

Static Transfer Systems (STS) —

Part 1: General and safety requirements

The European Standard EN 62310-1:2005 has the status of a British Standard

ICS 29.240.99

National foreword

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The UK participation in its preparation was entrusted to Technical Committee PEL/22, Power, electronics, which has the responsibility to:

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Static transfer systems (STS)
Part 1: General and safety requirements
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Systèmes de transfert statique (STS)
Partie 1: Exigences générales et règles
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CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 22H/66/FDIS, future edition 1 of IEC 62310-1, prepared by SC 22H, Uninterruptible power systems (UPS), of IEC TC 22, Power electronic systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62310-1 on 2005-03-01.

The following dates were fixed:

- | | | |
|--|-------|------------|
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Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62310-1:2005 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60947-6-1	NOTE	Harmonized as EN 60947-6-1:1991 (not modified).
IEC 61032	NOTE	Harmonized as EN 61032:1998 (not modified).
IEC 61140	NOTE	Harmonized as EN 61140:2002 (not modified).
IEC 62040	NOTE	Harmonized in EN 62040 series (modified).
IEC 62040-1-1	NOTE	Harmonized as EN 62040-1-1:2003 (not modified).
IEC 62040-1-2	NOTE	Harmonized as EN 62040-1-2:2003 (not modified).
IEC 62040-3	NOTE	Harmonized as EN 62040-3:2001 (modified).

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STATIC TRANSFER SYSTEMS (STS) –

Part 1: General and safety requirements

1 Scope

IEC 62310 consists of three parts and applies to free standing a.c. static transfer systems (STS) intended to ensure the continuity of power to load by automatically or manually controlled transfer, with or without interruption, from two or several a.c. independent sources.

This part of IEC 62310 concerns general and safety requirements. See future IEC 62310-2 for electromagnetic compatibility (EMC) and future IEC 62310-3 for the method of specifying performance and test requirements.

This part of IEC 62310 is intended to reduce the risk of fire, electric shock, or injury to persons from installed equipment subject to installing, operating, and maintaining the equipment in the manner prescribed by the manufacturer.

This part of IEC 62310 includes requirements for the switching elements, their control and protective elements, where applicable. This part of IEC 62310 also includes information for the overall integration of the STS and its accessories into the a.c. power distribution system.

Components or devices necessary for the operation/control/protection/isolation (e.g. circuit-breakers, fuses, transformers, etc.) of a STS should comply with the requirements of the relevant IEC standards and are not covered by this part of IEC 62310.

This standard applies to systems up to 1 000 V (a.c. value) which are intended to be used in single phase or phase-phase or three phase applications.

This standard does not apply to:

- devices for d.c. source switching;
- static transfer system using only electromechanical switching devices intended to be used in emergency power systems with interruption of the supply to the load during transfer. This equipment is covered by IEC 60947-6-1;
- the automatic switching devices integrated into UPS covered by IEC 62040 series.

NOTE For STS intended to be used in vehicles, onboard ships or aircraft, in tropical countries, for emergency power systems (such as those used for health care facilities, fire fighting, emergency rescue, etc.), or on elevations greater than 1 000 m, different requirements may be necessary.

2 Normative references

The following referenced documents are indispensable for the application 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 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60083, *Plugs and socket-outlets for domestic and similar general use, standardised in member countries of IEC*

IEC 60085, *Electrical insulation – Thermal classification*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60364-5-54, *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors*

IEC 60364-7-707, *Electrical installations of building – Part 7: Requirements for special installations or locations – Section 707: Earthing requirements for the installation of data processing equipment*

IEC 60417-DB:2002³, *Graphical symbols for use on equipment*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:1992, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*⁴

Amendment 1 (2000)

Amendment 2 (2002)

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60730-1:1999, *Automatic electrical controls for household and similar use – Part 1: General requirements*⁵

Amendment 1 (2003)

IEC 60755, *General requirements for residual current operated protective devices*

³ “DB” refers to the IEC on-line database.

⁴ A consolidated edition 1.2 exists including IEC 60664-1:1992 and its Amendments 1 (2000) and 2 (2002).

⁵ A consolidated edition 3.1 exists including IEC 60730-1:1999 and its Amendment 1 (2003).

