IEC

IEC TS 63033-1

Edition 1.0 2017-05

TECHNICAL SPECIFICATION

colour inside

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

IEC TS 63033-1:2017-05(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 It also gives information on projects, replaced and withdrawn publications.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 TS 63033-1

Edition 1.0 2017-05

TECHNICAL SPECIFICATION

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.160.99; 43.040.15 ISBN 978-2-8322-4282-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

CAR MULTIMEDIA SYSTEMS AND EQUIPMENT – DRIVE MONITORING SYSTEM

Part 1: General

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.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

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.

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 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

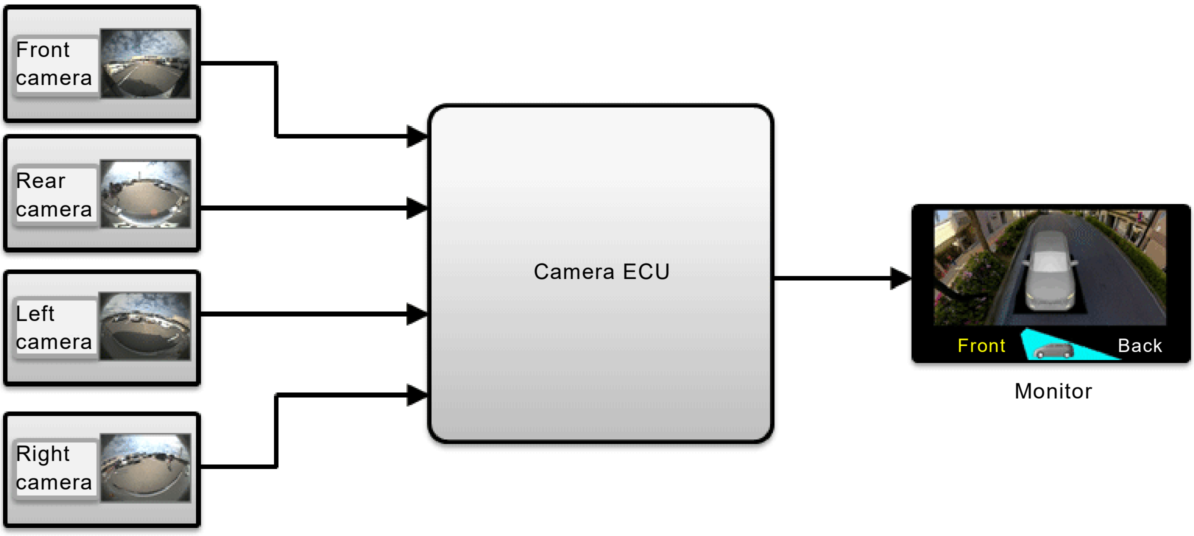
3.2 Abbreviated terms

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.

