



Mobileye Shield Plus Connect

Technical Overview and Product Specification



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1. Introduction

Mobileye Shield Plus Connect is an intelligent blind-spot detection system for buses and heavy goods vehicles (HGV) that utilizes strategically placed, artificial-vision smart sensors. It provides informational assistance to drivers and its activation gives enough time for them to avoid dangerous situations. The artificial vision is trained to identify VRUs (Vulnerable Road Users—pedestrians, cyclists, and motorcyclists) while ignoring inanimate objects. Furthermore, the artificial-vision Mobileye Shield Plus Connect includes a gyro sensor to improve the real-time vehicle and VRU trajectories, which are used to assess the risk of an accident. This technical overview paper provides key information about the system, how it works, installation assembly combinations and requirements.

1.1 System Components and Assembly options

1.1.1 Exterior cameras and bridge SeeQ's

The Shield Plus Connect supports one or more side cameras according to customer needs and vehicles type, every side-camera unit comprises:

- An exterior housing, which holds the camera lens and a serializer
- A back-part unit called a SeeQ Bridge installed close the side camera, which includes an EyeQ4 Mobileye processor

Each camera is connected by coaxial cables that transmit the video signals to its SeeQ bridges for object analysis.

Mobileye Shield Plus Connect supports different system configurations depending on the number of side-camera units, which may vary according to the vehicle.

Mobileye Shield Plus Connect standard profile supports vehicle with rigid sections of up to 20 meters. The relevant parameter can be set and adjusted during the calibration and configuration process.

The table below describes a few installation types.

Installation Type	Number of Cameras	Description
Standard bus/truck installation	2–3	Master unit (mandatory) Left and/or right-side camera(s)
Articulated bus, tram, or trailer (cabin with separated trailer)	2+	Master unit (mandatory) Each rigid section of the vehicle can have a camera on either of the sides towards its back. As a rule of thumb, the standard installation is (number of rigid sections) * 2 side camera(s)

*Supporting articulated busses with multiple sensors, as well trailers etc.


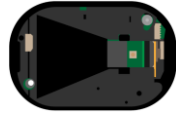
1.1.2 In cabin components - Mobileye 8 master unit and displays

- Master unit, which includes EyeQ 4 and main front-facing camera
- EyeWatch, which is the main display
- LEDs to the left and/or right, which display alerts from the side cameras

