

# TEST REPORT

## OF

FCC Part 15 Subpart C §15.209, §15.231 / IC RSS-210 Issue 8, RSS-Gen  
Issue 3

FCC ID/IC Certification : TQ8-RKE-4F24 / 5074A- RKE4F24

Equipment Under Test : Remote Keyless Entry  
Model Name : RKE-4F24  
Applicant : Hyundai Mobis Co., Ltd.  
Manufacturer : DAEDONG Co., Ltd.  
Date of Test(s) : 2014. 08. 13 ~ 2014. 09. 04  
Date of Issue : 2014. 09. 04

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

Tested By:



Alvin Kim

Date:

2014. 09. 04

Approved By:



Logan Lee

Date:

2014. 09. 04

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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>.

Phone No. : + 82 31 688 0901

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### 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    | Remote Keyless Entry               |
| Model Name         | RKE-4F24                           |
| 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 Pattern Antenna                |

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## 1.4. Test Equipment List

| Equipment         | Manufacturer   | Model                                | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|-------------------|----------------|--------------------------------------|-------------|---------------|--------------|---------------|
| Signal Generator  | Agilent        | E8257D                               | MY51501169  | Jul. 17, 2014 | Annual       | Jul. 17, 2015 |
| Spectrum Analyzer | Agilent        | N9030A                               | MY53120526  | Jul. 17, 2014 | Annual       | Jul. 17, 2015 |
| Spectrum Analyzer | R&S            | FSV30                                | 100768      | Mar. 27, 2014 | Annual       | Mar. 27, 2015 |
| DC power Supply   | Agilent        | U8002A                               | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |
| Attenuator        | Mini-Circuits  | BW-N20W5+                            | 0950-4      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Preamplifier      | H.P.           | 8447D                                | 2944A07087  | Jan. 06, 2014 | Annual       | Jan. 06, 2015 |
| Preamplifier      | R&S            | SCU-18                               | 10117       | Jan. 14, 2014 | Annual       | Jan. 14, 2015 |
| High Pass Filter  | Mini-Circuits  | NHP-800+                             | V8207600724 | Mar. 24, 2014 | Annual       | Mar. 24, 2015 |
| High Pass Filter  | Wainwright     | WHK3.0/18G-10SS                      | 344         | Jun. 10, 2014 | Annual       | Jun. 10, 2015 |
| Test Receiver     | R&S            | ESU26                                | 100109      | Mar. 04, 2014 | Annual       | Mar. 04, 2015 |
| Loop Antenna      | SCHWARZBECK    | FMZB1519                             | 1519-039    | Jul. 09, 2013 | Biennial     | Jul. 09, 2015 |
| Bilog Antenna     | SCHWARZBECK    | VULB9163                             | 396         | Jun. 07, 2013 | Biennial     | Jun. 07, 2015 |
| Horn Antenna      | R&S            | HF906                                | 100326      | Dec. 10, 2013 | Biennial     | Dec. 10, 2015 |
| Antenna Master    | INN-CO         | MM4000                               | N/A         | N.C.R.        | N/A          | N.C.R.        |
| Turn Device       | DE-3600-RH     | INN-CO                               | N/A         | N.C.R.        | N/A          | N.C.R.        |
| Turn Table        | INN-CO         | DS 1200S                             | N/A         | N.C.R.        | N/A          | N.C.R.        |
| Anechoic Chamber  | SY Corporation | L × W × H<br>(9.6 m × 6.4 m × 6.6 m) | N/A         | N.C.R.        | N/A          | N.C.R.        |

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## 1.5. Summary of Test Results

The EUT has been tested according to the following specifications:

| APPLIED STANDARD       |                                    |                                                                              |          |
|------------------------|------------------------------------|------------------------------------------------------------------------------|----------|
| Section in FCC Part 15 | Section in RSS-210, RSS-Gen        | Test Item                                                                    | Result   |
| 15.209(a)<br>15.231(b) | RSS-210, Issue 8,<br>A1.1, Table B | Radiated emission,<br>Spurious Emission and<br>Field Strength of Fundamental | Complied |
| 15.231(c)              | RSS-210, Issue 8,<br>A1.1.3        | Bandwidth of Operation frequency                                             | Complied |
| 15.231(a)              | RSS-210, Issue 3,<br>A1.1.1        | Transmission Time                                                            | Complied |
| -                      | RSS-Gen, Issue 3,<br>4.6.1         | Occupied Bandwidth                                                           | Complied |

