

**Test Report No. 719164299-EEC-01**  
dated 09 Dec 2009



PSB Singapore

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH  
FCC Parts 15B & C : 2008  
OF  
**RF TRANSCEIVER CARDS**  
[ Models : SH-FX71 & RFAX1012 ]  
[ FCC IDs : ACJR10001 & ACJT10001 ]

**TEST FACILITY** TÜV SÜD PSB Pte Ltd,  
Electrical & Electronics Centre (EEC), Product Services,  
1 Science Park Drive, Singapore 118221

**FCC REG. NO.** 99142 (3m and 10m Semi-Anechoic Chamber)  
871638 (3m Semi-Anechoic Chamber)

**IND. CANADA REG. NO.** 29321-1 (3m and 10m Semi-Anechoic Chambers)

**PREPARED FOR** Mr. Vincent Yee  
Panasonic AVC Networks (S) Pte Ltd  
202, Bedok South Avenue 1,  
Singapore 469332  
Tel : (+65) 6240 1891 Fax : (+65) 6245 8804

**QUOTATION NUMBER** 219102327

**JOB NUMBER** 719164299

**TEST PERIOD** 24 Nov 2009 – 02 Nov 2009

**PREPARED BY**

Quek Keng Huat  
Associate Engineer

**APPROVED BY**

Lim Cher Hwee  
Assistance Vice President



Laboratory:  
TUV SUD PSB Pte. Ltd.  
Testing Services  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

Regional Head Office:  
TUV SUD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
TUV®



LA-2007-0380-A  
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LA-2007-0382-B  
LA-2007-0383-G  
LA-2007-0384-G  
LA-2007-0385-E  
LA-2007-0386-C

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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 SUMMARY**

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

**Test Results Summary**

Test Standard	Description	Pass / Fail
FCC Part 15: 2008		
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	Refer to page 55 for details



**TEST SUMMARY**

**Notes**

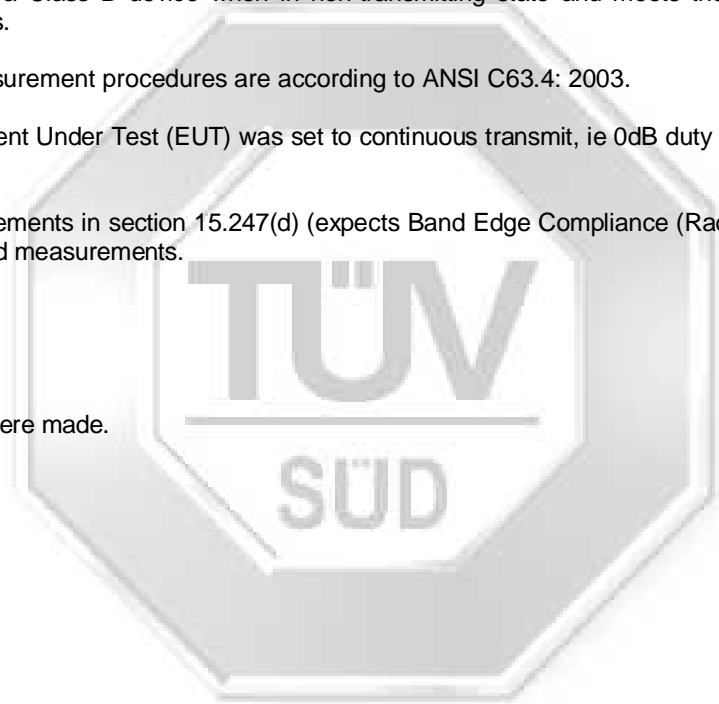
1. Three channels as listed below, which respectively represent the lower, middle and upper channels of the Equipment Under Test (EUT) were chosen and tested. For each channel, the EUT was configured to operate in the test mode.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>
Channel 0	2.412
Channel 1	2.438
Channel 2	2.462

2. The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.
3. All test measurement procedures are according to ANSI C63.4: 2003.
4. The Equipment Under Test (EUT) was set to continuous transmit, ie 0dB duty cycle during the transmit mode.
5. The measurements in section 15.247(d) (expects Band Edge Compliance (Radiated)) was done based on conducted measurements.

**Modifications**

No modifications were made.





**PRODUCT DESCRIPTION**

Description : The Equipment Under Test (EUT) are two **RF TRANSCEIVER CARDS**.

Manufacturer : Panasonic AVC Networks (S) Pte Ltd  
202, Bedok South Avenue 1,  
Singapore 469332

Model Numbers : SH-FX71 & RFAX1012

FCC IDs : ACJR10001 & ACJT10001

Serial Number : Nil

Microprocessor : Integrated

Operating / Transmitting Frequency : 2.412GHz to 2.462GHz  
3 channels in total

Clock / Oscillator Frequency : 16MHz

Modulation : OFDM

Antenna Gain : -3.0 dBi

Port / Connectors : Refer to manufacturer's user manual / operating manual.

Rated Input Power : 5Vdc via AC/DC power adaptor

Accessories : Refer to manufacturer's user manual / operating manual.



**SUPPORTING DESCRIPTION DESCRIPTION**

<b>Equipment Description (Including Brand Name)</b>	<b>Model, Serial &amp; FCC ID Number</b>	<b>Cable Description (List Length, Type &amp; Purpose)</b>
Panasonic AC/DC Adapter (for test jig)	M/N: DE-922A S/N: H400540DC FCC ID: Nil	1.30m unshielded AC power cable 1.80m unshielded DC power cable



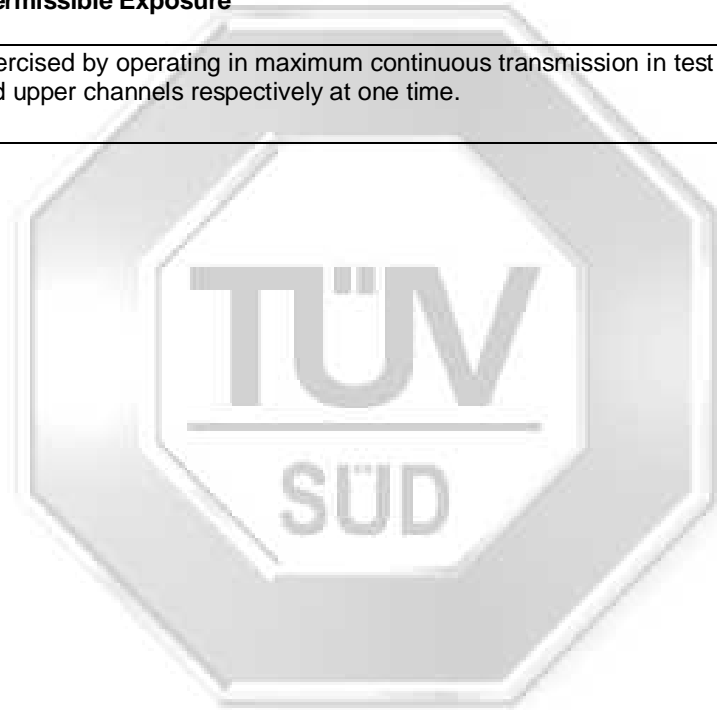


**EUT OPERATING CONDITIONS**

**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 (dBµV)	
	Quasi-peak (QP)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50

\* Decreasing linearly with the logarithm of the frequency

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

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	07 Oct 2010
Agilent EMC Analyzer-SA7	E7403A	US41160167	25 May 2010
Schaffner LISN – LISN10 (for EUT)	NNB42	04/10055	03 Jul 2010
EMCO LISN (for supporting) – LISN6	3825/2	9309-2127	03 Jul 2010





**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 9kHz. 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**

RFX1012



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



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

**CONDUCTED EMISSION TEST**

SH-FX71



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



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



**CONDUCTED EMISSION TEST**

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

Test Input Power	110V 60Hz	Temperature	23°C
Line Under Test	AC Mains	Relative Humidity	58%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Lim Chia Fa

Frequency (MHz)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	AV Value (dB $\mu$ V)	AV Margin (dB)	Line	Channel * See Note 4
0.3035	44.7	-15.4	40.9	-9.2	Live	2
0.3066	43.4	-16.7	40.1	-10.0	Neutral	2
0.5928	28.0	-28.0	24.0	-22.0	Neutral	2
0.9132	27.3	-28.7	22.3	-23.7	Live	2
1.1423	23.7	-32.3	20.3	-25.7	Neutral	2
2.1167	24.8	-31.2	21.0	-25.0	Neutral	2

Test Input Power	110V 60Hz	Temperature	23°C
Line Under Test	AC Mains	Relative Humidity	58%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Lim Chia Fa

Frequency (MHz)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	AV Value (dB $\mu$ V)	AV Margin (dB)	Line	Channel * See Note 4
0.6871	24.0	-32.0	20.0	-26.0	Neutral	2
1.2142	27.5	-28.5	22.5	-23.5	Live	2
1.8219	26.0	-30.0	21.8	-24.2	Neutral	2
2.1038	26.5	-29.5	22.0	-24.0	Neutral	2
2.1317	24.5	-31.5	20.6	-25.4	Live	2
4.5834	23.3	-32.7	20.2	-25.8	Live	2

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: 9kHz      VBW: 30kHz
- Channel 2 is the worst emissions channel.
- 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 is  $\pm 3.0$ 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) – ESMI2	ESMI	829214/006 829550/001	27 May 2010
Schaffner Preampfier (9kHz-2GHz) –PA13	CPA9231A	3422	13 Feb 2010
Toyo Preampfier	HAP26-40W	00000005	02 Apr 2010
Agilent Preampfier (PA7)	87405B	10020	04 Feb 2010
Schaffner Bilog Antenna – BL4	CBL6112B	2593	13 May 2010
EMCO Horn Antenna- H2	3115	9403-4250	13 May 2010
Mirco-Tronics 2.4GHz Bandstop Filter	BRM50701	042	13 Aug 2010



**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.

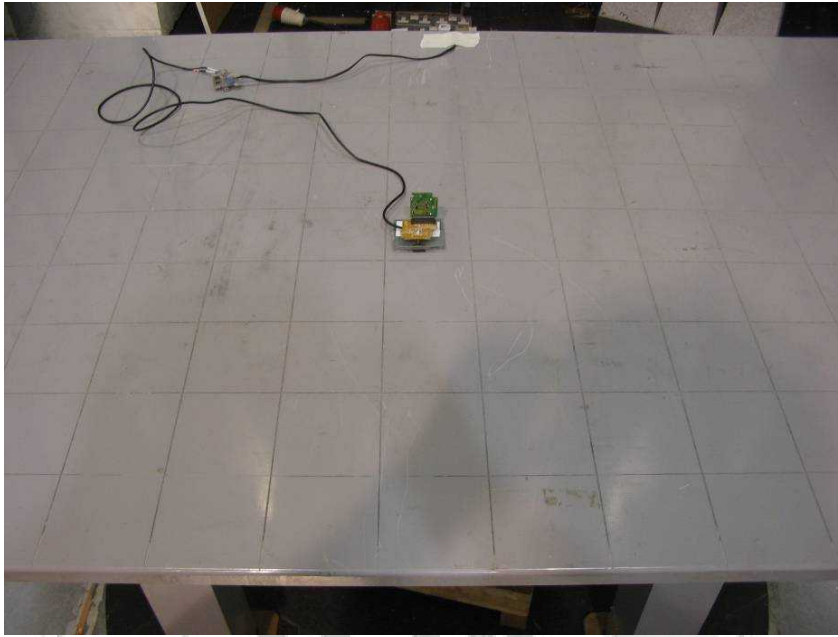
**FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method**

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 altitude 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 1GHz, and the Horn antenna above 1GHz.

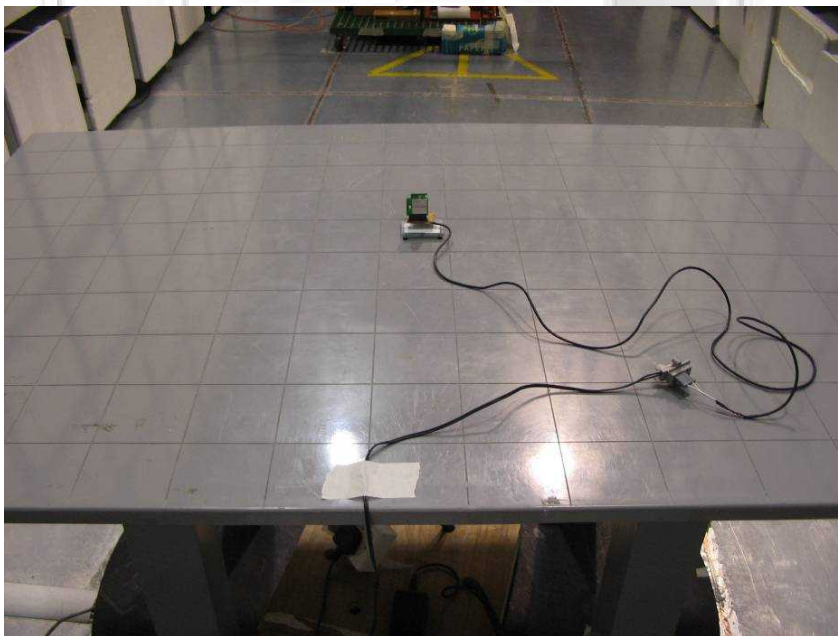
**Sample Calculation Example**

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

**RADIATED EMISSION TEST**



**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	110V 60Hz	Temperature	24°C
Test Distance	3m	Relative Humidity	58%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

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
37.6200	28.5	-11.5	97	299	V	2
48.5050	24.9	-15.1	32	100	V	2
71.3650	29.3	-10.7	18	299	V	2
74.6310	27.4	-12.6	79	100	V	2
78.9850	25.5	-14.5	95	100	V	2
897.5790	28.7	-17.3	343	100	H	2

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
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**RADIATED EMISSION TEST**

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

Test Input Power	110V 60Hz	Temperature	24°C
Test Distance	3m	Relative Humidity	58%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

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
30.0000	21.8	-18.2	237	300	V	1
38.7080	18.5	-21.5	116	399	V	1
769.1290	30.8	-15.2	178	100	H	1
833.3540	28.8	-17.2	178	100	H	1
891.0470	34.0	-12.0	23	299	H	1
896.4900	29.3	-16.7	132	100	H	1

Spurious Emissions above 1GHz

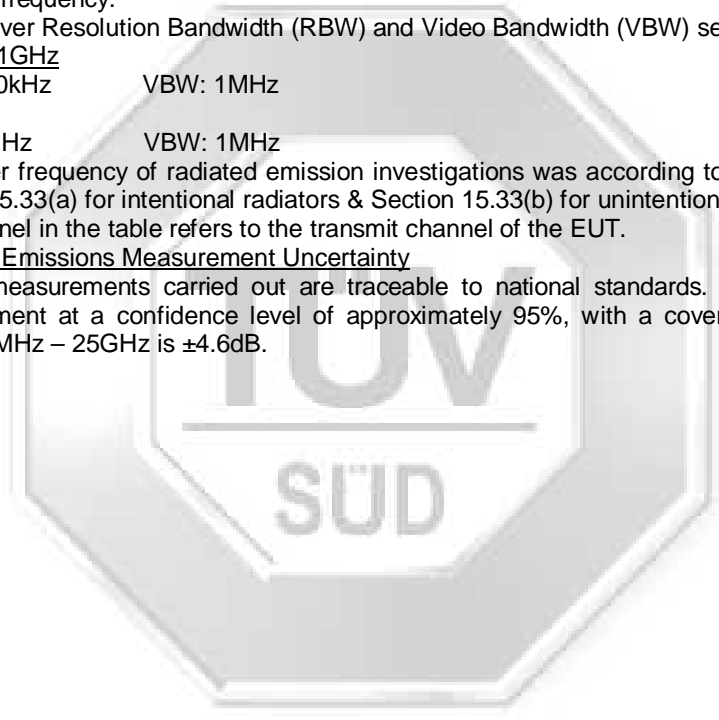
Frequency (GHz)	Peak Value (dB $\mu$ V/m)	Average Value (dB $\mu$ V/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
3.7472	24.8	20.2	-33.8	0	100	H	0
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**RADIATED EMISSION TEST**

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 is  $\pm 4.6\text{dB}$ .





