Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**19660034 001**	**Seite 1 von 29** *Page 1 of 29*

Auftraggeber: *Client:*	**ATMEL NORWAY AS** **VESTRE ROSTEN 79** **7075 TILLER** **TRONDHEIM** **NORWAY - 7075**		
Gegenstand der Prüfung: *Test item:*	**ATZB-RF-233-1-C 2.4GHz Amp ZigBit Module**		
Bezeichnung: *Identification:*	**ATZB-RF-233-1-C**	**Serien-Nr.:** *Serial No.*	**Engineering Sample**
Wareneingangs-Nr.: *Receipt No.:*	**1803001638**	**Eingangsdatum:** *Date of receipt:*	**30.09.2013**
Prüfort: *Testing location:*	**Refer Page 4 of 29 for test facilities**		
Prüfgrundlage: *Test specification:*	**FCC Part 15, Subpart C**		
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test items passed the test specification(s).*		
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland (India) Pvt. Ltd.** 82/A, 3rd Main, West Wing, Electronic City Phase 1 Hosur Road, Bangalore – 560 100. India **FCC Registration No.: 176555; IC Assigned Code: 3466E**		

geprüft / *tested by:*			**kontrolliert /** *reviewed by:*		
30.09.2013	Saibaba Siddapur Engineer		07.10.2013	Raghavendra Kulkarni Sr.Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges /*Other Aspects:* **FCC ID : VW4A091729**

Abkürzungen:	***P(ass)***	***=***	***entspricht Prüfgrundlage***	***Abbreviations:***	***P(ass)***	***=***	***passed***
	F(ail)	***=***	***entspricht nicht Prüfgrundlage***		***F(ail)***	***=***	***failed***
	N/A	***=***	***nicht anwendbar***		***N/A***	***=***	***not applicable***
	N/T	***=***	***nicht getestet***		***N/T***	***=***	***not tested***

Test Result Summary

Clause	Test Item	Result
FCC 15.247(b) (3)	Maximum Conducted Peak Output Power	Pass
FCC 15.247(a) (2)	6dB Bandwidth	Pass
FCC 15.247(e)	Power Spectral Density	Pass
FCC 15.247(d)	Band-edge compliance	Pass
FCC 15.209 / FCC 15.205	Spurious Radiated Emissions and Restricted Bands of Operation	Pass
FCC 15.207	Conducted Emissions on A.C Power lines	Pass

Content

List of Type and Measurement Instruments 4

General Product Information 5

Product Function and Intended Use 5
Ratings and System Details 5

Test Set-up and Operation Mode 6

Principle of Configuration Selection 6
Test Operation and Test Software 6
Special Accessories and Auxiliary Equipment 6
Countermeasures to achieve EMC Compliance 6

Test Methodology 8

Radiated Emission Test 8

Test Results 9

Maximum Conducted Peak Output Power	**Section 15.247(b) (3) 9**
Power Spectral Density	**Section 15.247(e) 12**
6 dB Bandwidth	**Section 15.247(a) (2) 15**
Band-edge Compliance	**Section 15.247(d) 19**
Spurious Radiated Emissions and Restricted Bands of Operation	**Section 15.209 and 15.205 ..... 24**
Conducted Emission Test on A.C. Power Line	**Section 15.207 ..... 27**

Appendix 1: Test Setup Photo

Appendix 2: EUT External Photo

Appendix 3: EUT Internal Photo

Appendix 4: FCC Label and Label Location

Appendix 5: Block Diagram

Appendix 6: Specification of EUT

Appendix 7: Schematic Diagrams

Appendix 8: Bill of Material

Appendix 9: User Manual

Appendix 10: Maximum Permissible Exposure Calculation

List of Type and Measurement Instruments

Equipment	Manufacturer	Model	S/N	Calibration Due Date
EMI Test Receiver	Rohde &Schwarz	ESU 40	100288	04.10.2013
Hybrid Log Periodic antenna	ETS Lindgren	3142D	00081354	01.11.2013
Broadband Horn Antenna	Frankonia	HAX-18	HAX18-802	10.10.2013
Emission Horn Antenna	ETS Lindgren	116706	00107323	01.11.2013
Active Loop Antenna	Frankonia	LAX-10	LAX-10-800	01.11.2013
Spectrum Analyser	Agilent Technologies	E4407B	US41192772	22.03.2014

Testing Facilities:

1) TUV Rheinland (India) Private Limited
No. 108, West Wing
Electronic city Phase I
Bangalore – 560100

General Product Information

Product Function and Intended Use

The ZigBit RF233-Amp is a Zigbit module of the Atmel AT86RF233 radio transceiver and SE2431L integrated PA, LNA front end IC. Radio transceiver supports the worldwide accessible 2.4GHz ISM band.

The system is designed standard-based applications such as ZigBee/IEEE 802.15.4, ZigBee RF4CE, and 6LoWPAN, as well as high data rate ISM applications.

Ratings and System Details

Operating Frequency	2400MHz – 2483.5MHz
No. of channels	15
Channel Spacing	5MHz
Modulation	DSSS (O-QPSK)
Transmitted Power	23.26 dBm
Data Rate	250 kbps
Antenna Type	Ceramic Antenna
Number of antenna	One
Antenna Gain	0dBi
Supply Voltage	1.8V to 3.6VDC
Dimensions	20mm x 25mm
Environmental	-20°C to +85°C temperature range

Test Conditions:

Voltage: Voltage: 5 V DC (from USB Port)

Environmental conditions:

Temperature: +23 º C **RH:** 62%

Test Set-up and Operation Mode

Principle of Configuration Selection

Transmission was enabled with 100% duty cycle on low, mid and high channel.

Test Operation and Test Software

Hyper Terminal in the laptop was used to enable the transmission with 100% duty cycle and to change the channels in 2.4 GHz band on the EUT for the tests in this report.

Special Accessories and Auxiliary Equipment

- None

Countermeasures to achieve EMC Compliance

- None

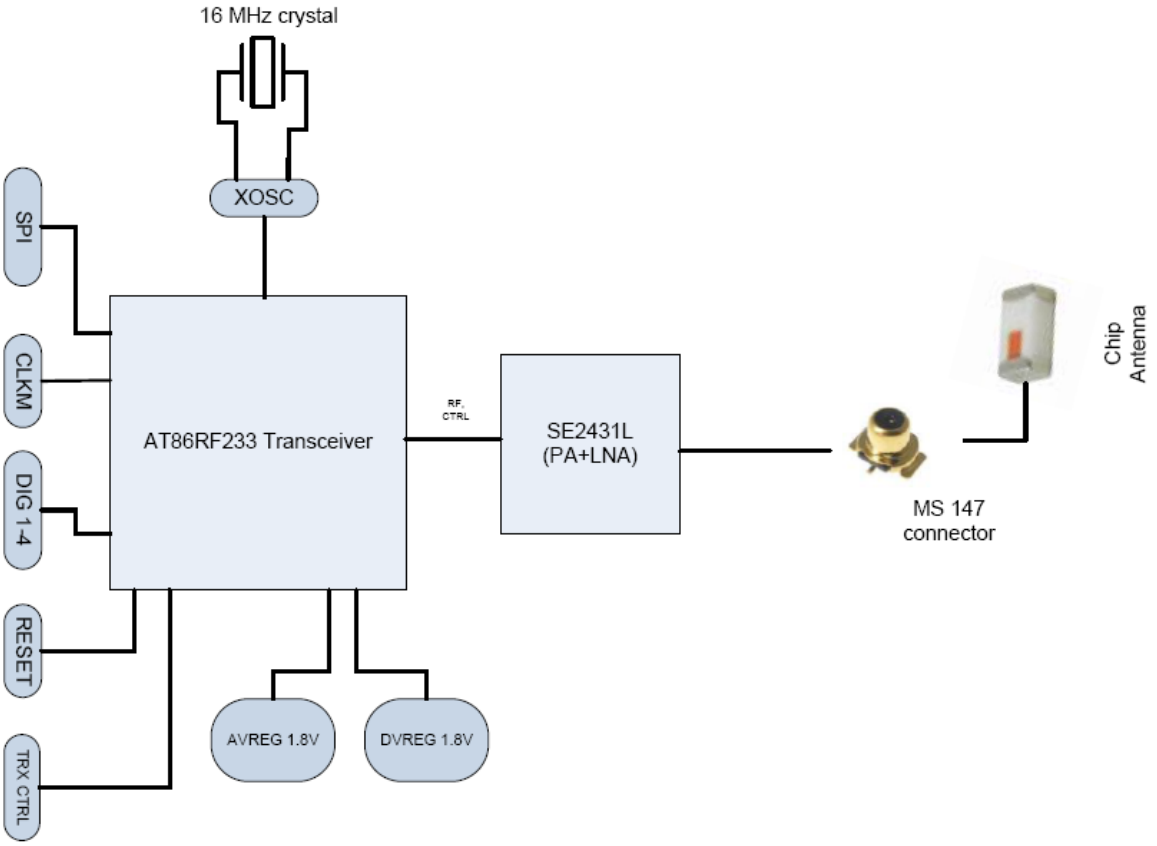
Table of frequencies

Frequency Band	Channel No.	Frequency (MHz)
2400-2483.5 MHz	11	2405
	12	2410
	13	2415
	14	2420
	15	2425
	16	2430
	17	2435
	18	2440
	19	2445
	20	2450
	21	2455
	22	2460
	23	2465
	24	2470
	25	2475

