

TEST REPORT



Your Ref:

Date: 21 Dec 2004

Our Ref: 56S040987/01

Page: 1 of 35

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
FCC PARTS 15B & C : 2004
OF A
CREATIVE BLUETOOTH HEADSET
[MODEL : CB2455]
[FCC ID : GX5-CB2455]

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)
IC 4257 (10m Anechoic Chamber)

IND. CANADA REG. NO.

PREPARED FOR

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JOB NUMBER

56S040987

TEST PERIOD

27 November 2004 – 17 December 2004

PREPARED BY

Desmond Poon
Engineer

APPROVED BY

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Assistance 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

TEST SUMMARY

PRODUCT DESCRIPTION

SUPPORTING
EQUIPMENT LIST

EUT OPERATING
CONDITION

TEST RESULTS

- | | | |
|---------|---|--|
| ANNEX A | - | TEST INSTRUMENTATION & GENERAL PROCEDURES |
| ANNEX B | - | EUT PHOTOGRAPHS / DIAGRAMS |
| ANNEX C | - | USER MANUAL, TECHNICAL DESCRIPTION, BLOCK & CIRCUIT DIAGRAMS |
| ANNEX D | - | FCC LABEL & POSITION |

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

Test Results Summary

The following tests were tested.

FCC Paragraphs	Descriptions	Pass / Fail
15.107	Conducted Emissions	Pass
15.205	Radiated Emissions (Restricted Band Requirements)	Pass
15.109, 15.209	Radiated Emissions (Spurious Emissions)	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 (c)	RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Terminal	Pass
15.247 (d)	Peak Power Spectral Density	Pass

Notes

- 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 Bluetooth test mode

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>
Channel 0	2.402
Channel 39	2.441
Channel 78	2.480
- All the measurements in section 15.247 were done based on conducted measurements.
- The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.
- The EUT cannot transmit and receive upon charging with the adapter.

Modifications

No modifications were done.

PRODUCT DESCRIPTION

Description	: The Equipment Under Test (EUT) is a Creative Bluetooth Headset.
Manufacturer	: Broadxent Pte Ltd
Model Number	: CB2455
Serial Number	: Nil
Microprocessor	: CSR Bluecore2
Operating / Transmitting Frequency	: <u>Bluetooth</u> 2.402GHz to 2.480GHz 79 channels. Starting at 2.402MHz with subsequent channel at 1MHz interval from the preceding channel.
Clock / Oscillator Frequency	: 16 MHz
Modulation	: <u>Bluetooth</u> Gaussian Frequency Shift Keying (GFSK) with BT = 0.5
Port / Connectors	: 1 x AC to DC jack
Rated Input Power	: 5V via AC/DC Power Adapter

SUPPORTING EQUIPMENT DESCRIPTION

The EUT was tested as a stand-alone unit during radiated emissions test. It was tested with following supporting devices during RF Conducted tests.

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
NEC Notebook	M/N: Versa Note S/N: 1186100011 FCC ID: Doc	Nil
NEC Notebook AC/DC Adapter	M/N: ADP-50MB S/N: 9201421DA FCC ID: DoC	2.0m unshielded AC power cable 2.0m unshielded DC power cable with moulded ferrite bead
CSR Headset Development Board	M/N: SCL1 S/N: Nil FCC ID: Nil	2.0m UTP Ethernet cable 2.0m shielded RS232 cable
Trekker Mouse	M/N: X04-81530 S/N: 90318-OEM- FCC ID: DoC	2.0 standard mouse cable
Seiko Smart Label	M/N: SLP-220 S/N: B011331000 FCC ID: DoC	1.8m parallel cable.
Seiko Smart Label AC/DC Power Adapter	M/N: PW-4012-W1 S/N: 00009 FCC ID: Nil	1.8m unshielded AC power cable. 2.0m unshielded DC output cable.
Agilent DC Power Supply (as a power source to CSR Headset Development Board)	M/N: E3620A S/N: MY40000448 FCC ID: Nil	2.0m unshielded AC power cable 2.0m unshielded DC power cable

EUT OPERATING CONDITIONS

Tests	Description Of Operation
1. Conducted Emissions 2. Radiated Emissions 3. Carrier Frequency Separation 4. Spectrum Bandwidth (20dB Bandwidth Measurement) 5. Number of Hopping Frequencies 6. Average Frequency Dwell Time 7. Maximum Peak Power 8. RF Conducted Spurious Emissions at the Transmitter Antenna Terminal 9. Band Edge Compliance at the Transmitter Antenna Terminal 10. Peak Power Spectral Density	The EUT was exercised by operating in the following operating modes during the tests: <u>Bluetooth test mode (continuous transmit in hopping with maximum power)</u> - Carrier Frequency Separation - Number of Hopping Frequency - Average Frequency Dwell Time - Band Edge at the Transmitting Antenna <u>Bluetooth test mode (continuous transmit in hopping off with maximum power)</u> - Radiated Emissions - Spectrum Bandwidth (20dB Bandwidth Measurement) - Maximum Peak Power - RF Conducted Spurious Emissions at the Transmitter Antenna Terminal - Peak Power Spectral Density <u>Charging mode</u> - Conducted Emissions

FCC Part 15 (15.107) Conducted Emission Results

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line
0.5954	33.5	-22.5	28.1	-17.9	Neutral
0.6314	34.7	-21.3	31.8	-14.2	Live
2.6300	36.9	-19.1	37.5	-8.5	Neutral
2.8994	40.3	-15.7	38.9	-7.1	Live
3.2910	38.9	-17.1	29.2	-16.8	Neutral
4.3258	39.9	-16.1	35.7	-10.3	Live

Tested by: TSS

Notes

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the 6 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. This test is only applicable when the EUT is in charging state using an AC/DC adapter (transmit and receive modes are disabled). An internal battery is used for transmit and receive modes.
4. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
9kHz - 30MHz
RBW: 10kHz VBW: 30kHz
5. 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.



Conducted Emissions Setup (Front View)



Conducted Emissions Setup (Rear View)

FCC Part 15 (15.109 & 15.209) Radiated Emission (Spurious Emissions) Results

Test Distance : 3m

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
288.6000	26.7	-19.3	39	137	100	H
361.9000	25.6	-20.4	78	189	121	V
365.1000	22.8	-23.2	39	204	105	V
436.3000	24.8	-21.2	0	35	100	V
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Spurious Emissions above 1GHz

Frequency (GHz)	Peak Value (dBµV/m)	Average Value (dBµV/m)	Average Margin (dB) See Note 3	Channel	Azimuth (Degrees)	Height (cm)	Pol (H/V)
1.2422	45.2	See Note 2	-8.8	78	165	120	H
1.7600	40.2	See Note 2	-13.8	78	19	100	H
2.0622	42.2	See Note 2	-11.8	39	60	104	H
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Tested by: DP

Notes

- All possible modes of operation were investigated from 30MHz to 25GHz. All other emissions were relatively insignificant.
- As the measured peak shows compliance to the average limit, as such no average measurement was required.
- The average margin indicates the margin of the measured peak value below the average limit.
- "--" indicates no emissions were found and shows compliance to the limits as specified in sections 15.109 and 15.209. The emissions were merely the noise floor.
- 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.
- 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:
30MHz - 1GHz
 RBW: 120kHz VBW: 1MHz
>1GHz
 RBW: 1MHz VBW: 1MHz

8. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
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).

TEST RESULTS

FCC Part 15 (15.205) Radiated Emissions (Restricted Band Requirements) Results

Test Distance : 3m

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
258.4000	23.8	-22.2	78	245	100	V
284.3000	23.4	-22.6	0	120	105	V
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Spurious Emissions above 1GHz

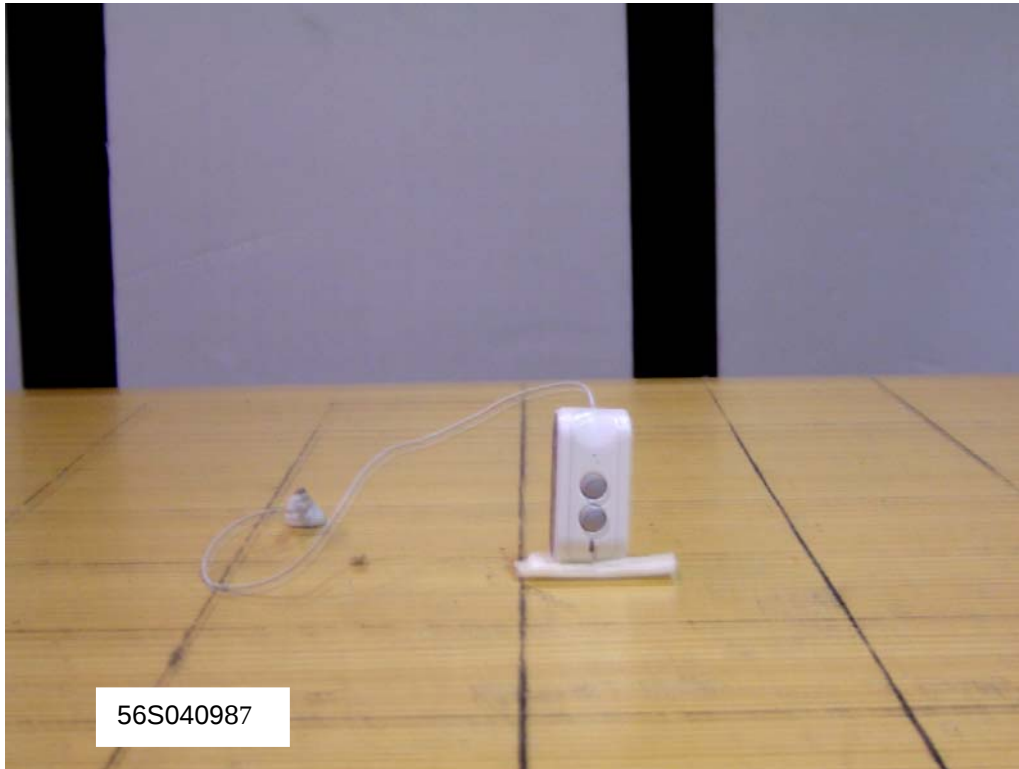
Frequency (GHz)	Peak Value (dBμV/m)	Average Value (dBμV/m)	Average Margin (dB) See Note 3	Channel	Azimuth (Degrees)	Height (cm)	Pol (H/V)
1.2044	45.0	See Note 2	-9.0	0	43	100	V
1.2222	46.6	See Note 2	-7.4	39	321	103	H
1.4999	44.5	See Note 2	-9.5	0	20	130	V
2.4886	47.6	See Note 2	-6.4	78	50	100	H
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Tested by: DP

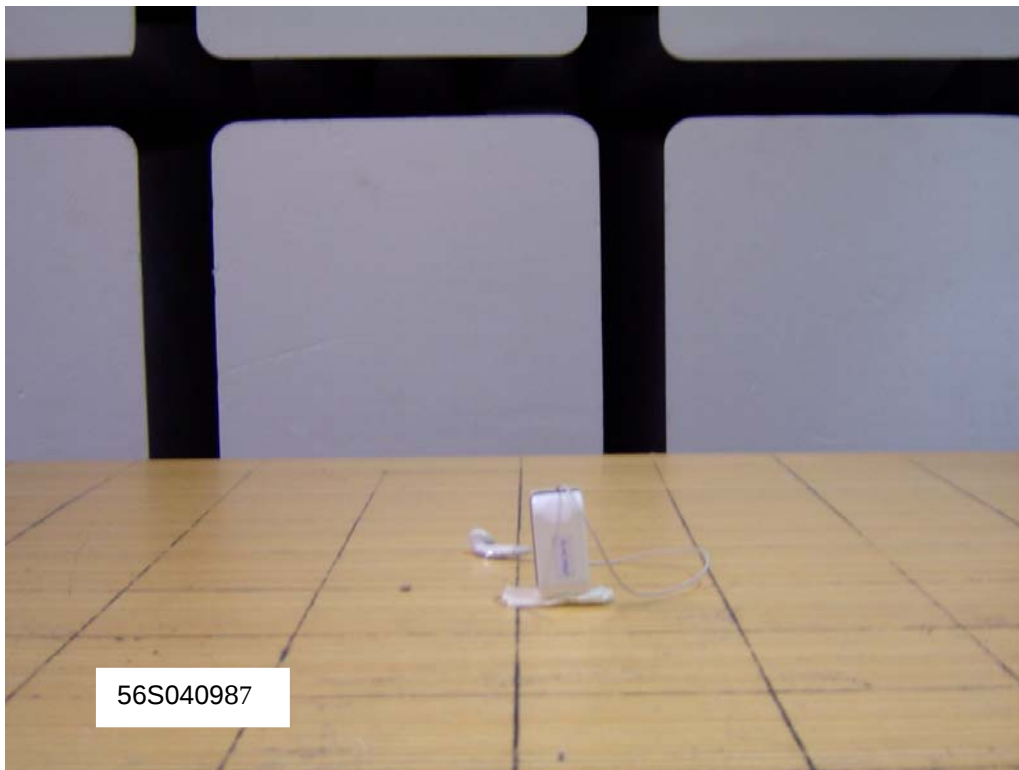
Notes

- All possible modes of operation were investigated from 30MHz to 25GHz. All other emissions were relatively insignificant.
- As the measured peak shows compliance to the average limit, as such no average measurement was required.
- The average margin indicates the margin of the measured peak value below the average limit.
- "--" indicates no emissions were found and shows compliance to the limits as specified in section 15.209. The emissions were merely the noise floor.
- 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.
- 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:
30MHz - 1GHz
RBW: 120kHz VBW: 1MHz
>1GHz
RBW: 1MHz VBW: 1MHz

8. The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
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).



Radiated Emissions Setup (Front View)



Radiated Emissions Setup (Rear View)

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

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.

