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Electromagnetic compatibility (EMC)

Part 1–7: General — Power factor in single-phase systems under non-sinusoidal conditions

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

FOREWORD 4
INTRODUCTION 6
0.1 Series overview 6
0.2 Purpose of this document 6
1 Scope 8
2 Normative references 8
3 Terms and definitions 8
4 General 11
5 Electric power quantities under non-sinusoidal conditions 15
5.1 Voltages and currents 15
5.1.1 Instantaneous values 15
5.1.2 Reference fundamental components 16
5.1.3 Total distortion contents 16
5.1.4 RMS values of the voltage and current 16
5.1.5 RMS values of total distortion contents 17
5.1.6 DC ratios 17
5.1.7 Total distortion ratios 17
5.2 Instantaneous power 18
5.3 Definitions related to the active power 18
5.3.1 Active power 18
5.3.2 DC power 18
5.3.3 Fundamental active power 19
5.3.4 Distortion active power 19
5.4 Definitions related to the apparent power 19
5.4.1 Apparent power 19
5.4.2 Fundamental apparent power 20
5.5 Definitions related to the power factor 20
5.5.1 Power factor 20
5.5.2 Fundamental power factor 21
5.5.3 Non-fundamental power factor 21
5.6 Summary 21
6 Electric power quantities with a sinusoidal voltage and a current distorted only with harmonics 22
6.1 Voltages and currents 22
6.1.1 Instantaneous values 22
6.1.2 Fundamental components 22
6.1.3 Harmonic content of the current 23
6.1.4 RMS values of the voltage and current 23
6.1.5 RMS value of the harmonic content of the current 23
6.1.6 Total harmonic ratio of the current 24
6.1.7 Fundamental factor 24
6.2 Instantaneous power 24
6.3 Active power 24
6.4 Definitions related to the apparent power 25
6.4.1 Apparent power 25

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6.4.2 Fundamental apparent power 25
6.5 Definitions related to the power factor 25
6.5.1 Power factor 25
6.5.2 Fundamental power factor 26
6.5.3 Non-fundamental power factor 26
6.6 Summary 27
Annex A (normative) Electric power quantities under sinusoidal conditions 28
A.1 Instantaneous values of the voltage and current 28
A.2 Instantaneous power 29
A.3 Active power 30
A.4 Reactive power 30
A.5 Apparent power 30
A.6 Power factor 30
Annex B (informative) Fundamental active factor 32
B.1 Fundamental active factor and its use 32
B.2 Consumer convention 32
Bibliography 34

Figure A.1 – Illustration of the displacement angle (φ) when the voltage leads the current, $\varphi > 0$ 28
Figure A.2 – Illustration of the displacement angle (φ) when the voltage lags the current, $\varphi < 0$ 29
Figure B.1 – Consumer sign convention of the fundamental active factor, fundamental active power and fundamental reactive power 33

Table 1 – Summary of the power quantities under non-sinusoidal conditions 21
Table 2 – Summary of the power quantities with a sinusoidal voltage and a current distorted only with harmonics 27

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-7: General – Power factor in single-phase systems under non-sinusoidal conditions

FOREWORD

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IEC TR 61000-1-7, which is a Technical Report, has been prepared by subcommittee 77A: *EMC – Low frequency phenomena,* of IEC technical committee 77*: Electromagnetic compatibility*.

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

Enquiry draft	Report on voting
77A/911/DTR	77A/920/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.

A list of all parts in the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, 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 website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

0.1 Series overview

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 levels

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 sections which are to be published either as international standards, technical specifications, or as technical reports.

These standards and reports will be published in chronological order and numbered accordingly (for example, 61000-6-1).

0.2 Purpose of this document

The prevalence of loads drawing non-sinusoidal current from power systems requires clarification of such concepts as power and power factor, in order to avoid confusion due to

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implied assumptions of sinusoidal voltage and current. This document specifically addresses the terms related to the power factor of equipment that are applicable regardless of the voltage and current waveforms.

When voltages and currents on power supply networks are perfectly sinusoidal, cos φ corresponds to the power factor. But this is not true anymore when electric quantities are distorted. In some existing documents, cos φ is still used as power factor, leading to an incorrect assessment of the equipment impact to supply networks.

The purpose of this Technical Report is to give clear information on both components in the power factor:

- the fundamental power factor, which is due to the phase difference between the voltage and current at the fundamental frequency (cos φ_1), and
- the non-fundamental power factor, which is related to the distortion of the voltage and/or current.

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-7: General – Power factor in single-phase systems under non-sinusoidal conditions

1 Scope

This part of IEC 61000, which is a Technical Report, provides definitions of various electrical power quantities and the relationship between them under non-sinusoidal conditions, in order to give clear information on both components in the power factor: the fundamental power factor, which is due to the phase difference between the voltage and current at the fundamental frequency, and the non-fundamental power factor, which is related to the distortion of the voltage and/or current. This Technical Report is applicable only to single-phase systems.

This Technical Report provides definitions for the three following cases:

- the general case where the voltage and current are both distorted (Clause 5),
- the case where the voltage is assumed to be sinusoidal and the current is only distorted with harmonic components (Clause 6),
- the particular case where the voltage and current are both sinusoidal (Annex A).

Annex B gives information on the fundamental active factor, which is used to describe the behaviour of a piece of equipment as a load or a generator.

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.

Void.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
root-mean-square value
rms value
effective value
for a time-dependent quantity, positive square root of the mean value of the square of the quantity taken over a given time interval

Note 1 to entry: The root-mean-square value of a periodic quantity is usually taken over an integration interval the range of which is the period multiplied by a natural number.

Note 2 to entry: For a sinusoidal quantity $a(t) = \hat{A}\cos(\omega t + \vartheta_0)$, the root-mean-square value is $A_{\text{eff}} = \hat{A}/\sqrt{2}$.

Note 3 to entry: The root-mean-square value of a quantity may be denoted by adding one of the subscripts eff or rms to the symbol of the quantity.

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