IEC 60950-1:2001, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC 62103:2003, *Electronic equipment for use in power installations*

IEC 62310-2, ____ *Static transfer systems (STS) – Part 2: Electromagnetic Compatibility (EMC) requirements*⁶

ISO 3864-1:2002, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas*

ISO 7000:2004, *Graphical symbols for use on equipment – Index and synopsis*

3 Terms and definitions

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

3.1 General definitions

3.1.1

transfer switch

switching equipment consisting of one or more switches used to transfer power from one source to another

3.1.2

static transfer system

STS

system that transfers a load, by static means, between a preferred source and an alternate source

NOTE 1 The transfer may be automatic and/or manual.

NOTE 2 The transfer may be with or without interruption.

3.1.3

electronic (power) switch

operative unit for electronic power switching comprising at least one controllable valve device

[IEV 551-13-01]

3.1.4

line commutated electronic switch

electronic switch where the commutating voltage is supplied by the line

⁶ To be published.

3.1.5**maintenance by-pass**

power path designed to allow isolation of an appropriate section or sections of a STS for safety during maintenance and/or to maintain continuity of load power

3.1.6**redundant system**

addition of functional units or groups of functional units in a system to enhance the continuity of power to the load

3.1.7**STS input power**

power supplied to STS and bypass, if any, which can be either the preferred source or the alternate source

3.1.8**alternate source**

source used as alternate power supply of the load when the preferred source fails or is out of tolerance or is switched off for maintenance

3.1.9**preferred source**

source used as normal power supply to the load, usually set by the operator

3.1.10**linear load**

load where the current drawn from the supply is defined by the relationship:

$$I = U/Z$$

where

I is the load current;

U is the supply voltage;

Z is the constant load impedance.

3.1.11**non linear load**

load where the parameter Z (load impedance) is no longer a constant but is a variable dependent on other parameters, such as voltage or time

3.1.12**power failure**

any variation in power source deemed to cause unacceptable performance of the load equipment

3.1.13**normal mode of STS operation**

when the load is supplied by the preferred source or the alternate source via the electronic (power) switches

3.1.14**by-pass mode**

when the load is supplied via the maintenance by-pass isolation switch

3.1.15

manual control

control of an operation by human intervention

[IEV 441-16-04]

3.1.16

manual transfer

transfer operation initiated by human intervention

3.1.17

automatic control

control of an operation without human intervention, in response to the occurrence of predetermined conditions

[IEV 441-16-05]

3.1.18

automatic transfer

transfer initiated without human intervention, in response to the occurrence of predetermined conditions

3.1.19

STS synchronous transfer

transfer of load power between two sources which are synchronised within specified limits of frequency, voltage phase and magnitude

3.1.20

STS asynchronous transfer

transfer of load power between two sources which are not synchronised within specified limits

3.1.21

operator access area

area to which, under normal operating conditions, one of the following applies:

- access can be gained without the use of a tool, or
- the means of access is deliberately provided to the operator, or
- the OPERATOR is instructed to enter regardless of whether or not a tool is needed to gain access

NOTE The terms "access" and "accessible", unless qualified, relate to operator access area as defined above.

3.1.22

service access area

area, other than an operator access area, where it is necessary for service personnel to have access even with the equipment switched on

3.1.23

restricted access location

location for equipment where both of the following paragraphs apply:

- access can only be gained by service personnel or by users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and

- access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location

NOTE The requirements for equipment intended for installation in restricted access locations are the same as for operator access areas, except as given in 1.7.17, 2.1.3 and 4.5.1 of IEC 60950-1.

3.1.24

STS primary circuit

internal circuit which is directly connected to the external supply source which supplies the electric power to the load, including the primary windings of transformers, motors, other loading devices and the means of connection to the supply source

3.1.25

STS secondary circuit

circuit which has no direct connection to STS primary circuit

3.1.26

decisive voltage

voltage, taking into account non-sinusoidal waveforms (see 5.2.13 of IEC 62103), defining the borderlines to be used between extra-low-voltage, low voltage and high voltage

NOTE These borderlines are used to determine the requirements of protective earthing when designing clearances and creepage distances for the arrangement of protective measures.