Adjacent Channels	Channel Separation (MHz)
0 and 1 (2.402GHz and 2.403GHz)	1.005
38 and 39 (2.440GHz and 2.441GHz)	1.040
39 and 40 (2.441GHz and 2.442GHz)	1.020
77 and 78 (2.479GHz and 2.480GHz)	1.025

Please refer to the attached Plots 1 - 4 for details.

Tested by: DP

Notes

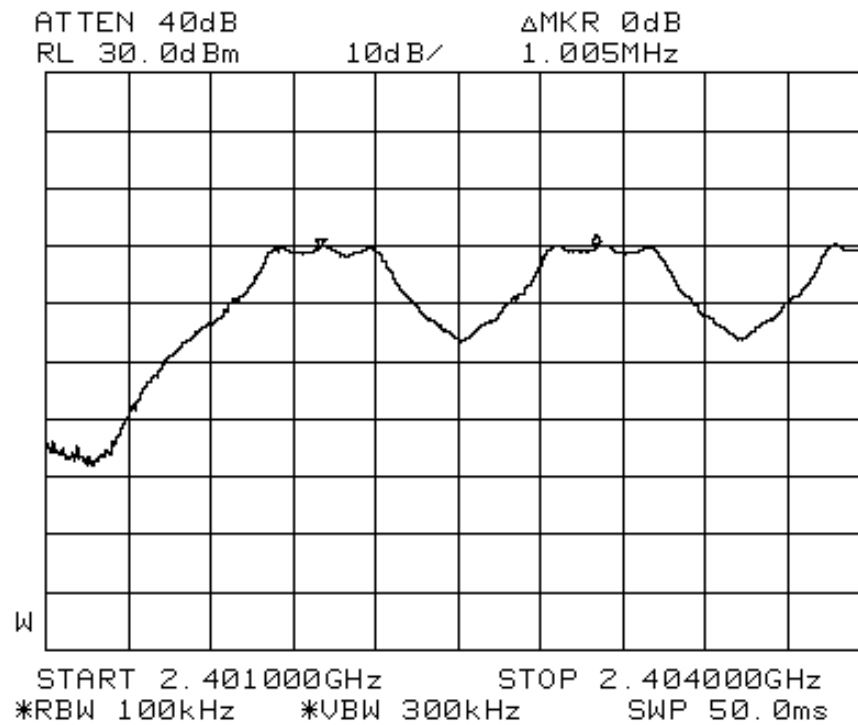
- Environmental Conditions

Temperature	23°C
Relative Humidity	55%
Atmospheric Pressure	1030mbar

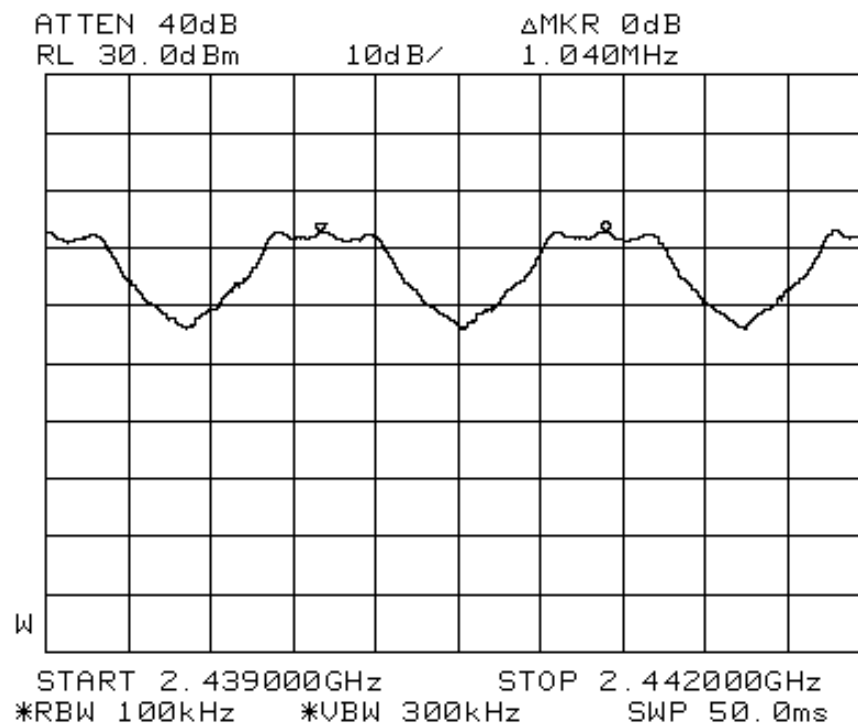


Carrier Frequency Separation Measurement Test Setup

CARRIER FREQUENCY SEPARATION PLOTS

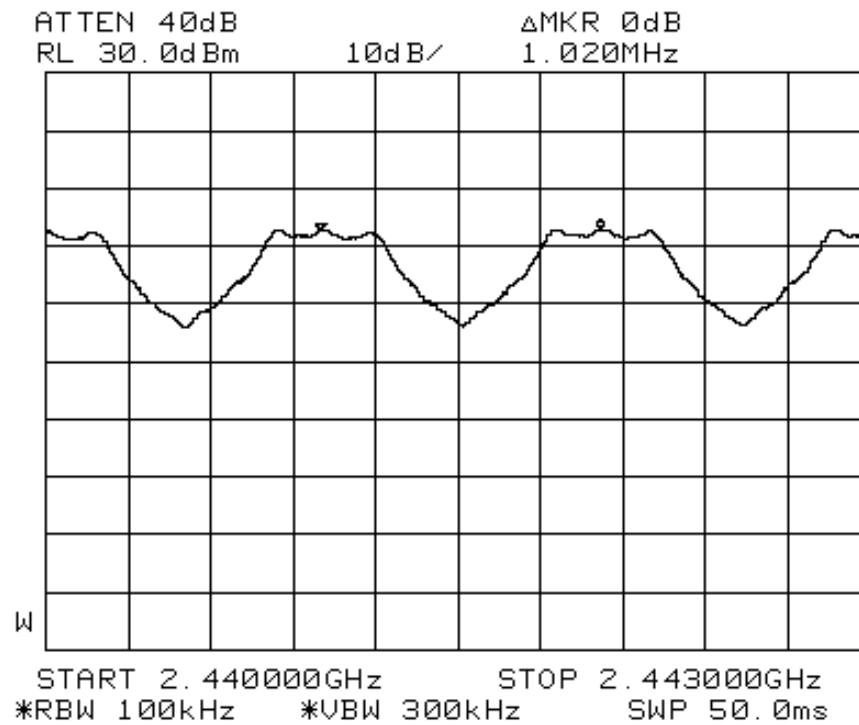


Plot 1- Channels 0 and 1 Separation

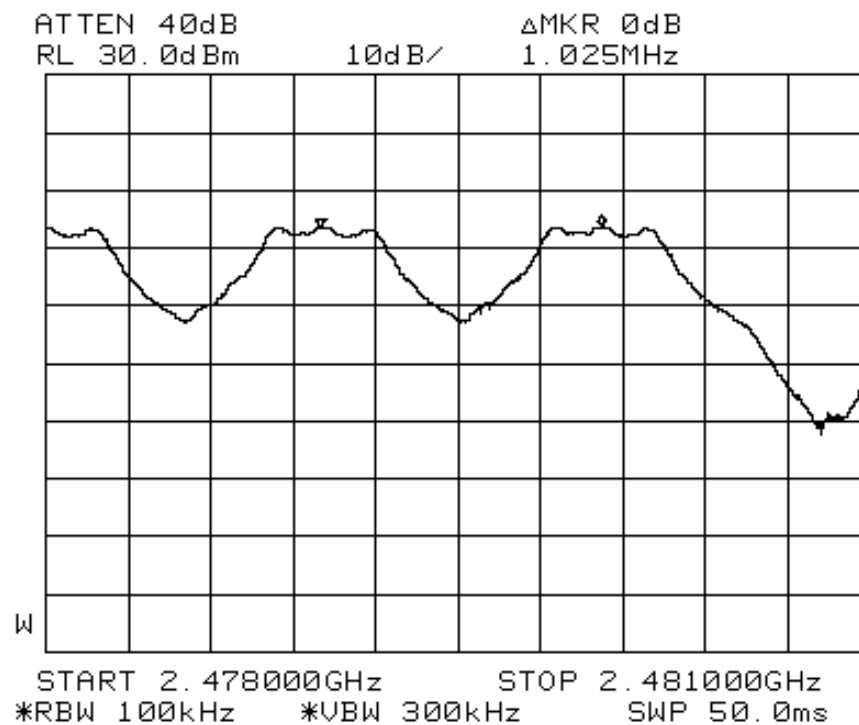


Plot 2 – Channels 38 and 39 Separation

CARRIER FREQUENCY SEPARATION PLOTS



Plot 3 - Channel 39 & 40 Separation



Plot 4 - Channel 77 and 78 Separation

FCC Part 15 (15.247(a)(1)) Spectrum Bandwidth (20dB Bandwidth Measurement) Results

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.

Channel	Channel Frequency (GHz)	20dB Bandwidth (MHz)
0	2.402	0.723
39	2.441	0.733
78	2.480	0.727

Note: The EUT is a Bluetooth device, which supports no overlapping for each channel.

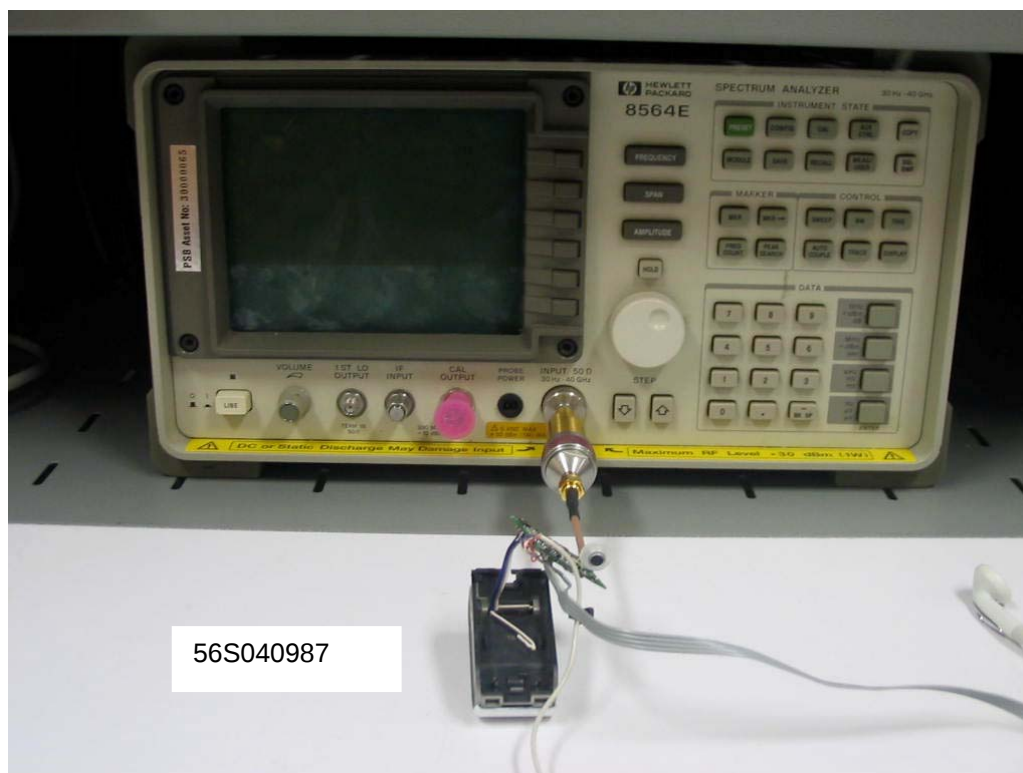
Please refer to attached Plots 5 - 7 for details.

