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NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

Audio/video, information and communication technology equipment – Part 3: Safety aspects for DC power transfer through communication cables and ports

Équipements des technologies de l'audio/vidéo, de l'information et de la communication – Partie 3: Aspects liés à la sécurité relatifs au transfert de puissance en courant continu au moyen de câbles et d'accès de communication

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AUDIO/VIDEO, INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT –

Part 3: Safety aspects for DC power transfer through communication cables and ports

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

FDIS	Report on voting
108/695/FDIS	108/696/RVD

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

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

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This International Standard is to be used in conjunction with IEC 62368-1:2014.

It has the status of a group safety publication in accordance with IEC Guide 104.

The subclauses of IEC 62368-1 apply as far as reasonable. Where safety aspects are similar to those of IEC 62368-1, the relevant clause or subclause of IEC 62368-1 is given for reference in a note in the relevant subclause. Where a requirement in IEC 62368-3 refers to a requirement or criterion of IEC 62368-1, a specific reference to IEC 62368-1 is made.

In this standard, the following print types are used:

– requirements proper and normative annexes: in roman type;
– *compliance statements and test specifications: in italic type;*
– notes and other informative matter: in smaller roman type;
– normative conditions within tables: in smaller roman type;
– terms that are defined in Clause 3 and in IEC 62368-1:2014: in **bold type**.

The following differing practices of a less permanent nature exist in the countries indicated below.

– 6.1: other requirements apply regarding power transfer using RFT (US);
– 6.3.3.1: regarding separation from other circuits and parts, see note in 4.1.15 of IEC 62368-1:2014 (Norway);
– A.1: RFT-V systems and requirements (North America).

A list of all parts in the IEC 62368 series, published under the general title *Audio/video, information and communication technology equipment,* 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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AUDIO/VIDEO, INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT –

Part 3: Safety aspects for DC power transfer through communication cables and ports

1 Scope

This part of IEC 62368 applies to equipment intended to supply and receive operating power through communication cables or ports**.** It covers particular requirements for circuits that are designed to transfer DC power from a **power sourcing equipment (PSE)** to a **powered device (PD)**.

The power transfer uses voltages at ES1 or ES2 or in very specific cases voltage levels at ES3.

NOTE 1 ES1 can generally be assumed to have similar limits as non-hazardous voltage definitions used in other standards (for example, SELV, PELV).

NOTE 2 ES2 can generally be assumed to have similar limits for **single fault conditions** as non-hazardous voltage definitions used in other standards.

NOTE 3 PS2 circuits are generally expected to provide less than 100 W to an undefined load under both **normal operating conditions** and **single fault conditions**.

EXAMPLES

- For power transfer using voltages at ES1: USB, PoE, ISDN S0, etc.
- For power transfer using voltages at ES2: analogue telephone during ringing, ISDN U, etc.
- For power transfer using voltages at ES3: power feeding used by communications service providers and utilities communication circuits (for example, RFT circuits, such as line powered HDSLx, SHDSLx, VDSLx and G.fast).

NOTE 4 Any cable provided with a connector defined by an industry standard that permits DC power transfer between equipment is considered a communication cable even if communication does not take place. For example, a USB cable can be used just to recharge a portable device **battery**.

This group safety publication is primarily intended to be used as a product safety standard for the products mentioned in the scope, but shall also be used by technical committees in the preparation of standards for products similar to those mentioned in the scope of this standard, in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications and/or group safety publications in the preparation of its publications.

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 62368-1:2014, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

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ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62368-1:2014 and the following apply.

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

– IEC Electropedia: available at http://www.electropedia.org/

– ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
power sourcing equipment
PSE
equipment, other than dedicated external power supply units intended to supply specific equipment within the scope of IEC 62368-1, supplying DC power to other equipment through communication cables or ports

Note 1 to entry: It should be noted that the IEEE 802.3-2015 standard has a similar but different definition.

Note 2 to entry: This note applies to the French language only.

