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Integrated circuits **FEMC** evaluation of transceivers **FEW** Part 2: LIN transceivers (standards.iteh.ai)

Circuits intégrés – Évaluation de la CEM des émetteurs-récepteurs – Partie 2: Émetteurs-récepteurs LIN 29341383d1cd/iec-62228-2-2016





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Integrated circuits **TEMC** evaluation of transceivers **VIEW** Part 2: LIN transceivers (standards.iteh.ai)

Circuits intégrés – Évaluation de <u>la CEM des émetteurs-récepteurs</u> – Partie 2: Émetteurs-récepteurs <u>LIN</u>g/standards/sist/0fc0186e-fbef-4b53-8459-29341383d1cd/iec-62228-2-2016

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CONTENTS

FC	DREWO	RD	5		
1	Scop	e	7		
2	Norm	ative references	7		
3	Term	s, definitions and abbreviations	8		
	3.1	Terms and definitions	8		
	3.2	Abbreviations	8		
4	Gene	eral	8		
5	Test	and operating conditions	9		
	5.1	Supply and ambient conditions	9		
	5.2	Test operation modes	10		
	5.3	Test configuration	10		
	5.3.1	General test configuration for functional test	10		
	5.3.2	General test configuration for unpowered ESD test	11		
	5.3.3	Coupling ports and coupling networks for functional tests	11		
	5.3.4	Coupling ports and coupling networks for unpowered ESD tests	12		
	5.4	Test signals	13		
	5.4.1		13		
	5.4.2	Test signals for normal operation mode K.C. V.I.C. W	13		
	5.4.3	Test signal for wake-up from sleep mode	14		
	5.5	Evaluation criteria	14		
	5.5.1	General <u>IEC 62228-2:2016</u>	14		
	5.5.2	Evaluation criteria in functional operation modes during exposure to disturbances	15		
	5.5.3	Evaluation criteria in unpowered condition after exposure to disturbances	16		
	5.5.4	Status classes	17		
6	Test	and measurement	17		
	6.1	Emission of RF disturbances	17		
	6.1.1	Test method	17		
	6.1.2	Test setup	17		
	6.1.3	Test procedure and parameters	18		
	6.2	Immunity to RF disturbances	19		
	6.2.1	Test method	19		
	6.2.2	Test setup	19		
	6.2.3	Test procedure and parameters	20		
	6.3	Immunity to impulses	22		
	6.3.1	Test method	22		
	6.3.2	Test setup	23		
	6.3.3	Test procedure and parameters	23		
	6.4	Electrostatic Discharge (ESD)	26		
	6.4.1	Test method	26		
	6.4.2	Test setup	26		
_	6.4.3	Test procedure and parameters	28		
7	7 Test report				
Ar	nex A (normative) LIN test circuits	29		
	A.1	General	29		

