


**Produkte**  
*Products*

<b>Prüfbericht - Nr.:</b>		<b>19660066 001</b>		<b>Seite 1 von 29</b>	
<i>Test Report No.:</i>		<i>Page 1 of 29</i>			
<b>Auftraggeber:</b> <i>Client:</i>		<b>ATMEL NORWAY AS</b> <b>VESTRE ROSTEN 79</b> <b>7075 TILLER</b> <b>TRONDHEIM</b> <b>NORWAY – 7075</b>			
<b>Gegenstand der Prüfung:</b> <i>Test item:</i>		<b>2.4GHz ZigBit with ATmega256RFR2 and UFL connector</b>			
<b>Bezeichnung:</b> <i>Identification:</i>		<b>ATZB-S1-256-3-0-UF</b>	<b>Serien-Nr.:</b> <i>Serial No.</i>	<b>Engineering Sample</b>	
<b>Wareneingangs-Nr.:</b> <i>Receipt No.:</i>		<b>1803029223</b>	<b>Eingangsdatum:</b> <i>Date of receipt:</i>	<b>12.01.2014</b>	
<b>Prüfort:</b> <i>Testing location:</i>		<b>Refer Page 4 of 29 for test facilities</b>			
<b>Prüfgrundlage:</b> <i>Test specification:</i>		<b>FCC Part 15, Subpart C</b>			
<b>Prüfergebnis:</b> <i>Test Result:</i>		<b>Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).</b> <i>The test items passed the test specification(s).</i>			
<b>Prüflaboratorium:</b> <i>Testing Laboratory:</i>		<b>TÜV Rheinland (India) Pvt. Ltd.</b> 82/A, 3rd Main, West Wing, Electronic City Phase 1 Hosur Road, Bangalore – 560 100. India <b>FCC Registration No.: 176555; IC Assigned Code: 3466E</b>			
<b>geprüft / tested by:</b>			<b>kontrolliert / reviewed by:</b>		
14.01.2014	Saibaba Siddapur Engineer		24.01.2014	Raghavendra Kulkarni Sr.Manager	
<b>Datum</b> <i>Date</i>	<b>Name/Stellung</b> <i>Name/Position</i>	<b>Unterschrift</b> <i>Signature</i>	<b>Datum</b> <i>Date</i>	<b>Name/Stellung</b> <i>Name/Position</i>	<b>Unterschrift</b> <i>Signature</i>
<b>Sonstiges / Other Aspects:</b> <b>FCC ID:VW4092107</b>					
<b>Abkürzungen:</b>		<b>P(ass) = entspricht Prüfgrundlage</b>	<b>Abbreviations:</b>		<b>P(ass) = passed</b>
<b>F(ail) = entspricht nicht Prüfgrundlage</b>					<b>F(ail) = failed</b>
<b>N/A = nicht anwendbar</b>					<b>N/A = not applicable</b>
<b>N/T = nicht getestet</b>					<b>N/T = not tested</b>
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.</i>					

**Test Result Summary**

<b>Clause</b>	<b>Test Item</b>	<b>Result</b>
FCC 15.247(b) (3)	Maximum Conducted Peak Output Power	Pass
FCC 15.247(e)	Power Spectral Density	Pass
FCC 15.247(a) (2)	6dB Bandwidth	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

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**List of Type and Measurement Instruments**

Equipment	Manufacturer	Model	S/N	Calibration Due Date
EMI Test Receiver	Rohde & Schwarz	ESU 40	100288	04.10.2014
Hybrid Log Periodic antenna	ETS Lindgren	3142D	00081354	01.11.2014
Broadband Horn Antenna	Frankonia	HAX-18	HAX18-802	10.10.2014
Emission Horn Antenna	ETS Lindgren	116706	00107323	01.11.2014
Active Loop Antenna	Frankonia	LAX-10	LAX-10-800	01.11.2014
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 RFR2 UFL is a ZigBit module of the Atmel ATmega256RFR2. The IC integrates a powerful, 8-bit AVR® RISC microcontroller, an IEEE 802.15.4-compliant transceiver, and additional peripheral features. The built-in 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. Module has a unique antenna connector- U.FL (U.FL-R-SMT-1(10)).

### Ratings and System Details

Operating Frequency	2400MHz – 2483.5MHz
No. of channels	16
Channel Spacing	5MHz
Modulation	DSSS ( O-QPSK)
Transmitted Power	4.65dBm
Data Rate	250 kbps
Antenna Type	Refer Page 6 of 29
Number of antenna	One
Antenna Gain	Refer Page 6 of 29
Supply Voltage	1.8V to 3.6VDC
Dimensions	33 mm x 20 mm x 0.7mm
Environmental	-40 to +125 degrees C range

### Test Conditions:

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

### Environmental conditions:

**Temperature:** +23 °C    **RH:** 62%

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## 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

Test software (Atmel Studio 6.1) was used to enable the transmission with 100% duty cycle and 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

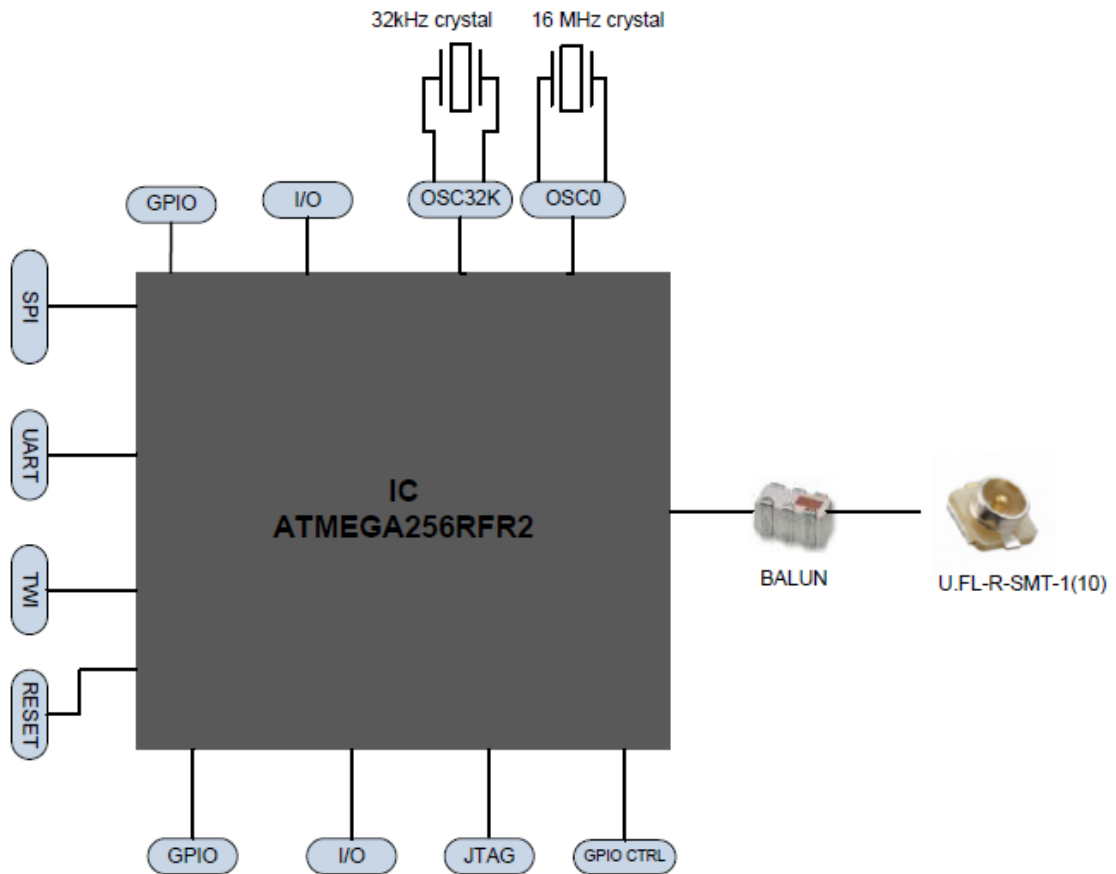
Frequency Band	Channel No.	Frequency (MHz)
2400-2483.5 MHz	11	2405
	12	2410
	13	2415
	14	2420
	15	2425
	16	2430
	17	2435
	18	2440
	19	2445
	20	2450
	21	2455
	22	2460
	23	2465
	24	2470
	25	2475
	26	2480

