The Nebraska Center for Excellence in Electronics
4740 Discovery Drive
Lincoln, NE 68521
Phone: 402.323.6233
Fax: 402.323.6238
www.nceelabs.com

Amended

FCC/IC Test Report

Includes NCEE Labs report R20141003-20 and its amendment in full

Prepared for:	**Hunter Douglas** **2550 Midway Boulevard** **Broomfield, CO 80020**
Product:	**Silhouette** **Wireless Window Blind Controller**
FCC ID:	**UXUSIL1**
IC:	**7316A-SIL1**
Test Report No:	**R20141003-20A**
Approved By:	**Nic S. Johnson, NCE** **Technical Manager** **iNARTE Certified EMC Engineer #EMC-003337-NE**
DATE:	**27 May 2015**
Total Pages:	**36**

ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

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	Pass	Permanently attached antenna
FCC Part 15.207 RSS-Gen Section 8.8	Conducted Emissions	Pass	Representative Power supply was used
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.

1.1 Reason for amendment

Page 32, Figure 18 has been added to the amended test report to show this configuration.

The Table of equipment in Section 3.0 on Page 6 has been updated to state that the 10m chamber used for testing has been validated according to CSIPR 16-1-4 by an accredited calibration lab. Figure 22 on Page 34 shows a photo of this absorber.

Section 4.4 in the amended report has been modified to remove any reference to the 20dB down requirement.
Section 4.2 has been updated in the amended report to include the limits at the fundamental from FCC Part 15.249.

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: 11 March 2015
EUT Tested Dates: 11 March 2015 – 22 April 2015

MODEL	Silhouette
Serial No.	Low channel unit: NCEE 2407 Mid channel: NCEE 2440 High Channel: NCEE 2480 Receive: NCEE STANDARD CODE All serial numbers were assigned by the lab as the test samples were not serialized.
FCC ID:	UXUSIL1
IC:	7316A-SIL1
POWER SUPPLY	18 VDC Class 2 Power Supply Part No. 2989048000 Model: ADS0333-W180200 Input: 100-240VAC, 1.0A Output: 18V, 2.0A Note: the power supply was used as a representative sample and the EUT will not be sold with a specific power supply. It contains the required power regulation to meet the modular approval requirements.
ANTENNA TYPE	Internal Board Mount antenna

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 42 ± 4%

Temperature of 30 ± 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) ANSI C63.10:2009
(3) Industry Canada RSS-Gen Issue 4
(4) Industry Canada RSS-210 Issue 8

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.

2.7 Modular or Limited Modular Approval

The unit was tested as a stand-alone PCB without enclosure. Testing was performed with the intention to meet either modular or limited-modular approval and it is required to be compliant without any additional shielding supplied by an enclosure.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Rohde & Schwarz Test Receiver	ES126	100037	20 Jan 2015	20 Jan 2016
EMCO Biconilog Antenna	3142B	1647	13 Aug 2014	13 Aug 2015
EMCO Horn Antenna	3115	6416	14 Jan 2014	14 Jan 2016
EMCO Horn Antenna	3116	2576	31 Mar 2014	31 Mar 2016
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	19 Nov 2014*	19 Nov 2015
Trilithic High Pass Filter	6HC330	23042	19 Nov 2014*	19 Nov 2015
10m Chamber	NCEE 10M	4740 Discovery Drive	26 March 2014**	26 March 2016

*Internal Characterization
****** The 10m chamber at NCEE was validated to CISPR 16-1-4:2010 in March of 2014 by an accredited calibration laboratory. The site validation is performed once every 2 years and includes absorber placed between the EUT and receiving antenna for measurement above 1GHz.

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 is permanently attached and internal to the EUT. It is soldered to the PCB and not replaceable.

4.2 Radiated emissions

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 0.8 meters 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.

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 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

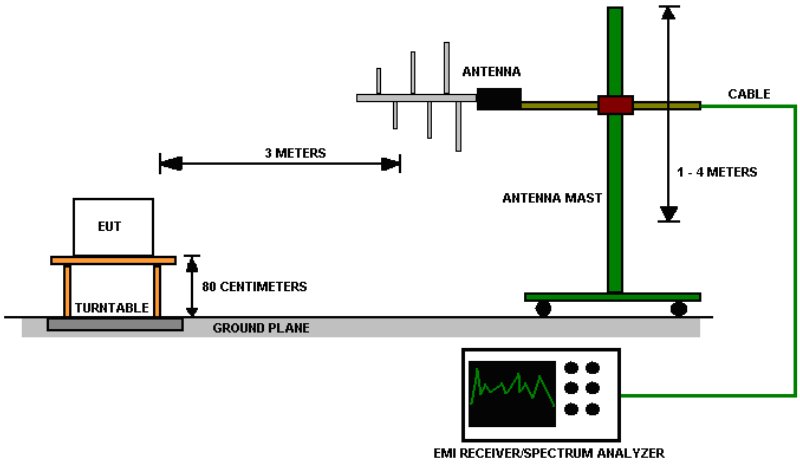

Figure 1 - Radiated Emissions Test Setup

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	Silhouette	MODE	Receive
INPUT POWER	18 VDC	FREQUENCY RANGE	30MHz – 26GHz
ENVIRONMENTAL CONDITIONS	30 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

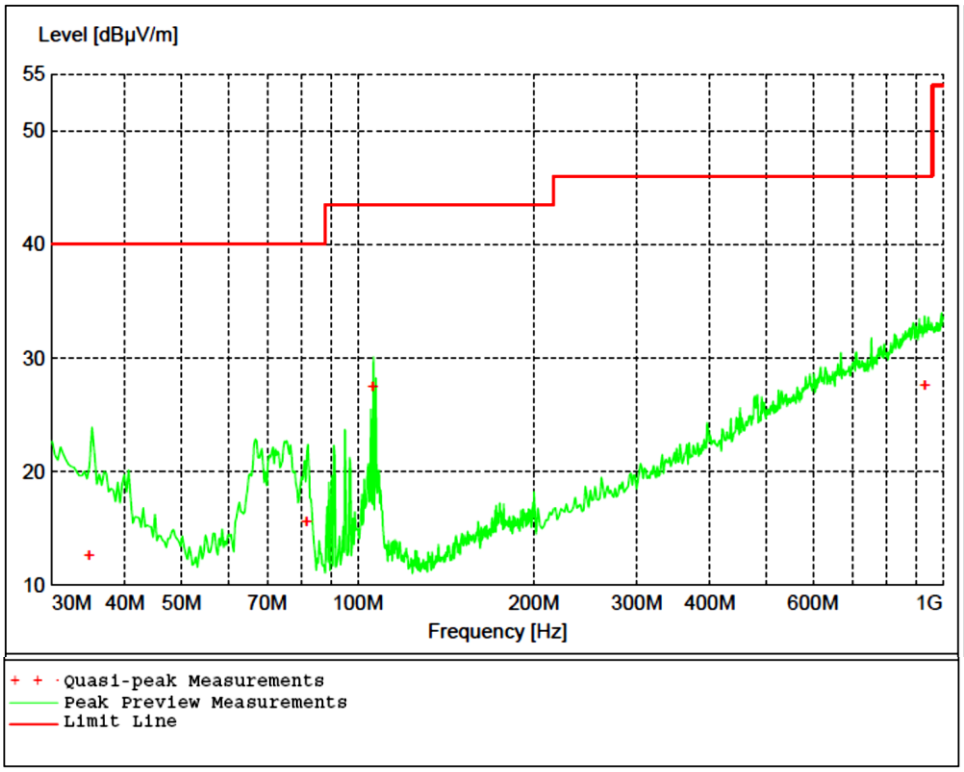

Figure 2 - Radiated Emissions Plot, Receive

Horizontal orientation was fond 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.

