

# Ground-Fault Systems for Circuit Breakers Equipped with Micrologic™ Electronic Trip Units

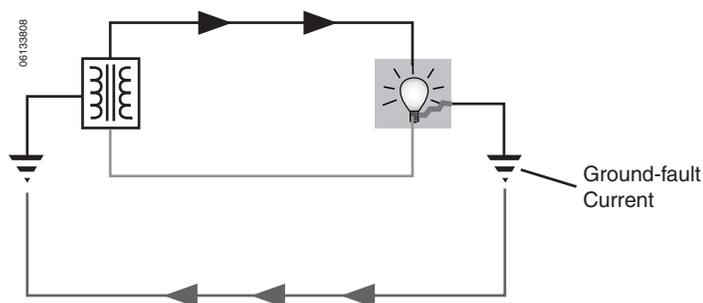
## Masterpact™ NT/NW, PowerPact™ H-, J-, L-, P-, and R-frame, and Compact™ NS630b–NS3200 Circuit Breakers

Retain for future use.

### Ground-Fault Systems

Circuit breakers equipped with Micrologic™ trip units have the capability of providing ground-fault protection on three-phase, three-wire and three-phase, four-wire solidly-grounded systems. The ground-fault protection feature of the Micrologic trip units cannot be used as a ground detector on ungrounded or resistance grounded systems. On such systems, ground fault current is limited and can not be detected by the trip unit.

It has been estimated that more than 85% of all faults begin as low-level ground faults. Ground faults are an inadvertent flow of current between the normal current-carrying conductors and ground. These ground faults usually start at a low level and, if left undetected, escalate to cause significant heat and mechanical damage to the electrical system. In extreme cases, the ground fault can escalate to a phase-to-phase fault causing major system damage. The ground-fault systems in Micrologic trip units monitor the flow of current in the system and detects ground-fault currents. The circuit breaker will trip to protect the circuit, or send an alarm through the appropriate interface equipment, depending on the option installed.



The National Electric Code® (NEC®) requires ground-fault protection on solidly grounded circuits of 1000 A or more with greater than 150 V to ground and 600 V or less phase-to-phase. This includes service entrance, feeders and building disconnects. The NEC also requires ground-fault alarm (no tripping) on emergency systems and allows ground-fault alarm on continuous processes, fire pumps, and other circuits that would be more hazardous if stopped without an orderly shutdown.

### Ground-Fault Alarm—Without Tripping

Masterpact™ NT and NW, PowerPact™ P- and R-frame, and Compact™ NS630b–NS3200 circuit breakers with Micrologic™ 5.0P and 5.0H trip units come standard with the ability to sense and report a ground-fault alarm through the optional programmable contact module or communication network. A neutral current sensor (NCT) must be installed in the neutral if ground-fault alarm is used on a three-phase, four-wire system.

### Ground-Fault Alarm—With Tripping

PowerPact™ H-, J-, and L-frame circuit breakers with Micrologic™ 6.2A, 6.2E, 6.3A, and 6.3E trip units come standard with the ability to monitor

measurements using a pre-alarm assigned to ground-fault protection (PAL  $I_g$ ). By default, this alarm is active. The ground-fault pre-alarm is accessible using the communication network or on the Front Display Module (FDM121). This alarm by default is also assigned to an SDx Module output.

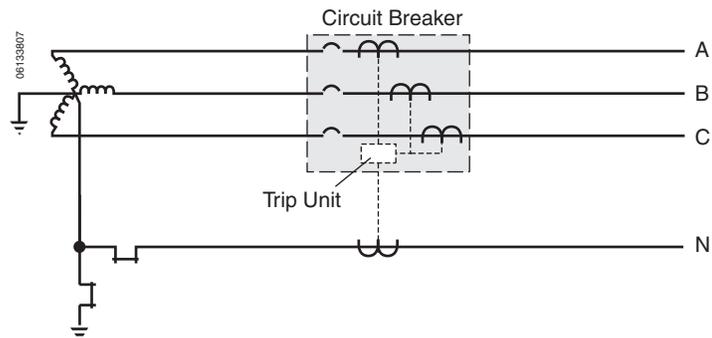
## Ground-Fault Protection—With Tripping

Ground-fault protection is standard on circuit breakers with Micrologic 6.0A, 6.0P and 6.0H trip units for Masterpact™ NT and NW, PowerPact™ P- and R-frame, and Compact NW630b–NS3200 circuit breakers. Ground-fault protection is standard for PowerPact™ H-, J-, and L-frame circuit breakers with Micrologic 6.2A, 6.2E, 6.3A, and 6.3E trip units. A neutral current sensor (NCT) must be installed in the neutral of three-phase, four-wire systems.

## Residual Ground-Fault Sensing

Micrologic 6.0A, 6.0P and 6.0H trip units for Masterpact™ NT and NW, PowerPact™ P- and R-frame, and Compact NW630b–NS3200 circuit breakers offer three different ground-fault sensing options: residual, ground-source return, and modified differential. Sensing options make it possible to match the ground-fault protection to the application.

