



MEASUREMENT AND TEST REPORT

VERSION 1.0

Report Prepared for: Exegin Technologies Limited
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Canada

Equipment Under Test (EUT): Q58-3
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IC Certification number: 7163A-58Q3

FCC Rule Part(s): Part 15B, 15C
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Tested by: Island Compliance Services Inc.
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Note: This test report has been prepared for the Applicant and device described herein. It may not be duplicated or used in part without prior written consent from Island Compliance Services Inc.

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Revision History

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2 SUMMARY OF TEST RESULTS

The equipment under test was found to comply with the test standards and criteria outlined herein.

Test Description	Reference Specification FCC	Reference Specification Industry Canada	Result	Comment
RF Peak Power Output	FCC Subpart C 15.247(b) (3)	RSS 210 Issue 8 A8.4(4)	Complies	
Occupied Bandwidth 6dB Bandwidth	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 8 A8.2(a)	Complies	
Occupied Bandwidth 20dB Bandwidth	N/A	RSS-Gen Issue 3 4.6.1	Complies	
Power Spectral Density	FCC Subpart C 15.247(e)	RSS 210 Issue 8 A8.2(b)	Complies	
Conducted Spurious Emissions	FCC Subpart C 15.247(d)	RSS 210 Issue 8 A8.5	Complies	
Conducted Spurious Emissions Band Edge	FCC Subpart C 15.247(d)	RSS 210 Issue 8 A8.5	Complies	
Radiated Spurious Emissions Band Edge	FCC Subpart C 15.209(a) 15.205(a)	RSS 210 Issue 8 2.5, A8.5	Complies	
Radiated Spurious Emissions (TX and RX)	FCC Subpart C 15.247, 15.205 FCC Subpart B 15.109	RSS 210 Issue 8 2.5, A8.5 RSS Gen Issue 3 Section 4.10 and section 6 for RX ICES-003 Issue 4	Complies	
Power line Conducted Emission	FCC Subpart C 15.207 (a) FCC Subpart B 15.107	RSS-Gen Issue 3 7.2.4 Ices-003 Issue 4	Complies	

2.1 ENVIRONMENTAL CONDITIONS

Description	Reading
Test Dates: 20/12/2013-9/1/2014	
Indoor Temperature	18°C - 22°C
Indoor Humidity	40% - 55%
Outdoor Temperature	0°C -10°C
Outdoor Humidity	40% - 85%

2.2 STANDARD TEST CONDITIONS AND ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedures were observed during the testing:

CFR 47, FCC rules Part 15 subpart C, ANSI C63.4 (2009), DTS procedures KDB 558074, IC standards RSS-GEN and RSS0210. ANSI C63.4-2003 or later, was used for all test procedures as required by RSS-Gen I3 2010, Section 4.1. Deviations, modification or clarifications (if any) to above mentioned documents are described herein.

Measurement results, unless otherwise noted, are worst-case measurements.

3 GENERAL EQUIPMENT SPECIFICATIONS

Item	Description
Manufacturer	Exegin Technologies Limited
Applicant	Exegin Technologies Limited
Model Number(s)	Q58-3
Function	Zigbee interface module
Power Supply Input	3.3 VDC
Power Output	Transmitter 1: 22.3 dBm (cond.) Transmitter 2: 22.3 dBm (cond.)
Antenna Gain/Type	TE Connectivity. P/N 2118059-1 2300–3800 MHz Single Band Antenna, 4 dBi
Channel Spacing	Transmitter 1: 5 MHz Transmitter 2: 5 MHz
Frequency Range	Transmitter 1: 2405 MHz-2480 MHz Transmitter 2: 2405 MHz-2480 MHz
Modulation	Transmitter 1: OQPSK Transmitter 2: OQPSK

3.1 AUXILIARY EQUIPMENT

Equipment	Description
Laptop	HP EliteBook 2170p
Development board	Intel Clanton/Quark development platform

3.2 NOTES

The RF module contains two identical 2.4 GHz transmitter implementations. RF conducted measurements were undertaken on one transmitter only and radiated measurements were made on both transmitters, as per guidance from the TCB.

3.3 MODIFICATIONS REQUIRED

Transmit power on the highest channel (26) was reduced to '-10' (firmware setting) to bring radiated upper band edge measurements within limits. All other measurements were made at full power ('+3' firmware setting) unless otherwise stated. The power settings are restricted in firmware to constrain the end user to those which conform to limits.

4 RF PEAK POWER OUTPUT

Test Name	Reference Specification	Result	Notes
RF Peak Power Output	15.247(b)(3) A8.4 (4)	Complies	

4.1 TEST METHOD

RSS-Gen Issue 3 4.8 and FCC Publication 558074, Section 15.247(b) – 2. Set the RBW \geq EBW. Set VBW $\geq 3 \times$ RBW. Set span = zero. Sweep time = auto couple. Detector = peak. Trace mode = max hold. Allow trace to fully stabilize. Use peak marker function to determine the peak amplitude level within the fundamental emission.

4.2 DATA

Channel	Tuned Frequency (GHz)	Peak Power (dBm)	CF (dB)	Corrected (dBm)	Limit (dBm)
Low (11)	2.405	12.3	+10	22.3	30
Mid (18)	2.440	12.2	+10	22.2	30
High (26)	2.480	-11.3	+0	-11.3	30

