TEST REPORT

Dt&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2410-0126
2. Customer
   - Name (FCC) : MOTREX CO.,LTD.
   - Address (FCC) : 1-1301, 56, Geumto-ro 80beon-gil, Sujeong-gu, Seongnam-si, Gyeonggi-do, South Korea
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Smart Display / MC310L_VP2NG
   FCC ID : BP9-MC310LVP2NG
5. FCC Regulation(s): Part 15.247
   Test Method used: KDB558074 D01v05r02, ANSI C63.10-2013
6. Date of Test : 2024.09.30 ~ 2024.10.16
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
8. Testing Environment : See appended test report.
9. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : SeokHo Han	(Signature)	Technical Manager Name : JaeJin Lee	(Signature)

2024 . 10 . 29 .

Dt&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2410-0126	Oct, 29. 2024	Initial issue	SeokHo Han	JaeJin Lee

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1. General Information

1.1. Description of EUT

Equipment Class	Digital Transmission System (DTS)
Product Name	Smart Display
Model Name	MC310L_VP2NG
Add Model Name	-
Firmware Version Identification Number	v1.00
EUT Serial Number	Conducted: 0000764C45230D , Radiated: 0002176F85230D
Power Supply	DC 12 V
Modulation Technique	▪ 802.11b: CCK, DSSS ▪ 802.11g/n: OFDM
Antenna Specification	Antenna Type: Chip Antenna Antenna Gain : 2.22 dBi (PK) Path loss form the conducted test point to the antenna terminal: 5.4dB Antenna gain including path loss form the conducted test point to the antenna terminal: -3.18dBi

Band	Mode	Tx. frequency(MHz)	Max. conducted power(dBm)
2.4 GHz	802.11b	1 Mbps	16.87
	802.11g	6 Mbps	23.60
	802.11n (HT20)	MCS 0	23.43
	802.11n(HT40)	MCS 0	22.24

1.2. Declaration by the applicant / manufacturer

N/A

1.3. Testing Laboratory

Dt&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of Part 2.948 according to ANSI C63.4-2014. **- FCC & IC MRA Designation No. : KR0034** **- ISED#: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.4. Testing Environment

Ambient Condition	
▪ Temperature	+21 ℃ ~ +24 ℃
▪ Relative Humidity	+40 % ~ +43 %

1.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
Antenna-port conducted emission	1.0 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz Below)	5.0 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz ~ 18 GHz)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated emission (18 GHz Above)	5.8 dB (The confidence level is about 95 %, k = 2)

1.6. Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	23/12/15	24/12/15	MY48010133
Spectrum Analyzer	Agilent Technologies	N9020A	24/06/03	25/06/03	US47360812
Spectrum Analyzer	Agilent Technologies	N9020A	24/06/03	25/06/03	MY46471622
DC Power Supply	Agilent Technologies	66332A	24/06/05	25/06/05	US37474125
DC Power Supply	SM techno	SDP30-5D	24/06/05	25/06/05	305DMG288
Multimeter	FLUKE	17B+	23/12/15	24/12/15	36390701WS
Signal Generator	Rohde Schwarz	SMBV100A	23/12/15	24/12/15	255571
Signal Generator	ANRITSU	MG3695C	23/12/15	24/12/15	173501
Thermohygrometer	BODYCOM	BJ5478	23/12/15	24/12/15	120612-1
Thermohygrometer	BODYCOM	BJ5478	23/12/15	24/12/15	120612-2
Thermohygrometer	BODYCOM	BJ5478	24/06/05	25/06/05	N/A
Loop Antenna	ETS-Lindgren	6502	23/11/09	24/11/09	00060496
Hybrid Antenna	Schwarzbeck	VULB 9160	23/12/15	24/12/15	3362
Horn Antenna	ETS-Lindgren	3117	24/06/04	25/06/04	00143278
Horn Antenna	A.H.Systems Inc.	SAS-574	24/06/11	25/06/11	155
PreAmplifier	tsj	MLA-0118-B01-40	23/12/15	24/12/15	1852267
PreAmplifier	tsj	MLA-1840-J02-45	24/06/03	25/06/03	16966-10728
PreAmplifier	H.P	8447D	23/12/15	24/12/15	2944A07774
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	24/06/12	25/06/12	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	24/06/12	25/06/12	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	24/06/12	25/06/12	3
Attenuator	Hefei Shunze	SS5T2.92-10-40	24/06/12	25/06/12	16012202
Attenuator	Aeroflex/Weinschel	56-3	24/06/12	25/06/12	Y2370
Attenuator	SMAJK	SMAJK-2-3	24/06/12	25/06/12	3
Attenuator	SMAJK	SMAJK-2-3	24/06/12	25/06/12	2
Attenuator	Aeroflex/Weinschel	86-10-11	24/06/03	25/06/03	408
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	23/12/15	24/12/15	1338004 1911481
Cable	Dt&C	Cable	24/01/03	25/01/03	G-2
Cable	HUBER+SUHNER	SUCOFLEX 100	24/01/03	25/01/03	G-3
Cable	Dt&C	Cable	24/01/03	25/01/03	G-4
Cable	OMT	YSS21S	24/01/03	25/01/03	G-5
Cable	Junkosha	MWX241	24/01/03	25/01/03	mmW-1
Cable	Junkosha	MWX241	24/01/03	25/01/03	mmW-4
Cable	HUBER+SUHNER	SUCOFLEX100	24/01/03	25/01/03	M-01
Cable	HUBER+SUHNER	SUCOFLEX100	24/01/03	25/01/03	M-02
Cable	JUNKOSHA	MWX241/B	24/01/03	25/01/03	M-03
Cable	JUNKOSHA	J12J101757-00	24/01/03	25/01/03	M-07
Cable	HUBER+SUHNER	SUCOFLEX106	24/01/03	25/01/03	M-09
Cable	Radiall	TESTPRO3	24/01/03	25/01/03	RFC-70
Test Software (Radiated)	tsj	EMI Measurement	NA	NA	Version 2.00.0185

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note2: The cable is not a regular calibration item, so it has been calibrated by Dt&C itself.

2. Test Methodology

The measurement procedures described in the ANSI C63.10-2013 and the guidance provided in KDB558074 D01v05r02 were used in measurement of the EUT.
The EUT was tested per the guidance of KDB558074 D01v05r02. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the test mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB558074 D01v05r02.
So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.
The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB558074 D01v05r02. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on section 12.1 of the KDB558074 D01v05r02.
The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

2.4. Instrument Calibration

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.5. Description of Test Modes

The EUT has been tested with the operating condition for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting.

Transmitting Configuration of EUT

Mode	Data rate
802.11b	1 Mbps ~ 11 Mbps
802.11g	6 Mbps ~ 54 Mbps
802.11n(HT20)	MCS 0 ~ MCS 7
802.11n(HT40)	MCS 0 ~ MCS 7

EUT Operation test setup

- **Test Software:** PuTTY 0.64.0.29
- **Power setting:** Refer to the table below

Mode	Frequency [MHz]	Power Setting
802.11b	2 412	14
	2 437	14
	2 462	15
802.11g	2 412	14
	2 437	17
	2 462	14
802.11n (HT20)	2 412	13
	2 437	17
	2 462	12
802.11n (HT40)	2 422	8
	2 437	14
	2 452	7

Test Mode

Test mode	Worst case data rate	Tested Frequency (MHz)		
TM 1	802.11b 1 Mbps	2 412	2 437	2 462
TM 2	802.11g 6 Mbps	2 412	2 437	2 462
TM 3	802.11n(HT20) MCS 0	2 412	2 437	2 462
TM 4	802.11n(HT40) MCS 0	2 422	2 437	2 452

Note1: The worst case data rate was determined according to the power measurements.
Note2: The power measurement results for all modes and data rate were reported.

3. Antenna Requirements

■ **According to Part 15.203**

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

The antenna is attached on the PCB.
Therefore this E.U.T complies with the requirement of Part 15.203

4. Summary of Test Result

FCC part section(s)	Test Description	Limit	Test Condition	Status Note 1
15.247(b)	Maximum Peak Conducted Output Power	< 1 Watt	Conducted	C
15.247(a)	6 dB Bandwidth	> 500 kHz		C
15.247(e)	Power Spectral Density	< 8 dBm / 3 kHz		C
15.247(d)	Unwanted Emissions(Conducted)	20 dBc in any 100 kHz BW		C
15.247(d) 15.205 15.209	Unwanted Emissions(Radiated)	Part 15.209 limits (Refer to section 5.5)	Radiated	C
15.207	AC Power-Line Conducted Emissions	Part 15.207 limits (Refer to section 5.6)	AC Line Conducted	NA Note3
15.203	Antenna Requirements	Part 15.203 (Refer to section 3)	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable
Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.
Note 3: This device is installed in a car. Therefore the power source is a battery of car.

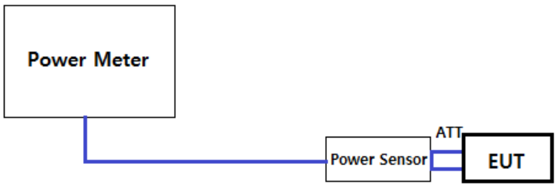
5. Test Result

5.1. Maximum Peak Conducted Output Power

▣ Test Requirements and limit, Part 15.247(b)

The maximum permissible conducted output power is 1 Watt.

5.1.1. Test Setup



5.1.2. Test Procedures

- **KDB558074 D01v05r02 - Section 8.3.1.3**
- **ANSI C63.10-2013 – Section 11.9.1.3**

RBW ≥ DTSPKPM1 Peak-reading power meter method

The maximum conducted output powers were measured using a broadband peak RF power meter which has greater video bandwidth than DUT's DTS bandwidth and utilize a fast-responding diode detector.

- **KDB558074 D01v05r02 - Section 8.3.2.3**
- **ANSI C63.10-2013 – Section 11.9.2.3**

Method AVGPM-G

The average conducted output powers were measured using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

5.1.3. Test Results

- Refer to the next page

Mode	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm)							
			Data Rate (Mbps)							
			1	2	5.5	11	-	-	-	-
802.11b	2 412	PK	16.20	16.07	15.94	15.81	-	-	-	-
		AV	13.61	13.45	13.28	13.08	-	-	-	-
	2 437	PK	16.22	16.15	16.08	15.75	-	-	-	-
		AV	13.74	13.43	13.12	13.11	-	-	-	-
	2 462	PK	16.87	16.77	16.67	16.15	-	-	-	-
		AV	14.39	14.06	13.95	13.58	-	-	-	-

Mode	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2 412	PK	22.56	22.47	22.43	22.34	22.22	22.19	22.14	22.12
		AV	14.17	14.08	14.03	13.94	13.89	13.81	13.75	13.81
	2 437	PK	23.60	23.58	23.52	23.48	23.38	23.34	23.22	23.08
		AV	16.04	16.02	15.92	15.83	15.69	15.63	15.50	15.37
	2 462	PK	22.14	22.06	22.02	21.98	21.83	21.78	21.71	21.53
		AV	12.98	12.84	12.70	12.62	12.48	12.37	12.26	12.24

Mode	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm)							
			Data Rate (MCS)							
			0	1	2	3	4	5	6	7
802.11n (HT20)	2 412	PK	21.62	21.52	21.49	21.45	21.39	21.35	21.28	21.25
		AV	12.21	12.13	12.03	11.97	11.89	11.84	11.81	11.74
	2 437	PK	23.43	23.34	23.20	23.18	23.06	22.93	22.82	22.76
		AV	15.95	15.85	15.81	15.75	15.65	15.50	15.43	15.35
	2 462	PK	21.65	21.53	21.41	21.37	21.22	21.10	21.07	20.92
		AV	11.91	11.80	11.68	11.56	11.45	11.43	11.40	11.38

Mode	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm)							
			Data Rate (MCS)							
			0	1	2	3	4	5	6	7
802.11n (HT40)	2 422	PK	17.13	17.09	17.00	16.89	16.85	16.79	16.69	16.62
		AV	7.04	7.01	6.92	6.89	6.85	6.81	6.77	6.70
	2 437	PK	22.24	22.17	22.13	22.08	21.98	21.92	21.84	21.70
		AV	13.63	13.61	13.49	13.39	13.31	13.26	13.19	13.07
	2 452	PK	16.38	16.22	16.10	15.93	15.83	15.68	15.59	15.50
		AV	6.87	6.84	6.75	6.71	6.60	6.45	6.39	6.26

5.2. 6 dB Bandwidth

▣ Test Requirements and limit, Part 15.247(a)

The bandwidth at 6 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the EUT's antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6 dB bandwidth is 500 kHz.

5.2.1. Test Setup

Refer to the APPENDIX I.

5.2.2. Test Procedures

- **KDB558074 D01v05r02 - Section 8.2**
- **ANSI C63.10-2013 – Section 11.8.2**

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

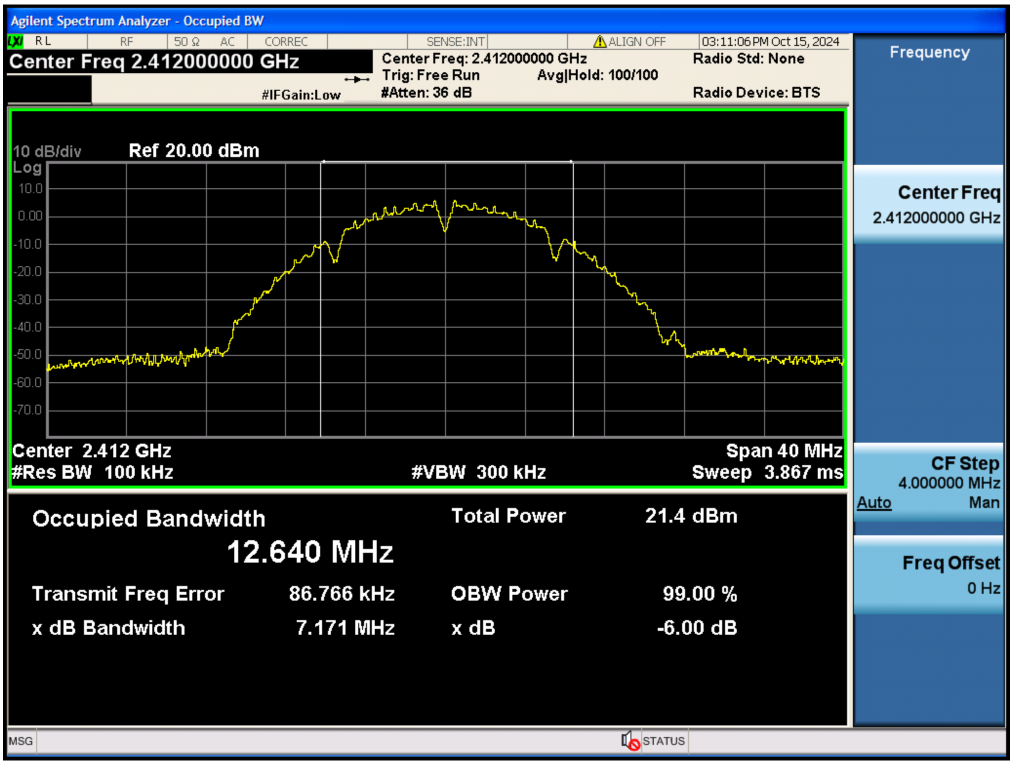
   Option 2 - The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

5.2.3. Test Results

Test Mode	Frequency	Test Results (MHz)
TM 1	2 412	7.17
	2 437	7.20
	2 462	7.18
TM 2	2 412	14.07
	2 437	15.31
	2 462	15.87
TM 3	2 412	15.09
	2 437	15.42
	2 462	15.45
TM 4	2 422	35.07
	2 437	33.18
	2 452	35.07

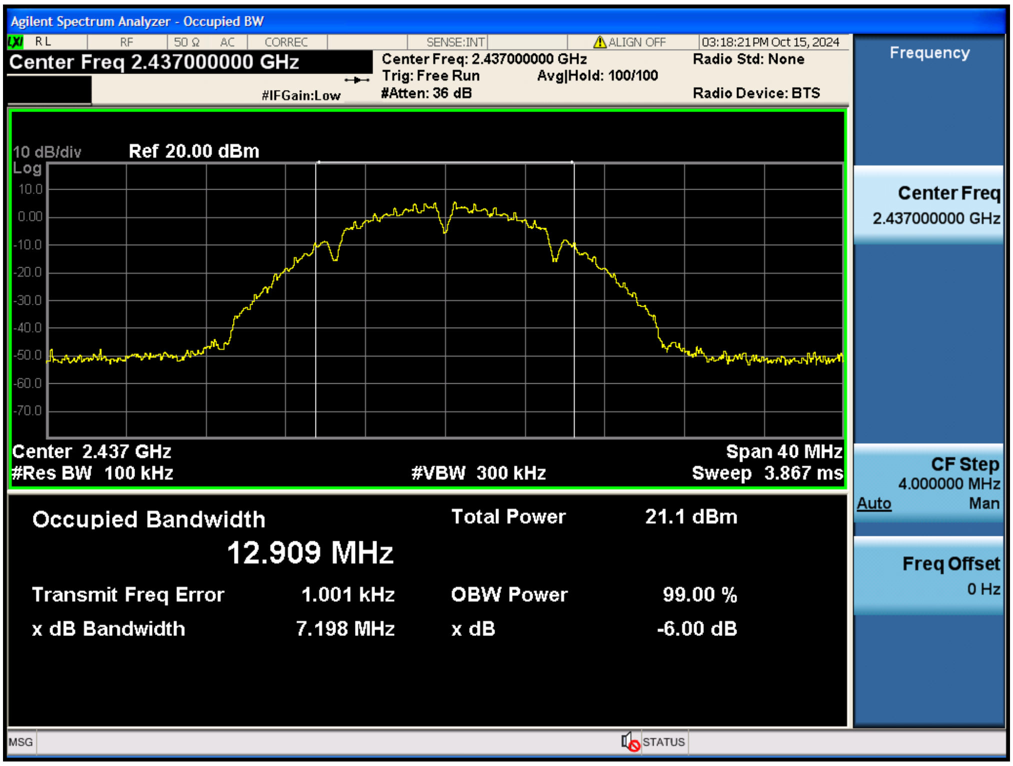
6 dB Bandwidth

TM 1 & 2 412



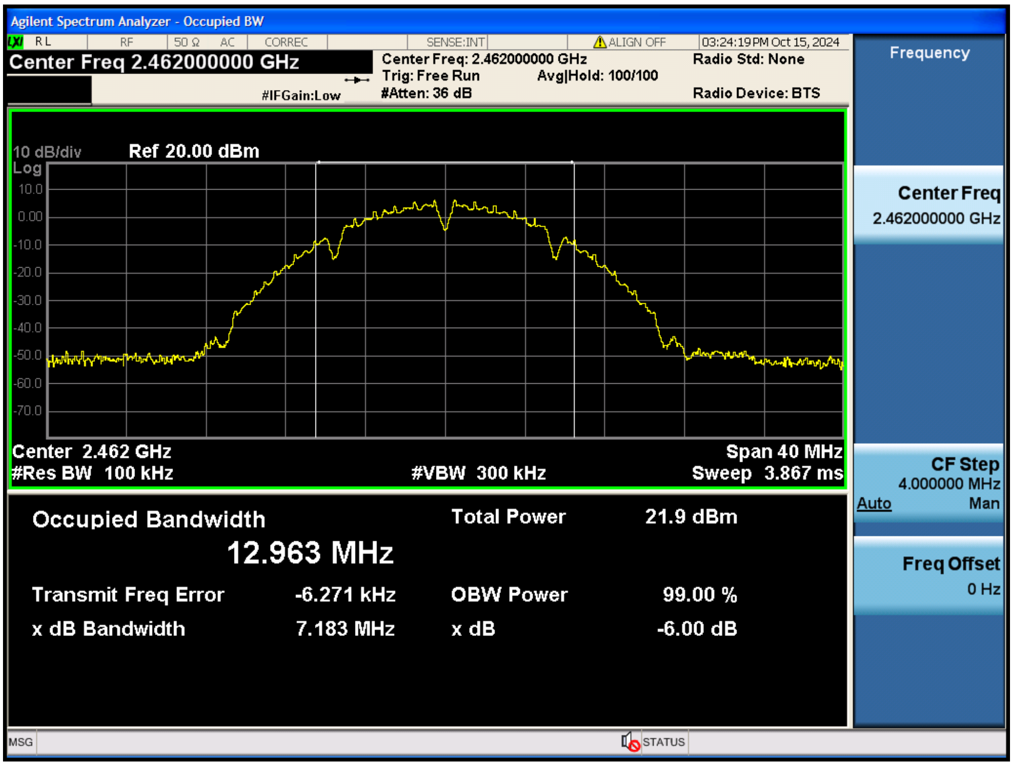
6 dB Bandwidth

TM 1 & 2 437



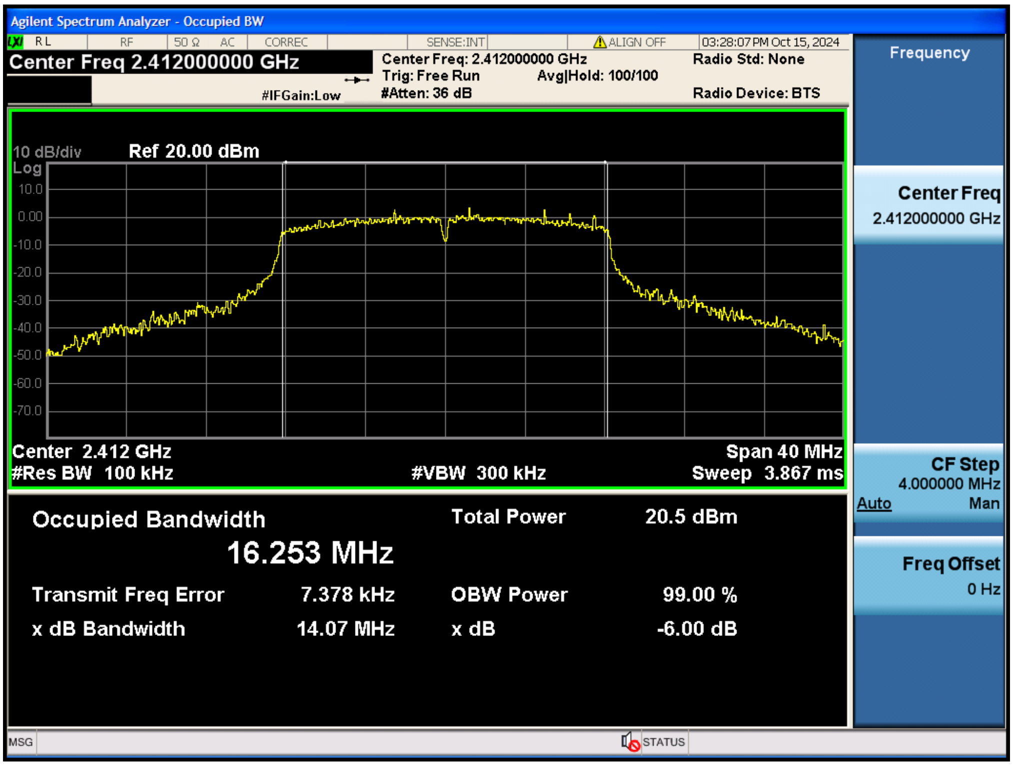
6 dB Bandwidth

TM 1 & 2 462



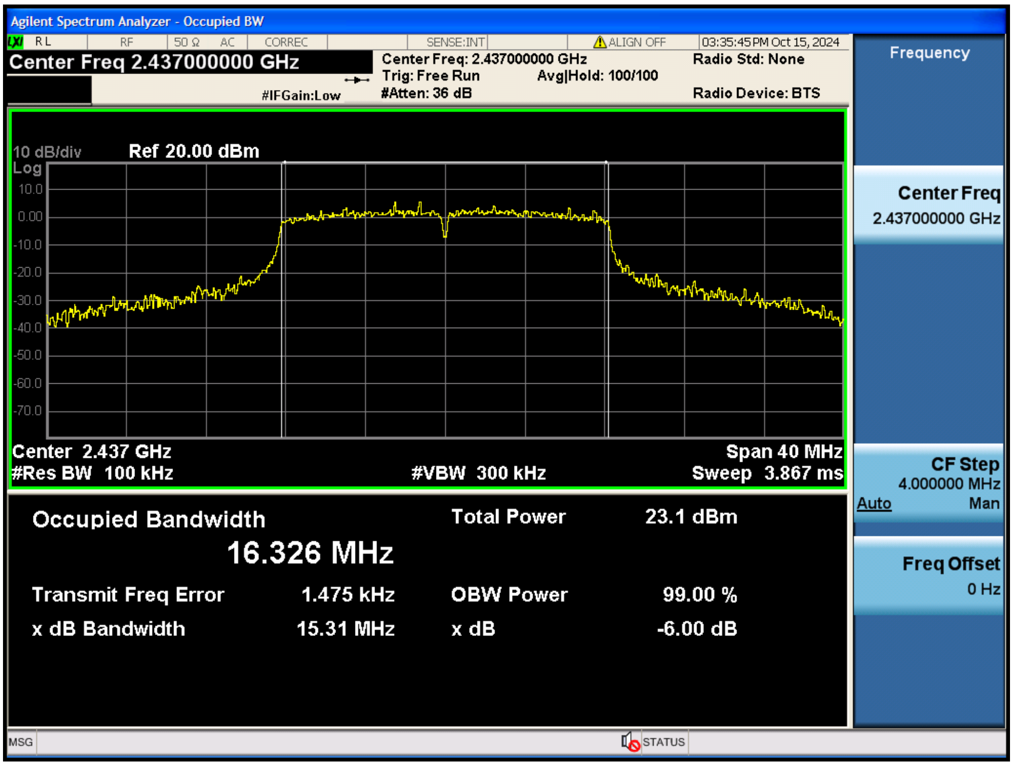
6 dB Bandwidth

TM 2 & 2 412



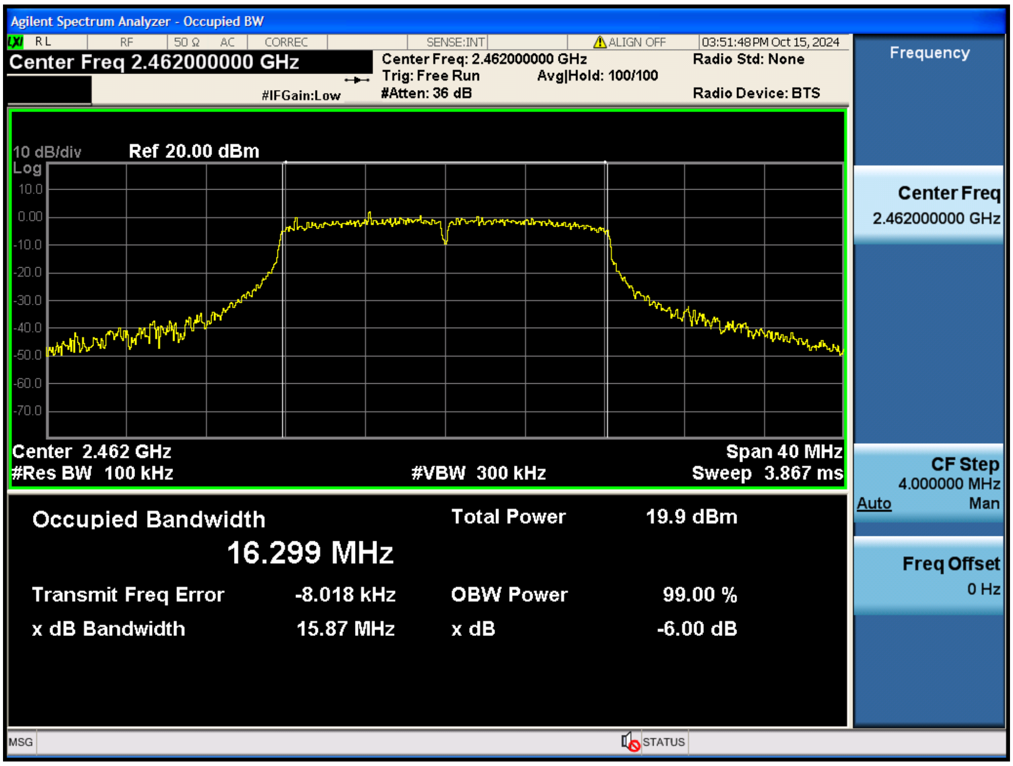
6 dB Bandwidth

TM 2 & 2 437

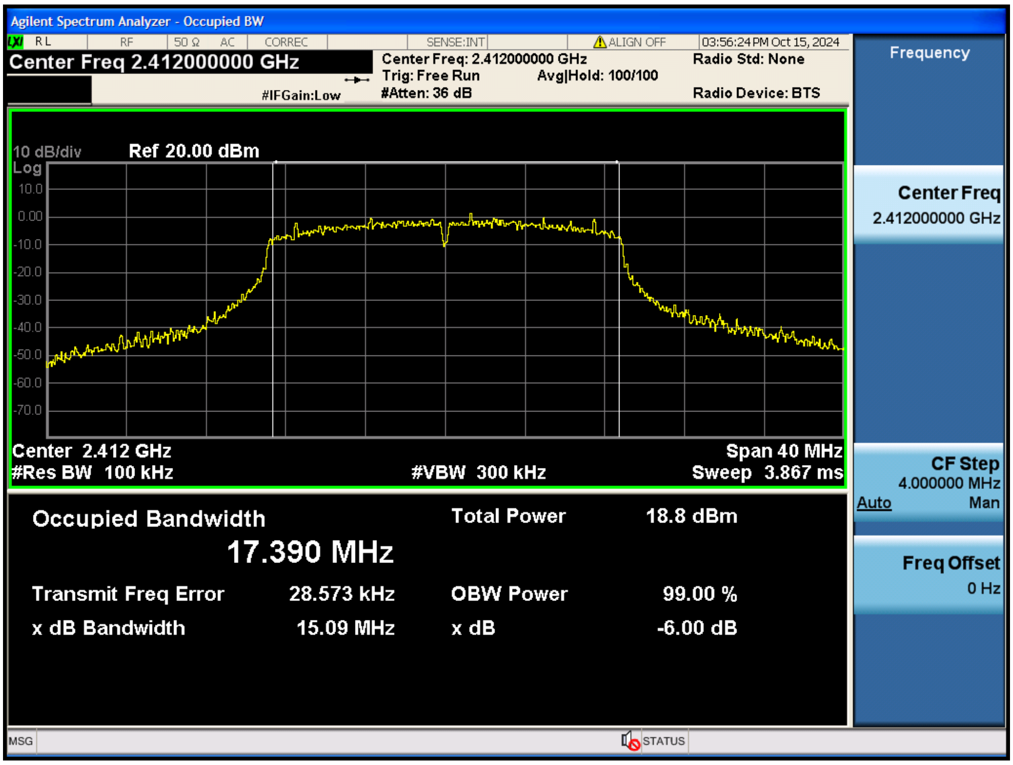


6 dB Bandwidth

TM 2 & 2 462



6 dB Bandwidth TM 3 & 2 412



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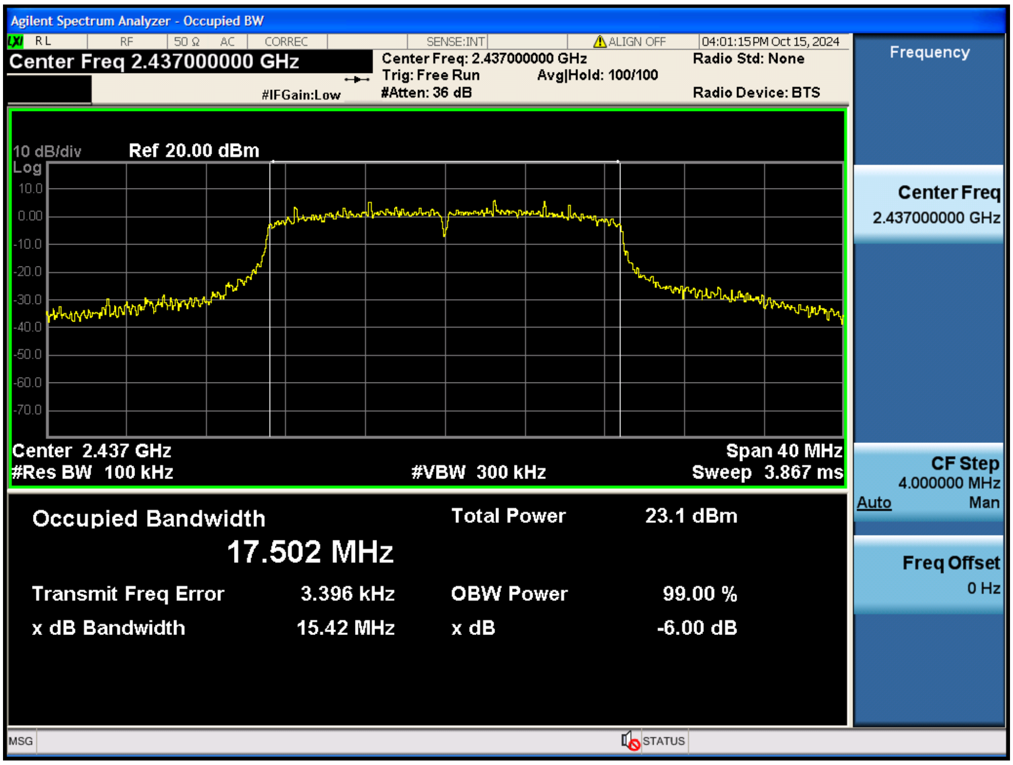
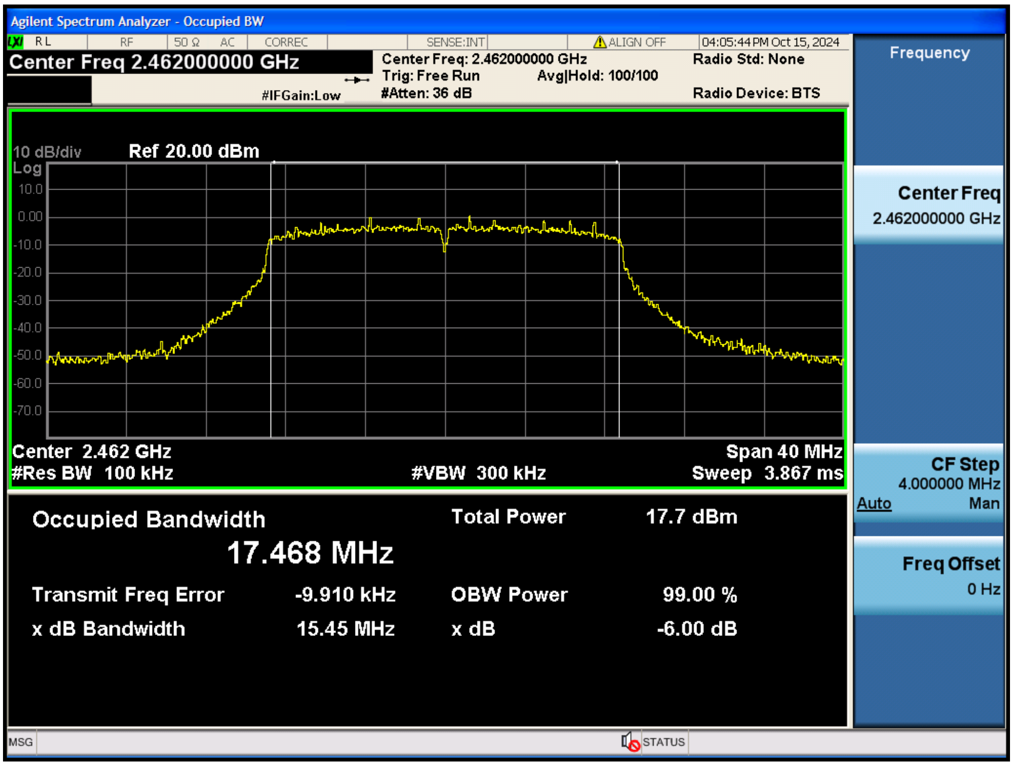