A.2	LIN test circuit for standard LIN transceiver ICs for functional tests	.29
A.3	LIN test circuit for IC with embedded LIN transceiver for functional tests	.31
A.4	LIN test circuit for LIN transceiver ICs for unpowered ESD test	.32
Annex B (normative) Test circuit boards	.33
B.1	Test circuit board for functional tests	.33
B.2	ESD test	.33
applicatio	Informative) Examples for test limits for LIN transceiver in automotive	.35
C.1	General	35
C.2	Emission of RF disturbances	.35
C.3	Immunity to RF disturbances	.36
C.4	Electrostatic Discharge (ESD)	.31
Annex D ((informative) Test of indirect ESD discharge	.38
	General	.00 .28
D.1	Test setun	.38
D.3	Typical current wave form for indirect ESD test	.39
D.4	Test procedure and parameters	.39
Figure 1 -	- General test configuration for tests in functional operation modes	.10
Figure 2 -	- General test configuration for unpowered ESD test	.11
Figure 3 -	- Coupling ports and networks for functional tests?).	.11
Figure 4 -	- Coupling ports and networks for unpowered ESD tests	.12
Figure 5 -	- Principal drawing of the maximum deviation on an I-V characteristic	.16
Figure 6 -	- Test setup for measurement30f RFd disturbances16	.18
Figure 7 -	- Test setup for DPI tests	.19
Figure 8 -	- Test setup for impulse immunity tests	.23
Figure 9 -	- Test setup for direct ESD tests	.27
Figure A. ² transceive	1 – General drawing of the circuit diagram of test network for standard LIN er ICs for functional test	.30
Figure A.2 embeddeo	2 – General drawing of the circuit diagram of the test network for ICs with d LIN transceiver for functional test	.32
Figure A.3 transceive	3 – General drawing of the circuit diagram for direct ESD tests of LIN er ICs in unpowered mode	.32
Figure B.	1 – Example of IC interconnections of LIN signal	.33
Figure B.2	2 – Example of ESD test board for LIN transceiver ICs	.34
Figure C.	1 – Example of limits for RF emission	.36
Figure C.2	2 – Example of limits for RF immunity for functional status class A _{IC}	.36
Figure C.3	3 – Example of limits for RF immunity for functional status class C_{IC} or D_{IC}	.37
Figure D.	1 – Test setup for indirect ESD tests	.38
Figure D.2	2 – Example of ESD current wave form for indirect ESD test at V _{ESD} = -8 kV	.39
Table 1 –	Overview of required measurements and tests	9
Table 2 –	Supply and ambient conditions for functional operation	. 10

Table 3 – Definition of coupling ports and coupling network component values forfunctional tests12

Table 4 – Definitions of coupling ports for unpowered ESD tests	13
Table 5 – Communication test signal TX1	13
Table 6 – Communication test signal TX2	14
Table 7 – Wake-up test signal TX3	14
Table 8 – Evaluation criteria for Standard LIN transceiver IC in functional operation modes	15
Table 9 – Evaluation criteria for ICs with embedded LIN transceiver in functional operation modes	16
Table 10 – Definition of functional status classes	17
Table 11 – Parameters for emission measurements	18
Table 12 – Settings of the RF measurement equipment	19
Table 13 – Specifications for DPI tests	20
Table 14 – Required DPI tests for functional status class A _{IC} evaluation of standard LIN transceiver ICs	21
Table 15 – Required DPI tests for functional status class A _{IC} evaluation of ICs with embedded LIN transceiver	22
Table 16 – Required DPI tests for functional status class C _{IC} or D _{IC} evaluation of standard LIN transceiver ICs and ICs with embedded LIN transceiver	22
Table 17 – Specifications for impulse immunity tests	24
Table 18 – Parameters for impulse immunity test P.R.F	24
Table 19 – Required impulse immunity tests for functional status class A _{IC} evaluation of standard LIN transceiver ICs (Standards.tten.al)	25
Table 20 – Required impulse immunity tests for functional status class A _{IC} evaluation of ICs with embedded LIN transceiver <u>IEC 62228-2:2016</u>	25
Table 21 – Required impulse immunity tests for functional status class C _{IC} or D _{IC} evaluation of standard LIN transceiver ICs and ICs with embedded LIN transceiver	26
Table 22 – Recommendations for direct ESD tests	28
Table B.1 – Parameter ESD test circuit board	34
Table C.1 – Example of limits for impulse immunity for functional status class C_{IC} or D_{IC} 37	
Table D.1 – Specifications for indirect ESD tests	40

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INTEGRATED CIRCUITS – EMC EVALUATION OF TRANSCEIVERS –

Part 2: LIN transceivers

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

FDIS	Report on voting
47A/994/FDIS	47A/998/RVD

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.

