

**Test Report No. 56S060708/03**  
**dated 12 Feb 2007**



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**FORMAL REPORT ON TESTING IN ACCORDANCE WITH**  
**FCC Parts 15B & C : 2006**  
**OF A**  
**BLUETOOTH HEADSET**  
**[ Model : ARGARD M10 ]**  
**[ FCC ID : UGCM 10 ]**

**TEST FACILITY** TÜV SÜD PSB Corporation Pte Ltd,  
Telecoms & EMC, Testing Group,  
1 Science Park Drive, Singapore 118221

**FCC REG. NO.** 90937 (3m & 10m OATS)  
99142 (10m Anechoic Chamber)  
871638 (5m Anechoic Chamber)  
325572 (10m Anechoic Chamber)

**IND. CANADA REG. NO.** IC 4257 (3m and 10m Anechoic Chambers)

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**QUOTATION NUMBER** 56Q0600553

**JOB NUMBER** 56S060708

**TEST PERIOD** 04 Dec 2006 – 28 Jan 2007

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LA-2001-0212-A  
LA-2001-0213-F  
LA-2001-0214-E  
LA-2001-0215-B  
LA-2001-0216-G  
LA-2001-0217-G  
LA-2006-0355-C

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

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**TEST SUMMARY**

The product was tested in accordance with the customer's specifications.

**Test Results Summary**

Test Standard	Description	Pass / Fail
FCC Part 15: 2006		
15.107(a), 15.207	Conducted Emissions	Pass
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(1)	Carrier Frequency Separation	Pass
	Spectrum Bandwidth (20dB Bandwidth Measurement)	Pass
15.247(a)(1)(iii)	Number of Hopping Frequencies	Pass
	Average Frequency Dwell Time	Pass
15.247(b)(1)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions	Pass
15.247(d)	Band Edge Compliance (Conducted)	Pass
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Pass
15.35(c)	Duty Cycle Factor Computation	Refer to page 61for details

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**TEST SUMMARY**

**Notes**

1. Three channels as listed below, which respectively represent the lower, middle and upper channels of the Equipment Under Test (EUT) were chosen and tested. For each channel, the EUT was configured to operate in the test mode.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>
Channel 00	2.402
Channel 39	2.441
Channel 78	2.480

2. All the measurements in section 15.247 were done based on conducted measurements.
3. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.
4. All test measurement procedures are according to ANSI C63.4: 2003.

**Modifications**

1. No modifications were made.

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**PRODUCT DESCRIPTION**

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Description	: The Equipment Under Test (EUT) is a <b>Bluetooth Headset</b> .
Manufacturer	: Argard Co., Ltd. 2571 Latpraw Road, Wangthonglang, Bangkok, Thailand
Model Number	: Argard M10
FCC ID	: UGCM 10
Serial Number	: Nil
Microprocessor	: CSR BC03_AF_2
Operating / Transmitting Frequency	: 2.402GHz (lower channel) to 2.480GHz (upper channel)
Modulation	: Gaussian Frequency Shift Keying (GFSK)
Port / Connectors	: Refer to manufacturer's user manual / operating manual.
Rated Input Power	: <u>Splim Electronics AC/DC Adapter</u> Input: 100 - 240V 50Hz/ 60Hz Output: 6VDC 250mA
Accessories	: Nil



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**SUPPORTING EQUIPMENT DESCRIPTION**

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The EUT was tested as a stand-alone unit without any supporting equipment.

**EUT OPERATING CONDITIONS**

**FCC Part 15**

1. Conducted Emissions
2. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)
3. Spectrum Bandwidth (20dB Bandwidth Measurement)
4. Maximum Peak Power
5. RF Conducted Spurious Emissions
6. Peak Power Spectral Density
7. Duty Cycle Factor Computation

The EUT was exercised by operating in maximum continuous transmission with frequency hopping off, i.e transmitting at lower, middle and upper channels respectively at one time.

**FCC Part 15**

1. Carrier Frequency Separation
2. Number of Hopping Frequencies
3. Average Frequency Dwell Time
4. Band Edge Compliance (Conducted)
5. Band Edge Compliance (Radiated)

The EUT was exercised by operating in maximum continuous transmission with frequency hopping on.

**CONDUCTED EMISSION TEST**

**FCC Parts 15.107(a) and 15.207 Conducted Emission Limits**

Frequency Range (MHz)	Limit Values (dBμV)	
	Quasi-peak (QP)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50
* Decreasing linearly with the logarithm of the frequency		

**FCC Parts 15.107(a) and 15.207 Conducted Emission Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	04 Aug 2007
Schaffner LISN – LISN7 (for EUT)	NNB42	00008	15 May 2007



## CONDUCTED EMISSION TEST

### FCC Parts 15.107(a) and 15.207 Conducted Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50 $\Omega$ /50 $\mu$ H EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another LISN.

### FCC Parts 15.107(a) and 15.207 Conducted Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.
3. High peaks, relative to the limit line, were then selected.
4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10kHz. Both Quasi-peak and Average measurements were made.
5. Steps 2 to 4 were then repeated for the LIVE line.

### **Sample Calculation Example**

At 20 MHz	Q-P limit (Class B) = 1000 $\mu$ V = 60.0 dB $\mu$ V
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dB $\mu$ V (Calibrated for system losses)	
Therefore, Q-P margin = 40.0 - 60.0 = -20.0	i.e. <b>20.0 dB below Q-P limit</b>

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**CONDUCTED EMISSION TEST**



**Conducted Emissions Test Setup (Front View)**



**Conducted Emissions Test Setup (Rear View)**

## CONDUCTED EMISSION TEST

### FCC Parts 15.107(a) and 15.207 Conducted Emission Results

Test Input Power	110V 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	55%
		Atmospheric Pressure	1030mbar
		Tested By	Chua Choon Meng

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.3807	37.1	-21.2	24.7	-23.6	Neutral	78
0.4252	34.4	-22.9	23.8	-23.5	Neutral	78
1.7663	35.4	-20.6	25.7	-20.3	Neutral	78
2.0840	32.3	-23.7	24.9	-21.1	Live	78
2.8253	36.4	-19.6	26.4	-19.6	Neutral	78
3.3517	36.3	-19.7	25.9	-20.1	Neutral	78

### Notes

- All possible modes of operation were investigated from 150kHz to 30MHz. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
- A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
- EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:  
9kHz - 30MHz  
RBW: 10kHz VBW: 30kHz
- Conducted Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 30MHz (Average & Quasi-peak) is  $\pm 2.4$ dB.

## RADIATED EMISSION TEST

### FCC Part 15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
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	Above 38.6
13.36 - 13.41			

### FCC Parts 15.109(a) and 15.209 Radiated Emission Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m) @ 3m
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
Above 960	54.0*

\* Above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.

### FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESM11	ESMI	849182/003 848926/007	04 Jul 2007
Agilent Preamplifier (0.01-4GHz) – PA6	87405B	10003	12 Jan 2007
Schaffner Bilog Antenna –BL4	CBL6112B	2593	12 May 2007
EMCO Horn Antenna – H14	3115	0003-6087	19 May 2007
Bandstop Filter (2.4-2.5 GHz)	BRM50701	017	13 Aug 2007

## **RADIATED EMISSION TEST**

### **FCC Parts 15.109(a) and 15.209 Radiated Emission Test Setup**

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

### **FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
  - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
  - b. The EUT was then rotated to the direction that gave the maximum emission.
  - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point that above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from 30MHz to 10<sup>th</sup> harmonics of the EUT fundamental frequency, using the Bi-log antenna for frequencies from 30MHz up to 3GHz, and the Horn antenna above 3GHz.

### **Sample Calculation Example**

At 300 MHz	Q-P limit (Class B) = 200 $\mu$ V/m = 46.0 dB $\mu$ V/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dB $\mu$ V/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 40.0 - 46.0 = -6.0	i.e. <b>6 dB below Q-P limit</b>

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**RADIATED EMISSION TEST**



**Radiated Emissions Test Setup**

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**RADIATED EMISSION TEST**

**FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results**

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
230.7900	33.8	-12.2	10	100	H	78
288.9900	34.0	-12.0	0	100	H	78
384.0500	33.0	-13.0	2	100	H	78
558.6500	32.0	-14.0	355	100	H	78
860.3200	29.5	-16.5	0	100	H	78
910.7600	30.0	-16.0	358	100	H	78

Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
1.6002	57.3	51.9	-2.1	344	100	V	0
1.6279	59.2	51.6	-2.4	301	100	V	39
1.6539	57.7	48.0	-6.0	311	100	V	39
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**RADIATED EMISSION TEST**

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Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. "--" indicates no emissions were found and shows compliance to the limits.
3. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
4. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
5. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:  
30MHz - 1GHz  
RBW: 120kHz                      VBW: 1MHz  
>1GHz  
RBW: 1MHz                      VBW: 1MHz
6. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
7. The channel in the table refers to the transmit channel of the EUT.
8. Radiated Emissions Measurement Uncertainty  
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz (QP only @ 3m & 10m) is  $\pm 4.3\text{dB}$  (for EUTs < 0.5m X 0.5m X 0.5m).



## **CARRIER FREQUENCY SEPARATION TEST**

### **FCC Part 15.247(a)(1) Carrier Frequency Separation Limits**

The EUT shows compliance to the requirements of this section, which states the adjacent carrier frequencies must be separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, the EUT may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW (21dBm).

### **FCC Part 15.247(a)(1) Carrier Frequency Separation Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

### **FCC Part 15.247(a)(1) Carrier Frequency Separation Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 100kHz.
5. All other supporting equipment were powered separately from another filtered mains.

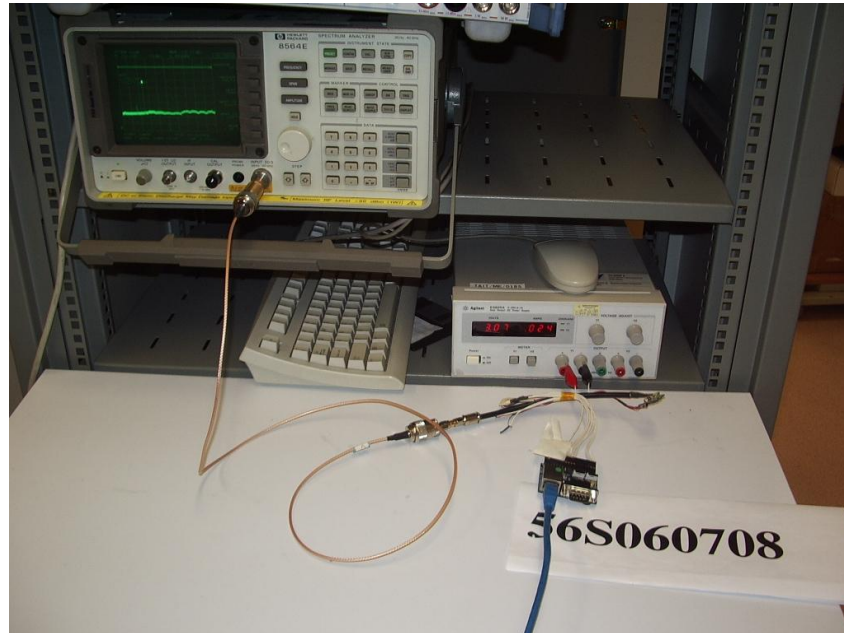
### **FCC Part 15.247(a)(1) Carrier Frequency Separation Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The start and stop frequencies of the spectrum analyser were set to 2.401GHz and 2.404GHz.
3. The spectrum analyser was set to max hold to capture the two adjacent transmitting frequencies within the span. The signal capturing was continuous until no further signals were detected.
4. The carrier frequency separation of the two adjacent operating frequencies was measured by finding the carrier frequency difference between the two adjacent channels.
5. The steps 2 to 4 were repeated with the following start and stop frequencies settings:
  - a. 2.439GHz to 2.442GHz
  - b. 2.440GHz to 2.443GHz
  - c. 2.478GHz to 2.481GHz

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**CARRIER FREQUENCY SEPARATION TEST**

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**Carrier Frequency Separation Test Setup**

**CARRIER FREQUENCY SEPARATION TEST**

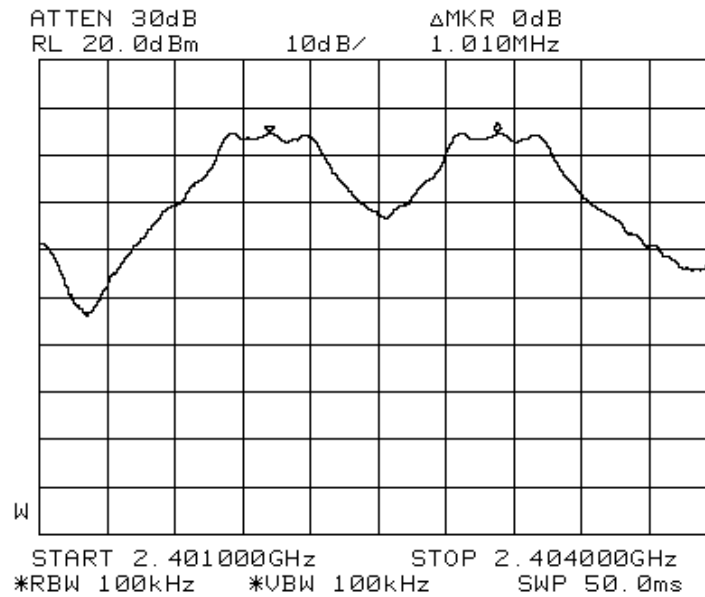
**FCC Part 15.247(a)(1) Carrier Frequency Separation Results**

