



FCC Test Report

Report No.: BUMK-ESH-P20111018B-1

FCC ID: 2AWXZTY-R8824

Product: Smart Camera

Model: SC103-WO2

Received Date: Nov.13, 2020

Test Date: Nov.18, 2020 to Jan.8, 2021

Issued Date: Jan.11, 2021

Applicant: Zhejiang Tuya Smart Electronics Co., Ltd

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Issued By: BUREAU VERITAS ADT (Shanghai) Corporation

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Release Control Record

Issue No.	Description	Date Issued
BUMK-ESH-P20111018B-1	Original release	Jan.11, 2021



1 Certificate of Conformity

Product: Smart Camera

Brand: --

Model: SC103-WO2

Applicant: Zhejiang Tuya Smart Electronics Co., Ltd

Test Date: Nov.18, 2020 to Jan.11, 2021

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by :

Scott XU

, Date:

Jan. 11, 2021

Scott XU
Project Engineer

Approved by :



, Date:

Jan. 11, 2021

Daniel SUN
EMC Lab Manager



2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.203	Antenna Requirement	PASS	No antenna connector is used.
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.247(a)(2)	Minimum 6dB Bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output Power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.247(d)	Conducted Band Edges Measurement	PASS	Meet the requirement of limit.
15.247(d)	Conducted Spurious Emissions	PASS	Meet the requirement of limit.
15.247(d)	Emissions in restricted frequency bands	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions Measurement	PASS	Meet the requirement of limit.

2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid Antenna(25MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1012	Jul.29, 20	Jul.28, 22
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Aug.25, 20	Aug.24, 22
Double Ridge Horn Antenna(18G-40G)	COM-POWER	AH-840	E1A1040	Jul.15, 20	Jul.14, 22
Pre-Amplifier(100kHz-1.3GHz)	Agilent	8447D	E1A2001	Apr.20, 20	Apr.19, 21
Pre-Amplifier(0.5GHz-18GHz)	EMCI	EMC184045SE	E1A2009	Jul.06, 20	Jul.05, 21
Pre-Amplifier(18GHz-40GHz)	EMCI	EMC051845SE	E1A2008	Jul.06, 20	Jul.05, 21
EMI test receiver	R&S	ESR7	E1R1005	Apr.20, 20	Apr.19, 21
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jul.23, 20	Jul.22, 21
Spectrum Analyzer	Keysight	N9020A	E1S1004	Mar.03, 20	Mar.02, 21
EMI test receiver	R&S	ESCS30	E1R1001	May.12, 20	May.11, 21
LISN	R&S	ENV216	E1L1011	May.12, 20	May.11, 21
Humidity&Temp Tester	Baolima	WS508	E1H1011	Apr. 03, 20	Apr. 02, 21
RF Control Unit	Toscend	JS0806-2	E1C5003	N/A	N/A
Test Software	ADT	ADT_COND_V7 .3.1	N/A	N/A	N/A
Test Software	Toscend	JS32-RE	N/A	N/A	N/A
Test Software	Toscend	JS1120	N/A	N/A	N/A
Test Software	Toscend	JS1120-3	N/A	N/A	N/A

2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Measurement	Frequency	Expanded Uncertainty ($k=2$) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Smart Camera
Brand	--
Test Model	SC103-WO2
Model Difference	--
Power Rating	5VDC/1A with adaptor 100-240V~,50/60Hz
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Operating Frequency	See clause 3.2
Number of Channel	See clause 3.2
Antenna Type	Ceramic Antenna
Antenna Connector	--
Antenna Gain	3dBi

Note: For more details, please refer to the User's manual of the EUT.

Modulation Mode	TX /RX Function
802.11b	1TX / 1RX
802.11g	1TX / 1RX
802.11n (HT20)	1TX / 1RX

3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20).

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz	-	-

3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to				Description
	RE ≥ 1G	RE < 1G	PLC	APCM	
-	√	√	√	√	-

Where **RE≥1G**: Radiated Emission above 1GHz **RE≤1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **APCM**: Antenna Port Conducted Measurement

Radiated Emission Test (Above 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5

Radiated Emission Test (Below 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Power Line Conducted Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1	DSSS	DBPSK	1.0

Antenna Port Conducted Measurement

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5

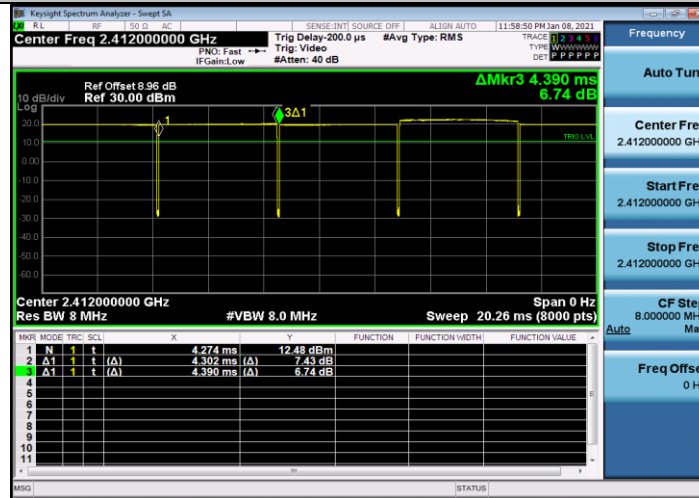
3.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE ≥ 1G	25deg. C, 60%RH	120Vac, 60Hz
RE < 1G	25deg. C, 60%RH	120Vac, 60Hz
PLC	25deg. C, 60%RH	120Vac, 60Hz
APCM	25deg. C, 60%RH	120Vac, 60Hz

