



F2 Labs
16740 Peters Road
Middlefield, Ohio 44062
United States of America
www.f2labs.com

CERTIFICATION TEST REPORT

Manufacturer: **Chandler Systems, Inc.**
710 Orange Street
Ashland, Ohio 44805 USA

Applicant: **Same as Above**

Product Name: **Legacy View Valve**

Product Description: The Legacy View Valve controls water softening and water filtering appliances. The valve controller can operate several different models of softeners and filters and gives the user the ability to change settings and view information about water treated by the appliance. The Legacy View Valve can be connected to via Bluetooth using a Google or Apple App, giving the user a convenient user interface to interact with.

**Operating Voltage/Freq.
of EUT During Testing:** 12VDC

Model: **EVB-034**

FCC ID: **SWP-EVB-034**

Testing Commenced: 2023-11-29

Testing Ended: 2024-02-13

Summary of Test Results: **In Compliance**

The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant.

Rules:

- **FCC Part 15 Subpart C, Section 15.247**
- **FCC15.207 - Conducted Limits**
- **FCC Part 15.31(e)**
- **ANSI C63.10:2013**



Evaluation Conducted by:

Julius Chiller, Senior Wireless Project Engineer

Report Reviewed by:

Ken Littell, Vice President of Operations

F2 Labs
26501 Ridge Road
Damascus, MD 20872
Ph 301.253.4500

F2 Labs
16740 Peters Road
Middlefield, OH 44062
Ph 440.632.5541

F2 Labs
8583 Zionsville Road
Indianapolis, IN 46268
Ph 317.610.0611

This test report may be reproduced in full; partial reproduction only may be made with the written consent of F2 Labs. The results in this report apply only to the equipment tested.



TABLE OF CONTENTS

1	<u>ADMINISTRATIVE INFORMATION</u>
2	<u>SUMMARY OF TEST RESULTS/MODIFICATIONS</u>
3	<u>TABLE OF MEASURED RESULTS</u>
4	<u>ENGINEERING STATEMENT</u>
5	<u>EUT INFORMATION AND DATA</u>
6	<u>LIST OF MEASUREMENT INSTRUMENTATION</u>
7	<u>OCCUPIED BANDWIDTH</u>
8	<u>CONDUCTED OUTPUT POWER</u>
9	<u>VOLTAGE VARIATIONS</u>
10	<u>CONDUCTED SPURIOUS EMISSIONS</u>
11	<u>RADIATED SPURIOUS EMISSIONS</u>
12	<u>PEAK POWER SPECTRAL DENSITY (PSD)</u>
13	<u>CONDUCTED EMISSIONS</u>
14	<u>TEST SETUP PHOTOGRAPHS</u>



1 ADMINISTRATIVE INFORMATION

1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

1.2 Measurement Procedure:

All measurements were performed according to ANSI C63.10 and recommended FCC procedure of measurement of DTS operating under Section 15.247 and in KDB558074. A list of the measurement equipment can be found in Section 6.

1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data and are expressed with a 95% confidence factor. Note: Only measurements listed below which relate to tests included in this Test Report are applicable to it.

Measurement Range	Expanded Uncertainty	Combined Uncertainty
Radiated Emissions <1 GHz @ 3m	±5.07dB	±2.54
Radiated Emissions <1 GHz @10m	±5.09dB	±2.55
Radiated Emissions 1 GHz to 2.7 GHz	±3.62dB	±1.81
Radiated Emissions 2.7 GHz to 18 GHz	±3.10dB	±1.55
AC Power Line Conducted Emissions, 150kHz to 30 MHz	±2.76dB	±1.38

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

1.4 Document History

Document Number	Description	Issue Date	Approved By
F2P30963A-01E	First Issue	2024-02-13	K. Littell



2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
Occupied Bandwidth	CFR 47 Part 15.247(a)(2) / KDB558074	Complies
Output Power	CFR 47 Part 15.247(b)(2) / KDB558074	Complies
Voltage Variations	CFR 47 Part 15.31(e)	Complies
Conducted Spurious Emissions	CFR 47 Part 15.247(d) / Part 15.207 / KDB558074	Complies
Radiated Spurious Emission	CFR 47 Part 15.247(d) / Part 15.209 / KDB558074	Complies
Peak Power Spectral Density	CFR 47 Part 15.247(e) / KDB558074	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Complies

Modifications Made to the Equipment
None



3 TABLE OF MEASURED RESULTS

Test		Low Channel 2.402 GHz	Mid Channel 2.440 GHz	High Channel 2.480 GHz
Conducted Output Power	1Mb	59.98mW / 17.78dBm	64.12mW / 18.07dBm	69.82mW / 18.84dBm
	2Mb	58.61mW / 17.68dBm	63.24mW / 18.01dBm	68.71mW / 19.37dBm
Conducted Output Power Limit		1 Watt / 30dBm	1 Watt / 30dBm	1 Watt / 30dBm
E.I.R.P.	1Mb	59.98mW / 17.78dBm	64.12mW / 18.07dBm	69.82mW / 18.44dBm
	2Mb	58.61mW / 17.68dBm	63.24mW / 18.01dBm	68.71mW / 18.37dBm
E.I.R.P. Limit		4 Watts / 36.02dBm	4 Watts / 36.02dBm	4 Watts / 36.02dBm
Peak Power Spectral Density	1Mb	4.29dBm	5.35dBm	5.38dBm
	2Mb	2.20dBm	2.15dBm	2.08dBm
Peak Power Spectral Density Limit		8 dBm	8 dBm	8 dBm
-6dB Occupied Bandwidth MHz	1Mb	0.745	0.758	0.677
	2Mb	1.290	1.241	1.225
99% Occupied Bandwidth MHz	1Mb	1.076	1.068	1.062
	2Mb	2.067	2.09	2.09
Occupied Bandwidth Limit		>500kHz	>500kHz	>500kHz
Voltage Variations	1Mb			
	Nominal	--	--	54.83mW / 17.39dBm
	-15%	--	--	54.7mW / 17.38dBm
	+15%	--	--	54.45mW / 17.36dBm
	2Mb			
	Nominal	--	--	47.21mW / 16.74dBm
	-15%	--	--	46.45mW / 16.67dBm
+15%	--	--	48.75mW / 16.88dBm	
Limit		1W / 30dBm	1W / 30dBm	1W / 30dBm



4 ENGINEERING STATEMENT

This report has been prepared on behalf of Chandler Systems Inc. to provide documentation for the testing described herein. This equipment has been tested and found to comply with Part 15.247 of the FCC Rules using ANSI C63.10 and KDB558074 standards. The test results found in this test report relate only to the items tested.



5 EUT INFORMATION AND DATA

5.1 Equipment Under Test:

Product: Legacy View Valve

Model: EVB-034

Serial No.: 000001

FCC ID: SWP-EVB-034

5.2 Trade Name:

Chandler Systems, Inc.

5.3 Power Supply:

Chandler Systems model 2001X125

5.4 Applicable Rules:

CFR 47, Part 15.247, subpart C

5.5 Equipment Category:

Radio Transmitter-DTS

5.6 Antenna:

Integral

5.7 Accessories:

N/A

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set to transmit a continuous modulated signal on the low-mid and high channels in the 2.4 GHz Bluetooth Band. GFSK modulation was used at 1Mb and 2Mb data rates. The highest emissions were recorded in the data tables.

**6 LIST OF MEASUREMENT INSTRUMENTATION**

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	2024-11-15
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2024-04-10
Horn Antenna	CL098	Emco	3115	9809-5580	2025-01-02
Pre-amplifier	CL153	Agilent	83006-69007	MY57280115	2024-11-14
Pre-amplifier	CL284	A.H. Systems, Inc.	PAM-1001	131	2024-04-12
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2024-04-10
Amplifier w/Monopole & 18" Loop	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	2024-12-14
Software:	Tile Version 1.0		Software Verified: 2023-11-29 to 2024-02-13		
Software:	EMC 32, Version 8.53.0		Software Verified: 2023-11-29 to 2024-02-13		
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	2024-09-26
Antenna, Horn	CL114	A. H. Systems, Inc.	SAS-572	237	2026-01-09
Spectrum Analyzer	0141	Hewlett Packard	8591E	3520A04145	2024-04-11
Transient Limiter	0202	Hewlett Packard	11947A	3107A00729	2024-04-11
LISN	CL184	Com-Power	LI-125A	191213	2026-11-02
LISN	CL185	Com-Power	LI-125A	191214	2026-11-02
Temp/Hum. Recorder	CL294	Thermpro	TP50	2	2026-04-27



7 OCCUPIED BANDWIDTH

7.1 Requirements:

The 6dB bandwidth shall be greater than 500 kHz.

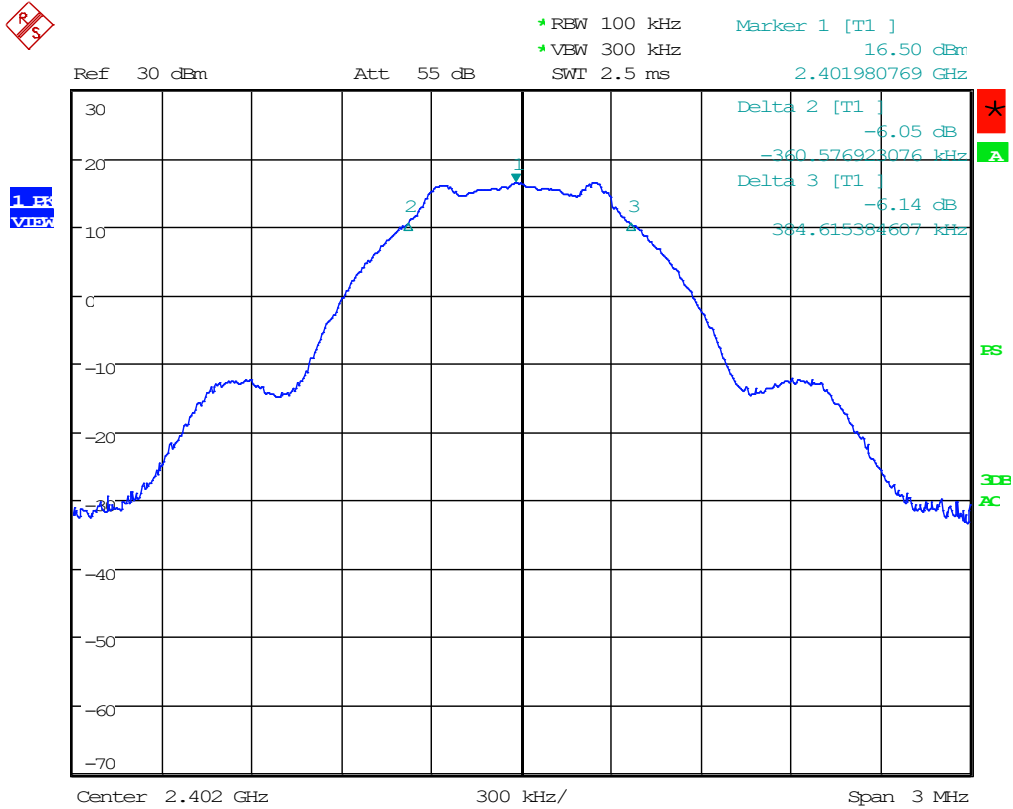
Bandwidth measurements were made at the low (2.402 GHz), mid (2.440 GHz) and upper (2.480 GHz) frequencies with the resolution Bandwidth set at 100 kHz (video bandwidth set at 300 kHz) while the span was set at 3MHz. The 6dB bandwidth was measured using the marker delta method. The 99% bandwidth was measured with the analyzer's measurement function.



7.2 Occupied Bandwidth Test Data

Test Date:	2023-12-04	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(a)(2); KDB558074	Air Temperature:	20.2°C
		Relative Humidity:	38%