Test Input Power	3VDC (via a DC source)	Temperature	24°C
Attached Plots	1 - 4	Relative Humidity	59%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

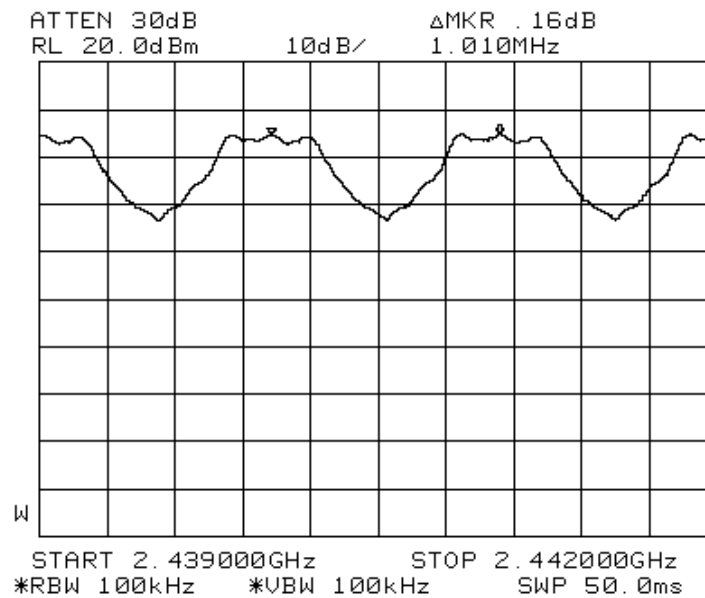
Adjacent Channels	Channel Separation (MHz)
0 and 1	1.010
38 and 39	1.010
39 and 40	1.015
77 and 78	1.010

## CARRIER FREQUENCY SEPARATION TEST

### Carrier Frequency Separation Plots



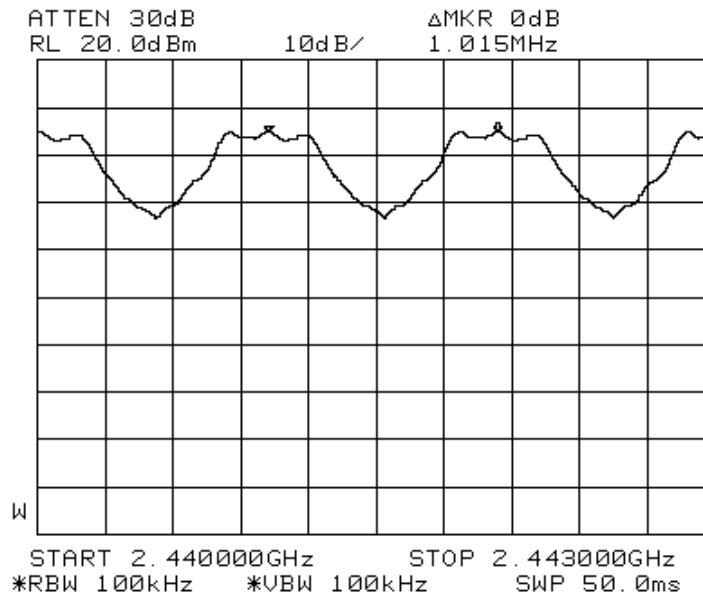
Plot 1 - Channels 0 and 1 Separation



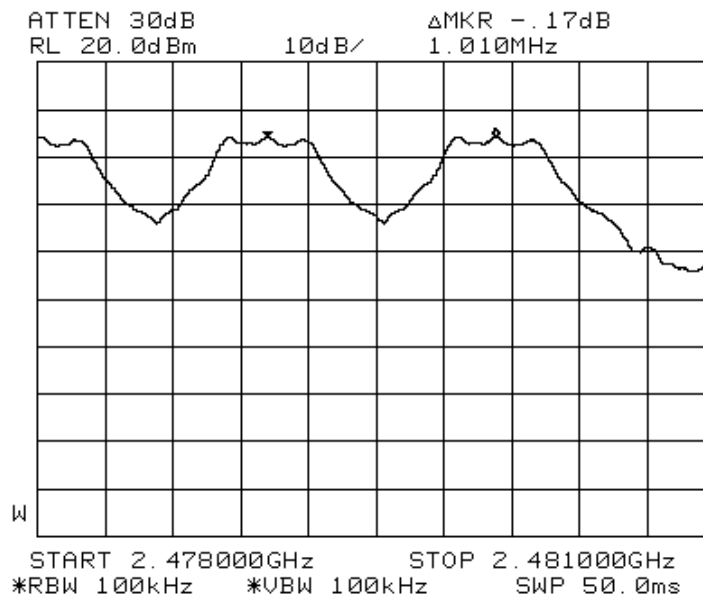
Plot 2 – Channels 38 and 39 Separation

## CARRIER FREQUENCY SEPARATION TEST

### Carrier Frequency Separation Plots



Plot 3 - Channels 39 and 40 Separation



Plot 4 - Channels 77 and 78 Separation

## **SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST**

### **FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Limits**

The EUT shows compliance to the requirements of this section, which states that the 20dB bandwidth of the hopping channel shall be the channel frequency separation by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

### **FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

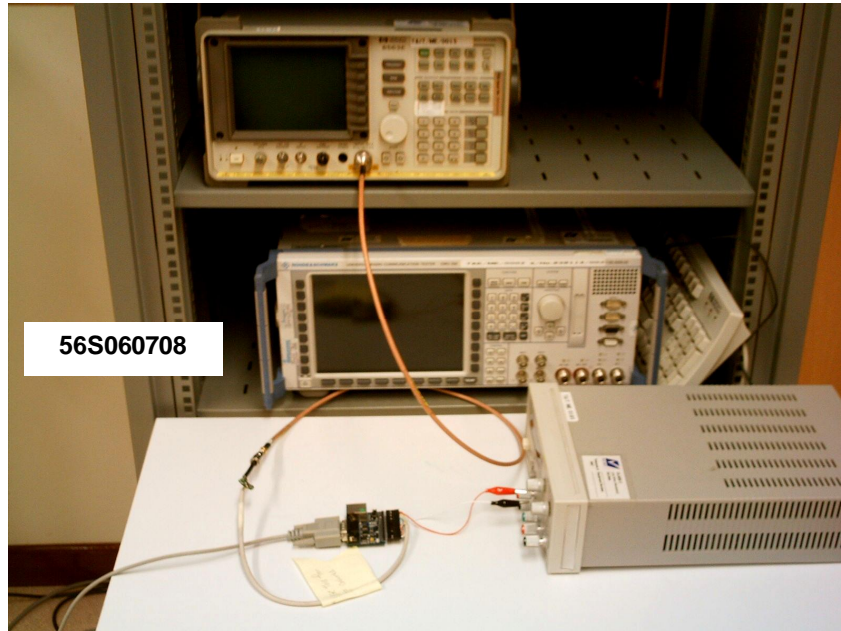
### **FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 10kHz and 30kHz.
5. All other supporting equipment were powered separately from another filtered mains.

### **FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 20dB bandwidth of the transmitting frequency.
3. The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.
4. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 20dB peak frequency at lower ( $f_L$ ) and upper ( $f_H$ ) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.
5. The 20dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies,  $|f_H - f_L|$ .
6. The steps 2 to 5 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

**SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST**



**Spectrum Bandwidth (20dB Bandwidth Measurement) Test Setup**



**SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST**

**FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Results**

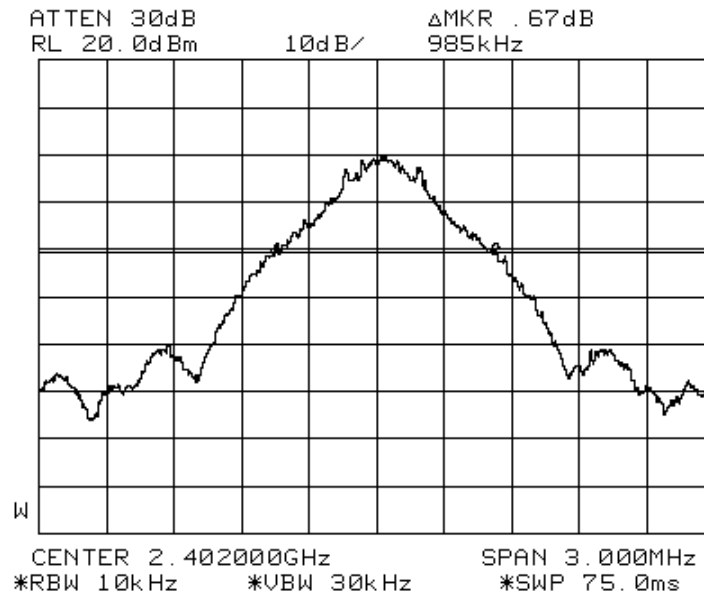
Test Input Power	3VDC (via a DC source)	Temperature	23°C
Attached Plots	5 - 7	Relative Humidity	55%
		Atmospheric Pressure	1030mbar
		Tested By	Thor Wen Lei

Channel	Channel Frequency (GHz)	20dB Bandwidth (MHz)
0	2.402	0.985
39	2.441	0.850
78	2.480	0.730

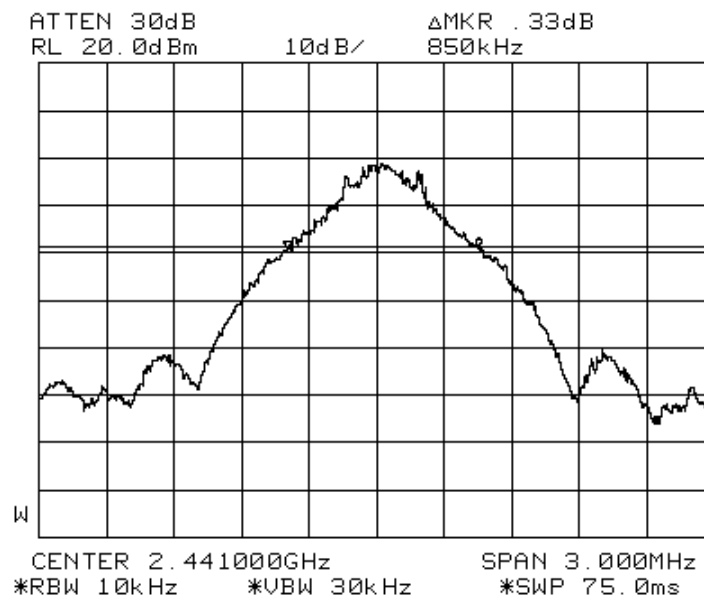


**SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST**

**Spectrum Bandwidth (20dB Bandwidth Measurement) Plots**



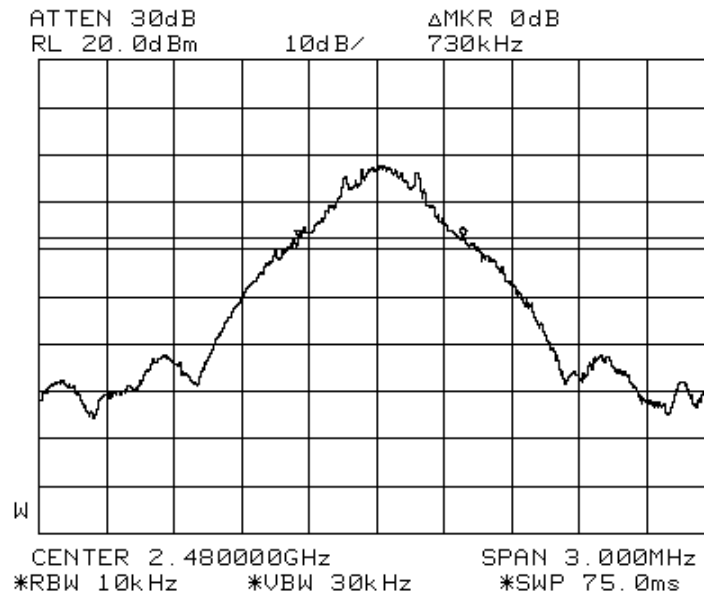
**Plot 5 – Channel 0**



**Plot 6 – Channel 39**

**SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST**

**Spectrum Bandwidth (20dB Bandwidth Measurement) Plots**



**Plot 7 – Channel 78**

#### NUMBER OF HOPPING FREQUENCIES TEST

##### **FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Limits**

The EUT shows compliance to the requirements of this section, which states the EUT shall use at least 15 channels.