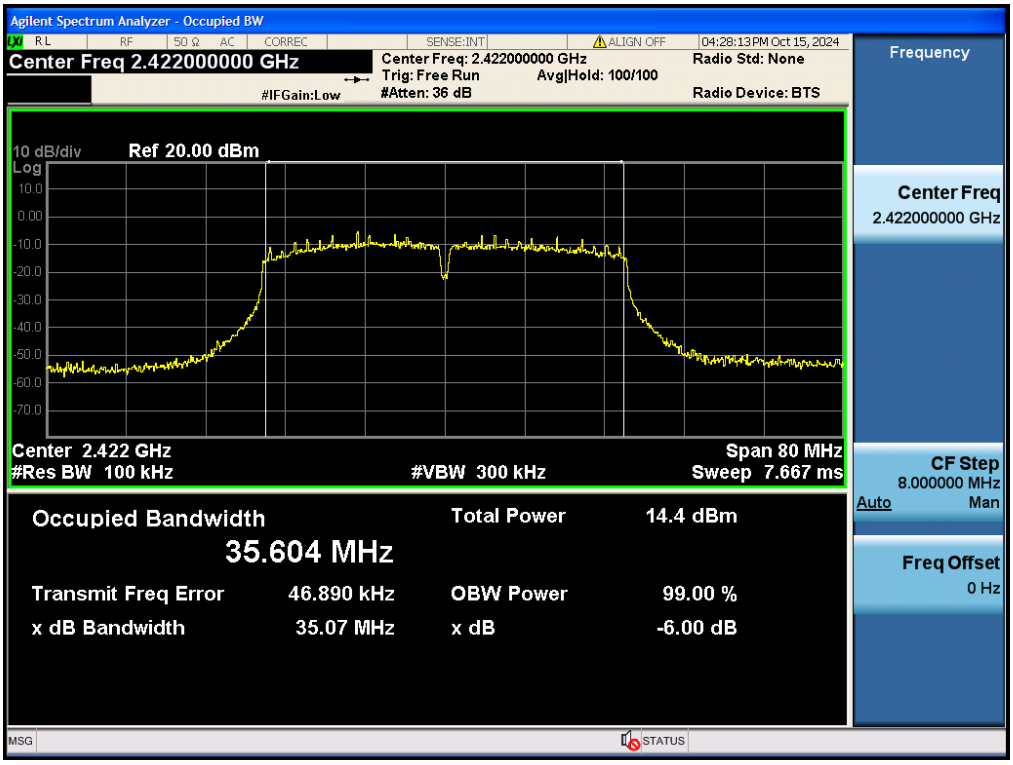
6 dB Bandwidth

TM 3 & 2 462



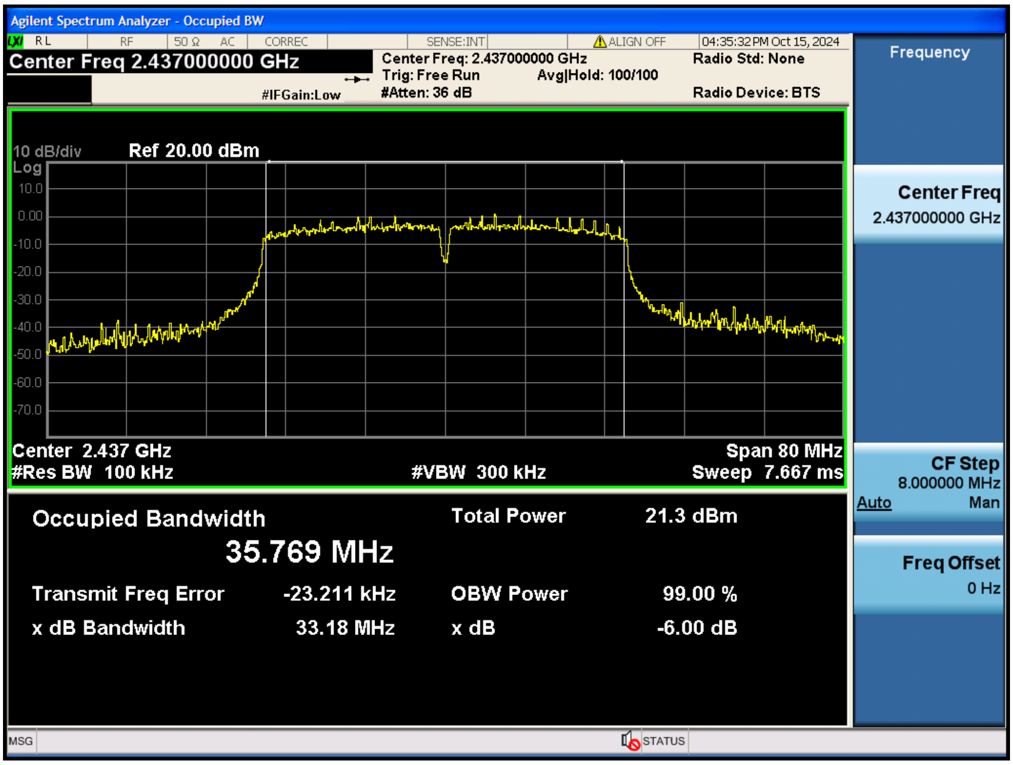
6 dB Bandwidth

TM 4 & 2 422



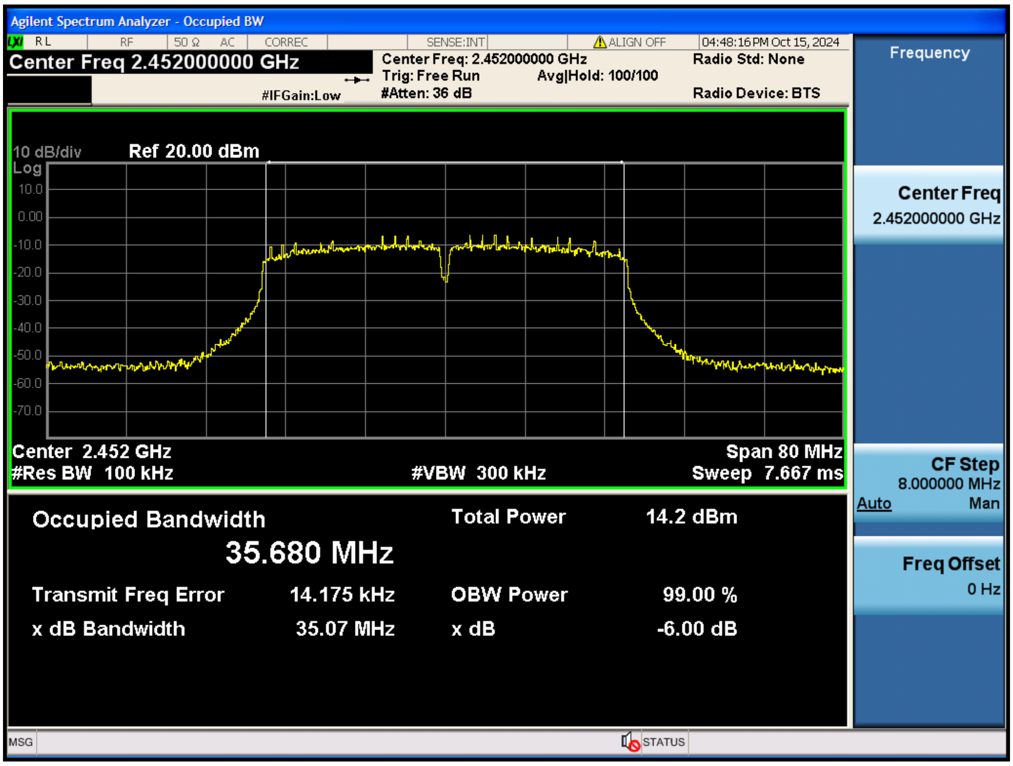
6 dB Bandwidth

TM 4 & 2 437



6 dB Bandwidth

TM 4 & 2 452



5.3. Power Spectral Density

▣ Test requirements and limit, Part 15.247(e)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.3.1. Test Setup

Refer to the APPENDIX I.

5.3.2. Test Procedures

- **KDB558074 D01v05r02 - Section 8.4**
- **ANSI C63.10-2013 – Section 11.10.2**

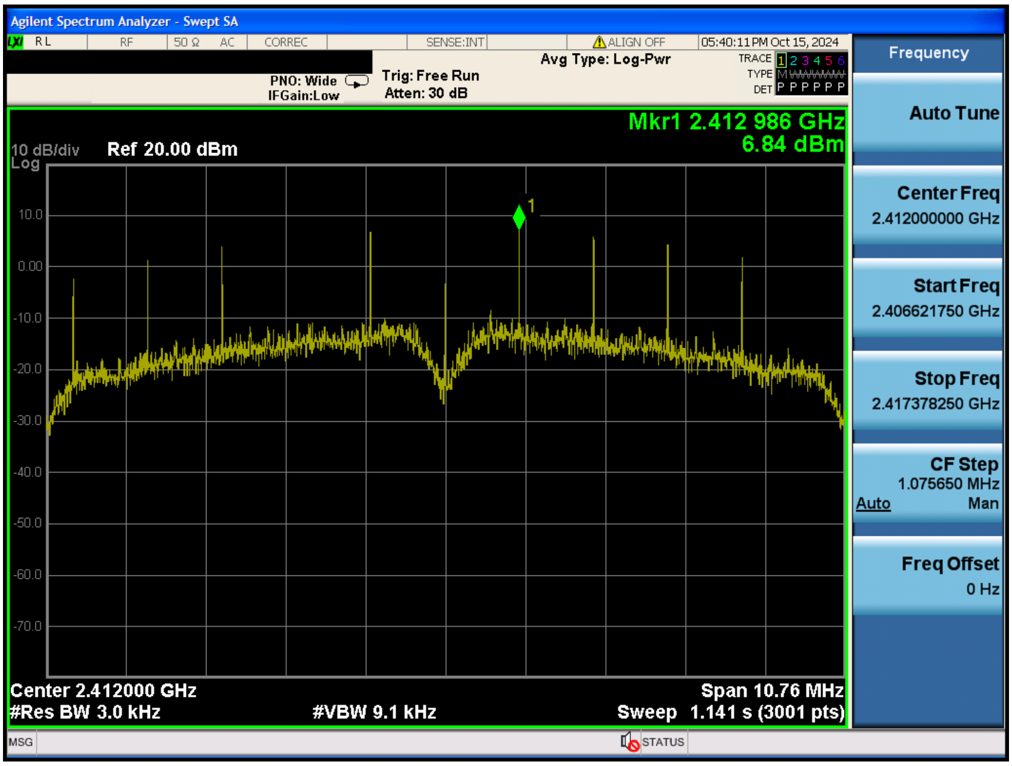
Method PKPSD (peak PSD)

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

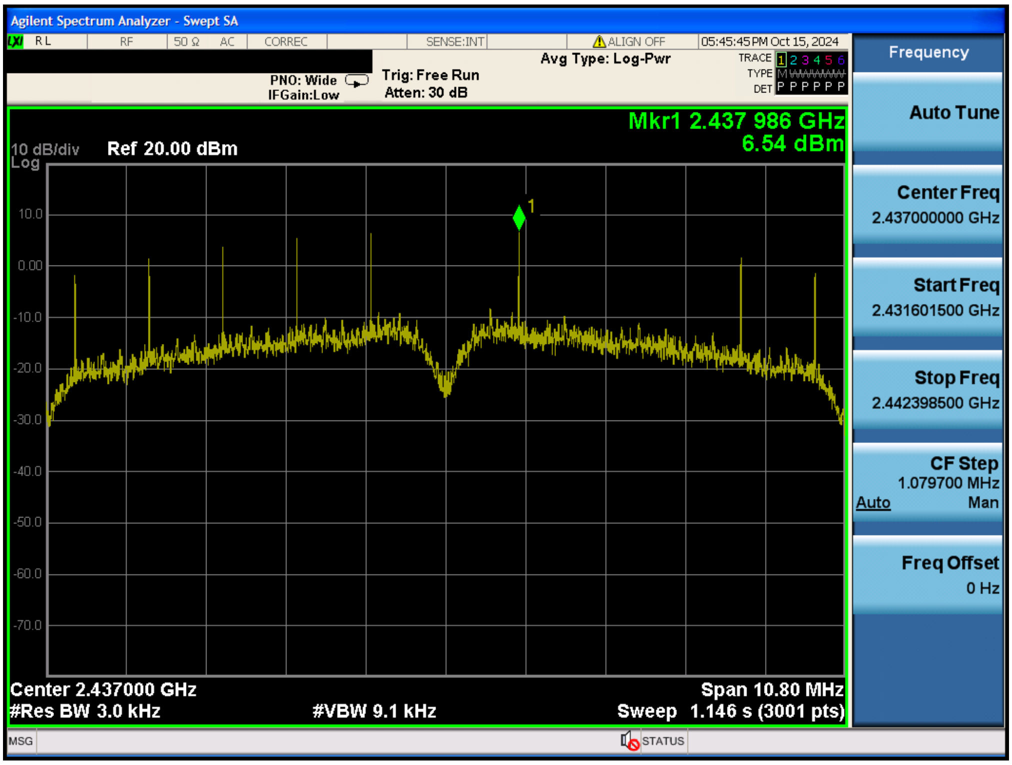
5.3.3. Test Results

Test Mode	Frequency	RBW	PKPSD (dBm)	Limit (dBm / 3 kHz)
TM 1	2 412	3 kHz	6.84	8.00
	2 437	3 kHz	6.54	8.00
	2 462	3 kHz	6.78	8.00
TM 2	2 412	3 kHz	-12.30	8.00
	2 437	3 kHz	-9.15	8.00
	2 462	3 kHz	-12.71	8.00
TM 3	2 412	3 kHz	-12.95	8.00
	2 437	3 kHz	-9.50	8.00
	2 462	3 kHz	-14.59	8.00
TM 4	2 422	3 kHz	-19.86	8.00
	2 437	3 kHz	-13.31	8.00
	2 452	3 kHz	-20.33	8.00

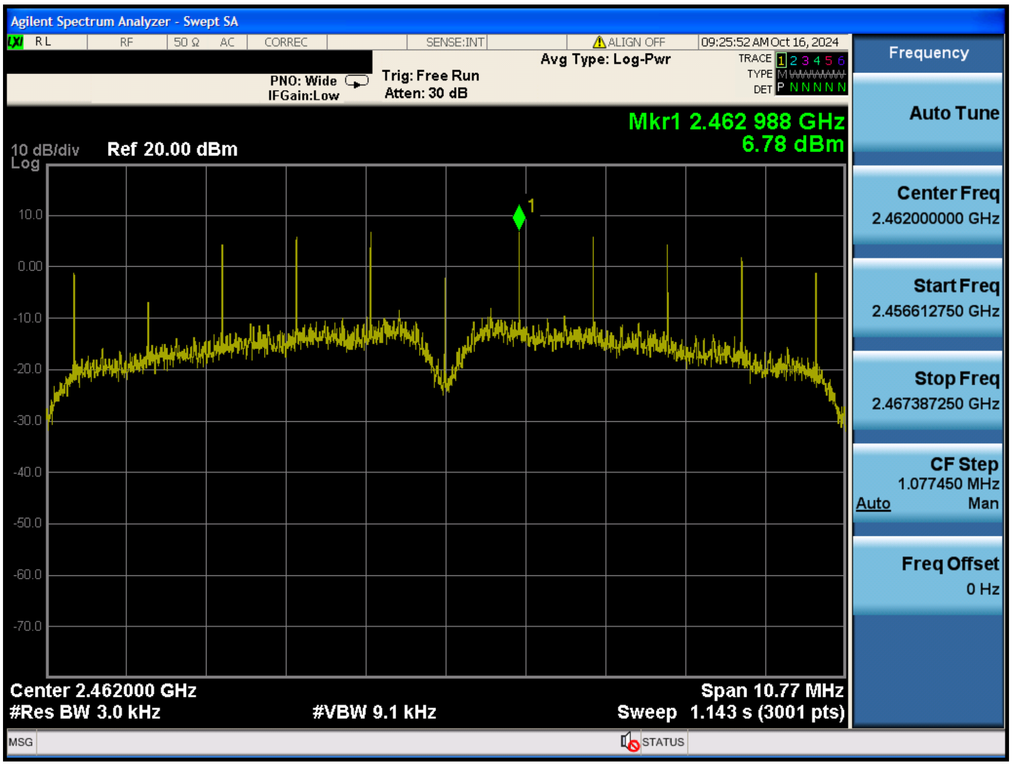
Power Spectral Density TM 1 & 2 412



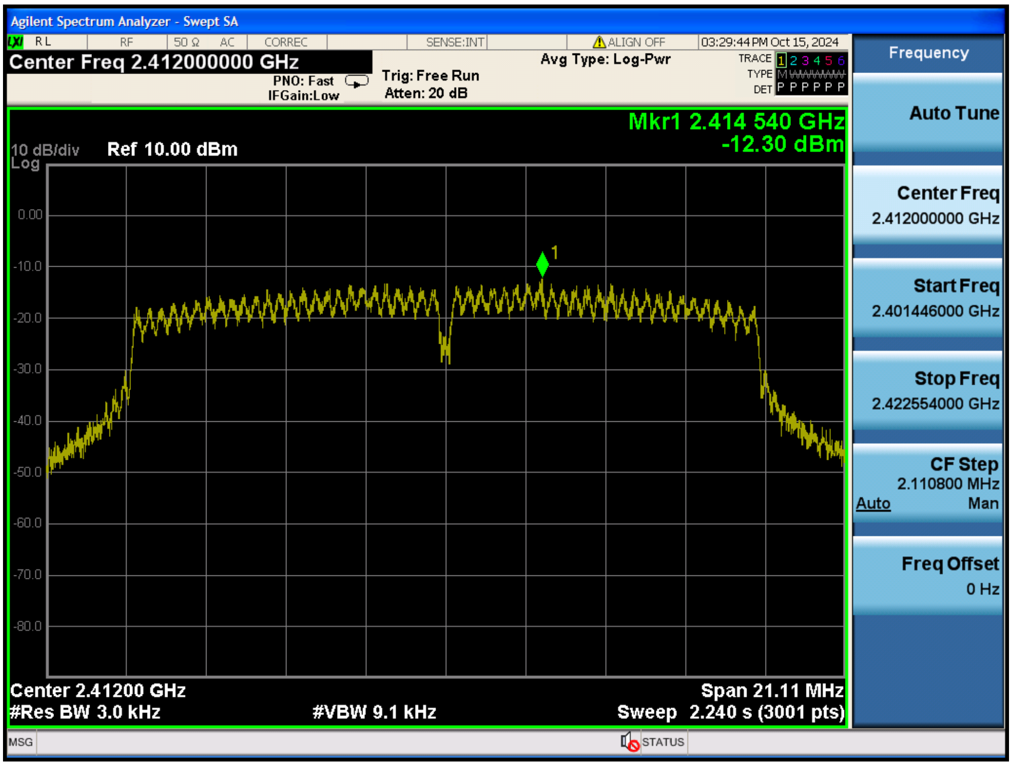
Power Spectral Density TM 1 & 2 437



Power Spectral Density TM 1 & 2 462



Power Spectral Density TM 2 & 2 412



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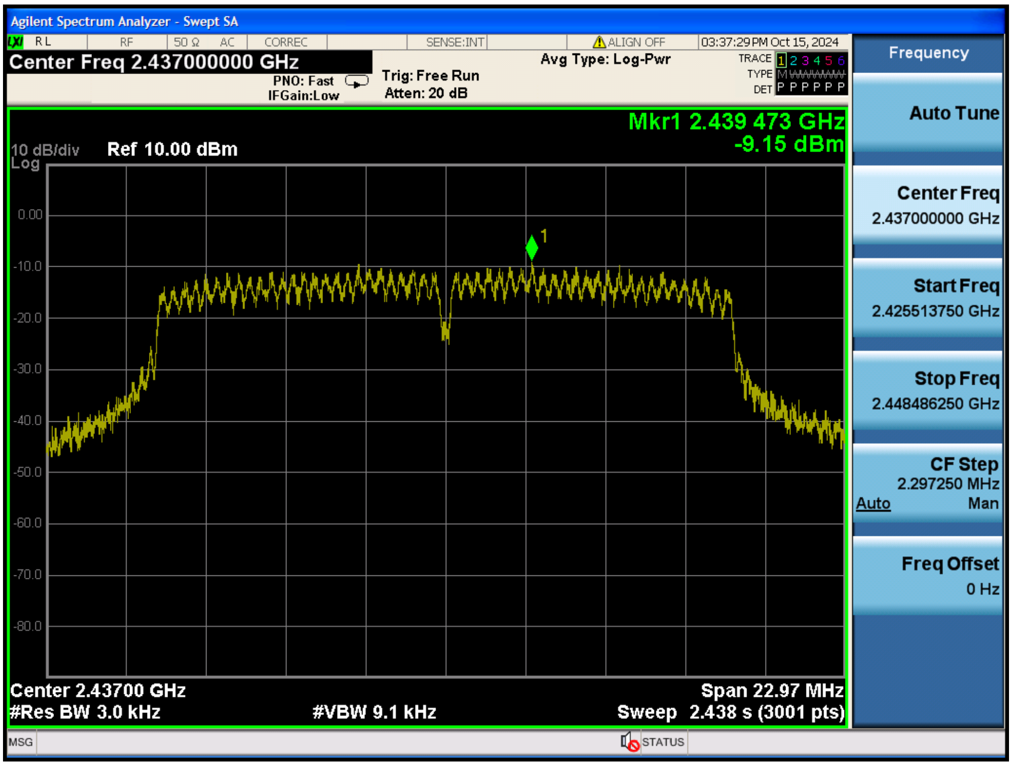

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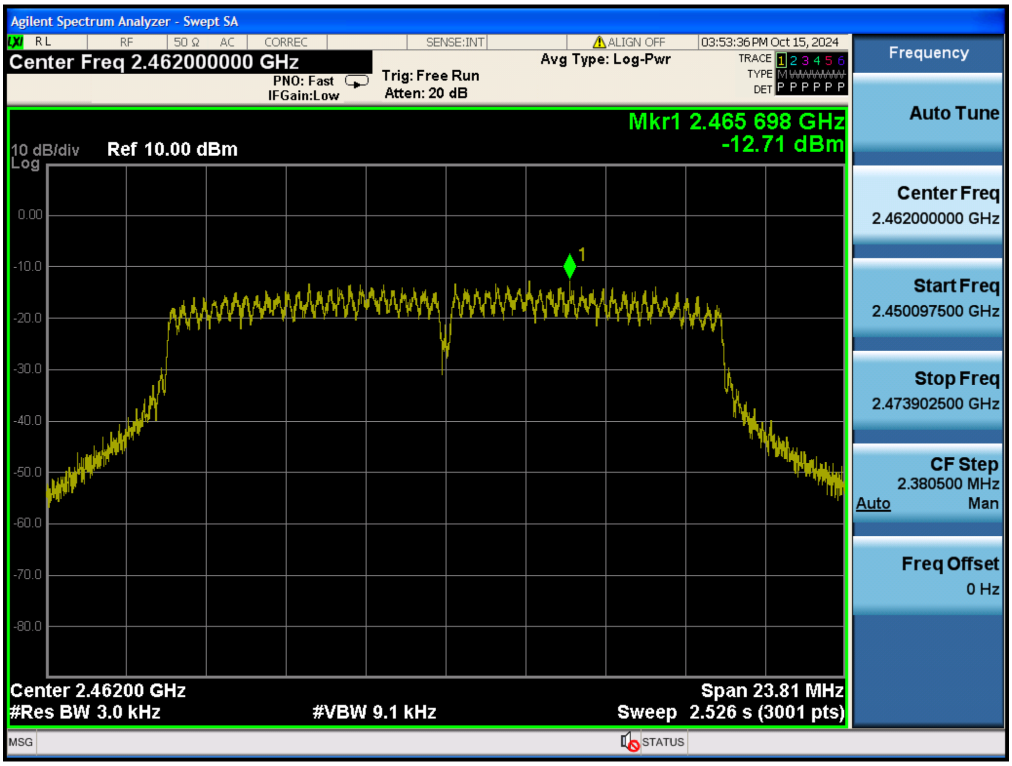
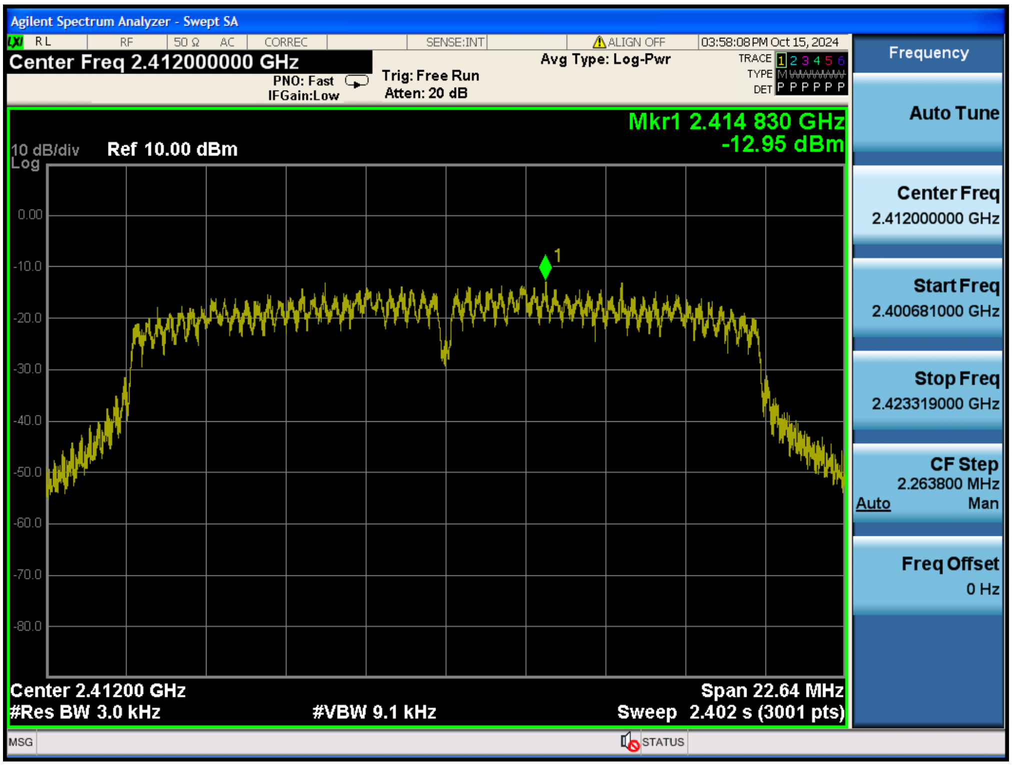
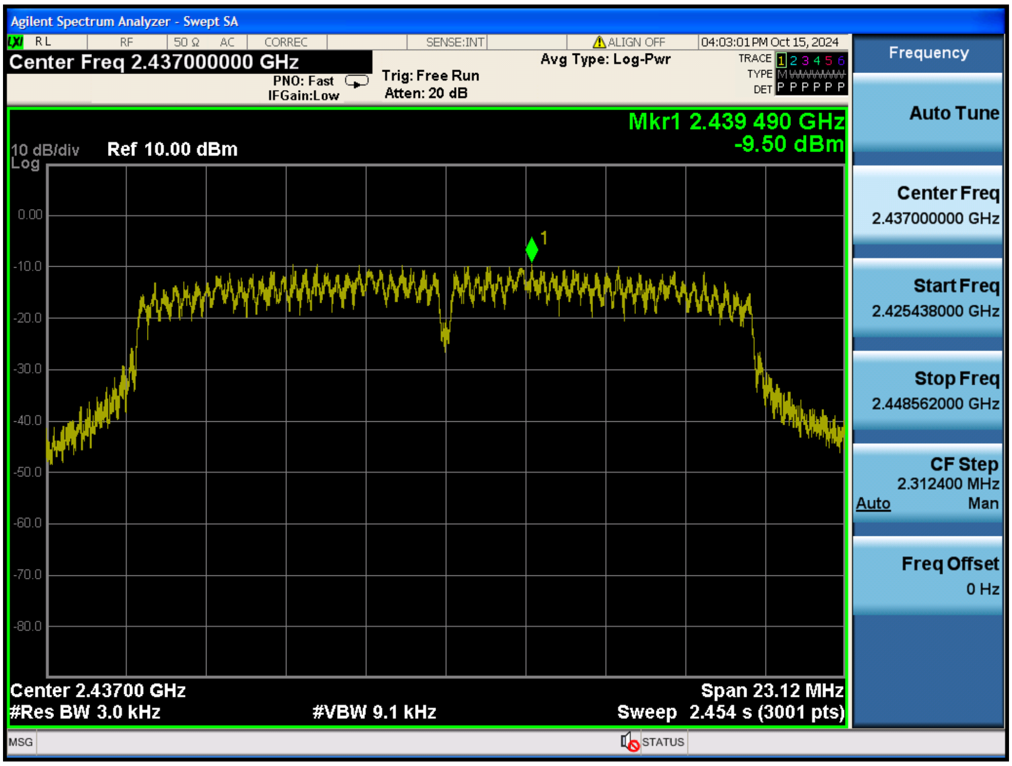


