Test Report No. 7191102563-EEC14/01
dated 31 Dec 2014

PSB Singapore

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 15B & C : 2012
OF A
PRONTO
[Model : OV500201/01BRPS]
[FCC ID : 2AADIOV500201]

TEST FACILITY	TÜV SÜD PSB Pte Ltd Electrical & Electronics Centre (EEC), Product Services, No. 1 Science Park Drive, Singapore 118221
FCC REG. NO.	99142 (3m and 10m Semi-Anechoic Chamber, Science Park) 160581 (3m and 10m Semi-Anechoic Chamber, International Business Park)
IND. CANADA REG. NO.	2932I-1 (3m and 10m Semi-Anechoic Chamber, Science Park) 2932N-1 (10m Semi-Anechoic Chamber, International Business Park)
PREPARED FOR	Home Control Singapore Pte Ltd 620A Lorong 1 Toa Payoh Singapore 319762 Tel : +65 6882 3321 Fax : +65 6254 1691
QUOTATION NUMBER	2191009333
JOB NUMBER	7191102563
TEST PERIOD	09 Dec 2014 – 26 Dec 2014

PREPARED BY	**APPROVED BY**
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TÜV SÜD PSB

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ACCREDITED LABORATORY SAC-SINGLAS

LA-2007-0380-A
LA-2007-0381-F
LA-2007-0382-B
LA-2007-0382-B-1
LA-2007-0383-G
LA-2007-0383-G-1
LA-2007-0384-G
LA-2007-0385-E
LA-2007-0386-C
LA-2010-0464-D
FFT-2013-0002-A

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

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TEST SUMMARY

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

Test Results Summary

Test Standard	Description	Pass / Fail
47 CFR FCC Part 15: 2012		
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 5
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 (Non-Restricted Bands)	Pass
15.247(d)	RF Conducted Spurious Emissions (Restricted Bands)	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 54 for details
15.35(c)	Duty Cycle Factor Computation	Not Applicable *See Note 1

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 with continuous RF transmission.

Transmit Channel	Frequency (MHz)
Channel 0 (Lower Channel)	2402
Channel 19 (Middle Channel)	2440
Channel 39 (Upper Channel)	2480

2. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.

3. All test measurement procedures are according to ANSI C63.4: 2003 and KDB 558074 D01 DTS Measurement Guidance V03R02.

4. The maximum measured RF power of the Equipment Under Test is -0.97dBm (0.8mW).

5. The Equipment Under Test (EUT) is a battery operated device and contains no provision for public utility connections.

6. The EUT was tested using fully charged batteries with DC voltage of 6VDC.

Modifications

No modifications were made.

PRODUCT DESCRIPTION

Description	:	The Equipment Under Test (EUT) is a **PRONTO**. It turns iPhone into a smart universal remote. It allows the iPhone to virtually control all TVs, set-up boxes, DVD, Blue-ray, etc and change channels with one tap from your personalized TV Guide.
Manufacturer	:	Home Control Singapore Pte Ltd 620A Lorong 1 Toa Payoh Singapore 319762
Model Number	:	OV500201/01BRPS
FCC ID	:	2AADIOV500201
Serial Number	:	Nil
Microprocessor	:	Texas Instrument CC2541
Operating / Transmitting Frequency	:	2402MHz (lower channel) to 2480MHz (upper channel) – 40 channels in total
Clock / Oscillator Frequency	:	32kHz, 32MHz
Modulation	:	Gaussian Frequency Shift Keying (GFSK) (Bluetooth Low Energy)
Antenna Gain	:	-3.0dBi
Port / Connectors	:	Refer to manufacturer's user manual / operating manual
Rated Input Power	:	4 x AA batteries
Accessories	:	IR Emitter

SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Fujitsu Lifebook Notebook	M/N: S6310 S/N: R6z00134 FCC ID: DoC	Nil
Fujitsu AC Adapter	M/N: SEC100P3-19.0 S/N: 06Z02274B FCC ID: Verification	2.0m unshielded DC power cable 1.8m unshielded AC power cable
Apple iPhone	M/N: A1429?? S/N: F17L6FVWDTWD FCC ID: BCG-E2599A	Nil
Apple iPhone AC Adapter	M/N: A1399 S/N: Nil FCC ID: Verification	1.0m Lightning to USB cable
Texas Instrument Bluetooth Dongle	M/N: CC2540Dongle S/N: 0000 13D7 FCC ID: ZAT2540USB	Nil

EUT OPERATING CONDITIONS

47 CFR FCC Part 15
1. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement) **2. Spectrum Bandwidth (6dB Bandwidth Measurement)** **3. Maximum Peak Power** **4. RF Conducted Spurious Emissions (Non-Restricted Bands)** **5. RF Conducted Spurious Emissions (Restricted Bands)** **6. Band Edge Compliance (Conducted)** **7. Band Edge Compliance (Radiated)** **8. Peak Power Spectral Density** **9. Maximum Permissible Exposure**
The EUT was exercised in the following modes during the tests: - Continuous IR (Infra-Red) transmission (for radiated emissions) - Bluetooth test mode with maximum RF transmissions at lower, middle and upper channels (for radiated emissions and other tests)

47 CFR 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									

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m)
0.009 - 0.490	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 - 88	40.0 @ 3m
88 - 216	43.5 @ 3m
216 - 960	46.0 @ 3m
Above 960	54.0* @ 3m
* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.	

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
EMCO Loop Antenna	6502	134413	01 Oct 2015
R&S Test Receiver – ESI1	ESI40	100010	23 Jul 2015
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441096	13 Oct 2015
Schaffner Bilog Antenna –(30MHz-2GHz) BL3 (Ref)	CBL6112D	2549	23 Jan 2015
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	14 Mar 2015
TDK-RF Horn Antenna	HRN-0118	130256	10 Jul 2015
Toyo Preamplifier (26.5GHz-40GHz)	HAP26-40W	00000005	02 Oct 2015
ETS Horn Antenna(18GHz-40GHz)(Ref)	3116	0004-2474	02 Oct 2015
Micro-Tronics Bandstop Filter (2.4-2.5 GHz)	BRM50701	017	13 Aug 2015

47 CFR 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.

47 CFR 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 in the range of 9kHz – 90kHz, 110kHz – 490kHz and 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 the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, 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 = 46.0 dBμV/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dBμV/m
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 46.0 - 40.0 = 6.0 i.e. 6.0 dB below Q-P limit

47 CFR FCC Parts 15.109(a) Radiated Emission Results

Test Input Power	6VDC	Temperature	26°C
Test Distance	3m (30MHz – 1GHz)	Relative Humidity	59%
Operating Mode	IR Transmit	Atmospheric Pressure	1030mbar
		Tested By	Li Chaoming

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
97.1960	17.0	43.5	26.5	392	286	H	39
319.9450	20.3	46.0	25.7	100	1	H	39
384.0020	26.4	46.0	19.6	100	286	V	39
415.9760	19.5	46.0	26.5	113	263	V	39
447.9740	18.2	46.0	27.8	100	266	V	39
735.9660	20.5	46.0	25.5	200	138	H	39

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. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a “negative” margin indicates a FAIL.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
4. The highest frequency of internal sources of the EUT is less than 108MHz, as such the measurement was made up to 1GHz.
5. 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 – 25.0GHz is ±4.0dB.

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

Test Input Power	6VDC	Temperature	26°C
Test Distance	10m (<30MHz) 3m (≥30MHz – 25GHz)	Relative Humidity	59%
Operating Mode	Bluetooth (Continuous Transmit)	Atmospheric Pressure	1030mbar
		Tested By	Lim Kay Tak

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 3

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
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Spurious Emissions ranging from 9kHz – 30MHz *See Note 3

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
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Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
97.1960	17.0	43.5	26.5	392	286	H	39
319.9450	20.3	46.0	25.7	100	1	H	39
384.0020	26.4	46.0	19.6	100	286	V	39
415.9760	19.5	46.0	26.5	113	263	V	39
447.9740	18.2	46.0	27.8	100	266	V	39
735.9660	20.5	46.0	25.5	200	138	H	39

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

Spurious Emissions above 1GHz – 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
4.8031	50.0	74.0	24.0	28.8	54.0	25.2	316	212	H	0
4.9582	46.2	74.0	27.8	27.9	54.0	26.1	252	30	H	39
5.1215	47.0	74.0	27.0	26.6	54.0	27.4	228	121	H	39
7.1960	42.6	74.0	31.4	28.9	54.0	25.1	110	250	H	0
7.3193	55.0	74.0	19.0	33.9	54.0	20.1	235	107	H	19
7.4396	52.8	74.0	21.2	32.2	54.0	21.8	319	116	H	39

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. The measurement was done at 10m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
4. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
5. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
6. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
7. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
8. The channel in the table refers to the transmit channel of the EUT.
9. Radiated Emissions Measurement Uncertainty
   All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz is ±4.0dB.

SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST

47 CFR 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.

47 CFR 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)	E7405A	US40240195	19 Mar 2015
Agilent Dual Output DC Power Supply	E3620A	MY40000336	Output Monitored

47 CFR 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 the following:
   RBW = 100kHz
   VBW = 3 times RBW
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(a)(2) Spectrum Bandwidth (6dB Bandwidth Measurement) Test Method

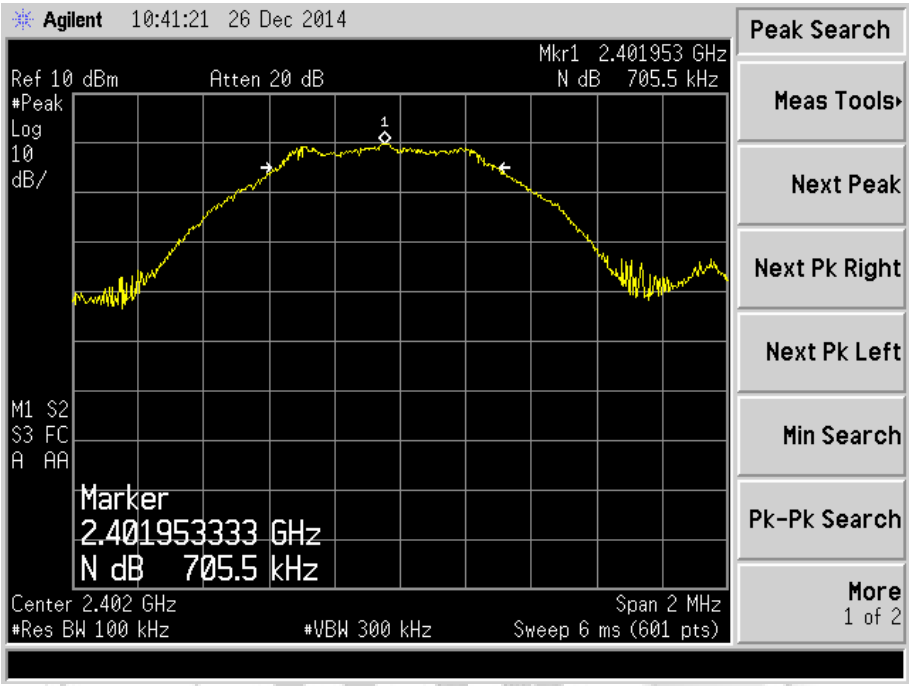
1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel.
2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB 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 middle and upper channel respectively.

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

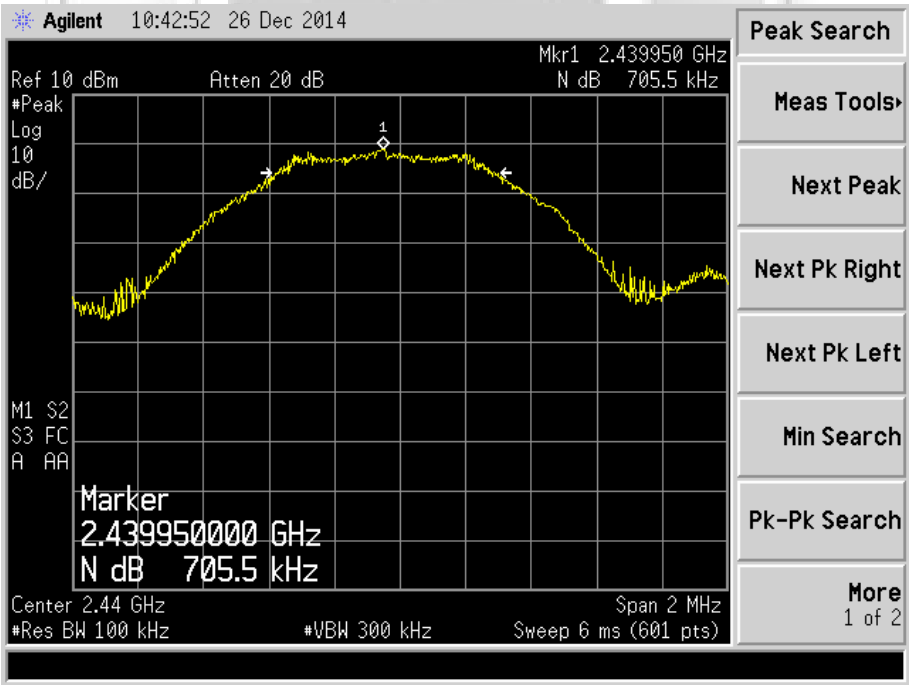
Test Input Power	6VDC	Temperature	24°C
Attached Plots	1 – 3	Relative Humidity	54%
		Atmospheric Pressure	1028mbar
		Tested By	Foo Kai Maun

Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz)
0 *(lower ch)*	2.402	0.7055
19 *(mid ch)*	2.440	0.7055
39 *(upper ch)*	2.480	0.6889

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots

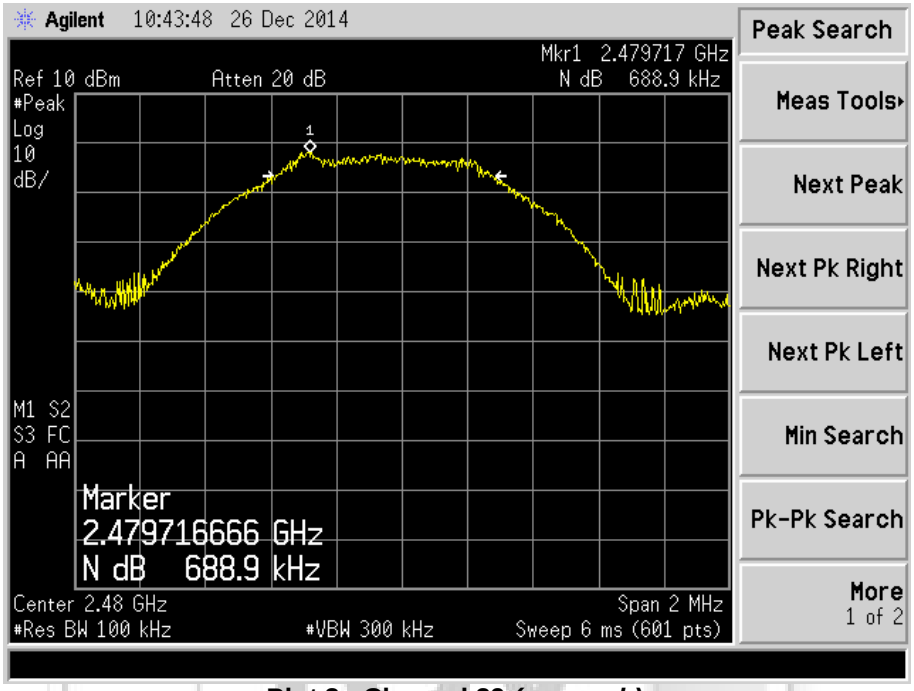


Plot 1 - Channel 0 *(lower ch)*



Plot 2 - Channel 19 *(middle ch)*

Spectrum Bandwidth (6dB Bandwidth Measurement) Plots



Plot 3 - Channel 39 *(upper ch)*

47 CFR 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).

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

Instrument	Model	S/No	Cal Due Date
Agilent Power Meter	E4419B	GB43312680	28 May 2015
Agilent Power Sensor	E9304A	MY41496637	28 May 2015
Agilent Dual Output DC Power Supply	E3620A	MY40000336	Output Monitored

47 CFR 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.
4. All other supporting equipment were powered separately from another filtered mains.

47 CFR 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 lower channel.
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 middle and upper channel respectively.