## 1.6. Test Report Revision

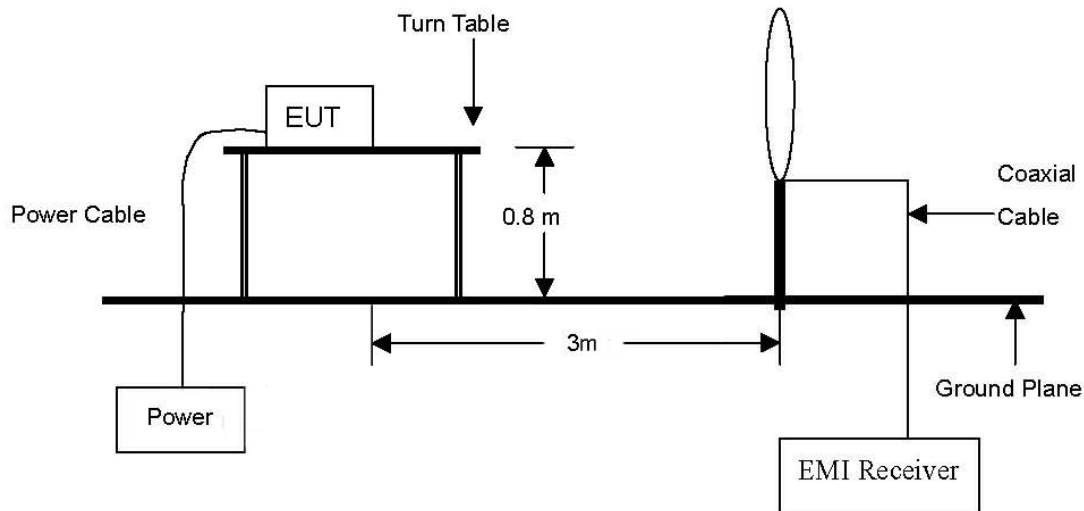
| Revision | Report number        | Date of issue | Description |
|----------|----------------------|---------------|-------------|
| 0        | F690501/RF-RTL007994 | 2014.09.04    | Initial     |

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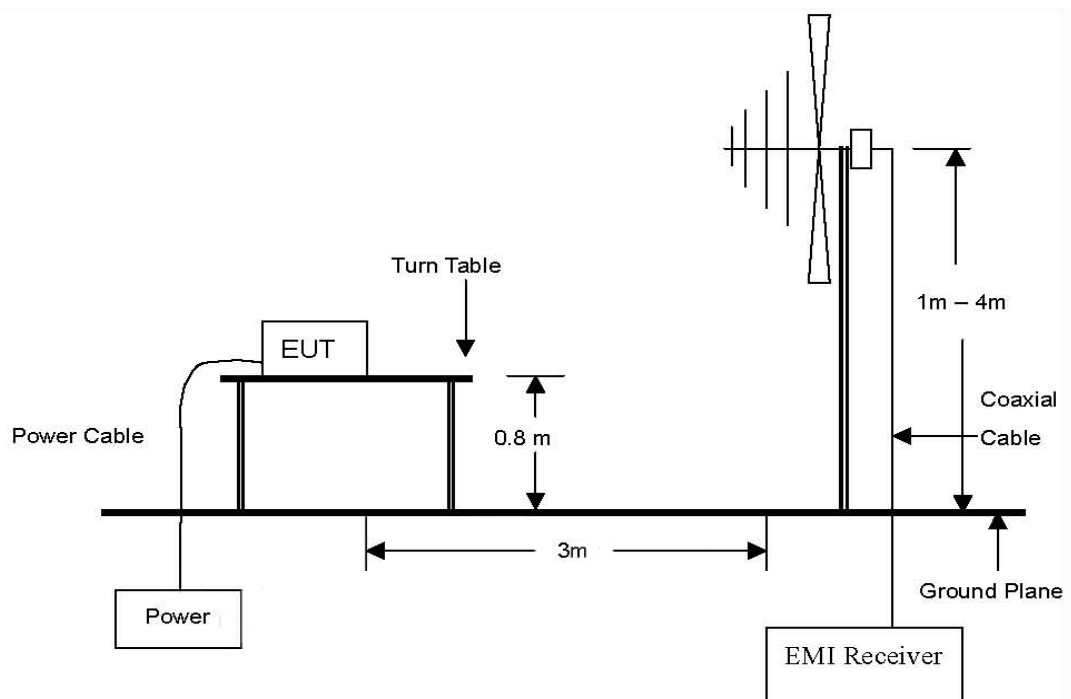
## 2. Field Strength of Fundamental