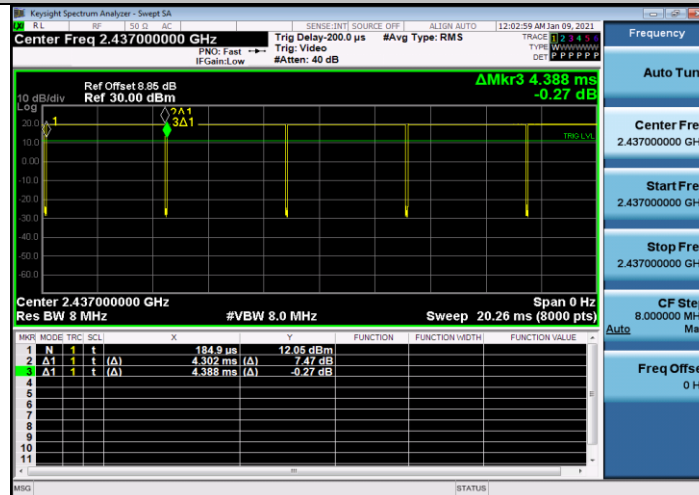
3.3 Duty Cycle of Test Signal

Test Mode	Antenna	Channel [MHz]	Duty Cycle [%]	10log(1/x) Factor[dB]
11B	Ant1	2412	97.95	0.09
		2437	97.95	0.09
		2462	97.95	0.09
11G	Ant1	2412	88.75	0.52
		2437	88.75	0.52
		2462	89.87	0.46
11N20SISO	Ant1	2412	94.37	0.25
		2437	94.37	0.25
		2462	94.37	0.25

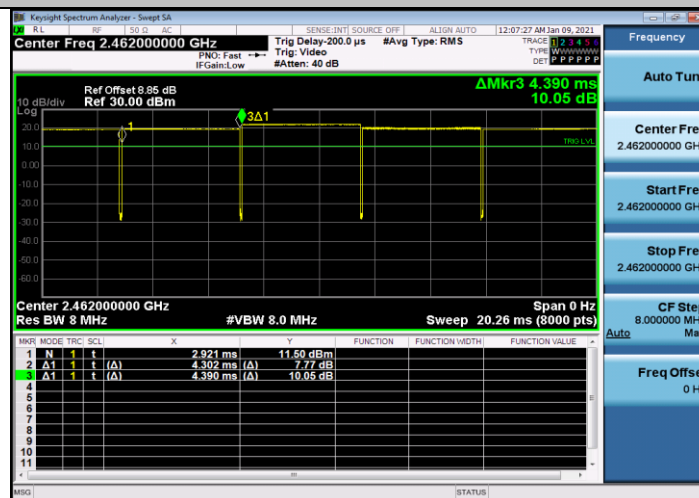
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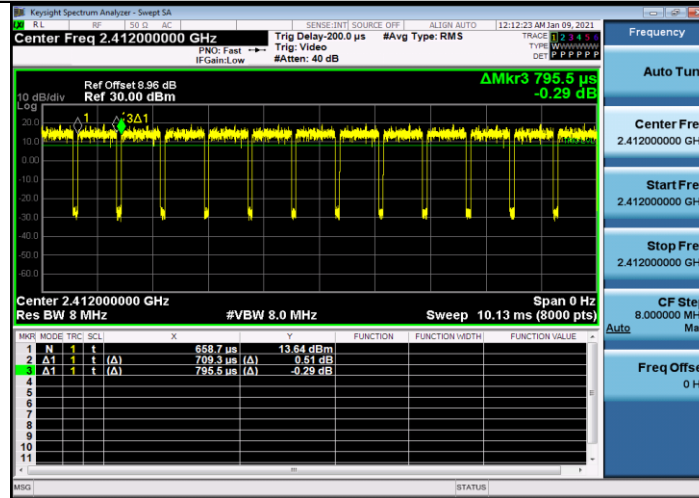
11B_Ant1_2437



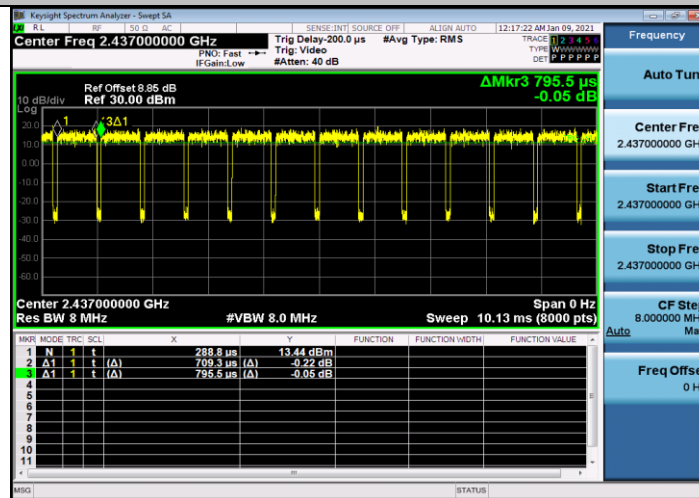
11B_Ant1_2462



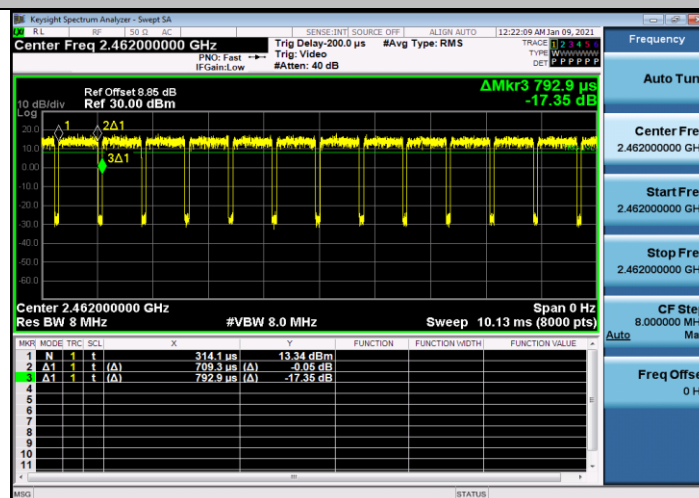
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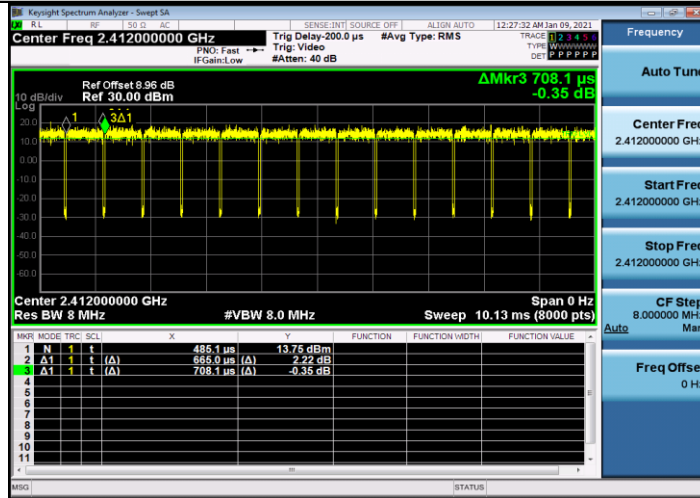
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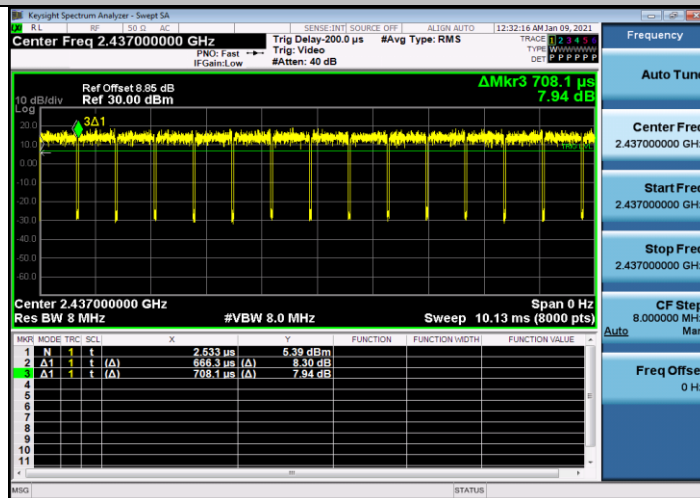
11G_Ant1_2462



