SLOVENSKI STANDARD

SIST-TP IEC TR 61000-2-8:2026

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Elektromagnetna združljivost (EMC) - 2-8. del: Okolje - Upadi napetosti in kratkotrajne prekinitve napajanja v javnih električnih napajalnih sistemih s statističnimi merilnimi rezultati

Electromagnetic compatibility (EMC) - Part 2-8: Environment - Voltage dips and short interruptions on public electric power supply systems with statistical measurement results

Compatibilité électromagnétique (CEM) - Partie 2-8: Environnement - Creux de tension et coupures brèves sur les réseaux d'électricité publics incluant des résultats de mesures statistiques

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2-8: Environment – Voltage dips and short interruptions on public electric power supply systems with statistical measurement results

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example “state of the art”.

IEC 61000-2-8, which is a technical report, has been prepared by subcommittee 77A: Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It has the status of a basic EMC publication in accordance with IEC Guide 107.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
77A/375/DTR	77A/396/RVC

Full information on the voting for the approval of this technical report 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.

The committee has decided that the contents of this publication will remain unchanged until 2010. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as International Standards, technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and completed by a second number identifying the subdivision (example: 61000-6-1).

Detailed information on the various types of disturbances that can be expected on public power supply systems can be found in IEC 61000-2-1.

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 2-8: Environment – Voltage dips and short interruptions on public electric power supply systems with statistical measurement results

1 Scope

This technical report describes the electromagnetic disturbance phenomena of voltage dips and short interruptions in terms of their sources, effects, remedial measures, methods of measurement, and measurement results (in so far as these are available). They are discussed primarily as phenomena observed on the networks of public electricity supply systems and having an effect on electrical equipment receiving its energy supply from those systems.

"Voltage sag" is an alternative name for the phenomenon voltage dip.

2 Definitions

2.1
voltage dip
voltage sag
sudden reduction of the voltage at a particular point on an electricity supply system below a specified dip threshold followed by its recovery after a brief interval

NOTE 1 Typically a dip is associated with the occurrence and termination of a short circuit or other extreme current increase on the system or installations connected to it.

NOTE 2 A voltage dip is a two-dimensional electromagnetic disturbance, the level of which is determined by both voltage and time (duration).

2.2
short interruption
sudden reduction of the voltage on all phases at a particular point on an electricity supply system below a specified interruption threshold followed by its restoration after a brief interval

NOTE Short interruptions are typically associated with switchgear operation related to the occurrence and termination of short circuits on the system or installations connected to it.

2.3
(voltage dip) reference voltage
<measurement of voltage dips and short interruptions>
value specified as the base on which depth, thresholds and other values are expressed in per unit or percentage terms

NOTE The nominal or declared voltage of the supply system is frequently selected as the reference voltage.

2.4
voltage dip start threshold
<voltage dip measurement>
r.m.s. value of the voltage on an electricity supply system specified for the purpose of defining the start of a voltage dip

NOTE Typically values between 0,85 and 0,95 of the reference voltage have been used for this threshold.

2.5
voltage dip end threshold
<voltage dip measurement>
r.m.s. value of the voltage on an electricity supply system specified for the purpose of defining the end of a voltage dip

NOTE Typically, the value used for the end threshold has been the same as the start threshold or has exceeded it by 0,01 of the reference voltage.

2.6
interruption threshold
<measurement of voltage dips and short interruptions>
r.m.s. value of the voltage on an electricity supply system specified as a boundary such that a voltage dip in which the voltage on all phases falls below it is classified as a short interruption

2.7
residual voltage (of voltage dip)
minimum value of r.m.s. voltage recorded during a voltage dip or short interruption

NOTE The residual voltage may be expressed as a value in volts or as a percentage or per unit value relative to the reference voltage.

2.8
depth (of voltage dip)
difference between the reference voltage and the residual voltage

NOTE 1 The depth may be expressed as a value in volts or as a percentage or per unit value relative to the reference voltage.

NOTE 2 Frequently the word ‘depth’ is used in a descriptive, non-quantitative sense, to refer to the voltage dimension of a voltage dip, without the intention of specifying whether that dimension is expressed as the *residual voltage* or *depth*, as defined above. Care is needed to ensure that this meaning is clear in the context in which it is used.

2.9
duration (of voltage dip)
time between the instant at which the voltage at a particular point on an electricity supply system falls below the start threshold and the instant at which it rises to the end threshold.

NOTE In polyphase events, practice varies in regard to relating the start and end of the dip to the phases concerned. Future practice is likely to be that for polyphase events a dip begins when the voltage of at least one phase falls below the dip start threshold and ends when the voltage on all phases is equal to or above the dip end threshold.

2.10
(voltage dip) sliding reference voltage
<measurement of voltage dips and short interruptions>
r.m.s. value of the voltage at a particular point on an electricity supply system continuously calculated over a specified interval to represent the value of the voltage immediately preceding a voltage dip for use as the reference voltage

NOTE The specified interval is much longer than the duration of a voltage dip.

3 Description of voltage dips and short interruptions

3.1 Source of voltage dips

The primary source of voltage dips observed on the public network is the electrical short circuit occurring at any point on the electricity supply system.

The short circuit causes a very large increase in current, and this, in turn, gives rise to large voltage drops in the impedances of the supply system. Short circuit faults are an unavoidable occurrence on electricity systems. They have many causes, but basically they involve a breakdown in the dielectric between two structures which are intended to be insulated from each other and which normally are maintained at different potentials.

