

Produkte
Products

Prüfbericht - Nr.:		19660403 001		Seite 1 von 37	
<i>Test Report No.:</i>				<i>Page 1 of 37</i>	
Auftraggeber:		The Kroger Co.			
<i>Client:</i>		11450 Grooms Rd.			
		Blue Ash, OH 45242			
		United States			
Gegenstand der Prüfung:		CC2538-CC2592 ZigBee Module			
<i>Test item:</i>					
Bezeichnung:		SREXRGM3	Serien-Nr.:	Engineering Sample	
<i>Identification:</i>			<i>Serial No.</i>		
Wareneingangs-Nr.:		1803372044	Eingangsdatum:	13.03.2018	
<i>Receipt No.:</i>			<i>Date of receipt:</i>		
Prüfort:		Refer Page 5 of 37 for Test site details			
<i>Testing location:</i>					
Prüfgrundlage:		RSS 247 Issue 2 & RSS Gen Issue 4			
<i>Test specification:</i>		ANSI C63.10-2013			
Prüfergebnis:		Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).			
<i>Test Result:</i>		<i>The test items passed the test specification(s).</i>			
Prüflaboratorium:		TÜV Rheinland (India) Pvt. Ltd.			
<i>Testing Laboratory:</i>		27/B, 2nd Cross Road, Electronics City Phase 1,			
		Bangalore – 560 100, India			
		FCC Test Site Registration no.: 496599			
		ISED Test Site Registration no.: 3466E			
geprüft / tested by:			kontrolliert / reviewed by:		
13.03.2018	Pramod Sharma R		15.06.2018	Shrikanth S Naik	
	Engineer			Assistant Manager	
Datum	Name/Stellung	Unterschrift	Datum	Name/Stellung	Unterschrift
<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>	<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>
Sonstiges / Other Aspects:			IC:24718-SZMDLM3BR1		
Abkürzungen:			Abbreviations:		
P(ass) = entspricht Prüfgrundlage			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		
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.					
<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>					

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TEST SUMMARY

ISED	Test item	Result	Remarks
RSS 247 Issue 2 Section 5.4 (d)	Maximum Peak Conducted Output Power	Pass	-
RSS 247 Issue 2 Section 5.2 (a)	6 dB / DTS Bandwidth	Pass	
RSS 247 Issue 2 Section 5.2 (b)	Maximum Power Spectral Density	Pass	
RSS 247 Issue 2 Section 5.5	Emissions in non – restricted band	Pass	
RSS Gen Issue 4, Section 8.9 &8.10	Restricted bands of Emissions and Restricted Bands of Operation.	Pass	
RSS Gen Issue 4, Section 8.8	Conducted emission on A.C power lines	Pass	

DOCUMENT HISTORY:

Version	Remarks
1.0	RSS 247 Issue 2, RSS Gen 4

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1 GENERAL REMARKS

Complimentary Materials

All attachments are integral part of this test report. This applies especially to the following items:

- 1:** TEST SETUP PHOTOS
- 2:** EUT EXTERNAL PHOTOS
- 3:** EUT INTERNAL PHOTOS
- 4:** LABEL ARTWORK AND LOCATION
- 5:** BLOCK DIAGRAM
- 6:** SPECIFICATION OF EUT
- 7:** SCHEMATIC DIAGRAM
- 8:** BILL OF MATERIAL
- 9:** USER MANUAL
- 10:** MAXIMUM PERMISSIBLE EXPOSURE INFORMATION

2 TEST SITES

Testing Facilities

TUV Rheinland (India) Private Limited
108 , Beside ISBR Business School,
Electronic city Phase I
Bangalore - 560 100.

TUV Rheinland (India) Private Limited
27/B, 2nd Cross Road, Electronics City Phase 1,
Bangalore – 560 100. India

List of Test and Measurement Instruments

Table 1: List of test and measurement instruments

Equipment	Manufacturer	Model Name	Serial Number	Calibration Due Date	Periodicity	Used for Test Items
Signal Analyser	Rohde & Schwarz	FSV7	101644	15-12-2018	Yearly	Antenna - Port Measurements
EMI Test Receiver	Rohde & Schwarz	ESU 40	100288	24-10-2018	Yearly	Radiated Spurious Emission
Active loop antenna	Frankonia	LAX-10	LAX-10-800	13-04-2018	Yearly	
Biconical Antenna	Schwarzbeck mess-elektronik	VHBB-9124 / BBA-9106	9124-656	09-01-2019	Yearly	
Log-Periodic Antenna	Schwarzbeck mess-elektronik	VUSLP-9111B	9111B-111	16-01-2019	Yearly	
Broadband Horn Antenna	Frankonia	HAX-18	HAX18-802	16-03-2018	Yearly	
Emission Horn Antenna	ETS Lindgren	116706	00107323	22-06-2018	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	Conducted Emission on AC Power Lines
EMI Test Receiver	Rohde & Schwarz	ESR7	101133	13-02-2019	Yearly	
Two Line V-Network (LISN)	Rohde & Schwarz	ENV216	100022	05-09-2018	Yearly	

3 GENERAL PRODUCT INFORMATION

Product Function and Intended Use

The SREXRGM3 Module is designed using CC2538 (ARM Cortex-M3) SoC with CC2592 as RF Front End. It will be used for 802.15.4 and ZigBee Wireless network applications. The Module is 2.4GHz 802.15.4/ZigBee Wireless device to be used with Host device to create low power wireless network. The Module has RF Front end with SoC to boost the RF Power level for range extension. The module will be soldered on Host Board and will be powered through Host Board power system. The module will transmit/receive data over the air. The module will communicate with Host CPU through SPI/UART/I2C interface and I/O pins.

Ratings and System Details

Table 2: Ratings and System Details

Operating Frequency Range	2400 MHz – 2483.5 MHz
Radio Protocol	ZigBee
Verified RF Power	18.93 dBm
Channel Spacing	5 MHz
Modulation	DSSS
Number of antennas	1
Antenna type and gain	PCB Inverted F antenna & 3.27 dBi
Dimensions	Height: 38.1 mm Width: 20.96 mm
Supply Voltage to Product	2.7 V – 3.6 VDC
Environmental conditions	Temp: -30 °C to +75°C Humidity: 20-80% RHG

Measurement Uncertainty:

Table 3: Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3 dB
Unwanted Emissions, conducted	±3 dB
All emissions, radiated	±6 dB
Temperature	±3 °C
Supply Voltages	±3 %
Time	±5 %

TEST SET-UP AND OPERATION MODE

Principle of Configuration Selection

Transmission was enabled with highest possible duty cycle transmission on low, mid and high channel.

Test Operation and Test Software

Testing software was used to enable the continuous transmission on low/mid/high channels on the EUT for the tests in this report.

Test Software Details: Smart RF Flash Programmer 2

Firmware Version: 1.7.5

Hardware Version: REV A

Special Accessories and Auxiliary Equipment

- None

Countermeasures to achieve EMC Compliance

- None

Test modes – data rates and modulations

For Radiated spurious emissions, the tests were performed for supported data rates and only worst case results are reported in this report.

List of frequencies

Table 4: List of Center Frequencies and the corresponding power settings

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

4 TEST METHODOLOGY

Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable for below 1 GHz & 1.5 m height for above 1 GHz measurement, 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 1 m and 4 m, 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 1000 MHz was performed by horn antenna, The measurement below 30 MHz was performed by loop antenna, Measurement from 30 MHz to 200 MHz was performed by Baloon and Biconical Antenna, and mesurement from 200 MHz to 1 GHz was performed by Log-Periodic Antenna.

The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded.

