Test Report

Product： Smart Plug

Trade Mark: Loocam

Model Number： MK1

FCC ID： 2BCLE-MK1

Prepared for

Zhongshan Vzzon Energy Tech Co., Ltd.

Zone A, 2nd And 3rd Floors, No.8, Liantangxia Road, Wushi Village, Sanxiang Town, Zhongshan, GuangDong, 528463 China

Prepared by

Shenzhen HongBiao Certification& Testing Co., Ltd

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TEST RESULT CERTIFICATION

Applicant's Name..... :	Zhongshan Vzzon Energy Tech Co., Ltd.
Address ..... :	Zone A, 2nd And 3rd Floors, No.8, Liantangxia Road, Wushi Village, Sanxiang Town, Zhongshan, GuangDong, 528463 China
Manufacturer's Name ..... :	Zhongshan Vzzon Energy Tech Co., Ltd.
Address ..... :	Zone A, 2nd And 3rd Floors, No.8, Liantangxia Road, Wushi Village, Sanxiang Town, Zhongshan, GuangDong, 528463 China

Product description

Product name ..... :	Smart Plug
Model Number ..... :	MK1
Standards..... :	FCC Part 15.247
Test procedure..... :	IEEE/ANSI C63.10-2020

This device described above has been tested by Shenzhen HongBiao Certification& Testing Co,.Ltd and the test results show that the equipment under test (EUT) is in compliance with the EMC requirements. And it is applicable only to the tested sample identified in the report.

Date of Test

Date (s) of performance of tests..... :	August 14. 2023~August 23. 2023
Test Result..... :	**Pass**

Testing Engineer : Zoe Su

(Zoe Su)

Technical Manager : Gary Lu

(Gary Lu)

Authorized Signatory : Leo Su

(Leo Su)

Revision History

Revised No.	Date of Issue	Description
01	August 24. 2023	Original

1 General Description

1.1 Description of EUT

Product name:	Smart Plug
Model name:	MK1
Series Model:	-
Different of series model:	N/A
Operation frequency:	802.11b/g/n20:2412~2462 MHz
Modulation type:	IEEE 802.11b : DSSS (DBPSK, DQPSK, CCK) IEEE 802.11g/n (HT20) : OFDM (64QAM, 16QAM, QPSK, BPSK)
Bit Rate of transmitter:	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n(20MHz) use 800 ns GI: 65.0/58.5/52.0/39.0/26.0/19.5/13.0/6.5 Mbps (MCS0~MCS7)
Antenna type:	PCB Antenna
Antenna gain:	2.5dBi
Max. output power:	10.08dBm
Hardware version:	HW.V1.MKE
Software version:	SKET.V1.0.0
Battery:	N/A
Power supply:	Input: AC 120V-60Hz Output: AC 120V-60Hz 10A MAX
Adapter information:	N/A

1.2 Test Mode

Channel List for 802.11b/g/n (20)

Channel	Channel	Frequency (MHz)
Low	01	2412
Middle	06	2437
High	11	2462

1.3 Operation Channel list

Channel List for 802.11b/g/n (20)

Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	07	2442
02	2417	08	2447
03	2422	09	2452
04	2427	10	2457
05	2432	11	2462
06	2437	\	\

1.4 Test Setup

See photographs of the test setup in the report for the actual setup and connections between EUT and support equipment.

1.5 Ancillary Equipment

Equipment	Model	S/N	Manufacturer
/	/	/	/

2 Summary of Test Result

No.	Standard Section	Test Item	Result	Remark
1	15.203	Antenna Requirement	Pass	
2	15.247 (b)	Peak Output Power	Pass	
3	15.207	Conducted Emission	Pass	
4	15.247 (d) & 15.209	Radiated Spurious Emission	Pass	
5	15.247 (e)	Power Spectral Density	Pass	
6	15.247 (a)(2)	6dB Bandwidth	Pass	
7	558074 D01 15.247 Meas Guidance v05r02 Chapter 6	Duty Cycle	Pass	
8	15.205	Band Edge Emission	Pass	
9	15.247(d)	Spurious RF Conducted Emissions	Pass	

3 Test Facilities and Accreditations

3.1 Test Laboratory

Test Site	Shenzhen HongBiao Certification& Testing Co., Ltd
Test Site Location	Room 102, 201, Building 2, Yuanwanggu RFID Industrial Park, Tongguan Road, Tianliao Community, Yutang Street, Guangming District, Shenzhen, China
Telephone:	(86-755) 2998 9321
Fax:	(86-755) 2998 5110
FCC Registration No.:	CN1341
A2LA Certificate No.:	6765.01

3.2 Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15ºC~35ºC
Relative Humidity:	20%~75%
Air Pressure:	98kPa~101kPa

3.3 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 %.

Measurement Frequency Range	U，(dB)	Note
RF frequency	$2x\ 10^{-5}$	
RF power, conducted	± 0.57 dB	
Conducted emission(150kHz~30MHz)	± 2.5 dB	
Radiated emission(30MHz~1GHz)	± 4.2 dB	
Radiated emission (above 1GHz)	± 4.7 dB	
Temperature	±1 degree	
Humidity	± 5 %	

3.4 Test Software

Software name	Manufacturer	Model	Version
EMI Measurement	Farad	EZ-EMC	V1.1.4.2
Conducted test system	MWRF-test	MTS 8310	V2.0.0

4 List of Test Equipment

Radiation emission							
Item	Equipment No.	Equipment name	Manufacturer	Model	Serial No.	Calibration date	Due date
1	HB-E001	Horn Antenna	Schwarzbeck	BBHA 9120D	02592	2022-04-02	2024-04-01
2	HB-E002	Biconical log-periodic composite antenna	Schwarzbeck	VULB 9168	01340	2022-04-06	2024-04-05
3	HB-E003	SHF-EHF Horn	Schwarzbeck	BBHA 91270	01193	2022-04-02	2024-04-01
4	HB-E004	Preamplifier	Noyetec	LAN-0910	NYCM1420101	2023-05-11	2024-05-10
5	HB-E005	Preamplifier	Noyetec	LAN-0118	NYCM1420102	2023-05-12	2024-05-11
6	HB-E006	Preamplifier	Noyetec	LAN-1840	NYCM1420103	2023-06-11	2024-06-10
7	HB-E007	EMI TEST RECEIVER	R&S	ESR7	102520	2023-05-12	2024-05-11
8	HB-E009	POSITINAL COTROLLER	Noyetec	N/A	N/A	/	/
9	HB-E013	RF switch	Noyetec	NY-RF4	NY0CM1420204	/	/
10	HB-E066	Illuminance Tester	TASI	TA8121	N/A	2023-05-11	2024-05-10
11	HB-E075	Active loop antenna	Schwarzbeck	FMZB 1519B	1519B-245	2022-07-24	2024-07-23
Conduction emission							
Item	Equipment No.	Equipment name	Manufacturer	Model	Serial No.	Calibration date	Due date
1	HB-E014	4 Path V-LISN	Schwarzbeck	NNLK 8121	00770	2023-05-12	2024-05-11
2	HB-E015	Pulse Limiter	Schwarzbeck	VTSD 9561-F	00949	2023-05-12	2024-05-11
3	HB-E016	ZN23201	Noyetec	ZN23201	N/A	2023-05-11	2024-05-10
4	HB-E059	Attenuator	Xianghua	TS2-6-1	220215166	2023-05-12	2024-05-11
5	HB-E069	EMI TEST RECEIVER	R&S	ESCI	N/A	2023-05-12	2024-05-11

RF							
Item	Equipment No.	Equipment name	Manufacturer	Model	Serial No.	Calibration date	Due date
1	HB-E041	MXG Anaiog Signal	Agilent	N5181A	MY47070421	2023-05-11	2024-05-10

		Generator					
2	HB-E042	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW500	132108	2023-05-11	2024-05-10
3	HB-E043	MXG Anaiog Signal Generator	Agilent	N5182A	US46240335	2023-05-11	2024-05-10
4	HB-E044	Signal& spectrum Analyzer	R&S	FSV3044	101264	2023-05-11	2024-05-10
5	HB-E045	RF Control Box	Noyetec	NY100-RFCB	N/A	/	/
6	HB-E058	Thermometer Clock Humidity Monitor	N/A	HTC-1	N/A	/	/

Note: the calibration interval of the above test instruments is 12&24 months and the calibrations are traceable to international system unit (SI).

5 Test Item And Results

5.1 Antenna Requirement

5.1.1 Standard Requirement

15.203 requirement: For intentional device, according to 15.203: 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

5.1.2 Test Result

The EUT antenna is PCB Antenna. It comply with the standard requirement. In case of replacement of broken antenna the same antenna type must be used.

5.2 Conducted Emission

5.2.1 Limits

Limits – Class B		
Frequency (MHz)	Limit (dBμV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

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.

5.2.2 Test Procedures

a) 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.

b) 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

c) The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

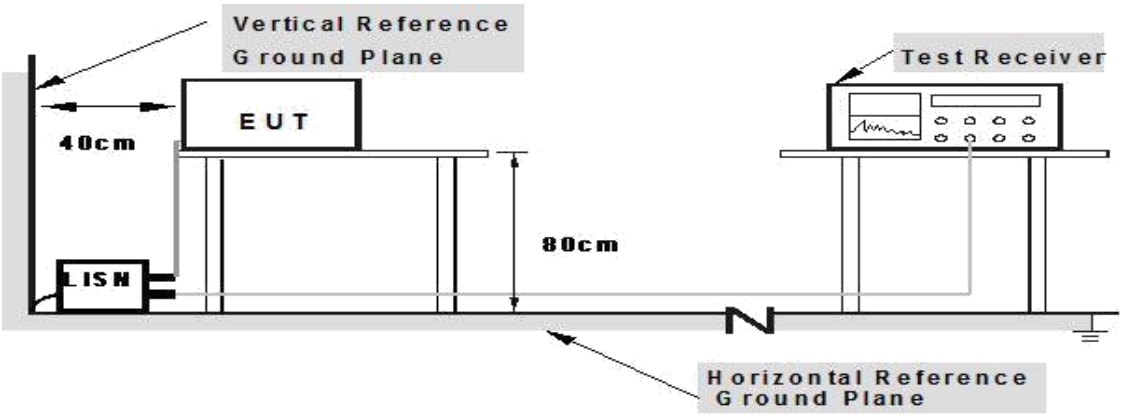
d) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

e) 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.

f) LISN is at least 80 cm from nearest part of EUT chassis.

