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# FCC/IC Test Report

| | |
|---|---|
| **Prepared for:** | **Digital Monitoring Products** |
| **Address:** | **2500 North Partnership Blvd.<br>Springfield, MO 6582** |
| **Product:** | **1166 Smoke Detector** |
| **FCC ID:<br>IC:** | **CCKPC0194<br>5251A-PC0194** |
| **Test Report No:** | **R20170718-25** |
| **Approved By:** | **Nic S. Johnson, NCE**<br>**Technical Manager**<br>**iNARTE Certified EMC Engineer #EMC-003337-NE** |
| **DATE:** | **4 October 2017** |
| **Total Pages:** | **40** |

ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

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# 1.0 Summary of test results

## 1.1 Test Results

The EUT has been tested according to the following specifications:

| SUMMARY | | | |
|---|---|---|---|
| **Standard Section** | **Test Type and Limit** | **Result** | **Remark** |
| FCC 15.203 | Unique Antenna Requirement | Pass | Internal Antenna |
| FCC 15.209<br>RSS-Gen, 7.1.2 | Receiver Radiated Emissions | Pass | Meets the requirement of the limit. |
| FCC 15.247(a)(1)(i)<br>RSS-247, 5.1c | Minimum Bandwidth,<br>Limit: Max. <250 kHz/ 50+ channels | Pass | Meets the requirement of the limit. |
| FCC 15.247(b)(1)<br>RSS-247, 5.4 | Maximum Peak Output Power, Limit: Max. 30 dBm | Pass | Meets the requirement of the limit. |
| FCC 15.209<br>RSS-Gen, 8.9<br>RSS-247, 5.3 | Transmitter Radiated Emissions | Pass | Meets the requirement of the limit. |
| FCC 15.247(a) (1) (i)<br>RSS-247, 5.1c | Frequency hopping system,<br>Limit: Max. 0.4 Seconds in 20 Second Period | Pass | Meets the requirement of the limit. |
| FCC 15.209, 15.205<br>RSS-247, 5.5<br>RSS-Gen, 8.9 | Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency | Pass | Meets the requirement of the limit. |
| FCC 15.207<br>RSS-Gen, 8.8 | Conducted AC Emissions | N/A | The EUT is powered by a battery. |

# 2.0 Description

## 2.1 Equipment under test

The Equipment Under Test (EUT) was 1166 a wireless remote smoke detector, manufactured by DMP wireless devices. It has transmit and receive capabilities.

EUT Received Date: 8 September 2017
EUT Tested Dates: 29 September 2017 – 3 October 2017

| | |
|---|---|
| MODEL | 1166 |
| Serial No. | NCEETEST1 (assigned) |
| POWER SUPPLY | 3VDC (CR2477) |
| ANTENNA TYPE | Antenna is not user replaceable |

*NOTE:* For more detailed features description, please refer to the manufacturer's specifications or user's manual.

## 2.2 Laboratory description

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

| | |
|---|---|
| A2LA Certificate Number : | 1953.01 |
| FCC Accredited Test Site Designation No: | US1060 |
| Industry Canada Test Site Registration No: | 4294A-1 |
| NCC CAB Identification No: | US0177 |

Environmental conditions varied slightly throughout the tests:
Relative humidity of 32 ± 4%
Temperature of 22 ± 3° Celsius

### 2.3 Description of test modes

The EUT operates on, and was tested at the frequencies below:

| Channel | Frequency |
|---|---|
| Low | 905.60 |
| Middle | 915.00 |
| High | 924.40 |

These are the only three representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

### 2.4 Applied standards

The EUT is a frequency hopping device operating in the 905 MHz to 924 MHz amateur band. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**FCC Part 15, Subpart C; 15.209 and 15.247**
**Industry Canada, RSS-247, Issue 2**
**Industry Canada, RSS-Gen, Issue 4**
**ANSI C63.10:2013**

All test items have been performed and recorded as per the above.

### 2.5 Description of support units

None

### 2.6 Configuration of system under test

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, highest and one channel in the middle.

## 3.0 Test equipment used

| DESCRIPTION AND MANUFACTURER | MODEL NO. | SERIAL NO. | LAST CALIBRATION DATE | CALIBRATION DUE DATE |
|---|---|---|---|---|
| Rohde & Schwarz Test Receiver | ES126 | 100037 | 24 Jan 2017 | 24 Jan 2018 |
| EMCO Biconilog Antenna | 3142B | 1647 | 02 Aug 2017 | 02 Aug 2018 |
| EMCO Horn Antenna | 3115 | 6416 | 25 Jan 2016 | 25 Jan 2018 |
| Rohde & Schwarz Preamplifier | TS-PR18 | 3545700803 | 09 Feb 2017* | 09 Feb 2018* |
| Trilithic High Pass Filter | 6HC330 | 23042 | 09 Feb 2017* | 09 Feb 2018* |
| Mini Circuits 1700 – 5000Mhz High Pass Filter*** | 15542 | 31618 | 09 Feb 2017* | 09 Feb 2018* |
| Rohde & Schwarz LISN | ESH3-Z5 | 100023 | 23 Jan 2017 | 23 Jan 2018 |
| RF Cable (preamplifier to antenna) | MFR-57500 | 01-07-002 | 09 Feb 2017* | 09 Feb 2018* |
| RF Cable (antenna to 10m chamber bulkhead) | FSCM 64639 | 01E3872 | 09 Feb 2017* | 09 Feb 2018* |
| RF Cable (10m chamber bulkhead to control room bulkhead) | FSCM 64639 | 01E3874 | 09 Feb 2017* | 09 Feb 2018* |
| RF Cable (Control room bulkhead to RF switch) | FSCM 64639 | 01E3871 | 09 Feb 2017* | 09 Feb 2018* |
| RF Cable (RF switch to test receiver) | FSCM 64639 | 01F1206 | 09 Feb 2017* | 09 Feb 2018* |
| RF switch – Rohde and Schwarz | TS-RSP | 1113.5503.14 | 09 Feb 2017* | 09 Feb 2018* |
| N connector bulkhead (10m chamber) | PE9128 | NCEEBH1 | 09 Feb 2017* | 09 Feb 2018* |
| N connector bulkhead (control room) | PE9128 | NCEEBH2 | 09 Feb 2017* | 09 Feb 2018* |

*Internal Characterization

## 4.0 Detailed results

### 4.1 Unique antenna requirement

#### 4.1.1 Standard applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

#### 4.1.2 Antenna description

The antenna on the EUT is an antenna on the PCB so it’s not user replaceable.

## 4.2 Radiated emissions

Test Method: ANSI C63.10, Section(s) 6.5, 6.6

### 4.2.1 Limits for radiated emissions measurements

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

| FREQUENCIES (MHz) | FIELD STRENGTH (μV/m) | MEASUREMENT DISTANCE (m) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 3 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

**NOTE:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

#### 4.2.2 Test procedures

a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements form 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was 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 used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB 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.

g. The EUT was maximized in all 3 orthogonal positions.

**NOTE:**

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

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector and average detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

### 4.2.3 Deviations from test standard

No deviation.

### 4.2.4 Test setup

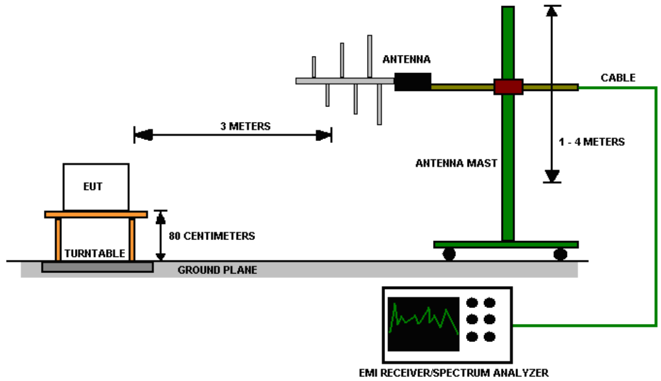



**Figure 1 - Radiated Emissions Test Setup**

The EUT was tested in all 3 orthogonal axis of the EUT and meet the requirements from ANS C63.10 Section 5.10.1.

### 4.2.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

### 4.2.6 Test results

| | | | |
|---|---|---|---|
| EUT | 1166 | MODE | Receive |
| INPUT POWER | 3 VDC | FREQUENCY RANGE | 30MHz – 10GHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