3.1.2
powered device
PD
equipment supplied DC power by a **PSE** through communication cables or ports

Note 1 to entry: It should be noted that the IEEE 802.3-2015 standard has a similar but different definition.

Note 2 to entry: Some in line devices may just function as a **PSE** to inject power into the cable connecting to **PD** equipment. IEEE 802.3-2015 identifies such devices as Midspan **PSE**.

Note 3 to entry: Some **PD** equipment may also have a **PSE** output to pass on unused power to other **PD** equipment.

Note 4 to entry: This note applies to the French language only.

3.1.3
information and communication technology network
ICT network
metallically terminated transmission medium and its associated equipment and communication cables

Note 1 to entry: The cable consists of two or more conductors intended for communication and/or power transfer between the various pieces of equipment. The equipment may be located within the same or separate structures, buildings or locations, excluding:

– the mains system for supply, transmission and distribution of electrical power, if used as a communication transmission medium;

– a dedicated HBES/BACS network.

Note 2 to entry: This may include twisted pairs, and may include circuits, that are subjected to transients as indicated by ID1 in Table 14 of IEC 62368-1:2014 (assumed to be 1,5 kV).

Note 3 to entry: An **ICT network** may be:

– publicly or privately owned;

– subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

Note 4 to entry: Examples of **ICT networks** are:

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– a public switched telephone network;
– a public data network;
– an Integrated Services Digital Network (ISDN);
– a private network with electrical interface characteristics similar to the above.

Note 5 to entry: For information about circuit voltages and signals which may be present, see Annex B of IEC 62949:2017.

Note 6 to entry: This note applies to the French language only.

3.1.4
RFT circuit
remote feeding telecommunication circuit
remote feeding communication circuit
equipment circuit within the **ICT network** not connected to an AC **mains**, intended to supply or receive DC power at voltages exceeding the limits of ES2, and on which overvoltages may occur

Note 1 to entry: Communication signalling is not required to be present on an **RFT circuit**.

Note 2 to entry: This note applies to the French language only.

3.1.5
RFT-C circuit
RFT circuit which is so designed and protected that under **normal operating conditions** and **single fault conditions**, the currents in the circuit do not exceed defined values

Note 1 to entry: The limit values of current under **normal operating conditions** and **single fault conditions** are specified in 6.3.1.1.

3.1.6
RFT-V circuit
RFT circuit which is so designed and protected that under **normal operating conditions** and **single fault conditions**, the voltages are limited and the **accessible** area of contact is limited

Note 1 to entry: The limit values of voltage under **normal operating conditions** and **single fault conditions** are specified in 6.3.1.2.

3.2 Abbreviated terms

BACS	building automation and control system
HBES	home and building electronic system
HDSL	high bit-rate digital subscriber line
ICT	information and communication technology
ISDN	integrated services digital network
LPS	limited power source
PD	powered device
PoE	power over ethernet
PSE	power sourcing equipment
RFT	remote feeding (tele)communication
SHDSL	symmetric high bit-rate digital subscriber line
USB	universal serial bus
VDSL	very-high-bit-rate digital subscriber line

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4 General requirements

For equipment serving as a **PD** or a **PSE** using voltages at ES1 or ES2, the requirements of Clause 5 apply. However, Clause 5 does not apply to equipment used as **PSE** or **PD** with proprietary connectors or where a proprietary protocol is used to enable the power transfer.

NOTE A proprietary connector is a connector not used in an industry standard and which is under the control of one manufacturer.

For equipment serving as a **PD** or a **PSE** using RFT, the requirements of Clause 6 apply.

5 Power transfer using ES1 or ES2 voltages

5.1 General requirements

The maximum rated output voltage of the **PSE** under **normal operating conditions** shall not exceed the rated limits of the intended communication systems power source functional specifications under conditions of no load, normal load, and maximum rated load.

NOTE 1 For USB 2.0 and 3.1, the limits are 5,25 V. For a USB battery charger, the limit is 6 V. USB power delivery can be rated up to 20 V max.

