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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Semiconductor devices for IoT system –
Part 1: Test method of sound variation detection

Dispositifs à semiconducteurs – Dispositifs à semiconducteurs pour système IDO –
Partie 1: Méthode d'essai de détection de variation acoustique

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SEMICONDUCTOR DEVICES – SEMICONDUCTOR DEVICES FOR IOT SYSTEM –

Part 1: Test method of sound variation detection

FOREWORD

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

Draft	Report on voting
47/2782/FDIS	47/2792/RVD

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 International Standard 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/publications.

A list of all parts in the IEC 63364 series, published under the general title *Semiconductor devices – Semiconductor devices for IoT system*, can be found on the IEC website.

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- amended.

SEMICONDUCTOR DEVICES – SEMICONDUCTOR DEVICES FOR IOT SYSTEM –

Part 1: Test method of sound variation detection

1 Scope

This part of IEC 63364 specifies terms, the test method, and the report of sound variation detection system based on IoT. It provides the evaluation method for each part of the sound variation detection system based on IoT in the block diagram, the characterization parameters, symbols, test setups and the conditions. In addition, this document defines the configuration items and criteria of standard space and firing situation for the quality evaluation measurement of sound field variation detection system with IoT.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
transfer function
response characteristics function of sound pressure which transfers to microphone in the securing sound space

3.2
standard space
securing sound space which is controlled and frequency pre-scanned for the occurrence of event

3.3
SNR
signal to noise ratio value which is defined by the ratio of the value of event occurred and without the event

3.4
frequency shift index
characteristic frequency shift value for the event occurred

4 Evaluation method and test setup

4.1 General

Changing sound field composed of low-cost speaker and microphone in the sensor module, a sound field is generated by the speaker in the standard space. The extent to which the generated sound field is distorted by firing objects is measured and detected with a microphone, in a dark environment. The extent is about the primary space when events are monitored. In this securing space, the modelling is described by the governing equation of acoustic wave propagation and boundary conditions of wave source, speed and wave pressure. In order to make a sound field, the speaker should generate the 4 kHz wave. Figure 1 shows a sound field sphere,

where

P is the pressure of the sound;

S_u is the sound velocity boundary;

S_p is the sound pressure boundary;

U is the velocity of the sound.

