

TEST REPORT

Applicant: TrickleStar Limited

Address of Applicant: Room 901, Centre Point, 181-185 Gloucester Road, Wan Chai, Hong Kong, China

Manufacturer: Computime Ltd.

Address of Manufacturer: 6/F, Building 20E, Phase 3, Hong Kong Science Park, 20 Science Park East Avenue Shatin, New Territories, Hongkong, China

Factory: Computime Electronics (Shenzhen) Company Limited

Address of Factory: Yuekenguangyu Industrial Park, Kangqiao Road 88#, Danzhutou Community, Nanwan Street office, Longgang District, Shenzhen, China.

Equipment Under Test (EUT)

Product Name: Thermostat

Model No.: TS2501

FCC ID: 2AG8Q-TS2501

IC: 7723A-TS2501

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247
RSS-247 Issue 2
RSS-Gen Issue 5

Date of sample receipt: August 12, 2020

Date of Test: August 13-September 17, 2020

Date of report issued: September 18, 2020

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Robinson Lo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	September 18, 2020	Original

Prepared By:

Tiger Chen

Date:

September 18, 2020

Project Engineer

Check By:

Robinson

Date:

September 18, 2020

Reviewer

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203/15.247 (c) RSS-Gen Section 6.8	Pass
AC Power Line Conducted Emission	15.207 RSS-Gen Section 8.8	N/A
Conducted Output Power	15.247 (b)(3) RSS-247 Section 5.4(d)	Pass
Channel Bandwidth	15.247 (a)(2) RSS-247 Section 5.2(a)	Pass
99% Occupy Bandwidth	RSS-Gen Section 6.7	
Power Spectral Density	15.247 (e) RSS-247 Section 5.2(b)	Pass
Band Edge	15.247(d) RSS-247 Section 5.5	Pass
Spurious Emission	15.205/15.209 RSS-247 Section 5.5	Pass
Frequency stability	RSS-Gen Section 6.11& Section 8.11	Pass

Remarks:

1. Pass: The EUT complies with the essential requirements in the standard.
2. Test according to ANSI C63.10:2013 and RSS-Gen.

Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

5 General Information

5.1 General Description of EUT

Product Name:	Thermostat
Model No.:	TS2501
Test sample(s) ID:	GTS202008000079-1
Sample(s) Status:	Engineer sample
Serial No.:	N/A
Hardware Version:	N/A
Software Version:	N/A
Operation Frequency:	2402MHz~2480MHz
Channel Numbers:	40
Channel Separation:	2MHz
Modulation Type:	GFSK
Antenna Type:	Integral Antenna
Antenna Gain:	0dBi(declare by applicant)
Power Supply:	AC 24V

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402 MHz	11	2422 MHz	21	2442 MHz	31	2462 MHz
2	2404 MHz	12	2424 MHz	22	2444 MHz	32	2464 MHz
3	2406 MHz	13	2426 MHz	23	2446 MHz	33	2466 MHz
4	2408 MHz	14	2428 MHz	24	2448 MHz	34	2468 MHz
5	2410 MHz	15	2430 MHz	25	2450 MHz	35	2470 MHz
6	2412 MHz	16	2432 MHz	26	2452 MHz	36	2472 MHz
7	2414 MHz	17	2434 MHz	27	2454 MHz	37	2474 MHz
8	2416 MHz	18	2436 MHz	28	2456 MHz	38	2476 MHz
9	2418 MHz	19	2438 MHz	29	2458 MHz	39	2478 MHz
10	2420 MHz	20	2440 MHz	30	2460 MHz	40	2480 MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2402MHz
The middle channel	2440MHz
The Highest channel	2480MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode
<i>Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.</i>	

5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
Supplied by client	AC adaptor	PPI76-24V05AC	N/A

5.4 Deviation from Standards

None.

5.5 Abnormalities from Standard Conditions

None.

5.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations: ● FCC —Registration No.: 381383 Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383. ● IC —Registration No.: 9079A The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A ● NVLAP (LAB CODE:600179-0) Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

5.7 Test Location

All tests were performed at:
Global United Technology Services Co., Ltd. Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960

5.8 Additional instructions

Test Software	Test command provide by manufacturer.
Power level setup	Default

6 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 02 2020	July. 01 2025
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 25 2020	June. 24 2021
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 25 2020	June. 24 2021
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 25 2020	June. 24 2021
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 25 2020	June. 24 2021
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 25 2020	June. 24 2021
9	Coaxial Cable	GTS	N/A	GTS211	June. 25 2020	June. 24 2021
10	Coaxial cable	GTS	N/A	GTS210	June. 25 2020	June. 24 2021
11	Coaxial Cable	GTS	N/A	GTS212	June. 25 2020	June. 24 2021
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 25 2020	June. 24 2021
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 25 2020	June. 24 2021
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 25 2020	June. 24 2021
15	Band filter	Amindeon	82346	GTS219	June. 25 2020	June. 24 2021
16	Power Meter	Anritsu	ML2495A	GTS540	June. 25 2020	June. 24 2021
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 25 2020	June. 24 2021
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 25 2020	June. 24 2021
19	Splitter	Agilent	11636B	GTS237	June. 25 2020	June. 24 2021
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 25 2020	June. 24 2021
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 19 2019	Oct. 18 2020
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 19 2019	Oct. 18 2020
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 19 2019	Oct. 18 2020
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 25 2020	June. 24 2021

Conducted Emission						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.15 2019	May.14 2022
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 25 2020	June. 24 2021
4	ENV216 2-L-V-NETZNACHB.DE	ROHDE&SCHWARZ	ENV216	GTS226	June. 25 2020	June. 24 2021
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 25 2020	June. 24 2021
8	Absorbing clamp	Elektronik-Feinmechanik	MDS21	GTS229	June. 25 2020	June. 24 2021
9	ISN	SCHWARZBECK	NTFM 8158	GTD565	June. 25 2020	June. 24 2021

RF Conducted Test:						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 25 2020	June. 24 2021
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 25 2020	June. 24 2021
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 25 2020	June. 24 2021
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 25 2020	June. 24 2021
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 25 2020	June. 24 2021
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 25 2020	June. 24 2021
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 25 2020	June. 24 2021
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 25 2020	June. 24 2021

General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 25 2020	June. 24 2021
2	Barometer	ChangChun	DYM3	GTS255	June. 25 2020	June. 24 2021

7 Test results and Measurement Data

7.1 Antenna requirement

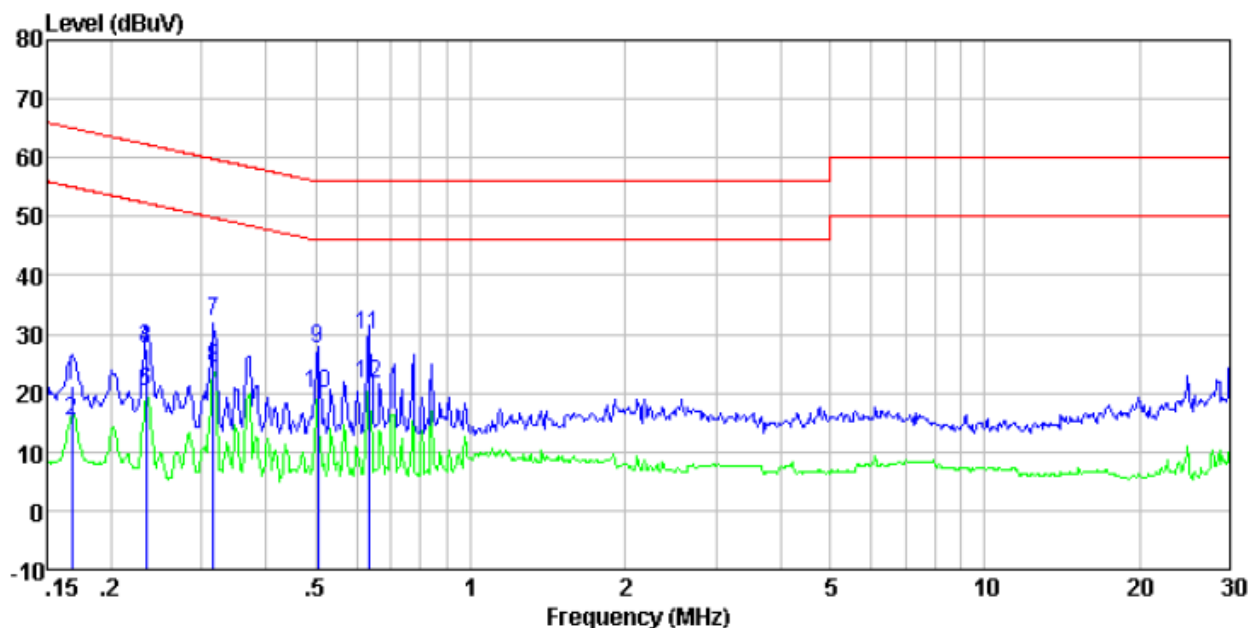
Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
Standard requirement:	RSS-Gen Section 6.8
A transmitter can only be sold or operated with antennas with which it was approved. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. For transmitters of RF output power of 10 milliwatts or less, only the portion of the antenna gain that is in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power to demonstrate compliance with the radiated power limits specified in the applicable standard. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power	
E.U.T Antenna:	
<i>The antenna is Integral antenna, the best case gain of the is 0dBi, reference to the appendix II for details</i>	

7.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207 RSS-Gen Section 8.8																			
Test Method:	ANSI C63.10:2013 and RSS-Gen																			
Test Frequency Range:	150KHz to 30MHz																			
Class / Severity:	Class B																			
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto																			
Limit:	<table><tr><th rowspan="2">Frequency range (MHz)</th><th colspan="2">Limit (dBuV)</th></tr><tr><th>Quasi-peak</th><th>Average</th></tr><tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr><tr><td>0.5-5</td><td>56</td><td>46</td></tr><tr><td>5-30</td><td>60</td><td>50</td></tr></table> * Decreases with the logarithm of the frequency.						Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)																			
	Quasi-peak	Average																		
0.15-0.5	66 to 56*	56 to 46*																		
0.5-5	56	46																		
5-30	60	50																		
Test setup:	Reference Plane Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m																			
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2009 on conducted measurement.																			
Test Instruments:	Refer to section 6.0 for details																			
Test mode:	Refer to section 5.2 for details																			
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar														
Test results:	Pass																			

