

# TECHNICAL SPECIFICATION



**Car multimedia systems and equipment – Drive monitoring system  
Part 1: General**

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## CAR MULTIMEDIA SYSTEMS AND EQUIPMENT – DRIVE MONITORING SYSTEM

### Part 1: General

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IEC TS 63033-1, which is a technical specification, has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
100/2819/DTS	100/2877/RVDTS

Full information on the voting for the approval of this technical specification 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 63033 series, published under the general title *Car multimedia systems and equipment*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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## INTRODUCTION

The drive monitoring system is a camera-based visual system enabling the car user to record and view in real time the surrounding visual image of their vehicle from anywhere within a 360° surround view perspective. The purpose of this document is to specify the model for generating the desired surrounding visual image of the drive monitoring system. Typically, the drive monitoring system is defined by the audio-visual monitoring system requirements of the car multimedia system and equipment.

To ensure the correct positioning of the car in relation to its surroundings, the rear-view monitor for parking assistance, the blind spot monitor for displaying views of the blind spots, and the bird's-eye view monitor are used. Each drive monitoring system provides a different viewpoint to the car's driver. It's a heavy burden for a car driver to switch between these systems and quickly recognize the multiple fields of view. In addition, the fields of view are limited to these camera systems which cannot freely change the eye point depending on the driving situation. As a result, the usage cases for these types of systems are limited to singular functions such as parking assistance. Furthermore, on commercial vehicles such as trucks, buses and other special vehicles, ranging from construction to agricultural machinery, the usage cases for these systems is even more limited. In these vehicle types, there might exist situations in which no one is available to assist the driver in properly ensuring the car's correct and safe position.

To resolve these problems, the drive monitoring system provides the driver with the optimal surround view image as constructed by the model explained in this document. It provides the optimal viewpoint of the vehicle and its surroundings to the driver for ensuring the car's good positioning in various driving situations (parking, turning, high traffic situations, etc.). This is not only true for passenger cars, but good positioning can also be quickly ensured for commercial vehicles and other special vehicles as well.

Part 1 specifies the model for generating the surrounding visual image of the drive monitoring system. Part 2 specifies the information sets that are provided by the drive monitoring system, which include recording methods for that information and the actual visual images. Part 3 specifies the measurement methods of surrounding visual images for the drive monitoring system.



# CAR MULTIMEDIA SYSTEMS AND EQUIPMENT – DRIVE MONITORING SYSTEM

## Part 1: General

### 1 Scope

This document specifies the model for generating the surrounding visual image of the drive monitoring system.