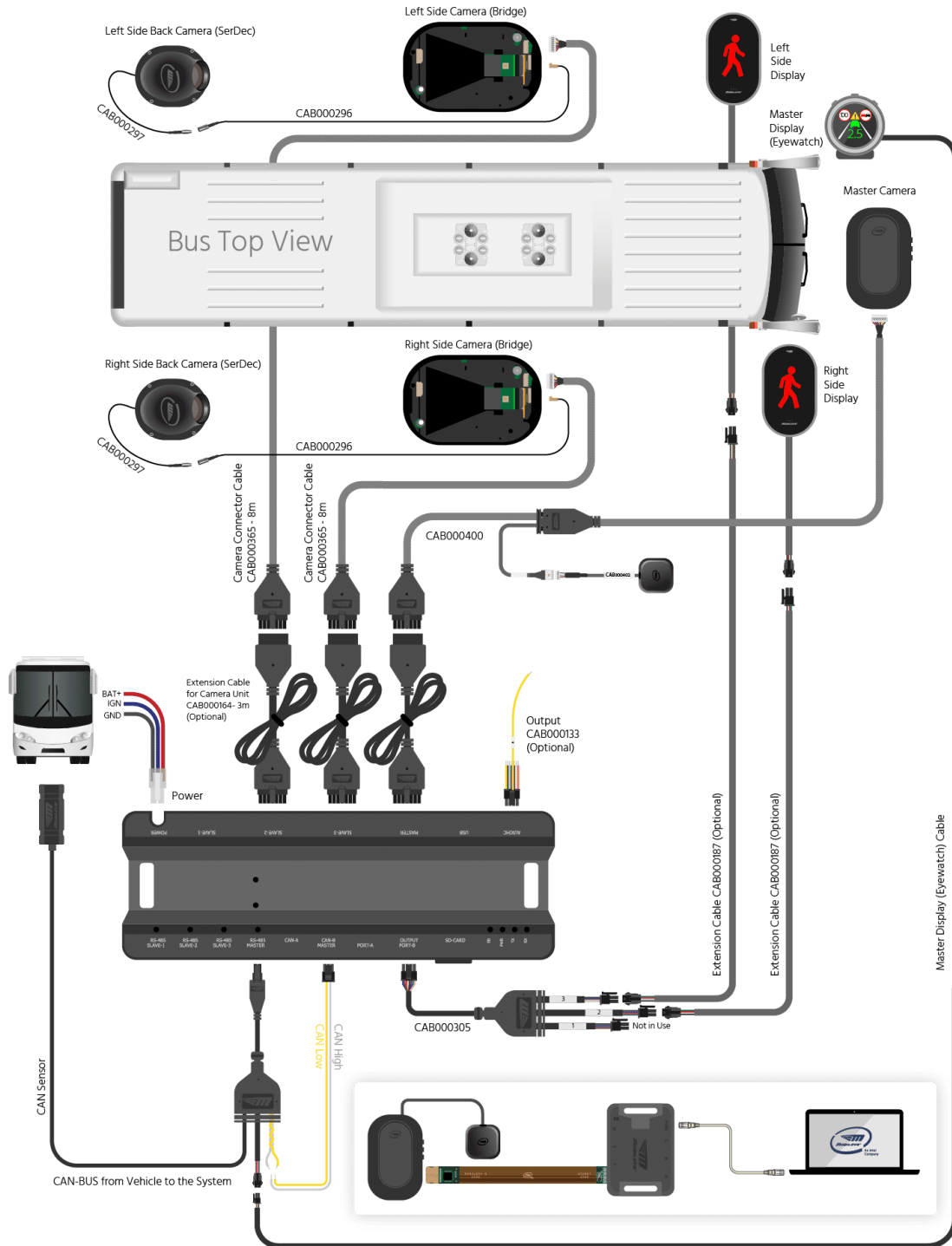


1.2 System Components

The Mobileye Shield Plus Connect standard kit is composed of the following components:

Component	Description	Mobileye P/N
	The Mobileye Shield Plus Connect Master (main) unit contains the front facing camera, a Gyro Sensor, an audio buzzer, and the main processor (EyeQ4™). This camera is mounted on the front windshield.	Master Camera ASY0000000000805
	The EyeWatch is the display of the master camera, providing the driver of all alerts that are processed from the front camera	Master Camera Display ASY000130
Rear camera 	The Rear SerDec Camera/s unit contains the camera sensor inside a sealed housing (IP69) bracket and a coax connector cable. The kit contains a metal bracket and 4 screws to mount, attach and secure the camera on the vehicle and a black rubber to prevent vibration	Rear camera PAC0000000000S4L/R
	Mobileye shield Plus Connect Bridge Board unit (S+ SeeQ) The Bridge Board unit is based on the Mobileye 5 hardware and contains the Mobileye chip on board system (EyeQ2™). - on Board Image Processing Chip – Real-time image processing at 15 FPS.	Mobileye Shield+ SeeQ (bridge unit) ASY000269
	The Mobileye Junction Box is a plug & play connection hub for all the Mobileye Shield+ components. The Junction box will retrieve power and the relevant signals from the vehicle and will provide to each of the system components.	PAC000000SHIELD4
	The LED display units are fitted in the front part of the vehicle, one on each side of the driver, delivering danger zone warnings and collision warnings to the driver	Side Display PAC000LED
	For Master camera which will be connected to the Junction box	Harnesses Cable CAB000400 8 meters long
	For rear cameras which will be connected to the Junction box and according to the required length – depend on the Junction box location.	Harnesses Cables CAB000365/CAB000600 8 meters long
	To extend bridge boards harness cables (CAB000365) if required and according to location and vehicle length	Extension cables CAB000587 – 9 meters long CAB000164 – 3 meters long
CAN Reader 	a non-intrusive solution for CAN-Bus connection that allows a quick and easy connection to the vehicle CAN-bus wires (to retrieve the required signals) by simply placing the Mobileye CAN-Sensor on the vehicle CAN-bus wires without any wire cutting or pinching.	CANREADER1

