

TEST REPORT

Report No: KST-FCR-140010

Applicant	Name	eSSys Co., Ltd
	Address	Daeryung Post Tower 5 15F, 60-3, Gasan-dong, Geumcheon-gu, Seoul, Korea
Manufacturer	Name	eSSys Co., Ltd
	Address	Daeryung Post Tower 5 15F, 60-3, Gasan-dong, Geumcheon-gu, Seoul, Korea
Equipment	Name	eSSys WAVE RSE
	Model No	EWR1
	Brand	None
	FCC ID	2ADQJ-EWR1
Test Standard	FCC CFR 47, Part 90. Subpart M ANSI/TIA-603-D-2010, FCC KDB 971168, FCC KDB 412172	
Test Date(s)	2014. 12. 04 ~ 2014. 12. 05	
Issue Date	2014. 12. 08	
Test Result	Compliance	
Note	-	

Supplementary Information

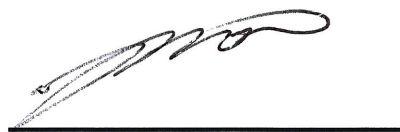
The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in ANSI/TIA-603-D-2010.

We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by Mi Young, Lee

Approved by Gyeong Hyeon, Park

Signature



Signature



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1. GENERAL INFORMATION

1.1 Test Facility

Test laboratory and address

KOSTEC Co., Ltd.

128(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

The open area field test site and conducted measurement facility are used for these testing. This site at was fully described in a reports submitted to the Federal Communications Commission (FCC).

The details of these reports have been found to be in complies with the requirements of Section 2.948 of the FCC Rules on November 14, 2002. The facility also complies with the radiated and conducted test site criteria set forth in ANSI C 63.10-2009 and ANSI/TIA-603-D-2010.

The Federal Communications Commission (FCC) has the reports on file and KOSTEC Co., Ltd. is listed under FCC Registration No.525762. The test site has been approved by the FCC for public use and is List in the FCC Public Access Link CORES (Commission Registration System)

Registration information

KCC (Korea Communications Commission) Number : KR0041

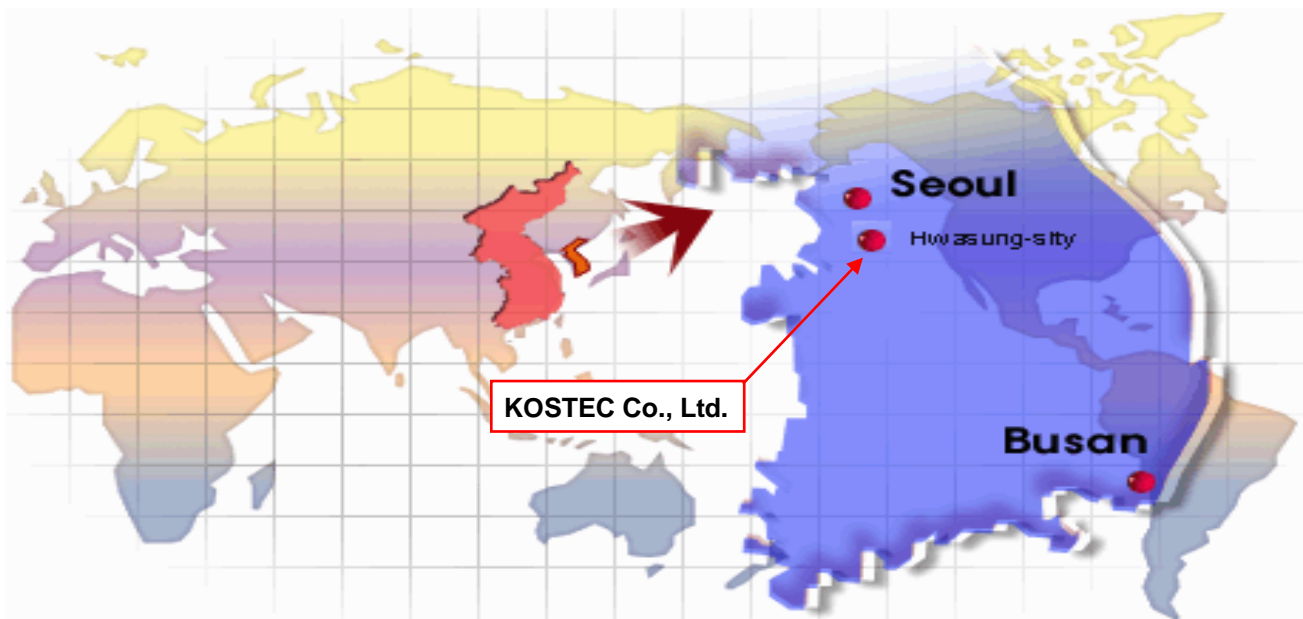
KOLAS(Korea Laboratory Accreditation Scheme) Number : 232

FCC Registration Number(FRN) : 525762

VCCI Registration Number : R-1657 / C –1763

IC Registration Site Number : 8305A-1

1.2 Location



2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

Equipment Name	eSSys WAVE RSE
Model No	EWR1
Usage	Roadside Units
Serial Number	Proto type
Data connection Type	OFDM
Modulation type	802.11p: OFDM (BPSK / QPSK / 16QAM / 64QAM)
Max average output	32.58 dBm*
Operated Frequency	5 860 MHz – 5 920 MHz
Channel Number	7 CH
Operation temperature	- 20 °C ~ + 55 °C
Power Source	DC 12 V
Antenna Description	Directional Patch antenna, gain: 12 dBi
FCC ID	2ADQJ- EWR1
Remark	<p>1. The data rates used when evaluating the DUT was the lowest data rates. The device was operating at its maximum output power at the lowest data rate for all measurements.</p> <p>2. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.</p> <p>3. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.</p> <p>5. The above DUT's information was declared by manufacturer. Please refer to the specifications or user manual for more detailed description.</p>

* Conducted power including antenna gain, declared by the applicant

3. SYSTEM CONFIGURATION FOR TEST

3.1 Characteristics of equipment

The Equipment Under Test (EUT) use for Dedicated Short-Range Communications Service. DSRCS system is transmit status and instructional messages related to the units involved. This unit is Roadside Unit.

3.2 Used peripherals list

Description	Model No.	Serial No.	Manufacture	Remark
Note book	S210-KP84K	811KSF014491	LG	
AC adapter	PA-1900-08	8801213202	Dongguang Lite Power 2ND Plant	For note book

3.3 Product Modification

N/A

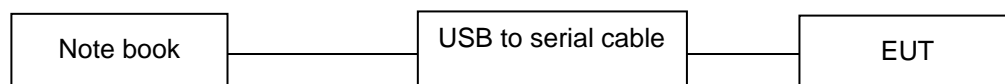
3.4 Operating Mode

- * Constantly transmitting with a modulated carrier at maximum power/widest bandwidth on the bottom, middle and top channels as required using the supported data rates/modulation types.
- * The EUT has one transmit/receive RF port. RF cables and attenuators connecting the test equipment to the EUT ports were calibrated before use and the calibration data incorporated into the conducted measurement results.
- * Radiated emissions tests were performed with all unused ports terminated.

3.5 Test Setup of EUT

The measurements were taken in continuous transmit mode using the TEST MODE.

For controlling the EUT as typing the commands using hyper-terminal, commands were provided by the applicant.



3.6 Parameters of Test Software Setting

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test software version	Type commands using terminal program		
Modulation Mode	Test Frequency (MHz)		
	5860	5890	5920
802.11p-10M	7	7	7

3.7 Table for Carrier Frequencies

Frequency Range: 5850 - 5925 MHz		
Frequency Range	Channel	BW: 5/10MHz
5855-5865	172	5860 MHz
5865-5875	174	5870 MHz
5875-5885	176	5880 MHz
5885-5895	178	5890 MHz
5895-5905	180	5900 MHz
5905-5915	182	5910 MHz
5915-5925	184	5920 MHz

3.8 Tested Data rate & Modulation

Emission Types(Modulation)	D1D(OFDM:BPSK, QPSK, 16QAM, 64QAM)
Modulation Standard	DSRC for IEEE 802.11p
Data rate	802.11p-10M : 3 - 27 Mbps / Worst case : 3 Mbps

3.9 Duty Cycle Of Test signal

Duty cycle is < 98%, duty factor shall be considered.

