CERTIFICATION TEST REPORT

Report Number. : 11886412-E2V5

Applicant	:	SONOS, INC. 614 CHAPALA STREET SANTA BARBARA, CA, 93101, U.S.A.
Model	:	S14
FCC ID	:	SBVRM014
ISED	:	5373A-RM014
EUT Description	:	HOME THEATER SPEAKER
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS - 247 ISSUE 2 ISED RSS-GEN ISSUE 4

Date Of Issue:
March 16, 2018

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NVLAP LAB CODE 200065-0

Report Revision History

Rev.	Issue Date	Revisions	Revised By
V1	12/5/2017	Initial Issue	D. Coronia
V2	12/13/2017	Updated Section 5.3	D. Coronia
V3	02/22/2018	Updated Section 5.5, 5.6, 9.2, 11. Added section 9.6	C. Susa
V4	03/12/2018	Updated EUT description from Wireless Smart Speaker to Home Theater Speaker	C. Susa
V5	03/16/2018	Updated Product description, Section 5.1	C. Susa

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SONOS, INC.

EUT DESCRIPTION: HOME THEATER SPEAKER

MODEL: S14

SERIAL NUMBER: 179-94-9F-3E-C0-07-0E-3 CA (Radiated Sample)
1708 94 -9F-3E-D0-05-FE-2 (Radiated Sample)
1709-94-9F-3E-D0-07-09-E (Conducted Sample)

DATE TESTED: NOVEMBER 14 to 29, 2017; February 14th - 16th, 2018

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
*ISED RSS-247 Issue 2	Complies
ISED RSS-GEN ISSUE 4	Complies

*This report contains data that are not covered by the NVLAP accreditation

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

DAN CORONIA
OPERATIONS LEADER
UL VERIFICATION SERVICES INC

Tested By:

ERIC YU
TEST ENGINEER
UL VERIFICATION SERVICES INC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v04, KDB 662911 D01 Multiple Transmitter Output v02r01, KDB 662911 D02 MIMO with Cross Polarized Antenna v01 and ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☒ Chamber A(IC: 2324B-1)	☐ Chamber D(IC: 22541-1)
☒ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 22541-2)
☐ Chamber C(IC: 2324B-3)	☐ Chamber F(IC: 22541-3)
	☐ Chamber G(IC: 22541-4)
	☐ Chamber H(IC: 22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.
UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.
Chambers A through C are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under Industry Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

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

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is 802.11 a/b/g/n (HT20) master device. The model S14 is a high-performance all-in-one home theater smart speaker and part of Sonos' home sound system.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows
:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b 4TX	25.96	394.46
2412 - 2462	802.11g 4TX	25.68	369.83
2412 - 2462	802.11n HT20 4TX	25.45	350.75

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range MHz	2.4GHz Antenna Identification / Max Antenna Gain dBi			
	PWS-Stamped (Vertical Polarization)	PWR-Dipole (Horizontal Polarization)	HYSK-IFA (Vertical Polarization)	HTSK-Slot (Horizontal Polarization)
2412-2462	Chain 0 / **3.47**	Chain 1 / **3.66**	Chain 2 / **4.76**	Chain 3 / **3.45**

NOTE: All final tests were performed using the EUT highest antenna gain with same polarity as the test measurement setup.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Atheros Radio Test 2 (ART2-GUI).

5.5. WORST-CASE CONFIGURATION AND MODE

All measurements were performed with the AC plugged into a power source. The worst-case configuration for below 1GHz radiated emissions were performed with the EUT including the HDMI port exercised and the channel with the highest output power. The worst-case configuration for radiated emissions above 1GHz, and power line conducted emissions were performed with the EUT only and set to transmit at the channel with highest output power.

Radiated bandage, harmonics, and spurious emissions from 1 GHz to 18GHz were performed. The EUT was set to transmit at the Low/Middle/High channels with designed (target) output powers.

The EUT can only be setup in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

For simultaneous transmission in the 2.4GHz and 5GHz bands, tests were conducted for various configurations having the highest power. No noticeable new emission was found.

Worst-case data rates as provided by the client were:
802.11b mode: 11 Mbps.
802.11g mode: 24 Mbps.
802.11n HT20mode: MCS9.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	Lenovo	X201	R9-BC7TG
AC/DC Adapter	Lenovo	ADLX90NCT2A	11S42T4418Z1ZF3B048J2Z
Television	Sony	XBR-43X830C	5082247

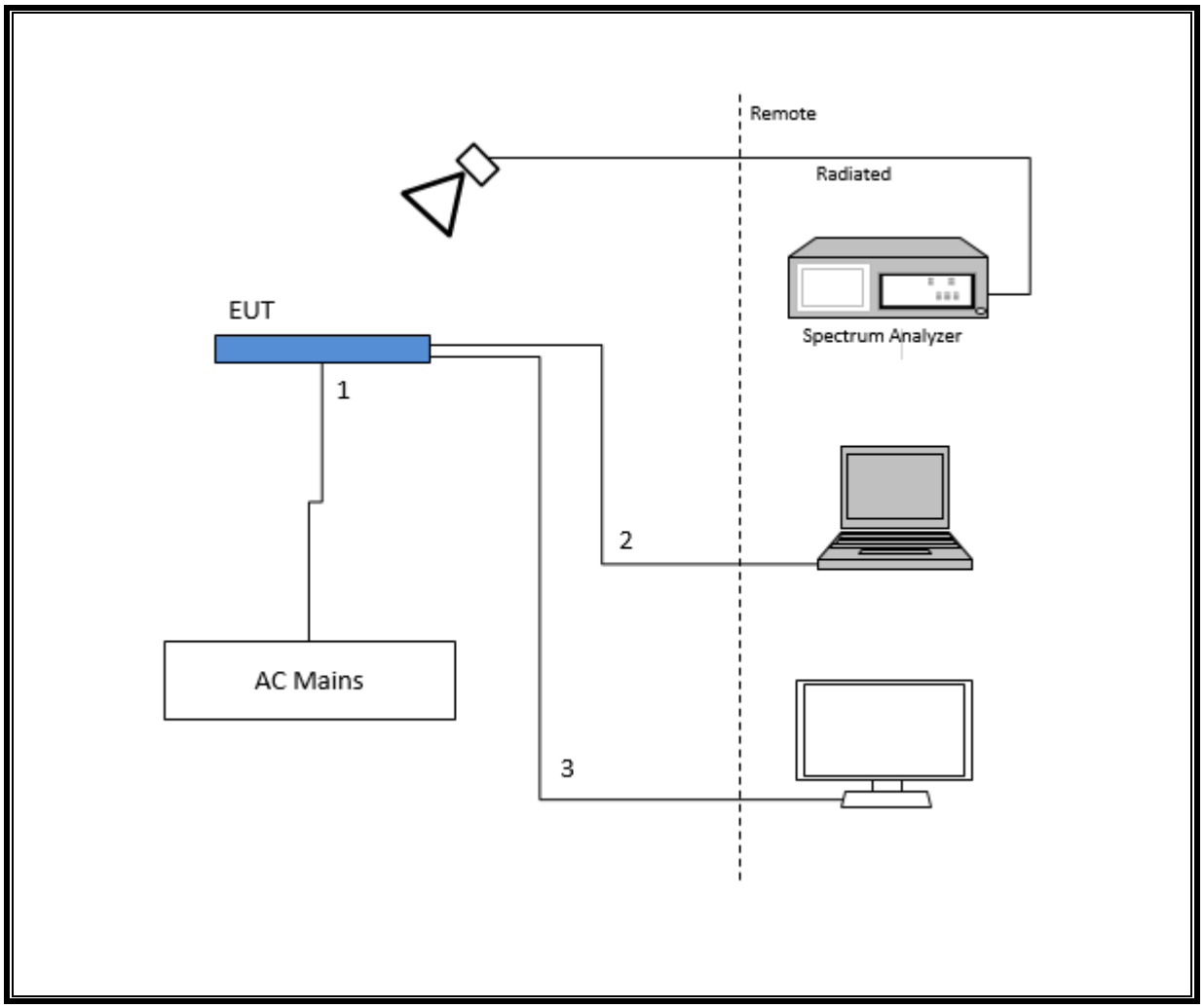
I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC Power	1	AC	Unshielded	1.2	AC Mains to EUT
2	Ethernet	1	RJ45	Unshielded	1.5	Laptop to EUT
3	HDMI	1	HDMI	shielded	10.2	

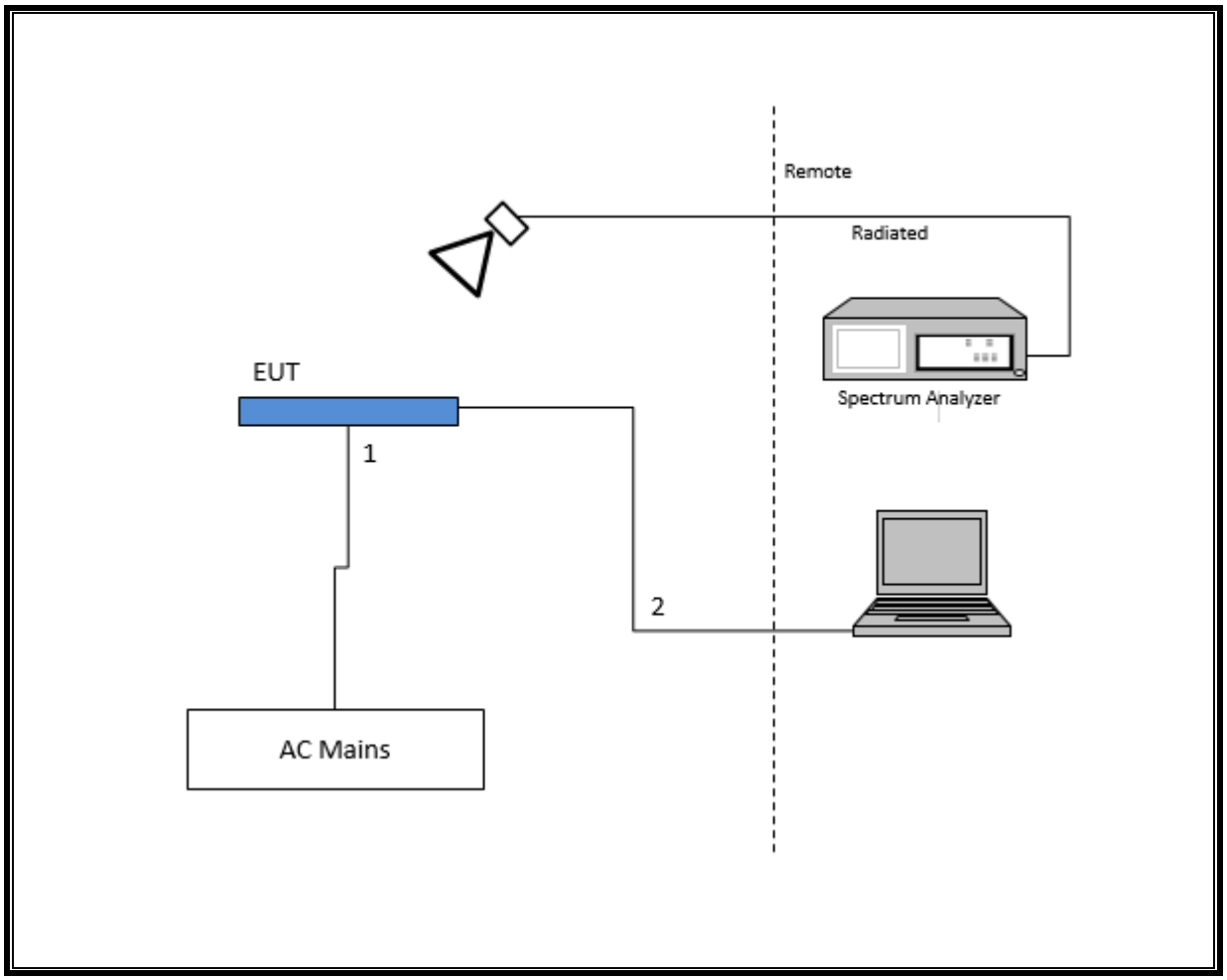
TEST SETUP

The EUT is a stand-alone unit, and the radio is exercised by Atheros Radio Test 2 (ART2-GUI) software, via Ethernet cable.

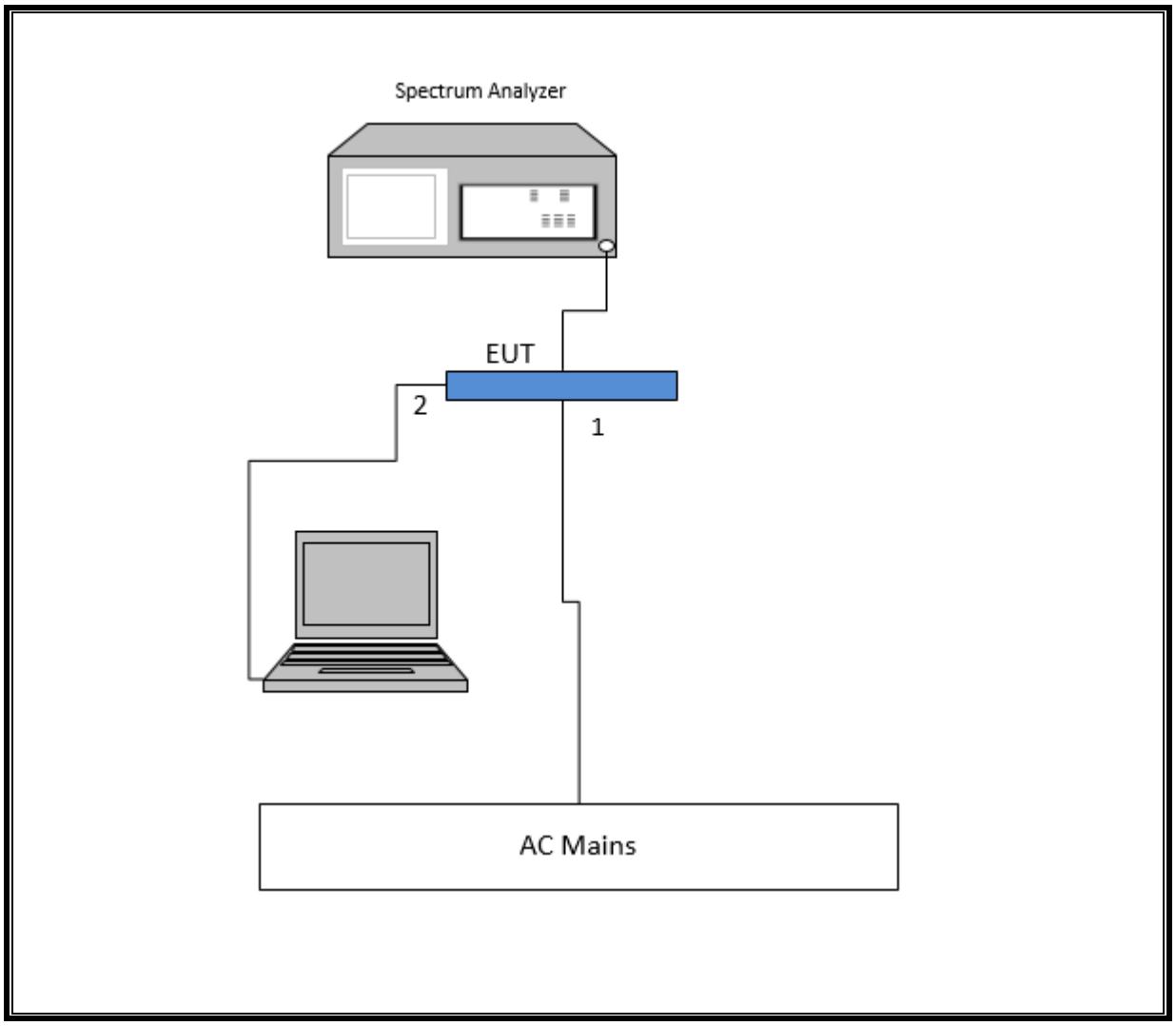
SETUP DIAGRAM FOR RADIATED BELOW 1GHZ TESTS



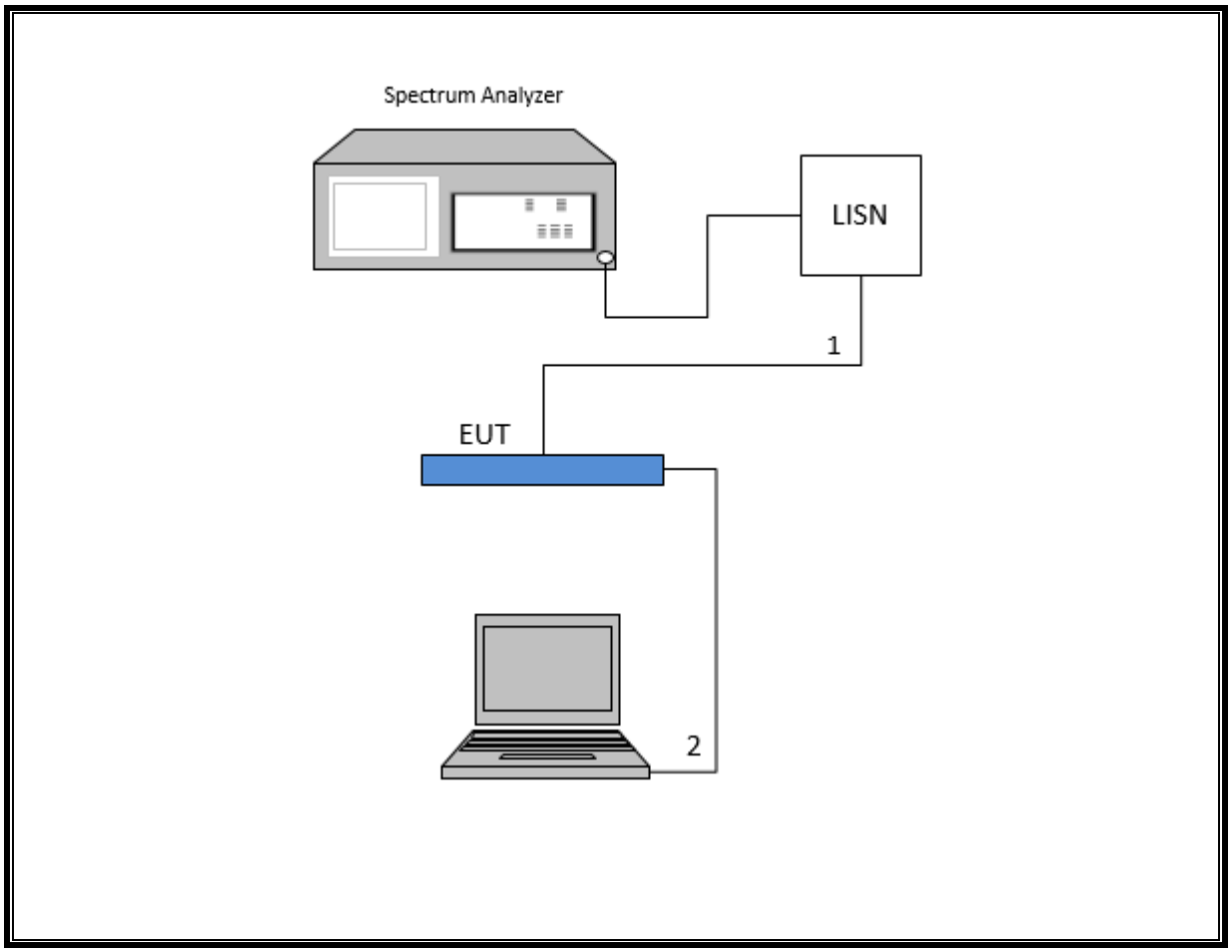
SETUP DIAGRAM FOR RADIATED ABOVE 1GHZ TESTS



SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR AC LINE CONDUCTED TEST



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset**	**Cal Due**
Antenna, Broadband Hybrid, 30MHz to 2000MHz w/4dB Pad	Sunol Sciences Corp.	JB1	T130	10/16/2018
Antenna, Active Loop 9kHz-30MHz	ETS-Lindgren	6502	T1683	02/17/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T863	06/09/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T862	06/09/2018
Antenna, Horn 18-26.5GHz	ARA	MWH-1826/B	T89	05/26/2018
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T1264	07/08/2018
Power Sensor, P – series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T413	06/20/2018
Amplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	T493	12/16/2018
Amplifier, 10kHz-1GHz	Agilent (Keysight) Technologies	8447D	T15	08/26/2018
Amplifier, 1-26.5GHz	Keysight	8449B	T404	07/23/2018
Filter, BRF 5150 to 5350MHz	Micro-Tronics	BRC50703	T1850	07/16/18
Filter, BRF 2400 to 2500MHz	Micro-Tronics	BRM50702-02	T1784	05/16/18
High pass filter 3GHz	Micro-Tronics	HPM17543	T485	12/16/18
High Pass Filter 6GHz	Micro-Tronics	HPS17542	T483	12/16/18
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Agilent (Keysight) Technologies	E4440A	T199	07/22/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T907	01/23/2018
Spectrum Analyzer, PSA, 3Hz to 26.5GHz	Agilent (Keysight) Technologies	E9030A	T905	01/11/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1466	04/11/2018
LISN	FISCHER	FCC-LISN-50/250-25-2-01	T1310	01/17/2018
Receiver, 10kHz-7GHz	ROHDE & SCHWARZ	ESR	T1436	01/06/2018

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5, Dec 01, 2016
Conducted Emissions Software	UL	UL EMC	Ver 9.5, May 26, 2015
Antenna Port Software	UL	UL RF	Ver 6.0, Jan 19, 2017

7. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 558074 D01 v04, Section 6.

6 dB BW: KDB 558074 D01 v04, Section 8.1.

99% BW: ANSI C63.10-2013, Section 6.9.3.

Output Power: KDB 558074 D01 v04, Section 9.2.3.2.

Power Spectral Density: KDB 558074 D01 v04, Section 10.3.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.1 (b).

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

8. ANTENNA PORT TEST RESULTS

ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
11b 4TX CDD	1.000	1.000	1.000	100.00%	0.00	0.010
11g 4TX CDD	0.691	0.718	0.963	96.30%	0.16	1.446
11n HT20 4TX CDD	0.656	0.684	0.959	95.91%	0.18	1.524

DUTY CYCLE PLOTS

DUTY CYCLE 802.11b MODE

DUTY CYCLE 802.11g MODE

DUTY CYCLE 802.11n HT20 MODE

8.1. 11b 4TX CDD MIMO MODE IN THE 2.4GHz BAND

8.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

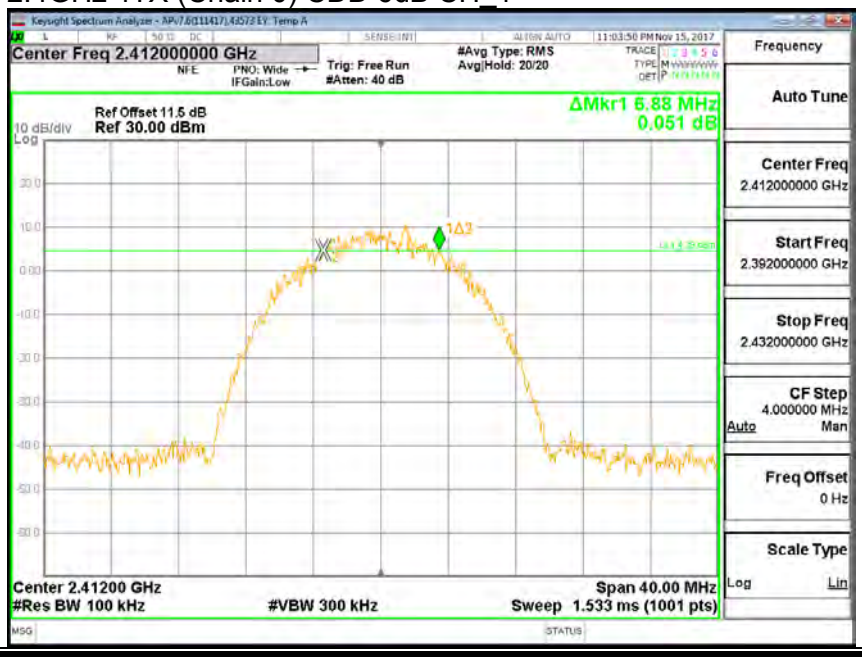
IC RSS-247 (5.2) (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

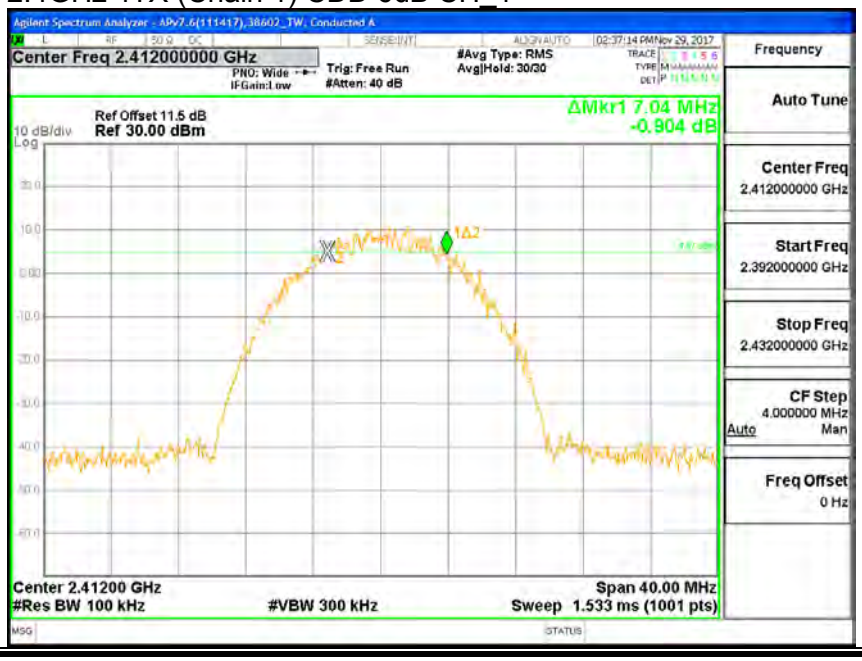
RESULTS

Channel	Frequency	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	6 dB BW Chain 2 (MHz)	6 dB BW Chain 3 (MHz)	Minimum Limit (MHz)
CH_1	2412	6.88	7.04	7.68	7.16	0.5
CH_6	2437	5.84	7.00	**8.36**	6.84	0.5
CH_11	2462	6.64	7.04	7.00	7.04	0.5