4.1.1 Test Setup Configuration

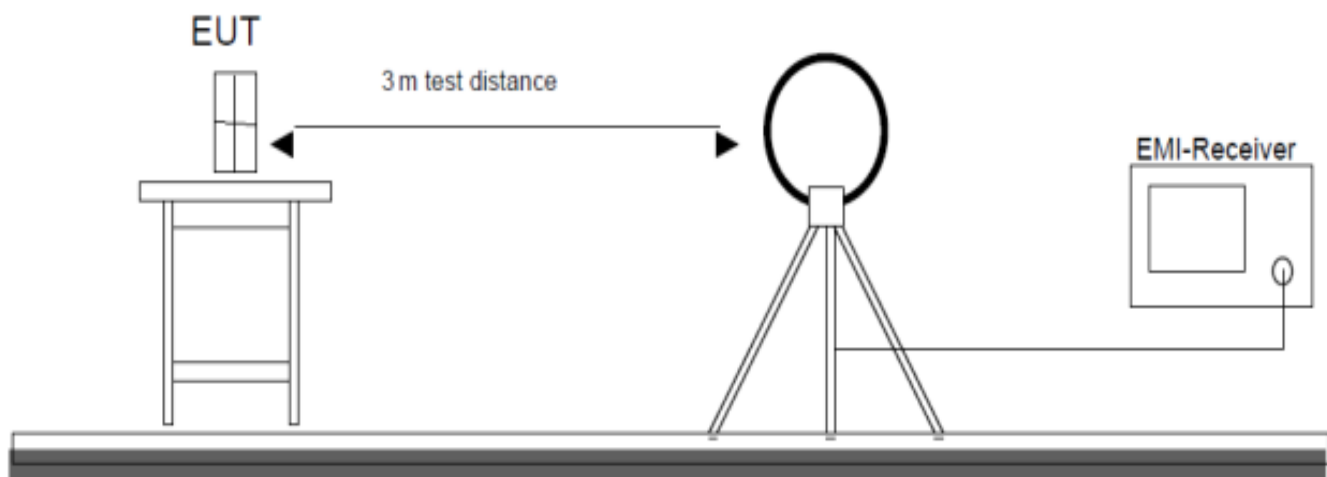


Figure 1: Frequency Range 9 kHz- 30 MHz

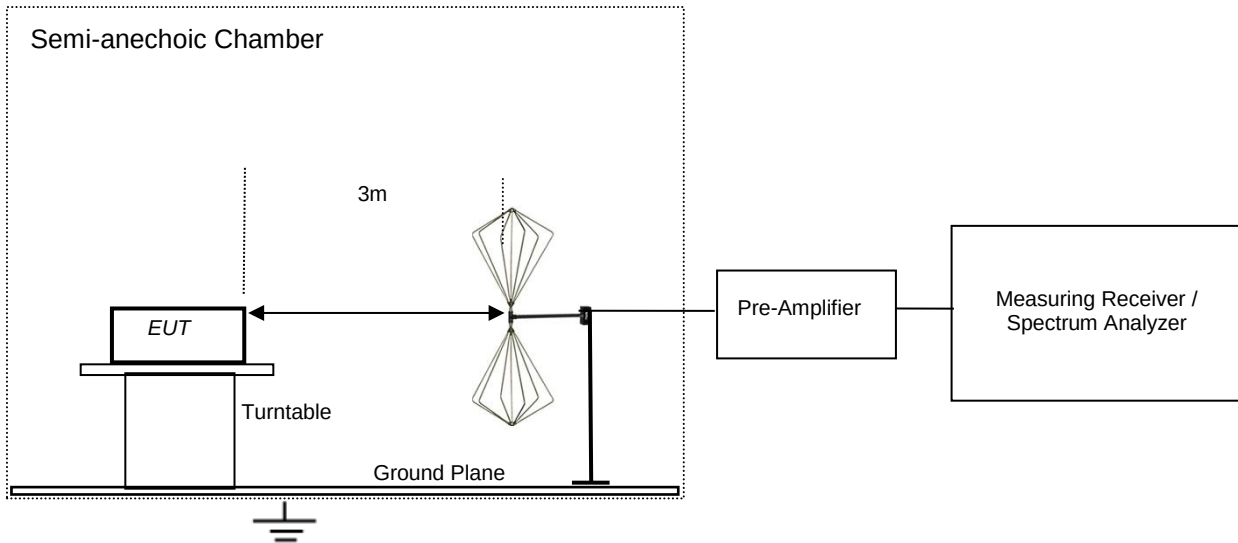


Figure 2: Frequency Range 30 MHz – 200 MHz

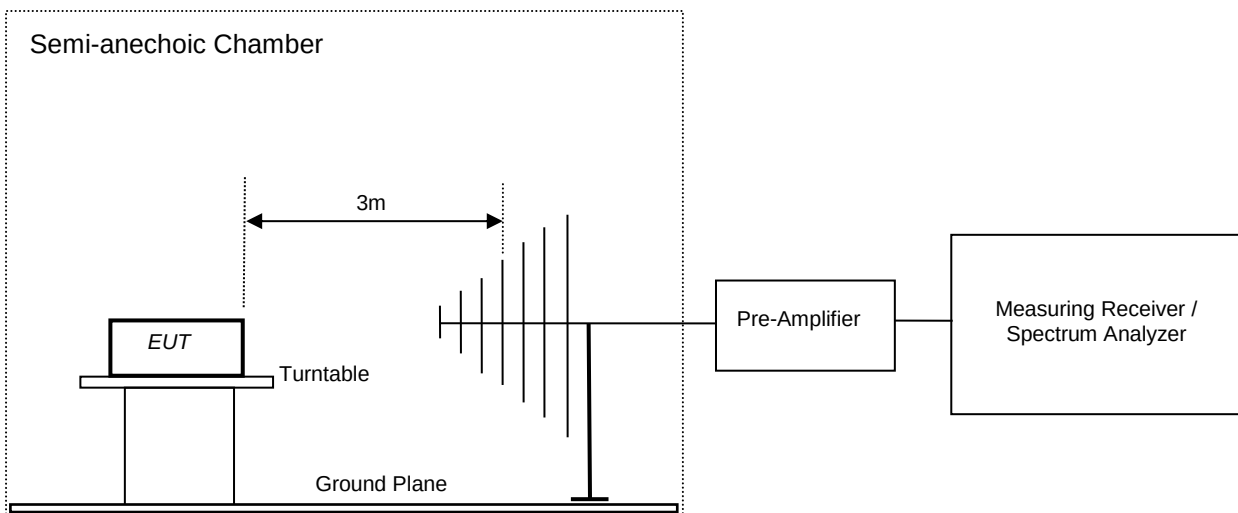


Figure 3: Frequency Range 200 MHz - 1GHz

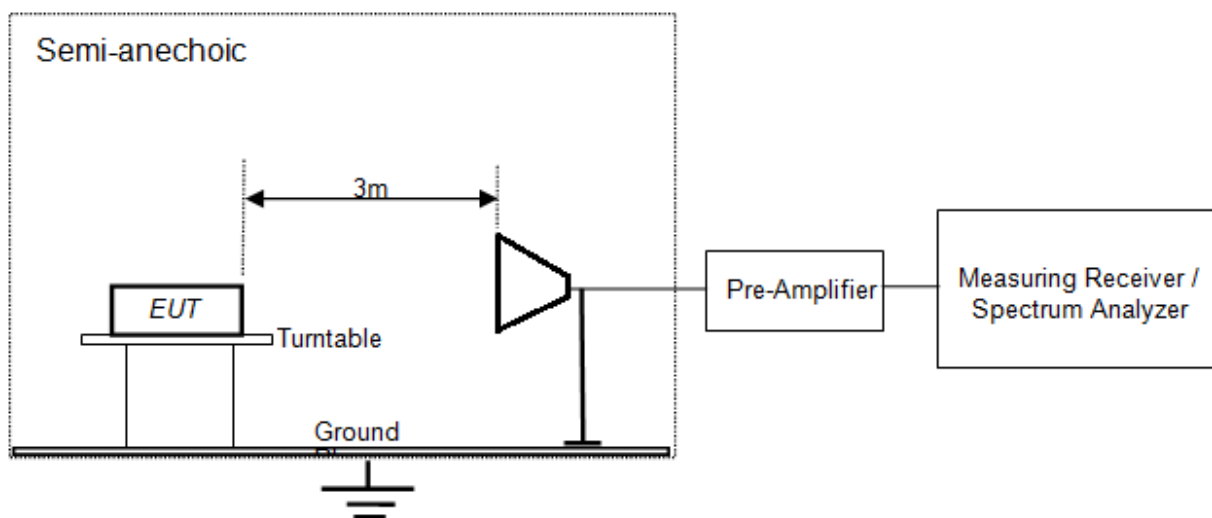


Figure 4: Frequency Range above 1 GHz

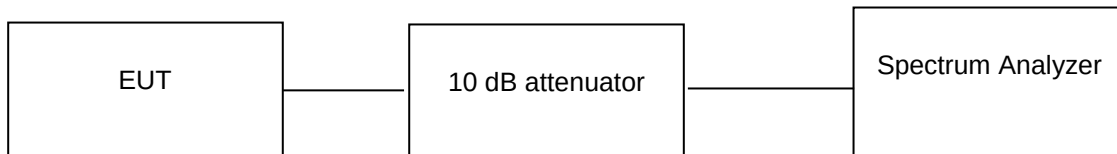
5 TEST RESULTS

Maximum Peak Conducted Output Power

Result

Pass

Test Specification	RSS 247 Issue 2, Section 5.4 (d)
Measurement Bandwidth	1 MHz
Detector	Peak
Requirement	$\leq 1 \text{ W (30 dBm)}$



Test results:

Note: Measurements were made as per section 9.1.1 in KDB 558074 D01 DTS Meas Guidance v04.

10 dB attenuator + 0.8 Cable loss = 10.8 dB offset is considered in below result

Table 5: Maximum peak conducted output power verified Test Results

Channel Frequency (MHz)	Output power (dBm)	Limit (dBm)
2405	18.93	30.00
2440	18.45	30.00
2475	17.73	30.00
2480	11.23	30.00

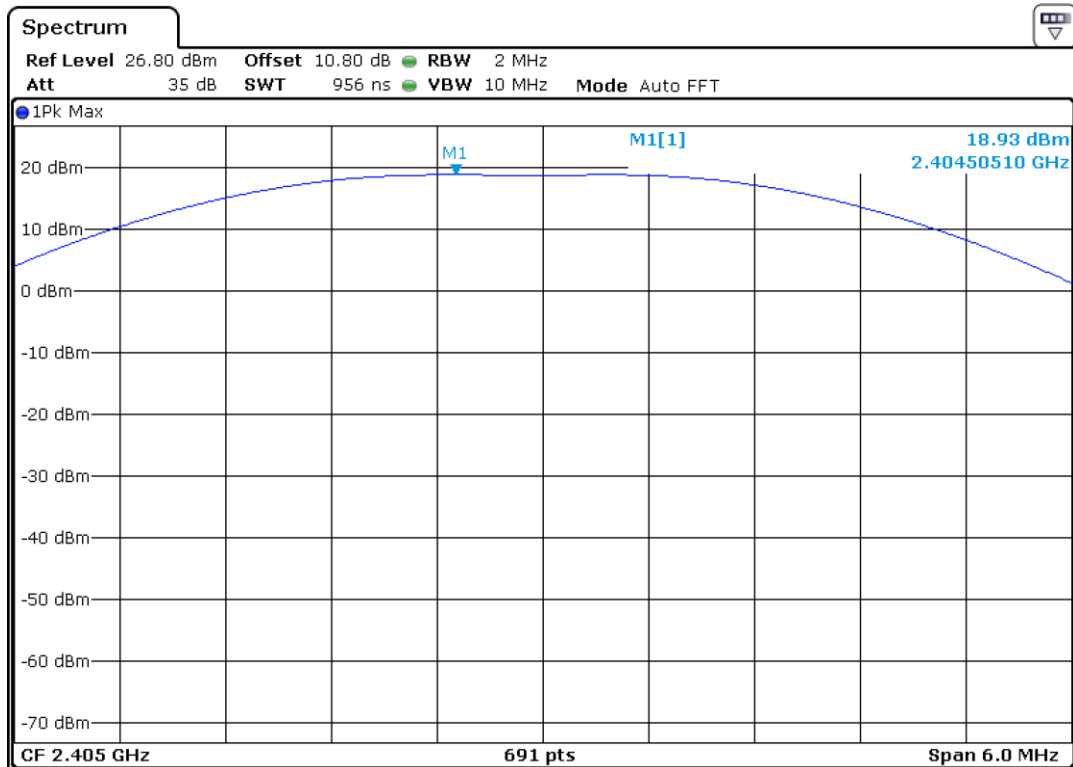
Prüfbericht - Nr.:

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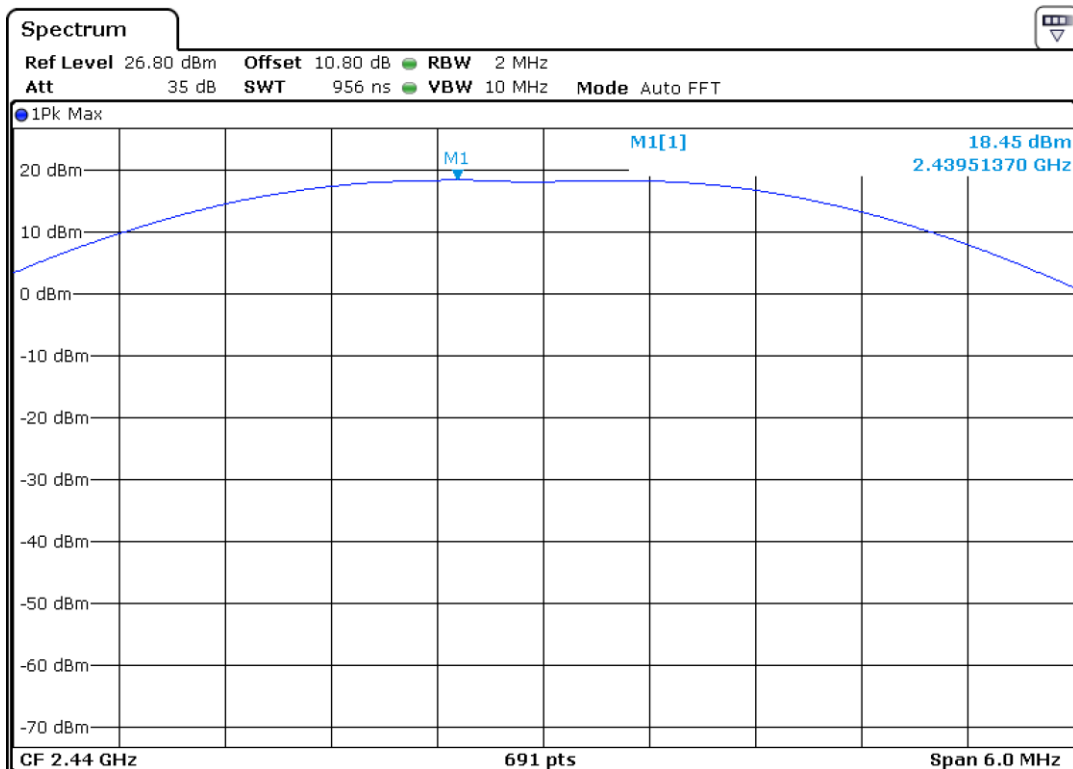
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Channel low – 2405 MHz



