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TECHNICAL REPORT

colour inside

Semiconductor devices – Standardization roadmap of fault test method for automotive vehicles

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SEMICONDUCTOR DEVICES – STANDARDIZATION ROADMAP OF FAULT TEST METHOD FOR AUTOMOTIVE VEHICLES

FOREWORD

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IEC TR 63357 has been prepared by the 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
47/2677/DTR	47/2714/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.

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.

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- withdrawn,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
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SEMICONDUCTOR DEVICES – STANDARDIZATION ROADMAP OF FAULT TEST METHOD FOR AUTOMOTIVE VEHICLES

1 Scope

This Technical Report describes standardization roadmap of fault test methods for integrated circuits used in automotive vehicles. Since automotive vehicles are exposed in harsh environment such as very low or high temperature, vibration, high frequency signals, etc. Therefore, they are tested for possible faults which can be caused by harsh environment. There are several fault test methods and related issues to be standardized.

Semiconductor devices used in automotive vehicles are exposed in harsh environment of very high or very low temperature, vibration, high frequency signals, etc. Therefore, they are tested for possible faults which can be caused by harsh environment Evaluation results following this fault test methods will provide robustness of the semiconductor device.

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 60050-192*, International Electrotechnical Vocabulary (IEV) – Part 192: Dependability*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-192 apply, as well as the following.

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
automatic test pattern generation
ATPG
method/technology used to find an input (or test) sequence that, when applied to a digital circuit, enables automatic test equipment to distinguish between the correct circuit behavior and the faulty circuit behavior caused by defects

Note 1 to entry: The generated patterns are used to test semiconductor devices after manufacture, or to assist with determining the cause of failure. The effectiveness of ATPG is measured by the number of modeled defects, or fault models, detectable and by the number of generated patterns. These metrics generally indicate test quality (higher with more fault detections) and test application time (higher with more patterns).

3.2
error
discrepancy between an observed or measured value or condition, and the true, specified or theoretically correct value or condition

[IEC 60050-192:2015, 192-03-02, modified – The words "a computed, observed or measured" have been replaced by "an observed or measured" and the notes to entry have been removed.]

3.3
failure
loss of ability to perform as required

[IEC 60050-192:2015, 192-03-01, modified – The specific use <of an item> as well as the three existing notes have been removed.]

3.4
fault
inability to perform as required, due to an internal state

[IEC 60050-192:2015, 192-04-01, modified – The specific use <of an item> has been deleted, as well as the four existing notes.]

3.5
fault coverage
proportion of faults that can be detected, under given conditions

[IEC 60050-192:2015, 192-07-24]

3.6
fault detection
event by which the presence of a fault becomes apparent

[IEC 60050-192:2015, 192-06-18, modified – The note has been removed.]

3.7
fault model
definition of a possible fault type which gives incorrect values at any speed or at-speed, and sensitized by performing only one operation or multiple operations sequentially

3.8
fault simulation
simulation of DUT in the presence of faults to evaluate the quality of a test set, usually in terms of fault coverage

3.9
permanent fault
fault that will remain unless it is removed by some intervention

Note 1 to entry: The "intervention" may be modification or maintenance.

[IEC 60050-192:2015, 192-04-04, modified – The specific use <of an item> and the second preferred term "persistent fault" have been removed.]

3.10
scan test
functional test in which test data are first entered via a scan chain, the appropriate functions are then performed, and finally the test results are extracted via the scan chain

3.11
scan chain
group of scan cells that can be connected when required as a shift register for entry of test input data or extraction of test results data

3.12
scan cell
1-bit storage unit that would normally function as part of the DUT, that can be set instead to hold input data prior to a test or hold data resulting from a test

Note 1 to entry: Scan cells are placed at strategic points in the DUT that break up its overall function into smaller segments that can be tested independently for success or failure. Thereby a complex arrangement of logic can be tested more easily than it can as a whole.

Note 2 to entry: A scan cell need not be a functioning part of the DUT.

3.13
test coverage
proportion of tests that can be performed by a set of tests relative to the number of tests that are needed to verify all the intended functions or only a subset of them

3.14
transient fault
fault that disappears without intervention

[IEC 60050-192:2015, 192-04-05, modified – The specific use <of an item>, the deprecated term "volatile fault" as well as the notes have been removed.]

4 Background

4.1 Motivation

Semiconductor devices in automotive vehicles are exposed to harsh environments such as vibration, dust, high and low temperature, and high-frequency signals as shown in Figure 1.