4.3 PLOT(s)

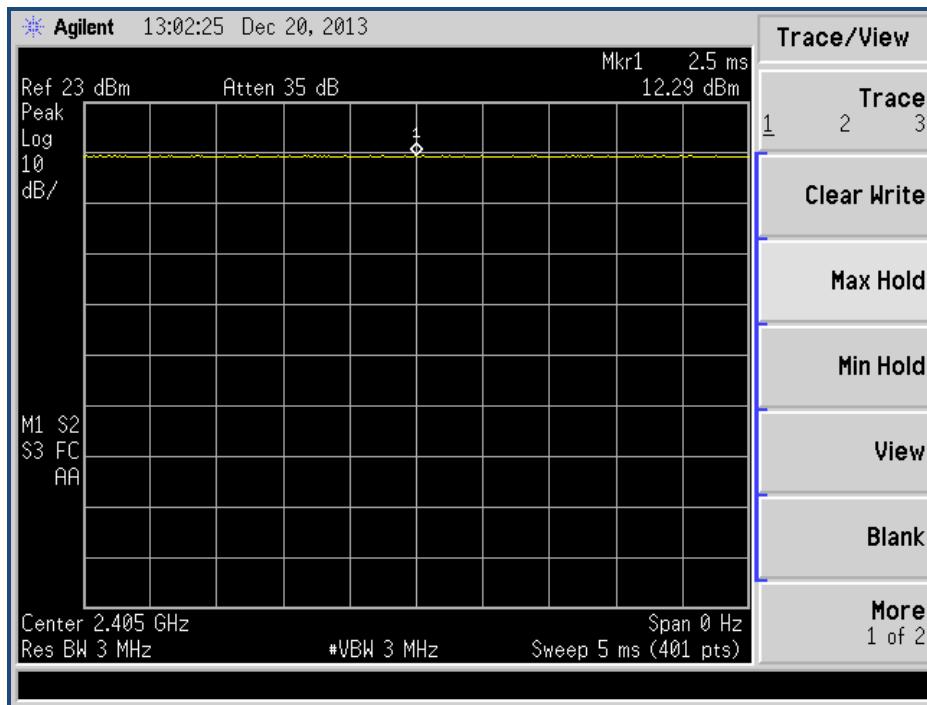


FIGURE 1 - PEAK OUTPUT POWER, LOW CHANNEL

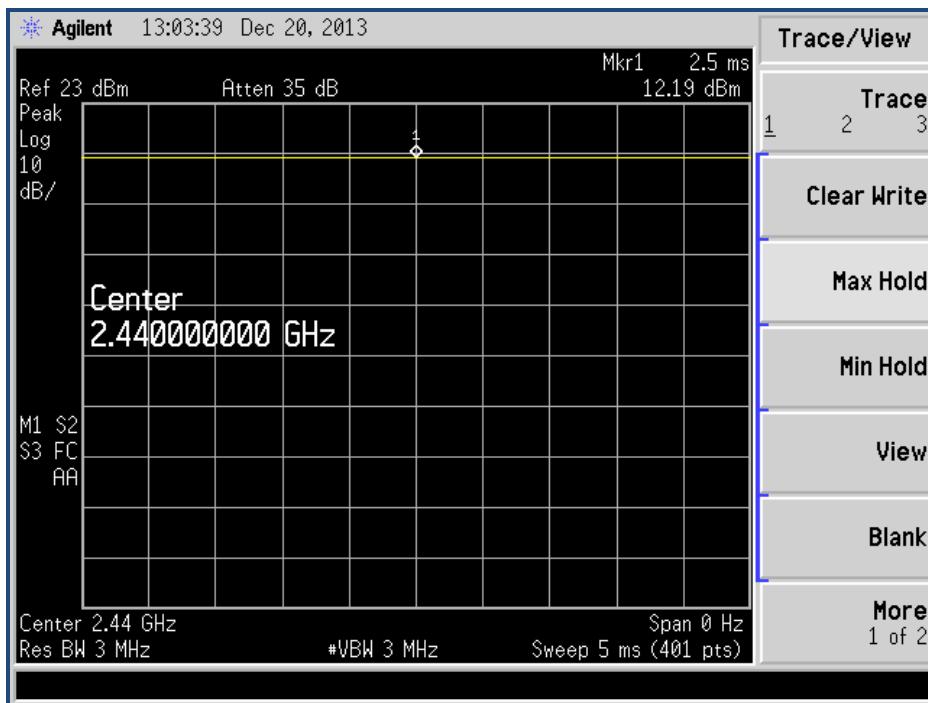


FIGURE 2 - PEAK POWER, MID CHANNEL

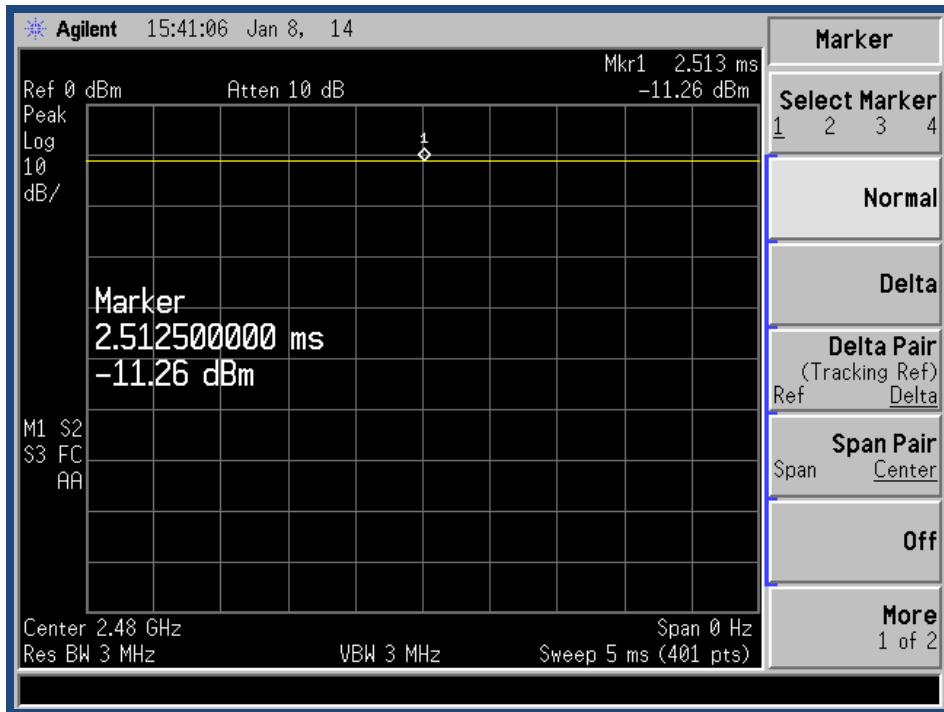


FIGURE 3 - PEAK POWER, HIGH CHANNEL

5 OCCUPIED BANDWIDTH

Test Description	Reference Specification	Result	Notes
Occupied Bandwidth 6dB and 20dB	15.247(a) A8.2(a) 4.6.1	Complies	

5.1 TEST METHOD

RSS-Gen Issue 4.6.1 and FCC Publication 558074, Section 15.247(a) (2) – Emission Bandwidth (EBW) -
 Method: Set RBW=1-5% of the emission bandwidth (EBW), VBW= \geq 3 x RBW, Detector=Peak, Trace mode=max hold, Sweep=auto couple, allow trace to stabilize. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5%.

Test performed with modulation ON and 100% duty cycle, at maximum power.

5.2 DATA

Channel	Frequency (GHz)	20dB Bandwidth (MHz)	6dB Bandwidth (MHz)
Low (11)	2.405	2.42	1.57
Mid (18)	2.440	2.42	1.53
High (26)	2.480	2.51	1.57