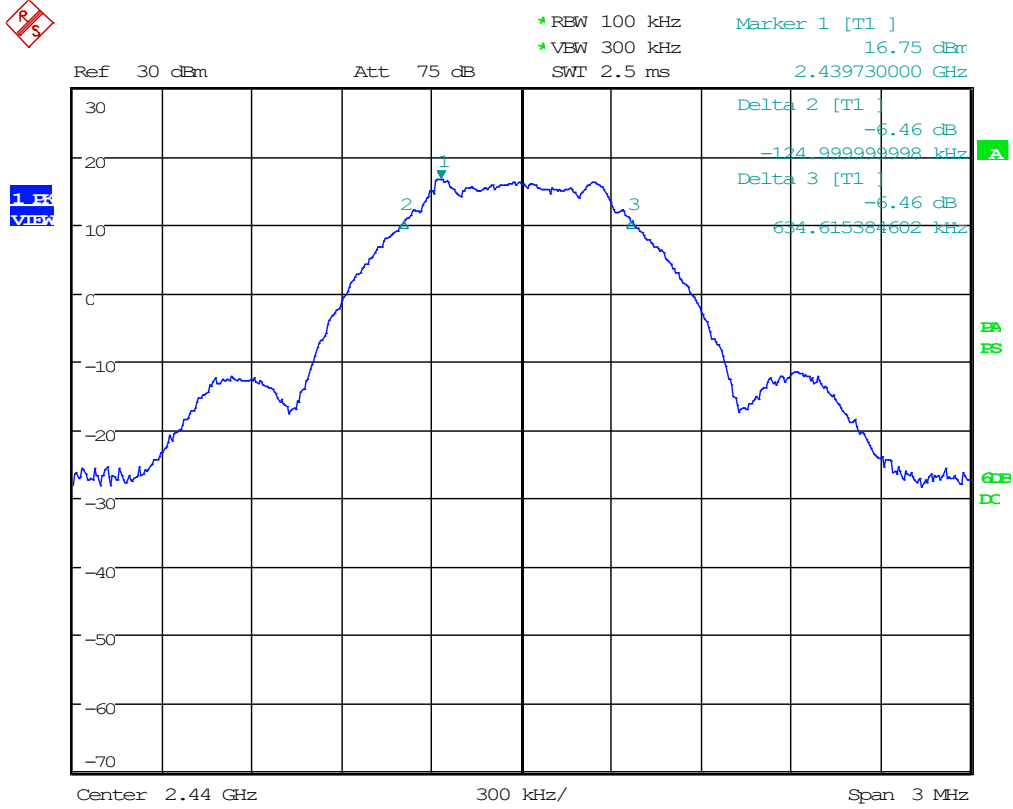
Mb1, -6dB OBW: Low Channel



Date: 8.DEC.2023 14:53:31



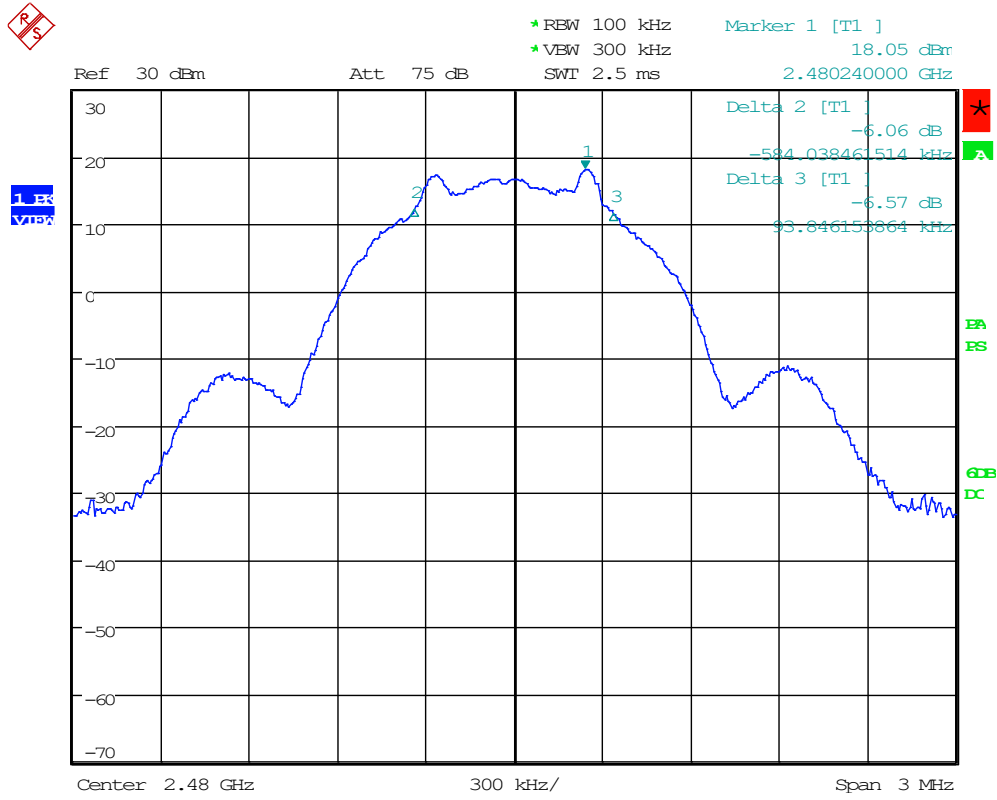
Mb1, -6dB OBW: Mid Channel



Date: 4.DEC.2023 09:31:16



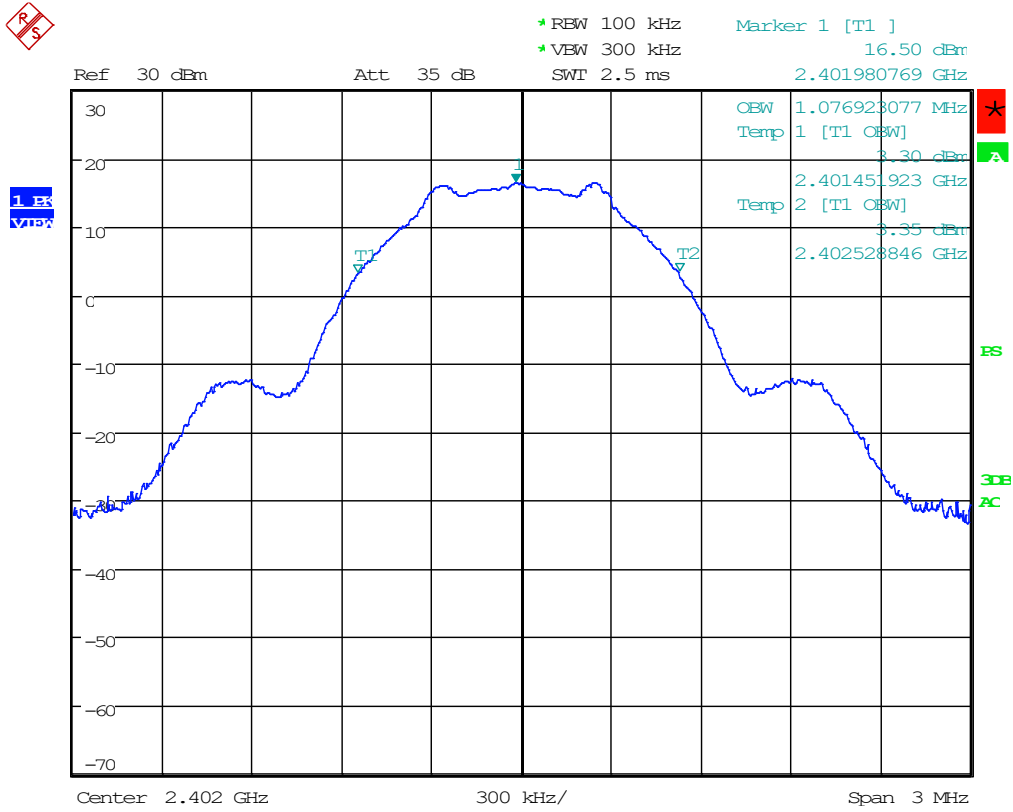
Mb1, -6dB OBW: High Channel



Date: 4.DEC.2023 09:34:28



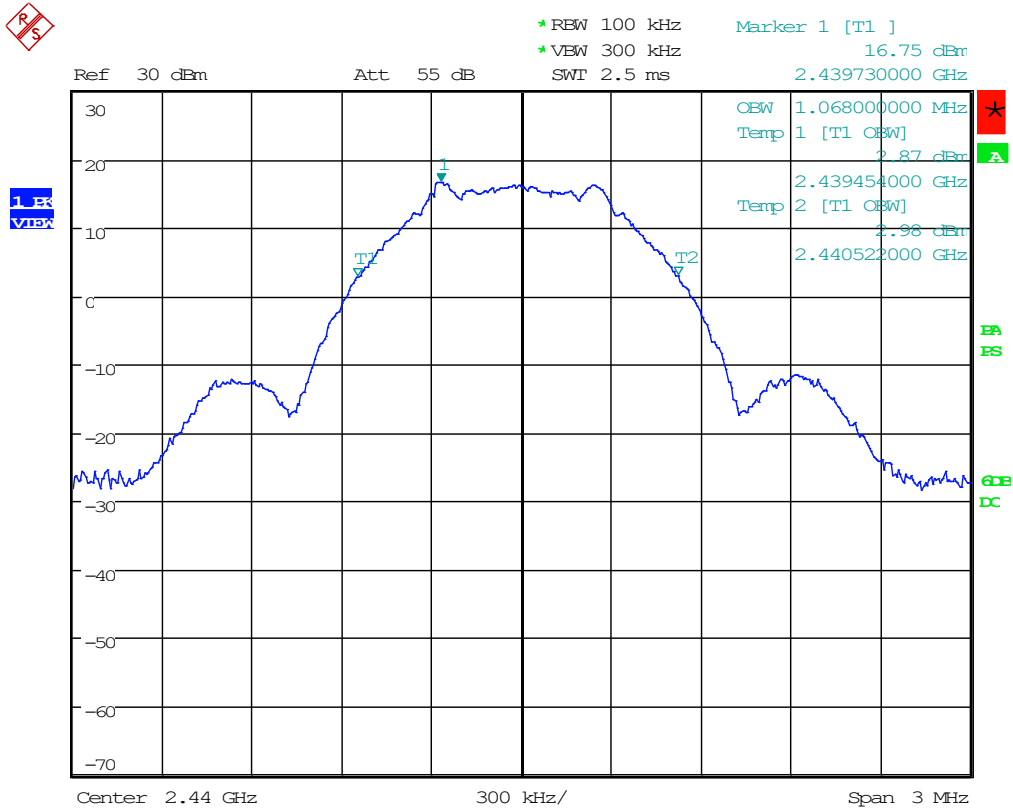
Mb1, 99% OBW: Low Channel



Date: 8.DEC.2023 14:52:44



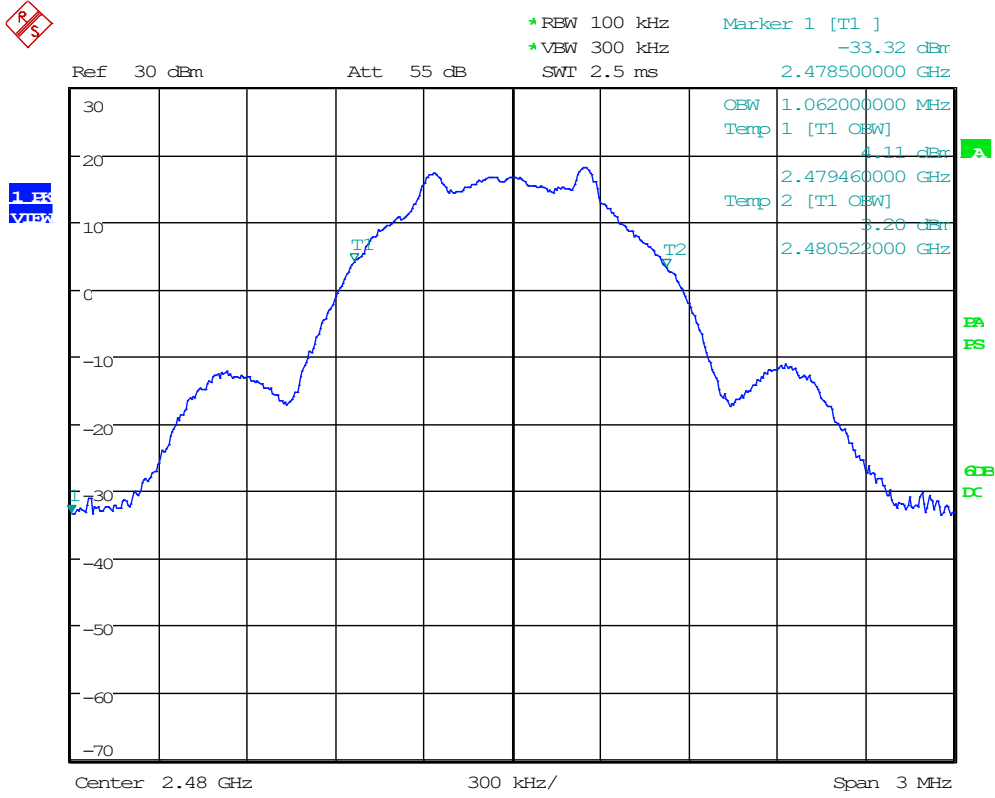
Mb1, 99% OBW: Mid Channel



Date: 4.DEC.2023 09:32:16



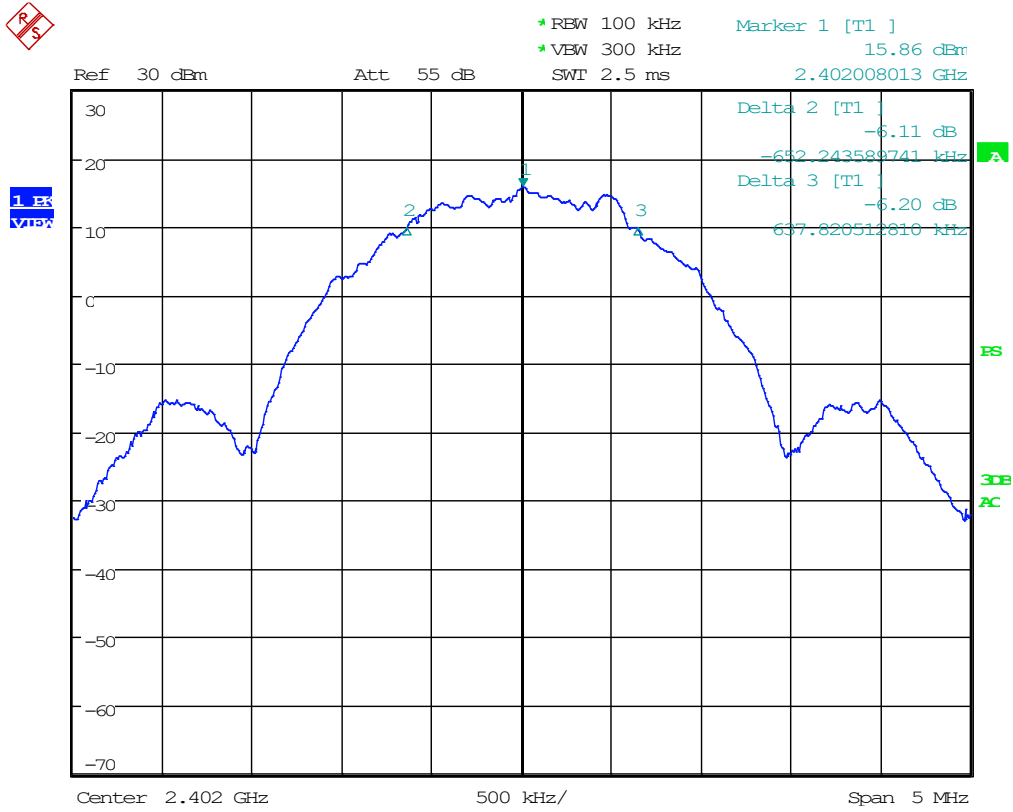
Mb1, 99% OBW: High Channel



Date: 4.DEC.2023 09:33:48



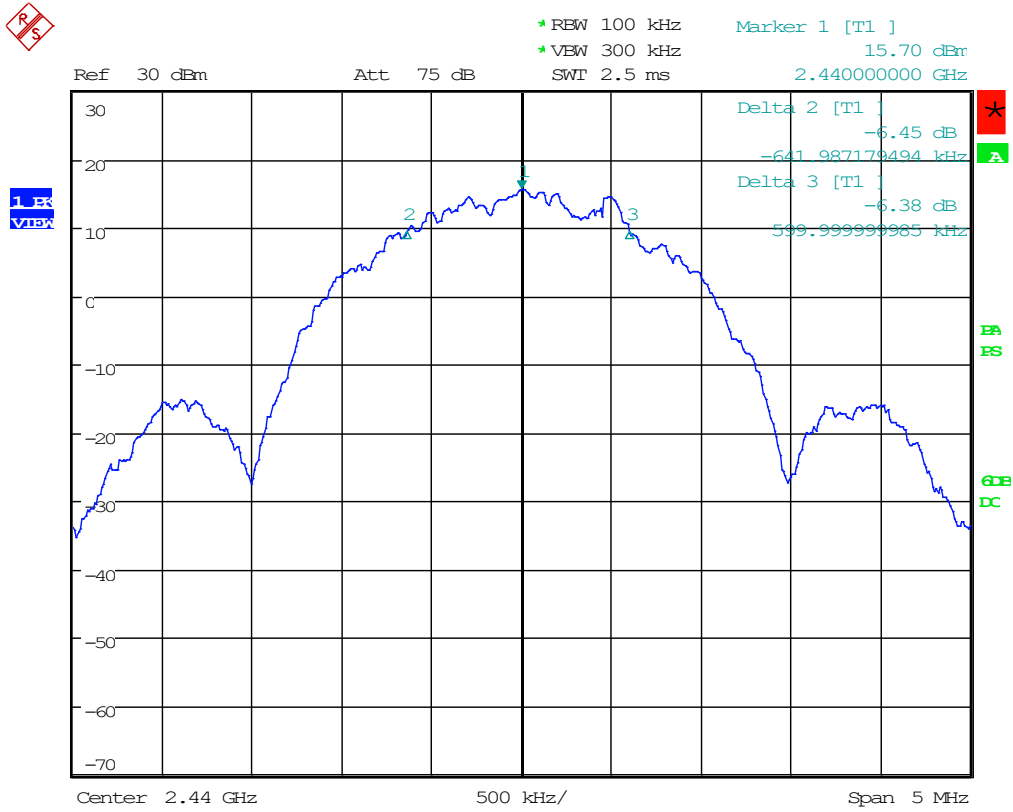
Mb2, -6dB OBW: Low Channel



Date: 8.DEC.2023 14:55:39



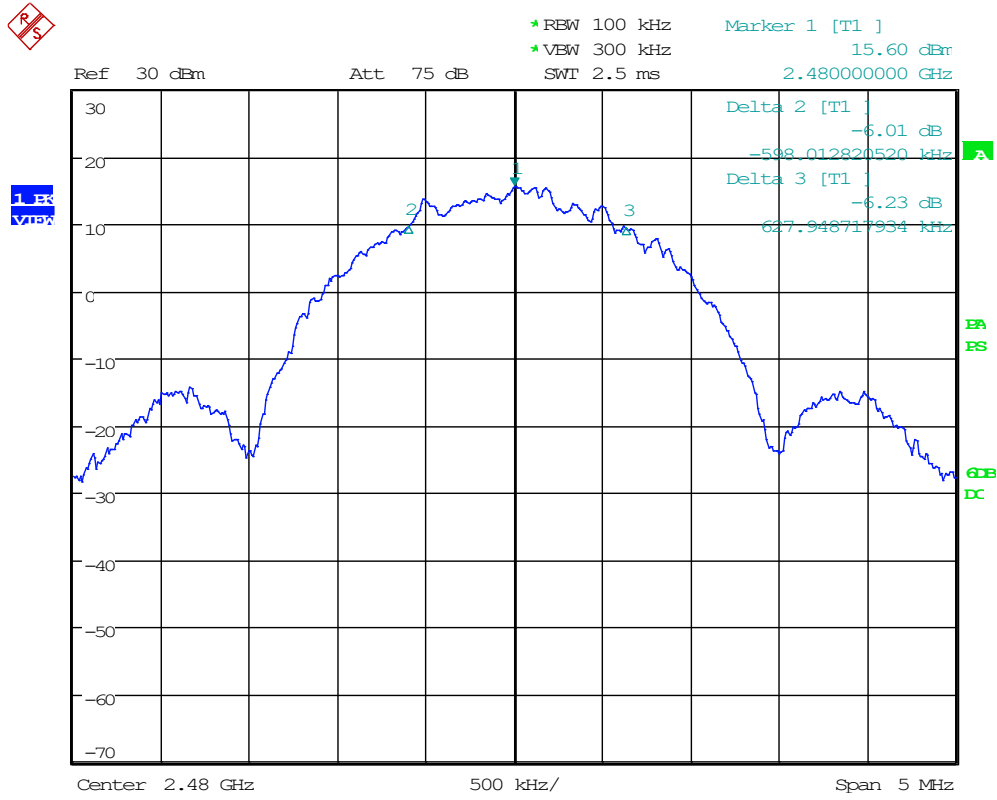
Mb2, -6dB OBW: Mid Channel



Date: 4.DEC.2023 09:40:17



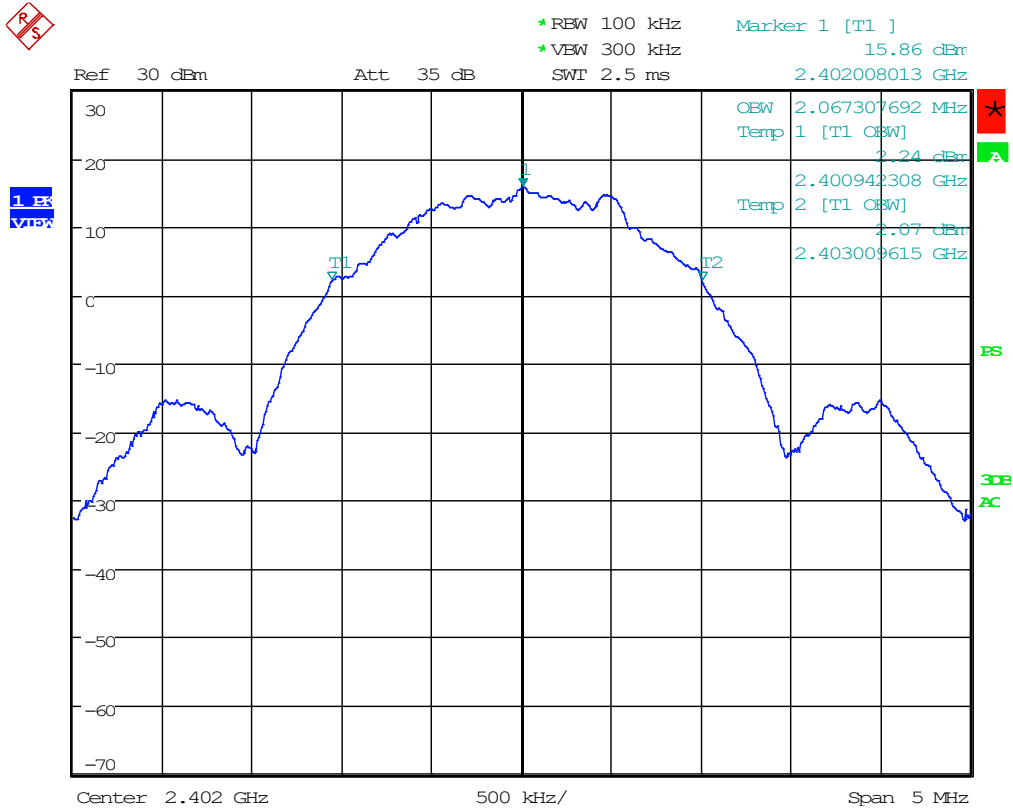
Mb2, -6dB OBW: High Channel



Date: 4.DEC.2023 09:36:58



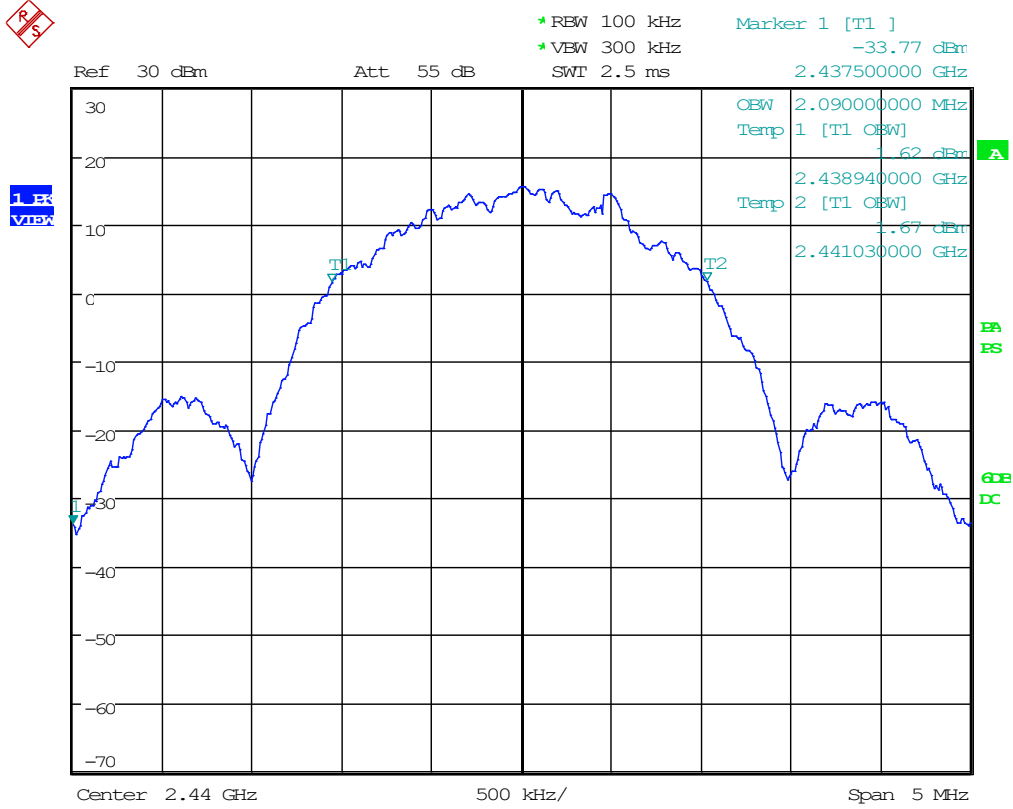
Mb2, 99% OBW: Low Channel



Date: 8.DEC.2023 14:56:43



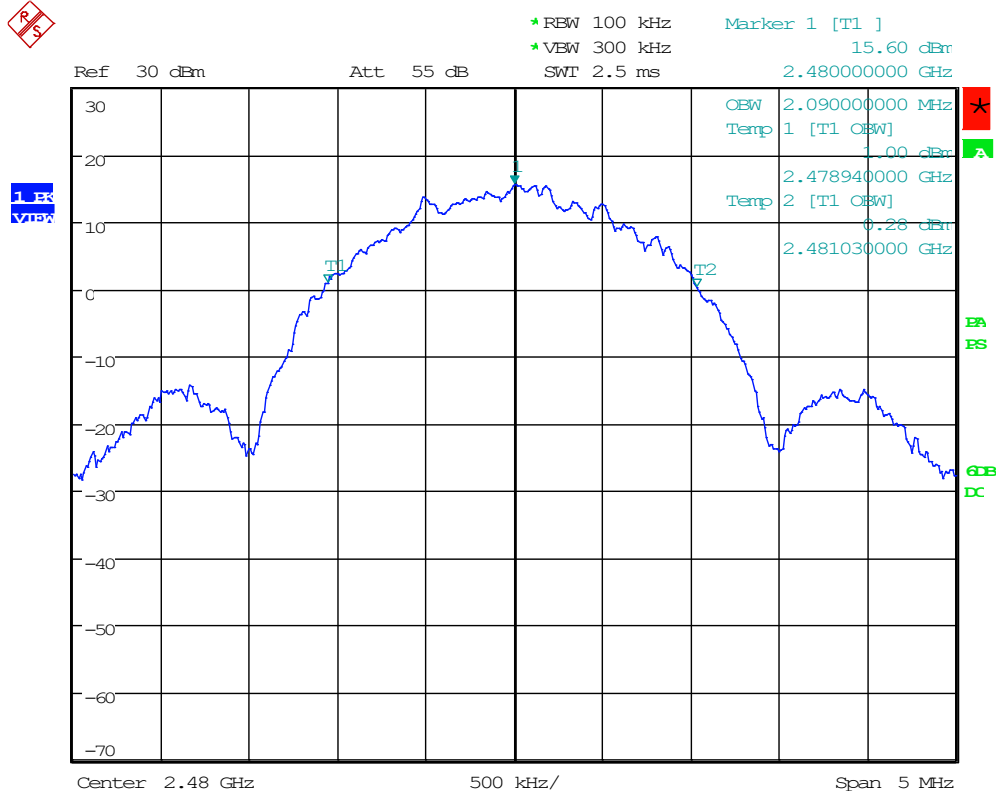
