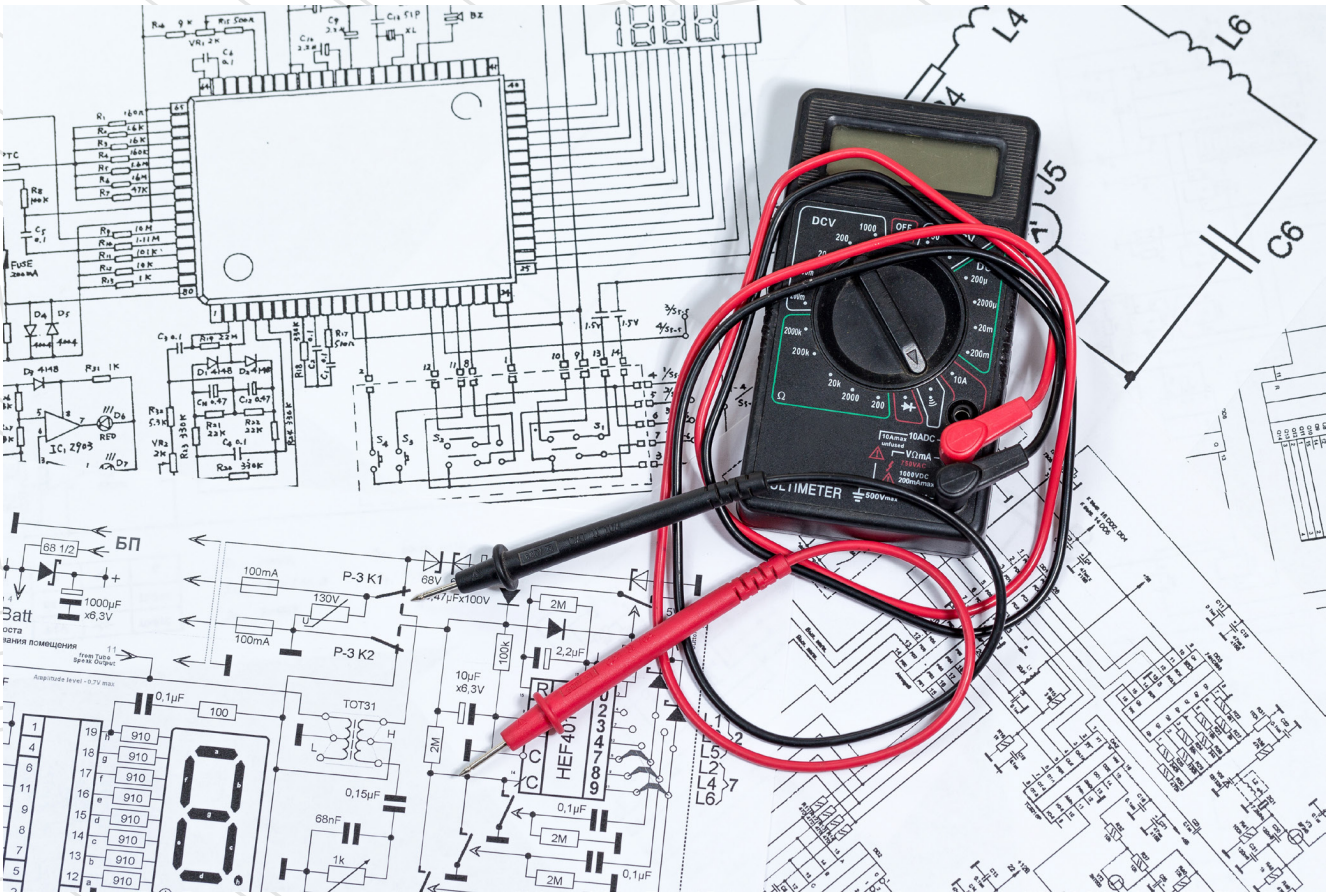

IEC/EN61000 Standards for Power Supplies

SL Power Application Note

PURPOSE

This application note provides a general description of the EMC standards for power supplies, including the test levels and an explanation of the different performance criteria that can be met for each standard.

