TEST REPORT

Your Ref:

Date: 05 Dec 2005

Our Ref: 56S051023/01

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
FCC Parts 15B & C : 2005
OF A
WIRELESS MULTIMEDIA SPEAKER SYSTEM
[Model : MF4080]
[FCC ID : IBA-MF4080TX01, IBA-MF4080RX01]

TEST FACILITY	Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd 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 (10m Anechoic Chamber)
PREPARED FOR	Mr Koh Nai Ghee Creative Technology Ltd 31 International Business Park Creative Resource Singapore 609921 Tel : (65) 6895 4483 Fax : (65) 6895 4050
JOB NUMBER	56S051023
TEST PERIOD	23 Nov 2005 - 29 Nov 2005

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ISO 9001 JQA-QMA 10040

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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	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 marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

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

Test Results Summary

Test Standard	Description	Pass / Fail
FCC Part 15: 2005		
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	Pass
15.247(e)	Peak Power Spectral Density	Pass
1.1310	Maximum Permissible Exposure	Pass
15.35(c)	Duty Cycle Factor Computation	Refer to page 67-70 for details

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.

Transmit Channel	Frequency (GHz)
Channel 1	2.403
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.

Modifications

1. No modifications were made.

Description	:	**Creative Wireless Multimedia Speaker System (model MF4080)** is a 5.1-multimedia speaker system for audio playback with PCs and DVD home theatre systems. The speaker is capable of producing 36W per satellite output and 130W for subwoofer. The main amplifiers for front channels and subwoofer are located within the subwoofer box and an external volume control pod controls the system. The rear channels are wireless and utilize 2.4GHz digital technology. The wireless transmitter is housed within the volume control pod whereas the wireless receiver is housed together with the rear channels amplifier and power supply. The satellite, control and audio input cables connected to the product are not longer than 3m.
Manufacturer	:	Gigatek Electronics (Dong Guan) Co. Ltd In Yang Industrial Zhang Yang District, Zhangmutou Zhen, Dong Guan City, Guang Dong Province, China.
Model Number	:	MF4080
FCC ID	:	IBA-MF4080TX01, IBA-MF4080RX01
Serial Number	:	Nil
Microprocessor	:	NEC - uPD78F0501, VConnect/Open Solution – DWM3100, PI – TOP249Y
Operating Frequency/Transmitting Frequency	:	2.4030GHz (lower channel) to 2.4800GHz (upper channel) 69 channels.
Clock /Oscillator Frequency	:	132KHz(jitter), 330KHz, 12.288MHz, 16MHz, 20MHz, 32MHz,
Port / Connectors	:	Subwoofer Unit: DSUB15 – Volume Control Pod RCA x 6 – Audio inputs Speaker Push Terminal x 3 pairs – satellite cable output AC mains socket with fuse holder – Power mains input Transmitter Unit 4 pole stereo socket – Aux input 3 pole stereo socket – Headphone output Receiver Unit: Speaker Push Terminal x 2 pairs – satellite cable output AC mains socket with fuse holder – Power mains input
Rated Input Power	:	Subwoofer/Transmitter: 120Vac, 60Hz, 2A Receiver : 100-240VAC 50/60Hz,1A
Accessory	:	Stereo to RCA x 3 4 pole to 4 pole stereo cable x 1 Power cord x 2 Satellite cable x 5 Satellite table stand and screw x 5 Wall mounting Screw x 7 Remote control

SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	**Model, Serial & FCC ID Number**	**Cable Description** (List Length, Type & Purpose)
HP Spectrum Analyzer	M/N: 8564E S/N: 3846A01433 FCC ID: DoC	1.80m standard power cable
RSS Universal Radio Communication Tester	M/N: CMU200 S/N: 837587/068 FCC ID: DoC	1.80m standard power cable
Agilent DC Power Supply	M/N: E3034A S/N: MY4000158 FCC ID: DoC	1.80m standard power cable
Agilent DC Power Supply	M/N: E3620A S/N: Nil FCC ID: DoC	1.80m standard power cable

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. **Maximum Permissible Exposure** 8. **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**
The EUT was exercised by operating in maximum continuous transmission with frequency hopping on.

FCC Parts 15.107(a) and 15.207 Conducted Emission Limits

Frequency Range	Limit Values (dBµV)	
(MHz)	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
Agilent EMC Analyzer – SA6	E7403A	US41160166	26 May 2006
R&S Test Receiver – ESI1	ESI40	100010	1 Aug 2006
Schaffner LISN (for EUT)	NNB42	04-10057	20 May 2006

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 50Ω/50µH 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.

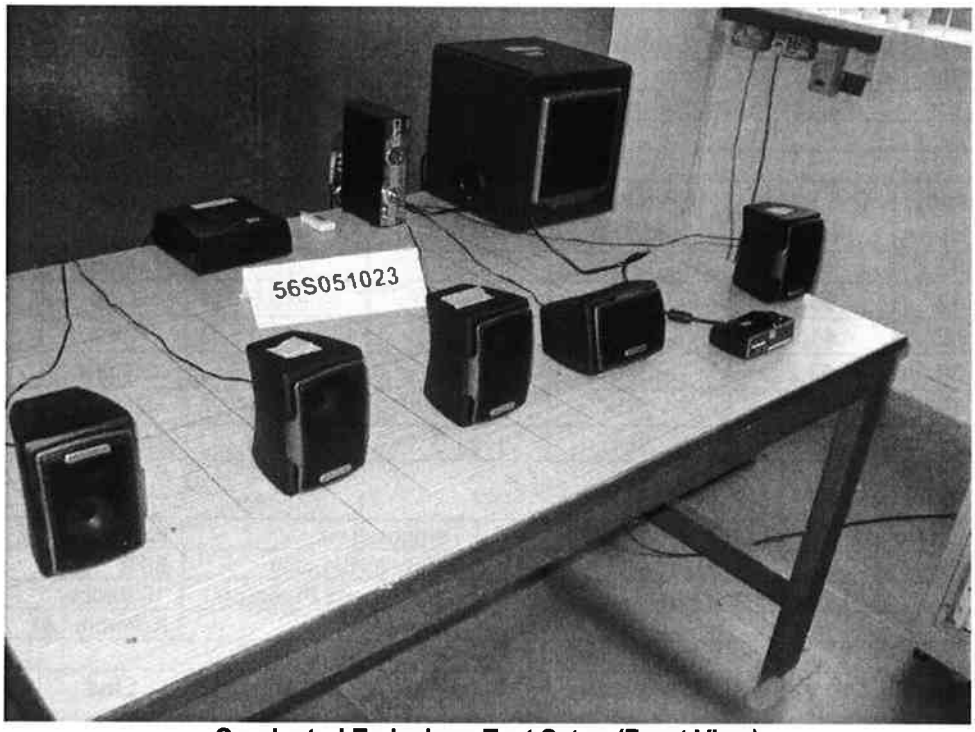
Sample Calculation Example

At 20 MHz Q-P limit (Class B) = 100 µV = 60.0 dBµV

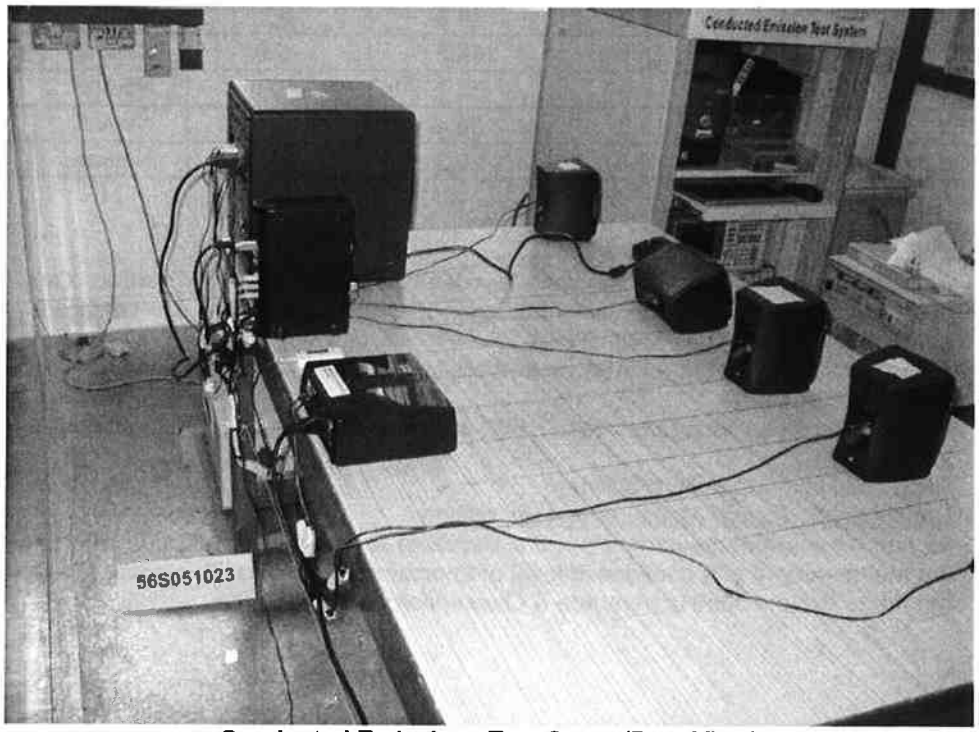
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dBµV
(Calibrated for system losses)

Therefore, Q-P margin = 40.0 - 60.0 = -20.0 i.e. **20.0 dB below Q-P limit**



Conducted Emissions Test Setup (Front View)



Conducted Emissions Test Setup (Rear View)

FCC Parts 15.107(a) and 15.207 Conducted Emission Results

Test Input Power	110Vac 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	58%
Eut	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.5403	40.2	-15.8	30.7	-15.3	Live	Mid
8.2242	36.9	-23.1	34.5	-15.5	Live	Mid
22.1225	41.5	-18.5	36.6	-13.4	Live	Mid
0.2689	42.2	-19.0	35.5	-15.7	Neutral	Mid
0.3942	42.5	-15.5	34.6	-13.4	Neutral	Mid
1.3524	35.6	-20.4	21.0	-25.0	Neutral	Mid

Test Input Power	110Vac 60Hz	Temperature	22°C
Line Under Test	AC Mains	Relative Humidity	58%
Eut	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Kenneth Ler

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.2679	52.3	-8.9	46.0	-5.2	Neutral	Mid
0.3944	52.7	-5.3	44.9	-3.1	Neutral	Mid
0.5357	50.3	-5.7	40.5	-5.5	Neutral	Mid
0.6561	46.1	-9.9	35.2	-10.8	Neutral	Mid
1.3462	46.5	-9.5	30.4	-15.6	Neutral	Mid
1.4738	46.2	--9.8	29.3	-16.7	Neutral	Mid

Notes

1. 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.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   9kHz - 30MHz
   RBW: 10kHz VBW: 30kHz
4. 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 ±2.4dB.

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) – ESMI3	ESMI	829214/005 829550/004	04 Oct 2006
HP Preamplifier (for ESMI2, 0.01-3GHz) – PA2	8447D	2944A08173	01 Apr 2006
MITEQ Preamplifier (0.1-26.5GHz) – PA3	NSP2650-N	592346	01 Apr 2006
Schaffner Bilog Antenna – BL9	CBL6143	5045	19 May 2006
EMCO Horn Antenna – H5	3115	6214	25 Apr 2006

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

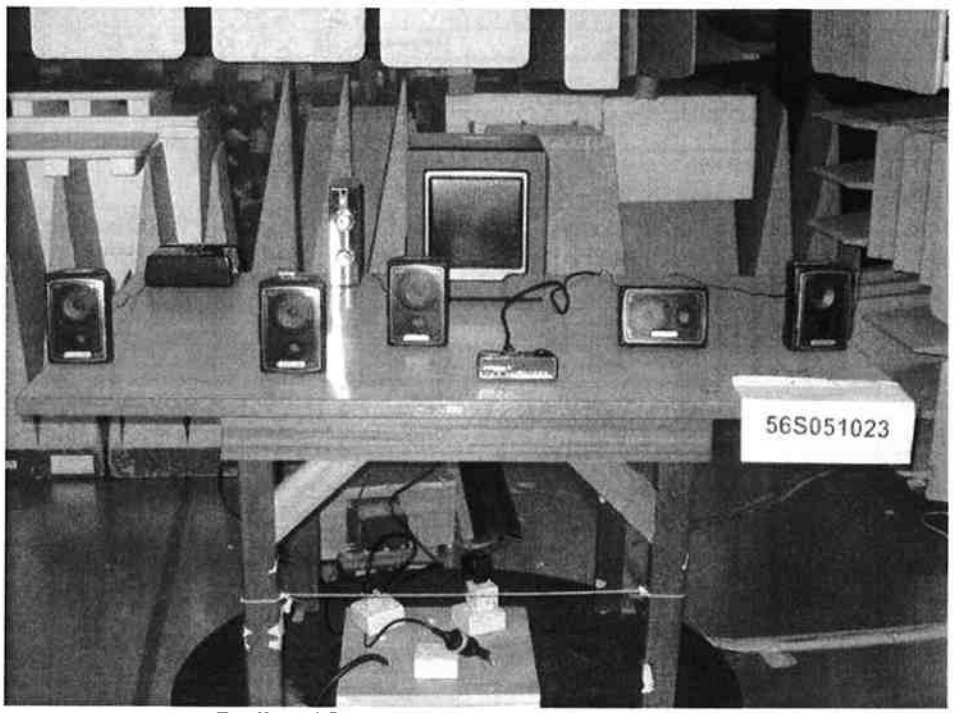
1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The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