Mb2, 99% OBW: Mid Channel



Date: 4.DEC.2023 09:39:21



Mb2, 99% OBW: High Channel



Date: 4.DEC.2023 09:38:17



8 CONDUCTED OUTPUT POWER

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the receiver. The peak power output was measured.

8.1 Requirements:

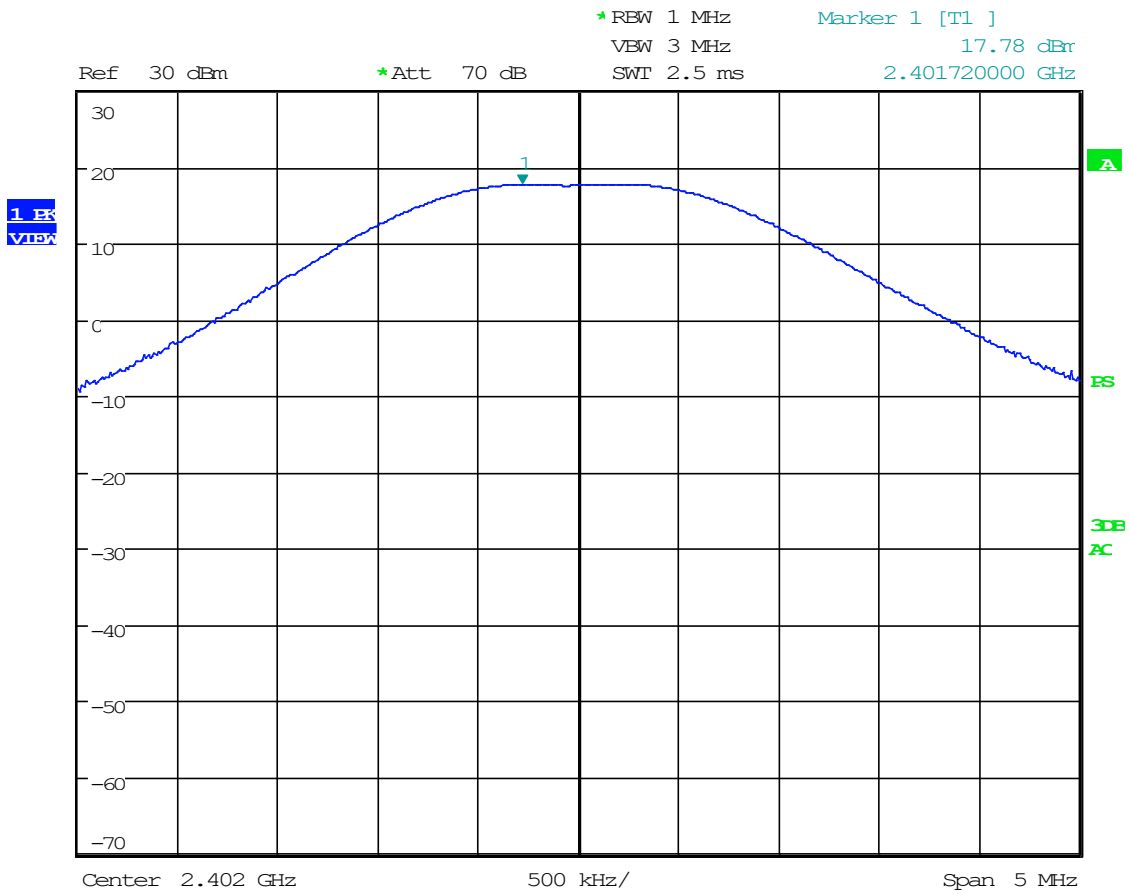
The peak power output shall be 1 watt (30 dBm) or less when using an antenna with a gain of less than 6dBi. For antennas having a gain of more than 6dBi, the limit is reduced by 1dB for every dB the antenna gain is over 6dBi.



8.2 Conducted Output Power Test Data

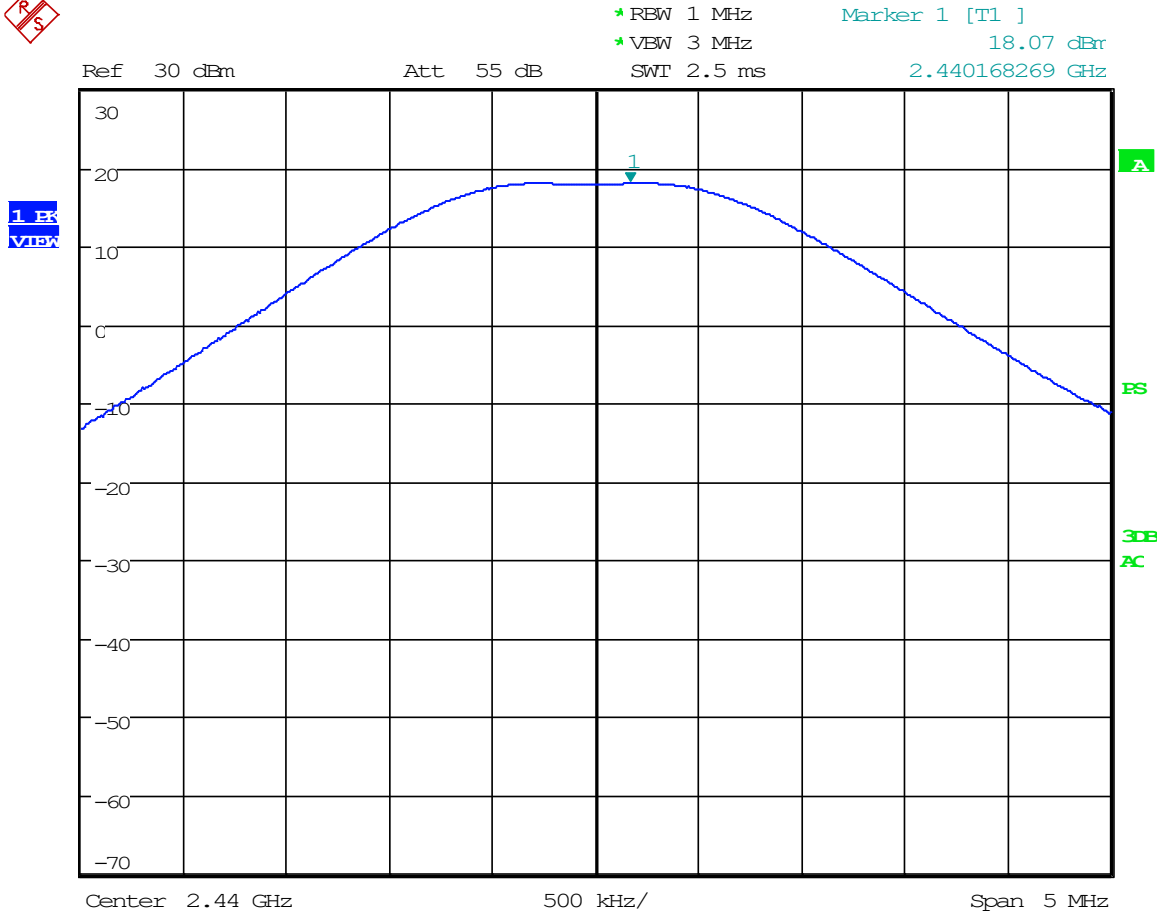
Test Date:	2023-12-04	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(b)(3); KDB558074	Air Temperature:	20.5°C
		Relative Humidity:	38%

1Mb: Low Channel





1Mb: Mid Channel



Date: 4.DEC.2023 10:26:54

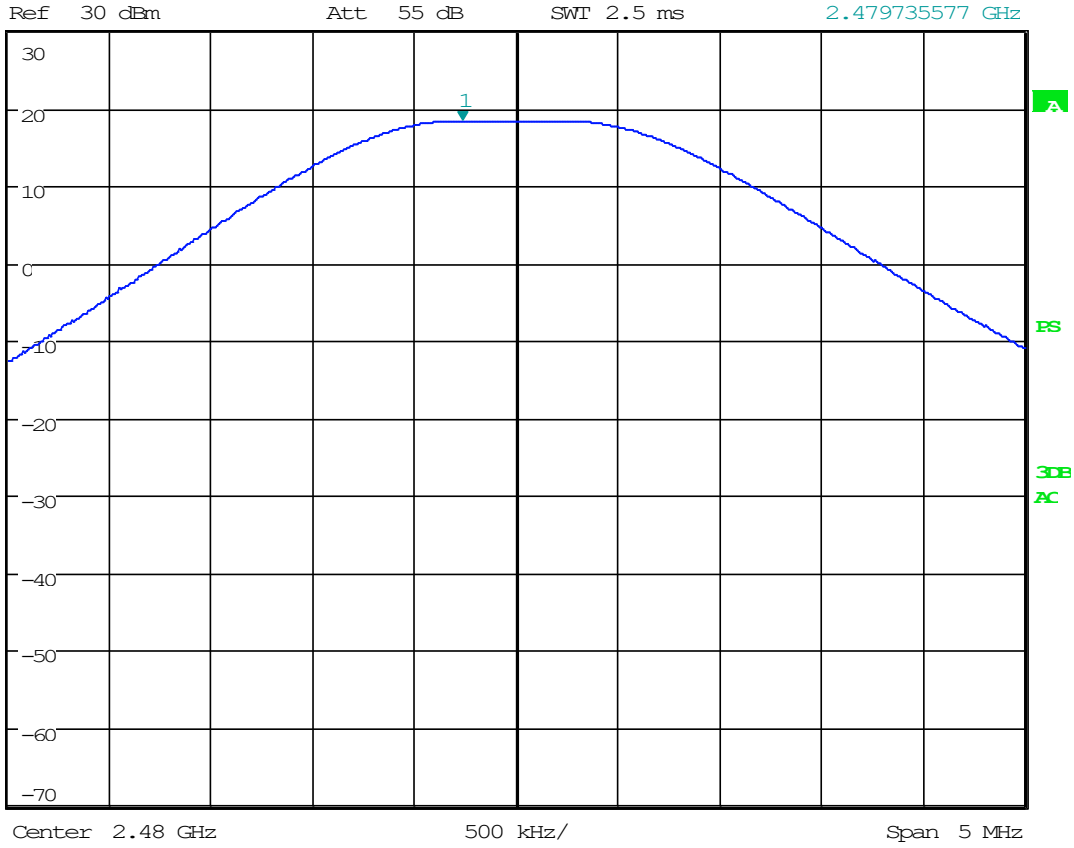


1Mb: High Channel



1.8k
VITW

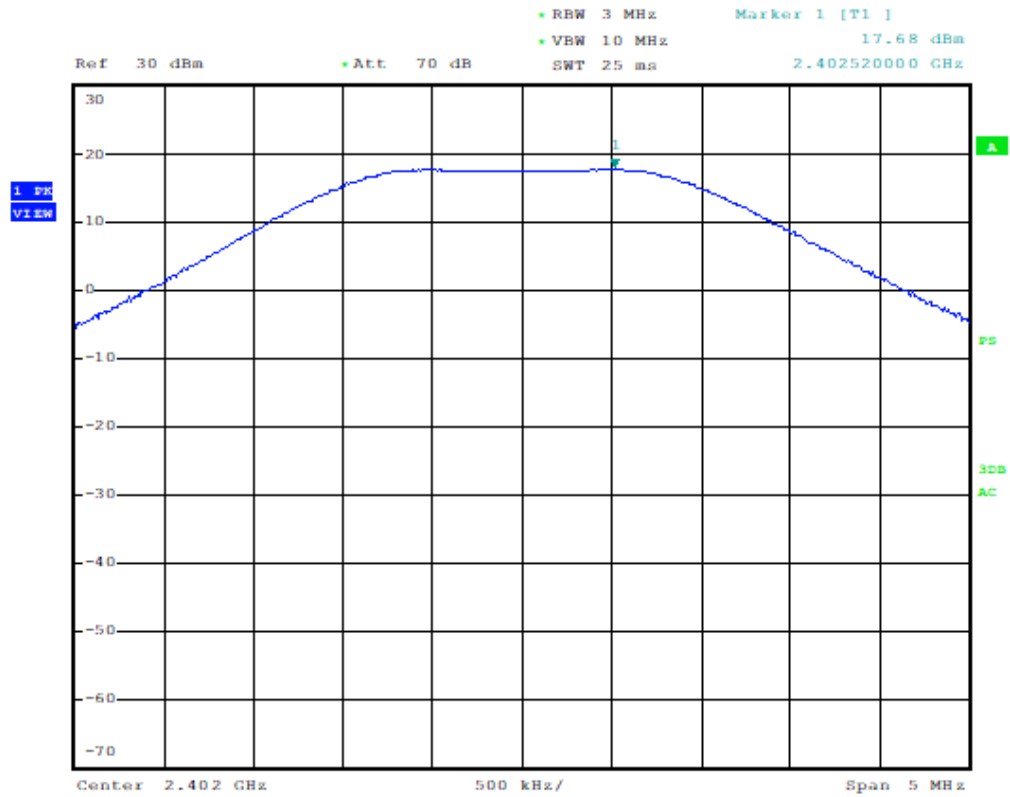
*RBW 1 MHz
*VBW 3 MHz
SWI 2.5 ms
Marker 1 [T1]
18.44 dBc
2.479735577 GHz



