

FCC/IC Test Report

Prepared for: Digital Monitoring Products

Address: 2500 North Partnership Blvd.
Springfield, MO 6582

Product: 1166 Smoke Detector

FCC ID: CCKPC0194
IC: 5251A-PC0194

Test Report No: R20170718-25

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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 RSS-Gen, 7.1.2	Receiver Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.247(a)(1)(i) RSS-247, 5.1c	Minimum Bandwidth, Limit: Max. <250 kHz/ 50+ channels	Pass	Meets the requirement of the limit.
FCC 15.247(b)(1) RSS-247, 5.4	Maximum Peak Output Power, Limit: Max. 30 dBm	Pass	Meets the requirement of the limit.
FCC 15.209 RSS-Gen, 8.9 RSS-247, 5.3	Transmitter Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.247(a) (1) (i) RSS-247, 5.1c	Frequency hopping system, Limit: Max. 0.4 Seconds in 20 Second Period	Pass	Meets the requirement of the limit.
FCC 15.209, 15.205 RSS-247, 5.5 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 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 $32 \pm 4\%$

Temperature of $22 \pm 3^{\circ}$ 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 ($\mu\text{V/m}$)	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) = $20 * \log * \text{Emission level } (\mu\text{V/m})$.
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 from 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

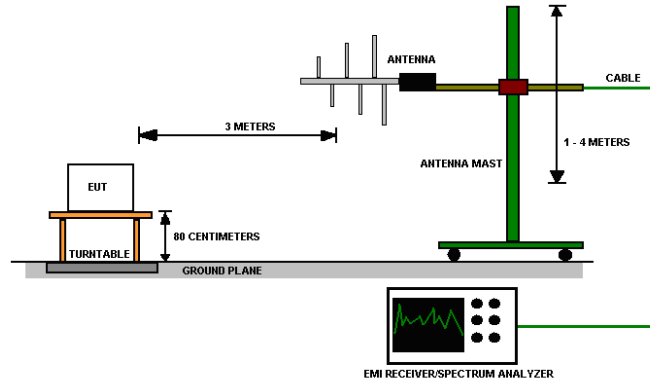


Figure 1 - Radiated Emissions Test Setup

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 23 ± 3°C	TECHNICIAN	KVepuri

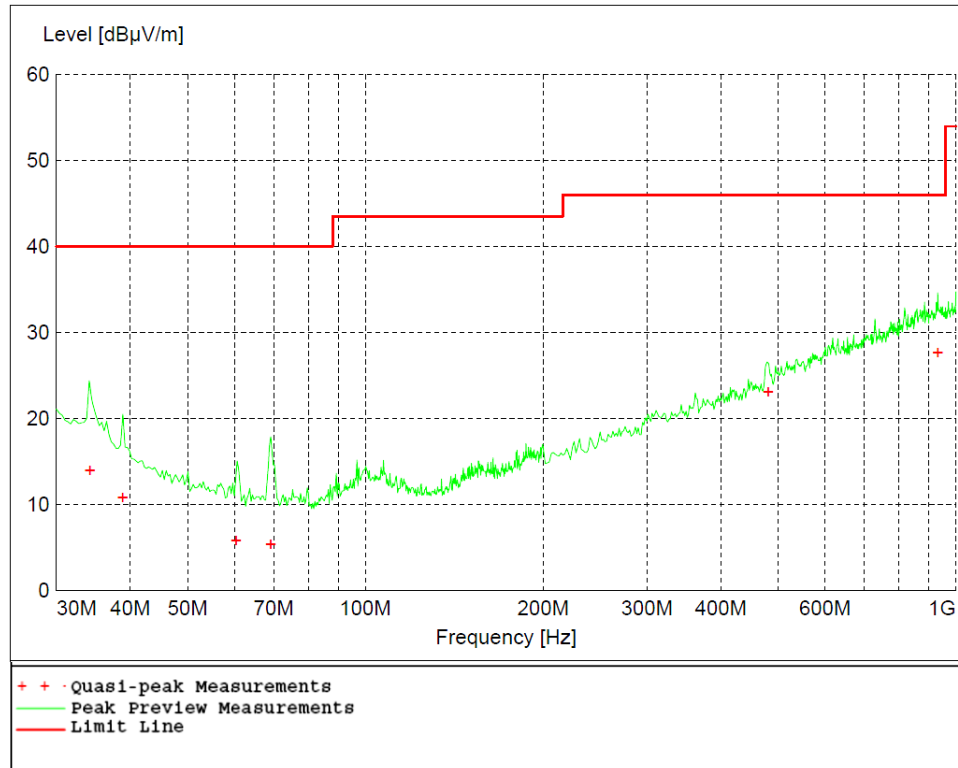


Figure 2 - Radiated Emissions Plot, Receive

REMARKS:

1. Emission level (dBμV/m) = Raw Value (dBμV) + 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	dB μ V/m	dB μ V/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	dB μ V/m	dB μ V/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 23 ± 3°C	TECHNICIAN	KVepuri

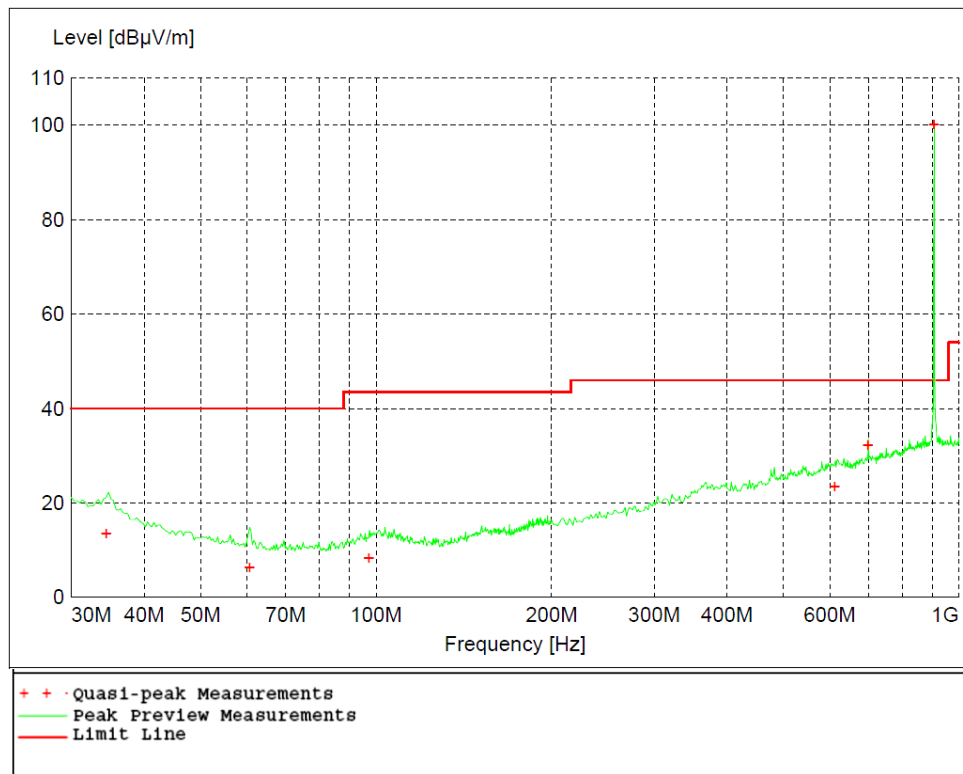


Figure 3 - Radiated Emissions Plot, Low Channel

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 23 ± 3°C	TECHNICIAN	KVepuri

