

# TEST REPORT



Your Ref:

Date: 05 Dec 2005

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Page: 1 of 71

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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)  
IC 4257 (10m Anechoic Chamber)

**IND. CANADA REG. NO.**

**PREPARED FOR**

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**JOB NUMBER**

56S051023

**TEST PERIOD**

23 Nov 2005 - 29 Nov 2005

**PREPARED BY**

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Vice President



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.

TEST SUMMARY

PRODUCT DESCRIPTION

SUPPORTING EQUIPMENT DESCRIPTION

EUT OPERATING CONDITIONS

CONDUCTED EMISSION TEST

RADIATED EMISSION TEST

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

- |         |                                                                      |
|---------|----------------------------------------------------------------------|
| ANNEX A | - EUT PHOTOGRAPHS / DIAGRAMS                                         |
| ANNEX B | - FCC LABEL & POSITION                                               |
| ANNEX C | - USER MANUAL, TECHNICAL<br>DESCRIPTION, BLOCK & CIRCUIT<br>DIAGRAMS |

**TEST SUMMARY**

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.  

| <u>Transmit Channel</u> | <u>Frequency (GHz)</u> |
|-------------------------|------------------------|
| 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.

**PRODUCT DESCRIPTION**

|                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description                                      | : <b>Creative Wireless Multimedia Speaker System (model MF4080)</b> 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.<br>The satellite, control and audio input cables connected to the product are not longer than 3m. |
| Manufacturer                                     | : Gigatek Electronics (Dong Guan) Co. Ltd<br>In Yang Industrial Zhang Yang District, Zhangmutou Zhen,<br>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,<br>PI – TOP249Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Operating<br>Frequency/Transmitting<br>Frequency | : 2.4030GHz (lower channel) to 2.4800GHz (upper channel)<br>69 channels.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Clock /Oscillator Frequency                      | : 132KHz(jitter), 330KHz, 12.288MHz, 16MHz, 20MHz, 32MHz,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Port / Connectors                                | : Subwoofer Unit:<br>DSUB15 – Volume Control Pod<br>RCA x 6 – Audio inputs<br>Speaker Push Terminal x 3 pairs – satellite cable output<br>AC mains socket with fuse holder – Power mains input<br><br>Transmitter Unit<br>4 pole stereo socket – Aux input<br>3 pole stereo socket – Headphone output<br><br>Receiver Unit:<br>Speaker Push Terminal x 2 pairs – satellite cable output<br>AC mains socket with fuse holder – Power mains input                                                                                                                                                                                                                                                                                                      |
| Rated Input Power                                | : Subwoofer/Transmitter: 120Vac, 60Hz, 2A<br>Receiver : 100-240VAC 50/60Hz, 1A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Accessory                                        | : Stereo to RCA x 3<br>4 pole to 4 pole stereo cable x 1<br>Power cord x 2<br>Satellite cable x 5<br>Satellite table stand and screw x 5<br>Wall mounting Screw x 7<br>Remote control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**SUPPORTING EQUIPMENT DESCRIPTION**

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

**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. **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.

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

| Frequency Range<br>(MHz) | Limit Values (dB $\mu$ V) |              |
|--------------------------|---------------------------|--------------|
|                          | 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 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**

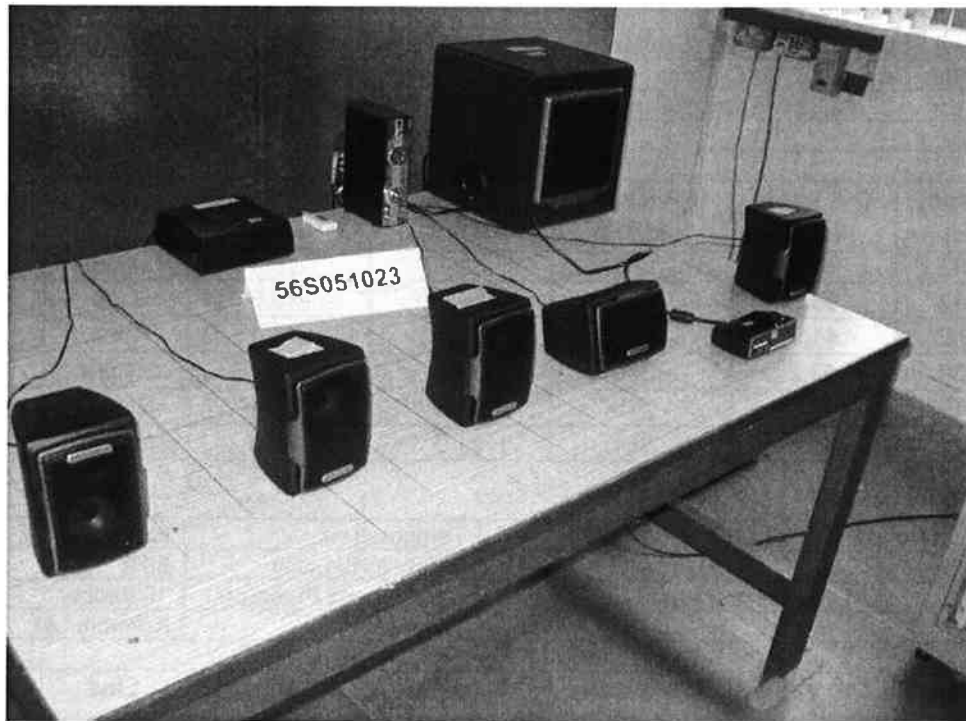
At 20 MHz Q-P limit (Class B) = 100  $\mu$ V = 60.0 dB $\mu$ V

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

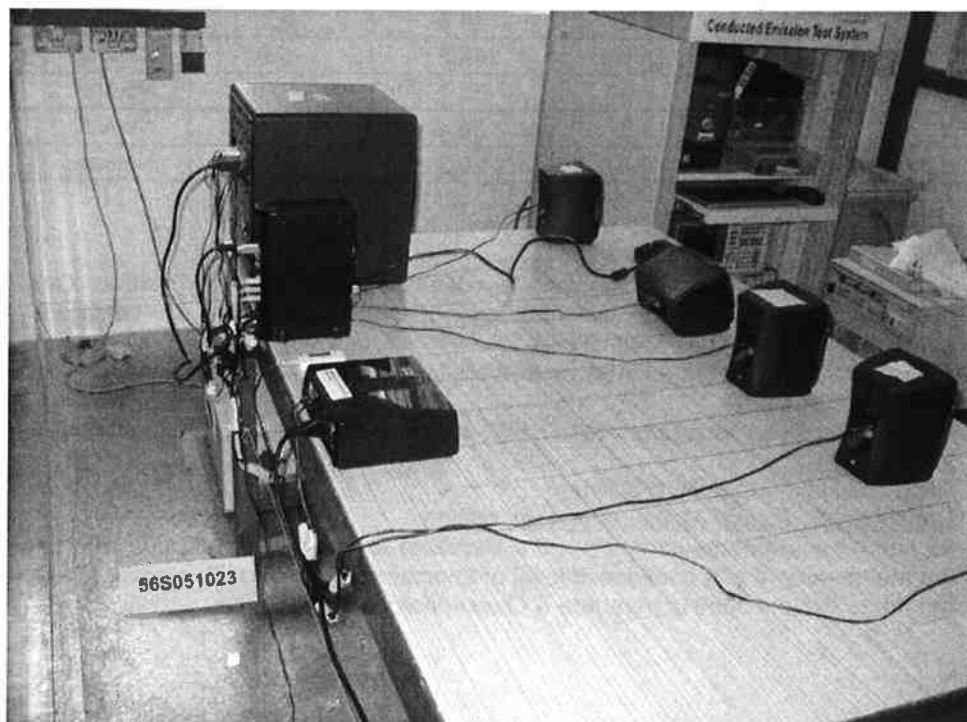
Q-P reading obtained directly from EMI Receiver = 40.0 dB $\mu$ V  
(Calibrated for system losses)

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





**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 | 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 (dB $\mu$ V) | Q-P Margin (dB) | AV Value (dB $\mu$ V) | 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 (dB $\mu$ V) | Q-P Margin (dB) | AV Value (dB $\mu$ V) | 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**

- 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) – ESMI3     | ESMI      | 829214/005<br>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  |

**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**

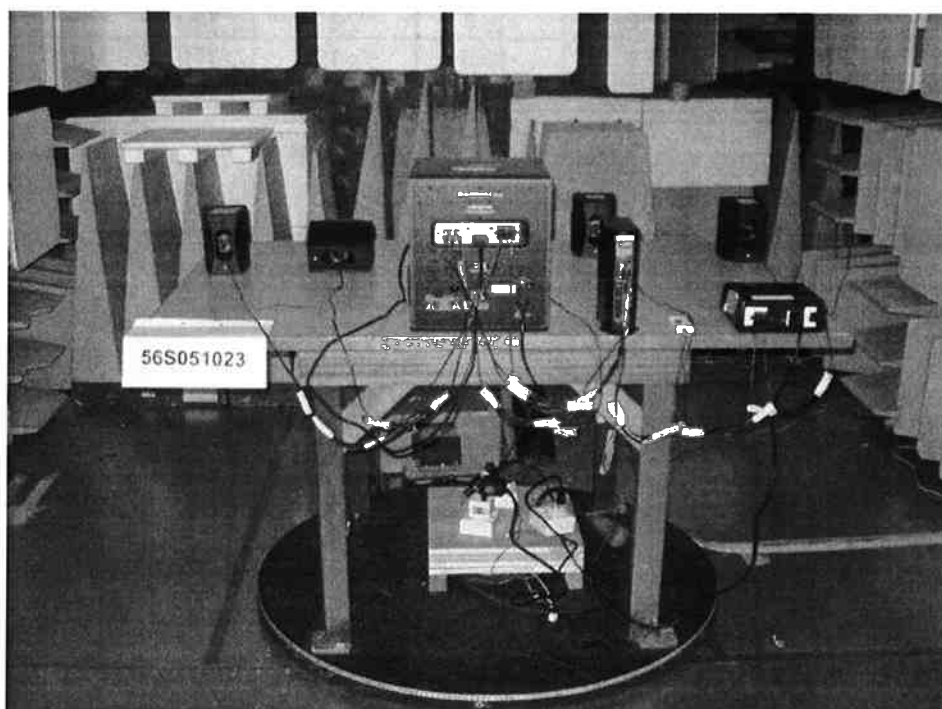
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which attitude 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<br>(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>                        |



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



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

**RADIATED EMISSION TEST**

**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 (dB $\mu$ V/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 (dB $\mu$ V/m) | Average Value (dB $\mu$ V/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     |

**RADIATED EMISSION TEST****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 (dB $\mu$ V/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 (dB $\mu$ V/m) | Average Value (dB $\mu$ V/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.

**RADIATED EMISSION TEST**

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  $\pm 4.3\text{dB}$  (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 | 8564E | 3846A01433 | 27 Apr 2006  |

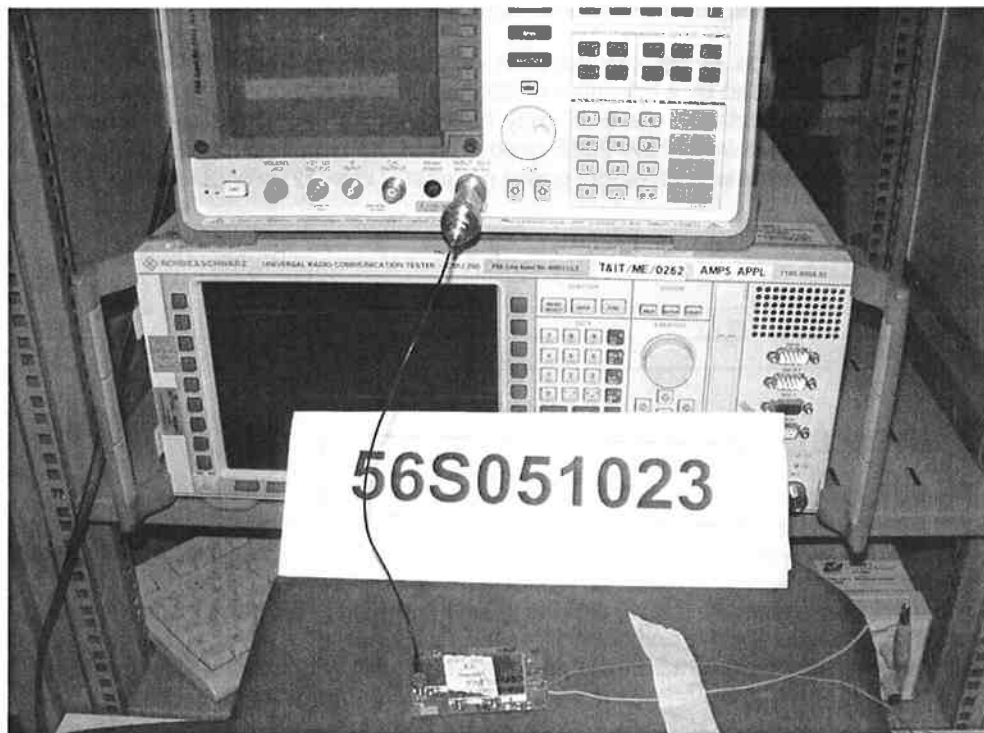
**FCC Part 15.247(a)(1) Carrier Frequency Separation Test Setup**