1.3 Basic connection scheme



2. How the system works

The Mobileye Shield Plus Connect delivers two kinds of warnings based on the severity of the risk of collision – Danger zone warning and Collision warning, In addition to the familiar Mobileye alerts which will be generated by the master (main) camera unit – **See details in [Appendix 1](#)**

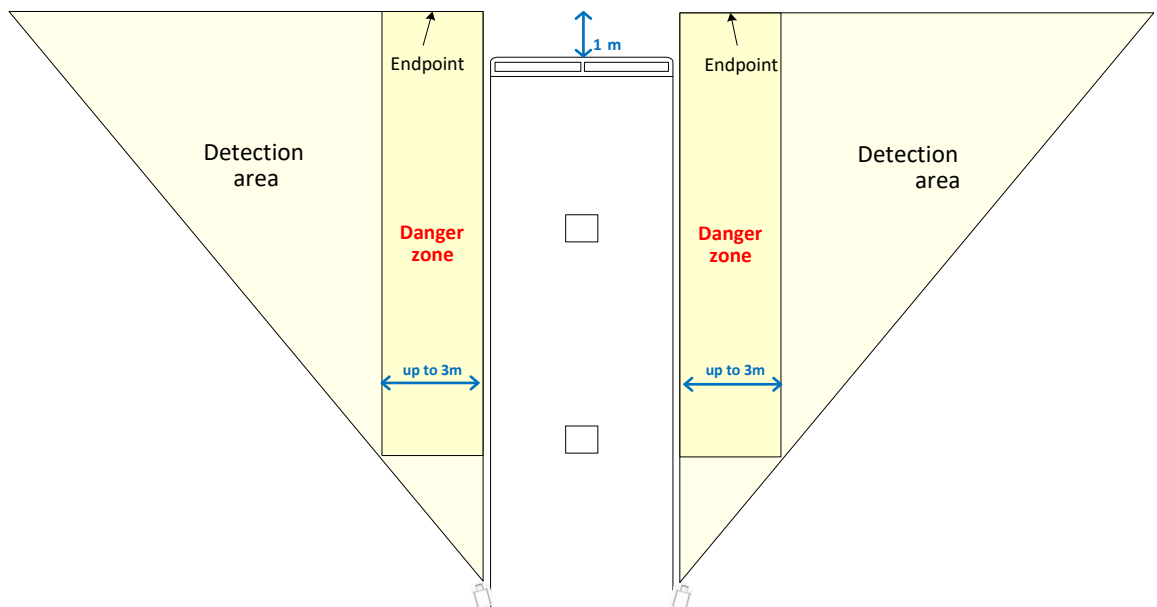
Mobileye Shield Plus Connect automatically defines the relevant danger-zones size and the LTTC (Lateral Time to Collision) to the VRU according to the trajectory and vehicle length. Every warning has two levels of sensitivity.

2.1 Shield Plus Connect Automatic sensitivity switches:

2.1.1 Low Sensitivity - narrow danger zone with low LTTC

When a vehicle is traveling on a straight course, the potential for a collision with a VRU (at the side of the vehicle) is lower. The blind zone of the driver is also smaller. The Shield Plus Connect side cameras monitor a narrow danger zone (with default width up to 300 cm) according to the blind zone that normally not covered by the vehicle's mirror.

The danger zone is the longitudinal distance from the closest point the camera can detect objects up to a certain distance ahead of the vehicle (configurable), but not more than 20 meters ahead of the camera.

