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# TEST REPORT

# Part 15 Subpart C 15.231

| | |
|---|---|
| **Equipment under test** | Wireless call bell |
| **Model name** | SOLTBELL |
| **FCC ID** | 2ABE3SOLTBELL |
| **Applicant** | SOLT Co., Ltd. |
| **Manufacturer** | SOLT Co., Ltd. |
| **Date of test(s)** | 2013.11.25 ~ 2013.12.02 |
| **Date of issue** | 2012.12.03 |

**Issued to**

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| **Test and report completed by :** | **Report approval by :** |
|---|---|
|  |  |
| Kwang-Yeol Choo<br>Test engineer | Jeff Do<br>Technical manager |

# Revision history

| Revision | Date of issue | Test report No. | Description |
|---|---|---|---|
| - | 2013.12.03 | KES-RF-13T0031 | Initial |

# TABLE OF CONTENTS

**1. General information** ..... **4**
1.1. EUT description ..... 4
1.2. Test frequency ..... 4
1.3. Information about variant model ..... 4
1.4. Device modifications ..... 4
1.5. Test facility ..... 5
1.6. Laboratory accreditations and listings ..... 5
**2. Summary of tests** ..... **6**
**3. Test results** ..... **7**
3.1. The field strength of fundamental and the field strength of spurious emission ..... 7
3.2. 20 dB bandwidth ..... 13
3.3. Transmission time ..... 15
**Appendix A. Measurement equipment** ..... **17**
**Appendix B. Test setup photos** ..... **18**

# 1. General information

## 1.1. EUT description

| | |
|---|---|
| **Equipment under test** | Wireless call bell |
| **Model name** | SOLTBELL |
| **Serial number** | N/A |
| **Frequency Range** | 433.05 ㎒ ~ 434.79 ㎒ |
| **Modulation technique** | FSK |
| **Number of channels** | 11 |
| **Antenna type** | PCB antenna |
| **Power source** | DC 3 V(Battery) |

## 1.2. Test frequency

| | **Low channel** | **Middle channel** | **High channel** |
|---|---|---|---|
| **Frequency (㎒)** | 433.05 | 433.95 | 434.79 |

## 1.3. Information about variant model

N/A

## 1.4. Device modifications

N/A

## 1.5. Test facility

C3701 Dongil Techno Town, 889-1, Gwanyang 2-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea 477-6, Hageo-ri, Yeoju-eup, Yeoju-gun, Gyeonggi-do, 469-803, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003.

## 1.6. Laboratory accreditations and listings

| Country | Agency | Scope of accreditation | Certificate No. |
|---|---|---|---|
| USA | FCC | 3 & 10 meter Open Area Test Sites and<br>one conducted site to perform FCC Part 15/18 measurements. | 343818 |
| KOREA | KC | EMI<br>(10 meter Open Area Test Site and two conducted sites)<br>Radio<br>(3 & 10 meter Open Area Test Sites and one conducted site) | KR0100 |
| CANADA | IC | 3 & 10 meter Open Area Test Sites<br>and one conducted site | 4769B-1 |

## 2. Summary of tests

| Reference | Parameter | Status |
|---|---|---|
| 15.209(a)<br>15.231(b) | The field strength of fundamental and the field strength of spurious emission | C |
| 15.231(c) | 20 dB bandwidth | C |
| 15.231(a)(1) | Transmission time | C |
| Note: C=Complies NC=Not complies NT=Not tested NA=Not applicable | | |

# 3. Test results

## 3.1. The field strength of fundamental and the field strength of spurious emission

**Test location**

Testing was performed at a test distance of 3 meter Open Area Test Site

**Test procedures**

[9 ㎑ to 30 ㎒]

The EUT was placed on the top of a rotating table 0.8 meter 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 Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

[30 ㎒ to 1 ㎓ and above 1 ㎓]

