tech tips

TECHNICAL INFORMATION AND PRODUCT SOLUTIONS

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Emergency Mains Off Circuitry

Emergency Mains Off (EMO) is a common requirement in medical, industrial and data processing facilities. It provides a means to ensure the safety of personnel in case of fire, personal electrocution, or accidental personnel contact with equipment. EMO circuits allow operators to quickly and easily shut off all power to a room or single piece of equipment simply by actuating one button. Therefore, an EMO circuit is an important power system design feature that is defined and regulated in many safety standards.

There is more than one approach to providing an EMO circuit. Additionally, battery backed power systems (UPS) present special problems that need to be considered. This tech tip provides an overview of several issues associated with EMO design with respect to power systems offered by ONEAC.

Shunt Trip

Traditional *Mains Off* or *Emergency Power Off* circuits operate as a “shunt trip” device. This method uses a circuit breaker incorporating a special actuator coil. The coil causes the circuit breaker to open and power to be cut when voltage is applied. Shunt trip coils are available in a variety of AC or DC voltages.

Shunt trip EMO circuitry tends to be simple and inexpensive. It activates when voltage is applied to the trip circuitry. This type of circuit will not work however, in instances where loose wiring or conductors exist within the EMO circuitry, where there is a loss of EMO circuit supply voltage, or when a fuse is blown within the EMO circuit. These fault conditions are likely to be undetected within a system until the EMO circuit is used. These fault conditions risk the reliable operation of a shunt trip EMO circuit.

Fail-safe

Because a shunt trip EMO circuit can be rendered inoperable by an undetected fault, some safety guidelines recommend the use of a fail-safe EMO. A fail-safe EMO is activated by a loss of control voltage rather than an application of voltage. This is a safer alternative than “shunt trip”, because any fault condition will result in power being stopped.

SEMI S2-93 for example, suggests that equipment have an “emergency off” system which “when activated, places the equipment into a safe shut down condition”. This EMO system is further defined within the SEMI standards to be a fail-safe circuit that shuts off all electrical power to the equipment so that only the safe voltage EMO (typically 24 volts) and its supply remain energized.

A disadvantage to this type of EMO circuitry is the potential incidence of nuisance tripping. Under-voltage sags or drop-outs may cause the EMO release to trip and require a reset of the circuit breaker. In areas where power outages and voltage drops are common, nuisance tripping can be very costly—having the same impact on process continuity as a power failure.

A UPS may be a means of providing continuity to the Fail-Safe EMO circuit to prevent nuisance tripping. A UPS in an EMO circuit however, whether to protect the EMO or to support loads in the application, presents a unique set of problems to an EMO implementation. These are discussed on the following page.

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Special Considerations for Uninterruptible Power Systems

When an uninterruptible power source (UPS) is used in a room or facility protected by an EMO circuit, the UPS will defeat the intent of the EMO for all loads powered by the UPS. When the facility EMO is activated, the UPS will see this as a power failure and will continue to provide power to its load for the duration of available battery reserves.

This presents certain problems and priority decisions that need to be considered in each application.

For a room, or centralized facility UPS (one which supplies emergency power to all loads in the room or facility), the decision is simple—control of the UPS output needs to be included in the facility EMO scheme in order to preserve the safety intent of the EMO.

For smaller UPSs which may be used to protect specific computers used in the application, linking control of the UPS output power to the room EMO will force the UPS to ignore its battery reserves when the EMO is activated. This will defeat any automatic graceful shutdown features that had been implemented between the UPS and computer systems it is powering.

If it is determined that there is unacceptable risk in leaving a computer system powered in a scenario that would activate an EMO, then control of output power of smaller UPSs also needs to be integrated into a room EMO scheme.

UPS EMO and SEMI S2 Conformance

SEMI S2-93A is a standard often referenced by the semiconductor manufacturing industry that provides recommendations based on an interpretation of appropriate OSHA and NFPA guidelines. It defines that the room EMO be of a *hardware-based fail-safe* type requiring a manual reset. The SEMATECH Application Guide for SEMI S2-93 defines *hardware-based* as a safety interlock that is controlled by electromechanical devices in general, solid state devices under certain restrictions and not computer controlled in any circumstance (See S2-93 Application Guide Revision 2.0, Section 5.1).

SEMI S2-93A further defines that the room EMO scheme include control of UPSs with an output voltage of 30V or more and a power capacity of 500 volt-amps or greater (see SEMI S2-93A Section 11.3, 11.4 and 12.2-4).

A strict interpretation of these guidelines would maintain that control of a UPS output by way of the UPS's internal computer control systems would not meet the letter of the S2-93A standard. Further, that control of the UPS output only—even *hardware-based*, while leaving UPS battery circuits energized (most UPSs of 2kVA and over use DC rails of 48V or more), would also be non-conforming to the specifics of the letter of standard.

Remote ON/OFF options for ONEAC ON Series® UPSs

1. Shunt Trip: Accommodation for Shunt Trip style Remote Off is available in every v96 ON Series UPS through the standard dual function communications port. See the ON Series UPS User's Manual (Addendum C) for further details.

2. Fail-safe: A supplementary accessory card (PN# IF-REMOFF) that slides into a slot on the back panel of any (v96) ON Series UPS (requires ON UPS firmware version 1.9 or later). Terminal strip, hardwired connection to the facility EMO control circuit is provided.

   NOTE: *When using the Remote Off accessory, control of the UPS output power is ultimately provided via the UPS CPU. Battery circuits (24V or 48V DC) remain "connected". While this option meets the fundamental objective of a "fail-safe" vs. shunt trip EMO scheme; it does not satisfy all details recommended under SEMI S2-93A as noted above.*

3. SEMI S2-93A conformant EMO: A hardware-based, fail-safe output control with an internal battery circuit disconnect—is available as a factory-installed option for the ON Series 3.3kVA and 5.0kVA UPS models (available Q4 99).