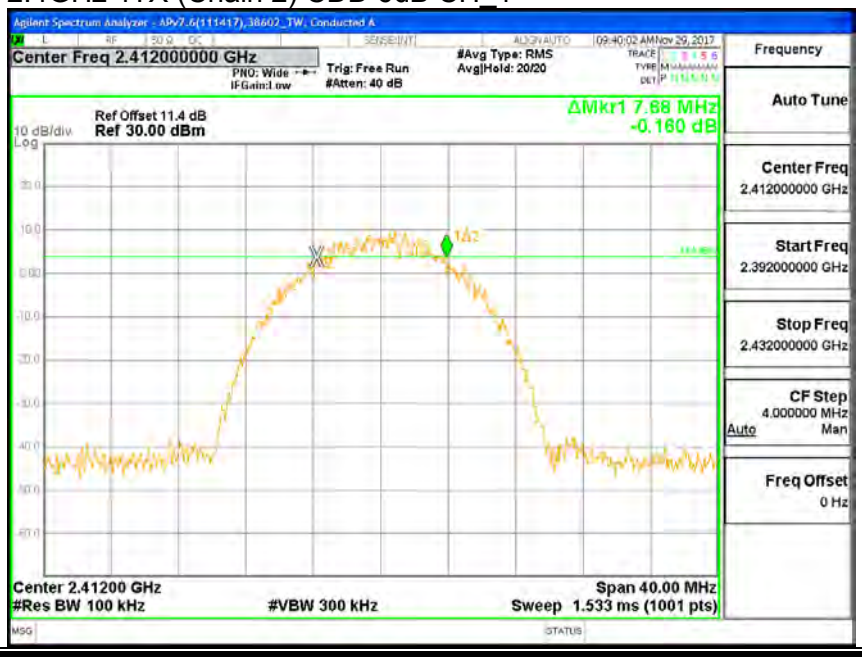
2.4GHz 4TX (Chain 0) CDD 6dB CH_1



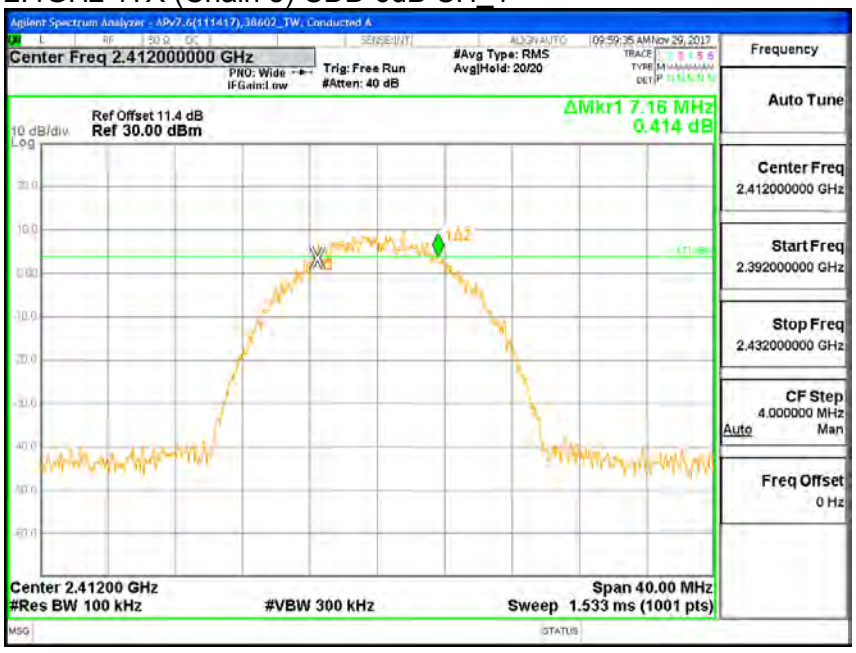
2.4GHz 4TX (Chain 1) CDD 6dB CH_1



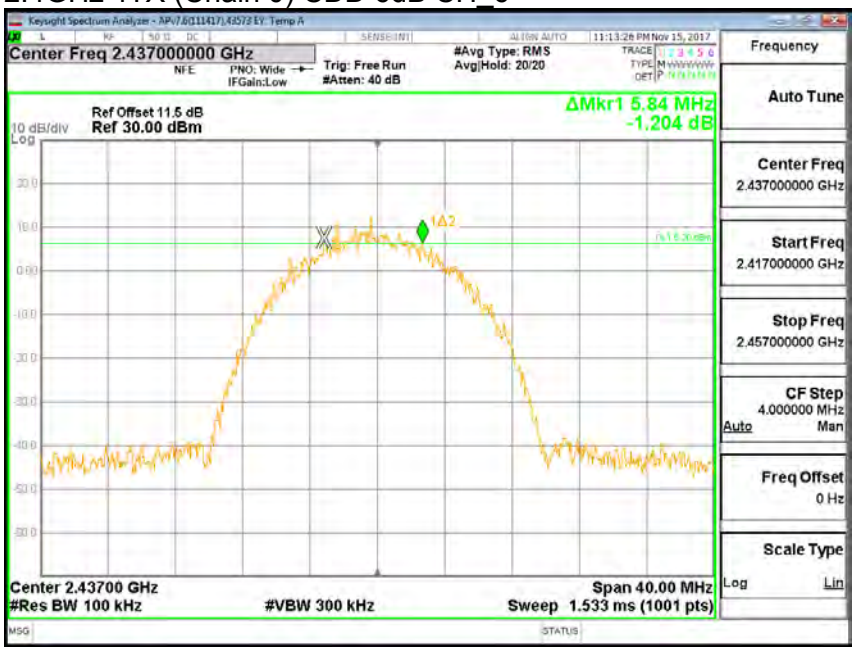
2.4GHz 4TX (Chain 2) CDD 6dB CH_1



2.4GHz 4TX (Chain 3) CDD 6dB CH_1

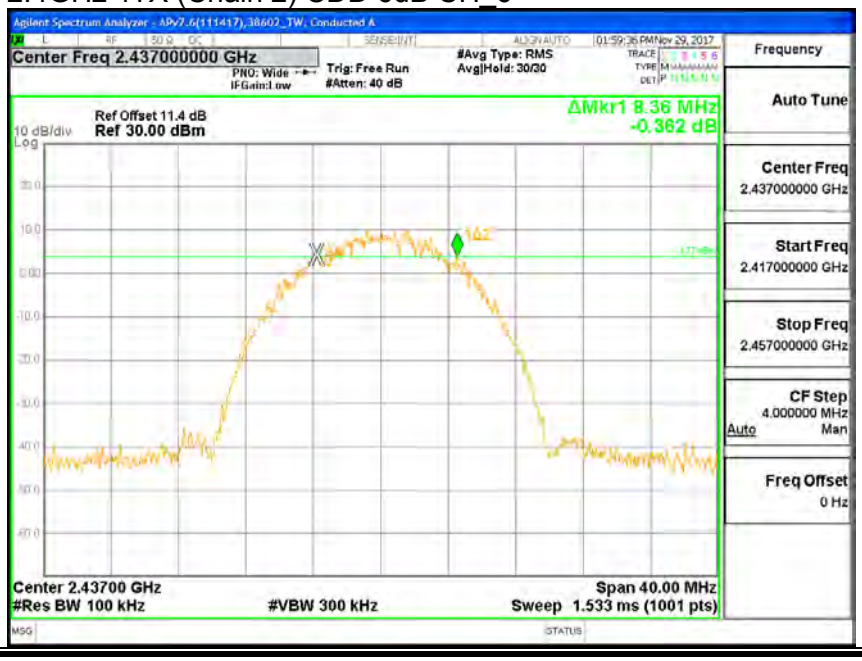


2.4GHz 4TX (Chain 0) CDD 6dB CH_6

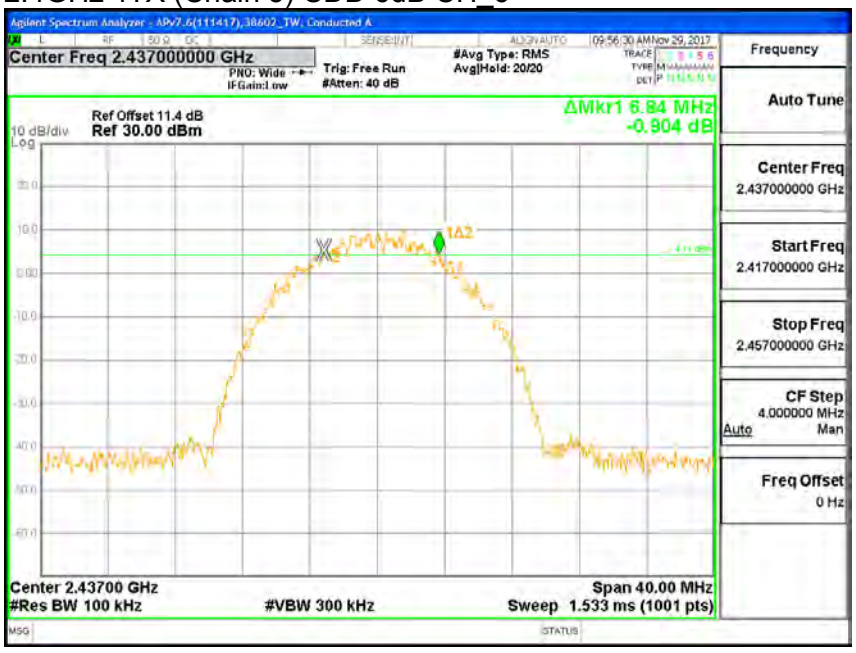


2.4GHz 4TX (Chain 1) CDD 6dB CH_6

2.4GHz 4TX (Chain 2) CDD 6dB CH_6

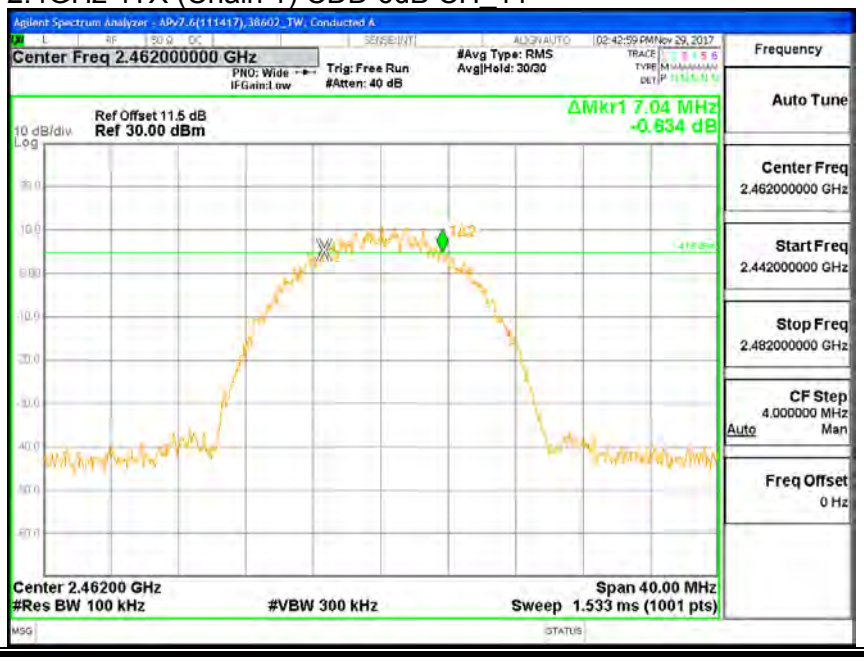


2.4GHz 4TX (Chain 3) CDD 6dB CH_6

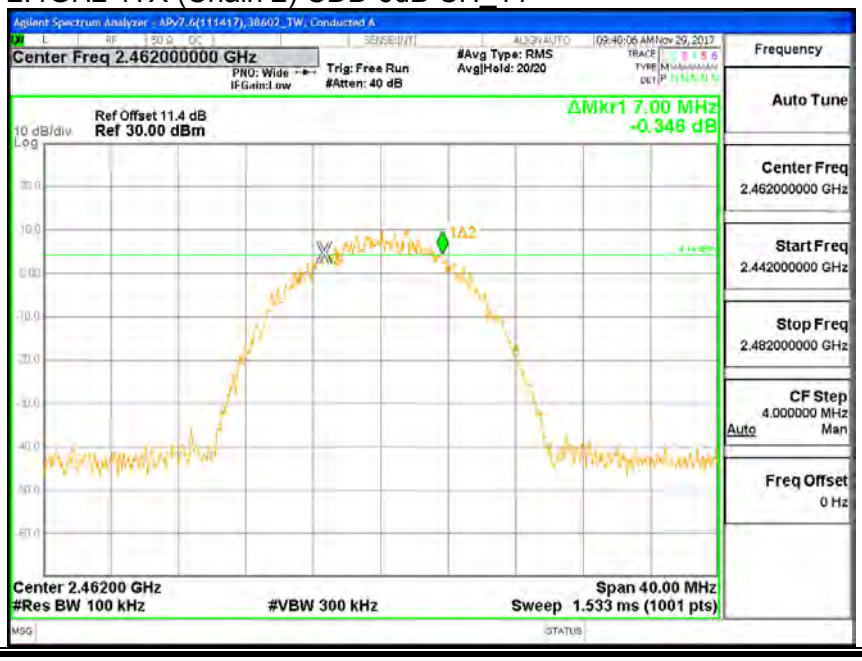


2.4GHz 4TX (Chain 0) CDD 6dB CH_11

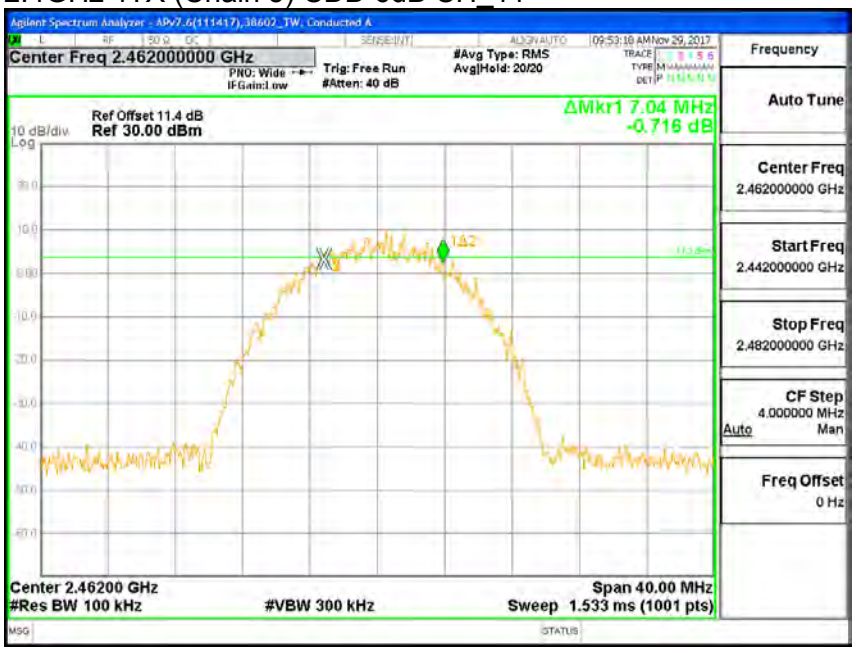
2.4GHz 4TX (Chain 1) CDD 6dB CH_11



2.4GHz 4TX (Chain 2) CDD 6dB CH_11



2.4GHz 4TX (Chain 3) CDD 6dB CH_11



8.1.2. 99% BANDWIDTH

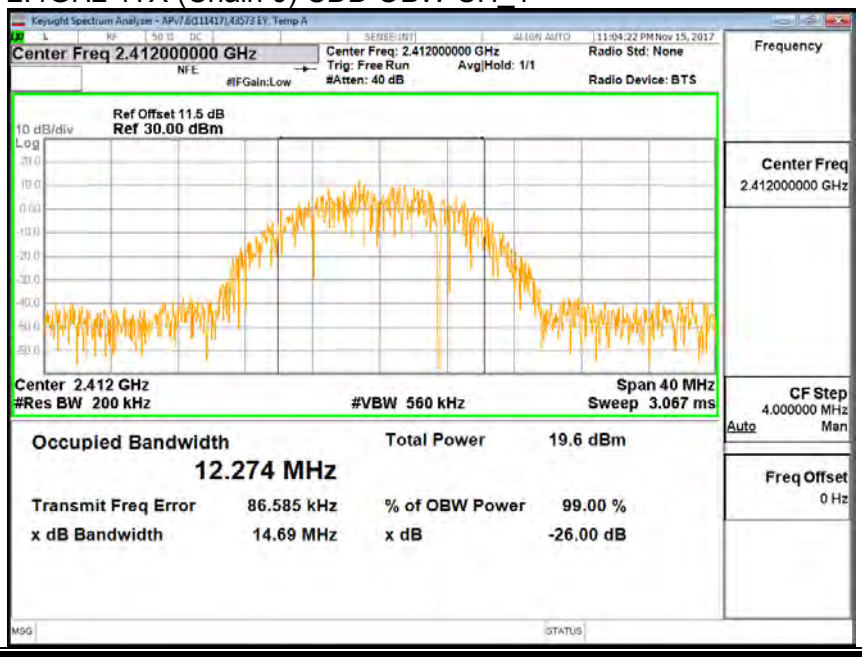
LIMITS

None; for reporting purposes only.

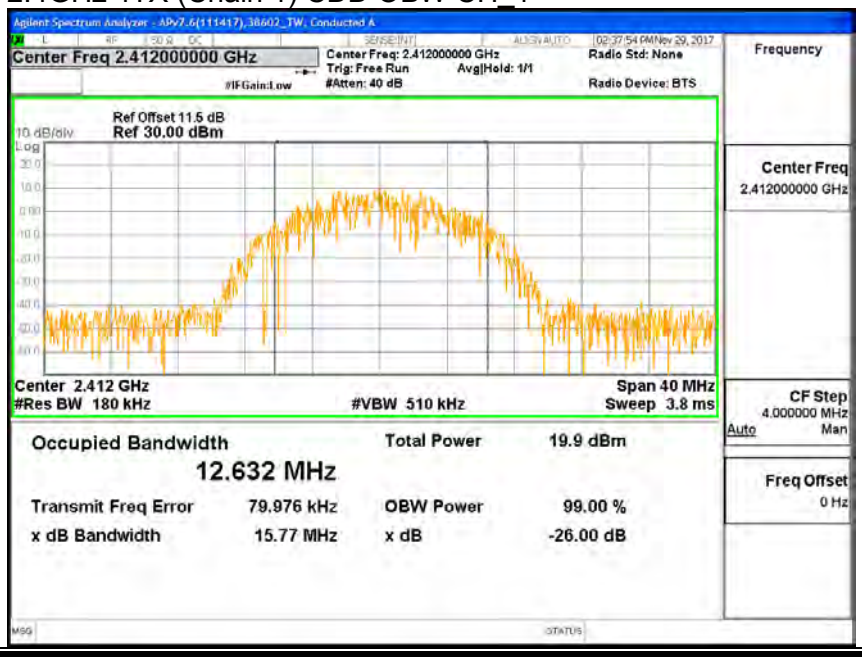
RESULTS

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)	99% Bandwidth Chain 2 (MHz)	99% Bandwidth Chain 3 (MHz)
CH_1	2412	12.274	**12.632**	11.926	12.377
CH_6	2437	12.327	12.358	12.094	12.203
CH_11	2462	11.911	12.441	11.951	12.525

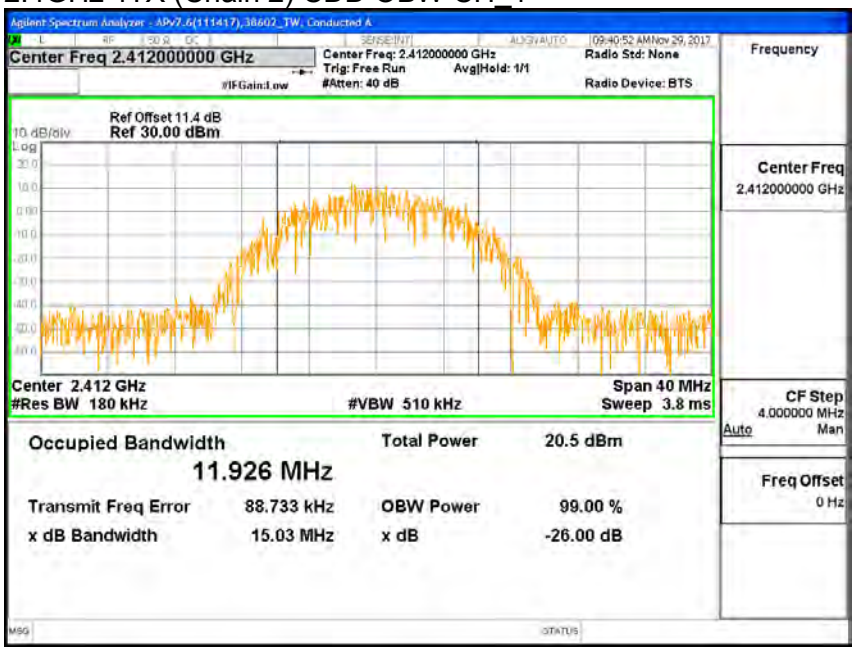
2.4GHz 4TX (Chain 0) CDD OBW CH_1



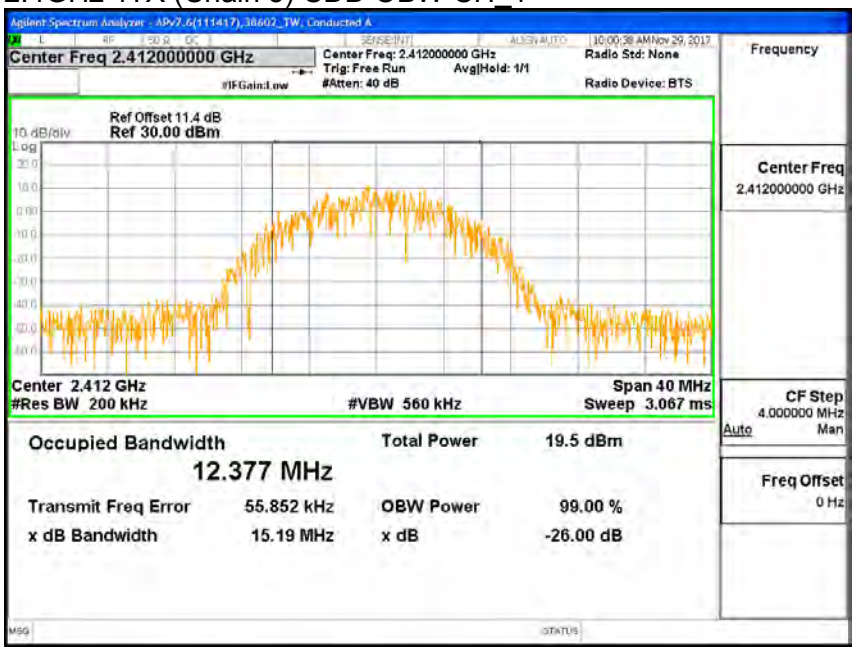
2.4GHz 4TX (Chain 1) CDD OBW CH_1



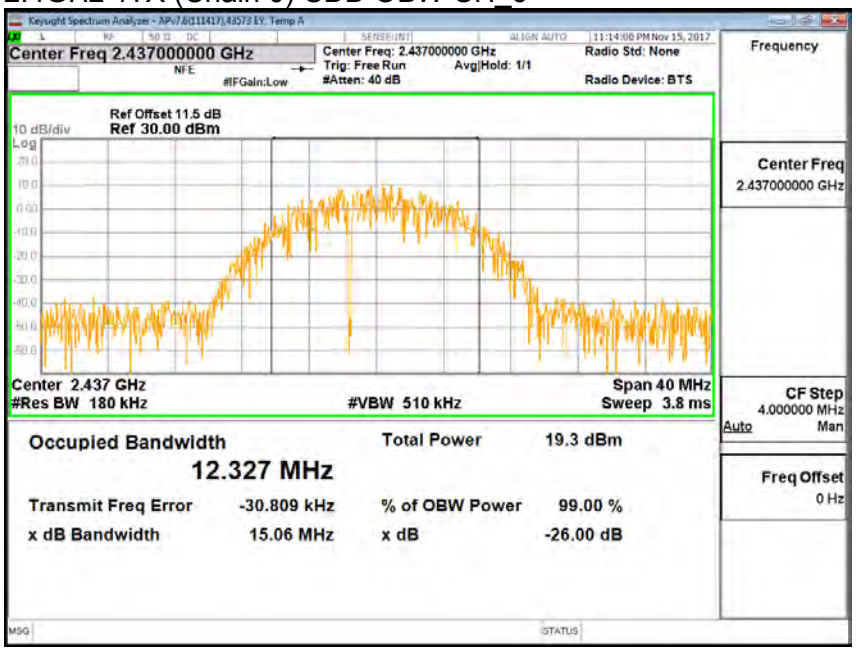
2.4GHz 4TX (Chain 2) CDD OBW CH_1



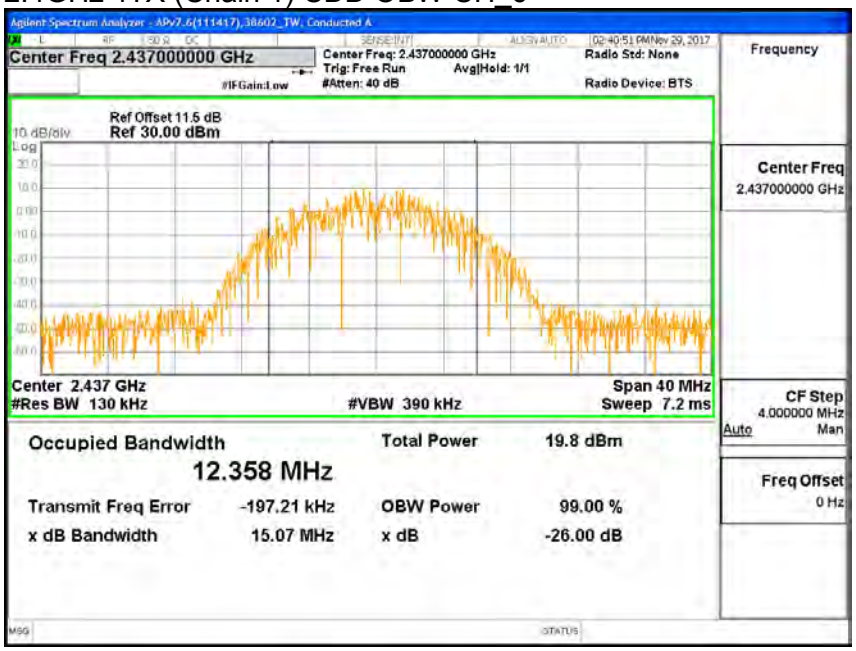
2.4GHz 4TX (Chain 3) CDD OBW CH_1



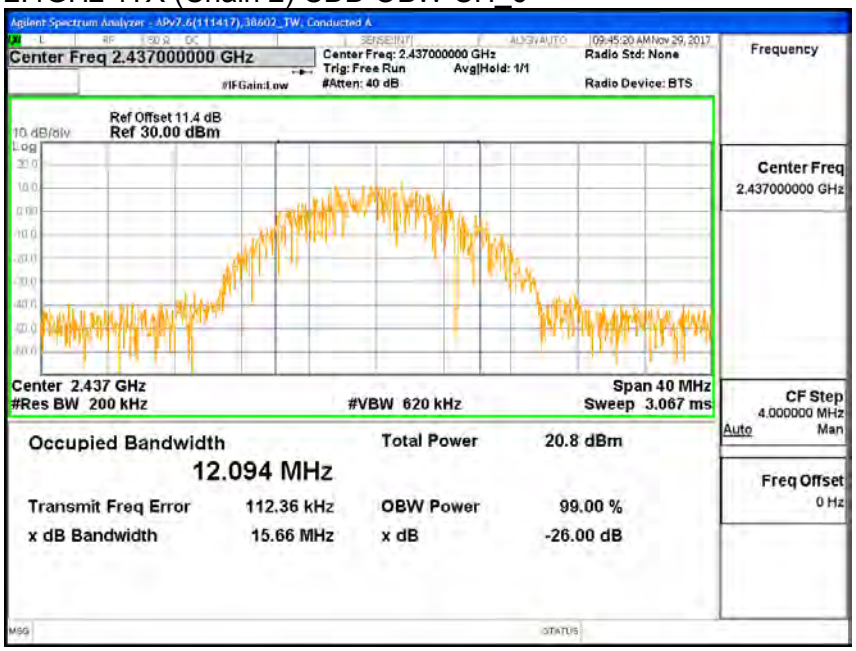
2.4GHz 4TX (Chain 0) CDD OBW CH_6



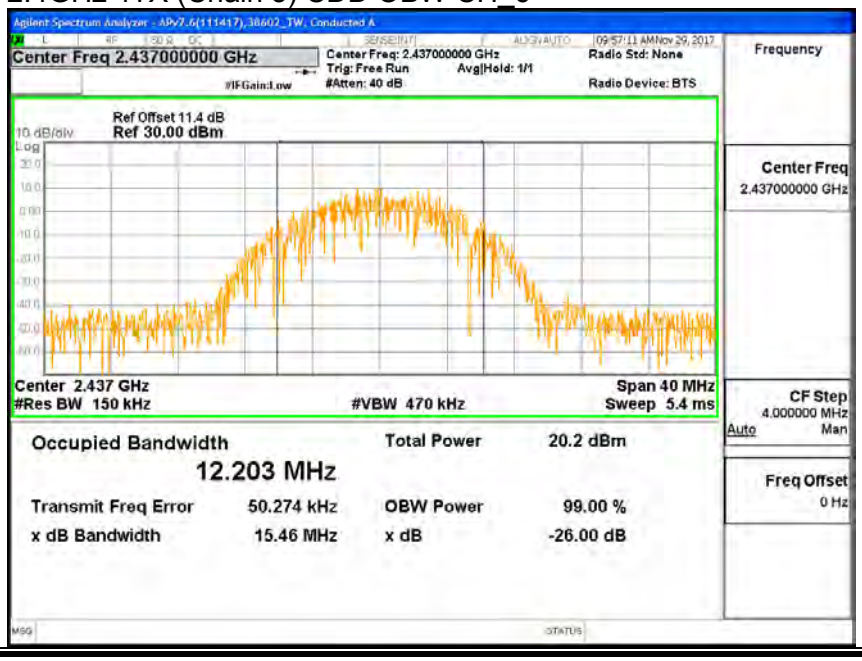
2.4GHz 4TX (Chain 1) CDD OBW CH_6



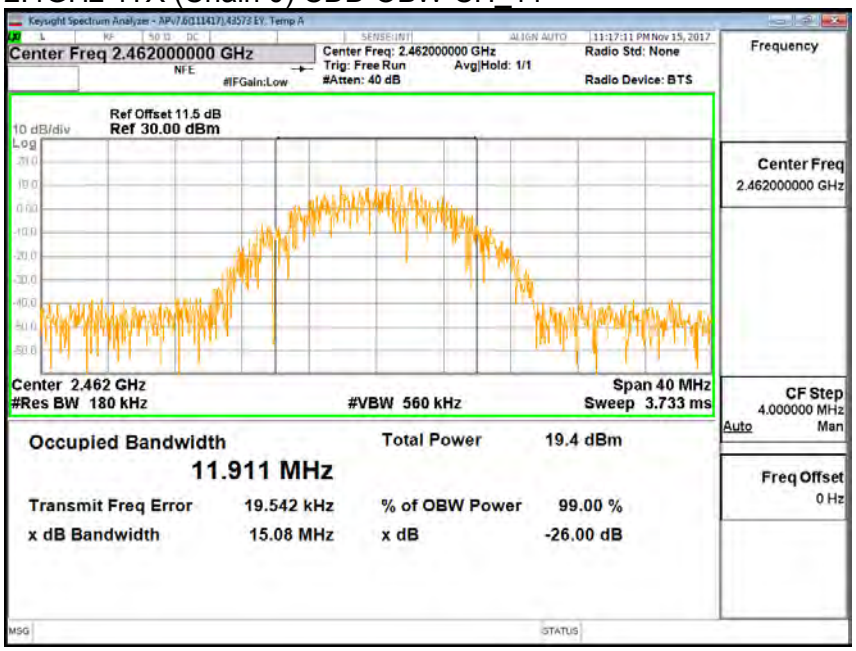
2.4GHz 4TX (Chain 2) CDD OBW CH_6



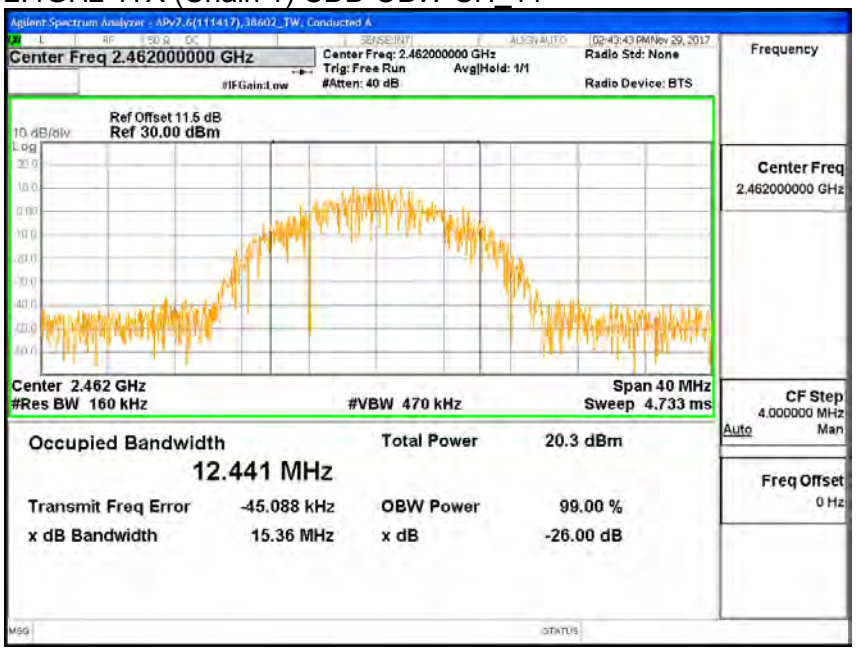
2.4GHz 4TX (Chain 3) CDD OBW CH_6



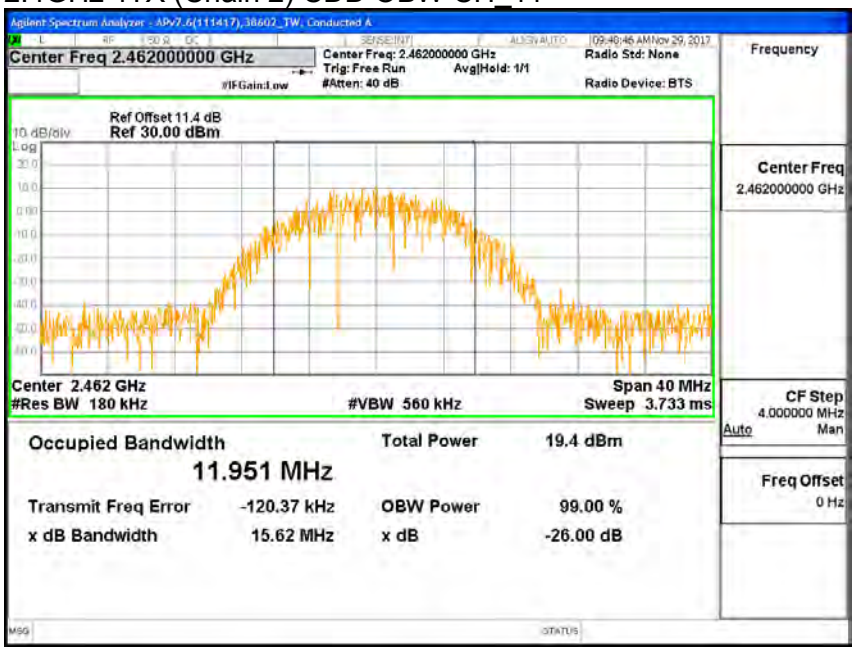
2.4GHz 4TX (Chain 0) CDD OBW CH_11



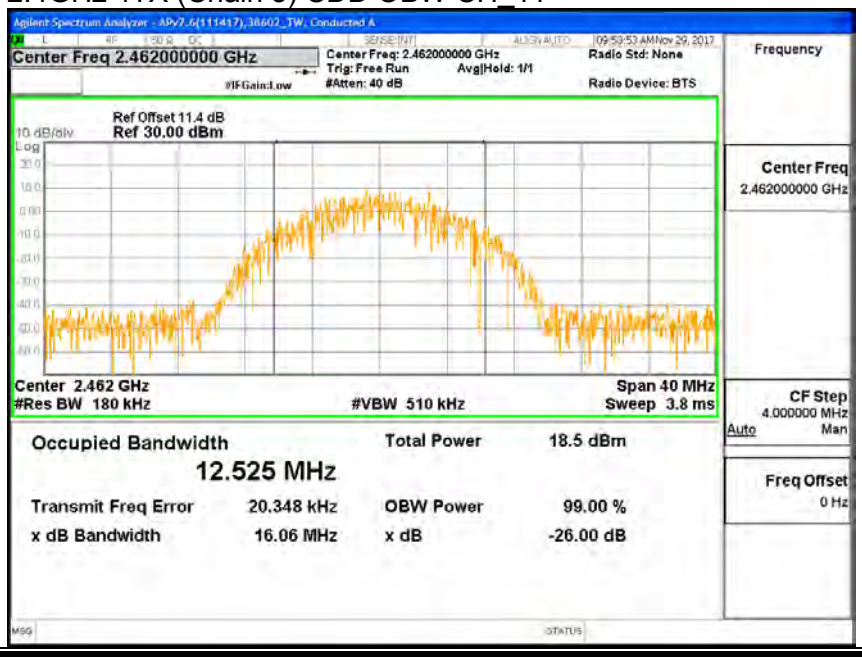
2.4GHz 4TX (Chain 1) CDD OBW CH_11



2.4GHz 4TX (Chain 2) CDD OBW CH_11



2.4GHz 4TX (Chain 3) CDD OBW CH_11



8.1.3. OUTPUT POWER

ID:	12506	Date:	11/15/17

LIMITS

FCC §15.247

IC RSS-247 (5.4) (d)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Horizontal Polarity

Chain 1 Antenna Gain (dBi)	Chain 3 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.66	3.45	3.56

Vertical Polarity (Worst Case)

Chain 0 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.47	4.76	4.16

RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	IC EIRP Limit (dBm)
Ch_1	2412	4.16	30.00	30	36	30.00
Ch_6	2437	4.16	30.00	30	36	30.00
Ch_11	2462	4.16	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Ch_1	2412	19.20	20.09	19.50	19.35	25.57	30.00	-4.43
Ch_6	2437	20.03	20.65	19.50	19.49	**25.96**	30.00	-4.04
Ch_11	2462	19.09	19.46	19.00	18.60	25.07	30.00	-4.93

8.1.4. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-247 (5.2) (b)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

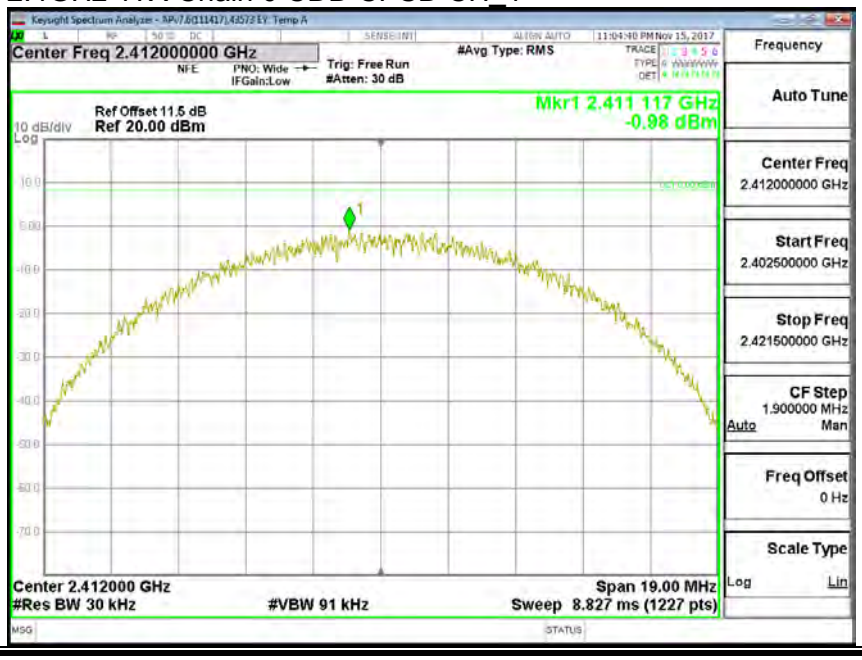
RESULTS

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD

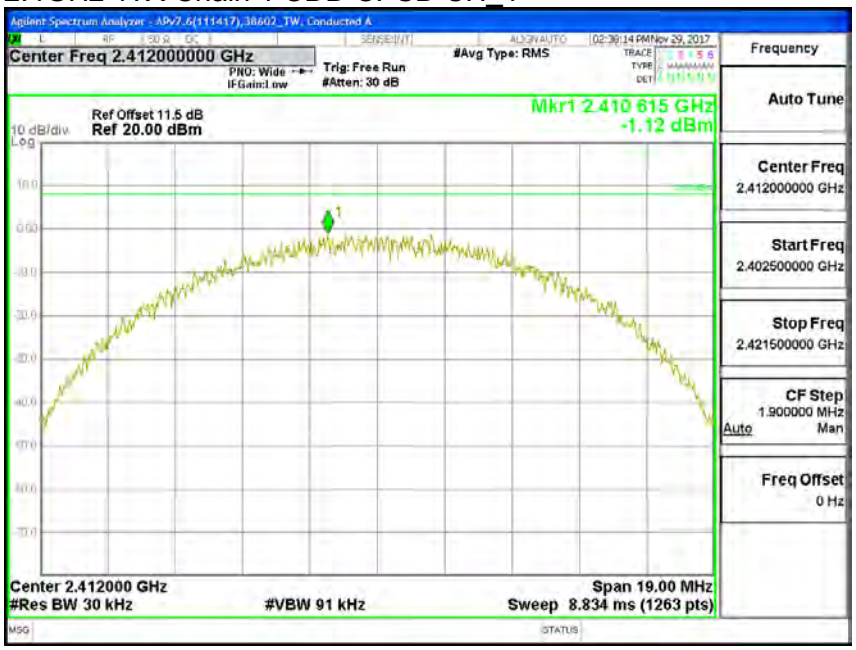
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Chain 2 Meas (dBm)	Chain 3 Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
CH_1	2412	-0.98	-1.12	-0.90	-1.20	4.97	8.0	-3.0
CH_6	2437	-1.23	-1.08	-0.61	-1.03	**5.04**	8.0	-3.0
CH_11	2462	-1.92	-1.04	-1.56	-2.48	4.30	8.0	-3.7