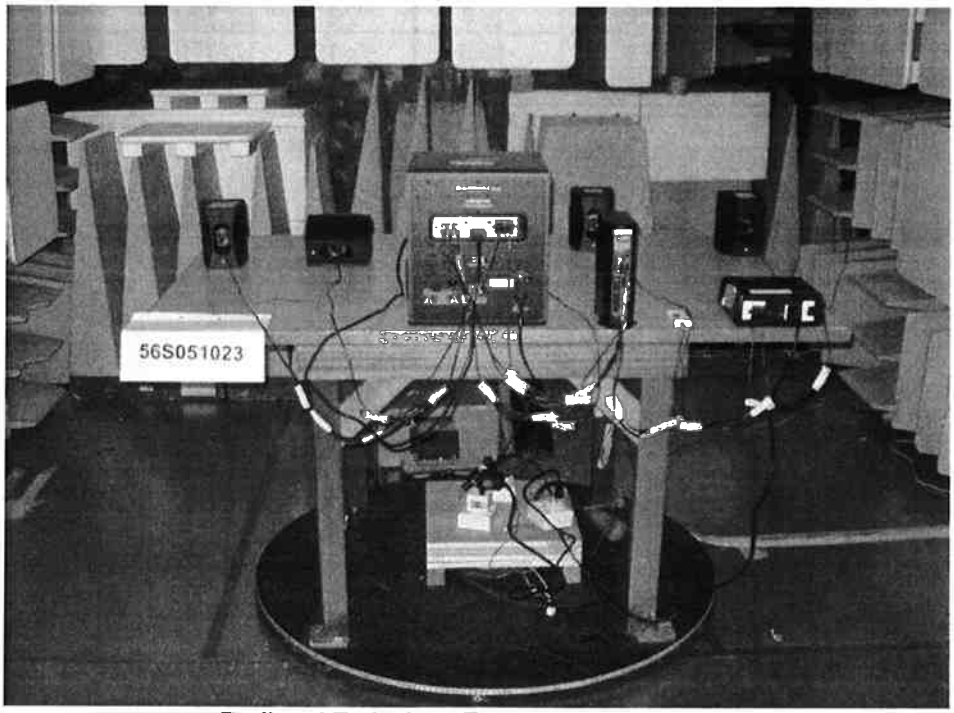
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which attitude 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 10th 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 μV/m = 46.0 dBμV/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dBμV/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 40.0 - 46.0 = -6.0	i.e. **6 dB below Q-P limit**



Radiated Emissions Test Setup (Front View)



Radiated Emissions Test Setup (Rear View)

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

Test Input Power	110Vac 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	58%
Eut	Transmitter	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
40.9300	30.5	-9.5	326	100	V	Mid
61.3400	27.8	-12.2	25	100	V	Mid
159.7190	39.7	-3.8	310	100	V	Mid
294.8800	37.7	-8.4	344	100	V	Mid
368.6101	38.2	-7.8	317	100	H	Mid
417.7594	38.6	-7.4	319	101	V	Mid

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
2.0010	44.8	31.8	-22.2	0	100	H	Mid
2.4021	47.4	34.4	-19.6	1	100	H	Mid
2.6666	48.7	35.7	-18.3	0	100	H	Mid
4.7999	50.2	37.2	-16.8	2	100	H	Mid
5.2777	51.1	38.1	-15.9	1	100	H	Mid
7.2000	46.8	33.8	-20.2	1	100	H	Mid

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

Test Input Power	110Vac 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	58%
Eut	Receiver	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
442.3200	36.9	-9.1	48	100	H	Mid
577.5093	41.5	-4.5	170	101	H	Mid
602.0800	41.0	-5.0	171	100	H	Mid
639.9500	40.4	-5.6	340	101	H	Mid
687.9294	40.6	-5.4	236	100	H	Mid
703.9372	39.7	-6.3	269	101	H	Mid

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
5.2030	48.2	32.9	-21.1	1	100	H	Mid
6.0008	47.9	32.6	-21.4	0	100	H	Mid
6.4010	46.9	31.6	-22.4	0	100	H	Mid
7.6000	50.0	34.7	-19.3	2	100	H	Mid
8.0100	49.9	34.6	-19.4	5	100	H	Mid
8.2001	50.1	34.8	-19.2	2	100	H	Mid

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. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. 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.

5. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
6. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
7. 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.
8. The channel in the table refers to the transmit channel of the EUT.
9. 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 ±4.3dB (for EUTs < 0.5m X 0.5m X 0.5m).

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

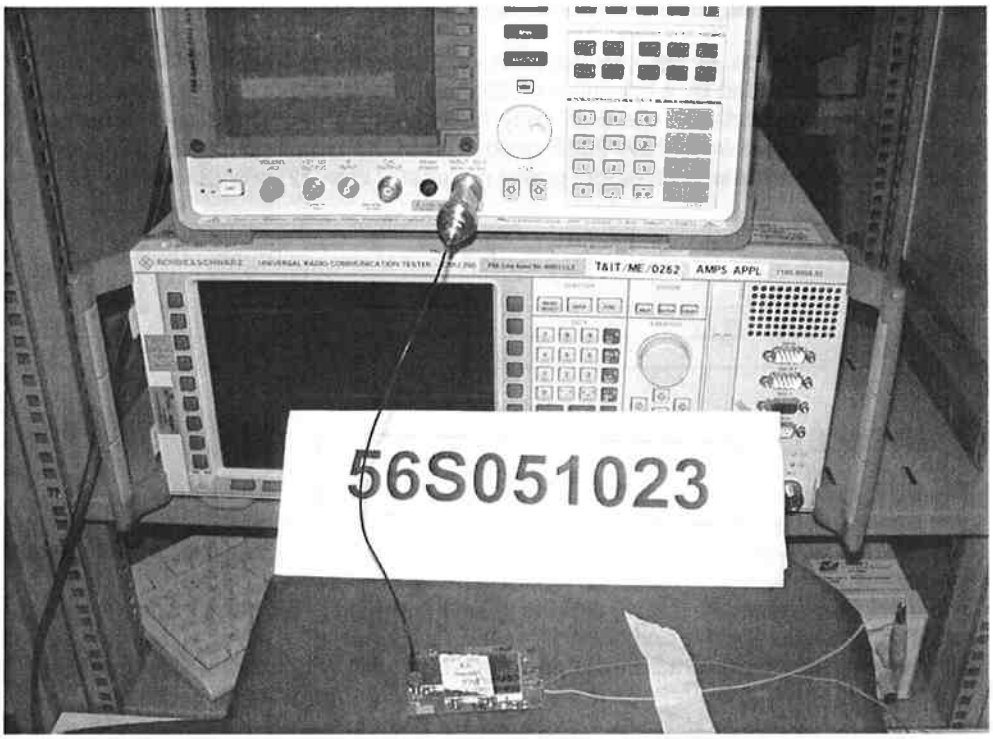
Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer	8564E	3846A01433	27 Apr 2006

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 2.402GHz and 2.405GHz.
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 transmitting / operating frequency 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. 2.478GHz to 2.481GHz



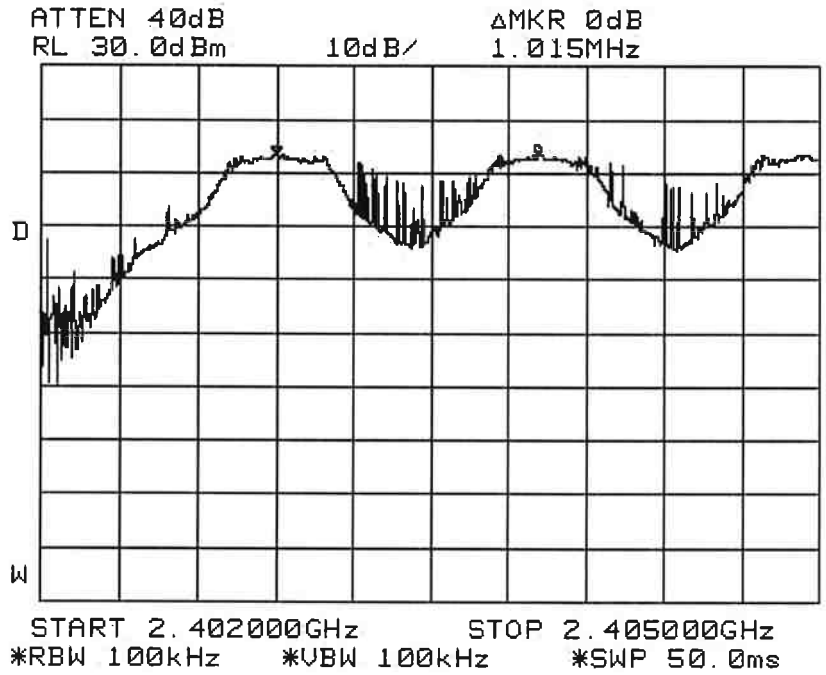
Carrier Frequency Separation Test Setup

FCC Part 15C (15.247(a)(1)) Carrier Frequency Separation Results

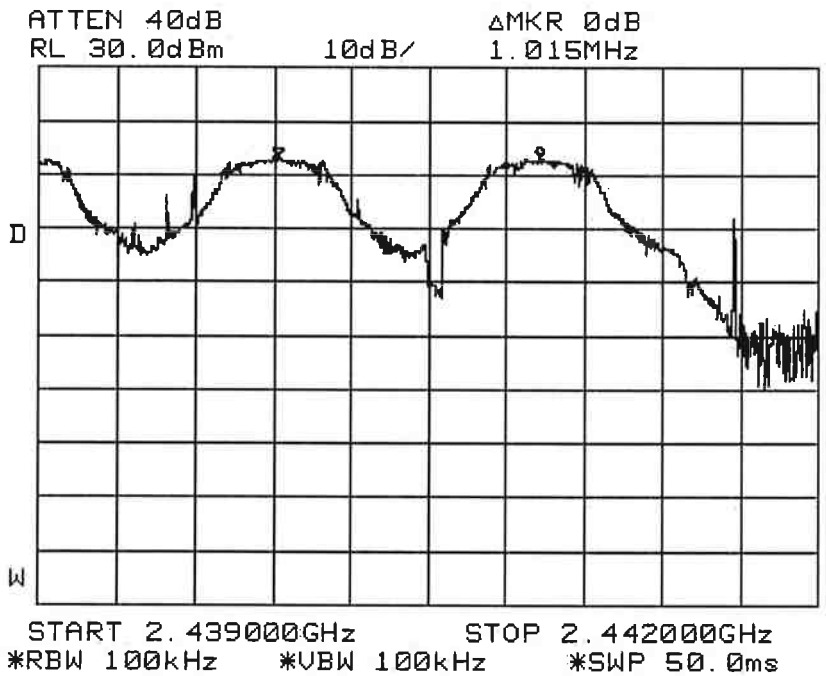
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	1 - 3	Relative Humidity	60%
Module	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Adjacent Channels	Channel Separation (MHz)
1 and 2 (2.403GHz and 2.404GHz)	1.015
38 and 39 (2.440GHz and 2.441GHz)	1.015
77 and 78(2.479GHz and 2.480GHz)	1.015

