FCC Test Report

Report No.:	ARFR-ESH-P22080199B-1
FCC ID:	2A789SC009
Product:	Smart Camera
Model:	main test model: SC009-WL2 Series model: SC009-WL2A、SC009-WL2B、SC009-WL2C；SC009-WL1、SC009-WL1A、SC009-WL1B、SC009-WL1C； SC009-WL3、SC009-WL3A、SC009-WL3B、SC009-WL3C
Received Date:	Aug.3, 2022
Test Date:	Aug.3 to Aug.23, 2022
Issued Date:	Aug.23, 2022
Applicant:	Ningbo Lingzhu Technology CO., Ltd.
Address:	No.578,Building 7,No.535 Kangqiao South Road,Jiangbei District,Ningbo,PRC
Manufacturer:	Ningbo Lingzhu Technology CO., Ltd.
Address:	No.578,Building 7,No.535 Kangqiao South Road,Jiangbei District,Ningbo,PRC
Issued By:	BUREAU VERITAS ADT (Shanghai) Corporation
Lab Address:	No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)
FCC Registration / Designation Number:	176467/ CN1213

Test Lab
Cert 2343.01

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Release Control Record

Issue No.	Description	Date Issued
ARFR-ESH-P22080199B-1	Original release	Aug.23, 2022

1 Certificate of Conformity

Product:	Smart Camera
Brand:	--
Model:	main test model: SC009-WL2 Series model: SC009-WL2A、SC009-WL2B、SC009-WL2C; SC009-WL1、SC009-WL1A、SC009-WL1B、SC009-WL1C; SC009-WL3、SC009-WL3A、SC009-WL3B、SC009-WL3C
Applicant:	Ningbo Lingzhu Technology CO., Ltd.
Test Date:	Aug.3 to Aug.10, 2022
Standards:	**47 CFR FCC Part 15, Subpart C (Section 15.247)** **ANSI C63.10:2020**

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 : Jan.Zhou , **Date:** Aug.23, 2022

Yan ZHOU

Project Engineer

Approved by : Daniel , **Date:** Aug.23, 2022

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.
Loop Antenna	ETS-LINDGREN	6502	E1A1039	Apr.15,22	Apr.14,24
Double Ridged Broadband Horn (30MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1001	Dec.20,21	Dec.19,23
Horn Antenna (1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Jul.25,22	Jul.24,24
Pre-Amplifier(9kHz-1GHz)	SONOMA	310	E1A2007	Mar.03,22	Mar.02,23
Pre-Amplifier(1GHz-26.5GHz)	Agilent	8449B	E1A2002	Mar.03,22	Mar.02,23
Signal Generator	ANRITSU	MG3692B	E1S9006	Jun.21,22	Jun.20,23
Signal Generator	Keysight	N5171B	E1S9016	Mar.03,22	Mar.02,23
Signal Generator	Keysight	N5182B	E1S9017	Mar.03,22	Mar.02,23
Wireless Connectivity Tester	R&S	CMW270	E1S9021	NCR	NCR
Spectrum Analyzer	Keysight	N9030B	E1S1003	Sep.16,21	Sep.15,22
Spectrum Analyzer	Keysight	N9020A	E1S1004	Mar.03,22	Mar.02,23
Spectrum Analyzer	R&S	ESR7	E1R1005	Aug.09,22	Aug.08,23
RF Control Unit	Toscend	JS0806-2	E1C5003	NCR	NCR
DC Power supply	Chroma	62024p-80-60	S1S1009	Mar.23,22	Mar.22,23
Humidity&Temp Programmable Tester	ESPEC	SE TH-Z-042U	C1TH002	Jun.08,22	Jun.07,23
Test Software	Toscend	JS1120-3	N/A	N/A	N/A
Test Software	Toscend	JS36-RSE	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) (±)
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	main test model: SC009-WL2 Series model: SC009-WL2A、SC009-WL2B、SC009-WL2C；SC009-WL1、SC009-WL1A、SC009-WL1B、SC009-WL1C； SC009-WL3、SC009-WL3A、SC009-WL3B、SC009-WL3C
Model Difference	--
Power Rating	DC 5V 1A
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Operating Frequency	2412MHz-2462MHz
Number of Channel	802.11b, 802.11g and 802.11n (HT20):11
Antenna Type	PCB Antenna
Antenna Connector	--
Antenna Gain	1.26 dBi

Note:

1. 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.

☒ For different antenna gain, select high gain antenna 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).

☒ Following channel(s) was (were) selected for the final test as listed below.

☒ For different antenna gain, select high gain antenna 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

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	DC 5V 1A
RE < 1G	25deg. C, 60%RH	DC 5V 1A
PLC	25deg. C, 60%RH	DC 5V 1A
APCM	25deg. C, 60%RH	DC 5V 1A

3.3 Duty Cycle of Test Signal

Test Mode	Antenna	Channel [MHz]	Duty Cycle [%]	10log(1/x) Factor[dB]
11B	Ant1	2412	89.66	0.47
		2437	89.66	0.47
		2462	89.66	0.47
11G	Ant1	2412	80.65	0.93
		2437	75.76	1.21
		2462	60.98	2.15
11N20SISO	Ant1	2412	75.00	1.25
		2437	86.21	0.64
		2462	67.57	1.70

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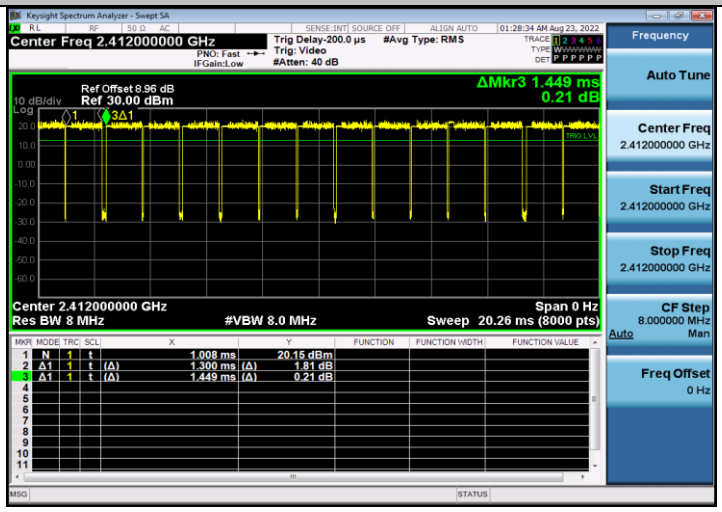
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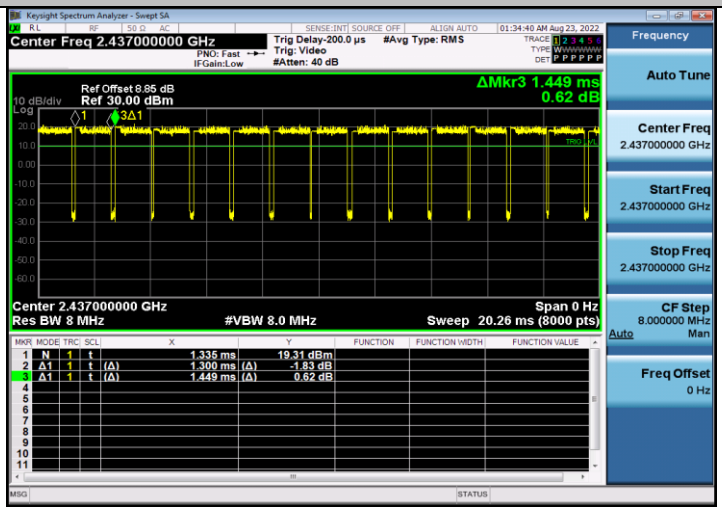
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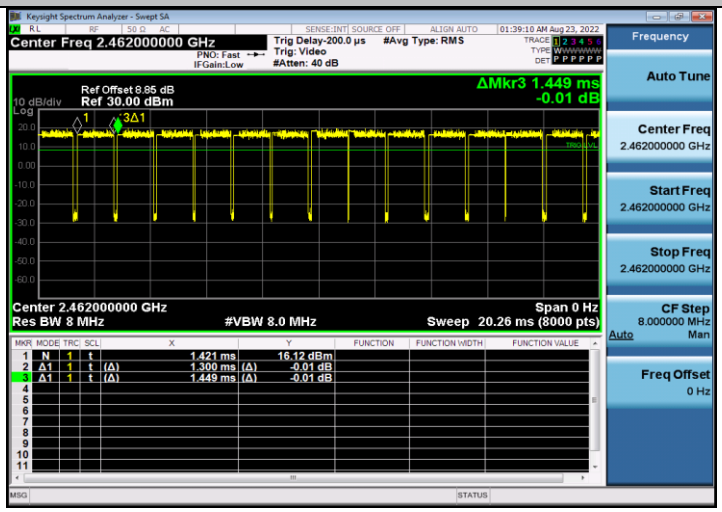
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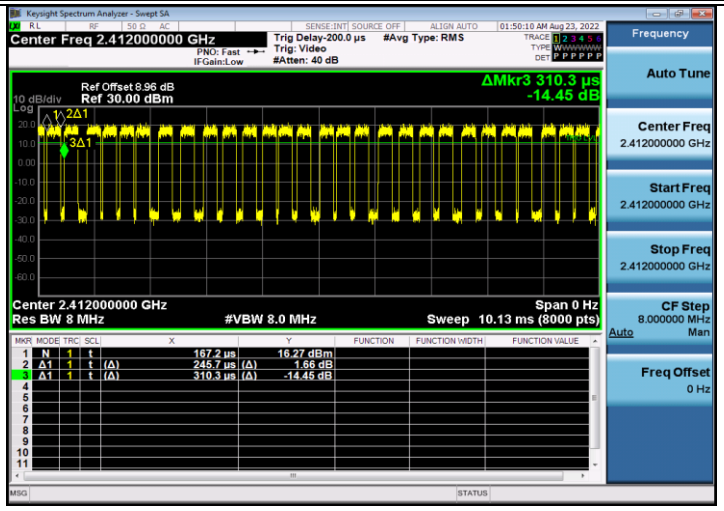