NOTE 2 Other ES1 and ES2 DC power transfer systems are under investigation.

Where a **PD** or **PSE** have the capability to both provide power and receive power, all the requirements from 5.1 to 5.4 shall apply for each mode as applicable.

NOTE 3 Equipment can have multiple ports serving different **PSE** and **PD** roles simultaneously in any combination.

5.2 Electrical-caused injury, electrical sources and safeguards

The requirements of Clause 5 of IEC 62368-1:2014 apply for a **PSE** classified as ES1 and ES2.

5.3 Electrical-caused fire, power sources and safeguards

5.3.1 DC power transfer interconnection to building wiring

To protect the communication cables, including building wiring, and other devices including the **PD**, the **PSE** shall implement power limiting control to reduce the likelihood of ignition and shall limit the output current to a value that does not cause damage to the wiring system.

To reduce the likelihood of ignition, the **PSE** circuit that provides power shall comply with the requirements for a limited power source (LPS) of Clause Q.1 of IEC 62368 1:2014.

NOTE 1 This means that a **fire enclosure** is not normally required in the power feeding load circuits of the **PD**.

For interconnection of **PSE** circuits to other devices for DC power transfer via building wiring, where it is unknown whether remotely attached devices comply with this document, the **PSE** shall limit the output current to a value that does not cause damage to the wiring system due to overheating, under any conditions of external load up to and including short circuits. The maximum continuous current from the equipment shall not exceed a current limit that is suitable for the minimum wire gauge specified in the equipment installation instructions.

For a **PD** that receives multiple power input circuits from one or more **PSE**, the **PD** also shall implement power limiting in accordance with PS2 or Annex Q of IEC 62368-1:2014 to control additive power from returning to another **PSE** under **normal operating conditions**, **abnormal operating conditions** and **single fault conditions**.

NOTE 2 The requirement for **single fault condition** does not apply to an IC current limiter in compliance with Clause G.9 of IEC 62368-1:2014.

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EXAMPLES of such **PD** equipment are: an analogue telephone, a security camera, a network switch or hub, or devices outside the scope of IEC 62368-1 such as lighting or novelty items.

PSE circuits connected to external paired conductor cable, such as those described in ID numbers 1 and 2 of Table 14 of IEC 62368-1:2014 having a minimum wire diameter of 0,4 mm, shall have the current limited to not more than 1,3 A.

Compliance is checked with 6.2 or Clause Q.1 of IEC 62368-1:2014.

NOTE 3 These **safeguards** typically apply to equipment that are not located in close proximity to each other, such as those associated with power over Ethernet and similar communication cables.

5.3.2 DC power transfer interconnection to other equipment

For interconnection of DC power transfer **PSE** circuits to other equipment, via either direct plug-in connectors or via fly leads, where it is unknown that the attached devices are likely to comply with IEC 62368-1, the delivered power shall comply with either PS2 or Clause Q.1 of IEC 62368-1:2014.

EXAMPLES for such equipment are a scanner, mouse, keyboard, DVD drive, CD-ROM drive, camera, network switch or hub, or devices outside the scope of IEC 62368-1, such as lighting or novelty items.

Compliance is checked in accordance with 6.2 or Clause Q.1 of IEC 62368-1:2014.

For **PSE** circuits under **abnormal operating conditions** and **single fault conditions** in the **PSE**, the available output power shall not exceed the specified fault current rating in the power delivery specification. Where there is no prescribed maximum fault current specified for the standardized interface, the available current shall not exceed the rated maximum output current of the power delivery specification by more than:

– 50 % for circuits equal to or less than 2 A for more than 5 s; and
– 30 % for circuits greater than 2 A for more than 5 s; and
– shall not exceed 8,0 A under any circumstances.

For example, for USB **PSE** circuits under **abnormal operating conditions** and **single fault conditions** in the **PSE**, a rated current of 3 A is specified in the USB power delivery specification for USB Micro-A, Micro-AB and Micro-B connectors and a rated current of 1,8 A in the USB 2.0 and USB 3.0 specification.