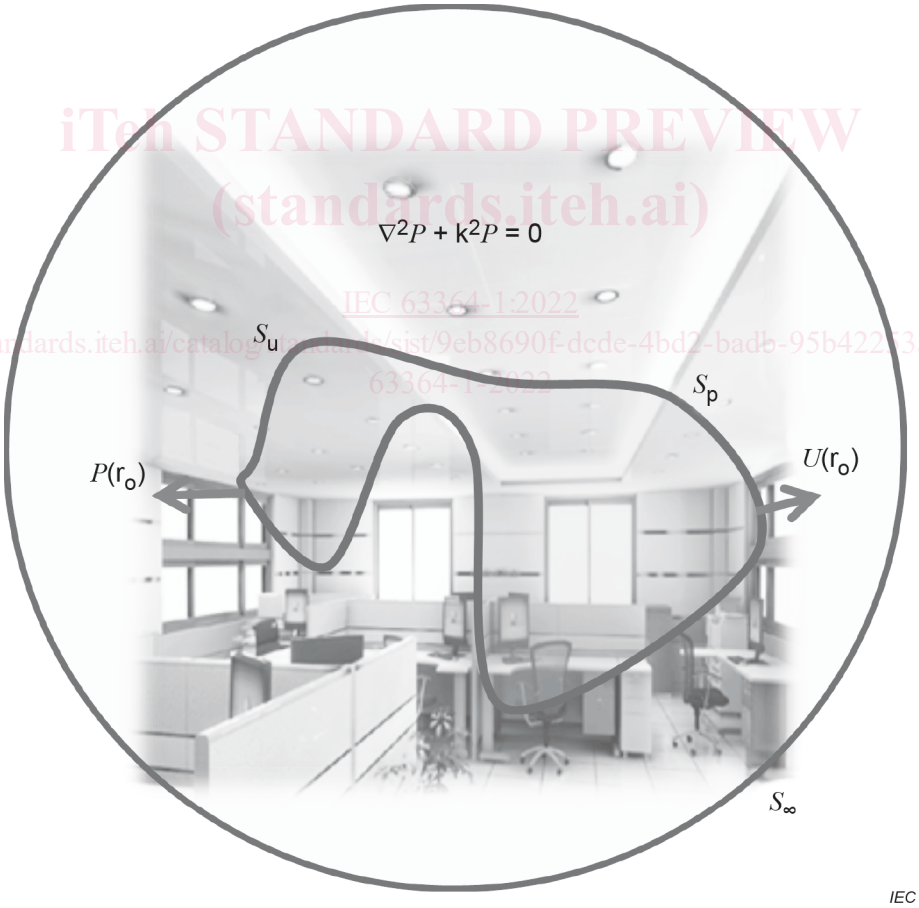


Figure 1 – Sound field space with boundary conditions and governing equation

4.2 Equipment and tools

The equipment for a sound variation detection system requires a set of speaker and microphone which are placed on each corner of the securing space. An event is located at the arbitrary position as shown in Figure 2 a). The multi-tone sound source is composed of 17 sine waves around a central frequency of 4 kHz with an interval. The sound pressure data are acquired by a data acquisition module, and the data are processed simultaneously. A sound signal with a 0,5 s duration is measured and 25 600 sampling data are used to obtain the sound pressure level data with a sampling frequency of 51 200 Hz. In addition, the frequency resolution is 2 Hz for the FFT spectra. The sound pressure level spectra are measured at multi-tone frequencies of 17 channels ranging from 3 968 to 4 032 Hz with a frequency step of 4 Hz. The sound pressure level in the position of the distance of 10 cm from the front of a speaker is set to be 94 dB by controlling the volume of the speaker. The sound pressure level for the multi-tone frequencies is measured within a time interval of 0,5 min after the event source such as sound, temperature has occurred.

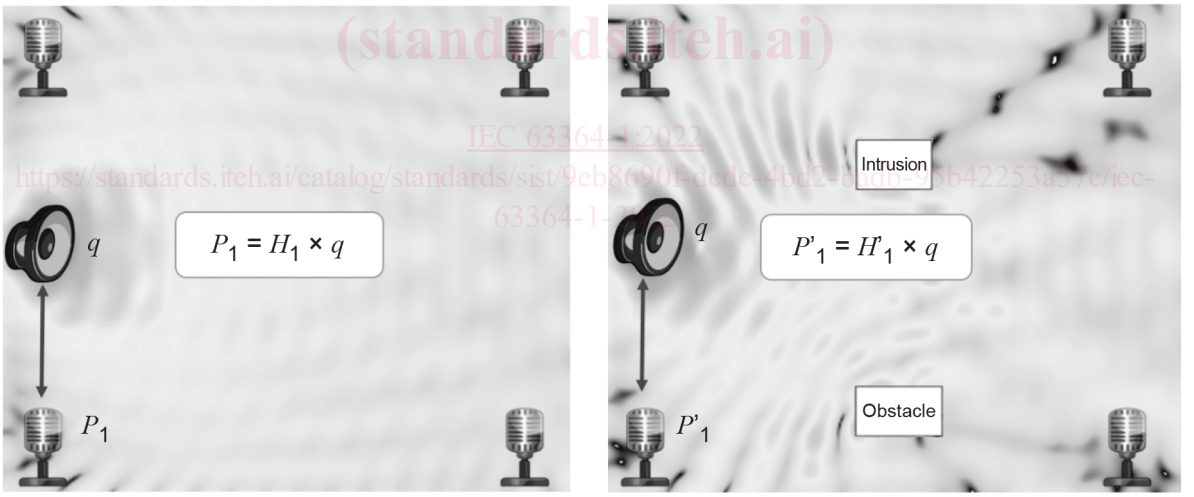
A speaker and a microphone are used to measure the transfer function of the given space.

