20% of its maximum. When growth occurs, the ampacity may be increased up to the circuit breaker's maximum. The versatility of the adjustments on an electronic trip circuit breaker offers the designer a multitude of options to meet initial and future capacity requirements.

Another way to plan for future growth or to save space and minimize cost is to specify 100% rated electrical distribution equipment. A circuit breaker either carries a standard rating or a 100% rating. The standard rating is subject to NEC sizing rules which limit the application to 80% of the circuit breaker rating when continuous loads are involved.

The National Electrical Code (NEC) recognizes overcurrent devices that are listed for operation at 100% of their rating for continuous loading. This means that the equipment has undergone additional testing to verify that it can handle the additional heat rise associated with this level of operation. 100% rated circuit breakers are permitted to be loaded continuously at their full rating (as long as minimum enclosure requirements, venting configurations and wire insulation requirements have been met).
PART 2 – MICROLOGIC® TRIP SYSTEMS

GENERAL

Square D electronic trip circuit breakers are equipped with either the MICROLOGIC® Standard-function Trip System or the MICROLOGIC Full-function Trip System. Both trip systems provide adjustable tripping functions and characteristics using true root-mean-square (rms) current sensing.

Adjustable rotary switches on the trip unit allow the user to set the proper overcurrent or ground current protection required in the electrical system. If current exceeds the set value for longer than its set time delay, the trip system automatically opens the circuit breaker. All MICROLOGIC protective functions are fully fault powered, no external power source is required.

Circuit breakers are shipped with the long-time pickup switch set at 1.0 and all other trip unit adjustments set at their lowest settings. Actual settings required for a specific application must be determined by a qualified consultant or plant engineer. A coordination study is recommended to provide coordination between all overcurrent protective devices in the distribution system.

RMS SENSING

The sensing system on an electronic trip circuit breaker responds to the flow of current through the circuit breaker. Electronic trip circuit breakers are limited to ac systems because the electronic trip system uses current transformers to sense the current.

The MICROLOGIC trip system samples the current waveform 33 times per cycle on a 60 Hz system. It then uses this data to calculate the true rms current.

MICROLOGIC trip systems use a set of current transformers (called CTs or sensors) to sense current, either a standard-function or full-function trip unit to evaluate the current, and a tripping solenoid to trip the circuit breaker.
True rms sensing accurately measures the magnitude of a non-sinusoidal waveform. Therefore, the heating effects of harmonically distorted waveforms are accurately evaluated.

Electronic trip circuit breakers with MICROLOGIC trip systems can be used on 50/60 Hz systems with alternating current (ac) to direct current (dc), dc to ac, and ac to ac converters. This includes applications that use silicon-controlled rectifiers (SCRs) and adjustable frequency controls.

**RATING PLUGS**

Rating plugs are used to determine the circuit breaker ampere rating \( P \) according to the following equation:

\[
Ampere (P) = \frac{Sensor (S)}{Rating Size} \times \frac{Rating}{Plug \%}
\]

The ampere rating and the long-time pickup switch are then combined to determine the circuit breaker continuous current rating. For example:

\[
\text{Continuous Current Rating} = \frac{Sensor (S)}{Rating Size} \times \frac{Rating}{Plug \%} \times \frac{Long-time Setting}{0.5}
\]

![Figure 5 – Rating Plug](image)

The ammeter/trip indicator displays current in phases A, B and C, and the ground-fault current associated with the circuit. Each value can be viewed one at a time using the phase select/indicator reset button. (Phase values are displayed in true rms. Ground-fault current values are displayed in calculated rms based on measured peak current.) A bar graph is provided indicating the level of operating current as a percentage of the continuous current rating \( P \times \text{long-time setting} \) of the circuit breaker. The ammeter may not display if the load is less than 20\% of the CT rating.

Rating plugs and ammeter/trip indicators are subject to damage from static charge. Internal damage can result if these devices are handled by their contacts. If either device is removed from the trip unit, it must be held against grounded metal, such as the metal circuit breaker enclosure, for at least two seconds before reinstalling.

Each MICROLOGIC circuit breaker is shipped with a rating plug factory installed. The label on the circuit breaker marked “Configuration as Shipped” gives the circuit breaker configuration as it left the factory. Field-installable rating plug kits are also available.

Ground-fault pickup values are based on the sensor size of the circuit breaker and are not affected by changing the rating plug.

**AMMETER/TRIP INDICATOR**

The ammeter/trip indicator is used to identify the type of overcurrent if the circuit breaker trips, to monitor operating current, and to identify potential overcurrent situations.

