

TROUBLESHOOTING PLAYBOOK

ReliaHome[™] circuit breakers Electrical panels



New technology and innovation are constantly being created and designed to improve quality, adapt to ever-changing environments and address existing problems. As technology changes, certain risks arise that need to be addressed.

01 ReliaHome™ load center

In 1893, at the World's Fair in Chicago, President Grover Cleveland lit 100,000 incandescent bulbs at once with a single switch. This illuminated the entire grounds, launching the World's Columbian Exposition and signifying the era of electrification. In the background, William Henry Merrill, Jr., the founder of Underwriters Laboratories (UL), was an electrical inspector assessing fire risk at the fair.

Underwriters Laboratories (UL)

With the changing world, regulations needed to be put in place due to different hazards that arise. UL's team has used science-based research for the last 125 years to publish more than 500 standards for electrical safety.

UL standards provide requirements for equipment construction, performance, testing and installation to ensure safety without exposing people and property to hazards. The standards address new dangers and risks with ever-changing technology while regulating the safety, performance and sustainability of new and evolving equipment. The standards are in place to protect against:

- Arc flash Arc flash occurs when an electrical current leaves its intended path and travels from one point to another, typically from conductor-toconductor contact. Some common causes include corrosion, faulty installation, condensation, material failure, accidental contact or exposed voltage sources.
- Electrical shock Electrical shock occurs when electric current passes through the body and can lead to fatal and nonfatal injuries with more than 30,000 nonfatal incidents each year. Electrical shock can be caused by exposed or damaged cables, faulty appliances, lightning strikes and electrostatic discharge.
- Fire Electrical fires cause more than 35,000 home fires and \$1.4 billion in property damage each year due to worn or inadequate wiring, overloaded circuits, overheating of energized equipment and proximity to fuel.

02 NEC in effect as of Feb. 1, 2025, according to NFPA. To view the NFPA's latest NEC adoption maps, visit https://www.nfpa.org/ NEC/NEC-adoption-anduse/NEC-adoption-maps. ABB's circuit breakers are tested to UL safety standards to ensure the product, processes and materials have undergone stringent evaluation by a third party. ABB's breakers are tested and listed under the following UL standards, dependent on the specific circuit breaker.

- UL 489 Molded case circuit breakers, molded case switches and circuit breaker enclosures
- UL 943 Ground fault circuit interrupters, 5 mA
- UL 1053 Ground fault circuit interrupters, 30 mA
- UL 1699 Arc fault circuit interrupters
- UL 1998 Software in programmable components

In an ever-evolving technological landscape, the need for rigorous safety standards is more critical than ever. Since its founding during the dawn of electrification at the 1893 World's Fair, Underwriters Laboratories has remained at the forefront of electrical safety, using science-based research to develop over 500 standards that protect people and property from emerging risks. From arc flash and electrical shock to fire hazards. UL standards ensure that as innovation advances, safety keeps pace. ABB's circuit breakers are tested against these stringent UL standards, demonstrating a commitment to reliability and safety through third-party verification. As technology continues to transform our world, UL standards and companies like ABB play a crucial role in safeguarding lives and sustaining trust in modern electrical systems.

National Electrical Code (NEC)

The National Fire Protection Agency (NFPA) develops the National Electrical Code (NEC) as "the benchmark for safe electrical design, installation and inspection to protect people and property from electrical hazards." The code is not federal law, but some form of the NEC has been adopted by all 50 states. Thus, compliance with the NEC within the U.S. is not optional, but mandatory, and critical to the safety and wellbeing of workers, homeowners and tenants. As you can see from the map below, different states adopt NEC updates at different rates.

The NFPA updates the NEC every three years. For each new edition, the NFPA reviews submitted amendments that can be proposed by anyone, including the public, through data-based facts. From there, panels review the proposed revisions and comments to establish the next NEC edition. ABB offers a full range of GFCI, AFCI and DFCI circuit breakers, Type 1 and Type 2 surge protective devices, safety disconnect switches and enclosed circuit breakers in accordance with NEC requirements.



- NEC requirements for ground fault circuit interrupters (GFCIs) — According to the Electrical Safety Foundation International (ESFI), an estimated average of 1,101 electrocutions occurred each year in the U.S., including 491 consumer product electrocutions, between 1971 and 1980. In 1971, GFCIs were required only on outdoor receptacles and receptacles near swimming pools. Since then, requirements have expanded inside the home as potential for contact between water and electricity increased. Since the introduction and expansion of GFCIs from 1971 and beyond, the number of electrocutions has dropped significantly. Between 2011 and 2022, an estimated yearly average of 246 electrocutions occurred, with 41 being consumer product electrocutions.
- NEC requirements for arc fault circuit interrupters (AFCIs) — According to ESFI, electrical fires cause more than 35,000 home fires and \$1.4 billion in property damage each year due to worn or inadequate wiring, overburdened circuits, aging electrical systems and outdated technology. AFCIs use advanced technology to detect hazardous arcing conditions and are designed to de-energize the circuit. Combination AFCIs have been required by the NEC since 2008.
- NEC requirements for surge protective devices
 (SPDs) Beginning in 2020, the NEC required SPDs to be installed in new and renovated homes for power surges. SPDs help protect entire home electronics and appliances against damaging power surges. The average home has \$15,000 worth of equipment that can be damaged by a surge and is a common cause for the failure of electrical equipment.

In conclusion, the National Electrical Code (NEC) plays a vital role in safeguarding lives and property through stringent electrical safety standards. Its evolution, driven by data, public input and technological advancements, reflects a commitment to adapting to modern needs. The implementation of devices such as GFCIs, AFCIs and SPDs—backed by NEC guidelines—has led to a measurable reduction in electrocutions, electrical fires and equipment damage. As the NEC continues to be updated and adopted across all states, adherence to its requirements remains essential for protecting both people and property in residential and commercial environments.