### Antenna Used

Make	Model/Part #	Antenna Gain (dBi)	Type of Antenna
RF SOLUTIONS	ANT-24G-S21-P5FL	0dBi	PIG TAIL
TEK FUN	M07-FL	5dBi	STUBBY

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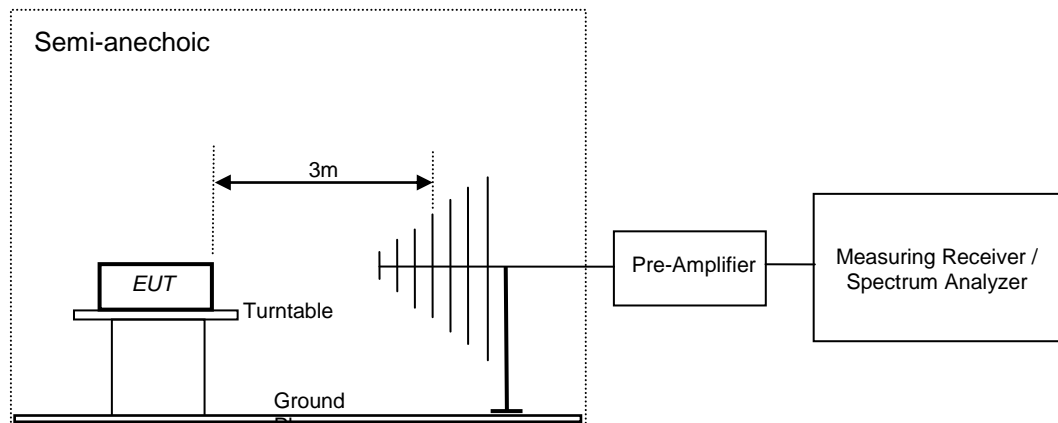
## Block Diagram



## 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.





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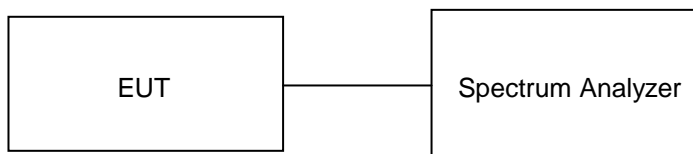
## Test Results

### Maximum Conducted Peak Output Power Result

Section 15.247(b) (3)  
Pass

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

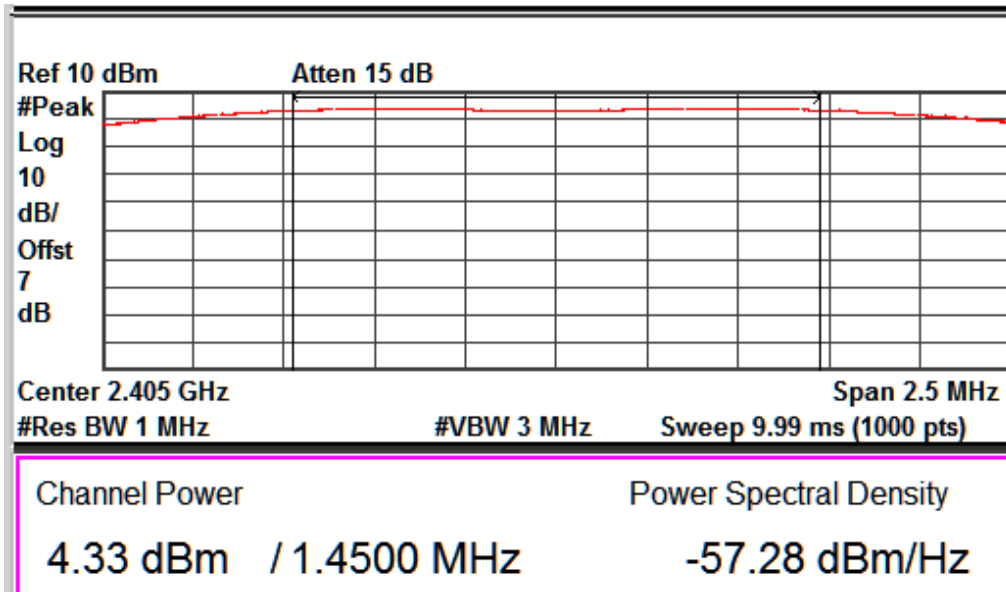
### Test Method:



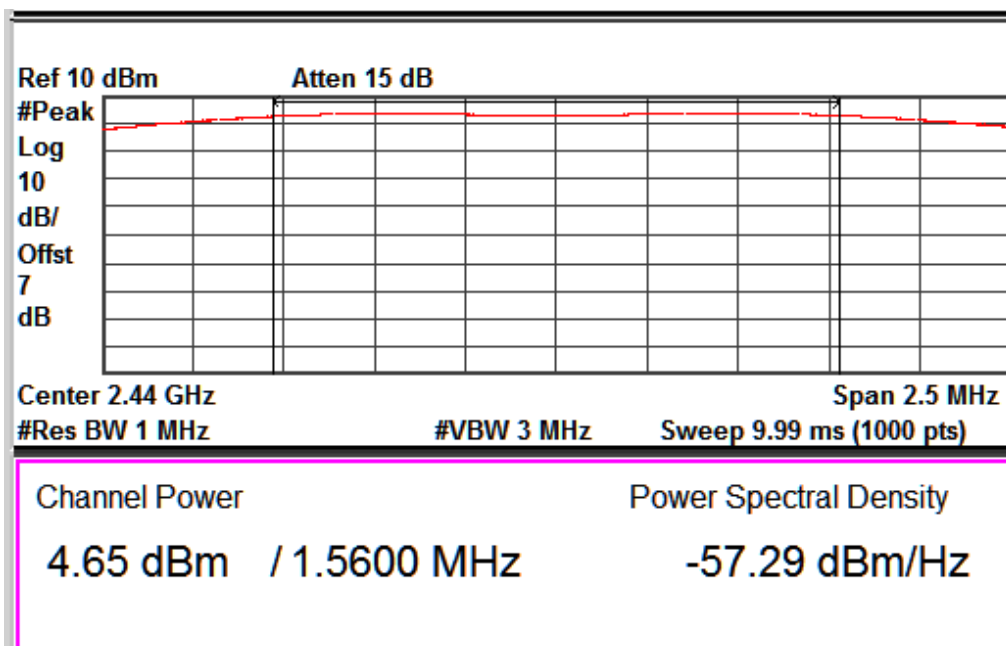
Attenuator +Cable Loss: 7dB (Included in the test results)

### Test Result:

Frequency (MHz)	Total Output power (dBm)	Limit (dBm)	Margin (dB)
2405	4.33	30	-25.67
2440	4.65	30	-25.35
2480	4.54	30	-25.46

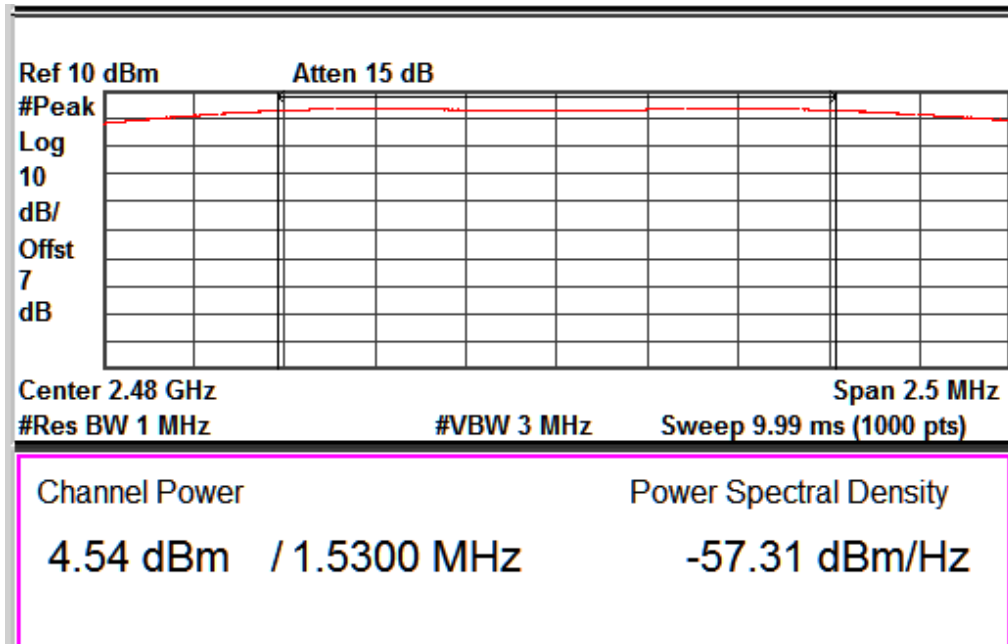


Channel Frequency: 2405 MHz



Channel Frequency: 2440 MHz

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Channel Frequency: 2480 MHz

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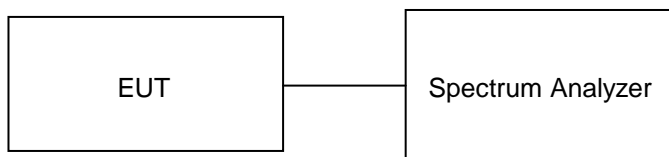
**Power Spectral Density  
Result**

