

TEST REPORT

OF

FCC Part 15 Subpart C §15.209, §15.231
FCC ID : TQ8-RKE-4F05

Equipment Under Test : RF Keyless Entry System(Transmitter)
Model Name : RKE-4F05
Serial No. : N/A
Applicant : Hyundai Mobis Co., Ltd.
Manufacturer : Hyundai Mobis Co., Ltd.
Date of Test(s) : 2013.02.25 ~ 2013.03.08
Date of Issue : 2013.03.08

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

Tested By:



Hyunchae You

Date: 2013.03.08

Approved By:



Ham Denny

Date: 2013.03.08

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TABLE OF CONTENTS

Page

1. General Information -----	3
2. Field Strength of Fundamental -----	6
3. Spurious Emission-----	11
4. Bandwidth of Operation Frequency-----	14
5. Transmission Time-----	16
6. Duty Cycle Correction Factor-----	17

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SGS Korea Co., Ltd. (Gunpo Laboratory) 8-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea, 435-040

Tel. +82 31 428 5700 / Fax. +82 31 427 2371

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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

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FAX : +82 31 427 2371

1.2. Details of Applicant

Applicant : Hyundai Mobis Co., Ltd.

Address : #679-4, Yeoksam-Dong, Gangnam-Gu, Seoul, 135-977, 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	RF Keyless Entry System (Transmitter)
Model Name	RKE-4F05
Serial Number	N/A
Power Supply	DC 3.0 V (Lithium type of battery)
Frequency Range	Tx: 433.92 MHz
Modulation Type	FSK
Number of Channels	1
Antenna Type	PCB Antenna

1.4. Details of Modification

- N/A

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1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan, 08, 2013	Annual	Jan, 08, 2014
Spectrum Analyzer	R&S	FSV30	101004	Jul. 05, 2012	Annual	Jul. 05, 2013
Spectrum Analyzer	R&S	FSV40	100007	Apr. 16, 2012	Annual	Apr. 16, 2013
Preamplifier	H.P.	8447D	1726A01265	Sep. 28, 2011	Annual	Sep. 28, 2012
Preamplifier	R&S	SCU18	10070	Aug. 06, 2012	Annual	Aug. 06, 2013
High Pass Filter	Mini-Circuits	NHP-400	VUU21201115-1	Aug.01, 2012	Annual	Aug.01, 2013
Test Receiver	R&S	ESC17	100778	Aug. 01, 2012	Annual	Aug. 01, 2013
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	390	Apr. 19, 2012	Biennial	Apr. 19, 2014
Horn Antenna	R&S	HF907	100208	Aug. 13, 2012	Biennial	Aug. 13, 2014
Antenna Master	INNCO SYSTEMS	MA4000-EP	N/A	N/A	N/A	N.C.R.
Turn Table	INNCO SYSTEMS	DT-3000S-3T	N/A	N/A	N/A	N.C.R.
10m Chamber	SY Corporation	L × W × H (21.5 m × 13.0 m × 9.0 m)	N/A	N/A	N/A	N.C.R.
Controller	INNCO SYSTEMS	CONTROLLER CO2000	N/A	N/A	N/A	N.C.R.
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Jul. 12, 2012	Annual	Jul, 12, 2013
Horn Antenna	R&S	HF 906	100326	Nov. 23, 2011	Biennial	Nov. 23, 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 × W × H	(9.6 m × 6.4 m × 6.6 m)	N/A	N/A	N/A

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1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

15.APPLIED STANDARD		
Section in FCC 15	Test Item	Result
15.209(a) 15.231(b)	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
15.231(c)	Bandwidth of Operation frequency	Complied
15.231(a)	Transmission Time	Complied

