

INTERNATIONAL STANDARD

IEC
255-22-4

First edition
1992-03

Electrical relays

Part 22:

Electrical disturbance tests for measuring relays
and protection equipment

Section 4: Fast transient disturbance test

Relais électriques

Partie 22:

*Essais d'influence électrique
concernant les relais de mesure et dispositifs
de protection*

*Section 4: Essai de susceptibilité aux
perturbations transitoires rapides*



Reference number
IEC 255-22-4: 1992

Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

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For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams*.

* See web site address on title page.

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CONTENTS

	Page
FOREWORD	5
Clause	
1 Scope and object	7
2 Normative references	7
3 Definitions	8
4 Fast transient disturbance test	8
4.1 Test severity classes	8
4.2 Test generator	8
4.3 Coupling/decoupling network	8
4.4 Capacitive coupling clamp	8
4.5 Test procedure	9
4.6 Criteria for acceptance	10
Figures	11
Annexes	
A Examples of relay settings and values of input energizing quantities that should determine the operate and non-operate conditions during the fast transient disturbance test	13
B Explanatory notes on the fast transient disturbance test for measuring relays and protection equipment	16

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL RELAYS

Part 22: Electrical disturbance tests for measuring relays
and protection equipment

Section 4: Fast transient disturbance test

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

This section of International Standard IEC 255-22 has been prepared by Sub-Committee 41B: Measuring relays and protection equipment, of IEC Technical Committee No. 41: Electrical relays.

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

DIS	Report on Voting
41B(CO)53	41B(CO)55

Full information on the voting for the approval of this section can be found in the Voting Report indicated in the above table.

Annexes A and B form an integral part of this section.

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ELECTRICAL RELAYS

Part 22: Electrical disturbance tests for measuring relays and protection equipment

Section 4: Fast transient disturbance test

1 Scope and object

This section of IEC 255-22 is based on IEC 801-4 and refers to that publication where applicable.

This section specifies general requirements for fast transient disturbance tests of static measuring relays and protection equipment with or without output contacts.

The object of the test is to confirm that the equipment under test will not malfunction when energized and subjected to fast transients such as those originating from interruption of inductive loads, relay contact bounce, etc. The requirements are applicable only to relays and protection equipment in new condition.

The test specified in this section is a type test.

NOTE - The test may also, where appropriate, be applied to electromechanical relays, for example high speed or high sensitivity electromechanical relays.

The object of this section is to state:

- definitions of terms used;
- standard test severity classes;
- test conditions;
- test procedure;
- criteria for acceptance.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 255-22. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 255-22 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50: *International Electrotechnical Vocabulary (IEV)*.

IEC 255-6: 1988, *Electrical relays – Part 6: Measuring relays and protection equipment*.

IEC 801-4: 1988, *Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4: Electrical fast transient/burst requirements*.

3 Definitions

For definitions of general terms, reference should be made to the International Electrotechnical Vocabulary (IEV)[IEC 50]. For special terms used, reference is made to clause 4 of IEC 801-4.

4 Fast transient disturbance test

4.1 Test severity classes

To cover different environmental conditions, this section of IEC 255-22 includes different severity classes.

General guidance for the selection of a severity class is given in annex B.

The test severity class shall be chosen from the following table. In this section, the severity is expressed as the open circuit output voltage of the test generator.

Class	Test voltage
0	-
I	0,5 kV ± 10 %
II	1 kV ± 10 %
III	2 kV ± 10 %
IV	4 kV ± 10 %

Class III is the preferred class for measuring relays and protection equipment for normal use in power plants, substations and industrial plants.

A relay or protection equipment may have different test severity classes for different input and output circuits.

4.2 Test generator

The fast transient generator is defined in 6.1 of IEC 801-4.

4.3 Coupling/decoupling network

The application of the fast transient test voltage to the equipment under test via coupling/decoupling networks, as defined in 6.2 of IEC 801-4, is the preferred test method. The test voltage shall be applied in common mode to all input and output circuits of the relay or protection equipment, unless otherwise specified by the manufacturer (see 4.4 below).