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

Test Input Power	6VDC	Temperature	24°C
Antenna Gain	-3.0dBi	Relative Humidity	54%
		Atmospheric Pressure	1028mbar
		Tested By	Foo Kai Maun

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
0 *(lower ch)*	2.402	0.0008	1.0
19 *(mid ch)*	2.440	0.0007	1.0
39 *(upper ch)*	2.480	0.0006	1.0

Notes

1. Nil.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) 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.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent Spectrum Analyzer	E4440A	MY45304764	14 Nov 2015
Agilent Dual Output DC Power Supply	E3620A	MY40000336	Output Monitored

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) 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.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Test Method

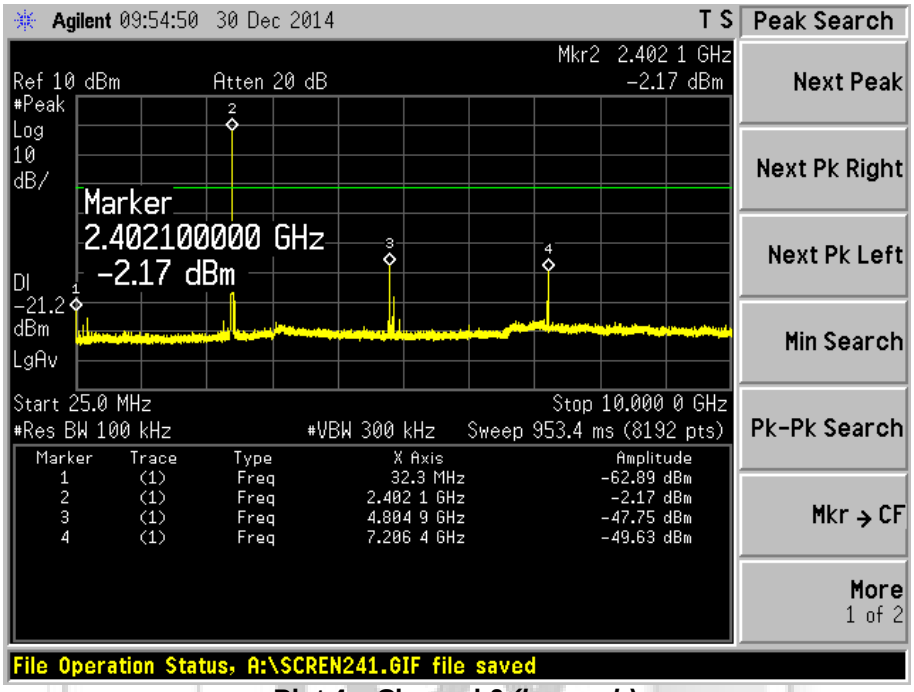
1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with the transmitting frequency was set to lower channel.
2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.
3. The spectrum 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 middle and upper channel respectively.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Non-Restricted Bands) Results

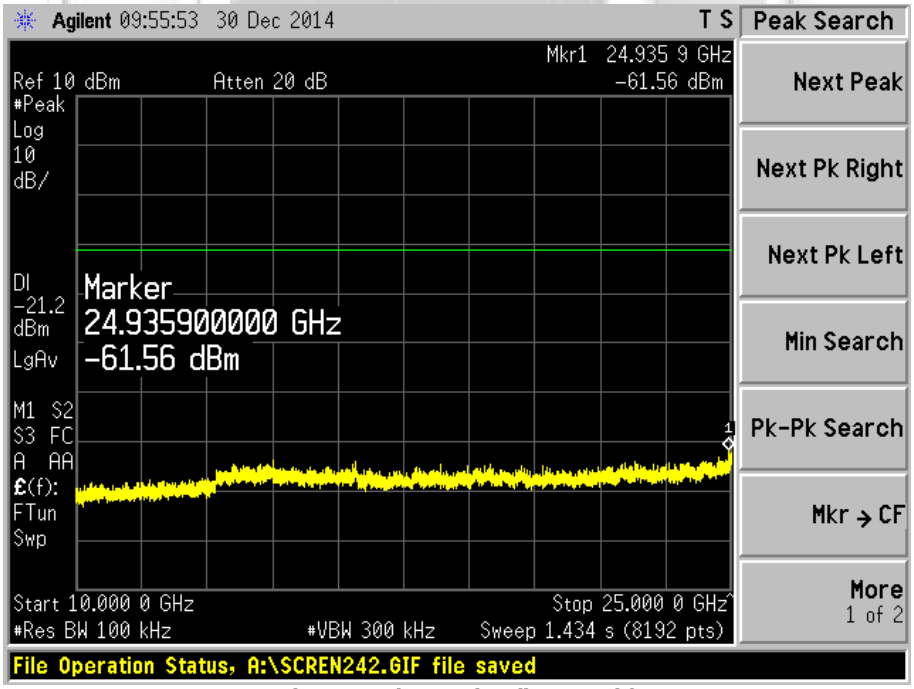
Test Input Power	6VDC	Temperature	24°C
Attached Plots	4 – 9	Relative Humidity	54%
		Atmospheric Pressure	1028mbar
		Tested By	Foo Kai Maun

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

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots

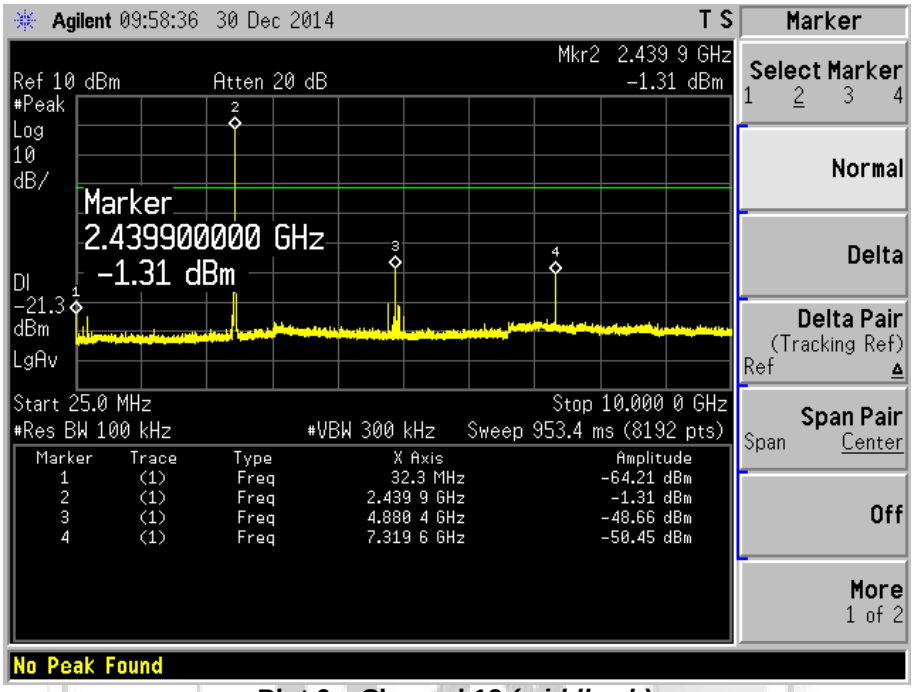


Plot 4 – Channel 0 *(lower ch)*

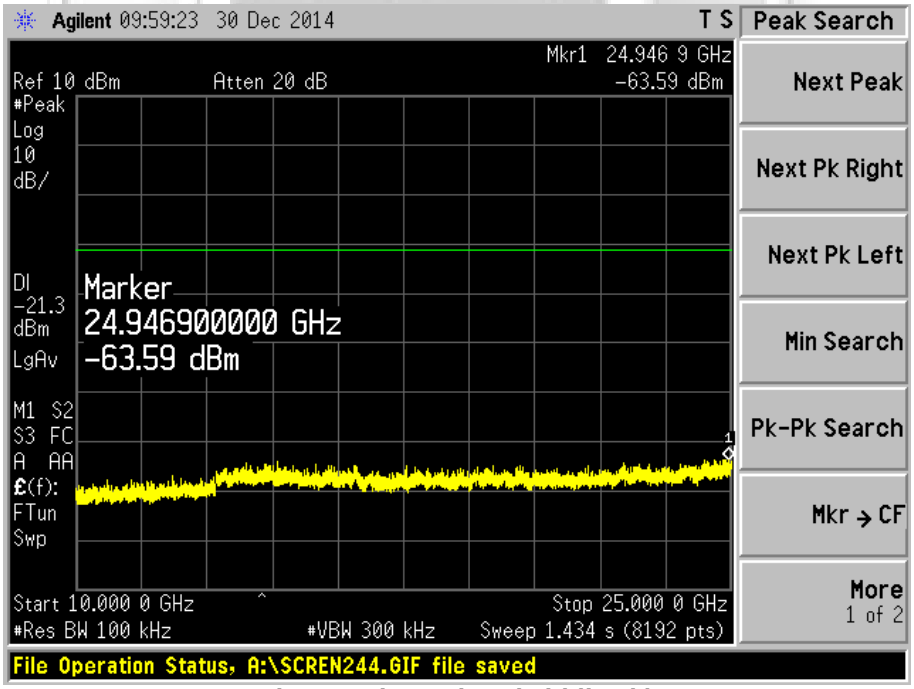


Plot 5 – Channel 0 *(lower ch)*

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots

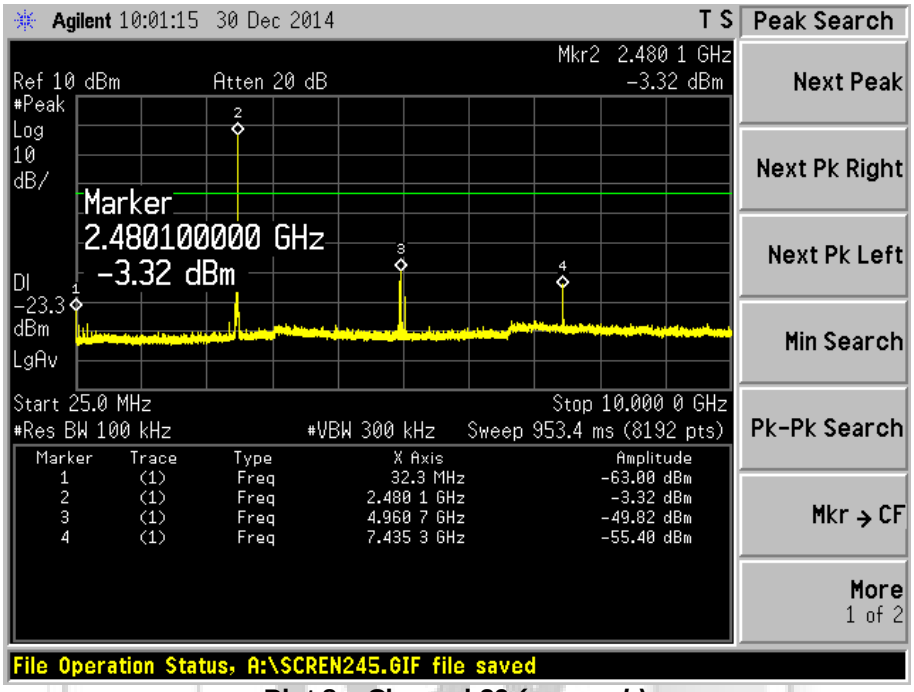


Plot 6 – Channel 19 *(middle ch)*

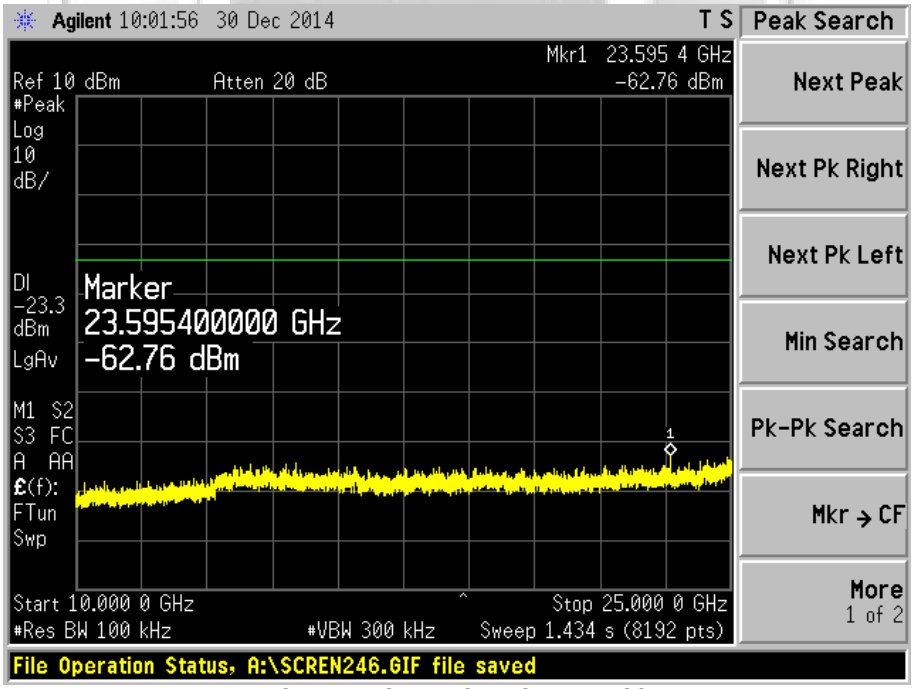


Plot 7 – Channel 19 *(middle ch)*

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots



Plot 8 – Channel 39 *(upper ch)*



Plot 9 – Channel 39 *(upper ch)*

47 CFR 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									

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Limits

The EUT shows compliance to the requirements of this section, which states that emissions which fall in the restricted bands must comply with the radiated emission limits specified in the table below:

Frequency Range (MHz)	EIRP (dBm)	Radiated Emissions (dBµV/m)
0.009 – 0.490	-6.7 – (-41.4) **	67.6 – 20logF* @ 300m **
0.490 – 1.705	-41.4 – (-52.3) **	87.6 – 20logF* @ 30m **
1.705 – 30	-45.7	29.5 @ 30m
30 - 88	-55.2	40.0 @ 3m
88 - 216	-51.7	43.5 @ 3m
216 - 960	-49.2	46.0 @ 3m
>960	-41.2 ***	54.0 @ 3m ***
* F is frequency in kHz.		
** Decreasing linearly with the logarithm of the frequency.		
*** Above 1GHz, a peak limit of 20dB above the average limit does apply.		

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent Spectrum Analyzer	E4440A	MY45304764	14 Nov 2015
Agilent Dual Output DC Power Supply	E3620A	MY40000336	Output Monitored
Micro-tonics Bandstop Filter	BRM50701-02	007	13 Aug 2015

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) 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) of the spectrum analyser was set to the following settings. The video bandwidth (VBW) was set to at least three times of the RBW.

Frequency (MHz)	RBW (kHz)
0.009 – 0.150	0.2
0.150 – 30.0	9.0
30.0 - 1000	100.0
> 1000	1000.0

5. The detector of the spectrum analyser was set to peak detection mode.
6. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Test Method

1. Measurement in the range 9kHz – 1000MHz

1.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with the transmitting frequency was set to lower channel.

1.2 The start and stop frequencies of the spectrum analyser were set according to the supported RBW.

1.3 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.

1.4 No further measurement was required if all the captured emissions complied to the limits. Else, the spectrum analyser was set to zoom to the captured emission with the detector of the spectrum analyser was set to quasi-peak. The emission level of the captured frequency was measured.

1.5 The step 1.4 was repeated until all the captured emissions which exceeding the limits were measured.

1.6 The steps 1.2 to 1.5 were repeated with the transmitting frequency was set to middle and upper channel respectively.

2. Measurement above 1000MHz

2.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with the transmitting frequency was set to lower channel.

2.2 The start and stop frequencies of the spectrum analyser were set according to the supported frequency band of the set RBW with the number of points in a sweep was set to equal or greater than 2 times of the ratio of span over RBW.

2.3 The detector of the spectrum analyser was set to power average (RMS) mode with the sweep time was set to equal or greater than 10 times of the product of number of measurement points in a sweep and transmission symbol time.

2.4 The spectrum analyser was then allowed to capture any spurious emissions within a single sweep. The peak marker function of the spectrum analyser was used to locate the highest power level.

2.5 The steps 2.2 to 2.4 were repeated until all the required frequency bands were measured.

2.6 The steps 2.2 to 2.5 were repeated with the transmitting frequency was set to middle and upper channel respectively.

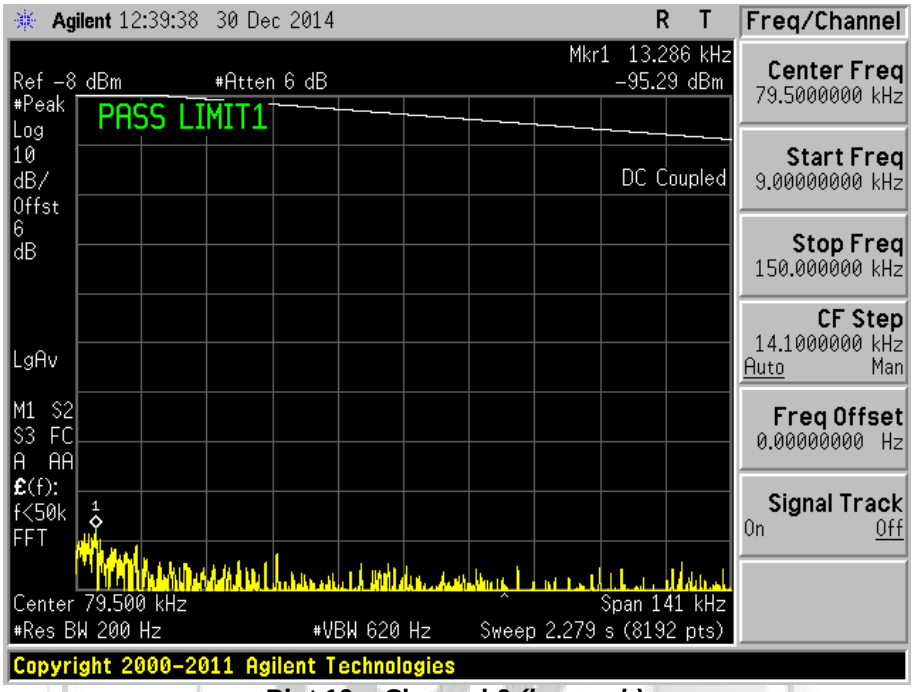
2.7 The measurements were repeated with the detector of the spectrum analyser was set to peak detecting mode. The sweep time was set to auto coupler.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions (Restricted Bands) Results