**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
Agilent EMC Analyzer (9kHz-26.5GHz) BITE (Ref)	E7405A	US40240195	20 Jan 2010

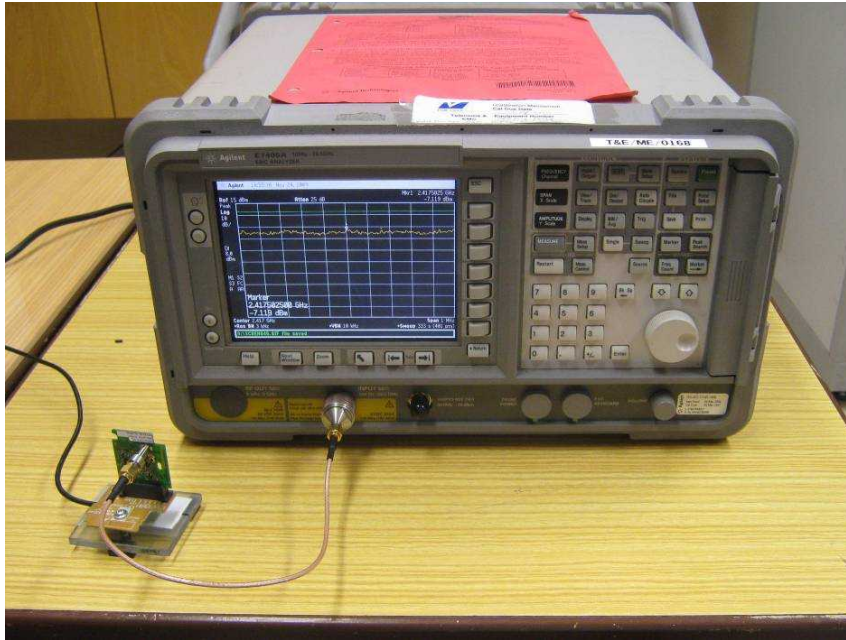
**FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Setup**

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 (2.438GHz) and Channel 2 (2.462GHz) respectively.

**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST**



**Spectrum Bandwidth (6dB Bandwidth Measurement) Test Setup**

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

Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	1 – 3	Relative Humidity	60%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)
0	2.412	16.500
1	2.438	16.500
2	2.462	16.500

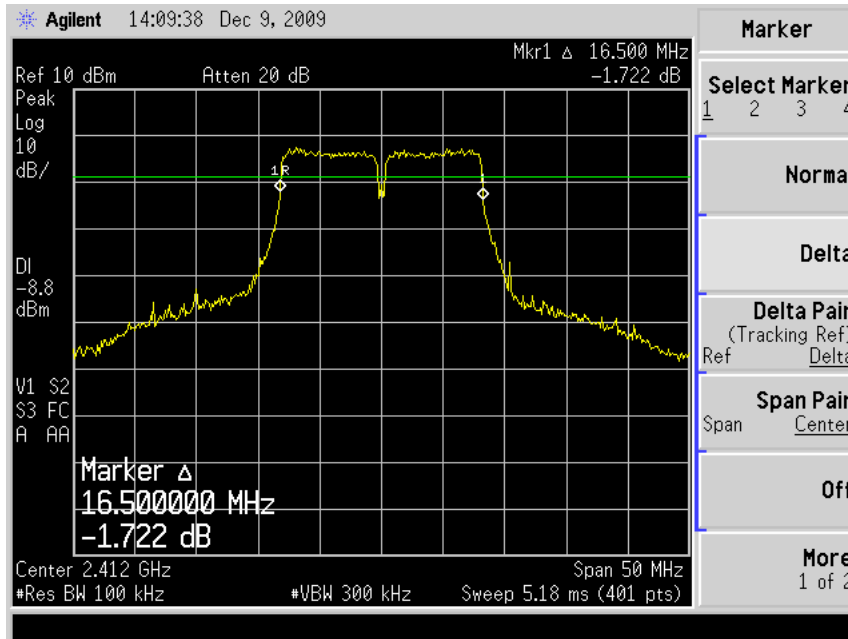
Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	4 – 6	Relative Humidity	60%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)
0	2.412	16.500
1	2.438	16.500
2	2.462	16.500

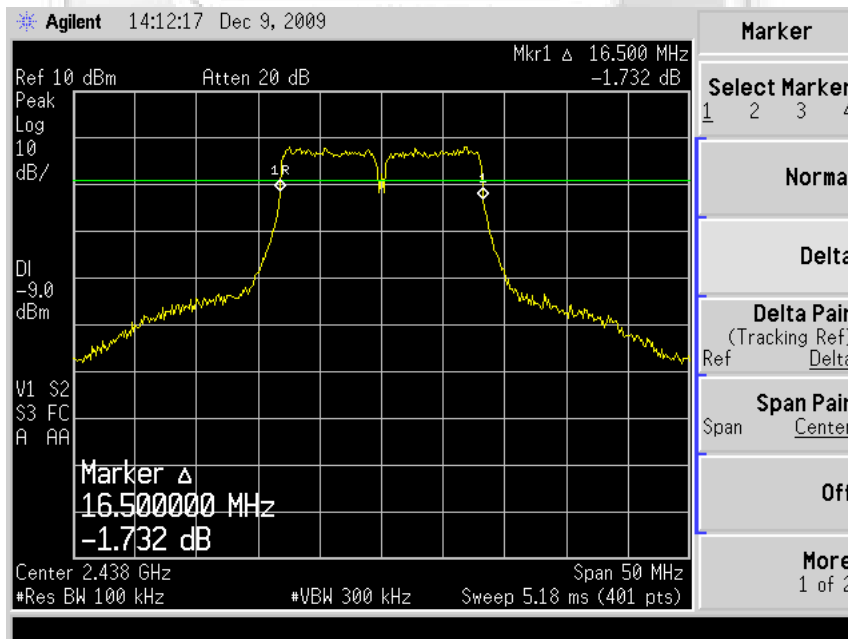


**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST**

**Spectrum Bandwidth (6dB Bandwidth Measurement) Plots - RFAX1012**



Plot 1 - Channel 0

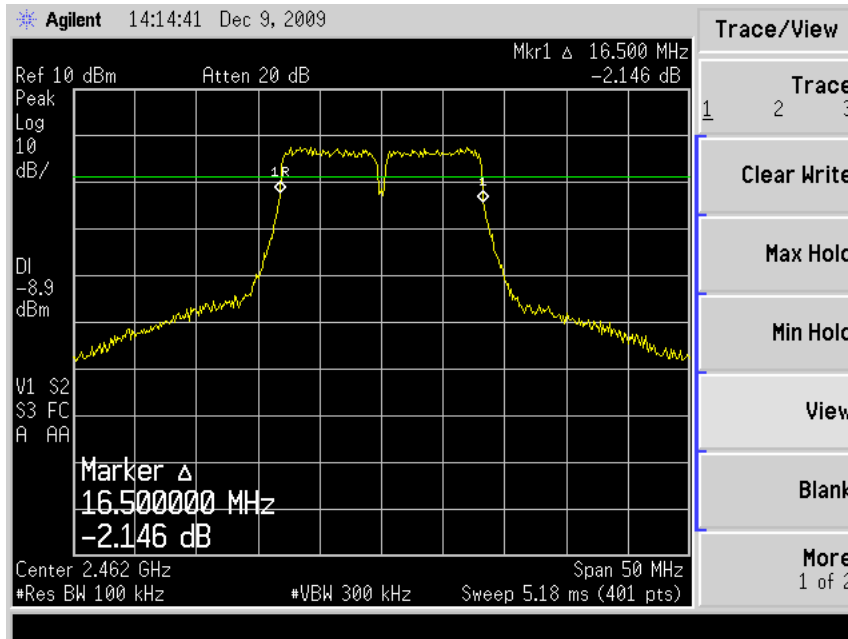


Plot 2 - Channel 1



**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST**

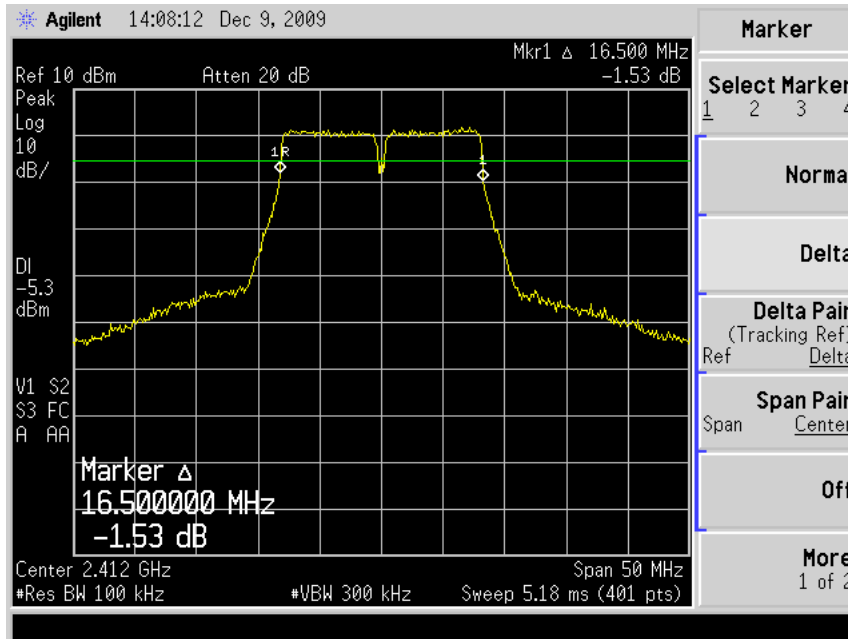
**Spectrum Bandwidth (6dB Bandwidth Measurement) Plots - RFAX1012**



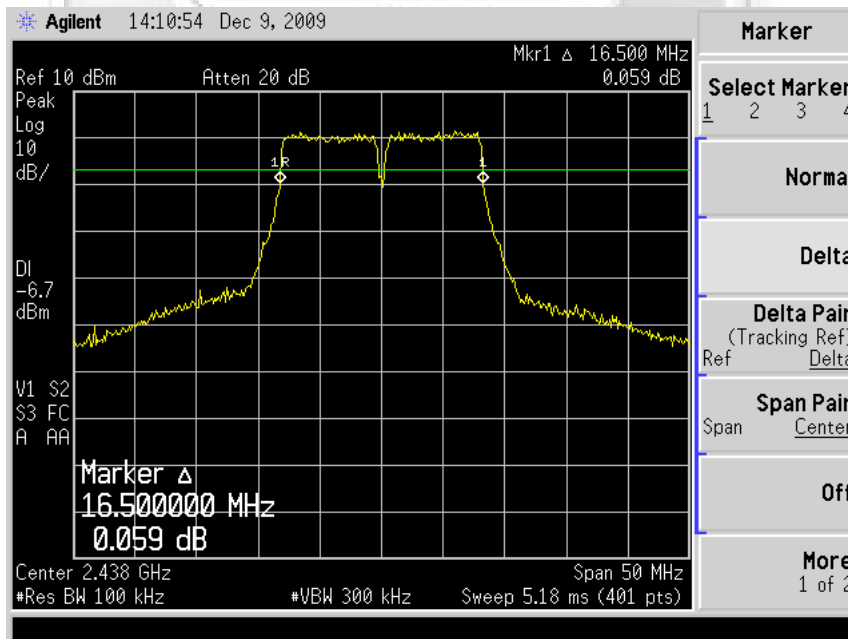


**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST**

**Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – SH-FX71**



**Plot 4 - Channel 0**

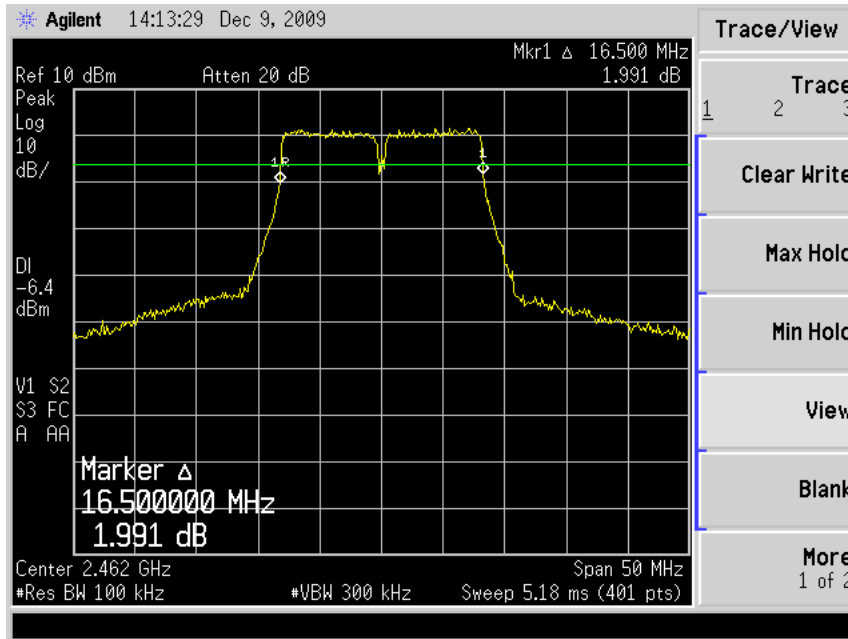


**Plot 5 - Channel 1**



**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST**

**Spectrum Bandwidth (6dB Bandwidth Measurement) Plots – SH-FX71**





**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
R&S Universal Radio Communication Tester	CMU 200	837587/068	25 Dec 2009

**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 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)(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 Equivalent Isotropic Radiated Power (EIRP) of the EUT was computed by adding its antenna gain to the measured maximum peak power.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to Channel 1 (2.438GHz) and Channel 2 (2.462GHz) 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	24°C
Antenna Gain	-3.0 dBi	Relative Humidity	60%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Maximum EIRP (W)	Limit (W)
0	2.412	0.0871	0.0437	1.0
1	2.438	0.0977	0.0470	1.0
2	2.462	0.0955	0.0479	1.0

Test Input Power	110V 60Hz	Temperature	24°C
Antenna Gain	-3.0 dBi	Relative Humidity	60%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Maximum EIRP (W)	Limit (W)
0	2.412	0.0890	0.0447	1.0
1	2.438	0.0891	0.0447	1.0
2	2.462	0.0890	0.0447	1.0

Notes

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



**RF CONDUCTED SPURIOUS EMISSIONS TEST**

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

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

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

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz) BITE (Ref)	E7405A	US40240195	20 Jan 2010

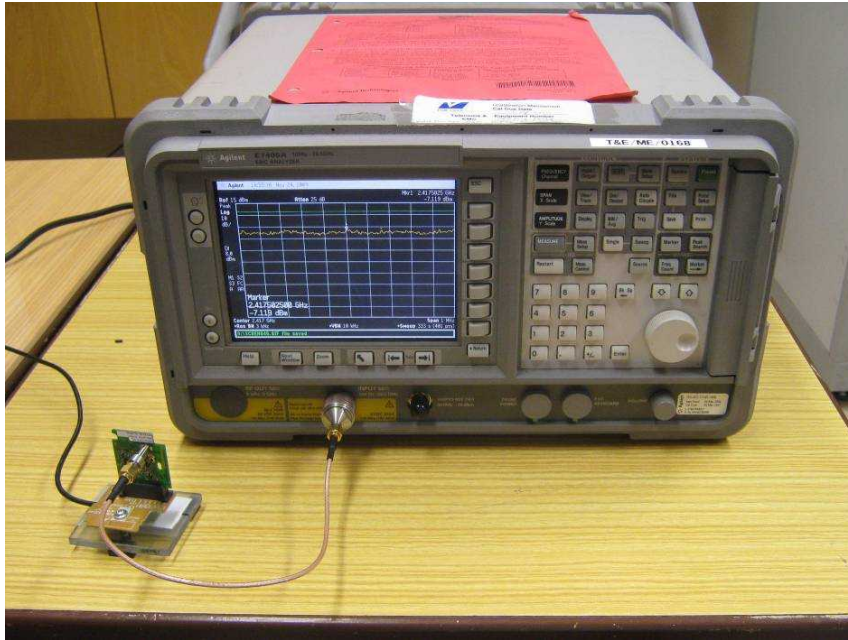
**FCC Part 15.247(d) RF Conducted Spurious Emissions Test Setup**

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 (2.462GHz) 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	110V 60Hz	Temperature	24°C
Attached Plots	7 - 12	Relative Humidity	60%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