### 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.

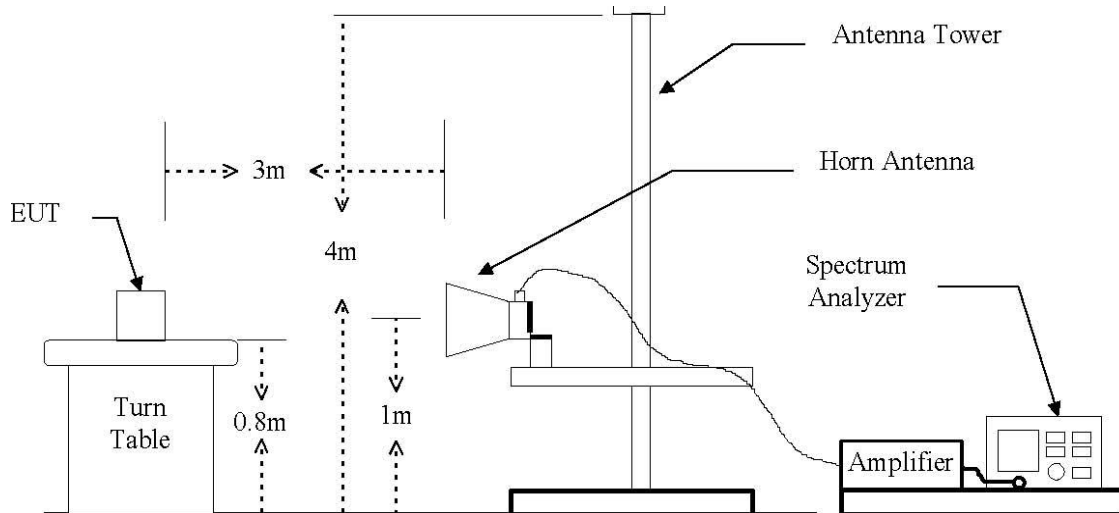


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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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 =  $41.6667(F)-7083.3333$ . 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 1 000 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.

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## 2.4. Test Result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

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

| Freq.<br>(MHz) | Detector | Ant. Pol. | Reading<br>(dB $\mu$ V) | Antenna<br>Factor (dB) | Cable<br>Loss (dB) | Result<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB) |
|----------------|----------|-----------|-------------------------|------------------------|--------------------|--------------------------|-------------------------|----------------|
| 433.92         | Peak     | H         | 43.80                   | 17.09                  | 2.75               | 63.64                    | 100.83                  | 37.19          |
| 433.92         | Average  | H         | 39.00                   | 17.09                  | 2.75               | 58.84                    | 80.83                   | 21.99          |

### 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:

1. 3 m Limit (dB $\mu$ V/m) =  $20\log[41.6667(F_{MHz})-7083.3333] = 80.83$
2. Correction Factor = Antenna Factor + Cable Loss
3. Average Result = The average result was investigated due to Pulse train over 100 ms.  
(Tx on time = 382.5 ms, Tx on+off time = 391.5 ms)

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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 1 000 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.