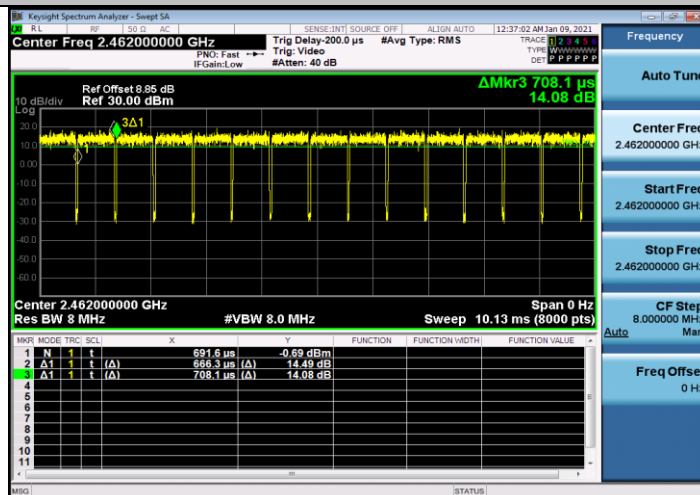
11N20SISO_Ant1_2412



11N20SISO_Ant1_2437



11N20SISO_Ant1_2462





3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.5 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

FCC Part 15, Subpart C (15.247)

KDB 558074 D01 DTS Meas Guidance v05r02

ANSI C63.10:2013

All relaxed test items have been performed and recorded as per the above standard.

4 Test Procedure and Results

4.1 AC Power Conducted Emission

4.1.1 Limits

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.1.2 Test Procedures

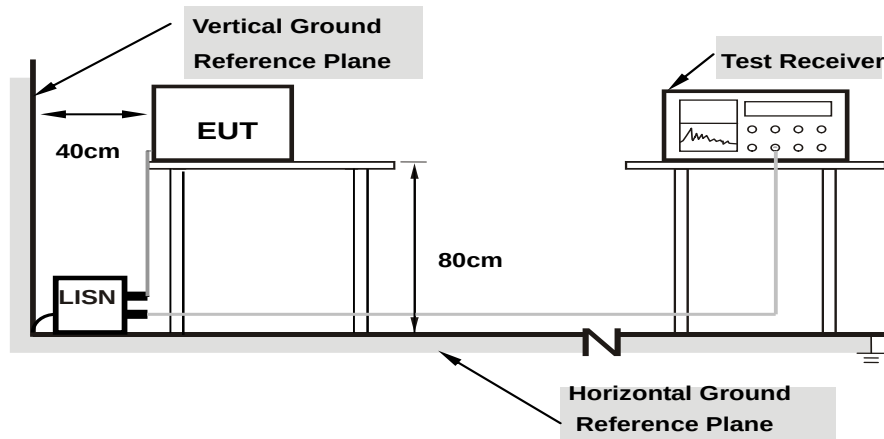
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.1.3 Deviation from Test Standard

No deviation.

4.1.4 Test Setup



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

For the actual test configuration, please refer to the attached file (Test Setup Photo).