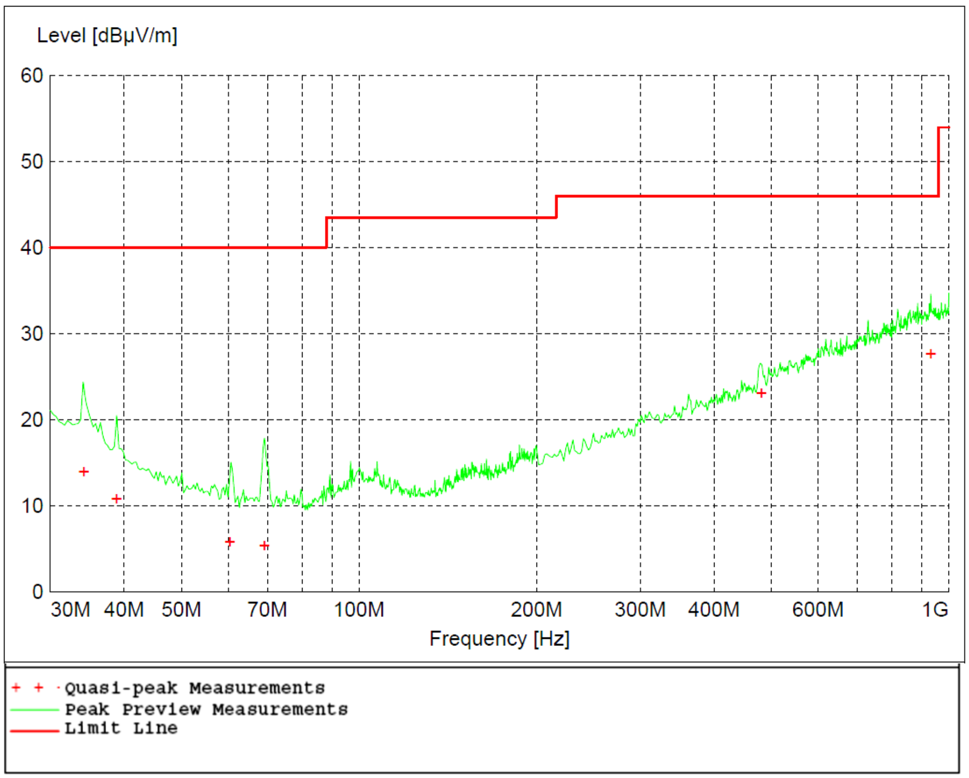



**Figure 2 - Radiated Emissions Plot, Receive**

**REMARKS**:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

**Table 1 - Radiated Emissions Quasi-peak Measurements, Receive**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 34.200000 | 13.92 | 40.00 | 26.10 | 183 | 119 | VERT | X |
| 38.820000 | 10.76 | 40.00 | 29.20 | 247 | 33 | VERT | X |
| 60.480000 | 5.84 | 40.00 | 34.20 | 336 | 94 | VERT | X |
| 69.180000 | 5.39 | 40.00 | 34.60 | 156 | 108 | VERT | X |
| 481.320000 | 23.06 | 46.00 | 22.90 | 240 | 359 | HORI | X |
| 932.580000 | 27.58 | 46.00 | 18.40 | 281 | 194 | VERT | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

**Table 2 - Radiated Emissions Peak Measurement vs Average Limits, Receive**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 1818.800000 | 32.62 | 54.00 | 21.38 | 220 | 260 | HORI | X |
| 1841.600000 | 32.91 | 54.00 | 21.09 | 100 | 360 | HORI | X |
| 2741.800000 | 35.23 | 54.00 | 18.77 | 398 | 360 | VERT | X |
| 2742.800000 | 35.23 | 54.00 | 18.77 | 401 | 321 | VERT | X |
| 3650.000000 | 38.98 | 54.00 | 15.02 | 100 | 290 | VERT | X |
| 3663.200000 | 39.01 | 54.00 | 14.99 | 400 | 267 | VERT | X |
| 4575.400000 | 39.37 | 54.00 | 14.63 | 99 | 224 | VERT | X |
| 4581.800000 | 40.16 | 54.00 | 13.84 | 383 | 33 | VERT | X |
| 5489.000000 | 41.99 | 54.00 | 12.01 | 398 | 57 | VERT | X |
| 5489.800000 | 42.38 | 54.00 | 11.62 | 401 | 359 | VERT | X |

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

| | | | |
|---|---|---|---|
| EUT | 1166 | MODE | Transmit, Low Channel |
| INPUT POWER | 3 VDC | FREQUENCY RANGE | 30MHz – 10GHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

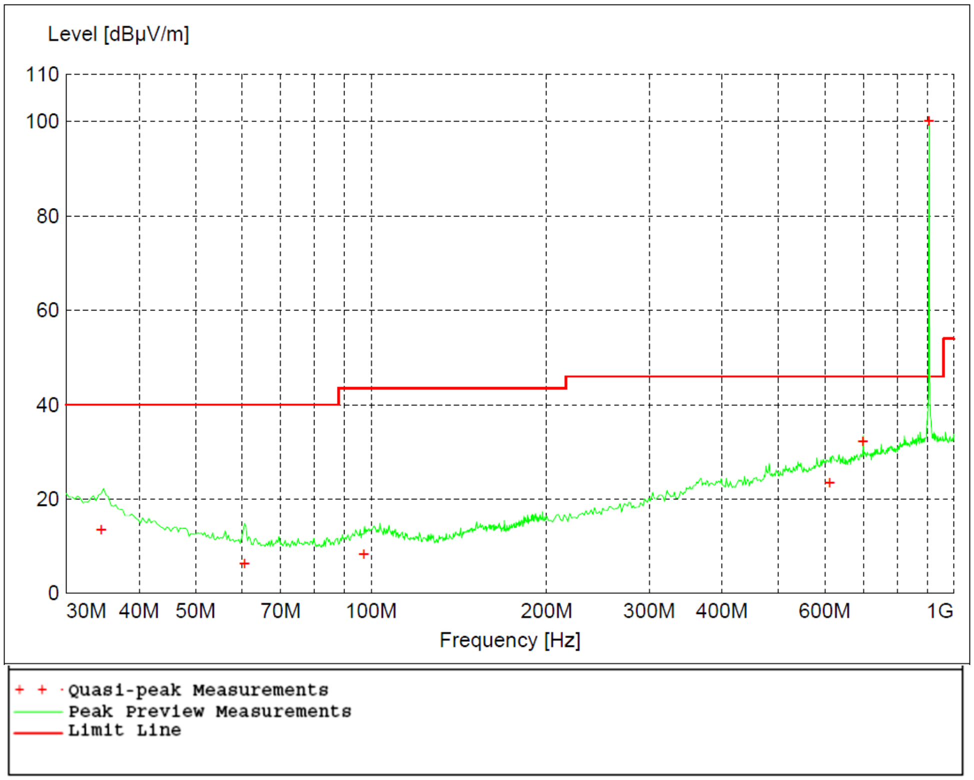



**Figure 3 - Radiated Emissions Plot, Low Channel**

**REMARKS**:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

**Table 3 - Radiated Emissions Quasi-peak Measurements, Low Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | dBµV/m | dB | cm. | deg. | | |
| 34.440000 | 13.48 | 40.00 | 26.50 | 115 | 217 | VERT | X |
| 60.720000 | 6.26 | 40.00 | 33.70 | 100 | 61 | VERT | X |
| 97.260000 | 8.18 | 43.50 | 35.30 | 102 | 79 | VERT | X |
| 612.180000 | 23.31 | 46.00 | 22.70 | 166 | 227 | VERT | X |
| 697.560000 | 32.10 | 46.00 | 13.90 | 130 | 162 | HORI | X |
| 905.590000 | 100.07 | NA | NA | 99 | 61 | HORI | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

**Table 4 - Radiated Emissions Average Measurements, Low Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | dBµV/m | dB | cm. | deg. | | |
| 1811.200000* | 62.29 | NA | NA | 100 | 164 | HORI | X |
| 2716.800000 | 38.49 | 54.00 | 15.50 | 136 | 142 | HORI | X |
| 3622.400000 | 28.72 | 54.00 | 25.30 | 146 | 82 | HORI | X |
| 4527.800000 | 38.87 | 54.00 | 15.10 | 136 | 126 | HORI | X |
| 5433.600000 | 50.48 | 54.00 | 3.50 | 167 | 35 | VERT | X |
| 6339.000000 | 45.42 | 54.00 | 8.60 | 157 | 195 | VERT | X |
| 7244.800000 | 49.55 | 54.00 | 4.50 | 177 | 142 | HORI | X |
| 8150.400000 | 41.34 | 54.00 | 12.70 | 143 | 197 | VERT | X |
| 9055.800000 | 35.21 | 54.00 | 18.80 | 100 | 226 | VERT | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above. Average detector was used as the fundamental was transmitting at 100 percent duty cycle for this test.

**Table 5 - Radiated Emissions Peak Measurements, Low Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | dBµV/m | dB | cm. | deg. | | |
| 1811.200000* | 62.73 | NA | NA | 100 | 164 | HORI | X |
| 2716.800000 | 42.78 | 74.00 | 31.22 | 136 | 142 | HORI | X |
| 3622.400000 | 44.69 | 74.00 | 29.31 | 146 | 82 | HORI | X |
| 4527.800000 | 45.28 | 74.00 | 28.72 | 136 | 126 | HORI | X |
| 5433.600000 | 53.08 | 74.00 | 20.92 | 167 | 35 | VERT | X |
| 6339.000000 | 49.94 | 74.00 | 24.06 | 157 | 195 | VERT | X |
| 7244.800000 | 52.76 | 74.00 | 21.24 | 177 | 142 | HORI | X |
| 8150.400000 | 49.60 | 74.00 | 24.40 | 143 | 197 | VERT | X |
| 9055.800000 | 50.71 | 74.00 | 23.29 | 100 | 226 | VERT | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.
*Unrestricted band – Meets the limit of being 20dB below the fundamental

| | | | |
|---|---|---|---|
| EUT | 1166 | MODE | Transmit, Mid Channel |
| INPUT POWER | 3 VDC | FREQUENCY RANGE | 30MHz – 10GHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

