AS/NZS IEC 61000.4.4:2013
IEC 61000-4-4, Ed. 3.0 (2012)
Reconfirmed 2020

Australian/New Zealand Standard™

Electromagnetic compatibility (EMC)

Part 4.4: Testing and measurement techniques—Electrical fast transient/burst immunity test

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee TE-003, Electromagnetic Interference. It was approved on behalf of the Council of Standards Australia on 22 May 2013 and on behalf of the Council of Standards New Zealand on 23 April 2013.
This Standard was published on 20 June 2013.

The following are represented on Committee TE-003:

Australian Broadcasting Corporation
Australian Communications and Media Authority
Australian Industry Group
Australian Information Industry Association
Consumer Electronics Suppliers Association
Consumers Federation of Australia
Curtin University of Technology
Department of Defence, Australia
Electrical Compliance Testing Association
Energy Networks Association
Engineers Australia
Lighting Council New Zealand
Lighting Council of Australia
Ministry of Economic Development, New Zealand
National Measurement Institute
Wireless Institute Australia

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.saiglobal.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR AS/NZS IEC 61000.4.4.

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

RECONFIRMATION

OF
AS/NZS IEC 61000.4.4:2013
Electromagnetic compatibility (EMC)
Part 4.4: Testing and measurement techniques—Electrical fast transient/burst immunity test

RECONFIRMATION NOTICE

Technical Committee TE-003 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 11 September 2020.

Approved for reconfirmation in New Zealand on behalf of the New Zealand Standards Approval Board on 18 June 2020.

The following are represented on Technical Committee TE-003:

Australian Broadcasting Corporation
Australian Communications and Media Authority
Australian Industry Group
Australian Information Industry Association
Consumer Electronics Suppliers Association
Department of Defence (Australian Government)
Electrical Compliance Testing Association of Australia
EMC Society of Australia
Energy Networks Australia
Engineers Australia
Free TV Australia
Ministry of Business, Innovation and Employment (NZ)
National Measurement Institute
Wireless Institute Australia

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

NOTES

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

Australian/New Zealand Standard™

Electromagnetic compatibility (EMC)

Part 4.4: Testing and measurement techniques—Electrical fast transient/burst immunity test

Originated as AS/NZS 61000.4.4:2006.
Jointly revised and designated AS/NZS IEC 61000.4.4:2013.

COPYRIGHT

© Standards Australia Limited/Standards New Zealand

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, Private Bag 2439, Wellington 6140.

AVA Documents
Document Sharing Hub

ISBN 978 1 74342 478 0

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee TE-003, Electromagnetic Interference, to supersede AS/NZS 61000.4.4:2006.

The objective 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. The test method documented in this Standard describes a consistent method to assess the immunity of equipment or a system against a defined phenomenon.

This Standard is identical with, and has been reproduced from IEC 61000-4-4, Ed. 3.0 (2012), *Electromagnetic compatibility (EMC),* Part 4-4: *Testing and measurement techniques—Electrical fast transient/burst immunity test.*

As this Standard is reproduced from an International Standard, the following applies:

(a) Its number appears on the cover and title page while the International Standard number appears only on the cover.

(b) In the source text ‘this part of IEC 61000’ should read ‘this Australian/New Zealand Standard’.

(c) A full point substitutes for a comma when referring to a decimal marker.

None of the normative references in the source document have been adopted as Australian or Australian/New Zealand Standards.

The term ‘informative’ has been used in this Standard to define the application of the annex to which it applies. An informative annex is only for information and guidance.