![Figure 6 – Ammeter/Trip Indicator](image)

The ammeter/trip indicator window displays “OVERLOAD,” “SHORT CIRCUIT,” or “GROUND FAULT” when the circuit breaker trips from an overcurrent. The indicator must be manually reset by pushing the phase select/indicator reset button.
The phase select/indicator reset button can be pressed at any time to test the ammeter/trip indicator battery condition. The window will display a battery symbol. If this does not occur, contact Square D for a replacement ammeter/trip indicator.

The ammeter/trip indicator is factory installed on the full-function circuit breaker and is available as a field-installable option on the standard-function circuit breaker.

MEMORY FEATURE

MICROLOGIC trip systems feature a memory circuit for intermittent overload or ground-fault conditions. This enables the circuit breaker to respond to a series of ON and OFF overload or ground-fault conditions which could cause conductor overheating.

If the circuit breaker trips due to an overcurrent condition, wait at least one minute before resetting the circuit breaker. This allows the memory to clear itself sufficiently for the circuit breaker to be turned ON. If checking trip times, wait fifteen minutes after the circuit breaker trips before resetting to allow memory to reset completely to zero (or use a memory reset module, Cat. No. MTMB).

GROUND-FAULT DETECTION

Both standard-function and full-function circuit breakers are available with integral ground-fault protection for equipment. This feature will trip the circuit breaker if a ground-fault occurs.

Full-function circuit breakers are also available with integral ground-fault alarm (no trip) to monitor the flow of ground-fault current and signal an alarm condition through the POWERLOGIC® system. This feature meets NEC Sections 700-7(d) and 700-26 for emergency systems. Circuit breakers with the ground-fault alarm trip system DO NOT trip if a ground-fault occurs.

Ground-fault protection (trip) trip units include both ground-fault pickup and delay adjustments. Ground-fault alarm (no trip) trip units include only ground-fault pickup adjustments.

Circuit breakers with either ground-fault protection (trip) or alarm (no trip) trip systems are equipped with an internal ground-fault push-to-test feature. The ground-fault push-to-test feature is built into the circuit breaker and eliminates the need for any additional test equipment, such as monitor panels. The push-to-test feature requires 120 Vac control power.

TRIP CHARACTERISTICS

MICROLOGIC trip units provide a full range of adjustable tripping characteristics using a programmable microcomputer that constantly monitors the line currents.

| Table 1 – Adjustable Tripping Characteristics for Electronic Trip Circuit Breakers |
|-----------------------------------|-----------------------------------|
| **Standard-function Trip Unit**  | **Full-function Trip Unit**       |
| Long-time pickup                 | Long-time pickup                  |
| Long-time delay                  | Long-time delay                   |
| Short-time pickup                | Short-time pickup                 |
| Short-time delay (I²t IN only)   | Short-time delay (I²t IN and I²t OUT) |
| Instantaneous pickup             | Instantaneous pickup              |
| Ground-fault pickup              | Instantaneous OFF                  |
| Ground-fault delay (I²t OUT only)| Ground-fault pickup               |
|                                  | Ground-fault delay (I²t IN and I²t OUT) |
|                                  | Ground-fault alarm                |

The overcurrent or ground-fault current pickup and delay levels are set using adjustable rotary switches on the face of the trip unit. If the line current exceeds the trip settings longer than the delay settings, the microcomputer signals the circuit breaker to trip.
Trip settings are used to obtain a coordinated system in which a downstream circuit breaker will trip before an upstream circuit breaker.

Properly adjusting the MICROLOGIC trip settings will result in a circuit breaker trip curve that falls above and to the right of the downstream circuit breaker trip curve. Under overcurrent conditions, the downstream circuit breaker will trip first.

Square D recommends that a system coordination study be done to find the proper trip unit settings to optimize coordination with other devices.

**STANDARD-FUNCTION TRIP UNIT FUNCTIONS**

The trip curve below illustrates how the adjustments made to a standard-function trip unit will affect the circuit breaker's trip characteristics.

Adjusting the trip unit switches will shift that area of the trip curve.

*Figure 8 – Standard-function Trip Unit Curve*

*Ampere Rating (P) = Sensor Size (S) x Rating Plug (%).
Long-time Trip Function

LONG-TIME PICKUP Switch — switch value (multiplied by the ampere rating) sets the maximum current level which the circuit breaker will carry continuously. If the current exceeds this value for longer than the set delay time, the circuit breaker will trip.

LONG-TIME DELAY Switch — sets length of time that the circuit breaker will carry a sustained overload before tripping. Delay bands are labeled in seconds of overcurrent at six times the ampere rating. For maximum coordination, eight delay bands are available.

Long-time delay is an inverse time characteristic in that the tripping time decreases as the current increases.

