THE MAIN TYPES OF BREAKER PROTECTIONS

There are many types of breaker protections used in breakers, receptacles, and other equipment as safety measures. The different types of protection are suited for specific applications, for example commercial and residential buildings use different types of breaker protection in breaker devices, receptacles, and more. While there are many types of circuit breakers with different breaker protections, here are eight common circuit breaker protections found in breakers and other safety devices.

MAGNETIC BREAKER PROTECTIONS

An electric current generates an electromagnetic field in proportion to the strength of the current. A magnetic circuit breaker contains an electromagnet or solenoid calibrated to the expected strength of a passing current. When the electromagnetic current from the electrical current is more powerful than the magnet in the breaker device, the increase in the electromagnetic field will pull the trip bar, turning the current off. This is an instantaneous mechanism in that the breaker is tripped as soon as the event occurs.

Magnetic breakers are best at preventing damage to equipment when there is a powerful interrupting current and exist in numerous products and electrical boxes. Short circuits, line-line, and line-ground faults are the most common cause of powerful interrupting currents. These events can damage electronics, induce fires, and potentially injure users.

However, these breakers will not detect low-level surges that can cause damage over time. Instead, other types of breaker mechanisms, including thermal, detect these events.

THERMAL MAGNETIC BREAKER PROTECTIONS

Thermal magnetic circuit breakers use two methods of detection for shutting a circuit down and are the most common type of breaker used in households. They mechanically shut down the current when it generates electromagnetic or heat irregularities.

The more powerful an electric current is, the more heat it generates. The mechanism involves a bimetallic strip; as the strip becomes hotter, its shape is distorted, causing it to push the trip bar. Because the strip is activated over time, the thermal piece of the equation has a time delay. Thermal detection protects users from prolonged low-level surge damage.

The second safety mechanism in a thermal breaker is the magnetic circuit breaker described above. Having the two types of breaker protection in the breaker allow people to protect against current surges while using appliances that draw an excessive amount of power when they are first turned on. The magnetic breaker protection is set slightly higher than most items commonly used, and the time-delayed detection prevents damage from persistent lower-level problems.

LS BREAKER PROTECTIONS

LS stands for long-time and short-time breaker protection. These types of breaker protection are time-based and can be made using electronic and electromagnetic trip mechanisms set to different sensitivities. The long-time unit would typically be set to a higher sensitivity than the short-time unit to detect irregularities over 0.5–1000 seconds. The long-time protection would allow for temporary surges due to transformers, generators, and large machines coming online and overloading the system.

The short-time unit works similarly to the long-time unit. The short-time unit would be set to a lower sensitivity, tripping the breaker when significant current interruptions come through that last between 0.05–0.5 seconds. These breaker protections are most commonly used in conjunction with other breaker protections. Still, they are commonly found in industrial applications because they can be fine-tuned and tend to be more expensive than a general-purpose thermal magnetic breaker.

LSI BREAKER PROTECTIONS

LSI breaker protections include long-time, short-time, and instantaneous detection mechanisms. An LSI breaker comprises what has been described above with the addition of instantaneous protection. Instantaneous protection consists of no time delay, similarly to the magnetic breaker above. Once the current is strong enough, the breaker trips, cutting off the current. So, an instantaneous unit's sensitivity is set to cut off the current at levels that would cause damage to the system. LSI breakers can be found in commercial and industrial settings but usually include additional safeguards.

LSIG BREAKER PROTECTIONS

The letter G stands for ground. This piece protects against ground fault and is required for UPS systems fed by 480–1000 V. The ground fault detection unit is designed to pick up electrical arcing pulses of around 100 kHz that last for at least a few milliseconds.

Arcing can be dangerous and cause fires, and it happens when wires are damaged, or wire insulation is worn down. A complete LSIG breaker system will protect from a range of surge conditions and arcing and are usually found in commercial settings.

