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INTERNATIONAL STANDARD

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BASIC EMC PUBLICATION

PUBLICATION FONDAMENTALE EN CEM

AMENDMENT 1

AMENDEMENT 1

Electromagnetic compatibility (EMC) –
Part 4-5: Testing and measurement techniques – Surge immunity test

Compatibilité électromagnétique (CEM) –
Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc

IEC 61000-4-5:2014-05/AMD1:2017-08(en-fr)

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FOREWORD

This amendment has been prepared by subcommittee 77B: High frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

The text of this amendment is based on the following documents:

CDV	Report on voting
77B/762/CDV	77B/773/RVC

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Introduction to the amendment

Rationale:

The method for testing DC products in the current revision of IEC61000-4-5 is causing many field related problems for test labs and manufacturers. Many products will not power up through the power CDN in the standard and in some cases may be damaged by the inductance that is necessary to apply the surge (see 77B/734/DC for further information).

The DC./DC converter problem is related to the switching of the converter which produces a voltage drop at the decoupling inductors on one hand and oscillations produced by the EUT impedance in combination with the source on the other hand. Measurements were performed using different brands of CDNs with a device known to show that problem as an EUT. The result shows different oscillations and signal forms of the voltage at the EUT for different CDNs. According to the outcome, the use of a CDN with a higher current rating (i.e. smaller decoupling inductivity) can solve the problem. At the meeting of SC77B/MT12 in Akishima, Japan on August 26, 2016, it was decided to add a statement into 7.3 allowing surge tests with higher current rated CDNs and to add a new Annex I to explain the problem in detail.

7.3 Test setup for surges applied to EUT power ports

Add, between the second and the third paragraph, the following new paragraph:

In case, where an EUT having DC/DC input converters cannot power up through the appropriate current-rated CDN, it is permitted to use a higher current-rated CDN with ratings up to and including 125 A, which fulfills the specifications according to its current rating given in Table 4. In such case, the use of this higher rated CDN shall be described in the test report. Annex I includes further information regarding this special case.

Annexes

Add, after Annex H, the following new Annex I:

Annex I
(informative)

Issues relating to powering EUTs having DC/DC converters at the input

I.1 General

As industry mandates energy saving equipment design, especially in classic data server ‘farms’ and central office locations that can contain hundreds or thousands of server/router communications equipment running continuously, the equipment manufacturers are re-designing their equipment to be more efficient and less wasting of energy in the form of heat dissipation. One of the largest wasteful components has been the power supply. By designing the equipment power supplies to operate from DC voltage and then converting the nominal input voltage to the voltages required by the circuits of the system, vast amounts of energy can be conserved when using modern switching design controlled by microprocessor technologies to only draw power from the source when actually needed by the loading circuits. Larger storage capacitors formerly used to store energy between conduction cycles are being eliminated or reduced dramatically. The result is that the input current of such DC/DC power supplies is no longer true direct current. It has become pulsed current. The frequency of this pulsed current is often a problem when passing through the inductor used in the decoupling network of the CDNs. The inductance of the decoupling network was selected to provide very low reactance to DC and AC power line frequencies typically up to 50 Hz or 60 Hz. As frequency increases, so does the inductive reactance. Thus, for a surge impulse having 1,2 μs rise time and 50 μs duration, the reactance becomes very high and effectively attenuates the surge impulse from passing through to the source supply connected to the CDN. The surge impulse is therefore ‘steered’ to the EUT output of the CDN. The frequency of the input current pulses of DC/DC converters is evolving to faster and faster speeds to more effectively increase efficiency. As these switching supply technologies are evolving to use PWM (pulse width modulation) techniques, the input current of these supplies is becoming a complex waveform actually containing many frequencies and their harmonics (due to the square wave nature of the pulses). As a result, the decoupling inductor, through which this current flows to its source, cannot pass these rapid changes in current. Its high reactance to these high frequency transitions causes the voltage supplied to the EUT to drop instantaneously. Because the EUT supply has little capacitance to ‘hold up’ voltage to its loads, its output voltage drops. This can cause the load equipment circuitry to stop working or to perform erratically. The DC/DC supply has rapidly responding circuitry so it immediately attempts to draw more current from its source. It would change its PWM (duty cycle) to increase current from the source. This change effectively changes the frequency of the chopped current through the decoupling inductor which can further reduce instantaneous voltage to the EUT or increase it depending upon frequency effect of the PWM, and the cycle starts over again.

