

Test Report

Report Number:

F201553E3

Equipment under Test (EUT):

**Hino Telematics Control Unit
Hino TCU**

Applicant:

Hino Motors Sales U.S.A., Inc

Manufacturer:

Bosch Car Multimedia Portugal SA



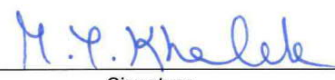

Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

- [1] **ANSI C63.4:2014** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- [2] **FCC 47 CFR Part 2:** General Rules and Regulations
- [3] **FCC 47 CFR Part 15:** Radio Frequency Devices (Subpart B)
- [4] **ICES-003 Issue 6:** Information Technology Equipment (including Digital Apparatus)

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

Tested and written by:	Mohamed Yassine KHALEK Name	 Signature	03.03.2021 Date
Reviewed and approved by:	Bernd STEINER Name	 Signature	03.03.2021 Date

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1 Identification

1.1 Applicant

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Country:	United States of America
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eMail Address:	suttle@hino.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	Bosch Car Multimedia Portugal SA
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Country:	Portugal
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Phone:	+351 (253) 078761
Fax:	N.A.
eMail Address:	Maria.Pereira3@pt.bosch.com
Manufacturer represented during the test by the following person:	None

1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-06 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Type of equipment: *	Telematics Control Unit
Type / PMN: *	Hino Telematics Control Unit
Product number: *	7620.000.271
Serial number: *	2710003193
FCC ID: *	2AXKD-HINOTCU
IC certification number: *	26600-HINOTCU
HVIN (Hardware Version Identification Number): *	Hino Telematics Control Unit
FVIN (Firmware Version Identification Number): *	N.A.
EUT marking: *	none
PCB identifier: *	8638.920.344
Hardware version: *	4246H04
Software version: *	GENERIC.CCU.20.01.D.032.PLATFORM

* Declared by the applicant

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

EUT data			
Power supply EUT: *	DC		
Supply voltage EUT: *	$U_{nom} = 12.0 \text{ V}$	$U_{min} = 8.0 \text{ V DC}$	$U_{max} = 16.0 \text{ V DC}$
Temperature range: *	-40 °C to +70 °C		
Lowest / highest internal clock frequency: *	32.768 kHz / 16 MHz / 24 MHz / 26 MHz / 2.480 GHz		

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Antennas	SMB FAKRA plugs	Combined GPS/cellular/WLAN/BT antenna	~ 1.8 m	Yes
Main connector	Customized 24 pin	DC Laboratory plug* ³ used for power supply with back up vehicular battery/ Other wires left open	~ 1.8 m	No
SIM plug	SIM plug	-	-	-
USB	Micro USB port, type B	Test laptop* ⁴	~ 3 m	Yes

Equipment used for testing	
Cables (connected to the EUT): * ¹ * ³	<ul style="list-style-type: none"> - Main connector - cable only connected to DC supply during the tests*³ (~ 3 m) - USB cable – X7601 @ EUT connected to test Laptop PC*⁴ - X700 – SMB port for WLAN/BT – connected to P407087 antenna during radiated tests. - X7201, X7200, X7000 Cellular connectors + GNSS connector – connected to PP407087 antenna during radiated tests
Laptop PC:* ¹	<ul style="list-style-type: none"> - HP 840 G2 (S/N: 5CG546382G)

*¹ Provided by the applicant

*² Provided by the laboratory

*³ Powered with 13.5 V during the tests. Buffered via car battery inside the anechoic chamber for radiated tests.

*⁴ Connected via USB to fiber optic converters to the Laptop PC during the radiated tests in the anechoic chamber.

1.6 Dates

Date of receipt of test sample:	29.10.2020
Start of test:	07.01.2021
End of test:	18.01.2021

2 Operational States

Description of function of the EUT:

The product is a telematics control unit integrated into the vehicle. It collects data from the vehicle and the environment via various internal interfaces, processes and sends them over the mobile network customer's backend server.

The following states were defined as the operating conditions:

The EUT has been connected to a load box through the main connector. To simulate a CAN system, the 3 high speed CAN bus lines have been connected to 3 sensors and forwarded by means of CAN/optical converters to a CAN Vector interface to connect to the laptop outside the semi anechoic chamber.

