TEST REPORT

OF

FCC Part 15 Subpart C §15.209 / IC RSS-210 Issue 8, RSS-Gen Issue 3
FCC ID/IC Certification: TQ8-SMK-4E07 / 5074A-SMK4E07

Equipment Under Test	:	SMART KEY ECU
Model Name	:	SMK-4E07
Applicant	:	Hyundai MOBIS Co., Ltd.
Manufacturer	:	Hyundai MOBIS Co., Ltd.
Date of Test(s)	:	2014.10.20 ~ 2014.10.31
Date of Issue	:	2014.11.07

In the configuration tested, the EUT complied with the standards specified above.

Tested By: **Alvin Kim** **Date:** **2014.11.07**

Approved By **Hyunchae You** **Date:** **2014.11.07**

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
-Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-837
All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx.
Telephone : + 82 31 688 0901
FAX : + 82 31 688 0921

1.2. Details of Applicant

Applicant : Hyundai Mobis Co., Ltd.
Address : 203, Teheran-ro, Gangnam-gu, Seoul, 135-977 Republic of Korea
Contact Person : Choi, Seung-Hoon
Phone No. : + 82 31 260 0098

1.3. Description of EUT

Kind of Product	SMART KEY ECU
Model Name	SMK-4E07
Power Supply	DC 12 V (Used by Vehicle battery)
Frequency Range	Tx: 125.00 ㎑ (LF Antenna) Rx: 433.92 ㎒ (RF Antenna)
Modulation Technique	ASK
Number of Channels	1
Operating Conditions	-30 ℃ ~ 75 ℃
Antenna Type	Internal Type (Coil Antenna)

1.4. Declarations by the manufacturer

- RF antenna is only Receiver antenna
- The EUT of antennas cannot operate at the same time.

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due.
Spectrum Analyzer	R&S	FSV30	100768	Mar. 27, 2014	Annual	Mar. 27, 2015
Signal Generator	R&S	SMBV100A	255834	Jun. 25, 2014	Annual	Jun. 25, 2015
Loop Antenna	SCHWARZBECK	FMZB 1519	1519-039	Jul. 09, 2013	Biennial	Jul. 09, 2015
Bilog Antenna	SCHWARZBECK	VULB9163	396	Jun. 07, 2013	Biennial	Jun. 07, 2015
DC power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015
Test Receiver	R&S	ESU26	100109	Mar. 04, 2014	Annual	Mar. 04, 2015
Preamplifier	H.P.	8447F	2944A03908	Aug. 27, 2014	Annual	Aug. 27, 2015
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-1	Jun. 10, 2014	Annual	Jun. 10, 2015
Antenna Master	MA 2000	INN-CO	N/A	N.C.R.	N.C.R.	N.C.R.
Turn Device	DE-3600-RH	INN-CO	N/A	N.C.R.	N.C.R.	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (21.5 m × 13.0 m × 9.0 m)	N/A	N.C.R.	N.C.R.	N.C.R.

1.6. Test Report Revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL008123	2014.10.31	Initial
1	F690501/RF-RTL008123-1	2014.11.07	Modified antenna polarity and detector on the table of field strength

1.7. Summary of Test Results

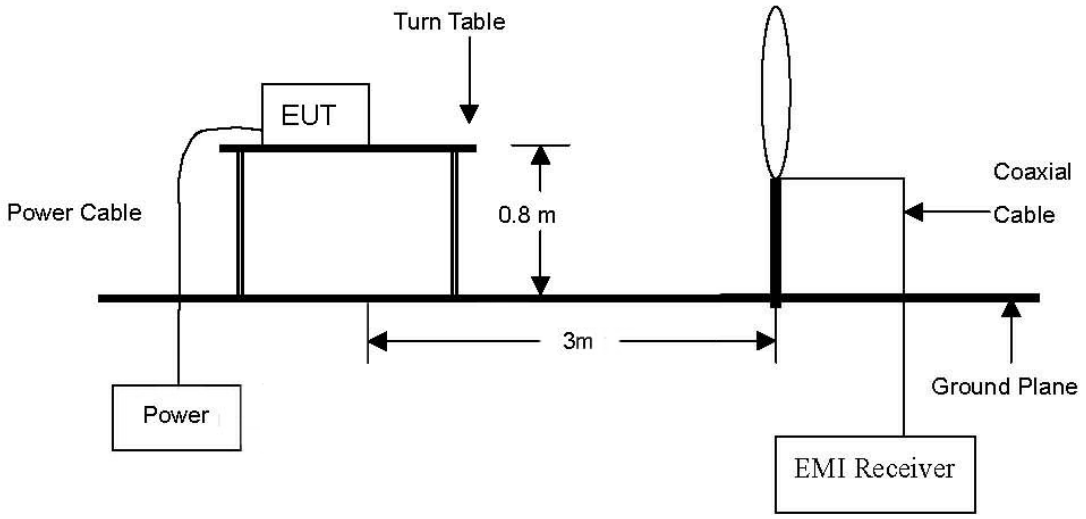
The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart C 15.209/ IC RSS-210 Issue8, RSS-Gen Issue3			
Section in FCC 15 Subpart B&C §15.209	**Section in IC RSS-210 Issue8, RSS-Gen Issue 3**	**Test Item**	**Result**
15.209(a)	RSS-210 Issue8, 2.5.1 RSS-Gen Issue3, 7.2.5 Table 6	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
-	RSS-Gen Issue3, 4.6.1	Occupied Bandwidth	Complied