Tested by: DP

Notes

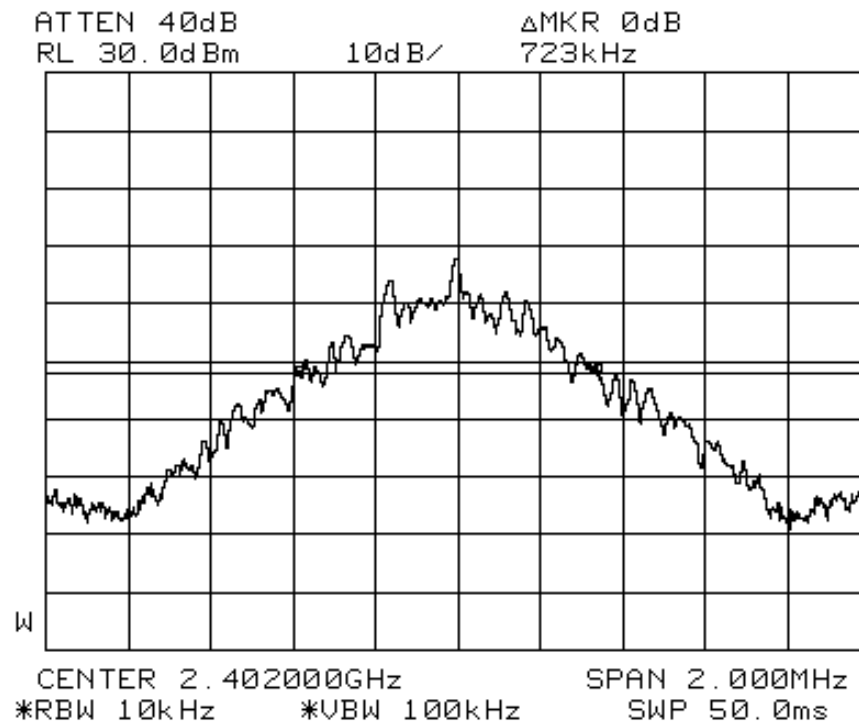
- Environmental Conditions

Temperature	23°C
Relative Humidity	55%
Atmospheric Pressure	1030mbar

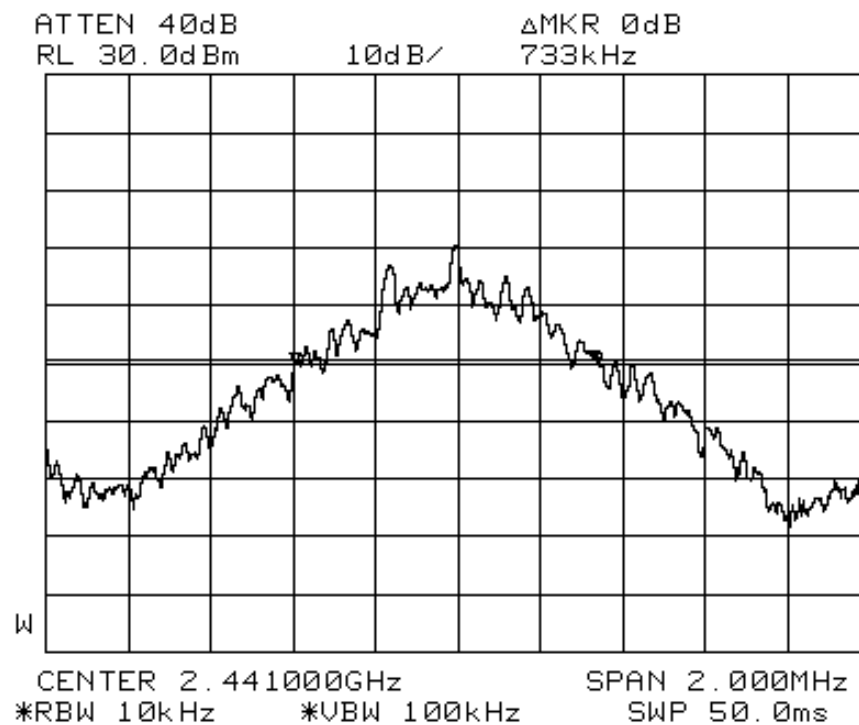


Spectrum Bandwidth Measurement Test Setup

SPECTRUM BANDWIDTH (20DB BANDWIDTH MEASUREMENT) PLOTS

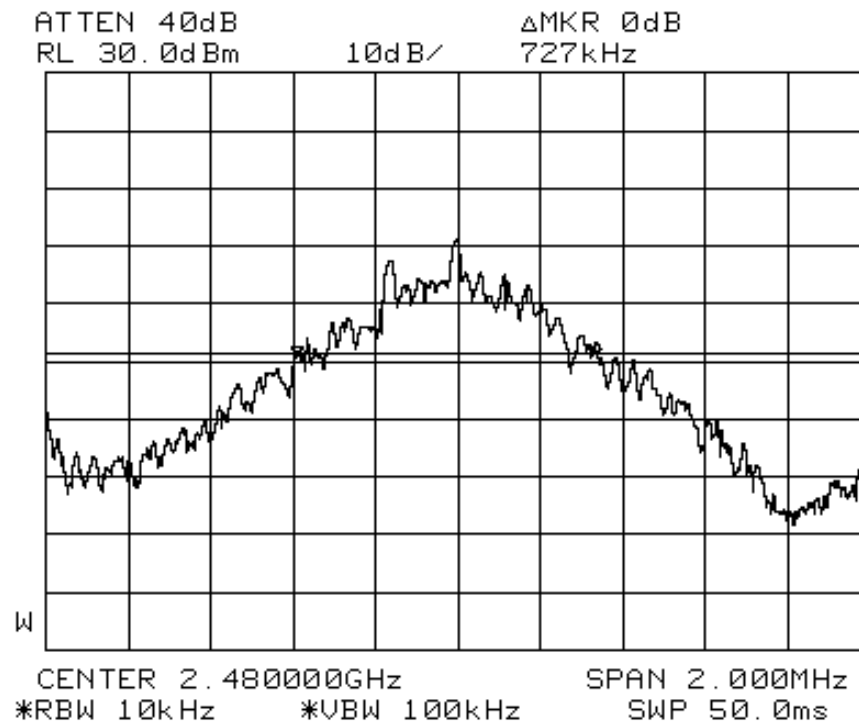


Plot 5 – Channel 0



Plot 6 – Channel 39

SPECTRUM BANDWIDTH (20DB BANDWIDTH MEASUREMENT) PLOTS



Plot 7 – Channel 78

FCC Part 15 (15.247(a)(1)(iii)) Number of Hopping Frequencies Results

The EUT shows compliance to the requirements of this section, which states the number of hopping frequencies shall be at least 75.

The EUT was found to have 79 hopping frequencies.

Please refer to the attached Plots 8 - 11 for details.

Tested by: DP

Notes

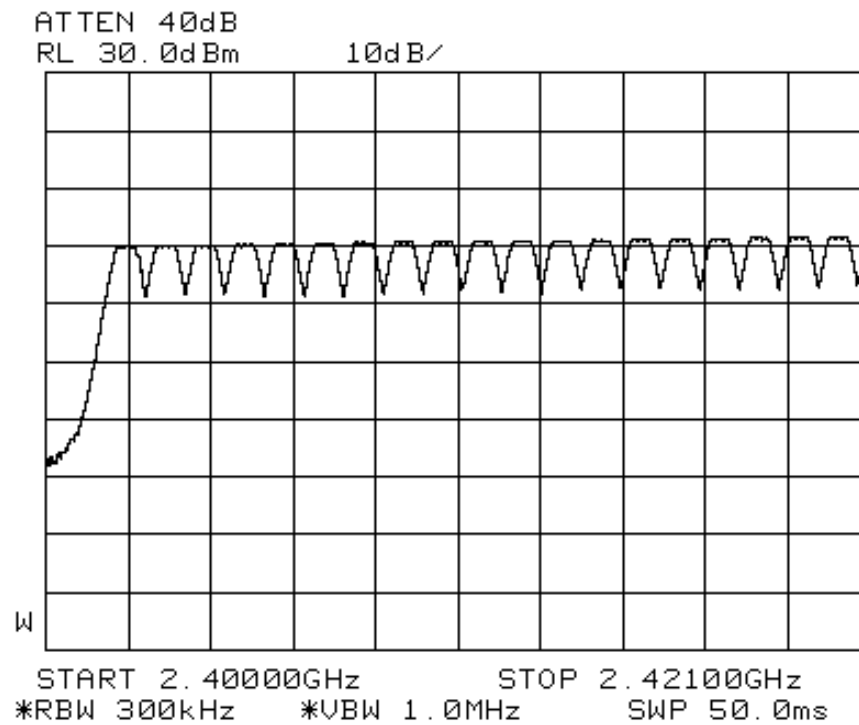
- Environmental Conditions

Temperature	23°C
Relative Humidity	55%
Atmospheric Pressure	1030mbar

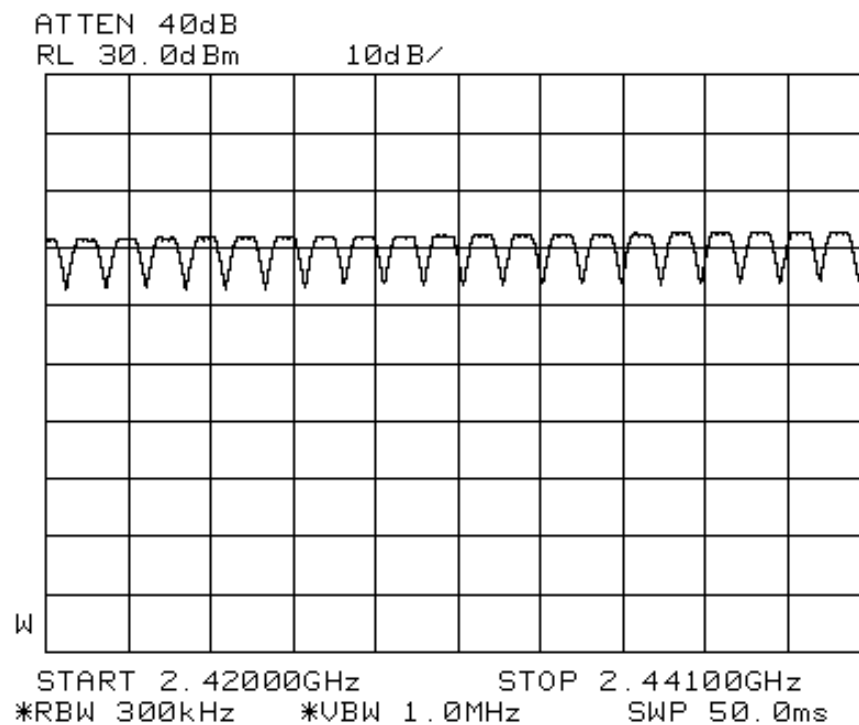


Number of Hopping Frequencies Measurement Test Setup

NUMBER OF HOPPING FREQUENCIES PLOTS

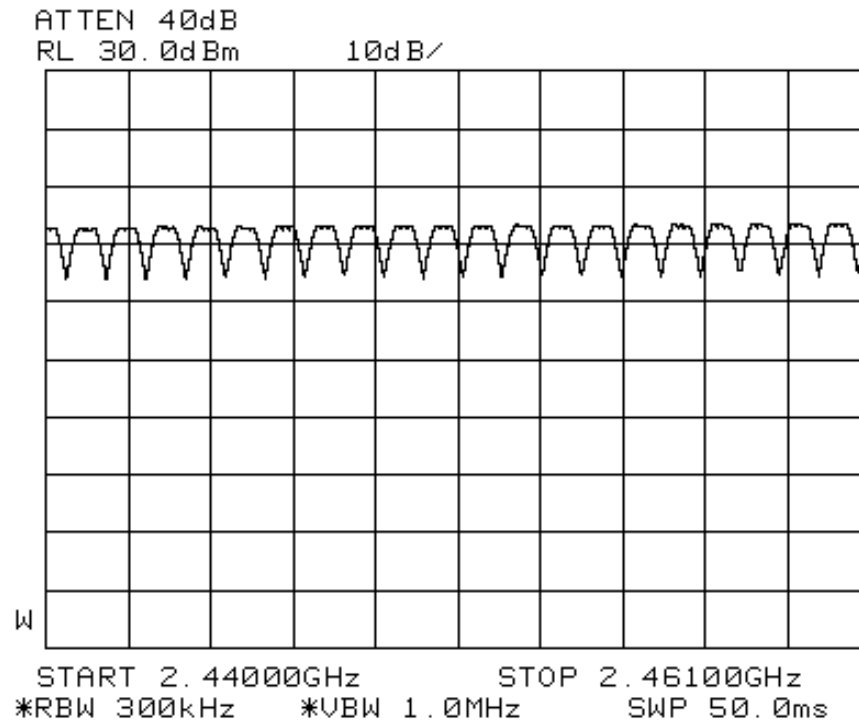


Plot 8 - Channels 0 to 18

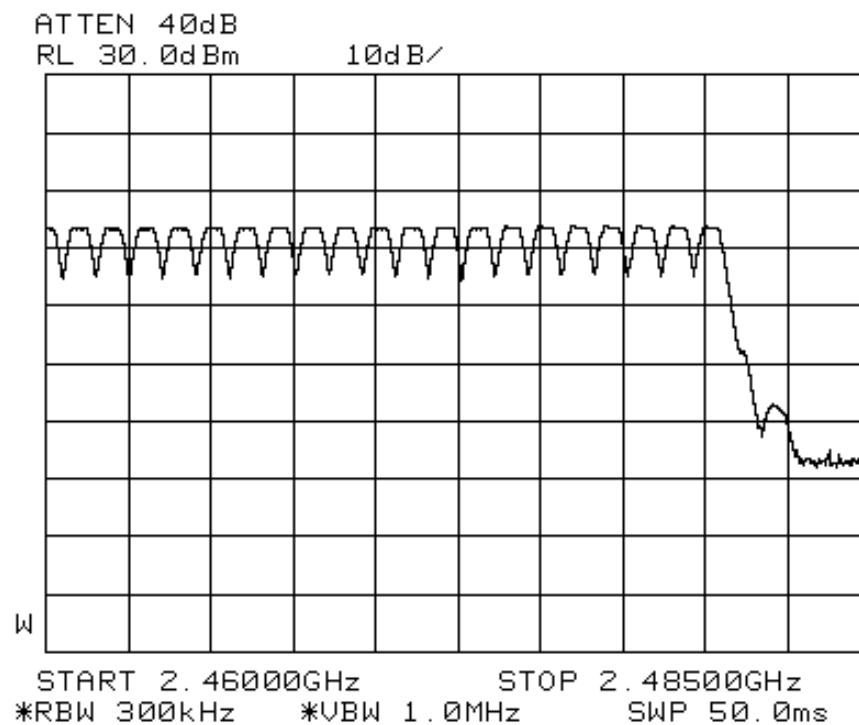


Plot 9 - Channels 19 to 38

NUMBER OF HOPPING FREQUENCIES PLOTS



Plot 10 - Channels 39 to 58



Plot 11 - Channels 59 to 78

FCC Part 15 (15.247(a)(1)(iii)) Average Frequency Dwell Time Results

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 0.4second multiplied by the number of hopping channels employed.

