Uncertainties of immunity measurements

DTI-NMSPU project R2.2b1

Annex B Description of the measurement setup (conducted immunity)

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Annex B

Description of the measurement setup

This annex gives more detailed information on the measurement setup used to obtain the data for the conducted immunity analysis.

Surrogate EUT and AE

The EUT is a metal box of 28 x 43 x 18cm placed on an insulating stand 10cm above a ground plane. It has two ports, one single wire for input and one BNC coaxial for output, at opposite ends of the front panel. The input port is coupled via a switchable impedance to the case. The minimum series impedance is given by a 3R3 low inductance resistor and the voltage across this is passed to the output BNC connector through a 47R matching resistor, and thence via the external cable and CDN-S1 to the measuring instrument. The internal circuit is shown in Figure 1.

In the circuit models shown in Annex A, because the output voltage must be ground-referred, it is taken via an ideal transformer and thence to the 47 ohm matching resistor to the output measuring point. Ignoring the loss in the coax cable, this is equivalent to the actual circuit where the 47 ohm matching resistor is connected directly to the 3.3 ohm shunt resistor across which the output voltage is developed. The need to use the transformer in the model is only because of this limitation of the modelling software.

Figure 1 also shows the switched impedance which is used to give a reproducible but selectable common mode impedance Z_{AE} at the AE position.

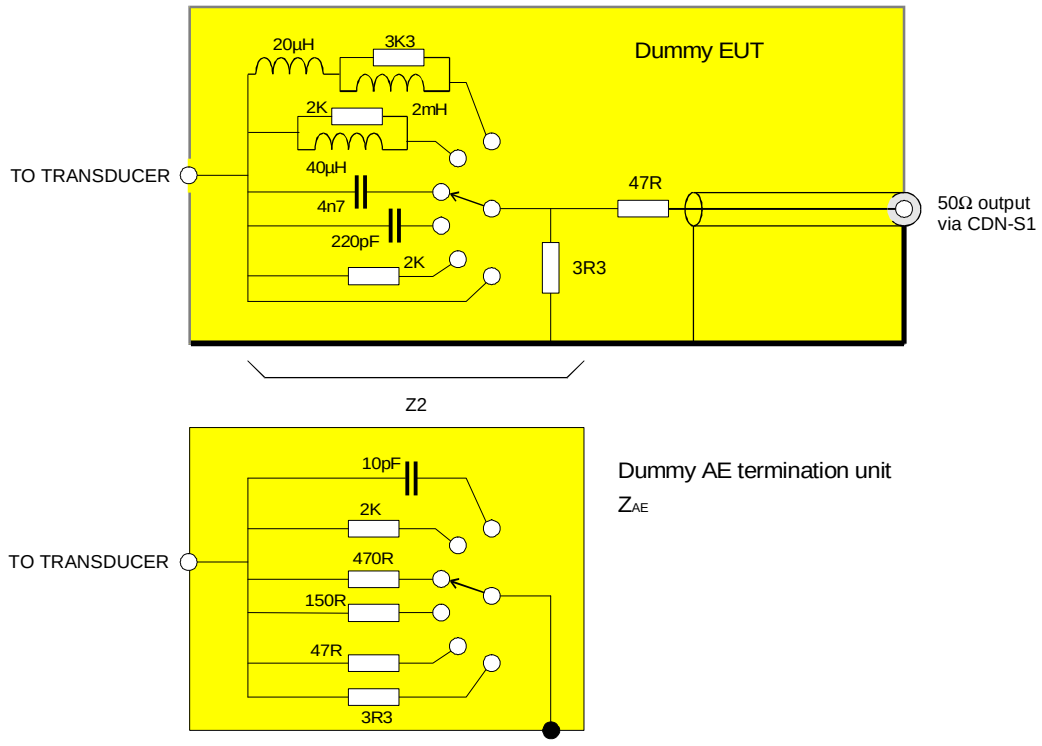


Figure 1 Dummy EUT and AE impedance circuits

Layout

The general setup follows the instructions given in IEC 61000-4-6 as far as possible. These instructions include:

- use of a metal ground plane, with the dummy EUT at a height of 0.1m and more than 0.5m from other metallic objects
- the distance from the EUT input connector to the transducer set to between 10cm and 30cm

- the height of the cable from the EUT input connector to the transducer set to between 3cm and 5cm
- the distance from the transducer (current probe or EM-clamp) to the dummy AE should be less than 0.3m “where possible”; it is set to 0.1m, 0.5m or 1m (not applicable for the CDN)
- the height of the cable from the transducer (current probe or EM-clamp) to the dummy AE set to between 3cm and 5cm
- the non-tested cable is the coaxial line from the output port, which should be terminated in a separate CDN to give a 150Ω common mode impedance; a CDN-S1 is used, and the cable is invariant, and set to 4cm height and 20cm length (the middle of the required range)

Variations were made between the extreme values for the EUT and AE cable layout. The wire used for the input (cable under test) was a combination of lengths of 16/0.2 stranded insulated copper. For the output connection to the CDN-S1, the cable was standard 50Ω RG58C/U.

A general view of the setup is shown in Figure 2.