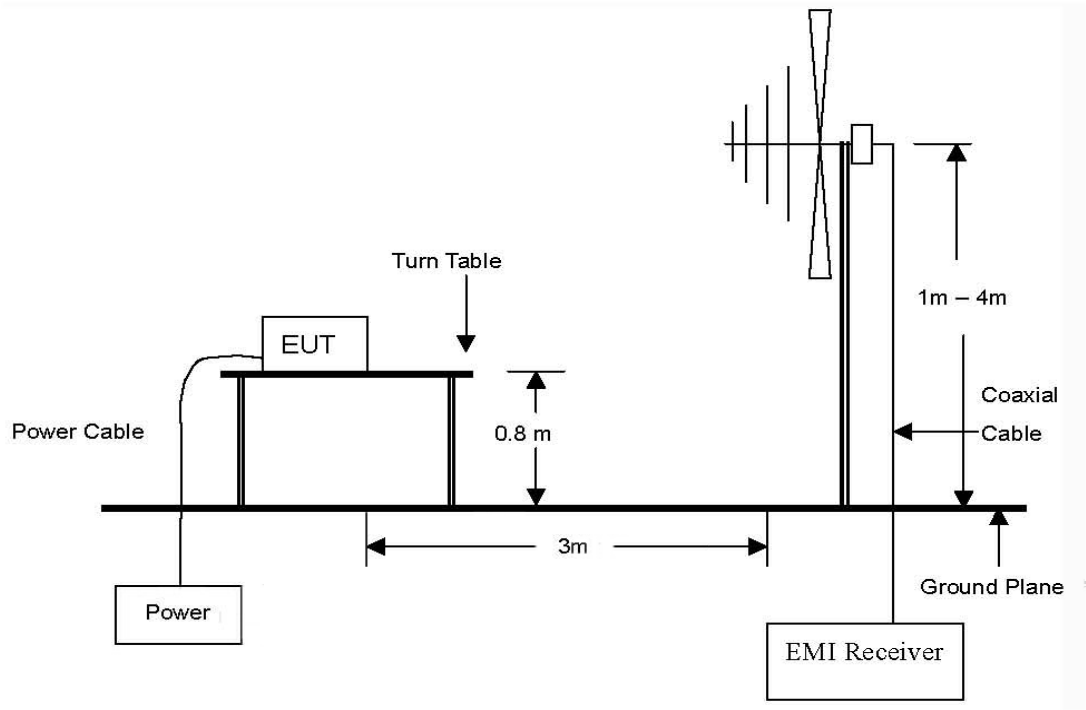
2. Field Strength of Fundamental

2.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



2.2. Limit

2.2.1. Radiated emission limits, general requirements

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (㎒)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009 – 0.490	2400/F(㎑)	300
0.490 – 1.705	24000/F(㎑)	30
1.705 – 30.0	30	30
30 -88	100**	3
88 -216	150**	3
216 - 960	200**	3
Above 960	500	3

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

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

2.3.1. Test Procedures for emission from 9 ㎑ to 30 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
c. For each suspected emission, the EUT was arranged to its worst case and also external antennas of EUT were investigated through X, Y and Z axis at the center of turn table.
d. the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to average Detect Function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from 30 ㎒ to 1 000 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

2.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical. The field strength of spurious emission was measured in three orthogonal EUT antenna position (x-axis, y-axis and z-axis). Worst case is x-axis.