##### **FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

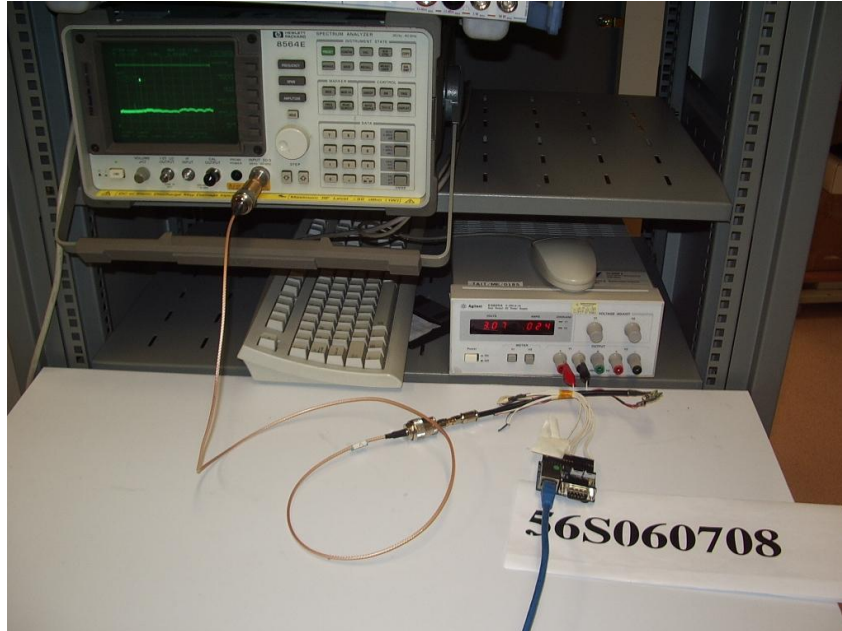
##### **FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 300kHz and 1MHz.
5. All other supporting equipment were powered separately from another filtered mains.

##### **FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The start and stop frequencies of the spectrum analyser were set to 2.40GHz and 2.421GHz.
3. The spectrum analyser was set to max hold to capture all the transmitting frequencies within the span. The signal capturing was continuous until all the transmitting frequencies were captured and no further signals were detected.
4. The numbers of transmitting frequencies were counted and recorded.
5. The steps 2 to 4 were repeated with the following start and stop frequencies settings:
  - a. 2.420GHz to 2.441GHz
  - b. 2.440GHz to 2.461GHz
  - c. 2.460GHz to 2.4835GHz
6. The total number of hopping frequencies is the sum of the number of the hopping frequencies found for each span.

**NUMBER OF HOPPING FREQUENCIES TEST**



**Number of Hopping Frequencies Test Setup**

**NUMBER OF HOPPING FREQUENCIES TEST**

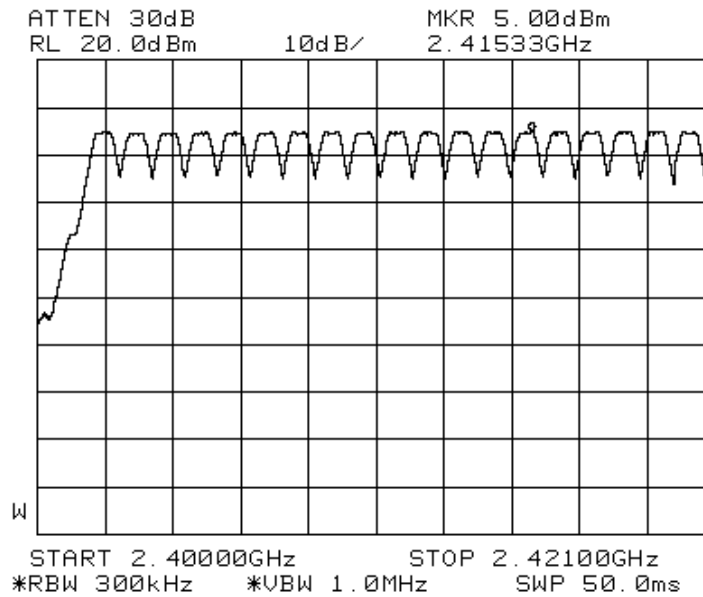
**FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Results**

Test Input Power	3VDC (via a DC source)	Temperature	24°C
Attached Plots	8- 11	Relative Humidity	59%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

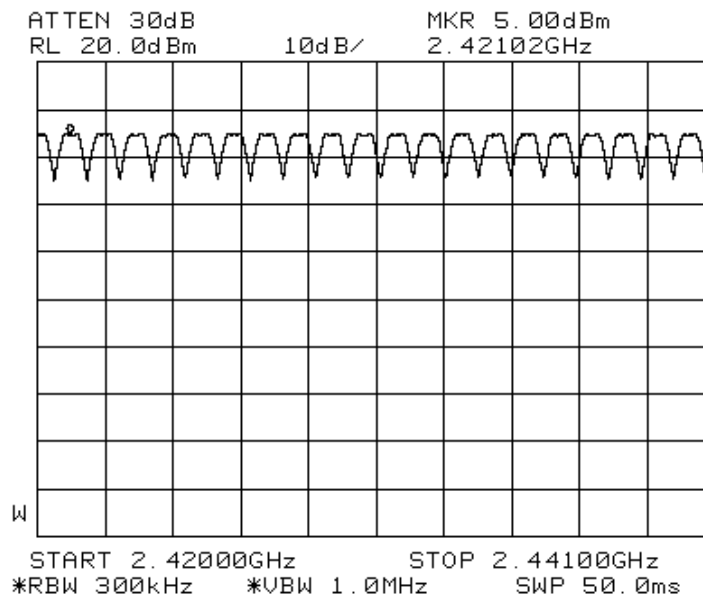
The EUT was found to have 79 hopping frequencies. Please refer to the attached plots.

**NUMBER OF HOPPING FREQUENCIES TEST**

**Number Of Hopping Frequencies Plots**



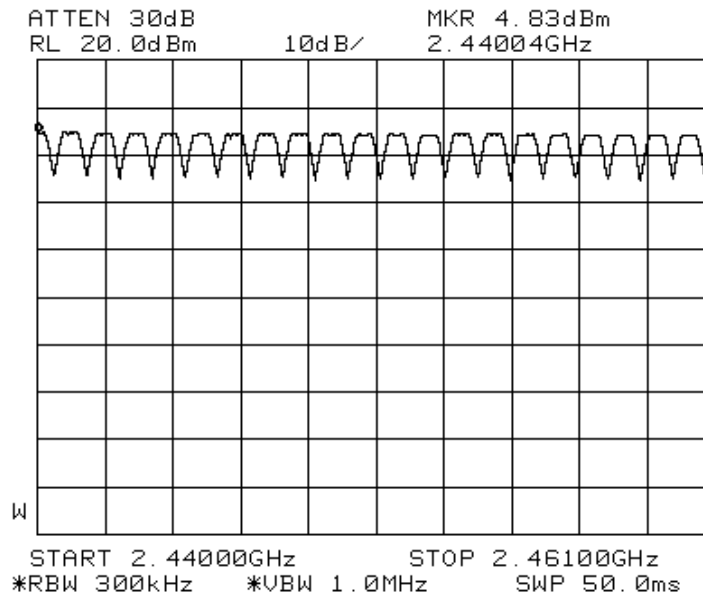
**Plot 8 - Channels 0 to 18**



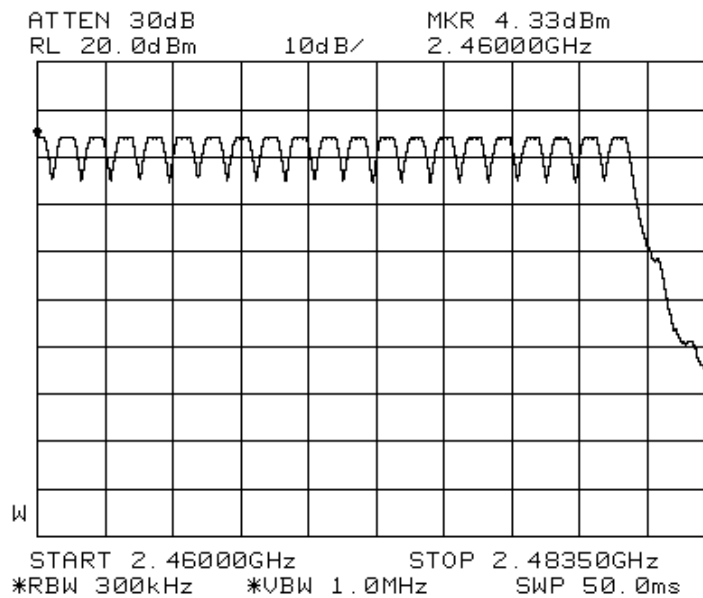
**Plot 9 - Channels 19 to 38**

## NUMBER OF HOPPING FREQUENCIES TEST

### Number Of Hopping Frequencies Plots



Plot 10 - Channels 39 to 58



Plot 11 - Channels 59 to 78

#### AVERAGE FREQUENCY DWELL TIME TEST

##### FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Limits

The EUT shows compliance to the requirements of this section, which states the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

##### FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

##### FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Test Setup

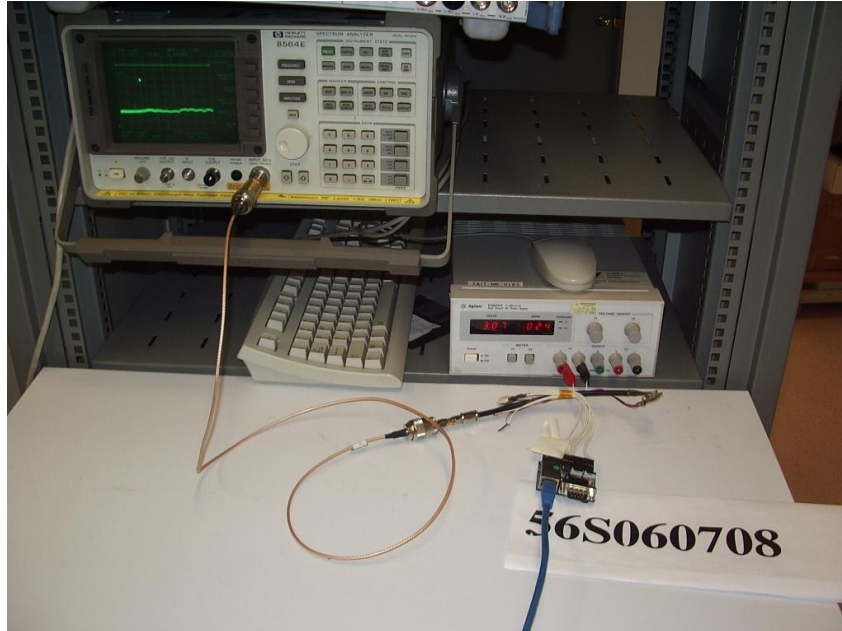
1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 1MHz and 1MHz.
5. All other supporting equipment were powered separately from another filtered mains.

##### FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The center frequency of the spectrum analyser was set to 2.402GHz with zero frequency span (spectrum analyser acts as an oscilloscope).
3. The sweep time of the spectrum analyser was adjusted until a stable signal can be seen on the spectrum analyser.
4. The duration (dwell time) of a packet was measured using the marker-delta function of the spectrum analyser. The average dwell time of the transmitting frequency was computed based on general expression as shown below:  
$$\text{Average Frequency Dwell Time} = [\text{measured time slot length} \times \text{hopping rate} / \text{number of hopping channels}] \times [0.4 \times \text{number of hopping channels}]$$
5. The steps 2 to 4 were repeated with the center frequency of the spectrum analyser were set to 2.441GHz and 2.480GHz respectively.