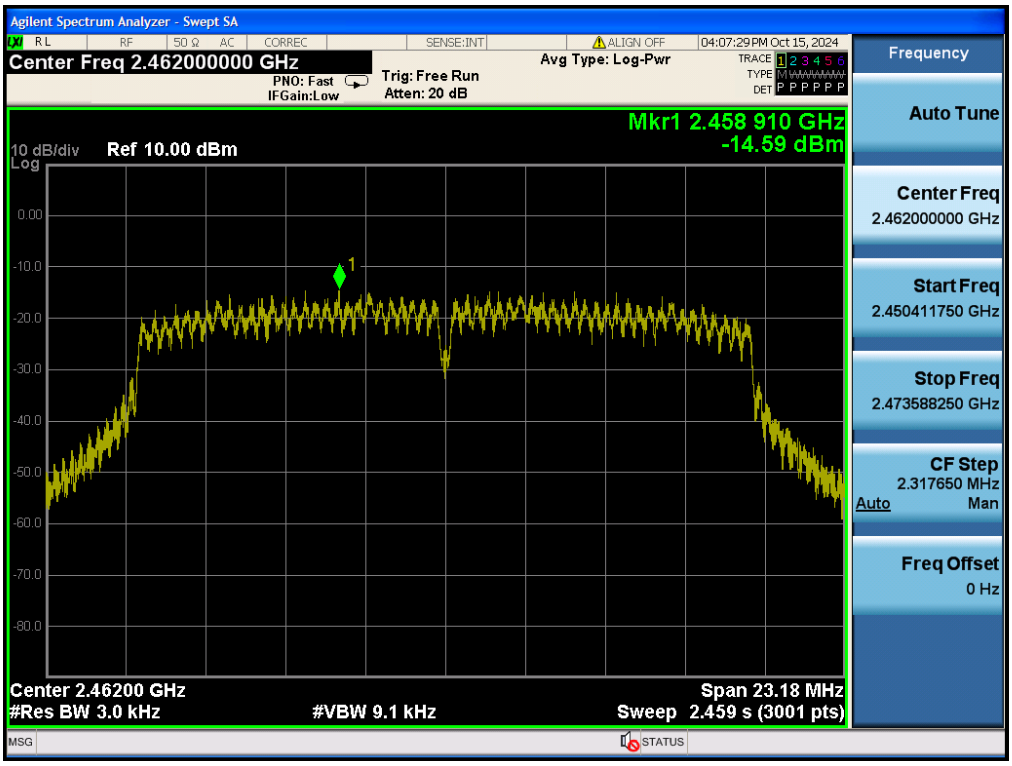
Power Spectral Density TM 3 & 2 412



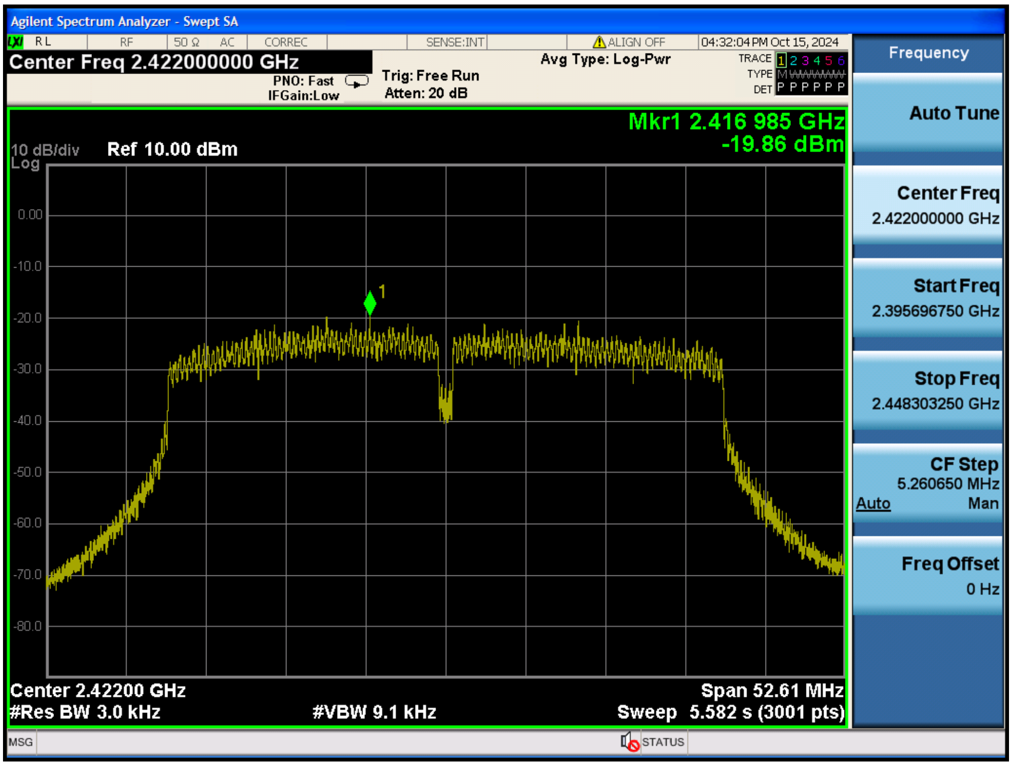
Power Spectral Density TM 3 & 2 437



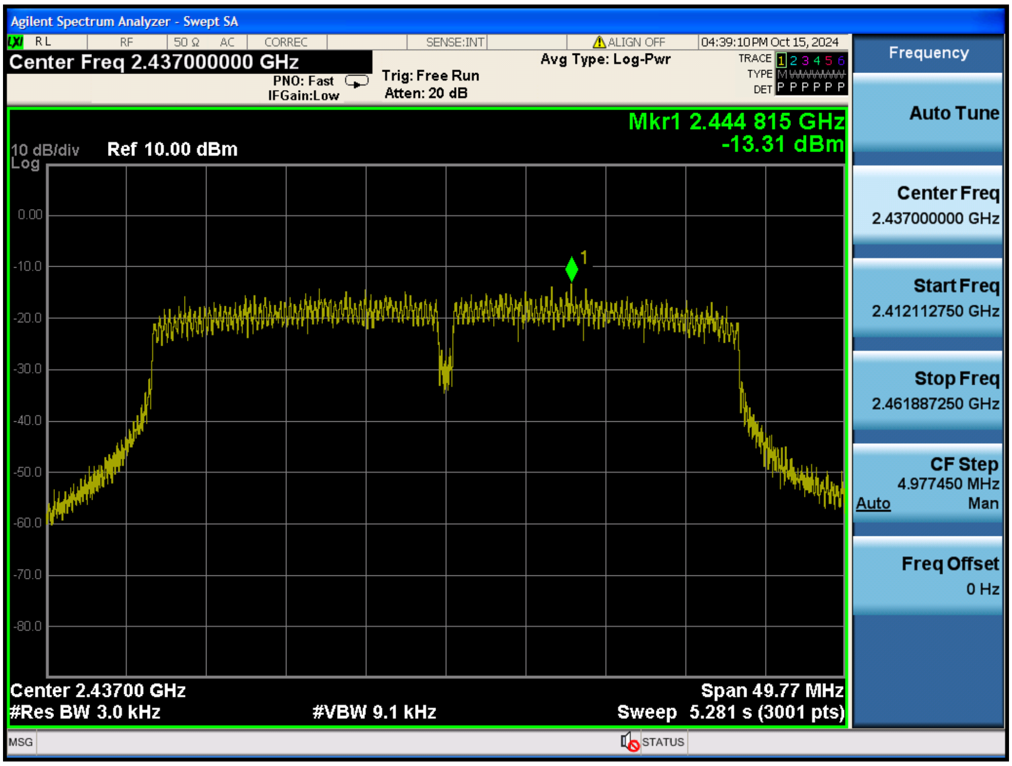
Power Spectral Density TM 3 & 2 462



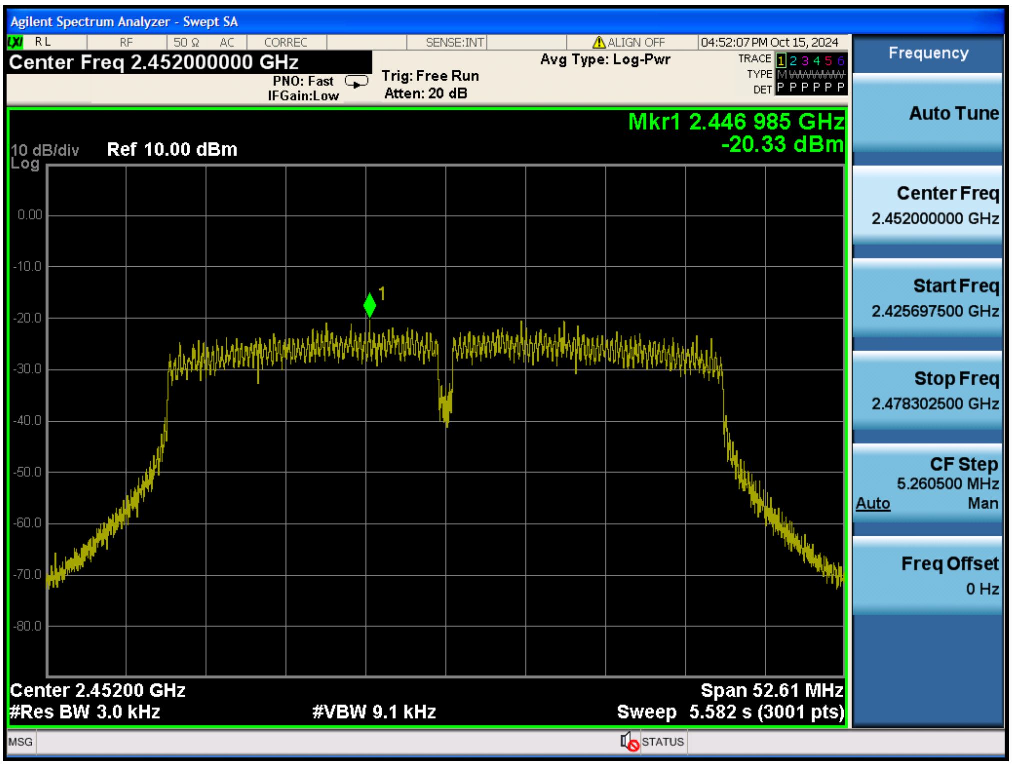
Power Spectral Density TM 4 & 2 422



Power Spectral Density TM 4 & 2 437



Power Spectral Density TM 4 & 2 452



5.4. Unwanted Emissions (Conducted)

▣ **Test requirements and limit, Part 15.247(d)**

In any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions :

If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to 15.247(b)(3) requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to 15.247(b)(3) requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured inband average PSD level.

In either case, attenuation to levels below the general emission limits specified in §15.209(a) is not required.

5.4.1. Test Setup

Refer to the APPENDIX I including path loss

5.4.2. Test Procedures

- **KDB558074 D01v05r02 - Section 8.5**
- **ANSI C63.10-2013 – Section 11.11**

Reference level measurement

1. Set instrument center frequency to DTS channel center frequency.
2. Set the span to ≥ 1.5 times the DTS bandwidth.
3. Set the RBW = 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum PSD level

LIMIT LINE = 20 dB below of the reference level.

Emission level measurement

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.(Actual 1 MHz , See below note)
3. Set the VBW ≥ 3 x RBW.(Actual 3 MHz, See below note)
4. Detector = peak.
5. Ensure that the number of measurement points ≥ span / RBW
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use the peak marker function to determine the maximum amplitude level.

Note: The unwanted emission(conducted) was tested with below settings.

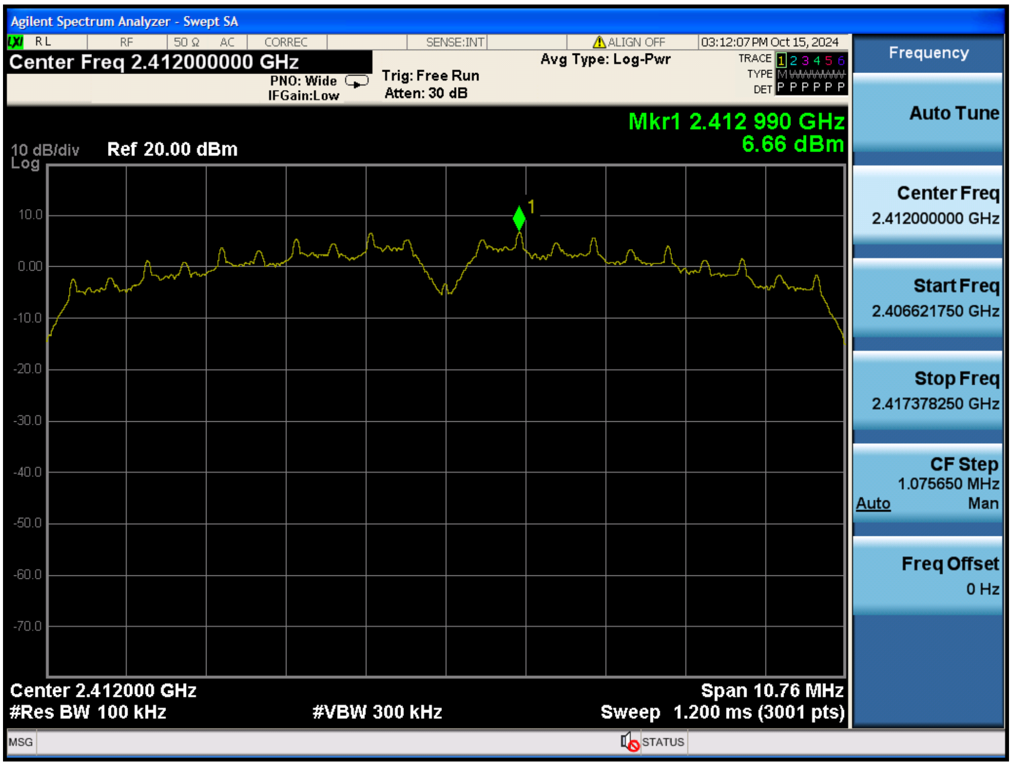
Frequency range	RBW	VBW	Detector	Trace	Sweep Point
9 kHz ~ 30 MHz	100 kHz	300 kHz	Peak	Max Hold	40 001
30 MHz ~ 10 GHz	1 MHz	3 MHz			
10 GHz ~ 25 GHz	1 MHz	3 MHz			

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2 001 to get accurate emission level within 100 kHz BW.

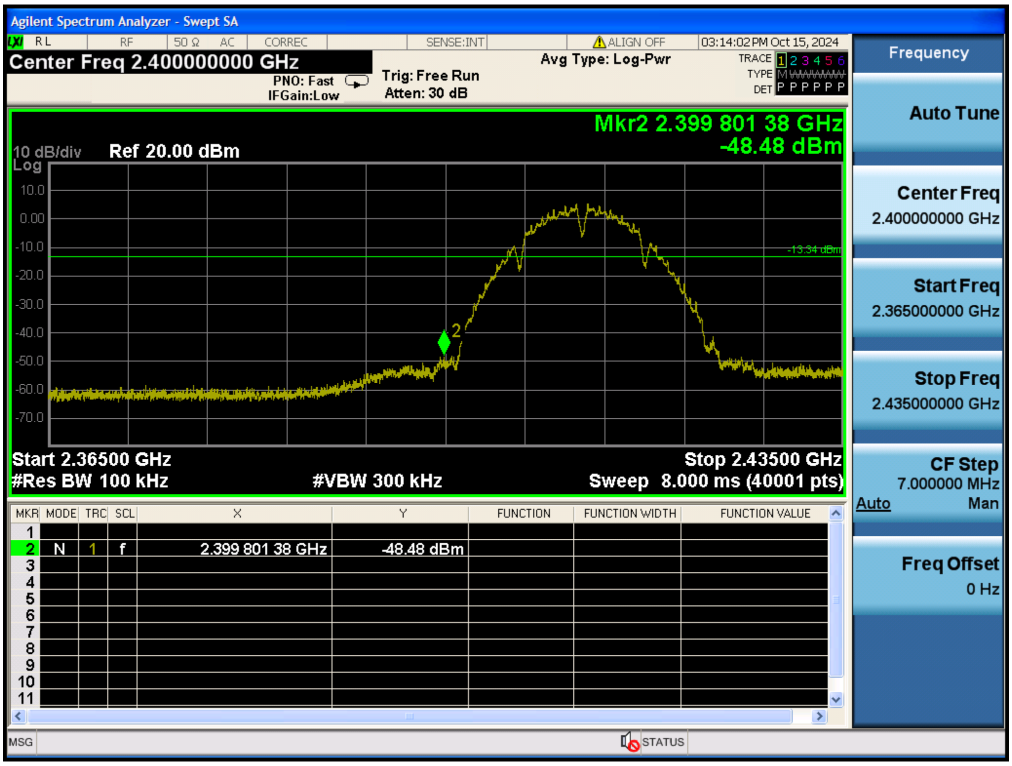
5.4.3. Test Results

TM 1 & 2 412

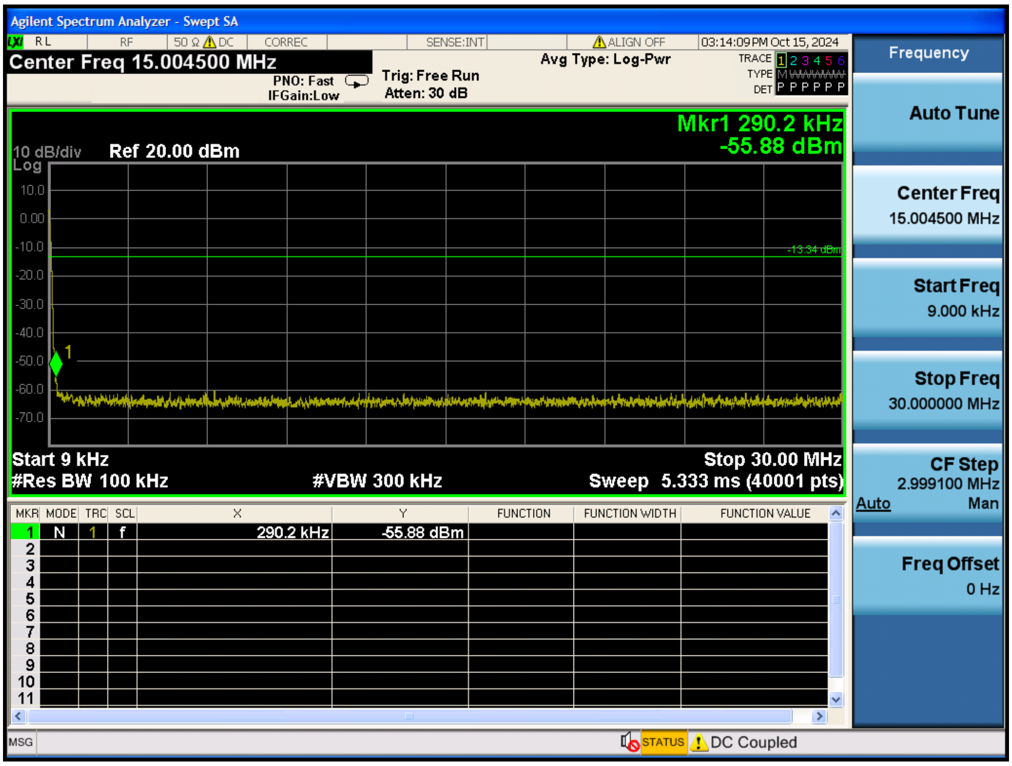
Reference



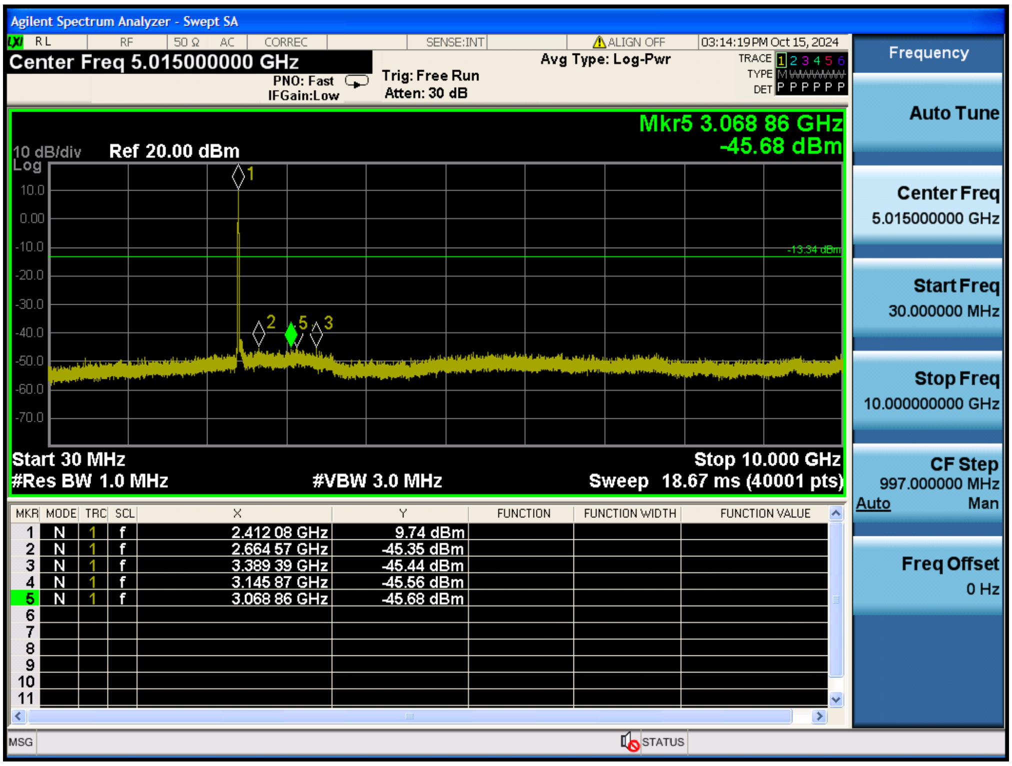
Low Band-edge

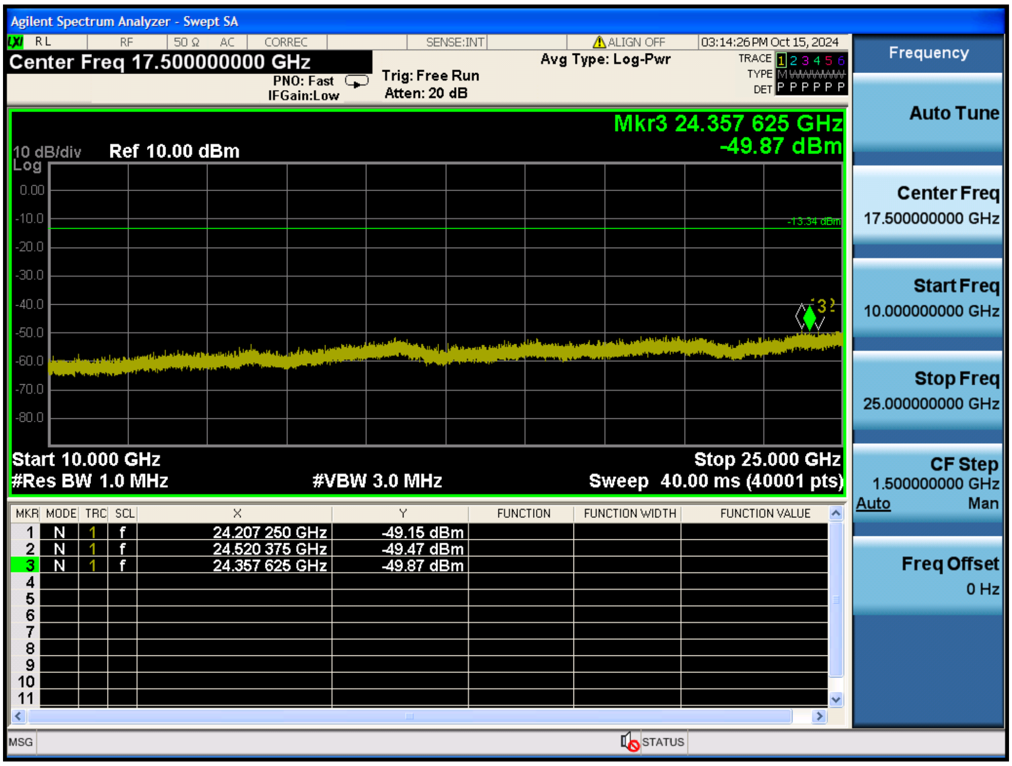


Conducted Spurious Emissions



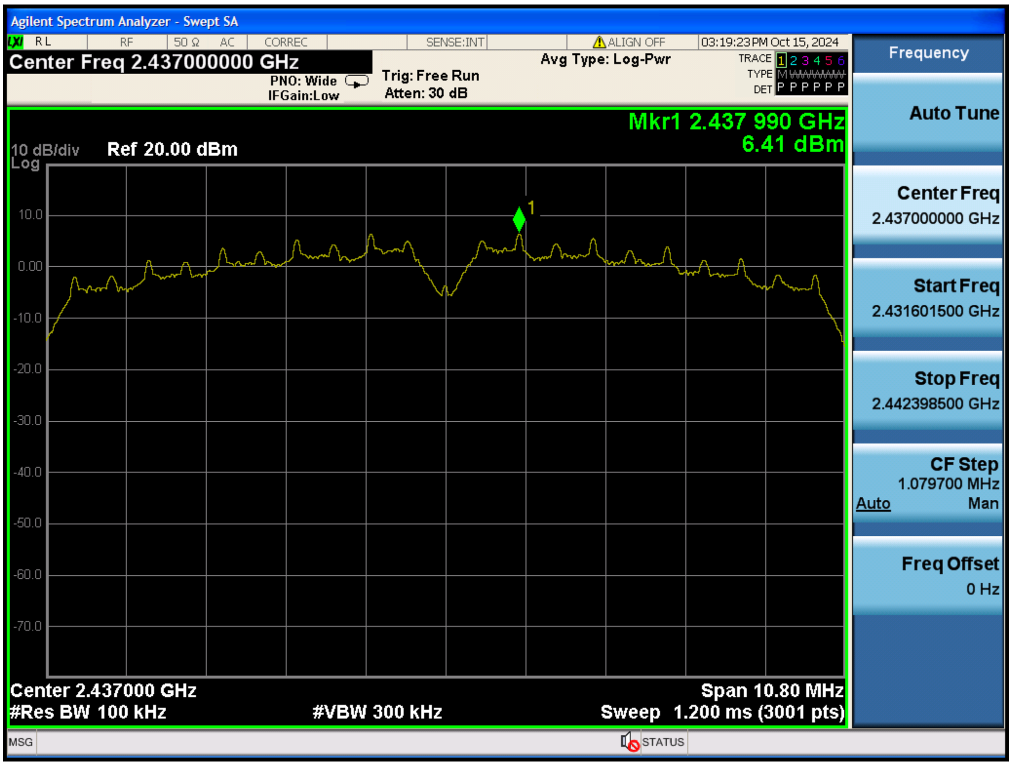
Conducted Spurious Emissions





TM 1 & 2 437

Reference



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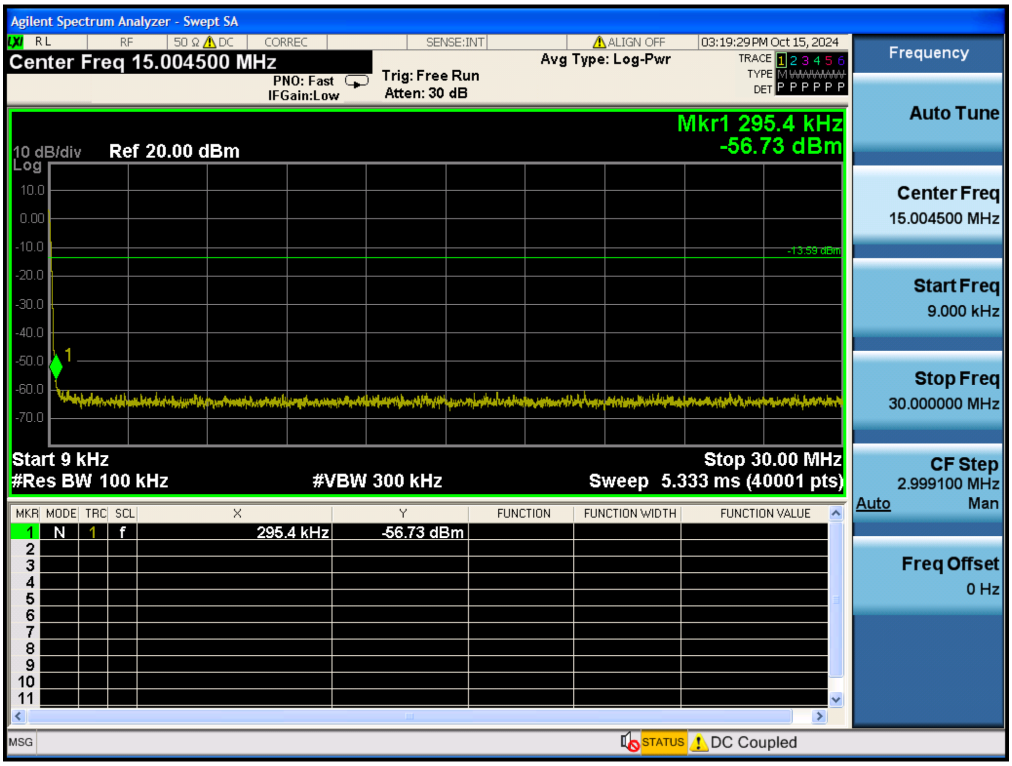
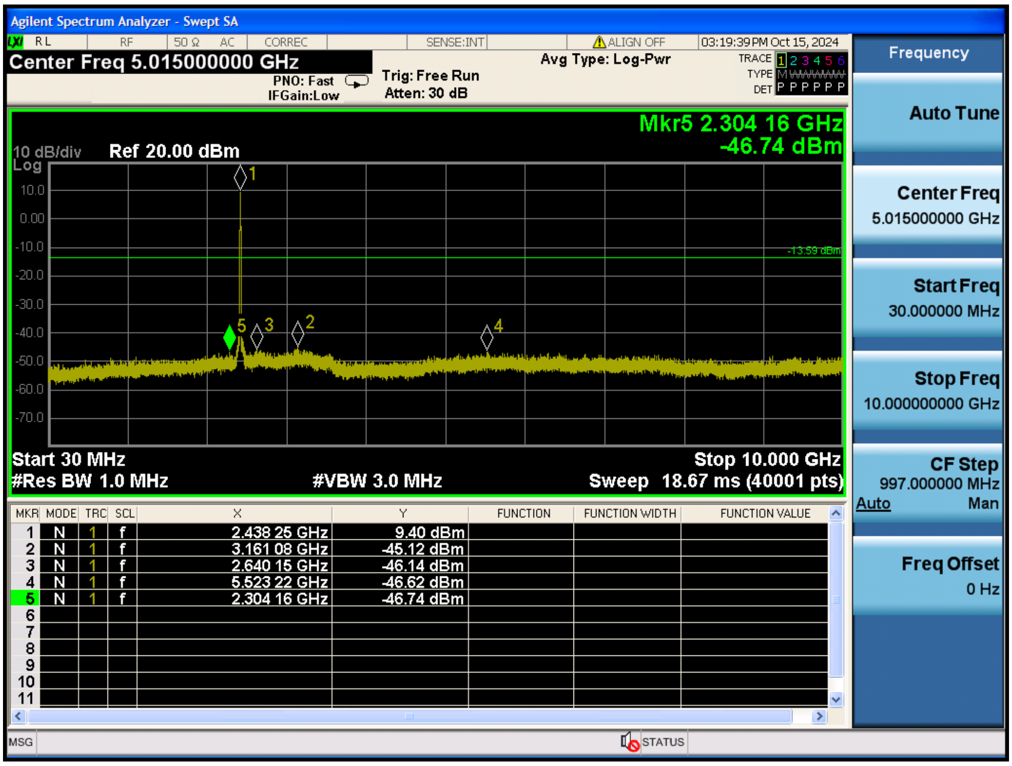
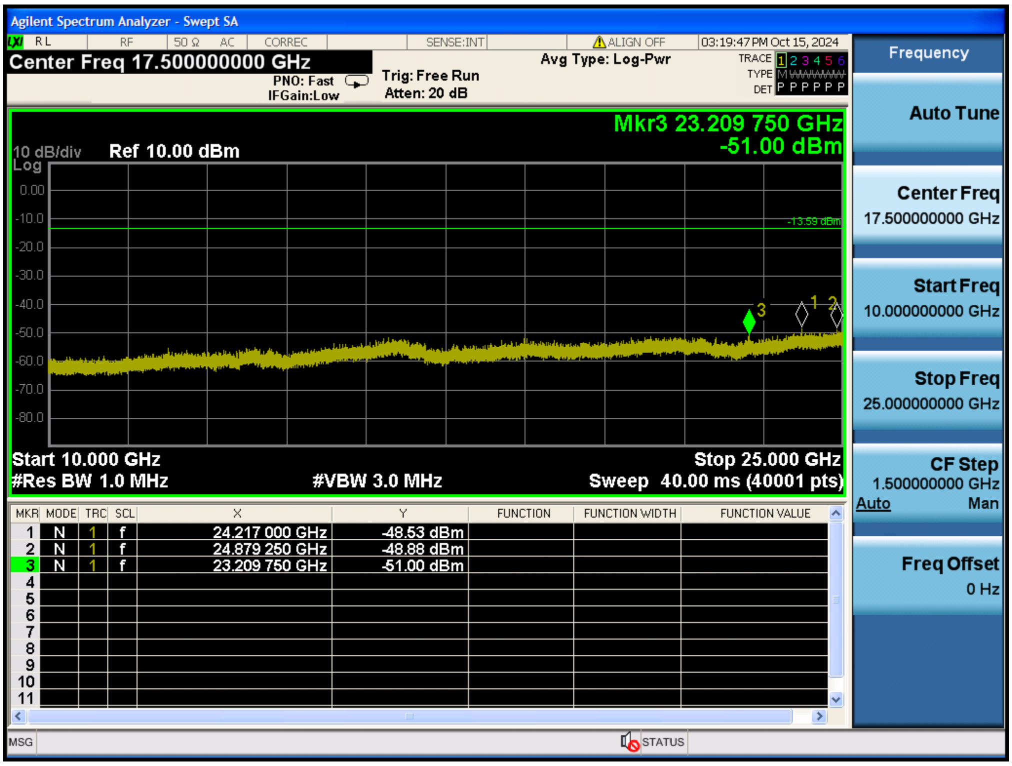


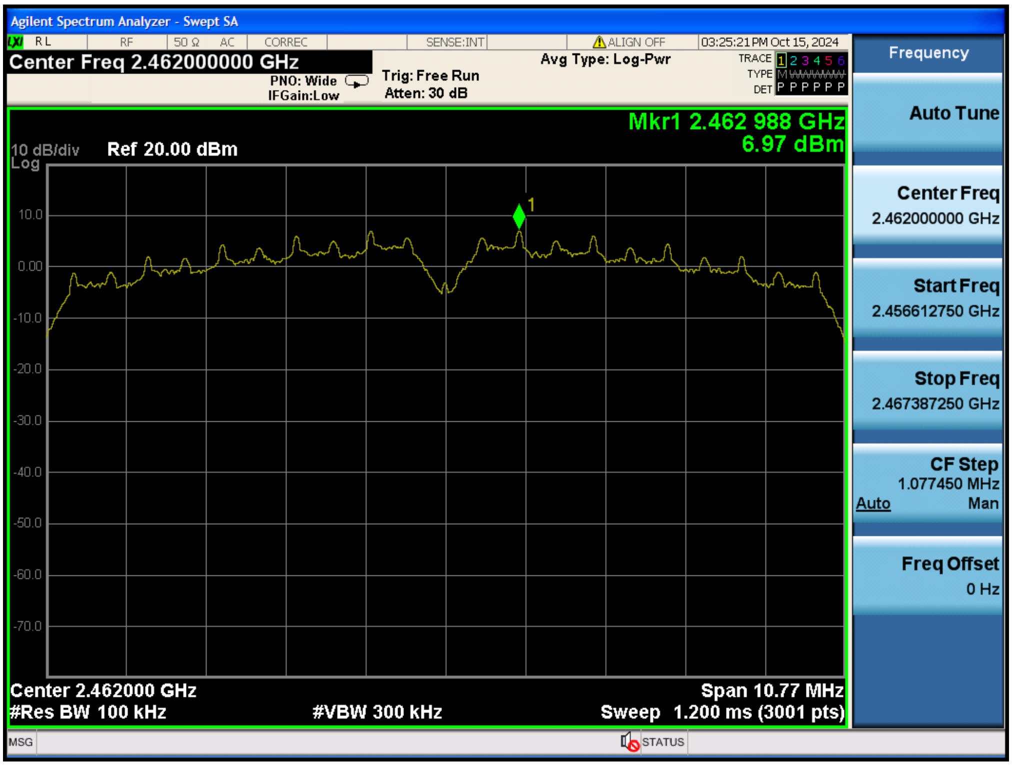
Conducted Spurious Emissions



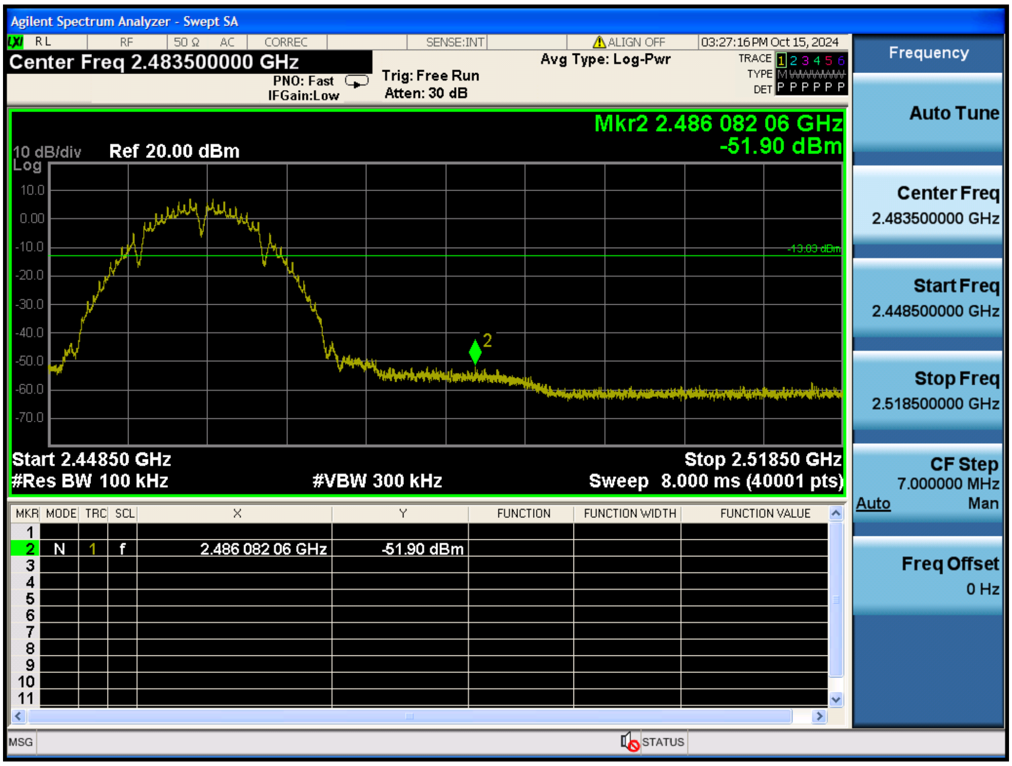


TM 1 & 2 462

Reference



High Band-edge



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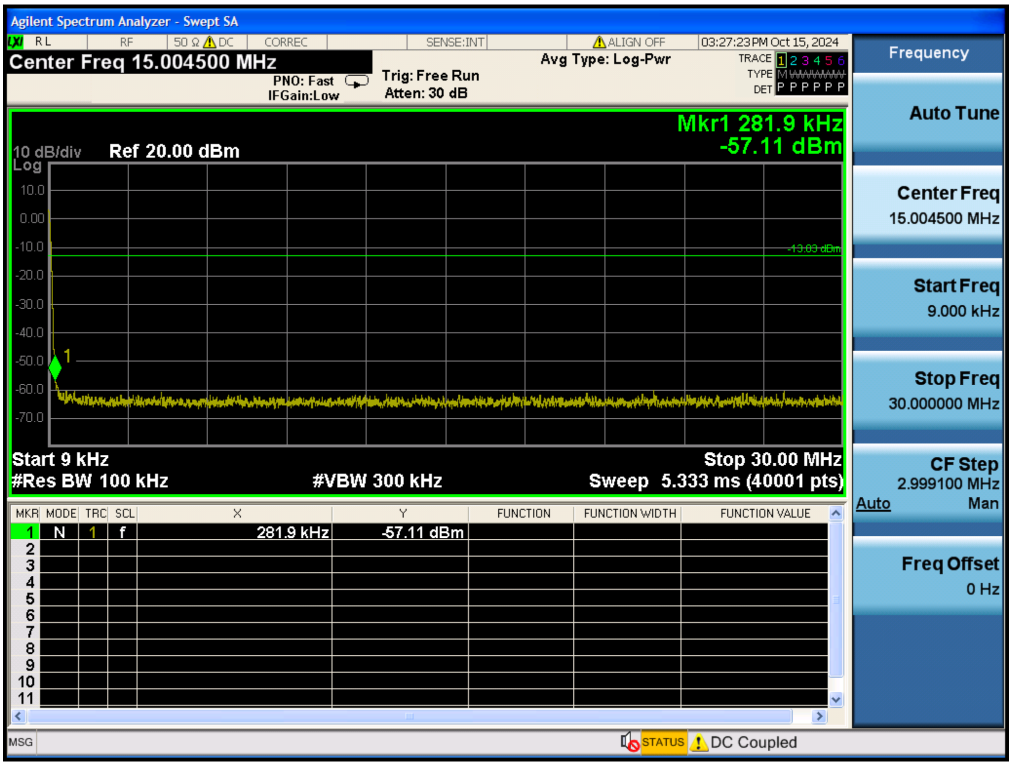

