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Amended

FCC/IC Test Report

Includes NCEE Labs report R20161219-20-01A and its amendment in full

Prepared for:	**Hunter Douglas**
Address:	**2550 Midway Boulevard** **Broomfield, CO 80020**
Product:	**Single Chip** **Wireless Module**
FCC ID: **IC:**	**UXUROL** **7316A-ROL**
Test Report No:	**R20161219-20-01C**
Approved By:	 **Nic S. Johnson, NCE** **Technical Manager** **iNARTE Certified EMC Engineer #EMC-003337-NE**
DATE:	**28 March 2017**
Total Pages:	**38**

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:

APPLIED STANDARDS			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
FCC Part 15.203	Unique Antenna Requirement	NA	EUT is a module
RSS-Gen Section 6.6 RSS-Gen Section 6.12	Bandwidth and peak EIRP	NA	Informational only
FCC Part 15.209 RSS-Gen Section 7.0	Receiver Radiated Emissions,	Pass	Meets the requirement of the limit.
FCC Part 15.249 RSS-Gen Section 8.9 RSS-210 A2.9	Transmitter Radiated Emissions,	Pass	Meets the requirement of the limit.
FCC Part 15.249 RSS-Gen Section 8.9 RSS-210 A2.9	Band Edge Measurement	Pass	Meets the requirement of the limit.
FCC Part 15.207 RSS-Gen Section 8.8	Conducted Emissions	Pass	Representative Power supply was used

1.2 Reason for amendment

-Section 4.4 was modified to list the measurement at 2400 MHz referenced to the FCC Part 15.209 limits.

-Section 2.4 – References #5 was corrected to show RSS 210 Issue 9.

-Section 4.2 – averaging factor was adjusted to show 4 pulses

-Tables 10 and 11 have been corrected.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was a wireless module used to control window blinds. It operates from 2407 to 2480 MHz and has transmit and receive capabilities. It is intended to be paired with a remote.

EUT Received Date: 24 January 2017
EUT Tested Dates: 24 January 2017 – 21 February 2017

Description	Wireless Window Blind Module
MODEL	Single Chip
Serial No.	"NCEE Compliance Code" (Assigned)(PCB:2002000037) "NCEE Standard Code (Assigned)" All serial numbers were assigned by the lab as the test samples were not serialized.
POWER SUPPLY	18 VDC (MN:ADS0366-W180200)
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	2407
Middle	2440
High	2480

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 uses digital modulation and operates between 2400.0MHz and 2483.5MHz. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

(1) FCC Part 15, Subpart C (15.207, 15.209, 15.249)
(2) FCC Part 15, Subpart B (15.107, 15.109)
(3) ANSI C63.10:2013
(4) Industry Canada RSS-Gen Issue 4
(5) Industry Canada RSS-210 Issue 9

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.

AC/DC Power Supply used for testing:

Manufacturer:	Hunter Douglas,
P/N:	2989048000
M/N:	ADS0366-W1802000
Input:	100 – 240VAC, 50/60Hz
Output:	18VDC, 2.0A

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 2016	02 Aug 2017
EMCO Horn Antenna	3115	6416	25 Jan 2016	25 Jan 2018
EMCO Horn Antenna	3116	2576	26 Jan 2016	26 Jan 2018
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	9 Feb 2017*	9 Feb 2018*
Trilithic High Pass Filter	6HC330	23042	9 Feb 2017*	9 Feb 2018*
Rohde & Schwarz LISN	ESH3-Z5	100023	23 Jan 2017	23 Jan 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 a patch antenna attached to the PCB. The EUT is a module and compliance with this requirement is dependent on final installation.

4.2 Radiated emissions

Test Method: ANSI C63.10, Section(s) 6.5
ANSI C63.4. Section(s) 8.3

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 measured in both the horizontal and vertical orientation. It was then rotated 360° in each orientation so that all possible angles were investigated. 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.

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 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

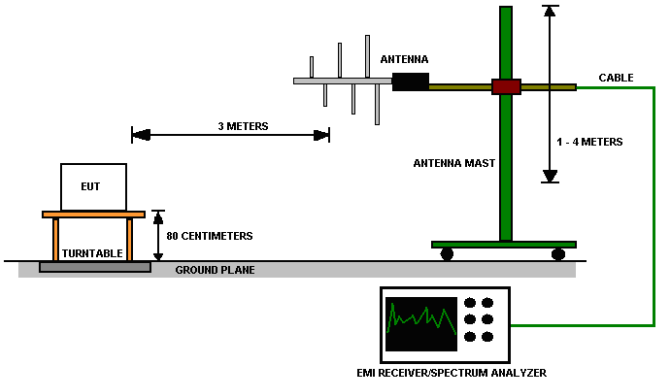
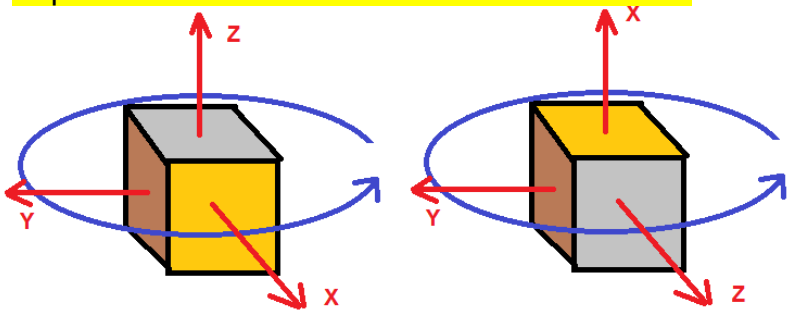


Figure 1 - Radiated Emissions Test Setup

The EUT was tested in both the vertical and horizontal position. The turntable was rotated 360 degrees in order to measure emissions in all **3 orthogonal axis** of the EUT and meet the requirements from **ANS C63.10 Section 5.10.1**.



"Horizontal" orientation **"Vertical" orientation**

The horizontal orientation covers the Y and X axis. The vertical orientation test the Y and Z axis, so each of the 3 axis is covered in at least one configuration. For the actual test configuration, please refer to Appendix A for photographs of the test configuration.

4.2.5 EUT operating conditions

The EUT was powered by 18 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 MODULE	Single Chip	MODE	Receive
INPUT POWER	18 VDC	FREQUENCY RANGE	30MHz – 26GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

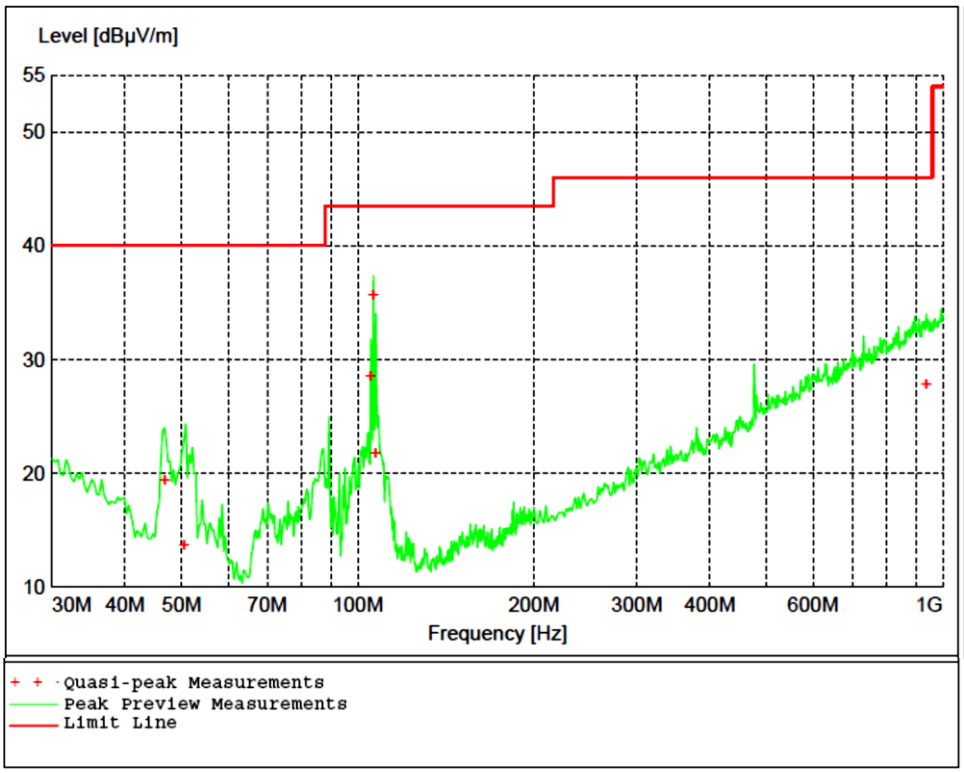


Figure 2 - Radiated Emissions Plot, Receive

Horizontal orientation of EUT was found to be the worse-case

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. Since peak measurements were compliant with the average limit, average measurements were not required.
6. 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
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
46.800000	19.41	40.00	20.60	100	39	VERT
50.460000	13.70	40.00	26.30	137	273	VERT
105.300000	28.48	43.50	15.00	99	360	VERT
106.320000	35.70	43.50	7.80	100	4	VERT
107.280000	21.71	43.50	21.80	99	57	VERT
938.100000	27.84	46.00	18.20	100	345	HORI

