

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures –  
Part 9: Equipment for insulation fault location in IT systems**

**Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V C.A et 1 500 V C.C – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection –  
Partie 9: Dispositifs de localisation de défauts d'isolement pour réseaux IT**



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

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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**ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –****Part 9: Equipment for insulation fault location in IT systems**

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IEC 61557-9 has been prepared by IEC technical committee 85: Measuring equipment for electrical and electromagnetic quantities. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

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

- a) new terms and definitions on maximum admissible locating AC and DC currents and voltages;
- b) the requirements on locating current and locating voltage have been revised;

- c) performance requirements have been added;
- d) the test requirements for locating current and locating voltage have been revised;
- e) the structure of this document has been adapted to that of IEC 61557-1:2019;
- f) the limit values under Clause A.2 were adapted to fit the changed test methods in 6.2.3.

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

Draft	Report on voting
85/896/FDIS	85/901/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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts in the IEC 61557 series, published under the general title *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures*, can be found on the IEC website.

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](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

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# ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

## Part 9: Equipment for insulation fault location in IT systems

### 1 Scope

This part of IEC 61557 specifies the requirements for the insulation fault location system (IFLS) that localizes insulation faults in any part of the system in unearthed IT AC systems and unearthed IT AC systems with galvanically connected DC circuits having nominal voltages up to 1 000 V AC, as well as in unearthed IT DC systems with voltages up to 1 500 V DC, independent of the measuring principle.

NOTE 1 IT systems are described in IEC 60364-4-41. Further information on insulation fault location can be found in the following International Standards: IEC 60364-4-41:2005, 411.6 and IEC 60364-4-41:2005/AMD1:2017, 411.6, and IEC 60364-5-53:2019/AMD1:2020, 531.3.

NOTE 2 This document covers both passive IFLS and active IFLS. Active IFLS can be used in de-energised systems.

NOTE 3 This document does not cover IMD complying with IEC 61557-8.

### 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 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60364-7-710:2021, *Low-voltage electrical installations – Part 7-710: Requirements for special installations or locations – Medical locations*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-1:2018, *Classification of environmental conditions – Part 3-1: Classification of groups of environmental parameters and their severities – Storage*

IEC 60721-3-2:2018, *Classification of environmental conditions – Part 3-2: Classification of groups of environmental parameters and their severities – Transportation and handling*

IEC 60721-3-3:2019, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations*

IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

IEC 60947-5-4:2002, *Low-voltage switchgear and controlgear – Part 5-4: Control circuit devices and switching elements – Method of assessing the performance of low-energy contacts – Special tests*

IEC 60947-5-4:2002/AMD1:2019

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61010-1:2010/AMD1:2016

IEC 61010-2-030, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits*

IEC 61010-031, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated probe assemblies for electrical test and measurement*

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61326-1:2020, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61326-2-2, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-2: Particular requirements – Test configurations, operational conditions and performance criteria for portable testing, measuring and monitoring equipment used in low-voltage distribution systems*

IEC 61326-2-4, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-4: Particular requirements – Test configurations, operational conditions and performance criteria for insulation monitoring devices according to IEC 61557-8 and for equipment for insulation fault location according to IEC 61557-9*

IEC 61557-1:2019, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

IEC 61557-8:2014, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

IEC 61810-2:2017, *Electromechanical elementary relays – Part 2: Reliability*

### 3 Terms, definitions and abbreviated terms

#### 3.1 Terms, definitions, symbols and units

For the purposes of this document, the terms and definitions given in IEC 61557-1, IEC 61557-8 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>

##### 3.1.1

#### **insulation fault location system**

##### **IFLS**

device, equipment or combination of devices used for insulation fault location in IT systems

Note 1 to entry: IFLS functionality can be used in addition to insulation monitoring functionality. It injects a locating current between the electrical system and earth and locates the insulation fault.

##### 3.1.2

#### **locating current**

##### $I_L$

current that is injected by the locating current injector during the location process

Note 1 to entry: The locating current can be generated by:

- an active locating source with a sufficiently large internal impedance using an independent voltage source different from the system to be monitored, or
- a passive locating current source driven directly from the system to be monitored.

##### 3.1.3

#### **locating voltage**

##### $U_L$

voltage present at the measuring terminals of the locating current injector during the measurement when the device has an active locating source

Note 1 to entry: In a fault-free, de-energized system, this represents the voltage present between the terminals of the locating device to the system to be monitored and the terminals for the connection to the PE conductor.

##### 3.1.4

#### **response sensitivity**

value of the locating current or insulation resistance at which the insulation fault locator responds under specified conditions

Note 1 to entry: Response sensitivity may either be a fixed threshold or a response curve.

##### 3.1.5

#### **insulation fault locator**

##### **IFL**

device or part of a device, that has the function to locate the insulation fault

##### 3.1.6

#### **locating current sensor**

##### **LCS**

sensor for the detection of the locating current used for the location of the insulation fault

**3.1.7****locating current injector****LCI**

device or part of a device, that has the function to inject the locating current into the IT system in order to locate the insulation fault

**3.1.8****passive locating current injector****PLCI**

locating current injector that generates the locating current directly from the system to be monitored

**3.1.9****active locating current injector****ALCI**

locating current injector that generates the locating current from a locating voltage source which is different from the system to be monitored

**3.1.10****insulation fault location system in medical location****MED-IFLS**

specific insulation fault location equipment dedicated to locating insulation faults in IT systems of group 2 medical locations

Note 1 to entry: The MED-IFLS is described in IEC 61557-9:2023, Annex A.