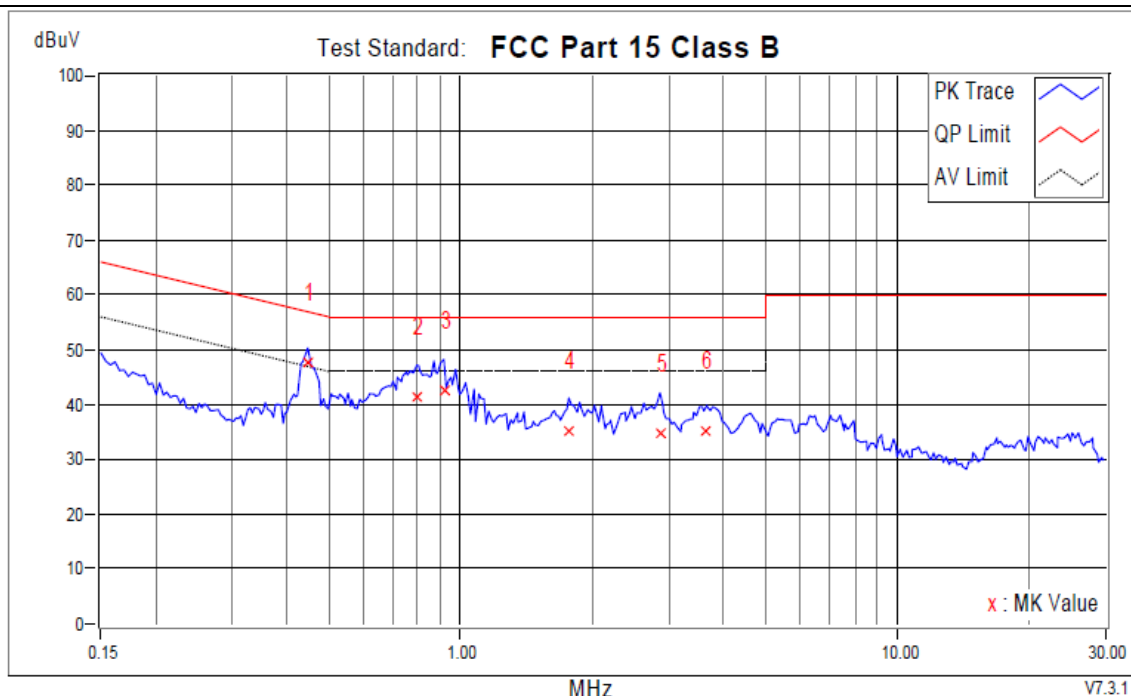
4.1.5 EUT Operating Conditions

Same as 4.1.6.

4.1.6 Test Results

Working While Charging

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 120V, 60Hz		

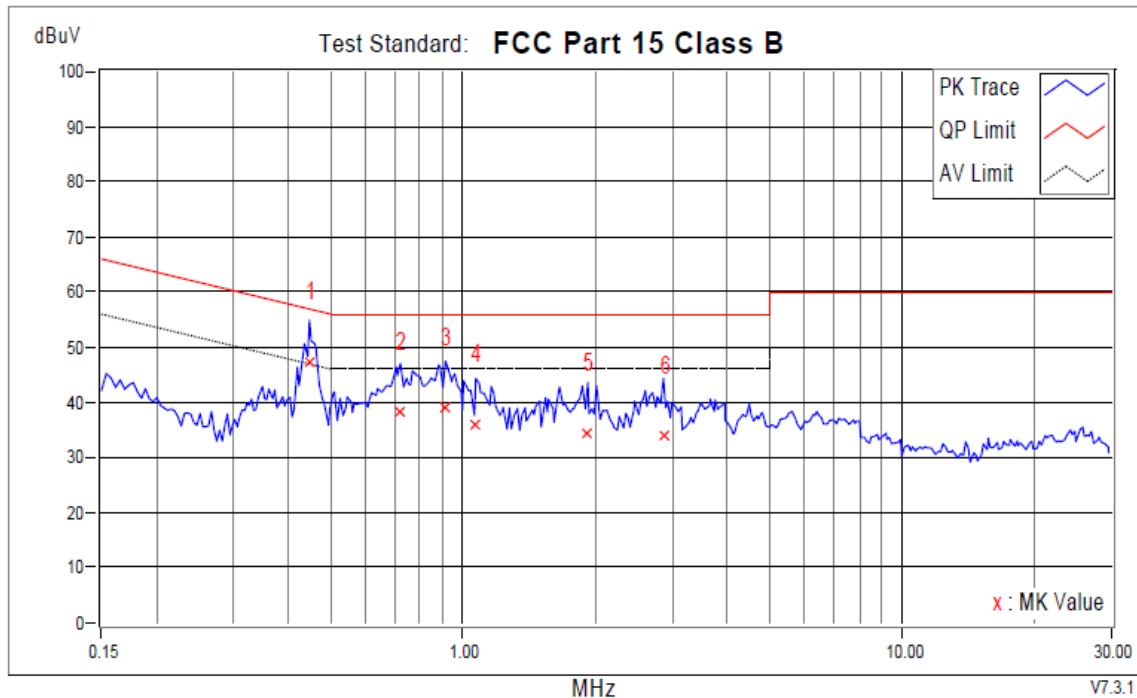


MHz											V7.3.1
No.	Frequency MHz	Corr. Factor dB	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
			QP	AV	QP	AV	QP	AV	QP	AV	
+1	0.44716	9.73	37.74	24.56	47.47	34.29	56.93	46.93	-9.45	-12.63	
2	0.79515	9.60	31.87	17.52	41.47	27.12	56.00	46.00	-14.53	-18.88	
3	0.91636	9.61	32.87	16.12	42.48	25.73	56.00	46.00	-13.52	-20.27	
4	1.77027	9.73	25.56	12.62	35.29	22.35	56.00	46.00	-20.71	-23.65	
5	2.86507	9.80	24.81	11.90	34.61	21.70	56.00	46.00	-21.39	-24.30	
6	3.66271	9.82	25.28	13.19	35.10	23.01	56.00	46.00	-20.90	-22.99	