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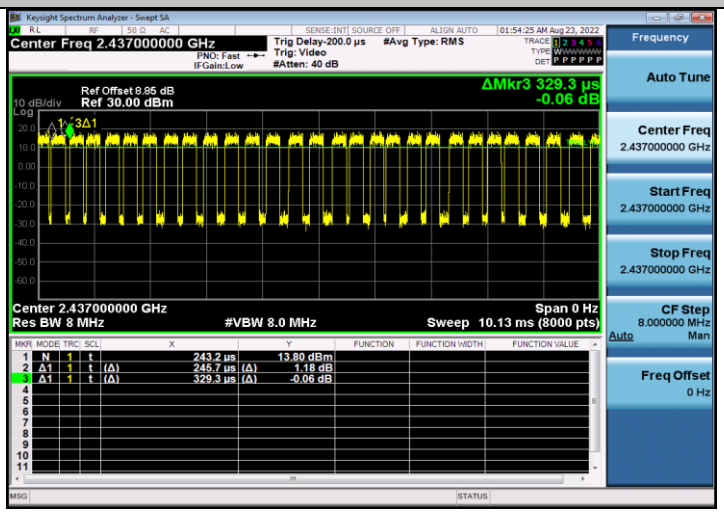

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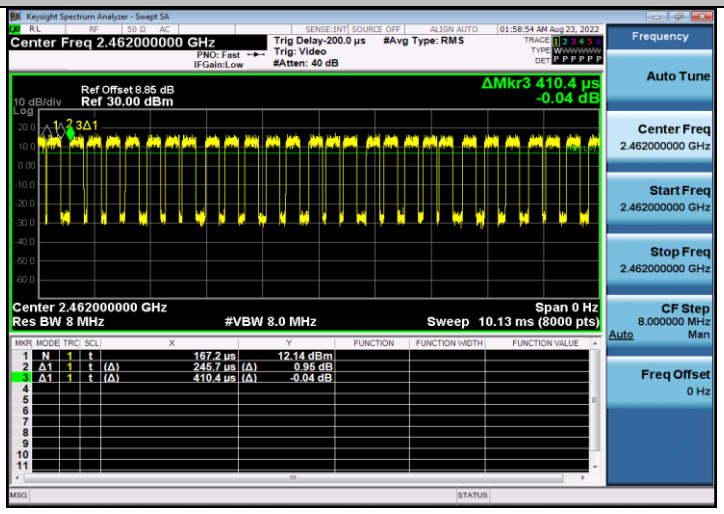

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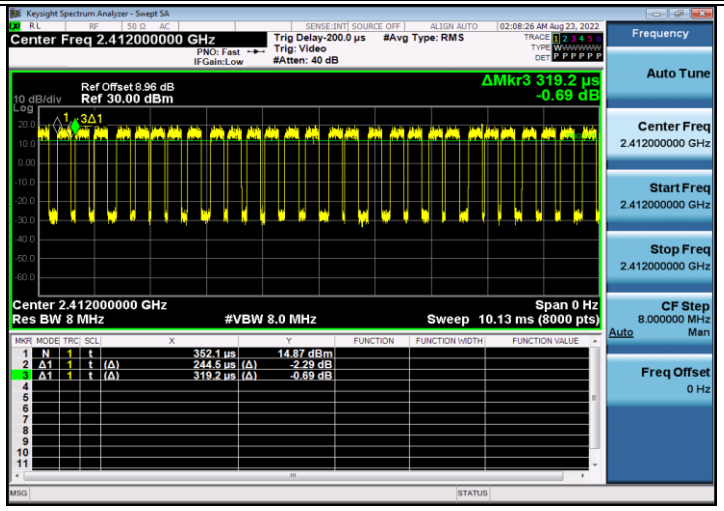

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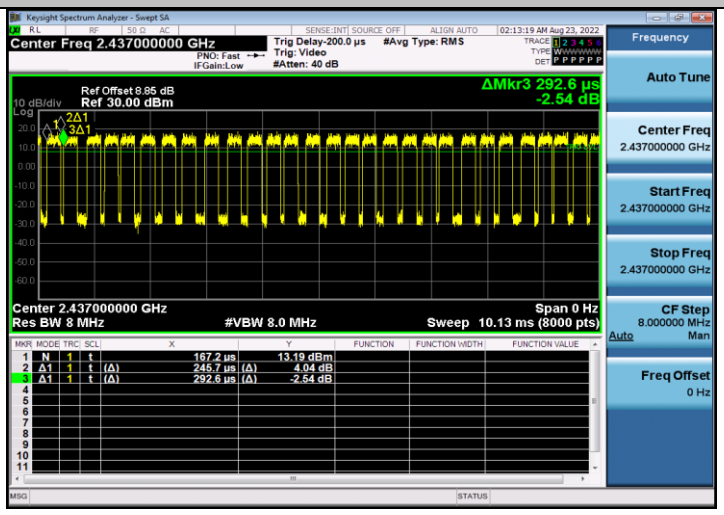

