



## Arc-Fault Circuit Interrupters (AFCIs) Frequently Asked Questions

**Please note, as of September 6<sup>th</sup>, 2012, a full 2,000 W (16A) of connected dimming load can now be achieved without false tripping using Eaton® *BR, CH, or QB series* AFCI breakers. See information beginning on page 4 for more details.**

Lutron also offers dimming panels with factory-installed AFCI breakers that can be used to meet the 2008 National Electric Code® (NEC®) AFCI requirements. Note that the AFCI breakers installed in these panels are **not** the Eaton *BR, CH, or QB series* breakers. See page 8 for more information about Lutron’s AFCI breaker panels.

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## **AFCI General Overview FAQ's**

### ***What are AFCIs and what purpose do they serve?***

An AFCI is a special circuit breaker that is designed to help protect against fires resulting from electrical arcing, often caused by damaged or deteriorated wires and cords. Fires result from the heat generated from electrical arcing near combustible materials such as paper, wood, carpet, etc. Some causes of damaged and deteriorated wiring include puncturing of wire insulation from picture hanging, cable staples, drywall screws, poorly installed outlets or switches, cords caught in doors or under furniture, furniture pushed against plugs in an outlet, natural aging, and cord exposure to heat vents and sunlight.

### ***How have AFCIs evolved into the National Electric Code (NEC)?***

The 2002 edition of the *National Electric Code (NEC)*, Section 210.12 requires all branch circuits that supply 120-volt, single-phase, 15- and 20-ampere outlets ("outlets" includes lighting fixtures as defined by code) installed in dwelling unit bedrooms to be protected by an AFCI listed to provide protection of the entire branch circuit. This requirement became effective January 2002 for all new installations.

The 2008 edition of the *NEC*, Section 210.12 Arc-Fault Circuit Interrupter Protection increases these requirements to include dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms for all new installations. The attached Appendix A is a copy of Section 210.12 of the 2008 *NEC*.

For reference, Appendix B shows dwelling unit requirements for tamper resistant receptacles, GFCI protection, and AFCI protection.

### ***How do AFCIs work?***

The internal circuitry of an AFCI continuously monitors current flow in the branch circuit. AFCIs apply intelligent algorithms to the current flow information in an attempt to distinguish between normal arcing (for example the arcing that occurs when a mechanical switch is opened or closed) and unwanted arcing. This allows AFCIs to detect arcing conditions that conventional circuit breakers are unable to detect. Conventional circuit breakers only respond to sustained overloads and short circuits; so they do not protect against arcing that is characterized by erratic current flow. Once an unwanted arcing condition is detected, the control circuitry in the AFCI trips – de-energizing the circuit to avoid a potential fire.

## AFCI Responses to Dimmed and Switched Loads FAQ's

### ***How do AFCIs respond to solid-state dimmed loads?***

Dimmers reduce the amount of power delivered to lighting loads, therefore reducing light output, by electronically switching current flow on and off. This electronic switching results in current flow as seen in Figure 1 below. AFCIs will interpret this current waveform as arcing and consequently may trip if the amplitude of the current exceeds its' predetermined threshold. The higher the connected load wattage, the higher the current and the closer the current will get to the trip threshold. Additionally, most lighting loads have a brief warm-up period, during which they will draw significantly more than their rated power (~10 times). The fact that the current flow is temporarily higher in amplitude than normal and changing rapidly during this warm-up period, means that false tripping may occur at turn on.

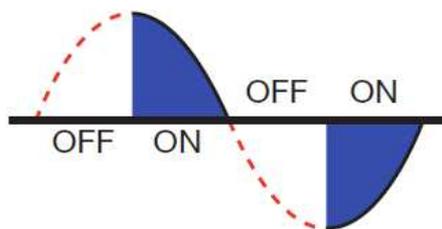


Figure 1 – Typical Dimmer Current Flow

### ***How do AFCIs respond switched loads?***

A switched output at no point removes power from the load while in the on state, such that the current flow looks like Figure 2 below. The AFCI interprets this as “normal” current flow and likewise will not trip.

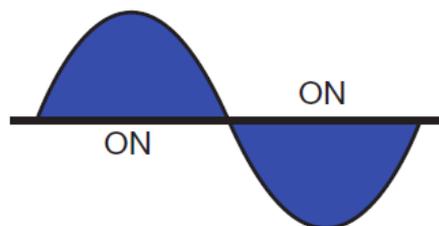


Figure 2 – Switched Output Current Flow

### ***Will switched lighting zones cause an AFCI to trip?***

NO. You can load an AFCI to its full allowable *NEC* rating (typically 2000 W) for switched lighting. If combining dimmed lighting and switched lighting on the same AFCI, the amount of dimmed lighting should not exceed 1000 W, unless Eaton's *BR*, *CH*, or *QB series* AFCI breakers are being used.

***If I set a dimmer to high-end with a zero second fade time, is that the same as a switch?***

NO. Most dimming products require a portion of the sine wave for charging their internal power supply and performing three-way signaling; shown as the small pieces removed from the sine wave in Figure 3 below. Dimmers will not power the load during this reserved period, meaning they do not meet the requirements of a switch.

Therefore, setting a dimmer to high-end with a zero second fade time may cause an AFCI to trip if 1000 W of dimmable load is exceeded on any AFCI breaker other than Eaton's *BR*, *CH*, or *QB series* AFCI breakers.

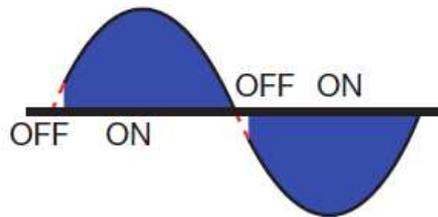


Figure 3—Dimmer Current Flow at High-End

### **Using Eaton AFCI Breakers to Achieve 2000 W of Dimming FAQ's**

***Am I able to fully load an AFCI circuit with 2000 Watts (16A) of dimmable load?***

YES. On September 6<sup>th</sup>, 2012, Lutron and Eaton announced the industry's first AFCI breaker verified to operate with up to 2000 W (16A) of connected dimming load. Lutron and Eaton teamed up to jointly and rigorously test Eaton's latest generation *BR*, *CH*, and *QB series* AFCIs. The result is a verified 2000 W of dimming capability with **ALL** Lutron dimming systems and controls (HomeWorks®, RadioRA®, AuroRA®, GRAFIK Eye®, and wallbox dimmers). Eaton's *BR*, *CH*, and *QB series* breakers are currently the **only** AFCI breaker that can achieve the full 2000 W of dimming capability with Lutron's dimming systems and controls. Refer to Appendix E for Eaton's Technical Data Sheets for their latest generation AFCI breakers.