Table 1 - Radiated Emissions Quasi-peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
34.740000	12.55	40.00	27.40	228	7	VERT
81.840000	15.52	40.00	24.50	139	304	VERT
106.260000	27.45	43.50	16.10	99	112	VERT
932.040000	27.55	46.00	18.40	256	351	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.	
2437.000000	37.02	54.00	16.98	100	155	HORI
4887.000000	42.52	54.00	11.48	400	226	HORI
7344.400000	45.50	54.00	8.50	399	355	VERT
9772.800000	45.99	54.00	8.01	99	306	HORI
12214.000000	39.48	54.00	14.52	99	59	VERT

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

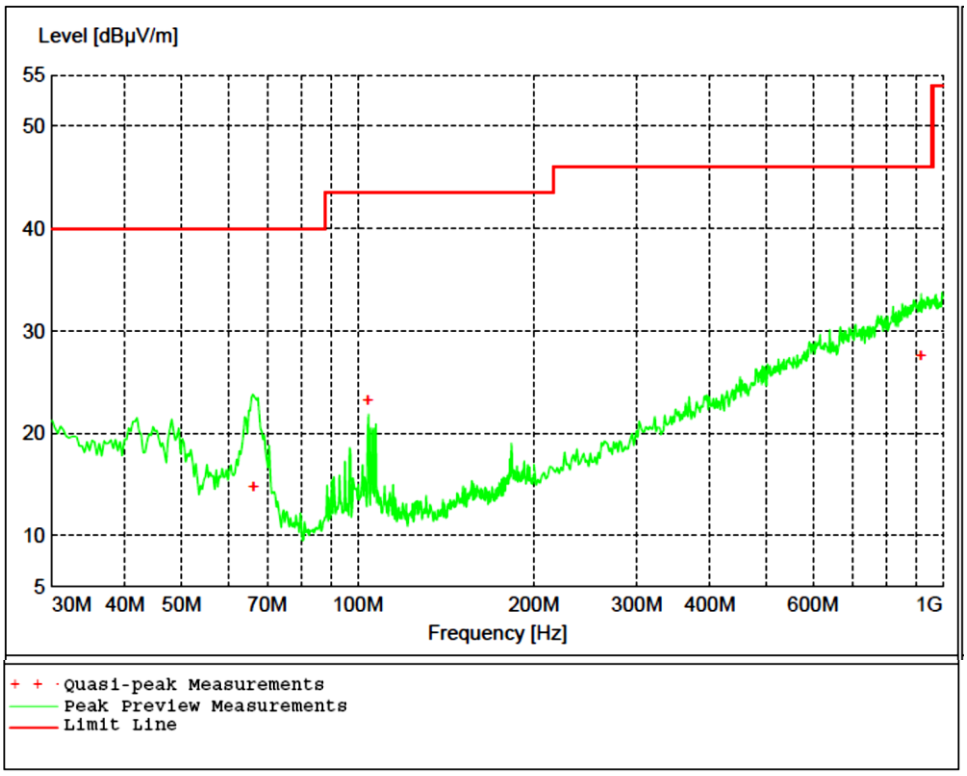

Figure 3 - Radiated Emissions Plot, Channel 1

Horizontal orientation was fond to be the worse-case

Table 3 - Radiated Emissions Quasi-peak Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
66.300000	14.75	40.00	25.30	156	48	VERT
104.100000	23.18	43.50	20.30	100	329	VERT
917.700000	27.57	46.00	18.40	339	292	HORI

Table 4 - Radiated Emissions Average Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2407.000000	74.44	93.97	19.53	100	121	HORI
4814.400000	33.92	54.00	20.08	236	117	VERT
7203.600000	24.80	54.00	29.20	366	360	HORI
9636.400000	25.82	54.00	28.18	396	271	VERT
12024.800000	23.16	54.00	30.84	251	213	VERT
14415.800000	28.64	54.00	25.36	399	265	VERT
16875.800000	30.94	54.00	23.06	99	299	VERT

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, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2407.000000	94.44	113.97	19.53	100	121	HORI
4814.400000	53.92	74.00	20.08	236	117	VERT
7203.600000	44.80	74.00	29.20	366	360	HORI
9636.400000	45.82	74.00	28.18	396	271	VERT
12024.800000	43.16	74.00	30.84	251	213	VERT
14415.800000	48.64	74.00	25.36	399	265	VERT
16875.800000	50.94	74.00	23.06	99	299	VERT

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

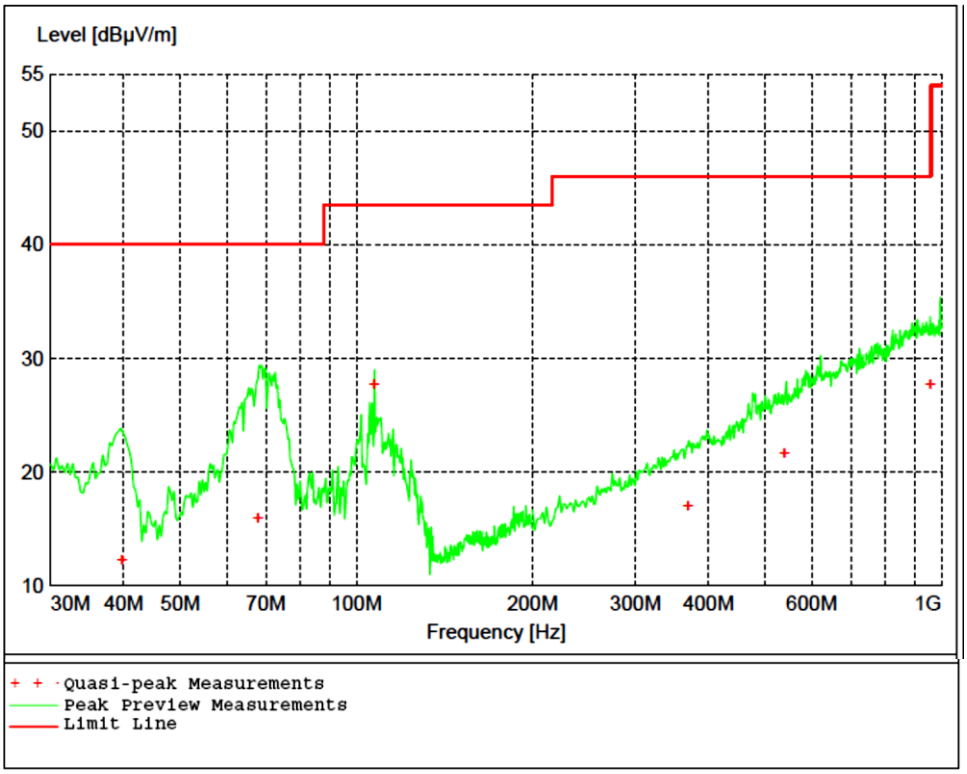

Figure 4 - Radiated Emissions Plot, Channel 2

Horizontal orientation was fond 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.

Table 6 - Radiated Emissions Quasi-peak Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
39.720000	12.26	40.00	27.70	99	214	VERT
67.860000	15.93	40.00	24.10	167	95	VERT
107.340000	27.65	43.50	15.90	159	58	VERT
369.300000	16.97	46.00	29.00	267	343	HORI
538.920000	21.61	46.00	24.40	117	307	VERT
957.060000	27.71	46.00	18.30	330	59	VERT

Table 7 - Radiated Emissions Average Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2440.000000	72.76	93.97	21.21	98	360	HORI
4880.400000	33.71	54.00	20.29	250	249	VERT
7350.200000	25.41	54.00	28.59	197	44	HORI
9733.600000	25.96	54.00	28.04	259	40	VERT
12197.400000	19.87	54.00	34.13	325	144	VERT
14669.200000	25.45	54.00	28.55	164	76	VERT
17073.600000	29.85	54.00	24.15	362	151	VERT

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, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2440.000000	92.76	113.97	21.21	98	360	HORI
4880.400000	53.71	74.00	20.29	250	249	VERT
7350.200000	45.41	74.00	28.59	197	44	HORI
9733.600000	45.96	74.00	28.04	259	40	VERT
12197.400000	39.87	74.00	34.13	325	144	VERT
14669.200000	45.45	74.00	28.55	164	76	VERT
17073.600000	49.85	74.00	24.15	362	151	VERT