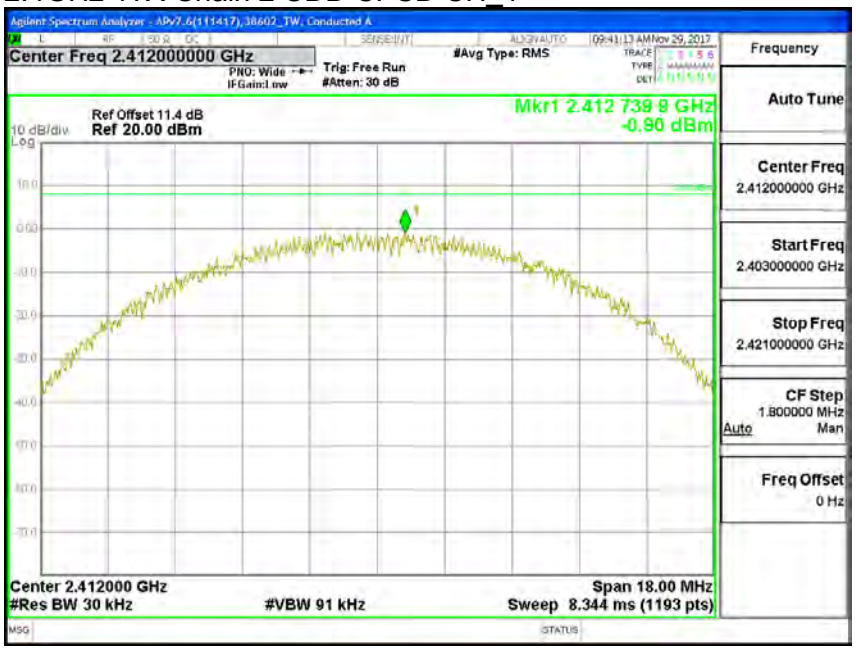
2.4GHz 4TX Chain 0 CDD CPSD CH_1



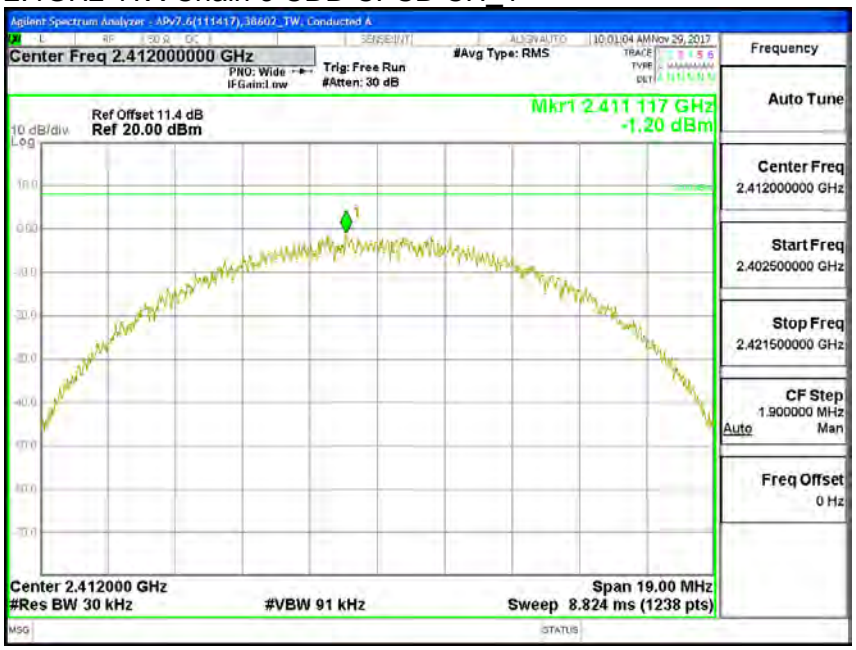
2.4GHz 4TX Chain 1 CDD CPSD CH_1



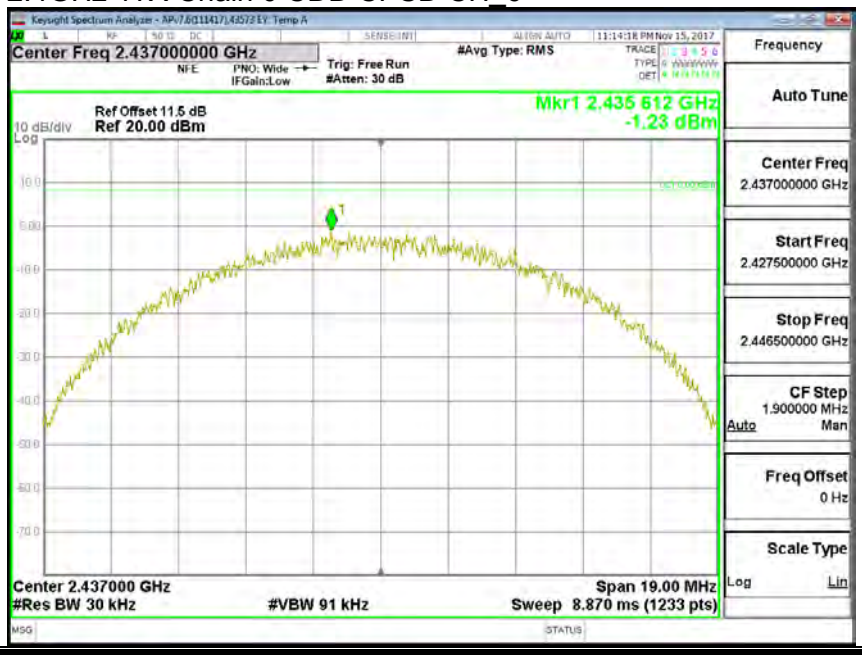
2.4GHz 4TX Chain 2 CDD CPSD CH_1



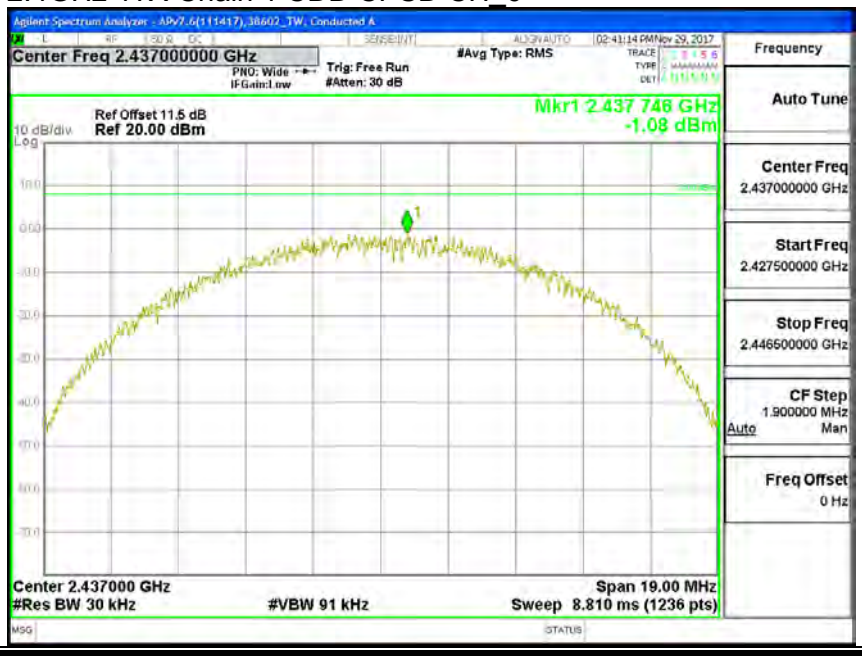
2.4GHz 4TX Chain 3 CDD CPSD CH_1



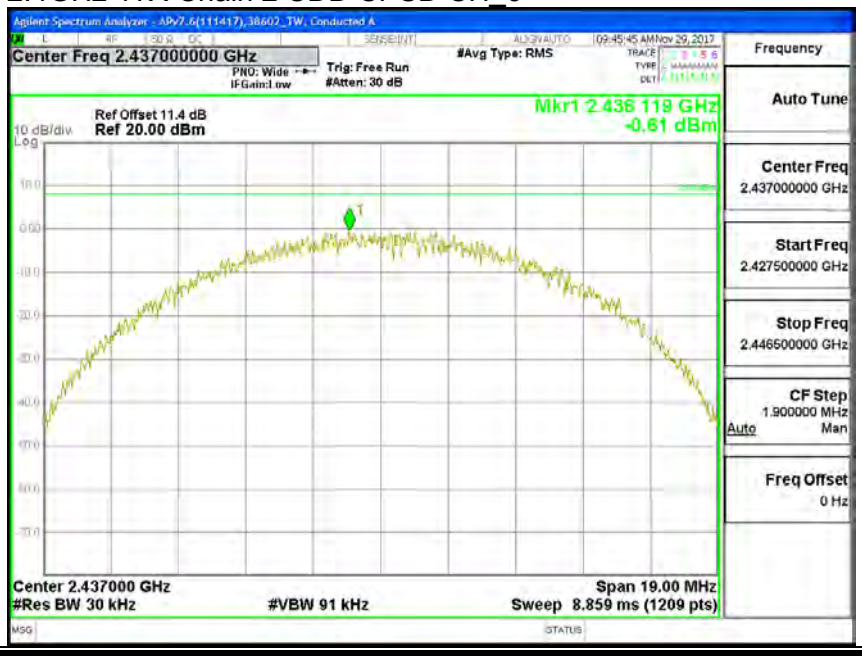
2.4GHz 4TX Chain 0 CDD CPSD CH_6



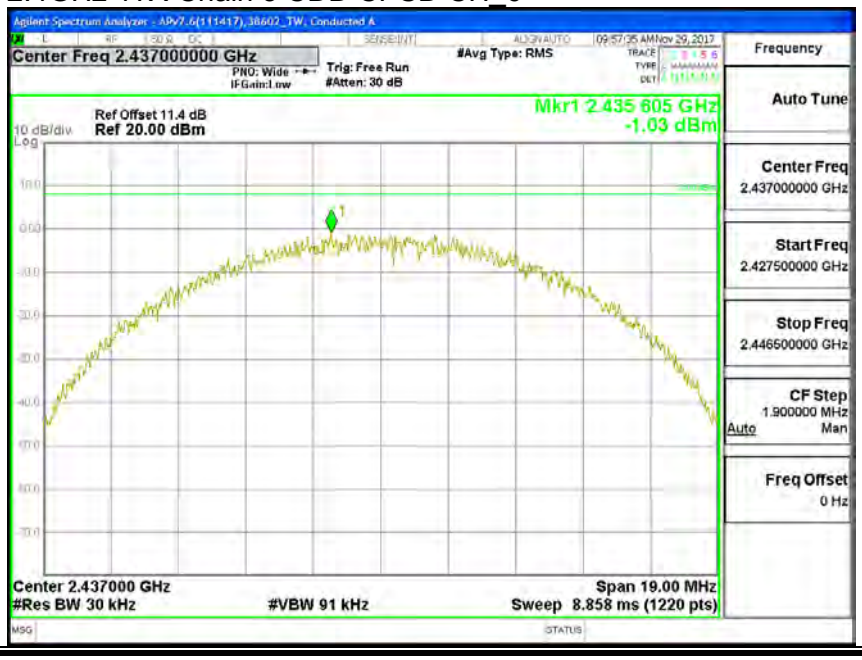
2.4GHz 4TX Chain 1 CDD CPSD CH_6



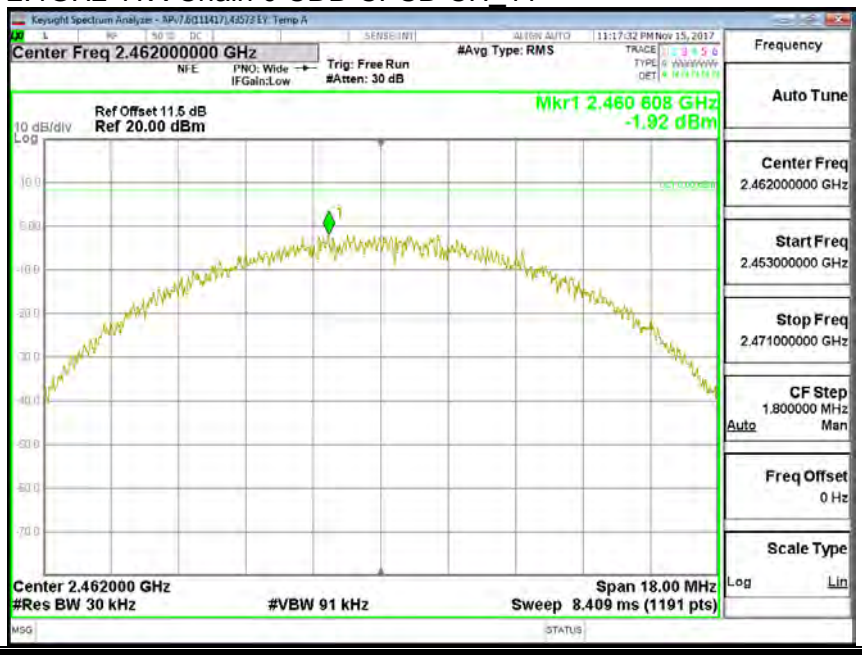
2.4GHz 4TX Chain 2 CDD CPSD CH_6



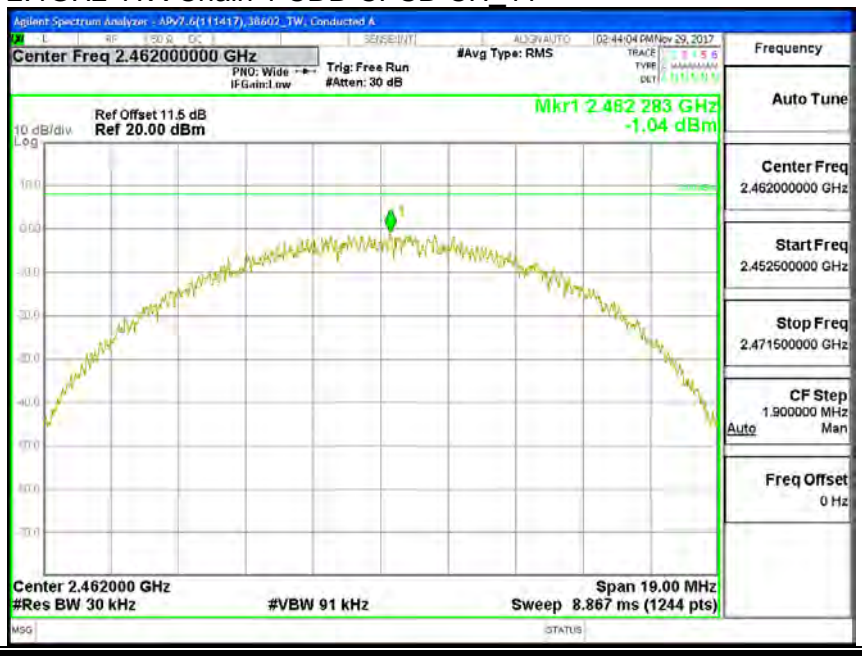
2.4GHz 4TX Chain 3 CDD CPSD CH_6



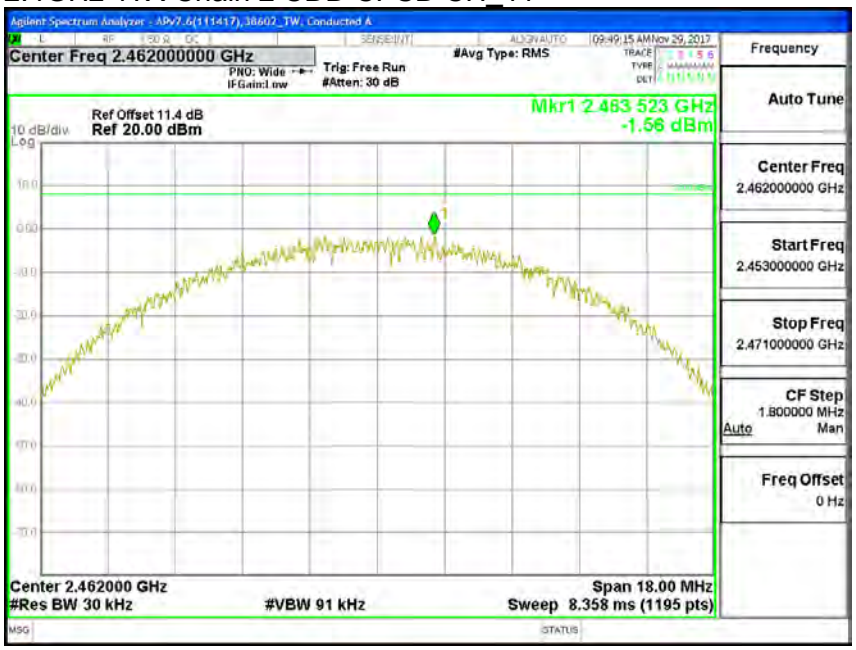
2.4GHz 4TX Chain 0 CDD CPSD CH_11



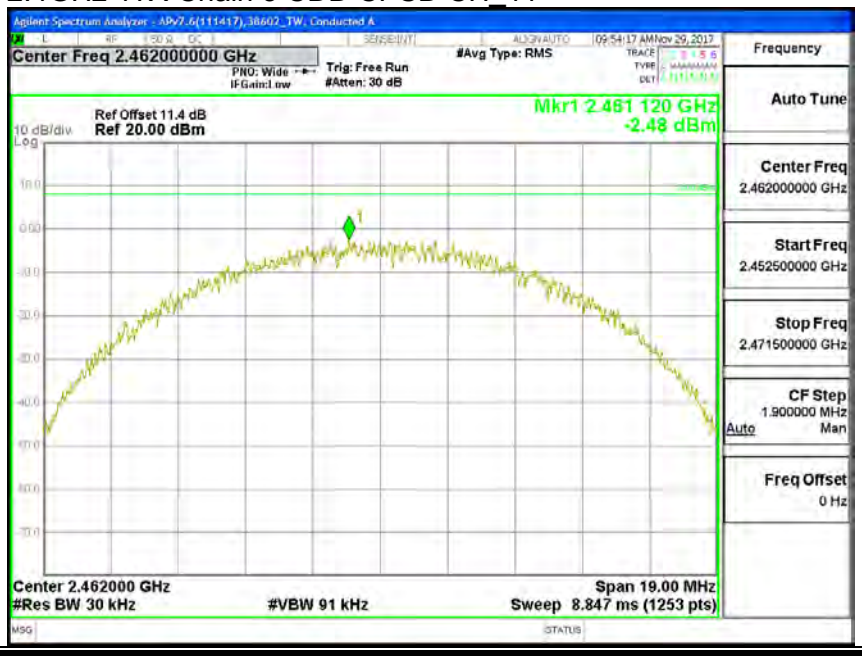
2.4GHz 4TX Chain 1 CDD CPSD CH_11



2.4GHz 4TX Chain 2 CDD CPSD CH_11

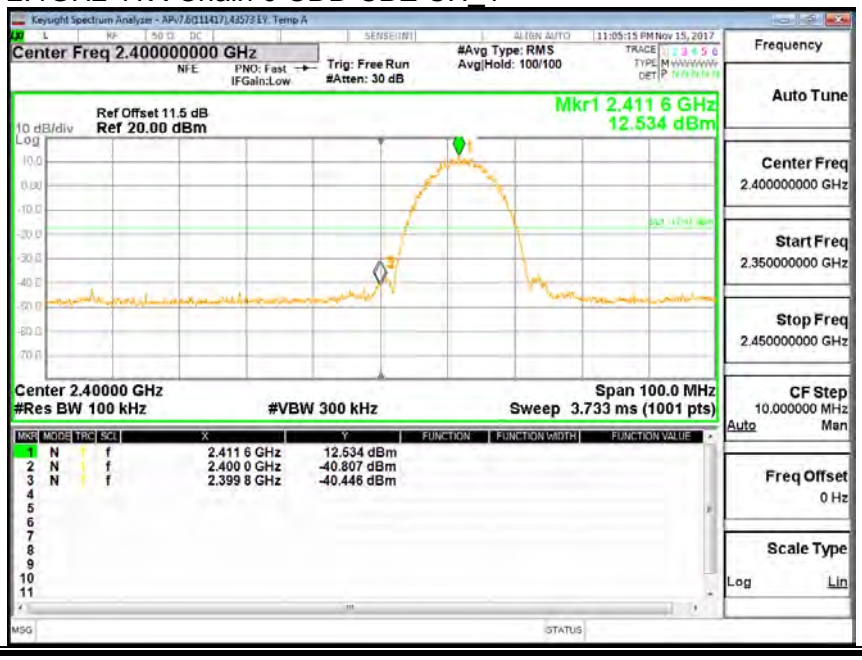


2.4GHz 4TX Chain 3 CDD CPSD CH_11

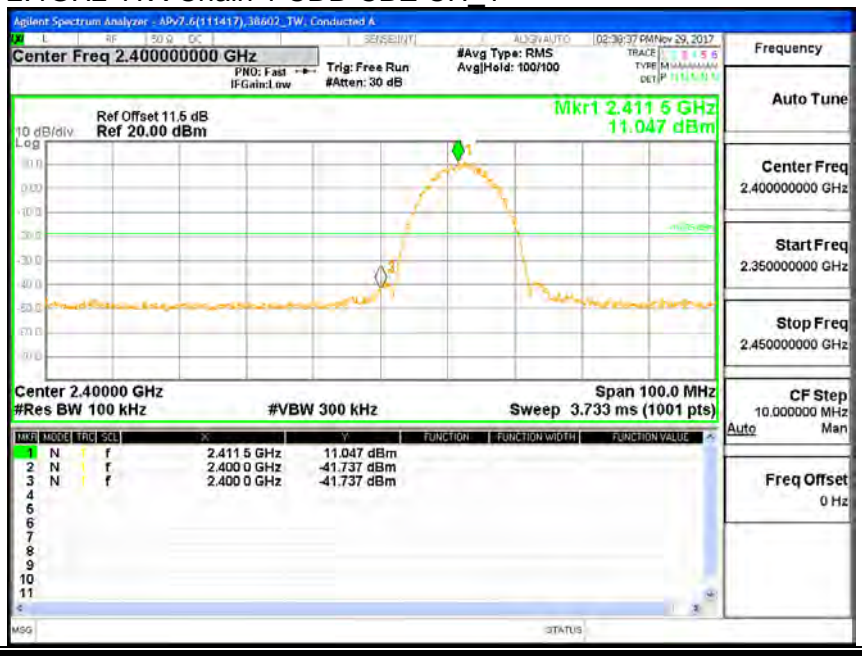


8.1.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

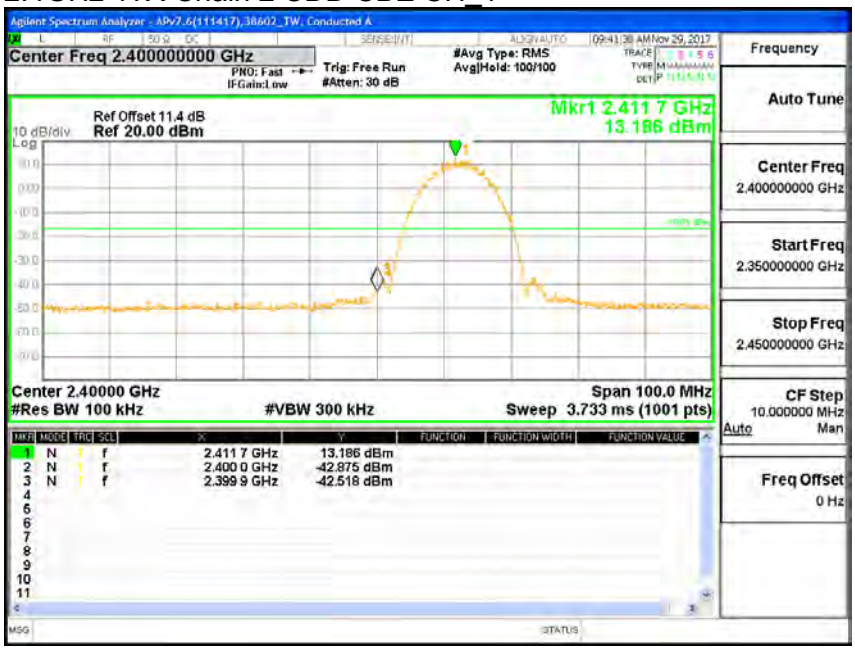
2.4GHz 4TX Chain 0 CDD CBE CH_1



2.4GHz 4TX Chain 1 CDD CBE CH_1

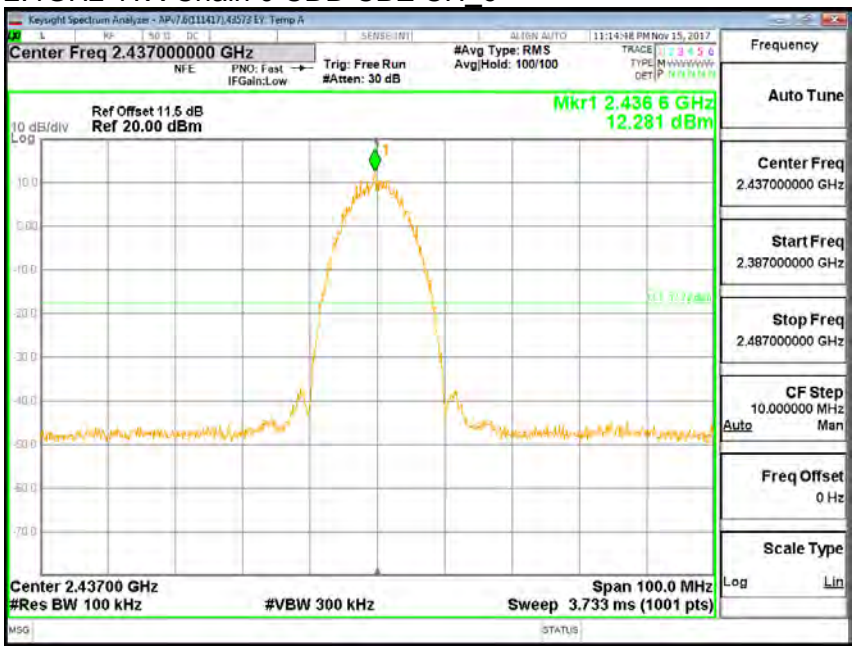


2.4GHz 4TX Chain 2 CDD CBE CH_1

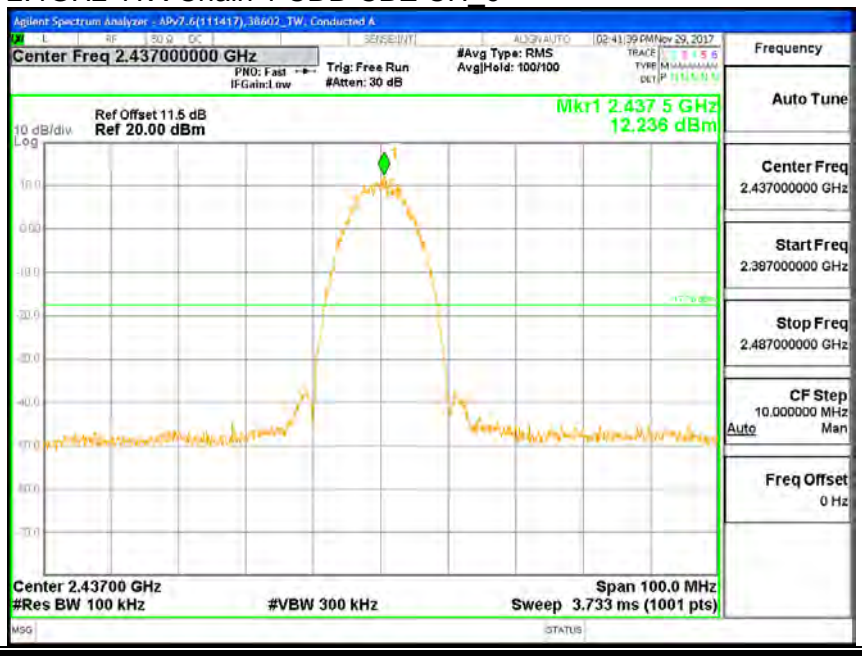


2.4GHz 4TX Chain 3 CDD CBE CH_1

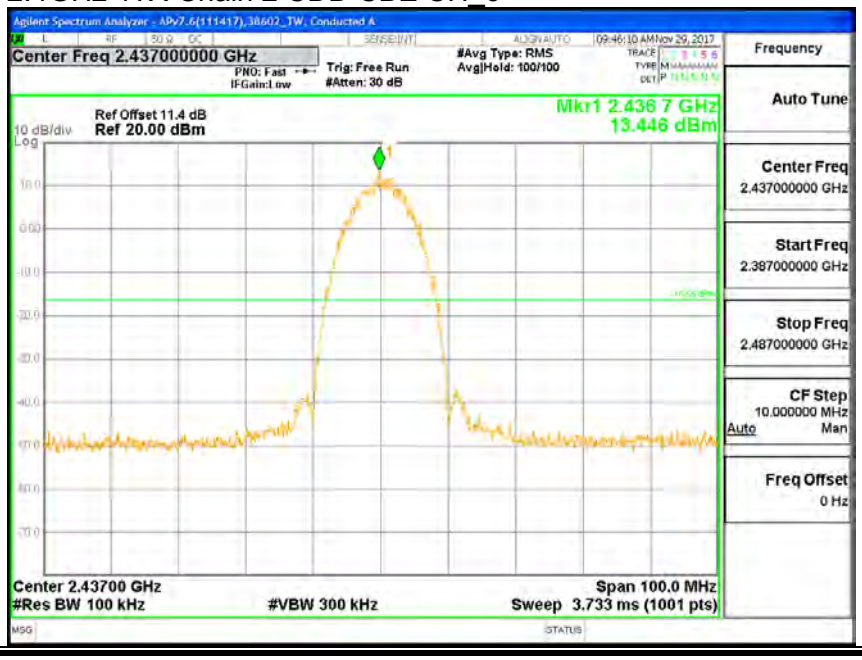
2.4GHz 4TX Chain 0 CDD CBE CH_6



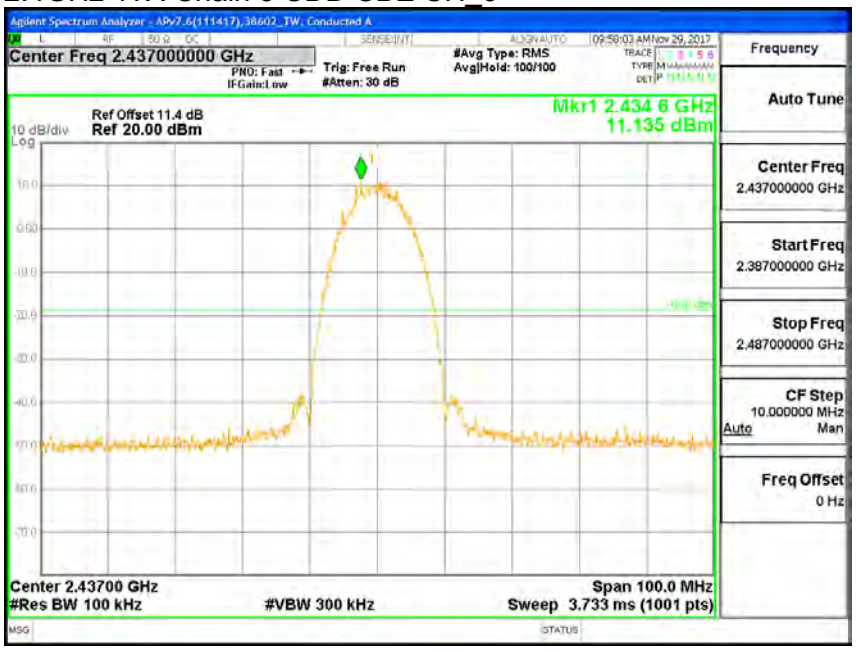
2.4GHz 4TX Chain 1 CDD CBE CH_6



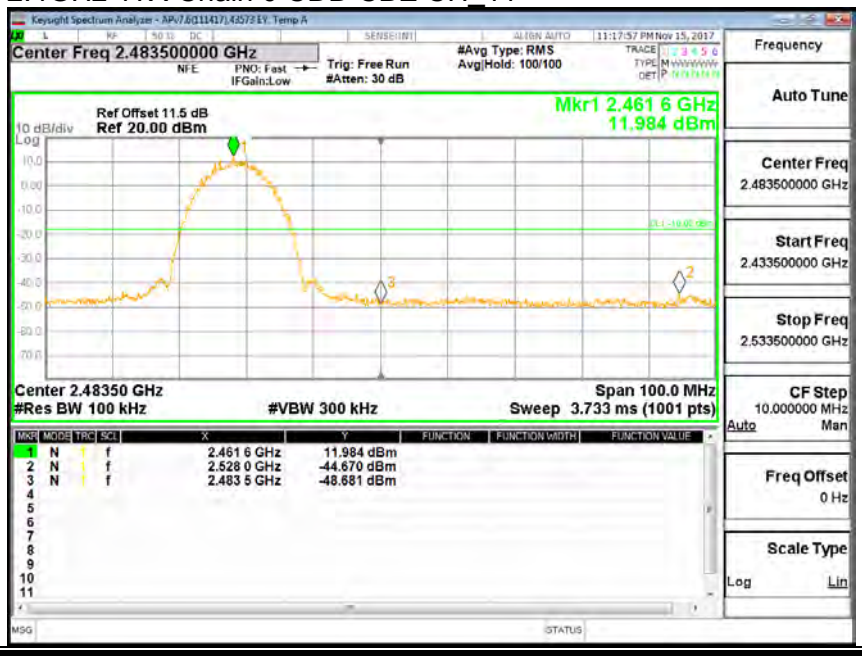
2.4GHz 4TX Chain 2 CDD CBE CH_6



2.4GHz 4TX Chain 3 CDD CBE CH_6

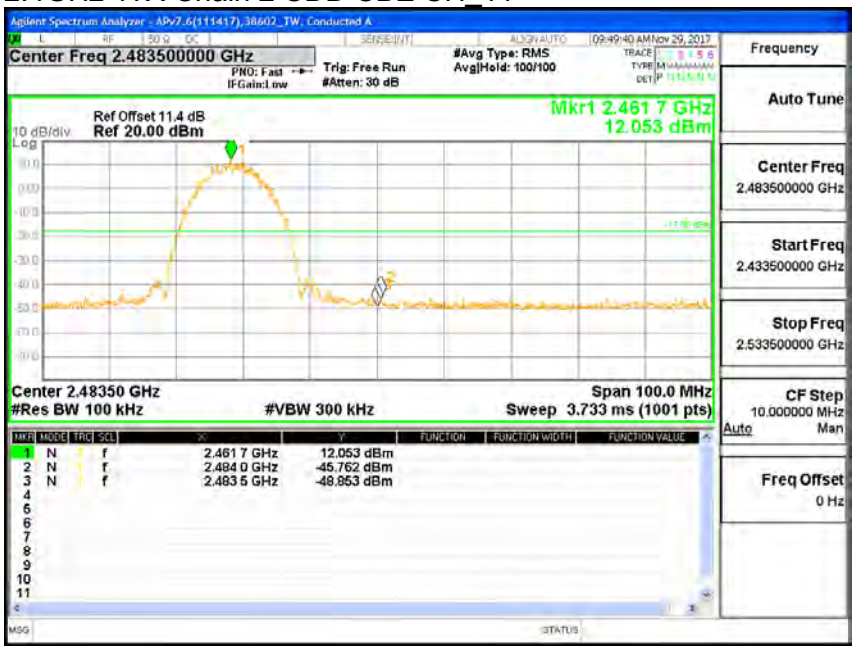


2.4GHz 4TX Chain 0 CDD CBE CH_11



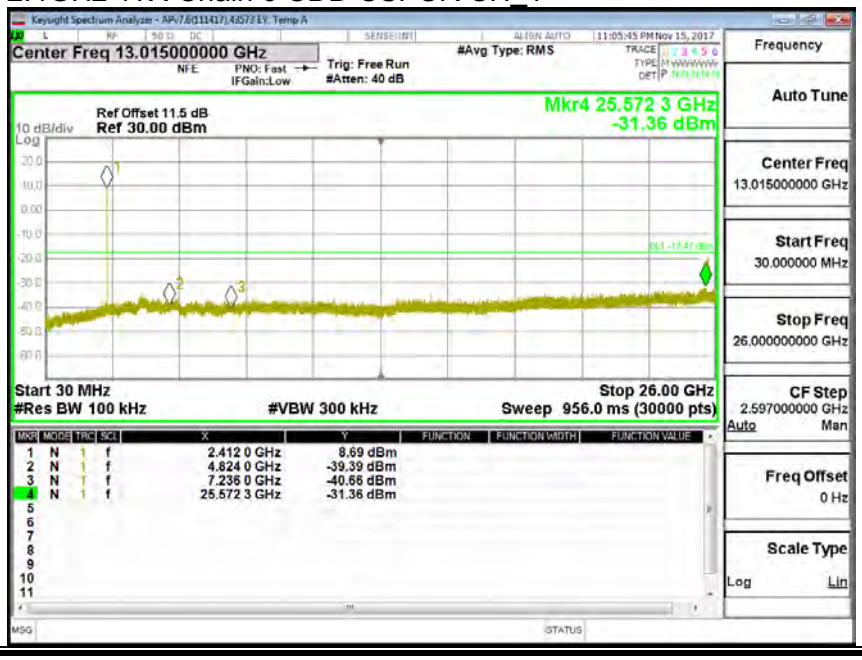
2.4GHz 4TX Chain 1 CDD CBE CH_11

2.4GHz 4TX Chain 2 CDD CBE CH_11



2.4GHz 4TX Chain 3 CDD CBE CH_11

2.4GHz 4TX Chain 0 CDD CSPUR CH_1

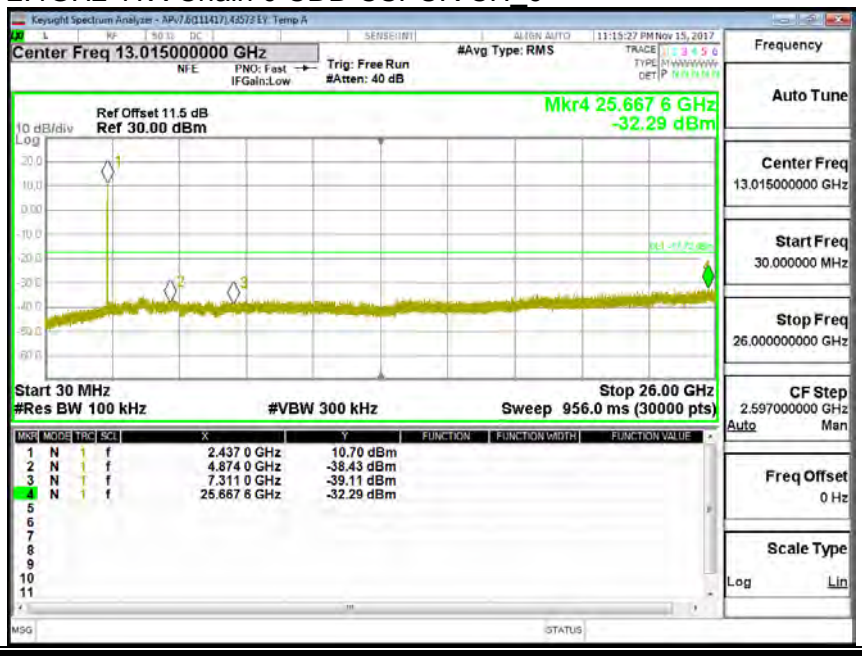


2.4GHz 4TX Chain 1 CDD CSPUR CH_1

2.4GHz 4TX Chain 2 CDD CSPUR CH_1

2.4GHz 4TX Chain 3 CDD CSPUR CH_1

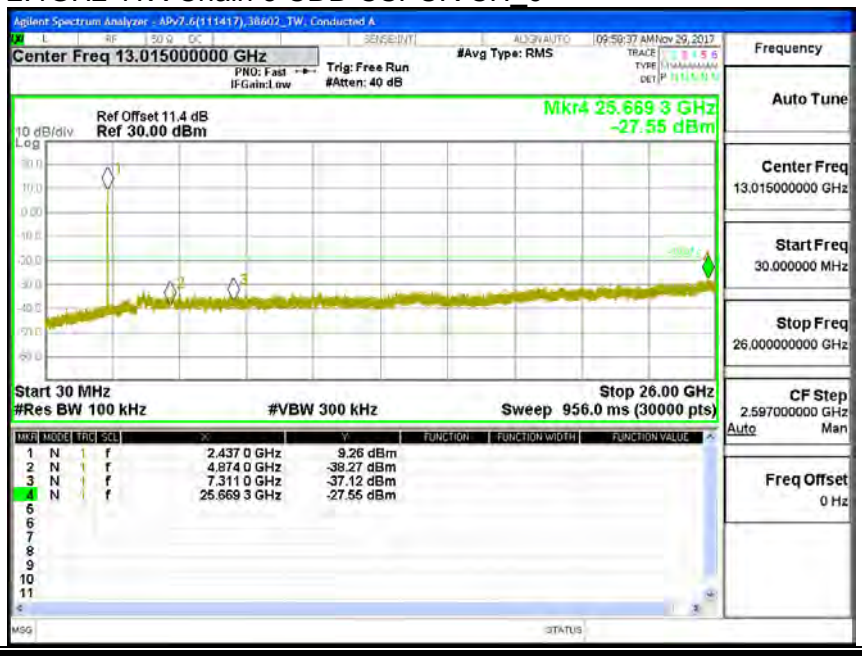
2.4GHz 4TX Chain 0 CDD CSPUR CH_6



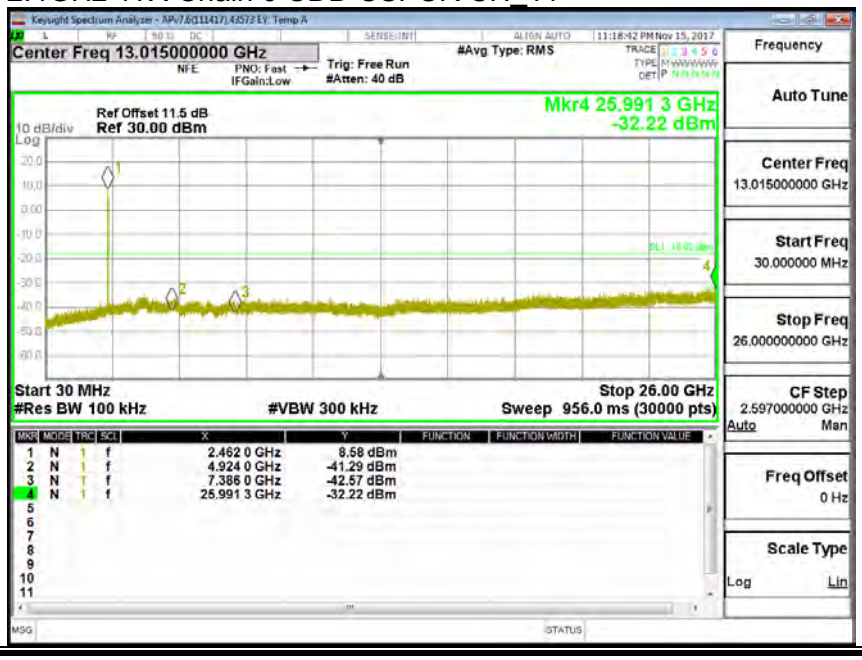
2.4GHz 4TX Chain 1 CDD CSPUR CH_6

2.4GHz 4TX Chain 2 CDD CSPUR CH_6

2.4GHz 4TX Chain 3 CDD CSPUR CH_6

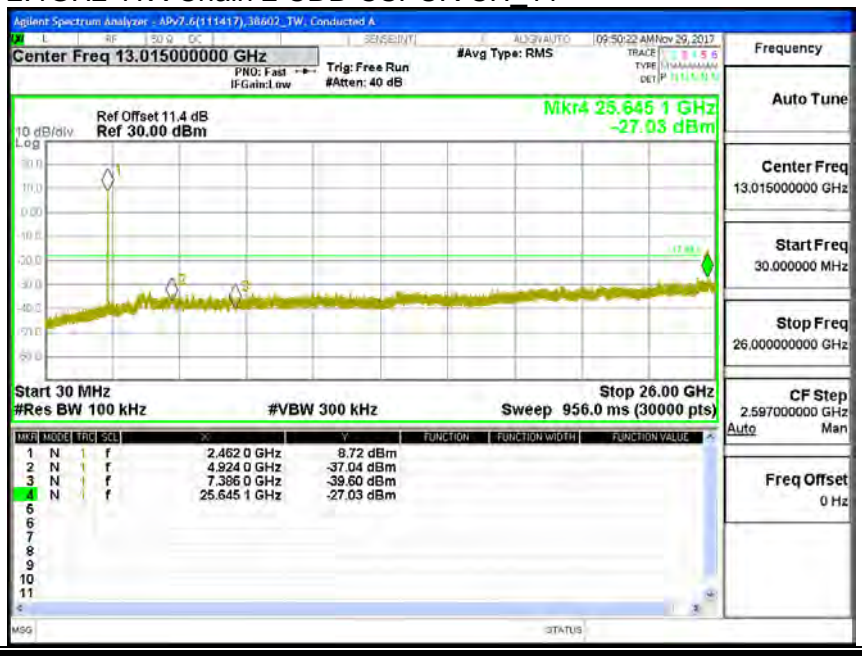


2.4GHz 4TX Chain 0 CDD CSPUR CH_11



2.4GHz 4TX Chain 1 CDD CSPUR CH_11

2.4GHz 4TX Chain 2 CDD CSPUR CH_11



2.4GHz 4TX Chain 3 CDD CSPUR CH_11

8.2. 11g 4TX CDD MIMO MODE IN THE 2.4GHz BAND

8.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

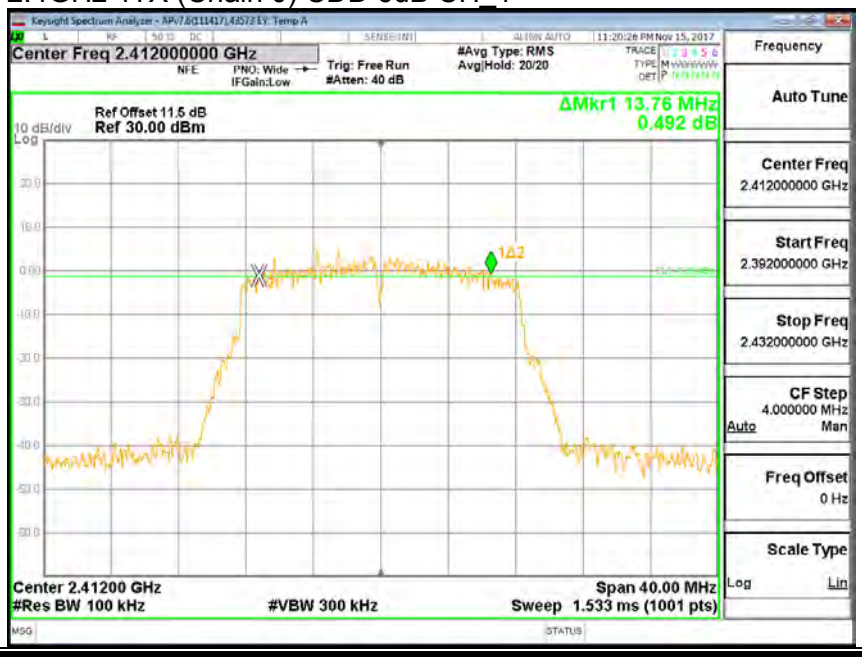
IC RSS-247 (5.2) (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

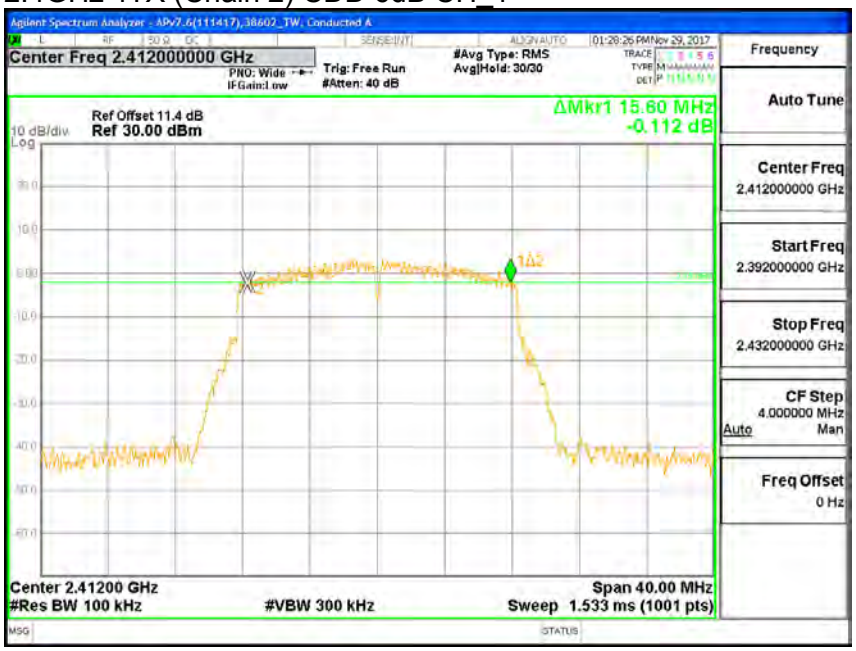
Channel	Frequency	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	6 dB BW Chain 2 (MHz)	6 dB BW Chain 3 (MHz)	Minimum Limit (MHz)
CH_1	2412	13.76	15.64	15.60	15.64	0.5
CH_2	2417	12.64	16.36	15.92	**16.40**	0.5
CH_6	2437	13.76	16.32	15.40	15.68	0.5
CH_10	2457	13.52	16.36	16.28	16.04	0.5
CH_11	2462	15.72	15.88	15.64	15.76	0.5