***What are the model numbers of the Eaton breakers that allow for 2000 W of dimming and where can they be purchased?***

The following breaker models are available for 2000 W of dimming:

**CH Series (3/4" Plug-on)**

- CHFCAF115 (1 pole, 15A)
- CHFCAF120 (1 pole, 20A)

**BR Series (1" Plug-on)**

- BRCAF115 (1 pole, 15A)
- BRCAF120 (1 pole, 20A)

**QB Series (1" Bolt-on)**

- QB1015CAF (1 pole, 15A)
- QB1020CAF (1 pole, 20A)

These breakers are available today at your local Eaton distributor or your local home improvement center.

**Using 'Other' AFCI Breakers to Achieve 1000 W of Dimming FAQ's**

***Am I able to fully load an AFCI circuit with 2000 W of dimmable load with 'other' AFCI breakers?***

NO. Currently Eaton's *BR, CH, and QB series* AFCI breakers are the only breakers that have been verified with ALL Lutron products that allow for the full 2000 W of dimming capability. The maximum allowable dimming load with any AFCI breaker other than Eaton's *BR, CH, or QB series* AFCI breakers is **1000 W**.

***Why can other AFCIs only have 1000 W of dimmable lighting load connected?***

Breakers of all types are Underwriters Laboratories® (UL) Listed before being sold. To become UL Listed, one of the testing criteria states that an AFCI will not trip when less than 1000 W of dimmed tungsten lighting is connected (UL File 1699, Section 41.3.1, Subsection C). According to these testing requirements set by UL, it is permissible for an AFCI to trip with greater than 1000 W of dimmed tungsten lighting load. Remember that the goal of an AFCI is to try to detect arcs and disconnect the circuit.

Lutron worked with several breaker manufacturers to design and test an AFCI breaker capable of handling 2000 W of dimming. Lutron's testing has concluded that the margin above 1000 W of dimming using an AFCI breaker, other than Eaton's *BR, CH, and QB series* AFCI breaker, is very small and that it should not be exceeded. **Therefore, to avoid false tripping on dimming circuits that are fed by an AFCI, Lutron recommends using Eaton's BR, CH, or QB series AFCI breakers to allow for the full 2000 W of dimmable load, or NOT exceeding the maximum of 1000 W of dimmable load using any other AFCI breaker.**

***What other factors affect the other manufacturer's AFCIs trip point?***

There are many application / field factors that affect the exact trip point for a specific AFCI: the incoming power line's source impedance (stiff or soft line conditions), length of wire runs and wire gauge, number and type of bulbs used (for example a single 150 W bulb behaves differently than three 50 W bulbs; multiple lower wattage bulbs are better than one higher wattage bulb), bulb warm-up issues, the starting up of multiple loads simultaneously, speed of fading to on or off, type of phase-control being used for loads (forward or reverse), the state (on or off) and type (resistive, capacitive or inductive) of other loads that are connected to the AFCI, manufacturer of / revision of the AFCI used, design tolerances within the AFCI, the ambient temperature of the AFCI, and many more. Some of these can be controlled, others cannot, and some can change over time. This means that for systems that are not using Eaton's *BR, CH, or QB series* breakers that are near to or exceeding the 1000 W dimming limit, the AFCIs may seem to trip randomly, or AFCIs that never tripped at installation time may begin nuisance tripping later.

When not using Eaton's *BR, CH, or QB series* AFCI breakers you will need to spread out the dimming loads as much as possible to allow for the most headroom below the 1000 W limit.

***If I am not using Eaton's BR, CH, or QB series AFCI breakers, how does this impact my project design?***

Lutron recommends using Eaton's *BR, CH, or QB series* AFCI breaker whenever possible, however, we realize that this may not always be feasible.

To maximize dimming equipment utilization while still meeting the 1000 W maximum dimmed lighting load requirement on AFCIs that are not Eaton's *BR, CH, or QB series*, it is recommended that lighting zones which typically do not require dimming be controlled by a switching device and that the load type be designated in the software as non-dimmed (when it is selectable). Mix these switched loads with dimmed loads to maximize equipment utilization. Closets, garages, and some outdoor lighting are often applications where dimming is not required, so switch those zones. By thoughtfully combining dimmed and switched lighting zones and being mindful of the 1000 W dimmed lighting maximum using AFCIs that are not Eaton's *BR, CH, or QB series*, you can minimize the need for additional AFCIs and lighting control equipment.

See below for project design recommendations when using RPM panels, local Maestro controls, or GRAFIK Eye/WPM units that are controlling AFCI loads. If you exceed 1000 W of dimming in any of the examples below, you will need to use one or more power boosters. Each power booster **must** be on a separate AFCI.

### RPM Panels

Dimming modules (4As and 4Us) accept one dedicated feed from the distribution panel. To minimize the required number of AFCI breakers, place all AFCI controlled loads together. Do not place more than 1000 W of dimming load on each Arc-Fault Circuit Interrupter breaker.

- HW-RPM-4A or HW-RPM-4U.

A single HW-RPM-4A or HW-RPM-4U can support 4 zones @ 1920 W total. Up to 1000 W on any or all of those 4 zones can be dimmed. Any load beyond the dimmed 1000 W must be switched.

Example:

	<u>Dimmed Load</u>		<u>Switched Load</u>	
<b>Zone 1</b>	<b>300 W</b>			
<b>Zone 2</b>			<b>400 W</b>	
<b>Zone 3</b>	<b>500 W</b>			
<b>Zone 4</b>	<b>200 W</b>			
<i>Dimmed total may not exceed 1000 W</i>	<b>1000 W</b>	<b>+</b>	<b>400 W</b>	<b>= 1400 W</b> ( <i>RPM total may not exceed 1920 W</i> )

### Maestro Local Controls

Do not place more than 1000 W of dimming load on *Maestro* dimmers fed by AFCIs.

