



Institut luxembourgeois de la normalisation
de l'accréditation, de la sécurité et qualité
des produits et services

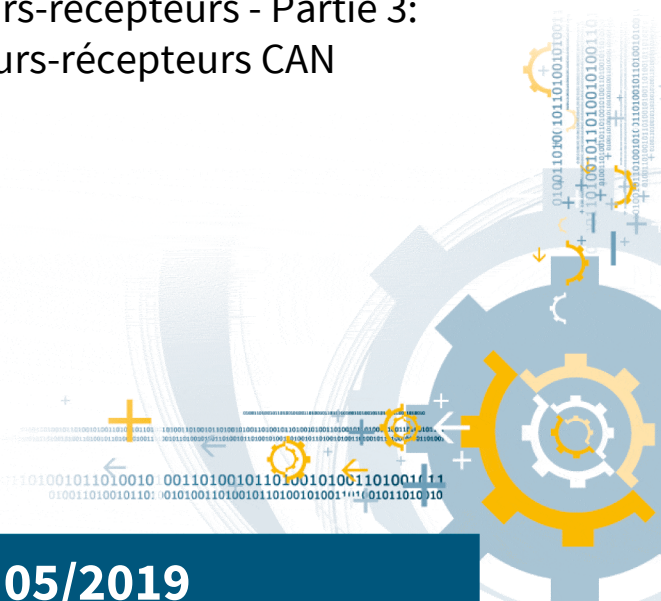
ILNAS-EN IEC 62228-3:2019

Integrated circuits - EMC evaluation of transceivers - Part 3: CAN transceivers

Integrierte Schaltungen - Bewertung der
elektromagnetischen Verträglichkeit von
Sende-Empfangsgeräten - Teil 3: CAN-
Sende-Empfangsgeräte

Circuits intégrés - Évaluation de la CEM
des émetteurs-récepteurs - Partie 3:
Émetteurs-récepteurs CAN

05/2019



National Foreword

This European Standard EN IEC 62228-3:2019 was adopted as Luxembourgish Standard ILNAS-EN IEC 62228-3:2019.

Every interested party, which is member of an organization based in Luxembourg, can participate for FREE in the development of Luxembourgish (ILNAS), European (CEN, CENELEC) and International (ISO, IEC) standards:

- Participate in the design of standards
- Foresee future developments
- Participate in technical committee meetings

<https://portail-qualite.public.lu/fr/normes-normalisation/participer-normalisation.html>

THIS PUBLICATION IS COPYRIGHT PROTECTED

Nothing from this publication may be reproduced or utilized in any form or by any mean - electronic, mechanical, photocopying or any other data carries without prior permission!

ILNAS-EN IEC 62228-3:2019

EUROPEAN STANDARD **EN IEC 62228-3**
NORME EUROPÉENNE
EUROPÄISCHE NORM

May 2019

ICS 31.200

English Version

**Integrated circuits - EMC evaluation of transceivers - Part 3:
CAN transceivers
(IEC 62228-3:2019)**

Circuits intégrés - Évaluation de la CEM des émetteurs-
récepteurs - Partie 3: Émetteurs-récepteurs CAN
(IEC 62228-3:2019)

Integrierte Schaltungen - Bewertung der
elektromagnetischen Verträglichkeit von Sende-
Empfangsgeräten - Teil 3: CAN-Sende-Empfangsgeräte
(IEC 62228-3:2019)

This European Standard was approved by CENELEC on 2019-04-15. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 47A/1050/CDV, future edition 1 of IEC 62228-3, prepared by SC 47A "Integrated circuits" of IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62228-3:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-01-15
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-04-15

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62228-3:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61000-4-4	NOTE	Harmonized as EN 61000-4-4
CISPR 16-1-1	NOTE	Harmonized as EN 55016-1-1

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61967-1	-	Integrated circuits - Measurement of electromagnetic emissions - Part 1: General conditions and definitions	EN IEC 61967-1	-
IEC 61967-4	-	Integrated circuits - Measurement of electromagnetic emissions, 150 kHz to 1 GHz - Part 4: Measurement of conducted emissions, 1 ohm/150 ohm direct coupling method	EN 61967-4	-
IEC 62132-1	-	Integrated circuits - Measurement of electromagnetic immunity - Part 1: General conditions and definitions	EN 62132-1	-
IEC 62132-4	-	Integrated circuits - Measurement of electromagnetic immunity 150 kHz to 1 GHz - Part 4: Direct RF power injection method	EN 62132-4	-
IEC 62215-3	-	Integrated circuits - Measurement of impulse immunity - Part 3: Non-synchronous transient injection method	EN 62215-3	-
IEC 62228-1	-	Integrated circuits - EMC evaluation of transceivers - Part 1: General conditions and definitions	EN IEC 62228-1	-
ISO 7637-2	-	Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only	-	-
ISO 10605	-	Road vehicles - Test methods for electrical disturbances from electrostatic discharge	-	-
ISO 11898-1	-	Road vehicles - Controller area network (CAN) - Part 1: Data link layer and physical signalling	-	-
ISO 11898-2	-	Road vehicles - Controller area network (CAN) - Part 2: High-speed medium access unit	-	-



INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Integrated circuits – EMC evaluation of transceivers –
Part 3: CAN transceivers**

**Circuits intégrés – Évaluation de la CEM des émetteurs-récepteurs –
Partie 3: Émetteurs-récepteurs CAN**

CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references	8
3 Terms, definitions and abbreviated terms	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	10
4 General	10
5 Test and operating conditions.....	11
5.1 Supply and ambient conditions.....	11
5.2 Test operation modes	12
5.3 Test configuration	12
5.3.1 General test configuration for transceiver network	12
5.3.2 General test configuration for unpowered ESD test.....	13
5.3.3 Transceiver network tests – Coupling ports and networks.....	14
5.3.4 ESD tests – Coupling ports and networks	15
5.4 Test signals	16
5.4.1 General	16
5.4.2 Test signals for normal operation mode	16
5.4.3 Test signal for wake-up from low power mode	18
5.5 Evaluation criteria	22
5.5.1 General	22
5.5.2 Evaluation criteria for functional operation modes.....	22
5.5.3 Evaluation criteria in unpowered condition after exposure to disturbances	28
5.5.4 Status classes	29
6 Test and measurement	29
6.1 Emission of RF disturbances.....	29
6.1.1 Test method	29
6.1.2 Test setup	29
6.1.3 Test procedure and parameters	30
6.2 Immunity to RF disturbances.....	31
6.2.1 Test method	31
6.2.2 Test setup	31
6.2.3 Test procedure and parameters	32
6.3 Immunity to impulses	37
6.3.1 Test method	37
6.3.2 Test setup	37
6.3.3 Test procedure and parameters	38
6.4 Electrostatic discharge (ESD)	41
6.4.1 Test method	41
6.4.2 Test setup	41
6.4.3 Test procedure and parameters	43
7 Test report.....	44
Annex A (normative) CAN test circuits	45
A.1 General.....	45
A.2 Test circuit for CAN transceivers for functional tests	45

A.3	Test circuit for CAN transceiver for ESD test.....	49
Annex B (normative)	Test circuit boards.....	51
B.1	Test circuit board for functional tests	51
B.2	ESD test	51
Annex C (informative)	Examples for test limits for CAN transceiver in automotive application	53
C.1	General.....	53
C.2	Emission of RF disturbances.....	53
C.3	Immunity to RF disturbances.....	54
C.4	Immunity to impulses	57
C.5	Electrostatic discharge (ESD)	57
Annex D (informative)	Characterization of common mode choke for CAN bus interfaces.....	58
D.1	General.....	58
D.2	Abbreviations	58
D.3	CMC test.....	58
D.3.1	General	58
D.3.2	Leakage inductance mismatch measurement.....	59
D.3.3	S-parameter measurement mixed mode.....	63
D.3.4	ESD damage	68
D.3.5	Saturation test at RF disturbances.....	71
Bibliography		74
Figure 1	– General test configuration for tests in transceiver network	13
Figure 2	– General test configuration for unpowered ESD test	13
Figure 3	– Transceiver network tests – coupling ports and networks	14
Figure 4	– Coupling ports and networks for ESD tests	16
Figure 5	– Definition for trigger points and violation masks for CAN transceivers with flexible data rate capability	26
Figure 6	– Principal drawing of the maximum deviation on an I-V characteristic	28
Figure 7	– Test setup for measurement of RF disturbances	30
Figure 8	– Test setup for DPI tests.....	32
Figure 9	– Test setup for impulse immunity tests	37
Figure 10	– Test setup for direct ESD tests – principal arrangement.....	42
Figure 11	– Test setup for direct ESD tests – stimulation and monitoring	43
Figure A.1	– General drawing of the circuit diagram of test network for CAN standard transceivers for functional test.....	47
Figure A.2	– General drawing of the circuit diagram of test network for CAN PN transceivers for functional test	49
Figure A.3	– General drawing of the circuit diagram for direct ESD tests of CAN transceivers in unpowered mode.....	50
Figure B.1	– Example of IC interconnections of CAN signal	51
Figure B.2	– Example of ESD test board for CAN transceivers.....	52
Figure C.1	– Example of limits for RF emission – CAN with bus filter	53
Figure C.2	– Example of limits for RF emission – other global pins	54
Figure C.3	– Example of limits for RF emission – local supplies.....	54

