

Test Report No. 56S061101/01
dated 30 Nov 2006



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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
FCC Parts 15B & C : 2006
OF A
TRANSMITTER AND RECEIVER MODULES
[Models : SH-FX65T and SE-FX65]
[FCC IDs : ACJT07001 and ACJR07001]

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

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

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QUOTATION NUMBER 56Q0601390

JOB NUMBER 56S061101

TEST PERIOD 26 Nov 2006 – 29 Nov 2006

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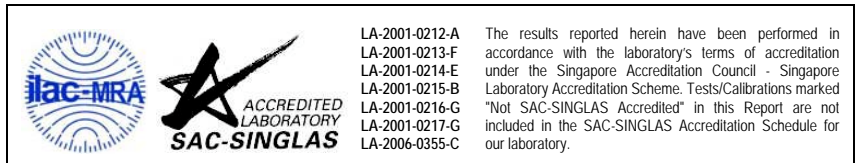
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TABLE OF CONTENTS

TEST SUMMARY

PRODUCT DESCRIPTION

SUPPORTING EQUIPMENT DESCRIPTION

EUT OPERATING CONDITIONS

CONDUCTED EMISSION TEST

RADIATED EMISSION TEST

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

MAXIMUM PEAK POWER TEST

RF CONDUCTED SPURIOUS EMISSIONS TEST

BAND EDGE COMPLIANCE (CONDUCTED) TEST

BAND EDGE COMPLIANCE (RADIATED) TEST

PEAK POWER SPECTRAL DENSITY TEST

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

ANNEX A - EUT PHOTOGRAPHS / DIAGRAMS

ANNEX B - FCC LABEL & POSITION

ANNEX C - USER MANUAL, TECHNICAL DESCRIPTION, BLOCK & CIRCUIT DIAGRAMS

Test Report No. 56S061101/01
dated 30 Nov 2006



TEST SUMMARY

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

Test Results Summary

Test Standard	Description	Pass / Fail
FCC Part 15: 2006		
15.107(a), 15.207	Conducted Emissions	Pass
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Pass
15.247(b)(3)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions	Pass
15.247(d)	Band Edge Compliance (Conducted)	Pass
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Pass
1.1310	Maximum Permissible Exposure	Pass
15.35(c)	Duty Cycle Factor Computation	Not Applicable ^{*See Note 5}

TEST SUMMARY

Notes

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

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>
Channel 0	2.412
Channel 1	2.438
Channel 2	2.464

2. All the measurements in section 15.247 were done based on conducted measurements.
3. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.
4. All test measurement procedures are according to ANSI C63.4: 2003.
5. The Equipment Under Test (EUT) is was tested in a continuous transmission mode, ie. 0dB duty cycle.
6. Each module (transmitter or receiver modules) of the Equipment Under Test (EUT) consists of two identical microstrip antennas, which at one time instance, only one antenna is activated (mutual exclusive). As such, only one antenna port was activated and used for measurement purposes.

Modifications

1. No modifications were made.

PRODUCT DESCRIPTION

Description	: The Equipment Under Test (EUT) is a Transmitter and Receiver Modules which individually is a RF transceiver module.
Manufacturer	: Panasonic AVC Networks Singapore Pte Ltd 202 Bedok South Avenue 1 Singapore 469332
Model Number	: SH-FX65T (Transmitter) SE-FX65 (Receiver)
FCC IDs	: ACJT07001 (Transmitter) ACJR07001 (Receiver)
Serial Number	: Nil
Microprocessor	: NEC upD78F0500 (Transmitter and Receiver)
Operating / Transmitting Frequency	: 2.412GHz (lower channel) to 2.464GHz (upper channel)
Clock / Oscillator Frequency	: 12.288MHz, 22MHz
Modulation	: DSSS
Port / Connectors	: Refer to manufacturer's user manual / operating manual.
Rated Input Power	: 4.5VDC
Accessories	: Nil



SUPPORTING EQUIPMENT DESCRIPTION

The EUT was tested as a stand-alone unit with using the below listed AC/DC power adapter as the source of DC input power. The tests were conducted using 110V 60Hz source.

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Panasonic AC/DC Power Adapter	M/N: DE-992A S/N: H400540DC FCC ID: Verification	1.5m unshielded AC/DC power cable

EUT OPERATING CONDITIONS

FCC Part 15

1. **Conducted Emissions**
2. **Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)**
3. **Spectrum Bandwidth (6dB Bandwidth Measurement)**
4. **Maximum Peak Power**
5. **RF Conducted Spurious Emissions**
6. **Band Edge Compliance (Conducted)**
7. **Band Edge Compliance (Radiated)**
8. **Peak Power Spectral Density**
9. **Maximum Permissible Exposure**

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



CONDUCTED EMISSION TEST

FCC Parts 15.107(a) and 15.207 Conducted Emission Limits

Frequency Range (MHz)	Limit Values (dB μ 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
Schaffner EMI Measuring Receiver	SCR 3501	238	23 Nov 2007
Agilent EMC Analyzer	E7403A	US41160165	22 May 2007
R&S Pulse Limiter	EHS3-Z2	100346	15 Apr 2007

CONDUCTED EMISSION TEST

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

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

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

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

Sample Calculation Example

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

CONDUCTED EMISSION TEST



Conducted Emissions Test Setup (Front View)



Conducted Emissions Test Setup (Rear View)

Test Report No. 56S061101/01
dated 30 Nov 2006



CONDUCTED EMISSION TEST

FCC Parts 15.107(a) and 15.207 Conducted Emission Results

Test Input Power	110V 60Hz	Temperature	24°C
Line Under Test	AC Mains	Relative Humidity	58%
EUT	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.2571	42.2	-19.3	30.9	-20.6	Live	0
0.4118	27.7	-30.0	17.3	-30.4	Live	0
0.4802	34.2	-22.1	23.2	-23.1	Live	0
0.5495	24.3	-31.7	11.6	-34.4	Neutral	0
0.9642	26.0	-30.0	14.0	-32.0	Live	0
1.4346	28.6	-27.5	15.8	-30.2	Live	0

Test Input Power	110V 60Hz	Temperature	24°C
Line Under Test	AC Mains	Relative Humidity	58%
EUT	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Frequency (MHz)	Q-P Value (dBμV)	Q-P Margin (dB)	AV Value (dBμV)	AV Margin (dB)	Line	Channel
0.2566	40.0	-21.5	28.0	-23.5	Neutral	0
0.3425	24.9	-34.2	15.4	-33.7	Live	0
0.4155	26.5	-31.0	14.5	-33.0	Neutral	0
0.499	34.4	-21.6	22.5	-23.5	Live	0
1.2713	21.7	-34.3	10.9	-35.1	Live	0
1.4905	27.7	-28.3	14.4	-31.6	Neutral	0

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 ±2.4dB.

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
EMCO Horn Antenna – H14	3115	0003-6087	19 May 2007
R&S Test Receiver (20Hz –26.5GHz) – ESM11	ESMI	849182/003 848926/007	04 Jul 2007
Schaffner Bilog Antenna –BL4	CBL6112B	2593	12 May 2007
Agilent Preamplifier (0.01-4GHz) – PA6	87405B	10003	12 Jan 2007
Bandstop Filter (2.4-2.5 GHz)	BRM50701	017	13 Aug 2007
HP Preamplifier	8449B0PTH02	3008A00516	25 Jan 2007

RADIATED EMISSION TEST

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

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

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

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

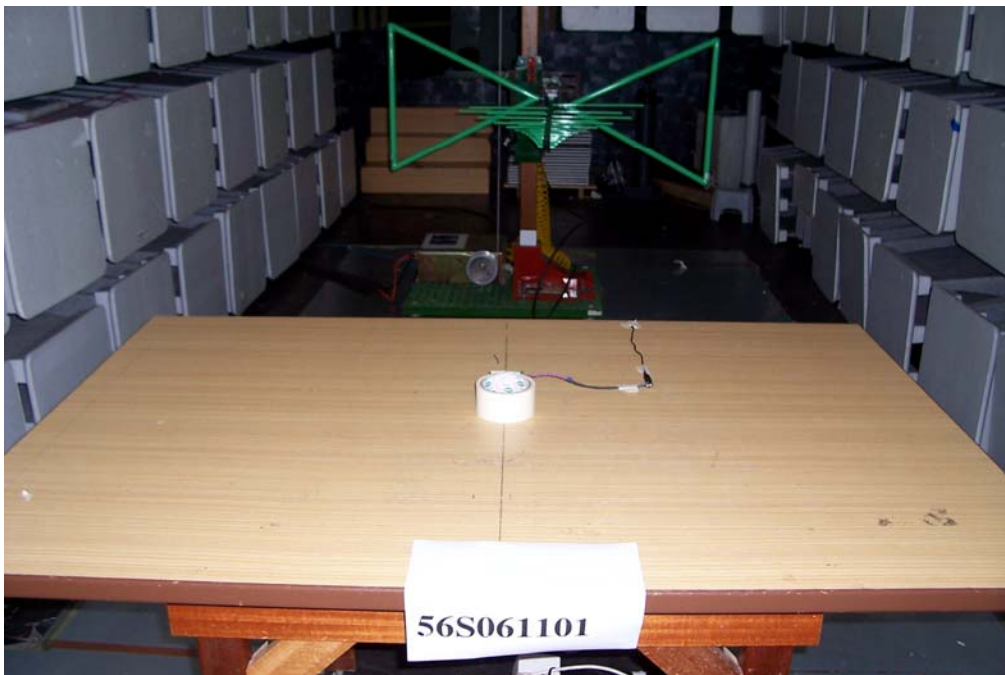
Sample Calculation Example

At 300 MHz	Q-P limit (Class B) = 200 μ V/m = 46.0 dB μ 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 μ V/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 40.0 - 46.0 = -6.0	i.e. 6 dB below Q-P limit

RADIATED EMISSION TEST



Radiated Emissions Test Setup (Front View)



Radiated Emissions Test Setup (Rear View)