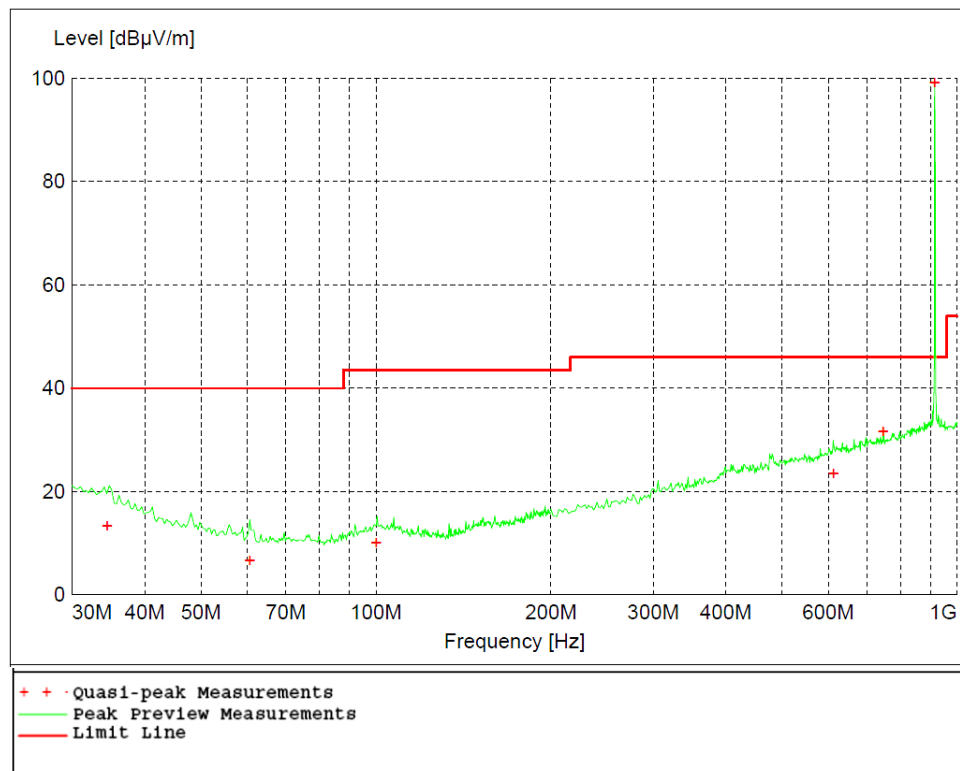


Figure 4 - Radiated Emissions Plot, Mid Channel

REMARKS:

1. Emission level (dBμV/m) = Raw Value (dBμV) + 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 23 ± 3°C	TECHNICIAN	KVepuri

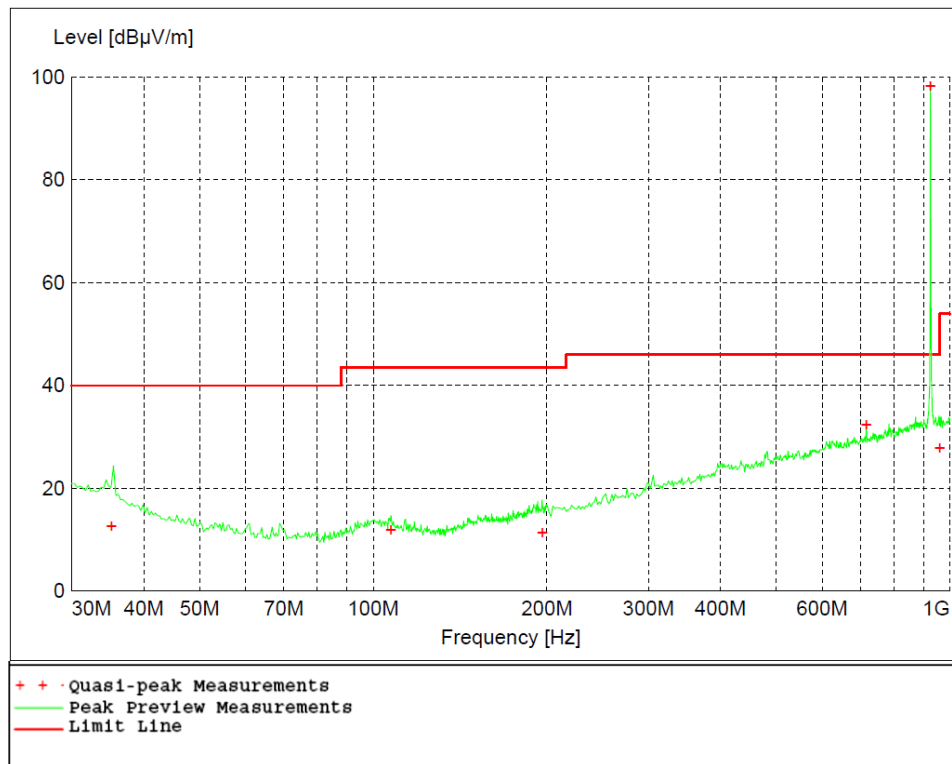


Figure 5 - Radiated Emissions Plot, High Channel

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

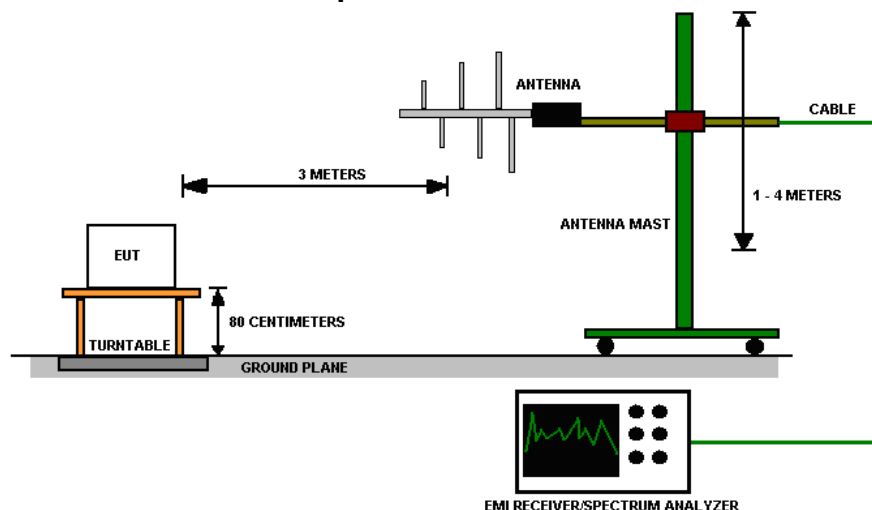


Figure 6 - Bandwidth Measurements Test Setup

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 % $\pm$ 5% RH 23 $\pm$ 3°C	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