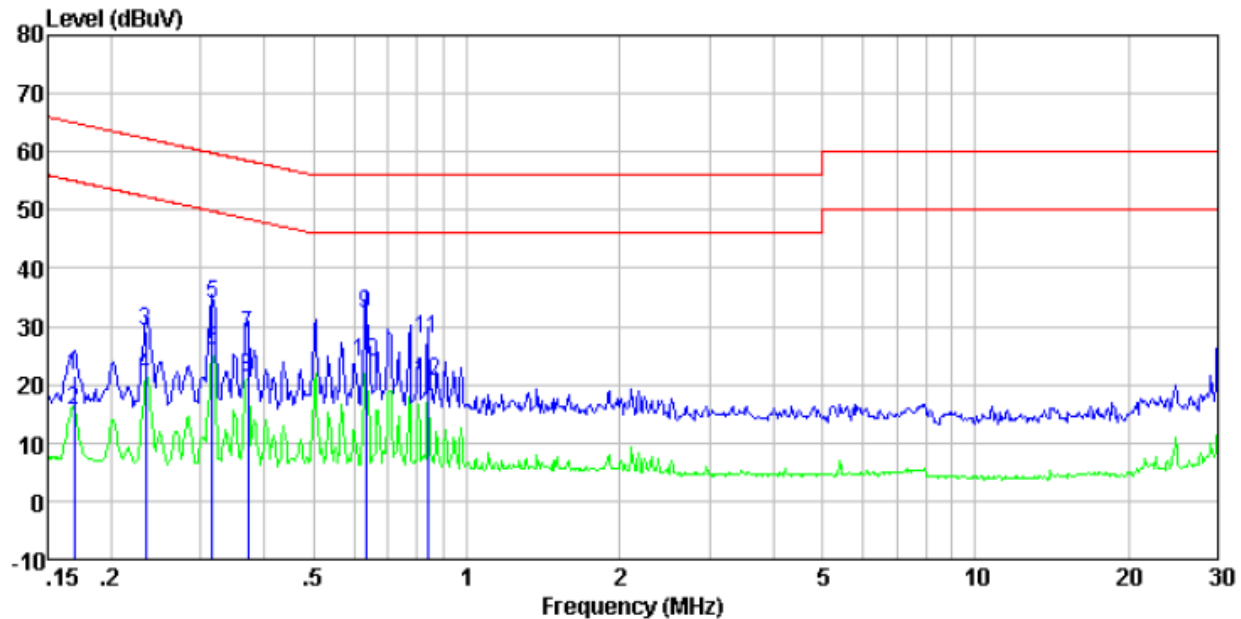
Measurement data

Line:



Freq MHz	Reading level dBuV	LISN/ISN factor dB/m	Cable loss dB	Level dBuV	Limit level dBuV	Over limit dB	Remark
0.17	0.65	20.40	0.09	21.14	65.08	-43.94	QP
0.17	-5.24	20.40	0.09	15.25	55.08	-39.83	Average
0.23	7.16	20.40	0.11	27.67	62.30	-34.63	QP
0.23	7.10	20.40	0.11	27.61	62.30	-34.69	QP
0.23	-0.16	20.40	0.11	20.35	52.30	-31.95	Average
0.23	-0.24	20.40	0.11	20.27	52.30	-32.03	Average
0.32	11.77	20.39	0.10	32.26	59.80	-27.54	QP
0.32	3.84	20.39	0.10	24.33	49.80	-25.47	Average
0.50	7.20	20.31	0.11	27.62	56.00	-28.38	QP
0.50	-0.68	20.31	0.11	19.74	46.00	-26.26	Average
0.63	9.45	20.28	0.12	29.85	56.00	-26.15	QP
0.63	1.09	20.28	0.12	21.49	46.00	-24.51	Average

Neutral:

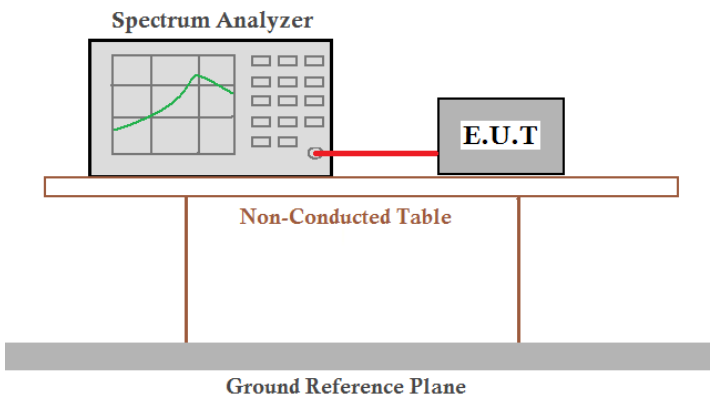


Freq MHz	Reading level dBuV	LISN/ISN factor dB/m	Cable loss dB	Level dBuV	Limit level dBuV	Over limit dB	Remark
0.17	1.01	20.40	0.09	21.50	64.99	-43.49	QP
0.17	-4.98	20.40	0.09	15.51	54.99	-39.48	Average
0.23	8.68	20.40	0.11	29.19	62.30	-33.11	QP
0.23	1.18	20.40	0.11	21.69	52.30	-30.61	Average
0.32	13.43	20.39	0.10	33.92	59.80	-25.88	QP
0.32	5.35	20.39	0.10	25.84	49.80	-23.96	Average
0.37	8.08	20.36	0.10	28.54	58.47	-29.93	QP
0.37	0.60	20.36	0.10	21.06	48.47	-27.41	Average
0.63	11.86	20.28	0.12	32.26	56.00	-23.74	QP
0.63	3.34	20.28	0.12	23.74	46.00	-22.26	Average
0.84	7.46	20.23	0.14	27.83	56.00	-28.17	QP
0.84	0.26	20.23	0.14	20.63	46.00	-25.37	Average

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss
4. If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

7.3 Conducted Output Power

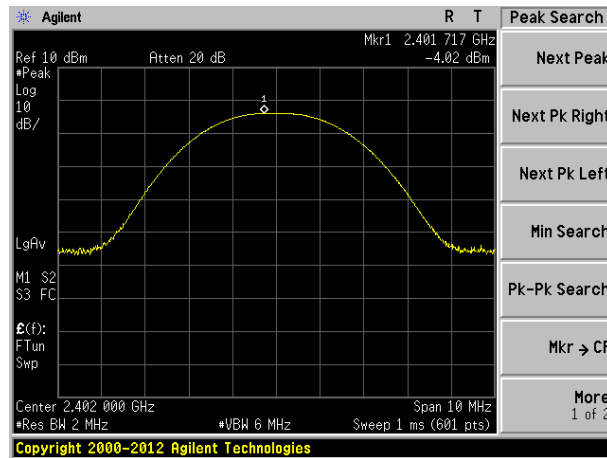
Test Requirement:	FCC Part15 C Section 15.247 (b)(3) RSS-247 Section 5.4(d)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 and RSS-Gen
Limit:	30dBm 36dBm(4W for e.i.r.p)
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T are placed on a Non-Conducted Table. The table is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

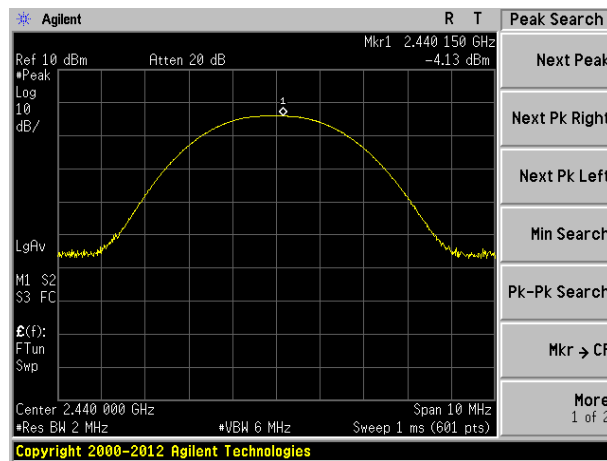
Test channel	Peak Output Power (dBm)	Limit(dBm)	Result
Lowest	-4.02	30.00	Pass
Middle	-4.13		
Highest	-5.13		

Test channel	e.i.r.p. (dBm)	Limit(dBm)	Result
Lowest	-4.02	36.00	Pass
Middle	-4.13		
Highest	-5.13		

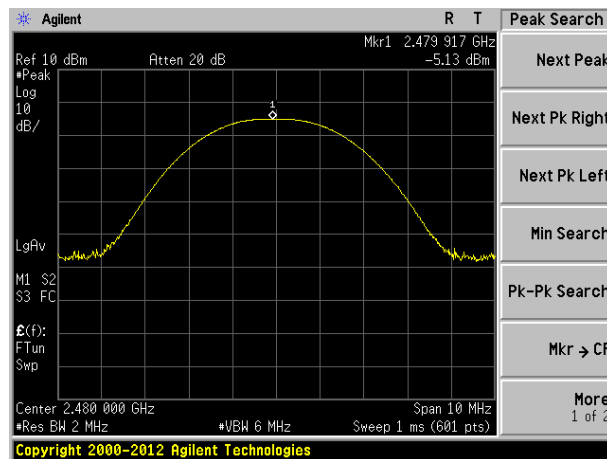
Test plot as follows:



Lowest channel

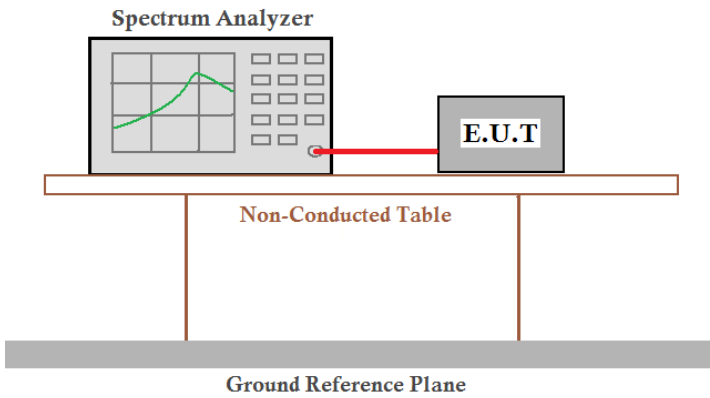


Middle channel



Highest channel

7.4 Channel Bandwidth & 99% Occupy Bandwidth

Test Requirement:	FCC Part15 C Section 15.247 (a)(2) & RSS-247 Section 5.2(a)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 and RSS-Gen
Limit:	>500KHz
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by two vertical legs. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

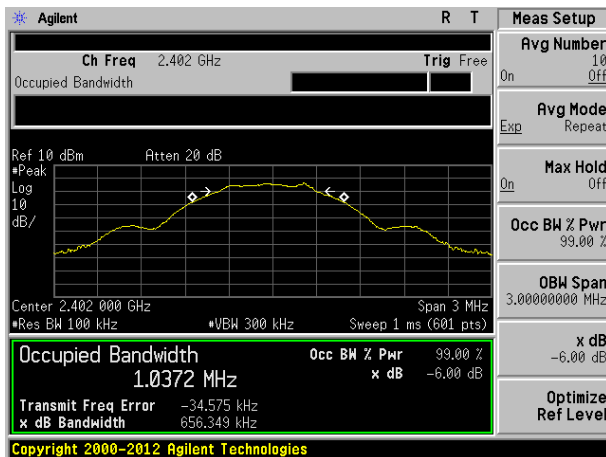
Measurement Data

Test channel	Channel Bandwidth (MHz)	Limit(KHz)	Result
Lowest	0.656	>500	Pass
Middle	0.693		
Highest	0.657		