Test Report No. 56S061101/01
dated 30 Nov 2006



RADIATED EMISSION TEST

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

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	56%
EUT	Transmitter	Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
36.8400	20.7	-19.3	1	100	V	Low
61.4000	33.9	-6.1	134	100	V	Low
479.2000	31.2	-14.8	205	100	V	Low
731.0800	30.4	-15.6	325	100	H	Low
805.4000	21.8	-24.2	141	100	V	Low
826.5400	22.5	-23.5	15	223	H	Low

Spurious Emissions above 1GHz (Restricted Band)

Frequency (GHz)	Peak Value (dB μ V/m)	Average Value (dB μ V/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
4.8266	56.8	51.7	-2.3	78	100	V	0
4.8300	56.8	51.7	-2.3	76	100	V	1
4.9366	57.8	51.1	-2.9	88	100	V	2
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15.247(d) Spurious Emissions above 1GHz (Non-Restricted Band)

Frequency (GHz)	Peak Value (dB μ V/m)	Peak Margin (dBc)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
3.2200	50.4	-50.6	100	100	V	0
3.2533	51.4	-48.0	80	100	V	1
3.3287	54.7	-47.2	89	100	V	2
6.4277	66.1	-34.9	98	100	V	0
6.5000	67.9	-31.5	76	100	V	1
6.5666	69.1	-31.9	80	100	V	2

RADIATED EMISSION TEST

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

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	56%
EUT	Receiver	Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
61.4200	34.0	-6.0	77	100	V	Low
110.5600	28.7	-14.8	120	100	V	Low
405.4800	30.8	-15.2	114	100	H	Low
651.2400	29.2	-16.8	310	100	H	Low
675.8000	28.4	-17.6	328	100	H	Low
897.0400	24.0	-22.0	309	101	H	Low

Spurious Emissions above 1GHz (Restricted Band)

Frequency (GHz)	Peak Value (dB μ V/m)	Average Value (dB μ V/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
4.8266	58.8	52.3	-1.7	163	100	V	0
4.8766	59.2	52.7	-1.3	177	100	V	1
4.9366	58.2	51.1	-2.9	126	100	V	2
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15.247(d) Spurious Emissions above 1GHz (Non-Restricted Band)

Frequency (GHz)	Peak Value (dB μ V/m)	Peak Margin (dBc)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
3.2199	50.2	-46.7	166	100	V	0
3.2533	51.2	-44.3	146	100	V	1
3.3287	50.4	-45.7	152	100	V	2
6.4277	58.7	-38.2	108	100	V	0
6.5055	57.4	-38.1	162	100	V	1
6.5722	58.3	-37.8	145	100	V	2

RADIATED EMISSION TEST

Notes

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

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Limits

The EUT shows compliance to the requirements of this section, which states that the minimum bandwidth of the EUT employing digital modulation techniques shall be at least 500kHz.

FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyser – SA10	8564E	3846A01433	28 Apr 2007

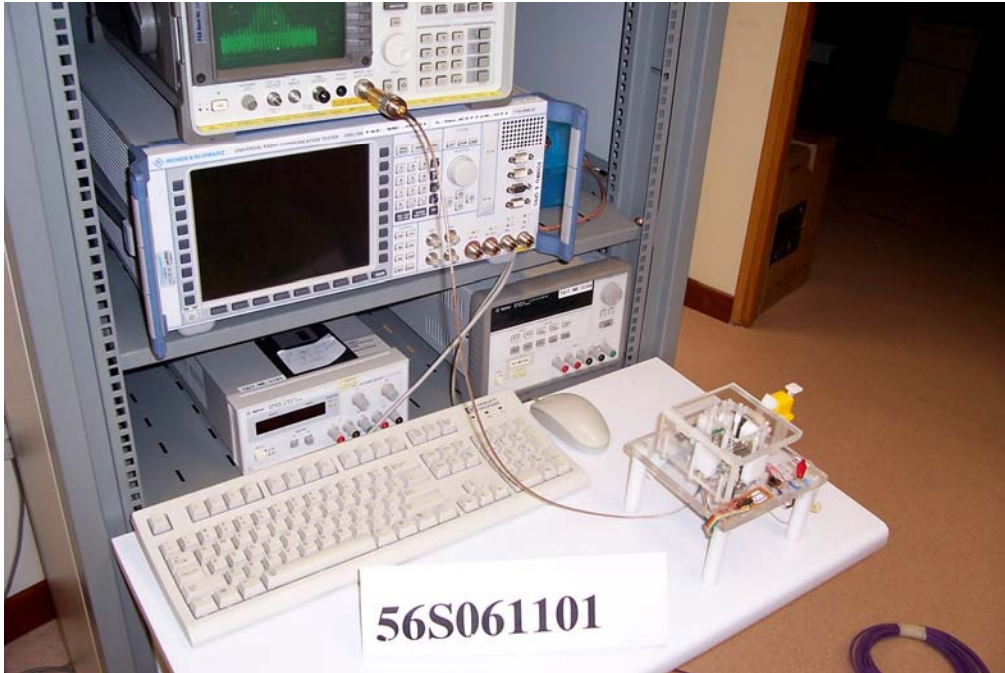
FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Setup

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 100kHz and 300kHz.
5. All other supporting equipment were powered separately from another filtered mains.

FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB 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 at Channel 0 (2.412GHz).
2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB 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 6dB 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 6dB 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 1 (.438GHz) and Channel 2 (2.464GHz) respectively.

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST



Spectrum Bandwidth (6dB Bandwidth Measurement) Test Setup

Test Report No. 56S061101/01
dated 30 Nov 2006



SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Results

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	1 - 3 (Transmitter) 4 - 6 (Receiver)	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Transmitter

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)
0	2.412	6.830
1	2.438	7.670
2	2.464	7.920

Receiver

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)
0	2.412	6.330
1	2.438	7.170
2	2.464	7.170

MAXIMUM PEAK POWER TEST

FCC Part 15.247(b)(3) Maximum Peak Power Limits

The EUT shows compliance to the requirements of this section, which states the maximum peak power of the EUT employing digital modulation shall not exceed 1W (30dBm).

FCC Part 15.247(b)(3) Maximum Peak Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Bonton RF Power Meter	4532	97701	28 Jan 2007
Bonton Power Sensor	51075	32002	28 Jan 2007

FCC Part 15.247(b)(3) 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 power meter via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another filtered mains.

FCC Part 15.247(b)(3) 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 at Channel 0 (2.412GHz).
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 1 (2.438GHz) and Channel 2 (2.464GHz) respectively.

MAXIMUM PEAK POWER TEST



Maximum Peak Power Test Setup



MAXIMUM PEAK POWER TEST

FCC Part 15.247(b)(3) Maximum Peak Power Results

Test Input Power	110V 60Hz	Temperature	22°C
		Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	

Transmitter

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0	2.412	0.178	1.0
1	2.438	0.270	1.0
2	2.464	0.330	1.0

Receiver

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0	2.412	0.175	1.0
1	2.438	0.257	1.0
2	2.464	0.282	1.0



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 Analyser – SA10	8564E	3846A01433	28 Apr 2007

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

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

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

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at Channel 0 (2.412GHz).
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 1 (2.438GHz) and Channel 2 (2.464GHz) respectively.

RF CONDUCTED SPURIOUS EMISSIONS TEST



RF Conducted Spurious Emissions Test Setup



RF CONDUCTED SPURIOUS EMISSIONS TEST

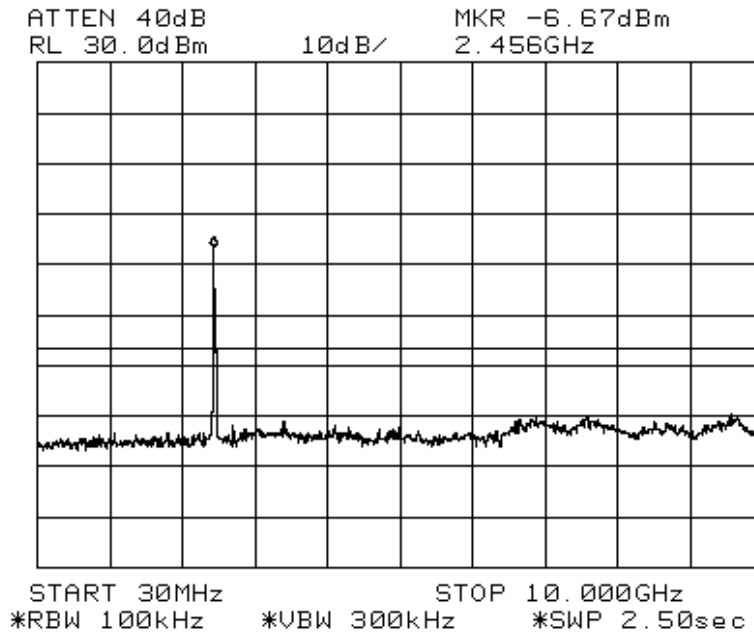
FCC Part 15.247(d) RF Conducted Spurious Emissions Results

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	7 - 12 (Transmitter) 13 - 18 (Receiver)	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

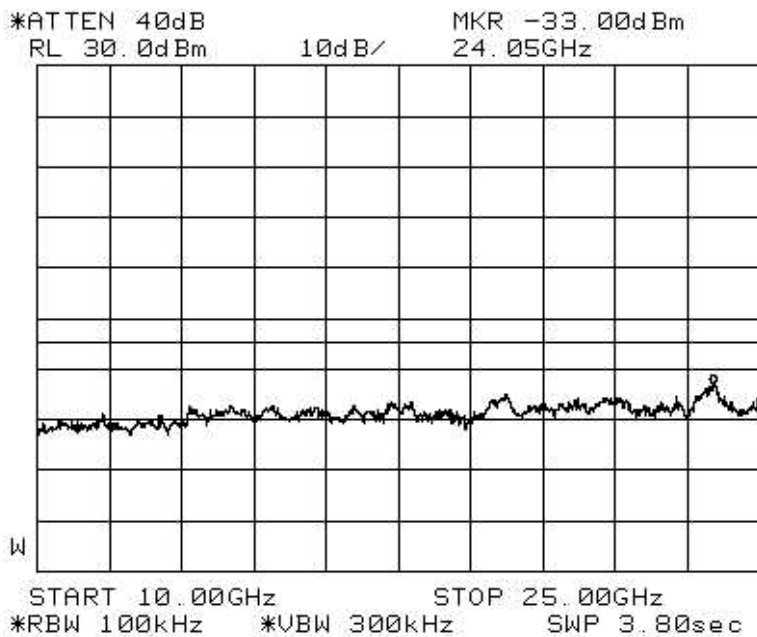
All spurious signals found were below the specified limit. Please refer to the attached plots.

