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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Integrated circuits – EMC evaluation of transceivers – Part 7: CXPI transceivers

Circuits intégrés – Évaluation de la CEM des émetteurs-récepteurs – Partie 7: Émetteurs-récepteurs CXPI

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Circuits intégrés – Évaluation de la CEM des émetteurs-récepteurs – Partie 7: Émetteurs-récepteurs CXPI

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INTEGRATED CIRCUITS – EMC EVALUATION OF TRANSCEIVERS –

Part 7: CXPI transceivers

FOREWORD

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The text of this International Standard is based on the following documents:

Draft	Report on voting
47A/1130/FDIS	47A/1133/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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INTEGRATED CIRCUITS – EMC EVALUATION OF TRANSCEIVERS –

Part 7: CXPI transceivers

1 Scope

This part of IEC 62228 specifies test and measurement methods for the EMC evaluation of CXPI transceiver ICs under network condition. It defines test configurations, test conditions, test signals, failure criteria, test procedures, test setups and test boards. This specification is applicable for standard CXPI transceiver ICs and ICs with embedded CXPI transceiver 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 – 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 62132-4:2006, *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 20794-4, *Road vehicles – Clock extension peripheral interface (CXPI) – Part 4: Data link layer and physical layer*

ISO 20794-7:2020, *Road vehicles – Clock extension peripheral interface (CXPI) – Part 7: Data link and physical layer conformance test plan*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 62228-1, IEC 61967-1 and 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 Terms and definitions

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
standard CXPI transceiver IC
standalone CXPI transceiver according to ISO 20794-4 or IC with integrated CXPI transceiver cell with access to CXPI RXD and TXD signal

3.1.3
IC with embedded CXPI transceiver
IC with integrated CXPI transceiver cell and CXPI protocol handler but without access to CXPI RXD or TXD signal

3.1.4
mandatory components, pl
components needed for proper function of IC as specified by the IC manufacturer

3.2 Abbreviated terms

ASSP	application specific standard product
CRC	cyclic redundancy check
CXPI	Clock Extension Peripheral Interface
DLL	data link layer
EN	enable
FI	frame information
IBS	inter byte space
NRZ	non-return to zero
PCB	printed circuit board
PID	protected identifier
PMA	physical media attachment
PS	physical signalling
PWM	pulse width modulation
RX_{PWM}	output signal for receiver in CXPI bus-line driver
RXD_{NRZ}	output signal for receiver in CXPI codec circuit

TX_{PWM}	input signal for transmitter in CXPI bus-line driver
TXD_{NRZ}	input signal for transmitter in CXPI codec circuit
UART	universal asynchronous receiver / transmitter

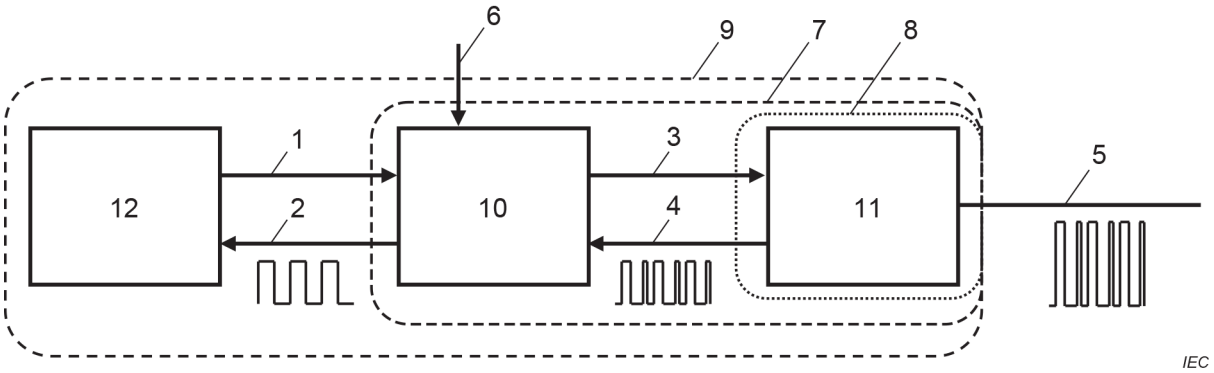
4 General

The intention of this document is to evaluate the EMC performance of CXPI transceiver ICs under application conditions in a minimal network. CXPI Transceiver ICs are generally classified into three types, as listed in Table 1.

Figure 1 shows a sample configuration of each type of CXPI transceiver IC. The overview of the PHY sublayers is following ISO 20794-4. Standard type-A comprises a CXPI transceiver IC that contains the PS sublayer and the PMA sublayer. Standard type-B contains only the PMA sublayer. The Embedded type includes a microcontroller or ASSP function, in addition to the functions of Standard type-A. The PMA sublayer transmits and receives communication data on the bus line in the PWM signal format. The PS sublayer has the clock generation function, the encoding and decoding of CXPI frames and the bit-wise collision resolution logic. The microcontroller or ASSP transmits and receives the communication data in the NRZ signal format according to the specifications of the application.

