

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



Applicant: DENSO International America, Inc.
2251 Rutherford Rd., Suite 100, Carlsbad, CA. 92008

Product Name: V2X On-Board Unit

Brand Name: DENSO

Model No.: Hercules H7.1E

Model Difference: N/A

Report Number: ER/2021/50134

FCC ID LXC-V2X-OBU-HERC

Issue Date: August 11, 2021

Date of Test: June 4, 2021 ~ August 10, 2021

Date of EUT Received: May 21, 2021

Approved By 
Blue Yang

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.26:2015 and the energy emitted by the sample EUT comply with FCC rule part §95 Subpart L.

The results of this report relate only to the sample identified in this report.

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Revision History

Report Number	Revision	Description	Issue Date	Revised By
ER/2021/50134	00	Original	August 11, 2021	Yuri Tsai

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	V2X On-Board Unit
Brand Name:	DENSO
Model No.:	Hercules H7.1E
Model Difference:	N/A
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	U12QL1800006C01
Power Supply:	DC 12V

1.2 RF Specification

WLAN 5GHz:

Wi-Fi	Frequency Range	Channels	Rated Power (Avg)	Modulation Technology
802.11p (10MHz)	5900-5920 MHz	3	19.82	OFDM
Modulation Technology	802.11p (DSRC)			
Modulation type	OFDM, 1/2BPSK			
Data Rate	10MHz Bandwidth : 3,4,5,6,9,12,18,24,27Mbps			

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Ch0 / Ch1	Peak Antenna Gain (dBi)	Worst Antenna Gain
Magnetic Mount	5850~5925	Ch0	7	-
		Ch1	7	-

Note: Antenna information is provided by the applicant.

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1.4 Test Methodology of Applied Standards

FCC Part 95, Subpart L

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

ANSI C63.26:2015

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction A	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		
Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.				

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Measurement at Antenna Port

The EUT is placed on a table which is 0.8 m above ground plane. A low loss of RF cable was used to connect the antenna port of EUT to measurement equipment.

2.3.2 Radiated Emissions (ERP/EIRP)

The EUT is placed on a turn table, for emission measurements below 1 GHz is 0.8 m above ground plane, for emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both Horizontal and Vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Configuration of Tested System

Fig. 2-1 Radiated Emission configuration

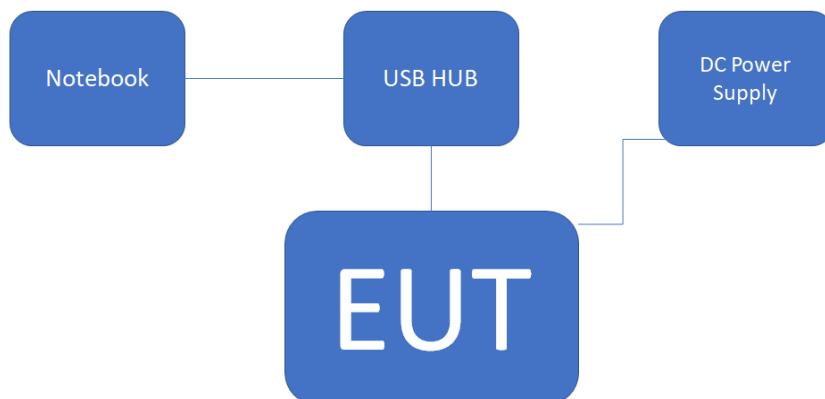


Fig. 2-2 Conducted (Antenna Port) Configuration Emission

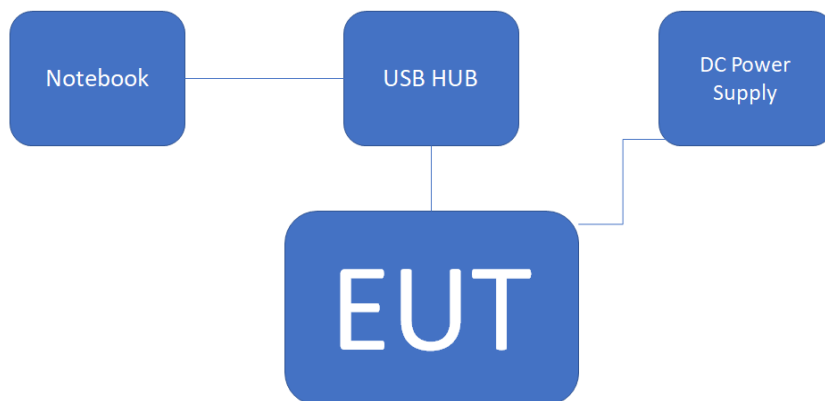


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Notebook	Lenovo	L480	PF-1S9NT5	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	MY40005907	N/A	N/A
3.	4Ports USB HUB	Samrt	HB-560	20080701	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§2.1049	Occupied Bandwidth	Compliant
FCC §2.1046; §95.3167 §95.3189	Maximum Transmitter Power	Compliant
§95.3189	Transmit Spectrum Mask	Compliant
§ 2.1051 §95.3189	Transmitter Conducted Unwanted Emissions	Compliant
§2.1053 §95.3189	Radiated Spurious Emission	Compliant
§ 2.1055 §95.3189	Frequency Stability	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in DSRC Band

3 channels are provided for 10MHz

CHANNEL	FREQUENCY (MHz)
180	5900
182	5910
184	5920

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

The given UE is pre-scanned among below modes.

Modulation	Transmission Chain				Single Transmission Spatial	Multiple Transmission Spatial
<input checked="" type="checkbox"/> OFDM	<input checked="" type="checkbox"/> Ch0	<input checked="" type="checkbox"/> Ch1	<input type="checkbox"/> Ch2	<input type="checkbox"/> Ch3	<input type="checkbox"/> 1TX	<input checked="" type="checkbox"/> 2TX

4. Therefore, below summary is the modes of test configuration that yield the highest reading and generate the highest emission chosen to carry out the relevantly mandatory test items.

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4.3 Radiated Emission Test:

MODE	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
RADIATED EMISSION TEST (BELOW 1 GHz)				
802.11p 10MHz	180, 182, 184	OFDM	3	2TX
RADIATED EMISSION TEST (ABOVE 1 GHz)				
802.11p 10MHz	180, 182, 184	OFDM	3	2TX
Note: The field strength of radiation emission was measured as EUT three orthogonal planes, E1 / E2 / H, are positioned to pre-scan the emission generating the highest one. The worst position is tested, and recorded.				

4.4 Antenna Port Conducted Measurement:

CONDUCTED TEST				
MODE	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
802.11p 10MHz	180, 182, 184	OFDM	3	2TX

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
RF Power Output	+/- 1 dB
ERP/ EIRP measurement	+/- 3 dB
	+/- 3 dB
Emission Bandwidth	+/- 1.53 Hz
Out of Band Emissions at Antenna Terminals and Mask	+/- 1.69 dB
Frequency Stability vs. Temperature	+/- 1.53 Hz
Frequency Stability vs. Voltage	+/- 1.53 Hz
Temperature	+/- 0.4 °C
Humidity	+/- 3.5 %
DC / AC Power Source	+/- 1 %

Radiated Spurious Emission Measurement Uncertainty		
Polarization: Vertical	+/- 2.64 dB	9kHz~30MHz
	+/- 4.93 dB	30MHz - 1000MHz
	+/- 4.81 dB	1GHz - 18GHz
	+/- 4.52 dB	18GHz - 40GHz
Polarization: Horizontal	+/- 2.64 dB	9kHz~30MHz
	+/- 4.45 dB	30MHz - 1000MHz
	+/- 4.81 dB	1GHz - 18GHz
	+/- 4.52 dB	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 TRANSMITTER OUTPUT POWER

6.1 Standard Applicable

According to Part 95.3167:

The maximum output power for portable On-Board Unit transmitter types is 1.0 mW. For purposes of this paragraph, a portable is a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

And

According to Part 95.3189:

On-Board Unit transmitter types operating in the 5895-5925 MHz band must be designed to comply with the technical standard IEEE 802.11p or ASTM E2213-03 of limit:

OBU Device

Channel	Frequency (MHz)	Bandwidth (MHz)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
180	5900	10	20	23
182	5910	10	20	23
184	5920	10	20	33

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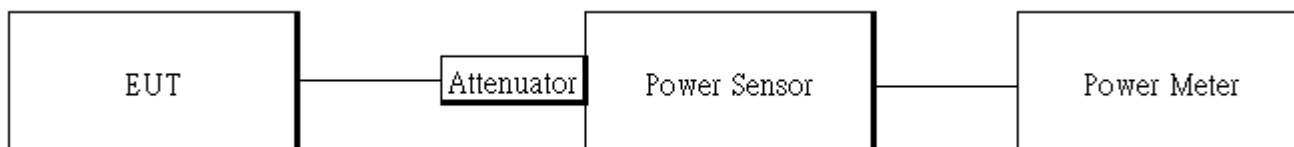
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6.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2021	04/26/2022
DC Power Supply	Agilent	E3640A	MY40005907	10/29/2020	10/28/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	12/16/2020	12/15/2021
DC Block	Mini-Circuits	BLK-18-S+	1	12/16/2020	12/15/2021

6.3 Test Set-up

Power Meter:



6.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of ANSI C63.26-2015 .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

Power Meter:

It is used as the auxiliary test equipment to conduct the output power measurement.