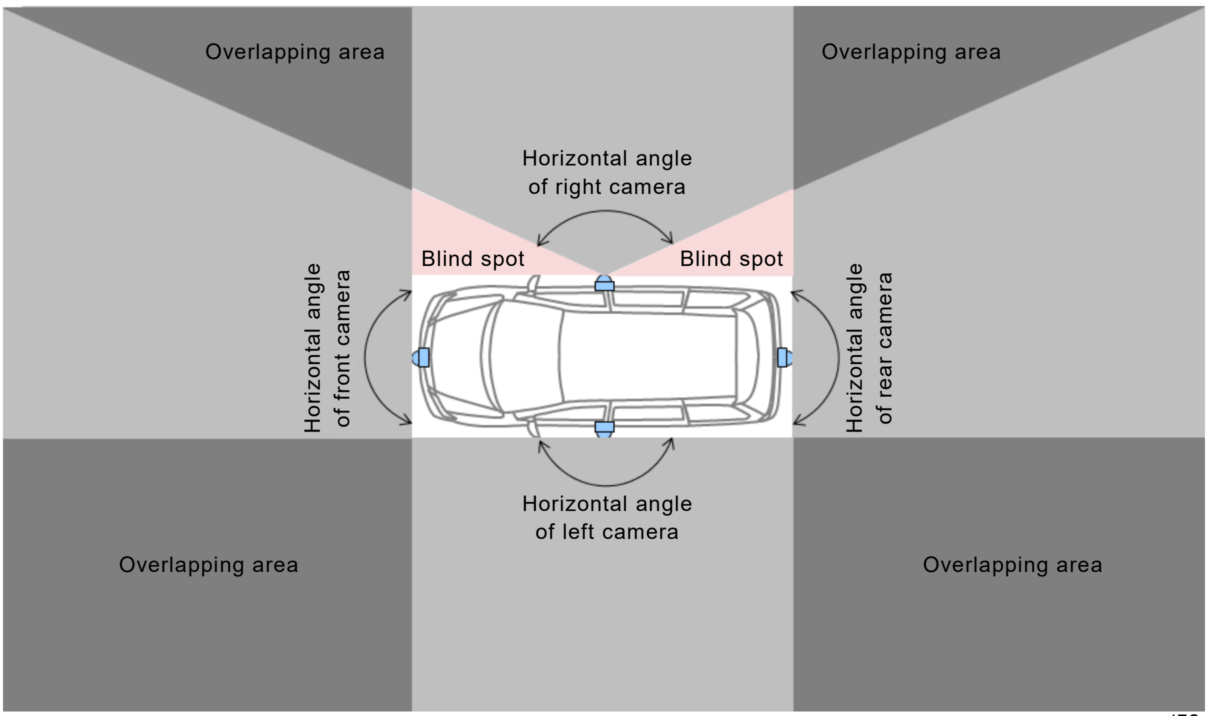


IEC

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 (ψ_{Front}, ψ_{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 (ψ) of the camera. The vertical angle of view of the camera and the tilt angle (ψ) should be decided such to ensure that no blind spots are generated. The details are described in Annex A.



IEC

Figure 2 – Horizontal angle of view of the camera

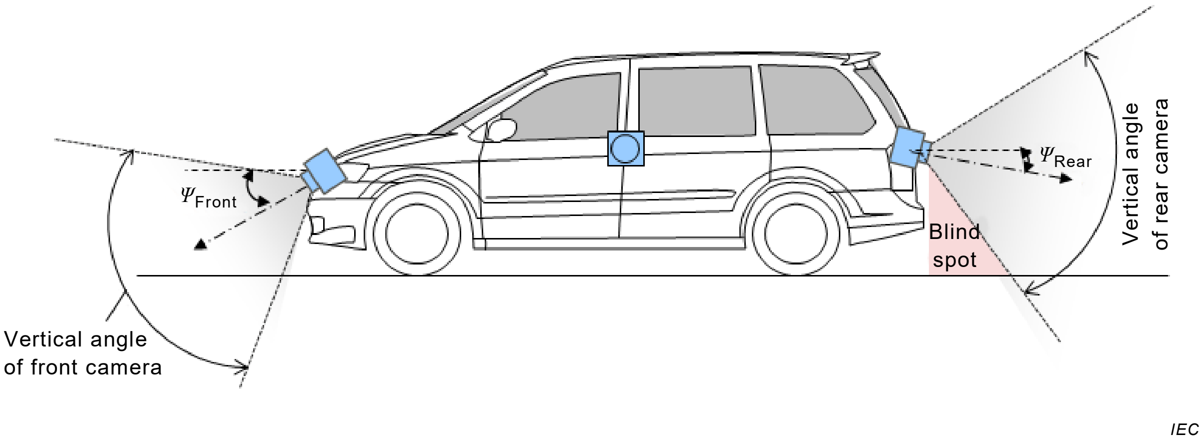


Figure 3 – Vertical angles of view of the camera

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.