5.3 PLOTS

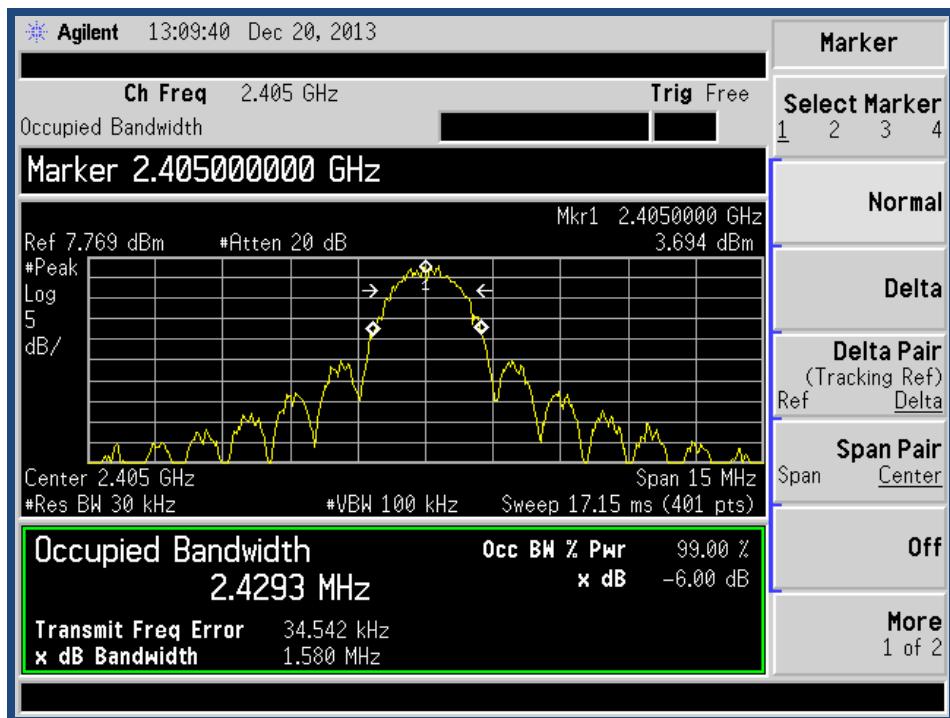


FIGURE 4 - LOW CHANNEL OCCUPIED BANDWIDTH

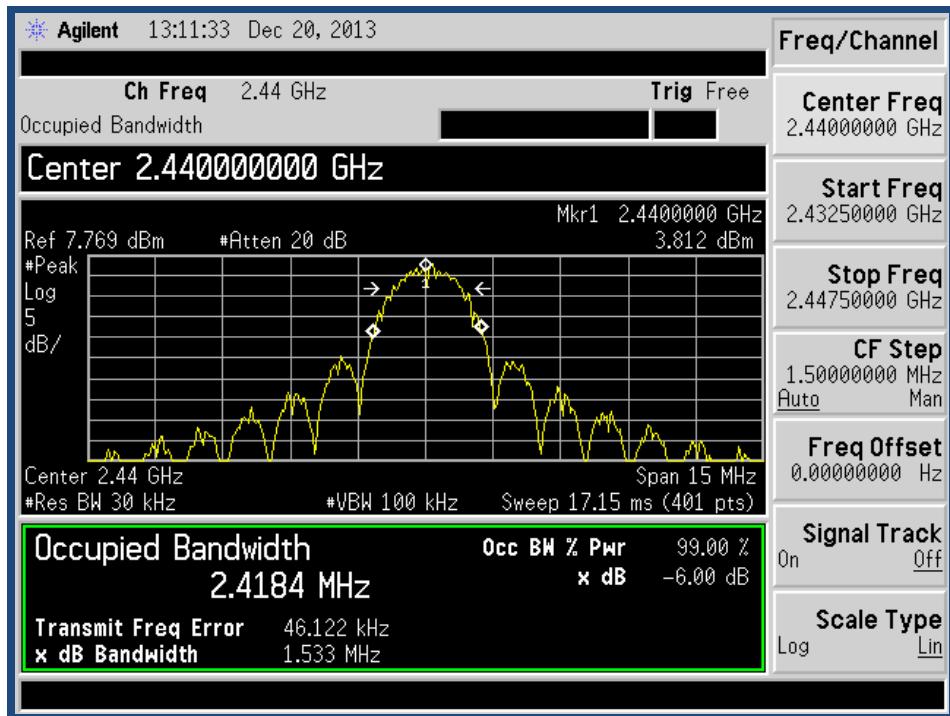


FIGURE 5 – MID CHANNEL OCCUPIED BANDWIDTH

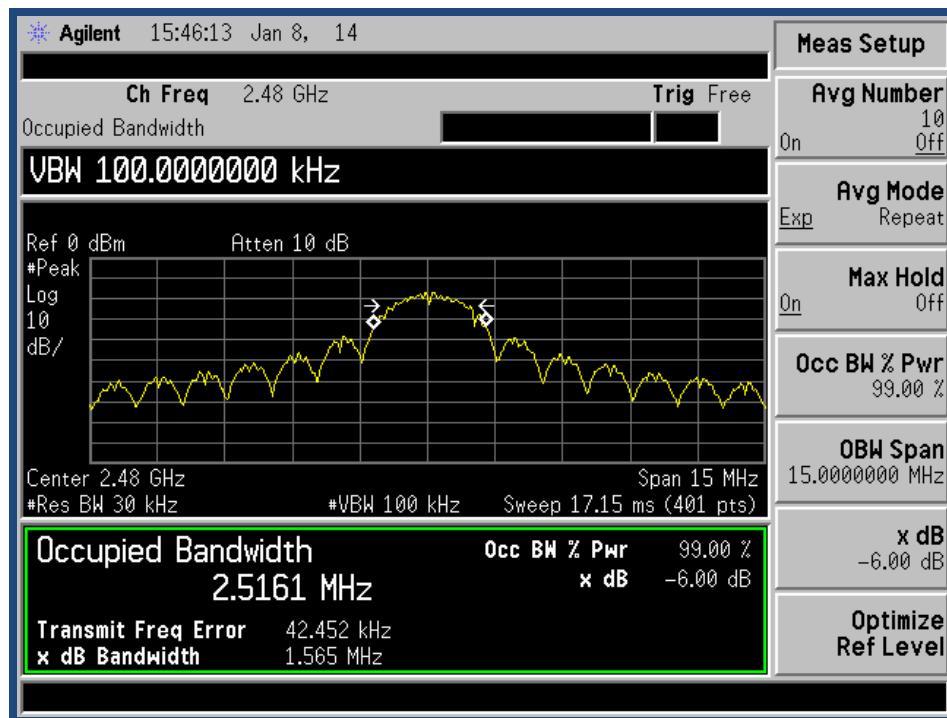


FIGURE 6 - HIGH CHANNEL OCCUPIED BANDWIDTH

6 POWER SPECTRAL DENSITY

Test Description	Reference Specification	Result	Notes
Power Spectral Density	15.247(e) A8.2 (b)	Complies	maximum measured power spectral density: -18.3 dBm

6.1 TEST METHOD

RSS-210 Issue 8 and FCC Publication 558074, Section 15.247(e) - Maximum Power Spectral Density Level in the Fundamental Emission (PSD) – Method: RBW = 100 kHz, VBW \geq 300 kHz, Span=5-30 % greater than the EBW, Detector= peak, Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize. The peak marker function is used to determine the maximum power level in any 100 kHz band segment within the fundamental EBW. The observed power level is scaled to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = $10\log(3\text{ kHz}/100\text{ kHz}) = -15.2\text{ dB}$.

6.2 LIMITS

15.247(e) specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission.

6.3 DATA

Channel	Frequency (GHz)	Pk Power (dBm)	CF (dB)	BWCF	PSD (dBm)
Low (11)	2.405	-3.1	0	-15.2	-18.3
Mid (18)	2.440	-3.1	0	-15.2	-18.3
High (26)	2.480	-13.6	0	-15.2	-28.8

Note: All final reported values are corrected values

6.4 PLOTS

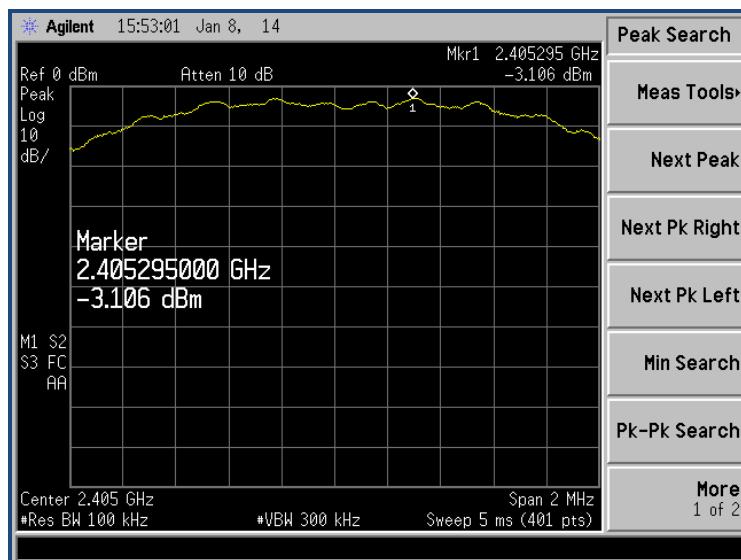


FIGURE 7 – PEAK POWER (LOW CHANNEL)

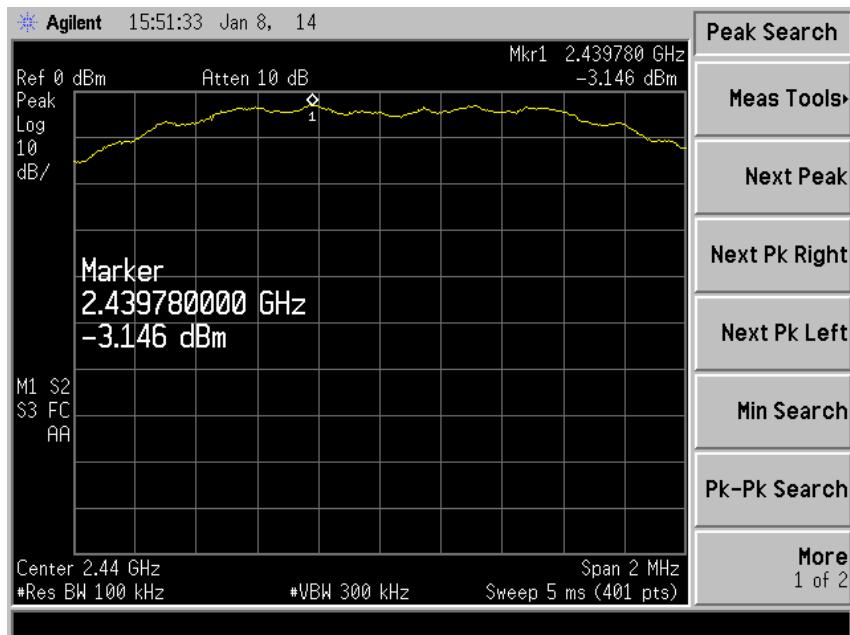


FIGURE 8 - PEAK POWER (MID CHANNEL)

