

## **Environmental Engineering (EE); General Requirements for UPS for use in Telecommunication Environment**

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Reference

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## Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Environmental Engineering (EE).

The present document concerns the requirements for UPS for powering telecommunications equipment and to be able to coexist within telecommunication equipment. Various references and detailed measurement and test arrangements are contained in the present document.

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# 1 Scope

The present document is a guidance on the characteristics have to be considered to have a coexistence of UPS with other equipment in a normal telecommunication installation.

Due to the increasing IT/Telco convergence AC-powered infrastructure needs to be considered as well as DC-powered infrastructure.

In order to ensure continuous operation of AC powered equipment, uninterruptible power systems (UPS) with AC-output can be used.

In the present document the requirements (EMC-performance criterion and power-line influences) for UPS Systems of any rated output are recommended. Particularly it is considered that the UPS may coexist with standard Telecommunication equipment in a telecommunication centre.

This UPS is responsible for the continuous (uninterruptible) supply of AC-powered Telecommunication- or Datacom equipment.

The application of UPS for powering Telecommunication and Datacom equipment is provided in TR 102 121 [3].

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# 2 References

For the purposes of this Technical Report (TR), the following references apply:

- [1] ETSI ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources".
- [2] ETSI EN 300 132-3: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V".
- [3] ETSI TR 102 121: "Environmental Engineering (EE); Guidance for power distribution to telecommunication and datacom equipment".
- [4] ETSI EN 300 019-1-1: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-1: Classification of environmental conditions; Storage".
- [5] ETSI EN 300 019-1-2: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation".
- [6] ETSI EN 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".
- [7] ETSI EN 300 019-2-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3: Specification of environmental tests; Stationary use at weatherprotected locations".
- [8] ETSI ETS 300 753: "Equipment Engineering (EE); Acoustic noise emitted by telecommunications equipment".
- [9] ETSI EN 300 386: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements".
- [10] IEC 62040-1-1: "Uninterruptible power systems (UPS), Part 1-1: General and safety requirements for UPS used in operator access areas".

- [11] IEC 61000-2-2: "Electromagnetic compatibility (EMC) - Part 2-2: Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems".
- [12] CENELEC EN 55022: "Limits and methods of measurement of radio interference characteristics of information technology equipment".
- [13] IEC 61000-3-2: "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current  $\leq 16$  A per phase)".
- [14] IEC 61000-4-2: "Electromagnetic compatibility (EMC)- Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".
- [15] IEC 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".
- [16] IEC 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".
- [17] IEC 61000-4-5: "Electromagnetic compatibility (EMC)- Part 4-5: Testing and measurement techniques - Surge immunity test".
- [18] IEC 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields".
- [19] CENELEC EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".
- [20] CENELEC EN 61000-6-2: "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments".
- [21] CENELEC EN 61000-6-4: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 4: Emission standard for industrial environments".
- [22] IEC EN 61000-3 (sub-part 2/3/4/5): "Electromagnetic compatibility (EMC) - part 3-2: "Limits - Limits for harmonic current emissions (equipment input current  $\leq 16$ A per phase) Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current  $\leq 16$  A per phase and not subject to conditional connection / Part 3-4: Limits - Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A / Part 5: Limits - Section 5: Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 16 A".
- [23] ETSI EN 300 253: "Environmental Engineering (EE); Earthing and bonding of telecommunication equipment in telecommunication centres".
- [24] CENELEC EN 50310: "Application of equipotential bonding and earthing in buildings with information technology equipment".
- [25] CENELEC EN 55016-2-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements".

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**abnormal voltage range:** range of steady-state voltage over which the equipment will not be expected to maintain normal service but will survive undamaged

**maximum continuous input current:** maximum continuous input current, stated by the manufacturer, for a fully-loaded UPS, at nominal voltage.