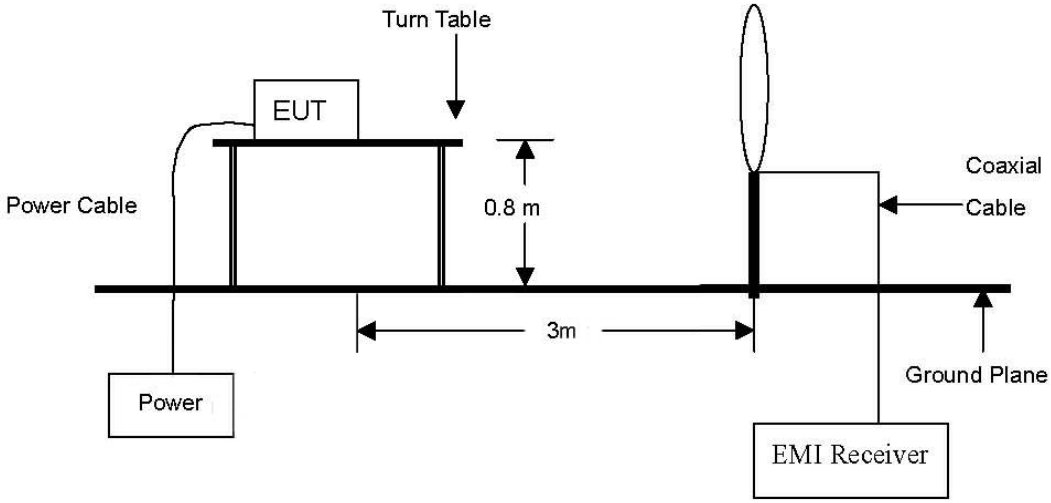
The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

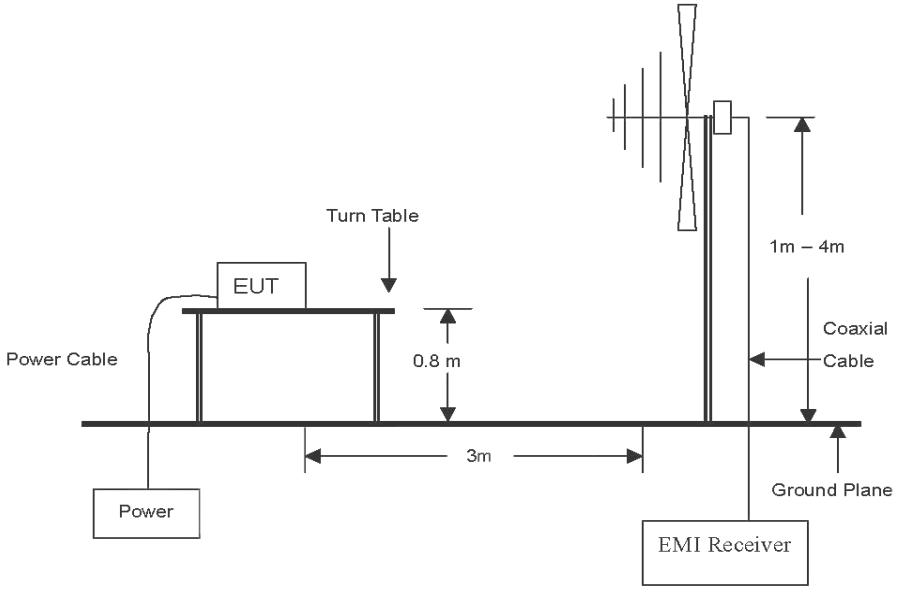
The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection at frequency above 1 ㎓.

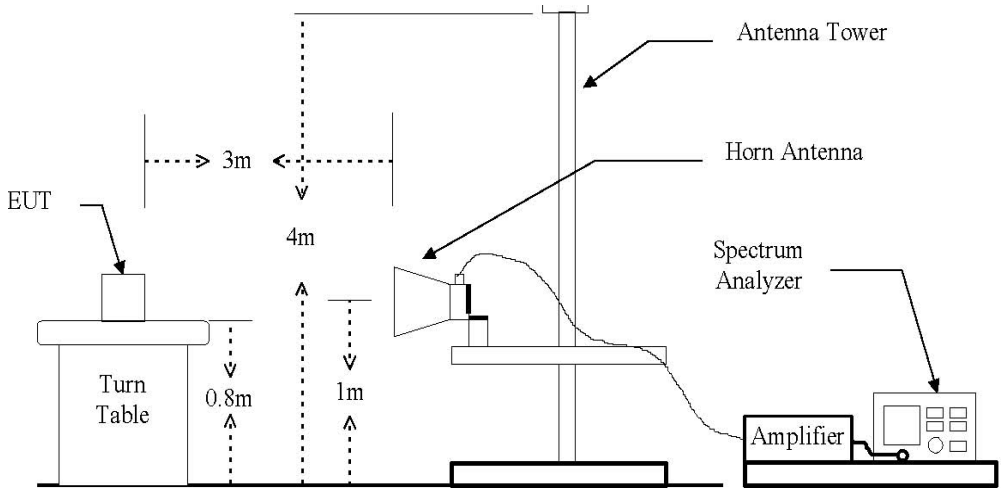
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.