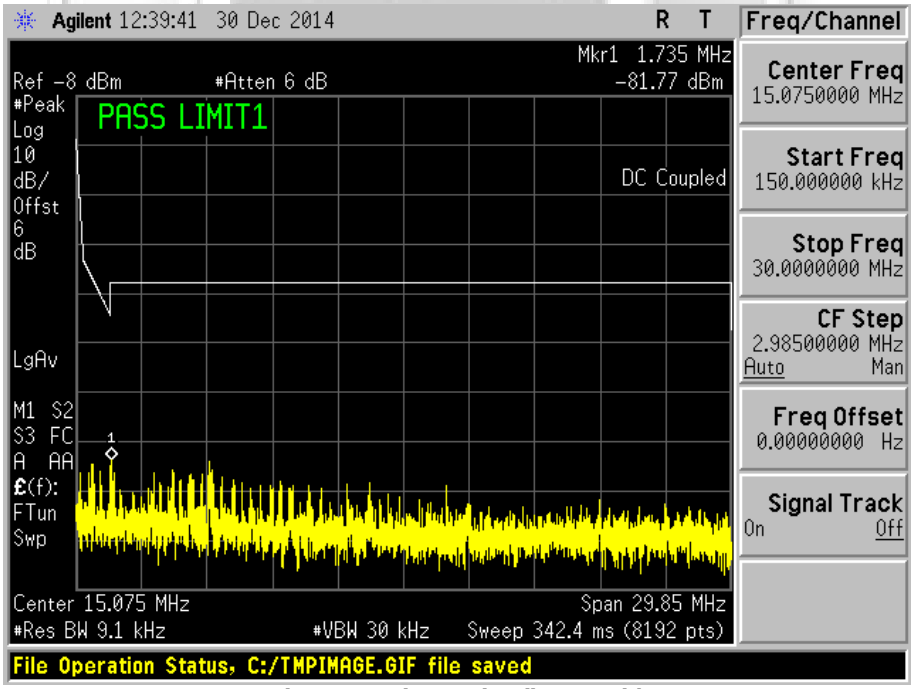
Test Input Power	6VDC	Temperature	24°C
Attached Plots	10 – 36	Relative Humidity	54%
		Atmospheric Pressure	1028mbar
		Tested By	Foo Kai Maun

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

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

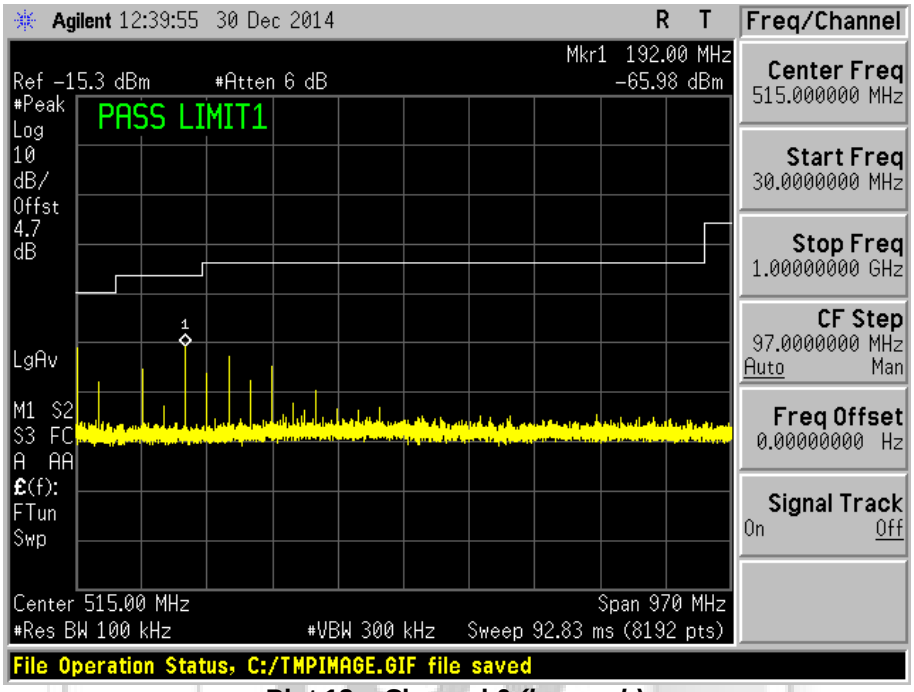


Plot 10 – Channel 0 *(lower ch)*

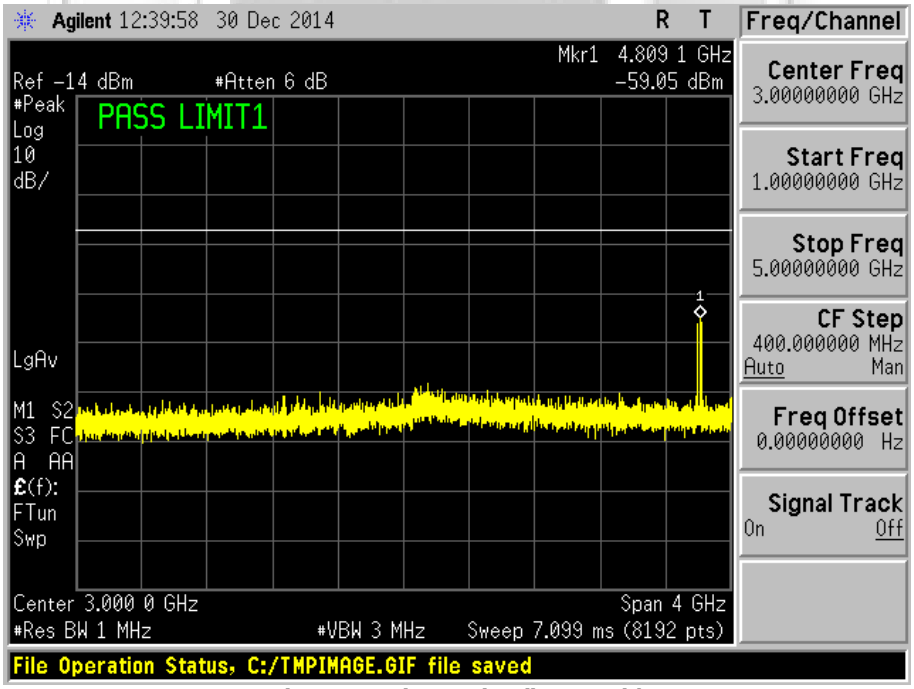


Plot 11 – Channel 0 *(lower ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

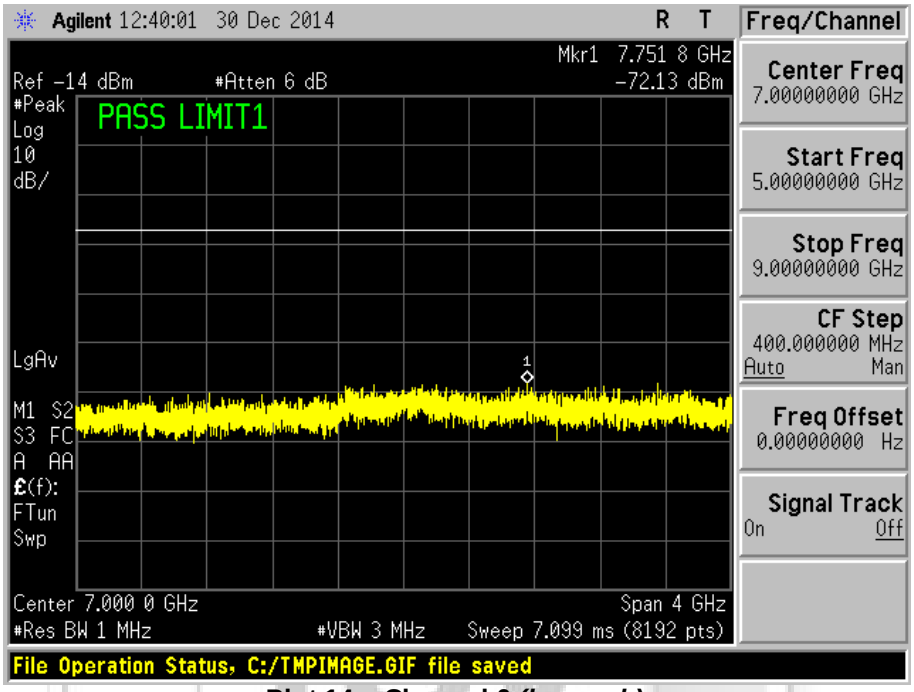


Plot 12 – Channel 0 *(lower ch)*

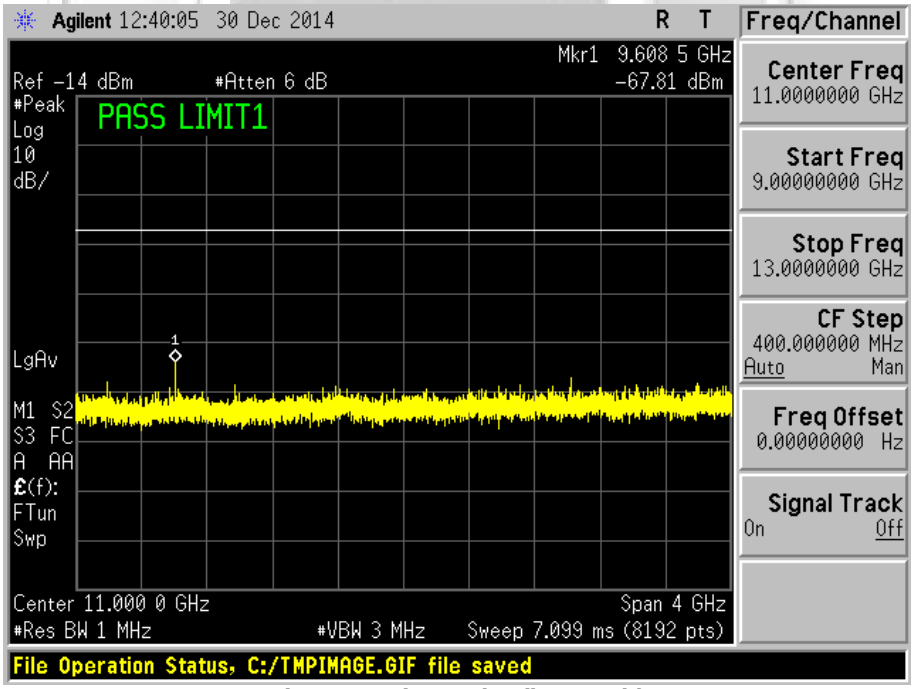


Plot 13 – Channel 0 *(lower ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

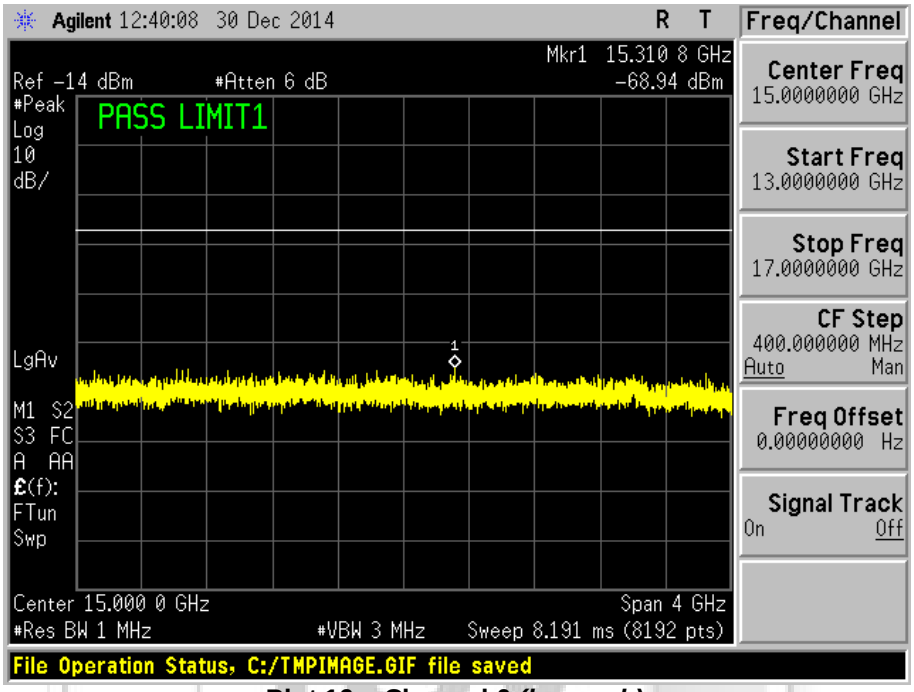


Plot 14 – Channel 0 ***(lower ch)***

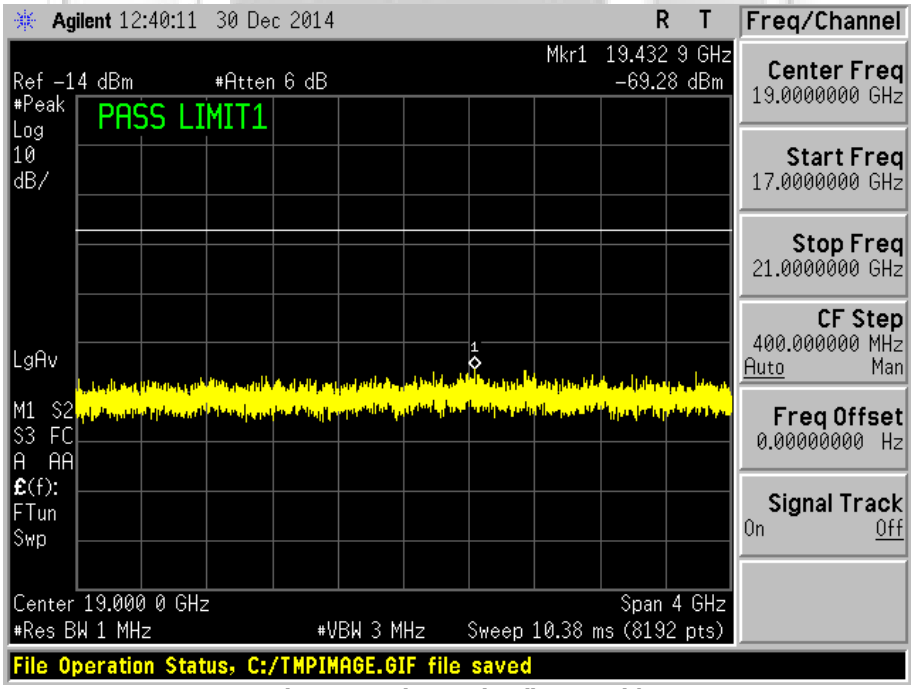


Plot 15 – Channel 0 ***(lower ch)***

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

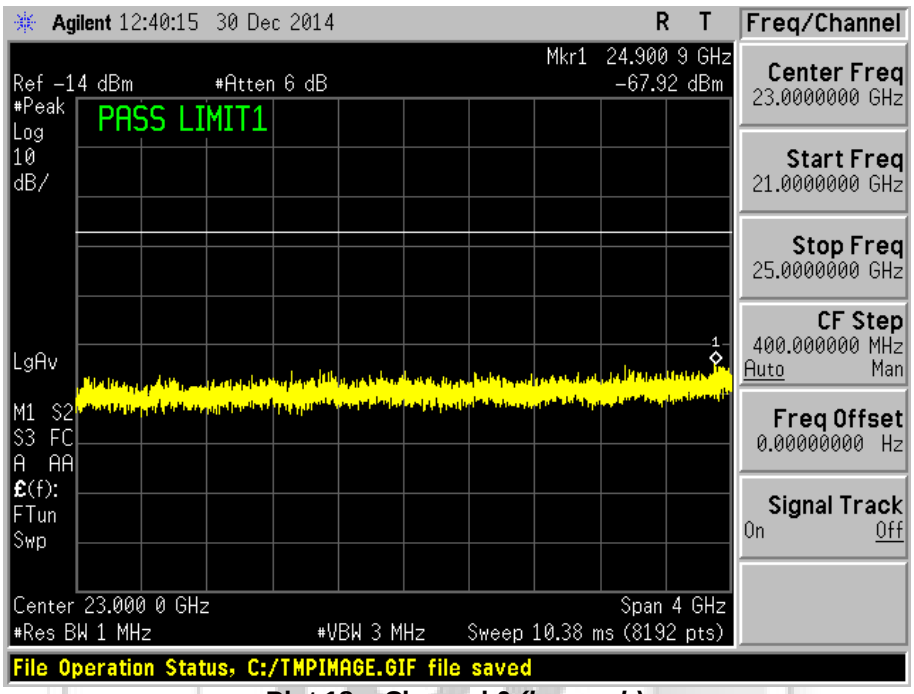


Plot 16 – Channel 0 *(lower ch)*



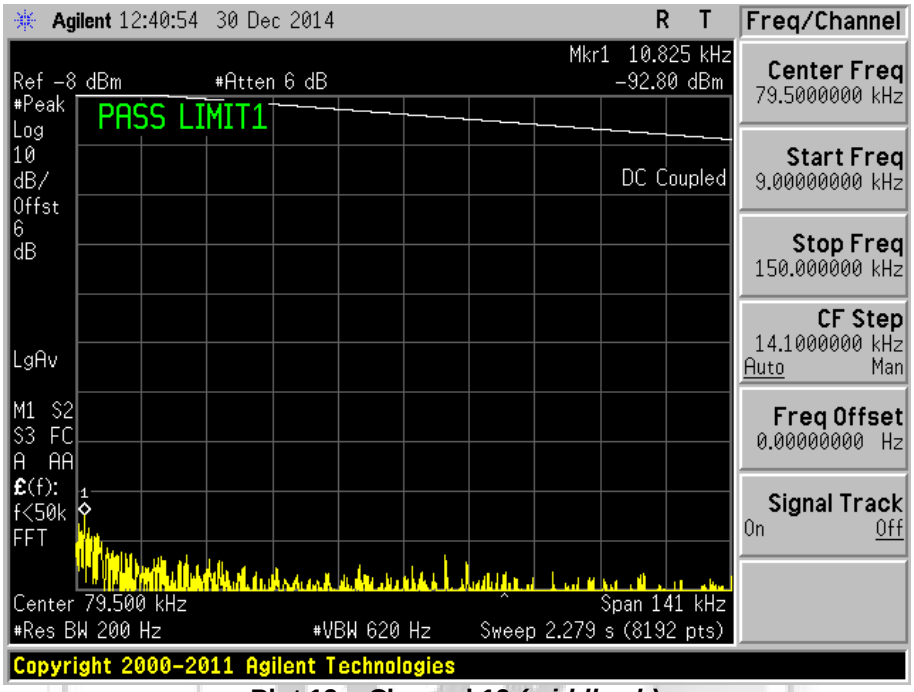
Plot 17 – Channel 0 *(lower ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