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**



**Carrier Frequency Separation Test Setup**

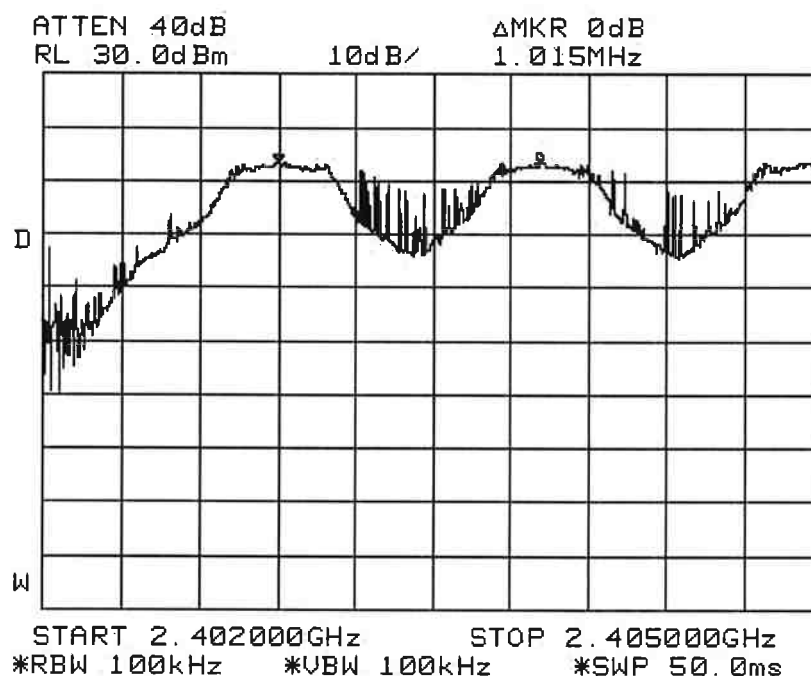
**FCC Part 15C (15.247(a)(1)) Carrier Frequency Separation Results**

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

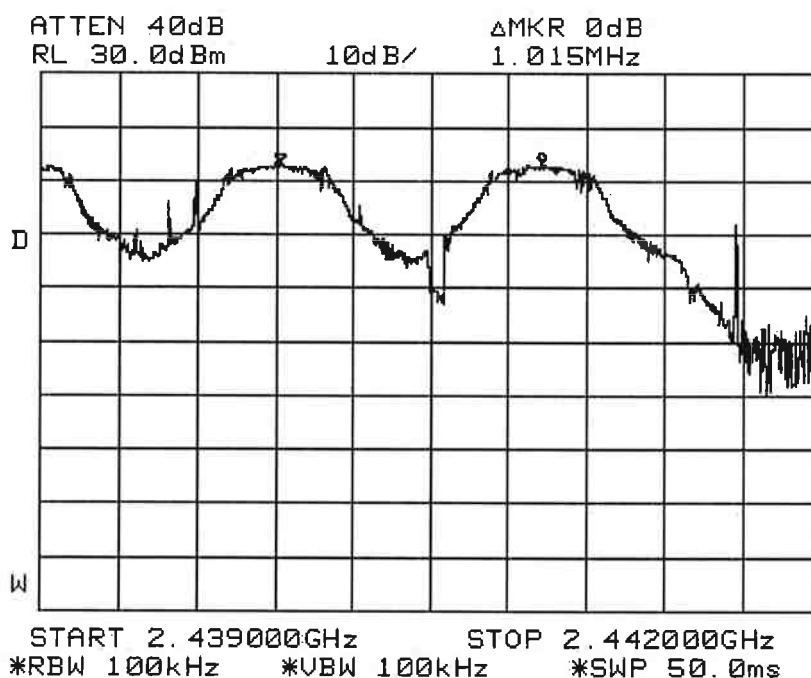
| Adjacent Channels                 | Channel Separation (MHz) |
|-----------------------------------|--------------------------|
| 1 and 2 (2.403GHz and 2.404GHz)   | 1.015                    |
| 38 and 39 (2.440GHz and 2.441GHz) | 1.015                    |
| 77 and 78(2.479GHz and 2.480GHz)  | 1.015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

**CARRIER FREQUENCY SEPARATION TEST**

**Carrier Frequency Separation Plots - Transmitter**



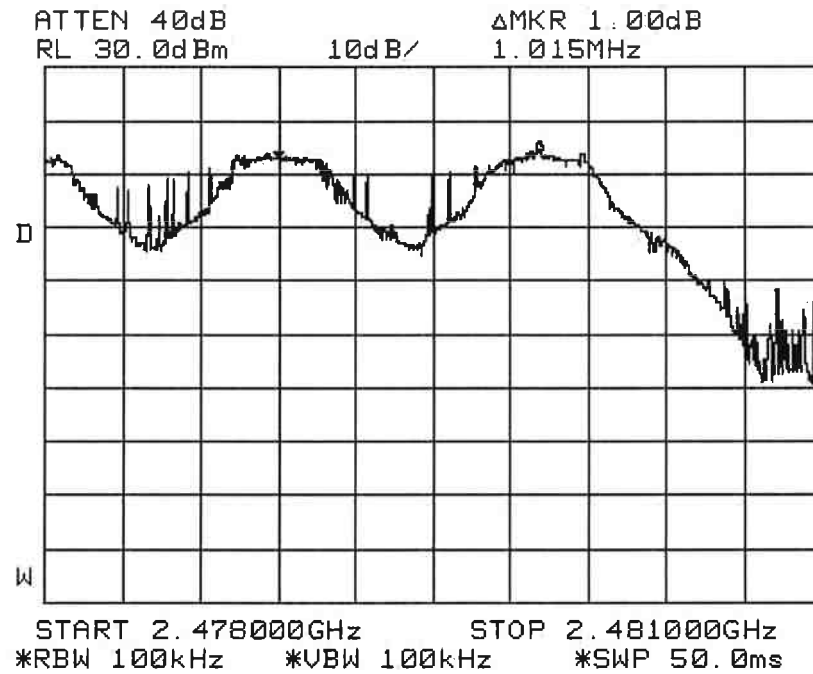
**Plot 1 - Channels 1 and 2 Separation**



**Plot 2 - Channels 38 and 39 Separation**

**CARRIER FREQUENCY SEPARATION TEST**

**Carrier Frequency Separation Plots - Transmitter**



**Plot 3 - Channels 77 and 78 Separation**

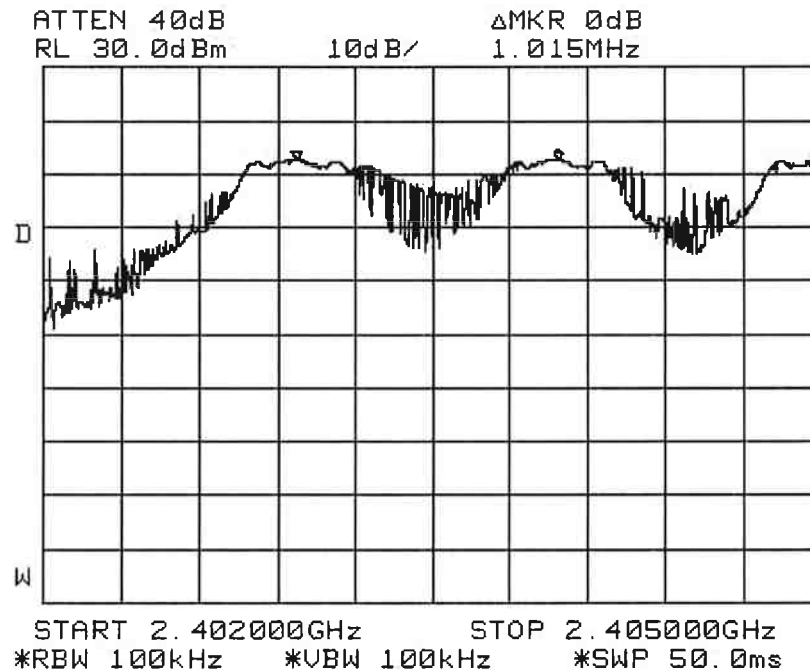
**CARRIER FREQUENCY SEPARATION TEST**

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

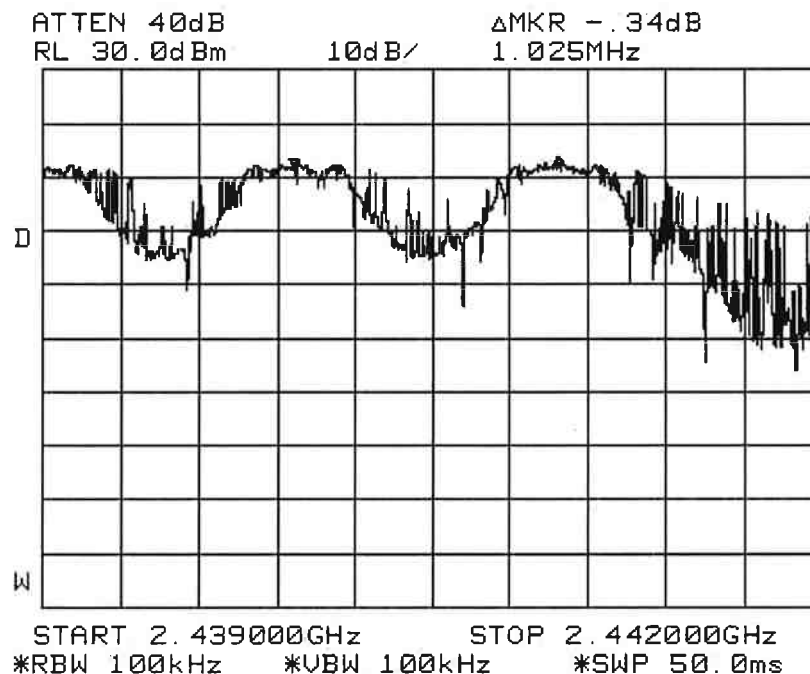
| Adjacent Channels                 | Channel Separation (MHz) |
|-----------------------------------|--------------------------|
| 1 and 2 (2.403GHz and 2.404GHz)   | 1.015                    |
| 38 and 39 (2.440GHz and 2.441GHz) | 1.025                    |
| 77 and 78(2.479GHz and 2.480GHz)  | 1.015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

**CARRIER FREQUENCY SEPARATION TEST**

**Carrier Frequency Separation Plots - Receiver**



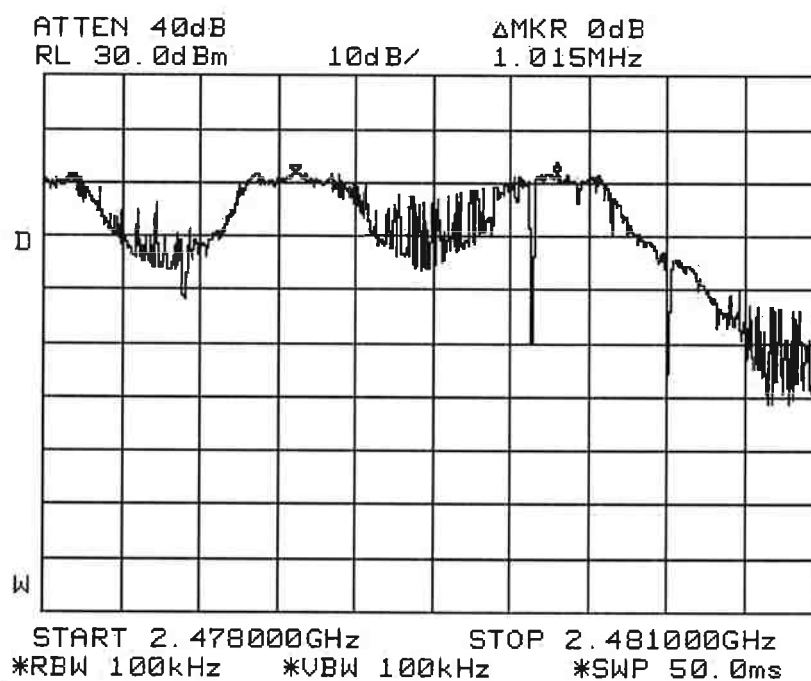
**Plot 3 - Channels 1 and 2 Separation**