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

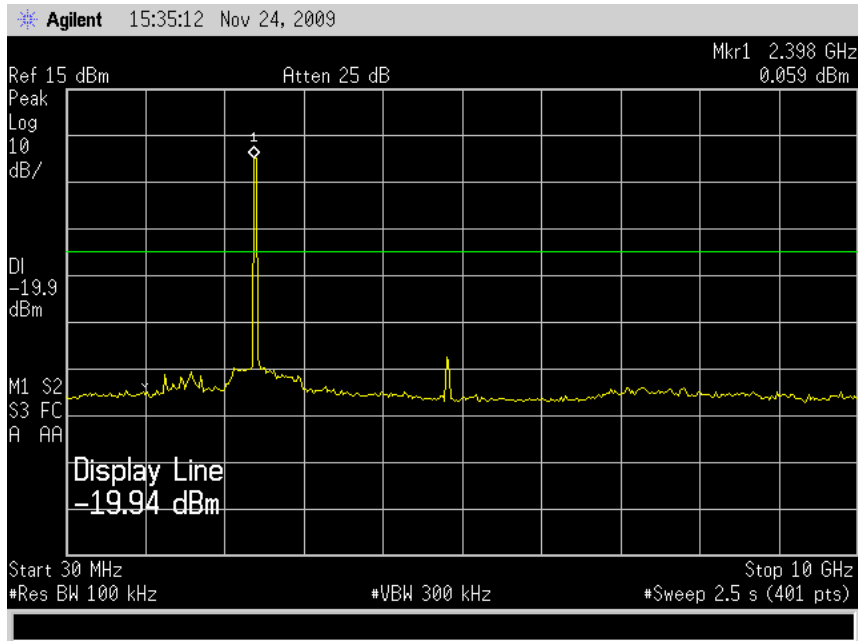
Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	13 - 18	Relative Humidity	60%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