Note: Testing carried with different register value for different channel as listed below

Channel	Register Value
Low (2405MHz)	0xD
Mid (2440MHz)	0x0
High (2475MHz)	0xE

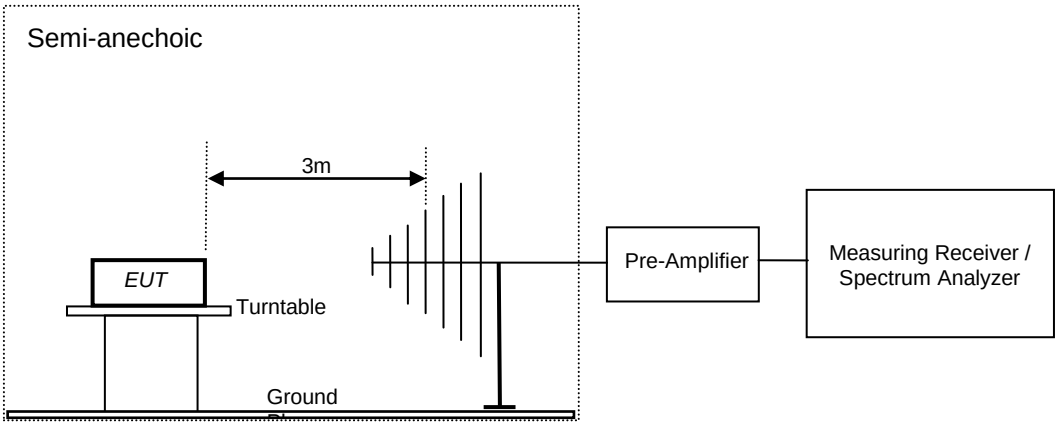
Block Diagram



Test Methodology

Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.4-2003. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable, and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360˚ for obtaining the maximum emission. The height of the measuring antennas was scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000MHz was performed by horn antenna. The measurement below 30MHz was performed by loop antenna.
The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded.

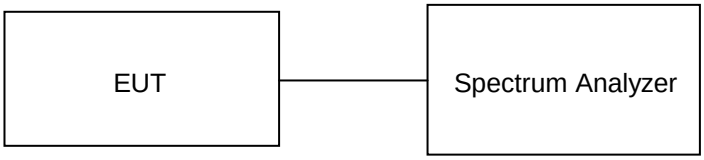


Test Results

Maximum Conducted Peak Output Power **Section 15.247(b) (3)**
Result **Pass**

Test Specification	FCC Part 15 Subpart C
Measurement Bandwidth (RBW)	1 MHz
Detector	Peak
Requirement	<1 watt (30dBm).

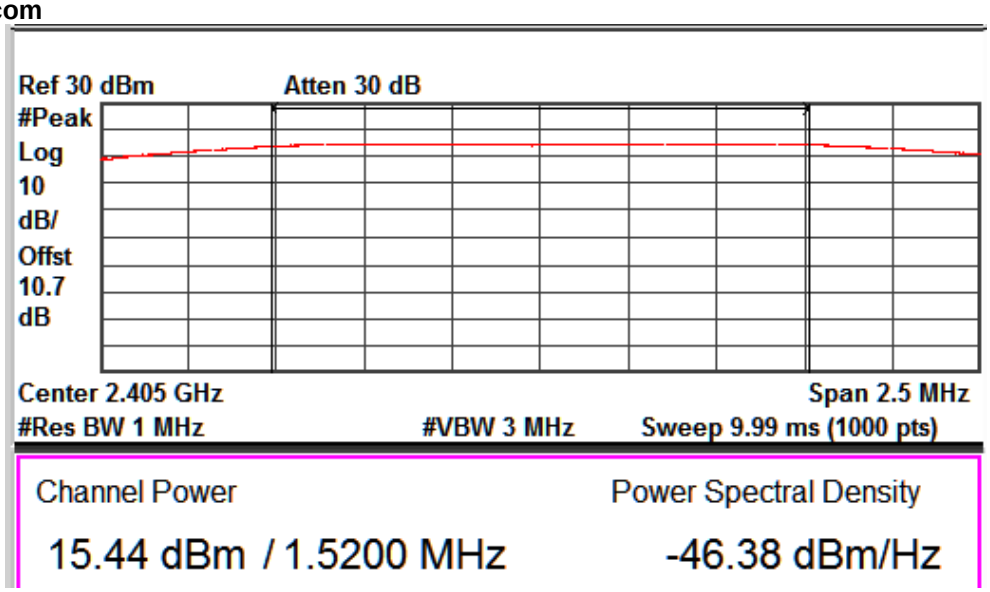
Test Method:



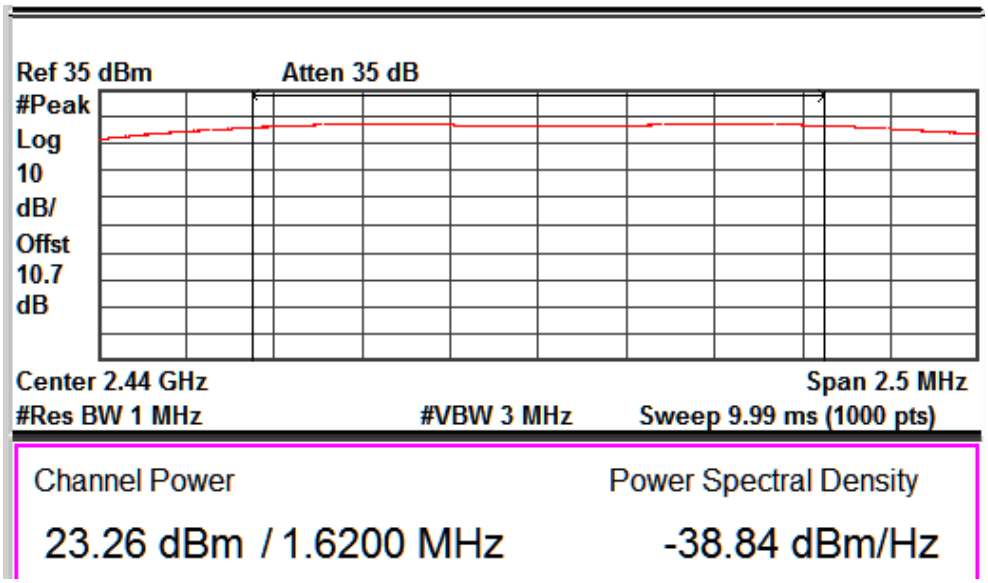
Cable Loss + Attenuation: 10.7dB (Included in the test results)

Test Result:

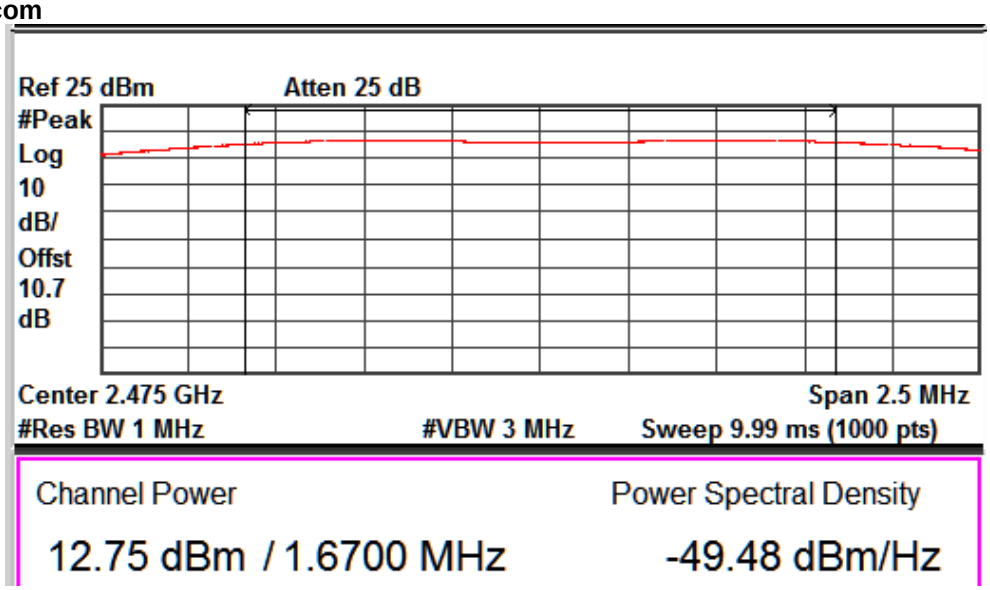
Frequency (MHz)	Total Output power (dBm)	Limit (dBm)	Margin (dB)
2405	15.44	30.00	-14.56
2440	23.26	30.00	-6.74
2475	12.75	30.00	-17.25