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

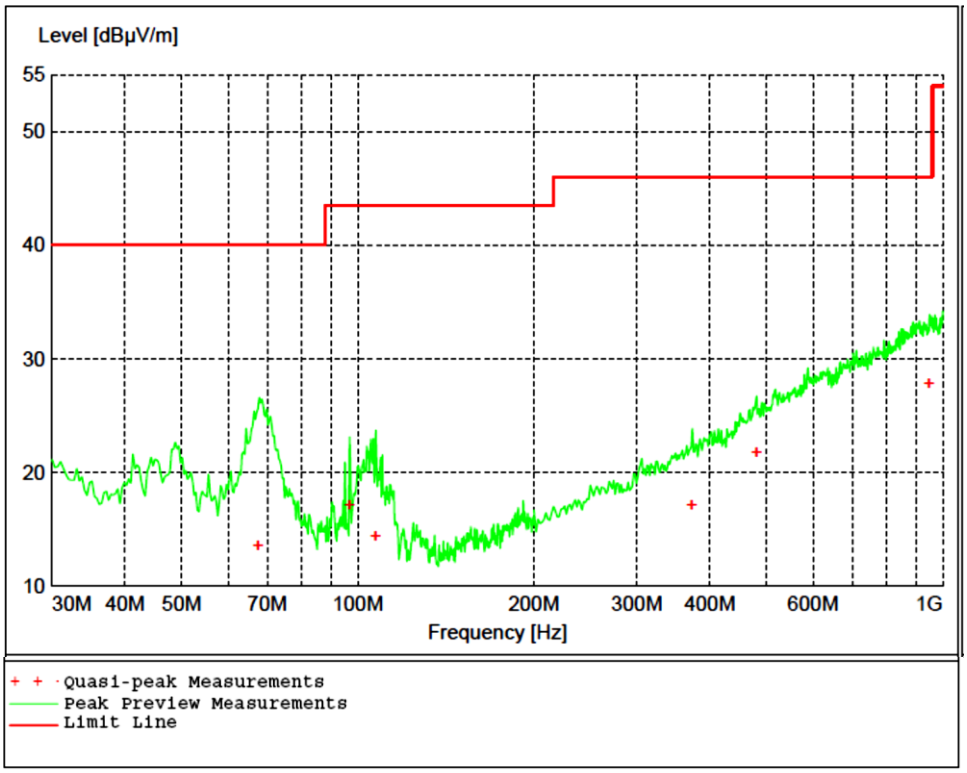

Figure 5 - Radiated Emissions Plot, Channel 3

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.

Table 9 - Radiated Emissions Quasi-peak Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
67.500000	13.51	40.00	26.50	183	149	VERT
96.840000	17.10	43.50	26.40	100	80	VERT
107.280000	14.35	43.50	29.20	100	310	VERT
372.240000	17.13	46.00	28.90	273	222	HORI
480.780000	21.77	46.00	24.20	399	0	VERT
947.940000	27.82	46.00	18.20	307	238	HORI

Table 10 - Radiated Emissions Average Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2480.000000	76.27	93.97	17.70	99	165	HORI
4960.400000	33.46	54.00	20.54	243	155	VERT
7450.200000	27.01	54.00	26.99	130	1	VERT
9946.800000	28.00	54.00	26.00	399	111	VERT
12423.800000	19.86	54.00	34.14	237	360	HORI
14897.000000	26.39	54.00	27.61	399	200	HORI
17367.200000	30.83	54.00	23.17	230	62	VERT

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, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2480.000000	96.27	113.97	17.70	99	165	HORI
4960.400000	53.46	74.00	20.54	243	155	VERT
7450.200000	47.01	74.00	26.99	130	1	VERT
9946.800000	48.00	74.00	26.00	399	111	VERT
12423.800000	39.86	74.00	34.14	237	360	HORI
14897.000000	46.39	74.00	27.61	399	200	HORI
17367.200000	50.83	74.00	23.17	230	62	VERT

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

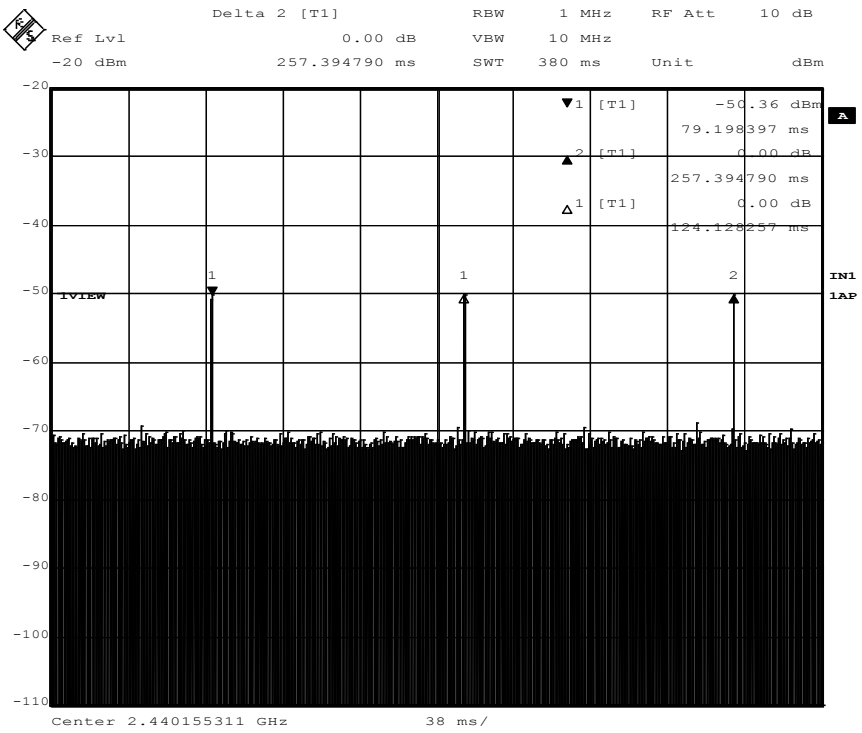

Figure 6 - Period = 124.128 ms

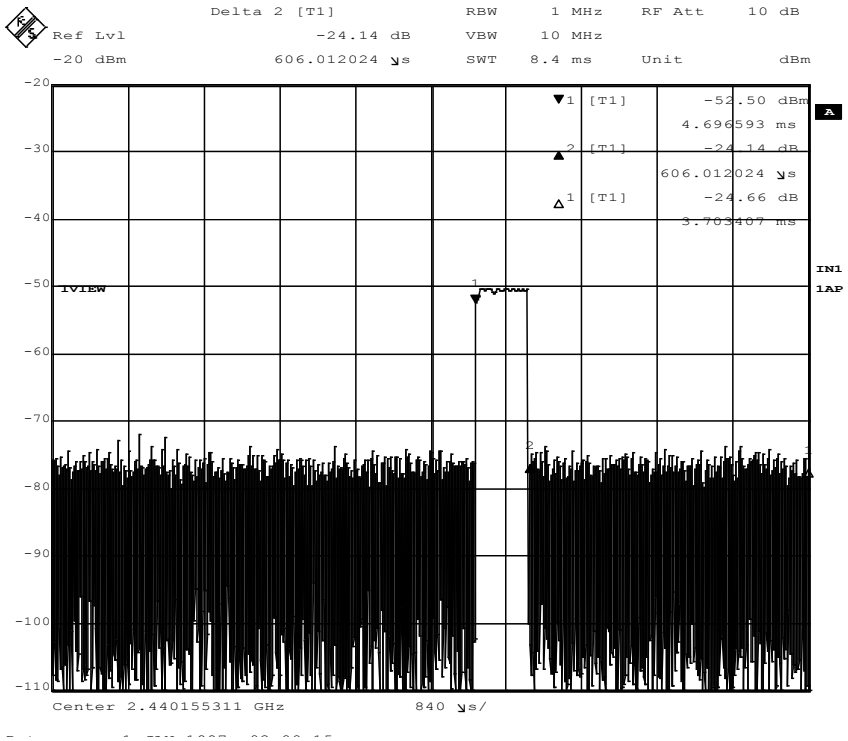

Figure 7 – Maximum Pulse Width = 606.01 µs

Duty cycle correction factor = 20*log(0.606/124.128) = -46.22 dB

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

Note: 20dB is the maximum averaging factor, so that was used

4.3 Bandwidth and Peak EIRP

4.3.1 Limits of bandwidth measurements

The 99% occupied bandwidth and peak EIRP are displayed for informational purposes only.

