IEC TS 62001-3

Edition 1.0 2026-05

TECHNICAL SPECIFICATION

High-voltage direct current (HVDC) systems - Guidance to the specification and design evaluation of AC filters -
Part 3: Modelling aspects

ICS 29.200

ISBN 978-2-8327-1271-9

IEC TS 62001-3:2026-05(en)

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High-voltage direct current (HVDC) systems - Guidance to the specification and design evaluation of AC filters - Part 3: Modelling aspects

FOREWORD

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IEC TS 62001-3 has been prepared by subcommittee 22F: Power electronics for electrical transmission and distribution systems, of IEC technical committee 22: Power electronic systems and equipment. It is a Technical Specification.

This first edition cancels and replaces the first edition of IEC TR 62001-3 published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC TR 62001-3:2016:

a) added Clause 3 on terms and definitions;
b) added new Clause 4;
c) rearranged Clause 5, Clause 6 and Clause 7;
d) updated Bibliography.

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

Draft	Report on voting
22F/862/DTS	22F/869/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/publications.

A list of all parts in the IEC 62001 series, published under the general title *High-voltage direct current (HVDC) systems - Guidance to the specification and design evaluation of AC filters*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,

– withdrawn, or

– revised.

INTRODUCTION

IEC 62001 (all parts) deals with the specification and design evaluation of AC side harmonic performance and AC side filters for HVDC schemes. It is intended to be primarily for the use of the utilities and consultants who are responsible for issuing the specifications for new HVDC projects and evaluating designs proposed by prospective suppliers.

The IEC TR 62001 series is structured in five parts as follows.

IEC TR 62001-1 – Overview

This part concerns specifications of AC filters for high-voltage direct current (HVDC) systems with line-commutated converters, permissible distortion limits, harmonic generation, filter arrangements, filter performance calculation, filter switching and reactive power management and customer specified parameters and requirements.

IEC TS 62001-2 – Harmonic performance aspects

This part deals with telephone interference, current-based interference criteria, field measurements and compliance verification.

IEC TS 62001-3 – Modelling aspects

This part addresses modelling of three specific aspects of design: AC network impedance modelling, the treatment of pre-existing harmonics in performance and rating calculations, and harmonic interaction across converters (cross-modulation).

IEC TR 62001-4 – Equipment

This part concerns steady-state and transient ratings of AC filters and their components, power losses, audible noise, design issues and special applications, filter protection, audible noise, seismic requirements, equipment design and test parameters.

IEC TR 62001-5 – AC side harmonics and appropriate harmonic limits for high-voltage direct current (HVDC) systems with voltage sourced converters (VSC)

This part addresses the AC side harmonic performance of voltage sourced converters (VSC).

1 Scope

This part of IEC 62001 provides in-depth consideration regarding three particularly important aspects of design, which are also mentioned elsewhere in other parts of the IEC 62001 series, which are: AC network impedance modelling, the treatment of pre-existing harmonics in performance and rating calculations, and harmonic interaction across converters (cross-modulation).

This document concentrates on passive AC filter technology and line-commutated high-voltage direct current (HVDC) converters, but much of the content is equally relevant to VSC converter technology. Where there is a distinction, this is indicated in the text.

The scope of this document covers AC side filtering for the frequency range of interest in terms of harmonic distortion and audible frequency disturbances. It excludes filters specifically designed to be effective in the PLC and radio interference spectra.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

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

3.1
modelling
action of representing a physical situation to enable analysis

4 Overview of modelling

HVDC converter stations are large, complex and costly. Extensive simulations are required to ensure that the HVDC converter station acts as intended and to meet the requirements of the end customer. Such simulations can also be used to configure and adjust the parameters of the HVDC converter station to optimise and enhance the operation and performance.

To ensure that the simulations are realistic, it is important the models used are appropriate to the task in hand. For the purpose of this document, the focus on the modelling is in the frequency domain, although where time domain studies can be more appropriate, this is indicated. Modelling is discussed in many places throughout the various parts of the IEC 62001 series; however, this document focusses in-depth on a number of key aspects of modelling of the HVDC converter.

Clause 5 examines the connected AC system and the appropriate methods of modelling this for representation as a harmonic impedance.

Clause 6 considers the appropriate way to model the harmonic distortion already present in the AC system such that effect of the connection of the HVDC converter is modelled correctly in terms of the changes to the harmonic distortion at various points in the system and the rating of components.