Articles

What advances in circuit protection are having the biggest impact on the industry?

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I see three basic trends in in this area. One is miniaturization. Mobile products in the consumer, medical, industrial and mil/aero markets have increased functionality in smaller form factors. This forces the circuit protection manufacturers to develop consistently smaller single-channel devices and tightly packed multi-channel arrays. ESD protection devices have been shrinking in size for some time, but other circuit protection devices like fuses and hybrid protectors have reduced footprints as well.

Second, consumer products continually support higher data throughput whether streaming high definition video on tablets and LCD TVs or migrating to second and third-generation protocols on computers and computer peripherals. The electrical protocols used to support these applications (HDMI, DisplayPort, USB 3.0, PCIe 3.0, etc.) have data rates in the Gbps ranges. Providing ESD protection at higher frequencies and higher data rates requires consistently smaller device capacitance and faster response times. The circuit protection manufacturers consistently innovate to the needs of the market. The current generation of ESD protection devices provide sub-picofarad channel capacitance and nanosecond response time.

Lastly miniaturization, continual progress in material science and the need for increased product ruggedness and reliability provide opportunities for circuit protection manufacturers to broaden their hybrid protection portfolio. Many new combinations in a single device are now available: Zener diodes and PPTCs, MOVs and GDTs, MOVs and PPTCs, bimetals and PPTCs. This list goes on. Each hybrid protection scheme answers a specific circuit protection need. This trend started as a trickle, but I further expect to see more offerings going forward.

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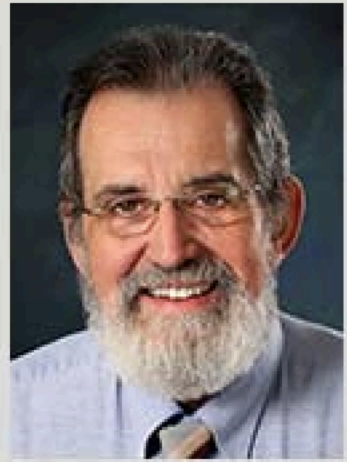

The generation of inductive or switching transients is a well-known phenomenon to design engineers and field technicians. The suppression of these transients is required for two general purposes: for contact protection and/or prevention of electromagnetic interference (EMI) generation. When arc suppression is required, the suppression device is placed across the switching device. When EMI is to be suppressed, optimum results are obtained when the suppression device is placed across the load, particularly if long leads are required between the switching device and the load.

Many techniques have been devised to eliminate or suppress the transients, but which method is most effective? Taking features such as size, cost and effect on the circuit into consideration, the most effective application is a series Resistor-Capacitor (RC) Network. But, what RC value combination is needed and how is it determined? Before purchasing a RC Network, determine RC in one of two ways. Calculate R using this formula: C = (I2/10)Mfd. Calculate C using this formula: R = E/10(3.16vC)(1+50/E). For reference, C = Capacitance in Mfd. | I = Load Current in Amps | R = Resistance in Ohms | E = Source Voltage.

However, calculating RC value can be difficult to determine by formula due to contributing factors such as equipment wiring and component location – which can vary from machine to machine.

A Resistor-Capacitor Substitution Box (RCSB) is a time-saving second option that eliminates the need for a toolbox full of individual resistor and capacitor values. Temporarily clip the RCSB into the circuit. Then, with the aid of a storage oscilloscope, select and match various combinations of resistors and capacitors to optimize spike reduction and/or and reduce EMI levels.