Protection of Solid State Relay Circuits : Fuse Selection

I- Type of publication

- [ ] Typical application
- [x] Best know Method (BKM)
- [ ] Troubleshooting guide
- [ ] Level 2 use
- [ ] Internal use
- [x] Customer

II- Product

- Product range : Zelio Relay

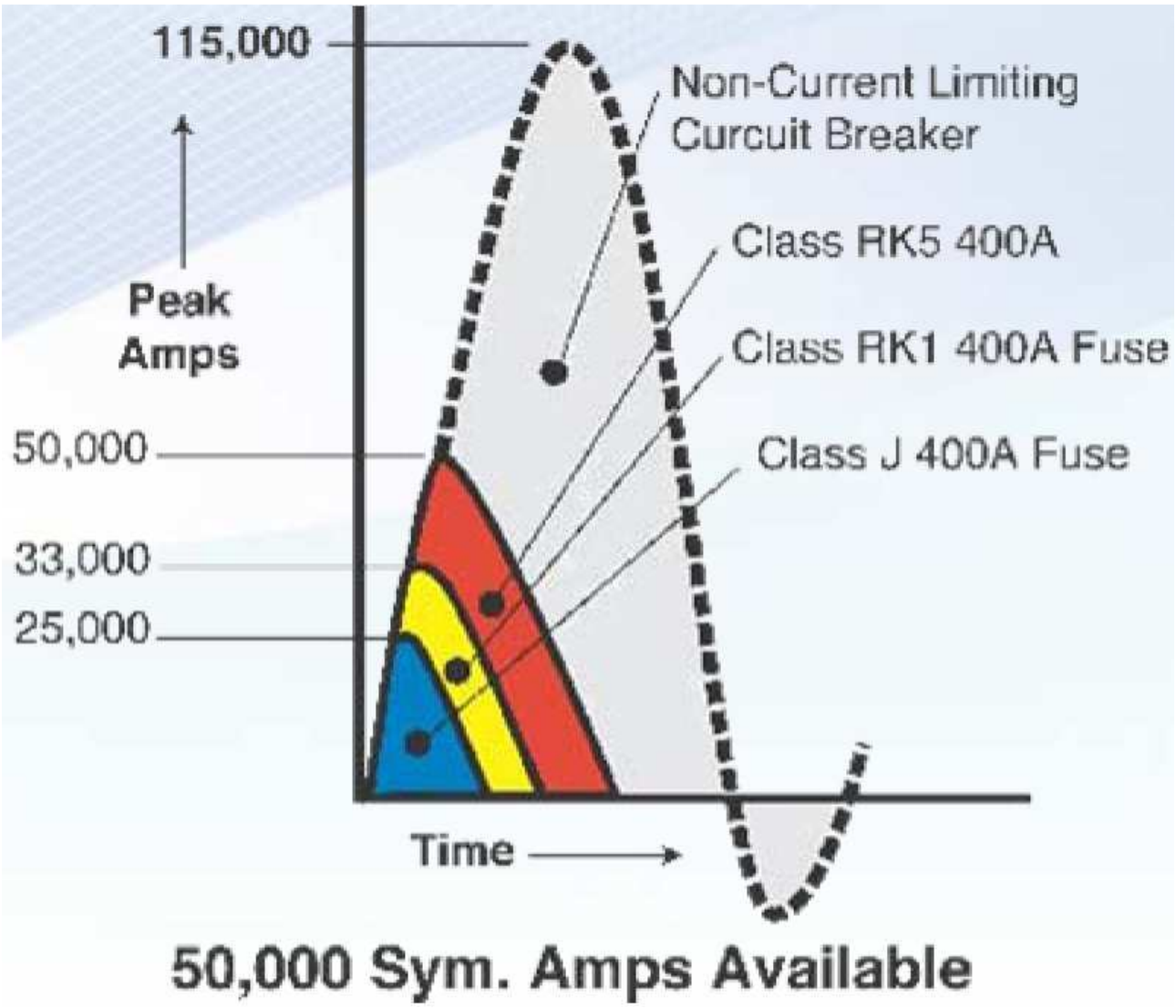
- Product family : SSR

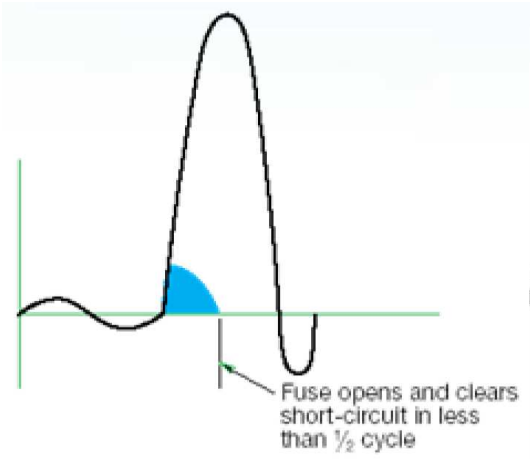
III- Introduction

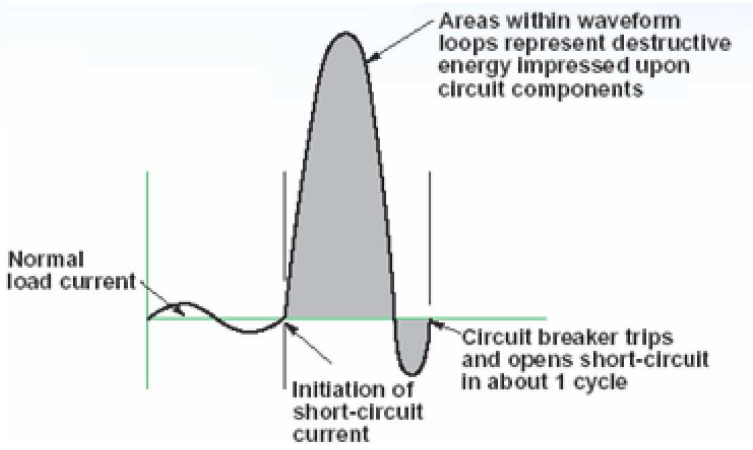
Absolute protection of a solid state relay from a shorted load or line condition requires more thought than simply providing a common circuit breaker or fuse in the circuit.

Compared to electromechanical switching devices, the solid state thyristor switching elements used in the output section of a Solid State relay have very short thermal time constants.
Consequently, extreme current levels and surges caused by load or line faults, even if only applied over extremely short time periods, may cause the thyristor devices to permanently fail.

Standard fuses and circuit breakers simply cannot react quickly enough to prevent the fault current from exceeding the maximum levels that the thyristors can withstand.


115,000
Peak
Amps
50,000
33,000
25,000
Non-Current Limiting
Curcuit Breaker
Class RK5 400A
Class RK1 400A Fuse
Class J 400A Fuse
Time
50,000 Sym. Amps Available


Fuse opens and clears
short-circuit in less
than ½ cycle


Areas within waveform
loops represent destructive
energy impressed upon
circuit components
Normal
load current
Initiation of
short-circuit
current
Circuit breaker trips
and opens short-circuit
in about 1 cycle

IV- Description

The solid state relay manufacturers provide within their datasheets a specification value that designates the maximum current vs. time that the thyristors can handle. This value is commonly listed as "I^2t", (amperes squared seconds).