Table 2 - Radiated Emissions Peak Measurements vs. Average Limit, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2407.000000	38.27	54.00	15.70	157	340	VERT
4805.200000	41.38	54.00	12.60	99	236	VERT
7213.800000	43.93	54.00	10.10	399	133	VERT
9635.400000	44.99	54.00	9.00	174	141	VERT
12050.000000	42.47	54.00	11.50	100	36	VERT
14439.600000	50.25	54.00	3.70	198	170	VERT
16875.600000	48.63	54.00	5.40	168	221	HORI

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

EUT MODULE	Single Chip	MODE	Transmit, Low Channel
INPUT POWER	18 VDC	FREQUENCY RANGE	30MHz – 26GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

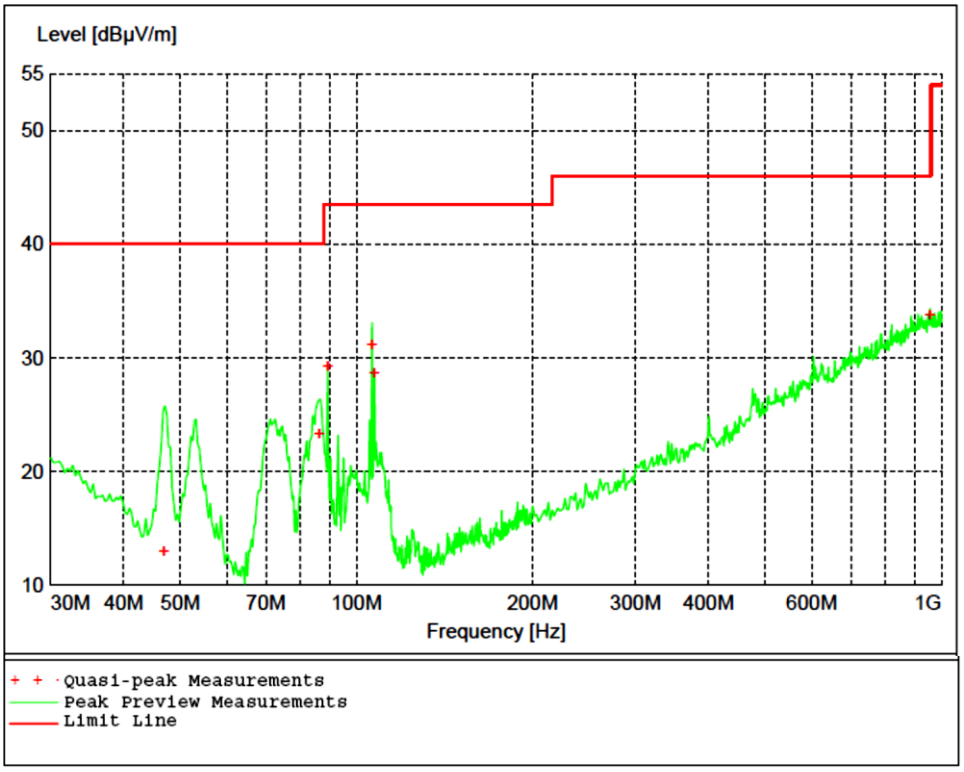


Figure 3 - Radiated Emissions Plot, Low Channel

Horizontal orientation of EUT was found to be the worse-case

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
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
46.920000	12.97	40.00	27.00	101	41	VERT
86.400000	23.32	40.00	16.70	123	80	VERT
89.280000	29.19	43.50	14.30	139	53	VERT
106.320000	31.13	43.50	12.40	99	14	VERT
107.340000	28.60	43.50	14.90	99	54	VERT
956.220000	33.82	46.00	12.20	151	360	VERT

Table 4 - Radiated Emissions Average Measurements, Low Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2407.000000	88.81	NA	NA	140	39	VERT
4814.000000	39.95	54.00	14.05	141	253	VERT
7210.800000	36.90	54.00	17.10	115	187	HORI
9628.600000	38.23	54.00	15.77	167	360	VERT
12026.200000	34.90	54.00	19.10	288	128	VERT
14469.000000	40.77	54.00	13.23	206	60	HORI
16870.400000	45.61	54.00	8.39	373	319	HORI

Note: Average Level = Peak Level – Duty Cycle Correction Factor
Duty Cycle Correction Factor is calculated in Figures 6 and 7. 20dB was used.

Table 5 - Radiated Emissions Peak Measurements, Low Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2407.000000	96.87	NA	NA	140	39	VERT
4814.000000	48.01	74.00	25.99	141	253	VERT
7210.800000	44.96	74.00	29.04	115	187	HORI
9628.600000	46.29	74.00	27.71	167	360	VERT
12026.200000	42.96	74.00	31.04	288	128	VERT
14469.000000	48.83	74.00	25.17	206	60	HORI
16870.400000	53.67	74.00	20.33	373	319	HORI

Average measurement values = Peak measurement values – averaging factor (8.06 dB). See Figures 6 and 7 for details.

EUT MODULE	Single Chip	MODE	Transmit, Mid Channel
INPUT POWER	18 VDC	FREQUENCY RANGE	30MHz – 26GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

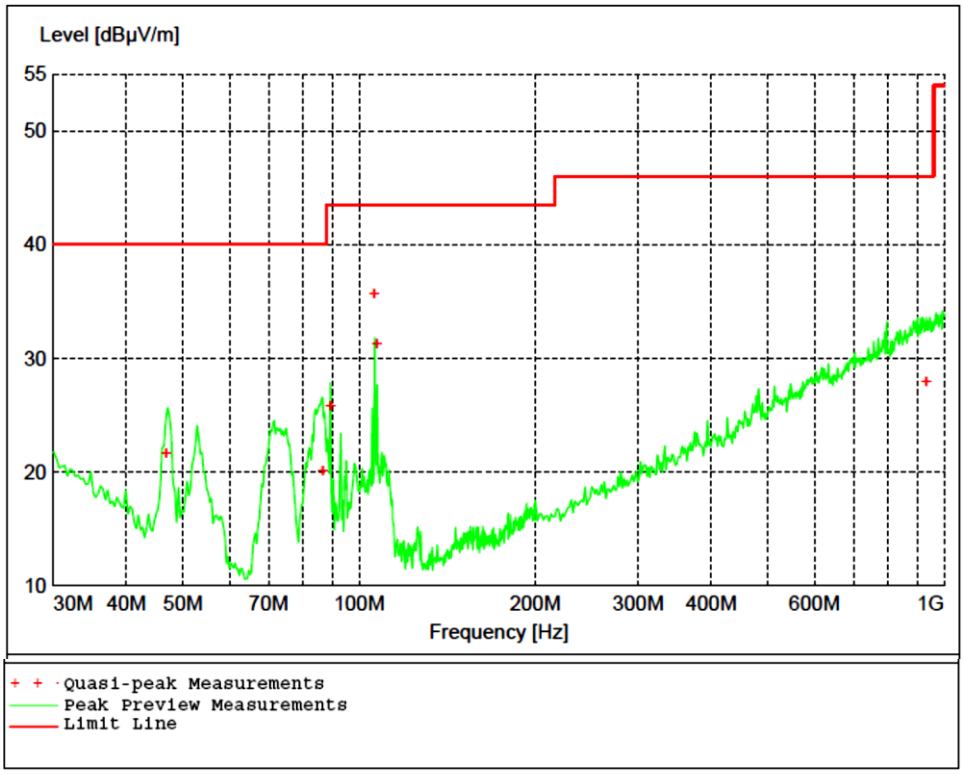


Figure 4 - Radiated Emissions Plot, Mid Channel

Horizontal orientation of EUT was found to be the worse-case

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
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
46.800000	21.68	40.00	18.30	99	125	VERT
86.760000	20.10	40.00	19.90	124	61	VERT
89.280000	25.78	43.50	17.70	129	55	VERT
106.260000	35.62	43.50	7.90	100	20	VERT
107.340000	31.31	43.50	12.20	100	53	VERT
931.920000	27.96	46.00	18.00	290	172	HORI

Table 7 - Radiated Emissions Average Measurements, Mid Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2440.000000	88.06	NA	NA	187	39	VERT
4880.000000	48.64	54.00	5.36	146	348	VERT
7345.600000	35.75	54.00	18.25	394	279	HORI
9759.000000	39.80	54.00	14.20	261	99	VERT
12183.000000	33.95	54.00	20.05	258	256	VERT
14673.400000	42.04	54.00	11.96	332	19	HORI
17077.400000	45.34	54.00	8.66	217	0	HORI

Note: Average Level = Peak Level – Duty Cycle Correction Factor
Duty Cycle Correction Factor is calculated in Figures 6 and 7. 20dB was used.

Table 8 - Radiated Emissions Peak Measurements, Mid Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2440.000000	96.12	NA	NA	187	39	VERT
4880.000000	56.70	74.00	17.30	146	348	VERT
7345.600000	43.81	74.00	30.19	394	279	HORI
9759.000000	47.86	74.00	26.14	261	99	VERT
12183.000000	42.01	74.00	31.99	258	256	VERT
14673.400000	50.10	74.00	23.90	332	19	HORI
17077.400000	53.40	74.00	20.60	217	0	HORI

Average measurement values = Peak measurement values – averaging factor (8.06 dB). See Figures 6 and 7 for details.

