Unintentinal Transient Voltages caused by LISNs (CDNs)

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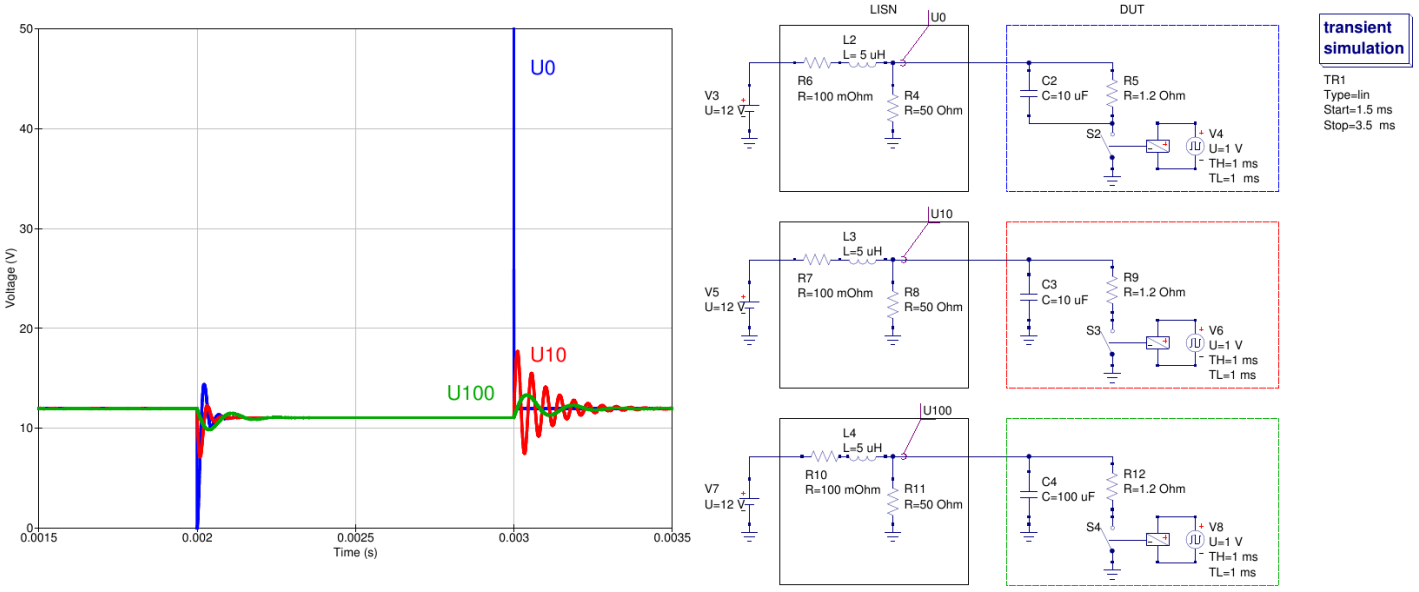
In EMC test, LISNs (also called artificial network (AN), artificial mains network (AMN)) and CDNs (coupling/decoupling network) are frequently used.

LISNs and CDNs have series inductance, which can cause transient voltage when load current rapidly changed due to on/off of DUT's mains switch or DUT's load switching.

5 µH LISN

For standards such as CISPR 25 and ISO 11452-*, 5 µH LISN are used. 5 µH inductor will store relatively small energy (LI^2 / 2 is 0.25 mJ for I = 10 A, 25 mJ for I = 100 A) but can still cause significant transient voltage.