- AST ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m	Limit (dB㎶/m)	Margin (dB)
0.121	60.10	Average	H	20.03	0.07	80.20	0.20	25.95	25.75

- BUM ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m	Limit (dB㎶/m)	Margin (dB)
0.121	57.40	Average	H	18.69	0.07	76.16	-3.84	25.95	29.79

- DRV ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 300 m	Limit (dB㎶/m)	Margin (dB)
0.121	56.60	Average	H	20.03	0.07	76.70	-3.30	25.95	29.25

- INT1 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m	Limit (dBμV/m)	Margin (dB)
0.121	60.30	Average	H	20.03	0.07	80.40	0.40	25.95	25.55

- INT2 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m	Limit (dBμV/m)	Margin (dB)
0.121	60.10	Average	H	20.03	0.07	80.20	0.20	25.95	25.75

- SSB ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 300 m	Limit (dBμV/m)	Margin (dB)
0.125	60.90	Average	H	18.69	0.07	79.66	-0.34	25.67	26.01

Note:

1. 300 m Result(dBμV/m) = 3 m Result(dBμV/m) – 40log(300/3) (dBμV/m)

3. Spurious Emission

3.1. Test Setup

Same as section 2.1 of this report

3.2. Limit

Same as section 2.2 of this report

3.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

3.3.1. Test Procedures for emission from 9 ㎑ to 30 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
d. The test-receiver system was set to quasi-peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

3.3.2. Test Procedures for emission from 30 ㎒ to 1 000 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

3.4. Test Result

Ambient temperature : (24 ± 1) ℃
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

3.4.1. Spurious emission from 9 ㎑ to 30 ㎒

- AST ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual[1] (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m)	Margin (dB)
2.914	5.50	Quasi Peak	H	20.09	0.20	25.79	-14.21	29.54	43.75
13.942	0.30	Quasi Peak	H	20.14	0.49	20.93	-19.07	29.54	48.61

- BUM ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual[1] (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m)	Margin (dB)
0.201	11.00	Average	H	18.65	0.08	29.73	-50.27	13.82	64.09
16.698	6.80	Quasi Peak	H	17.53	0.56	24.89	-15.11	29.54	44.65

- DRV ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual[1] (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m)	Margin (dB)
0.217	42.10	Average	H	20.02	0.08	62.20	-17.80	20.88	38.68
2.380	33.10	Quasi Peak	H	20.13	0.19	53.42	13.42	29.54	16.12
13.560	5.90	Quasi Peak	H	20.13	0.49	26.52	-13.48	29.54	43.02

- INT1 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual[1] (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m)	Margin (dB)
0.473	6.70	Average	H	20.11	0.11	26.92	-53.08	14.11	67.19
10.417	0.50	Quasi Peak	H	20.12	0.41	21.03	-18.97	29.54	48.51

- INT2 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual[1] (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m)	Margin (dB)
0.842	25.80	Quasi Peak	H	20.21	0.14	46.15	6.15	29.10	22.95
17.596	2.60	Quasi Peak	H	20.22	0.58	23.40	-16.60	29.54	46.14

- SSB ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual[1] (dB㎶/m) at 300 m or 30 m	Limit (dB㎶/m)	Margin (dB)
2.523	35.80	Quasi Peak	H	18.50	0.19	54.49	-25.51	16.45	41.96
13.558	41.00	Quasi Peak	H	17.64	0.49	59.13	19.13	29.54	10.41

Note:

1. 300 m Result(dB㎶/m) = 3 m Result(dB㎶/m) – 40log(300/3) (dB㎶/m)
   or 30 m Result(dB㎶/m) = 3 m Result(dB㎶/m) – 40log(30/3) (dB㎶/m)

3.4.2. Spurious emission from 30 ㎒ to 1 000 ㎒

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. All reading values are peak values.