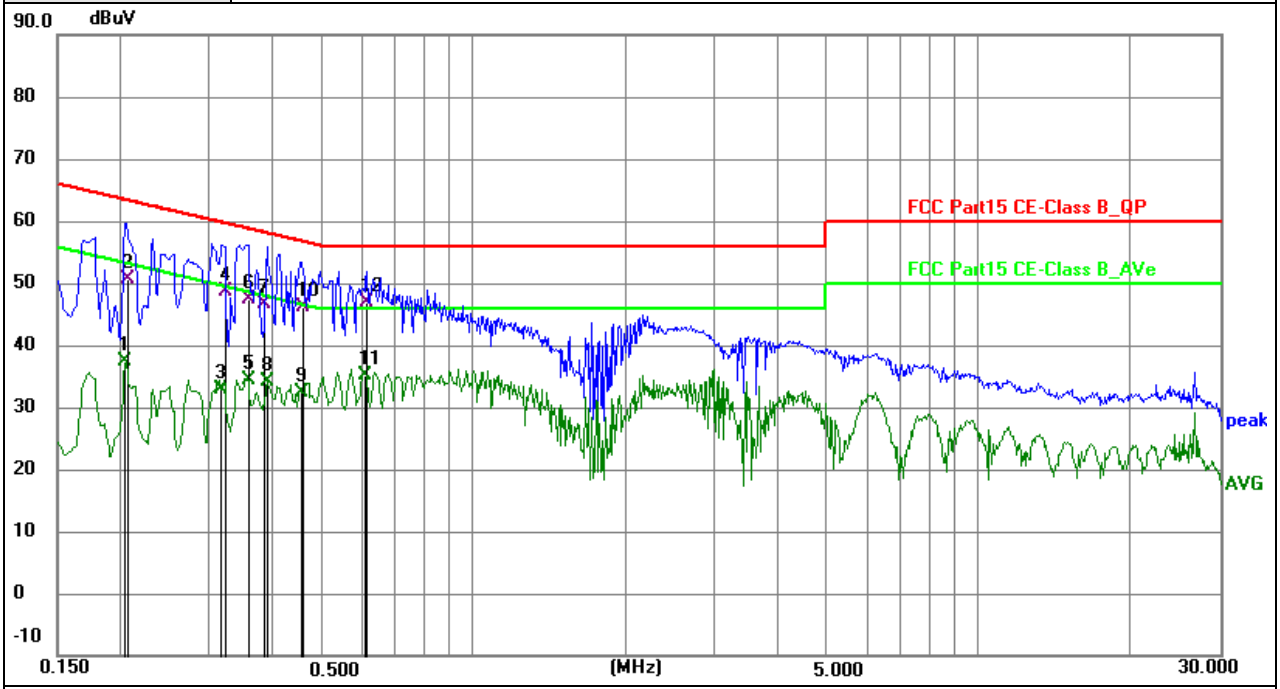
g) For the actual test configuration, please refer to the related Item – photographs of the test setup.

5.2.3 Test Setup



5.2.4 Test Result

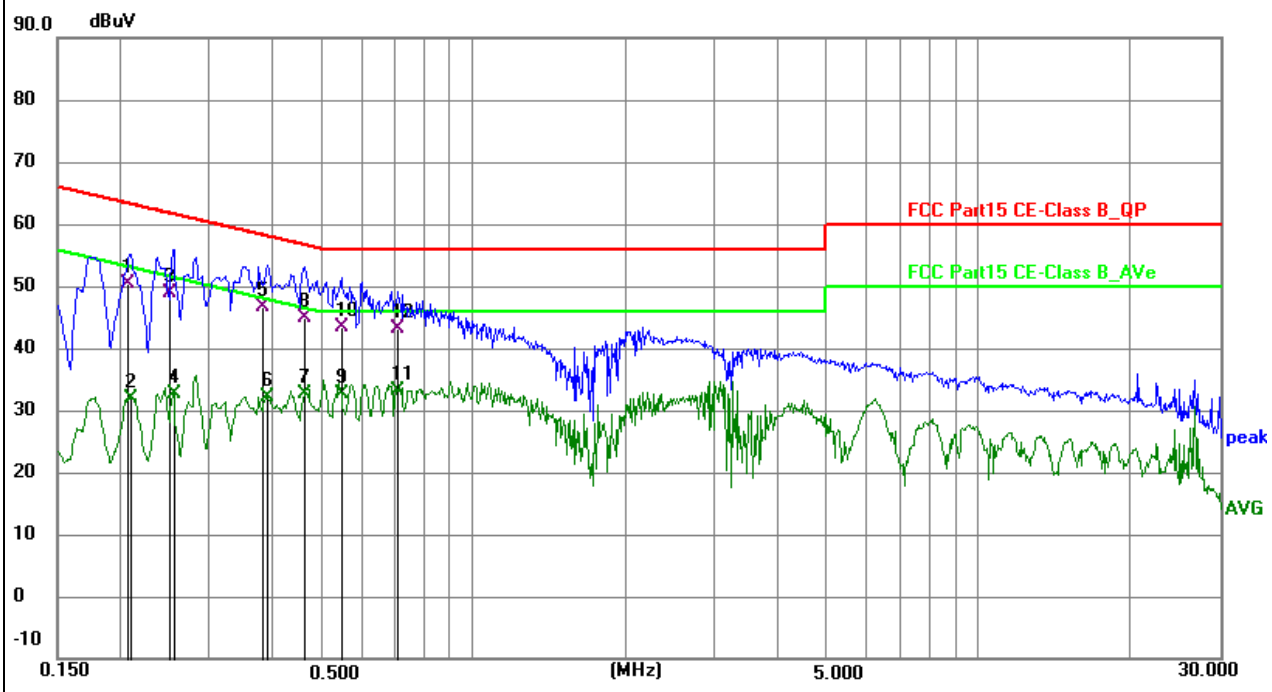
EUT:	Smart Plug	Model Name:	MK1
Test Mode:	Working	Phase :	L
Test Voltage:	AC 120V/60Hz		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.2040	27.59	9.74	37.33	53.45	-16.12	AVG	P	
2	0.2080	40.77	9.75	50.52	63.28	-12.76	QP	P	
3	0.3165	23.00	9.94	32.94	49.80	-16.86	AVG	P	
4	0.3238	38.73	9.94	48.67	59.61	-10.94	QP	P	
5	0.3570	24.39	9.94	34.33	48.80	-14.47	AVG	P	
6	0.3608	37.37	9.95	47.32	58.71	-11.39	QP	P	
7	0.3844	36.75	10.00	46.75	58.18	-11.43	QP	P	
8	0.3885	24.21	10.01	34.22	48.10	-13.88	AVG	P	
9	0.4560	22.32	9.98	32.30	46.77	-14.47	AVG	P	
10	0.4604	36.15	9.98	46.13	56.69	-10.56	QP	P	
11	0.6134	25.15	9.90	35.05	46.00	-10.95	AVG	P	
12 *	0.6147	36.87	9.90	46.77	56.00	-9.23	QP	P	

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.Mesurement Level = Reading level + Correct Factor
4.All test modes were pre-tested, but we only recorded the worst case in this report.

EUT：	Smart Plug	Model Name:	MK1
Test Mode：	Working	Phase :	N
Test Voltage:	AC 120V/60Hz		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.2075	40.78	9.71	50.49	63.30	-12.81	QP	P	
2	0.2085	22.16	9.71	31.87	53.26	-21.39	AVG	P	
3	0.2511	39.06	9.80	48.86	61.72	-12.86	QP	P	
4	0.2535	22.92	9.81	32.73	51.64	-18.91	AVG	P	
5 *	0.3810	36.75	9.90	46.65	58.26	-11.61	QP	P	
6	0.3885	22.31	9.90	32.21	48.10	-15.89	AVG	P	
7	0.4605	22.66	9.92	32.58	46.68	-14.10	AVG	P	
8	0.4640	35.08	9.92	45.00	56.62	-11.62	QP	P	
9	0.5460	22.60	9.93	32.53	46.00	-13.47	AVG	P	
10	0.5514	33.36	9.92	43.28	56.00	-12.72	QP	P	
11	0.7080	23.28	9.88	33.16	46.00	-12.84	AVG	P	
12	0.7091	33.12	9.89	43.01	56.00	-12.99	QP	P	

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.Mesurement Level = Reading level + Correct Factor
4.All test modes were pre-tested, but we only recorded the worst case in this report.

5.3 Radiated Emission

5.3.1 Limits

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

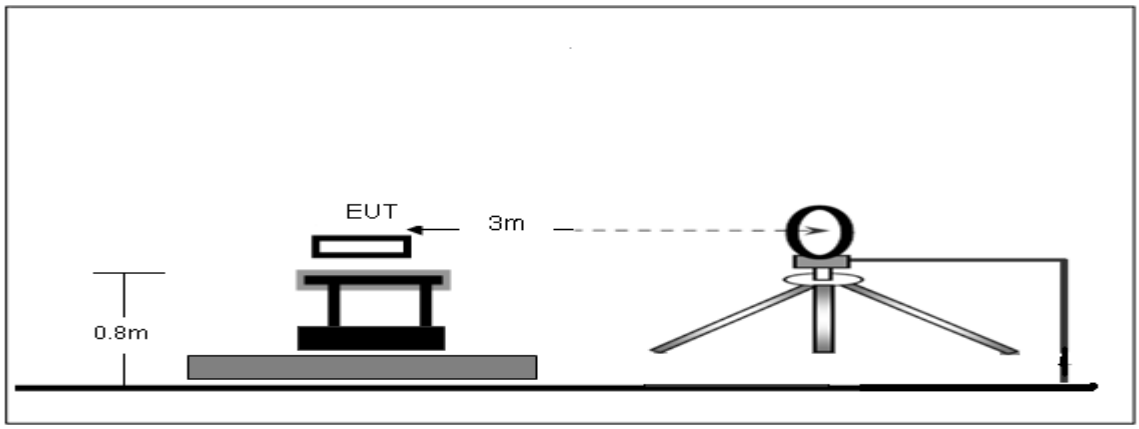
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

5.3.2 Test Procedures

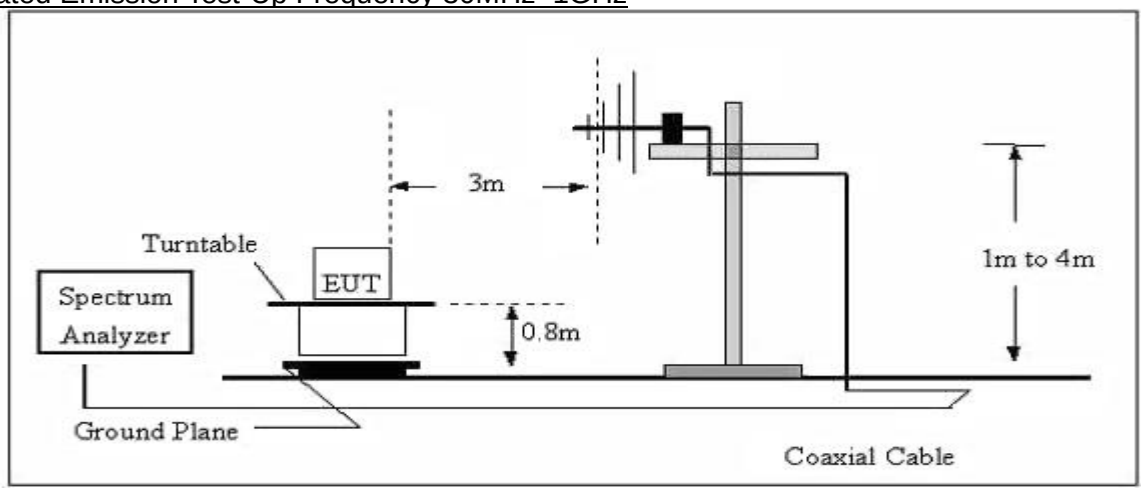
a) The radiated emission tests were performed in the 3 meters.
b) The EUT was placed on the top of a rotating table 0.8 meters above the ground. The table was rotated 360 degrees to determine the position of the highest radiation.
c) The height of the test antenna shall vary between 1m to 4m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d) If the peak mode measured value compliance with and lower than quasi peak mode limit, the EUT shall be deemed to meet QP limits and then no additional QP mode measurement performed.
e) If the peak mode measured value compliance with and lower than average mode limit, the EUT shall be deemed to meet average limits and then no additional average mode measurement performed.
f) For the actual test configuration, please refer to the related item – EUT test photos.