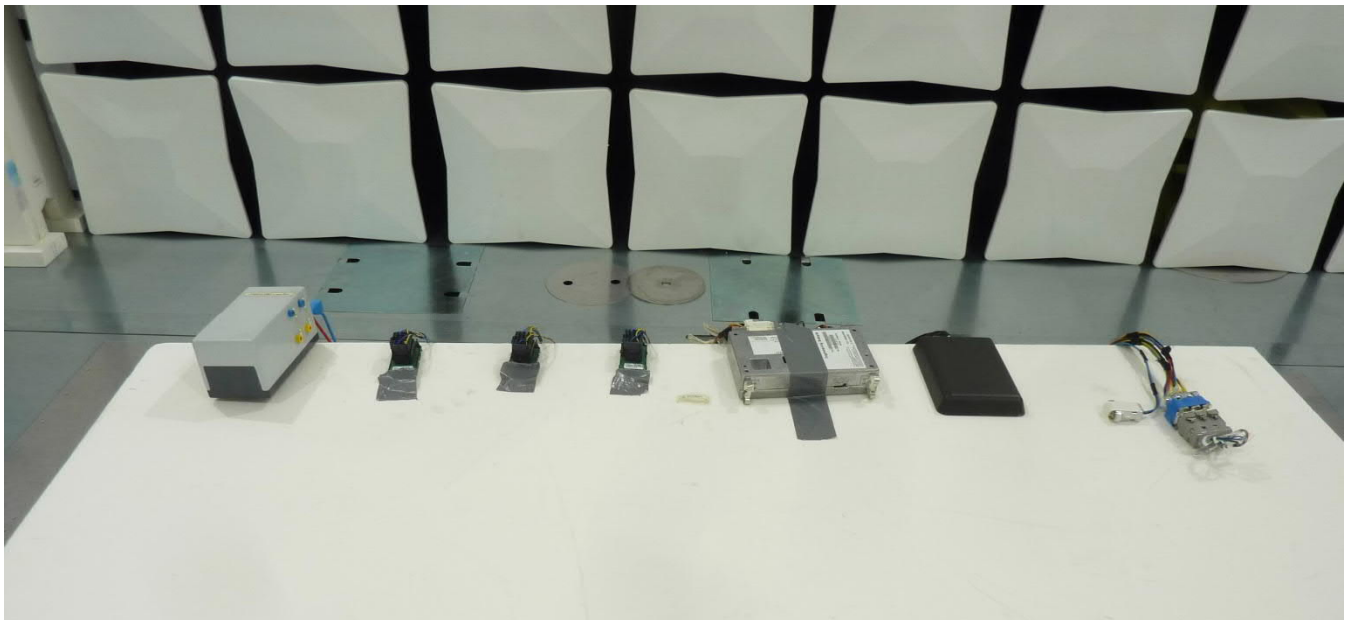
The USB port from the EUT has been also connected via USB/optical converters to the laptop to simulate a data transmission.

The WLAN signal has been also routed outside the chamber using an antenna to a router and from the router through a LAN cable to the laptop.

The cellular module was active during the test.

The RS232 interfaces were terminated.

During the tests the EUT and the load box were powered by 13.5 V DC from a generator.



Test setup



Label plate of the EUT

3 Additional Information

General information:

- none

Classification of cables:

- none

Maximum length of cables, declared by the manufacturer:

- no maximum length declared

Type of cables, declared by the manufacturer:

- no special type of cable declared

Deviation of the standard or test plan:

- no deviation

Special EMC measures, as a result of the tests:

- none

4 Overview

Conducted emissions FCC 47 CFR Part 15 section 15.107 (b) [3] / ICES-003 Issue 6 section 6.1 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
AC supply line	0.15 to 0.5 MHz 0.5 to 30 MHz	79 dB μ V (QP) 66 dB μ V (AV) 73 dB μ V (QP) 60 dB μ V (AV)	ANSI C63.4	Class A	N.A.
AC supply line	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dB μ V (QP)* 56 to 46 dB μ V (AV)* 56 dB μ V (QP) 46 dB μ V (AV) 60 dB μ V (QP) 50 dB μ V (AV)	ANSI C63.4	Class B	N.A.
*: Decreases with the logarithm of the frequency					
Radiated emissions FCC 47 CFR Part 15 section 15.109 (b) [3] / ICES-003 Issue 6 section 6.2 [4]					
Application	Frequency range	Limits	Reference standard	Remark	Status
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	39.0 dB μ V /m QP at 10 m 43.5 dB μ V /m QP at 10 m 46.5 dB μ V /m QP at 10 m 49.5 dB μ V /m QP at 10 m 49.5 dB μ V /m AV at 10 m and 69.5 dB μ V /m PK at 10 m	ANSI C63.4	Class A	-
Radiated Emission	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dB μ V/m QP at 3 m 43.5 dB μ V/m QP at 3 m 46.0 dB μ V/m QP at 3 m 54.0 dB μ V/m QP at 3 m 54.0 dB μ V/m AV at 3 m and 74.0 dB μ V/m PK at 3 m	ANSI C63.4	Class B	Passed