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INTEGRATED CIRCUITS – EMC EVALUATION OF TRANSCEIVERS –

Part 2: LIN transceivers

1 Scope

This part of IEC 62228 specifies test and measurement methods for EMC evaluation of LIN 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 standard LIN transceiver ICs and ICs with embedded LIN 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

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 62228-2:2016

IEC 61967-1, Integrated circuits – Measurement of electromagnetic emissions 150 kHz to 1 GHz – Part 1: General conditions and definitions 228-2-2016

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: Nonsynchronous transient injection method

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 17987-6.2¹, Road vehicles – Local interconnect network (LIN) – Part 6: Protocol conformance test specification

¹ To be published.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

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 LIN transceiver IC

stand alone LIN transceiver according to ISO 17987 or IC with integrated LIN transceiver cell with access to LIN RxD and TxD signal

3.1.3

IC with embedded LIN transceiver

IC with integrated LIN transceiver cell and LIN protocol handler but without access to LIN RxD or TxD signal

3.2 Abbreviations

DUT	Device understestSTANDARD PREVIEW
DPI	Direct RF power injection
INH	Inhibit IEC 62228-2:2016 https://standards.iteh.ai/catalog/standards/sist/0fc0186e-fbef-4b53-8459-
LIN	Local interconnect network
РСВ	Printed circuit board
RxD	Receive data
SBC	System base chip
TxD	Transmit data

4 General

The intention of this document is to evaluate the EMC performance of LIN transceiver ICs under application conditions in a minimal network. LIN transceiver ICs are in general available in two types as standard LIN transceiver IC and as IC with embedded LIN transceiver.

The evaluation of the EMC characteristics of LIN transceivers shall be performed in functional operation modes under network condition 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 on dedicated global pins of the LIN transceiver which are considered as EMC relevant in the application. For a standard LIN transceiver IC, these pins are LIN, VBAT and local WAKE and for an IC with an embedded LIN transceiver, these pins are at least LIN and VBAT.

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

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

Table 1 – Overview of required measurements and tests

The 150 Ω direct coupling, DPI and impulse immunity test methods are chosen for the evaluation of the EMC characteristic of transceivers in functional 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 and increases the reproducibility and comparability of test results.

The ESD test is performed on passive transceiver IC 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. 29341383d1cd/iec-62228-2-2016

In general, the test definition is done for standard LIN transceiver ICs. For ICs with embedded LIN transceivers some adaptations are necessary which are mainly described in this document. Finally such adaptations have to be done individually for the dedicated IC but shall follow the general definitions.

In order to verify filter effects on the EMC performance of LIN transceivers, configurations with and without a bus filter at the LIN pin, with values based on ISO 17987, are defined in this document. In consequence the frequency characteristic of these filter elements have to be taken into account for the interpretation of the test results.

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 LIN transceivers. If a transceiver is designed or targeted for higher 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.

Parameter	Value
Voltage supply V _{BAT}	(14 \pm 0,2) V (default)
Voltage supply V $_{\rm CC}$	(5 \pm 0,1) V (default)
Test temperature	(23 ± 5) °C

Table 2 – Supply and ambient conditions for functional operation

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 LIN transceiver ICs shall be tested in powered functional operation modes and passive in unpowered off mode. 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 LIN transceivers with mandatory external components and components for filtering and decoupling (LIN node) in a minimal test network, where filtered power supplies, signals, monitoring probes and coupling networks are connected as shown in Figure 1.



Figure 1 – General test configuration for tests in functional operation modes

For evaluation of RF emission, RF immunity and impulse immunity characteristic of a LIN transceiver in functional operation mode a minimal LIN test network consisting of two LIN 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 LIN transceiver IC (DUT), or
- one IC with embedded LIN transceiver (DUT) and one standard LIN 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.

General drawings of schematics with more details for both types of LIN transceivers test networks are given in Annex A.

5.3.2 General test configuration for unpowered ESD test

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



IEC 62228-2:2016 Figure 2^{-//st}General^btest^tconfiguration⁰for unpowered ⁸ESD test 29341383d1cd/iec-62228-2-2016

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 3. The values of the components are dependent on the test method and defined in Table 3. The tolerance of the components shall be 1 % or less.