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 1MHz RBW and 10 MHz 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 1 MHz 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

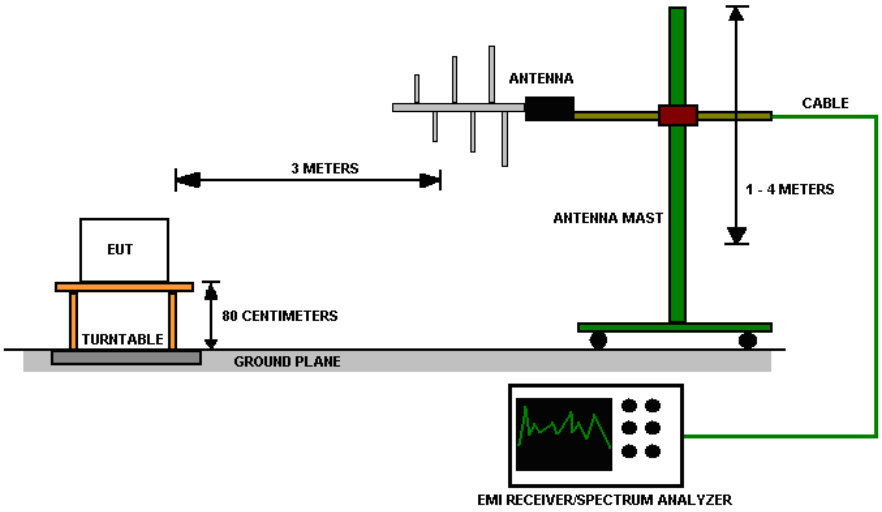

Figure 8 - Bandwidth Measurements Test Setup

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	Silhouette	MODE	Transmit
INPUT POWER	18 VDC	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	30 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

99% Occupied Bandwidth

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (MHz)
1	2407	2.32
2	2440	2.48
3	2480	2.41

REMARKS:
None

Peak EIRP

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP PEAK POWER OUTPUT (dBm)	RESULT
1	2407	0.34	PASS
2	2440	-1.40	PASS
3	2480	1.66	PASS

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

REMARKS:
None

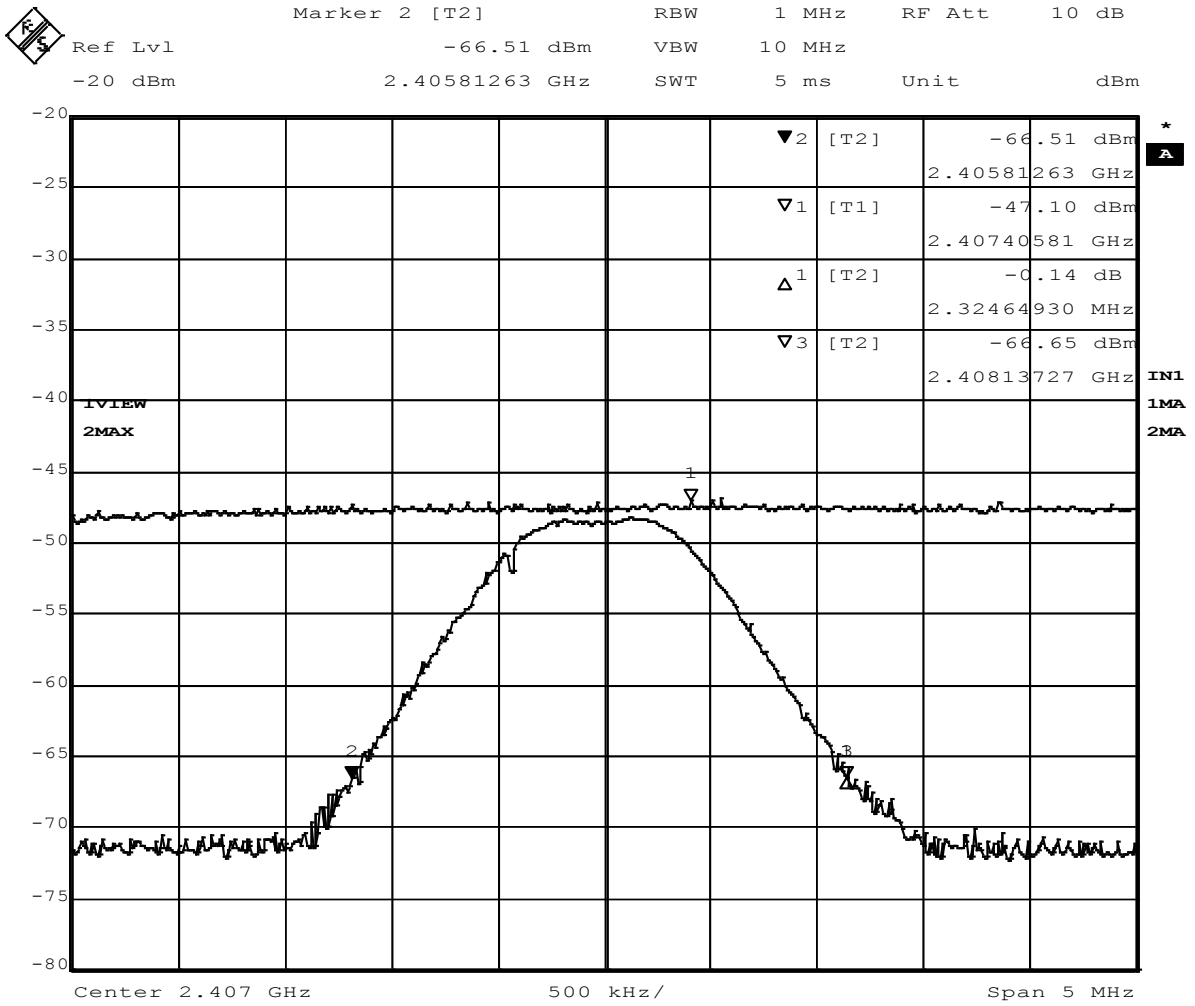

Figure 9 - 99% Occupied Bandwidth, Low Channel. 2.32MHz

Maximum power = -47.10 dBm + 107 + CL + AF - 95.23 = <u>0.34 dBm</u>

CF = cable loss = 7.20 dB
AF = antenna factor = 28.47 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.

