Training Course on Conformity and Interoperability,
Tunis-Tunisia, 22-26 May 2017

EMC Standards

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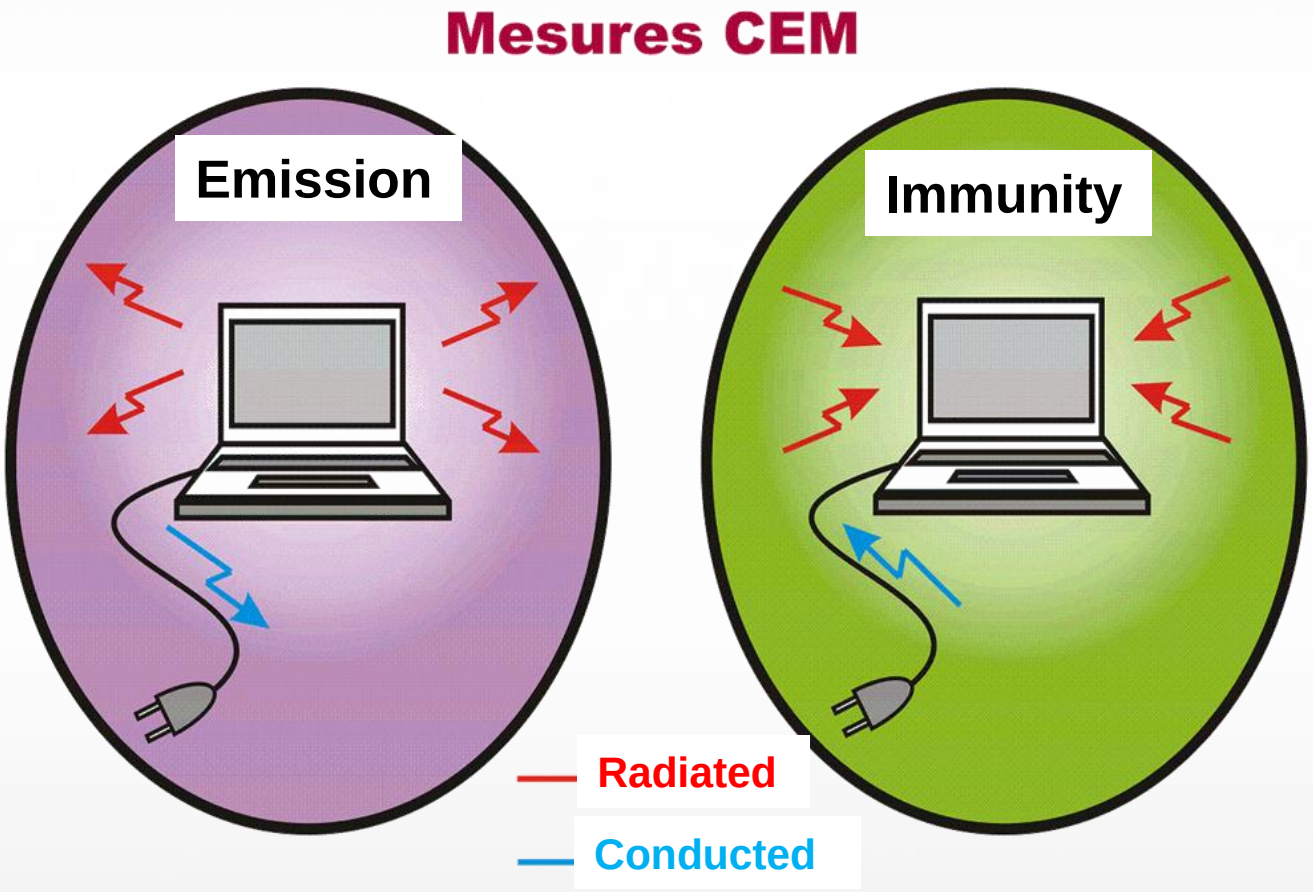
Types of EMC measures



Immunity tests

The purpose of immunity tests is to subject a product to a controlled stress that represents the likely range which is mostly dedicated by practical aspects and experience of real-world problems.

Immunity tests

1 – transient phenomena

Performance Criteria for Immunity Tests

Results of immunity tests are classified into four categories:

- Performance Criteria A – ‘Performance within specification limits’
- Performance Criteria B – ‘Temporary degradation which is self-recoverable’
- Performance Criteria C – ‘Temporary degradation which requires operator intervention’
- Performance Criteria D – ‘Loss of function which is not recoverable’

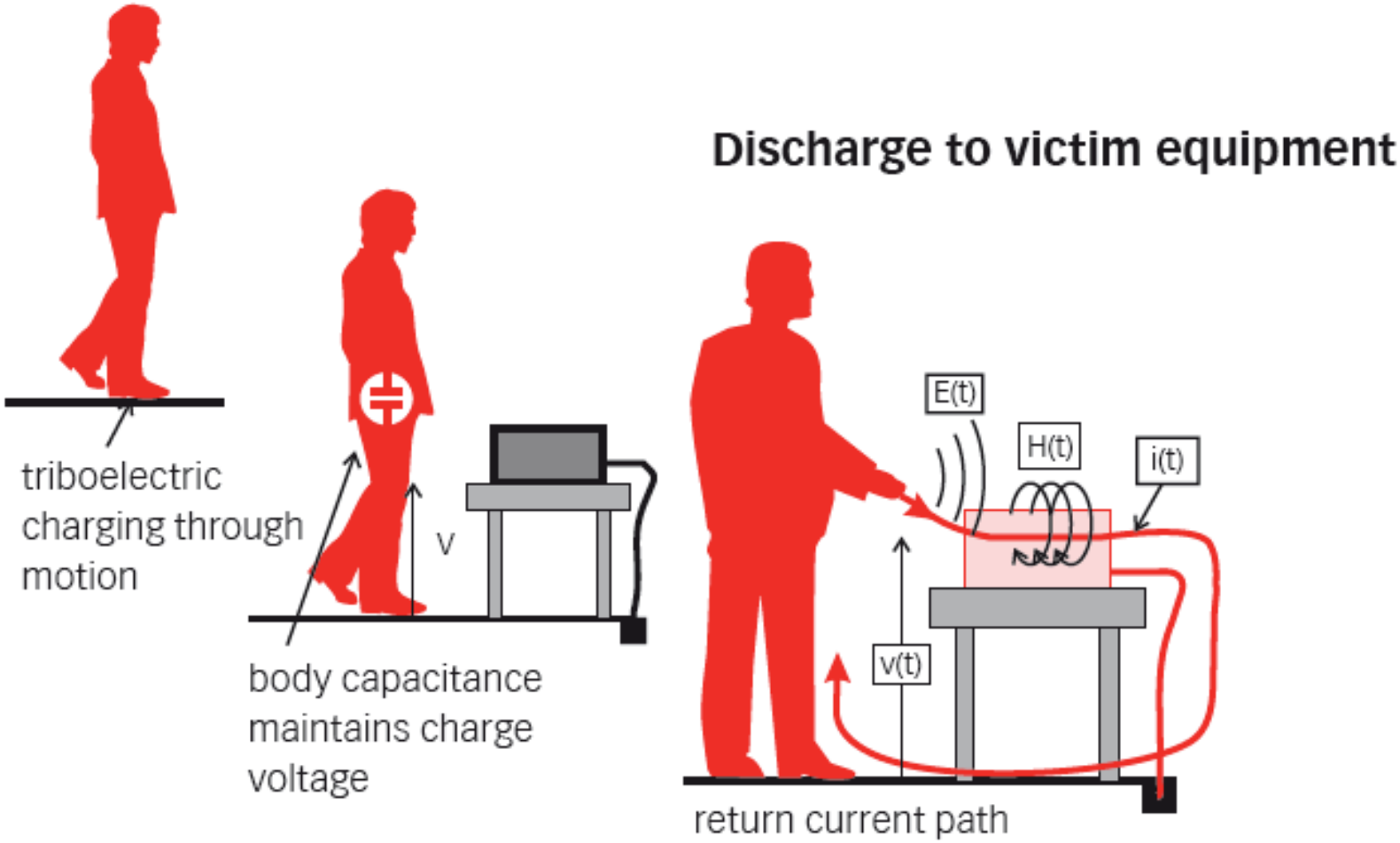
Standards calls

Standard	Scope	ESD	EFT-burst	Surge
IEC/EN 61000-6-1: 2001	Residential, commercial & light industrial generic	4 kV contact, 8 kV air to IEC/EN 61000-4-2	1 kV AC power, 0.5 kV DC power > 10 m, signal and functional earth > 3 m to IEC/EN 61000-4-4	1 kV L-L, 2 kV L-E on AC power input; 0.5 kV L-L & L-E DC power > 10 m, to IEC/EN 61000-4-5
IEC/EN 61000-6-2: 2005	Industrial generic	4 kV contact, 8 kV air to IEC/EN 61000-4-2	2 kV AC power, DC power > 3 m, 1 kV signal and functional earth > 3 m to IEC/EN 61000-4-4	1 kV L-L, 2 kV L-E on AC power; 0.5 kV L-L & L-E DC power connected to a distribution network; 1 kV L-E signal > 30 m, to IEC/EN 61000-4-5
EN 55014-2: 1997 + A1: 2001	Household appliances etc.	4 kV contact, 8 kV air to IEC/EN 61000-4-2	1 kV AC power, 0.5 kV DC power, signal and control > 3 m to IEC/EN 61000-4-4	1 kV L-L, 2 kV L-E on AC mains, to IEC/EN 61000-4-5
EN 55020: 2002	Broadcast receivers etc.	4 kV contact, 8 kV air to IEC/EN 61000-4-2	1 kV AC power to IEC/EN 61000-4-4	Not required
EN 55024: 1998	Information technology equip-ment	4 kV contact, 8 kV air to IEC/EN 61000-4-2	1 kV AC power, 0.5 kV DC power, signal and telecom > 3 m to IEC/EN 61000-4-4	1 kV L-L, 2 kV L-E on AC mains, 0.5 kV L-E on DC power with outdoor cables, to IEC/EN 61000-4-5; 1.5 kV 10/700 µs on signal/telecom ports with outdoor cables, to ITU-T K recs.

