RF TEST REPORT

FCC / ISED

APPLICANT

Tesla Motors, Inc.

MODEL NAME

1642783

FCC ID

2AEIM-1642783

ISED ID

20098-1642783

REPORT NUMBER

HA210413-TES-002-R01

TEST REPORT

Date of Issue
April 30, 2021

Test Site
Hyundai C-Tech, Inc. dba HCT America, Inc.
1726 Ringwood Ave, San Jose, CA 95131, USA

Applicant	Tesla Motors, Inc.
Applicant Address	3500 Deer Creek Road, Palo Alto, CA 94304, USA
FCC ID	2AEIM-1642783
ISED ID	20098-1642783
Model Name	1642783
EUT Type	Bluetooth USB Hub
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
FCC Classification	Spread Spectrum Transmitter (DSS)
FCC Rule Part(s)	Part 15.247
ISED Rule Part(s)	RSS-247 Issue 2 (February 2017), RSS-Gen Issue 5 (April 2018)
Test Procedure	ANSI C63.10-2013

The device bearing the trade name and model specified above, has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures required. The results of testing in this report apply only to the product which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Hyundai C-Tech, Inc. dba HCT America, Inc. certifies that no party to application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C 862

Tested By	**Reviewed By**
Yongsoo Park	Sunwoo Kim
Test Engineer	Technical Manager

REVISION HISTORY

The revision history for this document is shown in table.

TEST REPORT NO.	DATE	DESCRIPTION
HA210413-TES-002-R01	4/30/2021	Initial Issue

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Hyundai C-Tech, Inc. dba HCT America, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA TEL: +1-510-933-8848 FAX: +1-510-933-8849

1. GENERAL INFORMATION

EUT DESCRIPTION

Model	1642783
EUT Type	Bluetooth USB Hub
Power Supply	10 – 17.5 VDC (16 VDC nominal)
RF Specification	Bluetooth BDR/EDR
Operating Environment	Indoor and outdoor
Operating Temperature	-40 °C ~ +85 °C

RF SPECIFICATION SUBJECT TO THE REPORT

RF Specification	Bluetooth BR/EDR
Transmitter Chain	1
Frequency Range	2402 MHz – 2480 MHz
Max. RF Output Power	Peak : 4.94 dBm (3.121mW)
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Number of Channels	79 Channels
Antenna Specification [1)]	Antenna Type : PCB Trace Antenna Peak Gain : 4.89 dBi
Firmware Version [2)]	CYW89072A1_001.001.005.0422.0860
Hardware Version [2)]	Rev.B
Date(s) of Tests	April 14, 2021 ~ April 26, 2021

Note(s) :
1. Antenna information is based on the document provided.
2. Firmware and Hardware Versions are provided by the client.

OPERATING FREQUENCY CHANNELS

Bluetooth (BDR/EDR)							
Channel	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**	**Channel**	**Frequency (MHz)**
00	2 402	**20**	2 422	**40**	2 442	**60**	2 462
01	2 403	**21**	2 423	**41**	2 443	**61**	2 463
02	2 404	**22**	2 424	**42**	2 444	**62**	2 464
03	2 405	**23**	2 425	**43**	2 445	**63**	2 465
04	2 406	**24**	2 426	**44**	2 446	**64**	2 466
05	2 407	**25**	2 427	**45**	2 447	**65**	2 467
06	2 408	**26**	2 428	**46**	2 448	**66**	2 468
07	2 409	**27**	2 429	**47**	2 449	**67**	2 469
08	2 410	**28**	2 430	**48**	2 450	**68**	2 470
09	2 411	**29**	2 431	**49**	2 451	**69**	2 471
10	2 412	**30**	2 432	**50**	2 452	**70**	2 472
11	2 413	**31**	2 433	**51**	2 453	**71**	2 473
12	2 414	**32**	2 434	**52**	2 454	**72**	2 474
13	2 415	**33**	2 435	**53**	2 455	**73**	2 475
14	2 416	**34**	2 436	**54**	2 456	**74**	2 476
15	2 417	**35**	2 437	**55**	2 457	**75**	2 477
16	2 418	**36**	2 438	**56**	2 458	**76**	2 478
17	2 419	**37**	2 439	**57**	2 459	**77**	2 479
18	2 420	**38**	2 440	**58**	2 460	**78**	2 480
19	2 421	**39**	2 441	**59**	2 461	-	-

WORST CASE CONFIGURATION

RADIATED TEST

1. EUT Axis

All X, Y, and Z positions for horizontal / vertical antenna polarization were investigated to find the worst-case position. Y position was selected as the worst-case for full evaluation.