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

CONTENTS

1 Scope 7
2 Normative references 7
3 Terms, definitions and abbreviations 7
3.1 Terms and definitions 7
3.2 Abbreviations 10
4 General 10
5 Test levels 10
6 Test equipment 11
6.1 Overview 11
6.2 Burst generator 11
6.2.1 General 11
6.2.2 Characteristics of the fast transient/burst generator 12
6.2.3 Calibration of the characteristics of the fast transient/burst generator 14
6.3 Coupling/decoupling network for a.c./d.c. power port 15
6.3.1 Characteristics of the coupling/decoupling network 15
6.3.2 Calibration of the coupling/decoupling network 16
6.4 Capacitive coupling clamp 17
6.4.1 General 17
6.4.2 Calibration of the capacitive coupling clamp 18
7 Test setup 20
7.1 General 20
7.2 Test equipment 20
7.2.1 General 20
7.2.2 Verification of the test instrumentation 20
7.3 Test setup for type tests performed in laboratories 21
7.3.1 Test conditions 21
7.3.2 Methods of coupling the test voltage to the EUT 24
7.4 Test setup for in situ tests 26
7.4.1 Overview 26
7.4.2 Test on power ports and earth ports 26
7.4.3 Test on signal and control ports 27
8 Test procedure 28
8.1 General 28
8.2 Laboratory reference conditions 28
8.2.1 Climatic conditions 28
8.2.2 Electromagnetic conditions 28
8.3 Execution of the test 28
9 Evaluation of test results 29
10 Test report 29
Annex A (informative) Information on the electrical fast transients 30
Annex B (informative) Selection of the test levels 32
Annex C (informative) Measurement uncertainty (MU) considerations 34
Bibliography 43

Documents
Document Sharing Hub
Full document details: AS NZS IEC 61000.4.4-2013 (2020)

Page

Figure 1 – Simplified circuit diagram showing major elements of a fast transient/burst generator 12
Figure 2 – Representation of an electrical fast transient/burst 13
Figure 3 – Ideal waveform of a single pulse into a 50 Ω load with nominal parameters t_r = 5 ns and t_w = 50 ns 13
Figure 4 – Coupling/decoupling network for a.c./d.c. power mains supply ports/terminals 16
Figure 5 – Calibration of the waveform at the output of the coupling/decoupling network 17
Figure 6 – Example of a capacitive coupling clamp 18
Figure 7 – Transducer plate for coupling clamp calibration 19
Figure 8 – Calibration of a capacitive coupling clamp using the transducer plate 19
Figure 9 – Block diagram for electrical fast transient/burst immunity test 20
Figure 10 – Example of a verification setup of the capacitive coupling clamp 21
Figure 11 – Example of a test setup for laboratory type tests 22
Figure 12 – Example of test setup using a floor standing system of two EUTs 23
Figure 13 – Example of a test setup for equipment with elevated cable entries 24
Figure 14 – Example of a test setup for direct coupling of the test voltage to a.c./d.c. power ports for laboratory type tests 25
Figure 15 – Example for in situ test on a.c./d.c. power ports and protective earth terminals for stationary, floor standing EUT 26
Figure 16 – Example of in situ test on signal and control ports without the capacitive coupling clamp 27

Table 1 – Test levels 11
Table 2 – Output voltage peak values and repetition frequencies 15
Table C.1 – Example of uncertainty budget for voltage rise time (t_r) 36
Table C.2 – Example of uncertainty budget for EFT/B peak voltage value (V_P) 37
Table C.3 – Example of uncertainty budget for EFT/B voltage pulse width (t_w) 38
Table C.4 – α factor (Equation (C.4)) of different unidirectional impulse responses corresponding to the same bandwidth of the system B 40

Documents
Document Sharing Hub
Full document details: AS NZS IEC 61000.4.4-2013 (2020)

INTRODUCTION

IEC 61000 is published in separate parts, according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as international standards or as technical specifications or technical reports, some of which have already been published as sections. Others are published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61000-6-1).

This part is an international standard which gives immunity requirements and test procedures related to electrical fast transients/bursts.

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

NOTES

Documents
Document Sharing Hub

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

AUSTRALIAN/NEW ZEALAND STANDARD

Electromagnetic compatibility (EMC)

Part 4.4: Testing and measurement techniques—Electrical fast transient/burst immunity test

1 Scope

This part of IEC 61000 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. The test method documented in this part of IEC 61000 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon.

NOTE As described in IEC Guide 107, this is a basic EMC publication for use by product committees of the IEC. As also stated in Guide 107, the IEC product committees are responsible for determining whether this immunity test standard is applied or not, and if applied, they are responsible for determining the appropriate test levels and performance criteria.[1]

The standard defines:

– test voltage waveform;
– range of test levels;
– test equipment;
– calibration and verification procedures of test equipment;
– test setups;
– test procedure.

The standard gives specifications for laboratory and in situ tests.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-161:1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60050-161, as well as the following apply.

[1] TC 77 and its subcommittees are prepared to co-operate with product committees in the evaluation of the value of particular immunity tests for their products.

Documents Document Sharing Hub

COPYRIGHT

Full document details: AS NZS IEC 61000.4.4-2013 (2020)

NOTE Several of the most relevant terms and definitions from IEC 60050-161 are presented among the definitions below.

