

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Terminology for high-voltage direct current (HVDC) transmission**

**Terminologie pour le transport d'énergie en courant continu à haute tension (CCHT)**

IEC 60633:1998

<https://standards.iteh.ai/catalog/standards/iec/463cfe16-3f46-4d20-ba8b-9c68d6a34f11/iec-60633-1998>



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### TERMINOLOGY FOR HIGH-VOLTAGE DIRECT CURRENT (HVDC) TRANSMISSION

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**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.**

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# TERMINOLOGY FOR HIGH-VOLTAGE DIRECT CURRENT (HVDC) TRANSMISSION

## 1 Scope

This International Standard defines terms for high-voltage direct current (HVDC) power transmission systems and for HVDC substations using electronic power converters for the conversion from a.c. to d.c. or vice versa.

This standard is applicable to HVDC substations with line commutated converters, most commonly based on three-phase bridge (double way) connections (see figure 2) in which unidirectional electronic valves, e.g. semiconductor valves, are used.

## 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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050-551:~~1998~~, *International Electrotechnical Vocabulary – Part 551: Power electronics*

IEC 60146-1-1:~~1991~~, *General requirements and line commutated convertors – Part 1-1: Specifications of basic requirements*

IEC 60617-5:~~1996~~, *Graphical symbols for diagrams – Part 5: Semiconductors and electron tubes*

IEC 60617-6:~~1996~~, *Graphical symbols for diagrams – Part 6: Production and conversion of electrical energy*

## 3 Symbols and abbreviations

The list covers only the most frequently used symbols. For a more complete list of the symbols which have been adopted for static converters see IEC 60027 and other standards listed in the normative references and the bibliography.

### 3.1 List of letter symbols

$U_d$	direct voltage (any defined value)
$U_{d0}$	<del>conventional</del> nominal no-load direct voltage
$U_{di0}$	ideal no-load direct voltage
$U_{dN}$	rated direct voltage
$U_L$	line-to-line voltage on line side of converter transformer, r.m.s. value including harmonics
$U_{LN}$	rated value of $U_L$
$U_{v0}$	no-load phase-to-phase voltage on the valve side of transformer, r.m.s. value excluding harmonics

$I_d$	direct current (any defined value)
$I_{dN}$	rated direct current
$I_L$	current on line side of converter transformer, r.m.s. value including harmonics
$I_{LN}$	rated value of $I_L$
$I_v$	current on valve side of transformer, r.m.s. value including harmonics
$\alpha$	(trigger) delay angle
$\beta$	(trigger) advance angle
$\gamma$	extinction angle
$\mu$	overlap angle
$p$	pulse number
$q$	commutation number

### 3.2 List of subscripts

0 (zero)	at no load
N	rated value or at rated load
d	direct current or voltage
i	ideal
L	line side of converter transformer
v	valve side of converter transformer
max	maximum
min	minimum
$n$	pertaining to harmonic component of order $n$

### 3.3 List of abbreviations

The following abbreviations are always in capital letters and without dots.

HVDC	high-voltage direct current
MVU	multiple valve (unit) (see 6.3.2)
SCR	short-circuit ratio (see 7.32)
ESCR	effective short-circuit ratio (see 7.33)
MTDC	multiterminal HVDC transmission system (see 8.2.2)
MRTB	metallic return transfer breaker (see 9.12)
ERTB	earth return transfer breaker (see 9.13)
VDCOL	voltage dependent current order limit (see 12.9)
SSTI	sub-synchronous torsional interaction (see 10.10)

## 4 Graphical symbols

Figure 1 shows the specific graphical symbols which are defined only for the purposes of this standard. For a more complete list of the graphical symbols which have been adopted for static converters, see IEC 60617-5 and IEC 60617-6.

## 5 General terms related to converter circuits

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

NOTE – For a more complete list of the terms which have been adopted for static converters, see IEC 60050(551) and IEC 60146-1-1.

**5.1  
conversion**

in the context of HVDC, the transfer of energy from a.c. to d.c. or vice versa, or a combination of these operations

**5.2  
converter connection**

electrical arrangement of arms and other components necessary for the functioning of the main power circuit of a converter

**5.3  
bridge (converter connection)**

double-way connection, as illustrated in Figure 2, comprising six converter arms ~~which are connected~~ such that the centre terminals are the phase terminals of the a.c. circuit, and that the outer terminals of like polarity are connected together and are the d.c. terminals

~~NOTE – The term “bridge” may be used to describe either the circuit connection or the equipment implementing that circuit (see 6.2).~~

**5.3.1  
uniform bridge**

bridge where all converter arms are either controllable or non-controllable

**5.3.2  
non-uniform bridge**

bridge with both controllable and non-controllable converter arms

**5.4  
(converter) arm**

~~part of an operative circuit used for conversion which is connected between an a.c. terminal and a d.c. terminal, with the ability to conduct current in only one direction, defined as the forward direction (see 7.3)~~

~~NOTE – The main function of a converter arm is conversion; it may also perform additional functions such as voltage limiting, damping, etc.~~

~~part of a bridge connecting two points of different potentials within a bridge, for example, between an AC terminal and a DC terminal~~

**5.4.1  
controllable converter arm**

converter arm in which the start of forward conduction may be determined by an externally applied signal

**5.4.2  
non-controllable converter arm**

converter arm in which the start of forward conduction is determined solely by the voltage applied to its terminals

**5.5  
by-pass path**

low resistance path between the d.c. terminals of one or several bridges excluding the a.c. circuit

NOTE – The by-pass path may either constitute a unidirectional path, e.g. a by-pass arm (see 5.5.1), or a by-pass pair (see 5.5.2), or it may constitute a bidirectional path, e.g. a by-pass switch (see 6.20).