



Cutler-Hammer

Why Choosing a Molded Case Circuit Breaker Makes Sense

Application Note

December 2007
Updated Information

Introduction

A fundamental choice exists when selecting overcurrent protection in a power system: fuses or circuit breakers. Either device may be used. Recent claims by fuse manufacturers about the simplicity of design and benefits of high interruption and coordination have reignited the debate of using breakers over fuses. Recent changes to the National Electric Code (NEC) have made the review of circuit breaker advantages more relevant than ever. It is important to evaluate factors such as protection, reliability, and use of capital when making a choice between breakers and fuses. This paper highlights some of the advantages of using circuit breakers over fuses.



Figure 1. Series G Molded Case Circuit Breaker Family

Motor Circuit Protection

Two special application breakers are available for motor protection. The motor circuit protector (Type GMCP/HMCP/HMCPE) is designed with adjustable magnetic settings to allow the operator to set the breaker's magnetic protection level just above the inrush level of the motor. Overload protection for the motor is supplied in the starter's overload relay. This combination offers the ultimate in protection for the motor without causing nuisance trips. Motor Circuit Protectors are UL Recognized components.

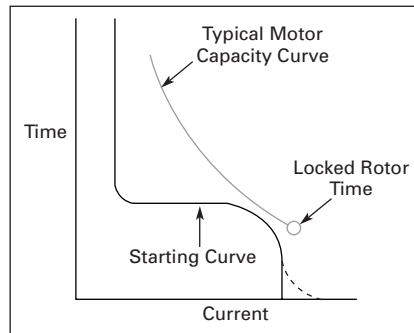


Figure 2. Typical Motor Start-Up Curve

The Motor Protector Circuit Breaker is a UL Listed circuit breaker with fixed magnetic protection and built-in motor overload protection. The breaker's trip unit is adjustable for motor FLA and overload Trip Class. The Motor Protector breaker can be used with a contactor for a complete motor starting and protection package.



Figure 3. Motor Protector Circuit Breaker Trip Unit

System Unbalance and Single Phase Prevention

The majority of faults in an electrical system are phase to ground. Single phasing is caused when only one fuse interrupts in a circuit during a phase to ground fault. The amperage in the other two phases will typically increase by 173 percent. This is a problem when using fuses.

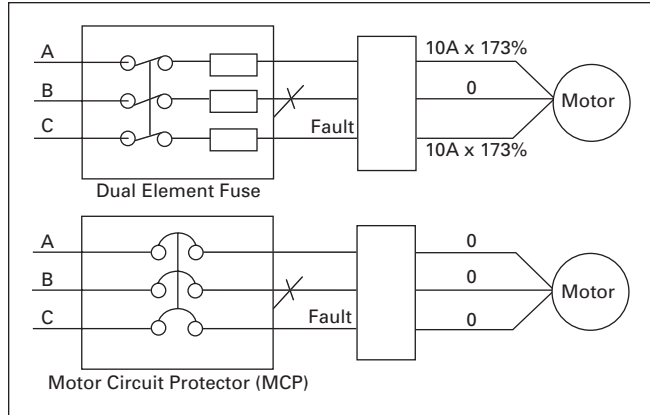


Figure 4. Single Phasing Example Circuit

Motors are often oversized and in these cases, the load is not large enough to blow the other two fuses. Conductors and motors can eventually burn up due to the heating caused by only two phases turning the motor.

This also creates a dangerous situation since the motor acts like a generator, back feeding the fault to approximately four times the full load amps of the motor on the phase which the fuse has blown. Circuit breakers and motor circuit protectors are designed to open all three phases at once, thus preventing the damaging effects of single phasing.

Enhanced Safety

As greater demands are placed on electrical systems, more power is required to ensure reliable operation. Along with greater power comes an increase in the amount of electrical energy available at various points in the electrical system. To ensure the safety of people working around high current systems, circuit protection devices need to not only act rapidly to clear faults, but also to reduce the amount of energy available to a safe level. The current limiting arc design of circuit breakers reduces arc flash energy, requiring only Category 1 Personal Protective Equipment for maintenance personnel.

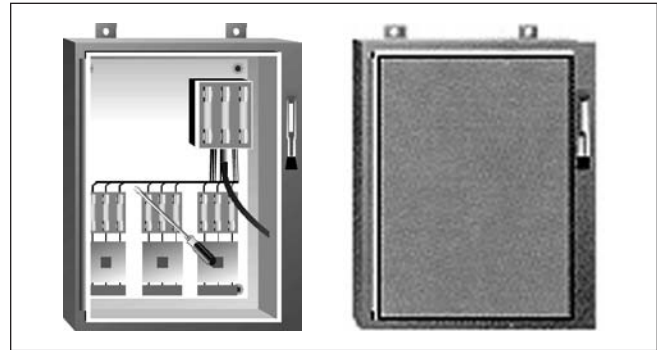


Figure 5. Example of Tool Contacting Live Parts of a Panel

Although personnel should never work on live equipment, faults are often caused by someone contacting a tool with a live uncovered part, such as a fusible switch, older design starter or bus bar. Circuit breakers are self-contained, dead front units that increase personnel safety by protecting from exposure to these live parts.

