Requirements for Universal Modular Fuses (UMF's)

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Summary

A new type of miniature fuse-link is described, which is specifically designed for use on printed circuit boards. These fuse-links are particularly suitable for use at low voltages, down to 32 V and currents up to 5 A. The requirements for such fuse-links, both dimensional and electrical, are discussed. Achievements to date and possibilities for future developments are considered.

1. Introduction

The increasing tendency towards miniaturisation and the increased use of electronics in domestic, commercial and industrial situations has revealed the need for a system of protective fusing which can be used on printed circuit boards and which is designed for application at low voltages.

The special requirements for such fuses lie in their dimensions, materials and methods of insertion into the pcb, as well as their electrical characteristics.

A special Working Group of IEC SC32C (Miniature Fuses) was established to deal with these types of fuse, and to determine their characteristics, thus making sure that they are universally accepted, so that they can be used in electronic equipment which is likely to be moved freely from one country to another.

The specification for these fuses will be Part 4 of the IEC series on miniature fuses (IEC 127). A unique symbol will be used to identify them.

2. Construction

Because the fuses must fit into a pcb, the dimensions of the fuse body and terminals are limited by the normal dimensions of pcb's and the way they are handled by automatic insertion machinery. The two different types of UMF which are being standardised are the through hole radial type, designed for soldering directly into a printed circuit board, and the surface mounting type, which is designed to be attached into the surface of a substrate by solder or other means.

For the through hole type, the terminals (pins) must go through the hole in the pcb (1 mm), which gives a maximum cross-sectional area, but they must also be able to carry the required current without overheating, and this determines the minimum cross-sectional area of the pins. The spacing of the pins corresponds to multiples of the hole spacing in the pcb and depends on the rated voltage of the fuselink, as shown in Fig 1.

The terminals of the surface mounting types are arranged as shown in Fig 2, and their dimensions and spacing are only limited by the creepage and clearance requirements for the rated voltage and by the stacking dimensions of the components on the pcb.

The fuse element is completely enclosed. The enclosure should be made of a material which can withstand the heat required for soldering the terminals into or onto the board and its other maximum dimensions are standardised as shown in Figs 1 and 2.

The fuse links are marked with rated current, maker's name or symbol, UMF symbol, characteristic symbol (eg, F, T, R, S) and a symbol indicating rated voltage and breaking capacity. Because these fuses are small, one-letter codes are specified for each of these, as shown in Fig 3. Alternatively, colour coding may be used.

3. Electrical Properties

The electrical requirements for these fuses are very similar to those of the more familiar miniature cartridge fuses, as they are meant to perform a similar protective function.

The range of current ratings is the same as for miniature cartridge fuses, from 32 mA, to 5 A, and voltage ratings are 32, 63, 125 and 250 V, with low breaking capacity only up to 125 V, and low, intermediate and high breaking capacity at 250 V. These breaking capacities are defined as shown in Table 1.

Four types of time/current characteristic are envisaged for these fuse-links: R: super-quick acting; F: quick-acting; T: time-lag; S: super time-lag.

All fuses should operate within the harmonised system of time/current gates, ie their pre-arcing times at 1.25 times rated current should be at least one hour, and at 1.7 times rated current they should not exceed 5 minutes.

At 10 times rated current the pre-arcing times depend on the type:-

Type R: not exceeding 0.005 seconds
Type F: between 0.005 and 0.015 seconds
Type T: between 0.015 and 0.100 seconds
Type S: between 0.100 and 1.00 seconds.

Temperature rise for these fuse-links is of particular importance, because of their close proximity to the pcb and other components on the pcb, and therefore a special test has been included in the specification to ensure that the hottest point of the fuse-link when carrying 1.25 times its rated currents does not rise to more than 135 K above ambient temperature. As these fuselinks have element lengths which are considerably less than those of the conventional 5 x 20 mm cartridge fuselinks, it is possible to limit their maximum voltage drop and maximum sustained power dissipation to comply with this requirement.

It is important to limit the overvoltages which occur during fuse operation, so as to avoid damage to other components , and therefore the maximum overvoltages are laid down as shown in Table 2, where the overvoltages are seen to be dependent on the voltage system in which the fuse-links are being used.

4. Future Developments

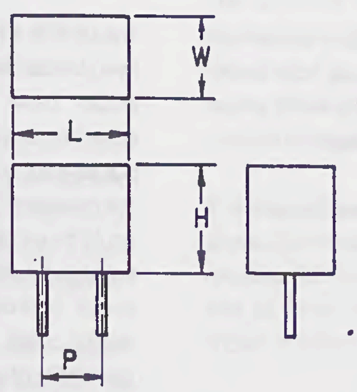
At present these fuselinks are being manufactured to a limited degree. Some examples of the fuses available are shown in the photograph. It is expected, however, that a considerable expansion of the manufacture and use of these types will follow the general acceptance of the new IEC specification, and in particular that these fuses will be developed in low voltage and low current ratings. It is difficult to manufacture conventional miniature fuse types with such ratings because of their inherently larger volt drop and the fact that sophisticated design methods are necessary to produce elements with reproducible time/current characteristics and the required mechanical properties.