Carrier Frequency Separation Plots - Transmitter

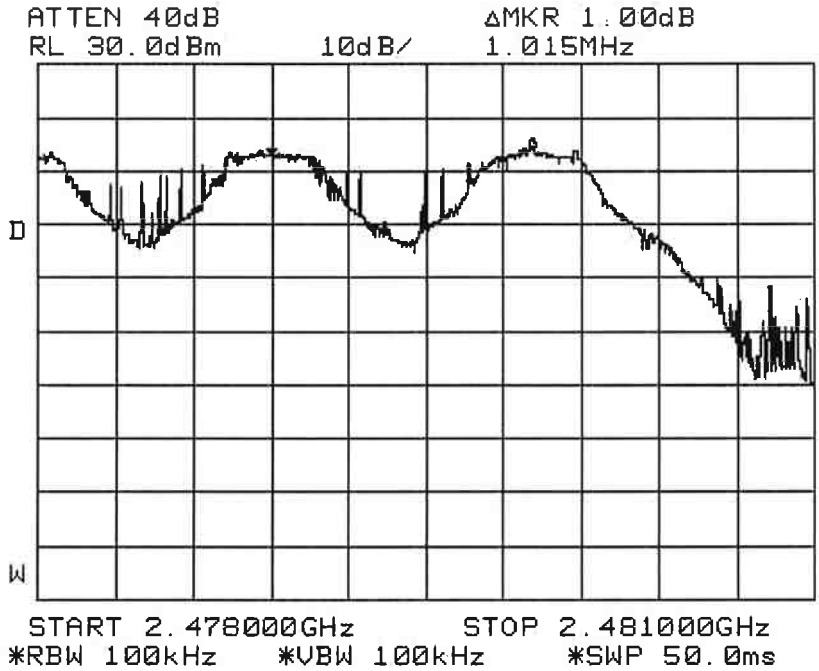


Plot 1 - Channels 1 and 2 Separation



Plot 2 - Channels 38 and 39 Separation

Carrier Frequency Separation Plots - Transmitter



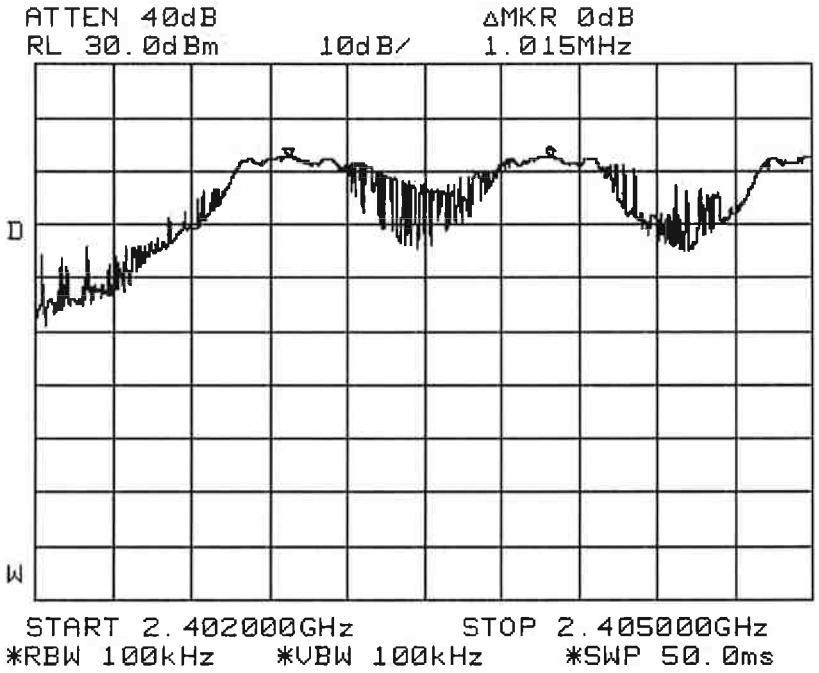
Plot 3 - Channels 77 and 78 Separation

CARRIER FREQUENCY SEPARATION TEST

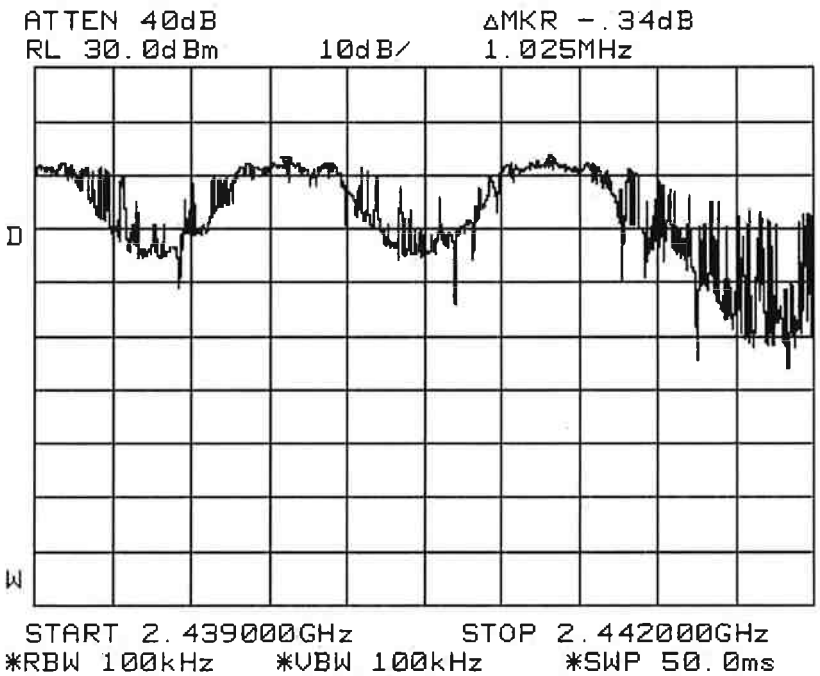
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	4 - 6	Relative Humidity	60%
Module	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Adjacent Channels	Channel Separation (MHz)
1 and 2 (2.403GHz and 2.404GHz)	1.015
38 and 39 (2.440GHz and 2.441GHz)	1.025
77 and 78(2.479GHz and 2.480GHz)	1.015

Carrier Frequency Separation Plots - Receiver

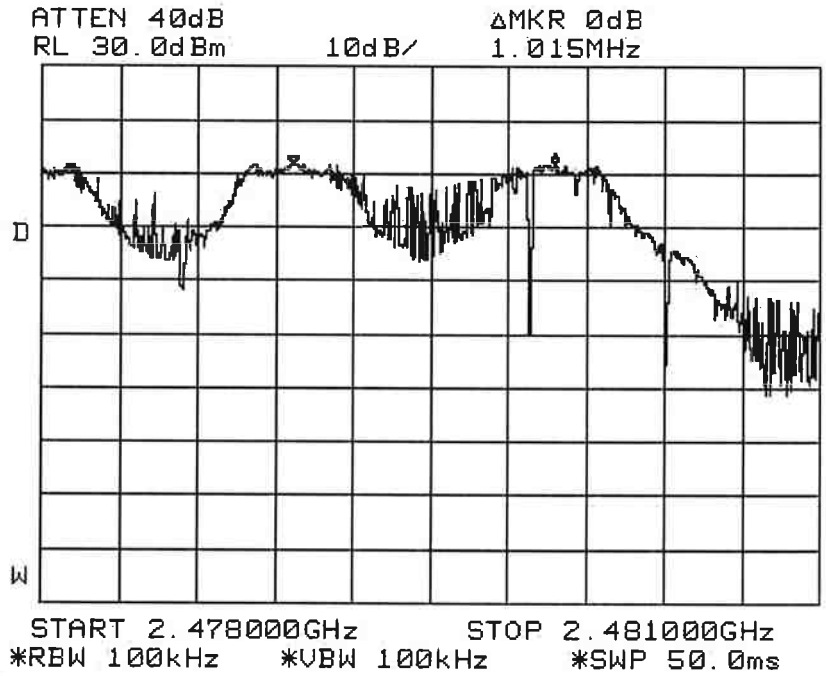


Plot 3 - Channels 1 and 2 Separation



Plot 4 - Channels 38 and 39 Separation

Carrier Frequency Separation Plots - Receiver



Plot 6 - 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

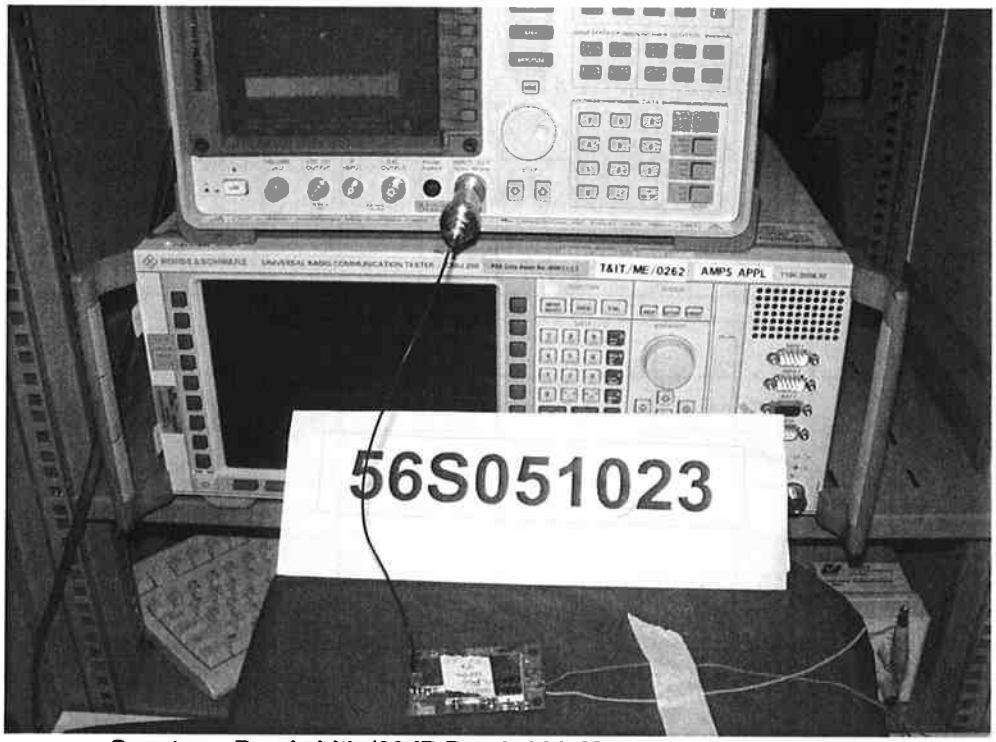
Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer	8564E	3846A01433	27 Apr 2006

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 1 (2.403GHz)
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 38 (2.441GHz) and Channel 78 (2.480GHz) respectively.



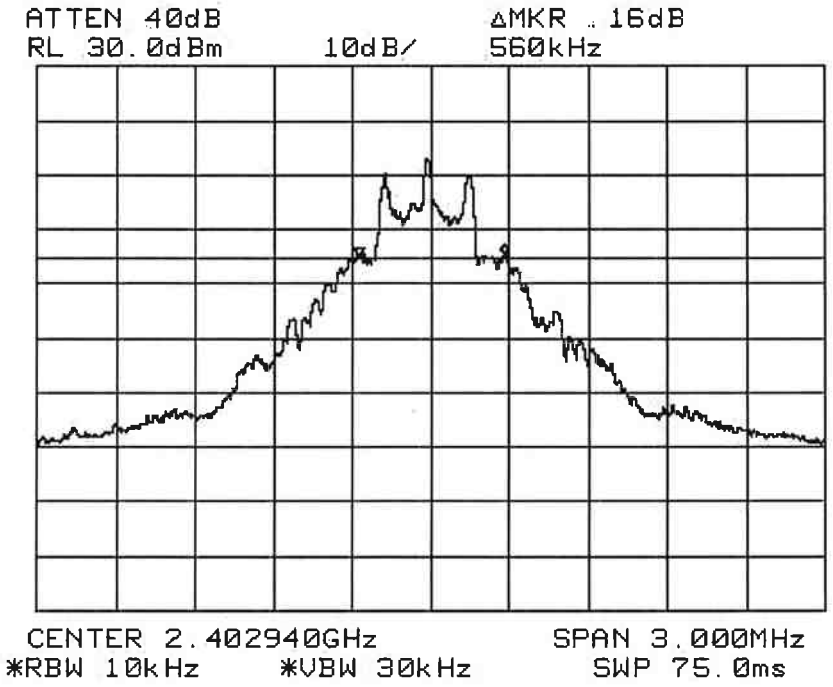
Spectrum Bandwidth (20dB Bandwidth Measurement) Test Setup

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

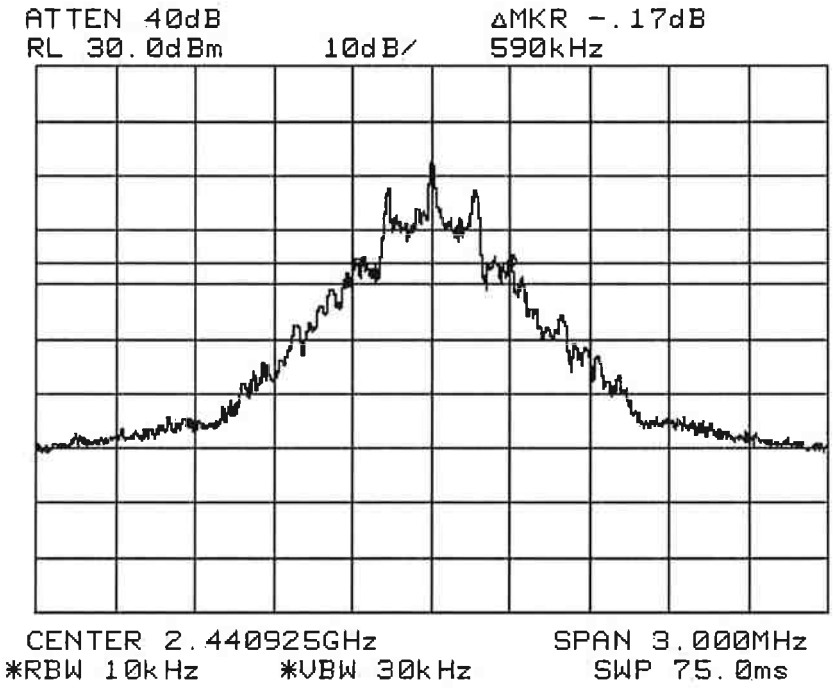
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	7 - 9	Relative Humidity	60%
Module	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Channel	Channel Frequency (GHz)	20dB Bandwidth (MHz)
1	2.403	0.560
39	2.441	0.590
78	2.480	0.605

