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Test Report
No.: 76123843-2
Moving Off Information System for the Detection of Pedestrians and Cyclists

With selected test cases following
UN ECE-R159
L 184/62 of 25.05.2021

This test report covers the evaluation of a moving off information system for motor vehicles according to the version of UN-ECE R159, L 184/62 of 25.05.2021.

The moving off information system (MOIS) is a system that detects and informs the driver of the presence of pedestrians and cyclists in the close-proximity forward blind-spot of the vehicle and, if deemed necessary based on manufacturer strategy, warn the driver of a potential collision.

System under Test: Mobileye Shield + 150-degree MOIS / AWS4_4.20.5_RC7_v8.2.24
Test vehicle: Ford Transit Mk7

Munich, 19.12.2022_____

Date, Signature

Dipl.-Ing. (FH) Robert Matawa

Lead Engineer Testing HAD
Business Unit Automotive

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0. Summary

TÜV SÜD tested the Mobileye System “Shield + 150-degree MOIS” / Software version AWS4_4.20.5_RC7_v8.2.24 according to the version of UN-ECE R159, L 184/62 of 25.05.2021, a directive to regulate the type-approval of vehicles equipped with a moving off information system for motor vehicles.

TÜV SÜD tested the Mobileye System in a Ford Transit Mk7 using an advanced metrology system. The motion of the test vehicle was real time monitored, using an IMU/GNSS based tool chain developed to meet the requirements regarding precision for the testing of automated vehicle functions and compared to ground truth, respectively the digital map of the proving ground used during the test.

Findings:

The System under Test

passed all tests *)

*) Applicable paragraphs 6.5, 6.6 and 6.7 of the regulation UN-ECE R159, L 184/62 of 25.05.2021.

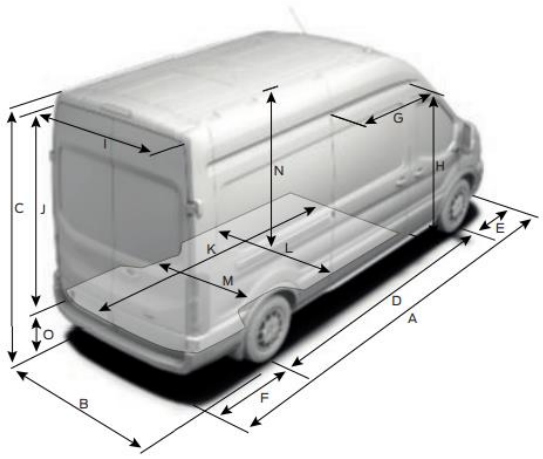
1. General information / Vehicle information

Test date:	01.08.2022 to 05.08.2022
Test track/Route:	Proving ground Airport, Mnichovo Hradiště, CZ
Weather conditions:	Partly cloudy and sunny, dry
Air temperature:	25 to 35°C
Road surface material:	Concrete

Vehicle:	Ford Transit Mk7

System Hardware:	Shield + 150-degree MOIS camera installed on the hood of the vehicle
System Software:	AWS4_4.20.5_RC7_v8.2.24

Vehicle dimensions:



A	Fahrzeuglänge	6.704
B	Fahrzeugbreite mit Spiegeln	2.474
	Fahrzeugbreite mit angeklappten Spiegeln	2.112
	Fahrzeugbreite ohne Spiegel (Einzelbereifung)	2.059
	Fahrzeugbreite ohne Spiegel (Zwillingsbereifung)	2.126
C	Fahrzeughöhe*	2.778-2.680
D	Radstand	3.750
E	Überhang vorn	1.023
F	Überhang hinten	1.931
G	Schiebetür Öffnungsweite	1.300
H	Schiebetür Öffnungshöhe	1.600
I	Hecktür Öffnungsweite	1.565

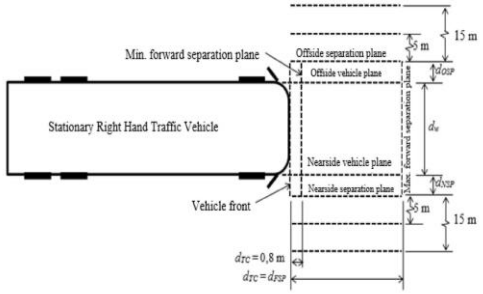
J	Hecktür Öffnungshöhe	1.887
K	Maximale Laderaumlänge am Boden (ohne/mit Vinylboden "Easy Clean")	4.217/ 4.168
	Maximale Laderaumlänge in 1,2m Höhe	4.073
L	Maximale Laderaumbreite	1.784
M	Laderaum zwischen Radhäusern (Einzelbereifung)	1.392
	Laderaum zwischen Radhäusern (Zwillingsbereifung)	1.154
N	Maximale Laderaumhöhe	2.025
O	Beladehöhe*	677-608
P	Max. Laderaumvolumen (m³)	15,1
	Laderaumvolumen (VDA) (m³)	14,1

2. Static Crossing Test Evaluation

2.1. Overview (according to Chapter 6.5 of R159)

Three tests where a vulnerable road user crosses in front of the vehicle must be passed by the system under test.