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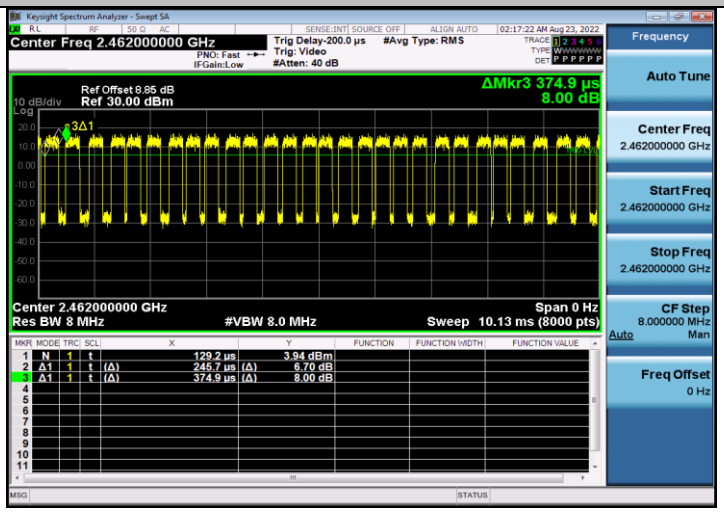


3.4 Description of Support Units

NO.	PRODUCT	BRAND/ Manufacturer	MODEL NO.
1	Adaptor	Shenzhen Teka Technology Co., Ltd	TEKA006-0501000CHU

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 C63.10:2020

All related 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

a. 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.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

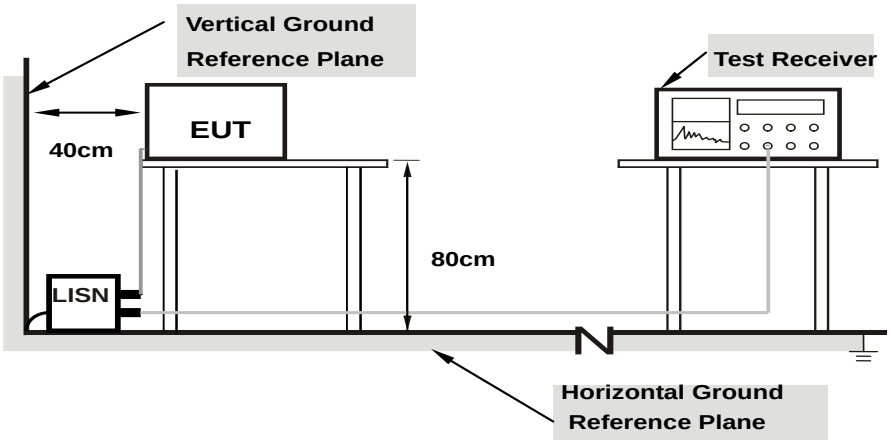
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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.

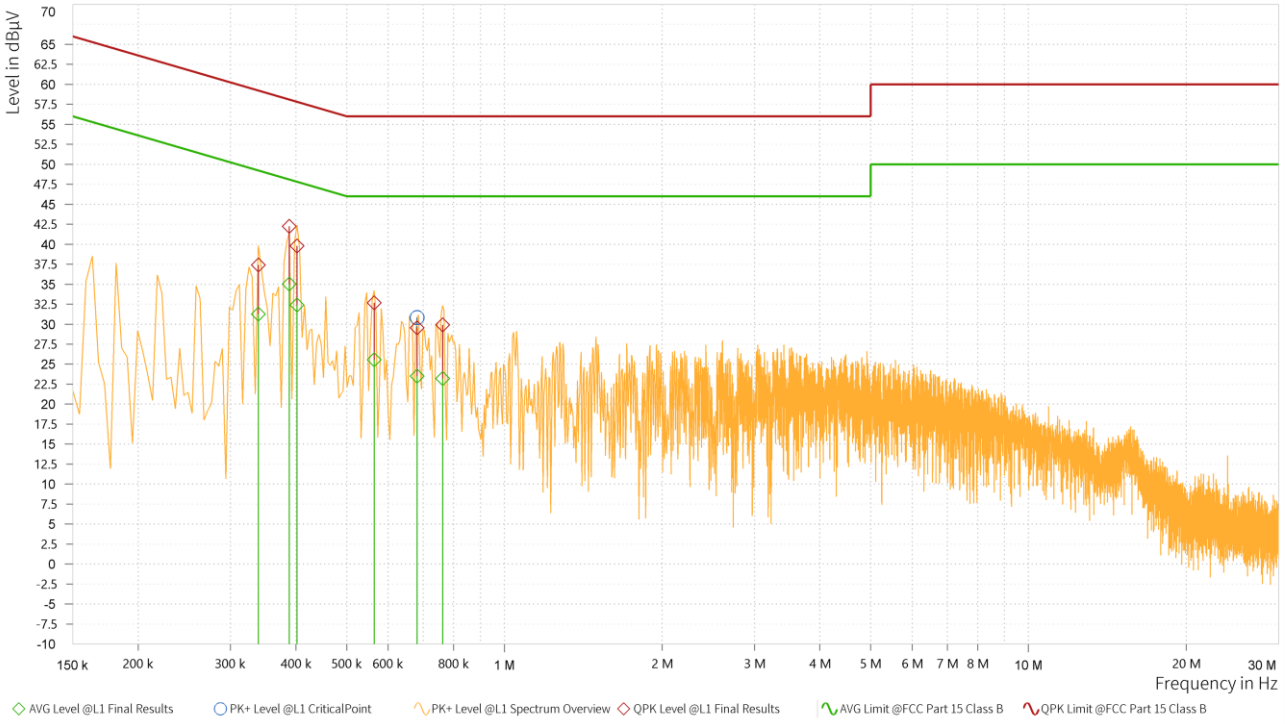
For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.5 EUT Operating Conditions

Same as 4.1.6.