**Plot 4 - Channels 38 and 39 Separation**

**CARRIER FREQUENCY SEPARATION TEST**

**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**

| <b>Instrument</b>    | <b>Model</b> | <b>S/No</b> | <b>Cal Due Date</b> |
|----------------------|--------------|-------------|---------------------|
| HP Spectrum Analyzer | 8564E        | 3846A01433  | 27 Apr 2006         |

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

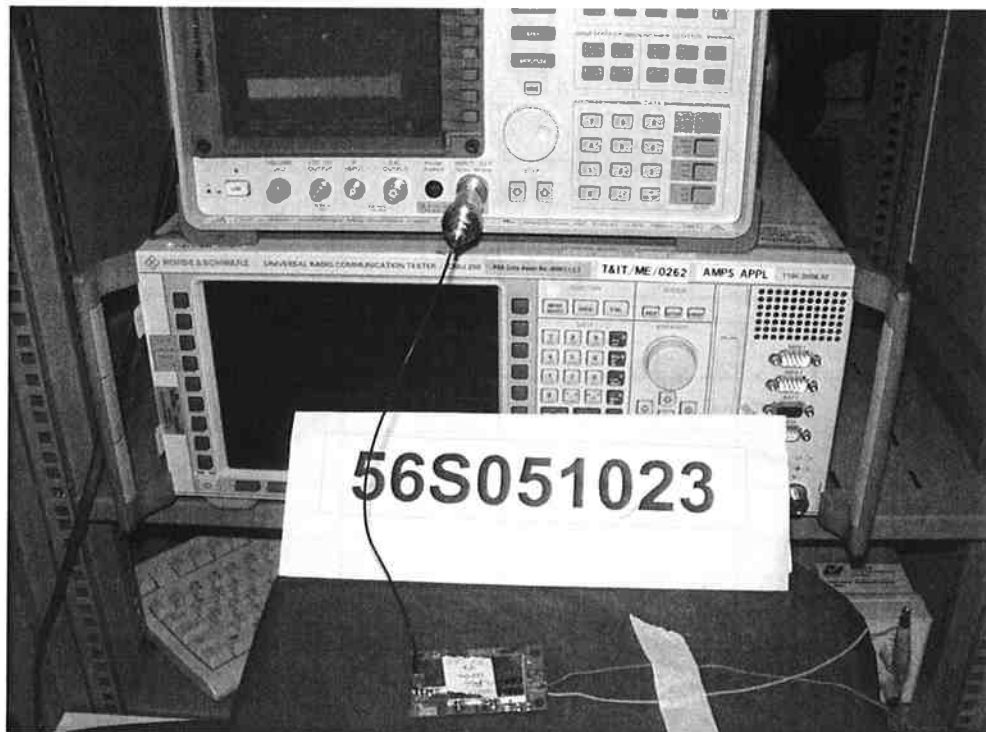
1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW)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



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

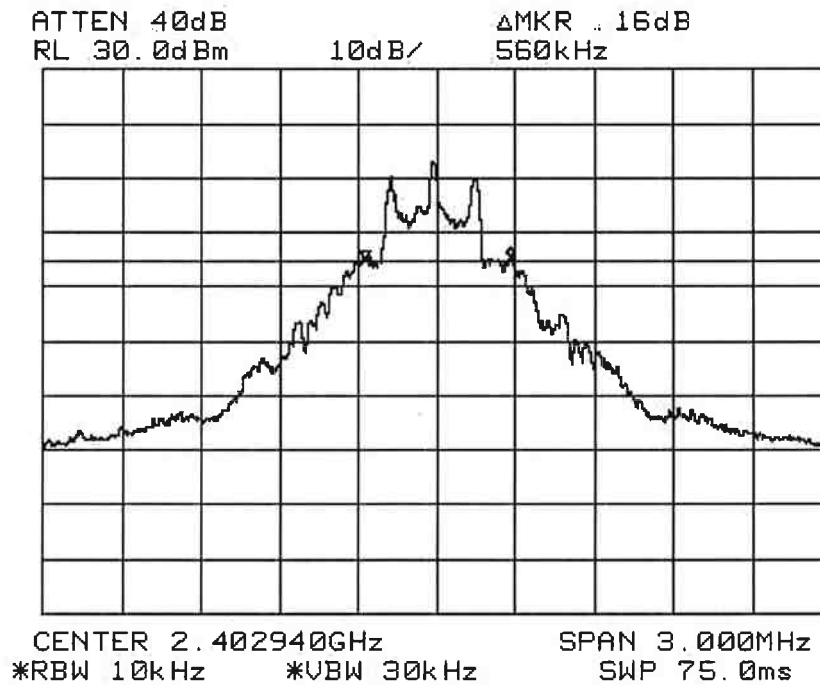
**FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Results**

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

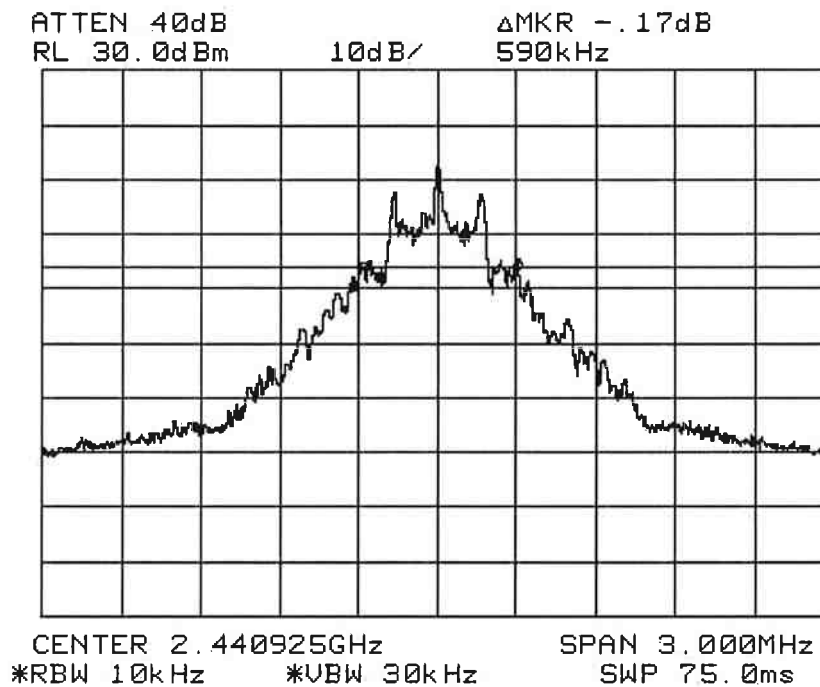
| Channel | Channel Frequency (GHz) | 20dB Bandwidth (MHz) |
|---------|-------------------------|----------------------|
| 1       | 2.403                   | 0.560                |
| 39      | 2.441                   | 0.590                |
| 78      | 2.480                   | 0.605             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

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

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



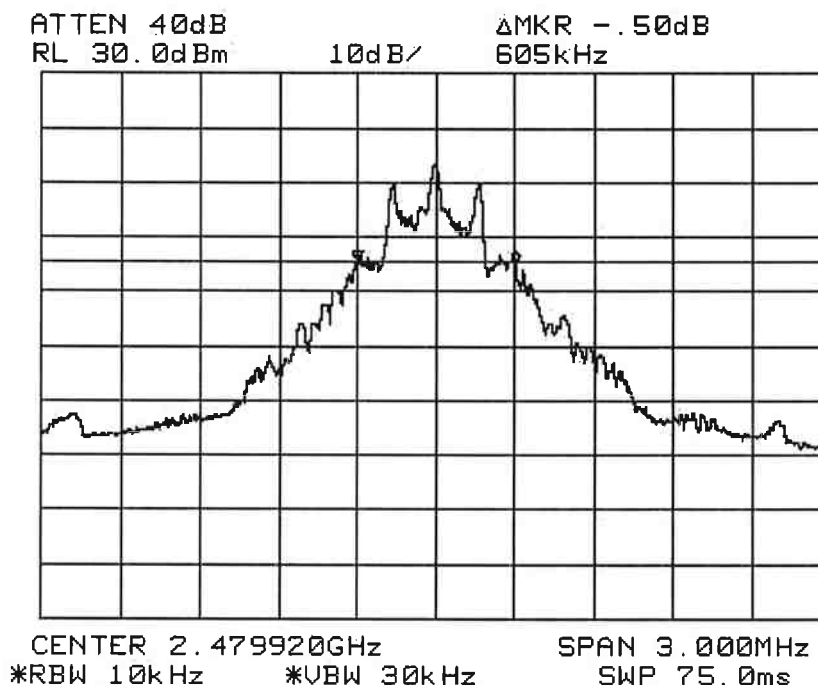
**Plot 7 – Channel 1**



**Plot 8 – Channel 39**

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

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



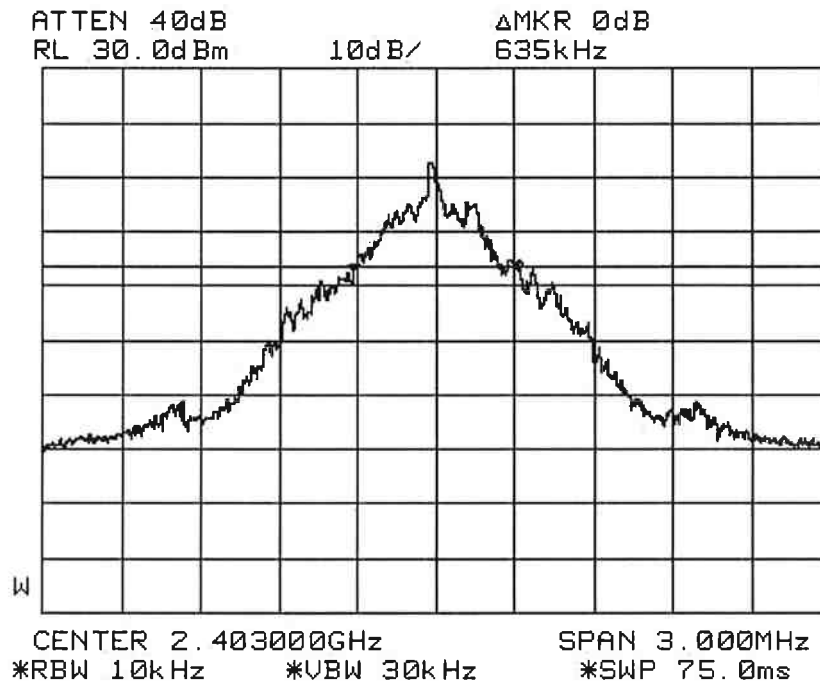
**Plot 9 – Channel 78**

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

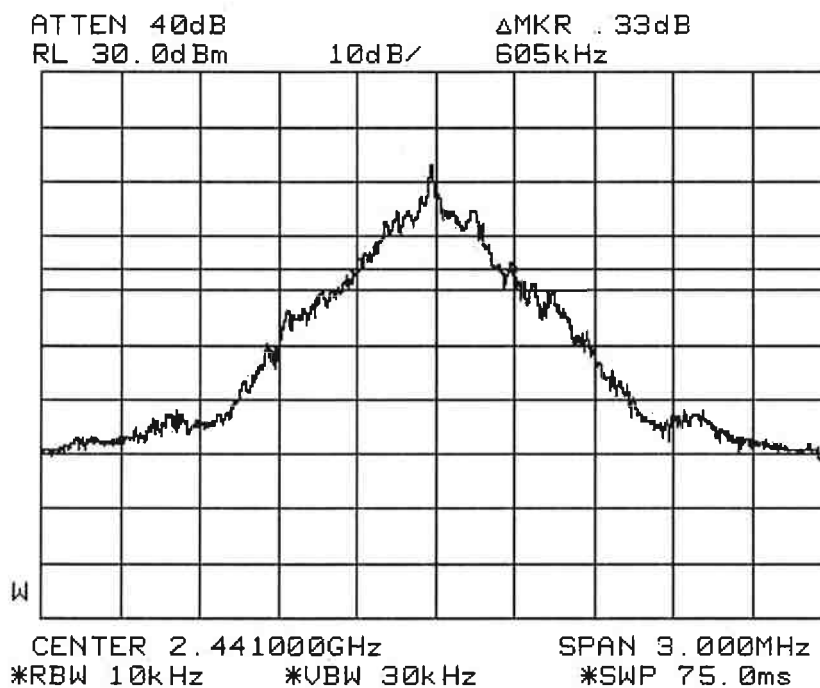
| Channel | Channel Frequency (GHz) | 20dB Bandwidth (MHz) |
|---------|-------------------------|----------------------|
| 1       | 2.403                   | 0.635                |
| 39      | 2.441                   | 0.605                |
| 78      | 2.480                   | 0.600             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