4.4 Capacitive coupling clamp

For the application of the fast transient test voltage to circuits where a direct connection to the terminals is not possible, or where the insertion of a coupling/decoupling network itself would upset the operation of the equipment under test, a capacitive coupling clamp, as defined in 6.3 of IEC 801-4, shall be used.

NOTE - An example of such an application is where the fast transient test voltage would be applied to a connection between separate units belonging to the same protection equipment or system.

4.5 Test procedure

The test shall be carried out with the equipment under the reference conditions stated in the applicable standard (e.g. IEC 255-6).

The tests shall be carried out with the following values of energizing quantities (auxiliary and input) and loading applied to the appropriate circuits (for examples, see annex A):

- auxiliary energizing quantity(ies): rated value(s);
- input energizing quantity(ies): value(s) equal to the operating value adjusted both above and below by an amount equal to the claimed variation due to the disturbance voltage, or rated values where appropriate (e.g. frequency relays);
- output circuit loading: circuit characteristics as specified by the manufacturer.

The equipment shall be tested in as close to installed conditions as possible. The wiring shall be consistent with the manufacturer's recommended procedures, and the equipment shall be tested in its case. When there are no recommendations given by the manufacturer, all parts to be earthed shall be earthed with copper straps of at least 20 mm width.

A ground reference plane shall be used to get reproducible conditions regarding the capacitive coupling. The plane shall consist of a metallic sheet with conductivity of at least that of aluminium, and with at least 0,3 mm thickness and a minimum of 1 m² size. The size is also determined by the fact that the ground reference plane shall project beyond the equipment under test by at least 0,1 m on all sides. The ground reference plane shall be connected to the earthing system of the test room.

The equipment shall be placed on the ground reference plane, but distanced from it by means of at least 0,1 m thick insulating supports. The distance to walls and metallic structures shall be at least 1 m.

Cables interconnecting the various parts of the equipment under test shall be kept at a distance of at least 0,1 m from the ground plane.

The test voltage shall be applied in common mode, and the effect checked, to one circuit at a time and with a test duration of at least 1 min for each polarity.

For relays with an operating time greater than 1 min, it is recommended that the test is carried out with a minimum time setting. In such cases, the period of application of the disturbing signal may be extended by agreement between the manufacturer and the user to cover the minimum time.

The variations due to fast transient tests shall be declared by the manufacturer.

4.5.1 Application of fast transient test voltage via coupling/decoupling network

An example of the test set-up for a rack-mounted relay is shown in figure 1.

The length of leads between the fast transient generator and the coupling/decoupling network should be as short as possible; the use of a single assembly for the generator and coupling/decoupling network is preferred. The leads to the relay under test should be no longer than 1 m.

Apart from the circuit under test, all other circuits shall be arranged to provide a high impedance path to earth for the fast transient. This may be provided by open circuits (where the circuit is not subject to supply or monitoring) or leads longer than 2 m. Where necessary for the supply or monitoring equipment, decoupling circuits may be added in the leads, connected as shown in figure 1.

4.5.2 *Application of the fast transient voltage via capacitive coupling clamp*

An example of the test set-up for an equipment in a cubicle is shown in figure 2.

The circuit under test shall be connected, using the type of cable and method of termination and connections recommended by the manufacturer. The cable between the capacitive coupling clamp and the equipment under test shall be no longer than 1 m. The cable shall extend at least 10 m (or the maximum length permitted by the manufacturer if less than 10 m) from the clamp. Excess cable should be loosely coiled, maintaining a distance of at least 0,1 m from any ground plane or metallic structure.

Circuits other than the circuit under test should be connected as specified in 4.5.1.

4.6 *Criteria for acceptance*

When the characteristic quantity is set at a value equal to the claimed variation below the operating value of the characteristic quantity for maximum measuring relays (above for minimum measuring relays), the relay shall not operate during the period of disturbance.

When the characteristic quantity is set at a value equal to the claimed variation above the operating value of the characteristic quantity for maximum measuring relays (below for minimum measuring relays), the relay shall comply with the declared performance specification and shall not disengage during the period of disturbance.