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### 3.4. Test Result

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

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

| 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) |
| 867.76             | 41.40          | Peak        | H    | 23.28              | -23.30            | 41.38           | 80.83          | 39.45       |
| 867.76             | 34.20          | Average     | H    | 23.28              | -23.30            | 34.18           | 60.83          | 26.65       |
| *1 301.70          | 52.00          | Peak        | H    | 25.16              | -37.57            | 39.59           | 74.00          | 34.41       |
| *1 301.70          | 46.13          | Average     | H    | 25.16              | -37.57            | 33.72           | 54.00          | 20.28       |
| 1 735.63           | 47.41          | Peak        | H    | 26.94              | -36.65            | 37.70           | 80.83          | 43.13       |
| 1 735.63           | 39.03          | Average     | H    | 26.94              | -36.65            | 29.32           | 60.83          | 31.51       |
| 2 169.60           | 45.61          | Peak        | H    | 27.58              | -35.87            | 37.32           | 80.83          | 43.51       |
| 2 169.60           | 34.26          | Average     | H    | 27.58              | -35.87            | 25.97           | 60.83          | 34.86       |
| 2 603.21           | 46.17          | Peak        | H    | 28.59              | -35.75            | 39.01           | 80.83          | 41.82       |
| 2 603.21           | 36.65          | Average     | H    | 28.59              | -35.75            | 29.49           | 60.83          | 31.34       |
| 3 039.15           | 44.93          | Peak        | H    | 29.90              | -35.50            | 39.33           | 80.83          | 41.50       |
| 3 039.15           | 33.42          | Average     | H    | 29.90              | -35.50            | 27.82           | 60.83          | 33.01       |
| 3 471.30           | 44.10          | Peak        | H    | 31.03              | -35.10            | 40.03           | 80.83          | 40.80       |
| 3 471.30           | 32.64          | Average     | H    | 31.03              | -35.10            | 28.57           | 60.83          | 32.26       |
| *3 909.02          | 42.23          | Peak        | H    | 32.40              | -33.62            | 41.01           | 74.00          | 32.99       |
| *3 909.02          | 32.05          | Average     | H    | 32.40              | -33.62            | 30.83           | 54.00          | 23.17       |
| *4 337.86          | 42.19          | Peak        | H    | 32.14              | -33.62            | 40.71           | 74.00          | 33.29       |
| *4 337.86          | 31.87          | Average     | H    | 32.14              | -33.62            | 30.39           | 54.00          | 23.61       |
| Above 4 400.00     | Not detected   | -           | -    | -                  | -                 | -               | -              | -           |

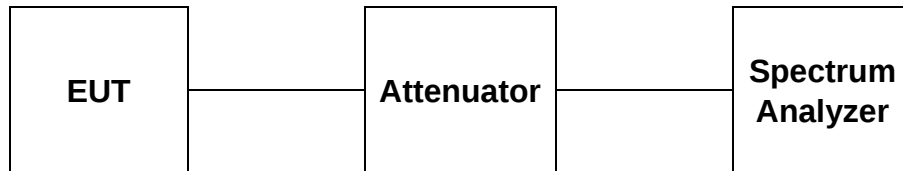
#### Remark:

- 3 m Limit (dBμV/m) =  $20\log[41.6667(F_{\text{MHz}})-7083.3333] = 80.83$
- Correction Factor = Antenna Factor + Cable Loss
- Average Result = The average result was investigated due to Pulse train over 100 ms.  
(Tx on time = 382.5 ms, Tx on+off time = 391.5 ms)
- "\*" means the restricted band.
- Spurious Emission test results meet both peak and average limit.

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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