The area of focus is within the nearside and the offside vehicle planes in front of the vehicle.



The point of interest [POI] for the dummies are as follows:

- Pedestrian: hip point near to vehicle front
- Bicycle: near to vehicle H-Point and centerline intersection with most forward plane of bicycle.

Remark: At Mobileye's request, the number of tests was doubled to six so that each test variant was approached from both sides of the vehicle.

Following tests were performed to evaluate the systems performance.

Test name	2_1_L	2_1_R	2_2_L	2_2_R	2_3_L	2_3_R
v_{Dummy} [km/h]	3	3	5	5	4	4
dummy type	child	child	bicycle	bicycle	bicycle	bicycle
POI distance to vehicle front [m]	0.8	0.8	3.7	3.7	1.5	1.5
Crossing direction	offside (left) to nearside (right)	nearside (right) to offside (left)	offside (left) to nearside (right)	nearside (right) to offside (left)	offside (left) to nearside (right)	nearside (right) to offside (left)

2.2. Test Run Validation

This table shows the validation check of each test run.

Run	2_1_L_1	2_1_R_1	2_2_L_1	2_2_R_1	2_3_L_1	2_3_R_2
v_{Dummy} at x ≥ 15.5 m	OK	OK	OK	OK	OK	OK
v_{Dummy} maintained until x ≤ -7.5 m	OK	OK	OK	OK	OK	OK
Valid	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

2.3. System Performance

The results of the tests are shown in the table below.

Run	2_1_L_1	2_1_R_1	2_2_L_1	2_2_R_1	2_3_L_1	2_3_R_2
Information Signal is active at X ≥ 0.5 m	OK	OK	OK	OK	OK	OK
Information Signal stays active until X ≤ -2.56 m	OK	OK	OK	OK	OK	OK
System meets requirements	Yes	Yes	Yes	Yes	Yes	Yes

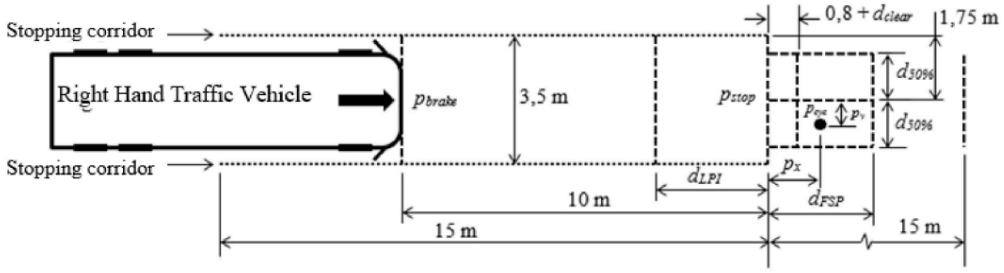
The system has passed the verification.

3. Longitudinal Stopping for Moving Off Cyclists Test Evaluation

3.1. Overview (according to Chapter 6.6 of R159)

Three tests where a bicyclist is standing still, and the vehicle approaches it from behind and stops right at the back of it. After a specific amount of time the bicyclist moves off.

The area of focus is within the nearside and the offside vehicle planes in front of the vehicle.



The point of interest [POI] for the bicyclist is the center of the bottom bracket.

Following tests were performed to evaluate the systems performance.

Test name	3_1	3_2	3_3
$x_{bicycle}$ [m] (starting position in front of vehicle)	0.87	3.6	2.7
$y_{bicycle}$ [m] (starting position right to vehicles centerline)	0.0	-1.0	0.5

3.2. Test Run Validation

For these tests the vehicle and the bicycle were driven manually. To achieve valid tests TÜV SÜD has increased the speed and offset tolerances accordingly. Based on the TÜV SÜD expertise, this has no influence on the evaluability of the systems performance.

Following tolerances were increased.

	tolerance according to R159	extended tolerances
v_{VUT} approaching bicycle	9.5 to 10.0 [km/h]	9 to 10.5 [km/h]
v_{VUT} and $v_{Bicycle}$ after stand still	9.5 to 10.0 [km/h]	9 to 12.5 [km/h]
VUT and Bicycle lateral offset after stand still	0.05 [m]	0.2 [m]

This table shows the validation check of each test run.

Run	3_1_1	3_2_1	3_3_1
v_{VUT} = 9 to 10.5 [km/h] from x_{VUT} = 15 [m] to x_{VUT} = 10 [m]	OK	OK	OK
VUT stands still at stopping line and engages neutral gear	OK	OK	OK
Bicycle starts after more than 10s after VUT stand still	OK	OK	OK
$v_{bicycle}$ = 9 to 12.5 [km/h] within 5m of travel	OK	OK	OK
Bicycle lateral offset within 0.2m	OK	OK	OK

3.3. System Performance

The results of the tests are shown in the table below.