One of the least well defined specifications on a power supply datasheet are the IEC/EN61000-3 and -4 standards. Stating that the power supply complies to a given standard without specifying the test level at which it complies and the performance criteria during the test, does not provide the system designer with enough of the details needed to properly evaluate the effectiveness of the supply.

A list of pertinent IEC/EN61000 immunity standards is provided for a quick reference and description of the standard. The information provided in this application note is for guidance and may not represent the latest standards requirement. Consult the actual standard for applicable levels and requirements.

IEC/EN Electromagnetic Compatibility (EMC) Immunity Standards Useful for Power Supplies	**Reference Number**
Limits for Harmonic Current	IEC/EN61000-3-2
Limitation Voltage Fluctuation/Flicker	IEC/EN61000-3-3
Electrostatic Discharge Test	IEC/EN61000-4-2
Radiated RFI Immunity	IEC/EN61000-4-3
Electrical Fast Transients/Burst	IEC/EN61000-4-4
Mains Surges	IEC/EN61000-4-5
Conducted RFI	IEC/EN61000-4-6
Mains Frequency Magnetic Field	IEC/EN61000-4-8
Pulsed Magnetic Field	IEC/EN61000-4-9
Damped Oscillatory Magnetic Field	IEC/EN61000-4-10
Supply Voltage Dips and Interruptions	IEC/EN61000-4-11

EVALUATION OF TEST RESULTS (Acceptance Criteria)

The test results for the various sections of the EN61000-4 Standards are classified in terms of the loss of functionality or degradation of performance of the equipment under test (EUT),relative to a performance level defined by its manufacturer, the requestor of the test, or agreed upon between the manufacturer and the purchaser of the product. The recommended classifications apply to all sections of the standard detailed herein, and are as follows:

– **Criteria A:** Normal performance within limits specified by the manufacturer, requestor or purchaser.
– **Criteria B:** Temporary loss of functionality or degradation of performance which ceases after the disturbance is removed, and from which the EUT recovers its normal performance without operator intervention.
– **Criteria C:** Temporary loss of functionality or degradation of performance, the correction of which requires operator intervention.
– **Criteria D:** Loss of functionality or degradation of performance which is not recoverable, owing to damage to hardware or software, or loss of data.

IEC/EN 61000-3-2

Limits for Harmonic Current Emissions

Background
IEC/EN 61000-3-2 deals with the limitation of harmonic currents that is supplied from mains network with voltage not less than 220V and current up to and i ncluding 16A per phase. It specifies limits of harmonic components of the input current which may be produced by equipment tested under specified conditions with the exception of the following equipment.

– Equipment with rated power less than 75W, except class C equipment
– Professional equipment with power >1 kW
– Symmetrically controlled heating elements with power ≤200W
– Independent dimmers for incandescent luminaries with power ≤1 kW

Power Supply Consideration

Harmonic currents are caused by non-linear electric loads such as rectifiers which typically draw non-sinusoidal currents. Some examples of non-linear loads are switch mode power supplies, without input current waveform or power factor correction (PFC), used in office equipment like computers and printers, lighting ballasts, and battery chargers. The nonsinusoidal currents from non-linear loads can become quite complex, but can be broken down into simple sinusoids that occur at multiples of the fundamental frequency of the AC input or harmonics. The greater the value of each current harmonic, the more distortion it puts back onto the AC input line.

Distortions can cause higher temperatures in neutral conductors or distribution transformers due to increased currents in the power system. The higher frequency harmonics can cause additional core losses in motors resulting in additional heat in the motor core. It can also cause changes to the voltage waveform which some electronic components cannot handle. The increased temperatures and inability to handle the voltage distortions can cause the life span of the equipment connected to the AC line to be significantly shortened or cause the equipment to fail prematurely.

Minimizing the amount of current at each harmonic, decreases the total amount of distortion that is seen on the AC line and thus decreases the effects on other equipment on the AC line.

Classification

Class A

– Three phase equipment
– Household appliances, except class D equipment
– Stationary, fixed tools
– Dimming equipment intended to be combined with incandescent lamps
– Audio equipment
– Other equipment that is not classified as class B, class C or class D
– Examples: Frequency converters, cooking appliances, fixed woodworking equipment, lighting dimmers, audio amplifiers, subwoofers, heaters with regulation.

