IEC 61557-9

Edition 3.0 2014-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – 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

IEC 61557-9:2014-12(en-fr)

IEC Central Office
3, rue de Varembé
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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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

FOREWORD

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

This third edition cancels and replaces the second edition published in 2009. This edition constitutes a technical revision.

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

a) the scope, normative references, terms and definitions have been complemented;
b) abbreviations are listed and explained;
c) requirements, marking and operating instructions have been revised;
d) mandatory and optional functions have been defined and their terminology has been adapted to IEC 61557-15;

e) mechanical requirements have been added;

f) Clause 6 “Tests” has been revised;

g) new Tables have been added.

The text of this standard is based on the following documents:

FDIS	Report on voting
85/486/FDIS	85/503/RVD

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

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

This part of IEC 61557 shall be used in conjunction with Part 1.

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 a.c. and 1 500 V d.c. – 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
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- amended.

The contents of the corrigenda 1 (May 2016) and 2 (January 2017) have been included in this copy.

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) which localizes insulation faults in any part of the system in unearthed IT a.c. systems and unearthed IT a.c. systems with galvanically connected d.c. circuits having nominal voltages up to 1 000 V a.c., as well as in unearthed IT d.c. systems with voltages up to 1 500 V d.c., independent of the measuring principle.

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.

NOTE Further information on insulation fault location can be found in the following standards: IEC 60364-4-41:2005, 411.6, and IEC 60364-5-53:2001, 531.3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

IEC 60364-7-710:2002, *Electrical installations of buildings – Part 7-710: Requirements for special installations or locations – Medical locations*

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

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

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

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

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

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

IEC 61010-2-030, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for 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 probe assemblies for 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 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 test, 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, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

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

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

3 Terms, definitions and abbreviations

3.1 Terms, definitions, symbols and units

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

3.1.1
insulation fault location system
IFLS
device 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

Note 1 to entry: An IFLS injects a locating current between the electrical system and earth.

3.1.2
locating current
I_L
r.m.s. value of the current that is injected by the locating current injector during the location process. 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

3.1.3
locating voltage
U_L
r.m.s. value of the voltage present at the measuring terminals of the locating current injector during the measurement when the device has an independent 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 current or insulation resistance at which the evaluator responds under specified conditions

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

3.1.5
insulation fault locator
device or part of a device for the location of the insulation fault

3.1.6
locating current sensor
sensor for the detection of the locating current used for the location of the insulation fault

3.1.7
locating current injector
device or part of a device, which function it is to inject the locating current in the IT system in order to locate the insulation fault

3.1.8
passive locating current injector
locating current injector that generates the locating current directly from the system to be monitored

3.1.9
active locating current injector
locating current injector that generates the locating current from a locating voltage source which is independent from the system to be monitored

3.1.10
equipment for insulation fault location in medical locations
specific insulation fault location equipment dedicated to locating insulations faults in IT systems of group 2 medical locations complying with Annex A

3.1.11
response time
t_{al}
time required by insulation fault location equipment to respond under the conditions of A.2.2.4

3.1.12
group 2 medical locations
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]

3.1.13
portable equipment for insulation fault location
equipment used for temporary insulation fault location in IT systems instead of, or additionally, to fixed installed insulation fault location equipment

3.2 Abbreviations

For the purposes of this document, the terms and abbreviations given in Table 1 apply.

Table 1 – Abbreviations

Abbreviation	Term	Clause (in this part 9)	Other referenced standard
C_{Ld}	System leakage capacitance downstream of the evaluating current sensor	Figure C.2	
C_{Lu}	System leakage capacitance upstream of the evaluating current sensor	Figure C.2	
EMC	Electromagnetic Compatibility	4.5	IEC 60050-161:1990, 161-01-07
FE	Functional Earth	4.6.3	IEC 61010-1
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	4.6.3	IEC 60050-195:1998, 195-02-09
PIFL	Portable Insulation Fault Locator	Annex C	
PLCS	Portable Locating Current Sensor	B.2.2.1	
R_F	Insulation resistance	6.2.2, C.2	IEC 61557-8, 3.1.2
RLW	Remote Location Warning	4.2.3	
T	Transformer in an IT system	Annex C	

4 Requirements

4.1 General requirements

In addition to the requirements of Clause 4 of IEC 61557-1:2007, the requirements of Clause 4 apply.

Equipment for insulation fault location shall be capable of localizing symmetrical as well as asymmetrical insulation faults in an IT system and to give a location warning, if the insulation resistance in a part of the installation falls below the response sensitivity.

If equipment for insulation fault location has a self-test function, the self-test shall not produce an insulation fault to earth.

NOTE 1 See also IEC 61557-8.

NOTE 2 Insulation monitoring devices (IMDs) can be deactivated during the location process.

NOTE 3 Warning indication can be done by a lamp, a buzzer or by any other kind of indication.

NOTE 4 An IFLS can have a self-test function. Checking the response sensitivity is not necessary.

NOTE 5 An IFLS with an active locating current source can also be used for insulation fault location in de-energized systems.

4.2 Mandatory functions provided by an IFLS

4.2.1 Location warning

An IFLS shall contain a visual warning device, which indicates if an insulation fault is detected or allow connection to such a device for the indication of a fault. If externally connectable audible signalling devices are provided, they may be fitted with a resetting facility. In this case, after clearing a fault or resetting the device, the audible signal shall sound if a new fault occurs. The location warning shall be either a local location warning or a remote location warning or both together.