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - Transmitter



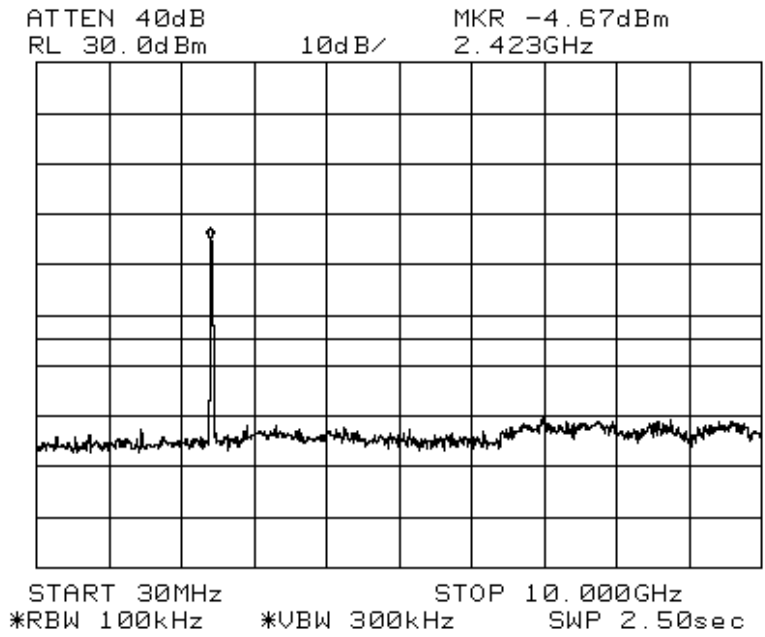
Plot 11 – Channel 2



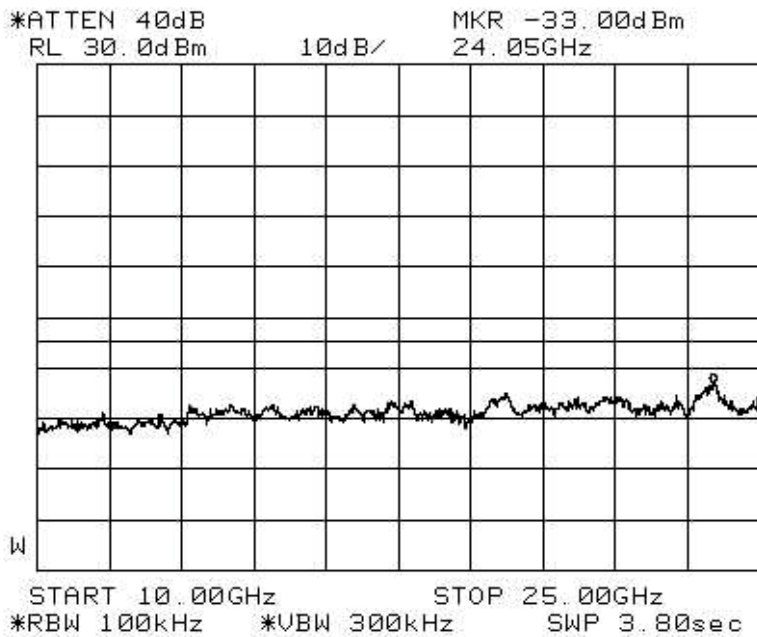
Plot 12 – Channel 2

RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - Receiver



Plot 15 – Channel 1



Plot 16 – Channel 1

BAND EDGE COMPLIANCE (CONDUCTED) TEST

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

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

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

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyser – SA10	8564E	3846A01433	28 Apr 2007

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

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

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

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

BAND EDGE COMPLIANCE (CONDUCTED) TEST



Band Edge Compliance (Conducted) Test Setup



BAND EDGE COMPLIANCE (CONDUCTED) TEST

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

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	19 - 20 (Transmitter) 21 - 22 (Receiver)	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

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

BAND EDGE COMPLIANCE (RADIATED) TEST

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

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

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

Instrument	Model	S/No	Cal Due Date
EMCO Horn Antenna – H14	3115	0003-6087	19 May 2007
R&S Test Receiver (20Hz –26.5GHz) – ESMI1	ESMI	849182/003 848926/007	04 Jul 2007
Schaffner Bilog Antenna –BL4	CBL6112B	2593	12 May 2007
Agilent Preamplifier (0.01-4GHz) – PA6	87405B	10003	12 Jan 2007
Hp Preamp	8449B0PTH02	3008A00516	NIL

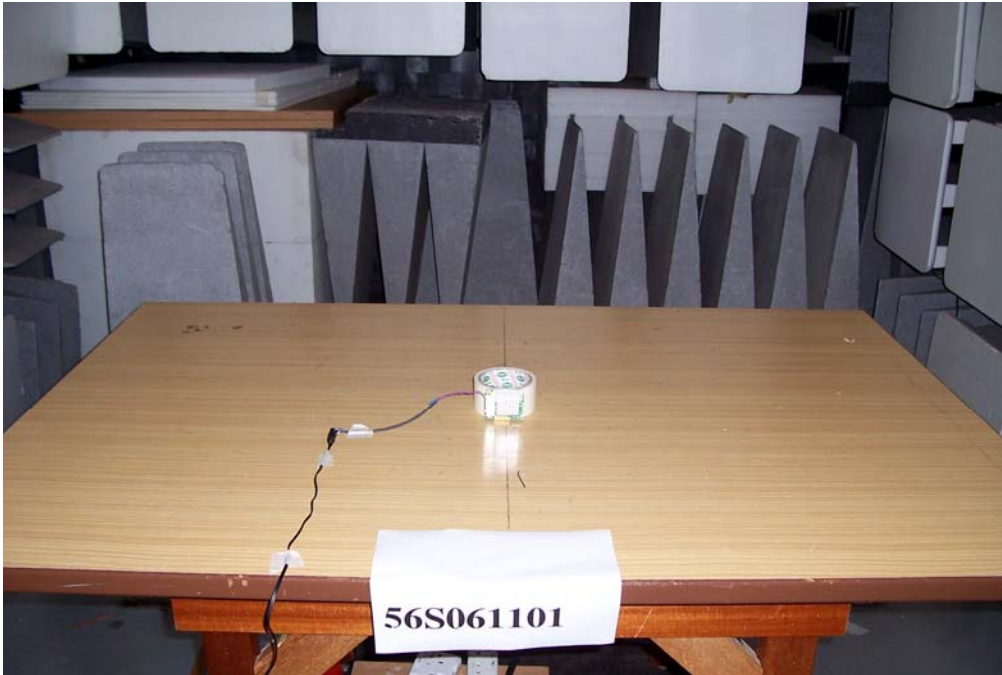
FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Setup

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

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

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

BAND EDGE COMPLIANCE (RADIATED) TEST



Band Edge Compliance (Radiated) Test Setup



BAND EDGE COMPLIANCE (RADIATED) TEST

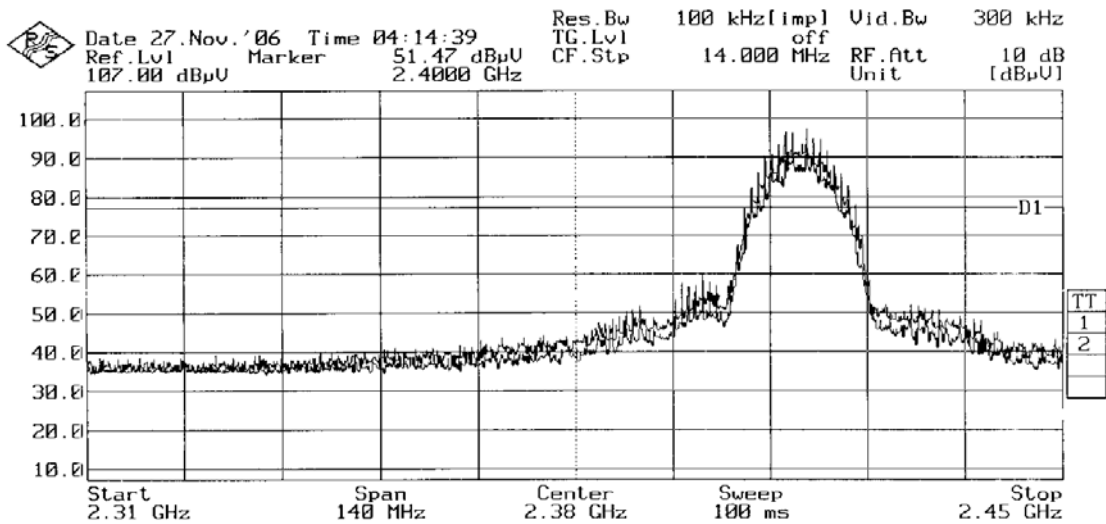
FCC Part 15.247(d) Band Edge Compliance (Radiated) Results

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	23 - 28 (Transmitter) 29 - 34 (Receiver)	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

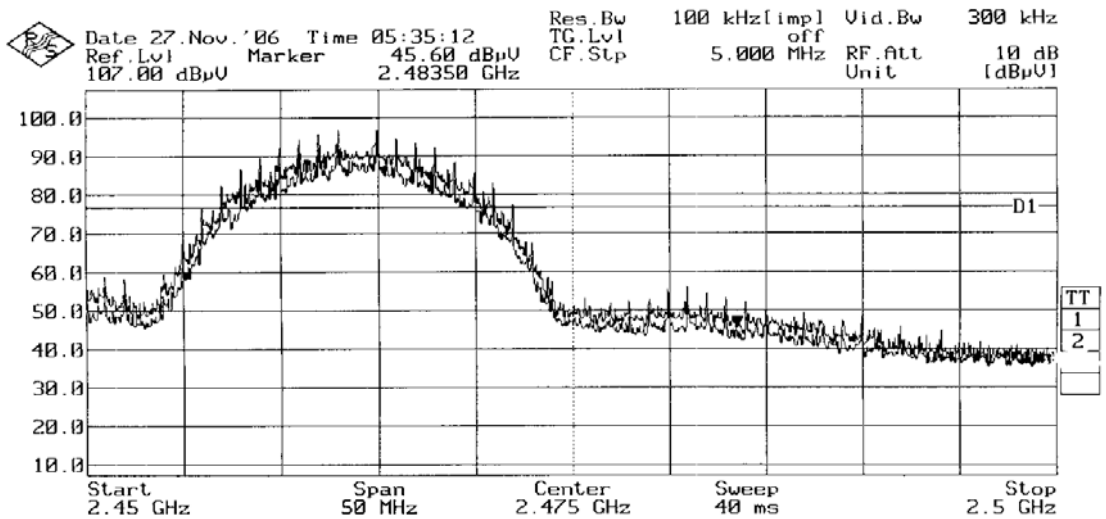
No significant signal was found and they were below the specified limit.