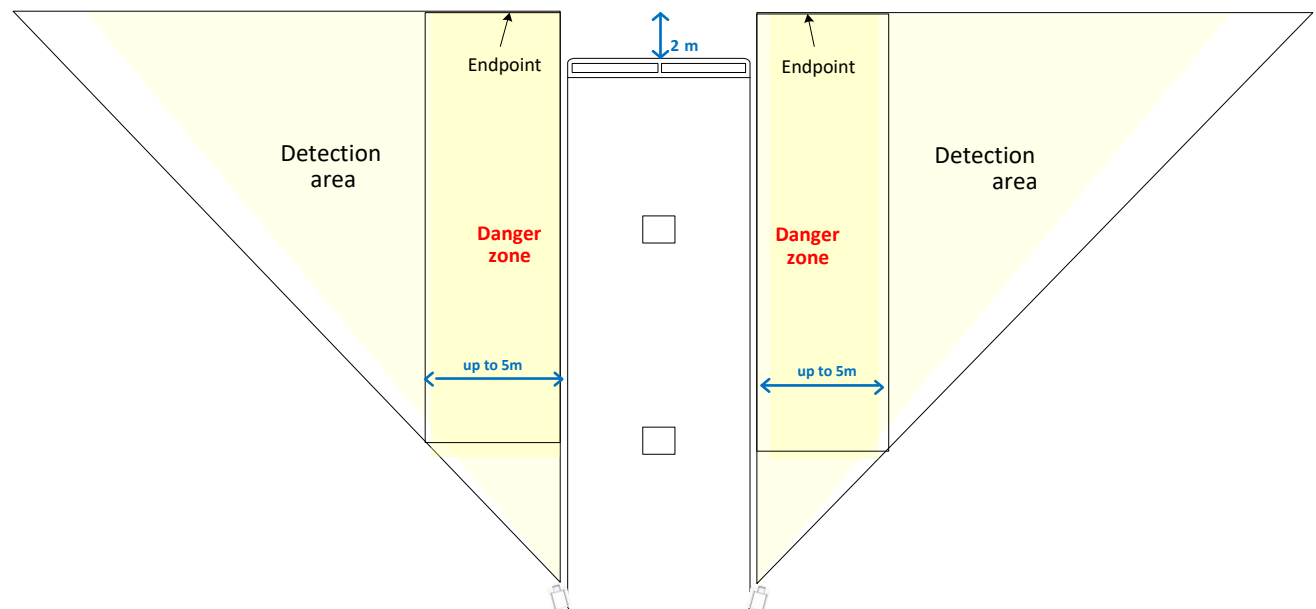


2.1.2 High sensitivity – Wide danger zone with High LTTC

When the vehicle is turning the potential of a collision (at the side of the vehicle) with a VRU's is higher. The blind zone of the driver is also increasing because of the maneuver. The Mobileye Shield Plus Connect side camera monitors a wider danger zone (width of up to 500 cm), according to the future potential of collision with a VRU. A red PCW warning will be generated based on the calculated TTC from the VRU.

The high-sensitivity danger zone is the longitudinal distance from the closest point the camera can detect objects up to two meters ahead of the vehicle, but not more than 20 meters ahead of the camera.

The following illustration showing the dimensions of the high sensitivity - wider danger zone laterally to the host vehicle:



3. Detection

3.1 Environmental detection

- Mobileye Shield Plus Connect works in both day and nighttime
- Minimum lighting of 15LUX

3.2 Object detection rules

- The System detects VRUs at the following driving speeds of the vehicle:

VRU Type	Driving speed of the vehicle at which the VRU is detected
Pedestrian	From 0/1 km/h to 70 km/h
Cyclist	From 0 km/h to 70 km/h
Motorcyclist	From 0 km/h to 70 km/h

- The system detects pedestrians above height of 1.1 meter (3.61ft).

