IEC 62969-4

Edition 1.0 2018-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Semiconductor interface for automotive vehicles – Part 4: Evaluation method of data interface for automotive vehicle sensors

Dispositifs à semiconducteurs – Interface à semiconducteurs pour les véhicules automobiles – Partie 4: Méthode d'évaluation de l'interface de données destinée aux capteurs de véhicules automobiles

IEC 62969-4:2018-06(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

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 It also gives information on projects, replaced and withdrawn publications.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/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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@iec.ch.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue
Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org
Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC 62969-4

Edition 1.0 2018-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Semiconductor interface for automotive vehicles – Part 4: Evaluation method of data interface for automotive vehicle sensors

Dispositifs à semiconducteurs – Interface à semiconducteurs pour les véhicules automobiles – Partie 4: Méthode d'évaluation de l'interface de données destinée aux capteurs de véhicules automobiles

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 31.080.99

ISBN 978-2-8322-5791-3

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

SEMICONDUCTOR DEVICES – SEMICONDUCTOR INTERFACE FOR AUTOMOTIVE VEHICLES –

Part 4: Evaluation method of data interface for automotive vehicle sensors

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

International Standard IEC 62969-4 has been prepared by IEC technical committee 47: Semiconductor devices.

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

FDIS	Report on voting
47/2470/FDIS	47/2487/RVD

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

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

A list of all parts in the IEC 62969 series, published under the general title *Semiconductor devices – Semiconductor interface for automotive vehicles*, 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

INTRODUCTION

The IEC 62969 series is composed of four parts as follow:

- IEC 62969-1 *Semiconductor devices – Semiconductor interface for automotive vehicles – Part 1: General requirements of power interface for automotive vehicle sensors*
- IEC 62969-2 *Semiconductor devices – Semiconductor interface for automotive vehicles – Part 2: Efficiency evaluation methods of wireless power transmission using resonance for automotive vehicle sensors*
- IEC 62969-3 *Semiconductor devices – Semiconductor interface for automotive vehicles – Part 3: Shock driven piezoelectric energy harvesting for automotive vehicle sensors*
- IEC 62969-4 *Semiconductor devices – Semiconductor interface for automotive vehicles – Part 4: Evaluation method of data interface for automotive vehicle sensors*

The IEC 62969 series covers power and data interfaces for sensors in automotive vehicles. The first part covers general requirements of test conditions such as temperature, humidity, vibration, etc., for automotive sensor power interface. It also includes various electrical performances of power interface such as voltage drop from power source to automotive sensors, noises, voltage level, etc. The second part covers “Efficiency evaluation methods of wireless power transmission using resonance for automotive vehicle sensors “. The third part covers “Shock driven piezoelectric energy harvesting for automotive vehicle sensors”. The fourth part covers “Evaluation methods of data interface for automotive vehicle sensors”.

SEMICONDUCTOR DEVICES – SEMICONDUCTOR INTERFACE FOR AUTOMOTIVE VEHICLES –

Part 4: Evaluation method of data interface for automotive vehicle sensors

1 Scope

This part of IEC 62969 specifies a method of directly fault injection test for automotive semiconductor sensor interface that can be used to support the conformance assurance in the vehicle communications interface.

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.

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions 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
data interface
transfer of data with electrical signal from a sensor source to another ECU in vehicle such as ECU and sensors via cable or electric and/or magnetic fields through air or medium

3.1.2
fault injection
technique for improving the coverage of a test by introducing faults to device under test

3.1.3
disturbance
temporary change of environmental conditions that can cause a fault to the device under test

3.1.4
crosstalk
appearance of undesired energy in a channel, owing to the presence of a signal in another channel, caused by, for example induction, conduction or non-linearity

[SOURCE: IEC 60050-722:1992, 722-15-03]

3.2 Abbreviated terms

ECU: Electronic Control Unit (see IEC 60050-442:1998, 442-04-22)

DUT: Device Under Test

4 Evaluation and tests

4.1 Evaluation test setup

Figure 1 shows the conceptual diagram of the semiconductor-based sensor data interface test with fault injection.