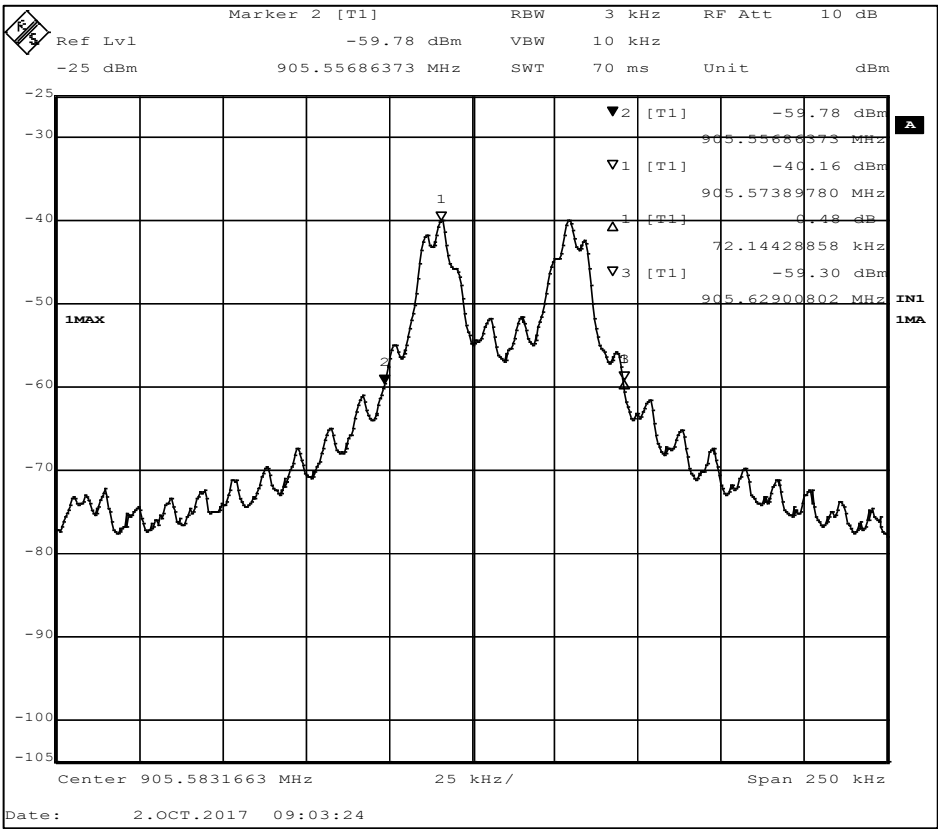


Figure 7 – 20 dB Bandwidth, Low Channel. 72.14 kHz

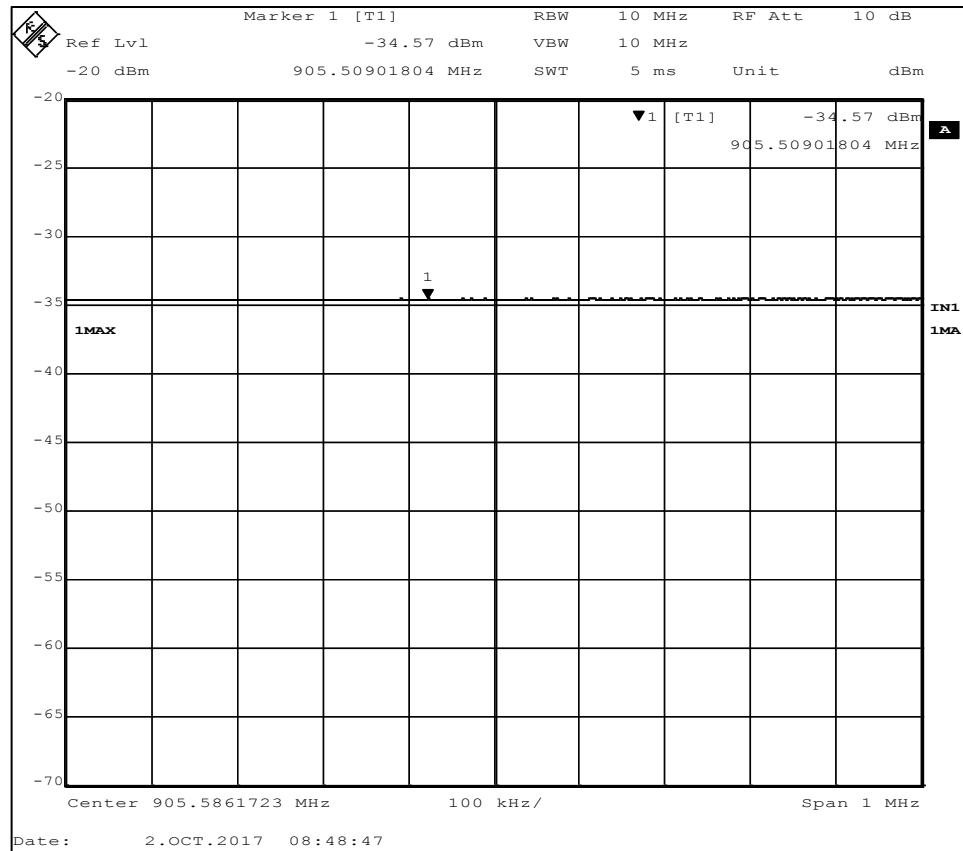


Figure 8 – Output Power, Low Channel.

Maximum power = $-34.57 \text{ dBm} + 107 + \text{CL} + \text{AF} - 95.23 = 5.60 \text{ dBm}^*$