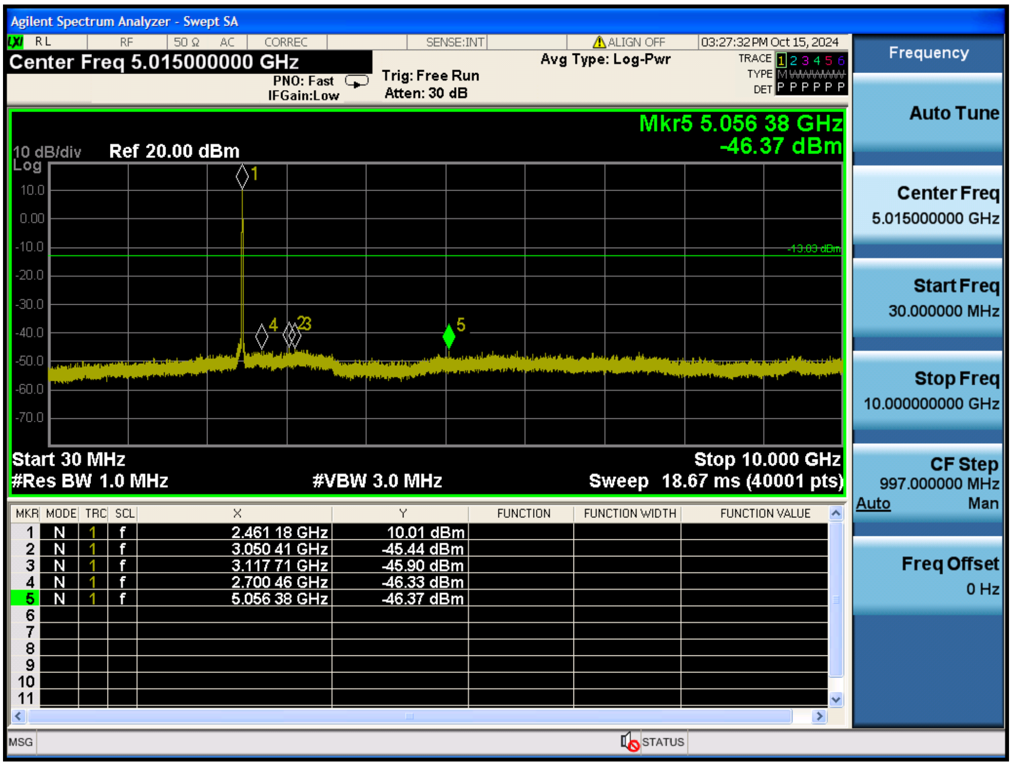

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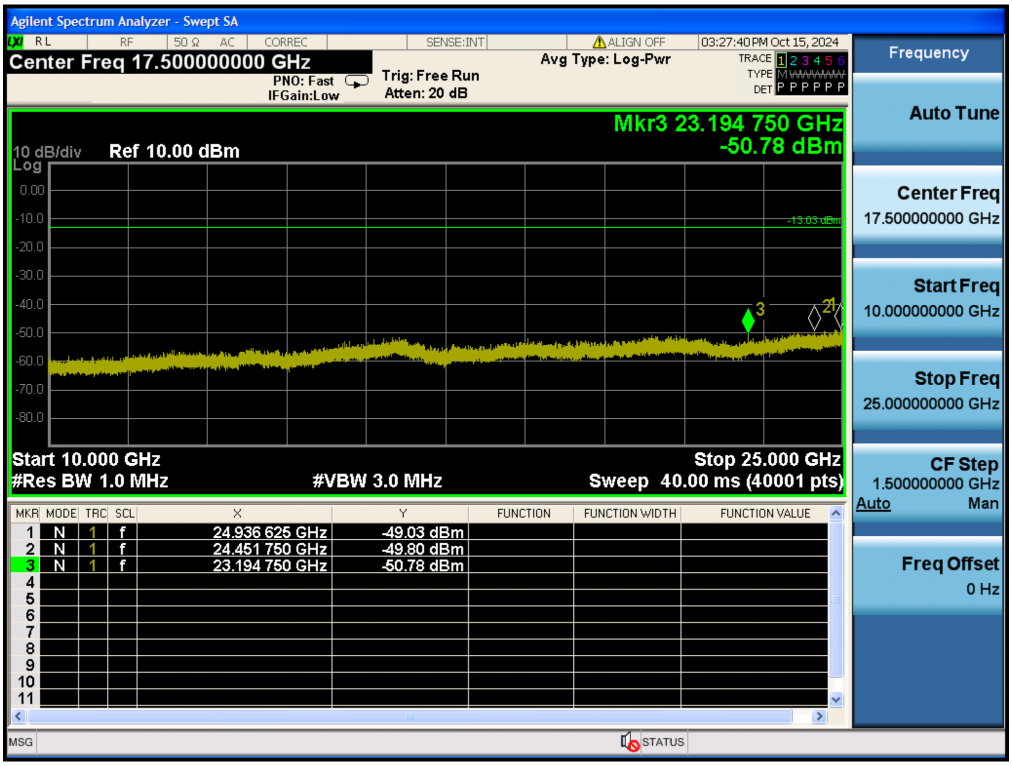
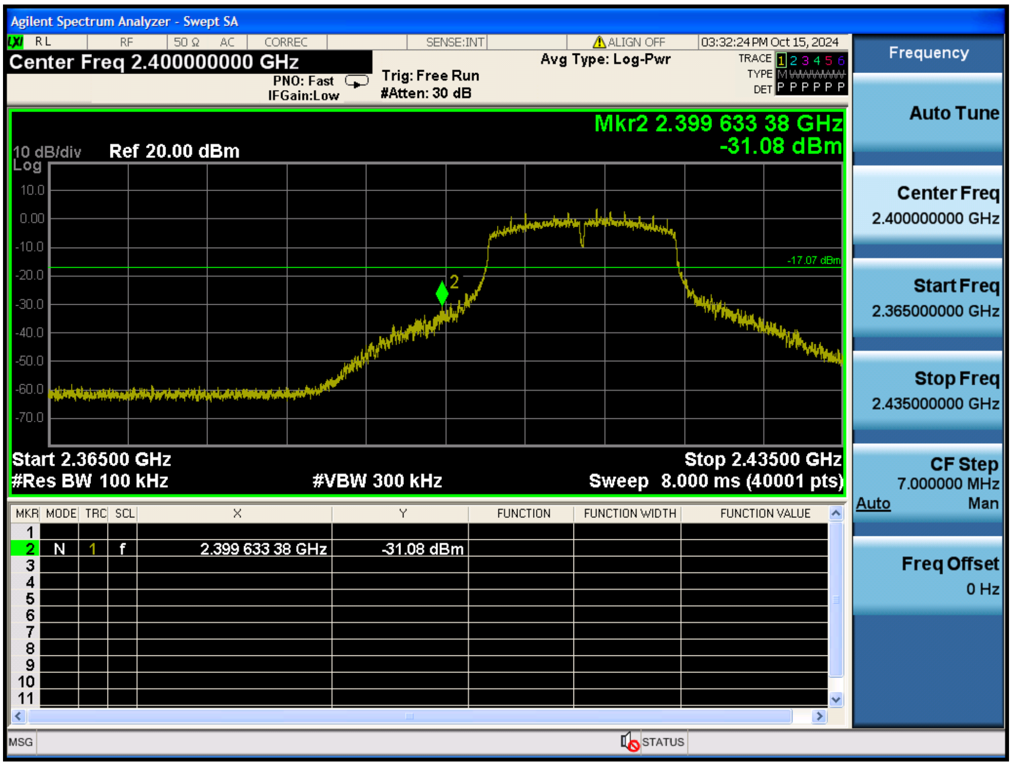


TM 2 & 2 412

Reference

Low Band-edge



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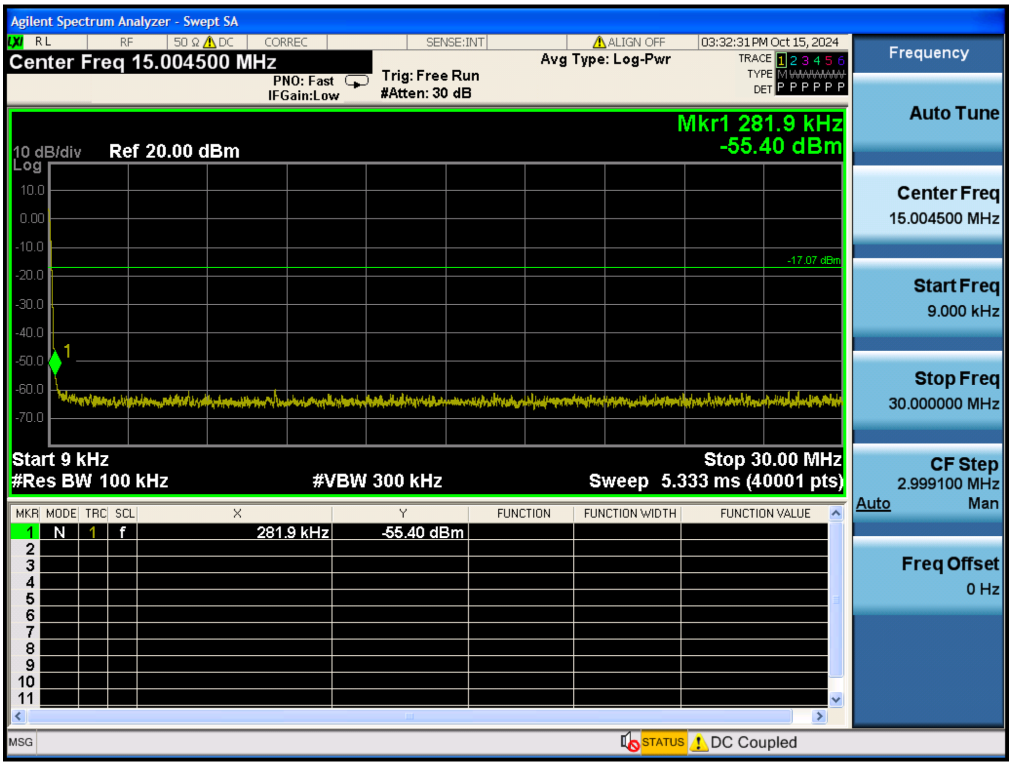

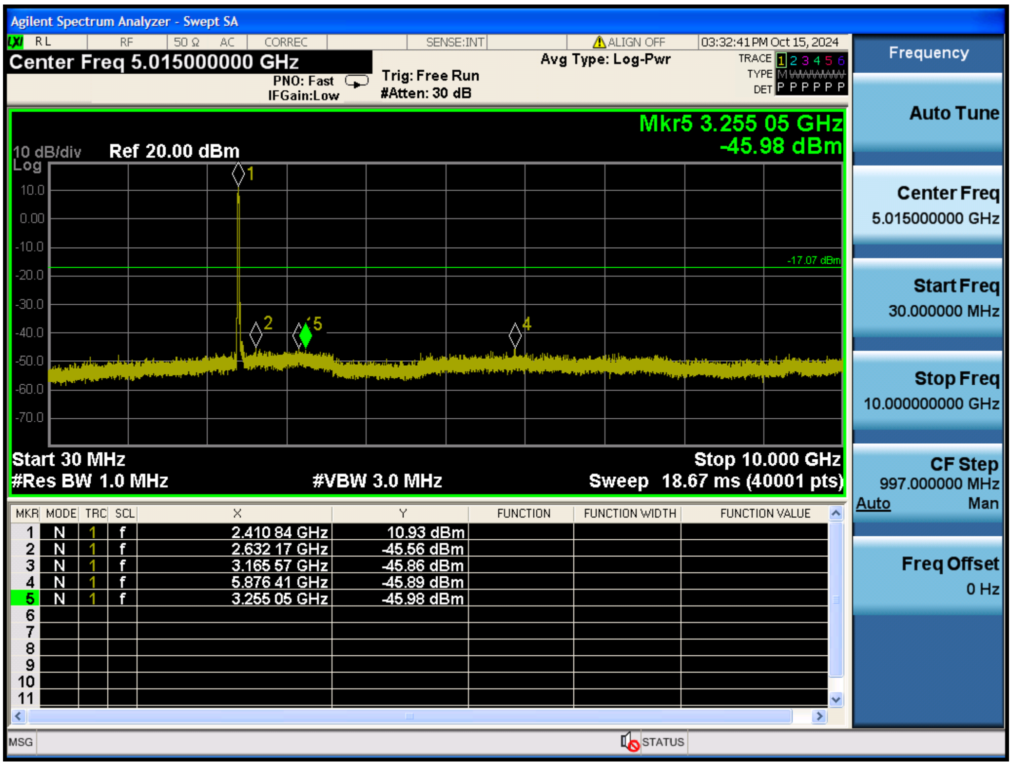

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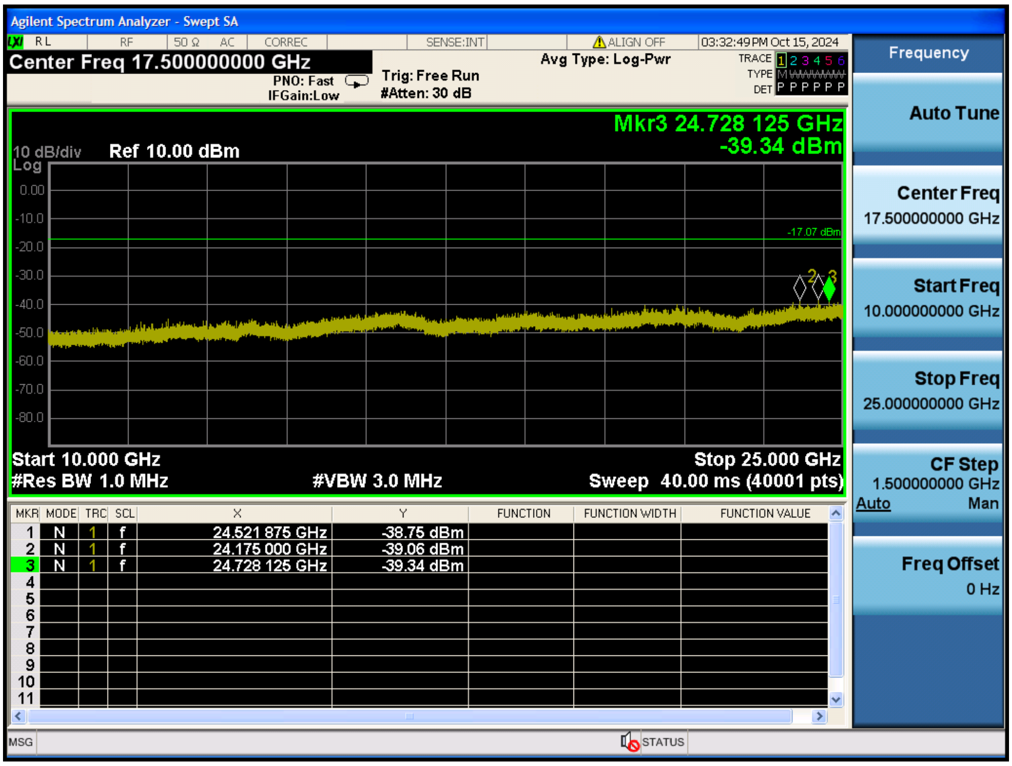
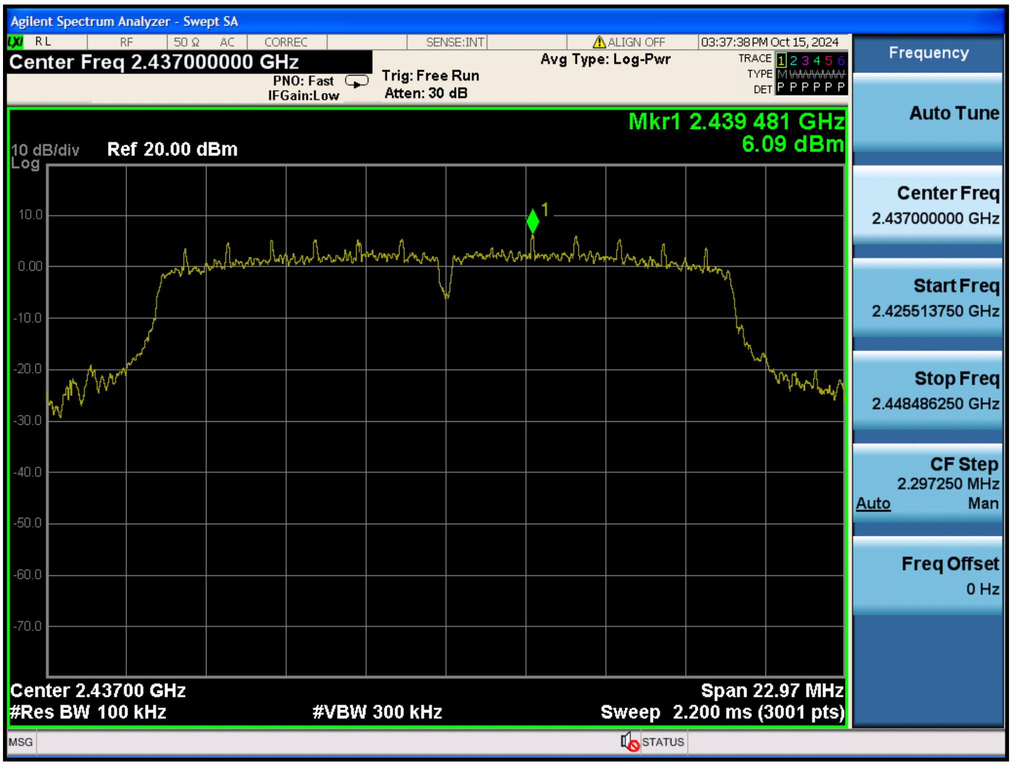


TM 2 & 2 437

Reference



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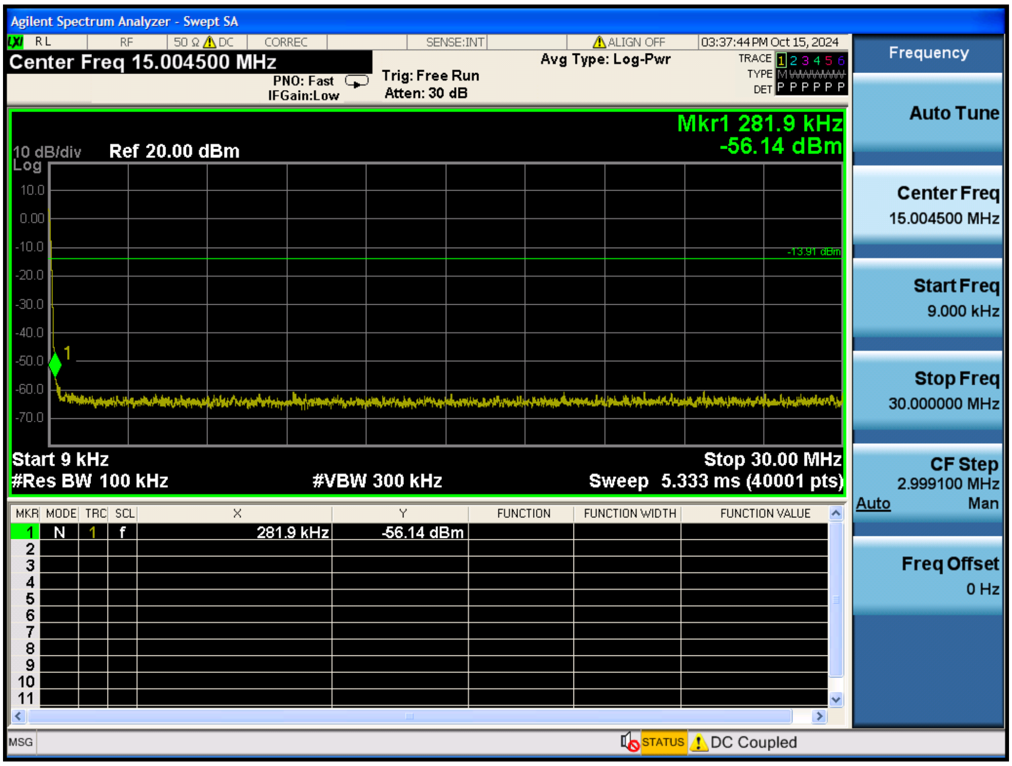

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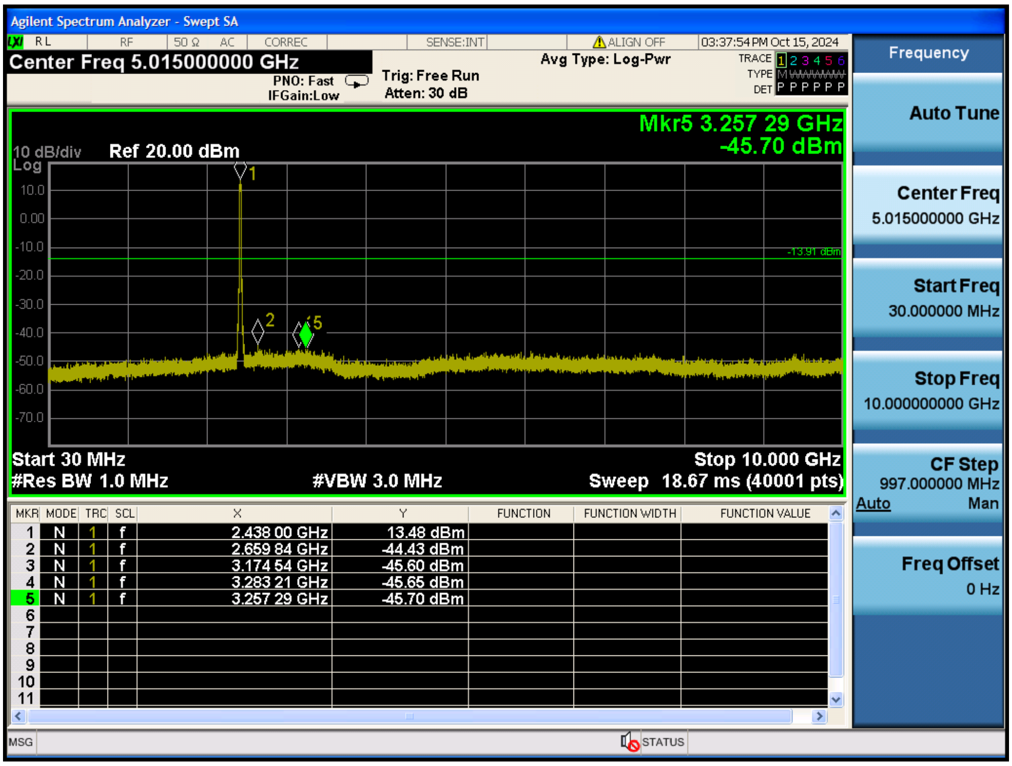

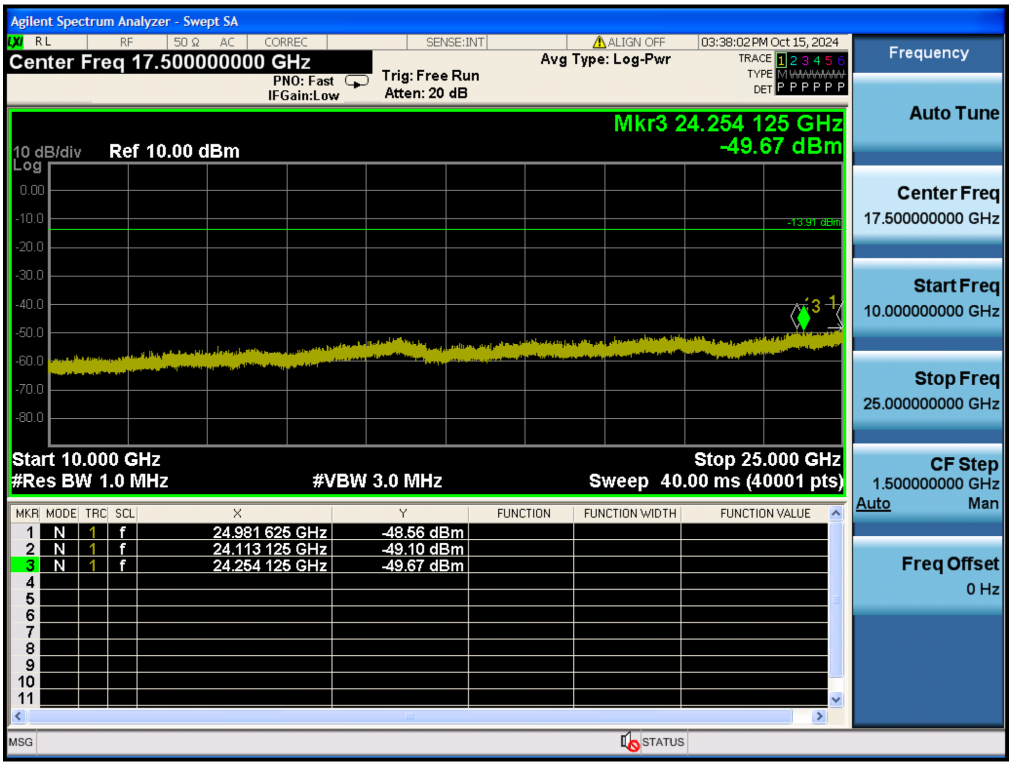

TM 2 & 2 462

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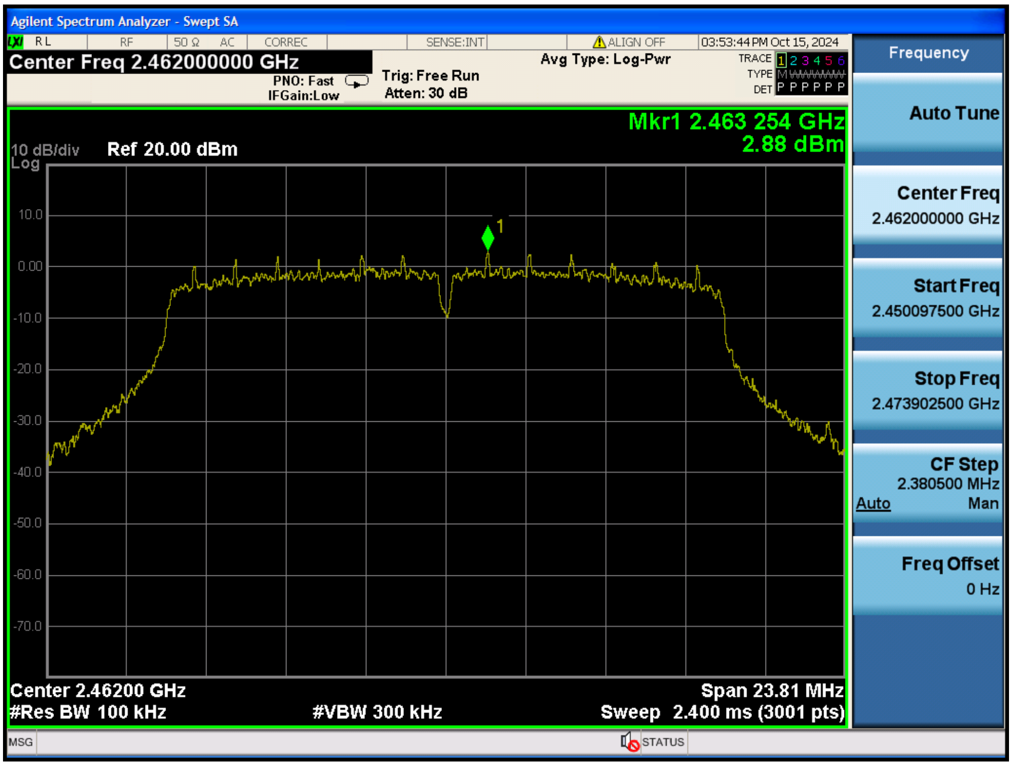
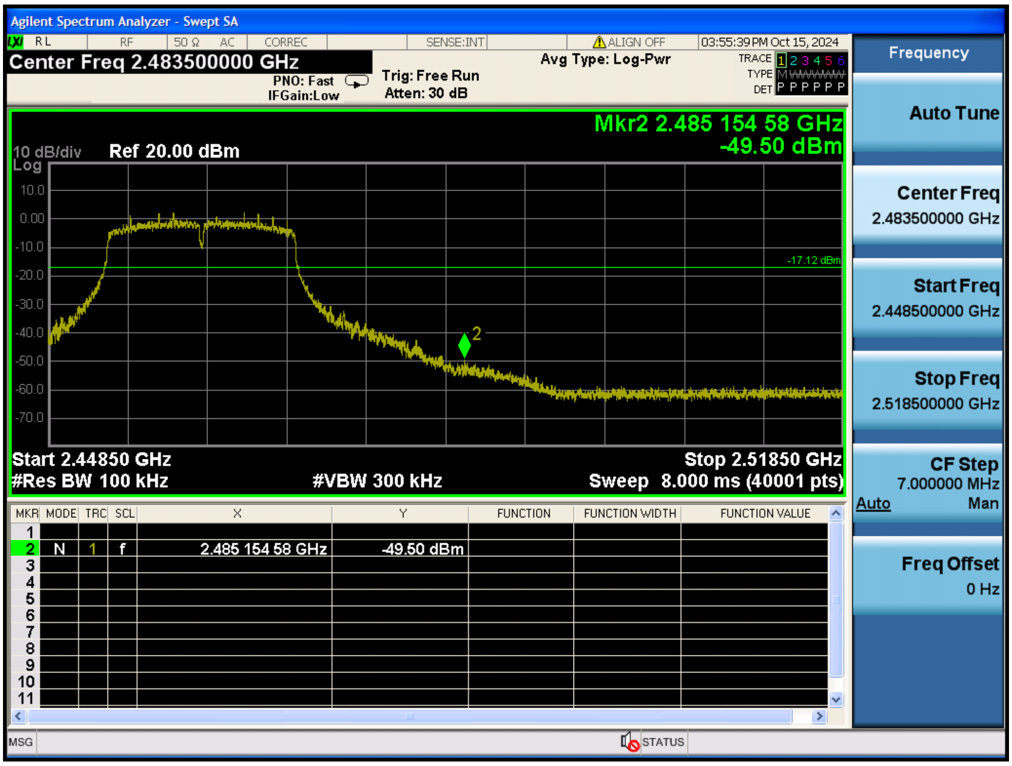


High Band-edge



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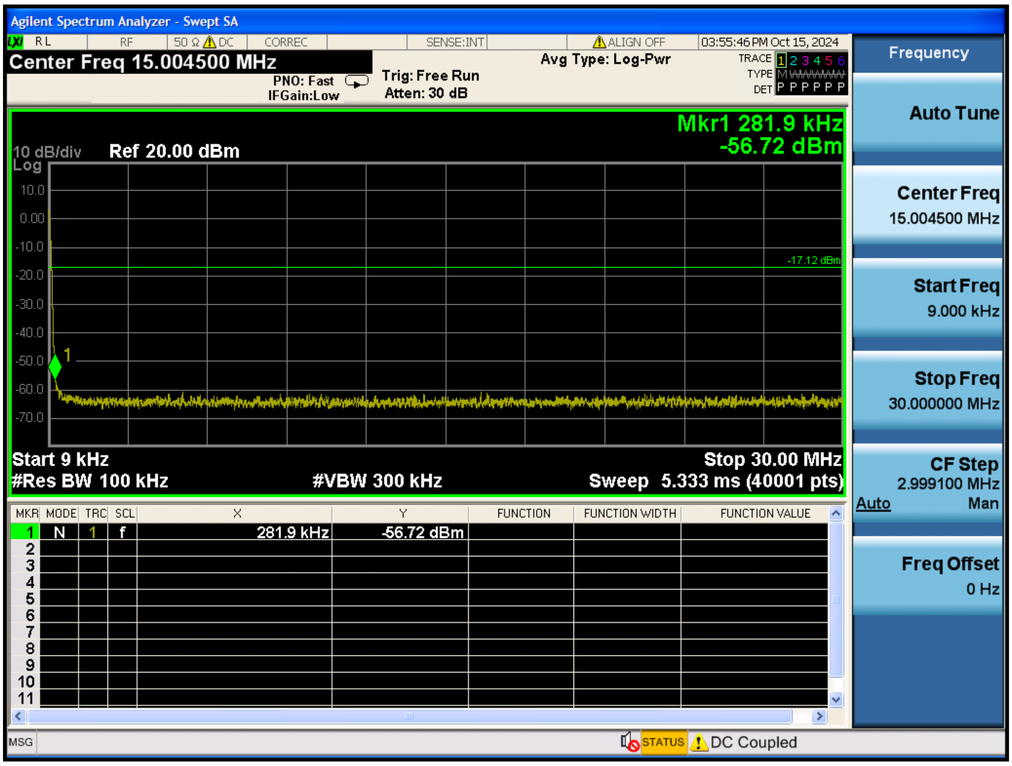