EUT MODULE	Single Chip	MODE	Transmit, High Channel
INPUT POWER	18 VDC	FREQUENCY RANGE	30MHz – 26GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

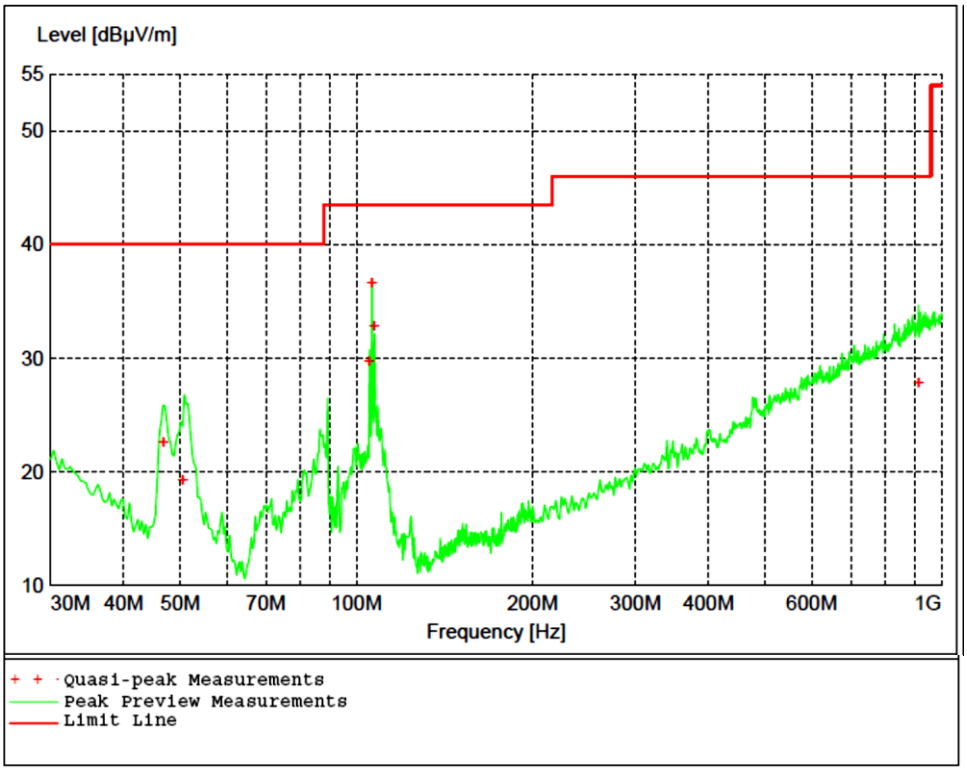


Figure 5 - Radiated Emissions Plot, High Channel

Horizontal orientation of EUT was found to be the worse-case

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
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
46.800000	22.57	40.00	17.40	101	58	VERT
50.460000	19.30	40.00	20.70	99	214	VERT
105.300000	29.75	43.50	13.80	100	0	VERT
106.320000	36.65	43.50	6.90	100	0	VERT
107.220000	32.80	43.50	10.70	98	1	VERT
914.400000	27.77	46.00	18.20	189	103	VERT

Table 10 - Radiated Emissions Average Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2480.000000	88.55	NA	NA	187	38	VERT
4960.000000	50.87	54.00	3.13	99	112	HORI
7426.600000	35.67	54.00	18.33	400	177	VERT
9932.600000	38.07	54.00	15.93	99	26	VERT
12415.800000	35.79	54.00	18.21	217	90	VERT
14893.600000	42.32	54.00	11.68	260	333	VERT
17337.400000	46.79	54.00	7.21	305	360	HORI

Note: Average Level = Peak Level – Duty Cycle Correction Factor
Duty Cycle Correction Factor is calculated in Figures 6 and 7. 20dB was used.

Table 11 - Radiated Emissions Peak Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2480.000000	96.61	NA	NA	187	38	VERT
4960.000000	58.93	74.00	15.07	99	112	HORI
7426.600000	43.73	74.00	30.27	400	177	VERT
9932.600000	46.13	74.00	27.87	99	26	VERT
12415.800000	43.85	74.00	30.15	217	90	VERT
14893.600000	50.38	74.00	23.62	260	333	VERT
17337.400000	54.85	74.00	19.15	305	360	HORI

Average measurement values = Peak measurement values – averaging factor (8.06 dB). See Figures 6 and 7 for details.