**Section 15.247(e)  
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:**

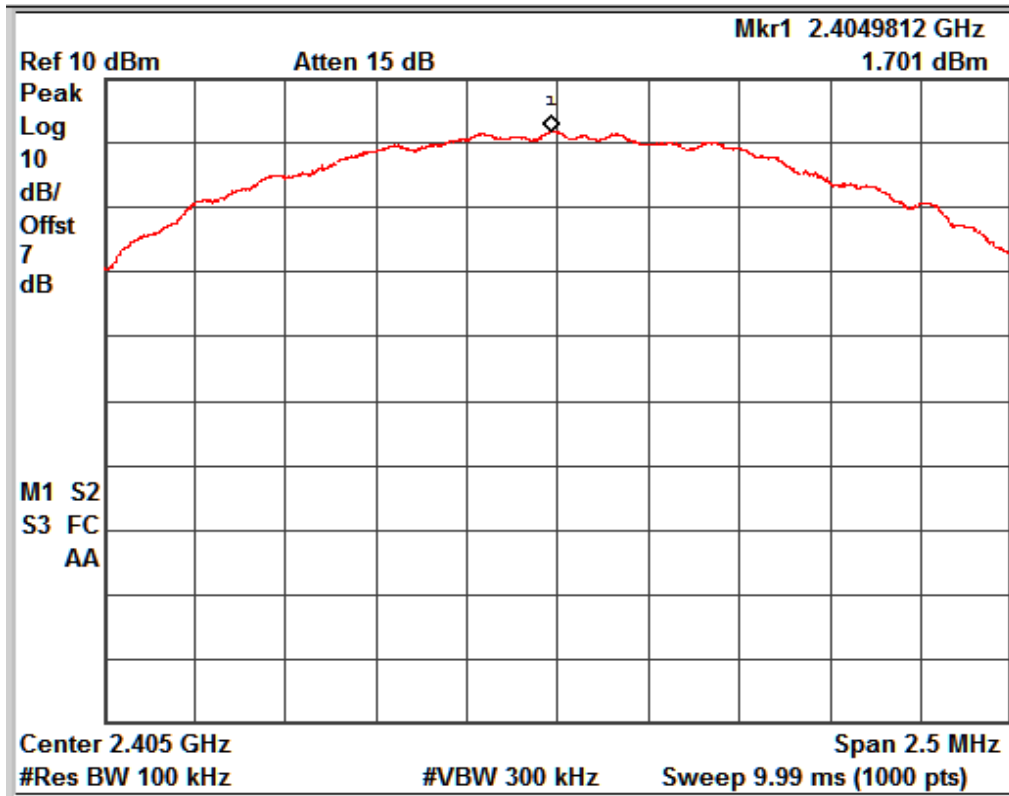


Attenuator +Cable Loss: 7dB (Included in the test results)

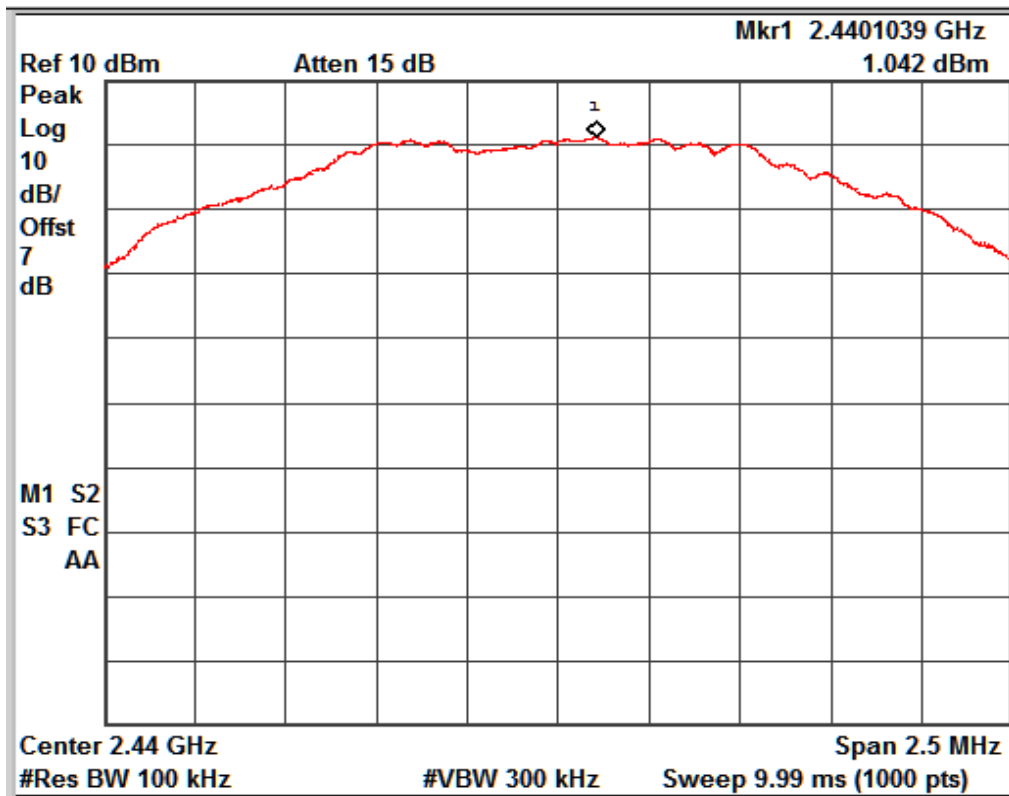
**Test Result:**

Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin(dB)
2405	1.70	8	-6.3
2440	1.02	8	-6.98
2480	0.87	8	-7.13

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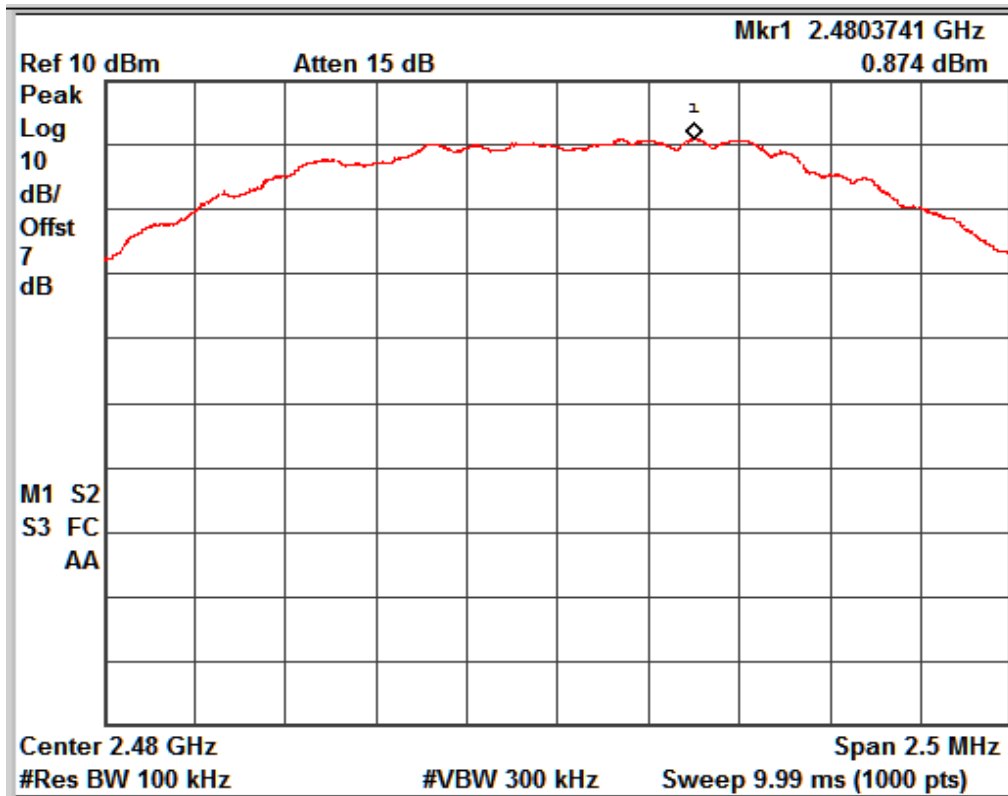