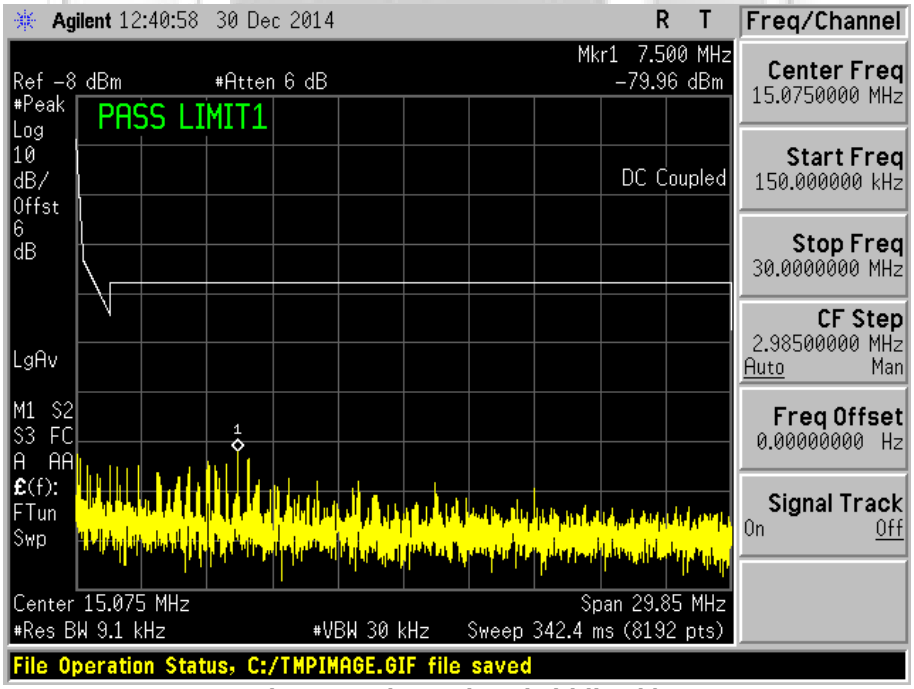


Plot 18 – Channel 0 ***(lower ch)***

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

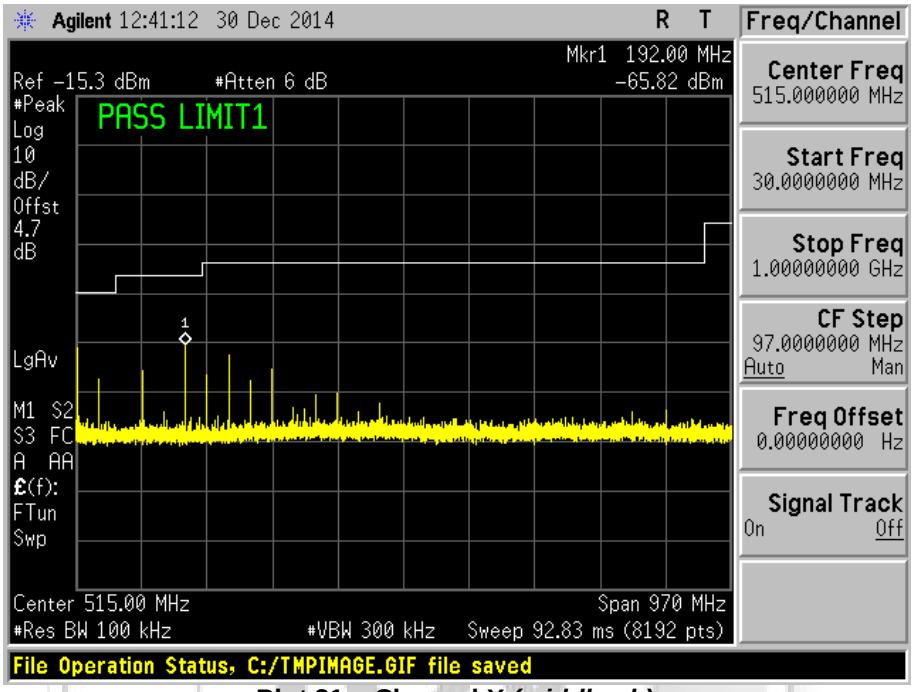


Plot 19 – Channel 19 *(middle ch)*

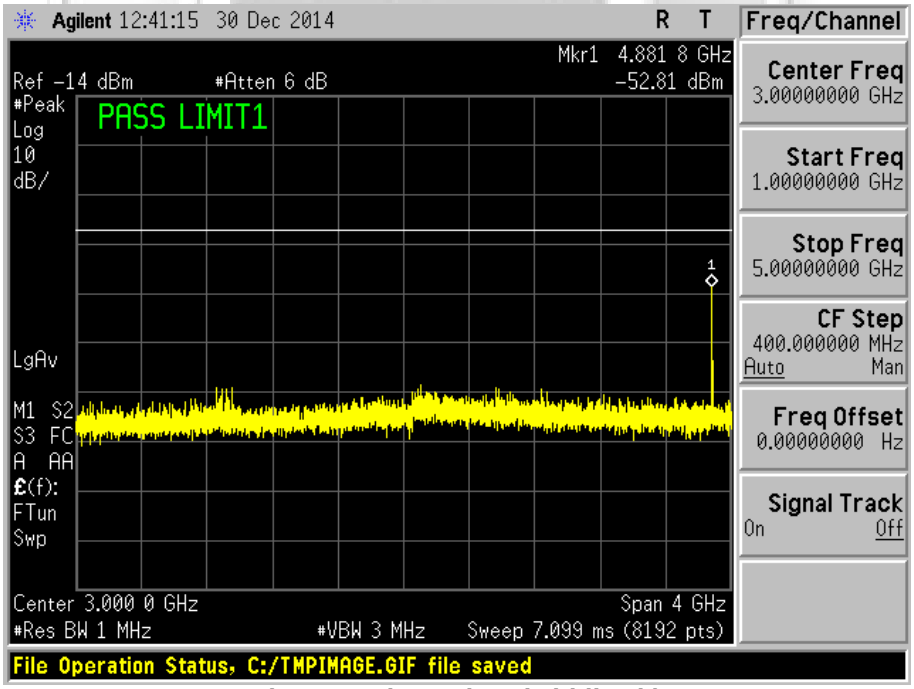


Plot 20 – Channel 19 *(middle ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

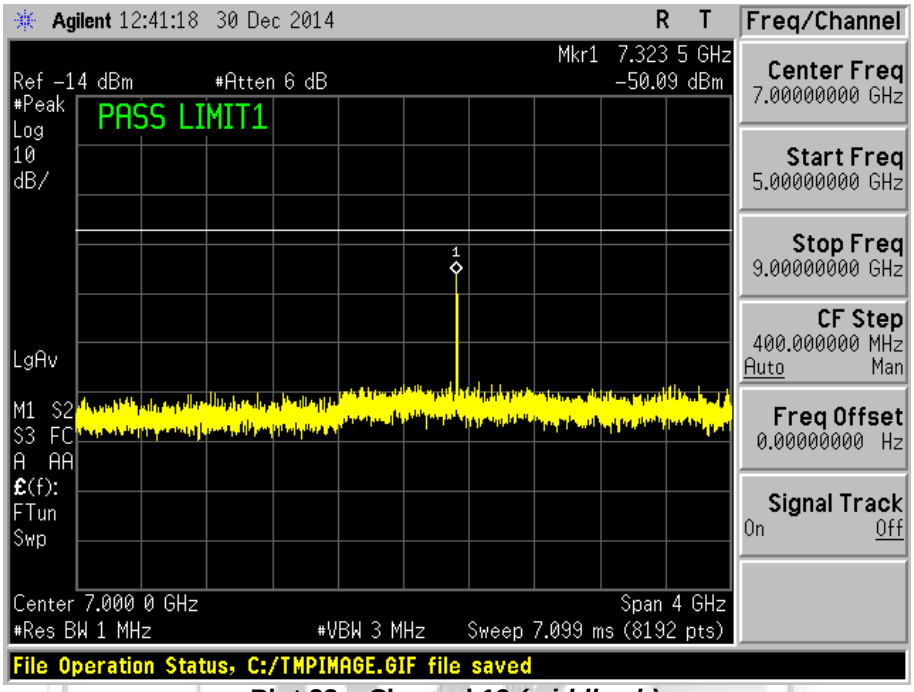


Plot 21 – Channel X *(middle ch)*

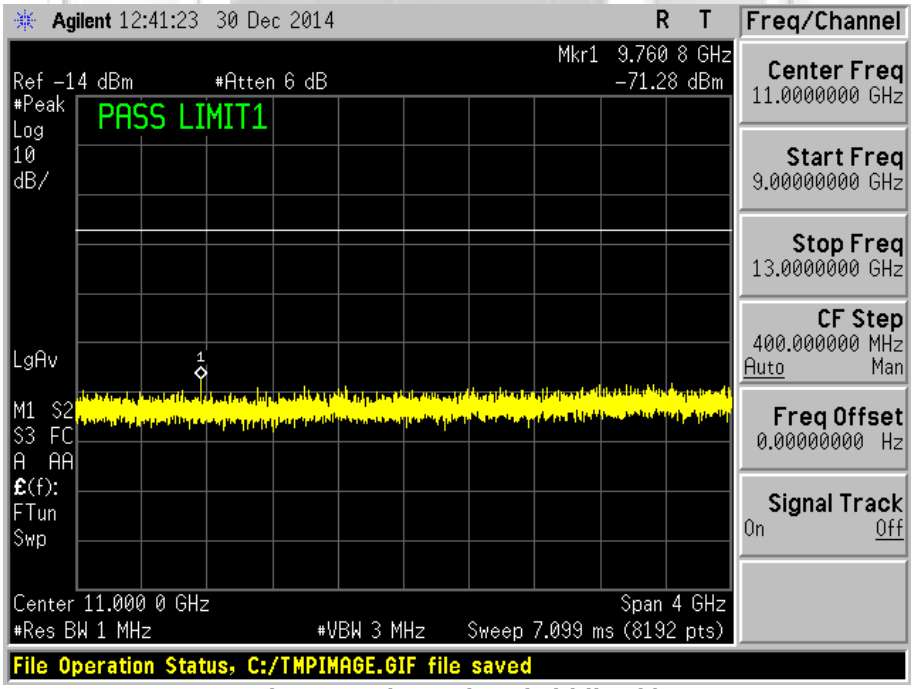


Plot 22 – Channel 19 *(middle ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

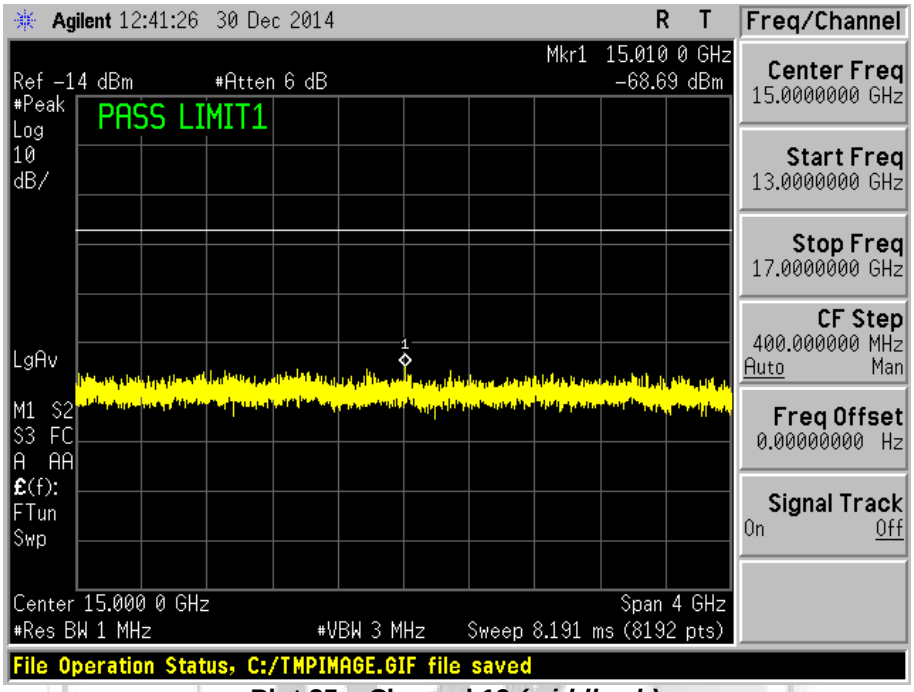


Plot 23 – Channel 19 *(middle ch)*

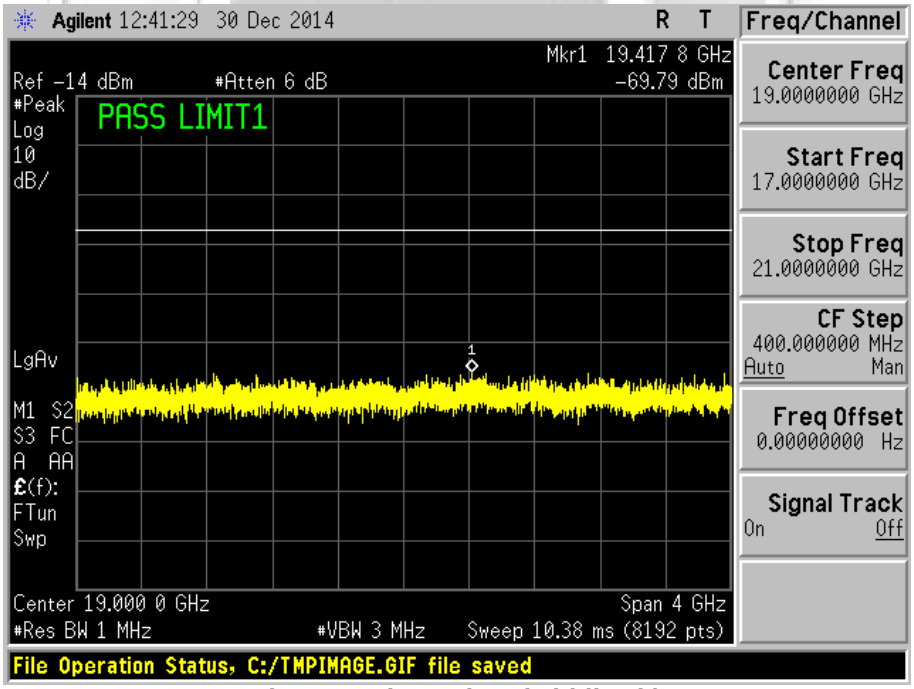


Plot 24 – Channel 19 *(middle ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

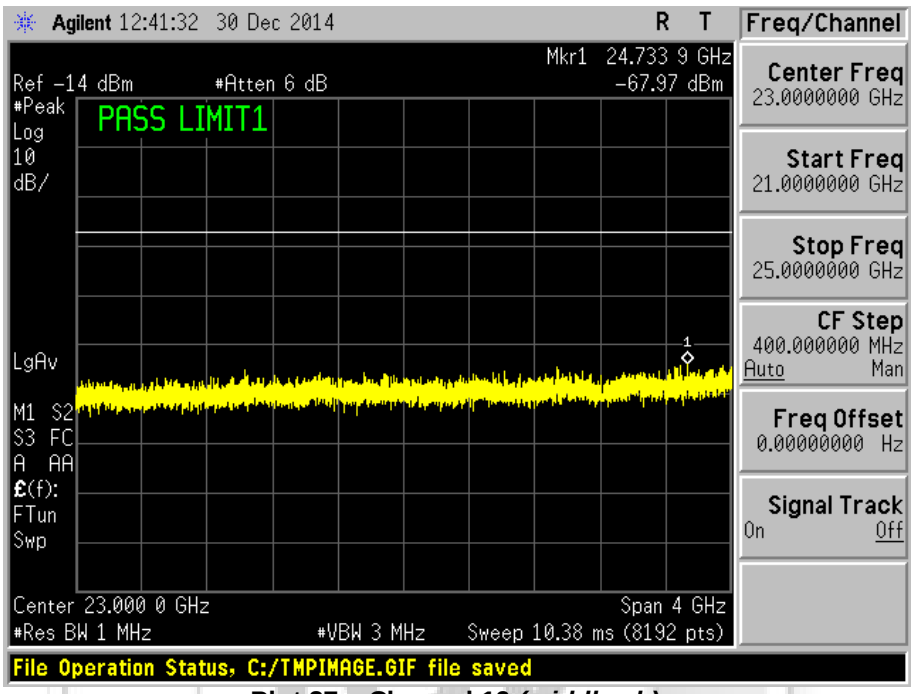


Plot 25 – Channel 19 *(middle ch)*



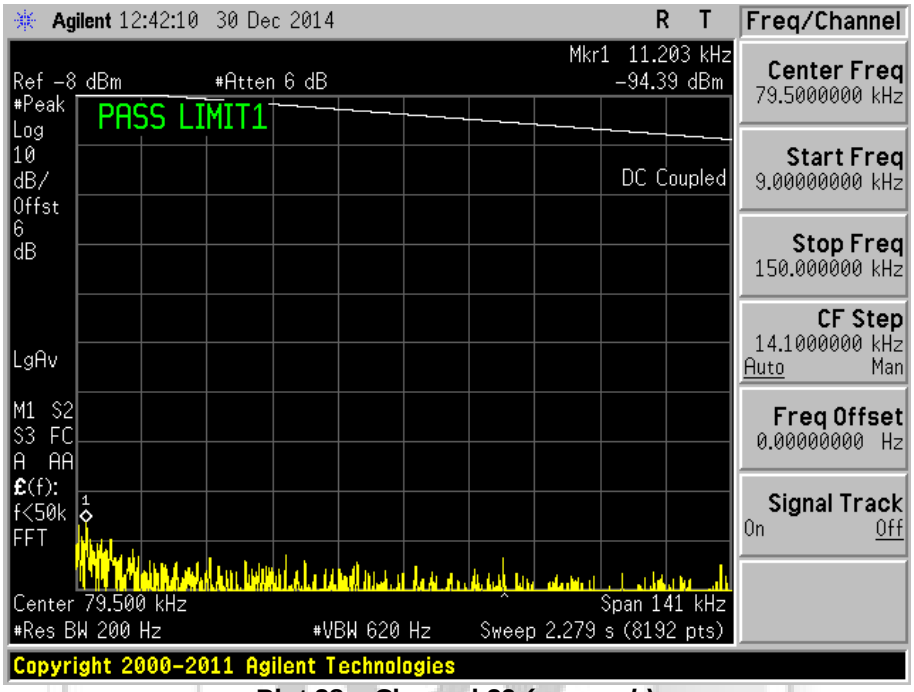
Plot 26 – Channel 19 *(middle ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

