



## TECHNICAL ARTICLE

# Overcoming arc fault shared and mixed neutral challenges



The AFCI Advantage handles multi-wired circuits, shared neutrals, and mixed neutrals with ease. It is offered exclusively by ABB through GE by ABB residential arc fault circuit breakers.<sup>1</sup>

It seems that even some of the simplest wiring and retrofit jobs have become complicated and even painful with the expanding NEC arc fault requirements. Multi-wire circuits and shared/mixed neutral installations did not work easily with AFCI protection. Electricians had to rethink how they wire new work and, even worse, spend hours tracing neutrals to install new AFCI breakers in old work.

The AFCI Advantage is a unique technology-driven solution that enables you to wire, replace and retrofit AFCI breakers exactly how you've been installing breakers for decades.

### **First-generation AFCI breakers and thermal magnetic breakers work differently**

Decades of installations, experience, and training relied on thermal magnetic breakers for circuit protection. Thermal magnetic breakers were not looking for arcing event potential. Their technology enabled electricians to protect circuits while sharing and mixing neutrals throughout an installation. It was common to mix and share as needed to simplify wiring and be more flexible with layouts.

When AFCI breakers were introduced in response to the NEC requirements, the new technology monitored the complete circuit. That meant the hot side and the neutral needed to show no signs of potential for arc fault events – usually the result of deteriorated wire, poor connections, or insulation breaches. To achieve this, AFCIs incorporated some level of ground fault detection and, as such, needed a dedicated neutral path back to the breaker to avoid nuisance tripping. That is very different from pre-AFCI thermal magnetic breakers, and it meant that shared and mixed neutrals had to be avoided.

**Breakthrough technology provided NEC/UL arc fault protection without monitoring for ground faults**

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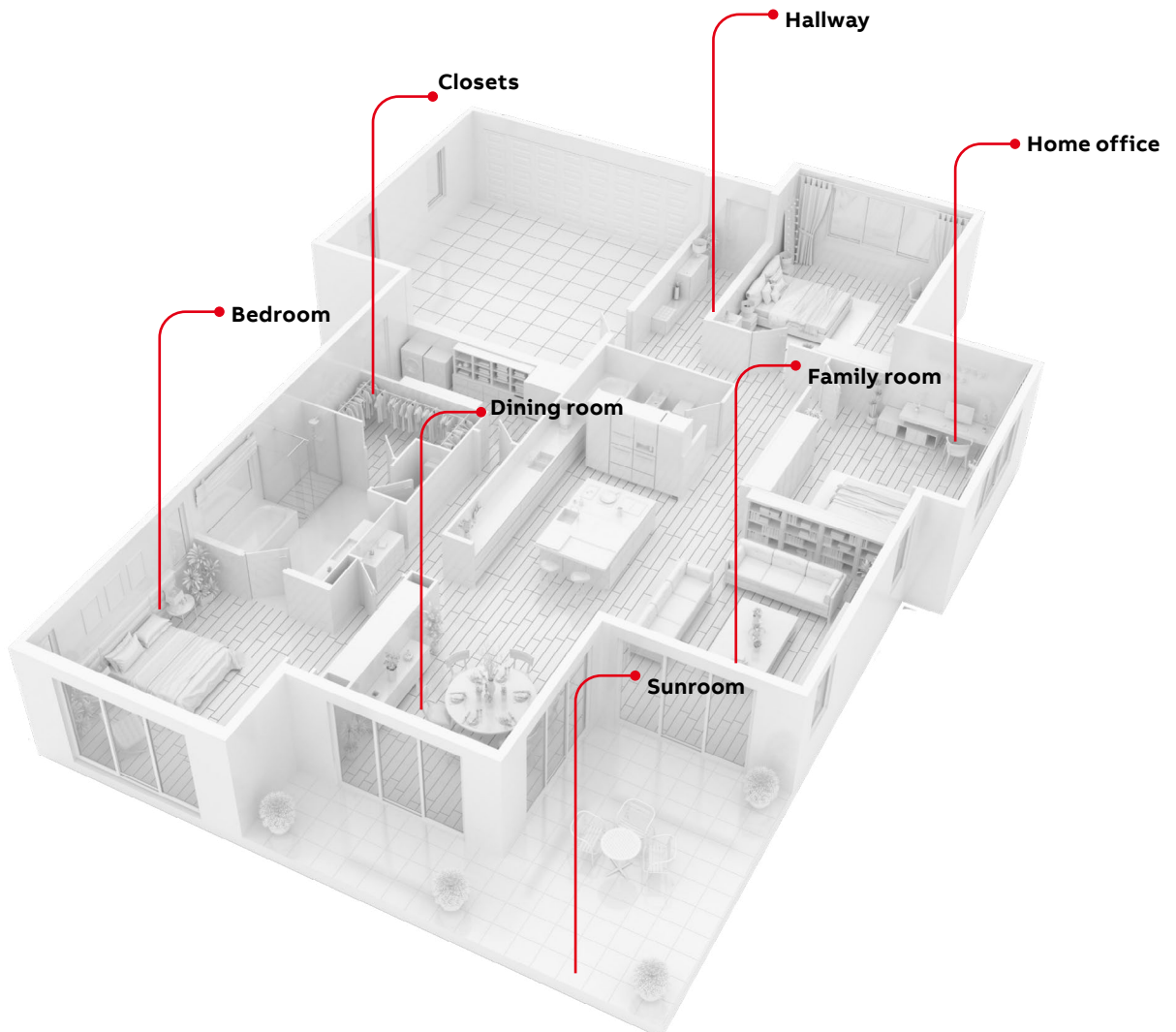
**ABB's shared neutral AFCI Advantage features two one-pole arc fault circuit breakers that are tied together with a handle tie, creating a simple, two-pole neutral solution. You can run a single #14/3 or #12/3 wire to a location close to the utilization area. The neutral wire is split, with one going to the red wire and one going to the black wire. Ordinarily, you wouldn't be able to have just one neutral coming back to a typical AFCI breaker – but with ABB's AFCI Advantage you can fully protect against arc faults without monitoring the circuit neutrals. So now you can wire a multi-wire or a shared neutral the same way you would wire a thermal magnetic breaker. You get complete AFCI protection with the flexibility, time, and labor savings of traditional breakers.**