4.1.6 Test Results

Phase: L Voltage:120V 60Hz

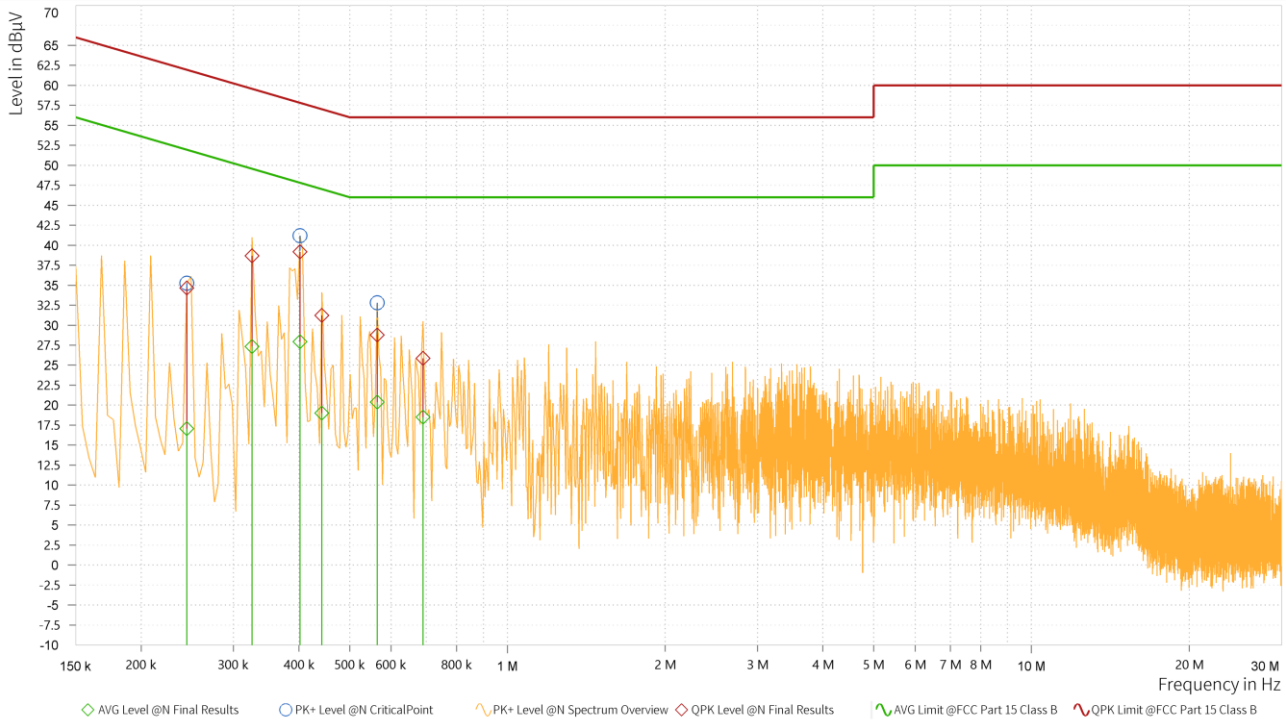


Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line
0.339	37.39	59.23	21.84	31.26	49.23	17.96	9.66	L1
0.389	42.22	58.10	15.87	35.01	48.10	13.09	9.66	L1
0.402	39.78	57.81	18.04	32.39	47.81	15.42	9.66	L1
0.564	32.67	56.00	23.33	25.54	46.00	20.46	9.62	L1
0.681	29.55	56.00	26.45	23.49	46.00	22.51	9.56	L1
0.762	29.93	56.00	26.07	23.22	46.00	22.78	9.55	L1

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: N Voltage:120V 60Hz



Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG Limit [dBµV]	AVG Margin [dB]	Correction [dB]
0.245	34.66	61.94	27.28	17.04	51.94	34.90	9.79
0.326	38.67	59.57	20.89	27.34	49.57	22.23	9.83
0.402	39.19	57.81	18.62	27.95	47.81	19.86	9.81
0.443	31.24	57.01	25.78	19.01	47.01	28.00	9.79
0.564	28.78	56.00	27.22	20.38	46.00	25.62	9.77
0.690	25.85	56.00	30.15	18.51	46.00	27.49	9.76

REMARKS:

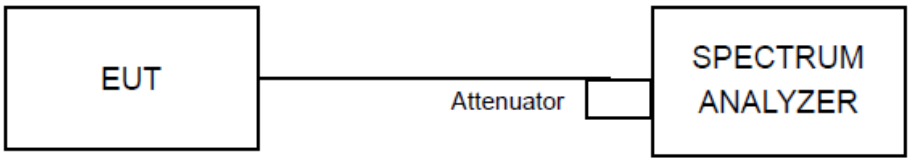
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

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 ≥ 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

TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	8.160	2408.040	2416.200	>=0.5	PASS
		2437	8.960	2432.440	2441.400	>=0.5	PASS
		2462	8.240	2457.680	2465.920	>=0.5	PASS
11G	Ant1	2412	16.440	2403.800	2420.240	>=0.5	PASS
		2437	16.400	2428.800	2445.200	>=0.5	PASS
		2462	16.400	2453.840	2470.240	>=0.5	PASS
11N20SISO	Ant1	2412	16.400	2403.800	2420.200	>=0.5	PASS
		2437	16.440	2428.760	2445.200	>=0.5	PASS
		2462	16.400	2453.840	2470.240	>=0.5	PASS

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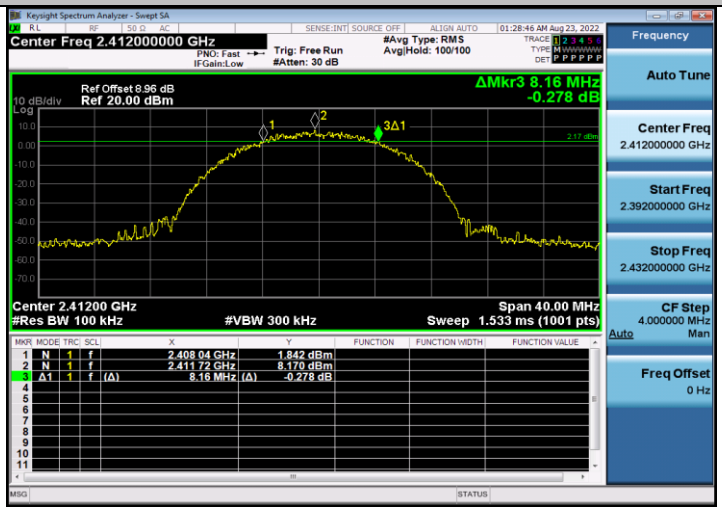
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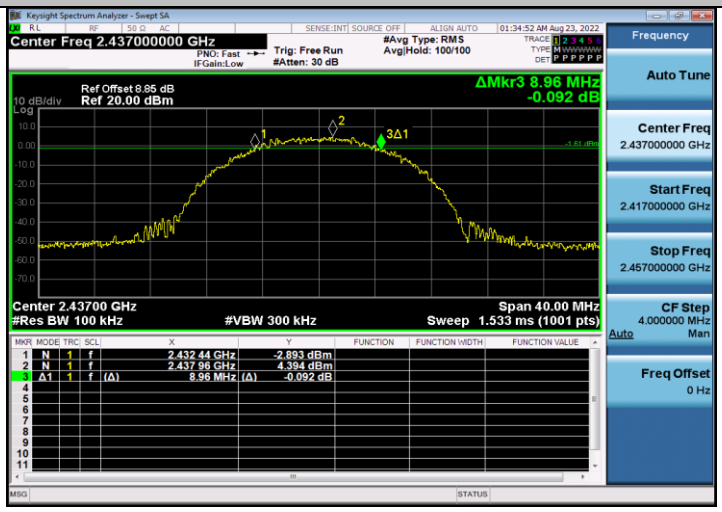
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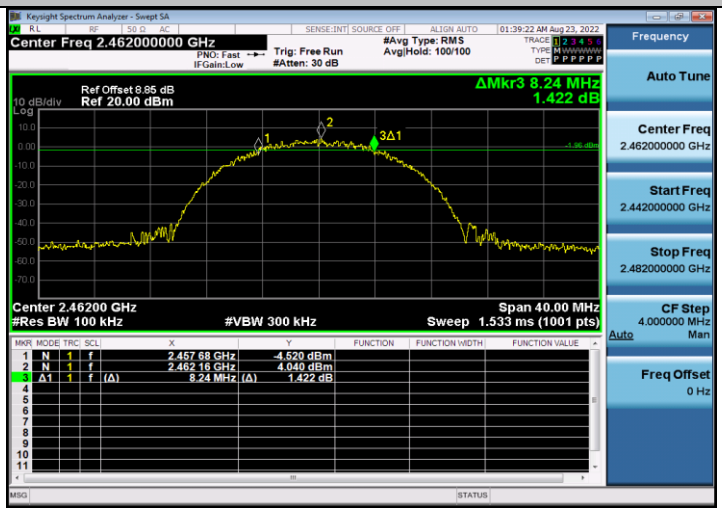
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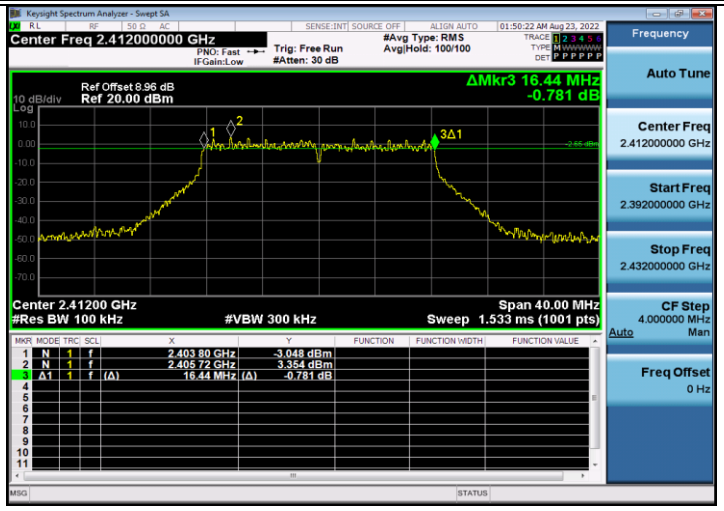