5. Conclusions

The UMF is a type of fuselink, which, if accepted world-wide as a standardised fuse type for use on printed circuit-boards, would have considerable economical and technical advantages over the fuses in use at present. Their use would put an end to the ambiguity in rating philosophy at present still prevalent in different parts of the world, so that fuselinks could be replaced with greater safety. The designs are also suitable for direct insertion or surface mounting on printed circuit boards using automatic machinery, saving time, labour costs, and materials. These economics give the possibility of using more fuses in each circuit, thus isolating faulty sub-circuits with good discrimination and enhanced safety. Identification of faults in design or component performance which cause the return of electronic products will thus be facilitated.

Fig.1 Fuselinks-UMF Through hole radial type	Standard sheet I

Dimensions

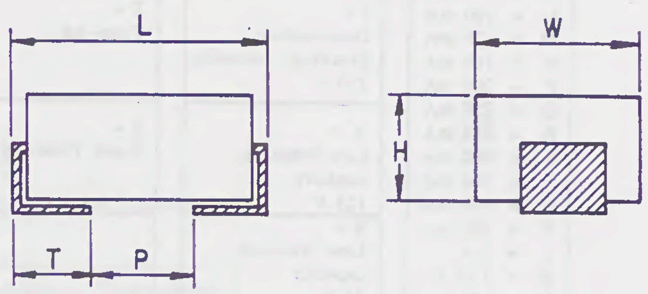


Rated Voltage	Pin Spacing (mm)	Maximum Dimensions (mm)		
	P	W	H	L
32	2.5			8
63	2.5			8
125	5	7.5	10	10.5
250 (lbc)	7.5			12.5
250 (ibc)	10			15.0
250 (hbc)	12.5			18

Note: The termination must go through a in hole and have a minimum cross-sectional area of 0.15 m^2. The geometry of the cross section is optional.

	Fig.2 Fuselinks-UMF Surface mounting type	Standard sheet 2

Dimensions



Rated Voltage	Spacing P (mm min.)	Maximum Dimensions (mm)			
		W	H	L	T
32 63 125	1.5 2 2.5	7.5	10	5 8 10	
250 (lbc) 250 (ibc) 250 (hbc)	4 4 4			12.5 15.8 18	

Note: 1) The point at which the terminations protrude from the body is optional and the terminations may vary provided both stay within the specified fuselink dimensional limits.

2) The clearance from the underside of the fuselink to the surface of the printed circuit board must not be less than 0.05 mm and must not exceed 0.3 mm.

Example :

UMF of 200 mA rating Low Breaking-capacity Quick-acting Reflow type SMT:-

UPLF

UMF Symbol

A	=	10 mA
B	=	12 mA
C	=	16 mA
D	=	20 mA
E	=	25 mA
F	=	32 mA
G	=	40 mA
H	=	50 mA
J	=	63 mA
K	=	80 mA
L	=	100 mA
M	=	125 mA
N	=	160 mA
P	=	200 mA
Q	=	250 mA
R	=	315 mA
S	=	400 mA
T	=	500 mA
U	=	630 mA
V	=	800 mA
1	=	1 A
W	=	1.25 A
X	=	1.6 A
2	=	2 A
3*	=	3.15 A
4	=	4 A
5	=	5 A
6	=	6.3 A

H = High breaking -capacity 250 V
L = Low breaking -capacity 250 V
I = Intermediate breaking capacity 250 V
A = Low breaking capacity 125 V
B = Low breaking capacity 63 V
C = Low breaking capacity 32 V

R = Super Quick-acting
F = Quick-acting
T = Time-lag
S = Super Time-lag

Fig 3a Abbreviated marking code for universal modular fuse links

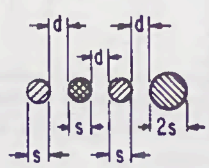


Fig 3b Alternative colour dot marking

Table 1
Breaking Capacity

Rated Voltage	Breaking Capacity
32 (lbc)	35 A or 10I_n*
63 (lbc)	35 A or 10I_n*
125 (lbc)	50 A or 10I_n*
250 (lbc)	100 A
250 (ibc)	500 A
250 (hbc)	1500 A

* whichever is the greater

Table 2
Maximum Overvoltages During Fuse Operation

Rated Voltages	Maximum Overvoltage
$0 < U_n <= 50$	500
$50 < U_n <= 100$	800
$100 < U_n <= 150$	1500
$150 < U_n <= 300$	2500

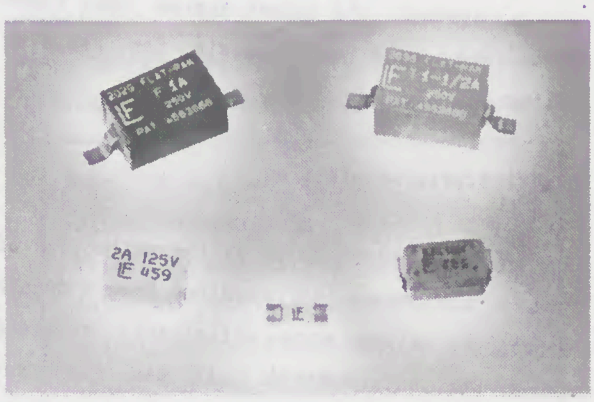


Fig.4 Photograph of UMF's available at present