Figure C.4 – Example of limits for RF immunity for functional status class A _{IC} – CAN with bus filter	55
Figure C.5 – Example of limits for RF immunity for functional status class A _{IC} – CAN	55
Figure C.6 – Example of limits for RF immunity for functional status class A _{IC} – other global pins	56
Figure C.7 – Example of limits for RF immunity for functional status class C _{IC} or D _{IC} – CAN with bus filter	56
Figure C.8 – Example of limits for RF immunity for functional status class C _{IC} or D _{IC} – other global pins	57
Figure D.1 – General electrical drawing of a CMC	59
Figure D.2 – Test setup for 2-port S-Parameter measurements for leakage inductance evaluation	59
Figure D.3 – Example of a two-port test board for CMC leakage inductance characterization	60
Figure D.4 – Example of CMC characterization measurement results	63
Figure D.5 – Test setup for S-Parameter measurements	64
Figure D.6 – Example test board S-Parameter measurement – mixed mode, top layer	65
Figure D.7 – Example test board S-Parameter measurement – single ended, top layer	65
Figure D.8 – Recommended characteristics for S _{dd21} (IL)	67
Figure D.9 – Recommended characteristic for S _{cc21} (CMR)	68
Figure D.10 – Recommended characteristic for S _{sd21} and S _{sd12} (DCMR)	68
Figure D.11 – Test setup for ESD damage tests	69
Figure D.12 – Example test board ESD, top layer	70
Figure D.13 – Test setup for RF saturation measurements	71
Figure D.14 – Example RF saturation / S-Parameter test board, top layer	72
Table 1 – Overview of measurements and tests	11
Table 2 – Supply and ambient conditions for functional operation	12
Table 3 – Transceiver network tests – component value definitions of coupling ports and networks	15
Table 4 – Definitions of coupling ports for ESD tests	16
Table 5 – Communication test signal TX1	17
Table 6 – Communication test signal TX2a	17
Table 7 – Communication test signal TX2b	18
Table 8 – Wake-up test signal TX3	18
Table 9 – Communication test signal TX4a	19
Table 10 – Communication test signal TX4b	19
Table 11 – Communication test signal TX4c	19
Table 12 – Communication test signal TX4d	20
Table 13 – Communication test signal TX4e	20
Table 14 – Communication test signal TX4f1	20
Table 15 – Communication test signal TX4f2	21
Table 16 – Communication test signal TX4g	21
Table 17 – Communication test signal TX4h	21
Table 18 – Communication test signal TX4i	22

Table 19 – Evaluation criteria for CAN transceiver standard functions	23
Table 20 – Evaluation criteria for CAN transceivers with partial networking functionality	23
Table 21 – Specific definition for test procedure for evaluation of CAN transceiver partial networking function	24
Table 22 – Evaluation criteria for CAN transceivers with flexible data rate capability.....	25
Table 23 – Definitions for violation masks for CAN transceivers with flexible data rate capability	27
Table 24 – Definition of functional status classes	29
Table 25 – Settings of the RF measurement equipment	31
Table 26 – RF emission measurements	31
Table 27 – Specifications for DPI tests	33
Table 28 – DPI tests for functional status class A _{IC} evaluation of CAN transceiver standard function	34
Table 29 – DPI tests for functional status class A _{IC} evaluation of CAN transceiver partial networking function	35
Table 30 – DPI tests for functional status class A _{IC} evaluation of CAN transceiver CAN FD function	36
Table 31 – DPI tests for functional status class C _{IC} or D _{IC} evaluation of CAN transceivers	36
Table 32 – Specifications for impulse immunity tests	38
Table 33 – Parameters for impulse immunity test	38
Table 34 – Impulse immunity tests for functional status class A _{IC} evaluation of CAN transceiver standard function	39
Table 35 – Impulse immunity tests for functional status class A _{IC} evaluation of CAN transceiver partial networking function	40
Table 36 – Impulse immunity tests for functional status class A _{IC} evaluation of CAN transceiver CAN FD function	40
Table 37 – Impulse immunity tests for functional status class C _{IC} or D _{IC} evaluation of CAN transceivers	41
Table 38 – Specifications for direct ESD tests.....	43
Table 39 – ESD tests in unpowered mode for functional status class D _{IC} evaluation of CAN transceivers	44
Table B.1 – Parameters of ESD test circuit board	52
Table C.1 – Example of limits for impulse immunity for functional status class C _{IC} or D _{IC} ...	57
Table D.1 – Test procedure and parameters for leakage inductance evaluation	61
Table D.2 – Leakage inductance measurements	62
Table D.3 – Leakage inductance mismatch classes	63
Table D.4 – Test procedure and parameters for 3-port test board characterization.....	64
Table D.5 – Test procedure and parameters for S-Parameter measurements.....	66
Table D.6 – Required S-Parameter measurements	67
Table D.7 – Test parameters for ESD damage tests.....	70
Table D.8 – Required ESD tests for damage	71
Table D.9 – Test procedure and parameters for RF saturation tests.....	72
Table D.10 – Required RF saturation tests.....	73