5.3.3 Test Setup

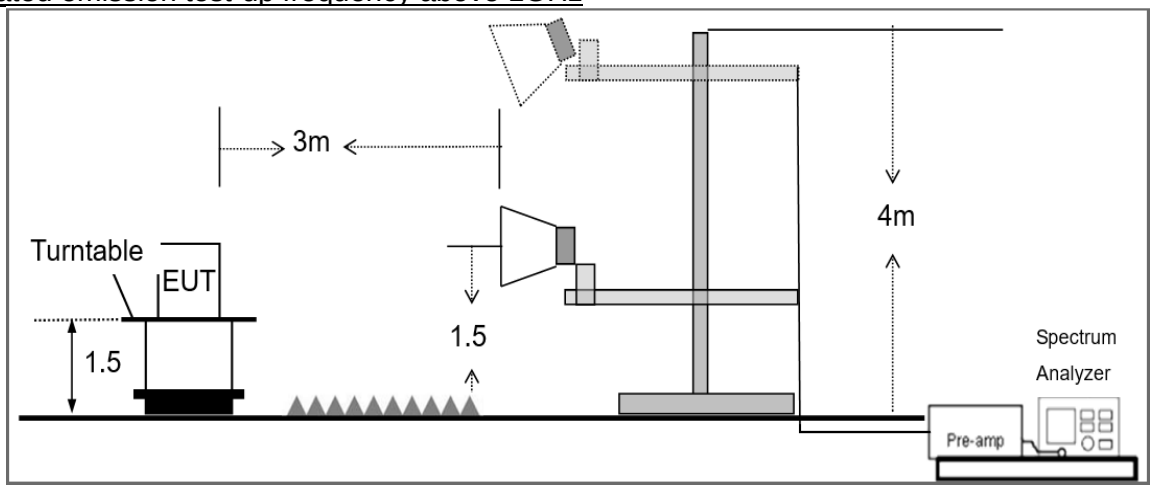
Radiated Emission Test-Up Frequency Below 30MHz



Radiated Emission Test-Up Frequency 30MHz~1GHz



Radiated emission test-up frequency above 1GHz



5.3.4 Test Result

Below 30MHz

EUT:	Smart Plug	Model Name:	MK1
Pressure:	1010 hPa	Test Voltage:	AC 120V/60Hz
Test Mode:	Working	Polarization:	--

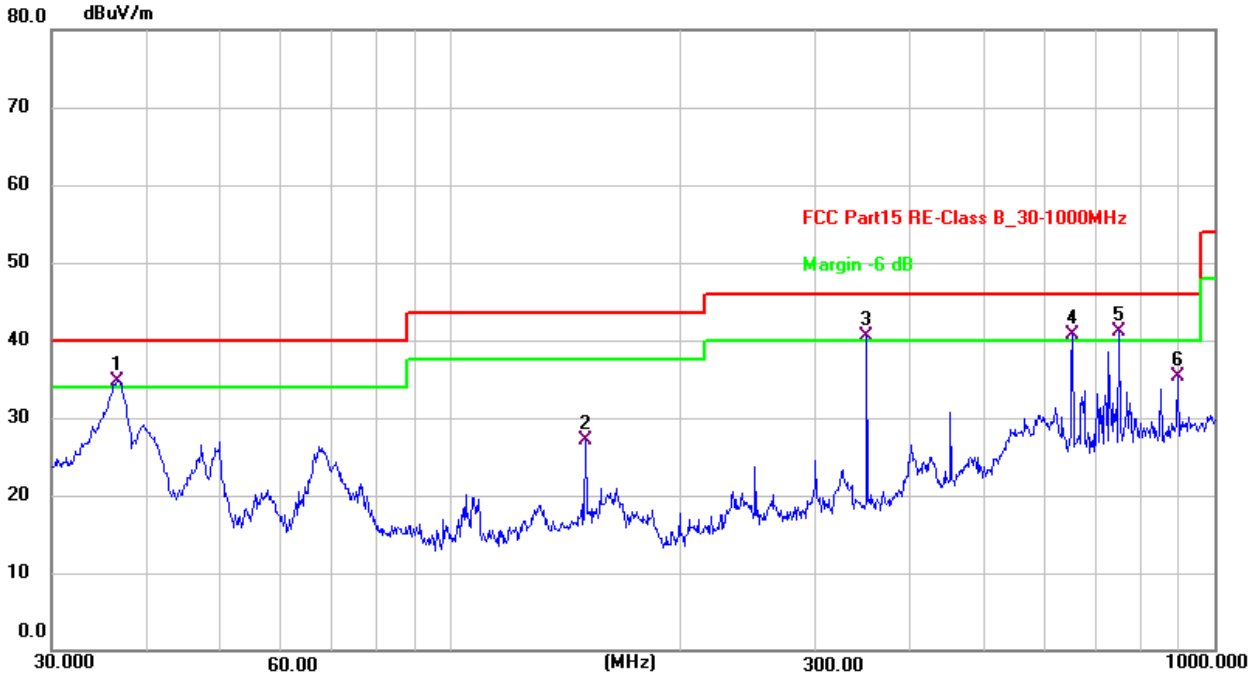
Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	Pass
--	--	--	--	Pass

Note:

1. For 9kHz-30MHz, the amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Distance extrapolation factor =40 log (specific distance/test distance)(dB);
3. Limit line = specific limits (dBuV) + distance extrapolation factor.

Frequency range (30MHz – 1GHz)

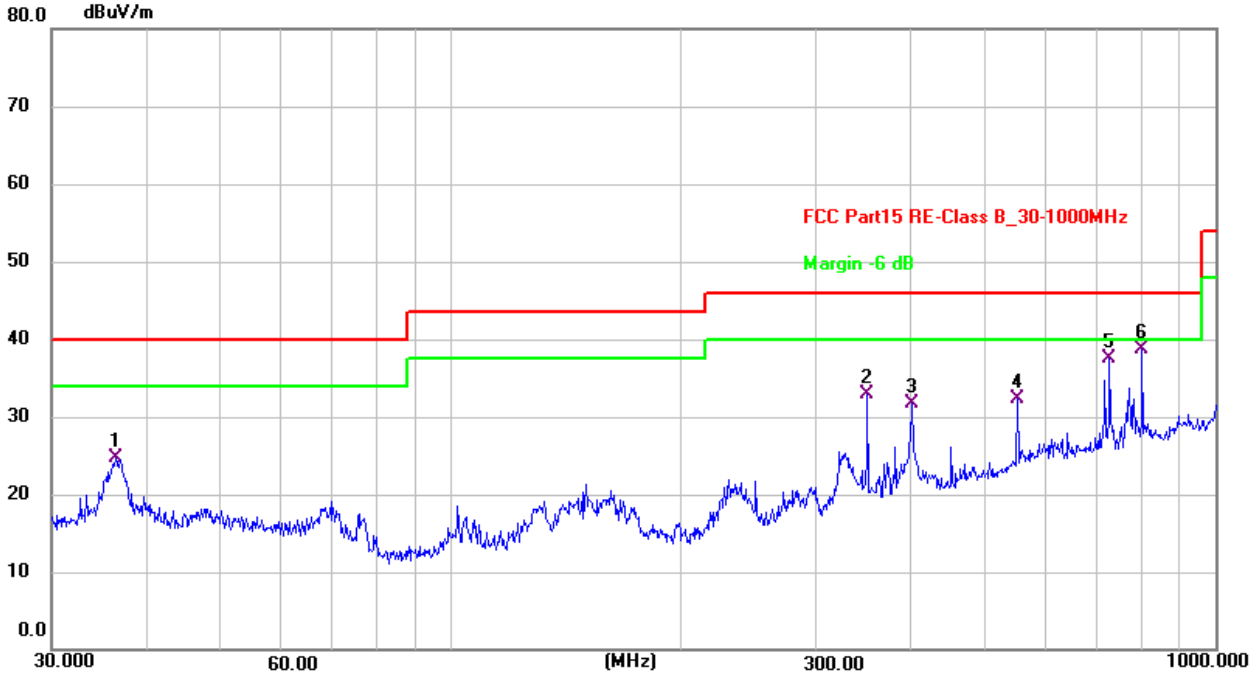
EUT:	Smart Plug	Model Name:	MK1
Test Mode:	Working	Phase :	Vertical
Test Voltage:	AC 120V/60Hz		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1 !	36.6375	43.38	-8.63	34.75	40.00	-5.25	QP	100	315	P	
2	150.0108	35.82	-8.73	27.09	43.50	-16.41	QP	100	39	P	
3 !	350.4768	48.09	-7.55	40.54	46.00	-5.46	QP	100	170	P	
4 !	651.9416	41.08	-0.43	40.65	46.00	-5.35	QP	100	53	P	
5 *	750.1082	40.33	0.83	41.16	46.00	-4.84	QP	100	178	P	
6	893.8565	31.79	3.61	35.40	46.00	-10.60	QP	100	349	P	

Remarks:
1. Mesurement Level = Reading level + Correct Factor, Margin = Mesurement Level – Limit.
2.The emission levels of other frequencies are very lower than the limit and not show in test report.
3.All test modes were pre-tested, but we only recorded the worst case in this report.

EUT：	Smart Plug	Model Name:	MK1
Test Mode：	Working	Phase :	Horizontal
Test Voltage:	AC 120V/60Hz		



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	36.3814	33.38	-8.66	24.72	40.00	-15.28	QP	100	279	P	
2	350.4768	40.48	-7.55	32.93	46.00	-13.07	QP	100	112	P	
3	400.4319	37.52	-5.86	31.66	46.00	-14.34	QP	100	9	P	
4	550.9480	35.14	-2.85	32.29	46.00	-13.71	QP	100	92	P	
5	726.8052	36.71	0.75	37.46	46.00	-8.54	QP	100	9	P	
6 *	801.7863	36.33	2.46	38.79	46.00	-7.21	QP	100	162	P	

Remarks:
1. Mesurement Level = Reading level + Correct Factor, Margin = Mesurement Level – Limit.
2.The emission levels of other frequencies are very lower than the limit and not show in test report.
3.All test modes were pre-tested, but we only recorded the worst case in this report.

Frequency range (1GHz-25GHz)

Frequency	Read Level	Cable loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Remark	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)		
Low Channel (2412 MHz)(802.11b)--Above 1G									
4824	65.12	4.36	32.92	45.53	56.87	74.00	-17.13	Pk	Vertical
4824	54.73	4.36	32.92	45.53	46.48	54.00	-7.52	AV	Vertical
7236	59.89	5.02	37.63	45.56	56.98	74.00	-17.02	Pk	Vertical
7236	43.16	5.02	37.63	45.56	40.25	54.00	-13.75	AV	Vertical
4824	65.19	4.36	32.92	45.53	56.94	74.00	-17.06	Pk	Horizontal
4824	52.03	4.36	32.92	45.53	43.78	54.00	-10.22	AV	Horizontal
7236	60.56	5.02	37.63	45.56	57.65	74.00	-16.35	Pk	Horizontal
7236	44.07	5.02	37.63	45.56	41.16	54.00	-12.84	AV	Horizontal
Middle Channel (2437 MHz)(802.11b)--Above 1G									
4874	66.54	4.41	33.01	45.76	58.20	74.00	-15.80	Pk	Vertical
4874	54.84	4.41	33.01	45.76	46.50	54.00	-7.50	AV	Vertical
7311	58.73	5.02	37.68	45.59	55.84	74.00	-18.16	Pk	Vertical
7311	44.68	5.02	37.68	45.59	41.79	54.00	-12.21	AV	Vertical
4874	67.91	4.41	33.01	45.76	59.57	74.00	-14.43	Pk	Horizontal
4874	53.80	4.41	33.01	45.76	45.46	54.00	-8.54	AV	Horizontal
7311	57.66	5.02	37.68	45.59	54.77	74.00	-19.23	Pk	Horizontal
7311	45.41	5.02	37.68	45.59	42.52	54.00	-11.48	AV	Horizontal
High Channel (2462 MHz)(802.11b)--Above 1G									
4924	67.09	4.50	33.26	46.07	58.78	74.00	-15.22	Pk	Vertical
4924	53.70	4.50	33.26	46.07	45.39	54.00	-8.61	AV	Vertical
7386	59.40	5.02	37.78	45.77	56.43	74.00	-17.57	Pk	Vertical
7386	44.97	5.02	37.78	45.77	42.00	54.00	-12.00	AV	Vertical
4924	65.31	4.50	33.26	46.07	57.00	74.00	-17.00	Pk	Horizontal
4924	51.50	4.50	33.26	46.07	43.19	54.00	-10.81	AV	Horizontal
7386	58.93	5.02	37.78	45.77	55.96	74.00	-18.04	Pk	Horizontal
7386	44.87	5.02	37.78	45.77	41.90	54.00	-12.10	AV	Horizontal

Note:
1. Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor
2. All other emissions more than 20dB below the limit.
3. The three modulated high, medium and low channels have been tested. The report only shows the worst mode. The worst mode is 802.11b.