Remark: As declared by the applicant the highest generated frequency is the Bluetooth module frequency at 2.480 GHz.
Therefore the radiated emission measurement has been carried out up to the 5th harmonic in this case 13 GHz.

The EUT was classified by the applicant as CLASS B equipment.

5 Results

5.1 Radiated emissions

5.1.1 Test method

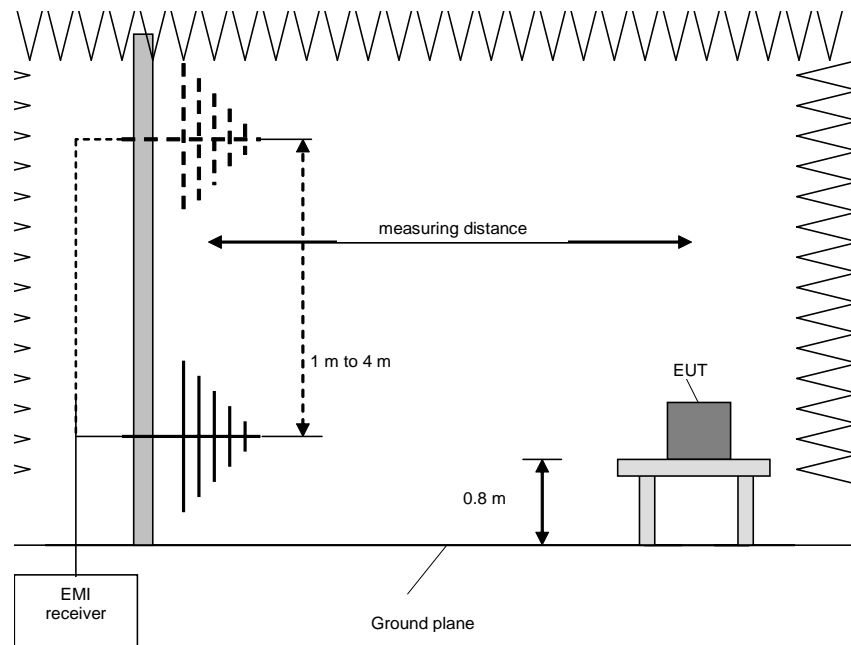
Preliminary and final measurement (30 MHz to 1 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with a metal ground plane in a 3 m distance.

During the test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Test	Frequency range	Resolution bandwidth
Preliminary measurement	30 MHz to 1 GHz	100 kHz
Frequency peak search	+ / - 1 MHz	10 kHz
Final measurement	30 MHz to 1 GHz	120 kHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT position (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst-case antenna height and the worst-case turntable azimuth
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