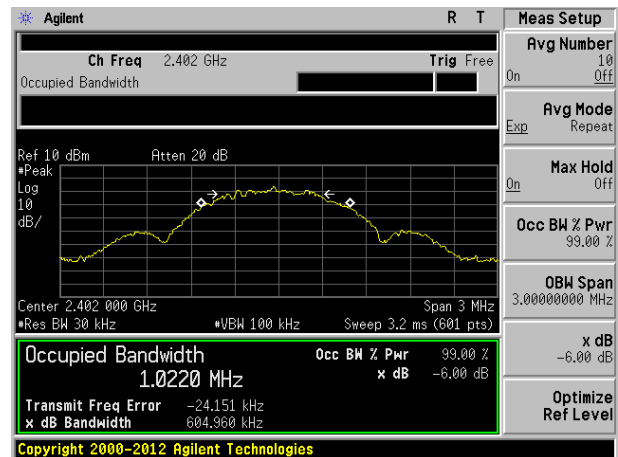
Test channel	99% Bandwidth (MHz)	Result
Lowest	1.0220	Pass
Middle	1.0276	
Highest	1.0295	

Test plot as follows:

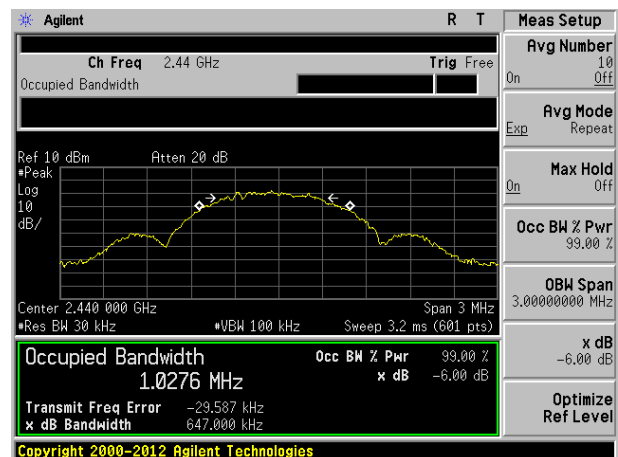
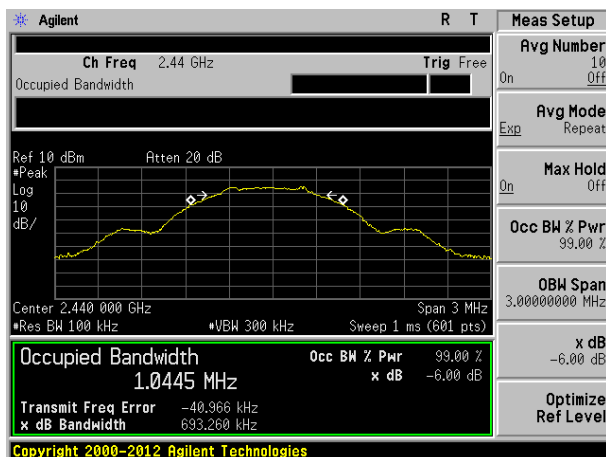
-6dB BW



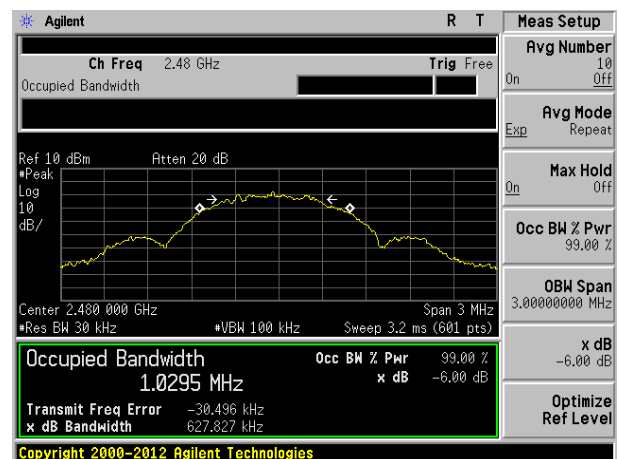
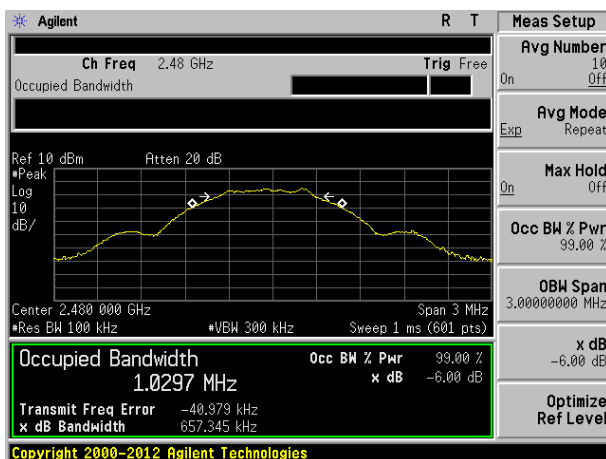
99% BW



Lowest channel

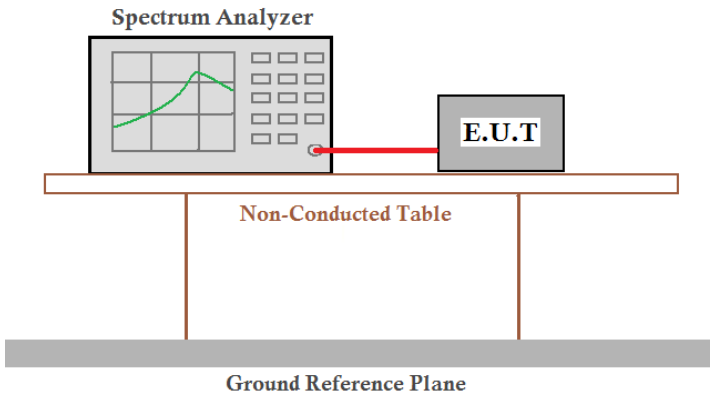


Middle channel



Highest channel

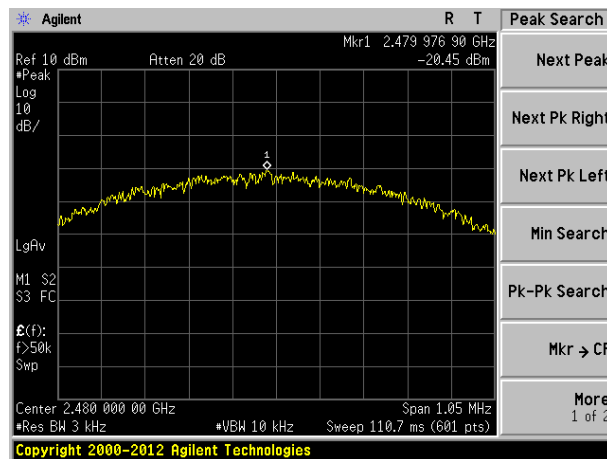
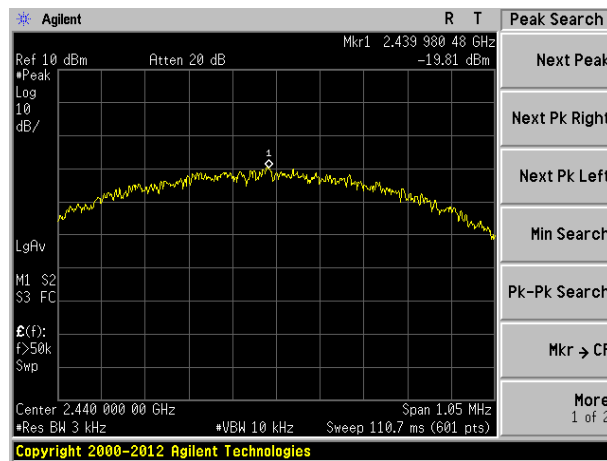
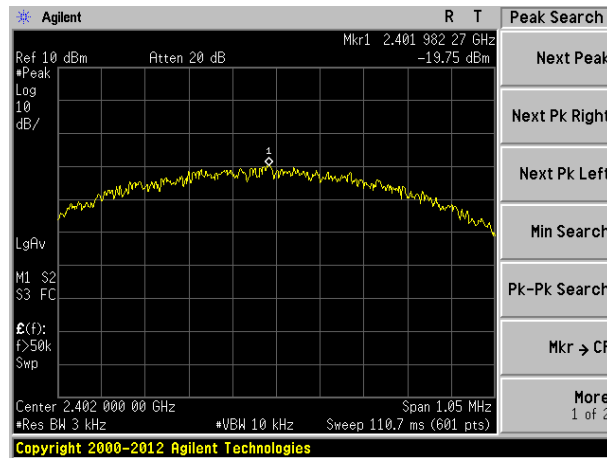
7.5 Power Spectral Density

Test Requirement:	FCC Part15 C Section 15.247 (e) RSS-247 Section 5.2(b)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 and RSS-Gen
Limit:	8dBm/3kHz
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

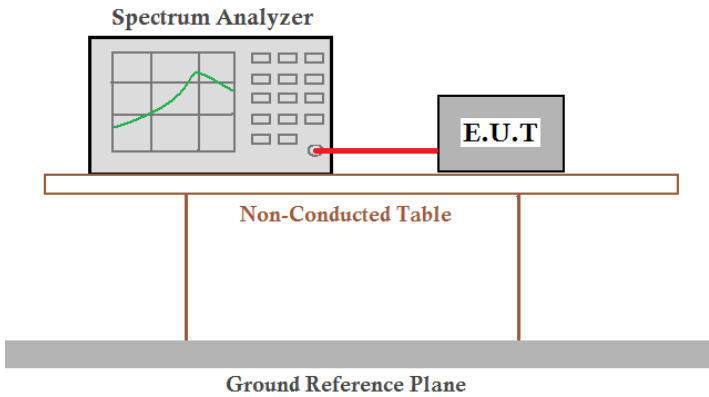
Test channel	Power Spectral Density (dBm/3kHz)	Limit(dBm/3kHz)	Result
Lowest	-19.75	8.00	Pass
Middle	-19.81		
Highest	-20.45		

Test plot as follows:

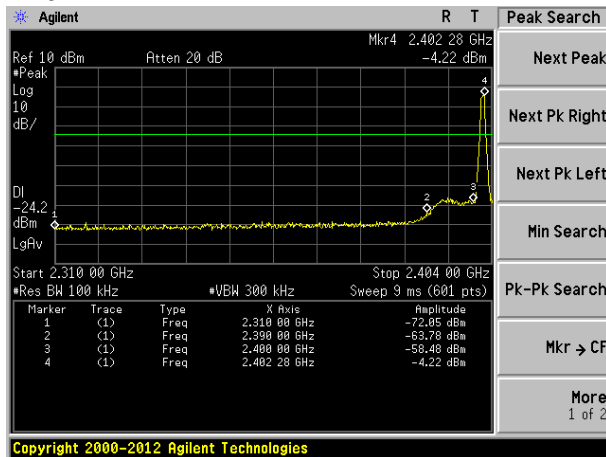


7.6 Band edges

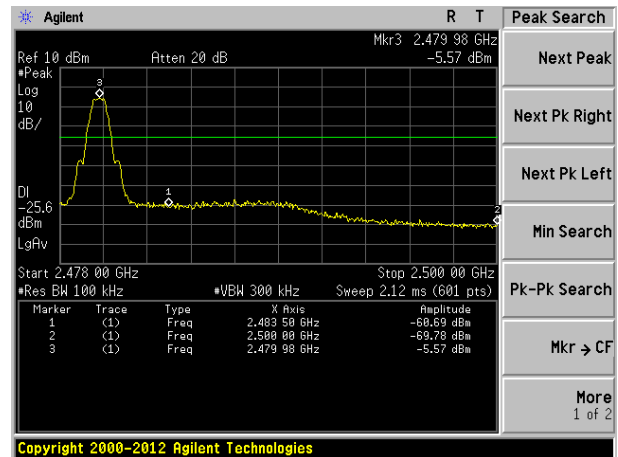
7.6.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d) RSS-247 Section 5.5
Test Method:	ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 & RSS-Gen
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. The table is supported by two vertical legs and sits on a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Test plot as follows:

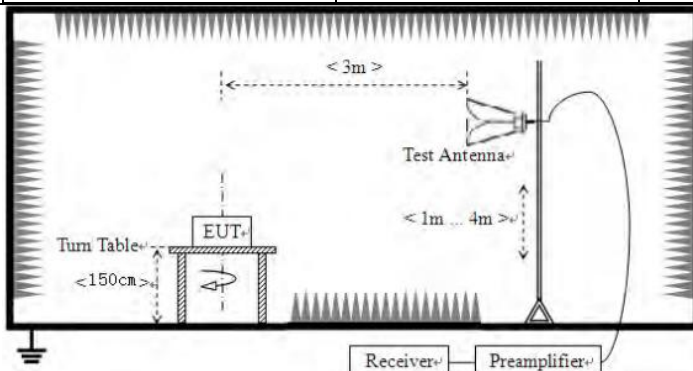


Lowest channel



Highest channel

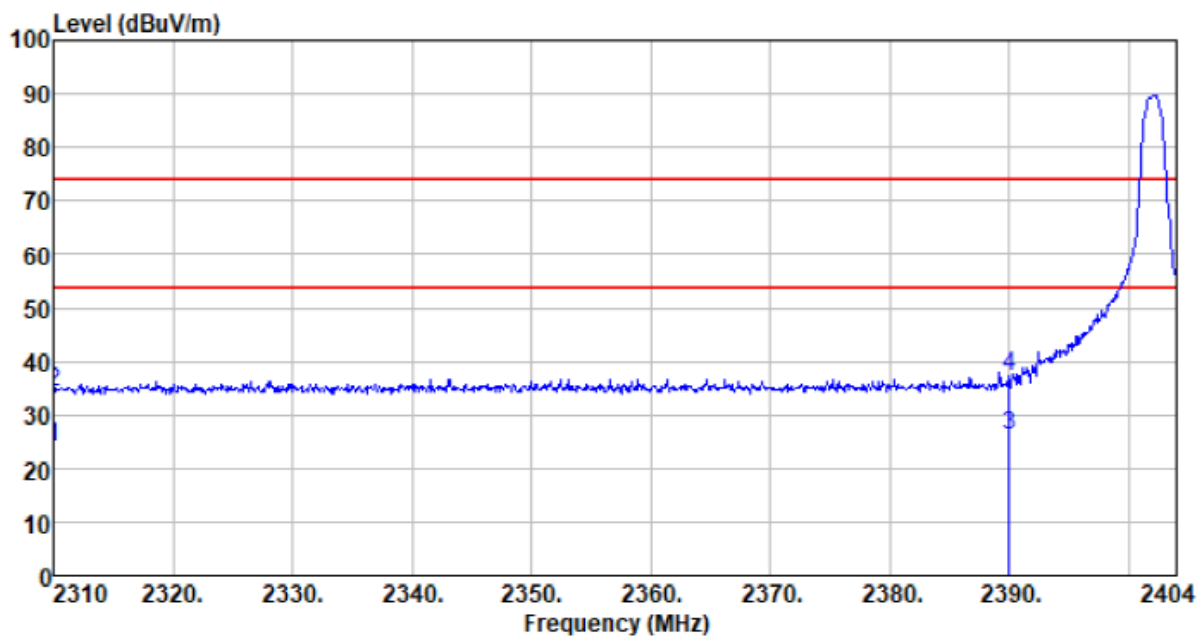
7.6.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205 RSS-247 Section 3.3 & RSS-Gen Section 8.10				
Test Method:	ANSI C63.10:2013 & RSS-Gen				
Test Frequency Range:	All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed.				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	Above 1GHz	Peak RMS	1MHz 1MHz	3MHz 3MHz	Peak Average
Limit:	Frequency		Limit (dBuV/m @3m)		Value
	Above 1GHz		54.00 74.00		Average Peak
Test setup:					
Test Procedure:	1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. 7. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.				
Test Instruments:	Refer to section 6.0 for details				
Test mode:	Refer to section 5.2 for details				
Test results:	Pass				

Measurement Data

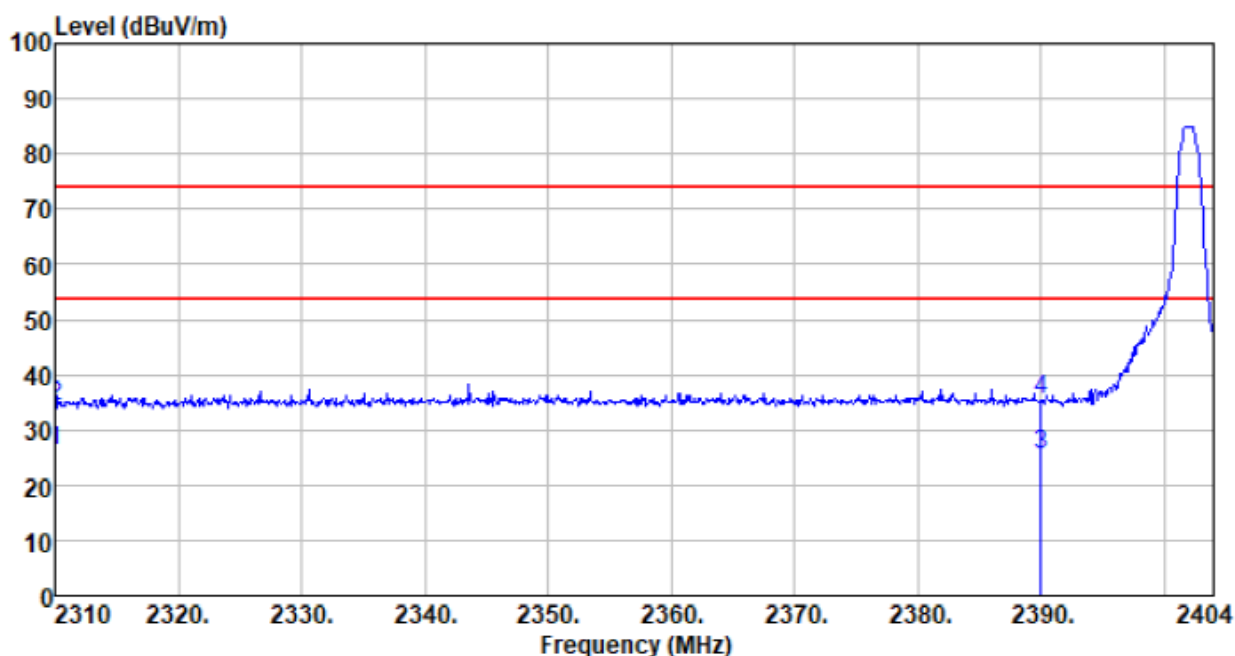
Test channel:	Lowest
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	25.62	27.14	5.30	34.11	23.95	54.00	-30.05	Average
2310.000	35.86	27.14	5.30	34.11	34.19	74.00	-39.81	Peak
2390.000	27.64	27.37	5.38	34.01	26.38	54.00	-27.62	Average
2390.000	38.53	27.37	5.38	34.01	37.27	74.00	-36.73	Peak

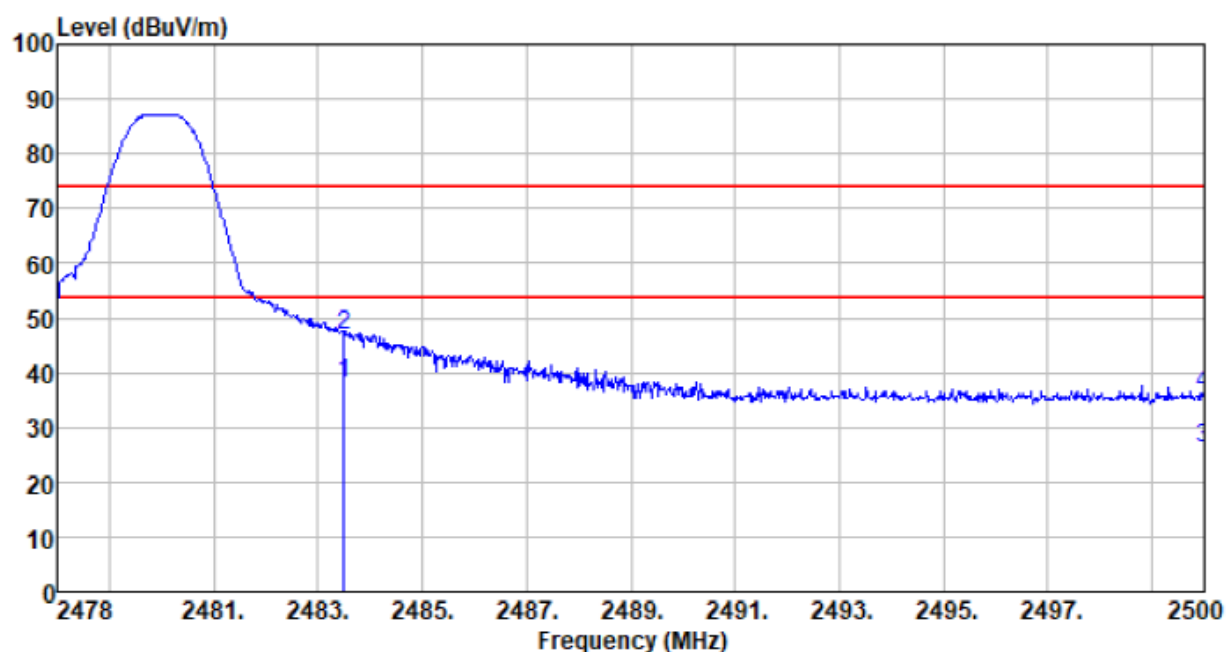
Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	27.70	27.14	5.30	34.11	26.03	54.00	-27.97	Average
2310.000	36.05	27.14	5.30	34.11	34.38	74.00	-39.62	Peak
2390.000	26.87	27.37	5.38	34.01	25.61	54.00	-28.39	Average
2390.000	36.77	27.37	5.38	34.01	35.51	74.00	-38.49	Peak