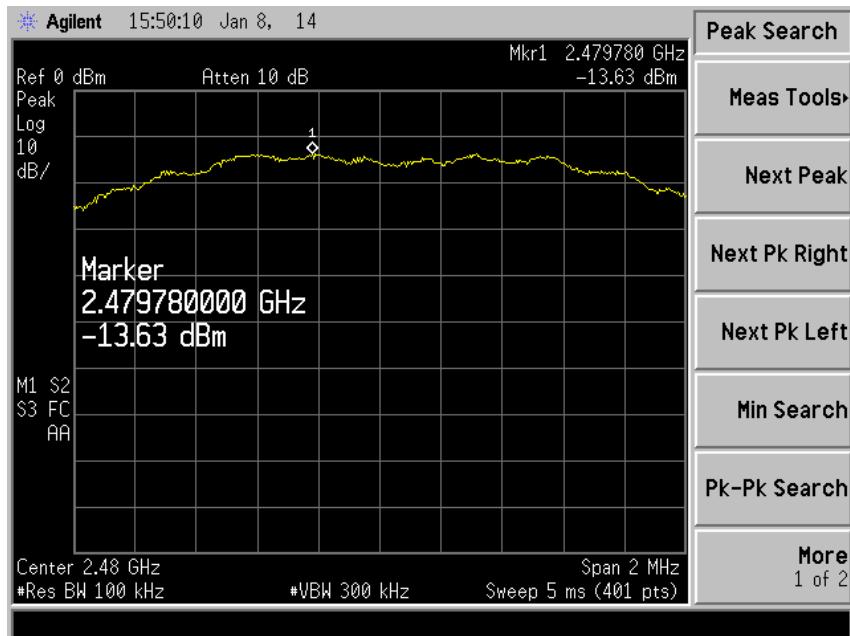


FIGURE 9 - PEAK POWER (HIGH CHANNEL)

7 CONDUCTED SPURIOUS EMISSIONS

Test Description	Reference Specification	Result	Notes
Conducted Spurious Emissions	15.247(c) A8.5	Complies	

7.1 TEST METHOD

RF conducted as per FCC Publication 558074. RSS-210 Issue 8 A8.5.

7.2 LIMITS

15.247(c) In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(1) (see 15.205(c)).

7.3 DATA

		Harmonics (dBc)						
Channel	Fund (dBm)	2nd	3rd	4th	5th	Limit (dBc)	Margin (dB)	Result
Low (11)	-10.1	56.1	46.8	53.5	-	20	26.8	Complies
Mid (18)	-8.4	-	45.6	53.1	54.4	20	25.6	Complies
High (26)	-16.6	47.8	50.9	-	-	20	27.8	Complies