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

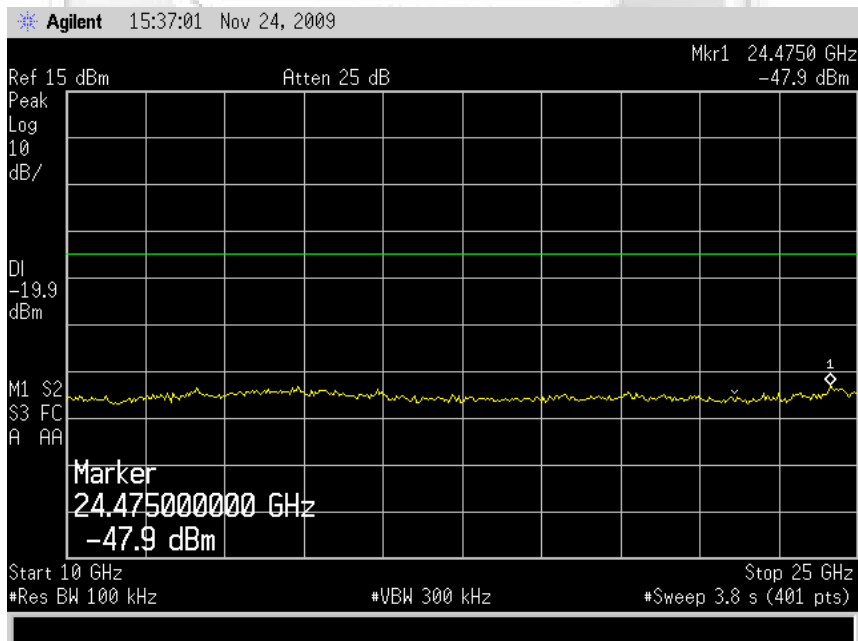


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - RFAX1012



Plot 7 - Channel 0

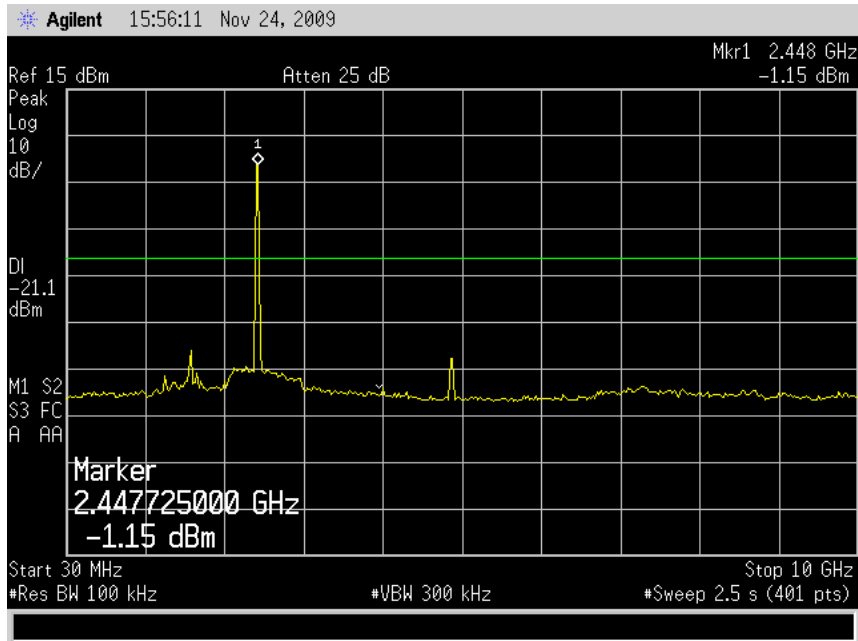


Plot 8 - Channel 0

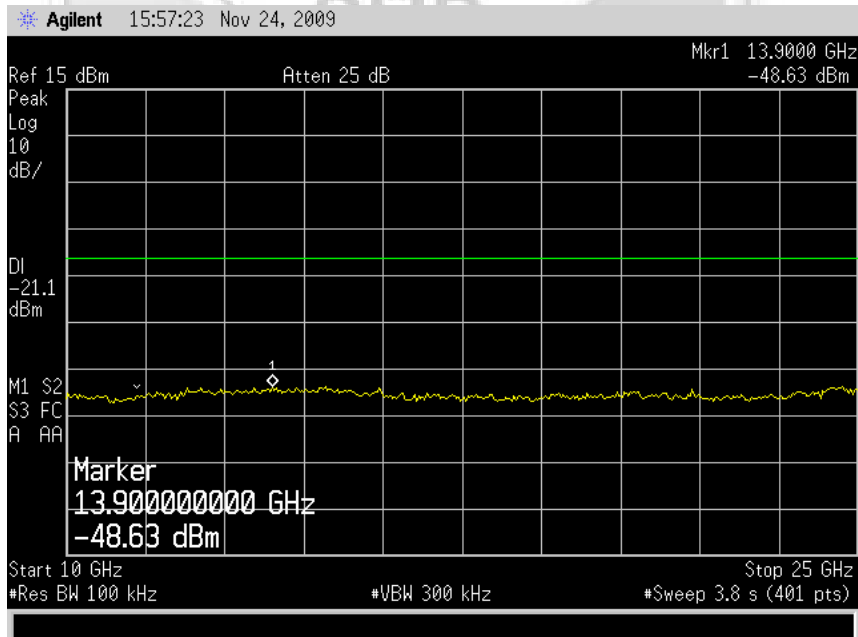


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - RFAX1012



Plot 9 - Channel 1

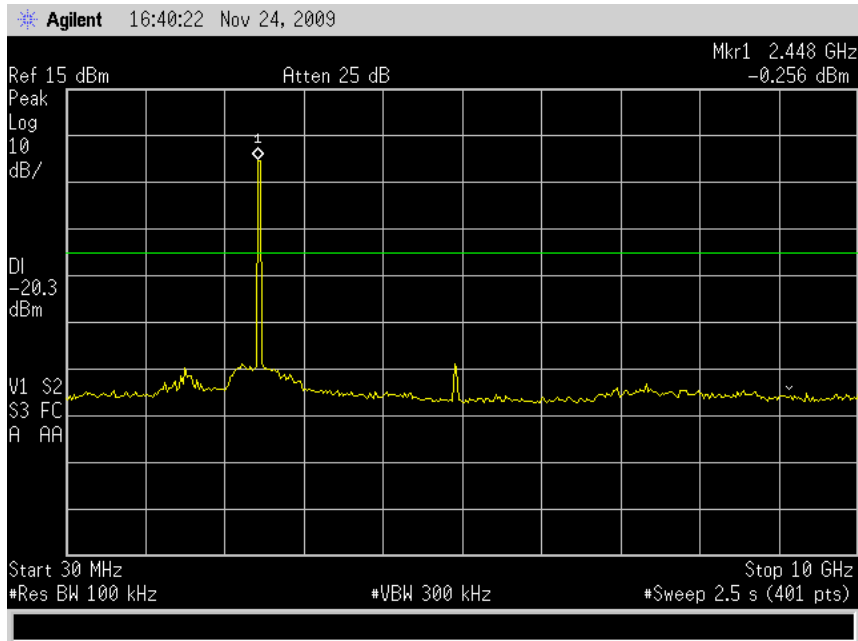


Plot 10 - Channel 1

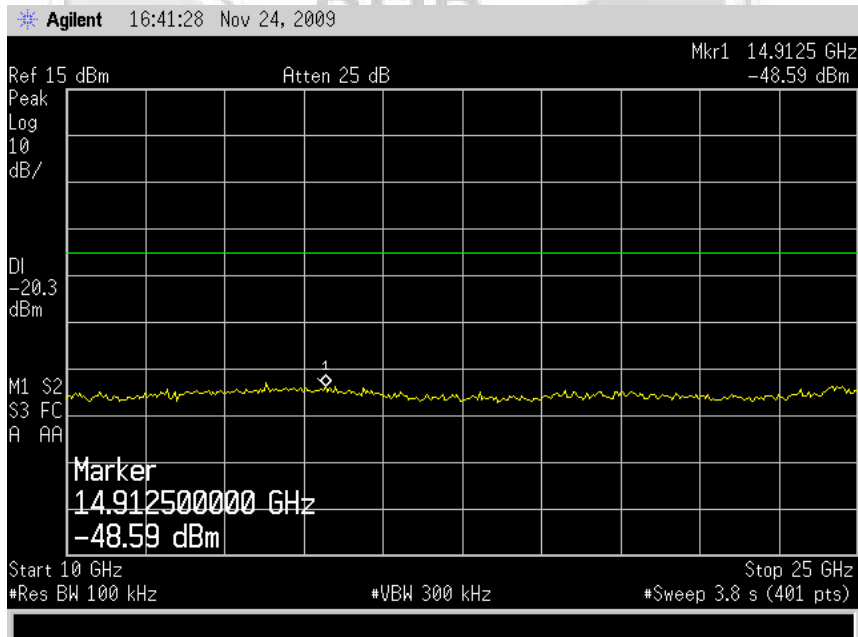


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - RFAX1012



Plot 11 - Channel 2

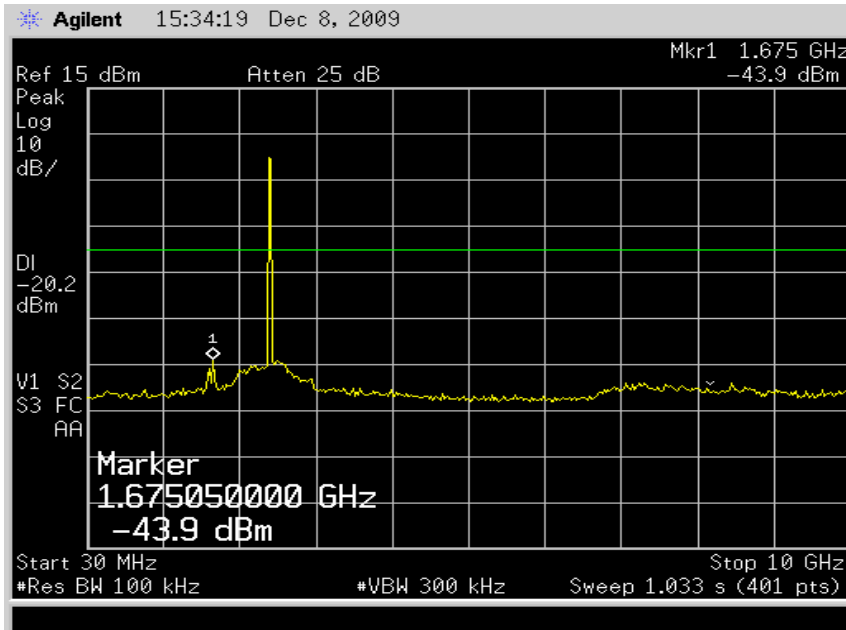


Plot 12 - Channel 2

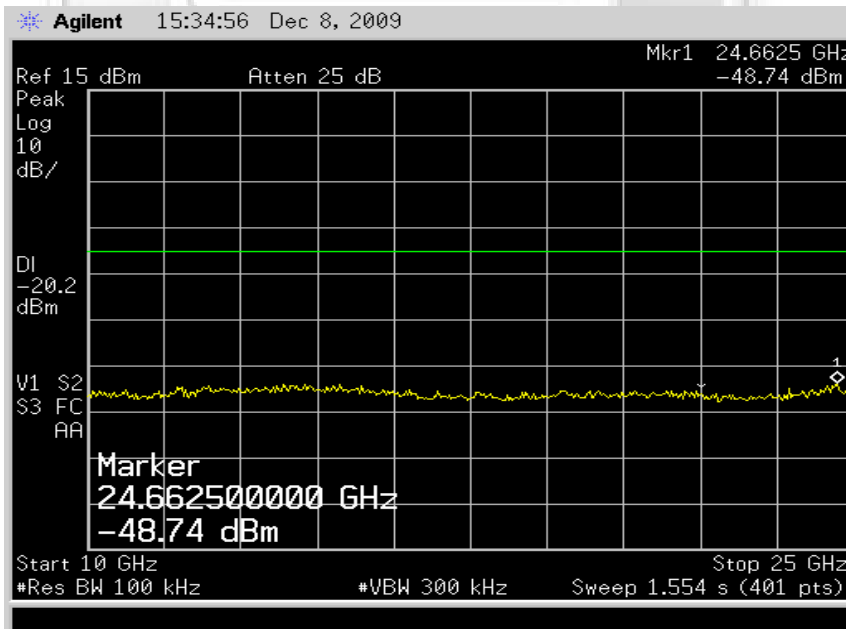


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - SH-FX71



Plot 13 - Channel 0

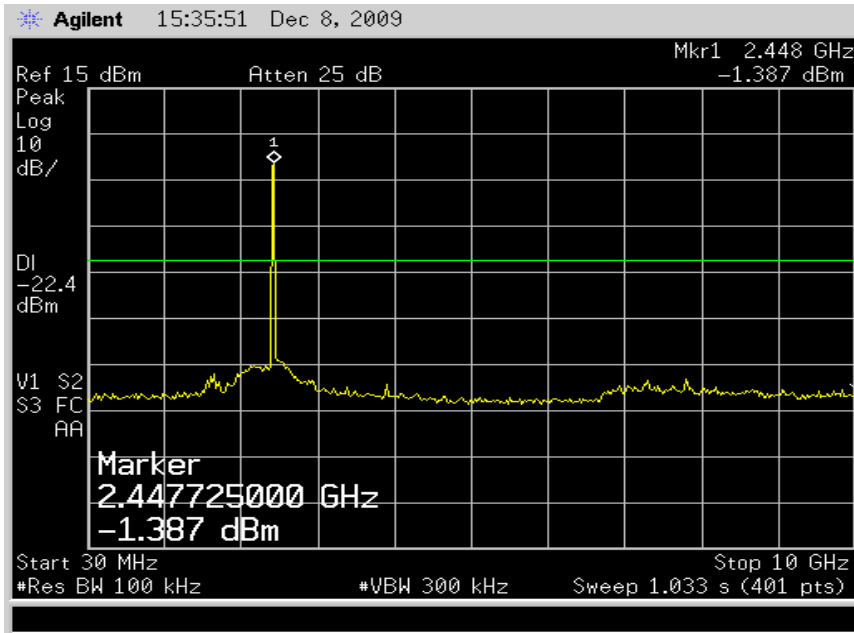


Plot 14 - Channel 0

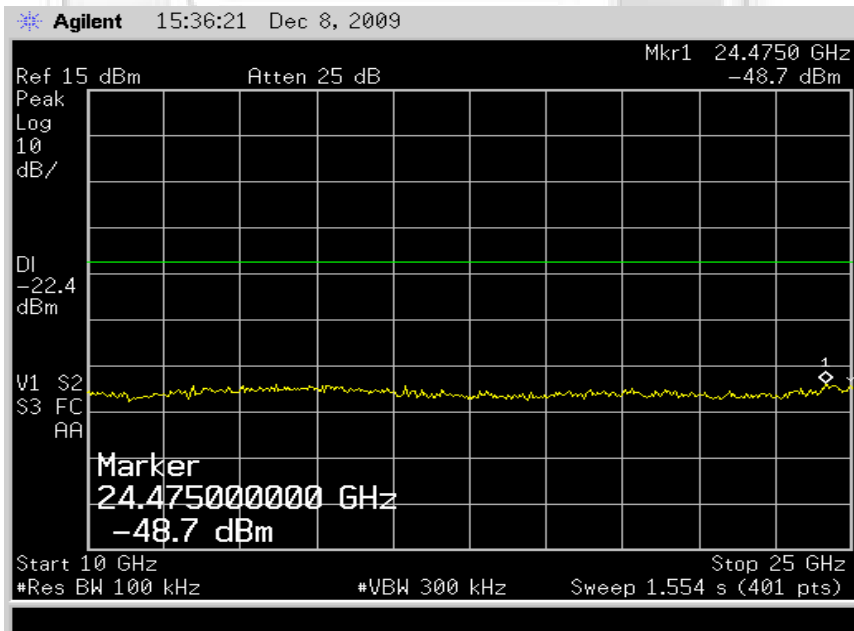


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - SH-FX71



Plot 15 - Channel 1

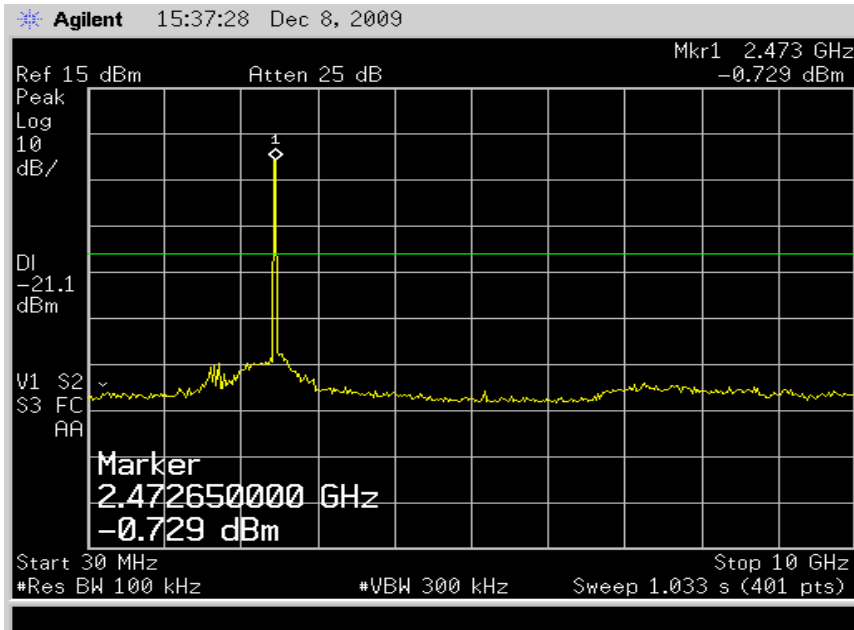


Plot 16 - Channel 1

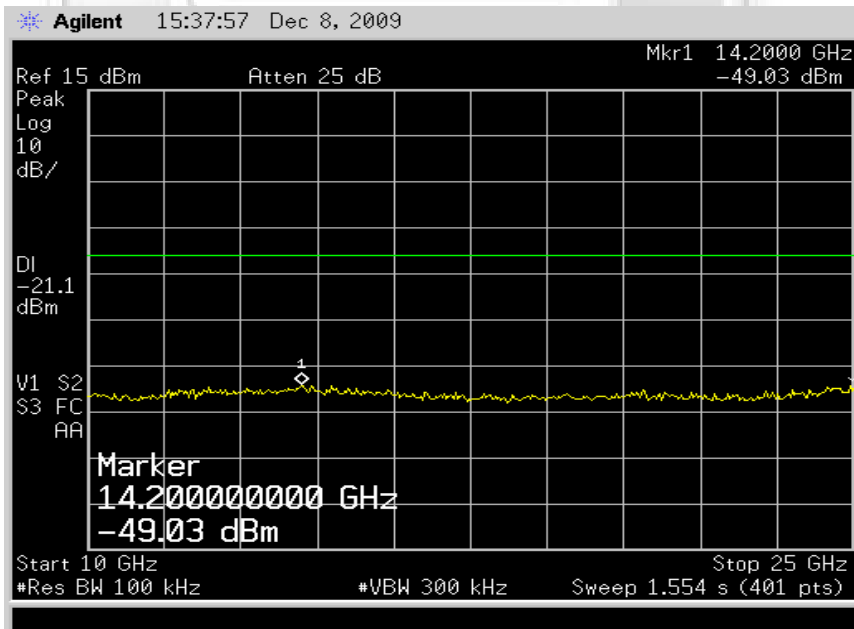


RF CONDUCTED SPURIOUS EMISSIONS TEST

RF Conducted Spurious Emissions Plots - SH-FX71



Plot 17 - Channel 2



Plot 18 - Channel 2



**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
Agilent EMC Analyzer (9kHz-26.5GHz) BITE (Ref)	E7405A	US40240195	20 Jan 2010

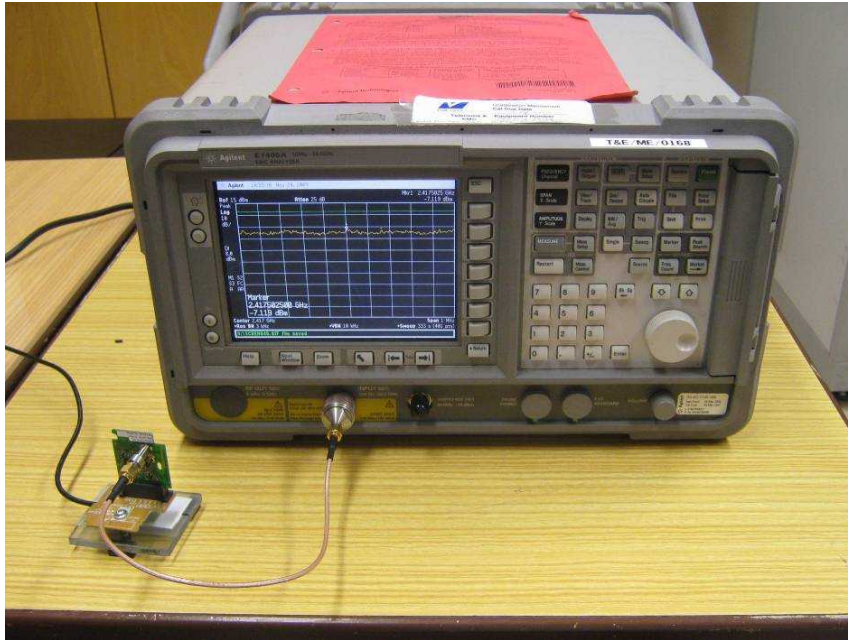
**FCC Part 15.247(d) Band Edge Compliance (Conducted) Test Setup**

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**

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

Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	19 - 20	Relative Humidity	60%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

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

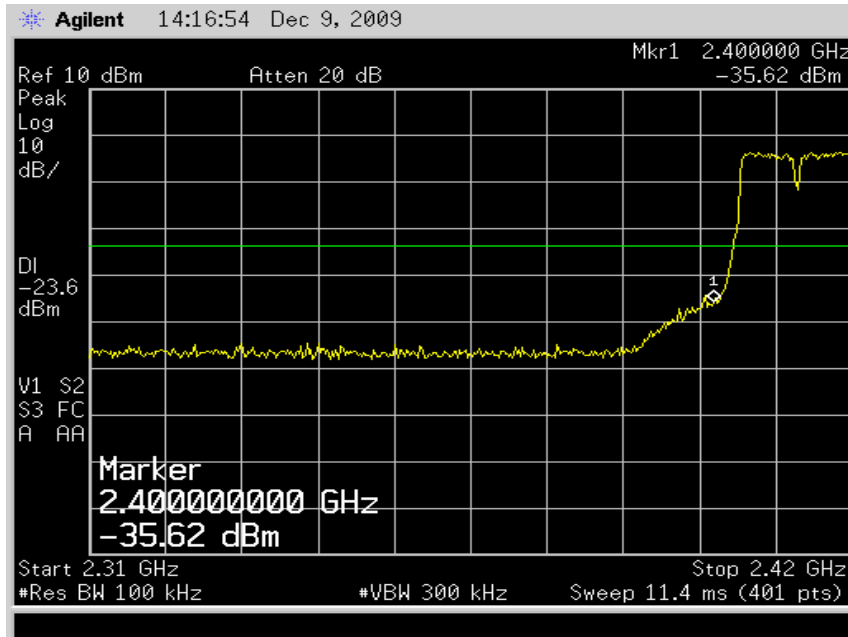
Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	21 - 22	Relative Humidity	60%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

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

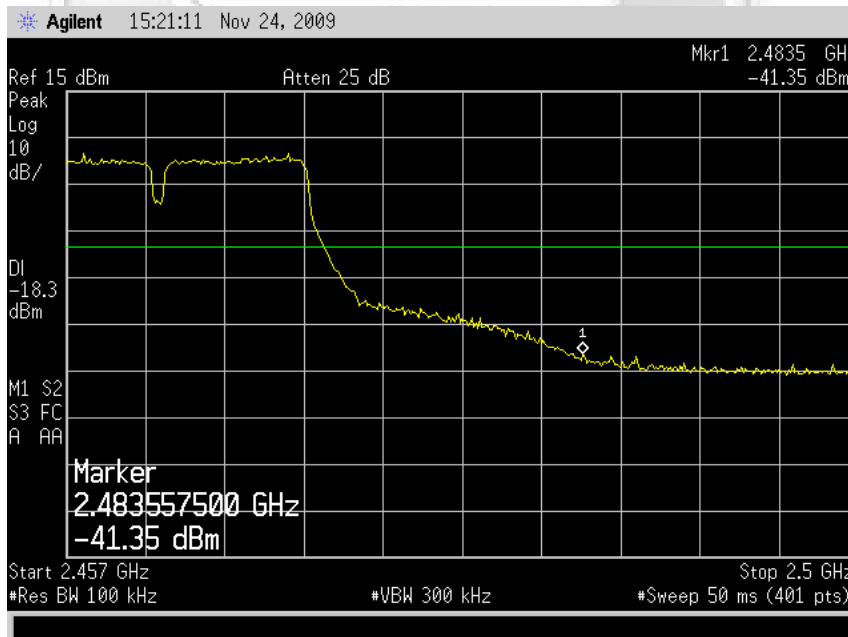


**BAND EDGE COMPLIANCE (CONDUCTED) TEST**

**Band Edge Compliance (Conducted) Plots - RFAX1012**



**Plot 19 – Lower Band Edge at 2.4000GHz**

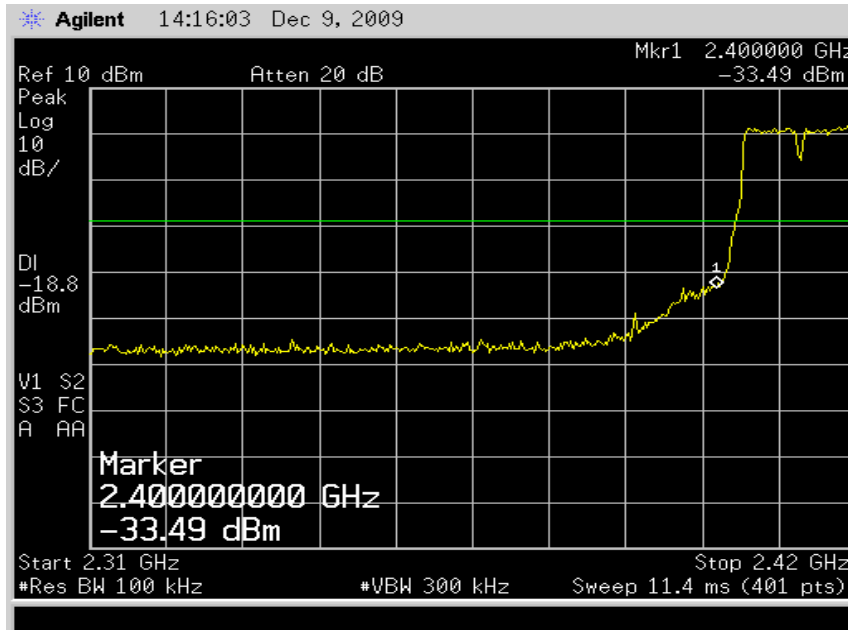


**Plot 20 – Upper Band Edge at 2.4835GHz**

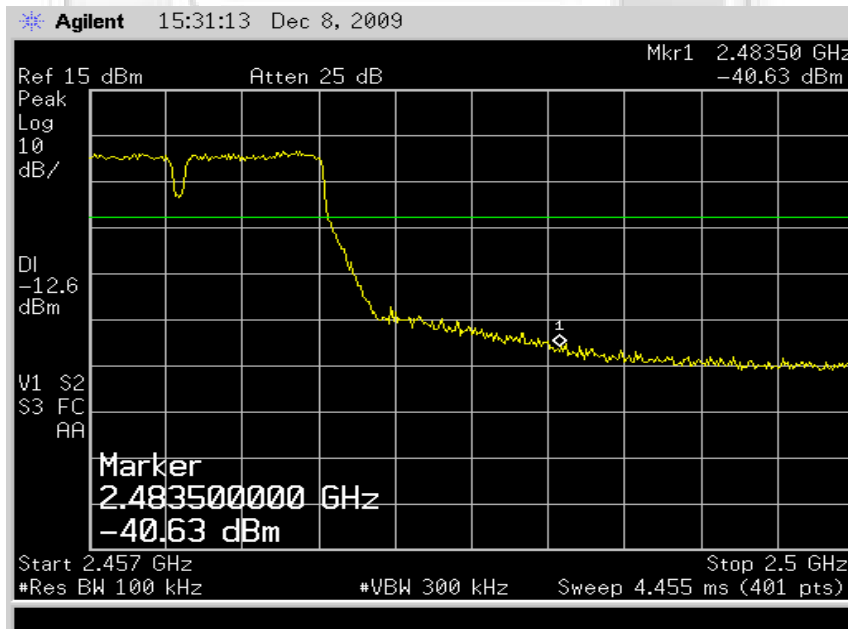


**BAND EDGE COMPLIANCE (CONDUCTED) TEST**

**Band Edge Compliance (Conducted) Plots - SH-FX71**



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



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



**BAND EDGE COMPLIANCE (RADIATED) TEST**

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

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

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

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver (20Hz–26.5GHz) – ESMI2	ESMI	829214/006 829550/001	27 May 2010
Schaffner Preamplifier (9kHz-2GHz) –PA13	CPA9231A	3422	13 Feb 2010
Toyo Preamplifier	HAP26-40W	00000005	02 Apr 2010
Agilent Preamplifier (PA7)	87405B	10020	04 Feb 2010
Schaffner Bilog Antenna – BL4	CBL6112B	2593	13 May 2010
EMCO Horn Antenna- H2	3115	9403-4250	13 May 2010

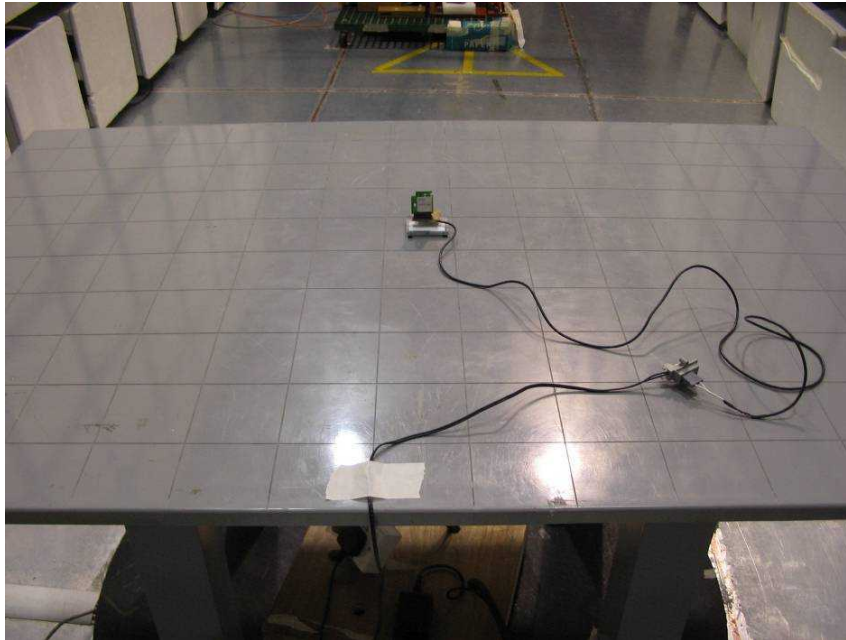
**FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Setup**