4. Record the max. Reading as observed from Spectrum or Power Meter.

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6.5 Measurement Result

802.11p ch0										
CH	Frequency (MHz)	Data Rate	TOTAL POWER (dBm)	Cable loss	Conducted power	Antenna Gain (dBi)	EIRP (dBm)	Conducted Power LIMIT (dBm)	EIRP Conducted Power LIMIT (dBm)	RESULT
180	5900	3	19.20	3.50	15.70	7.00	22.70	20	23	PASS
182	5910	3	19.49	3.50	15.99	7.00	22.99	20	23	PASS
184	5920	3	22.96	3.50	19.46	7.00	26.46	20	33	PASS

802.11p ch1										
CH	Frequency (MHz)	Data Rate	TOTAL POWER (dBm)	Cable loss	Conducted power	Antenna Gain (dBi)	EIRP (dBm)	Conducted Power LIMIT (dBm)	EIRP Conducted Power LIMIT (dBm)	RESULT
180	5900	3	19.10	3.50	15.60	7.00	22.60	20	23	PASS
182	5910	3	19.43	3.50	15.93	7.00	22.93	20	23	PASS
184	5920	3	22.91	3.50	19.41	7.00	26.41	20	33	PASS

802.11p_2TX												
CH	Frequency (MHz)	Data Rate	Avg. POWER (dBm)		TOTAL POWER (dBm)	Cable loss	Conducted power	Antenna Gain (dBi)	EIRP (dBm)	Conducted Power LIMIT (dBm)	EIRP Conducted Power LIMIT (dBm)	RESULT
			CH 0	CH 1								
180	5900	3	16.37	16.29	19.49	3.50	15.99	7.00	22.99	20	23	PASS
182	5910	3	16.35	16.27	19.47	3.50	15.97	7.00	22.97	20	23	PASS
184	5920	3	19.75	20.54	23.32	3.50	19.82	7.00	26.82	20	33	PASS

*** Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.**

Note: The conducted power is include cable loss.

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7 OCCUPIED BANDWIDTH MEASUREMENT

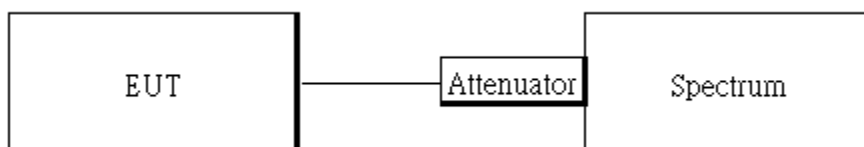
7.1 Standard Applicable

According to 2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power

7.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2021	04/26/2022
Temperature Chamber	Giant Force	GTH-150-40-CP-AR	MAA0512-018	05/19/2021	05/18/2022
DC Power Supply	Agilent	E3640A	MY40005907	10/29/2020	10/28/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	12/16/2020	12/15/2021
DC Block	Mini-Circuits	BLK-18-S+	1	12/16/2020	12/15/2021

7.3 Test Set-up



7.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of ANSI C63.26 - 2015 Section 5.4.3 and 5.4.4 were used.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Turn on the 99% bandwidth function, max reading.
5. Repeat above procedures until all test default channel is completed

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7.5 99% Bandwidth

Ch0		
CH	Frequency (MHz)	99% BW (MHz)
180	5900	8.0701
182	5910	8.0754
184	5920	8.0415

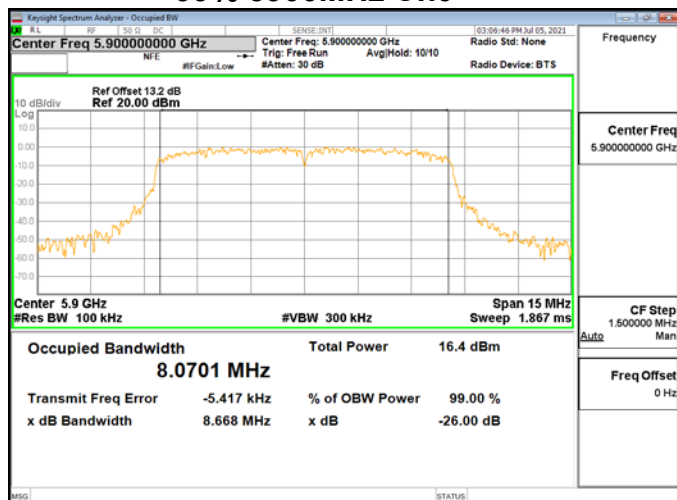
Ch1		
CH	Frequency (MHz)	99% BW (MHz)
180	5900	8.0502
182	5910	8.0339
184	5920	8.0997

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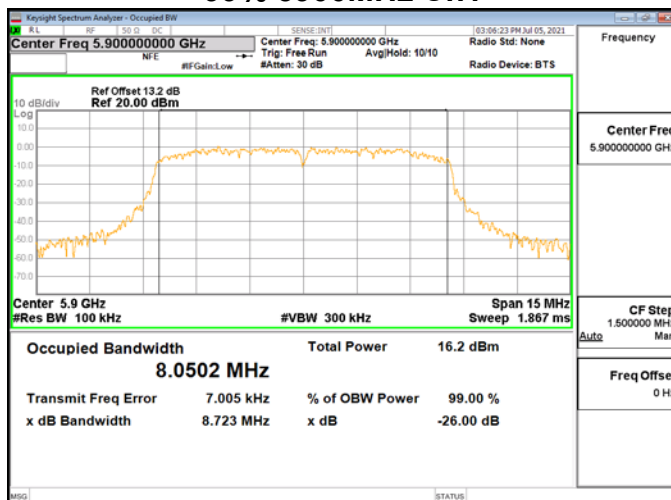
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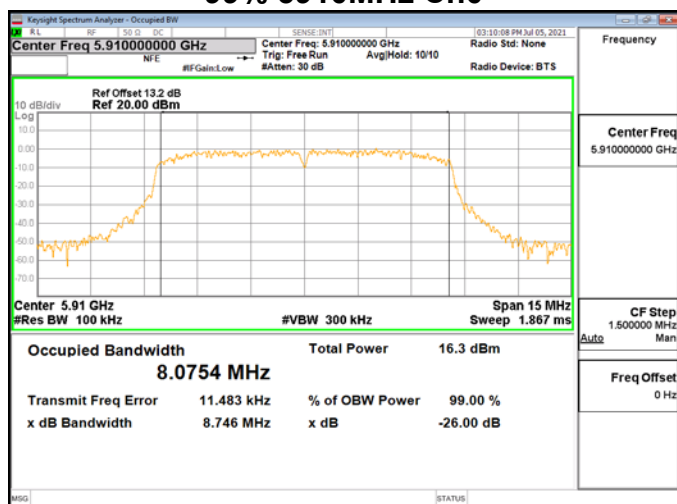
99% 5900MHz Ch0



