

TEST REPORT

 CTK Co., Ltd. The Power Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2017-02260 Page (1) / (28) Pages	
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1. Client

- Name : CNSLink Co., Ltd
- Address : #3F,11, Banga-ro 16,Bundang-gu,Seongnam-si,Gyeonggi-do, Republic of Korea
- Date of Receipt : 2017-10-19

2. Manufacturer

- Name : CNSLink Co., Ltd
- Address : #3F,11, Banga-ro 16,Bundang-gu,Seongnam-si,Gyeonggi-do, Republic of Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: CAR DVR / 250-8950 and E200

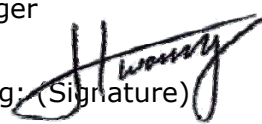
5. Date of Test : 2017-10-19 to 2017-11-23

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247

7. Testing Environment: Temp.: (25 ± 5) °C, Humidity: (48 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by  Ji-Hye, Kim: (Signature)	Technical Manager  Won-Jae, Hwang: (Signature)
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2017-11-29

Republic of KOREA **CTK Co., Ltd.**

REPORT REVISION HISTORY

Date	Revision	Page No
2017-11-29	Issued (CTK-2017-02260)	all

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250.0 General Product Description

FCC ID	2AOD7-X52FH						
Equipment model name	250-8950						
Variant model name	E200						
Serial number	Prototype						
EUT condition	Pre-production, not damaged						
Frequency Range	802.11b : 2 437 MHz						
<table> <tr> <td>Frequency Range(MHz)</td><td>2 437</td></tr> <tr> <td>Mode</td><td>802.11b</td></tr> <tr> <td>RF output power</td><td>15.41</td></tr> </table>		Frequency Range(MHz)	2 437	Mode	802.11b	RF output power	15.41
Frequency Range(MHz)	2 437						
Mode	802.11b						
RF output power	15.41						
Number of channels	802.11b : 1						
Transfer Rate	802.11b : 11 / 5.5 / 2 / 1 Mbps						
Type of Modulation	802.11b : DSSS						
Power Source	DC 12 V – DC 24 V						
Duty Cycle	802.11b : 99.06 %						
Antenna Type	Chip Antenna						
Antenna Gain	3.0 dBi						
Hardware Rev	17-026						
Software Rev	V2.1.2						

2.0 Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

2.2 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	KR0025 (805871)	
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3.0 Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Limit	Status (Note 1)	Test Condition
15.247(a)	6 dB Bandwidth	> 500 kHz	C	Conducted
15.247(b)	Maximum Output Power	< 1 Watt	C	
15.247(d)	Conducted Spurious emission	> 30 dBc	C	
15.247(d)	Band Edge	> 30 dBc	C	
15.247(e)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz	C	
15.209	Field Strength of Harmonics	15.209(a)	C	Radiated
15.207	AC Conducted Emissions	15.207(a)	NA	Line Conducted
<i>Note 1:</i> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
<i>Note 2:</i> The data in this test report are traceable to the national or international standards.				

The sample was tested according to the following specification:
FCC Part 15.247, ANSI C63.10-2013

The tests were performed according to the method of measurements prescribed in
KDB No.558074.

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission.

For WLAN function, the engineering test program was provided and enabled to make EUT continuous transmit/receive.

All modulation modes were tests. The results are only attached worst cases.

This EUT is supported the DC 12 V and DC 24 V. We have done all test mode.

Worst case is DC 12 V. So the worst data of DC 12 V are shown.

Preliminary radiated emissions test were performed Semi-Anechoic Chamber or anechoic chamber (Distance of antenna and EUT was 3 m). To find worst mode, several typical mode and typical cable position were tested and peak level and frequency were recorded.

