

TEST REPORT

OF

FCC Part 15 Subpart B&C §15.209 / IC RSS-210 Issue 8, RSS-Gen Issue 3
FCC ID/IC Certification: TQ8-SMK-4N03 / 5074A-SMK4N03

Equipment Under Test : Smart Key ECU
Model Name : SMK-4N03
Serial No. : N/A
Applicant : Hyundai Mobis Co., Ltd.
Manufacturer : Hyundai Mobis Co., Ltd.
Date of Test(s) : 2012.12.12 ~ 2013.01.05
Date of Issue : 2013.01.07

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

Tested By:



Date

2013.01.07

Hyunchae You

Approved By



Date

2013.01.07

Feel Jeong

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SGS Korea Co., Ltd. (Gunpo Laboratory)

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www.ee.sgs.com/korea

1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 400-2, Gomae-Dong, Giheung-Gu, Yongin-Shi, Kyungki-Do, South Korea 446-901
- Wireless Div. 3FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

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>.

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1.2. Details of Applicant

Applicant : Hyundai Mobis Co., Ltd.
Address : 80-9, Mabook-Dong, Giheung-Gu, Yongin-Shi, Gyunggi-Do, 446-912, South Korea
Contact Person : Kim, Jong-Tae
Phone No. : +82 31 288 6081
Fax No. : +82 31 899 1788

1.3. Description of EUT

Kind of Product	Smart Key ECU
Model Name	SMK-4N03
Serial Number	N/A
Power Supply	DC 12 V (Vehicle battery)
Frequency Range	Tx: 125.00 kHz (LF Antenna) Rx: 433.92 MHz (RF Antenna)
Modulation Technique	ASK
Number of Channels	1
Operating Conditions	-30°C ~ 75°C
Antenna Type	Internal type (Coil Antenna)

1.4. Declarations by the manufacturer

- Operation temperature: -30°C ~ 75°C
- The EUT of antennas cannot operate at the same time.

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1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due.
Spectrum Analyzer	R&S	FSL6	100768	Jul. 05, 2012	Annual	Jul. 05, 2013
Loop Antenna	R&S	HFH2-Z2	100118	Aug. 24, 2011	Biennial	Aug. 24, 2013
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	396	Apr. 27, 2011	Biennial	Apr. 27, 2013
DC Power Supply	Agilent	U8002A	MY50070064	Mar. 29, 2012	Annual	Mar. 29, 2013
Test Receiver	R&S	ESU26	100109	Feb. 21, 2012	Annual	Feb. 21, 2013
Antenna Master	INN-CO	MM4000	N/A	N/A	N/A	N.C.R.
Turn Table	INN-CO	DS 1200 S	N/A	N/A	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N/A	N/A	N.C.R.

1.6. Test Report Revision

Revision	Report number	Description
0	F690501/RF-RTL006119	Initial

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

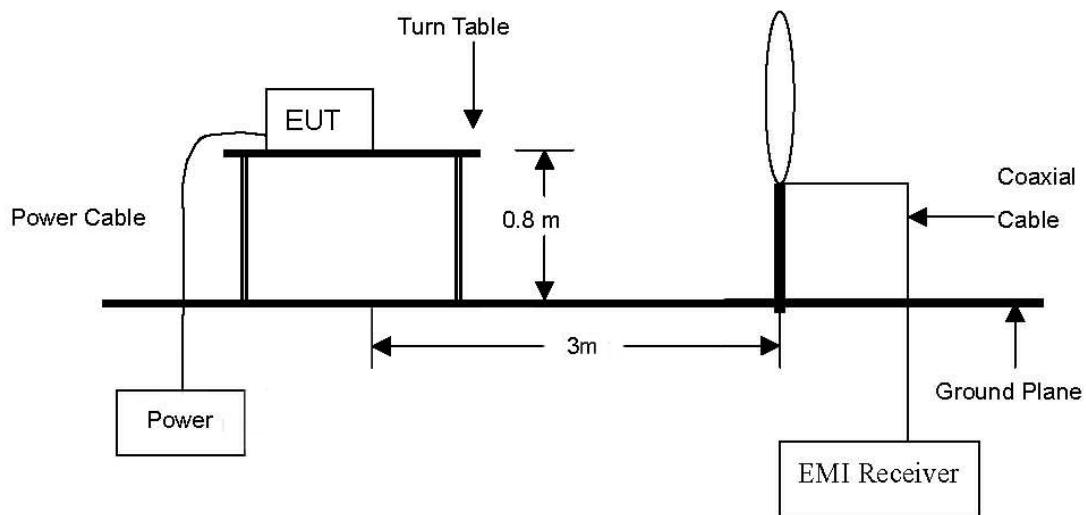
APPLIED STANDARD: FCC Part 15 Subpart B&C 15.209/ IC RSS-210 Issue8, RSS-Gen Issue3			
Section in FCC 15 Subpart B&C §15.209	Section in IC RSS-210 Issue8, RSS-Gen Issue 3	Test Item	Result
15.209(a)	RSS-210 Issue8, 2.5.1 RSS-Gen Issue3, 7.2.5 Table 6	Radiated emission, Spurious Emission and Field Strength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

