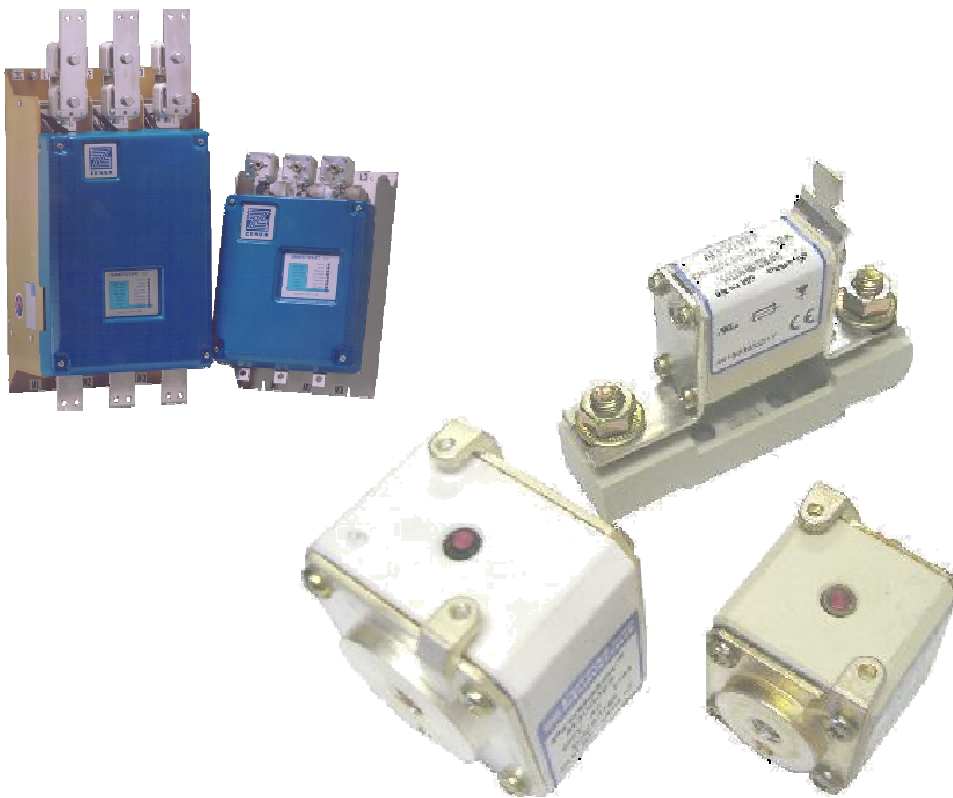


Soft Starters & Semiconductor Fuses



www.zener.com.au

Note: This article is intended as a guide only. It is the responsibility of the installer to define and accommodate all environmental & site factors influencing the drive selection & ensure compliance with all local rules & regulations.

Reference: IMI0037 Rev A

Dated: February 2009

Why Semiconductor Fuses on Soft Starters ?

The semiconductor device used in soft starters are known as SCR's (Silicon Controlled Rectifier) or thyristors. On each phase there are two SCR's in parallel, back to back (a total of 6 per starter). The SCR device consists of a silicon chip which can be destroyed within a few milliseconds by a high, rapidly increasing surge current as experienced with short circuits. Circuit breakers and standard fuses are not fast enough to protect the SCR in the event of a short circuit. Special semiconductor fuses described as super fast, ultra fast or ultra rapid have been developed for this purpose.

Fig.1

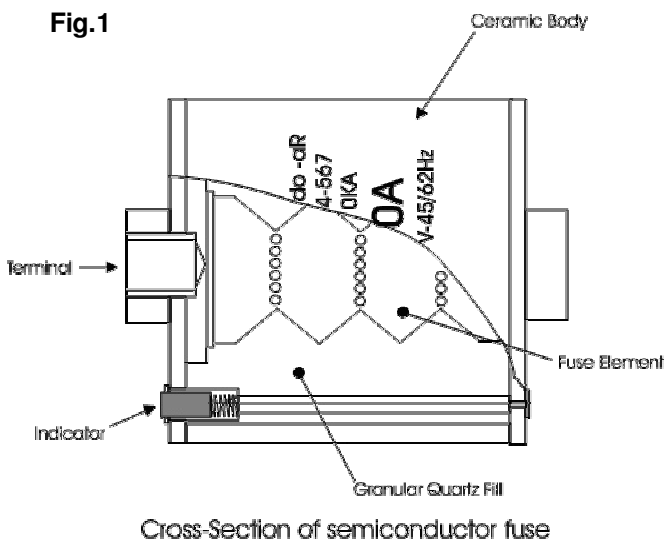


Fig.1 shows the construction of a typical semiconductor fuse. The fuse elements are usually made of pure silver strips with regions of reduced cross sectional area (often called notches). There may be several strips in parallel, depending on the ampere rating of the fuse. They are enclosed within an insulating tube or ceramic body filled with pure quartz sand. During normal operation the fuse elements carry the rated currents without melting. However when a short circuit occurs the elements melt very quickly at the 'notches'. A number of small arcs are produced in the notches, which result in the fault current to be rapidly reduced to zero and the arcs extinguished.