Transient false information given by indicating devices on the equipment under test, such as LEDs, flags, etc., shall be tolerated.

After the tests, the relay or equipment shall still comply with the relevant performance specification.

In addition, for static relays without output contacts, the effectively non-conducting output current (off-state current) in the output circuit shall not exceed the value declared by the manufacturer when measured at 110 % of the rated voltage for that circuit. However, depending on the nature of the output circuits, the manufacturer may declare other criteria which adequately identify changes in the output due to the tests.

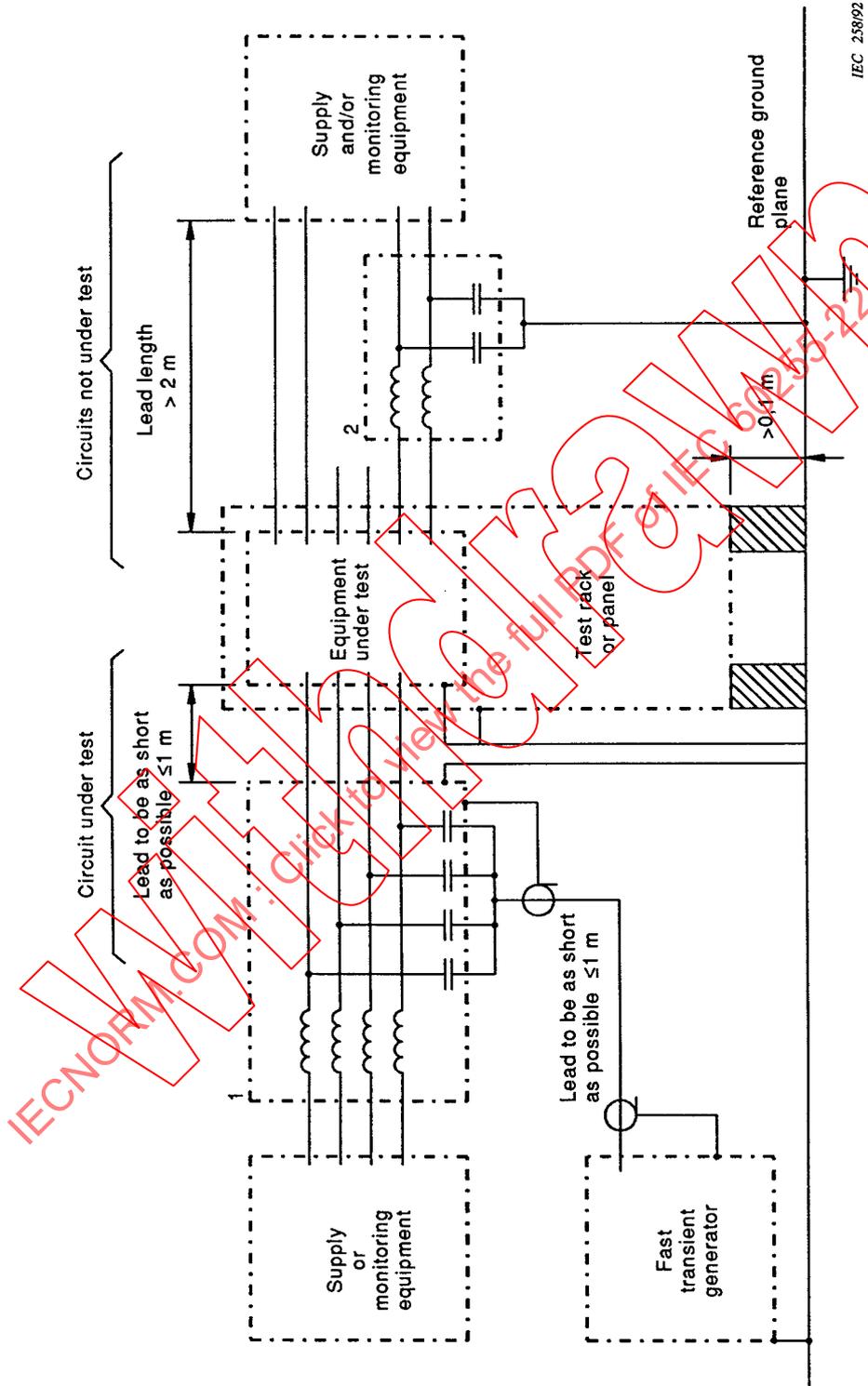


Figure 1 – Example of test set-up for fast transient test via coupling/decoupling network