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 120V, 60Hz		

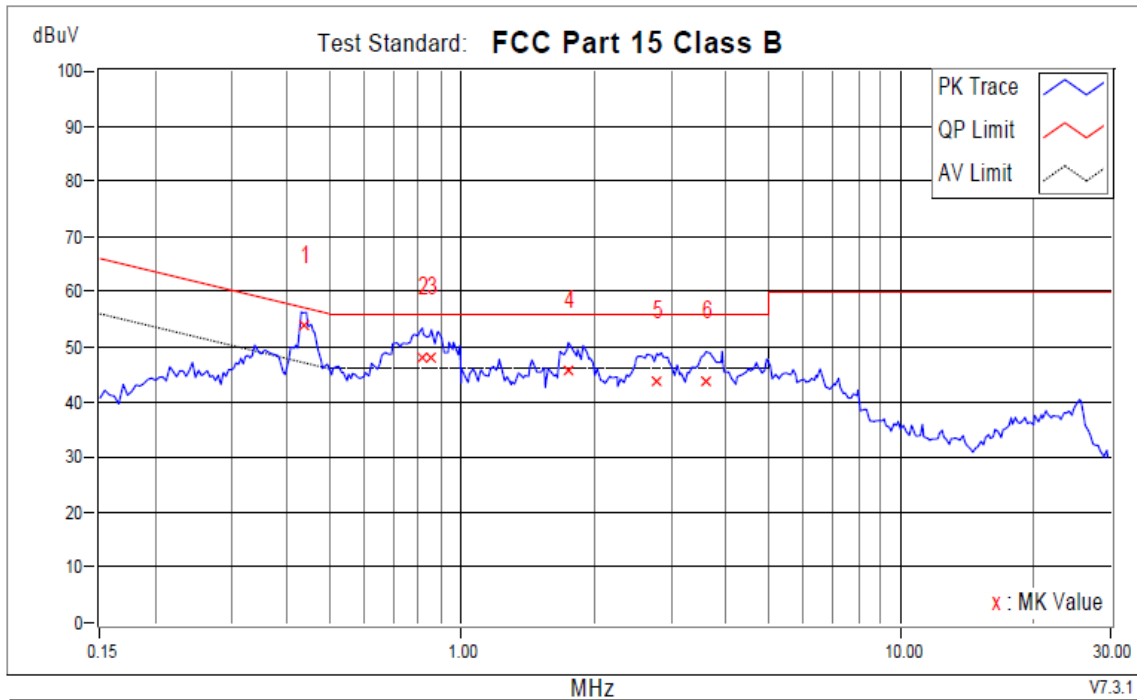


No.	Frequency MHz	Corr. Factor dB	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
			QP	AV	QP	AV	QP	AV	QP	AV	
+1	0.44716	9.87	37.31	25.90	47.18	35.77	56.93	46.93	-9.75	-11.16	
2	0.72086	9.84	28.43	19.88	38.27	29.72	56.00	46.00	-17.73	-16.28	
3	0.91245	9.91	29.34	19.92	39.25	29.83	56.00	46.00	-16.75	-16.17	
4	1.07038	9.91	26.05	16.77	35.96	26.68	56.00	46.00	-20.04	-19.32	
5	1.92667	9.93	24.48	14.53	34.41	24.46	56.00	46.00	-21.59	-21.54	
6	2.86507	9.96	24.11	14.29	34.07	24.25	56.00	46.00	-21.93	-21.75	

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 240V, 50Hz		

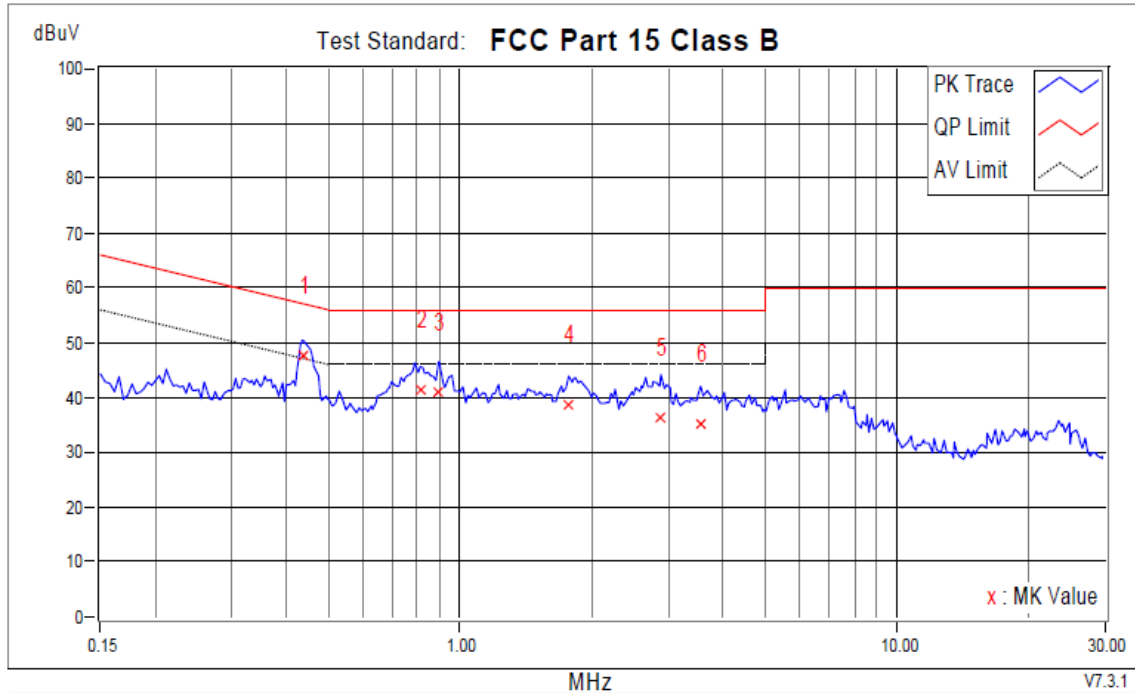


No.	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	
+1	0.43543	9.73	44.05	33.36	53.78	43.09	57.15	47.15	-3.36	-4.05	
2	0.81470	9.60	38.47	28.29	48.07	37.89	56.00	46.00	-7.93	-8.11	
3	0.85380	9.60	38.53	26.55	48.13	36.15	56.00	46.00	-7.87	-9.85	
4	1.75072	9.73	36.03	20.55	45.76	30.28	56.00	46.00	-10.24	-15.72	
5	2.78687	9.79	34.08	23.04	43.87	32.83	56.00	46.00	-12.13	-13.17	
6	3.60406	9.82	33.96	21.32	43.78	31.14	56.00	46.00	-12.22	-14.86	

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 240V, 50Hz		



No.	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	
+1	0.43543	9.87	37.93	26.90	47.80	36.77	57.15	47.15	-9.35	-10.38	
2	0.81079	9.90	31.44	20.23	41.34	30.13	56.00	46.00	-14.66	-15.87	
3	0.89290	9.90	31.16	16.19	41.06	26.09	56.00	46.00	-14.94	-19.91	
4	1.77418	9.93	28.63	14.16	38.56	24.09	56.00	46.00	-17.44	-21.91	
5	2.88462	9.97	26.51	14.61	36.48	24.58	56.00	46.00	-19.52	-21.42	
6	3.56105	9.84	25.47	16.02	35.31	25.86	56.00	46.00	-20.69	-20.14	

REMARKS:

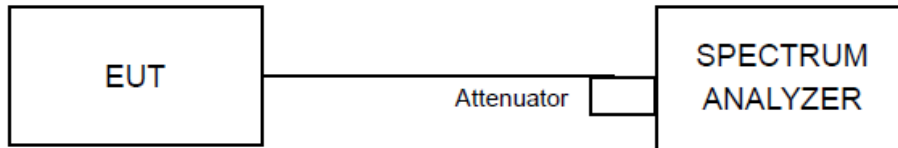
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

4.2 Minimum 6dB Bandwidth

4.2.1 Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500 kHz

4.2.2 Test Setup



4.2.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 8.2).

