RADIO TEST REPORT

Report No.: SHATBL2109019W02

Applicant:
IDEAL INDUSTRIES LIGHTING LLC, DBA CREE LIGHTING

Address:
4401 SILICON DRIVE DURHAM, NC 27703 USA

Product Name	:	Wireless Controller
Brand Name	:	CREE LIGHTING
Model Name	:	CMACC-CMSC-UNV-WH
Series Model	:	CMACC-CMWD-UNV-WH
Test Standard	:	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019

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TEST RESULT CERTIFICATION

Applicant's Name ..... :	IDEAL INDUSTRIES LIGHTING LLC, DBA CREE LIGHTING
Address ..... :	4401 SILICON DRIVE DURHAM, NC 27703 USA
Manufacturer's Name ..... :	MCWONG LIGHTING SHANGHAI CO LTD
Address ..... :	159 FULIAN YI RD GU CUN INDUSTRIAL PARK,BAO SHAN DISTRICT SHANGHAI, 201906 China

Product Description

Product Name ..... :	Wireless Controller
Brand Name ..... :	CREE LIGHTING
Model Name ..... :	CMACC-CMSC-UNV-WH
Series Model ..... :	CMACC-CMWD-UNV-WH
Test Standards ..... :	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019
Test Procedure..... :	ANSI C63.10-2013

This device described above has been tested by ATBL, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of Test..... :	
Date of receipt of test item..... :	14 Sep. 2021
Date (s) of performance of tests..... :	14 Sep. 2021 ~ 16 Sep. 2021
Date of Issue ..... :	17 Sep. 2021
Test Result ..... :	**Pass**

Report Prepared by : Roean Wei
(Roean wei)

Report Approved by : Chopin Xiao
(Chopin Xiao)

Authorized Signatory : Terry Yang
(Terry yang)

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Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	17 Sep. 2021	SHATBL2109019W02	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC Part 15.247,Subpart C RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019			
Standard Section	Test Item	Judgment	Remark
15.207 RSS-GEN 8.8	Conducted Emission	PASS	--
15.247 (a)(2) RSS-247 Clause 5.2(a)	6dB&99% Bandwidth	PASS	--
15.247 (b)(3) RSS-247 Clause 5.4(d)	Output Power	PASS	--
15.247(d) & 15.209 & 15.205 RSS-247 Clause 5.5 & RSS-GEN 6.13 RSS-GEN 8.9 RSS-GEN 8.10	Radiated Spurious Emission	PASS	--
§15.247(d) & 15.205 RSS-247 Clause 5.5 RSS-GEN 8.10	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e) RSS-247 Clause 5.2(b)	Power Spectral Density	PASS	--

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2013.

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

<table>
<tr><td>Product Name</td><td>Wireless Controller</td></tr>
<tr><td>Trade Name</td><td>CREE LIGHTING</td></tr>
<tr><td>Model Name</td><td>CMACC-CMSC-UNV-WH</td></tr>
<tr><td>Series Model</td><td>CMACC-CMWD-UNV-WH</td></tr>
<tr><td>Model Difference</td><td>The electrical circuit design, layout, components used, and internal wiring are identical. Only model name and appearance is different.</td></tr>
<tr><td>Product Description</td><td>The EUT is a Wireless Controller
<table>
<tr><td>Operation Frequency:</td><td>802.11b/g/n 20: 2412~2462 MHz
802.11n(40MHz):2422~2452MHz</td></tr>
<tr><td>Modulation Type:</td><td>802.11b(DSSS):CCK,DQPSK,DBPSK
802.11g(OFDM):BPSK,QPSK,16-QAM,64-QAM
802.11n(OFDM):BPSK,QPSK,16-QAM,64-QAM</td></tr>
<tr><td>Bit Rate of Transmitter:</td><td>802.11b:11/5.5/2/1 Mbps
802.11g:54/48/36/24/18/12/9/6Mbps
802.11n(20MHz):
65/58.5/52/39/26/19.5/13/6.5Mbps
802.11n(40MHz):
135/121.5/108/81/54/40.5/37/13.5Mbps</td></tr>
<tr><td>Number of Channel:</td><td>802.11b/g/n20: 11CH
802.11n 40: 7CH</td></tr>
<tr><td>Antenna Designation:</td><td>Please refer to the Note 3.</td></tr>
<tr><td>Antenna Gain (dBi):</td><td>2.2dBi</td></tr>
<tr><td>Duty Cycle:</td><td>>98%</td></tr>
</table></td></tr>
<tr><td>Channel List</td><td>Please refer to the Note 2.</td></tr>
<tr><td>Adapter</td><td>None</td></tr>
<tr><td>Hardware version number</td><td>N/A</td></tr>
<tr><td>Software version number</td><td>N/A</td></tr>
<tr><td>Connecting I/O Port(s)</td><td>Please refer to the Note 1.</td></tr>
</table>

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.

2.

Operation Frequency of channel			
802.11b/g/n(20MHz)		Channel List for 802.11n(40MHz)	
Channel	Frequency	Channel	Frequency
01	2412	03	2422
02	2417	04	2427
03	2422	05	2432
04	2427	06	2437
05	2432	07	2442
06	2437	08	2447
07	2442	09	2452
08	2447		
09	2452		
10	2457		
11	2462		

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

2.4GHz Test Frequency:

For 802.11b/g/n (HT20)		For 802.11n (HT40)	
Channel	Freq.(MHz)	Channel	Freq.(MHz)
01	2412	03	2422
06	2437	06	2437
11	2462	09	2452

3.

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Note
1	CREE LIGHTING	CMACC-CMSC-UNV-WH	PBC	N/A	2.2dBi	WLAN ANT

2.2 DESCRIPTION OF THE TEST MODES

Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Worst Mode	Description	Data Rate
Mode 1	TX IEEE 802.11b CH1	11 Mbps
Mode 2	TX IEEE 802.11b CH6	11 Mbps
Mode 3	TX IEEE 802.11 b CH11	11 Mbps
Mode 4	TX IEEE 802.11g CH1	54 Mbps
Mode 5	TX IEEE 802.11g CH6	54 Mbps
Mode 6	TX IEEE 802.11g CH11	54 Mbps
Mode 7	TX IEEE 802.11n HT20 CH1	MCS 7
Mode 8	TX IEEE 802.11n HT20 CH6	MCS 7
Mode 9	TX IEEE 802.11n HT20 CH11	MCS 7
Mode 10	TX IEEE 802.11n HT40 CH3	MCS 7
Mode 11	TX IEEE 802.11n HT40 CH6	MCS 7
Mode 12	TX IEEE 802.11n HT40 CH9	MCS 7

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.

(2) We have be tested for all avaiable U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V /60Hz is shown in the report.

(3) The battery is fully-charged during the radited and RF conducted test.

DC Conducted Emission

Test Case	
DC Conducted Emission	Mode13: Keeping WIFI TX

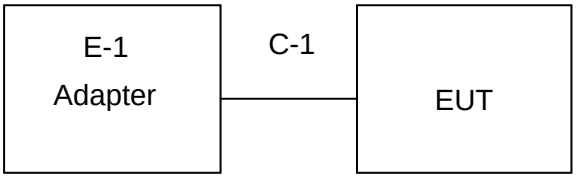
2.3 TEST SOFTWARE AND POWER LEVEL

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

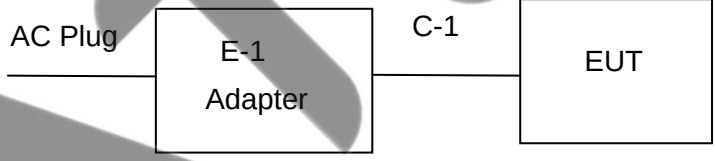
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
WIFI(2.4G)	2.4G WIFI	802.11b	2.2	0	QRCT
		802.11g		0	
		802.11n(HT20)		0	
		802.11n(HT40)		0	

2.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiation Test Set



Conduction Test Set



2.5 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Type No.	Note
E-2	Notebook	Lenovo	DESKTOP-USDEO09	00326-10000-00000-AA636	N/A
C-1	USB Cable	N/A	100cm	N/A	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.6 LABORATORY INFORMATION

Company Name:	Shanghai ATBL Technology Co., Ltd.
Address:	Building 8, No. 160, Basheng Road, Waigaoqiao Free Trade Zone, Pudong New Area, Shanghai
Telephone:	+86(0)21-51298625

2.7 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.958dB
2	Conducted spurious emissions	±2.988dB
3	All emissions, radiated 30MHz-1GHz	±2.50dB
4	All emissions, radiated 1GHz-18GHz	±3.51dB
5	Occupied bandwidth	±23.20dB
6	Power spectral density	±0.886dB

2.8 EQUIPMENTS LIST

2.8.1 Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Management number	Calibrated until
Test Receiver	R&S	ESCI	100469	SHATBL-E003	2022.07.13
Spectrum Analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2022.07.13
Bilog Antenna	SCHWARZBECK	VLUB 9168	01174	SHATBL-E008	2023.09.27
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	SHATBL-E009	2023.09.27
Pre-Amplifier (0.1M-3GHz)	JPT	JPA-10M1G35	21010100035001	SHATBL-E005	2021.07.22
Pre-Amplifier (1G-18GHz)	JPT	JPA0118-55-303A	1910001800055000	SHATBL-E006	2022.07.13
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E016	2021.10.13
Antenna/Turntable Controller	Brilliant	N/A	N/A	SHATBL-E007	N/A
Test SW	FALA	EMC-RI(Ver.4A2)		SHATBL-E046	N/A

2.8.2 RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	equipment number	Calibrated until
MIMO Power measurement test Set	DARE	RPR3006W	16I00054SN016	SHATBL-W006	2021.10.13
			RPR6W-20001005	SHATBL-W013	2021.10.13
Signal Analyzer	Agilent	N9020A	MY57300196	SHATBL-W004	2021.10.13
Signal Generator	Agilent	N5182B	MY46240556	SHATBL-W005	2021.10.13
Wireless Communications Test Set	R&S	CMW500	101331	SHATBL-W007	2021.10.13
Temperature & Humidity	Deli	deli	N/A	SHATBL-W011	2021.10.13
Attenuator	Agilent	8494B	DC-18G	SHATBL-W009	2021.10.13
Attenuator	Agilent	8496B	DC-18G	SHATBL-W010	2021.10.13
power splitter	MNK	MPD-DC/6-2S	62315 G51	SHATBL-W015	2021.11.27
			62315 G52	SHATBL-W016	2021.11.27
Filter	Chengdu kangmaiwei	ZBSF-C2400-2483.5-T3	N/A	SHATBL-W021	N/A
Constant temperature and humidity box	KSON	THS-B6C-150	6159K	SHATBL-W019	2022.01.26
Test SW	FALA	LZ-RF(Ver.LzRF-03A3.1)		SHATBL-W020	N/A

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

FREQUENCY (MHz)	Conducted Emissionlimit (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