Test mode

Test Item	Modulation	Data Rate
6 dB Bandwidth Maximum Output Power Conducted Spurious emission Band Edge Power Spectral Density Radiated Emissions	802.11b	1 Mbps

Test Frequency

- 802.11b

Lowest channel	Middle channel	Highest channel
-	2 437 MHz	-

3.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

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3.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253QPR
AC/DC Adapter	HP	HSTNN-CA40	-

3.5 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	± 1.5 dB
Power Spectral Density	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions ($f \leq 1$ GHz)	± 4.0 dB
Radiated Emissions ($f > 1$ GHz)	± 5.0 dB

3.6 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 5.1.0

4.0 Technical Characteristic Test

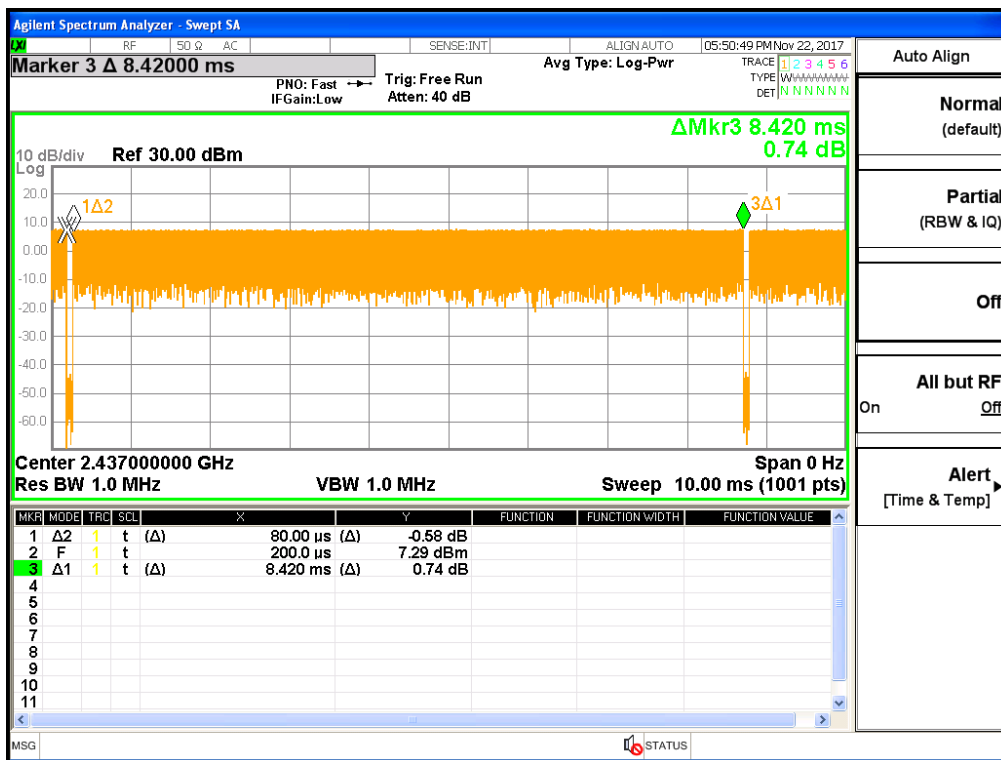
4.1 ON Time, Duty Cycle

Test Procedures

KDB 558074 Zero-Span Spectrum Analyzer Method.

Test Data:

	ON Time (ms)	Period (ms)	TX OFF (ms)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)
802.11b	8.42	8.50	0.08	0.9906	99.06	-



Duty Cycle_802.11b

4.2 6dB Bandwidth

Test Procedures (ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Procedures (ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

- | | |
|--|----------------------------|
| a) RBW = 100 kHz | b) VBW $\geq 3 \times$ RBW |
| c) Detector = peak | d) Trace mode = Max hold |
| e) Sweep = auto couple | |
| f) Allow trace to fully stabilize | |
| g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. | |

Minimum Standard:

6 dB Bandwidth > 500kHz

Test Data:

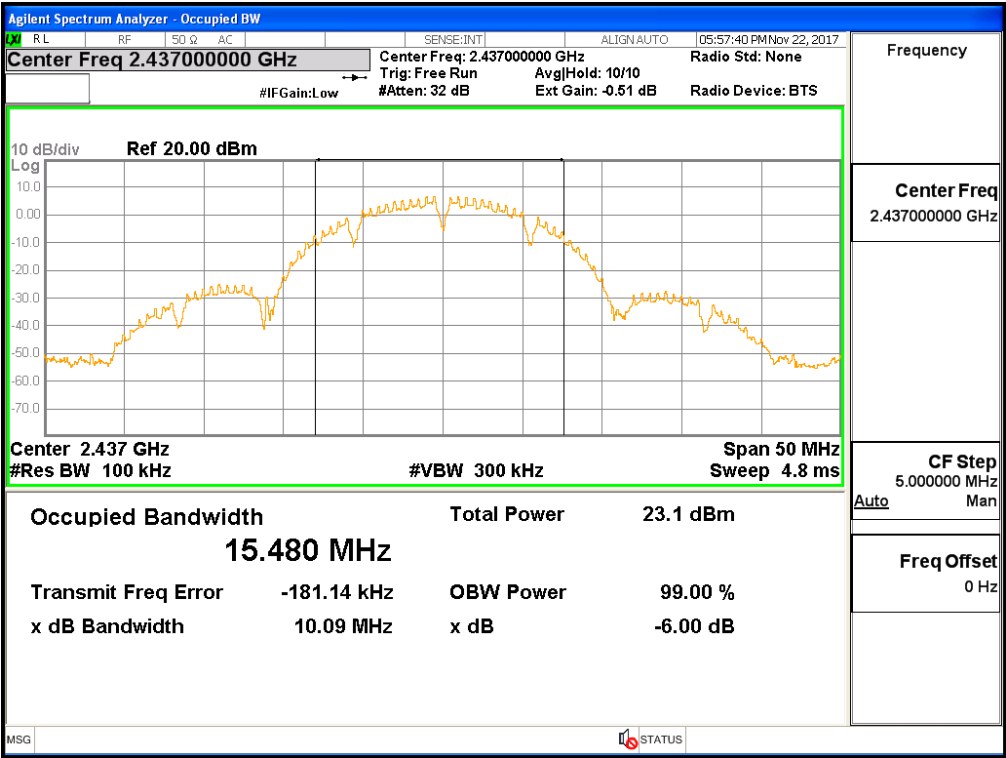
	6 dB Bandwidth and 99% Bandwidth (MHz)	
Frequency	2 437 MHz	
Mode	6dB	99%
802.11b	10.09	15.48

See next pages for actual measured spectrum plots.



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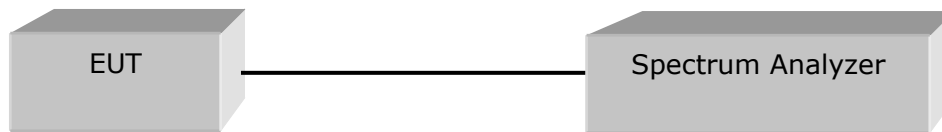
802.11b

4.3 OUTPUT POWER

Test Procedures

Average Power(Procedure 9.2.2.2 in KDB 558074, Method AVGSA-1)

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



Test Settings:

Center frequency = the highest, middle and the lowest channels

- | | |
|--------------------------------------|-------------------------|
| a) span $\geq 1.5 \times \text{OBW}$ | b) RBW = 1 MHz |
| c) VBW $\geq 3 \times \text{RBW}$ | d) Sweep time = auto |
| e) Detector = RMS | f) average at least 100 |

