Bussmann series C308F fuses for intrinsic safety

Introduction to hazardous environments

Fire outbreaks and explosions are common risks in many industries. For a fire or explosion to occur, certain elements must be present at the same time — a fuel source, oxygen, and a source of heat or ignition. The combination of these three elements, also known as a 'fire triangle' in hazardous environments such as hydrocarbon drilling rigs, refineries, chemical factories, mines, and gas stations, can cause combustion that results in damage to property, physical injuries, and loss of life.

Hazardous environments, such as those mentioned above, contain varying amounts of flammable gases and combustible dust which can ignite when exposed to heat or sparks from nearby electric circuits. Thus, engineers must apply intrinsic safety (IS) to mitigate these hazards.

Intrinsic safety and why it exists

Intrinsic safety is a low-energy signaling technique that helps prevent explosions in hazardous environments by ensuring that the transferred energy is well below the energy required to initiate an explosion. The energy levels made available for signaling are small but usable, and they are more than adequate for the majority of instrumentation systems.

Intrinsic safety (IS) offers a host of benefits for hazardous applications. It is...

- The only technique which provides solutions for problems in hazardous areas and meets all equipment criteria.
- Acceptable to ATEx and OSHA directives and fulfills IECEx scheme requirements.
- The only solution with a history of safety for Zone 0 instrumentation - suitable for environments where explosive gas-air mixtures are continuously present.
- Classified under the group IIC gas classification - compatible with all kinds of gas-air mixtures.
- Compatible with conventional instruments and cables allowing for reduced overall system cost.

According to the IEC 60079-11 standard, electrical components exposed to potentially hazardous environments should have energy levels sufficiently low to prevent inadvertent combustion due to heating or sparking effects. IS-approved circuit protection devices (such as fuses) are widely utilized in the oil and gas, petrochemical, and mining industries - environments with a high concentration of combustible gases, vapors, and dust.

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Fault conditions and how fuses help

To use a fuse safely in a hazardous location, a spark's energy must be contained in order to avoid igniting explosive materials present in the environment.

Fuses in intrinsically safe applications are necessary to help prevent overcurrent conditions and ensure that the circuit will open without generating a spark capable of causing ignition. During an overcurrent, arcing occurs inside the fuse when opening, which is intended to be contained within the fuse. To help provide an additional level of safety, a fuse is further encapsulated to ensure the internal arcing does not escape the fuse into the atmosphere. The surface temperature of the fuse must also be kept below the temperature of ignition for explosive gases or dust. By opening rapidly during overcurrent conditions, the fuse limits the current to the rest of the circuit.

Intrinsic safety basics for fuses

The following are some fundamental principles of intrinsic safety:

- The protection technique of IS is energy limitation.
- Power limitation is necessary to prevent thermal conditions that could ignite explosive atmospheres.
- The current rating (I_n) of the intrinsic safety fuse applies to all analysis calculations (1.7 safety factor multiplied by I_n).

Eaton C308F fuses for IS applications

Fuses are designed to safely protect other components in the circuit, but can require an additional level of protection in hazardous environments. The following are some justifications for fuse encapsulation:

- When a fuse opens a circuit, arcing occurs within the fuse.
- This arcing could have sufficient energy to ignite flammable materials in explosive atmospheres.
- Fuse encapsulation can prevent the explosive atmosphere from entering the fuse.

For safety-critical applications requiring IEC 60079-11 certification, Eaton provides C308F fuses suited for encapsulation. C308F fuses are available as surface mount ferrule-type or through hole axial-leaded fuses in compact tape and reel packaging. They have interrupt ratings of 4000 A at 250 V AC or DC with current ratings as low as 40 mA. Eaton C308F fuses offer lower direct current resistance (DCR) to offer lower power dissipation (watts loss) than comparable products on the market.

Eaton's C308F fast-acting fuses are designed to ensure adequate circuit protection in hazardous environments such as refineries, petrochemical plants, and mines. The C308F fuses are suitable for both primary and secondary circuit protection and meet EN 60079-11 electrical performance specifications for intrinsic safety (IS) applications.

Eaton C308F fuse selection for IS applications

For adequate and safety-compliant operation in potentially hazardous environments, Eaton recommends the following considerations:

- **In environments where sparks can be ignited at higher currents:** ultra fast-acting fuses that can open in milliseconds are required.
- **In applications where the fault current can be large:** fuses with high interrupting ratings/breaking capacity are required.
- **Fuses that will be installed in space-constrained explosive environments:** fuses compliant with barrier network standards (EN 60079-11) are required.
- **Applications with very specific opening requirements:** fuses that meet the IEC 60079-11 opening characteristics with low DCR.