Date: 4.DEC.2023 10:27:54



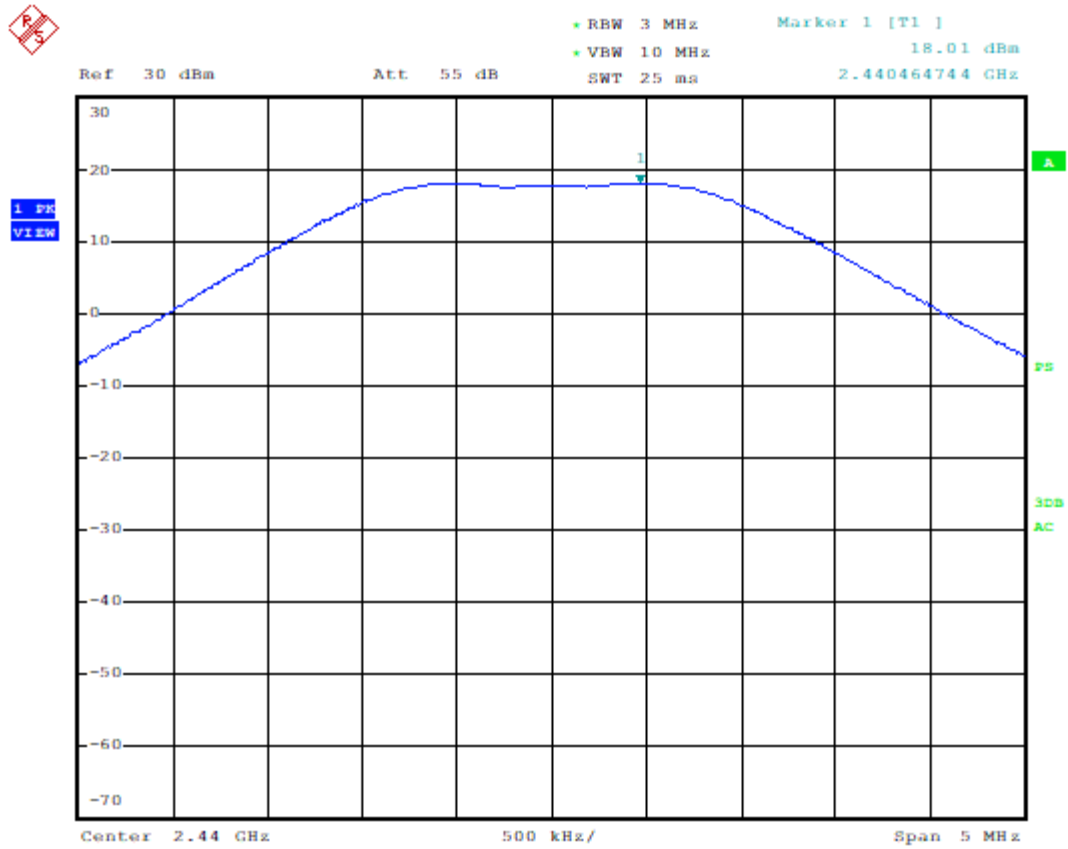
2Mb: Low Channel



Date: 8.DEC.2023 12:25:45



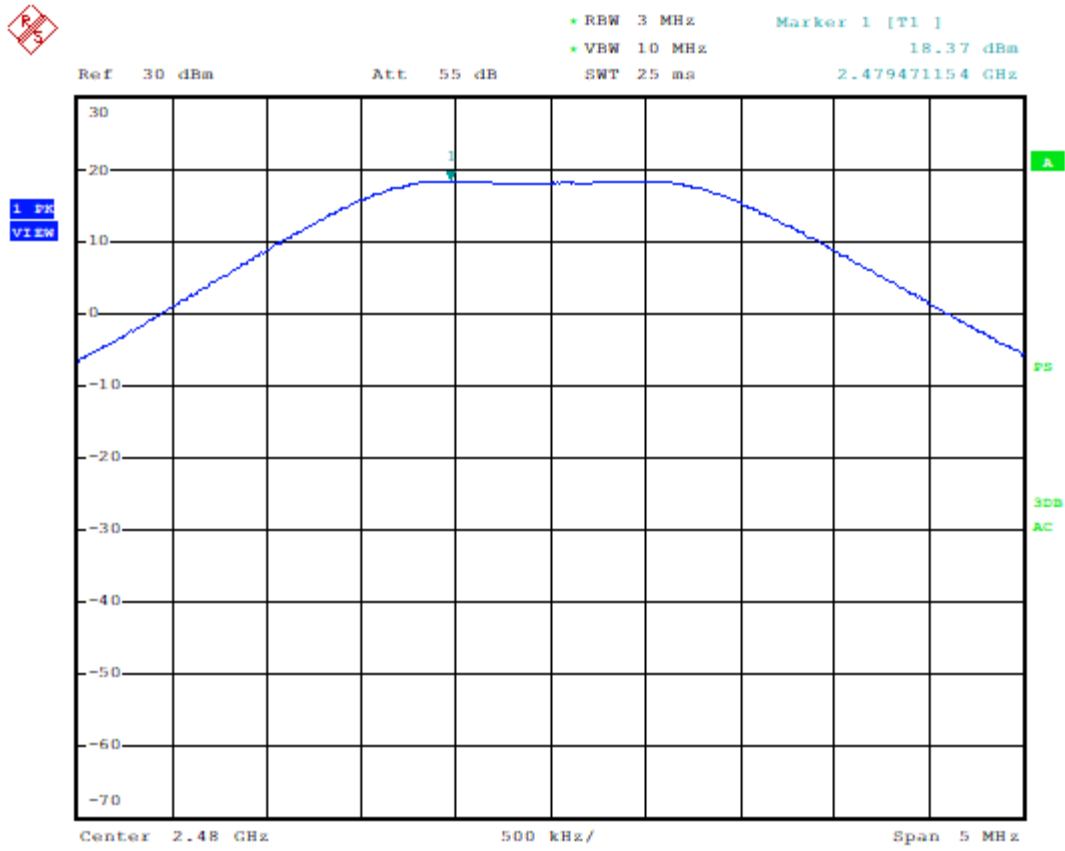
2Mb: Mid Channel



Date: 4.DEC.2023 10:29:24



2Mb: High Channel



Date: 4.DEC.2023 10:30:10



9 VOLTAGE VARIATIONS

9.1 Requirements

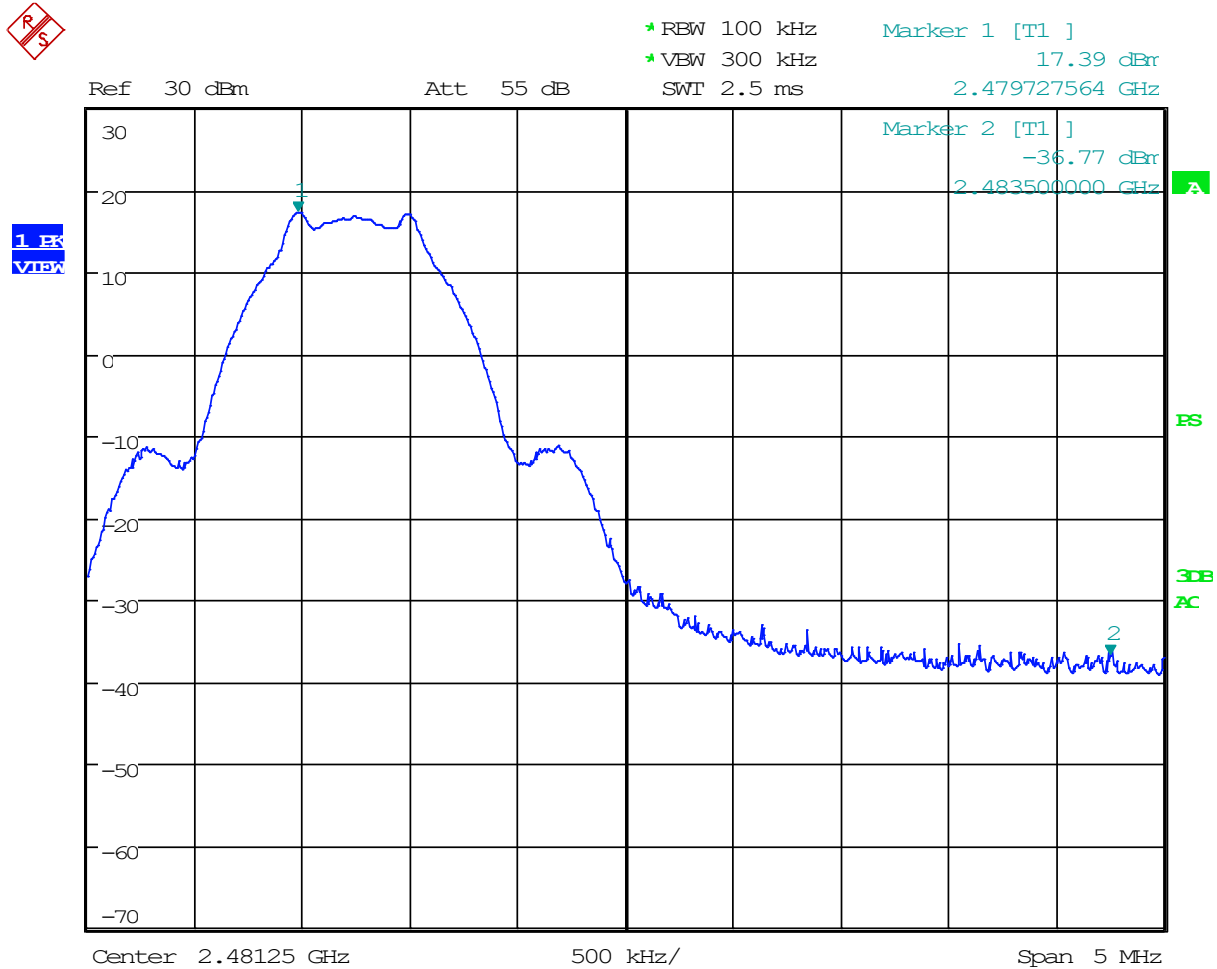
For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery-operated equipment, the equipment tests shall be performed using a new battery.



9.2 Voltage Variations Test Data

Test Date(s):	2023-12-04	Test Engineer:	J. Chiller
Rule:	15.31(e)	Air Temperature:	22.2° C
Test Results:	Complies	Relative Humidity:	36%