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots - Transmitter

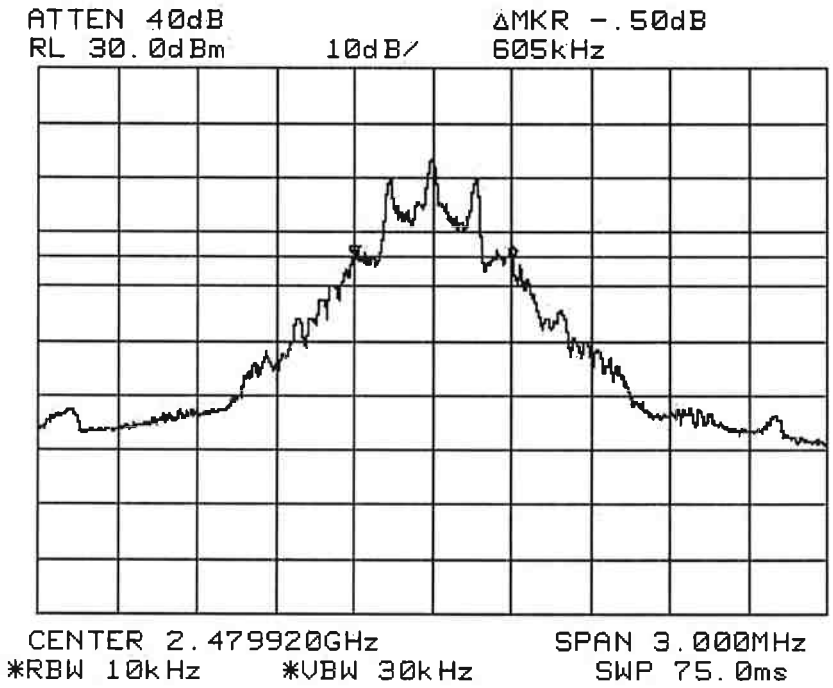


Plot 7 – Channel 1



Plot 8 – Channel 39

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots- Transmitter

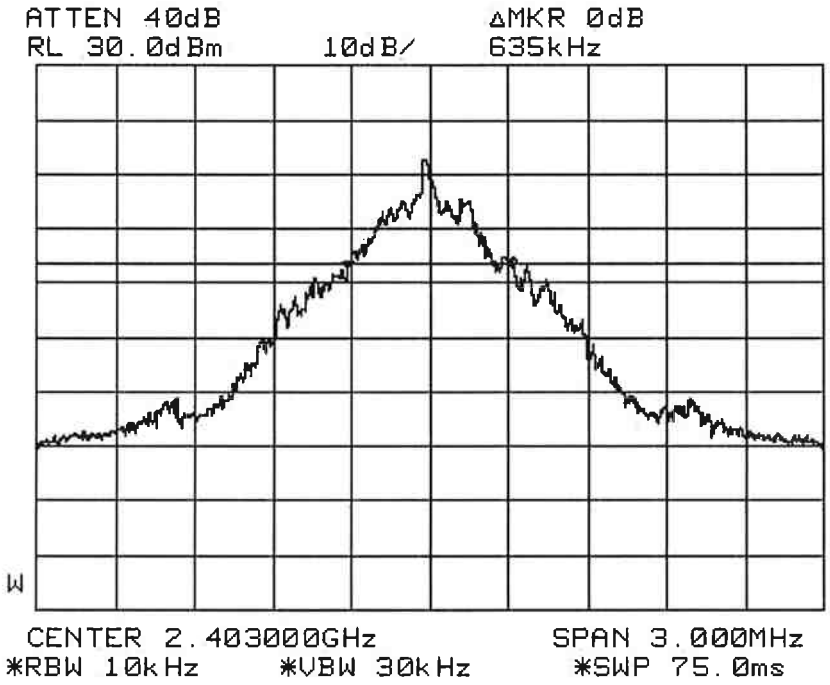


Plot 9 – Channel 78

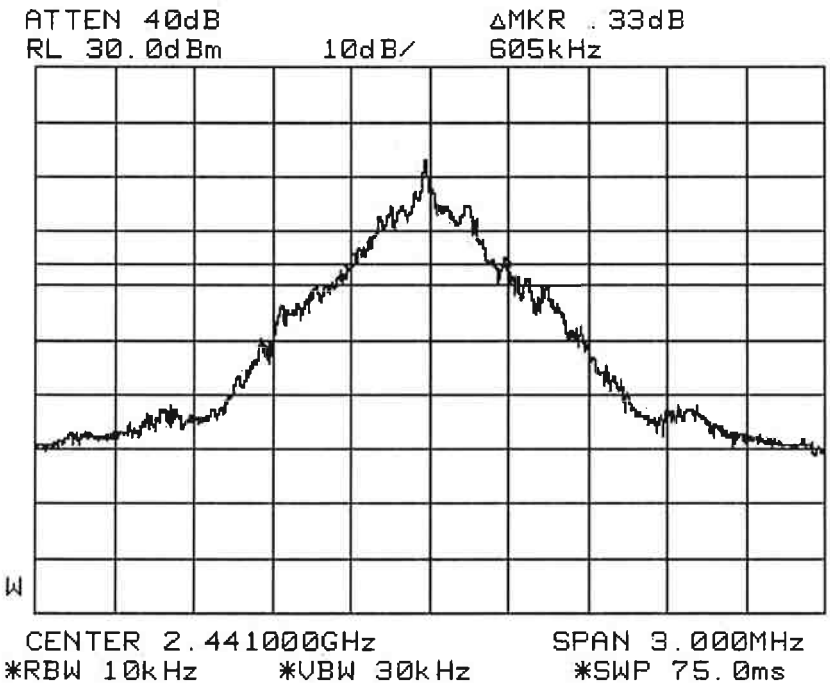
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	10 - 12	Relative Humidity	60%
Module	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Channel	Channel Frequency (GHz)	20dB Bandwidth (MHz)
1	2.403	0.635
39	2.441	0.605
78	2.480	0.600

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots- Receiver

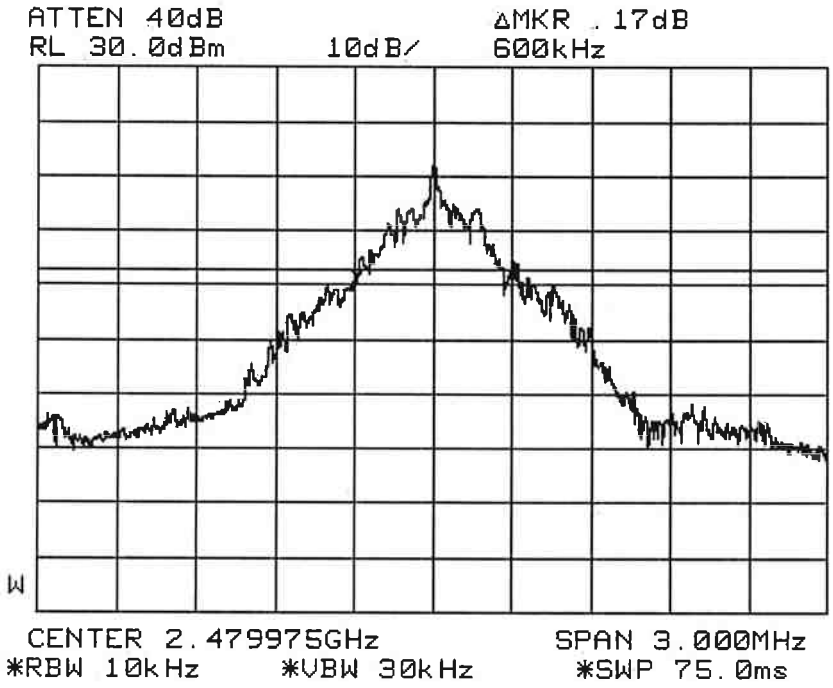


Plot 10 – Channel 1



Plot 11 – Channel 39

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots - Receiver



Plot 12 – Channel 78

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

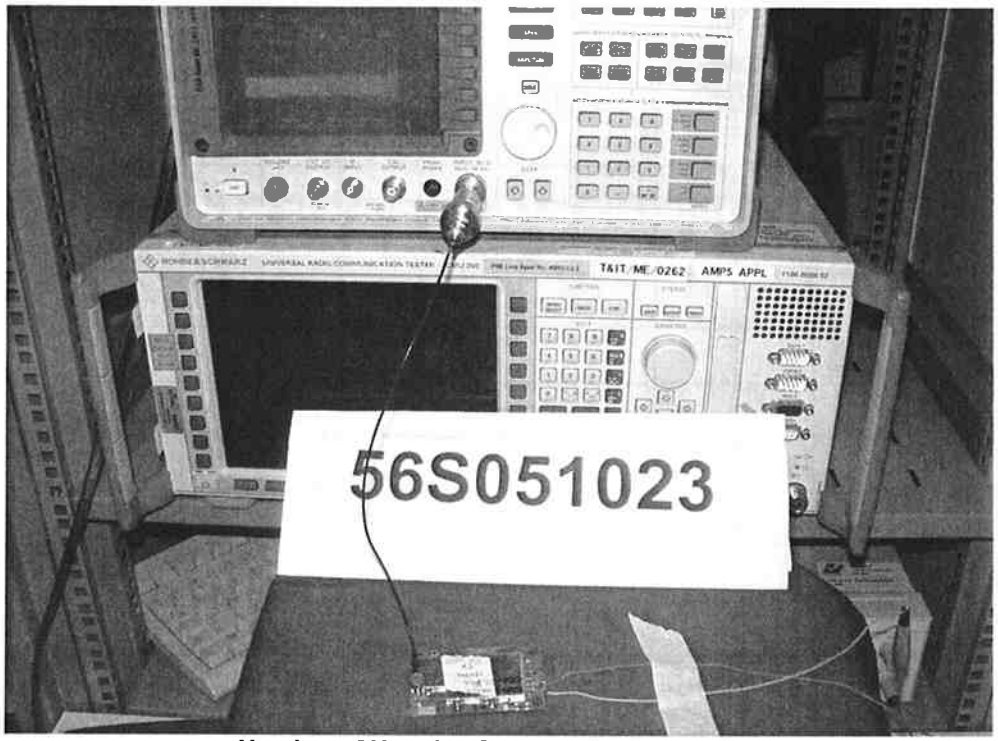
Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer	8564E	3846A01433	27 Apr 2006

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.



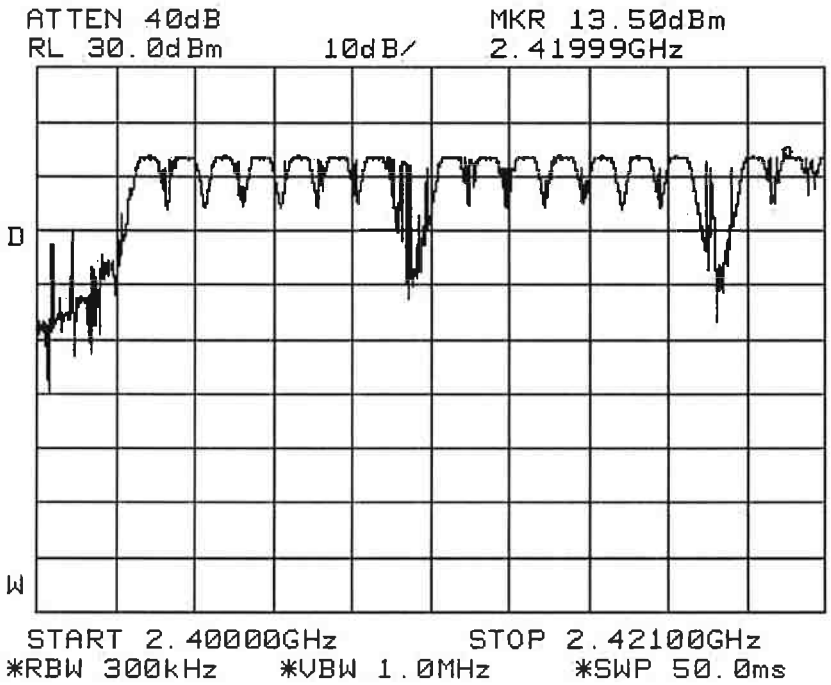
Number of Hopping Frequencies Test Setup

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

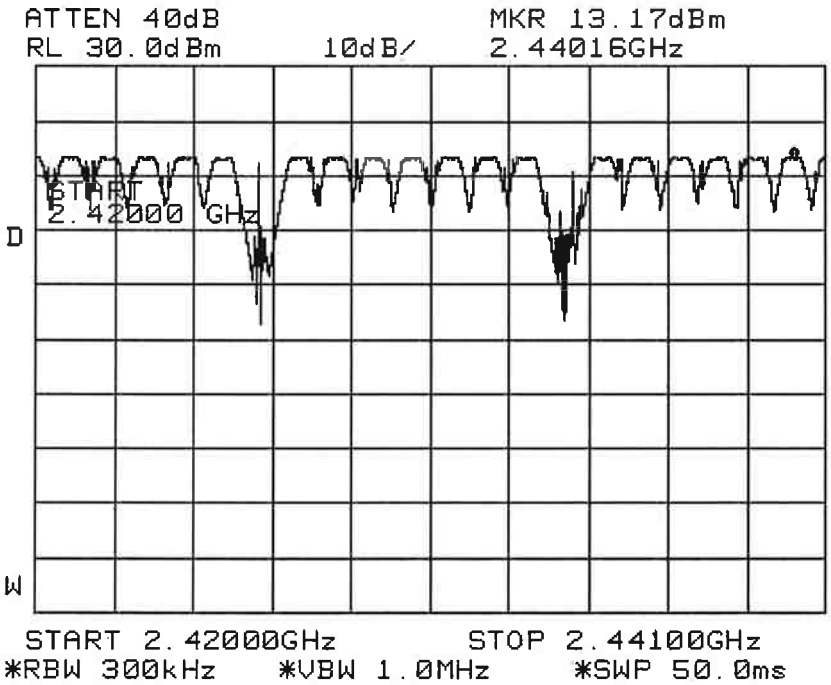
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	13 - 16	Relative Humidity	60%
Module	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

The EUT was found to have 69 hopping frequencies. Please refer to the attached plots.