1.7 Test Report Revision

Revision	Report number	Description
0	F690501/RF-RTL006306	Initial

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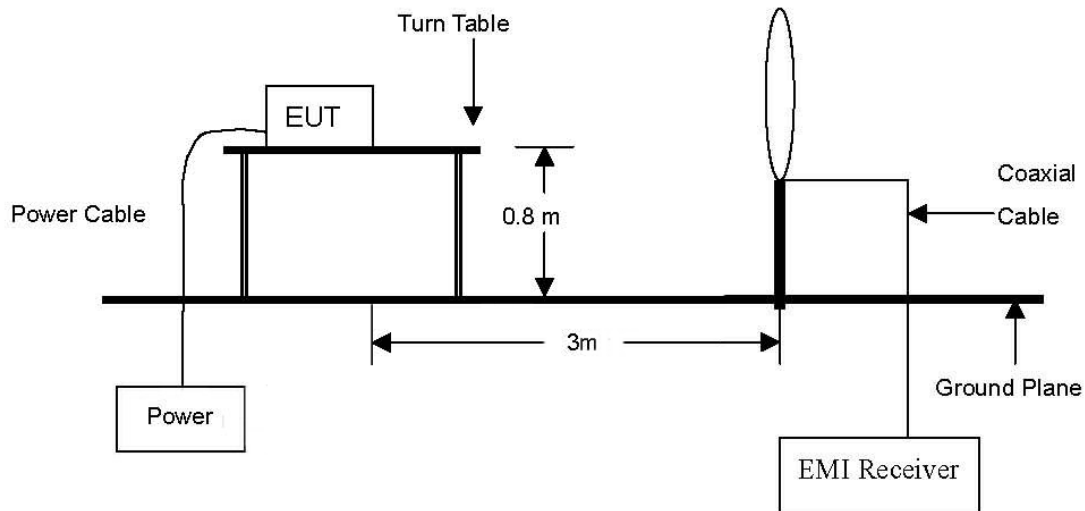
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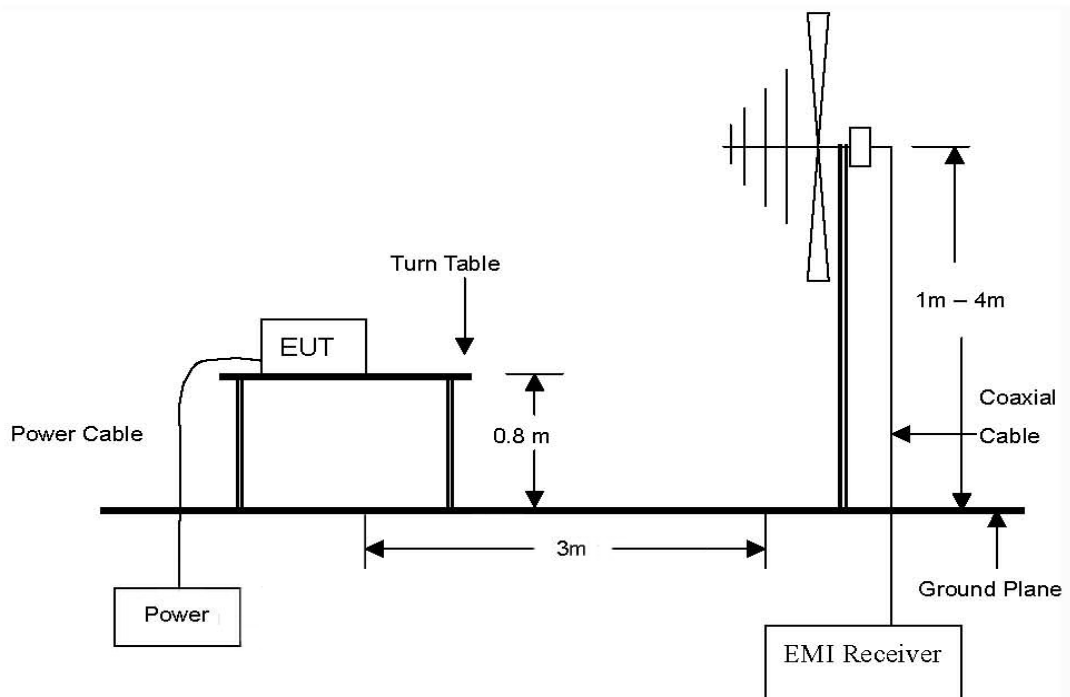
2. Field Strength of Fundamental

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.