EUT hopping rate = 1600 hops/data packet length/s

Number of EUT hopping frequencies = 79 hops

DH1 packet was used as a transmission packet

Average Frequency Dwell Time = measured time slot length (l) x hopping rate (h) / number of hopping frequencies x 30 seconds period

Channel	Channel Frequency (GHz)	Measured Time Slot Length for DH1 Packet (ms)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
0	2.402	0.625	0.3798	0.4
39	2.441	0.625	0.3798	0.4
78	2.480	0.625	0.3798	0.4

Please refer to the attached Plots 12 – 14 for details.

Tested by: DP

Notes

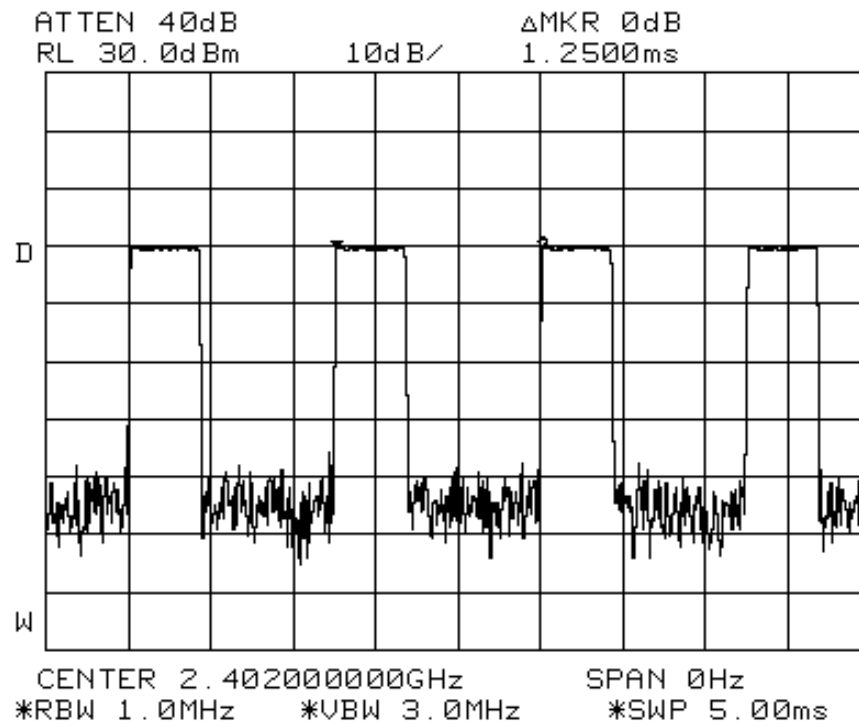
- Environmental Conditions

Temperature	23°C
Relative Humidity	55%
Atmospheric Pressure	1030mbar

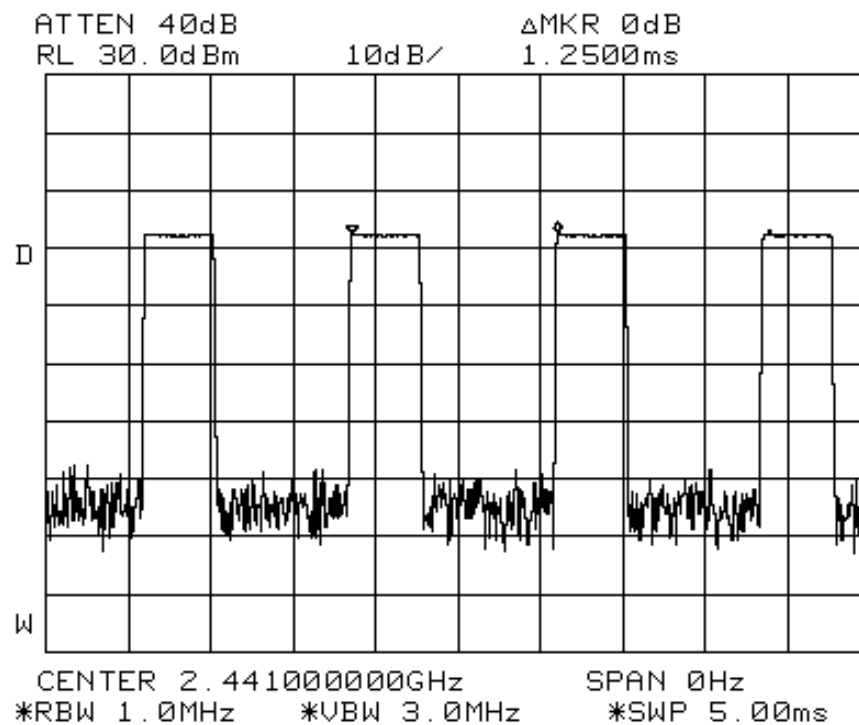


Average Frequency Dwell Time Measurement Test Setup

AVERAGE FREQUENCY DWELL TIME PLOTS

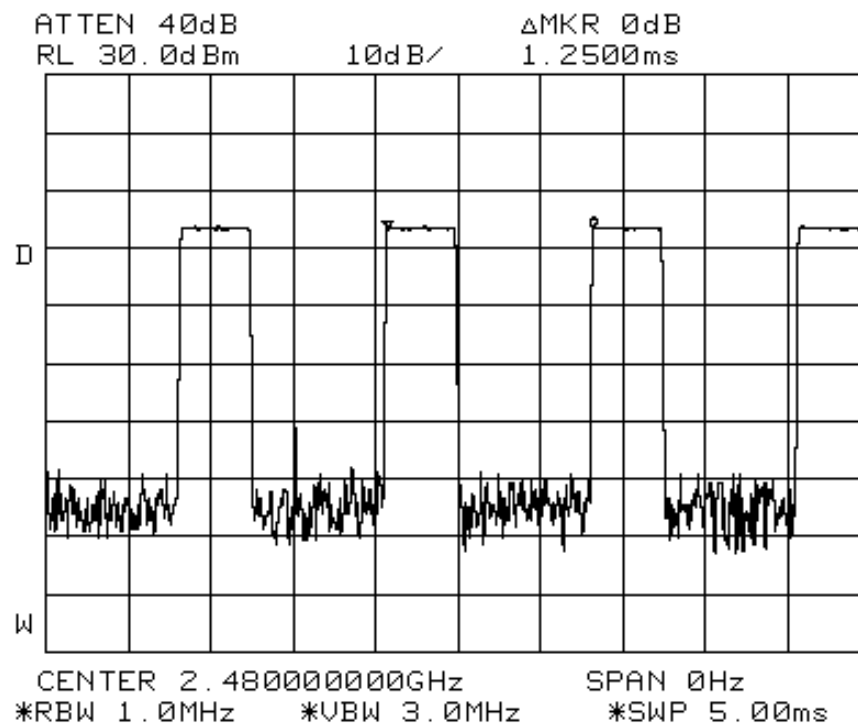


Plot 12 – Channel 0



Plot 13 – Channel 39

AVERAGE FREQUENCY DWELL TIME PLOTS



Plot 14 – Channel 78

FCC Part 15 (15.247(b)(1)) Maximum Peak Power Results

The EUT shows compliance to the requirements of this section, which states the peak power of an intentional radiator (EUT) shall not exceed 30dBm (1 Watt).

The maximum peak power for Channels 0, 39 and 78 at 2.402GHz, 2.441GHz and 2.480GHz respectively were investigated and found below 30dBm (1Watt).

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0	2.402	0.00135	1
39	2.441	0.00157	1
78	2.480	0.00163	1

Tested by: DP

Notes

- Environmental Conditions**

Temperature 23°C
Relative Humidity 55%
Atmospheric Pressure 1030mbar
- 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.



Maximum Peak Power Measurement Test Setup

FCC Part 15 (15.247(c)) RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Results

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 RF power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The RF conducted spurious emissions were scanned from 30MHz to 25GHz for Channels 0, 39, and 78 with channel frequency at 2.402GHz, 2.441GHz and 2.480GHz respectively. No significant signal was found and they were below the specified limit. Please refer to the attached Plots 15 – 20 for details.

The conducted spurious at lower and upper band-edges (2.4000GHz and 2.4835GHz) were scanned. The spurious emissions at band-edges were found below the specified limit. Please refer to the attached Plots 21 – 22 for details.