Number Of Hopping Frequencies Plots - Transmitter

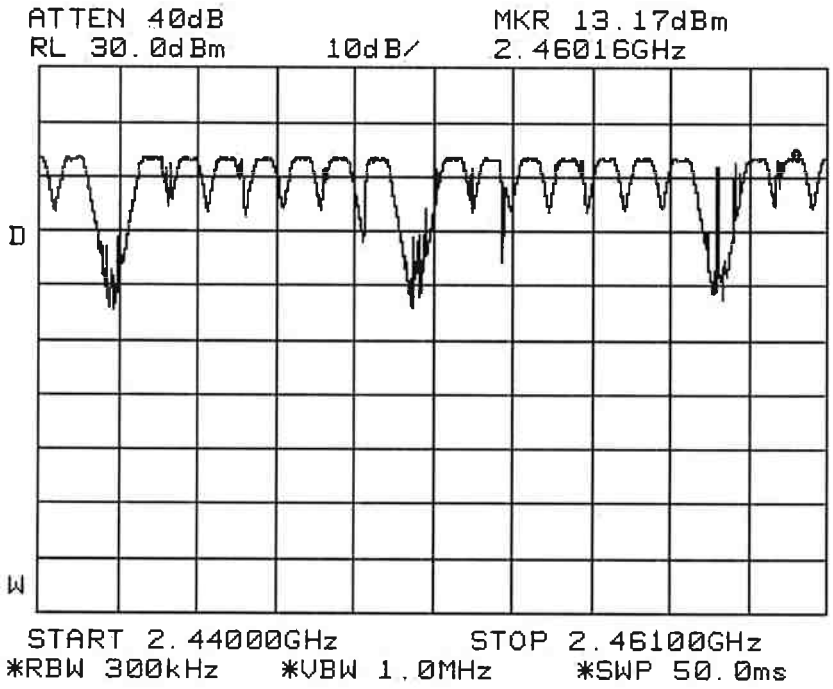


Plot 13 – Channels 1 to 18

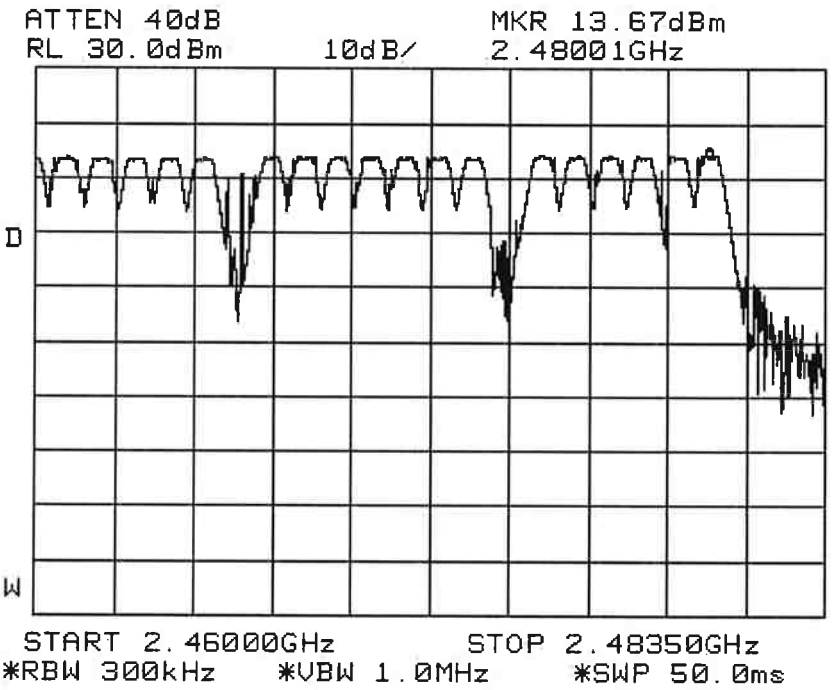


Plot 14 – Channels 19 to 38

Number Of Hopping Frequencies Plots - Transmitter



Plot 15 – Channels 39 to 58

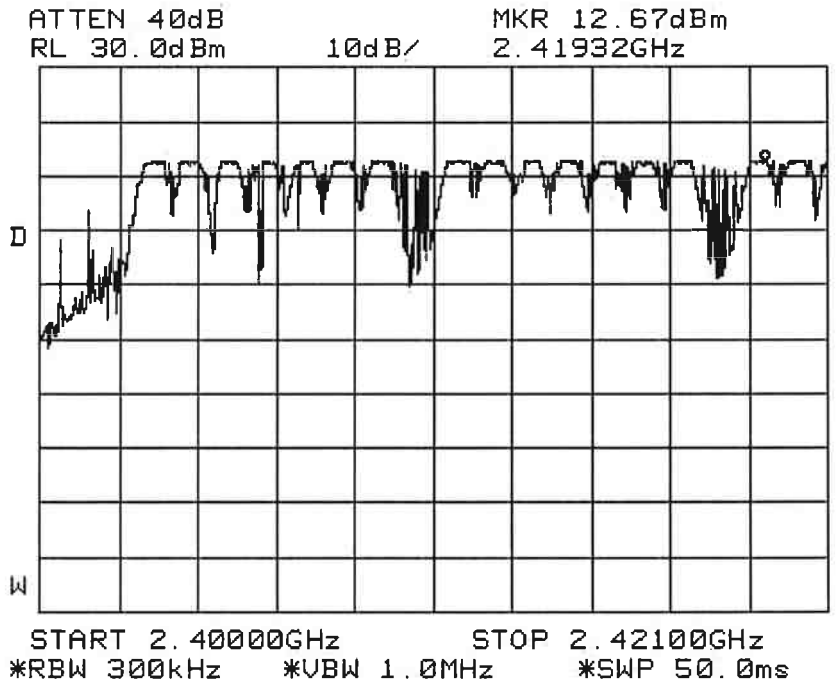


Plot 16 - Channels 59 to 78

NUMBER OF HOPPING FREQUENCIES TEST

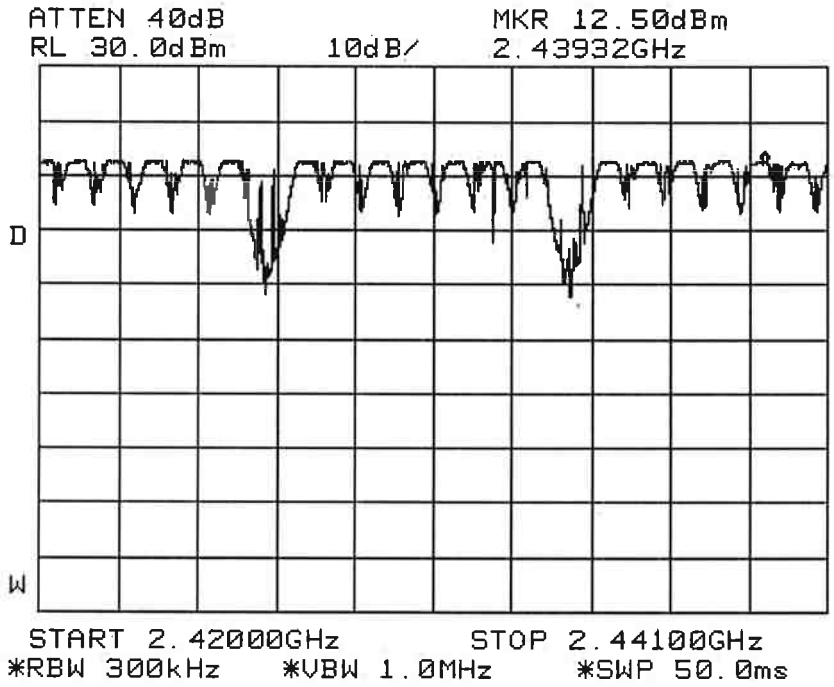
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	17 - 20	Relative Humidity	60%
Module	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

The EUT was found to have 69 hopping frequencies. Please refer to the attached plots.

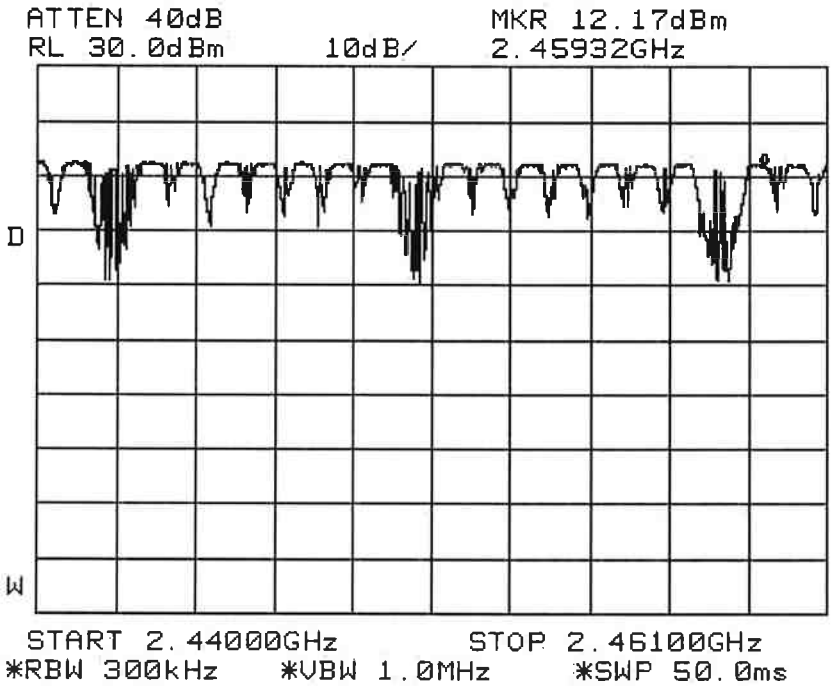


Plot 17 - Channels 1 to 18

Number Of Hopping Frequencies Plots - Receiver

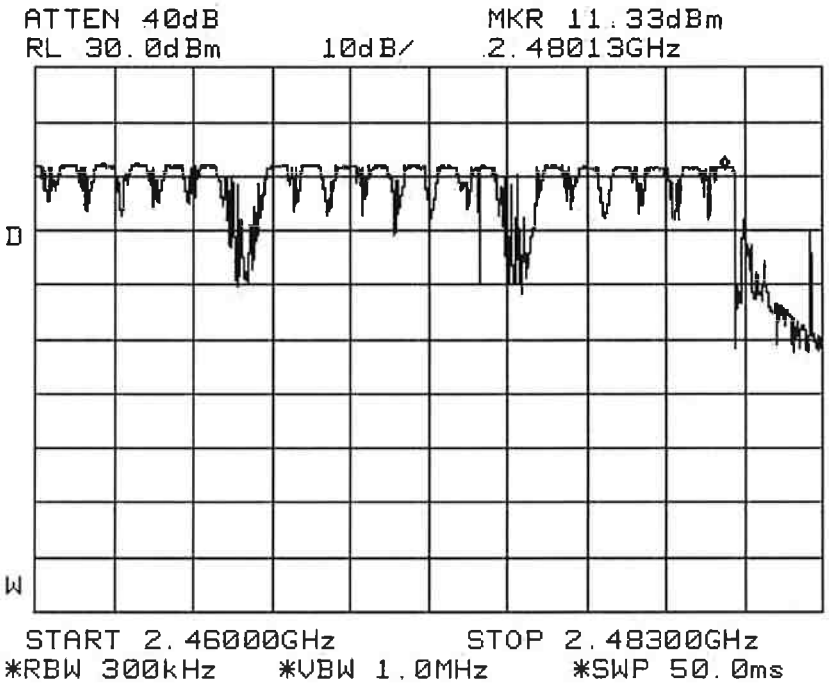


Plot 18 - Channels 19 to 38



Plot 19 - Channels 39 to 58

Number Of Hopping Frequencies Plots - Receiver



Plot 20 - Channels 59 to 78

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	8564E	3846A01433	27 Apr 2006

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 3MHz
5. All other supporting equipment were powered separately from another filtered mains.

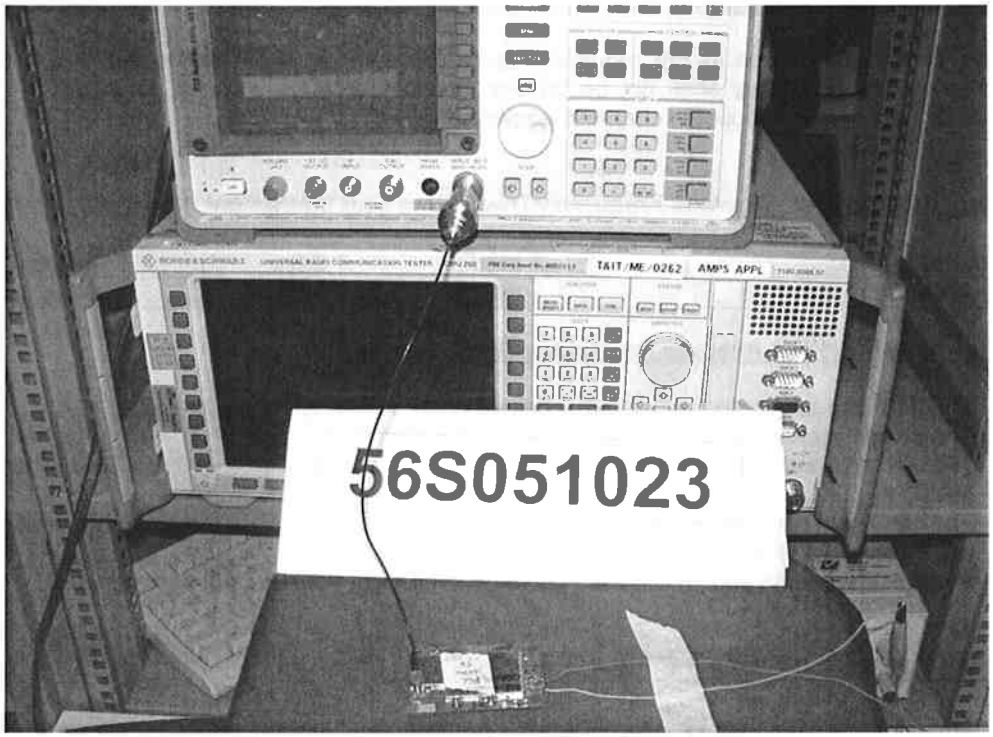
FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Test Method

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 2.403GHz 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 as below:

   Average Frequency Dwell Time = [measured time slot length x hopping rate / number of hopping channels] x [0.4 x number of hopping channels]

   where EUT hopping rate = 400 hops/s
   Number of EUT hopping channels = 69 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 Setup