Figure 3 – Coupling ports and networks for functional tests

Port	Туре	Purpose	Component		
			R _{CP13}	С _{СР13}	R _{CP13t}
	EMI1	RF emission measurement on LIN	120 Ω	4,7 nF	51 Ω
CP1	RF1	RF coupling for immunity test on LIN	0 Ω	4,7 nF	not used
	IMP1	Impulse coupling on LIN	0 Ω	1,0 nF	not used
	EMI2	RF emission measurement on V_{BAT}	120 Ω	6,8 nF	51 Ω
CP2	RF2	RF coupling for immunity test on V_BAT	0 Ω	6,8 nF	not used
	IMP2	Impulse coupling on V_BAT	0 Ω	Shorted	not used
	EMI3	RF emission measurement on Wake	120 Ω	6,8 nF	51 Ω
CP3	RF3	RF coupling for immunity test on Wake	0 Ω	6,8 nF	not used
	IMP3	Impulse coupling on Wake	0 Ω	1,0 nF	not used

Table 3 – Definition of coupling ports and coupling network component values for functional tests

The test configurations with coupling ports and coupling networks connected to the LIN test network are given in the general drawing of schematics in Figure A.1 for standard LIN transceiver ICs and in Figure A.2 for ICs with embedded LIN transceiver.

The characterization of the coupling ports and coupling networks is carried out as follows:

The magnitude of insertion losses (S21 measurement) between the ports CP1 to CP3 and the respective transceiver signal pads on the test board shall be measured and documented in the test report. For this characterization the coupling port shall be configured for RF immunity test and the LIN transceiver ICs shall be removed. All other components which are directly connected to the coupling port (e.g. filter to power supply or loads) remain on the test board.

5.3.4 Coupling ports and coupling networks for unpowered ESD tests

The coupling ports and coupling networks used for unpowered direct ESD tests connect the discharge points to the LIN transceiver IC test circuitry. The schematic and definitions of the coupling ports, networks and pins are given in Figure 4 and Table 4.



Figure 4 – Coupling ports and networks for unpowered ESD tests

Port	Туре	Purpose	Components
CP1	ESD1	ESD coupling on LIN	metal trace for galvanic connection ^a
CP2	ESD2	ESD coupling on V _{BAT}	metal trace for galvanic connection ^a
CP3 ESD3 ESD coupling on Wake metal trace for galvanic connection		metal trace for galvanic connection ^a	
^a The optional resistors R1 to R3 with $R \ge 200 \text{ k}\Omega$ are used to avoid static pre-charge of discharge point caused by the ESD generator. A spark over at these resistors at high test levels shall be avoided. If a static pre- charge is prevented by the ESD generator construction these resistors are not needed. Alternatively an external resistor can be used to remove pre-charges of each discharge point before each single test.			

Table 4 – Definitions of coupling ports for unpowered ESD tests

5.4 Test signals

5.4.1 General

Depending on the transceiver type, different test signals are defined for communication in normal operation mode and wake-up from sleep mode of the LIN transceiver ICs.

5.4.2 Test signals for normal operation mode

The communication test signal TX1 shall be used for testing standard LIN transceiver ICs in normal operation mode. For ICs with embedded LIN transceiver TX1 is used to analyze if the DUT effects other LIN communication which is not addressed to it. The parameters of this periodical signal are defined in Table 5.

Test signal	IEC 62228-2:201 fx1
Signal type	$High TxD Low \underbrace{High}_{Low} \underbrace{50 \ \mu s}_{4 \ ms} \underbrace{9 \ ms}_{9 \ ms} \underbrace{IEC}$
Frequency	10 kHz
Cycle time	9 ms
Frame length	4 ms
Amplitude	VCC ± 0,1 V

Table 5- Communication test signal TX1

The communication test signal TX2 shall be used for tests of ICs with embedded LIN transceiver in normal mode. The signal is defined as a LIN frame with the parameters given in Table 6 where the embedded LIN transceiver has to transmit and/or respond depending on its designed or programmed functionality.