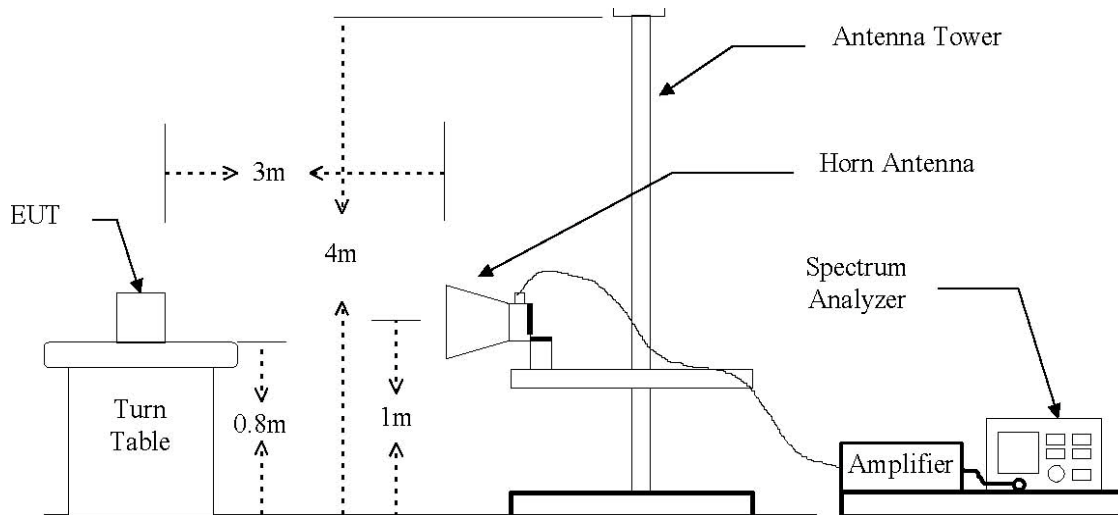


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



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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

2.2.2. Periodic operation in the band 40.66-40.70 MHz and above 70 MHz

In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 – 40.70	2,250	225
70 - 130	1,250	125
130 – 174	1,250 to 3,750 **	125 to 375 **
174 – 260	3,750	375
260 – 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** linear interpolations

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows : for the band 130-174 MHz, $\mu V/m$ at 3 meters = $56.81818(F)-6136.3636$; for the band 260-470 MHz, $\mu V/m$ at 3 meters = $41.6667(F)-7083.333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

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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

- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

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

- 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.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.

2.3.3. Test Procedures for emission above 1 GHz

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

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2.4. Test Result

Ambient temperature : (23 ± 2) °C
Relative humidity : 46 % R.H.

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

Freq. (MHz)	Ant. Pol	Reading (dBμV)	Correction Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detect Mode
					AVG	AVG	
433.92	H	48.61	19.15	67.76	100.82	33.06	PEAK
433.92	H	43.80	19.15	62.95	80.82	17.87	AVG

Remark:

To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-axis. Worst case is X-axis.

Note:

- 3m Limit(dBuV/m) = $20\log[41.6667(F_{\text{MHz}})-7083.3333] = 80.82$
- Correction Factor = Antenna Factor + Cable Loss
- Duty cycle = Tx on / Tx on+off = 384.478 / 391.304 = 98.26 %

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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

- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

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

- 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.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.

3.3.3. Test Procedures for emission above 1 GHz

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

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3.4. 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

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Amp Gain +CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
867.85	24.62	Quasi-Peak	H	20.76	5.07	50.45	60.82	10.37
*1301.69	46.33	Peak	H	25.20	-37.37	34.16	74.00	39.84
*1301.69	34.30	Average	H	25.20	-37.37	22.13	54.00	31.87
Above 1 305.00	Not Detected	-	-	-	-	-	-	-

Remark:

1. To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-axis. Worst case is X-axis.
2. "*" means the restricted band.

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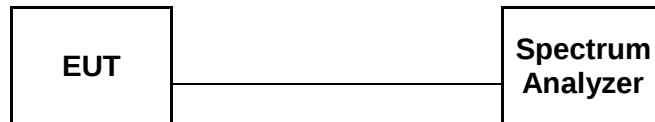
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4. Bandwidth of Operation Frequency