### 2 Normative references

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

##### car

any kind of powered wheeled vehicle

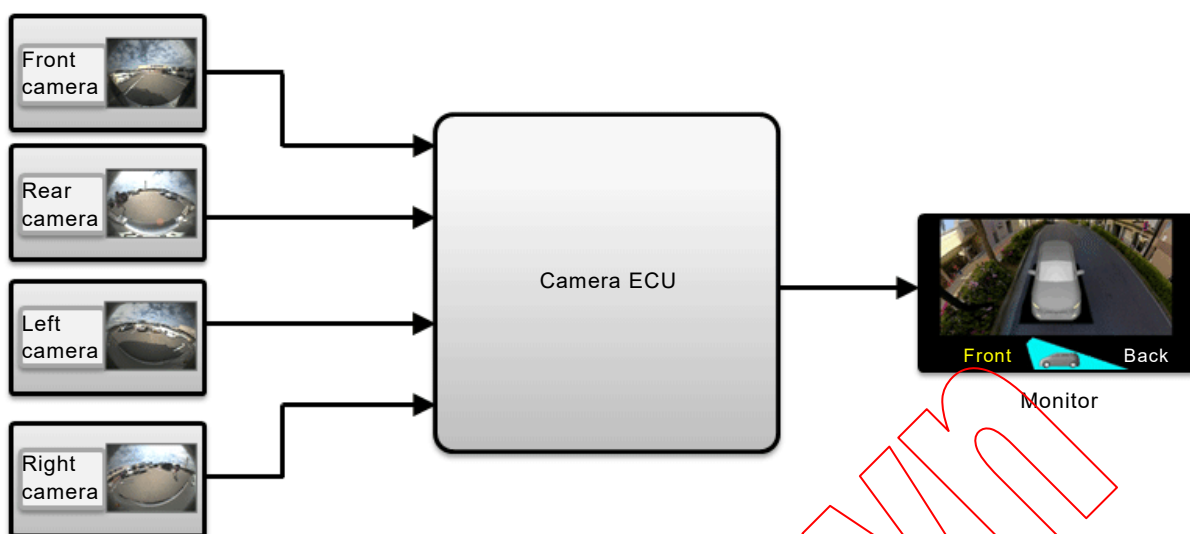
#### 3.2 Abbreviated terms

3D	three dimensional
camera ECU	camera electronic control unit
CAN	controller area network
GUI	graphical user interface

### 4 System model

#### 4.1 General

The system model of the drive monitoring system is described in Figure 1. Cameras, which are mounted on the outside the car, capture the visual image of the environment outside the car. The visual images are projected onto a virtual 3D projection surface that is then displayed as a composite image onto the monitor. The images displayed can be rendered from any viewpoint within the 3D projection surface, thus enabling the optimal viewing perspective onto the display based on the scenario. The number of cameras required on vehicles other than passenger cars may be more than four depending on the size and shape of the car. This model defines a drive monitoring system with four cameras as typical for most car type applications. The number of cameras used in generating each composite image may change depending on the viewpoint. The mounting positions and angles for the four cameras should be calibrated as per the method described in 4.2 and 4.3.

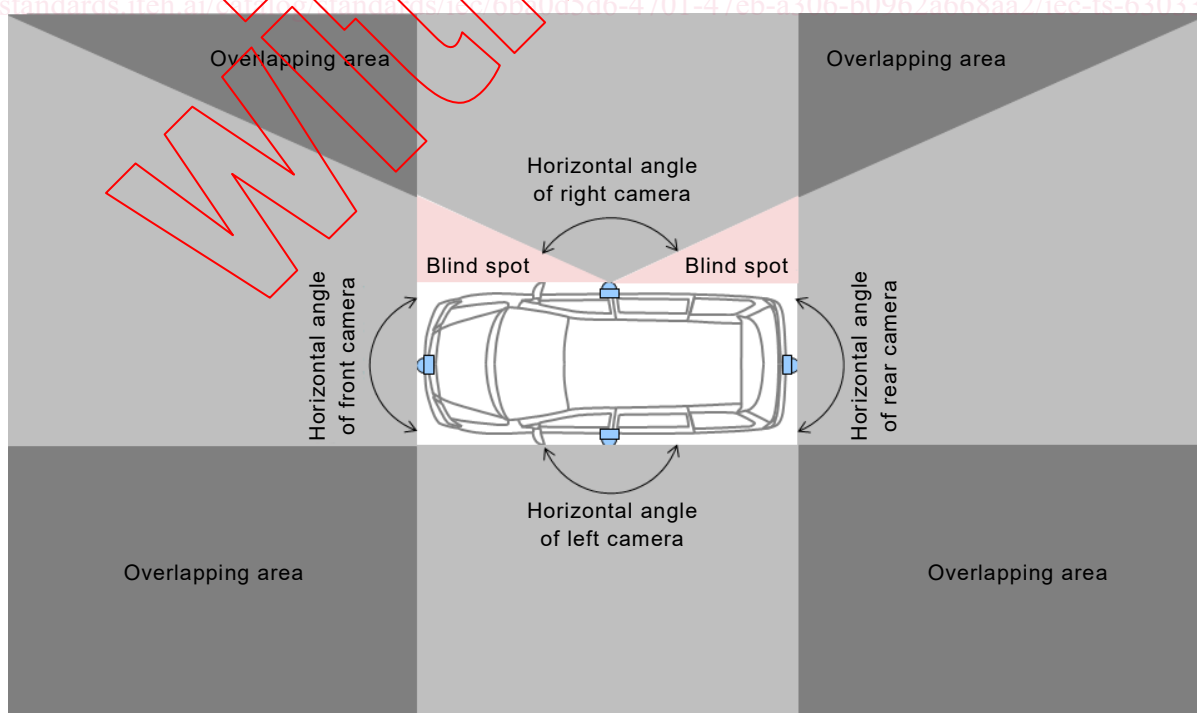


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Figure 1 – System model for the drive monitoring system