- HQRx- or HWx, -6D, -6ND, -6NA, -10D, -10ND

1920 W can be attached to a single 20 AMP AFCI breaker. Up to 1000 W may be dimmed lighting load. This 1000 W can be on a single dimmer or several dimmers combined, so long as the dimmed lighting load does not exceed 1000 W. The remaining 920 W (available for that AFCI) must be switched.

Example:

	<u>Dimmed Load</u>		<u>Switched Load</u>	
<b>Dimmer 1</b>	<b>100 W</b>			
<b>Dimmer 2</b>	<b>300 W</b>			
<b>Switch 1</b>			<b>200 W</b>	
<b>Switch 2</b>			<b>150 W</b>	
<b>Dimmer 3</b>	<b>400 W</b>			
<b>Dimmer 4</b>	<b>200 W</b>			
<i>Dimmed total may not exceed 1000 W</i>	<b>1000 W</b>	<b>+</b>	<b>350 W</b>	<b>= 1350 W</b> ( <i>circuit total may not exceed 1920 W</i> )

### **GRAFIK Eye or Wallbox Power Module (WPM)**

Do not place more than 1000 W of dimming load on *GRAFIK Eye* or *WPM* units fed by an AFCI breaker.

- QSGRJ-(3/4/6)P or HQRJ-WPM-6D-120 (zone count can vary on QSGRJ models)  
For example, a QSGRJ-4P can support 4 zones @ 1920 W total. Up to 1000 W total can be dimmed across any of those 4 zones. **Note: you may not exceed more than 800 W on any single zone of a GRAFIK Eye or WPM unless you are using a power booster.** The remaining 920 W (available for that AFCI) must be switched.

Example:

	<b><u>Dimmed Load</u></b>		<b><u>Switched Load</u></b>	
<b>Zone 1</b>	<b>600 W</b>			
<b>Zone 2</b>			<b>200 W</b>	
<b>Zone 3</b>	<b>400 W</b>			
<b>Zone 4</b>			<b>500 W</b>	
<i>Dimmed total may not exceed 1000 W</i>	<b>1000 W</b>	<b>+</b>	<b>700 W</b>	<b>= 1700 W</b> <i>(total may not exceed 1920 W)</i>

### **Using AFCI Breakers in Lutron Panels FAQ's**

#### ***Am I able to use Eaton's BR, CH or QB series breakers in Lutron's dimming panels?***

NO. Eaton's *BR, CH, and QB series* breakers have only been rated for use in Eaton's load centers. Testing has not yet been performed on the mounting and use of Eaton's *BR, CH, or QB series* breakers in any panel other than an Eaton load center, therefore it is not permissible to mount Eaton's *BR, CH, or QB series* breakers in anything other than an Eaton load center.

Also, the breakers used in Lutron's breaker panels use a proprietary mounting system (from the breaker manufacturer) that only allows for the mounting and use of their breakers. Lutron recommends using feed-through panels that are fed from an Eaton distribution panel with *BR, CH, or QB series* breakers installed to achieve the full 2000 W of dimming per AFCI circuit.

#### ***Does Lutron offer panels with AFCI breakers installed, and if so, am I able to load each AFCI circuit with a full 2000 W of dimmable load?***

Lutron does offer panels with AFCI breakers installed, *however*, the AFCI breakers that are used in Lutron's panels are **NOT** Eaton's *BR, CH, or QB series* breakers, therefore you must not exceed 1000 W of dimming load per AFCI circuit when using Lutron's AFCI breaker panels.

**What type of AFCI breakers does Lutron use in the AFCI breaker panels and what are the panel model numbers?**

Lutron utilizes Square D® QO115CAFI and QO120CAFI commercial-grade, high-magnetic inrush, combination AFCI breakers. These breakers protect against series arcs, parallel arcs, and line-to-ground arcs for protection of the entire branch circuit (lower grade breakers only protect against parallel arcs). The high-magnetic inrush prevents false tripping when dimming large lighting loads (**1000 W and under**). Lutron offers the following 59" rough-in panels with eight factory-installed Square D AFCI breakers for up to 8 RPMs (4A, 4U, 4M, 4FSQ):

- HWAP-8D-15-120L3 – 15A, single-phase
- HWAP-8D-20-120L3 – 20A, single-phase
- HWAP-8D-15-120L4 – 15A, three-phase
- HWAP-8D-20-120L4 – 20A, three-phase

Alternatively, Lutron recommends using HWI-PNL-5 or HWI-PNL-8 remote power feed-through panels, fed from Eaton's *BR, CH, or QB series* AFCI breakers to achieve the full 2000 W of dimmable load per AFCI circuit. Lutron's feed-through panels do not accommodate breakers within the panels, so a separate Eaton load center will be required for mounting the *BR, CH, or QB series* AFCI breakers.

**Can I retrofit a standard breaker panel (HWBP) with AFCI breakers?**

YES, as long as you use Square D QO series AFCI breakers (called out above). Refer to the attached Appendix C for instructions. This procedure will require re-wiring a portion of the panel due to neutral wire requirements of the AFCI breakers. Modifying the breaker panel may affect the UL Listing of the panel – a qualified UL inspector should inspect the panel after the modifications have been made. Contact Lutron for details.

Note: Eaton's *BR, CH, and QB series* AFCI breakers cannot be retrofit into a Lutron breaker panel, therefore you will need to be certain that you do not exceed 1000 W of dimming per AFCI circuit.

**WARNING:** Shock hazard. To avoid the risk of electric shock, this installation must be done by a qualified person, and must meet all local and NEC® codes. Failure to comply could result in serious injury or death.

**Can I replace AFCI breakers in HWAP panels with standard breakers?**

YES, Lutron HWAP panels were designed with additional terminal block connection points to make installation, removal, and replacement of AFCI and standard breakers easy to accomplish. Refer to Appendix D for instructions.