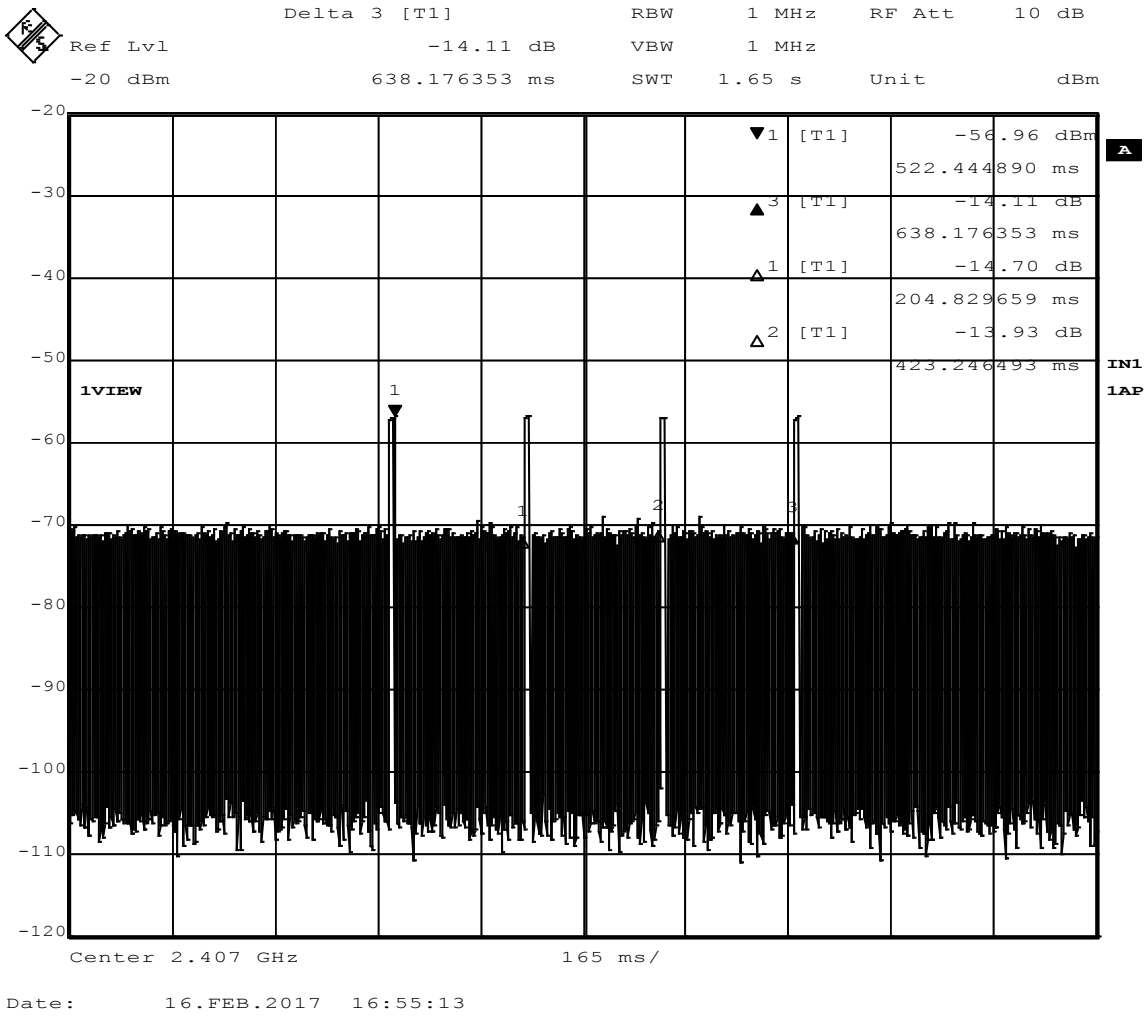


Figure 6 – Period

A maximum of 4 pulses can occur in any 100 ms window

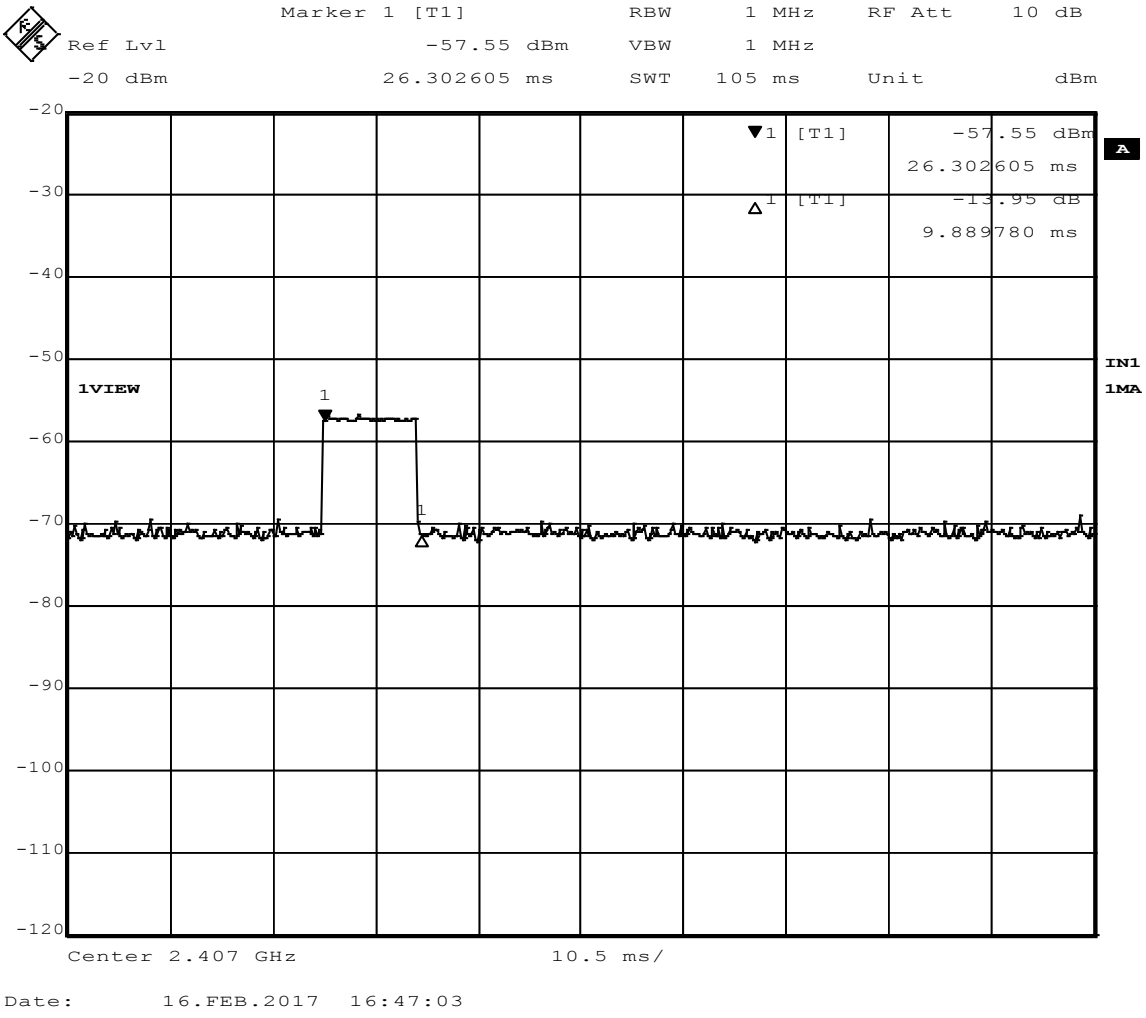


Figure 7 – Maximum Pulse Width

Duty cycle correction factor = 20*log((9.88 x 4)/100) = -8.06 dB

Note 1: 100ms is the longest allowed period per FCC Part 15.35

Note 2: there were 4 9.88ms pulses per 100ms period, so 9.88 x 4 was used for the pulse width.

4.3 Bandwidth and Peak EIRP

Test Method: ANSI C63.10, Section(s) 6.7, 6.9

4.3.1 Limits of bandwidth measurements

The 99% occupied bandwidth and peak EIRP are displayed for informational purposes only. The peak EIRP was measured using a 10 MHz RBW, which was over-laid on the plot showing the bandwidth using a 100 kHz RBW.

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 100 kHz RBW and 300 kHz VBW.

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded. The signal was then captured with a 100 kHz resolution bandwidth and the frequencies where the measurements were 20dB below the maximum power were marked. The bandwidth between these frequencies was recorded as the 99% occupied bandwidth.

4.3.3 Deviations from test standard

No deviation.

4.3.4 Test setup

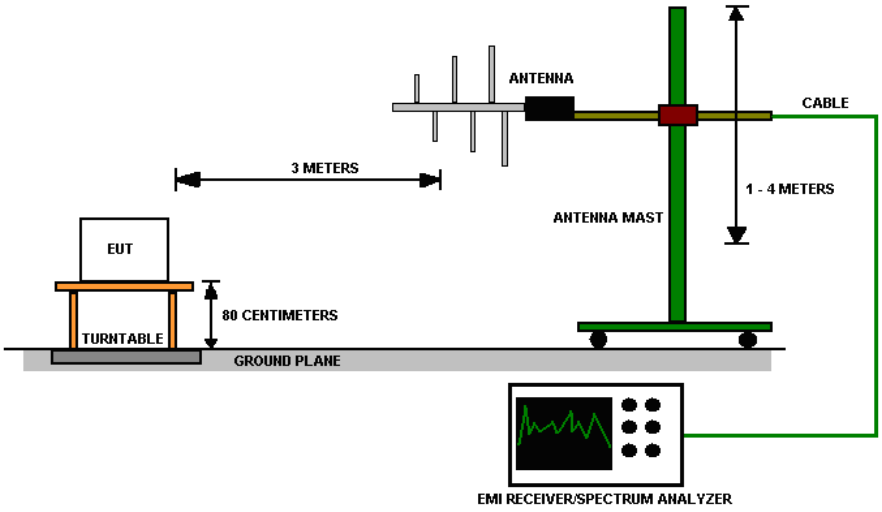


Figure 8 - Bandwidth Measurements Test Setup

4.3.5 EUT operating conditions

The EUT was powered by 18 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	Single Chip Wireless Window Blind Controller Module	MODE	Transmit
INPUT POWER	18 VDC	FREQUENCY RANGE	2407 – 2480 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

99% Occupied Bandwidth

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (MHz)
1	2407	2.09
2	2440	2.04
3	2480	1.98

REMARKS:
None

Peak EIRP

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP PEAK POWER OUTPUT (dBm)	RESULT
1	2407	2.26	PASS
2	2440	0.94	PASS
3	2480	1.59	PASS

All measurements were taken from the 99% occupied bandwidth screen captures.

REMARKS:
None

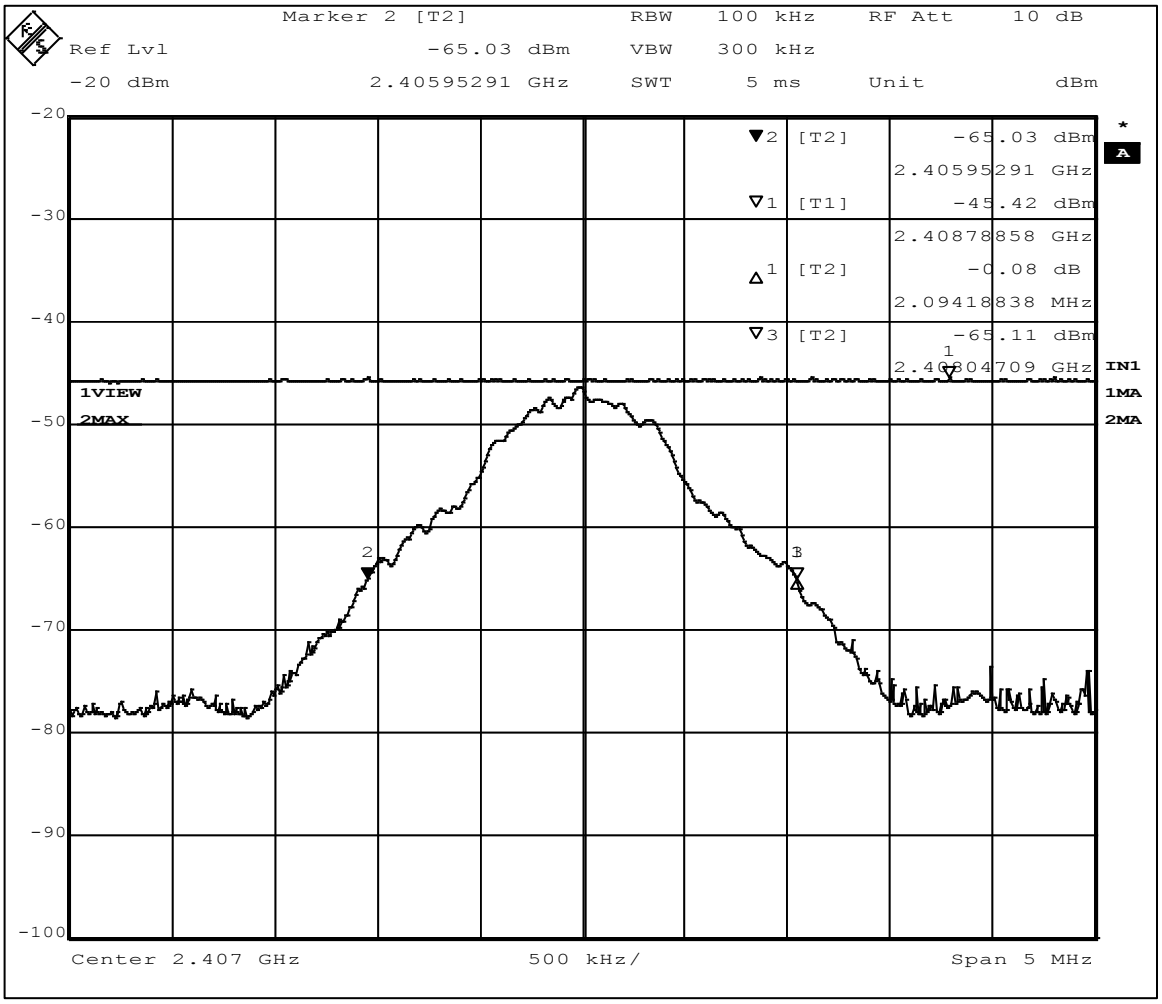


Figure 9 - 99% Occupied Bandwidth, Low Channel. 2.09 MHz

Maximum power = -45.42 dBm + 107 + CL + AF - 95.23 = 2.26 dBm

CL = cable loss = 7.60 dB
AF = antenna factor = 28.31 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: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