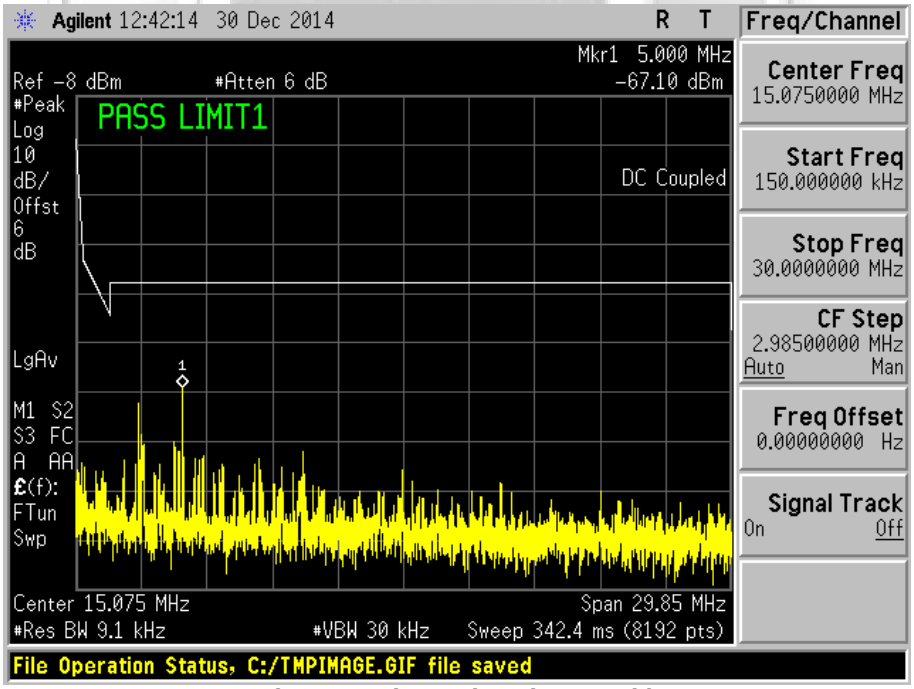


Plot 27 – Channel 19 *(middle ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

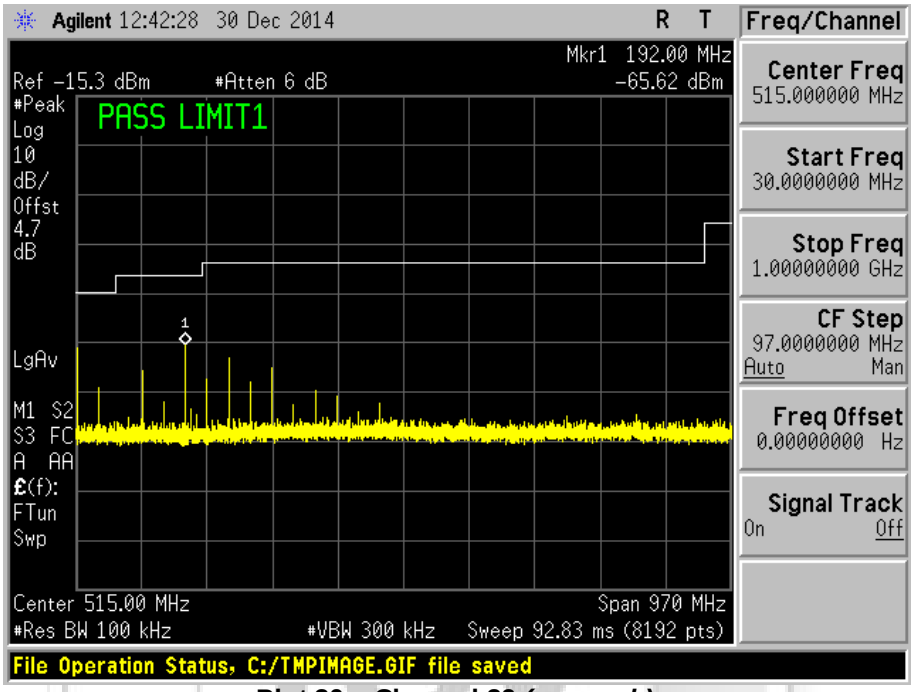


Plot 28 – Channel 39 *(upper ch)*

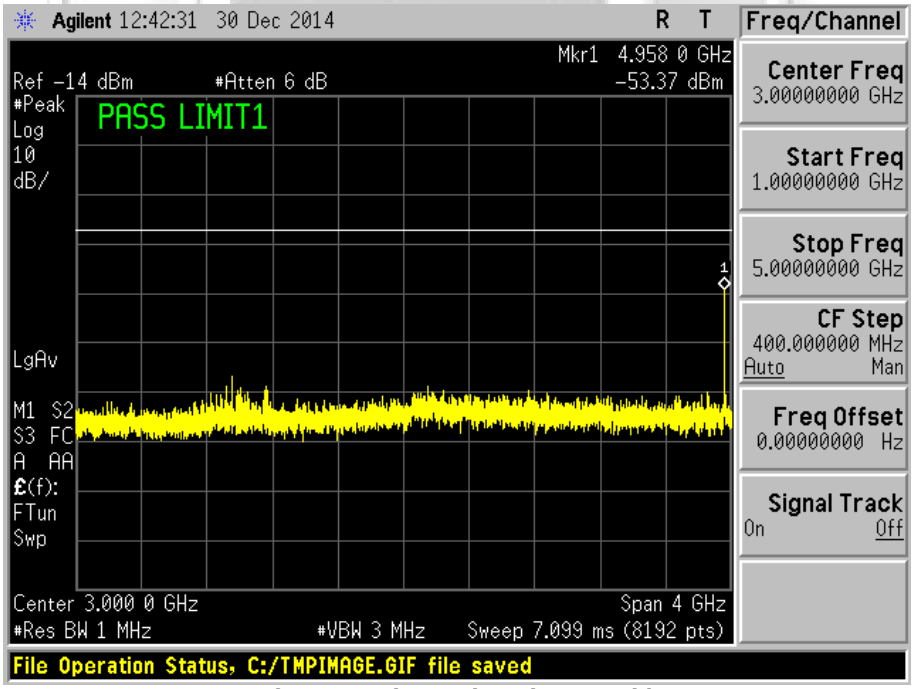


Plot 29 – Channel 39 *(upper ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

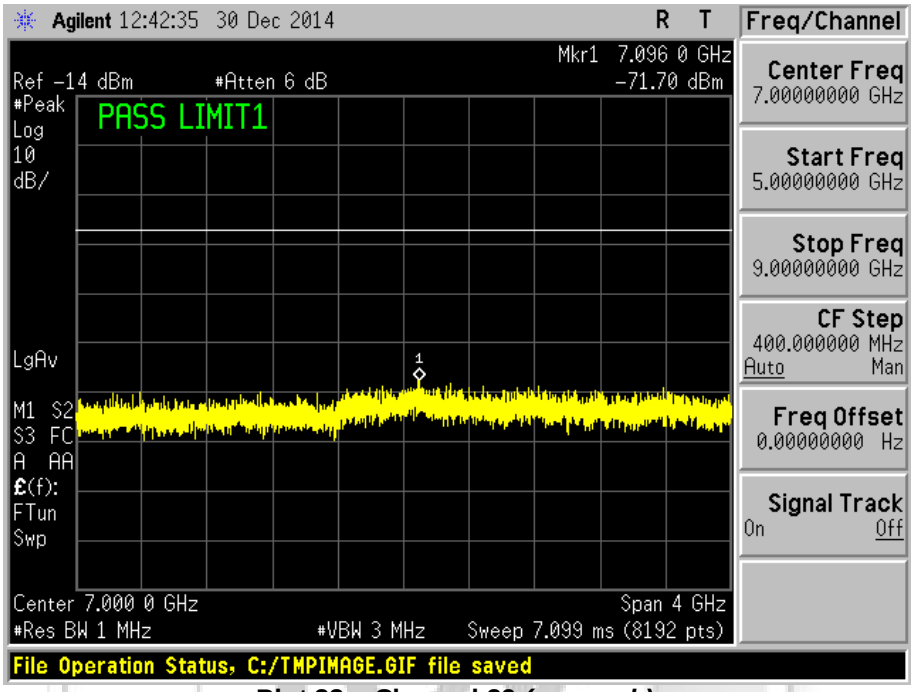


Plot 30 – Channel 39 *(upper ch)*

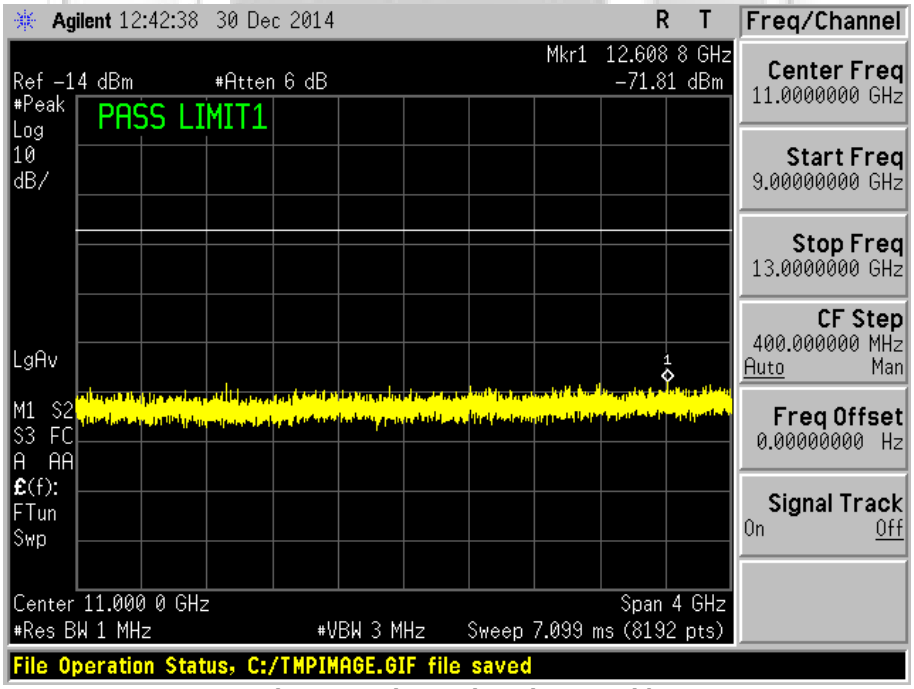


Plot 31 – Channel 39 *(upper ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

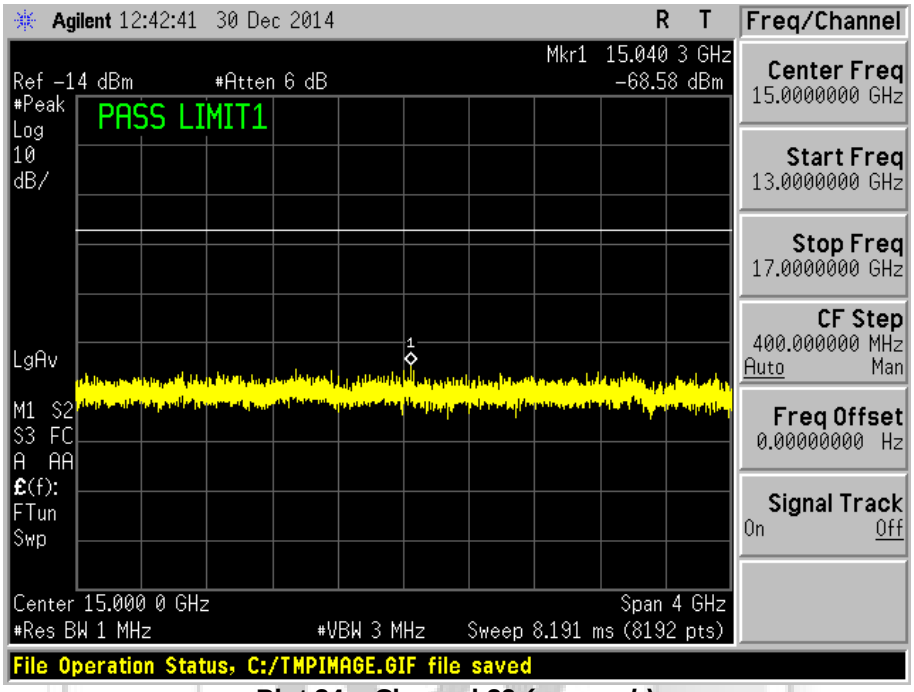


Plot 32 – Channel 39 *(upper ch)*

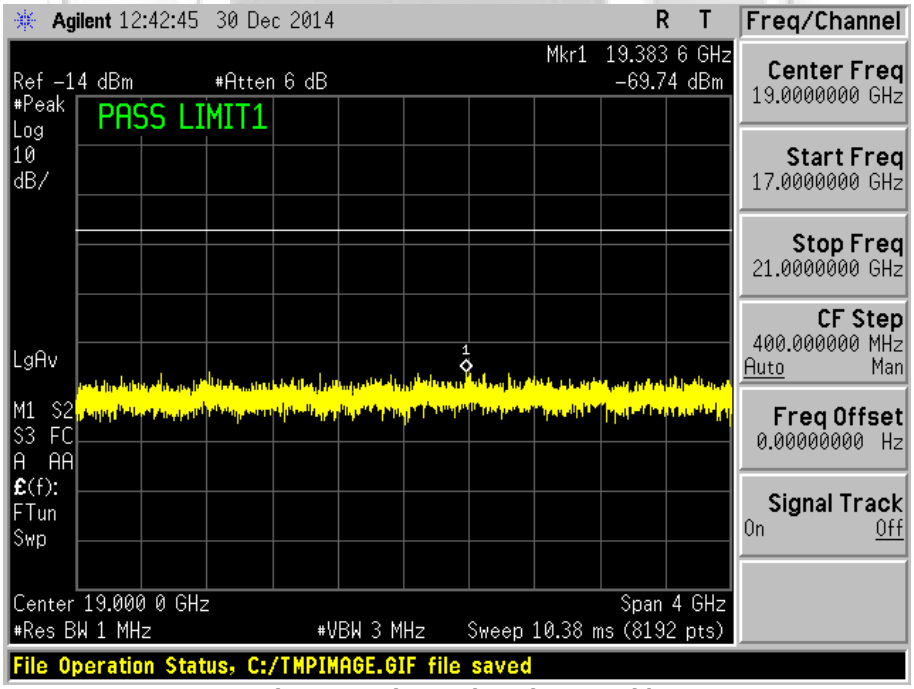


Plot 33 – Channel 39 *(upper ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak

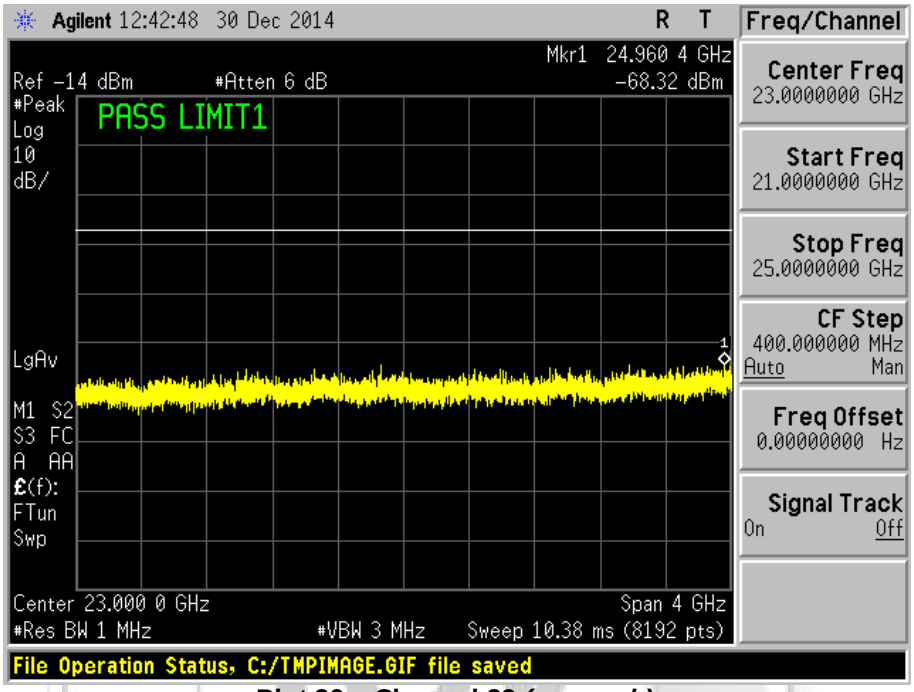


Plot 34 – Channel 39 *(upper ch)*



Plot 35 – Channel 39 *(upper ch)*

RF Conducted Spurious Emissions (Restricted Bands) Plots – Peak



Plot 36 – Channel 39 *(upper ch)*

47 CFR 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.

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

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	19 Mar 2015
Agilent Dual Output DC Power Supply	E3620A	MY40000336	Output Monitored

47 CFR 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.

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

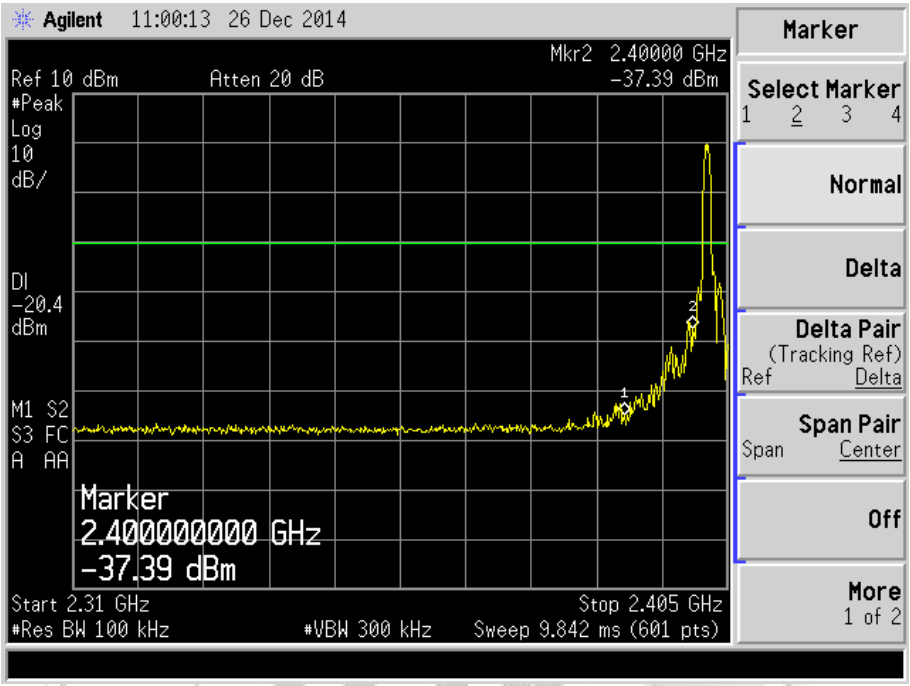
1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions 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.