**normal service:** service mode where the UPS operates within its specification

**normal service voltage range:** range of steady-state voltages over which the UPS will maintain normal service

**nominal voltage:** nominal value of the voltage that designates the type of supply

**power supply:** power source to which UPS is intended to be connected

**telecommunication centre:** location where telecommunications equipment is installed and which is the sole responsibility of the operator

### 3.2 Symbols

For the purposes of the present document, the following symbols apply:

A	Compliance Criterion, Normal Performance, according to EN 300 386 [9]
B	Compliance Criterion, Reduced performance, according to EN 300 386 [9]
C	Compliance Criterion, Loss of Function, Self recovery; according to EN 300 386 [9]

### 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
DC	Direct Current
P	electric Power in Watt (W)
Un	nominal voltage in Volt (V)
UPS	Uninterruptible Power Supply 230 VAC or 3 × 400 VAC

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## 4 General Requirements

### 4.1 AC-Output Voltage

The AC secondary voltage-range shall be in accordance with the normal service condition defined in ETS 300 132-1 [1].

The long-term voltage fluctuations at the AC secondary interface shall be within  $\pm 10$  % of the nominal voltage.

## 5 EMC-Requirements

### 5.1 Immunity

Test condition: resistive (ohmic) nominal-load.

**Table 1: EMC-requirements according to EN 61000-6-2 [20], EN 61000-6-4 [21] and EN 300 386 [9]**

Phenomenon	Coupling	Ref.	Test-Level	Performance Criterion / Remarks	
Electrostatic Discharge	Enclosure	IEC 61000-4-2 [14]	6kV (contact) 8kV (air-discharge)	A	No ESD-protected Environment in Power-supply rooms.
			8kV (contact) 15kV (air-discharge)	B	
Electromagnetic Fields	Enclosure	IEC 61000-4-3 [15]	3V/m	A	Normal- and Battery-operation.
800 -960 MHz 1400 – 2200 MHz for use in Radio Base Stations	Enclosure		10V/m	B	
Fast Transients	AC-Input- and AC-Output-Lines	IEC 61000-4-4 [16]	10V/m	A	Filtering (Input/Output) in Normal- and Bypass-mode: Transient voltage on the output must be lower than the immunity limit of the powered equipment.
			Signal-Lines	1kV	
	Battery-Lines		2kV	B	
			1 kV	A	
Surges	AC-Input-Lines	IEC 61000-4-5 [17]	2 kV	C	Filtering (Input/Output) in Normal- and Bypass-mode: Absorption factor > 4.
			1kV (LL) 2kV (LPE)	A	
	Battery-Lines and Signal-Lines		2kV (LL) 4kV (LPE)	B	
			0.5kV asymm. 0.5kV symm.	A	Normal-, Bypass- and Battery-operation.
Conducted HF-Disturbances	AC-Input-, AC-Output-, Battery- and Signal-Lines	IEC 61000-4-6 [18]	2kV asymm. 1kV symm.	B	Resistive Nominal-Load.
			150kHz – 80 MHz; 3V; 1kHz AM 80 %	A	
			150kHz – 80 MHz; 10V; 1kHz AM 80 %	B	
Voltage Dips and Interruptions	AC-Input		10 ms / <5 % Un 100ms / 40 % Un 5s / <5 % Un	A	Resistive Nominal-Load.



## 5.2 Emission

Test condition: resistive (ohmic) nominal-load.

**Table 2**

Phenomenon	Coupling	Ref.	Test-setup	Limits / Remarks
Harmonic Emission and Flicker	AC-Input	CENELEC EN 61000-3-X	Resistive Nominal-load; 80 % non-linear load.	part -2 / -3 / -4 / -5
Conducted Emissions	AC-Input	CENELEC EN 55022 [12] and special	AC-Input-, and Output-lines are both connected via 50Ω/50μH AMNs.	AC-Input: 10kHz - 150kHz: For P ≤ 20 kVA: 90dBμV/QP For P ≤ 20 kVA: 100dBμV/QP
	AC-Output	CENELEC EN 55022 [12]	The test should be carried out in mains operation and battery mode for all of the following load conditions: no-load; resistive nominal-load.	150kHz - 30MHz: Class A. If the current rating of an EUT exceeds the rating of available AMNs, the AMN may be used as a voltage probe according to Appendix A.5 of CENELEC EN 55016-2-1 [25] and using the set-up of Fig. A.8.
	Battery-lines	CENELEC EN 55022 [12]		Signal lines should be tested with the same test methods and limits of telecommunications lines.
	Signal and telecommunication Lines	CENELEC EN 55022 [12]		
Radiated Emissions	Enclosure	CENELEC EN 55022 [12]	30MHz – 1GHz  The test should be carried out in mains operation and battery mode for all of the following load conditions: no-load; resistive nominal-load.	Class A

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## 6 Additional Requirements

### 6.1 Earthing and bonding

According to EN 300 253 [23] and CENELEC EN 50310 [24].