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 $\geq$ 3 RBW, peak detector with maximum hold) is implemented by the instrumentation function.

4.2.4 Deviation of Test Standard

No deviation.

4.2.5 Test Results

Test Mode	Antenna	Channel [MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	9.640	2406.960	2416.600	≥ 0.5	PASS
		2437	9.160	2432.440	2441.600	≥ 0.5	PASS
		2462	9.160	2457.440	2466.600	≥ 0.5	PASS
11G	Ant1	2412	16.160	2403.840	2420.000	≥ 0.5	PASS
		2437	16.440	2428.800	2445.240	≥ 0.5	PASS
		2462	16.400	2453.800	2470.200	≥ 0.5	PASS
11N20SISO	Ant1	2412	17.080	2403.400	2420.480	≥ 0.5	PASS
		2437	16.840	2428.600	2445.440	≥ 0.5	PASS
		2462	17.400	2453.200	2470.600	≥ 0.5	PASS

11B_Ant1_2412



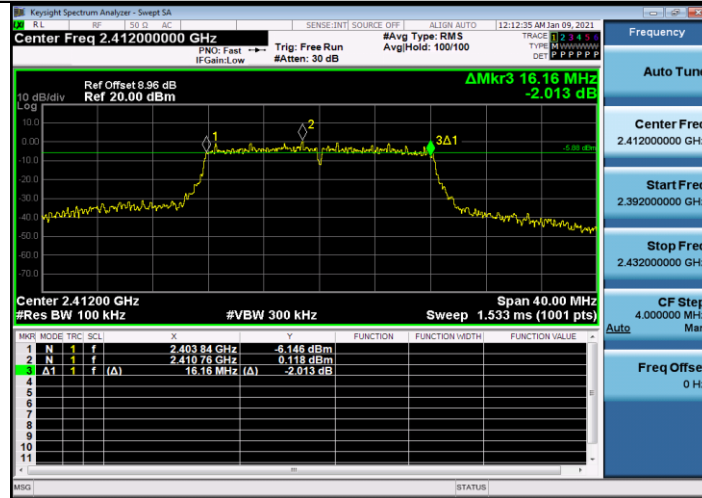
11B_Ant1_2437



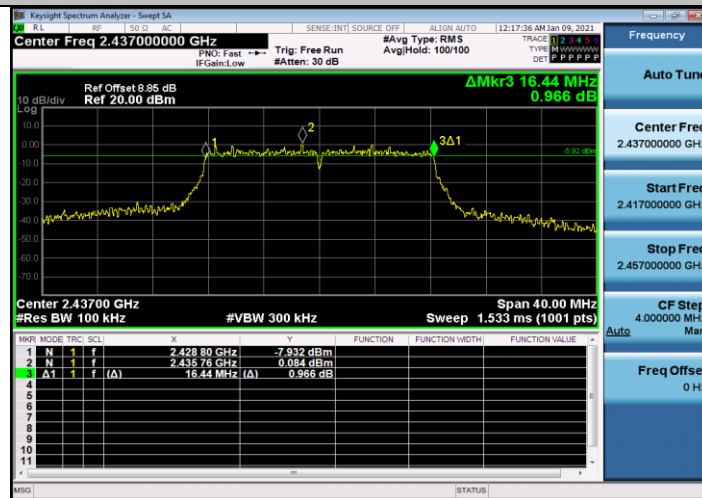
11B_Ant1_2462



11G_Ant1_2412



11G_Ant1_2437



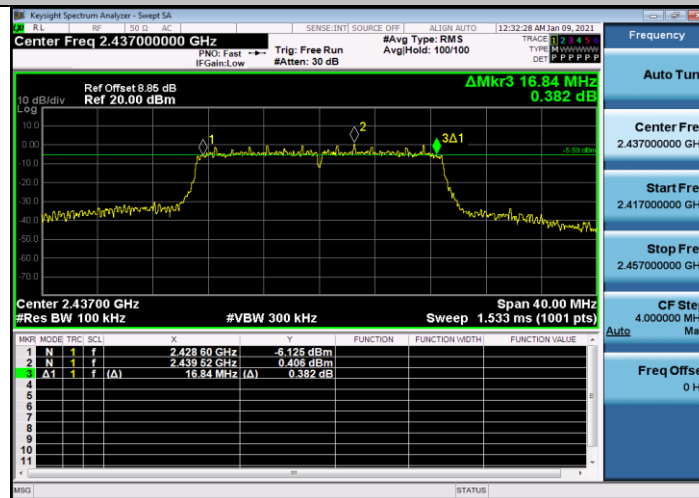
11G_Ant1_2462



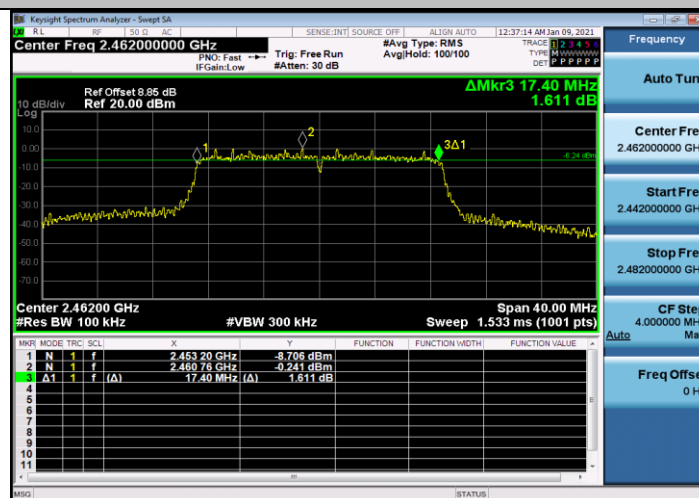
11N20SISO_Ant1_2412



11N20SISO_Ant1_2437



11N20SISO_Ant1_2462

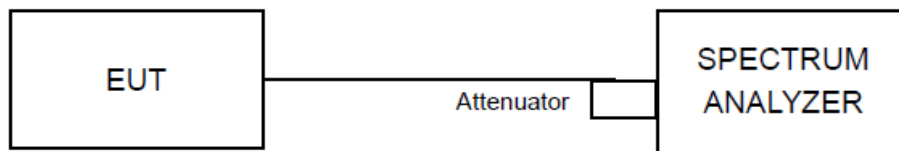


4.3 Conducted Output Power

4.3.1 Limit

For systems using digital modulation in the 2400 – 2483.5 MHz bands: 1 Watt (30 dBm)

4.3.2 Test Setup



4.3.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” for compliance to FCC 47CFR 15.247 requirements (clause 9.2.2.4).