NOTE 1 Other USB specifications use higher values, such as 5 A or 6 A.

Compliance is checked by inspection and test.

NOTE 2 These **safeguards** typically apply to equipment and accessories located in close proximity to each other, such as those associated with USB and similar communication cables.

5.4 Safeguards to protect against a single fault condition in the PSE

NOTE See Annex B for the rationale for 5.4.1 and 5.4.2.

5.4.1 Requirement for the PSE

Under **single fault conditions** in the **PSE** with a single output, the output voltage of the **PSE** shall not exceed 130 % of the nominal rated output voltage and shall not exceed ES2 limits at the relevant DC power transfer port of the **PSE.**

For **PSE**s that can deliver a range of different nominal output voltages via negotiation with the **PD** (for example USB power delivery), if it is not always known what type of **PD** will be attached, the voltage from the **PSE** under **single fault conditions** shall be limited to

– 130 % for circuits greater than 5 V (with a minimum of 7,5 V), and
– 150 % for circuits equal to or less than 5 V

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of the nominal output voltage that was negotiated.

NOTE The USB power delivery specification power rules require the support by a **PSE** for 5 V (up to 15 W rating), 5 V/9 V (> 15 W and up to 27 W rating), 5 V/9 V/15 V (> 27 W and up to 45 W rating) and 5 V/9 V/15 V/20 V (> 45 W and up to 100 W rating), with current not to exceed 3 A (up to 60 W rating) or 5 A (> 60 W at 20 V). Other voltages are allowed in the specification provided that the required voltages and currents are supported for the **PSE** rating. These rules supersede the previous "Profiles", and are normative (the previous profiles were optional normative).

5.4.2 Requirement for the PD

The **PD** shall not create any hazard when supplied with

– 130 % of the nominal rated input voltage of the PD at the relevant DC power transfer port for circuits greater than 5 V (with a minimum of 7,5 V); and

– 150 % of the nominal rated input voltage of the PD at the relevant DC power transfer port for circuits equal to or less than 5 V.

Any consequential failure of components in the **PD** shall not create a hazard.

6 Power transfer using RFT

6.1 General requirements

NOTE 1 In the US, other requirements apply (see ITU-T K 50).

Power transfer with voltages at ES3 is a very specific technology used for supplying repeaters and communication terminals via a long distance over communication cables and is known under the term "remote feeding".

Access to the conductors of the **RFT circuit** is normally restricted to a **skilled person**. Access by an **instructed person** is restricted in accordance with 5.3.2.1 and 5.3.2.2 of IEC 62368-1:2014. Access by an **ordinary person** is not allowed.

NOTE 2 Clause 6 covers power feeding to remote equipment at voltages in excess of the voltage limits for ES2 (see Annex A).

6.2 Connection to ICT networks

An **RFT circuit** may be directly connected to an **ICT network.**

6.3 Electrically caused injury

6.3.1 Classification and limits of electrical energy sources

6.3.1.1 RFT-C circuit limits

6.3.1.1.1 General

Unless the current limits in 6.3.1.1.2 to 6.3.1.1.4 are inherently met, the **RFT-C circuit** should have a monitoring and control device (for example, a balance control), that maintains the required current limits.

6.3.1.1.2 Limits under normal operating conditions

Under **normal operating conditions**, an **RFT-C circuit** shall comply with all of the following.

a) The steady state current that can flow from the **RFT-C circuit** supply equipment into the **ICT network** shall not exceed 60 mA DC under any load condition.

b) The steady state current that can flow from one conductor of the **RFT-C circuit** supply equipment through the **ICT network** to earth shall not exceed 2 mA DC.

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c) The **RFT-C circuit** shall be limited to the voltage rating of the wiring of the **ICT network**, if this voltage is known.

NOTE If the voltage rating of the wiring of the **ICT network** is not known, see 6.3.4 d).

d) The voltage rating of the insulation between conductors and from any conductor to earth in an **RFT-C circuit** shall be co-ordinated with the maximum **RFT-C circuit** voltage in the **RFT-C circuit** supply equipment, if this is known. If this is not known, the insulation shall be suitable for 800 V DC.