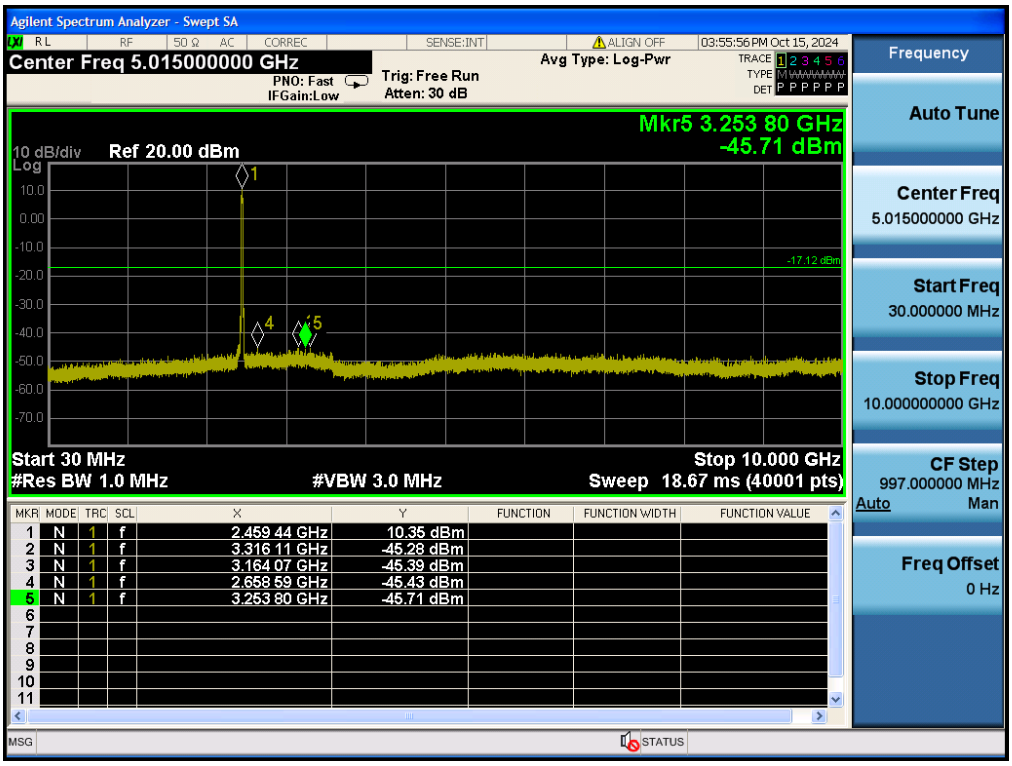

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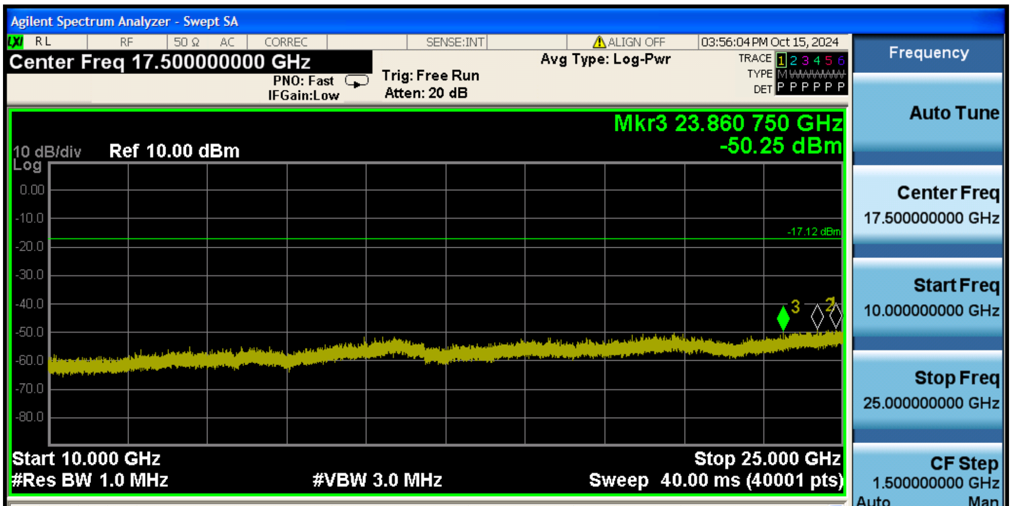
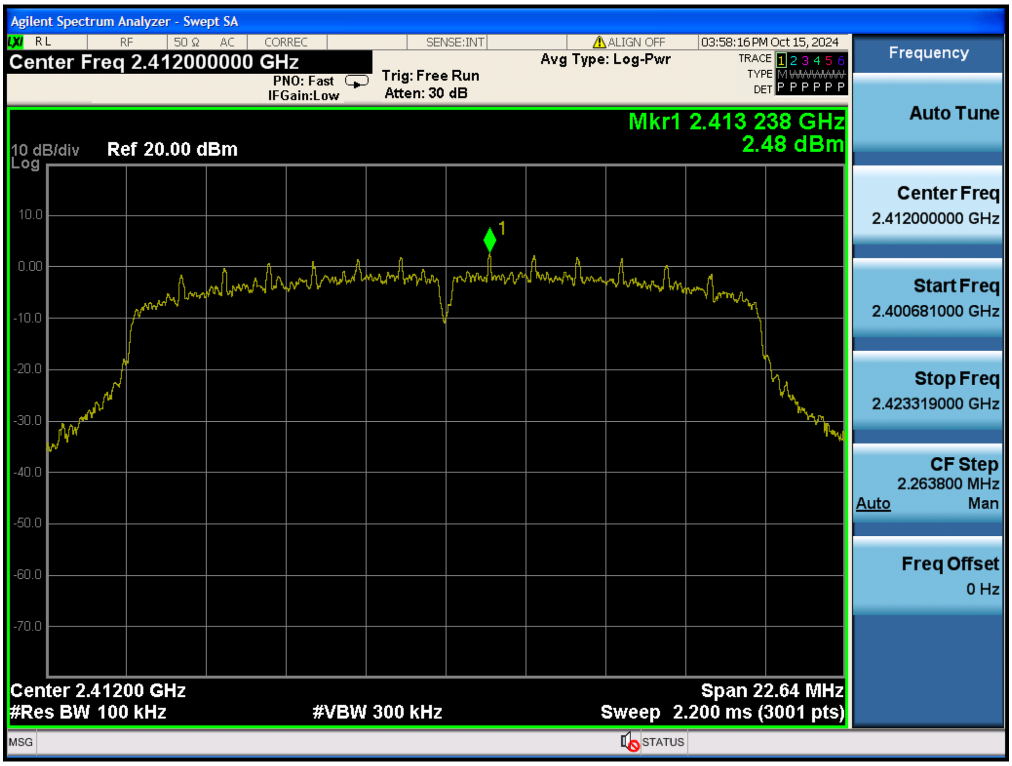


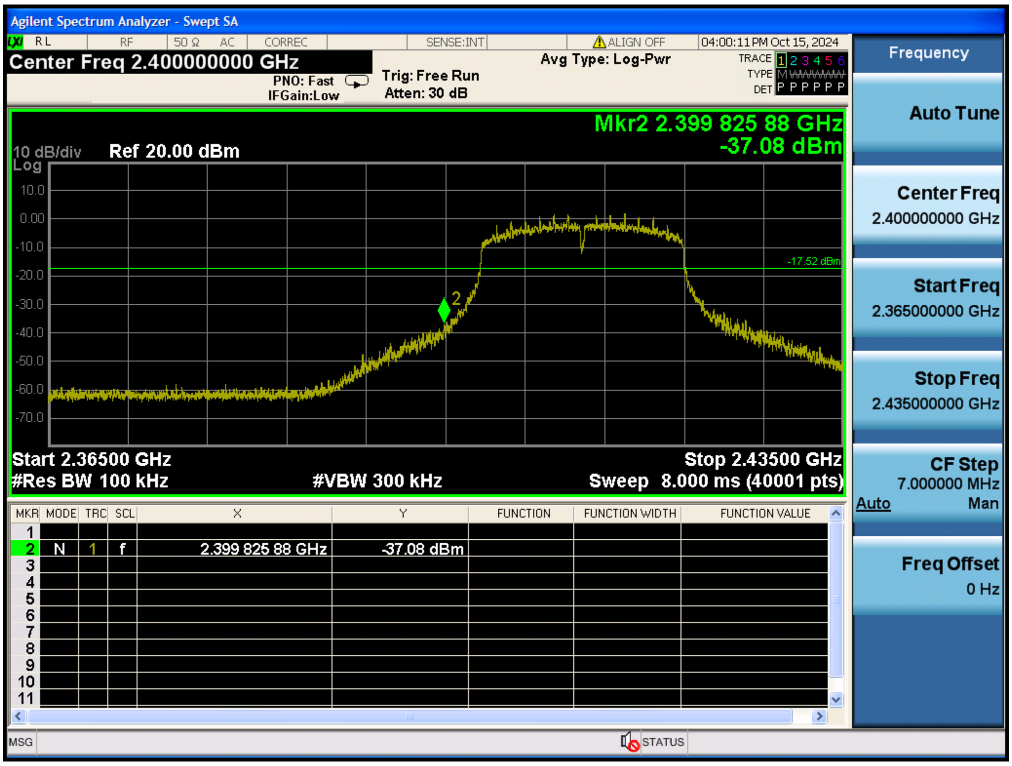
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	24.859 750 GHz	-49.16 dBm			
2	N	1	f	24.508 000 GHz	-49.32 dBm			
3	N	1	f	23.860 750 GHz	-50.25 dBm			
4								
5								
6								
7								
8								
9								
10								
11								

TM 3 & 2 412

Reference



Low Band-edge



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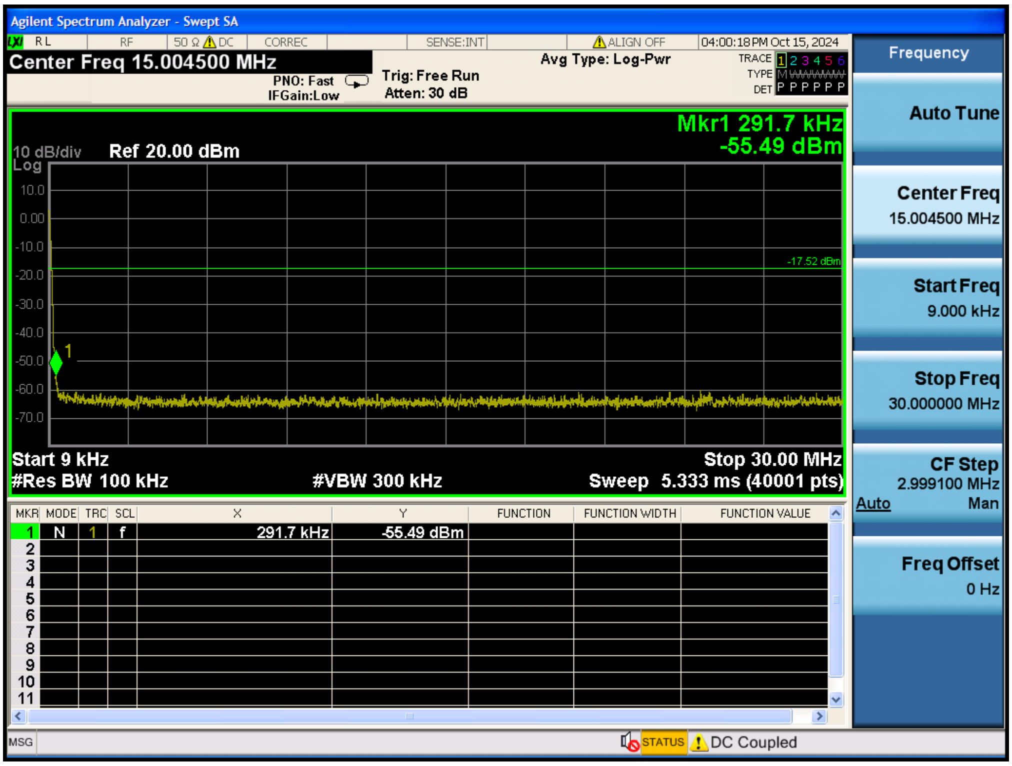

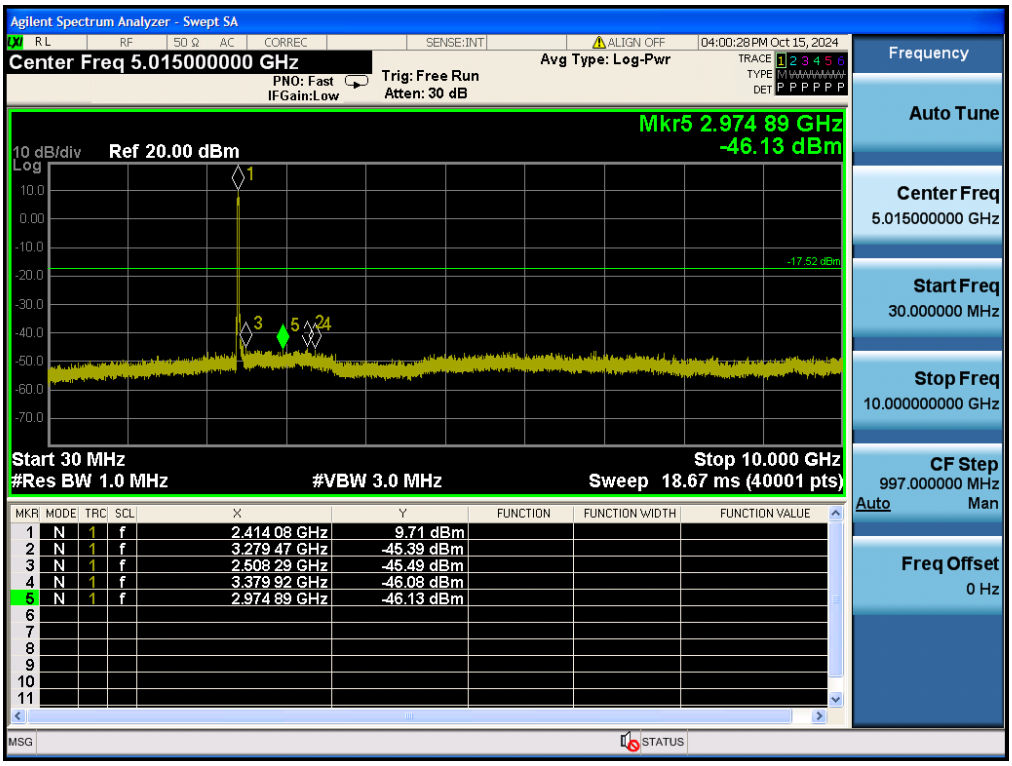

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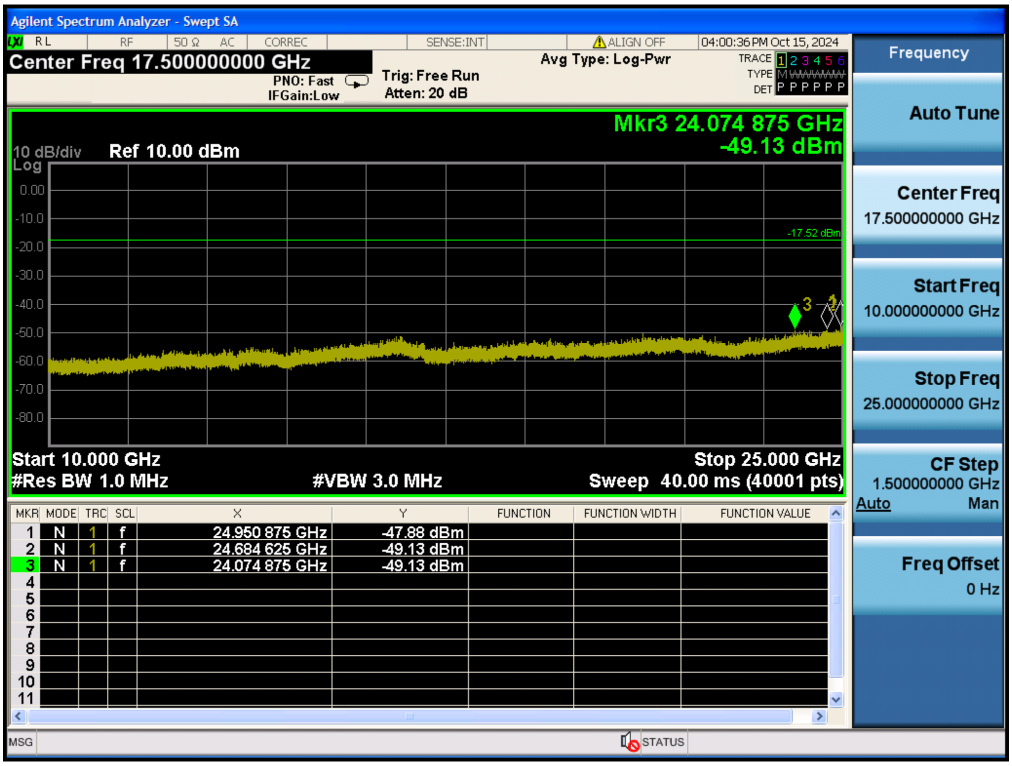

TM 3 & 2 437

Reference

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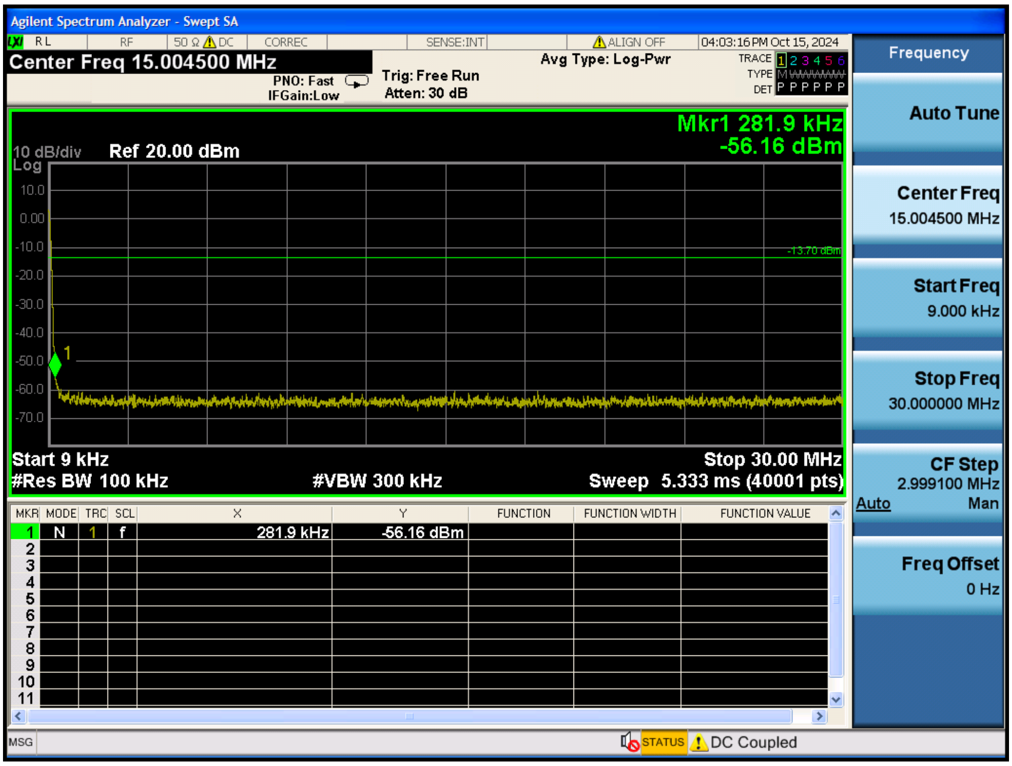

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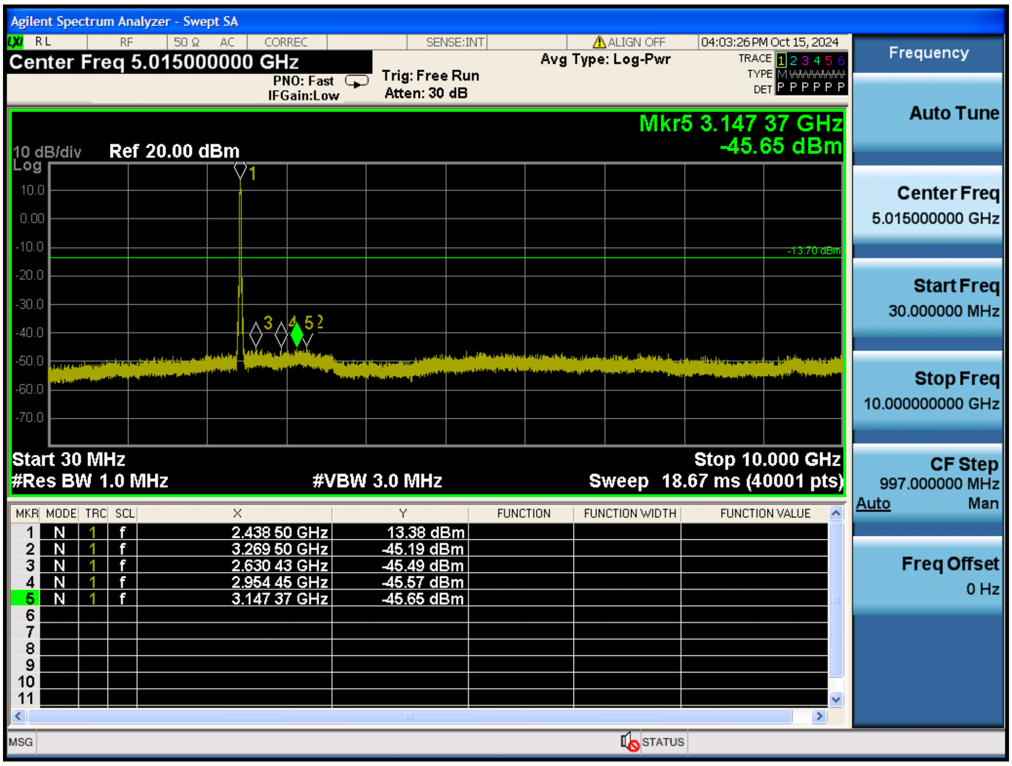
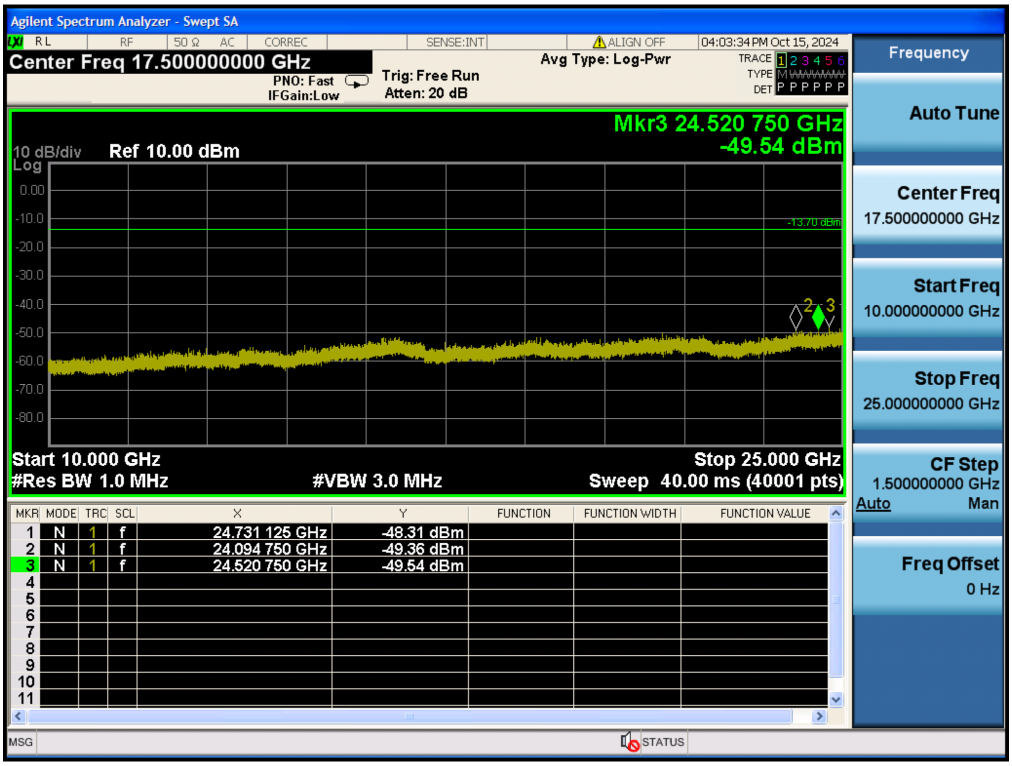
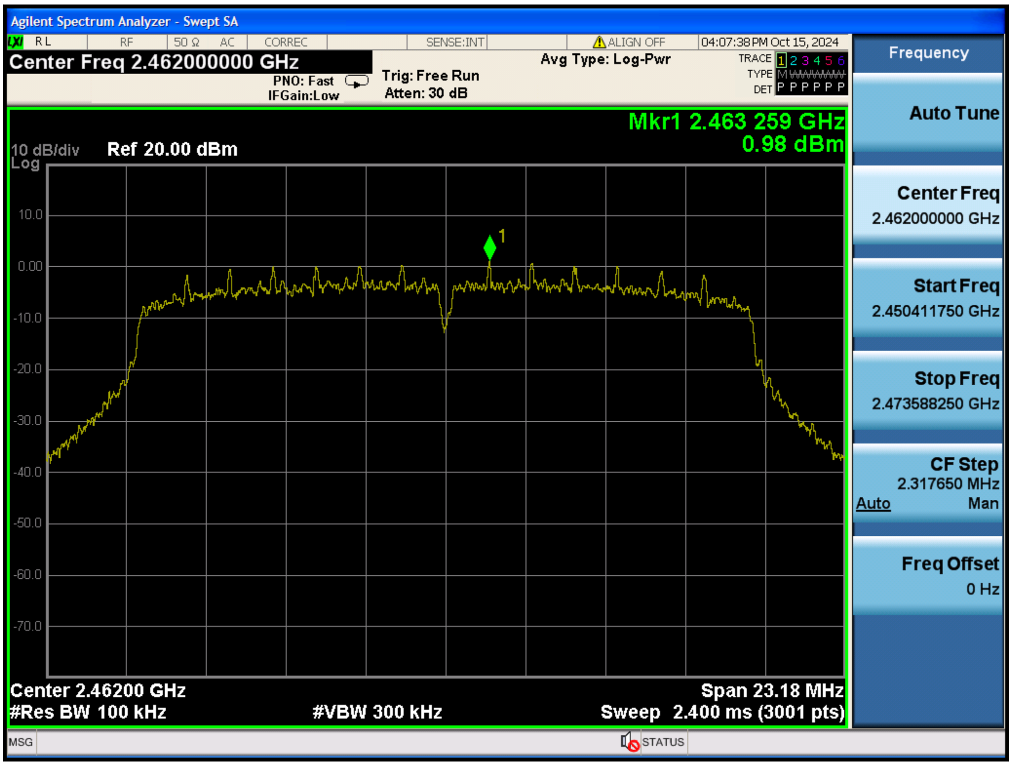


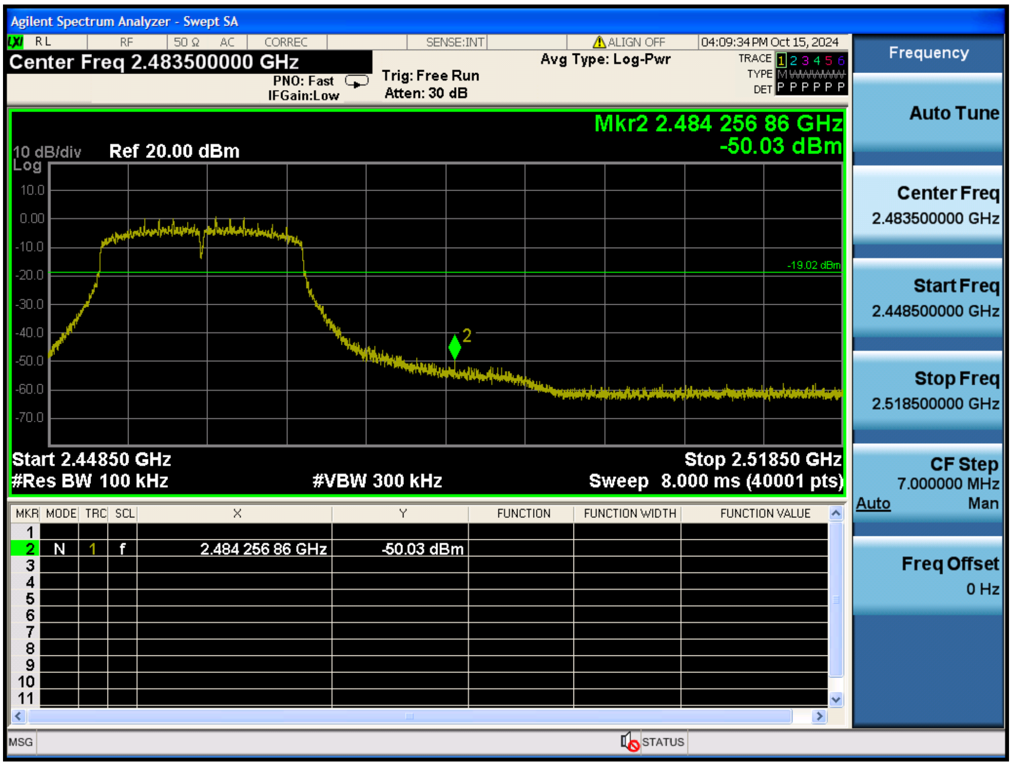


TM 3 & 2 462

Reference



High Band-edge



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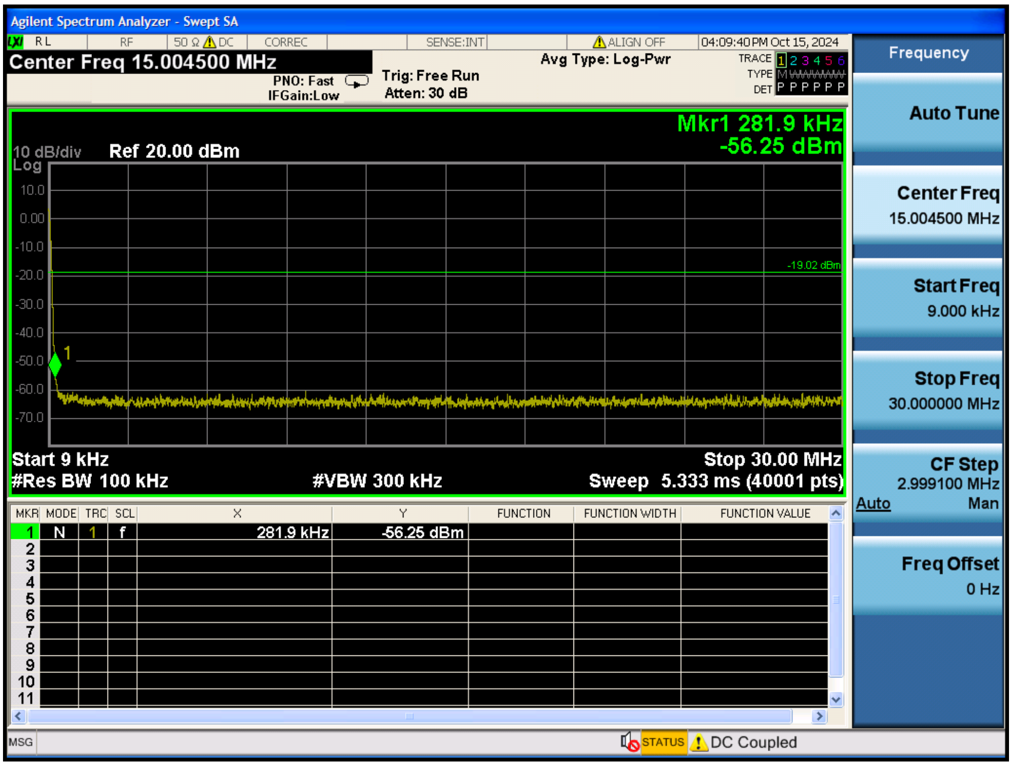
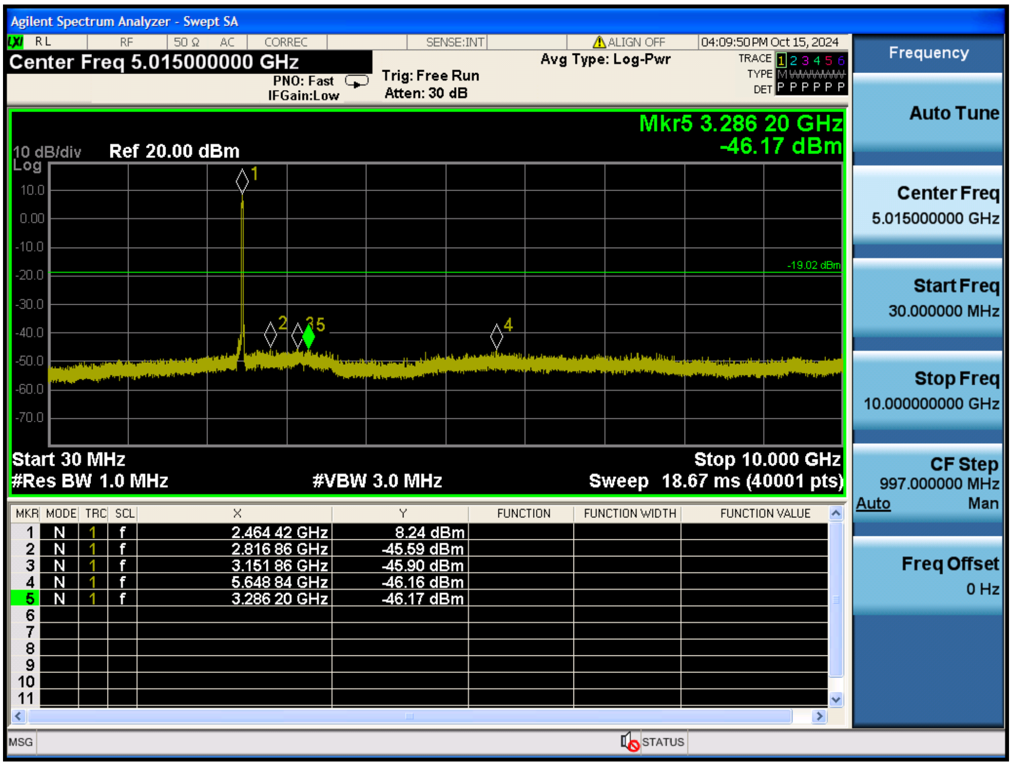
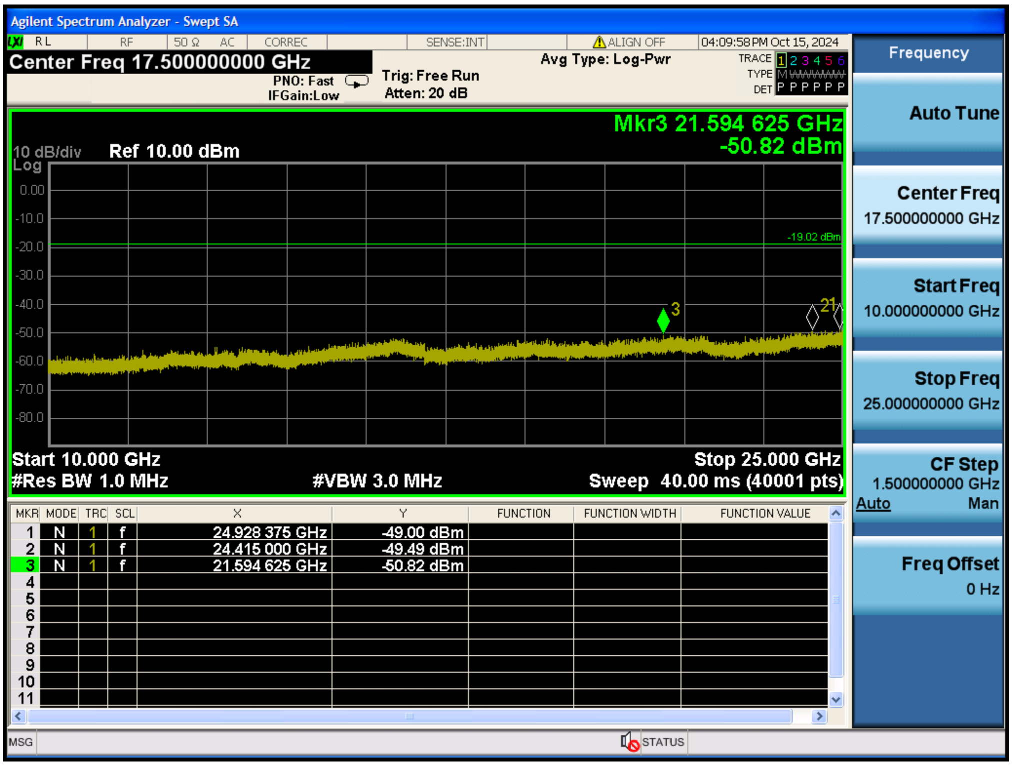