5.3.5 Radiated Band Edge

Frequency	Read Level	Cable loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Remark	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)		
802.11b									
2310.00	58.91	2.40	27.70	40.40	48.61	74.00	-25.39	Pk	Horizontal
2310.00	44.86	2.40	27.70	40.40	34.56	54.00	-19.44	AV	Horizontal
2310.00	58.29	2.40	27.70	40.40	47.99	74.00	-26.01	Pk	Vertical
2310.00	42.04	2.40	27.70	40.40	31.74	54.00	-22.26	AV	Vertical
2390.00	59.71	2.44	28.30	40.10	50.35	74.00	-23.65	Pk	Vertical
2390.00	43.37	2.44	28.30	40.10	34.01	54.00	-19.99	AV	Vertical
2390.00	58.13	2.44	28.30	40.10	48.77	74.00	-25.23	Pk	Horizontal
2390.00	42.61	2.44	28.30	40.10	33.25	54.00	-20.75	AV	Horizontal
2483.50	57.04	2.48	28.70	39.80	48.42	74.00	-25.58	Pk	Vertical
2483.50	41.45	2.48	28.70	39.80	32.83	54.00	-21.17	AV	Vertical
2483.50	57.20	2.48	28.70	39.80	48.58	74.00	-25.42	Pk	Horizontal
2483.50	43.50	2.48	28.70	39.80	34.88	54.00	-19.12	AV	Horizontal
802.11g									
2310.00	59.89	2.40	27.70	40.40	49.59	74.00	-24.41	Pk	Horizontal
2310.00	43.18	2.40	27.70	40.40	32.88	54.00	-21.12	AV	Horizontal
2310.00	58.66	2.40	27.70	40.40	48.36	74.00	-25.64	Pk	Vertical
2310.00	43.03	2.40	27.70	40.40	32.73	54.00	-21.27	AV	Vertical
2390.00	57.87	2.44	28.30	40.10	48.51	74.00	-25.49	Pk	Vertical
2390.00	43.87	2.44	28.30	40.10	34.51	54.00	-19.49	AV	Vertical
2390.00	59.44	2.44	28.30	40.10	50.08	74.00	-23.92	Pk	Horizontal
2390.00	43.01	2.44	28.30	40.10	33.65	54.00	-20.35	AV	Horizontal
2483.50	58.75	2.48	28.70	39.80	50.13	74.00	-23.87	Pk	Vertical
2483.50	43.83	2.48	28.70	39.80	35.21	54.00	-18.79	AV	Vertical
2483.50	58.34	2.48	28.70	39.80	49.72	74.00	-24.28	Pk	Horizontal
2483.50	43.30	2.48	28.70	39.80	34.68	54.00	-19.32	AV	Horizontal

802.11n20									
2310.00	59.68	2.40	27.70	40.40	49.38	74.00	-24.62	Pk	Horizontal
2310.00	44.79	2.40	27.70	40.40	34.49	54.00	-19.51	AV	Horizontal
2310.00	57.13	2.40	27.70	40.40	46.83	74.00	-27.17	Pk	Vertical
2310.00	44.60	2.40	27.70	40.40	34.30	54.00	-19.70	AV	Vertical
2390.00	57.14	2.44	28.30	40.10	47.78	74.00	-26.22	Pk	Vertical
2390.00	43.01	2.44	28.30	40.10	33.65	54.00	-20.35	AV	Vertical
2390.00	57.95	2.44	28.30	40.10	48.59	74.00	-25.41	Pk	Horizontal
2390.00	42.54	2.44	28.30	40.10	33.18	54.00	-20.82	AV	Horizontal
2483.50	59.37	2.48	28.70	39.80	50.75	74.00	-23.25	Pk	Vertical
2483.50	41.06	2.48	28.70	39.80	32.44	54.00	-21.56	AV	Vertical
2483.50	57.58	2.48	28.70	39.80	48.96	74.00	-25.04	Pk	Horizontal
2483.50	41.15	2.48	28.70	39.80	32.53	54.00	-21.47	AV	Horizontal

Note:

1. All Readings are Peak Value (VBW=3MHz) and AV Value (VBW=10Hz).
2. Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor.
3. All the modulation modes have been tested, and only the worst results are reflected in the report.

5.3.6 Spurious Emission in Restricted Band 3260MHz-18000MHz

All the modulation modes have been tested, the worst mode is 802.11b and the worst result was report as below:

Frequency	Read Level	Cable loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Remark	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)		
3260	59.90	3.27	30.02	38.05	55.14	74.00	-18.86	Pk	Vertical
3260	39.90	3.27	30.02	38.05	35.14	54.00	-18.86	AV	Vertical
3260	58.85	3.27	30.02	38.05	54.09	74.00	-19.91	Pk	Horizontal
3260	39.40	3.27	30.02	38.05	34.64	54.00	-19.36	AV	Horizontal
3332	60.27	3.31	30.00	37.91	55.67	74.00	-18.33	Pk	Vertical
3332	42.37	3.31	30.00	37.91	37.77	54.00	-16.23	AV	Vertical
3332	59.87	3.31	30.00	37.91	55.27	74.00	-18.73	Pk	Horizontal
3332	40.67	3.31	30.00	37.91	36.07	54.00	-17.93	AV	Horizontal
17797	43.67	8.63	44.23	39.60	56.93	74.00	-17.07	Pk	Vertical
17797	27.14	8.63	44.23	39.60	40.40	54.00	-13.60	AV	Vertical
17788	42.05	8.63	44.23	39.60	55.31	74.00	-18.69	Pk	Horizontal
17788	28.16	8.63	44.23	39.60	41.42	54.00	-12.58	AV	Horizontal

5.4 Peak Output Power

5.4.1 Limit

FCC Part15 Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247(b)(3)	Peak output power	1 watt or 30dBm	2400-2483.5

5.4.2 Test Procedure

(1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

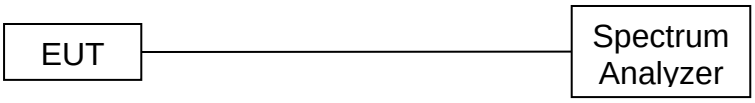
(2) Spectrum Setting:

RBW=1MHz, VBW=3MHz, Detector=Peak (If 20dB BW ≤1 MHz)

RBW=3MHz, VBW=8MHz, Detector=Peak (If 20dB BW > 1 MHz)

(3) The EUT was set to continuously transmitting in the max power during the test.

5.4.3 Test Setup



5.4.4 Test Results

EUT:	Smart Plug	Model Name:	MK1
Test Mode:	TX b/g/n(20) Mode /CH01, CH06, CH11	Test Voltage:	AC 120V/60Hz

802.11b

Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power(dBm)	Limit (dBm)
CH01	2412	10.08	30
CH06	2437	9.84	30
CH11	2462	10.02	30

802.11g

Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power(dBm)	Limit (dBm)
CH01	2412	7.69	30
CH06	2437	7.58	30
CH11	2462	7.82	30

802.11n20

Test Channel	Frequency (MHz)	Maximum Peak Conducted Output Power(dBm)	Limit (dBm)
CH01	2412	7.11	30
CH06	2437	7.07	30
CH11	2462	7.25	30

5.5 Power Spectral Density

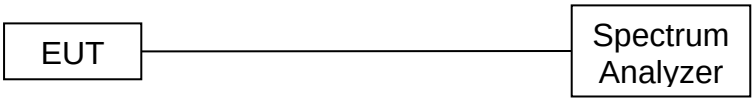
5.5.1 Limit

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247	Power Spectral Density	8 dBm (in any 3kHz)	2400-2483.5

5.5.2 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 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.

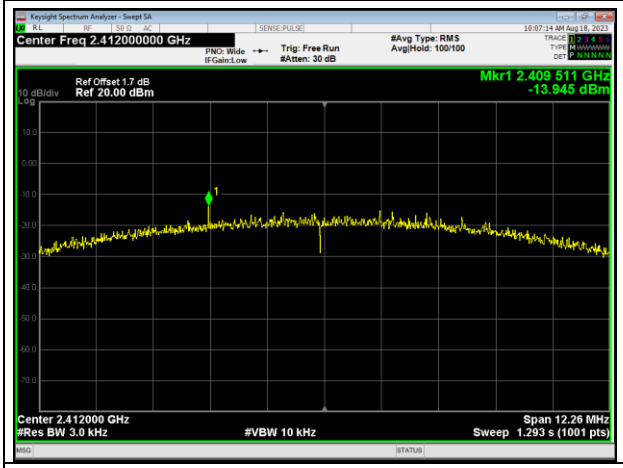
5.5.3 Test Setup



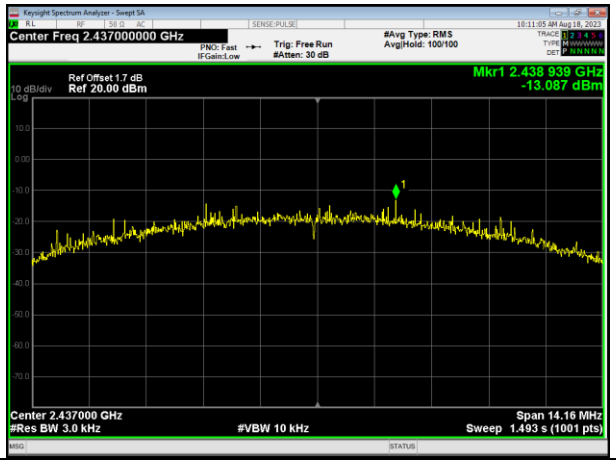
5.5.4 Test Results

802.11b			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412 MHz	-13.95	8	Pass
2437 MHz	-13.09	8	Pass
2462 MHz	-13.54	8	Pass

