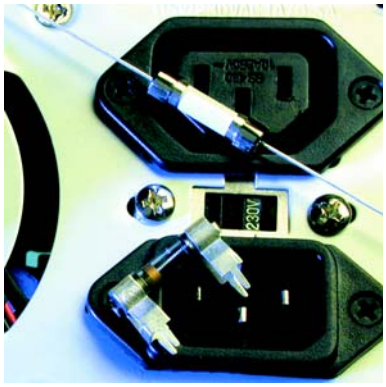
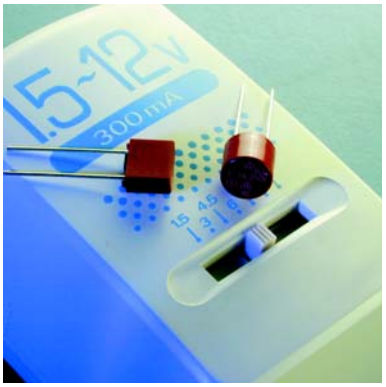
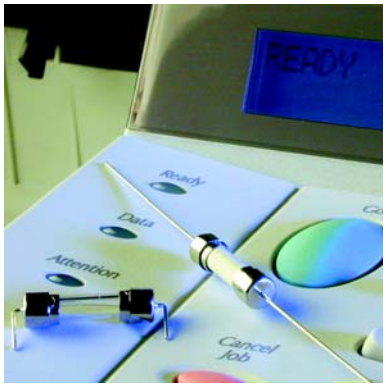
Littelfuse®







SWITCH MODE POWER SUPPLIES
APPLICATION NOTE

Switch mode power supplies are becoming more common in electronic devices. Compared to conventional commercial power frequency transformers, they are more efficient and offer smaller footprints. This high efficiency characteristic is especially important for devices operated in stand-by mode. These devices also are good for the environment since they conserve valuable energy.

In a switch mode power supply, the AC input current is rectified and then converted into a square wave at a high frequency. This high frequency (typically up to 1 MHz) enables the use of small, highly efficient transformers. Lastly, the voltage is rectified and stabilized into a clean operating waveform.

To prevent the supply network from being fed with a noisy input pulse, additional components, such as a filter choke, have to be integrated. An overvoltage component, usually a metal-oxide varistor and an overcurrent component, usually a blow-type fuse, is placed in the device's input circuitry.