3.1.1
auxiliary equipment
AE
equipment necessary to provide the equipment under test (EUT) with the signals required for normal operation and equipment to verify the performance of the EUT

3.1.2
burst
sequence of a limited number of distinct pulses or an oscillation of limited duration

[SOURCE: IEC 60050-161:1990, 161-02-07]

3.1.3
calibration
set of operations which establishes, by reference to standards, the relationship which exists, under specified conditions, between an indication and a result of a measurement

Note 1 to entry: This term is based on the "uncertainty" approach.

Note 2 to entry: The relationship between the indications and the results of measurement can be expressed, in principle, by a calibration diagram.

[SOURCE: IEC 60050-311:2001, 311-01-09]

3.1.4
coupling
interaction between circuits, transferring energy from one circuit to another

3.1.5
common mode (coupling)
simultaneous coupling to all lines versus the ground reference plane

3.1.6
coupling clamp
device of defined dimensions and characteristics for common mode coupling of the disturbance signal to the circuit under test without any galvanic connection to it

3.1.7
coupling network
electrical circuit for the purpose of transferring energy from one circuit to another

3.1.8
decoupling network
electrical circuit for the purpose of preventing EFT voltage applied to the EUT from affecting other devices, equipment or systems which are not under test

3.1.9
degradation (of performance)
undesired departure in the operational performance of any device, equipment or system from its intended performance

Note 1 to entry: The term "degradation" can apply to temporary or permanent failure.

[SOURCE: IEC 60050-161:1990, 161-01-19]

3.1.10
EFT/B
electrical fast transient/burst

Documents
Document Sharing Hub
COPYRIGHT
Full document details: AS NZS IEC 61000.4.4-2013 (2020)

3.1.11
electromagnetic compatibility
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:1990, 161-01-07]

3.1.12
EUT
equipment under test

3.1.13
ground reference plane
GRP
flat conductive surface whose potential is used as a common reference

[SOURCE: IEC 60050-161:1990, 161-04-36]

3.1.14
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-01-20]

3.1.15
port
particular interface of the EUT with the external electromagnetic environment

3.1.16
pulse width
interval of time between the first and last instants at which the instantaneous value reaches 50 % value of the rising and falling edge of the pulse

[SOURCE: IEC 60050-702:1992, 702-03-04, modified]

3.1.17
rise time
interval of time between the instants at which the instantaneous value of a pulse first reaches 10 % value and then the 90 % value

[SOURCE: IEC 60050-161:1990, 161-02-05, modified]

3.1.18
transient
pertaining to or designating a phenomenon or a quantity which varies between two consecutive steady states during a time interval which is short compared with the time-scale of interest

[IEC 60050-161:1990, 161-02-01]

3.1.19
unsymmetric mode (coupling)
single line coupling versus the ground reference plane

Documents
Document Sharing Hub
COPYRIGHT
Full document details: AS NZS IEC 61000.4.4-2013 (2020)

3.1.20
verification
set of operations which is used to check the test equipment system (e.g. the test generator and the interconnecting cables) and to gain confidence that the test system is functioning within the specifications given in Clause 6

Note 1 to entry: The methods used for verification may be different from those used for calibration.

Note 2 to entry: For the purposes of this basic EMC standard this definition is different from the definition given in IEC 60050-311:2001, 311-01-13.

3.2 Abbreviations

AE	Auxiliary Equipment
CDN	Coupling/Decoupling Network
EFT/B	Electrical Fast Transient/Burst
EMC	ElectroMagnetic Compatibility
ESD	ElectroStatic Discharge
EUT	Equipment Under Test
GRP	Ground Reference Plane
MU	Measurement Uncertainty
PE	Protective Earth
TnL	Terminator non Linearity

4 General

The repetitive fast transient test is a test with bursts consisting of a number of fast transients, coupled into power, control, signal and earth ports of electrical and electronic equipment. Significant for the test are the high amplitude, the short rise time, the high repetition frequency, and the low energy of the transients.

The test is intended to demonstrate the immunity of electrical and electronic equipment when subjected to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce, etc.).

5 Test levels

The preferred test levels for the electrical fast transient test, applicable to power, control, signal and earth ports of the equipment are given in Table 1.