2. The following modes were selected for the final evaluation of radiated spurious emission.

BDR : 1-DH5
EDR : 3-DH5

CONDUCTED TEST

1. RF conducted test was performed at all available data rate, 1-DH5, 2-DH5 and 3-DH5.

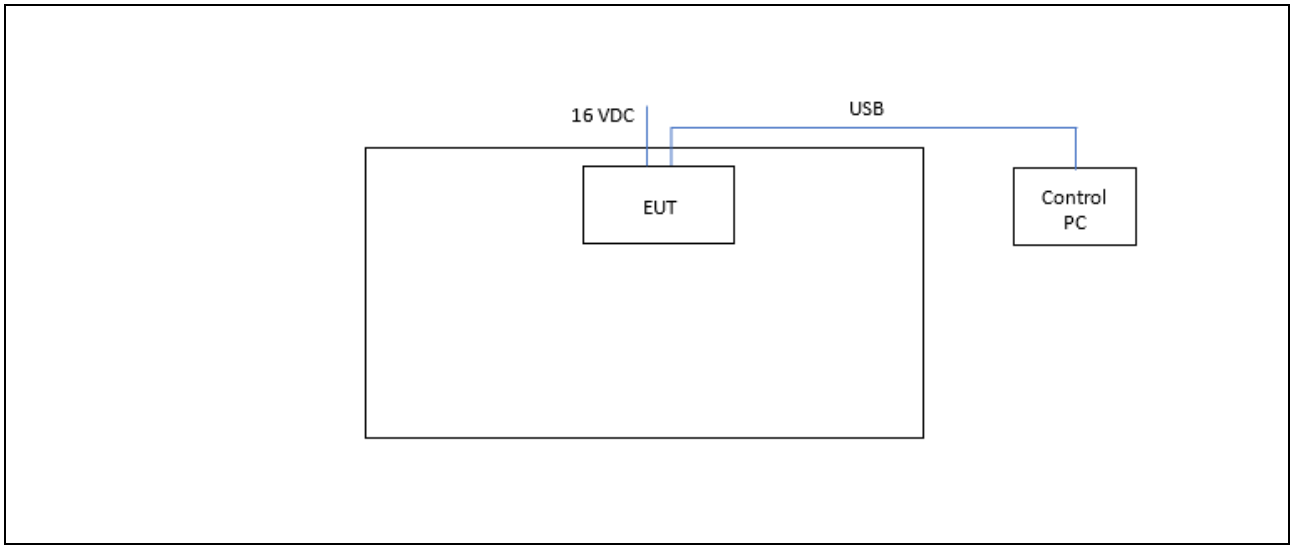
2. The time of occupancy test was performed at all DH1/3/5 modes.

BDR : 1-DH1 / 1-DH3 / 1-DH5
EDR : 2-DH1 / 2-DH3 / 2-DH5 / 3-DH1 / 3-DH3 / 3-DH5

OUTPUT POWER SETTING

Frequency (MHz)	Channel	Output Power Setting
2 402	0	+4 dBm
2 441	39	+4 dBm
2 480	78	+4 dBm

EUT SETUP CONFIGURATION



LIST OF SUPPORT EQUIPMENT

Equipment Type	Model No.	Serial Number	Manufacturer	Qty	Note
Laptop	T450	TA181240	Lenovo	1	-
AC Adapter	ADLX65SDC2A	36200350	Delta	1	100-240 VAC, 1.5A 50-60Hz (20 VDC)
USB Cable (mini)	-	-	-	1	Length : 4m Unshielded

2. METHODOLOGY

Frequency Hopping Spread Spectrum System (FHSS) and the measurement procedure described in ANSI C63.10 (Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency and the frequency hopping that were for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C / the RSS-GEN issue 5, RSS-247 issue 2.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. Also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

ANSI C63.10-2013

DESCRIPTION OF TEST MODES

The EUT has been tested at continuous Bluetooth operating mode. Cybluetool software was used to control the channels, power setting, continuous TX/RX mode.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, California 95131, USA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Accredited Laboratory

A2LA has accredited

HYUNDAI C-TECH, INC. DBA HCT AMERICA, INC.