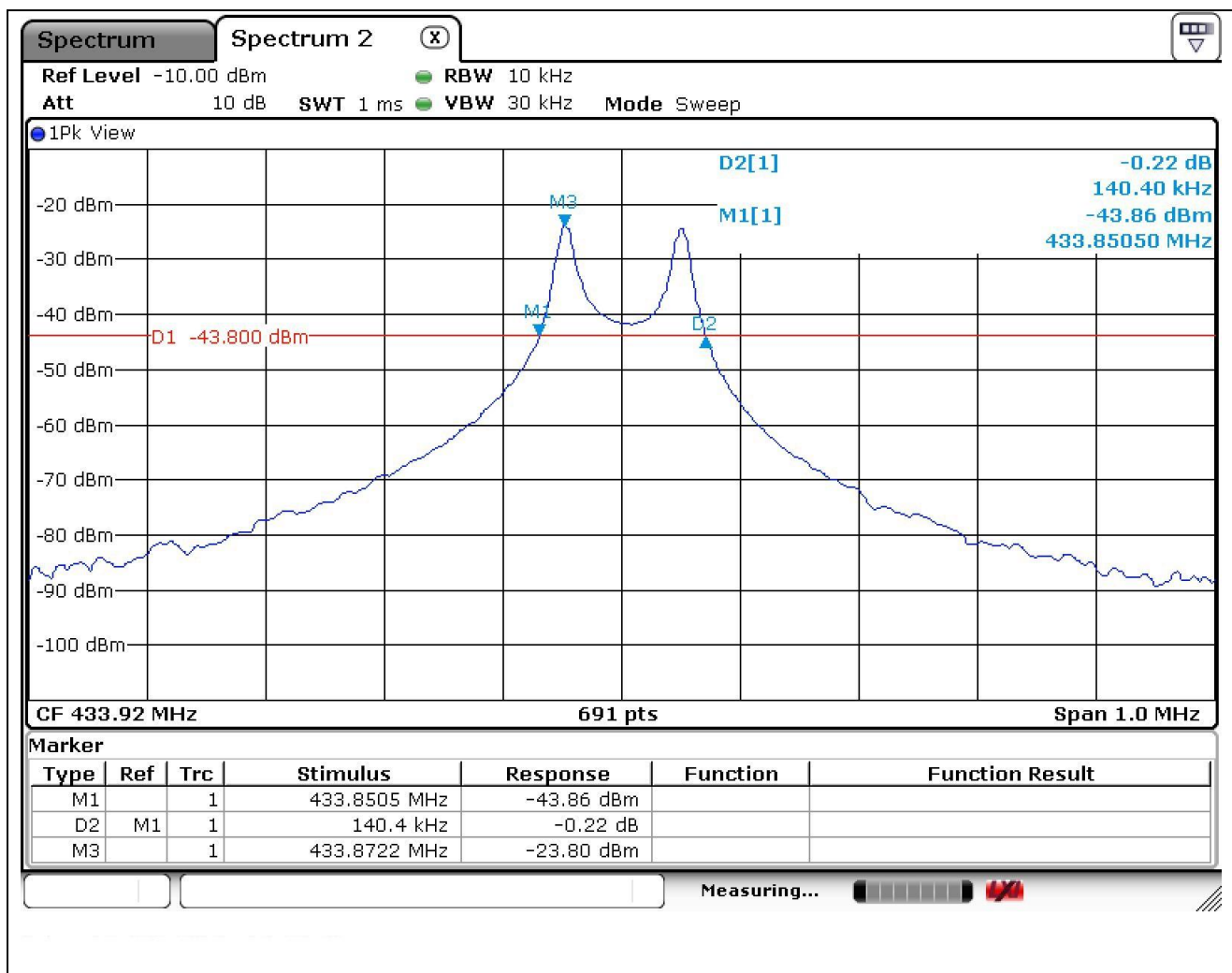
1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=10 kHz, VBW=30 kHz and Span=1 MHz.
3. The bandwidth of fundamental frequency was measured and recorded.

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## 4.4. Test Result

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

| Carrier Frequency (MHz) | Bandwidth of the emission (kHz) | Limit (kHz) | Remark                                          |
|-------------------------|---------------------------------|-------------|-------------------------------------------------|
| 433.92                  | 140.40                          | 1 084.80    | The point 20 dB down from the modulated carrier |