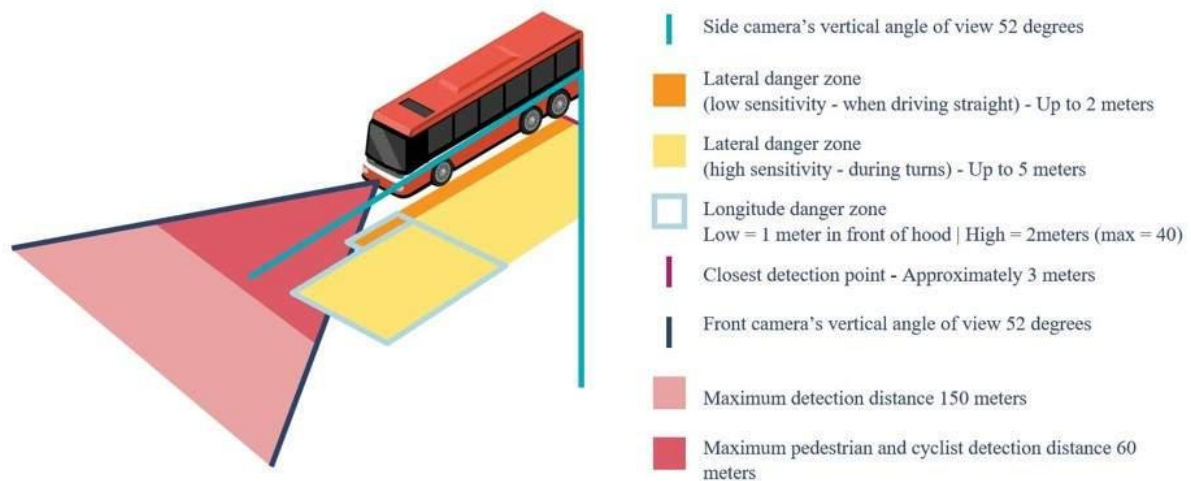
3.3 Detection range

The side camera of Mobileye Shield Plus Connect is forward facing, covering a beam of 52° horizontal

and 42° vertical FOV from the vehicle edge to the right or left blind-spot area.

The side camera detects objects from about 4 meters ahead of the camera installation point and up to 20 meters from the camera installation point, which is the detection endpoint.

The danger zone is configured to corridor width default of 0.8 meters (configurable between 0.1-10 meters) from the detection start point up to the endpoint



4. System Component Alerts

4.1 Front-Camera Alerts

The Mobileye Shield Plus Connect kit includes a forward-facing master camera based on Mobileye 8 Connect series (see Appendix A).

4.2 Side-Camera Alerts

In addition to alerts generated by the front-facing camera unit, Mobileye Shield Plus Connect side camera units deliver the following warnings, based on the risk of collision:



- **Danger-Zone warning:** Yellow LED visual alert indicating that a VRU is present in one of the blind-spot danger zones of the vehicle, alerting the driver to drive with caution



- **Collision warning:** Red, flashing LED visual and audio alerts indicating that a VRU and the vehicle are on an imminent collision course, triggered when the LTTC between the VRU and the vehicle shortens to a critical time, alerting the driver to take immediate action to prevent a collision.

4.3 Priority of Side-Camera Alerts

The collision warning has higher priority over the danger-zone warning. If there are both danger zone warning(s) and collision warning(s) on the same side of the vehicle, then the side LED display for that side indicates the collision warning.

5. System Functionality

5.1 System Configuration Customization and Adjustments

Mobileye Shield Plus Connect configurations (detection ranges, sensitivities, etc.) can be customized and adjusted to satisfy the needs of various types of vehicles, to meet the relevant requirements according to certain conditions and scenarios.

TTC threshold sensitivity levels can be changed to increase or decrease the sensitivity levels of collision and danger-zone warnings (red and yellow alerts, respectively).

Audio alerts can be configured to be produced for yellow or red warnings.

Alert patterns, durations, and volumes can be configured to increase or decrease sensitivity levels.

5.2 Environmental Operational Conditions

The operational temperature of the system is between -40°C and $+80^{\circ}\text{C}$.

The system is waterproof, and the side-camera units are IP69K dust and waterproof rated.




The system operates stably during vibration and is resistant to shocks endured by an HGV that meet military and HGV standards.