4.1. Test Setup



4.2. Limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

4.3. Test Procedure

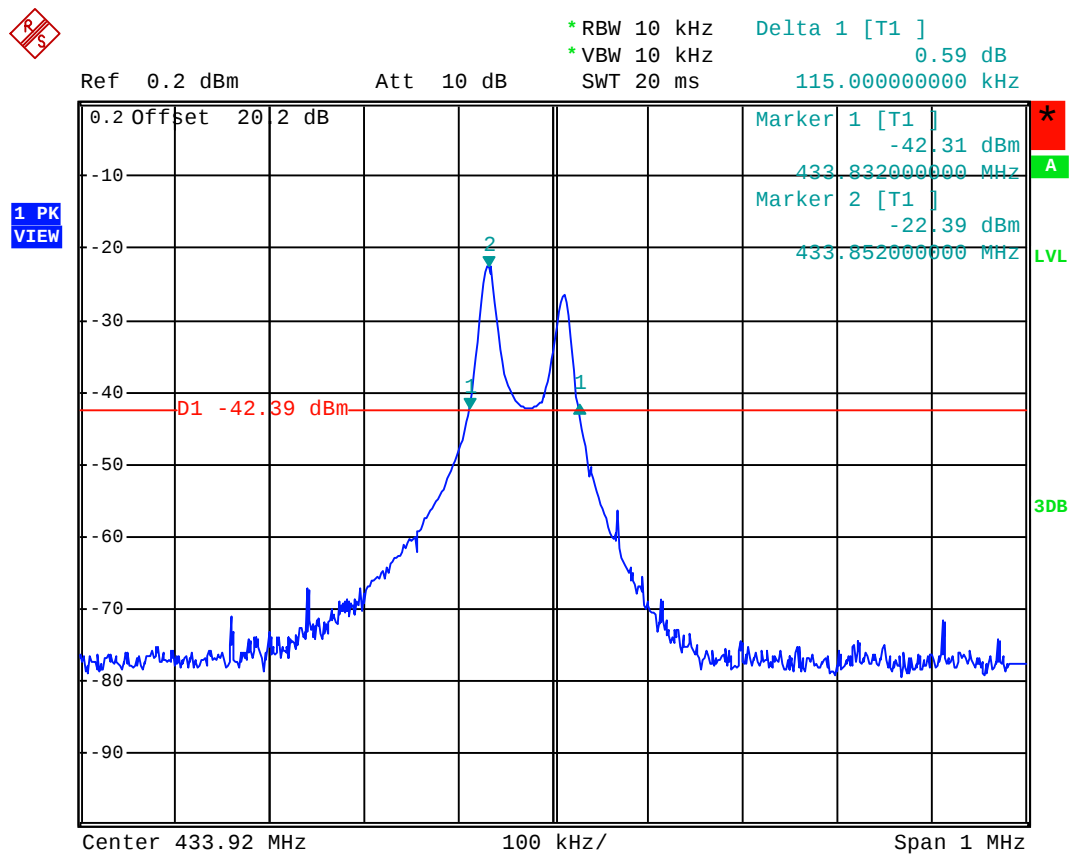
1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=10 kHz, VBW=10 kHz and Span=1 MHz.
3. The bandwidth of fundamental frequency was measured and recorded.

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4.4. Test Result

Ambient temperature : (23 ± 2) °C
Relative humidity : 46 % R.H.

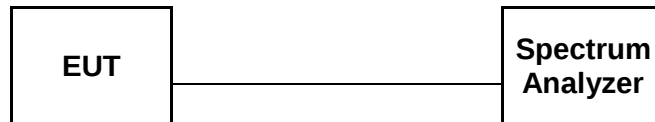
Carrier Frequency (MHz)	Bandwidth of the emission (kHz)	Limit (kHz)	Remark
433.92	115.00	1 084.8	The point 20 dB down from the modulated carrier