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

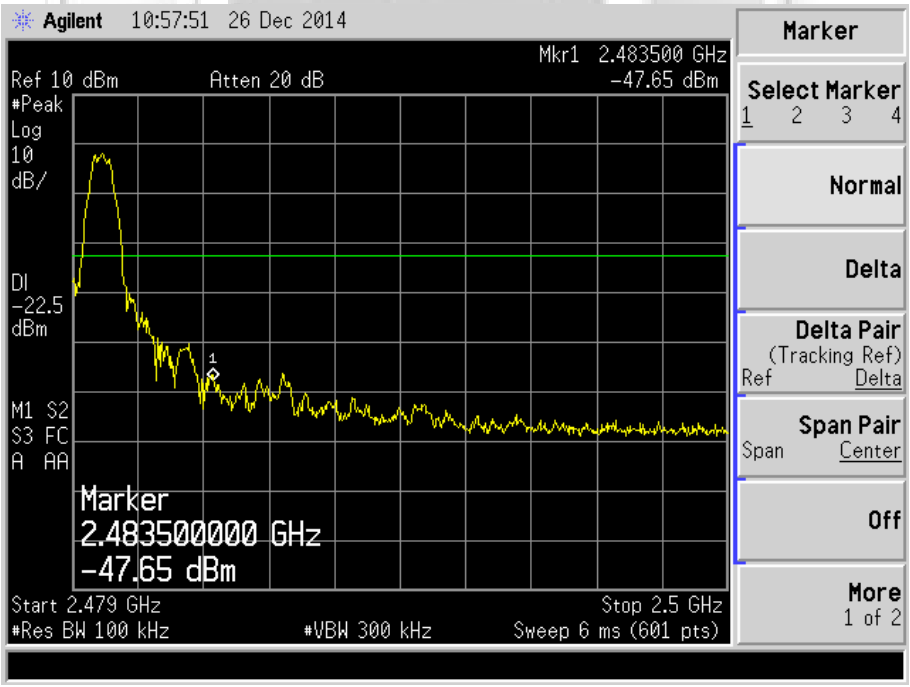
Test Input Power	6VDC	Temperature	24°C
Attached Plots	37 - 38	Relative Humidity	54%
		Atmospheric Pressure	1028mbar
		Tested By	Foo Kai Maun

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

Band Edge Compliance (Conducted) Plots



Plot 37 – Lower Band Edge at 2.4000GHz



Plot 38 – Upper Band Edge at 2.4835GHz

47 CFR 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.

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

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	23 Jul 2015
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	14 Mar 2015
TDK-RF Horn Antenna	HRN-0118	130256	10 Jul 2015

47 CFR 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.

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

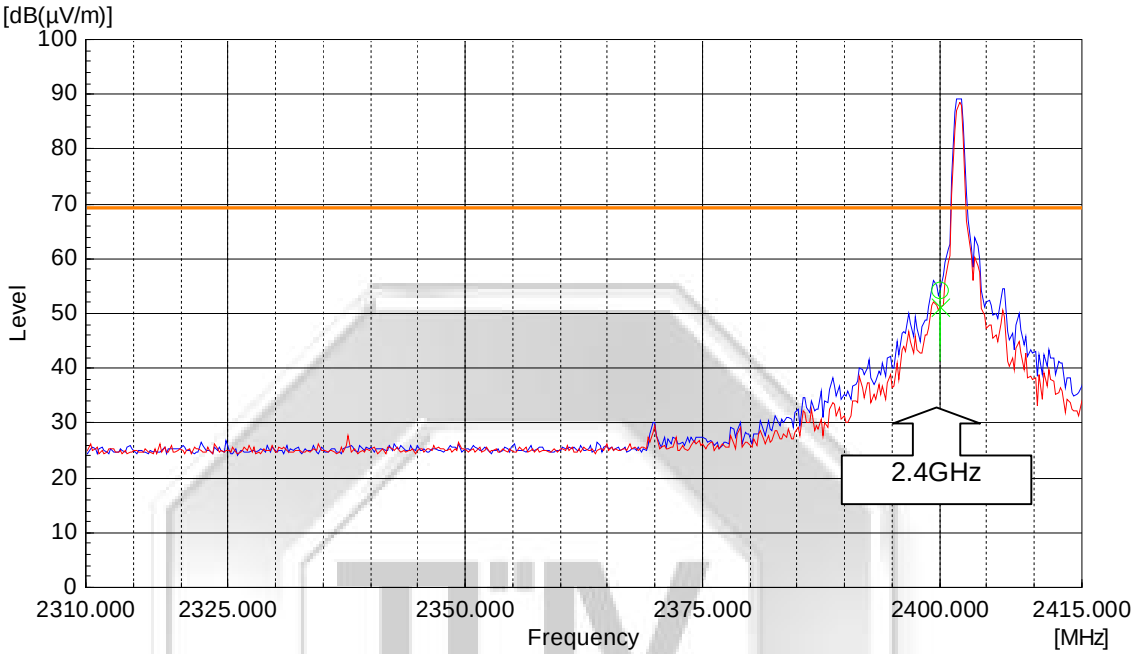
1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions 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.

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

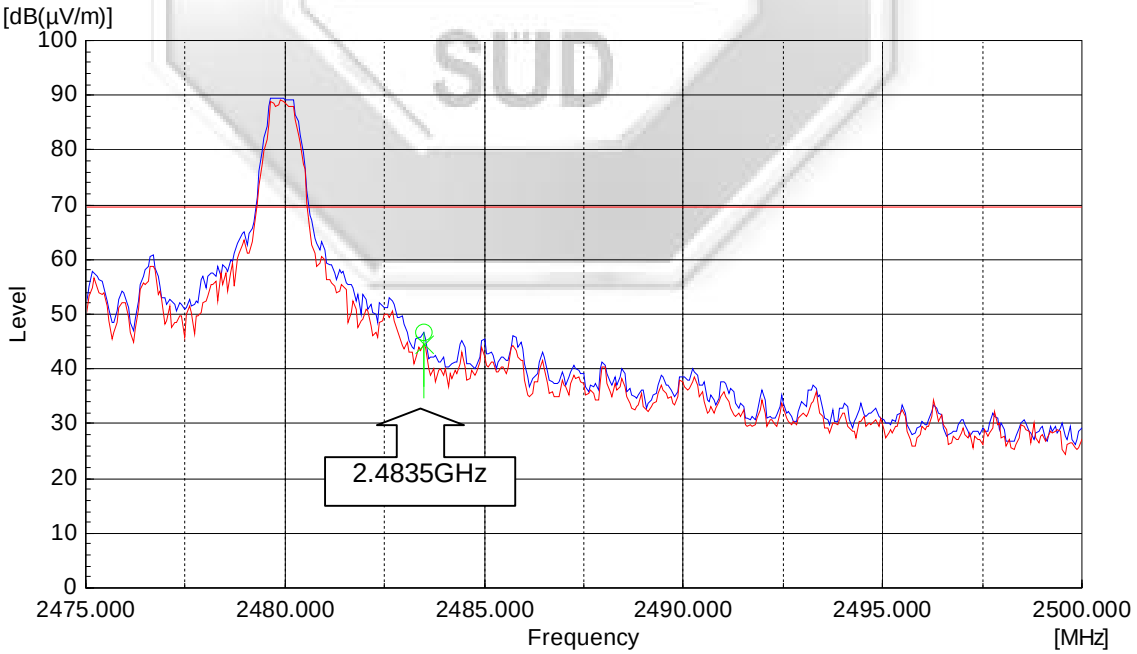
Test Input Power	6VDC	Temperature	25°C
Attached Plots	39 – 44	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Lim Kay Tak

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

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

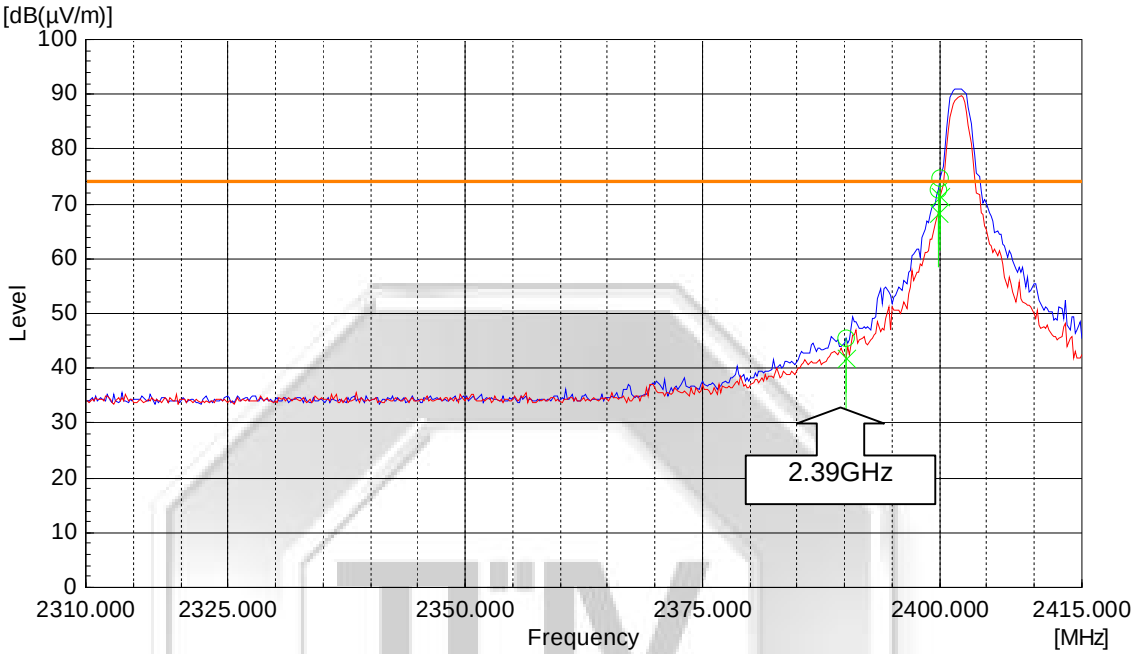


Plot 39 – Lower Band Edge at 2.4000GHz

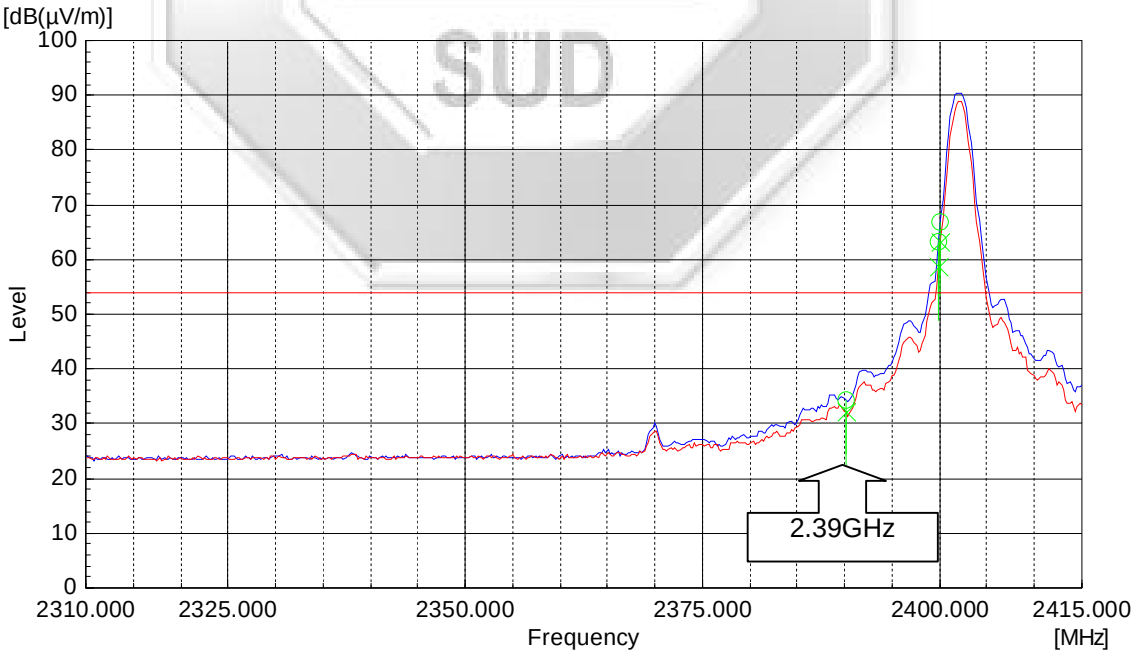


Plot 40 – Upper Band Edge at 2.4835GHz

Band Edge Compliance (Radiated) Plots (Restricted Band)

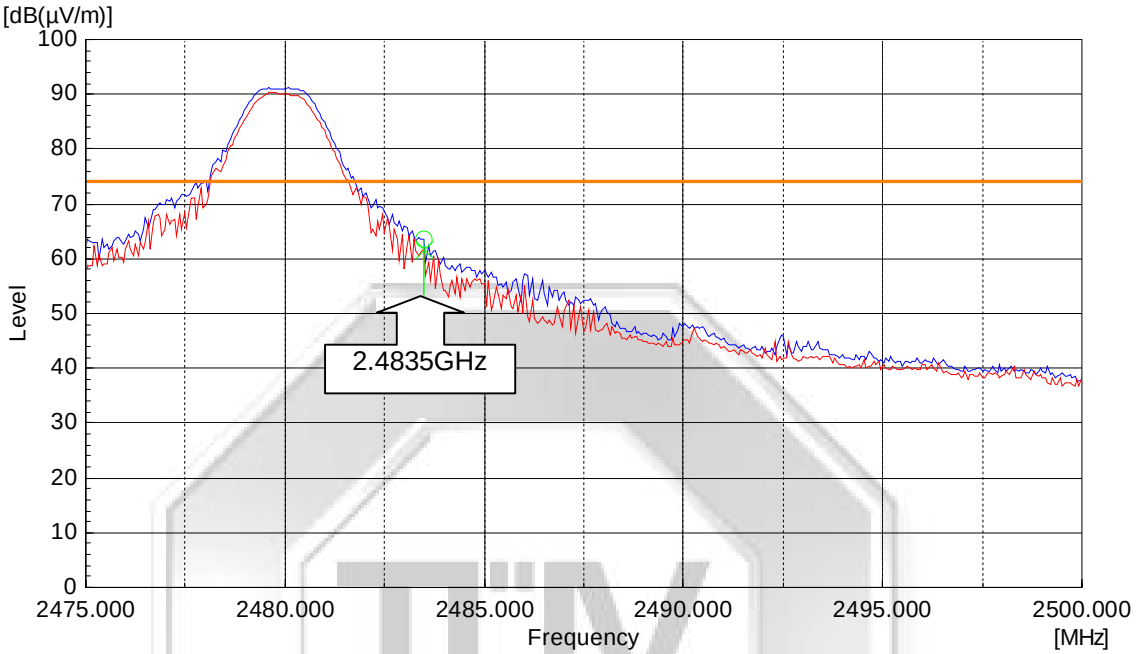


Plot 41 – Peak Plot at Lower Band Edge at 2.3900GHz

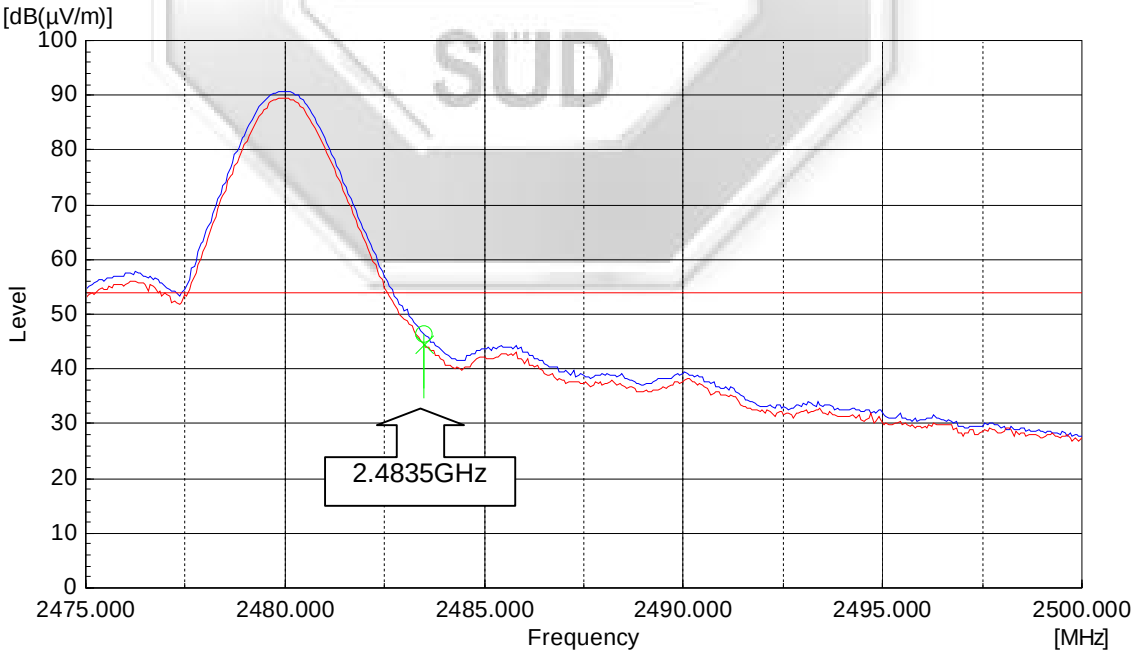


Plot 42 – Average Plot at Lower Band Edge at 2.3900GHz

Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 43 – Peak Plot at Upper Band Edge at 2.4835GHz



Plot 44 – Average Plot at Upper Band Edge at 2.4835GHz

47 CFR 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.

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

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	19 Mar 2015
Agilent Dual Output DC Power Supply	E3620A	MY40000336	Output Monitored

47 CFR 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), video bandwidth (VBW) and span of the spectrum analyser were set to the following:
   RBW = 3kHz
   VBW = 9kHz
   Span = 1.5 times the channel bandwidth
   Sweep time = auto couple
5. All other supporting equipment were powered separately from another filtered mains.