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## 5. Occupied Bandwidth

### 5.1. Test Setup



### 5.2. Limit

None; for reporting purposed only

### 5.3. Test Procedure

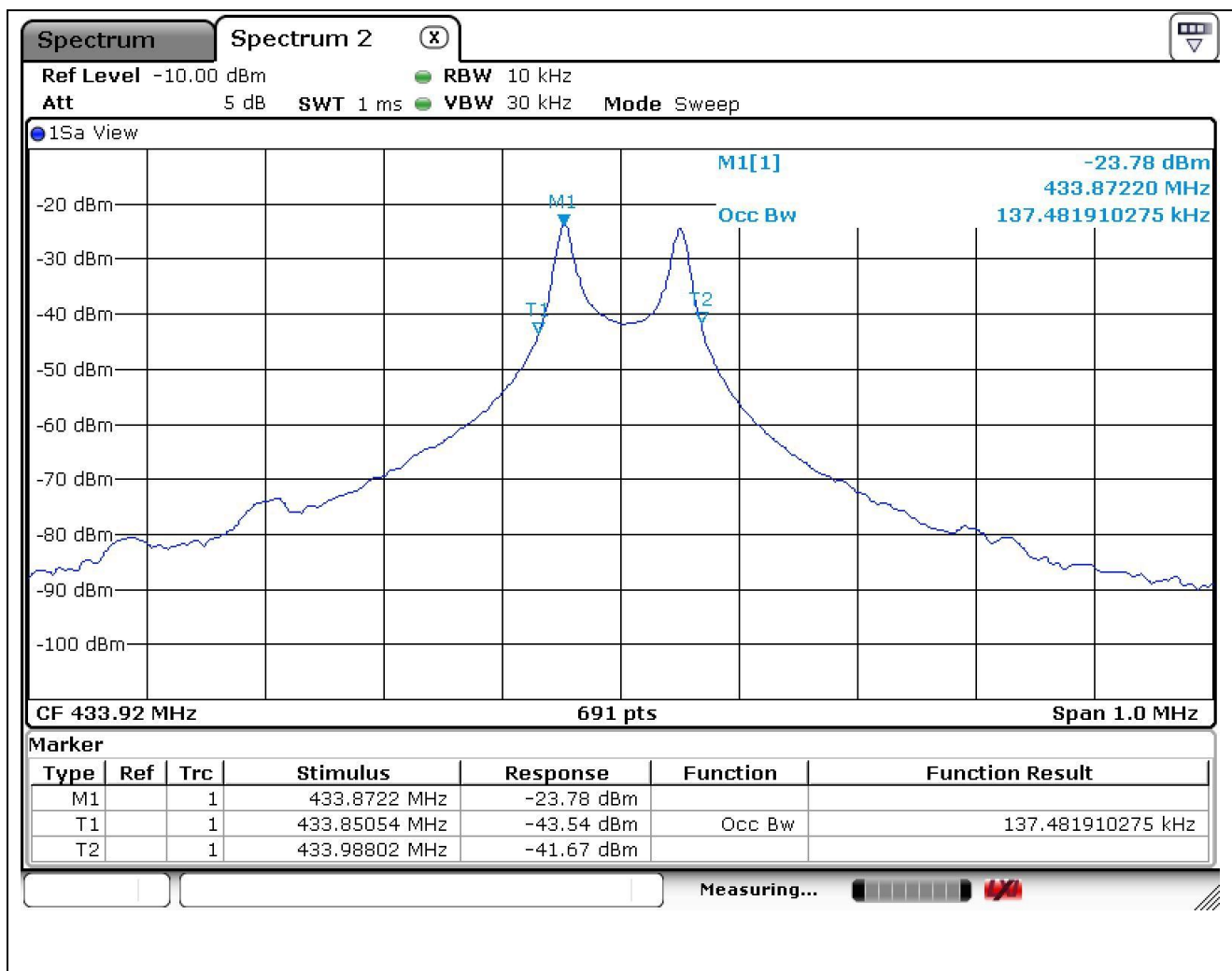
1. Set the spectrum analyzer as SPAN = 2 or 3 times necessary bandwidth, RBW = approximately 1 % of the SPAN, VBW is set to 3 times RBW, Detector = Sample, Trace mode = max hold.
2. Measure lowest and highest frequencies are placed in a running sum until 0.5 % and 99.5 % of the total is reached.
3. Record the SPAN between the lowest and the highest frequencies for the 99 % occupied bandwidth.
4. Repeat until all the test channels are investigated.

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## 6.4. Test Result

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

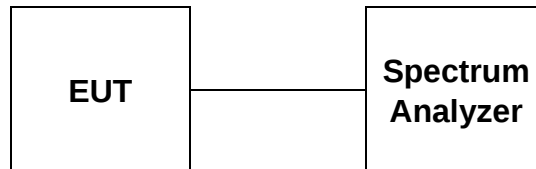
| Carrier Frequency (MHz) | Occupied Bandwidth (kHz) | Limit (kHz) | Remark                  |
|-------------------------|--------------------------|-------------|-------------------------|
| 433.92                  | 137.48                   | -           | 99 % Occupied bandwidth |