Channel Frequency: 2405 MHz



Channel Frequency: 2440 MHz

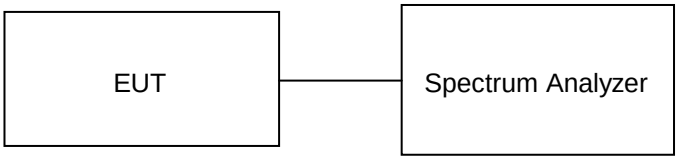


Channel Frequency: 2475 MHz

Power Spectral Density **Section 15.247(e)**
Result **Pass**

Test Specification	FCC Part 15 Subpart C
Detector Function	Peak
Requirement	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm.

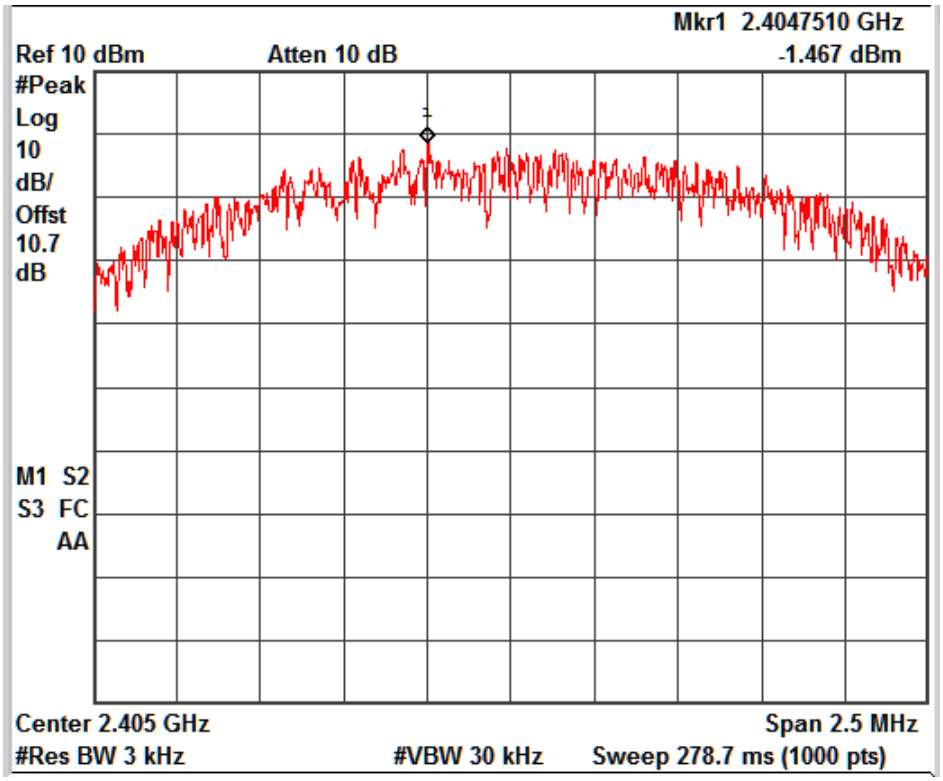
Test Method:



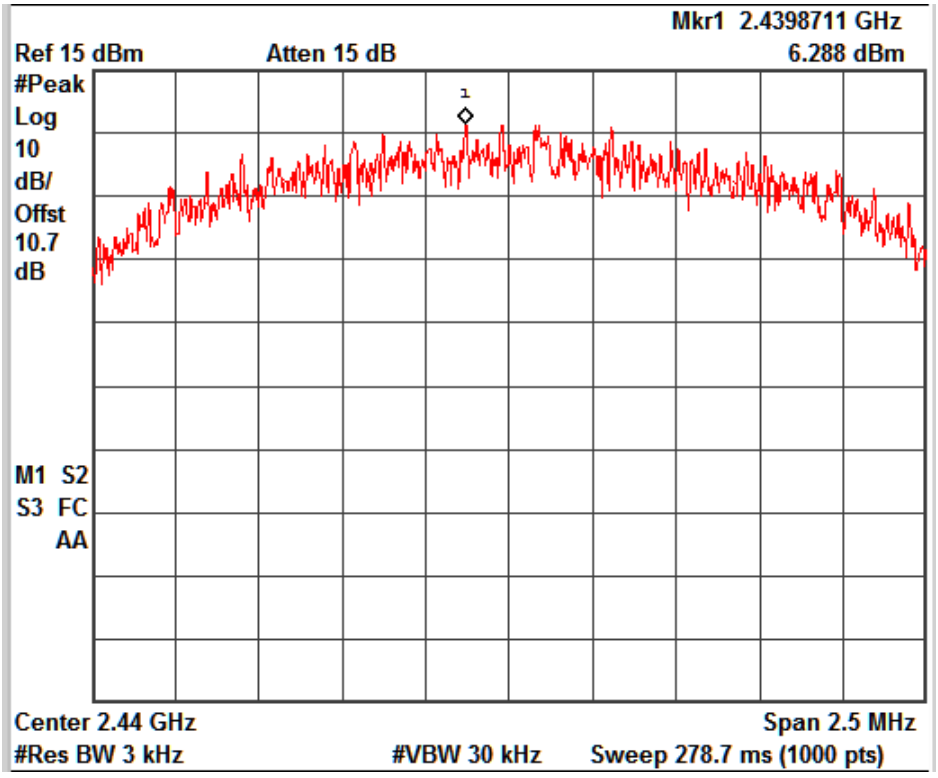
Cable Loss + Attenuation: 10.7dB (Included in the test results)

Test Result:

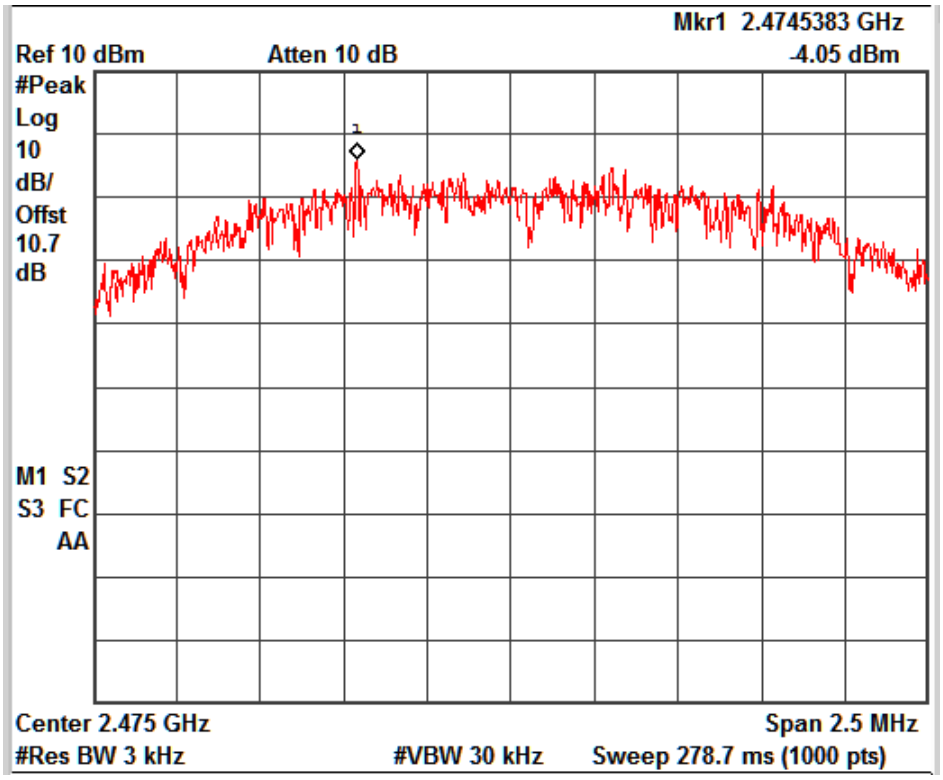
Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin(dB)
2405	-1.47	8.00	-9.47
2440	6.29	8.00	-1.71
2475	-4.05	8.00	-12.05



Channel Frequency: 2405 MHz



Channel Frequency: 2440 MHz

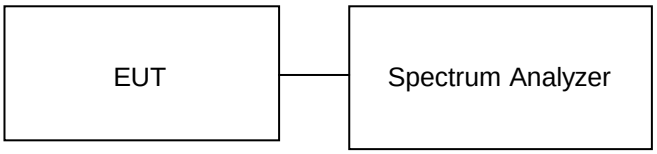


Channel Frequency: 2475 MHz

6 dB Bandwidth **Section 15.247(a) (2)**
Result **Pass**

Test Specification FCC Part 15 Subpart C
Requirement The minimum 6 dB bandwidth shall be at least 500 kHz.