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

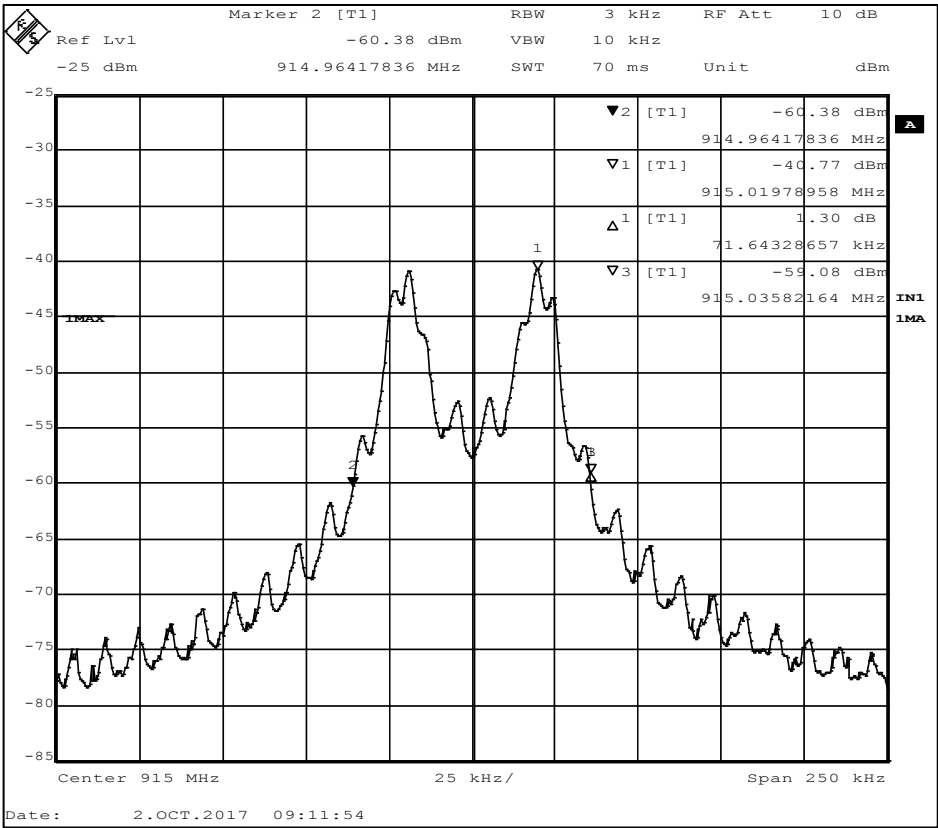


Figure 9 – 20 dB Bandwidth, Mid Channel, 71.64 kHz

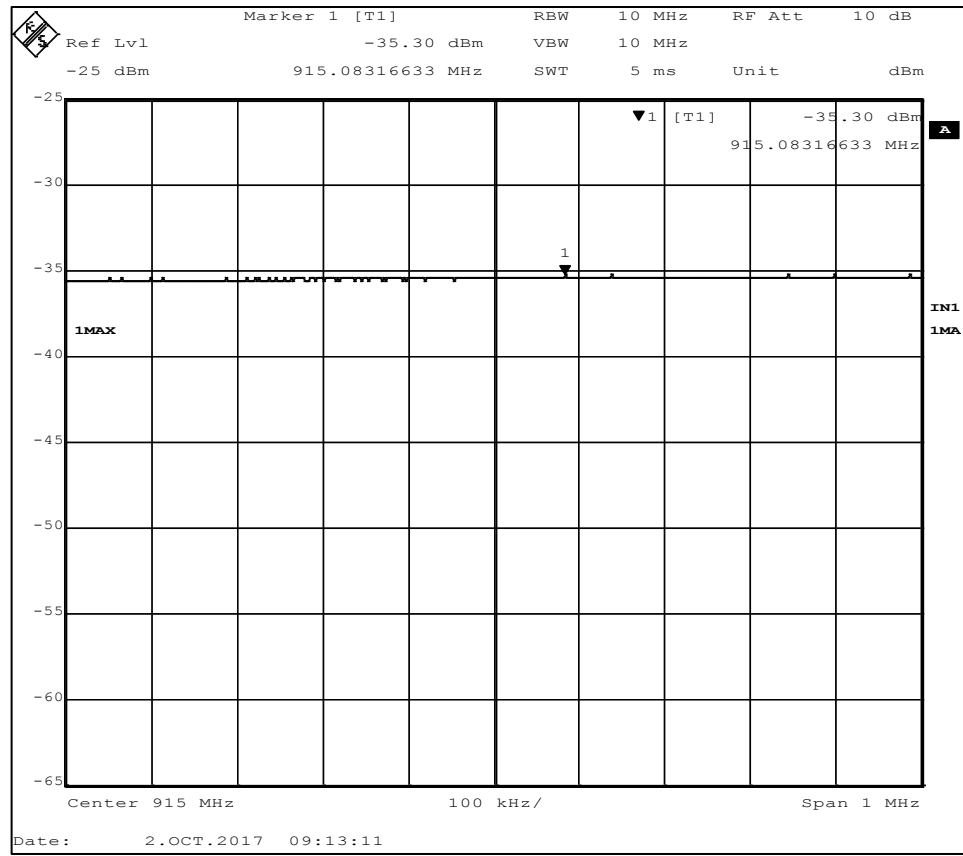


Figure 10 – Output Power, Mid Channel

Maximum power = $-35.30 \text{ dBm} + 107 + \text{CL} + \text{AF} - 95.23 = 4.77 \text{ dBm}^*$