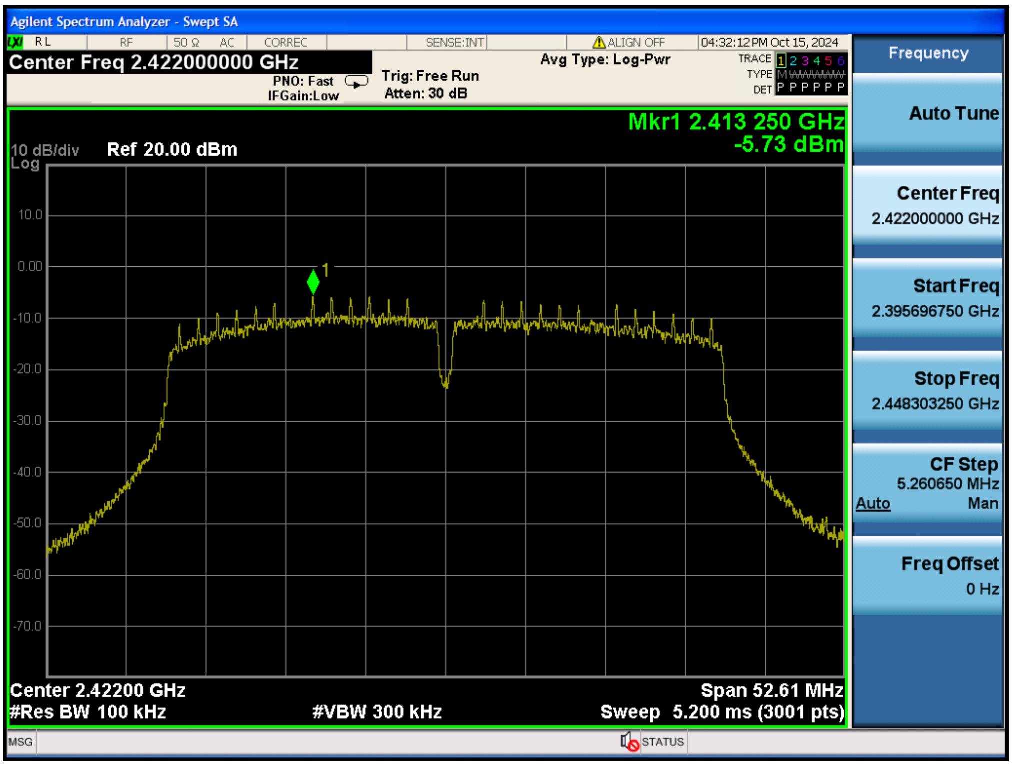


Conducted Spurious Emissions

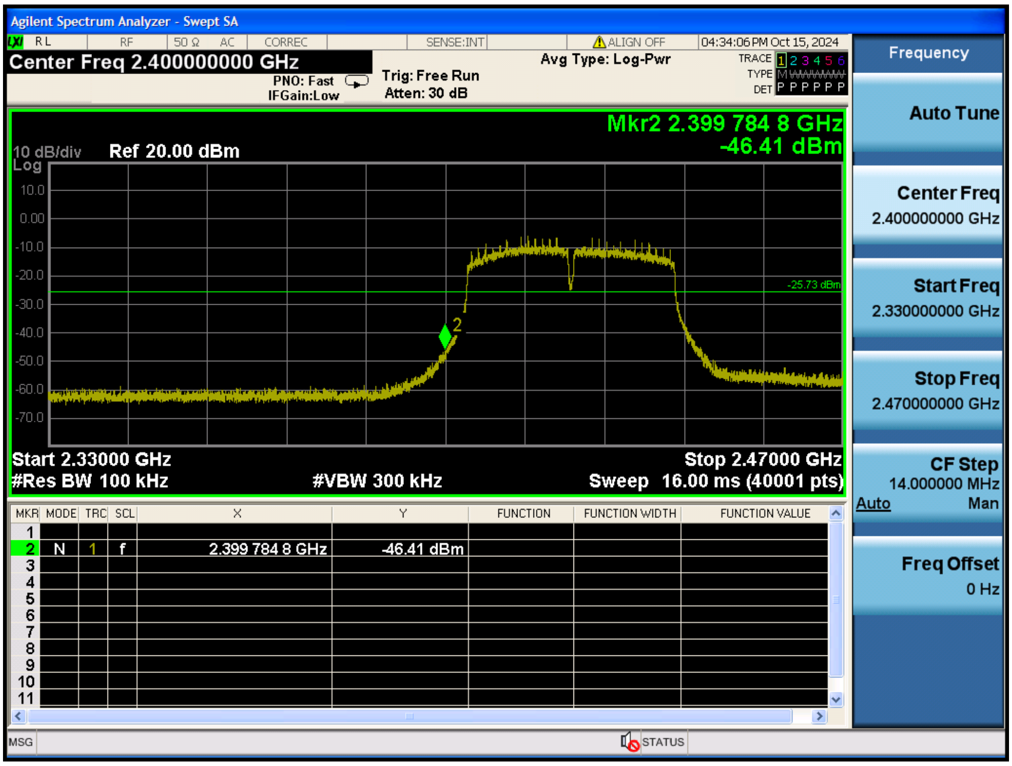


TM 4 & 2 422

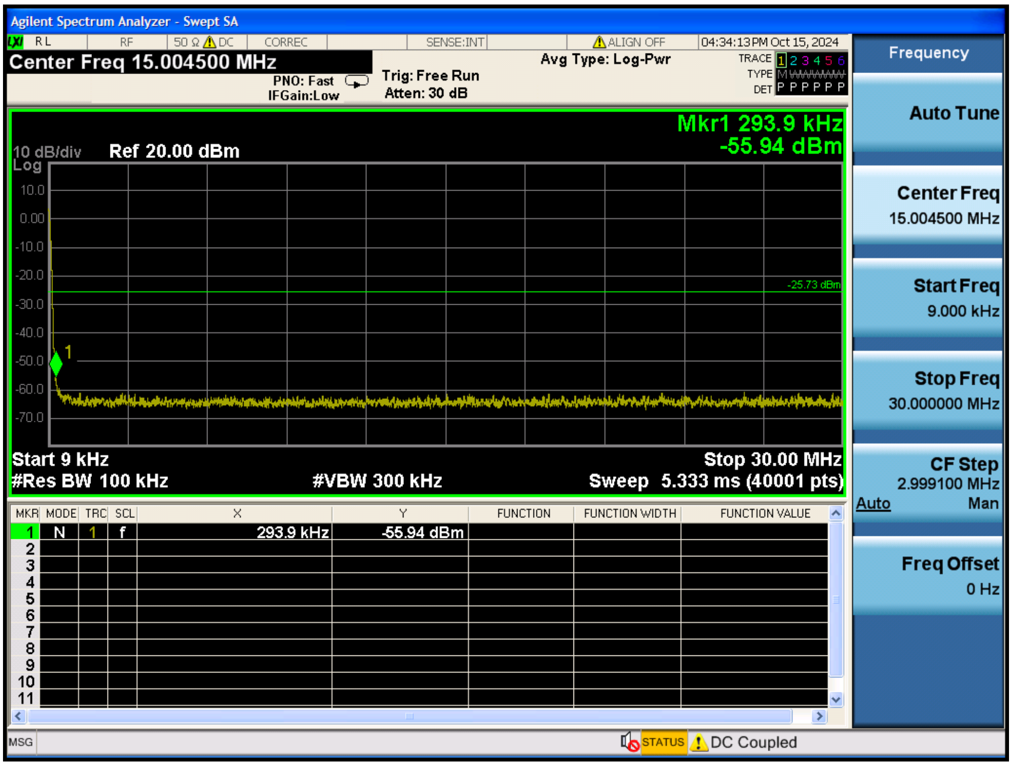
Reference

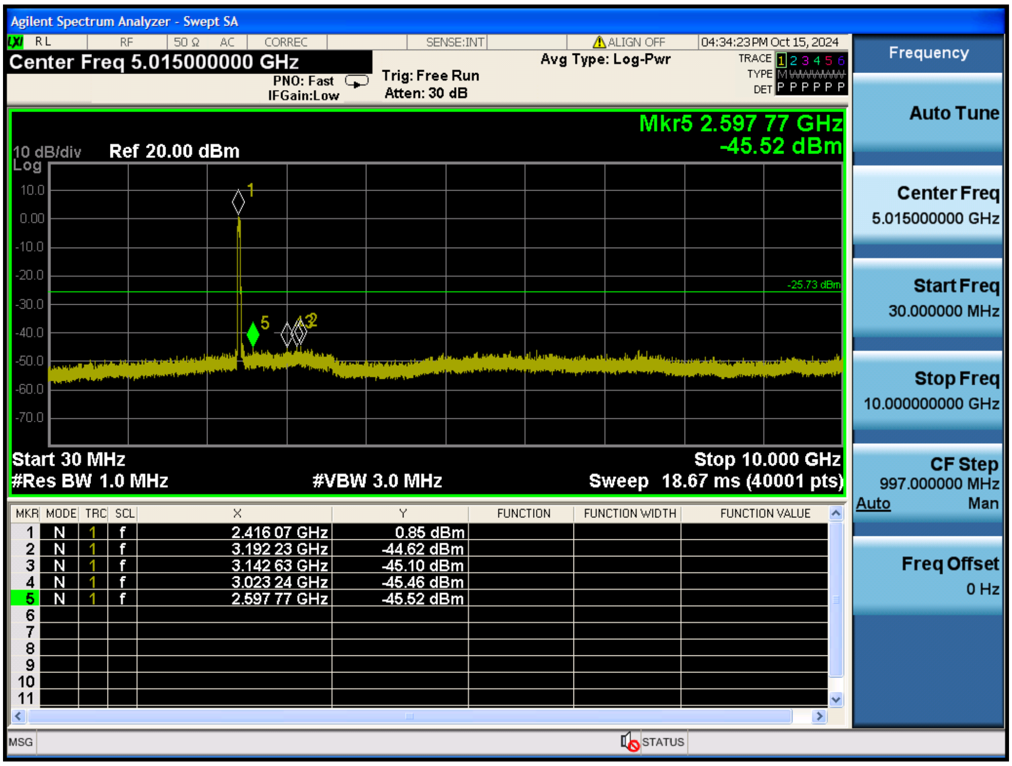


Low Band-edge

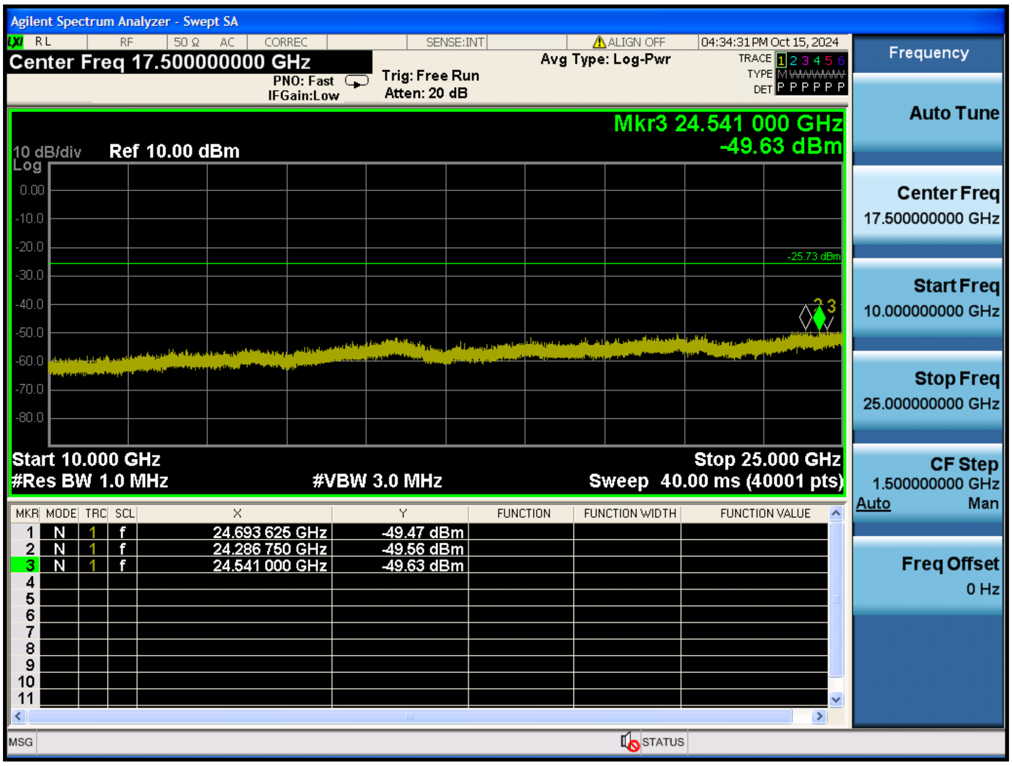


Conducted Spurious Emissions





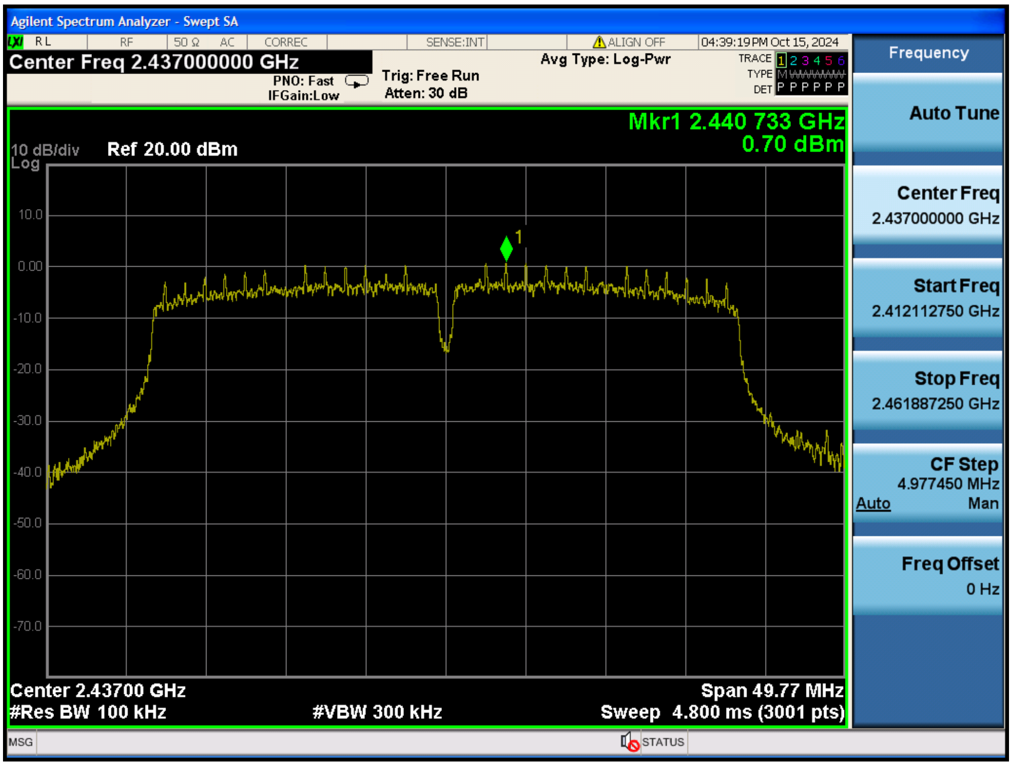
Conducted Spurious Emissions



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	24.693 625 GHz	-49.47 dBm			
2	N	1	f	24.286 750 GHz	-49.56 dBm			
3	N	1	f	24.541 000 GHz	-49.63 dBm			

TM 4 & 2 437

Reference



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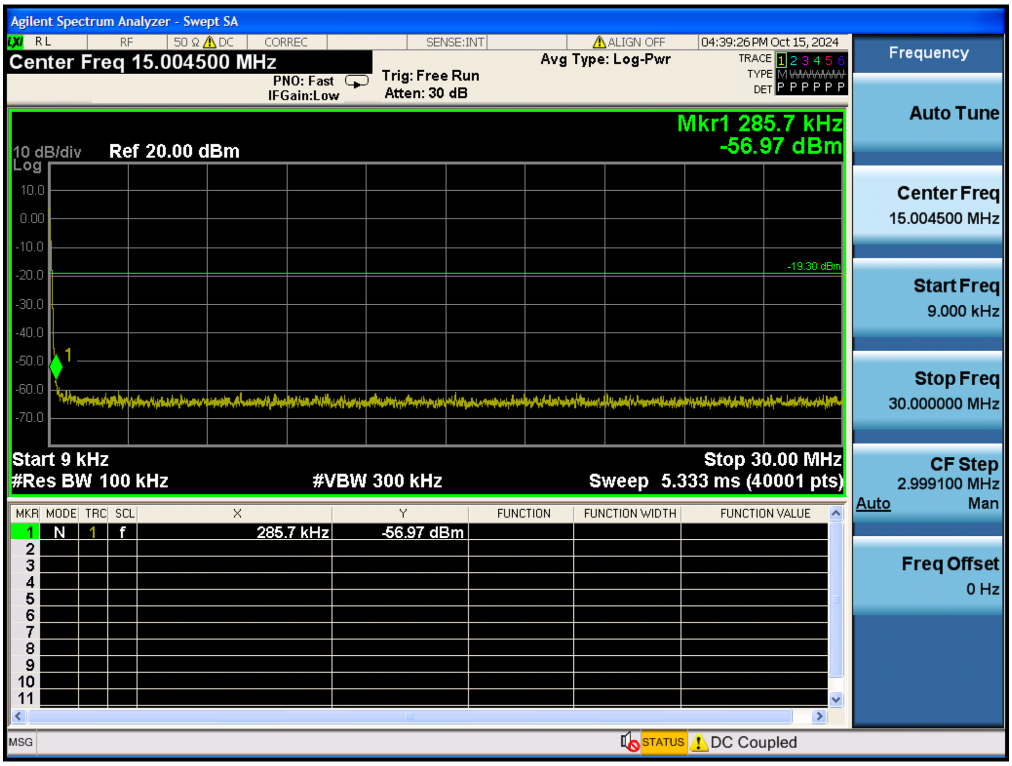
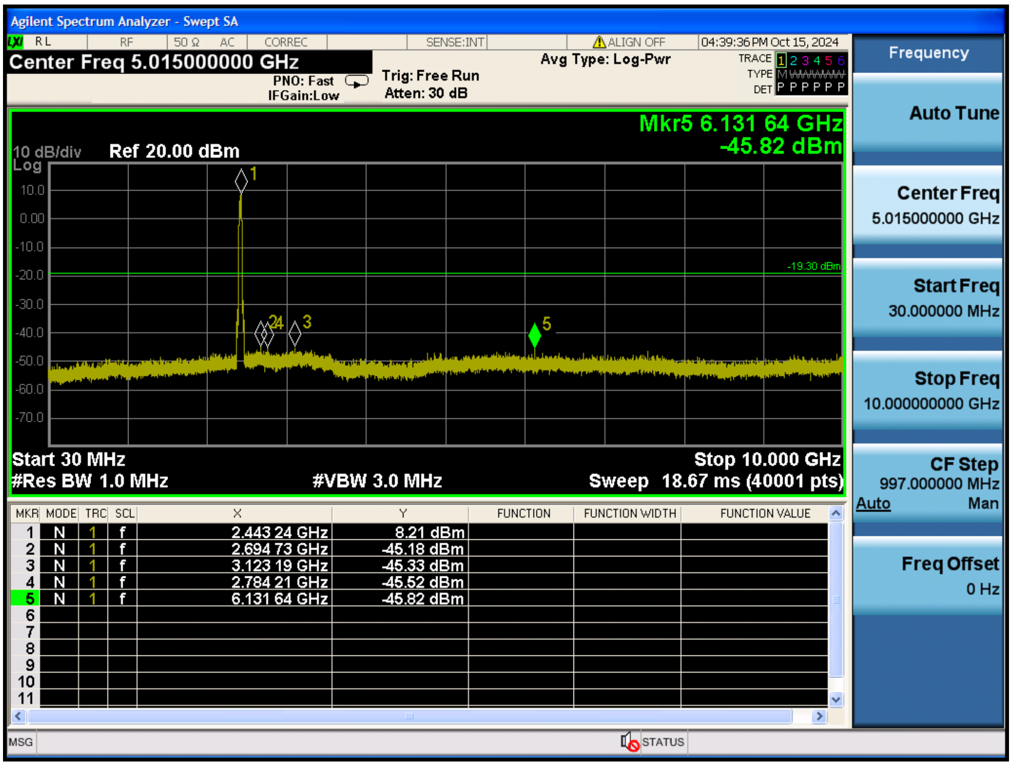
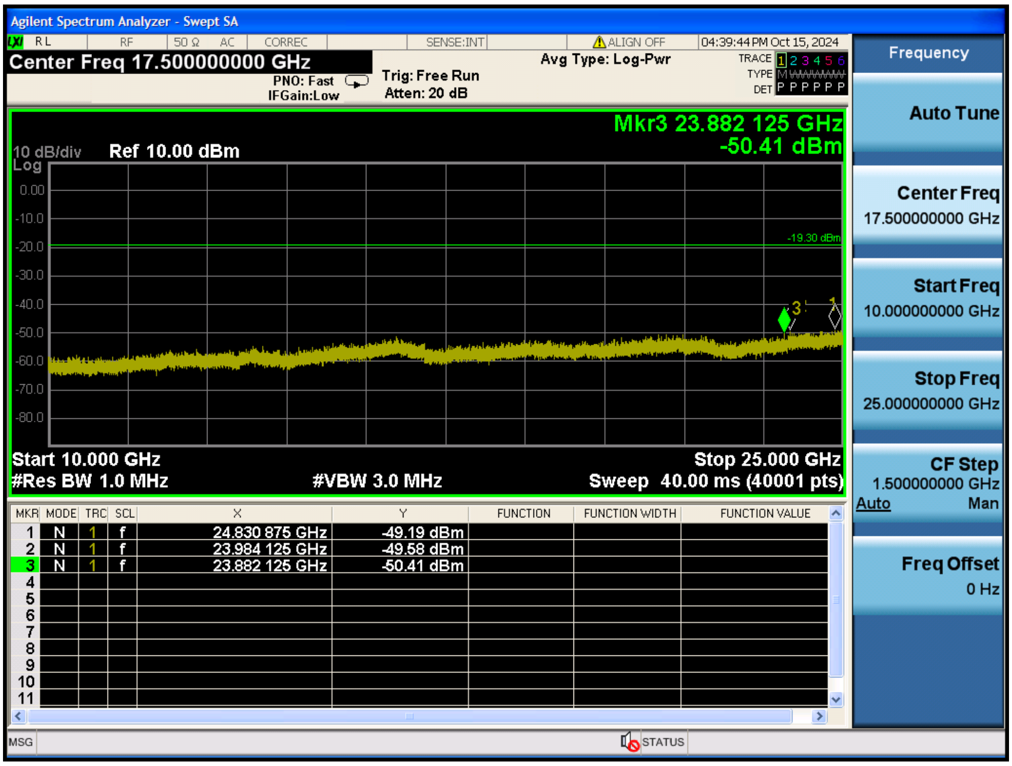


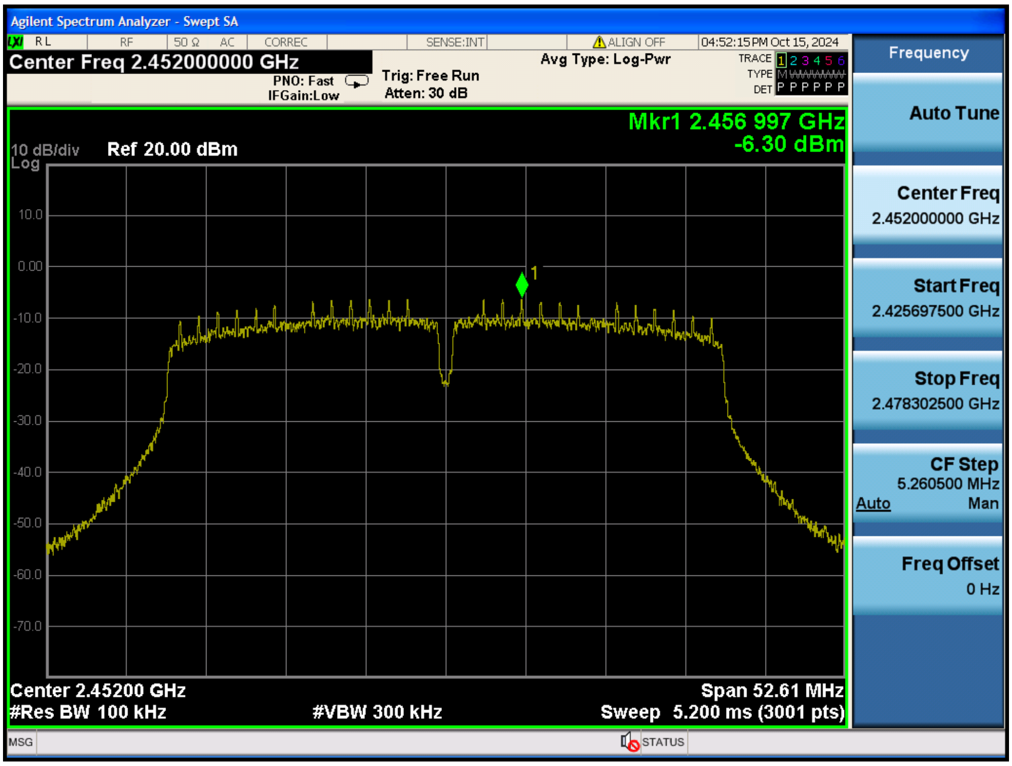
Conducted Spurious Emissions



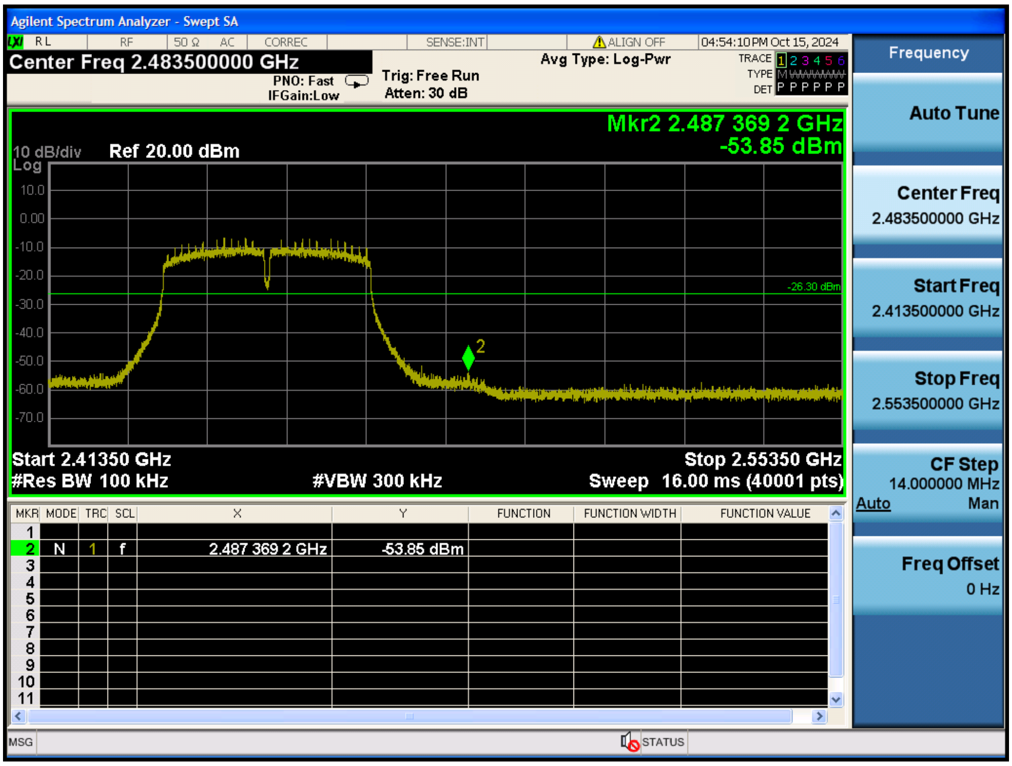


TM 4 & 2 452

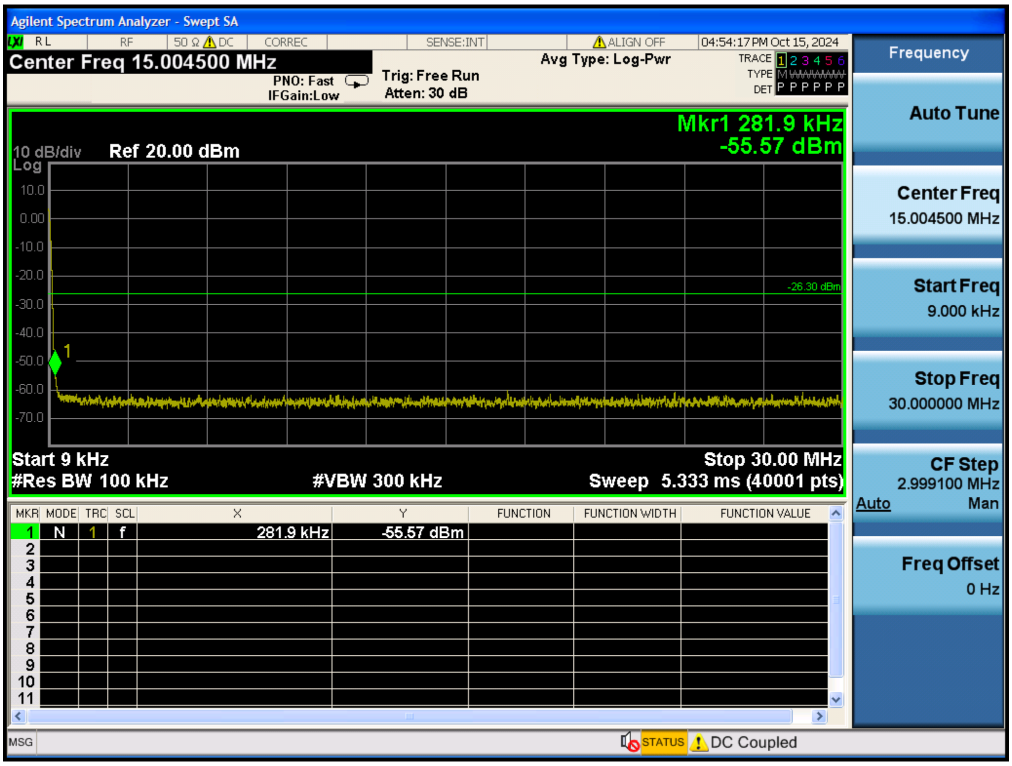
Reference

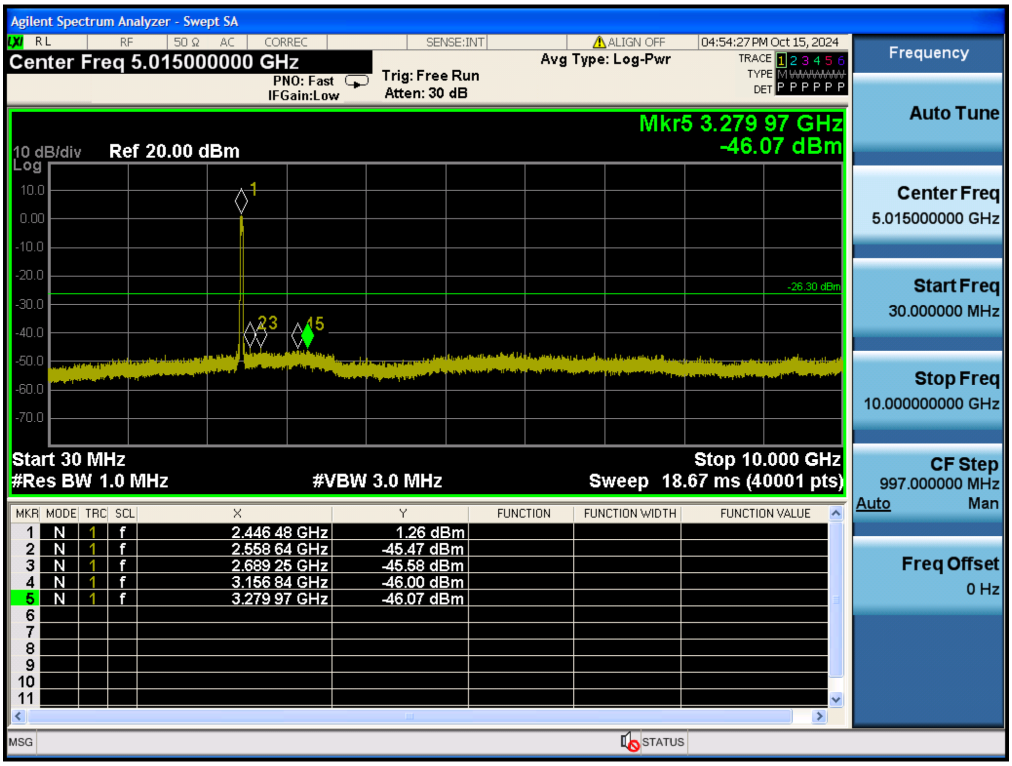


High Band-edge

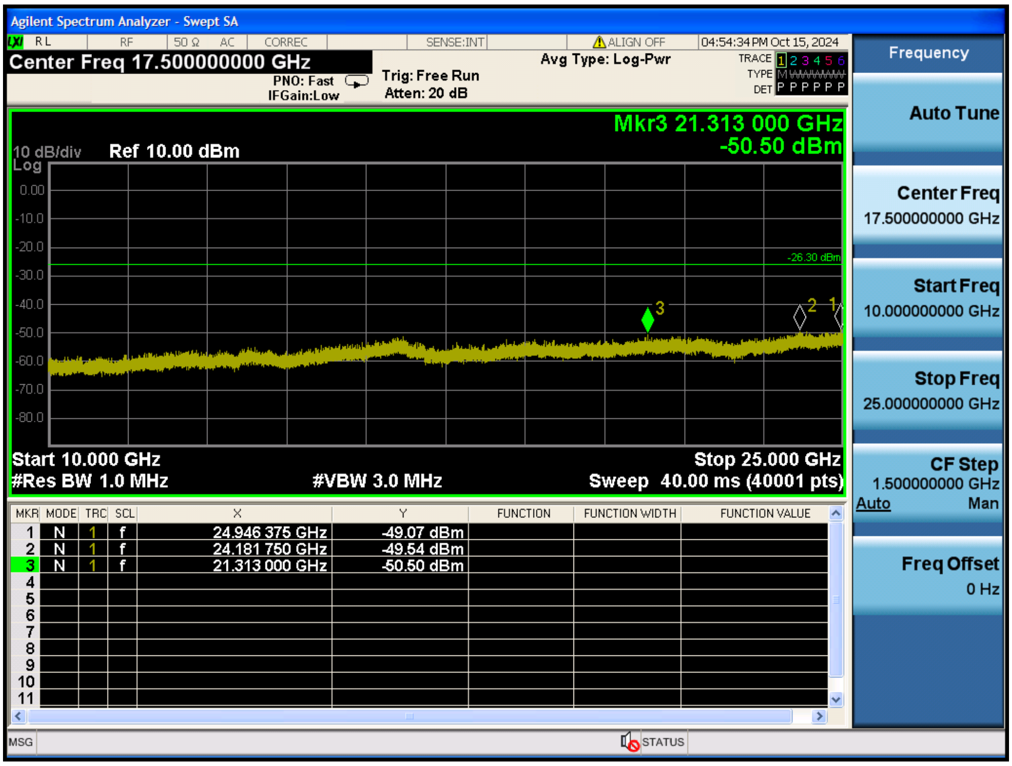


Conducted Spurious Emissions





Conducted Spurious Emissions



5.5. Unwanted Emissions (Radiated)

▣ **Test Requirements and limit,**

Part 15.247(d), Part 15.205, Part 15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of Part 15.247 the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