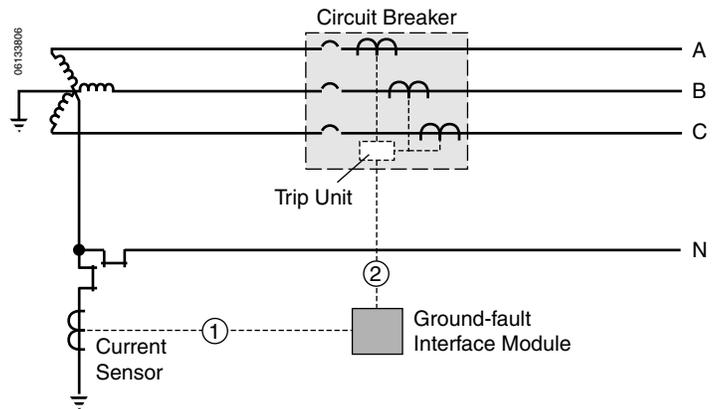
Residual ground-fault sensing systems use one current sensor for each current-carrying conductor. The trip unit vectorially sums the secondary outputs from each sensor to determine if there is a ground fault and the magnitude of the ground fault. The following diagram shows the current sensors for a three-phase, four-wire system. There is a current sensor on each phase and the neutral.



The sensors for the phase conductors A, B and C are inside the circuit breaker. The neutral current transformer is installed in the neutral. If the circuit breaker were used on a three-phase, three-wire system, the neutral current transformer would not be necessary.

## Ground-Source Return

Ground-source return ground-fault sensing systems use one current sensor on the ground conductor. The current sensor measures the ground current flow. The following diagram shows the current sensor for a three-phase, four-wire system. Ground source return can also be used on grounded systems which do not carry the neutral.



- ① Minimum #14 AWG wire. Wiring must be shielded cable or twisted pair. Maximum of 500 ft. (152.4 m) between ground-fault interface module and current sensors.
- ② Minimum #14 AWG wire. Wiring must be shielded cable or twisted pair. Maximum of 32 ft. (10 m) between ground-fault interface module and trip unit.

Ground-source return sensing systems require the use of the optional ground-fault interface module and a sensor installed in the ground circuit.

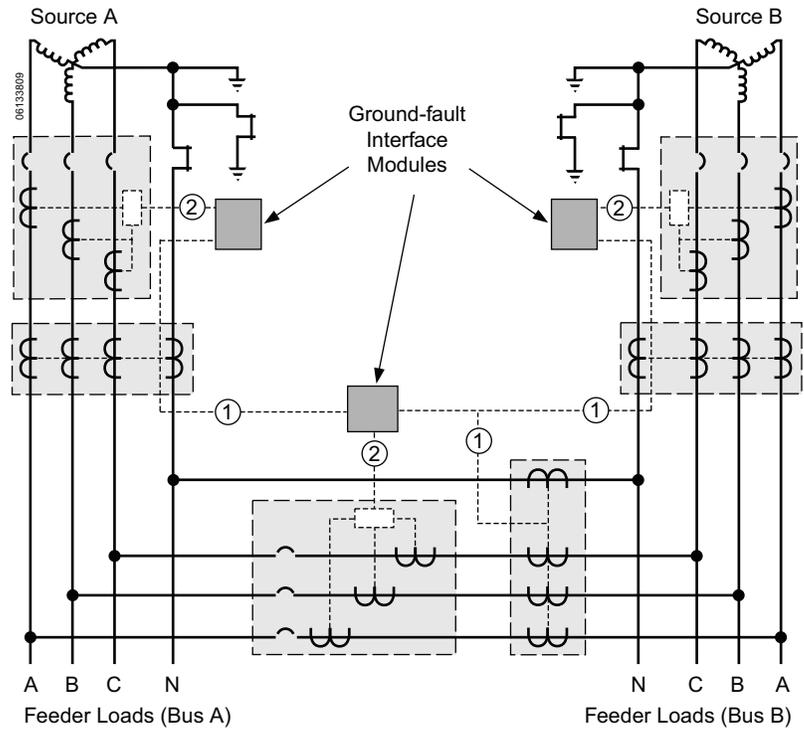
The current sensor and ground-fault interface module must be wired per the installation and wiring instructions included with the ground-fault interface module.

### Modified Differential Ground-Fault System (MDGF)

A modified differential ground-fault system is used for multiple-sourced systems. Normal residual and ground-source return systems will not correctly sum all of the circulating currents caused by the multiple neutral paths and multiple grounds. The following diagram shows a typical main-tie-main system. Each source transformer is grounded, and the service entrance neutral is bonded to ground. Multiple neutral paths allow neutral current to circulate and return to the supplying transformer by several different paths. The ground-fault system must be capable of correctly summing these circulating currents to minimize nuisance tripping and maximize protection.

The modified differential ground-fault sensing system requires the use of optional ground-fault interface modules and current sensors installed in all normal current-carrying conductors.

The current sensors and ground-fault interface modules must be wired in parallel and the polarity of the current sensors must be maintained per the installation and wiring instructions included with the ground-fault interface module.



- ① Minimum #14 AWG wire. Wiring must be shielded cable or twisted pair. Maximum of 500 ft. (152.4 m) between ground-fault interface module and current sensors.
- ② Minimum #14 AWG wire. Wiring must be shielded cable or twisted pair. Maximum of 32 ft. (10 m) between ground-fault interface module and trip unit.

In a multiple source MDGF system like in a main-tie-main system, different types of circuit breakers can be used together. Example: A Masterpact 6-pole (main), PowerPact R-frame (tie), and another Masterpact three-pole (main) is appropriate as long as all three circuit breakers are connected to their correct MDGF output terminals on the MDGF summing module (standard construction [three-pole] or wide construction [six-pole] output terminals).

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