3.1.27

hazardous voltage

voltage exceeding 42,4 V (peak value), or 60 V (d.c. value), existing in a circuit which does not meet the requirements of either:

- a limited current circuit, or
- a TNV circuit that is in compliance with the requirements of 3.1.31

3.1.28

extra-low voltage

ELV

secondary circuit with voltages between conductors, and between any conductor and earth, not exceeding 42,4 V (peak value), or 60 V (d.c. value) under normal operating conditions, which is separated from hazardous voltage by at least basic insulation, and which meets neither all of the requirements for an SELV circuit nor all of the requirements for a limited current circuit

3.1.29

SELV-system (safety extra-low voltage)

electrical system

- in which the voltage cannot exceed ELV, and
- with protective separation from systems other than SELV, and
- with no provision for earthing the SELV-system, or its exposed conductive parts, and
- with simple separation from earth

NOTE Under normal conditions this limit is either 42,4 V (peak value), or 60 V (d.c. value).

3.1.30

SELV circuit

secondary circuit which is so designed and protected that under normal operating conditions and single fault conditions, its voltages do not exceed a safe value

NOTE 1 The limit values of voltages under normal operating conditions and single fault conditions (see IEC 60950-1, 1.4.14) are specified in 2.2 of IEC 60950-1. See also Table 1A of IEC 60950-1.

NOTE 2 This definition of an SELV circuit differs from the term "SELV system" as used in IEC 61140.

3.1.31

TNV circuit

circuit which is in the equipment and to which the accessible area of contact is limited and that is so designed and protected that, under normal operating conditions and single fault conditions, the voltages do not exceed specified limit values

NOTE TNV circuits are classified as TNV-1, TNV-2 and TNV-3 circuits as defined in 3.1.32, 3.1.33 and 3.1.34.

3.1.32

TNV-1 circuit

TNV circuit

- whose normal operating voltages do not exceed the limits for an SELV circuit under normal operating conditions, and
- on which overvoltages from telecommunication networks are possible

3.1.33

TNV-2 circuit

TNV circuit

- whose normal operating voltages exceed the limits for an SELV circuit under normal operating conditions, and
- which is not subject to overvoltages from telecommunication networks

3.1.34

TNV-3 circuit

TNV circuit

- whose normal operating voltages exceed the limits for an SELV circuit under normal operating conditions, and
- on which overvoltages from telecommunication networks are possible

3.1.35

safety interlock

means either of preventing access to a hazardous area until the hazard is removed, or of automatically removing the hazardous condition when access is gained

3.1.36

make-time

interval of time between the initiation of the closing operation and the instant when the current begins to flow in the main circuit

[IEV 441-17-40]

NOTE In the case of an electronic switch, the initiation is the instant when a control signal is applied to the control terminal of the switch.

3.1.37

break-time

interval of time between the initiation of the opening operation of a STS switch and the end of current flow in the circuit considered

[IEV 441-17-39, modified]

NOTE In the case of an electronic switch, the initiation is the instant when a control signal is applied to the control terminal of the switch.

3.1.38

interruption time

time interval during which the output voltage is below the lower limit of the tolerance band

3.1.39

transfer time

time interval between initiation of transfer and the instant when the output quantities have been transferred

3.1.40

total STS transfer time

time interval between the occurrence of an abnormality or out-of tolerance condition and the instant when the output quantities have been transferred

3.1.41

return transfer time (for performance part)

the time from the instant when the preferred source is fully restored to the instant when the set of semiconductor switches is closed on the preferred source

3.1.42

emergency power systems

those power systems that are classed by legal authorities as having jurisdiction as essential power systems, that when interrupted could create hazard to life, hamper rescue or fire-fighting operations, or jeopardise any such emergency operations

3.1.43

optional standby power systems

those power systems where life safety does not depend on the performance of the power system, however, power interruption could cause discomfort, interruption of data processing or communication, serious malfunction/interruption of industrial processes, damage to the product or the like

3.2 Specified values

3.2.1

rating

set of rated values and operating conditions of a machine or a device or equipment

[IEV 151-16-11, modified]

3.2.2

rated value

quantity value assigned, generally by a manufacturer, for a specified operating condition of a component, device or equipment

[IEV 151-16-08, modified]

3.2.3

nominal value

suitable approximate quantity value used to designate or identify a component, device or equipment

[IEV 151-16-09, modified]

3.2.4

limiting value

in a specification, greatest or smallest admissible value of one of the quantities

[IEV 151-16-10, modified]

3.2.5

tolerance band

range of values of a quantity within specified limits

3.2.6

deviation

difference between the desired value and the actual value of a variable at a given instant

[IEV 351-12-15]

3.2.7

rated voltage

input or output voltage (for three-phase supply, the phase-to-phase voltage) as declared by the manufacturer

3.2.8

rated voltage range

input or output voltage range as declared by the manufacturer expressed by its lower and upper rated voltages

3.2.9

r.m.s voltage variation

difference between the r.m.s voltage and the corresponding previously undisturbed r.m.s voltage

NOTE For the purposes of this part of IEC 62310, the term "variation" has the following meaning: the difference of the value of a quantity before and after a change of an influence quantity.

