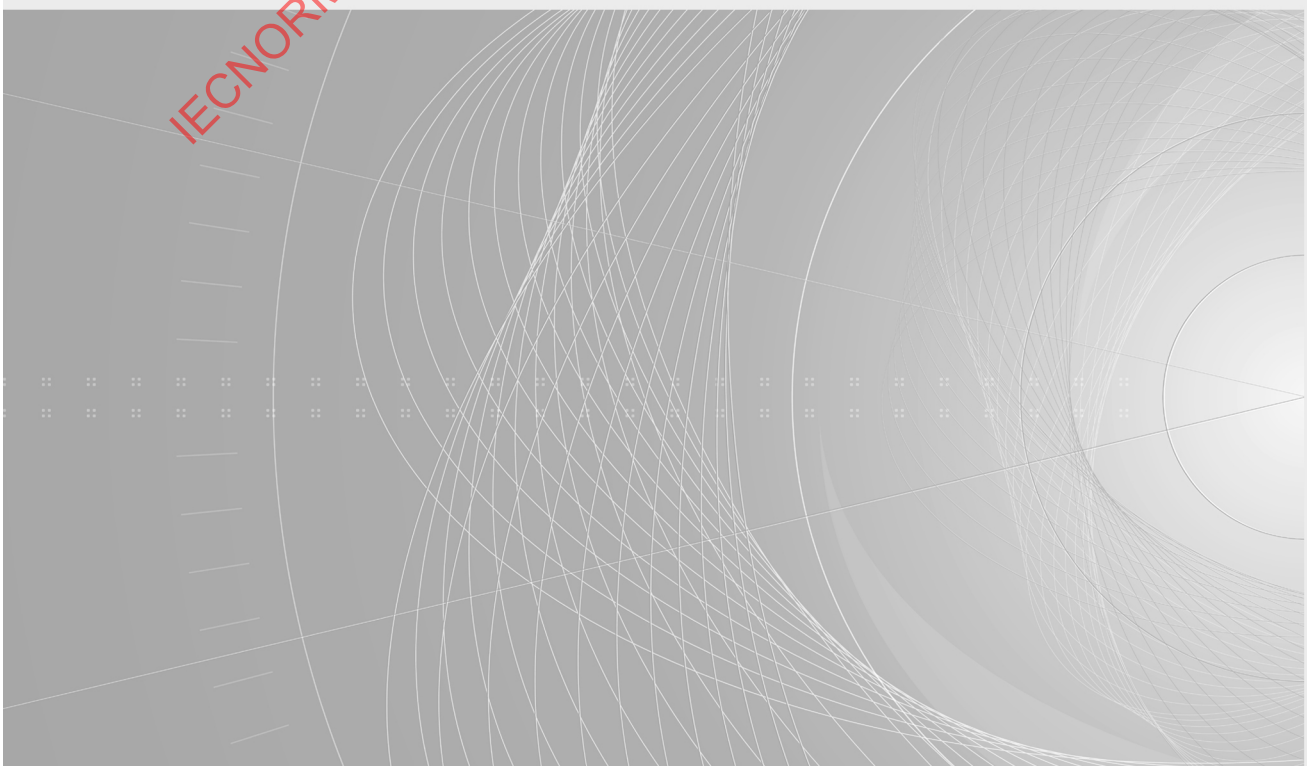
IEC 62969-1

Edition 1.0 2017-12

INTERNATIONAL STANDARD

colour inside

Semiconductor devices – Semiconductor interface for automotive vehicles – Part 1: General requirements of power interface for automotive vehicle sensors



IEC 62969-1:2017-12(en)

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 - www.iec.ch/searchpub
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 It also gives information on projects, replaced and withdrawn publications.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 20 000 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
65 000 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: csc@iec.ch.