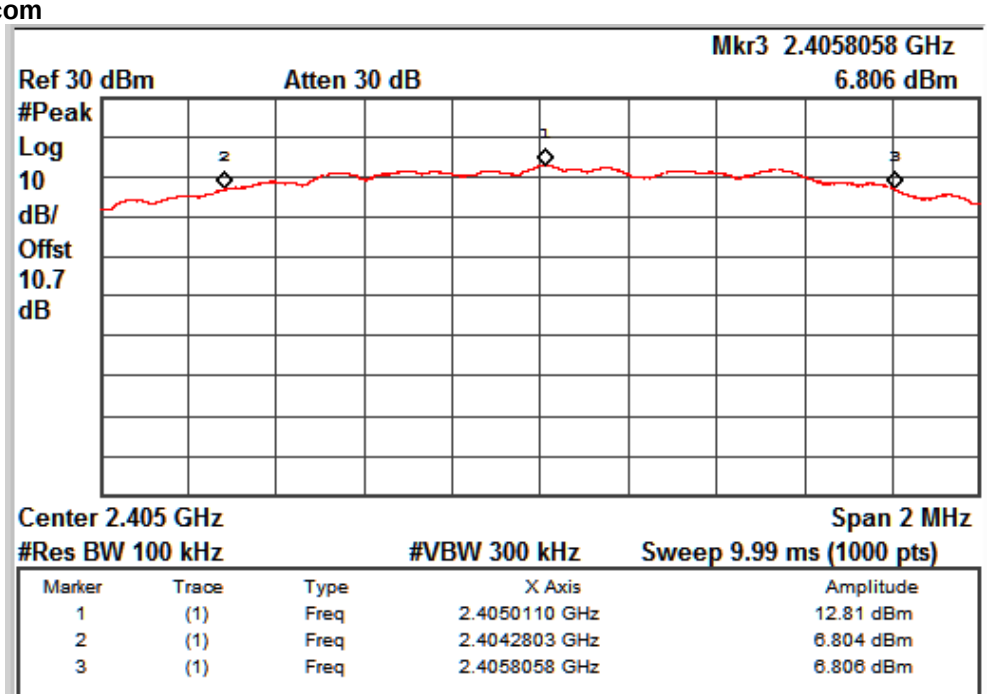
Test Method:



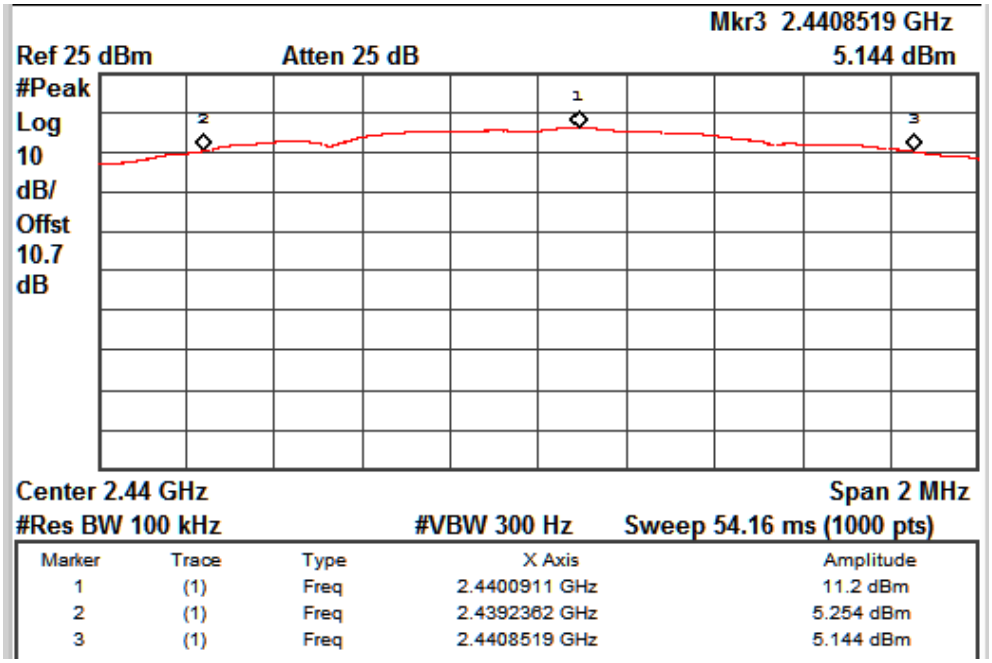
Cable Loss + Attenuation: 10.7dB (Included in the test results)

Test Result:

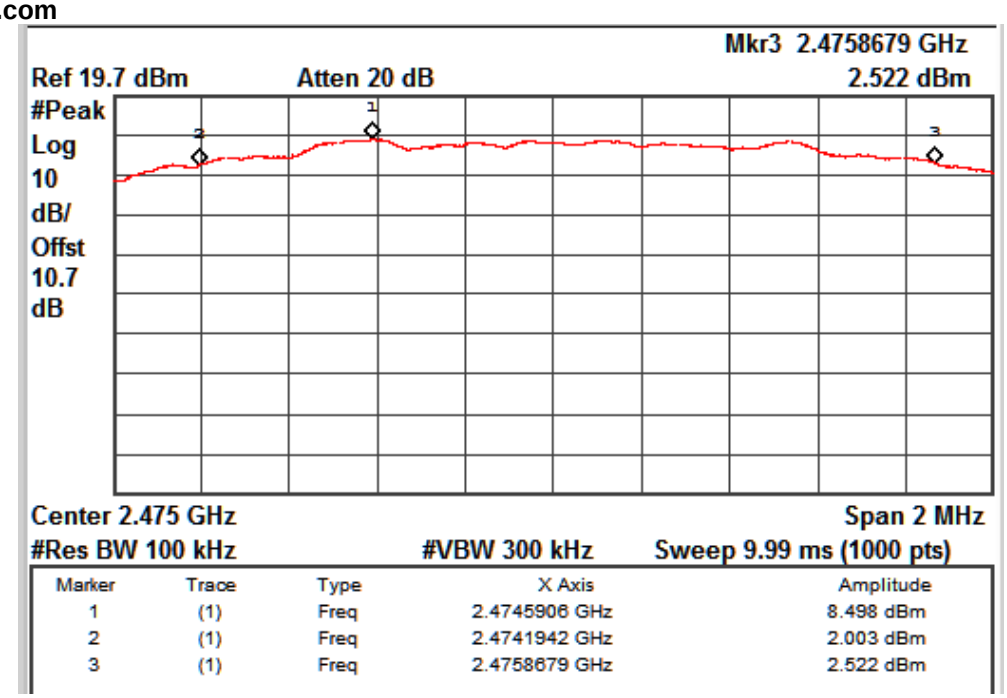
Frequency (MHz)	Lower Frequency (MHz)	Upper Frequency (MHz)	6 dB Bandwidth (MHz)	OBW (MHz)
2405	2404.28	2405.81	1.53	2.40
2440	2439.24	2440.85	1.62	2.47
2475	2474.19	2475.87	1.67	2.54