2.4GHz 4TX (Chain 0) CDD 6dB CH_1



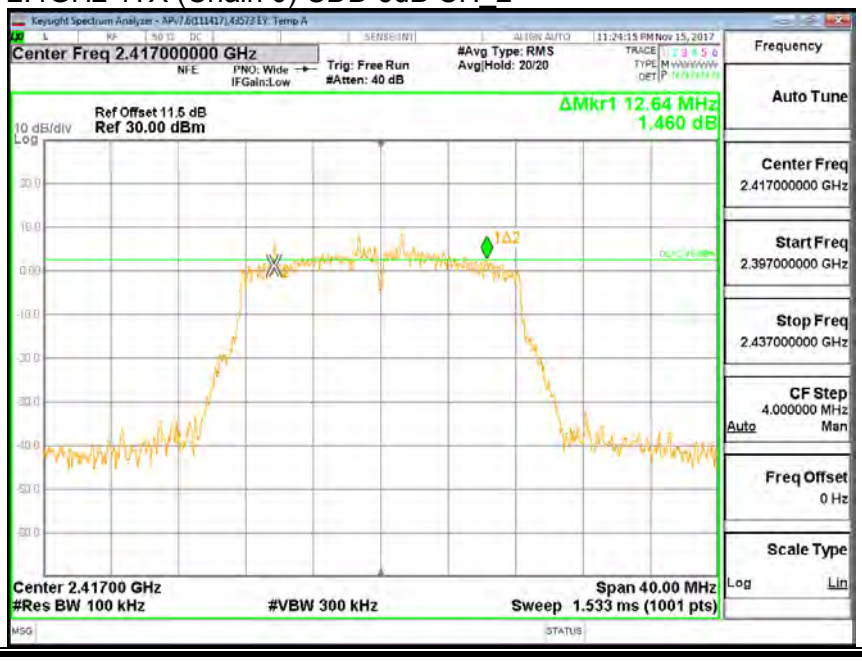
2.4GHz 4TX (Chain 1) CDD 6dB CH_1

2.4GHz 4TX (Chain 2) CDD 6dB CH_1



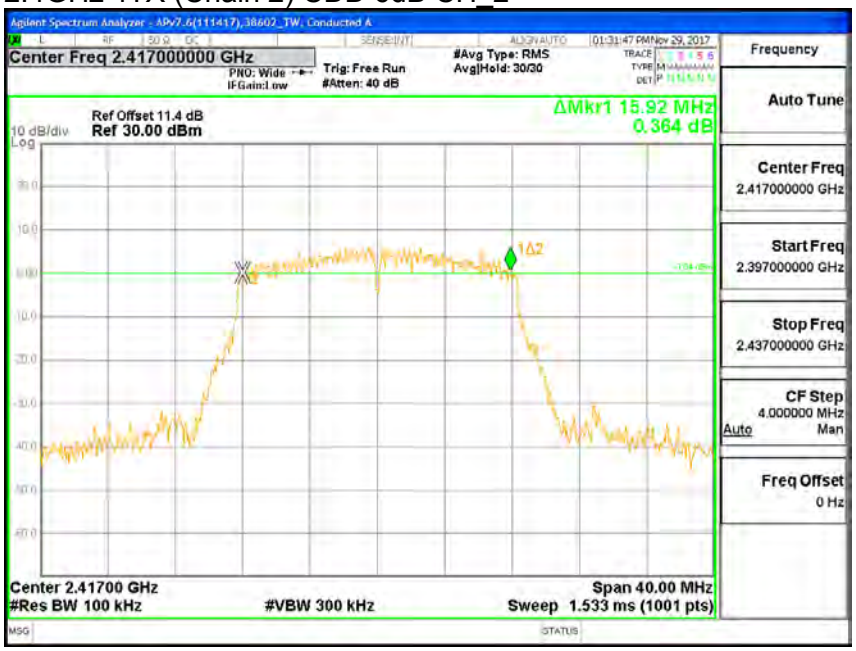
2.4GHz 4TX (Chain 3) CDD 6dB CH_1

2.4GHz 4TX (Chain 0) CDD 6dB CH_2



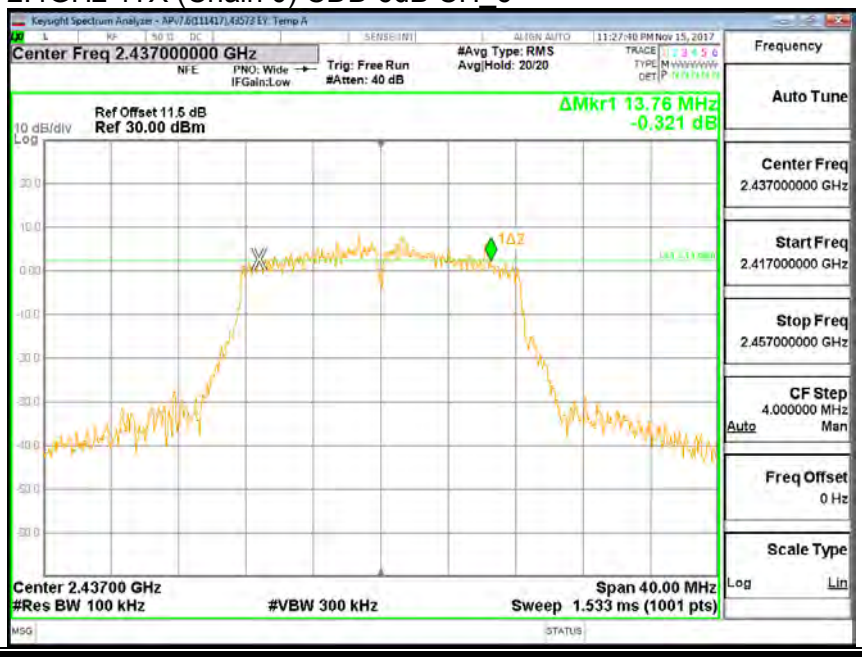
2.4GHz 4TX (Chain 1) CDD 6dB CH_2

2.4GHz 4TX (Chain 2) CDD 6dB CH_2

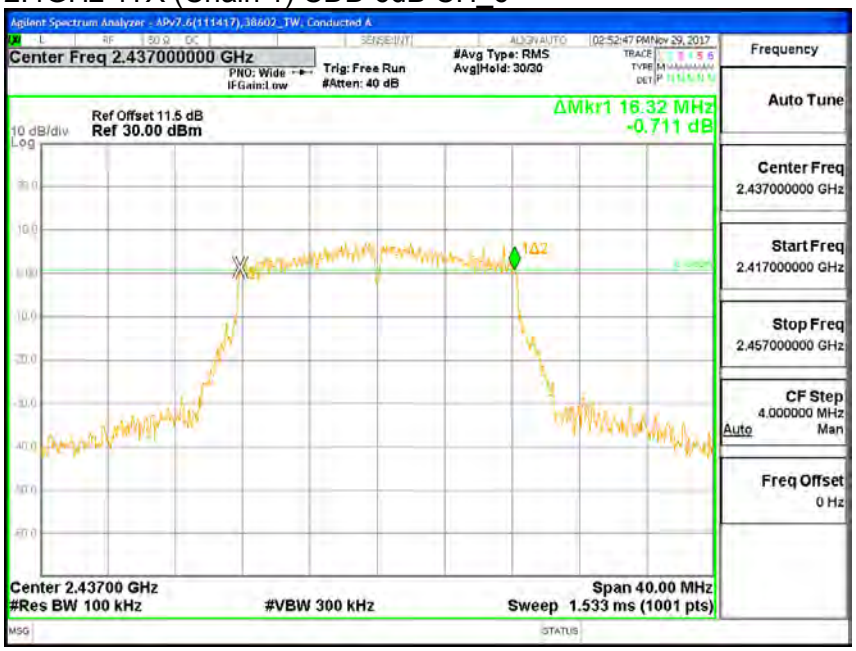


2.4GHz 4TX (Chain 3) CDD 6dB CH_2

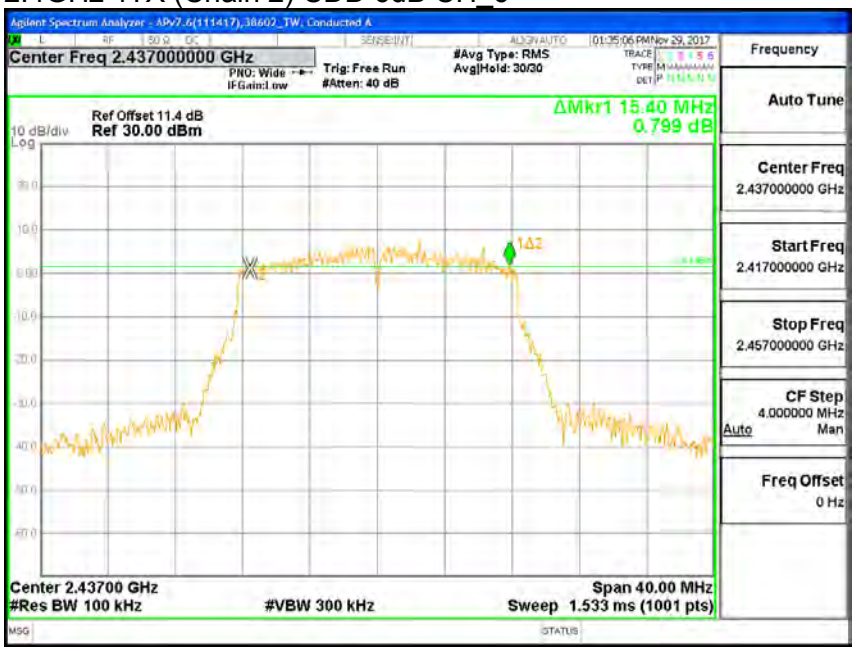
2.4GHz 4TX (Chain 0) CDD 6dB CH_6



2.4GHz 4TX (Chain 1) CDD 6dB CH_6

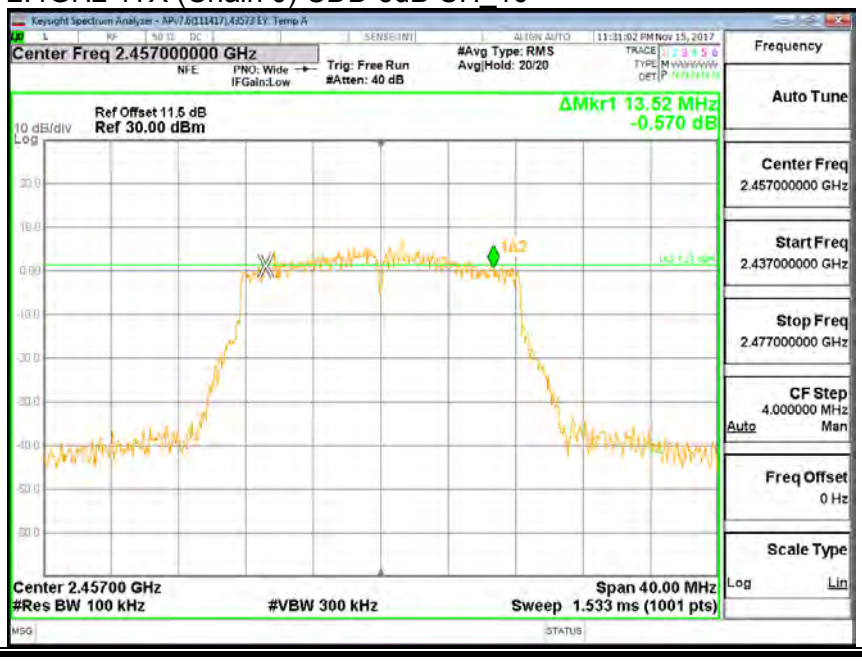


2.4GHz 4TX (Chain 2) CDD 6dB CH_6

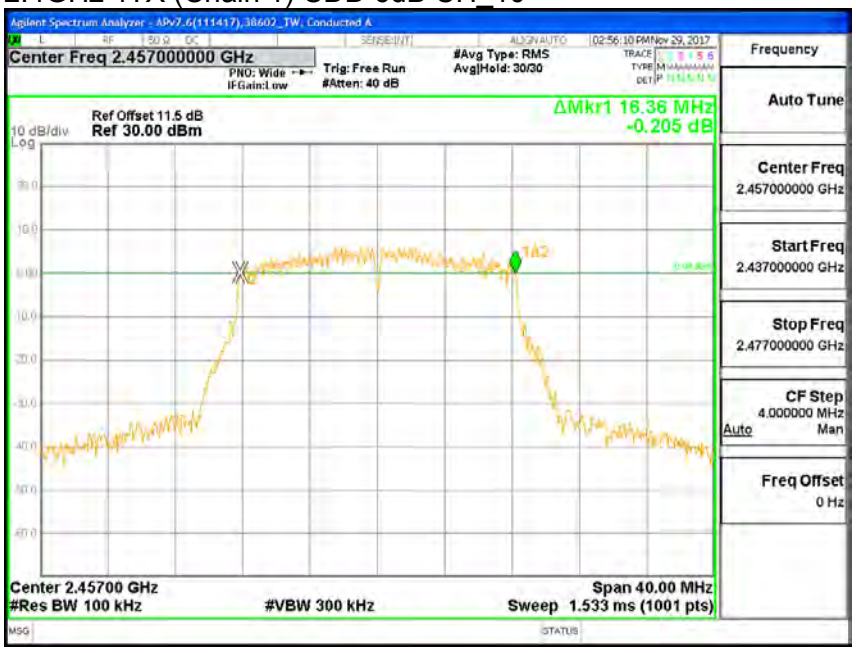


2.4GHz 4TX (Chain 3) CDD 6dB CH_6

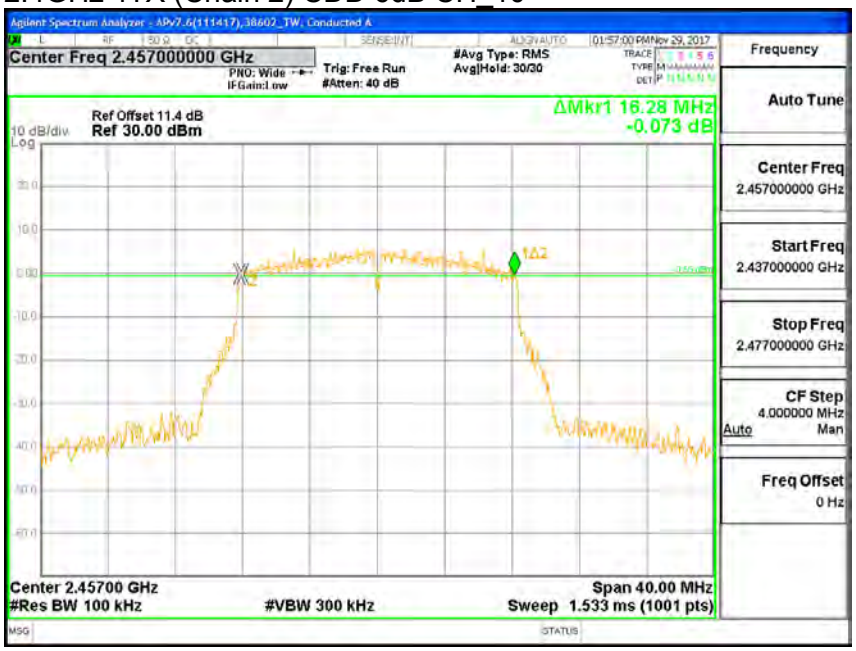
2.4GHz 4TX (Chain 0) CDD 6dB CH_10



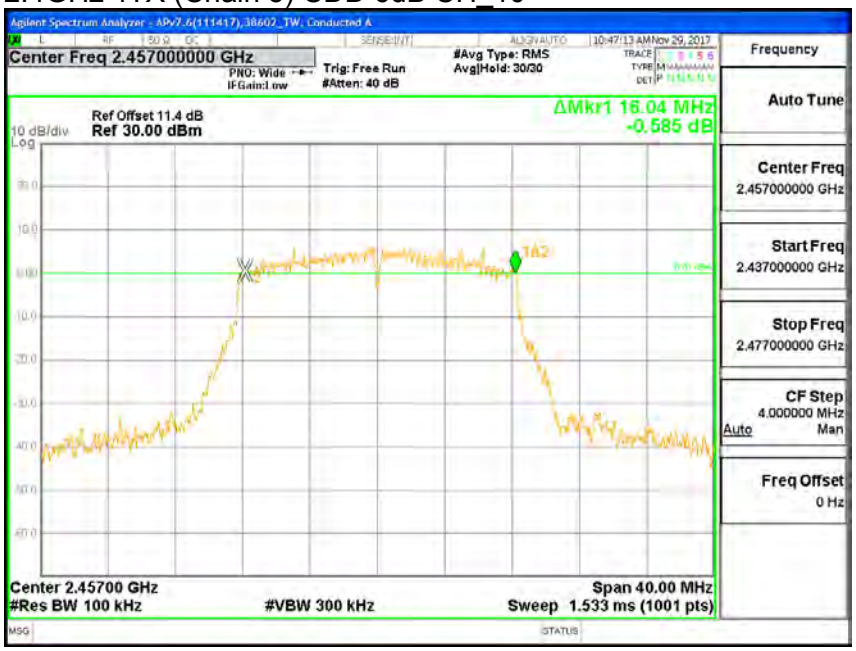
2.4GHz 4TX (Chain 1) CDD 6dB CH_10



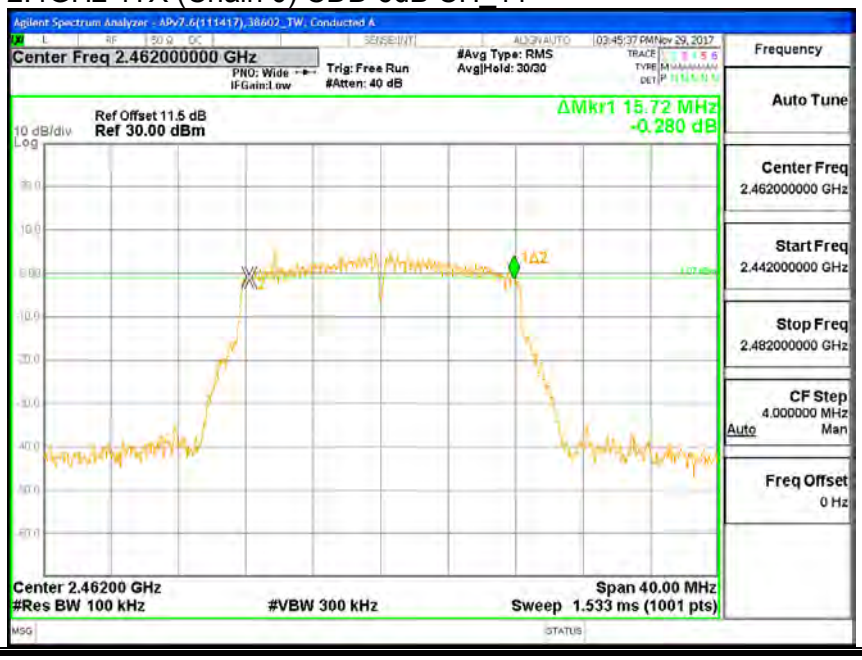
2.4GHz 4TX (Chain 2) CDD 6dB CH_10



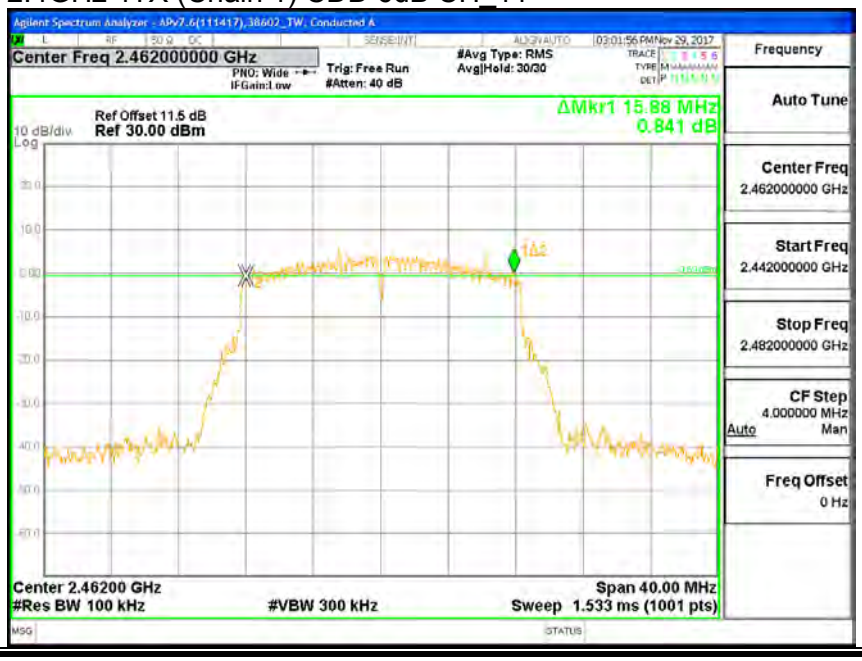
2.4GHz 4TX (Chain 3) CDD 6dB CH_10



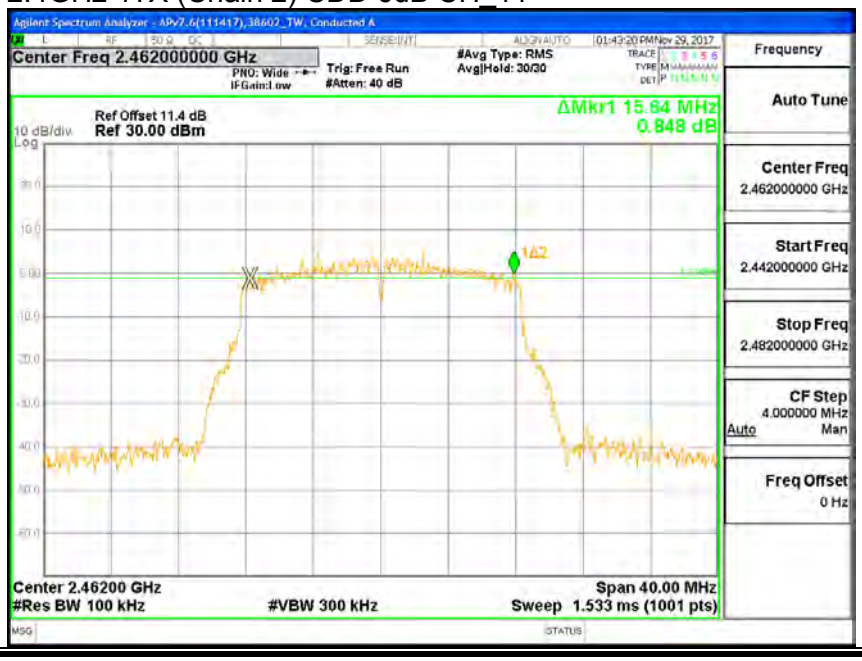
2.4GHz 4TX (Chain 0) CDD 6dB CH_11



2.4GHz 4TX (Chain 1) CDD 6dB CH_11



2.4GHz 4TX (Chain 2) CDD 6dB CH_11



2.4GHz 4TX (Chain 3) CDD 6dB CH_11

8.2.2. 99% BANDWIDTH

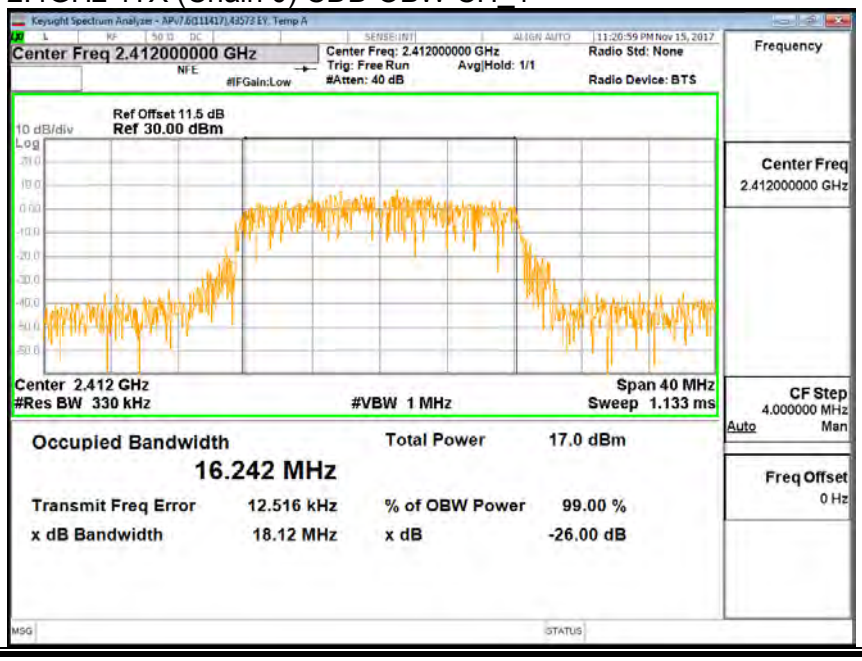
LIMITS

None; for reporting purposes only.

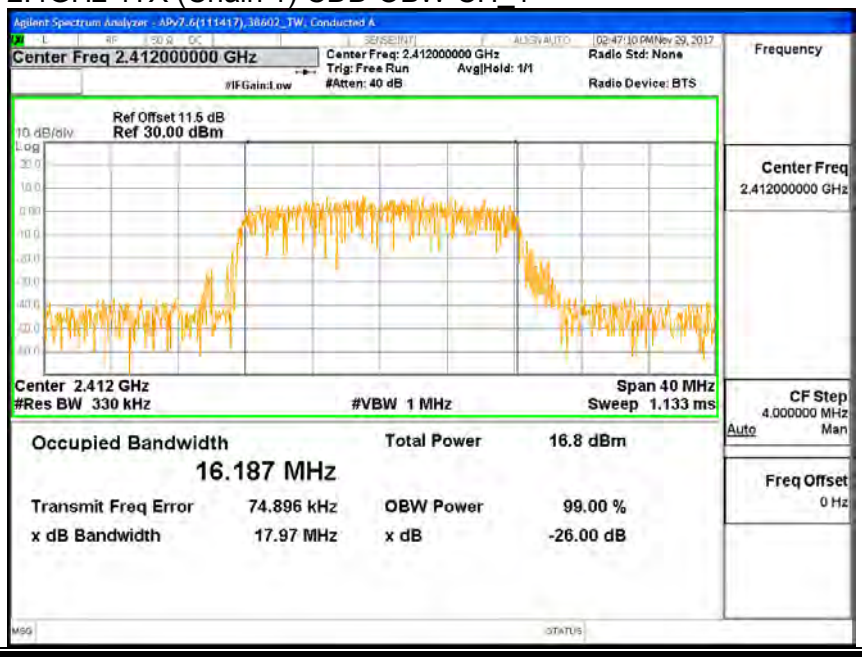
RESULTS

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)	99% Bandwidth Chain 2 (MHz)	99% Bandwidth Chain 3 (MHz)
CH_1	2412	16.242	16.187	16.253	16.011
CH_2	2417	16.332	16.252	**16.403**	16.099
CH_6	2437	16.249	16.342	16.314	16.265
CH_10	2457	16.251	16.344	16.313	16.220
CH_11	2462	16.261	16.343	16.250	16.220

2.4GHz 4TX (Chain 0) CDD OBW CH_1



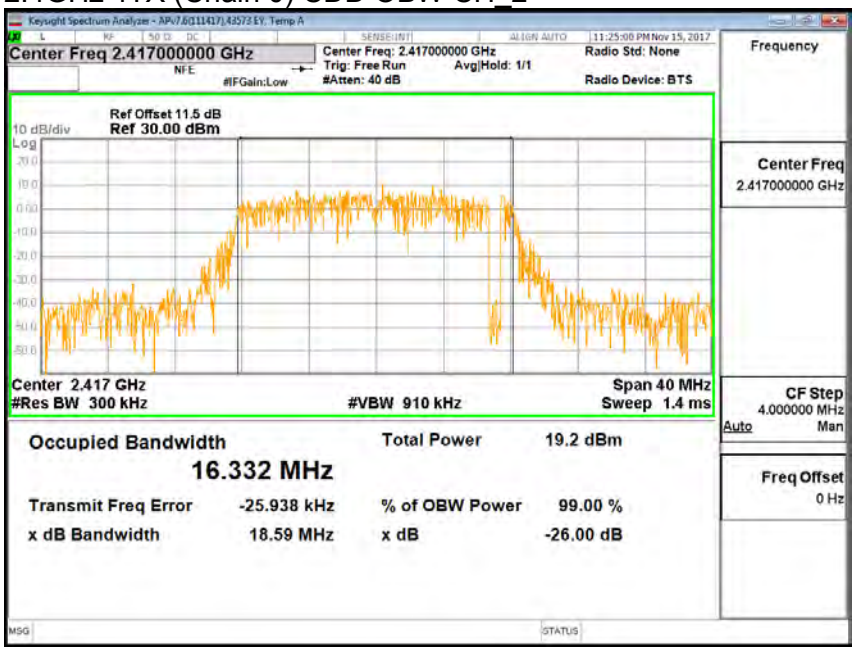
2.4GHz 4TX (Chain 1) CDD OBW CH_1



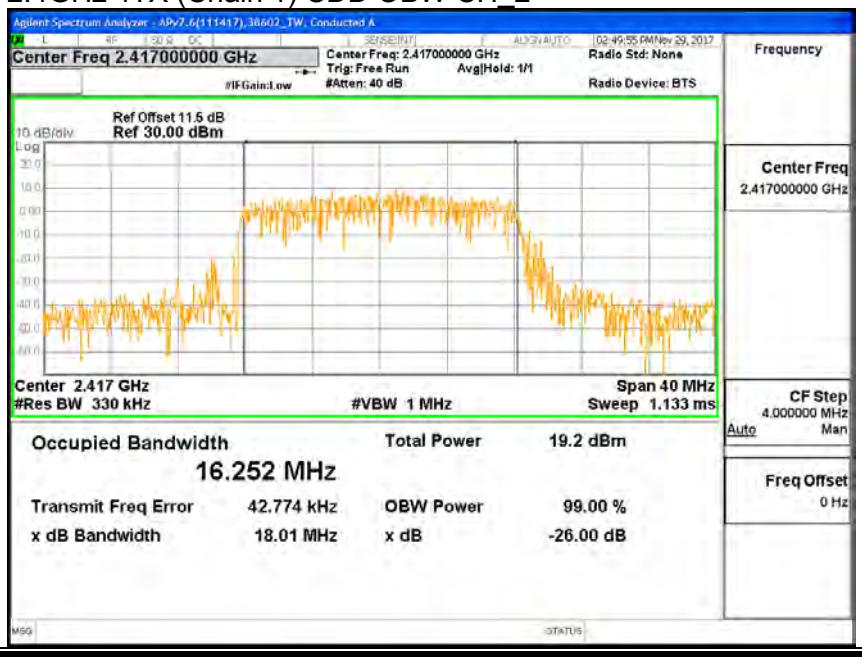
2.4GHz 4TX (Chain 2) CDD OBW CH_1

2.4GHz 4TX (Chain 3) CDD OBW CH_1

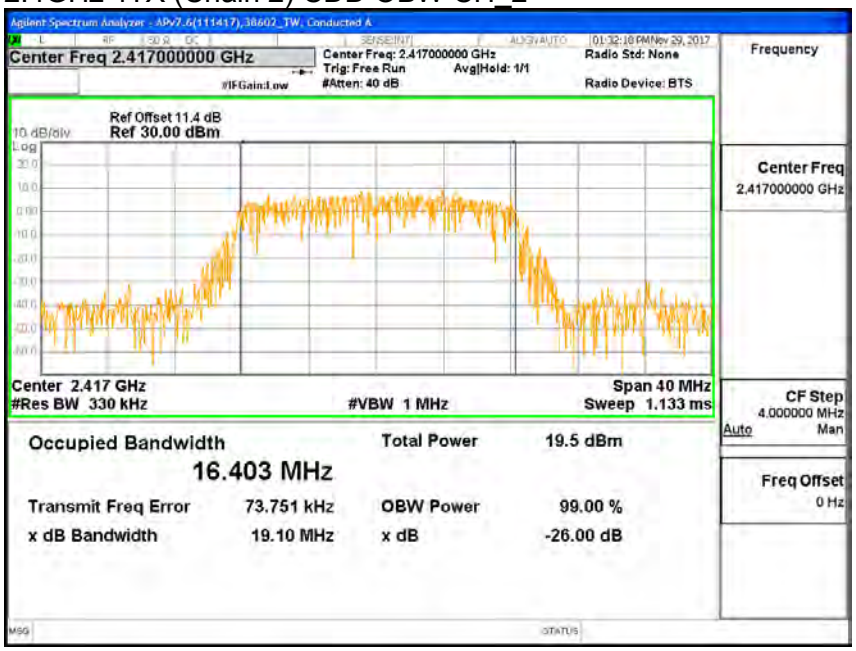
2.4GHz 4TX (Chain 0) CDD OBW CH_2



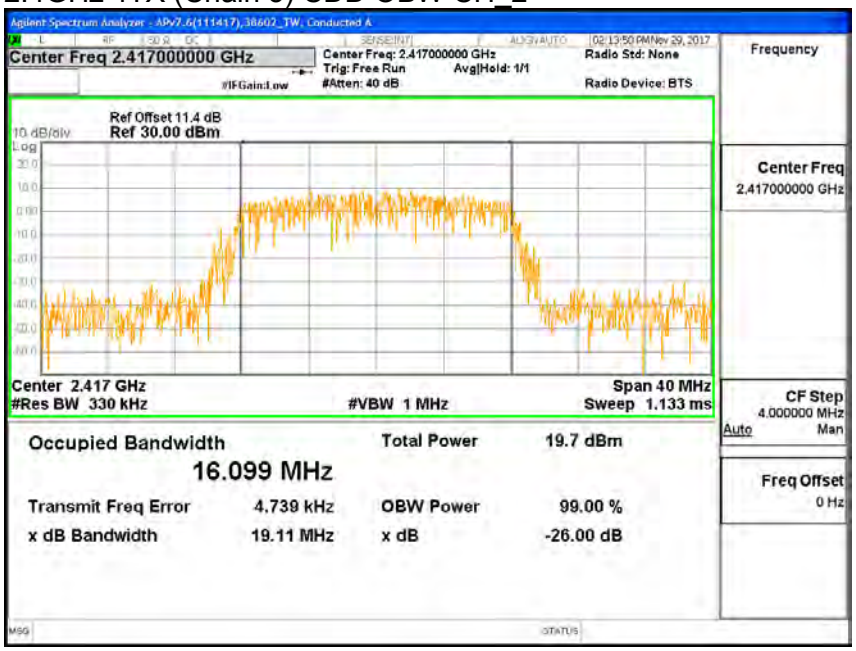
2.4GHz 4TX (Chain 1) CDD OBW CH_2



2.4GHz 4TX (Chain 2) CDD OBW CH_2

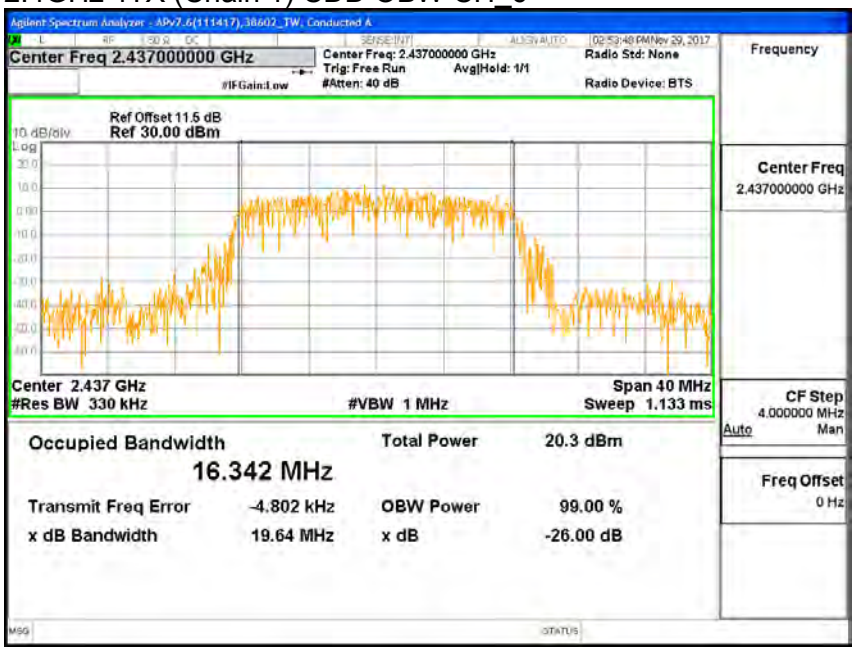


2.4GHz 4TX (Chain 3) CDD OBW CH_2

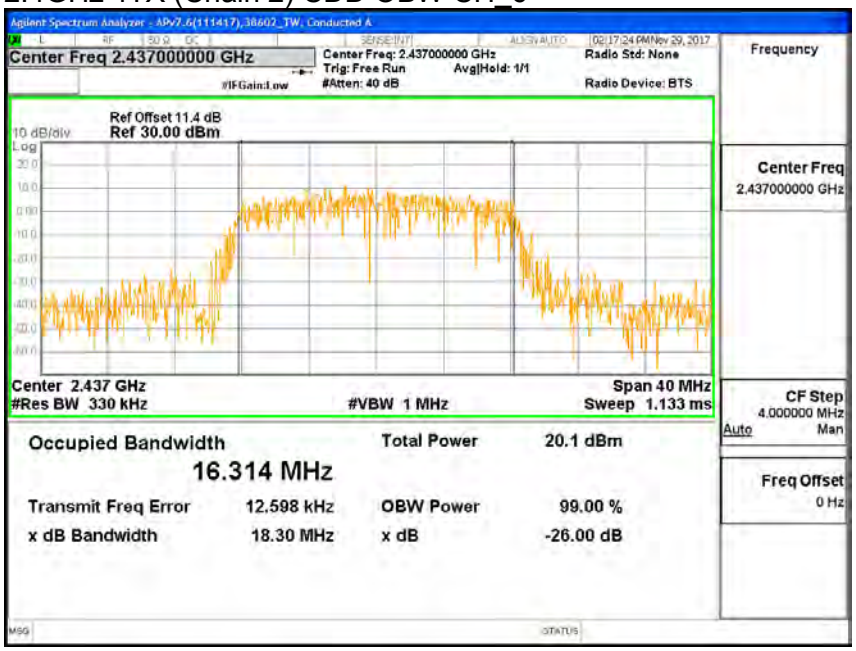


2.4GHz 4TX (Chain 0) CDD OBW CH_6

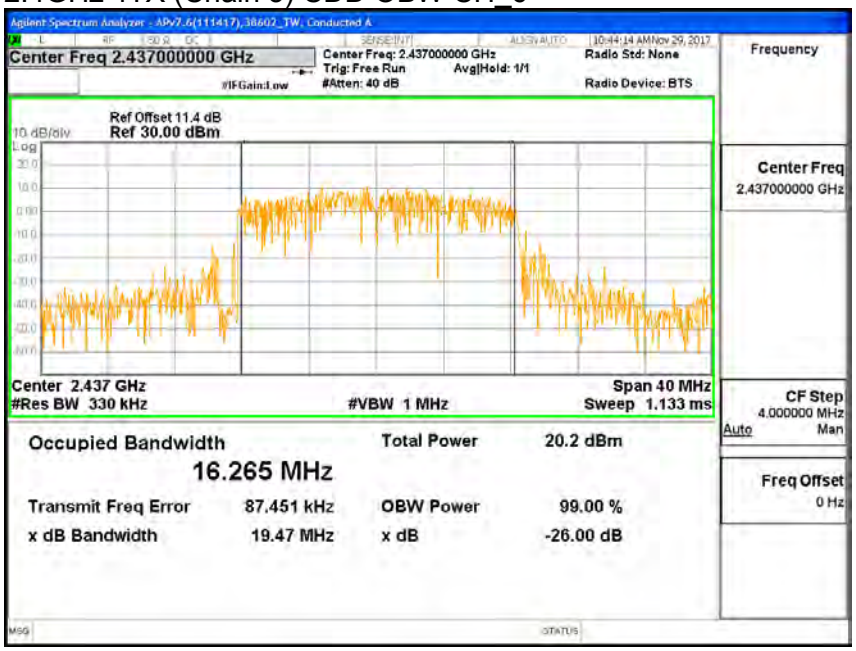
2.4GHz 4TX (Chain 1) CDD OBW CH_6



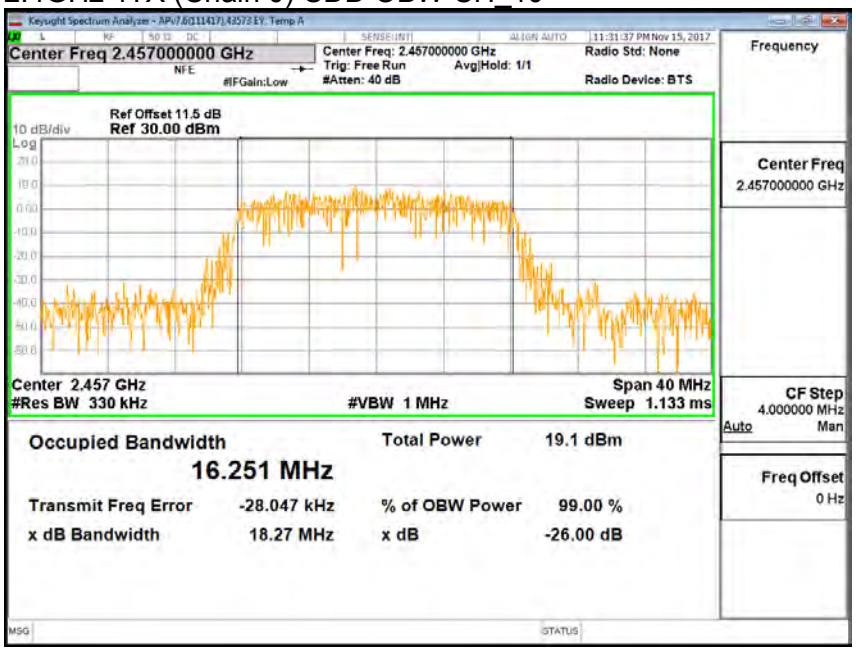
2.4GHz 4TX (Chain 2) CDD OBW CH_6



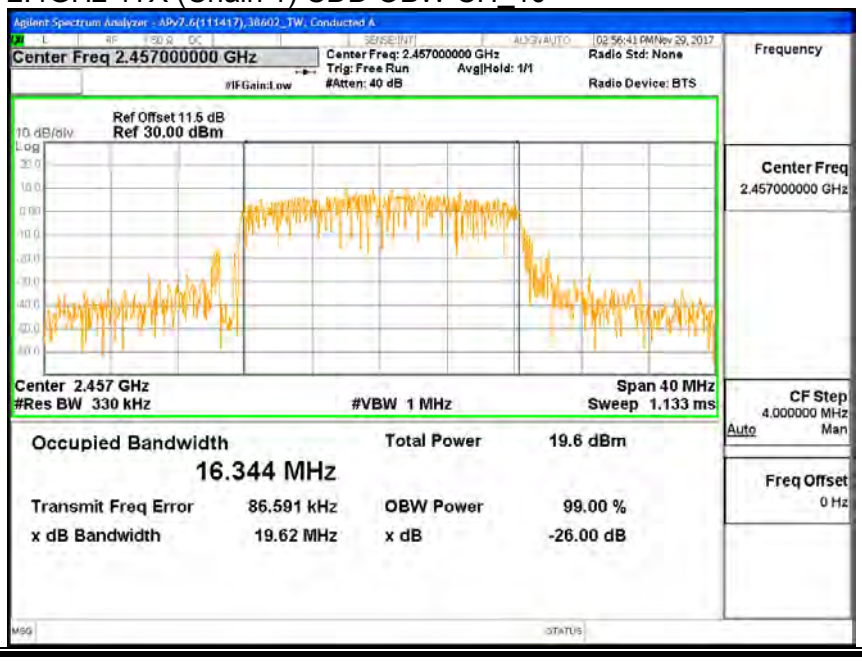
2.4GHz 4TX (Chain 3) CDD OBW CH_6



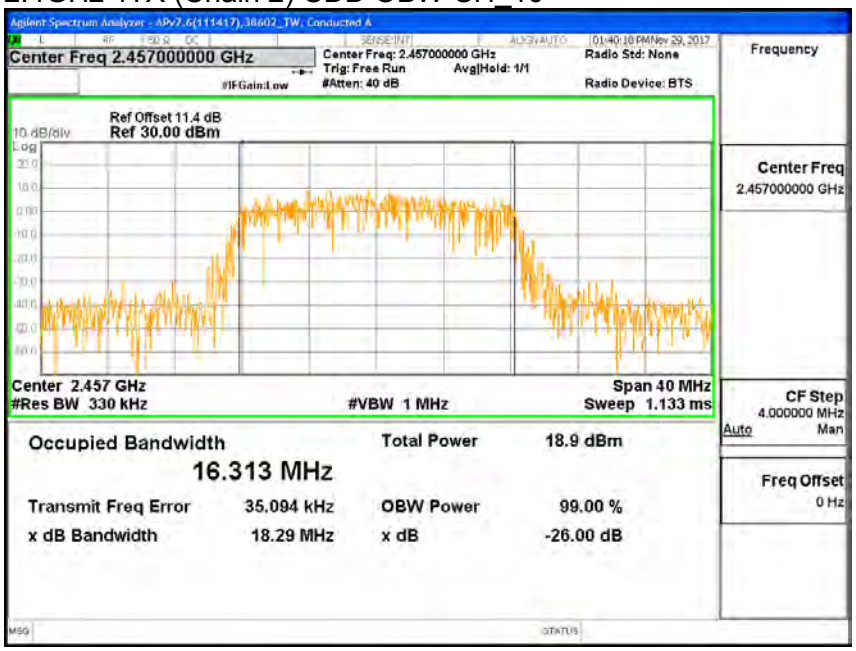
2.4GHz 4TX (Chain 0) CDD OBW CH_10



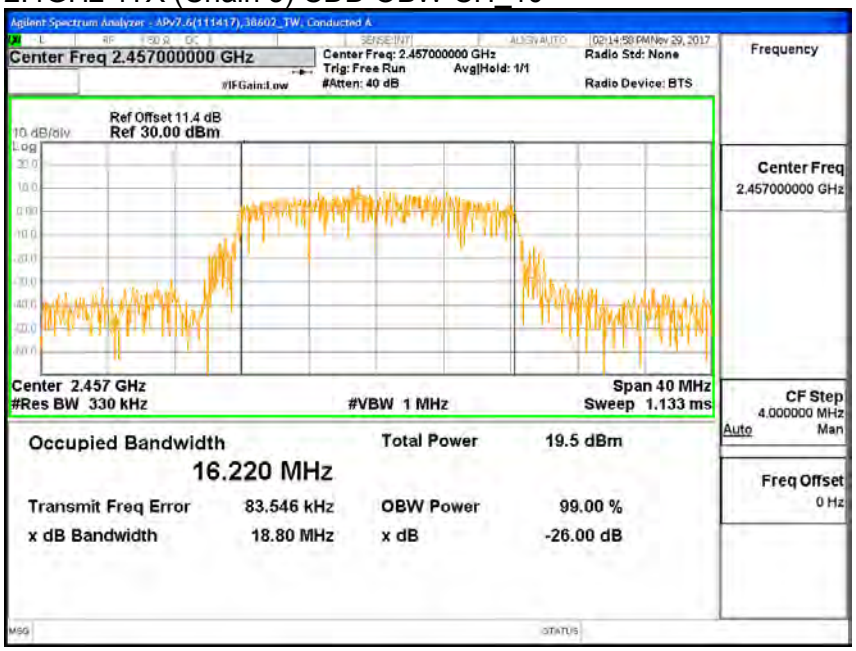
2.4GHz 4TX (Chain 1) CDD OBW CH_10



2.4GHz 4TX (Chain 2) CDD OBW CH_10

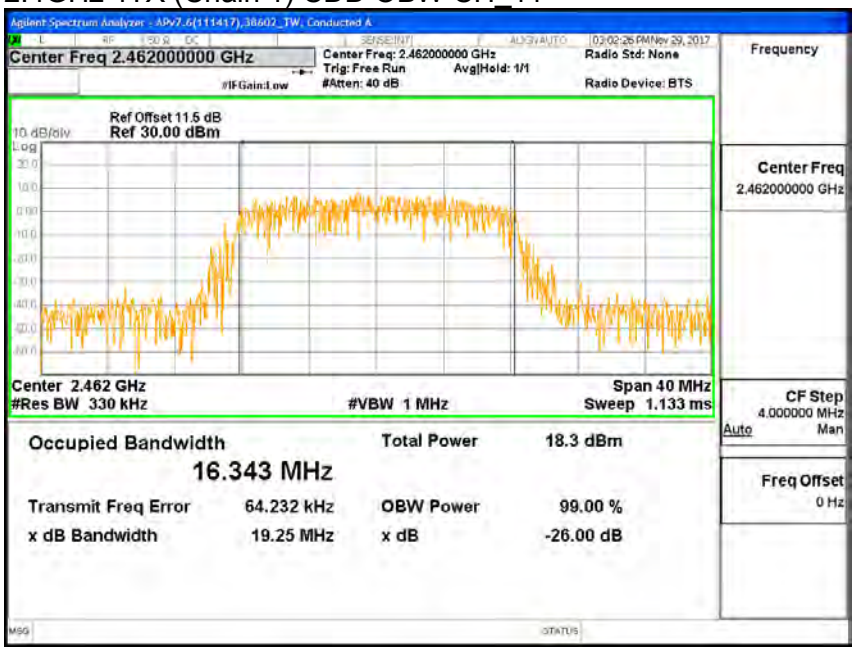


2.4GHz 4TX (Chain 3) CDD OBW CH_10

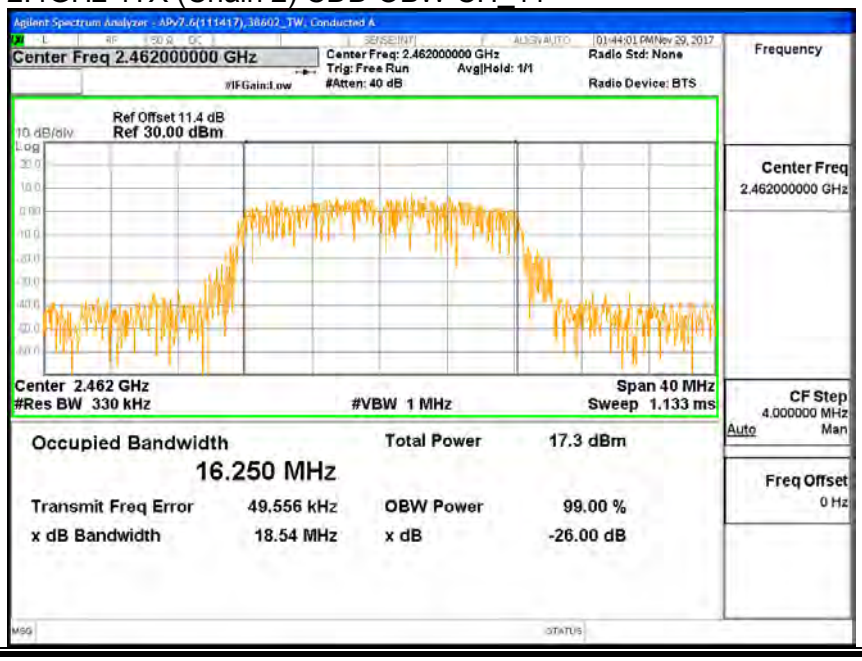


2.4GHz 4TX (Chain 0) CDD OBW CH_11

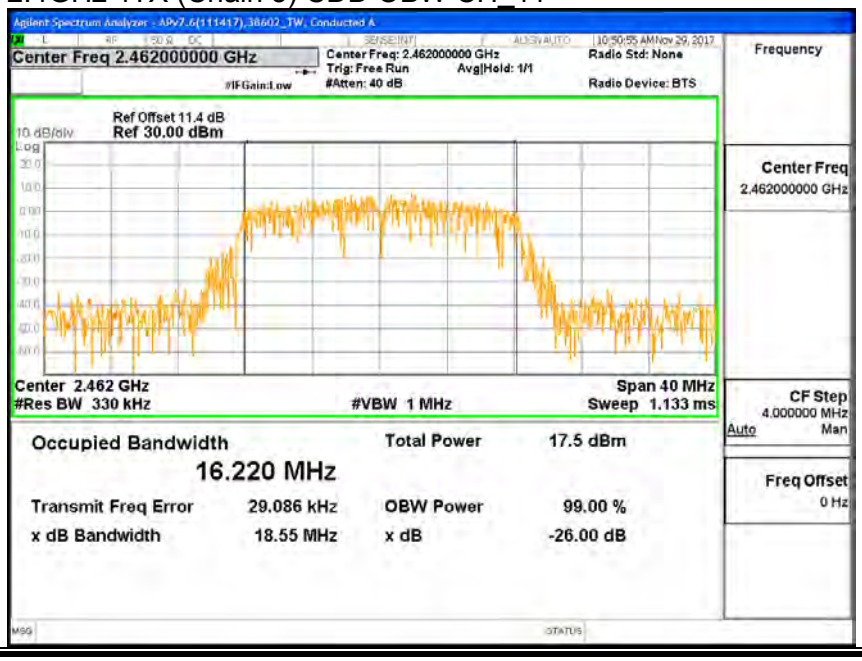
2.4GHz 4TX (Chain 1) CDD OBW CH_11



2.4GHz 4TX (Chain 2) CDD OBW CH_11



2.4GHz 4TX (Chain 3) CDD OBW CH_11



8.2.3. OUTPUT POWER

ID:	12506	Date:	11/15/17

LIMITS

FCC §15.247

IC RSS-247 (5.4) (d)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Horizontal Polarity

