



Edition 1.0 2025-08

TECHNICAL REPORT

EMC IC modelling -

Part 4-1: Use of ICIM-CI model to predict the IC conducted immunity in a PCB

IEC TR 62433-4-1:2025-08(en)

ISBN 978-2-8327-0663-3



THIS PUBLICATION IS COPYRIGHT PROTECTED Copyright © 2025 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat Tel.: +41 22 919 02 11

3, rue de Varembé info@iec.ch CH-1211 Geneva 20 www.iec.ch Switzerland

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search -

webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublishedStay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@jec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC TR 62433-4-1:2025 © IEC 2025

CONTENTS

F	OREWO	PRD	3
1	Scop	pe	5
2	Norn	mative references	
3	Term	ns, definitions and abbreviations	5
	3.1	Terms and definitions	5
	3.2	Abbreviated terms	6
4	Philo	psophy	7
5	ICIM	-CI model extraction flow	7
	5.1	General	7
	5.2	Failure criteria definition	9
	5.3	PDN extraction	10
	5.3.1	General	10
	5.3.2	PDN extraction from SYZ-parameters measurements	11
	5.3.3	PDN extraction from existing models	13
	5.3.4		4.4
	E 1	generator	
	5.4 5.5	Conducted immunity characterization IB extraction	
	5.6	Validation of the ICIM-CI model	
	5.7	Final ICIM-CI model	
6	• • •	of ICIM-CI model for immunity prediction on an application PCB	
U	6.1	General	
	6.2	Calculation of the power flowing into the under-test IC pin	
Δ		(informative) Example of ICIM-CI model written as SPICE subckt	
^	A.1	General	
	A.1 A.2	Example	
Δ		(informative) Example of conducted immunity calculation applied to a LIN	23
^		sceiver used in an automotive application	33
	B.1	General	33
	B.2	LIN driver ICIM-CI model	33
	B.3	Application board modelling	34
	B.4	Conducted immunity calculation	36
	B.4.	Calculation without non-linear element	36
	B.4.2	Calculation with non-linear element	37
В	ibliograp	phy	39
F	igure 1 -	- Example of ICIM-CI model structure	8
F	igure 2 -	- ICIM-CI model extraction flow proposal	8
F	igure 3 -	- Pin description of the IC under test	9
F	igure 4 -	- Example of PCB dedicated to S-parameters measurement	11
		- Example of reflection coefficient measurement performed on the IC	12
		- Example of LIN pin impedances depending on state	
	•	- Example of transmission coefficient measurement performed on the IC	12
		- Example of transmission coefficient measurement performed on the IC t	13
		- Structure of IBIS model	
	.,, .,		I-T

IEC TR 62433-4-1:2025 © IEC 2025

Figure 9 – Example of packaging extraction tool	14
Figure 10 – Example of parasitic elements computation with an advanced packaging extraction tool	15
Figure 11 – Example of DPI test setup	15
Figure 12 – Example of PCB dedicated to DPI test	16
Figure 13 – Example of a configuration for LIN driver DPI measurement	17
Figure 14 – Example of incident power at IB extraction board LIN input during DPI measurement of the initial configuration for each OO	17
Figure 15 – Example of block diagram for DPI setup modelling	19
Figure 16 – Example of DPI SPICE modelling to calculated power transmitted to VBAT pin during a 0 dBm power injection at IB extraction board input	20
Figure 17 – Example of IB extraction board trace modelling using SPICE subcircuit model	20
Figure 18 – Example of transmitted power and voltage magnitude calculated at VBAT pin of the IC under test during DPI SPICE simulation performed at 0 dBm	21
Figure 19 – Example of comparison incident vs transmitted power for a DPI on + 12 V board pin	22
Figure 20 – Example of transmitted power calculated at LIN pin input during DPI SPICE simulation performed at 0 dBm: validation vs IB extraction configuration	23
Figure 21 – Example of incident power calculated at LIN pin input inducing a fault on LIN pin during DPI SPICE validation simulation: calculation vs measurement	24
Figure 22 – ICIM-CI XML writer	25
Figure 23 – Example of white box construction of a DPI setup modelling at application level	26
Figure 24 – Example of transmitted power calculation at application board	
Figure 25 – Example of voltage V and current I calculation	
Figure 26 – Example of fault prediction	28
Figure A.1 – Example of ICIM-CI model written as SPICE subcircuit	32
Figure B.1 – Example of an automotive application board	33
Figure B.2 – LIN driver ICIM-CI model	
Figure B.3 – Example of an automotive application board schematic	35
Figure B.4 – Example of an automotive application board 3D modelling	35
Figure B.5 – Example of conducted immunity calculation modelling	36
Figure B.6 – Example of comparison of the calculated transmitted power with the IB and the RF power injection measurement – without non-linear element	37
Figure B.7 – Example of comparison of the calculated transmitted power with the IB and the RF power injection measurement – with non-linear elements	37
Figure B.8 – Example of current and voltage calculation during a transient analysis	38
Figure B.9 – Example of calculated current and voltage at 10 MHz (Nyquist sampling)	38
Table 1 – Examples of OO, failure criteria and DI for different types of IC	9
Table 2 – Examples of OO, failure criteria and DI for the IC under test	
Table B.1 – OO, failure criteria and DI for the LIN transceiver under test	

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EMC IC modelling Part 4-1: Use of ICIM-CI model to predict the IC conducted immunity in a PCB

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC [had/had not] received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC TR 62433-4-1 has been prepared by subcommittee 47A: Integrated circuits, of IEC technical committee 47: Semiconductor devices. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
47A/1191/DTR	47A/1197/RVDTR

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 Technical Report is English.

IEC TR 62433-4-1:2025 © IEC 2025

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/publications.

A list of all parts of the IEC 62433 series, published under the general title *EMC IC modelling*, 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

- reconfirmed,
- withdrawn, or
- revised.

1 Scope

This part of IEC 62433-4 provides an overview of good practices to extract an ICIM-CI model from measurements and to build a numerical model of the PCB in which the ICIM-CI model is used to predict RF immunity of an IC in its application PCB.

This document also discusses factors which can be considered to obtain proper results in an ICIM-CI model extraction and use of the actual model at the PCB level.

2 Normative references

There are no normative references in this document.