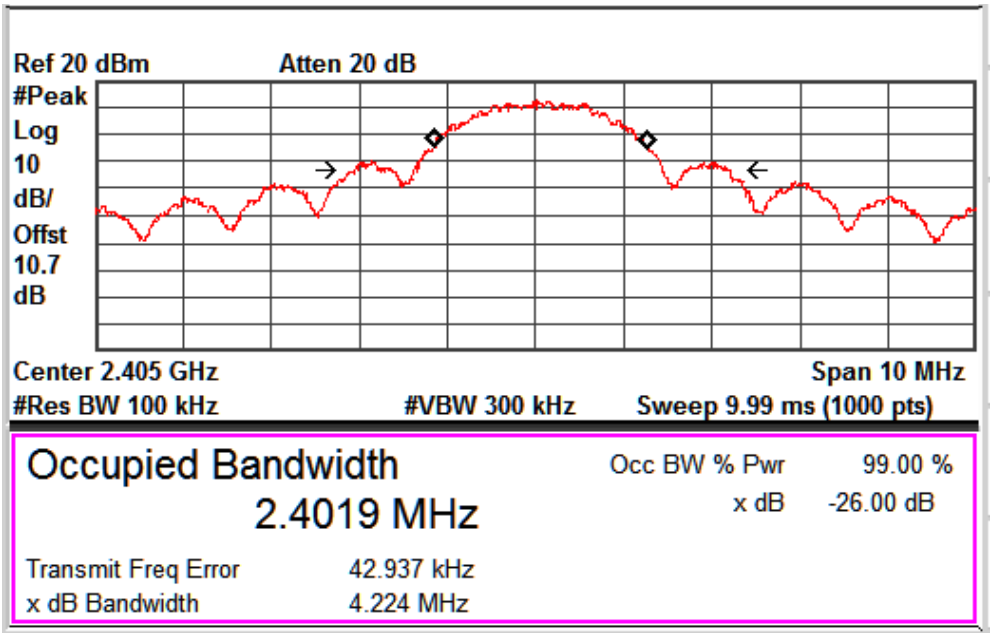
Channel frequency: 2405 MHz



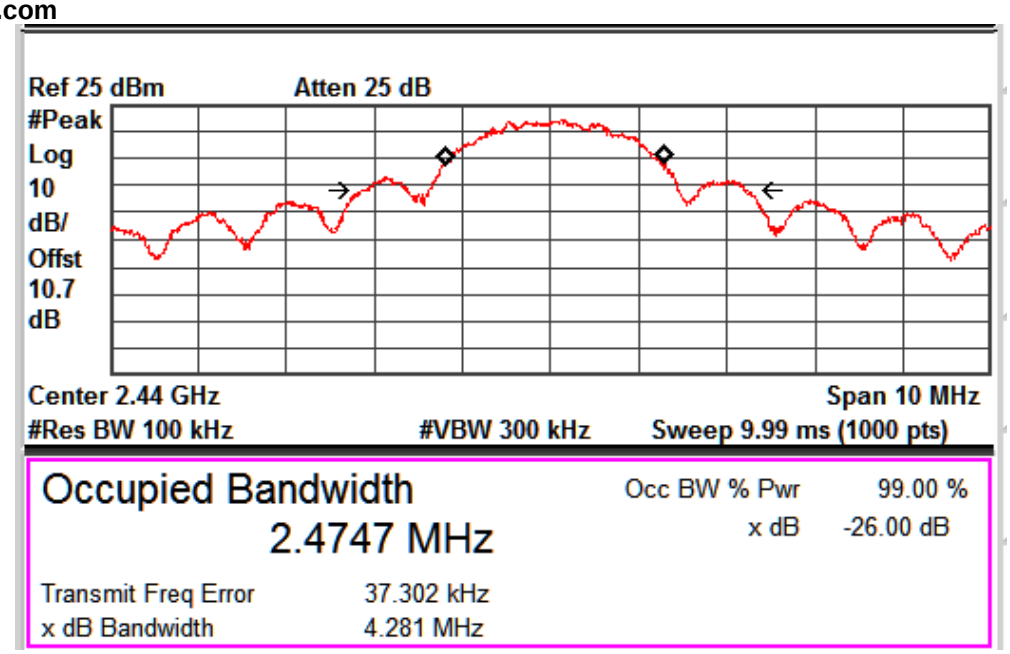
Channel frequency: 2440 MHz



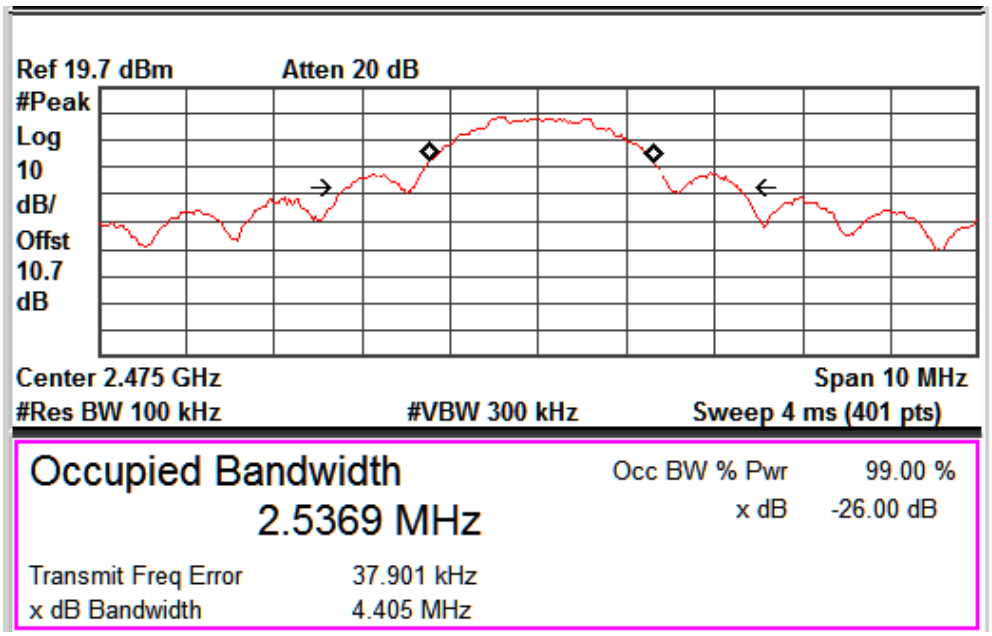
Channel frequency: 2475 MHz



OBW Channel frequency: 2405 MHz



OBW Channel frequency: 2440 MHz

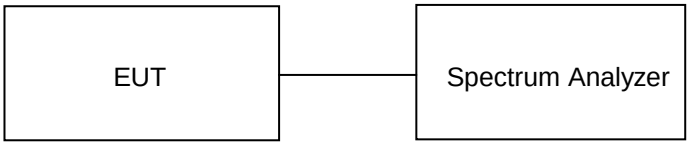


OBW Channel frequency: 2475 MHz

Band-edge Compliance **Section 15.247(d)**
Result **Pass**

Test Specification	FCC Part 15 Subpart C
Detector Function	Peak
Requirement	If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level. If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to 15.247(b)(3) requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

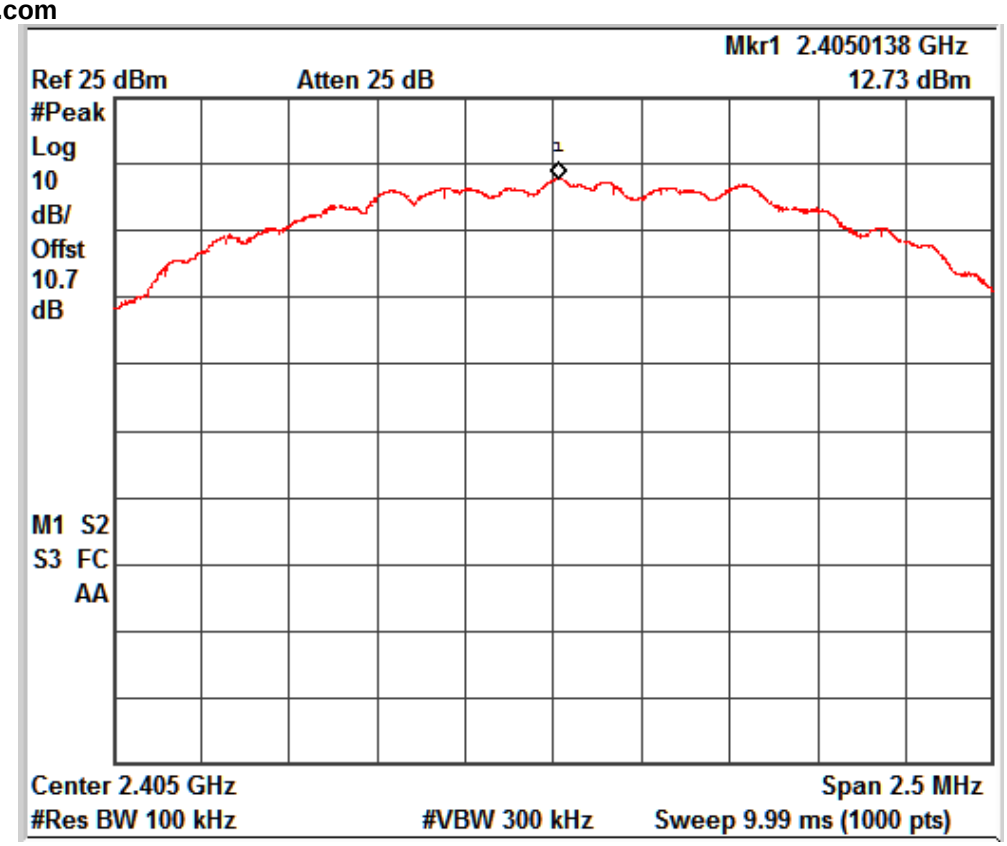
Test Method:



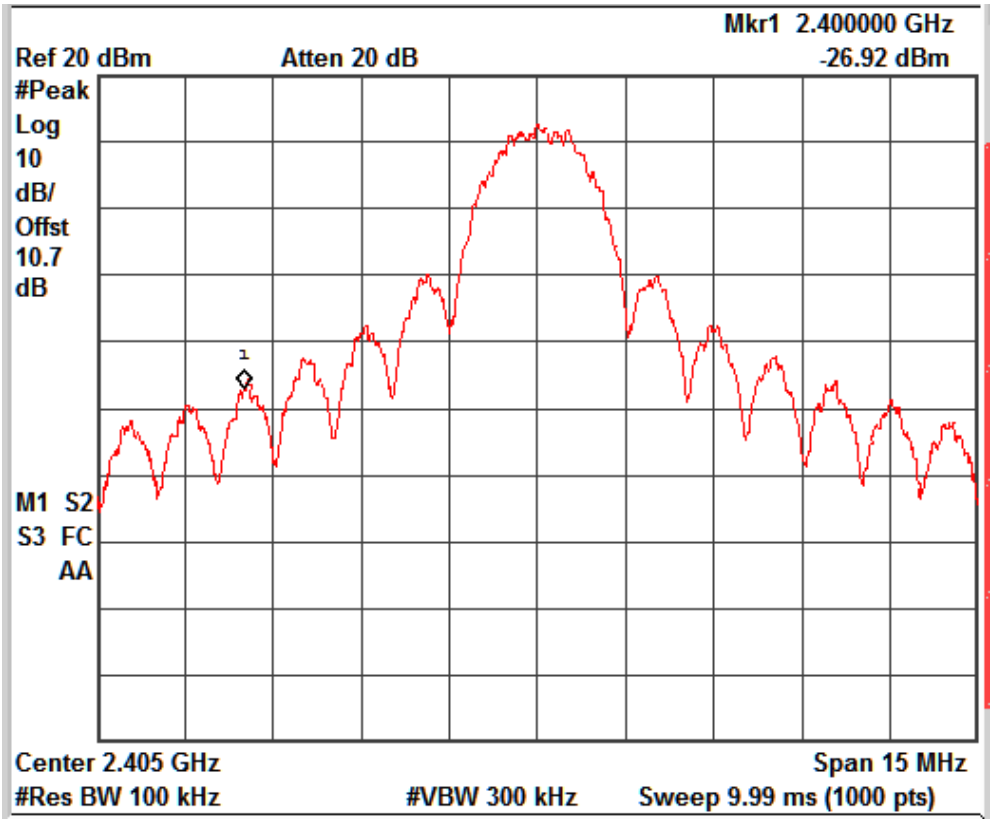
Cable Loss + Attenuation: 10.7dB (Included in the test results)

Test Result:

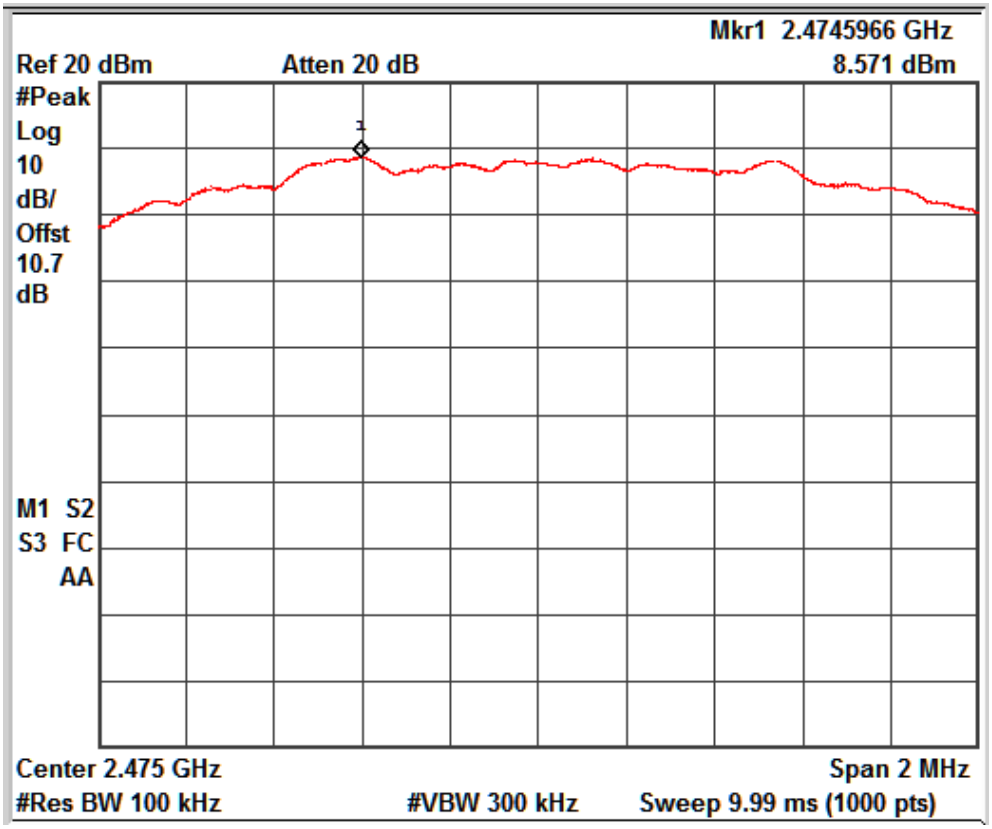
Channel Frequency (MHz)	Value at Band Edge				Limit (dB)
	Band Edge Frequency (MHz)	Reference Level (dBm)	Band Edge Value (dBm)	Value (dB)	
2405	2400.00	12.73	-26.92	-39.65	-20.00
2475	2483.50	08.57	-44.72	-53.29	-20.00