Eaton recommends using its C308F fuses for applications that satisfy one or more of the above requirements. Eaton's C308F series fuses offer the following benefits:

- Compact size: 3 mm x 8 mm footprint, SMD or THT mounting
- Fast-acting operation (10 I_n in 2 milliseconds)
- Can help comply with EN 60079-11 for explosive environments
  - Conforms to the electrical specifications in IEC 60079-11 but would require further encapsulation
- 1500/4000 A interrupting rating
- 40 mA - 250 mA ratings

Typical fuse ratings per application

- 40 mA - 80 mA: Transmitters, switches, solenoids, proximity switches, vibration probes, AC/DC sensors, and thermocouples.
- 100 mA - 125 mA: 12 Vdc systems, strain-gauge bridges, and controller outputs.
- 160 mA - 200 mA: Gas detectors.
- 250 mA: 2 or 3-wire RTDs.

Eaton C308F fuse in active barriers of complex systems

Barrier circuits (see Figure 1) are placed between safe and hazardous areas to limit the amount of electrical energy transferred to a field device. These circuits consist of passive components that enable normal
equipment functionality under safe working conditions. However, this limits the energy during fault events.

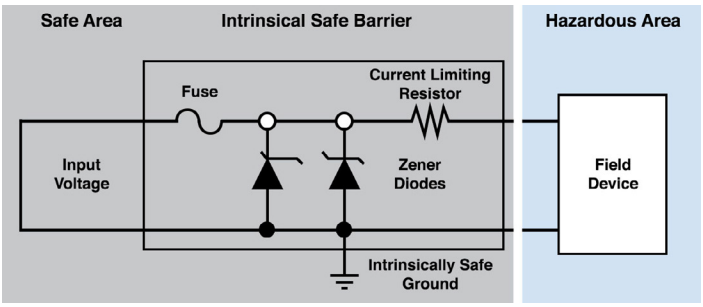

Figure 1. C308F fuse in an active barrier protecting a field device.

Figure 2 shows an example of a 4 - 20 mA transmitter operated by 20 - 35 Vdc power supply. Here, an active barrier containing Eaton's C308F fuse limits the voltage to 16.2 V or 11.0 V to the transmitter.

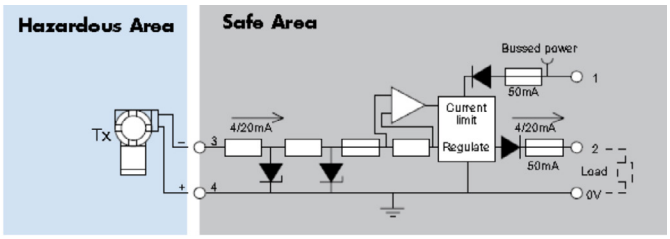

Figure 2. C308F fuse in an active barrier protecting a 4 - 20 mA transmitter.

Figure 3 shows an example of switch inputs/switched outputs with 10 - 35 Vdc inputs. Here, the current limiter is limiting the current to 50 mA to prevent the fuse from nuisance opening immediately the voltage rises slightly over 27 V (the voltage at which the shunt diodes become activated).

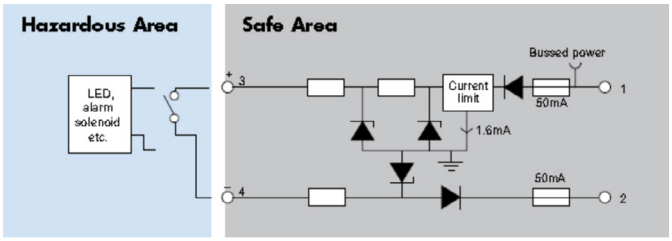

Figure 3. C308F fuse in an active barrier protecting electronic devices in a hazardous area.

Final notes

Eaton C308F fuses are designed to provide low-current circuit protection in hazardous environments where conventional fuse usage could potentially cause explosions, due to heating effects or sparks. They provide a one-time positive disconnect after opening the circuit under overload or short circuit conditions.

How to purchase

For more information about purchasing Eaton's C308F fuses, please contact Eaton Electronics or search our distributor's inventories.

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