- Part 15.209: General requirement

Frequency (MHz)	FCC Limit (uV/m)	Measurement Distance (m)
0.009 – 0.490	2 400 / F (kHz)	300
0.490 – 1.705	24 000 / F (kHz)	30
1.705 – 30.0	30	30

Frequency (MHz)	FCC Limit (uV/m)	Measurement Distance (m)
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

- Part 15.205(a): Restricted band of operation

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.414 25 ~ 8.414 75	108 ~ 121.94	1 300 ~ 1 427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1 435 ~ 1 626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.173 5 ~ 2.190 5	12.519 75 ~ 12.520 25	149.9 ~ 150.05	1 645.5 ~ 1 646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.576 75 ~ 12.577 25	156.524 75 ~ 156.525 25	1 660 ~ 1 710	8.025 ~ 8.5	22.01 ~ 23.12
4.177 25 ~ 4.177 75	13.36 ~ 13.41	156.7 ~ 156.9	1 718.8 ~ 1 722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.207 25 ~ 4.207 75	16.42 ~ 16.423	162.012 5 ~ 167.17	2 200 ~ 2 300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.694 75 ~ 16.695 25	167.72 ~ 173.2	2 310 ~ 2 390	10.6 ~ 12.7	36.43 ~ 36.5
6.267 75 ~ 6.268 25	16.804 25 ~ 16.804 75	240 ~ 285	2 483.5 ~ 2 500	13.25 ~ 13.4	Above 38.6
6.311 75 ~ 6.312 25	25.5 ~ 25.67	322 ~ 335.4	2 655 ~ 2 900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3 260 ~ 3 267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3 332 ~ 3 339		
8.376 25 ~ 8.386 75	74.8 ~ 75.2	960 ~ 1 240	3 345.8 ~ 3 358		
			3 600 ~ 4 400		

5.5.1. Test Setup

Refer to the APPENDIX I.

5.5.2. Test Procedures

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

Note: Measurement Instrument Setting for Radiated Emission Measurements.

- **KDB558074 D01v05r02 - Section 8.6**
- **ANSI C63.10-2013 – Section 11.12**

1. Frequency Range Below 1 GHz

RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. Frequency Range > 1 GHz

Peak Measurement > 1 GHz

RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Average Measurement > 1 GHz

1. RBW = 1 MHz (unless otherwise specified).
2. VBW ≥ 3 x RBW.
3. Detector = RMS (Number of points ≥ 2 x Span / RBW)
4. Averaging type = power (i.e., RMS).
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.
7. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
   1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is 10 log(1 / D), where D is the duty cycle.
   2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is 20 log(1 / D), where D is the duty cycle.
   3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

Duty Cycle Correction factor

Test Mode	Date rate	T_{on}(ms)	T_{on+off} (ms)	D = T_{on} / (T_{on+off})	DCCF = 10 log(1/D) (dB)
TM 1	1 Mbps	12.430	12.540	0.991 2	0.04
TM 2	6 Mbps	2.064	2.179	0.947 2	0.24
TM 3	MCS 0	1.924	2.040	0.943 1	0.25
TM 4	MCS 0	0.948	1.054	0.899 4	0.46

Note1: Where, T= Transmission duration / D= Duty cycle

Note2: Please refer to the appendix II for duty cycle plots.

5.5.3. Test Results

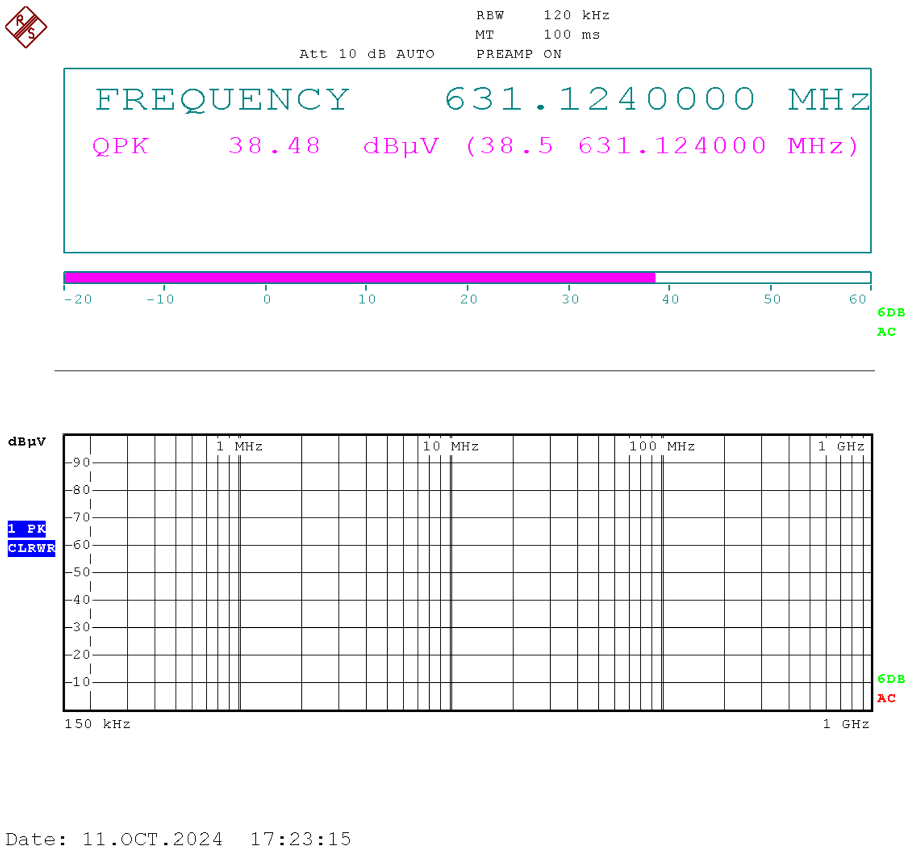
- Test Notes

1. The radiated emissions below 1 GHz were investigated 9 kHz to 1 GHz and the worst case data was reported.
2. Information of Distance Correction Factor
   For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.
   In this case, the distance factor is applied to the result.
   - Calculation of distance correction factor
   At frequencies below 30 MHz = 40 log(tested distance / specified distance)
   At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)
   When distance factor is “N/A”, the measurements were performed at the specified distance and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High pass filter Loss, AL = Attenuator Loss,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

Radiated Emissions data(9 kHz ~ 1 GHz) : TM 1

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin(dB)
2 412	631.12	H	X	QP	38.50	2.37	N/A	N/A	40.87	46.00	5.13
	631.13	V	X	QP	34.80	2.37	N/A	N/A	37.17	46.00	8.83
	797.99	H	X	QP	33.90	5.39	N/A	N/A	39.29	46.00	6.71

TM 1 & 2 412 MHz & X axis & Hor **Detector Mode : QP**



- Test Notes

1. The radiated emissions were investigated 1 GHz to 25 GHz. And no other spurious and harmonic emissions were found below listed frequencies.
2. Information of Distance Correction Factor
   For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.
   In this case, the distance factor is applied to the result.
   - Calculation of distance correction factor
   At frequencies below 30 MHz = 40 log(tested distance / specified distance)
   At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)
   When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High pass filter Loss, AL = Attenuator Loss,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

Radiated Emissions data(1 GHz ~ 25 GHz) : TM 1

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin(dB)
2 412	2389.43	H	X	PK	48.76	4.97	N/A	N/A	53.73	74.00	20.27
	2389.89	H	X	AV	39.37	4.97	N/A	N/A	44.34	54.00	9.66
	4824.83	V	X	PK	49.53	2.44	N/A	N/A	51.97	74.00	22.03
	4824.18	V	X	AV	39.57	2.44	N/A	N/A	42.01	54.00	11.99
2 437	4873.51	V	X	PK	50.67	2.36	N/A	N/A	53.03	74.00	20.97
	4872.83	V	X	AV	39.50	2.36	N/A	N/A	41.86	54.00	12.14
2 462	2483.72	H	X	PK	50.56	5.66	N/A	N/A	56.22	74.00	17.78
	2483.57	H	X	AV	39.96	5.65	N/A	N/A	45.61	54.00	8.39
	4924.35	V	X	PK	49.40	3.14	N/A	N/A	52.54	74.00	21.46
	4924.08	V	X	AV	39.39	3.14	N/A	N/A	42.53	54.00	11.47

Radiated Emissions data(1 GHz ~ 25 GHz) : TM 2

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin(dB)
2 412	2389.97	H	X	PK	48.88	4.97	N/A	N/A	53.85	74.00	20.15
	2389.66	H	X	AV	39.75	4.97	0.24	N/A	44.96	54.00	9.04
	4825.16	V	X	PK	49.69	2.44	N/A	N/A	52.13	74.00	21.87
	4824.99	V	X	AV	39.86	2.44	0.24	N/A	42.54	54.00	11.46
2 437	4872.50	V	X	PK	49.89	2.36	N/A	N/A	52.25	74.00	21.75
	4872.58	V	X	AV	39.61	2.36	0.24	N/A	42.21	54.00	11.79
2 462	2483.91	H	X	PK	52.23	5.66	N/A	N/A	57.89	74.00	16.11
	2483.58	H	X	AV	42.35	5.65	0.24	N/A	48.24	54.00	5.76
	4922.25	V	X	PK	50.59	3.13	N/A	N/A	53.72	74.00	20.28
	4922.63	V	X	AV	39.27	3.13	0.24	N/A	42.64	54.00	11.36

Radiated Emissions data(1 GHz ~ 25 GHz) : TM 3

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin(dB)
2 412	2388.22	H	X	PK	50.08	4.96	N/A	N/A	55.04	74.00	18.96
	2388.68	H	X	AV	39.36	4.96	0.25	N/A	44.57	54.00	9.43
	4825.56	V	X	PK	50.30	2.44	N/A	N/A	52.74	74.00	21.26
	4825.31	V	X	AV	39.39	2.44	0.25	N/A	42.08	54.00	11.92
2 437	4872.58	V	X	PK	50.92	2.36	N/A	N/A	53.28	74.00	20.72
	4872.50	V	X	AV	39.65	2.36	0.25	N/A	42.26	54.00	11.74
2 462	2483.74	H	X	PK	50.86	5.66	N/A	N/A	56.52	74.00	17.48
	2483.63	H	X	AV	39.81	5.65	0.25	N/A	45.71	54.00	8.29
	4922.65	V	X	PK	49.94	3.13	N/A	N/A	53.07	74.00	20.93
	4922.50	V	X	AV	39.17	3.13	0.25	N/A	42.55	54.00	11.45

Radiated Emissions data(1 GHz ~ 25 GHz) : TM 4

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin(dB)
2 422	2 388.01	H	X	PK	49.70	4.96	N/A	N/A	54.66	74.00	19.34
	2 387.65	H	X	AV	39.39	4.96	0.46	N/A	44.81	54.00	9.19
	4 843.15	V	X	PK	49.69	2.41	N/A	N/A	52.10	74.00	21.90
	4 842.50	V	X	AV	39.34	2.41	0.46	N/A	42.21	54.00	11.79
2 437	4 872.73	V	X	PK	50.51	2.36	N/A	N/A	52.87	74.00	21.13
	4 872.81	V	X	AV	39.69	2.36	0.46	N/A	42.51	54.00	11.49
2 452	2 484.28	H	X	PK	49.97	5.67	N/A	N/A	55.64	74.00	18.36
	2 484.03	H	X	AV	39.77	5.66	0.46	N/A	45.89	54.00	8.11
	4 903.25	V	X	PK	50.22	3.00	N/A	N/A	53.22	74.00	20.78
	4 902.72	V	X	AV	39.75	3.00	0.46	N/A	43.21	54.00	10.79

5.6. AC Power-Line Conducted Emissions

▣ **Test Requirements and limit, Part 15.207**

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5.0	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

5.6.1. Test Setup

NA

5.6.2. Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10-2013.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

5.6.3. Test Results

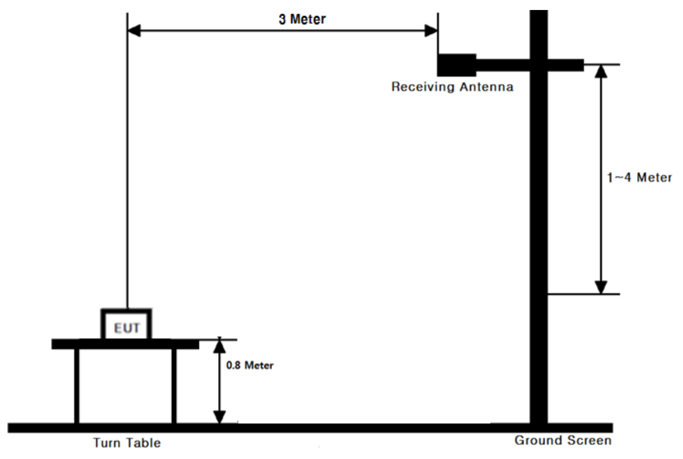
NA

APPENDIX I

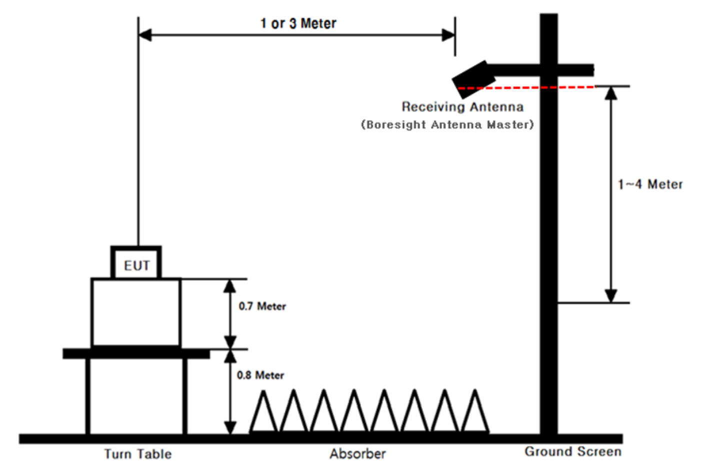
Test set up diagrams

- **Radiated Measurement**

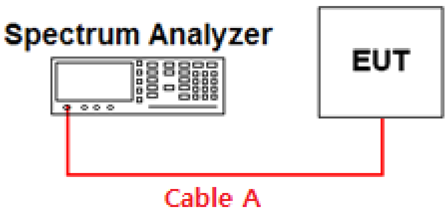
Below 1 GHz



Above 1 GHz



- **Conducted Measurement**



Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	10.77	15	11.88
1	11.05	20	12.16
2.412 & 2.437 & 2.462	11.18	25	12.94
5	11.32	-	-
10	11.70	-	-

Note 1: The path loss from EUT to Spectrum analyzer was measured and used for test.
Path loss (S/A's correction factor) = Cable A + Attenuator

APPENDIX II

Duty cycle plots

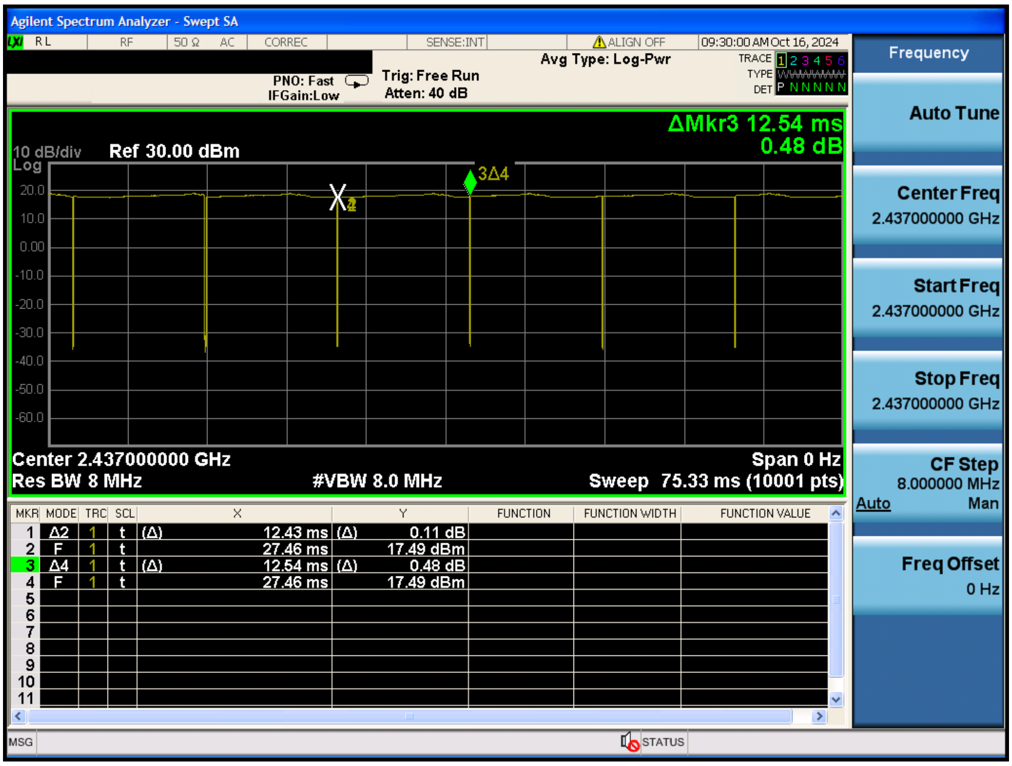
▪ Test Procedures

- KDB558074 D01v05r02 – Section 6

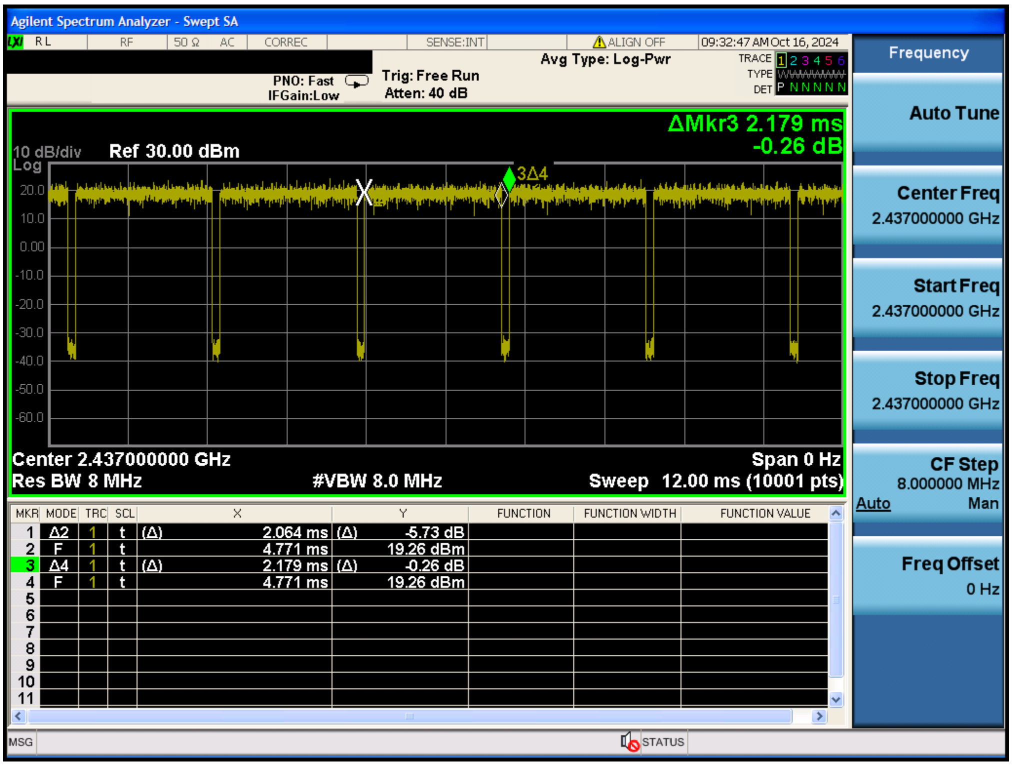
The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50 /T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

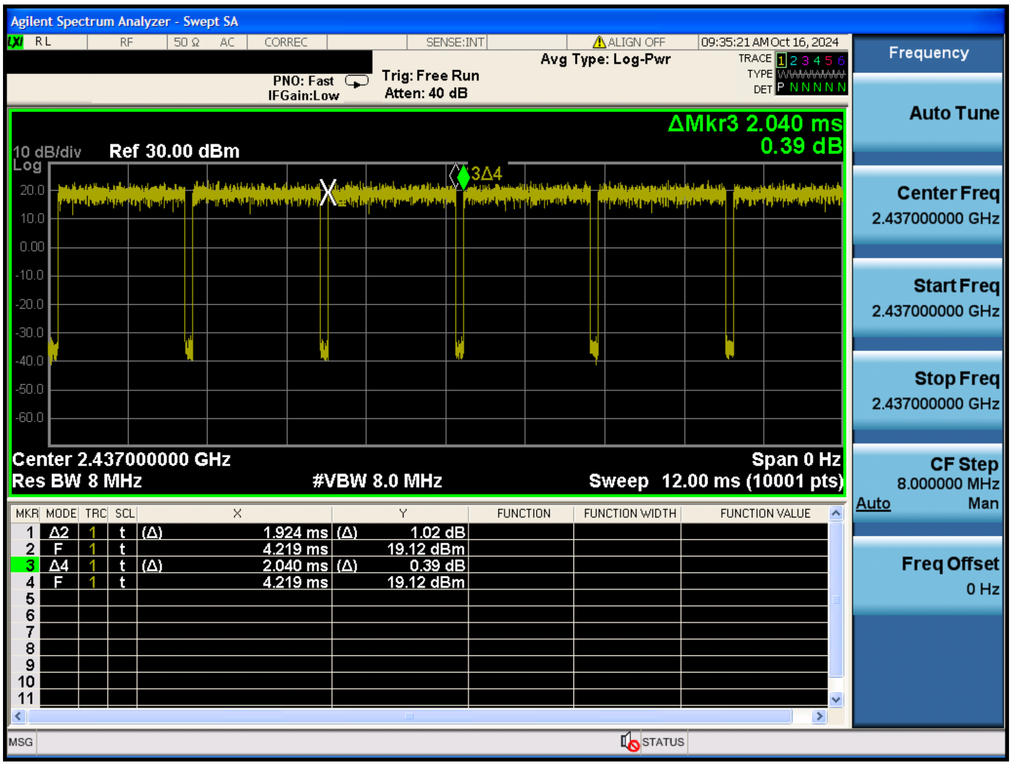
Duty Cycle TM 1 & 2 437 MHz



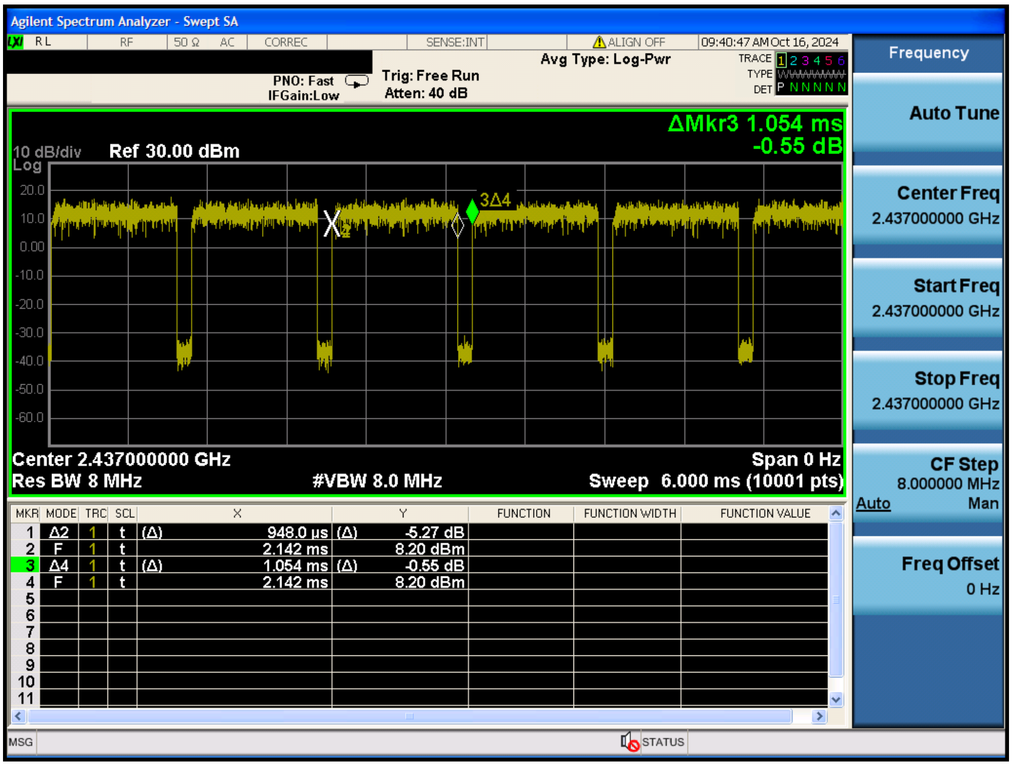
Duty Cycle TM 2 & 2 437 MHz



Duty Cycle TM 3 & 2 437 MHz



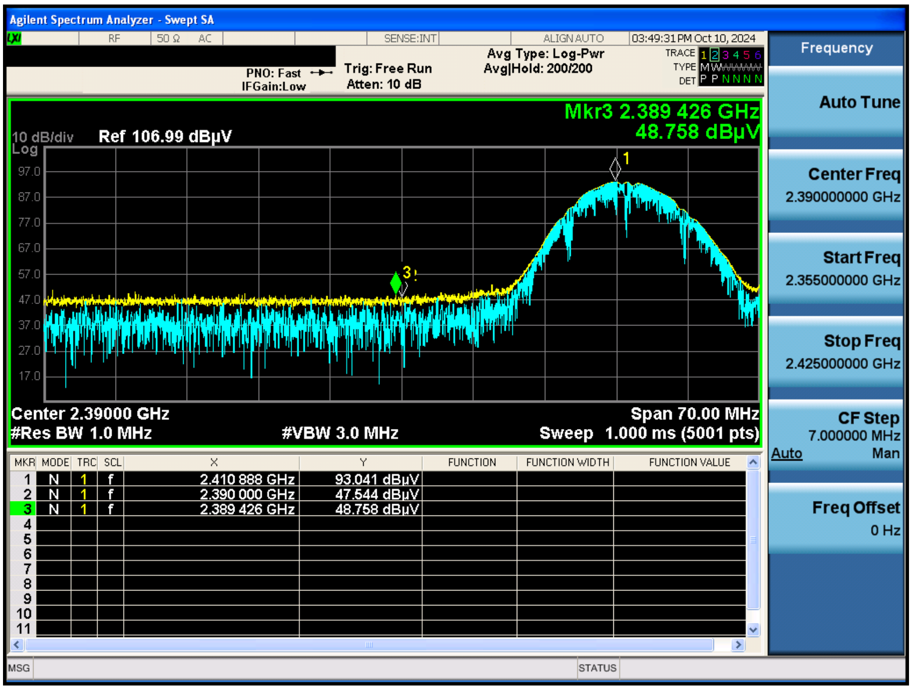
Duty Cycle **TM 4 & 2 437 MHz**



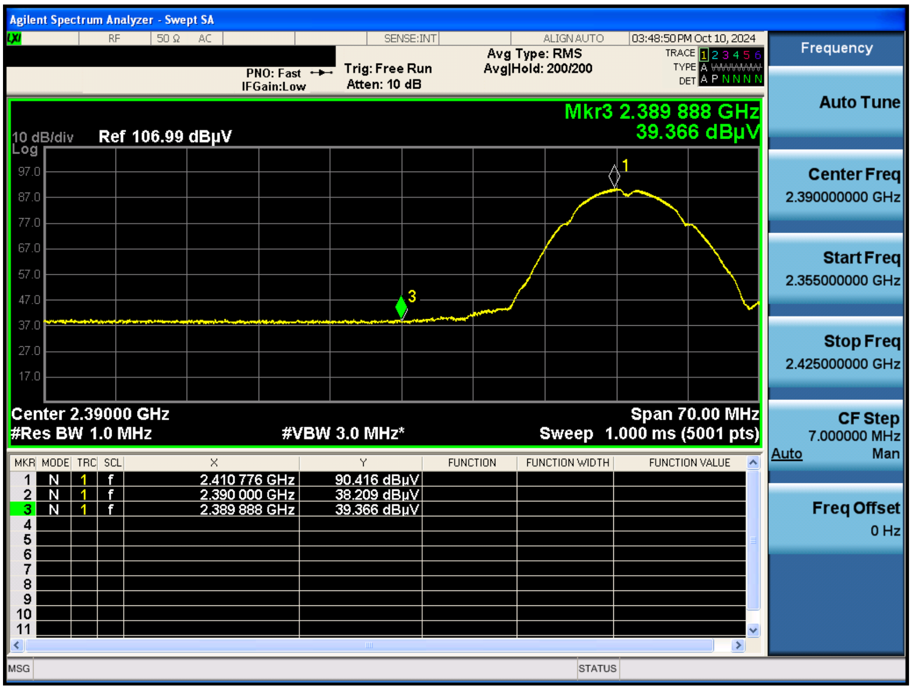
APPENDIX III

Unwanted Emissions (Radiated) Test Plot

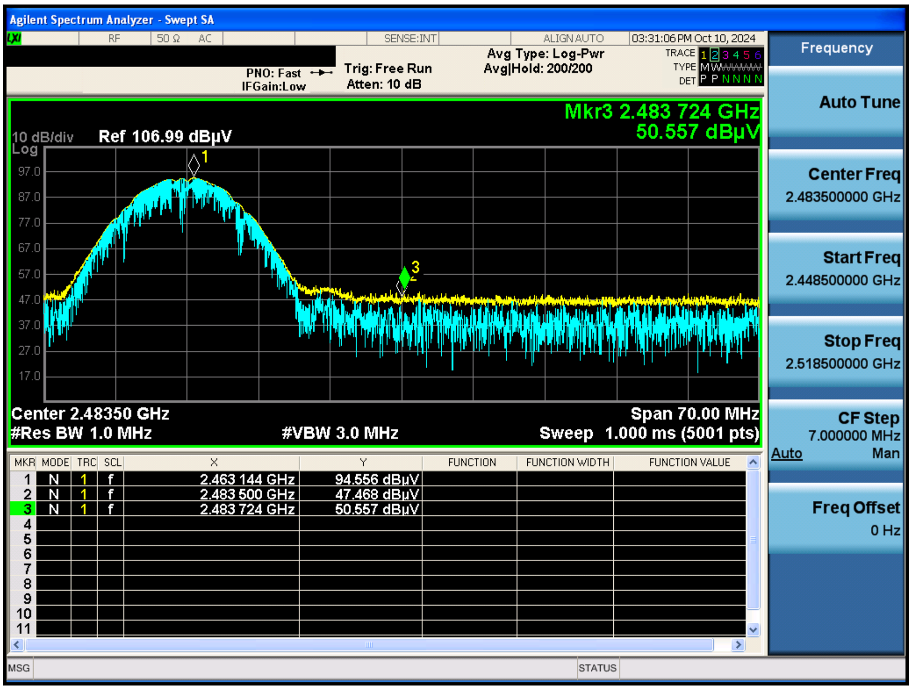
TM 1 & 2 412 & X axis & Hor **Detector Mode : PK**