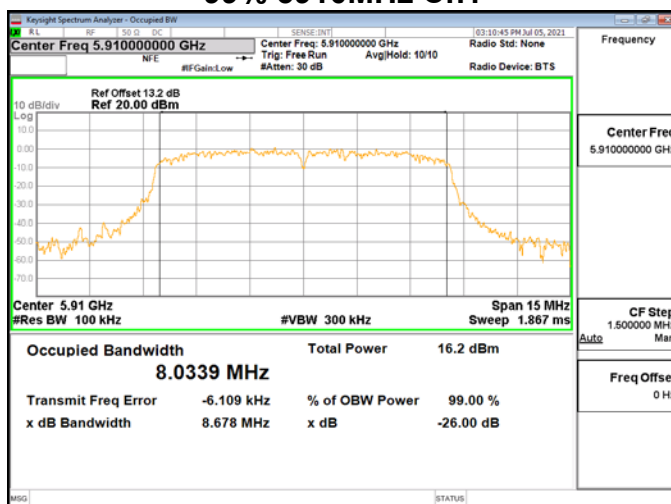
99% 5900MHz Ch1



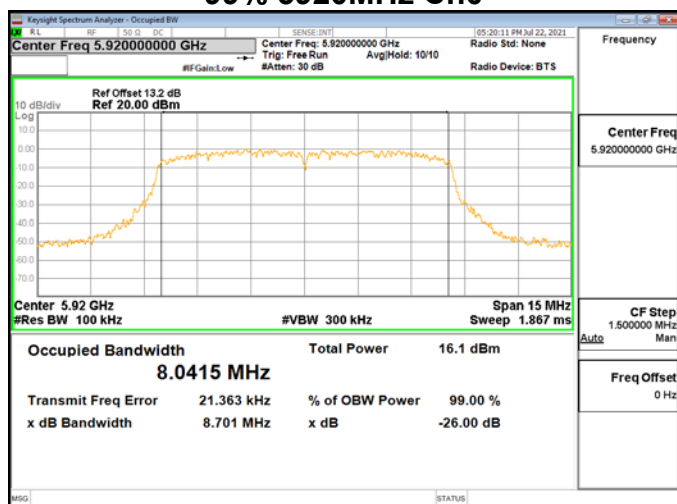
99% 5910MHz Ch0



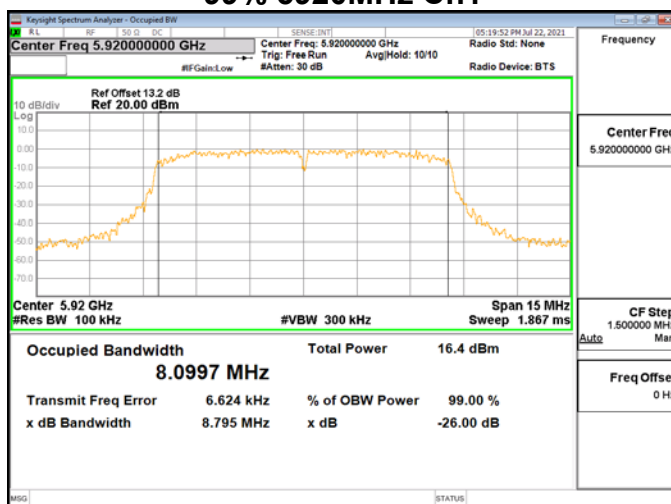
99% 5910MHz Ch1



99% 5920MHz Ch0



99% 5920MHz Ch1



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8 TRANSMIT SPECTRUM MASK

8.1 Standard Applicable

According to Part 95.3189 On-Board Unit transmitter types operating in the DSRC band must be designed to comply with the technical standard ASTM E2213-03 or IEEE 802.11p

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be -25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by $55 + 10\log(P)$ dB, where P is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall:

TABLE 9 DSRC Device Classes and Transmit Power Levels^A

Device Class	Maximum Device Output Power, dBm
A	0
B	10
C	20
D	28.8 or more

TABLE 10 DSRC Spectrum Mask^A

NOTE 1—Reduction in Power Spectral Density, dBr.

Class	± 4.5 -MHz Offset	± 5.0 -MHz Offset	± 5.5 -MHz Offset	± 10 -MHz Offset	± 15 -MHz Offset
Class A	0	-10	-20	-28	-40
Class B	0	-16	-20	-28	-40
Class C	0	-26	-32	-40	-50
Class D	0	-35	-45	-55	-65

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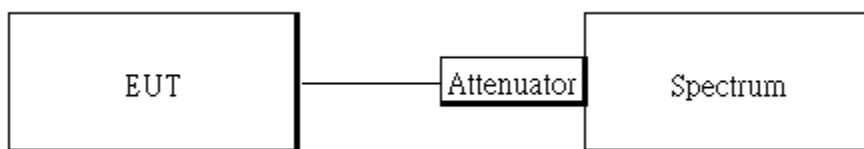
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8.3 Measurement Equipment Used

Conducted Emission Test Site: Conducted 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2021	04/26/2022
Temperature Chamber	Giant Force	GTH-150-40-CP-AR	MAA0512-018	05/19/2021	05/18/2022
DC Power Supply	Agilent	E3640A	MY40005907	10/29/2020	10/28/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	12/16/2020	12/15/2021
DC Block	Mini-Circuits	BLK-18-S+	1	12/16/2020	12/15/2021

8.4 Measurement Equipment Used



8.5 Measurement Procedure

1. Set analyzer center frequency to DSRC channel center frequency.
2. The testing follows the Measurement Procedure of ANSI C63.26 - 2015.
3. Transmitted spectrum for all DSRC devices shall be -25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by $55 + 10\log(P)$ dB, where P is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask. The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

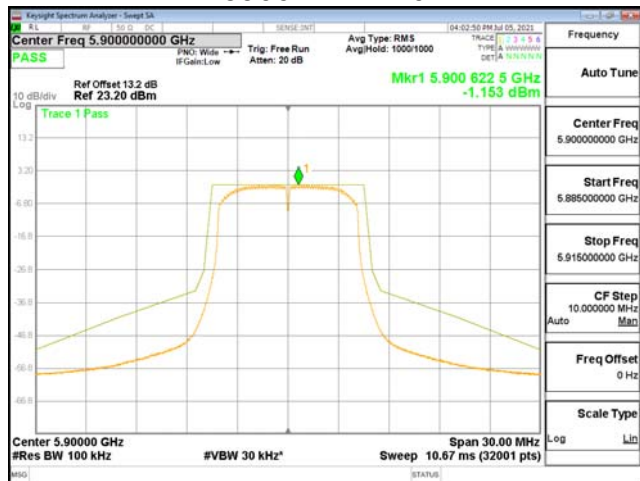
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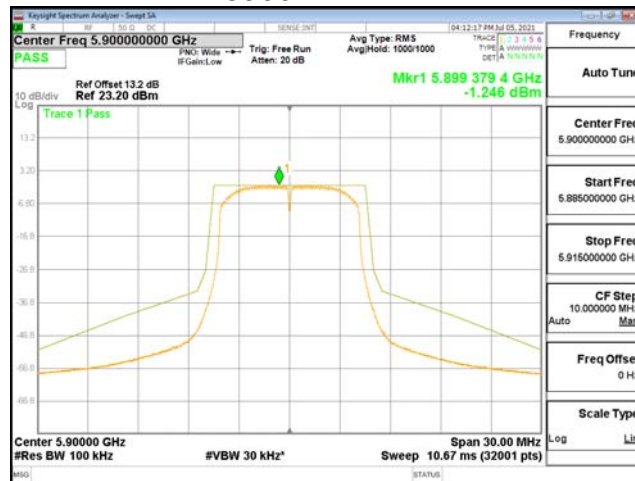
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8.6 Measurement Result