Class B

– Portable tools, non-professional arc welding equipment

Class C

– Lighting equipment
– Examples: LED lighting, LED street lighting and other lighting equipment.

Class D

– Equipment type with power less than 600W (including):
– Personal computers and similar
– Television receivers
– Refrigerators and freezers that are equipped with variable speed drives
– Examples: Personal computers, tablets, laptops, TVs, refrigerators.

Requirements

Conducted emission requirements covered by this standard are up to the 40th harmonic. The table below illustrates the differences between the equipment classifications:

Limit lines

Harmonic Order	Current Limit				
	Class A	Class A	Class C	Class D	
n	[A]	[A]	Expressed as percentage of the input current at the fundamental frequency **[%]**	Permissible current per Watt **[mA/W]**	Permissible harmonic current **[A]**
2	1.08	1,62	2	-	-
3	2.30	3,45	3*λ	3.4	2.30
4	0.43	0,64	-	-	-

See the specific standard for the limits for each of the other h armonics.
All limit values expressed with precision 0.01. λ — power factor of the circuit.

IEC/EN 61000-3-3

Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems (Flicker)

Background

IEC/EN 61000-3-3 deals with the limitation of voltage fluctuations and flicker that is supplied from mains network with input voltage between 220V and 250V line to neutral at 50 Hz and current up to and including 16A per phase and not subject to conditional connection. It specifies limits of voltage changes which may be produced by equipment tested under specified conditions and gives guidance on methods of assessment.

Power Supply Considerations

Flicker has to do with the effects of changing loads on the power utility that would cause lighting to flicker and be a nuisance to people or affect operation of other equipment. Flicker can impair vision and cause fatigue resulting in reduced concentration and workplace accidents. A power supply with a constant load would not have a problem passing this requirement. However, equipment with a changing load, such as a high powered strobe, may have an issue and the power supply is limited in filtering this affect. High frequency (>~20-30Hz) would be filtered pretty well, but lower frequency large load changes would not.

Requirements

Parameter	Limit		Conditions
Short-term flicker indicator	Pst	1.0	
Long-term flicker indicator	Plt	0.65	
Relative voltage change	d(t)	3,3%	For more than 500ms
Relative steady-state voltage change	dc	3,3%	
Maximum relative voltage change	dmax	4%	Without additional conditions
		6%	For equipment which is switched manually or switched automatically more frequently than twice per day
		7%	For equipment which is attended while in use (hair dry-ers, vacuum cleaners, mixers, lawn mowers, electric drills), or switched on automatically, or is intended to be switched on manually, no more than twice per day

IEC/EN 61000-4-2

Electrostatic Discharge Immunity Test (ESD)

Background

The IEC/EN 61000-4-2 standard defines four standard levels of ESD protection, using two different testing methodologies. Contact discharge involves discharging an ESD pulse directly from the ESD test gun that is touching the device unde r test. This is the preferred method of testing. However, the standard provides for an alternate test methodology known as air discharge for cases where contact discharge testing is not possible. In the air discharge test, the ESD test gun is brought close to the device under test until a discharge occurs. The standards are defined so that each level is considered equivalent – a Level 4 contact discharge of 8kV is considered equivalent to a 15kV air discharge.

Power Supply Considerations

Internal type power supplies are meant to be handled only during the manufacturing process, as parts are installed in end equipment. Therefore, the assumption might be that the power supply is to be designed for and tested to Level 3. However, as internal power supplies are increasingly being designed into portable devices such as home healthcare equipment, power supplies meeting the Level 4 test parameters will provide the end system designer a more robust power supply, potentially allowing easier system compliance to Level 4.

External power supplies, however, are commonly handled frequently, and therefore it would be beneficial for engineers choosing an external power supply for use with their system to opt for a power supply compliant with Level 4 test levels.

Test Levels

Level	Realtive Humidity as low as	Antistatic Material	Synthetic Material	Contact Discharge Test Voltage	Air Discharge Test Voltage
1	35%	X		2kV	2kV
2	10%	X		4kV	4kV
3	50%		X	6kV	6kV
4	10%		X	8kV	15kV

The ESD threat is divided into four threat levels depending on material and ambient humidity. Threat Level 1 is considered the least severe while threat Level 4 is the most severe.