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**

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

Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	23 - 28	Relative Humidity	57%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Lucas Beh

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

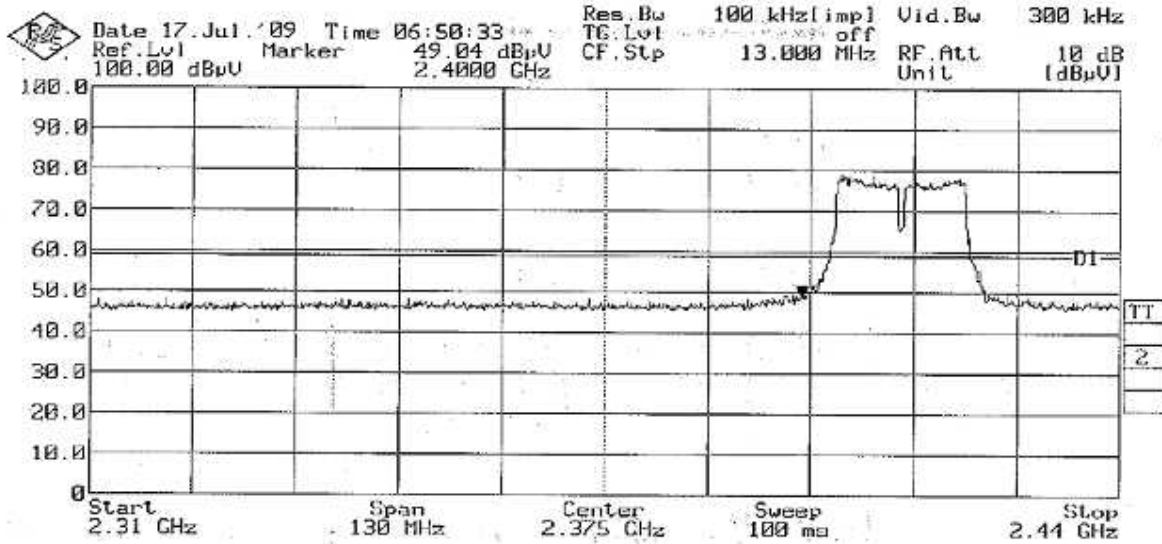
Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	29 - 34	Relative Humidity	57%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Lucas Beh