IEC 62969-1

Edition 1.0 2017-12

INTERNATIONAL STANDARD

colour inside

Semiconductor devices – Semiconductor interface for automotive vehicles – Part 1: General requirements of power interface for automotive vehicle sensors

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.080.99

ISBN 978-2-8322-5147-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

SEMICONDUCTOR DEVICES – SEMICONDUCTOR INTERFACE FOR AUTOMOTIVE VEHICLES –

Part 1: General requirements of power 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 62969-1 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
47/2433/FDIS	47/2447/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 the 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.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

- 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 methods 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. This part 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 1: General requirements of power interface for automotive vehicle sensors

1 Scope

This part of IEC 62969 provides general requirements for performance evaluations and environmental conditions for the power interface of automotive vehicle sensors. For performance evaluations, various electrical performances such as voltage drop from power source to automotive sensors, AC noises and voltage level are included. For environmental conditions, various test conditions such as temperature, humidity and vibration are included. In addition, terms, definitions, symbols and configurations are covered in this part.

NOTE Additional information on power interface for automotive vehicle sensors is provided in Annex A.

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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721 (all parts), Classification of environmental conditions

IEC 60749-10, *Semiconductor devices – Mechanical and climatic test methods – Part 10: Mechanical shock*

IEC 60749-12, *Semiconductor devices – Mechanical and climatic test methods – Part 12: Vibration, variable frequency*

IEC 61851-1, *Electric vehicle conductive charging system – Part 1: General requirements*

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

IEC 61967-2, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 2: Measurement of radiated emissions – TEM cell and wideband TEM cell method*

IEC TS 61967-3, *Integrated circuits – Measurement of electromagnetic emissions – Part 3: Measurement of radiated emissions – Surface scan method*

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

IEC 61967-5, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 5: Measurement of conducted emissions – Workbench Faraday Cage method*

IEC 61967-6, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 6: Measurement of conducted emissions – Magnetic probe method*

IEC 61967-8, *Integrated circuits – Measurement of electromagnetic emissions – Part 8: Measurement of radiated emissions – IC stripline method*

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

IEC 62132-2, *Integrated circuits – Measurement of electromagnetic immunity – Part 2: Measurement of radiated immunity – TEM cell and wideband TEM cell method*

IEC 62132-3, *Integrated circuits – Measurement of electromagnetic immunity, 150 kHz to 1 GHz – Part 3: Bulk current injection (BCI) method*

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

IEC 62132-5, *Integrated circuits – Measurement of electromagnetic immunity, 150 kHz to 1 GHz – Part 5: Workbench Faraday cage method*

IEC TS 62215-2, *Integrated circuits – Measurement of impulse immunity – Part 2: Synchronous transient injection method*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

3 Terms and definitions

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
power interface
physical connection between two different functional units those are connected via cable, printed circuit or wireless connection through a medium such as air to transfer the electrical power

EXAMPLE connection between battery and electrical load such as electronic control units (ECU) and sensors through electrical cable to transfer electrical power.

3.2
reference voltage
V_r
value of the voltage in accordance with which the relevant performance of a meter is fixed

[SOURCE: IEC 60050-314:2001, 314-07-04]

3.3
maximum voltage
V_{max}
the specified highest voltage applied to a load at which the load (systems or devices) operate normally

3.4
minimum voltage
V_{min}
the specified lowest voltage applied to a load at which the load (systems or devices) operate normally

4 General system

4.1 General system blocks

Power sources in automotive vehicles vary depending on the type of automotive vehicles. Using energy harvesting and wireless power transfer technologies, the battery in an automotive vehicle can be charged to provide power to sensors directly or through ECU as shown in Figure 1.