- Levels 1 & 2 are reserved for equipment which is installed in a controlled environment and in the presence of anti-static materials.
- Level 3 is used for equipment which is sparsely but not continuously handled.
- Level 4 is required for any equipment which is continuously handled.

IEC/EN 61000-4-3

Radiated, radio-frequency, electromagnetic field immunity test (RF Field Susceptibility)

Background

The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to radiated, radio-frequency electromagnetic fields. The test method describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon. This part deals with immunity tests related to the protection against RF electromagnetic fields from any source. Particular considerations are devoted to the protection against radio-frequency emissions from digital radiotelephones and other RF emitting devices.

Power Supply Considerations

Most electronic equipment is, in some manner, affected by electromagnetic radiation. This radiation is frequently generated by general purpose sources such as the small hand-held radio transceivers that are used by operating, maintenance and security personnel, fixed station radio and television transmitters, vehicle radio transmitters, and various industrial electromagnetic sources. In addition to electromagnetic energy deliberately generated, there is also radiation caused by devices such as welders, thyristors, fluorescent lights, switches operating inductive loads, etc.

For the most part, this interference manifests itself as conducted electrical interference and, as such, is dealt with in other parts of the IEC 61000-4 s tandard series. Methods employed to prevent effects from electromagnetic fields will normally also reduce the effects from these sources. The electromagnetic environment is determined by the strength of the electromagnetic field. The field strength is not easily measured without sophisticated instrumentation nor is it easily calculated by classical equations and formulas because of the effect of surrounding structures or the proximity of other equipment that will distort and/or reflect the electromagnetic waves.

Test Levels

Level	Test Field Strength
1	1V/m
2	3V/m
3	10V/m
4	30V/m

Test levels related to general purposes

The test levels and the frequency bands are selected in accordance with the electromagnetic radiation environment to which the EUT can be exposed when finally installed. For equipment intended for operation in a variety of locations, the following guidance may be used in selecting the test level to be applied.

– – **Class 1**: Low-level electromagnetic radiation environment. Levels typical of local radio/television stations located at more than 1km, and transmitters/receivers of low power.
Class 2: Moderate electromagnetic radiation environment. Low power portable transceivers (typically less than 1W rating) are in use, but with restrictions on use in close proximity to the equipment. A typical commercial environment.
– **Class 3**: Severe electromagnetic radiation environment. Portable transceivers (2W rating or more) are in use relatively close to the equipment, b ut not less than 1m. High power broadcast transmitters are in close proximity to the equipment and ISM equipment may be located close by. A typical industrial environment.
– **Class 4**: Portable transceivers are in use within less than 1m of the equipment. Other sources of significant interference may be within 1 m of the equ ipment.

IEC/EN 61000-4-4

Electrical Fast Transient/Burst Immunity Test (EFT)

Background
This part of IEC 61000-4 relates to the immunity of electrical and electronic equipment to repetitive electrical fast transients. It gives immunity requirements and test procedures related to electrical fast transients/bursts. It additionally defines ranges of test levels and establishes test procedures. The object of this standard is to establish a common and reproducible reference in order to evaluate the immunity of electrical and electronic equipment when subjected to electrical fast transient/bursts on supply, signal, control and earth ports.

Power Supply Considerations
Transient noise couples to the end equipment via the AC power cord, DC power, and signal/control lines and if proper filtering is not used, the noise can propagate to different parts of the system. The transient noise can be both common mode and differential mode noise. Common-mode noise is present on both conductors. Differential noise is present on only one conductor.

Test Levels

Level	Power Supply Port		I/O, Signal, Data & Control Lines	
	Voc	Isc	Voc	Isc
1	35%	X		2kV
2	10%	X		4kV
3	50%		X	6kV
4	10%		X	8kV

The EFT is divided into levels depending on the environment the EUT would be used in.
Level 1 is considered the least severe while Level 4 is the most severe.
– Level 1 is a well-protected environment.
– Level 2 is a protected environment.
– Level 3 is a typical industrial environment.
– Level 4 is a severe industrial environment.