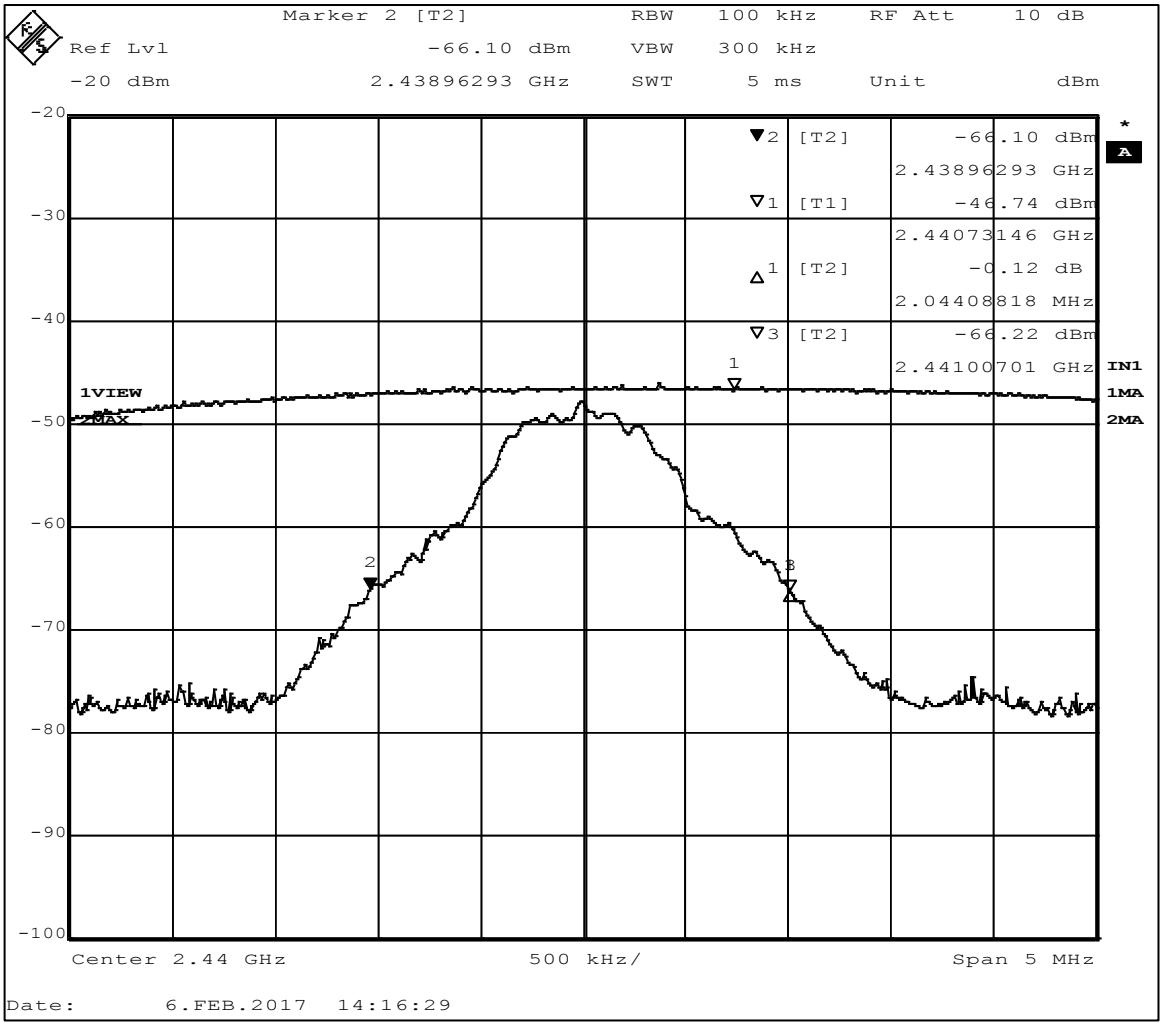


Figure 10 - 99% Occupied Bandwidth, Mid Channel, 2.04 MHz

Maximum power = -46.74 dBm + 107 + CL + AF - 95.23 = 0.94 dBm

CL = cable loss = 7.60 dB
AF = antenna factor = 28.31 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: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

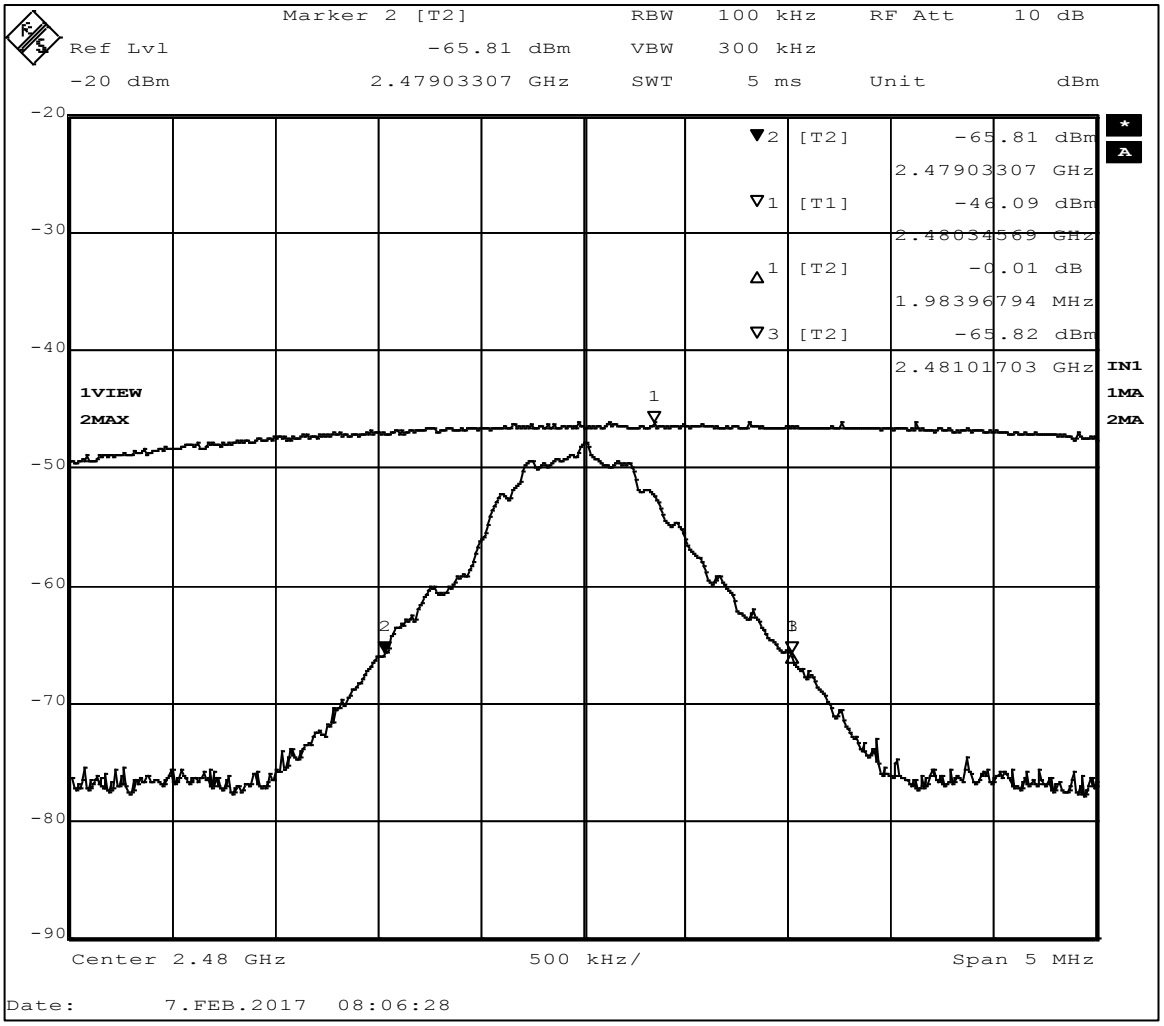


Figure 11 - 99% Occupied Bandwidth, High Channel, 1.98 MHz

Maximum power = -46.09 dBm + 107 + CL + AF - 95.23 = 1.59 dBm

CL = cable loss = 7.60 dB
AF = antenna factor = 28.31 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: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

4.4 Bandedges

Test Method: ANSI C63.10, Section(s) 6.10.5.2

4.4.1 Limits of bandedge measurements

For emissions outside of the allowed band of operation (2400.0MHz – 2483.5MHz), 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 18 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 MODULE	Single Chip	MODE	Transmit
INPUT POWER	18 VDC	FREQUENCY RANGE	2390MHz – 2495 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 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	2400.0	-88.15	-49.85	38.30	22.87	PASS
3	2483.5	-105.18	-50.35	54.83	22.61	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 2407MHz for low channel = 76.87dBµV/m
Fundamental average field strength at 2480MHz for high channel = 76.61dBµV/m