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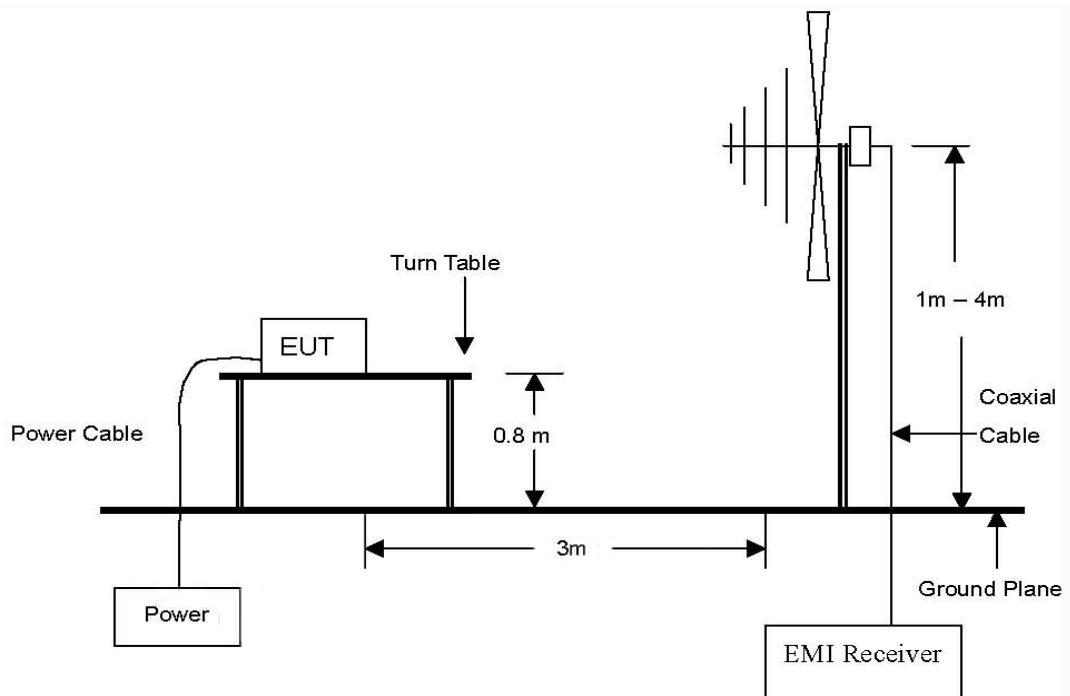
2. Field Strength of Fundamental

2.1. Test Setup

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



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



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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 (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	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 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. 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 kHz to 30 MHz

- 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 average Detect Function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from 30 MHz to 1000 MHz

- 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 GHz, 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 GHz, 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 dB 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 dB 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 ± 2) °C

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 position (x-axis, y-axis and z-axis). Worst case is x-axis.