BAND EDGE COMPLIANCE (RADIATED) TEST

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



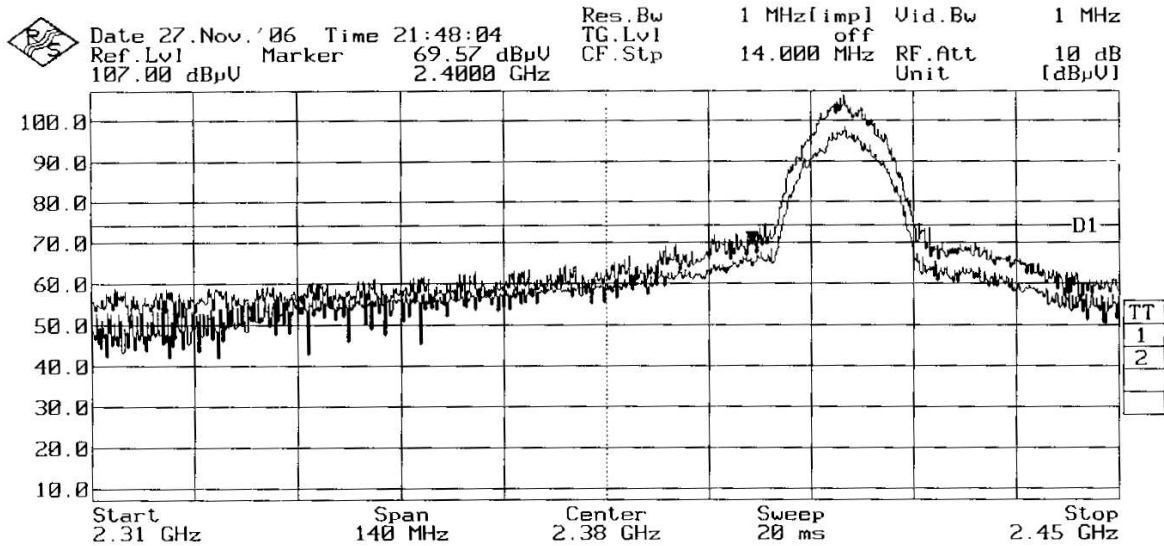
Plot 23 – Lower Band Edge at 2.4000GHz



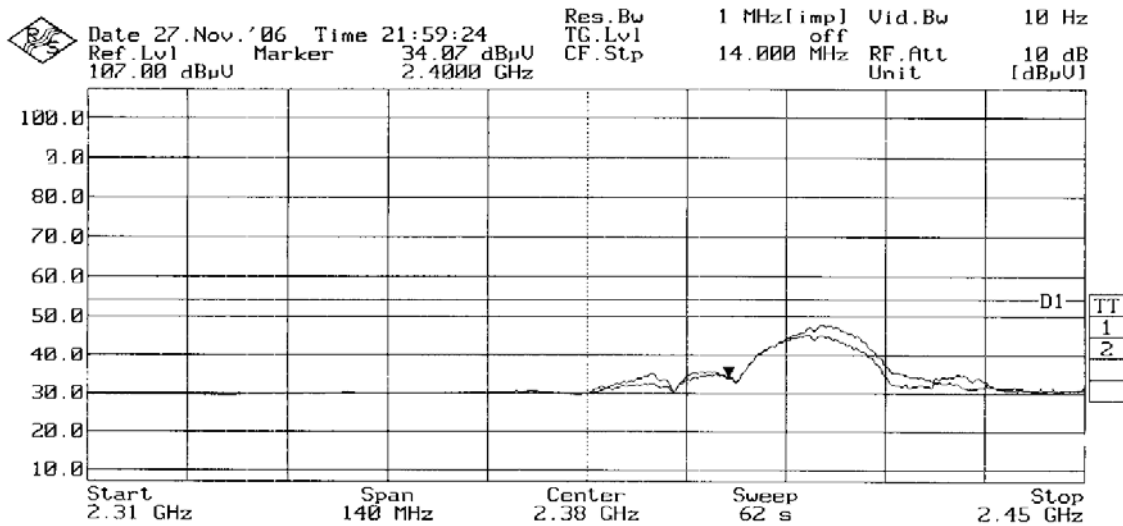
Plot 24 – Upper Band Edge at 2.4835GHz

BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - Transmitter



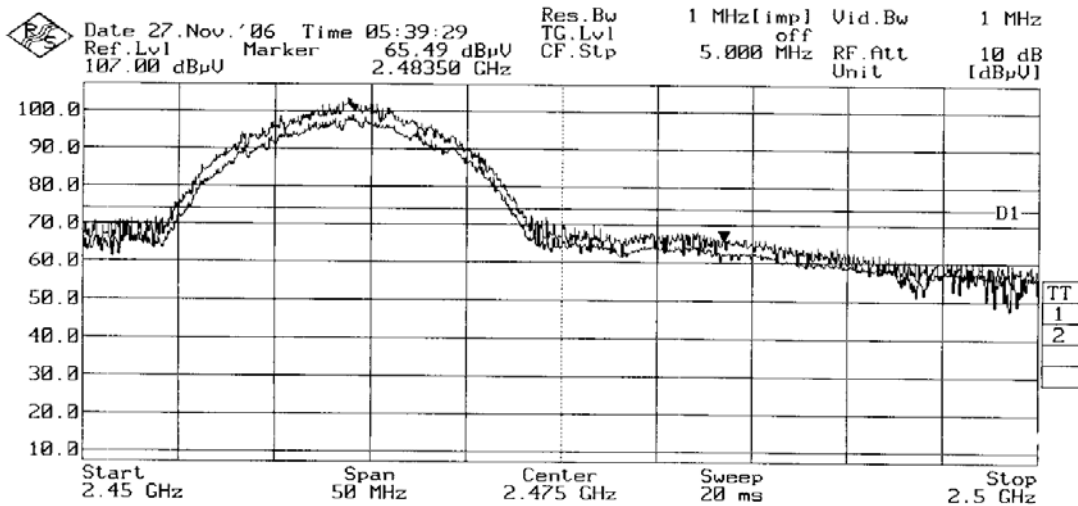
Plot 25 – Peak Plot at Lower Band Edge at 2.4000GHz



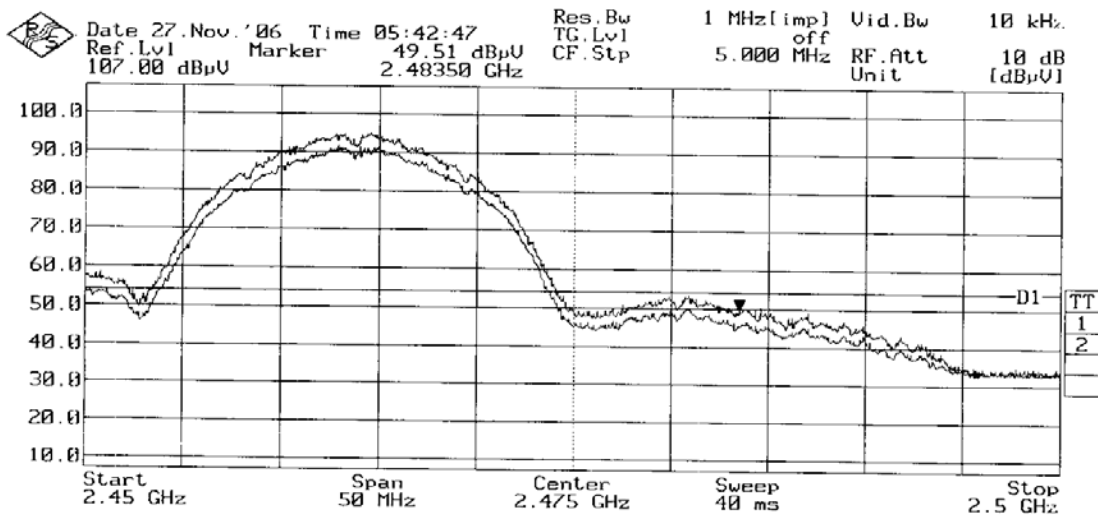
Plot 26 – Average Plot at Lower Band Edge at 2.4000GHz

BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - Transmitter



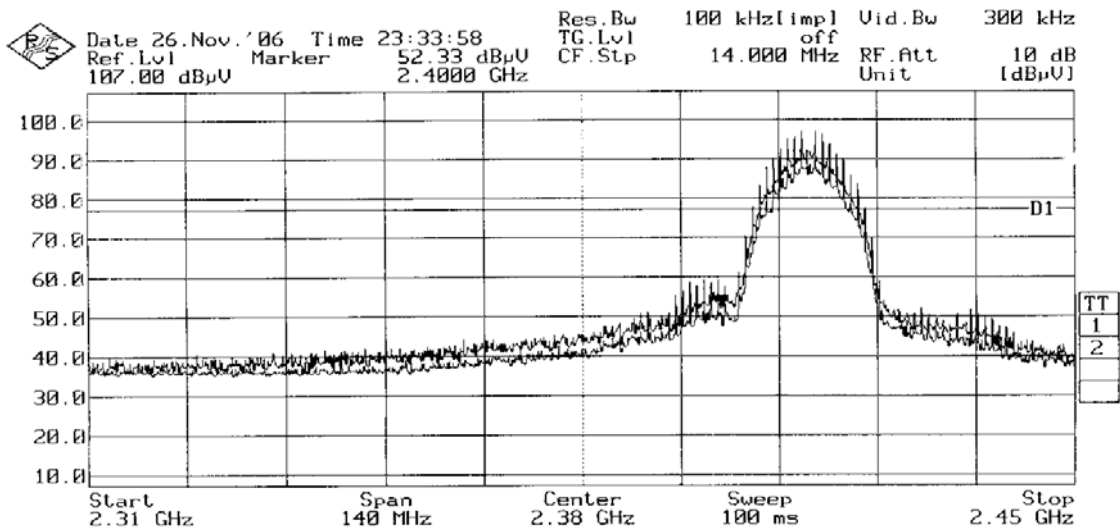
Plot 27 – Peak Plot at Upper Band Edge at 2.4835GHz



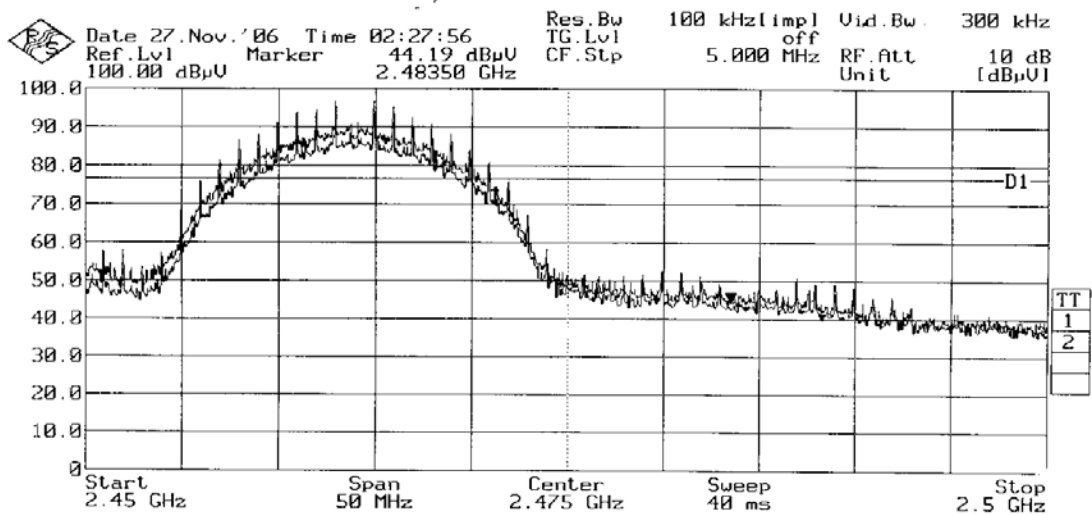
Plot 28 – Average Plot at Upper Band Edge at 2.4835GHz

BAND EDGE COMPLIANCE (RADIATED) TEST

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



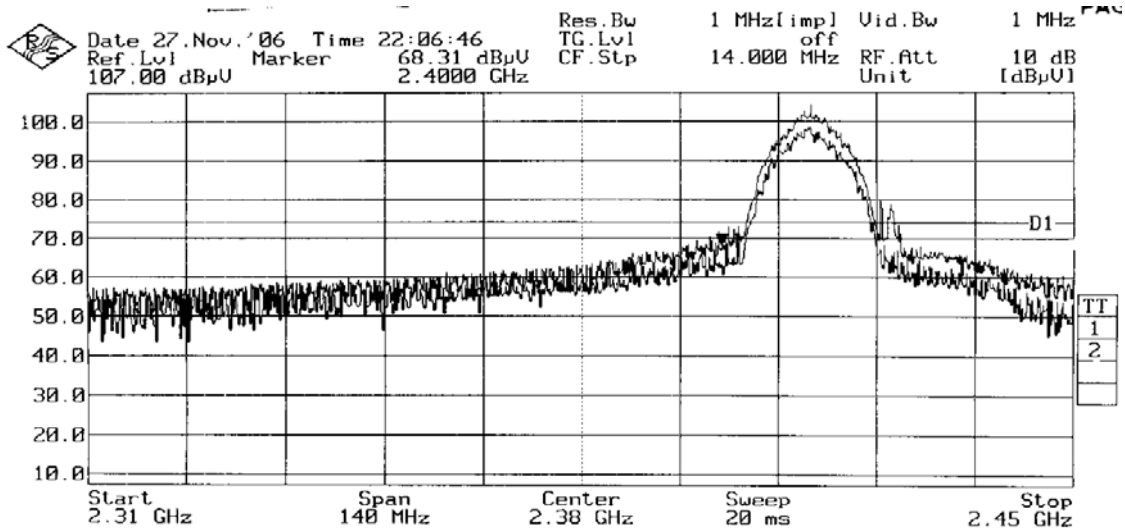
Plot 29 – Lower Band Edge at 2.4000GHz



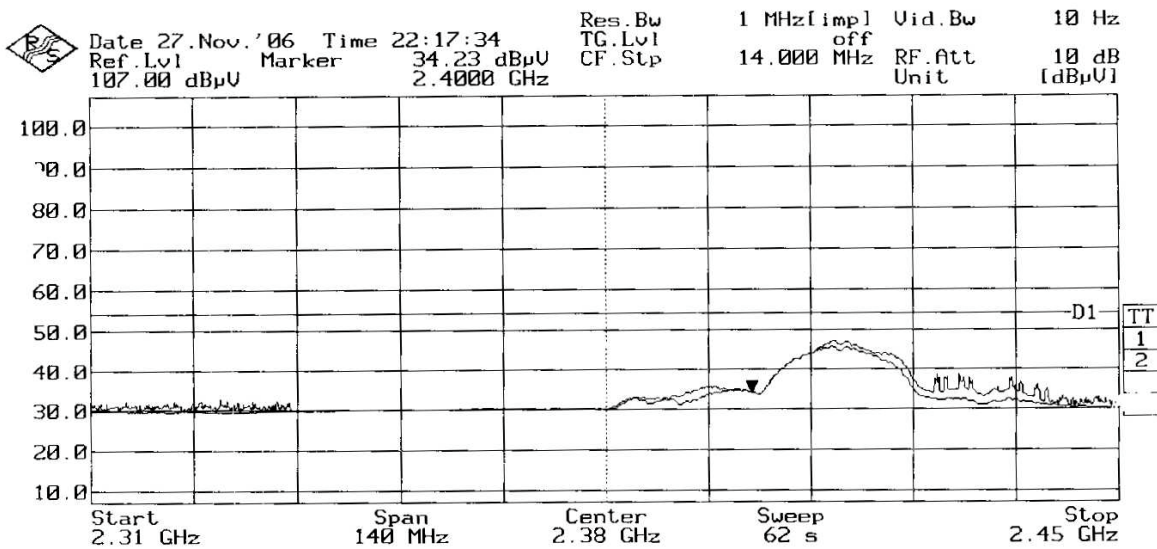
Plot 30 – Upper Band Edge at 2.4835GHz

BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - Receiver



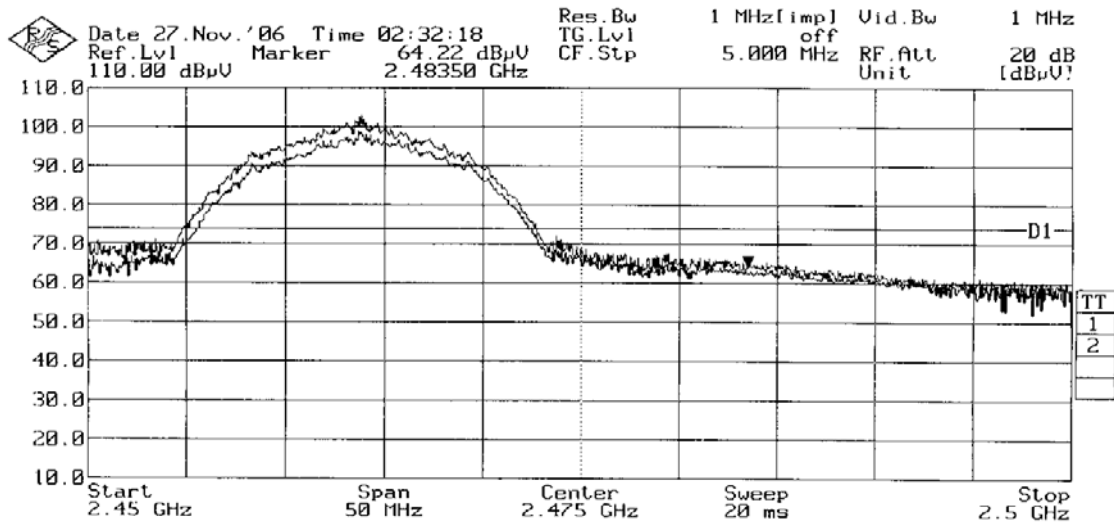
Plot 31 – Peak Plot at Lower Band Edge at 2.4000GHz