5.2.1 Operational Limitations – visibility conditions

Rear camera performance in conditions of poor visibility:

1. Poor/reduced visibility may be caused by a number of factors: both extrinsic – e.g. fog, heavy rain, bright sunshine shining directly into camera – and intrinsic – e.g. camera blockage by paper inserted into gap between camera and windscreen, or extremely dirty windscreen opposite camera lens.
2. When the EyeQ4 detects a degradation in visibility which is relevant to its ability to ‘see’ (and is not merely in its peripheral vision), it classifies the degree of degradation as low, medium, or high.
3. Whatever the degree of degradation, the EyeQ4 continues to operate as best it can.
4. At low level, no warning is issued, as it assumes that the degradation is transient. At medium and high level, a visual warning (see below) is issued on the EyeWatch.
5. Mobileye strives for the best performance possible, in the full range of weather conditions, and our technology has been designed to operate even in such circumstances. However, it is not infallible in extreme situations, any more than a human driver is not infallible in such situations. In any event, it must be recalled that

the Mobileye Shield+ is a driver assistance technology, and as such the sole responsibility for operating the vehicle correctly is the driver.

System Status	Icon on EW3	Possible Solution
No Errors – system is fully working		N/A
Error in System	Constant 	Contact Mobileye technical support team
Low visibility on rear camera – a VRU will not be detected	Blinking 	Check rear camera’s view – if needed, clean lens
Night mode – system will work normally but might not detect if lux level will be less than 15		Expected behavior – no action required

5.3 Environmental and Electric Characteristics

The housing of the side camera is anti-scratch and has a heater to prevent icing and humidity blockage of the FOV. The heater should not work when no risk of frost/snow on glass.

The system rated voltage can be between 10 and 32 Volts. The system current consumption is 3000 mA.

The side-camera has a corning gorilla glass, which minimizes the effect of fingerprints and smudges.

6. Input and Output Signals

6.1 Digital Input

Mobileye Shield Plus Connect can receive CAN input signals from the car, as follows:

- Speed
- Brakes
- Turn indicators
- High beam
- Wipers

6.2 UART Interfaces

Mobileye Shield Plus Connect can provide analog output signals with the following formats:

- RS485 (used for EW communication)

6.3 Analog Interfaces

Mobileye Shield Plus Connect can provide analog output signals with the following formats:

- Aux/IHC (as output)
- Diagnostics and alerts (via GPIO J15 – I/O Port-A and J16- Output Port-B sockets in Junction Box)

6.4 Digital Interfaces

Mobileye Shield Plus Connect can provide digital output signals with the following formats:

- CAN Protocol—CAN output messages can be sent for alerts and system status
- J1939—J1939 output messages can be sent for alerts and system status







The system supports the following output message types: according to DBC

- Right & Left Lane Departure Warning
- Left Lane Departure Warning
- Headway Monitoring Warning
- Forward Collision Warning
- Pedestrian Collision Warning
- Traffic Sign Warning
- Diagnostic message

7. Appendix

7.1 Appendix 1 – Mobileye 8 series (Master) alerts

The Mobileye collision avoidance system helps drivers by acting as a “third eye”, constantly monitoring the road in front of the vehicle. It identifies potentially dangerous situations and provides audio and visual alerts to assist the driver in preventing or mitigating a collision.

<p>Forward Collision Warning</p> <p>The FCW provides an alert up to 2.7 seconds before a possible collision with the vehicle in front, both on highways and in urban areas, up to 2.7 seconds before a collision.</p>	
<p>Headway Monitoring Warning</p> <p>The HMW displays the time, in seconds, to the vehicle in front. The system provides an alert if the time becomes dangerously short</p>	
<p>Intelligent High-Beam Control</p> <p>The intelligent high-beam control automatically activates and deactivates the high-beams on dark roads when no traffic is nearby</p>	
<p>Speed Limit Indicator & Traffic Sign Recognition</p> <p>Mobileye detects and classifies various speed limit signs and provides a visual alert when the vehicle's speed exceeds the posted speed limit.</p>	
<p>Pedestrian & Cyclist Collision Warning</p> <p>The PCW provides an alert up to 2.0 seconds before a possible collision, when a pedestrian crosses in front of the vehicle's path. (Under 50 kph).</p>	
<p>Lane Departure Warning</p> <p>Mobileye alerts you with visual and audio warnings when there is an unintentional deviation from the driving lane.</p>	

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