Tested by: DP

Notes

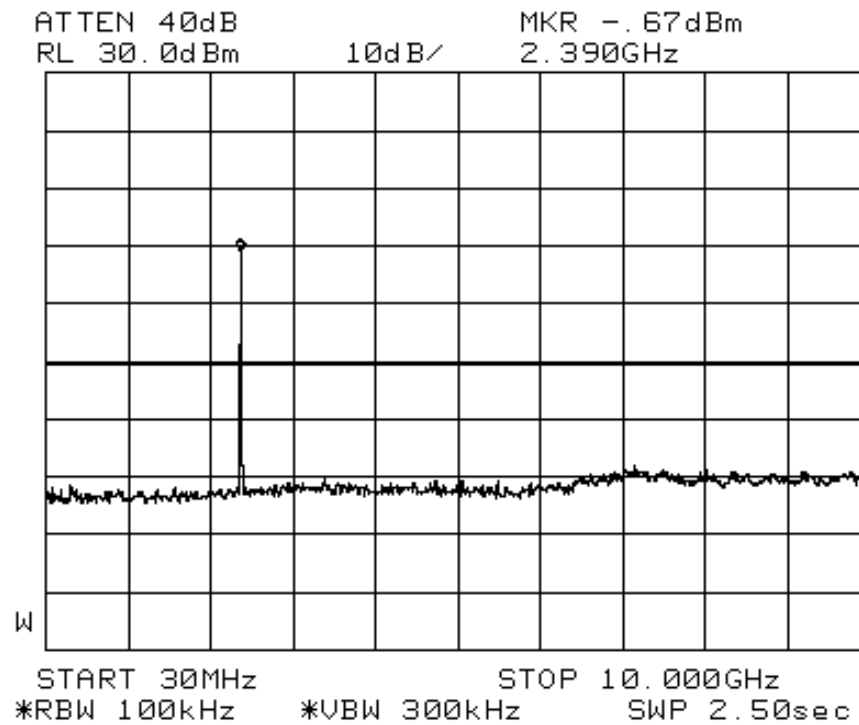
- Environmental Conditions

Temperature	23°C
Relative Humidity	55%
Atmospheric Pressure	1030mbar

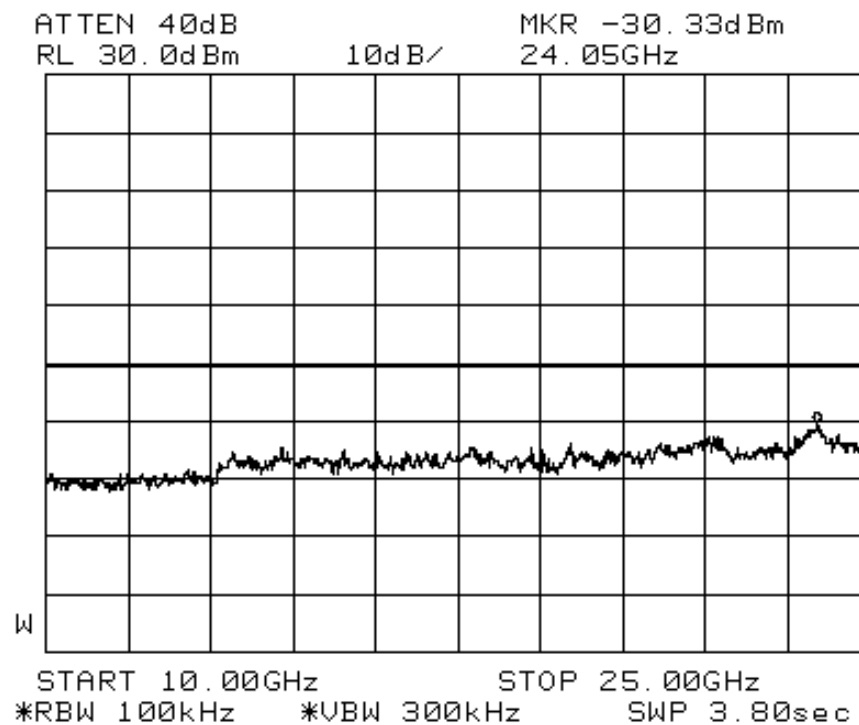


RF Conducted Spurious & Band Edge Measurement Test Setup

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

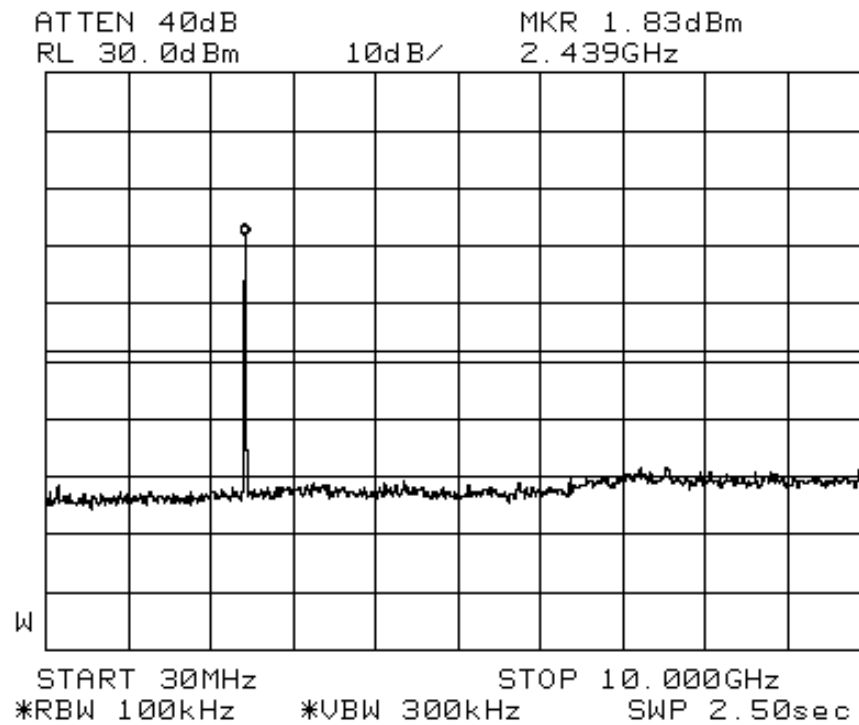


Plot 15 – Channel 0

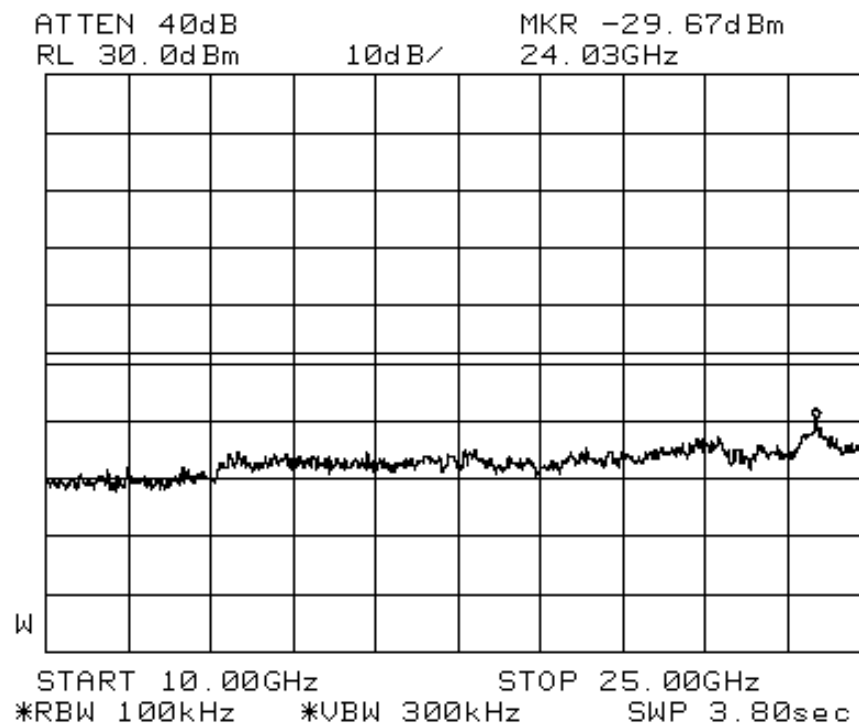


Plot 16 – Channel 0

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

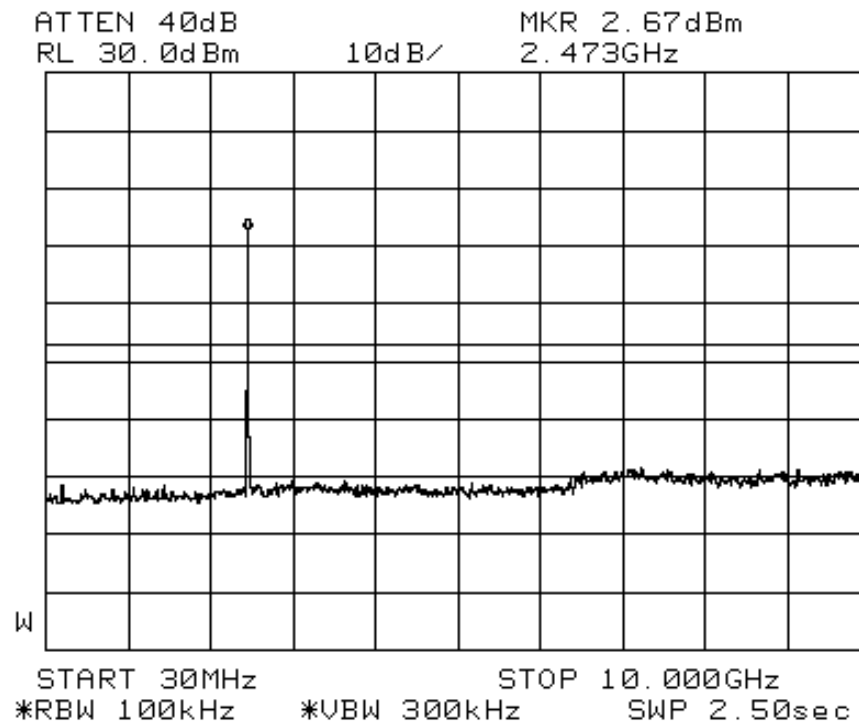


Plot 17 – Channel 39

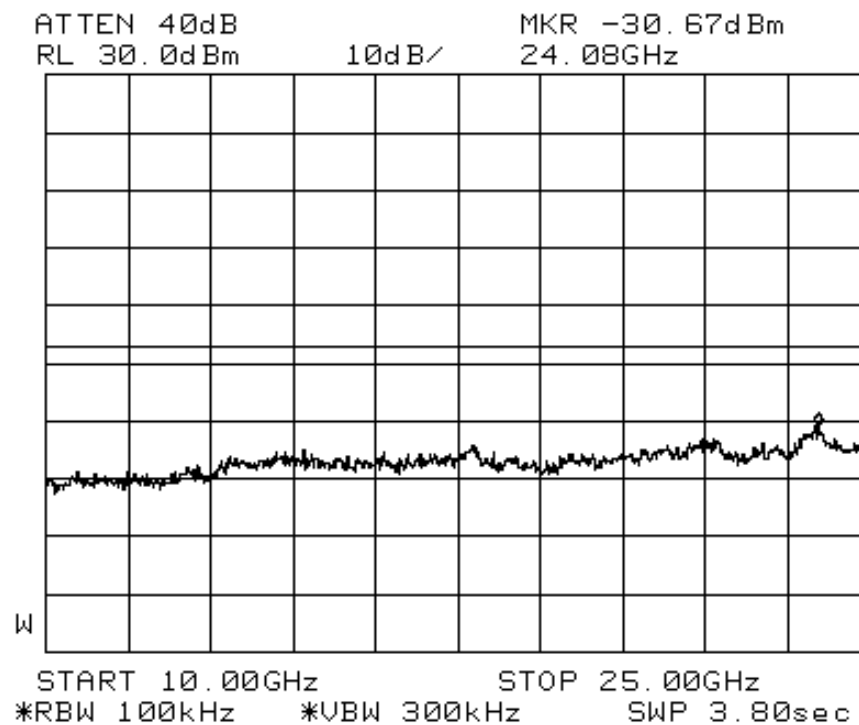


Plot 18 – Channel 39

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

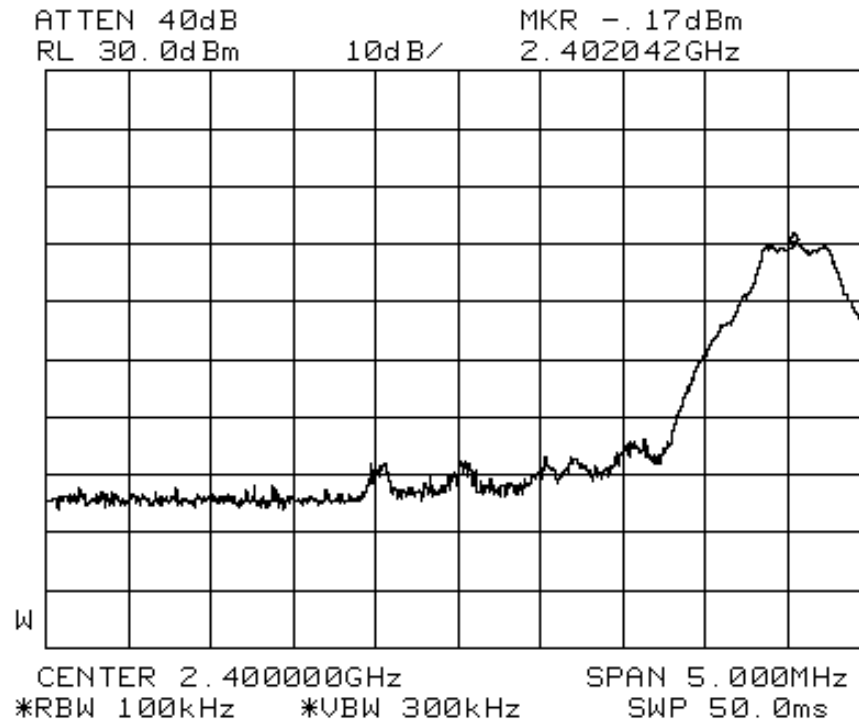


Plot 19 – Channel 78

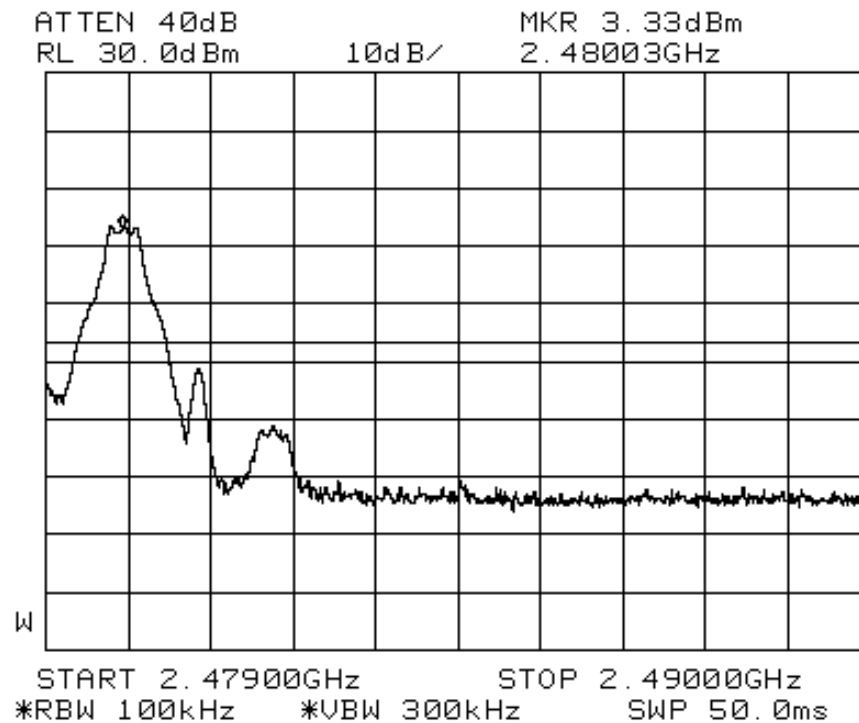


Plot 20 – Channel 78

BAND EDGE COMPLIANCE PLOTS



Plot 21 – Lower Band Edge at 2.40GHz



Plot 22 – Upper Band Edge at 2.4835GHz

FCC Part 15 (15.247(d)) Peak Power Spectral Density Results

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

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.402	0.1310	6.3
39	2.441	0.2416	6.3
78	2.480	0.3163	6.3

Please refer to the attached Plots 23 – 25 for details.