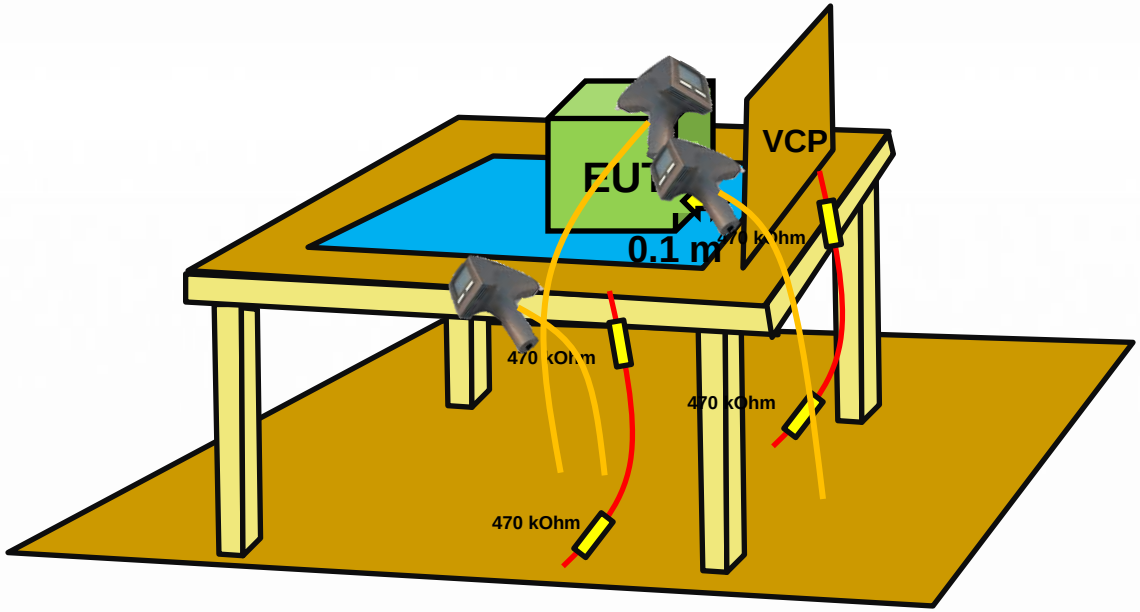
ESD

IEC 61000-4-2

Electrostatic Discharge
ESD – IEC 61000-4-2



ESD Test setup

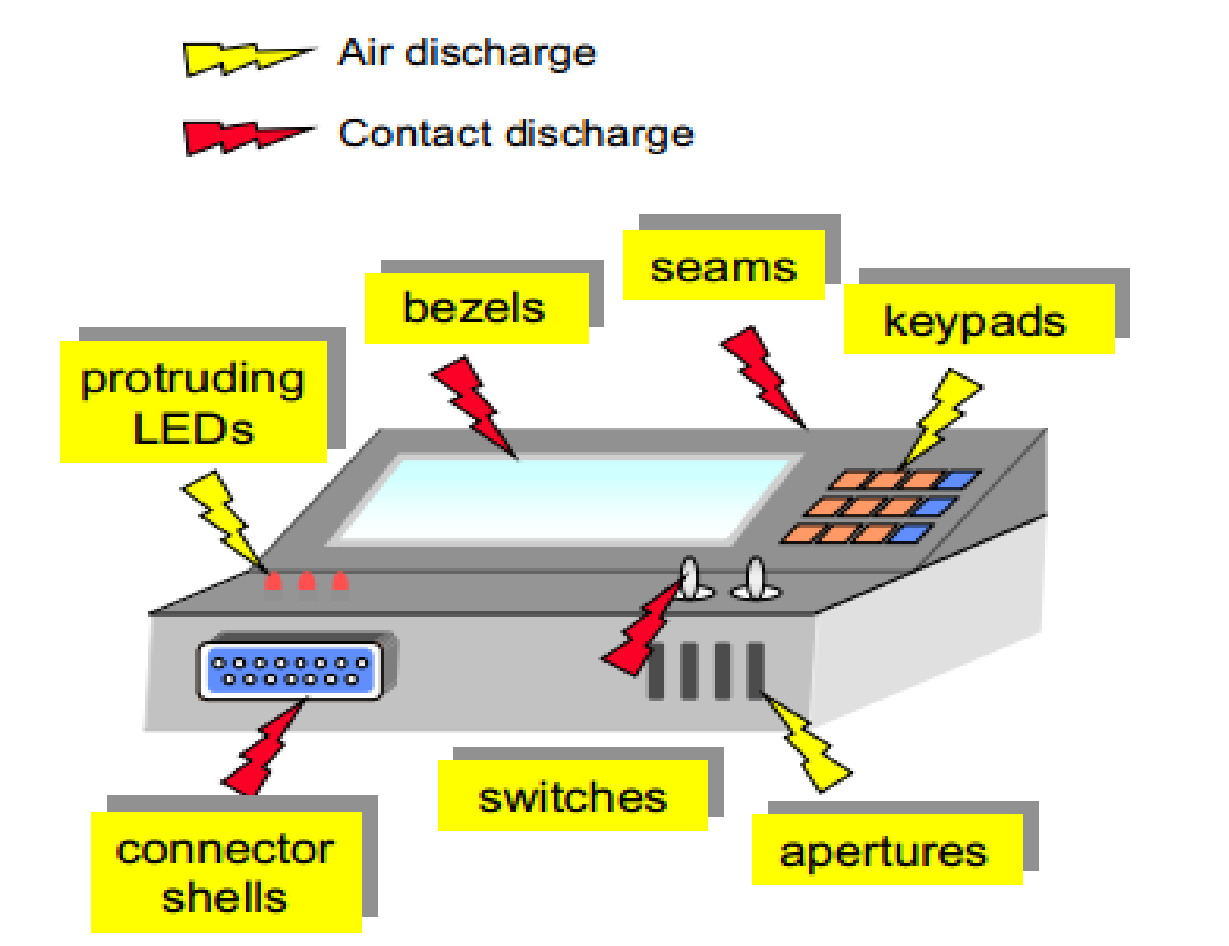


Conducting surface

Dielectrical material

Isolating surface

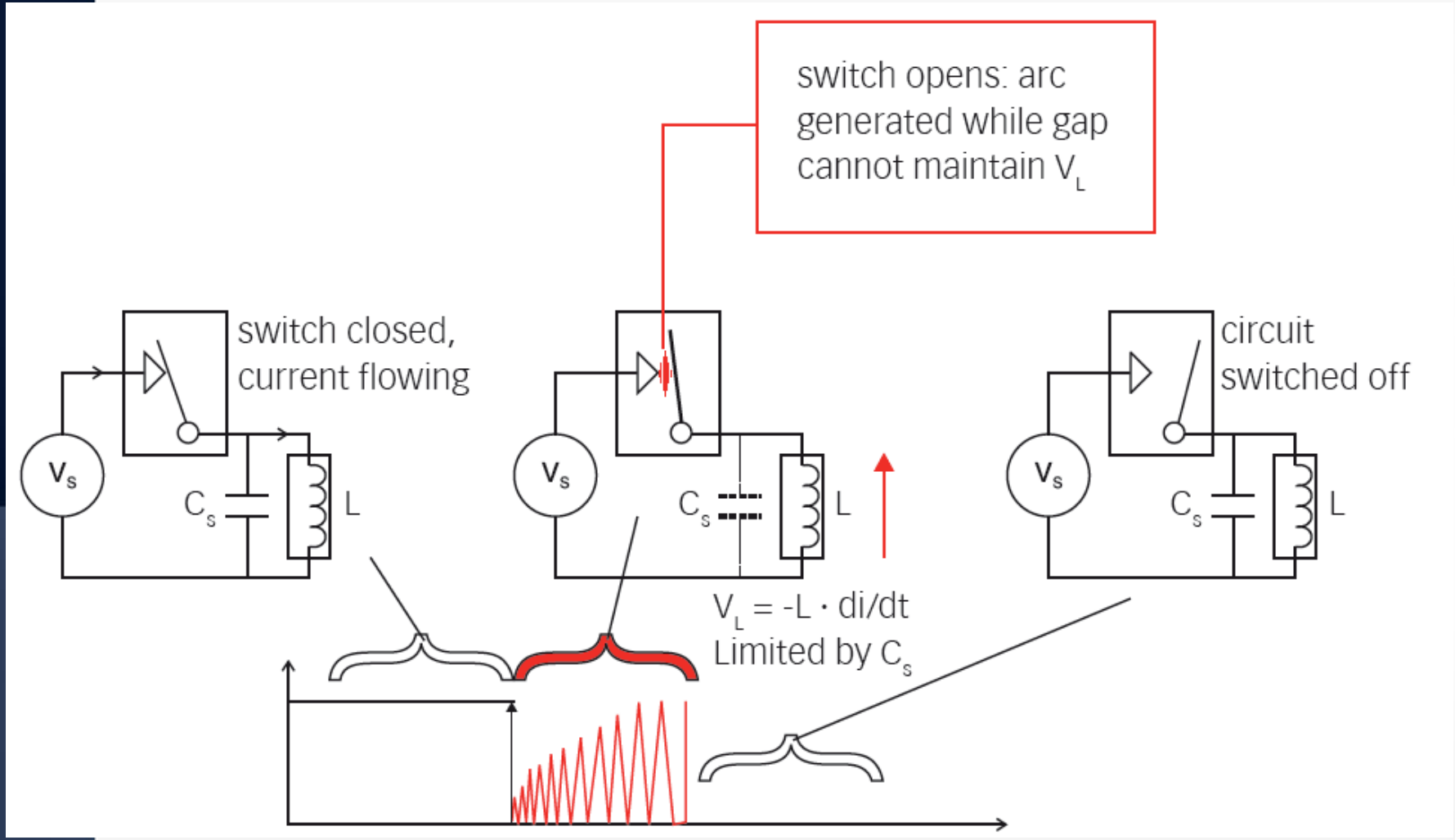
Choice of discharge points



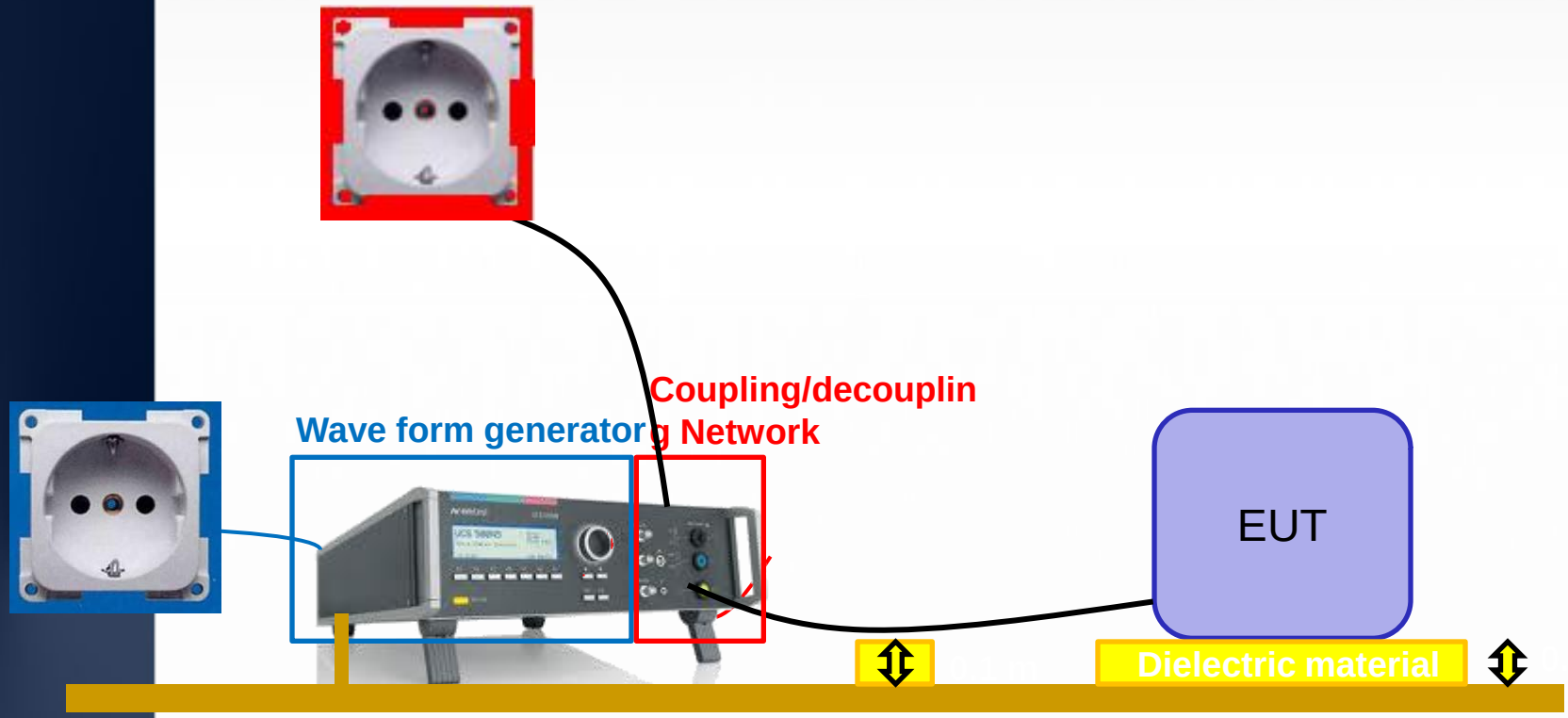
EFT

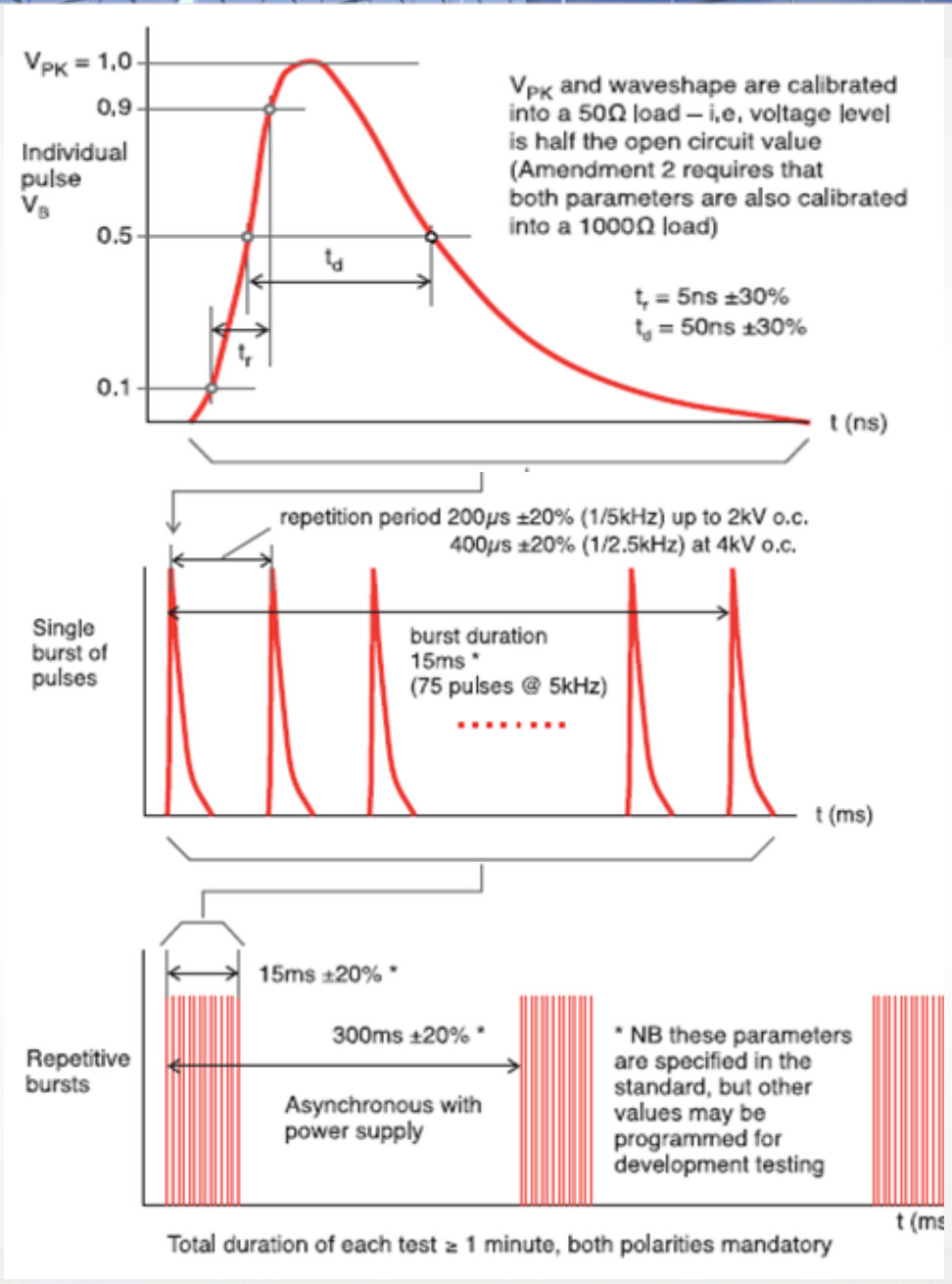
IEC 61000-4-4

The EFT phenomenum



Electric Fast Transients
EFT – Burst – EN 61000-4-4

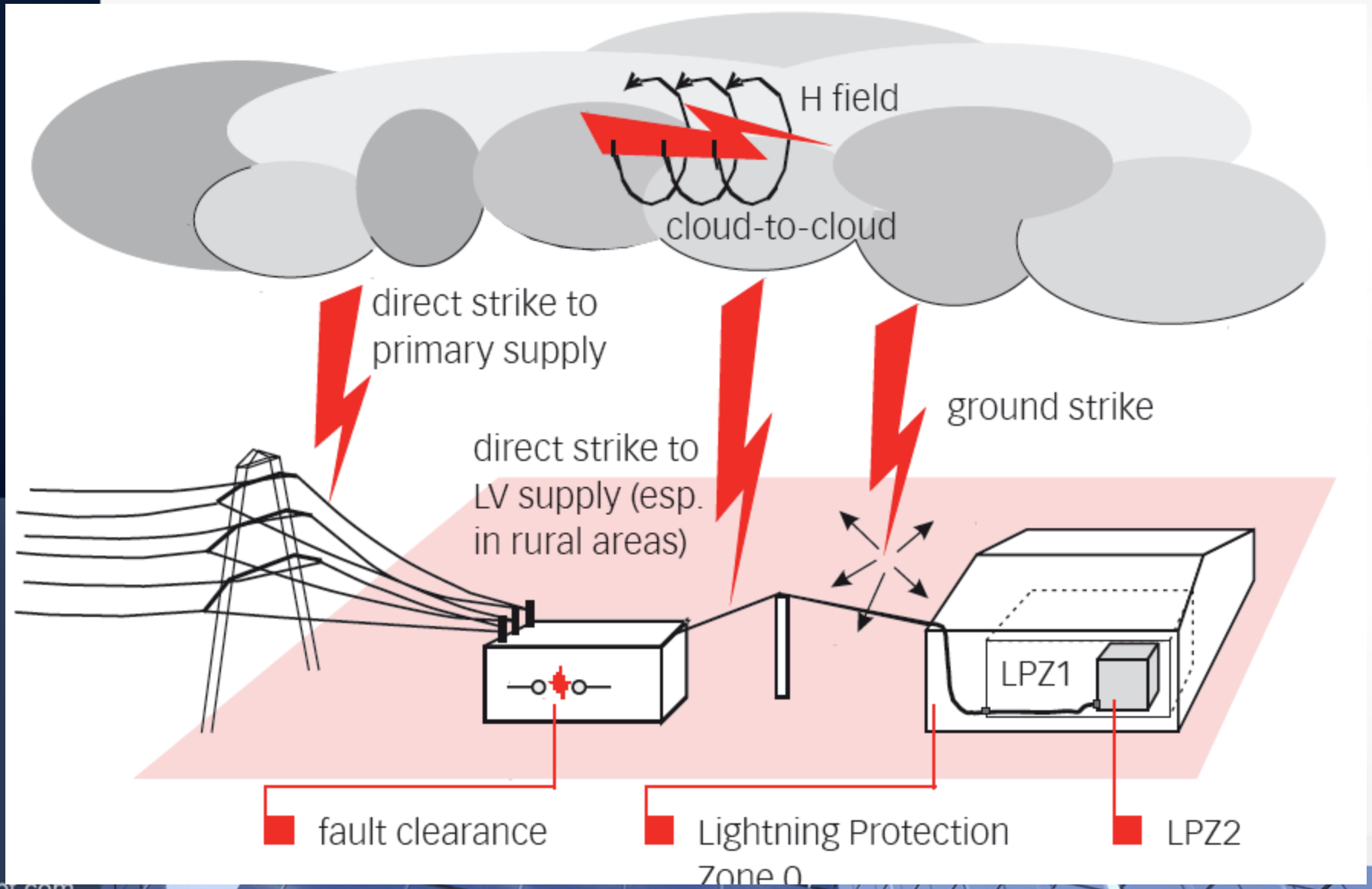



V_{PK} = 1,0
0,9
Individual pulse V_B
0.5
0.1
t_d
t_r
V_{PK} and waveshape are calibrated into a 50Ω load – i,e, voltage level is half the open circuit value (Amendment 2 requires that both parameters are also calibrated into a 1000Ω load)
t_r = 5ns ±30%
t_d = 50ns ±30%
t (ns)
repetition period 200μs ±20% (1/5kHz) up to 2kV o.c.
400μs ±20% (1/2.5kHz) at 4kV o.c.
Single burst of pulses
burst duration
15ms *
(75 pulses @ 5kHz)
t (ms)
15ms ±20% *
300ms ±20% *
Repetitive bursts
Asynchronous with power supply
* NB these parameters are specified in the standard, but other values may be programmed for development testing
t (ms
Total duration of each test ≥ 1 minute, both polarities mandatory