Documents
Document Sharing Hub
COPYRIGHT
Full document details: AS NZS IEC 61000.4.4-2013 (2020)

Table 1 – Test levels

Open circuit output test voltage and repetition frequency of the impulses				
Level	Power ports, earth port (PE)		Signal and control ports	
	Voltage peak kV	Repetition frequency kHz	Voltage peak kV	Repetition frequency kHz
1	0,5	5 or 100	0,25	5 or 100
2	1	5 or 100	0,5	5 or 100
3	2	5 or 100	1	5 or 100
4	4	5 or 100	2	5 or 100
X [a]	Special	Special	Special	Special
The use of 5 kHz repetition frequency is traditional, however, 100 kHz is closer to reality. Product committees should determine which frequencies are relevant for specific products or product types. With some products, there may be no clear distinction between power ports and signal ports, in which case it is up to product committees to make this determination for test purposes.				
[a] "X" can be any level, above, below or in between the others. The level shall be specified in the dedicated equipment specification.				

For selection of test levels, see Annex B.

6 Test equipment

6.1 Overview

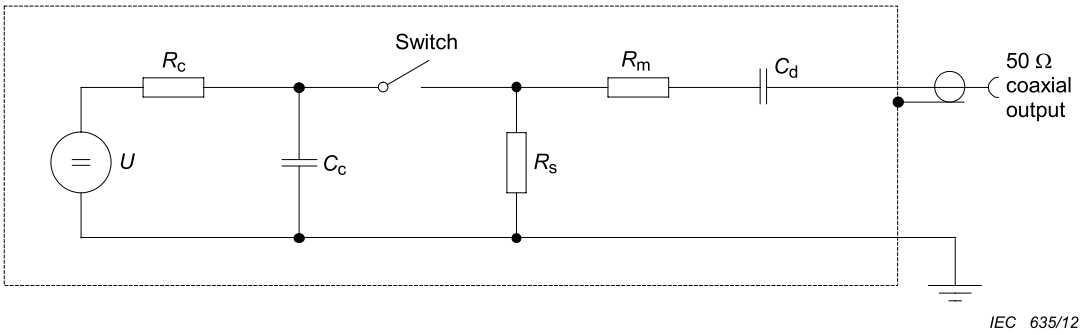
The calibration procedures of 6.2.3, 6.3.2 and 6.4.2 ensure the correct operation of the test generator, coupling/decoupling networks, and other items making up the test setup so that the intended waveform is delivered to the EUT.

6.2 Burst generator

6.2.1 General

The simplified circuit diagram of the generator is given in Figure 1. The circuit elements C_c, R_s, R_m, and C_d are selected so that the generator delivers a fast transient under open circuit conditions and with a 50 Ω resistive load. The effective output impedance of the generator shall be 50 Ω.

Documents
Document Sharing Hub
COPYRIGHT
Full document details: AS NZS IEC 61000.4.4-2013 (2020)



Components	
U	high-voltage source
R_c	charging resistor
C_c	energy storage capacitor
R_s	impulse duration shaping resistor
R_m	impedance matching resistor
C_d	d.c. blocking capacitor
Switch	high-voltage switch

NOTE The characteristics of the switch together with stray elements (inductance and capacitance) of the layout shape the required rise time.

Figure 1 – Simplified circuit diagram showing major elements of a fast transient/burst generator

6.2.2 Characteristics of the fast transient/burst generator

The characteristics of the fast transient/burst generator are the following.

– Output voltage range with 1 000 Ω load shall be at least 0,24 kV to 3,8 kV.
– Output voltage range with 50 Ω load shall be at least 0,125 kV to 2 kV.

The generator shall be capable of operating under short-circuit conditions without being damaged.

Characteristics:

– polarity:	positive/negative
– output type:	coaxial, 50 Ω
– d.c. blocking capacitor	(10 ± 2) nF
– repetition frequency:	(see Table 2) ±20 %
– relation to a.c. mains:	asynchronous
– burst duration:	(15 ± 3) ms at 5 kHz
(see Figure 2)	(0,75 ± 0,15) ms at 100 kHz
– burst period:	(300 ± 60) ms
(see Figure 2)	
– wave shape of the pulse	
• into 50 Ω load	rise time t_r = (5 ± 1,5) ns
	pulse width t_w = (50 ± 15) ns
	peak voltage = according to Table 2, ±10 %

COPYRIGHT

Full document details: AS NZS IEC 61000.4.4-2013 (2020)