Tested by: DP

Notes

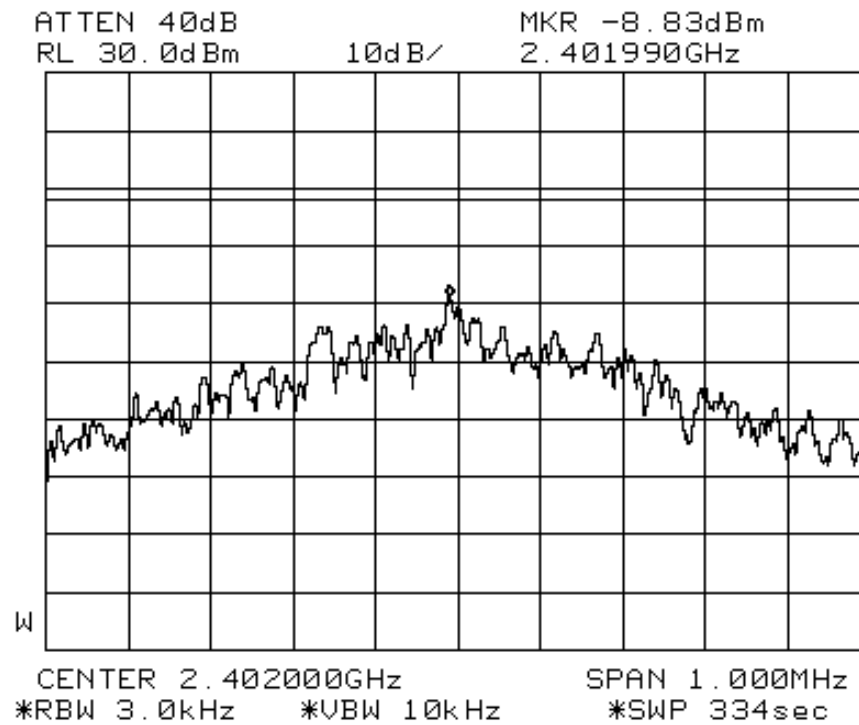
- Environmental Conditions

Temperature	23°C
Relative Humidity	55%
Atmospheric Pressure	1030mbar

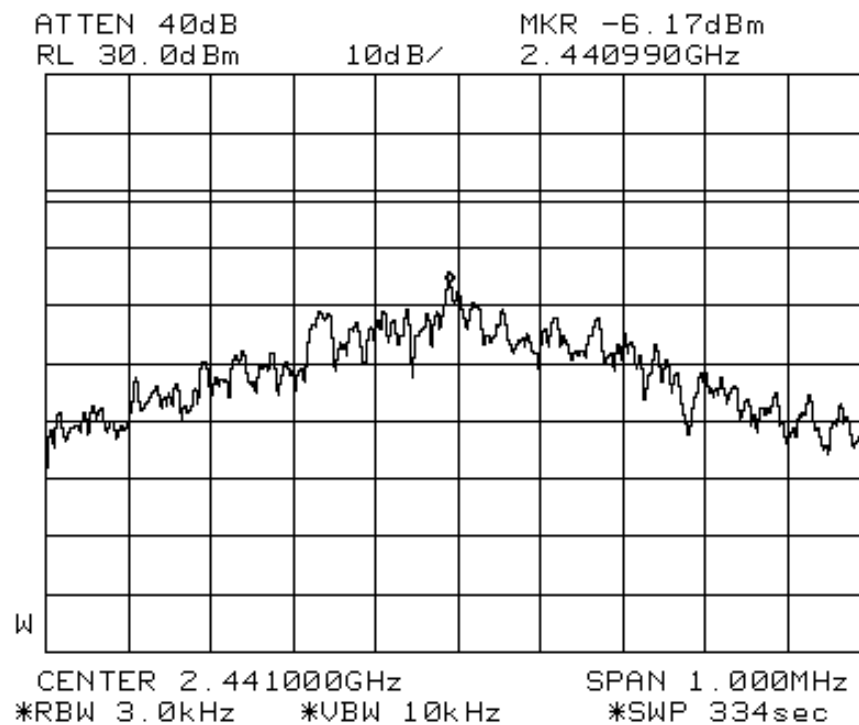


Peak Power Spectral Density Measurement Test Setup

PEAK POWER SPECTRAL DENSITY PLOTS

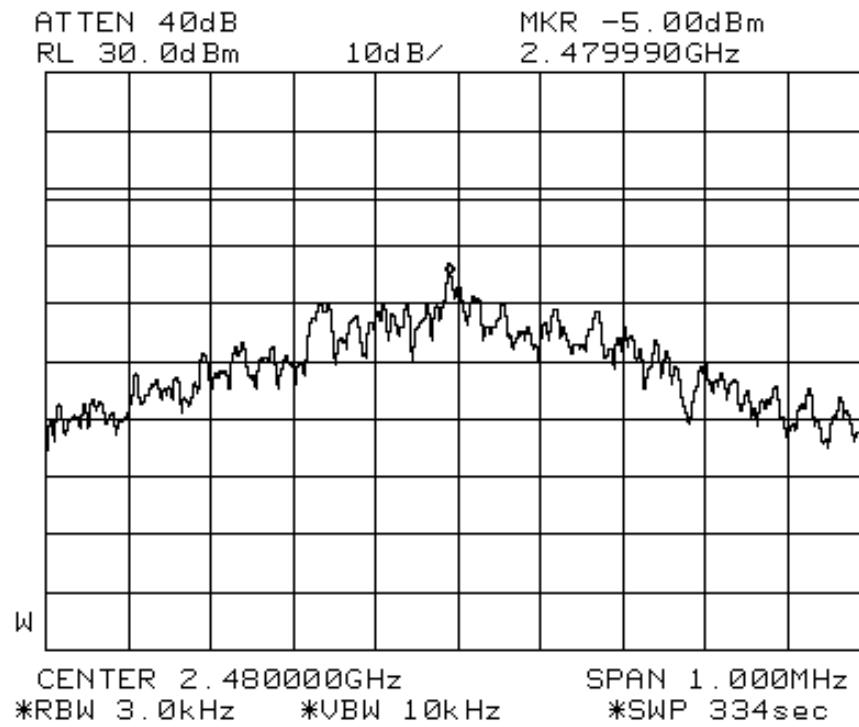


Plot 23 - Channel 0



Plot 24 - Channel 39

PEAK POWER SPECTRAL DENSITY PLOTS



Plot 25 - Channel 78

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1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
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August 2003

ANNEX A

TEST INSTRUMENTATION & GENERAL PROCEDURES

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****3m OATS Test Instrumentation
(Conducted Emissions)**

<u>Instrument</u>	<u>Model</u>	<u>S/No</u>	<u>Cal Due Date</u>	
R&S Test Receiver (9kHz-30MHz)	ESH3	862301/005	25 Jul 2005	X
Schaffner Pulse Limiter	CFL 9206	1720	1 Apr 2005	X
EMCO LISN (for EUT) – LISN6	3825/2	9309-2127	20 May 2005	X

**3m Anechoic Chamber Test Instrumentation
(Radiated Emissions)**

<u>Instrument</u>	<u>Model</u>	<u>S/No</u>	<u>Cal Due Date</u>	
R&S Test Receiver (20Hz-26.5GHz) – ESMI3	ESMI	829214/005 829550/004	25 Jul 2005	X
HP Preamplifier (for ESMI3, 0.01-3GHz) – PA6	87405A	3950M00353	1 Apr 2005	X
MITEQ Preamplifier (0.1-26.5GHz) – PA11	NSP2650-N	728231	1 Apr 2005	X
Schaffner Bilog Antenna – BL5	CBL6143	5041	18 May 2005	X
EMCO Horn Antenna – H14	3115	0003-6087	22 May 2005	X
Micro-tronics Band-Stop Filter	BRM50701	017	1 Apr 2005	X

Test Instrumentation

(Carrier Frequency Separation, Number of Hopping Frequencies, Spectrum Bandwidth (6dB and 20dB Bandwidth Measurement), Average Frequency Dwell Time, Maximum Peak Power, RF Conducted Spurious Emissions at the Transmitter Antenna Terminal, Band Edge Compliance at the Transmitter Antenna Terminal, Peak Power Spectral Density)

<u>Instrument</u>	<u>Model</u>	<u>S/No</u>	<u>Cal Due Date</u>	
HP Spectrum Analyzer	8563E	3846A09953	16 Dec 2005	X
R&S Universal Radio Communication Tester	CMU 200	837587/068	22 Mar 2005	X

CONDUCTED EMISSIONS TEST DESCRIPTION (BLUETOOTH)**Test Set-up**

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 Ω /50 μ 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.

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	limit = 250 μ V = 47.96 dB μ V
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB	
Q-P reading obtained directly from EMI Receiver = 40 dB μ V (Calibrated for system losses)	
Therefore, Q-P margin = 40 - 47.96 = -7.96	i.e. 7.96 dB below limit

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****RADIATED EMISSIONS TEST DESCRIPTION (3m ANC)****Test Set-up**

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.

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 find out the EUT highest emissions relative to the limit by rotating the EUT through three orthogonal axes to determine which attitude and equipment arrangement produces such emissions.
3. The final measurement was then carried out at the selected frequency points based on the highest emissions arrangement found from 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 25GHz, using the Bi-log antenna for frequencies from 30MHz up to 3GHz, and the Horn antenna above 3GHz.

Sample Calculation Example

At 300 MHz	limit = 200 μ V/m = 46 dB μ V/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.511 dB	
Q-P reading obtained directly from EMI Receiver = 40 dB μ V/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 40 - 46 = -6	i.e. 6 dB below limit

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****CARRIER FREQUENCY SEPARATION TEST DESCRIPTION (BLUETOOTH)****Test Set-up**

1. The EUT and supporting equipment were set up as shown in test setup photo; 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 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.

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 Bluetooth test mode with hopping sequence on.
2. The start and stop frequencies of the spectrum analyser were set to 2.401GHz and 2.404GHz with frequency sweeping set to 50ms.
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. 2.440GHz to 2.443GHz
 - c. 2.478GHz to 2.481GHz

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up as shown in test setup photo; 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 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 100kHz.
5. All other supporting equipment were powered separately from another filtered mains.

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

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****NUMBER OF HOPPING FREQUENCIES TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up as shown in test setup photo; 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 connected to a filtered mains.
4. 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.

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 Bluetooth test mode with hopping sequence on.
2. The start and stop frequencies of the spectrum analyser were set to 2.40GHz and 2.421GHz with frequency sweeping set to 50ms.
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 5 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.

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****AVERAGE FREQUENCY DWELL TIME TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up as shown in test setup photo; 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 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.

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 Bluetooth test mode, hopping sequence on.
2. The center frequency of the spectrum analyser was set to 2.402GHz with zero frequency span (spectrum analyser acts as an oscilloscope).
3. The sweep time of the spectrum analyser was adjusted until a stable signal can be seen on the spectrum analyser.
4. The duration (dwell time) of a packet was measured using the marker-delta function of the spectrum analyser. The average dwell time of the transmitting frequency was computed as below:

$$\text{Average Frequency Dwell Time} = \frac{\text{measured time slot length (l)} \times \text{hopping rate (h)}}{\text{number of hopping frequencies} \times 30 \text{ seconds period}}$$

$$\begin{aligned} \text{where EUT hopping rate} &= 1600 \text{ hops/data packet length/s} \\ \text{Number of EUT hopping frequencies} &= 79 \text{ hops} \end{aligned}$$

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.

MAXIMUM PEAK POWER TEST DESCRIPTION**Test Set-up**

1. The EUT and supporting equipment were set up as shown in test setup photo; 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 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.

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 Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. The step 2 was repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****RF CONDUCTED SPURIOUS EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 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.

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 Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with frequency span was set from 10GHz to 25GHz.
5. The steps 2 to 4 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

TEST INSTRUMENTATION & GENERAL PROCEDURES**ANNEX A****BAND EDGE COMPLIANCE AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up as shown in test setup photo; 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 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.

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 Bluetooth test mode, hopping sequence on.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the Bluetooth band, 2.40GHz and any spurious emissions at the band edge.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. The steps 2 to 3 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the Bluetooth band, 2.4835GHz and the any spurious emissions at the band-edge.