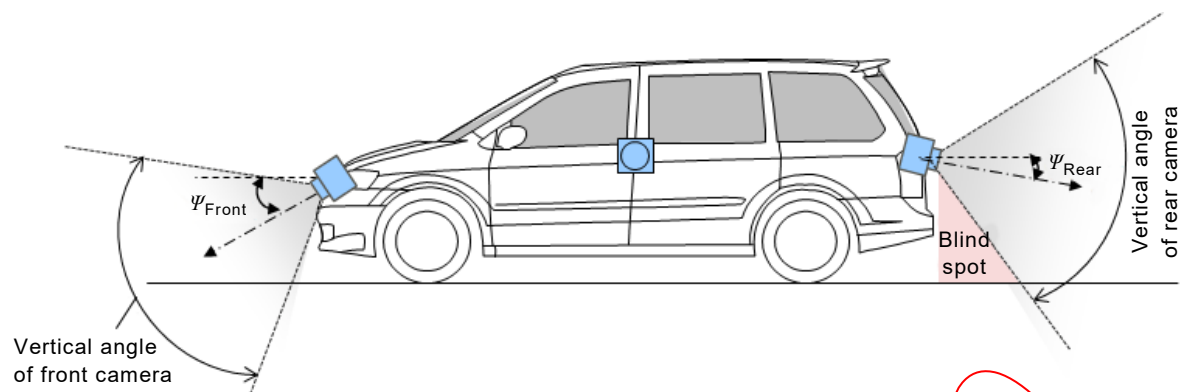
4.2 Number of cameras and camera field of view

The horizontal angle of view of the camera is described in Figure 2. Overlapping areas and blind spots on the horizontal field of view change depending on the number of cameras and the horizontal positioning – viewing angle of the cameras. Overlapping areas between adjacent cameras should be wide for better composite views. The number of cameras and the horizontal angle of view of the camera should be determined such to ensure there are no blind spots. In regards to the vertical angle of view, the tilt angle of the front and rear cameras ( $\psi_{Front}$ ,  $\psi_{Rear}$ ) is described in Figure 3. The blind spot of the vertical field of view will change depending on the vertical and the tilt angle ( $\psi$ ) of the camera. The vertical angle of view of the camera and the tilt angle ( $\psi$ ) should be decided such to ensure that no blind spots are generated. The details are described in Annex A.



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Figure 2 – Horizontal angle of view of the camera



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**Figure 3 – Vertical angles of view of the camera**

#### 4.3 Method for projecting visual image to 3D projection surface

Following the right-handed coordinate system, the length of the car is the  $Y_{car}$  axis, the width direction of the car is  $X_{car}$  axis and the vertical direction is the  $Z_{car}$  axis. The vehicle's cameras capture and generate a video image that is projected onto a virtual projection surface, with the road surface being at  $Z_v = 0$  (refer Figure 5). This virtual projection surface is then projected onto a 3D projection surface as further described in Figure 4 and Figure 5. The 3D projection surface that should be used is described in Figure 4. Projecting the camera generated image onto a 3D projection surface is described in Figure 5. The 3D projection surface should be a 3D sphere whose polygon model is similar to a polyhedron. One point of the projection image ( $P_V$  coordinate of the 3D projection surface), is converted to one point ( $P_C$  coordinate of the camera coordinate system) based on the optics origin of the car's cameras. This coordinate conversion is defined as:

$$P_C = M_{V \rightarrow C} \times P_V$$

Where  $M_{V \rightarrow C}$  is the coordinate conversion matrix to the car coordinate system, fixed by the camera mounted position and the angle for the car coordinates. Incident vector  $V_i$  when the car's camera photographs the subject at position  $P_C$  is defined as:

$$V_i = -\frac{P_C}{|P_C|}$$

The coordinates of the car's camera image that records the subject of incident vector  $V_i$  can be calculated by the internal parameter of the car's camera. Projecting the car's cameras' captured composite image onto a 3D projection surface is realized by arranging the pixels of four cameras with the relations mentioned above.