

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Miniature fuses –
Part 4: Universal modular fuse-links (UMF) – Through-hole and surface mount
types**

**Coupe-circuit miniatures –
Partie 4: Eléments de remplacement modulaires universels (UMF) – Types de
montage en surface et montage par trous**

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MINIATURE FUSES –

Part 4: Universal modular fuse-links (UMF) – Through-hole and surface mount types

FOREWORD

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IEC 60127-4 edition 3.2 contains the third edition (2005) [documents 32C/362/FDIS and 32C/366/RVD], its amendment 1 (2008) [documents 32C/411/FDIS and 32C/412/RVD] and its amendment 2 (2012) [documents 32C/456/CDV and 32C/463/RVC].

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 60127-4 has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses.

The major technical changes with regard to the previous edition are as follows: introduction of physically smaller devices with lower rated voltages. Fuse-link temperature test (9.7) is modified.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The clauses of this standard supplement, modify or replace the corresponding clauses in IEC 60127-1.

Where there is no corresponding clause or subclause in this standard, the clause or subclause of IEC 60127-1 applies without modification as far as is reasonable. When this standard states “addition”, “modification” or “replacement”, the relevant text in IEC 60127-1 is to be adapted accordingly.

The IEC 60127 series is subdivided as follows:

- Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links
- Part 2: Cartridge fuse-links
- Part 3: Sub-miniature fuse-links
- Part 4: Universal modular fuse-links (UMF)
- Part 5: Guidelines for quality assessment of miniature fuse-links
- Part 6: Fuse-holders for miniature fuse-links
- Part 7: (Free for further documents)
- Part 8: (Free for further documents)
- Part 9: (Free for further documents)
- Part 10: User guide for miniature fuses

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INTRODUCTION

The trend towards miniaturization of electronic equipment has caused users to require fuse-links of small dimensions, and of appropriate design for application to printed circuit boards or other substrate systems, possibly by automatic means. These fuse-links should be designed to incorporate a degree of non-interchangeability.

Rated voltages of 12,5 V, 25 V, 32 V, 50 V, 63 V, 125 V, and 250 V are specified together with the following characteristics: very quick acting (FF), quick acting (F), time-lag (T) and long time-lag (TT).

Because of the increasing importance of limitation of transient overvoltages in new technology, recommendations are included for limits to the overvoltages produced by these fuses under specified test conditions related to typical circuit configurations.

The option is given to specify the breaking capacity with alternating current or direct current; it is considered that fuses that meet the d.c. requirement will meet the a.c. requirement; however, testing is required to validate this. Fuses may be dual rated, in which case the manufacturer's literature should be referred to.

~~The users of miniature fuses express the wish that all standards, recommendations and other documents relating to miniature fuses should have the same publication number in order to facilitate reference to fuses in other specifications, for example, equipment specifications.~~

~~Furthermore, a single publication number and subdivision into parts would facilitate the establishment of new standards, because clauses and subclauses containing general requirements need not be repeated.~~

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MINIATURE FUSES –

Part 4: Universal modular fuse-links (UMF) – Through-hole and surface mount types

1 Scope and object

This part of IEC 60127 relates to universal modular fuse-links (UMF) for printed circuits and other substrate systems, used for the protection of electric appliances, electronic equipment, and component parts thereof, normally intended to be used indoors.

It does not apply to fuse-links for appliances intended to be used under special conditions, such as in a corrosive or explosive atmosphere.

These fuses are normally intended to be mounted or replaced only by appropriately skilled persons using specialized equipment.

~~Fuse links for use in fuse holders are under consideration.~~

This standard applies in addition to the requirements of IEC 60127-1.

The objectives of this part of IEC 60127 are as given in IEC 60127-1, with the additional requirement of a degree of non-interchangeability.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60068-2-20:1979, *Basic environmental testing procedures – Part 2: Tests – Test T: Soldering*~~
~~Amendment 2 (1987)~~

~~IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*~~

IEC 60068-2-21:1999, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-58:2004, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60127-1:1988, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links*¹
Amendment 1 (1999)
Amendment 2 (2002)

IEC 60194:1999, *Printed board design, manufacture and assembly – Terms and definitions*

¹ There exists a consolidated version (2003).