Duty cycle = Tx on/(Tx on+ Tx off)

Duty factor = 10*log(1/duty cycle)

Band	Mode	Duty cycle	Note
5850 - 5925 MHz	802.11p-10M	> 98 %	-

3.10 Used Test Equipment List

No.	Instrument	Model	S/N	Manufacturer	Due to cal date	Cal interval	used
1	T & H Chamber	EY-101	90E14260	TABAI ESPEC	2015.09.19	1 year	<input checked="" type="checkbox"/>
2	Constant switch Tester	DS-COT	None	Dong sung Ele.	N/A	N/A	<input type="checkbox"/>
3	Vibration Tester	70UA	L90016	IDEX Co.,Ltd	N/A	N/A	<input type="checkbox"/>
4	Vibration Meter	VM-6360	N225098	LANDTEK	2015.04.04	18 month	<input type="checkbox"/>
5	Falling Tester	SWD-8000	None	Sinwoo	N/A	N/A	<input type="checkbox"/>
6	Spectrum Analyzer	8563E	3846A10662	Agilent Technology	2015.02.07	1 year	<input checked="" type="checkbox"/>
7	Spectrum Analyzer	8593E	3710A02859	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
8	Spectrum Analyzer	FSV30	20-353063	Rohde& Schwarz	2015.02.07	1 year	<input checked="" type="checkbox"/>
9	EMI Test Receiver	ESCI7	100823	Rohde& Schwarz	2015.02.05	1 year	<input checked="" type="checkbox"/>
10	EMI Test Receiver	ESI	834000/002	Rohde& Schwarz	2015.02.05	1 year	<input checked="" type="checkbox"/>
11	Vector Signal Analyzer	89441A	3416A02620	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
12	Network Analyzer	8753ES	US39172348	AGILENT	2015.09.18	1 year	<input type="checkbox"/>
13	EPM Series Power meter	E4418B	GB39512547	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
14	RF Power Sensor	E9300A	MY41496631	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
15	Microwave Frequency Counter	5352B	2908A00480	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
16	Modulation Analyzer	8901A	3538A07071	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
17	Audio Analyzer	8903B	3514A16919	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
18	Audio Telephone Analyzer	DD-5601CID	520010281	CREDIX	2015.02.07	1 year	<input type="checkbox"/>
19	Digital storage Oscilloscope	TDS3052	B015962	Tektronix	2015.09.17	1 year	<input type="checkbox"/>
20	ESG-D Series Signal Generator	E4436B	US39260458	Agilent Technology	2015.02.07	1 year	<input checked="" type="checkbox"/>
21	ESG Vector Signal Generator	E4438C	MY42083133	Agilent Technology	2015.09.17	1 year	<input type="checkbox"/>
22	Vector Signal Generator	SMBV100A	257557	Rohde & Schwarz	2015.01.21	1 year	<input type="checkbox"/>
23	Tracking Source	85645A	070521-A1	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
24	Signal Generator	SML03	100692	Rohde& Schwarz	2015.02.07	1 year	<input type="checkbox"/>
25	SLIDAC	None	0207-4	Myoung sung Ele.	2015.02.07	1 year	<input type="checkbox"/>
26	DC Power supply	DRP-5030	9028029	Digital Electronic Co.,Ltd	2015.02.07	1 year	<input type="checkbox"/>
27	DC Power supply	6038A	3440A12674	Agilent Technology	2015.02.07	1 year	<input type="checkbox"/>
28	DC Power supply	E3610A	KR24104505	Agilent Technology	2015.02.07	1 year	<input checked="" type="checkbox"/>
29	DC Power supply	UP-3005T	68	Unicon Co.,Ltd	2015.02.07	1 year	<input type="checkbox"/>
30	DC Power Supply	SM 3004-D	114701000117	DELTAELEKTRONIKA	2015.02.07	1 year	<input type="checkbox"/>
31	Dummy Load	8173	3780	Bird Electronic Co., Corp	2015.02.07	1 year	<input type="checkbox"/>
32	Attenuator	50FH-030-500	140410 9433	JEW Industries Inc.	2015.02.07	1 year	<input type="checkbox"/>
33	Attenuator	765-20	9703	Narda	2015.09.17	1 year	<input type="checkbox"/>
34	Attenuator	8498A	3318A09485	HP	2015.02.07	1 year	<input type="checkbox"/>
35	Step Attenuator	8494B	3308A32809	HP	2015.02.07	1 year	<input type="checkbox"/>
36	Step Attenuator	8495D	3308A01464	HP	2015.02.07	1 year	<input type="checkbox"/>
37	Power divider	11636B	51212	HP	2015.09.17	1 year	<input checked="" type="checkbox"/>
38	3Way Power divider	KPDSU3W	00070365	KMW	2015.02.07	1 year	<input type="checkbox"/>
39	Band rejection filter	WTR-BRF2442-84NN	09020001	WAVE TECH Co.,LTD	2015.02.07	1 year	<input type="checkbox"/>
40	White noise audio filter	ST31EQ	101902	SoundTech	2015.09.17	1 year	<input type="checkbox"/>
41	Dual directional coupler	778D	17693	HEWLETT PACKARD	2015.02.07	1 year	<input type="checkbox"/>
42	Dual directional coupler	772D	2839A00924	HEWLETT PACKARD	2015.02.07	1 year	<input type="checkbox"/>
43	Band rejection filter	3TNF-0006	26	DOVER Tech	2015.02.07	1 year	<input type="checkbox"/>
44	Band rejection filter	3TNF-0008	317	DOVER Tech	2015.02.07	1 year	<input type="checkbox"/>
45	Band rejection filter	3TNF-0007	311	DOVER Tech	2015.02.07	1 year	<input type="checkbox"/>
46	Highpass Filter	WHJS1100-10EF	1	WAINWRIGHT	2015.02.07	1 year	<input type="checkbox"/>
47	Highpass Filter	WHJS3000-10EF	1	WAINWRIGHT	2015.02.07	1 year	<input type="checkbox"/>
48	Radio Communication Alalyzer	MT8815A	6200429622	ANRITSU	2015.02.07	1 year	<input type="checkbox"/>
49	CDMA Mobile Station Test Set	E8285A	US40081298	AGILENT	2015.02.07	1 year	<input type="checkbox"/>
50	WideBand Radio Communication Tester	CMW500	102276	Rohde & Schwarz	2015.04.10	1 year	<input type="checkbox"/>

No.	Instrument	Model	S/N	Manufacturer	Due to cal date	Cal interval	used
51	RF Up/Down Converter	DCP-1780	980901003	CREDIX	2015.02.07	1 year	<input type="checkbox"/>
52	DECT Test set	8923B	3829U00364	HP	2015.02.07	1 year	<input type="checkbox"/>
53	DECT Test set	CMD60	840677/005	Rohde & Schwarz	2015.09.17	1 year	<input type="checkbox"/>
54	Loop Antenna	6502	9203-0493	EMCO	2015.05.31	2 year	<input checked="" type="checkbox"/>
55	Dipole Antenna	HZ-12	100005	Rohde & Schwarz	2016.07.01	2 year	<input type="checkbox"/>
56	Dipole Antenna	HZ-13	100007	Rohde & Schwarz	2016.07.01	2 year	<input type="checkbox"/>
57	BiconiLog Antenna	3142B	1745	EMCO	2016.06.16	2 year	<input checked="" type="checkbox"/>
58	Horn Antenna	3115	9605-4834	EMCO	2016.06.16	2 year	<input checked="" type="checkbox"/>
59	Horn Antenna	3115	2996	EMCO	2016.02.26	2 year	<input type="checkbox"/>
60	Horn Antenna	BBHA9170	BBHA9170152	SCHWARZBECK	2015.05.27	2 year	<input checked="" type="checkbox"/>
61	Signal Generator	SMT-06	100552	Rohde & Schwarz	2015.02.07	1 year	<input type="checkbox"/>
62	HYGRO-Thermograph	NSII-Q	1611545	SATO	2015.09.22	1 year	<input type="checkbox"/>
63	Barometer	7612	81134	SATO	2016.01.20	2 year	<input type="checkbox"/>
64	Multi meter	DM-313	S60901832	LG Precision Co.,Ltd	2015.02.07	1 year	<input type="checkbox"/>
65	Antenna Mast(OSA)	AT14	None	Daeil EMC	N/A	N/A	<input type="checkbox"/>
66	Turn table(OSA)	None	None	Daeil EMC	N/A	N/A	<input type="checkbox"/>
67	RF Amplifier(OSA)	8447D	2944A07881	AGILENT	2015.02.04	1 year	<input type="checkbox"/>
68	Antenna Master(3)	AT13	None	AUDIX	N/A	N/A	<input checked="" type="checkbox"/>
69	Turn Table(3)	None	None	AUDIX	N/A	N/A	<input checked="" type="checkbox"/>
70	PREAMPLIFIER(3)	8449B	3008A02577	Agilent	2015.02.05	1 year	<input checked="" type="checkbox"/>
71	Antenna Master(10)	MA4000-EP	None	inno systems GmbH	N/A	N/A	<input checked="" type="checkbox"/>
72	Turn Table(10)	None	None	inno systems GmbH	N/A	N/A	<input checked="" type="checkbox"/>
73	AMPLIFIER(10)	TK-PA6S	120009	TESTEK	2015.02.05	1 year	<input type="checkbox"/>
74	Vernier Calipers	None	8280373	Mitutoyo	2015.09.18	1 year	<input type="checkbox"/>