**AVERAGE FREQUENCY DWELL TIME TEST**



**Average Frequency Dwell Time Test Setup**

**AVERAGE FREQUENCY DWELL TIME TEST**

**FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Results**

Test Input Power	3VDC (via a DC source)	Temperature	24°C
Attached Plots	12 - 14	Relative Humidity	59%
Hopping Rate	1600 hops / s	Atmospheric Pressure	1030mbar
Number of Hopping Channels	79 channels	Tested By	Johnsen Tia

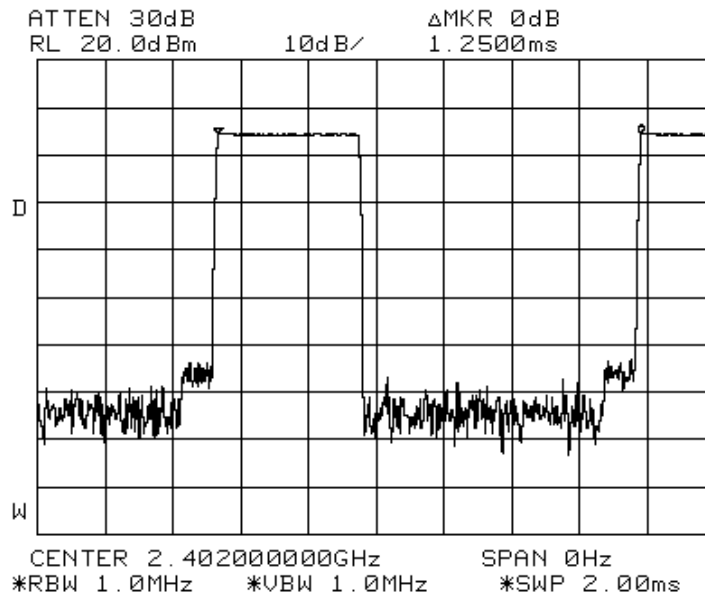
Channel	Channel Frequency (GHz)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
0	2.402	0.2000	0.4
39	2.441	0.2000	0.4
78	2.480	0.2000	0.4

**Notes**

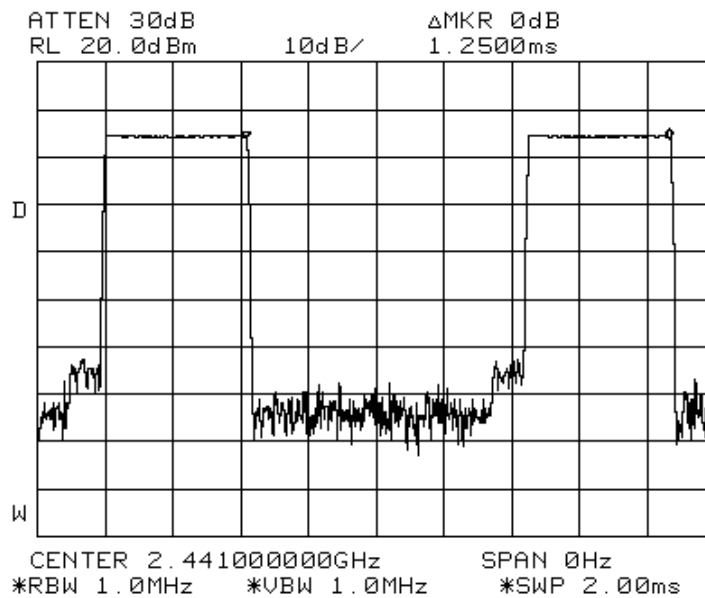
1. The EUT operates based on 1-slot transmission and 1-slot reception basis. As such, there are [  $79 / (1 + 1)$  ] transmissions per second and the time occupancy per channel is [ measured time slot length / 2 ].
2. Average Frequency Dwell Time = [ measured time slot length / 2 x hopping rate / 2 / number of hopping channels ] x [ 0.4 x number of hopping channels ]

**AVERAGE FREQUENCY DWELL TIME TEST**

**Average Frequency Dwell Time Plots**



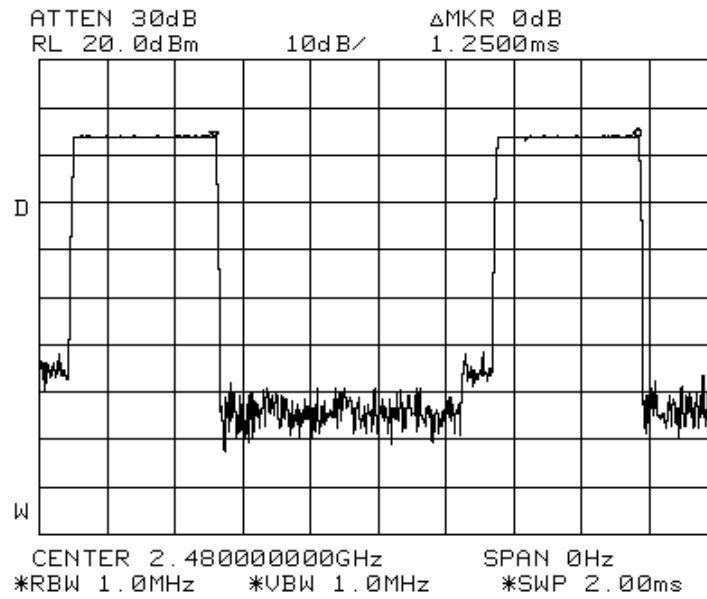
**Plot 12 – Channel 0**



**Plot 13 – Channel 39**

**AVERAGE FREQUENCY DWELL TIME TEST**

**Average Frequency Dwell Time Plots**



**Plot 14 – Channel 78**

## MAXIMUM PEAK POWER TEST

### FCC Part 15.247(b)(1) Maximum Peak Power Limits

The EUT shows compliance to the requirements of this section, which states the EUT employing at least 75 non-overlapping hopping channels shall not exceed 1W (30dBm). For the EUT employs other frequency hopping systems, the peak power shall not greater than 0.125W (21dBm).

### FCC Part 15.247(b)(1) Maximum Peak Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
R&S Universal Radio Communication Tester	CMU 200	837587/068	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

### FCC Part 15.247(b)(1) Maximum Peak Power Test Setup

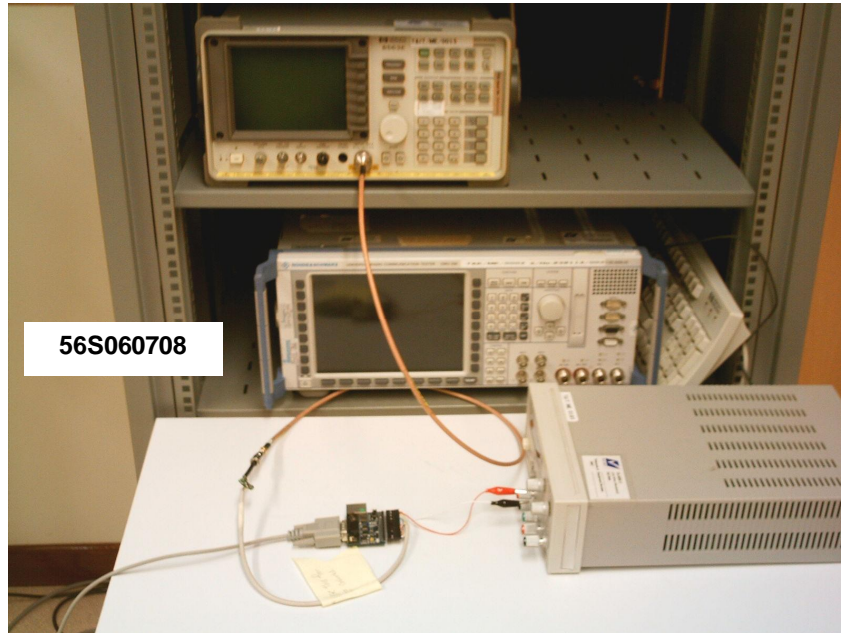
1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the Universal Radio Communication Tester, which set into power analyser mode via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another filtered mains.

### FCC Part 15.247(b)(1) Maximum Peak Power Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. The step 2 was repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

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**MAXIMUM PEAK POWER TEST**



**Maximum Peak Power Test Setup**

**MAXIMUM PEAK POWER TEST**

**FCC Part 15.247(b)(1) Maximum Peak Power Results**

Test Input Power	3VDC (via a DC source)	Temperature	23°C
		Relative Humidity	55%
		Atmospheric Pressure	1030mbar
		Tested By	Thor Wen Lei

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0	2.402	0.0024	1.0
39	2.441	0.0020	1.0
78	2.480	0.0016	1.0

Notes

1. Power analyser of Universal Radio Communication Tester was used for power measurement with peak detection as mode of measurement. The power analyser mode supports a wideband power measurement ranging from 100kHz to 2700MHz.

## RF CONDUCTED SPURIOUS EMISSIONS TEST

### FCC Part 15.247(d) RF Conducted Spurious Emissions Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

### FCC Part 15.247(d) RF Conducted Spurious Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

### FCC Part 15.247(d) RF Conducted Spurious Emissions Test Setup

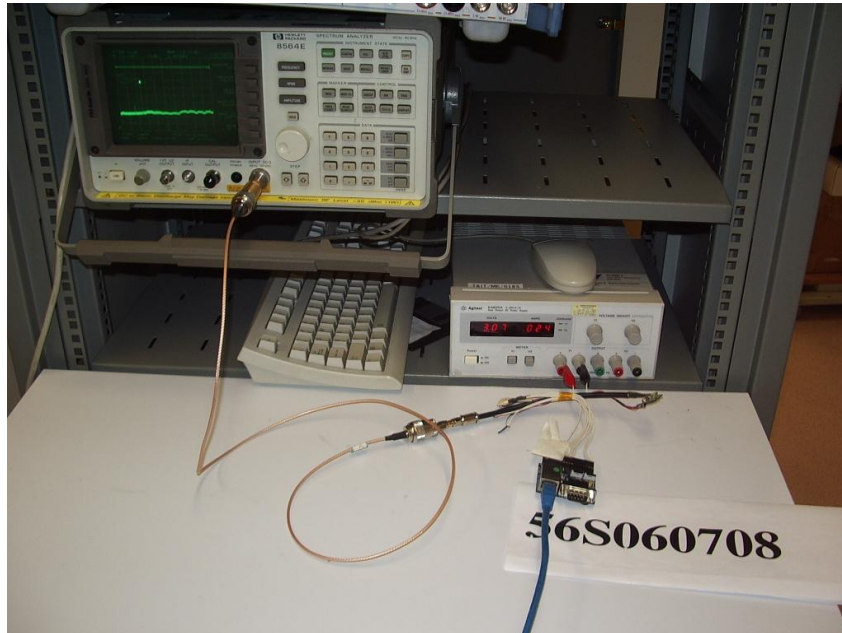
1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.
5. All other supporting equipment were powered separately from another filtered mains.

### FCC Part 15.247(d) RF Conducted Spurious Emissions Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with frequency span was set from 10GHz to 25GHz.
5. The steps 2 to 4 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.



**RF CONDUCTED SPURIOUS EMISSIONS TEST**



**RF Conducted Spurious Emissions Test Setup**

**Test Report No. 56S060708/03**  
dated 12 Feb 2007



**RF CONDUCTED SPURIOUS EMISSIONS TEST**

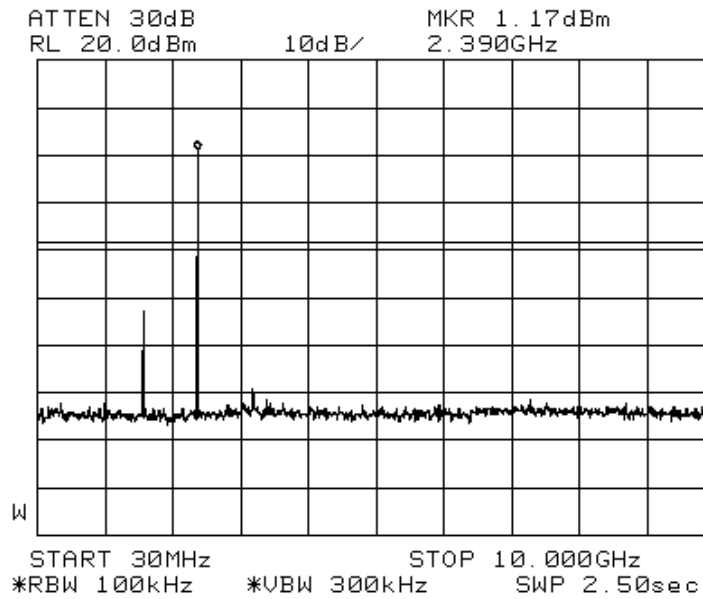
**FCC Part 15.247(d) RF Conducted Spurious Emissions Results**

Test Input Power	3VDC (via a DC source)	Temperature	24°C
Attached Plots	15 - 20	Relative Humidity	59%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

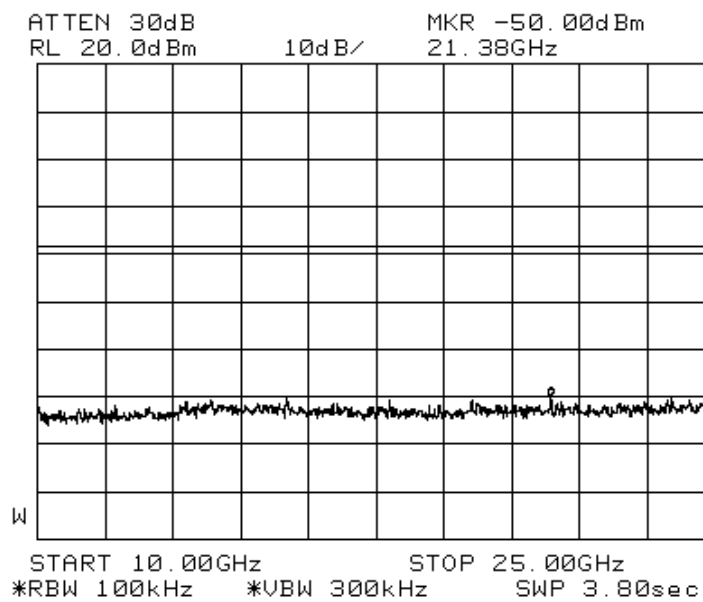
All spurious signals found were below the specified limit. Please refer to the attached plots.