Table 1 – Types for CXPI transceiver

Transceiver classification	CXPI transceiver type	Communication sublayer implementation
Standard CXPI transceiver IC	Standard type-A	with PMA and PS sublayer
	Standard type-B	with PMA sublayer only
IC with embedded CXPI transceiver	Embedded type	with PMA, PS sublayer and DLL



Key

1 TXD_{NRZ}
2 RXD_{NRZ}
3 TX_{PWM}
4 RX_{PWM}
5 CXPI network
6 Clock (master node only, provided externally or from micro controller)
7 Standard type-A
8 Standard type-B
9 Embedded type
10 PMA
11 PS
12 Microcontroller or ASSP etc. including DLL

Figure 1 – PHY sub-layers overview and CXPI transceiver types

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

The aim of these tests is to determine the EMC performance of the CXPI transceiver on dedicated global pins, which are considered as EMC relevant in the application. For a standard CXPI transceiver IC and an IC with an embedded CXPI transceiver, these pins are VBAT and CXPI.

The test methods used for EMC characterization are based on the international standards for IC EMC tests and are described in Table 2.

Table 2 – Overview of required measurement and tests

Transceiver mode	Required test	Test method	Evaluation	Functional operation mode
Functional (powered)	RF emission	150 Ω direct coupling (IEC 61967-4)	Spectrum	Normal
	RF immunity	DPI (IEC 62132-4)	Function	Normal
				Sleep
	Impulse immunity	Non-synchronous transient injection (IEC 62215-3)	Function	Normal
				Sleep
Passive (unpowered)	ESD	Contact discharge (ISO 10605)	Damage	Unpowered

The RF emission, RF immunity and impulse immunity test methods are selected for the evaluation of EMC characteristic of transceivers in functional (powered) modes. 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 required and increases the reproducibility and comparability of test results.

The ESD test is performed on passive (unpowered) transceiver IC on a separate test board.

All measurements and tests should be done with soldered transceivers on test boards as described in Annex B, to ensure application like conditions and avoid setup effects by sockets.

Annex C provides example test limits and levels for CXPI transceivers in automotive application.

In general, the test definition is done for standard CXPI transceiver ICs. For ICs with embedded CXPI transceivers some adaptations are necessary which are described in this document. Specific adaptations shall be done individually for the dedicated IC but shall follow the general definitions identified.

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 a 12 V power supply, which is the main application for CXPI transceivers. If a transceiver is designed or targeted for a higher power supply voltage, 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 3. Although the standard voltage of VCC_{ext} is 5 V, other voltages such as 3,3 V may be supplied depending on the product.

Table 3 – Supply and ambient conditions for functional operation

Parameter	Value
Voltage supply $VBAT_{ext}$	(14 ± 0,2) V (default)
Voltage supply VCC_{ext}	(5 ± 0,1) V (default), (3,3 ± 0,1) V
Test temperature	(23 ± 5) °C

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.

Unpowered ESD tests shall be carried out without any supply voltage, and the requirements of ISO 10605 climatic environmental conditions shall be applied.

5.2 Test operation modes

The CXPI transceiver ICs shall be tested in powered functional operation modes and in the unpowered mode. The functional operation modes are normal mode and sleep mode.

5.3 Test configuration

5.3.1 General test configuration for functional test

The test configuration in general consists of CXPI transceivers with mandatory external components and components for filtering and decoupling ($CXPI_{ext}$ node) in a minimal test network, where filtered power supplies, signals, monitoring probes and coupling networks are connected as shown in Figure 2. Node 1 is defined as the master node, and Node 2 is defined as the slave node.