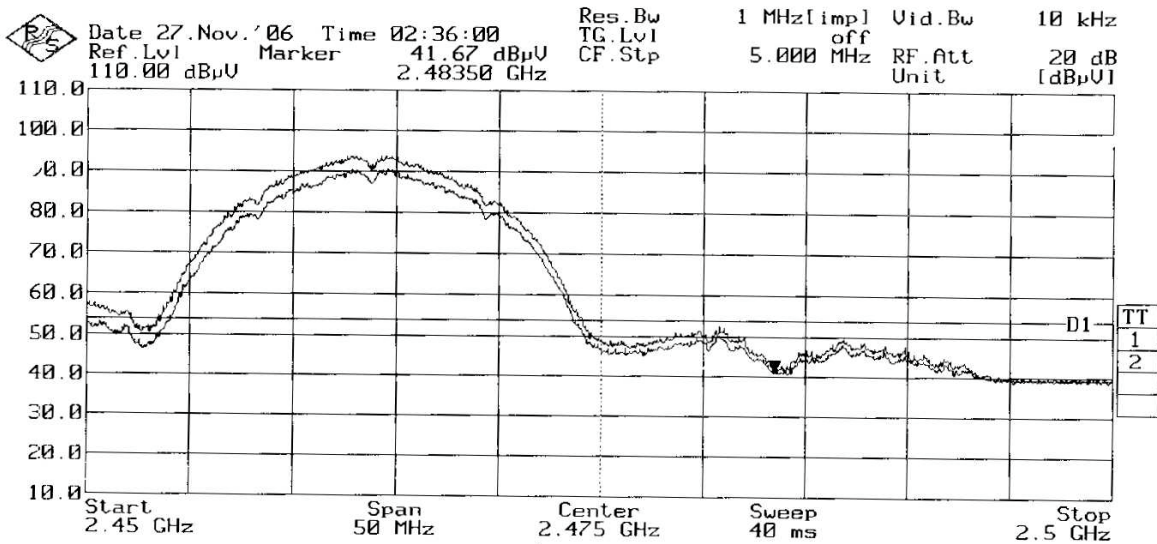
Plot 32 – Average Plot at Lower Band Edge at 2.4000GHz

BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band) - Receiver



Plot 33 – Peak Plot at Upper Band Edge at 2.4835GHz



Plot 34 – Average Plot at Upper Band Edge at 2.4835GHz

PEAK POWER SPECTRAL DENSITY TEST

FCC Part 15.247(e) Peak Power Spectral Density Limits

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

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

Instrument	Model	S/No	Cal Due Date
HP Spectrum Analyser – SA10	8564E	3846A01433	28 Apr 2007

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

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

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

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at Channel 0 (2.412GHz).
2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.
3. The peak power density of the transmitting frequency was detected and recorded.
4. The step 3 was repeated with the transmitting frequency was set to Channel 1 (2.438GHz) and Channel 2 (2.464GHz) respectively.

PEAK POWER SPECTRAL DENSITY TEST



Peak Power Spectral Density Test Setup



PEAK POWER SPECTRAL DENSITY TEST

FCC Part 15.247(e) Peak Power Spectral Density Results

Test Input Power	110V 60Hz	Temperature	22°C
Attached Plots	35 - 37 (Transmitter) 38 - 40 (Receiver)	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Transmitter

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.412	0.0112	6.3
1	2.438	0.0224	6.3
2	2.464	0.0108	6.3

Receiver

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.412	0.0052	6.3
1	2.438	0.0083	6.3
2	2.464	0.0043	6.3

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Limits

The EUT shows compliance to the requirements of this section, which states the MPE limits for general population / uncontrolled exposure are as shown below:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (min)
0.3 - 1.34	614	1.63	100 ^{Note 2}	30
1.34 - 30	824 / f	2.19 / f	180 / f ² ^{Note 2}	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f / 1500	30
1500 - 100000	-	-	1.0	30
Notes				
1. f = frequency in MHz				
2. Plane wave equivalent power density				

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
PMM 8053 Portable Field Meter	8053	0220J10308	16 Apr 2007
PMM Electric and Magnetic Field Analyzer	EHP-50A	1311L10515	16 Apr 2007

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Setup

1. The EUT and supporting equipment were set up as shown on the setup photo.
2. The relevant field probe was positioned at least 20cm away from the EUT and supporting equipment boundary.

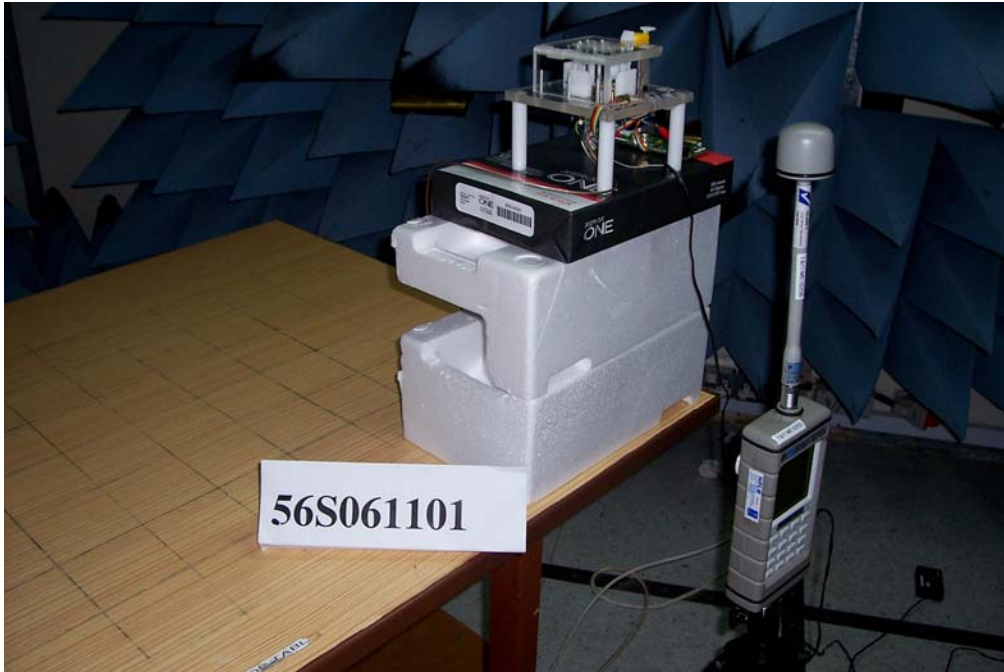
FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was first carried out at one of the positions / sides of the EUT.
3. Power density measurement (mW/cm²) was made using the field meter set to the required averaging time.
4. Steps 2 and 3 were repeated for the next position and its associate EUT operating mode, until all possible positions and modes were measured.

Sample Calculation Example

At 2400 MHz, limit = 1.0 mW/cm ²
Power density reading obtained directly from field meter = 0.3 mW/cm ² averaged over the required 30 minutes.
Therefore, margin = 0.3 – 1.0 = -0.7 mW/cm ² i.e. 0.7 mW/cm² below limit

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST



Maximum Permissible Exposure (MPE) Test Setup

MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

FCC Part 1.1310 Maximum Permissible Exposure (MPE) Results

Test Input Power	110V 60Hz	Temperature	22°C
Test Distance	20cm	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Transmitter

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm ²)	Margin (mW/cm ²)	Averaging Time (min)	Limit (mW/cm ²)
0	2.412	0.0023	-0.9977	30	1.0
1	2.438	0.0017	-0.9983	30	1.0
2	2.464	0.0003	-0.9997	30	1.0

Receiver

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm ²)	Margin (mW/cm ²)	Averaging Time (min)	Limit (mW/cm ²)
0	2.412	0.0015	-0.9985	30	1.0
1	2.438	0.0014	-0.9986	30	1.0
2	2.464	0.0002	-0.9998	30	1.0

Notes

1. All possible modes of operation were investigated. Only the worst case highest radiation levels were measured. Measurements were taken at the required averaging time. All other radiation levels 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. 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 0.1MHz – 3GHz is ±15%.

Test Report No. 56S061101/01
dated 30 Nov 2006



This Report is issued under the following conditions:

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



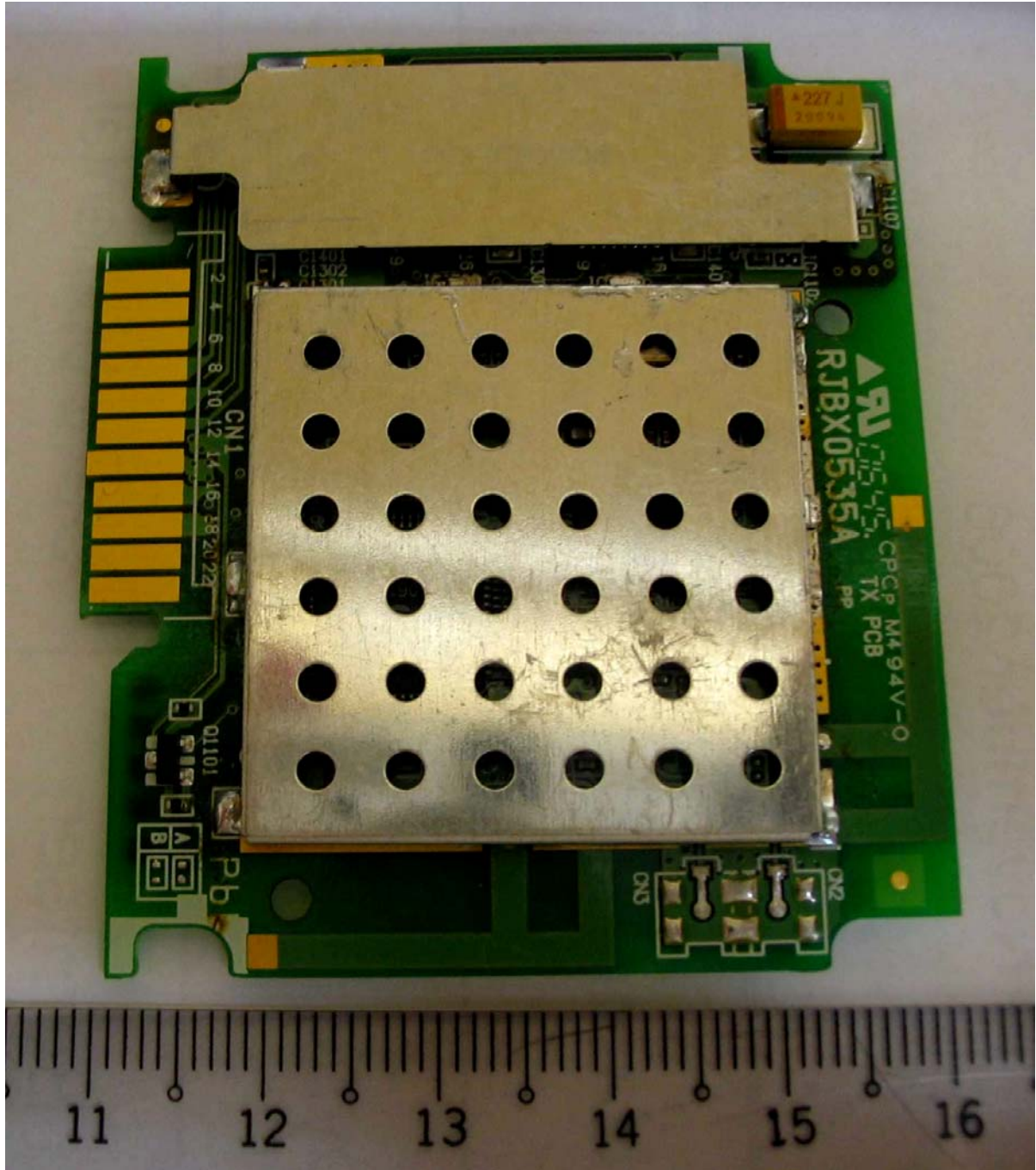
ANNEX A

EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS - Transmitter

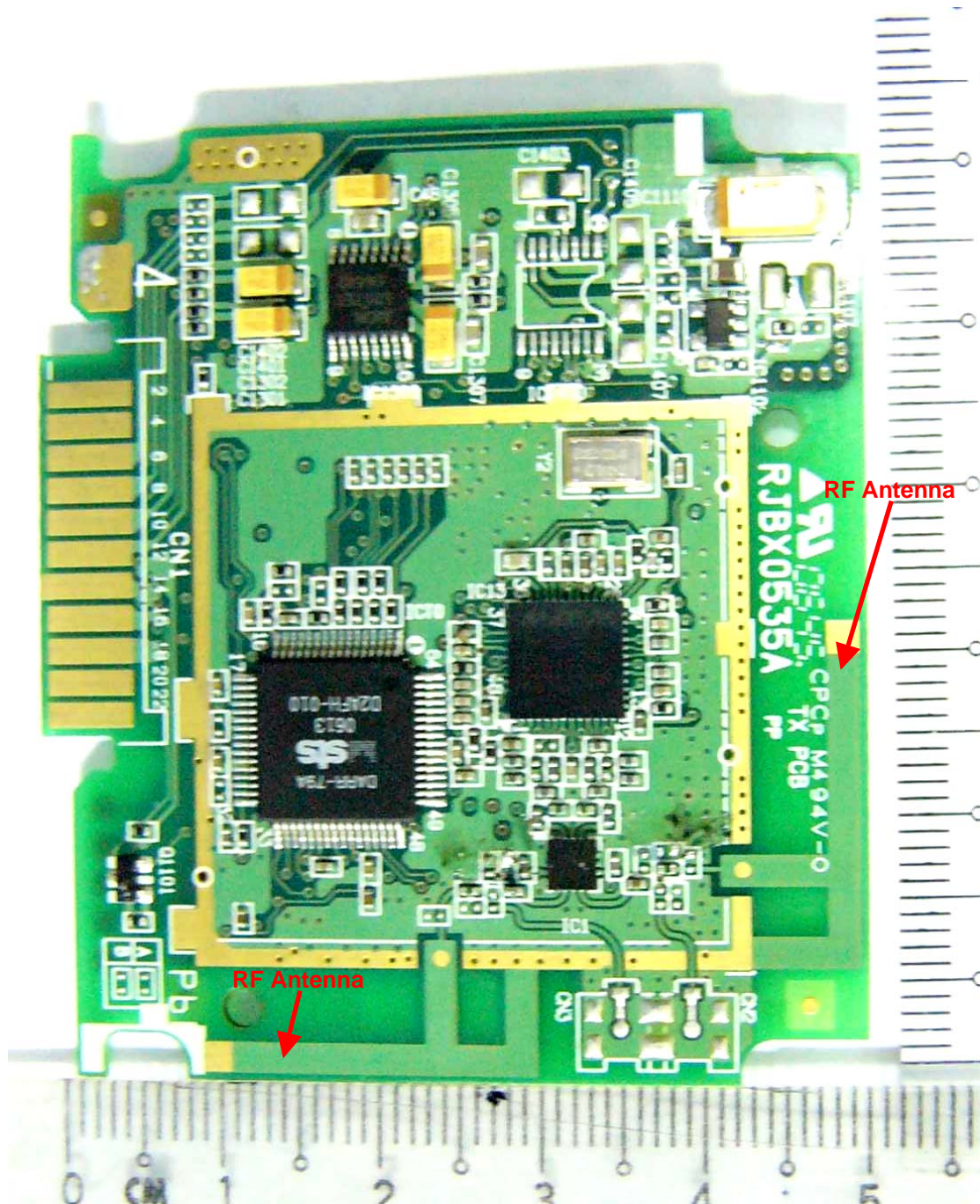


Front View

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS - Transmitter

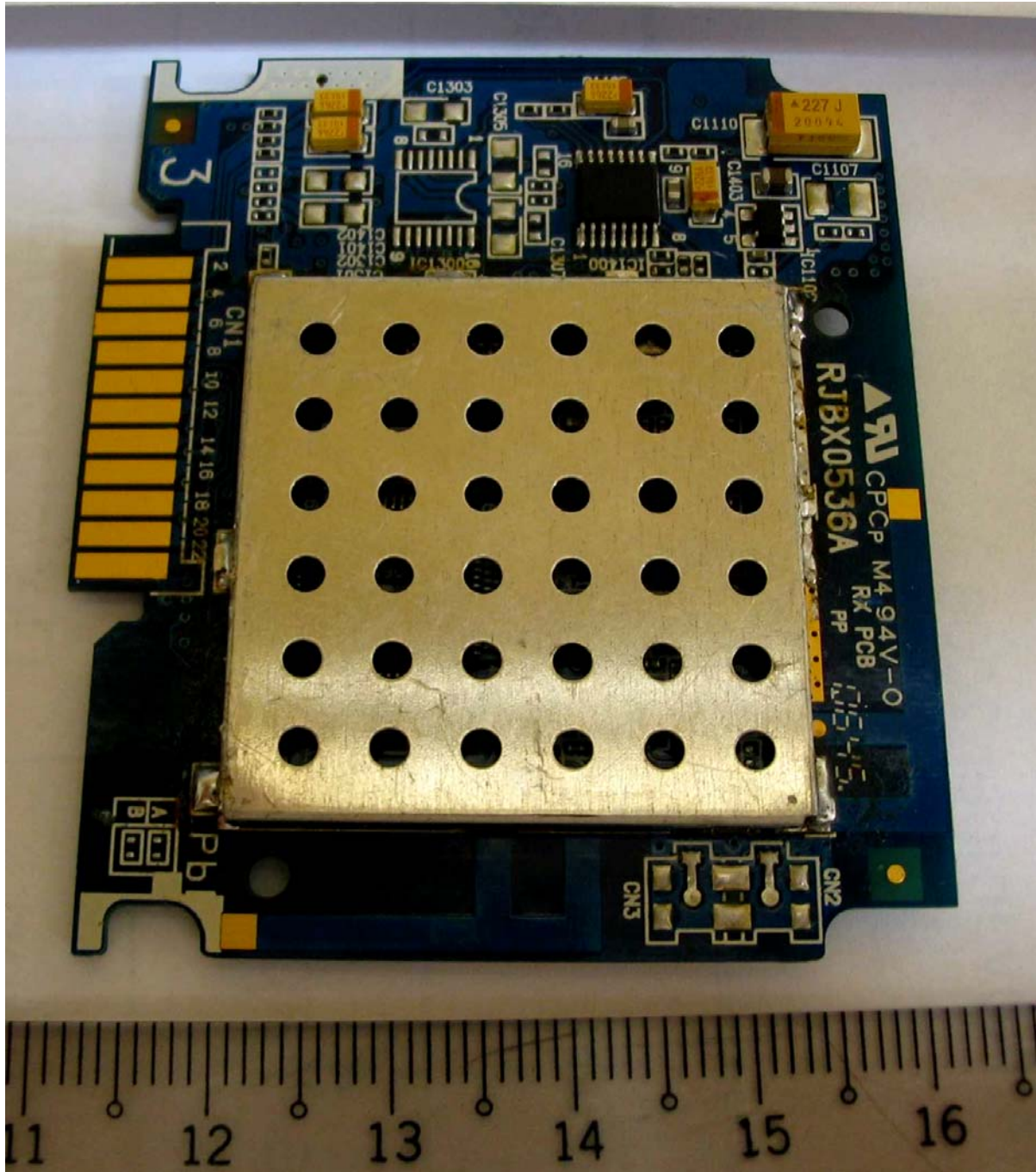


Front View (RF Shield Removed)