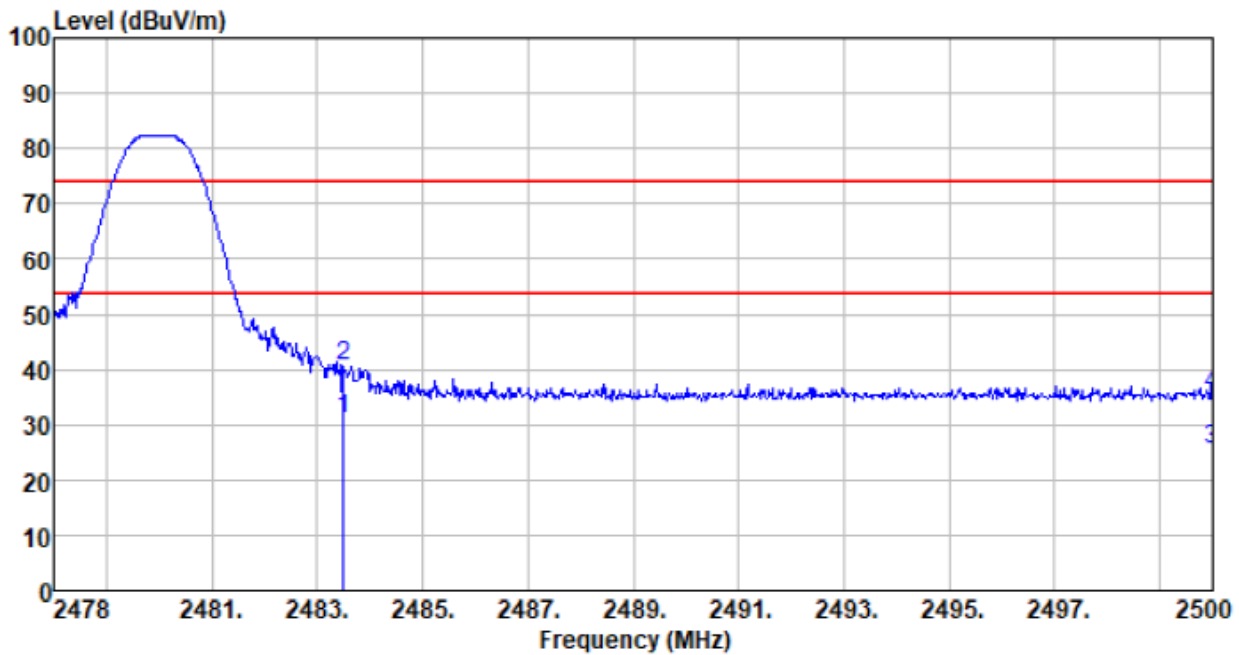
Test channel:	Highest
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	38.84	27.66	5.47	33.92	38.05	54.00	-15.95	Average
2483.500	47.73	27.66	5.47	33.92	46.94	74.00	-27.06	Peak
2500.000	26.97	27.70	5.49	33.90	26.26	54.00	-27.74	Average
2500.000	36.78	27.70	5.49	33.90	36.07	74.00	-37.93	Peak

Vertical::



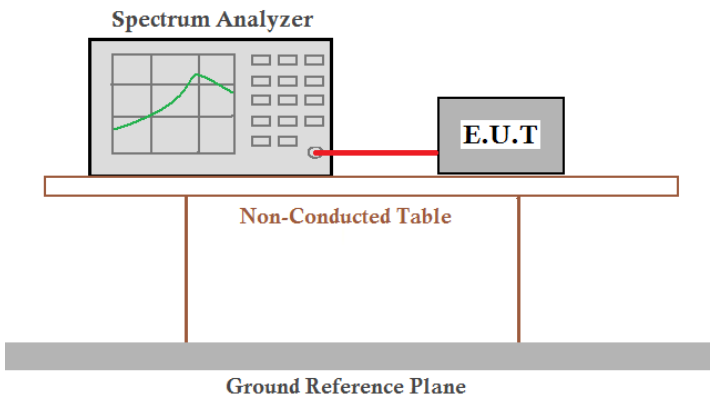
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	31.70	27.66	5.47	33.92	30.91	54.00	-23.09	Average
2483.500	41.28	27.66	5.47	33.92	40.49	74.00	-33.51	Peak
2500.000	26.07	27.70	5.49	33.90	25.36	54.00	-28.64	Average
2500.000	36.11	27.70	5.49	33.90	35.40	74.00	-38.60	Peak

Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Pre-amplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.
3. The pre-test were performed on lowest, middle and highest frequencies, only the worst case's (lowest and highest frequencies) data was showed.

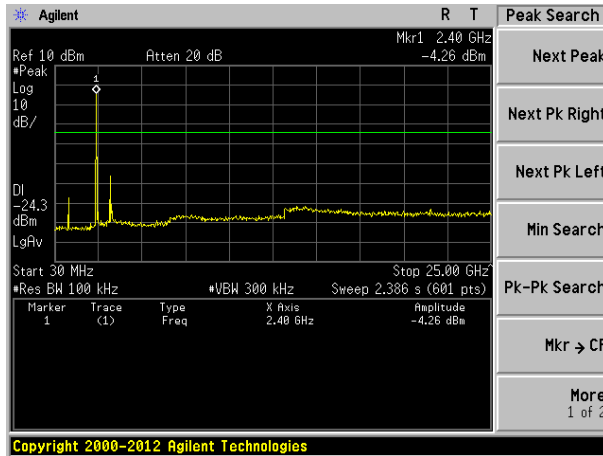
7.7 Spurious Emission

7.7.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d) RSS-247 Section 5.5
Test Method:	ANSI C63.10:2013 and KDB558074 D01 15.247 Meas Guidance v05r02 & RSS-Gen
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test setup:	 The diagram illustrates the test setup for conducted emissions. A Spectrum Analyzer is connected to an Equipment Under Test (E.U.T.) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table, which is supported by two vertical legs. Below the table is a Ground Reference Plane, represented by a thick grey bar.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

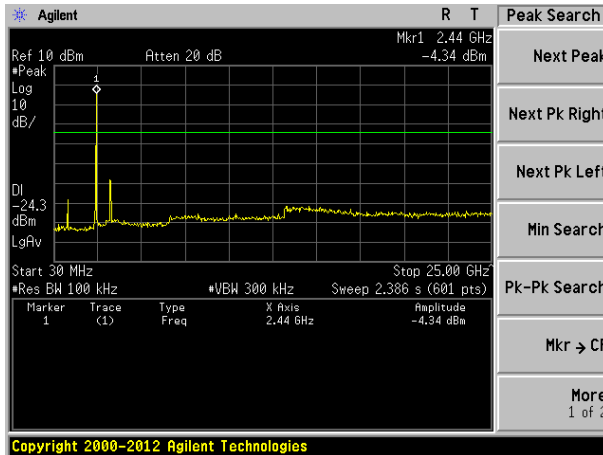
Test plot as follows:

Lowest channel



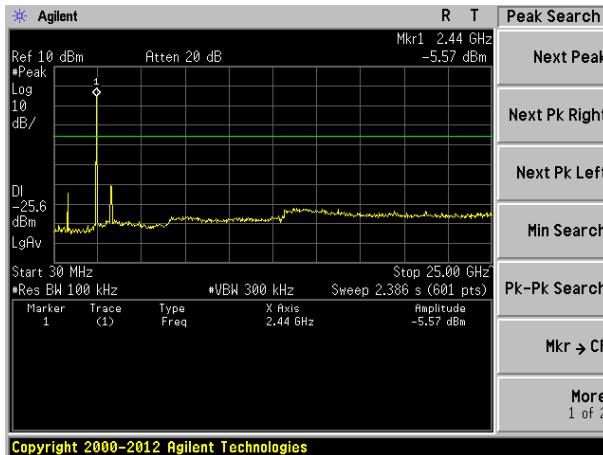
30MHz~25GHz

Middle channel



30MHz~25GHz

Highest channel



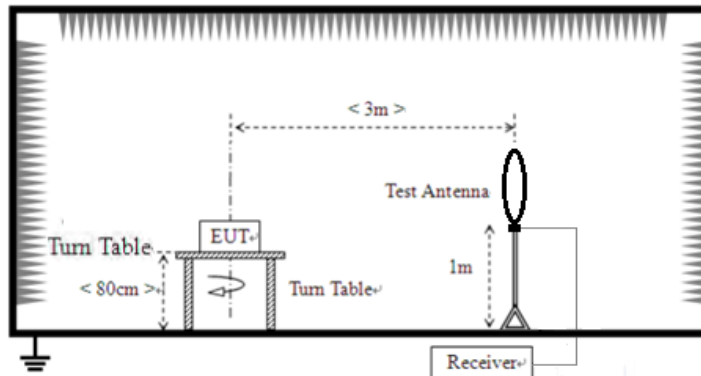
30MHz~25GHz

7.7.2 Radiated Emission Method

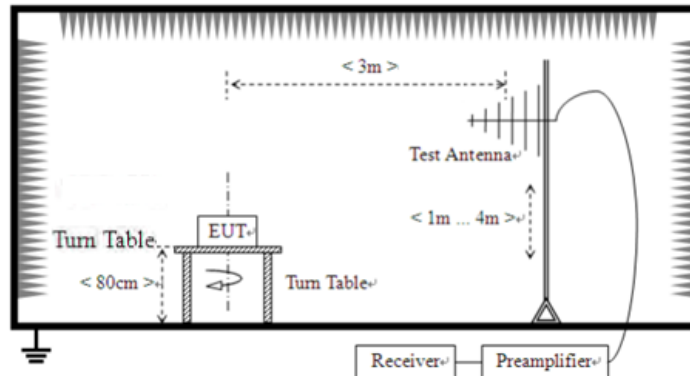
Test Requirement:	FCC Part15 C Section 15.209 RSS-247 Section 3.3 & RSS-Gen Section 8.9																												
Test Method:	ANSI C63.10:2013 & RSS-Gen																												
Test Frequency Range:	9kHz to 25GHz																												
Test site:	Measurement Distance: 3m																												
Receiver setup:	Frequency	Detector	RBW	VBW	Value																								
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak																								
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak																								
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak																								
	Above 1GHz	Peak	1MHz	3MHz	Peak																								
		Peak	1MHz	10Hz	Average																								
FCC Limit:	<table><tr><th>Frequency (MHz)</th><th>Field strength (microvolts/meter)</th><th>Measurement distance (meters)</th></tr><tr><td>0.009-0.490</td><td>2400/F(kHz)</td><td>300</td></tr><tr><td>0.490-1.705</td><td>24000/F(kHz)</td><td>30</td></tr><tr><td>1.705-30.0</td><td>30</td><td>30</td></tr><tr><td>30-88</td><td>100**</td><td>3</td></tr><tr><td>88-216</td><td>150**</td><td>3</td></tr><tr><td>216-960</td><td>200**</td><td>3</td></tr><tr><td>Above 960</td><td>500</td><td>3</td></tr></table> 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.					Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	0.009-0.490	2400/F(kHz)	300	0.490-1.705	24000/F(kHz)	30	1.705-30.0	30	30	30-88	100**	3	88-216	150**	3	216-960	200**	3	Above 960	500	3
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)																											
0.009-0.490	2400/F(kHz)	300																											
0.490-1.705	24000/F(kHz)	30																											
1.705-30.0	30	30																											
30-88	100**	3																											
88-216	150**	3																											
216-960	200**	3																											
Above 960	500	3																											
IC Limit:	Table 5 – General field strength limits at frequencies above 30 MHz <table><tr><th>Frequency (MHz)</th><th>Field strength (µV/m at 3 m)</th></tr><tr><td>30 – 88</td><td>100</td></tr><tr><td>88 – 216</td><td>150</td></tr><tr><td>216 – 960</td><td>200</td></tr><tr><td>Above 960</td><td>500</td></tr></table> Table 6 – General field strength limits at frequencies below 30 MHz <table><tr><th>Frequency</th><th>Magnetic field strength (H-Field) (µA/m)</th><th>Measurement distance (m)</th></tr><tr><td>9 - 490 kHz ¹</td><td>6.37/F (F in kHz)</td><td>300</td></tr><tr><td>490 - 1705 kHz</td><td>63.7/F (F in kHz)</td><td>30</td></tr><tr><td>1.705 - 30 MHz</td><td>0.08</td><td>30</td></tr></table> Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.					Frequency (MHz)	Field strength (µV/m at 3 m)	30 – 88	100	88 – 216	150	216 – 960	200	Above 960	500	Frequency	Magnetic field strength (H-Field) (µA/m)	Measurement distance (m)	9 - 490 kHz ¹	6.37/F (F in kHz)	300	490 - 1705 kHz	63.7/F (F in kHz)	30	1.705 - 30 MHz	0.08	30		
Frequency (MHz)	Field strength (µV/m at 3 m)																												
30 – 88	100																												
88 – 216	150																												
216 – 960	200																												
Above 960	500																												
Frequency	Magnetic field strength (H-Field) (µA/m)	Measurement distance (m)																											
9 - 490 kHz ¹	6.37/F (F in kHz)	300																											
490 - 1705 kHz	63.7/F (F in kHz)	30																											
1.705 - 30 MHz	0.08	30																											