Many short circuits are caused by overvoltages, which stress the insulation beyond its capacity. Atmospheric lightning is a notable cause of such overvoltages. Alternatively, the insulation can be weakened, damaged or bridged as a result of other weather effects (wind, snow, ice, salt spray, etc.), by the impact or contact of animals, vehicles, excavating equipment, etc., and as a result of deterioration with age.

The typical electricity supply system conveys energy from multiple sources (generating stations) to multiple loads (motors; resistive elements for lighting, heating, etc.; the power supply modules of electronic devices; etc.) The entire system, including generators, loads and everything between, is a single, integrated and dynamic system – any change of voltage, current, impedance, etc. at one point instantaneously brings about a change at every other point on the system.

Most supply systems are three-phase systems. The short circuit can occur between phases, phase and neutral, or phase and earth. Any number of phases can be involved.

At the point of the short circuit, the voltage effectively collapses to zero. Simultaneously, at almost every other point on the system the voltage is reduced to the same or, more generally, a lesser extent.

Supply systems are equipped with protective devices to disconnect the short circuit from the source of energy. As soon as that disconnection takes place, there is an immediate recovery of the voltage, approximately to its previous value, at every point except those disconnected. Some faults are self-clearing: the short circuit disappears and the voltage recovers before disconnection can take place.

The sudden reduction of voltage, followed by voltage recovery, as just described, is the phenomenon known as voltage dip (also known as voltage sag).

The switching of large loads, energising of transformers, starting of large motors and the fluctuations of great magnitude that are characteristic of some loads can all produce large changes in current similar in effect to a short circuit current. Although the effect is generally less severe at the point of occurrence, the resulting changes in voltage observed at certain locations can be indistinguishable from those arising from short circuits. In that case they also are categorised as voltage dips. (In the management of public networks, however, limits are applied, as a condition of supply, to the permissible voltage fluctuations from this cause.)

3.2 Voltage dip duration

Unless a self-clearing fault is involved, the duration of voltage dips is governed by the speed of operation of the protective devices.

In the main, the protective devices are either fuses or circuit breakers controlled by relays of various kinds. Protection relays often are designed to have an inverse time characteristic, so that the lower the short circuit current, the longer is the fault clearance time. Fuses have similar characteristics. The time characteristics and settings of the fuses and relays are carefully graduated and co-ordinated, so that a short circuit detected by several devices is cleared at the most appropriate point.

Many short circuits are cleared in the time range 100 ms – 500 ms. Faster times are often achieved for short circuits on major transmission lines, while the clearance of short circuits on distribution circuits can be considerably slower.

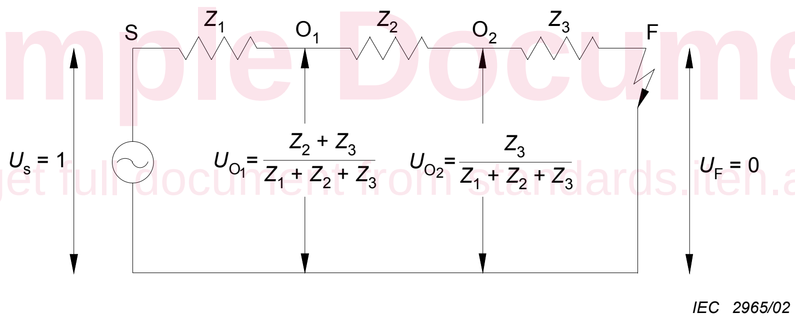
When a current fluctuation other than a short circuit is the source of the voltage dip, the duration is governed by that of the causative event.

Some loads draw a large inrush of current as the voltage recovers at the end of a voltage dip. This has the effect of delaying the recovery of the voltage and extending the duration of the voltage dip. The same effect can occur when transformers go into saturation during voltage recovery.

3.3 Voltage dip magnitude

The magnitude of the voltage dip is governed by the position of the observation point in relation to the site of the short circuit and the source(s) of supply.

The system can be represented by a simple equivalent circuit connecting the observation point to a single equivalent source and to the site of the fault. (see Figure 1.) The entire voltage (100 %) is dissipated over the impedance between the source and the short circuit. The voltage drop to the observation point depends on the relative magnitudes of the two impedances connecting that point to the source and the short circuit. Depending on these impedances, the depth of the voltage dip can be anywhere in the range 0 % to 100 %.



Voltage dips at observation points O_1 and O_2 for short circuit at F and single equivalent source at S (expressed in terms of residual voltage per unit.)

Figure 1 – Equivalent circuit for voltage dips

In broad terms, the nearer the observation point is to the site of the short circuit, the closer the voltage at that point is to the voltage at the fault site. In other words, the voltage dip approaches the maximum possible depth (zero residual voltage) near the short circuit. On the other hand, if an observation point is near a generation source or sources of stored energy, such as rotating machines, the effect is to move the observation point nearer to the equivalent single source as represented in Figure 1. This mitigates the severity of the observed voltage dip. (However, if the dip duration is prolonged, increased current is drawn by decelerating motors, and this can increase the severity of the dip.)

Whether a short circuit results in an observable voltage dip at a particular observation point depends on their positions on the supply system. A short circuit on the transmission system is likely to result in an appreciable voltage dip that is observed over a very wide area, even at a distance of some hundreds of kilometres. On the other hand, a short circuit on a distribution circuit has a much smaller field of observable influence. Observation points on the same circuit are likely to experience severe dips, the dip severity will be moderated considerably on neighbouring circuits, and at larger distances the dip is hardly discernible.