**Ups the game with new thinking: mixing neutrals with AFCI's**

A patented Discreet Wavelet Transform Algorithm is employed in the ABB AFCI to identify abnormalities in a circuit's waveform that may be caused by arcing conditions. The technology does not rely on a clean neutral path, so you're not restricted in how you can mix or share neutrals. In fact, the load neutral lug on the ABB AFCI breaker is simply there for your wiring convenience; it does not need to be utilized. For new construction, you can choose between returning the neutral wire to the breaker or to the neutral bar – whatever works best, given your layout and space.

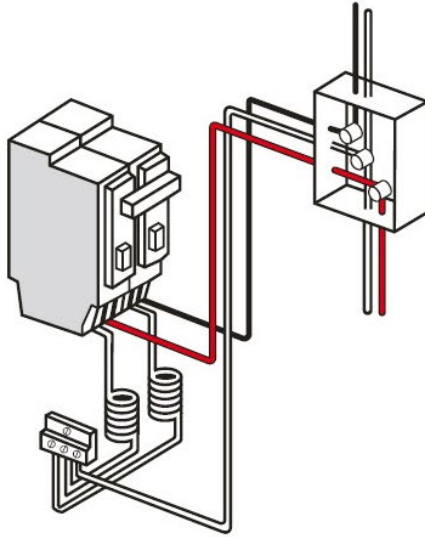
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Arc fault circuit interrupter application of AFCI according to NEC 2020.

- Bedroom
- Closets
- Den
- Dining room
- Family room
- Library
- Living room
- Office hallways
- Sunroom