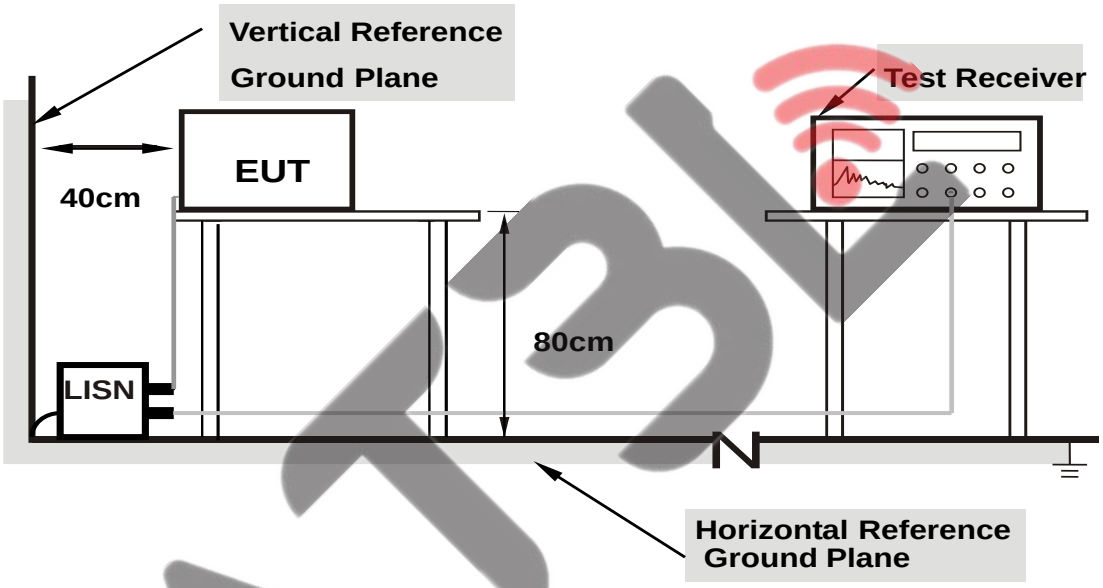
The following table is the setting of the receiver

Receiver Parameters	**Setting**
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.1.2 TEST PROCEDURE

a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN is at least 80 cm from the nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.1.3 TEST SETUP



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

3.1.4 EUT OPERATING CONDITIONS

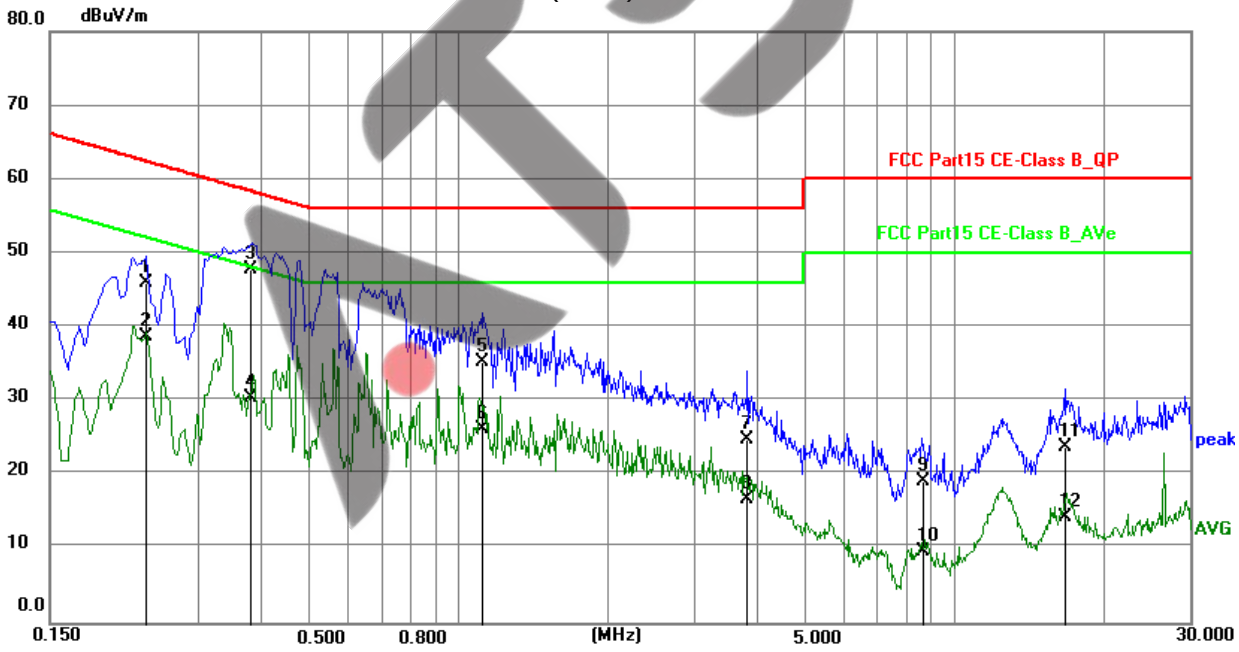
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.1.5 TEST RESULT

Temperature:	26.2(C)	Relative Humidity:	53%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.2330	36.05	10.09	46.14	62.34	-16.20	QP
2	0.2330	28.80	10.09	38.89	52.34	-13.45	AVG
3	0.3810	37.87	10.08	47.95	58.26	-10.31	QP
4	0.3810	20.49	10.08	30.57	48.26	-17.69	AVG
5	1.1170	25.40	9.95	35.35	56.00	-20.65	QP
6	1.1170	16.27	9.95	26.22	46.00	-19.78	AVG
7	3.8370	14.92	10.03	24.95	56.00	-31.05	QP
8	3.8370	6.89	10.03	16.92	46.00	-29.08	AVG
9	8.6720	9.01	10.23	19.24	60.00	-40.76	QP
10	8.6720	-0.44	10.23	9.79	50.00	-40.21	AVG
11	16.7690	13.10	10.74	23.84	60.00	-36.16	QP
12	16.7690	3.69	10.74	14.43	50.00	-35.57	AVG

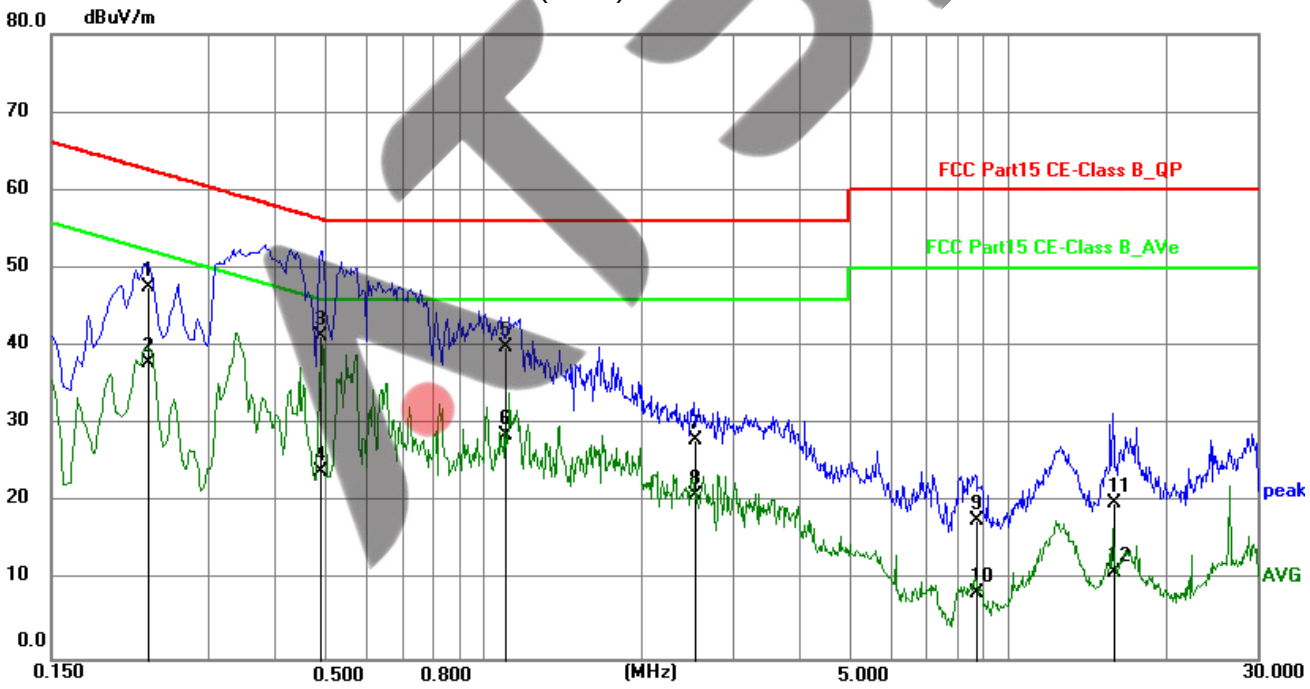
Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB)



Temperature:	26.2(C)	Relative Humidity:	53%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.2300	37.28	10.36	47.64	62.45	-14.81	QP
2	0.2300	27.65	10.36	38.01	52.45	-14.44	AVG
3	0.4900	31.15	10.20	41.35	56.17	-14.82	QP
4	0.4900	13.84	10.20	24.04	46.17	-22.13	AVG
5	1.1040	29.84	10.16	40.00	56.00	-16.00	QP
6	1.1040	18.53	10.16	28.69	46.00	-17.31	AVG
7	2.5280	17.90	10.26	28.16	56.00	-27.84	QP
8	2.5280	10.73	10.26	20.99	46.00	-25.01	AVG
9	8.6920	7.58	10.16	17.74	60.00	-42.26	QP
10	8.6920	-1.58	10.16	8.58	50.00	-41.42	AVG
11	15.9410	9.71	10.33	20.04	60.00	-39.96	QP
12	15.9410	0.90	10.33	11.23	50.00	-38.77	AVG

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB)



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/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

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	(dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FCC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

IC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 – 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 – 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 – 8500	
108 – 138		

For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP/AV
Start Frequency	9 KHz/150KHz(Peak/QP/AV)
Stop Frequency	150KHz/30MHz(Peak/QP/AV)
RB / VB (emission in restricted band)	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz); 200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP
Start Frequency	30 MHz(Peak/QP)
Stop Frequency	1000 MHz (Peak/QP)
RB / VB (emission in restricted band)	120 KHz / 300 KHz

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10th carrier hamonic(Peak/AV)
RB / VB (emission in restricted band)	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

For Restricted band

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2310 to 2430 MHz Upper Band Edge: 2445 to 2500 MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

Receiver Parameter	Setting
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

3.2.2 TEST PROCEDURE

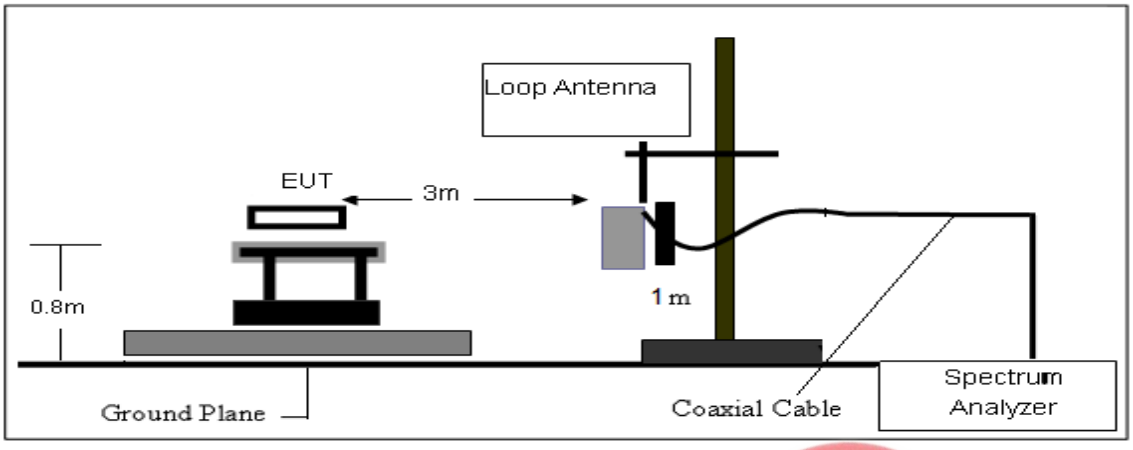
a. The measuring distance at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 m (above 1GHz is 1.5 m) above the ground at a 3 m anechoic chamber test site. The table was rotated 360 degree to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m (above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarization of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and QuasiPeak detector mode will be re-measured.
e. If the Peak Mode measured value is compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and no additional QP Mode measurement was performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