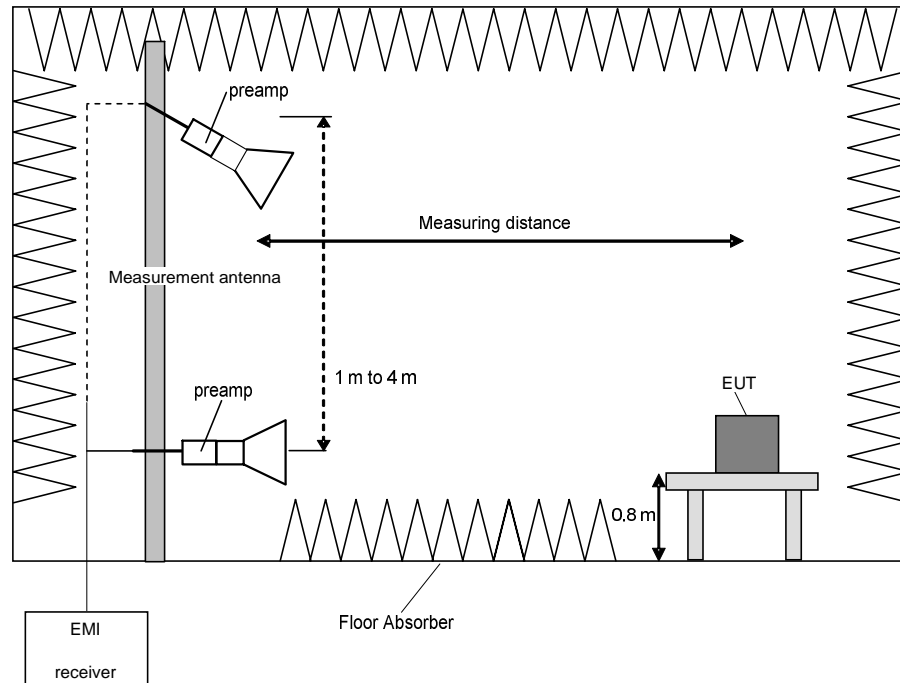
Preliminary and final measurement (1 – 40 GHz)

The preliminary and final measurements were conducted in a semi-anechoic chamber with floor absorbers between EUT and measurement antenna in a 3 m distance.

During the test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions. For each height the angle of the antenna will be tilted so that the measurement antenna is always aiming at the EUT.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Test	Frequency range	Resolution bandwidth
Preliminary measurement	1 - 40 GHz	1 MHz
Frequency peak search	+ / - 10 MHz	100 kHz
Final measurement	1 - 40 GHz	1 MHz



Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for the highest value.

Procedure final measurement:

The following procedure is used:

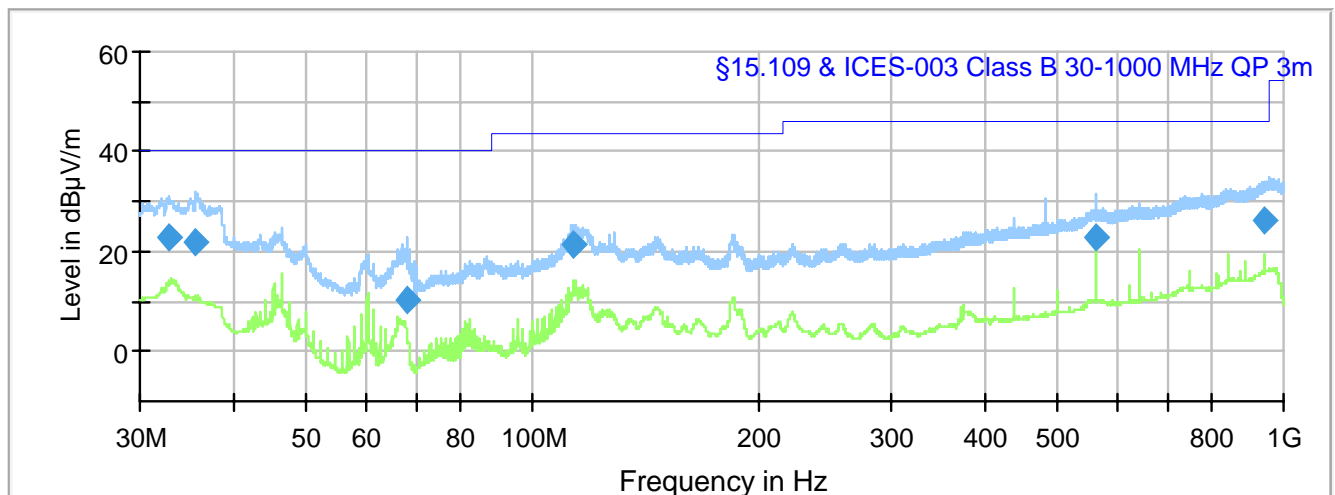
1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT orientation (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the worst case value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 30° from the worst case value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst case antenna height and the worst case turntable azimuth.
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

5.1.2 Result final measurement from 30 MHz to 1 GHz

Ambient temperature	22 °C	Relative humidity	23 %
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Test description:	Radiated emission measurement according to FCC PART 15
EUT:	Hino TCU
Manufacturer:	Bosch Car Multimedia Portugal SA
Operating conditions:	CAN, WLAN, Cellular, GNSS, USB connected
Test site:	PHOENIX TESTLAB GmbH, semi anechoic chamber M276
Operator:	Y. KHALEK
Comment:	13.5 V DC
Date of test	18.01.2020

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with “♦” are the measured results of the standard subsequent measurement in a semi anechoic chamber.