PEAK POWER SPECTRAL DENSITY TEST DESCRIPTION (BLUETOOTH)**Test Set-up**

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

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 Bluetooth test mode, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.
3. The peak power density of the transmitting frequency was detected and recorded.
4. The steps 1 to 3 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

ANNEX B

TEST PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS



EUT Front View

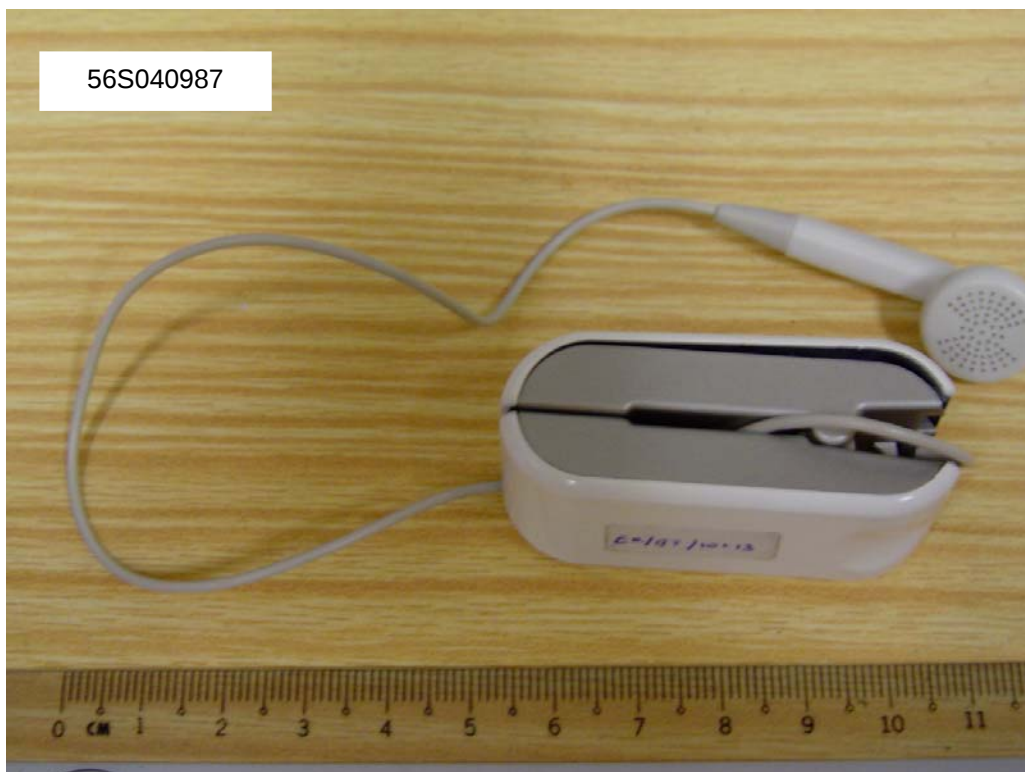


EUT Rear View

EUT PHOTOGRAPHS



EUT Left View



EUT Right View

EUT PHOTOGRAPHS



EUT Top View

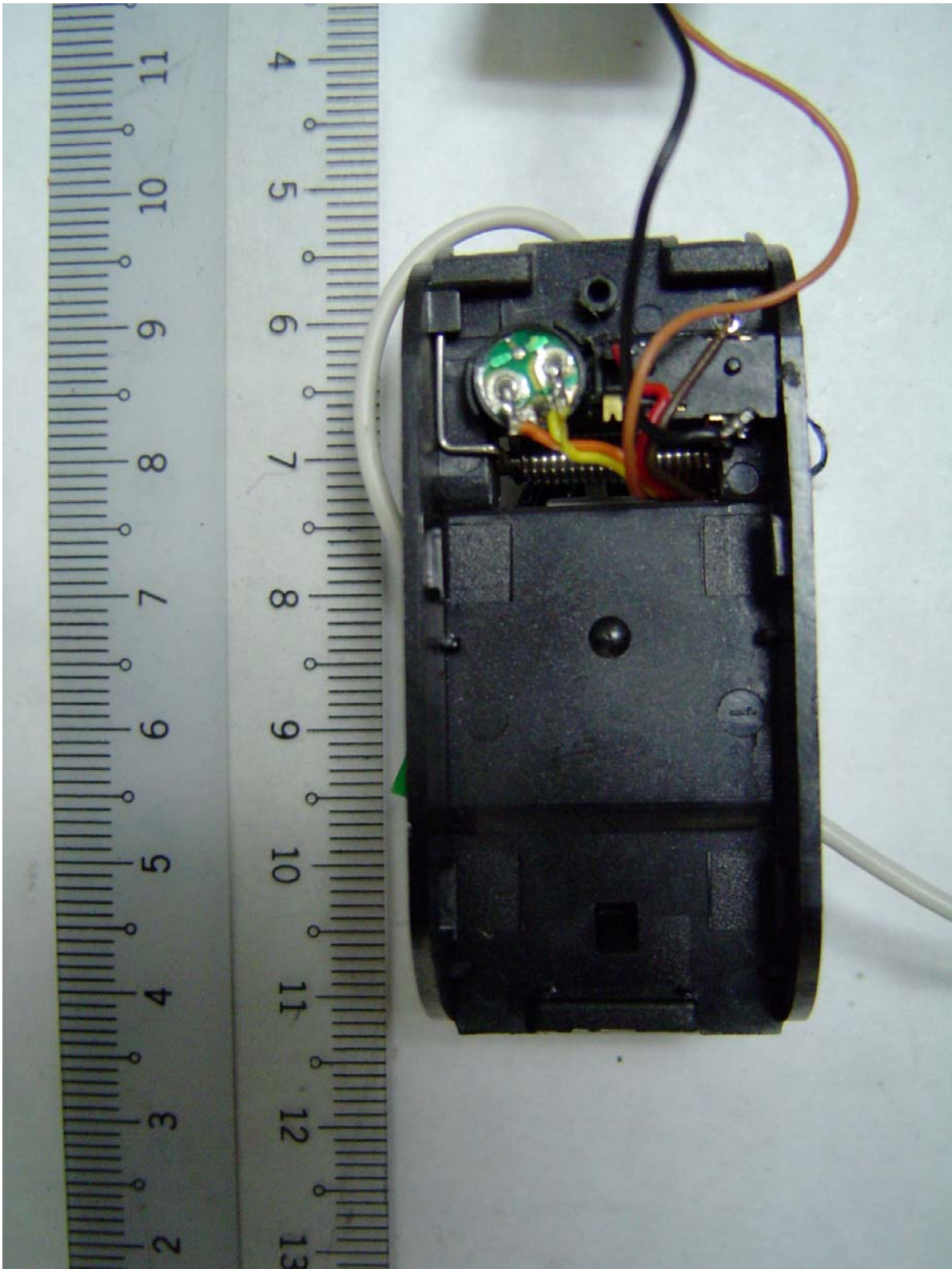


EUT Bottom View

EUT PHOTOGRAPHS

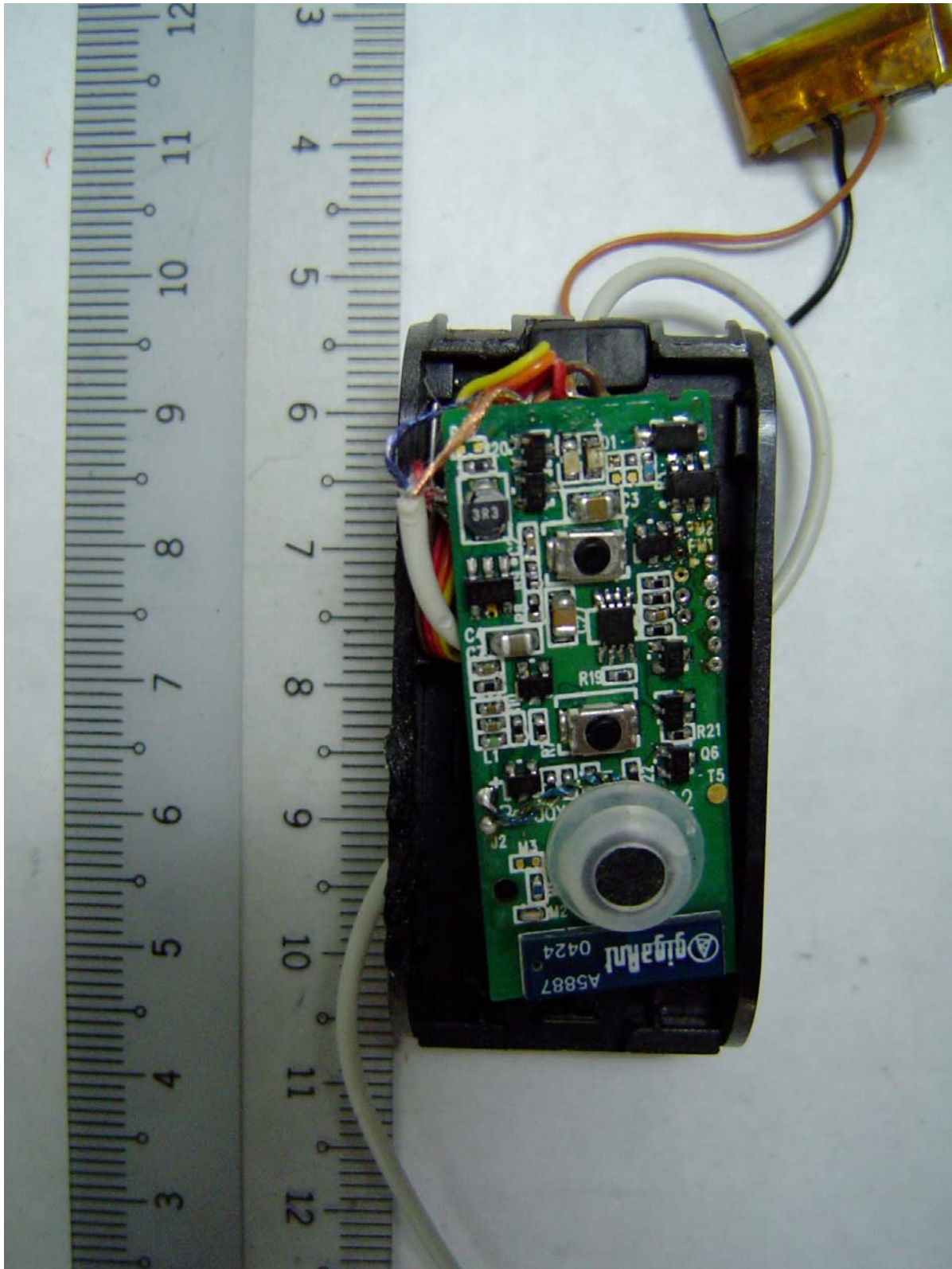
EUT Rear View (Battery Cover Removed)

EUT PHOTOGRAPHS

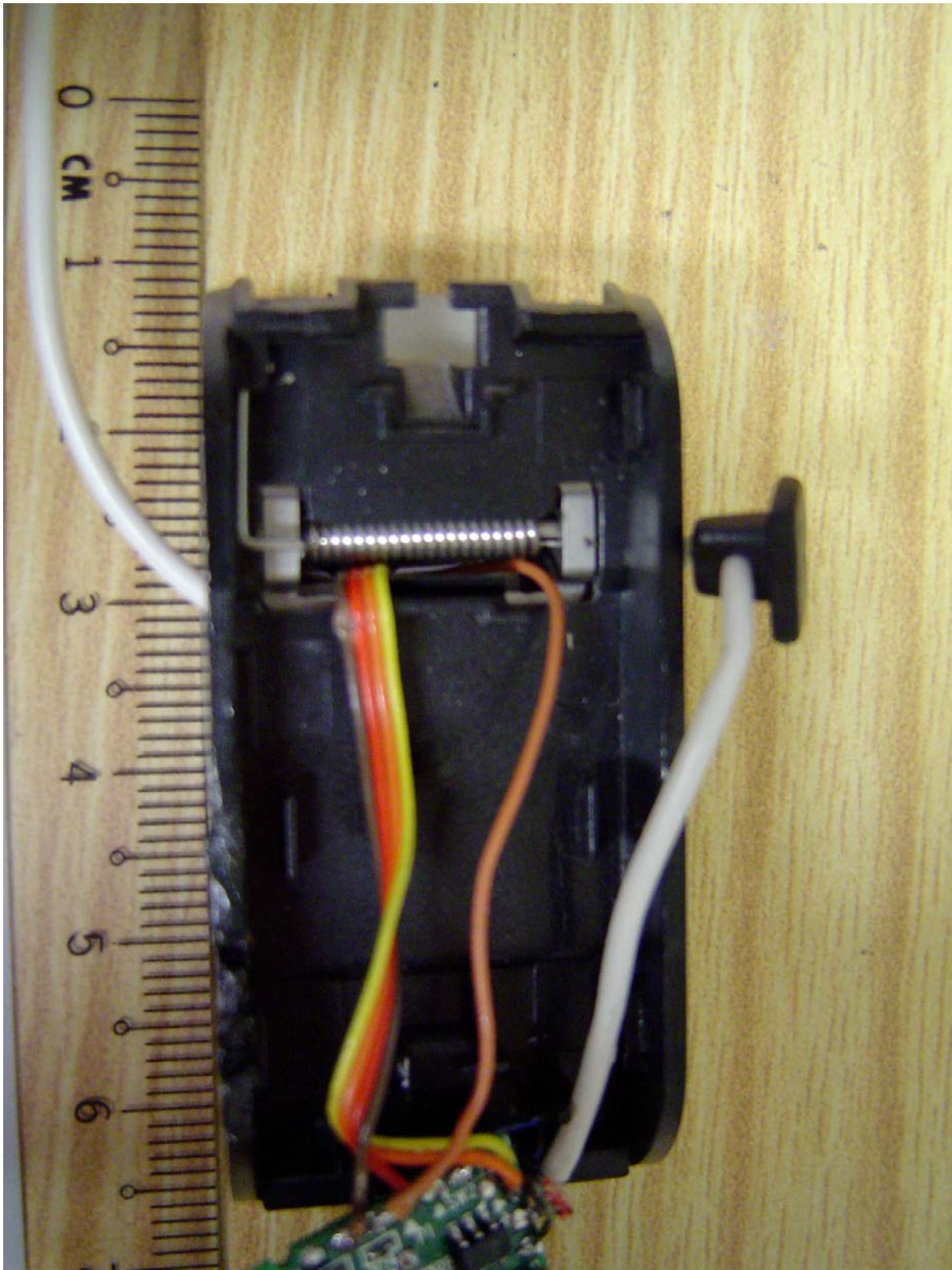


EUT Rear View (Battery Covered and Battery Removed)