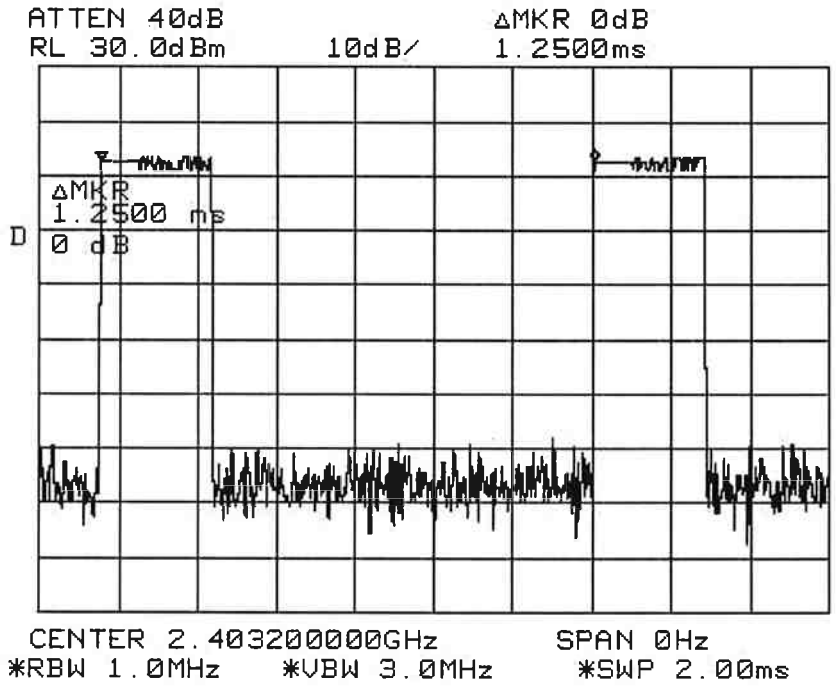
FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Results

Test Input Power	5Vdc	Temperature	24°C
Attached Plots	21 - 23	Relative Humidity	60%
Hopping Rate	400 hops / s	Atmospheric Pressure	1030mbar
Number of Hopping Channels	69 channels	Tested By	Johnsen Tia

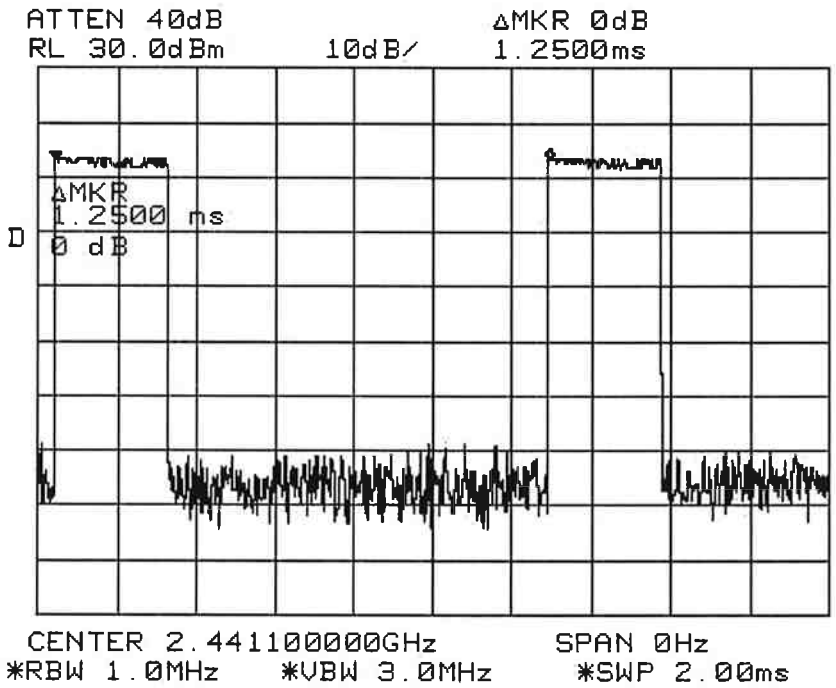
Transmitter

Channel	Channel Frequency (GHz)	Measured Time Slot Length (ms)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
1	2.403	1.2500	0.2	0.4
39	2.441	1.2500	0.2	0.4
78	2.480	1.2500	0.2	0.4

Average Frequency Dwell Time Plots - Transmitter

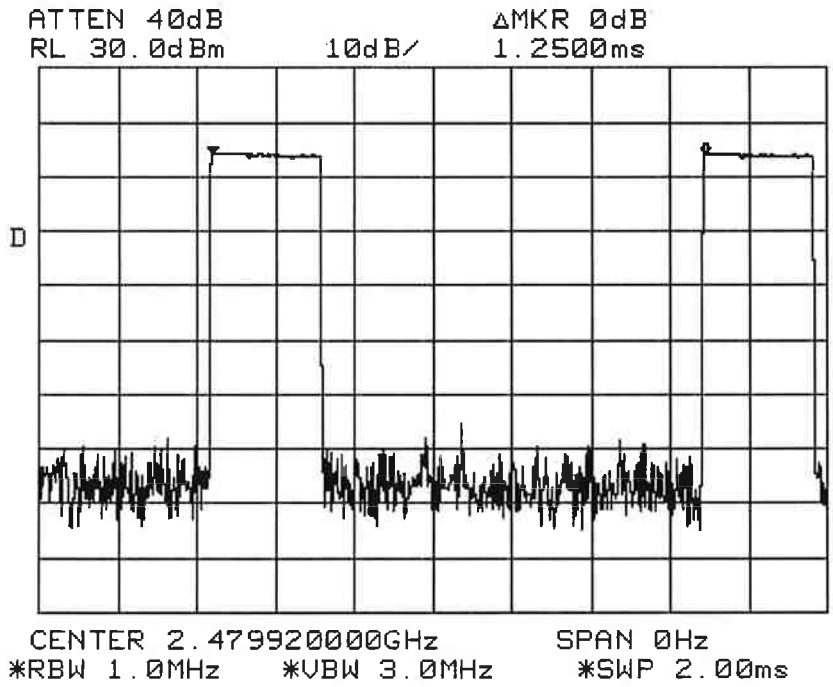


Plot 21 – Channel 1



Plot 22 – Channel 39

Average Frequency Dwell Time Plots - Transmitter



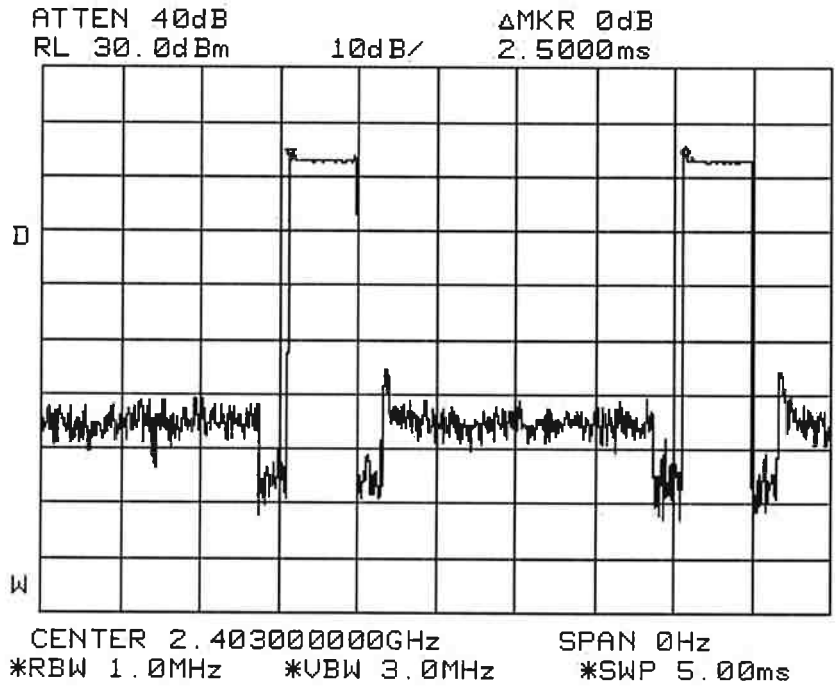
Plot 23 – Channel 78

Test Input Power	5Vdc	Temperature	24°C
Attached Plots	24 - 26	Relative Humidity	60%
Hopping Rate	400 hops / s	Atmospheric Pressure	1030mbar
Number of Hopping Channels	69 channels	Tested By	Johnsen Tia

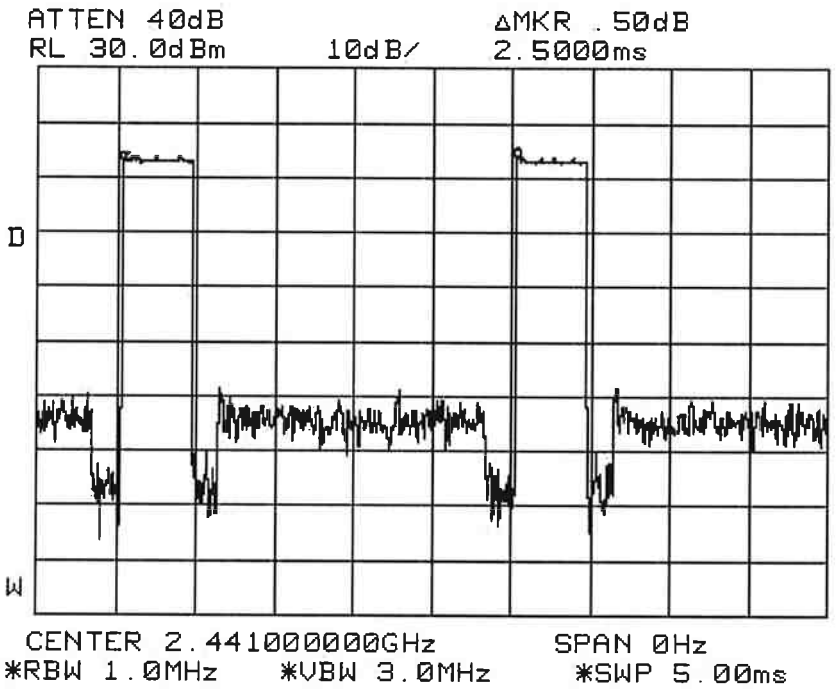
Receiver

Channel	Channel Frequency (GHz)	Measured Time Slot Length (ms)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
1	2.403	2.500	0.4	0.4
39	2.441	2.500	0.4	0.4
78	2.480	2.500	0.4	0.4

Average Frequency Dwell Time Plots - Receiver

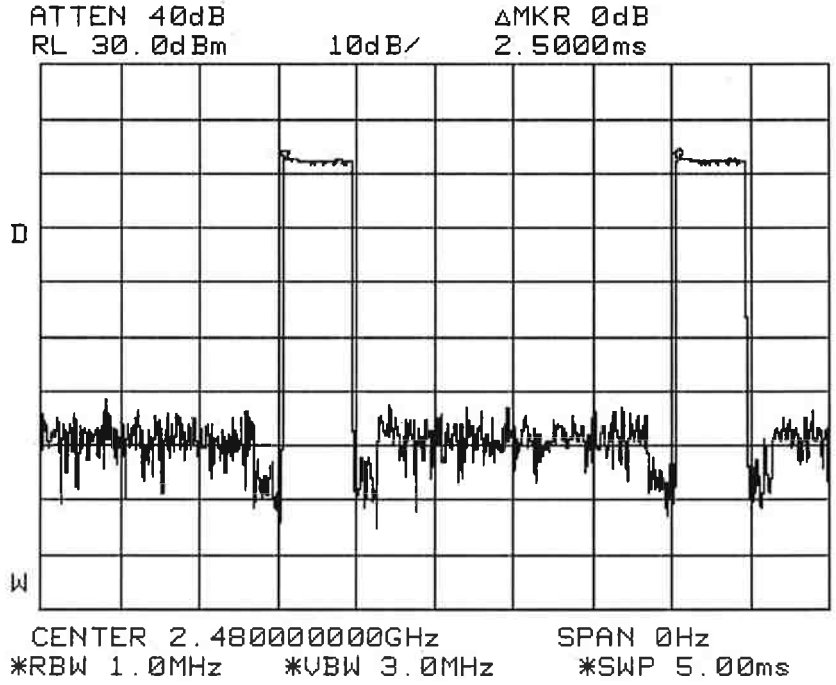


Plot 24 – Channel 1



Plot 25 – Channel 39

Average Frequency Dwell Time Plots - Receiver



Plot 26 – Channel 78

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

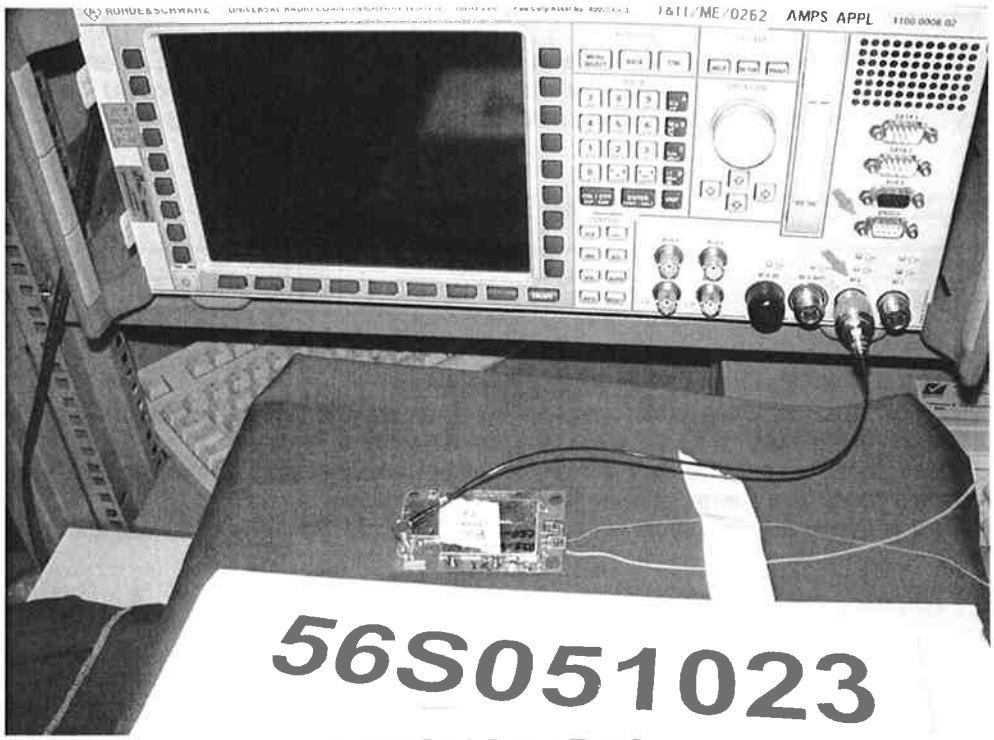
Instrument	Model	S/No	Cal Due Date
R & S Universal Radio Tester	CMU200	837587/068	23 Mar 2006

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 1 (2.403GHz).
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.