- AST ANT

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
30.12	49.02	Peak	V	12.55	-27.27	34.30	40.00	5.70
36.91	38.33	Peak	V	13.63	-27.16	24.80	40.00	15.20
52.76	32.81	Peak	H	15.50	-26.91	21.40	40.00	18.60
Above 100.00	Not detected	-	-	-	-	-	-	-

- BUM ANT

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
31.78	47.71	Peak	V	12.82	-27.23	33.30	40.00	6.70
40.67	32.81	Peak	H	15.92	-27.13	21.60	40.00	18.40
49.60	42.62	Peak	V	14.56	-26.98	30.20	40.00	9.80
100.33	33.60	Peak	H	14.57	-26.37	21.80	43.50	21.70
Above 200.00	Not detected	-	-	-	-	-	-	-

- DRV ANT

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
35.58	41.04	Peak	V	13.43	-27.17	27.30	40.00	12.70
36.87	36.23	Peak	H	15.43	-27.16	24.50	40.00	15.50
49.20	32.71	Peak	V	14.58	-26.99	20.30	40.00	19.70
106.43	33.60	Peak	H	13.75	-26.35	21.00	43.50	22.50
Above 200.00	Not detected	-	-	-	-	-	-	-

- INT1 ANT

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
30.12	39.52	Peak	V	12.55	-27.27	24.80	40.00	15.20
36.91	36.53	Peak	H	15.43	-27.16	24.80	40.00	15.20
97.86	33.31	Peak	H	14.27	-26.38	21.20	43.50	22.30
619.64	32.68	Peak	V	19.95	-24.73	27.90	46.00	18.10
Above 700.00	Not detected	-	-	-	-	-	-	-

- INT2 ANT

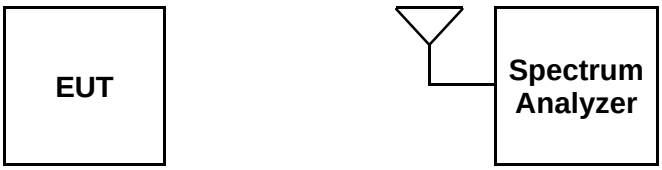
Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
32.02	39.57	Peak	V	12.86	-27.23	25.20	40.00	14.80
36.95	37.82	Peak	V	13.64	-27.16	24.30	40.00	15.70
55.83	33.88	Peak	H	15.17	-26.85	22.20	40.00	17.80
109.14	33.65	Peak	H	13.39	-26.34	20.70	43.50	22.80
Above 200.00	Not detected	-	-	-	-	-	-	-

- SSB ANT

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
31.74	41.33	Peak	V	12.81	-27.24	26.90	40.00	13.10
55.79	33.57	Peak	H	15.18	-26.85	21.90	40.00	18.10
570.49	33.80	Peak	V	18.93	-24.93	27.80	46.00	18.20
Above 600.00	Not detected	-	-	-	-	-	-	-

4. Occupied Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposed only

4.3. Test Procedure

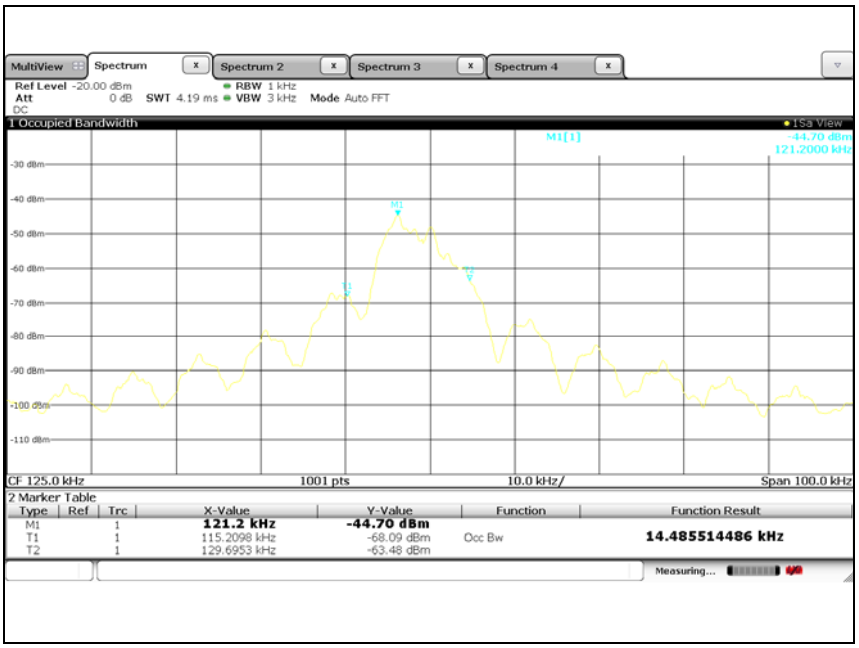
1. The Occupied Bandwidth is measured with a spectrum analyzer connected via a receiving antenna placed near the EUT.
1. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW= 1 ㎑, VBW= 3 ㎑ and Span=50 ㎑ and detector mode= Sample.
2. The bandwidth of fundamental frequency was measured and recorded.