San Jose, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 25th day of November 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4201.01
Valid to July 31, 2021

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203 :
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

(1) The antenna of this E.U.T is permanently attached and there is no provision for connection to an external antenna.
(2) The E.U.T Complies with the requirement of §15.203

According to RSS-Gen Issue 5 (Section 6.8) :
The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	2.55
Radiated Disturbance (9 kHz ~ 30 MHz)	3.20
Radiated Disturbance (30 MHz ~ 1 GHz)	4.73
Radiated Disturbance (1 GHz ~ 18 GHz)	5.21
Radiated Disturbance (18 GHz ~ 40 GHz)	5.18

7. DESCRIPTION OF TESTS

7.1. 20 dB BANDWIDTH / 99% OCCUPIED BANDWIDTH

TEST SETUP

TEST PROCEDURE (20 dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.
(Procedure Section 6.9.2 in ANSI C63.10-2013)

The Spectrum Analyzer Setting :

- RBW = 1% ~ 5% of 20 dB bandwidth
- VBW ≒ 3 x RBW
- Span : 2-5 times the 20 dB bandwidth, centered on the hopping channel
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Used the automatic bandwidth measurement capability of a spectrum analyzer, setting X dB as 20 dB.

TEST PROCEDURE (99 % Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.
(Procedure Section 6.9.3 in ANSI C63.10-2013)

- RBW = 1% ~ 5% of the occupied bandwidth
- VBW ≒ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Used the automatic bandwidth measurement capability of a spectrum analyzer.

Note(s) :
Occupied bandwidth profile installed on the spectrum analyzer was used during measurement.

7.2. OUTPUT POWER

LIMIT

§15.247(b)(1)
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels : 1 W

RSS-247 Issue2, Section 5.4 (b)
For FHSS operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels. The e.i.r.p. shall not exceed 4 W.

TEST SETUP

TEST PROCEDURE

The EUT is connected to the Spectrum Analyzer. Hopping mode shall be disabled.

Use the following Spectrum Analyzer setting :
(Procedure Section 7.8.5 in ANSI C63.10-2013)

- RBW ≥ 20 dB Bandwidth
- VBW ≥ RBW
- SPAN = Approximately 5 x RBW
- Detector Mode = Peak
- Sweep = Auto couple
- Trace Mode = Max hold
- Allow trace to fully stabilize.
- Use marker-to-peak function to determine the peak emission level

Note(s) :

Sample Calculation :
- Conducted Output Power (Peak) = Reading Value + ATT loss + Cable loss

7.3. NUMBER OF HOPPING CHANNELS

LIMIT

§15.247(a)(1)(iii) / RSS-247 Issue 2, Section 5.1 (d)
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

TEST SETUP

TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.
(Procedure 7.8.3 in ANSI C63.10-2013)

- RBW ≤ 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller
- VBW = 8 MHz (≥ RBW)
- SPAN = Frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans to allow the individual channels to be clearly seen.
- Sweep = Auto.
- Detector = Peak.
- Trace mode = Max hold.
- Allow the trace to stabilize.

7.4. CARRIER FREQUENCY SEPARATION

LIMIT

§15.247(a)(1) / RSS-247 Issue2, Section 5.1 (b)
For the frequency hopping systems operated in 2400 MHz~2483.5 MHz may have the hopping channel carrier frequencies separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power less than or equal to 125 mW.

TEST SETUP

TEST PROCEDURE

The EUT output shall be in the hopping mode and connected to the Spectrum Analyzer.

Use the following spectrum analyzer setting :
(Procedure 7.8.2 in ANSI C63.10-2013)

- RBW = Start with approximately 30% of the channel spacing; Then adjust as needed to best identify of each individual channel.
- VBW ≥ RBW.
- SPAN = Wide enough to capture two adjacent peaks.
- Sweep = Auto coupled.
- Detector = Peak.
- Trace mode = Max hold.
- Allow the trace to stabilize.

7.5. TIME OF OCCUPANCY (DWELL TIME)

LIMIT

§15.247(a)(1)(iii) / RSS-247 Issue 2 Section 5.1 (d)
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST SETUP

TEST PROCEDURE

The EUT output shall be in the hopping mode and connected to the Spectrum Analyzer.

Use the following spectrum analyzer setting :
(Procedure 7.8.4 in ANSI C63.10-2013)

- RBW ≤ Channel spacing and where possible, RBW should be set >> 1/T, where T is the expected dwell time per channel.
- VBW ≥ RBW.
- Span = Zero span, centered on a hopping channel.
- Sweep = As needed to capture entire dwell time per hopping channel (Use video trigger and trigger delay for the transmitted signal to better show the plot little after start). Second plot might be needed with longer sweep time to show two successive hops on a channel
- Detector = Peak.
- Trace mode = Max hold.