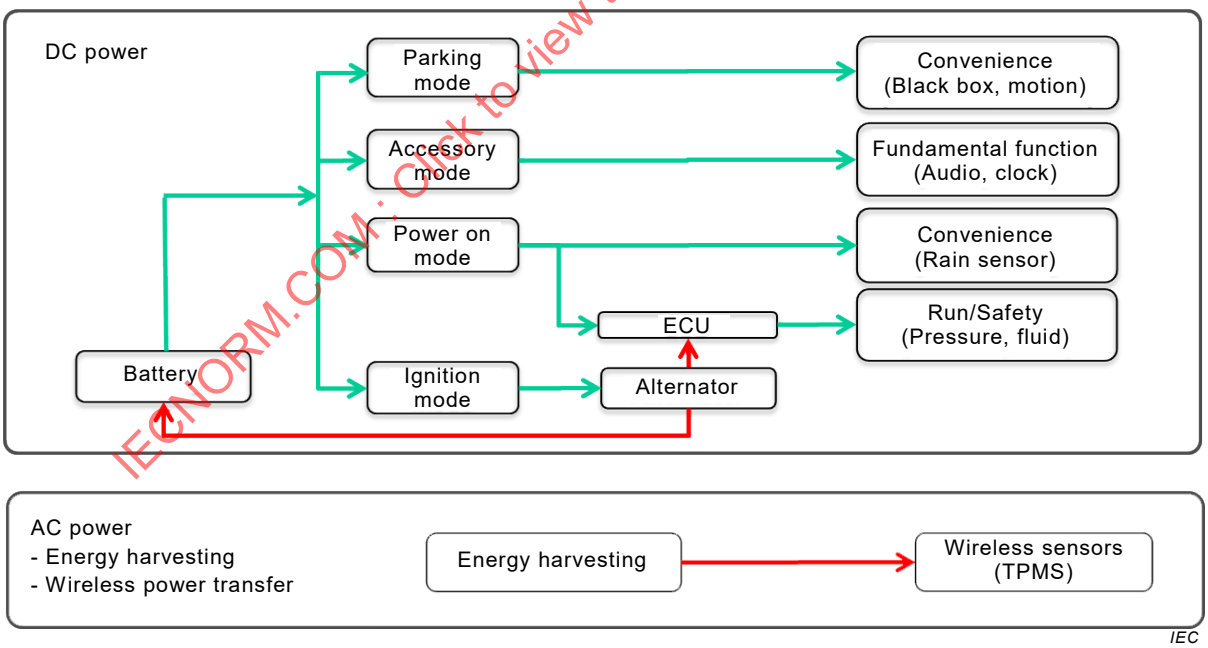


Figure 1 – Power supply chains to the vehicle sensors

4.2 Classification

4.2.1 Sensors in automotive vehicles

The type of the applicable sensors with respect to usage shall be listed as shown in Table 1.

Table 1 – Sensors for automotive vehicles

Usage	Sensors	Type
Run (power train and control)	oxygen sensor	gas sensor
	crankshaft position sensor	magnetic sensor
	engine coolant temperature sensor	temperature sensor
	wheels speed sensor	magnetic sensor
	shaft speed sensor	hall sensor
	manifold absolute pressure (MAP) sensor	pressure sensor
	throttle position sensor	hall sensor
	torque sensor	magnetic sensor
	transmission fluid temperature sensor	temperature sensor
	turbine speed sensor	magnetic sensor
	vehicle speed sensor	magnetic sensor
	current sensor	current sensor
	fuel level sensor	capacitive sensor
	engine oil level sensor	ultrasonic sensor
	brake fluid level sensor	magnetic sensor
Safety	air bag sensor	accelerometer sensor
	steering wheel angle sensor	magnetic sensor
	blind spot monitor	image sensor
	parking sensor	ultrasonic sensor
	radar sensor	radar sensor
	yaw rate sensor	gyro sensor
	tire pressure sensor	pressure sensor
Security, Convenience and Entertainment	rain sensor	light sensor
	light sensor	light sensor
	temperature/ humidity sensor	temperature/ humidity sensor
	air quality sensor	gas sensor
	black box	image sensor

NOTE Additional sensors can be added.

4.2.2 Power sources

To provide power to sensors, various power sourcing technologies can be used as in Table 2.

Table 2 – Power sources to sensors in automotive vehicles

Power sources	Power sourcing methods
Generating power using Fuel or gas	Activating engine to generate electrical power using fuel or gas
Wireless power transfer	Providing electrical power from transmitter to sensors through air or medium (inductive coupling, magnetic resonance, microwave-based transfer, etc.)
Energy harvesting	Acquiring electrical power from physical phenomena of environment such as vibration, thermal difference, etc.

NOTE Additional power sourcing technologies can be added.

4.3 Data interface

4.3.1 General

The functions described in 4.3.2 and 4.3.3 shall be included to control and monitor the status of power supply between ECU and sensors.

4.3.2 Reset

Reset function of power supply shall be provided. This function shall be done automatically or manually.

4.3.3 Monitoring

Monitoring function of power supply shall be provided. This function shall be provided with user interface (UI) such as display.