IEC/EN 61000-4-5

Surge Susceptibility Immunity Test

Background

This part of IEC 61000 relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by over-voltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment.

Power Supply Considerations

A surge of energy superimposed on the AC line, generally of short duration, can potentially have the most serious effects on electronic equipment due to their high energy content. Many events can cause surges, such as lightning bolts, utility grid switching, switching inductive loads on and off, and SCR (Silicon Control Rectifier) dimmers.

Test Levels

Level	Open Circuit Test Voltage (±10%)
1	0.5kV
2	1kV
3	2kV
4	4kV

Preferential ranges of test levels are given in the above table. These values are included for illustration only and do not form a recommendation or requirement. The values have been chosen only for explanatory purposes and are not put forward as some recommended practice. The more accurate classification of a power supply performance to this standard is made by the Installation Class. The Installation Class test levels and designations are detailed below:

	AC power supply and a.c. I/O directly connected to the mains network		AC power supply and a.c. I/O not directly connected to the mains network		DC power supply and d.c. I/O directly connected there to		Unsymmetrical operated circuit/ lines (Notes 4,6)		Symmetrical operated circuits/ lines (Notes 4,6)		Shield I/O and communication lines (Note 6)	
Installation Class	Coupling Mode		Coupling Mode		Coupling Mode		Coupling Mode		Coupling Mode		Coupling Mode	
	Line-Line	Line-Gnd	Line-Line	Line-Gnd	Line-Line	Line-Gnd	Line-Line	Line-Gnd	Line-Line	Line-Gnd	Line-Line	Line-Gnd
0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1	N/A	0.5kV	N/A	N/A	N/A	N/A	N/A	0.5kV	N/A	0.5kV	N/A	N/A
2	0.5kV	1kV	N/A	N/A	N/A	N/A	0.5kV	1kV	N/A	1kV	N/A	0.5kV
3	1kV	2kV	1kV (Note 5)	2kV (Note2, 5)	1kV (Note 5)	2kV (Note2, 5)	1kV (Note 3)	2kV (Note2, 3)	N/A	2kV (Note2, 3)	N/A	2kV (Note 3)
4	2kV	4kV (Note 2)	2kV (Note 5)	4kV (Note 2,5)	2kV (Note 5)	4kV (Note 2,5)	2kV (Note 3)	4kV (Note 2,3)	N/A	2kV (Note2, 3)	N/A	4kV (Note 3)
5	Note 1	Note1	2kV	4kV (Note 2)	2kV	4kV (Note 2)	2kV	4kV (Note 2)	N/A	4kV (Note 2)	N/A	4kV (Note 3)

Notes:

1. Depends on the class of the local power supply system.
2. Normally tested with primary protection.
3. The test level may be lowered by one level if the cable length is shorter or equal to 10m.
4. No test is advised at data connections intended for cables shorter than 10m.
5. If protection is specified upstream from the EUT, the test level should correspond to the protection level when the protection is not in place.
6. High speed communications lines could be included under unsymmetrical, symmetrical, shielded I/O and/or communications lines.

Installation Classifications:

• **Class 0:** Well-protected electrical environment, often within a special room. All incoming cables are provided with overvoltage (primary and secondary) protection. The units of the electronic equipment are interconnected by a well-designed grounding
system, which is not significantly influenced by the power installation or lightning. The electronic equipment has a dedicated power supply. Surge voltage may not exceed 25V.

• **Class 1:** Partly protected electrical environment. All incoming cables to the room are provided with overvoltage (primary) protection. The units of the equipment are wellinterconnected by a ground connection network, which is not significantly influenced by the power installation or lightning. The electronic equipment has its power supply completely separated from the other equipment. Switching operations can generate interference voltages within the room. Surge voltage may not exceed 500V.

• **Class 2:** Electrical environment where the cables are well-separated, even at short runs. The installation is grounded via a separate connection to the grounding system of the power installation which can be subjected to interference voltages generated by the installation itself or by lightning. The power supply to the electronic equipment is separated from other circuits, usually by a dedicated transformer for the mains power supply. Non-protected circuits are present in the installation, but well-separated and in restricted numbers. Surge voltages may not exceed 1kV.

