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Siemens unique AFCI trip indicators save time, simplify diagnostics.

afci TROUBLESHOOTING

Arc Fault Circuit Interrupters (AFCIs) are an important technology available to electrical contractors as they work to build safe, efficient electrical distribution systems. Diagnosing the cause of AFCI trips can be confusing, but the unique trip indicators built into every Siemens AFCI offer help that is not available on any other AFCI.

Siemens' unique AFCI trip indicators simplify troubleshooting
Because branch/feeder-type and combination-type AFCIs protect against multiple types of arc fault conditions, determining the cause of a trip can require some diagnostic investigation. To make the process easier, Siemens has built unique trip indicators into its AFCIs, to help qualified electrical professionals pin-point the type of trip. Siemens also has developed a step-by-step troubleshooting procedure that simplifies the process of diagnosing the cause of AFCI trips. The procedure is outlined in this article.

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Be methodical: Start by eliminating the routine
The first step in troubleshooting why a circuit breaker and AFCI tripped is to eliminate the most common and routine causes. On a new installation, these could include installation errors, using single pole devices on multi-wire branch circuits (commonly known as "shared neutrals"), and short circuits. On retrofits, loads already attached to the circuits also may be to blame.

Electricians are well versed in identifying and eliminating overload and short circuit conditions, so we won't repeat those procedures here. What's important to remember is that an electrician should begin to look for unusual conditions such as faults-to-ground and arc faults only after eliminating these routine situations as the potential cause.

In the absence of an overload or short circuit, the electrician may be dealing with an arc fault or fault-to-ground. In these cases, it is important to determine whether the fault condition exists in the permanent wiring, in utilization equipment, or in a power cord.

The Siemens circuit breaker and branch/feeder-type AFCI, as well as its circuit breaker and combination-type AFCI, are the only AFCIs on the market to offer help in this department. This assistance comes in the form of visual indicators, which pinpoint the type of fault that is present. These indicators are unique to Siemens and can save considerable time in detecting the root cause of a trip.

AFCI trips: Diagnosing the cause
The Siemens AFCI products feature trip indicators. If a yellow flag is visible in the window after the trip event, this indicates that the trip was caused by an arc fault or fault to ground. If no yellow flag is visible, the trip was caused by either an overload or short-circuit load-current event. These indicators save valuable time by helping an electrician diagnosis the cause of tripping more quickly and easily.

If these visual indicators identifies an arc fault as the possible cause of the trip, the electrician needs to take a few steps to rule out mis-wiring as a possible cause:

- First, check the AFCI wiring. Double-check that the load power, load neutral, and panel neutral (pigtail wire) are properly connected. If everything checks out ...

- If the AFCI is a single pole device determine whether the AFCI has been wired to a multi-wire branch circuit (shared neutral). Single-pole AFCIs cannot be wired this way. It will not perform properly when wired to a multi-wire branch circuit and will trip persistently (although this may not become apparent until a load is applied to at least one of the circuits). Each single-pole AFCI must have a neutral wire unique to that branch circuit. For multi-wire branch circuits, a two-pole AFCI must be used. Siemens two-pole AFCIs offer a common trip between the two poles, reducing the chance for a shock hazard when one circuit on a multi-wire branch circuit is energized and the other one is de-energized. *Multi-wire branch circuit inspections and repairs should be performed only by qualified electricians.*

- Verify that a neutral conductor has not inadvertently been connected to ground. If a neutral conductor is connected to ground, load current can be shared between the neutral and ground. If the magnitude of the ground current is high enough, the AFCI circuit breaker will detect this fault-to-ground condition, causing a trip. In such situations, a Siemens GFCI circuit breaker may be used as a troubleshooting device to detect a grounded neutral condition. This is possible because a GFCI circuit breaker can sense any connection between neutral and ground, regardless of the current involved. It is important to note that Siemens GFCIs introduced after May 2006 also have trip indicators that distinguish between ground fault and overload/short-circuit faults.

AFCI trips: Correcting the trip condition
If the tripping problem persists after all of the wiring is determined to be correct, disconnect any branch circuit loads on the affected circuit. Then turn the AFCI breaker on.

If the breaker does not trip with all loads disconnected
- Re-connect and energize each branch circuit load, one at a time, until the breaker trips. When the breaker trips, the most recently energized load probably is producing the arc fault. Only qualified electricians should attempt to locate and repair the arc fault.

If the breaker trips with all loads disconnected:
- Disconnect the AFCI load-side wires from the circuit breaker and then re-energize the AFCI. The neutral "pigtail" wire must remain connected to the neutral bar.

- If the breaker does not trip with the load-side wires disconnected, reconnect the load side wires to the AFCI and systematically disconnect the power at each electrical connection point, such as an outlet or junction box, beginning with the last known connection point in the wire run. The disconnected wires should be individually capped for safety. Re-energize the AFCI after disconnecting the power at each electrical connection point. Using this approach, the search for the damaged or suspect wiring can be narrowed down to a limited wire run. Check the suspect wire run of the branch circuit wiring for an arc fault and replace all damaged or suspect wiring. *Again, such inspections and repairs should only be performed by qualified electricians.*

AFCIs contribute to better work, safer customers
Diagnosing the cause of AFCI trips is considerably simplified by using Siemens' unique trip indicators. This feature saves electrical professionals valuable time and money by providing a head start in the debugging process. In cases where the indication shows an arc fault has occurred, following this methodical, step-by-step approach to analyzing the situation can help reduce the time spent resolving the problem.

Best of all, AFCIs help to ensure the safety of those who will live, work or play in the building by protecting them from hidden faults that can smolder for hours before breaking into the open in spectacular form. Few building trades do as much to protect the American public as electrical contractors, and AFCIs are an important new tool in the electrician's safety arsenal.

Additional Information:
Do You Know Your AFCI types?
AFCIs come in two types: branch/feeder-type AFCIs, required by the 1999-2005 National Electrical Code (NEC), and combination-type AFCIs, available today and required by the 2005 NEC beginning January 1, 2008. Branch/feeder-type AFCIs protect against line-to-ground and line-to-neutral arcs, known as parallel or high-energy arcs (>75A as required for UL 1699 for Branch-feeder AFCI), while combination-type AFCIs protect against both of these arc faults plus series arcs. Series arcing can occur well below the continuous current rating of the circuit breaker (as low as 5A as required by UL 1699), and typically is caused by broken conductors, loose screws and a host of other hidden faults.

Arc faults, which cannot be detected by conventional circuit breakers or ground fault circuit interrupters (GFCIs), are particularly dangerous because high temperature conditions can be generated by arcing, even at relatively low current levels. These high temperatures can easily ignite nearby flammable material if the circuit remains energized, allowing the arc to persist. Due to the fact that arcs can occur in wiring that is behind drywall or in attics, the problem often goes undetected until a fire breaks out. It is likely that many of the fires attributed to faulty wiring or other generic electrical issues actually are caused by undetected arc faults.

Electrical Code information:
To protect property and save lives, the requirements of the NEC, beginning with the 1999 version, mandate the use of AFCIs, which immediately cut the flow of electricity to the circuit when an arc fault condition is detected. At the time these codes were adopted, branch/feeder-type AFCIs were the best available technology to meet these code requirements.

As of January 1, 2008, the 2005 NEC specifically mandates the use of combination-type AFCIs in new residential construction. Siemens has already introduced combination-type AFCIs to the market. This technology can also be used to retrofit existing construction, protecting those properties and investments as well.

For more information on branch/feeder-type AFCIs, combination-type AFCIs and arc fault tripping diagnostic procedures, please call 1-800-964-4144 and ask for (reference code)