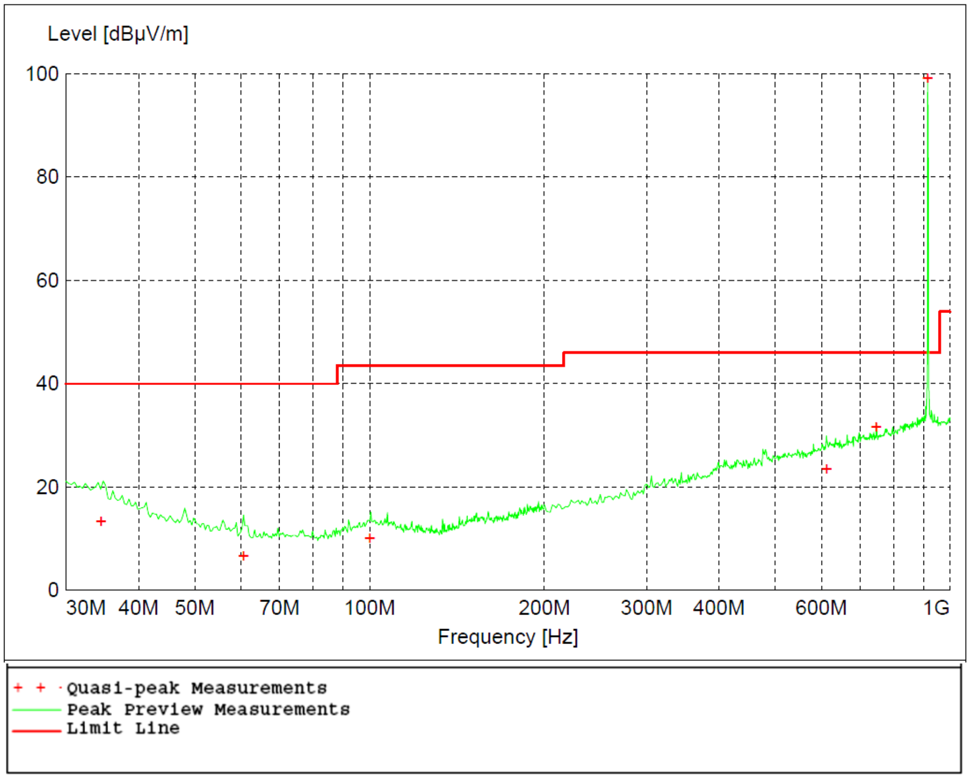



**Figure 4 - Radiated Emissions Plot, Mid Channel**

**REMARKS**:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

**Table 6 - Radiated Emissions Quasi-peak Measurements, Mid Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 34.500000 | 13.37 | 40.00 | 26.60 | 336 | 319 | VERT | X |
| 60.720000 | 6.51 | 40.00 | 33.50 | 377 | 129 | VERT | X |
| 100.200000 | 10.10 | 43.50 | 33.40 | 99 | 147 | VERT | X |
| 613.140000 | 23.42 | 46.00 | 22.60 | 400 | 348 | VERT | X |
| 745.980000 | 31.56 | 46.00 | 14.40 | 100 | 241 | HORI | X |
| 915.000000 | 99.12 | NA | NA | 156 | 226 | HORI | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

**Table 7 - Radiated Emissions Average Measurements, Mid Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 1830.000000 | 60.96 | NA | NA | 161 | 156 | HORI | X |
| 2745.000000 | 36.86 | 54.00 | 17.10 | 157 | 144 | HORI | X |
| 3659.800000 | 43.14 | 54.00 | 10.90 | 153 | 207 | VERT | X |
| 4575.000000 | 28.27 | 54.00 | 25.70 | 99 | 112 | HORI | X |
| 5490.000000 | 51.67 | 54.00 | 2.30 | 200 | 204 | VERT | X |
| 6405.000000 | 45.32 | 54.00 | 8.70 | 197 | 170 | VERT | X |
| 7320.000000 | 44.34 | 54.00 | 9.70 | 115 | 289 | VERT | X |
| 8235.000000 | 44.99 | 54.00 | 9.00 | 224 | 221 | VERT | X |
| 9150.000000 | 50.33 | 54.00 | 3.70 | 177 | 206 | HORI | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above. Average detector was used as the fundamental was transmitting at 100 percent duty cycle for this test.

**Table 8 - Radiated Emissions Peak Measurements, Mid Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 1830.000000* | 61.45 | NA | NA | 161 | 156 | HORI | X |
| 2745.000000 | 41.82 | 74.00 | 32.18 | 157 | 144 | HORI | X |
| 3659.800000 | 47.39 | 74.00 | 26.61 | 153 | 207 | VERT | X |
| 4575.000000 | 44.83 | 74.00 | 29.17 | 99 | 112 | HORI | X |
| 5490.000000 | 54.05 | 74.00 | 19.95 | 200 | 204 | VERT | X |
| 6405.000000 | 49.96 | 74.00 | 24.04 | 197 | 170 | VERT | X |
| 7320.000000 | 52.56 | 74.00 | 21.44 | 115 | 289 | VERT | X |
| 8235.000000 | 51.68 | 74.00 | 22.32 | 224 | 221 | VERT | X |
| 9150.000000 | 54.28 | 74.00 | 19.72 | 177 | 206 | HORI | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.
*Unrestricted band – Meets the limit of being 20dB below the fundamental

| | | | |
|---|---|---|---|
| EUT | 1166 | MODE | Transmit, High Channel |
| INPUT POWER | 3 VDC | FREQUENCY RANGE | 30MHz – 10GHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

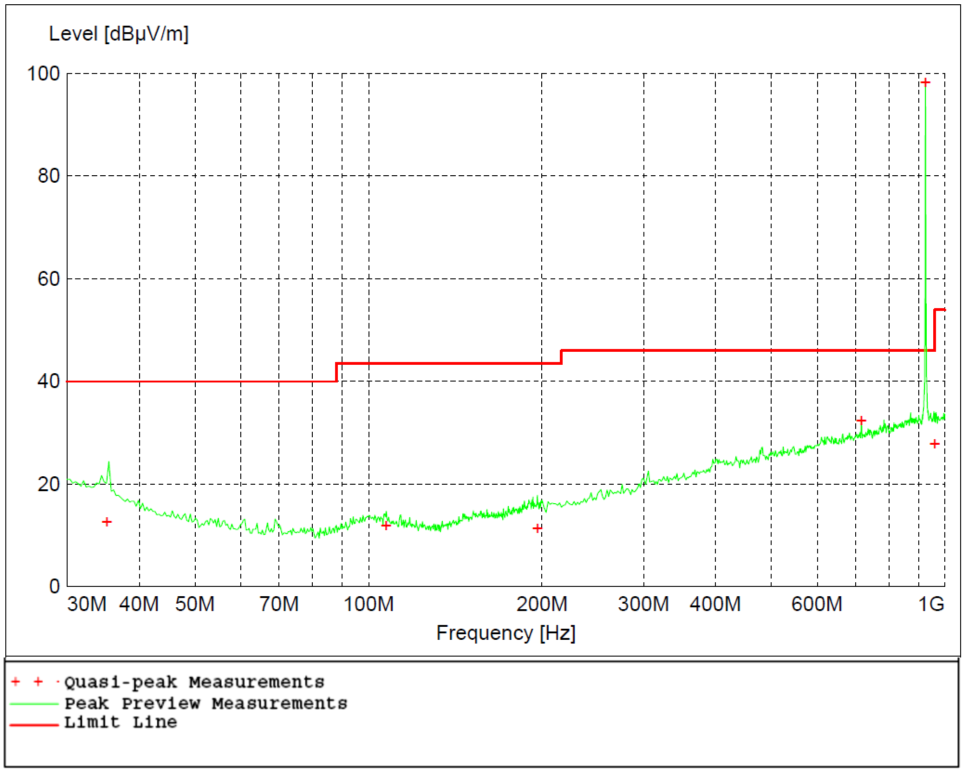



**Figure 5 - Radiated Emissions Plot, High Channel**

**REMARKS**:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

**Table 9 - Radiated Emissions Quasi-peak Measurements, High Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 35.160000 | 12.58 | 40.00 | 27.40 | 387 | 202 | HORI | X |
| 107.280000 | 11.86 | 43.50 | 31.70 | 156 | 104 | VERT | X |
| 196.380000 | 11.36 | 43.50 | 32.20 | 206 | 344 | HORI | X |
| 716.400000 | 32.30 | 46.00 | 13.70 | 106 | 236 | HORI | X |
| 924.400000 | 98.16 | NA | NA | 156 | 251 | HORI | X |
| 960.000000 | 27.75 | 46.00 | 18.30 | 370 | 104 | VERT | X |

The EUT was maximized in all 3 orthogonal axis.  The worst-case is shown in the table above.

**Table 10 - Radiated Emissions Average Measurements, High Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 1848.800000 | 59.59* | NA | NA | 100 | 148 | HORI | X |
| 2773.200000 | 35.13 | 54.00 | 18.90 | 126 | 126 | HORI | X |
| 3697.600000 | 43.52 | 54.00 | 10.50 | 163 | 209 | VERT | X |
| 4622.000000 | 34.93 | 54.00 | 19.10 | 100 | 360 | VERT | X |
| 5546.400000 | 52.00 | 54.00 | 2.00 | 100 | 35 | VERT | X |
| 6470.800000 | 45.15 | 54.00 | 8.80 | 170 | 176 | VERT | X |
| 7395.200000 | 52.88 | 54.00 | 1.10 | 99 | 285 | VERT | X |
| 8302.200000 | 33.40 | 54.00 | 20.60 | 368 | 334 | VERT | X |
| 9244.000000 | 47.36 | 54.00 | 6.60 | 206 | 209 | HORI | X |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above. Average detector was used as the fundamental was transmitting at 100 percent duty cycle for this test.

**Table 11 - Radiated Emissions Peak Measurements, High Channel**

| Frequency | Level | Limit | Margin | Height | Angle | Pol | Axis |
|---|---|---|---|---|---|---|---|
| MHz | dBμV/m | dBμV/m | dB | cm. | deg. | | |
| 1848.800000* | 60.08 | NA | NA | 100 | 148 | HORI | X |
| 2773.200000 | 40.72 | 74.00 | 33.28 | 126 | 126 | HORI | X |
| 3697.600000 | 47.20 | 74.00 | 26.80 | 163 | 209 | VERT | X |
| 4622.000000 | 43.62 | 74.00 | 30.38 | 100 | 360 | VERT | X |
| 5546.400000 | 54.28 | 74.00 | 19.72 | 100 | 35 | VERT | X |
| 6470.800000 | 49.88 | 74.00 | 24.12 | 170 | 176 | VERT | X |
| 7395.200000 | 55.17 | 74.00 | 18.83 | 99 | 285 | VERT | X |
| 8302.200000 | 46.54 | 74.00 | 27.46 | 368 | 334 | VERT | X |
| 9244.000000 | 52.40 | 74.00 | 21.60 | 206 | 209 | HORI | X |

The EUT was maximized in all 3 orthogonal axis.  The worst-case is shown in the table above.
*Unrestricted band – Meets the limit of being 20dB below the fundamental

## 4.3 Bandwidth and Peak EIRP

Test Method: ANSI C63.10, Section(s) 7.8.5, 6.9.2

### 4.3.1 Limits of bandwidth measurements

From FCC Part 15.247 (1) (i) and RSS-247 5.1(c)

The 20 dB occupied bandwidth and peak EIRP are displayed separately. The peak EIRP was measured using a 10 MHz RBW. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz. The output power is required to be less than 30 dBm for systems employing more than 50 channels. EIRP was calculated from field strength measurements using ANSI C63.10:2013, Section 9.5, Equation (22).