**WARNING:** Shock hazard. To avoid the risk of electric shock, this installation must be done by a qualified person, and must meet all local and NEC® codes. Failure to comply could result in serious injury or death.

## **Lutron Recommendations for AFCI Nuisance Tripping**

***I have existing AFCIs with dimmable loads over 1000 W that are nuisance tripping, what options do I have?***

1. Install or replace the existing load center with an Eaton load center with Eaton's *BR, CH, or QB series* AFCI breakers installed. This will allow for the full 2000 W of dimming per AFCI circuit.
2. If option 1 is not feasible or possible, you will need to re-lamp the circuit(s) to reduce the total wattage of the connected dimmable load(s).
3. If options 1 and 2 are not possible, convert some of the dimmed loads to switched loads.
4. If options 1, 2 and 3 are not possible, while not guaranteed to resolve nuisance tripping, the following four suggestions are known to affect what the AFCI detection circuitry is measuring and therefore what the internal algorithm decides is happening (arc or no arc). Whether these suggestions resolve the AFCI nuisance tripping will depend on the specific conditions at the installation (see "What other factors affect other AFCIs trip point?"):
  - a. Change bulb wattages. 40 W bulbs at a higher dim percentage may cause less tripping than 60 W bulbs with a lower dim percentage and give the same light output.
  - b. Stagger the turn on of loads – both switched and dimmed loads. Because of the 10 times inrush current when starting up a load, inserting a delay between the start up of large loads on the order of 1 to 2 seconds may avoid tripping.
  - c. Stagger the fade on/off rates of the dimmed loads. Fading on/off several loads at the same rate aligns the dimmers firing edges. Staggering these fading rates from typically 0.5 seconds to 3 seconds (or longer if possible) may avoid tripping.
  - d. Stagger or change the programmed dim percentages. 1000 W of dimming on multiple zones all set to exactly 50.0% may trip an AFCI but those same loads with the dimming staggered from 45 to 55% may not.
5. If all options above are not possible, rewiring to rebalance the loads would be a difficult last resort.

## **Appendices**

# APPENDIX A

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## 210.12 Arc-Fault Circuit-Interrupter Protection.

(A) **Definition:** Arc-Fault Circuit Interrupter (AFCI). A device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected.

(B) **Dwelling Units:** All 120-volt, single phase, 15- and 20-ampere branch circuits supplying outlets installed in dwelling unit family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, or similar rooms or areas shall be protected by a listed arc-fault circuit interrupter, combination-type, installed to provide protection of the branch circuit.

FPN No. 1: For information on types of arc-fault circuit interrupters, see UL 1699-1999, *Standard for Arc-Fault Circuit Interrupters*.

FPN No. 2: See 11.6.3(5) of NFPA 72<sup>®</sup>-2007, *National Fire Alarm Code<sup>®</sup>*, for information related to secondary power supply requirements for smoke alarms installed in dwelling units.

FPN No. 3: See 760.41(B) and 760.121(B) for power-supply requirements for fire alarm systems.

*Exception No. 1: Where RMC, IMC, EMT or steel armored cable, Type AC, meeting the requirements of 250.118 using metal outlet and junction boxes is installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a combination AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.*

*Exception No. 2: Where a branch circuit to a fire alarm system installed in accordance with 760.41(B) and 760.121(B) is installed in RMC, IMC, EMT, or steel armored cable, Type AC, meeting the requirements of 250.118, with metal outlet and junction boxes, AFCI protection shall be permitted to be omitted.*

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# APPENDIX B

## Dwelling Unit\* requirements - Tamper Resistant Receptacles, GFCI protection, AFCI protection, AFCI protection

Tamper-resistant receptacle outlets required in these locations 2008 code articles 210.52, 406.11	GFCI protection required for these receptacle outlet locations <sup>1</sup> 2008 code article 210.8	AFCI protection required on all outlets (not just receptacles) in these locations <sup>2</sup> 2008 code article 210.12
Bathrooms	Bathrooms	
Garages	Garages	
Outdoors	Outdoors	
Laundry	Laundry, Utility, Wet bar sinks	
Basements	Unfinished Basements	
Kitchens	Kitchens - countertop areas	
Living rooms		Living rooms
Dining Rooms		Dining rooms
Libraries		Libraries
Dens		Dens
Sunrooms		Sunrooms
Bedrooms		Bedrooms
Recreation rooms		Recreation rooms
Parlors		Parlors
Family rooms		Family rooms
Hallways		Hallways
Similar rooms or areas		Similar rooms or areas
	Crawl Spaces	
	Boathouses	
		Closets

\* Definition of Dwelling unit – One or more rooms arranged for complete, independent housekeeping purposes, with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation.

Note 1 - If GFCI receptacles are used, they would be required to be Tamper-resistant at those locations where tamper-resistant receptacle outlets are required.

Note 2 - Bold locations are new AFCI requirements for the 2008 Code.

RSS 20071023



## APPENDIX C

HWBP-8D 8-Module Integrated Control Enclosure  
 HWBP-2S 2-Module Integrated Control Enclosure

### Installation Instructions Addendum Please Read Before Installing

### Retrofitting AFCI breakers into HWBP-8D and -2S panels



**WARNING:** To avoid the risk of electric shock, this installation must be done by a qualified person, and must meet all local and NEC® codes.

#### Installation

1. Turn panel input power OFF.
2. Locate circuit breaker to be replaced.
3. Remove the black RPM Power Wire from breaker.
4. Remove breaker.
5. Install AFCI breaker.
6. Install the black RPM Power Wire to the Load Terminal on the AFCI breaker (as specified in the instruction sheet included with the AFCI breaker).
7. Remove the white RPM Neutral Wire from the RPM Terminal Block Assembly on the same circuit as the breaker being replaced.
8. Connect the white RPM Neutral Wire (wire just removed) to the AFCI Neutral Wire (pigtail wire permanently connected to AFCI). In most cases, an additional wire length will be necessary to reach the RPM Neutral Wire.
9. Install a jumper wire between the Neutral terminal on the RPM Terminal Block Assembly and the Neutral Load Terminal on the AFCI breaker.
10. Recheck wiring, and restore power to panel.