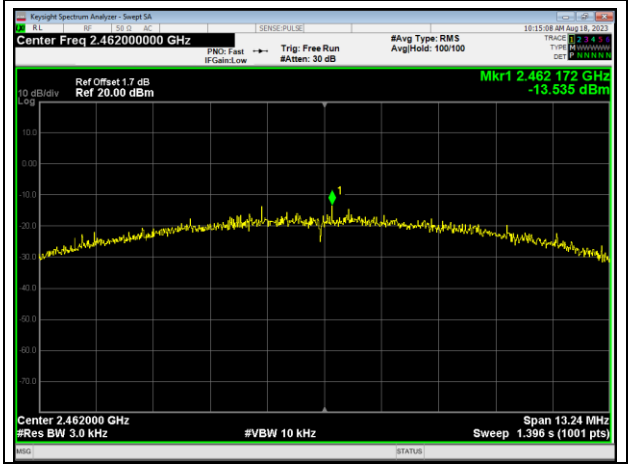
TX CH01



TX CH06

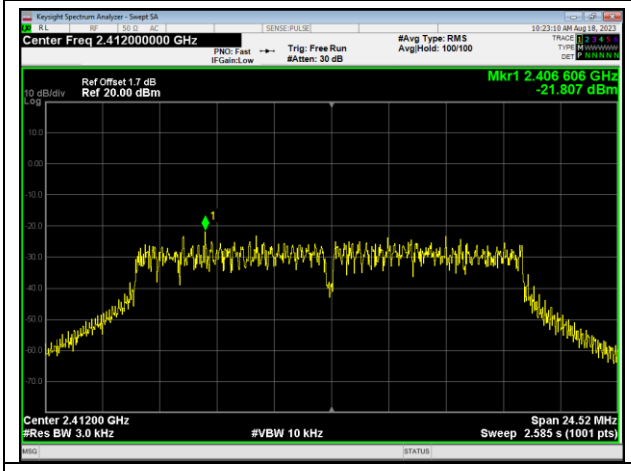


TX CH11

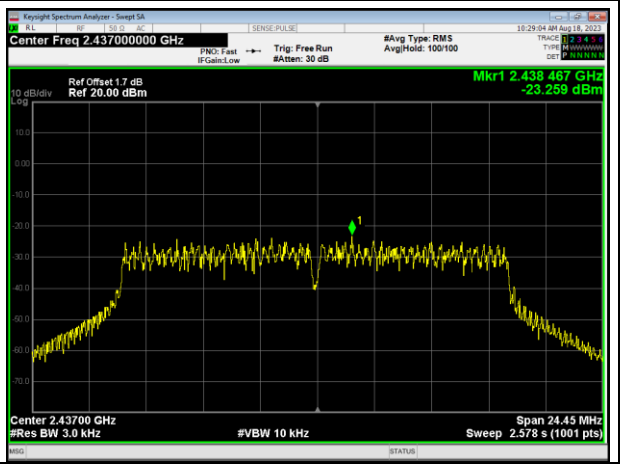


802.11g			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412 MHz	-21.81	8	Pass
2437 MHz	-23.26	8	Pass
2462 MHz	-22.56	8	Pass

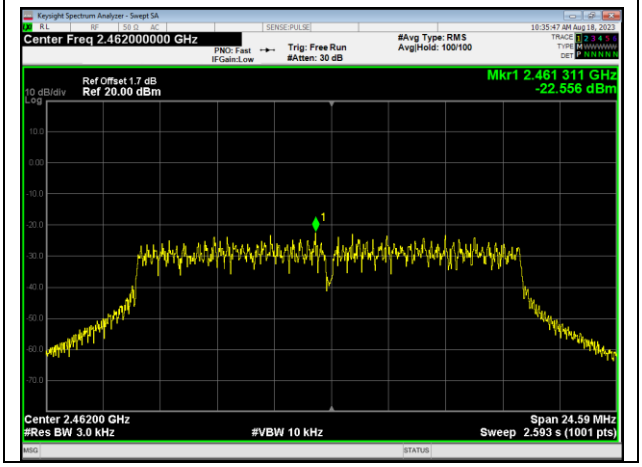
TX CH01



TX CH06

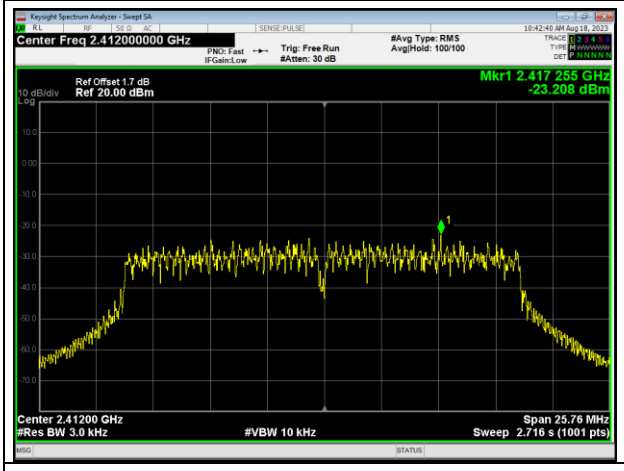


TX CH11

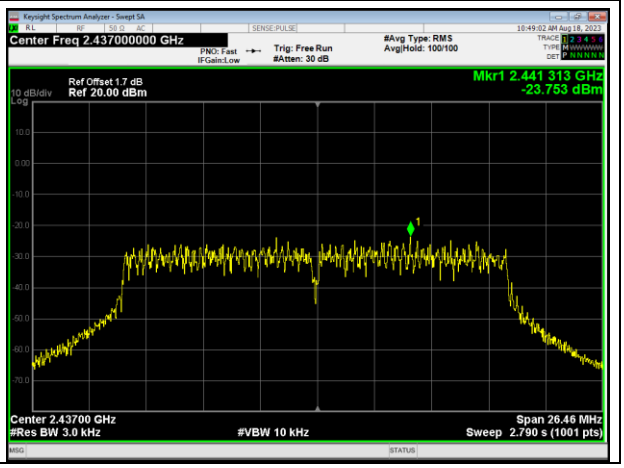


802.11n20			
Frequency	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412 MHz	-23.21	8	Pass
2437 MHz	-23.75	8	Pass
2462 MHz	-23.18	8	Pass

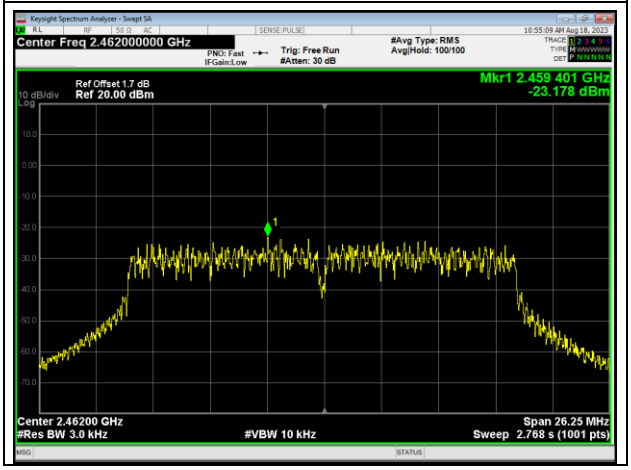
TX CH01



TX CH06



TX CH11



5.6 6dB Bandwidth

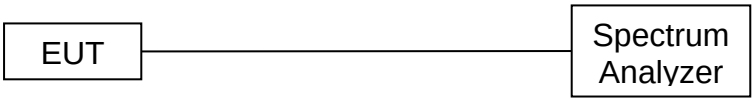
5.6.1 Limit

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
15.247(a)(2)	Bandwidth	>= 500kHz (6dB bandwidth)	2400-2483.5

5.6.2 Test Procedure

1. Set RBW= 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.6.3 Test Setup

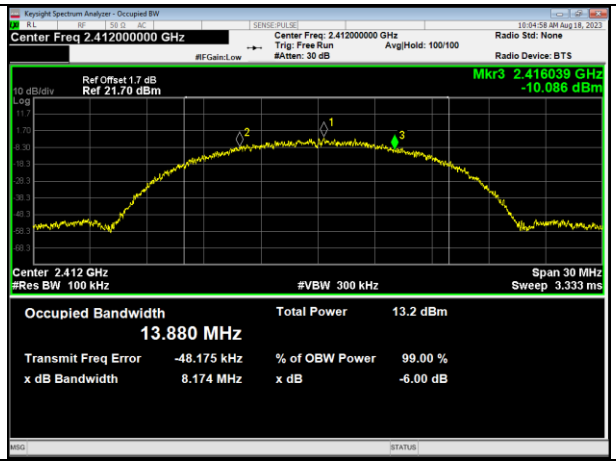
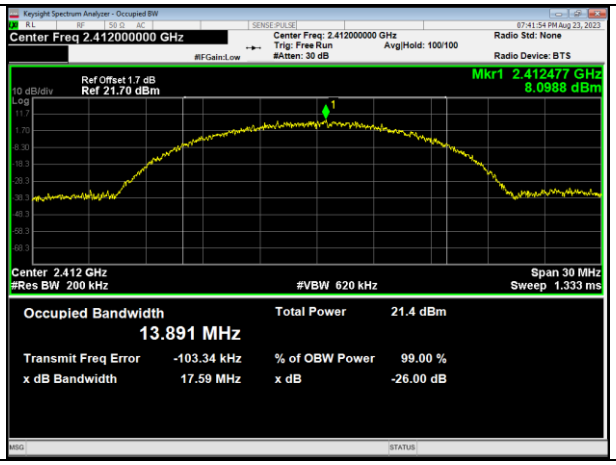
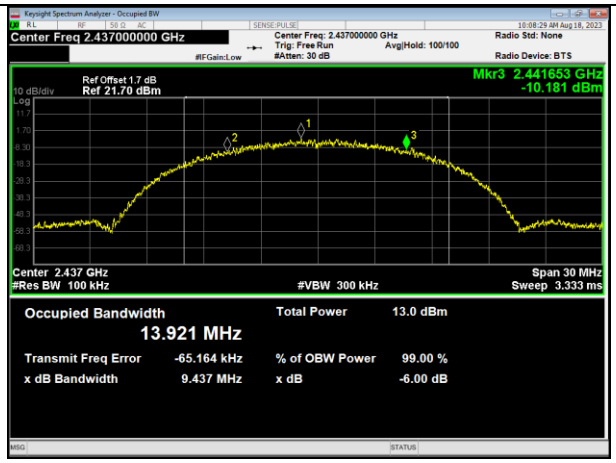
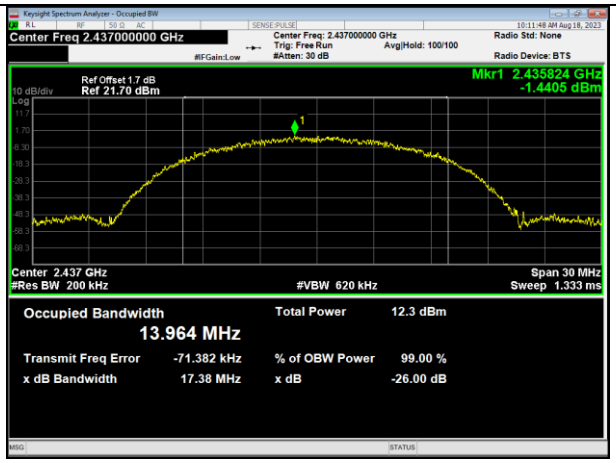


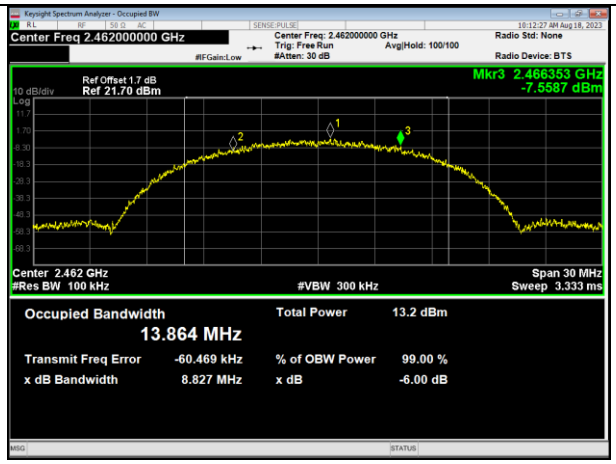
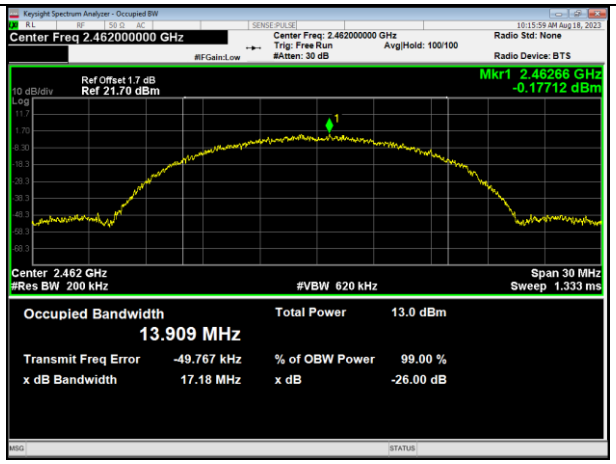
5.6.4 Test Results