### 4.3.2 Test procedures

All measurements were taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 kHz RBW and 10 kHz VBW.

The 20dB band width is defined as the bandwidth that is measured 20 dB down from the peak of the signal.

The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded.

### 4.3.3 Deviations from test standard

No deviation.

### 4.3.4 Test setup

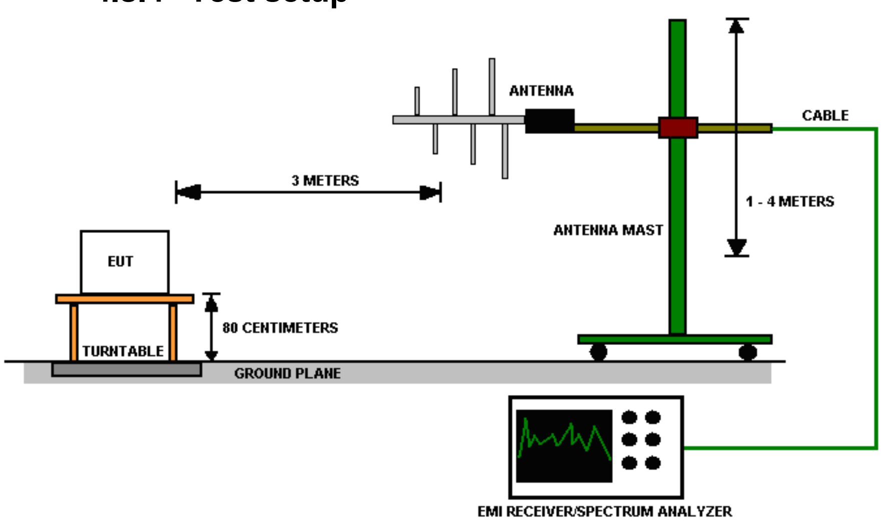


**Figure 6 - Bandwidth Measurements Test Setup**

### 4.3.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

### 4.3.6 Test results

| | | | |
|---|---|---|---|
| EUT MODULE | 1166 | MODE | Transmit |
| INPUT POWER | VDC | FREQUENCY RANGE | 905.6 MHz – 924.4 MHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

**20 dB Bandwidth**

| CHANNEL | CHANNEL FREQUENCY (MHz) | 20dB BW (kHz) |
|---|---|---|
| 1 | 905.59 | 72.14 |
| 2 | 915.00 | 71.64 |
| 3 | 924.40 | 71.14 |

*The measurements were conducted at 3 kHz RBW and 10 kHz VBW.

**REMARKS**:
None

**Peak EIRP**

| CHANNEL | CHANNEL FREQUENCY (MHz) | EIRP PEAK POWER OUTPUT (dBm) | EIRP LIMIT (dBm) | RESULT |
|---|---|---|---|---|
| 1 | 905.59 | 5.60 | 30 | PASS |
| 2 | 915.00 | 4.77 | 30 | PASS |
| 3 | 924.40 | 4.77 | 30 | PASS |

EIRP was calculated from field strength measurements using ANSI C63.10:2013, Section 9.5, Equation (22).

All measurements were taken from the Output Power screen captures.

**REMARKS**:
None

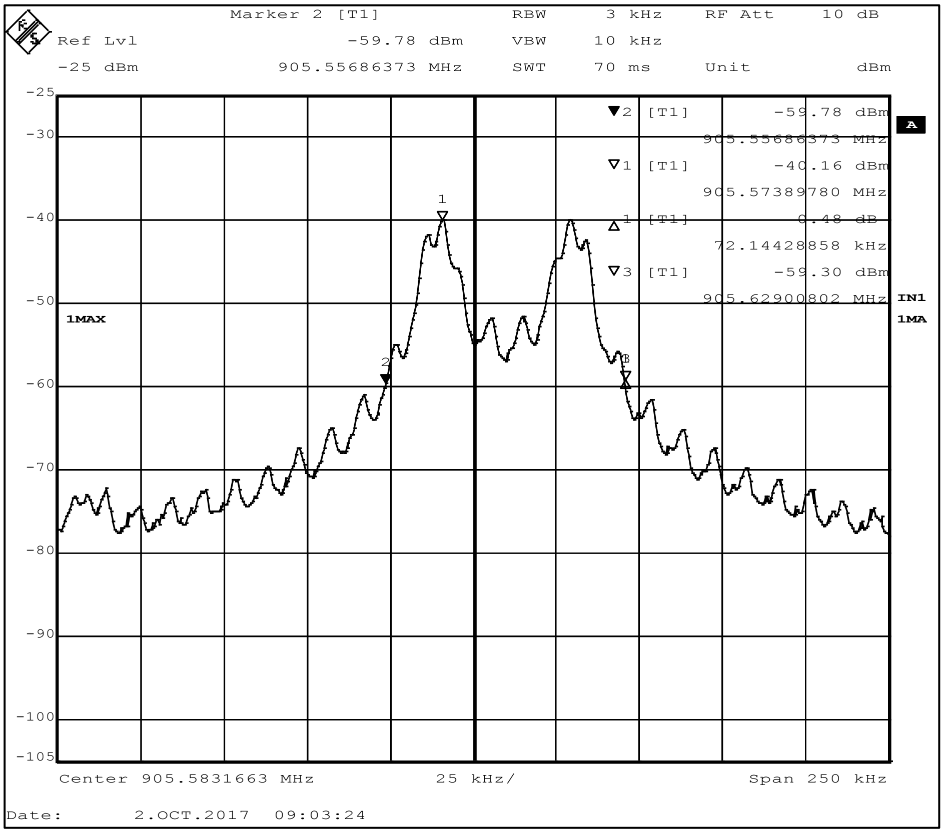



**Figure 7 – 20 dB Bandwidth, Low Channel. 72.14 kHz**

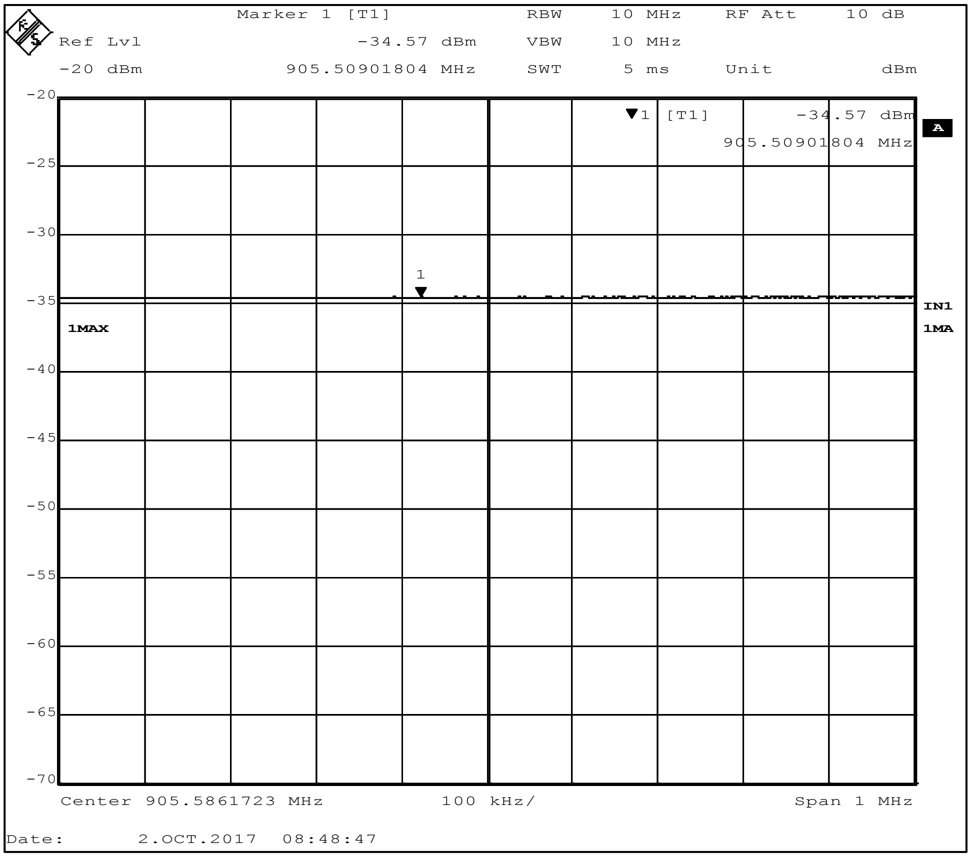



**Figure 8 – Output Power, Low Channel.**

Maximum power = -34.57 dBm + 107 + CL + AF - 95.23 = 5.60 dBm*
CL = cable loss = 4.70 dB
AF = antenna factor = 23.70 dB
107 = conversion from dBm to dBµV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBµV/m) to EIRP (dBm) at a 3m measurement distance.
Note: Measurements do not include duty cycle correction