#### Technical and Sales Assistance

If you need assistance, call the toll-free **Lutron Technical Support Center**. Please provide exact model number when calling.

1.800.523.9466 (U.S.A., Canada and the Caribbean)

Other countries call:

Tel: +1.610.282.3800

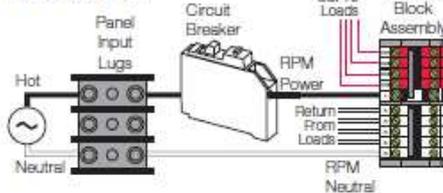
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Visit our Web site at [www.lutron.com](http://www.lutron.com)

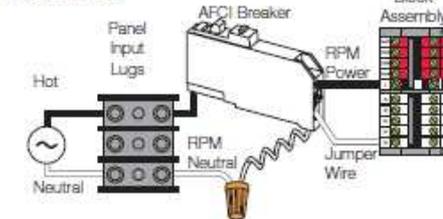
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#### Wiring Diagram

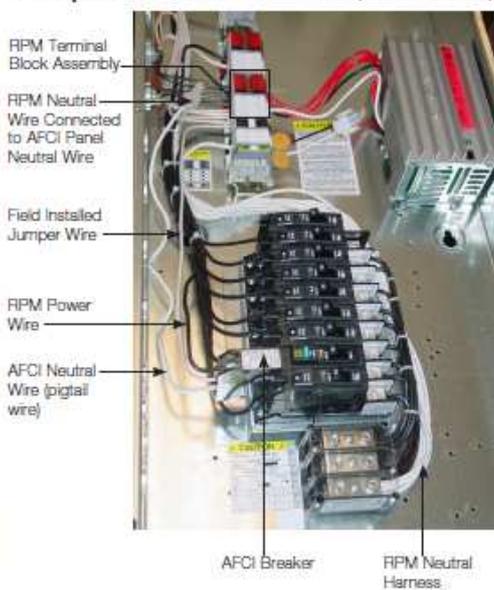
##### Before AFCI



##### After AFCI



#### Component/Wire Location (HWBP-8D shown)



### Installation Instructions Addendum Please Read Before Installing

**NOTICE:** Installation must be done by a qualified person, and must meet all local and NEC® codes.

#### Installation

1. Turn panel input power OFF.



**WARNING: Shock hazard.** The panel may be fed by multiple circuits. To avoid the risk of electric shock, locate and lock each supply circuit breaker in the off position before proceeding. Wiring with the power on could result in death or serious injury.

2. Locate circuit breaker to be replaced.
3. Remove the black RPM Power Wire and the white RPM Neutral Wire from the AFCI breaker.
4. Remove the white neutral wire permanently attached to the AFCI breaker from the Neutral Wire Terminal Block.
5. Remove AFCI breaker.
6. Install standard breaker.
7. Connect the black RPM Power Wire to the Load Terminal on the standard breaker.
8. Connect the white RPM Neutral Wire from the RPM Terminal Block Assembly to the Neutral Wire Terminal Block.
9. Recheck wiring, and restore power to panel.

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Other countries call:

Tel: +1.610.282.3800

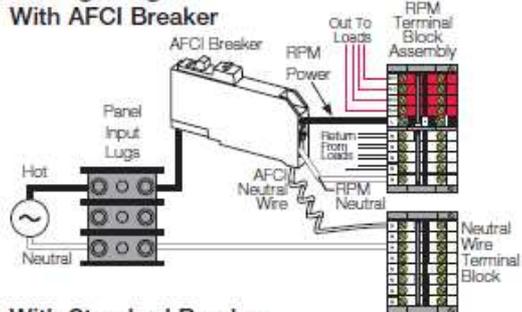
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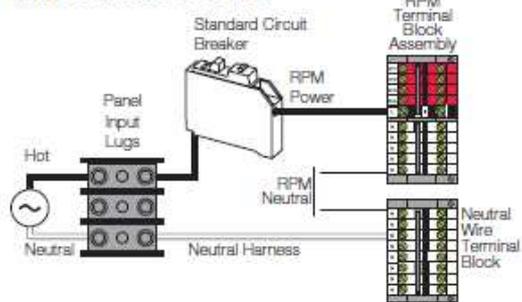
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### Retrofitting standard breakers into HWAP-8D Arc-Fault Panels

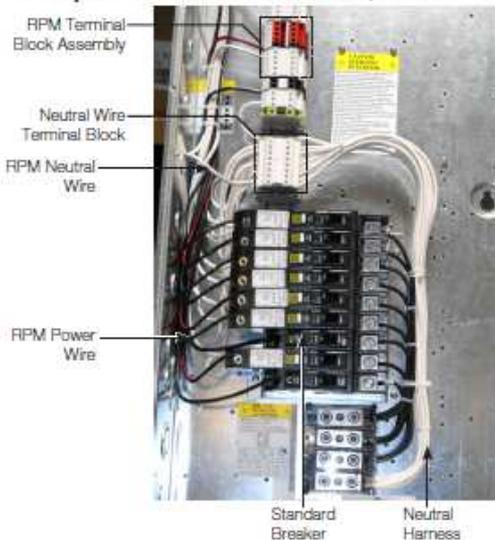
#### Wiring Diagram With AFCI Breaker



#### With Standard Breaker



#### Component/Wire Location (HWAP-8D shown)



# APPENDIX E

Technical Data TD003001EN

Effective August 2012

## Type BR (1") Combination Arc Fault Circuit Interrupter



### Description

Beginning in 2008, the National Electrical Code requires all circuits feeding dwelling areas in residential structures to be protected by Combination Type Arc Fault Circuit Interrupters.

Eaton's Type BR (1") Combination AFCI is available in 15 and 20 Amp configurations and includes options for 22kAIC interrupting rating. Eaton has also made a diagnostic version of the BR Arc Fault which includes an LED, indicating the most recent trip code to assist in troubleshooting.