5 Environmental conditions and requirements

5.1 General

The power interface for sensors in automotive vehicles shall be designed and manufactured to resist the effect of various solvents and fluids, vibration and shock, temperature changes, humidity changes and dust.

Environmental conditions shall be defined for semiconductor components used for automotive vehicle according to existing specifications based on IEC 61851-1 and classification of environmental conditions based on IEC 60721 (all parts).

5.2 Test conditions and items

5.2.1 General

All test conditions and items shall be listed in a table or diagram as shown as an example in Figure 2.

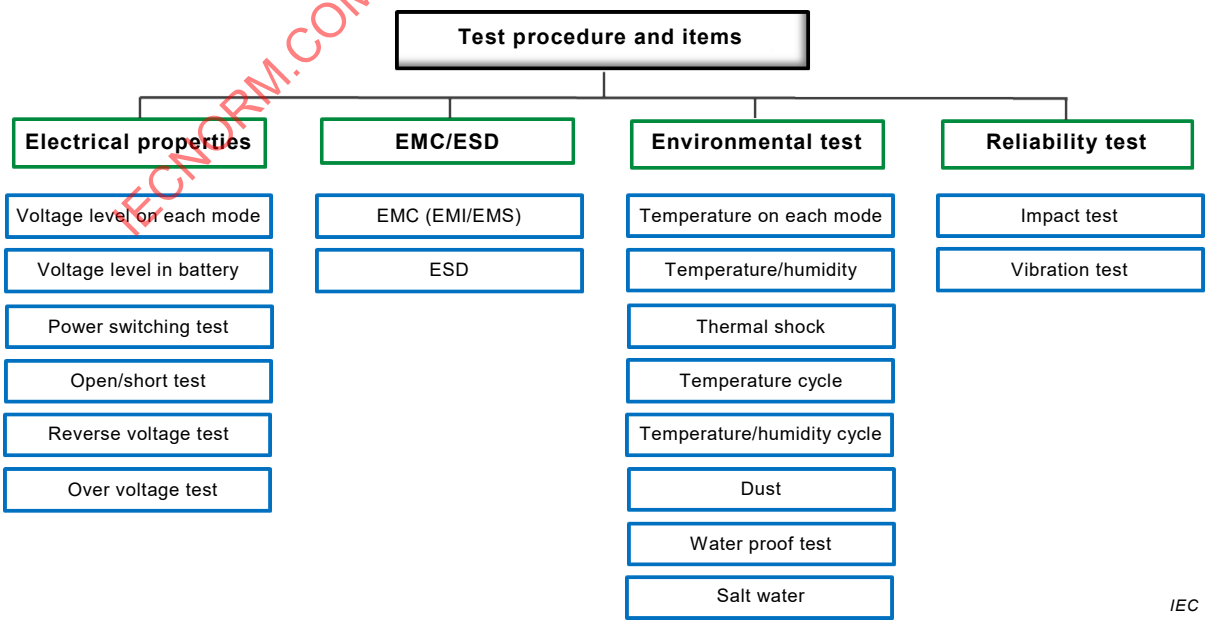


Figure 2 – Example of test conditions and items

NOTE Additional tests can be added.

5.2.2 Temperature range

5.2.2.1 General

The semiconductor components in the power interface shall be checked by ECU or another monitoring system under various temperature conditions to prevent malfunction and damage.

5.2.2.2 Temperature monitoring

The temperature for the ambient, coldest and hottest including damp heat and temperature cycling shall be monitored and recorded at real time and various places. For the monitoring, widely used thermistors can be used.

5.2.2.3 Ambient temperature

The ambient temperature shall be measured and recorded to provide reference temperature for the coldest and the hottest temperature conditions. The ambient temperature range shall be provided by the manufacturer.

5.2.2.4 Coldest temperature

The coldest temperature shall be measured and recorded at real time and in various places and the semiconductor components in the power interface shall be tested at the coldest temperature.

The test shall be in accordance with IEC 60068-2-1 at – 25 °C ± 3 °C for 16 hours.

5.2.2.5 Hottest temperature

The hottest temperature shall be measured and recoded at real time and in various places and the semiconductor components in the power interface shall be tested at the hottest temperature.