The results of the standard subsequent measurement in a semi anechoic chamber are indicated in the table below. The limits as well as the measured results (levels) refer to the above-mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.775000	22.73	40.00	17.27	1000.0	120.000	100.0	V	116.0	27.3
35.650000	21.64	40.00	18.36	1000.0	120.000	100.0	V	-28.0	25.9
67.845000	10.40	40.00	29.60	1000.0	120.000	185.0	V	240.0	13.2
113.050000	21.60	43.52	21.92	1000.0	120.000	100.0	V	123.0	17.5
562.510000	22.79	46.02	23.23	1000.0	120.000	100.0	V	310.0	28.4
940.515000	26.25	46.02	19.77	1000.0	120.000	230.0	H	265.0	33.6
Measurement uncertainty: ± 4.8 dB									

The correction factor was calculated as follows:

Corr. (dB) = cable attenuation (dB) + 6 dB attenuator (dB) + antenna factor (dB)

Therefore the reading can be calculated as follows:

Reading (dBμV/m) = result QuasiPeak (dBμV/m) - Corr. (dB)

Test equipment (please refer to chapter 6 for details)

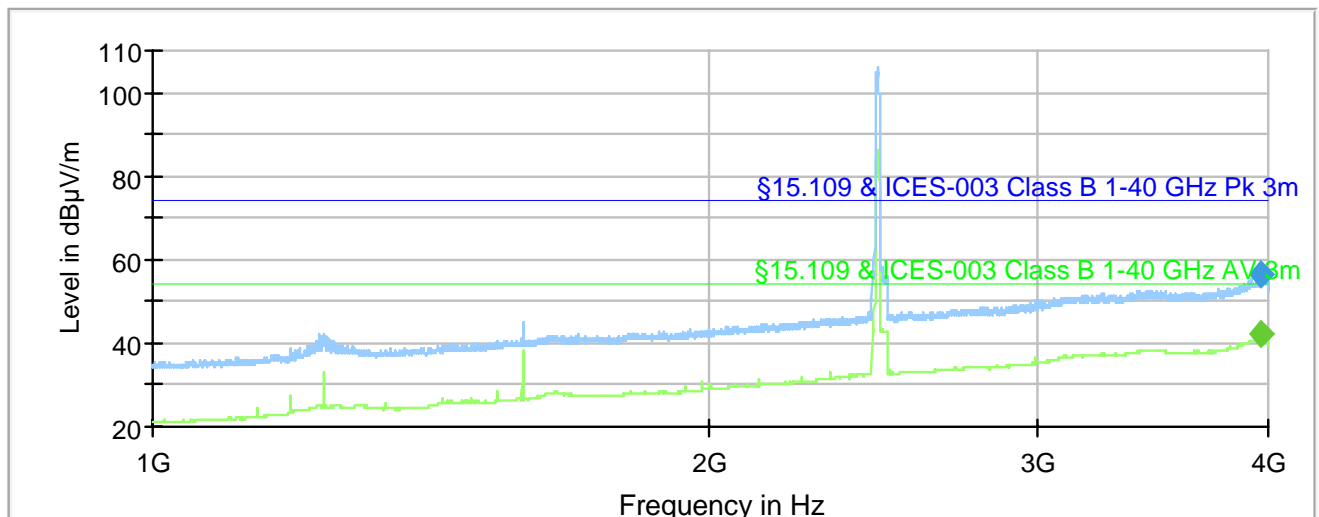
3 –12

5.1.3 Result final measurement above 1 GHz

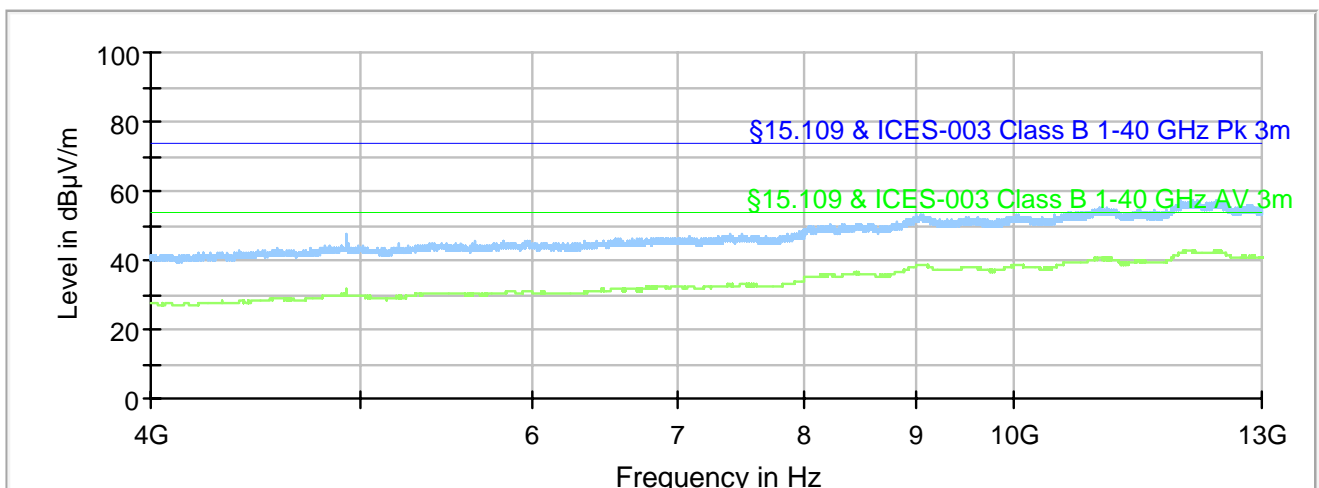
Ambient temperature	22 °C	Relative humidity	23 %
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Test description: Radiated emission measurement according to FCC PART 15
 EUT: Hino TCU
 Manufacturer: Bosch Car Multimedia Portugal SA
 Operating conditions: CAN, WLAN, Cellular, GNSS, USB connected
 Test site: PHOENIX TESTLAB GmbH, semi anechoic chamber M276
 Operator: Y. KHALEK
 Comment: 13.5 V DC
 Date of test: 12.01.2020

The top measured curve represents the peak measurement. The measured points marked with "◆" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◆" are frequency points for the final average detector measurement.



Note: The peak signal in the plot is a wanted WLAN signal.



The results of the standard subsequent measurement above 1 GHz in a semi anechoic chamber are indicated in the table below. The limits as well as the measured results (levels) refer to the above-mentioned standard while taking in account the specified requirements for a 3 m measuring distance.