Note: worst case harmonic: 45.6 dBc

7.4 NOTES

N/A

7.5 PLOTS

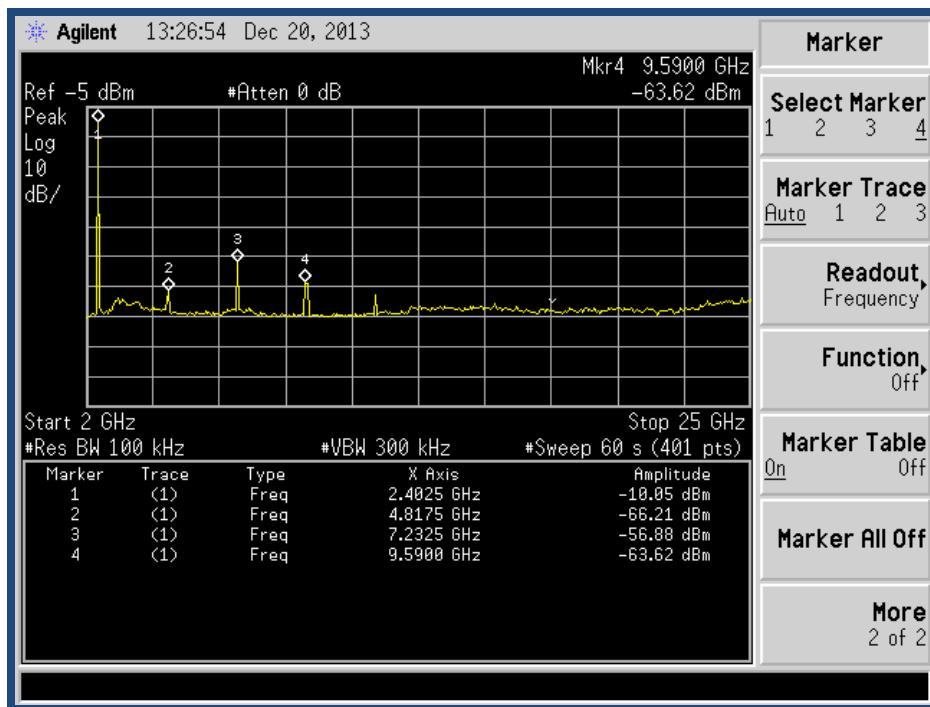


FIGURE 10 – LOW CHANNEL SPURIOUS, 2-25GHZ

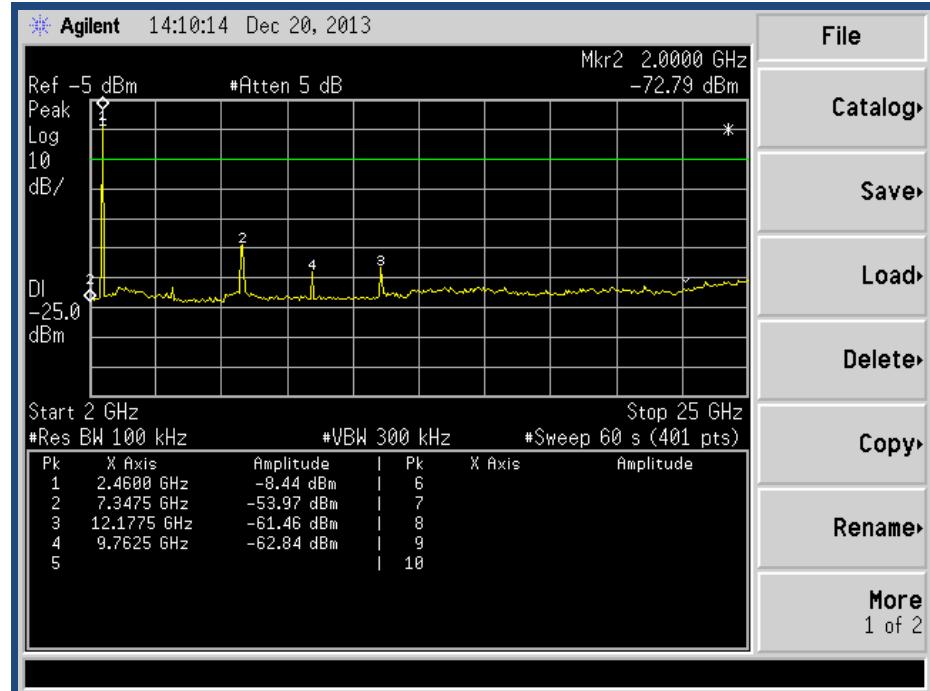


FIGURE 11 - MID CHANNEL SPURIOUS 2-25GHZ

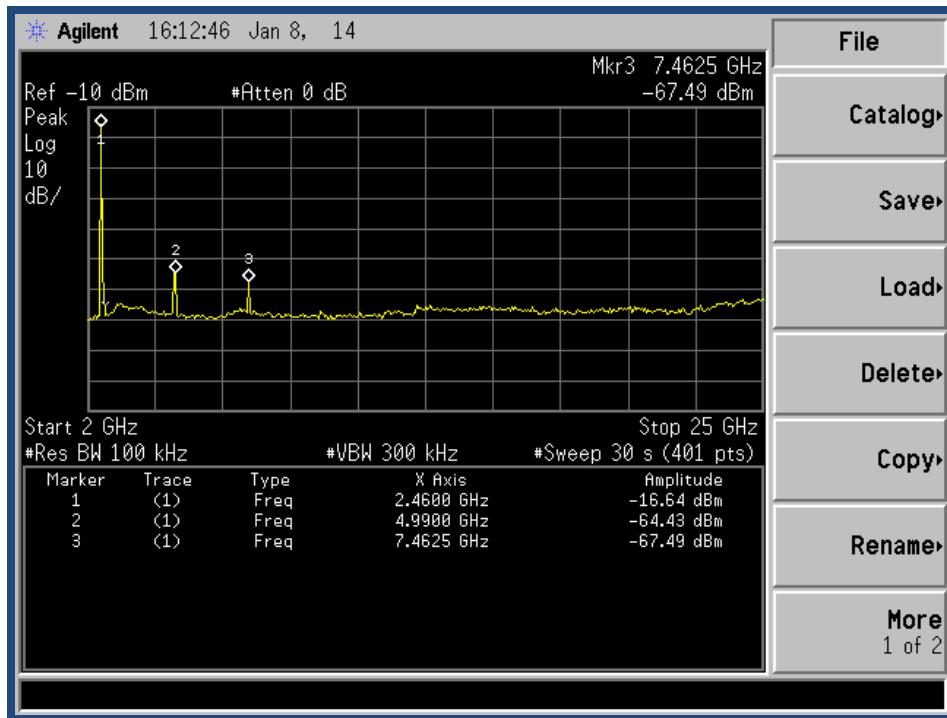


FIGURE 12 - HIGH CHANNEL SPURIOUS 2-25GHZ

8 CONDUCTED SPURIOUS EMISSIONS BANDEDGE

Test Description	Reference Specification	Limit	Result	Notes
Band Edge Compliance	15.247(d) A8.1	>20dBc, 74dBuV/m pk	Complies	

8.1 TEST METHOD

Using the marker-delta method an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and FCC Rules for the frequency being measured was undertaken. A spectrum analyzer span was chosen that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. The delta measurement is then subtracted from the field strengths measured. The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.

8.2 LIMITS

15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

8.3 DATA (TRANSMITTER 0)

An in-band field strength measurement taken at 3m, with RBW = 1MHz, VBW = 1MHz and in peak detection mode resulted in a corrected peak fundamental measurement of 117.3 dBuV/m at 2405 MHz and 101.5 dBuV/m at 2480 MHz.

Using the marker-delta method, band edge emissions were well below the 74dBuV/m peak limits for restricted bands.

Spurious Emission Frequency (MHz)	Pk Fundamental Radiated Ampl. (dBuV)	Band Edge Emission Level (dBc)	Band Edge Corrected Value (dBuV/m)	Limit	Margin (dB)	Result
2390	117.3	56.5	60.8	>20dBc, 74 dBuV/m pk	13.5	Complies
2483.9	101.5	36.2	65.3	>20dBc, 74 dBuV/m pk	8.7	Complies

8.4 NOTES

N/A

8.5 PLOTS

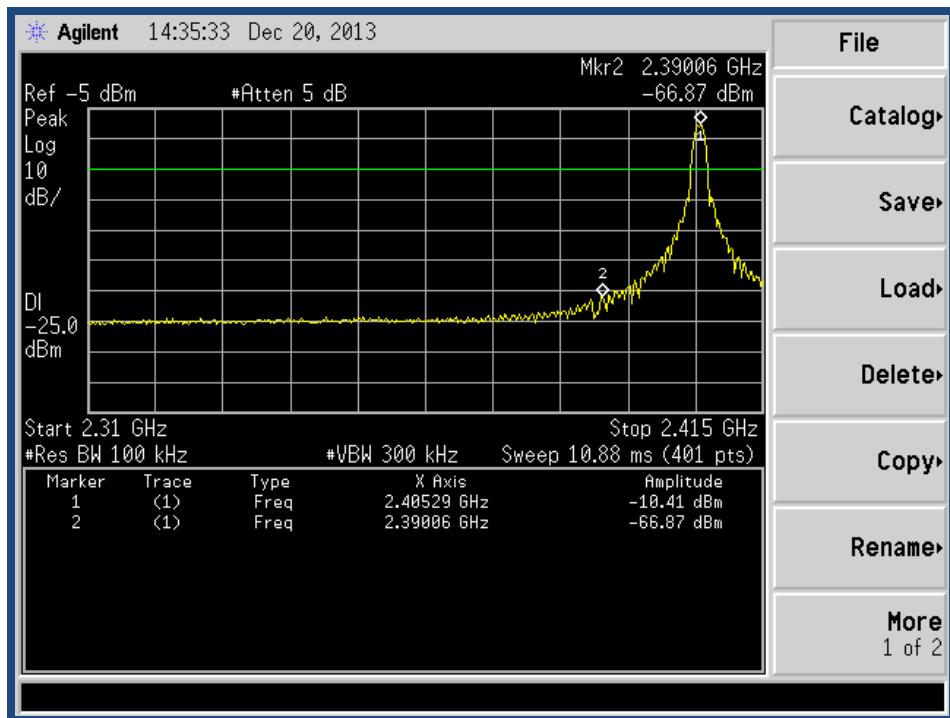


FIGURE 13 – CONDUCTED BAND EDGE (2310-2390)

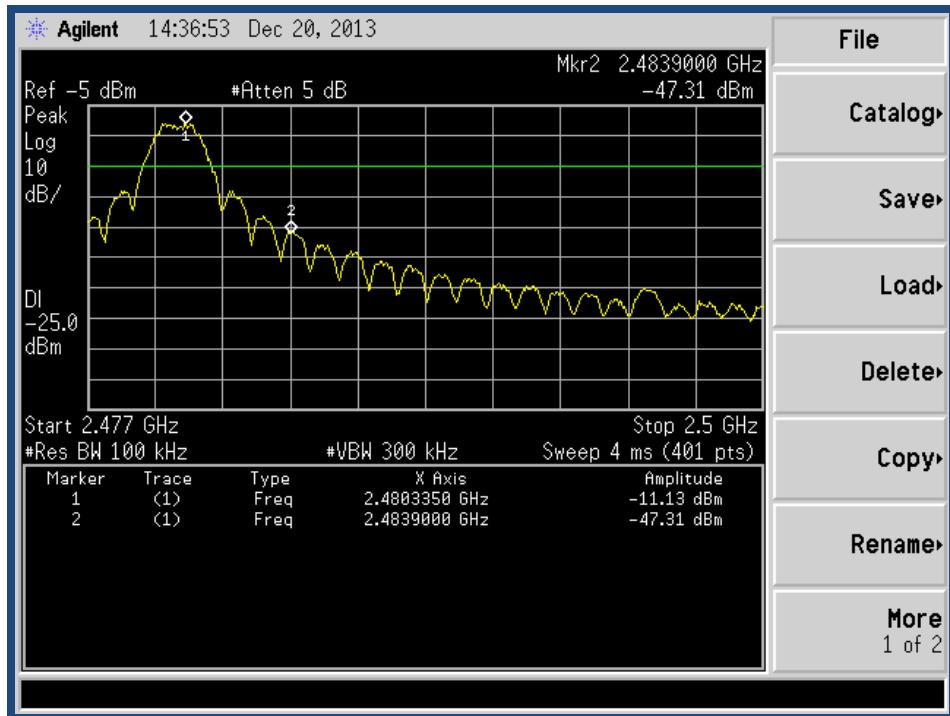


FIGURE 14 – CONDUCTED UPPER BANDEDGE (2477 - 2500)

8.6 DATA (TRANSMITTER 1)

An in-band field strength measurement taken at 3m, with RBW = 1MHz, VBW = 1MHz and in peak detection mode resulted in a corrected peak fundamental measurement of 118.8 dBuV/m at 2405 MHz and 107.5 dBuV/m at 2480 MHz.