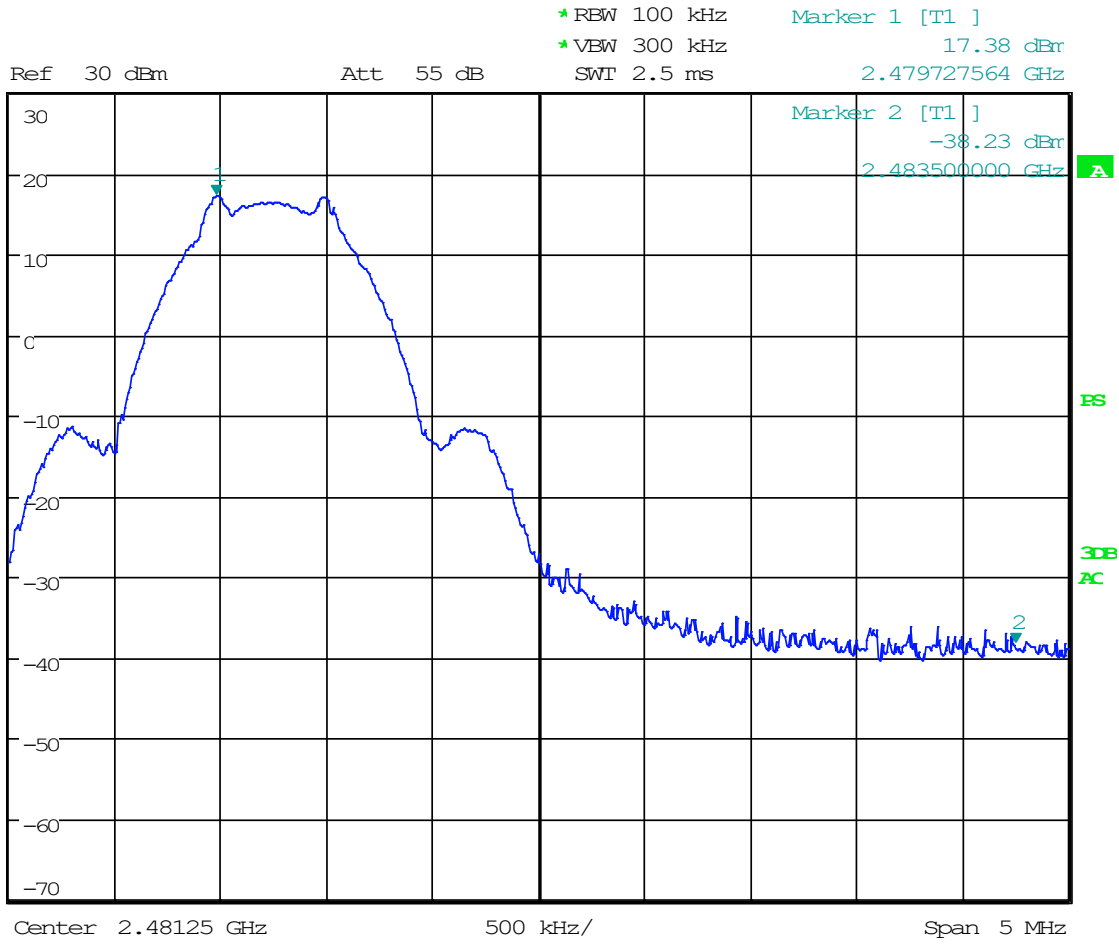
1Mb, High Channel: Nominal



Date: 4.DEC.2023 11:08:46



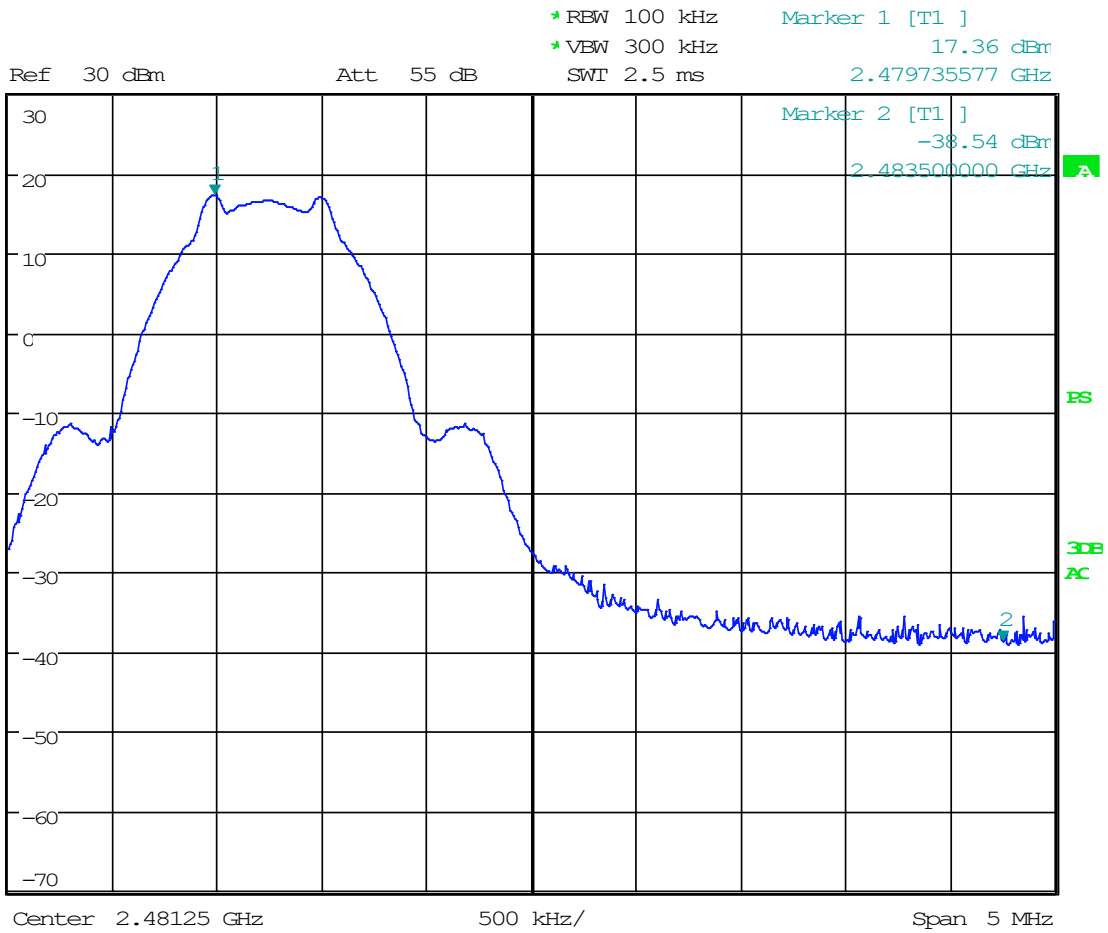
1Mb, High Channel: -15%



Date: 4.DEC.2023 11:09:03



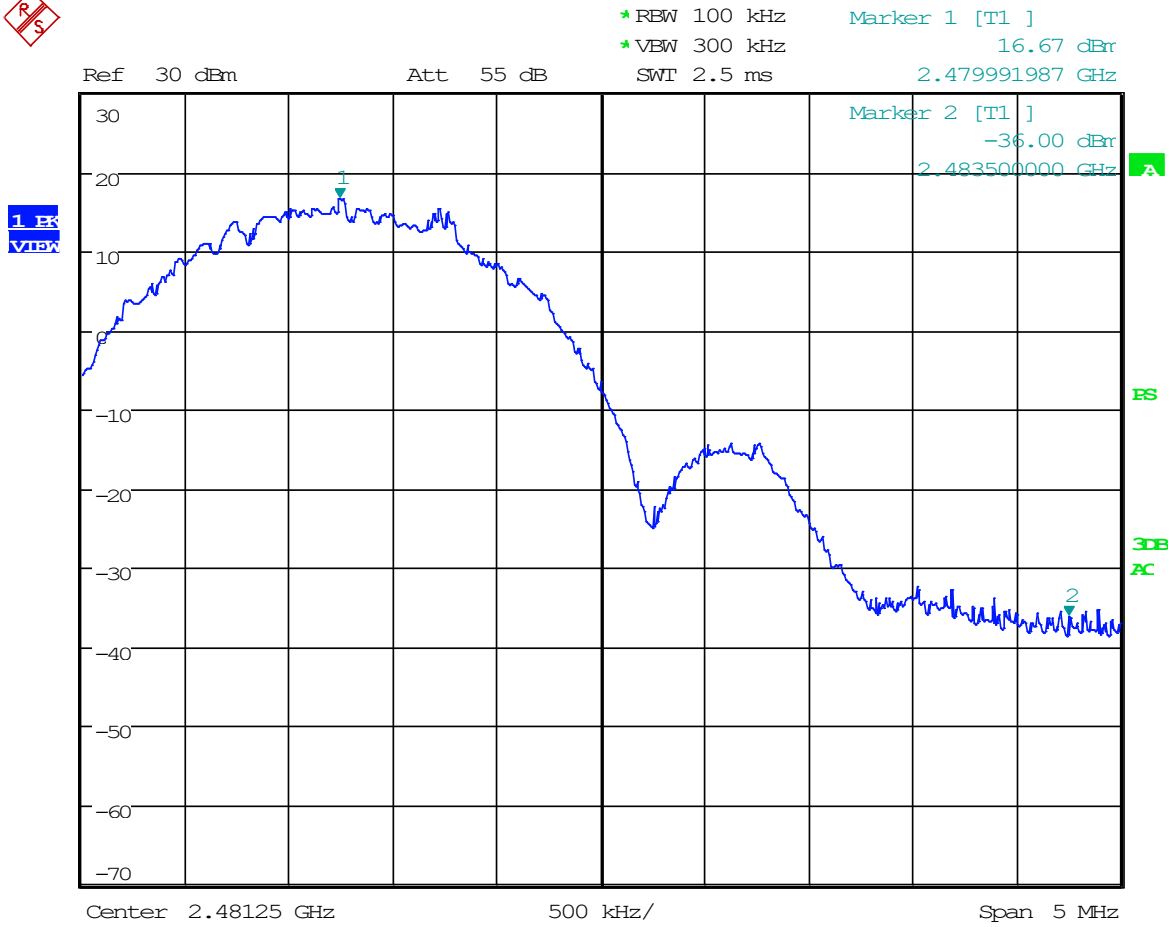
1Mb, High Channel: +15%



Date: 4.DEC.2023 11:09:36



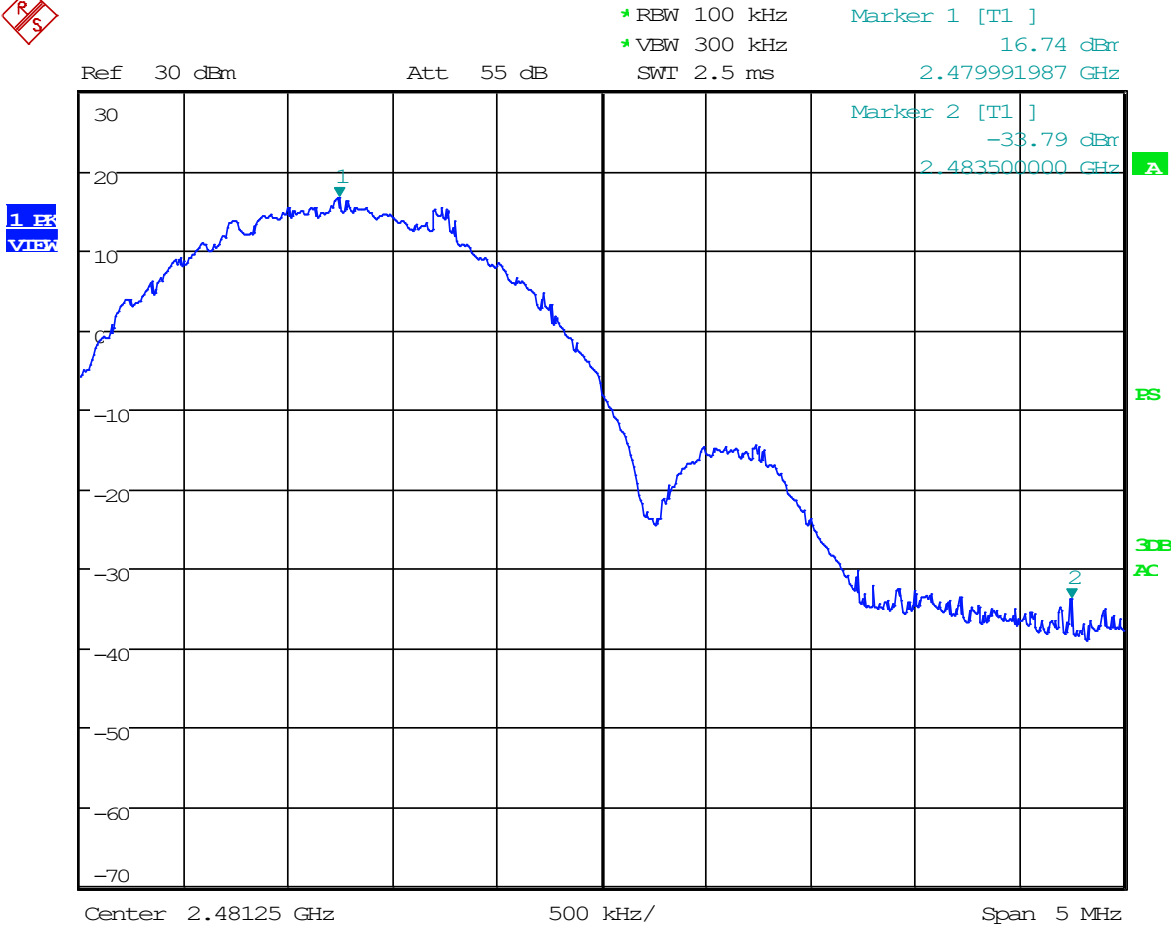
2Mb, High Channel: Nominal



Date: 4.DEC.2023 11:11:25



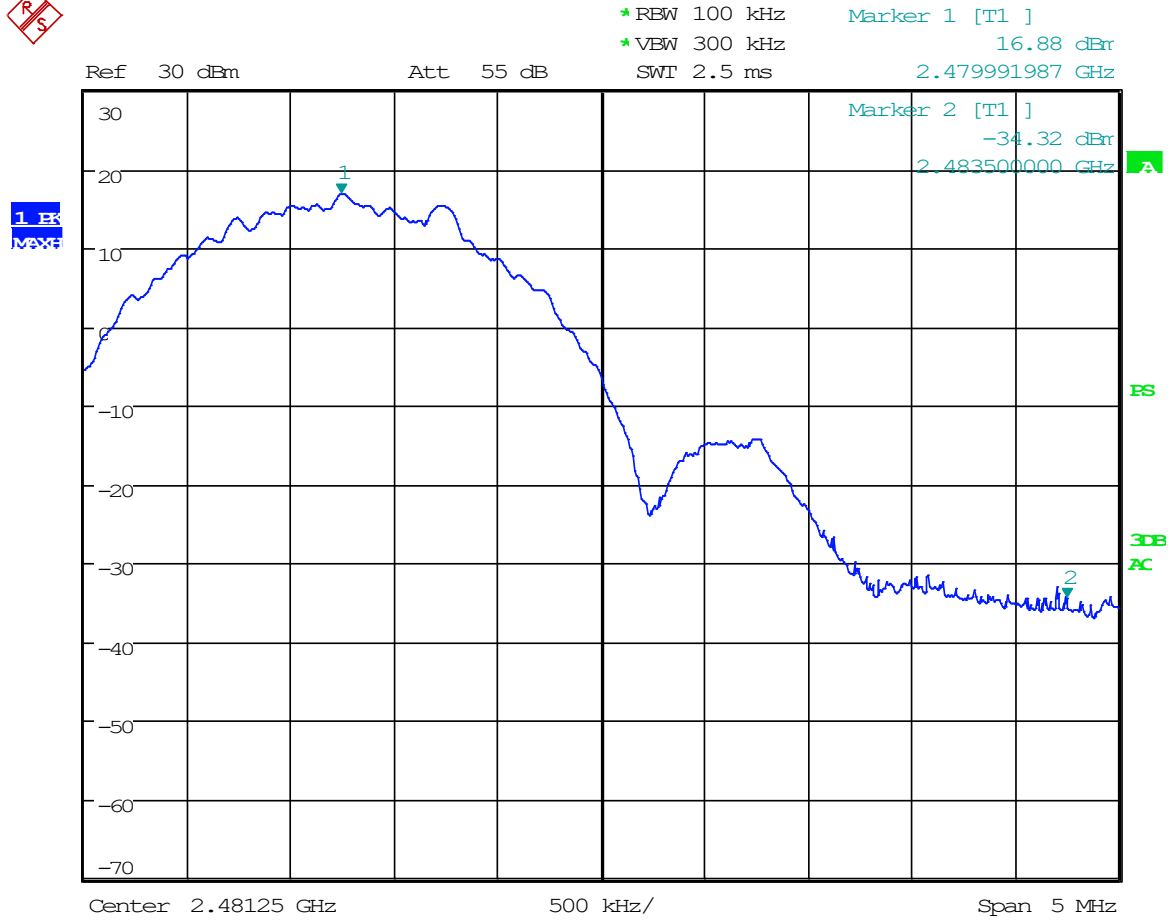
2Mb, High Channel: -15%



Date: 4.DEC.2023 11:11:43



2Mb, High Channel: +15%



Date: 4.DEC.2023 11:11:03



10 CONDUCTED SPURIOUS EMISSIONS

The following tests were performed to demonstrate compliance.

RF Antenna Conducted Test

The EUT antenna port was fitted with an SMA connector and directly connected to the input of the spectrum analyzer.

10.1 Requirements:

All Spurious Emissions must be at least 20dB down from the highest emission level measured within the authorized band up through the tenth harmonic.

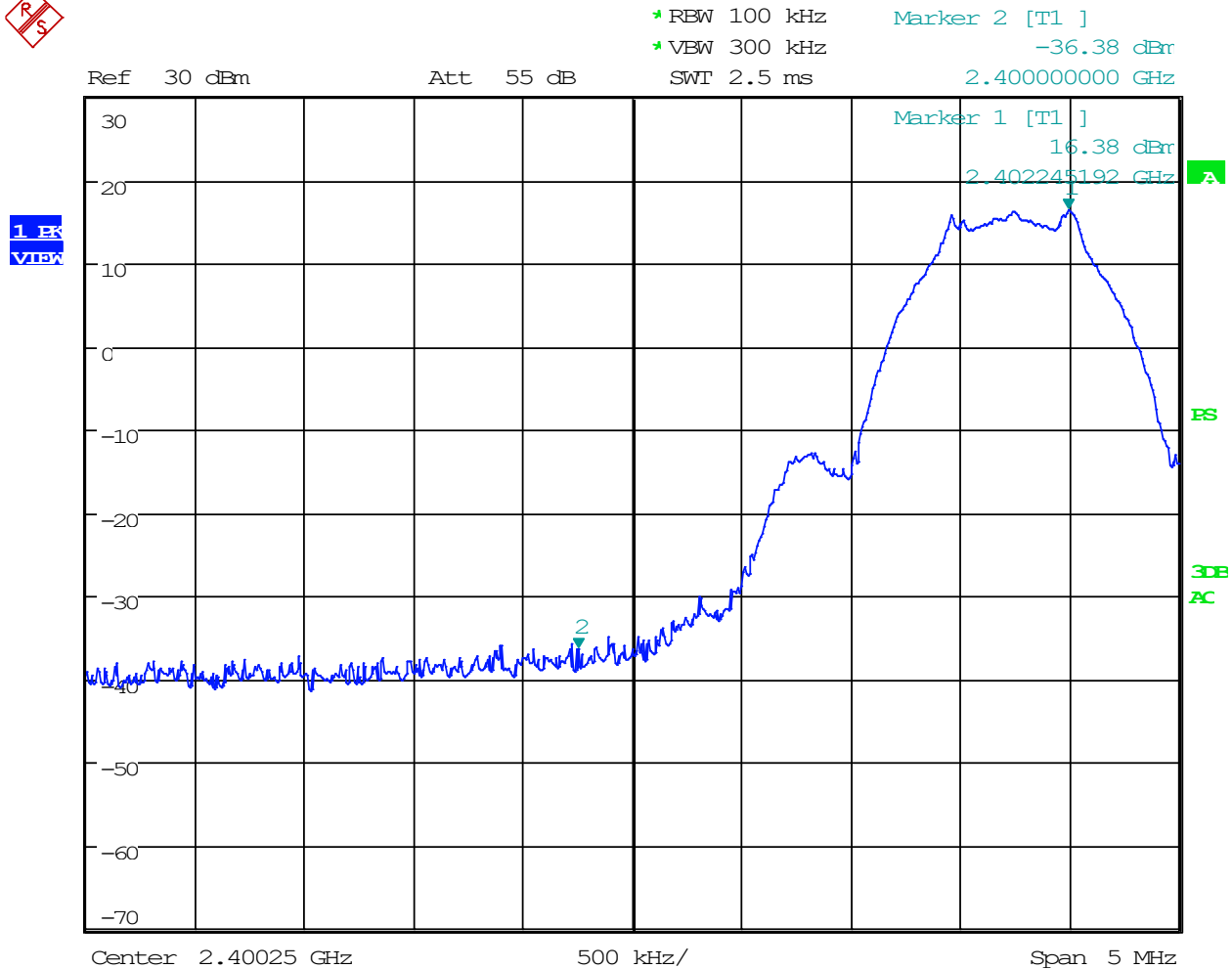
Spurious emissions measurements were made at the low, mid, and upper channels with the appropriate spectrum analyzer impulse bandwidth. Additionally, 20dB down points were measured for the low and high channels to verify band edge compliance.



10.2 Conducted Spurious Emissions Test Data

Test Date:	2023-12-04	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(d) / Part 15.207 KDB558074	Air Temperature:	22.5°C
		Relative Humidity:	36%

1Mb: Lower Band Edge



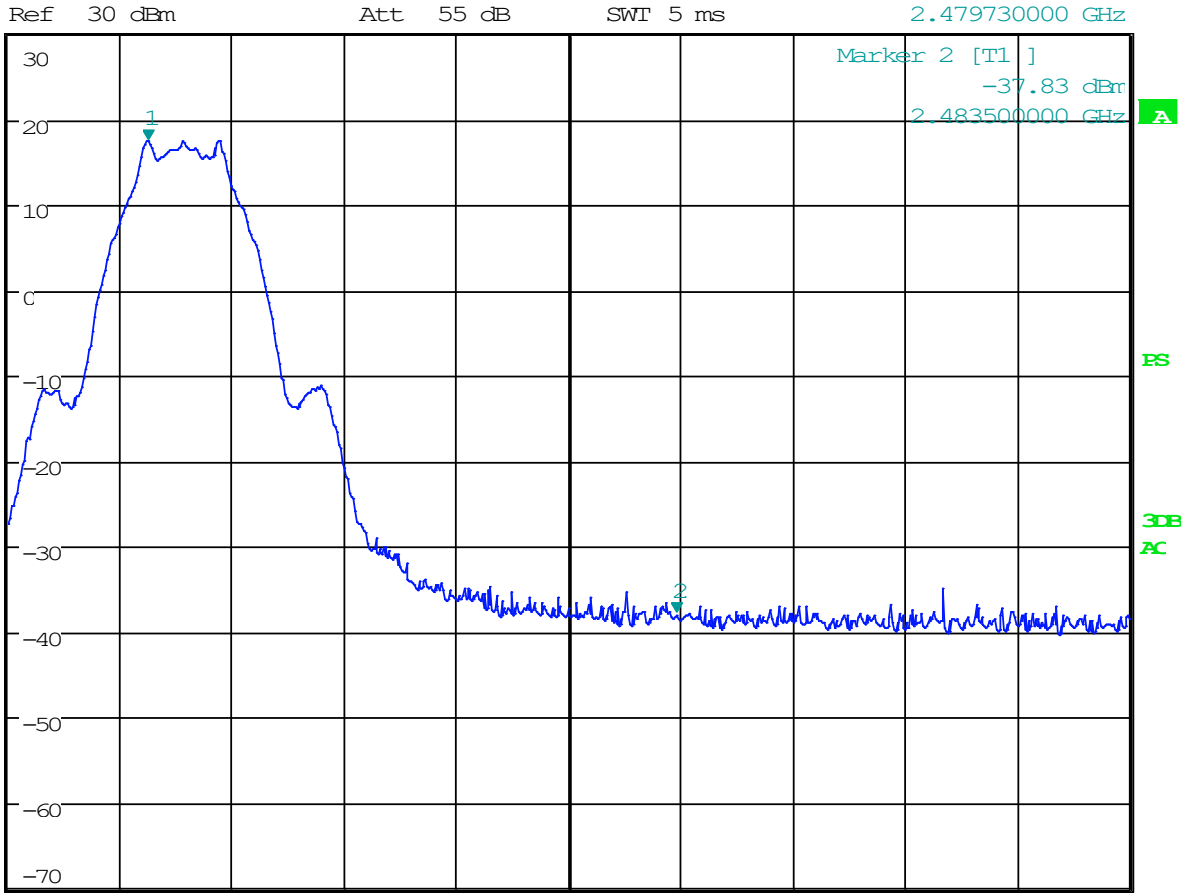
Date: 4.DEC.2023 13:27:29



1Mb: Upper Band Edge



REW 100 kHz Marker 1 [T1]
VEW 300 kHz 17.50 dBm
SWI 5 ms 2.479730000 GHz



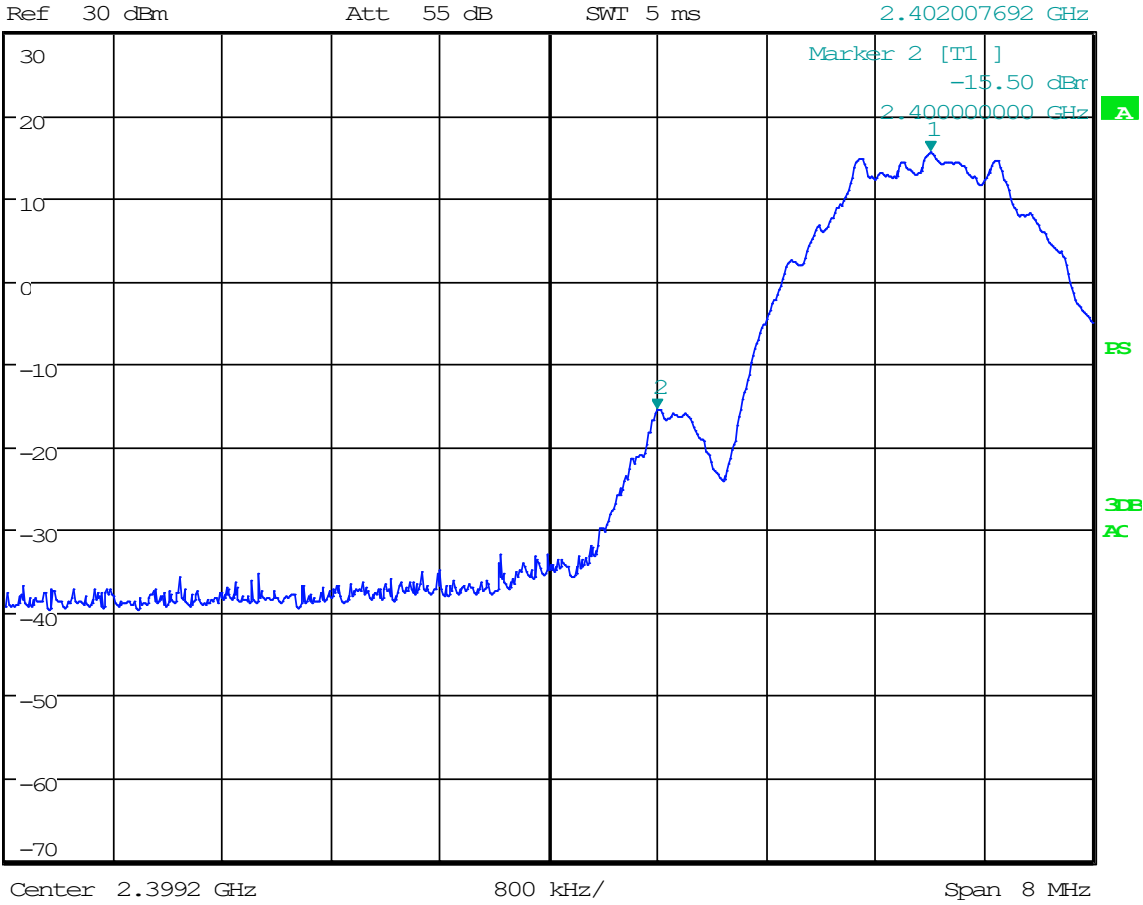
Date: 4.DEC.2023 13:30:01



2Mb: Lower Band Edge



*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz 15.53 dBm
SWI 5 ms 2.402007692 GHz