- SSB ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	57.83	Average	H	18.18	0.06	76.07	-3.93	25.67	29.60

- INT1 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	57.80	Average	H	18.18	0.06	76.04	-3.96	25.67	29.63

- INT2 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	59.45	Average	H	18.18	0.06	77.69	-2.31	25.67	27.98

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- INT3 ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	52.11	Average	H	18.18	0.06	70.35	-9.65	25.67	35.32

- DRV ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	52.07	Average	H	18.18	0.06	70.31	-9.69	25.67	35.36

- AST ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	59.44	Average	H	18.18	0.06	77.68	-2.32	25.67	27.99

- BUM ANT

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. (dB/m)	Cable (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m	Limit (dB μ V/m)	Margin (dB)
0.125	59.44	Average	H	18.18	0.06	77.68	-2.32	25.67	27.99

Note:

1. 300 m Result(dB μ V/m) = 3 m Result(dB μ V/m) - 40log(300/3) (dB μ V/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 kHz to 30 MHz

- 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 MHz to 1000 MHz

- 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 GHz, 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 GHz, 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 dB 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 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

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3.4. Test Result

Ambient temperature : (24 ± 2) °C

Relative humidity : 47 % R.H.

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

- SSB ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
0.361	27.64	Average	H	18.00/0.09	45.73	-34.27	25.67	59.94
0.617	21.44	Quasi	H	18.00/0.12	39.56	-0.44	45.67	46.11
24.006	17.48	Quasi	H	17.42/0.69	35.59	-4.41	29.54	33.95
Above 24.100	Not detected	-	-	-	-	-	-	-

- INT1 ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
4.284	15.89	Quasi	H	18.04/0.24	34.17	-5.83	29.54	35.37
29.679	14.99	Quasi	H	16.84/0.79	32.63	-7.47	29.54	37.01
Above 26.700	Not detected	-	-	-	-	-	-	-

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- INT2 ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
3.307	15.59	Quasi	H	18.08/0.22	33.90	-6.10	29.54	35.64
26.154	14.72	Quasi	H	17.34/0.73	32.79	-7.21	29.54	36.75
Above 26.200	Not detected	-	-	-	-	-	-	-

- INT3 ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
9.392	14.58	Quasi	H	17.65/0.41	32.64	-7.36	29.54	36.90
23.462	14.97	Quasi	H	17.38/0.68	33.03	-6.97	29.54	36.51
Above 23.500	Not detected	-	-	-	-	-	-	-

- DRV ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
6.702	14.78	Quasi	H	17.86/0.32	32.96	-7.04	29.54	36.58
27.756	14.29	Quasi	H	17.11/0.76	32.16	-7.84	29.54	37.38
Above 27.800	Not detected	-	-	-	-	-	-	-

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- AST ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
4.076	14.90	Quasi	H	18.05/0.24	33.19	-6.81	29.54	36.35
16.506	15.13	Quasi	H	17.17/0.55	32.85	-7.15	29.54	36.69
Above 16.600	Not detected	-	-	-	-	-	-	-

- BUM ANT

Radiated Emissions			Ant	Correction Factors	Total		FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF/CL (dB/m)/(dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 300 m or 30 m	Limit (dB μ V/m)	Margin (dB)
2.619	15.89	Quasi	H	18.08/0.21	34.18	-5.82	29.54	35.36
19.551	14.54	Quasi	H	17.11/0.61	32.26	-7.74	29.54	37.28
Above 19.600	Not detected	-	-	-	-	-	-	-

Note:

1. 300 m Result(dB μ V/m) = 3 m Result(dB μ V/m) - 40log(300/3) (dB μ V/m)
2. 30 m Result(dB μ V/m) = 3 m Result(dB μ V/m) - 40log(30/3) (dB μ V/m)

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4. Occupied Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposes 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 kHz, VBW= 3 kHz and Span=50 kHz and detector mode= Sample.
2. The bandwidth of fundamental frequency was measured and recorded.