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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 5 ㎓ emissions.




**Limit**

In the section 15.209:

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 (㎒) | Distance (Meters) | Radiated (㎶/m) |
|---|---|---|
| 0.009 ~ 0.490 | 300 | 2400 / F(㎑) |
| 0.490 ~ 1.705 | 30 | 24000 / F(㎑) |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 3 | 100** |
| 88 ~ 216 | 3 | 150** |
| 216 ~ 960 | 3 | 200** |
| Above 960 | 3 | 500 |

**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.

In the section 15.231(b):
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 (㎒) | Field strength of fundamental (microvolts / meter) | Field strength of spurious emission (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 |

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

**Test results (Below 30 ㎒)**

The frequency spectrum from 9 ㎑ to 30 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈.

| Radiated emissions | | Ant. | Correction factors | | | Total | Limit | |
|---|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (㏈㎶) | Pol. | Ant. factor (㏈/m) | Cable loss (㏈) | Fd (㏈) | Actual (㏈㎶/m) | Limit (㏈㎶/m) | Margin (㏈) |
| Below 30 | Not detected | | | | | | | |

**※ Remark**

1. All spurious emission at channels are almost the same below 30 ㎒, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + Fd
3. Fd = 40log(Dm / Ds)
   Where:
   Fd = Distance factor in ㏈
   Dm = Measurement distance in meters
   Ds = Specification distance in meters

## Low Channel

**Fundamental**

| Radiated emissions | | Ant. | Ant. factor (㏈/m) | Correction factor (㏈) | Total | Limit | |
|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (㏈㎶) | Pol. | | | Actual (㏈㎶/m) | Limit (㏈㎶/m) | Margin (㏈) |
| 433.05 | 42.86 | H | 16.30 | 5.71 | 64.87 | 100.79 | 35.92 |
| 433.05 | 29.31 | V | 16.30 | 5.71 | 51.32 | 100.79 | 49.47 |

**Spurious emission**

| Radiated emissions | | Ant. | Ant. factor (㏈/m) | Correction factor (㏈) | Total | Limit | |
|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (㏈㎶) | Pol. | | | Actual (㏈㎶/m) | Limit (㏈㎶/m) | Margin (㏈) |
| 866.1 | 5.17 | H | 22.93 | 8.71 | 36.81 | 80.79 | 43.98 |
| 866.1 | 4.22 | V | 22.93 | 8.71 | 35.86 | 80.79 | 44.93 |
| 2164.98 | 60.00 | H | 28.73 | -31.14 | 57.59 | 80.79 | 23.20 |
| 2599.13 | 56.20 | H | 29.43 | -30.62 | 55.01 | 80.79 | 25.78 |

**※ Remark**

1. Actual = Reading + Ant. factor + Correction factor(Cable loss or Amp. Gain + Cable loss)
2. Detector mode: Quasi peak
3. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes

## Middle Channel

**Fundamental**

| Radiated emissions | | Ant. | Ant. factor (dB/m) | Correction factor (dB) | Total | Limit | |
|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dB㎶) | Pol. | | | Actual (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
| 433.95 | 43.28 | H | 16.32 | 5.71 | 65.31 | 100.82 | 35.51 |
| 433.95 | 29.45 | V | 16.32 | 5.71 | 51.48 | 100.82 | 49.34 |