Channel mid – 2440 MHz

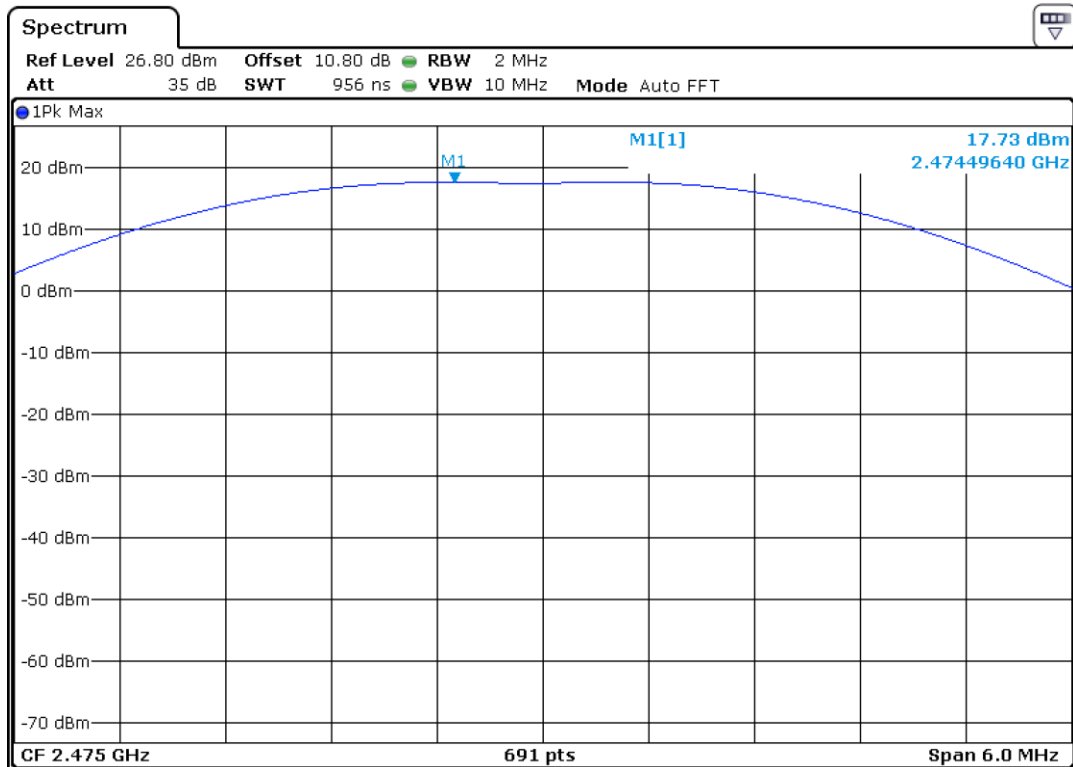
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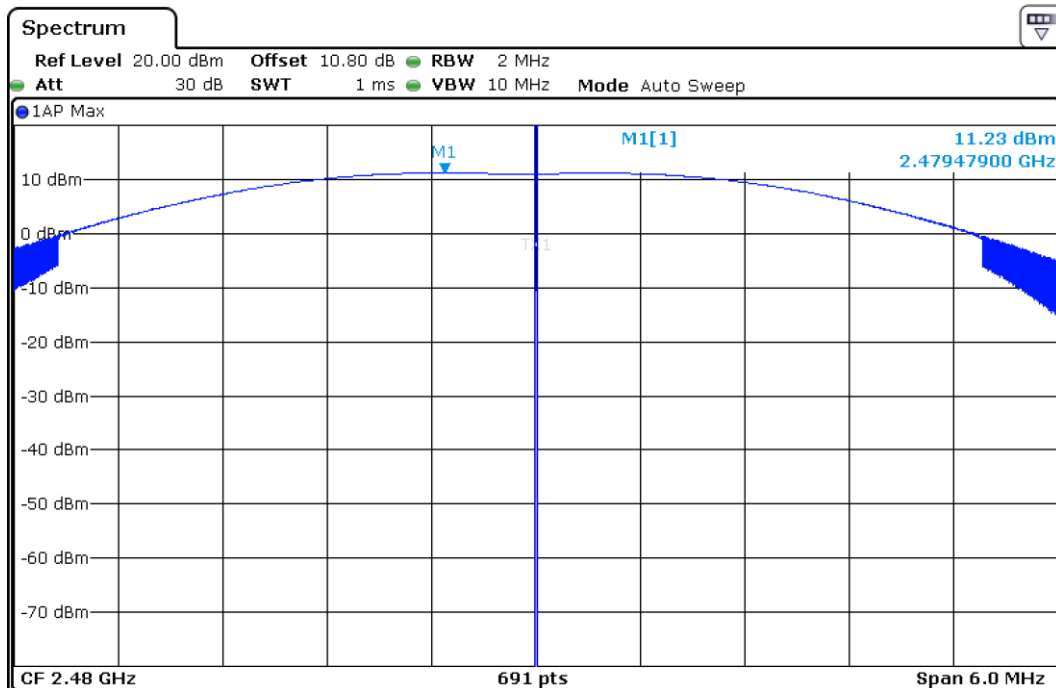
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Channel no. 25 – 2475 MHz



Channel high – 2480 MHz

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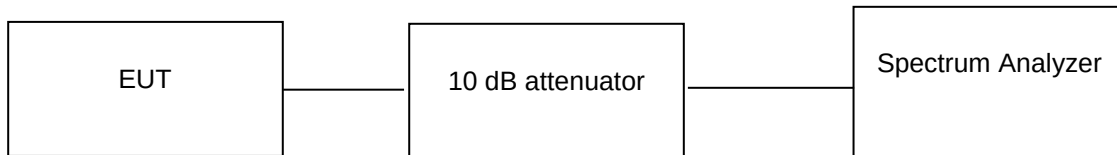
Maximum Power Spectral Density

Result

Pass

Test Specification RSS 247 Issue 2, Section 5.2 (b)
 Detector Function Peak
 Port of testing Antenna port
 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:



Test results:

Note: Measurements were made as per section 10.2 in KDB 558074 D01 DTS Meas Guidance v04.

10 dB attenuator + 0.8 Cable loss = 10.8 dB offset is considered in below result

Table 6 : Maximum power spectral density verified Test Results

Channel Frequency (MHz)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
2405.00	6.38	8.00	-1.62
2440.00	6.02	8.00	-1.98
2475.00	5.25	8.00	-2.75
2480.00	-1.53	8.00	-9.53

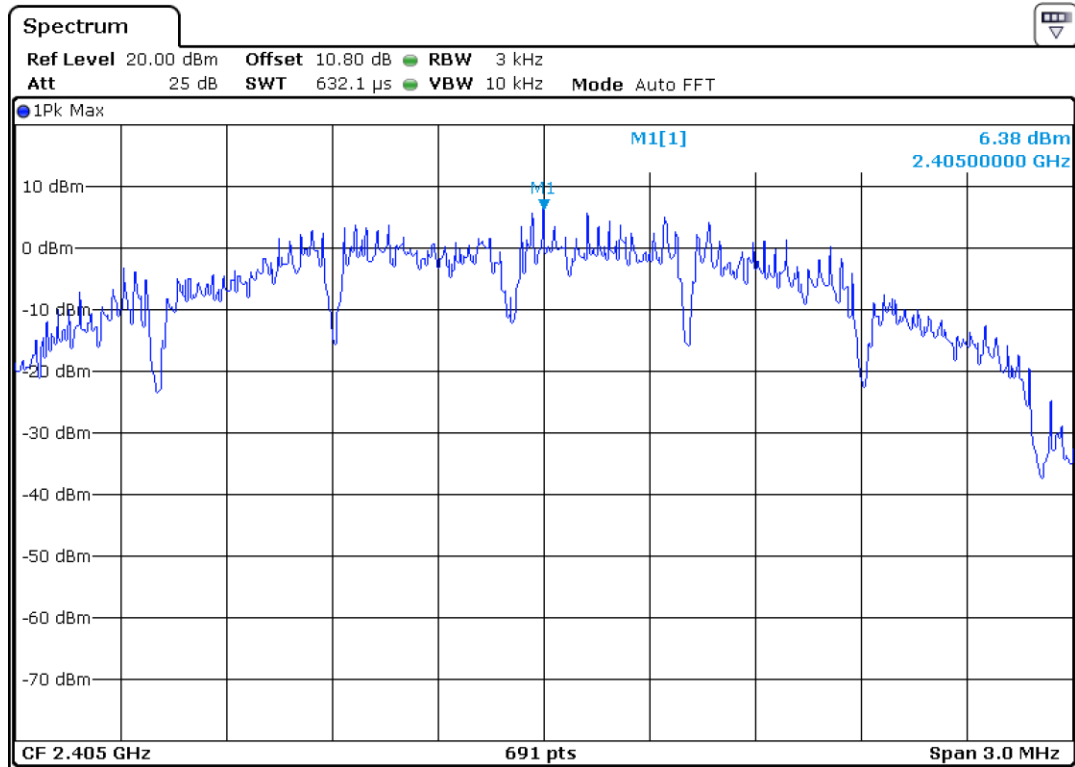
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Test Report No.:

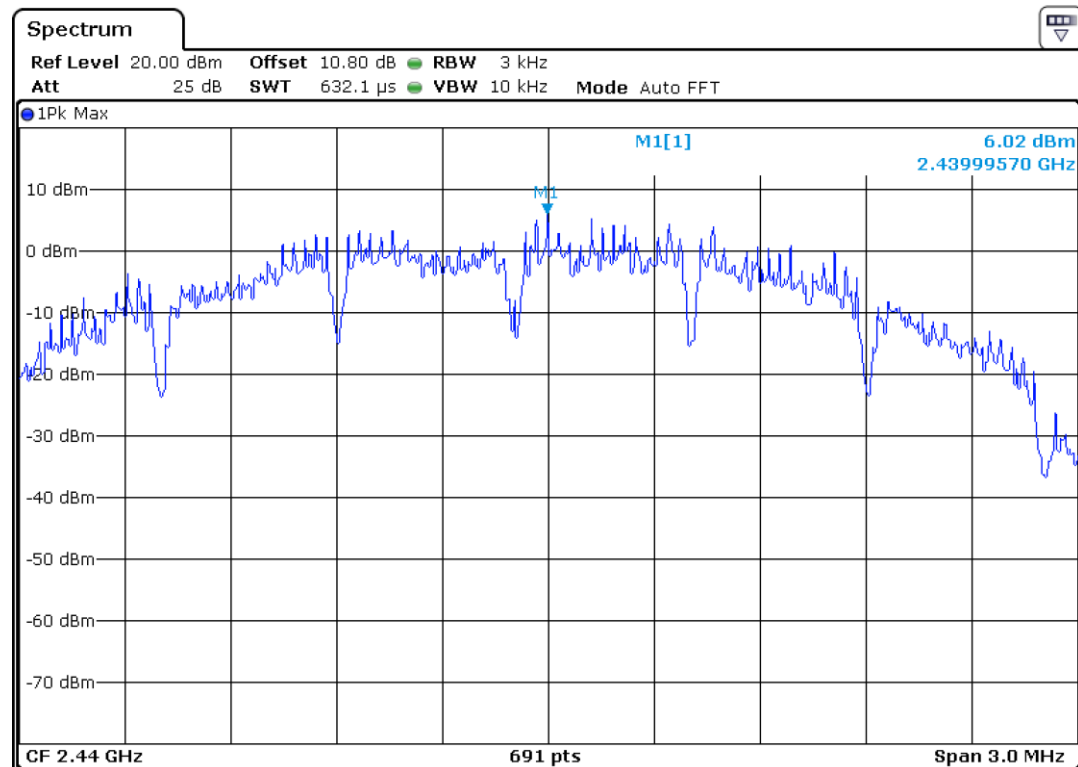
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Channel low – 2405 MHz



Channel mid – 2440 MHz

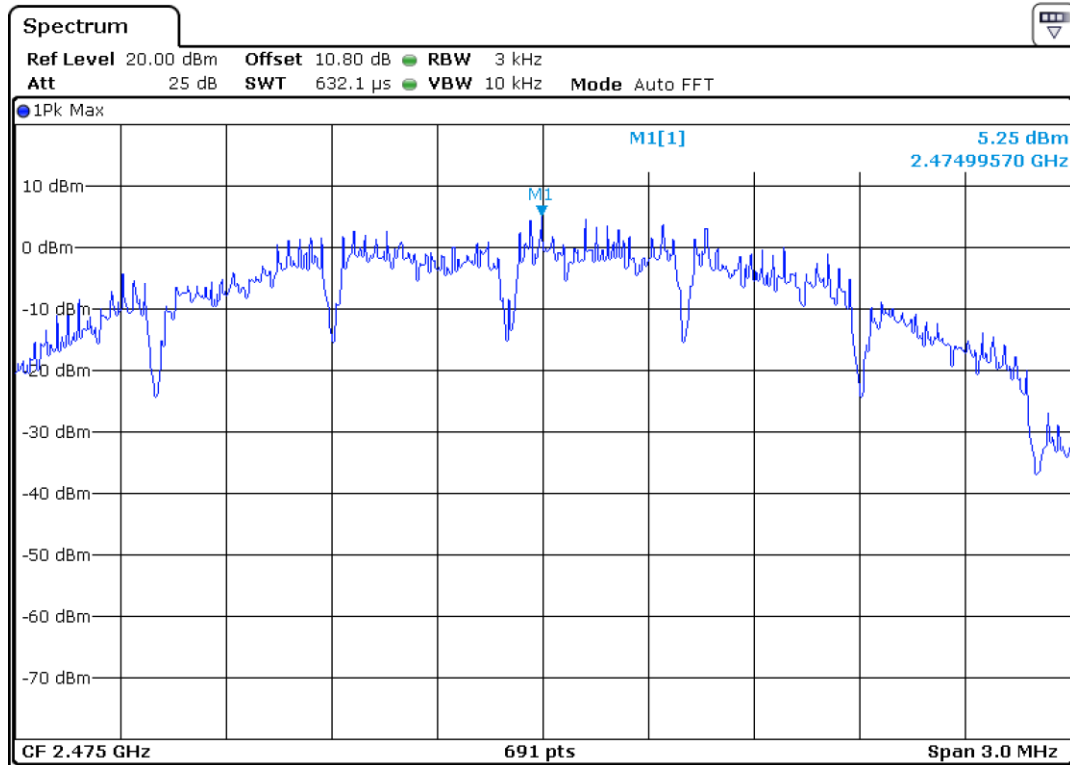
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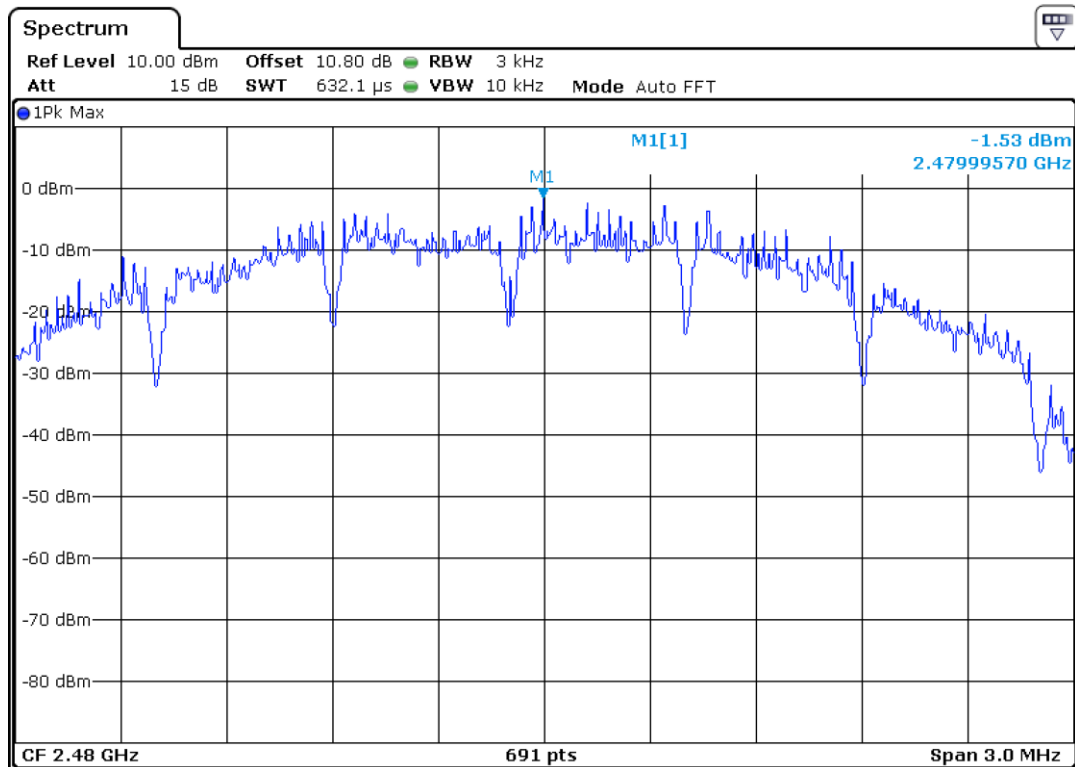
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Channel no. 25 – 2475 MHz