Chain 1 Antenna Gain (dBi)	Chain 3 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.66	3.45	3.56

Vertical Polarity (Worst Case)

Chain 0 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.47	4.76	4.16

RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	IC EIRP Limit (dBm)
CH_1	2412	4.16	30.00	30	36	30.00
CH_2	2417	4.16	30.00	30	36	30.00
CH_6	2437	4.16	30.00	30	36	30.00
CH_10	2457	4.16	30.00	30	36	30.00
CH_11	2462	4.16	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
CH_1	2412	16.60	17.38	16.30	16.55	22.75	30.00	-7.25
CH_2	2417	19.70	19.80	19.09	18.91	25.41	30.00	-4.59
CH_6	2437	19.82	20.35	19.30	19.06	**25.68**	30.00	-4.32
CH_10	2457	19.55	19.79	18.71	18.14	25.12	30.00	-4.88
CH_11	2462	17.24	17.97	17.19	16.69	23.32	30.00	-6.68

8.2.4. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-247 (5.2) (b)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

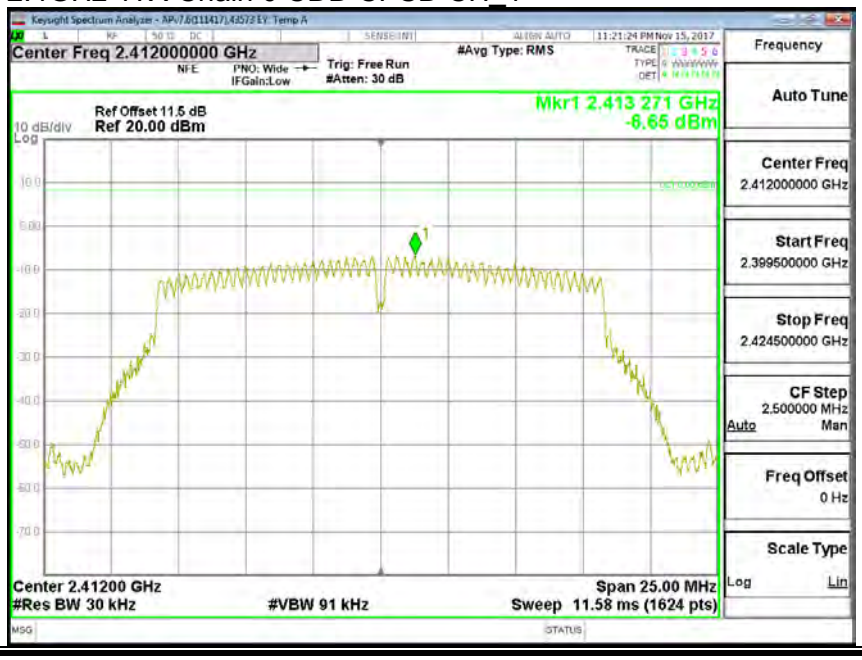
RESULTS

Duty Cycle CF (dB)	0.16	Included in Calculations of Corr'd PSD

PSD Results

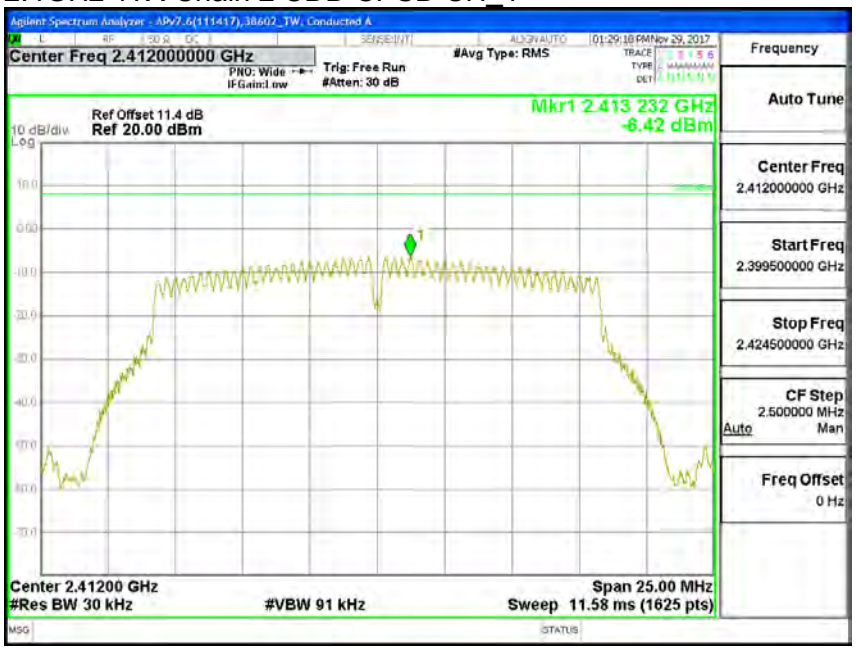
Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Chain 2 Meas (dBm)	Chain 3 Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
CH_1	2412	-6.65	-6.77	-6.42	-5.93	-0.25	8.0	-8.2
CH_2	2417	-4.57	-4.21	-4.14	-4.46	1.84	8.0	-6.2
CH_6	2437	-3.53	-3.38	-3.70	-3.36	**2.69**	8.0	-5.3
CH_10	2457	-4.89	-3.86	-4.28	-4.27	1.87	8.0	-6.1
CH_11	2462	-5.88	-5.39	-6.36	-6.28	0.22	8.0	-7.8