Use the marker-delta function to determine transmit time per hop. Repeat the test for each different mode of operation.

Note(s) :
Sample Calculation

No of hops specified in the requirement :
- No of hops on spectrum analyzer x (period specified in the requirement / sweep time on SA)

Dwell Time (s) :
- Transmit time per hops x No of hops specified in the requirement

7.6. CONDUCTED BAND EDGE / CONDUCTED SPURIOUS EMISSIONS

LIMIT

§15.247(d) / RSS-247 Issue 2, Section 5.5.
The maximum conducted (peak) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.
[Conducted > 20 dBc]

TEST SETUP

TEST PROCEDURE

The transmitter output port is connected to the spectrum analyzer.
(Procedure 7.8.6 and 7.8.8 in ANSI C63.10-2013)

- RBW = 100 kHz
- VBW = 300 kHz
- Set span to encompass the spectrum to be examined
- Detector = Peak
- Trace Mode = max hold
- Sweep time = auto couple
- Ensure that the number of measurement points ≥ 2*Span/RBW
- Allow trace to fully stabilize.
- Use peak marker function to determine the maximum amplitude level.

Measurements are made from 30 MHz to ten times operating frequency in GHz for the lowest, middle, and highest channels.

7.7. RADIATED EMISSIONS

RADIATED EMISSION LIMITS

FCC : 47 CFR § 15.209(a)		
Frequency (MHz)	**Field Strength (uV/m)**	**Measurement Distance (m)**
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

ISED : RSS-GEN Section 8.9		
Frequency (MHz)	**Field Strength (uV/m)**	**Measurement Distance (m)**
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Receiver Radiated Emission Limits

ISED : RSS-GEN Section 7.3		
Frequency (MHz)	**Field Strength (uV/m)**	**Measurement Distance (m)**
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

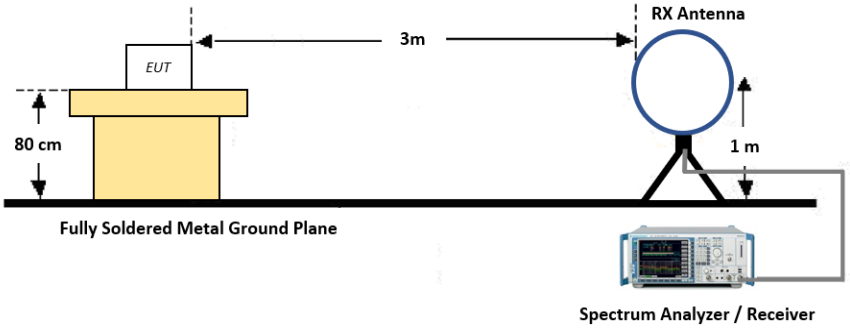
Restricted Bands of Operation

FCC : 47 CFR § 15.205(a)				
Frequency (MHz)	**Frequency (MHz)**	**Frequency (MHz)**	**Frequency (MHz)**	**Frequency (MHz)**
0.090 – 0.110	12.29-12.293	149.9 - 150.05	1660.0 - 1710.0	8025 – 8500
0.495 - 0.505	12.51975-12.52025	156.52475 - 156.52525	1718.8 - 1722.2	9000 – 9200
2.1735 – 2.1905	12.57675-12.57725	156.7 - 156.9	2200.0 - 2300.0	9300 – 9500
4.125 - 4.128	13.36-13.41	162.0125 - 167.17	2310.0 - 2390.0	10600 - 12700
4.17725-4.17775	16.42-16.423	167.72 - 173.2	2483.5 – 2500.0	13250 – 13400
4.20725-4.20775	16.69475-16.69525	240.0 - 285.0	2690.0 - 2900.0	14470 – 14500
6.215-6.218	16.80425-16.80475	322.0 - 335.4	3260.0 – 3267.0	15350 – 16200
6.26775-6.26825	25.5-25.67	399.9 - 410.0	3332.0 – 3339.0	17700 – 21400
6.31175-6.31225	37.5-38.25	608.0 - 614.0	3345.8 – 3358.0	22010 – 23120
8.291-8.294	73 - 74.6	960.0 - 1240.0	3600.0 – 4400.0	23600 – 24000
8.362-8.366	74.8 - 75.2	1300.0 - 1427.0	4500.0 – 5150.0	31200 – 31800
8.37625-8.38675	108 - 121.94	1435.0 - 1626.5	5350.0 – 5460.0	36430 – 36500
8.41425-8.41475	123 - 138	1645.5 - 1646.5	7250.0 – 7750.0	Above 38600