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots



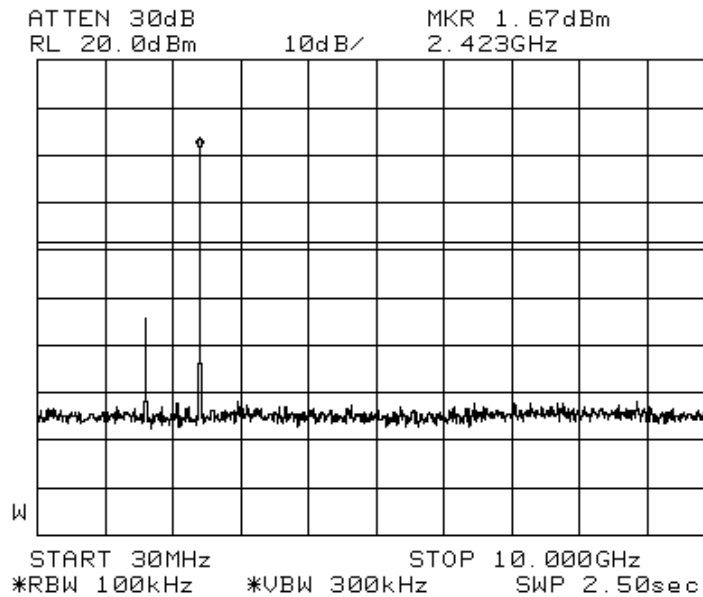
Plot 15 – Channel 0



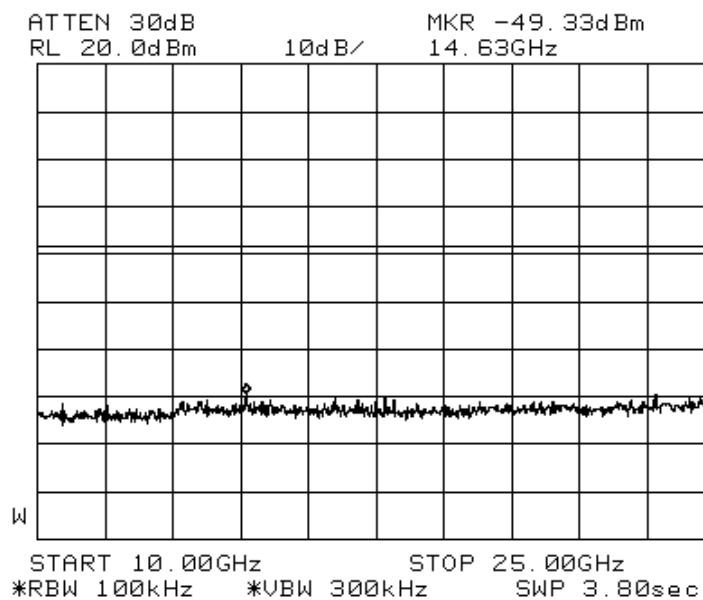
Plot 16 – Channel 0

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots



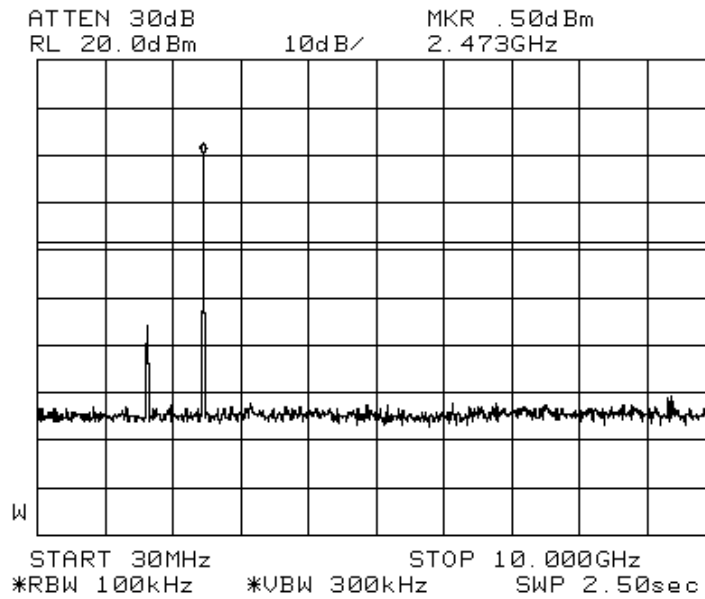
Plot 17 – Channel 39



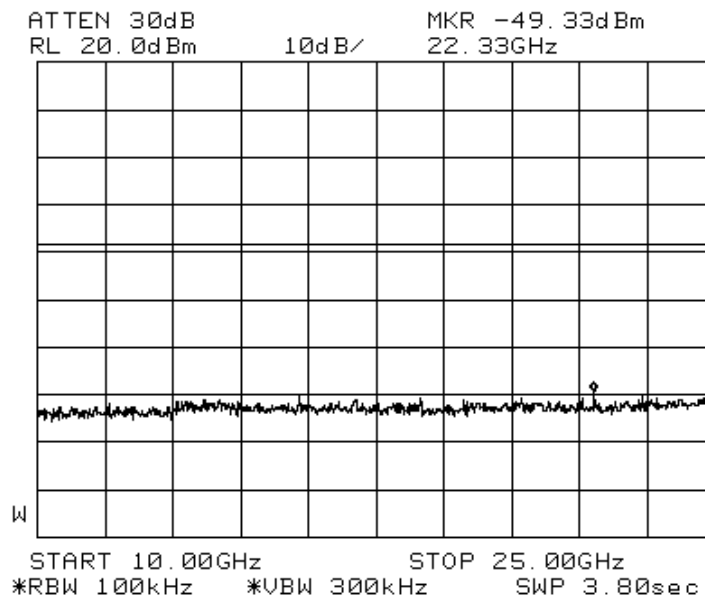
Plot 18 – Channel 39

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots



Plot 19 – Channel 78



Plot 20 – Channel 78

## **BAND EDGE COMPLIANCE (CONDUCTED) TEST**

### **FCC Part 15.247(d) Band Edge Compliance (Conducted) Limits**

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

### **FCC Part 15.247(d) Band Edge Compliance (Conducted) Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

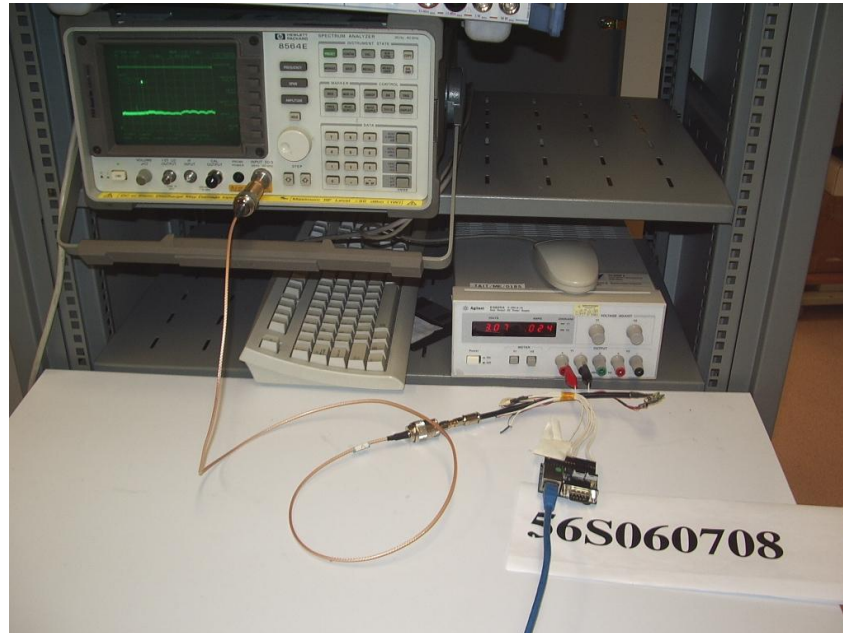
### **FCC Part 15.247(d) Band Edge Compliance (Conducted) Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.
5. All other supporting equipment were powered separately from another filtered mains.

### **FCC Part 15.247(d) Band Edge Compliance (Conducted) Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions at the band edge.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the transmission band, 2.4835GHz and the any spurious emissions at the band-edge.

**BAND EDGE COMPLIANCE (CONDUCTED) TEST**



**Band Edge Compliance (Conducted) Test Setup**



**BAND EDGE COMPLIANCE (CONDUCTED) TEST**

**FCC Part 15.247(d) Band Edge Compliance (Conducted) Results**

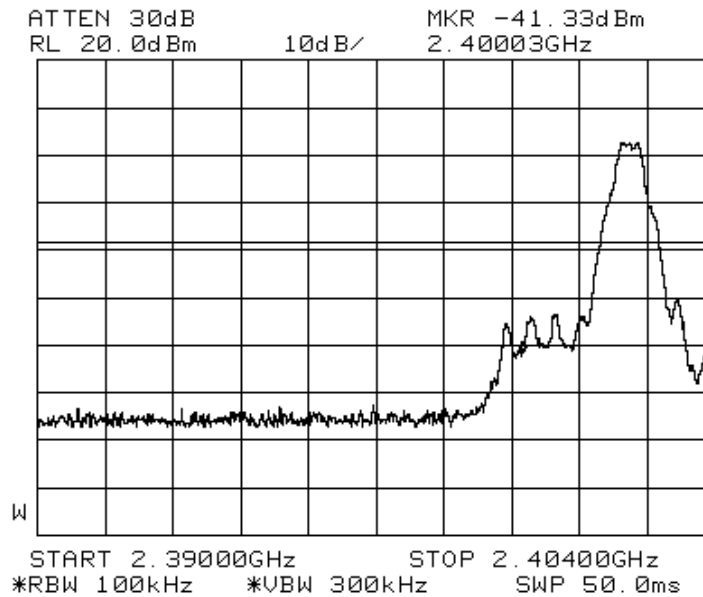
Test Input Power	3VDC (via a DC source)	Temperature	24°C
Attached Plots	21 - 22	Relative Humidity	59%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

No significant signal was found and they were below the specified limit.

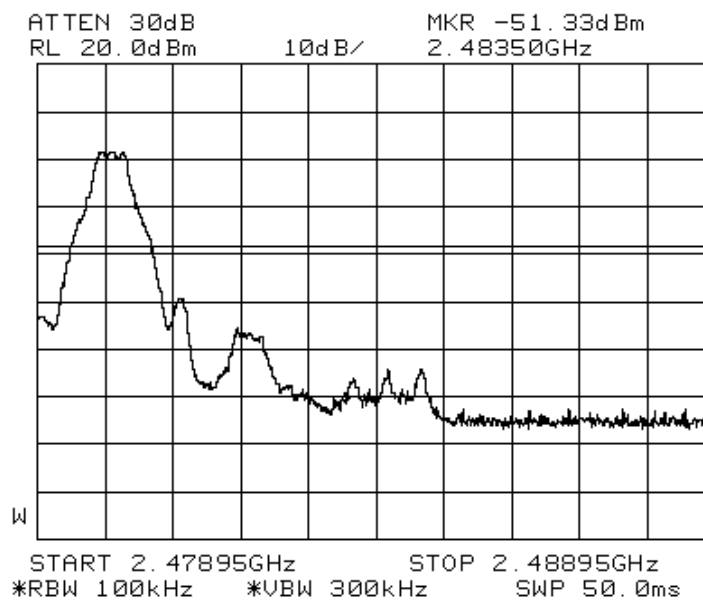


**BAND EDGE COMPLIANCE (CONDUCTED) TEST**

**Band Edge Compliance (Conducted) Plots**



**Plot 21 – Lower Band Edge at 2.4000GHz**



**Plot 22 – Upper Band Edge at 2.4835GHz**

## **BAND EDGE COMPLIANCE (RADIATED) TEST**

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Limits**

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power. In addition, radiated emissions which fall in the restricted bands shall comply to the radiated emission limits specified in 15.209.

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Instrumentation**

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz –26.5GHz) – ESMI1	ESMI	849182/003 848926/007	04 Jul 2007
Agilent Preamplifier (0.01-4GHz) – PA6	87405B	10003	12 Jan 2007
Schaffner Bilog Antenna –BL4	CBL6112B	2593	12 May 2007
EMCO Horn Antenna – H14	3115	0003-6087	19 May 2007

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Setup**

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz to show compliance of spurious at band edges are at least 20dB below the carriers. For restricted band spurious at band edges, peak and average measurement plots were taken using the following setting:
  - a. Peak Plot:  
RBW = VBW = 1MHz
  - b. Average Plot  
RBW = 1MHz, VBW = 10Hz
4. All other supporting equipment were powered separately from another filtered mains.

### **FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Method**

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions at the band edge.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the transmission band, 2.4835GHz and the any spurious emissions at the band-edge.