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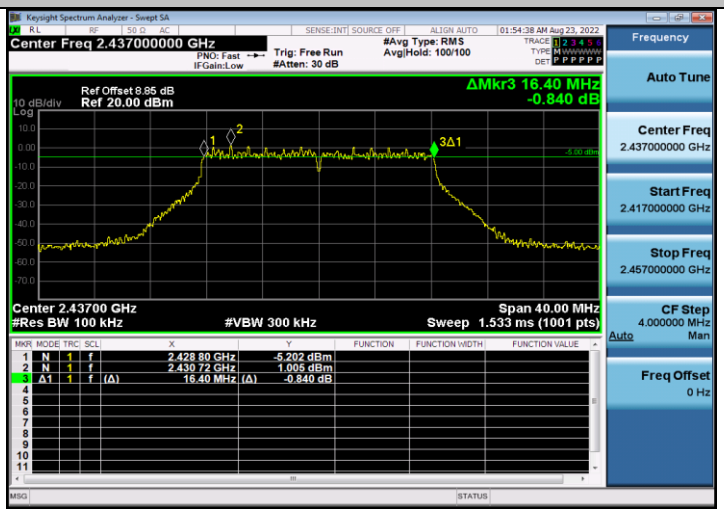

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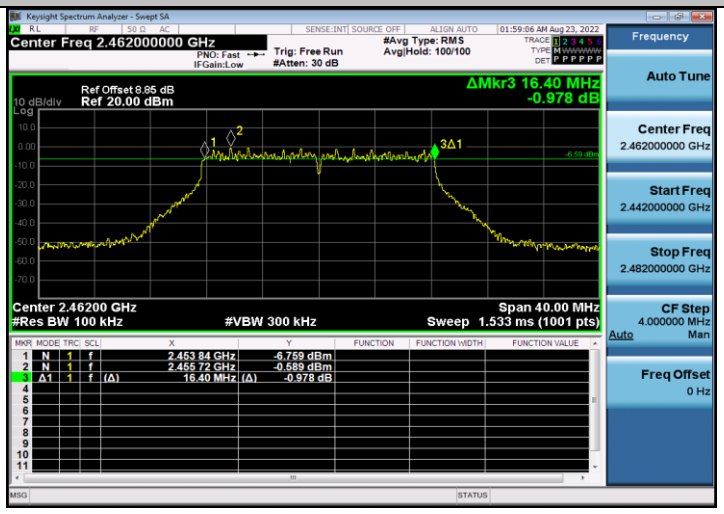

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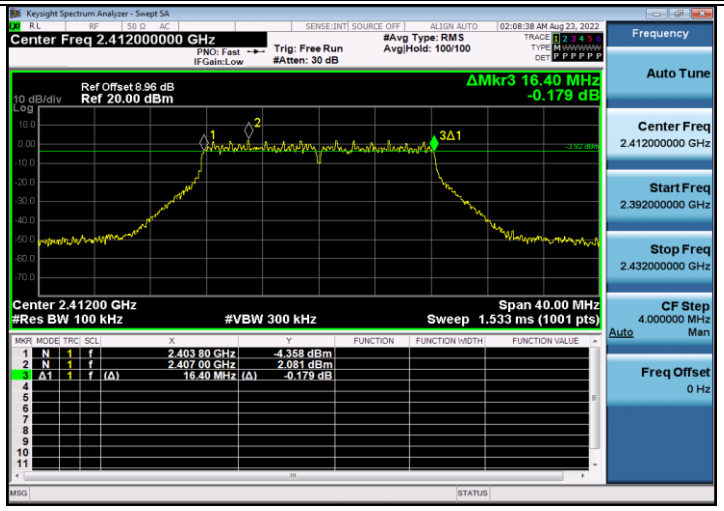

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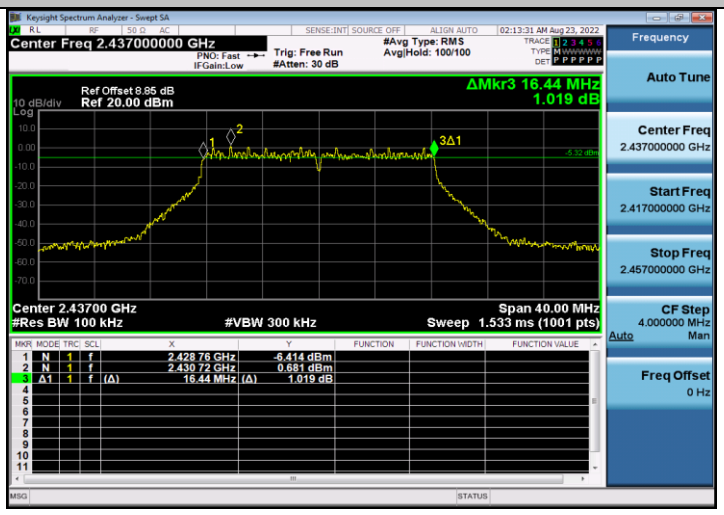

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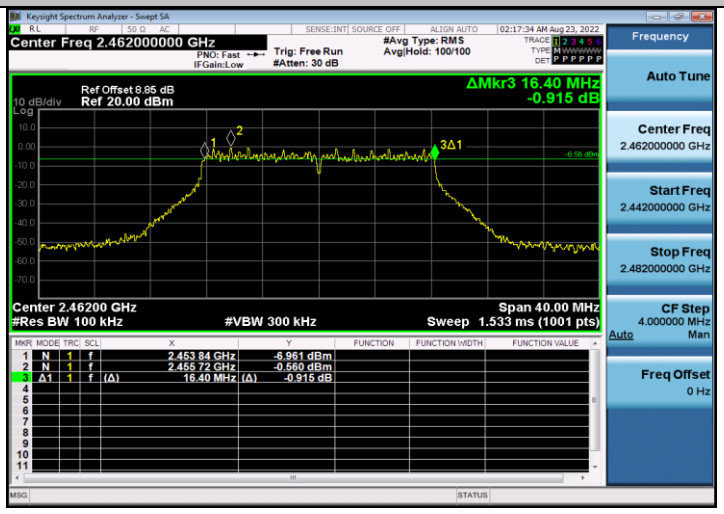
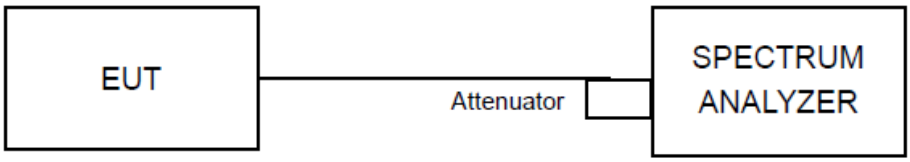


4.3 Conducted Output Power

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 $\geqslant$ 3 RBW.

e) Number of points in sweep $\geqslant$ 2 span / RBW. (This gives bin-to-bin spacing $\leqslant$ 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.