3.2.10

voltage time integral variation

difference between the voltage time integral over one half-cycle and the corresponding values of the previously undisturbed waveform

3.2.11

peak voltage variation

difference between the peak voltage and the corresponding value of the previously undisturbed waveform

3.2.12

phase angle

angle (usually expressed in electrical degrees or radians) between reference points on one or more a.c. waveforms

3.2.13

rated current

input or output current of the equipment as declared by the manufacturer

3.2.14**active power*****P***

sum of the electrical power at the fundamental frequency and the powers of each harmonic component

[IEV 131-11-42, modified]

3.2.15**power factor*****λ***

ratio of the active power to the apparent power

[IEV 131-11-46, modified]

$$\lambda = \frac{P}{S}$$

3.2.16**apparent power*****S***

product of the r.m.s values of voltage and current at a port

[IEV 131-11-41, modified]

$$S=UI$$

3.2.17**displacement factor**

displacement component of the power factor; ratio of the active power of the fundamental wave to the apparent power of the fundamental wave

3.2.18**STS efficiency**

ratio of output active power to input active power under specified conditions

3.2.19**rated frequency**

operating frequency as declared by the manufacturer

3.2.20**rated frequency range**

input or output frequency range as declared by the manufacturer, expressed by its lower and upper rated frequencies

3.2.21**frequency variation (performance part)**

variation of the input or output frequency

3.2.22**form factor**

ratio of r.m.s. value to the average value of a periodic quantity rectified

[IEV 101-14-56, modified]

3.2.23

peak factor

ratio of its peak value to the r.m.s. value of a periodic quantity

NOTE The term «crest factor» has the same meaning.

3.2.24

transient

behaviour of a variable during transition between two steady states

[IEV 351-14-04]

3.2.25

ambient temperature

average temperature of air or other medium in the vicinity of the equipment

NOTE During the measurement of the ambient temperature, the measuring instrument/probe should be shielded from draughts and radiant heating.

[IEV 826-10-03]

3.2.26

operating temperature

temperature at which an STS operates

NOTE The maximum ambient temperature of the air or other medium for operation of the STS is 40 °C unless otherwise specified by manufacturer.

3.3 Input values

3.3.1

input voltage tolerance

maximum variation of steady-state input voltage acceptable by the STS

3.3.2

input voltage distortion

input voltage harmonic distortion acceptable by the STS

3.3.3

input frequency tolerance

maximum variation of steady-state input frequency acceptable by the STS

3.3.4

source impedance

power source impedance at the input terminals to the STS with the STS disconnected

3.3.5

low impedance source failure

failure where the source impedance is negligible (for example upstream short circuit)

4 Safety requirements

4.1 Marking and instructions

4.1.1 General

The STS shall be provided with a marking as detailed below, provision shall be allowed for equivalent wording. For equipment intended to be installed by anyone other than a service person, the marking shall be readily visible either in an operator access area or shall be located on an outside surface of the equipment. If located on an outside surface of fixed equipment, the marking shall be visible after the equipment has been installed as in normal use.

Markings that are not visible from the outside of the equipment are considered to be in compliance if they are directly visible when opening a door or cover.

4.1.2 Equipment ratings

The markings shall include:

- rated operational voltage(s); or rated voltage range(s), in volts;
- rated frequency or rated frequency range, in hertz;
- rated current, in amperes;
- number of output phases (1 ϕ –3 ϕ) with or without neutral;
- number of poles switched;
- maximum ambient operating temperature range (optional).

When multiple ratings apply, ratings shall be separated by solidus (/).

For units designed with additional separate maintenance bypass(s) or additional input a.c. supply, it shall be allowed for relevant supply ratings to be specified in the accompanying installation instructions. Where this is done, the following instruction shall appear on or near the points of connection.