Channel 1 minimum delta = 76.87 – 54.0 dBµV/m = 22.87 dBc
Channel 3 minimum delta = 76.61 – 54.0 dBµV/m = 22.61 dBc

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

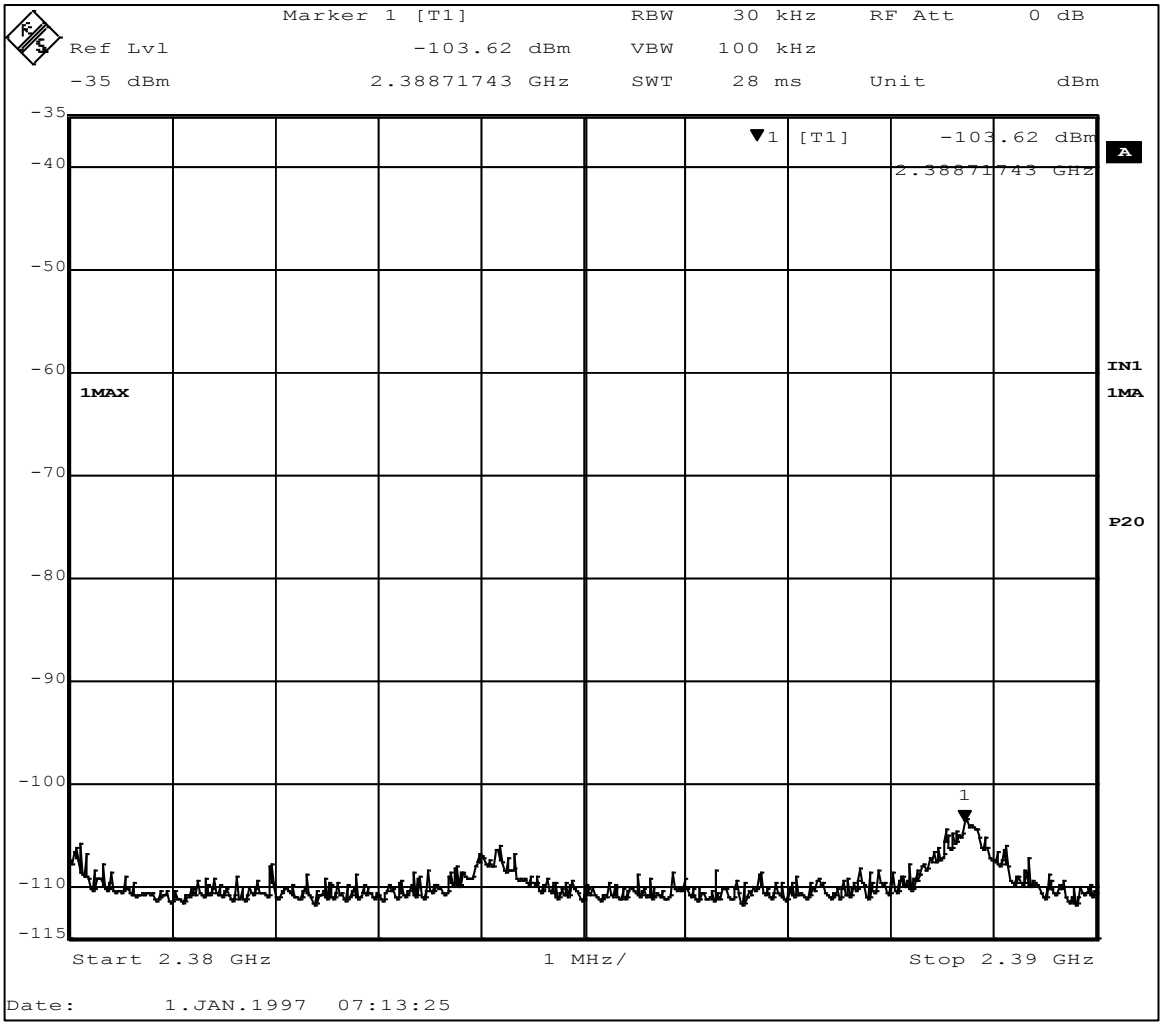


Figure 12 - Band-edge Measurement, Low Channel, Restricted Frequency

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

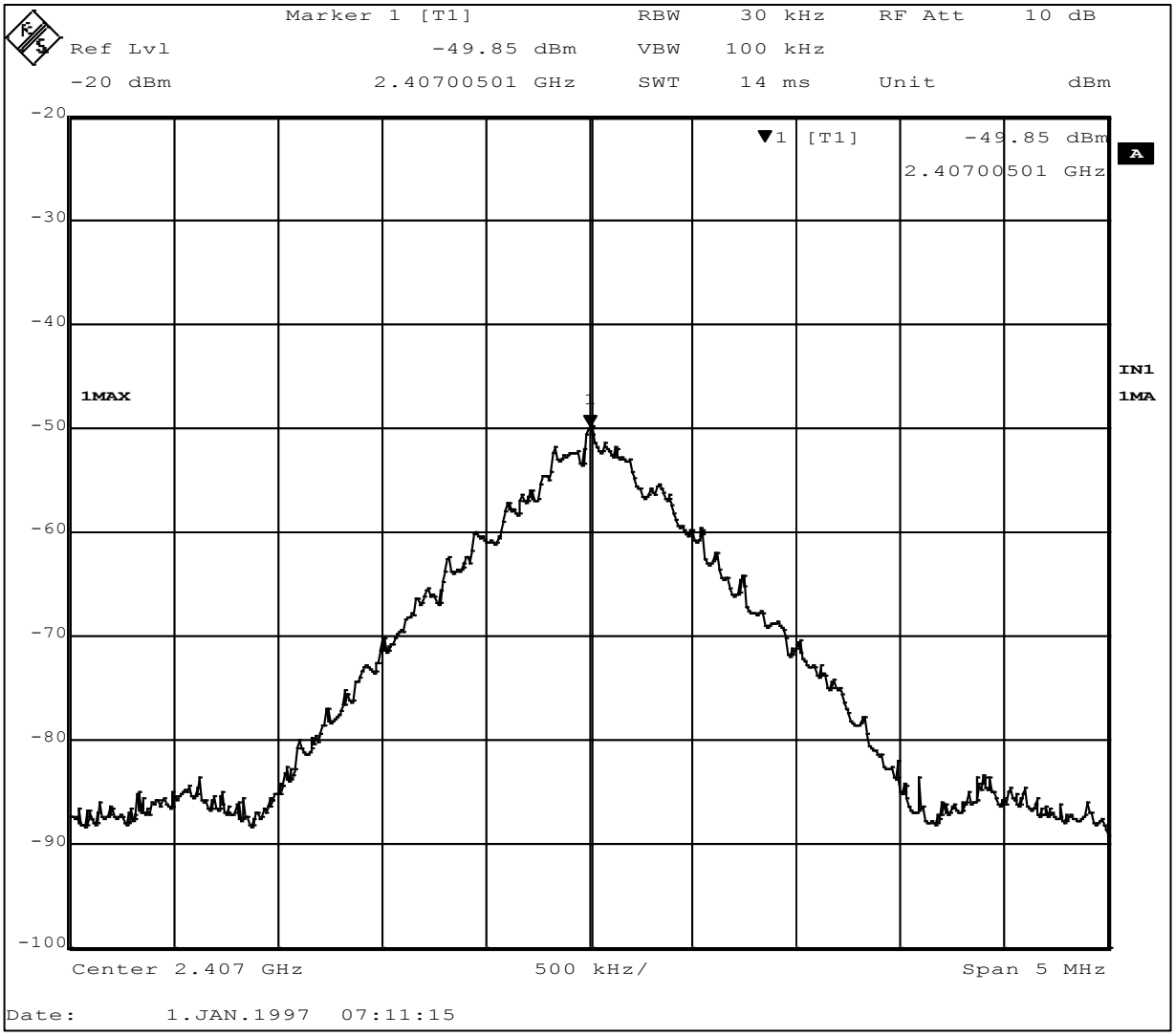


Figure 13 - Band-edge Measurement, Low Channel, Fundamental

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

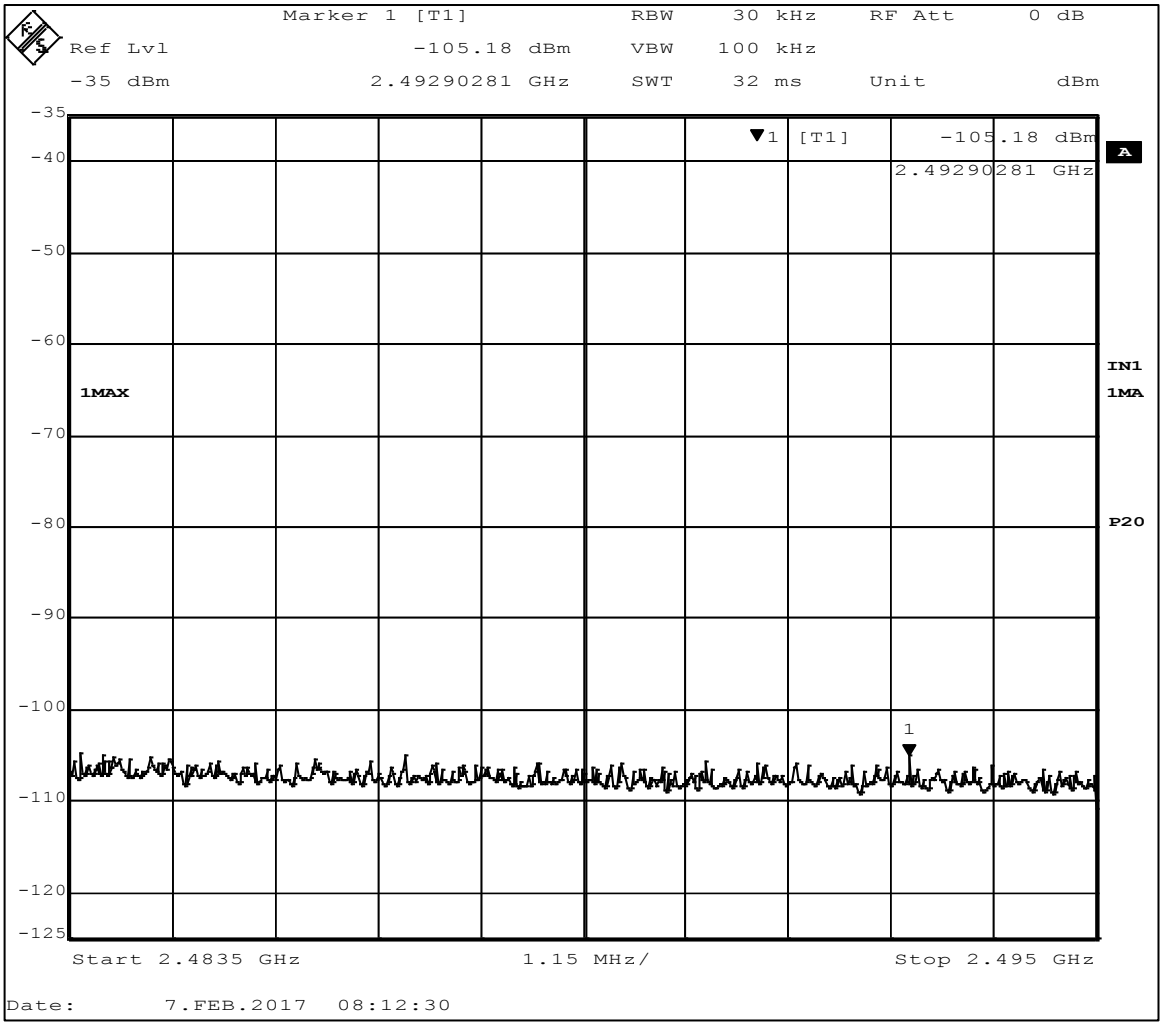


Figure 14 - Band-edge Measurement, High Channel, Restricted Frequency

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

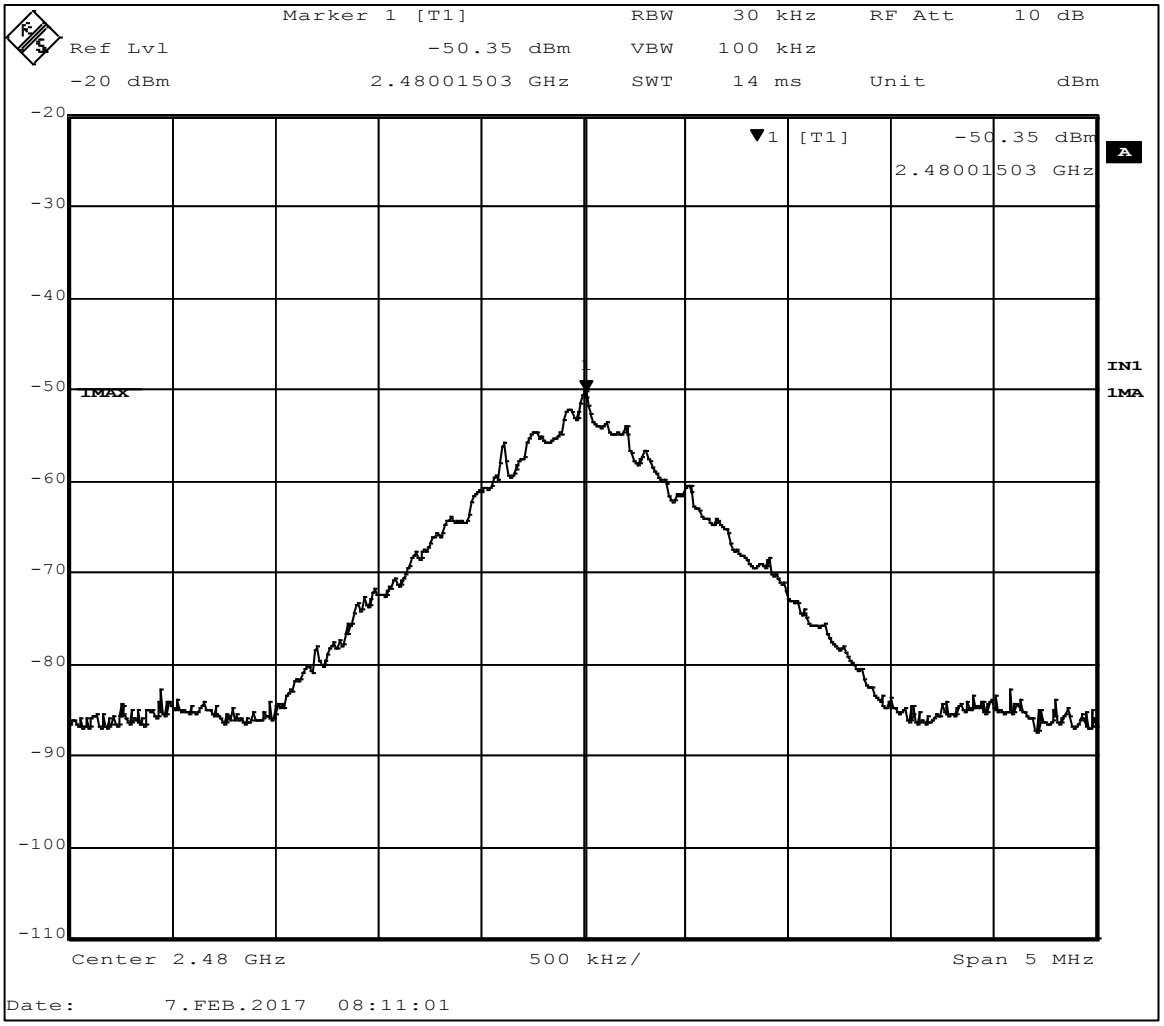