4. SUMMARY TEST RESULTS

Description of Test	FCC Rule	Reference Clause	Used	Test Result
Emission Bandwidth	2.1049/90.379	Clause 5.1	<input checked="" type="checkbox"/>	Compliance
Maximum Transmitter Power (Effective Isotropic Radiated Power (EIRP))	90.205/90.377/90.379	Clause 5.2	<input checked="" type="checkbox"/>	Compliance
Transmit Spectrum Mask	90.210/90.379	Clause 5.3	<input checked="" type="checkbox"/>	Compliance
Transmitter Conducted Unwanted Emissions	2.1051/90.379	Clause 5.4	<input checked="" type="checkbox"/>	Compliance
Transmitter Radiated Unwanted Emissions	2.1053/90.379	Clause 5.5	<input checked="" type="checkbox"/>	Compliance
Frequency Stability	90.213/90.379	Clause 5.6	<input checked="" type="checkbox"/>	Compliance
Emission Types	2.1047/90.379	Clause 5.7	<input checked="" type="checkbox"/>	Compliance
Modulation Standard	90.379	Clause 5.8	<input checked="" type="checkbox"/>	Compliance
<p>Compliance/pass : The EUT complies with the essential requirements in the standard.</p> <p>Not Compliance : The EUT does not comply with the essential requirements in the standard.</p> <p>N/A : The test was not applicable in the standard.</p>				

5. MEASUREMENT RESULTS

5.1 Emission Bandwidth

5.1.1 Standard Applicable [FCC §90.379]

5.1.2 Test Environment conditions

- Ambient temperature : (20 - 21) °C ,
- Relative Humidity : (43 - 45) % R.H.

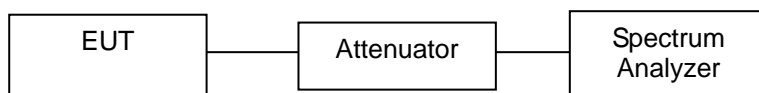
5.1.3 Measurement Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. The 99 % occupied bandwidth is the frequency bandwidth of the signal power at the 99 % channel power of occupied bandwidth when resolution bandwidth should be approximately 1 % to 5 % of the occupied bandwidth (OBW).

The spectrum analyzer is set to the as follows :

- RBW : >1 % of the emission bandwidth
- VBW : >3 x RBW
- Sweep : auto
- Detector function : peak
- Trace : max hold

5.1.4 Test setup

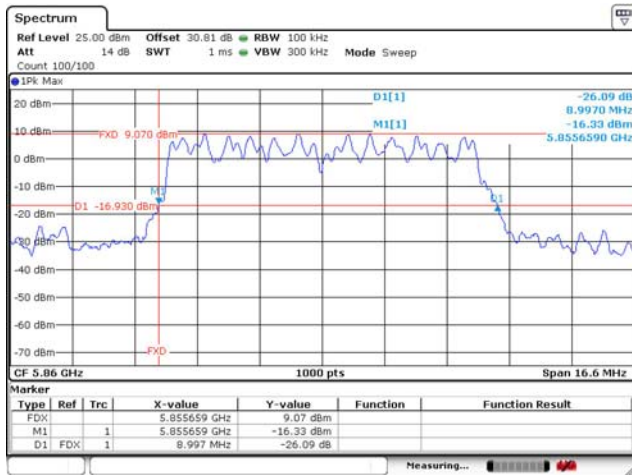


5.1.5 Measurement Result

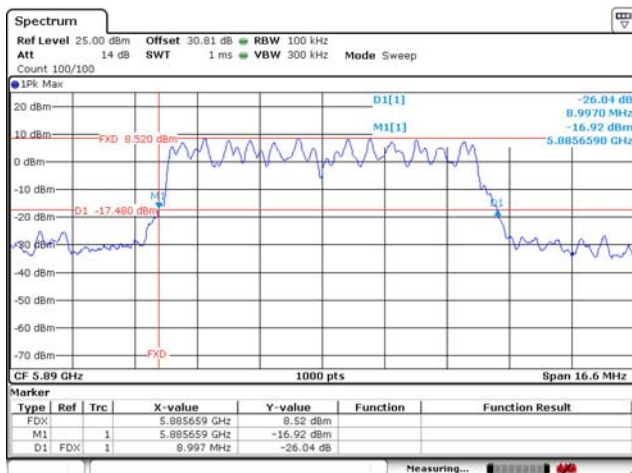
Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Limit [MHz]	Test Results
172	5 860	8.997	8.151	-	Compliance
178	5 890	8.997	8.151	-	Compliance
184	5 920	8.980	8.151	-	Compliance

5.1.6 Test Plot (26 dB band width)

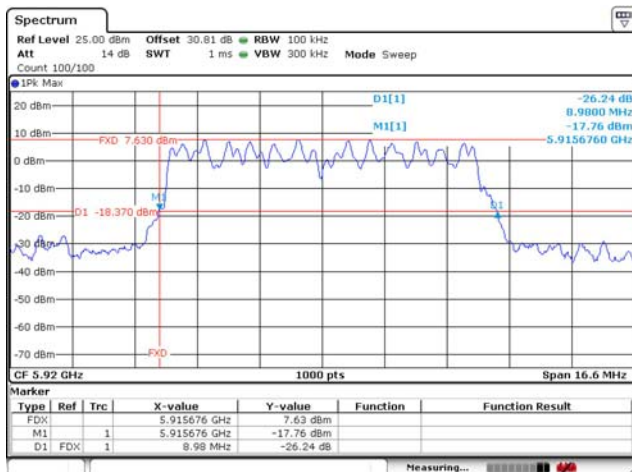
CH Low



CH Middle

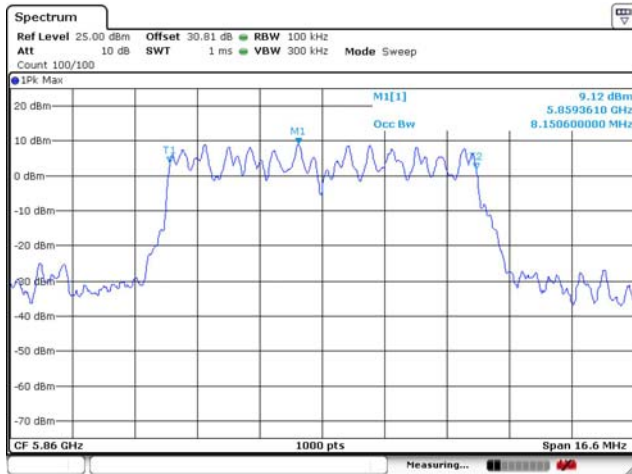


CH High

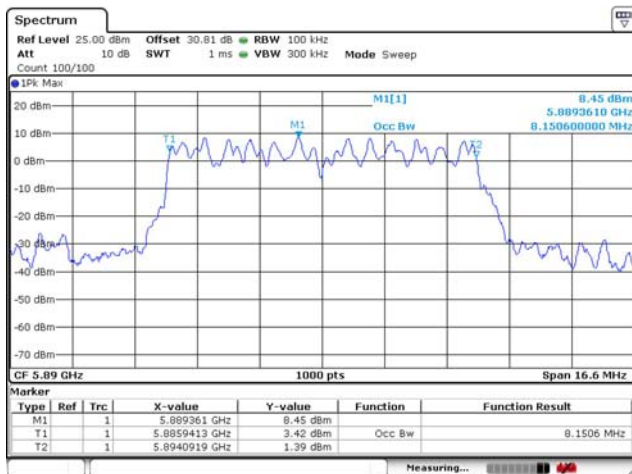


Test Plot (99 % band width)