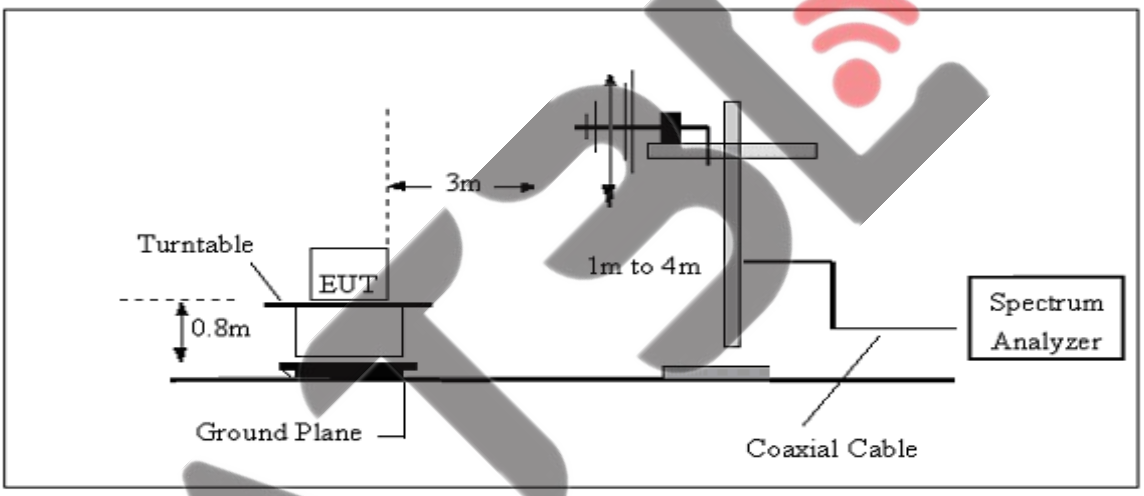
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

3.2.3 TEST SETUP

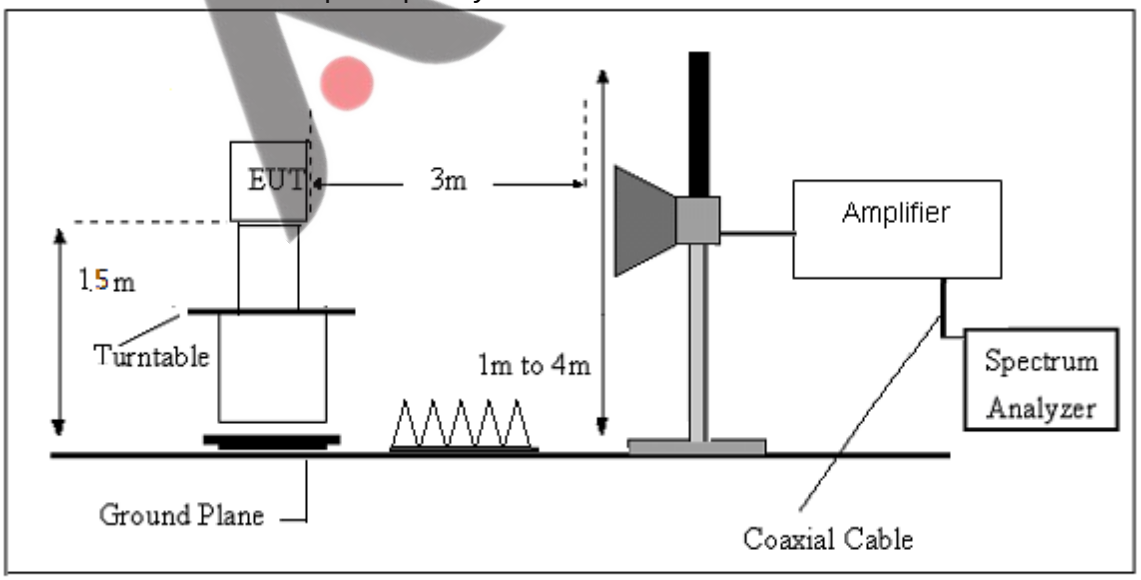
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



3.2.4 EUT OPERATING CONDITIONS

Please refer to section 3.1.4 of this report.

3.2.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting theAmplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

3.2.6 TEST RESULTS(RADIATED SPURIOUS EMISSIONS)

Temperature:	23.0(C)	Relative Humidtity:	59%RH
Test Voltage:	DC 3.3V	Polarization:	--
Test Mode:	TX Mode		

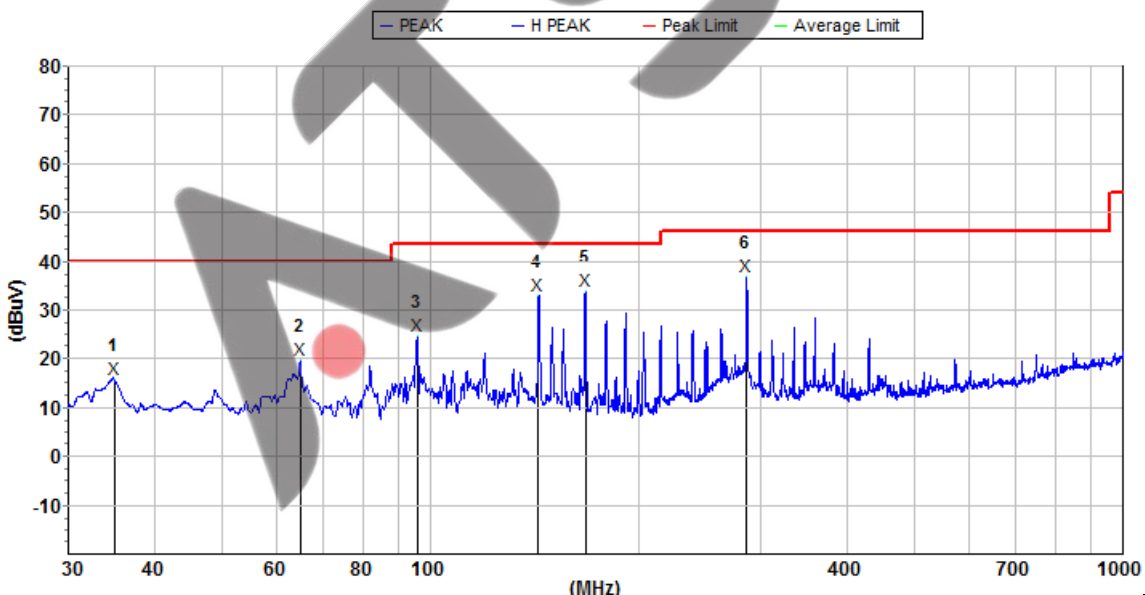
Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuv) + distance extrapolation factor.

30MHz - 18000MHz

Temperature:	23.0(C)	Relative Humidtity:	59%RH
Test Voltage:	DC 3.3V	Phase:	Horizontal
Test Mode:	Mode 1/2/3/4/5/6/7/8/9/10/11/12 (Mode 7 worst mode)		

30MHz~1GHz

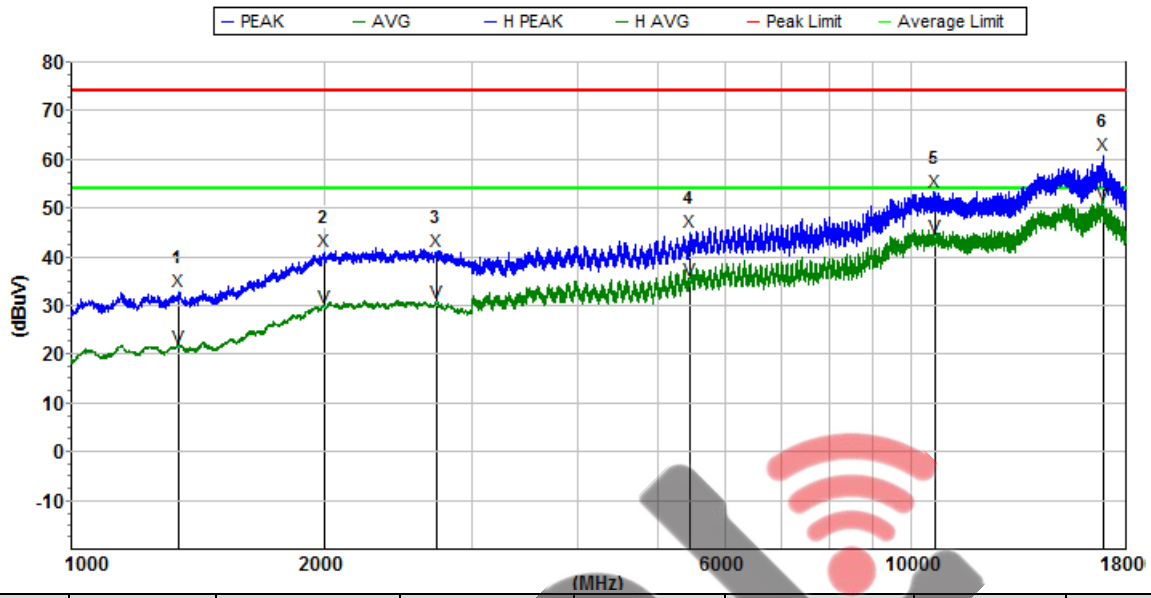
Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Pol.
Peak:							
1	34.943506	15.7	40.0	24.3	13.4	32.2	H
2	64.886534	19.7	40.0	20.3	11.8	32.8	H
3	95.930246	24.8	43.5	18.7	9.9	32.9	H
4	143.326064	33.1	43.5	10.4	13.7	32.9	H
5	167.530266	34.0	43.5	9.5	13.4	32.9	H
6	286.479617	37.0	46.0	9.0	12.5	32.7	H