Final_Result

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m) PK/AV	Margin (dB)	Meas. Time (ms)	Band-width (MHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
3962.750000	56.50	---	74.00	17.50	100.0	1000.0	319.0	H	320.0	40.2
3962.750000	---	42.24	54.00	11.76	100.0	1000.0	319.0	H	320.0	40.2
Measurement uncertainty: ± 5.1 dB										

The correction factor was calculated as follows:

Corr. (dB) = cable attenuation (dB) + preamplifier (dB) + antenna factor (dB)

Therefore, the reading can be calculated as follows:

Reading (dBμV/m) = result Peak or Average (dBμV/m) - Corr. (dB)

Test equipment (please refer to chapter 6 for details)

1 – 9, 12

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30- 00101800-25- 10P	Narda-Miteq	2110917	482967	18.02.2020	02.2022
2	Log Per Antenna	HL050	Rohde & Schwarz	4062.4063.02- 100908	482977	13.08.2019	08.2022
3	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
4	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
5	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
6	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
7	Systemsoftware EM276	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
8	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	14.11.2019	11.2021
9	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540- A138-10-0006	483227	Calibration not necessary	
10	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	09.10.2020	10.2023
11	Attenuator 6 dB	WA2-6	Weinschel	-	482793	Calibration not necessary	
12	Programmable Power Supply	HM8142	Hameg Instruments	142981P 03955	480719	16.01.2020	01.2022

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4a-2017	19.09.2019	18.09.2021
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.10.2019	30.09.2021

8 Report History

Report Number	Date	Comment
F201553E3	03.03.2021	Initial Test Report
-	-	-
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9 List of Annexes

Annex A Test Setup Photos

7 pages