INDICATOR — the trip unit includes an indicator that will flash when the current reaches 90% of the LONG-TIME PICKUP setting and will be lit continuously when the current is above 100% of the pickup setting.

Short-time Trip Function

SHORT-TIME PICKUP Switch — switch value (multiplied by the ampere rating) sets the short-circuit current level at which the circuit breaker will trip after the set SHORT-TIME DELAY.

SHORT-TIME DELAY Switch — sets length of time the circuit breaker will carry a short circuit within the short-time pickup range. Delay bands are labeled in seconds of short-circuit current at 12 times the ampere rating, P. The short-time delay can be set to one of four $I^2t$ ramp operation positions ($I^2t$ IN).

$I^2t$ IN delay is an inverse time characteristic in that the delay time decreases as the current increases.
Instantaneous Trip Function

INSTANTANEOUS PICKUP Switch — switch value (multiplied by the ampere rating) sets the short-circuit current level at which the circuit breaker will trip with no intentional time delay.

The instantaneous function will override the short-time function if the INSTANTANEOUS PICKUP is adjusted at the same or lower setting than the SHORT-TIME PICKUP.

Ground-fault pickup values are based on the circuit breaker sensor size only, not the rating plug multiplier. Changing the rating plug multiplier has no effect on ground-fault pickup values.

GROUND-FAULT DELAY Switch — sets the length of time the circuit breaker will carry ground-fault current which exceeds the GROUND-FAULT PICKUP level before tripping. Delay bands are labeled in seconds of ground-fault current at 1 times the sensor size, S. Ground-fault delay can be adjusted to one of four fixed time delay positions ($I^2t$ OUT).

Ground-fault Trip Function

GROUND-FAULT PICKUP Switch — switch value (multiplied by the sensor size) sets the current level at which the circuit breaker will trip after the set GROUND-FAULT DELAY.

$I^2t$ OUT delay is a fixed time characteristic in that the delay time does not change as the current increases.
FULL-FUNCTION TRIP UNIT FUNCTIONS

The full-function trip unit trip curve drawing, below, shows the various parts of a typical trip curve affected by the adjustments on a full-function trip unit.

Adjusting the trip unit switches will shift that area of the trip curve.

Figure 16 – Full-function Trip Unit Curve

LONG-TIME PICKUP Switch — switch value (multiplied by the ampere rating) sets the maximum current level which the circuit breaker will carry continuously. If the current exceeds this value for longer than the set delay time, the circuit breaker will trip.

Figure 17 – Long-time Pickup

LONG-TIME DELAY Switch — sets length of time that the circuit breaker will carry a sustained overload before tripping. Delay bands are labeled in seconds of overcurrent at six times the ampere rating. For maximum coordination, there are eight delay bands.

Figure 18 – Long-time Delay

Long-time delay is an inverse time characteristic in that the delay time decreases as the current increases.
INDICATOR — the trip unit includes an indicator that will flash when the current reaches 90% of the LONG-TIME PICKUP setting and will be lit continuously when the current is above 100% of the pickup setting.

Short-time Trip Function

SHORT-TIME PICKUP Switch — switch value (multiplied by the ampere rating) sets the short-circuit current level at which the circuit breaker will trip after the set SHORT-TIME DELAY.

SHORT-TIME DELAY Switch — sets length of time the circuit breaker will carry a short circuit within the short-time pickup range. Delay bands are labeled in seconds of short-circuit current at 12 times the ampere rating, P. The delay can be adjusted to four positions of $I^2t$ ramp operation ($I^2t$ IN) or four positions of fixed time delays ($I^2t$ OUT).

$I^2t$ IN delay is an inverse time characteristic in that the delay time decreases as the current increases.

$I^2t$ OUT delay is a fixed time characteristic in that the delay time does not change as the current increases.
Instantaneous Trip Function

INSTANTANEOUS PICKUP Switch — switch value (multiplied by the ampere rating) sets the short-circuit current level at which the circuit breaker will trip with no intentional time delay.

The instantaneous function will override the short-time function if the INSTANTANEOUS PICKUP is adjusted at the same or lower setting than the SHORT-TIME PICKUP.

In full-function trip units with both adjustable short-time and instantaneous trip functions, the adjustable instantaneous trip can be disabled by setting INSTANTANEOUS PICKUP to OFF. Even when the instantaneous pickup is turned OFF, an instantaneous override occurs above the circuit breaker short-time withstand rating.

Ground-fault Trip Function

GROUND-FAULT PICKUP Switch — switch value (multiplied by the sensor size) sets the current level at which the circuit breaker will trip after the set GROUND-FAULT DELAY.