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

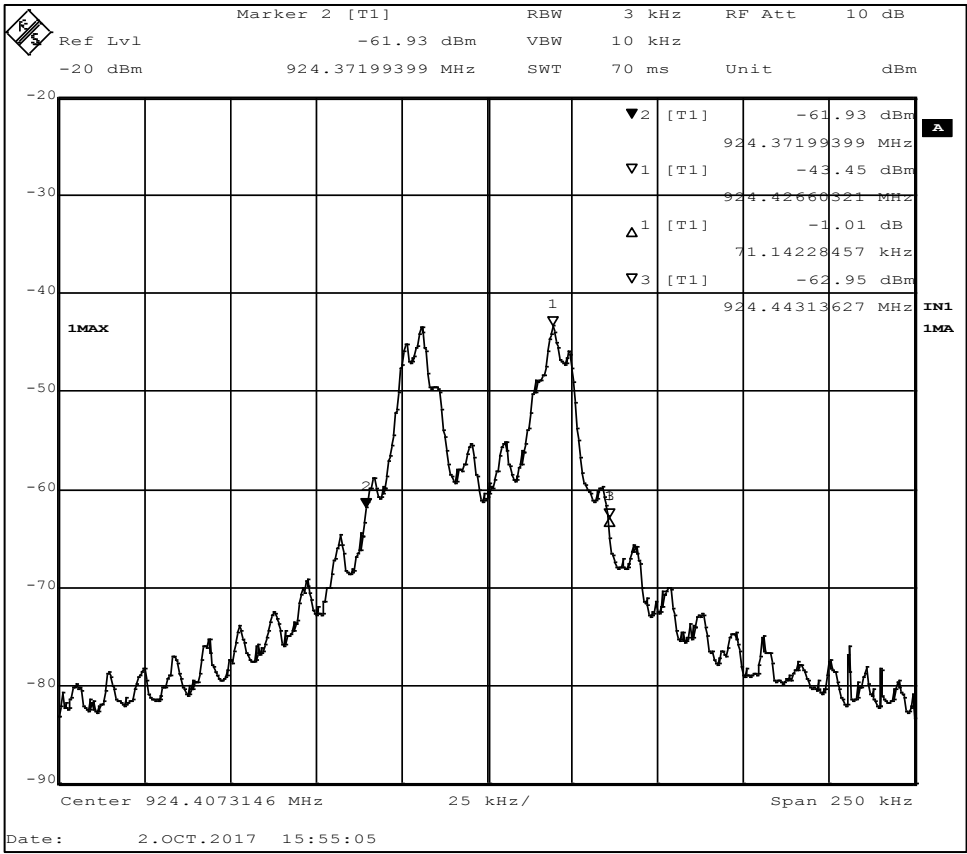


Figure 11 – 20 dB Bandwidth, High Channel, 71.14 kHz

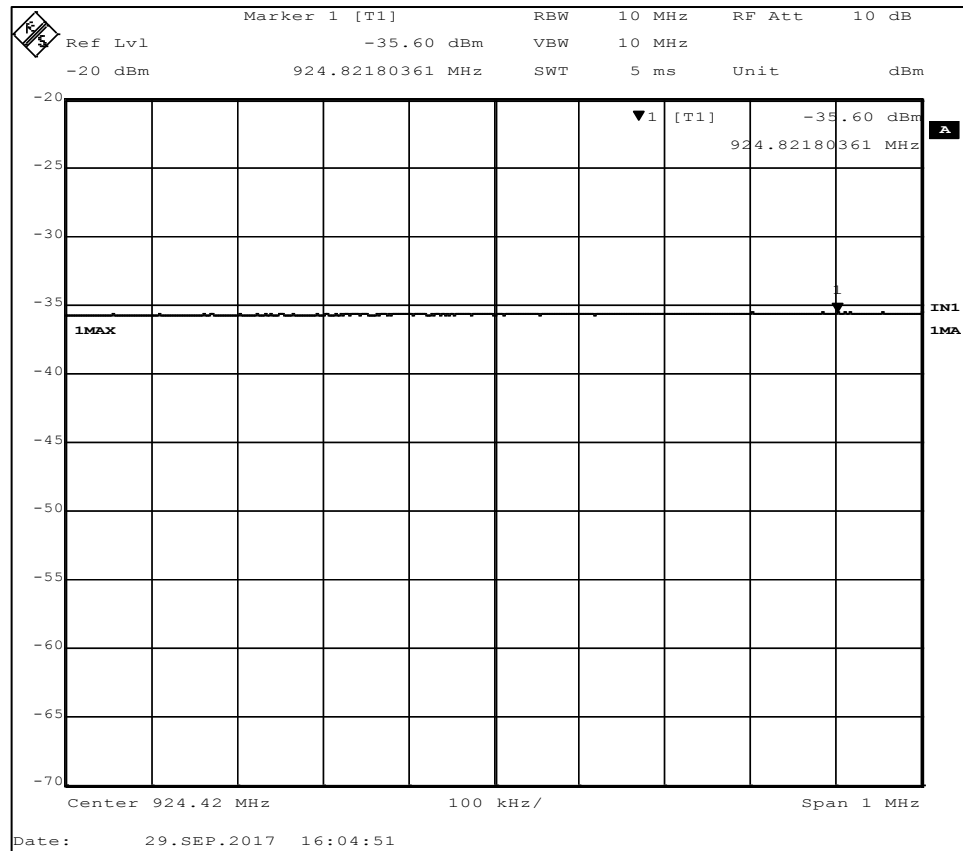


Figure 12 – Output Power, High Channel

Maximum power = $-35.60 \text{ dBm} + 107 + \text{CL} + \text{AF} - 95.23 = 4.77 \text{ dBm}^*$

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 23 ± 3°C	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 dB μ V/m
Fundamental average field strength at 924MHz for high channel = 98.16 dB μ V/m

Channel 1 minimum delta = 100.07 - 46.0 dB μ V/m = 54.07 dBc

Channel 3 minimum delta = 98.16 - 46.0 dB μ V/m = 52.16 dBc

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

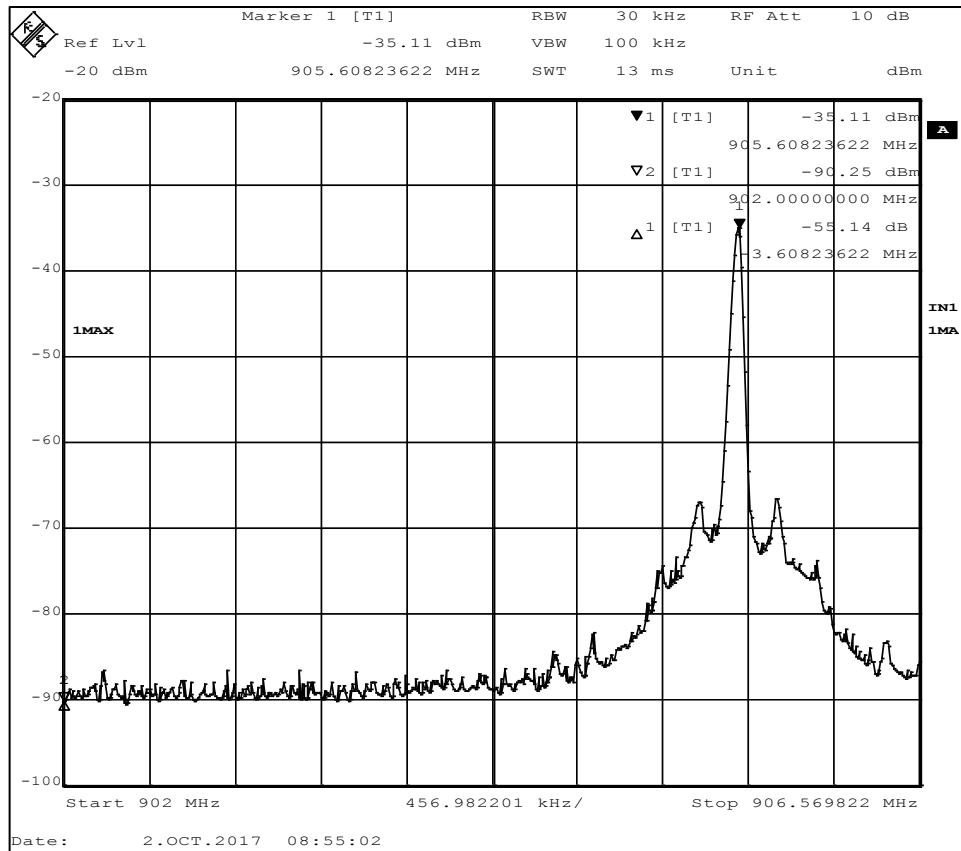


Figure 13 - Band-edge Measurement, Low Channel, Fundamental
The plot shows an uncorrected measurement, used for relative measurements only.