TYPES OF CIRCUIT INTERRUPTERS

ARC-FAULT CIRCUIT INTERRUPTERS (AFCI)

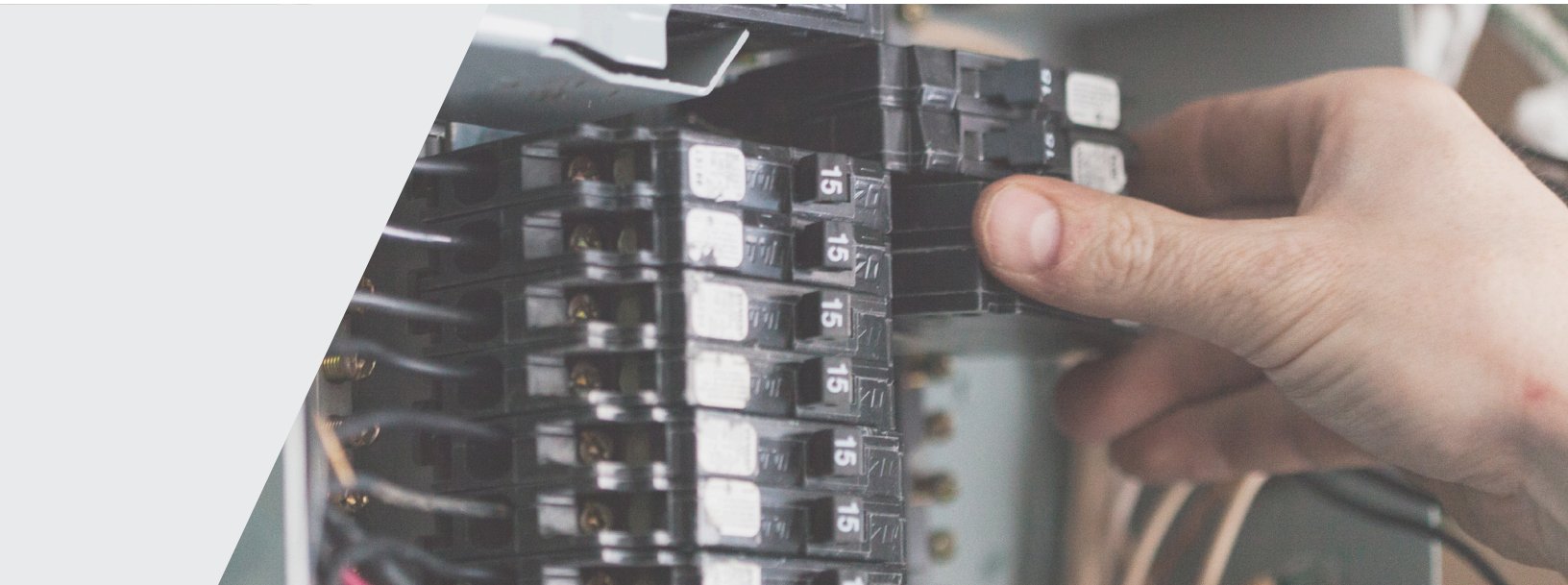
AFCIs detects parallel arcing, series arcing and ground arcing. They work as described in the LSIG section. When the arc fault breaker picks up a signal, it opens the circuit cutting off the current. AFCI mechanisms can be found in breakers, electrical outlets, and some electronics. They are used in residential and commercial settings. Having AFCI mechanisms in outlets helps detect structural damage causing arcing near the mechanism before a breaker further away might. AFCIs were added to the NEC electrical code in 1999 and have increased in popularity since.

GROUND-FAULT CIRCUIT INTERRUPTERS (GFCI)

A GFCI protects people from devices with faulty connections by stopping electrical incidences within 1/40 of a second. The trip occurs fast enough to safeguard users from severe electric shocks when the difference between the outgoing and returning currents is about five milliamperes. These devices can be found in breakers, receptacles, and other means of connecting power, such as an extension cord. Their use has become common in both residential and commercial settings.

COMBINATION CIRCUIT INTERRUPTERS (AFCI/GFCI)

Combination AFCI/GFCI circuit interrupters have seen increased use and regulation over the last couple of decades. Many states in the US require that homes be wired with these safety features. They work to stop arc-faults and ground-faults in the same ways as described above.



LAST THOUGHTS

While breaker protections involve fairly simple mechanisms, they are important parts of electrical safety. Whether you are building a home, designing a complex electrical system, using tools at work, or stringing up Christmas lights, understanding your outlet and breaker configurations is essential.

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