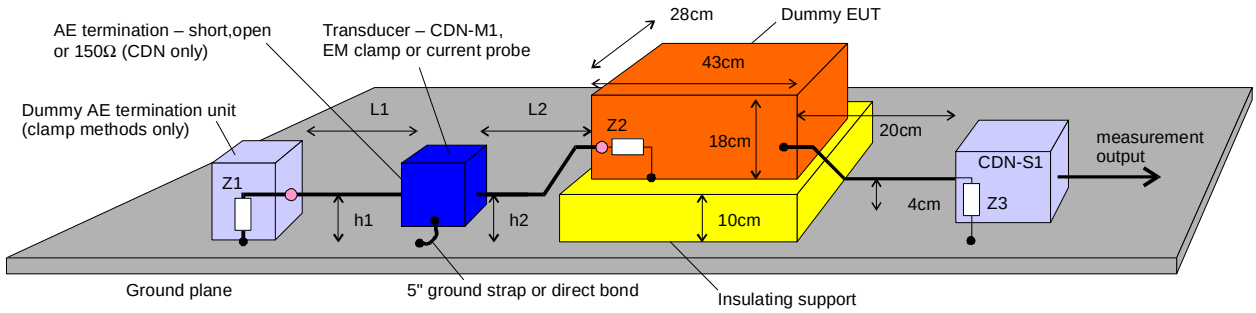
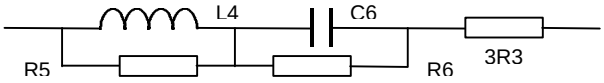


Figure 2 Conducted immunity test setup

The standard shows a “short earthing strap” used for the clamp method but gives no guidance for the ground bonding of the CDN. Since variations in the length of the earthing strap may contribute to the uncertainty, this was set to either 5 inches or a direct metal-to-metal contact.

Impedances

Z1 and Z2 in Figure 2 above were varied, as given in the tables below. Z2 is the EUT input impedance:



(see also Annex A)

EUT configuration	L4	R5	C6	L6	Comment
A	Open	0.1R	Open	0.1R	Low impedance, resistive
B	Open	0.1R	Open	2K0	High impedance, resistive
C	Open	0.1R	200pF	2K0	Capacitive impedance, signal line
D	Open	0.1R	5nF	2K0	Capacitive impedance, power line
E	40µH	2K0	Open	0.1R	Inductive impedance, signal line
F	2mH	2K0	Open	0.1R	Inductive impedance, power line

Config F represents a typical small mains filter, where the choke inductance can range from 0.2mH – 20mH
Config D represents Y-caps only, no filter
Config E represents a typical common-mode choke in series with the signal line
Config C represents low-value filter capacitors across the signal line to case

Z1 is the AE common mode impedance (also shown as Z_{AE}). This can be set to:

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CDN	Clamps	Comment
Short		Low-impedance, grounded AE
	3R3	
	47R	Medium-low impedance AE
150R		Correct impedance
	470R	Medium-high impedance AE
	2K	High impedance or floating AE
	10pF	
Open		

Equipment list

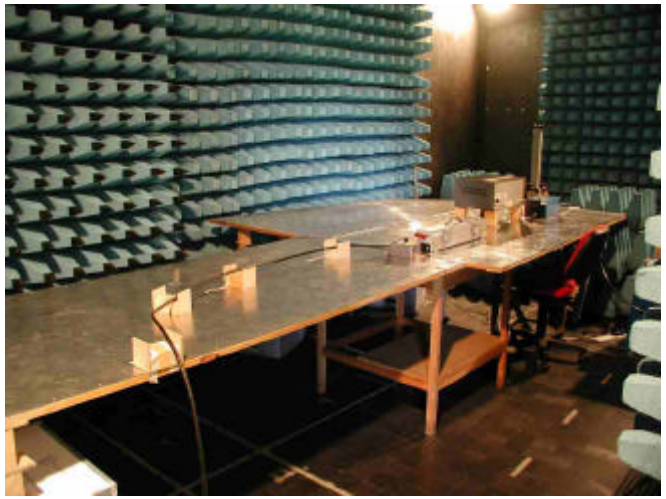
Spectrum Analyser: Advantest R3361B	Ser# 91730916
Amplifier: Amplifier Research AR 25A250A	Ser# 18056
50 Ohm load: Suhner	Ser# N/A
Measuring CDN (dummy EUT to analyser): Chase CDN-C-50	Ser# 9632
Test CDN: Chase CDN-M1-25	Ser# 9632
Current Probe: Chase Type 36A	Ser# 1133
EM Clamp: Luthi EMI01	Ser# N/A

Photographs

Photographs of the setups for the three transducers are shown on the following pages.

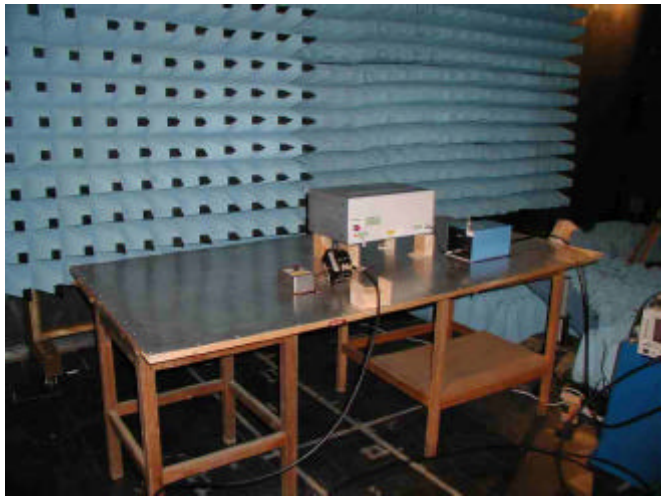
Photographs

CDN setup



EM Clamp setup

Current probe cal



Current probe setup