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

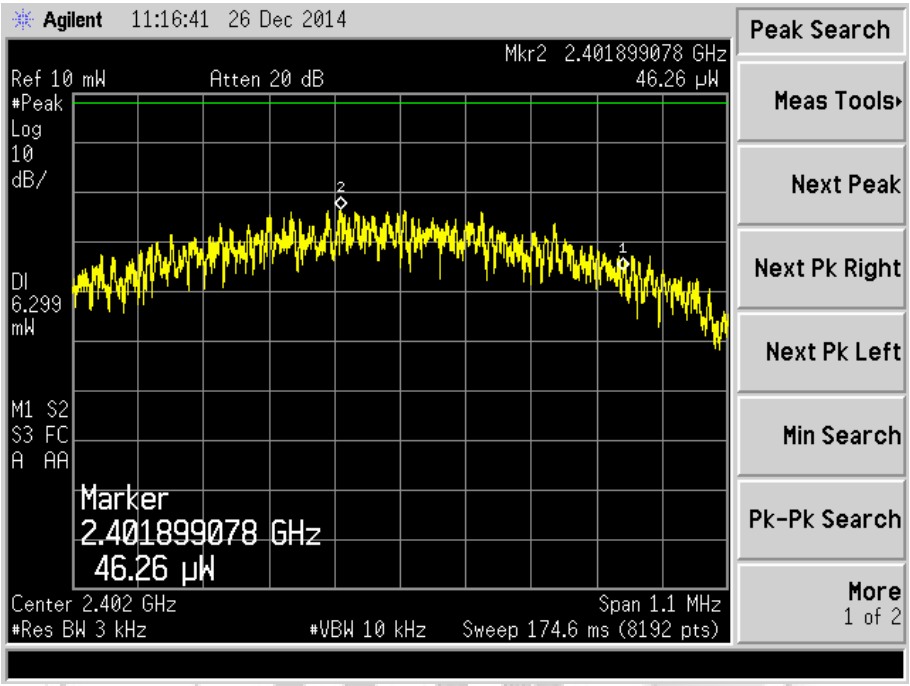
1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel.
2. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser.
3. The peak power density of the transmitting frequency was plotted and recorded.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to middle and upper channel respectively.

47 CFR FCC Part 15.247(e) Peak Power Spectral Density Results

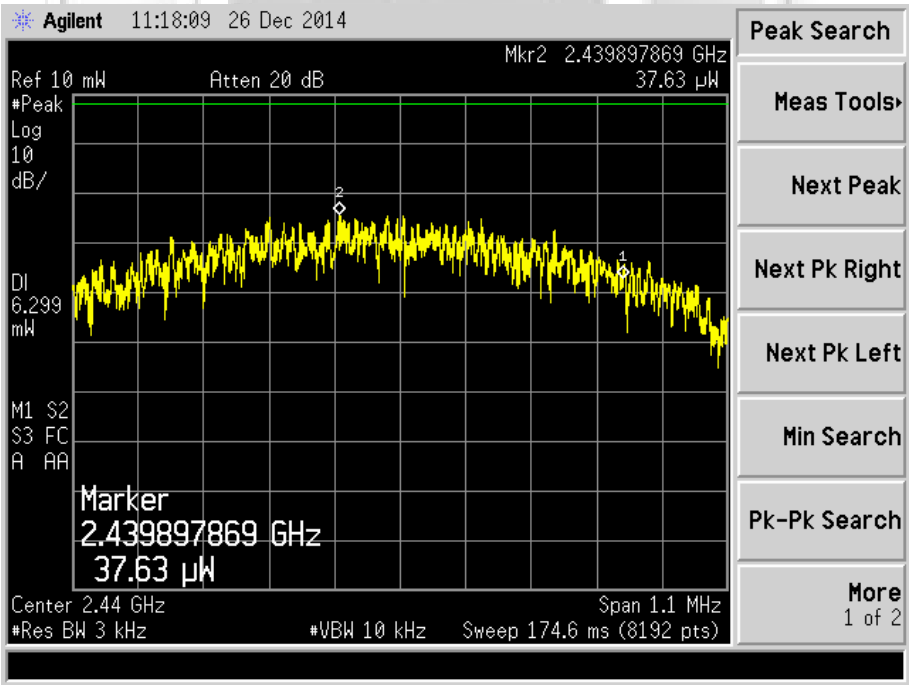
Test Input Power	6VDC	Temperature	24°C
Attached Plots	45 - 47	Relative Humidity	54%
		Atmospheric Pressure	1028mbar
		Tested By	Foo Kai Maun

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0 *(lower ch)*	2.402	0.04626	6.3
19 *(mid ch)*	2.440	0.03763	6.3
39 *(upper ch)*	2.480	0.03504	6.3

Peak Power Spectral Density Plots

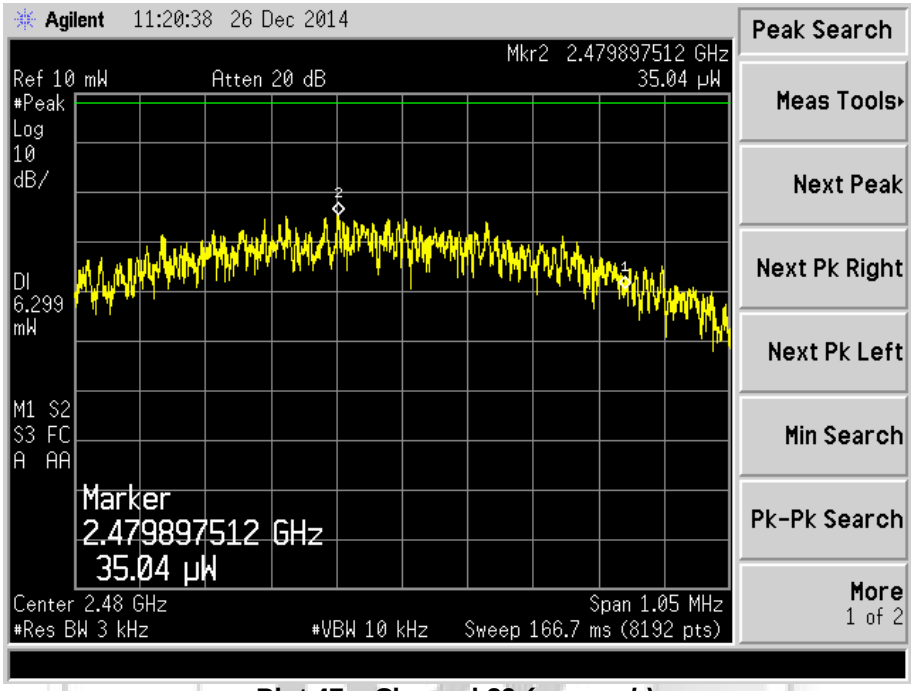


Plot 45 – Channel 0 *(lower ch)*



Plot 46 – Channel 19 *(middle ch)*

Peak Power Spectral Density Plots



Plot 47 – Channel 39 *(upper ch)*

47 CFR 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				

47 CFR FCC Part 1.1310 Maximum Permissible Exposure Computation

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

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

where S = Power density in W/m^2
P = 0.0008W *(maximum peak measured from Maximum Peak Power)*
d = Test distance at 0.2m
G = Numerical isotropic gain, 0.5 (-3.0dBi)

Substituting the relevant parameters into the formula:

S = [(30GP) / $377d^2$]
= $0.0008W/m^2$
= $0.00008mW/cm^2$

∴ The power density of the EUT at 20cm distance is $0.00008mW/cm^2$ based on the above computation and found to be lower than the power density limit of $1.0mW/cm^2$.

Please note that this Report is issued under the following terms :

1. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.

2. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

3. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.

4. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.

5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

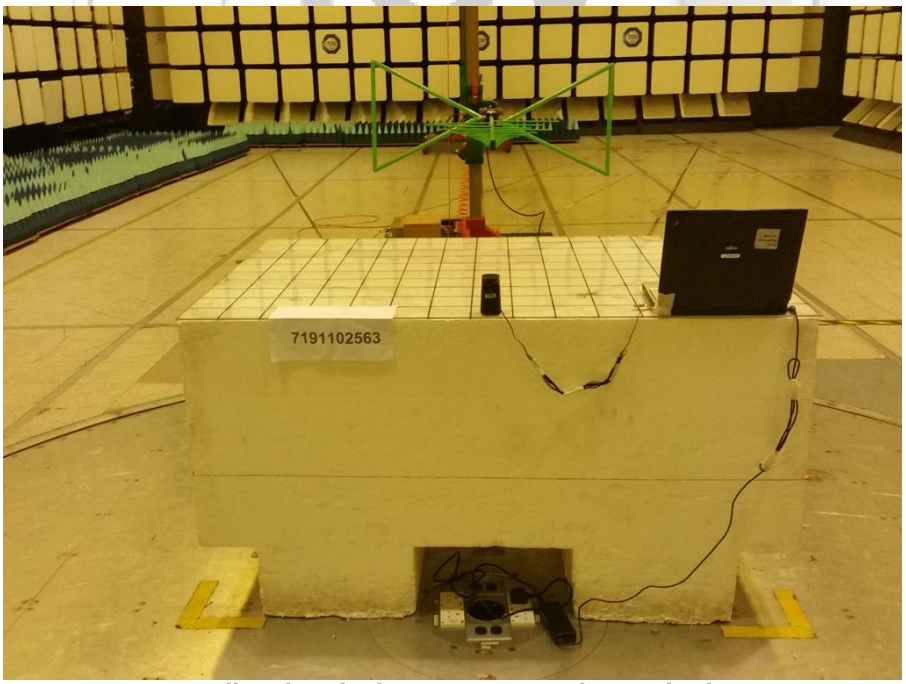
July 2011

ANNEX A

TEST SETUP / EUT PHOTOGRAPHS / DIAGRAMS

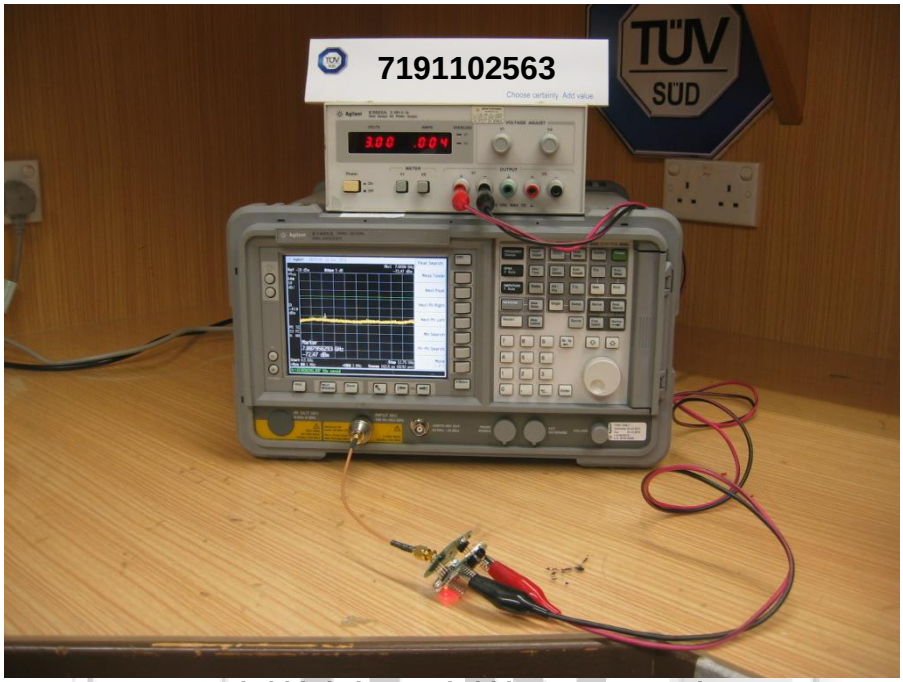
TEST SETUP

Radiated Emissions Test Setup (Front View)

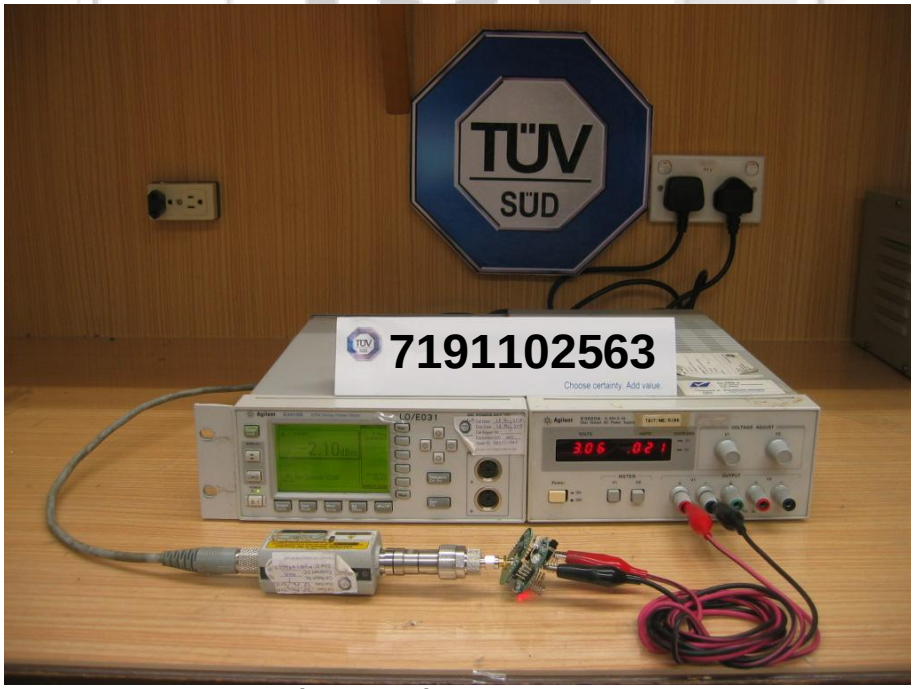


Radiated Emissions Test Setup (Rear View)

TEST SETUP



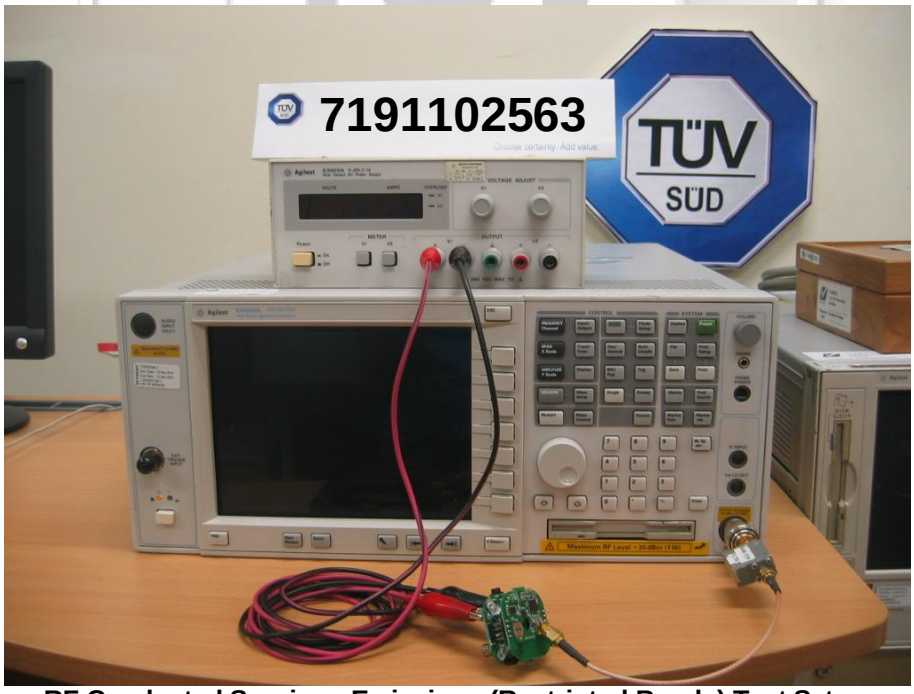
Spectrum Bandwidth (6dB Bandwidth Measurement) Test Setup