**Spurious emission**

| Radiated emissions | | Ant. | Ant. factor (dB/m) | Correction factor (dB) | Total | Limit | |
|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dB㎶) | Pol. | | | Actual (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
| 867.9 | 4.93 | H | 22.94 | 8.72 | 36.59 | 80.82 | 44.23 |
| 867.9 | 4.46 | V | 22.94 | 8.72 | 36.12 | 80.82 | 44.70 |
| 2170.80 | 59.66 | H | 28.74 | -31.13 | 57.28 | 80.82 | 23.54 |
| 2604.92 | 55.89 | H | 29.44 | -30.62 | 54.71 | 80.82 | 26.11 |

**※ Remark**

1. Actual = Reading + Ant. factor + Correction factor(Cable loss or Amp. Gain + Cable loss)
2. Detector mode: Quasi peak
3. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes

## High Channel

**Fundamental**

| Radiated emissions | | Ant. | Ant. factor (dB/m) | Correction factor (dB) | Total | Limit | |
|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dB㎶) | Pol. | | | Actual (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
| 434.79 | 43.39 | H | 16.33 | 5.72 | 65.44 | 100.85 | 35.41 |
| 434.79 | 29.38 | V | 16.33 | 5.72 | 51.43 | 100.85 | 49.42 |

**Spurious emission**

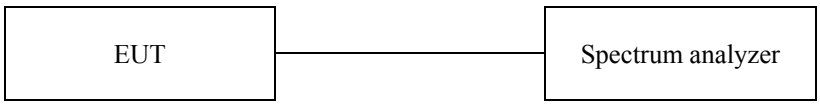
| Radiated emissions | | Ant. | Ant. factor (dB/m) | Correction factor (dB) | Total | Limit | |
|---|---|---|---|---|---|---|---|
| Frequency (㎒) | Reading (dB㎶) | Pol. | | | Actual (dB㎶/m) | Limit (dB㎶/m) | Margin (dB) |
| 869.58 | 5.05 | H | 22.95 | 8.73 | 36.73 | 80.85 | 44.12 |
| 869.58 | 4.73 | V | 22.95 | 8.73 | 36.41 | 80.85 | 44.44 |
| 2173.70 | 59.76 | H | 28.75 | -31.12 | 57.39 | 80.85 | 23.46 |
| 2607.80 | 55.50 | H | 29.44 | -30.62 | 54.32 | 80.85 | 26.53 |

**※ Remark**

1. Actual = Reading + Ant. factor + Correction factor(Cable loss or Amp. Gain + Cable loss)
2. Detector mode: Quasi peak
3. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes

## 3.2. 20 dB bandwidth

**Test setup**




**Test procedure**

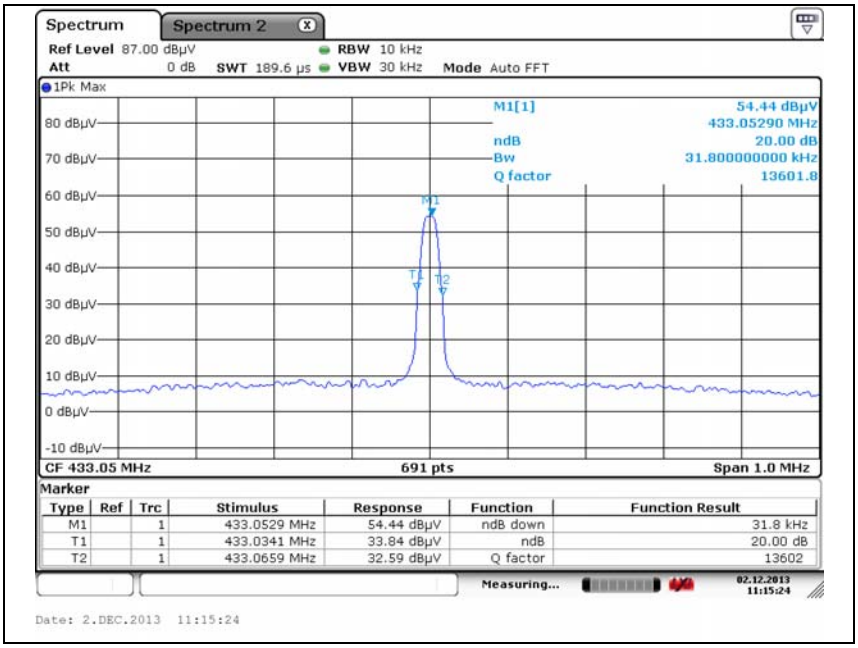
1. Use the following spectrum analyzer setting
2. RBW = 10 ㎑
3. VBW = 30 ㎑ (≥ RBW)
4. Span = 1 ㎒
5. Detector function = peak
6. Trace = max hold

