The wound-wire fuse's secret
Technical Paper

SOC

One might say the dawn of Japanese electronics began in the 1960s. At that time, the three sacred treasures for ordinary households were televisions, refrigerators, and washing machines. Black and white televisions were transitioning to color sets and completely new technology was being cultivated. Circuit design grew more complex, and transistors, IC, and LSI were developed. The transition from black and white televisions to color sets led to increased energy consumption, and capacitors for circuits grew larger in size and quantity.

Charging for all circuit capacitors could be activated by switching the circuit entry switch to ON. Because charging started from scratch, the charge current reached up to a maximum surge waveform of 60 A. The time for this was not long, just around 2-7 ms, but the energy, known as "rush current," was large. Our fuses were installed in the world's first all transistor solid state black and white television, which marked a significant step for SOC.

It is problematic if a fuse operates when the set is in a normal operating state, and even more so if it fails to operate against a fault current, which could lead to fire or smoke emissions. A fuse must interrupt the fault current and protect the set circuit. The current which flows through all circuits is determined by its time-current characteristics, which show time and current values. Previously, pure metals were used as elements. A fuse's characteristics can also be explained with time-current characteristics (hereinafter referred to as "I-t curve"). As each pure metal has its own physical characteristics, the I-t curve differs depending on the type of metal forming the element.

Despite searching across all metal types, we could not find an element that does not fuse against the aforementioned rush current. Therefore, we started considering alloys rather than pure metals and proceeded with testing various alloys. However, as we tried to create samples, the metal supplier put a wrench in our plans by informing us the minimum lot size acceptable as an order was 300 kg. After much deliberation, we decided to use two different types of metal together, creating the wound-wire fuse. This fuse satisfied requirements and spectacularly didn't fuse against the rush current. It became a world de facto standard, which led SOC to acquire a patent for the technology.