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

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



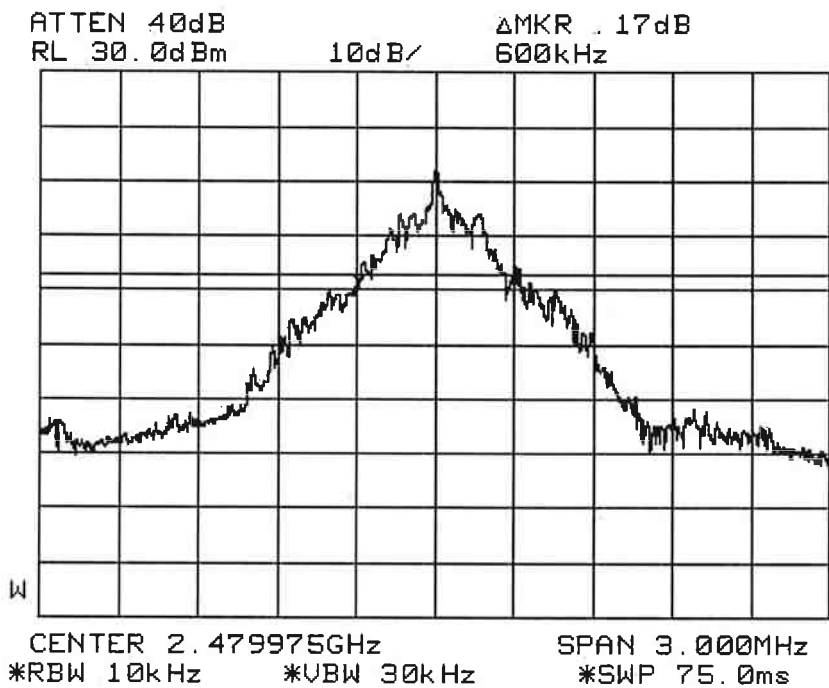
**Plot 10 – Channel 1**



**Plot 11 – Channel 39**

SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots - Receiver



Plot 12 – 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**

| <b>Instrument</b>    | <b>Model</b> | <b>S/No</b> | <b>Cal Due Date</b> |
|----------------------|--------------|-------------|---------------------|
| HP Spectrum Analyzer | 8564E        | 3846A01433  | 27 Apr 2006         |

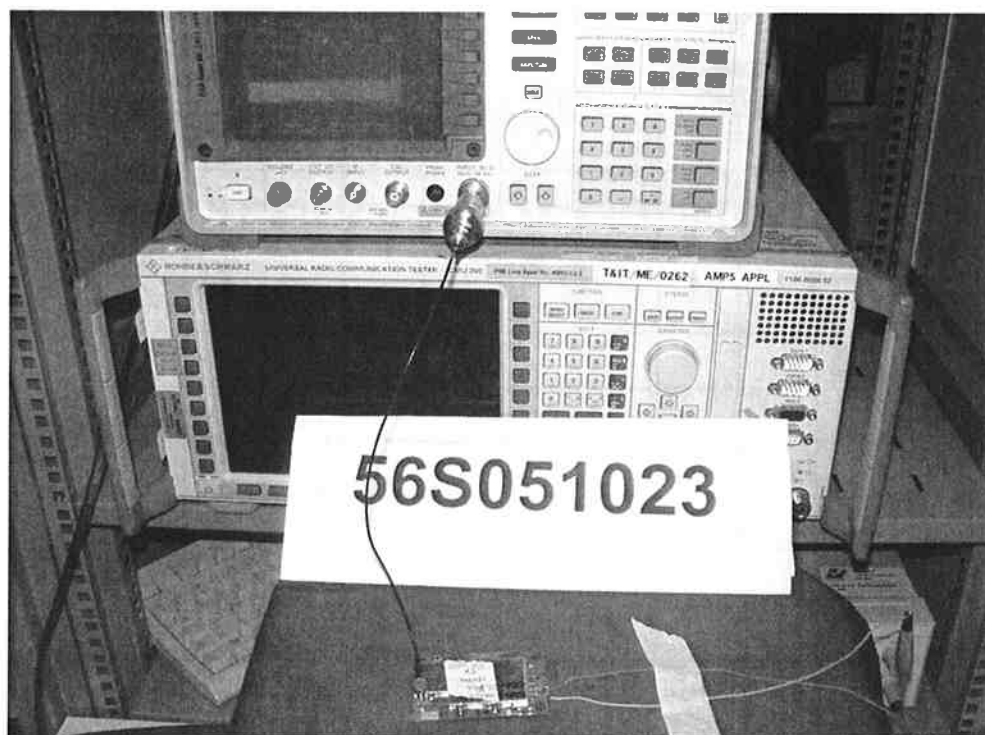
**FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Test Setup**

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**



**Number of Hopping Frequencies Test Setup**

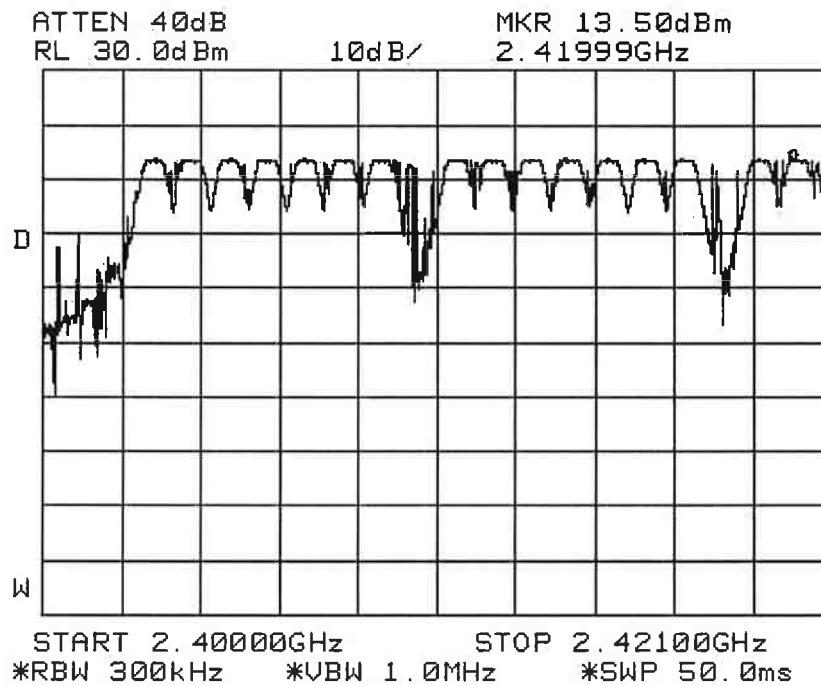
**FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Results**

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

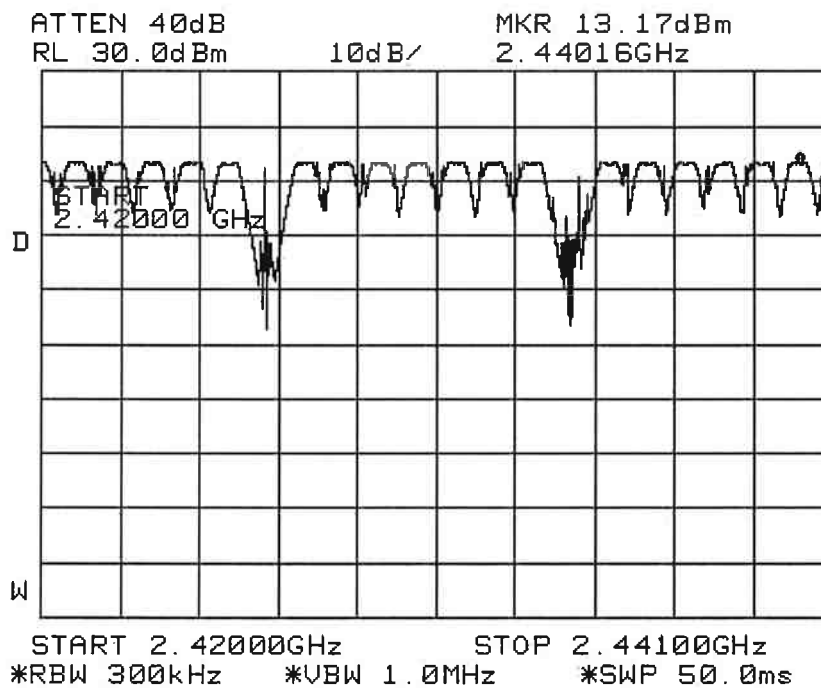
The EUT was found to have 69 hopping frequencies. Please refer to the attached plots.