Fuse manufacturers also give for certain types of fuses a "I^2t" value: the energy required to blow the fuse element. These fuses are generally called "Semiconductor" or "Ultra Fast Acting".
I^2t parameters are provided by charts in manufacturer data sheets for each fuse range.
The energy is mainly dependent on current and time for fuses.

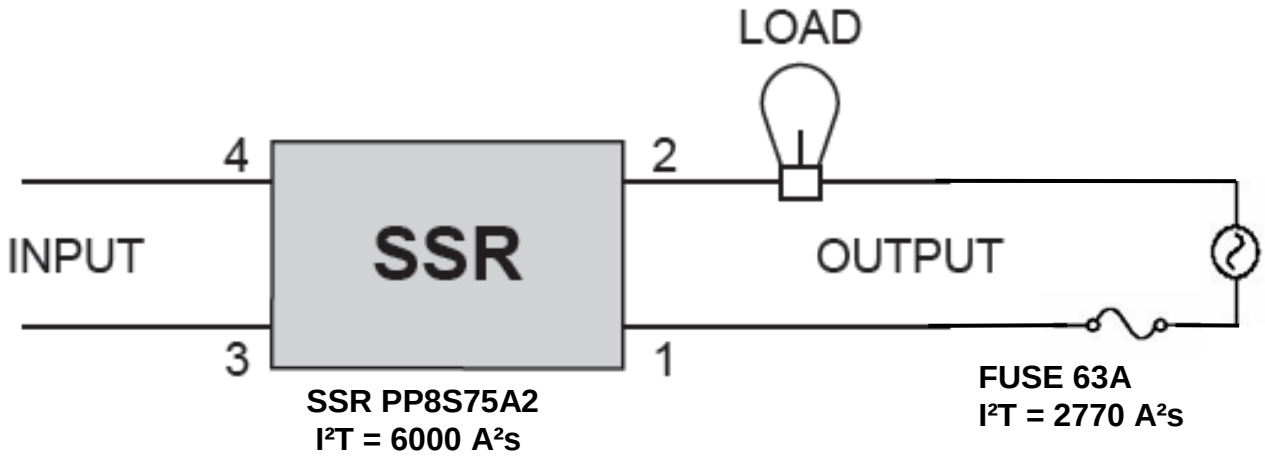
Assuming that the appropriate solid state relay has been selected for the particular load parameters, the fuse selection can be made by considering:

1. The fuse voltage rating to accommodate the system voltage.

2. The fuse current rating, (considering normal running load, start-up surges, operating temperatures, etc.)

3. The I^2t rating of the selected solid state relay (data given in catalogue).

4. The I^2t rating of the fuse. The "I^2t" rating of the fuse must be below the I^2t rating of the selected solid state relay, and above the expected "normal" current surges of the load.



It may happen on some occasions that the "normal" current and voltage ratings required of the fuse push its I^2t rating close to or beyond the I^2t rating of the solid state relay.
If this is the case, a higher I^2t rated solid state relay can be selected.

As stated previously, this is a general method of determining adequate fusing for solid state relays.

There are several other items that should be considered to complete the selection :

- The available fault current from the overall system.
- The amount of load surge cycling that will affect the cumulative heating of the fuse itself.
- The peak “let-through” current of the fuse prior to clearing.

Fuse manufacturers such as Ferraz – Shawmut, Bussmann, Littlefuse, etc., publish extensive notes detailing the calculations and methods of using those factors.