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**BAND EDGE COMPLIANCE (RADIATED) TEST**



**Band Edge Compliance (Radiated) Test Setup**



**BAND EDGE COMPLIANCE (RADIATED) TEST**

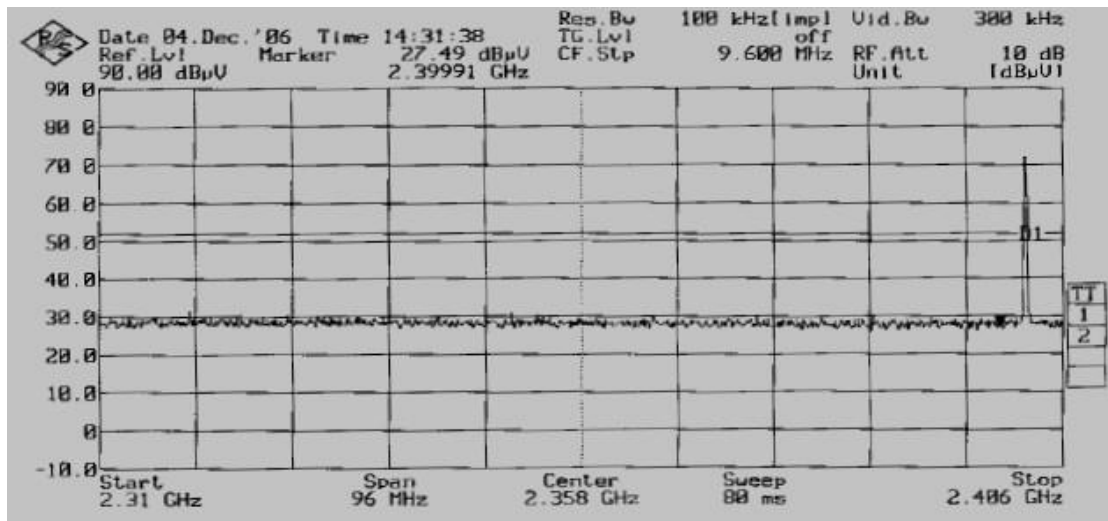
**FCC Part 15.247(d) Band Edge Compliance (Radiated) Results**

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	23 - 28	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

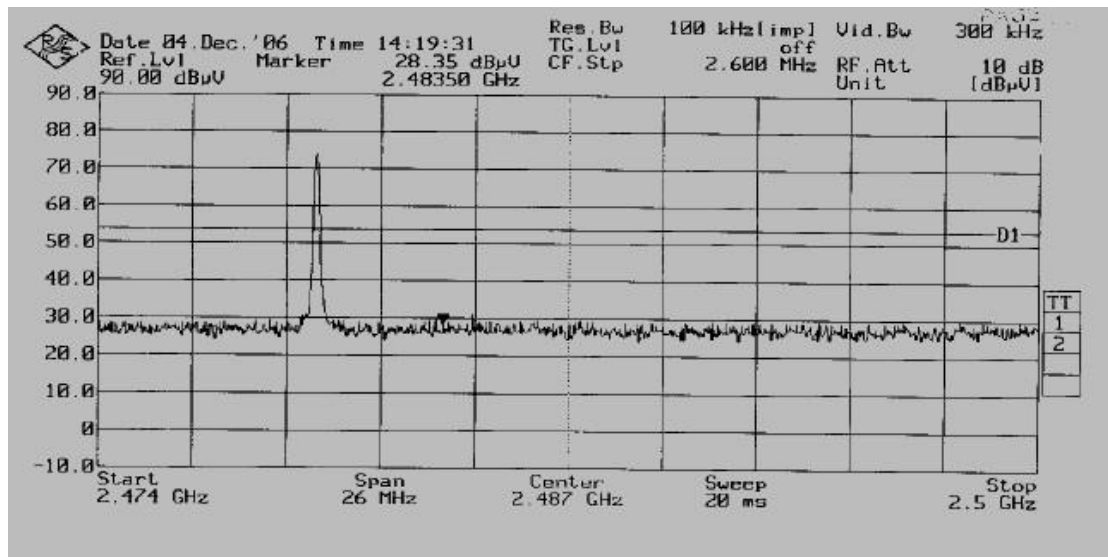
No significant signal was found and they were below the specified limit.

**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge)**



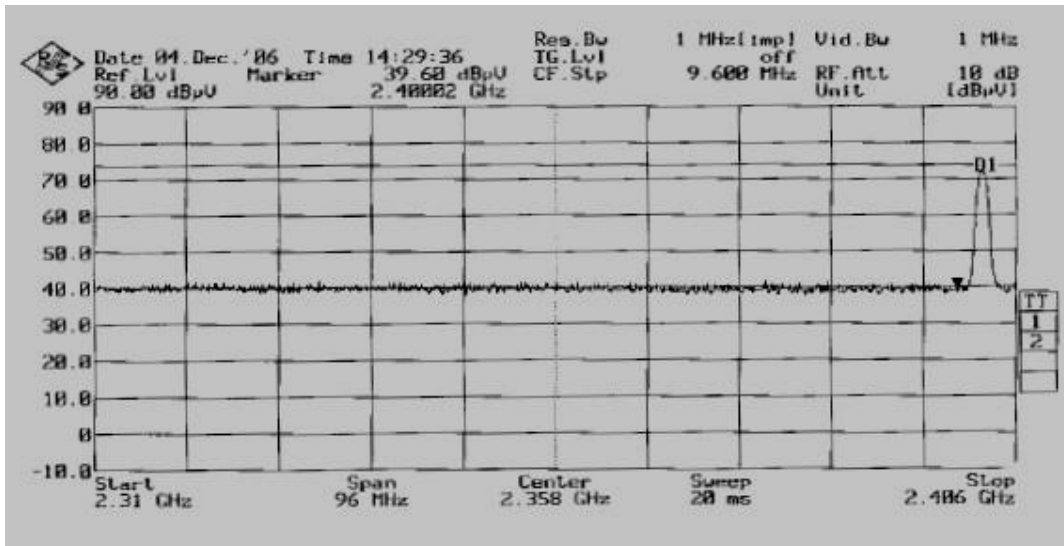
**Plot 23 – Lower Band Edge at 2.4000GHz**



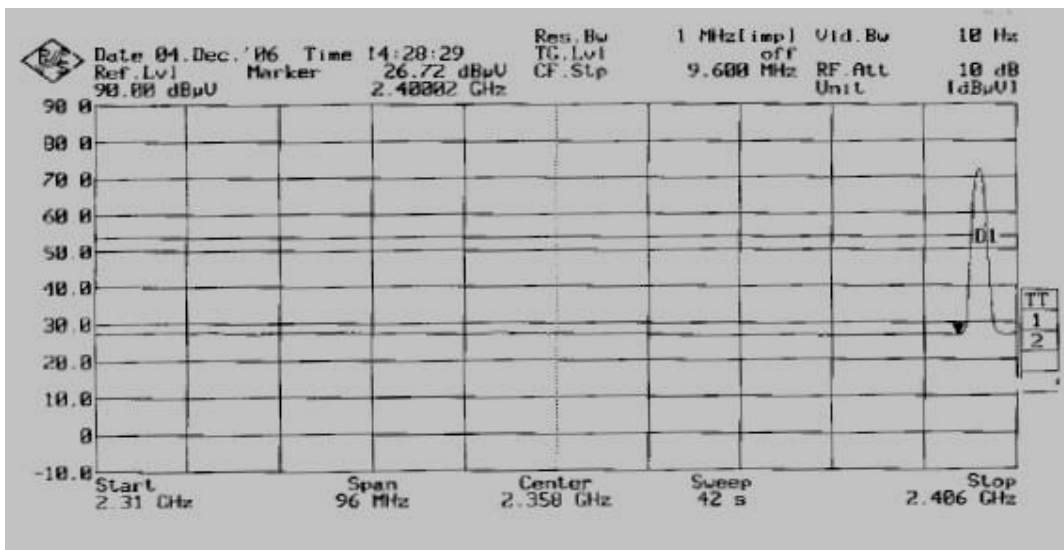
**Plot 24 – Upper Band Edge at 2.4835GHz**

**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (Restricted Band)**



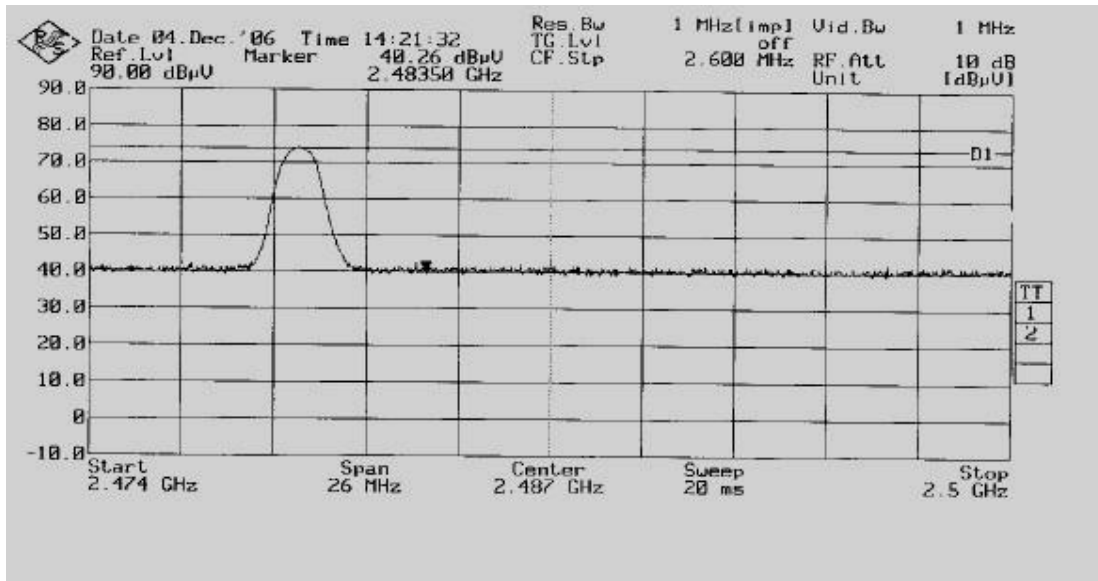
Plot 25 – Peak Plot at Lower Band Edge at 2.4000GHz



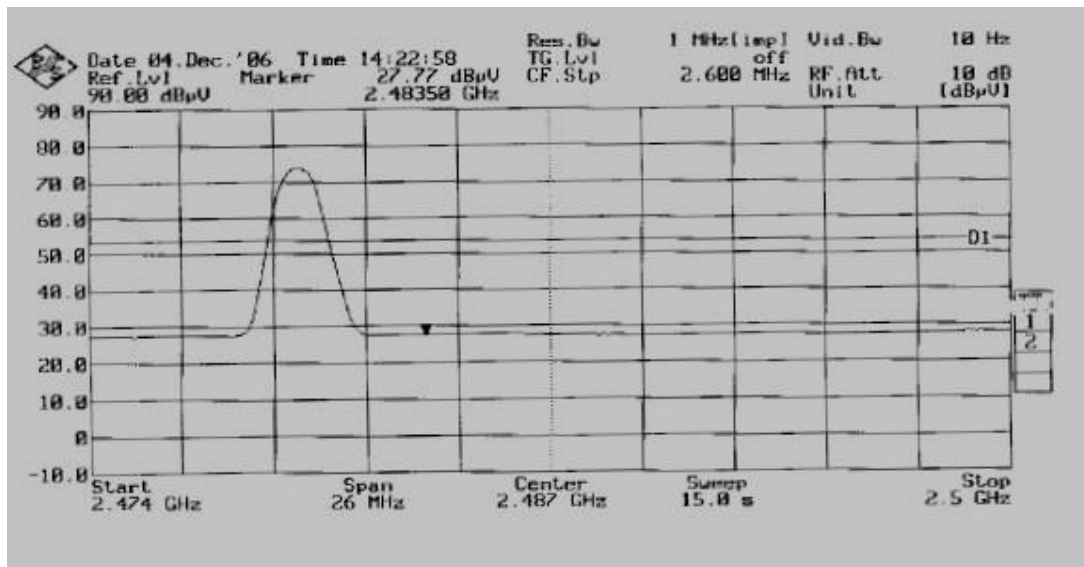
Plot 26 – Average Plot at Lower Band Edge at 2.4000GHz

# BAND EDGE COMPLIANCE (RADIATED) TEST

## Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 27 – Peak Plot at Upper Band Edge at 2.4835GHz



Plot 28 – Average Plot at Upper Band Edge at 2.4835GHz



## PEAK POWER SPECTRAL DENSITY TEST

### FCC Part 15.247(e) Peak Power Spectral Density Limits

The EUT shows compliance to the requirements of this section, which states the peak power spectral density conducted from the intentional radiator (EUT) to the antenna shall not be greater than 8dBm (6.3mW) in any 3kHz band during any time interval of continuous transmission.