4.4. Test Result

Ambient temperature : (24 ± 1) ℃
Relative humidity : 47 % R.H.

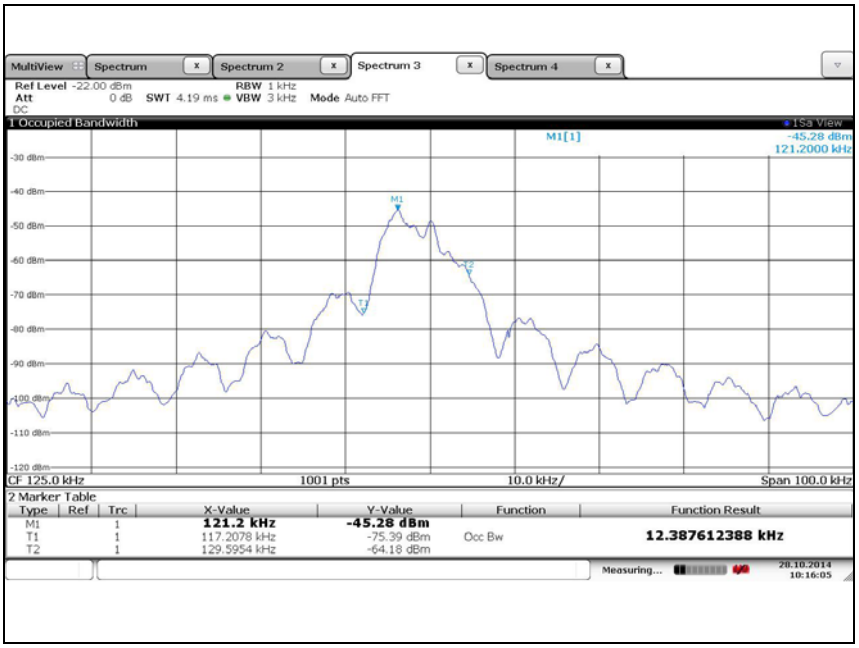
- AST ANT

Carrier Frequency (㎒)	Occupied Bandwidth (㎑)	Limit (㎑)	Remark
0.125	14.486	-	99 % Occupied bandwidth



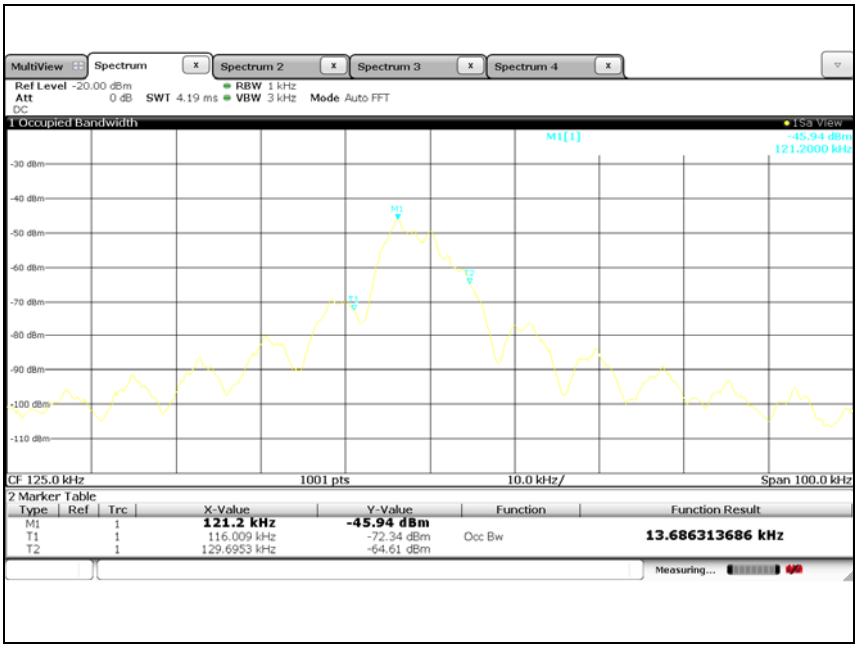
- BUM ANT

Carrier Frequency (㎒)	Occupied Bandwidth (㎑)	Limit (㎑)	Remark
0.125	12.388	-	99 % Occupied bandwidth