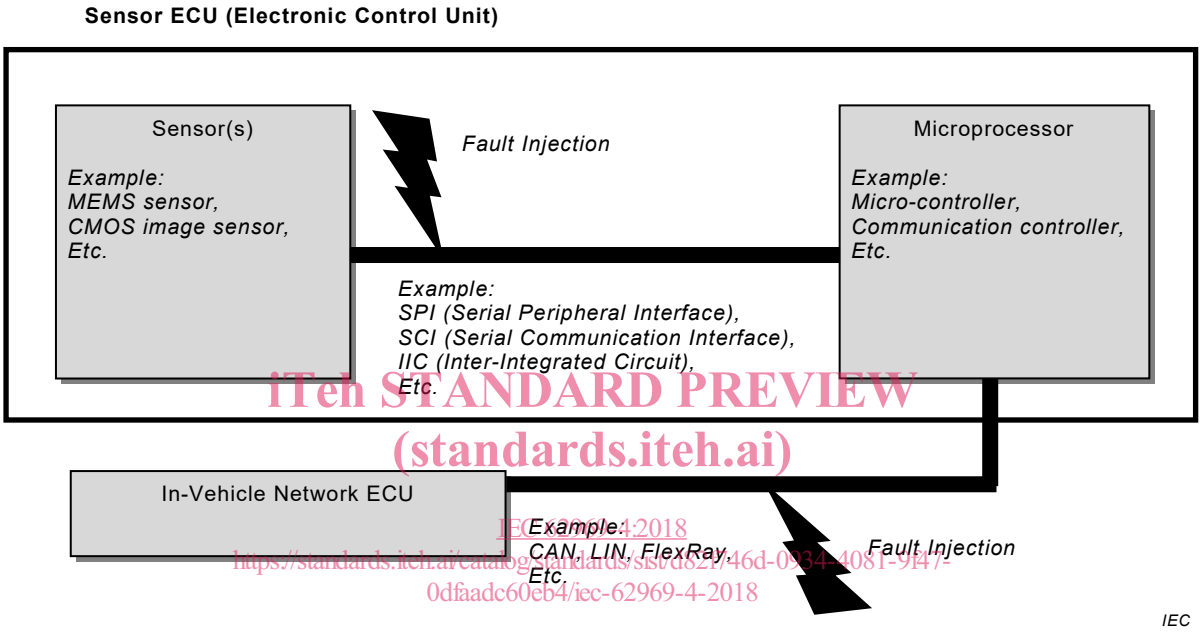


Figure 1 – The semiconductor-based sensor data interface test with fault injection

The fault injection tool can do the fault injection to a semiconductor type sensor and works as a communication monitoring for the fault injection node and system during fault injection. The fault injection tool provides fault injection of physical level and monitoring of node level.

It offers many new possibilities for the analysis of data interface errors. A representation of the physical layer is often indispensable, particularly during the execution of conformity tests. With data interface-specific trigger conditions and time synchronization, it can find the causes of protocol errors much quicker than with a traditional test method.

4.2 Block diagram

The block diagrams of the data communication interfaces and digital or analog disturbance units clarify the terminal assignments and uses of the externally accessible interface lines.

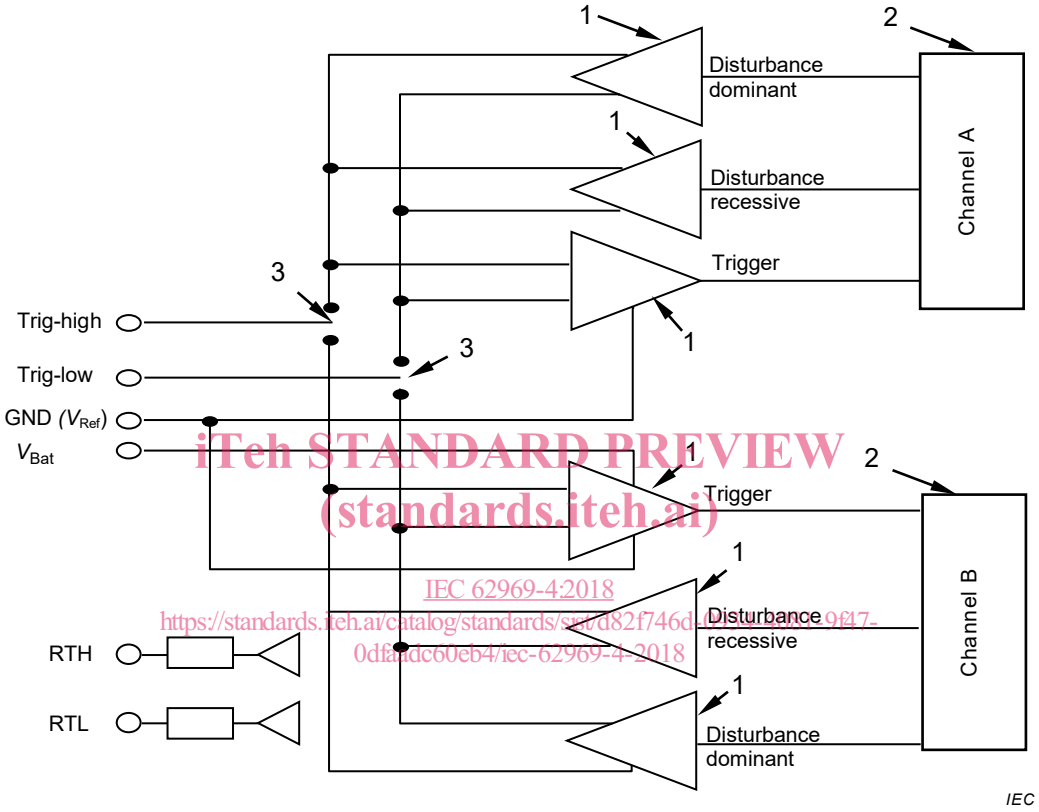
Figure 2 shows conceptual block diagram of the data interface example of duplex channel.