Where

H is the transfer function;

P is the sound pressure of the microphone;

q is the sound pressure of the speaker.



a) Without intrusion

b) With intrusion (fire)

Figure 2 – Variation of transfer function due to obstacles in security area

4.3 Block diagram and semiconductor components

4.3.1 General

The sound detection system using sound variation field is consisted with detection sensor, sound source, and the electric circuit with microcontroller and DSP (Digital Signal Processing) unit. Figure 3 shows a block diagram for sound variation detection system for IoT-based sound variation detection. The detection system should be tested for the uniformity of the sound source and fluctuation of the sound waves, the sensitivity of the sound detection sensors, date exchange rate between amplifier to DSP unit.

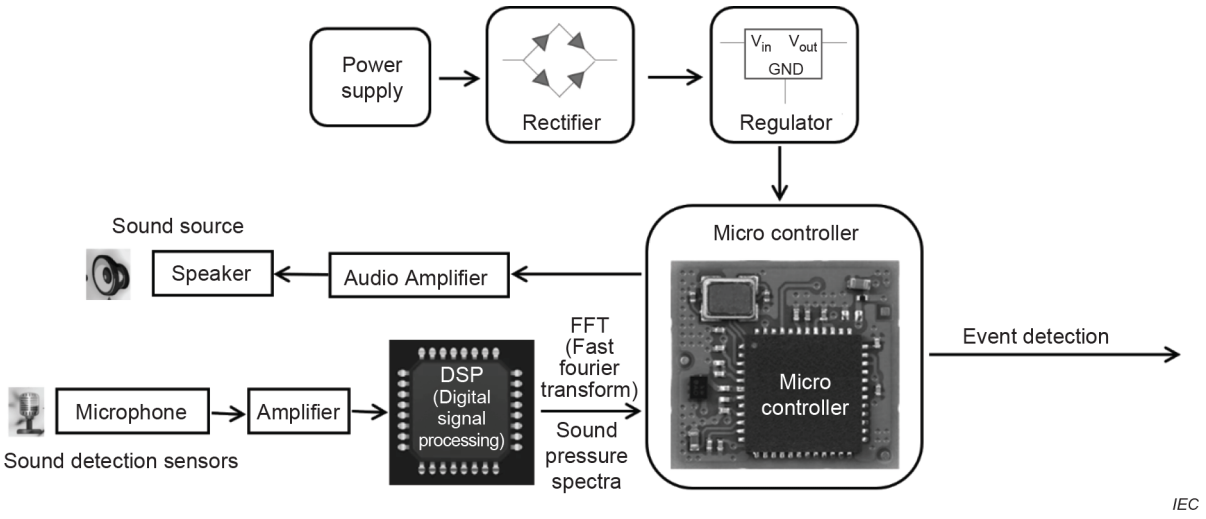


Figure 3 – Block diagram of the sound variation detection system for IoT-based event detection

4.3.2 Microphone sensor

Sound field variation detection system is consisted of microphone sensors for the sound variation detection. The 4 microphone sensors are required for a secured space such as closed room at least in order to get dependable data.

4.3.3 Speaker

The role of the speaker is making uniform sound field. The sound field variation detection system is surveilling the secure space by the change of the sound field. The speaker should generate uniform sound field in the secure space.

4.3.4 Micro controller

In the sound variation detection system, the micro controller is needed to analyse the spectrum. The sound pressure level (SPL) spectrum is fluctuated by frequency and shifted by event occurring. The micro controller can analyse the range of SPL shift to confirm the event has occurred or not.

4.3.5 Transmitting module

The transmitting module is required to monitor or to control the sound field variation detection system at the outside of the secure space. The sound field variation detection system is used on behalf of human watching. Therefore, the constant monitoring of secure space, the detection system should communicate the signal to the surveillance server system. The transmitting module sends the signal which is detected by the sound field variation detection system in the secure space.

4.4 Test methods

4.4.1 Cubic box

In order to test the sound field variation detection system, a cubic box with a length of 60 cm is used for a comparison with the simulation results. A gas lighter is used to simulate a temperature changing event. A 6 W speaker with a diaphragm of 3,5 cm in diameter is installed at the central hole of the left-side plane of the cube as shown in Figure 4.