- a) Measure the duty cycle, x , of the transmitter output signal as described in Section 6.0.
- b) Set span to at least 1.5 OBW.
- c) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz.
- d) Set VBW $\geq$ 3 RBW.
- e) Number of points in sweep $\geq$ 2 span / RBW. (This gives bin-to-bin spacing $\leq$ RBW/2, so that narrowband signals are not lost between frequency bins.)
- f) Sweep time = auto.
- g) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- h) Do not use sweep triggering. Allow the sweep to “free run”.
- i) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.
- j) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- k) Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on- and off-times of the transmission). For example, add $10 \log (1/0.25) = 6$ dB if the duty cycle is 25 %.

4.3.4 Deviation of Test Standard

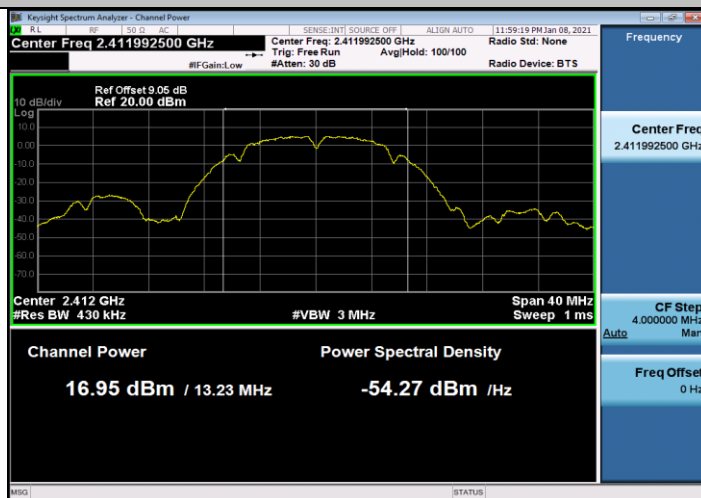
No deviation.

4.3.5 Test Results

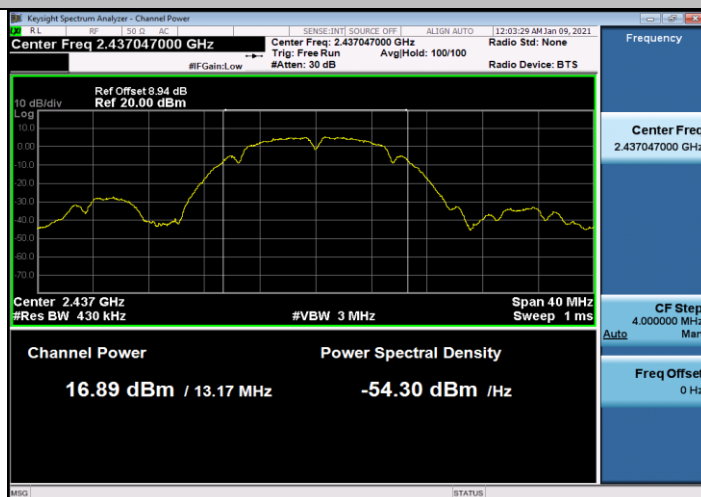
Test Mode	Antenna	Channel [MHz]	Level [dBm]	10log(1/x) Factor[dB]	Power [dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	16.95	0.09	17.04	<=30	PASS
		2437	16.89	0.09	16.98	<=30	PASS
		2462	16.62	0.09	16.71	<=30	PASS
11G	Ant1	2412	11.70	0.52	12.22	<=30	PASS
		2437	11.96	0.52	12.48	<=30	PASS
		2462	11.54	0.46	12	<=30	PASS
11N20SISO	Ant1	2412	12.02	0.25	12.27	<=30	PASS
		2437	11.67	0.25	11.92	<=30	PASS
		2462	11.55	0.25	11.8	<=30	PASS