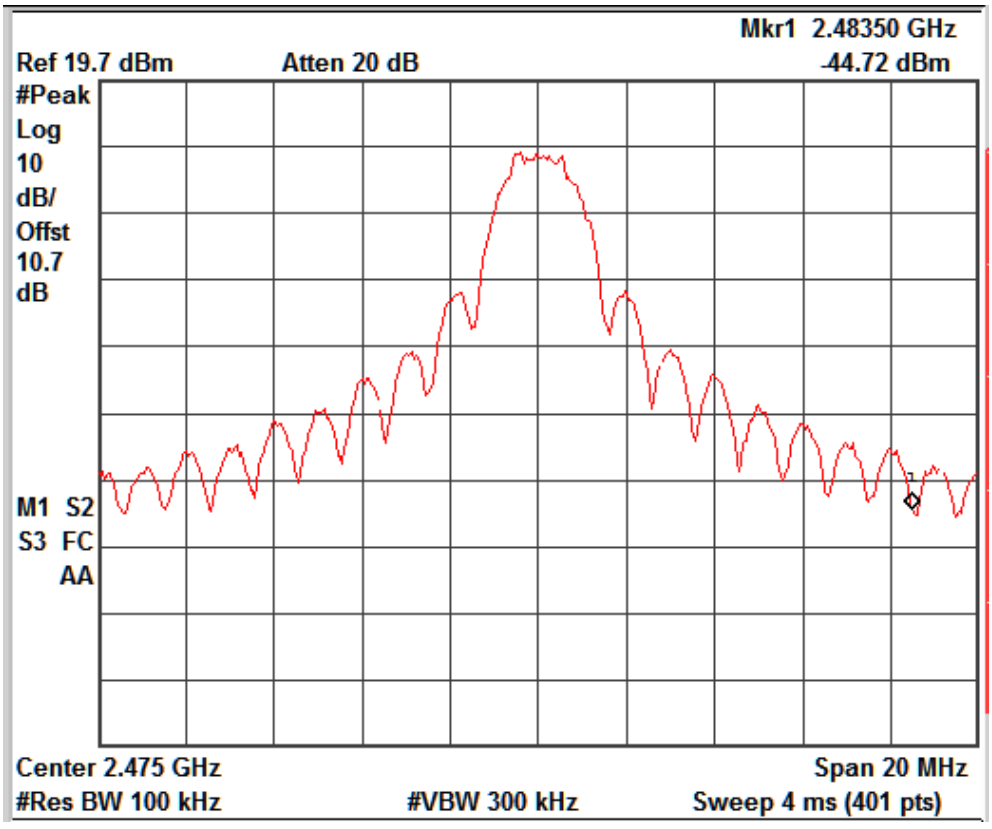
Reference Level: 2405 MHz



Channel frequency: 2405 MHz

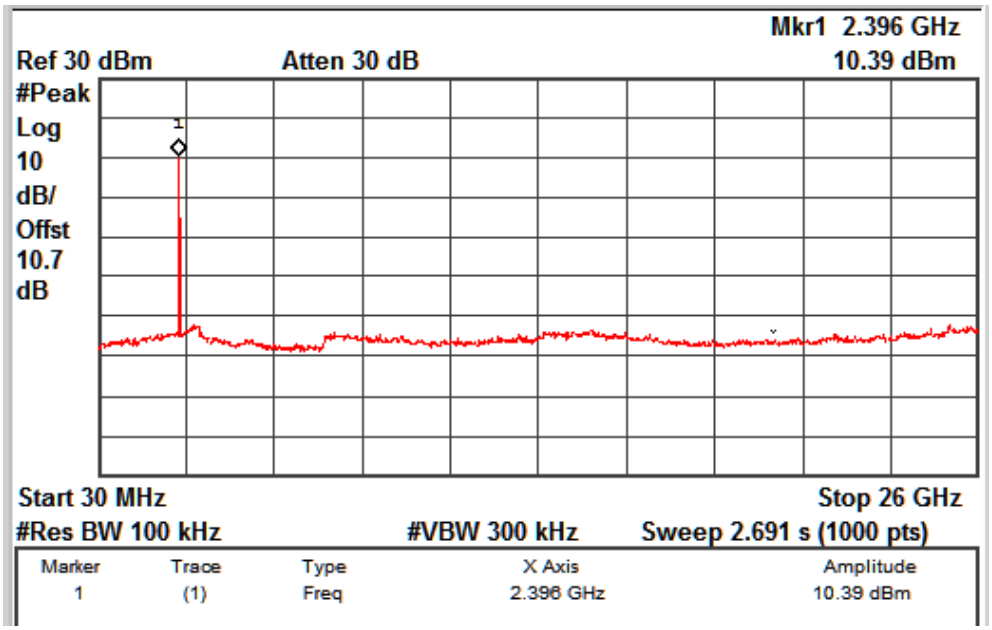


Reference Level: 2475 MHz

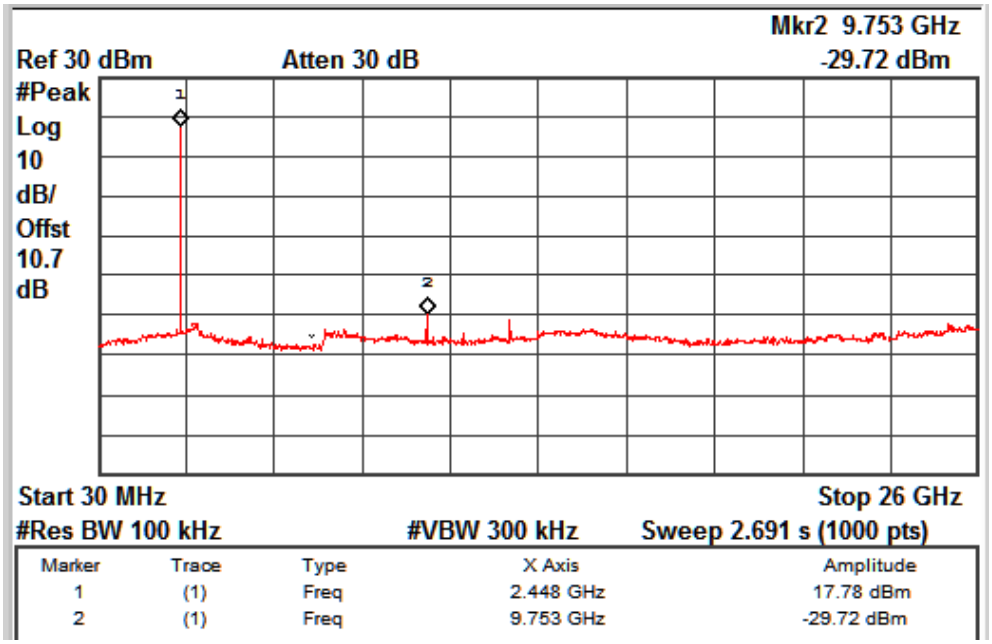


Channel frequency: 2475 MHz

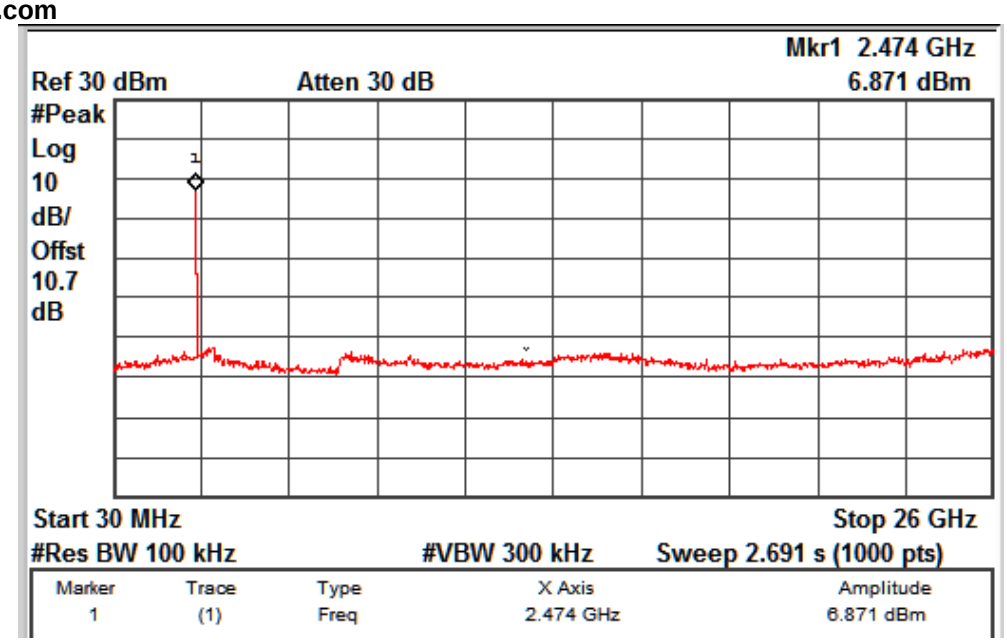
Conducted Spurious Emission



Channel frequency: 2405 MHz



Channel frequency: 2440 MHz



Channel frequency: 2475 MHz

Spurious Radiated Emissions and Restricted Bands of Operation **Section 15.209 and 15.205**

Result **Pass**

Test Specification	FCC Part 15 Subpart C
Measurement Location	Semi Anechoic Chamber
Measuring Distance	3m
Detection	QP for frequency below 1GHz, Peak and Average for frequency above 1GHz
Requirement	As per the limits mentioned in the bellow table

Limit for Radiated Emission of Section 15.209:

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Remark: * the limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 88, 50 – 53.80, 53.80 – 43.00 and 49.5dBµV/m at 3m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

Test result:

Emission below 1 GHz:

Worst case emissions observed are listed below.