The test shall be in accordance with IEC 60068-2-2.

5.2.3 Humidity

The semiconductor components in the power interface shall be checked by ECU or other monitoring system under various humidity conditions to prevent malfunction and damage.

The semiconductor components in the power interface shall be tested at a range between 5 % and 95 %. The test shall be in accordance with IEC 60068-2-30 for the 12 days. The test shall be done 5 cycles at the various damp heat cycling, (40 ± 3) °C and relative humidity of 95 % for 24 hours according to IEC 60068-2-30.

5.2.4 Damp heat

This test applies a highly accelerated temperature and humidity stress test for the purpose of evaluating the resistance of the semiconductor components in the power interface against damp heat conditions. The effect of damp heat conditions on semiconductor components in the power interface shall be checked by ECU or another monitoring system to prevent malfunction and damage.

5.2.5 Temperature cycling

The ability of the semiconductor components in the power interface to withstand mechanical stresses induced by alternating high and low temperature extremes shall be checked by ECU or another monitoring system to prevent malfunction and damage.

The test shall be in accordance with IEC 60068-2-14.

5.2.6 Mechanical impact and vibration

The effect of mechanical shock, impact and vibration to the semiconductor components in the power interface shall be checked by ECU or another monitoring system to prevent malfunction and damage. This test is intended to determine the suitability of the semiconductor components in the power interface for use in vehicles which may be subjected to moderately severe shocks as a result of suddenly applied forces or abrupt changes in motion produced by rough handling, transportation, or field operation.

The test shall be in accordance with IEC 62262 and IEC 60749-10.

5.2.7 EMC

5.2.7.1 General

The EMC of the semiconductor components in the power interface shall be tested to prevent malfunction and damage.

5.2.7.2 Immunity

The immunity of the semiconductor components in the power interface shall be tested with respect to performance criteria to prevent malfunction and damage.

The test shall be in accordance with IEC TS 62215-2, IEC 62132-1, IEC 62132-2, IEC 62132-3, IEC 62132-4 and IEC 62132-5.

5.2.7.3 Emission

The electromagnetic wave emission from the semiconductor components in the power interface shall be tested under the worst cast scenarios in order to create maximum emissions.

The test shall be in accordance with IEC 61967-1, IEC 61967-2, IEC 61967-3, IEC 61967-4, IEC 61967-5, IEC 61967-6 and IEC 61967-8.

5.2.8 IP ratings

The IP (Ingress Protection) rating of the semiconductor components in power interface shall be provided by the manufacturer.

The test shall be in accordance with IEC 60529.

5.3 Test setup

A multi-meter or other equipment can be used to evaluate quality of power from the power source through an interface such as switchboard to the ECU and sensors as shown in Figure 3.