Test setup:

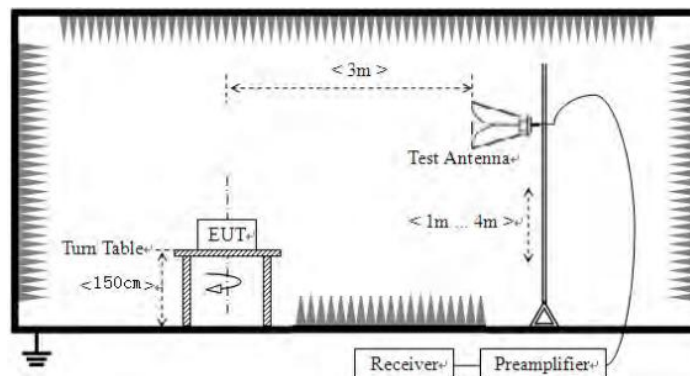
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



Test Procedure:

1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

	3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test results:	Pass					

Measurement data:

Remark:

Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

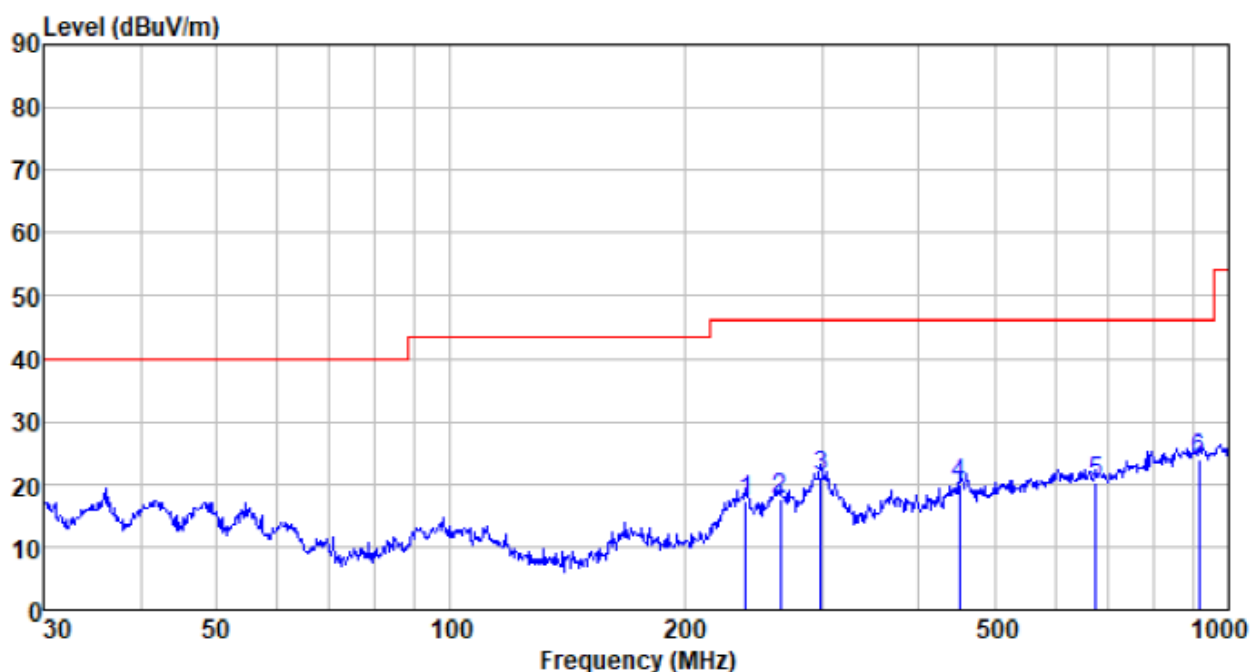
■ 9kHz~30MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

■ Below 1GHz

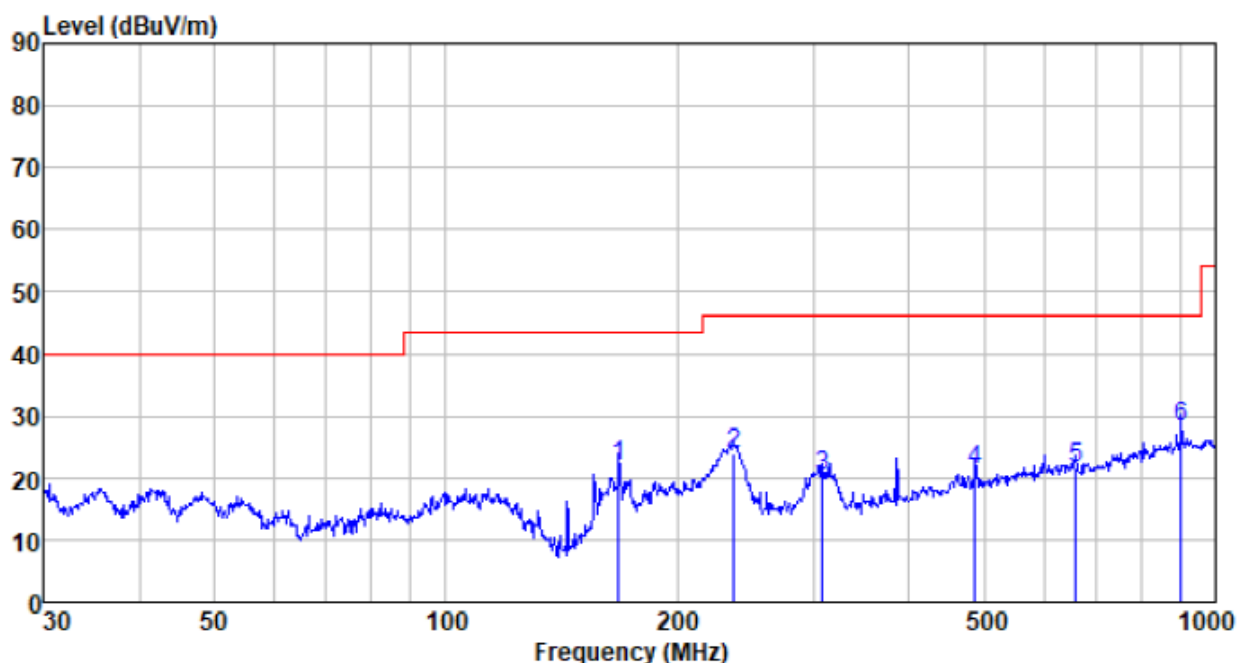
Pre-scan all test modes, found worst case at 2480MHz, and so only show the test result of 2480MHz

Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
239.987	40.57	11.85	2.07	37.37	17.12	46.00	-28.88	QP
265.676	39.99	12.65	2.20	37.39	17.45	46.00	-28.55	QP
299.316	42.68	13.60	2.35	37.42	21.21	46.00	-24.79	QP
451.135	37.96	16.40	3.09	37.51	19.94	46.00	-26.06	QP
675.208	34.37	19.58	4.00	37.61	20.34	46.00	-25.66	QP
916.069	34.25	22.35	4.91	37.58	23.93	46.00	-22.07	QP

Vertical:

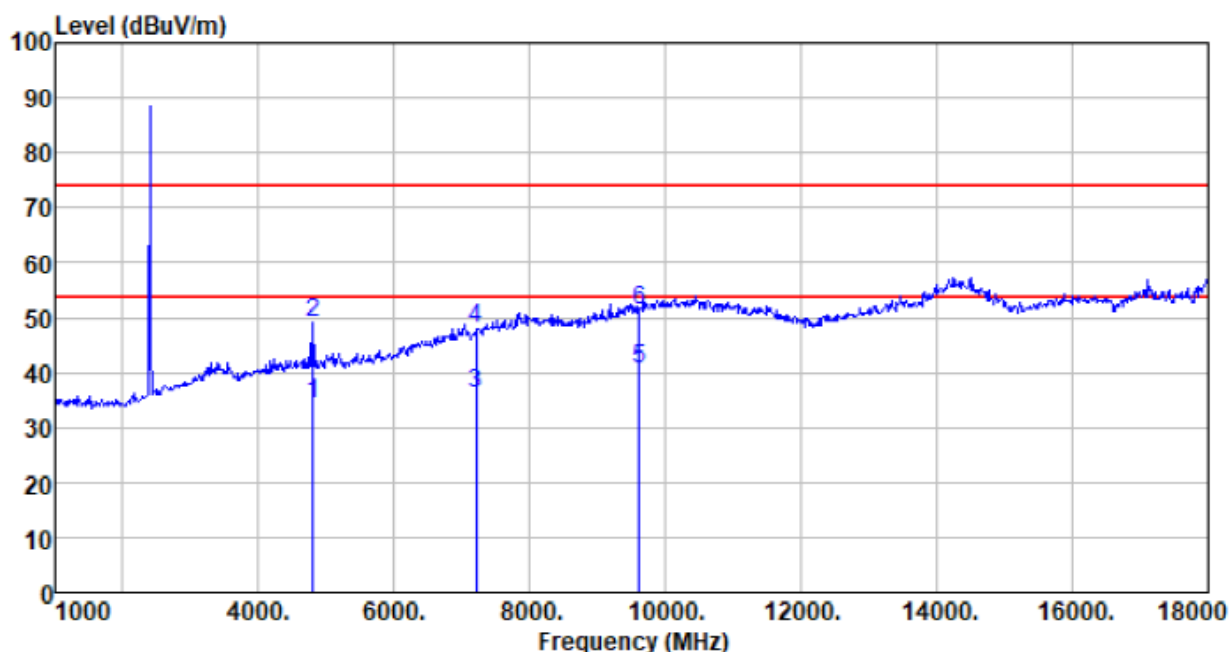


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
167.824	49.04	8.46	1.67	37.18	21.99	43.50	-21.51	QP
236.645	47.54	11.71	2.05	37.37	23.93	46.00	-22.07	QP
308.913	41.64	13.76	2.41	37.43	20.38	46.00	-25.62	QP
487.315	38.31	17.06	3.25	37.51	21.11	46.00	-24.89	QP
658.836	35.58	19.56	3.94	37.59	21.49	46.00	-24.51	QP
903.309	38.65	22.30	4.87	37.60	28.22	46.00	-17.78	QP

