ELECTRICAL PROTECTION TECHNOLOGY FOR OEM DESIGNS

Littelfuse designs and supplies Electrical Protection Technology to OEM customers for integration into their products. This technology protects against electric shock, fire, and arc faults.

Electric Shock Protection

For electric shock protection, the technology detects residual, differential, leakage, or ground fault currents. OEMs can integrate this technology into devices such as Residual Current Devices (SRCDs, PRCDs, RCCBs, RCBOs), Ground Fault Circuit Interrupters (GFCIs), Leakage Current Detectors (LCDs), and Equipment Leakage Current Interrupters (ELCIs).

When integrated into RCD-type products, the technology provides protection against multiple fault conditions, including AC residual currents, pulsating DC residual currents, DC residual currents, AC leakage currents, DC leakage currents, and multi-frequency residual or leakage currents.

The following matrix provides a better understanding of the options available.

CURRENT TYPE	PRODUCT TYPE		
AC residual currents	Type AC RCCB, RCBO, SRCD or PRCD (**Note 1)**	GFCI	-
AC & Pulsating DC residual currents (**Note 2**)	Type A RCCB, RCBO, SRCD or PRCD (**Notes 1 & 5)**	GFCI (**Note 2**)	-
AC, Pulsating DC residual currents & DC residual currents	Type A RCCB, RCBO, SRCD or PRCD (**Note 1)**	-	-
AC leakage currents	Type A RCCB, RCBO, SRCD or PRCD (**Note 1)**	-	LCD or ELCI
DC leakage currents	Type B RCCB or RCBO (**Note 5 & 6)**	-	-
Multi-frequency residual currents or multi-frequency leakage currents	Type B or Type F RCCB or RCBO (**Notes 1 & 5)**	-	LCD or ELCI (**Note 4**)

- **Note 1:** IEC61008 & IEC61009 set out the trip times for RCCBs and RCBOs respectively. Such RCDs may have a non delayed response or a delayed response to a fault current. RCDs with a non delayed response are known as General Types, and RCDs with a delayed response are known as S Types.
- **Note 2:** In addition to detection of AC, Type A RCDs can detect pulsating DC with conduction angles from 0 – 135 degrees. GFCIs only detect half wave rectified AC.
- **Note 3:** Multi-frequency refers to the presence of residual currents at two or more frequencies over the range 10Hz – 1000Hz.
- **Note 4:** LCDs and ELCIs are only required to detect AC leakage currents. However, WA can provide DC detection in addition to AC detection in such devices where required by customers.
- **Note 5:** Type A & Type A+ and Type B & Type B + RCDs. Type A RCDs provide a higher level of protection than Type AC RCDs, but under certain conditions Type A RCDs may be prone to nuisance tripping, e.g. due to lightning surges. WA offers Type A+ RCD technology for applications requiring higher levels of immunity to nuisance.
- **Note 6:** Type B RCDs operate over the range DC -1KHz. Type B+ RCDs operate over the range DC – 100KHz.

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RCD Trends

First-generation RCDs detected ac residual currents only. This design worked until electronic power controls appeared in tools, appliances, and equipment. Power control introduced partial or full rectification of the ac supply, creating pulsating dc. Type AC RCDs could not detect pulsating dc residual currents, which led to the development of Type A RCDs.

Type AC and Type A RCDs operated at power frequency (50 Hz or 60 Hz) and were typically blind to residual currents at much lower or higher frequencies. The adoption of inverters and motor controllers created a need for RCDs that function across a wide frequency range. Type F RCDs addressed this requirement.

Photovoltaic systems and electric vehicle charging introduced the risk of dc residual currents flowing alongside an ac supply. This drove the need for devices that detect ac, dc, or pulsating dc residual currents in a single installation. Type B RCDs were developed to meet this need.

Important:

Due to limited protection, the use of Type AC RCDs has declined. In several countries, including Germany, the Netherlands, and Switzerland, Type AC RCDs are prohibited or heavily restricted for personal protection. Today, Type A RCDs are the preferred choice for most installations worldwide.

With the growth of electric vehicles, Type B RCD usage will likely increase rapidly because it is the only RCD that provides universal protection against all known residual fault currents in ac and dc systems.

The following chart shows the hierarchy of protection afforded by RCDs

RCD – HIERARCHY OF PROTECTION

TYPE B: AC, PULSATING DC, MULTI-FREQUENCY, DC

TYPE F: AC, PULSATING DC, MULTI-FREQUENCY

TYPE A: AC, PULSATING DC

Why Type B Offers Superior Protection

Type B RCDs provide the most comprehensive protection because they detect all known residual fault currents—ac, pulsating dc, and pure dc—across a wide frequency range. This capability ensures safety in modern installations that include renewable energy systems, variable-speed drives, and electric vehicle charging, where mixed current types are common. Unlike Type AC, A, or F, Type B RCDs maintain reliable operation even under complex fault conditions, making them essential for universal protection in ac and dc systems.

Self-Testing RCDs (STEOL)

Littelfuse | Western Automation developed technology that enables RCDs and GFCIs to perform continuous self-testing and indicate End of Life (EOL) when a failure occurs. Each device runs a self-test every 2–3 seconds by generating and detecting a residual current. Self-testing continues throughout the product's life. When a critical component fails, the device cannot detect the residual current and switches to the EOL state.

EOL Options:

Users can choose one of two EOL behaviors:

a. The RCD/GFCI trips automatically and will trip again each time it is reset.

b. The RCD/GFCI does not trip automatically but provides a visual EOL indication.

Fire and Arc Fault Protection

Arc fault currents can cause electrical fires. WA's technology detects fault currents from series or parallel arc faults and integrates into Arc Fault Circuit Interrupters (AFCIs) compliant with UL1699 and Arc Fault Detection Devices (AFDDs) compliant with IEC62606.

Product Standards

All protective devices must comply with relevant national or international standards. Many countries adopt IEC or European Standards (EN) as national standards.

Examples include: UL943 for GFCIs, IEC61008 for RCCBs, IEC61009 for RCBOs, IEC62423 for Type B and Type F RCCBs and RCBOs, IEC62640 for SRCDs, EN61540 for PRCDs, In Europe, IEC standards are redesignated as ENs (European Norms), e.g., EN61008, EN61009, EN62423.