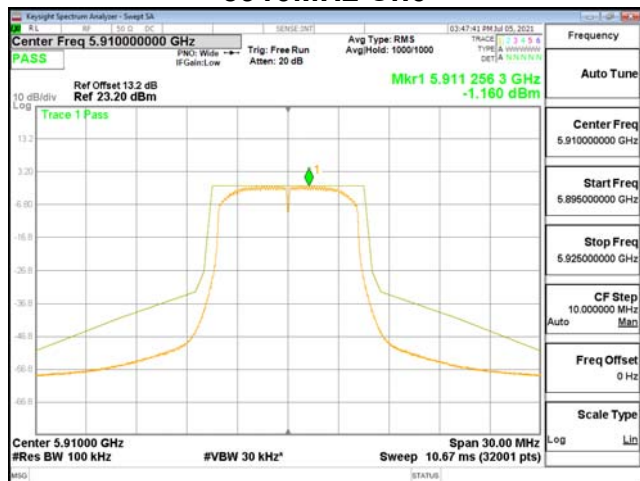
5900MHz Ch0



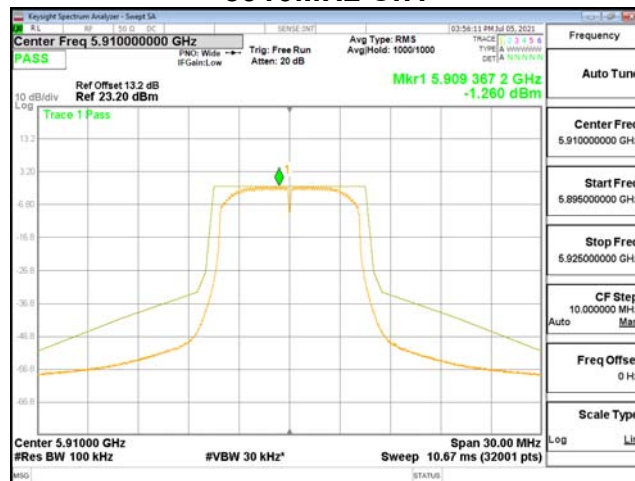
5900MHz Ch1



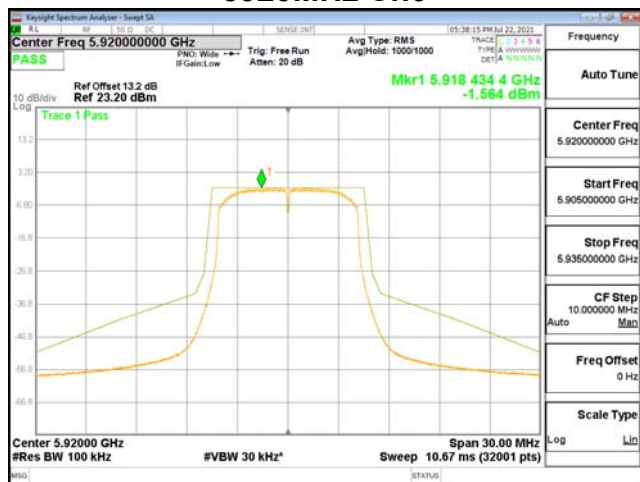
5910MHz Ch0



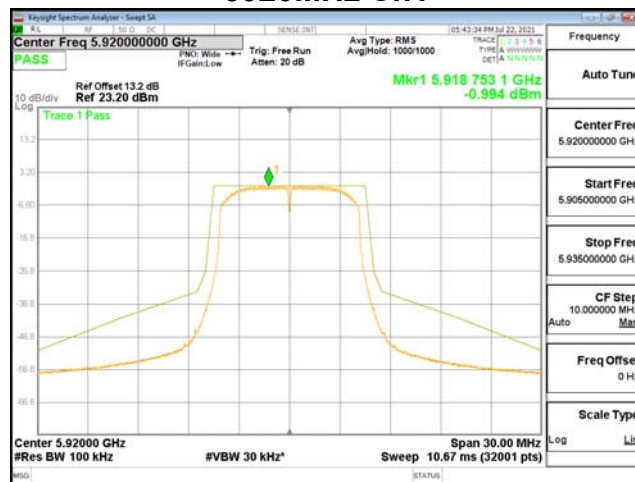
5910MHz Ch1



5920MHz Ch0



5920MHz Ch1



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9 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

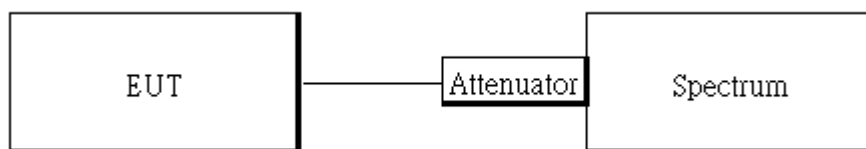
9.1 Standard Applicable

According to Part 2.1051 and Part 95.3189 On-Board Unit transmitter types operating in the DSRC band must be designed to comply with the technical standard ASTM E2213-03 or IEEE 802.11p. The power in the transmitted spectrum for all DSRC devices shall be -25 dBm.

9.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2021	04/26/2022
Temperature Chamber	Giant Force	GTH-150-40-CP-AR	MAA0512-018	05/19/2021	05/18/2022
DC Power Supply	Agilent	E3640A	MY40005907	10/29/2020	10/28/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	12/16/2020	12/15/2021
DC Block	Mini-Circuits	BLK-18-S+	1	12/16/2020	12/15/2021

9.3 Test SET-UP



9.4 Measurement Procedure

1. Set analyzer center frequency to DSRC channel center frequency.
2. The testing follows the Measurement Procedure of ANSI C63.26 - 2015.
3. As required by 47 CFR 2.1051, spurious emissions at antenna terminal measurements were made at the RF output terminals using a Spectrum Analyzer.

The EUT was connected to a Spectrum Analyzer. The Spectrum Analyzer was set to sweep 30 MHz and up to 10th harmonic of the fundamental or 40GHz whichever is the lesser. Measurements were made at the low, mid and high channels. The Conducted Spurious Emissions Limit is obtained by the following plots. Note: only noise floor was measurable above 26GHz.

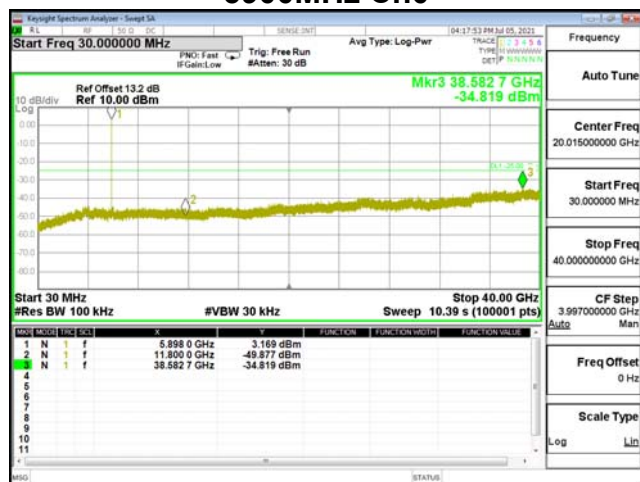
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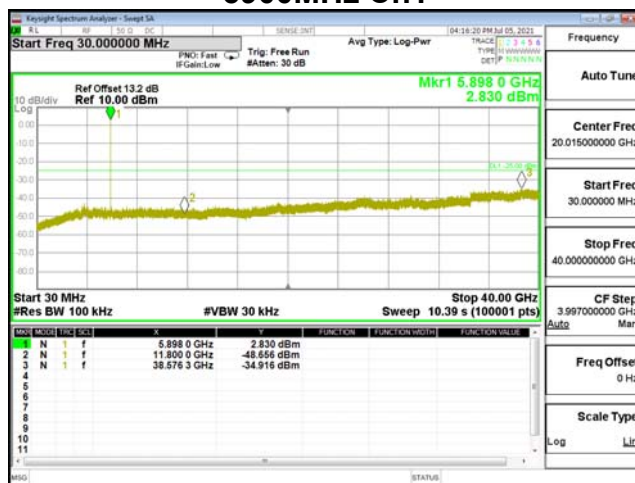
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9.5 Measurement Result