### Design Features

- Compact Footprint as Standard
- Arc Fault Detection Methodology Tolerant of Non-compliant Devices
- Lifetime Trip Code retention
- Overvoltage Protection
- Continuous Self-Test of electronic components
- Available Diagnostic LED to access most recent trip code

Table 1. Type BR (1") CAFCI Selection Chart

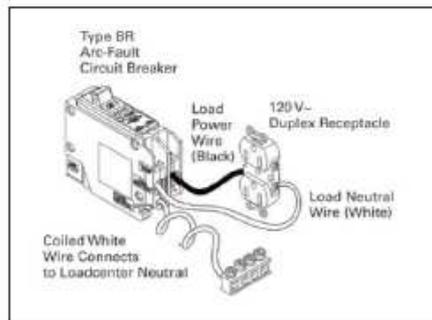
Catalog Number	Amps	Poles	kAIC
<b>Standard - Pigtail</b>			
BRCAF115	15	1	10
BRCAF120	20	1	10
<b>Diagnostic - LED</b>			
BRACAF115	15	1	10
BRACAF120	20	1	10
<b>High - Interrupting - 22 kAIC</b>			
BRHCAF115	15	1	22
BRHCAF120	20	1	22



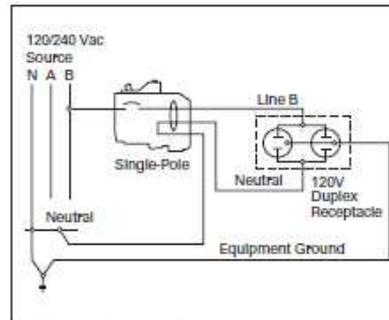
Table 2. Specifications

<b>Catalog Number</b>	BRCAF115, BRCAF120, BRHCAF115, BRHCAF120, BRACAF115, BRACAF120
<b>Voltage Requirement</b>	70 ≤ V ≤ 160
<b>Frequency Requirement</b>	60 ± 2 Hz
<b>Power Consumption</b>	0.75W
<b>Surge</b>	In accordance with IEC 61000-4-5
<b>Ambient Temperature</b>	-31°C to 66°C (32°F to 151°F)
<b>Humidity</b>	0% to 93% humidity, non-condensing
<b>Warranty</b>	10 Year
<b>Dimming Load</b>	Up to 2,000 Watts verified compatibility with the following systems and controls: <b>Lutron®:</b> <ul style="list-style-type: none"> <li>• HomeWorks®</li> <li>• RadioRA®</li> <li>• AuraRa®</li> <li>• Grafik Eye®</li> <li>• Wallbox dimmers</li> </ul>
<b>UL® Standards</b>	UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures UL 1699 - Arc Fault Circuit Interrupters UL 1998 - Software in Programmable Components
<b>UL File Number</b>	E-7619

### Installation



### Wiring Diagram

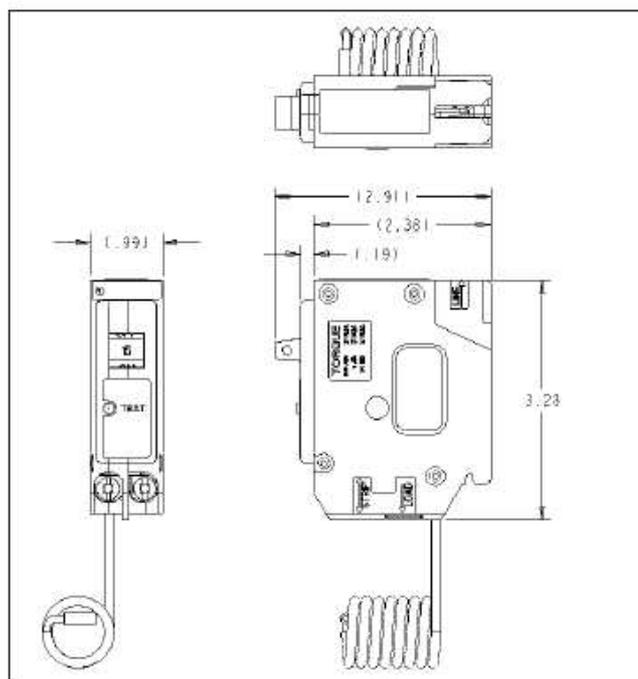


**1-Pole 120 Volt Load Application  
Sourced by 120/240 Vac**

**Table 3. Diagnostic Trip Codes** (The following Trip Codes are displayed through the Diagnostic AFCI (Catalog number: BRACAF000)

Blink Pattern	Description
0	<b>Mechanical Disconnect</b> The breaker has detected an overload, short circuit or was manually turned off
1	<b>Low Current Arc</b> A low current "series" arc has been detected within one of the current pathways. These arcs are typically found in worn or degraded appliance and extension cords, poor connections in appliances or fixtures, or in contacts within equipment
2	<b>High Current Arc</b> A high current "parallel" arc has been detected between two conductors. These arcs are usually found in installed wiring where the wire has been compromised by a nail or screw, tight staple, damaged insulation.
3	<b>Short Delay</b> Short delay is an electronic backup to the short circuit mechanism
4	<b>Overvoltage</b> The breaker will trip if it experiences voltage of 160V RMS or greater. The breaker can be reset and the "TEST" button can be pushed to verify the breaker is working properly
6	<b>Self Test Failure</b> The breaker continually tests the internal electronics and software to ensure the arc fault detection technology is working properly. If the self diagnostics fail, the breaker will trip

**Dimensions**



Technical Data TD003001EN  
Effective August 2012

## Type BR (1") Combination Arc Fault Circuit Interrupter



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# Type CH (3/4") Combination Arc Fault Circuit Interrupter



## Description

Beginning in 2008, the National Electrical Code requires all circuits feeding dwelling areas in residential structures to be protected by Combination Type Arc Fault Circuit Interrupters.

Eaton's Type CH (3/4") Combination AFCI is available in 15 and 20 Amp configurations. Eaton has also included a diagnostic LED as a standard feature in the CH AFCI which indicates the most recent trip code to assist in troubleshooting.