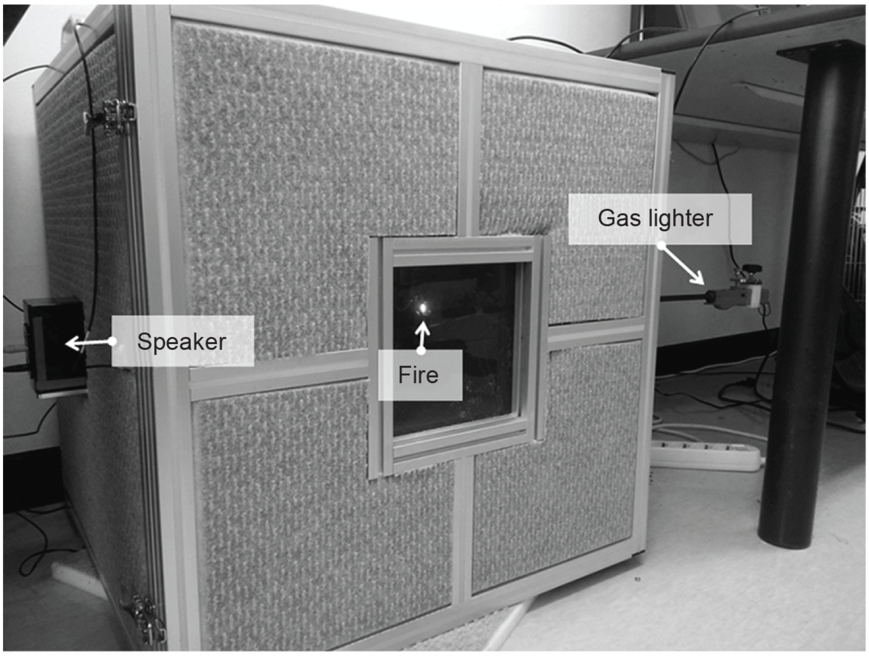


Figure 4 – Cubic box for experiment for sound field variation detection system

The detailed inner configuration used for the experiment is shown in Figure 5. The flame of the gas lighter is positioned at (10 cm, −10 cm) from the centre within the middle square plane of the cube. Two microphones are installed in the corners of the middle square plane and are numbered from #1 to #2. Two thermometers are located 5 cm in front of the gas lighter and near the bottom plate to measure simultaneously, as shown in Figure 5.

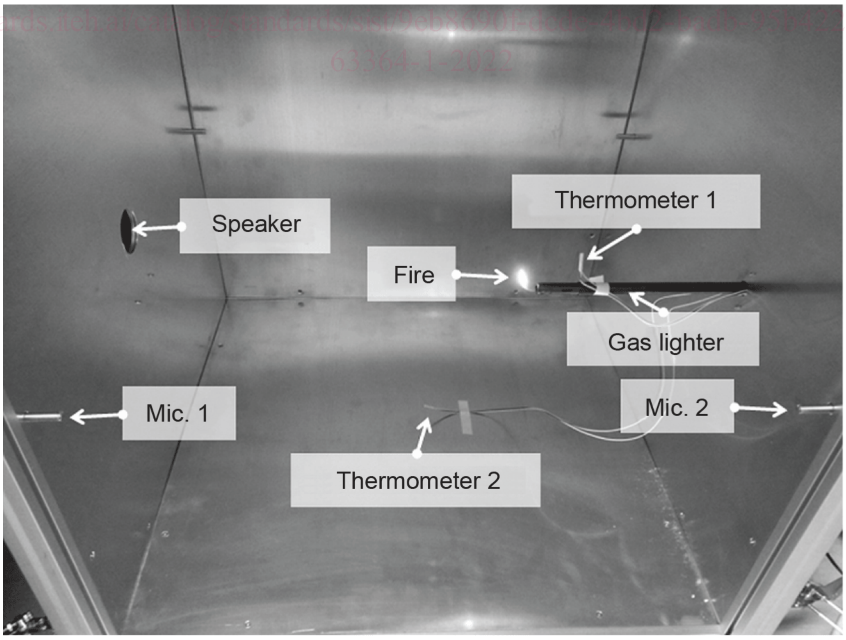


Figure 5 – Inner configuration within a cubic box