Maximum Peak Power Test Setup

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

Test Input Power	5Vdc	Temperature	24°C
Module	Transmitter	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.403	0.0269	0.125
39	2.441	0.0275	0.125
78	2.480	0.0283	0.125

MAXIMUM PEAK POWER TEST

Test Input Power	5Vdc	Temperature	24°C
Module	Receiver	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.403	0.0204	0.125
39	2.441	0.0234	0.125
78	2.480	0.0199	0.125

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.

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

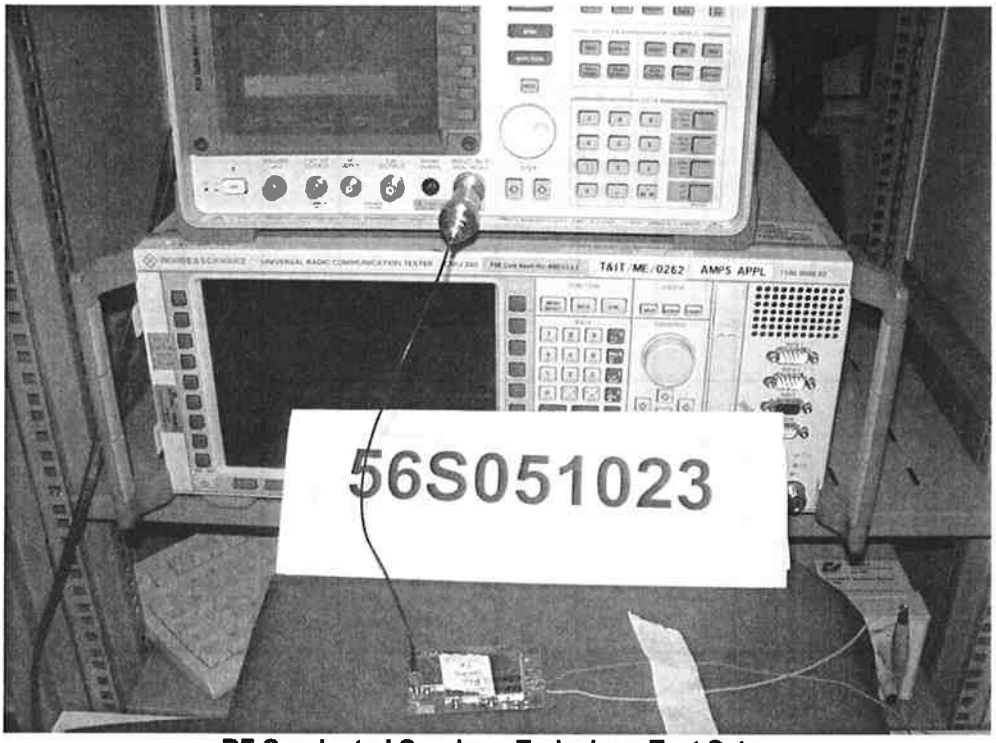
Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyzer	8564E	3846A01433	27 Apr 2006

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 1 (2.403GHz) .
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 Setup

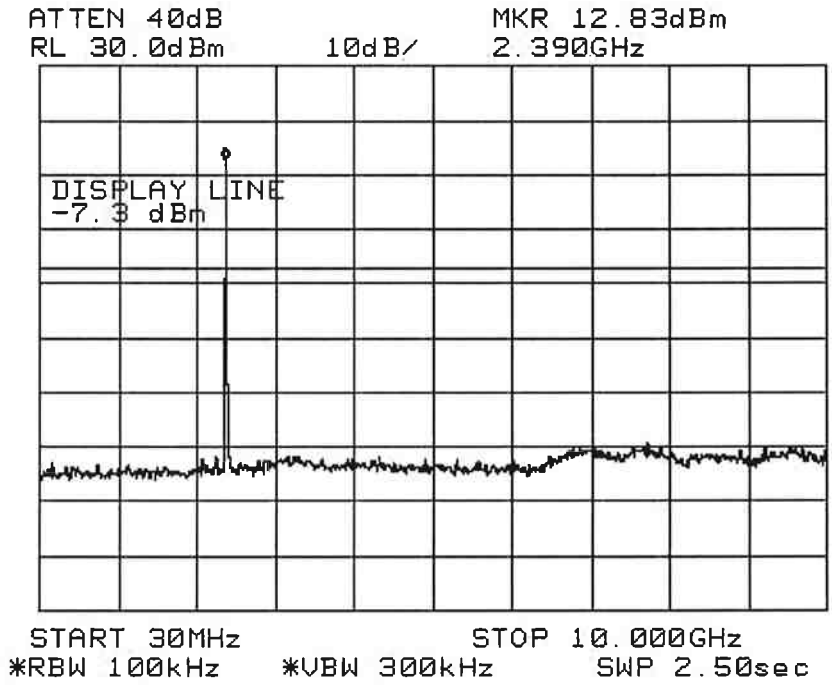
FCC Part 15.247(d) RF Conducted Spurious Emissions Results

Test Input Power	5Vdc	Temperature	24°C
Attached Plots	27 -32	Relative Humidity	60%
Module	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

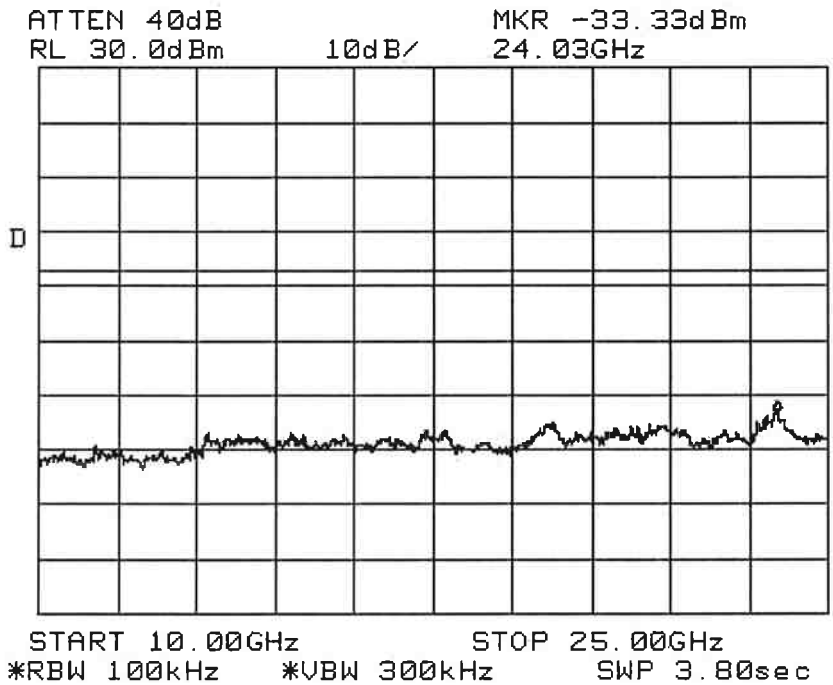
Test Input Power	5Vdc	Temperature	24°C
Attached Plots	33 - 38	Relative Humidity	60%
Module	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Johnsen Tia