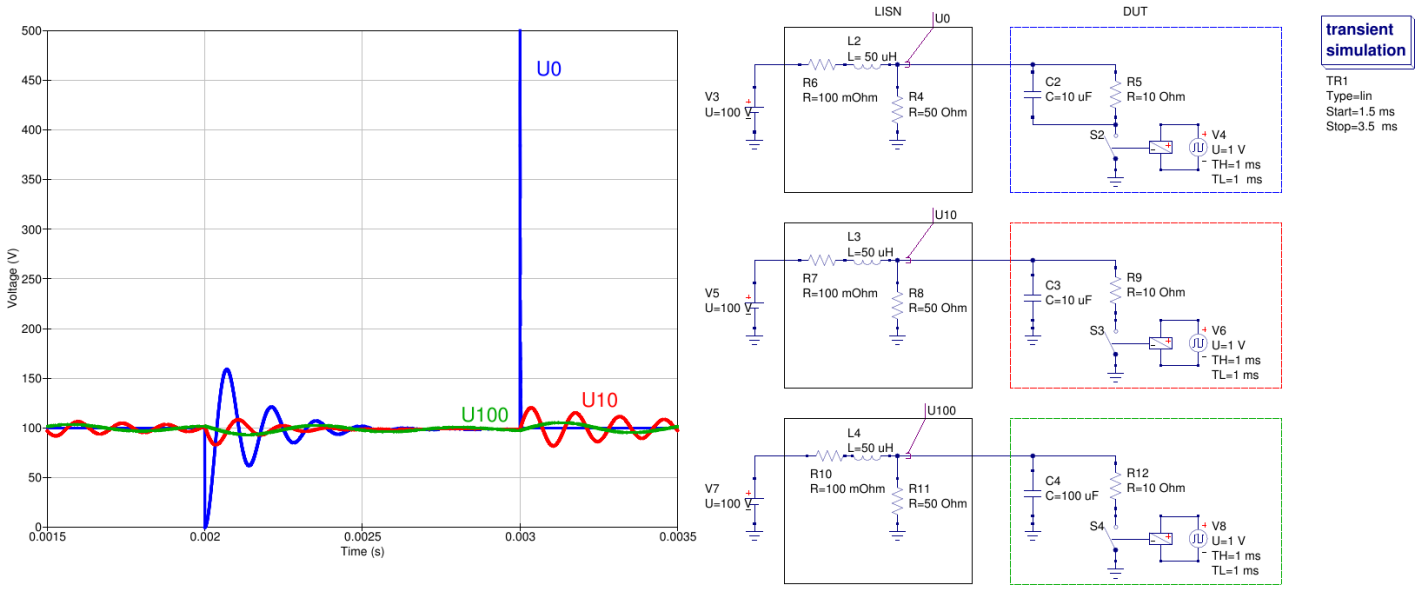
Very high transient voltage can be caused due to on/off of DUT's mains switch, which will switch the entire DUT including its decoupling capacitors (U0 in the graph above). DUT's load switching will usually cause lower peak voltage as DUT usually has decoupling capacitors (U10 in the graph, which assumes an 10 µF decoupling capacitor), but the resonance circuit constructed from the inductor and the capacitors can generates oscillating waveform triggered by the load switching. Larger decoupling capacitors help reduce these transients (U100 in the graph, which assumes an 100 µF decoupling capacitor).

Transients caused by DUT's load switching are caused on the DUT's own supply line, but DUT should not be badly affected by the transient as LISNs are assumed to simulate actual supply impedance.

When test instrument is connected to the RF port of the LISN, the transient voltage will also be applied to the input port of the instrument. When sensitive instrument such as EMI test receiver or RF preamplifier are connected to the RF port of the LISN, use of pulse limiter may be recommended to protect the input of the instrument.

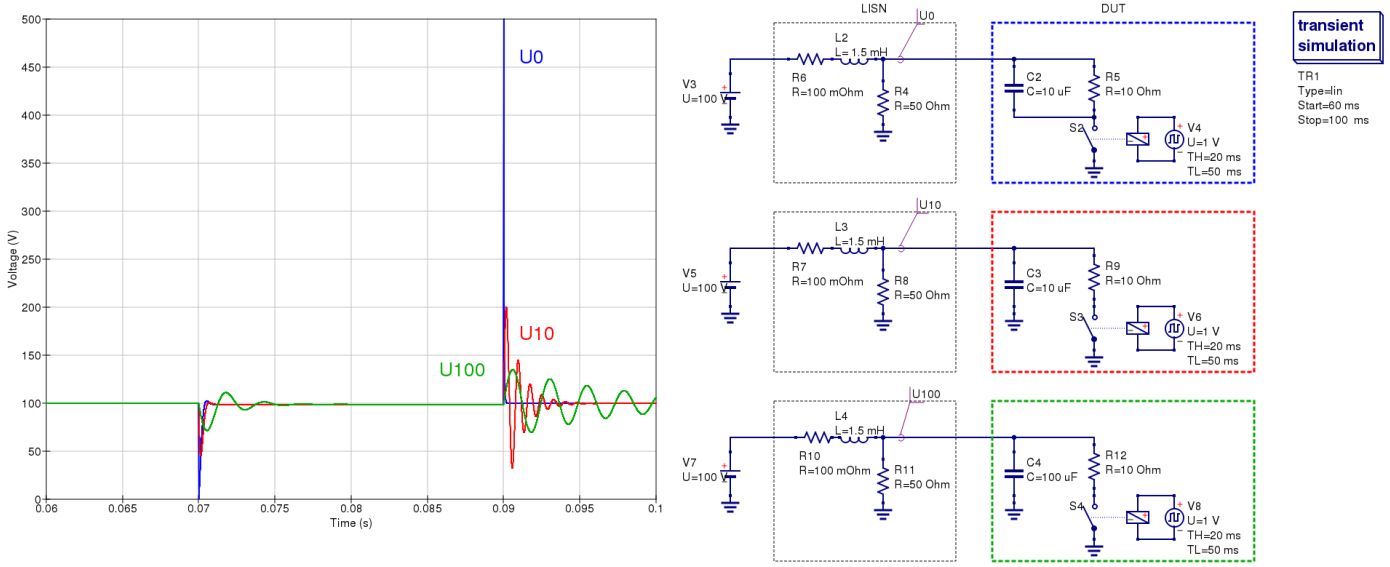
50 µH LISN

50 µH LISNs usually used for AC mains port conducted emissions measurement have 50 µH inductance, which can naturally store higher energy than 5 µH LISN for the same current.