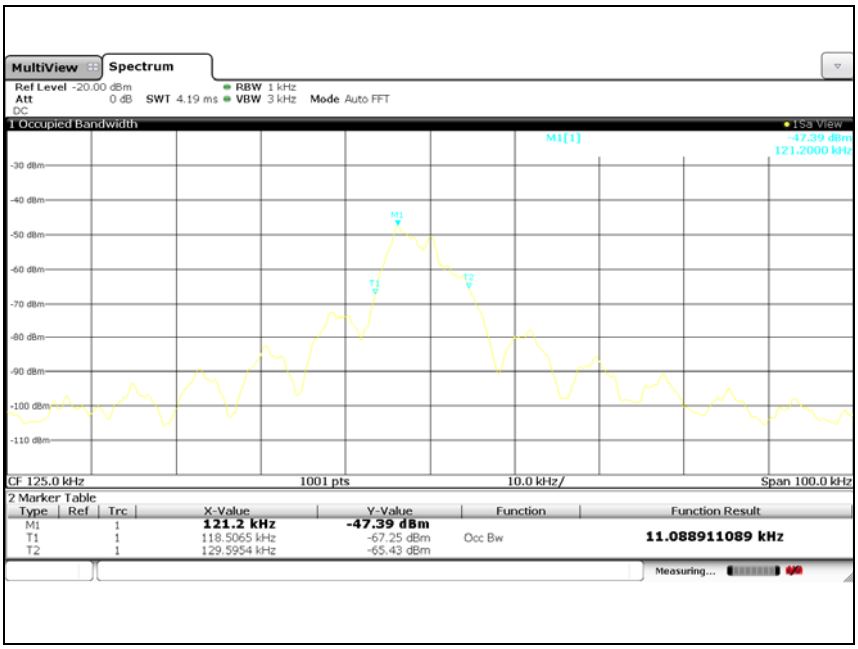
- DRV ANT

Carrier Frequency (㎒)	Occupied Bandwidth (㎑)	Limit (㎑)	Remark
0.125	13.686	-	99 % Occupied bandwidth



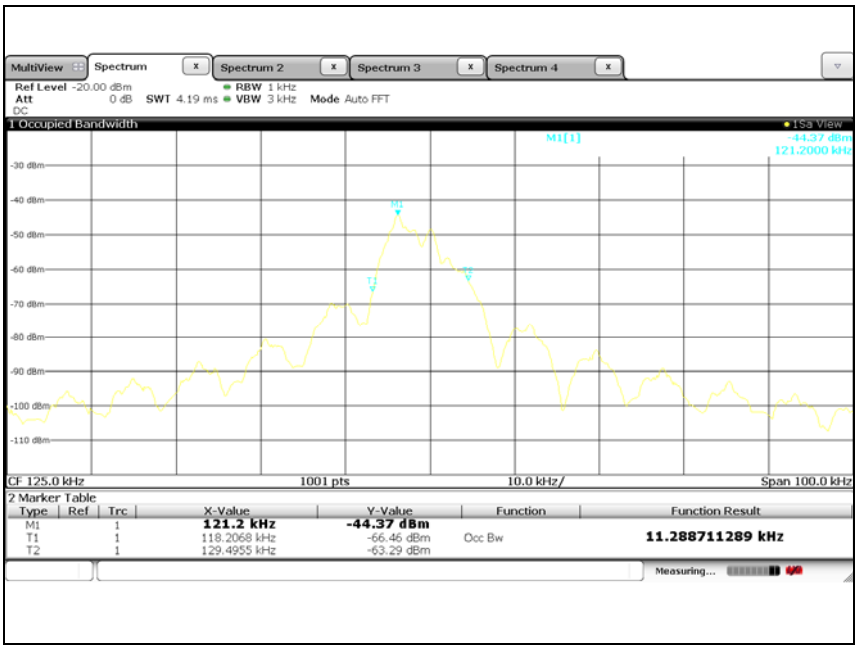
- INT1 ANT

Carrier Frequency (㎒)	Occupied Bandwidth (㎑)	Limit (㎑)	Remark
0.125	11.089	-	99 % Occupied bandwidth



- INT2 ANT

Carrier Frequency (㎒)	Occupied Bandwidth (㎑)	Limit (㎑)	Remark
0.125	11.289	-	99 % Occupied bandwidth



- SSB ANT

Carrier Frequency (㎒)	Occupied Bandwidth (㎑)	Limit (㎑)	Remark
0.125	29.570	-	99 % Occupied bandwidth