EUT:	Smart Plug	Model Name:	MK1
Pressure:	1012 hPa	Test Voltage:	AC 120V/60Hz
Test Mode:	TX b Mode /CH01, CH06, CH11		

Channel	Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	6dB bandwidth Limit (kHz)	Result
Low	2412	8.174	13.891	500	Pass
Middle	2437	9.437	13.964	500	Pass
High	2462	8.827	13.909	500	Pass

Test plots

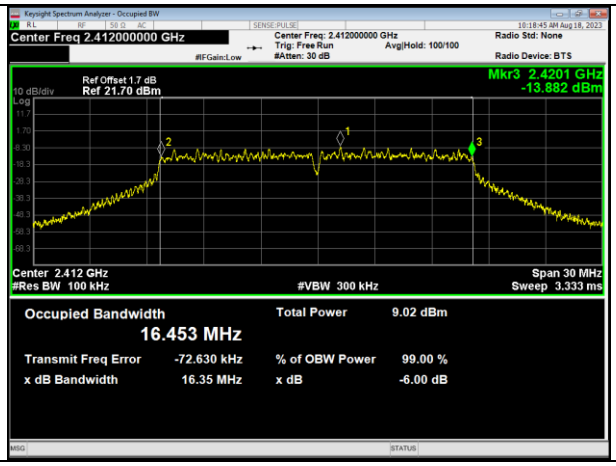
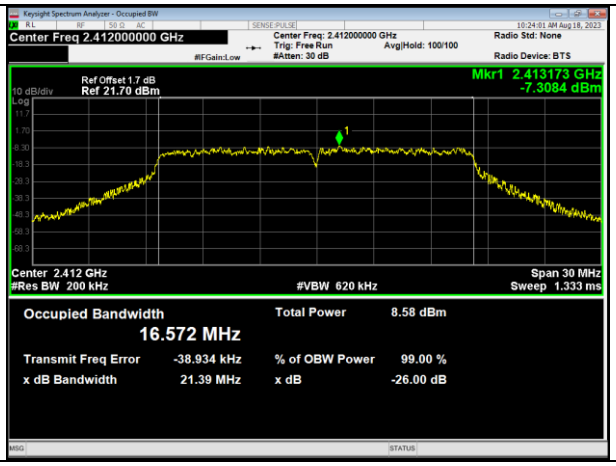
6dB bandwidth	99% bandwidth
TX CH 01	TX CH 01
	
TX CH 06	TX CH 06
	

TX CH 11	TX CH 11
	

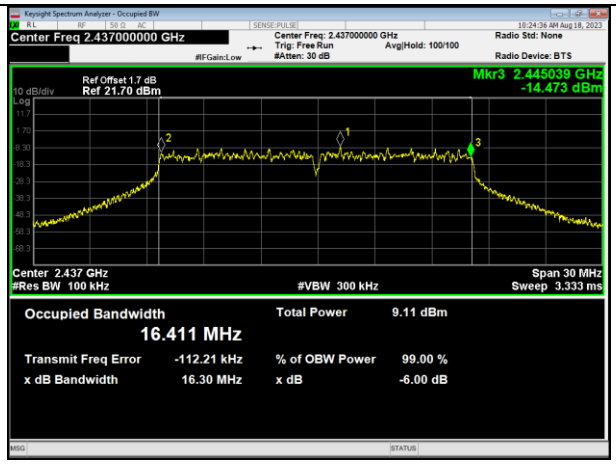
EUT:	Smart Plug	Model Name:	MK1
Pressure:	1012 hPa	Test Voltage:	AC 120V/60Hz
Test Mode:	TX g Mode /CH01, CH06, CH11		

Channel	Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	6dB bandwidth Limit (kHz)	Result
Low	2412	16.35	16.572	500	Pass
Middle	2437	16.30	16.528	500	Pass
High	2462	16.39	16.474	500	Pass

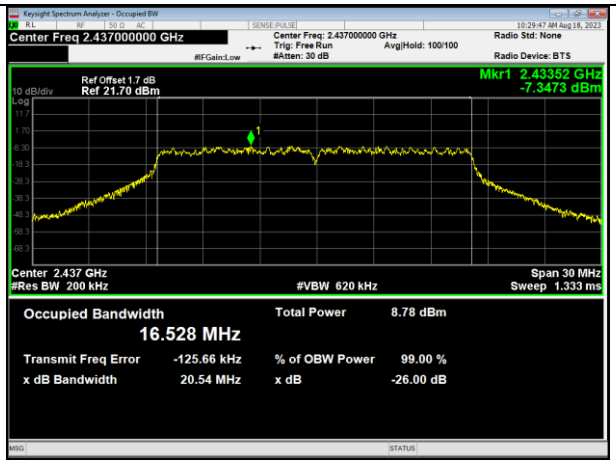
Test plots

6dB bandwidth	99% bandwidth
TX CH 01	TX CH 01
	

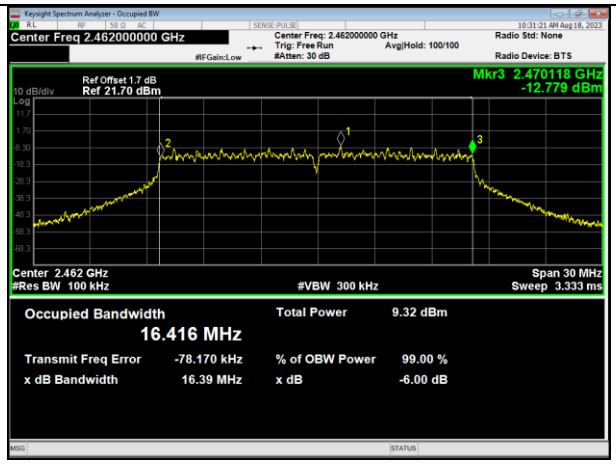
TX CH 06



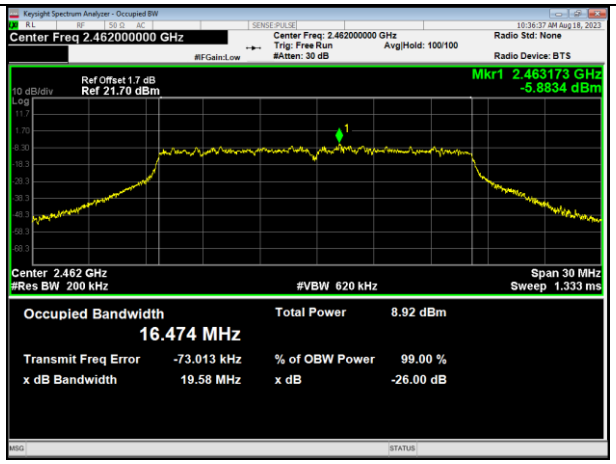
TX CH 06



TX CH 11



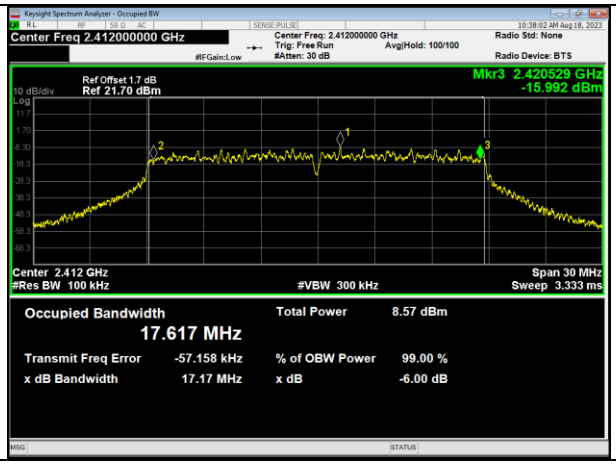
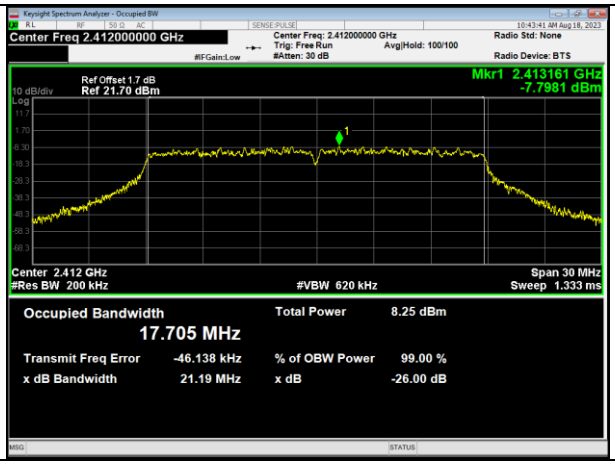
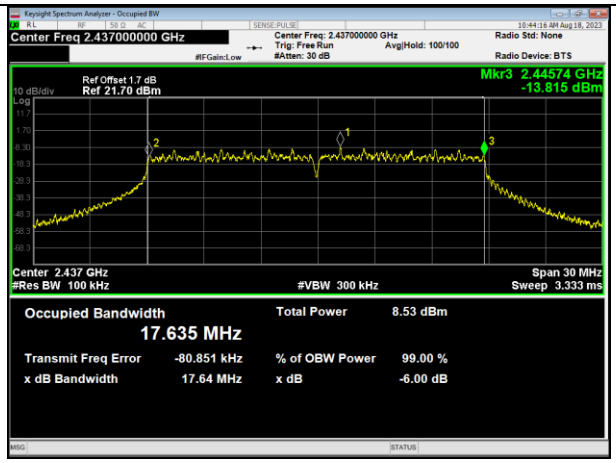
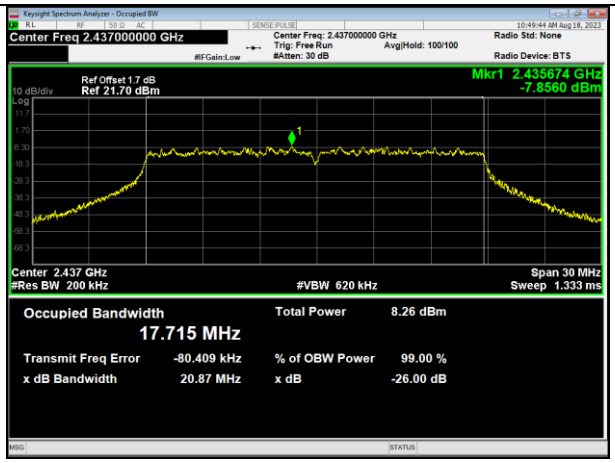
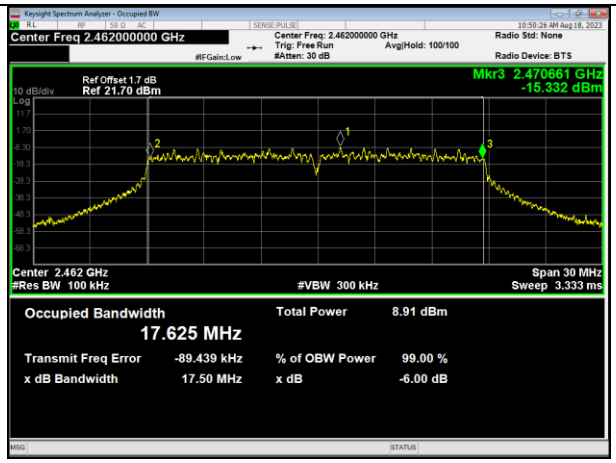
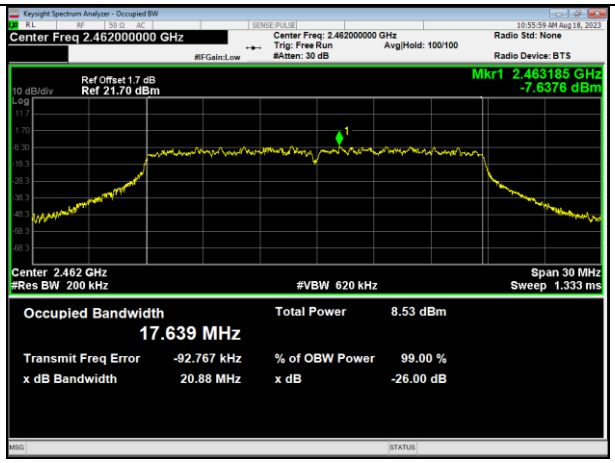
TX CH 11