Antenna Polarization	Frequency of Emission (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	143.00	21.45	43.50	-22.05
	174.91	23.95	43.50	-19.55
	195.87	25.82	43.50	-17.68
	237.87	32.36	46.00	-13.64
Horizontal	248.92	25.72	46.00	-20.28

Emission above 1 GHz:

Fundamental Frequency (MHz)	Antenna Polarization	Frequency of Emission (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2405	Vertical	2390(Pk)	51.99	74.00	-22.01
		2390(Av)	45.71	54.00	-08.29
		2405(Pk)	104.49	*	-
		2405(Av)	101.04	*	-
		4810(Pk)	54.56	74.00	-19.44
		4810(Av)	45.87	54.00	-08.13
		7215(Pk)	58.29	74.00	-15.71
		7215(Av)	44.54	54.00	-09.46
	Horizontal	2390(Pk)	56.13	74.00	-17.87
		2390(Av)	50.27	54.00	-03.73
		2405(Pk)	110.81	*	-
		2405(Av)	107.45	*	-
		4810(Pk)	57.99	74.00	-16.01
		4810(Av)	50.02	54.00	-03.98
		7215(Pk)	57.36	74.00	-16.64
		7215(Av)	45.82	54.00	-08.18
2440	Vertical	2440(Pk)	106.81	*	-
		2440(Av)	103.52	*	-
		4880(Pk)	54.77	74.00	-19.23
		4880(Av)	45.42	54.00	-08.58
		7320(Pk)	59.27	74.00	-14.73
		7320(Av)	45.44	54.00	-08.56
	Horizontal	2440(Pk)	117.37	*	-
		2440(Av)	114.01	*	-
		4880(Pk)	57.17	74.00	-16.83
		4880(Av)	49.04	54.00	-04.96
		7320(Pk)	58.93	74.00	-15.07
		7320(Av)	47.00	54.00	-07.00
2475	Vertical	2475(Pk)	97.22	*	-
		2475(Av)	93.78	*	-
		2483.5(Pk)	52.51	74.00	-21.49
		2483.5(Av)	42.88	54.00	-11.12
		4950(Pk)	50.04	74.00	-23.96
		4950(Av)	39.76	54.00	-14.24
		7425(Pk)	No Harmonics found		
		7425(Av)			
	Horizontal	2475(Pk)	104.23	*	-
		2475(Av)	100.63	*	-
		2483.5(Pk)	59.61	74.00	-14.39
		2483.5(Av)	51.05	54.00	-02.95
		4950(Pk)	52.49	74.00	-21.51
		4950(Av)	41.05	54.00	-12.95
		7425(Pk)	No Harmonics found		
		7425(Av)			

* - --> Fundamental Frequency
Pk--> Peak Detector
Av--> Average Detector

Conducted Emission Test on A.C. Power Line **Section 15.207**
Result **Pass**

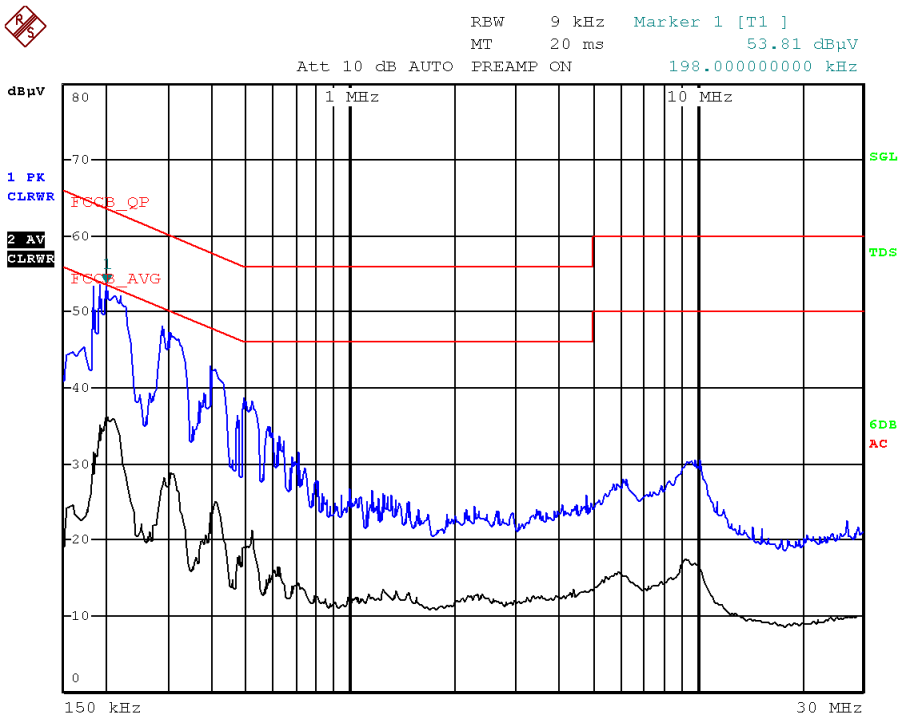
Test Specification	:	FCC Part 15 Section 15.207
Test Method	:	ANSI C63.4-2003
Testing Location	:	Screened room
Measurement Bandwidth	:	9kHz
Frequency Range	:	150kHz – 30MHz
Supply Voltage	:	120VAC,60Hz

Limit of section 15.207

Frequency of Emission (MHz)	QP Limit (dBµV)	AV Limit (dBµV/m)
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

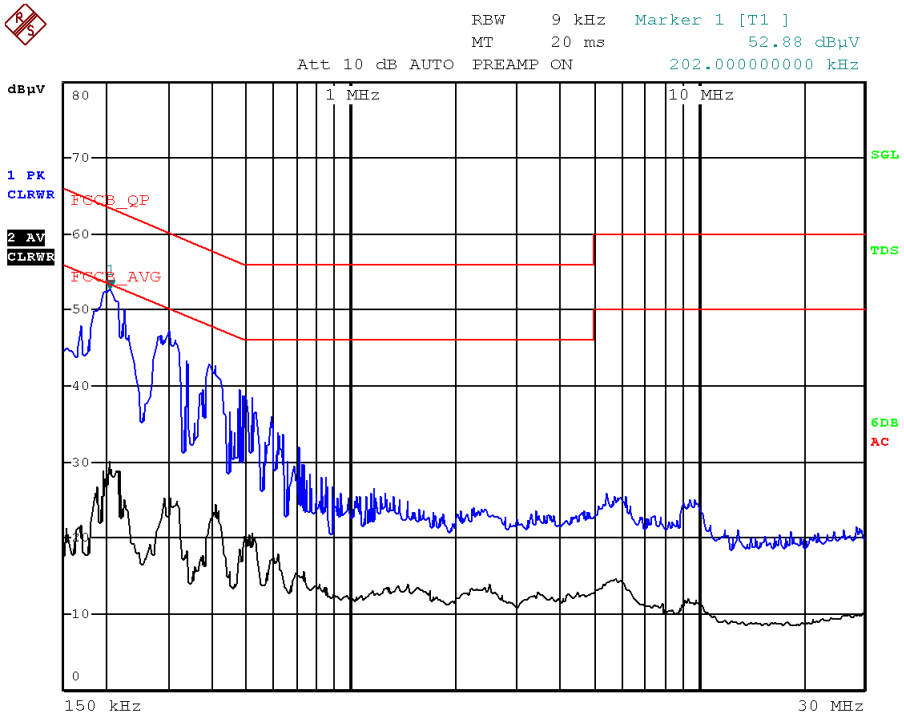
* Decreases with the logarithm of the frequency

Test Result:



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCCB_QP		
Trace2:	FCCB_AVG		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	198 kHz	48.44 L1	-15.24
2 Average	198 kHz	36.06 L1	-17.62
1 Quasi Peak	182 kHz	46.53 L1	-17.85
1 Quasi Peak	286 kHz	42.03 L1	-18.60
1 Quasi Peak	394 kHz	38.20 L1	-19.77
2 Average	298 kHz	28.53 L1	-21.76
1 Quasi Peak	494 kHz	33.55 L1	-22.55
2 Average	406 kHz	24.53 L1	-23.19
1 Quasi Peak	474 kHz	30.30 L1	-26.13
2 Average	518 kHz	19.67 L1	-26.32
1 Quasi Peak	586 kHz	28.57 L1	-27.42
2 Average	9.258 MHz	16.76 L1	-33.23
1 Quasi Peak	10.142 MHz	23.71 L1	-36.28

Mode: Line



EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB_QP
Trace2:	FCCB_AVG
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV		DELTA LIMIT dB
1 Quasi Peak	202 kHz	48.89	N	-14.63
1 Quasi Peak	298 kHz	42.93	N	-17.36
1 Quasi Peak	390 kHz	37.67	N	-20.39
1 Quasi Peak	334 kHz	37.59	N	-21.76
1 Quasi Peak	522 kHz	32.52	N	-23.47
1 Quasi Peak	486 kHz	32.56	N	-23.67
2 Average	406 kHz	23.10	N	-24.62
1 Quasi Peak	478 kHz	31.52	N	-24.85
2 Average	202 kHz	28.61	N	-24.91
2 Average	298 kHz	25.10	N	-25.19
2 Average	522 kHz	19.98	N	-26.01
1 Quasi Peak	446 kHz	29.75	N	-27.19

Mode: Neutral