Band edge emissions were well below the 74dBuV/m peak limits for restricted bands.

Spurious Emission Frequency (MHz)	Pk Fundamental Radiated Ampl. (dBuV)	Band Edge Emission Level (dBc)	Band Edge Corrected Value (dBuV/m)	Limit	Margin (dB)	Result
2390	118.8	56.5	62.3	>20dBc, 74 dBuV/m pk	11.7	Complies
2483.9	107.5	36.2	71.3	>20dBc, 74 dBuV/m pk	2.7	Complies

8.7 NOTES

N/A

9 RADIATED SPURIOUS EMISSIONS BAND EDGE

9.1 TEST PROCEDURE

The EUT is placed on a non-conducive turntable on the 3m OATS. An in-band field strength measurement of the fundamental emissions using RBW and detector function for the frequency being measured. Repeated with average detector. Spectrum analyzer span is chosen that encompasses both the peak and the fundamental emissions and the band edge emissions under investigation. Analyzer is set, RBW to 1% of total span (never less than 30kHz) with a video bandwidth equal to or greater than the RBW. Peak levels of the fundamental emissions and the relevant band edge emissions are recorded. Stored trace is observed and amplitude delta between the peak of fundamental and band edge emissions are measured. Delta is subtracted from field strengths, these measurements are used to determine compliance.

9.2 SUMMARY OF TEST RESULTS

Test Description	Reference Specification	Result	Notes
Radiated Spurious Emissions Band Edge	FCC Subpart C 15.209(a) 15.205(a) RSS 210 Issue 8 2.5, A8.5	Complies	

9.2.1 SUMMARY OF 15.205 LIMITS

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
1 ⁰ .495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

FIGURE 15 - RESTRICTED BANDS

9.2.2 NOTES

For low channel measurements, both transmitters were enabled and set to full power.

Data (Transmitter 0)

Spurious Emission Frequency (MHz)	Reading (dBuV)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
2405 (Fund)	115.2	121.2	-	-	Complies
2390.0 (pk)	57.7	63.7	74	10.3	Complies
2390.0 (avg)	44.4	50.4	54	3.6	Complies
2480 (Fund)	95.2	101.5	-	-	Complies
2484.0 (pk)	59.7	66.0	74	8.0	Complies
2484.0 (avg)	46.6	52.9	54	1.1	Complies

9.3 DATA (TRANSMITTER 1)

Spurious Emission Frequency (MHz)	Reading (dBuV)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result
2405 (Fund)	115.2	121.2	-	-	Complies
2390.0 (pk)	57.7	63.7	74	10.3	Complies
2390.0 (avg)	44.4	50.4	54	3.6	Complies
2480 (Fund)	101.2	107.5	-	-	Complies
2484.0 (pk)	64.1	70.4	74	3.4	Complies
2484.0 (avg)	44.6	50.9	54	3.1	Complies