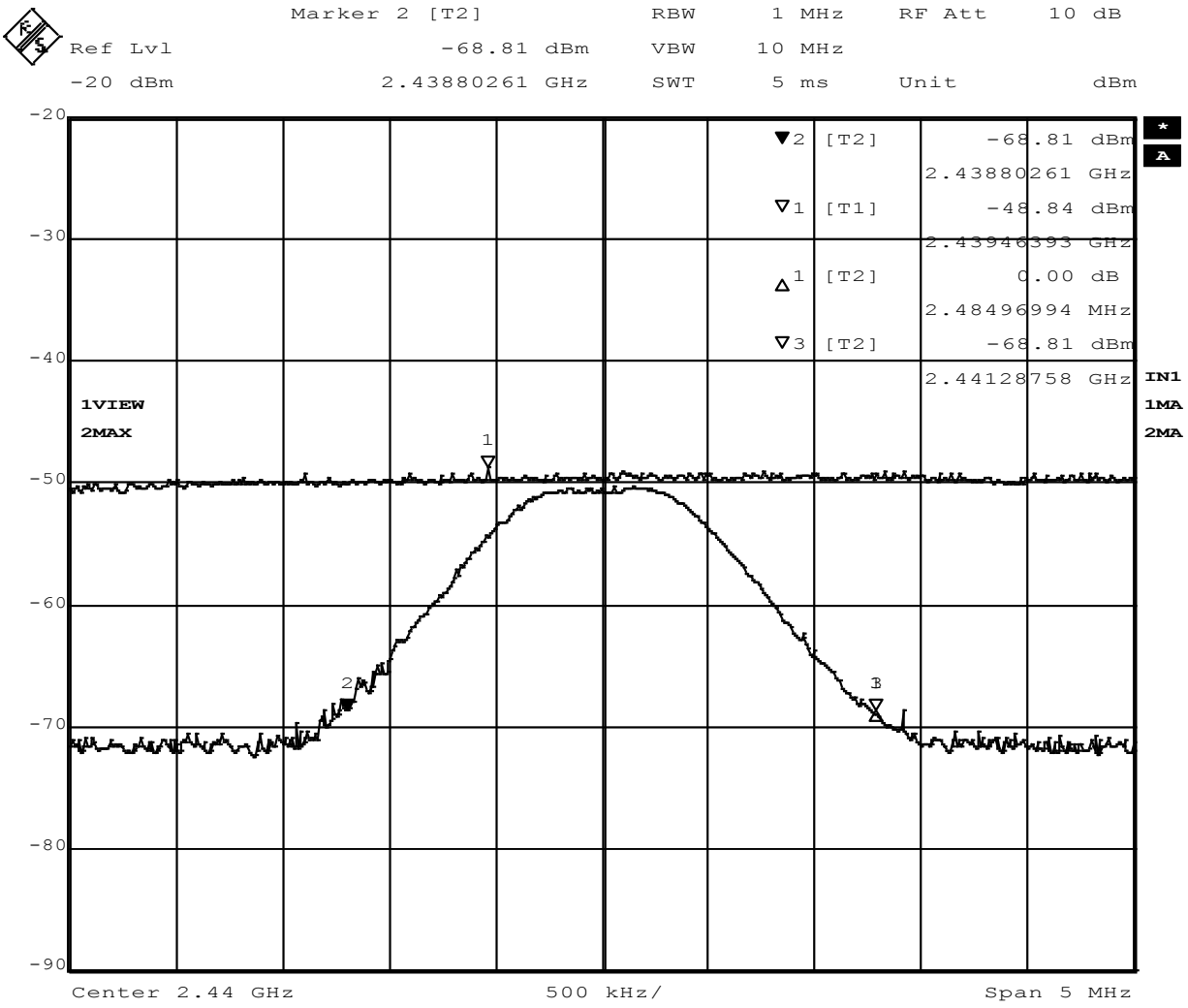

Figure 10 - 99% Occupied Bandwidth, Mid Channel, 2.48MHz

Maximum power = -48.84 dBm + 107 + CL + AF - 95.23 = <u>-1.40 dBm</u>

CF = cable loss = 7.20 dB
AF = antenna factor = 28.47 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.

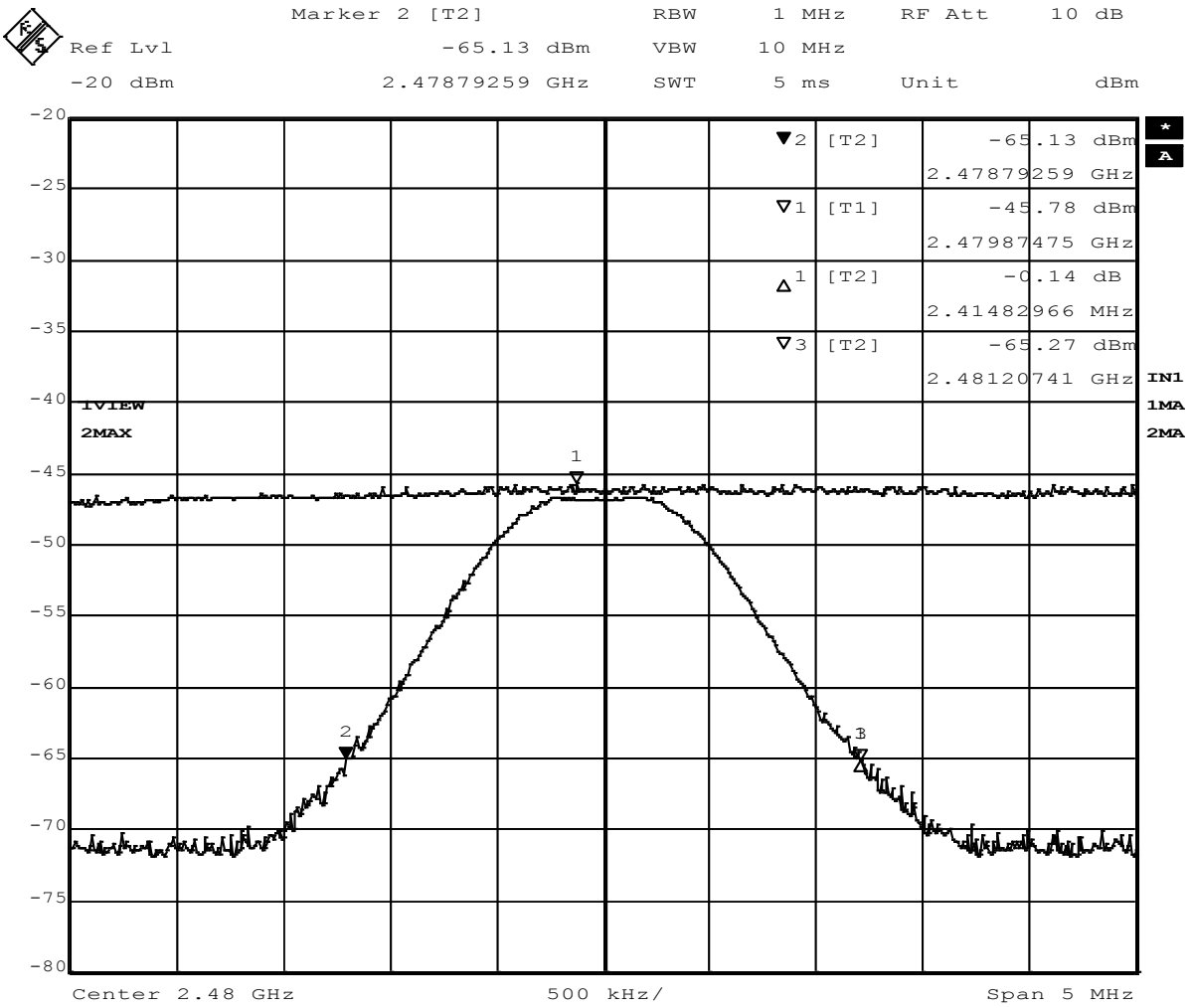

Figure 11 - 99% Occupied Bandwidth, High Channel, 2.41MHz

Maximum power = -45.78 dBm + 107 + CL + AF - 95.23 = <u>1.66 dBm</u>

CF = cable loss = 7.20 dB
AF = antenna factor = 28.47 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.

4.4 Bandedges

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 under the limits from Part 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	Silhouette	MODE	Transmit
INPUT POWER	18 VDC	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	30 % ± 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	2390.0	-107.16	-49.18	57.98	20.44	PASS
3	2483.5	-105.50	-47.46	58.04	18.76	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 =74.44 dBµV/m
Fundamental average field strength at 2480MHz for high channel =72.76 dBµV/m

Channel 1 minimum delta = 74.44 – 54.0 dBµV/m = 20.44 dBc
Channel 3 minimum delta = 72.76 – 54.0 dBµV/m = 18.76 dBc