Channel Frequency: 2405 MHz



Channel Frequency: 2440 MHz

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Channel Frequency: 2480 MHz

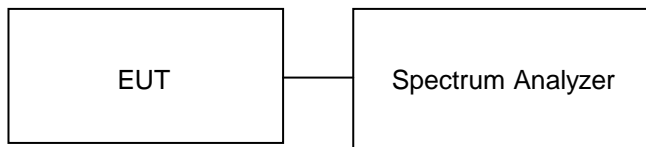
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**6 dB Bandwidth  
Result**

**Section 15.247(a) (2)  
Pass**

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

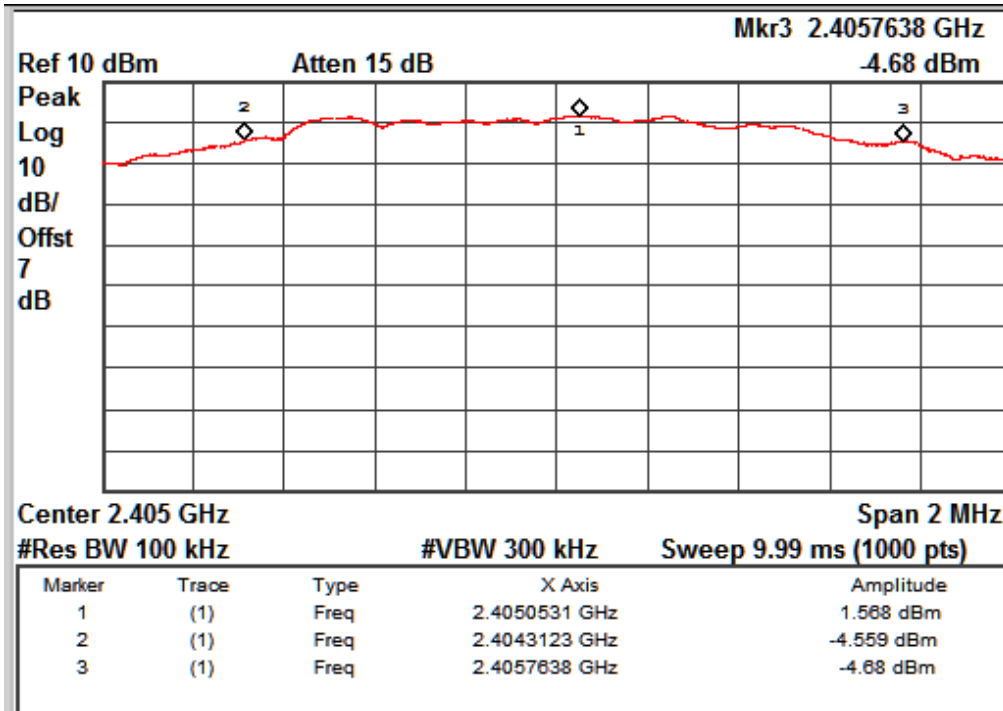
**Test Method:**



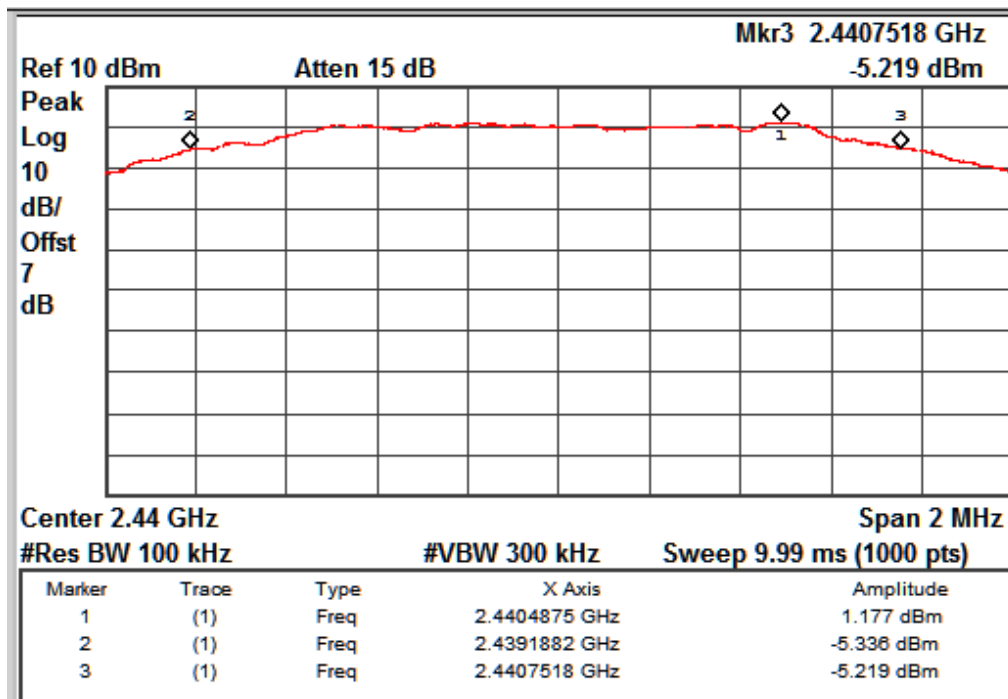
Attenuator +Cable Loss: 7dB (Included in the test results)

**Test Result:**

Frequency (MHz)	Lower Frequency (MHz)	Upper Frequency (MHz)	6 dB Bandwidth (MHz)	OBW (MHz)
2405	2404.31	2405.76	1.45	2.19
2440	2439.18	2440.75	1.57	2.22
2480	2479.2	2480.74	1.54	2.22