Note 2 to entry: Medical locations are defined in IEC 60364-7-710.

**3.1.11****response time** $t_{al}$ 

time required by insulation fault location equipment to respond under specified performance conditions

[IEC 61557-9:2023](https://standards.iteh.ai/catalog/standards/iec/61557-9-2023)

Note 1 to entry: The requirements for the condition can be found in IEC 61557-9:2023, A.2.2.4.

**3.1.12****group 2 medical location**

medical location where ME equipment or ME systems are intended to be used intrusively, externally or invasively to any part of the patient and where discontinuity of the electrical supply, such as protection against electric shock, represents a risk to the safety of the patient

[SOURCE: IEC 60364-7-710:2021, 710.3.9, modified – "medical location" added to the source term "group 2".]

**3.1.13****portable equipment for insulation fault location****PIFL**

equipment used for temporary insulation fault location in IT systems instead of, or in addition to, fixed installed equipment for insulation fault location

Note 1 to entry: The requirements for PIFL are defined in Annex B of this document.

**3.1.14  
system leakage capacitance for IFLS** $C_{el}$ 

maximum value of the total capacitance to earth of the system to be monitored including any connected appliances up to which the IFLS can work as specified

Note 1 to entry: The system leakage capacitance is the sum of the leakage capacitances of all phase conductors including the neutral conductor to earth.

**3.1.15  
maximum admissible locating AC current** $I_{\text{limit AC}}$ 

maximum peak value of the locating current above a pre-set level of frequency

Note 1 to entry: The frequency and current levels are derived from IEC 61140.

**3.1.16  
maximum admissible locating DC current** $I_{\text{limit DC}}$ 

maximum peak value of the locating current below a pre-set level of frequency

Note 1 to entry: The frequency and current levels are derived from IEC 61140.

**3.1.17  
maximum admissible locating AC voltage** $U_{\text{limit AC}}$ 

maximum peak value of the locating voltage above a pre-set level of frequency

Note 1 to entry: The frequency and voltage levels are derived from IEC 61140.

**3.1.18  
maximum admissible locating DC voltage** $U_{\text{limit DC}}$ 

maximum peak value of the locating voltage below a pre-set level of frequency

Note 1 to entry: The frequency and voltage levels are derived from IEC 61140.

**3.1.19  
injection resistance** $R_i$ 

resistance of the locating current injector between the injection terminal and the earth terminal

**3.1.20  
injection impedance** $Z_i$ 

total impedance of the locating current injector between the injection terminal and the earth terminal, measured at the nominal frequency

**3.1.21  
symmetrical insulation fault**

defect in the insulation of an electric installation or equipment creating a resistive path to earth having approximately the same resistance from all phase conductors to earth

**3.1.22  
asymmetrical insulation fault**

defect in the insulation of an electric installation or equipment creating a resistive path to earth having different resistances from all phase conductors to earth

### 3.2 Abbreviated terms and symbols

The abbreviated terms and symbols listed in Table 1 apply to this document.

**Table 1 – Abbreviated terms and symbols**

Abbreviated term or symbol	Explanation
$C_{Ld}$	System leakage capacitance downstream of the locating current sensor
$C_{Lu}$	System leakage capacitance upstream of the locating current sensor
$C_{el}$	System leakage capacitance for IFLS
EMC	Electromagnetic compatibility
FE	Functional earth terminal
$g_n$	Standard acceleration of free fall
IFL	Insulation fault locator
IFLS	Insulation fault location system
$I_L$	Locating current
IMD	Insulation monitoring device
IP	Degree of protection of enclosure
LCI	Locating current injector
LCS	Locating current sensor
LLW	Local location warning
PE	Protective earth conductor
PIFL	Portable equipment for insulation fault location
PLCI	Passive locating current injector
ALCI	Active locating current injector
PLCS	Portable locating current sensor
$Q$	Quality factor
$R_F$	Insulation resistance
RLW	Remote location warning
RMS	Root-mean-square value, effective value
T	Transformer in an IT system
$I_{limit AC}$	Maximum admissible locating AC current
$I_{limit DC}$	Maximum admissible locating DC current
$U_{limit AC}$	Maximum admissible locating AC voltage
$U_{limit DC}$	Maximum admissible locating DC voltage
MED-IFLS	Insulation fault location system in medical locations
$t_{al}$	Response time
RLW	Remote location warning
$\mu F$	Microfarad The farad (symbol: F) is the SI derived unit of electrical capacitance. 1 $\mu F$ (microfarad, one millionth ( $10^{-6}$ ) of a farad)
$U$	Formula symbol for a voltage in the SI unit volt
$U_1$	Calculated voltage for the locating voltage assessment
$U_B$	Measured voltage for the locating current assessment