Channel high – 2480 MHz

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DTS Bandwidth

Result

Pass

Test Specification

RSS 247 Issue 2, Section 5.2 (a)

Detector

Peak

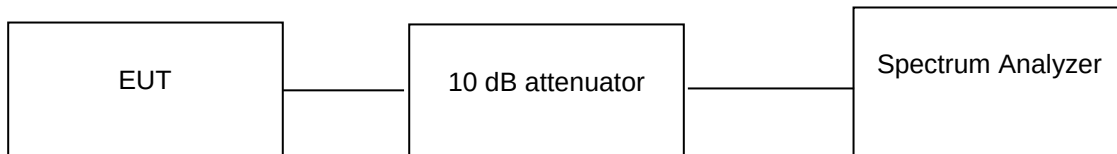
Port of testing

Antenna Port

Requirement

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Method:



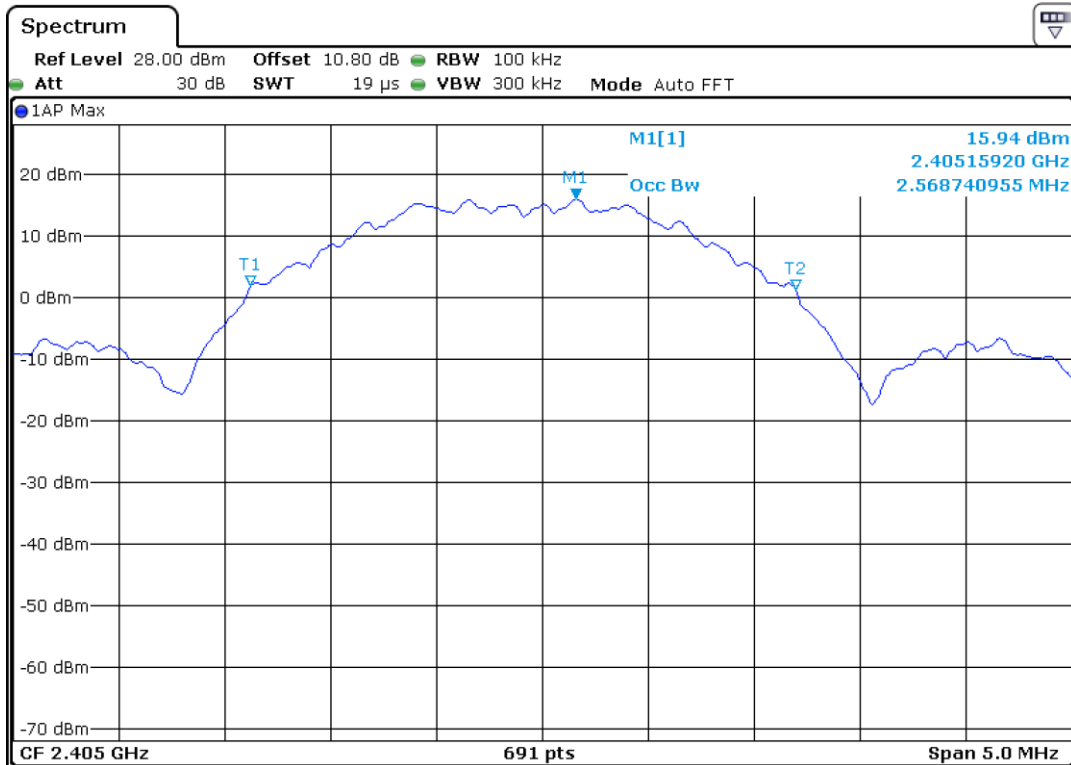
Test results:

Note: Measurements were made as per section 8.1, 8.2 in KDB 558074 D01 DTS Meas Guidance v04.

10 dB attenuator + 0.8 Cable loss = 10.8 dB offset is considered in below result

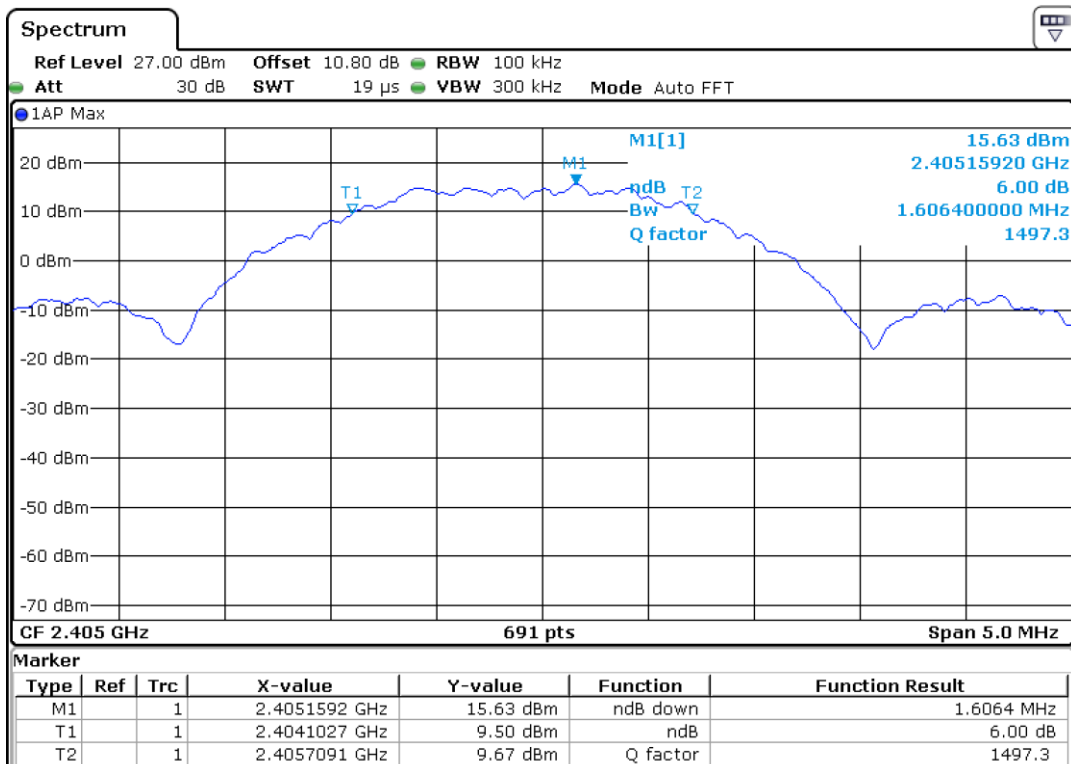
Table 7 : DTS Bandwidth verified Test Results

Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% OBW (MHz)
2405.00	1.606	2.568
2440.00	1.606	2.568
2475.00	1.606	2.575
2480.00	1.606	2.554