2.4GHz 4TX Chain 0 CDD CPSD CH_1

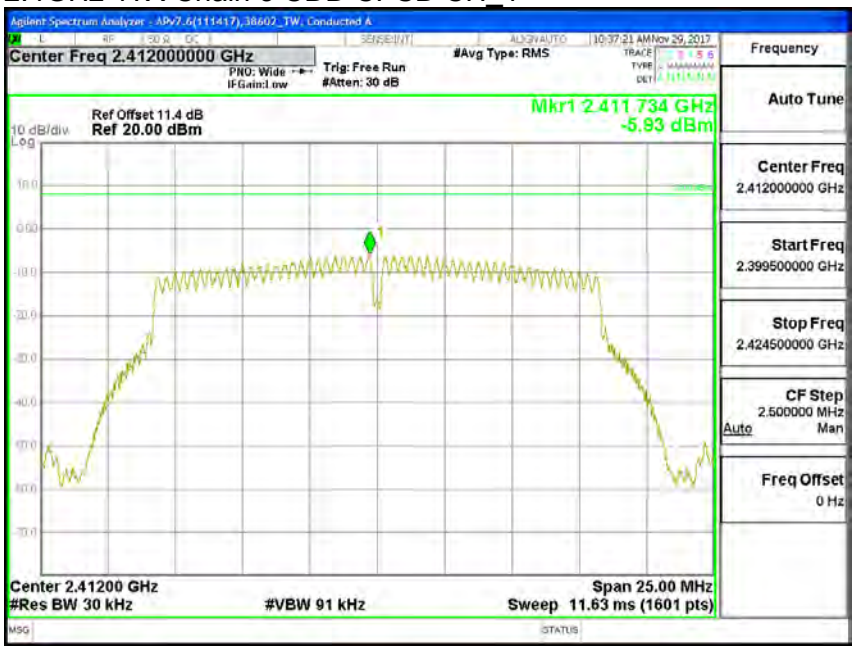


2.4GHz 4TX Chain 1 CDD CPSD CH_1

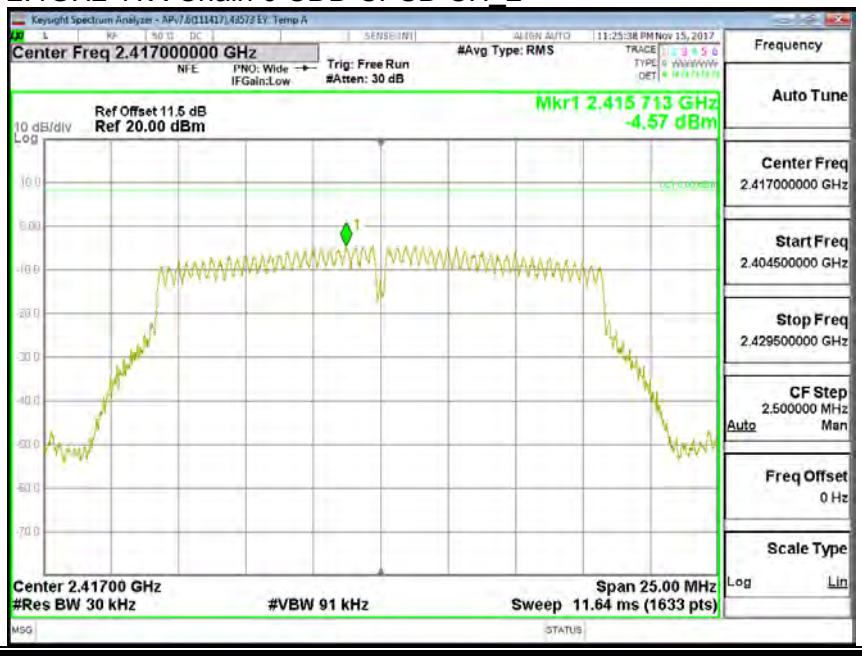
2.4GHz 4TX Chain 2 CDD CPSD CH_1



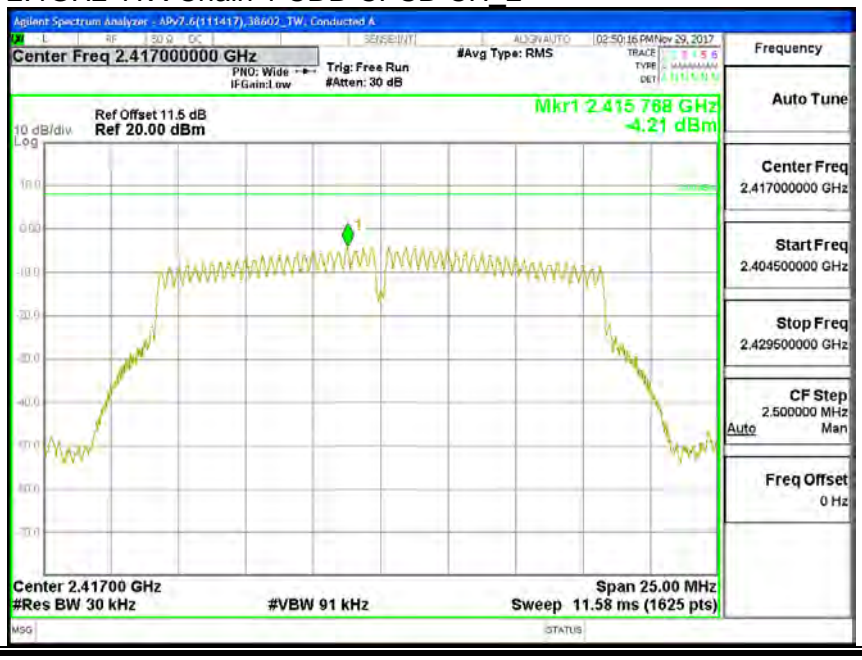
2.4GHz 4TX Chain 3 CDD CPSD CH_1



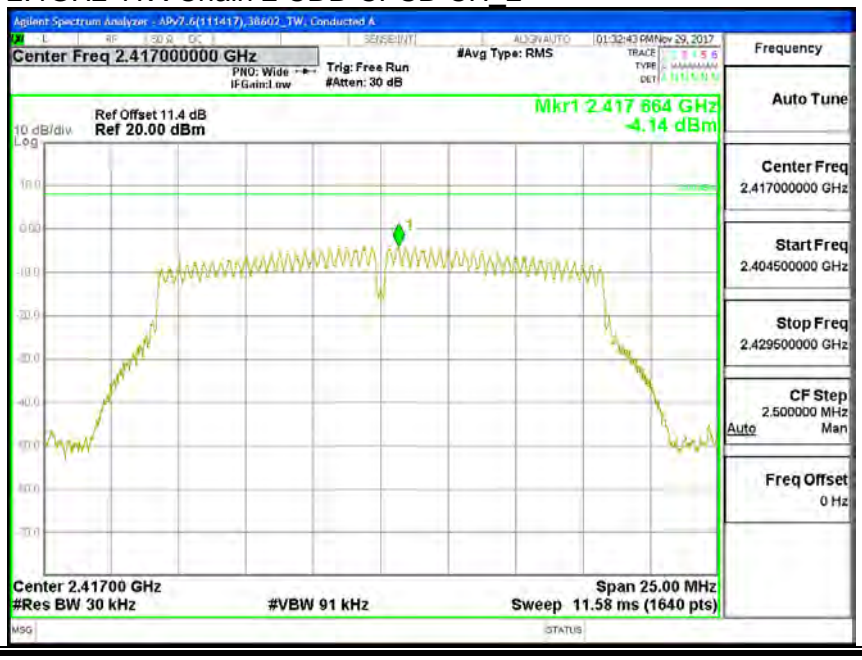
2.4GHz 4TX Chain 0 CDD CPSD CH_2



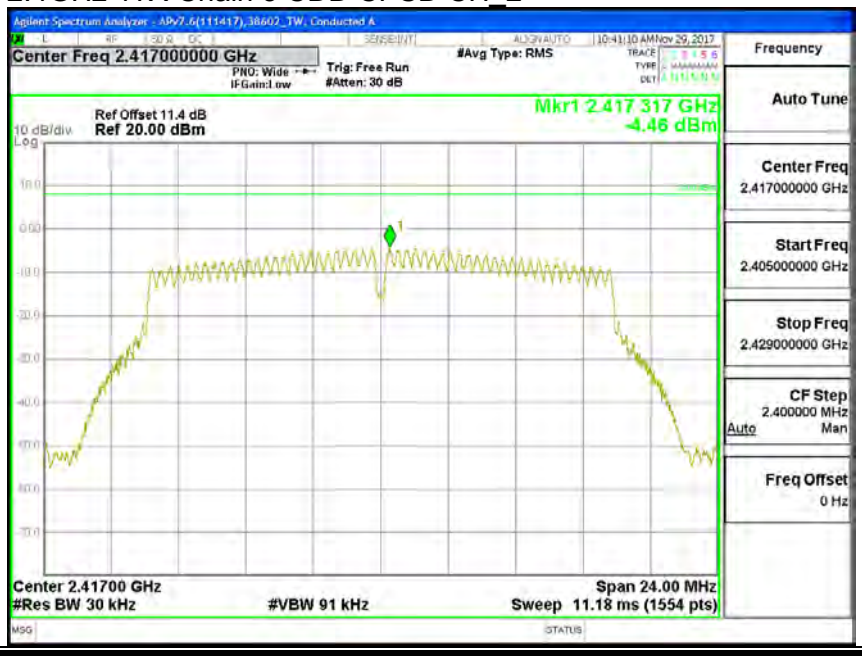
2.4GHz 4TX Chain 1 CDD CPSD CH_2



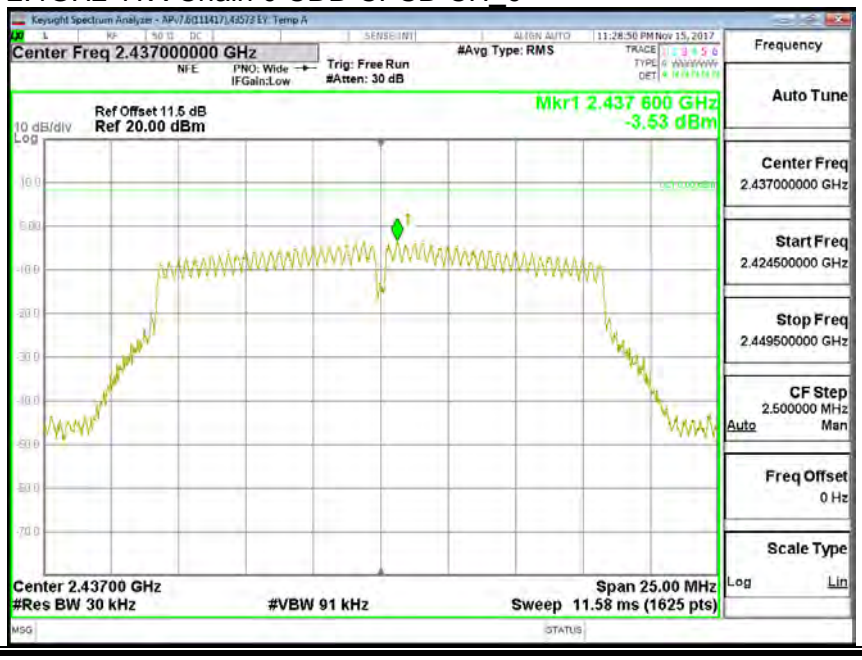
2.4GHz 4TX Chain 2 CDD CPSD CH_2



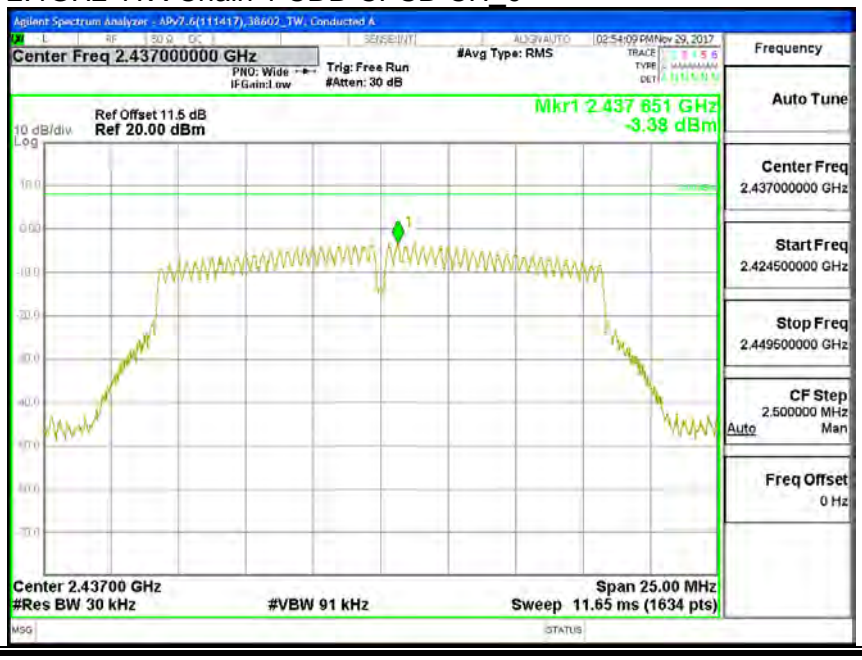
2.4GHz 4TX Chain 3 CDD CPSD CH_2



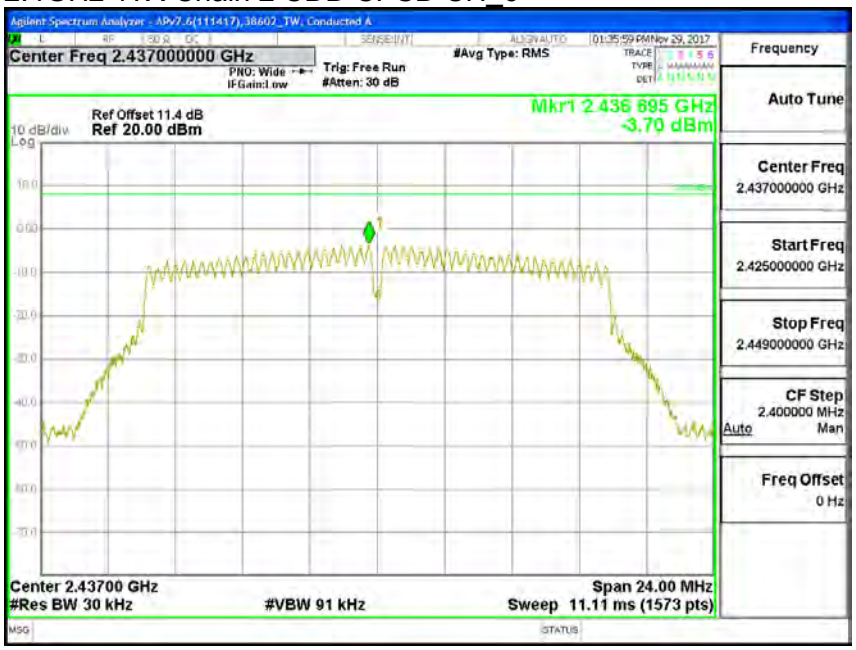
2.4GHz 4TX Chain 0 CDD CPSD CH_6



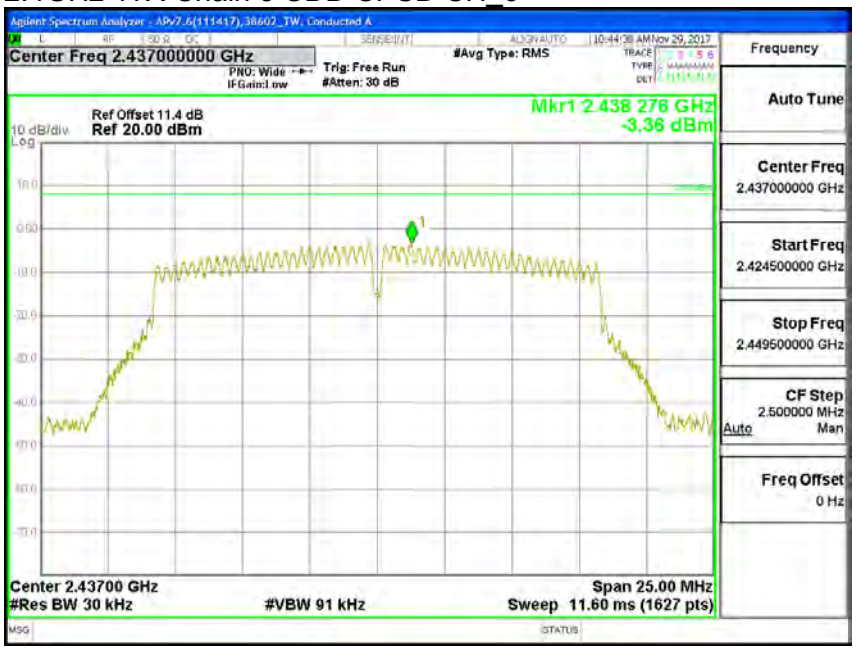
2.4GHz 4TX Chain 1 CDD CPSD CH_6



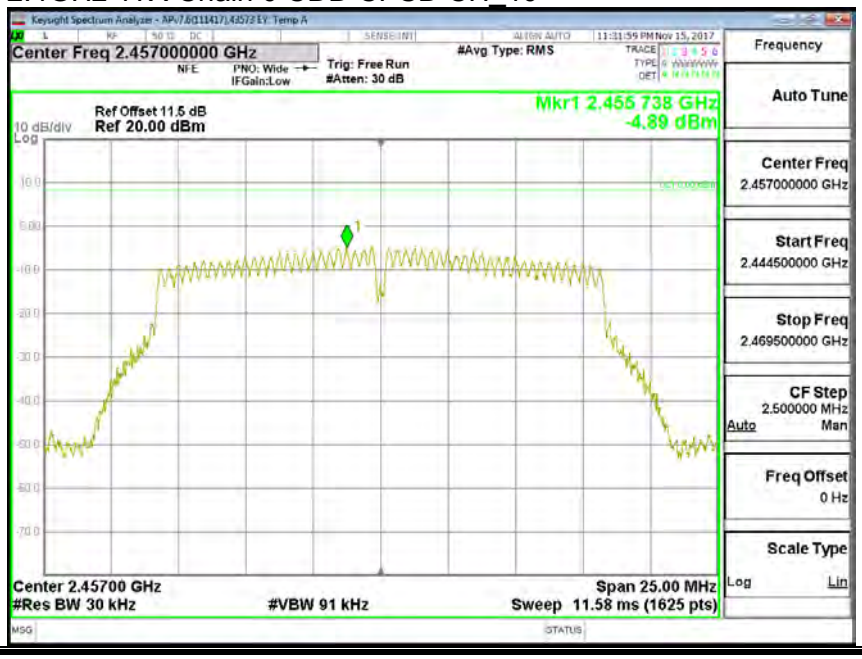
2.4GHz 4TX Chain 2 CDD CPSD CH_6



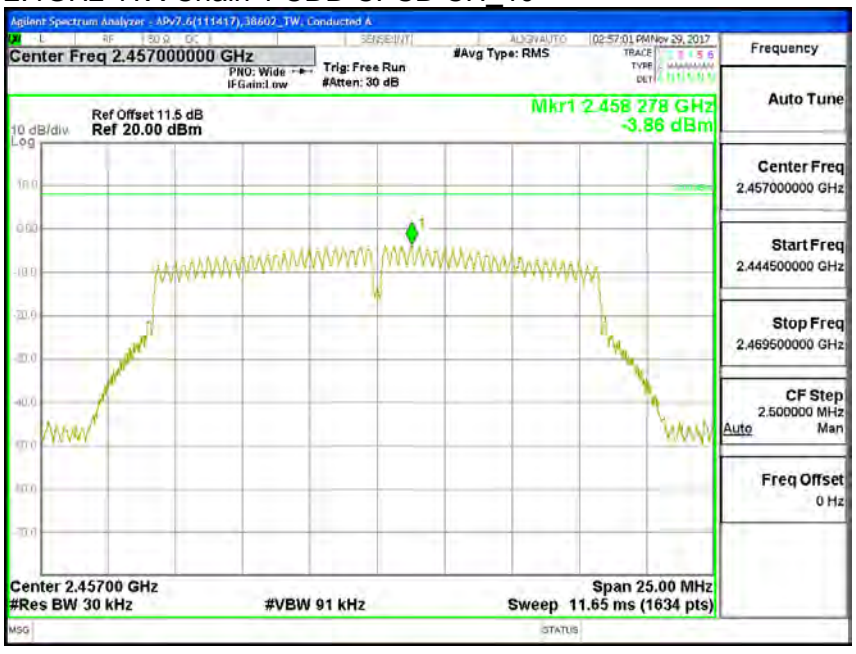
2.4GHz 4TX Chain 3 CDD CPSD CH_6



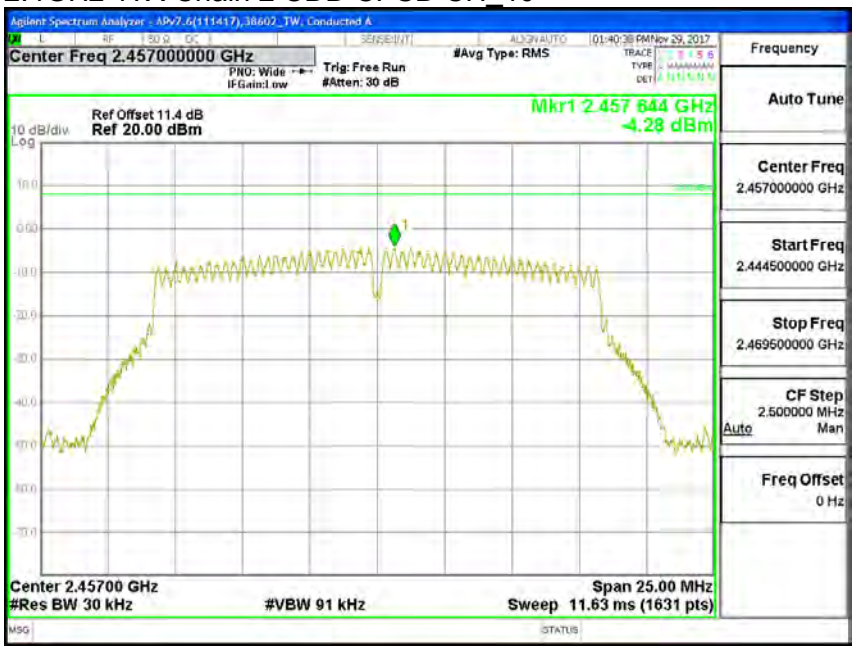
2.4GHz 4TX Chain 0 CDD CPSD CH_10



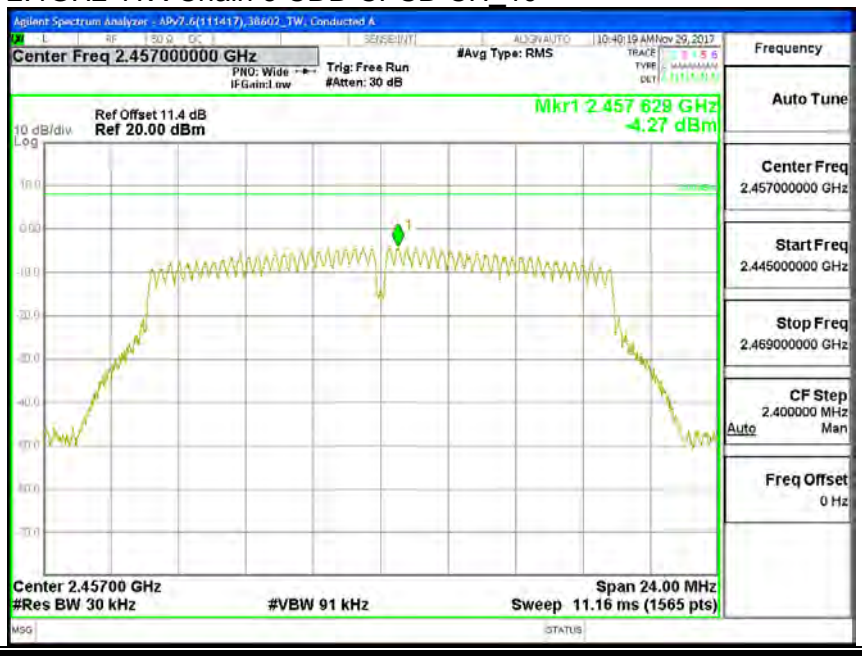
2.4GHz 4TX Chain 1 CDD CPSD CH_10



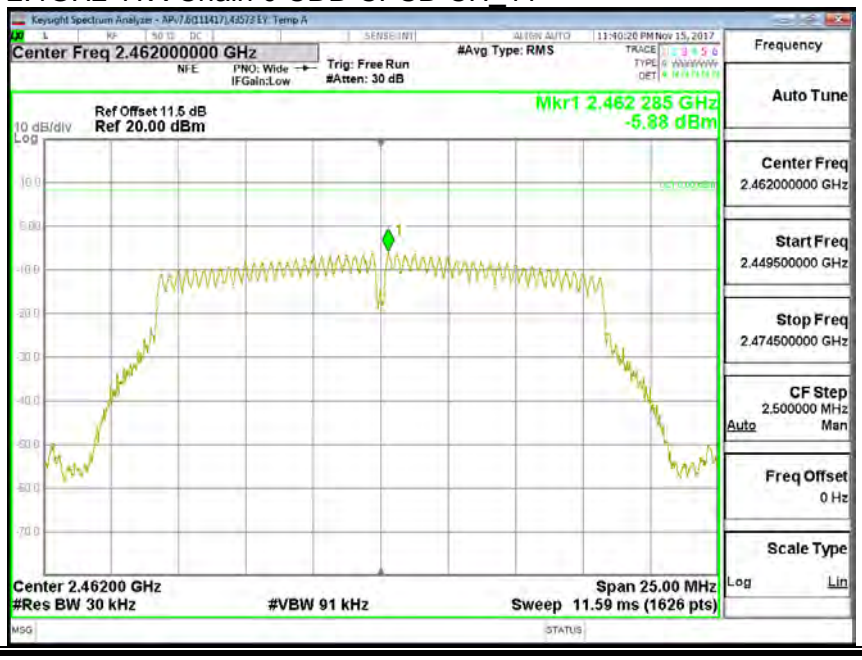
2.4GHz 4TX Chain 2 CDD CPSD CH_10



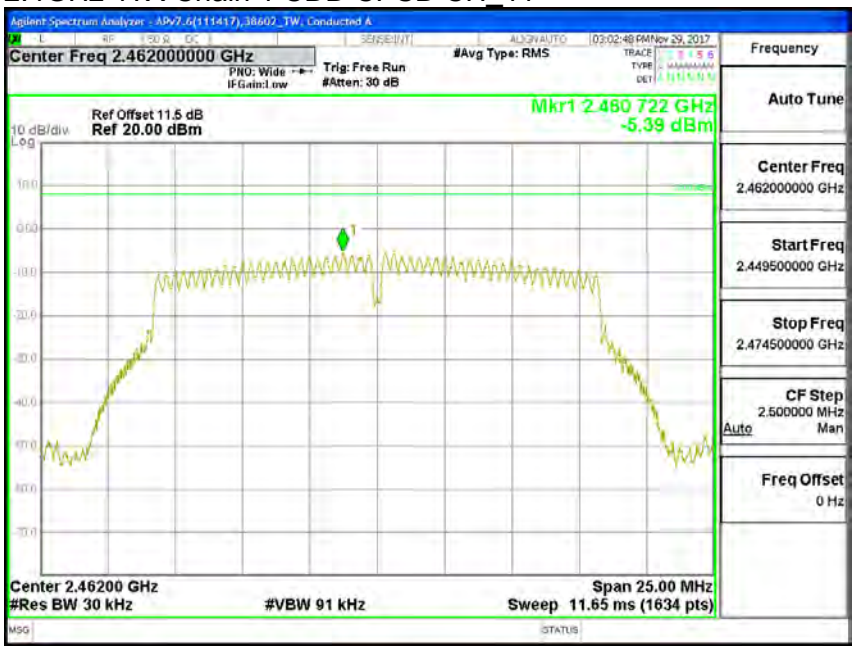
2.4GHz 4TX Chain 3 CDD CPSD CH_10



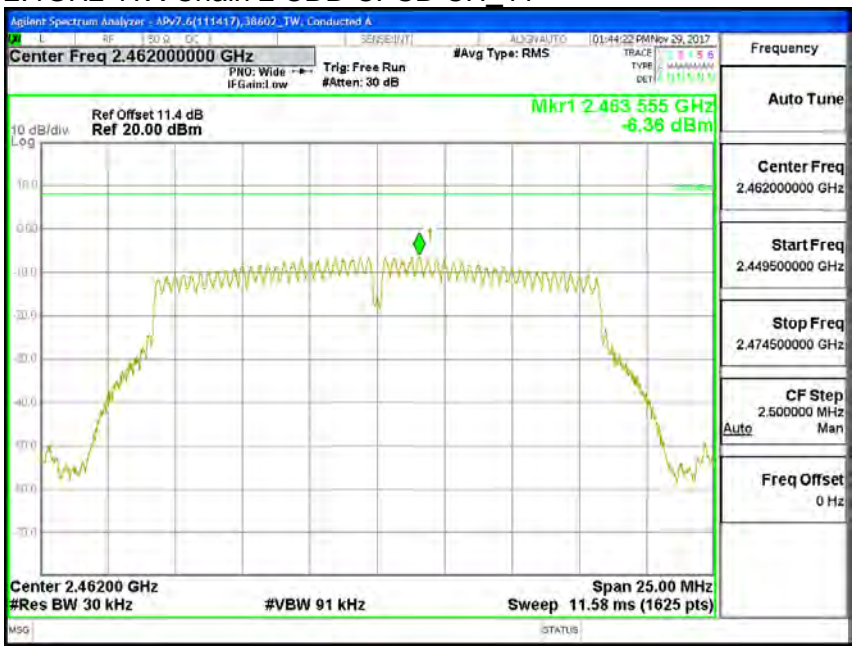
2.4GHz 4TX Chain 0 CDD CPSD CH_11



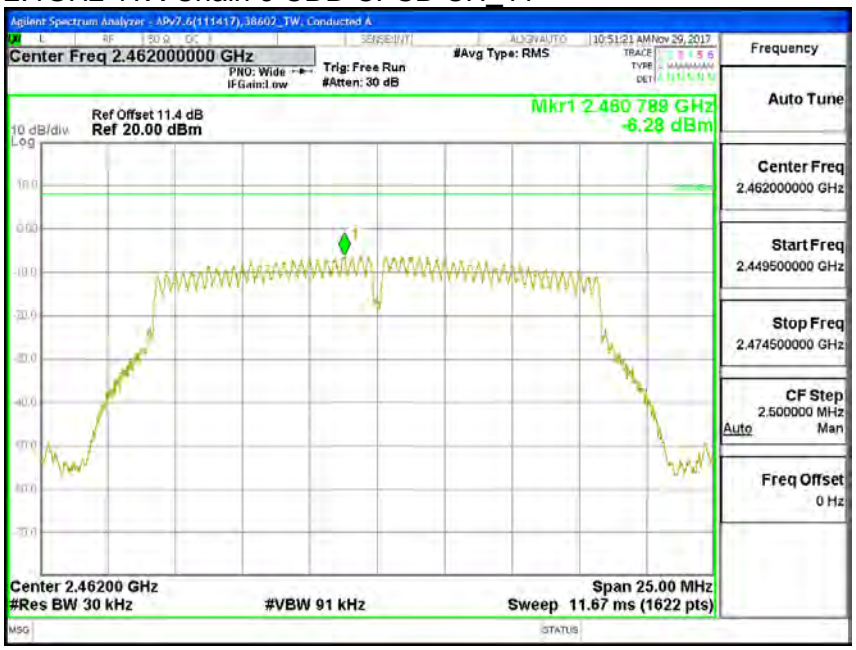
2.4GHz 4TX Chain 1 CDD CPSD CH_11



2.4GHz 4TX Chain 2 CDD CPSD CH_11

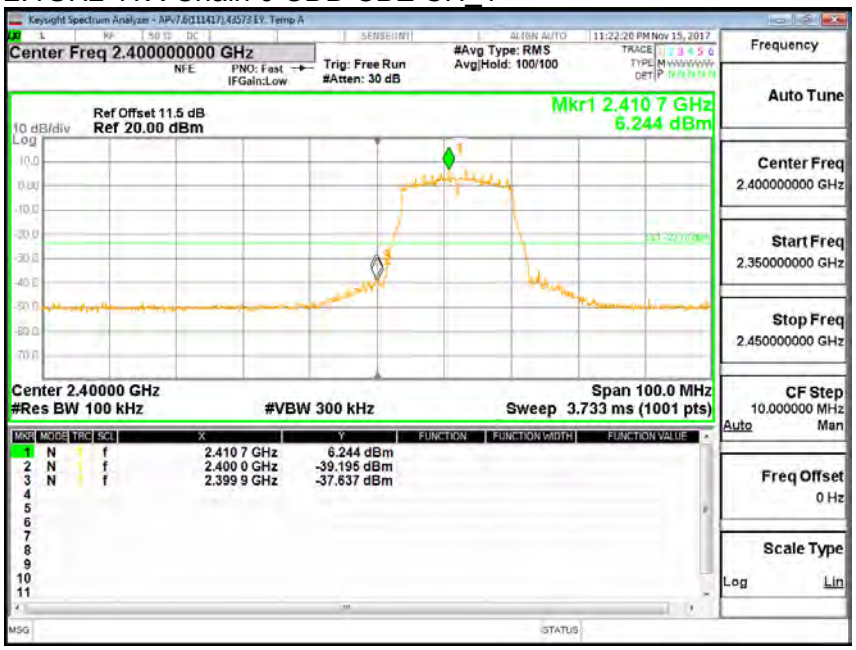


2.4GHz 4TX Chain 3 CDD CPSD CH_11



8.2.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

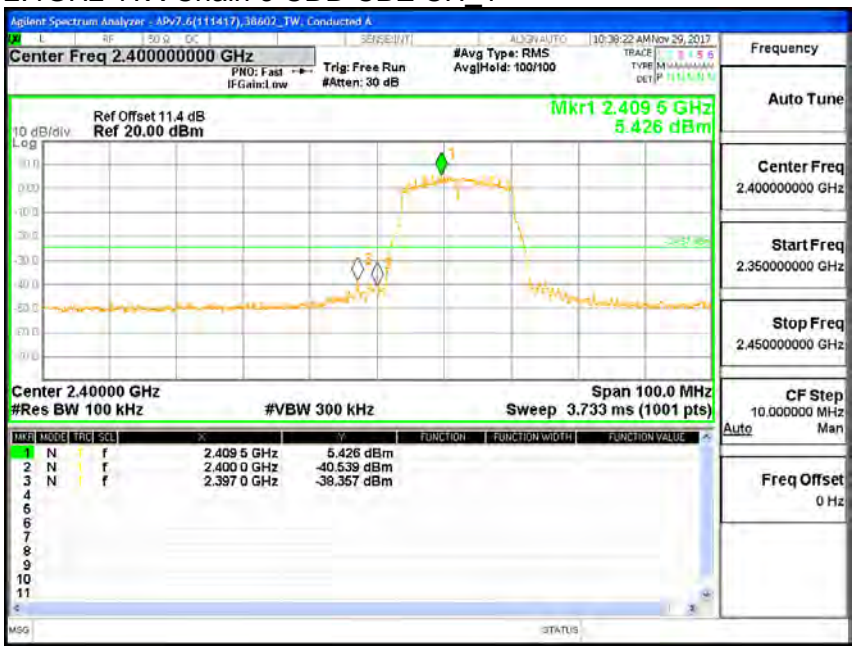
2.4GHz 4TX Chain 0 CDD CBE CH_1



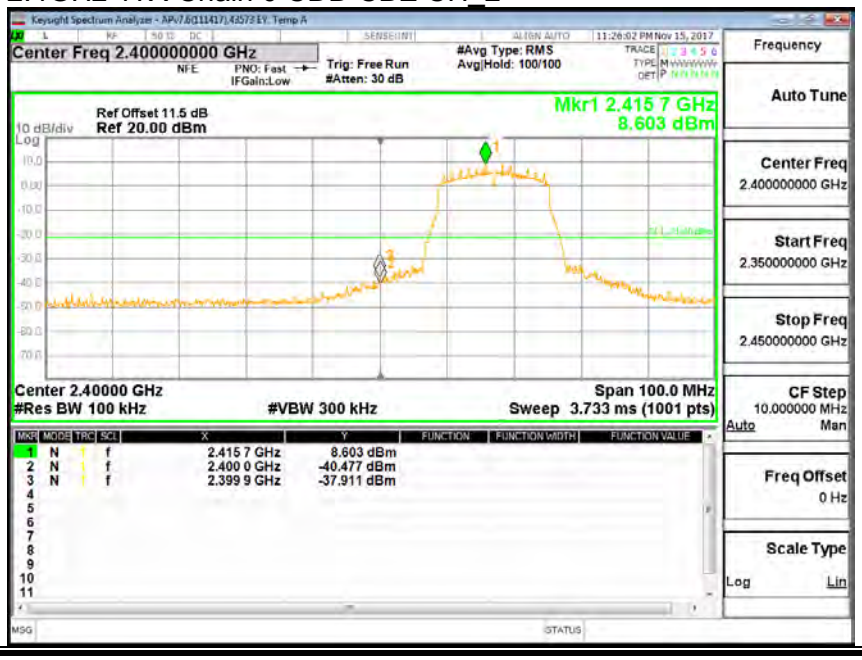
2.4GHz 4TX Chain 1 CDD CBE CH_1

2.4GHz 4TX Chain 2 CDD CBE CH_1

2.4GHz 4TX Chain 3 CDD CBE CH_1

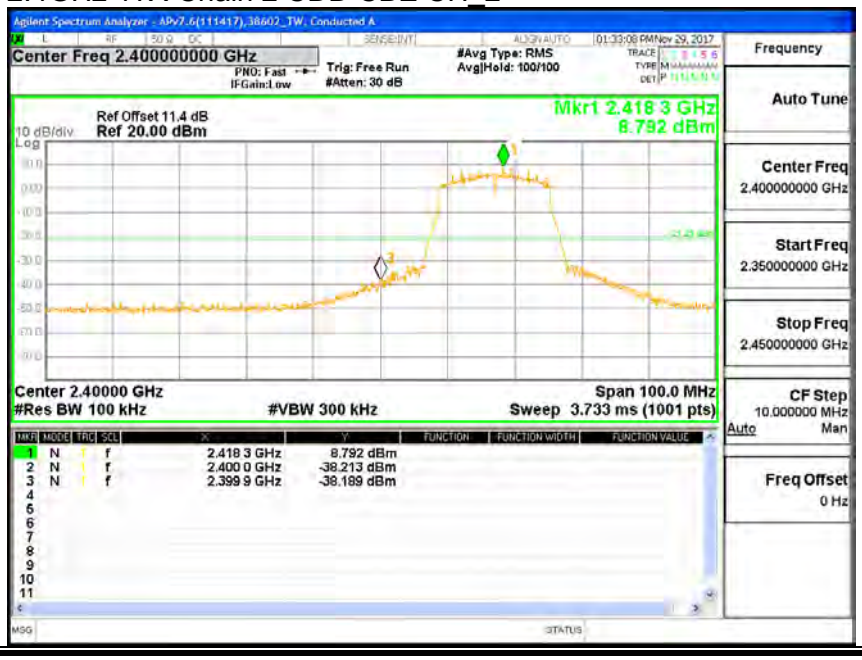