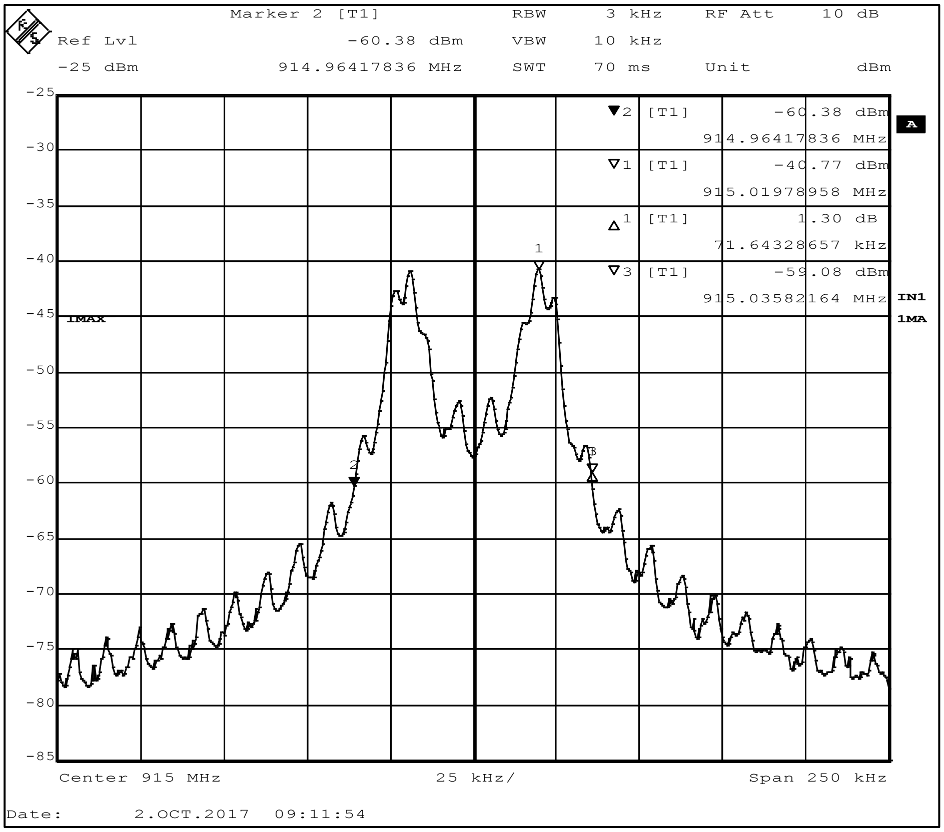



**Figure 9 – 20 dB Bandwidth, Mid Channel, 71.64 kHz**

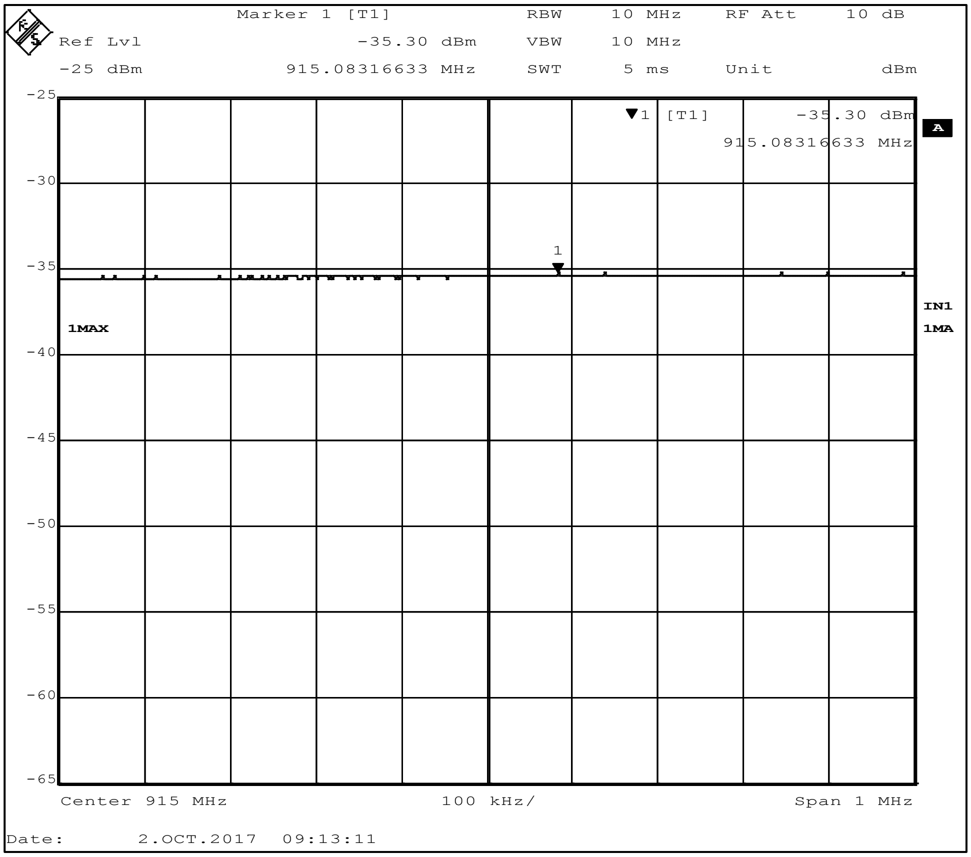



**Figure 10 – Output Power, Mid Channel**

Maximum power = -35.30 dBm + 107 + CL + AF - 95.23 = 4.77 dBm*
CL = cable loss = 4.80 dB
AF = antenna factor = 23.50 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.
Note: Measurements do not include duty cycle correction

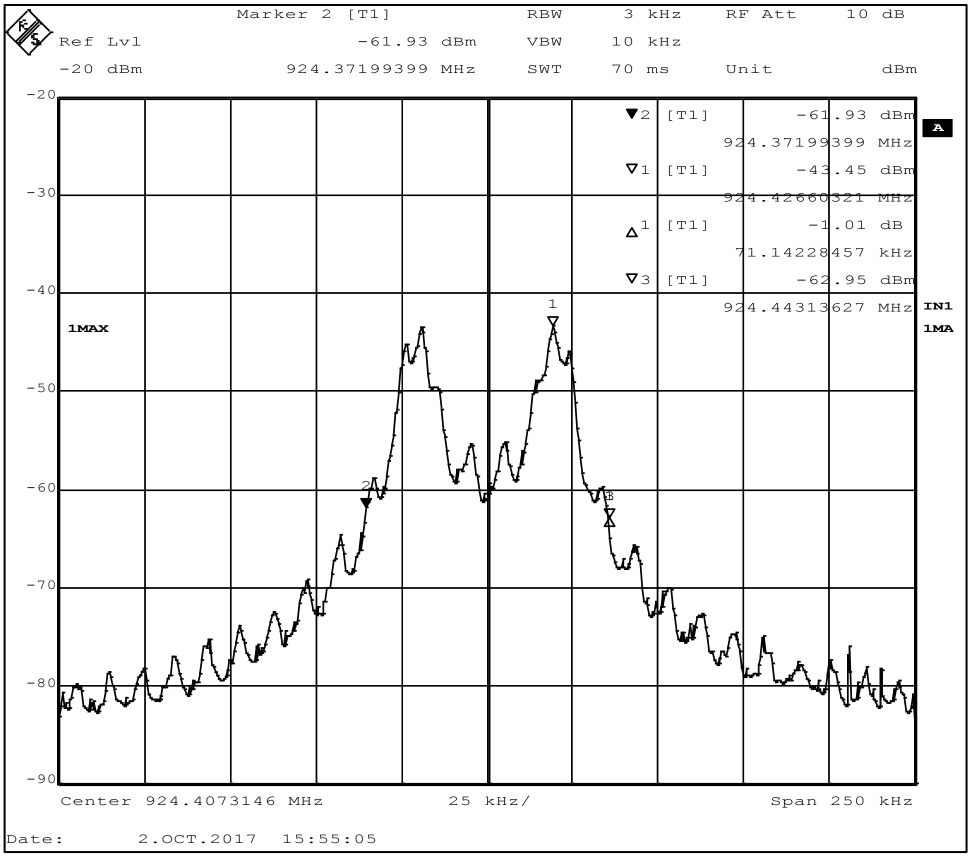



**Figure 11 – 20 dB Bandwidth, High Channel, 71.14 kHz**

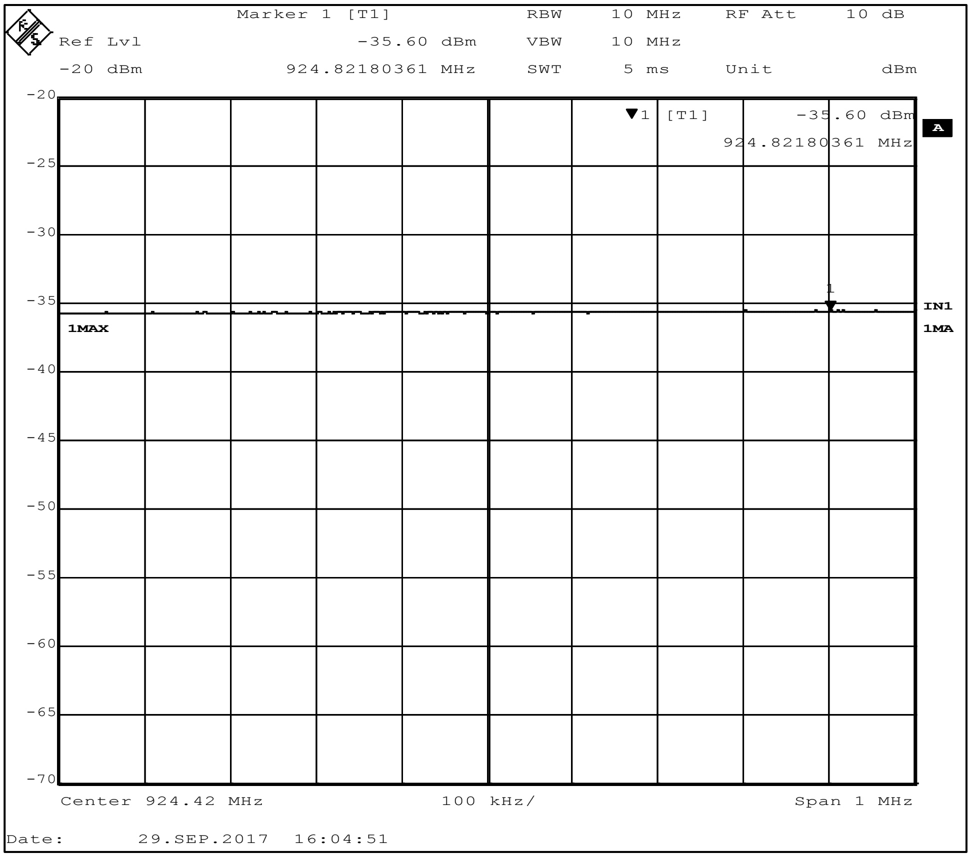



**Figure 12 – Output Power, High Channel**

Maximum power = -35.60 dBm + 107 + CL + AF - 95.23 = 4.77 dBm*
CL = cable loss = 4.80 dB
AF = antenna factor = 23.80 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.
Note: Measurements do not include duty cycle correction