Circuit breakers can also be remotely reset using the handle mechanism on the enclosure or using a motor operator that is remotely operated. This is a safety benefit that keeps the operator out of the panel. Although you can turn a fusible switch on and off remotely, the operator must still go into the panel to change or check the fuses.

Ground Faults

Another safety concern are low level ground faults. These faults are below the melting point of fuses, yet severe electrical damage can result. Molded case circuit breakers are available with internal ground fault and earth leakage protection. With these protective features, the circuit breaker will trip on a ground fault according to user-selectable settings, isolating the fault before it propagates throughout the system. This safety feature protects personnel and equipment from low level arcing currents. Fused devices will only interrupt a high level ground fault that exceeds the fuse overload "blow" point and require external sensors, relays and remote switching devices to detect and clear ground faults.



Figure 6. Example of Motor Damage Due to Ground Fault

Reliability and Uptime

Every molded case circuit breaker is tested off the manufacturing line. This assures that all units operate within the characteristics that are claimed. Fusible switches can only be tested once. Therefore you must rely on the next replacement fuse to have the same operating characteristics. Breakers are also subject to very stringent follow-up testing witnessed by UL Laboratories. The UL tests consist of up to 10,000 ON/OFF endurance operations, multiple interruption tests, calibration tests and dielectric withstand tests, just to name a few. This testing guarantees the circuit breaker's performance.

Circuit breakers are reset, not replaced, guaranteeing system coordination based on the original system design. Replacement of fuses of different types or from different manufacturers voids coordination and system protection. In addition, fuses of different ratings can look similar and be erroneously placed into the same fuse holder. Using circuit breakers reduces the possibility for misapplication, which can occur when replacing fuses. The resettable nature of breakers removes the need to search for replacement fuses during a downtime situation. This allows you to get your process up and running in the shortest amount of time.

Accessorization

Circuit breakers offer the widest range of internal and external accessories. The safety benefits of externally mounted handle mechanisms and motor operators have already been mentioned. Others include shunt trips, under voltage releases, auxiliary switches, alarm switches, terminal shields, lock offs, interlocking devices, etc. These accessories provide diagnostic information to the user and consume no additional panel space and are not available in fuses.

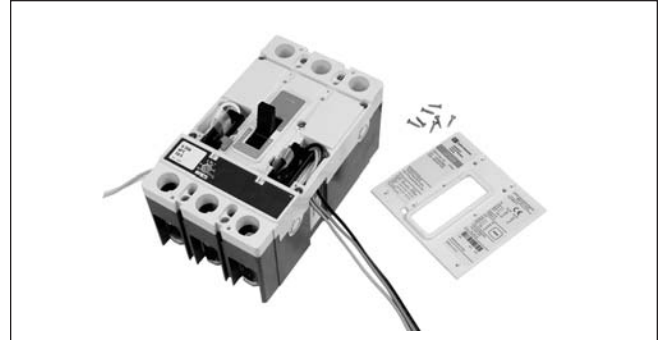


Figure 7. Series G Circuit Breaker with Installed Internal Accessories



Figure 8. Series G Breakers and Accessories

Effective Use of Capital

The installed cost of the circuit breaker distribution equipment is generally less than equivalent fused equipment plus fuses. An added cost advantage results from the resettable nature of circuit breakers reducing downtime in all installations, and eliminating the need for maintenance fuse inventories in industrial settings. Today's molded case circuit breakers are designed in compact frames that consume less panel space, saving real estate over fusible switch offerings.

Testing without destruction of overcurrent protective devices is an additional way to lower start-up costs. Available breaker options include internal accessories for remote indication and control, Zone Selective Interlocking to reduce potential system arc flash energy, and communications without adding costs for increased panel space.

Circuit Breakers Make Sense

Eaton's electrical business has been in the circuit protection business for over 100 years. Eaton offers the widest selection of application solutions in the industry from fused switches to the most sophisticated circuit breakers. Using modern circuit breakers for motor protection, electrical power distribution and in control panels makes sense.

Conclusion

The following is a summary of the top 10 reasons to use a circuit breaker as your circuit protection choice:

1. Resettable
2. Dead front, no exposed live parts
3. Prevents single phasing
4. Adjustable motor protection
5. Ability to protect during ground faults
6. Accessorization
7. Testable
8. Space savings
9. Prevents downtime
10. More cost-effective over the life of your equipment

Additional Information on Selected Topics

www.eaton.com/breakervfuse

Pub. Number Description

- TP08324001E: Applying Low-Voltage Circuit Breakers to Limit Arc Flash Energy
- CC01200004E: Eaton Molded Case Circuit Breaker Arc Flash Frame Comparison
- MZ01220001E: Maximizing the Life of Molded Case Circuit Breakers
- AP01211001E: Molded Case Circuit Breakers — Motor Circuit Protectors and High Efficiency Motors
- AP01200004E: Application of Multi-Wire Terminals for Molded Case Circuit Breakers
- SA08300002E: LEED Credits Guide to Eaton Products and Services
- SA05800001E: Understanding UL508A — Frequently Asked Questions
- IA01200002E: Tested Breaker Combinations for Selective Coordination

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