Limit

< 1 W

Test Data

Test Mode : 802.11b

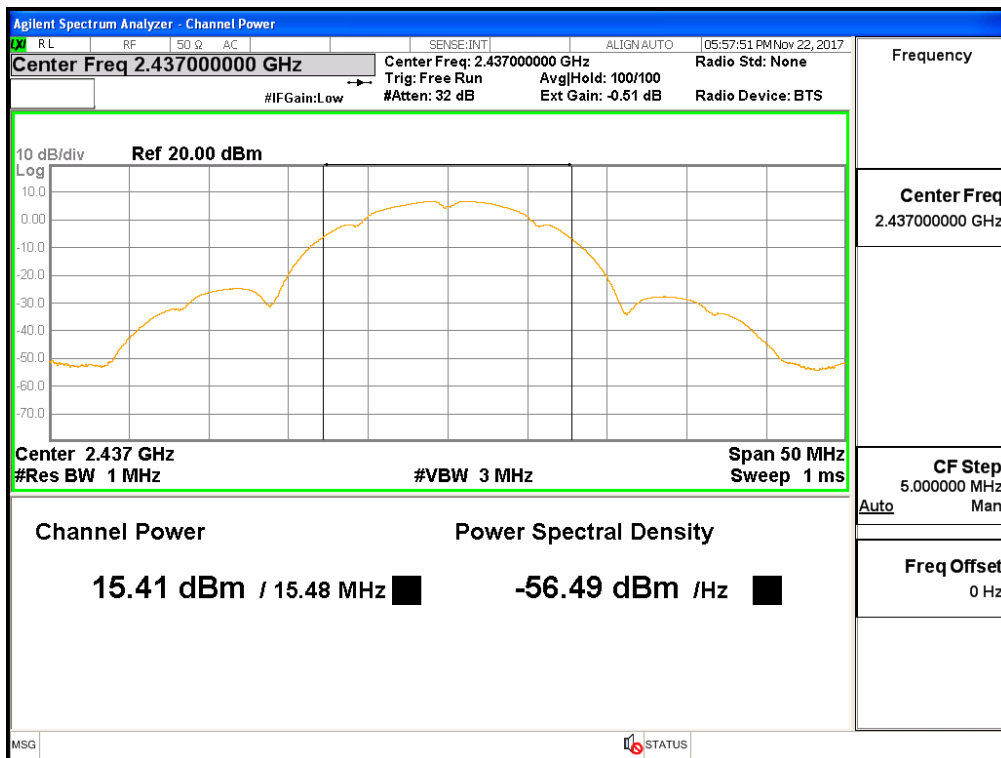
Frequency (MHz)	Output Power (dBm)				
	Measured Power (dBm)	Duty Cycle Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
2 437	15.41	-	15.41	30	14.59

See next pages for actual measured spectrum plots.



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802.11b

4.4 Power Spectral Density

Test Procedures

Procedure 10.2 in KDB 558074, Method Peak PSD

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Test Settings:

Center frequency = the highest, middle and the lowest channels

- | | |
|--|-----------------------------------|
| a) RBW : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ | b) VBW $\geq 3 \times \text{RBW}$ |
| c) span $\geq 1.5 \times \text{DTS bandwidth}$ | d) Sweep time = auto couple |
| e) Detector = peak | f) Trace mode= max hold |
| g) Allow trace to fully stabilize | |
| h) Use the peak marker function to determine the maximum amplitude level within the RBW. | |

Limit

Power Spectral Density	< 8dBm @ 3 kHz BW
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Test Data

Test Mode : 802.11b

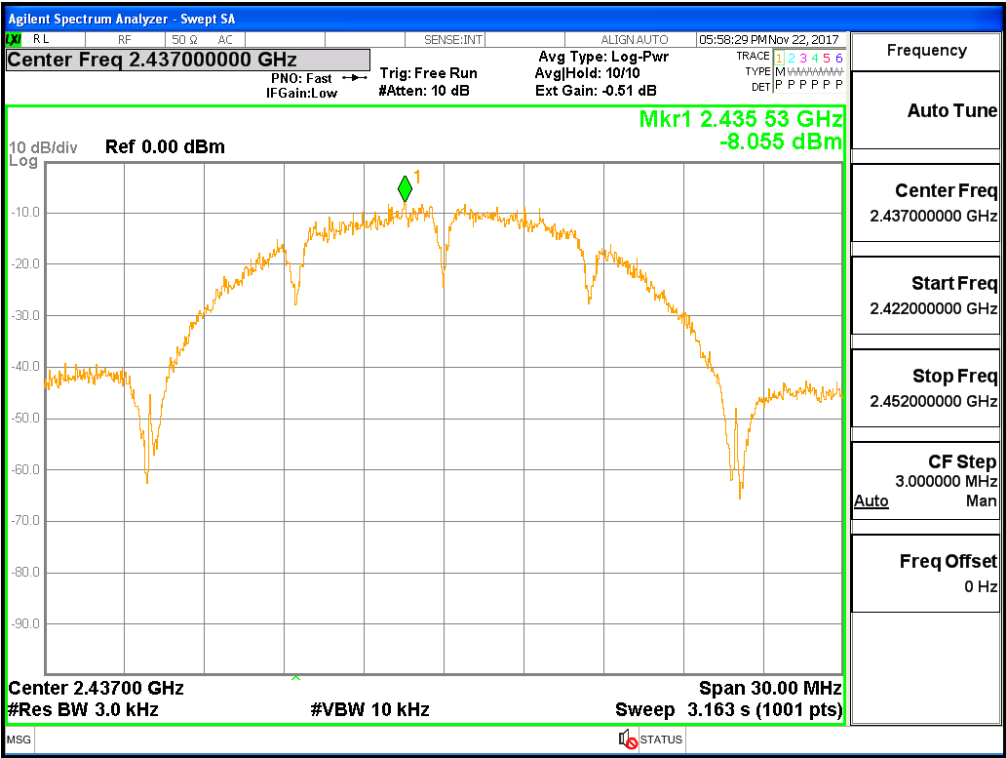
	Measured Power Density (dBm/3kHz)		
Frequency (MHz)	Result (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
2 437	-8.055	8	16.055