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

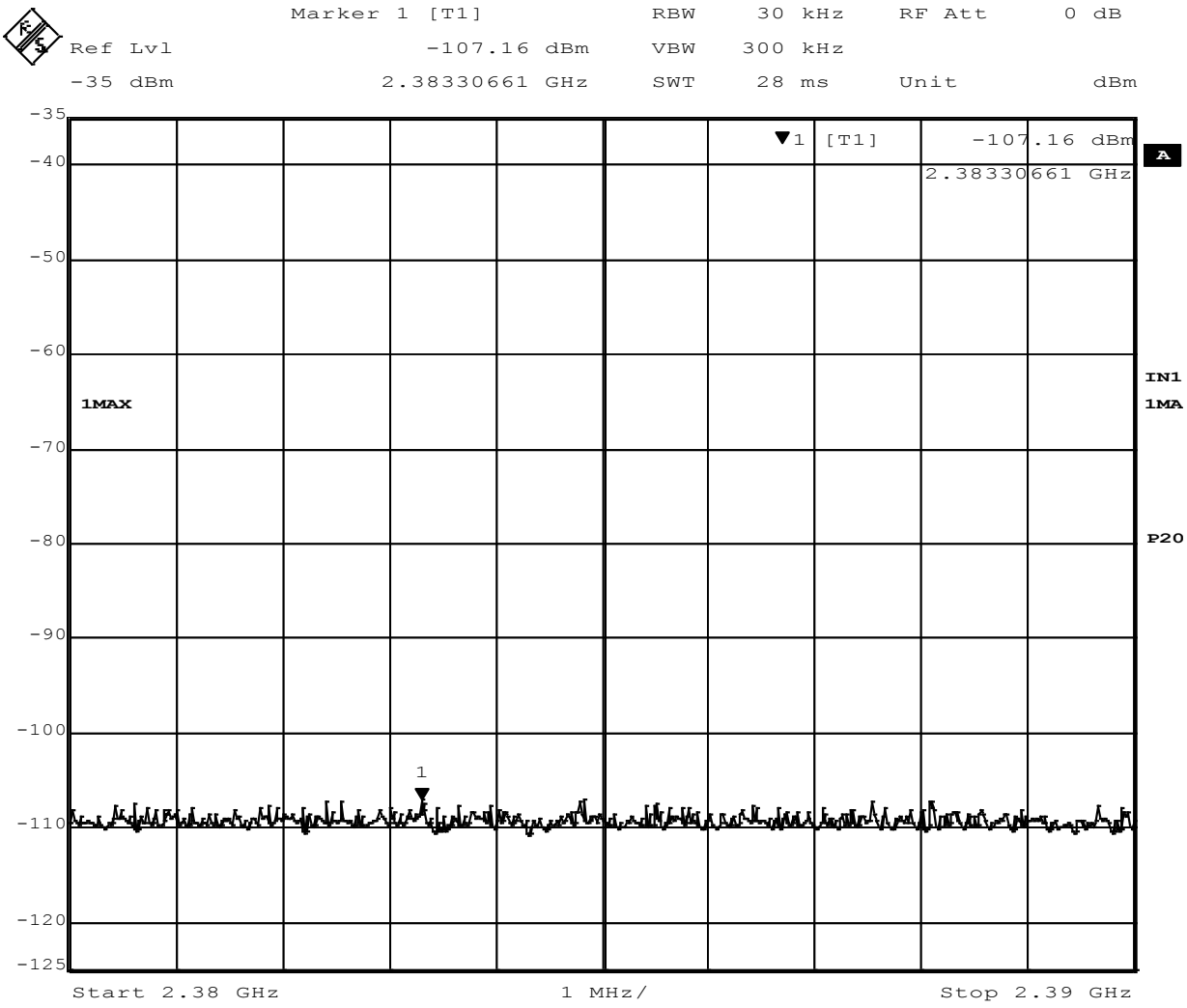

Figure 12 - Band-edge Measurement, Low Channel, Restricted Frequency

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

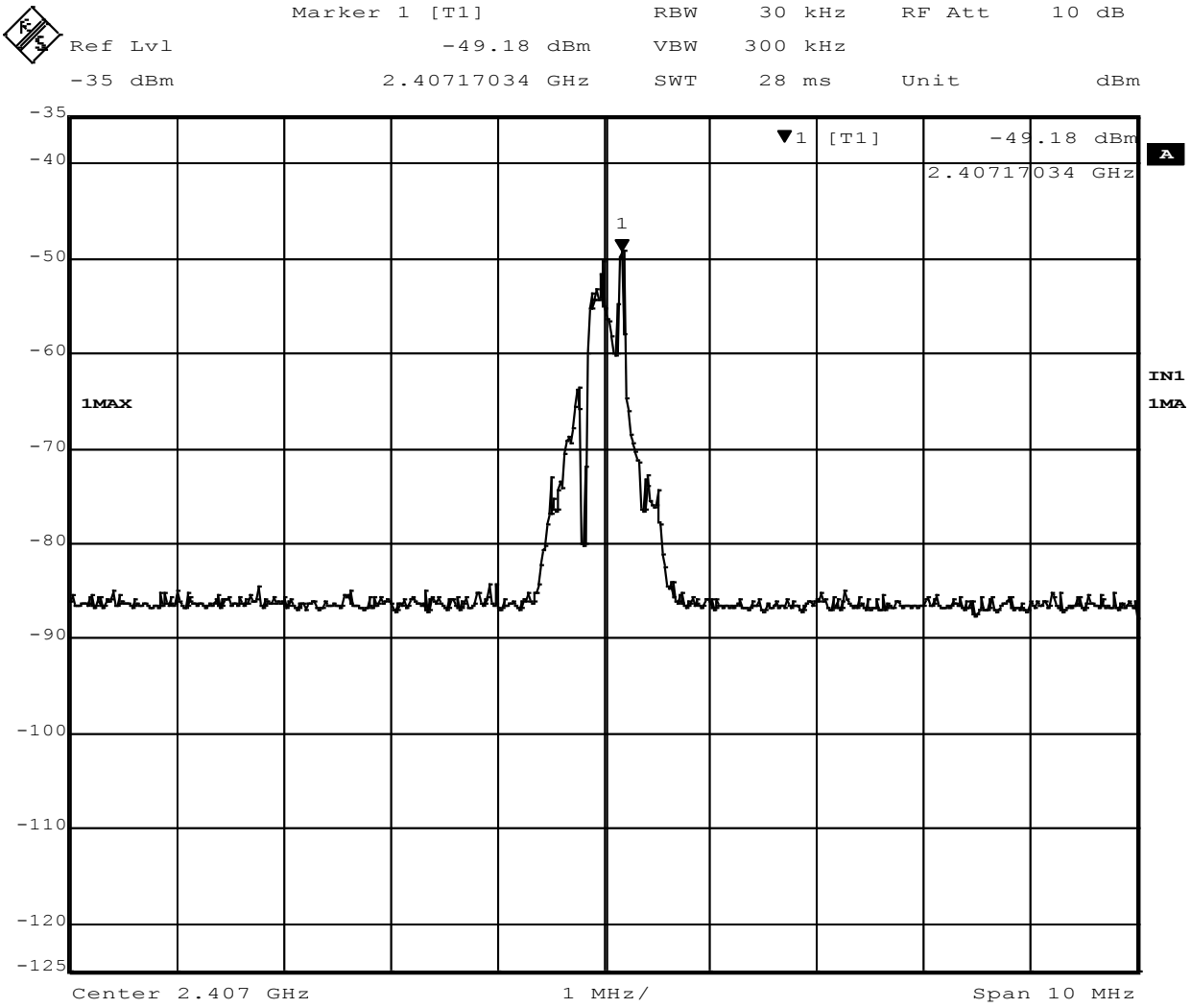

Figure 13 - Band-edge Measurement, Low Channel, Fundamental

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

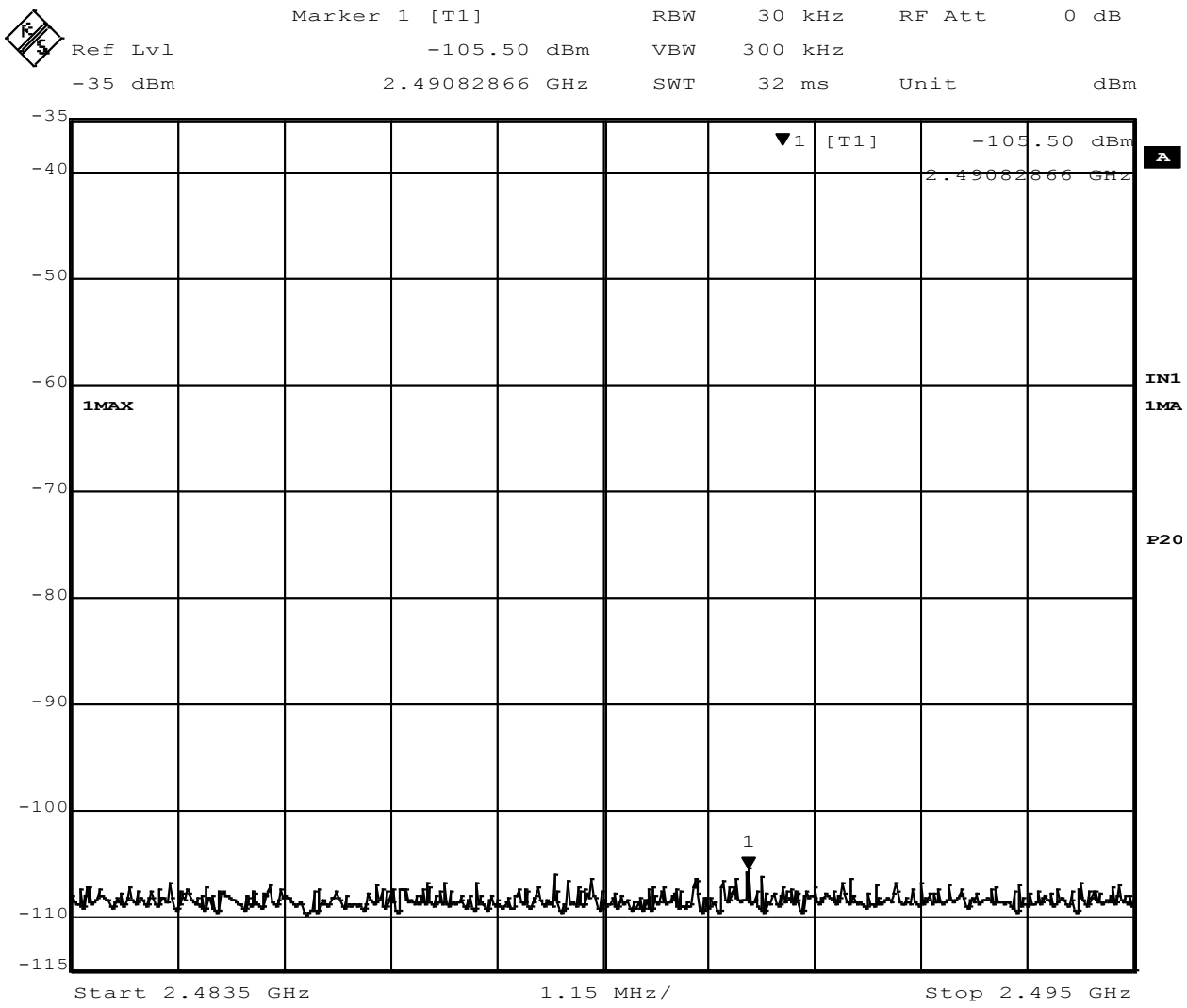

Figure 14 - Band-edge Measurement, Restricted Frequency

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

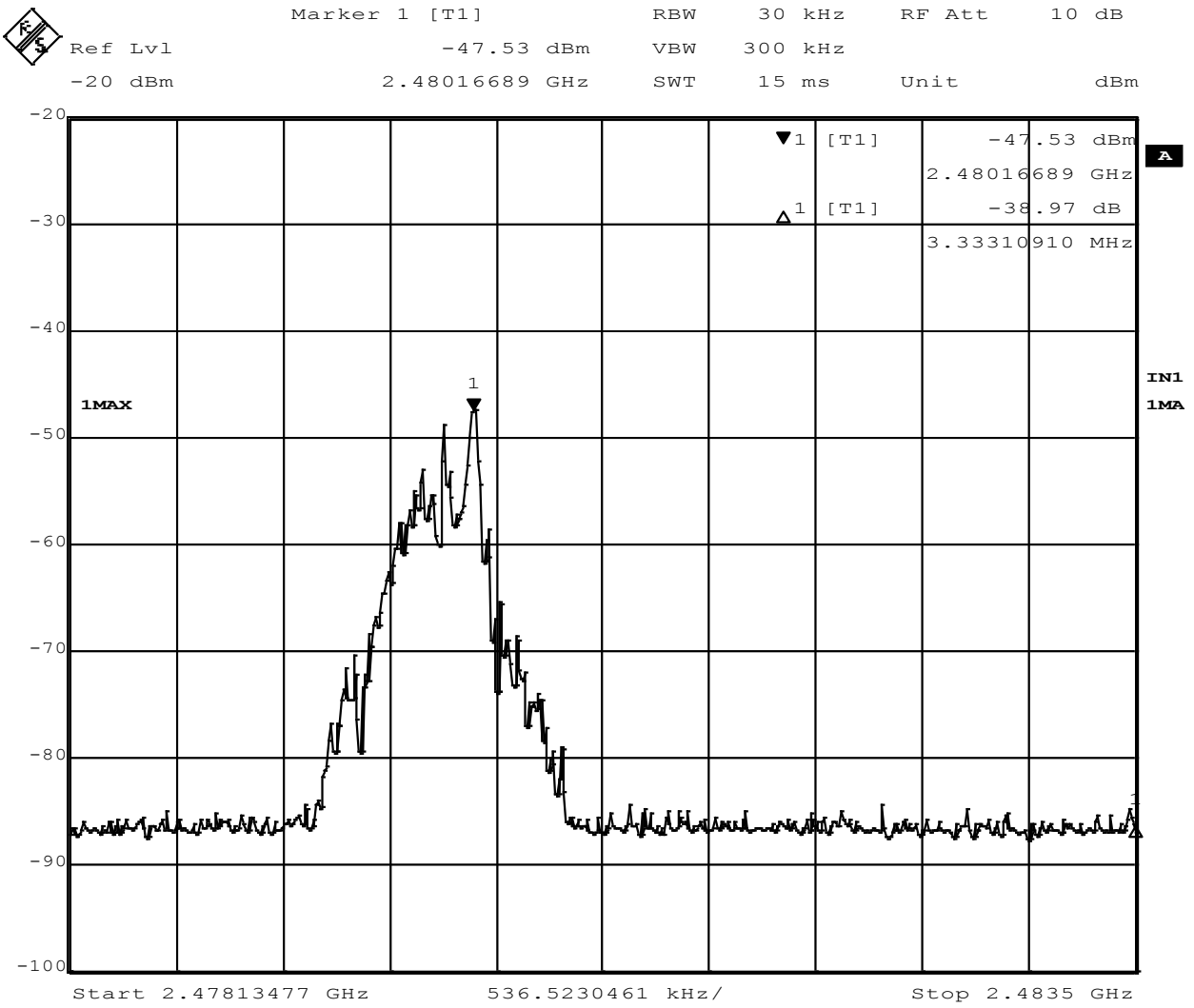