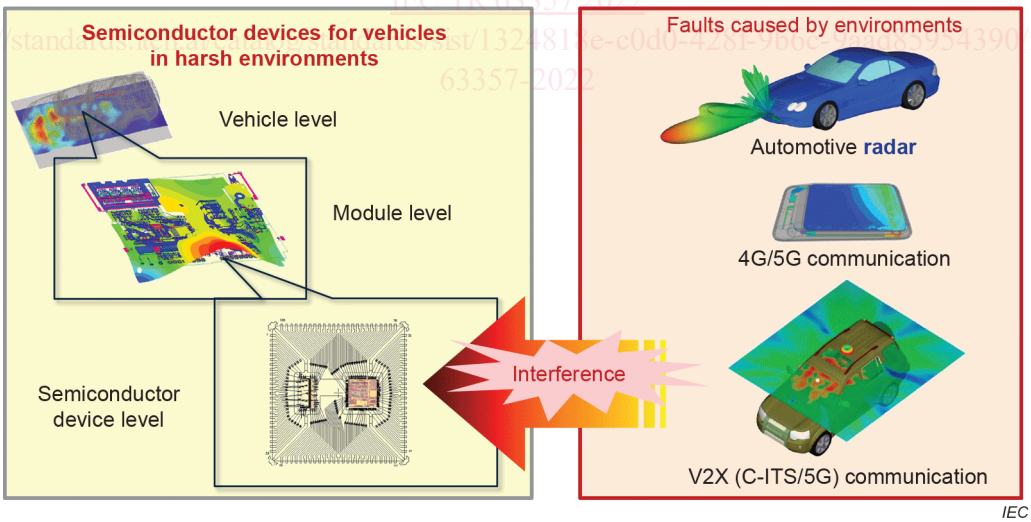

Figure 1 – Conceptual diagram of environment for semiconductor devices used in automotive vehicles

High-frequency signals include automotive RADAR from other vehicles, RF signals from mobile phones and stations, and V2X communications.

According to regulations on automotive RADAR, frequency bands are 24 GHz and 77 GHz to approximately 81 GHz as shown in Figure 2. And frequency band from 77 GHz to 81 GHz is promising since it provides wide bandwidth of 4 GHz.

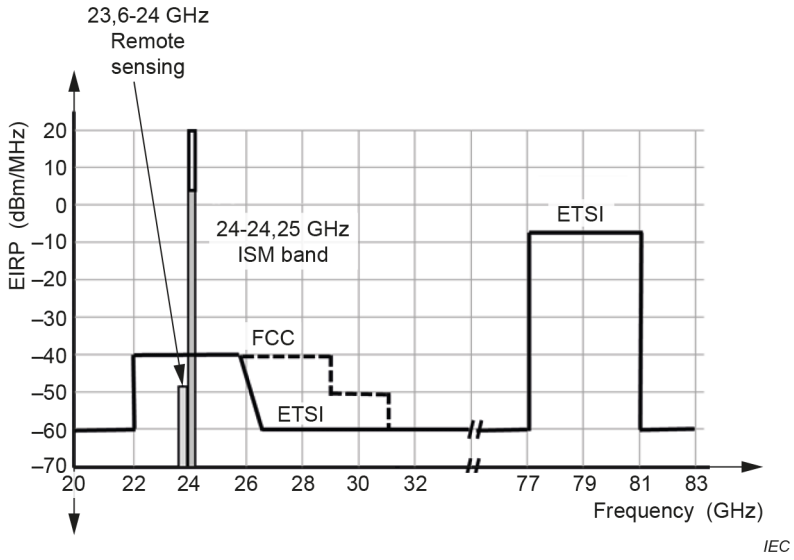

Figure 2 – Regulations on automotive RADAR

Frequency ranges of wireless communications are, 26 GHz to 28 GHz, 38 GHz to 42 GHz, and up to 100 GHz after 2020 as show in Figure 3.

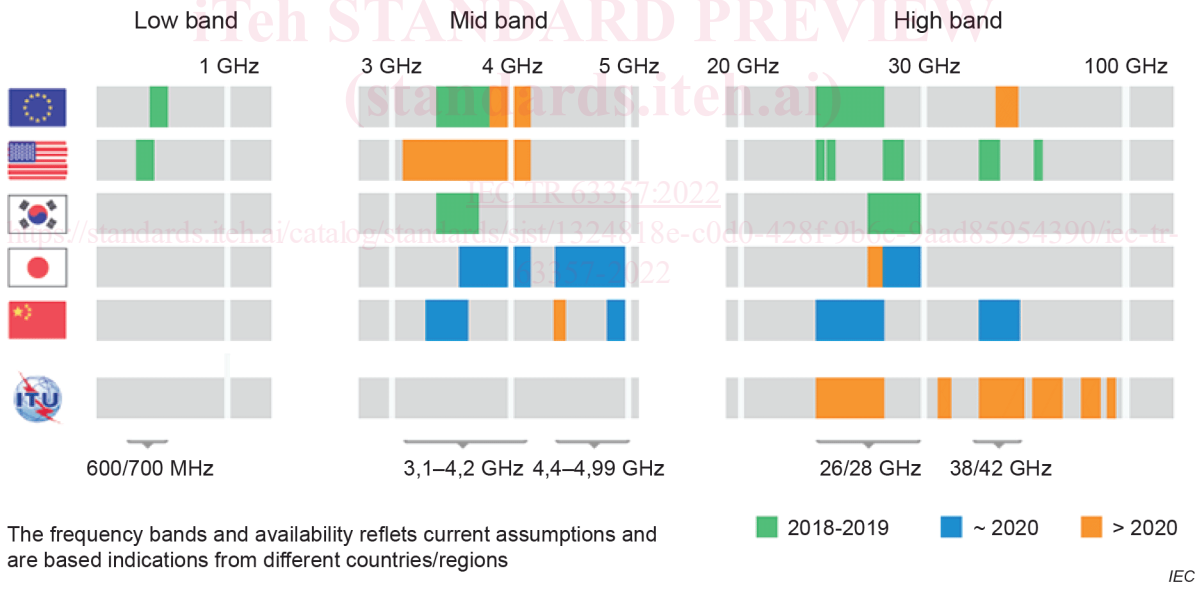

Figure 3 – Frequency bands for wireless communications

Frequency ranges of V2X communications used in Intelligent Transport Systems are 5,9 GHz (ECC) and 3,4 GHz to 3,8 GHz as show in Table 1.