EUT:	Smart Plug	Model Name:	MK1
Pressure:	1012 hPa	Test Voltage:	AC 120V/60Hz
Test Mode:	TX n20 Mode /CH01, CH06, CH11		

Channel	Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	6dB bandwidth Limit (kHz)	Result
Low	2412	17.17	17.705	500	Pass
Middle	2437	17.64	17.715	500	Pass
High	2462	17.50	17.639	500	Pass

Test plots

6dB bandwidth	99% bandwidth
TX CH 01	TX CH 01
	
TX CH 06	TX CH 06
	
TX CH 11	TX CH 11
	

5.7 Duty Cycle

5.7.1 Limit

No limit requirement.

5.7.2 Test Procedure

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

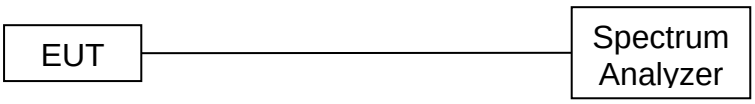
The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, 6.0(b) in KDB 558074 D01 DTS Meas Guidance v05r02.

The largest availble value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/T.

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
Set to the maximum power setting and enable the EUT transmit continuously.
The EUT was operating in controlled its channel.
Use the following spectrum analyzer settings:
Span = Zero Span
RBW = 8MHz (the largest available value)
VBW = 8MHz (≥ RBW)
Number of points in Sweep >100
Detector function = peak
Trace = Clear write
Measure Total and Ton
Calculate Duty Cycle = Ton / Total

5.7.3 Test Setup



5.7.4 Test Results

EUT:	Smart Plug	Model Name:	MK1
Pressure:	1012 hPa	Test Voltage:	AC 120V/60Hz
Test Mode:	TX b/g/n(20) Mode / CH06		

Mode	Data rate	Channel	T_{on}	T_{total}	Duty Cycle	Duty Cycle Factor (dB)	VBW Setting
802.11b	1Mbps	6	-	-	100%	0	8MHz
802.11g	6Mbps	6	-	-	100%	0	8MHz
802.11n HT20	MCS0	6	-	-	100%	0	8MHz

5.8 Conducted Band Edge

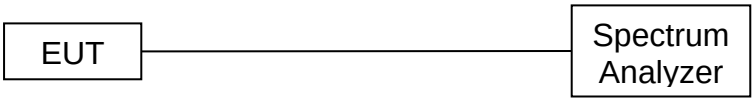
5.8.1 Limit

In any 100 kHz 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 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

5.8.2 Test Procedure

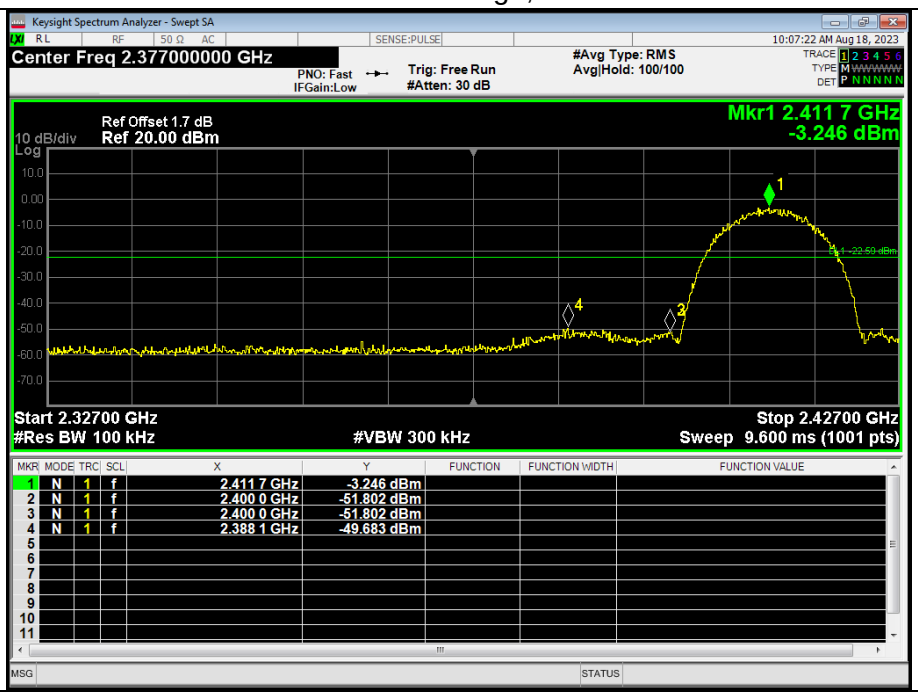
a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
c) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
d) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
e) Repeat above procedures until all measured frequencies were complete.