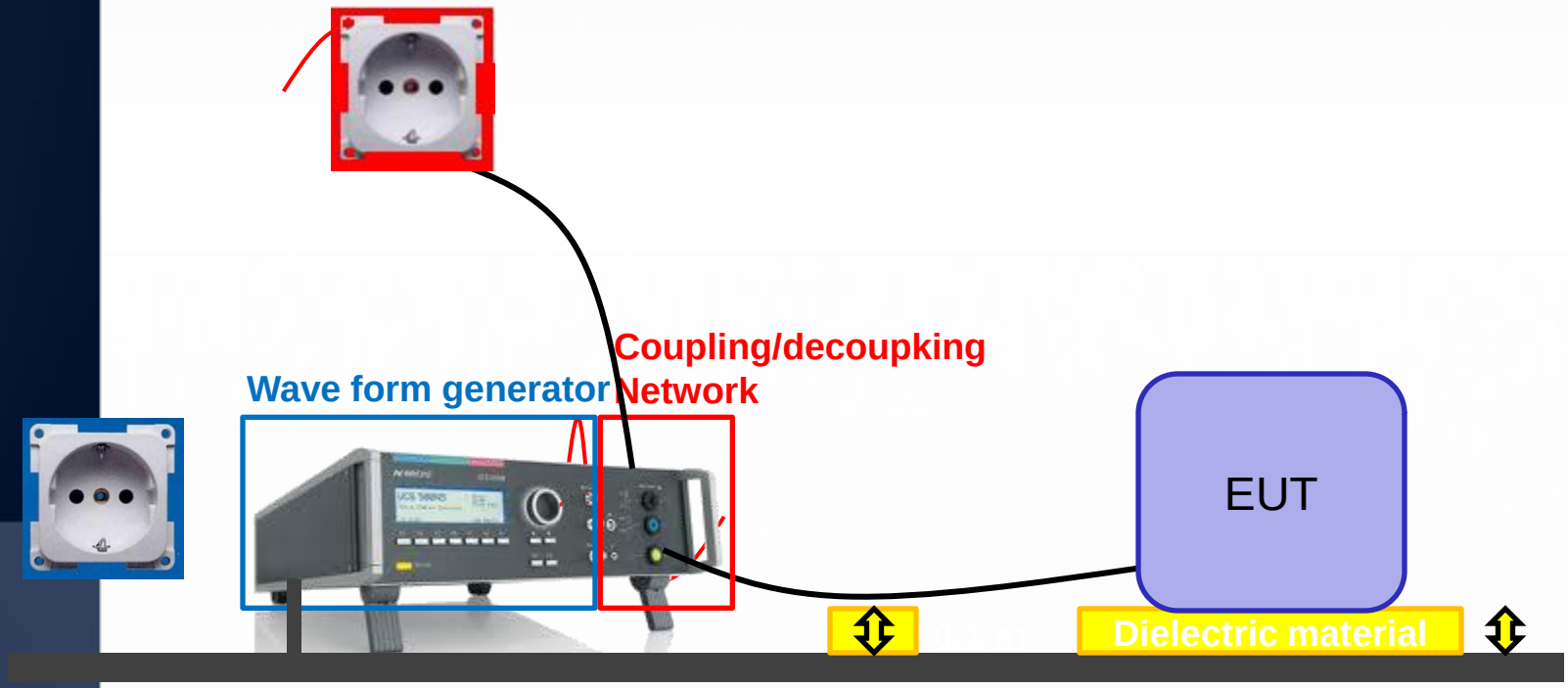
Surge

IEC 61000-4-5

The surge phenomenum

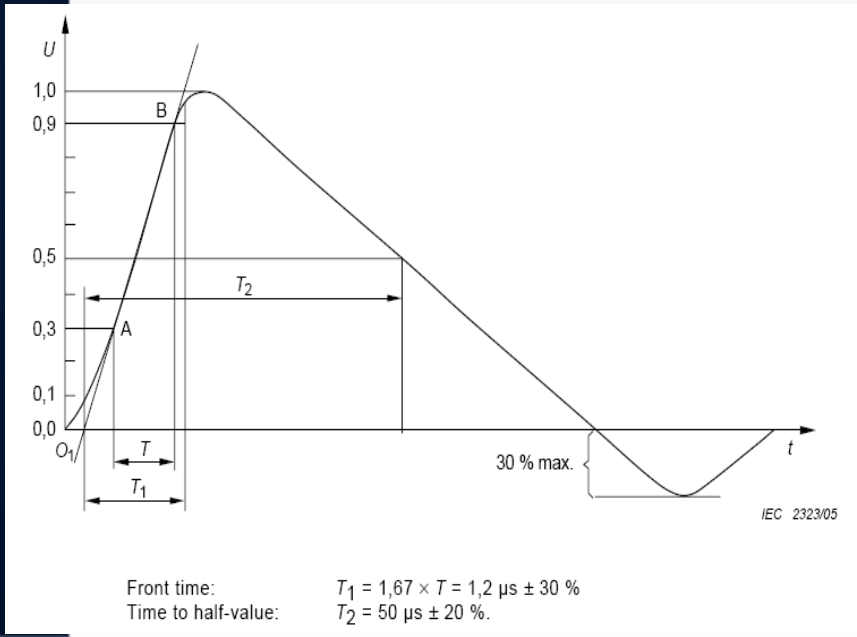


Surge immunity – IEC 61000-4-5



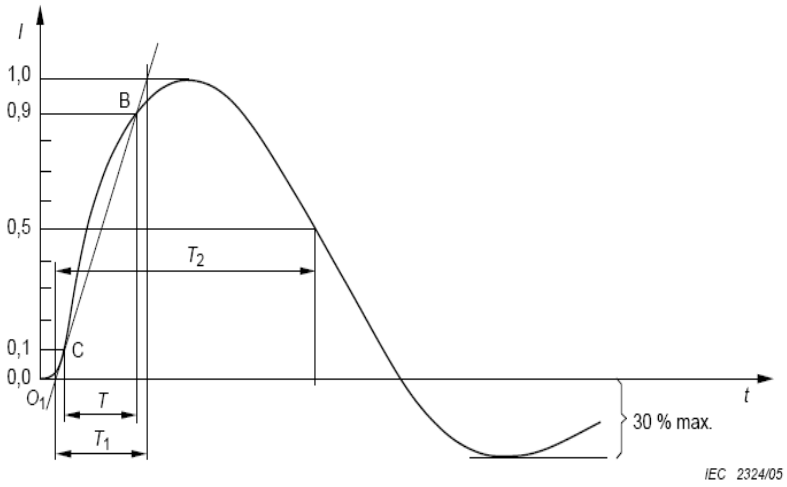
Surge generator
With integrated CDN

Surge Waveform, 1.2/50 µs



Front time: $T_1 = 1{,}67 \times T = 1{,}2\ \mu s \pm 30\ \%$
Time to half-value: $T_2 = 50\ \mu s \pm 20\ \%$.

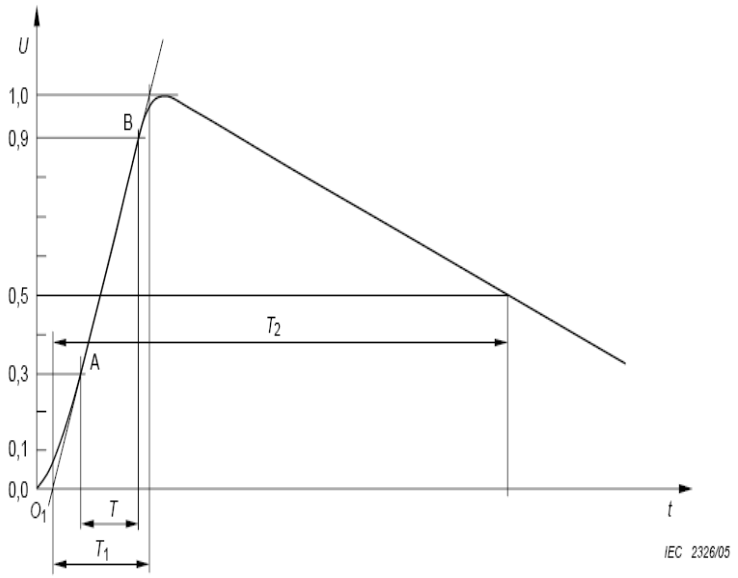
Waveform of open-circuit voltage (1,2/50 µs) at the output of the generator with no CDN connected (waveform definition according to IEC 60060-1)



Front time: $T_1 = 1{,}25 \times T = 8\ \mu s \pm 20\ \%$
Time to half-value: $T_2 = 20\ \mu s \pm 20\ \%$

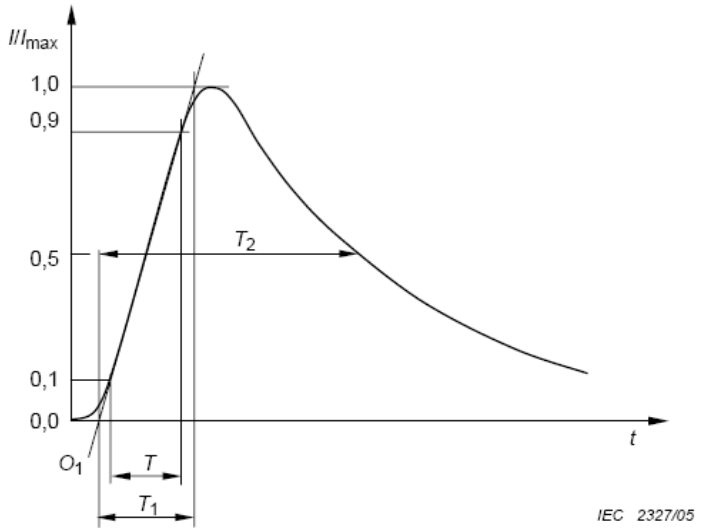
Waveform of short-circuit current (8/20 µs) at the output of the generator with no CDN connected (waveform definition according to IEC 60060-1)

Surge Waveform, 10/700 µs



Front time: $T_1 = 1{,}67 \times T = 10\ \mu s \pm 30\ \%$
Time to half-value: $T_2 = 700\ \mu s \pm 20\ \%$.

Waveform of open-circuit voltage (10/700 µs) (waveform definition according to **ITU-T K series** and IEC 60060-1)



Front time: $T_1 = 1{,}25 \times T = 5\ \mu s \pm 20\ \%$
Time to half-value: $T_2 = 320\ \mu s \pm 20\ \%$.

Waveform of the 5/320 µs short-circuit current waveform (definition according to **ITU-T K series** and IEC 60060-1)

Comparision between transient tests

Comparision of transient standards

The “energy measure” of a given waveform can be described by

$$W = \frac{1}{R} \cdot \int_0^T \left(\frac{V(t)}{2} \right)^2 dt \qquad W = R \cdot \int_0^T \left(\frac{I(t)}{2} \right)^2 dt$$