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5. Transmission Time

5.1. Test Setup



5.2. Limit

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

5.3. Test Procedure

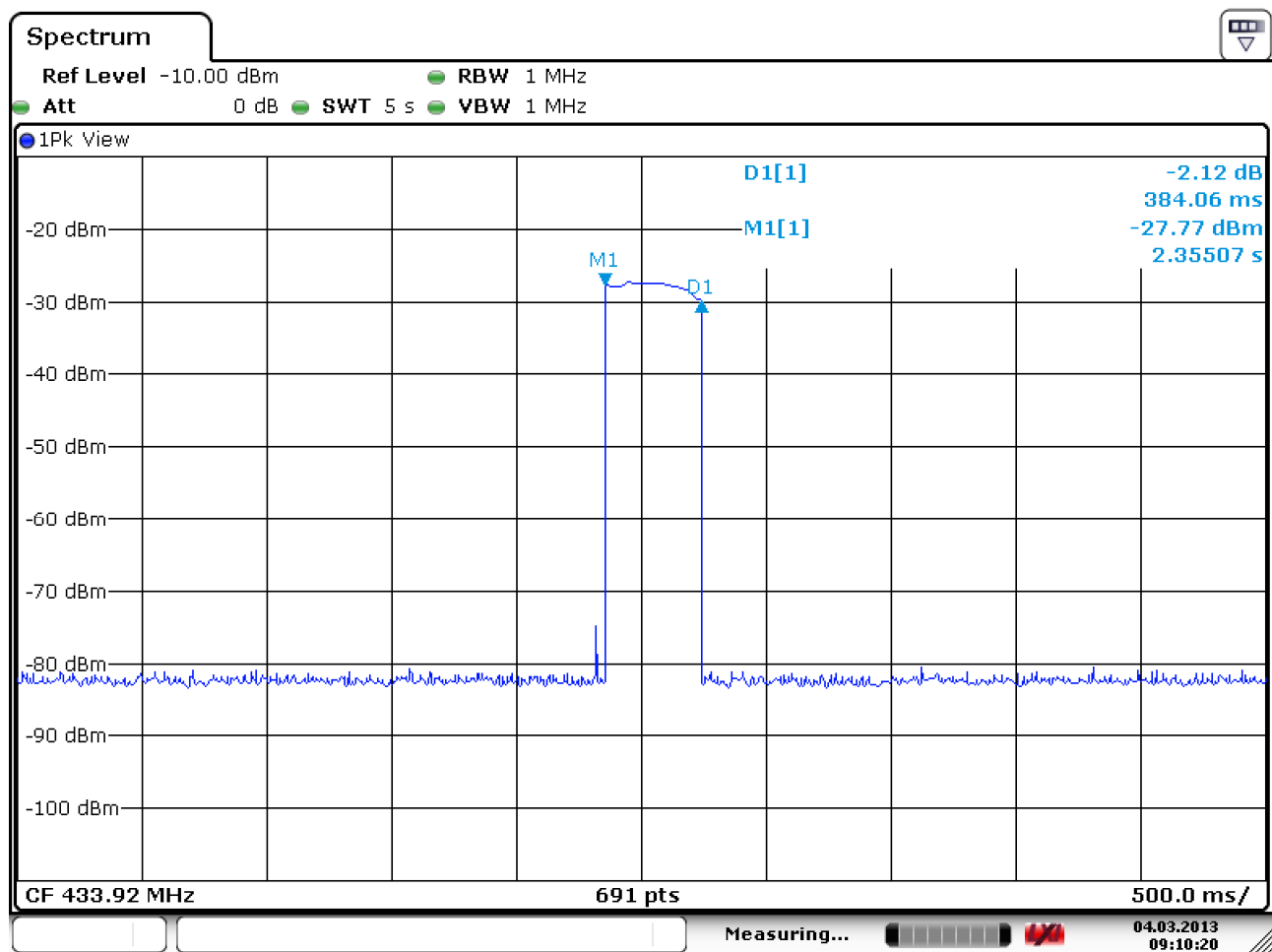
1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 1 MHz, VBW = 1 MHz, Span= 0 Hz, Sweep Time = 5 sec.
3. The bandwidth of fundamental frequency was measured and recorded.

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5.4. Test Result

Ambient temperature : (23 ± 2) °C
Relative humidity : 46 % R.H.

Carrier Frequency (MHz)	Transmission Time (sec)	Limit (sec)	Remark
433.92	0.38	Same or less than 5 s	Pass

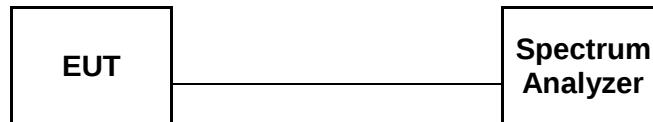


Date: 4.MAR.2013 09:10:20

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6. Duty Cycle Correction Factor

6.1. Test Setup



6.2. Limit

Nil (No dedicated Limit specified in the Rules)

6.3. Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW = 1 MHz, VBW = 1 MHz, Span = 0 Hz, Sweep Time = 600 ms.
5. Repeat above procedure until all frequency measured were complete.