This insulation level also applies to connectors.

Compliance is checked by inspection and measurement. Item 6.3.1.1.2 b) is checked by using a resistor of 2 000 Ω ± 2 %.

6.3.1.1.3 Limits under single fault conditions

Under **single fault conditions** (see Clause B.4 of IEC 62368-1:2014) within a **RFT-C circuit** supply equipment, or a failure of the insulation between one conductor of the **ICT network** and earth, the current in an **RFT-C circuit** shall not exceed the line-to-earth and line-to-line limits given in Figure 1. Moreover, the limits after 2 s are 25 mA and 60 mA, respectively.

Compliance is checked by inspection and measurement while simulating, one at a time, such failures of components and insulations as are likely to occur in the equipment, and failure of insulations between each connection point for the ICT network and earth. A resistor of 350 Ω ± 2 % is used between conductors and 2 000 Ω ± 2 % is used between one conductor and earth. In Figure 1, the time is measured from the initiation of the failure.

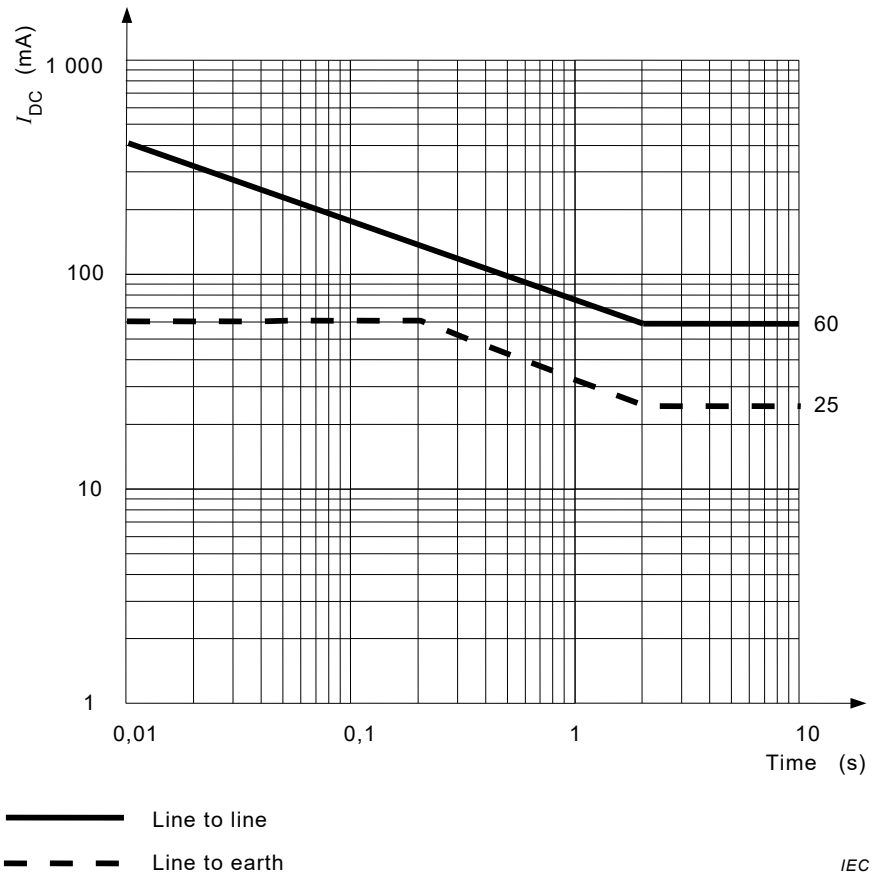

Figure 1 – Maximum current after a single fault

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6.3.1.1.4 Limits with one conductor earthed

If one conductor of an **RFT-C circuit** that normally connects to a **ICT network** is accidentally earthed:

– the current between the other conductor and earth, measured through a 2 000 Ω ± 2 % resistor, under any external load condition, shall not exceed the relevant line-to-earth limit given in Figure 1 with a limit of 25 mA after 10 s; and

– the open circuit voltage between the other conductor and earth shall not exceed the maximum RFT-C circuit voltage determined in 6.3.1.1.2 c) and 6.3.1.1.2 d). The measurement is made after 2 s.