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*²
Amendment 1 (2000)
Amendment 2 (2002)

IEC 61249-2-7:2002, *Materials for printed boards and other interconnecting structures – Part 2-7: Reinforced base materials clad and unclad - Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad*

ISO 3:1973, *Preferred numbers – Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60127-1, together with the following definitions, apply.

3.1

through-hole fuse-link

UMF designed for soldering directly into a printed wiring board, with insertion of its leads in suitably designed holes

3.2

surface mount fuse-link

UMF designed for direct conductive attachment by solder or other means on to the surface of a substrate, without insertion of its leads in suitably designed holes or sockets

3.3

land

portion of a conductive pattern usually but not exclusively used for the connection and/or attachment of components (see IEC 60194)

NOTE Further definitions which may be useful in the application of surface mount fuse-links may be found in IEC 60115-1 and IEC 60115-8³.

4 General requirements

See IEC 60127-1.

5 Standard ratings

5.1 Rated voltage

See standard sheets.

5.2 Rated current

See Table 1 for preferred ratings.

5.3 Rated breaking capacity

See standard sheets.

² There exists a consolidated version (2002).

³ This standard has been withdrawn.

6 Marking

In addition to the requirements of Clause 6 in IEC 60127-1, the following criteria concerning UMF shall be observed and marked:

6.1 Addition:

- e) For fuse-links rated at 250 V, a symbol denoting the breaking capacity. This symbol shall be placed between the marking for rated current and the marking for rated voltage.

These symbols are as follows:

H: denoting high-breaking capacity;

I: denoting intermediate-breaking capacity;

L: denoting low-breaking capacity.

- f) The distinctive symbol shown in Figure 1.

- g) The letters a.c. before the voltage for devices designed solely for alternating current application.

6.4 Colour coding for universal modular fuse-links

Under consideration.

6.5 Where marking is impractical due to space limitations, the relevant information should appear on the smallest package and in the manufacturer's technical literature.

7 General notes on tests

In addition to the requirements of Clause 7 in IEC 60127-1, the following criteria shall be observed:

[IEC 60127-4:2005](https://standards.iteh.ai/catalog/standards/iec/2a5678e0-1201-4717-a132-eed951d6c3ac/iec-60127-4-2005)

7.2 Addition:

7.2.1 For testing of individual fuse ratings according to standard sheets 1 and 2, see Table 2. For fuse-links designed and rated both for a.c. and d.c., the number of fuse-links required is 63. For fuse-links designed only for a.c., the number of fuse-links required is 48. There are nine spares.

For the maximum ampere rating of a homogeneous series according to standard sheets 1 and 2, see Table 3. For fuse-links designed and rated both for a.c. and d.c., the number of fuse-links required is 53. For fuse-links designed only for a.c., the number of fuse-links required is 48. There are 19 spares.

For the minimum ampere rating of a homogeneous series according to standard sheets 1 and 2, see Table 4. For fuse-links designed and rated both for a.c. and d.c., the number of fuse-links required is 38. For fuse-links designed only for a.c., the number of fuse-links required is 33. There are 16 spares.

7.3 Fuse-bases for tests

7.3.1 General requirements

Fuse-links shall be mounted upon the appropriate test board (see 7.3.2 or 7.3.3 as appropriate) by soldering.

This test board shall then be mounted on the test fuse-base (Figure 4). The test board shall be made of epoxide woven glass fabric copper-clad laminated sheet, as defined in IEC 61249-2-7:

- the nominal sheet thickness shall be 1,6 mm;
- the nominal thickness of copper layer shall be 0,035 mm (0,070 mm ~~above 6,3 A~~ for rated currents above 5 A).

Metal parts of the fuse-base shall be made of brass with a copper content between 58 % and 70 %. Contact parts shall be silver-plated.