11B_Ant1_2412



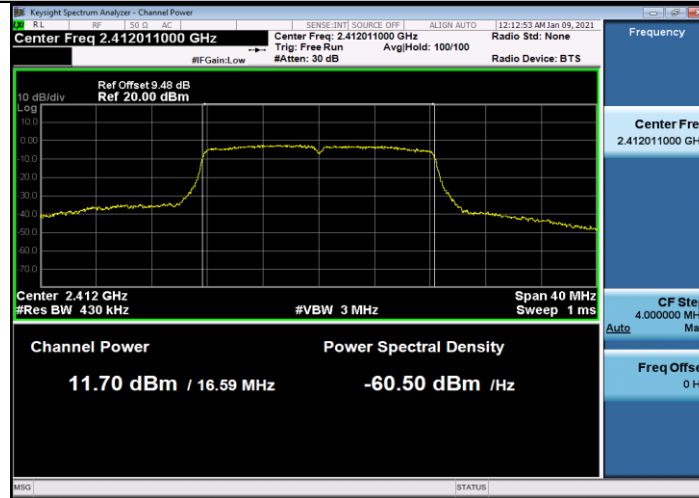
11B_Ant1_2437



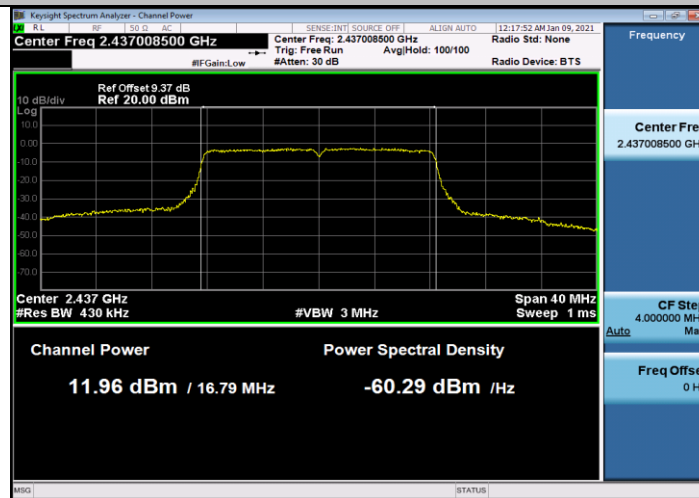
11B_Ant1_2462



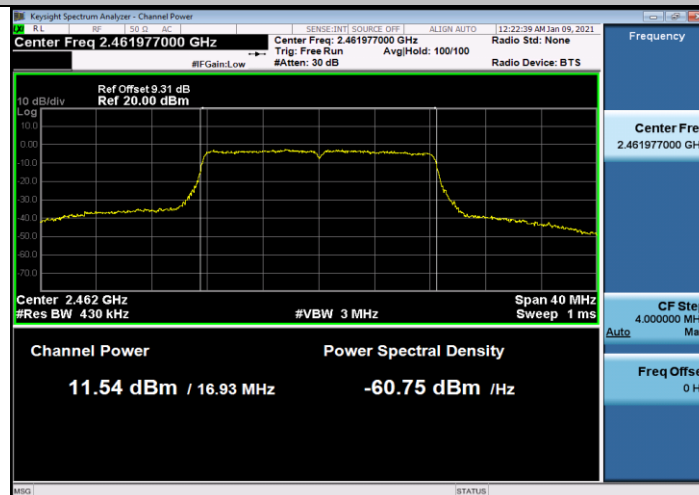
11G_Ant1_2412



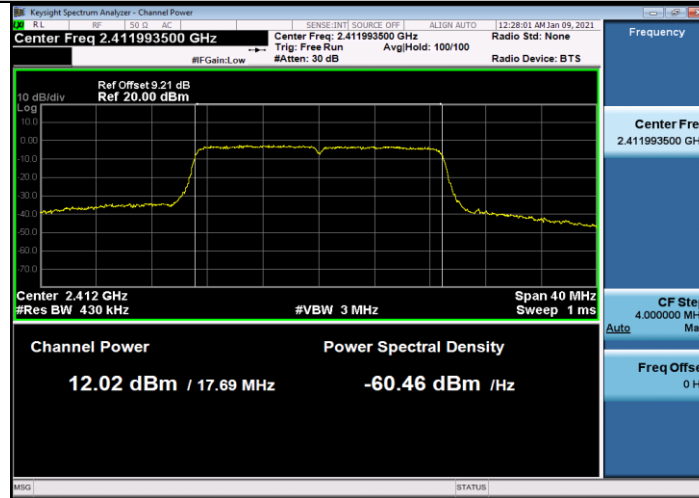
11G_Ant1_2437



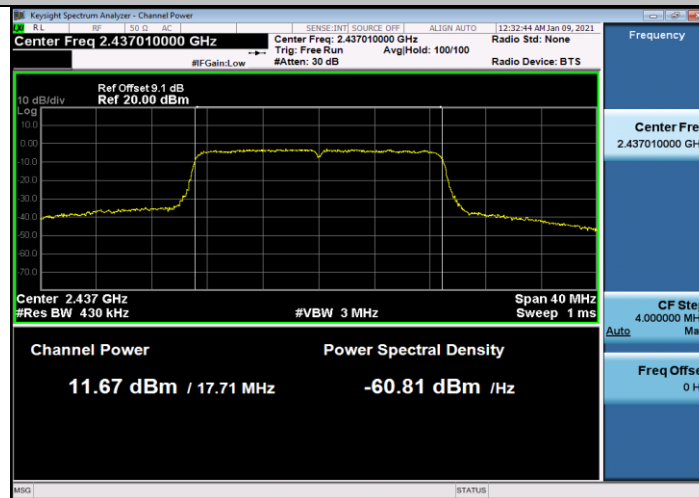
11G_Ant1_2462



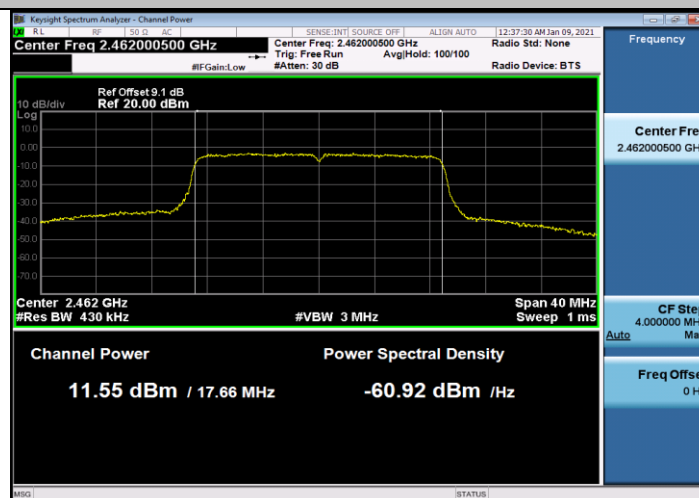
11N20SISO_Ant1_2412



11N20SISO_Ant1_2437



11N20SISO_Ant1_2462

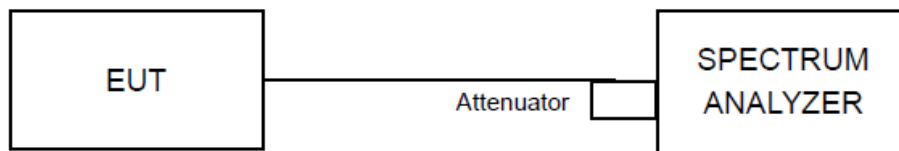


4.4 Power Spectral Density

4.4.1 Limit

The Maximum of Power Spectral Density Measurement is 8 dBm in any 3 kHz band.

4.4.2 Test Setup



4.4.3 Test Procedures

The power output per FCC § 15.247(e) was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 10.5) for compliance to FCC 47CFR 15.247 requirements.

- Measure the duty cycle (x) of the transmitter output signal.
- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 OBW.
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set VBW $\geq 3 \text{ RBW}$.
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep $\geq 2 \text{ span/RBW}$.
- Sweep time = auto couple.
- Do not use sweep triggering. Allow sweep to “free run”.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.
- Add $10 \log (1/x)$, where x is the duty cycle measured in step (a), to the measured PSD to compute the average PSD during the actual transmission time.
- If resultant value exceeds the limit, then reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

4.4.4 Deviation of Test Standard

No deviation.