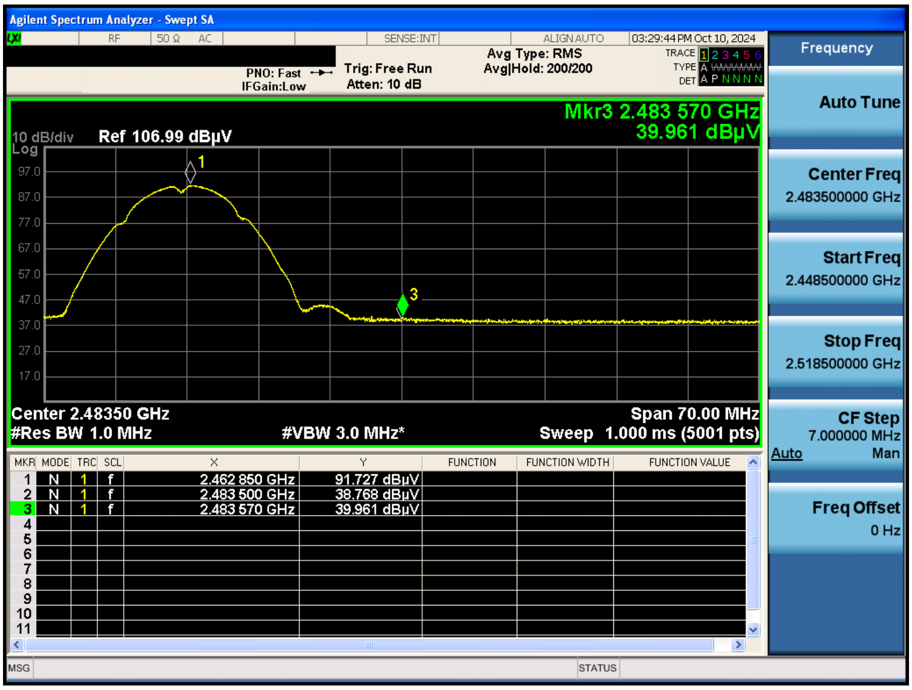
TM 1 & 2 412 & X axis & Hor **Detector Mode : AV**



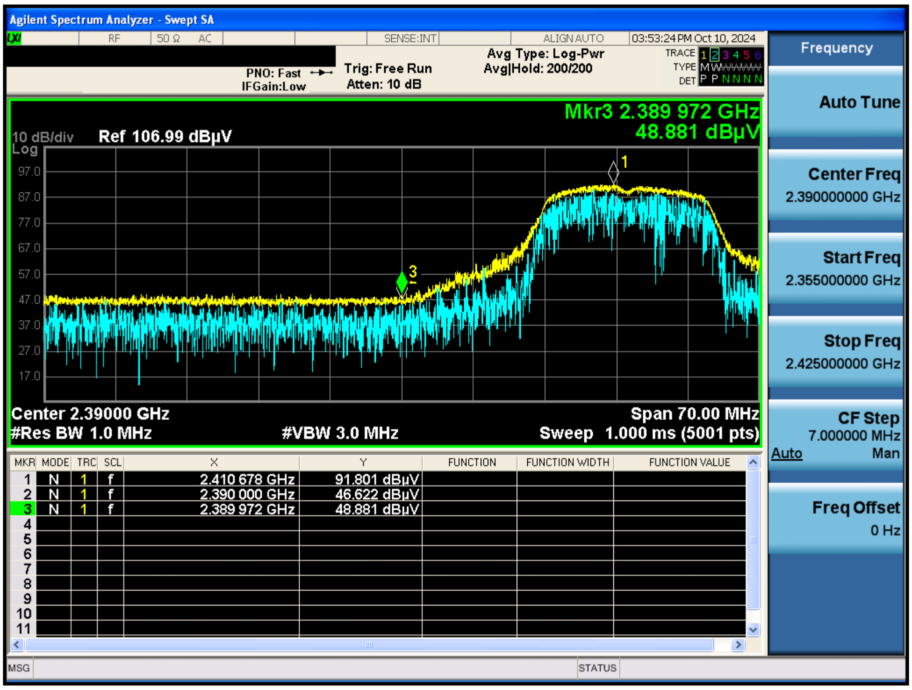
TM 1 & 2 462 & X axis & Hor **Detector Mode : PK**



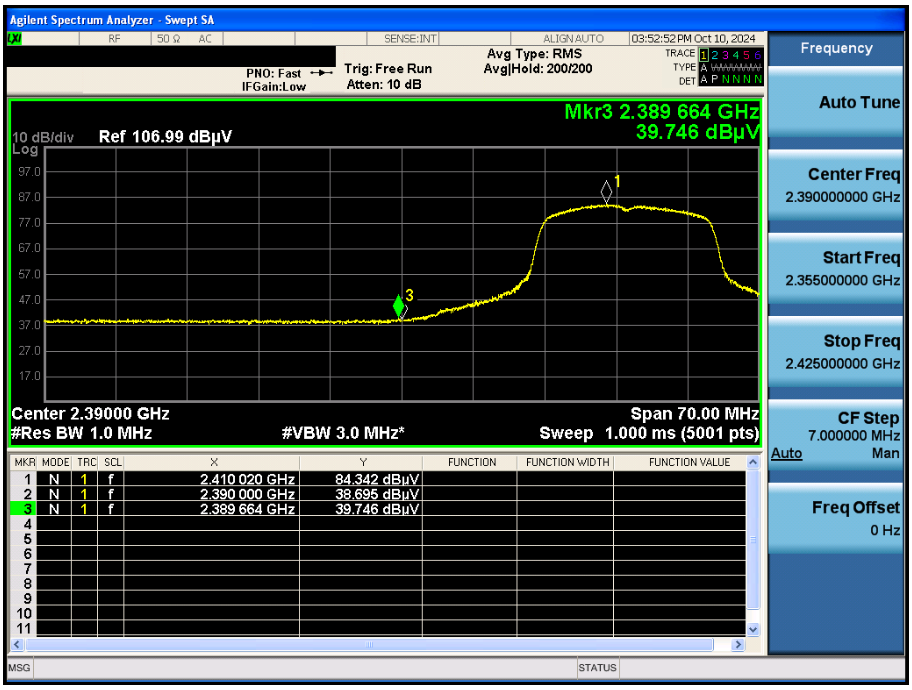
TM 1 & 2 462 & X axis & Hor **Detector Mode : AV**



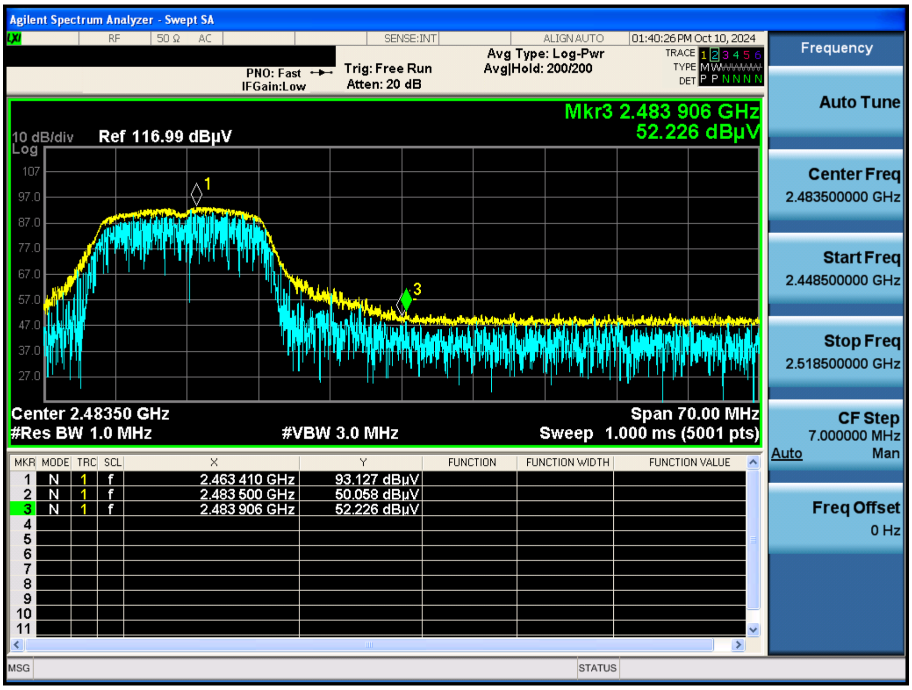
TM 2 & 2 412 & X axis & Hor **Detector Mode : PK**



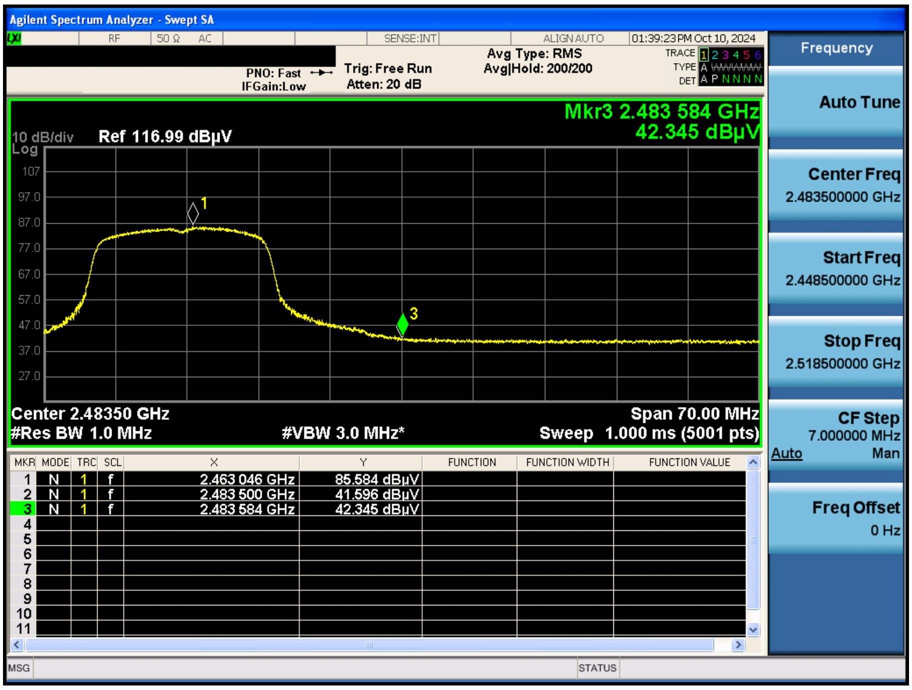
TM 2 & 2 412 & X axis & Hor **Detector Mode : AV**



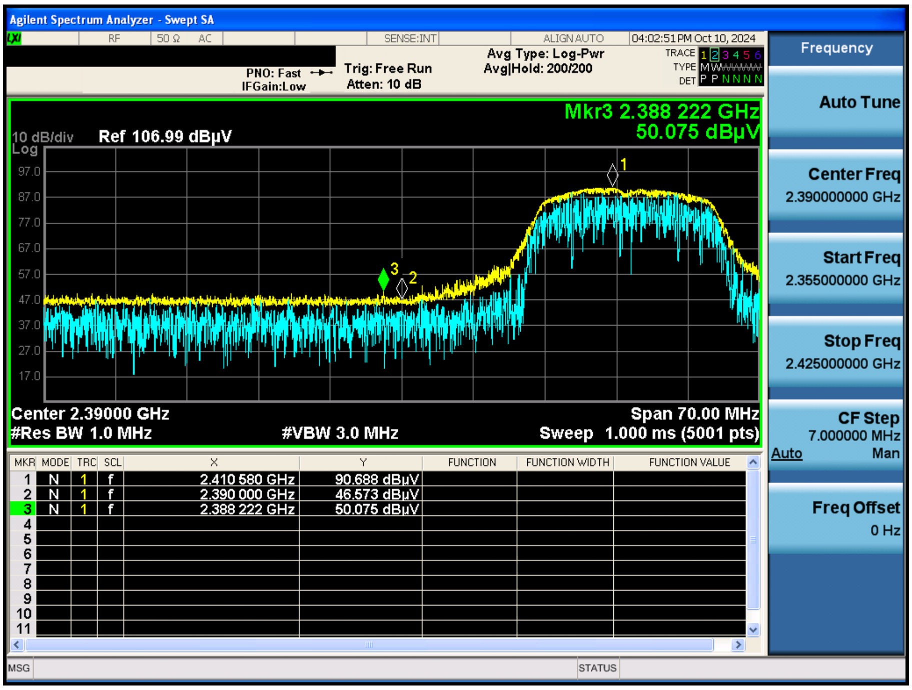
TM 2 & 2 462 & X axis & Hor **Detector Mode : PK**



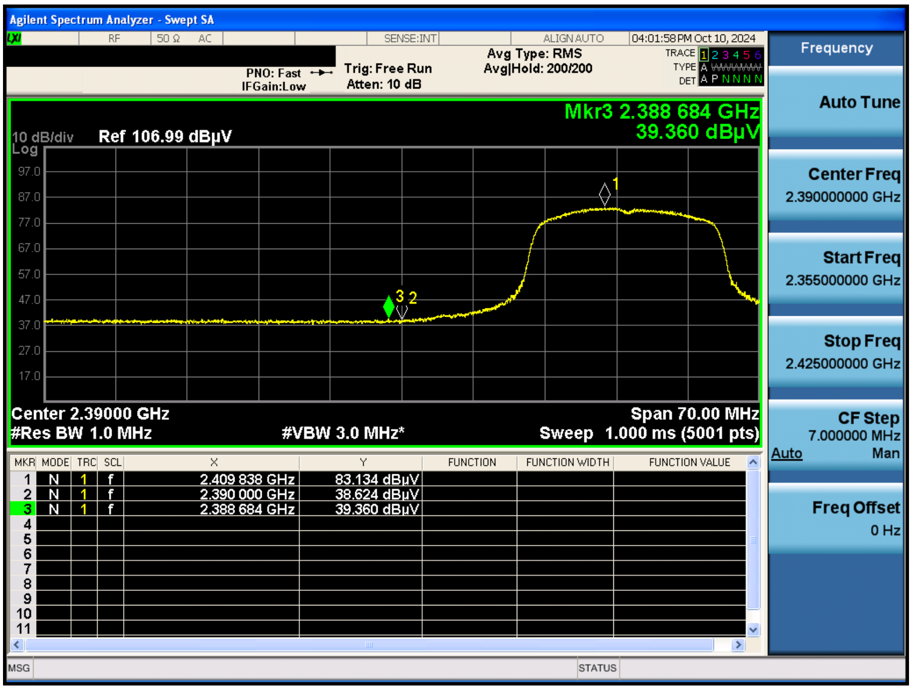
TM 2 & 2 462 & X axis & Hor **Detector Mode : AV**



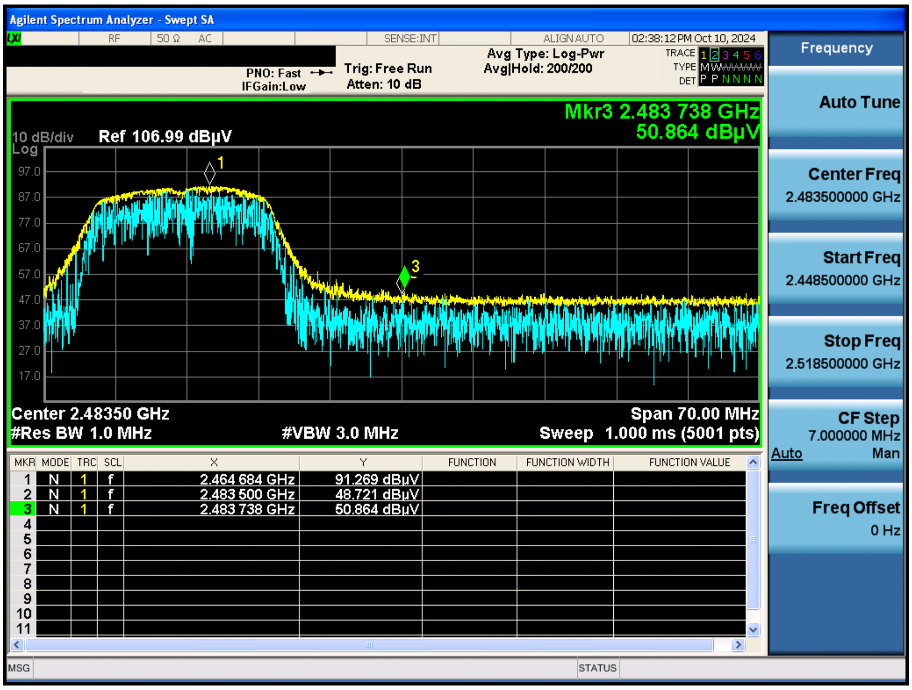
TM 3 & 2 412 & X axis & Hor **Detector Mode : PK**



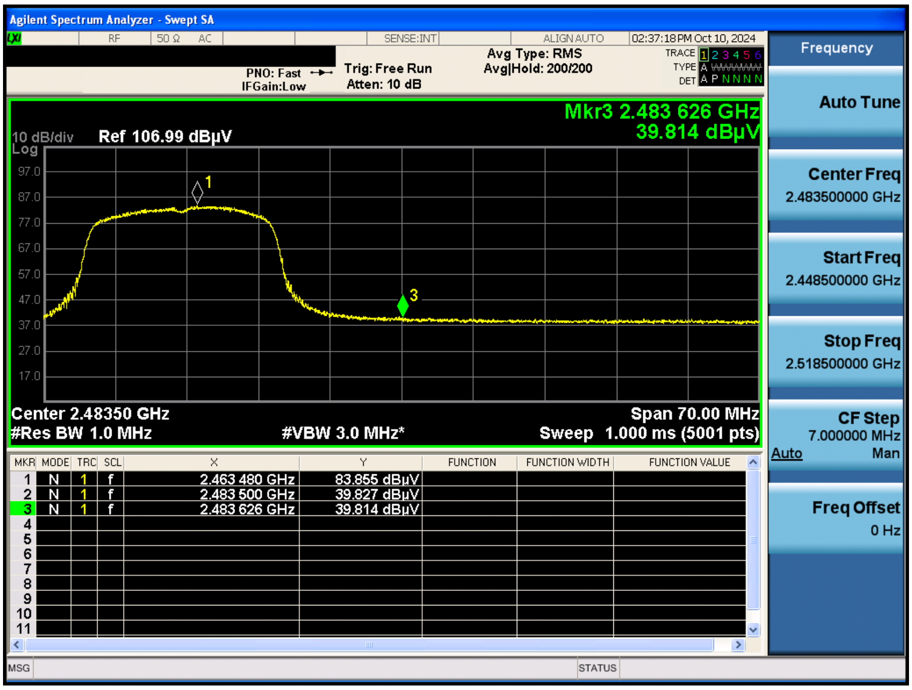
TM 3 & 2 412 & X axis & Hor **Detector Mode : AV**



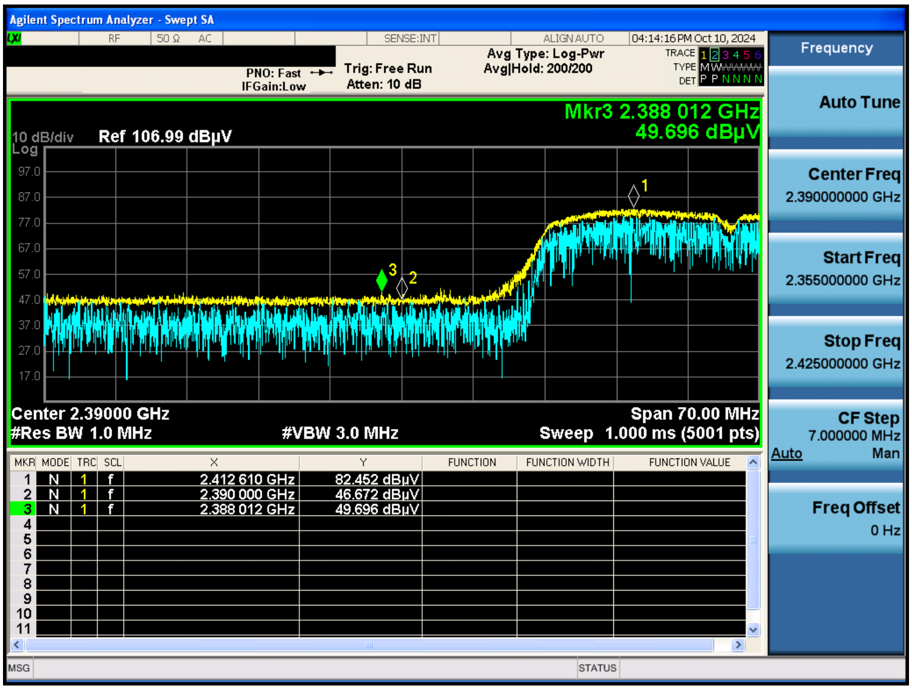
TM 3 & 2 462 & X axis & Hor **Detector Mode : PK**



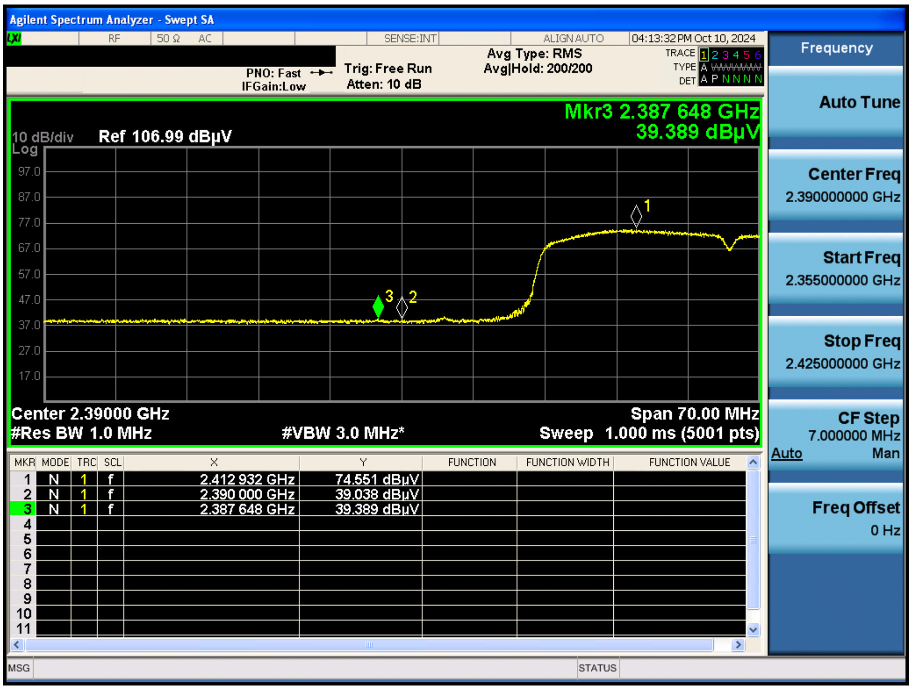
TM 3 & 2 462 & X axis & Hor **Detector Mode : AV**



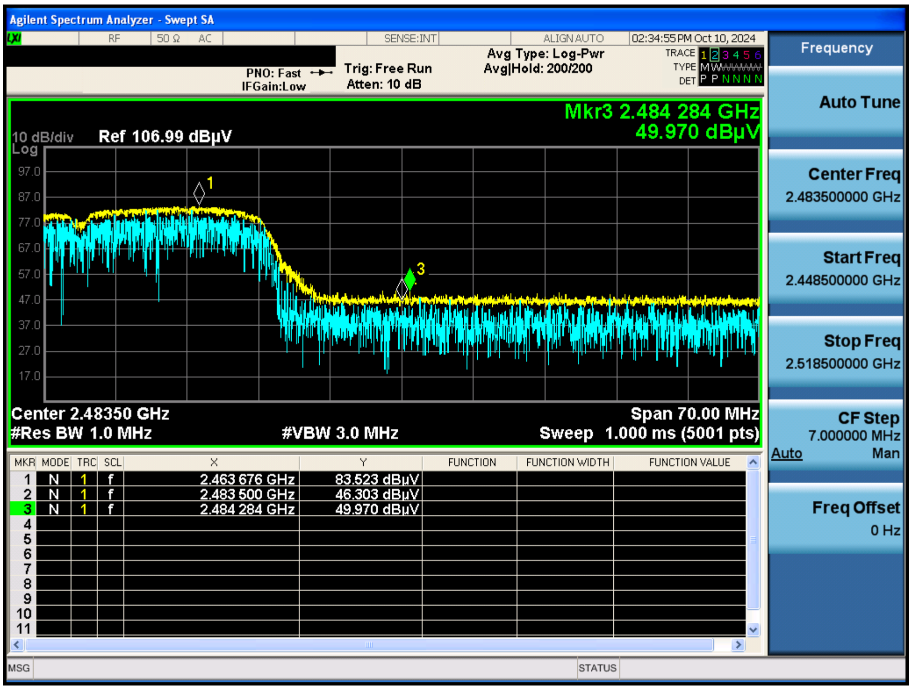
TM 4 & 2 412 & X axis & Hor **Detector Mode : PK**



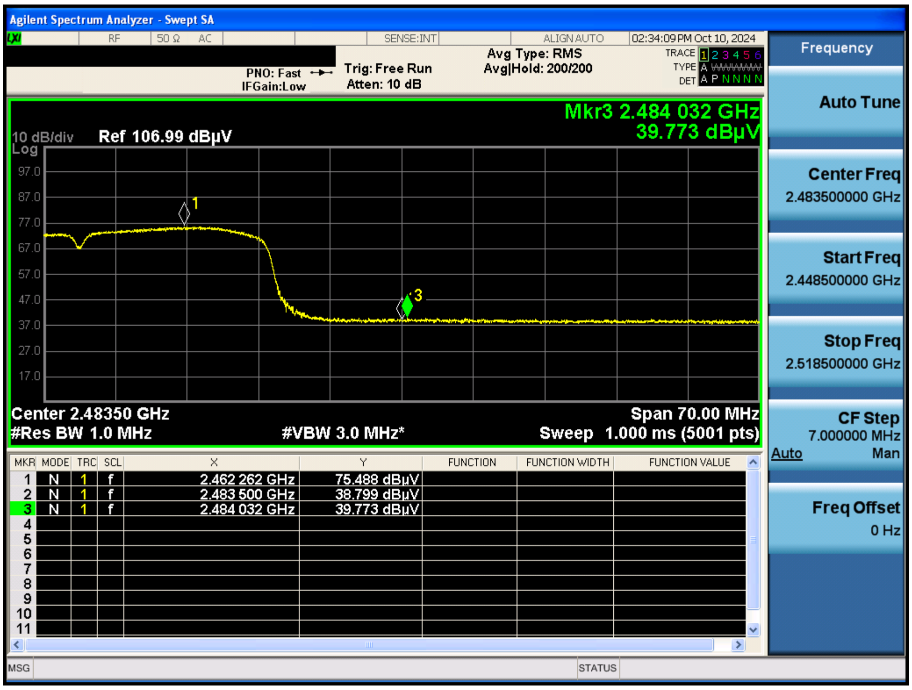
TM 4 & 2 412 & X axis & Hor **Detector Mode : AV**



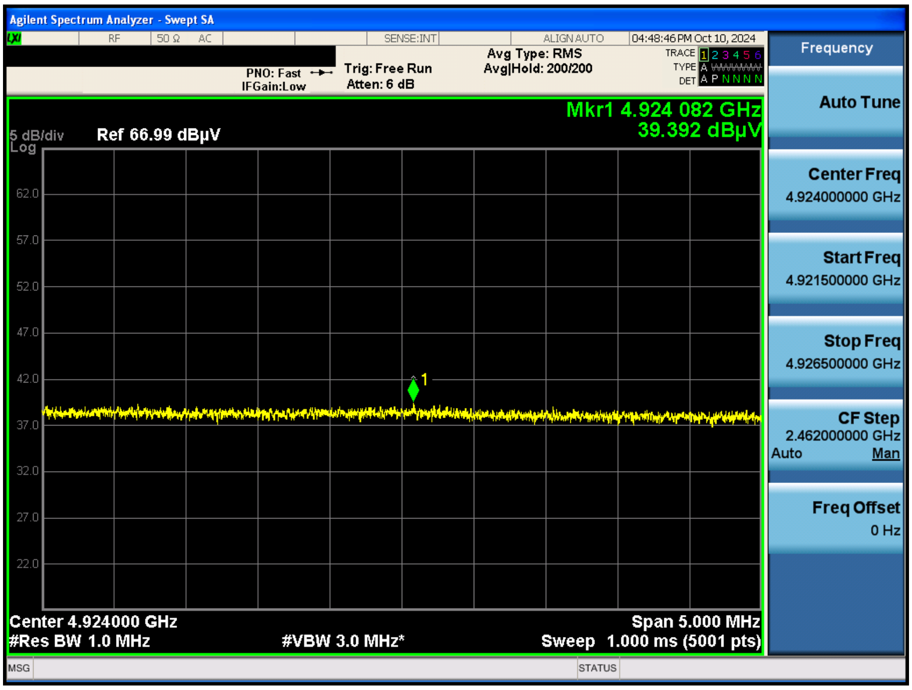
TM 4 & 2 452 & X axis & Hor **Detector Mode : PK**



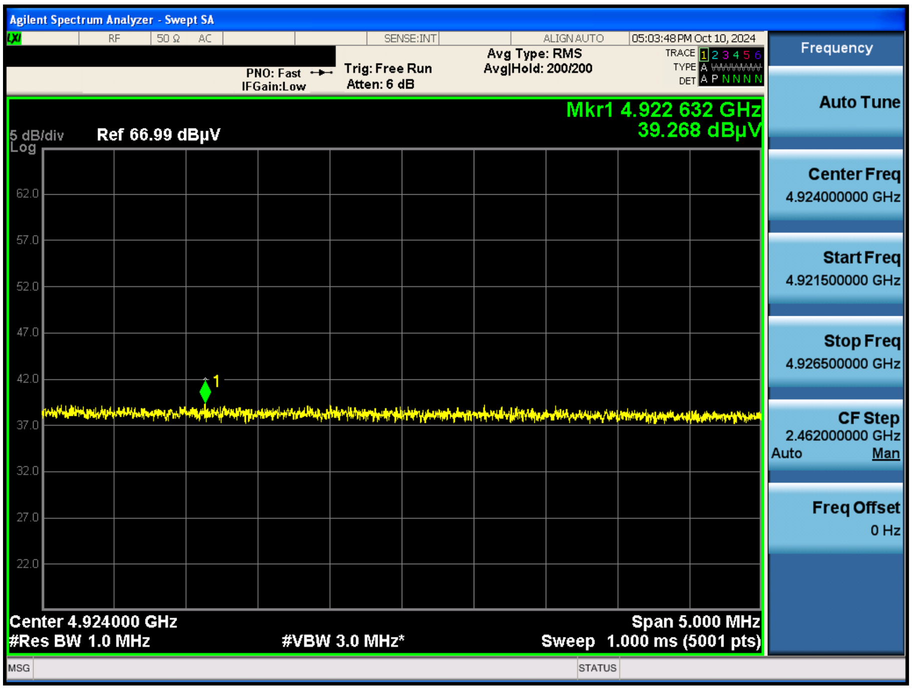
TM 4 & 2 452 & X axis & Hor **Detector Mode : AV**



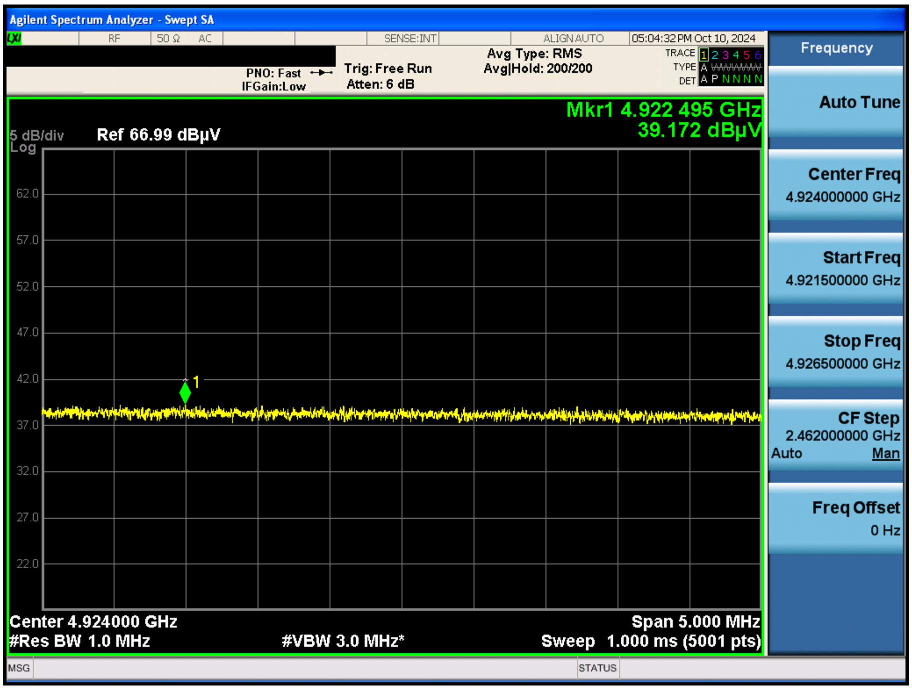
TM 1 & 2 462 & X axis & Ver Detector Mode : AV



TM 2 & 2 462 & X axis & Ver Detector Mode : AV



TM 3 & 2 462 & X axis & Ver Detector Mode : AV



TM 4 & 2 452 & X axis & Ver Detector Mode : AV