IEC TS 62578

Edition 2.0 2015-04

TECHNICAL SPECIFICATION

SPECIFICATION TECHNIQUE

colour inside

Power electronics systems and equipment – Operation conditions and characteristics of active infeed converter (AIC) applications including design recommendations for their emission values below 150 kHz

Systèmes et équipements électroniques de puissance – Conditions de fonctionnement et caractéristiques des convertisseurs à alimentation active (AIC), y compris les recommandations de conception pour leurs valeurs d'émission inférieures à 150 kHz

IEC TS 62578:2015-04(en-fr)

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POWER ELECTRONICS SYSTEMS AND EQUIPMENT –

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FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62578, which is a technical specification, has been prepared by IEC technical committee TC 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) IEC TS 62578, in its revised version includes observed values out of practical applications for emission values below 150 kHz.
b) Therefore the document has been extended compared to the first edition, several detailed analysis results are given in the extended Annexes.
c) Design recommendations have been derived from the international working group by an assessment of the power supply impedances between 2 kHz and 9 kHz, a comprehensive analysis of the withstand capability of power capacitors against harmonic currents injected by AIC, immunity tests of equipment and considerations about shifted resonances in the power supply network with increased population of undamped filter capacitors.

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

Enquiry draft	Report on voting
22/235/DTS	22/239/RVC

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

The French version of this technical specification has not been voted upon.

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 the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This revision of the technical specification IEC TS 62578 is necessary because active infeed converters (AIC) are a state of the art technology in power electronic products and will be of major importance in order to realize the "smart grid" and the "energy efficiency" initiatives.

AICs in industrial and domestic use are necessary to feedback energy from an energy source (e.g. solar panels, fuel cells or wind turbines) or from a motor load to the power supply network and make it available for other consumers instead of dissipating it as a waste-heat to the environment.

Dispersed power generating equipment uses AICs to synchronise their voltages and currents to the power supply network or to exchange electrical energy between energy storage devices such as batteries and consumers.

Utilities will require information on how to correctly apply the AICs in order to mitigate harmonics in the power supply network.

AICs can also be used to mitigate pre-existing harmonics in the supply system – information on this is of interest to utilities.

Different possible topologies of AICs are described together with their specific advantages.

Warning: The recommendations of maximum emission values for conducted emissions <150 kHz defined in this document are based on observations and experience gained from state of the art AICs operating today in most power supply networks together with other equipment without creating intolerable interference and should lead to an increased acceptance of using AICs.

Nevertheless it has to be highlighted that electromagnetic environment is subject to changes e.g. because of smart grid deployment and that emission limits that are currently under development by the IEC EMC Committees may be different to the maximum emission values recommended in this document.

This document is being issued in the Technical Specification series of publications (according to the ISO/IEC Directives, Part 1, 3.1.1.1) as a “prospective standard for provisional application” in the field of power electronics because there is an urgent need for guidance on the design and use of active infeed converters (AIC) today and in “smart grid environments”.

It remains unclear during revision of this document, how and when the smart grid vision will be realized and to what extent in the future. AICs will be the "key link components" if several electrical energy storage devices or storage technologies and energy users are to be connected together and will interact under "smart grid behaviour" conditions. The power supply network may adapt its future characteristics compared to the state of the art while increasing the installed density of AIC.

POWER ELECTRONICS SYSTEMS AND EQUIPMENT –

Operation conditions and characteristics of active infeed converter (AIC) applications including design recommendations for their emission values below 150 kHz

1 Scope

This Technical Specification IEC TS 62578 describes the operation conditions and typical characteristics of active infeed converters (AIC) of all technologies and topologies which can be connected between the electrical power supply network (lines) a.c. side and a constant current or voltage type d.c. side and which can convert electrical power (active and reactive) in both directions (generative or regenerative).

Applications with active infeed converters are commonly used with the d.c. sides of adjustable speed power drive systems (PDS), uninterruptible power systems (UPS), active filters, photovoltaic systems, wind turbine systems, battery backed power management systems etc. of all voltages and power ratings.

Active infeed converters are generally connected between the electrical power supply network (a.c. side) and a current or voltage d.c. side, with the objective to avoid emitting low frequency harmonics (e.g. less than 1 kHz) by synthesizing a sinusoidal a.c. current. Some of them can additionally compensate the pre-existing harmonic distortion of a given supply side voltage. They are moreover able to control the power factor of a power supply network section by moving the electrical power (active and reactive) in both directions (generative or regenerative), which enables energy saving in the system and stabilizes the power supply voltage or enables coupling of renewable energy sources or electrical energy storage devices to the supply.

A practical and analytical approach for emission values for AICs in power supply networks is given, which is based on the latest results for line impedance values between 2 kHz and 9 kHz and withstand capability of capacitors connected directly to the supply.

This results in design recommendations for emission values below 150 kHz.

The following is excluded from the scope.

- Requirements for the design, development or further functionality of active infeed applications.
- Probability of interactions or influences of the AIC with other equipment caused by parasitic elements in an installation or caused by poor electronic design as well as their mitigations.
- "Overhead line" power supply networks because of lack of information (measurements) of their three phase impedances. This could be the subject for future editions.

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.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at www.electropedia.org)

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*

IEC 61800-3, *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*

IEC 61800-5-1, *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy*

IEC 62040-1, *Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS*

IEC 62103, *Electronic equipment for use in power installations*

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/AMD1:2008

CISPR 16-1-1, *Radio disturbance and immunity measuring apparatus – Measuring apparatus*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60500 and the following apply

3.1
active equalization of the power supply network
AEP
ability of an AIC to enable and combine smart grid functionalities with a specific main application

Note 1 to entry: Specific main applications include:

- reduce or avoid emitting low frequency harmonics (e.g. less than 2 kHz) from the power supply network by synthesizing a sinusoidal line current
- contributes to controlling the reactive power of a power supply network
- exchanging the electrical power (active and reactive) in generative or regenerative modes
- stabilization of the power supply voltage and energy saving in the supply system
- exchanging electrical energy between power supply networks or other power generations applications like fuel cells and electrical energy storage devices
- coupling of decentralized power sources (e.g. from renewable energy) to the power supply network.

3.2
a.c. filter
filter consisting of passive components, such as inductors, capacitors and resistors connected to the a.c. side of a converter, designed to reduce the circulation of harmonic currents in the associated system

3.3
active filter
AIC operating as a filter to control the specific a.c. side harmonic and interharmonics voltages or currents usually without active power flow