• **Class 3:** Electrical environment where power and signal cables run in parallel. The installation is grounded to the common grounding system of the power installation which can be subjected to interference voltages generated by the installation itself or by lightning. Current due to ground faults, switching operations and lightning in the power installation may generate interference voltages with relatively high amplitudes in the grounding system. Protected electronic equipment and less sensitive electric equipment are connected to the same power supply network. The interconnection cables can be partly outdoor cables, but close to the grounding network. Unsuppressed inductive loads are present in the installation and usually there is no s eparation of the different field cables. Surge may not exceed 2 kV.

• **Class 4:** Electrical environment where the interconnections are running as outdoor cables along with power cables, and cables are used for both electronic and electric circuits. The installation is connected to the grounding system of the power installation which can be subjected to interference voltages generated by the installation itself or by lightning. Currents in the kA range due to ground faults, switching operations and lightning in the power supply installation may generate interference voltages with relatively high amplitudes in the grounding system. The power supply network can be the same for both the electronic and the other electrica l equipment. The interconnection cables are run as outdoor cables, even to the high-voltage equipment. A special case of this environment is when the electronic equipment is connected to the telecommunication network within a densely populated area. There is no systematically constructed grounding network outside the electronic equipment, and the grounding system consists only of pipes, cables, etc. Surge voltage may not exceed 4kV.

• **Class 5:** Electrical environment for electronic equipment connected to telecommunication cables and overhead power lines in a non-densely populated area. All of these cables and lines are provided with overvoltage (primary) protection. Outside the electronic equipment there is no widespread grounding system (exposed plant). The interference voltages due to ground faults (currents up to 10kA) and lightning (currents up to 100kA) can be extremely high. The requirements of this class are covered by the test Level 4.

IEC/EN 61000-4-6

Conducted RF Immunity

Background

This part of IEC 61000 relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9kHz up to 80MHz. Equ ipment not having at least one conducting cable (such as mains supply, signal line or earth connection) which can
couple the equipment to the disturbing RF fields is excluded. The object of this standard is to establish a common reference for evaluating the functional immunity of electrical and electronic equipment when subjected to conducted disturbances induced by RF fields.

Power Supply Consideration

Conducted RF Immunity simply refers to a product's ability to filter unwanted noisy RF voltages and currents carried by its external wires and cables. Significant levels of conducted RF noise can cause errors or malfunctions in analog or digital circuits. The purpose of the test is to simulate the proximity of the EUT and its connected cables to radio transmitters and RF manufacturing equipment operating at low frequencies. These frequencies are not easy to test using the radiated RF immunity techniques. It is hard to generate uniform fields in typical test facilities at frequencies much below 80MHz, but for typical sizes of apparatus, the immunity problems at frequencies below 80MHz are normally associated with cable coupling, so conducted testing of the cables is seen as a reasonable alternative to radiated methods at such frequencies.

Test Levels

No tests are required for induced disturbances caused by electromagnetic fields coming from intentional RF transmitters in the frequency range 9kHz to 150kHz.

Frequency Range 150kHz – 80MHz

Level	Open Circuit Test Voltage (±10%)	
	dB(µV)	Vrms
1	120	1
2	130	3
3	140	10

The RF Immunity Levels are divided depending on the environment the EUT would be used in. Level 1 is considered the least severe while Level 4 is the most severe.

• **Level 1:** Low level electromagnetic radiation environment. Typical level where radio/television stations are located at a distance of >1km and typical level for low power transceivers.

• **Level 2:** Moderate electromagnetic radiation environment. Low power portable transceivers (typically <1W rating) are in use, but with restrictions on use in close proximity to the equipment. A typical commercial environment.

• **Level 3:** Severe electromagnetic radiation environment. Portable transceivers (2W and more) are in use relatively close to the equipment, but at a di stance not less than 1m. High powered broadcast transmitters are in close proximity to the equipment and ISM equipment may be located close by. A typical industrial environment.