Figure 15 - Band-edge Measurement, High Channel, Fundamental

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

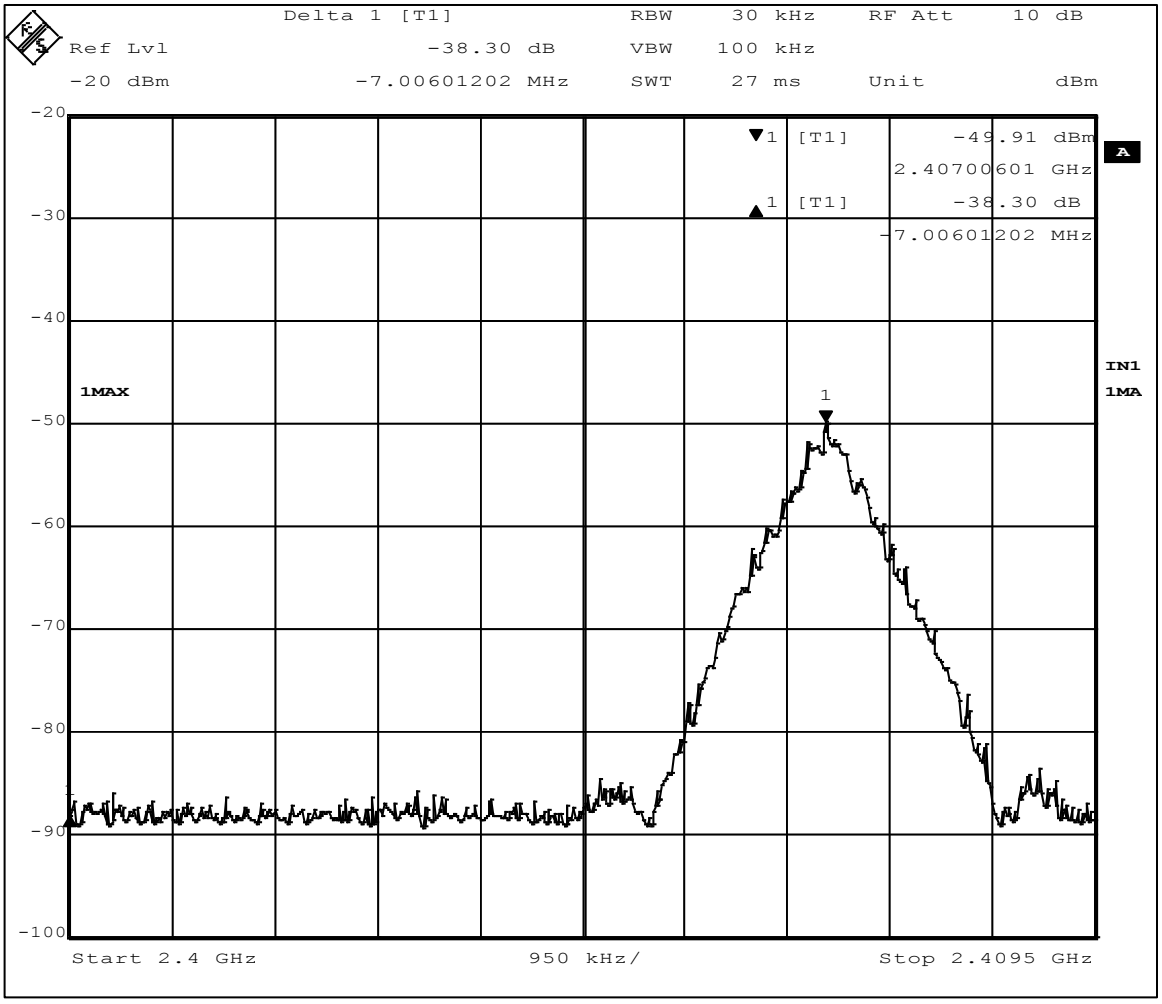


Figure 16 - Band-edge Measurement, Low Channel, out-of-band

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

Delta = 38.30 dB; Minimum = 22.87

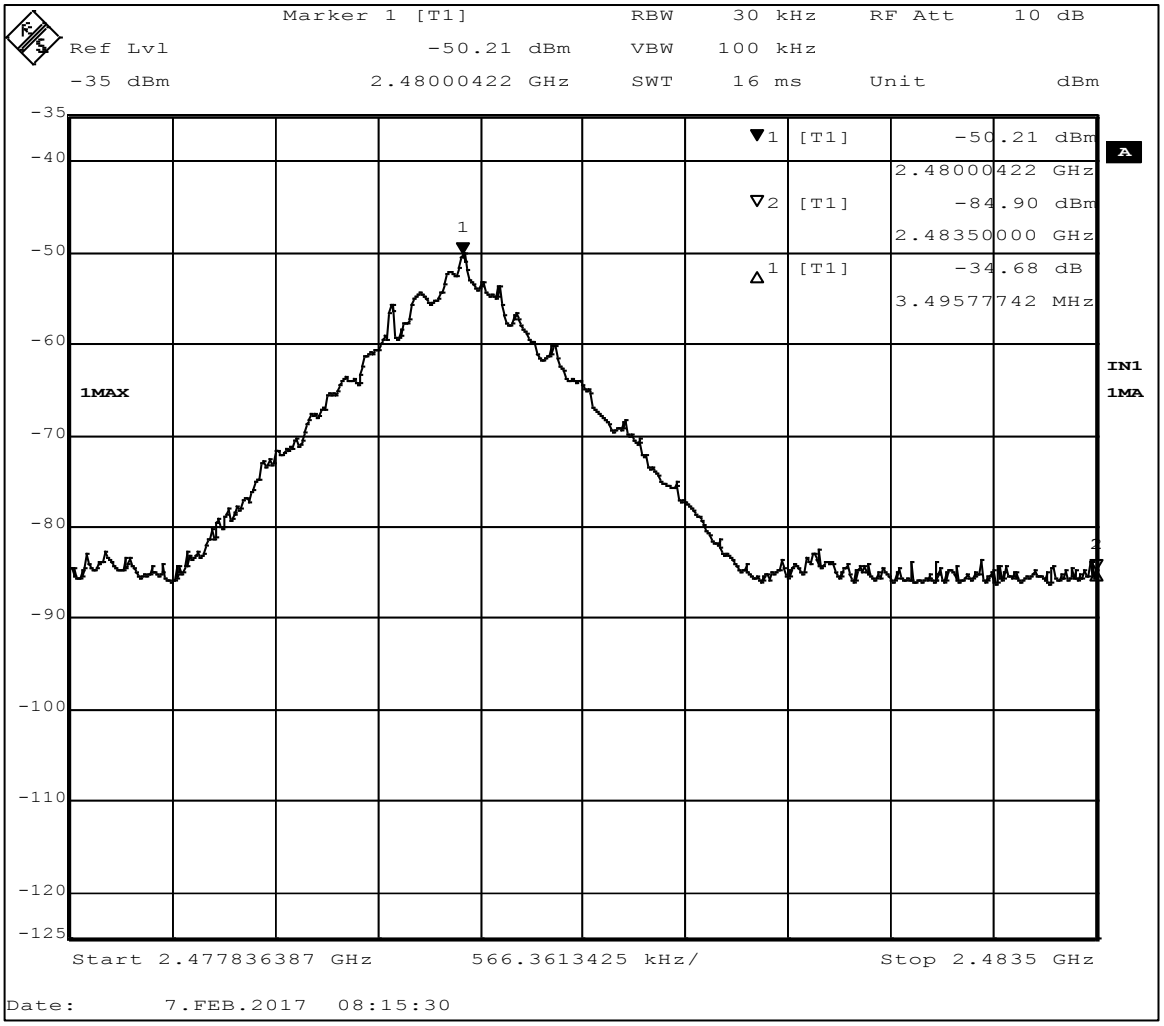


Figure 17 - Band-edge Measurement, High Channel, out-of-band

Delta = 34.68 dB Minimum = 22.61

4.5 *Conducted AC Mains Emissions*

Test Method: ANSI C63.10, Section(s) 6.2
ANSI C63.4, Section(s) 7

4.5.1 Limits for conducted emissions measurements

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

NOTE: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.5.2 Test Procedures