**Limit**

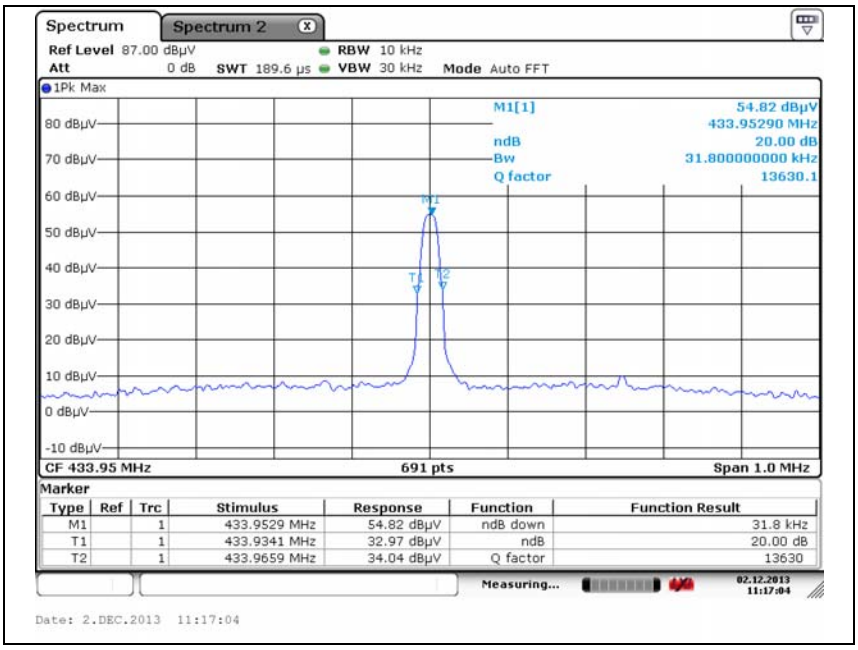
The bandwidth of the emissions shall be no wider than 0.25 % of the center frequency for devices operating above 70 ㎒ and below 900 ㎒. Bandwidth is determined at the points 20 dB down from the modulated carrier.