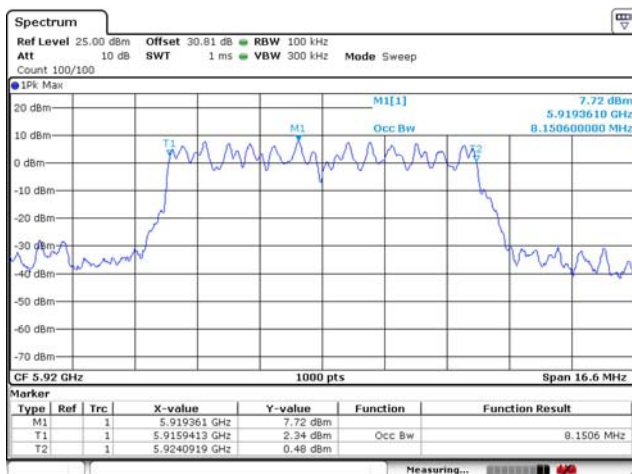
CH Low



CH Middle



CH High



5.2 Maximum Transmitter Power

5.2.1 Standard Applicable [FCC §90.205 & 90.377 & 90.379]

For the 5.850 - 5.925 GHz band, the maximum conducted output power shall not exceed the below table.

Portable DSRCS-OBUs is 1.0 mW, other as following as:				
Frequency Range(MHz)	Channel	BW: 5/10MHz	Cond. Power	EIRP Power
5855-5865	172	5860 MHz	28.8 dBm	33 dBm
5865-5875	174	5870 MHz	28.8 dBm	33 dBm
5875-5885	176	5880 MHz	28.8 dBm	33 dBm
5885-5895	178	5890 MHz	28.8 dBm	33 dBm
5895-5905	180	5900 MHz	20 dBm	23 dBm
5905-5915	182	5910 MHz	20 dBm	23 dBm
5915-5925	184	5920 MHz	28.8 dBm	33 dBm
Frequency Range(MHz)	Channel	BW:20MHz	Cond. Power	EIRP Power
5855-5865	175	5875 MHz	20 dBm	23 dBm
5865-5875	181	5905 MHz	20 dBm	23 dBm

Note 1: Conducted power could overcome limits but EIRP power shall under limits
Note 2: Refer as ASTM E2213-03 Clause 8.10.1, FCC Part 90.377 & FCC ET Docket No. 98-95.

DSRC Device Classes and Transmit Power Levels (5850–5925 MHz Band)	
Device Class	Maximum Device Output Power (dBm)
A	0
B	10
C	20
D	28.8 or more

5.2.2 Test Environment conditions

- Ambient temperature : (20 - 21) °C
- Relative Humidity : (43 - 45) % R.H.

5.2.3 Measurement Procedure

The transmitter output was connected to the power meter with an attenuator. The maximum output power was measured and recorded with the power meter. EUT was programmed to be in continuously transmitting mode. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.(in case, duty cycle=1)

Test method:

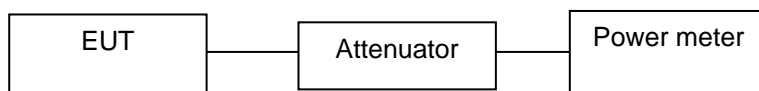
1) Maximum transmitter power :

ANSI/TIA-603-D, clause 3.2.1 for power meter measurement.

2) Effective Isotropic Radiated Power (EIRP)

KDB 412172, clause 1.3.2 following as power approach. $e.i.r.p. = P_T + G_T$.

5.2.4 Test setup



5.2.5 Measurement Result

Channel	Frequency [MHz]	Conducted output Power [dBm]	Conducted EIRP Power* [dBm]	Limit [dBm]		Test Results
				Conducted output Power	Conducted EIRP Power	
172	5 860	20.58	32.58	20	33	Compliance
178	5 890	20.01	32.01	20	33	Compliance
184	5 920	19.20	31.20	20	33	Compliance

*Conducted EIRP Power= Conducted output Power+Antenna gain(12 dBi)

5.2.6 Limit

- Please refer 5.2.1

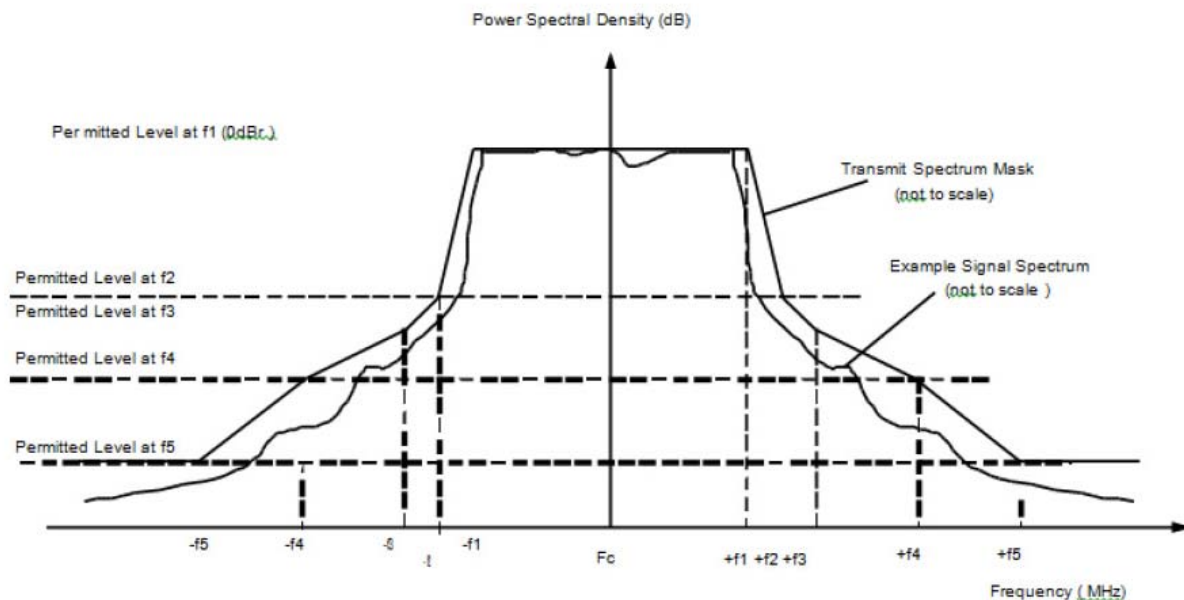
5.3 Transmit Spectrum Mask

5.3.1 Standard Applicable [FCC §90.210 & 90.379]

For the 5.850 - 5.925 GHz band, the Transmit Spectrum Mask shall not exceed the below table.

The 0 dBm level is the maximum power spectral density measured in the channel. The measurements of transmit spectral density are made using 100 kHz resolution bandwidth and 30 kHz video bandwidth.

5850–5925 MHz Band					
Portable DSRCS-OBUs is 1.0 mW, other as following as:					
Device Class	Maximum STA transmit power(mW)			Maximum permitted EIRP (dBm)	
A	1			23	
B	10			23	
<u>C</u>	<u>100</u>			<u>33</u>	
D	760			33 for non-government / 44.8 for government	
CFR § 90.210 / § 90.379 / ASTM – 8.9.2 Table 10 DSRC Spectrum Mask					
Device Class	± 4.5 MHz offset (±f1)	± 5.0 MHz offset (±f2)	± 5.5 MHz offset (±f3)	± 10 MHz offset (±f4)	± 15 MHz offset (±f5)
A	0	-10	-20	-28	-40
B	0	-16	-20	-28	-40
<u>C</u>	<u>0</u>	<u>-26</u>	<u>-32</u>	<u>-40</u>	<u>-50</u>
D	0	-35	-45	-55	-65



5.3.2 Test Environment conditions

- Ambient temperature : (20 - 21) °C ,
- Relative Humidity : (43 - 45) % R.H.