Another issue for active DC/DC converters is that the presence of an inductance between the DC power source and the DC/DC converter input can cause self-oscillations due to the dynamic voltage/current ratio of the input signal. dI/dV is negative for small excursions from the nominal voltage, and for some converters this in combination with the gain/phase properties of the converter control loop can cause unwanted self-oscillation. The stability margin of the DC/DC converter in combination with the surge CDN is in general not known by the testing laboratory.

While the switch to EUT power supplies is evolving to employ more energy efficient DC power inputs to such telecommunications EUT equipment, test laboratories should acquire DC power supplies to supply power to the inputs of the CDNs used for compliance testing to power up those EUT products. Modern technology has also changed the world of laboratory DC power supplies. Today these supplies also use switching mode technologies and have very sophisticated circuitry employed to keep their output voltage and current constant under a variety of changing loads while also reducing wasted energy in the form of heat, unlike the aging linear power supply technologies. This circuitry can pose a problem when powering up devices having DC/DC converters on their inputs due to the changing current and complex current waveforms caused by the switching frequencies of those DC/DC converters. The DC source supplies might not be able to cope with such rapid changes in load. Also their output impedance, when coupled to the CDN decoupling inductance and load inductance of the EUT, could make them susceptible to oscillation. Additionally, many of these DC supplies cannot tolerate or cope with the effect of any residual surge impulses passing through the decoupling network and can be damaged. Test engineers should really study and understand the limitations of such supplies as used for compliance testing to ensure their suitability for such applications.

I.2 Considerations for remediation

If a cause has not been found for the EUT not to power up through the CDN, the next step is to determine if the issue is due to the decoupling inductance limiting voltage to the EUT or whether the source DC supply is unable to maintain its output voltage, is oscillating or a combination of both. These are not always simple tasks to determine. Simultaneously viewing the input voltage and line current to the EUT with a dual channel oscilloscope can reveal whether there are oscillations or switching frequency spikes affecting the input voltage to the EUT. It is essential to have knowledge of all switching frequencies of the EUT supply as well as its minimum and maximum input voltage levels. If the waveform is complex (containing numerous frequencies at different amplitudes) suspect contamination from the DC source supply, such as its own switching frequencies and noise generations. Often it is required to eliminate sources of frequency contamination one step at a time, such as changing source DC power supply or even eliminating source DC supply by substituting storage batteries (e.g. automobile batteries work well) to attain the proper input voltage and current ratings. If the issue is an oscillation and believed to be caused by the decoupling inductance, then inserting a resistor-diode circuit in series with the source input to the CDN as shown in Figure I.1 can dampen or eliminate the oscillation. If it is damped enough so that the voltage does not exceed the EUT DC/DC power supply's minimum and maximum tolerances, then this should be sufficient to allow the EUT to power up and to perform the surge testing. As every EUT supply and source DC supply is different, it requires some intelligent experimentation to attain the optimal value of resistance for the optimum damping. Being placed on the input to the CDN, this circuit will not affect waveform parameters as specified in this document. Sometimes changing to a larger current-rated CDN (with lower decoupling inductance) is needed in addition to adding the damping circuit shown in Figure I.1.