### FCC Part 15.247(e) Peak Power Spectral Density Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer (SA10)	8563E	3846A014338	08 Apr 2007
Agilent Dual Output DC Power Supply	E3620A	Nil	04 Apr 2007

### FCC Part 15.247(e) Peak Power Spectral Density Test Setup

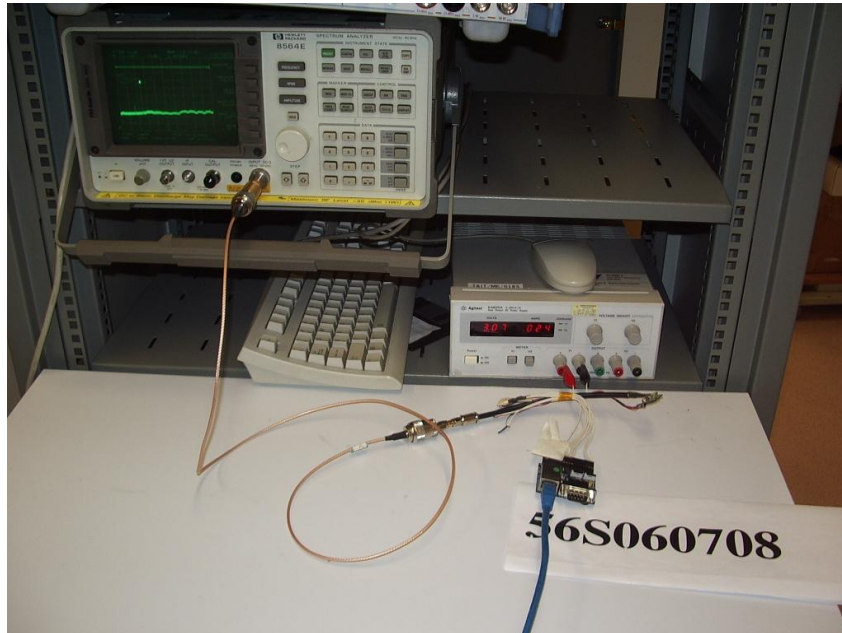
1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 3kHz and 10kHz.
5. All other supporting equipment were powered separately from another filtered mains.

### FCC Part 15.247(e) Peak Power Spectral Density Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.
3. The peak power density of the transmitting frequency was detected and recorded.
4. The step 3 was repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.



**PEAK POWER SPECTRAL DENSITY TEST**



**Peak Power Spectral Density Test Setup**

**PEAK POWER SPECTRAL DENSITY TEST**

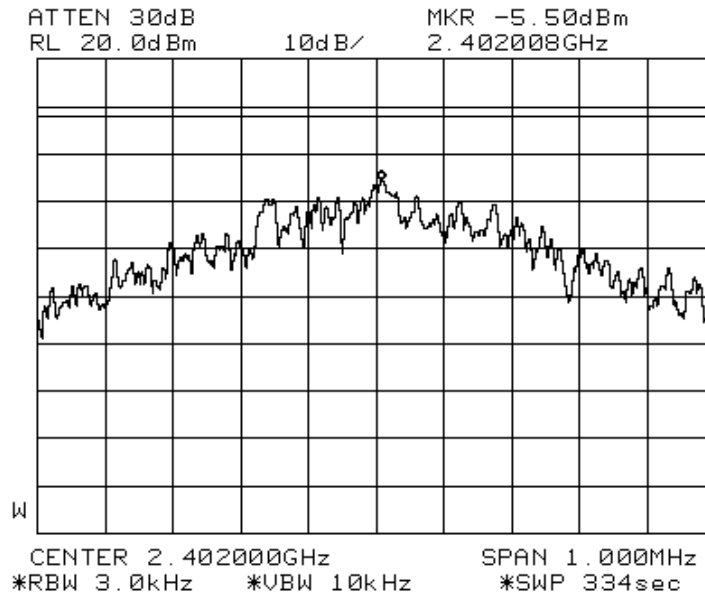
**FCC Part 15.247(e) Peak Power Spectral Density Results**

Test Input Power	3VDC (via a DC source)	Temperature	24°C
Attached Plots	29 - 31	Relative Humidity	59%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

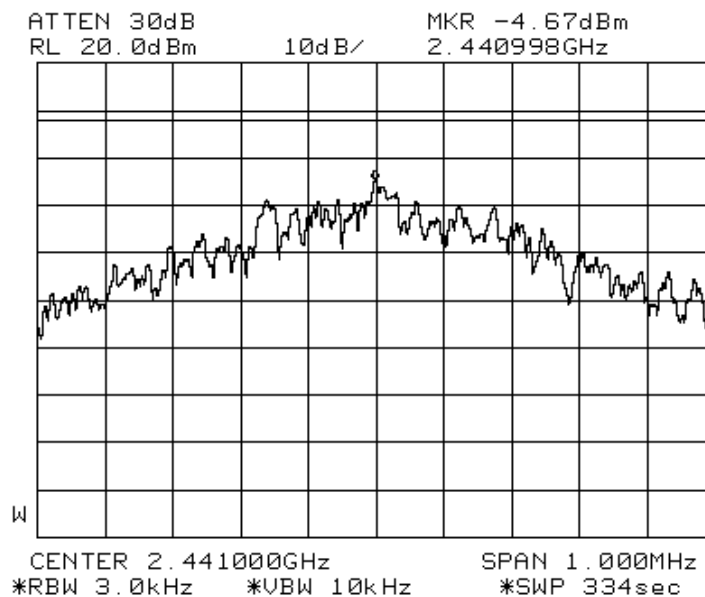
Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.402	0.3162	6.3
39	2.441	0.3412	6.3
78	2.480	0.2710	6.3

**PEAK POWER SPECTRAL DENSITY TEST**

**Peak Power Spectral Density Plots**



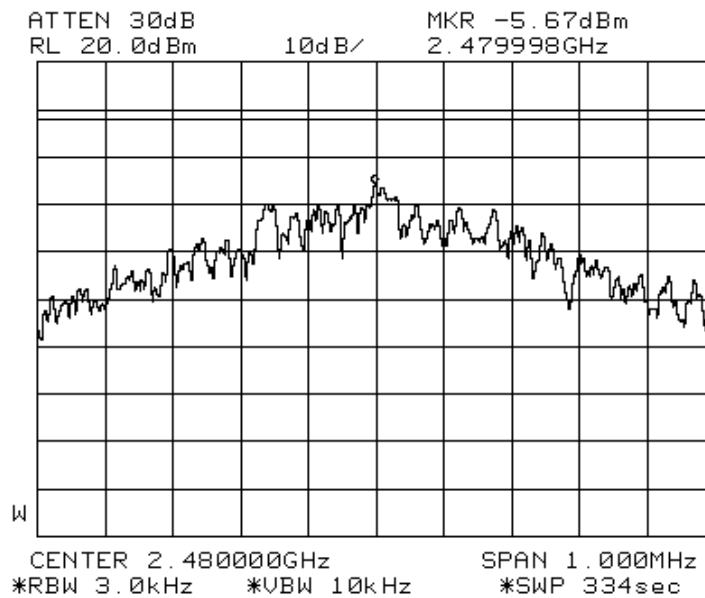
**Plot 29 – Channel 0**



**Plot 30 – Channel 39**

**PEAK POWER SPECTRAL DENSITY TEST**

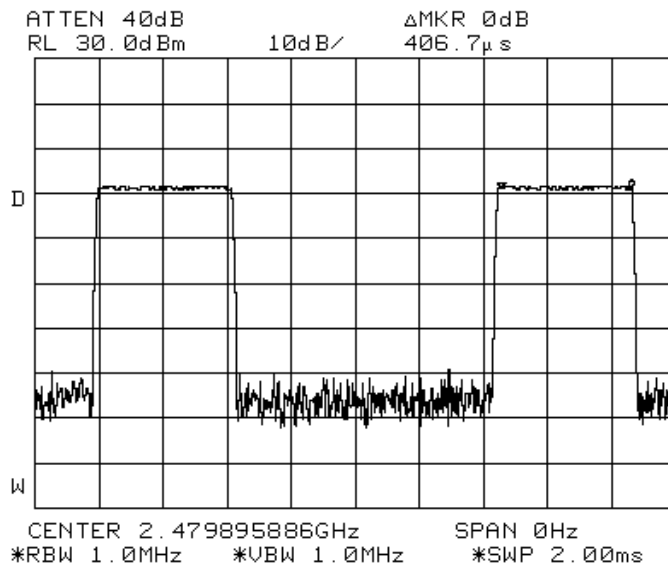
**Peak Power Spectral Density Plots**



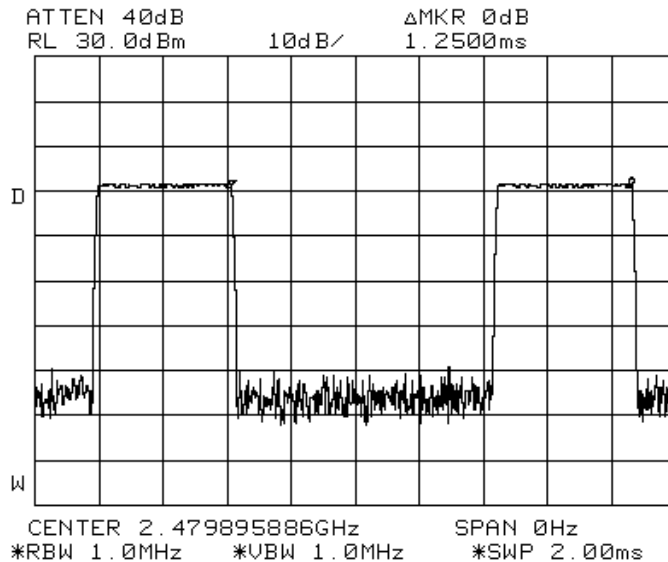
**Plot 31 – Channel 78**

## DUTY CYCLE FACTOR COMPUTATION

### FCC Part 15.35(c) Duty Cycle Correction Factor



On Time



Period

$$\begin{aligned}
 \text{Duty Cycle Factor (worst- case)} &= 20 \log [\text{Total On time} / \text{Period}] \\
 &= 20 \log [(0.4067 / 1.2500)] \\
 &= \underline{\underline{-9.7\text{dB}}}
 \end{aligned}$$

**Test Report No. 56S060708/03**  
**dated 12 Feb 2007**



This Report is issued under the following conditions:

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
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October 2006



**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

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## **ANNEX A**

### **EUT PHOTOGRAPHS / DIAGRAMS**

**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**Front View**



**Rear View**



**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**Left View**

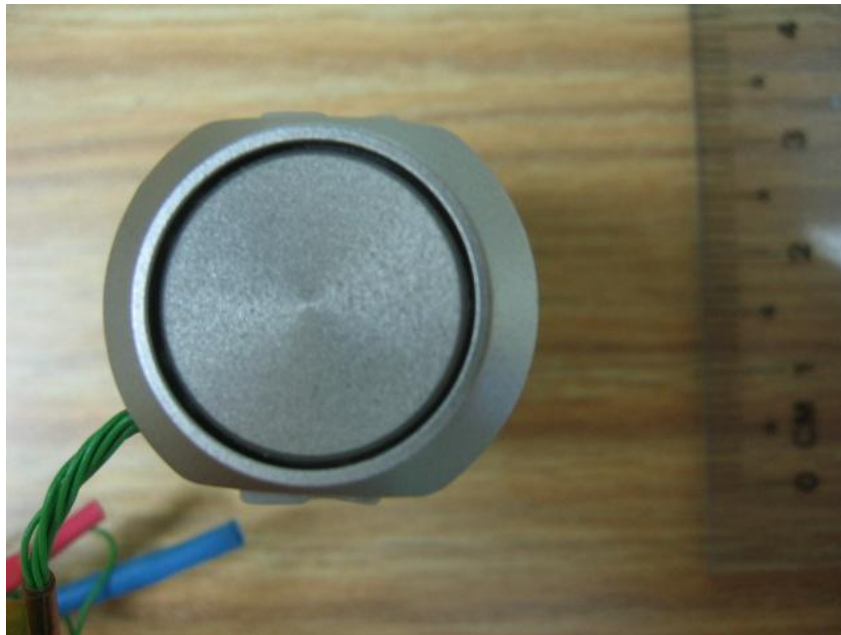


**Right View**

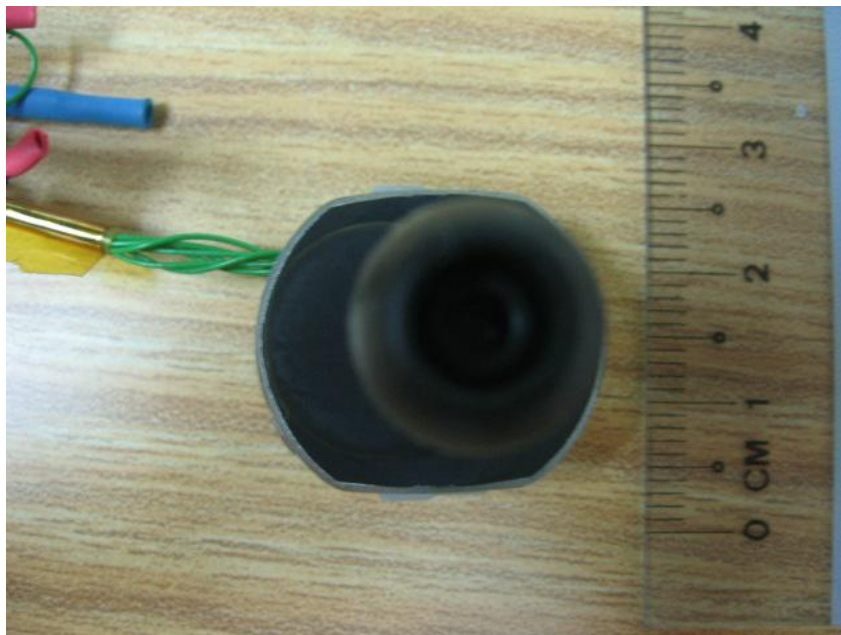
**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**Top View**