NUMBER OF HOPPING FREQUENCIES TEST

Number Of Hopping Frequencies Plots - Transmitter



Plot 13 – Channels 1 to 18

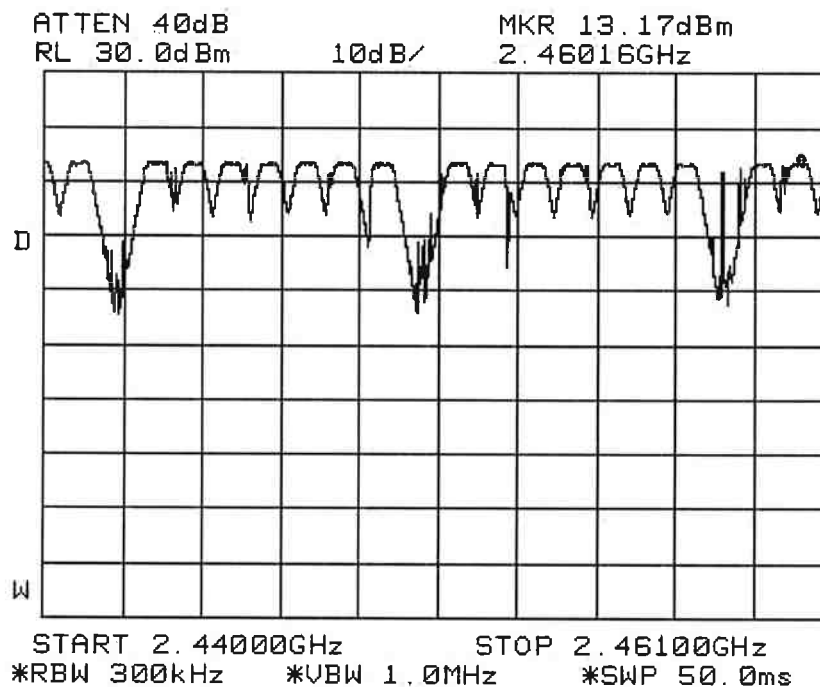


Plot 14 – Channels 19 to 38

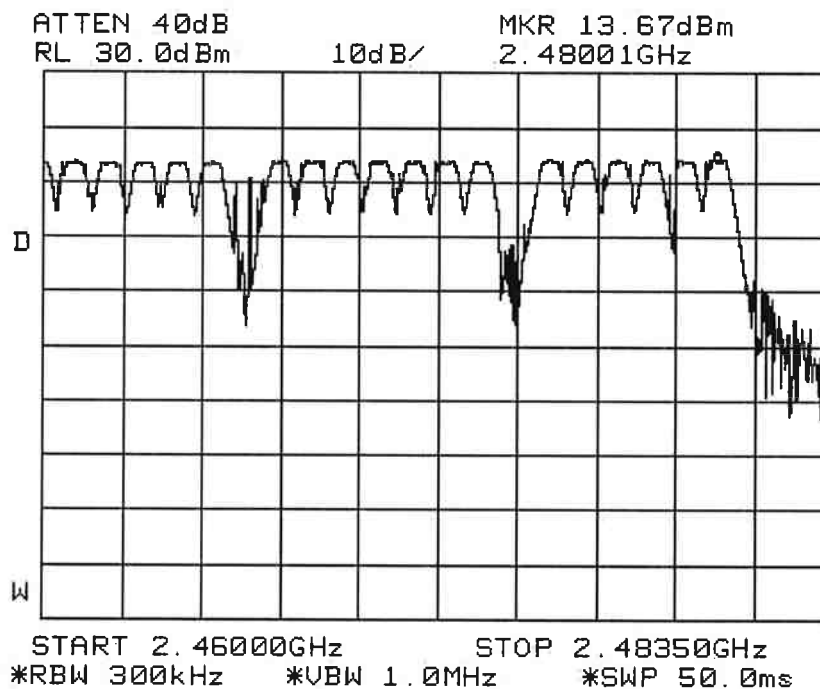


NUMBER OF HOPPING FREQUENCIES TEST

Number Of Hopping Frequencies Plots - Transmitter



Plot 15 – Channels 39 to 58

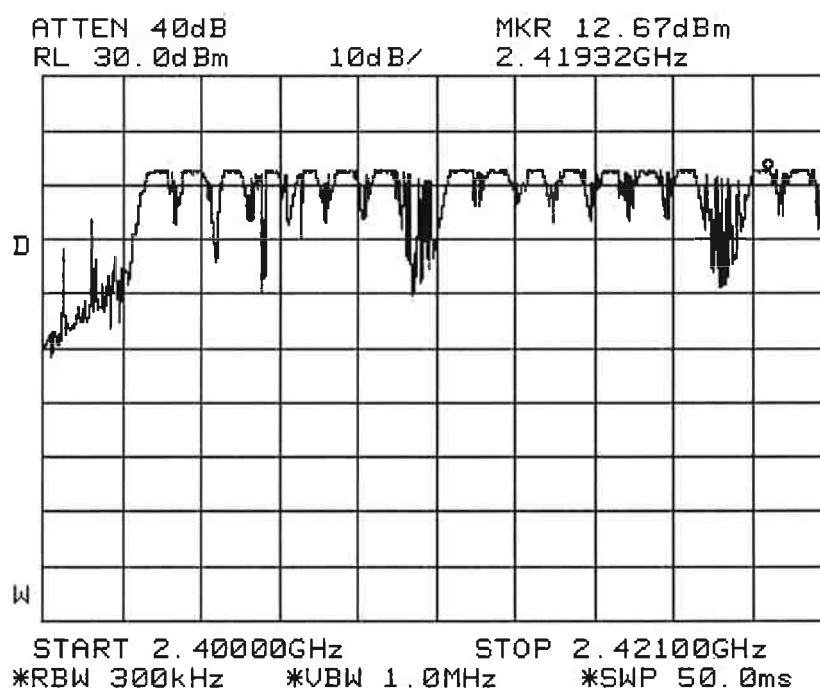


Plot 16 - Channels 59 to 78

# 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 |

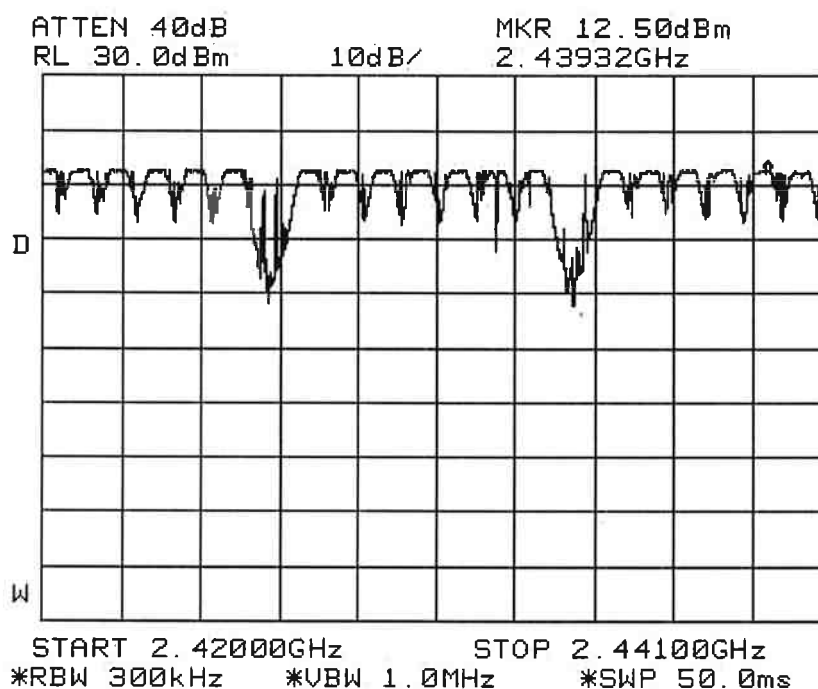
The EUT was found to have 69 hopping frequencies. Please refer to the attached plots.



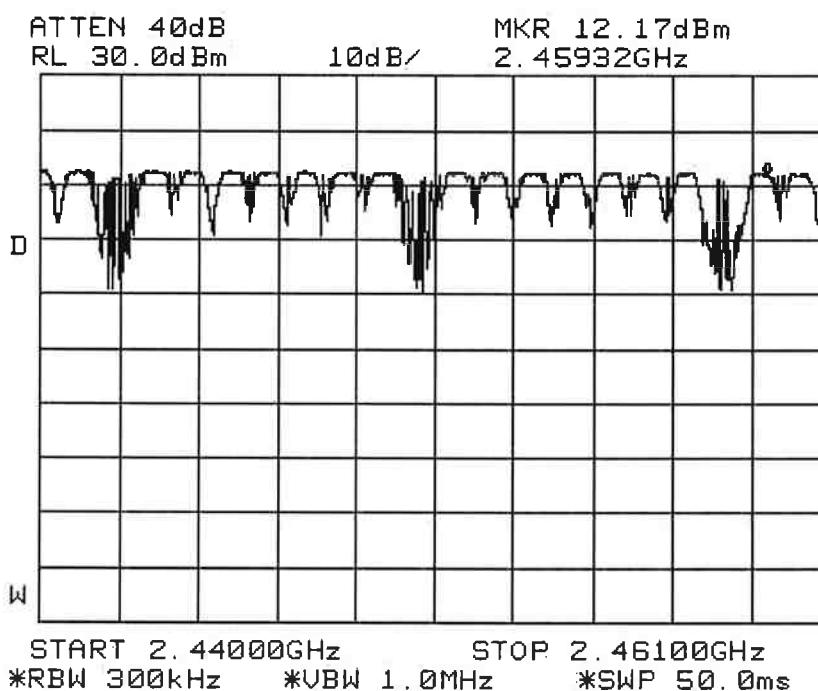
Plot 17 - Channels 1 to 18

**NUMBER OF HOPPING FREQUENCIES TEST**

**Number Of Hopping Frequencies Plots - Receiver**



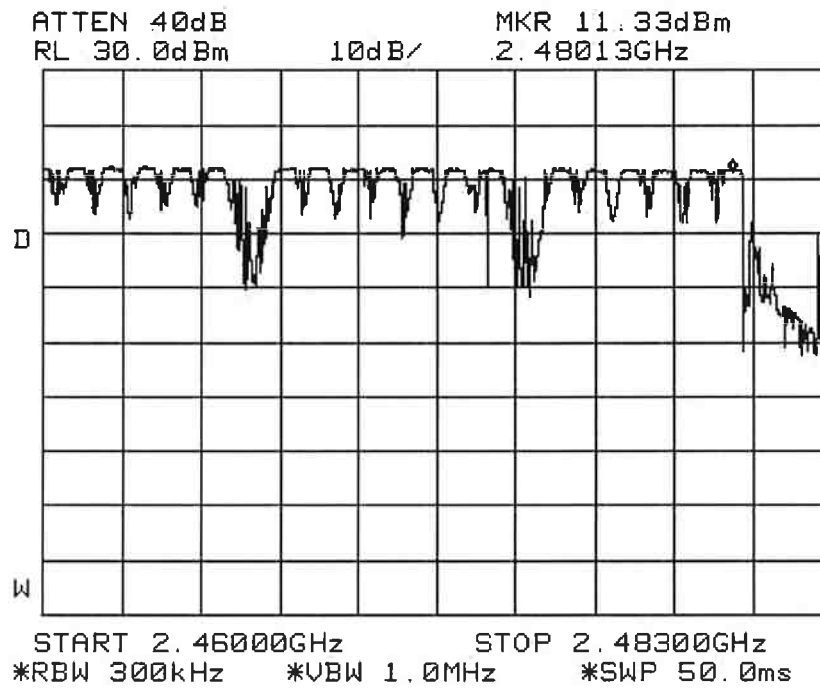
**Plot 18 - Channels 19 to 38**



**Plot 19 - Channels 39 to 58**

NUMBER OF HOPPING FREQUENCIES TEST

Number Of Hopping Frequencies Plots - Receiver



Plot 20 - 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 | 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**

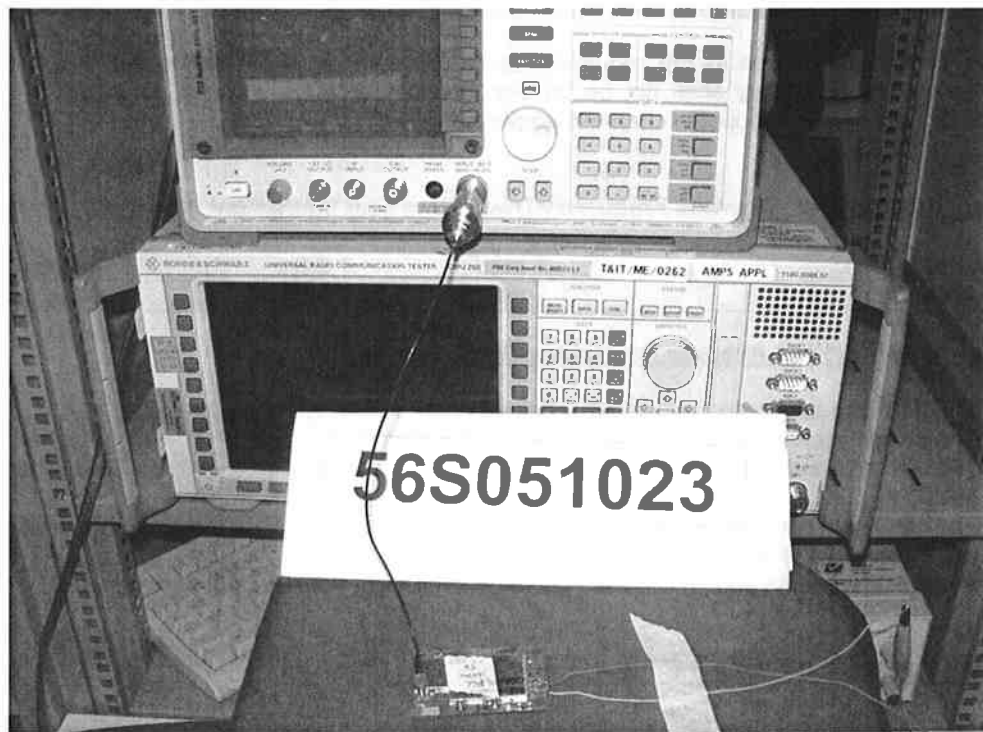
1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with frequency hopping sequence on.
2. The center frequency of the spectrum analyser was set to 2.403GHz with zero frequency span (spectrum analyser acts as an 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:

$$\text{Average Frequency Dwell Time} = [\text{measured time slot length} \times \text{hopping rate} / \text{number of hopping channels}] \times [0.4 \times \text{number of hopping channels}]$$

$$\begin{aligned} \text{where EUT hopping rate} &= 400 \text{ hops/s} \\ \text{Number of EUT hopping channels} &= 69 \text{ channels} \end{aligned}$$

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**

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

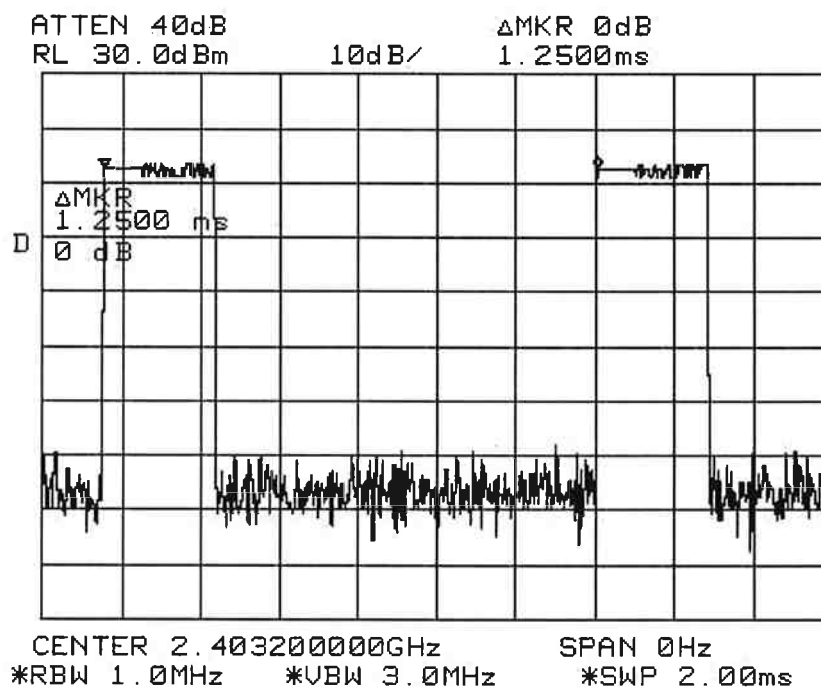
|                            |              |                      |             |
|----------------------------|--------------|----------------------|-------------|
| Test Input Power           | 5Vdc         | Temperature          | 24°C        |
| Attached Plots             | 21 - 23      | Relative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