Channel low – 2405 MHz

OBW



Channel low – 2405 MHz

6 dB Bandwidth

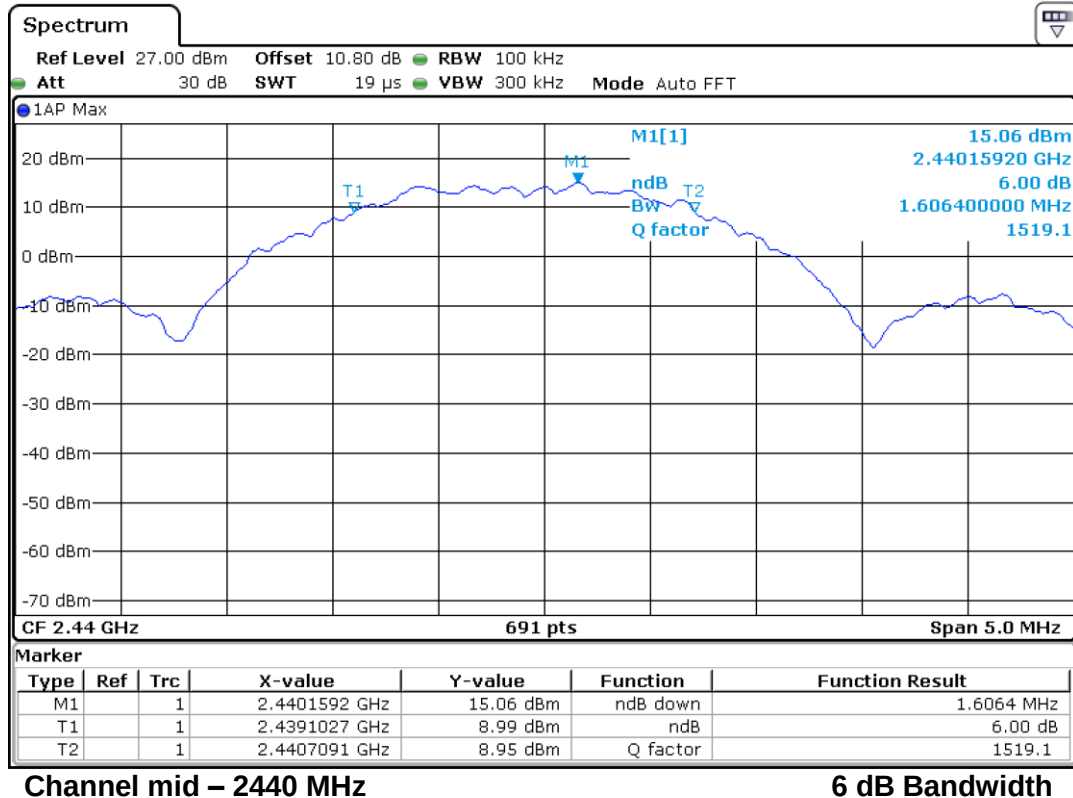
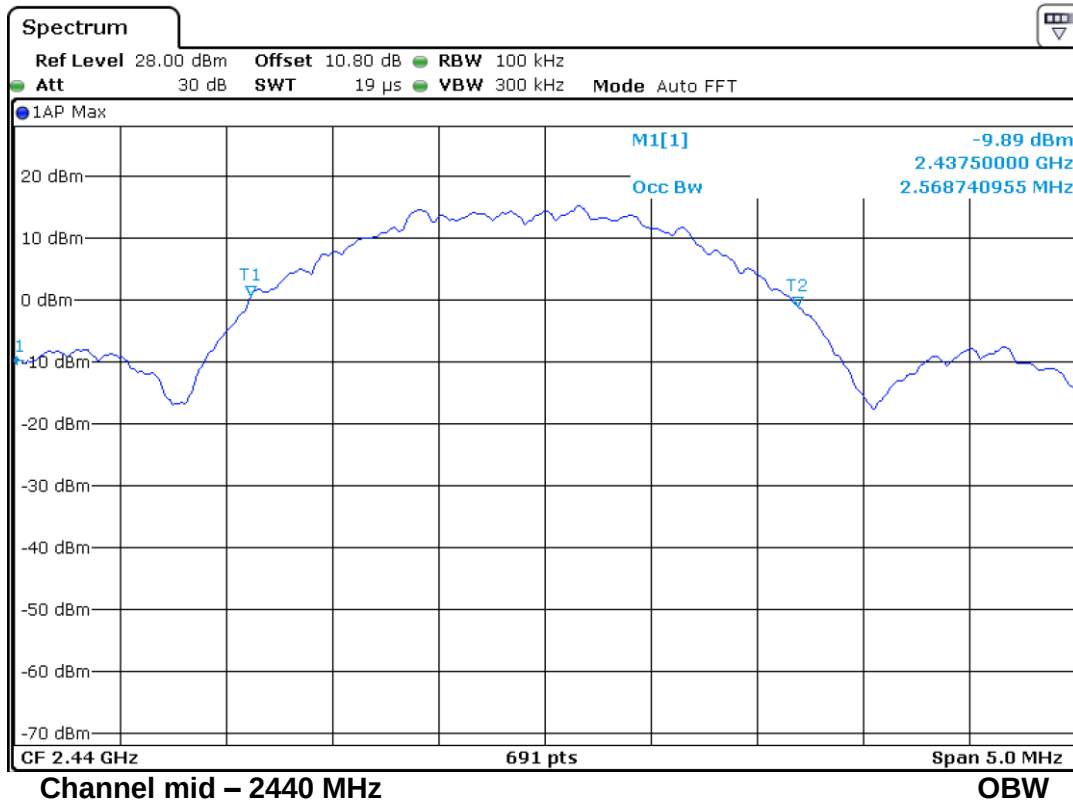
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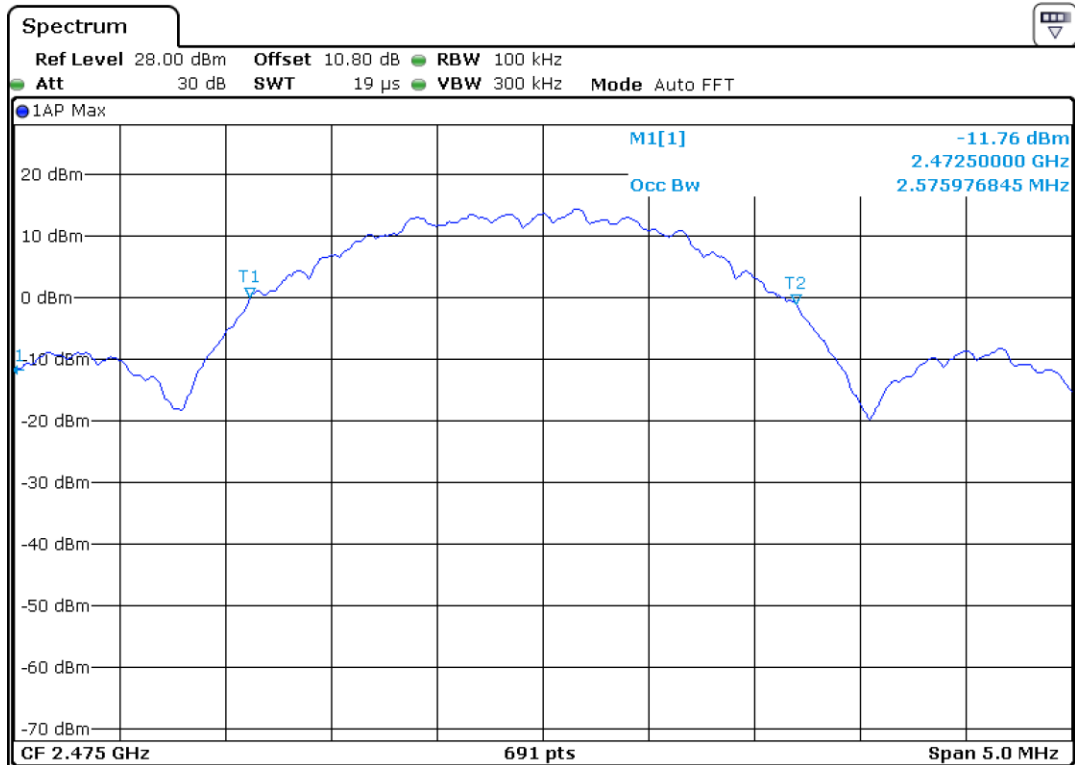
Prüfbericht - Nr.:

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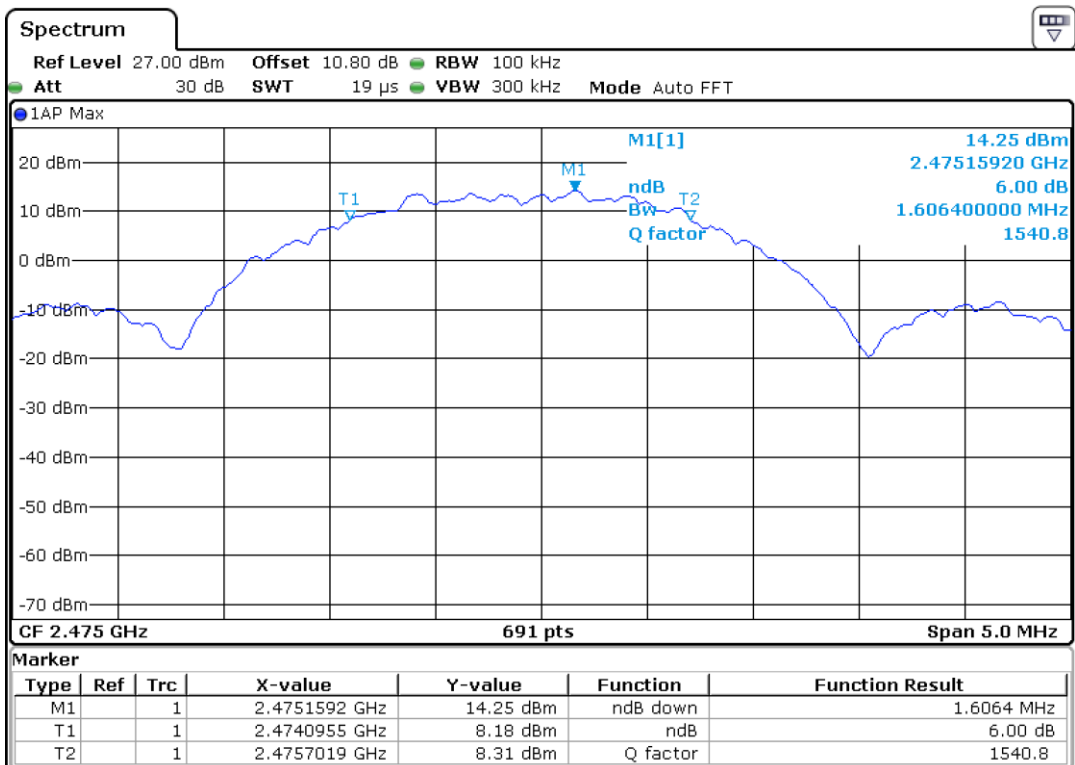
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Channel no. 25 – 2475 MHz

OBW



Channel no. 25 – 2475 MHz

6 dB Bandwidth

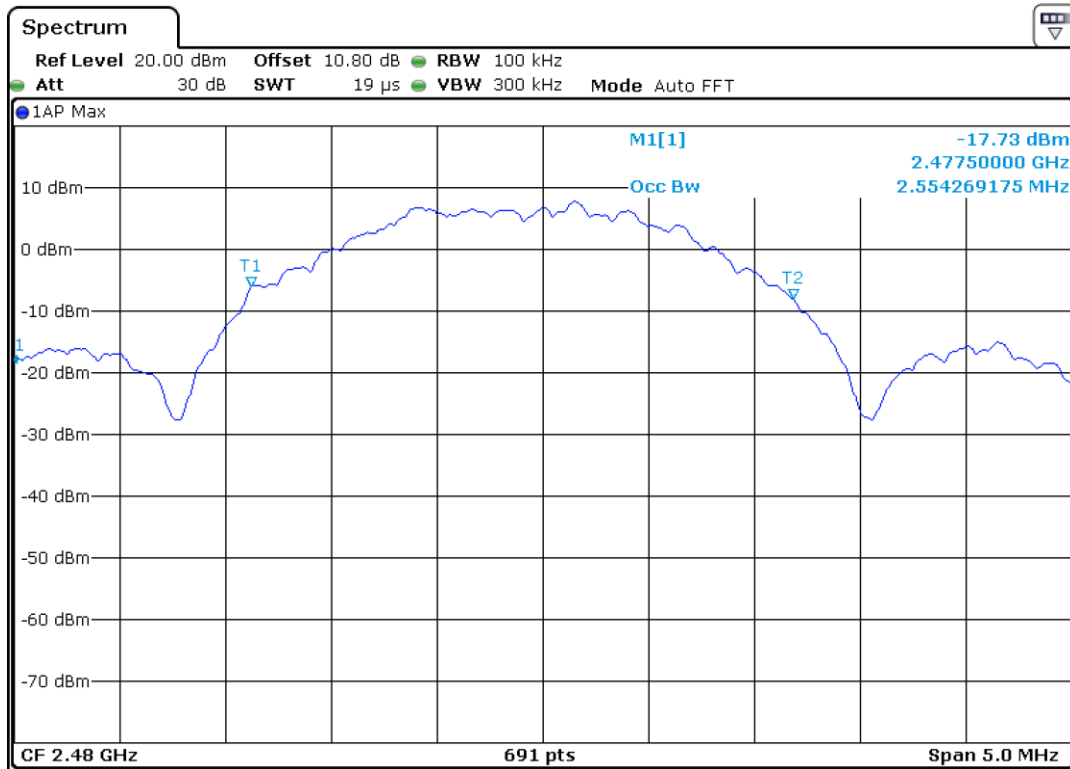
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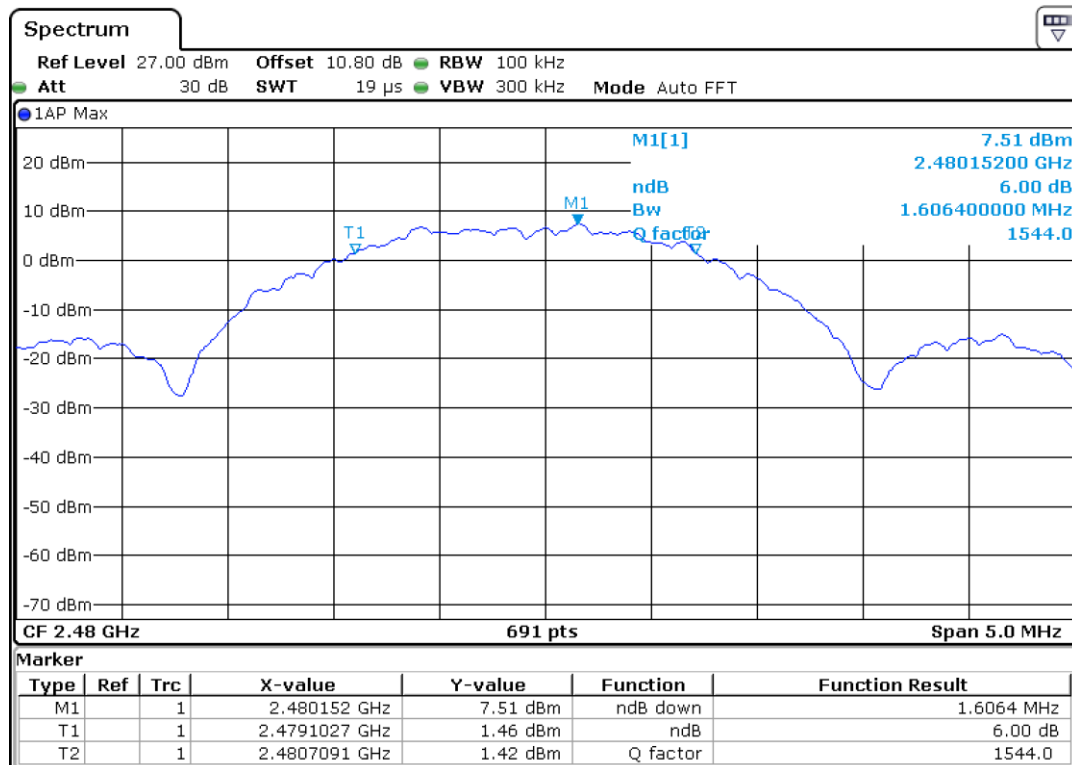
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Channel high – 2480 MHz