Delta = 55.14 dB

Min = 20 dB

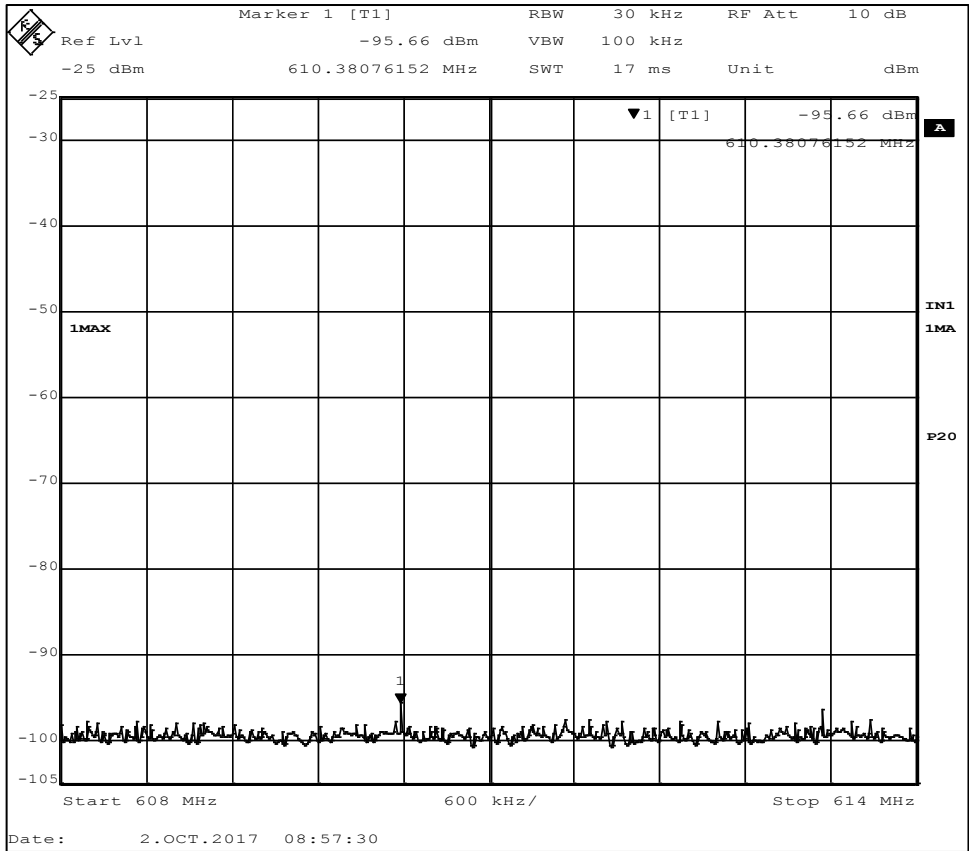


Figure 14 - Band-edge Measurement, Low Channel, Restricted
The plot shows an uncorrected measurement, used for relative measurements only.

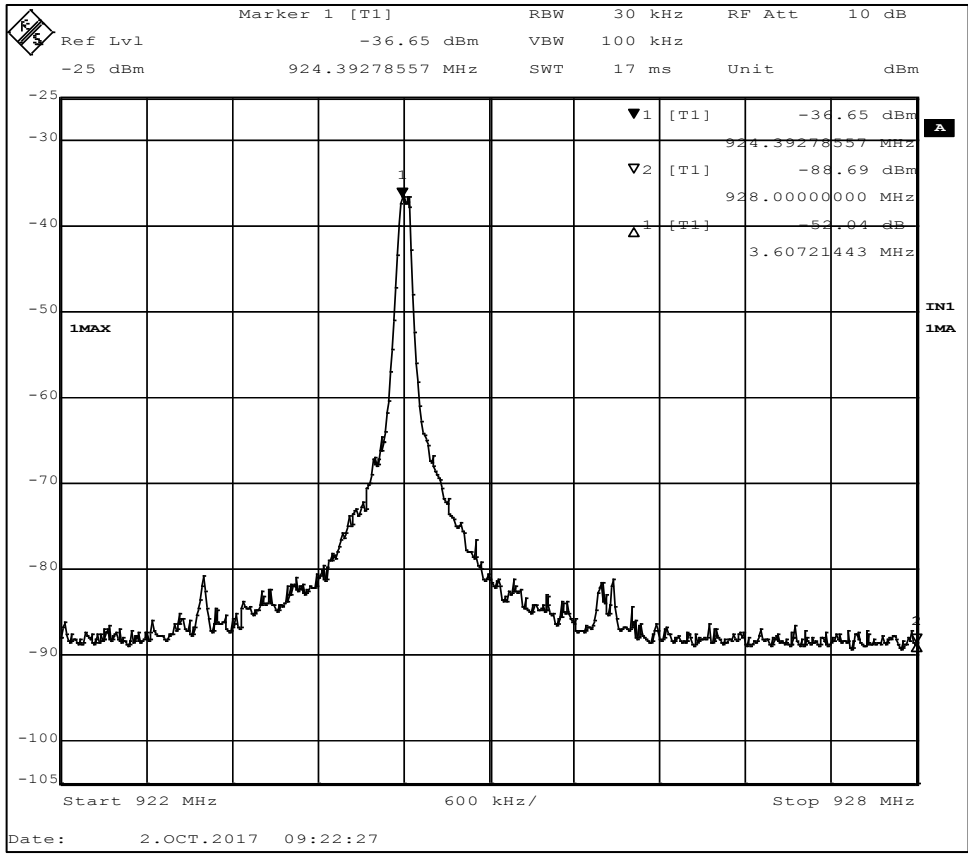


Figure 15 - Band-edge Measurement, High Channel, Fundamental
The plot shows an uncorrected measurement, used for relative measurements only.