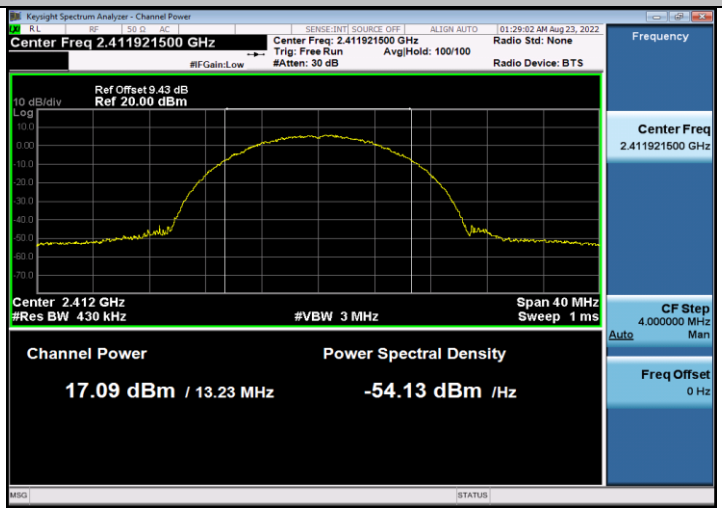
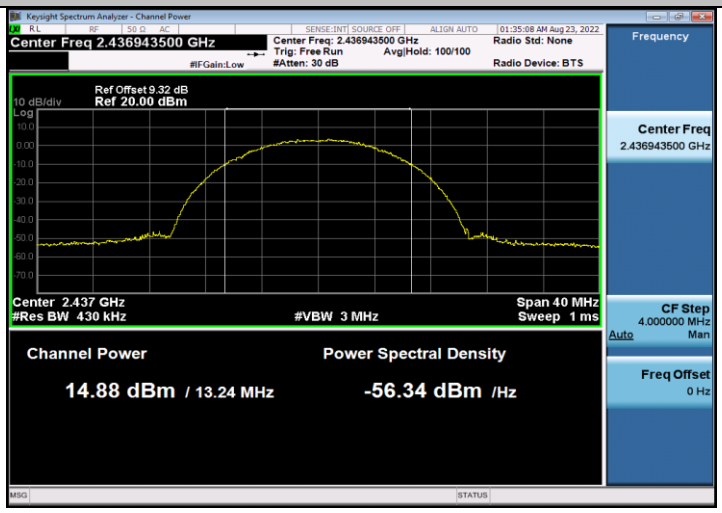
k) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on- and off-times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle 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	17.09	0.47	17.56	<=30	PASS
		2437	14.88	0.47	15.35	<=30	PASS
		2462	13.34	0.47	13.81	<=30	PASS
11G	Ant1	2412	13.85	0.93	14.78	<=30	PASS
		2437	11.75	1.21	12.96	<=30	PASS
		2462	11.46	2.15	13.61	<=30	PASS
11N20SISO	Ant1	2412	13.23	1.25	14.48	<=30	PASS
		2437	11.12	0.64	11.76	<=30	PASS
		2462	10.80	1.70	12.50	<=30	PASS

11B_Ant1_2412

11B_Ant1_2437

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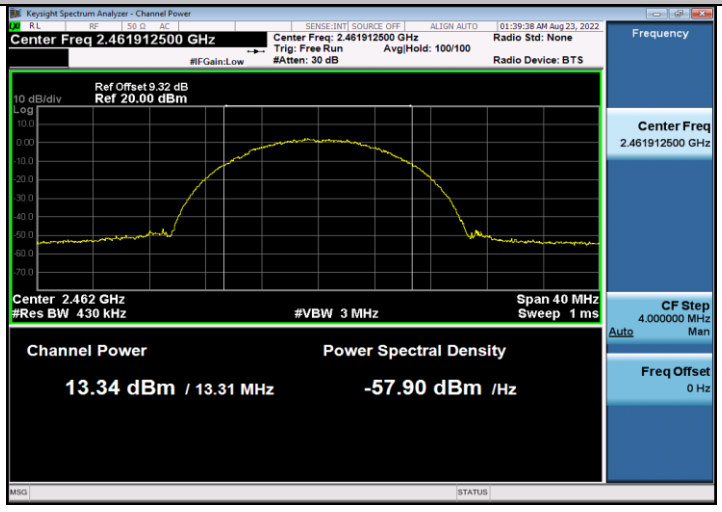
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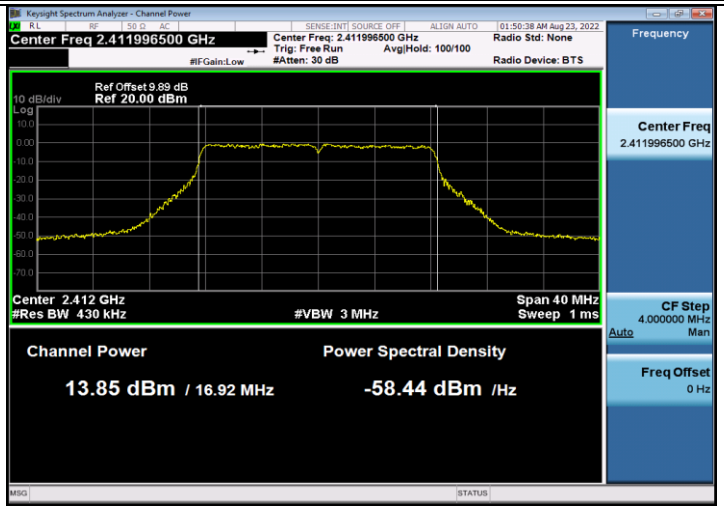

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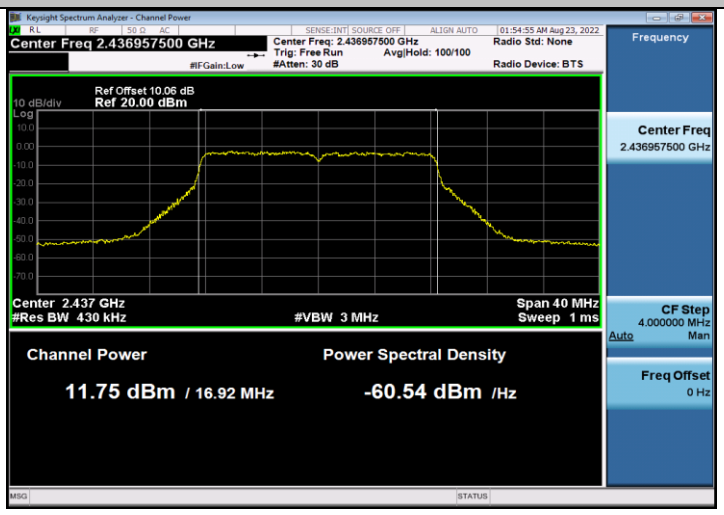

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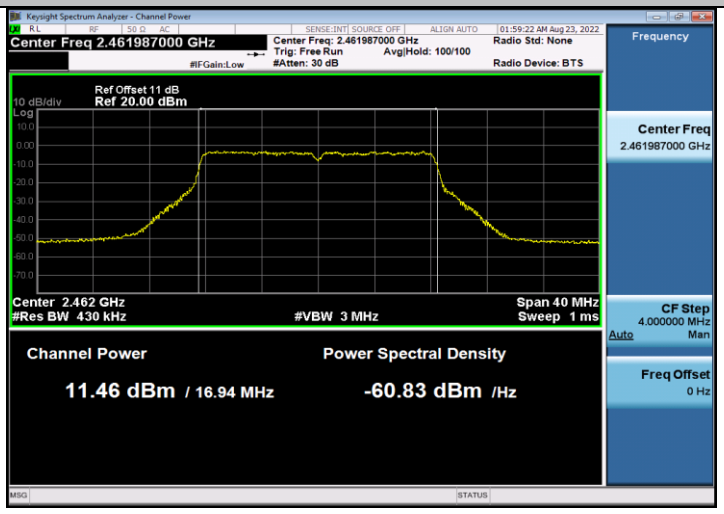