OBW



Channel high – 2480 MHz

6 dB Bandwidth

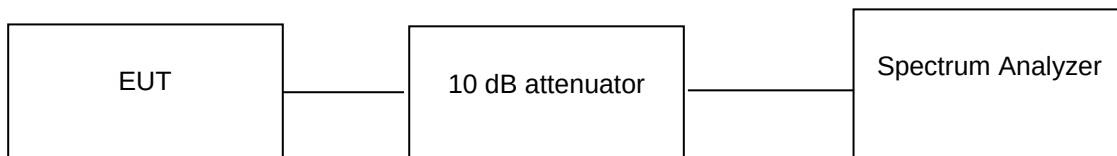
Emissions in non-restricted frequency bands

Result

Pass

Test Specification RSS 247 Issue 2, Section 5.5
 Detector Function Peak
 Port of testing Antenna port
 Requirement In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Method:



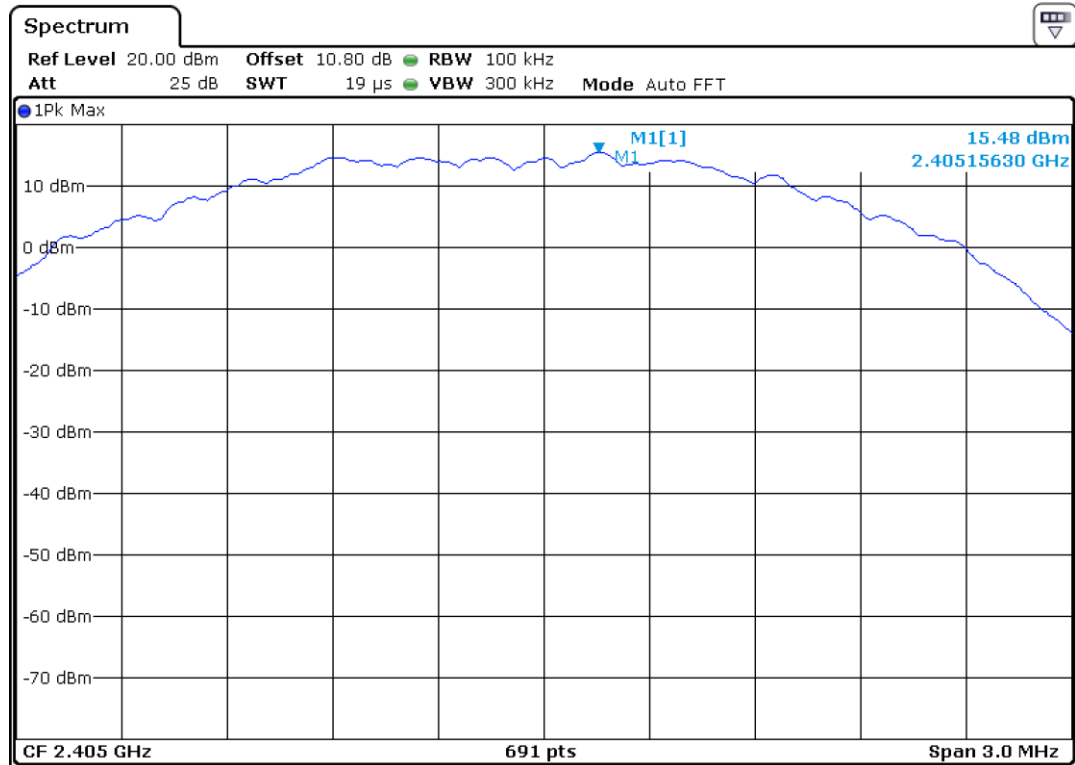
Test results:

Note: Measurements were made as per section 11.2, 11.3 in KDB 558074 D01 DTS Meas Guidance v04.

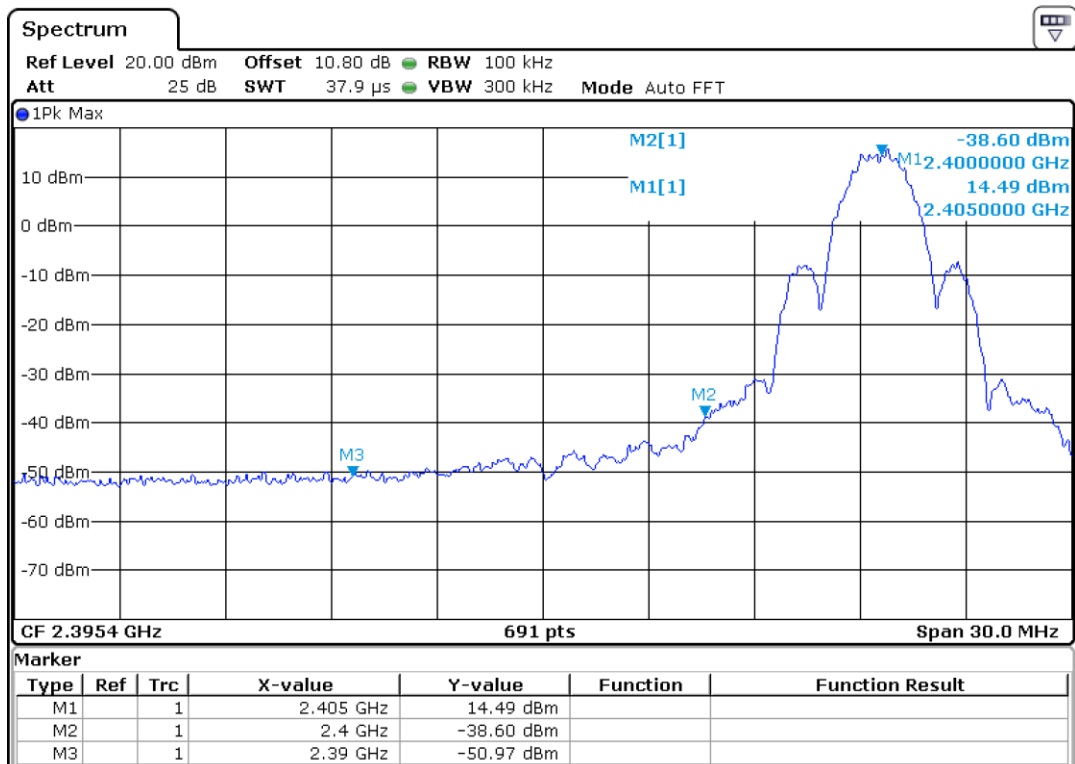
10 dB attenuator + 0.8 Cable loss = 10.8 dB offset is considered in below result

Table 8 : Verified Test Results of Emissions in non-restricted frequency bands

Channel Frequency (MHz)	Value at Band Edge		Reference PSD Value B (dBm)	Band Edge Value A~B (dB)	Limit (dB)
	Frequency (MHz)	Value A (dBm)			
2405	2400	-38.60	15.48	-54.08	-20.00
2475	2483.5	-50.13	14.18	-64.31	-20.00
2480	2483.5	-41.38	07.43	-48.81	-20.00



Reference Level Plot - Channel low 2405 MHz



Channel low – 2405 MHz

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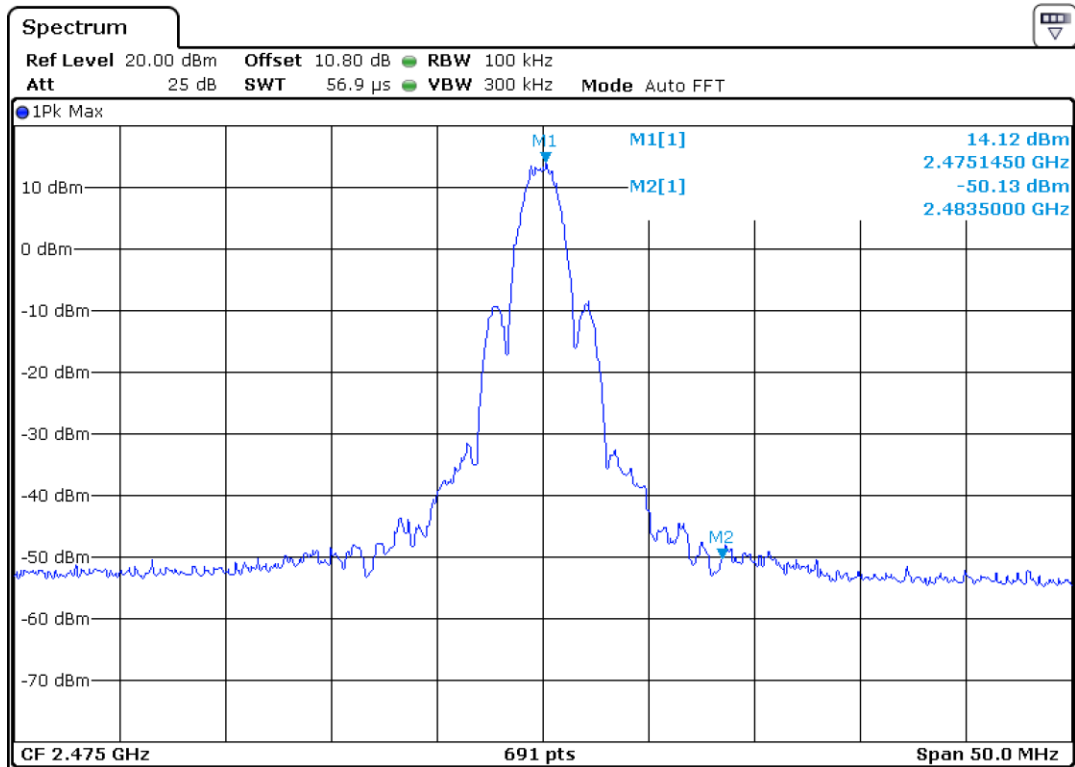
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Reference Level Plot - Channel no. 25- 2475 MHz



Channel no. 25 - 2475 MHz

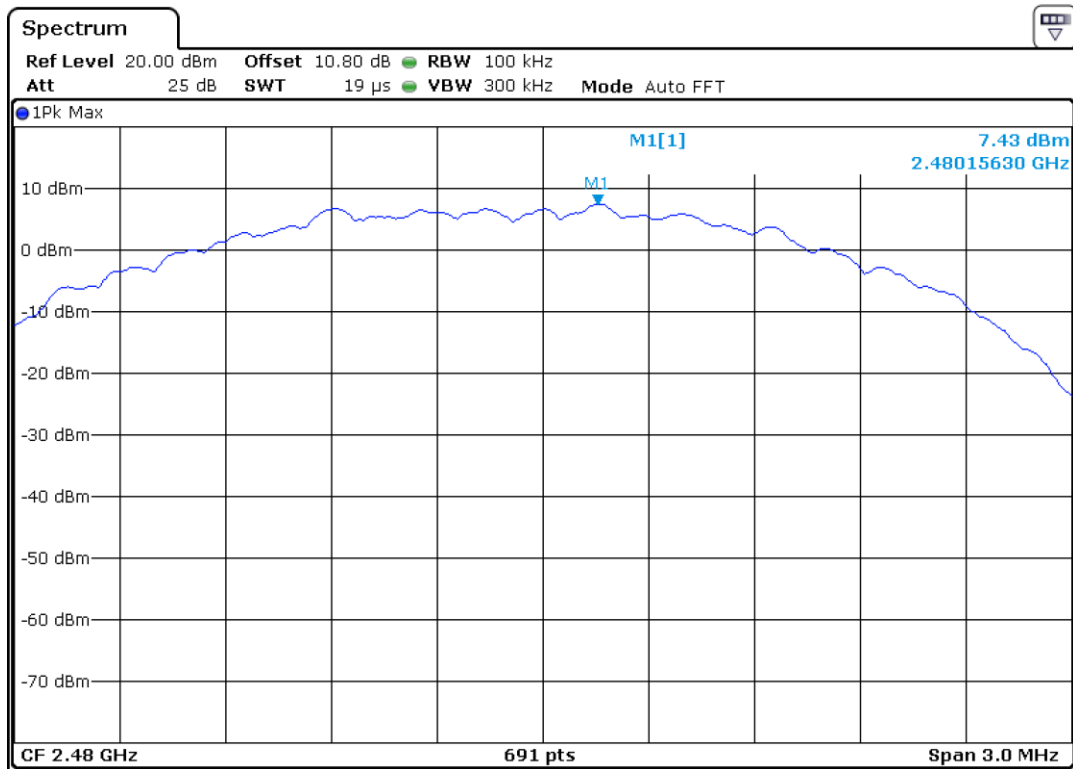
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Test Report No.:

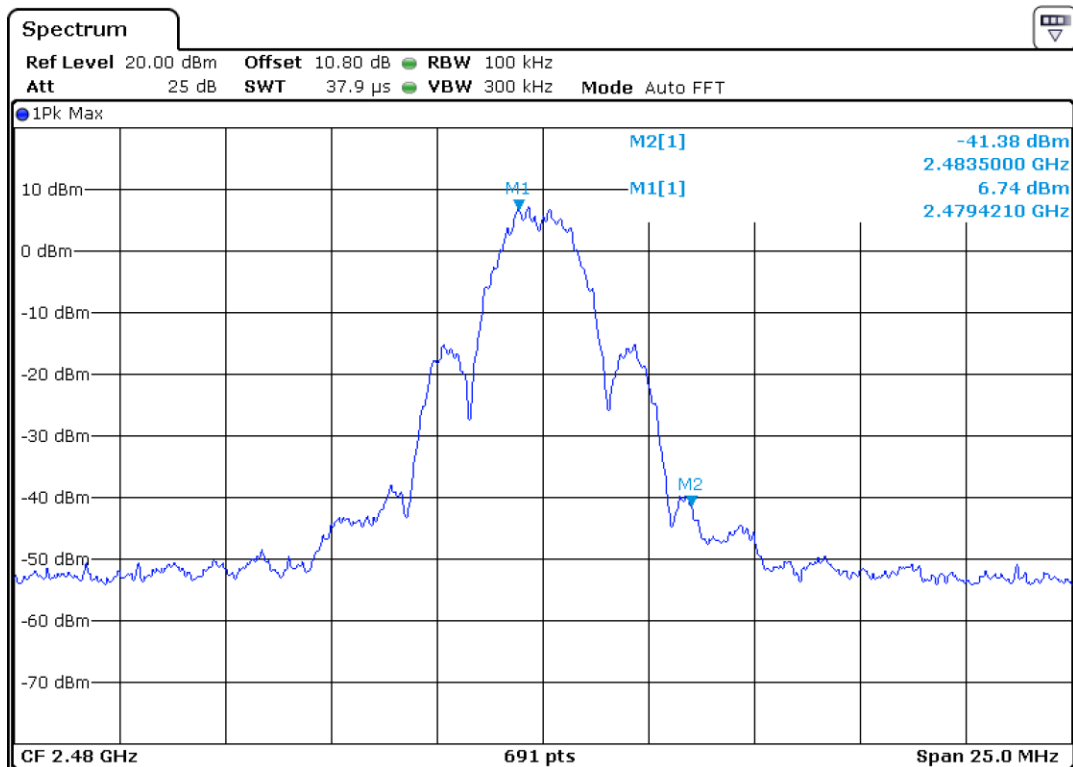
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Reference Level Plot - Channel high - 2480 MHz



Channel high - 2480 MHz

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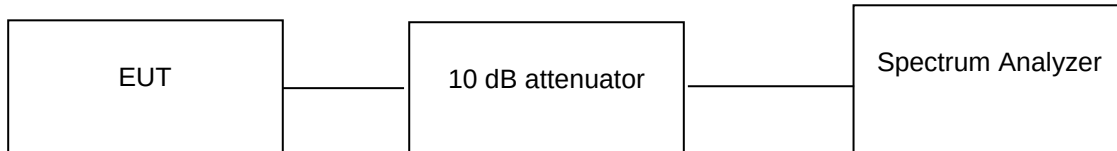
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Conducted Spurious Emission

Result

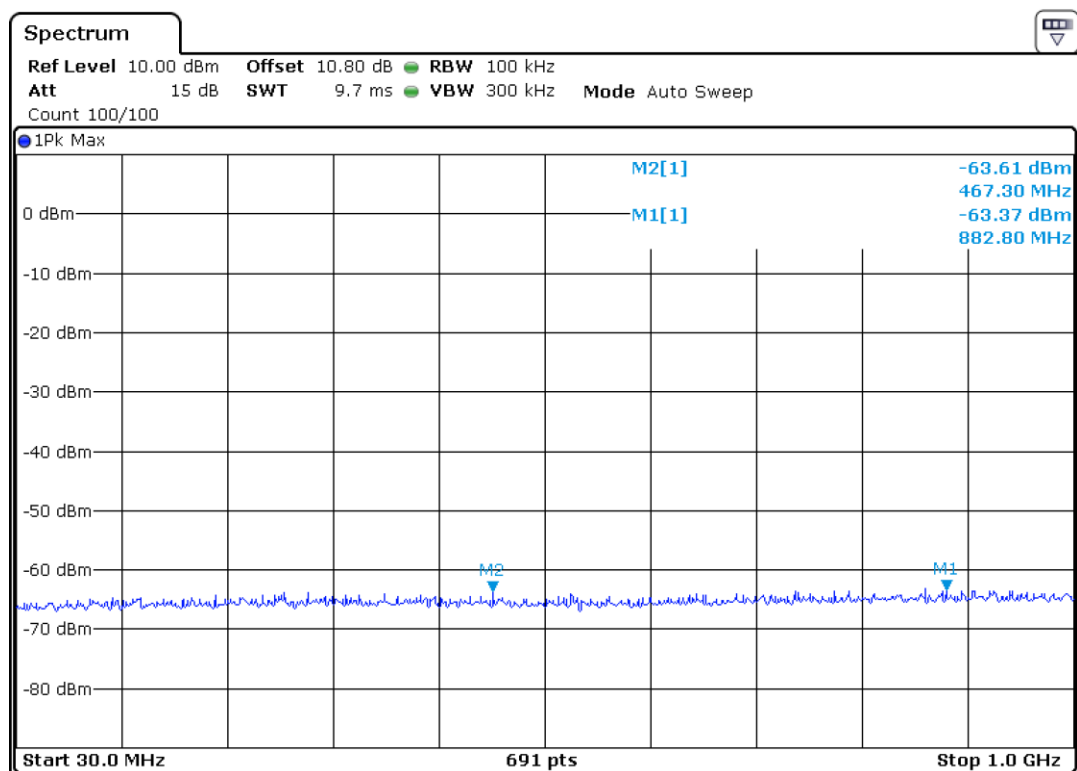
Pass

Test Method:



10 dB attenuator + 0.8 Cable loss = 10.8 dB offset is considered in below result

Test results:

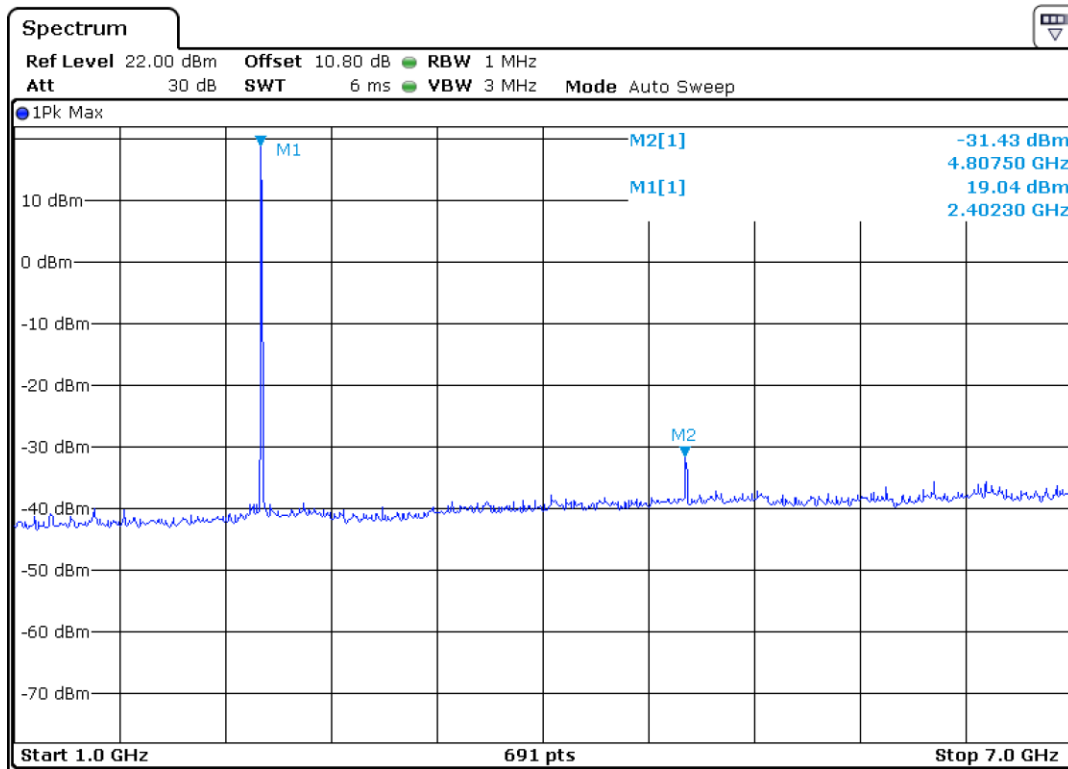


30MHz to 1GHz Spurious Emissions

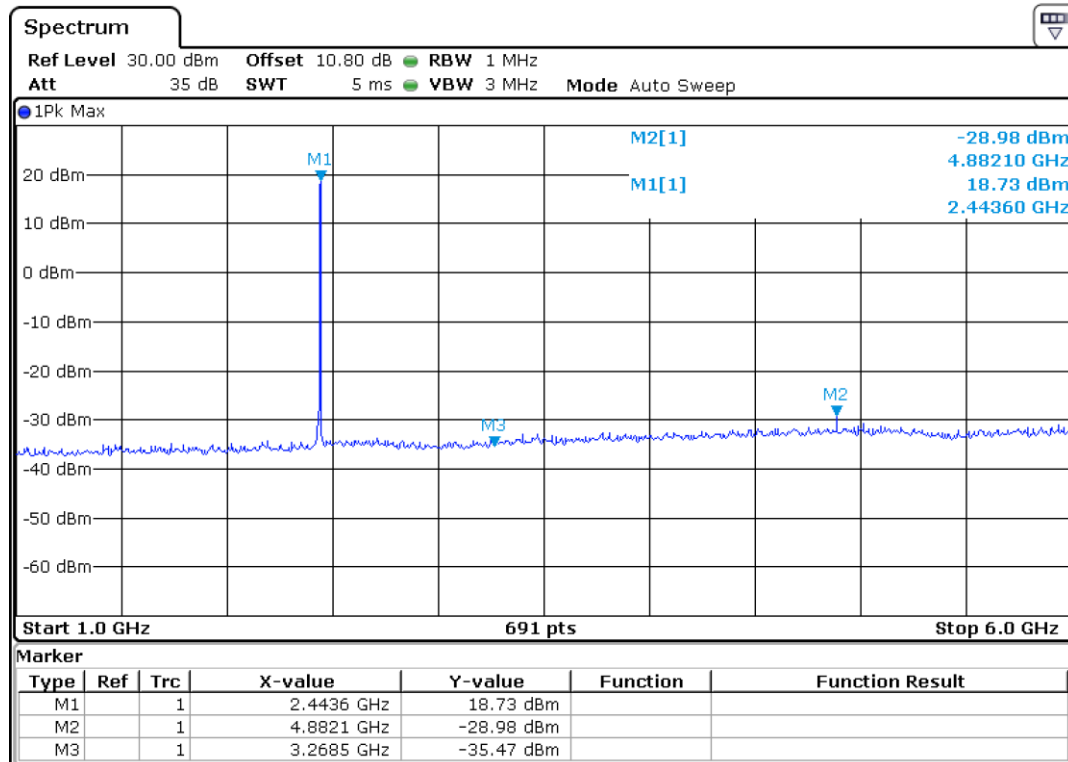
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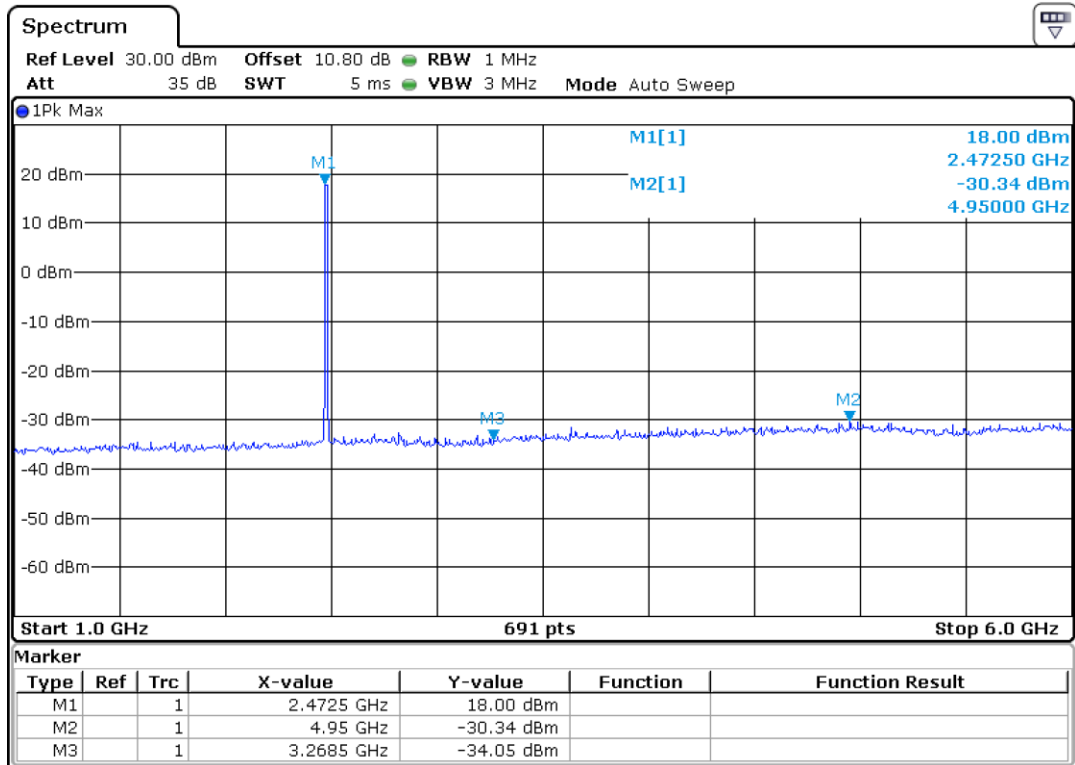
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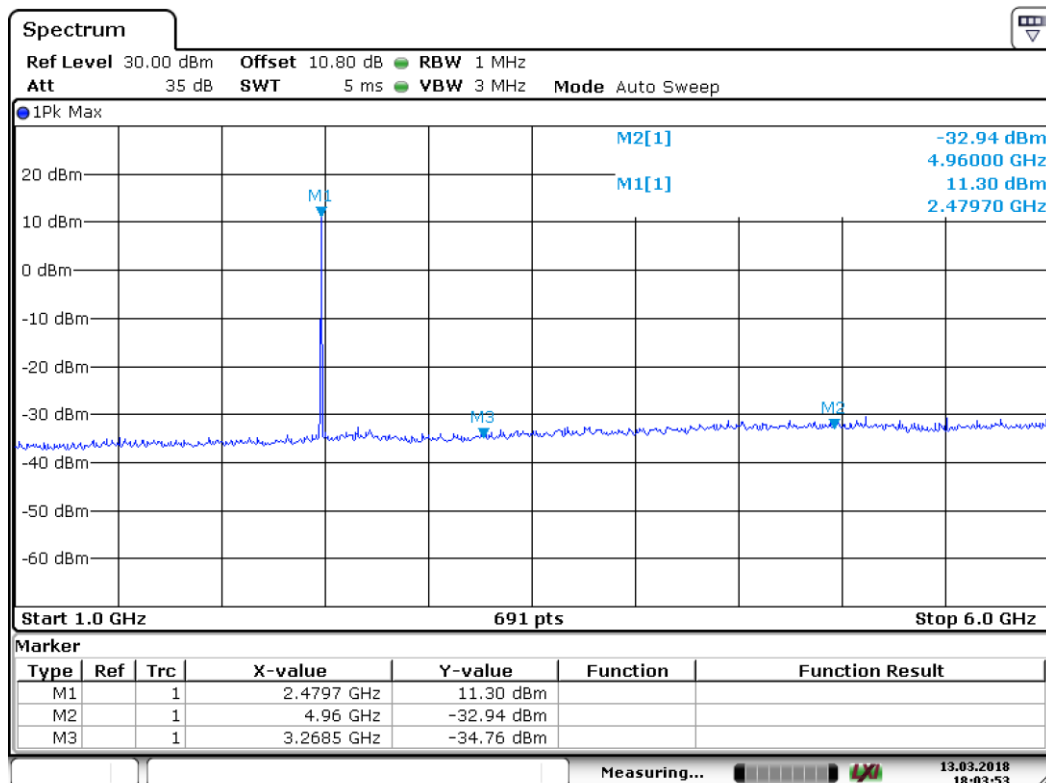
Channel Frequency 2405 MHz