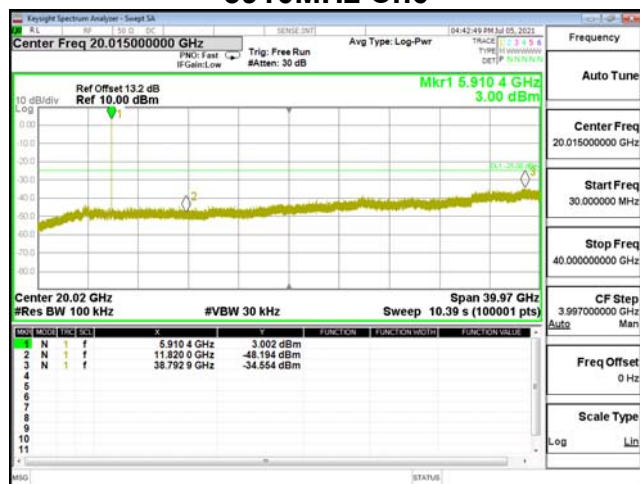
5900MHz Ch0



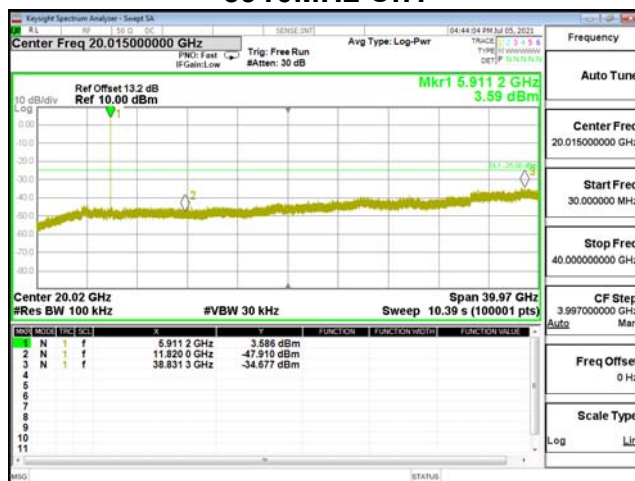
5900MHz Ch1



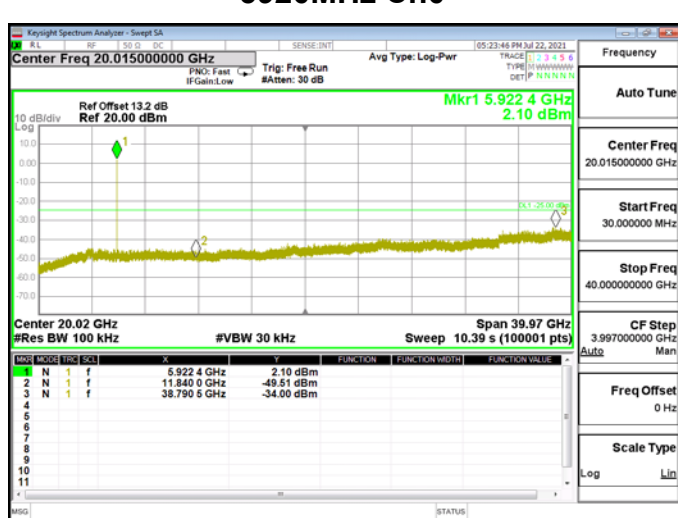
5910MHz Ch0



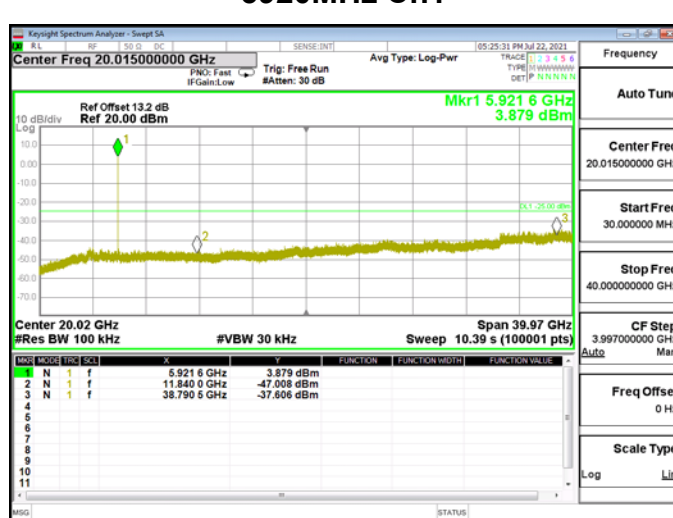
5910MHz Ch1



5920MHz Ch0



5920MHz Ch1



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10 RADIATED SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

According to Part 2.1053 and Part 95.3189 On-Board Unit transmitter types operating in the DSRC band must be designed to comply with the technical standard ASTM E2213-03 or IEEE 802.11p. The power in the transmitted spectrum for all DSRC devices shall be -25 dBm.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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10.2 Measurement Equipment Used:

Radiated Emission Test Site: SAC 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWARZBECK	VULB9168	378	08/06/2020	08/05/2021
Horn Antenna	SCHWARZBECK	BBHA9120D	1441	10/16/2020	10/15/2021
Horn Antenna	SCHWARZBECK	BBHA9170	184	12/11/2020	12/10/2021
Horn Antenna	SCHWARZBECK	BBHA9170	185	07/30/2020	07/29/2021
Site Cal	SGS	SAC I chamber	N/A	01/01/2021	12/31/2021
Horn Antenna	SCHWARZBECK	BBHA9120D	D803	12/17/2020	12/16/2021
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	01/13/2021	01/12/2022
Spectrum Analyzer	Agilent	E4446A	MY51100003	10/29/2020	10/28/2021
Radio Communication Analyser	Anritsu	MT8815B	6200711454	04/07/2021	04/06/2022
Radio Communication Analyser	Anritsu	MT8820C	6201465317	02/24/2021	02/23/2022
DC Power Supply	Agilent	E3640A	MY52410006	12/17/2020	12/16/2021
Test Software	audix	e3	Ver. 6.11-20180413	01/01/2021	12/31/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	12/16/2020	12/15/2021
Pre-Amplifier	HP	8449B	3008A01973	12/16/2020	12/15/2021
Pre-Amplifier	HP	8447D	2944A09469	12/16/2020	12/15/2021
7GHz High Pass Filter	WI	WHKX10-6090-80SS	3	04/20/2021	12/15/2021
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-2000	160123	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2630/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY22962/2	12/16/2020	12/15/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 102	SN 520430/2	12/16/2020	12/15/2021

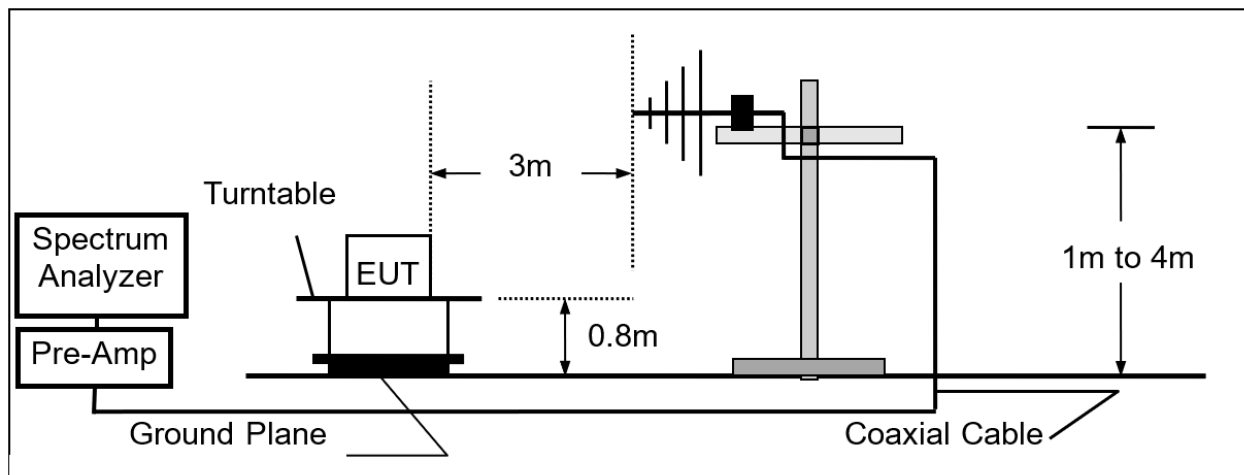
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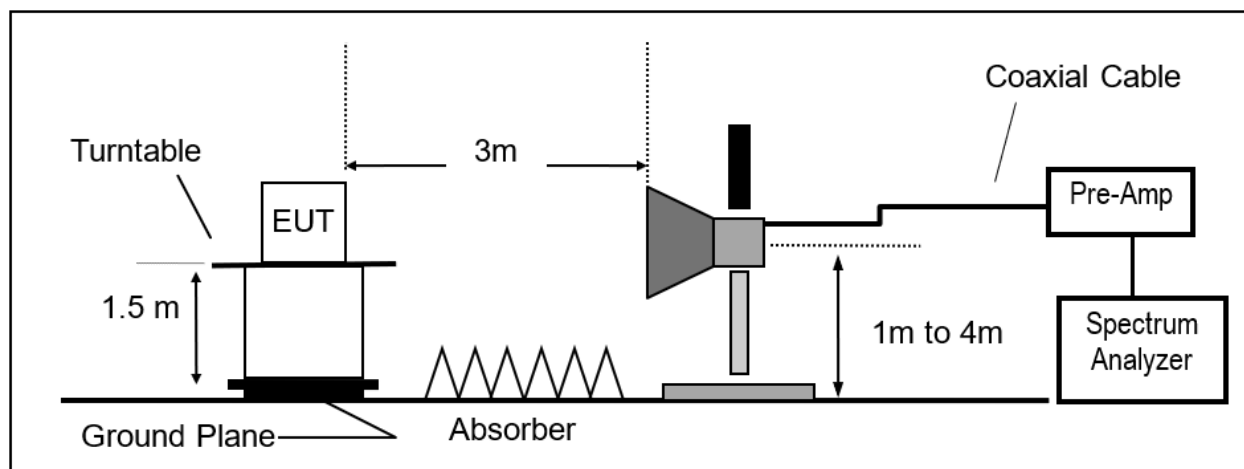
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10.3 Test SET-UP