Delta = 52.04 dB Min = 20 dB

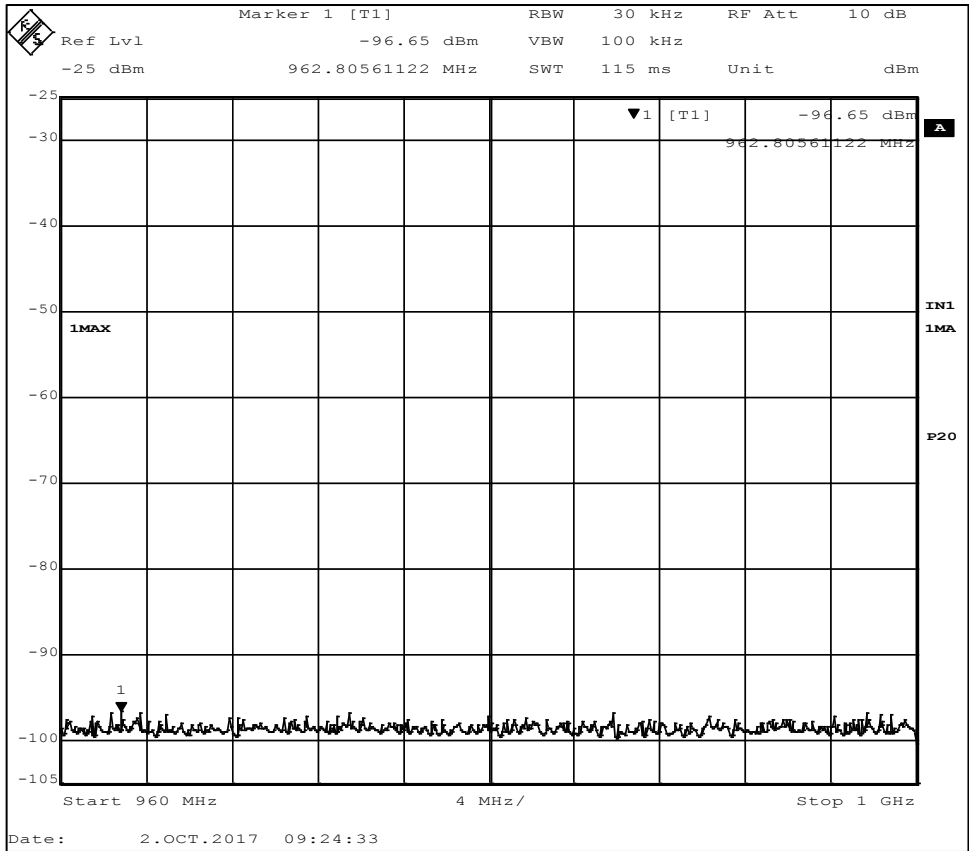


Figure 16 - Band-edge Measurement, High Channel, Restricted
The plot shows an uncorrected measurement, used for relative measurements only.

4.5.6 Test results

EUT	1166	MODE	Continuous Hop
INPUT POWER	3 VDC	FREQUENCY RANGE	905.6 MHz – 924.4 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3°C	TECHNICIAN	KVepuri

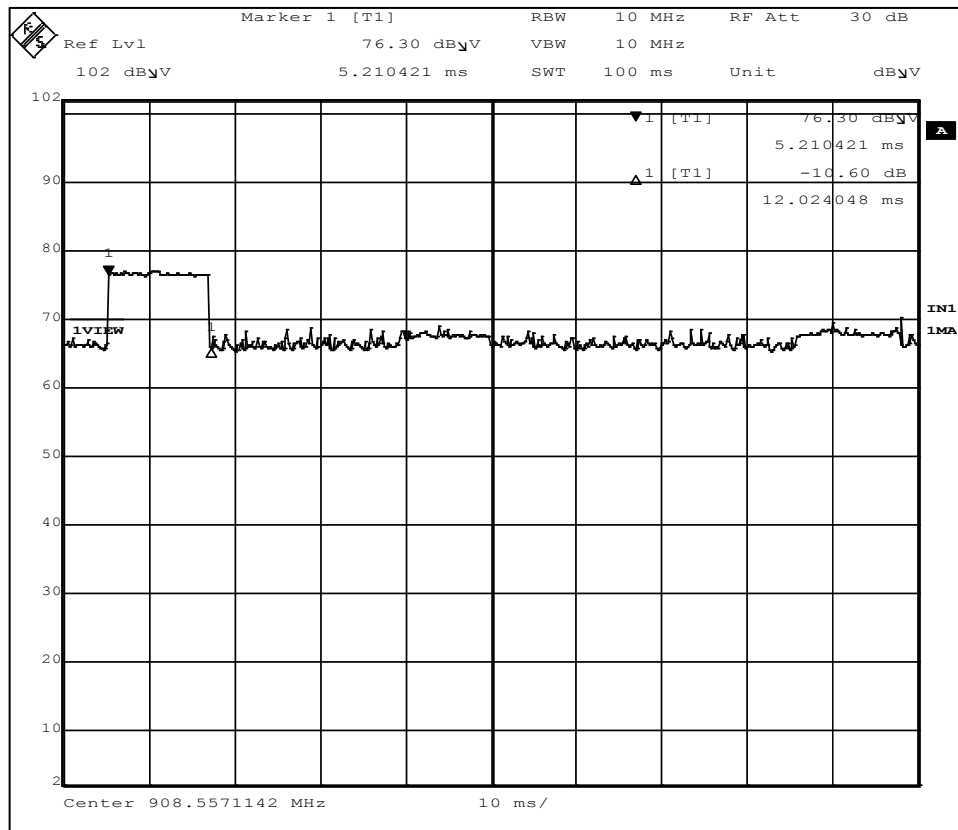


Figure 17 – Time of Occupancy (12.02 ms per Hop - Pass)

Max = 0.4 sec in 10 sec window

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

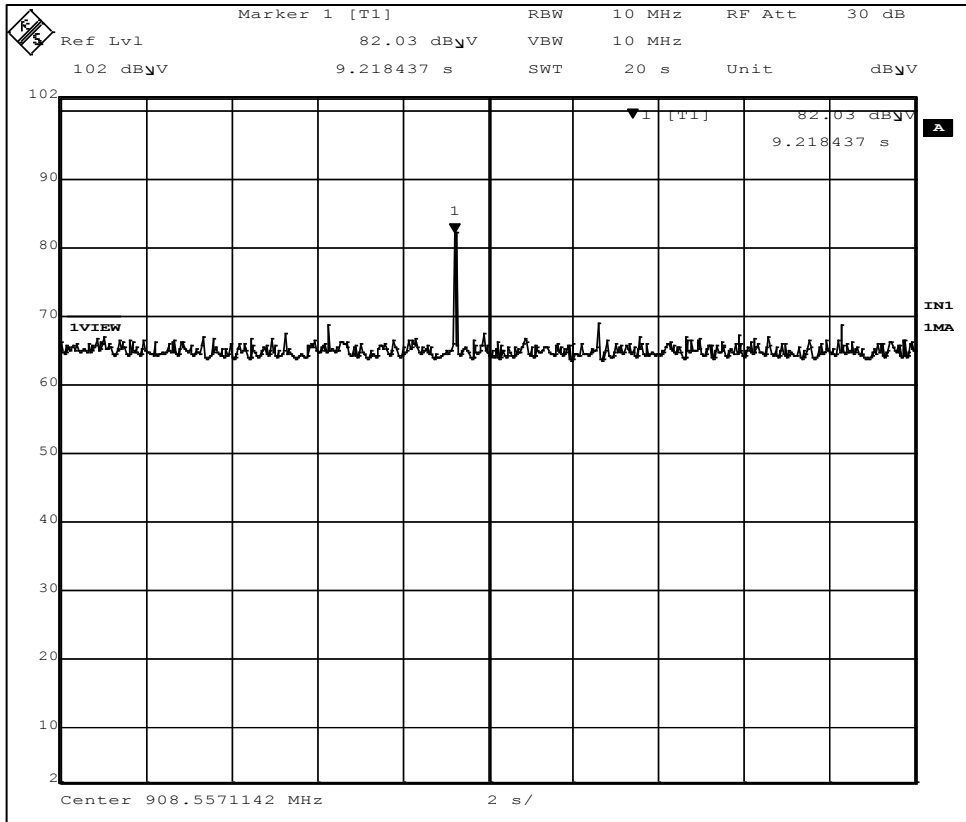


Figure 18 – Time of Occupancy - Period (Max – 1 peak in 20 seconds window)
Note: Measurement was taken on DMP 1136 wireless doorbell and manufacturer declared that these time measurements can be applied to the 1166 smoke detector.