1GHz~18GHz

Horizontal

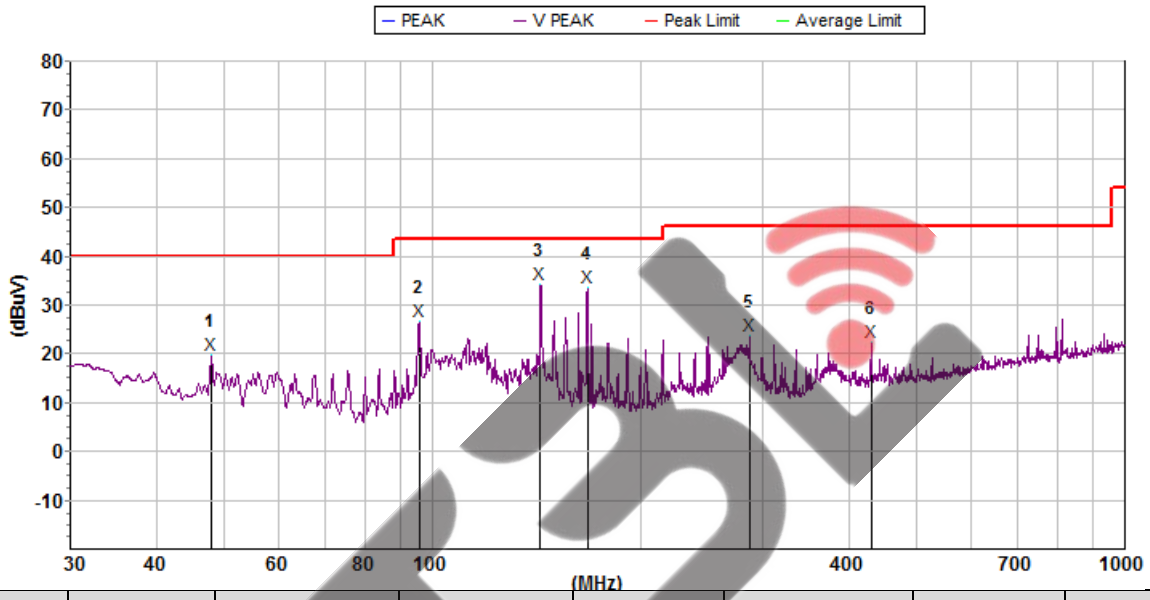


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Pol.
Peak:							
1	1342.00000	33.0	74.0	41.0	20.8	57.3	H
2	2004.00000	41.2	74.0	32.8	21.9	50.1	H
3	2721.00000	41.3	74.0	32.7	23.4	50.9	H
4	5439.00000	45.1	74.0	28.9	24.9	49.1	H
5	10683.7500	53.5	74.0	20.5	27.8	48.6	H
6	16910.2500	60.9	74.0	13.1	31.0	47.3	H
Avg							
1	1342.00000	21.6	54.0	32.4	20.8	57.3	H
2	2004.00000	29.6	54.0	24.4	21.9	50.1	H
3	2721.00000	30.5	54.0	23.5	23.4	50.9	H
4	5439.00000	35.4	54.0	18.6	24.9	49.1	H
5	10683.7500	44.2	54.0	9.8	27.8	48.6	H
6	16910.2500	50.7	54.0	3.3	31.0	47.3	H

Temperature:	23.0(C)	Relative Humidtity:	59%RH
Test Voltage:	DC 3.3V	Phase:	Vertical
Test Mode:	Mode 1/2/3/4/5/6/7/8/9/10/11/12 (Mode 7 worst mode)		

30MHz~1GHz

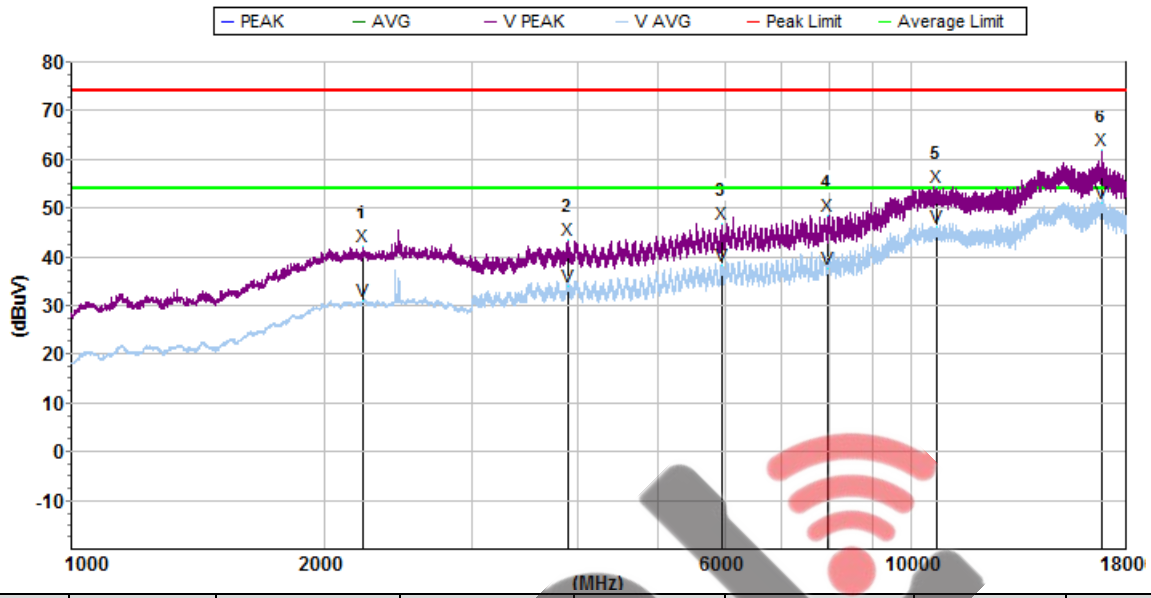
Vertical



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Pol.
Peak:							
1	47.909933	19.7	40.0	20.3	13.7	32.6	V
2	95.930246	26.8	43.5	16.7	9.9	32.9	V
3	143.326064	34.2	43.5	9.3	13.7	32.9	V
4	167.530266	33.6	43.5	9.9	13.4	32.9	V
5	287.485938	23.8	46.0	22.2	12.5	32.7	V
6	431.031591	22.4	46.0	23.6	15.5	32.4	V

1GHz~18GHz

Vertical



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Pol.
Peak:							
1	2227.00000	42.2	74.0	31.8	22.8	50.1	V
2	3894.75000	43.4	74.0	30.6	24.7	50.2	V
3	5946.00000	46.9	74.0	27.1	25.5	48.9	V
4	7961.25000	48.4	74.0	25.6	26.9	48.6	V
5	10704.0000	54.3	74.0	19.7	29.1	48.6	V
6	16846.5000	62.0	74.0	12.0	31.4	47.4	V
Avg							
1	2227.00000	30.9	54.0	23.1	22.8	50.1	V
2	3894.75000	33.8	54.0	20.2	24.7	50.2	V
3	5946.00000	38.1	54.0	15.9	25.5	48.9	V
4	7961.25000	37.6	54.0	16.4	26.9	48.6	V
5	10704.0000	46.0	54.0	8.0	29.1	48.6	V
6	16846.5000	51.1	54.0	2.9	31.4	47.4	V

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d), 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.

4.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 to 2432 MHz Upper Band Edge: 2442 to 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

4.3 DEVIATION FROM STANDARD

No deviation.

4.4 TEST SETUP

The EUT which is powered by the Battery, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

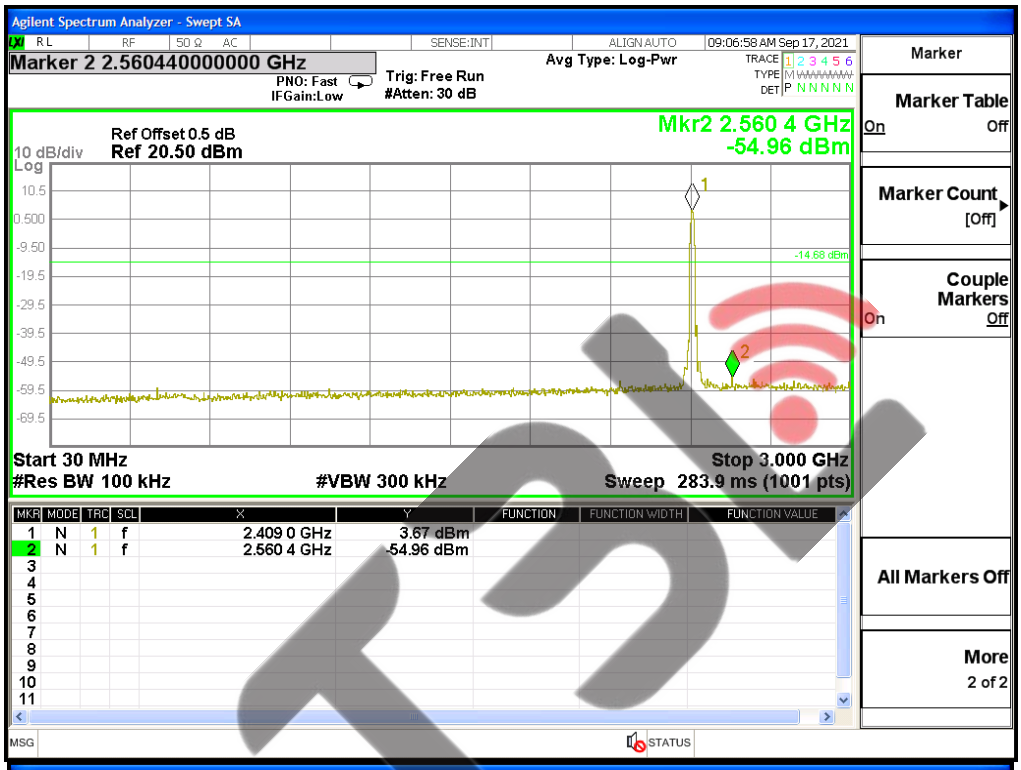
4.5 EUT OPERATION CONDITIONS

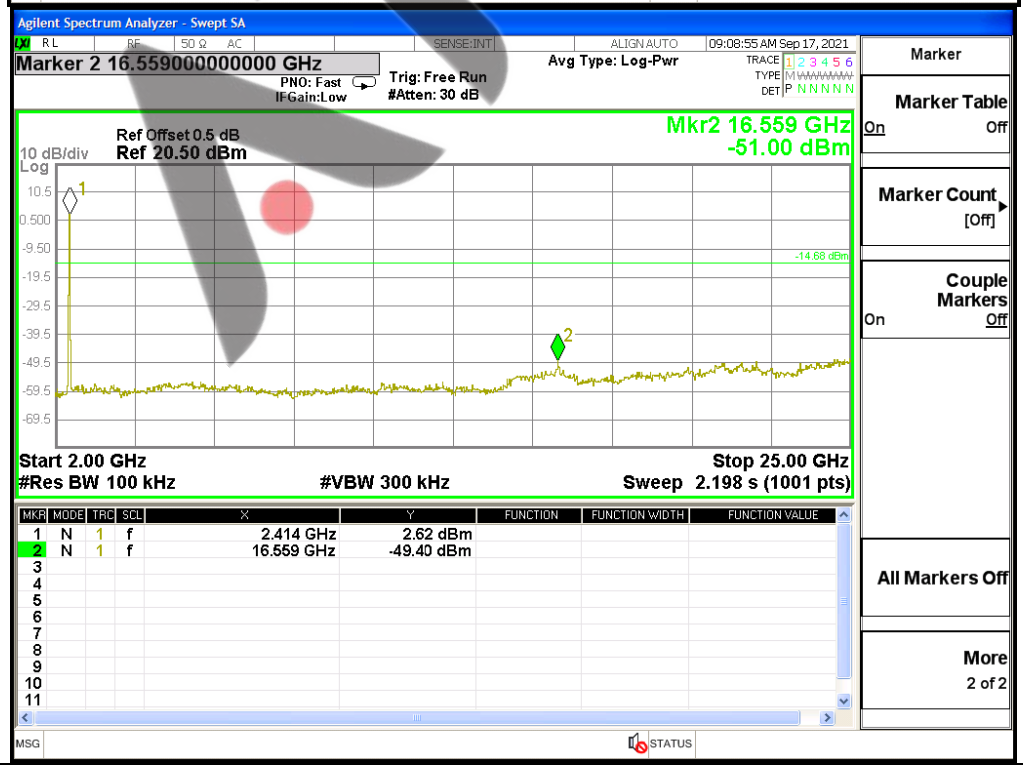
Please refer to section 3.1.4 of this report.