See next pages for actual measured spectrum plots.



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4.5 Band - edge

Test Procedures

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW $\geq 3 \times$ RBW
- c) Detector = peak
- d) Sweep time = auto couple
- e) Trace mode= max hold
- f) Allow trace to fully stabilize
- g) Use the peak marker function to determine the maximum amplitude level.

Limit :

Emission level < 30 dBc

Test Data: Complies

- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 30dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.



802.11b

4.6 Field Strength of Emissions

Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Test Settings:

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
- b) VBW $\geq$ RBW
- c) Sweep time = auto couple

Limit

- 15.209(a)

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement Distance (meters)
0.009-0.490	2 400/F(kHz)	-	300
0.490-1.705	24 000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

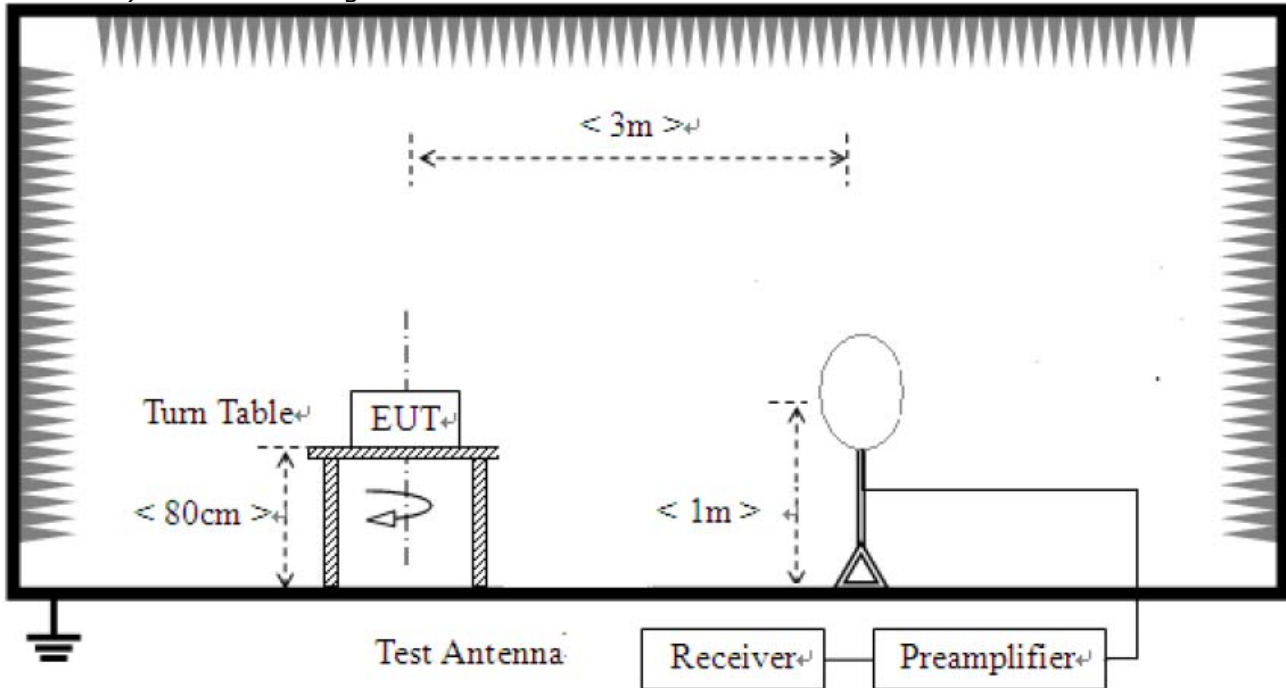
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