IEC/EN 61000-4-8

Power Frequency Magnetic Field Test

Background

This part of IEC 61000 relates to the immunity requirements of equipment, only under operational conditions, to magnetic disturbances at power frequencies of 50Hz and 60Hz related to:

- Residential and commercial locations
- Industrial installations and power plants
- Medium voltage and high voltage sub-stations

The applicability of this standard to equipment installed in different locations is determined by the presence of the phenomenon, as specified in Clause 4. This standard does not consider disturbances due to capacitive or inductive coupling in cables or other parts of the field installation.

The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment for household, commercial and industrial applications when subjected to magnetic fields at power frequency (continuous and short duration field).

Power Supply Consideration

The magnetic fields to which equipment is subjected may influence the reliable operation of equipment and systems. When one piece of equipment is in cl ose proximity to another, LF magnetic fields can cause interference. This is especially a problem for CRT image 'wobble', but also for baseband circuits such as instrumentation, video and audio, whose circuits and cables can couple with the magnetic fields and suffer significant amounts of crosstalk in some situations. These tests are intended to demonstrate the immunity of equipment when subjected to power frequency magnetic fields related to the specific locations and installation condition of the equipment. The power frequency magnetic field is generated by power frequency current in conductors or, more seldom, from other devices (e.g. leakage of transformers) in the proximity of equipment.

Test Levels

Level	Magnetic Field Strength A/m (rms)	
	Continuous	Short Duration
1	1	N/A
2	3	N/A
3	10	N/A
4	30	300
5	100	1000

IEC/EN 61000-4-11

Voltage dips, short interruptions and voltage variations immunity

Background

This part of IEC 61000 standard defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low voltage power supply networks for voltage dips, short interruptions, and voltage variations. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16A per phase, for connection to 50Hz or 60Hz AC networks.

The standard describes three different tests:

- **Voltage dips** are defined as sudden reduction in voltage to lower voltages for a short period of time, followed by recovery to the original voltage.
- **Short interruptions** are defined as a disappearance of AC voltage for a short period of time, typically not exceeding 1 minute, followed by recovery to the original voltage. Short interruptions can be considered as voltage dips to zero volts.
- **Voltage variations** are gradual changes of the supply voltage to a higher or lower value than the rated voltage. The duration can be short or long.

Power Supply Consideration

According to some experts, the effect of poor AC supply quality on electronic equipment is one of the most significant causes of downtime and financial l oss worldwide. Dips, sag, brownouts, swells, voltage variations, dropouts and interruptions are the main cause of poor supply quality. Voltage dips and short interruptions are caused by faults in the network, in installations or by a sudden large change of load. In certain c ases, two or more consecutive dips or interruptions may occur. Voltage variations are caused by the continuously varying loads connected to the network.

These phenomena are random in nature and can be characterized in terms of the deviation from the rated voltage and duration. Voltage dips and short interruptions are not always abrupt. Some equipment is more sensitive to gradual variations in voltage than to abrupt change. Most data-processing equipment has built-in power-fail detectors in order to protect and save the data in internal memory so that after the mains vo ltage has been restored, the equipment will start up in the correct way. Some power-fail detectors will not react sufficiently fast on a gradual decrease of the mains voltage. Therefore, the dc. voltage
to the power-fail detector is activated and data will be lost o r distorted. When the mains voltage is restored, the data-processing equipment will not be able to restart correctly before it has been re-programmed.

Test Levels

Class	Test Level and Durations for Voltage Dips (50/60Hz)				
1	Case-by-case according to the equipment requirements				
2	0% during ½ cycle	0% during ½ cycle	70% during 25/30 cycles		
3	0% during ½ cycle	0% during ½ cycle	40% during 10/12 cycles	70% during 25/30 cycles	80% during 250/300 cycles

Class	Test Level and Durations for Short Interruptions (50/60Hz)
1	Case-by-case according to the equipment requirements
2	0% during 250/300 cycles
3	0% during 250/300 cycles

Sources:

IEC 61000-3-2:2014;IEC 61000-3-3:2013 RLV;IEN61000-4-2, Edition 1.2 2001-04; Semtech AN96-07 2/2002; IEN61000-4-3, 3rd Edition 2006-02; IEN61000-4-4, 2nd Edition 2004-07; IEN61000-4-5, 2nd Edition 2005-11; EN61000-4-6:2009; EN61000-4-8:2010; EN61000-4-11: 2004

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