## Design Features

- Arc Fault Detection Methodology Tolerant of Non-compliant Devices
- Lifetime Trip Code retention
- Overvoltage Protection
- Continuous Self-Test of electronic components
- Diagnostic LED to access most recent trip code
- Two position, Trip to "OFF" handle

Table 1. Type CH (3/4") CAFCI Selection Chart

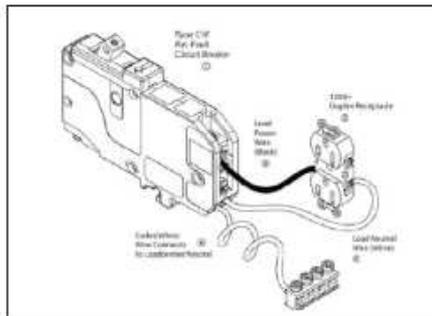
Catalog Number	Amps	Poles	kAIC
<b>Standard - Pigtail</b>			
CHFCAF115	15	1	10
CHFCAF120	20	1	10
<b>Plug-on Neutral</b>			
CHFCAF115PN	15	1	10
CHFCAF120PN	20	1	10



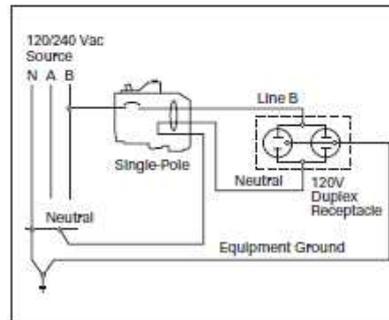
Table 2. Specifications

<b>Catalog Number</b>	CHCAF115, CHCAF120, CHCAF115PN, CHCAF120PN
<b>Voltage Requirement</b>	70 ≤ V ≤ 160
<b>Frequency Requirement</b>	60 ± 2 Hz
<b>Power Consumption</b>	0.75W
<b>Surge</b>	In accordance with IEC 61000-4-5
<b>Ambient Temperature</b>	-31°C to 66°C (32°F to 151°F)
<b>Humidity</b>	0% to 93% humidity, non-condensing
<b>Warranty</b>	Limited Lifetime
<b>Dimming Load</b>	Up to 2,000 Watts verified compatibility with the following systems and controls: <b>Lutron®:</b> <ul style="list-style-type: none"> <li>• HomeWorks®</li> <li>• RadioRA®</li> <li>• AeroRa®</li> <li>• Grafik Eye®</li> <li>• Wallbox dimmers</li> </ul>
<b>UL® Standards</b>	UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures UL 1699 - Arc Fault Circuit Interrupters UL 1998 - Software in Programmable Components
<b>UL File Number</b>	E-7619
<b>Ground Fault Protection</b>	30mA - Does not meet the requirements of UL 1053 for ground fault sensing & relaying equipment

### Installation



### Wiring Diagram



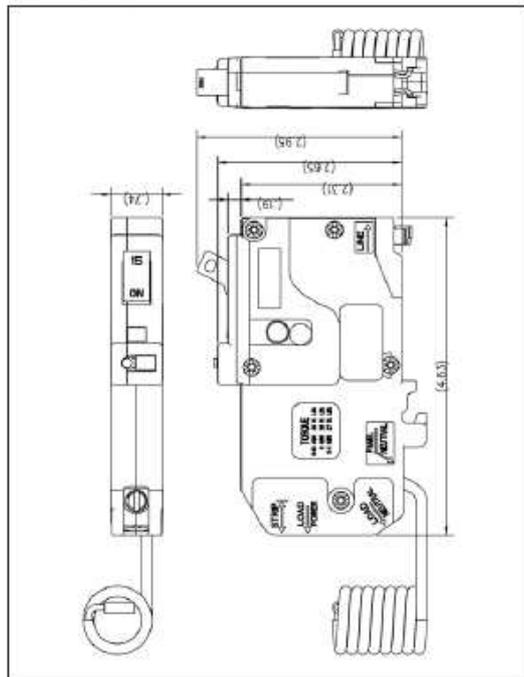
1-Pole 120 Volt Load Application  
Sourced by 120/240 Vac

**Table 3. Diagnostic Trip Codes** (The following Trip Codes are displayed through the Diagnostic AFCI (Catalog number: CHACAF000))

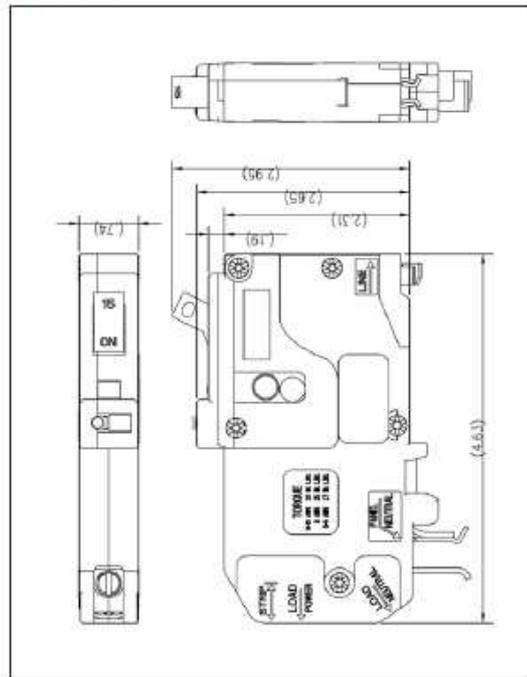
Blink Pattern	Description
0	<b>Mechanical Disconnect</b> The breaker has detected an overload, short circuit or was manually turned off
1	<b>Low Current Arc</b> A low current "series" arc has been detected within one of the current pathways. These arcs are typically found in worn or degraded appliance and extension cords, poor connections in appliances or fixtures, or in contacts within equipment
2	<b>High Current Arc</b> A high current "parallel" arc has been detected between two conductors. These arcs are usually found in installed wiring where the wire has been compromised by a nail or screw, tight staple, damaged insulation.
3	<b>Short Delay</b> Short delay is an electronic backup to the short circuit mechanism
4	<b>Overvoltage</b> The breaker will trip if it experiences voltage of 150V RMS or greater. The breaker can be reset and the "TEST" button can be pushed to verify the breaker is working properly
5	<b>Ground fault</b> Current has found an alternate path to ground.
6	<b>Self Test Failure</b> The breaker continually tests the internal electronics and software to ensure the arc fault detection technology is working properly. If the self diagnostics fail, the breaker will trip

### Dimensions

Standard Pigtail



Plug-on Neutral



Technical Data TD003002EN  
Effective August 2012

## Type CH (3/4") Combination Arc Fault Circuit Interrupter



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# Type QB (1") Combination Arc Fault Circuit Interrupter



## Description

Beginning in 2008, the National Electrical Code requires all circuits feeding dwelling areas in residential structures to be protected by Combination Type Arc Fault Circuit Interrupters.