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

RF Conducted Spurious Emissions Plots - Transmitter

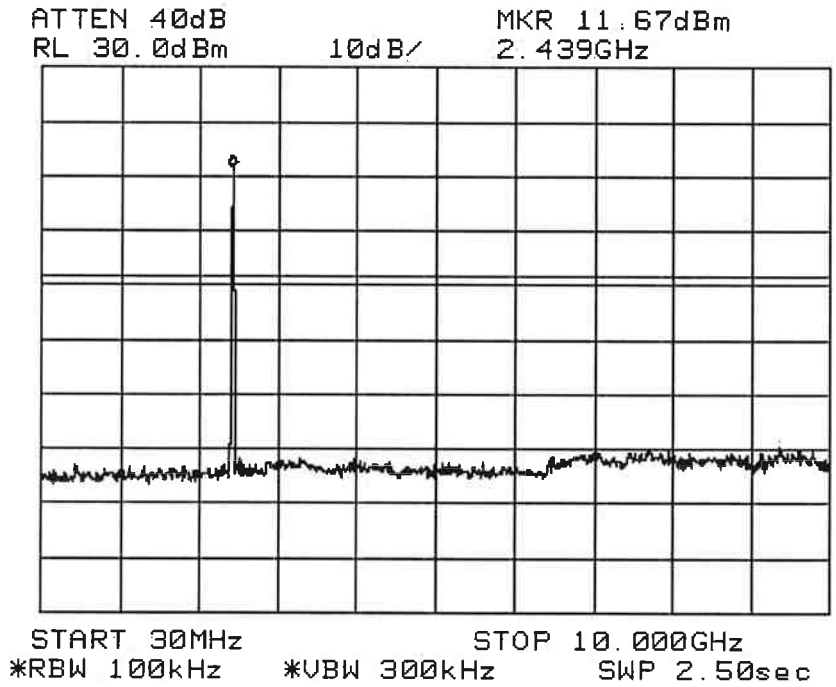


Plot 27 – Channel 1

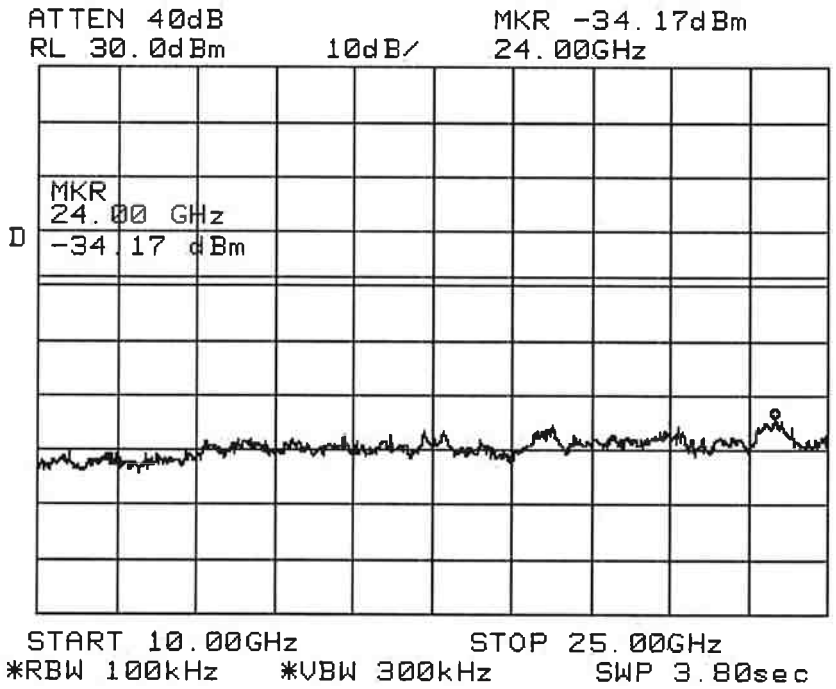


Plot 28– Channel 1

RF Conducted Spurious Emissions Plots- Transmitter

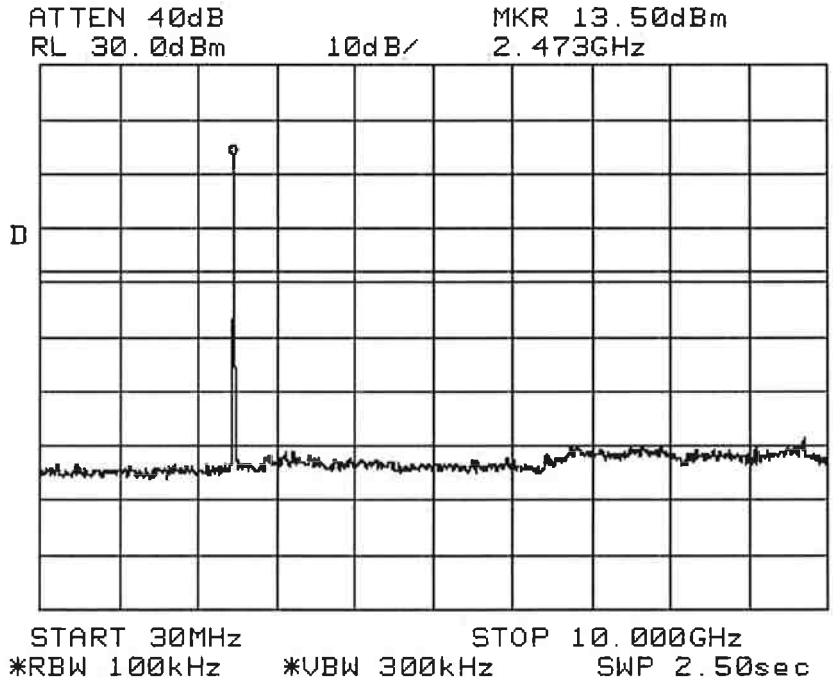


Plot 29 – Channel 39

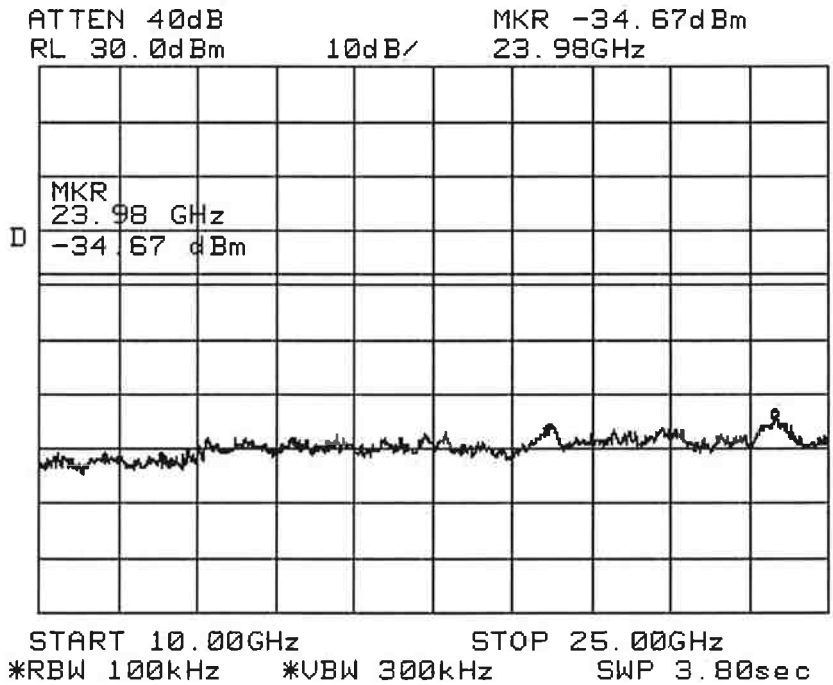


Plot 30 – Channel 39

RF Conducted Spurious Emissions Plots - Transmitter

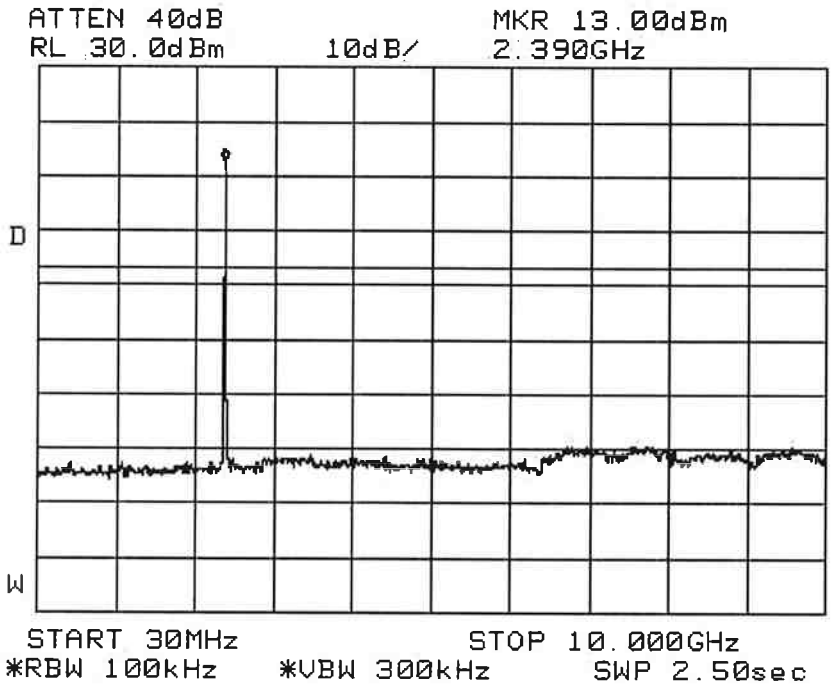


Plot 31 – Channel 78

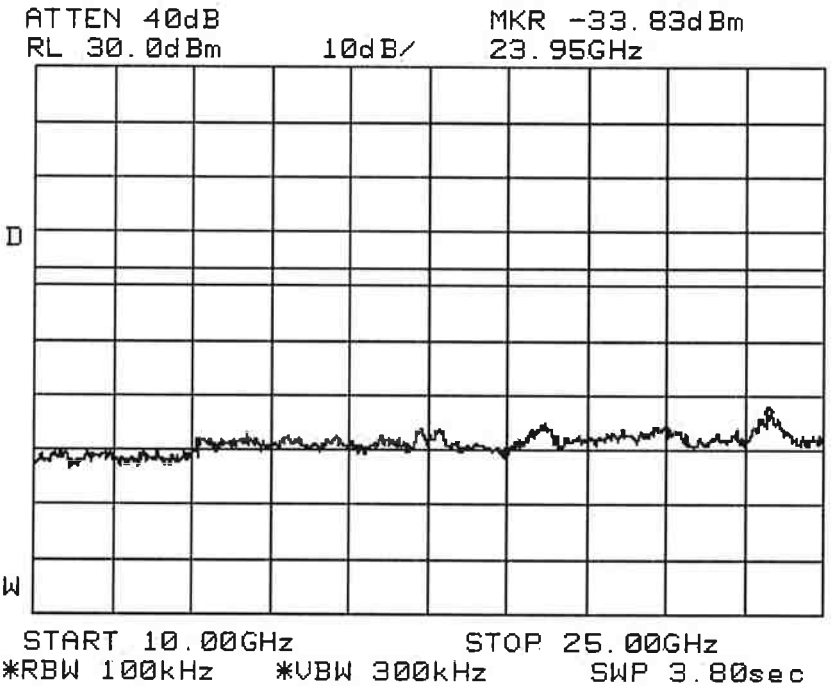


Plot 32 – Channel 78

RF Conducted Spurious Emissions Plots – Receiver

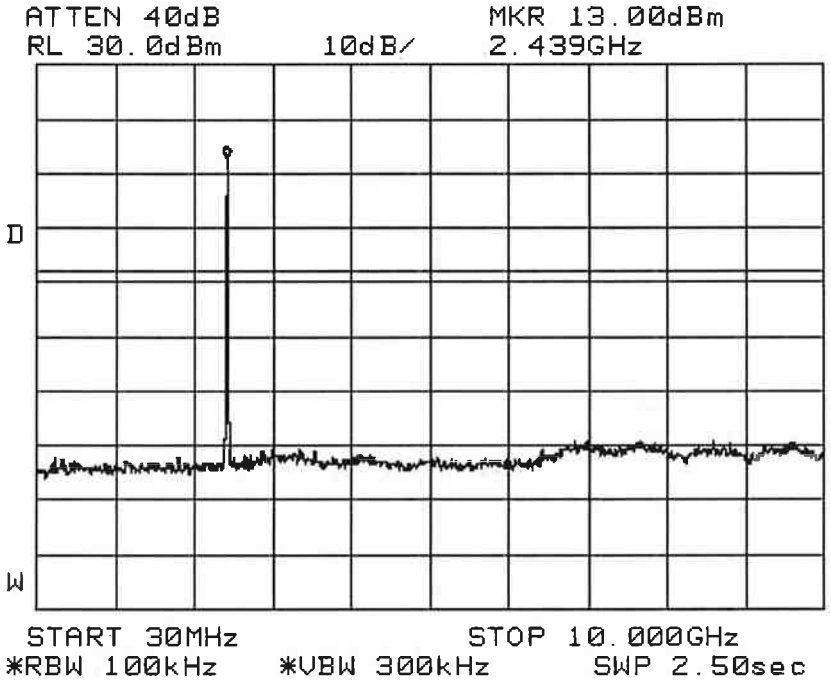


Plot 33 – Channel 1

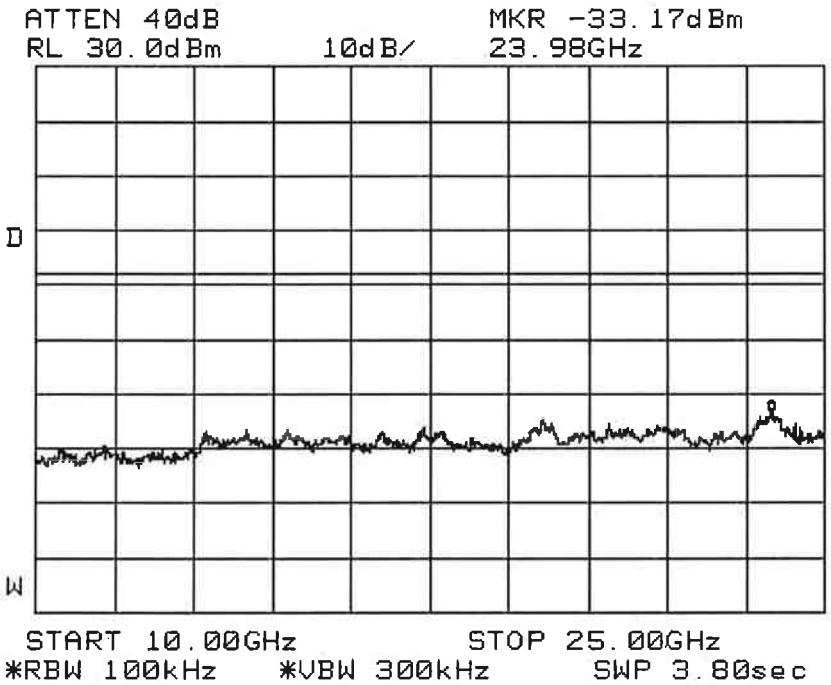


Plot 34 – Channel 1

RF Conducted Spurious Emissions Plots – Receiver

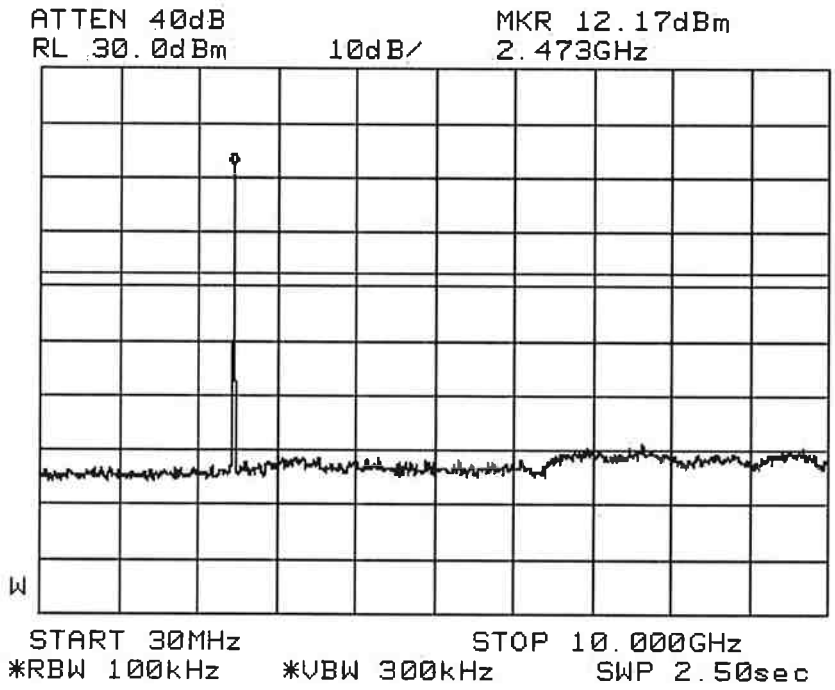


Plot 35 – Channel 39

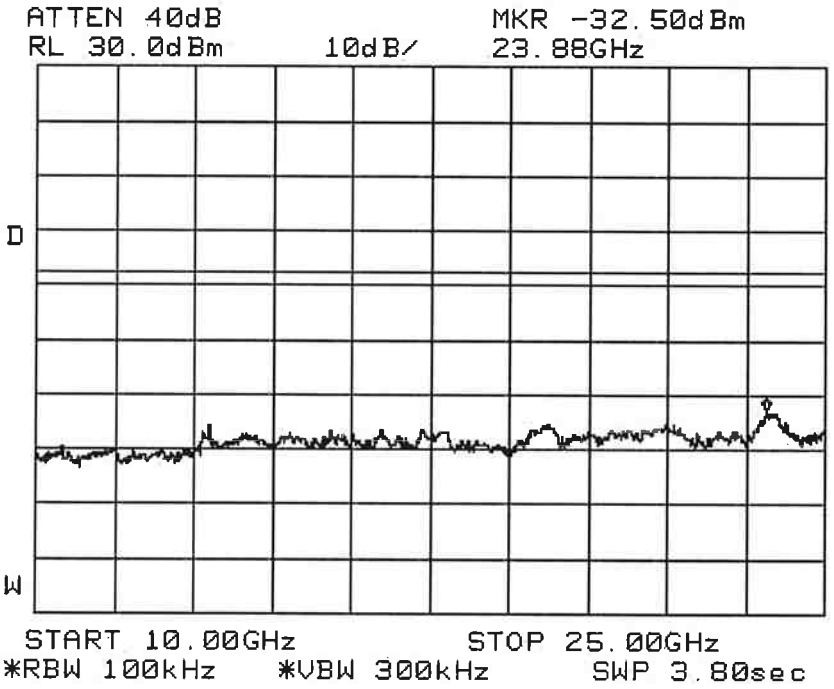


Plot 36 – Channel 39

RF Conducted Spurious Emissions Plots – Receiver



Plot 37 – Channel 78



Plot 38 – Channel 78