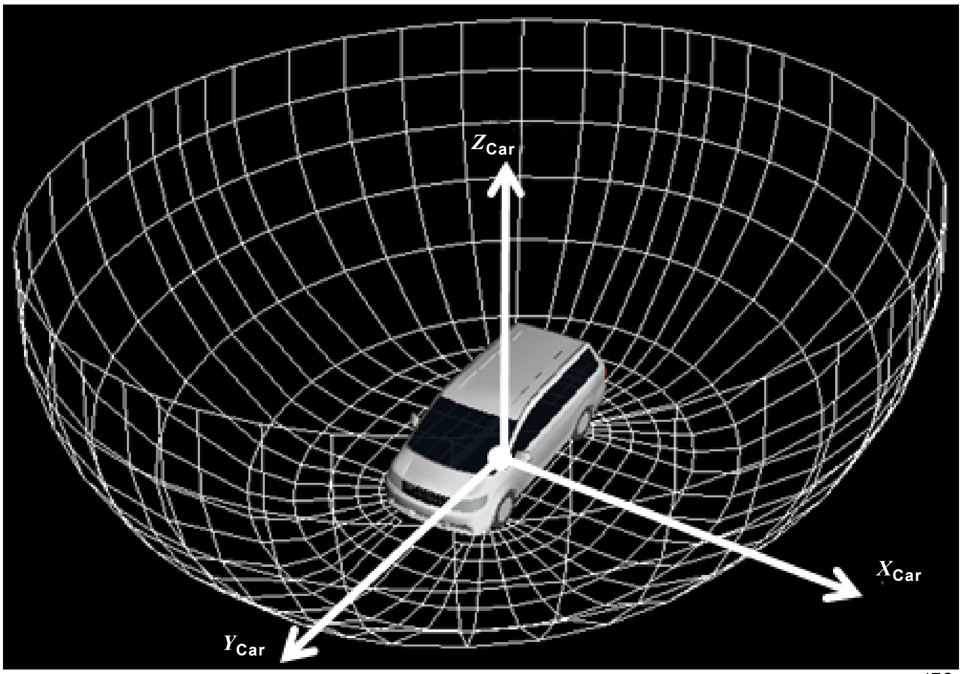


Figure 4 – 3D projection surface

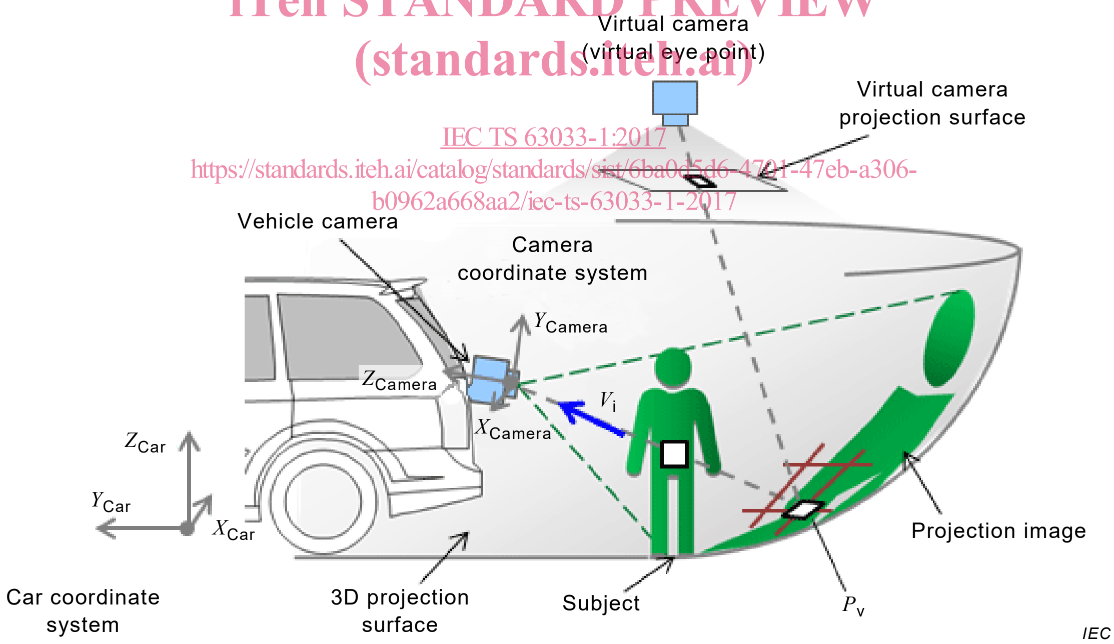


Figure 5 – Projecting to 3D projection surface

4.4 Visualizing the projection image at free eye point

The virtual eye point is the ability to change viewing perspective anywhere within the 3D projection. The polygon model constituting the 3D projection surface is visualized from any virtual eye point. Visualizing the polygon model uses 3D computer graphics technology. The texture image is the car's camera image updated at a video rate. The wrap around view image is composed by performing the polygon rendering, which associates the image coordinate of the car’s cameras with the polygon vertex as texture coordinates.