(A) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz



(B) Radiated Emission Test Set-Up, Frequency Above 1 GHz



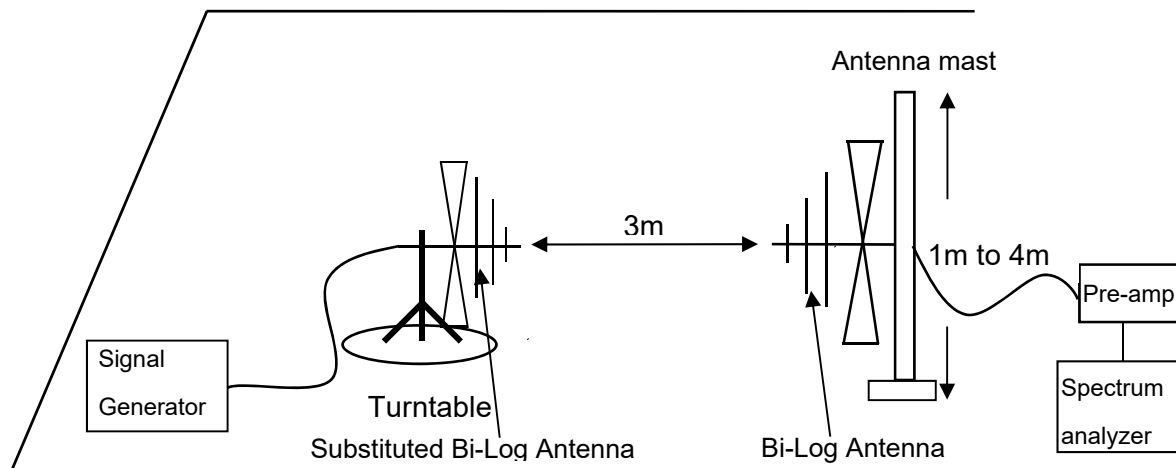
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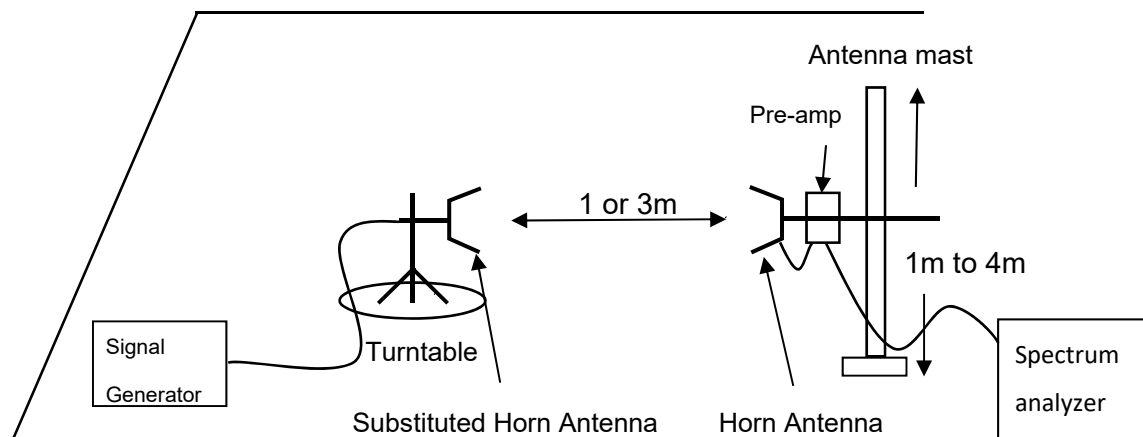
(C) Substitution Measurement

Frequency Below 1GHz



(D) Substitution Measurement

Frequency Above 1GHz



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10.4 Measurement Procedure

The EUT was placed on a non-conductive; the measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

The frequency range up to tenth harmonic was investigated for each of three fundamental frequencies (low, middle and high channels). Once spurious emission was identified, the power of the emission was determined using the substitution method.

The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and the spurious emissions frequency.

$$\text{ERP (dBm)} = \text{SG Level(dBm)} + \text{Antenna Gain(dBd)} + \text{Cable Loss(dB)}$$

$$\text{EIRP (dBm)} = \text{SG Level(dBm)} + \text{Antenna Gain(dBi)} + \text{Cable Loss(dB)}$$

10.5 Measurement Result

Note:

1. *Refer to next page spectrum analyzer data chart and tabular data sheets.*
2. *Measurements are completed at peak and average level, the mark of average is the highest emission in restricted bands*

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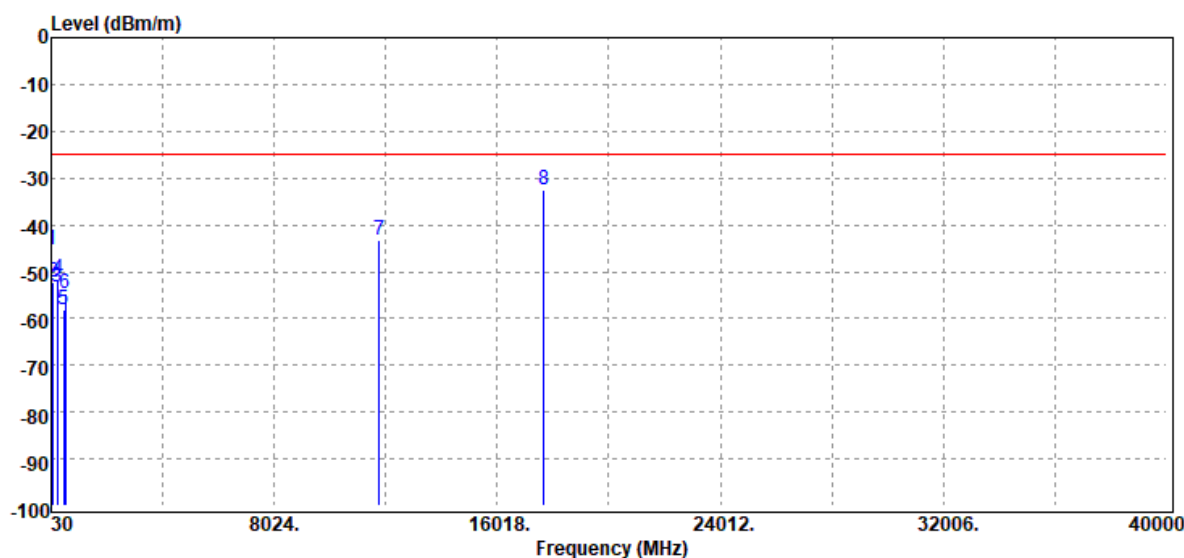
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10.5.1 Radiated Emission Result

Report Number :ER/2021/50134
Operation Mode :DSRC
Test Mode :Tx CH Low
EUT Pol :H Plane
Test Frequency :5900 MHz

Test Site :SAC I Chamber
Test Date :2021-07-10
Temp./Humi. :26.5/68
Antenna Pol. :VERTICAL
Engineer :Neo Tsai



Freq.	EIRP/ERP	SG	Antenna	Cable	Limit	Margin
MHz	dBm	Output Level dBm	Gain dBi/dBd	Loss dB	dBm	dB
36.79	-45.30	-30.93	-13.72	-0.65	-25.00	-20.30
95.96	-52.18	-50.90	-0.28	-1.00	-25.00	-27.18
240.49	-53.38	-56.15	4.38	-1.61	-25.00	-28.38
288.99	-51.70	-54.01	4.04	-1.73	-25.00	-26.70
479.11	-58.04	-59.82	4.21	-2.43	-25.00	-33.04
527.61	-54.56	-56.70	4.17	-2.03	-25.00	-29.56
11800.00	-43.18	-43.38	12.50	-12.30	-25.00	-18.18
17700.00	-32.54	-28.64	10.70	-14.60	-25.00	-7.54

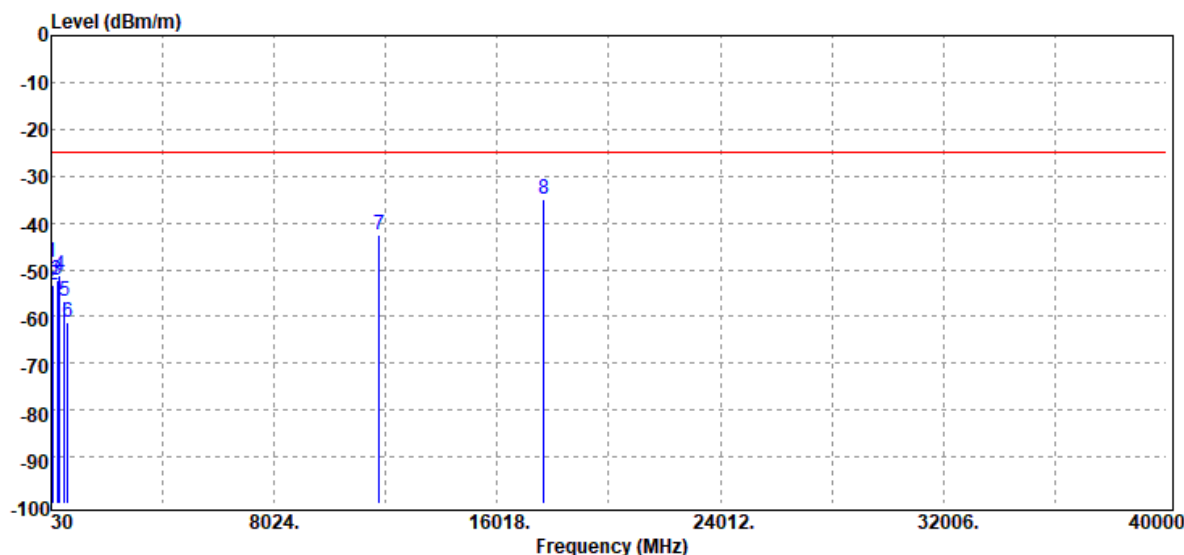
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Report Number :ER/2021/50134
Operation Mode :DSRC
Test Mode :Tx CH Low
EUT Pol :H Plane
Test Frequency :5900 MHz

Test Site :SAC I Chamber
Test Date :2021-07-10
Temp./Humi. :26.5/68
Antenna Pol. :HORIZONTAL
Engineer :Neo Tsai



