IEC 62228-3

Edition 1.0 2019-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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

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INTEGRATED CIRCUITS – EMC EVALUATION OF TRANSCEIVERS –

Part 3: CAN transceivers

FOREWORD

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International Standard IEC 62228-3 has been prepared by subcommittee 47A: Integrated circuits, of IEC technical committee 47: Semiconductor devices.

This first edition cancels and replaces the first edition of IEC TS 62228 published in 2007 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC TS 62228:

a) introduction of CAN transceivers with partial networking functionality and CAN transceivers with flexible data rate capability and addition of operation modes and test descriptions in the respective subclauses of the document;
b) introduction of minimal communication network with two CAN transceivers;
c) update of the test requirements and targets in Annex C;
d) addition of Annex D for common mode choke characterization.

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

CDV	Report on voting
47A/1050/CDV	47A/1069/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62228 series, published under the general *title Integrated circuits – EMC evaluation of transceivers*, can be found on the IEC website.

The committee has decided that the contents of this 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- withdrawn,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.

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INTEGRATED CIRCUITS – EMC EVALUATION OF TRANSCEIVERS –

Part 3: CAN transceivers

1 Scope

This part of IEC 62228 specifies test and measurement methods for EMC evaluation of CAN transceiver ICs under network condition. It defines test configurations, test conditions, test signals, failure criteria, test procedures, test setups and test boards. It is applicable for CAN standard transceivers, CAN transceivers with partial networking functionality and CAN transceivers with flexible data rate capability and covers

- the emission of RF disturbances,
- the immunity against RF disturbances,
- the immunity against impulses, and
- the immunity against electrostatic discharges (ESD).

2 Normative references

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.

IEC 61967-1, *Integrated circuits – Measurement of electromagnetic emissions – Part 1: General conditions and definitions*

IEC 61967-4, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 4: Measurement of conducted emissions – 1 Ω/150 Ω direct coupling method*

IEC 62132-1, *Integrated circuits – Measurement of electromagnetic immunity – Part 1: General conditions and definitions*

IEC 62132-4, *Integrated circuits – Measurement of electromagnetic immunity 150 kHz to 1 GHz – Part 4: Direct RF power injection method*

IEC 62215-3, *Integrated circuits – Measurement of impulse immunity – Part 3: Non-synchronous transient injection method*

IEC 62228-1, *Integrated circuits – EMC evaluation of transceivers – Part 1: General conditions and definitions*

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*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62228-1, IEC 61967-1, IEC 62132-1, as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
global pin
pin that carries a signal or power, which enters or leaves the application board without any active component in between

3.1.2
CAN standard transceiver
transceiver with functionality according to ISO 11898-2 with data rates up to 1 MBit/s and access to RxD and TxD signal

3.1.3
CAN PN transceiver
transceiver with partial networking functionality according to ISO 11898-2 with access to RxD and TxD signal

3.1.4
CAN FD transceiver
transceiver with flexible data rate capability according to ISO 11898-2 with data rates up to 2 MBit/s or 5 Mbit/s and access to RxD and TxD signal

3.1.5
Low Power – standby
transceiver functional operation mode low power with active bus biasing

3.1.6
Low Power – sleep
transceiver functional operation mode low power with inactive bus biasing

3.1.7
Low Power – PN standby
transceiver functional operation mode low power with active bus biasing and frame detection active

3.1.8
Low Power – PN sleep
transceiver functional operation mode low power with inactive bus biasing and frame detection configured

3.1.9
mandatory components, pl
components needed for proper function of IC as specified by the IC manufacturer

3.2 Abbreviated terms

ASIC	application specific integrated circuit
CMC	common mode choke
DUT	device under test
DPI	direct RF power injection
ERR	error
FD	flexible data rate
INH	inhibit
CAN	controller area network
PCB	printed circuit board
PN	partial networking
RxD	receive data
SBC	system base chip
TxD	transmit data
WUF	wake-up frame

4 General

The intention of this document is to evaluate the EMC performance of CAN transceivers under application conditions in a minimal network.