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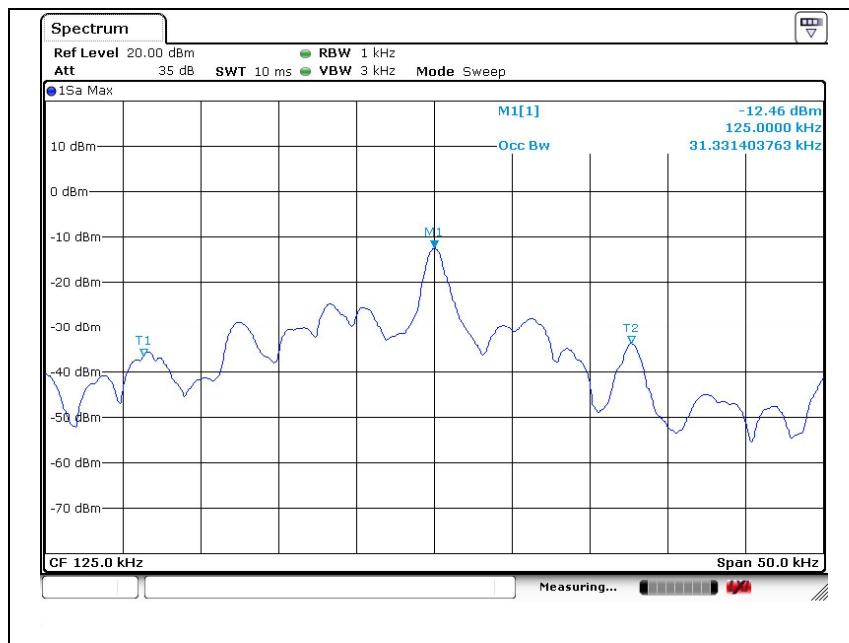
4.4. Test Result

Ambient temperature : (24 \pm 2) °C

Relative humidity : 47 % R.H.

- SSB ANT

Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	31.33	-	99 % Occupied bandwidth



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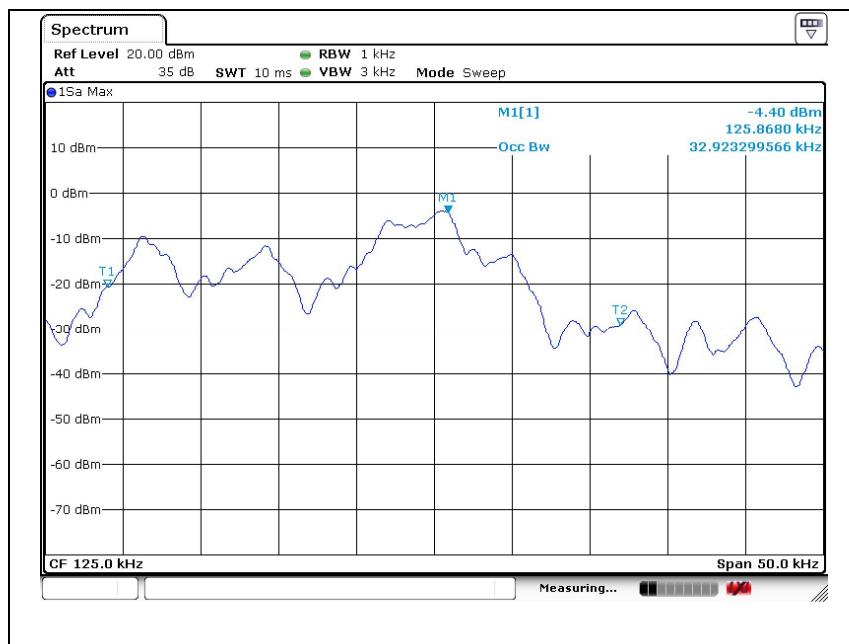
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- INT1 ANT

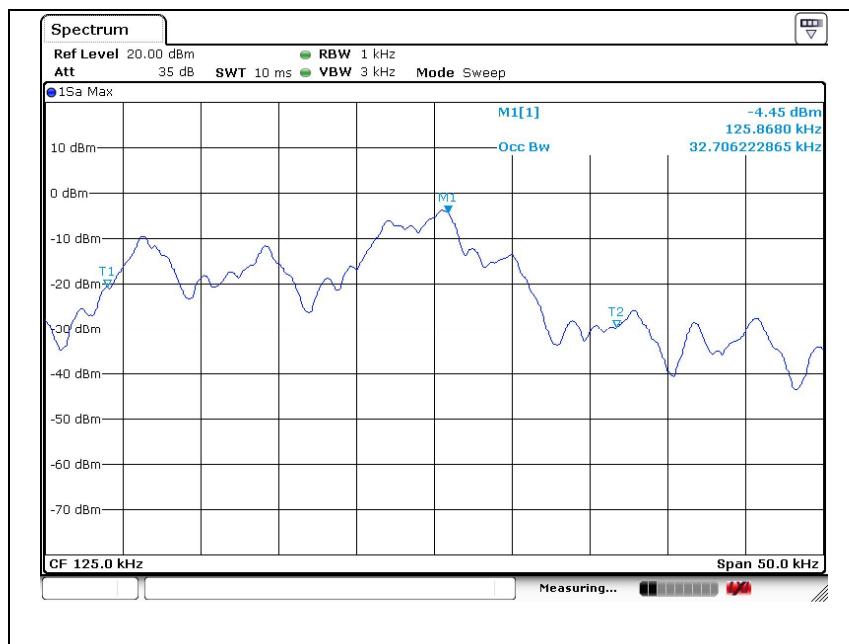
Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	32.92	-	99 % Occupied bandwidth