## 4.4 Bandedges

Test Method: ANSI C63.10, Section(s) 6.10.4

### 4.4.1 Limits of bandedge measurements

For emissions outside of the allowed band of operation (905.6 MHz – 924.4 MHz), the emission level needs to be 20dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209.

### 4.4.2 Test procedures

The EUT was tested in the same method as described in section *4.3 - Bandwidth*. The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 30kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the bandedge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209.

### 4.4.3 Deviations from test standard

No deviation.

### 4.4.4 Test setup

See Section 4.3

### 4.4.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

### 4.4.6 Test results

| EUT | 1166 | MODE | Transmit |
|---|---|---|---|
| INPUT POWER | 3 VDC | FREQUENCY RANGE | 905.6 MHz – 924.4 MHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

Highest Out of Band Emissions

| CHANNEL | Band edge Measurement Frequency (MHz) | Relative Highest out of band level dBm | Relative Fundamental Level (dBm) | Delta | Min (dBc) | Result |
|---|---|---|---|---|---|---|
| 1 | 902 | -95.66 | -35.11 | 60.10 | 54.07 | PASS |
| 3 | 928 | -96.65 | -36.65 | 60.00 | 52.16 | PASS |

*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [ Part 15.209 radiated emissions limit. ]

From Section 4.2

Fundamental average field strength at 905MHz for low channel = 100.07 dBµV/m
Fundamental average field strength at 924MHz for high channel = 98.16 dBµV/m

Channel 1 minimum delta = 100.07 - 46.0 dBµV/m = 54.07 dBc
Channel 3 minimum delta = 98.16 - 46.0 dBµV/m = 52.16 dBc

Measurements do not include correction factors and are intended to be relative measurements only.

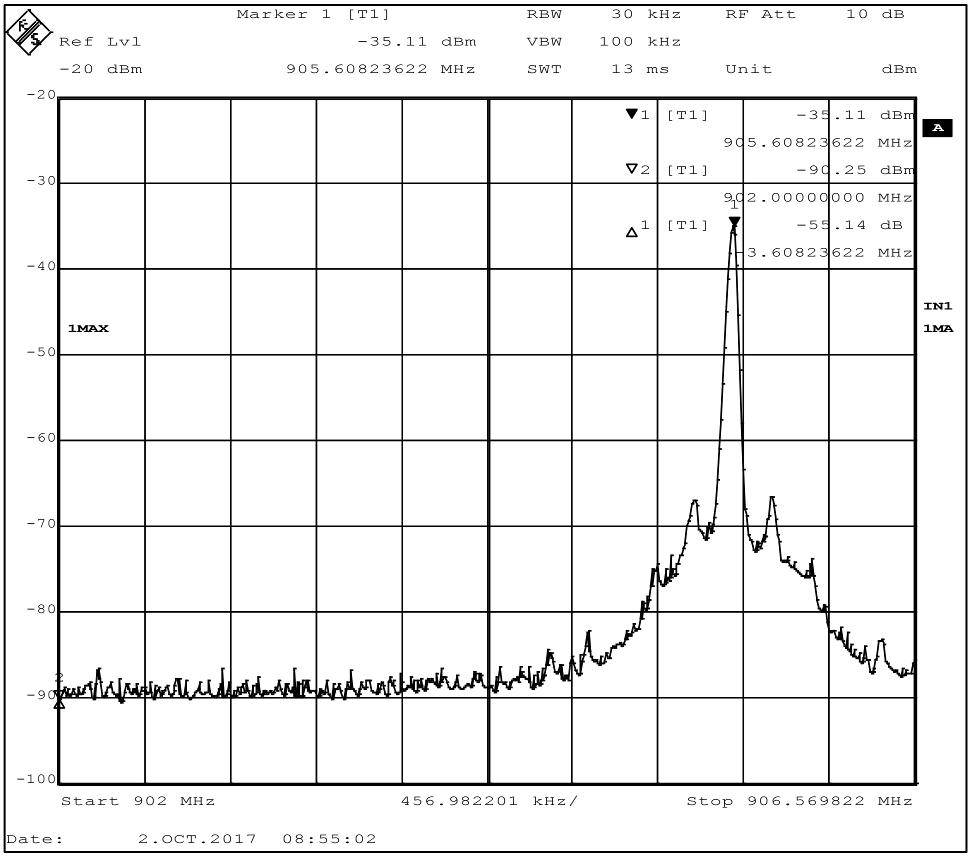



**Figure 13 - Band-edge Measurement, Low Channel, Fundamental**

The plot shows an uncorrected measurement, used for relative measurements only.

Delta = 55.14 dB Min = 20 dB

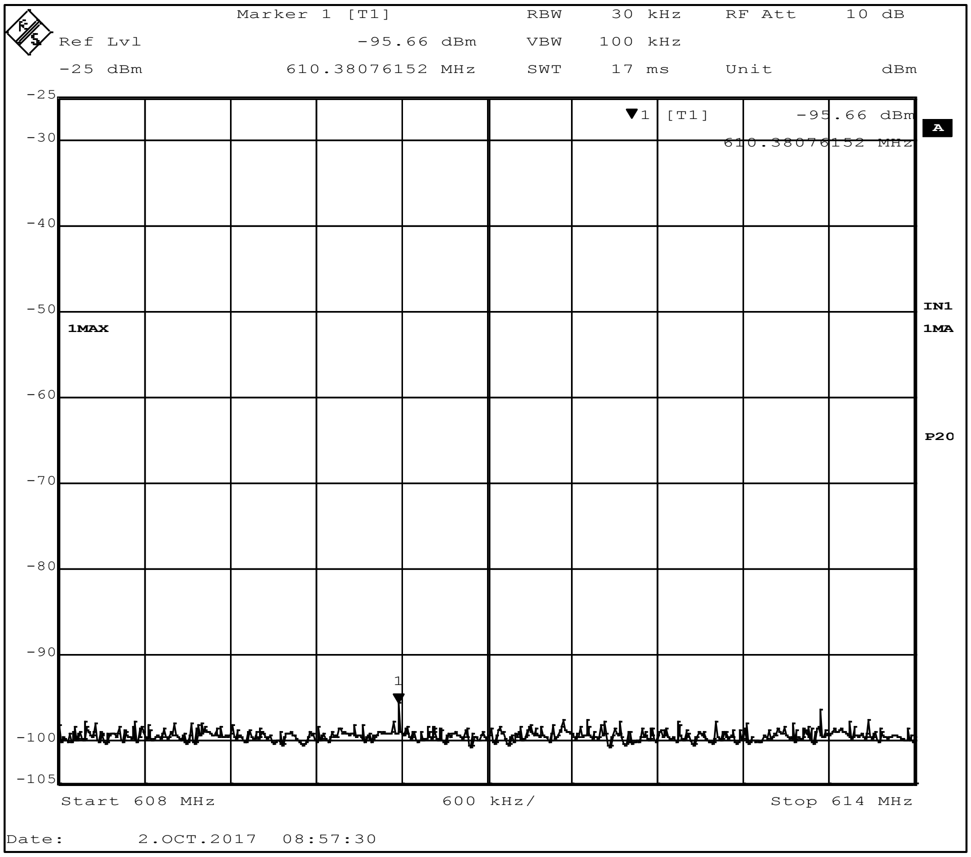



**Figure 14 - Band-edge Measurement, Low Channel, Restricted**

The plot shows an uncorrected measurement, used for relative measurements only.