Figure 15 - Band-edge Measurement, Fundamental

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

4.5 *Conducted AC Mains Emissions*

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

See photographs in Appendix A

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	Silhouette	MODE	Transmit (middle channel used)
INPUT POWER	18 VDC	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	30 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

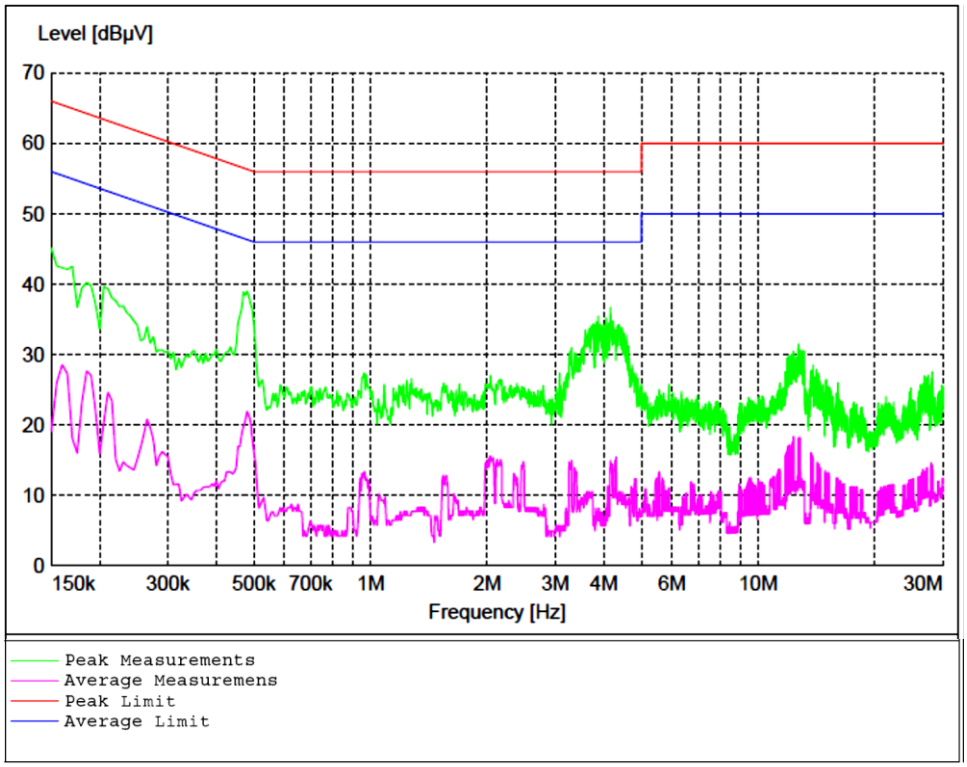

Figure 16 - Conducted Emissions Plot

All measurements were found to be at least 20dB below the applicable limit.