Date: 4.DEC.2023 13:32:14

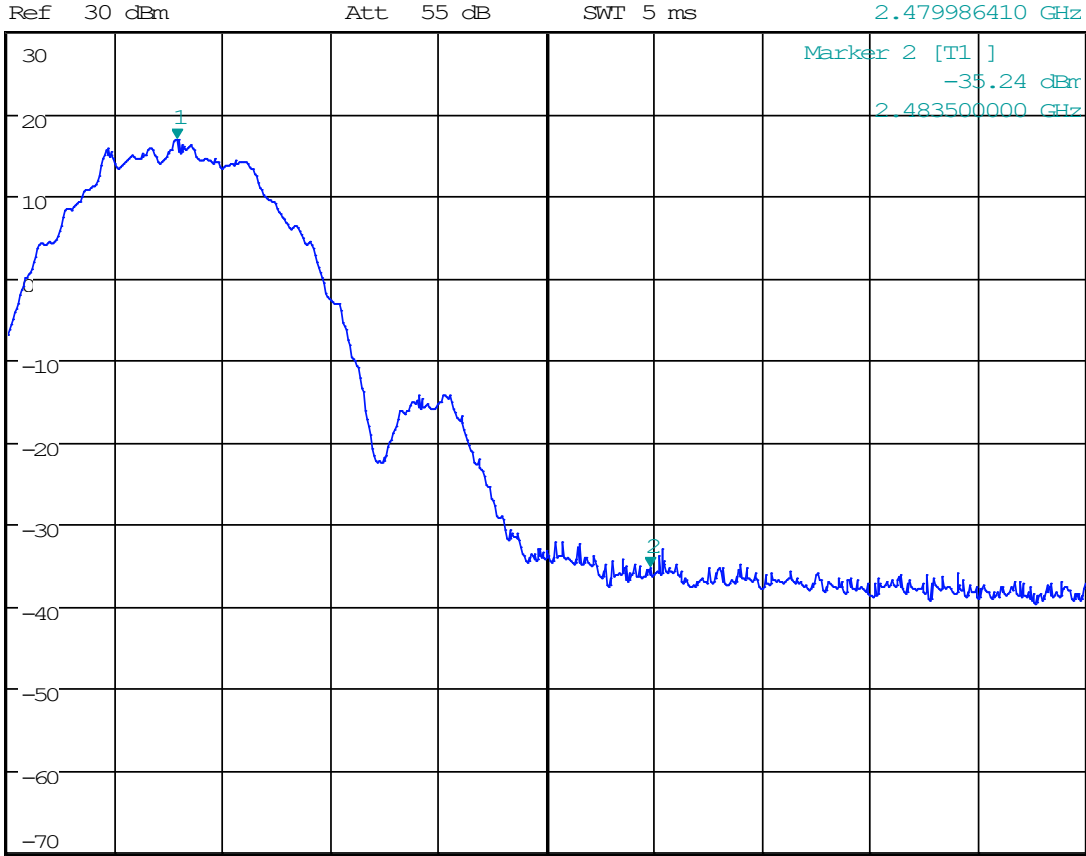


2Mb: Upper Band Edge



RBW 100 kHz
VBW 300 kHz
SWT 5 ms

Marker 1 [T1]
16.91 dBm
2.479986410 GHz



Center 2.48273 GHz 800 kHz/ Span 8 MHz

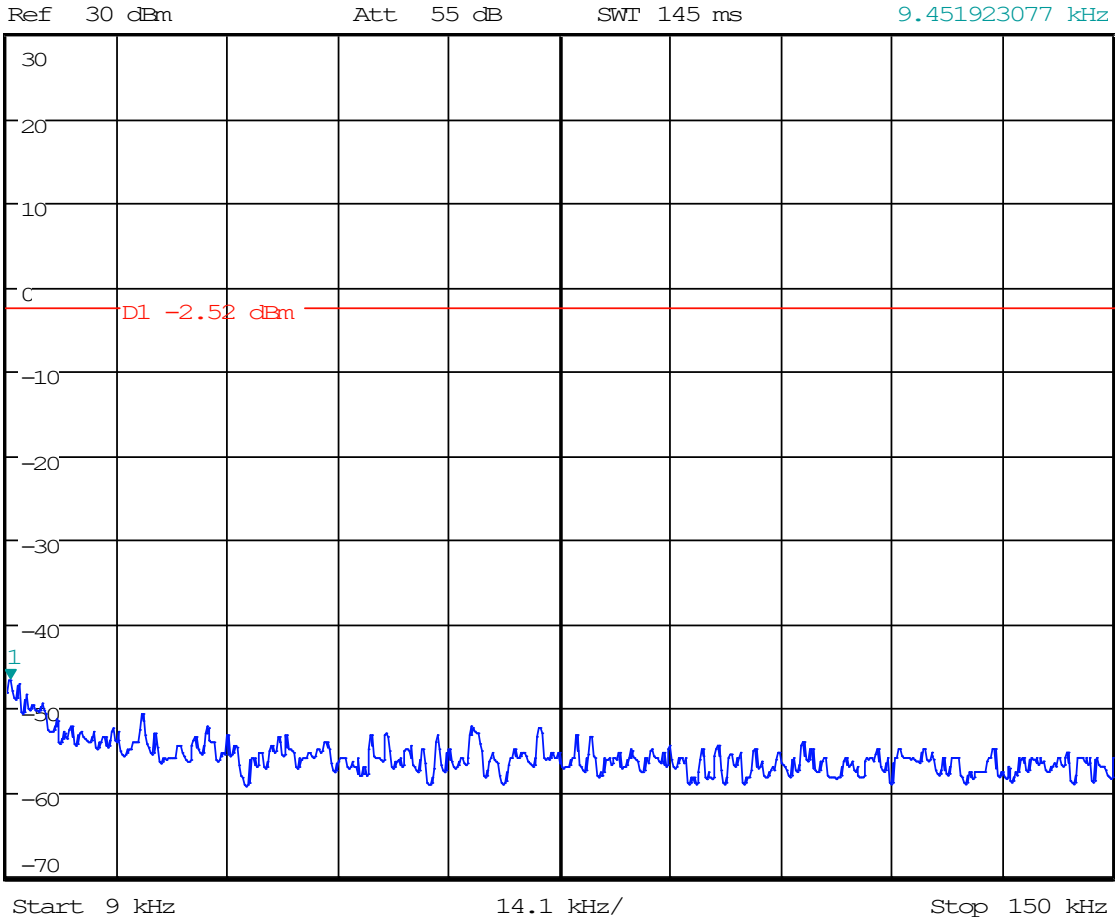
Date: 4.DEC.2023 13:31:07



1Mb: Low Channel, 0.009 MHz to 0.15 MHz



RBW 1 kHz Marker 1 [T1]
VBW 3 kHz -46.48 dB
SWI 145 ms 9.451923077 kHz



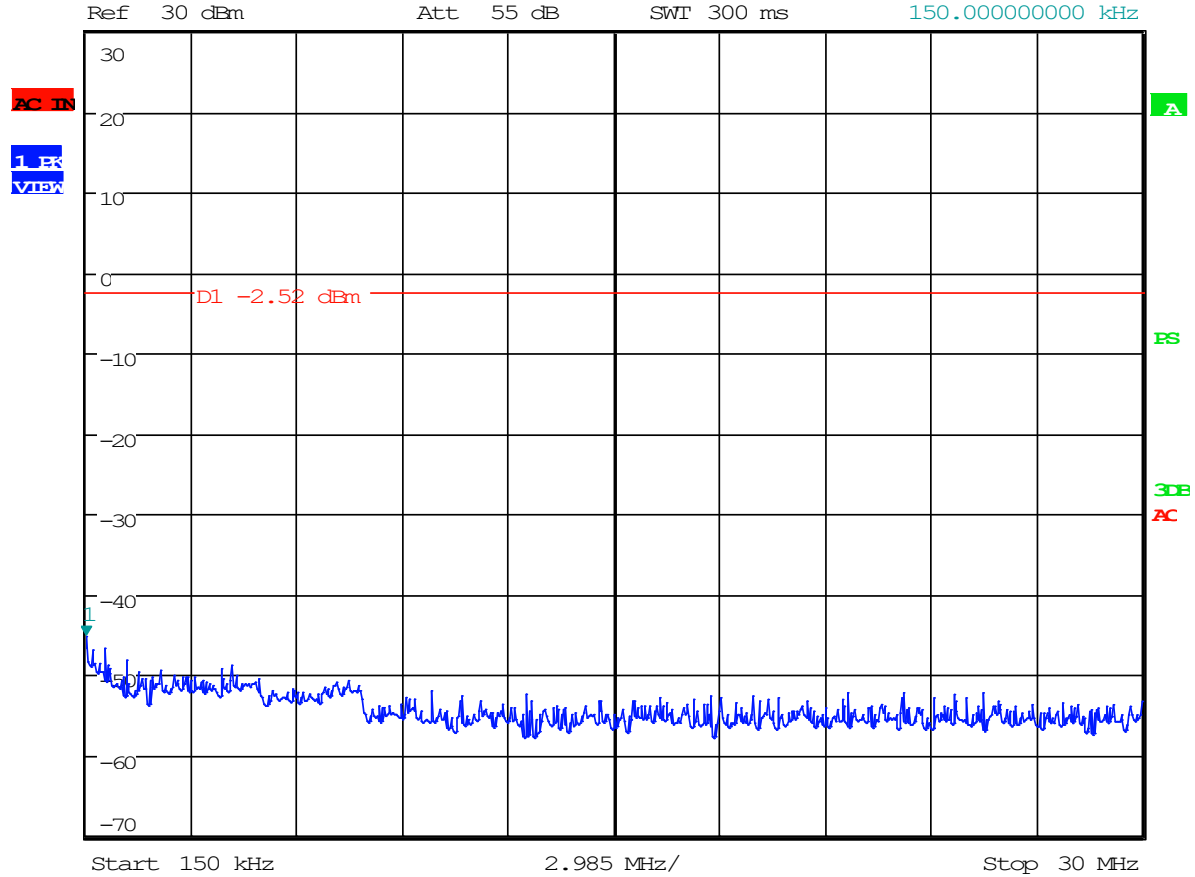
Date: 4.DEC.2023 13:24:17



1Mb: Low Channel, 0.15 MHz to 30 MHz



*RBW 10 kHz Marker 1 [T1]
*VBW 30 kHz -45.14 dBm
SWI 300 ms 150.00000000 kHz



Date: 4.DEC.2023 13:24:55

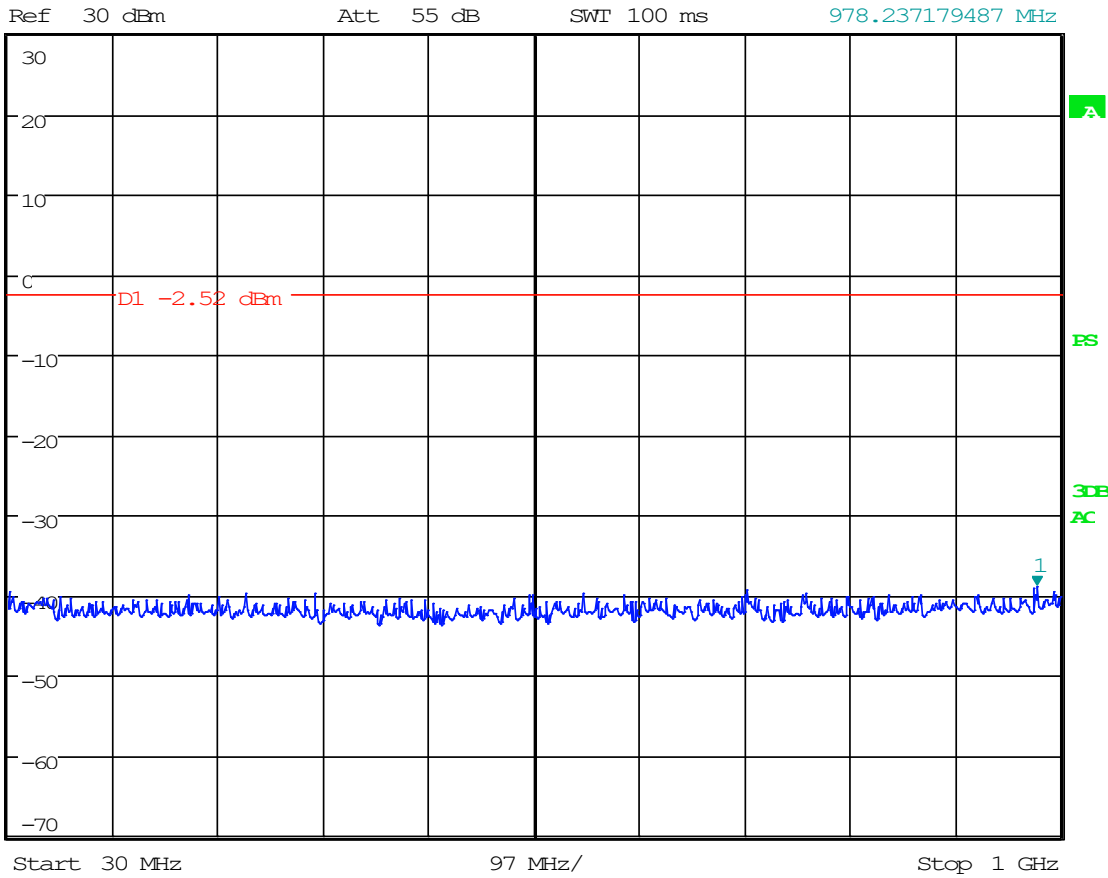


1Mb: Low Channel, 30 MHz to 1000 MHz



→ RBW 100 kHz Marker 1 [T1]
→ VBW 300 kHz -38.76 dBm
SWI 100 ms 978.237179487 MHz