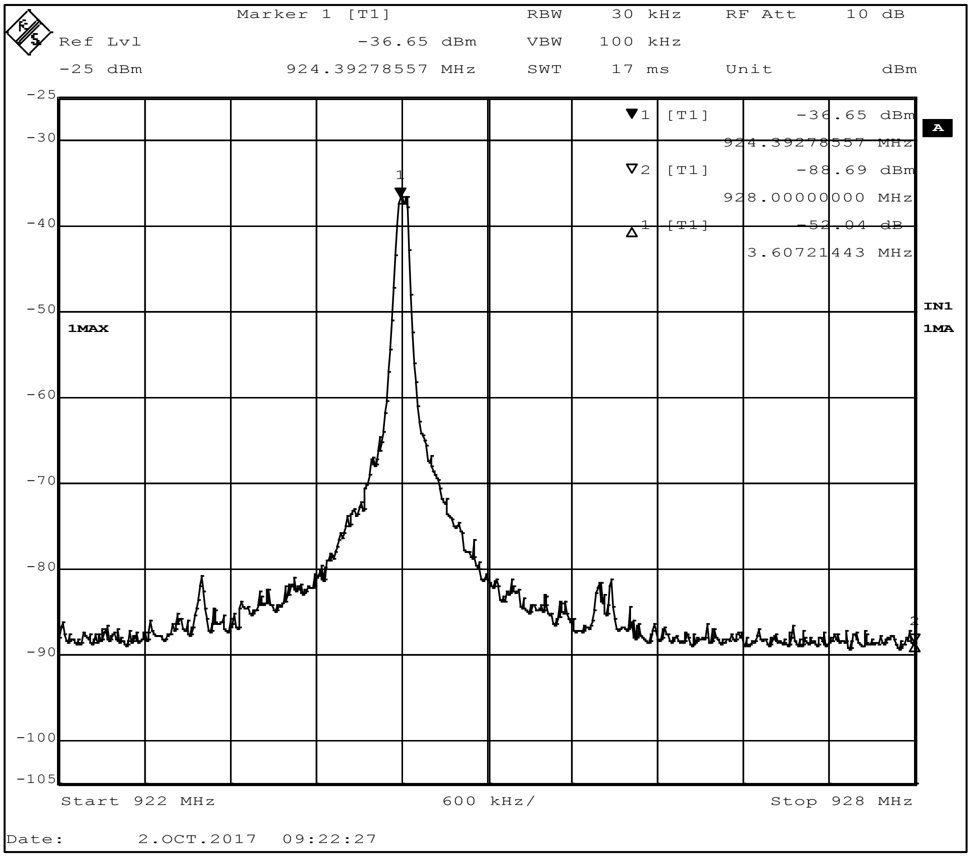



**Figure 15 - Band-edge Measurement, High Channel, Fundamental**

The plot shows an uncorrected measurement, used for relative measurements only.

Delta = 52.04 dB Min = 20 dB

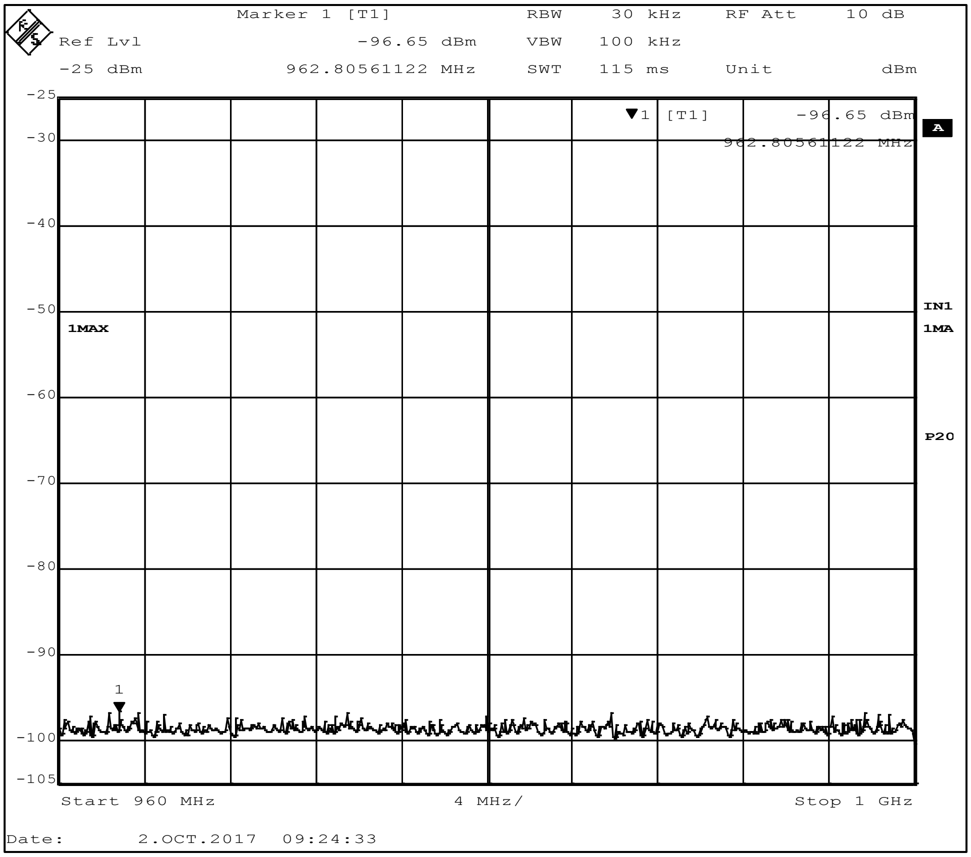



**Figure 16 - Band-edge Measurement, High Channel, Restricted**

The plot shows an uncorrected measurement, used for relative measurements only.

## 4.5 Carrier frequency separation, Number of hopping channels, Time of Occupancy

### 4.5.1 Limits for Time of Occupancy

For frequency hopping systems operating in the 902-928 MHz band:

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

### 4.5.2 Test procedures

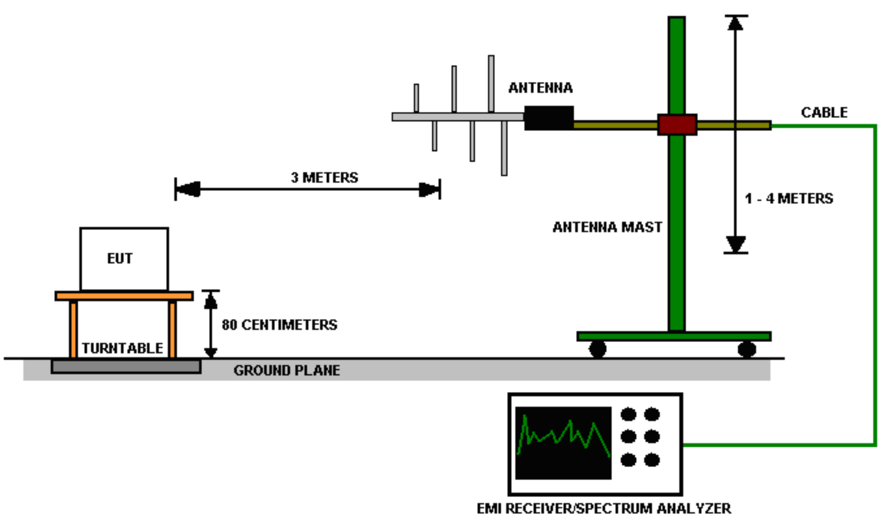
The method from FCC DA 00-705 was used.

All measurements were taken at a distance of 3m from the EUT.

### 4.5.3 Deviations from test standard

No deviation.

### 4.5.4 Test setup




### 4.5.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to continuously Hop on all the channels.

### 4.5.6 Test results

| EUT | 1166 | MODE | Continuous Hop |
|---|---|---|---|
| INPUT POWER | 3 VDC | FREQUENCY RANGE | 905.6 MHz – 924.4 MHz |
| ENVIRONMENTAL CONDITIONS | 32 % ± 5% RH<br>23 ± 3ºC | TECHNICIAN | KVepuri |

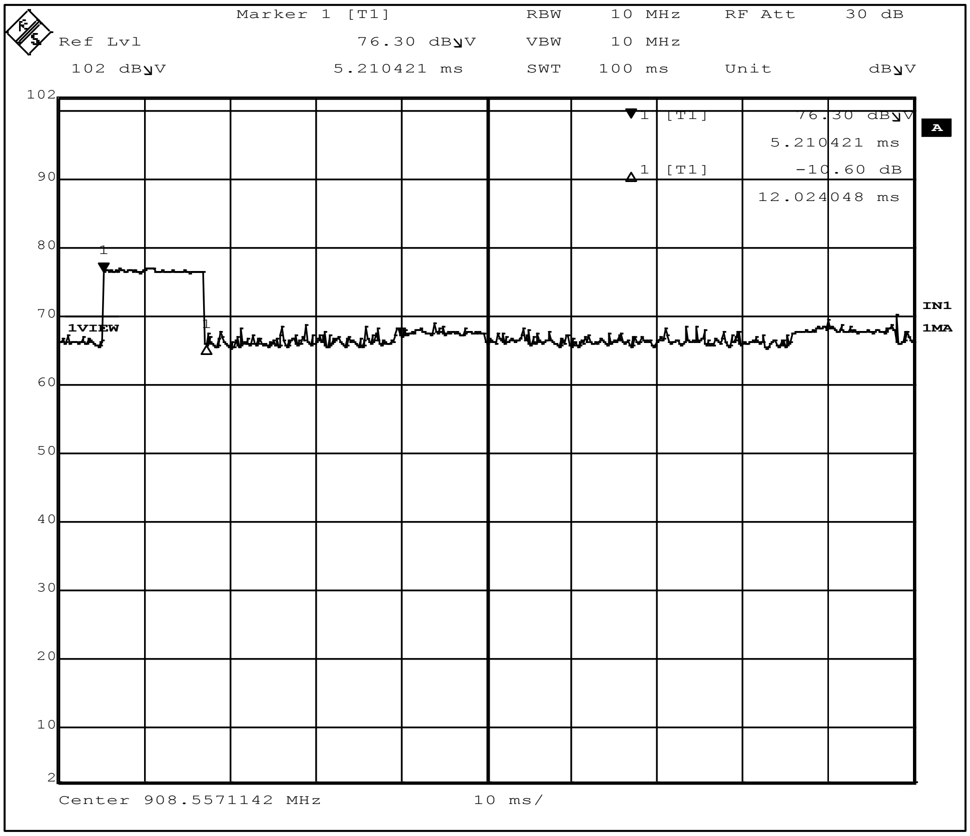



**Figure 17 – Time of Occupancy (12.02 ms per Hop - Pass)**

Max = 0.4 sec in 10 sec window

Note: Measurement was taken on DMP [illegible]36 wireless doorbell and manufacturer declared that these time measurements can be applied to the 1166 smoke detector.