4.2.2 Local location warning (LLW)

This functions aims at issuing a warning signal when the insulation resistance between the system and earth falls below the response sensitivity.

This function will include the localization of an insulation fault in an IT system including symmetrical and asymmetrical insulation faults, an assessment of this fault and a local warning.

A local warning should be made by visual indicators or audible signals generated by the product implementing the function.

NOTE Usually this function is provided by the IFLS.

4.2.3 Remote location warning (RLW)

This functions aims at issuing a remote warning signal if the insulation resistance between the system and earth falls below the response sensitivity.

This function will include the localization of an insulation fault in an IT system including symmetrical and asymmetrical insulation faults, an assessment of this fault and a remote warning.

A relay contact output or an electronic switching output or a data communication can be used to report the warning remotely.

NOTE The warning output could also be used in some applications for switching.

4.3 Optional functions provided by IFLS

4.3.1 Indication of the insulation value

When an IFLS includes means for the indication of the insulation value, the uncertainty of the indicated value shall be stated by the manufacturer.

4.3.2 Performance of the IFLS in case of the interruption of the connection to the locating current sensor (LCS)

If provided an indication if the connection to one or more LCSs is lost in a manner that the location function is not ensured shall be issued.

4.4 Performance requirements

4.4.1 Response sensitivity

An IFLS shall be designed in such a manner that the response sensitivity stated by the manufacturer will be met under the specified system conditions, at a total symmetrical system leakage capacitance of 1 μF upstream the evaluating current sensor (C_{Lu} = 1 μF, C_{Ld} = 0 μF according to Figure C.2).

Information on the influence of the system leakage capacitances higher than 1 μF on the response sensitivity as well as possible interference from the distribution system on the insulation fault location process shall be stated by the manufacturer.

NOTE The system leakage capacitance is the sum of the leakage capacitances of all phase conductors, including the neutral conductor to PE.

4.4.2 Locating current I_L

The maximum locating current I_L shall be limited to 500 mA r.m.s., to ensure that the locating current does not produce touch voltages above the conventional voltage limit (50 V a.c., 120 V d.c.) under the first fault in the distribution system. The locating current shall not increase above 500 mA r.m.s., under foreseeable component failures in the locating current injector (LCI). When the locating current is adjustable, unintentional changes of the setting shall be prevented by suitable means.

If an active locating voltage U_L above 50 V a.c. or 120 V d.c. is used the locating current shall not exceed 3,5 mA a.c. (r.m.s.) or 10 mA d.c. through a pure resistance of 2 kΩ.

If an active locating voltage U_L equal or below 50 V a.c. or 120 V d.c. is used, the locating current shall not exceed 500 mA r.m.s. through a shunt.

4.4.3 Locating voltage U_L

If an active locating voltage or locating current is used, the locating voltage U_L shall be equal or below 50 V a.c. or 120 V d.c. (see IEC 60364-4-41) under no load conditions.

4.5 Electromagnetic compatibility (EMC)

An IFLS shall comply with the EMC requirements in accordance with IEC 61326-2-4.

4.6 Safety requirements

4.6.1 General

In addition to the safety requirements of IEC 61010-1 and IEC 61010-2-030 the following safety requirements apply.

4.6.2 Clearances and creepage distances

An IFLS shall have minimum clearances and creepage distances in accordance with IEC 61010-1 and IEC 61010-2-030.

Clearances and creepage distances for fixed installed equipment according to Table 3 can be dimensioned in accordance with IEC 60664 series.

Clearances and creepage distances shall be selected for:

– overvoltage or measuring category III or II, depending on the overvoltage or measuring category in the system to be monitored;

– pollution degree 2.

NOTE Pollution degree 3 can be used for accessible parts on the outside of the housing.

A division into circuits with different nominal insulation voltages is permissible in device combinations for example for IT systems with nominal voltages U_n higher than 1 000 V a.c. and 1 500 V d.c., when the electrical connection is made via resistive, capacitive or inductive voltage dividers and if, in the case of a fault, the occurrence of inadmissibly high touch voltages or inadmissibly high currents to earth are prevented by circuit design features. Such circuit design features (see IEC 61140) can be, for example, additionally provided in the form of reliable voltage dividers or a duplication of the resistors (protective impedance) in the voltage divider.

4.6.3 Protection class and earth connection of the IFLS

Contrary to IEC 61557-1, the PE connection of an IFLS (LCI) is a measuring connection and shall be treated as functional earth connection (FE). If the IFLS has accessible parts which are earthed for protective purposes, these connections shall be treated as protective earth connections (PE).

4.7 Climatic environmental conditions

The IFLS shall operate at least under the following climatic conditions:

– operation: class 3K5 according to IEC 60721-3-3, -5 °C to +45 °C, except condensation and formation of ice,

– transport: class 2K3 according to IEC 60721-3-2, -25 °C to +70 °C,

– storage: class 1K4 according to IEC 60721-3-1, -25 °C to +55 °C.

4.8 Mechanical requirements

4.8.1 General

Instead of the requirements of 4.10 of IEC 61557-1:2007 the requirements of 4.8.2 and 4.8.3 apply.

4.8.2 Product mechanical robustness

Requirements of Table 2 shall be tested as type-tests.