The evaluation of the EMC characteristics of CAN transceivers shall be performed in functional operation modes under network condition for RF emission, RF immunity and impulse immunity tests and on a single transceiver for electrostatic discharge tests.

The aim of these tests is to determine the EMC performance on dedicated pins of the CAN transceiver which are considered as EMC relevant in the application. For a CAN transceiver IC, these pins are CAN_H, CAN_L, V_{BAT} and WAKE. Depending on the IC and its functionality, other pins as for example V_{CC} should be considered as well.

The test methods used for the EMC characterization are based on the international standards for IC EMC tests and are described in Table 1.

Table 1 – Overview of measurements and tests

	Test	Test method	Evaluation	Functional operation mode
Transceiver network	RF emission (EMI)	150 Ω direct coupling (IEC 61967-4)	Spectrum	Normal
				Low Power – standby [a]
	RF immunity (RF)	DPI (IEC 62132-4)	Function	Normal
				Low Power – standby [a]
				Low Power – sleep [a]
	Impulse immunity (IMP)	Non-synchronous transient injection (IEC 62215-3)	Function	Normal
				Low Power – standby [a]
				Low Power – sleep [a]
Single transceiver	ESD	Contact discharge (ISO 10605)	Damage	Unpowered

[a] If provided by the implementation.

The 150 Ω direct coupling, DPI and non-synchronous transient injection test methods are chosen for the evaluation of the EMC characteristic of transceivers in network condition. These three test methods are based on the same approach using conductive coupling. Therefore it is possible to use the same test board for all tests in functional operation mode, which reduces the effort and increases the reproducibility and comparability of test results.

The ESD test is performed on single transceiver on a separate test board.

All measurements and tests should be done with soldered transceivers on special test boards as described in Annex B to ensure application like conditions and avoid setup effects by sockets. For automotive applications, test limit examples are described in Annex C.

In general, the test definition is done for stand-alone CAN transceivers. CAN transceiver IP core embedded in SBCs or ASICs shall follow the test methods for single CAN transceivers, adapting test conditions and targets as necessary. Such adaptations shall be done individually for the dedicated IC but shall follow the general definitions.

In order to verify filter effects on the EMC performance of CAN transceivers, configurations with and without a bus filter (e.g. common mode choke, capacitor) at the CAN_H and CAN_L pins are defined in this document. As a consequence, the frequency characteristic of these filter elements shall be taken into account for the interpretation of the test results. See Annex D for more information about common mode choke characterization.

5 Test and operating conditions

5.1 Supply and ambient conditions

For all tests and measurements under operating conditions, the settings are based on systems with 12 V power supply, which is the main application of CAN transceivers. If a transceiver is designed or targeted for other power supply voltages, the test conditions and test targets shall be adapted and documented accordingly. The defined supply and ambient conditions for functional operation are given in Table 2.

Table 2 – Supply and ambient conditions for functional operation

Parameter	Value
Voltage supply V_{BAText} [a]	(14 ± 0,2) V (default)
Voltage supply V_{CCext} [a]	(5 ± 0,1) V (default)
Voltage supply V_{IOext} [a]	(3,3 ± 0,1) V (default)
Test temperature	(23 ± 5) °C
[a] V_{ext} means voltage at external terminal on the test board as shown e.g. in Figure A.1.	

For RF emission measurements, the ambient noise floor shall be at least 6 dB below the applied target limit and documented in the test report.

For ESD tests, the requirements of ISO 10605 climatic environmental conditions shall be applied.

5.2 Test operation modes

The CAN transceivers shall be tested in functional operation modes and unpowered according to Table 1.

5.3 Test configuration

5.3.1 General test configuration for transceiver network

The test configuration in general consists of CAN transceivers with mandatory external components and components for filtering and decoupling (CAN node) in a minimal test network, when filtered power supplies, signals, monitoring probes and coupling networks are connected as shown in Figure 1.