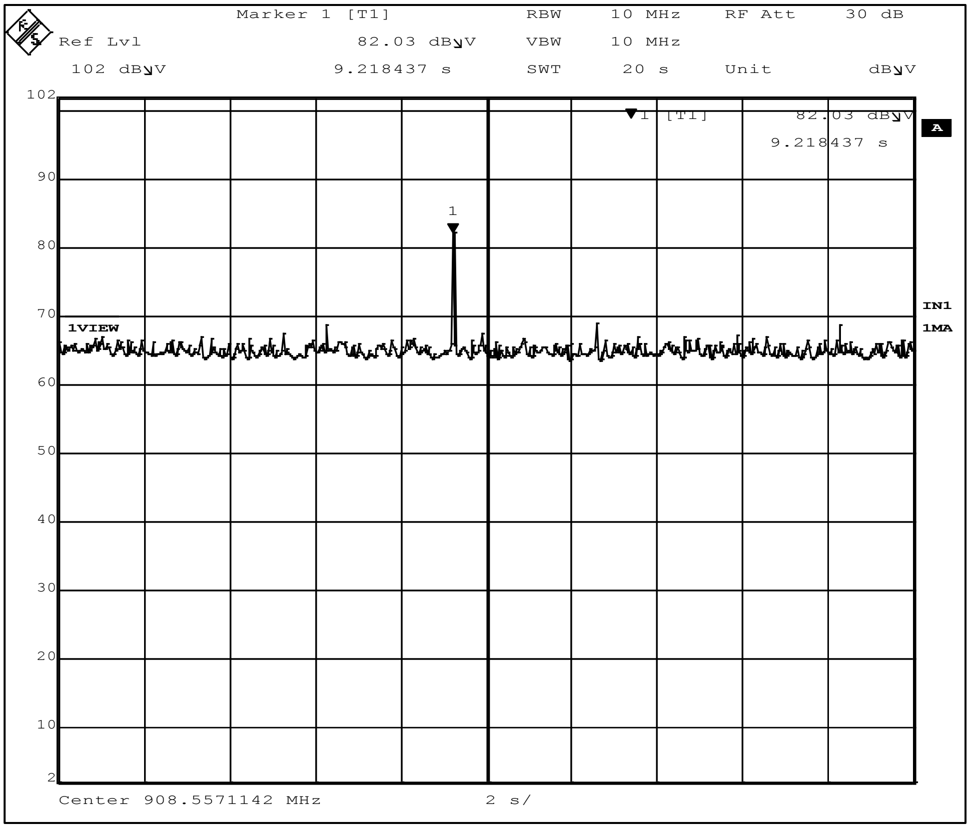



**Figure 18 – Time of Occupancy - Period (Max – 1 peak in 20 seconds window)**

Note: Measurement was taken on DMP 1136 wireless doorbell and manufacturer declared that these time measurements can be applied to the 1166 smoke detector.

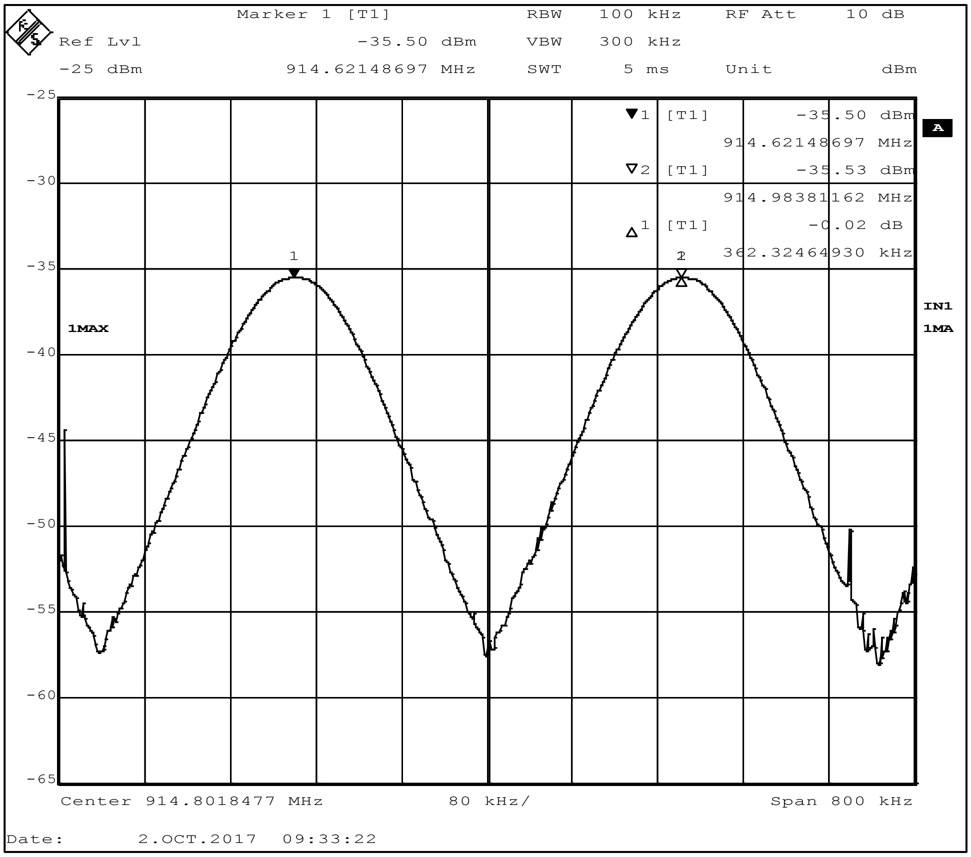



**Figure 19 – Frequency Separation (362.32 kHz)**

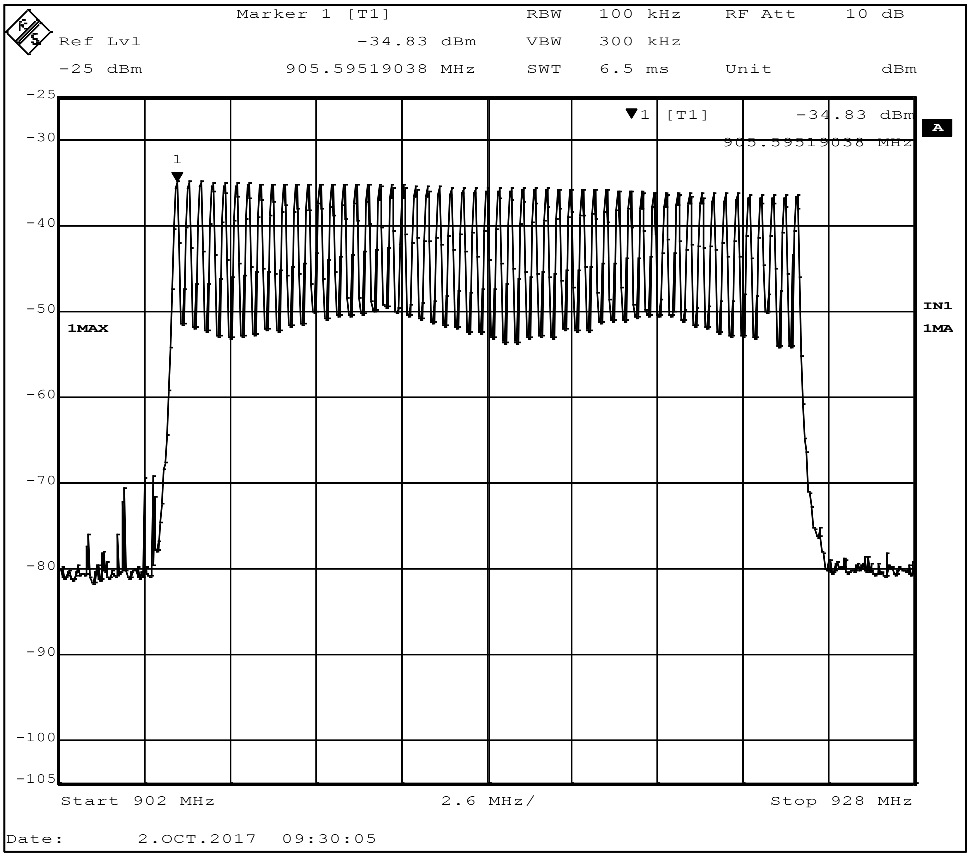



**Figure 20 – Hopping Channel Count (53 Channels - Pass)**

# Appendix A: Sample Calculation

## Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:
FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBμV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

AV is calculated by the taking the 20*log($T_{on}$/100) where $T_{on}$ is the maximum transmission time in any 100ms window.

## EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

*EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]$^2$ / [30 x Gain (numeric)]*

*Power (watts) = 10^[Power (dBm)/10] x 1000*

*Field Strength (dBµV/m) = Field Strength (dBm) = 107 (for 50Ω measurement systems)*

*Field Strength (V/m) = 10^[Field Strength (dBµV/m) / 20] / 10^6*

*Gain = 1 (numeric gain for isotropic radiator)*

*Conversion from 3m field strength to EIRP (d=3):*

*EIRP = (FS x d^2)/30 = FS [(d^2)/30] = FS [0.3}*

*EIRP(dBm) = FS(dBµV/m) – 10(log 10^9)+ 10log[0.3] = -95.23*

*10log( 10^) is the conversion from micro to milli*

# Annex B – Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

| Test | Frequency Range | Uncertainty Value (dB) |
|---|---|---|
| Radiated Emissions, 3m | 30MHz - 1GHz | 3.82 |
| Radiated Emissions, 3m | 1GHz - 18GHz | 4.44 |
| Emissions limits, conducted | 150kHz – 18GHz | ±3.30 dB |

Expanded uncertainty values are calculated to a confidence level of 95%.

CISPR 16-4-2:2011 was used to calculate the above values.