**Test results**

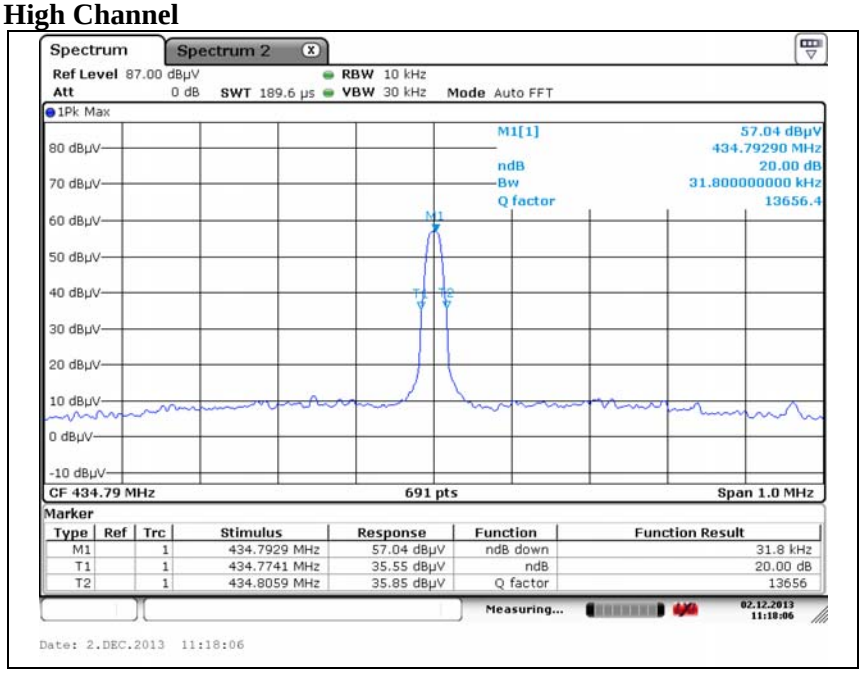
**Low Channel**



**Middle Channel**

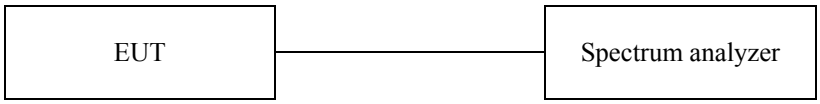



**High Channel**



## 3.3. Transmission time

**Test setup**




**Test procedure**

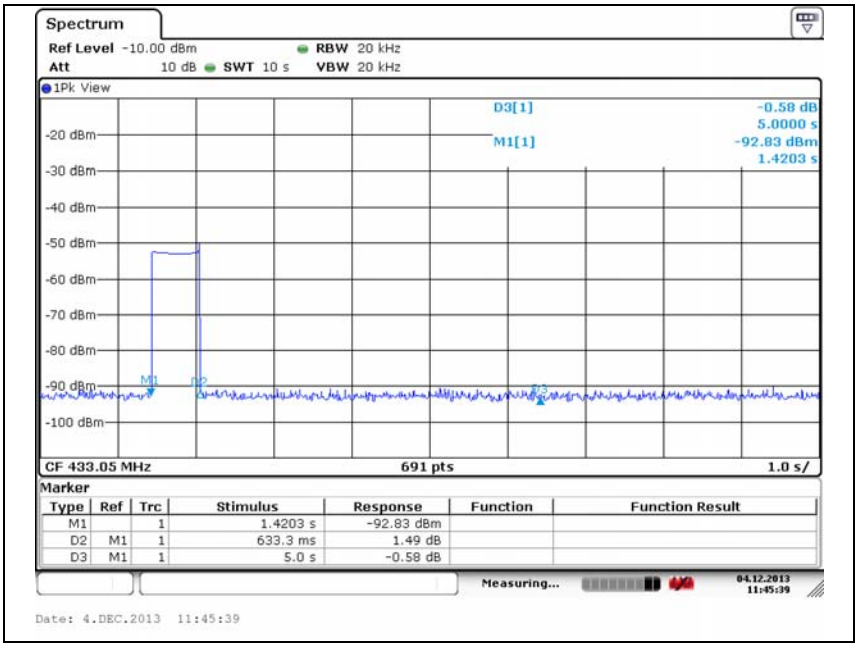
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW=20 ㎑, VBW=20 ㎑, Span=0 ㎐ and Sweep time=10 sec.