4.6 TEST RESULTS

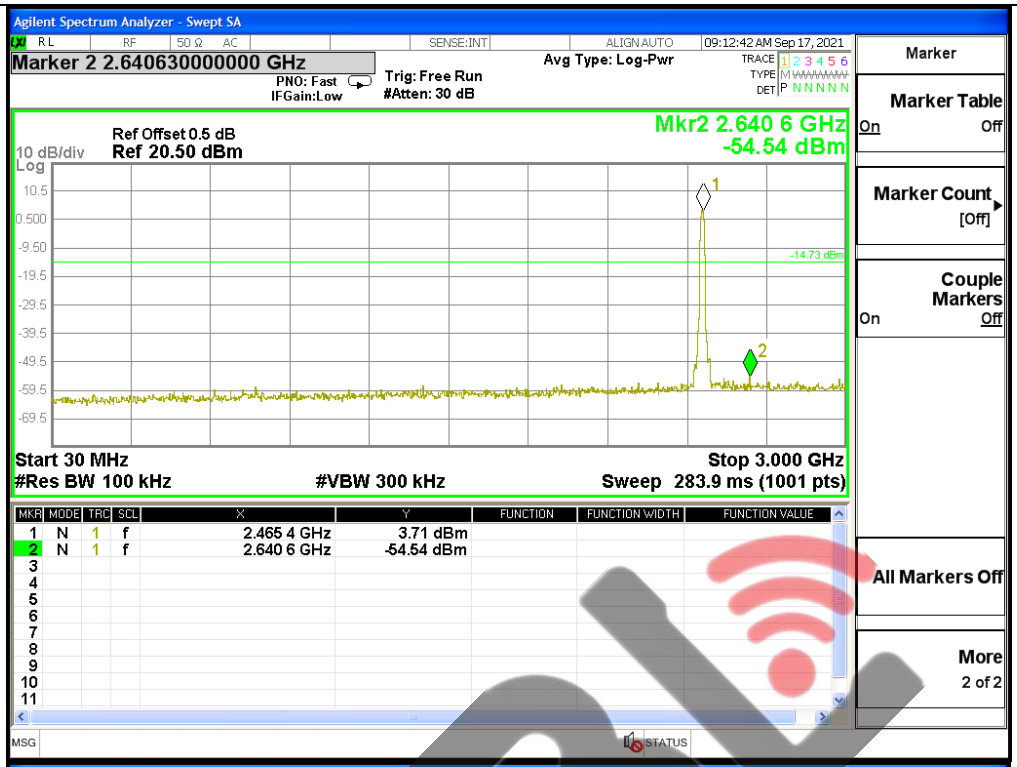
Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX b Mode /CH01, CH11

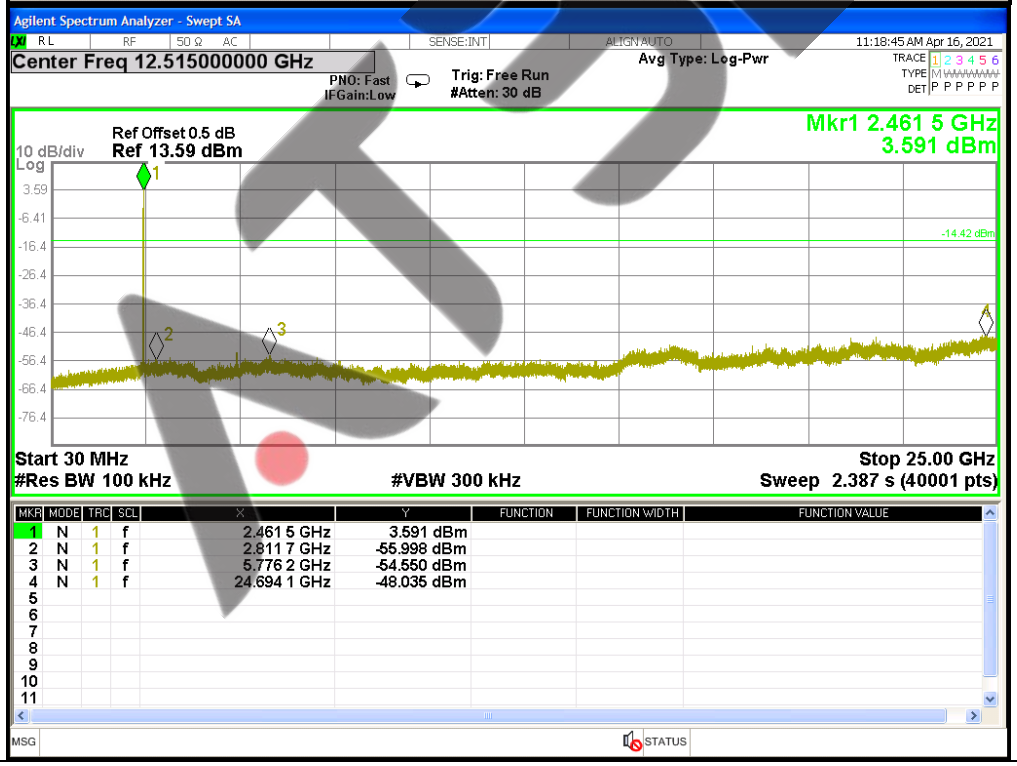
2412-channel 1





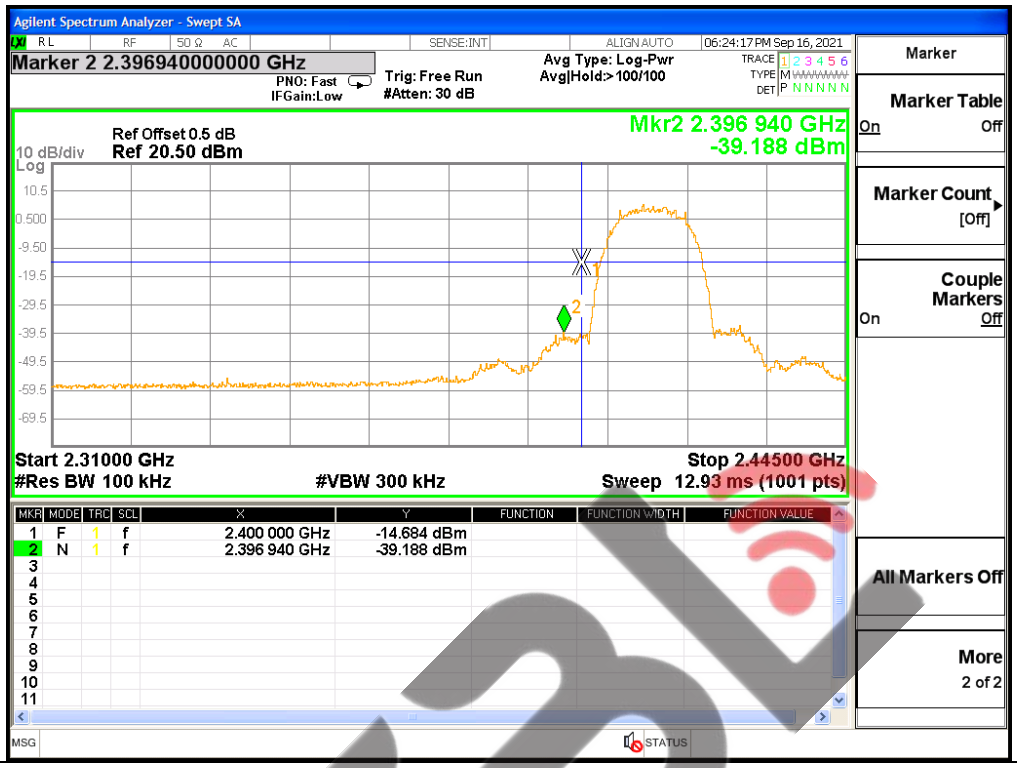
2462-channel 11


Agilent Spectrum Analyzer - Swept SA
Marker 2 2.640630000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
09:12:42 AM Sep 17, 2021
Ref Offset 0.5 dB
10 dB/div
Log
Ref 20.50 dBm
Mkr2 2.640 6 GHz
-54.54 dBm
-14.73 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 3.000 GHz
Sweep 283.9 ms (1001 pts)
1 N 1 f 2.465 4 GHz 3.71 dBm
2 N 1 f 2.640 6 GHz -54.54 dBm
Marker
Marker Table
On Off
Marker Count
[Off]
Couple Markers
On Off
All Markers Off
More
2 of 2

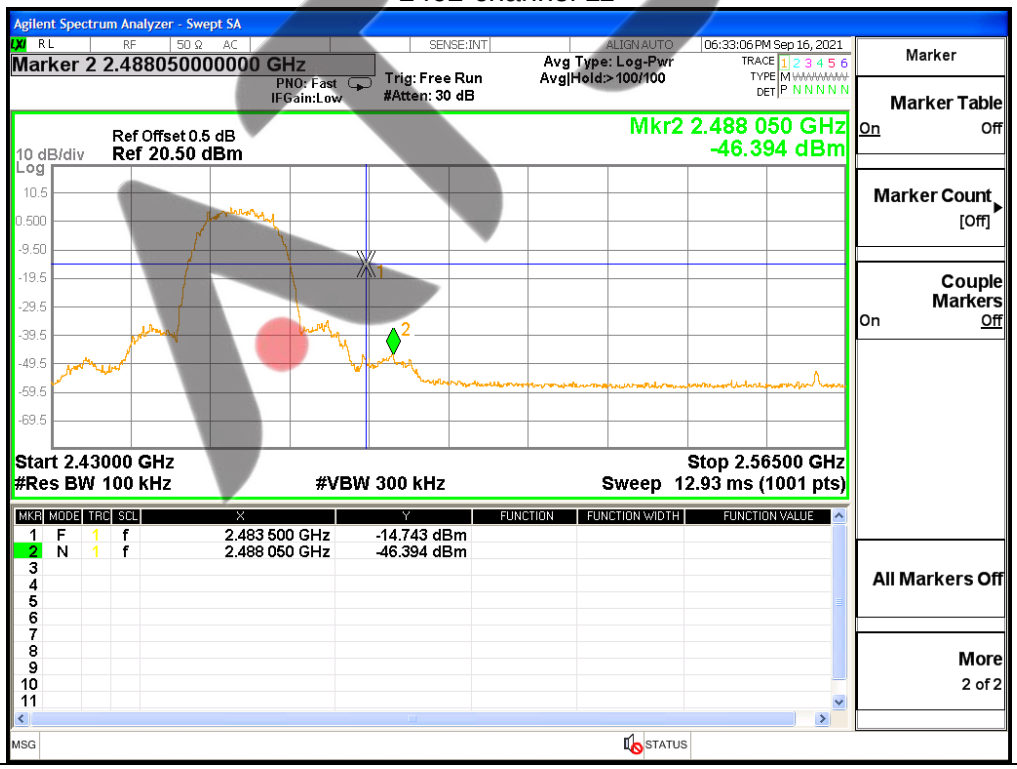

Agilent Spectrum Analyzer - Swept SA
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
11:18:45 AM Apr 16, 2021
Ref Offset 0.5 dB
10 dB/div
Log
Ref 13.59 dBm
Mkr1 2.461 5 GHz
3.591 dBm
-14.42 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.387 s (40001 pts)
1 N 1 f 2.461 5 GHz 3.591 dBm
2 N 1 f 2.811 7 GHz -55.998 dBm
3 N 1 f 5.776 2 GHz -54.550 dBm
4 N 1 f 24.694 1 GHz -48.035 dBm