**Transmitter**

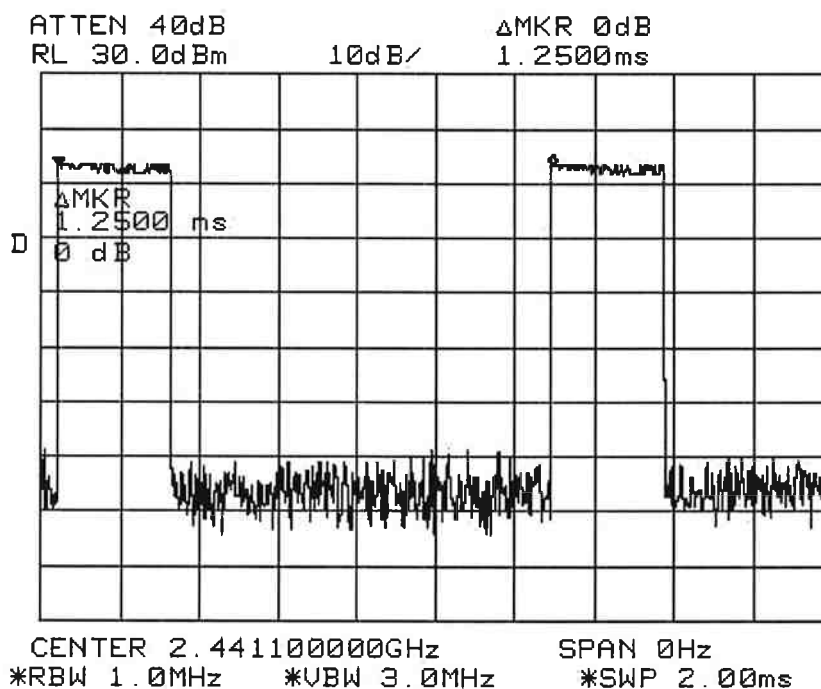
| Channel | Channel Frequency (GHz) | Measured Time Slot Length (ms) | Average Frequency Dwell Time (s) | Average Occupancy Limit (s) |
|---------|-------------------------|--------------------------------|----------------------------------|-----------------------------|
| 1       | 2.403                   | 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 TEST**

**Average Frequency Dwell Time Plots - Transmitter**



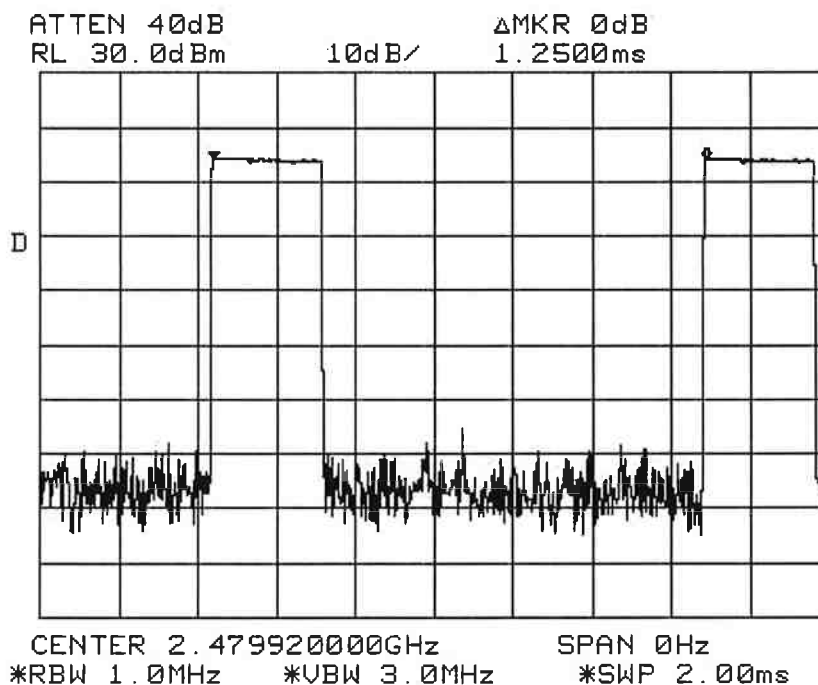
**Plot 21 – Channel 1**



**Plot 22 – Channel 39**

**AVERAGE FREQUENCY DWELL TIME TEST**

**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 |

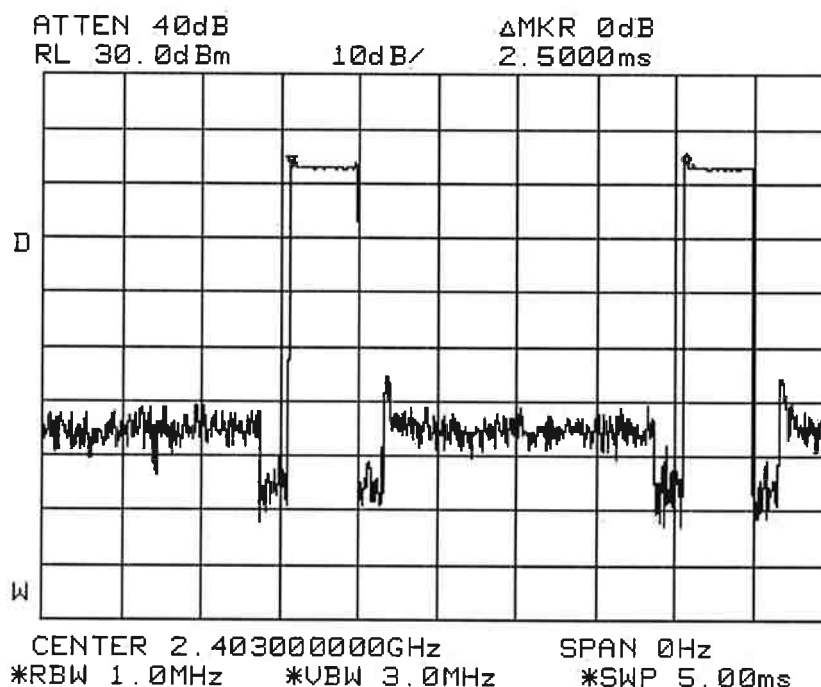
**Receiver**

| 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                         |

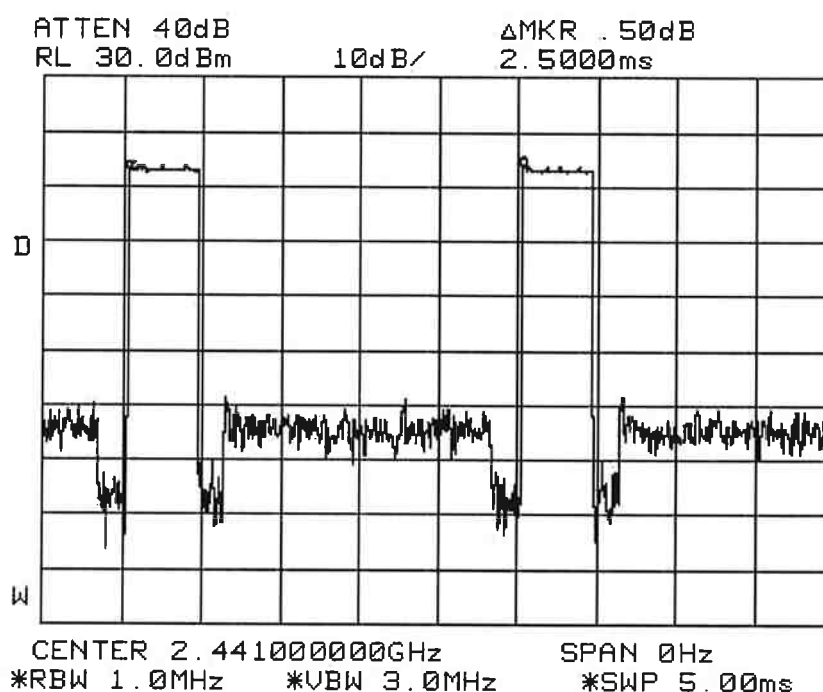


**AVERAGE FREQUENCY DWELL TIME TEST**

**Average Frequency Dwell Time Plots - Receiver**



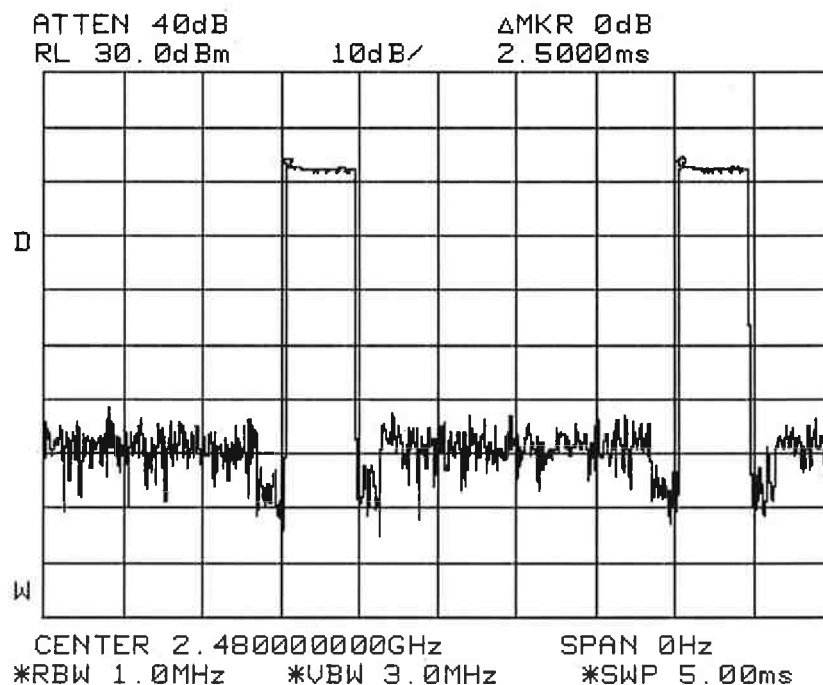
**Plot 24 – Channel 1**



**Plot 25 – Channel 39**

**AVERAGE FREQUENCY DWELL TIME TEST**

**Average Frequency Dwell Time Plots - Receiver**



**Plot 26 – 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 |
|------------------------------|--------|------------|--------------|
| R & S Universal Radio Tester | CMU200 | 837587/068 | 23 Mar 2006  |

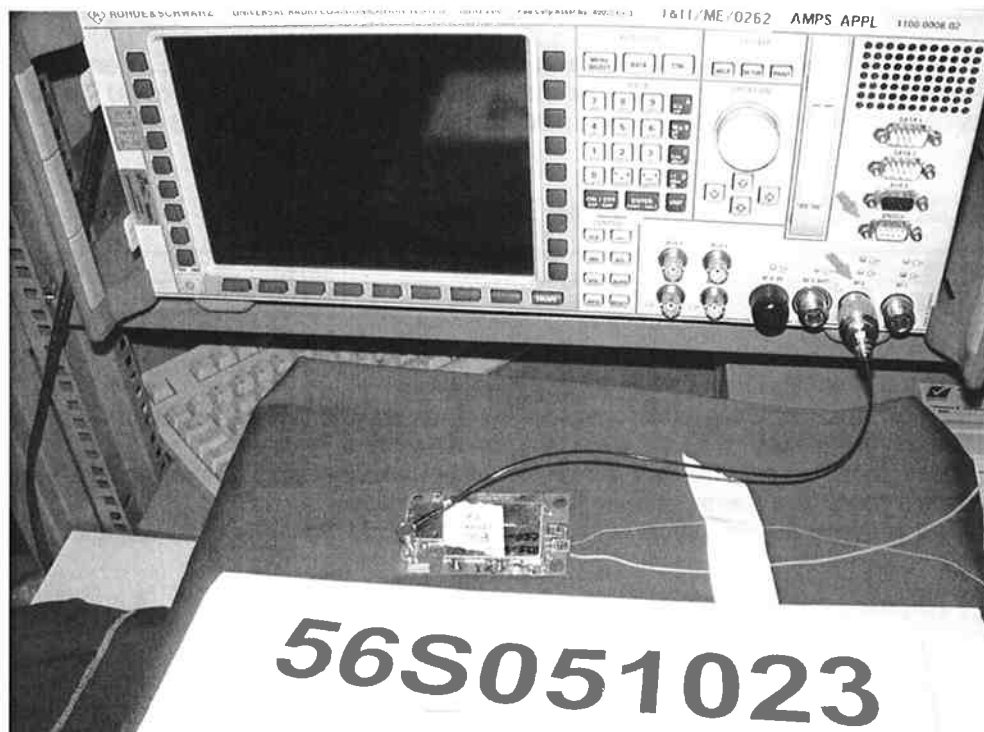
**FCC Part 15.247(b)(1) Maximum Peak Power Test Setup**

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**



**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**

- 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 | 8564E | 3846A01433 | 27 Apr 2006  |