2.4GHz 4TX Chain 0 CDD CBE CH_2

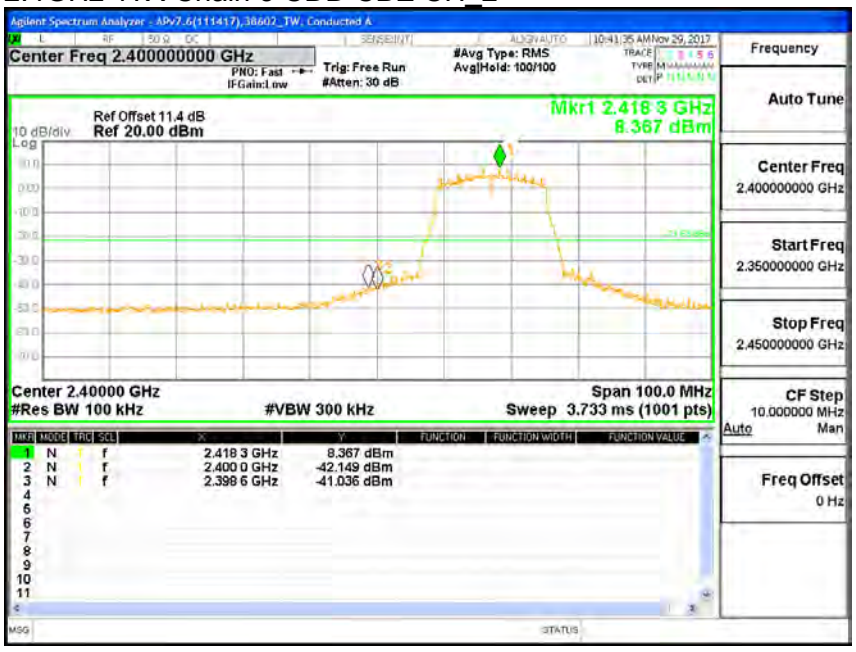


2.4GHz 4TX Chain 1 CDD CBE CH_2

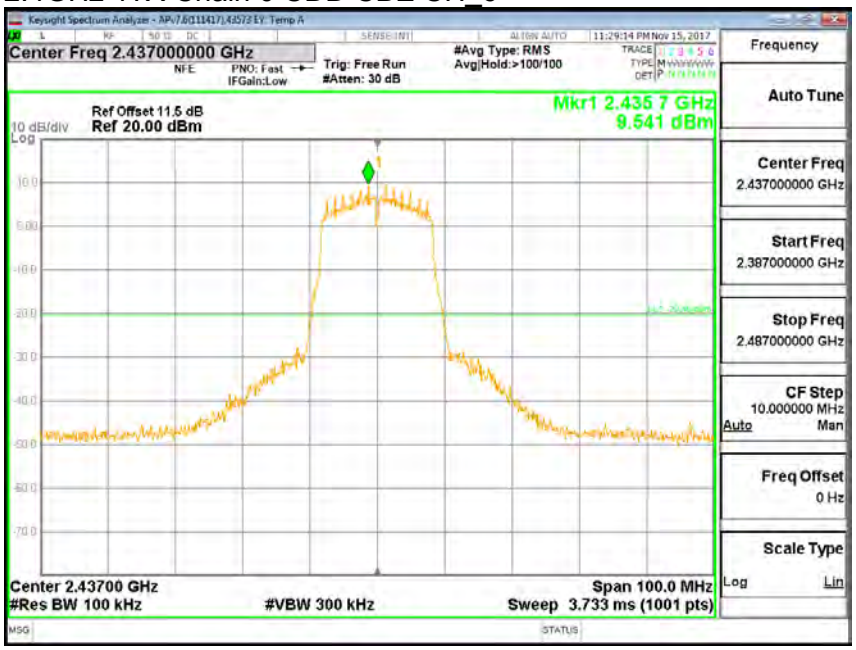
2.4GHz 4TX Chain 2 CDD CBE CH_2



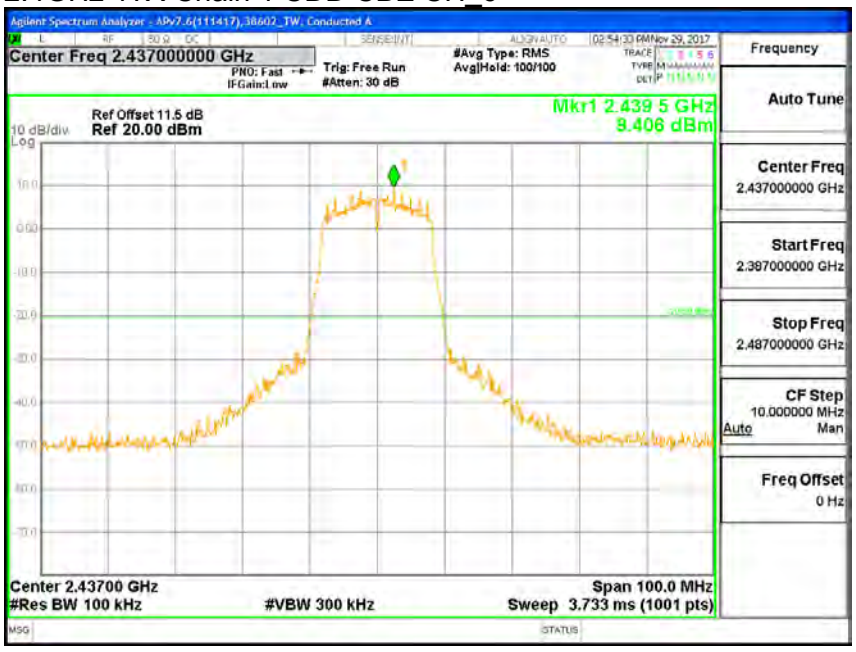
2.4GHz 4TX Chain 3 CDD CBE CH_2



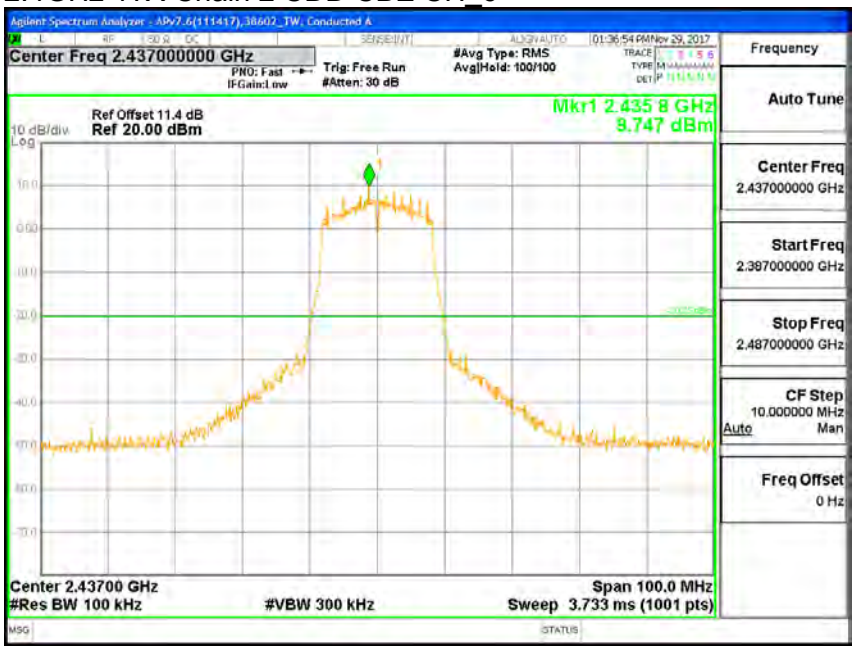
2.4GHz 4TX Chain 0 CDD CBE CH_6



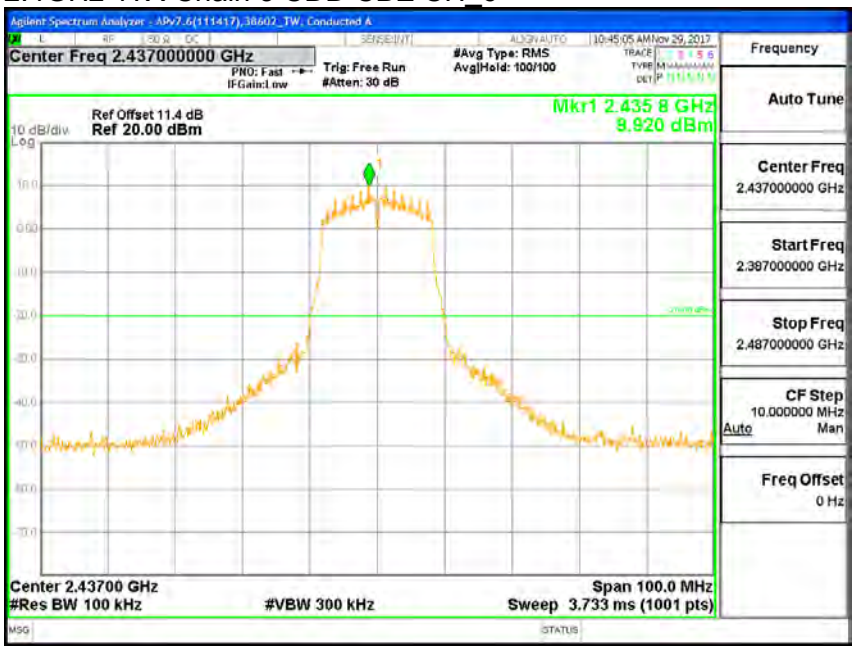
2.4GHz 4TX Chain 1 CDD CBE CH_6



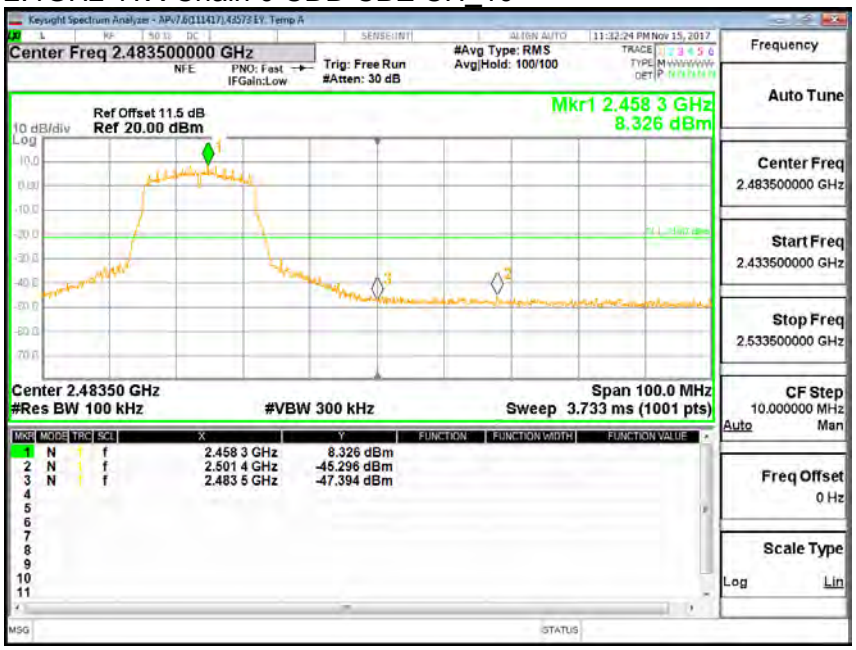
2.4GHz 4TX Chain 2 CDD CBE CH_6



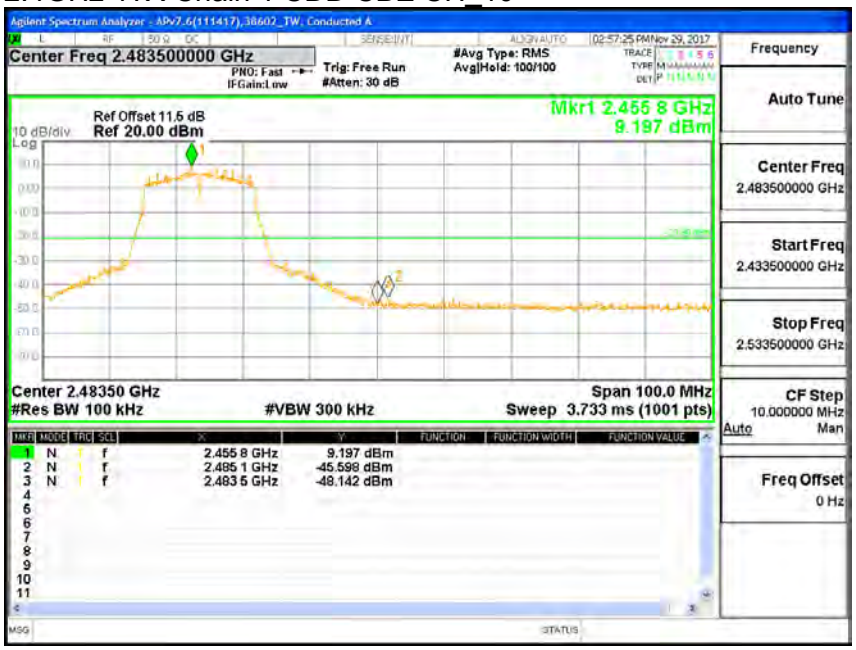
2.4GHz 4TX Chain 3 CDD CBE CH_6



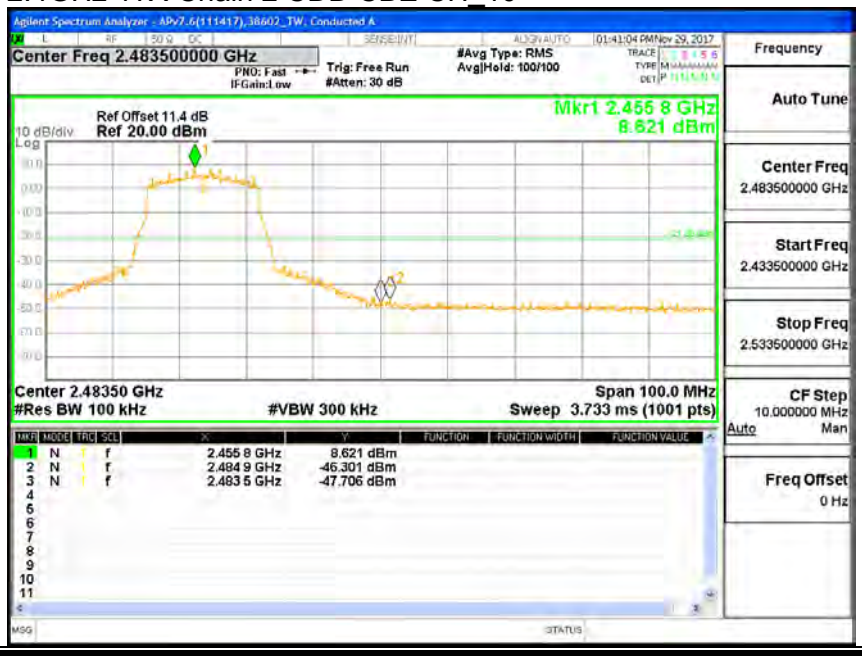
2.4GHz 4TX Chain 0 CDD CBE CH_10



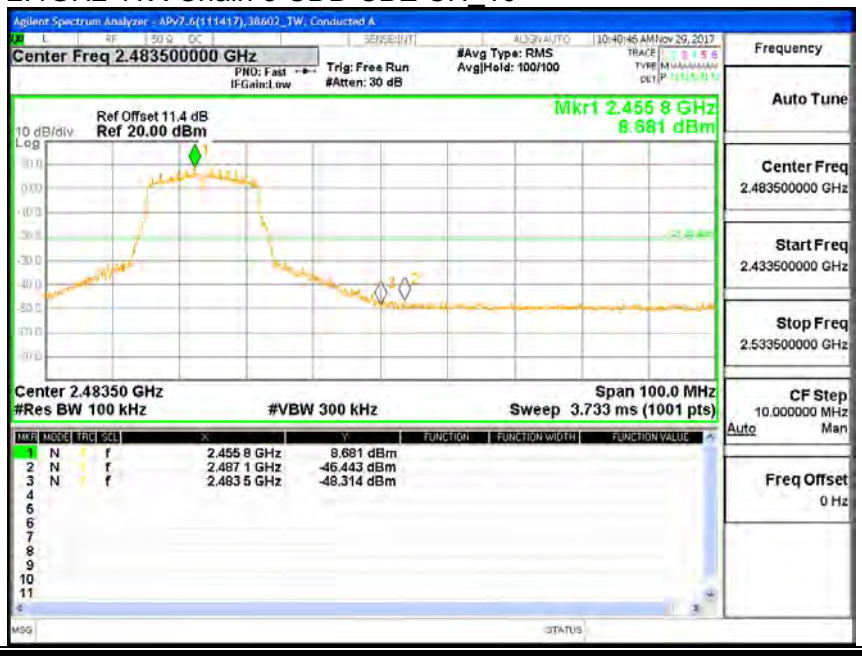
2.4GHz 4TX Chain 1 CDD CBE CH_10



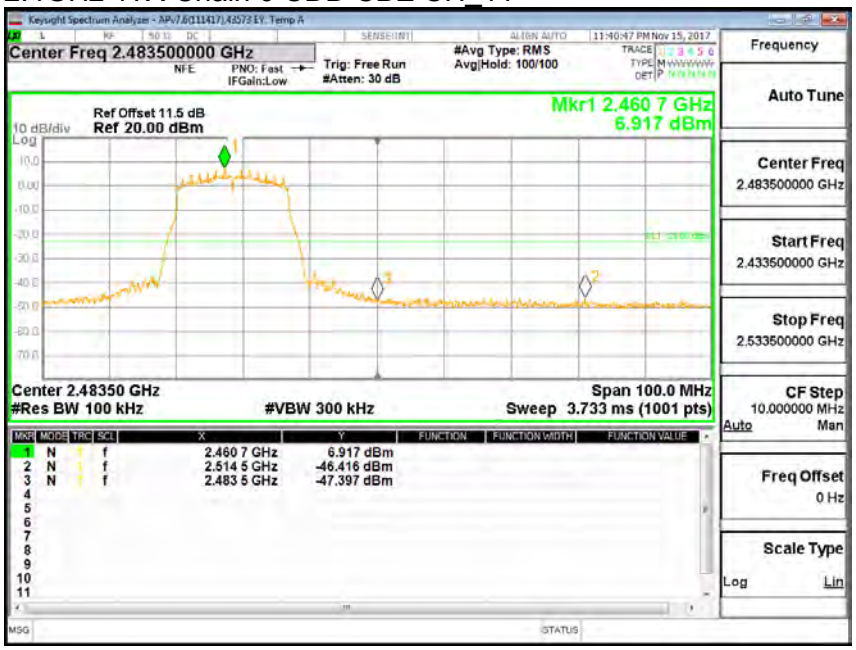
2.4GHz 4TX Chain 2 CDD CBE CH_10



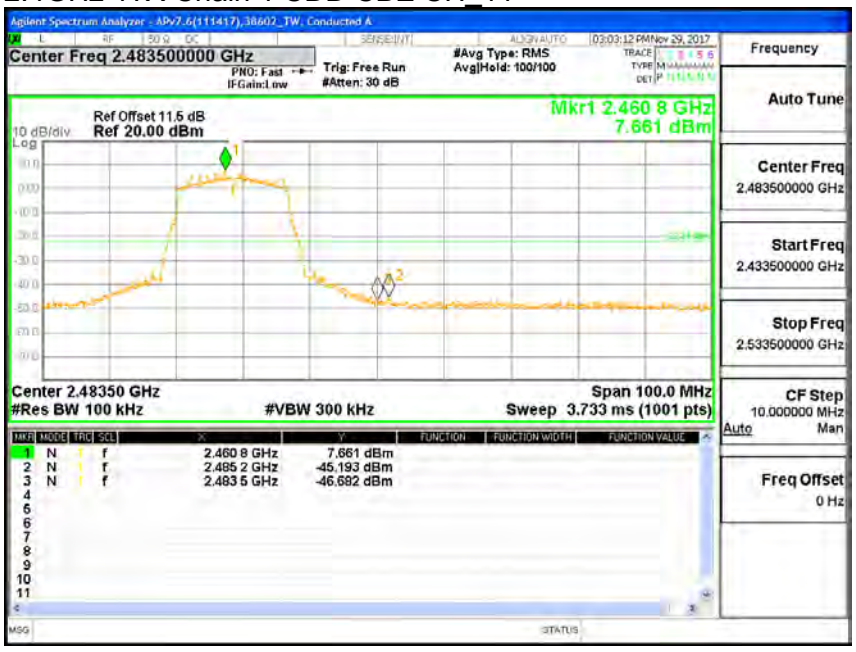
2.4GHz 4TX Chain 3 CDD CBE CH_10



2.4GHz 4TX Chain 0 CDD CBE CH_11

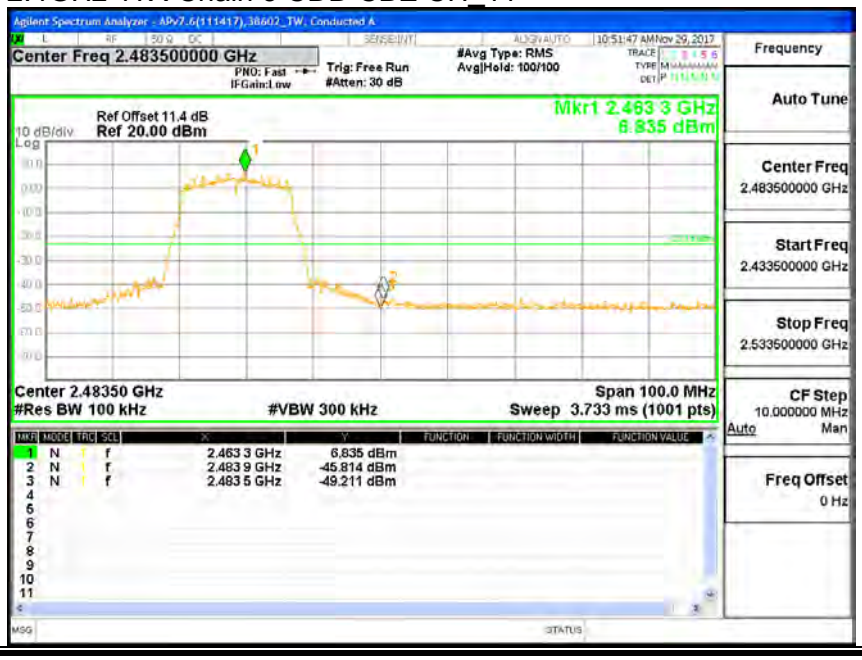


2.4GHz 4TX Chain 1 CDD CBE CH_11

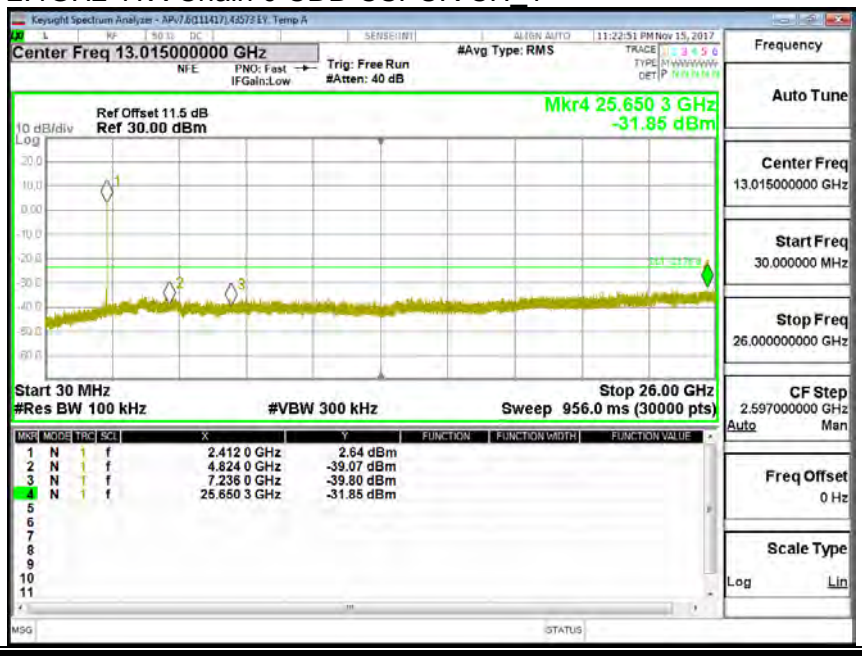


2.4GHz 4TX Chain 2 CDD CBE CH_11

2.4GHz 4TX Chain 3 CDD CBE CH_11



2.4GHz 4TX Chain 0 CDD CSPUR CH_1

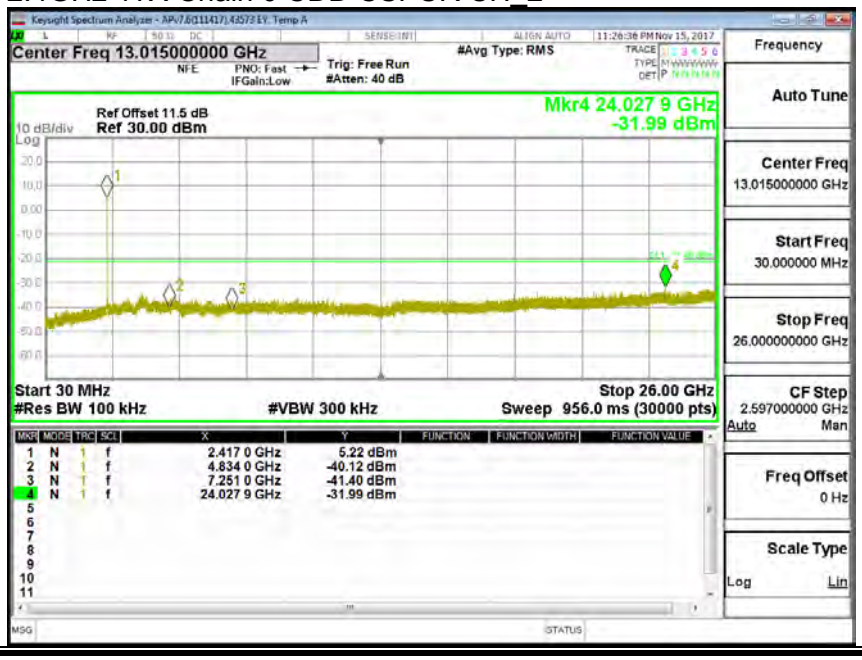


2.4GHz 4TX Chain 1 CDD CSPUR CH_1

2.4GHz 4TX Chain 2 CDD CSPUR CH_1

2.4GHz 4TX Chain 3 CDD CSPUR CH_1

2.4GHz 4TX Chain 0 CDD CSPUR CH_2

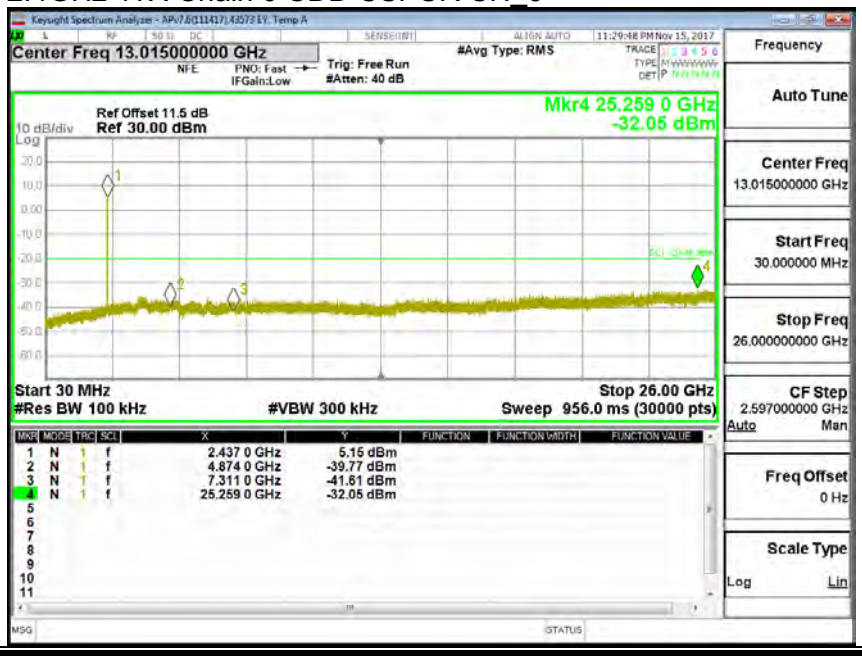


2.4GHz 4TX Chain 1 CDD CSPUR CH_2

2.4GHz 4TX Chain 2 CDD CSPUR CH_2

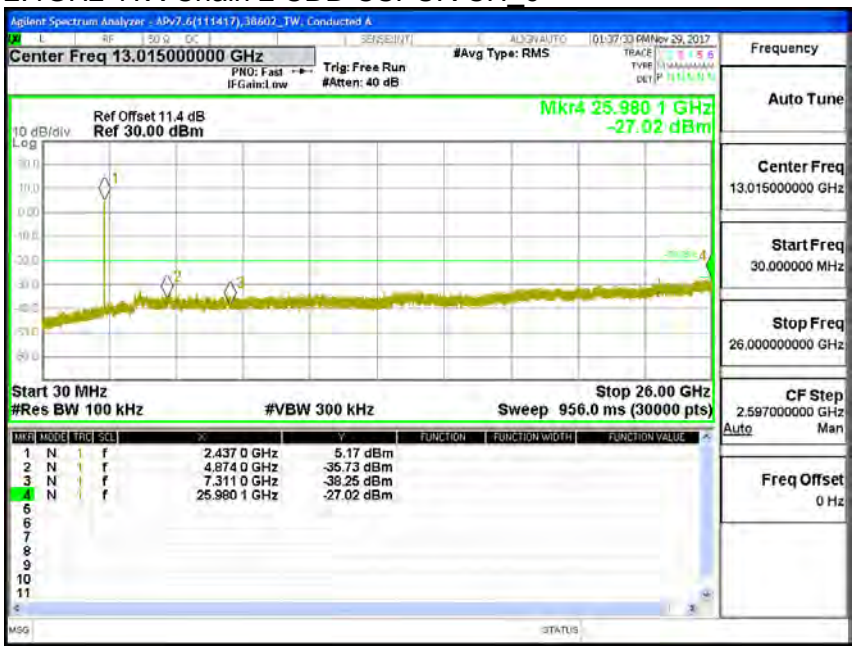
2.4GHz 4TX Chain 3 CDD CSPUR CH_2

2.4GHz 4TX Chain 0 CDD CSPUR CH_6

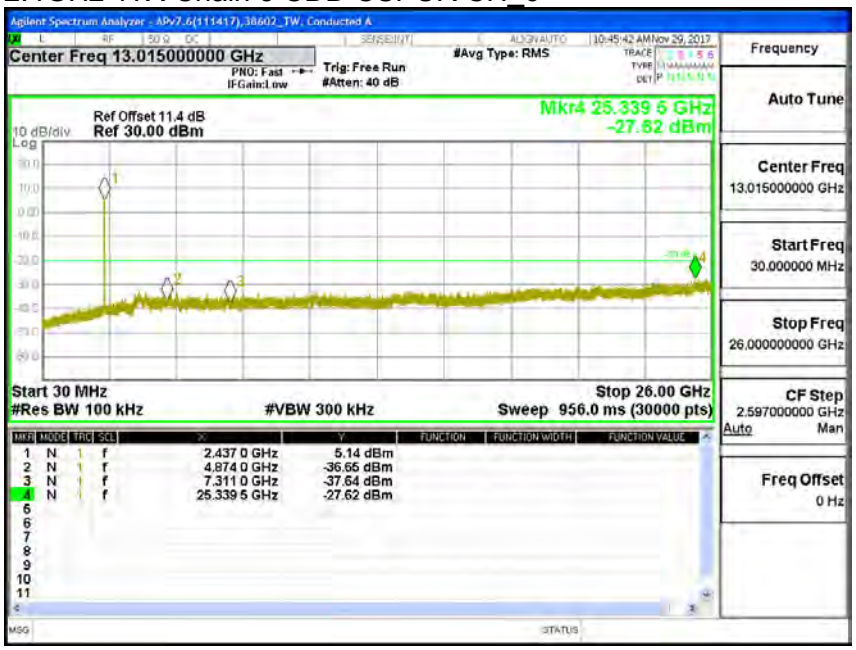


2.4GHz 4TX Chain 1 CDD CSPUR CH_6

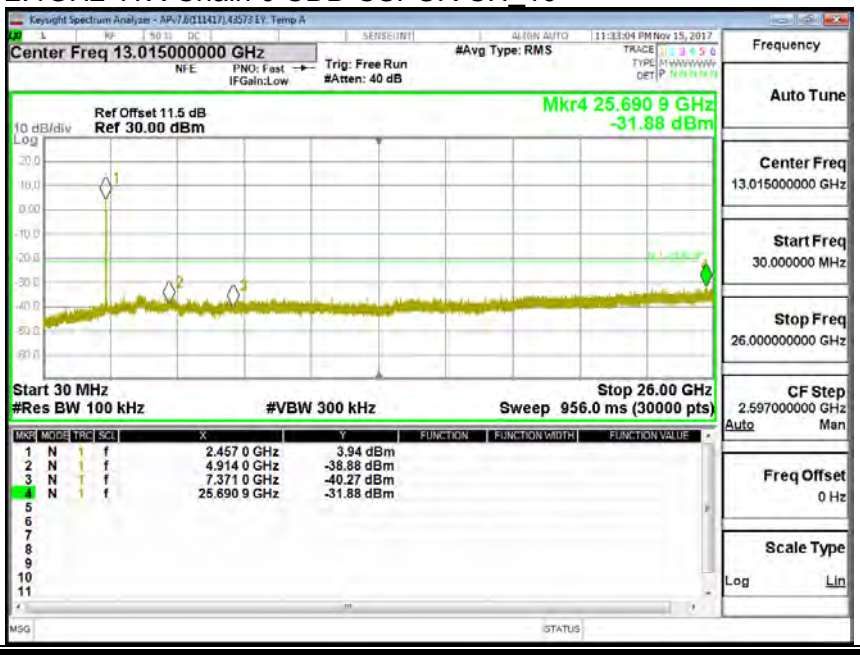
2.4GHz 4TX Chain 2 CDD CSPUR CH_6



2.4GHz 4TX Chain 3 CDD CSPUR CH_6

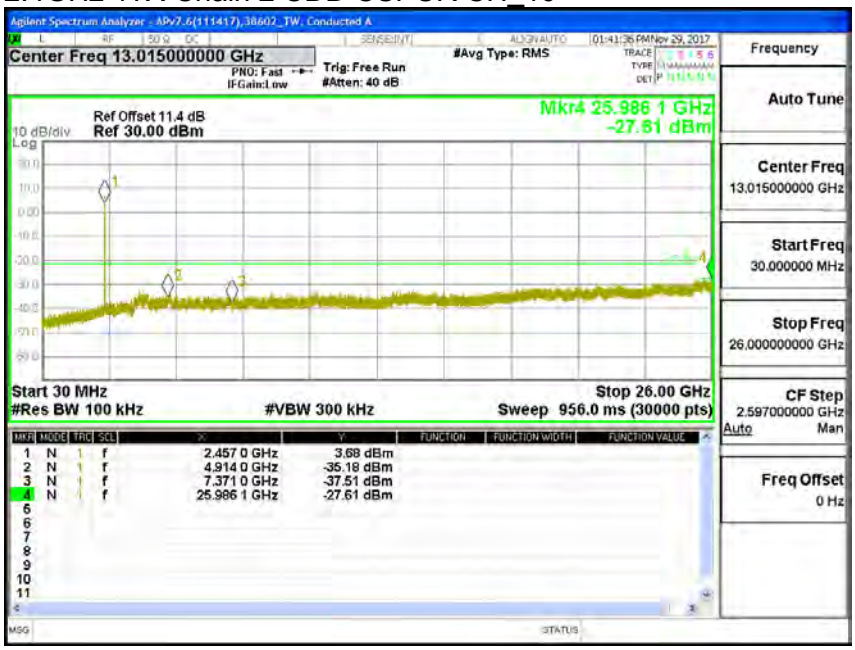