For Band edge(it's also the reference level for conducted spurious emission)

2412-channel 1



2462-channel 11



5. POWER SPECTRAL DENSITY TEST

5.1 LIMIT

FCC Part15.247 , Subpart C RSS-247 Clause 5.2(b)				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e) RSS-247 Clause 5.2(b)	Power Spectral Density	≤8 dBm (RBW ≥3KHz)	2400-2483.5	PASS

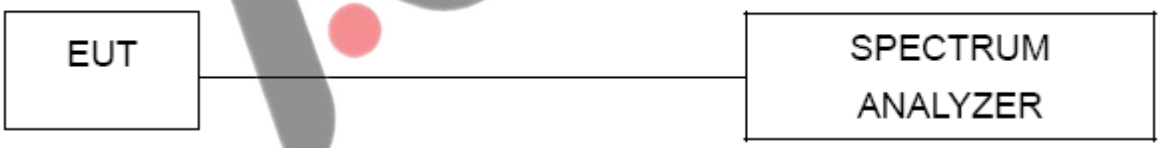
5.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the 100 kHz ≥ RBW ≥3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3 DEVIATION FROM STANDARD

No deviation.

5.4 TEST SETUP



5.5 EUT OPERATION CONDITIONS

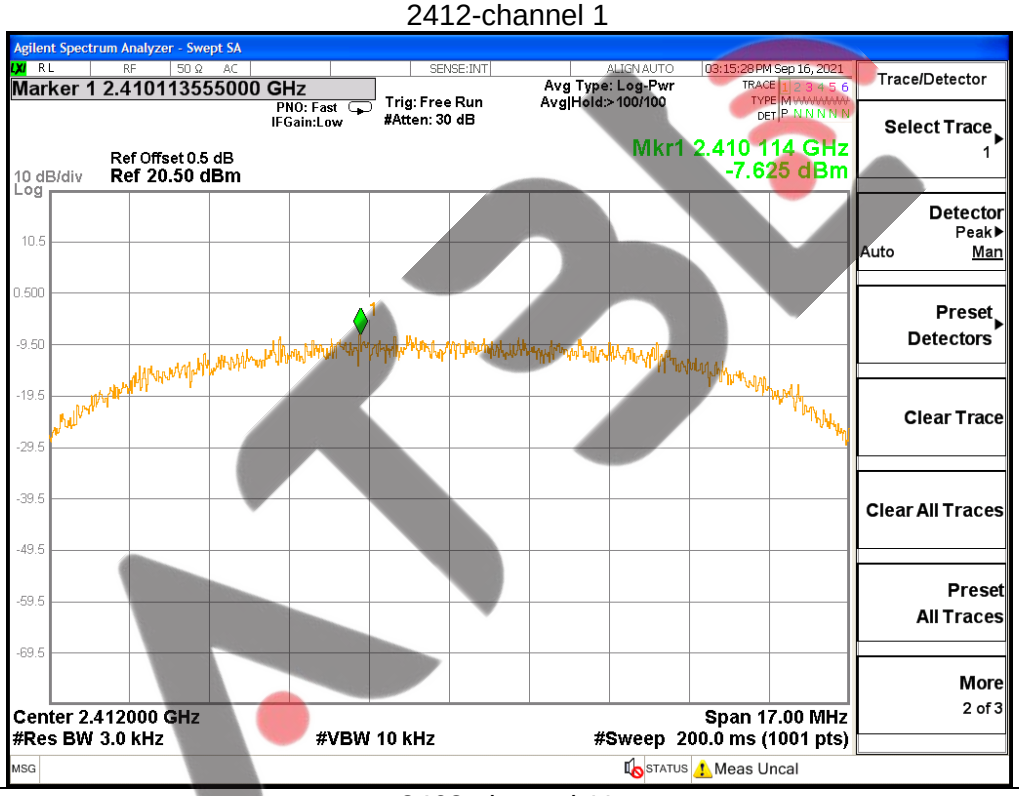
Please refer to section 3.1.4 of this report.

5.6 TEST RESULTS

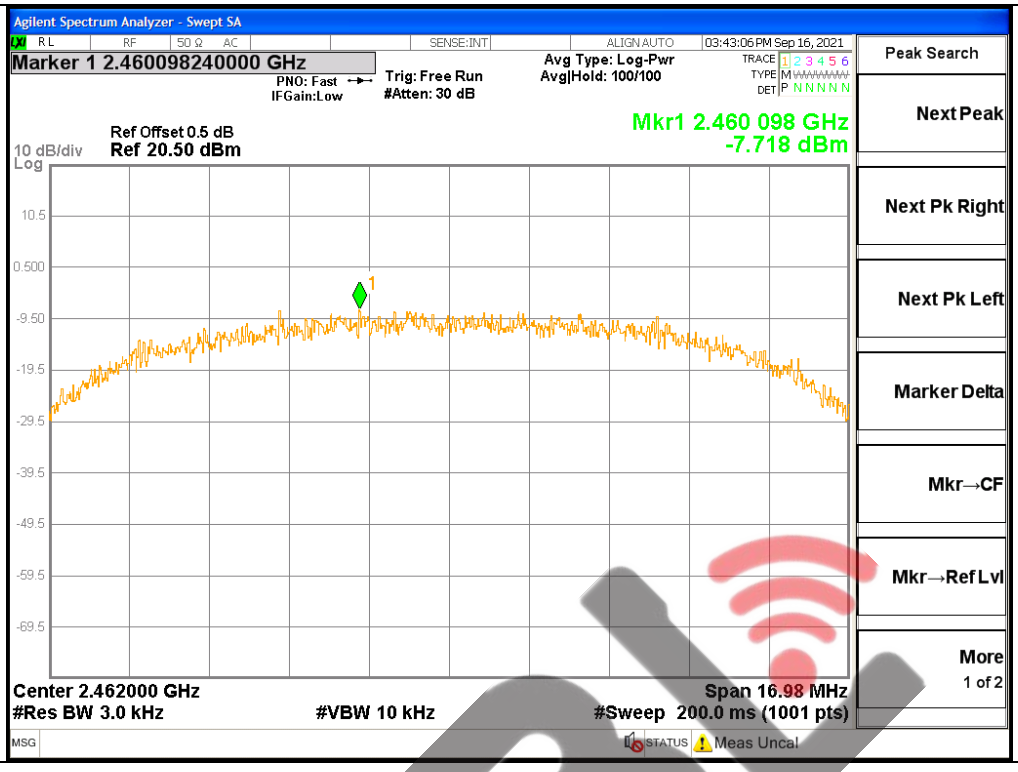
Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX b Mode /CH01, CH11

Frequency	Power Density (dBm/3kHz)	Limit (3KHz/dBm)	Result
2412 MHz	-7.625	≤8	PASS
2462 MHz	-7.718	≤8	PASS

2412-channel 1



2462-channel 11



6. BANDWIDTH TEST

6.1 LIMIT

FCC Part15.247,Subpart C RSS-Gen Clause 6.7				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2) RSS-247 5.2 (a)	Bandwidth	≥500KHz (6dB bandwidth)	2400-2483.5	PASS
RSS-Gen Clause 6.7	99% Bandwidth	For reporting purposes only.	2400-2483.5	PASS

6.2 TEST PROCEDURE

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW≥3RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be≥6 dB.

6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP

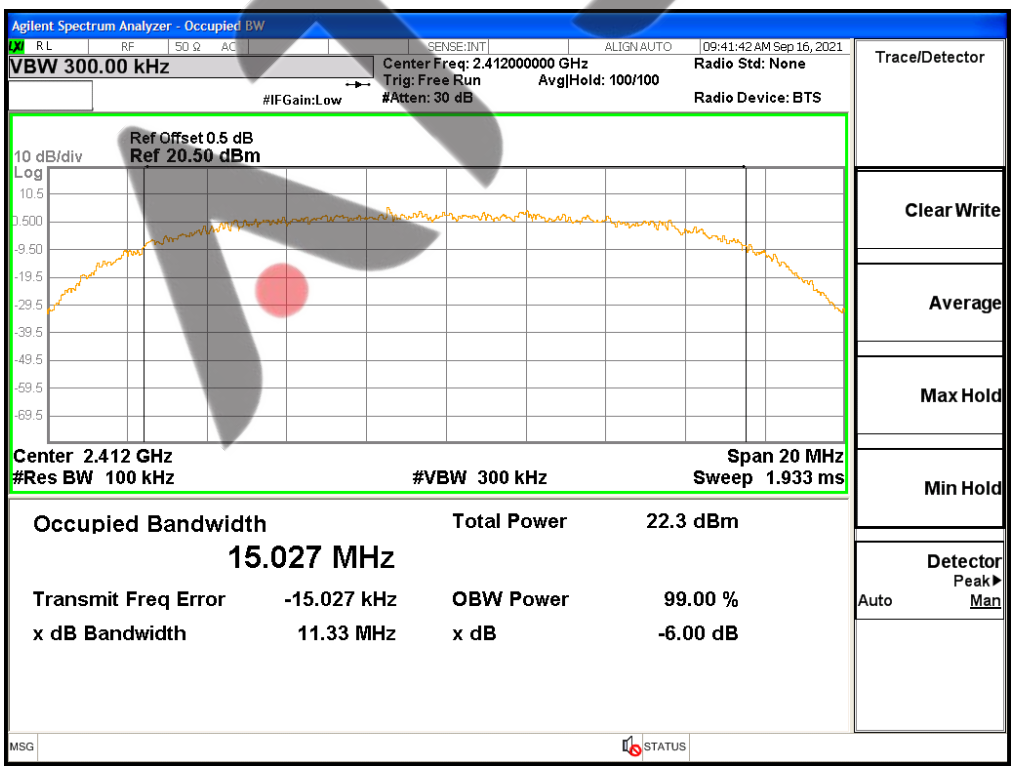
6.5 EUT OPERATION CONDITIONS
Please refer to section 3.1.4 of this report.