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- INT2 ANT

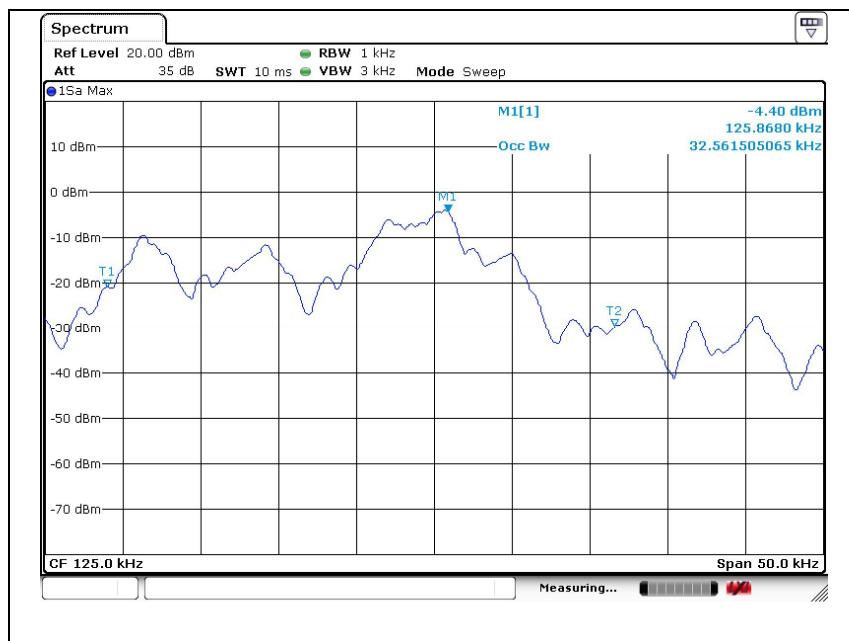
Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	32.71	-	99 % Occupied bandwidth



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- INT3 ANT

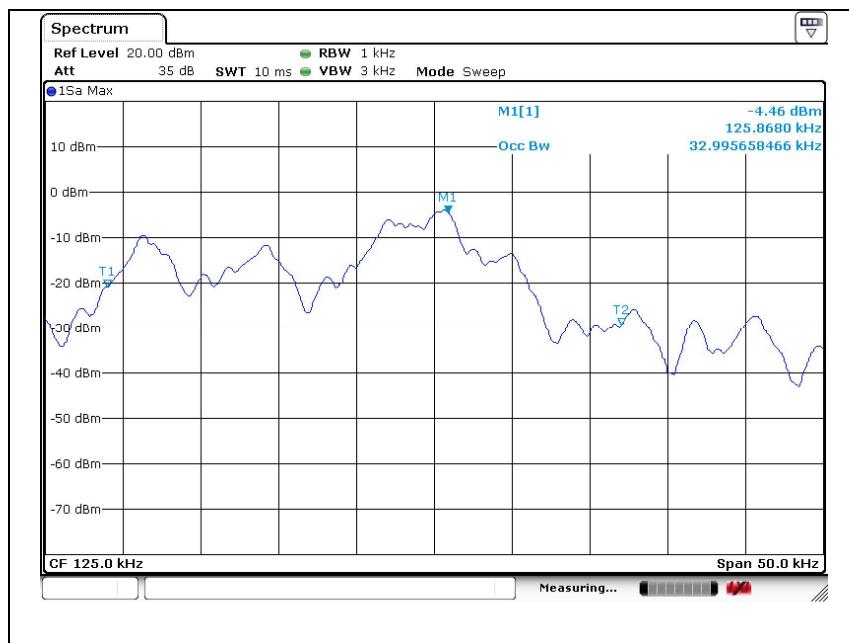
Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	32.56	-	99 % Occupied bandwidth