ESD : waveform magnitude in ns

EFT : waveform magnitude in ns

Surge : waveform magnitude in µs

Surge test is more energetic than ESD and EFT

Immunity tests

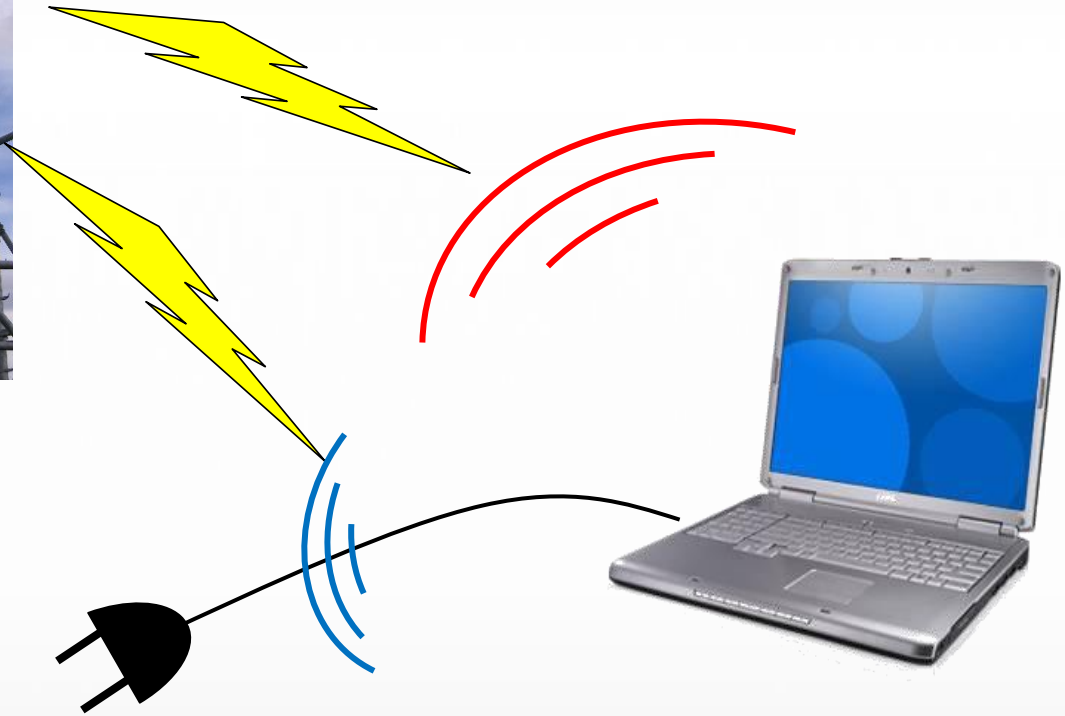
2 – LF and RF phenomena

Radiated immunity

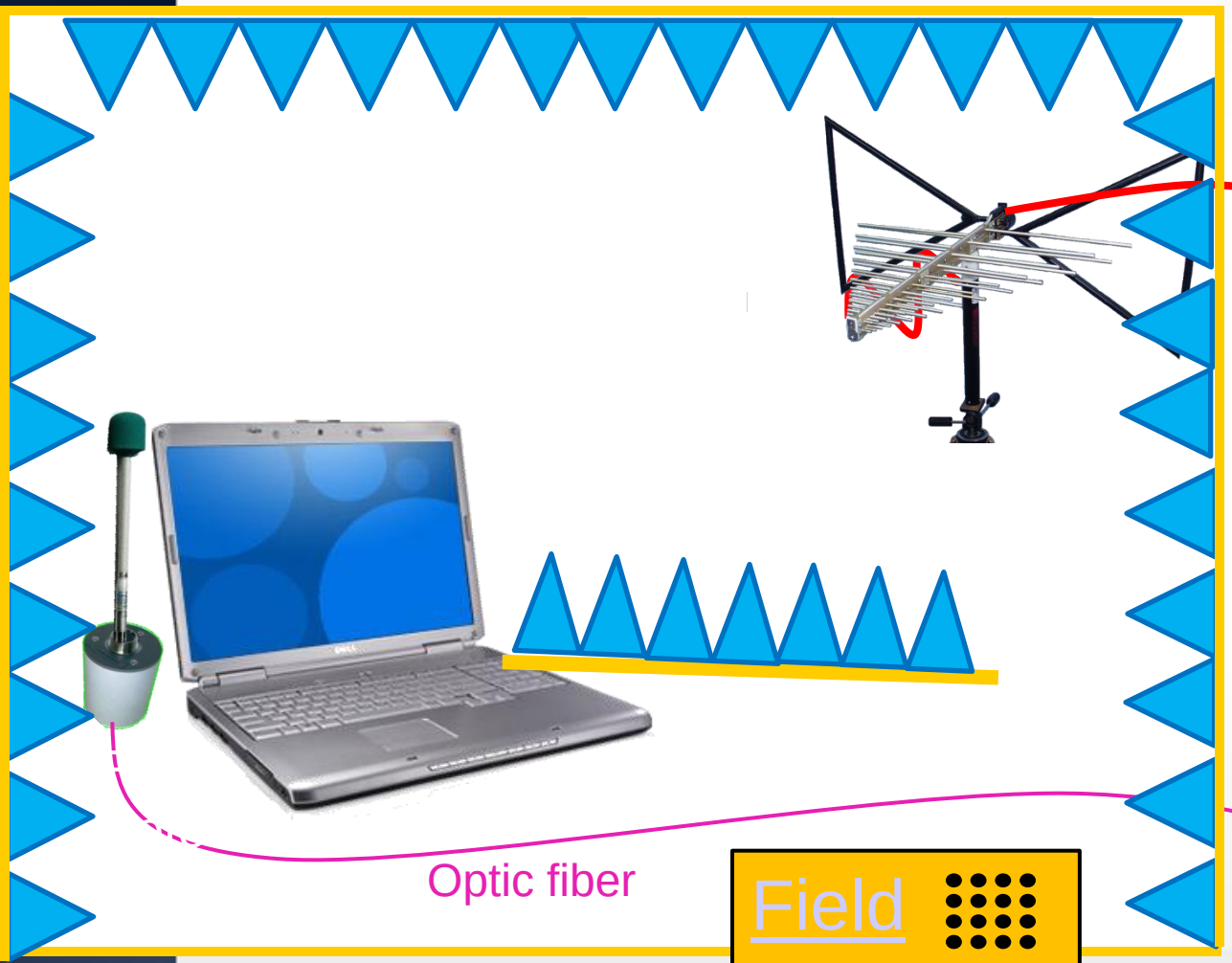
IEC 61000-4-3

RF coupling phenomenum

RF emitters



Radiated immunity – IEC 61000-4-3



Optic fiber

Field uniformity

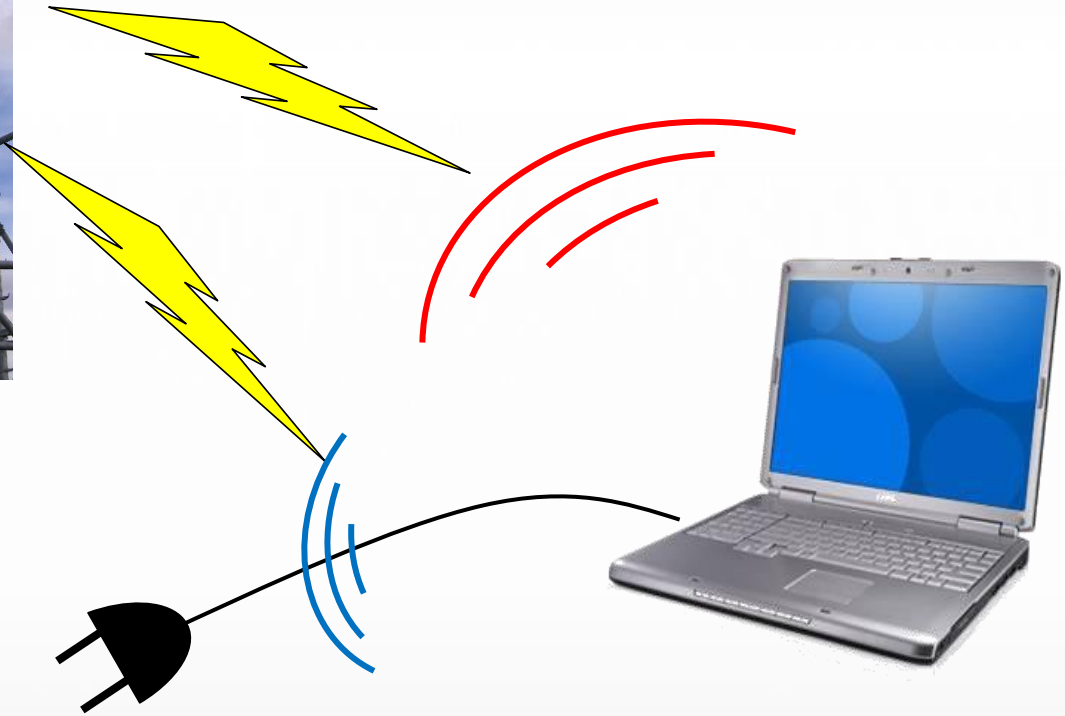
GPIB

Conducted immunity

IEC 61000-4-6

RF coupling phenomenum

RF emitters

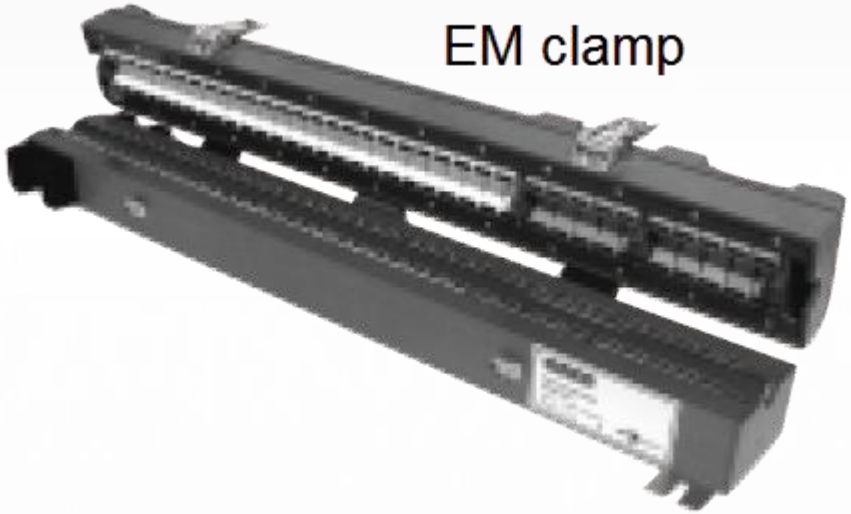


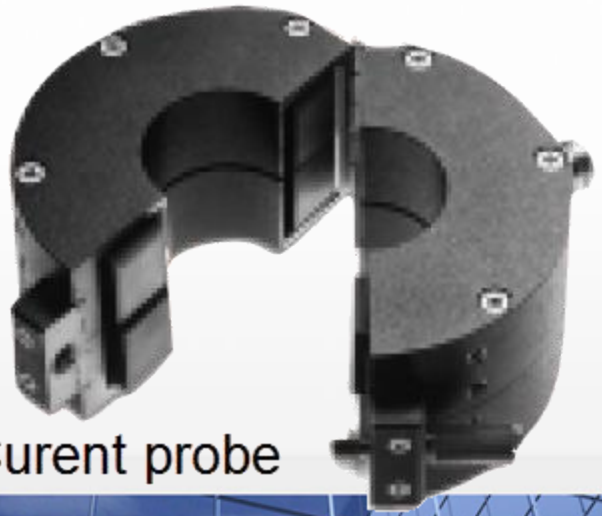
Conducted immunity – IEC 61000-4-6

Coupling devices

CDN

EM clamp





Curent probe

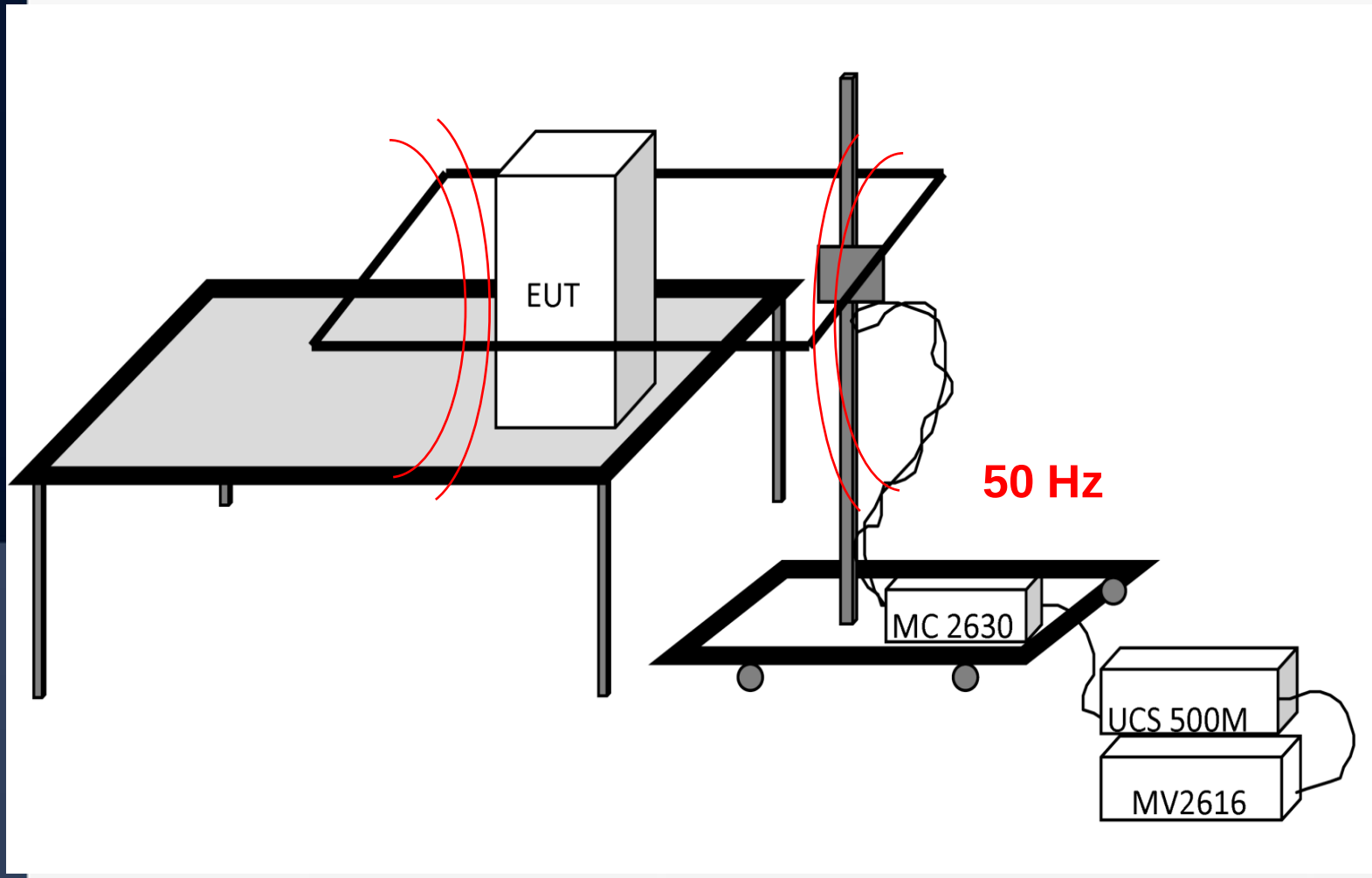
Types of CDNs

Typ	*Interconnected lines*
M1, M2, M3, M4, M5, M2+M3	Unscreened supply (mains)
AF2, AF4, AF6, AF8	Unscreened nonbalanced lines
S1, S2, S9, S25	Screened lines
T2, T4, T8	Unscreened balanced lines
RJ11, RJ45	Unscreened data lines
RJ11/S, RJ45/S, USB	Screened data lines

Immunity to magnetic fields

IEC 61000-4-8

Magnetic field immunity – IEC 61000-4-8



Immunity to voltage dips
and short interruptions
IEC 61000-4-11

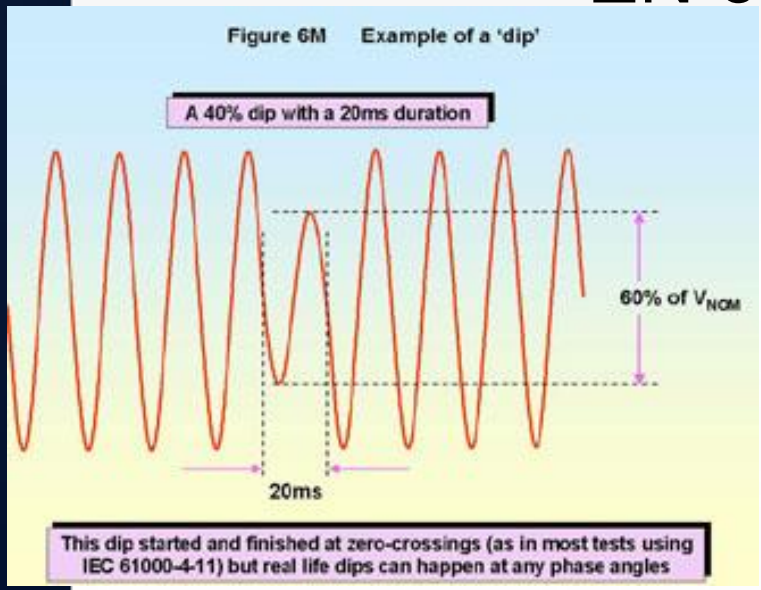
Voltage dips and short interruptions – IEC 61000-4-11