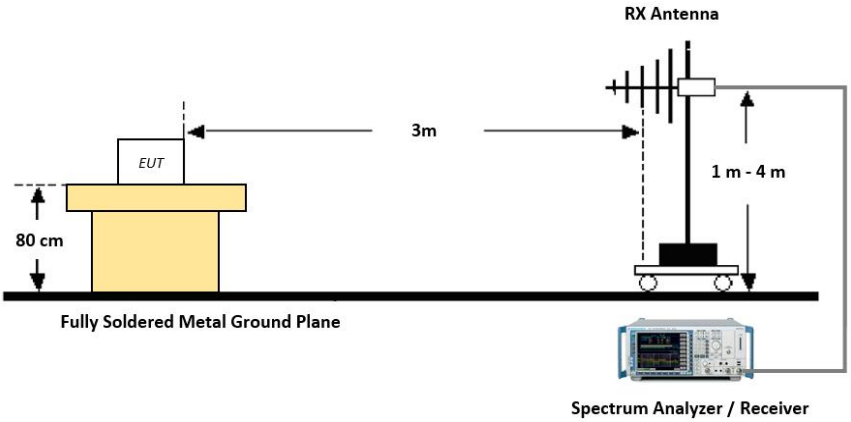
ISED : RSS-GEN Section 8.10				
Frequency (MHz)	**Frequency (MHz)**	**Frequency (MHz)**	**Frequency (MHz)**	**Frequency (MHz)**
0.090 - 0.110	8.37625 - 8.38675	108 – 138	1660 - 1710	8025 – 8500
0.495 - 0.505	8.41425 - 8.41475	149.9 - 150.05	1718.8 - 1722.2	9000 - 9200
2.1735 - 2.1905	12.29 - 12.293	156.52475 - 156.52525	2200 - 2300	9300 - 9500
3.020 - 3.026	12.51975 - 12.52025	156.7 - 156.9	2310 - 2390	10600 - 12700
4.125 - 4.128	12.57675 - 12.57725	162.0125 - 167.17	2483.5 - 2500	13250 – 13400
4.17725 - 4.17775	13.36 - 13.41	167.72 - 173.2	2655 - 2900	14470 – 14500
4.20725 - 4.20775	16.42 - 16.423	240 – 285	3260 – 3267	15350 – 16200
5.677 - 5.683	16.69475 - 16.69525	322 - 335.4	3332 - 3339	17700 – 21400
6.215 - 6.218	16.80425 - 16.80475	399.9 - 410	3345.8 - 3358	22010 – 23120
6.26775 - 6.26825	25.5 - 25.67	608 - 614	3500 - 4400	23600 – 24000
6.31175 - 6.31225	37.5 - 38.25	960 - 1427	4500 - 5150	31200 – 31800
8.291 - 8.294	73 - 74.6	1435 - 1626.5	5350 - 5460	36430 – 36500
8.362 - 8.366	74.8 - 75.2	1645.5 - 1646.5	7250 - 7750	Above 38600

TEST SETUP

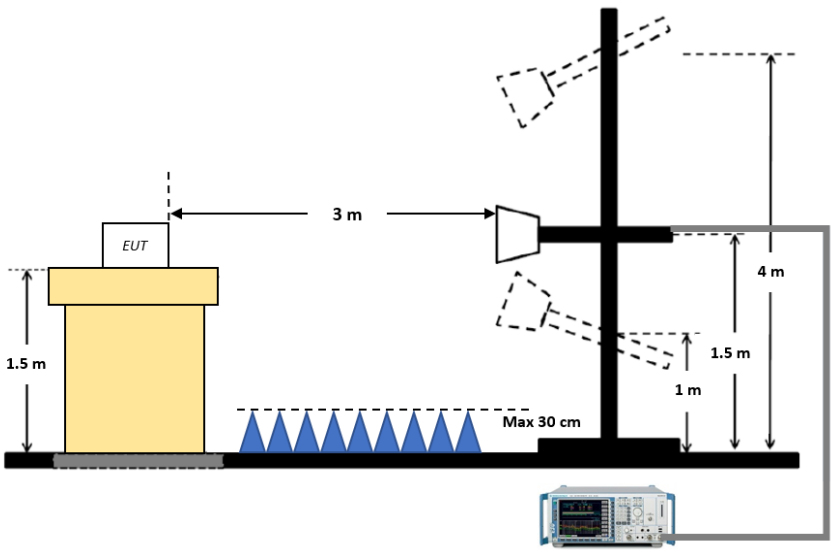
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE OF RADIATED SPURIOUS EMISSIONS (Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor (0.009 MHz – 0.490 MHz) = 40*log(3 m/300 m) = - 80 dB
   Measurement Distance: 3 m
7. Distance Correction Factor (0.490 MHz – 30 MHz) = 40*log(3 m/30 m) = - 40 dB
   Measurement Distance: 3 m
8. Spectrum Setting