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

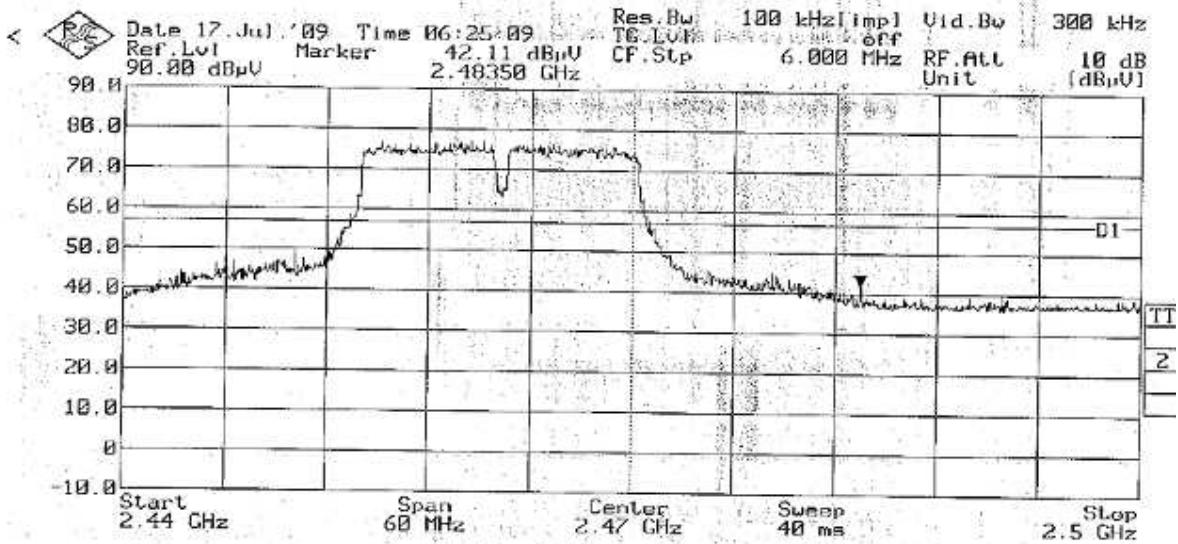


**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) - RFAX1012**



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

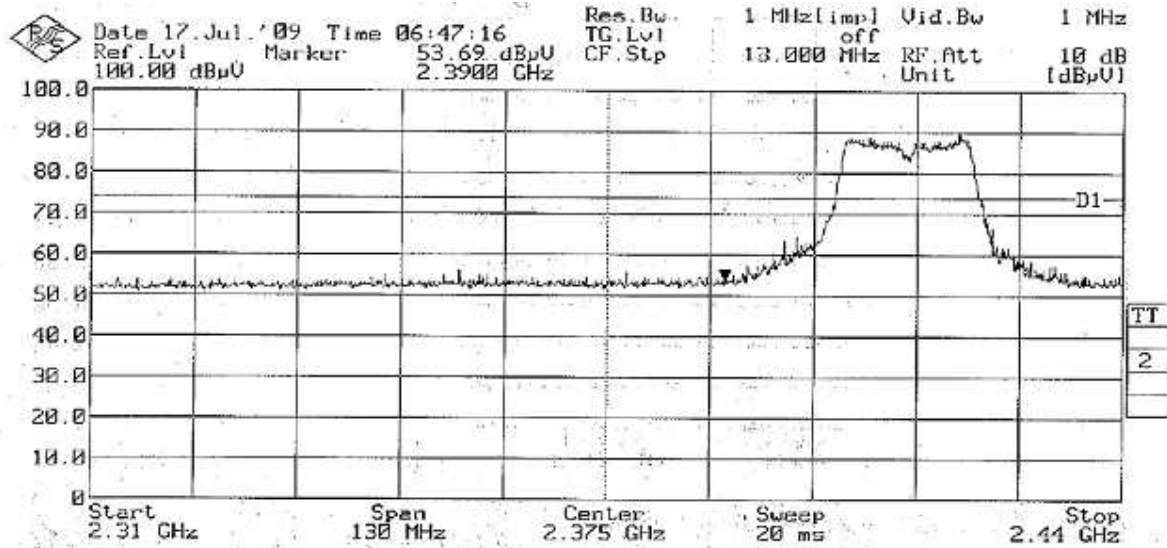


**Plot 24 – Upper Band Edge at 2.4835GHz**

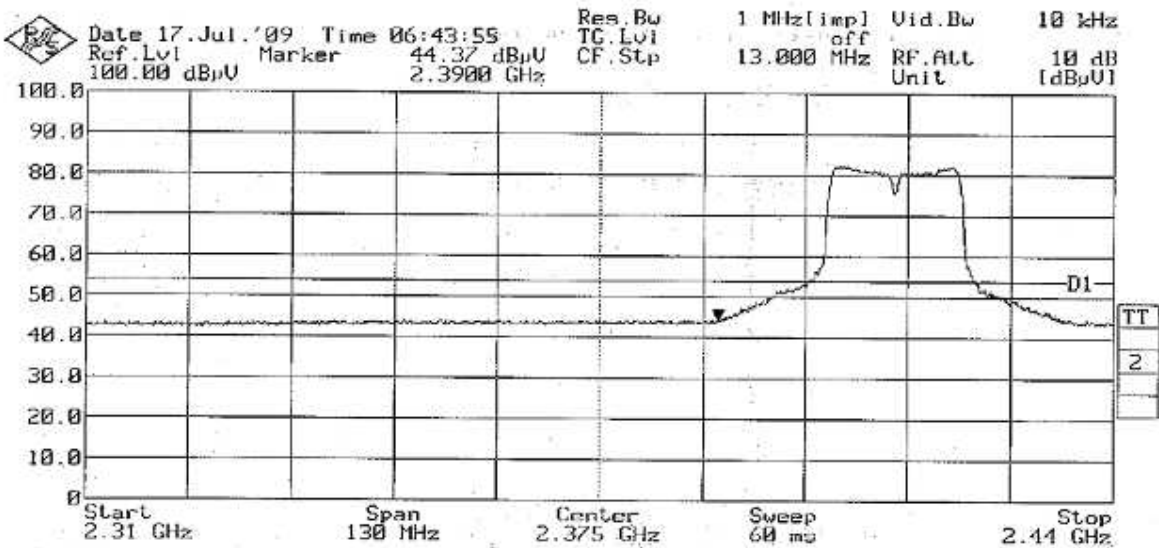


**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (Restricted Band) - RFAX1012**



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

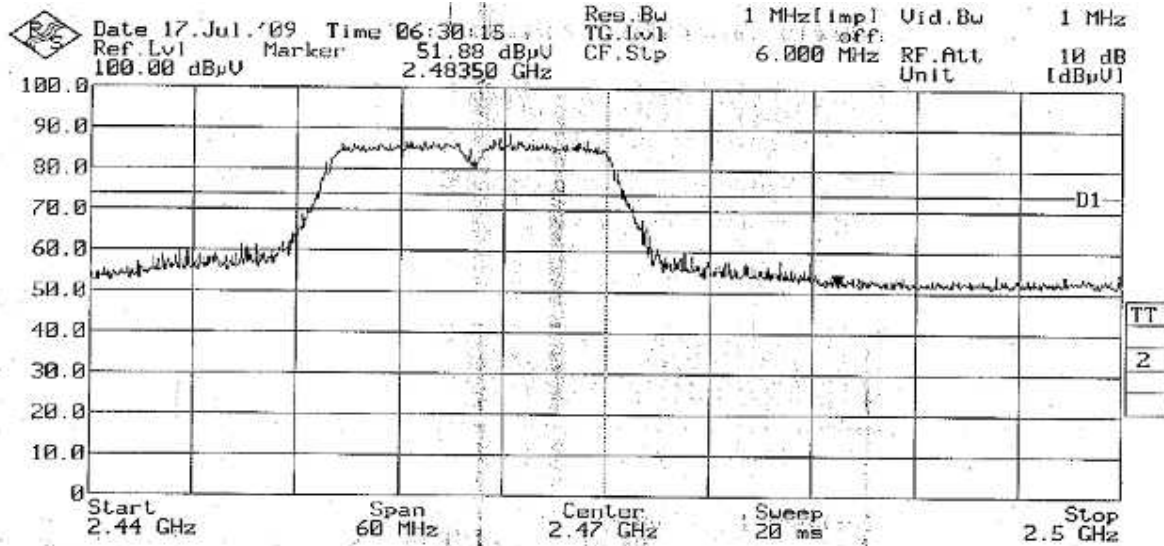


**Plot 26 – Average Plot at Lower Band Edge at 2.4000GHz**

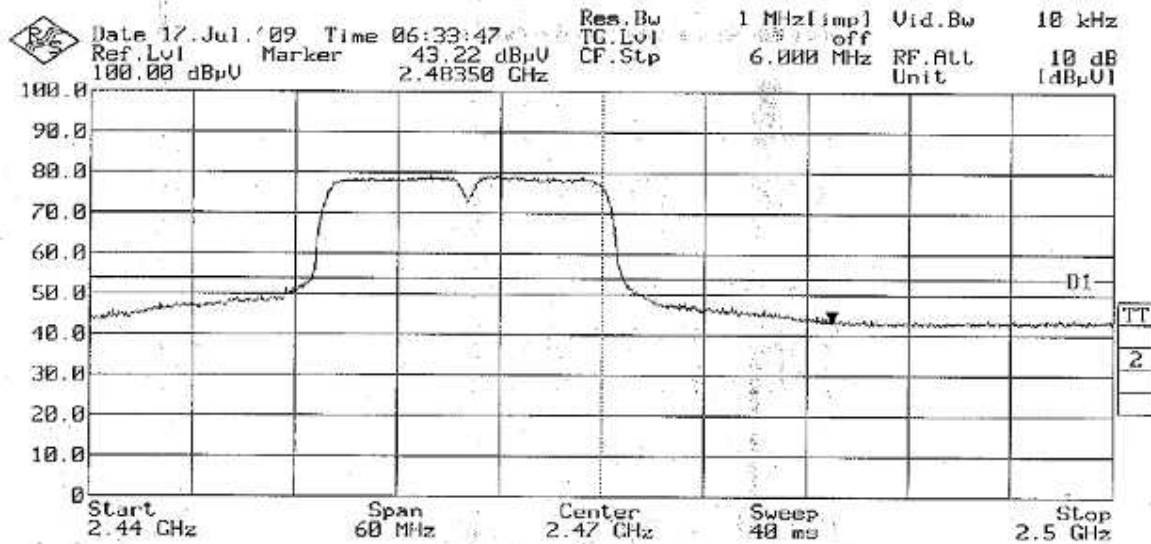


**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (Restricted Band) - RFAX1012**



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

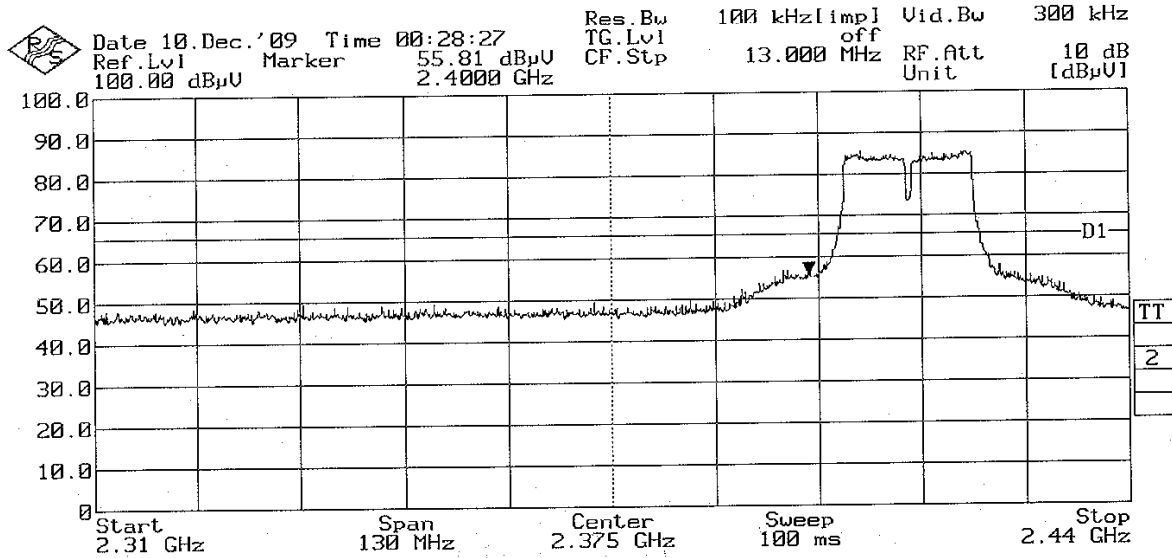


**Plot 28 – Average Plot at Upper Band Edge at 2.4835GHz**

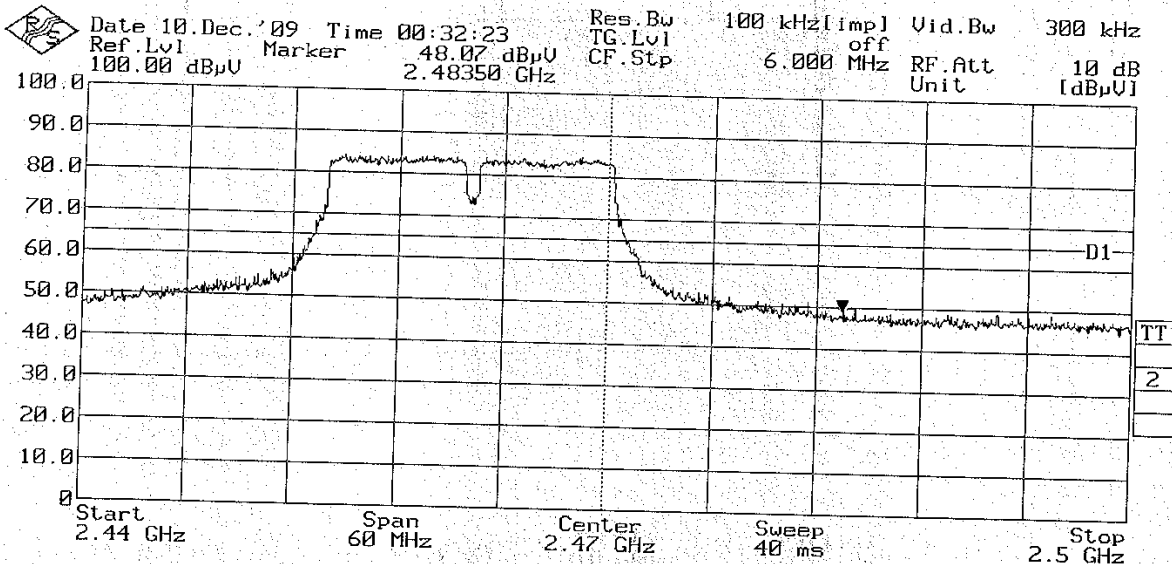


**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge) – SH-FX71**



**Plot 29 – Lower Band Edge at 2.4000GHz**

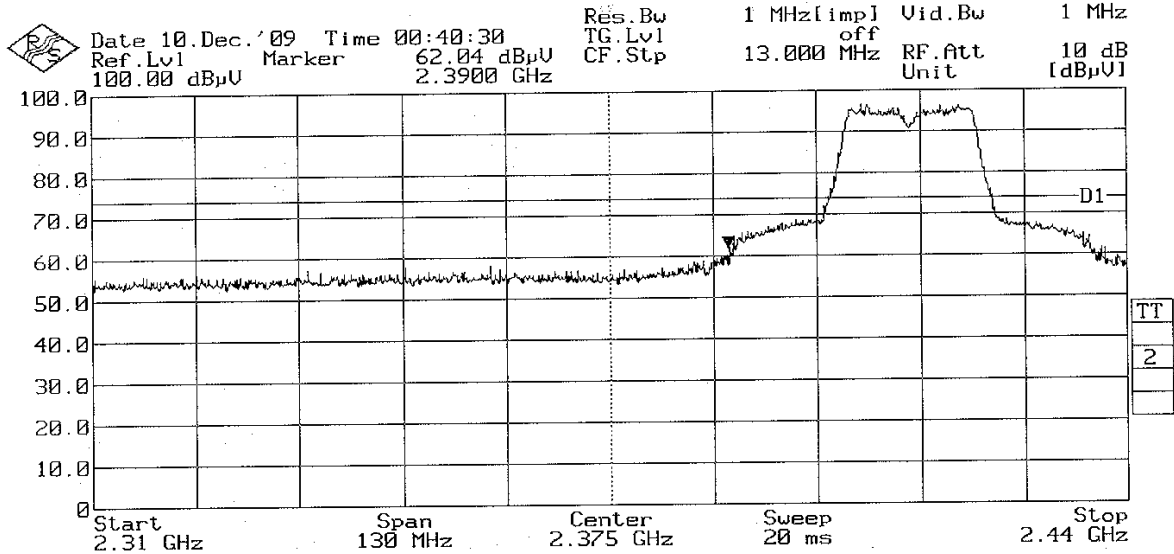


**Plot 30 – Upper Band Edge at 2.4835GHz**

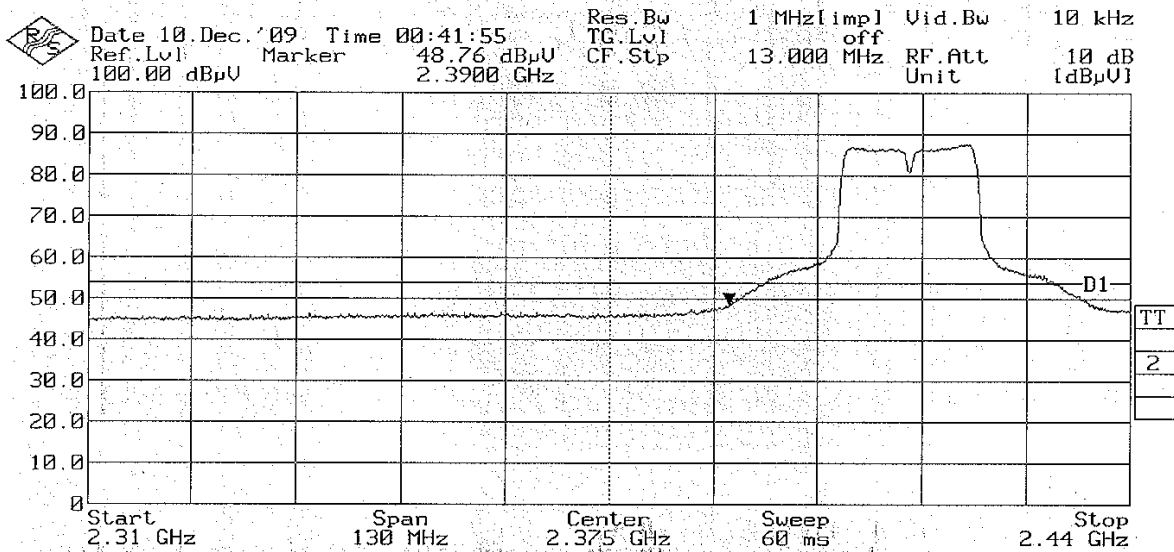


**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (Restricted Band) – SH-FX71**



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

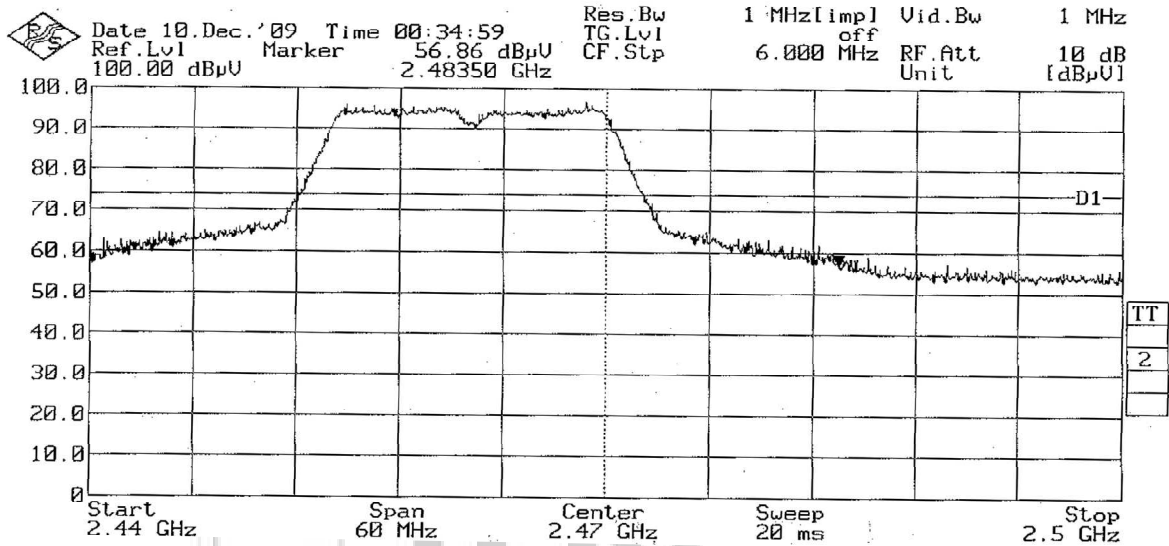


**Plot 32 – Average Plot at Lower Band Edge at 2.4000GHz**

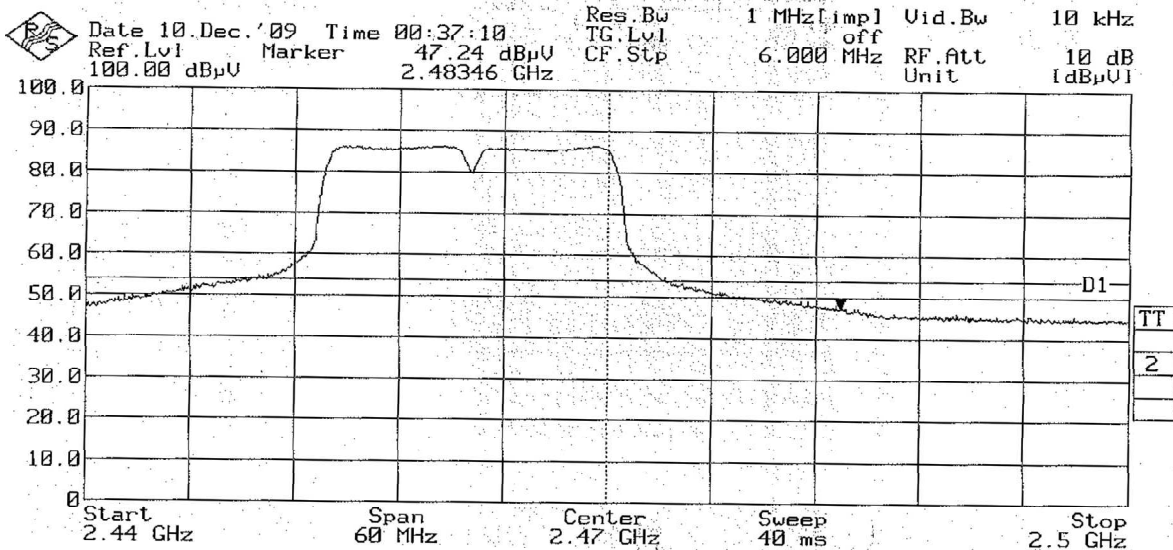


**BAND EDGE COMPLIANCE (RADIATED) TEST**

**Band Edge Compliance (Radiated) Plots (Restricted Band) – SH-FX71**



**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
Agilent EMC Analyzer (9kHz-26.5GHz) BITE (Ref)	E7405A	US40240195	20 Jan 2010

**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.

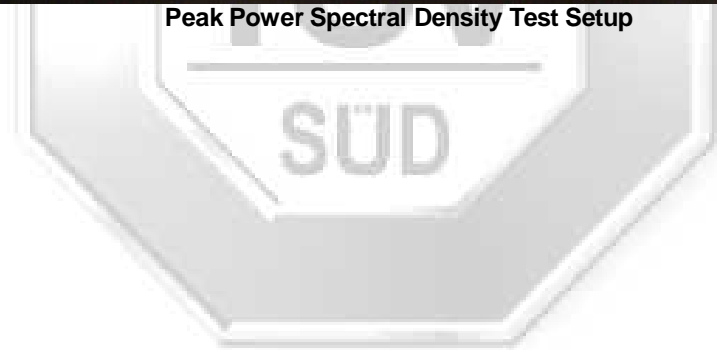
**FCC Part 15.247(e) Peak Power Spectral Density Test Method**

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 (2.462GHz) 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	24°C
Attached Plots	35 - 37	Relative Humidity	60%
Model	RFAX1012	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.412	0.1941	6.3
1	2.438	0.1708	6.3
2	2.462	0.2403	6.3

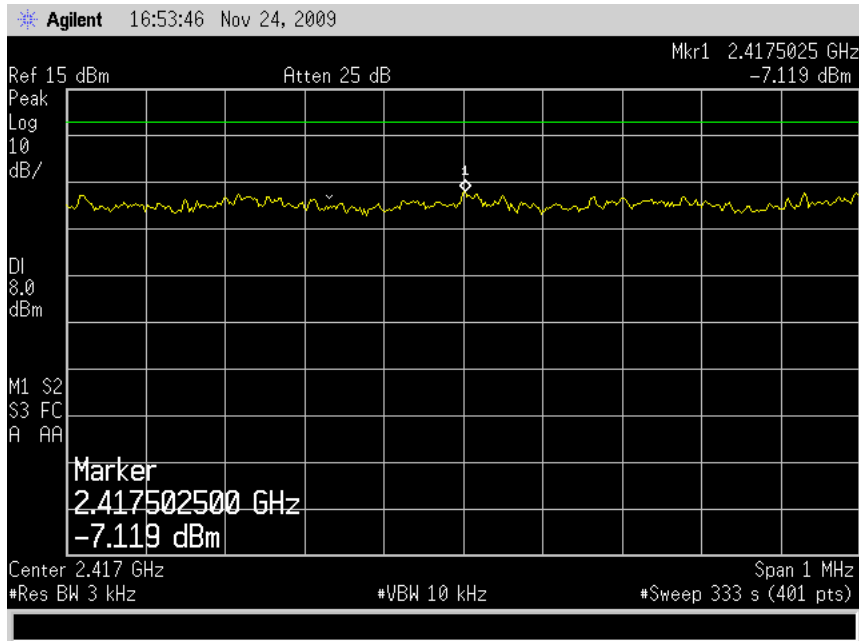
Test Input Power	110V 60Hz	Temperature	24°C
Attached Plots	38 - 40	Relative Humidity	60%
Model	SH-FX71	Atmospheric Pressure	1030mbar
		Tested By	Tan Say Eng

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.412	0.0776	6.3
1	2.438	0.0413	6.3
2	2.462	0.0889	6.3