6.6 TEST RESULTS

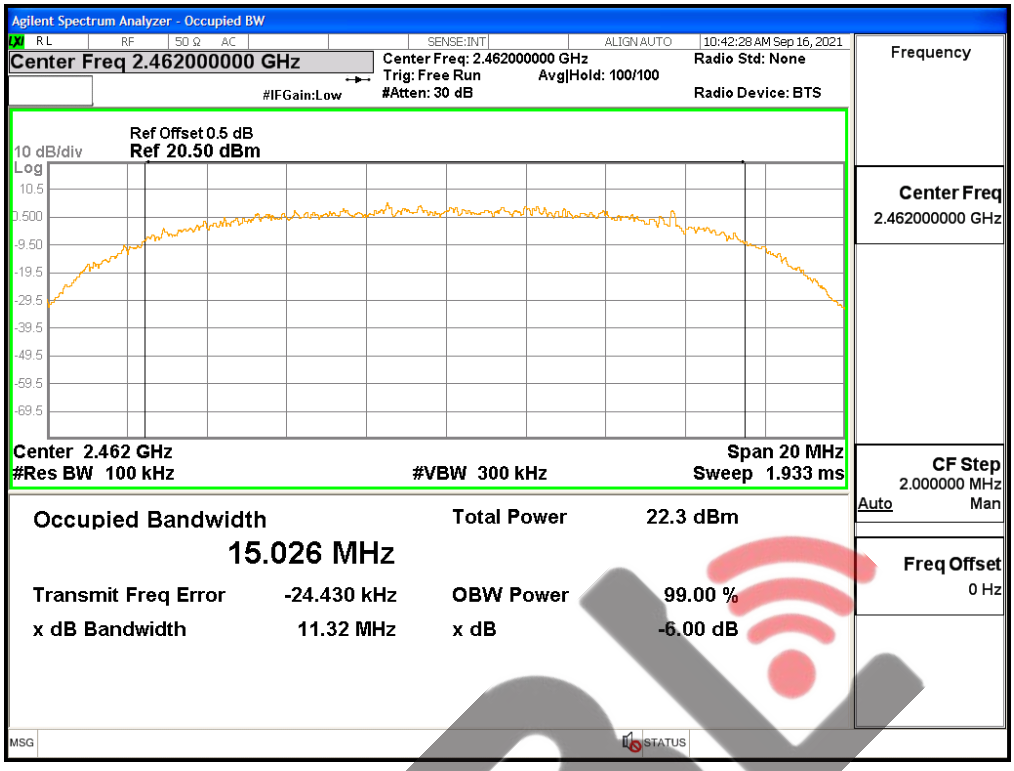
Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX b Mode /CH01, CH11

Frequency	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Channel Separation (KHz)	Result
2412 MHz	11.33	15.291	≥500KHz	PASS
2462 MHz	11.32	15.301	≥500KHz	PASS

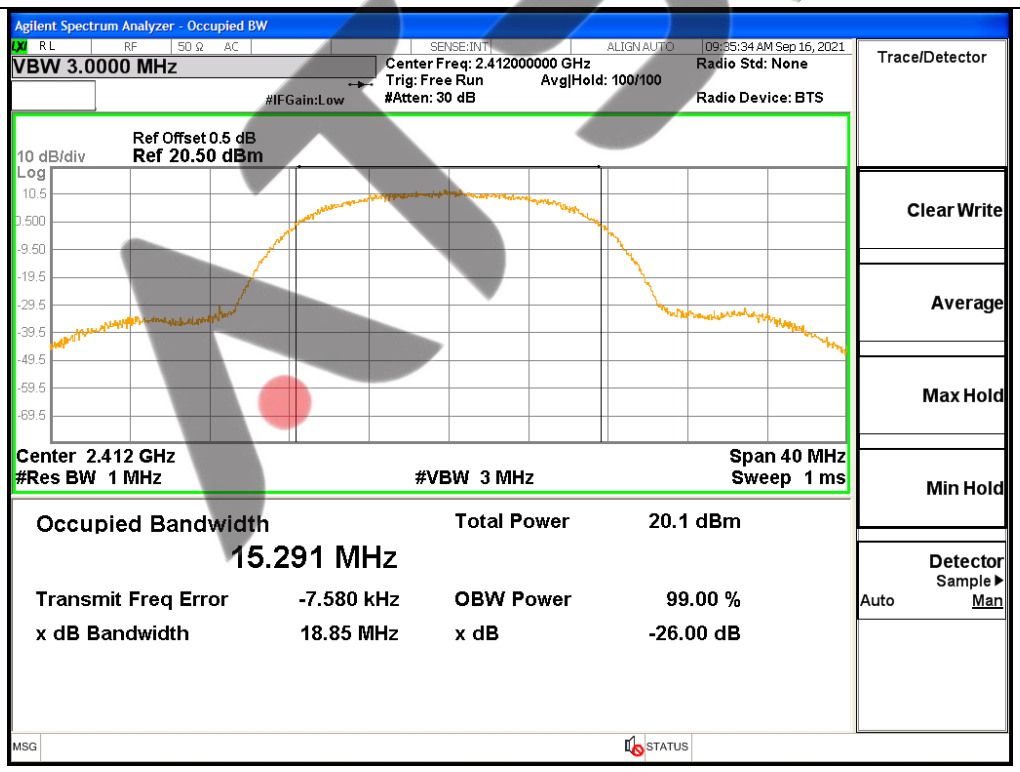
6dB Bandwidth TX CH 01



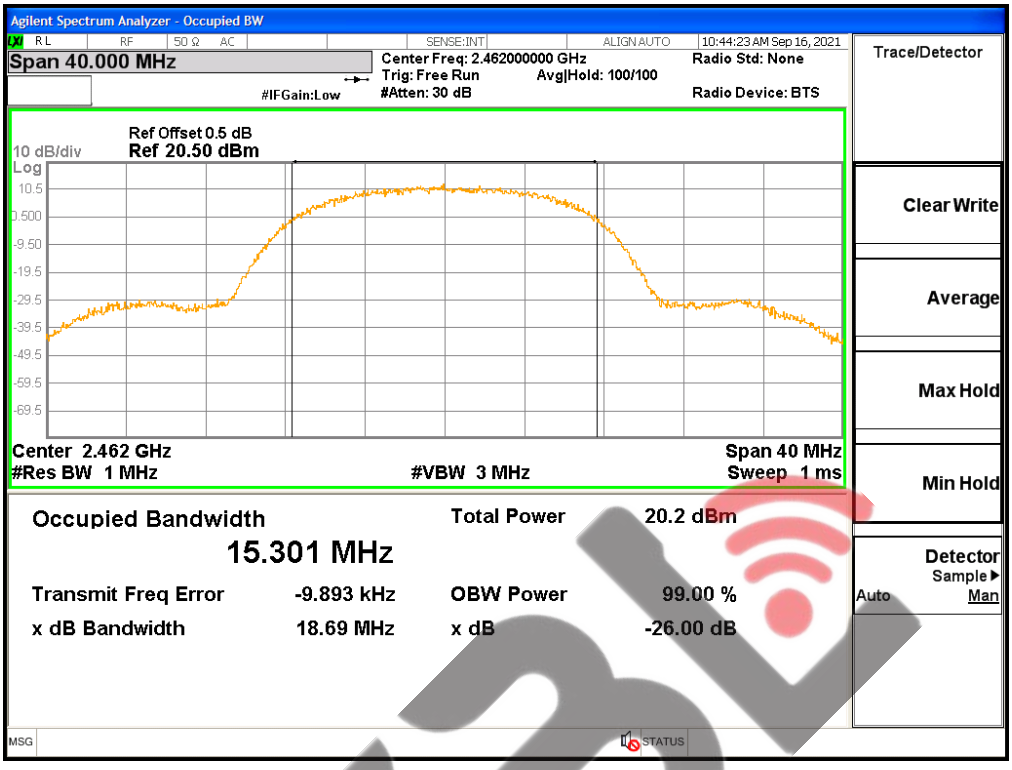
6dB Bandwidth TX CH 11



99% Bandwidth TX CH 01



99% Bandwidth TX CH 01



7. PEAK OUTPUT POWER TEST

7.1 LIMIT

FCC Part15.247,Subpart C RSS-247 Clause 5.4(d)				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3) RSS-247 Clause 5.4(d)	Output Power	1 watt or 30dBm	2400-2483.5	PASS
RSS-247	EIRP	4W	2400-2483.5	PASS

7.2 TEST PROCEDURE

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

Integrated band power method:

The following procedure can be used when the maximum available RBW of the instrument is less than the
DTS bandwidth:

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ [3 × RBW].
c) Set the span ≥ [1.5 × DTS bandwidth].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

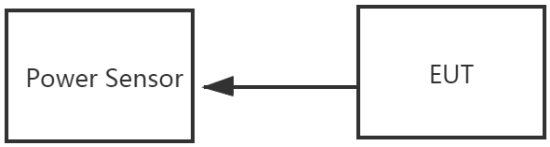
PKPM1 Peak power meter method:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



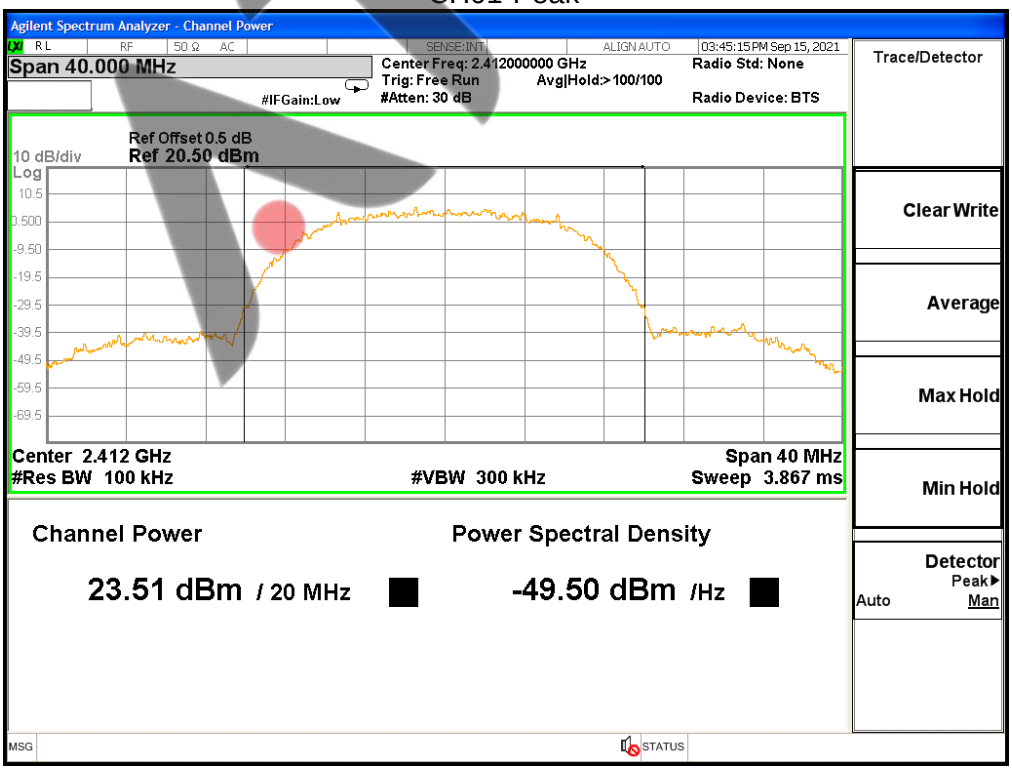
7.5 EUT OPERATION CONDITIONS
Please refer to section 3.1.4 of this report.