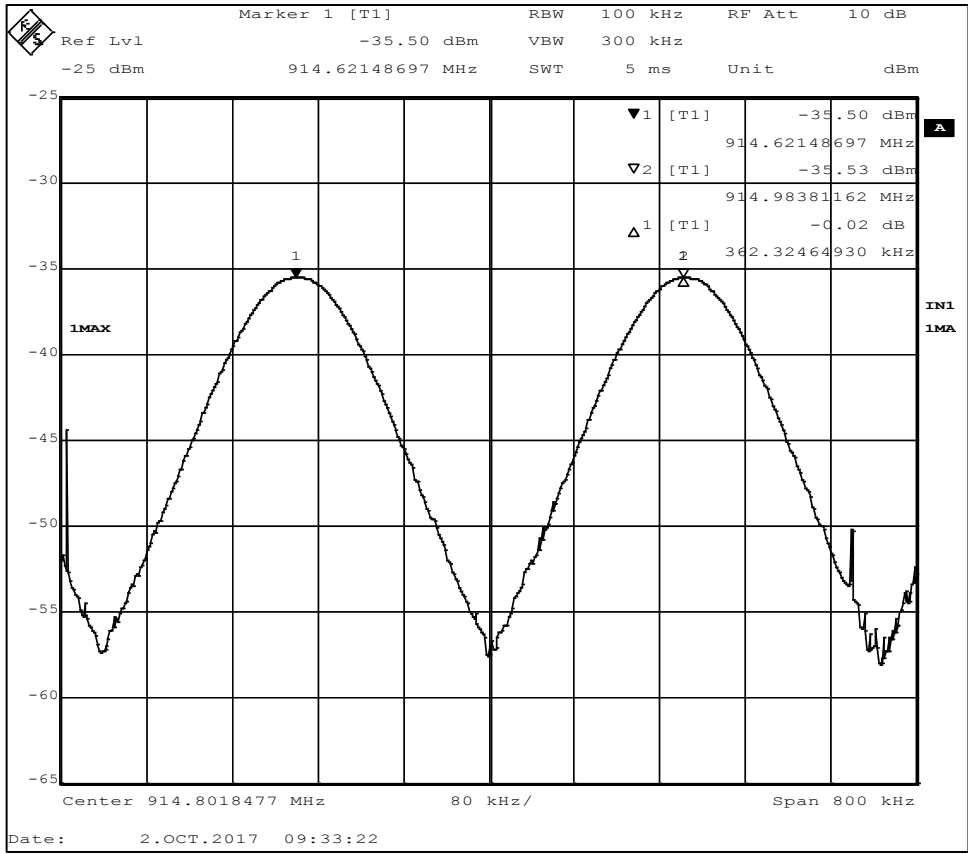


Figure 19 – Frequency Separation (362.32 kHz)

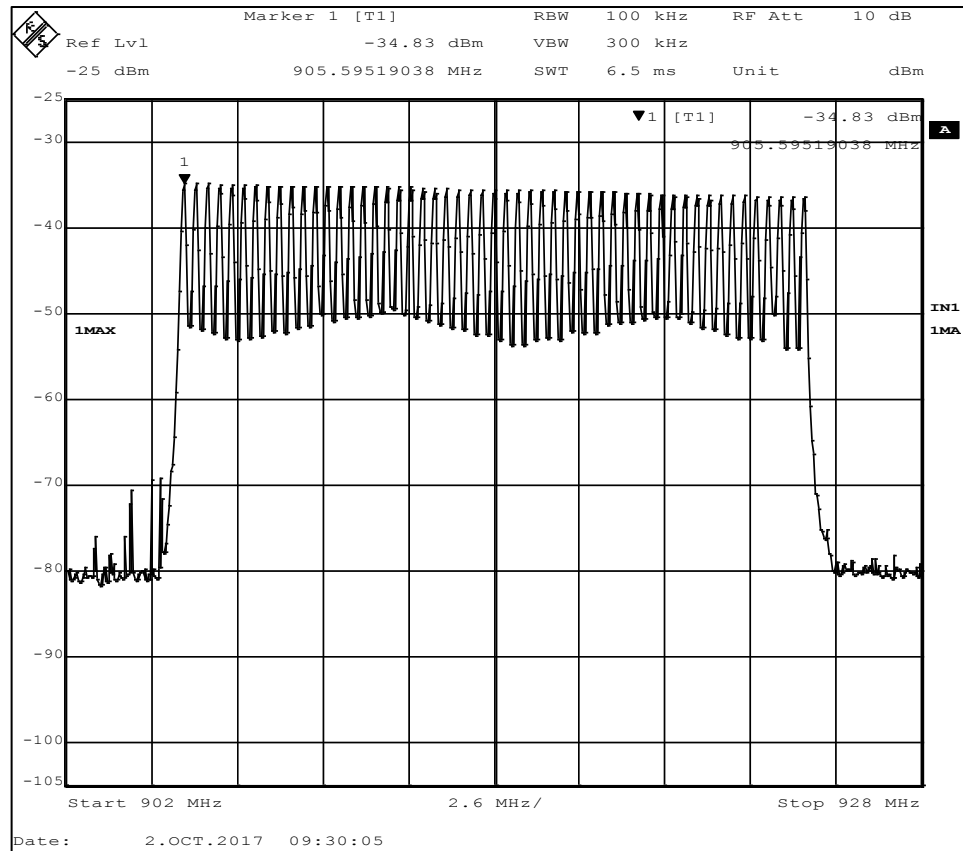


Figure 20 – Hopping Channel Count (53 Channels - Pass)

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 dB μ V 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 dB μ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

AV is calculated by taking the $20 \cdot \log(T_{\text{on}}/100)$ 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;

$$EIRP \text{ (Watts)} = [Field \text{ Strength (V/m)} \times antenna \text{ distance (m)}]^2 / [30 \times Gain \text{ (numeric)}]$$

$$Power \text{ (watts)} = 10^{[Power \text{ (dBm)}/10]} \times 1000$$

$$Field \text{ Strength (dB}\mu\text{V/m)} = Field \text{ Strength (dBm)} = 107 \text{ (for } 50\Omega \text{ measurement systems)}$$

$$Field \text{ Strength (V/m)} = 10^{[Field \text{ Strength (dB}\mu\text{V/m)} / 20]} / 10^6$$

$$Gain = 1 \text{ (numeric gain for isotropic radiator)}$$

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

$$EIRP = (FS \times d^2)/30 = FS [(d^2)/30] = FS [0.3]$$

$$EIRP(dBm) = FS(dB\mu V/m) - 10(\log 10^9) + 10\log[0.3] = -95.23$$

$10\log(10^9)$ 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.