- 1 = Coupling/decoupling network
- 2 = Filter for decoupling if necessary
- [Hatched box] Insulating support

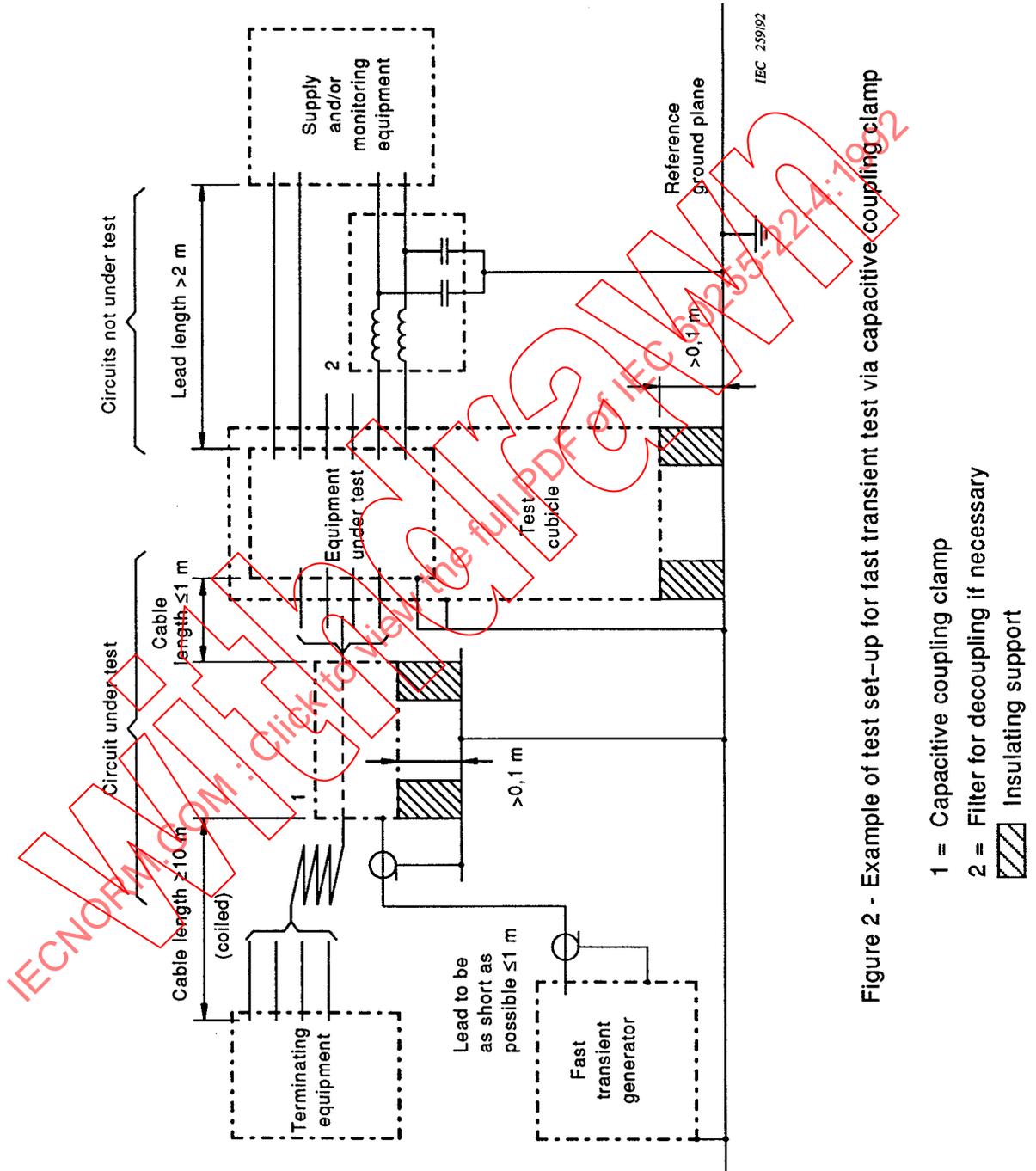


Figure 2 - Example of test set-up for fast transient test via capacitive coupling clamp