   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Max hold
   - RBW = 9 kHz
   - VBW ≥ 3*RBW

9. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)
10. There is a comparison data both open-field test site and alternative test site – semi-Anechoic chamber according to 414788 D01. And the results are properly calibrated.

TEST PROCEDURE OF RADIATED SPURIOUS EMISSIONS (Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting

   (1) Measurement Type (Peak):
   - Measured Frequency Range: 30 MHz – 1 GHz
   - Detector = Peak
   - Trace = Max hold
   - RBW = 100 kHz
   - VBW ≥ 3*RBW

   (2) Measurement Type(Quasi-peak):
   - Measured Frequency Range: 30 MHz – 1 GHz
   - Detector = Quasi-Peak
   - RBW = 120 kHz

   Method (2) has been applied

6. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)

TEST PROCEDURE OF RADIATED SPURIOUS EMISSIONS (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Use the following Spectrum Analyzer setting :

   (1) Measurement Type(Peak):
   - Measured Frequency Range : Up to 10^{th} harmonics
   - Detector = Peak
   - Trace = Max hold
   - RBW = 1 MHz
   - VBW ≥ 3*RBW

   (2) Measurement Type(Average):
   - Duty Cycle Correction Factor (DCCF) was applied to derive the average field strength from the peak field strength according to the rule part 15.35(c)
   - Duty Cycle = T_{ON} / 100 ms (or T_{ON} / One complete pulse train), whichever comes shorter.
   - T_{ON} = No (Pulse1) x Length (Pulse1) + No (Pulse2) x Length (Pulse2) + …
   - Average Emission Level = Peak Emission Level + 20 log(Duty Cycle)

8. Measurement value only up to 6 maximum emissions noted or would be lesser if no specific emissions from the EUT are recorded (i.e.: margin > 20 dB from the applicable limit) and considered that is already beyond the background noise floor.

9. Sample Calculation

   (1) Total (Peak) = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G)
   (2) Total (Average) = Total (Peak) + 20 log(Duty Cycle)

8. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	IC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§15.247(a)(1)	RSS-247, 5.1(a)	-	Conducted	PASS
Occupied Bandwidth	-	RSS-GEN, 6.7	-		PASS
Conducted Maximum Peak Output Power	§15.247(b)(1)	RSS-247, 5.4(b)	≤ 1.0 W (channels ≥ 75)		PASS
Maximum e.i.r.p.	-	RSS-247, 5.4(b)	≤ 4 W e.i.r.p. (channels ≥ 75)		PASS
Number of Hopping Channels	§15.247(a)(1)(iii)	RSS-247, 5.1(d)	channels ≥ 15		PASS
Carrier Frequency Separation	§15.247(a)(1)	RSS-247, 5.1(b)	≥ 25 kHz or 2/3 of 20dB BW [1)] Whichever is greater		PASS
Time of Occupancy	§15.247(a)(1)(iii)	RSS-247, 5.1(d)	≤ 0.4 s (within 0.4 s period)		PASS
Conducted Band Edge Conducted Spurious Emission	§15.247(d)	RSS-247, 5.5	≥ 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	RSS-GEN, 8.8	cf. Section 7.8		N/A [2)]
Radiated Spurious Emissions	§15.209(a) §15.205(a)	RSS-GEN, 8.9 RSS-GEN, 8.10	cf. Section 7.7	Radiated	PASS
Receiver Spurious Emissions	-	RSS-GEN, 7.3	cf. Section 7.7		PASS

Note(s) :

1. 2/3 of the 20 dB BW, which is greater than 25 kHz, was used as the limit in this report since the peak output power did not exceed 125 mW.
2. AC line conducted emission is not applicable since the EUT is powered by the vehicle's battery system.