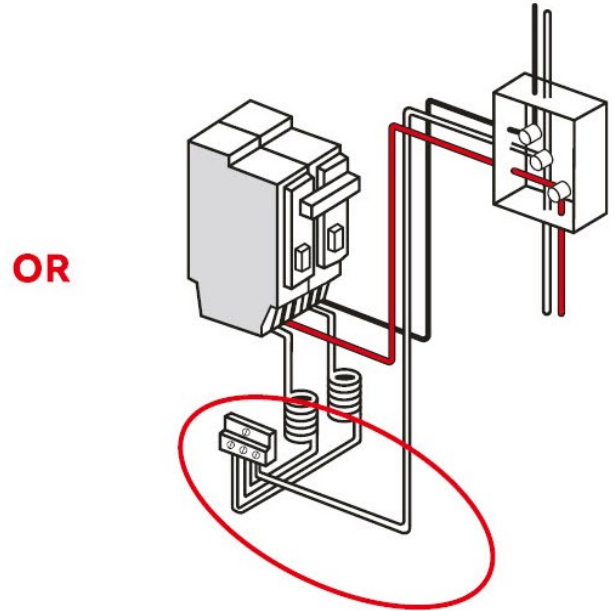


## Shared neutrals

Traditional wiring method

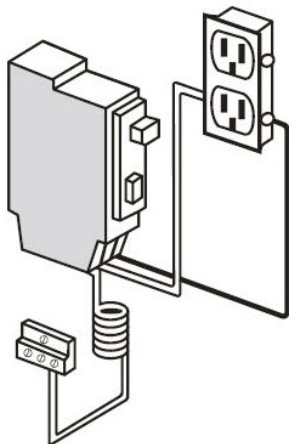


AFCI approved alternate wiring method

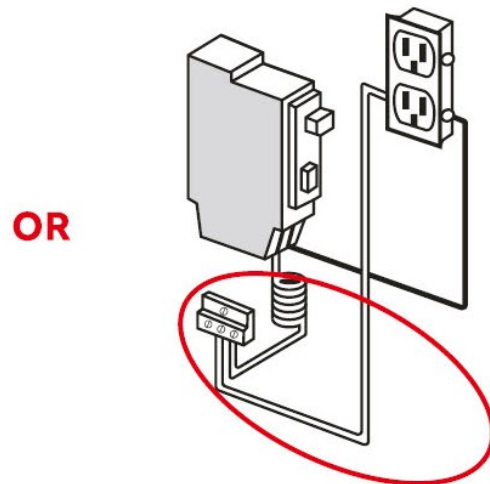


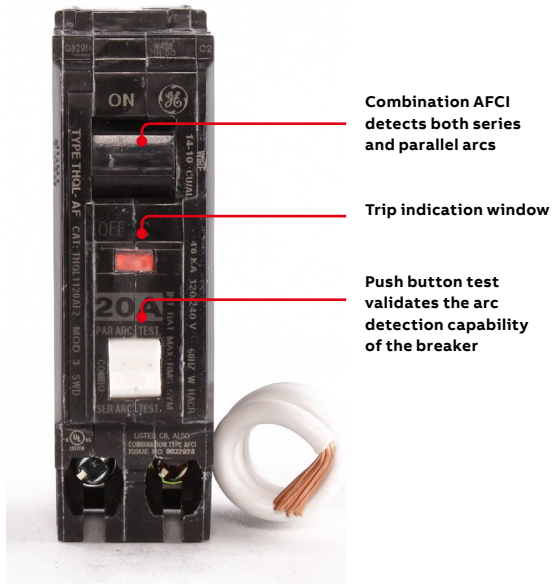
## Mixed neutrals

Traditional wiring method



AFCI approved alternate wiring method





#### GE Combination AFCIs help protect against all types of arc faults

An arc fault circuit interrupter (AFCI) detects arc faults and de-energizes the circuit before a fire can start. GE by ABB Combination AFCIs offer multiple kinds of protection.

- Parallel protection – Combination AFCIs can detect and interrupt parallel arc faults (line-to-line, line-to-ground, line-to-neutral, or a series arc fault)
- Series Protection – A series arc fault is the unintended flow of electricity over a gap within a single wire. These arc faults were not detectable until advanced technology allowed the development of the Combination AFCI breaker
- Overload protection
- Short circuit protection

These combination AFCI's electronically identify unique current and voltage characteristics of all arc faults and de-energize the entire circuit when one occurs.

#### Retrofits go from headaches to head start

Changing out an older breaker for a first-generation AFCI breaker used to mean a lot of wasted time and effort tracing circuits to identify and deal with the exact neutral wire that may be split or shared upstream. The odds are there were plenty of shared/mixed neutrals in a dwelling. If you didn't get it right, you were subject to nuisance tripping, improper protection, and code violation. You had no choice but to invest the time, effort, and dollars.

Now you have a head start on retrofits because you don't need any pre-replacement legwork. You can treat your new AFCI Advantage breaker exactly like you treated the thermal magnetic breaker it's replacing. You leave the existing neutrals of the old thermal magnetic breakers terminated on the neutral bar as they were. There is no need to identify those neutrals and land them on the new AFCI neutral lug. Simply remove the old thermal magnetic breaker, replace it with an AFCI breaker, reenergize, and you're done – with the AFCI protection you need. That's the kind of advantage that helps you submit more competitive bids to win more business – with better profit margins.

#### Flexibility beyond neutral advantages

Getting you in and out of a job fast is at the core of ABB's AFCI Advantage design. You now have the choice of running the neutral wire back to the breaker

or the neutral bar. You can also save on time and equipment costs in new construction by running one 3-wire conductor instead of two 2-wire conductors.

Simple Swap-Out AFCI Protection Is Now a Reality. Simple protection that enables you to meet arc fault code requirements for new construction and retrofit is here today. The UL- and cUL-approved AFCI Advantage circuit breakers enable a one-to-one exchange with outdated thermal magnetic breakers in existing GE by ABB panels (load centers) with no modification. But if it's time to upgrade and change out AFCI circuit breakers, it's also a good idea to upgrade and change out your panel. Installing a new GE by ABB panel with AFCI circuit breakers will be a huge time saver and ensure you have the latest technology protecting your work and your customers for years to come.

#### About ABB

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels. With a history of excellence stretching back more than 130 years, ABB's success is driven by about 105,000 talented employees in over 100 countries.