Run	3_1_1	3_2_1	3_3_1
Information signal is activated before the Last Point of Interest (x_{LPI})	OK	OK	OK
Information signal stays activated until dummy exceeds 3.7m distance to VUT	OK	OK	OK
System meets requirements	Yes	Yes	Yes

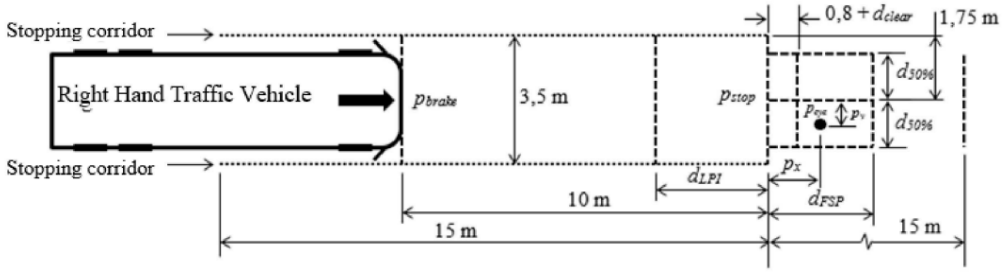
The system has passed the verification.

4. Longitudinal Moving Off with Cyclists Test Evaluation

4.1. Overview (according to Chapter 6.7 of R159)

Three Tests where a bicyclist is standing still, and the vehicle approaches it from behind and stops right at the back of it. After a specific amount of time the bicyclist **and the vehicle** move off.

The area of focus is within the nearside and the offside vehicle planes in front of the vehicle.



The point of interest [POI] for the bicyclist is the center of the bottom bracket.

Following tests were performed to evaluate the systems performance.

Test name	4_1	4_2	4_3
$x_{bicycle}$ [m] (starting position in front of vehicle)	0.87	3.6	2.7
$y_{bicycle}$ [m] (starting position right to vehicles centreline)	0.0	-1.0	0.5

4.2. Test Run Validation

For these tests the tolerances were increased. See 3.2.

This table shows the validation check of each test run.

Run	4_1_1	4_2_1	4_3_1
v_{VUT} = 9 to 10.5 [km/h] from x_{VUT} = 15 [m] to x_{VUT} = 10 [m]	OK	OK	OK
VUT stands still at stopping line and engages neutral gear	OK	OK	OK
Bicycle and VUT starts after more than 10s after VUT stand still	OK	OK	OK
$v_{bicycle}$ = 9 to 12.5 [km/h] and v_{VUT} = 9 to 12.5 [km/h] within 5m of travel and until 15m of travel	OK	OK	OK
Bicycle and VUT lateral offset within 0.2m	OK	OK	OK
Bicycle within 0.8m and 3.7m in front of VUT for 15m of travel	OK	OK	OK

4.3. System Performance

The results of the tests are shown in the table below.

Run	4_1_1	4_2_1	4_3_1
Information signal is activated before the Last Point of Interest (x_{LPI})	OK	OK	OK
Information signal stays activated until x_{VUT} < -15m	OK	OK	OK
System meets requirements	Yes	Yes	Yes

The system has passed the verification.

Annex A

Abbreviation list

MOIS	**Moving Off Information System**
LPI	**Last Point of Interest**
POI	**Point of Interest**
VUT	**Vehicle Under Test**

Annex B

List of the measurement equipment used

1. iMAR iREF-GNSS-PRO base station

- Providing the reference position
- Positioned 1x on the proving ground

2. SATELLINE-3AS Serial Modem

- Sending or receiving the correction data for the RTK mode
- Used 1x at the GNSS base station to transmit correction data
- Used in VUT/VRU to receive correction data for the positioning systems

3. Mikrotik Metal 52 AC AP WLAN Mesh Network

- Provide a network on the proving ground
  to transfer data between vehicles in real-time (position)
- Used in VUT/VRU and several devices on the proving ground
  to ensure communication coverage during the tests

4. iMAR iNAT-FSSG-1 Fibre-Optic-Inertial-Measurement-Unit

- High precision, dynamic fiber gyro position measurement system
  with 3-axis acceleration sensors and GNSS support
- Used in VUT for permanent position recording

5. 4active systems VRU targets

- Child pedestrian articulated (ISO 19206-2:2018)
- Bicycle pedestrian articulated- (ISO (CD) 19206-4)

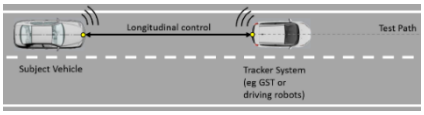
6. ABD SP05-i7-Flex-0

- Used in VUT for synchronization with VRU

7. ABD MKII GST

- Used to mount the VRU-Dummies and move them on the proving ground

8. ABD SP7004-i4-Synchro



- Used to sync the activities of dynamic objects on the proving ground

9. ABD RC Controller Software

- Used to control the ABD-equipment

10. IMAR iXCOM-CMD Software

- Used to control the iMAR-equipment

11. DEWESOFT Sirius / Krypton

- Used to record digital / analog channels in time and frequency domain
- Used to prepare, execute tests and postprocess data

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