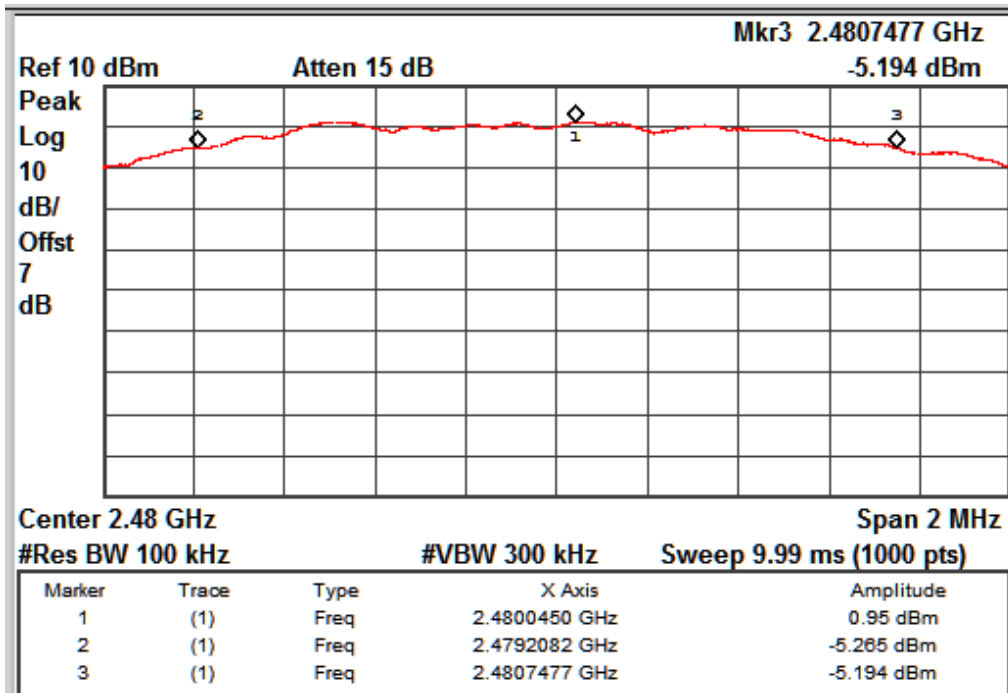


Channel frequency: 2405 MHz

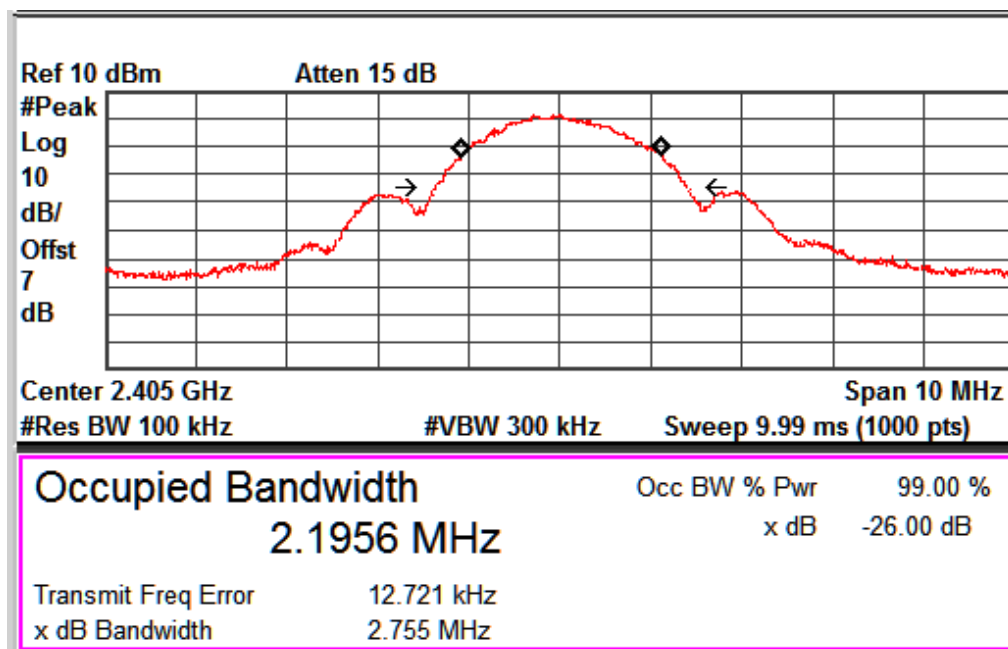


Channel frequency: 2440 MHz

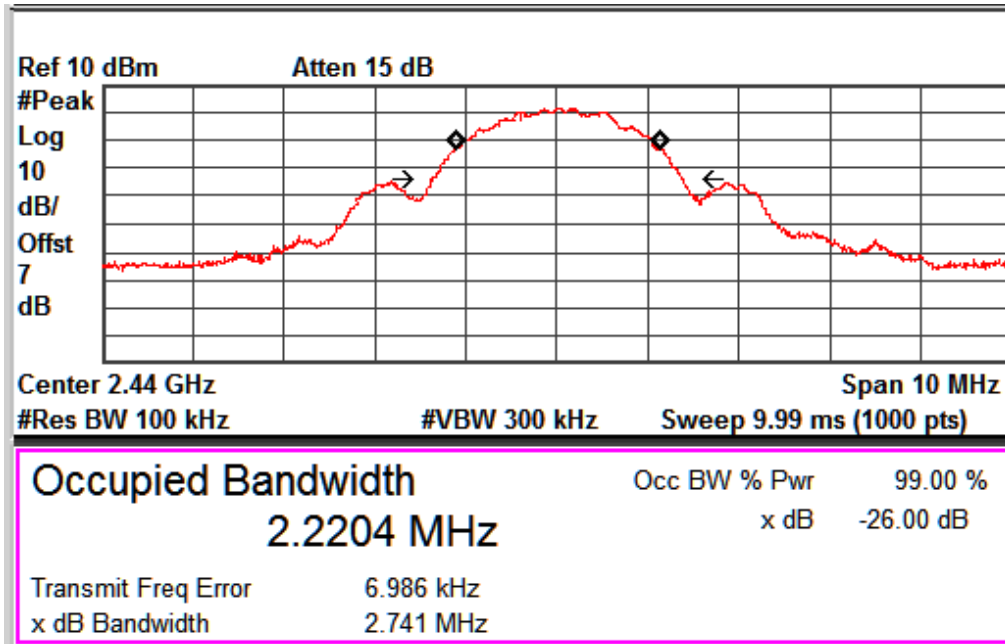




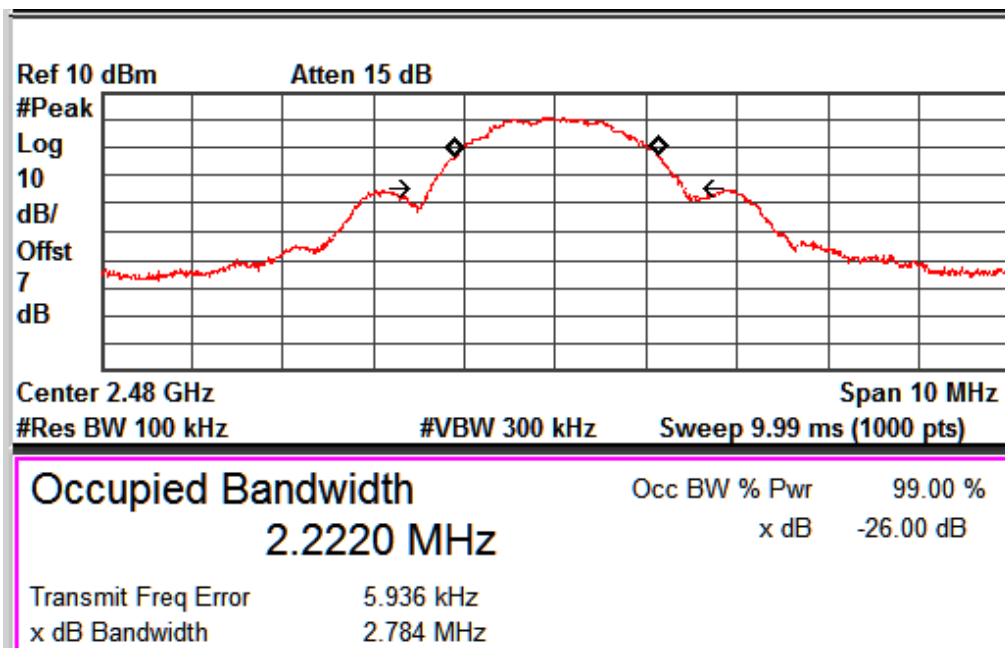
Channel frequency: 2480 MHz



OBW Channel frequency: 2405 MHz



OBW Channel frequency: 2440 MHz



OBW Channel frequency: 2480 MHz

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**Band-edge Compliance  
Result**

**Section 15.247(d)  
Pass**

Test Specification

FCC Part 15 Subpart C

Detector Function

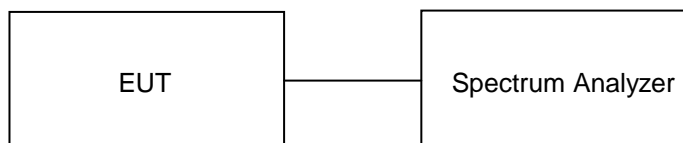
Peak

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:**



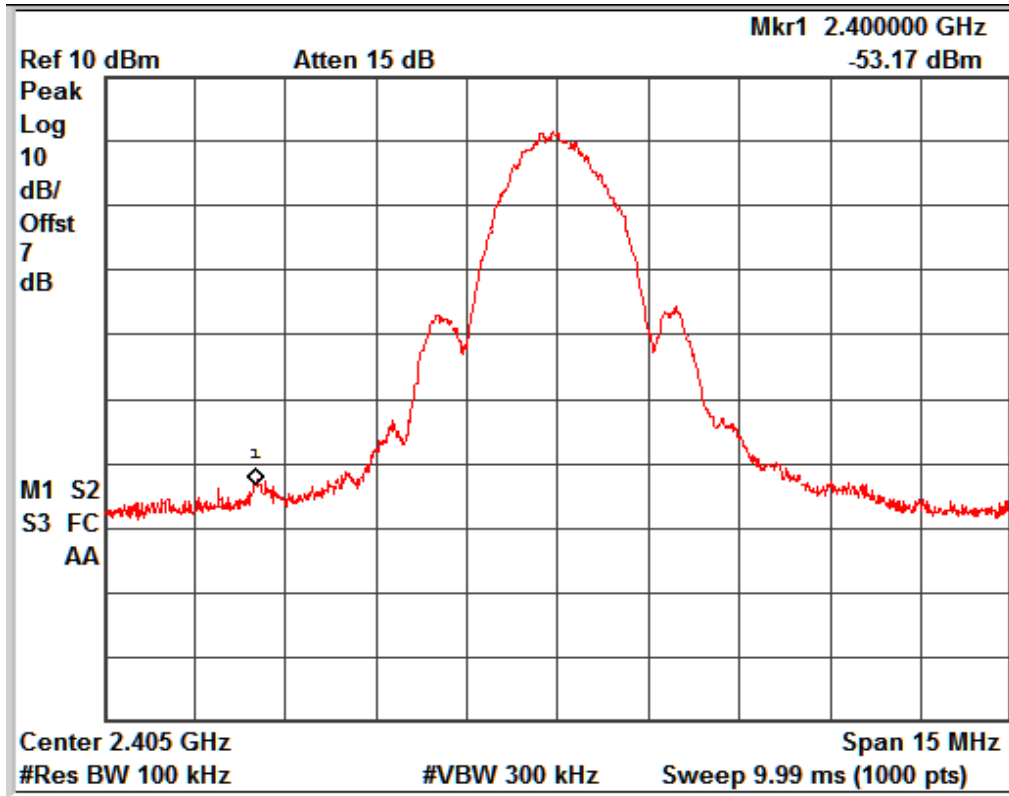
Attenuator + Cable Loss: 7dB (Included in the test results)