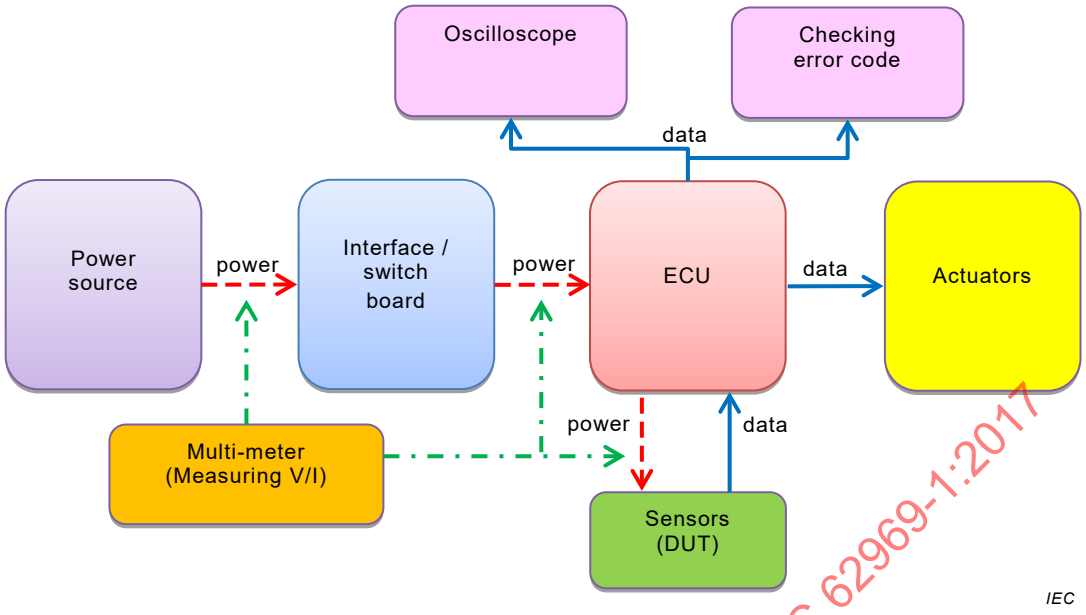
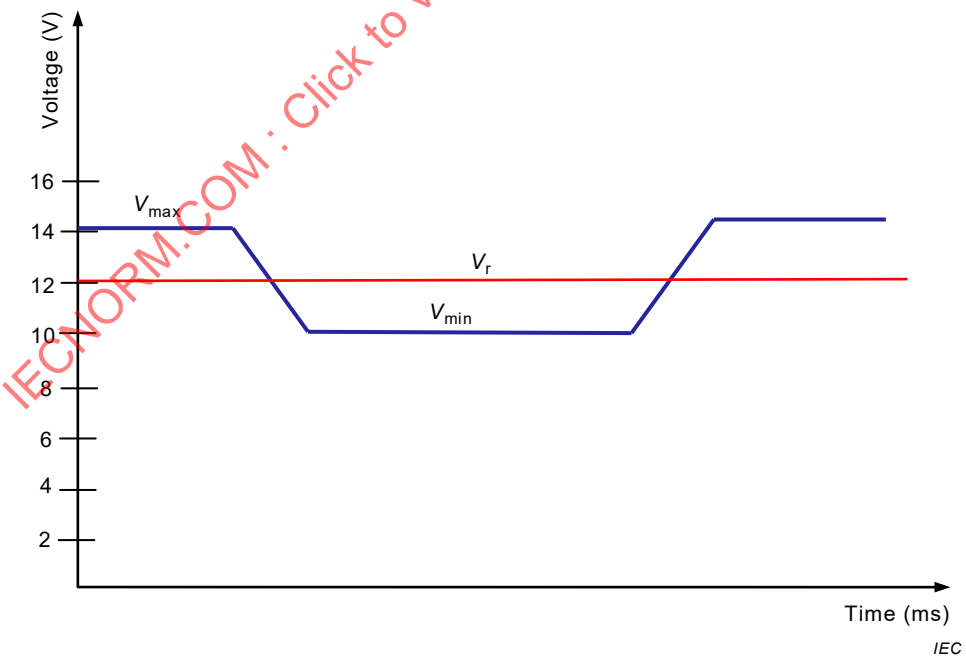


Figure 3 – Test setup for checking the power level to sensors

6 Power interfaces and checking items

6.1 Input voltage level

Many sensors could be used to provide drivers or users of automotive vehicles with convenience and safety. In that case, a secured power supply to the sensor is a key issue to ensure functional safety.



Key:

V_r Reference voltage

V_{max} Maximum voltage

V_{min} Minimum voltage

Figure 4 – Checking input voltage level to sensors (12 V sensors)

This test shall be performed to check the input voltage level to sensors as shown in Figure 4. Using an oscilloscope or multi-meter, input voltage level to sensors shall be checked to ensure proper function of sensors. The deviation between "V_r" and "V_{max}" or "V_r" and "V_{min}" shall be confirmed.

6.2 Main error sources

6.2.1 AC noise

AC noise level from motors, pan, oil pumps, etc. shall be provided by the manufacturer to evaluate power quality.

6.2.2 Voltage drop

Voltage drops from power sources (generator or battery) to sensors shall be checked according to a power path. The path could be printed circuit board, cable and some active semiconductor components.

6.3 Redundancy of power interface

Power interface could be open or voltage level could be unstable due to several reasons such as malfunctions or damage. To secure functional safety of power interface from power source to sensors, a redundant power interface shall be provided.