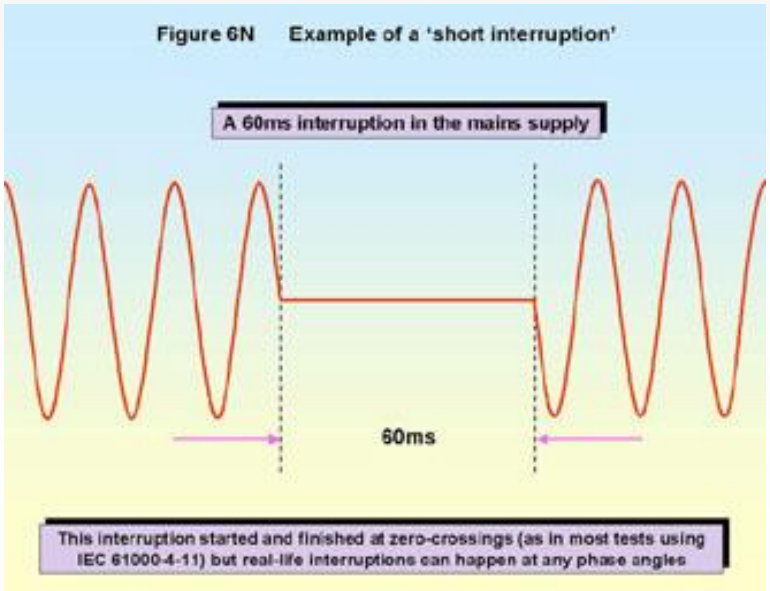
EUT

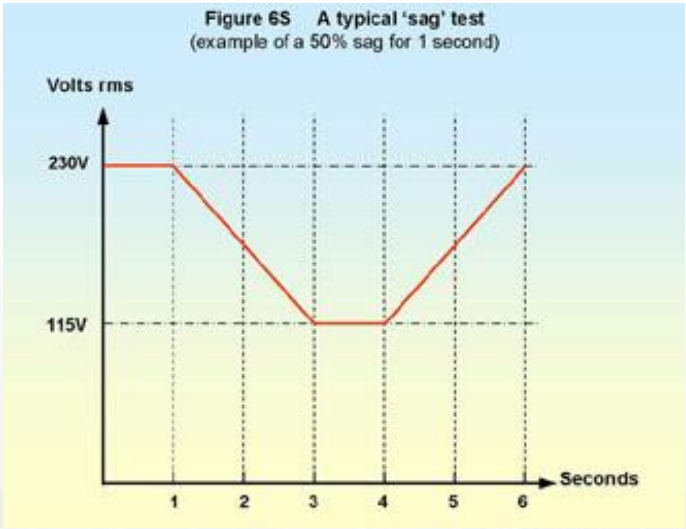
Power fail generator

Variac

Voltage dips and short interruptions – EN 61000-4-11







Emission tests

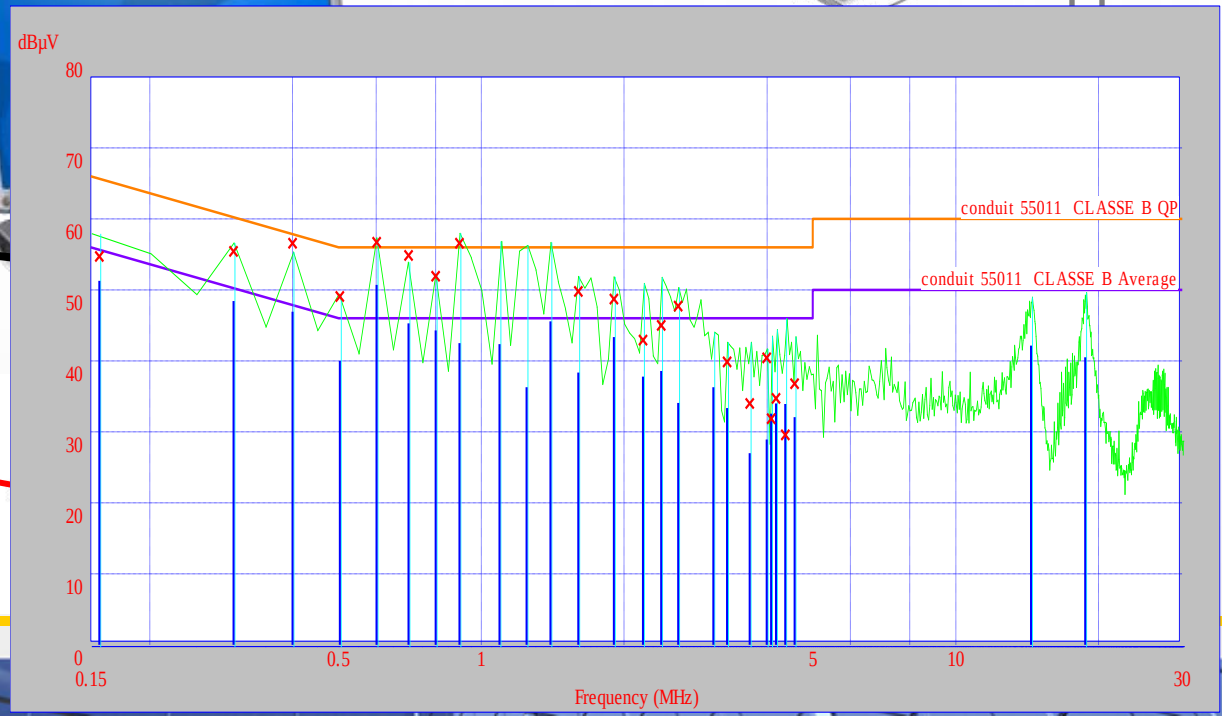
Emission

CISPR 22 / EN 55022

Conducted emissions
CISPR22/EN 55022

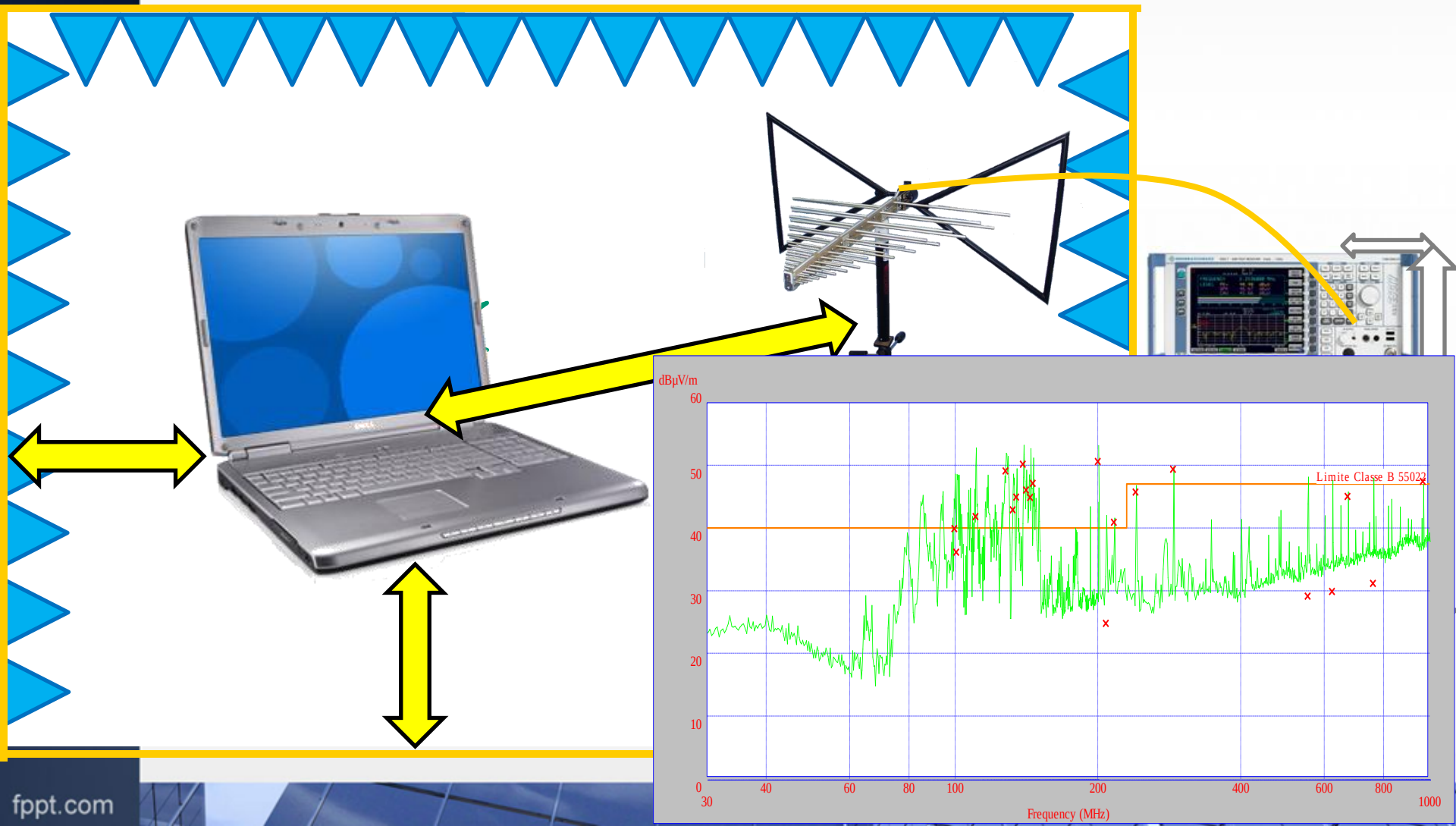
Conducted emission – CISPR22/ EN 55022

LISN

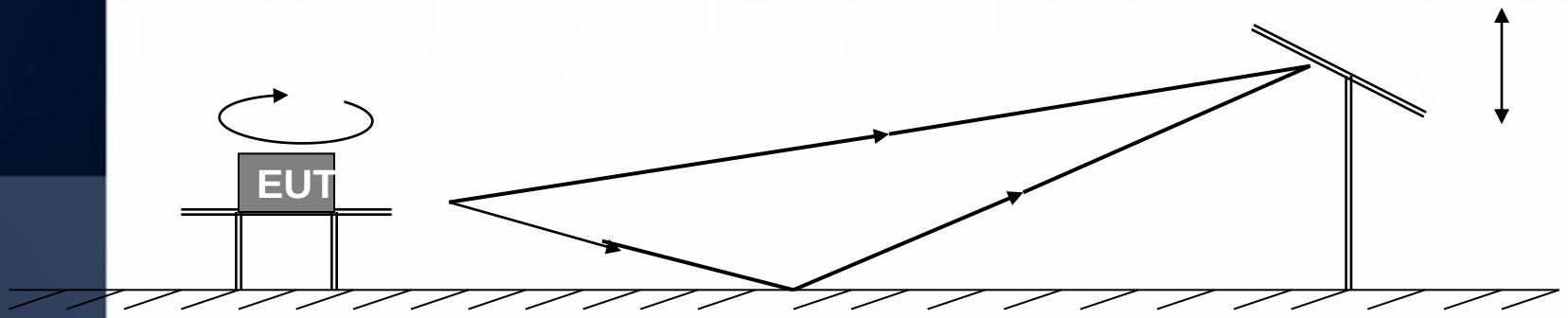


Radiated emissions
CISPR22/EN 55022

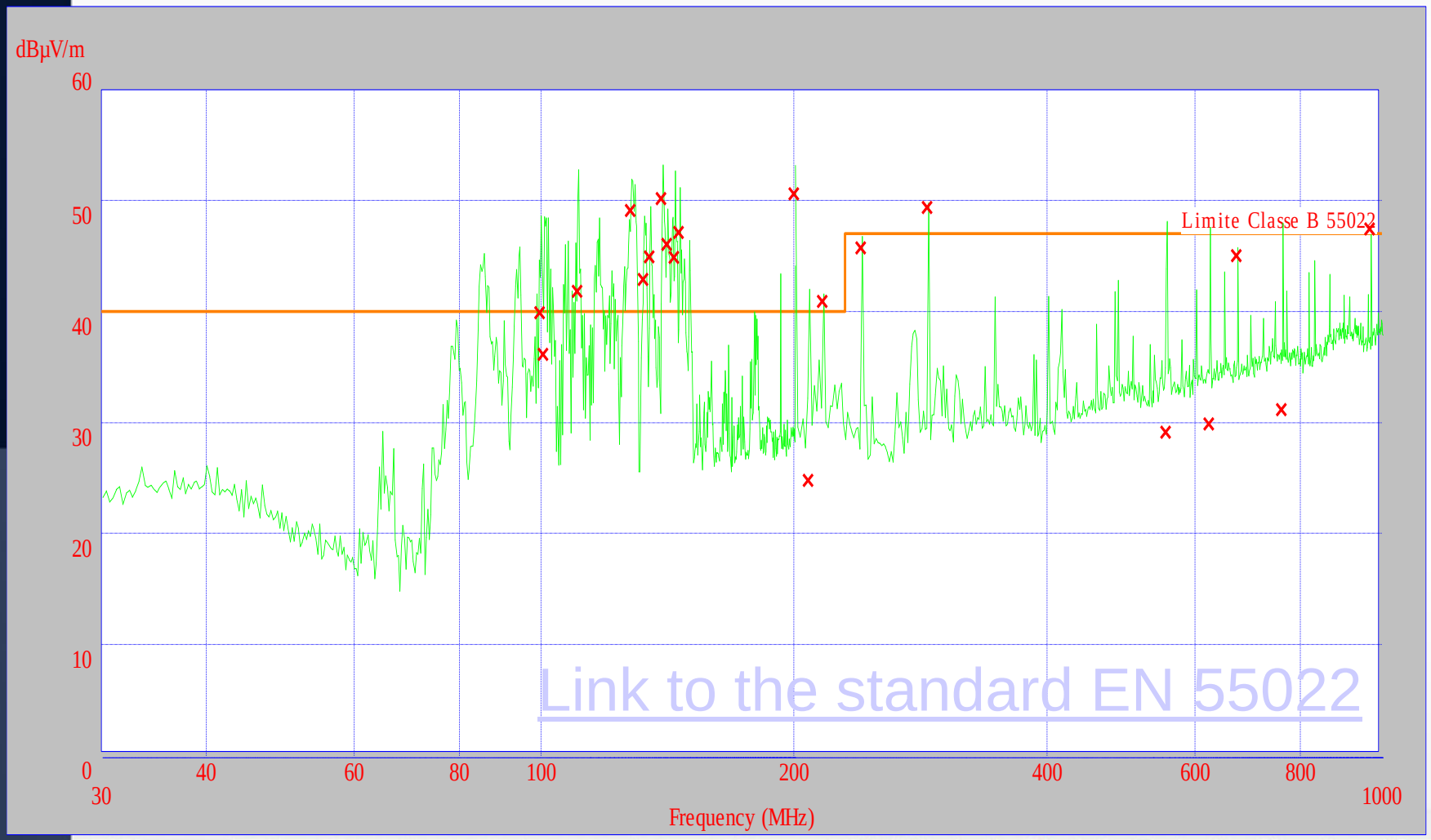