**Test Result:**

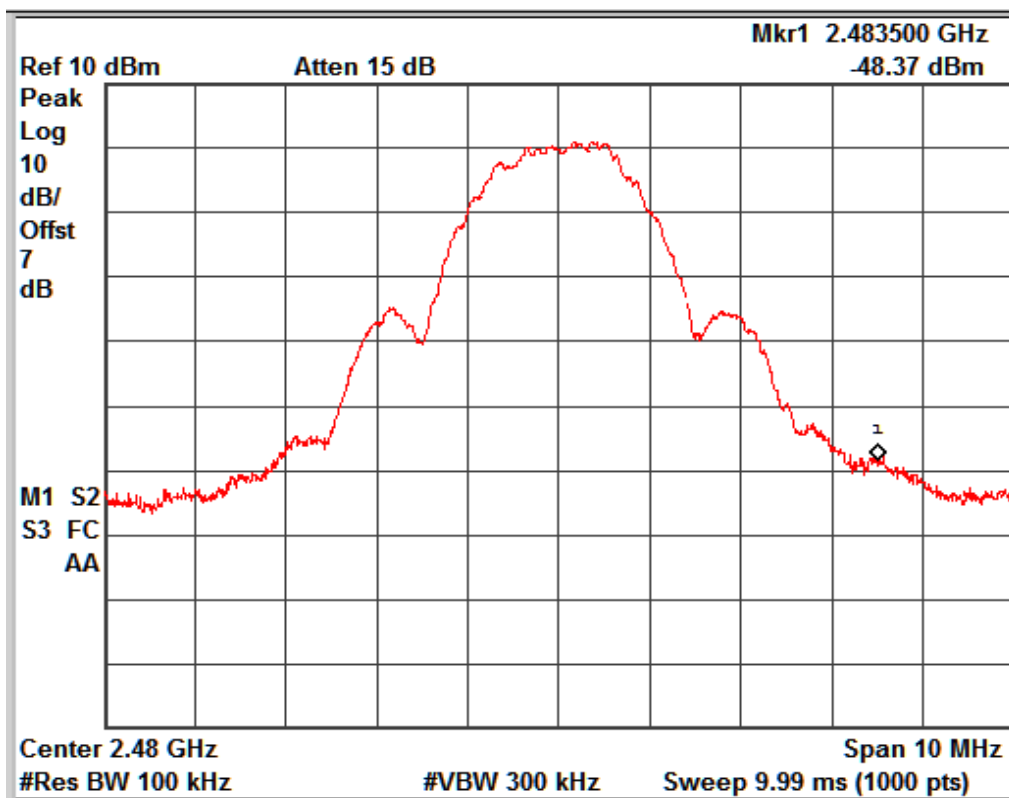
Channel Frequency (MHz)	Value at Band Edge				Limit (dB)
	Band Edge Frequency (MHz)	Measured PSD Level*	Band Edge Value (dBm)	Value (dBc)	
2405	2400.00	1.7	-53.17	-54.87	-20.00
2480	2483.50	0.87	-48.37	-49.24	-20.00

**Note:** The reference values are taken from the plots reported under the Power spectral Density Section 15.247(e).

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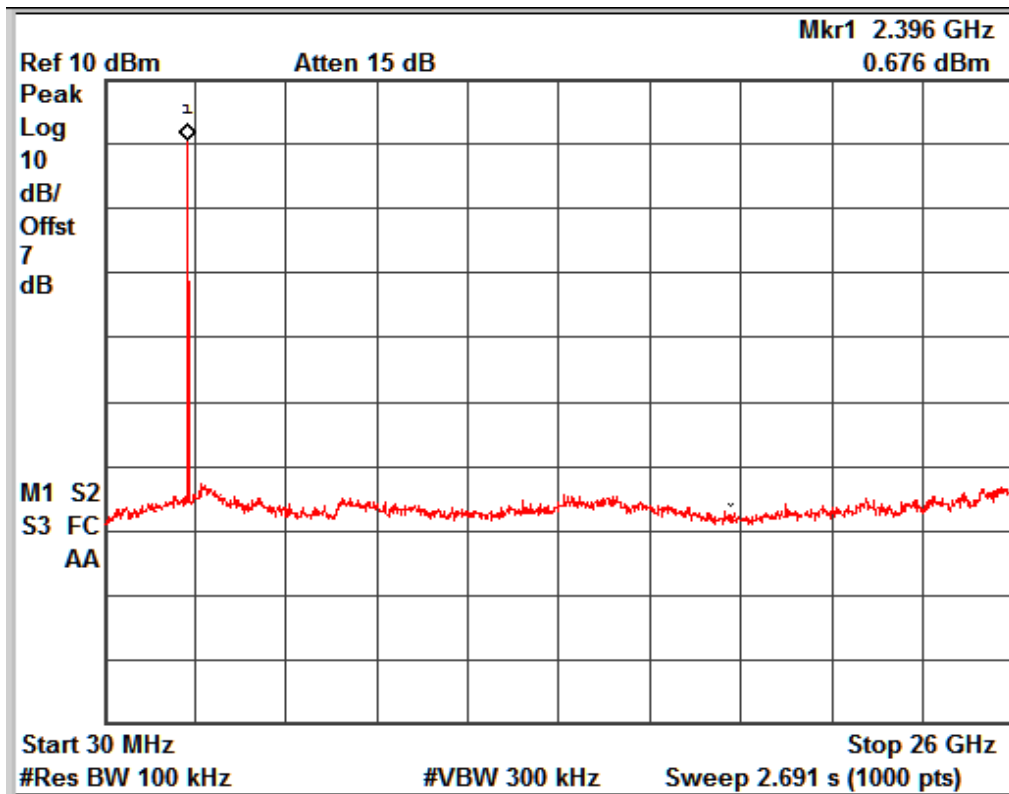