ABB electronic circuit breaker types

- ABB arc fault circuit interrupters (AFCIs) Arc faults are unintended electrical arcs that may ignite combustible materials. An AFCI uses advanced technology to monitor and detect arc faults and de-energize the circuit. Emergency equipment, such as smoke alarms, fire extinguishers and escape ladders, are used in homes to respond promptly when a fire occurs. An AFCI is designed to detect a wide range of electrical arcs to help prevent the electrical system from becoming an ignition source for a fire.
- ABB ground fault circuit interrupters (GFCIs) GFCIs detect low levels of electrical current leakage (ground faults) and act quickly to shut off power to help prevent serious shock. The electrical current traveling to the connected equipment is equal to the current traveling from that equipment. An imbalance in that flow indicates a current leak — also referred to as a ground fault. ABB's GFCIs monitor the circuit for minimal current differences and are designed to de-energize if current differences exceed allowed amounts.
- ABB dual function circuit interrupters (DFCIs) —
 A DFCI uses the latest technology to protect against both arc faults and ground faults in a single device.
 DFCIs provide the highest level of protection to people and equipment throughout the entire circuit.

ABB is dedicated to providing safe and reliable electrical products in compliance with UL and the NEC. As the NEC changes, ABB works closely with UL on updating its circuit breaker requirements to be compliant with both UL and NEC. ABB builds and continuously adapts its equipment to the constantly changing connected landscape while keeping personnel and equipment protection at the forefront of its offering. ABB supports the NEC and UL in changes to be proactive before the code goes into effect. ABB does not recommend the removal of GFCI protection, AFCI protection or requesting local code exceptions. ABB develops technology to be within the standards set by NEC, while passing current UL standards and building to future UL requirements. ABB concurrently works with the established NEC changes without requesting safety extensions.

This troubleshooting guide is provided as a supplement to the product installation guide and should be used in conjunction with those instructions, which should be read and understood before beginning installation. The information in this guide is not intended as a substitute for the product instructions nor as a substitute for adequate training in the installation, care, use and/or maintenance of the product or electrical equipment in general. Only qualified, competent personnel who have been trained, understand and follow all applicable safety procedures should conduct any installation, care, use, maintenance and/or troubleshooting of electrical equipment.

Disconnect power before conducting installation or maintenance on any electrical system.

Circuit breaker LEDs

LED activity	Detected	Next steps
Orange to steady purple	Overload — equipment attached to the circuit is exceeding the rated breaker amperage	Remove some of the equipment attached to this circuit and plug into another available circuit.
Orange to flashing red	Series arc fault	Check all connections. A loose connection, such as an untightened light bulb, can cause an arc. Check all plugs and electrical wires for damage.
Orange to steady red	Parallel arc fault	Check all connections. A loose connection, such as an untightened light bulb, can cause an arc. Check all plugs and electrical wires for damage.
Orange to flashing yellow	Neutral (white) wire is grounded on the load side of the GFCI	The grounded neutral must be cleared for proper operation of the GFCI.
Orange to steady yellow	Excessive leakage to ground; leakage current in excess of the trip level of the GFCI	The leakage to ground must be cleared for proper operation of the GFCI. Please contact the appliance manufacturer.
Flashing red and yellow	The breaker has lost its ability to detect and protect	Replace the breaker.

How to clear breaker LEDs on GFT2 breakers only

To reset the LEDs from a previously found fault, please follow the steps below.

- 1. Turn the breaker off.
- 2. Simultaneously hold the push-to-test button in the down direction and turn the breaker on.
- 3. Breaker will trip, then turn the breaker back on.
- 4. Orange functioning LED will then be present.

Best practices

- Make sure your home follows all current NEC and local jurisdiction requirements for new construction and renovation.
- Always check the area and connections for:
 - Exposed electrical parts
 - Electrical connections that feel warm, have damage or emit a burning odor
 - Worn insulation on wires or extension cords
 - A loose connection, such as wires or an untightened light bulb
 - Lack of grounding of equipment
 - Overloaded circuits
 - Any moisture in the immediate vicinity
 - Check to make sure there is no pressure on any plugged-in equipment
 - Other potential hazards
- Make sure all installed equipment is Underwriters Laboratories (UL) listed or the equivalent.
- Extension cords should only be used temporarily, and if using, consistently check cords for damage. Have an electrician install additional wall receptacles where you need them.
- Plug only one heat-producing appliance (such as a heated blanket) into an electrical outlet at a time.
- Follow the appliance manufacturer's instructions on where and how to use an appliance.

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"Push to test" button will not trip electronic breaker



Orange to solid purple LED



Breaker trips immediately after a load is applied



Breaker trips immediately with no load



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Ground fault troubleshooting

Best practices

- Confirm your breaker is not on a shared neutral. If your ground fault or dual function circuit interrupter is on a shared neutral, the breaker will trip.
- For 2-pole applications, please confirm if the attached equipment is a 4-wire application, to confirm the equipment does not have an attached bonding jumper. The instructions can be found in the connected equipment's manual.



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Orange to flashing yellow LED



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Orange to solid yellow LED
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If no damage or issues are found, please contact your local ABB representative with the following information or please scan QR code and submit form:

- 1. Breaker part number
- 2. Breaker date code
- 3. Breaker firmware
- All connected equipment's manufacturer and model numbers (including connected but not turned on/ in use equipment)
- 5. Is this a dedicated or shared circuit?
- 6. Is the breaker on shared neutrals?



Notes

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