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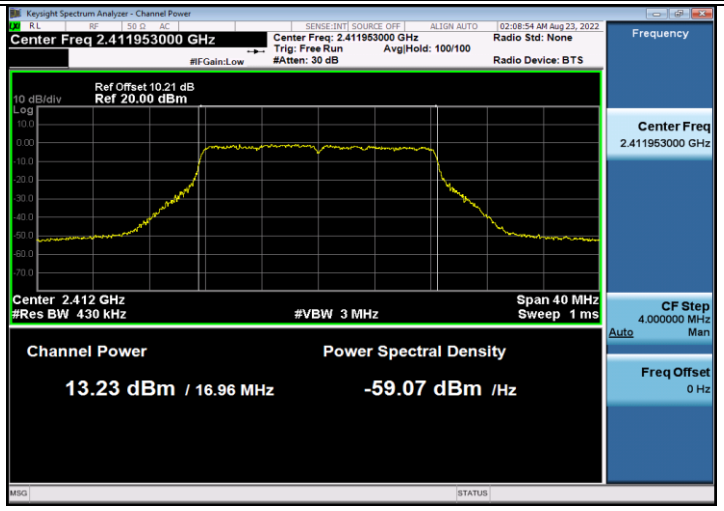

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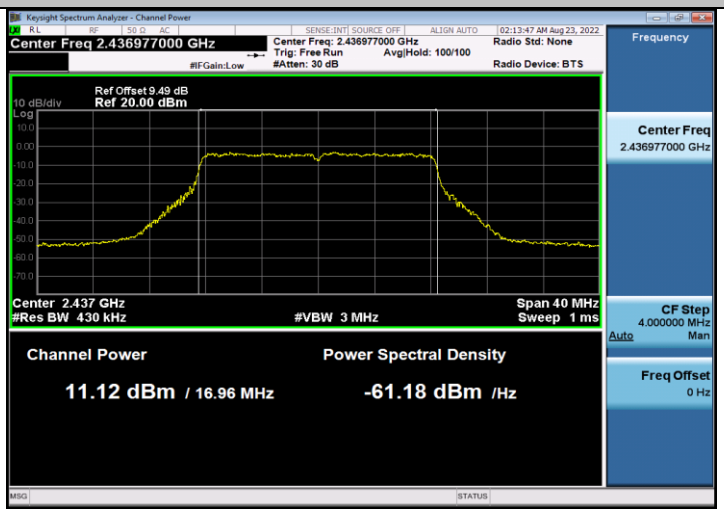
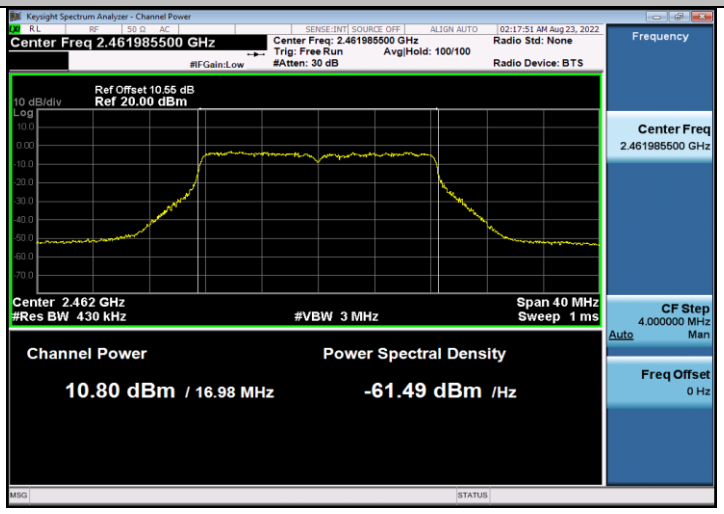


11N20SISO_Ant1_2462

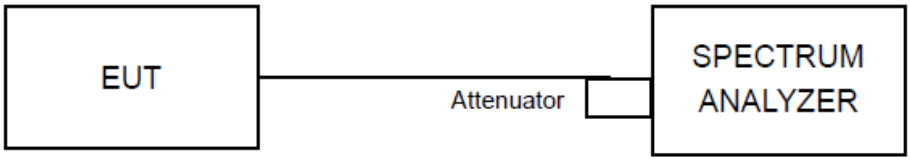


4.4 Power Spectral Density

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.

a) Measure the duty cycle (x) of the transmitter output signal.

b) Set instrument center frequency to DTS channel center frequency.

c) Set span to at least 1.5 OBW.

d) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

e) Set VBW ≥ 3 RBW.

f) Detector = power averaging (RMS) or sample detector (when RMS not available).

g) Ensure that the number of measurement points in the sweep ≥ 2 span/RBW.

h) Sweep time = auto couple.

i) Do not use sweep triggering. Allow sweep to "free run".

j) Employ trace averaging (RMS) mode over a minimum of 100 traces.

k) Use the peak marker function to determine the maximum amplitude level.

l) 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.

m) 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).

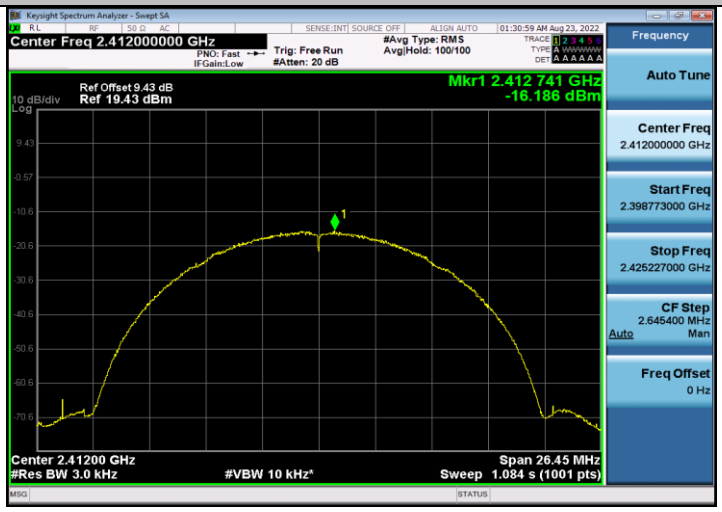
4.4.4 Deviation of Test Standard

No deviation.

4.4.5 Test Results

Test Mode	Antenna	Channel [MHz]	Level [dBm]	10log(1/x) Factor[dB]	PSD [dBm/3kHz]	Limit [dBm/3kHz]	Verdict
11B	Ant1	2412	-16.19	0.47	-15.72	<=8	PASS
		2437	-18.15	0.47	-17.68	<=8	PASS
		2462	-19.56	0.47	-19.09	<=8	PASS
11G	Ant1	2412	-19.7	0.93	-18.77	<=8	PASS
		2437	-21.33	1.21	-20.12	<=8	PASS
		2462	-21.37	2.15	-19.22	<=8	PASS
11N20SISO	Ant1	2412	-19.67	1.25	-18.42	<=8	PASS
		2437	-21.93	0.64	-21.29	<=8	PASS
		2462	-21.9	1.70	-20.20	<=8	PASS