Channel frequency: 2405 MHz

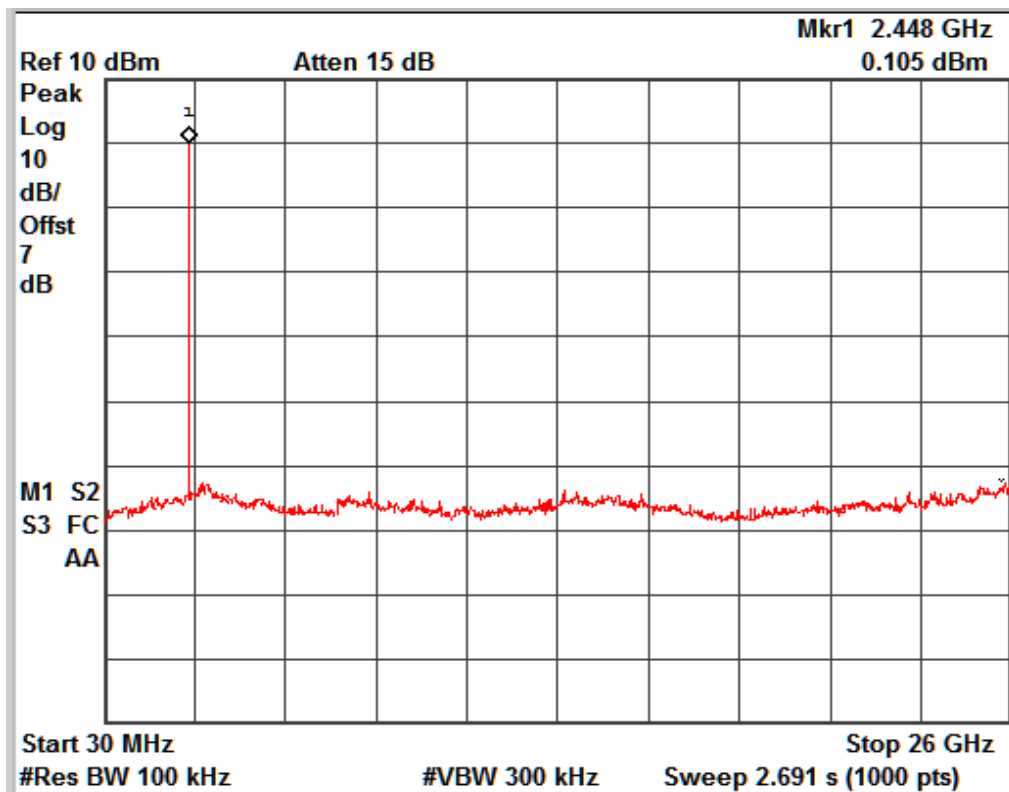


Channel frequency: 2480 MHz

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Conducted Spurious Emission

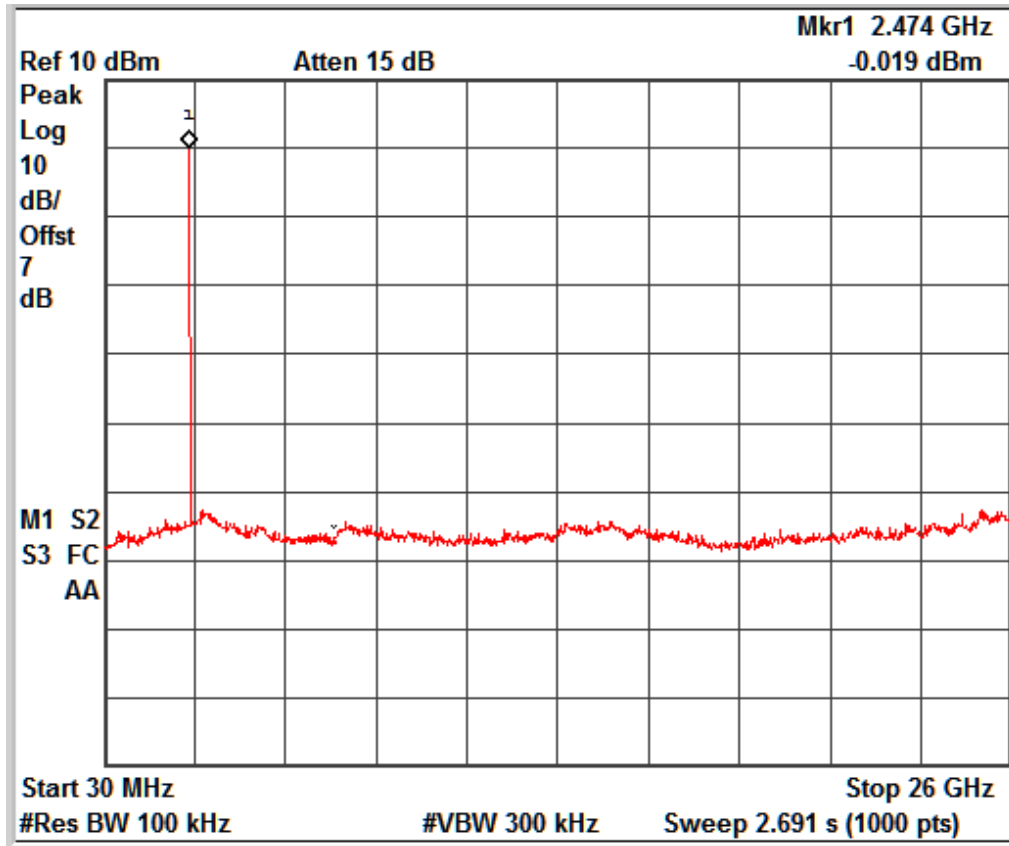


Channel frequency: 2405 MHz



Channel frequency: 2440 MHz

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Channel frequency: 2480 MHz

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**Spurious Radiated Emissions and  
Restricted Bands of Operation  
Result**

**Section 15.209 and 15.205  
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 ( $\mu\text{V/m}$ )	Field strength ( $\text{dB}\mu\text{V/m}$ )	Distance of Measurement (m)
0.009 – 0.490	$2400/F(\text{kHz})$	48.50 – 13.80	300*
0.490 – 1.705	$24000/F(\text{kHz})$	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 49.5dB $\mu\text{V/m}$  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.

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## Test result:

Worst case emissions observed are listed below.

Antenna Polarization	Frequency of Emission (MHz)	Field Strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
Vertical	239.61	38.02	46.00	-07.98
Horizontal	234.96	33.55	46.00	-12.45



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Emission above 1 GHz:

Antenna 0dBi

Fundamental Frequency (MHz)	Antenna Polarization	Frequency of Emission (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2405	V	2390(Pk)	40.53	74	-33.47
		2390(Av)	28.12	54	-25.88
		2405(Pk)	90.69	*	-
		2405(Av)	87.77	*	-
		4810(Pk)	52.21	74	-21.79
		4810(Av)	42.25	54	-11.75
	H	2390(Pk)	39.1	74	-34.9
		2390(Av)	27.6	54	-26.4
		2405(Pk)	88.21	*	-
		2405(Av)	85.65	*	-
		4810(Pk)	50.74	74	-23.26
		4810(Av)	39.4	54	-14.6
2440	V	2440(Pk)	89.55	*	-
		2440(Av)	87.01	*	-
		4880(Pk)	50.95	74	-23.05
		4880(Av)	39.39	54	-14.61
	H	2440(Pk)	87.61	*	-
		2440(Av)	85.09	*	-
		4880(Pk)	50.39	74	-23.61
		4880(Av)	38.49	54	-15.51
2480	V	2480(Pk)	88.46	*	-
		2480(Av)	85.7	*	-
		2483.5(Pk)	46.22	74	-27.78
		2483.5(Av)	35.15	54	-18.85
		4960(Pk)	50.38	74	-23.62
		4960(Av)	39.8	54	-14.2
	H	2480(Pk)	88.19	*	-
		2480(Av)	85.43	*	-
		2483.5(Pk)	46.06	74	-27.94
		2483.5(Av)	35.35	54	-18.65
		4960(Pk)	49.75	74	-24.25
		4960(Av)	37.28	54	-16.72

**Antenna 5dBi**

Fundamental Frequency (MHz)	Antenna Polarization	Frequency of Emission (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2405	V	2390(Pk)	44.44	74	-29.56
		2390(Av)	35.34	54	-18.66
		2405(Pk)	101.87	*	-
		2405(Av)	99.23	*	-
		4810(Pk)	52.05	74	-21.95
		4810(Av)	41.34	54	-12.66
	H	2390(Pk)	40.93	74	-33.07
		2390(Av)	29.82	54	-24.18
		2405(Pk)	96.41	*	-
		2405(Av)	93.85	*	-
		4810(Pk)	51.4	74	-22.6
		4810(Av)	40.21	54	-13.79
2440	V	2440(Pk)	101.78	*	-
		2440(Av)	98.58	*	-
		4880(Pk)	51.42	74	-22.58
		4880(Av)	40.27	54	-13.73
	H	2440(Pk)	95.01	*	-
		2440(Av)	92.21	*	-
		4880(Pk)	51.1	74	-22.9
		4880(Av)	39.78	54	-14.22
2480	V	2480(Pk)	100.14	*	-
		2480(Av)	97.26	*	-
		2483.5(Pk)	56.75	74	-17.25
		2483.5(Av)	46.64	54	-7.36
		4960(Pk)	-	74	-74
		4960(Av)	-	54	-54
	H	2480(Pk)	95.8	*	-
		2480(Av)	92.92	*	-
		2483.5(Pk)	52.52	74	-21.48
		2483.5(Av)	42.1	54	-11.9
		4960(Pk)	-	74	-74
		4960(Av)	-	54	-54

\* - --> Fundamental Frequency

Pk--> Peak Detector

Av--> Average Detector

**Note:** Emission measurement from 1GHz to 26GHz was done by rotating the EUT, and changing the antenna in both height and polarization, to maximize the measured emission. The emission was kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT was measured.