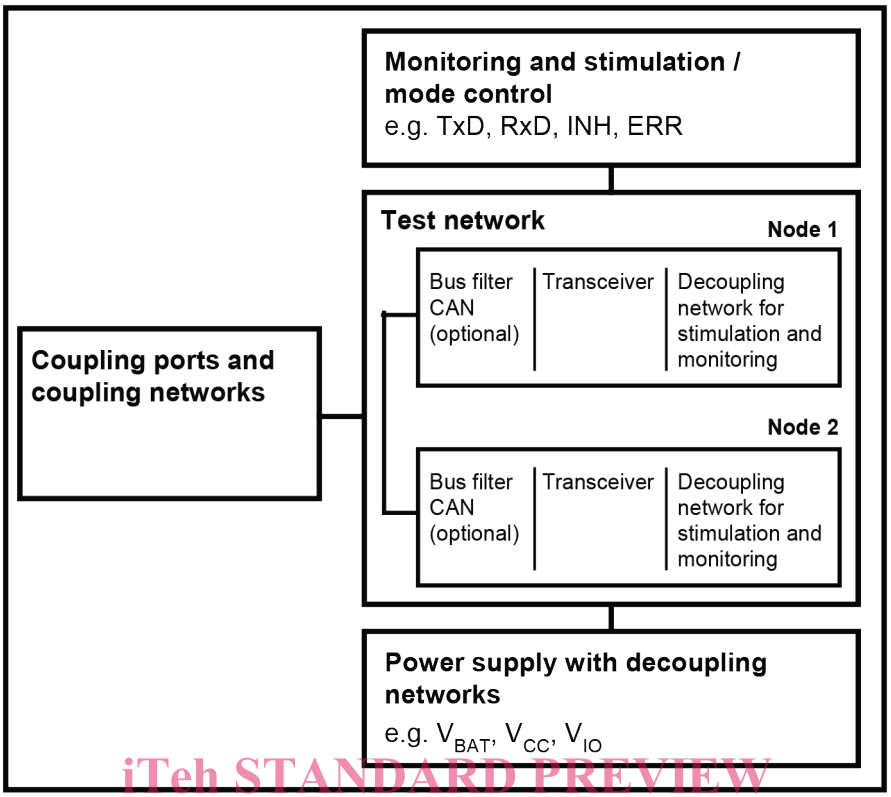

Figure 1 – General test configuration for tests in transceiver network

For evaluation of RF emission, RF immunity and impulse immunity characteristic of a CAN transceiver in functional operation mode a minimal CAN test network consisting of two CAN transceivers of same type shall be used.

NOTE In specific cases or for analyses, a deviation from this setup can be agreed between the users of this document and noted in the test report.

General drawings of schematics with more details are given in Annex A.

5.3.2 General test configuration for unpowered ESD test

The general test configuration for unpowered ESD test of CAN transceivers consists of a single CAN transceiver with mandatory external components and components for filtering on a test board with discharge coupling networks as shown in Figure 2.

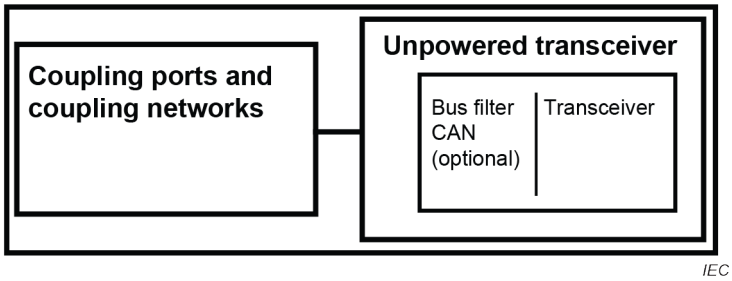

Figure 2 – General test configuration for unpowered ESD test