11B_Ant1_2412



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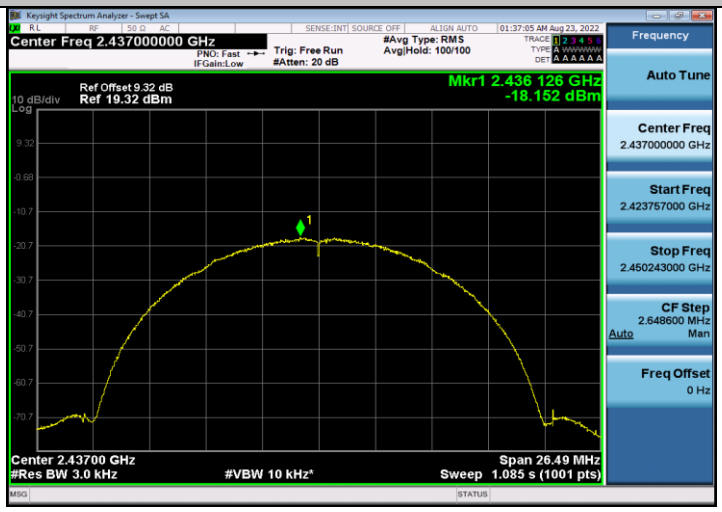
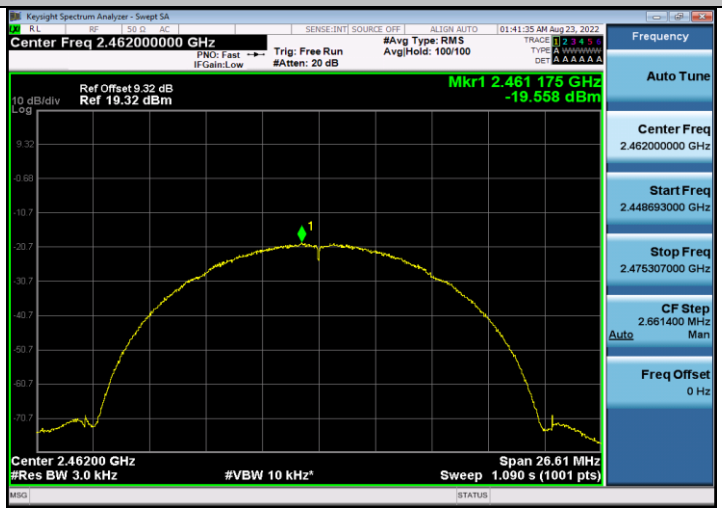
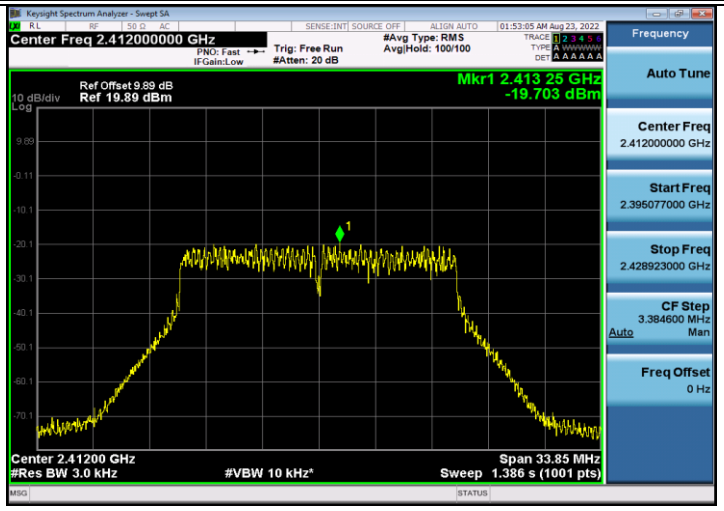


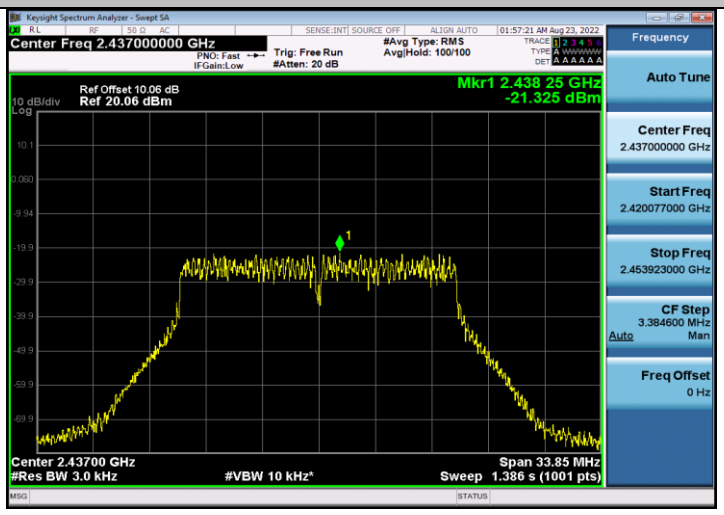
11B_Ant1_2462



11G_Ant1_2412



11G_Ant1_2437



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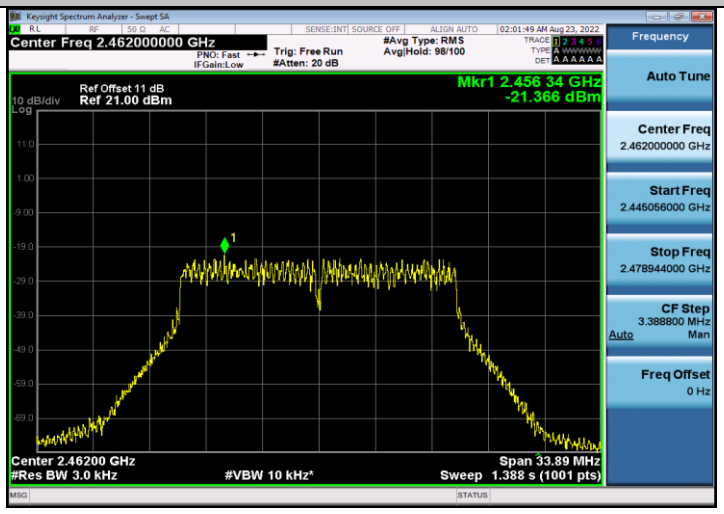

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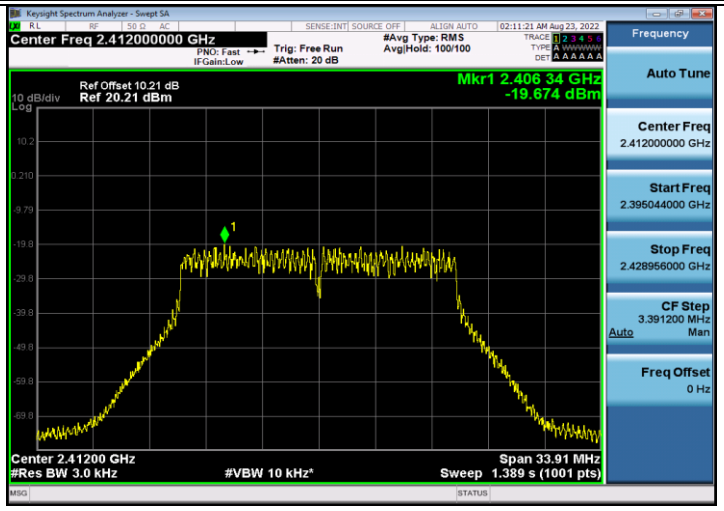

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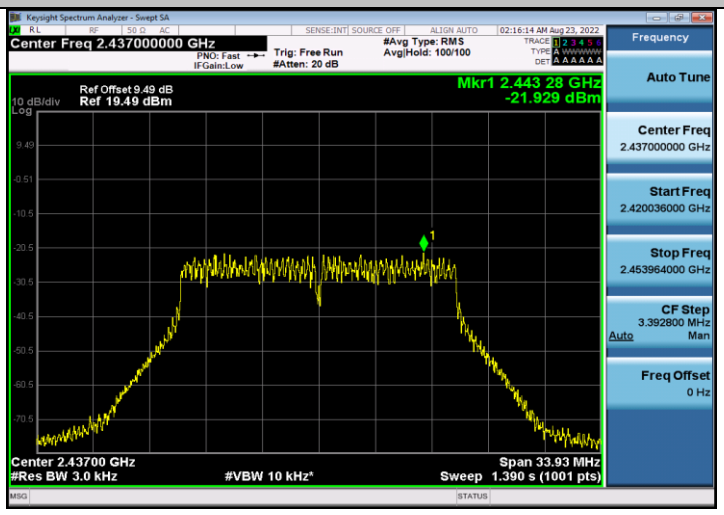

11N20SISO_Ant1_2462