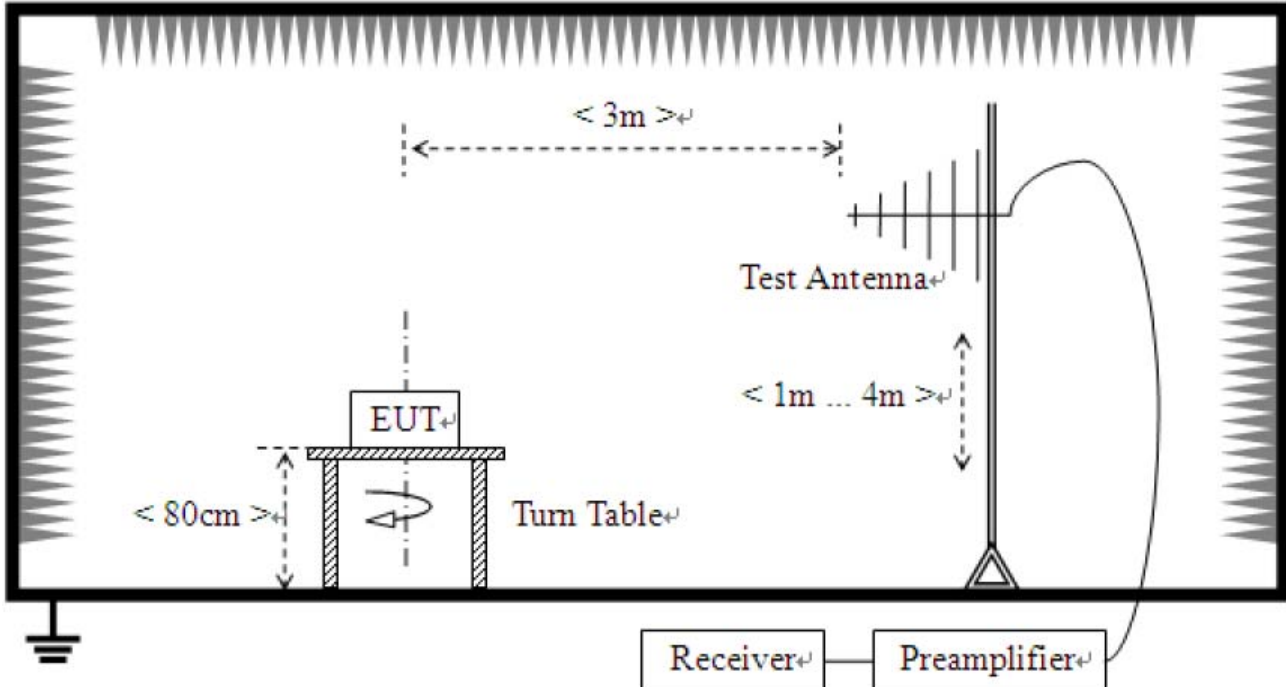
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