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## 6. Transmission Time

### 6.1. Test Setup



### 6.2. Limit

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

### 6.3. Test Procedure

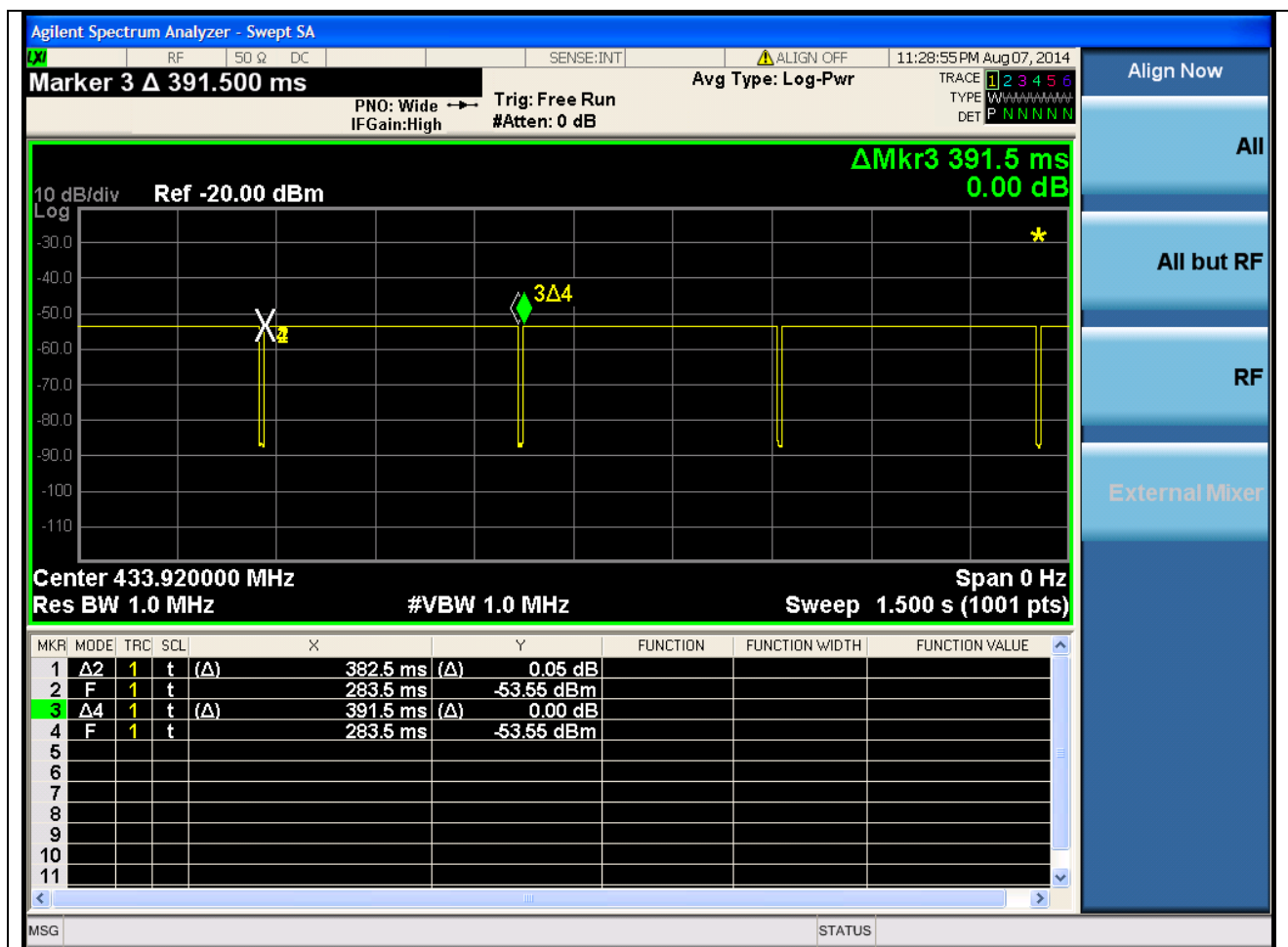
1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 1 MHz, VBW = 1 MHz, Span= 0 Hz, Sweep Time = 1.5 sec.
3. The bandwidth of fundamental frequency was measured and recorded.

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## 6.4. Test Result

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

| Carrier Frequency (MHz) | Transmission Time (sec) | Limit (sec)           | Remark |
|-------------------------|-------------------------|-----------------------|--------|
| 433.92                  | 0.383                   | Same or less than 5 s | Pass   |



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