SEE INSTALLATION INSTRUCTIONS BEFORE CONNECTING TO THE SUPPLY

Additional markings are permitted, provided that they do not lead to misunderstanding.

Where symbols are used, they shall conform to ISO 7000 or IEC 60417-DB:2002 where appropriate symbols exist.

4.1.3 Safety instructions

The manufacturer shall provide instructions to safely transport, store, install, operate and maintain STS. The manufacturer shall also provide relevant guidance on the level of competency needed to perform above tasks and to whom they apply e.g. operator, service personnel, etc.

When disconnect devices for isolation of input power supplies are not incorporated in the equipment, the installation instructions shall state that:

- for permanently connected equipment, an appropriate and readily accessible disconnect device shall be incorporated in the fixed wiring;
- for pluggable STS, the socket outlet that supplies the STS shall be installed near the STS and shall be easily accessible.

For permanently connected STS without internal automatic backfeed isolation, the installation instructions shall require fitting by the installer of a warning label on each dedicated and immediately upstream power isolator feeding the STS, to warn electrical maintenance personnel.

The warning label shall carry the following wording or equivalent.

**ISOLATE STATIC TRANSFER SYSTEM (STS)
BEFORE WORKING ON THIS CIRCUIT**

For STS provided with or designed to work with external separate bypass/maintenance bypass, relevant supply ratings shall be specified in the accompanying installation instructions. Where this is done, the following instruction shall appear on or near the point of connection:

**SEE INSTALLATION INSTRUCTIONS BEFORE
CONNECTING TO THE SUPPLY**

Compliance is determined by inspection.

4.1.4 Supply voltage adjustment

For equipment intended for connection to multiple rated voltages or frequencies, the method of adjustment shall be fully described in the servicing or installation instructions.

Unless the means of adjustment is a simple control near the power rating marking, and the setting is obvious by inspection, the following instruction or a similar one shall appear in or near the power rating marking:

**SEE INSTALLATION INSTRUCTIONS
BEFORE CONNECTING INPUT SUPPLIES**

4.1.5 Power outlets on the equipment

If any standard power supply outlet in the equipment is accessible to the operator, a marking shall be placed in the vicinity of the outlet to show the maximum load that is permitted to be connected to it.

Socket-outlets conforming to IEC 60083 are examples of standard power supply outlets.

4.1.6 Fuses identification

Marking shall be located adjacent to each fuse or fuseholder, or on the fuseholder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and, where fuses of different voltage rating value could be fitted, the fuse voltage rating.

Where fuses with special fusing characteristics such as time delay or breaking capacity are necessary, the type shall also be indicated.

For fuses not located in operator access areas and for soldered-in fuses located in operator access areas, it is permitted to provide an unambiguous cross-reference (e.g. F1, F2, etc.) to the servicing instructions which shall contain the relevant information.

4.1.7 Wiring terminals

4.1.7.1 Protective earthing and bonding terminals

A wiring terminal intended for connection of a protective earthing conductor shall be indicated by $\oplus$ (IEC 60417-5019 (DB:2002-10)). This symbol shall not be used for other earthing terminals.

It is not a requirement to mark terminals for protective bonding conductors, but where such terminals are marked, the symbol $\equiv$ (IEC 60417-5017(DB:2002-10)) shall be used.

The following situations are exempt from the above requirements:

- on subassemblies or components, the symbol $\oplus$ is permitted in place of the symbol $\equiv$ provided that it does not give rise to confusion.

These symbols shall not be located on screws, or other parts which might be removed when conductors are being connected.

These requirements are applicable to terminals for connection of a protective earthing conductor whether run as an integral part of a power supply cord or with supply conductors.

4.1.7.2 Terminals for a.c. supply conductors

For permanently connected equipment and equipment with ordinary non-detachable power supply cords:

- terminals intended exclusively for connection of the a.c. supplies neutral conductors, if any, shall be indicated by the capital letter N;
- on three-phase equipment, terminals intended for connection of the a.c. supplies line conductors shall be marked in such a way that, in conjunction with any installation instructions, the sequence of phase rotation is unambiguous.

These indications shall not be located on screws, or other parts which might be removed when conductors are being connected.

4.1.8 Controls and indicators

4.1.8.1 Identification, location and marking

Unless it is obviously unnecessary, indicators, switches and other controls affecting safety shall be identified or located so as to indicate clearly which function they control.