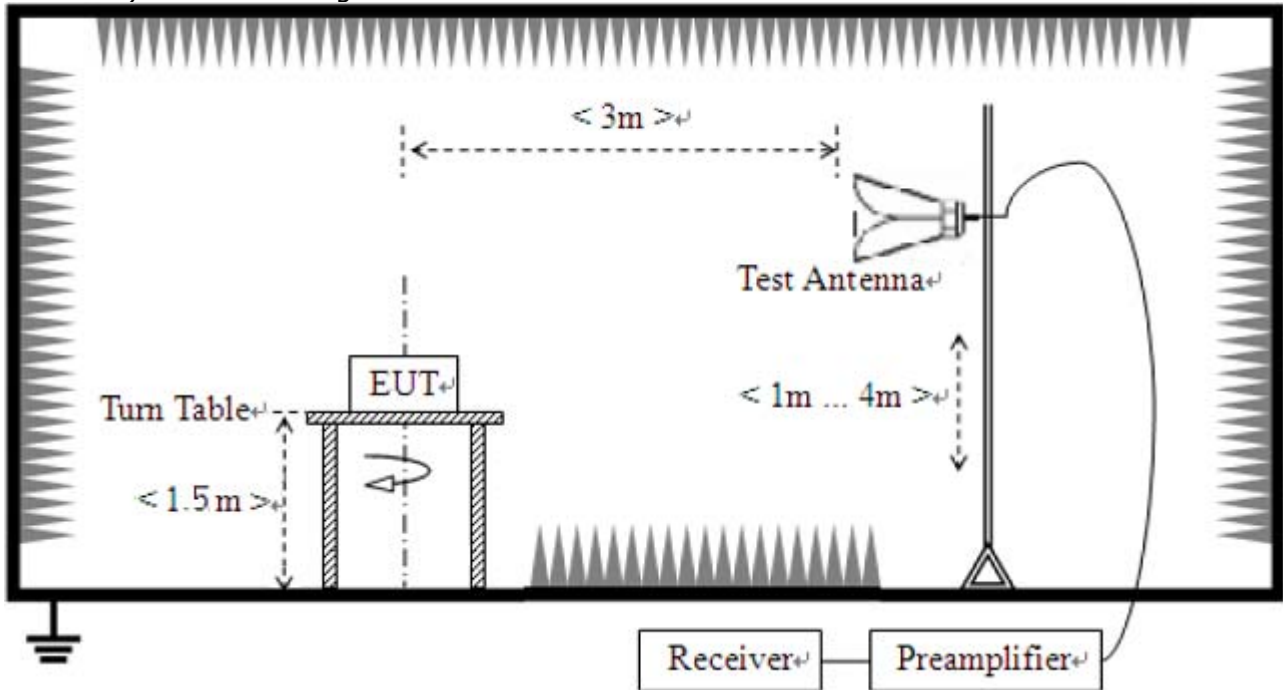
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



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Test Results

1) 9 kHz to 30 MHz

EUT	CAR DVR	Measurement Detail	
Model	250-8950	Frequency Range	9 kHz – 30 MHz
Test mode	802.11b	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)

2) 30 MHz to 1 GHz

Test mode : 802.11b

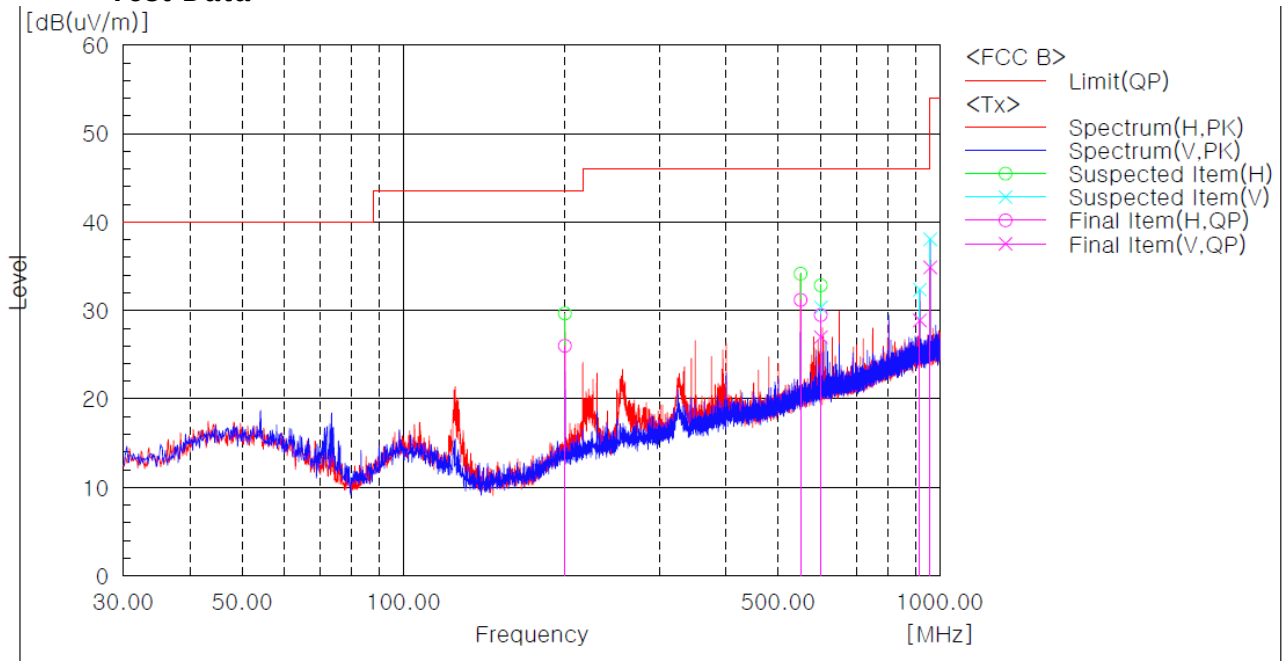
EUT	CAR DVR	Measurement Detail	
Model	250-8950	Frequency Range	Below 1 000 MHz
Configuration	802.11b	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
959.982	34.9	11.1	Quasi-Peak