The signals for generating trigger events are evaluated via the trig-high and trig-low connections. The digital disturbance types 'recessive' and 'dominant' are also output over these two connections.

V_{Ref} represents the reference voltage of the data interface signals. If the high-speed interface is being used, V_{Ref} shall be connected to the GND. When using the low-speed interface, connection to the GND is optional.

The supply voltage for the low-speed transceiver is fed in via V_{Bat} – which acts as the operating voltage for the rest of the transceivers used in the system. Alternatively, V_{Bat} may be left unconnected, and in this case an internal power supply generates a regulated voltage of vehicle for the transceiver supply. V_{Bat} is not necessary for operation of the high-speed interface.

RTH and RTL supply the voltages needed for a low-speed data interface termination by 1 kΩ internal resistors. If required, these connections can be made to the data interface lines directly or via supplemental external resistors in the cable connector.



Key

1 Operational Amplifier

2 Connector

3 Switch

Figure 2 – Block diagram of the data interface example of duplex channel

4.3 Input and output connector setup

The non-shield of the interface connectors is connected to GND. The output and input pins of the fault injection tool connectors are connected to input port and output port of the DUT, respectively. All port pins have a series resistance value and clamp diodes to GND and input voltages to protect them against overloading.

4.4 Test conditions and configurations

The test specification defines three test cases of the data interface: data interface, data interface line status, and fault injection. The disturbance test specification concerning the physical layer test is close to the data interface.

4.5 Disturbances test conditions

A test procedure consists of the definition of test condition and corresponding action. With the start of measurement, a set of test procedure can be transferred to the hardware for execution.

The test condition applies only to the DUT; it does not affect the device for the disturbance source.

The resistor settings are validated before the configuration that is set at the disturbance test user interface is downloaded to the hardware. This involves checking whether the current settings may be transferred to the hardware, or whether they could result in potential hardware damage. If there is a risk of hardware damage, transfer of the configuration to the hardware is aborted.

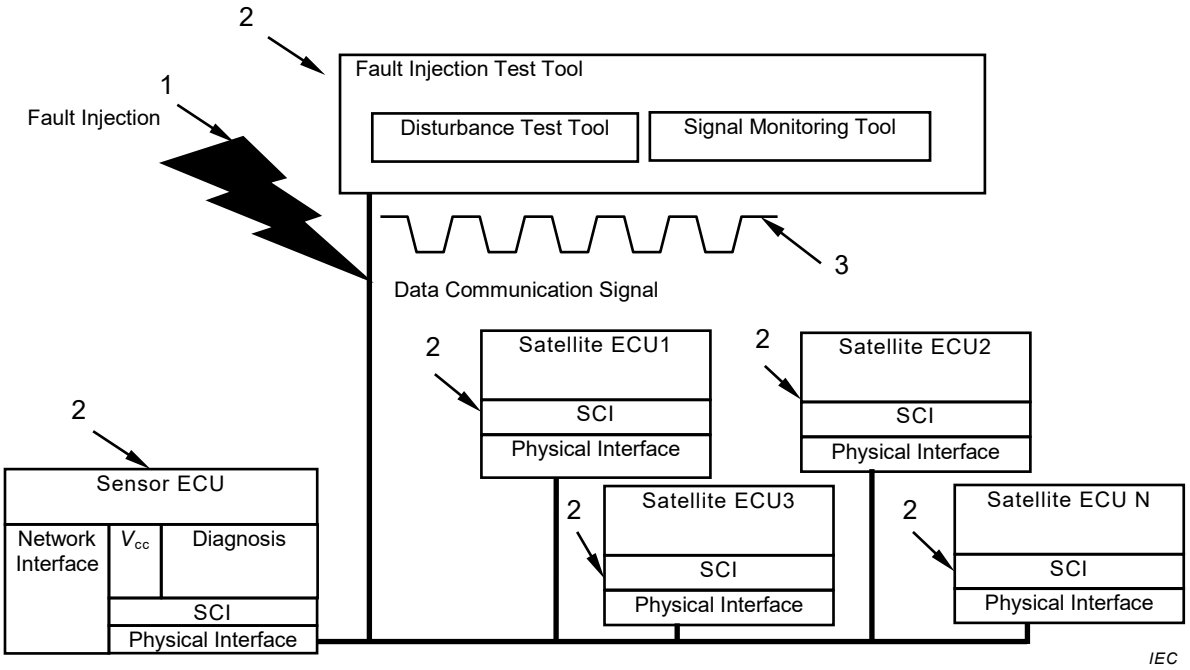
To ensure that the validation process will detect potential hardware damage and prevent transfer of the configuration that could result in damage, the voltage applied as the disturbance voltage shall be entered in the entry voltage signals.