EUT PHOTOGRAPHS

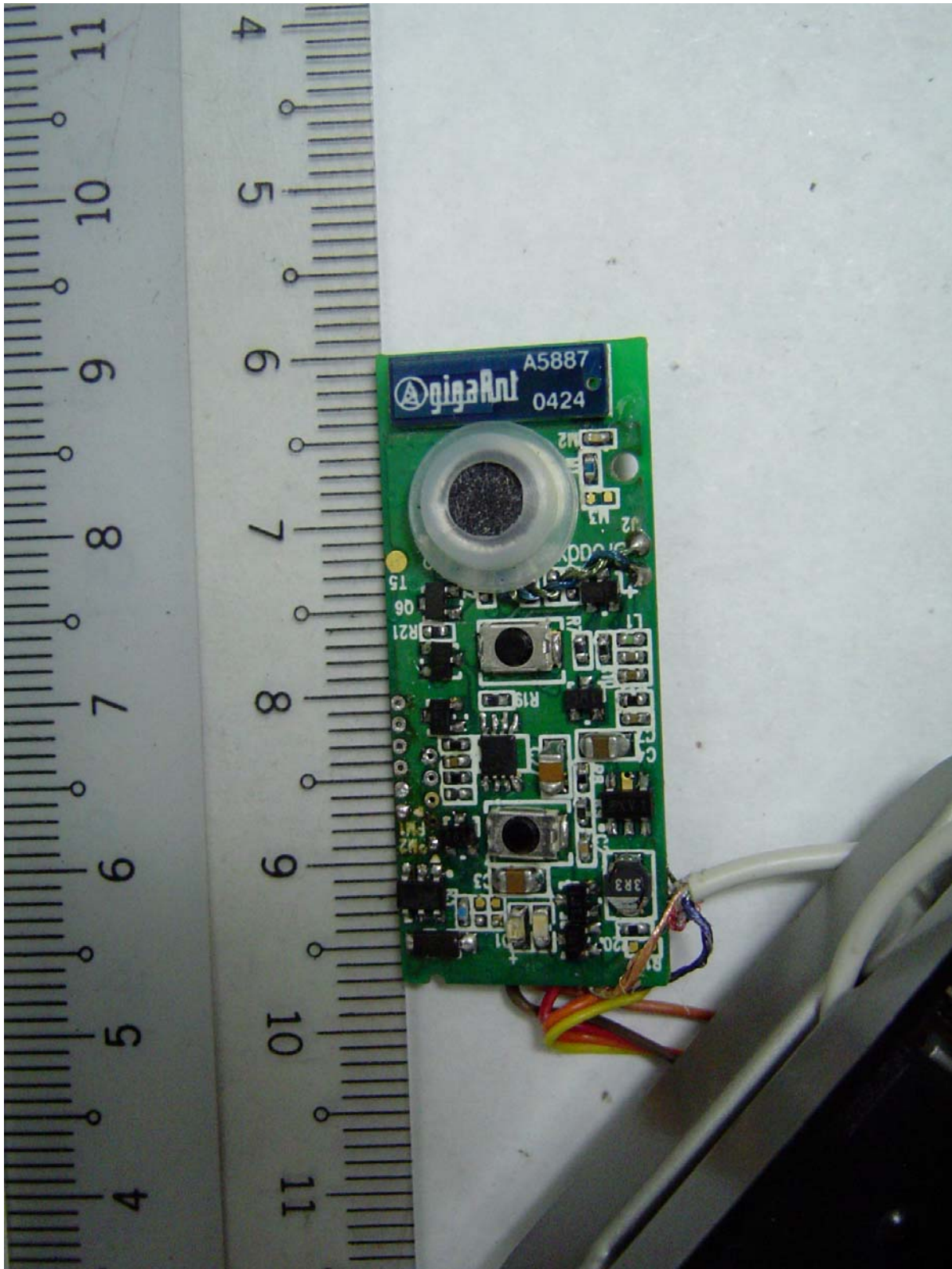
EUT Overall Front Internal View

EUT PHOTOGRAPHS



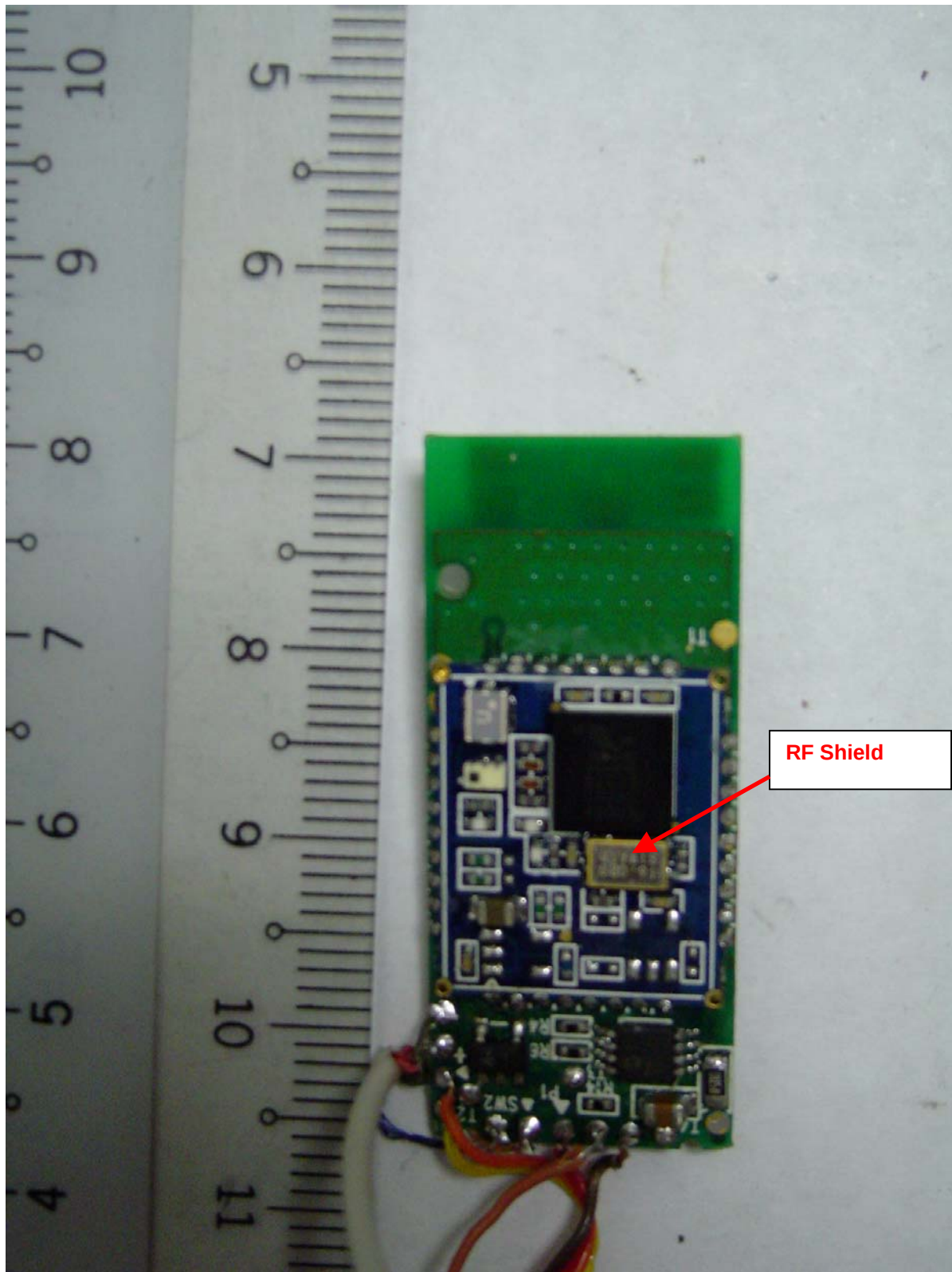
EUT Front View (Main PCB Removed)

EUT PHOTOGRAPHS



EUT Main PCB Component Internal View

EUT PHOTOGRAPHS

EUT Main PCB Trace Internal View

EUT PHOTOGRAPHS



EUT Power Adapter (Front View)



EUT Power Adapter (Rear View)

ANNEX C

**USER MANUAL
TECHNICAL DESCRIPTION
BLOCK & CIRCUIT DIAGRAMS**
(Please refer to attached copy)

ANNEX D

FCC LABEL & POSITION

FCC LABEL & POSITION**ANNEX D**

Labelling requirements per Section 2.925 & 15.19

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



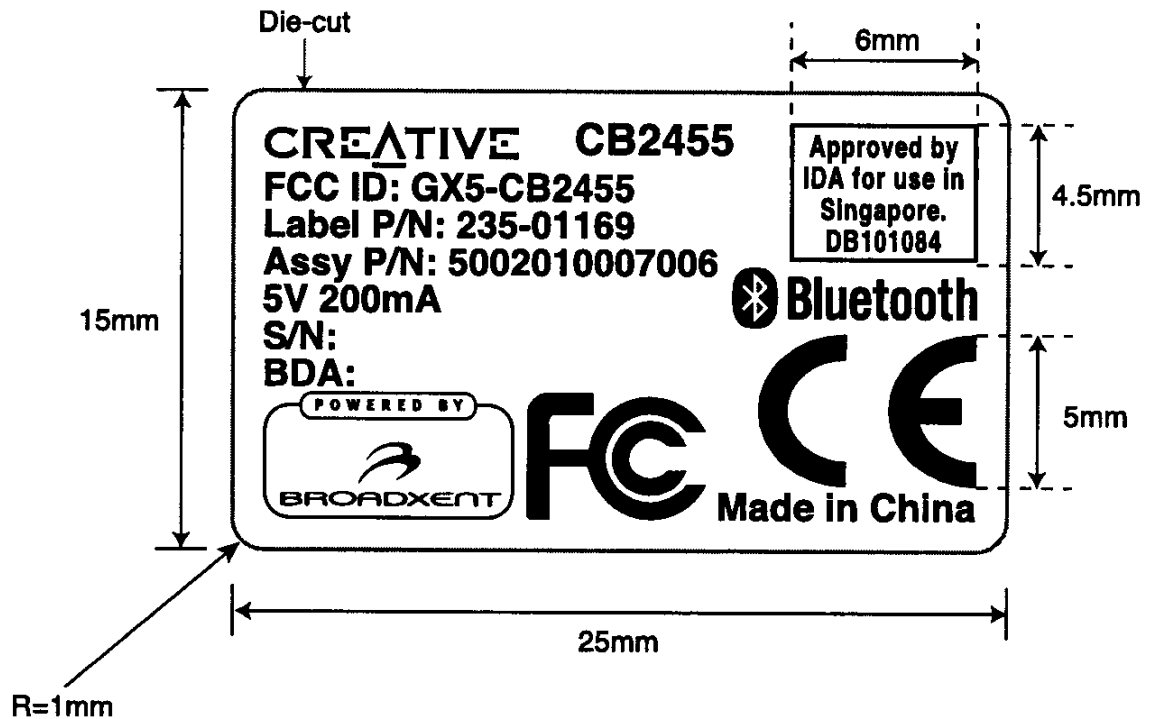
Physical Location of FCC ID on EUT

FCC LABEL & POSITION

ANNEX D

Labelling requirements per Section 2.925 & 15.19

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



FCC Identifier Sample Label