5.3.3 Measurement Procedure

The spectrum analyzer is set to the as follows

- RBW : 100kHz
- VBW : 30kHz
- Sweep : auto
- Detector function : RMS
- Trace : AVG 100

5.3.4 Test setup

Please refer 5.1.4

5.3.5 Measurement Result

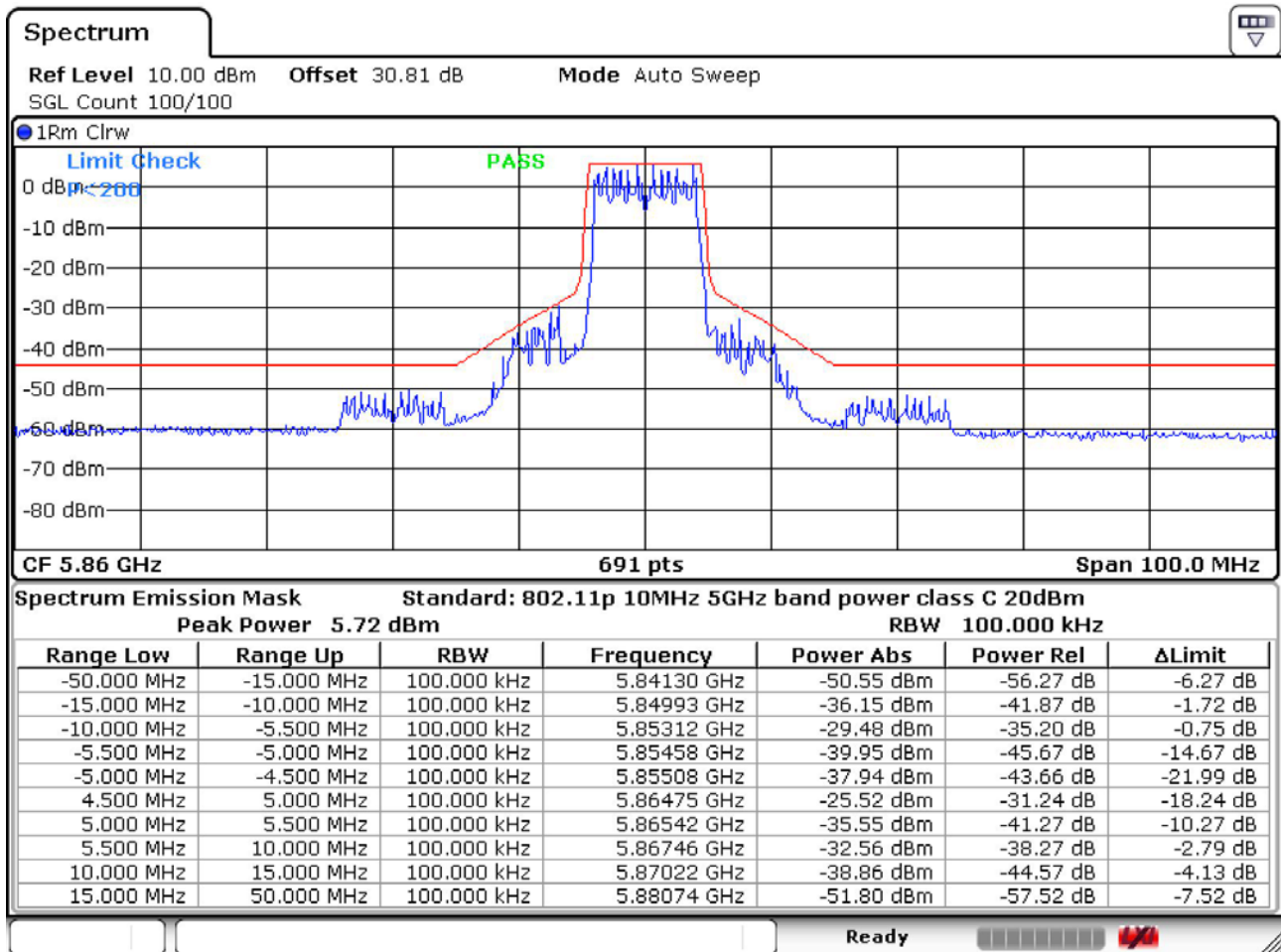
Compliance: please refer 5.3.7 for details