**Bottom View**

**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**EUT Power Adapter Front View**



**EUT Power Adapter Rear View**



**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**EUT Charger Station Front View**

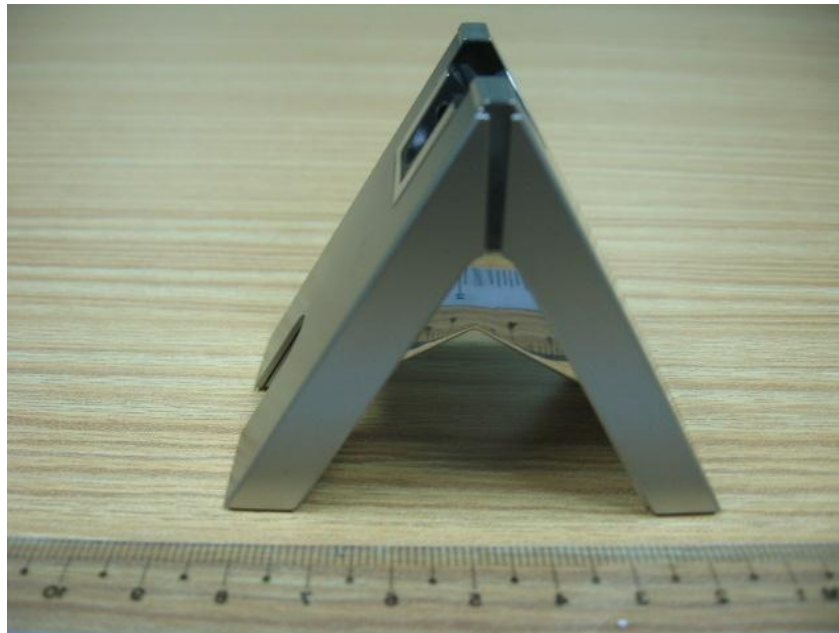


**EUT Charger Station Rear View**

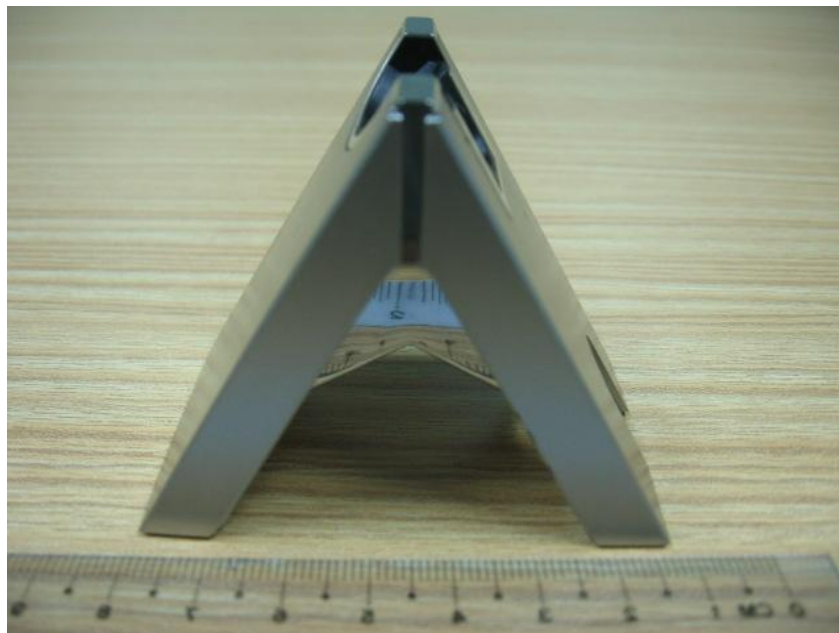
**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**EUT Charger Station Left View**

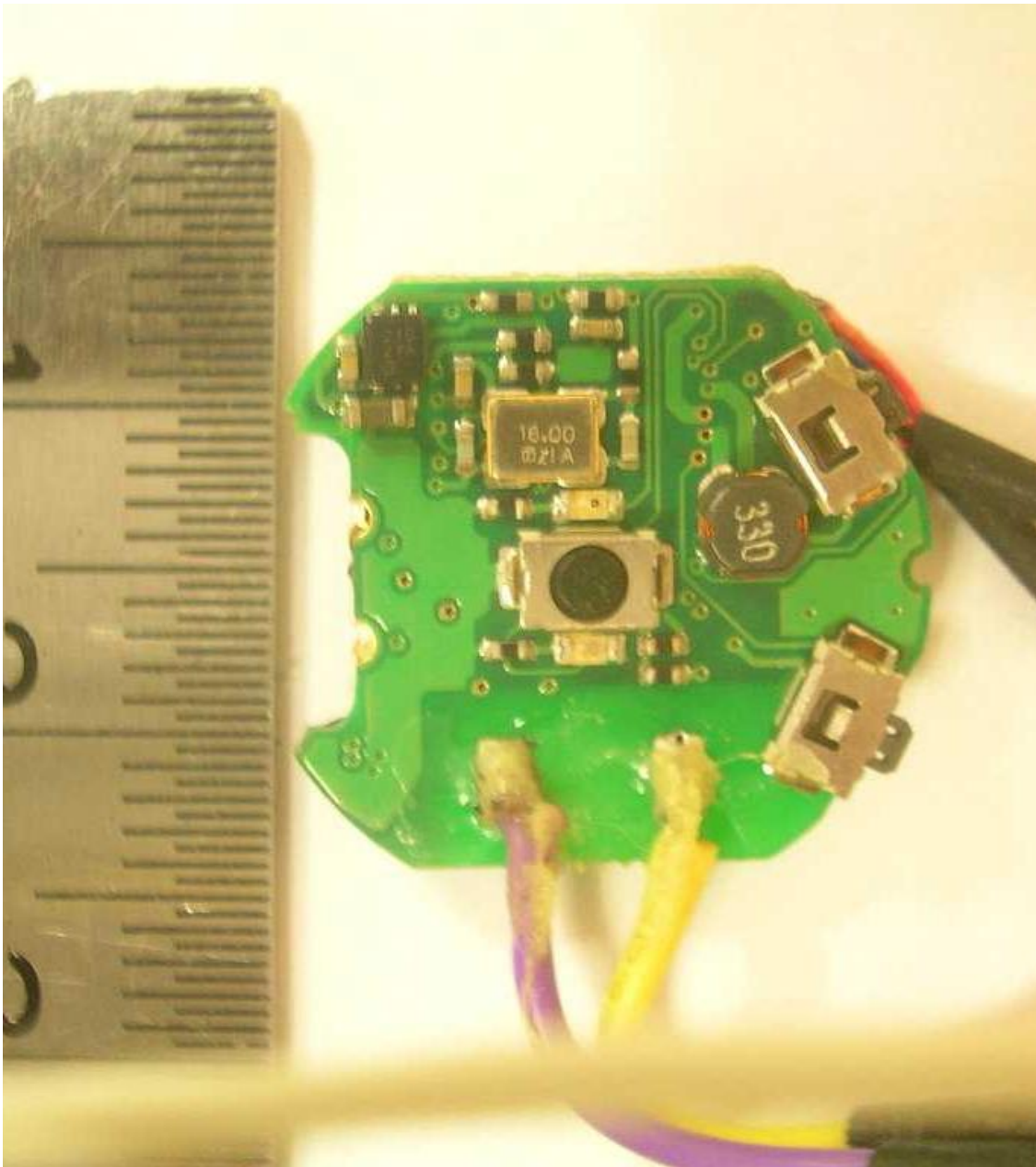


**EUT Charger Station Right View**

**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**

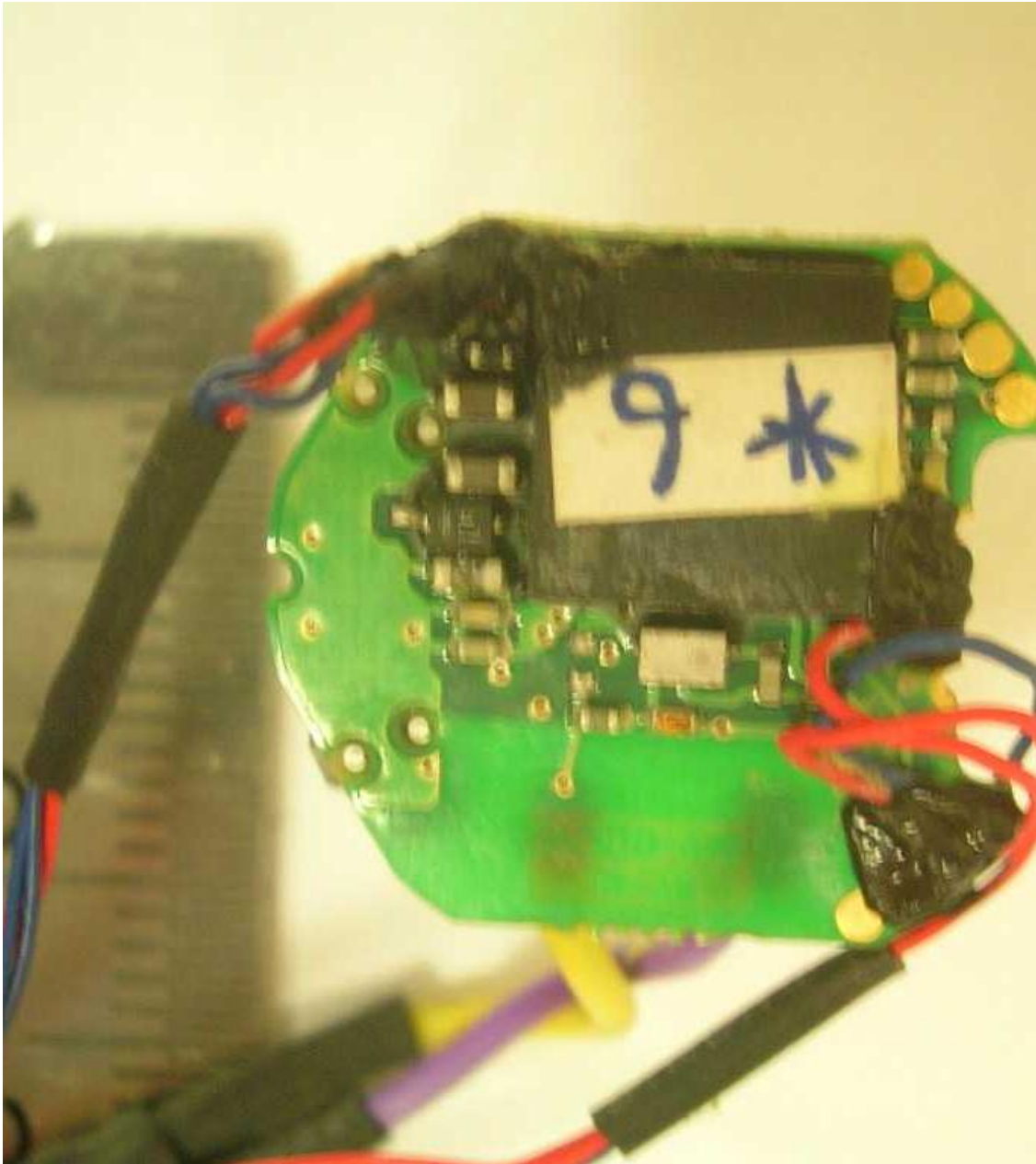


**Main-Board - PCB Component Side**

**EUT PHOTOGRAPHS / DIAGRAMS**

**ANNEX A**

**EUT PHOTOGRAPHS**



**Main-Board - PCB Trace Side**





**FCC LABEL & POSITION**

**ANNEX B**

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**ANNEX B**

**FCC LABEL & POSITION**

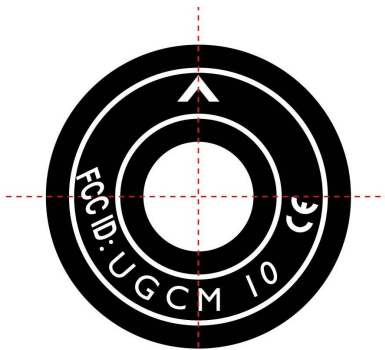


## FCC LABEL & POSITION

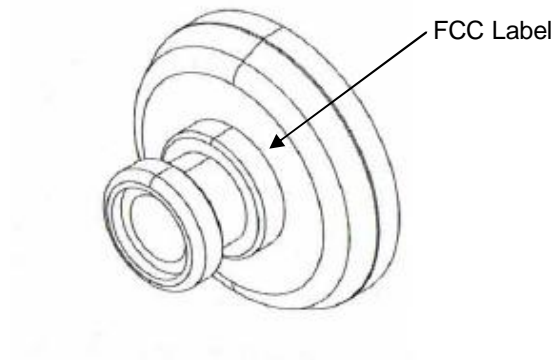
## ANNEX B

Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.



Sample Label



Physical Location of FCC Label on EUT

**USER MANUAL TECHNICAL DESCRIPTION BLOCK  
& CIRCUIT DIAGRAMS**

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**ANNEX C**

**ANNEX C**

**USER MANUAL  
TECHNICAL DESCRIPTION  
BLOCK & CIRCUIT DIAGRAMS**  
(Please refer to manufacturer for details)