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- DRV ANT

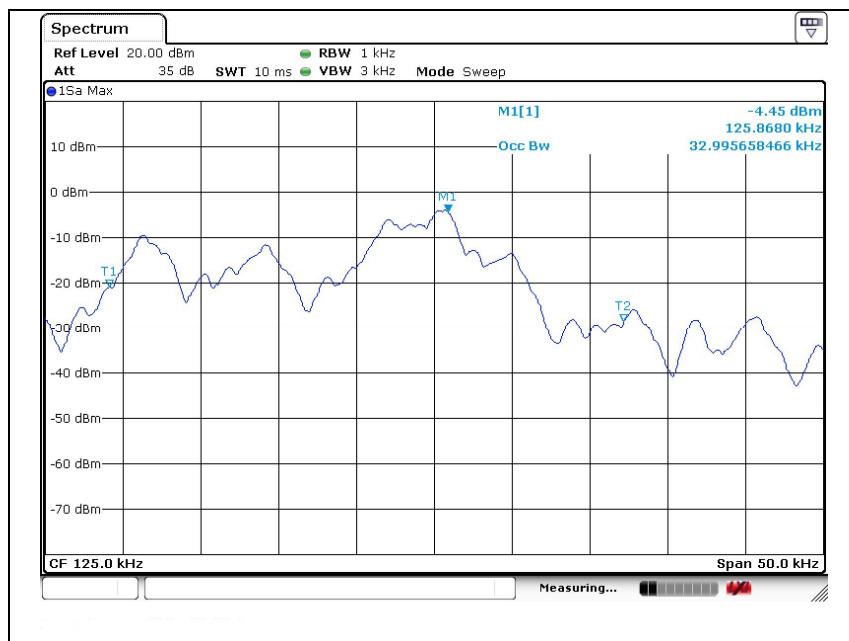
Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	33.00	-	99 % Occupied bandwidth



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- AST ANT

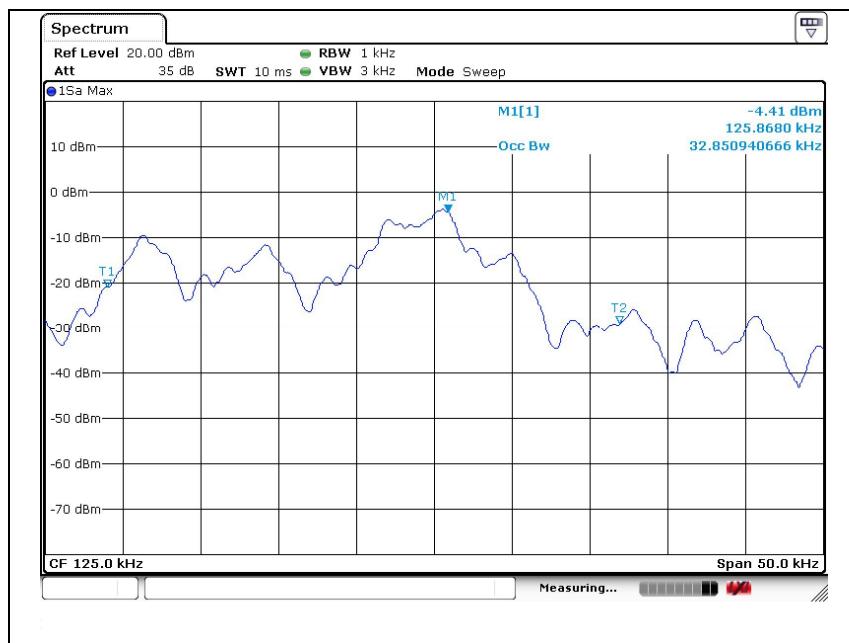
Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	33.00	-	99 % Occupied bandwidth



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- BUM ANT

Carrier Frequency (MHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Remark
0.125	32.85	-	99 % Occupied bandwidth



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