IEC TS 61000-3-16

Edition 1.0 2023-11

TECHNICAL SPECIFICATION

Electromagnetic compatibility (EMC) – Part 3-16: Limits – Limits for harmonic currents produced by the inverter of inverter-type electrical energy-supplying equipment with a reference current less than or equal to 75 A per phase connected to public low-voltage systems

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.100.01

ISBN 978-2-8322-7822-2

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms and definitions 7
4 General 9
4.1 Emissions for electrical ESE unable to cancel harmonics at the grid side 9
4.2 Emissions for electrical ESE which can cancel harmonics at the grid side 9
5 Measurement and simulation conditions 9
5.1 General conditions for test and simulation 9
5.2 Requirements for measurement 9
5.2.1 Supply of the ESE inverter 9
5.2.2 Supply into which the ESE inverter feeds energy 9
5.2.3 Determination of the reference current I_{ref} 10
5.2.4 Measurement of harmonic currents 10
5.3 Requirements for simulation 11
6 Emission limits 12
7 Product documentation 13
7.1 Test report 13
7.2 Instruction manual 13
Annex A (informative) Rationale for the limits in this document 15
A.1 General 15
A.2 History 15
A.3 Technology 16
A.3.1 Basic technology 16
A.3.2 Coping with grid voltage distortion 16
A.4 Limits 17
A.4.1 General 17
A.4.2 Justification for the emission limits in this document 18
Bibliography 20

Table 1 – Individual current harmonic limits for all ESE inverters up to 75 A per phase 12
Table 2 – Alternative presentation of individual current harmonic limits for all ESE inverters up to 75 A per phase 13
Table 3 – PHC limits for all ESE inverters up to 75 A per phase 13
Table A.1 – Example of the results of an actual measurement of a conforming inverter 18

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-16: Limits – Limits for harmonic currents produced by the inverter of inverter-type electrical energy-supplying equipment, with a reference current less than or equal to 75 A per phase, connected to public low-voltage systems

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61000-3-16 has been prepared by subcommittee 77A EMC – Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
77A/1167/DTS	77A//RVDTS

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

The language used for the development of this Technical Specification is English

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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.

This document has the status of a product family standard.

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

- 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 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 or as 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 a second number identifying the subdivision (example: IEC 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-16: Limits – Limits for harmonic currents produced by the inverter of inverter-type electrical energy-supplying equipment, with a reference current less than or equal to 75 A per phase, connected to public low-voltage systems

1 Scope

This part of IEC 61000 deals with the limits for harmonic (including grouped interharmonic) currents produced by the inverter of inverter-type electrical energy-supplying equipment (ESE) as defined in 3.2, but which does not include energy storage. The limits given in this document are applicable to inverters with a reference current as defined in 3.3 (see also 5.2.3) less than or equal to 75 A per phase, intended to be connected to public low-voltage AC distribution systems of the following types:

- single-phase, two or three wires; nominal voltage up to 240 V
- three-phase, three or four wires; nominal voltage up to 690 V
- nominal frequency of 50 Hz or 60 Hz.

This document specifies:

a) requirements and emission limits for equipment;

b) methods for type tests and simulations.

Tests in accordance with this document are type tests of complete pieces of equipment.

Equipment which mainly absorbs energy but which is capable of supplying energy to the public supply as a secondary function is out of the scope of this document.

EXAMPLE An elevator motor drive returning energy during braking.

This document provides limits and testing procedures for equipment in the range up to harmonic order 40 (h_{40}), i.e. 2 000 Hz or 2 400 Hz depending on line frequency.

NOTE 1 It is possible that limits for frequencies in the range from 2 kHz to 9 kHz will be added in a future edition of this document.

NOTE 2 It is possible that limits and procedures for storage systems will be added in a future edition of this document.

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 60038:2009, *IEC standard voltages*

IEC 61000-2-2:2002, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*
IEC 61000-2-2:2002 AMD1:2017
IEC 61000-2-2:2002 AMD2:2018

IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*
IEC 61000-4-7:2002 AMD:2008

IEC TR 60725:2012, *Consideration of reference impedances and public supply network impedances for use in determining the disturbance characteristics of electrical equipment having a rated current ≤ 75 A per phase*