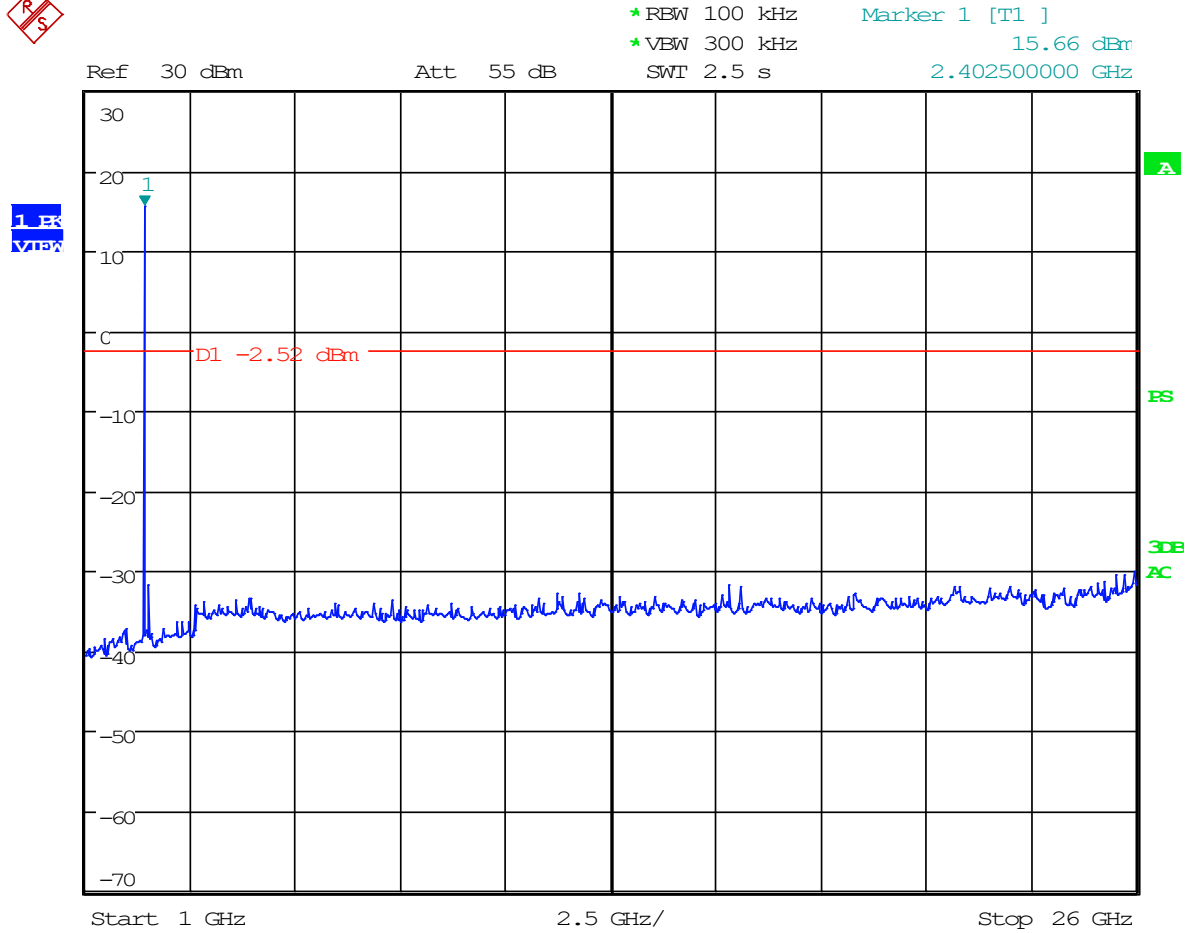
1 ER
VIEW



Date: 4.DEC.2023 13:25:24



1Mb: Low Channel, 1 GHz to 26 GHz



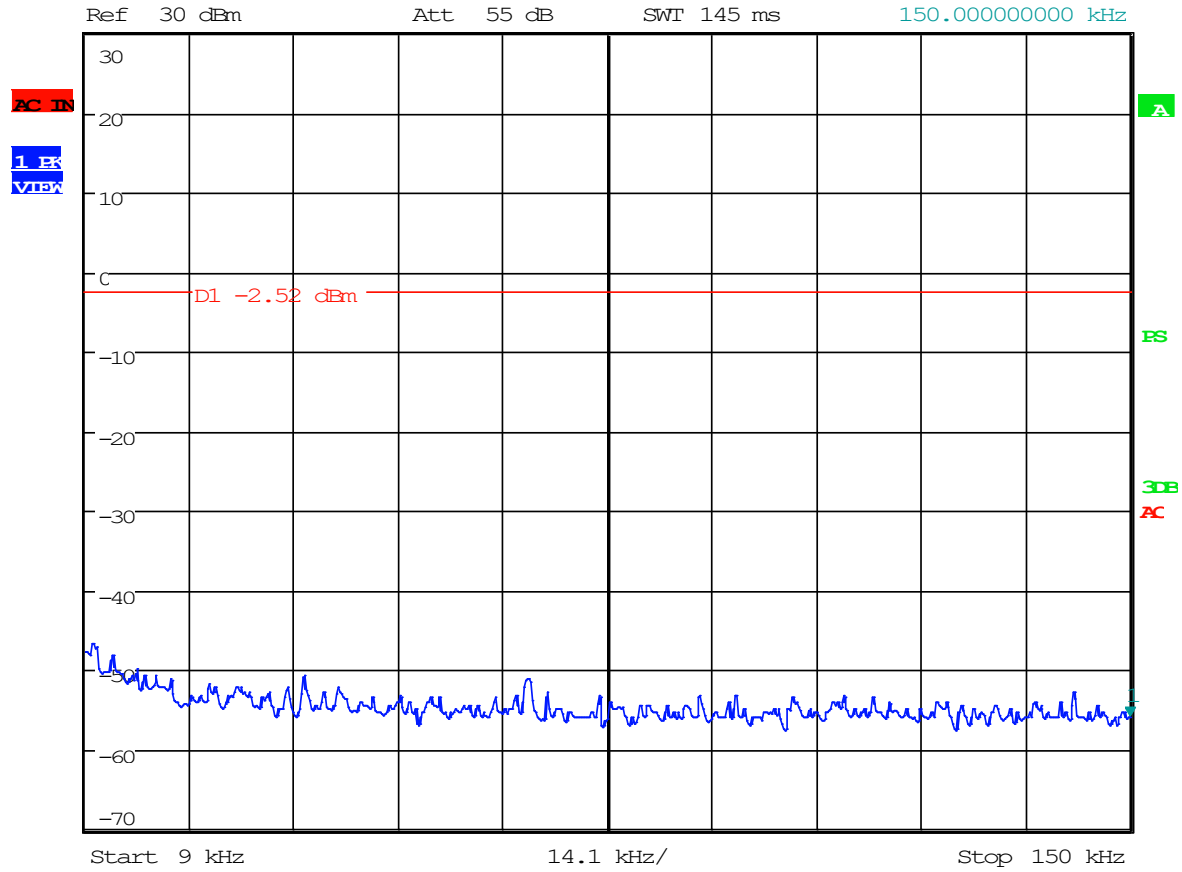
Date: 4.DEC.2023 13:26:22



1Mb: Mid Channel, 0.009 MHz to 0.15 MHz



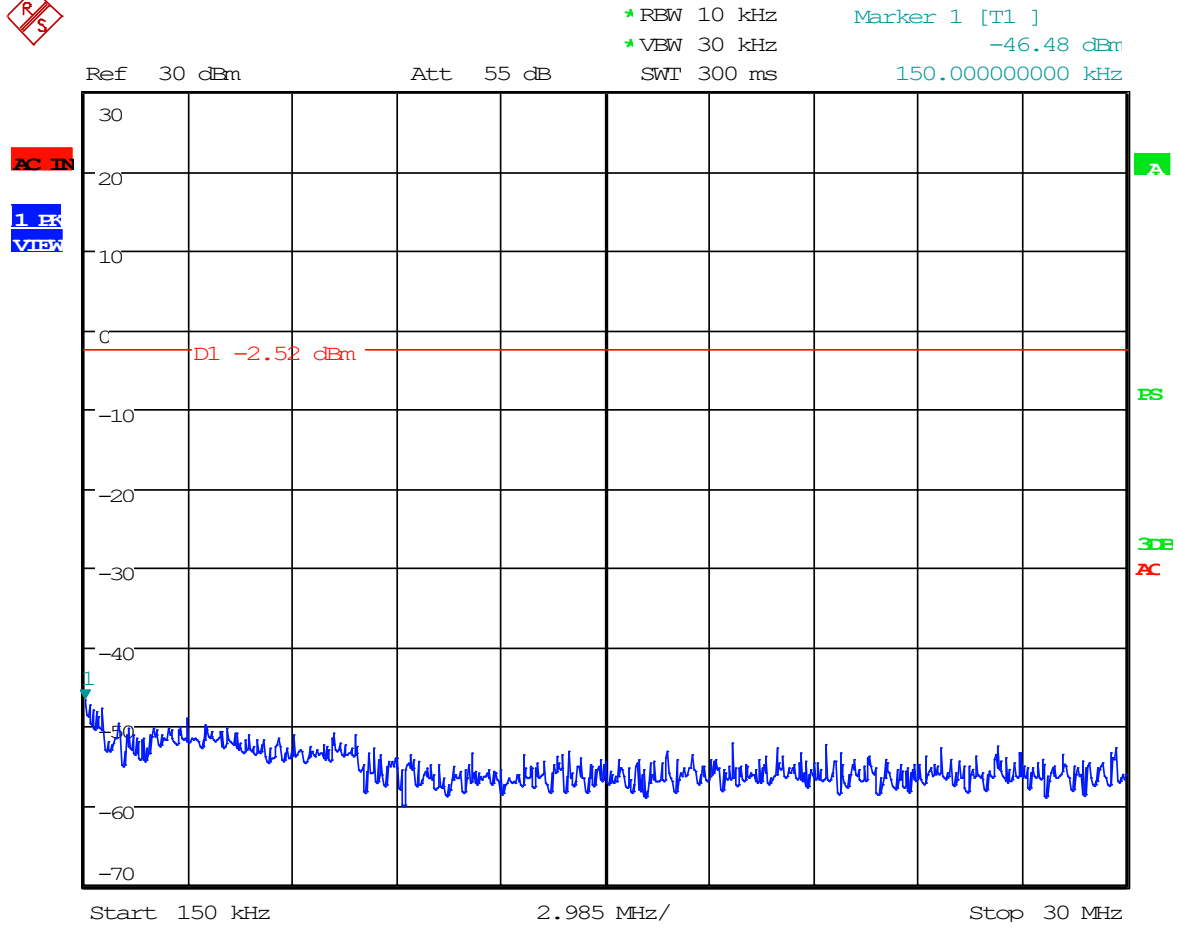
* REW 1 kHz
* VBW 3 kHz
Marker 1 [T1]
-55.81 dBm
150.00000000 kHz