5.3.6 Limit

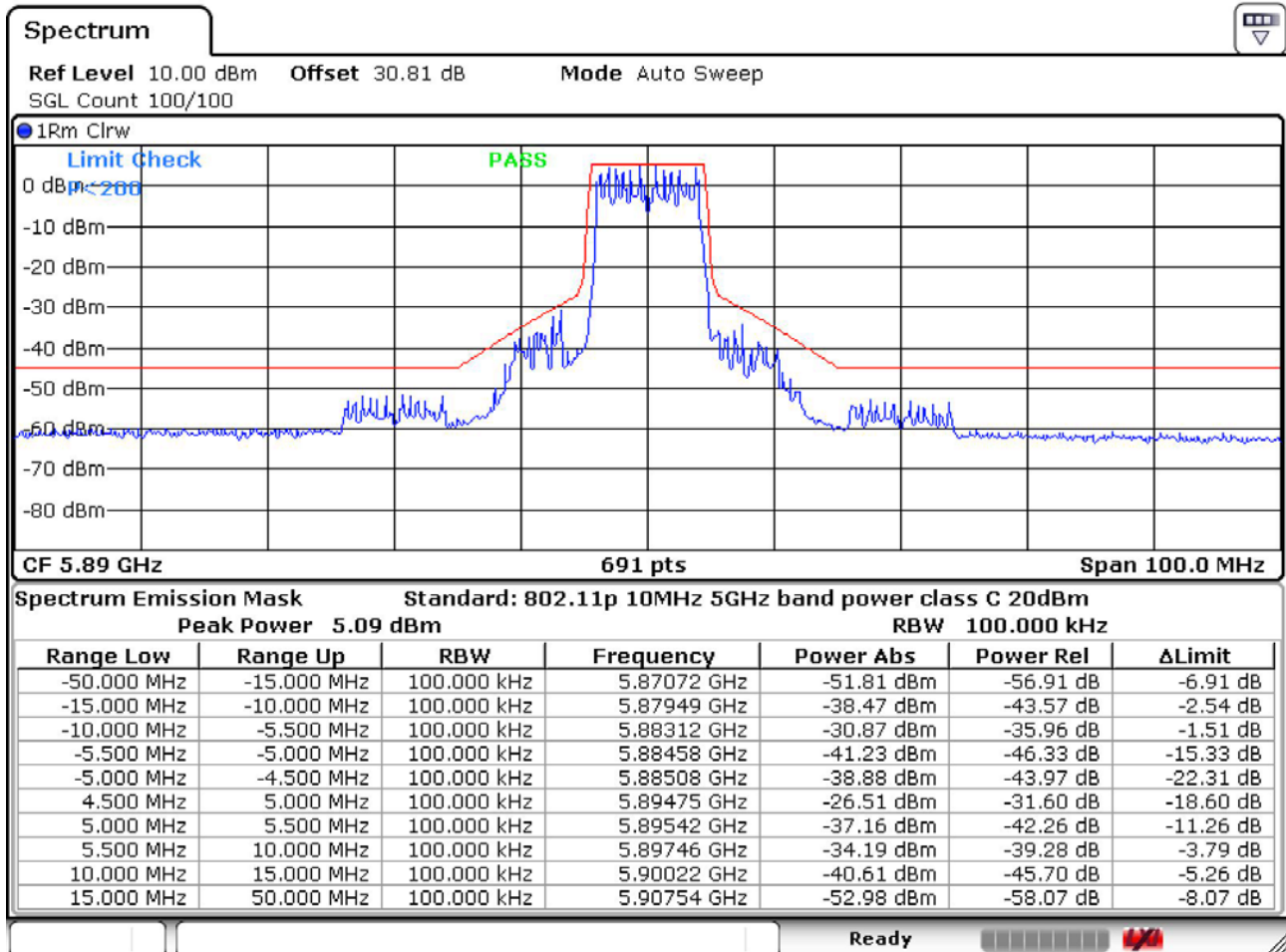
- Please refer 5.3.1

5.3.7 Test Plot

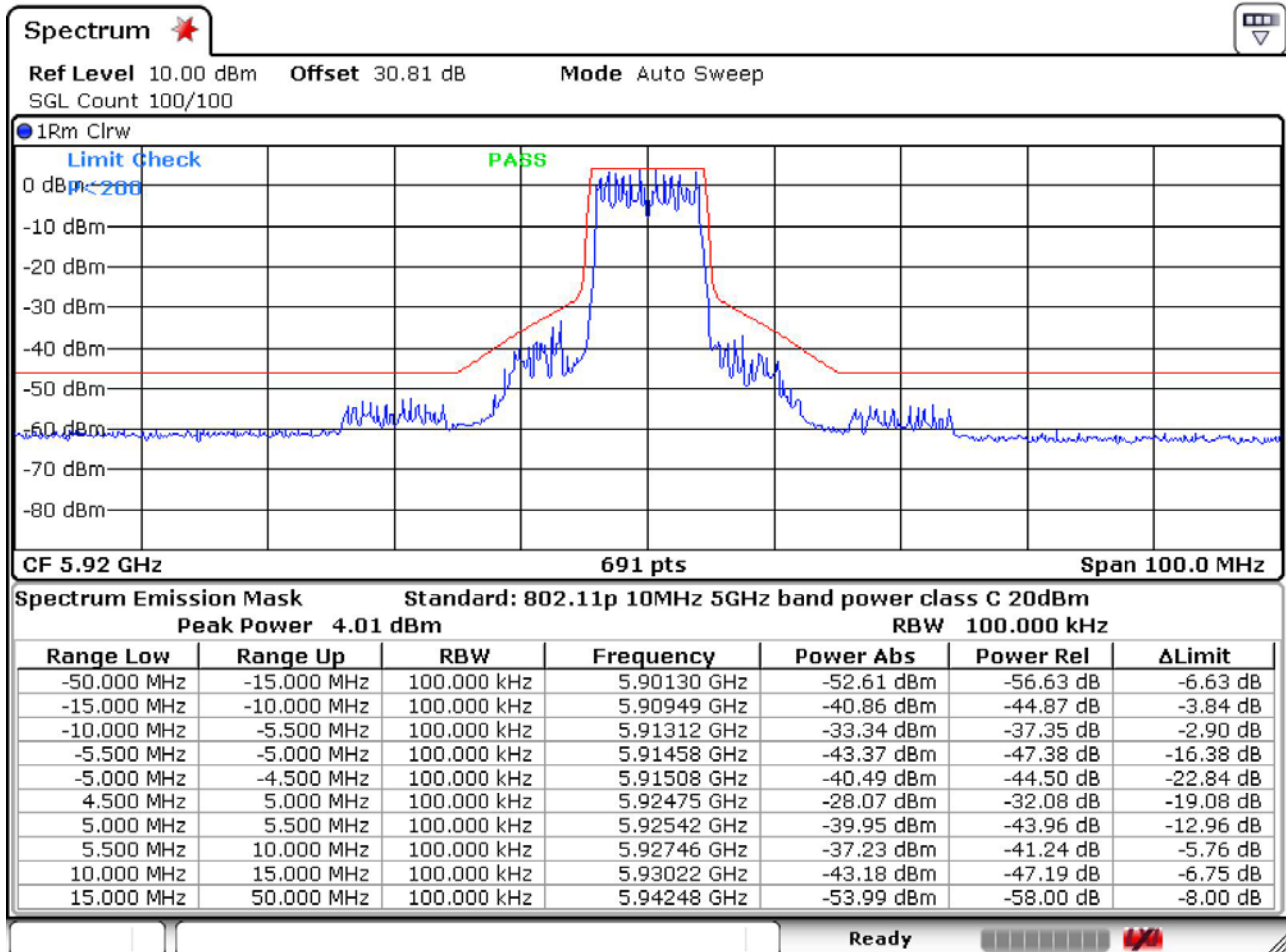
CH Low



CH Middle



CH High



5.4 Transmitter Conducted Unwanted Emissions

5.4.1 Standard Applicable [FCC §90.379]

For the 5.850 - 5.925 GHz band, The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $[55 + 10 \log (P)]$ (-25dBm).

5.4.2 Test Environment conditions

- Ambient temperature : (20 - 21) °C,
- Relative Humidity : (43 - 45) % R.H.

5.4.3 Measurement Procedure

EUT connect to Spectrum analyzer.

The spectrum analyzer is set to the as follows

- RBW : 1MHz
- VBW : 1MHz
- Sweep : auto
- Detector function : RMS
- Trace : max hold

Test Method : ANSI/TIA-603-D-2010, clause 3.2.13 for conducted measurement.

5.4.4 Test setup

Please refer 5.1.4

5.4.5 Measurement Result

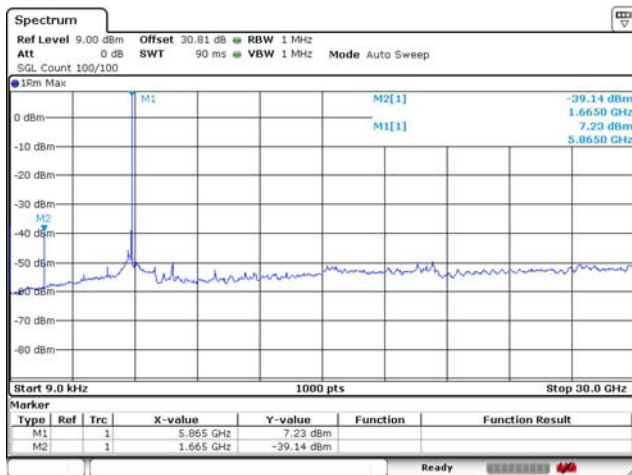
Transmitter Conducted Unwanted Emissions Result			
Frequency (MHz)	Conducted EIRP Emission(dBm/MHz)	EIRP Emission Limit (dBm)	Result
5 860	-39.14	-25	Compliance
5 890	-40.42	-25	Compliance
5 920	-42.13	-25	Compliance

5.4.6 Limit

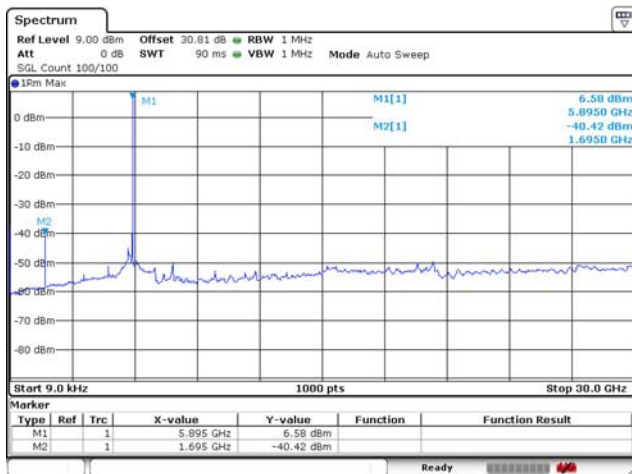
Attenuated at least -25 dBm

5.4.7 Test Plot

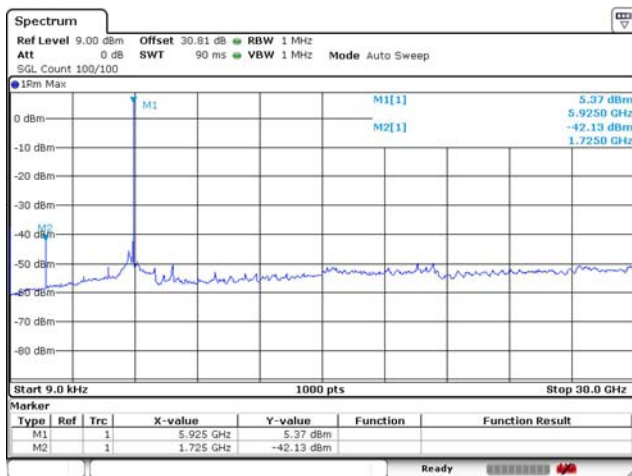
CH Low



CH Middle



CH High



There were no signals above 30 GHz and the worst-case emissions are reported.