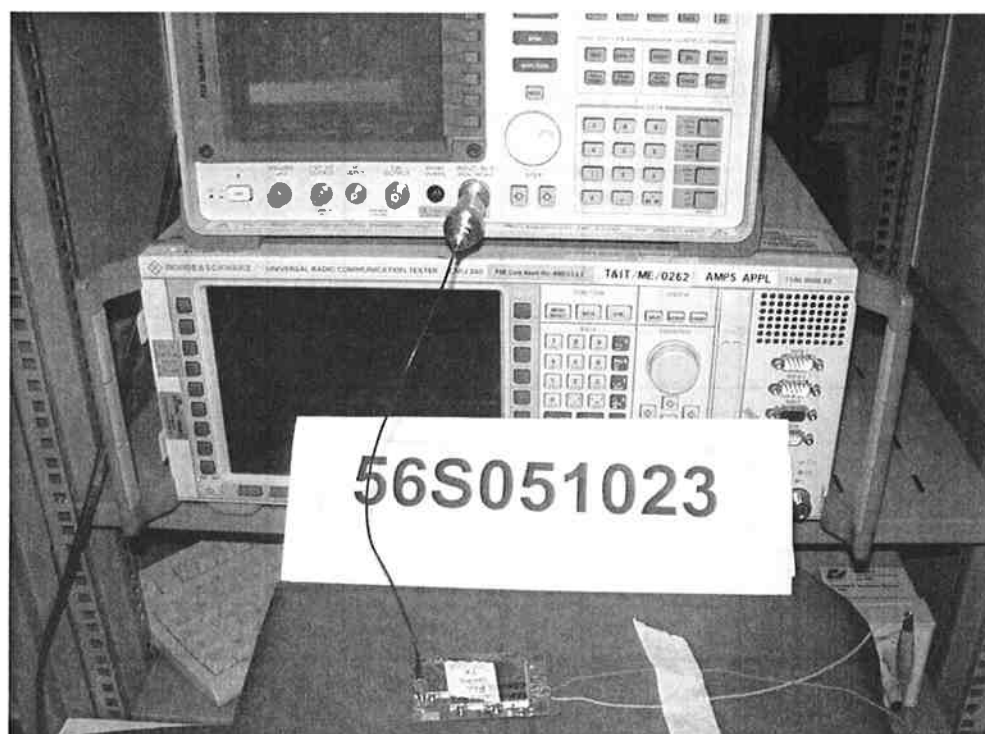
**FCC Part 15.247(d) RF Conducted Spurious Emissions Test Setup**

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**



**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 |

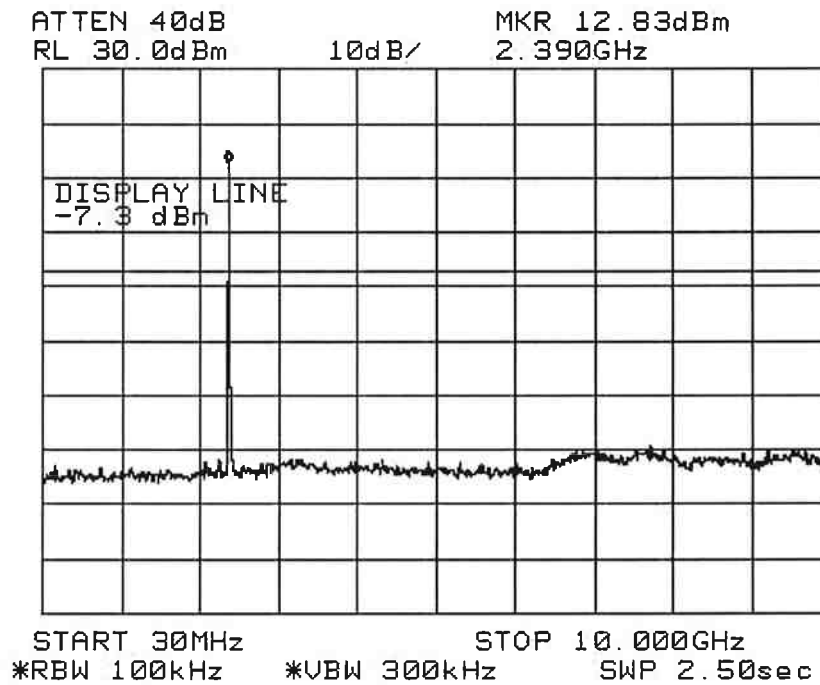
  

|                  |          |                      |             |
|------------------|----------|----------------------|-------------|
| Test Input Power | 5Vdc     | Temperature          | 24°C        |
| Attached Plots   | 33 - 38  | Relative Humidity    | 60%         |
| Module           | Receiver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

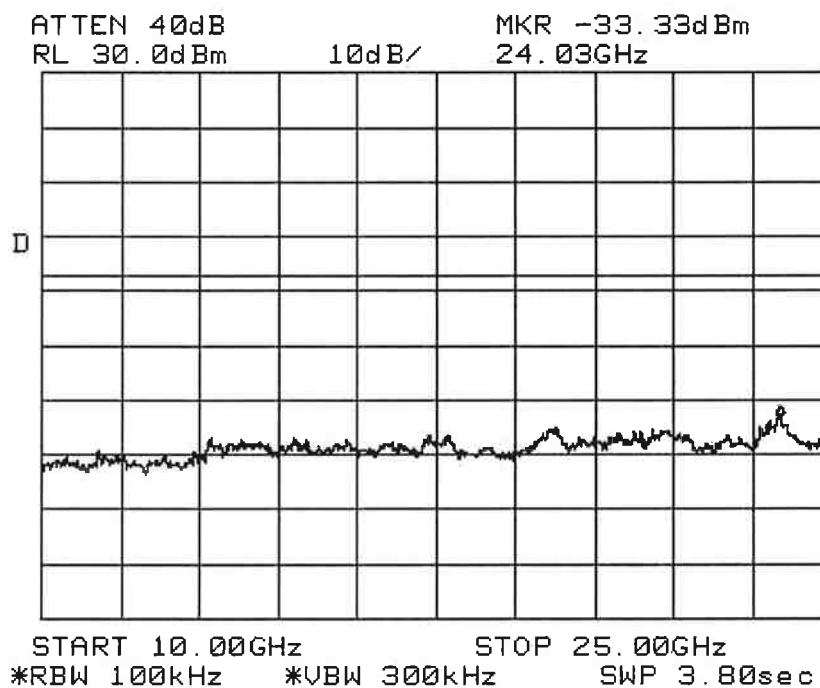
All spurious signals found were below the specified limit. Please refer to the attached plots.