2.4GHz 4TX Chain 0 CDD CSPUR CH_10



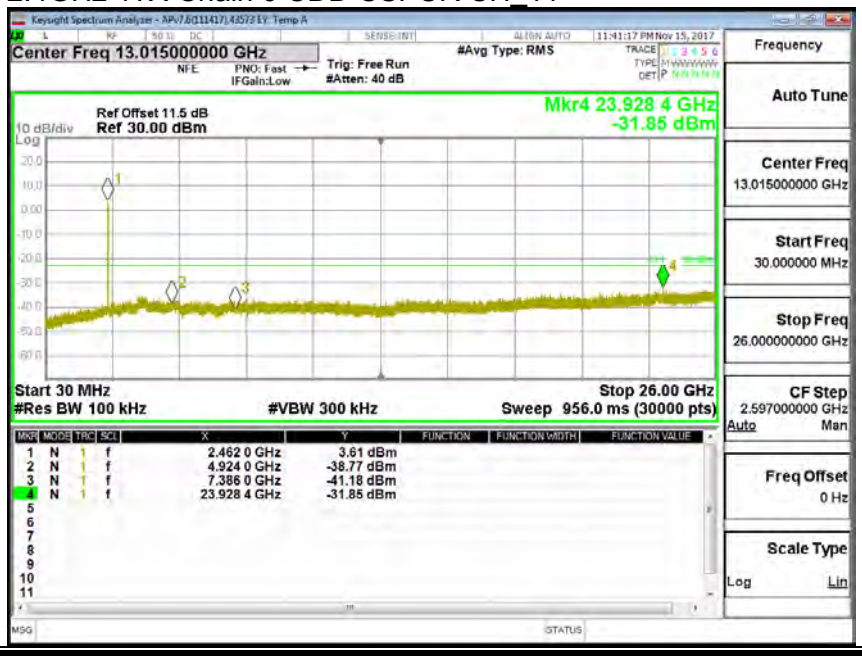
2.4GHz 4TX Chain 1 CDD CSPUR CH_10

2.4GHz 4TX Chain 2 CDD CSPUR CH_10



2.4GHz 4TX Chain 3 CDD CSPUR CH_10

2.4GHz 4TX Chain 0 CDD CSPUR CH_11



2.4GHz 4TX Chain 1 CDD CSPUR CH_11

2.4GHz 4TX Chain 2 CDD CSPUR CH_11

2.4GHz 4TX Chain 3 CDD CSPUR CH_11

8.3. 11n HT20 4TX CDD MIMO MODE IN THE 2.4GHz BAND

8.3.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

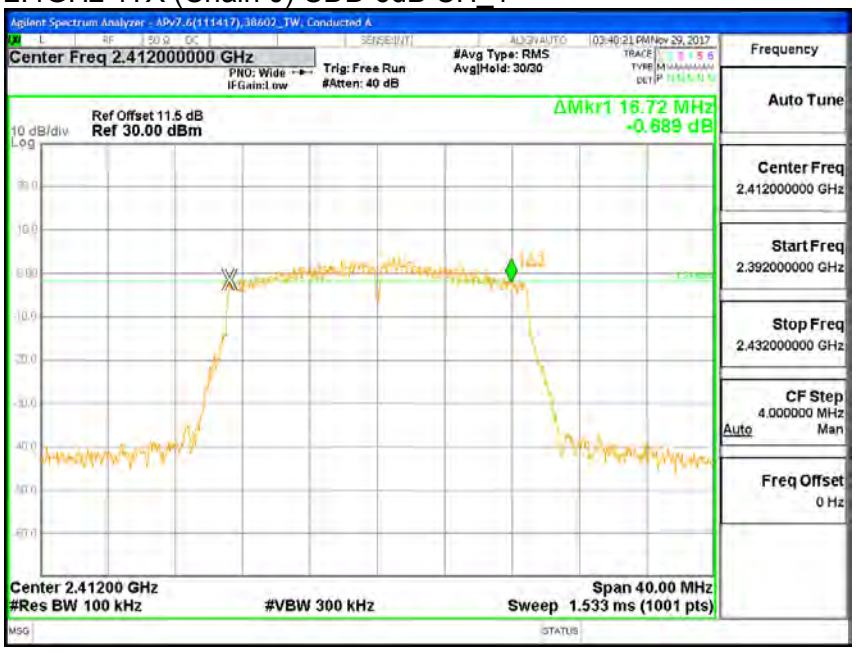
IC RSS-247 (5.2) (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

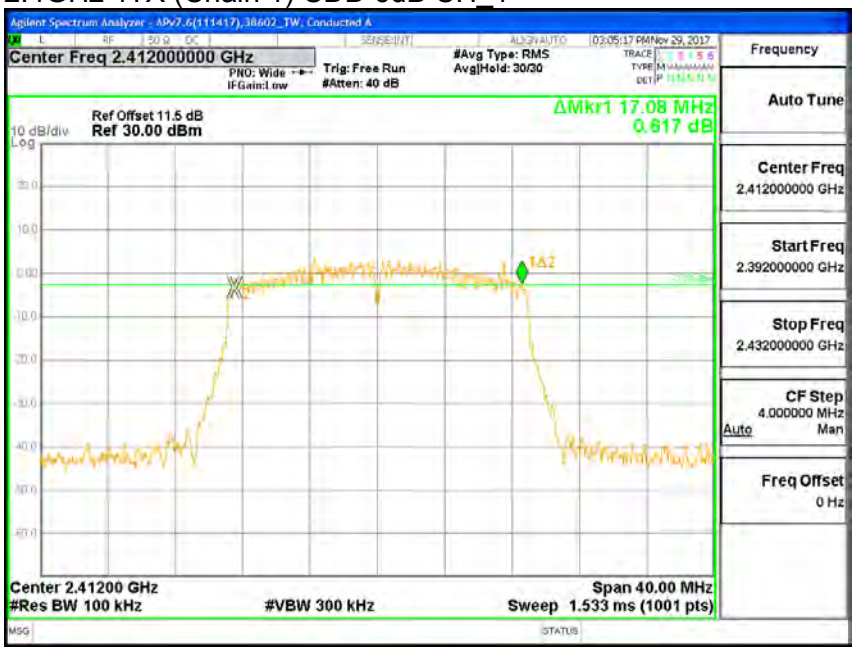
RESULTS

Channel	Frequency	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	6 dB BW Chain 2 (MHz)	6 dB BW Chain 3 (MHz)	Minimum Limit (MHz)
CH_1	2412	16.72	17.08	17.16	17.28	0.5
CH_2	2417	15.36	17.56	16.60	17.04	0.5
CH_6	2437	**17.64**	16.96	16.68	17.00	0.5
CH_9	2452	16.92	17.24	16.68	16.64	0.5
CH_10	2457	15.08	16.60	16.32	16.96	0.5
CH_11	2462	15.08	16.88	16.60	17.28	0.5

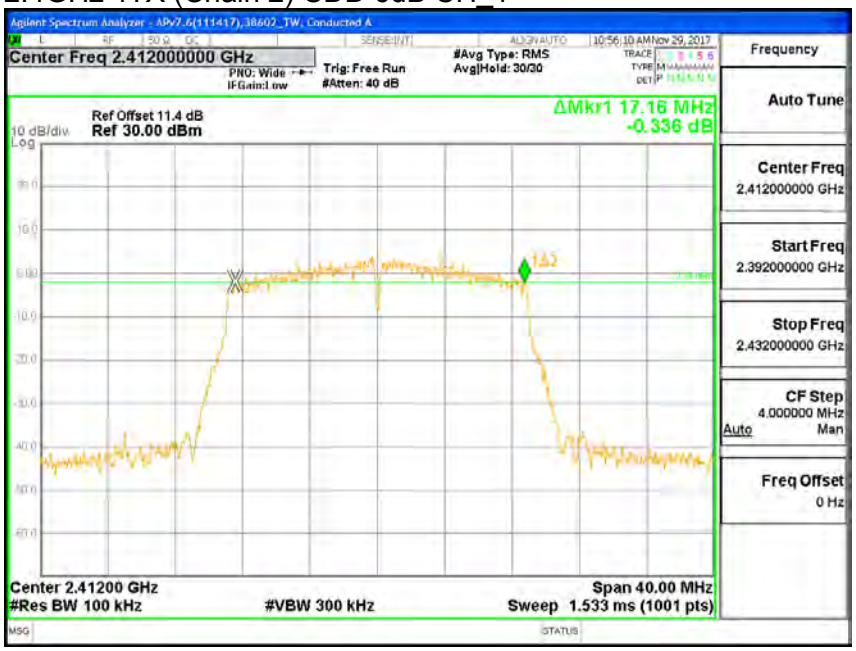
2.4GHz 4TX (Chain 0) CDD 6dB CH_1



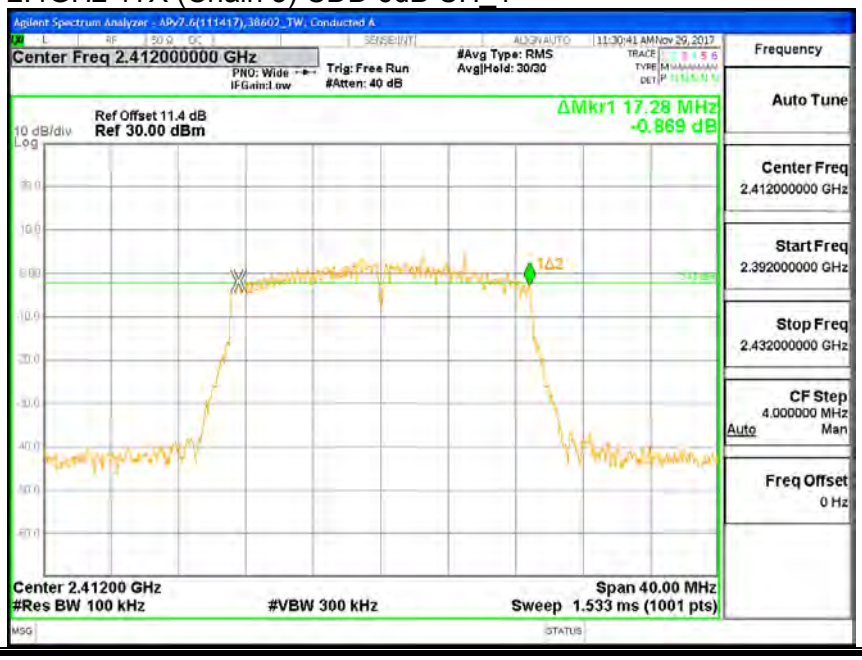
2.4GHz 4TX (Chain 1) CDD 6dB CH_1



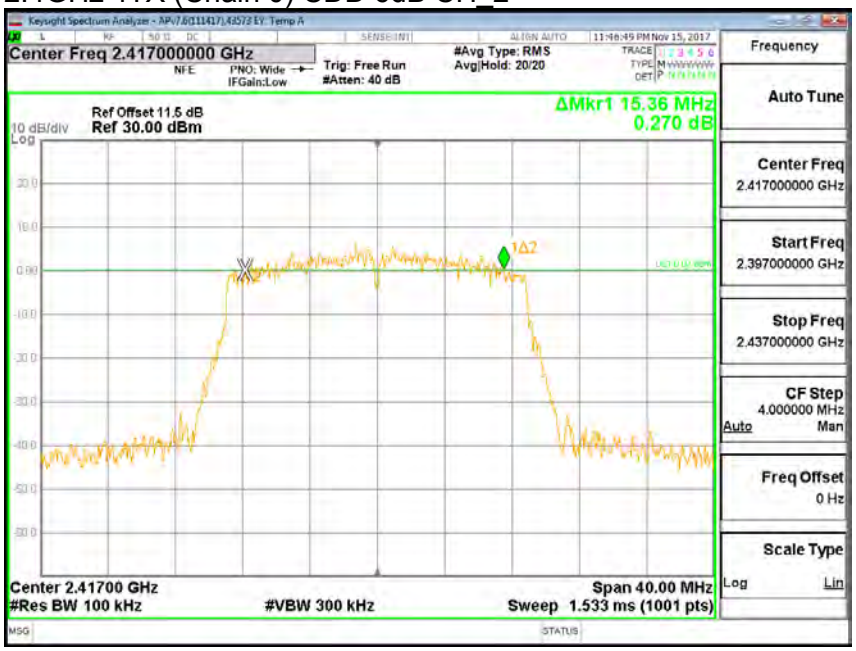
2.4GHz 4TX (Chain 2) CDD 6dB CH_1



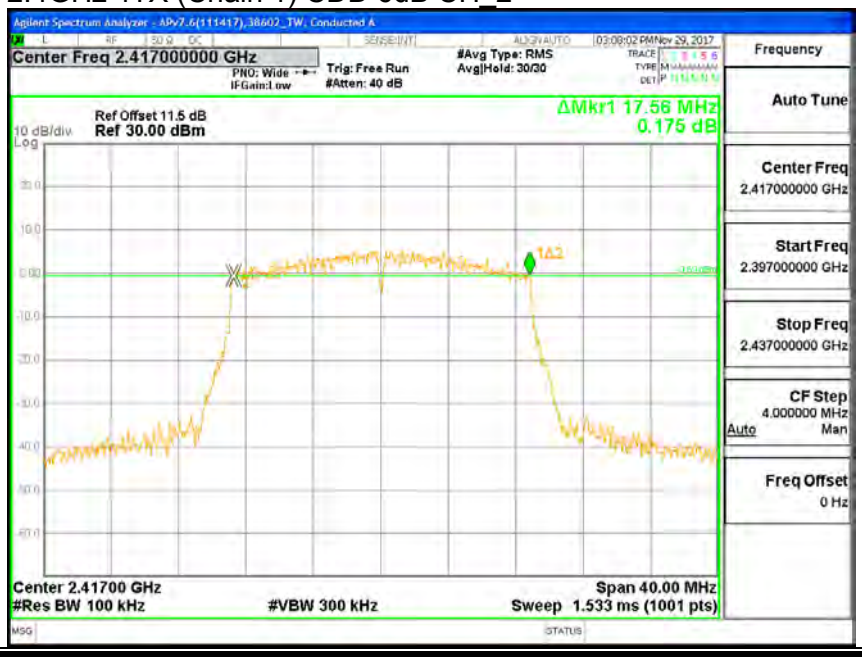
2.4GHz 4TX (Chain 3) CDD 6dB CH_1



2.4GHz 4TX (Chain 0) CDD 6dB CH_2

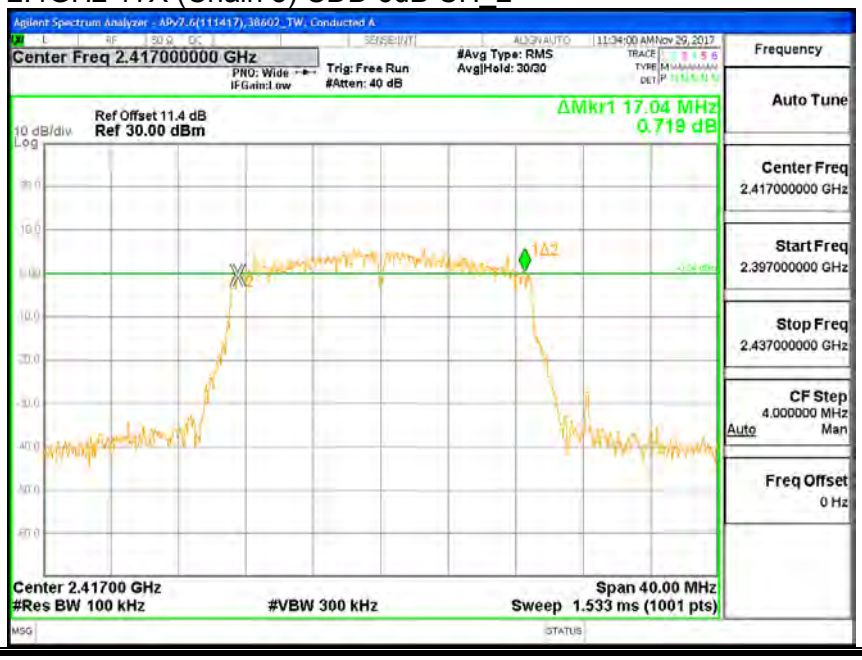


2.4GHz 4TX (Chain 1) CDD 6dB CH_2

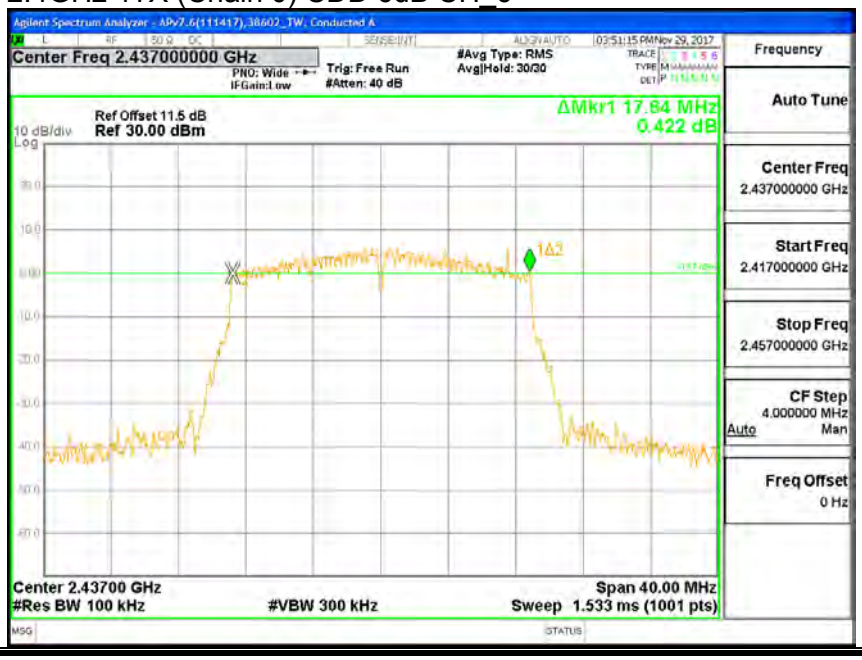


2.4GHz 4TX (Chain 2) CDD 6dB CH_2

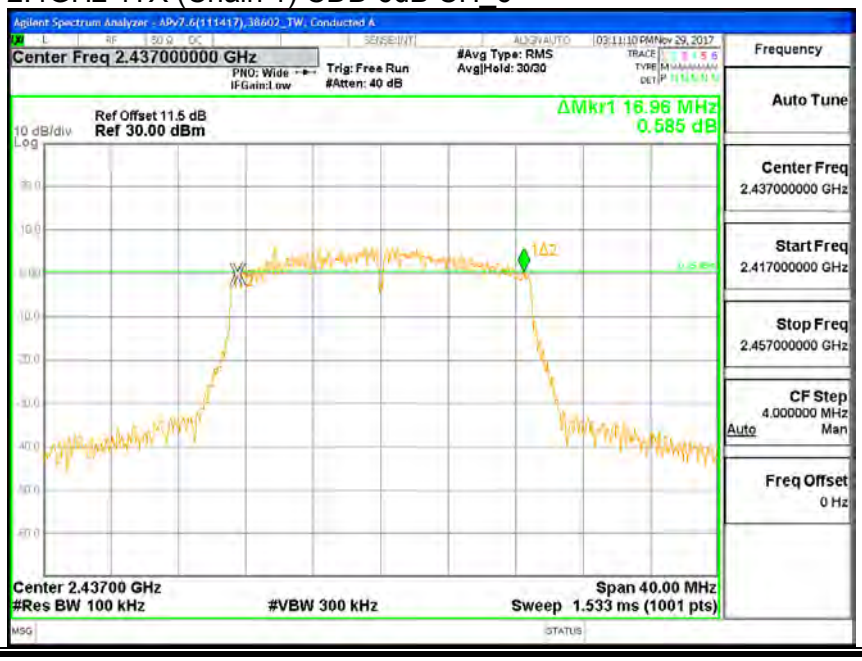
2.4GHz 4TX (Chain 3) CDD 6dB CH_2



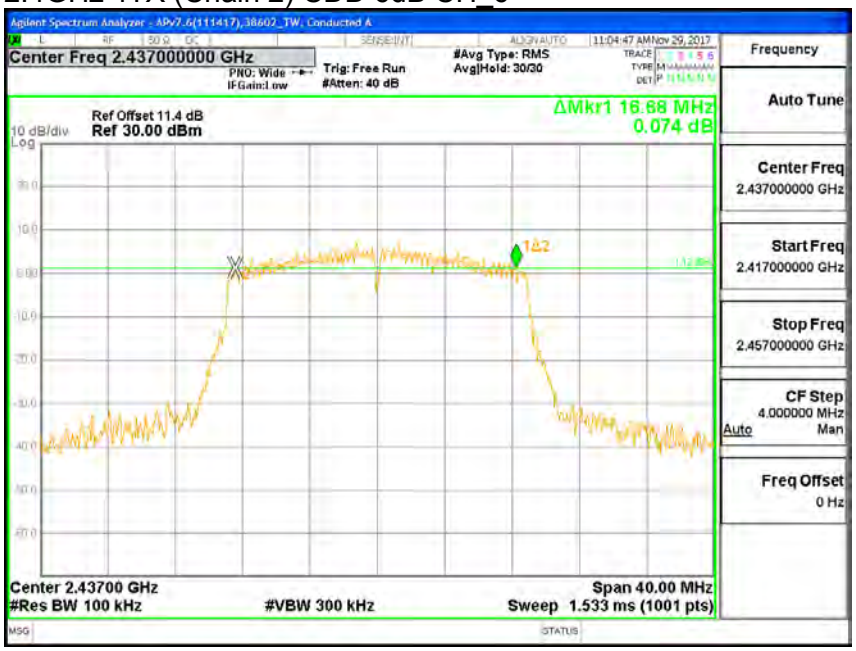
2.4GHz 4TX (Chain 0) CDD 6dB CH_6



2.4GHz 4TX (Chain 1) CDD 6dB CH_6



2.4GHz 4TX (Chain 2) CDD 6dB CH_6



2.4GHz 4TX (Chain 3) CDD 6dB CH_6