Compliance is checked by inspection and measurement.

6.3.1.2 RFT-V circuit limits

6.3.1.2.1 Limits under normal operating conditions

Under normal operating conditions, an **RFT-V circuit** shall comply with the following:

– the steady state open circuit voltage between earth and each conductor that normally connects to an **ICT network** shall not exceed:

  - 140 V DC, or
  - 200 V DC, provided that a monitoring and control device is used that limits the current to earth in accordance with 6.3.1.2.3;

– the voltage rating of the insulation of an **RFT-V circuit** receiving power via the **ICT network** shall be suitable for 400 V DC between conductors and 200 V DC between any conductor and earth.

Compliance is checked by inspection and measurement.

6.3.1.2.2 Limits under single fault conditions

Under **single fault conditions** (see Clause B.4 of IEC 62368-1:2014) within a **RFT-V circuit** supply equipment, with and without any conductor of the **RFT-V circuit** that normally connects to an **ICT network** being earthed:

– during the first 200 ms, the output voltage between each conductor and earth or between conductors shall not exceed the limits of Figure 2, measured across a 5 000 Ω ± 2 % resistor with all load circuits disconnected; and

– after the first 200 ms, the limits of 6.3.1.2.1 apply.

Compliance is checked by inspection and measurement while simulating failure of components and insulation such as are likely to occur in the equipment.

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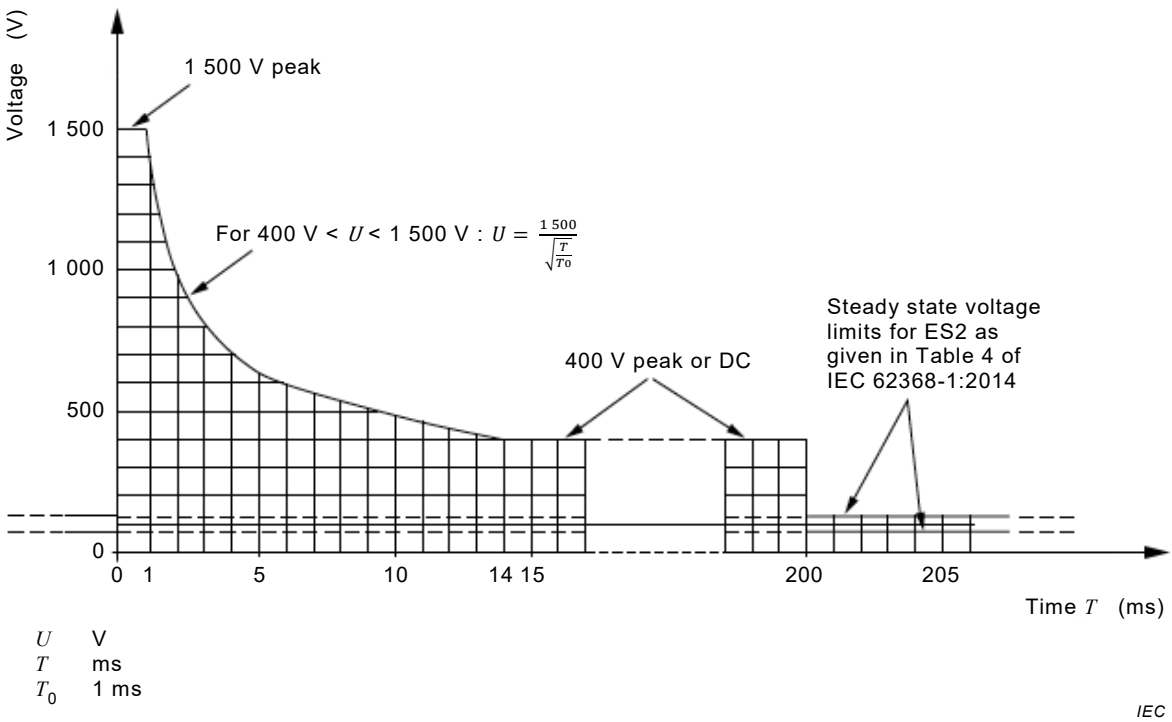

