

Solid State Fuses

– Limitations and possibilities

Today, blow-out fuses are commonly used in commercial vehicles for protecting cables and connectors from over currents. These are cheap, but dumb, and require replacement upon tripping. Technology has however advanced and semiconductors are used in many other applications. Therefore, it has been investigated whether it is advisable to start the transition to Solid State Fuses (SSF) in commercial vehicles and what limitations and possibilities they bring.

The blow out fuse is cheap and fairly robust. During the work, it has however been found that these have several drawbacks. The major drawback is that they need to be accessible in order to allow replacement. Another is that they actually do not trip for a majority of faults, not even a temporary, but direct short circuit to ground. In addition, they do not give any indication of why they tripped.

Instead a system using SSFs is proposed. This system contains solely solid state devices and is constituted by three general modules; measuring, detection and breaking. First, a physical quantity, e.g. current, is measured. The measurement values are used by the detection module. When this module identifies a fault, the breaker interrupts the current. As today, several fuses may be housed in the same physical unit in order to save space. The concept is illustrated in Figure 1.

The breaker constitutes one of the main challenges when designing the SSF as they need to be able of breaking almost every current. This includes breaking inductive currents, regenerative currents and currents caused by reversed battery polarity. In addition, it needs to be able of handling over voltage and voltage transients. Solutions for these are proposed in the main report. Heat is another challenge,

especially when the ambient temperature is high. This is a challenge that needs to be addressed when designing the system.

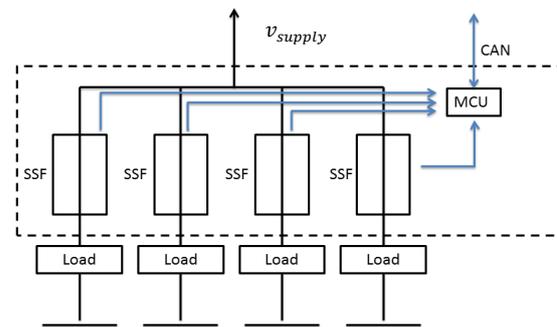


Figure 1: General build principle for the Solid State System

Regarding detection, the SSF opens up for a wide variety of methods since the system should include some kind of logic. Investigations regarding what characterizes a fault electrically were made, and many approaches to a detection system were found.

These different approaches open up for a whole new range of fusing action. Together with the fact that an SSF system may be reset automatically or using the vehicles on-board communication system, Solid State Fuses have been found to bring a great number of benefits. Apart from the mentioned, it is also possible to receive diagnostic signals from the system.

Finally, a demonstrator was built, proving that the concept actually is working. The demonstrator was able of identifying faults both faster and more accurately than a blow-out fuse.

For the full report see “Solid State Fuses for Commercial Vehicles – Limitations and Possibilities” by Robert Malmquist, written at Lund University in 2015.