Radiated emission - CISPR22/EN 55022



Radiated field measurement

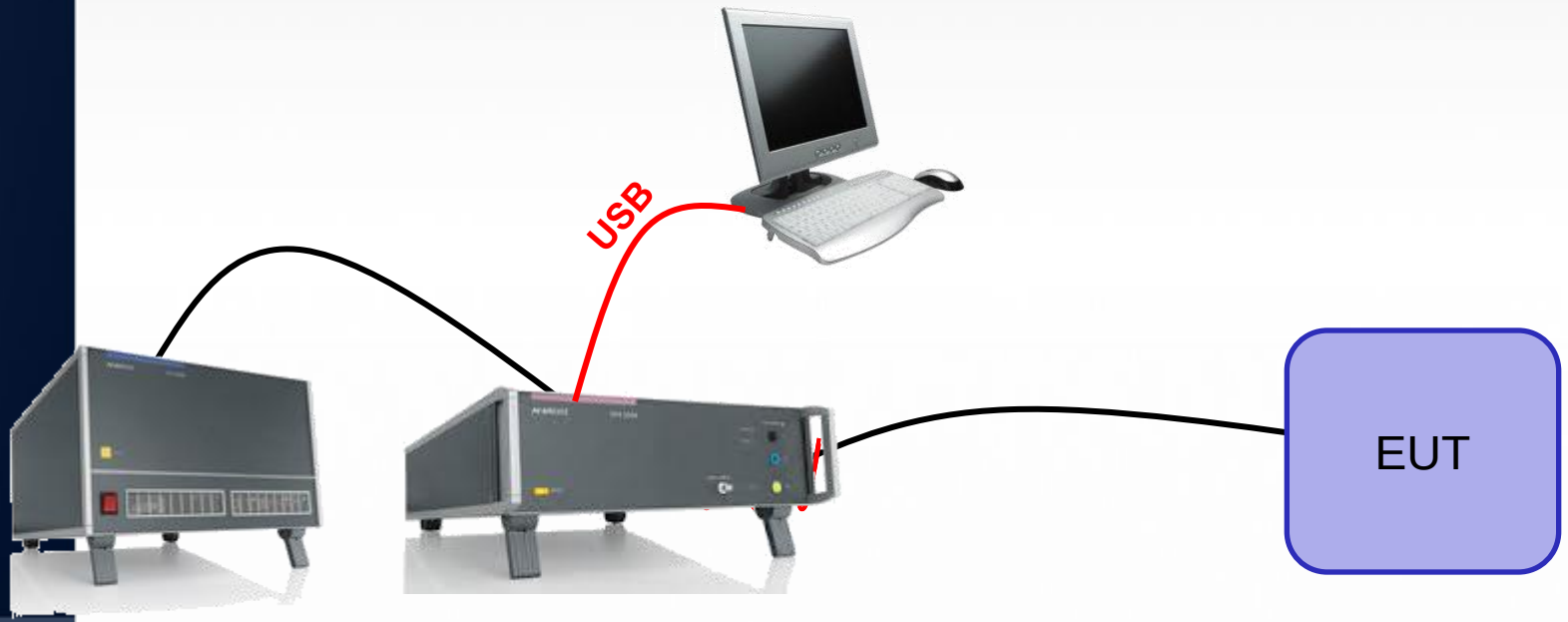


Measure



Harmonics emission
IEC 61000-3-2

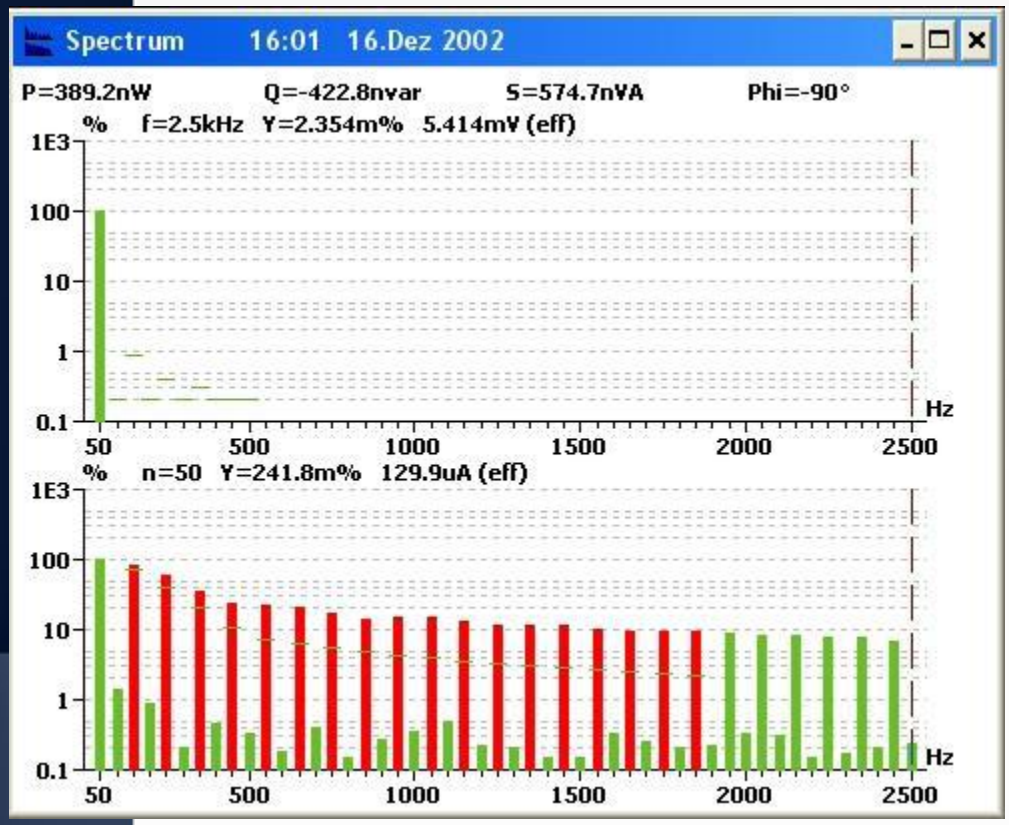
Harmonics emission – IEC 61000-3-2



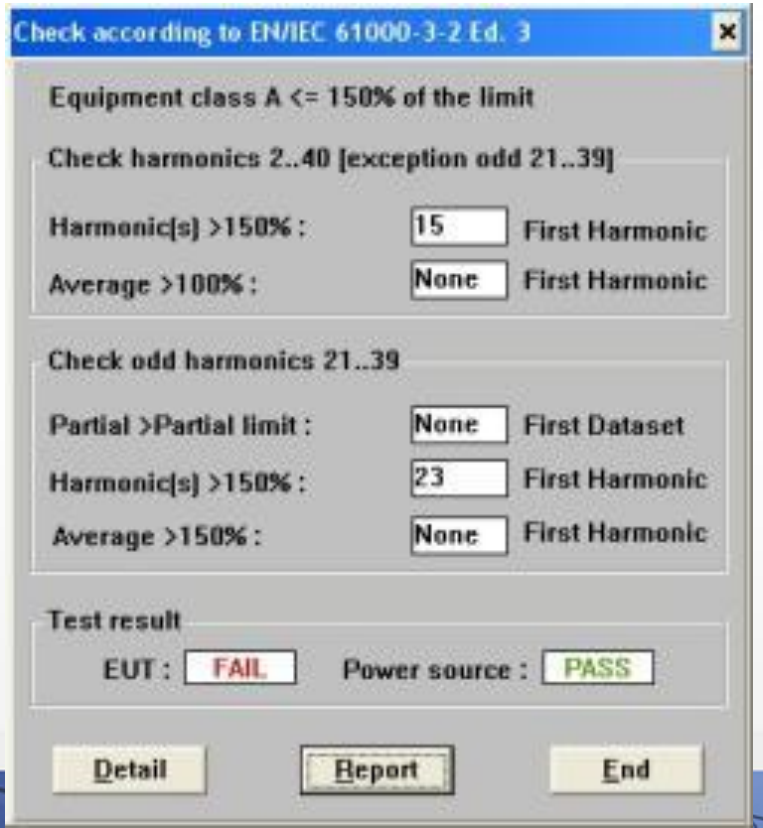
Stable source

Harmonics analyser

Test result

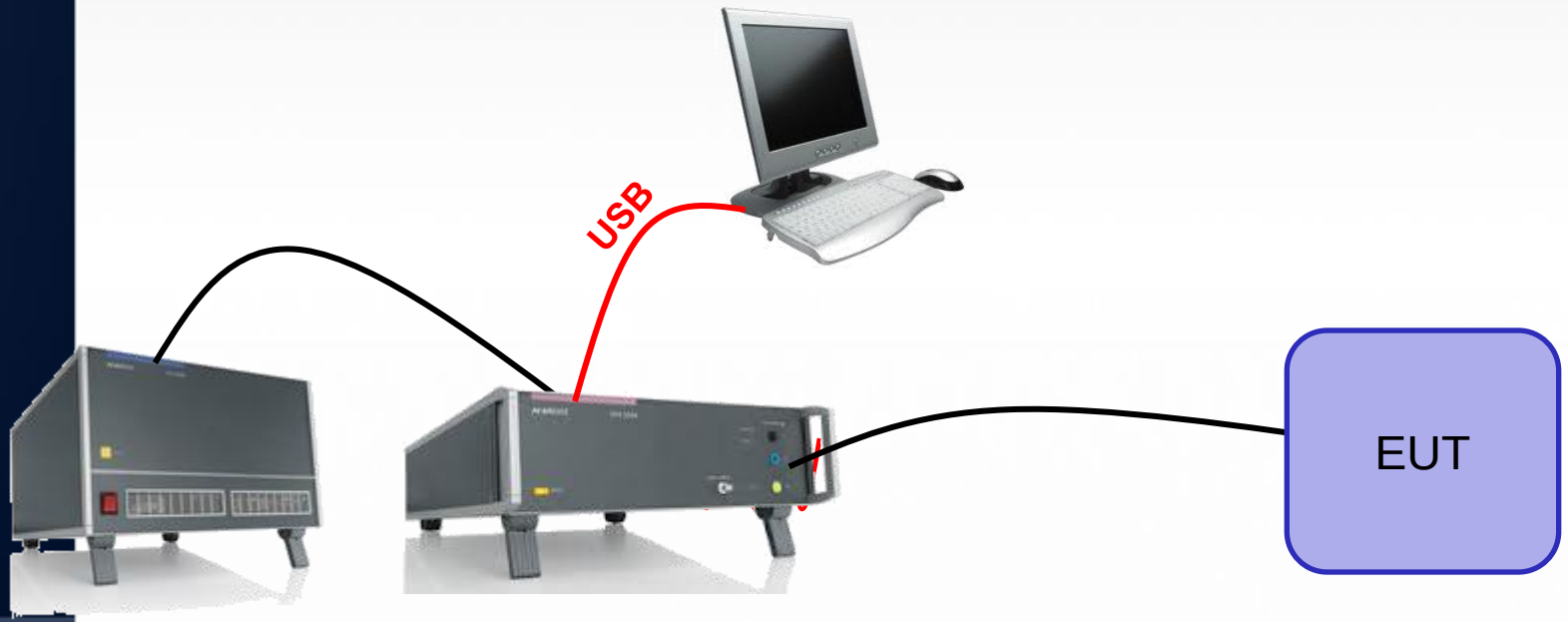


Limit values are indicated and harmonics exceeding the specified limit are marked in red colour.



Flickers emission