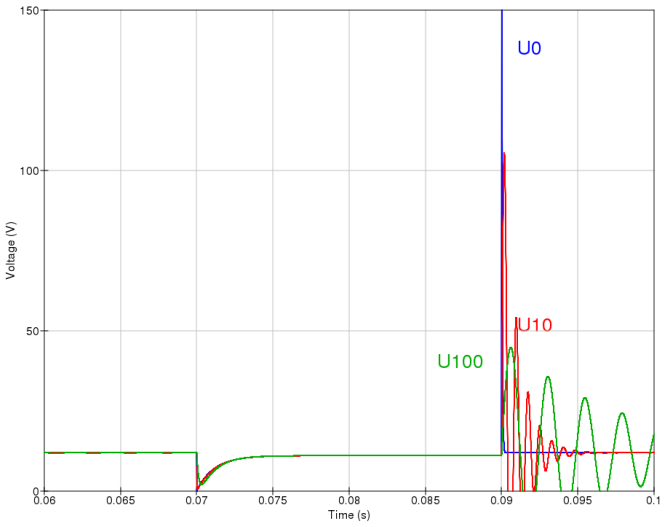


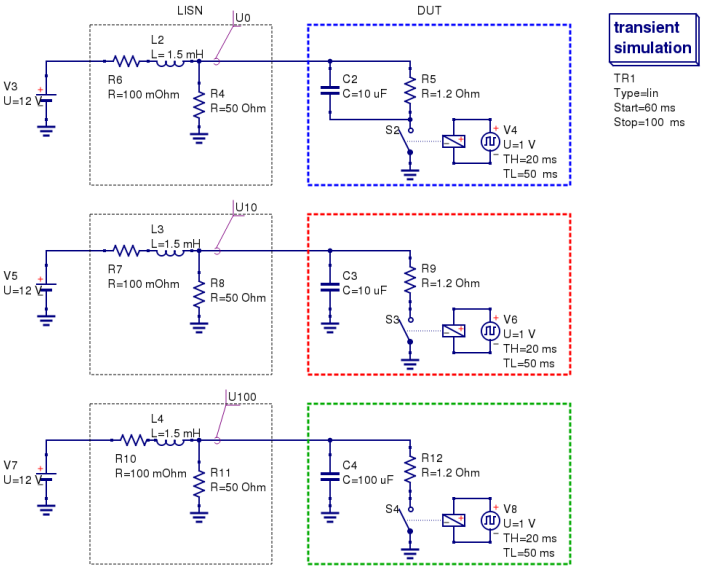
IEC 61000-4-5 CDN

CDNs used for IEC 61000-4-5 surge test usually have large decoupling inductance of order of mH (1.5 mH for example), which can store much higher energy (e.g., 7.5 J for 100 A).



If this type of CDNs are used on low voltage supplies such as 12 V d.c., voltage variations which can be caused by load switching may also disturb DUT's operation. In such cases, CDNs with smaller series inductance might be required to complete the tests.


150
100
50
0
Voltage (V)
0.06
0.065
0.07
0.075
0.08
0.085
0.09
0.095
0.1
Time (s)
U0
U10
U100


LISN
DUT
U0
L2
L=1.5 mH
V3
U=12 V
R6
R=100 mOhm
R4
R=50 Ohm
C2
C=10 uF
R5
R=1.2 Ohm
S2
V4
U=1 V
TH=20 ms
TL=50 ms
U10
L3
L=1.5 mH
V5
U=12 V
R7
R=100 mOhm
R8
R=50 Ohm
C3
C=10 uF
R9
R=1.2 Ohm
S3
V6
U=1 V
TH=20 ms
TL=50 ms
U100
L4
L=1.5 mH
V7
U=12 V
R10
R=100 mOhm
R11
R=50 Ohm
C4
C=100 uF
R12
R=1.2 Ohm
S4
V8
U=1 V
TH=20 ms
TL=50 ms
transient
simulation
TR1
Type=lin
Start=60 ms
Stop=100 ms