■ Above 1GHz

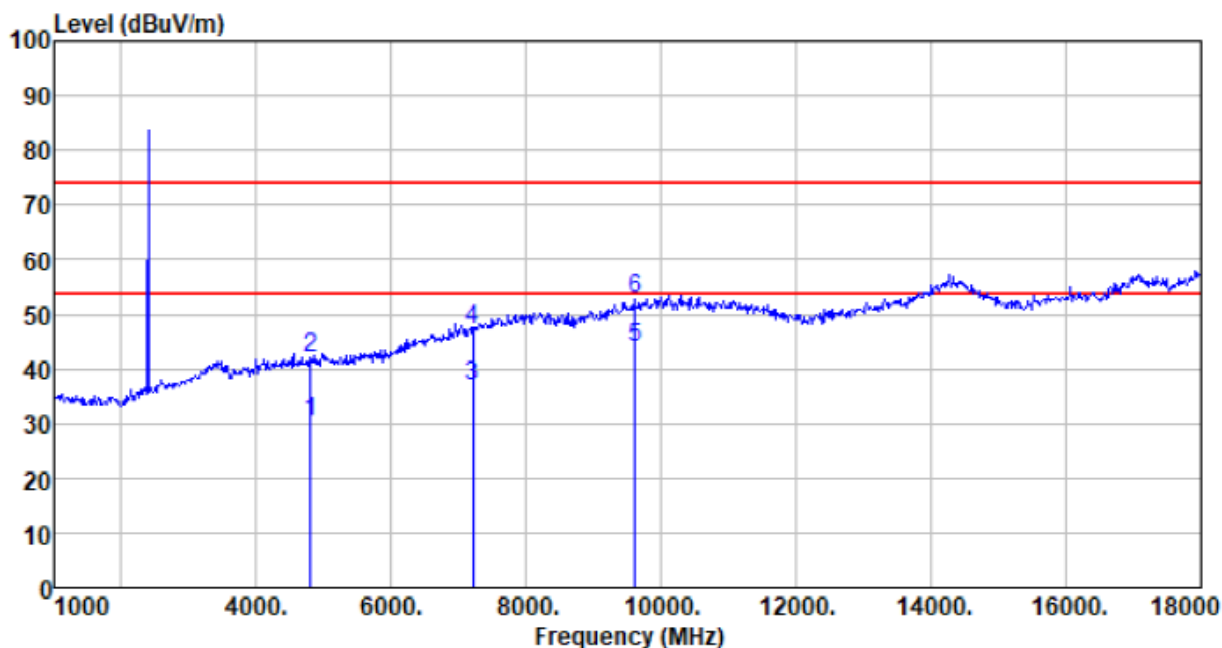
Test channel:	Lowest
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.000	26.74	31.20	8.60	32.09	34.45	54.00	-19.55	Average
4804.000	41.46	31.20	8.60	32.09	49.17	74.00	-24.83	Peak
7206.000	20.24	36.16	11.65	32.00	36.05	54.00	-17.95	Average
7206.000	32.08	36.16	11.65	32.00	47.89	74.00	-26.11	Peak
9608.000	19.98	37.93	14.14	31.62	40.43	54.00	-13.57	Average
9608.000	30.82	37.93	14.14	31.62	51.27	74.00	-22.73	Peak

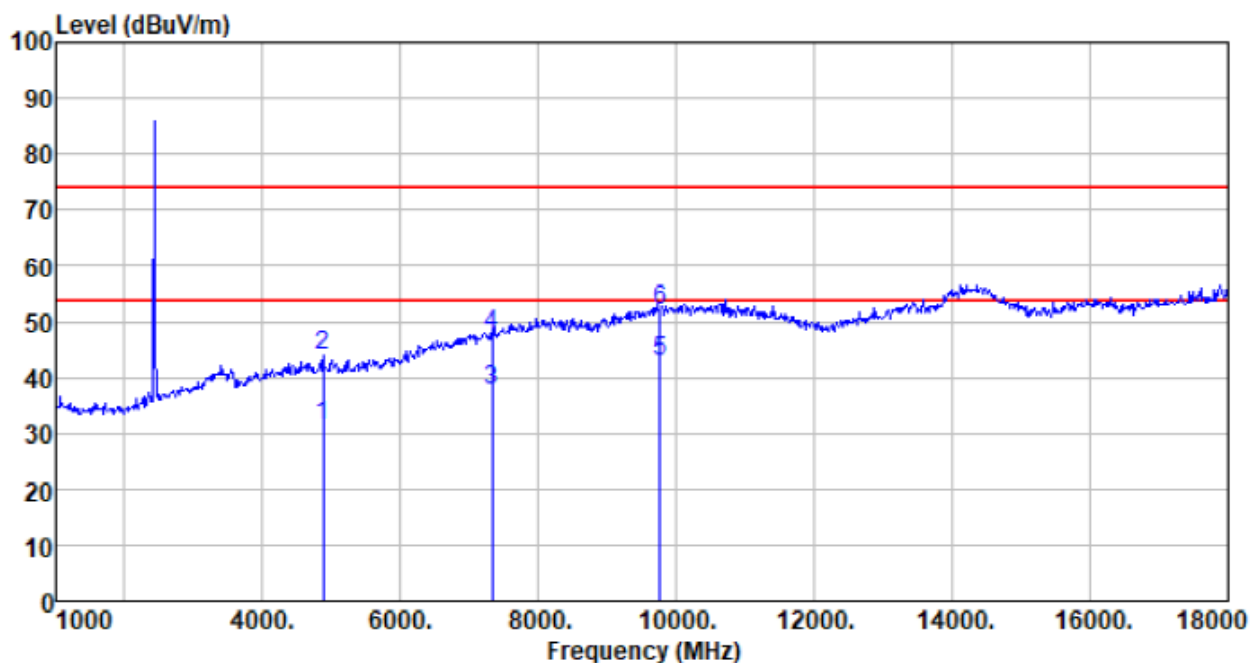
Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4804.000	22.42	31.20	8.60	32.09	30.13	54.00	-23.87	Average
4804.000	34.48	31.20	8.60	32.09	42.19	74.00	-31.81	Peak
7206.000	21.00	36.16	11.65	32.00	36.81	54.00	-17.19	Average
7206.000	31.41	36.16	11.65	32.00	47.22	74.00	-26.78	Peak
9608.000	23.55	37.93	14.14	31.62	44.00	54.00	-10.00	Average
9608.000	32.42	37.93	14.14	31.62	52.87	74.00	-21.13	Peak

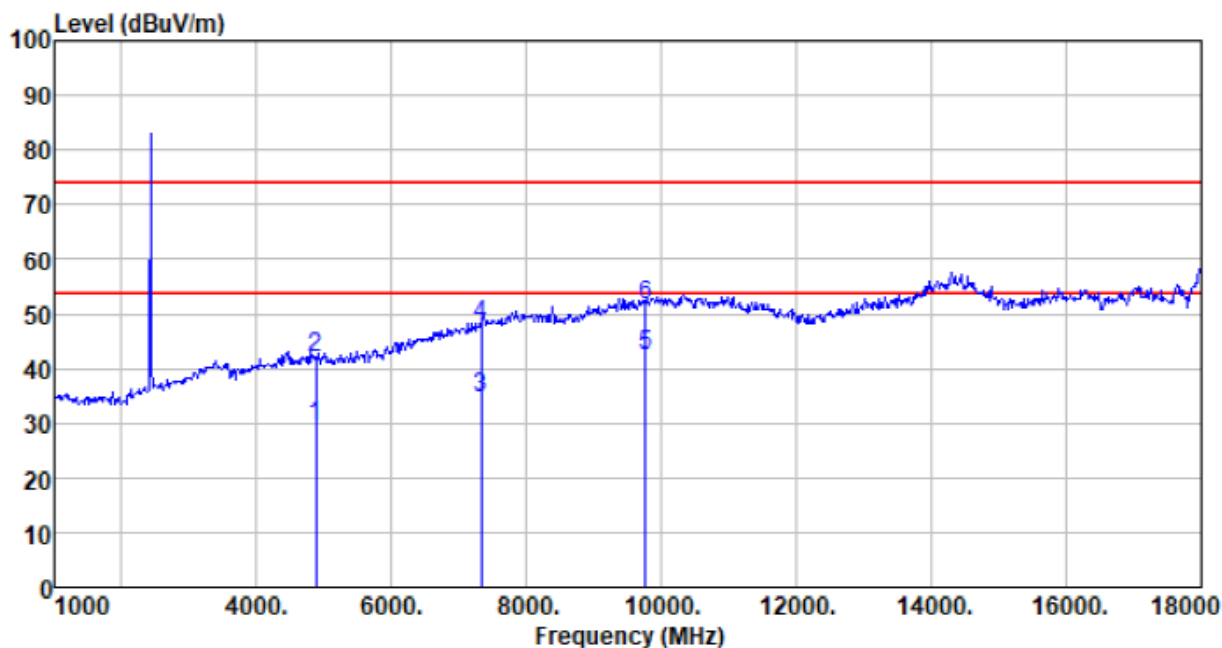
Test channel:	Middle
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.000	23.50	31.31	8.66	32.12	31.35	54.00	-22.65	Average
4880.000	36.11	31.31	8.66	32.12	43.96	74.00	-30.04	Peak
7320.000	21.49	36.43	11.72	31.89	37.75	54.00	-16.25	Average
7320.000	31.44	36.43	11.72	31.89	47.70	74.00	-26.30	Peak
9760.000	21.98	38.10	14.25	31.59	42.74	54.00	-11.26	Average
9760.000	31.24	38.10	14.25	31.59	52.00	74.00	-22.00	Peak