Maximum Peak Power Test Setup

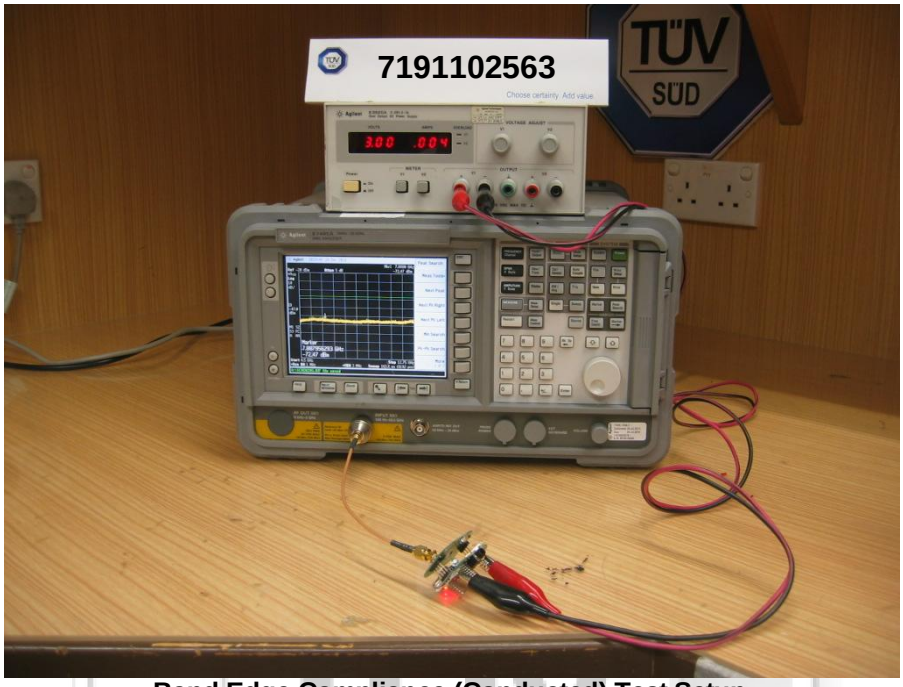
TEST SETUP

RF Conducted Spurious Emissions (Non-Restricted Bands) Test Setup

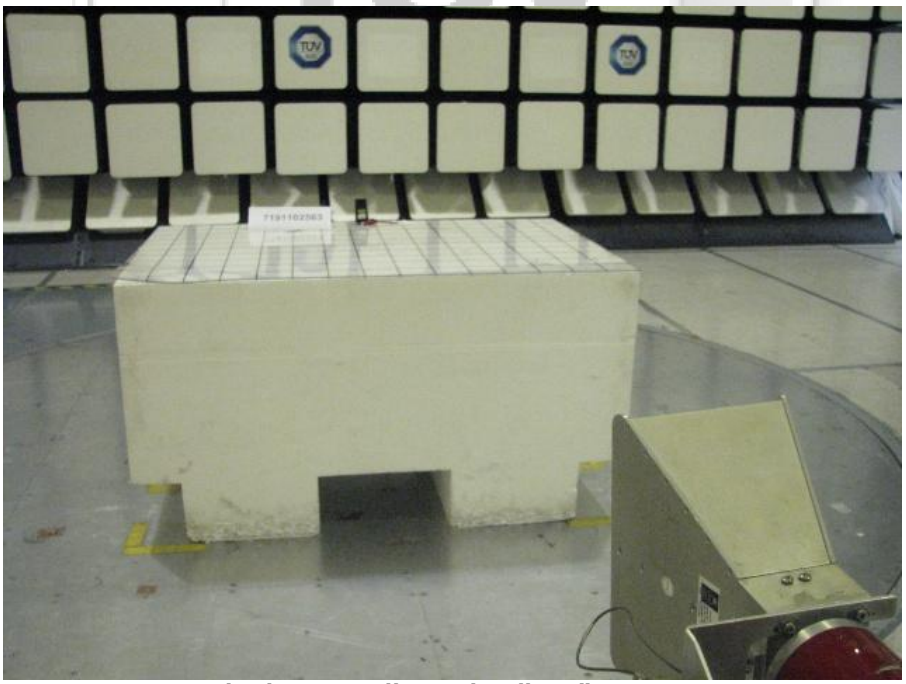


RF Conducted Spurious Emissions (Restricted Bands) Test Setup

TEST SETUP

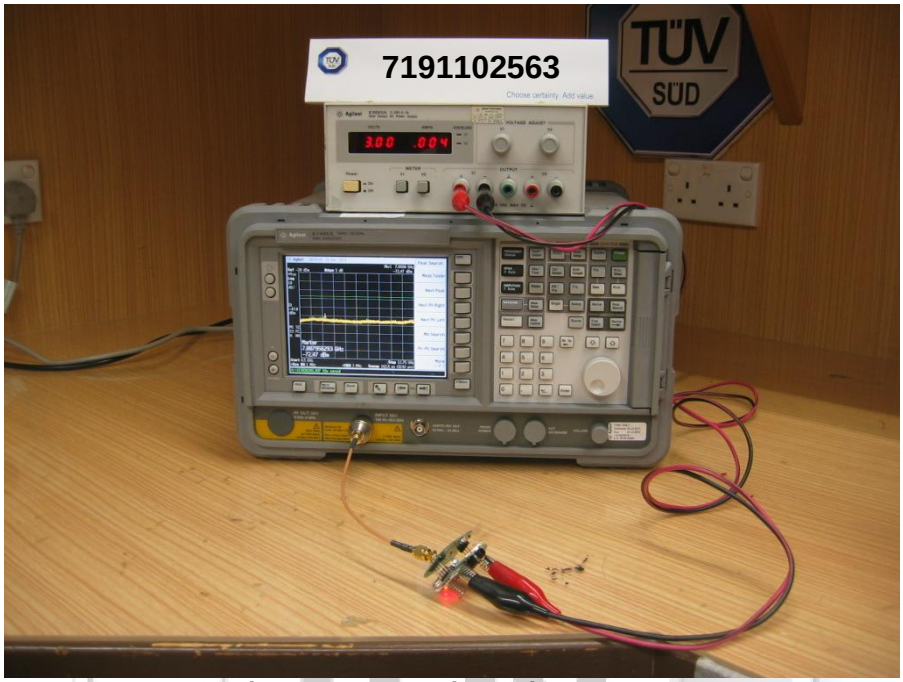


Band Edge Compliance (Conducted) Test Setup



Band Edge Compliance (Radiated) Test Setup

TEST SETUP



Peak Power Spectral Density Test Setup

EUT PHOTOGRAPHS

EUT View 1

EUT PHOTOGRAPHS

EUT View 2

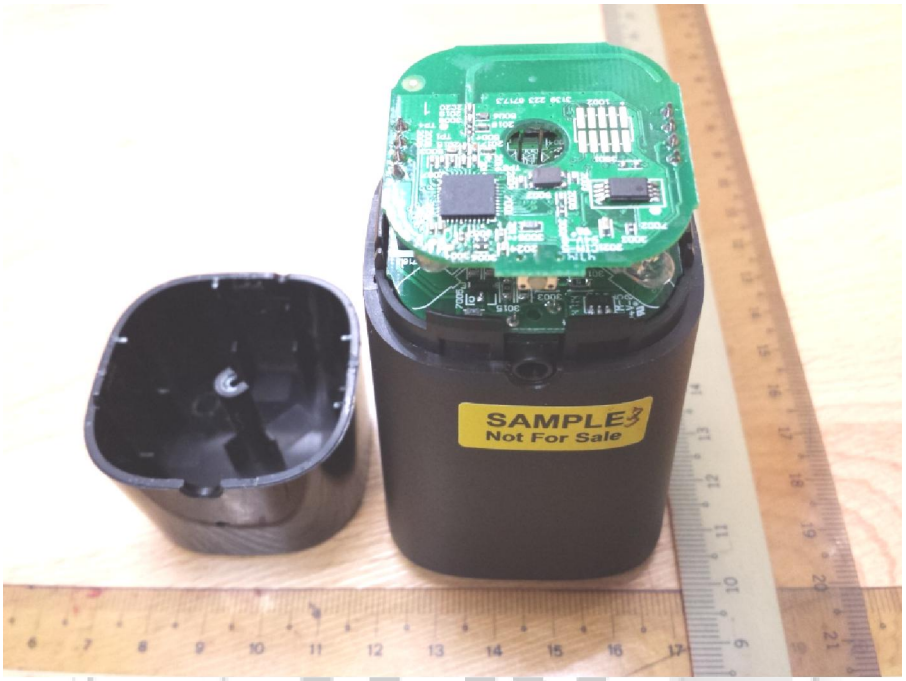
EUT PHOTOGRAPHS

EUT View 3

EUT PHOTOGRAPHS

IR Emitter

EUT PHOTOGRAPHS



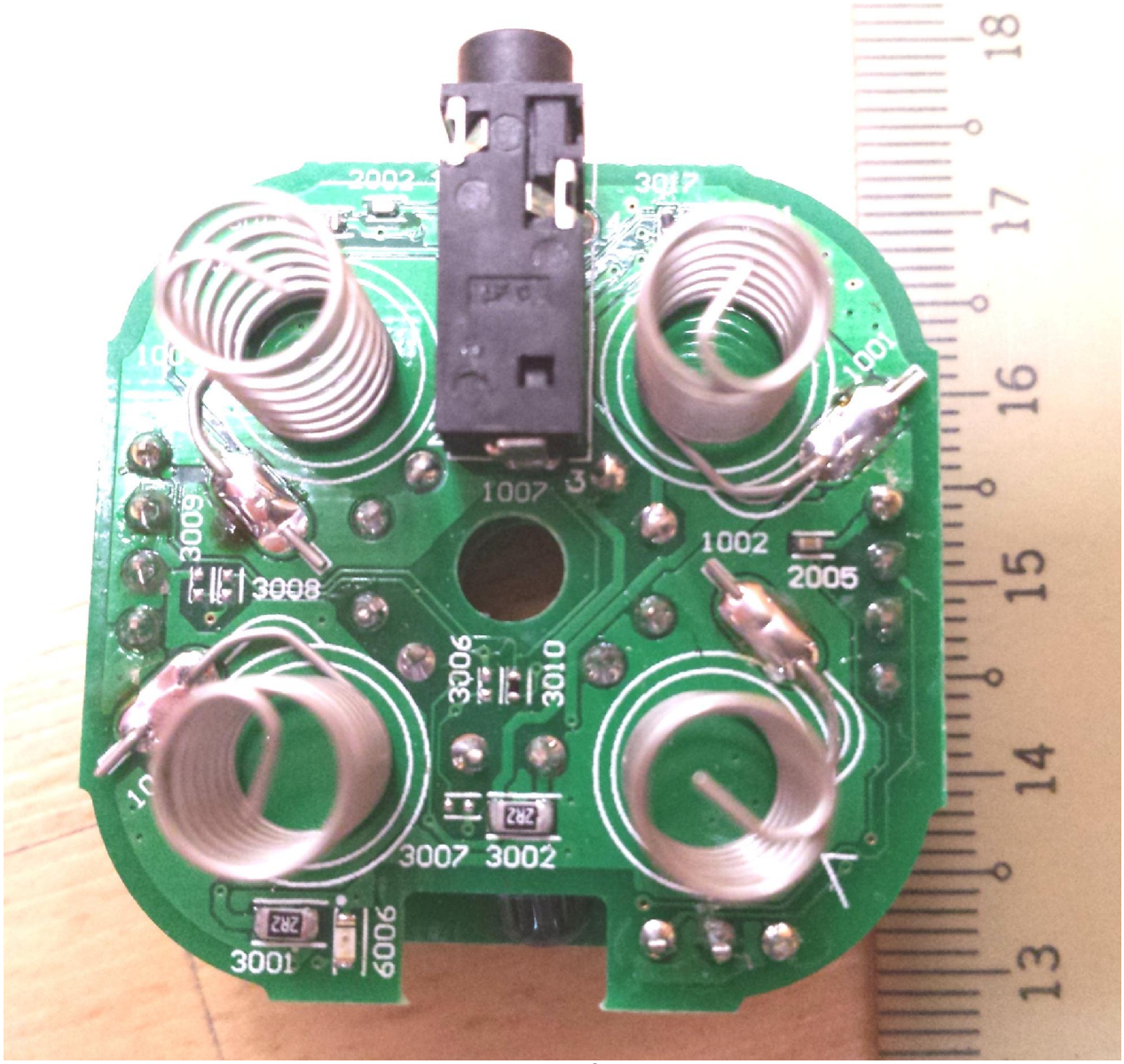
EUT Internal View 1

EUT Internal View 2

EUT PHOTOGRAPHS

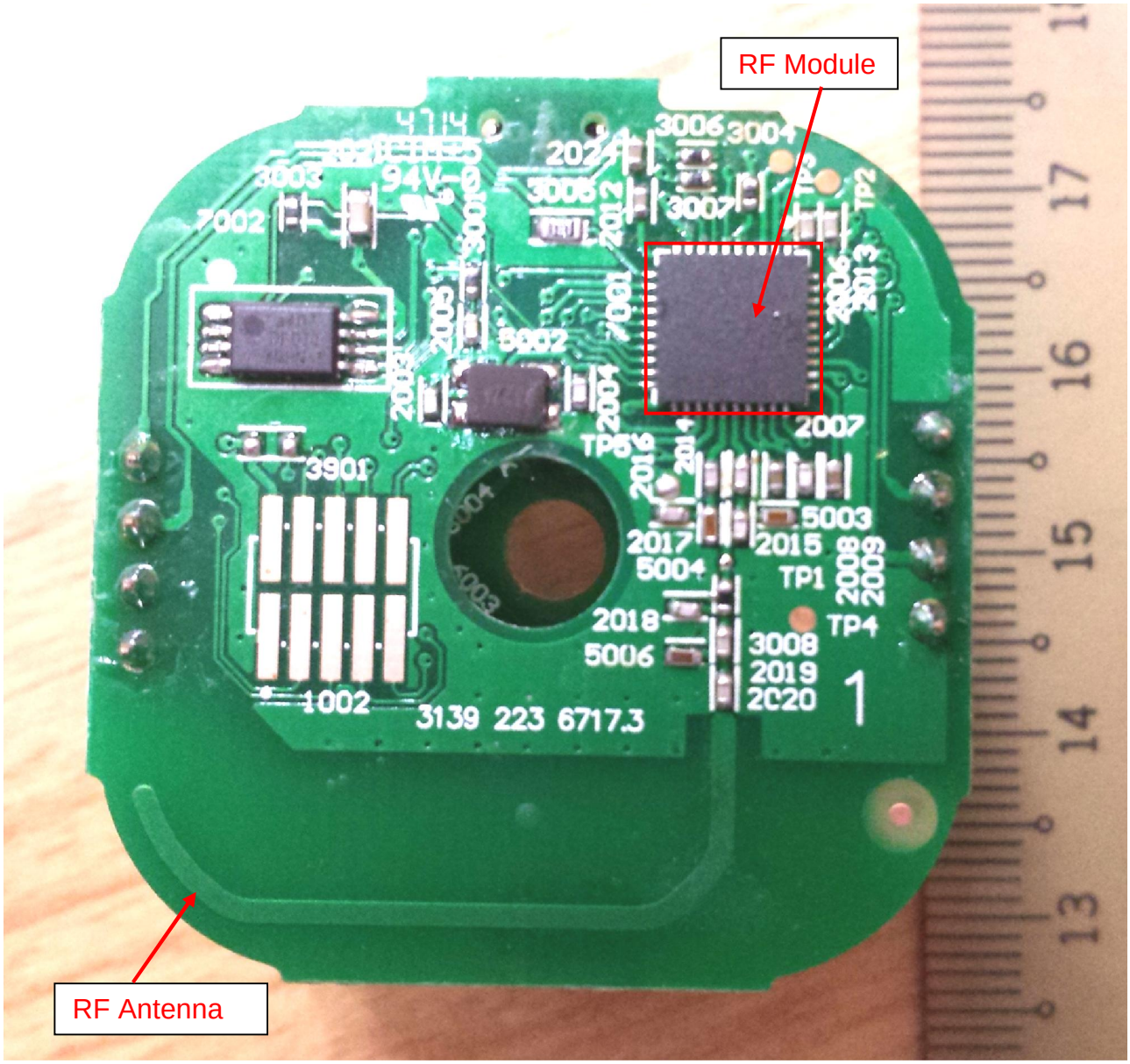
EUT Internal View 3

EUT PHOTOGRAPHS



EUT PCB View 1

EUT PHOTOGRAPHS



EUT PCB View 2

ANNEX B

USER MANUAL
TECHNICAL DESCRIPTION
BLOCK & CIRCUIT DIAGRAMS

(Please refer to manufacturer for details)

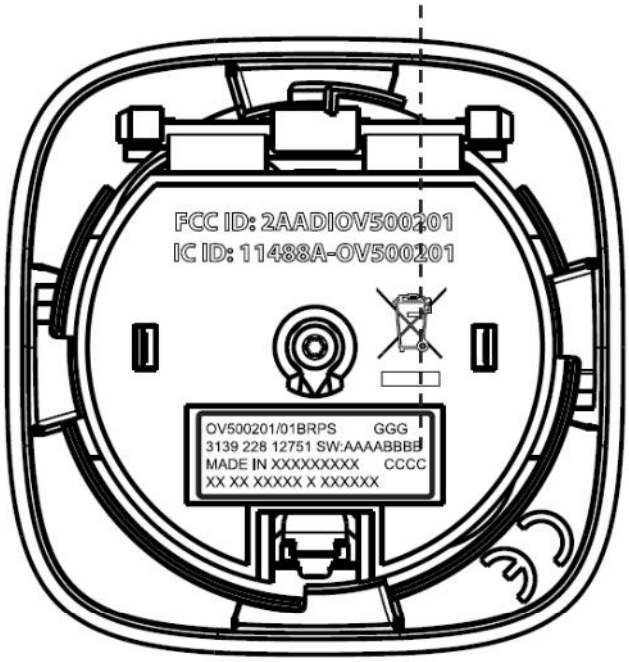
ANNEX C

FCC LABEL & POSITION

ANNEX C FCC LABEL & POSITION

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.



Sample Label and Physical Location of FCC Label on EUT