a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits could not be reported.
d. Results were compared to the 15.207 limits.

4.5.3 Deviation from the test standard

No deviation

4.3.4 Test setup

The EUT was tested as module.

4.3.5 EUT operating conditions

The EUT was powered by 18 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	Single Chip	MODE	Transmit (middle channel used)
INPUT POWER	18 VDC	FREQUENCY RANGE	150kHz – 30MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

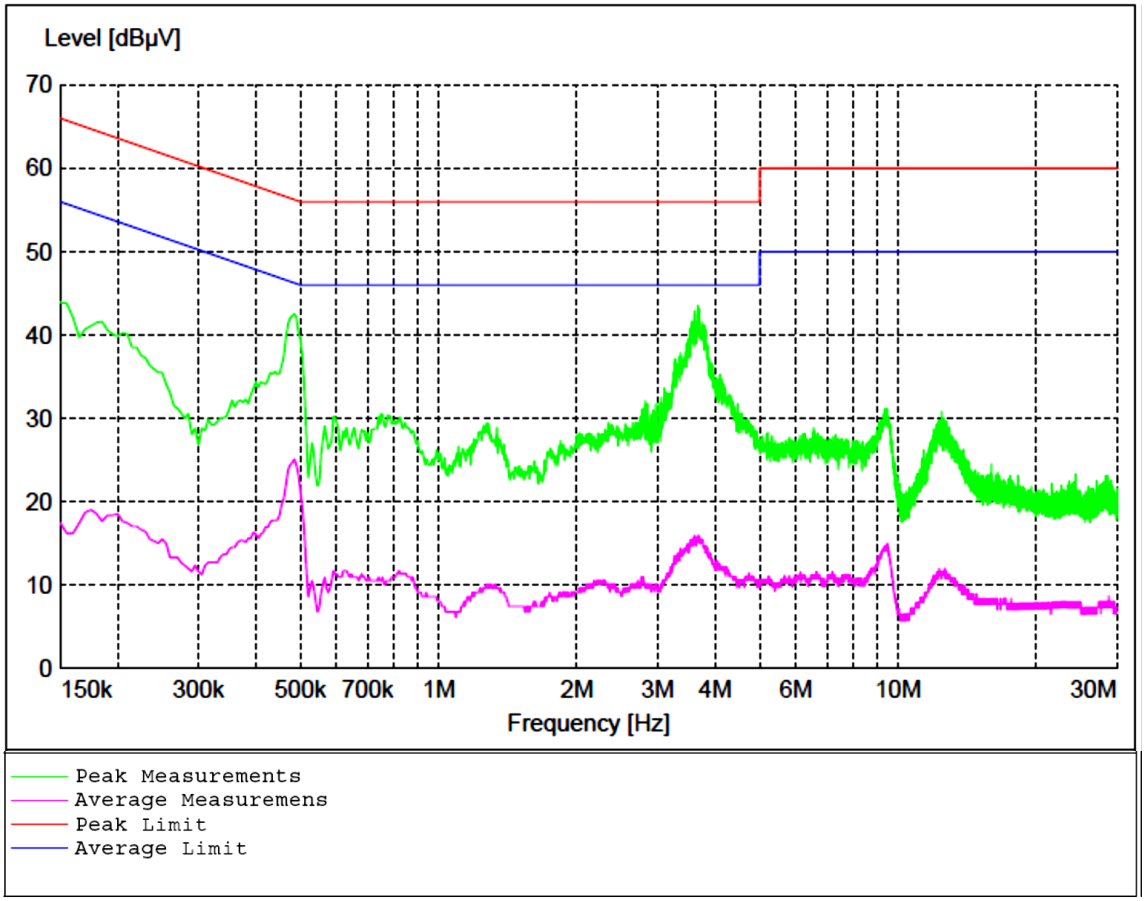


Figure 18 - Conducted Emissions Plot

All measurements were found to be at least 10dB below the applicable limit.

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.