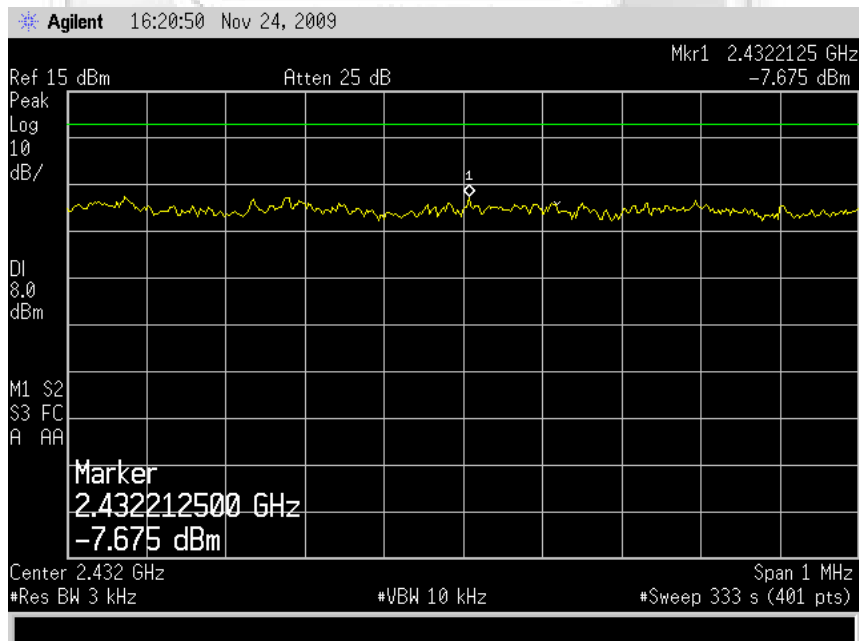


PEAK POWER SPECTRAL DENSITY TEST

Peak Power Spectral Density Plots - RFAX1012



Plot 35 - Channel 0

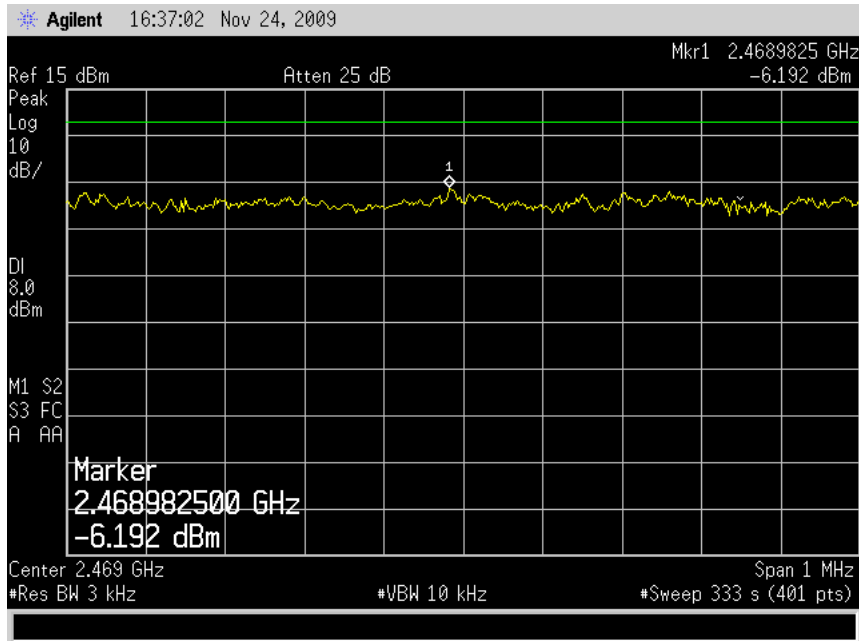


Plot 36 - Channel 1



PEAK POWER SPECTRAL DENSITY TEST

Peak Power Spectral Density Plots - RFAX1012



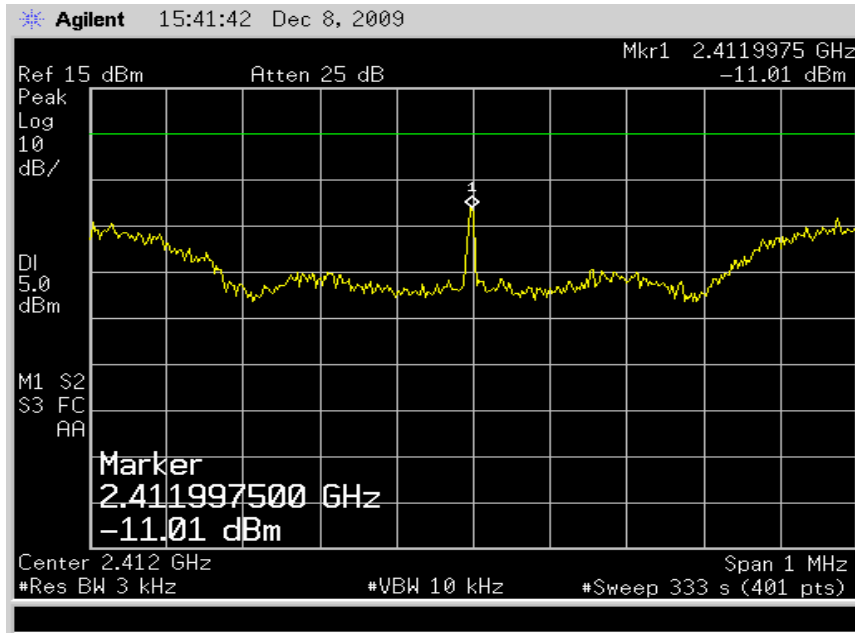
Plot 37 - Channel 2



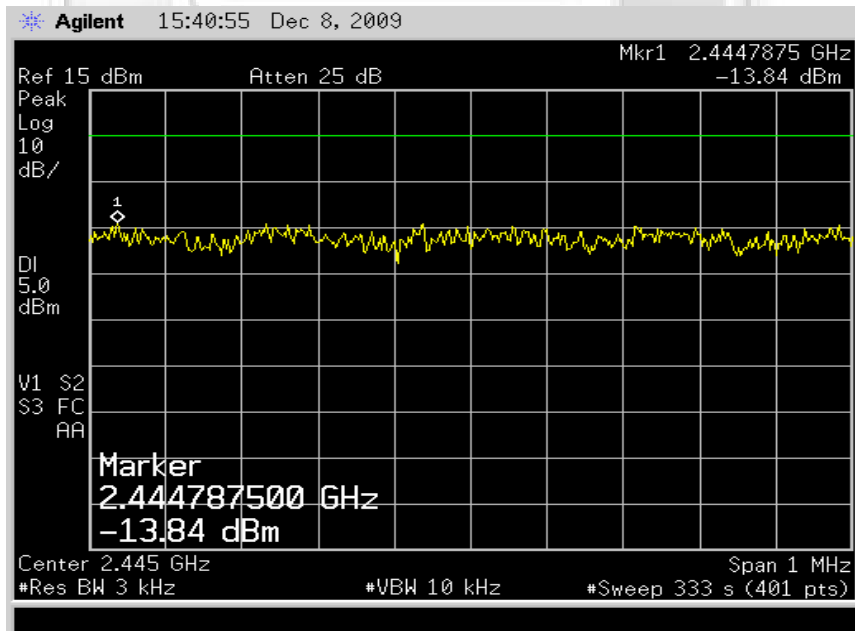


PEAK POWER SPECTRAL DENSITY TEST

Peak Power Spectral Density Plots - SH-FX71



Plot 38 - Channel 0

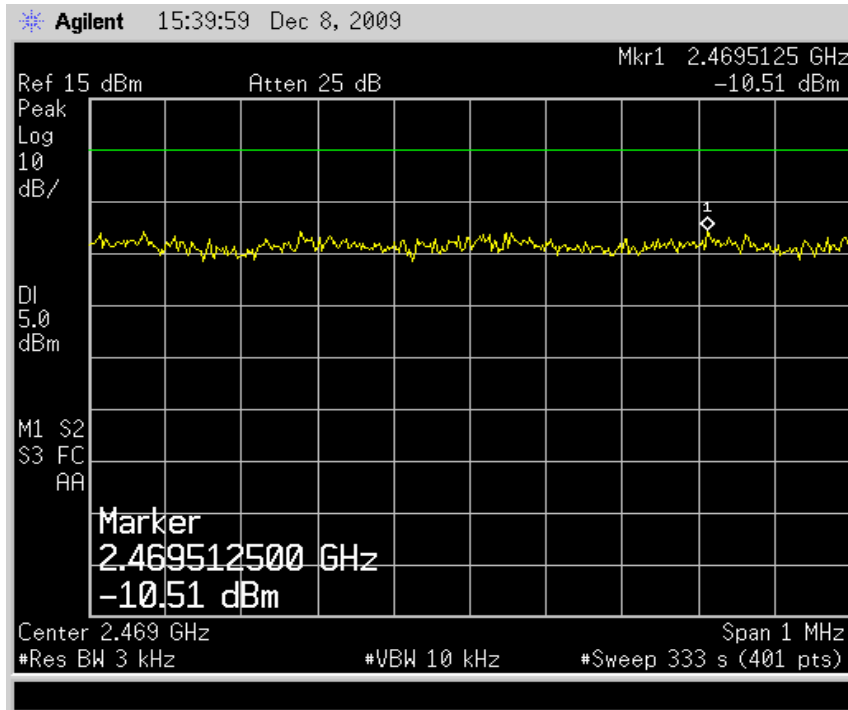


Plot 39 - Channel 1



PEAK POWER SPECTRAL DENSITY TEST

Peak Power Spectral Density Plots - SH-FX71



Plot 40 - Channel 2



**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 <sup>2</sup> )	Average Time (min)
0.3 - 1.34	614	1.63	100 <sup>Note 2</sup>	30
1.34 - 30	824 / f	2.19 / f	180 / f <sup>2</sup> <sup>Note 2</sup>	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 Computation**

**RFAX1012**

The power density at 20cm distance was computed from the following formula:

$$S = (30GP) / (377d^2)$$

where

- S = Power density in W/m<sup>2</sup>
- P = 0.0977
- d = Test distance at 0.2m
- G = Numerical isotropic gain, 0.5 (-3.0dBi)

Substituting the relevant parameters into the formula:

$$S = \sqrt{[(30GP) / 377d^2]}$$

$$= 0.3117 \text{ W/m}^2$$

$$= 0.03117 \text{ mW/cm}^2$$

∴ The power density of the EUT at 20cm distance is 0.0311 mW/cm<sup>2</sup> based on the above computation and found to be lower than the power density limit of 1.0mW/cm<sup>2</sup>.

**SH-FX71**

The power density at 20cm distance was computed from the following formula:

$$S = (30GP) / (377d^2)$$

where

- S = Power density in W/m<sup>2</sup>
- P = 0.0891
- d = Test distance at 0.2m
- G = Numerical isotropic gain, 0.5 (-3.0dBi)

Substituting the relevant parameters into the formula:

$$S = \sqrt{[(30GP) / 377d^2]}$$

$$= 0.2977 \text{ W/m}^2$$

$$= 0.02977 \text{ mW/cm}^2$$

∴ The power density of the EUT at 20cm distance is 0.02977mW/cm<sup>2</sup> based on the above computation and found to be lower than the power density limit of 1.0mW/cm<sup>2</sup>.

**Test Report No. 719164299-EEC-01**  
**dated 09 Dec 2009**

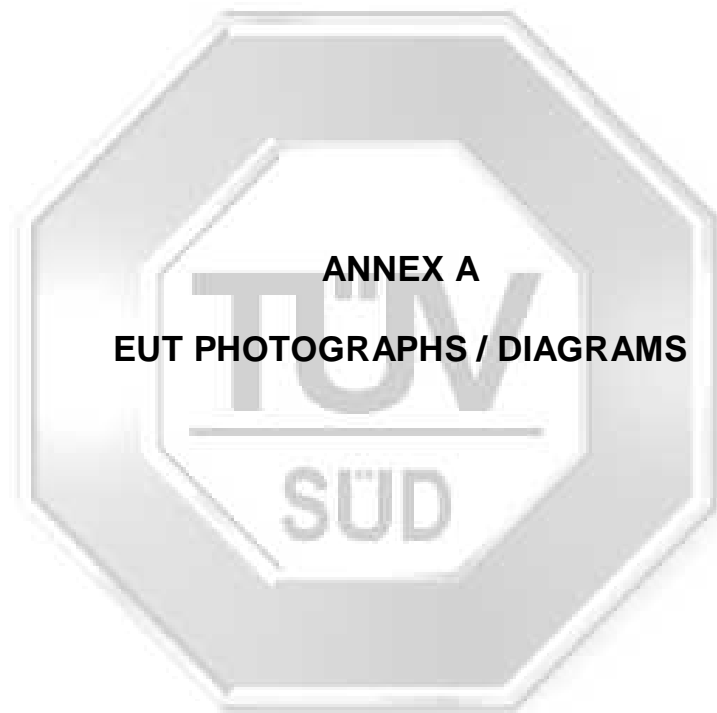


PSB Singapore

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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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March 2009



EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS FOR RF TRANSCEIVER CARD MODEL RFAX1012

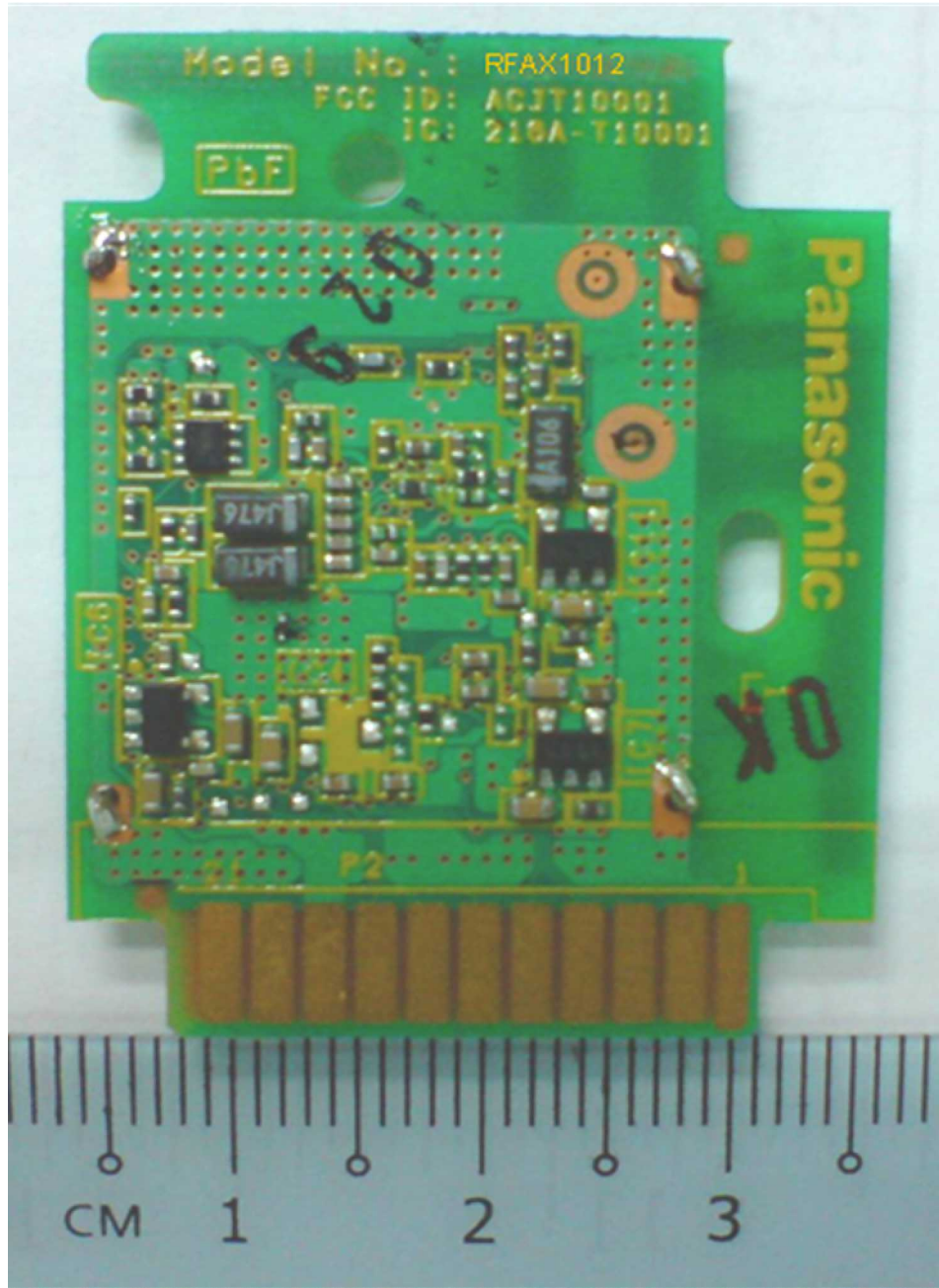


EUT Front View

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS FOR RF TRANSCEIVER CARD MODEL RFAX1012

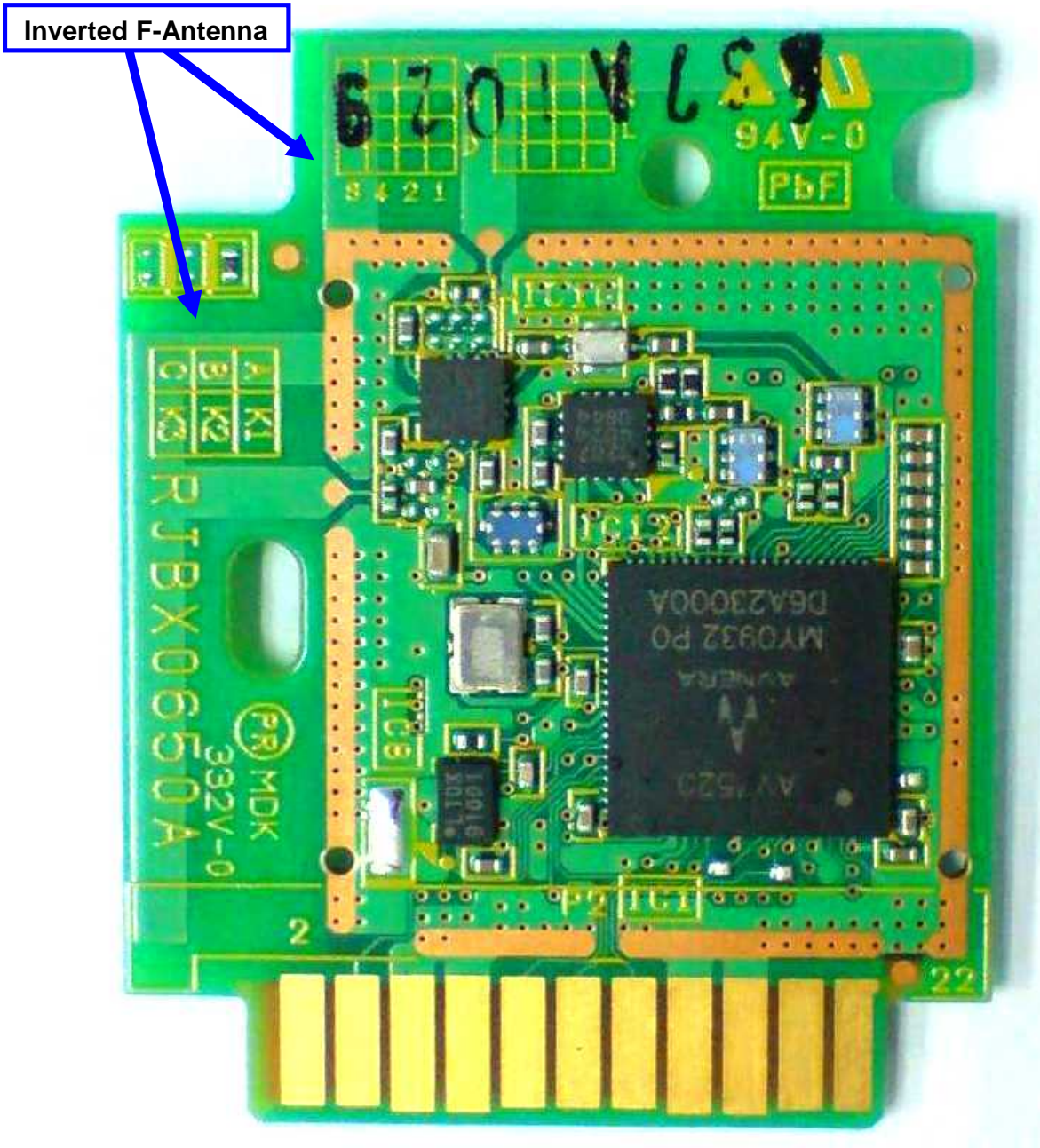


EUT Rear View

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS FOR RF TRANSCEIVER CARD MODEL RFAX1012