7.6 TEST RESULTS

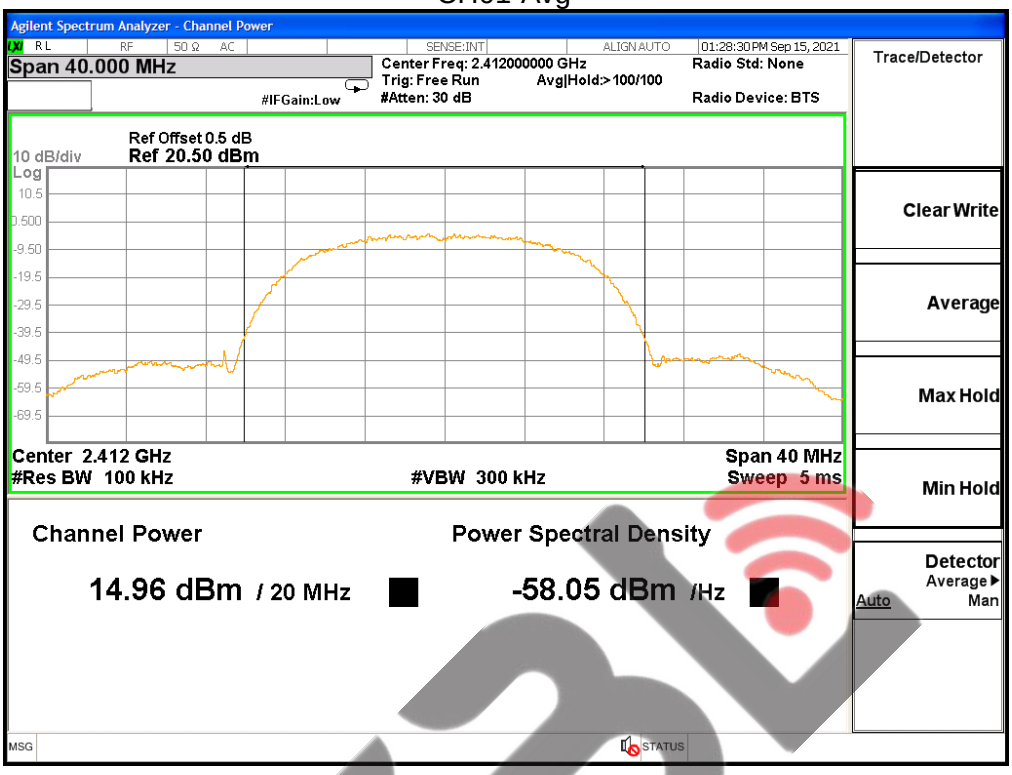
Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX b Mode /CH01, CH11

Mode	Test Channel	Frequency	Peak Conducted Output Power	Average Conducted Output Power	LIMIT
		(MHz)	(dBm)	(dBm)	dBm
TX 802.11b	CH01	2412	23.51	14.96	30
	CH11	2462	23.21	14.90	30

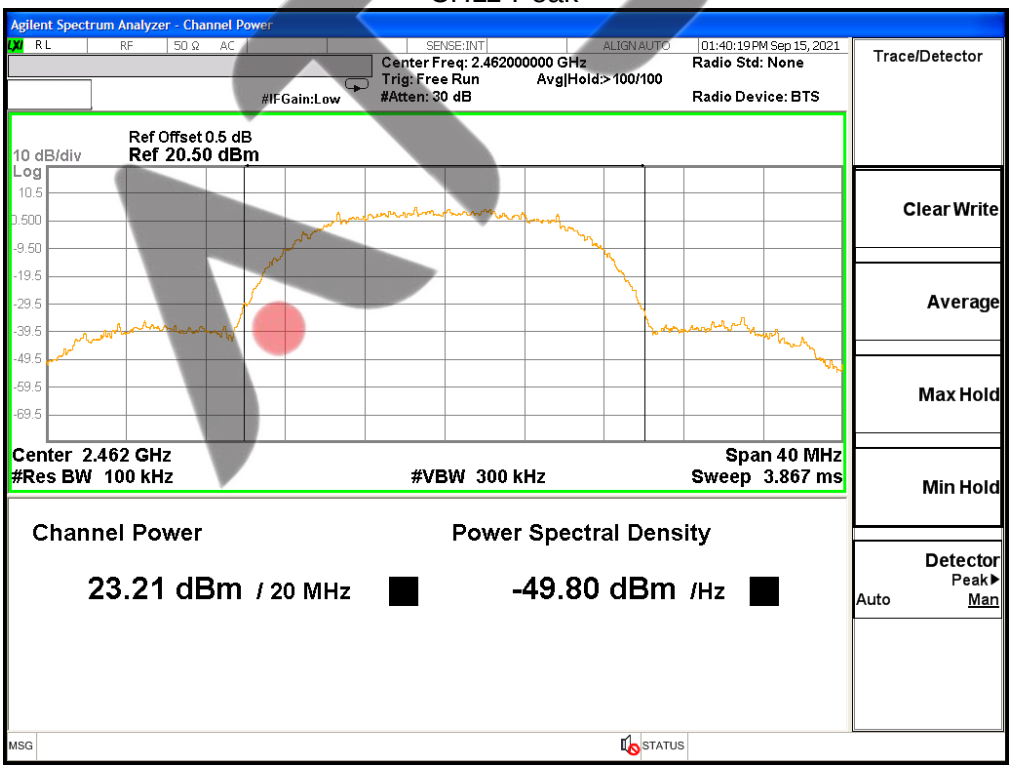
CH01-Peak



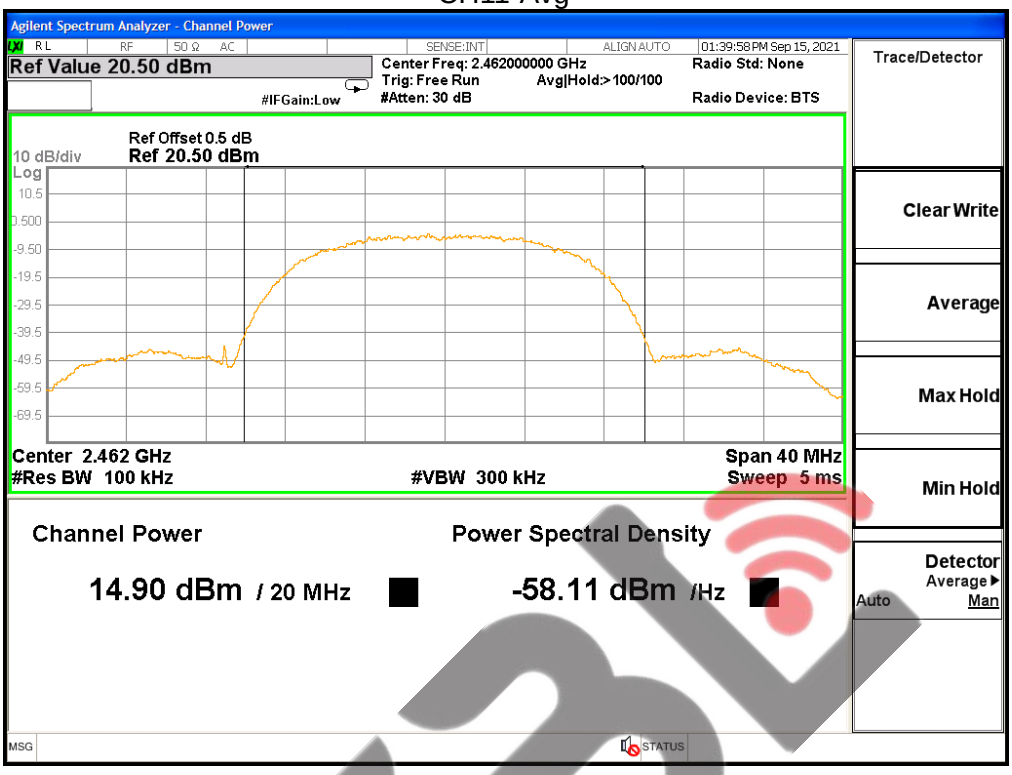
CH01-Avg



CH11-Peak



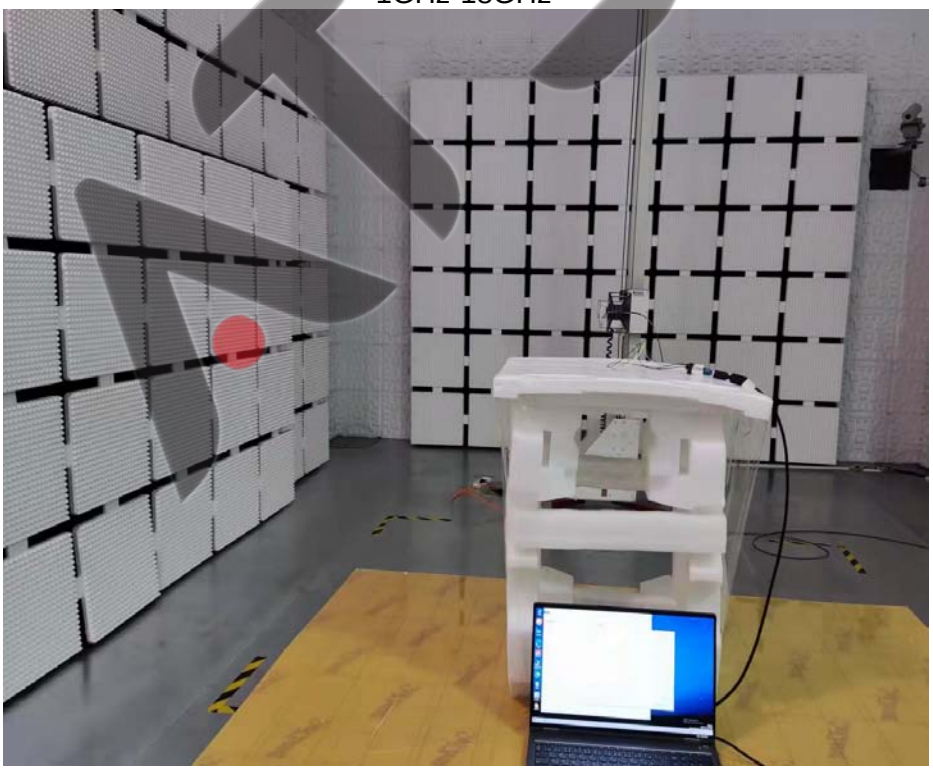
CH11-Avg


Agilent Spectrum Analyzer - Channel Power
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
01:39:58 PM Sep 15, 2021
Ref Value 20.50 dBm
Center Freq: 2.462000000 GHz
Trig: Free Run
Avg|Hold:>100/100
#IFGain:Low
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Trace/Detector
Ref Offset 0.5 dB
10 dB/div
Ref 20.50 dBm
Log
10.5
0.500
-9.50
-19.5
-29.5
-39.5
-49.5
-59.5
-69.5
Center 2.462 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 40 MHz
Sweep 5 ms
Clear Write
Average
Max Hold
Min Hold
Channel Power
14.90 dBm / 20 MHz
Power Spectral Density
-58.11 dBm /Hz
Detector
Average
Auto
Man
MSG
STATUS

APPENDIX-PHOTOS OF TEST SETUP

30MHz-1000MHz

1GHz-18GHz



※※※※※END OF THE REPORT※※※※※