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS - Receiver

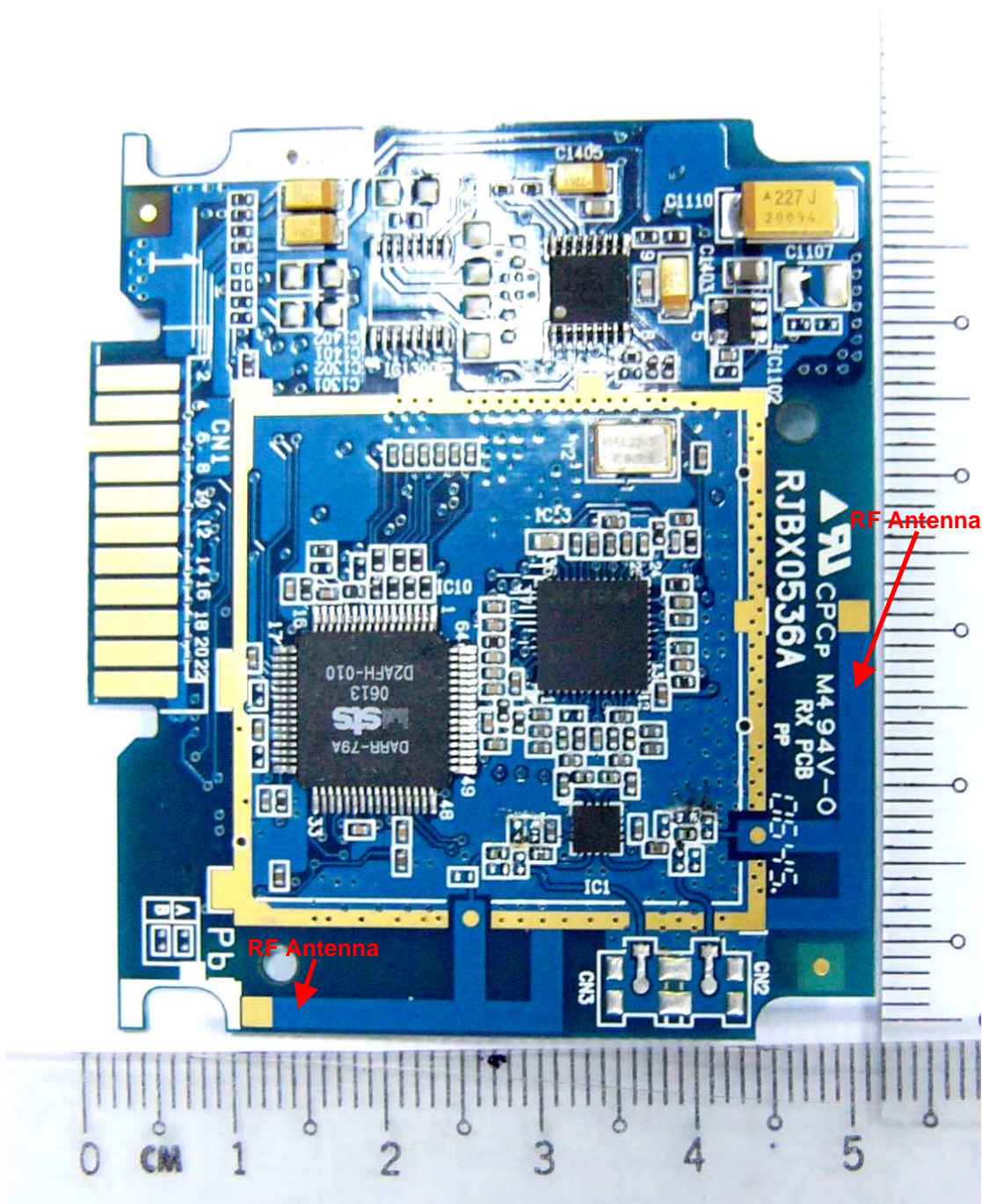


Front View

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS - Receiver



Front View (RF Shield Removed)

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS - Receiver



Rear View



ANNEX B

FCC LABEL & POSITION

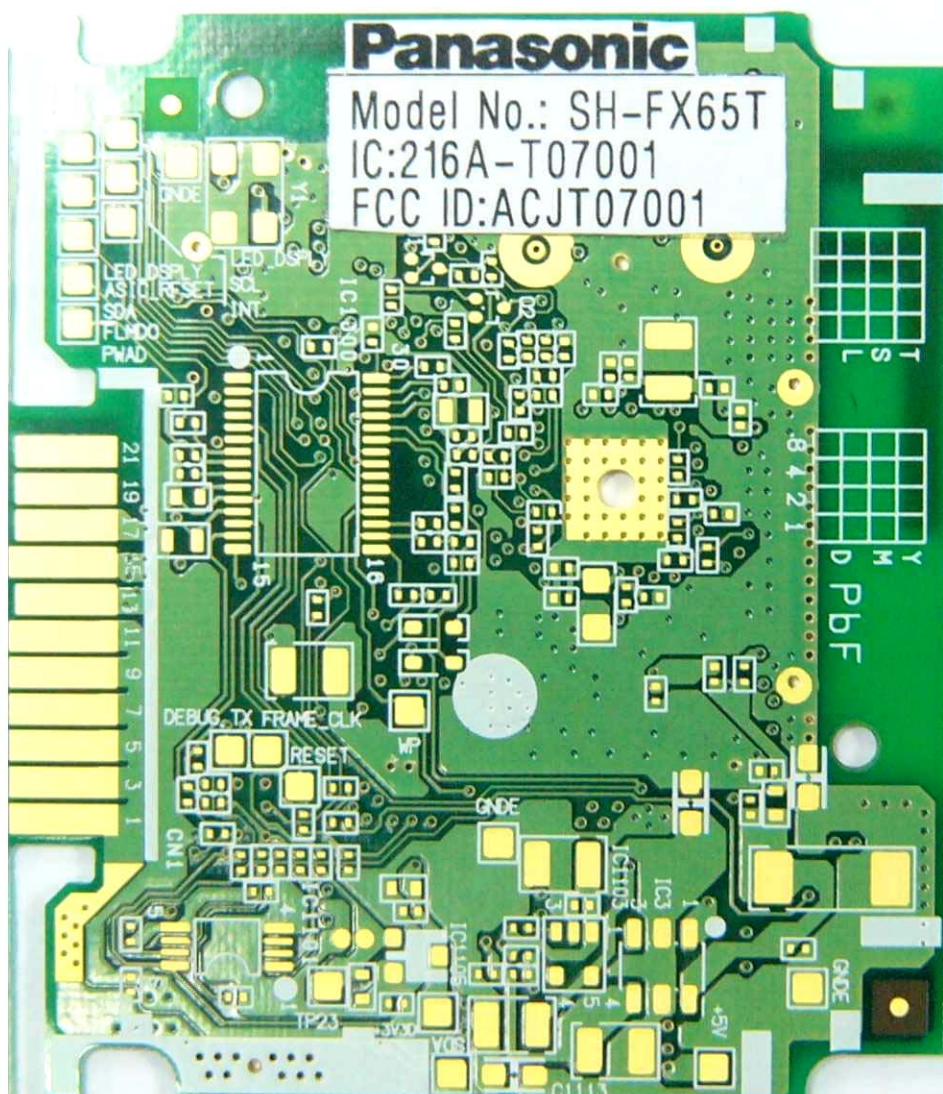
FCC LABEL & POSITION

ANNEX B

Labelling requirements per Section 2.925 & 15.19

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

Transmitter



FCC Sample Label and Location on EUT

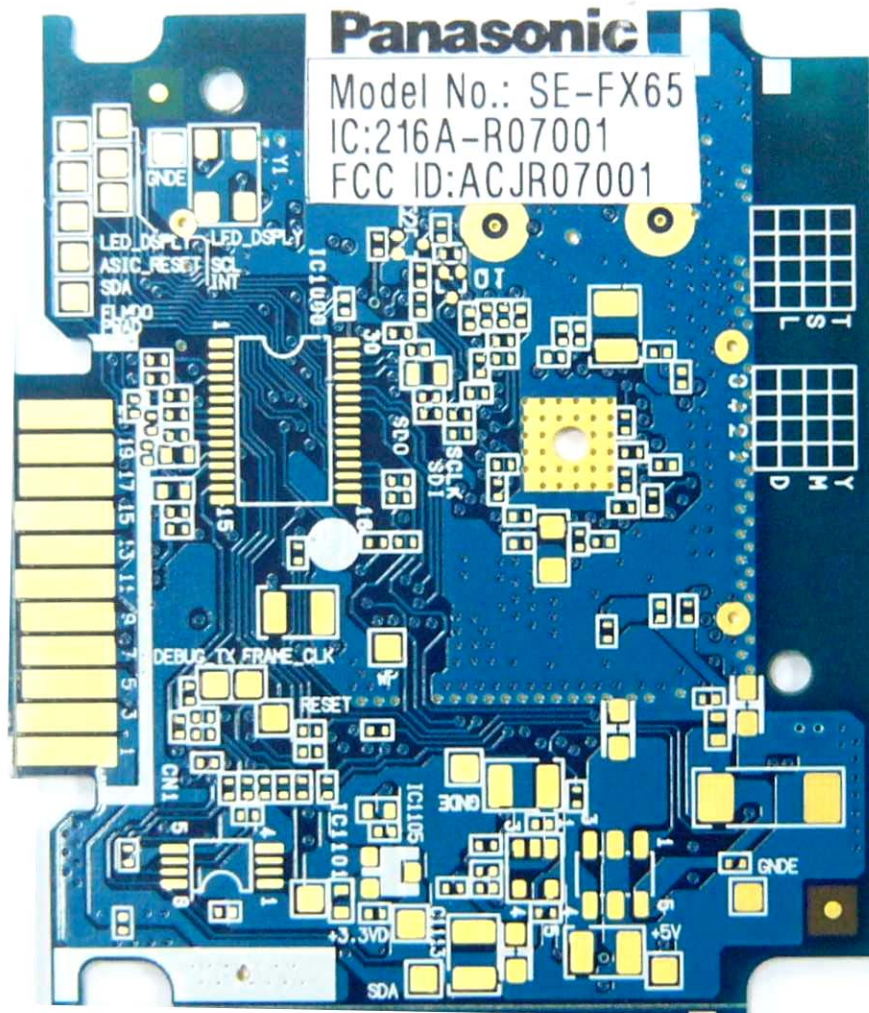
FCC LABEL & POSITION

ANNEX B

Labelling requirements per Section 2.925 & 15.19

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

Receiver



FCC Sample Label and Location on EUT

Test Report No. 56S061101/01
dated 30 Nov 2006



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

ANNEX C

ANNEX C

USER MANUAL TECHNICAL DESCRIPTION BLOCK & CIRCUIT DIAGRAMS

(Please refer to manufacturer for details)