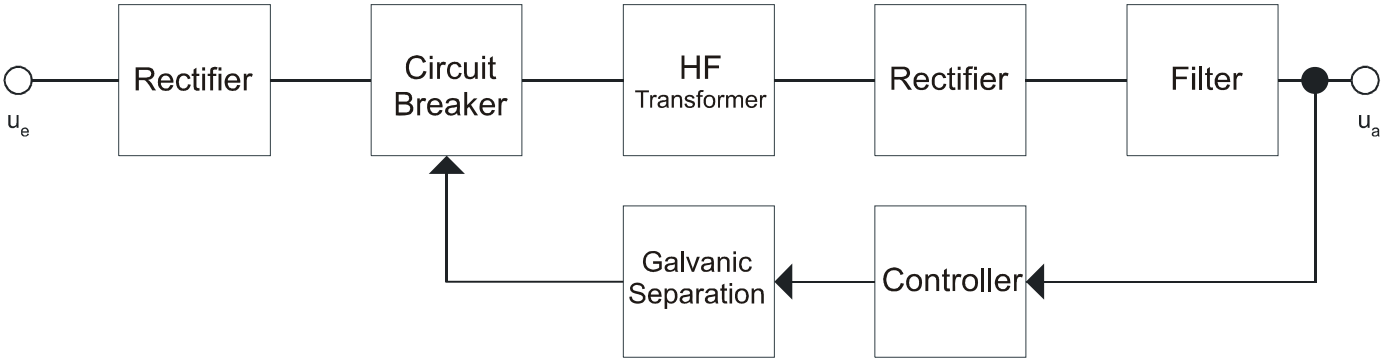


Fig. 1: elementary circuit diagram primary clocked switch controller

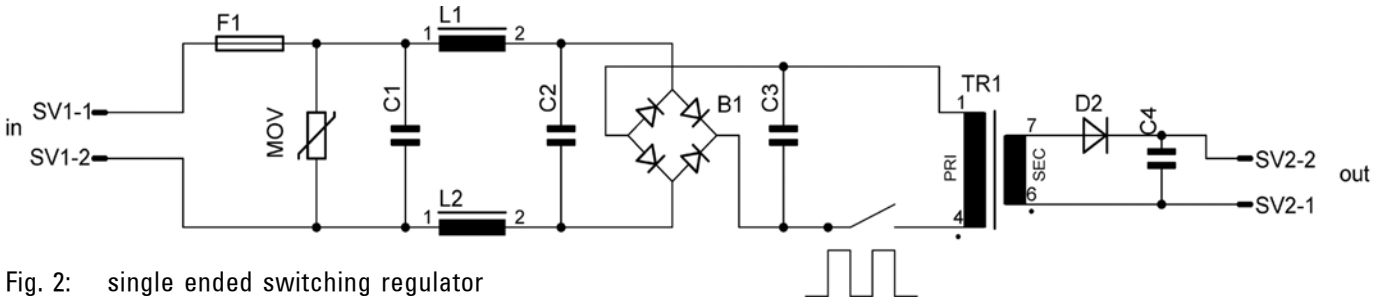


Fig. 2: single ended switching regulator

In order to select an appropriate blow-type fuse, both the required rated current and the pulse resistance, has to be taken into account.

The maximum pulse current that the fuse must withstand is determined by the varistor's response characteristics. Test parameters for switch mode power supplies are given in the relevant EMC standards. Chart 1 shows an overview of these standards.

Pulse wave 8/20µs					
Standard	Protection gauge	U-Pulse	max. I-Pulse	min. Pulse rate	Remarks
IEC 61643-1 / VDE 0675 Teil 6	max. 1,5kV	4 - 6kV	3kA	2	Isolation leads at double arrester rated voltage
ÖVE - SN 60 Teil 4	0,7 - 2kV	6kV	3kA	2	demand for telecom applications
IEC 61644-1/ VDE 0845 Teil 3	< 1kV	2kV	1kA	10	
typ. customer specification		6kV	3kA	64	Sufficient insulation distance (6kV) over (In) fuse required
		3kV	1,5kA	64	Fuse may not blow; sufficient pulse durability of the fuse necessary

Tab. 1: Standards

Chart 2 lists approximate values of the pulse melting integrals to be expected and the corresponding required melting integral of the fuse. In chart 3, there are recommendations for appropriate 5x20mm, TR5® and TE5® fuse types. For each maximum pulse current, the minimum rated current of the fuse is listed in the chart.

$I_{Pulse\ max.}$	I^2t_{Pulse}	$I^2t_{Fuse\ min.}$	
		VDE 675	typ. custom. specification
kA	A^2s		
1,0	12,00	19	25
1,2	17,28	27	36
1,5	27,00	42	56

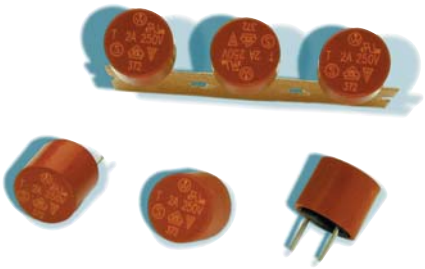
Tab. 2: Melting integrals

Possible fuse							
Standard	VDE 0675					typ. customer spec.	
Design	5x20mm		TR5		TE5	5x20mm	TR5
I pulse max. kA	181	196	382	384	392	181	384
1,0	4,0 A	1,6 A	2,50 A	2,50 A	2,00 A	6,3 A	2,50 A
1,2	5,0 A	4,0 A	3,15 A		2,00 A	6,3 A	
1,5	5,0 A	5,0 A	4,00 A		2,50 A	6,3 A	
2,0	6,3 A	6,3 A	5,00 A		3,15 A	6,3 A	
3,0	10,0 A					6,3 A	

Tab. 3: Applicable fuses

For power supplies susceptible to high short-circuit currents, 5x20mm ceramic fuses (Series 181) are available with a breaking capacity up to 1500A. Glass types such as Series 196 can safely interrupt fault

currents up to 150A at 250V. Miniature fuses are typically mounted into holders so they can easily be replaced. Shocksafe holders are available in PC Mount and Panel Mount versions. Open types such as clips or blocks offer a lower cost alternative. Additionally, you can directly solder 5x20mm fuses when assembled with plug-on end caps. For these power supply types, there is a ongoing trend towards more compact form factors. TR5® and TE5® fuse types offer a PC board space savings of up to 65% when compared to traditional 5x20mm glass fuses. These fuse types are delivered in a taped format. They can be soldered directly to the PC board via auto-matic insertion equipment and offer lower



assembly costs when compared to 5x20mm fuses.

For additional assistance in selecting the proper fuse type and rating, please fill please visit www.littelfuse.com.

After the initial selection of the fuse, the designer must perform electrical and mechanical parameter tests under normal operating conditions and fault conditions to verify product safety.