When two or more fuse-links are tested in series, the test fuse-bases shall be located so that there will be a spacing of not less than 50 mm between any two fuse-links under test. The conductor connecting the test fuse-bases together, and connecting the test fuse-bases to the ammeter and the source of supply shall be insulated copper wire. The length of each conductor shall be 250 mm, and the cross-sectional area of the wire shall be approximately 1 mm².

7.3.2 Through-hole fuse-links (standard sheet 1)

For electrical tests upon fuse-links covered by standard sheet 1, the fuse-link shall be mounted on the test board, as shown in Figure 2 in the pair of holes appropriate to the spacing of the terminations.

7.3.3 Surface mount fuse-links (standard sheet 2)

For electrical tests upon fuse-links covered by standard sheet 2, the fuse-link shall be mounted on the test board, as shown in Figure 3. See Annex A for guidance.

8 Dimensions and construction

8.1 Dimensions

The dimensions of the UMFs shall comply with the relevant standard sheets.

Compliance is checked by measurement of length, width and height.

For fuse-links to standard sheet 1, the termination spacing is checked. The termination shall also pass through a 1 mm hole. The length of the termination is not specified as this is subject to the method of packaging.

8.2 Construction

The fuse-element shall be completely enclosed.

The UMF shall withstand the heat and chemical exposure of a printed circuit board or other substrate assembly operations with its performance unimpaired.

Compliance is checked by the resistance to soldering heat test as specified in 8.7.

8.3 Terminations

8.3.1 Through-hole fuse-links

Terminations shall be firmly attached so that it is not possible to remove them without damaging the UMF.

Compliance is checked by carrying out the following test.

The samples are preconditioned by immersion in water for 24 h at a temperature between 15 °C and 35 °C.

The tests are carried out in accordance with IEC 60068-2-21.

The following tests shall be applied:

- tensile test U_{a1} , applied force 10 N;
- thrust test U_{a2} , applied force 2 N;
- bending test U_b , applied force 5 N, number of bends: 1.

The sample size is two fuses for each test. After testing, the terminations shall remain firmly attached. The voltage drop shall be measured in accordance with 9.1, and shall not exceed the maximum allowed in Table 1. Bending test U_b is omitted if the terminations are less than 5 mm.

8.3.2 Surface mount fuse-links

The fuse-links shall be mounted on the test board as shown in Figure 3. The test board, with the fuse-links on the underside, shall be placed in the bending jig as shown in Figure 5. The board shall then be bent by 1 mm at a rate of 1 mm/s. The test board shall be allowed to recover from the bent position, and then be removed from the test jig.

After the test, the terminations shall remain firmly attached, and the voltage drop shall be measured in accordance with 9.1, and shall not exceed the maximum allowed in Table 1.

8.4 Alignment and configuration of terminations

The termination configuration and spacing shall be as specified in the standard sheets.

NOTE 1 Through-hole fuse-links

For through-hole mounting of UMFs (standard sheet 1), the dimensions shown on the standard sheets are such as to permit installation on printed circuit boards having a grid system of holes located on centres of distance $e = 2,5$ mm. Attention is drawn to the fact that in some parts of the world the value $e = 2,54$ mm is still in use by printed circuit designers.

Electrical and electronic circuit designers are advised to apply the requirements of IEC 60326-3.

NOTE 2 Surface mount fuse-links

For surface mounting of UMFs (standard sheet 2), electrical and electronic circuit designers are advised to design substrate land areas to receive UMFs with due consideration for achieving the maximum area of contact in the application, taking into account the tolerance applied to mechanical placing of the component and the dimensions and tolerances for terminals in this standard.

8.5 Soldered joints

See IEC 60127-1.

8.6 Solderability of terminations

8.6.1 Through-hole fuse-links

The fuse-links shall be subjected to Test Ta of IEC 60068-2-20:2008, using Method 1, with the following conditions:

| | |
|-----------------------|--|
| Ageing: | None (as received) |
| Immersion conditions: | 235 °C ± 5 °C, 2 s ± 0,5 s 250 °C ± 3 °C, 3 s ± 0,3 s |
| Depth of immersion: | 2,0 mm ± 0,5 mm (from seating plane) |
| Flux type: | Non-activated |
| Screen: | A screen should be used. |

After the test, the dipped surface shall be covered with a smooth and bright solder coating, with no more than small amounts of scattered imperfections such as pin-holes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area. 10 × magnification shall be used.

A different solder bath temperature may be chosen because of the usage of various solders. The relevant combination of the solder bath temperature and the solder alloy shall be chosen according to IEC 60068-2-20:2008, Table 1.

8.6.2 Surface mount fuse-links

The fuse-links shall be ~~subjected to Test Td~~ tested according to 6.2 of IEC 60068-2-58:2004, with the following conditions:

| | |
|-----------------------|--|
| Ageing: | None (as received) |
| Immersion conditions: | 235 °C ± 5 °C, 2 s ± 0,2 s for wave soldering application 215 °C ± 3 °C, 3 s ± 0,3 s for reflow soldering application 245 °C ± 5 °C, 3 s ± 0,3 s |

Depth of immersion: The terminations shall be immersed successively in such a way that the entire metal surfaces are covered by the solder bath

Flux type: Non-activated

After the test, the contact areas shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pin-holes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area. 10 × magnification shall be used.

A different solder bath temperature may be chosen because of the usage of various solders. The relevant combination of the solder bath temperature and the solder alloy shall be chosen according to IEC 60068-2-58:2004 Table 2.

8.7 Resistance to soldering heat

8.7.1 Through-hole fuse-links

The fuse-links shall be subjected to Test Tb of IEC 60068-2-20:2008, Method 1A, with the following conditions:

| | |
|-----------------------|--------------------------------------|
| Ageing: | None (as received) |
| Immersion conditions: | 260 °C ± 5 °C, 10 s ± 1 s |
| Depth of immersion: | 2,0 mm ± 0,5 mm (from seating plane) |
| Flux type: | Activated |
| Screen: | A screen should be used. |

After the test, the fuse-link shall not be cracked. Marking shall be readable, and colour coding, if used, shall not have changed colour.

The voltage drop is measured as specified in 9.1, and shall not exceed the maximum values specified in Table 1.

8.7.2 Surface mount fuse-links

The fuse-links shall be ~~subjected to Test Td~~ tested according to 6.2 of IEC 60068-2-58, with the following conditions:

| | |
|-----------------------|---------------------------|
| Ageing: | None (as received) |
| Immersion conditions: | 260 °C ± 5 °C, 10 s ± 1 s |
| Depth of immersion: | 10 mm |
| Flux type: | Activated |

After the test, the fuse-link shall not be cracked. Marking shall be readable and colour coding, if used, shall not have changed colour.

The voltage drop is measured as specified in 9.1, and shall not exceed the maximum values specified in Table 1.

NOTE For some designs, it may be necessary to use a less severe test. This should be in accordance with the manufacturer's recommendations, and should be recorded in the test report.

9 Electrical requirements

9.1 Voltage drop

For measurement of voltage drop, see IEC 60127-1.

The voltage drop shall be measured at the points marked U in Figure 2 for through-hole fuse-links and in Figure 3 for surface mount fuse-links, using the test fuse-base shown in Figure 4 (see 7.3).

Values given in Table 1 apply.

9.2 Time/current characteristics

9.2.1 Time/current characteristics at normal ambient temperature

At 1,25 times rated current not less than 1 h (after completing endurance test).

At 2 times rated current not exceeding 2 min.

Pre-arcing time at 10 times rated current according to the following types:

| | |
|----------|--------------------------------|
| Type FF: | less than 0,001 s |
| Type F: | from 0,001 s to 0,01 s |
| Type T: | greater than 0,01 s to 0,1 s |
| Type TT: | greater than 0,100 s to 1,00 s |

9.2.2 Test at elevated temperature

None specified.