If no changes are made to the hardware, the V_{cc} supply voltage is also used as the disturbance voltage. Therefore, the entry signal voltage has already been set in the disturbance test.

A fault injection is placed on the data interface when a start of signal is detected. This occurs five times within one disturbance cycle. Afterwards the data interface is left undisturbed for some period of time such as 10 ms for signal stabilization. In this time period the data interface can recover, and the error counters of the nodes are decremented by correct receipt and transmission of messages.

The error rate of the protocol is according to the conformance test reference for each interface protocol.

Figure 3 shows conceptual diagram of the fault injection test configuration example of the sensor data interface.



Key

1 Fault injection

2 Node

3 Data communication signal

Figure 3 – Fault injection test configuration example of the sensor data interface

5 Disturbance test item

5.1 Data interface load

5.1.1 Variable impedance

5.1.1.1 Load on line

This test sets up a resistance and/or capacitance between one data interface line of a defined channel and ground (GND). The impedance parameter consists of a capacitor and the resistor value of the data interface-loading circuit.

5.1.1.2 Load on channel

This test sets up a resistance and/or capacitance between the high data interface and low data interface lines of a defined channel.

No.	Adjustable Parameter	Description
1	Impedance of data interface-loading circuit	capacitor value pF – sets capacitor value of line-loading circuit (pF) resistor value ohm – sets resistor value of line-loading circuit (Ω) Channel name – selects a channel
2	Duration of mismatch	value – sets a duration value for the mismatch unit – selects a time unit to set the mismatch duration

5.1.2 Direct crosstalk

This test sets up a resistance and/or a capacitance between the high data interface lines of channel A and the high data interface lines of channel B.

NOTE Direct crosstalk examples are described in Annex A.

5.1.3 Diagonal crosstalk

This test sets up a resistance and/or a capacitance between the high data interface lines of channel A and the low data interface lines of channel B.

NOTE Diagonal crosstalk examples are described in Annex A.

5.2 Data interface line status

5.2.1 Short circuit

5.2.1.1 Ground

This GND-short test configures, for a predefined duration, a short circuit of one data interface line (high data interface line or low data interface line) to ground (GND).

No.	Adjustable Parameter	Description
1	Channel with short circuit to GND	Channel name – selects a channel
2	Data interface line with short circuit to GND	line – selects a data interface line
3	Duration of short circuit to GND	value – sets a duration value for short circuit to GND unit – selects a time unit to set duration of short circuit to GND

NOTE Ground examples are described in Annex A.

5.2.1.2 External voltage source

V_{BAT}-short test configures a short circuit of one data interface line (high data interface line or low data interface line) to an external voltage source (V_{Bat}). Connect the external voltage source to the short-circuit voltage input interface, located on the rear panel of the disturbance node.

5.2.1.3 V_{CC}

V_{CC}-short test configures, for a predefined time, a short circuit of one data interface line (high data interface line or low data interface line) to V_{CC} using a predefined repetition rate.

No.	Adjustable Parameter	Description
1	Repetition rate of short circuit to V_{CC}	loop – sets a number of iterations
2	Channel with short circuit to V_{CC}	Channel name – selects a channel
3	Data interface line with short circuit to V_{CC}	line – selects a data interface line
4	Duration of short circuit to V_{CC}	value – sets a duration value for short circuit to V_{CC} unit – selects a time unit to set duration of short circuit to V_{CC}
5	Delay between two iterations of short circuit to V_{CC}	value – sets a value for the delay unit – selects a time unit for the delay