Freq.	EIRP/ERP	SG	Antenna	Cable	Limit	Margin
MHz	dBm	Output Level dBm	Gain dBi/dBd	Loss dB	dBm	dB
36.79	-48.47	-34.10	-13.72	-0.65	-25.00	-23.47
95.96	-53.23	-51.95	-0.28	-1.00	-25.00	-28.23
240.49	-52.22	-54.99	4.38	-1.61	-25.00	-27.22
335.55	-51.32	-53.70	4.28	-1.90	-25.00	-26.32
500.45	-56.90	-58.74	4.25	-2.41	-25.00	-31.90
624.61	-61.19	-62.34	3.49	-2.34	-25.00	-36.19
11800.00	-42.72	-42.92	12.50	-12.30	-25.00	-17.72
17700.00	-35.03	-31.13	10.70	-14.60	-25.00	-10.03

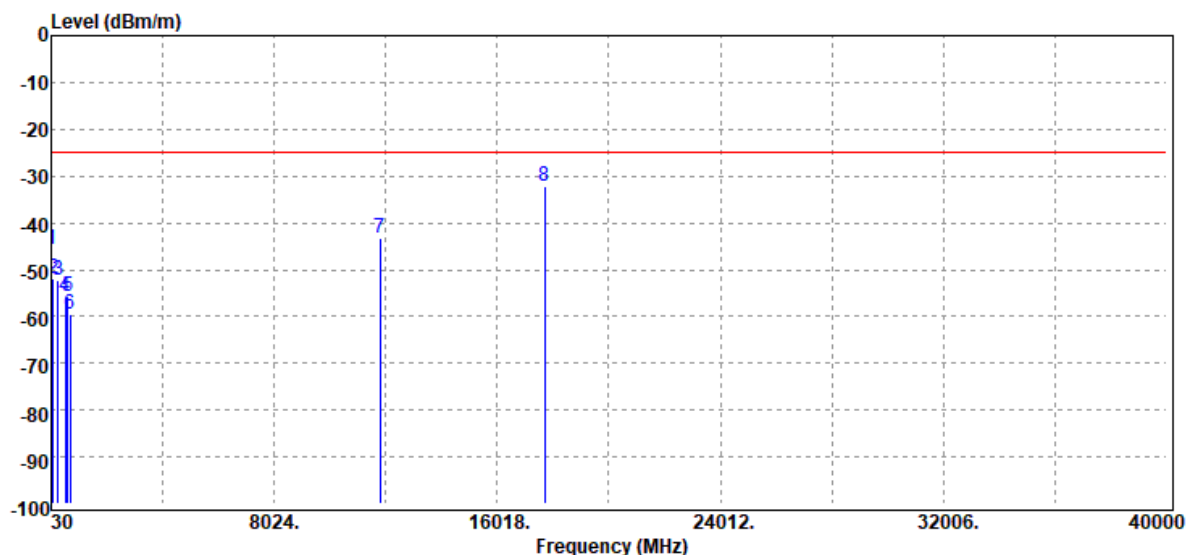
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Report Number :ER/2021/50134
Operation Mode :DSRC
Test Mode :Tx CH Mid
EUT Pol :H Plane
Test Frequency :5910 MHz

Test Site :SAC I Chamber
Test Date :2021-07-10
Temp./Humi. :26.5/68
Antenna Pol. :VERTICAL
Engineer :Neo Tsai



Freq.	EIRP/ERP	SG	Antenna	Cable	Limit	Margin
MHz	dBm	Output Level dBm	Gain dBi/dBd	Loss dB	dBm	dB
36.79	-45.68	-31.31	-13.72	-0.65	-25.00	-20.68
95.96	-52.06	-50.78	-0.28	-1.00	-25.00	-27.06
288.99	-52.16	-54.47	4.04	-1.73	-25.00	-27.16
527.61	-55.68	-57.82	4.17	-2.03	-25.00	-30.68
623.64	-55.87	-57.02	3.48	-2.33	-25.00	-30.87
720.64	-59.40	-60.26	3.48	-2.62	-25.00	-34.40
11820.00	-43.13	-43.38	12.56	-12.31	-25.00	-18.13
17730.00	-32.34	-28.24	10.25	-14.35	-25.00	-7.34

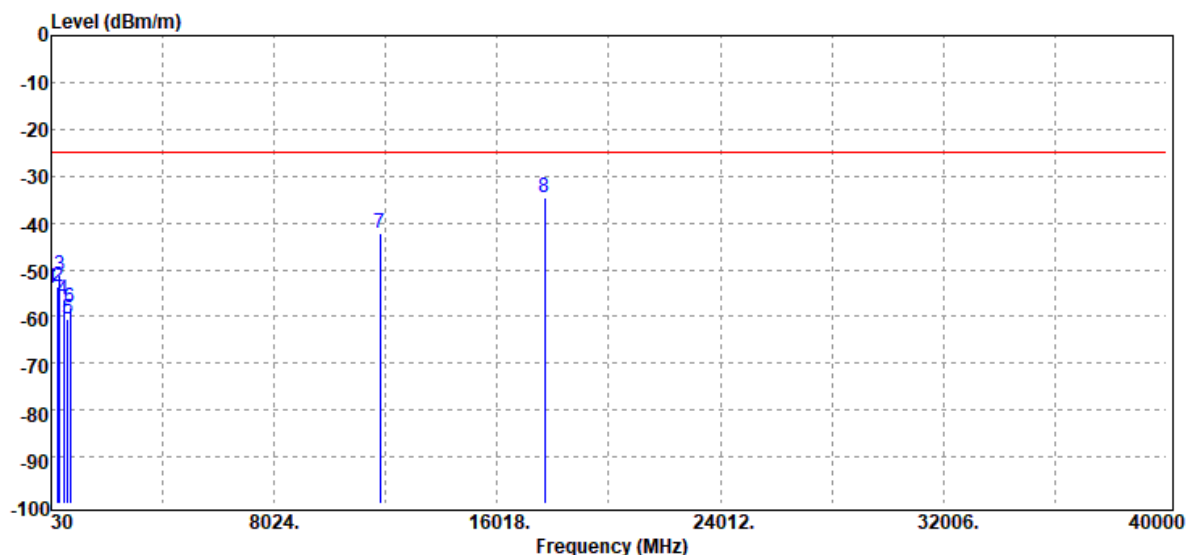
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Report Number :ER/2021/50134
Operation Mode :DSRC
Test Mode :Tx CH Mid
EUT Pol :H Plane
Test Frequency :5910 MHz

Test Site :SAC I Chamber
Test Date :2021-07-10
Temp./Humi. :26.5/68
Antenna Pol. :HORIZONTAL
Engineer :Neo Tsai



Freq.	EIRP/ERP	SG	Antenna	Cable	Limit	Margin
MHz	dBm	Output Level dBm	Gain dBi/dBd	Loss dB	dBm	dB
36.79	-54.10	-39.73	-13.72	-0.65	-25.00	-29.10
288.99	-53.77	-56.08	4.04	-1.73	-25.00	-28.77
335.55	-51.18	-53.56	4.28	-1.90	-25.00	-26.18
479.11	-56.47	-58.25	4.21	-2.43	-25.00	-31.47
623.64	-60.72	-61.87	3.48	-2.33	-25.00	-35.72
720.64	-58.23	-59.09	3.48	-2.62	-25.00	-33.23
11820.00	-42.25	-42.50	12.56	-12.31	-25.00	-17.25
17730.00	-34.77	-30.67	10.25	-14.35	-25.00	-9.77

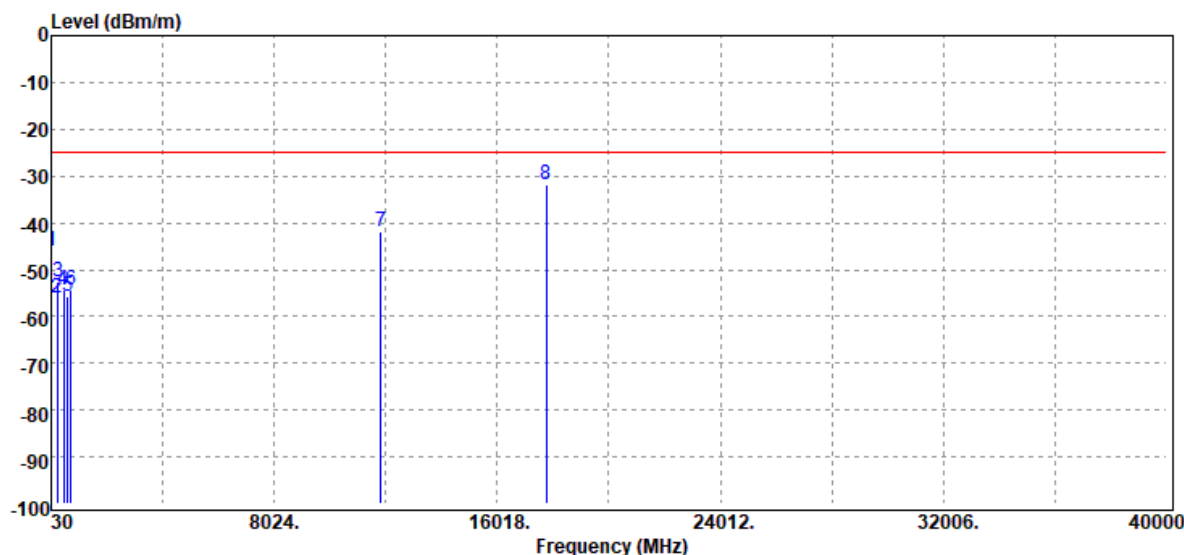
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Report Number :ER/2021/50134
 Operation Mode :DSRC
 Test Mode :Tx CH High
 EUT Pol :H Plane
 Test Frequency :5920 MHz