9.4 PLOTS TRANSMITTER 0

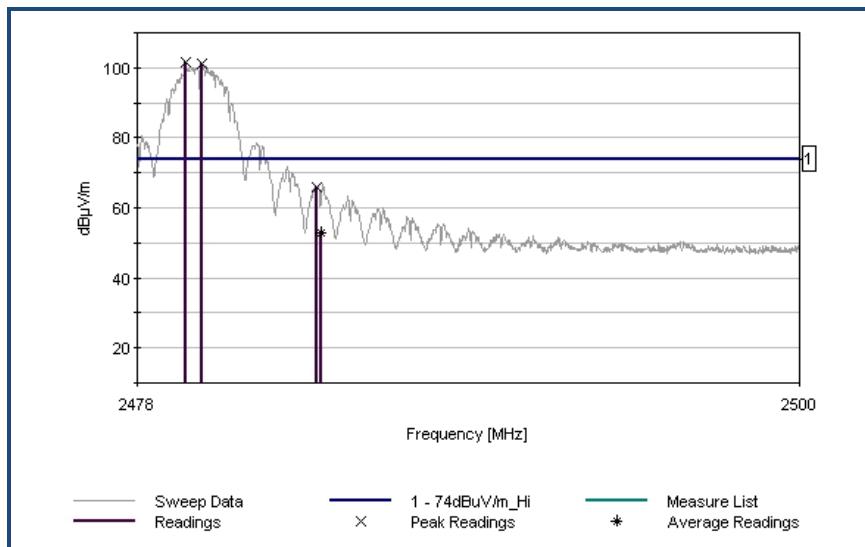


FIGURE 16 - UPPER BAND EDGE – HI CHANNEL

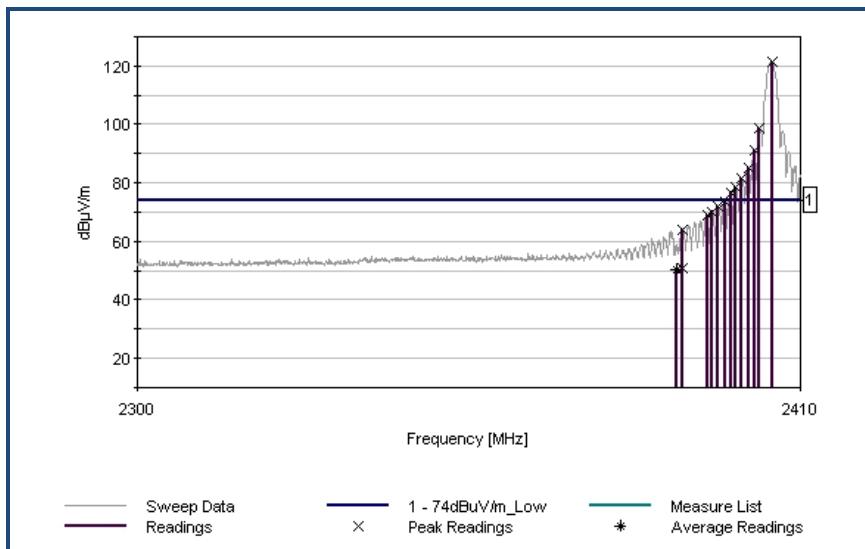


FIGURE 17 - LOWER BAND EDGE - LOW CHANNEL

9.5 PLOTS TRANSMITTER 1

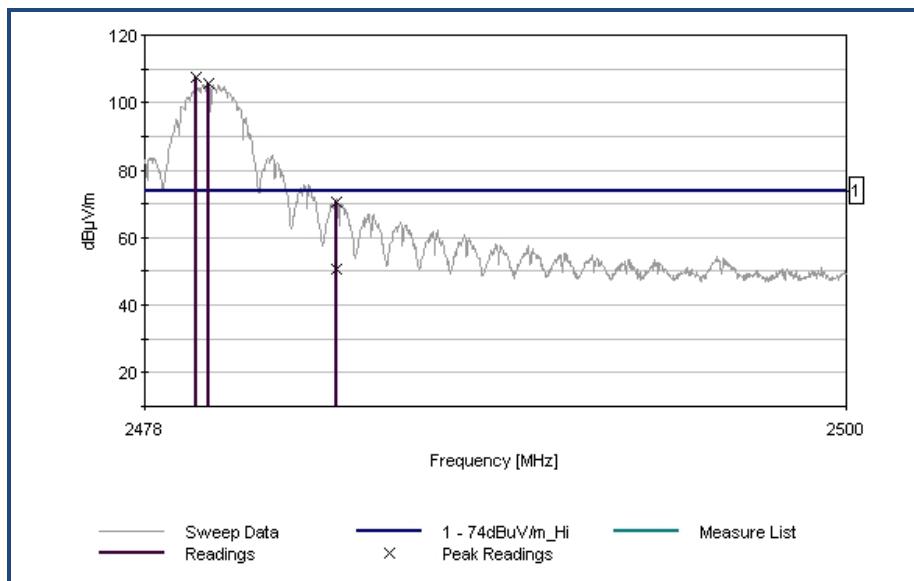


FIGURE 18 - UPPER BAND EDGE – HI CHANNEL

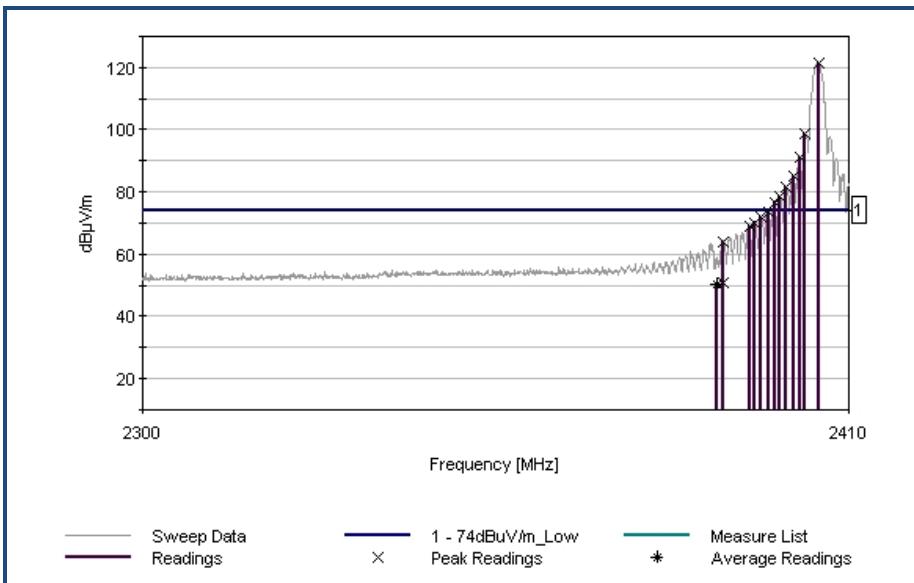


FIGURE 19 - LOWER BAND EDGE - LOW CHANNEL

10 RADIATED SPURIOUS EMISSIONS

10.1 TEST PROCEDURE

The EUT is placed on a non-conductive turntable on the 3m OATS. Exploratory measurements are made using a suitable antenna positioned within 1m of the EUT. The EUT antenna was manipulated through typical positions during exploratory testing to maximize emission levels. Maximizing procedure was performed on the six (6) highest emissions readings between the lowest RF frequency generated on the device (without going below 9 kHz) and the 10th harmonic of the highest fundamental frequency. Where applicable, a hybrid antenna, horn antenna and loop antenna were used to cover the relevant frequency bands. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

Notable emissions are maximized and final measurements are taken if the initial results are within 20 dB of the permissible limit. The EUT is placed at nonconductive plate at the turntable center. For each suspected frequency, the turntable is rotated 360 degrees and antenna is scanned from 1 to 4 m. This is repeated for both horizontal and vertical receive antenna polarizations. The emissions less than 20 dB below the permissible value are reported.

The measurement results are obtained as described below:

$$E [\mu\text{V}/\text{m}] = URX + ATOT$$

Where URX is receiver reading and ATOT is total correction factor including cable loss, antenna factor and preamplifier gain (ATOT = LCABLES + AF - GPREAMP).

10.2 SUMMARY OF TEST RESULTS

Test Description	Reference Specification	Result	Notes
Radiated Spurious Emissions	15.209(a) 15.205(a) A8.5	Complies	

Emissions were investigated from the lowest present clock frequency, to the 10th harmonic of the highest present clock frequency (up to 25 GHz). No other emissions were observed within 20 dB of the limits.

10.2.1 SUMMARY OF 15.205 LIMITS

See Figure 15 above.

10.3 DATA

No.	Freq (MHz)	Rdng (dBuV)	Corrected (dBuV/m)	Spec (dBuV/m)	Margin (dB)	Polarity	Antenna Height (cm)
1	396.305M	22.9	40.8 (QP)	46.0	-5.2	V	102
2	250.000M	24.0	37.7	46.0	-8.3	H	165
3	194.577M	23.2	34.6 (QP)	43.5	-8.9	H	301
4	72.710M	22.5	31.0	40.0	-9.0	H	125
5	275.018M	20.6	35.7	46	-10.3	H	103
6	168.780M	16.7	27.3	43.5	-16.2	H	109
7	264.0	Ambient	From aux equipment				

10.4 EMISSIONS PLOT

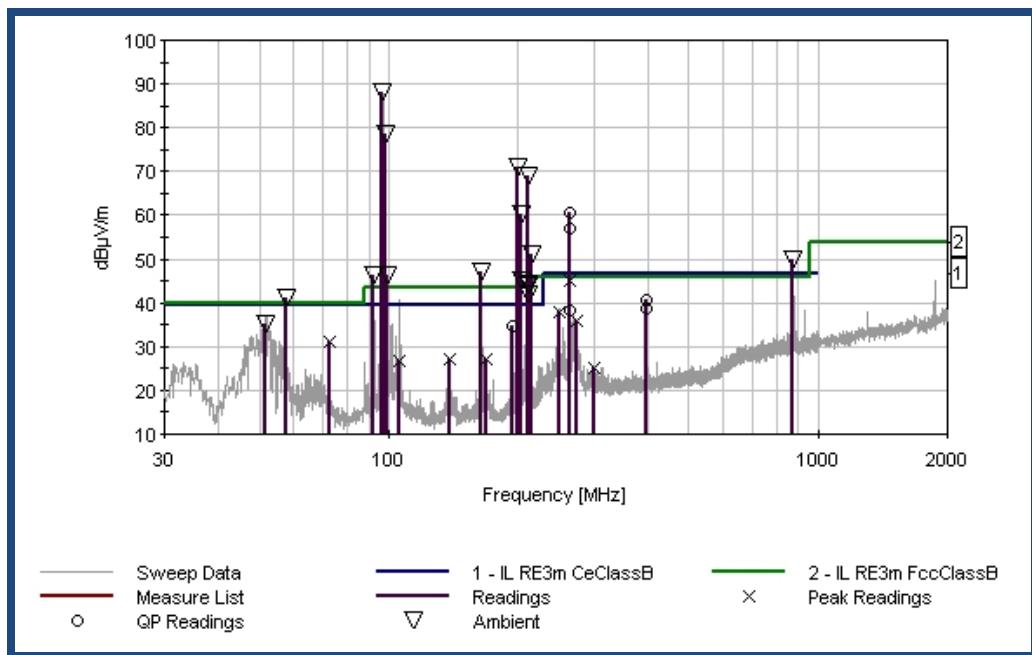


FIGURE 20 - SPURIOUS EMISSIONS PLOT

11 POWER LINE CONDUCTED EMISSIONS

11.1 TEST METHOD

For the duration of the conducted emissions test, the power cord of the EUT was connected to the main power outlet of the LISN. The LISN in turn is connected to an AC power source. Exploratory tests of the EUT are performed by varying modes and cable positioning. Maximizing procedures are performed on the highest emission readings from the EUT.