5.8.3 Test Setup

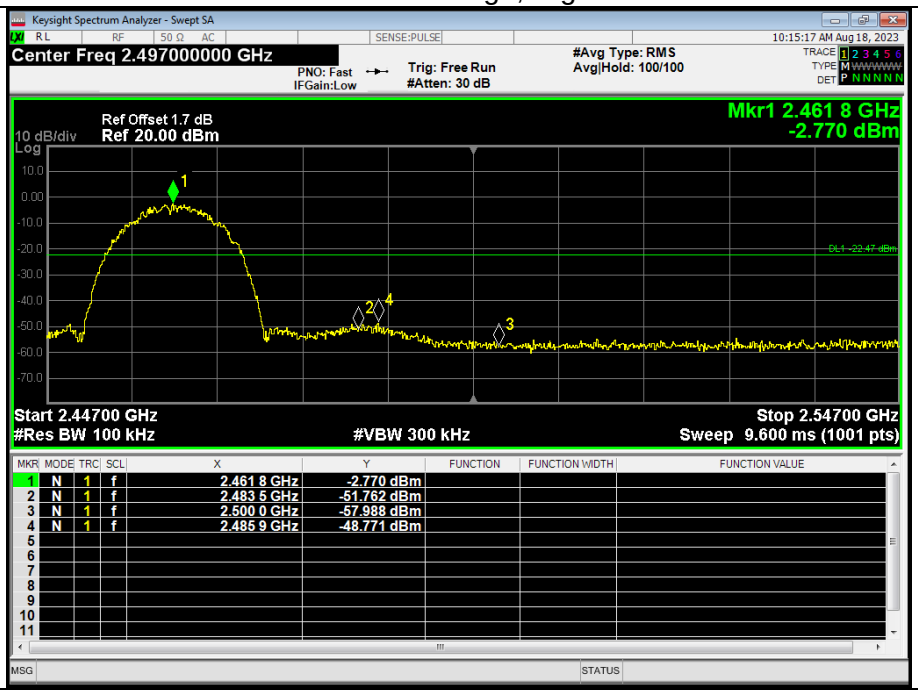


5.8.4 Test Results

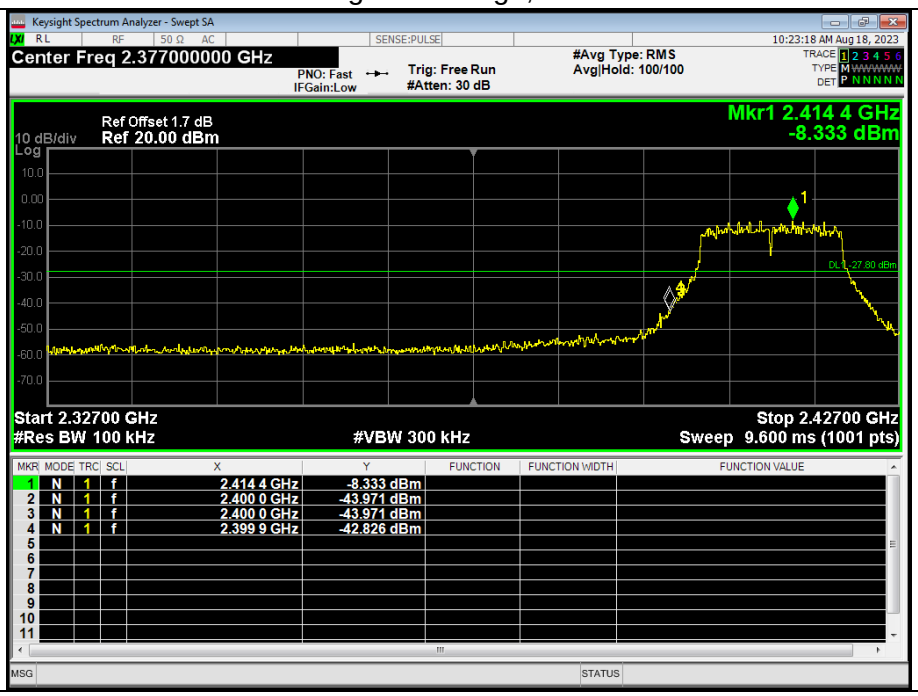
802.11b: Band Edge, Left Side



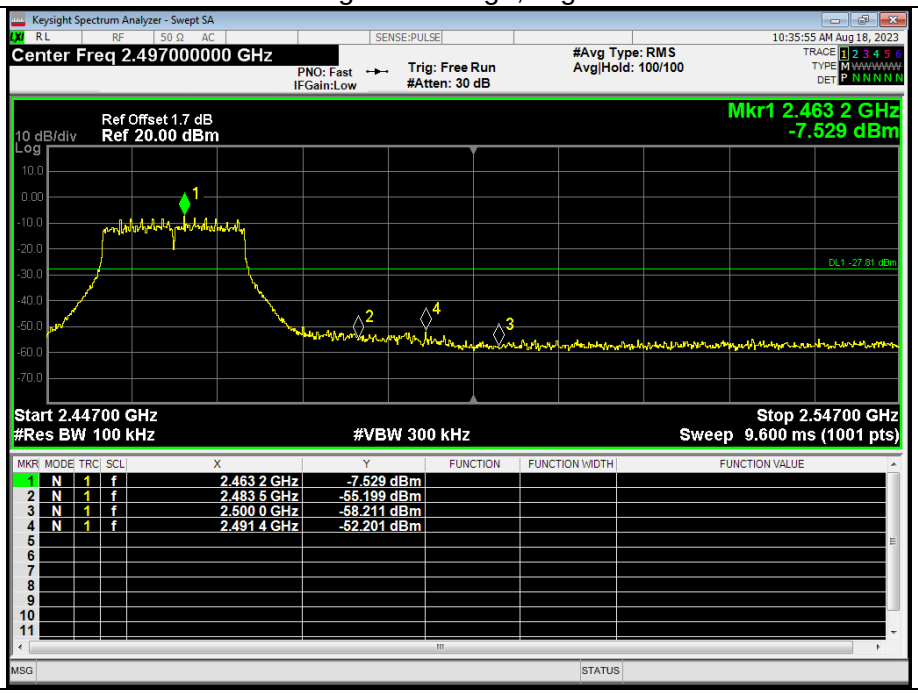
802.11b: Band Edge, Right Side



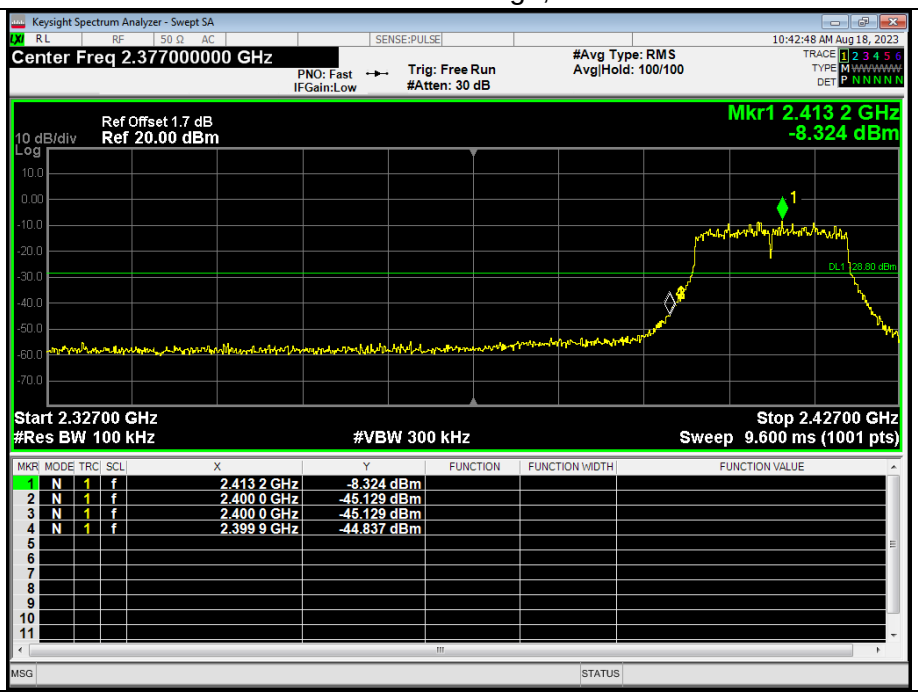
802.11g: Band Edge, Left Side



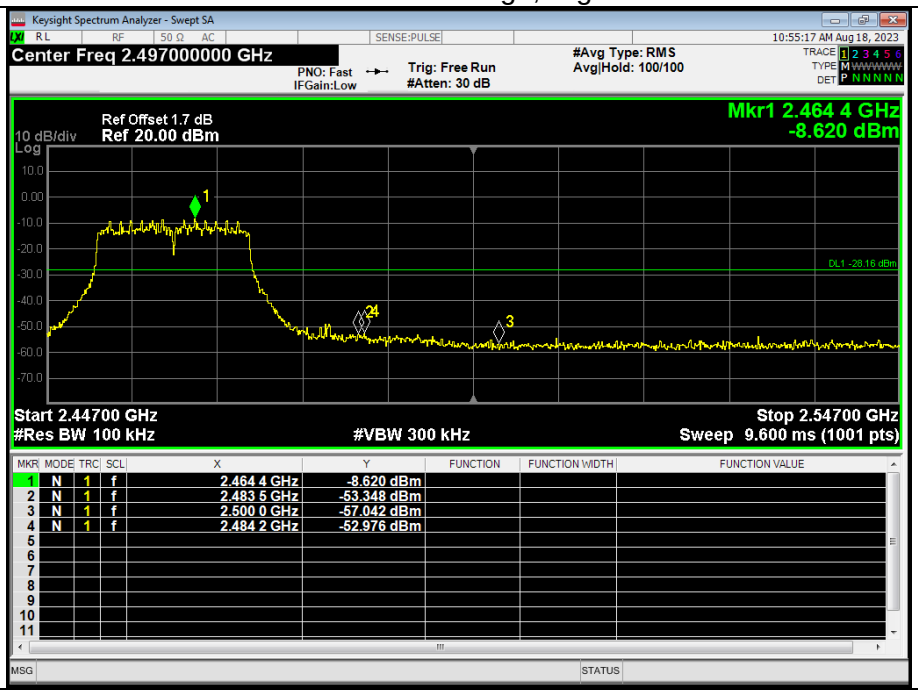
802.11g: Band Edge, Right Side



802.11n20: Band Edge, Left Side



802.11n20: Band Edge, Right Side



5.9 Spurious RF Conducted Emissions

5.9.1 Limit

Below -20dB of the highest emission level in operating band.

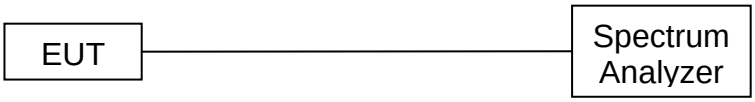
5.9.2 Measuring Instruments

The Measuring equipment is listed in the section 4 of this test report.

5.9.3 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300kHz to measure the peak field strength, and measure frequency range from 9kHz to 26.5GHz.

5.9.4 Test Setup



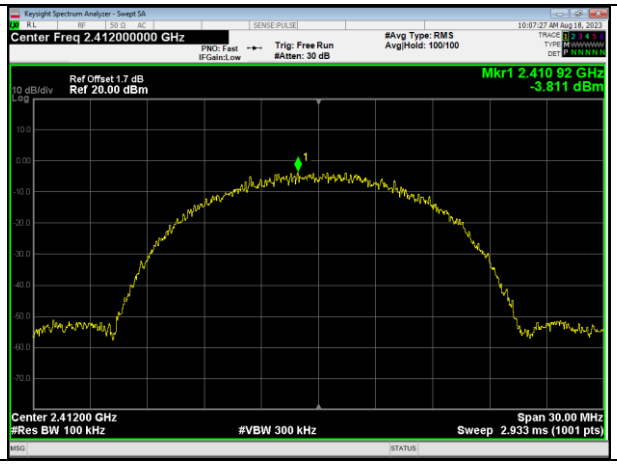
5.9.5 Test Results

Note:

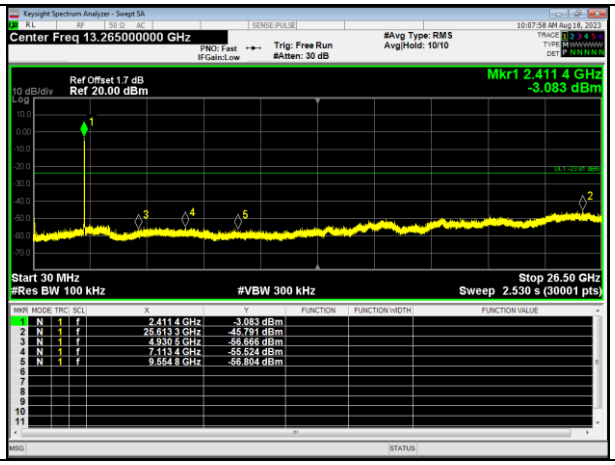
1: The measurement frequency range is from 9kHz to the 10th harmonic of the fundamental frequency; The lowest, middle and highest channels are tested to verify the spurious emissions and band edge measurement data.

2: The three modulated high, medium and low channels have been tested. The report only shows the worst mode. The worst mode is 802.11b CH01/06/11.

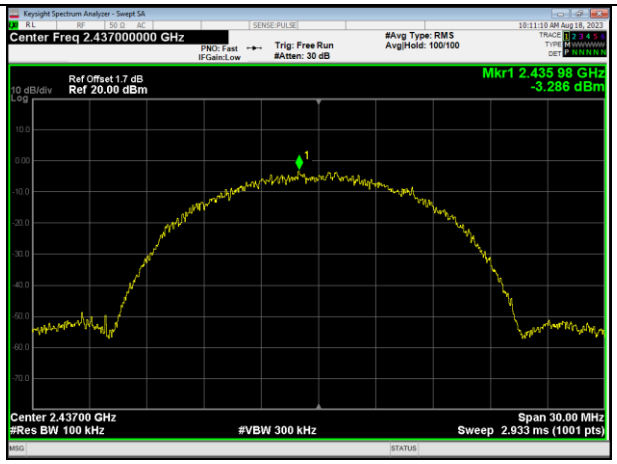
802.11b on Channel 01



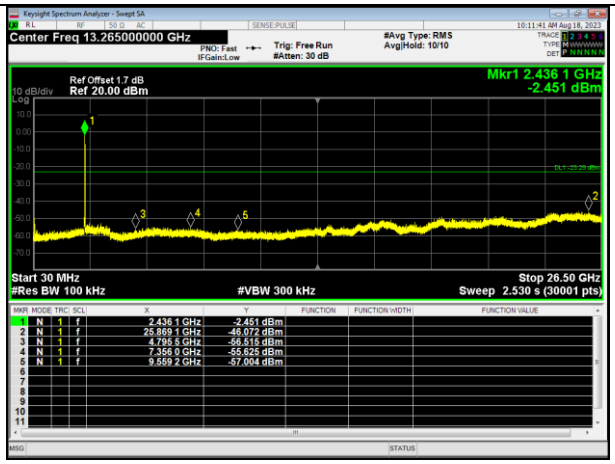
802.11b on Channel 01



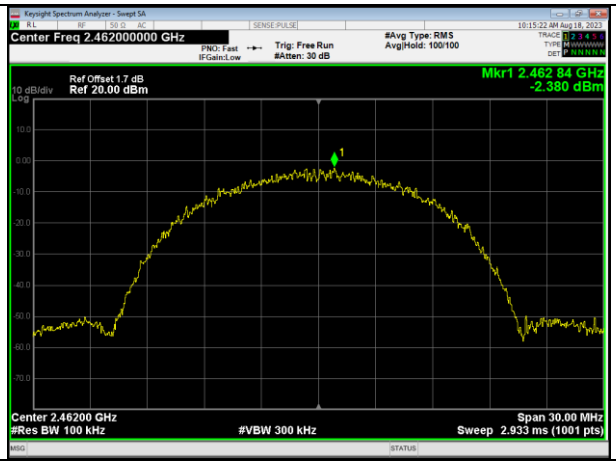
802.11b on Channel 06



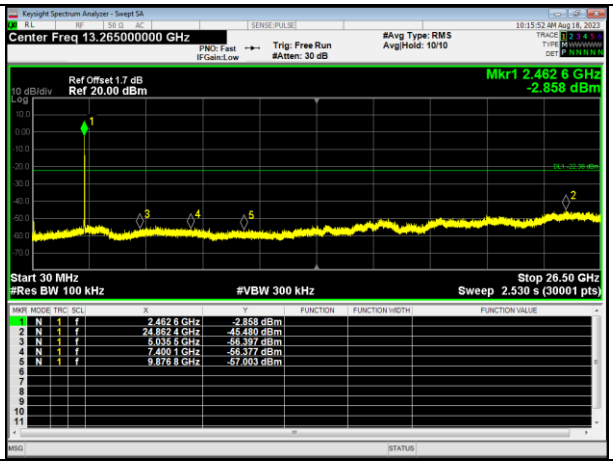
802.11b on Channel 06



802.11b on Channel 11



802.11b on Channel 11



6 Photographs of the Test Setup

Reference to the appendix Test Setup Photos for details.

7 Photographs of the EUT

Reference to the appendix External Photos and Internal Photos for details.

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