Short circuits are usually due to a catastrophic electrical failure where the resulting r.m.s value of the prospective short circuit current is high, typically more than 20 times the normal full load current of the system. An SCR or thyristor may fail when subjected to less than a 10ms pulse of only 10 times its nominal r.m.s current rating (10ms is equal to one half cycle of a 50hz power source). In comparison, a low voltage general purpose fuse may require 15-30 times its current rating to melt within 10ms, which is not fast enough to protect the semiconductor devices. A Semiconductor fuse typically requires only 5-6 times its current rating, thus protecting the thyristor.

Semiconductor fuses are intended for protection against short circuits, and not intended for providing protection against overload currents. Overload currents generally fall within an unprotected region of the fuse and protection is required by alternative devices. The overload capacity of an SCR is dependant by various factors, factors which generally increase the operating temperature of the SCR junction. Soft Starters generally offer protection by monitoring the heatsink temperature. Semiconductor fuses also do not provide thermal protection of the motor.

Variable Speed Drives differ from soft starters in that the electronics can switch the output semiconductor (IGBT's) off fast enough in the event of a short circuit. With soft starters, the SCR's cannot be switched off during it's conduction cycle but must wait until the next zero crossing, which may be as long as 10ms. Protection against short circuit currents which reach their maximum values within this half cycle cannot be achieved by inhibiting the triggering. For this reason semiconductor fuses are strongly recommended.

A low cost insurance:

Zener Electric recommends that semiconductor fuses be installed as your insurance. If semiconductor fuses are not installed, the SCR(s) will fail if a short circuit occurs. SCR's are a major cost component of the soft starter. Soft Starters may consist of 3 SCR modules or 6 SCR capsules in the larger starters, so the replacement cost could prove expensive in comparison to the initial cost of semiconductor fuses. There is also the cost of production down time to consider.

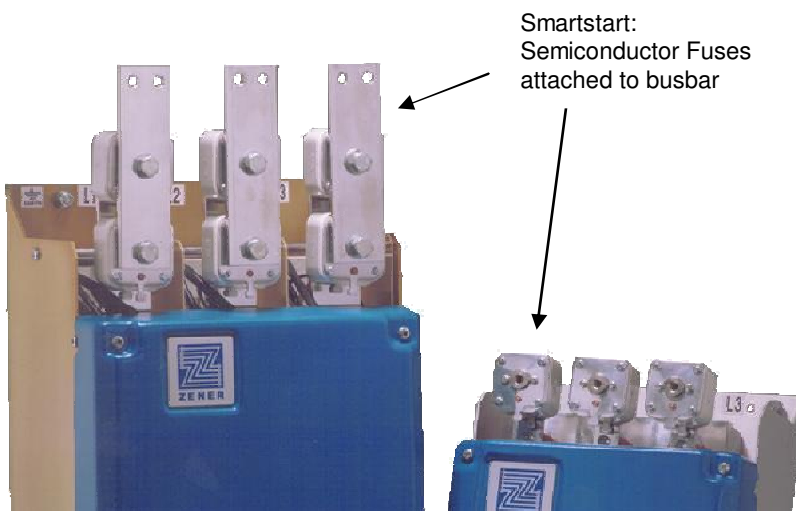
Since short circuit damage is normally a result of the installer, installation wiring or components, any damage to the soft starter is not likely to be covered under warranty.



Are Semiconductor Fuses supplied with the equipment:

The Zener Smartstart 480 series comes standard with semiconductor fuses conveniently mounted to the input busbar of the soft starter. This promotes ease of installation and a smaller footprint in switchboards.

Semiconductor fuses are optional with the AMC2000 with a semiconductor fuse kit available. The fuse kit consists of 3 bases, 3 fuses and a cover is also available if required.

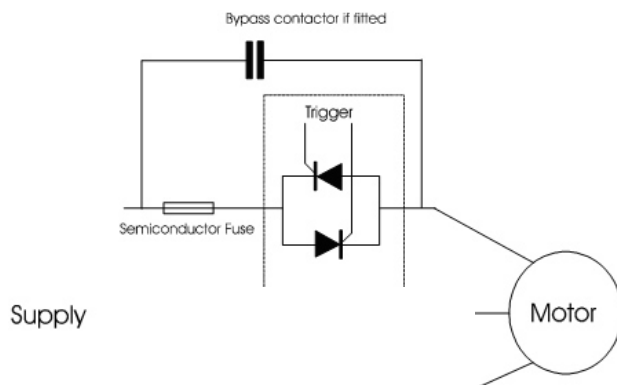


Zener has selected the fuse combination for each soft starter to provide the best protection of the thyristors being used, to save you time and provide the added assurance in the event of a short circuit.

Installation:

Semiconductor fuses should be installed on the input side of the thyristors. As the intention is to provide protection for the thyristors, it is not necessary to have them installed to provide protection of the bypass circuit.

It is also important to ensure semiconductor fuses have adequate ventilation for cooling by free air. Fuses operating at higher ambients may need to be derated.



Semiconductor fuses are installed on the line side of the softstarter.
The fuses must not be installed in the bypass circuit.

Selection of Semiconductor Fuses:

The semiconductor fuses must be carefully selected to match the semiconductor devices (thyristors) and the continuous current rating of the soft starter.

Zener Electric have selected the fuses that will provide the best protection of the SCR's (thyristors) used in each soft starter. Semiconductor fuses are provided as standard on the Smartstart 480 series and available as a fuse kit for the AMC2000 series.