5.5 Transmitter Radiated Unwanted Emissions

5.5.1 Standard Applicable [FCC §90.379]

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $[55 + 10 \log (P)]$ (e.i.r.p. -25 dBm [70.2 dBuV/m at 3m])

5.5.2 Test Environment conditions

- Ambient temperature : (20 - 21) °C,
- Relative Humidity : (43 - 45) % R.H.

5.5.3 Measurement Procedure

The EUT was setup according to ANSI/TIA 603D:2010 and tested according to test procedure of ASTM E2213-03 DSRC 8.10.3 for compliance to FCC 47CFR part 90 requirements. The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10, 2009 on radiated measurement. The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure(Duty cycle < 98%) ; RBW is set at 1MHz, VBW is set at 10Hz for Average measure(Duty cycle ≥ 98%)(according ANSI C63.10:2009 clause 4.2.3.2.3 procedure for average measure). Both PK and AV level test, PK detector is used.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas. The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna. The worst radiated emission is measured on the Final Measurement. The measurement frequency range from 9kHz - 10th Harmonic of fundamental was investigated.

- Test Method : ANSI/TIA-603-D-2010, clause 3.2.12 for radiated measurement.

Effective Isotropic Radiated Power (EIRP) :

KDB 412172, clause 1.3.1 following as field strength approach. e.i.r.p.= $(E \times d)^2 / 30$.

$E = (1000000/\sqrt{30P})/3 \mu V/m$, Where P is the EIRP in Watts

For radiated measurement. :

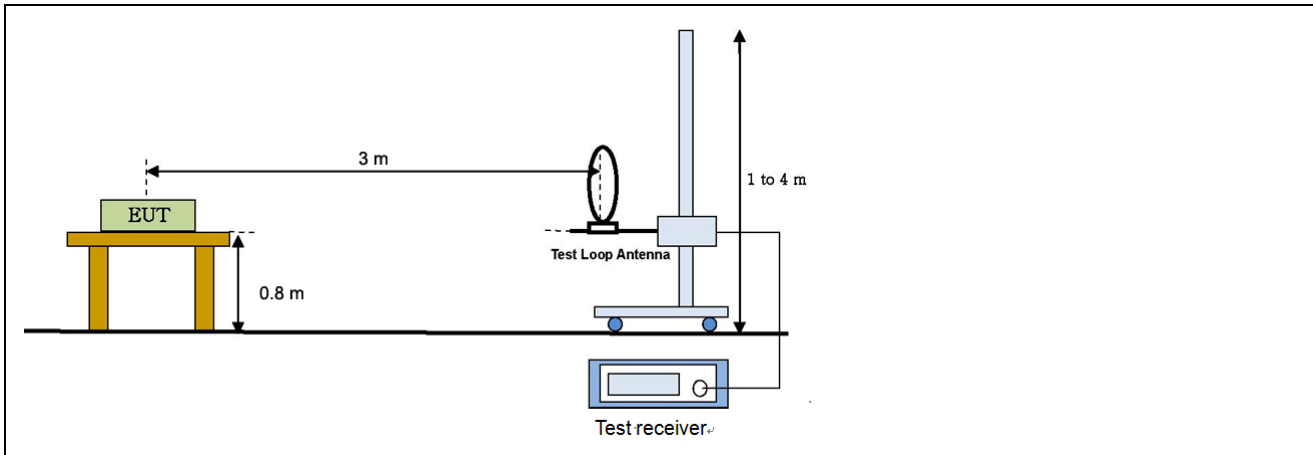
KDB 412172, clause 5 following eirp can be directly determined using the field strength.

5.5.4 Measurement Uncertainty

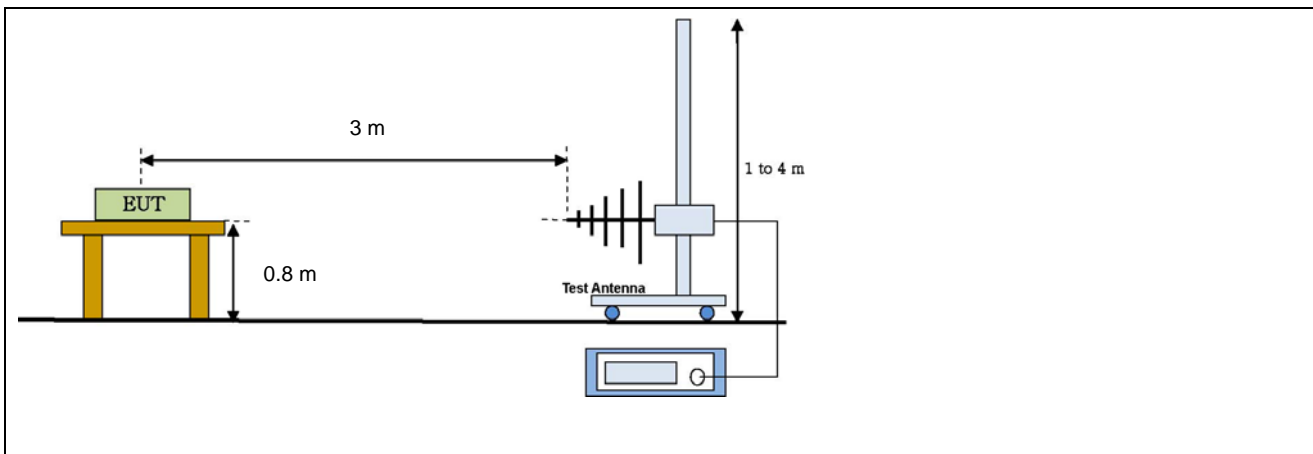
All measurements involve certain levels of uncertainties. The factors contributing to uncertainties are test receiver, Cable loss, Antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, Antenna frequency interpolation, measurement distance variation, Site imperfection, mismatch, and system repeatability based on NIS 80,81, The measurement uncertainty level with a 95 % confidence level were apply to Uncertainty of a radiation emissions measurement at Chamber of KOSTEC is ± 6.0 dB

5.5.5 Test Configuration

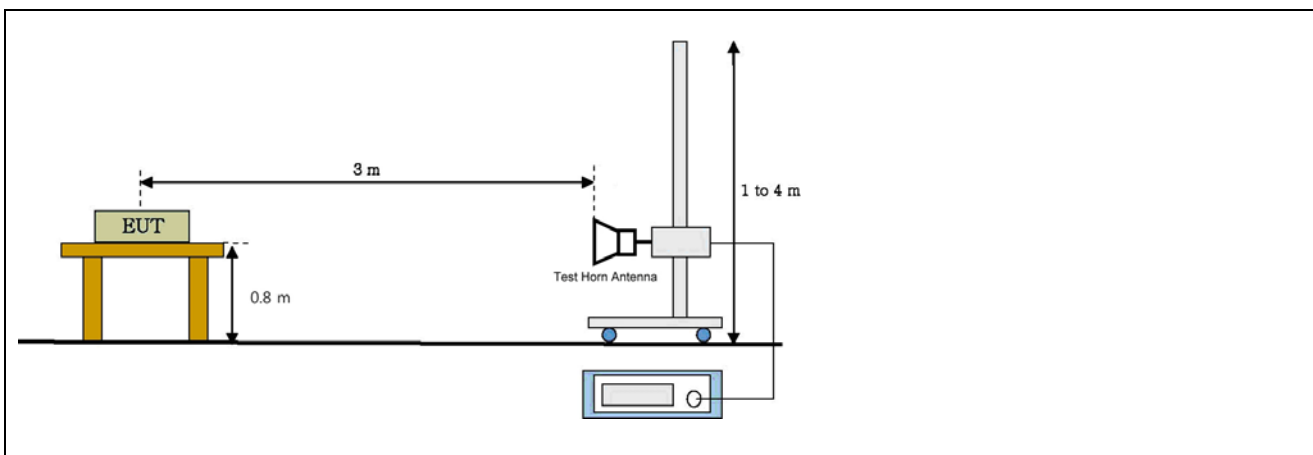
Radiated emission setup, Below 30 MHz



Radiated emission setup, Below 1 000 MHz



Radiated emission setup, Above 1 GHz



5.5.6 Measurement Result

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

Following channel(s) was (were) selected for the final test as listed below.