- 1 = Capacitive coupling clamp
- 2 = Filter for decoupling if necessary
-  Insulating support

Annex A (normative)

Examples of relay settings and values of input energizing quantities that should determine the operate and non-operate conditions during the fast transient disturbance test

The objective of this test is to confirm that the equipment under test will not maloperate when energized and subjected to fast transient disturbances.

The following examples indicate the method which should be adopted when testing the device.

The test values are declared by the manufacturer.

A.1 Independent time overcurrent relay

A.1.1 Relay specification

- Rated current: 5 A
- Current setting range: 2 – 10 A
- Limiting continuous withstand current: 10 A
- Time setting range: 0,3 – 3 s
- Claimed variation due to fast transient disturbance: 10 % of set current

A.1.2 Test procedure

The following settings for current and time delay should be chosen for the relay:

- Current: 5 A
- Time delay: 0,3 s

A.1.2.1 Energize the relay with a current having a value equal to the actual operating value minus a quantity corresponding to the claimed variation. Apply the test voltage and check that the relay does not operate during the test.

A.1.2.2 Energize the relay with a current having a value equal to the actual operating value plus a quantity corresponding to the claimed variation. Apply the test voltage and check that the relay does not disengage during the test.

A.1.2.3 Energize the relay with a current equal to a specified value lower than the operating value. Apply the test voltage. Check that the relay operates after set time delay during the test, when the current is increased from one specified value to another specified value higher than the operating value.

A.2 Instantaneous undervoltage relay

A.2.1 Relay specification

- Rated voltage: 100 V
- Setting range: 50 – 100 V
- Limited continuous withstand voltage: 120 V
- Claimed variation due to fast transient disturbance: 10 % of set voltage

A.2.2 Test procedure

The following voltage setting should be chosen for the relay:

- Voltage: 100 V

A.2.2.1 Energize the relay with a voltage having a value equal to the actual operating value plus a quantity corresponding to the claimed variation. Apply the test voltage and check that the relay does not operate during the test.

A.2.2.2 Energize the relay with a voltage having a value equal to the actual operating value minus a quantity corresponding to the claimed variation. Apply the test voltage and check that the relay does not disengage during the test.

A.3 Underimpedance (independent time delay) relay

A.3.1 Relay specification

- Rated voltage: 100 V
- Rated current: 5 A
- Limiting continuous withstand current: 10 A
- Limiting continuous withstand voltage: 130 V
- Impedance setting range: 5 – 20 Ω
- Time delay setting range: 0,3 – 3 s
- Claimed variation due to fast transient disturbance: 15 % of set impedance

A.3.2 Test procedure

The following settings for impedance and time delay should be chosen for the relay:

- Impedance: 20 Ω
- Time delay: 0,3 s

A.3.2.1 Energize the relay with a current of 5 A and a voltage with a specified power factor that results in an impedance value equal to the actual operating value plus a quantity corresponding to the claimed variation. Apply the test voltage and check that the relay does not operate during the test.

A.3.2.2 Energize the relay with a current of 5 A and a voltage with a specified power factor that results in an impedance value equal to the actual operating value minus a quantity corresponding to the claimed variation. Apply the test voltage and check that the relay does not disengage during the test.

A.3.2.3 Energize the relay with a current of 5 A and a voltage with a specified power factor that results in a specified impedance value higher than the operating value. Apply the test voltage.

Check that the relay operates after the set time delay during the test, when the energizing voltage is decreased to a value that results in a specified impedance value lower than the operating value.

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