Eaton's Type QB (1") Bolt-on Combination AFCI is available in 15 and 20 Amp configurations. Eaton has also included a diagnostic LED as a standard feature in the QB AFCI which indicates the most recent trip code to assist in troubleshooting.

## Design Features

- Arc Fault Detection Methodology Tolerant of Non-compliant Devices
- Lifetime Trip Code retention
- Overvoltage Protection
- Continuous Self-Test of electronic components
- Diagnostic LED to access most recent trip code

**Table 1. Type QB (1") CAFCI Selection Chart**

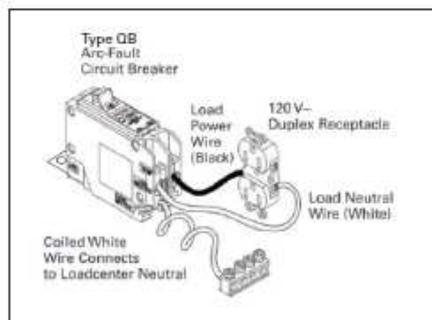
Catalog Number	Amps	Poles	kAIC
<b>Standard - Pigtail</b>			
QB1015CAF	15	1	10
QB1020CAF	20	1	10
<b>High - Interrupting - 22kAIC</b>			
QBH1015CAF	15	1	22
QBH1020CAF	20	1	22



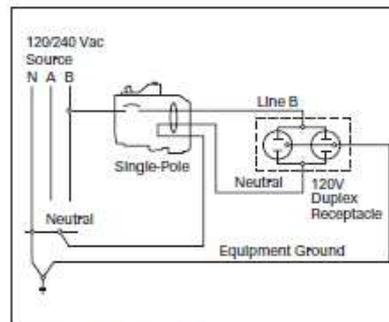
Table 2. Specifications

<b>Catalog Number</b>	QB1015CAF, QB1020CAF, QBH1015CAF, QBH1020CAF
<b>Voltage Requirement</b>	70 ≤ V ≤ 160
<b>Frequency Requirement</b>	60 ± 2 Hz
<b>Power Consumption</b>	0.75W
<b>Surge</b>	In accordance with IEC 61000-4-5
<b>Ambient Temperature</b>	-31°C to 66°C (32°F to 151°F)
<b>Humidity</b>	0% to 93% humidity, non-condensing
<b>Warranty</b>	1 year - From date of installation
<b>Dimming Load</b>	Up to 2,000 Watts verified compatibility with the following systems and controls: <b>Lutron®:</b> • HomeWorks® • RadioRA® • AuraRa® • Grafik Eye® • Wallbox dimmers
<b>UL® Standards</b>	UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures UL 1699 - Arc Fault Circuit Interrupters UL 1998 - Software in Programmable Components
<b>UL File Number</b>	E-7619

### Installation



### Wiring Diagram

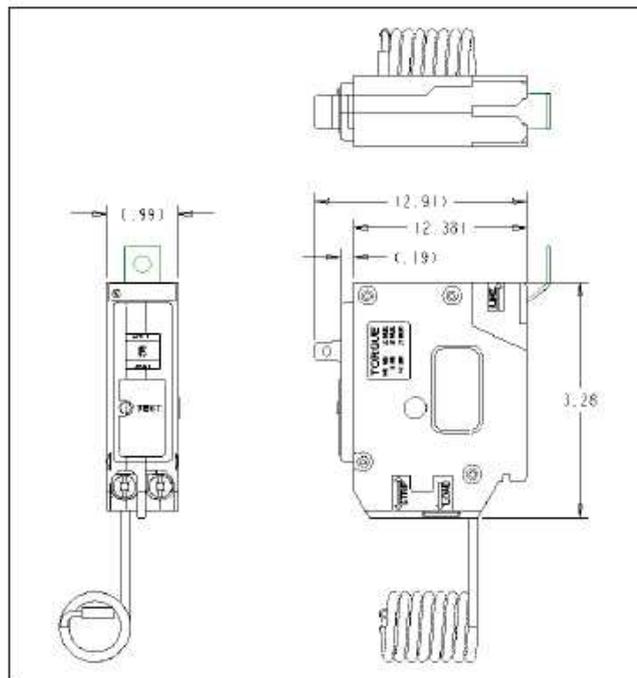


**1-Pole 120 Volt Load Application  
Sourced by 120/240 Vac**

**Table 3. Diagnostic Trip Codes** (The following Trip Codes are displayed through the Diagnostic AFCI (Catalog number: CHACAF000)

Blink Pattern	Description
0	<b>Mechanical Disconnect</b> The breaker has detected an overload, short circuit or was manually turned off
1	<b>Low Current Arc</b> A low current "series" arc has been detected within one of the current pathways. These arcs are typically found in worn or degraded appliance and extension cords, poor connections in appliances or fixtures, or in contacts within equipment
2	<b>High Current Arc</b> A high current "parallel" arc has been detected between two conductors. These arcs are usually found in installed wiring where the wire has been compromised by a nail or screw, tight staple, damaged insulation.
3	<b>Short Delay</b> Short delay is an electronic backup to the short circuit mechanism
4	<b>Overvoltage</b> The breaker will trip if it experiences voltage of 160V RMS or greater. The breaker can be reset and the "TEST" button can be pushed to verify the breaker is working properly
6	<b>Self Test Failure</b> The breaker continually tests the internal electronics and software to ensure the arc fault detection technology is working properly. If the self diagnostics fail, the breaker will trip

### Dimensions





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