Mode	Data rate	Measured CH
802.11p 5.9G-10M	3 Mbps	172 (5860 MHz)
		178 (5890 MHz)
		184 (5920 MHz)

Below 1 GHz

CH Low

Freq. (MHz)	Reading (dB μ V/m)	Table (Deg)	Antenna			CL (dB)	Pre AMP (dB)	Meas Result (dB μ V/m)	Limit (dB μ V/m)	Mgn (dB)	Result
			Height (m)	Pol. (H/V)	Fctr. (dB/m)						
152.22	30.68	110	1.0	V	8.48	1.15	-	40.31	70.2	29.89	Compliance
245.34	30.86	110	1.0	V	10.03	1.57	-	42.46	70.2	27.74	Compliance
336.52	27.84	130	1.2	H	12.76	1.96	-	42.56	70.2	27.64	Compliance

CH middle

Freq. (MHz)	Reading (dB μ V/m)	Table (Deg)	Antenna			CL (dB)	Pre AMP (dB)	Meas Result (dB μ V/m)	Limit (dB μ V/m)	Mgn (dB)	Result
			Height (m)	Pol. (H/V)	Fctr. (dB/m)						
153.21	31.52	120	1.0	V	8.48	1.15	-	41.15	70.2	29.05	Compliance
247.58	30.92	130	1.0	H	10.03	1.57	-	42.52	70.2	27.68	Compliance
338.12	28.12	130	1.0	V	12.76	1.96	-	42.84	70.2	27.36	Compliance

CH High

Freq. (MHz)	Reading (dB μ V/m)	Table (Deg)	Antenna			CL (dB)	Pre AMP (dB)	Meas Result (dB μ V/m)	Limit (dB μ V/m)	Mgn (dB)	Result
			Height (m)	Pol. (H/V)	Fctr. (dB/m)						
153.2	30.86	120	1.0	V	8.48	1.15	-	40.49	70.2	29.71	Compliance
247.86	31.12	110	1.0	V	10.03	1.57	-	42.72	70.2	27.48	Compliance
342.21	29.86	120	1.0	V	12.76	1.96	-	44.58	70.2	25.62	Compliance

Above 1 GHz

CH Low

Freq. (GHz)	Reading (dB μ V/m)		Table (Deg)	Antenna			CL+Pre AMP (dB)	Meas Result (dB μ V/m)		Limit (dB μ V/m)		Mgn. (dB)		Result
	PK	AV		Height (m)	Pol. (H/V)	Fctr. (dB/m)		PK	AV	PK	AV	PK	AV	
1.167	23.53	15.39	120	1.0	V	25.15	1.70	50.37	42.23	70.2	50.2	19.83	7.97	Compliance

There were no signals above 1.167 GHz

CH middle

Freq. (GHz)	Reading (dB μ V/m)		Table (Deg)	Antenna			CL+Pre AMP (dB)	Meas Result (dB μ V/m)		Limit (dB μ V/m)		Mgn. (dB)		Result
	PK	AV		Height (m)	Pol. (H/V)	Fctr. (dB/m)		PK	AV	PK	AV	PK	AV	
1.171	24.26	13.19	120	1.0	V	25.15	1.70	51.12	40.05	70.2	50.2	19.08	10.15	Compliance

There were no signals above 1.171 GHz

CH High

Freq. (GHz)	Reading (dB μ V/m)		Table (Deg)	Antenna			CL+Pre AMP (dB)	Meas Result (dB μ V/m)		Limit (dB μ V/m)		Mgn. (dB)		Result
	PK	AV		Height (m)	Pol. (H/V)	Fctr. (dB/m)		PK	AV	PK	AV	PK	AV	
1.180	24.06	12.97	120	1.0	V	25.17	1.71	50.94	39.85	70.2	50.2	19.26	10.35	Compliance

There were no signals above 1.180 GHz

※ Note

- All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
- Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
- Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
- For the below 30 MHz, measured any other signal is not detected on test receiver
- The transmitter radiated spectrum was investigated from 9 kHz to 40 GHz.

Freq.(MHz) : Measurement frequency, Reading(dB μ V/m) : Indicated value for test receiver,

Table (Deg) : Directional degree of Turn table,

Antenna (Height, Pol, Fctr) : Antenna Height, Polarization and Factor

Cbl(dB) : Cable loss, Pre AMP(dB) : Preamplifier gain(dB)

Meas Result (dB μ V/m) : Reading(dB μ V/m)+ Antenna factor.(dB/m) + CL(dB) - Pre AMP(dB)

Limit(dB μ V/m): Limit value specified with FCC Rule, Mgn(dB) : FCC Limit (dB μ V/m) – Meas Result(dB μ V/m)

5.6 Frequency Stability

5.6.1 Standard Applicable [FCC §90.213 & 90.379]

per ASTM E2213-03 Clause 8.10.4, The transmitter center frequency stability shall be ± 10 ppm maximum for DSRC 5.9GHz band.

5.6.2 Test Environment conditions

- Ambient temperature : (20 - 21) °C ,
- Relative Humidity : (43 - 45) % R.H.

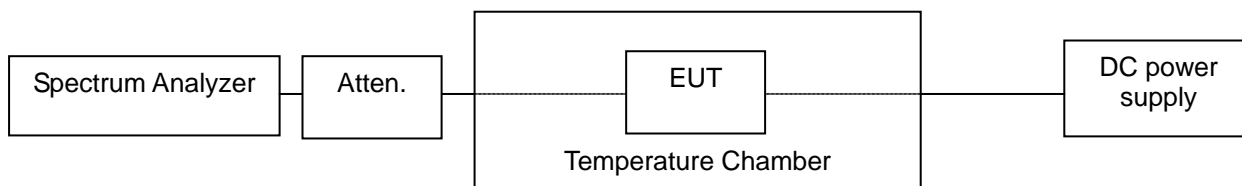
5.6.3 Measurement Procedure

EUT connect to Spectrum analyzer, test is performed in T&H chamber.

These measurements shall also be performed at normal and extreme test conditions.

- Test Method : ANSI/TIA-603-D-2010, clause 3.2.2 for frequency stability tests
 - Frequency stability with respect to ambient temperature
 - Frequency stability when varying supply voltage

5.6.4 Test setup



5.6.5 Measurement Result

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

Following channel(s) was (were) selected for the final test as listed below.

Mode	Data rate	Measured CH
802.11p 5.9G-10M	3 Mbps	172 (5860 MHz)

Temp(°C)	Power Supply	Measured Freq(MHz)	Freq Drift(ppm)
50	120(Vnom)	5859.998529	0.25
40	120(Vnom)	5859.998412	0.27
30	120(Vnom)	5859.998333	0.28
20	120(Vnom)	5859.998320	0.29
10	120(Vnom)	5859.998623	0.23
0	120(Vnom)	5860.001123	-0.19
-10	120(Vnom)	5860.001325	-0.23
-20	120(Vnom)	5860.001212	-0.21
Nom Temperature	102(Vmin)	5859.998531	0.25
Nom Temperature	120(Vnom)	5859.998533	0.25
Nom Temperature	138(Vmax)	5859.998433	0.27

5.7 Emission Types

5.7.1 Standard Applicable [FCC §90.379]

Emission Types	D1D
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5.8 Modulation Standard

5.8.1 Standard Applicable [FCC §90.379]

The carrier signal is OFDM. The sub-carriers have the following data rates and modulations:

Data rate	Modulation
3 MBit/s	BPSK
4.5 MBit/s	BPSK
6 MBit/s	QPSK
9 MBit/s	QPSK
12 MBit/s	16-QAM
18 MBit/s	16-QAM
24 MBit/s	64-QAM
27 MBit/s	64-QAM