Figure 2 – Maximum voltages permitted after a single fault

6.3.1.2.3 Limits with one conductor earthed

If one conductor of an **RFT-V circuit** that normally connects to a **ICT network** is earthed:

– the open circuit voltage between the other conductor and earth shall not exceed the maximum **RFT-V circuit** supply voltage after 200 ms; and

– for **RFT-V circuits** whose open circuit voltage exceeds 140 V DC under **normal operating conditions**, the current between the other conductor and earth, measured through a 2 000 Ω ± 2 % resistor, under any external load condition, shall not exceed the relevant line-to-earth limit given in Figure 1. Moreover, this current shall not exceed 10 mA DC after 10 s.

Compliance is checked by inspection and measurement.

6.3.2 Accessibility to electrical energy sources and safeguards

6.3.2.1 Accessibility for an ordinary person

NOTE See also 5.3.2 of IEC 62368-1:2014.

The equipment shall be so constructed that, for an **ordinary person,** there is adequate protection against contact with bare parts of **RFT circuits.**

These requirements apply for all positions of the equipment when it is wired and operated as in normal use.

Protection shall be achieved by insulation or by guarding or by the use of interlocks.

Compliance is checked as given in 5.3.2.3 of IEC 62368-1:2014.

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6.3.2.2 Accessibility for an instructed person

NOTE See also 4.3.3 of IEC 62368-1:2014.

For equipment to be installed in a **restricted access area** (see 3.3.6.7 of IEC 62368-1:2104), the requirements for an **ordinary person** apply, except that contact may be possible with the bare parts of an **RFT circuit** by the blunt probe shown in Figure V.3 of IEC 62368-1:2014; however, such parts shall be so located or guarded that unintentional contact is unlikely.

Compliance is checked by inspection and measurement. In deciding whether or not unintentional contact is likely, account is taken of the need to gain access past, or near to, the bare parts.

6.3.2.3 Accessibility for a skilled person

NOTE See also 4.3.4 and 5.3 of IEC 62368-1:2014.

For a **skilled person**, bare parts of **RFT circuits** shall be located or guarded so that accidental shorting to parts at ES1 or to parts at ES2, for example, by **tools** or test probes used by a **skilled person**, is unlikely.

Any guards required for compliance with this subclause shall be easily removable and replaceable if removal is necessary for servicing.

*Compliance is checked by inspection and measurement. In deciding whether or not unintentional contact is likely, account is taken of the way a **skilled person** needs to gain access past, or near to, the bare parts in order to service other parts.*

6.3.3 Safeguards

6.3.3.1 Separation from other circuits and parts

Within the equipment, **RFT circuits** shall be separated from:

– other **RFT circuits** by **functional insulation,** provided that neither circuit exceeds the limits of 6.3.1.1 and 6.3.1.2 if this insulation is short-circuited. Otherwise, the circuits shall be separated as if one were at ES3;

– earthed accessible parts, earthed ES1 circuits and earthed ES2 circuits by **basic insulation**;

NOTE 1 For requirements in Norway, see the note in 4.1.15 of IEC 62368-1:2014.

– unearthed accessible parts, unearthed ES1 circuits, unearthed ES2 circuits and ES3 circuits at by one or both of the following:

- **double insulation** or **reinforced insulation**;
- **basic insulation**, together with a conductive screen serving as **protective bonding conductor** and connected to the main **protective earthing** terminal.

NOTE 2 For requirements in Norway, see the note in 4.1.15 of IEC 62368-1:2014.

Compliance is checked by inspection and measurement.

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