Channel Frequency 2440 MHz



Channel Frequency 2475 MHz



Date: 13. MAR. 2018 18:03:53

Channel Frequency 2480 MHz

Spurious Radiated Emissions & Restricted Bands of Operation

Result

Pass

Test Specification	RSS -Gen Issue 4,Section 8.9 & 8.10
Test Method	ANSI C 63.10 - 2013
Measurement Location	Semi Anechoic Chamber
Measuring Distance	3 m
Detector	QP for frequency below 1 GHz, average for frequency above 1 GHz
Requirement	As per the limits mentioned in the below table

Table 9: Transmitter limits 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 128.51 – 93.80, 73.80 – 62.96 and 69.54 dBμV/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 Conditions:

2.7 V – 3.6 VDC

Environmental conditions:

Temperature: +23.2 °C RH: 60.9 %

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Test results:

No emissions found in frequency 9 kHz to 30 MHz

Test results for frequencies in the range 30 MHz - 200 MHz

Polarization	Frequency (MHz)	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
V	32.14	30.18	40	-9.82
	42.93	23.68	40	-16.32
	93.10	18.44	43.5	-25.06
	145.99	18.95	43.5	-24.55
H	32.17	16.78	40	-7.83
	43.51	13.24	40	-26.76
	90.99	14.51	43.5	-28.99
	118.38	13.90	43.5	-29.60

Test results for frequencies in the range 200 MHz – 1 GHz

Polarization	Frequency (MHz)	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
V	211.20	14.48	40	-25.52
	912.96	23.14	43.5	-20.36
H	216.56	16.45	43.5	-27.05
	836.8	37.41	46	-08.59

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Test results for frequencies in the range 1 GHz - 26.5 GHz

Table 10 : Restricted bands of emission verified Test Results

Channel	Polarization	Frequency (MHz)	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low	V	2390(Pk)	51.16	74	-22.84
		2390(Av)	32.02	54	-21.98
		2405(Pk)	102.43	*	-
		2405(Av)	98.25	*	-
		4810(Pk)	53.25	74	-20.75
		4810(Av)	40.98	54	-13.02
	H	2390(Pk)	48.57	74	-25.43
		2390(Av)	37.64	54	-16.36
		2405(Pk)	110.05	*	-
		2405(Av)	106.21	*	-
		4810(Pk)	55.46	74	-18.54
		4810(Av)	44.62	54	-09.38
Mid	V	4880(Pk)	53.77	74	-20.23
		4880(Av)	42.38	54	-11.62
	H	4880(Pk)	55.74	74	-18.26
		4880(Av)	47.02	54	-06.98
25	V	2475(Pk)	102.23	*	-
		2475(AV)	97.72	*	-
		2483.5(Pk)	44.79	74	-29.21
		2483.5(Av)	33.72	54	-20.28
		4950(Pk)	55.18	74	-18.82
		4950(Av)	42.87	54	-11.13
	H	2475(Pk)	109.55	-	*
		2475(AV)	106.30	-	*
		2483.5(Pk)	53.54	74	-20.46
		2483.5(Av)	42.26	54	-11.74
		4950(Pk)	55.83	74	-18.17
		4950(Av)	45.02	54	-08.98
High	V	2480(Pk)	94.07	-	*
		2480(Av)	91.69	-	*
		2483.5(Pk)	50.19	74	-23.81
		2483.5(Av)	42.84	54	-23.81
		4960(Pk)	53.56	74	-20.44
		4960(Av)	42.76	54	-11.24
	H	2480(Pk)	102.07	*	-
		2480(Av)	99.41	*	-
		2483.5(Pk)	53.24	74	-20.76
		2483.5(Av)	45.55	54	-08.45
		4960(Pk)	54.91	74	-19.09
		4960(Av)	44.99	54	-09.01

Note: Measured emission(dBμV/m) = Received emission(dBμV) + Antenna factor(dB/m) + Cable loss(dB) – Pre-amplifier Gain

Note: *: Fundamental frequency

Pk: Peak Detector

Av: Average Detector

Conducted Emission Test on A.C. Power Line

Result

Pass

Test Specification : RSS Gen Issue 4 section 8.8
 Test Method : ANSI C63.10-2013
 Testing Location : Screened room
 Measurement Bandwidth : 9kHz
 Frequency Range : 150kHz – 30MHz
 Supply Voltage : 120VAC,60Hz

Limits: RSS-Gen Issue 4 section 8.8

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: LINE Graph and Table

110v AC , 60Hz



Line Graph

Detector	Frequency	Level (dBμV)	Limit (dBμV)	Margin (dB)
Quasi Peak	158.0 kHz	56.6	65.55	08.95
Quasi Peak	170.0 kHz	54.18	64.93	10.75
Quasi Peak	198.0 kHz	50.03	63.63	13.60
Quasi Peak	230.0 kHz	43.1	62.36	19.26
Quasi Peak	458.0 kHz	35.99	56.49	20.50
Quasi Peak	770.0 kHz	29.17	56	26.83
Quasi Peak	4.51 MHz	36.16	56	19.84
Quasi Peak	7.454 MHz	34.84	60	25.16
Quasi Peak	18.894 MHz	33.47	60	26.53
Average	154.0 kHz	29.58	55.77	26.19
Average	198.0 kHz	25.19	53.63	28.44
Average	230.0 kHz	20.58	52.36	31.78
Average	466.0 kHz	27.01	46.35	19.34
Average	766.0 kHz	23.07	46	22.93
Average	4.362 MHz	27.79	46	18.21
Average	7.166 MHz	26.06	50	23.94
Average	19.13 MHz	27.00	50	23.00

Line Table

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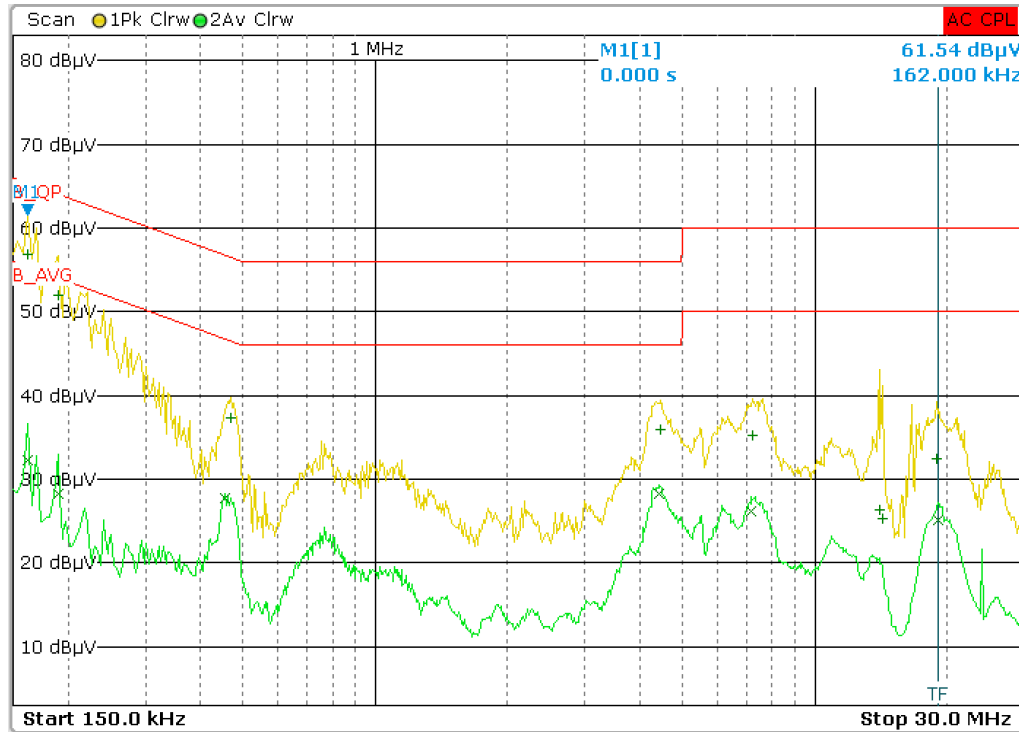
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NEUTRAL Graph and Table

110v AC , 60Hz - Adapter 1 with Battery 1 combination



Neutral Graph

Detector	Frequency	Level (dBμV)	Limit (dBμV)	Margin (dB)
Quasi Peak	162.0 kHz	37.38	65.34	8.4
Quasi Peak	170.0 kHz	29.02	64.93	10.93
Quasi Peak	190.0 kHz	40	63.98	11.99
Quasi Peak	470.0 kHz	33.5	56.27	18.93
Quasi Peak	4.454 MHz	43.45	56	20.12
Quasi Peak	7.242 MHz	47.8	60	24.83
Quasi Peak	14.034 MHz	47.53	60	33.69
Quasi Peak	14.254 MHz	28.88	60	34.72
Quasi Peak	18.986 MHz	32.97	60	27.47
Average	162.0 kHz	32.26	55.34	23.08
Average	190.0 kHz	28.28	53.98	25.7
Average	454.0 kHz	27.79	46.57	18.78
Average	4.426 MHz	28.35	46	17.65
Average	7.186 MHz	26.26	50	23.74
Average	19.134 MHz	25.20	50	24.8

Neutral Table

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*****END OF TEST REPORT*****