Test Site :SAC I Chamber
 Test Date :2021-07-10
 Temp./Humi. :26.5/68
 Antenna Pol. :VERTICAL
 Engineer :Neo Tsai



Freq.	EIRP/ERP	SG	Antenna	Cable	Limit	Margin
MHz	dBm	Output Level dBm	Gain dBi/dBd	Loss dB	dBm	dB
36.79	-46.16	-31.79	-13.72	-0.65	-25.00	-21.16
240.49	-56.01	-58.78	4.38	-1.61	-25.00	-31.01
288.99	-52.53	-54.84	4.04	-1.73	-25.00	-27.53
479.11	-54.30	-56.08	4.21	-2.43	-25.00	-29.30
623.64	-55.80	-56.95	3.48	-2.33	-25.00	-30.80
745.86	-54.43	-54.81	2.83	-2.45	-25.00	-29.43
11840.00	-41.83	-42.13	12.62	-12.32	-25.00	-16.83
17760.00	-31.86	-27.56	9.80	-14.10	-25.00	-6.86

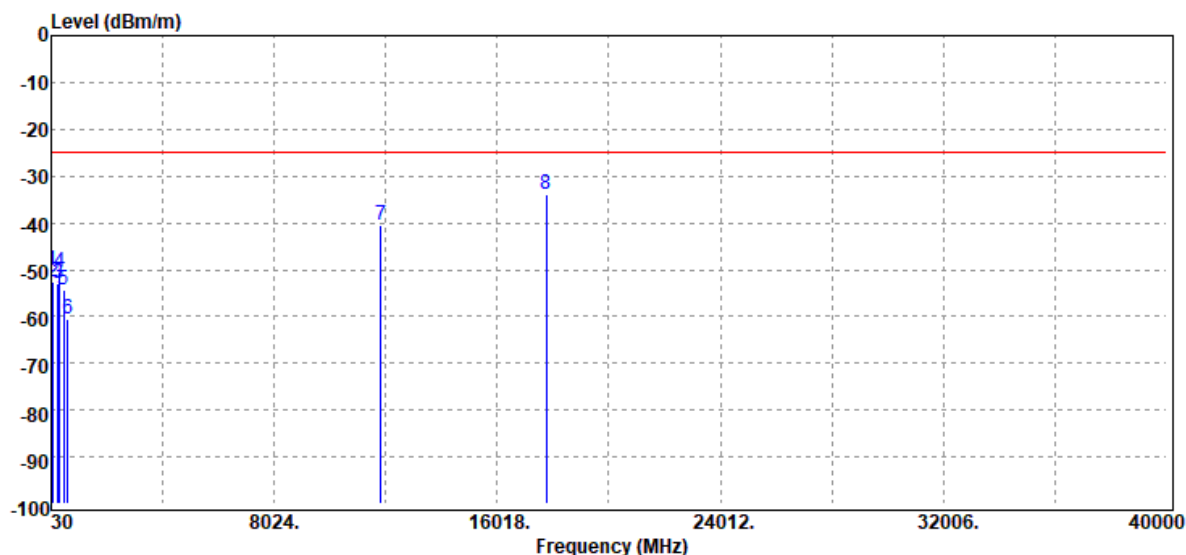
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Report Number :ER/2021/50134
Operation Mode :DSRC
Test Mode :Tx CH High
EUT Pol :H Plane
Test Frequency :5920 MHz

Test Site :SAC I Chamber
Test Date :2021-07-10
Temp./Humi. :26.5/68
Antenna Pol. :HORIZONTAL
Engineer :Neo Tsai



Freq.	EIRP/ERP	SG	Antenna	Cable	Limit	Margin
MHz	dBm	Output Level dBm	Gain dBi/dBd	Loss dB	dBm	dB
36.79	-50.25	-35.88	-13.72	-0.65	-25.00	-25.25
95.96	-52.57	-51.29	-0.28	-1.00	-25.00	-27.57
288.99	-53.03	-55.34	4.04	-1.73	-25.00	-28.03
335.55	-50.56	-52.94	4.28	-1.90	-25.00	-25.56
479.11	-54.48	-56.26	4.21	-2.43	-25.00	-29.48
623.64	-60.65	-61.80	3.48	-2.33	-25.00	-35.65
11840.00	-40.56	-40.86	12.62	-12.32	-25.00	-15.56
17760.00	-33.97	-29.67	9.80	-14.10	-25.00	-8.97

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11 FREQUENCY STABILITY MEASUREMENT

11.1 Standard Applicable

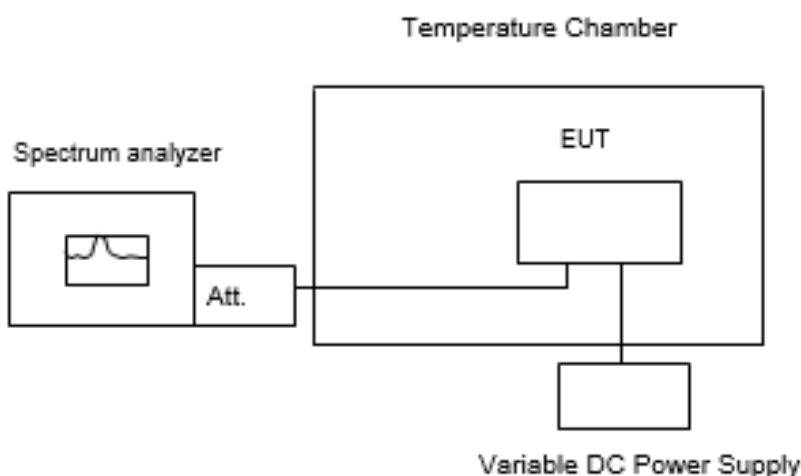
Accordinging to Part 2.1055 and Part 95.3189 On-Board Unit transmitter types operating in the DSRC band must be designed to comply with the technical standard ASTM E2213-03 or IEEE 802.11p:

Transmit Center Frequency Tolerance—The transmitted center frequency tolerance shall be 10 ppm maximum for RSUs and 10 ppm maximum for OBUs.

11.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted 4					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2021	04/26/2022
Temperature Chamber	Giant Force	GTH-150-40-CP-AR	MAA0512-018	05/19/2021	05/18/2022
DC Power Supply	Agilent	E3640A	MY40005907	10/29/2020	10/28/2021
Attenuator	Mini-Circuit	BW-S10W2+	4	12/16/2020	12/15/2021
DC Block	Mini-Circuits	BLK-18-S+	1	12/16/2020	12/15/2021

11.3 Test Set-up



Note: Measurement setup for testing on Antenna connector

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11.4 Measurement Procedure

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached, the temperature of +60°C was requested by product spec.

Set chamber temperature to 25°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation (+/- 15%) and endpoint as declared by the manufacturer, record the maximum frequency change.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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11.5 Measurement Result

Test Temp.(°C)	Test Voltage(V)	Channel	Nominal Center Frequency (MHz)	Calculated Center Frequency (MHz)	Deviation (ppm)	Limit (ppm)	Result
60	12	182	5910	5909.99	1.69	10	PASS
50		182	5910	5910.02	3.38	10	PASS
40		182	5910	5910.03	5.08	10	PASS
30		182	5910	5909.97	5.08	10	PASS
20		182	5910	5909.99	1.69	10	PASS
10		182	5910	5909.97	5.08	10	PASS
0		182	5910	5909.98	3.38	10	PASS
-10		182	5910	5910.01	1.69	10	PASS
-20		182	5910	5910.03	5.08	10	PASS
-30		182	5910	5909.98	3.38	10	PASS
Test Temp.(°C)	Test Voltage(V)	Channel	Nominal Center Frequency (MHz)	Calculated Center Frequency (MHz)	Deviation (ppm)	Limit (ppm)	Result
25	13.8	182	5910	5909.98	3.38	10	PASS
	12	182	5910	5910.01	1.69	10	PASS
	10.2	182	5910	5910.03	5.08	10	PASS

Note: The temperature of +60°C was requested by product spec.

~ End of Report ~

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