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**Conducted Emission Test on A.C. Power Line  
Result**

**Section 15.207  
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

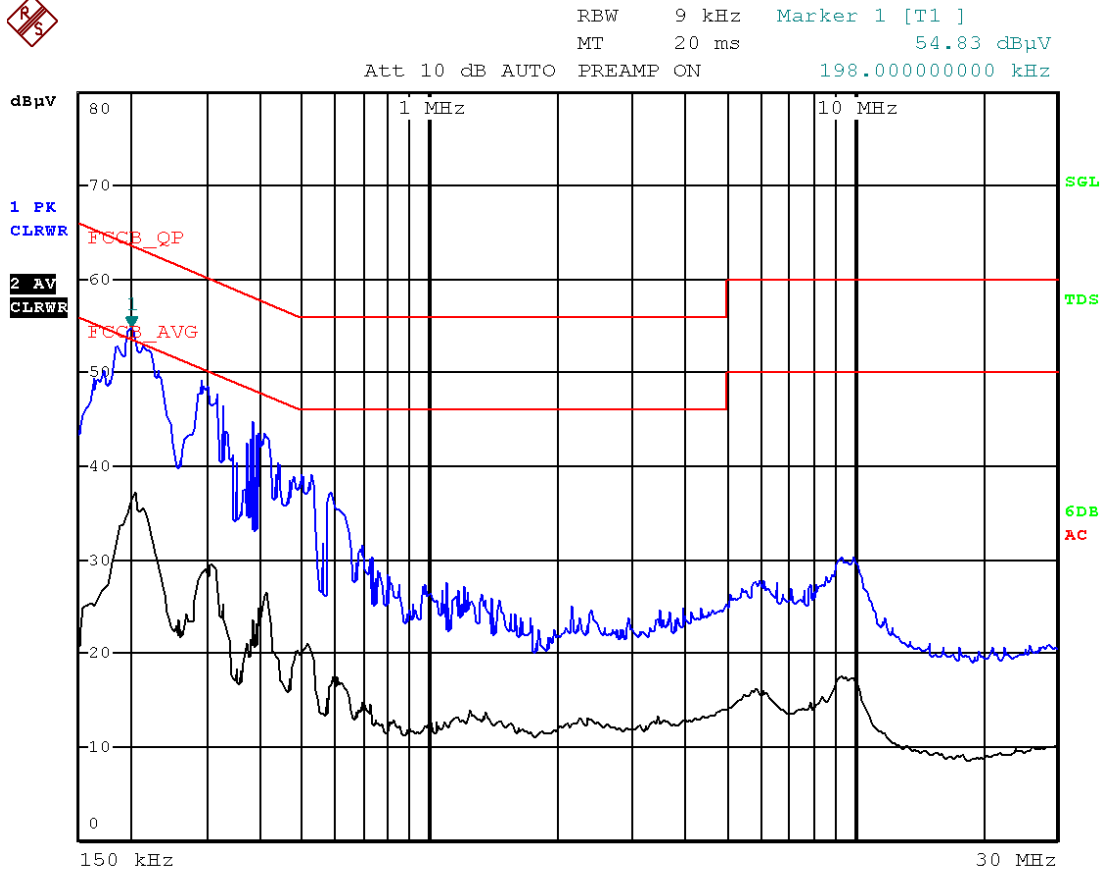
**Limit of section 15.207**

<b>Frequency of emission (MHz)</b>	<b>QP Limit (dB<math>\mu</math>V)</b>	<b>AV Limit (dB<math>\mu</math>V/m)</b>
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

\* Decreases with the logarithm of the frequency

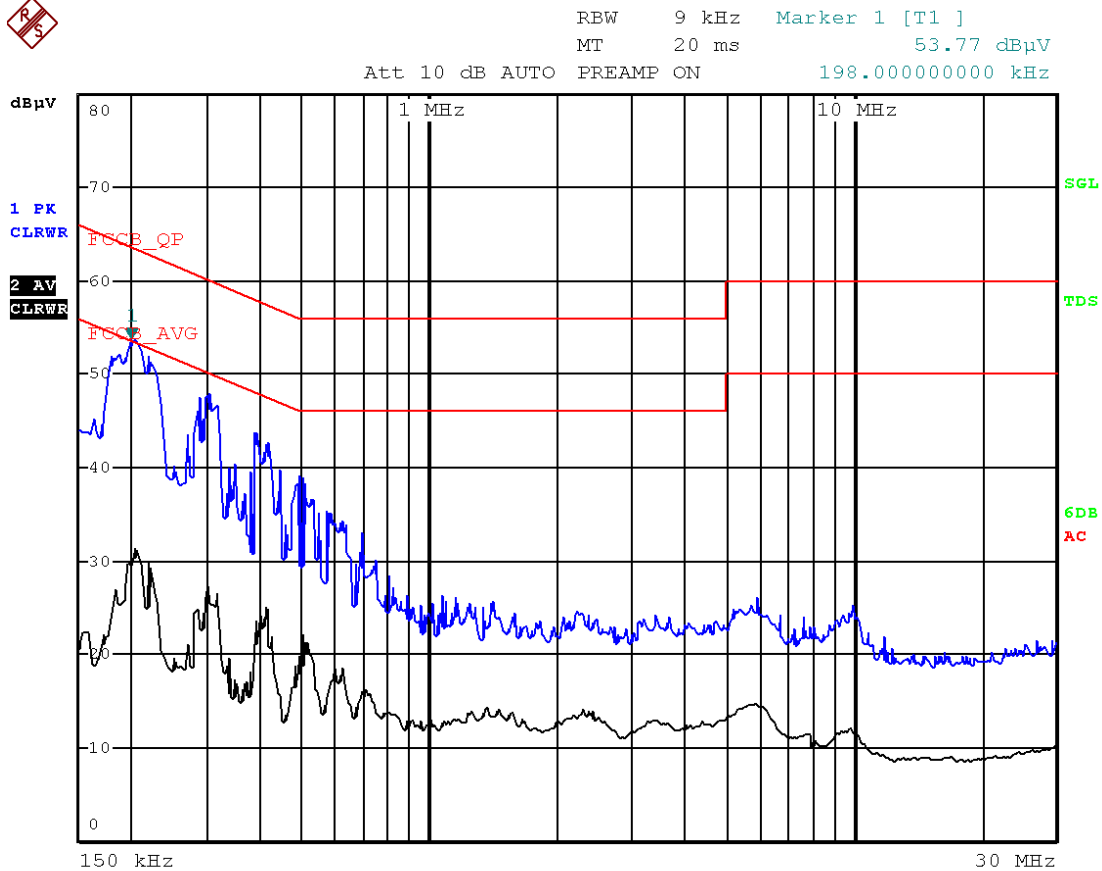
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Test Result:



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	49.93	L1	-13.75
1 Quasi Peak	290 kHz	44.11	L1	-16.40
2 Average	202 kHz	36.94	L1	-16.58
1 Quasi Peak	326 kHz	41.82	L1	-17.72
1 Quasi Peak	394 kHz	39.57	L1	-18.40
1 Quasi Peak	382 kHz	38.01	L1	-20.22
2 Average	302 kHz	29.40	L1	-20.78
2 Average	410 kHz	25.66	L1	-21.98
1 Quasi Peak	370 kHz	33.47	L1	-25.03
1 Quasi Peak	582 kHz	29.16	L1	-26.83
1 Quasi Peak	350 kHz	31.10	L1	-27.85
2 Average	9.246 MHz	16.78	L1	-33.21

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	198 kHz	49.92	N	-13.76
1 Quasi Peak	302 kHz	43.80	N	-16.38
1 Quasi Peak	386 kHz	38.02	N	-20.12
1 Quasi Peak	502 kHz	34.84	N	-21.15
1 Quasi Peak	494 kHz	34.67	N	-21.42
1 Quasi Peak	378 kHz	36.02	N	-22.29
2 Average	410 kHz	23.76	N	-23.88
2 Average	202 kHz	29.61	N	-23.90
2 Average	298 kHz	26.26	N	-24.03
2 Average	506 kHz	21.64	N	-24.35
1 Quasi Peak	574 kHz	27.26	N	-28.73
1 Quasi Peak	694 kHz	25.22	N	-30.77

Mode: Neutral