**RF CONDUCTED SPURIOUS EMISSIONS TEST**

**RF Conducted Spurious Emissions Plots - Transmitter**



**Plot 27 – Channel 1**

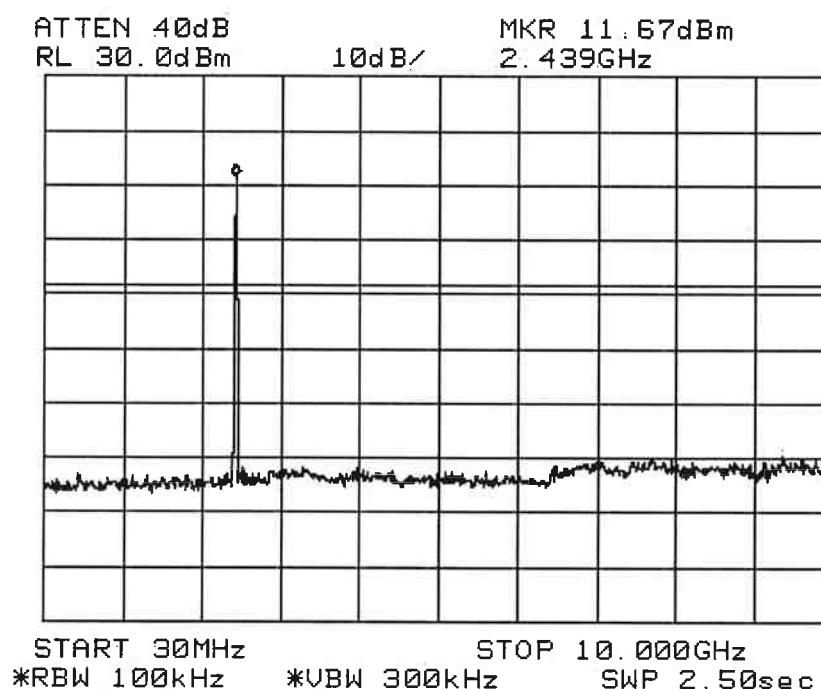


**Plot 28– Channel 1**

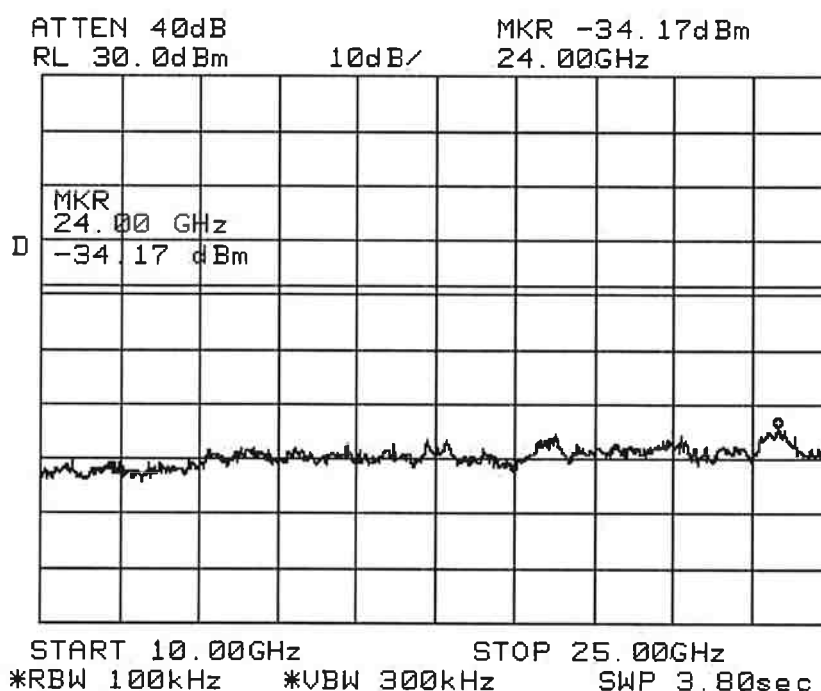


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots- Transmitter



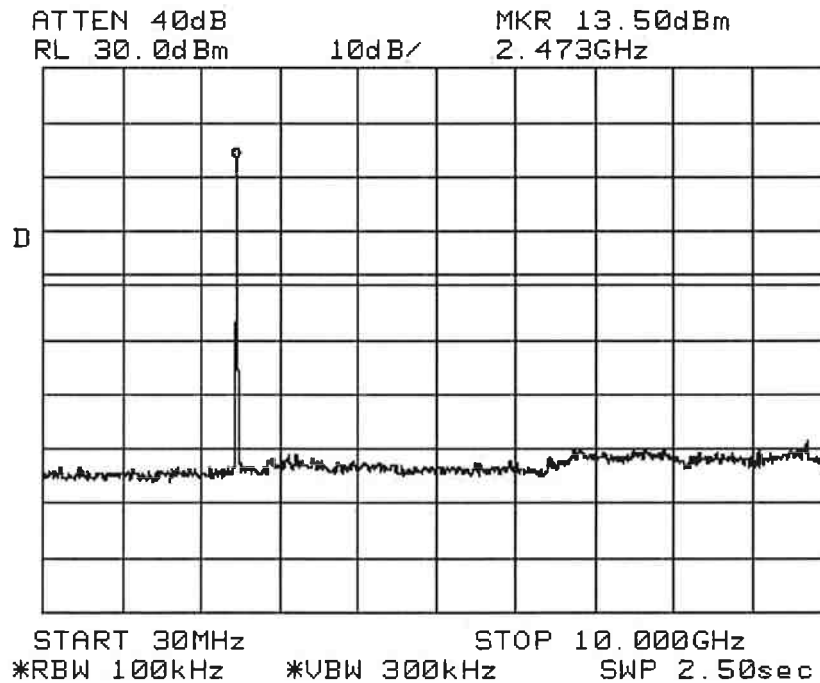
Plot 29 – Channel 39



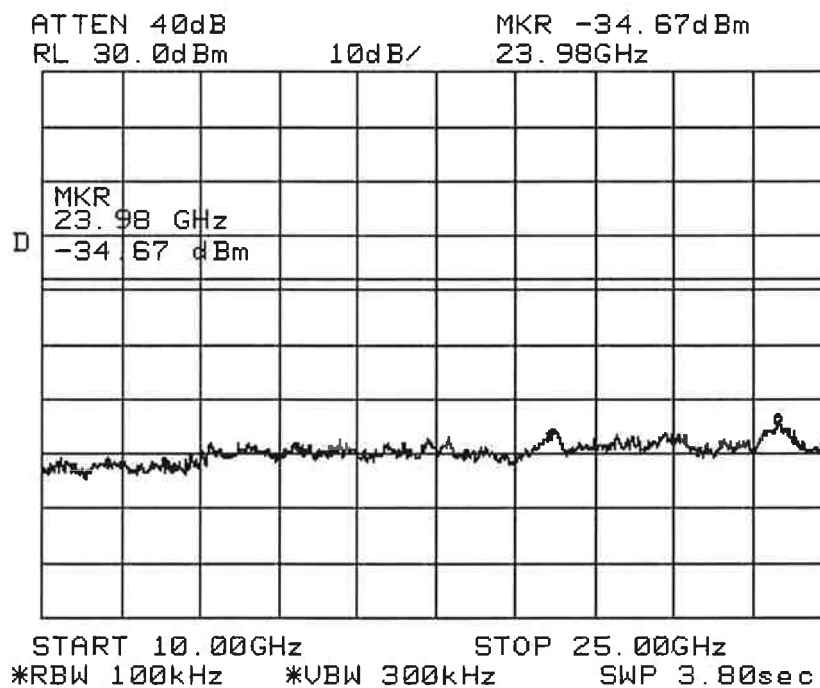
Plot 30 – Channel 39

**RF CONDUCTED SPURIOUS EMISSIONS TEST**

**RF Conducted Spurious Emissions Plots - Transmitter**



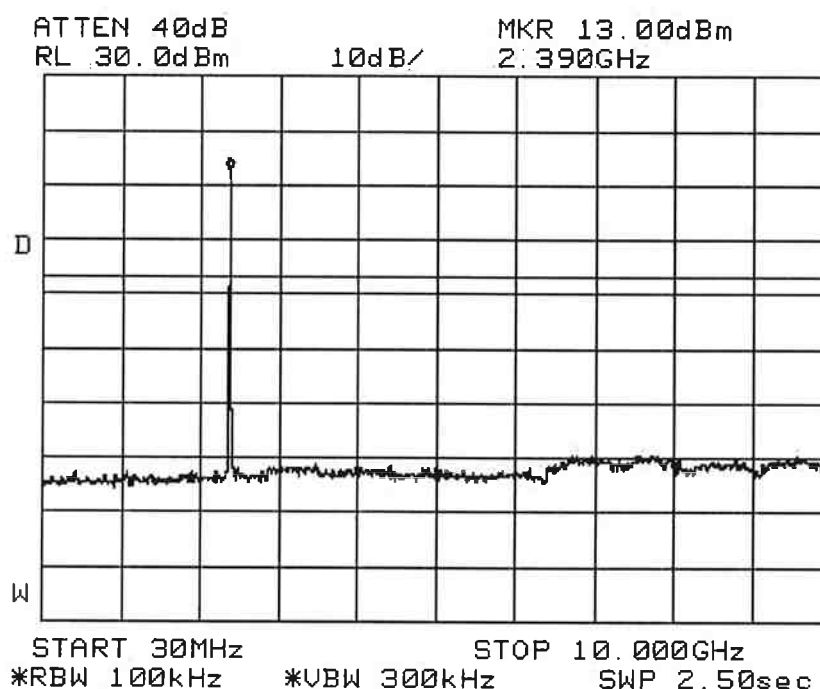
**Plot 31 – Channel 78**



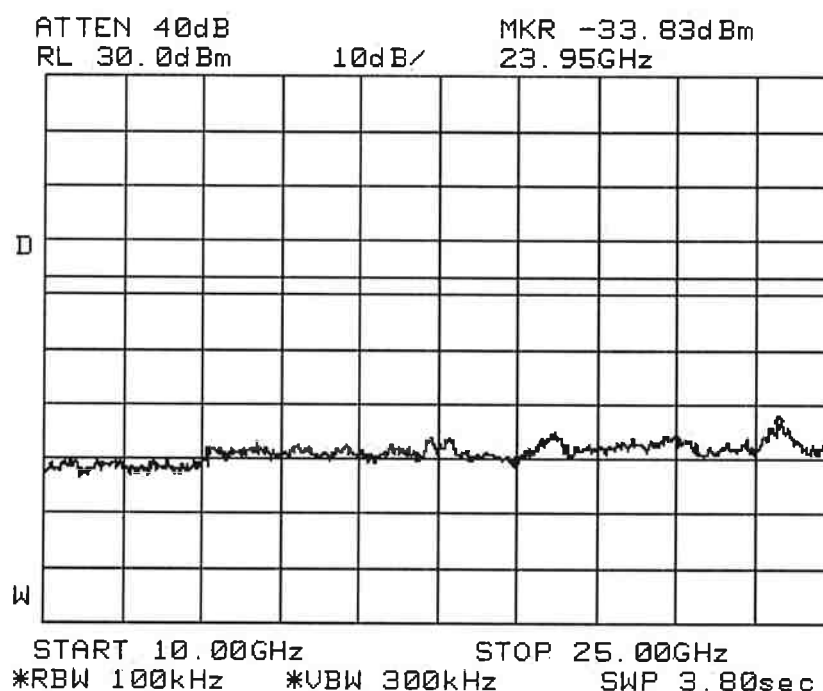
**Plot 32 – Channel 78**

**RF CONDUCTED SPURIOUS EMISSIONS TEST**

**RF Conducted Spurious Emissions Plots – Receiver**



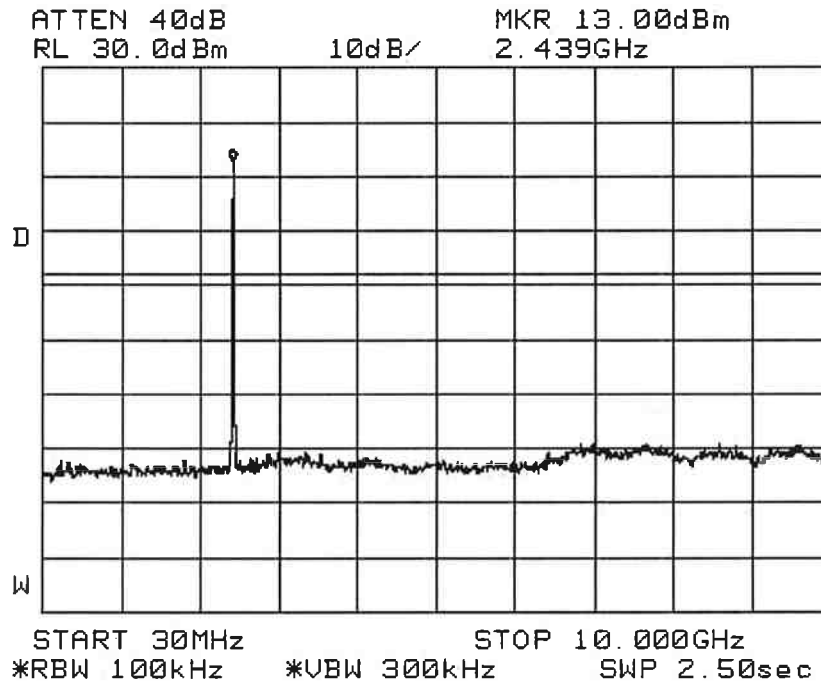
**Plot 33 – Channel 1**



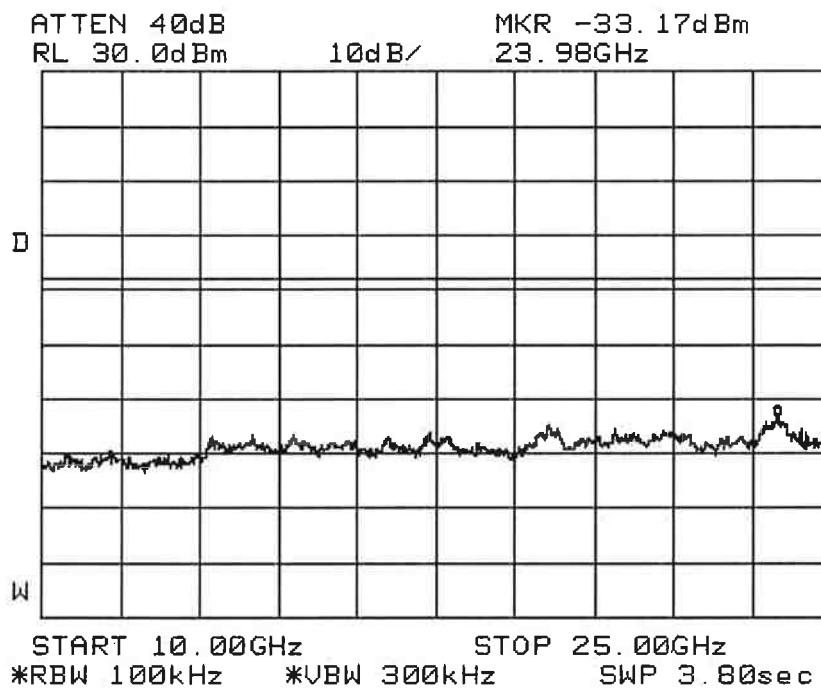
**Plot 34 – Channel 1**

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots – Receiver



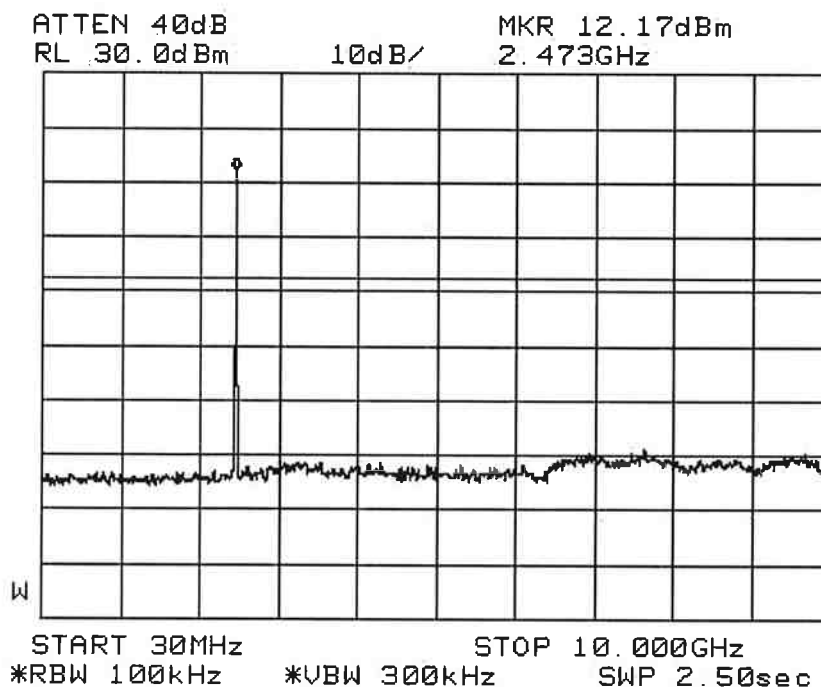
Plot 35 – Channel 39



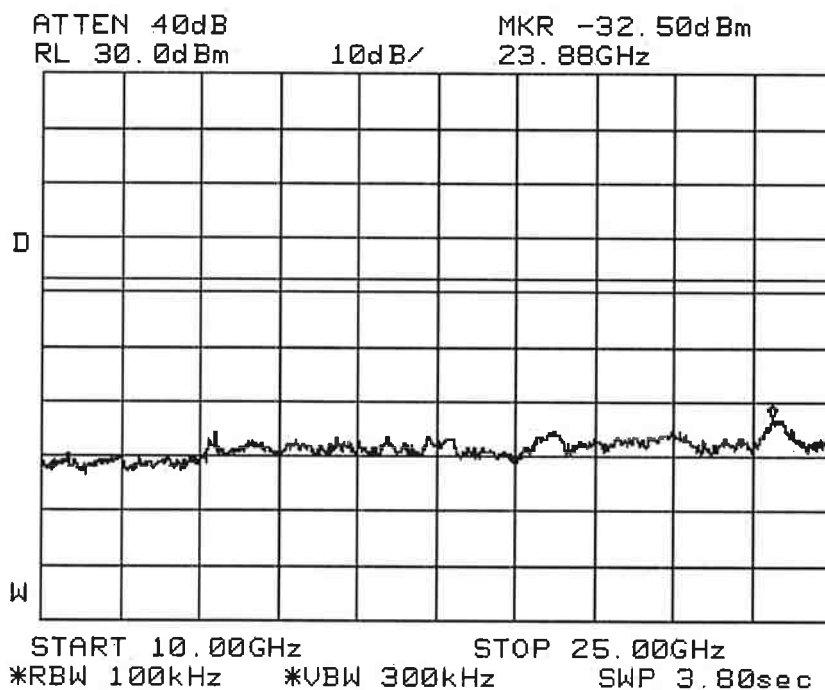
Plot 36 – Channel 39

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots – Receiver



Plot 37 – Channel 78



Plot 38 – Channel 78