

GROUND FAULT CIRCUIT PROTECTION IN DATA CENTER COOLING SYSTEMS

Background

Modern data centers require reliable and safe power distribution to ensure uninterrupted operation of critical cooling systems. A common configuration includes a Power Distribution Unit (PDU) supplying power to one or more Cooling Distribution Units (CDUs) that regulate and distribute liquid coolant to the servers.

In a typical data center liquid-cooling setup, three-phase power is delivered from an overhead busway or rack feed to the PDU. The PDU then distributes power to multiple output receptacles that serve the CDU and its subsystems, such as controllers, pumps, valves, and sensors. While ground fault circuit interrupter (GFCI) protection is not always mandated at the point of distribution, integrating it as a safety enhancement can significantly reduce the risk of electric shock for personnel working around liquid-cooled systems.

Best design practices have shown that implementing both GFCI and overcurrent protection at the receptacle level rather than solely at the main AC input allows operators to quickly identify and isolate the specific outlet or device that experienced a fault. This localized diagnostic capability allows maintenance teams to maintain the branch circuit for the unaffected outlets, reducing system downtime and keeping the broader CDU or cooling loop operational. This modular approach contrasts with traditional branch-level GFCI protection, where a single trip at the input would shut down the entire CDU until the issue is resolved.

Solution

The UL1053 listed LineGard® PGFM Series Sensing Module is engineered to provide advanced protection in critical environments. When integrated with Sensata's approved Airpax LEL Series UL489 hydraulic-magnetic circuit breaker featuring shunt trip and auxiliary switch, the module offers robust and localized protection for both personnel and equipment while simplifying compliance to meet UL, OSHA and ABYC standards.



Each receptacle circuit can be equipped with a PGFM module and LEL breaker, providing localized fault detection and personnel protection. The PGFM module continuously monitors current balance between phase and neutral conductors. If a leakage current indicating possible ground fault leakage is detected, the module triggers the LEL breaker's shunt trip coil, opening the circuit within 60 milliseconds. This rapid response removes hazardous voltage and limits potential shock exposure.

The PGFM-211-B-A1-291 is tailored for environments where sensitive electronic loads and switching power supplies generate natural leakage currents. Its elevated trip threshold of $18 \text{ mA} \pm 2 \text{ mA}$ provides a balance between personnel protection and equipment protection while avoiding nuisance tripping. The module's potted rectangular design supports rugged installation in enclosed or thermally dynamic environments, and its 240 VAC operation is suitable for single- or split-phase loads derived from 3-phase PDUs.

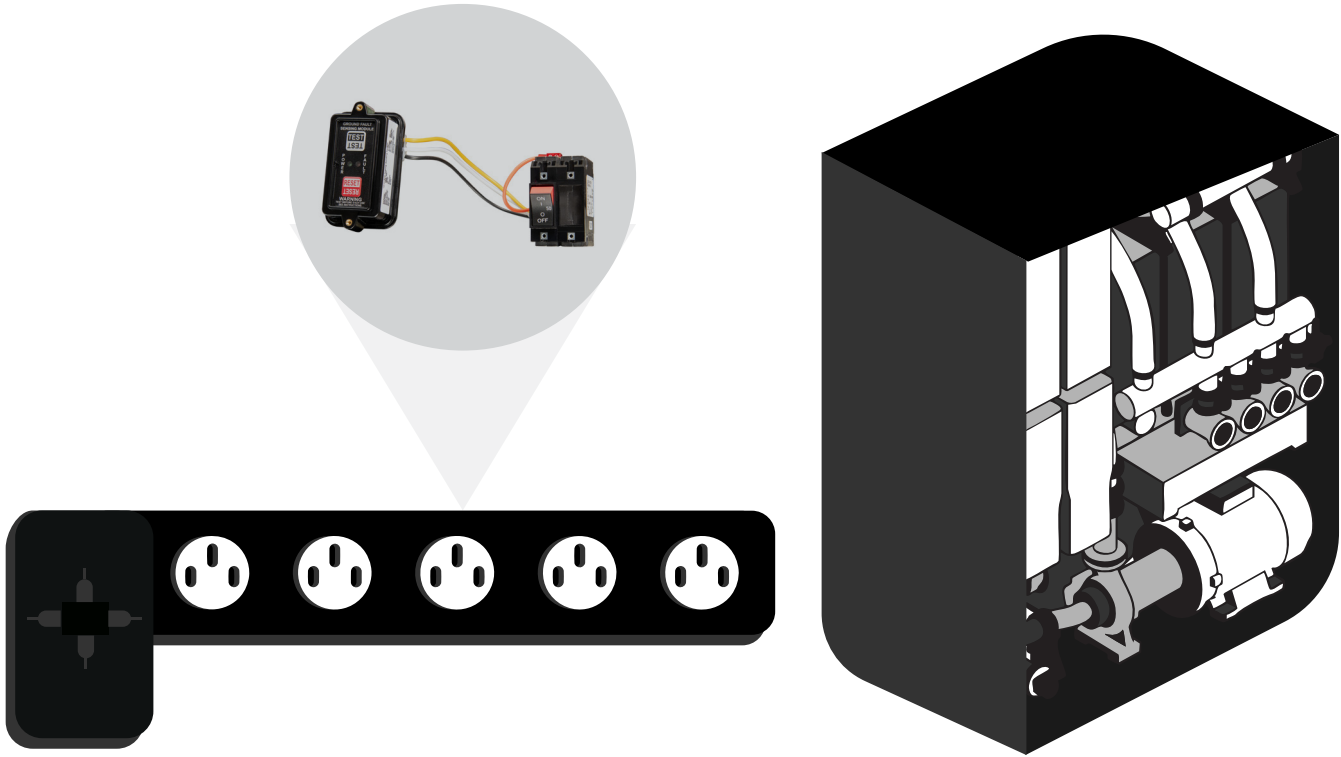
Together, a PGFM module and LEL circuit breaker deliver integrated branch circuit overload protection and ground fault detection in a single compact assembly. This solution provides a reliable safety enhancement for OEMs and data center integrators seeking to minimize downtime and improve protection in high-performance cooling systems.



RECOMMENDED PRODUCTS

Reference on Diagram	Product	Features	Function
1	 <p>LineGard® PGFM Series GFCI Ground Fault Protection Sensing Module</p>	<ul style="list-style-type: none"> • UL943 Listed 5mA Personal Protection (120V Only) • UL1053 Listed Equipment Leakage Sensing & Personal Protection (240V Only) 5mA, 10mA, 20mA, 30mA • Power & fault status indicators • Chemical and UV resistant enclosure • Operating & Interrupting Current. (120VAC 50A, 120/240VAC 50A) • Provides identification of a ground fault vs. short circuit trip 	Ground fault and equipment leakage sensing module
2	 <p>LEL Series Hydraulic Magnetic Circuit Breaker</p>	<ul style="list-style-type: none"> • UL 489 listed circuit breaker • Operating voltages of 120 VAC or 120/240 VAC 	Overcurrent and short circuit protection

PDU & CDU



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