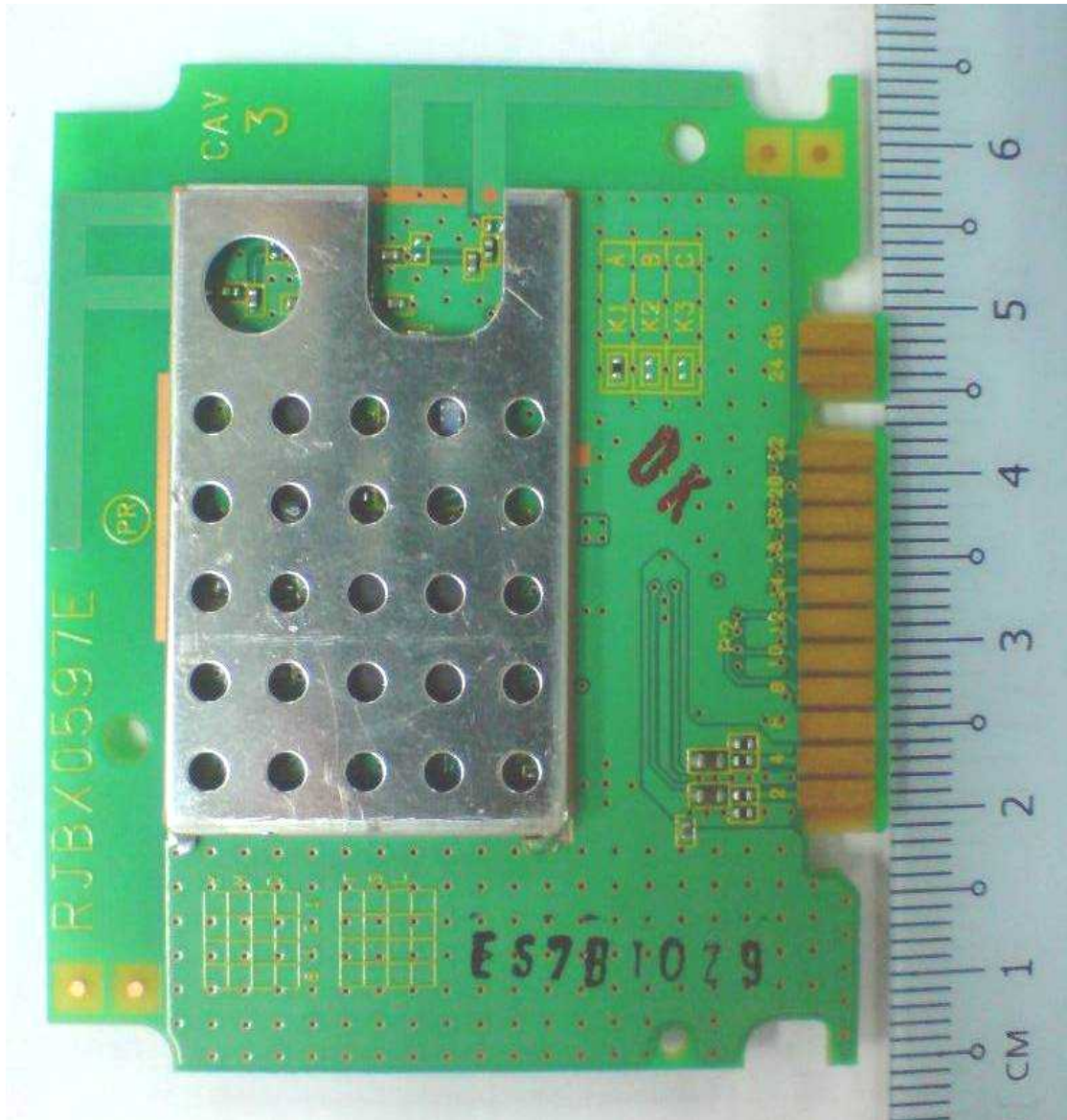


RF Module Circuit with RF Shield Removed

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS FOR RF TRANSCEIVER CARD MODEL SH-FX71

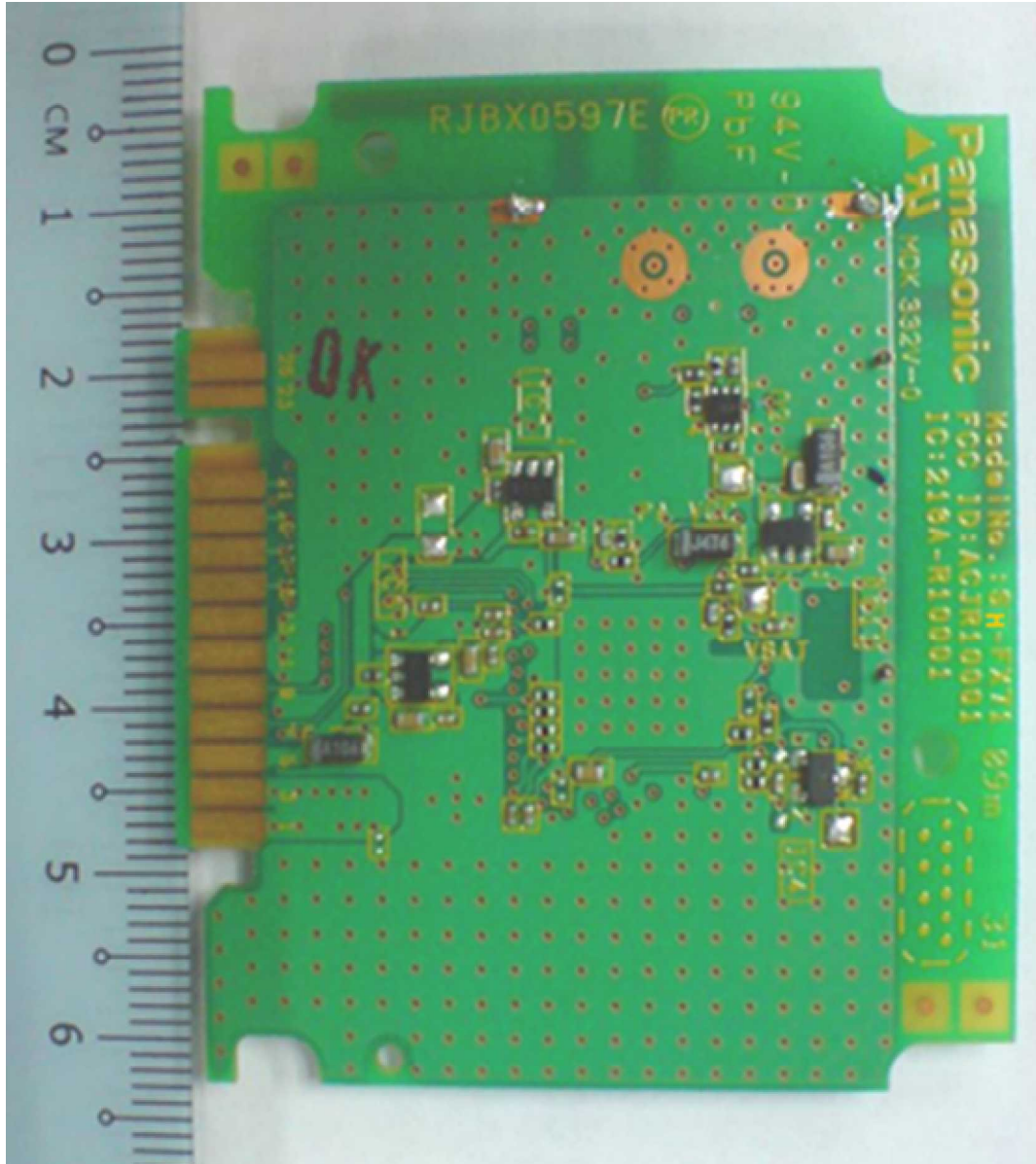


EUT Front View

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS FOR RF TRANSCEIVER CARD MODEL SH-FX71

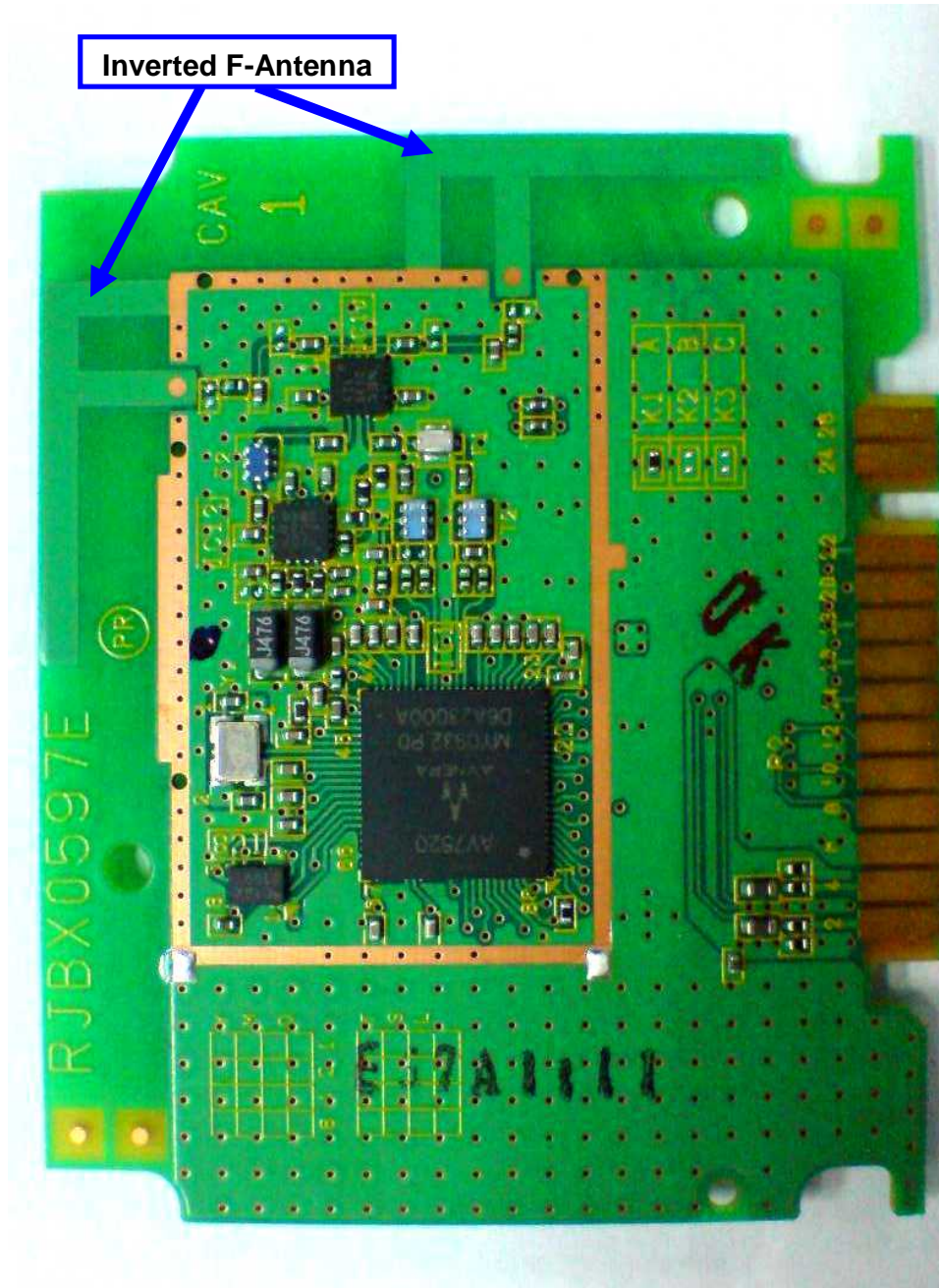


EUT Rear View

EUT PHOTOGRAPHS / DIAGRAMS

ANNEX A

EUT PHOTOGRAPHS FOR RF TRANSCEIVER CARD MODEL SH-FX71



RF Module Circuit with RF Shield Removed



## 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.



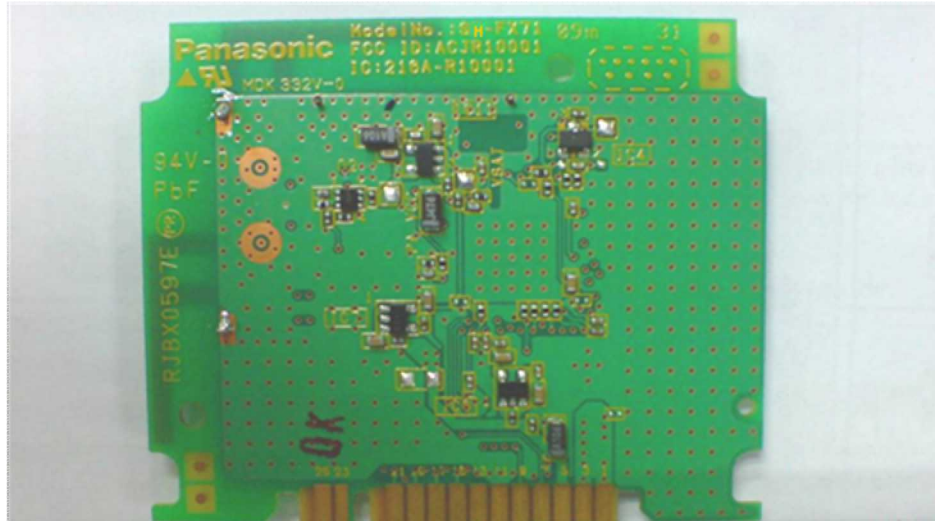
Physical Location of FCC Label on RF Transceiver Card (RFX1012)

## FCC LABEL & POSITION

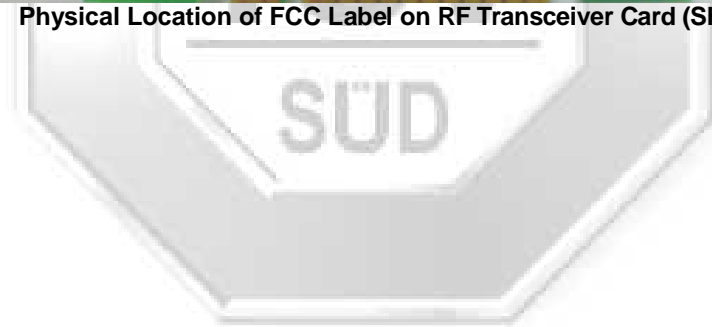
## ANNEX B

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.



Physical Location of FCC Label on RF Transceiver Card (SH-FX71)





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

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**ANNEX C**