Ground-fault pickup values are based on circuit breaker sensor size only, not on the rating plug multiplier. Changing the rating plug multiplier has no effect on ground-fault pickup values.
GROUND-FAULT DELAY Switch — sets length of time the circuit breaker will carry ground-fault current which exceeds the GROUND-FAULT PICKUP level before tripping. Delay bands are labeled in seconds of ground-fault current at 1 times the sensor size, S. Delay can be adjusted to four positions of \( I^2 t \) ramp operation (\( I^2 t \) IN) or four positions of fixed time delays (\( I^2 t \) OUT).

\( I^2 t \) IN delay is an inverse time characteristic in that the delay time decreases as the current increases.

\( I^2 t \) OUT delay is a constant time characteristic in that the delay time does not change as the current increases.

For sensor sizes below 2000 amperes and \( I^2 t \) IN ground-fault current levels less than 1 x S, the actual time delay will be longer than the delay setting. At ground-fault current levels equal to or greater than 1 x S, the delay will be equal to the delay setting.

For sensor sizes equal to or greater than 2000 amperes, the actual time delay will be equal to the delay setting for ground-fault currents of 2000 amperes and above.

**Ground-fault Alarm Function**

GROUND-FAULT ALARM Switch — switch value (multiplied by the sensor size) sets the current level at which the circuit breaker will signal the POWERLOGIC system that a ground fault is present.
PART 3 – A LOOK AT COORDINATION

COORDINATION

When designing an electrical distribution system, coordination must be considered.

Coordination is the process of localizing the protection against an overcurrent condition to restrict an outage to only affected equipment. Only the upstream device closest to the fault trips – leaving the rest of the system intact to continue supplying power to unaffected areas. Coordination does not exist when more than one device opens simultaneously during an overcurrent condition.

The degree of coordination required is dependent on the load. For less critical loads, such as commercial lighting, lack of coordination may only be a nuisance. For hospital applications, manufacturing processes and other critical loads, coordination may be required.

In order to maximize coordination, downstream branch devices should operate very fast – with little or no intentional delay – and main devices should delay operation so that the downstream devices can clear the fault.

Coordination is limited by the instantaneous trip characteristics of the upstream device. When the magnitude of the overcurrent exceeds the instantaneous pickup point of the upstream device, it will trip with no intentional delay and coordination is lost.

Electronic trip devices from Square D, such as MICROLOGIC® circuit breakers and GC GROUND-CENSOR® relays, have adjustable pickup and delay settings to maximize coordination with other overcurrent protective devices in the system.

For more information on coordination, see Circuit Breaker Application Guide SD354R2, Circuit Breaker Characteristic Trip Curves and Coordination.

COORDINATION UNDER GROUND-FAULT CONDITIONS

The National Electrical Code (NEC) requires that equipment ground-fault protection be provided at service entrance disconnecting means rated for 1000 amperes or more on solidly grounded wye systems between 150 volt-to-ground and 600 volts phase-to-phase (NEC 215-10 includes ground-fault protection requirements for feeders). In order to meet the minimum requirements set forth in the NEC, it is acceptable to provide ground-fault protection only at a single point in the electrical system – at the main.

What happens if a ground fault occurs farther down in the system, at the branch circuit level for instance? If the only device capable of detecting a ground fault is the service entrance main, a ground fault anywhere in the system will trip the main device. Coordination is lost because the main tripped and shut down the entire system!

It is estimated that over 80% of all overcurrents are low-level overloads and ground faults. Odds are very high that the situation described above will happen in the real world. In order to prevent a blackout condition, multiple levels of ground-fault protection are recommended. That is, equipment ground-fault protection should be provided at each level of distribution (main, feeder, branch, etc.) to maximize system continuity. By supplying multiple levels of ground-fault protection, it is possible to isolate ground faults to feeders and branch circuits or to any portion of the system with ground-fault protection.
ZONE-SELECTIVE INTERLOCKING

Coordination assures that continuity of service is maximized during any type of overcurrent. However, coordination does not eliminate the stress on the system caused by the energy generated during a fault. Zone-selective interlocking (ZSI) actually reduces the stress on the system resulting from a fault while maximizing continuity of service.

Without ZSI, a coordinated system results in the circuit breaker closest to the fault clearing the fault, but with an intentional delay.

With ZSI, the device closest to the fault will ignore its preset short-time and/or ground-fault delays and clear the fault with no intentional delay.

Eliminating intentional delay with ZSI results in faster tripping times without sacrificing coordination. This limits fault stress by reducing the amount of let-through energy the system is subjected to during an overcurrent.

Circuit breakers that are not coordinated (due to improper settings) will not be coordinated simply by using ZSI.

For more information on ZSI, see Circuit Breaker Application Guide 0600SC9102R6/95, Reducing Fault Stress with Zone-selective Interlocking.