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Angle [deg]	Remark
1	200.014	H	40.1	-14.1	26.0	43.5	17.5	329.3	
2	549.985	H	39.8	-8.6	31.2	46.0	14.8	359.6	
3	599.946	V	34.7	-7.7	27.0	46.0	19.0	359.4	
4	600.068	H	37.2	-7.7	29.5	46.0	16.5	88.7	
5	918.025	V	32.7	-3.8	28.9	46.0	17.1	92.9	
6	959.982	V	38.3	-3.4	34.9	46.0	11.1	107.8	

Remark :

1. The worst emission was found in li-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

3) above 1 GHz

Test mode : 802.11b

EUT	CAR DVR	Measurement Detail	
Model	250-8950	Frequency Range	1 - 25 GHz
Mode	802.11b	Detector function	Average / Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4 874.00	52.28	1.72	Average

Ch.6(2 437 MHz)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
1 440.00	H	-	-	-	-	-	-
1 440.00	V	54.00	74.00	36.89	42.38	17.11	31.62
4 874.00	H	54.00	74.00	48.38	50.97	5.62	23.03
4 874.00	V	54.00	74.00	52.28	54.13	1.72	19.87
2 390.00	H	54.00	74.00	40.57	50.46	13.43	23.54
2 390.00	V	54.00	74.00	40.39	50.59	13.61	23.41
2 483.50	H	54.00	74.00	34.15	47.56	19.85	26.44
2 483.50	V	54.00	74.00	33.55	46.84	20.45	27.16

Remarks

1. The worst emission was found in li-down position(Z axis) and the worst case was recorded.

4.7 AC Conducted Emissions

Test Location
Shielded Room

Frequency Range of Measurement
150 kHz to 30 MHz

Instrument Settings
IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

- **15.207(a)**

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency.

Test Results
The requirements are:

☒ **Not Applicable**

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	-

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2017-11-01	2018-11-01
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2017-11-01	2018-11-01
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2017-11-01	2018-11-01
4	Bilog Antenna	Schaffner	CBL6111C	2551	2016-05-13	2018-05-13
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2016-05-16	2018-05-16
6	6dB Attenuator	R&S	DNF	272.4110.50-2	2017-11-01	2018-11-01
7	6dB Attenuator	R&S	DNF	272.4110.50-1	2017-02-03	2018-02-03
8	AMPLIFIER	SONOMA	310	291721	2017-02-02	2018-02-02
9	Preamplifier	Agilent	8449B	3008A02011	2016-12-01	2017-12-01
10	Horn Antenna	ETS-Lindgren	3115	00078895	2017-04-25	2019-04-25
11	Horn Antenna	ETS-Lindgren	3116	00062916	2017-04-25	2019-04-25
12	Horn Antenna	ETS-Lindgren	3117	00154525	2017-09-14	2019-09-14
13	Band Reject Filter	Micro Tronics	BRM50702	G233	2017-02-03	2018-02-03
14	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2017-05-12	2018-05-12