

# INTERNATIONAL STANDARD



**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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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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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**A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.**

**This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.**

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 ~~amongst other literature. Additional data for a selection of devices in other standards should be noted.~~ **1** 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 60364-5-53:2004/2019/AMD1:2020, **2** 531.3.

NOTE 2 This document covers both passive IFLS and active IFLS. Active IFLS can be used in de-energised systems. **3**

NOTE 3 This document does not cover IMD complying with IEC 61557-8. **4**

### 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 60364-7-710:2002/2021, *Low-voltage electrical installations ~~of buildings~~ – Part 7-710: Requirements for special installations or locations – Medical locations*

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

~~IEC 60664 (all parts): Insulation coordination for equipment within low-voltage systems~~

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 ~~and~~ 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 ~~and test~~*

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*

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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:~~2007~~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*

~~CISPR 11, Industrial, scientific and medical equipment – Radio frequency disturbance characteristics – Limits and methods of measurement~~

### 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; ~~where the insulation fault location system is used in addition to an insulation monitoring device and is used to locate insulation faults~~ **5**

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. **5**

##### 3.1.2

#### locating current

##### $I_L$

~~r.m.s. value of the~~ **6** 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 independent locating voltage source, or~~
- ~~— an independent locating current source, or~~
- ~~— it can be driven directly from the system to be monitored~~
- 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. **7**

##### 3.1.3

#### locating voltage

##### $U_L$

~~r.m.s. value of the~~ **8** voltage present at the measuring terminals of the locating current injector during the measurement when the device has an ~~independent active~~ **9** ~~locating voltage or current~~ 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 ~~evaluating~~ locating current or insulation resistance at which the ~~evaluator~~ insulation fault locator responds under specified conditions **10**

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

##### 3.1.5

#### insulation fault locator

##### IFL

device or part of a device ~~for the location of~~, that has the function to locate **11** 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 ~~independent~~ different **12** from the system to be monitored

**3.1.10**

~~equipment for~~ **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 ~~complying with Annex A~~

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. **13**

**3.1.11**

**response time**

$t_{al}$

time required by insulation fault location equipment to respond under ~~the conditions of A.2.2.4~~ specified performance conditions

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 locations, where applied parts are intended to be used in applications such as intracardiac procedures, operating theatres and vital treatment, where discontinuity (failure) of the supply can cause danger to life~~

~~Note 1 to entry: —An intracardiac procedure is a procedure, whereby an electrical conductor is placed within the cardiac zone of a patient or is likely to come into contact with the heart, such conductor being accessible outside the patient's body. In this context, an electrical conductor includes insulated wires, such as cardiac pacing electrodes or intracardiac ECG electrodes, or insulated tubes filled with conducting fluids.~~

~~[SOURCE: IEC 60364-7-710:2002, 710.3.7]~~

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".] **14 15**

**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 ~~insulation fault location equipment~~ 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. **16**

**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. **17**

**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. **17**

**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. **18**

**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. **18**

**3.1.19****injection resistance** $R_i$ 

resistance of the locating current injector between the injection terminal and the earth terminal **19**

**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 **19**

**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 **20**

**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 **20**

**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	Term Explanation	Clause (in this part 9)	Other referenced standard
$C_{Ld}$	System leakage capacitance downstream of the <del>evaluating</del> locating current sensor	Figure C-2	
$C_{Lu}$	System leakage capacitance upstream of the <del>evaluating</del> locating current sensor	Figure C-2	
$C_{el}$	System leakage capacitance for IFLS		
EMC	Electromagnetic compatibility	4-5	IEC 60050-161:1990, 161-01-07
FE	Functional earth terminal	4-6-3	IEC 61010-1
$g_n$	Standard acceleration of free fall		
IFL	Insulation fault locator	3-1-5, C-1	
IFLS	Insulation fault location system	3-1-1, Annex C	
$I_L$	Locating current	4-4-2, C-1	
IMD	Insulation monitoring device	Annex C	IEC 61557-8, 3-1-14
IP	Degree of protection of enclosure	4-8-3	IEC 60050-246:2008, 426-04-02
LCI	Locating current injector	3-1-7, C-2	
LCS	Locating current sensor	3-1-6, C-1	
LLW	Local location warning	4-2-2	
PE	Protective earth conductor	4-6-3	IEC 60050-195:1998, 195-02-09
PIFL	Portable equipment for insulation fault location	Annex C	
PLCI	Passive locating current injector		
ALCI	Active locating current injector		
PLCS	Portable locating current sensor	B-2-2-1	
$Q$	Quality factor		
$R_F$	Insulation resistance	6-2-2, C-2	IEC 61557-8, 3-1-2
RLW	Remote location warning	4-2-3	
RMS	Root-mean-square value, effective value		
T	Transformer in an IT system	Annex C	