**Limit**

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

**Test results**

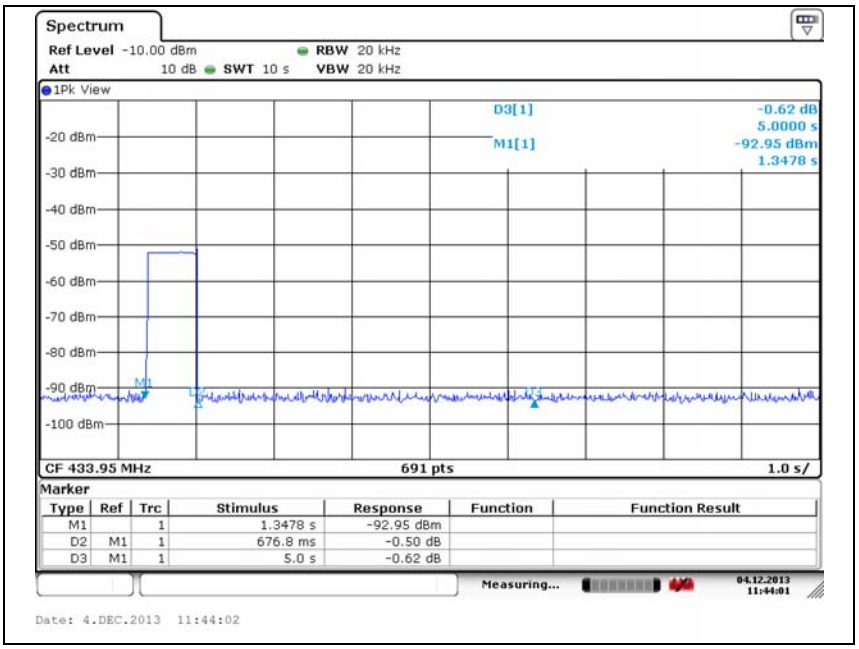
**Low Channel**




**Transmission time**

| Frequency(㎒) | Transmission time (sec) | Limit (s) |
|---|---|---|
| 433.05 | 0.633 3 | Same or less than 5 |

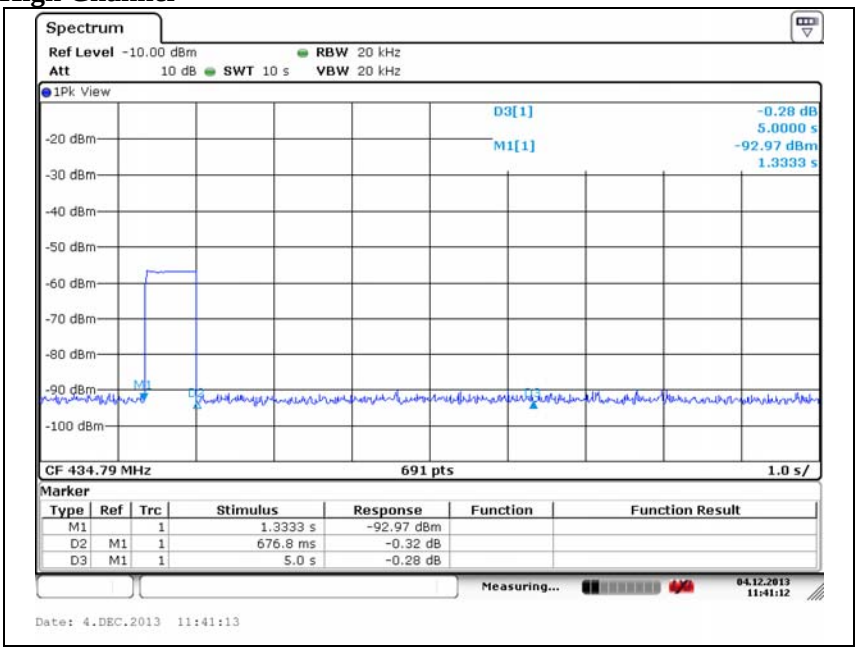
**Middle Channel**




**Transmission time**

| Frequency(㎒) | Transmission time (sec) | Limit (s) |
|---|---|---|
| 433.95 | 0.676 8 | Same or less than 5 |

**High Channel**




**Transmission time**

| Frequency(㎒) | Transmission time (sec) | Limit (s) |
|---|---|---|
| 434.79 | 0.676 8 | Same or less than 5 |

## Appendix A. Measurement equipment

| Equipment | Manufacturer | Model | Serial No. | Calibration Interval | Calibration due. |
|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV30 | 100736 | 1 year | 2014.01.09 |
| Vector Signal Generator | R&S | SMBV2100A | 1407.6004K02 | 1 year | 2014.01.10 |
| Trilog-Broadband Antenna | Schwarzbeck | VULB 9168 | 385 | 2 years | 2015.05.09 |
| Horn Antenna | A.H. | SAS-571 | 414 | 2 years | 2015.02.28 |
| Broadband Preamplifier | Schwarzbeck | BBV9718 | 9718-245 | 1 year | 2014.09.23 |
| EMI Test Receiver | R&S | ESHS10 | 862970/018 | 1 year | 2014.05.06 |

**Peripheral device**

| Device | Manufacturer | Model No. | Serial No. |
|---|---|---|---|
| N/A | | | |

## Appendix B. Test setup photos