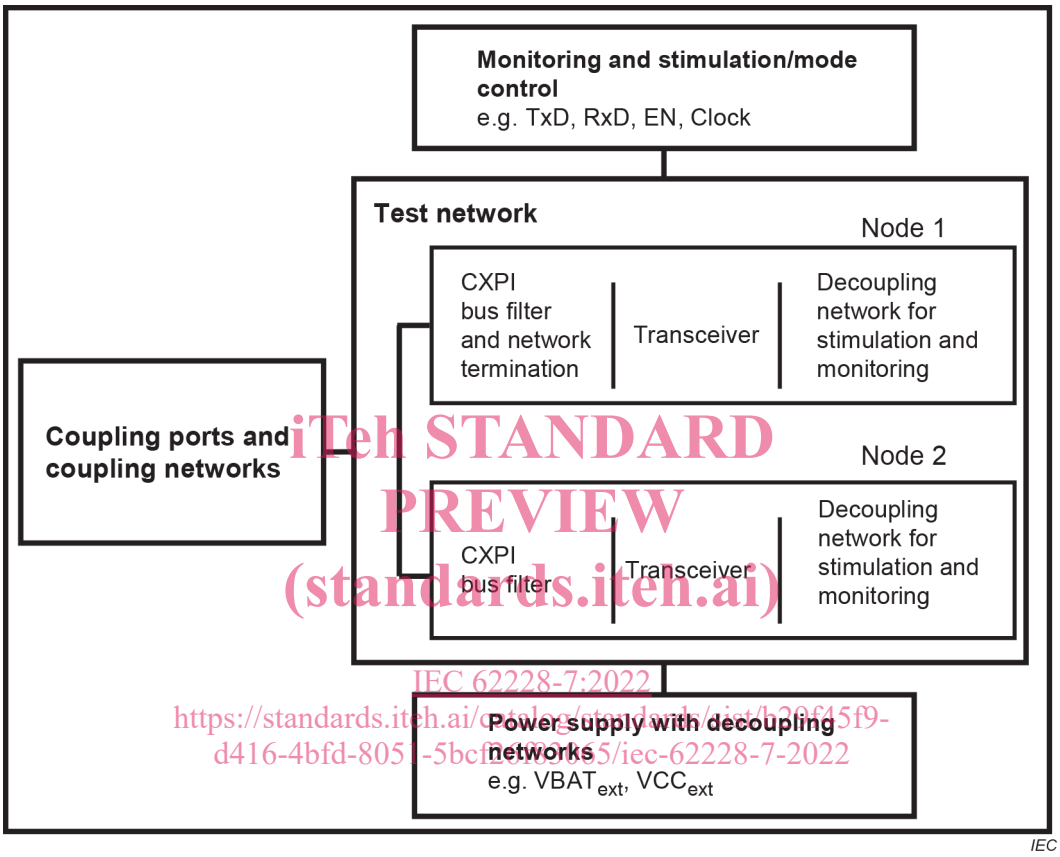


Figure 2 – General test configuration for tests in functional operation modes

For evaluation of RF emission, RF immunity and the impulse immunity characteristics of a CXPI transceiver in functional operation mode, a minimal CXPI test network consisting of two CXPI transceiver ICs shall be used. Depending on the type of transceiver the following network configurations are defined:

- two transceivers of same type in case of standard CXPI transceiver IC (DUT), or
- one IC with embedded CXPI transceiver (DUT) and one standard CXPI transceiver IC.

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

The CXPI network termination and bus filter including ESD suppression devices (e.g. zener diode) if used, shall comply with the time constant defined in ISO 20794-4. If an optional ESD suppression device is used (e.g. to achieve a certain ESD or impulse immunity level) it shall be used for all other tests of this document and documented in the test report.

A general drawing of a schematic with more details of the CXPI transceiver test network is given in Annex A.

5.3.2 General test configuration for unpowered ESD test

The general test configuration for unpowered ESD test of CXPI transceiver ICs consists of a single CXPI transceiver IC with mandatory external components and components for filtering on a test board with discharge coupling networks as shown in Figure 3.

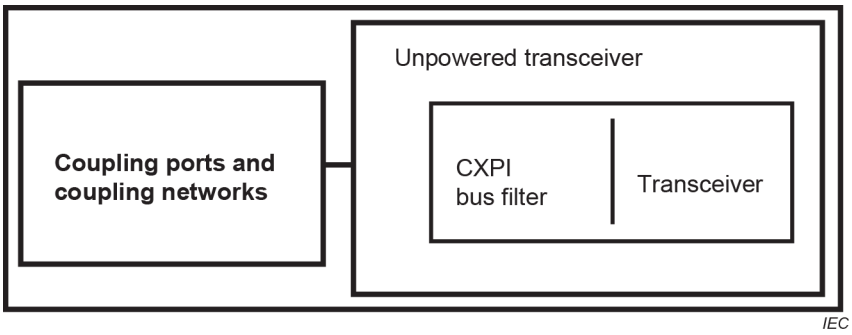
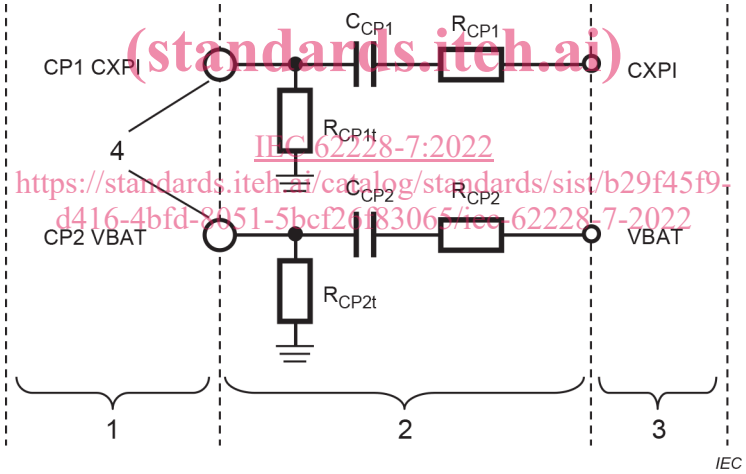


Figure 3 – General test configuration for unpowered ESD test

5.3.3 Coupling ports and coupling networks for functional tests

The coupling ports and coupling networks are used to transfer disturbances to or from the test network with a defined transfer characteristic. The schematic of the coupling ports, networks and pins are shown in Figure 4. The values of the components depend on the test method and are defined in Table 4. The tolerance of the components should be 1 % or less.



Key

1 Coupling ports

2 Coupling networks

3 Pin networks (including all external mandatory components for the respective pin)

4 RF connector

Figure 4 – Coupling ports and networks for functional tests