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colour inside

Utility-interconnected photovoltaic inverters – Test procedure for over voltage ride-through measurements

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UTILITY-INTERCONNECTED PHOTOVOLTAIC INVERTERS – TEST PROCEDURE FOR OVER VOLTAGE RIDE-THROUGH MEASUREMENTS

FOREWORD

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

Draft	Report on voting
82/1926/DTS	82/1960/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.

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- withdrawn,
- replaced by a revised edition, or
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UTILITY-INTERCONNECTED PHOTOVOLTAIC INVERTERS – TEST PROCEDURE FOR OVER VOLTAGE RIDE-THROUGH MEASUREMENTS

1 Scope

This document provides a test procedure for evaluating the performance of Over Voltage Ride-Through (OVRT) functions in inverters used in utility-interconnected photovoltaic (PV) systems.

This document is most applicable to large systems where PV inverters are connected to utility high voltage (HV) distribution systems. However, the applicable procedures may also be used for low voltage (LV) installations in locations where evolving OVRT requirements include such installations, e.g. single-phase or 3-phase systems.

Fundamentally, the assessed OVRT performance is valid only for the specific configuration and operational mode of the inverter under test. Separate assessment is required for the inverter in other factory or user-settable configurations, as these may cause the inverter OVRT response to behave differently.

The measurement procedures are designed to be as non-site-specific as possible, so that OVRT characteristics measured at one test site, for example, can also be considered valid at other sites.

This document is for testing of PV inverters, though it contains information that may also be useful for testing of a complete PV power plant consisting of multiple inverters connected at a single point to the utility grid. It further provides a basis for utility-interconnected PV inverters numerical simulation and model validation.

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 61400-21-1:2019, *Wind energy generation systems – Part 21-1: Measurement and assessment of electrical characteristics – Wind turbines*

IEC TS 61836:2016, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC TS 63106-1:2020, *Simulators used for testing of photovoltaic power conversion equipment – Recommendations – Part 1: AC power simulators*

IEC TS 63106-2:2022, *Simulators used for testing of photovoltaic power conversion equipment – Recommendations – Part 2: DC power simulators*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms in IEC TS 61836 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms, definitions and symbols

3.1.1
over voltage ride-through
OVRT
capability of an inverter to continue generating power to connected utility grid during a limited duration voltage swell (see 3.1.28) of grid voltage

3.1.2
utility grid
grid for which an electrical utility is responsible

[SOURCE: IEC TS 61836:2016, 3.3.29.2]

3.1.3
tap-changer
apparatus or accessory for usually automatically changing transformer taps to regulate system voltage

3.1.4
inverter
electric energy converter that changes direct electric current to single-phase or polyphase alternating currents

[SOURCE: IEC TS 61836:2016, 3.2.15]

3.1.5
equipment under test
EUT
equipment on which these tests are performed and refers to the utility-interconnected PV inverter

3.1.6
N_{EUT}
access point of the EUT during the test

3.1.7
P_n
rated power of EUT

3.1.8
proportionality constant K
K-factor
setting parameters affecting OVRT behaviour of the EUT regarding reactive current injection

3.1.9
photovoltaic array
mechanical and electrical assembly of photovoltaic modules, photovoltaic panels or photovoltaic sub-arrays and its support structure

[SOURCE: IEC TS 61836:2016, 3.3.59.1]

3.1.10
PV array simulator
simulator that has I-V characteristics equivalent to a PV array

[SOURCE: IEC TS 61836:2016, 3.5.3]

3.1.11
S_{EUT}
apparent short-circuit power at N_{EUT}

$S_{EUT} = I_{sc} \times U_N$,

I_{sc} refers to short-circuit current at N_{EUT} during the no-load test

3.1.12
single-phase fault
single-phase grounded fault

3.1.13
two-phase fault
two-phase short circuit fault or two-phase grounded fault

3.1.14
reactive power compensation device
device that is used to improve voltage regulation of the utility grid

3.1.15
grid fault simulator
simulator that has the ability to simulate static and dynamic voltage characteristics of different grid faults

3.1.16
over voltage fault
situation in which the amplitude of grid voltage is higher than normal working voltage range

3.1.17
AC main power port
point of connection of the AC grid to the EUT

3.1.18
DC main power port
point of connection of the DC power source to the EUT

3.1.19
voltage transformer
instrument transformer in which the secondary voltage in normal conditions of use, is substantially proportional to the primary voltage and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections

[SOURCE: IEC 60050-321:1986, 321-03-01]

3.1.20
current transformer
instrument transformer in which the secondary current in normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections

[SOURCE: IEC 60050-321:1986, 321-02-01]

3.1.21
tap transformer
device employing the principle of mutual induction to obtain different turn ratio, automatically changing transformer taps to regulate output voltage

3.1.22
short circuit
connection of comparatively low resistance accidentally or intentionally made between points on a circuit between which the resistance is normally much greater

3.1.23
back-to-back converter
power electronics equipment that converts input AC power to a DC link power with stable voltage or current, then converts the DC link power back to AC power

3.1.24
mechanical circuit breaker
mechanical switch that automatically interrupts the current of an overloaded electric circuit

3.1.25
step-up transformer
device employing the principle of mutual induction to obtain higher output voltage from low input voltage

3.1.26
A_n
voltage swell ratio

3.1.27
point of common coupling
PCC
point of a power supply network, electrically nearest to a particular load, at which other loads are, or may be, connected

Note 1 to entry: These loads can be either devices, equipment or system, or distinct customer's installations.

Note 2 to entry: In some applications, the term "point of common coupling" is restricted to public networks.

[SOURCE: IEC 60050-161:1990, 161-07-15]

3.1.28
voltage swell
temporary increase of the voltage magnitude at a point in the electrical system above a threshold

[SOURCE: IEC 61000-4-30:2015]