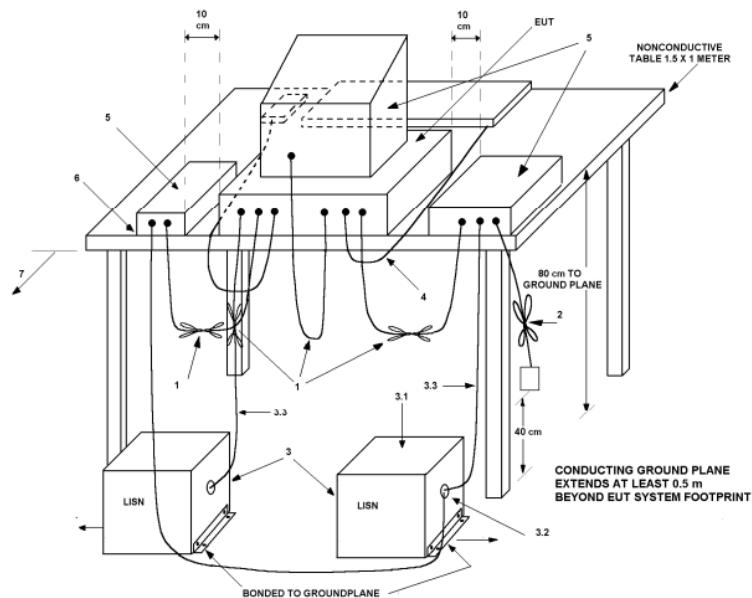


TABLE 1 - TEST ARRANGEMENT FOR CONDUCTED EMISSIONS OF TABLETOP EQUIPMENT

11.2 LIMITS AS PER 15.207

Frequency of emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

TABLE 2 – CONDUCTED EMISSION LIMITS

11.3 NOTES

During test both transmitters were operational

11.4 RESULTS PLOT 120V

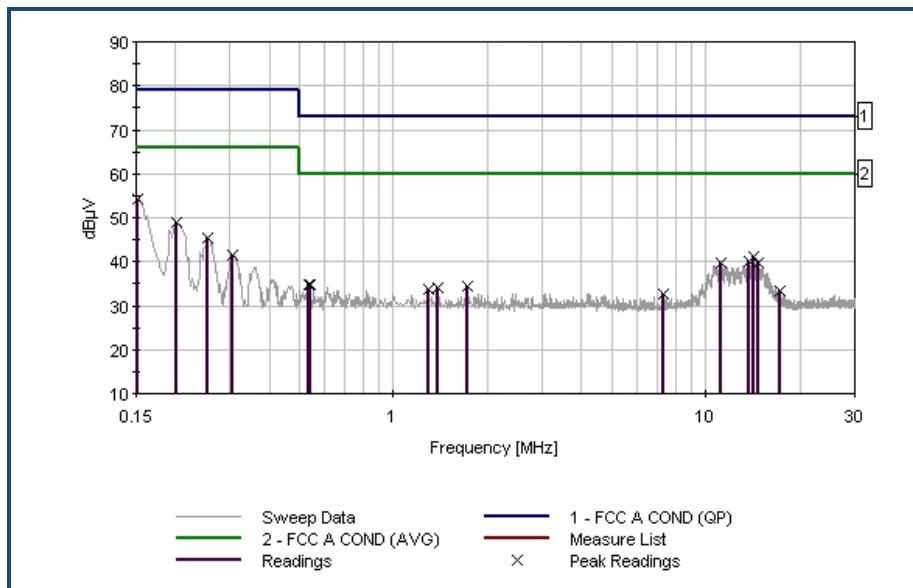


FIGURE 21 - CONDUCTED EMISSIONS PLOT – LINE

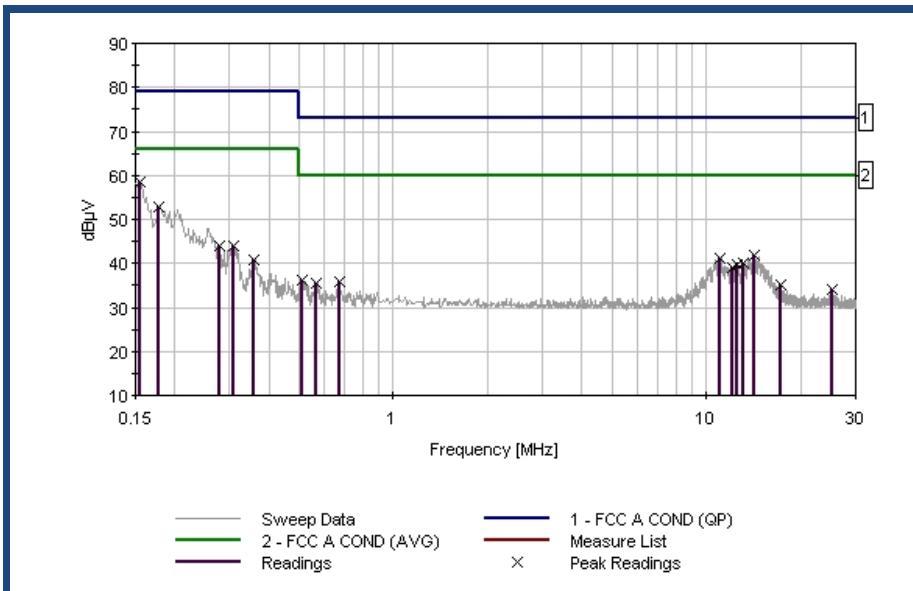


FIGURE 22 - CONDUCTED EMISSIONS PLOT – NEUTRAL

11.5 MEASUREMENT DATA, LINE

No.	Freq (Hz)	Rdng (dBuV)	Corrected (dBuV)	Spec (dBuV)	Margin (dB)	Polarity
1	151.818k	44.1	54.2	79.0	-24.8	Line
2	202.722k	38.7	48.8	79.0	-30.2	Line
3	14.291M	31.0	41.1	73.0	-31.9	Line
4	13.779M	29.9	40.0	73.0	-33.0	Line
5	11.183M	29.8	39.9	73.0	-33.1	Line
6	14.762M	29.5	39.6	73.0	-33.4	Line

11.6 MEASUREMENT DATA, NEUTRAL

No.	Freq (Hz)	Rdng (dBuV)	Corrected (dBuV)	Spec (dBuV)	Margin (dB)	Polarity
1	155.454k	48.3	58.4	79.0	-20.6	Neutral
2	179.088k	42.7	52.8	79.0	-26.2	Neutral
3	14.200M	31.6	41.7	73.0	-31.3	Neutral
4	11.103M	31.0	41.1	73.0	-31.9	Neutral
5	13.128M	29.9	40.0	73.0	-33.0	Neutral
6	12.616M	29.5	39.6	73.0	-33.4	Neutral

12 TEST EQUIPMENT

All applicable test equipment will be calibrated in accordance with ANSI Standard NCSL Z540-1 or other NIST traceable calibration standard. Equipment is calibrated on a 2 year cycle or according to the manufacturer's recommendations.

Manufacturer	Description	Model	Serial Number	Cal/Char Due Date D/M/Y
Agilent	Spectrum Analyzer	E4407B	US4142960	10/10/2014
Electro Metrics	Line Impedance Stabilization Network	EM-7823	115037	31/10/2014
Com-Power	Loop Antenna	AL-130	ICS100	15/1/2014
Electro Metrics	Hybrid Antenna	EM-3141	9902-1141	07/12/2014
HP	RF Amplifier	8449B	N/A	19/9/2015
AH Systems	Horn Antenna	SAS-571	1242	14/12/2014
Amawima	Horn Antenna	ANT-K	002009	7/2/2014

13 TEST DIAGRAMS

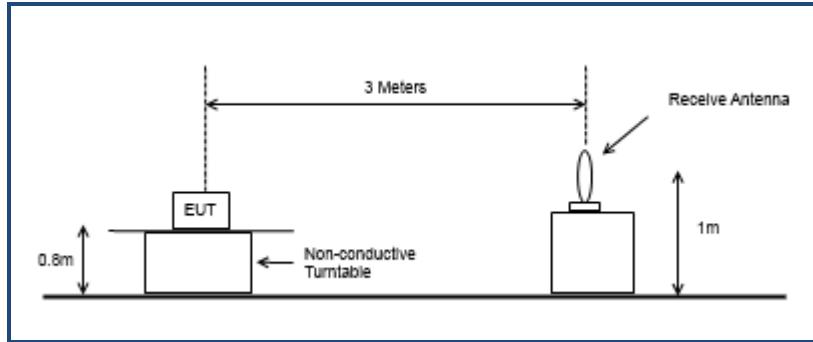
13.1 CONDUCTED RF TEST SETUP



13.2 POWER LINE CONDUCTED EMISSIONS TEST SETUP



13.3 LOW FREQUENCY EMISSIONS TEST SETUP (9 KHz – 30 MHz)



13.4 RADIATED EMISSIONS TEST SETUP