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6.4. Test Result

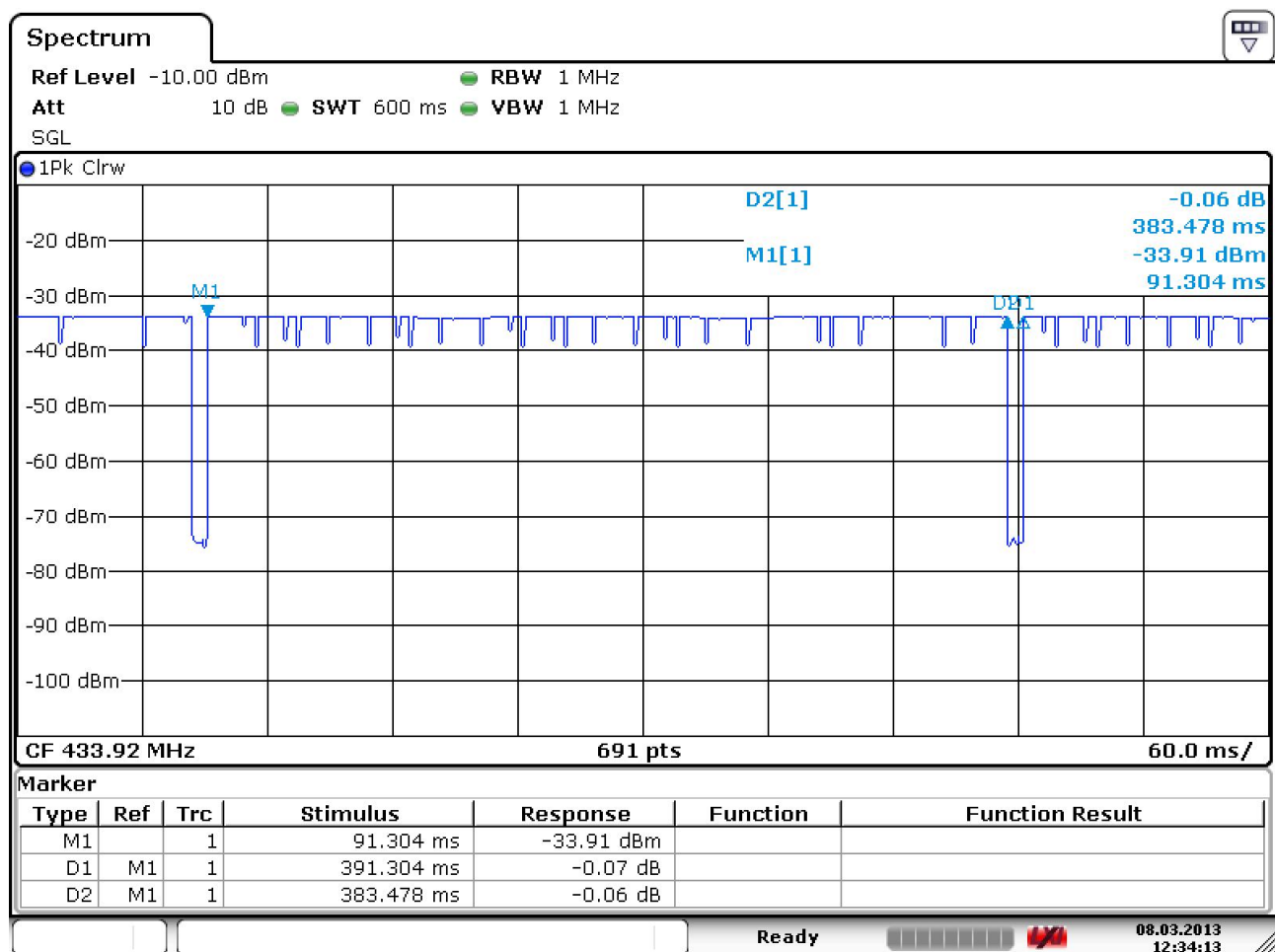
Ambient temperature : (23 ± 2) °C

Relative humidity : 47 % R.H.

$T_{on+off} = 391.304 \text{ ms}$

$T_{on} = 383.478 \text{ ms}$

Duty Cycle Correction Factor = $20\log(T_{on} / T_{on+off}) = 20\log(383.478 / 391.304) = -0.153$



Date: 8.MAR.2013 12:34:13

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