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HF GFCI breakers enhance safety and interoperability

Ground fault circuit breakers

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HF for circuit breakers is a proposed enhancement to existing standards, focusing on high-frequency applications. This standard aims to address the unique challenges posed by high-frequency currents on circuit breakers from the increasingly common sources in homes, like variable frequency drives in HVAC and pool equipment and loads from in-home electric vehicle charging. The standard includes specifications for improved materials, design modifications, and testing procedures to ensure reliable performance under high frequency conditions.

As part of the HF proposal, the governing standard for personnel-protection ground fault devices, UL 943, has been updated to align more closely with UL 101, the standard for appliances. UL 101 accounts for the Measurement Indication Unit (MIU), and UL 943 will now incorporate a similar unit called the Interoperability Indication Unit (IIU). Both the IIU and MIU are "60 Hz-equivalent" calculations that account for the effect of current on the human body, de-rating higher frequency currents that are less dangerous.

HF prioritizes both interoperability and safety

Interoperability is crucial, but safety is paramount. The "HF" standard is less strict for the "must trip" curve and allows for more interoperability, but, importantly, it provides less protection against electrical shock. The "HF" standard strikes a balance between these two important factors.

HF circuit breakers closely follow the proposed "must trip" line, maximizing safety and interoperability (exhibit two). This ensures that the breaker will trip above the "6mA-equivalent" line based on a table that de-rates the magnitude of leakage current according to frequency.

HF in action

The Ground Fault Circuit Interrupter (GFCI) samples the amplitude and frequency of the leakage current. The microprocessor then de-rates the leakage current amplitude based on the "Frequency Factor (FF)" shown in exhibit one. Finally, the circuit breakers tripping algorithm prescribes a specific amount of time for the breaker to trip based on the amplitude of the leakage current. Eaton's implementation trips faster than the maximum time allowed, but still pauses long enough to disregard transients.

Benefits of HF

The new curves suggested in the "HF" standard will standardize the responses of GFCI devices to high-frequency leakage currents. The additions to UL 101 will ensure less overlap between appliance leakage and GFCI protection. Importantly, safety will not be compromised in the name of convenience when following the HF suggested trip curve

Eaton's unique implementation

Eaton's approach to HF is unique in the industry. By adhering to the "HF" standard, we are setting a new benchmark for safety and interoperability for ground fault circuit breakers. This innovation ensures that our devices provide maximum protection while maintaining compatibility.

Learn more at Eaton.com/HF

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Exhibit 1: Frequency factor weighted table

Test Frequency (Hz)	Must-not-Trip leakage current (mA)	Shall-Trip leakage current (mA)	Frequency Factor (FF)
60	4.01	6	1
100	4.03	6.06	1.01
500	4.64	6.96	1.16
1,000	5.76	8.64	1.44
2,000	7.71	11.58	1.93
2,500	8.59	12.9	2.15
3,000	9.48	14.22	2.37
3,500	10.39	15.6	2.6
4,000	11.33	16.98	2.83
4,500	12.3	18.42	3.07
5,000	13.29	19.92	3.32
6,000	15.32	22.98	3.83
7,000	17.41	26.1	4.35
8,000	19.54	29.28	4.88
9,000	21.7	32.52	5.42
10,000	23.88	35.82	5.97

Exhibit 2: UL 943 - HF curves

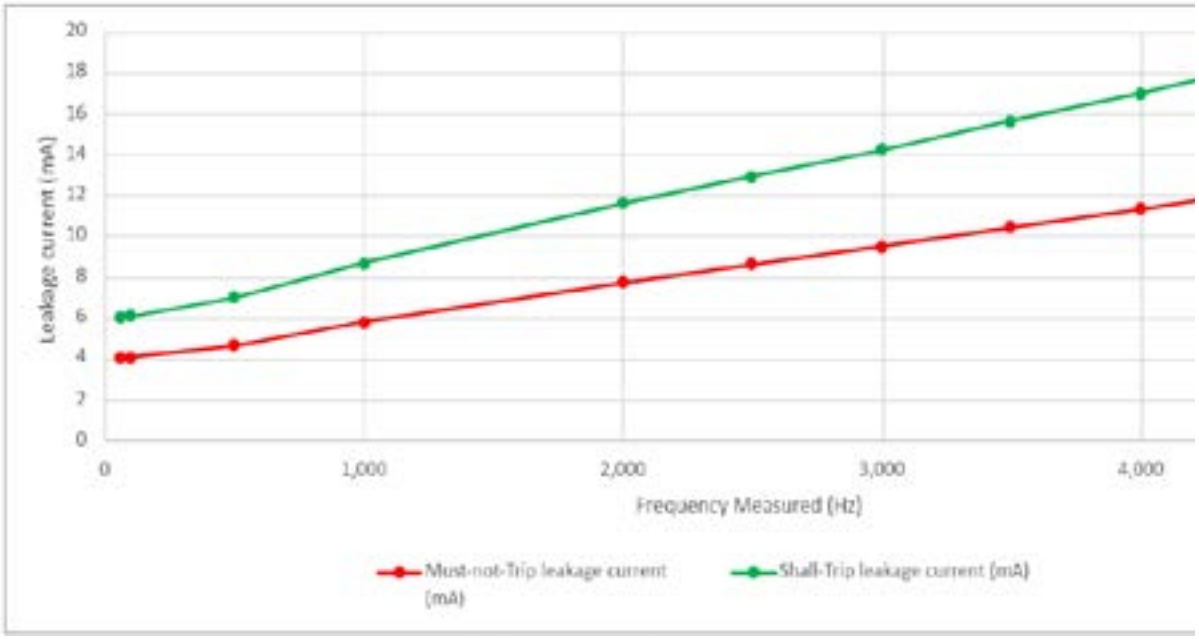

Chart SB2.2: 60Hz-Equivilant Trip Thresholds

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