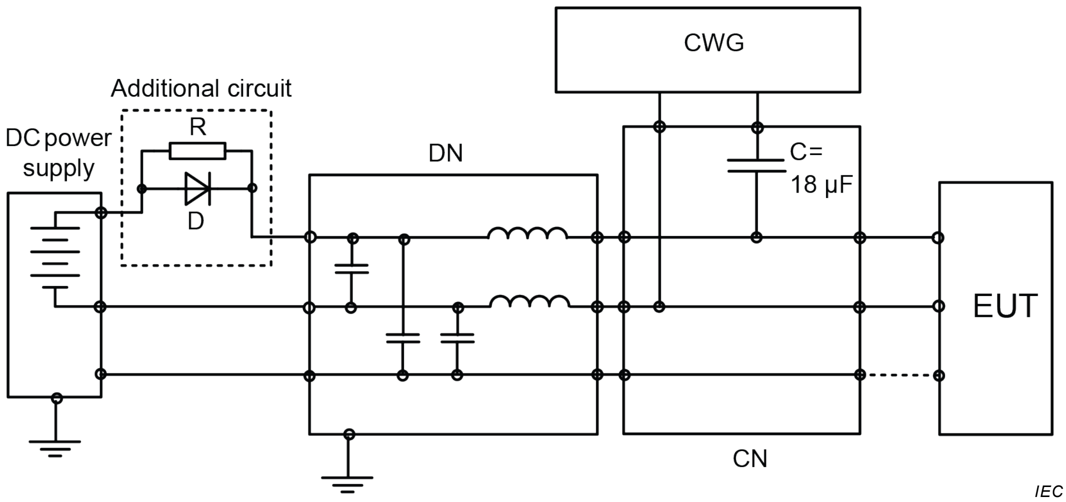

Figure I.1 – Example of adding a damping circuit to the CDN for DC/DC converter EUTs

AVANT-PROPOS

Le présent amendement a été établi par le sous-comité 77B:Phénomènes haute fréquence, du comité d'études 77 de l'IEC: Compatibilité électromagnétique.

Le texte de cet amendement est issu des documents suivants:

CDV	Rapport de vote
77B/762/CDV	77B/773/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cet amendement.

Le comité a décidé que le contenu de cet amendement et de la publication de base ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

Introduction à l'amendment

Justification:

La méthode utilisée pour les essais des produits en c.c dans la version actuelle de l'IEC 61000-4-5 est à l'origine de nombreux problèmes liés aux champs auxquels sont confrontés les laboratoires d'essai et les constructeurs. Beaucoup de produits ne démarreront pas avec les RCD de puissance dont il est question dans la présente norme et dans certains cas ils pourront être endommagés par l'inductance qui est nécessaire pour appliquer l'onde de choc (voir le document 77B/734/CD pour avoir plus d'informations).

Le problème d'un convertisseur c.c/c.c est lié à sa commutation qui produit une chute de tension au niveau des inductances de découplage d'une part et aux oscillations générées par l'impédance de l'EUT en combinaison avec la source d'autre part. Les mesures ont été réalisées en utilisant différentes marques de RCD avec un dispositif présentant notoirement ce problème comme EUT. Le résultat montre des oscillations et des formes de signal de la tension au niveau de l'EUT différentes pour des RCD différents. D'après le résultat, l'utilisation d'un RCD avec des valeurs assignées de courant plus élevées (c'est-à-dire avec une inductance de découplage plus faible) peut résoudre le problème. Lors de la réunion de la MT12 du SC77B à Akishima, au Japon, le 26 août 2016, il a été décidé de faire un ajout en 7.3 permettant les essais d'onde de choc avec des RCD ayant une valeur assignée de courant plus élevée et d'ajouter une nouvelle Annexe I pour expliquer le problème en détail.

7.3 Montage d'essai pour les ondes de choc appliquées aux accès d'alimentation de l'EUT

Ajouter, entre le deuxième et le troisième alinéa, le nouvel alinéa suivant:

Dans le cas où un EUT équipé de convertisseurs d'entrée c.c/c.c ne peut pas démarrer avec le RCD ayant une valeur assignée de courant appropriée, il est autorisé d'utiliser un RCD ayant une valeur assignée de courant supérieure avec des caractéristiques de courant jusqu'à 125 A inclus, qui satisfait aux spécifications des caractéristiques de courant données dans le Tableau 4. Dans un tel cas, l'utilisation de ce RCD avec une valeur assignée de courant supérieure doit être décrite dans le rapport d'essai. L'Annexe I contient des informations complémentaires concernant ce cas particulier.

Annexes

Ajouter, après l'Annexe H, la nouvelle Annexe I suivante: