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REDLINE VERSION

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

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CONTENTS

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

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60127-4:2005+AMD1:2008+AMD2:2012 CSV. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

This fourth edition cancels and replaces the third edition published in 2005, Amendment 1:2008 and Amendment 2:2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) align to IEC 60127-1:2023, third edition;
b) enhance the rated current of UMFs to 100A and provide the corresponding maximum voltage drop and maximum sustained dissipation;
c) modify the figures;
d) update the normative references to the latest version.

This International Standard is to be used in conjunction with IEC 60127-1:2023

The text of this International Standard is based on the following documents:

Draft	Report on voting
32C/676/FDIS	32C/680/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60127 series, published under the general title *Miniature fuses*, can be found on the IEC website.

This document is to be used in conjunction with IEC 60127-1:2023.

This document supplements or modifies the corresponding clauses in IEC 60127-1:2023, so as to convert that publication into the IEC standard: Universal modular fuse-links (UMF) – Through-hole and surface mount types.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

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.~~

According to the wish expressed by the users of miniature fuses, 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.

The new IEC 60127 series is thus subdivided as follows:

IEC 60127, *Miniature fuses (general title)*

IEC 60127-1, *Miniature fuses - Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links*

IEC 60127-2, *Miniature fuses - Part 2: Cartridge fuse-links*

IEC 60127-3, *Miniature fuses - Part 3: Sub-miniature fuse-links*

IEC 60127-4, *Miniature fuses - Part 4: Universal modular fuse-links (UMF) - Through-hole and surface mount types*

IEC 60127-5, *Miniature fuses - Part 5: Guidelines for quality assessment of miniature fuse- links*

IEC 60127-6, *Miniature fuses - Part 6: Fuse-holders for miniature fuse-links*

IEC 60127-7, *Miniature fuses - Part 7: Miniature fuse-links for special applications*

IEC 60127-8, *Miniature fuses - Part 8: Fuse resistors with particular overcurrent protection*

IEC 60127-9, *Miniature fuses - Part 9: Miniature fuse-links for special applications with partial-range breaking capacity*

IEC 60127-10 (withdrawn)

This part of IEC 60127 covers additional requirements, test equipment and standard sheets. The SI system of units is used throughout this standard.

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.

This document 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements 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:~~2008~~2021, *Environmental testing - Part 2-20: Tests - Test ~~T~~ Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21:~~1999~~2021, *Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-58:~~2004~~2015, *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 60068-2-58:2015/AMD1:2017

IEC 60127-1:~~1988~~2023, *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*~~

IEC 60194:2021 (all parts), *Printed boards design, manufacture and assembly - Vocabulary*

IEC 60216-1:2013, *Electrical insulating materials - Thermal endurance properties - Part 1: Ageing procedures and evaluation of test results*

~~[1] There exists a consolidated version (2003).~~

IEC 60664-1:~~1992~~2020, *Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests*[2]
~~Amendment 1 (2000)~~
~~Amendment 2 (2002)~~
IEC 60664-1:2020/AMD1:2025

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 60127-1:2023 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

3.1
through-hole fuse-link
UMF designed for soldering directly into a printed wiring board, with insertion of its terminations/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 terminations/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 1 to entry: Further definitions which may be useful in the application of surface mount fuse-links may be found in IEC 60115-1 and IEC 60115-8[3].

4 General requirements

Clause 4 of IEC 60127-1:2023 applies.

5 Standard ratings

5.1 Rated voltage

See Clause 10 standard sheets.

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[2] ~~There exists a consolidated version (2002).~~

[3] ~~This standard has been withdrawn.~~

5.2 Rated current

See ~~Table 1~~ Table 2 for preferred rated ratings.

5.3 Rated breaking capacity

See Clause 10 standard sheets.

6 Marking

In addition to the requirements of Clause 6 of IEC 60127-1:2023, 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 (see Annex B for more details).

g) The letters AC before the voltage for devices designed solely for alternating current application.

6.4 Colour coding for universal modular fuse-links

~~Under consideration.~~

Not applicable.

6.5 Space limitations for markings

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 of IEC 60127-1:2023, the following criteria shall be observed:

7.2 Atmospheric conditions for testing

7.2.1 *Addition:*

For testing of individual fuse ratings according to standard sheets 1 and 2, see ~~Table 2~~ Table 3. For fuse-links designed and rated both for AC and DC, the number of fuse-links required is 63. For fuse-links designed only for AC, the number of fuse-links required is 48. There are nine spares (fuse-link numbers 10, 11, 12, .37, 38, 39, 52, 53 and 54).

For the maximum ~~ampere~~ current rating of a homogeneous series according to standard sheets 1 and 2, see ~~Table 3~~ Table 4. For fuse-links designed and rated both for AC and DC, the number of fuse-links required is 53. For fuse-links designed only for AC, the number of fuse-links required is 48. There are 19 spares (fuse-link numbers 19, 20, 21, 32 to 41, 45, 46, 47, 51, 52 and 53).

For the minimum ~~ampere~~ current rating of a homogeneous series according to standard sheets 1 and 2, see ~~Table 4~~ Table 5. For fuse-links designed and rated both for AC and DC, the number of fuse links required is 38. For fuse-links designed only for AC, the number of fuse-links required is 33. There are 16 spares (fuse-link numbers 10, 11, 12, 23 to 32, 36, 37 and 38).

7.~~3~~4 Fuse-bases for tests

Replacement:

7.~~3~~4.1 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 for rated currents above 5 A)~~ in accordance with Table 6.

  The manufacturer shall declare the PCB (printed circuit board) parameters listed in Table 6 and provide assembled PCBs for the tests.

This test board shall then be mounted on the test fuse-base (Figure 4 or Figure 5). 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 for rated currents below and including 10A, and the cross-sectional area of the wire shall be approximately 1 mm^2.

For rated currents above 10 A the length of each conductor shall be at least 500 mm, and the cross-sectional area of the wire shall be according to Table 1.

Table 1 – Cross-sectional area of copper conductors

Rated current A	**Cross-sectional area of copper conductors** mm^2
Up to and including 10	1
More than 10, and up to and including 16	2,5
More than 16, and up to and including 25	4
More than 25, and up to and including 35	6
More than 35, and up to and including 60	35
More than 60, and up to and including 100	50

7.~~3~~4.2 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/leads.

7.~~3~~4.3 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 A, as shown in Figure 3. See Annex A for guidance. If it is impracticable to maintain the distance between voltage drop connections, then test board B may be used.

8 Dimensions and construction

Replacement:

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/leads spacing is checked. Through-hole fuse-links are only limited to 20 A. The termination shall pass through a 1 mm in diameter 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/leads 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 Ua_1, applied force 10 N;

– thrust test Ua_2, applied force 2 N;

– bending test Ub, applied force 5 N, number of bends: 1.

The sample size is two ~~fuses~~ fuse-links for each test. After testing, the terminations/leads 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~~ Table 2. Bending test Ub is omitted if the terminations/leads are less than 5 mm in length.

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~~ Figure 6. 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/leads 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~~ Table 2.

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 document.

8.5 Soldered joints

8.5 of IEC 60127-1:2023 is applicable.

8.6 Solderability of terminations

For the tests described in 8.6.1 to 8.6.2, lead-free solder as described in Table 2 of IEC 60068-2-58:2015/AMD1:2017 shall be used in the solder bath.

8.6.1 Through-hole fuse-links

The fuse-links shall be subjected to Test Ta, Method 1: Solder bath, 4.2 of IEC 60068-2-20:~~2008~~2021~~, using Method 1~~, with the following conditions:

Ageing:	None (as received)
Immersion conditions:	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~~2021, Table 1.

8.6.2 Surface mount fuse-links

The fuse-links shall be tested according to ~~6.2~~ Test Td_1, Method 1: Solder bath, 6.5 of IEC 60068-2-58:~~2004~~2015/AMD1:2017, with the following conditions:

Ageing:	None (as received)

Immersion conditions:	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~~2015/AMD1:2017, Table ~~2~~ 3.

8.7 Resistance to soldering heat

8.7.1 Through-hole fuse-links

The fuse-links shall be subjected to Test Tb, Method 1: Solder bath, 5.2 of IEC 60068-2-20:~~2008~~2021~~, Method 1~~, 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~~ Table 2.

8.7.2 Surface mount fuse-links

The fuse-links shall be tested according to ~~6.2~~ Test Td2, Method 1: Solder bath, 7.5 of IEC 60068-2-58:2015/AMD1:2017, 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~~ Table 2.

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

9 Electrical requirements

In addition to the requirements of Clause 9 of IEC 60127-1:2023, the following criteria shall be observed:

9.1 Voltage drop

For measurement of voltage drop, 9.1 of IEC 60127-1:2023 is applicable with the following addition:

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 and Figure 5 (see 7.3).

Values given in ~~Table 1~~ Table 2 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.

9.2.3 Test procedure

9.2.3 of IEC 60127-1:2023 is applicable.

9.2.4 Presentation of results

9.2.4 of IEC 60127-1:2023 is applicable.

9.3 Breaking capacity

9.3.1 General

9.3.1 of IEC 60127-1:2023 is applicable.

9.3.~~1~~2 Operating conditions

9.3.2 of IEC 60127-1:2023 is applicable with the following addition:

In the case of fuse-links in which any component is organic (such as with a moulded body), the recovery voltage shall be maintained for 5 min after the fuse-link has operated.

Typical test circuits for AC and DC are given in ~~Figure 6~~ Figure 7.

For low-breaking capacity fuse-links, the power factor of the AC test circuit shall be greater than 0,95. To obtain this result, the circuit current shall be adjusted by the use of resistors of negligible inductance.