Appendix A: Test Photos

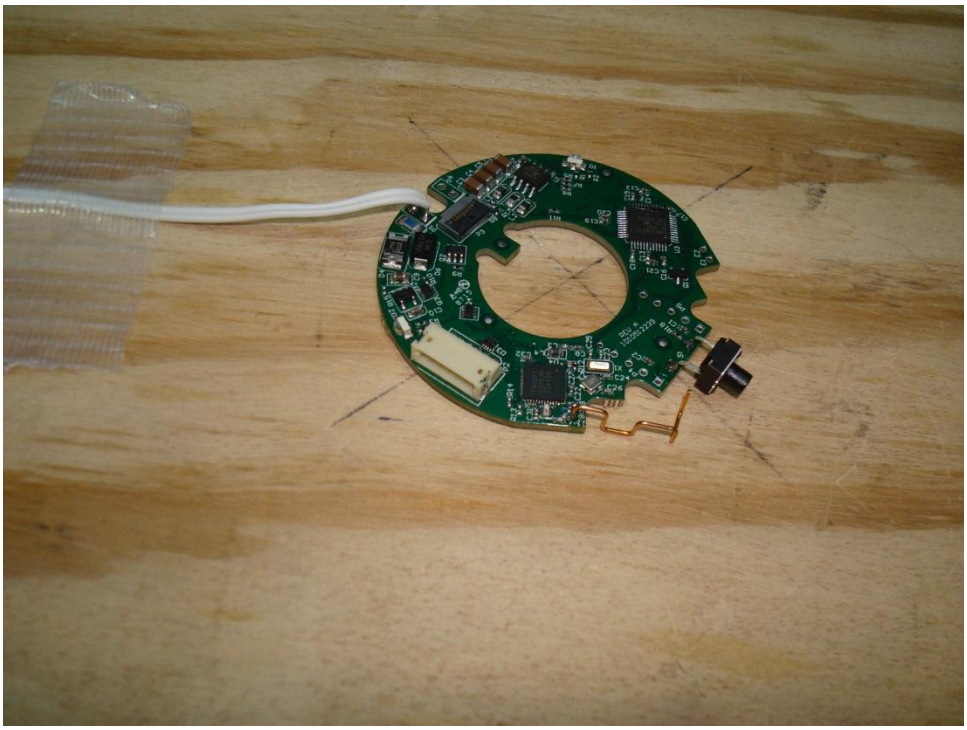

Figure 17 – Radiated Emissions Test Setup, Horizontal

Figure 18 - Radiated Emissions Test Setup, Vertical

Figure 19 - Radiated Emissions Test Setup, Horizontal

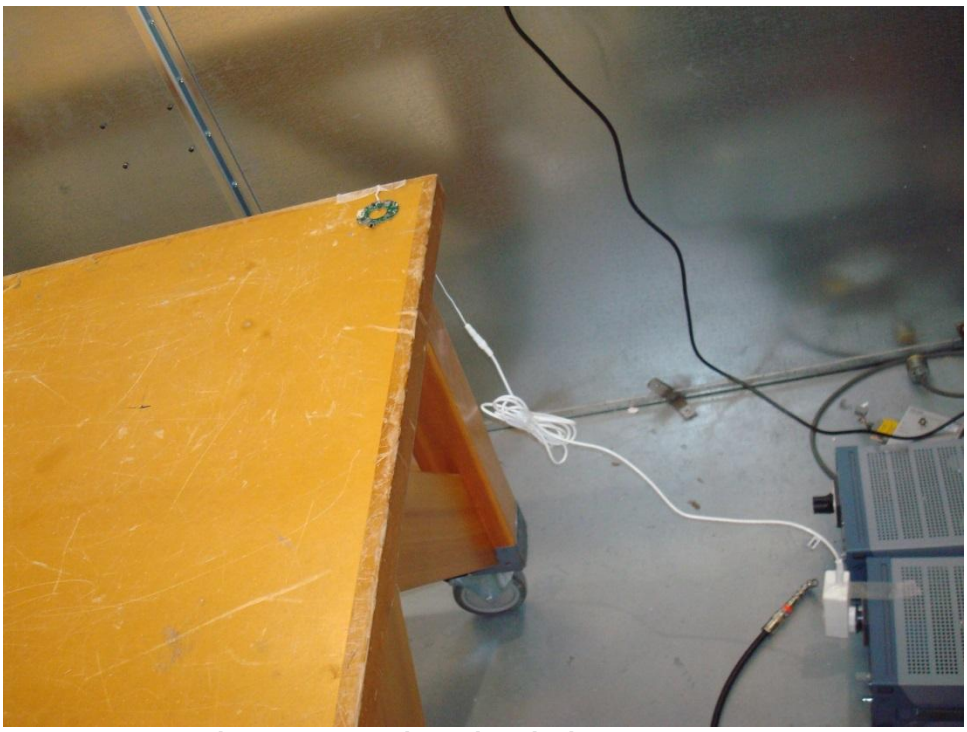

Figure 20 - Conducted Emissions Test Setup

Figure 21 – Power Supply Used for all Tests

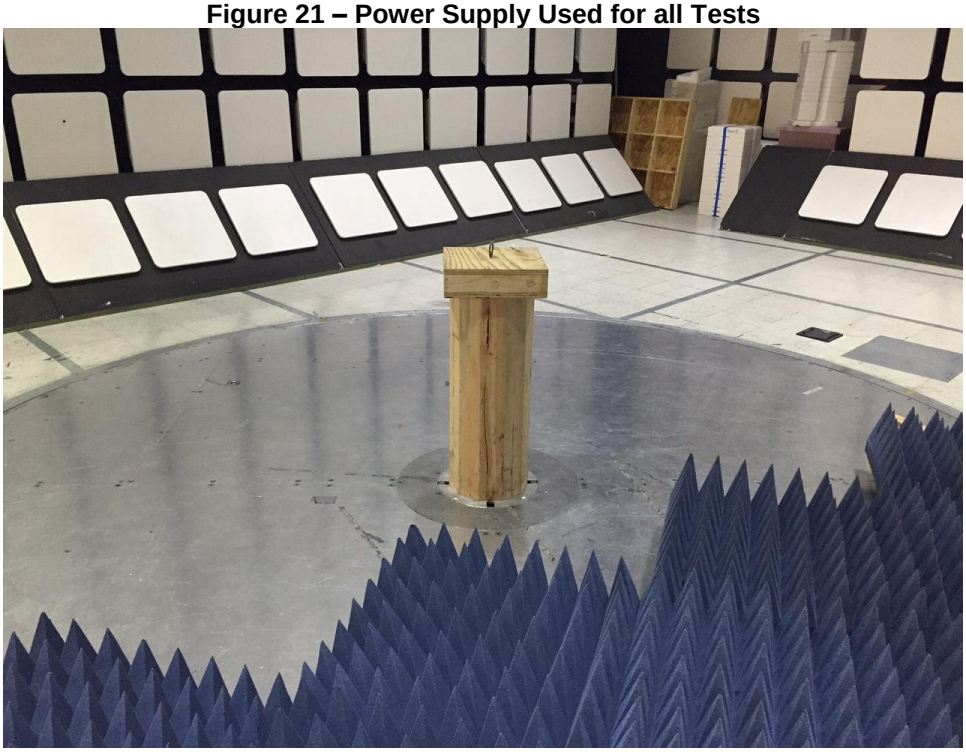

Figure 22 - Radiated Emissions - Receive Mode Model with Absorber >1GHz

Appendix B: 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

Appendix C: Table of Figures

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Table Number **Page**