### 6.2 Inrush-Current (UPS input)

Test setup according to ETS 300 132-1 [1]. The EUT is connected direct to the mains with adequate cables.

Load: resistive nominal-load.

Requirement: Line Breakers Type C (5 to 10 × In) may not obey switching on the EUT.

After a mains failure (also brief) the maximally specified inrush current according to ETS 300 132-1 [1] may not exceed.

## 6.3 Slow decrease and increase of the UPS-input-voltage (Brown-out)

- During a slow decrease of the input voltage (Brown-out) from  $3 \times 400/230$  VAC to 0 V, no damage shall occur.
- During a following slow increase of the input voltage from 0 V to  $3 \times 400/230$ , self recovery to normal performance shall occur.
- The "switch on" and "switch off" input-voltage level of the UPS must be ensured by a sufficient large Hysteresis, so that no instable on-off switching situation occurs.
- The maximum inrush current may not exceed 1.3 times the nominal input-current (at  $U_{in} = 230$  VAC or  $3 \times 400$  VAC, at nominal-load).

## 6.4 Immunity against Line Disturbances

- In case of asymmetrical load and a failure of one ore more phases at the input, no damage at the UPS, the connected equipment and the batteries may occur.
- Test condition: Battery disconnected. In case of mains failure of one or more phases at the input (high- or low-ohmic) no disturbance or damage may occur (simulation of defective battery).
- In case of the failure of 1 half-wave or the appearance of two immediately followed positive or negative half-waves at the input, no disturbance or damage may occur.

## 6.5 Climatic Conditions

The requirements for environmental conditions are defined in EN 300 019:

Specific requirements:

- Storage: according to EN 300 019-1-1 [4], Class 1.2.
- Transport: according to EN 300 019-1-2 [5], Class 2.2.
- Operation: according to EN 300 019-1-3 [6], Class 3.2.
- Laboratory test according to EN 300 019-2-3 [7], T 3.2.

## 6.6 Acoustic noise

The requirements for acoustic noise emissions are specified in ETS 300 753 [8].

# 7 Performance Criterion according to EN 300 386

## 7.1 Criterion A (continuous phenomena)

During the exposure, the AC secondary range shall be in accordance with the normal service condition defined in ETS 300 132-1 [1].

The long-term voltage fluctuations at the AC secondary interface shall be within  $\pm 10$  % of the nominal voltage.

During and after the exposure, the EUT shall operate without alarms, false alarm indications (power supply failure, protection failure, etc.) and false display indications.

## 7.2 Criterion B (transient phenomena)

Voltage interruptions at the AC secondary interface shall last no longer than 20 ms. The time between two voltage interruptions shall be no less than 10 s.

The voltage fluctuations at the AC secondary interface shall be in accordance with the requirements of ETS 300 132-1 [1]:

- for < 500 ms with respect to r.m.s. value: no worse than  $\pm 15$  % of nominal value;
- for < 2 ms with respect to actual value: no worse than  $\pm 40$  % of nominal value.

The frequency at the AC secondary interface shall not vary by more than  $\pm 3$  Hz and shall return to the nominal value within 5 s.

Peaks with a duration shorter than 0,25 of one period (5 ms for a 50 Hz system), which appear during the exposure, are permissible.

After the exposure, the EUT shall operate without alarms or false alarm indications (power supply failure, protection failure, etc.) or false display indications.

Self recovery to normal performance shall occur at the cessation of the exposure.

## 7.3 Criterion C

Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or, in the case of switching equipment, by normal subsequent use.

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## History

<b>Document history</b>		
V1.1.1	November 2005	Publication