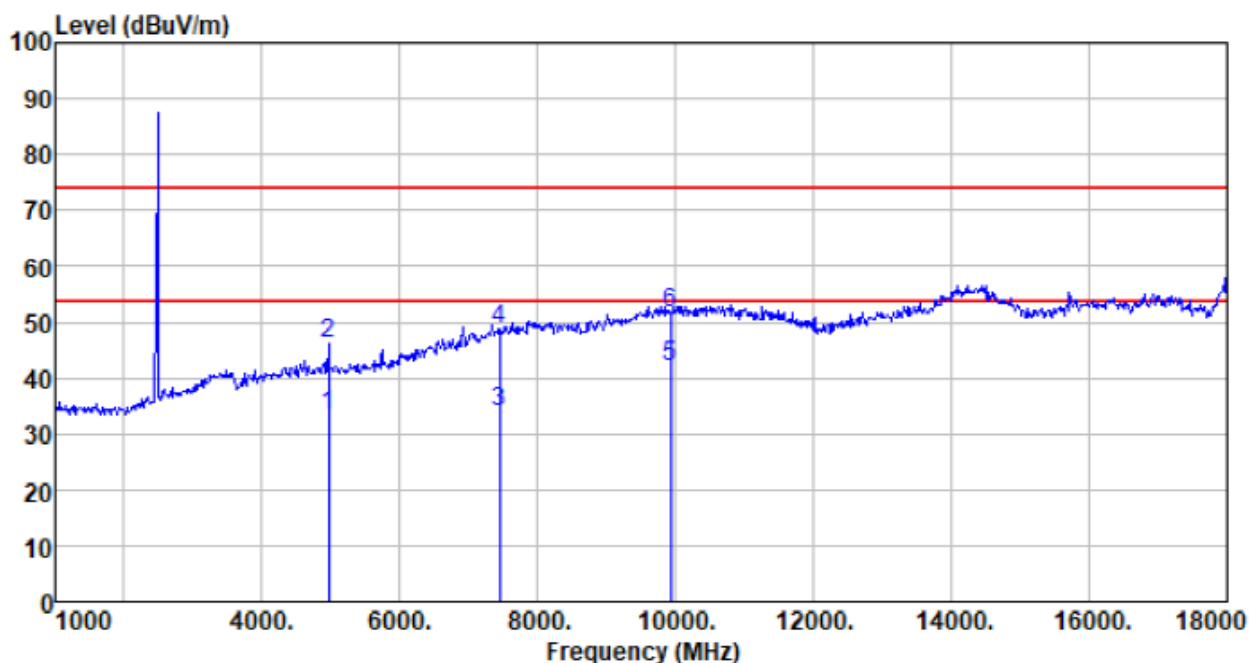
Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.000	21.62	31.31	8.66	32.12	29.47	54.00	-24.53	Average
4880.000	34.05	31.31	8.66	32.12	41.90	74.00	-32.10	Peak
7320.000	18.29	36.43	11.72	31.89	34.55	54.00	-19.45	Average
7320.000	31.89	36.43	11.72	31.89	48.15	74.00	-25.85	Peak
9760.000	21.56	38.10	14.25	31.59	42.32	54.00	-11.68	Average
9760.000	30.82	38.10	14.25	31.59	51.58	74.00	-22.42	Peak

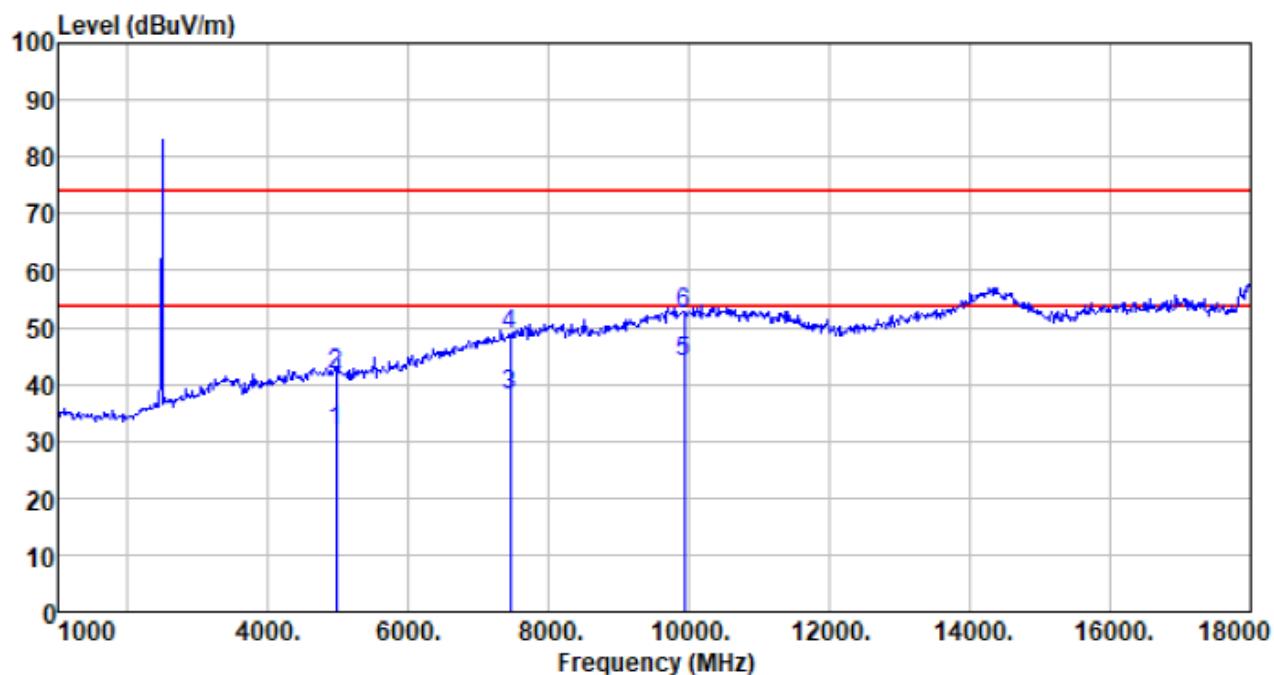
Test channel:	Highest
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4960.000	25.06	31.44	8.73	32.16	33.07	54.00	-20.93	Average
4960.000	38.00	31.44	8.73	32.16	46.01	74.00	-27.99	Peak
7440.000	17.13	36.66	11.79	31.78	33.80	54.00	-20.20	Average
7440.000	31.99	36.66	11.79	31.78	48.66	74.00	-25.34	Peak
9920.000	21.24	38.30	14.38	31.88	42.04	54.00	-11.96	Average
9920.000	30.95	38.30	14.38	31.88	51.75	74.00	-22.25	Peak

Vertical::

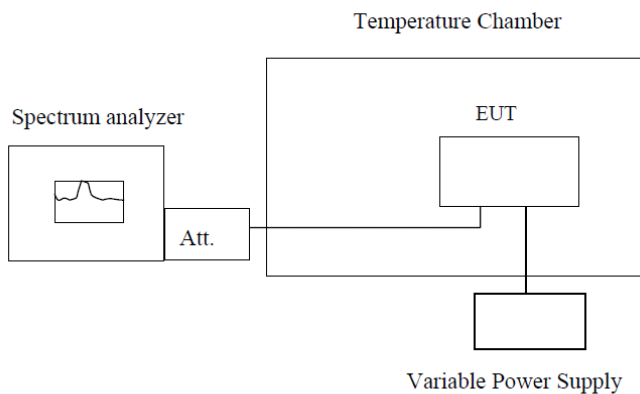


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4960.000	23.76	31.44	8.73	32.16	31.77	54.00	-22.23	Average
4960.000	33.60	31.44	8.73	32.16	41.61	74.00	-32.39	Peak
7440.000	21.30	36.66	11.79	31.78	37.97	54.00	-16.03	Average
7440.000	32.03	36.66	11.79	31.78	48.70	74.00	-25.30	Peak
9920.000	23.28	38.30	14.38	31.88	44.08	54.00	-9.92	Average
9920.000	31.54	38.30	14.38	31.88	52.34	74.00	-21.66	Peak

Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means this data is the too weak instrument of signal is unable to test.
3. The emission levels of other frequencies are very lower than the limit and not show in test report.

7.8 Frequency Stability

Test Requirement:	RSS-Gen Section 6.11& Section 8.11
Test Method:	ANSI C63.10: 2013 & RSS-Gen
Limit:	Manufactures of devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified
Test Procedure:	The EUT was setup to ANSI C63.10, 2013; tested to 2.1055 for compliance to RSS-Gen requirements.
Test setup:	 Note : Measurement setup for testing on Antenna connector
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Remark: Set the EUT transmits at un-modulation mode to test frequency stability.

Measurement data:

Frequency stability versus Temp.						
Power Supply: AC 24V						
Temp. (°C)	Operating Frequency (MHz)	0 minute Measured Frequency (MHz)	2 minute Measured Frequency (MHz)	5 minute Measured Frequency (MHz)	10 minute Measured Frequency (MHz)	Pass /Fail
-30	2402	2402.851	2402.739	2402.456	2402.136	Pass
	2440	2440.685	2440.210	2440.659	2440.865	Pass
	2480	2480.775	2480.826	2480.683	2480.044	Pass
-20	2402	2402.884	2402.168	2402.085	2402.450	Pass
	2440	2440.213	2440.027	2440.639	2440.346	Pass
	2480	2480.039	2480.099	2480.131	2480.267	Pass
-10	2402	2402.835	2402.615	2402.840	2402.577	Pass
	2440	2440.624	2440.213	2440.157	2440.699	Pass
	2480	2480.321	2480.446	2480.806	2480.821	Pass
0	2402	2402.344	2402.771	2402.716	2402.033	Pass
	2440	2440.531	2440.176	2440.591	2440.504	Pass
	2480	2480.707	2480.753	2480.050	2480.808	Pass
10	2402	2402.294	2402.060	2402.376	2402.901	Pass
	2440	2440.211	2440.290	2440.865	2440.595	Pass
	2480	2480.497	2480.856	2480.607	2480.727	Pass
20	2402	2402.456	2402.732	2402.480	2402.690	Pass
	2440	2440.710	2440.521	2440.742	2440.059	Pass
	2480	2480.759	2480.406	2480.716	2480.861	Pass
30	2402	2402.396	2402.473	2402.038	2402.024	Pass
	2440	2440.030	2440.606	2440.674	2440.881	Pass
	2480	2480.071	2480.201	2480.790	2480.846	Pass
40	2402	2402.185	2402.211	2402.972	2402.301	Pass
	2440	2440.639	2440.309	2440.576	2440.499	Pass
	2480	2480.594	2480.154	2480.005	2480.240	Pass
50	2402	2402.383	2402.347	2402.162	2402.604	Pass
	2440	2440.131	2440.935	2440.234	2440.585	Pass
	2480	2480.665	2480.306	2480.335	2480.971	Pass
Frequency stability versus Voltage						
Temperature: 25°C						
Power Supply (VDC)	Operating Frequency (MHz)	0 minute Measured Frequency (MHz)	2 minute Measured Frequency (MHz)	5 minute Measured Frequency (MHz)	10 minute Measured Frequency (MHz)	Pass /Fail
2.7	2402	2402.846	2402.978	2402.048	2402.671	Pass
	2440	2440.733	2440.444	2440.430	2440.069	Pass
	2480	2480.378	2480.684	2480.883	2480.814	Pass
3.3	2402	2402.519	2402.627	2402.675	2402.580	Pass
	2440	2440.816	2440.611	2440.899	2440.499	Pass
	2480	2480.292	2480.491	2480.923	2480.793	Pass

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

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