IEC 61000-3-3

Flickers emission – IEC 61000-3-3



Stable source

Flickers analyser

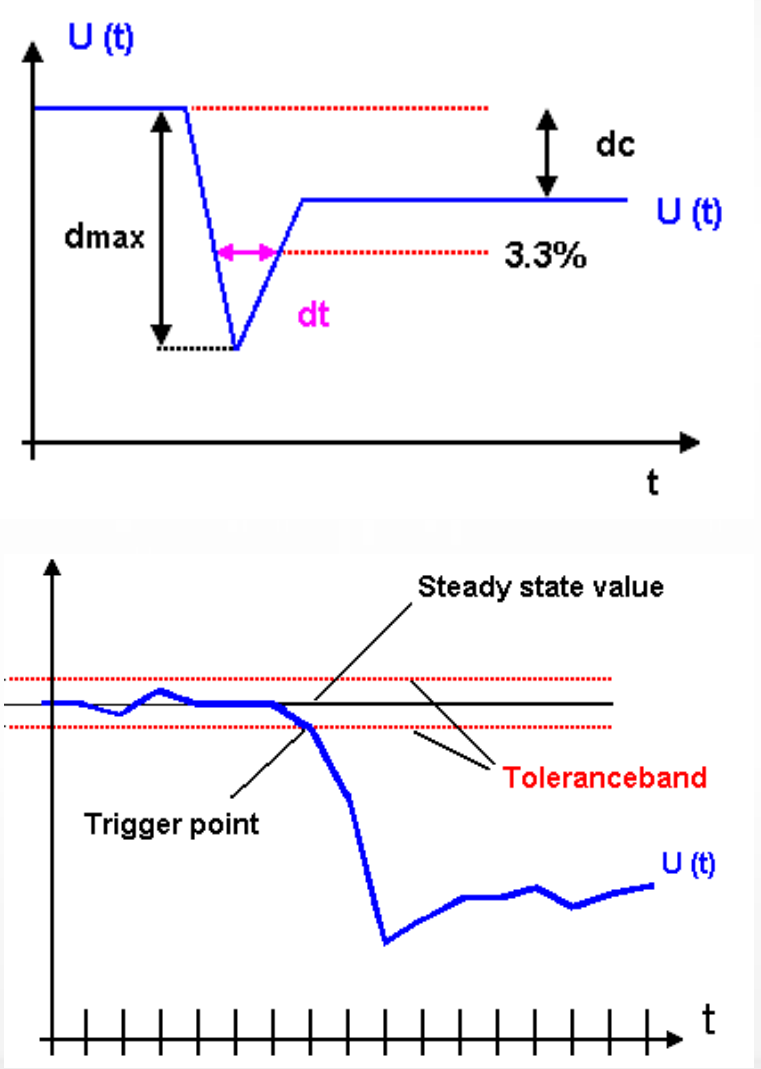
Test results

Result flicker measurement (maximum value)

Measurement time: 10 min Number of measurement: 12

	L1	L2	L3	Limit	Result
Pst	0.758	0.758	0.758	1.00	PASS
Plt	0.498	0.498	0.498	0.65	PASS
dc [%]	2.986	2.986	2.985	3.00	PASS
dmax [%]	5.121	5.126	5.126	4.00	FAIL
dt [s]	0.030	0.030	0.030	0.20	PASS

Detail Report End



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