Date: 4.DEC.2023 13:15:53



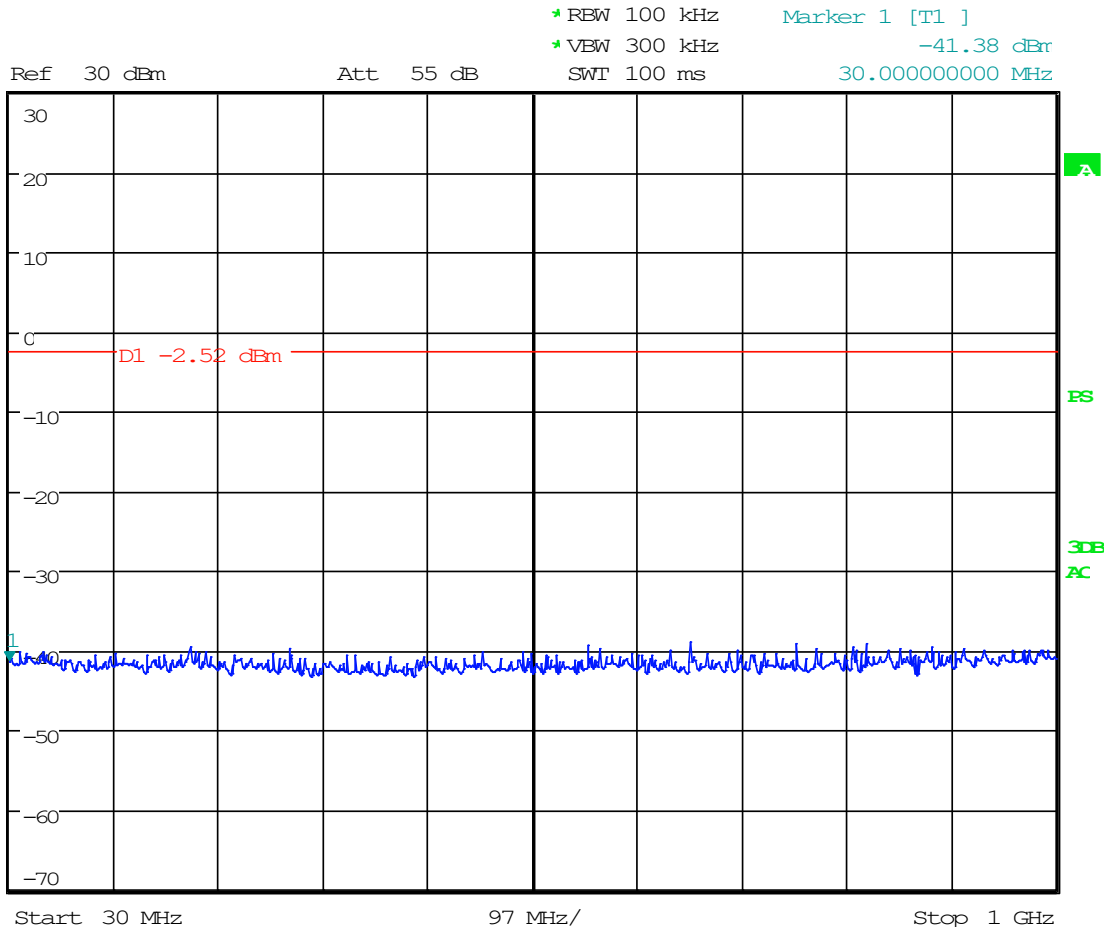
1Mb: Mid Channel, 0.15 MHz to 30 MHz



Date: 4.DEC.2023 13:16:24



1Mb: Mid Channel, 30 MHz to 1000 MHz



Date: 4.DEC.2023 13:16:50

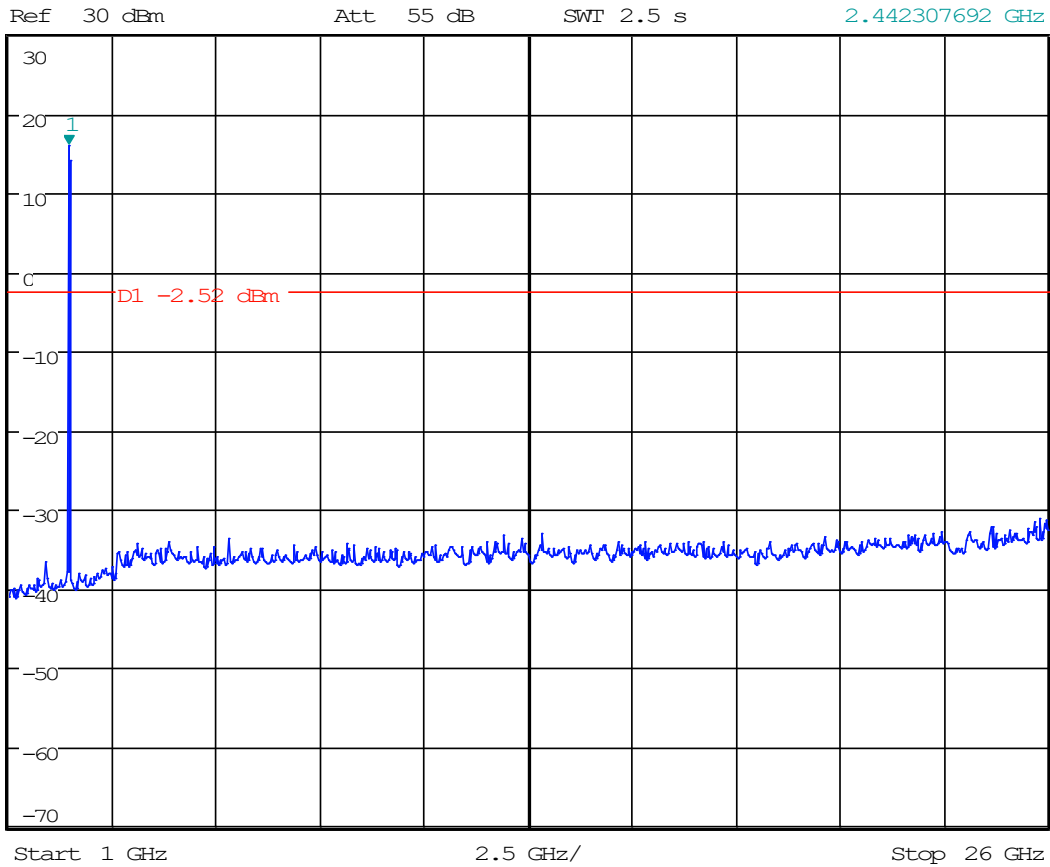


1Mb: Mid Channel, 1 GHz to 26 GHz



* RBW 100 kHz Marker 1 [T1]
* VBW 300 kHz 15.94 dBm
SWT 2.5 s 2.442307692 GHz

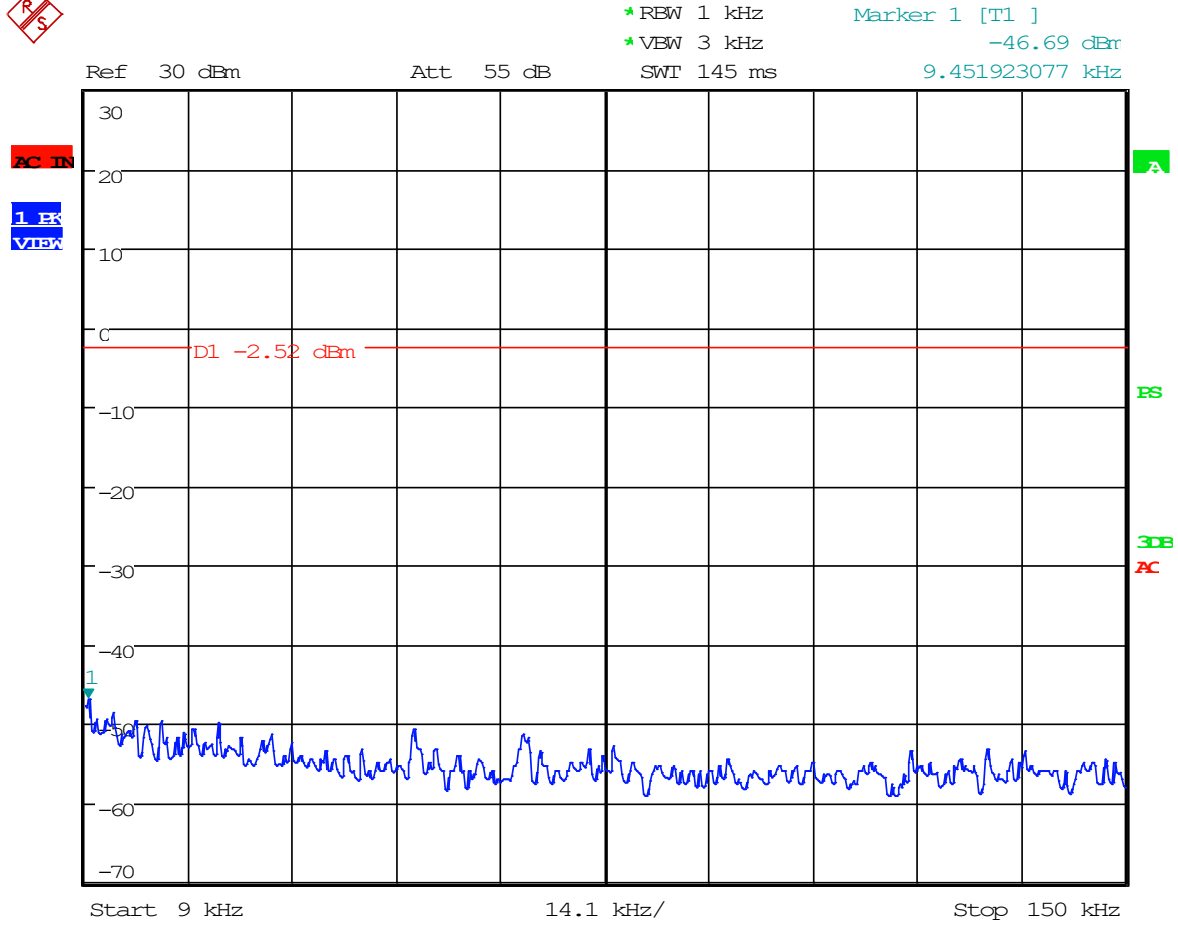
1.0E3
VITAX



Date: 4.DEC.2023 13:20:04



1Mb: High Channel, 0.009 MHz to 0.15 MHz



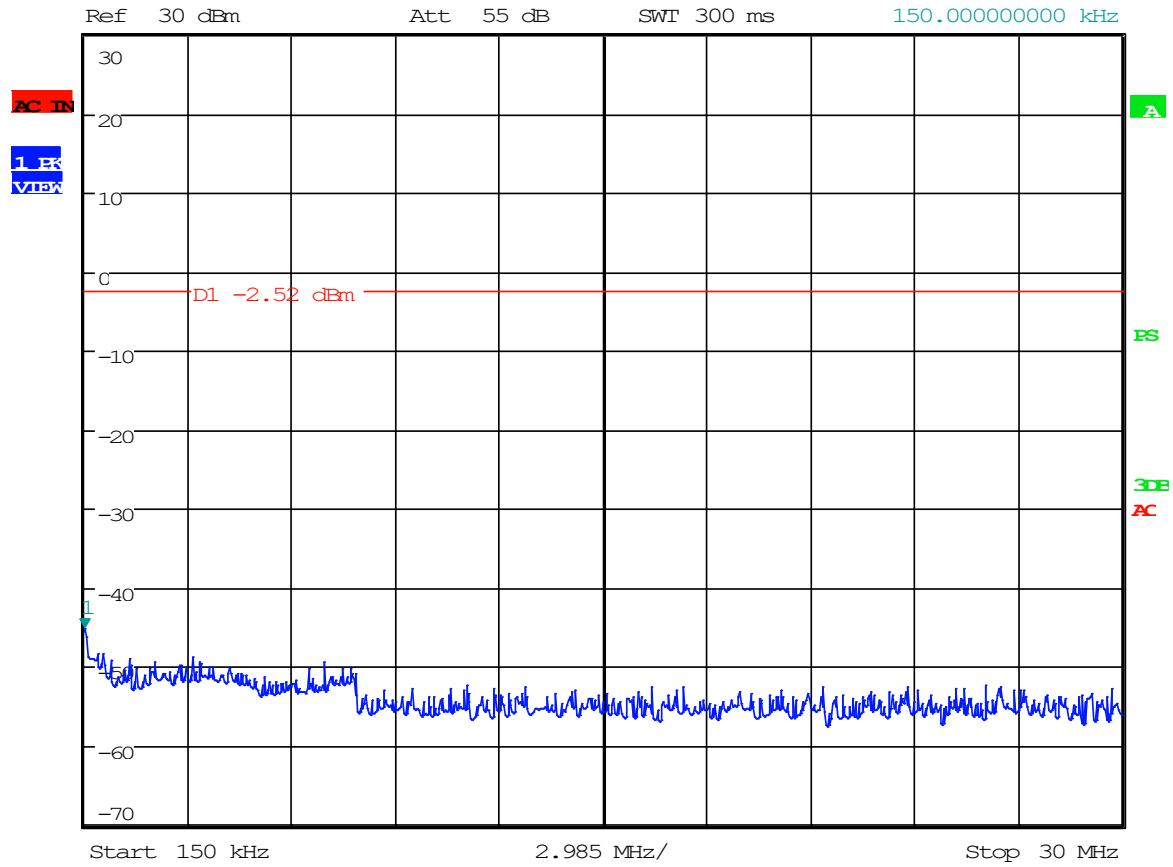
Date: 4.DEC.2023 13:23:22



1Mb: High Channel, 0.15 MHz to 30 MHz



*RBW 10 kHz Marker 1 [T1]
*VBW 30 kHz -45.14 dBm
SWT 300 ms 150.00000000 kHz



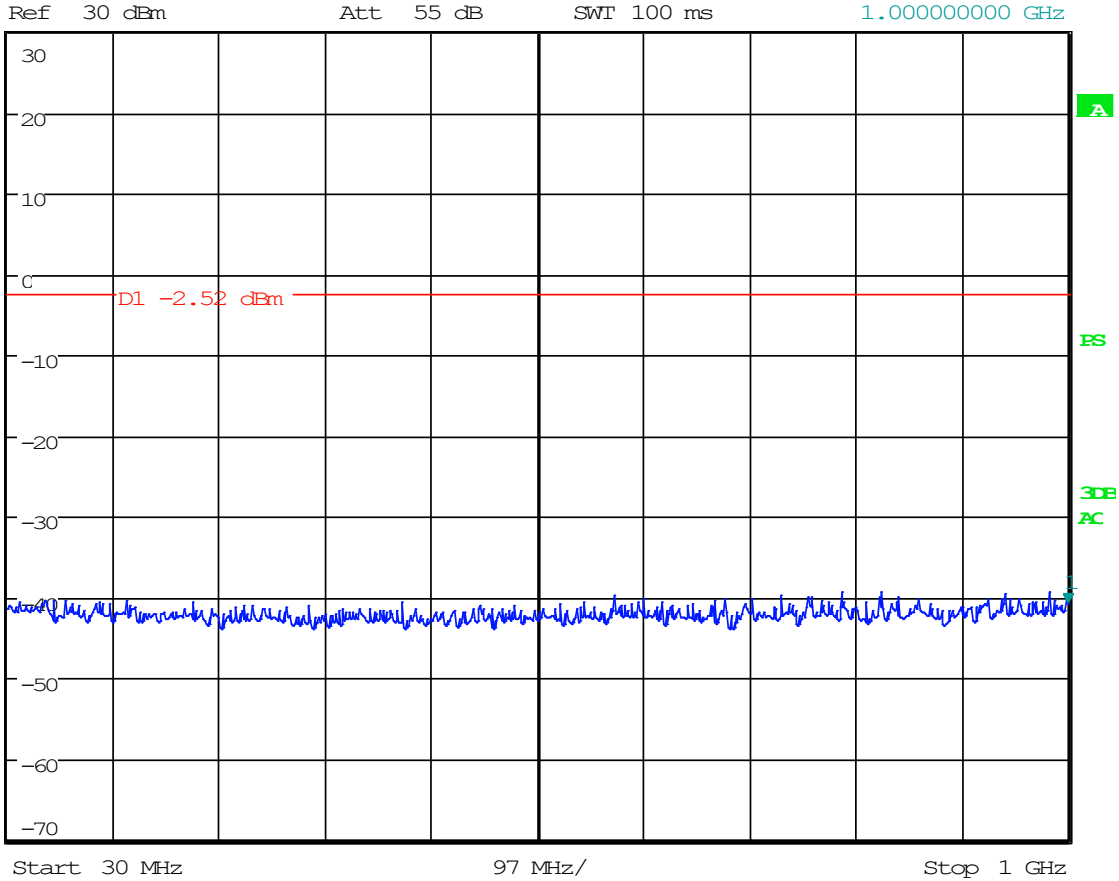
Date: 4.DEC.2023 13:22:46



1Mb: High Channel, 30 MHz to 1000 MHz



*RBW 100 kHz Marker 1 [T1]
*VBW 300 kHz -40.74 dBm
SWT 100 ms 1.000000000 GHz



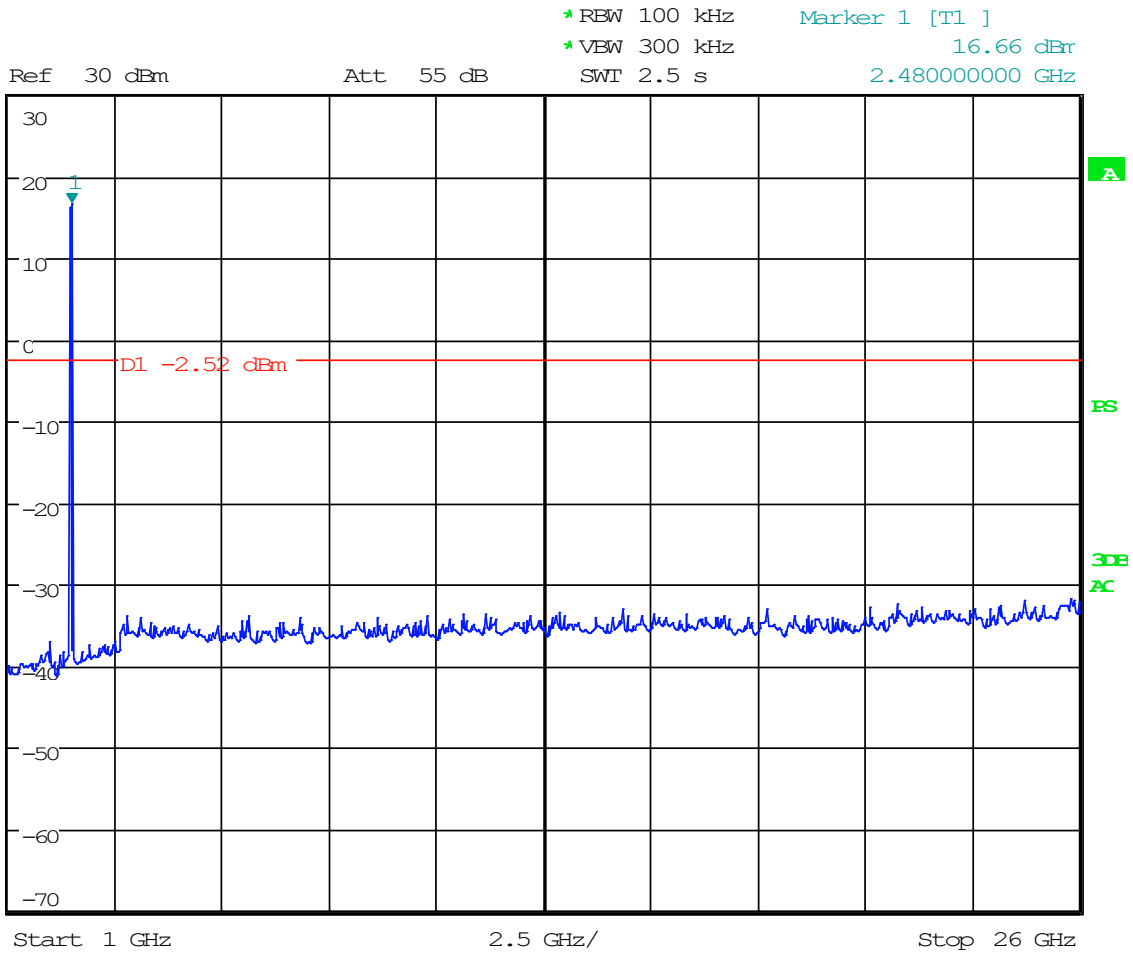
Date: 4.DEC.2023 13:22:07



1Mb: High Channel, 1 GHz to 26 GHz



1 Mb
VIEW



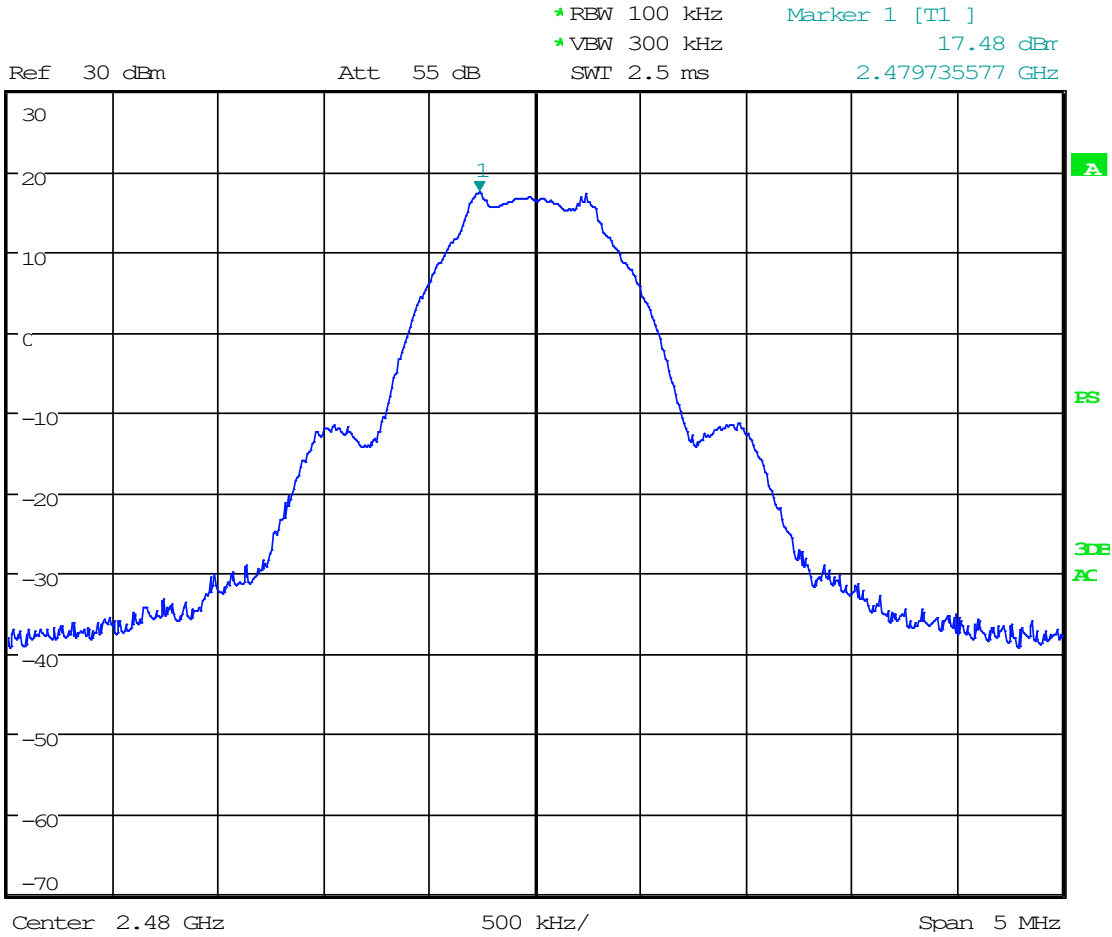
Date: 4.DEC.2023 13:21:47



1Mb: Spur Reference



1.8k
VTP%



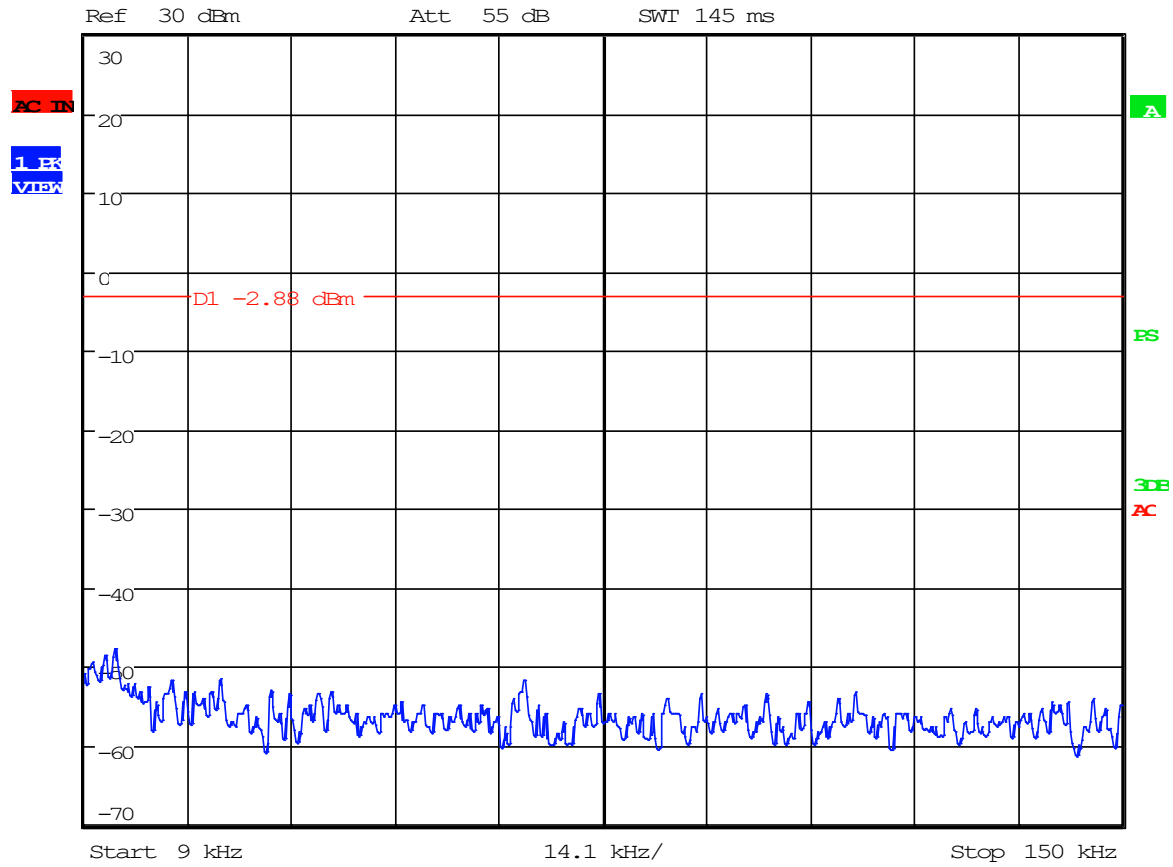
Date: 4.DEC.2023 13:14:17



2Mb: Low Channel, 0.009 MHz to 0.15 MHz



* RBW 1 kHz
* VBW 3 kHz
SWT 145 ms



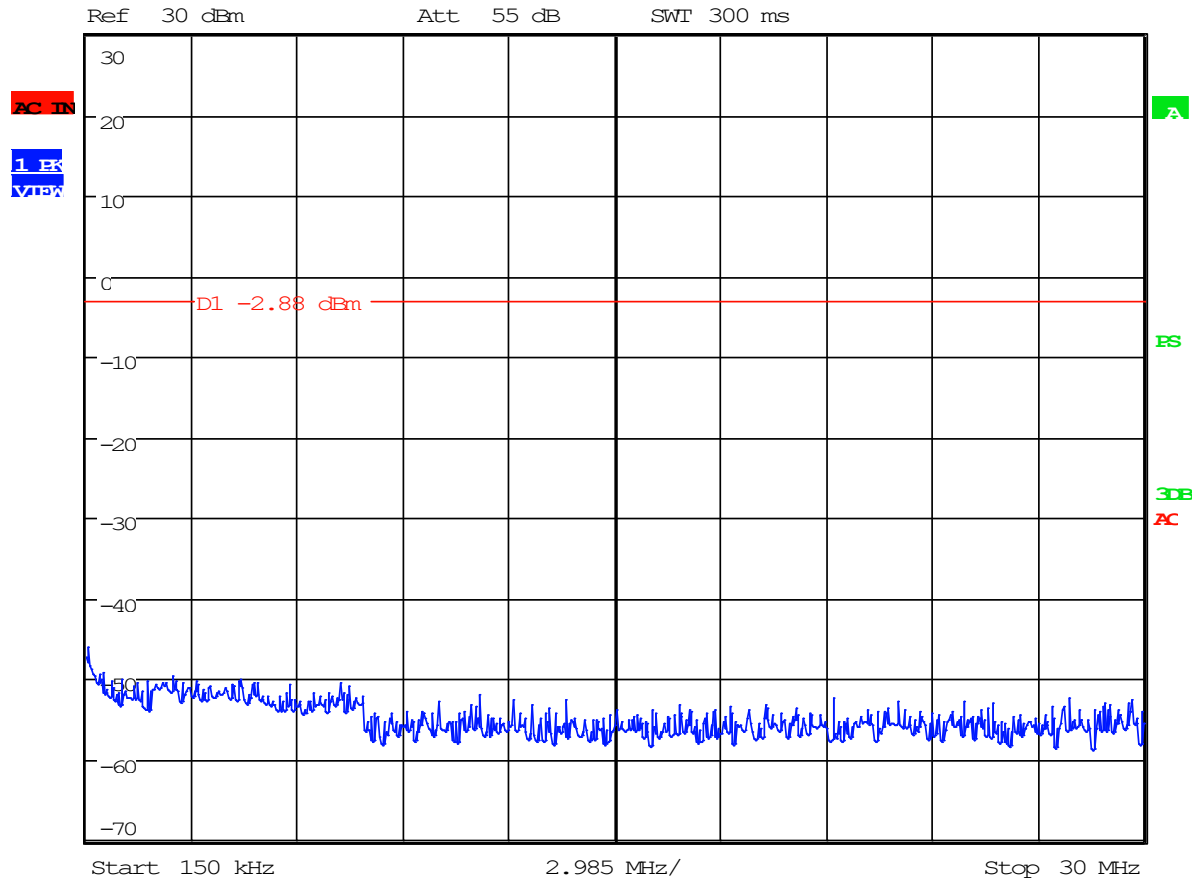
Date: 4.DEC.2023 15:13:16



2Mb: Low Channel, 0.15 MHz to 30 MHz



* RBW 10 kHz
* VBW 30 kHz
SWI 300 ms



Date: 4.DEC.2023 15:13:45



2Mb: Low Channel, 30 MHz to 1000 MHz

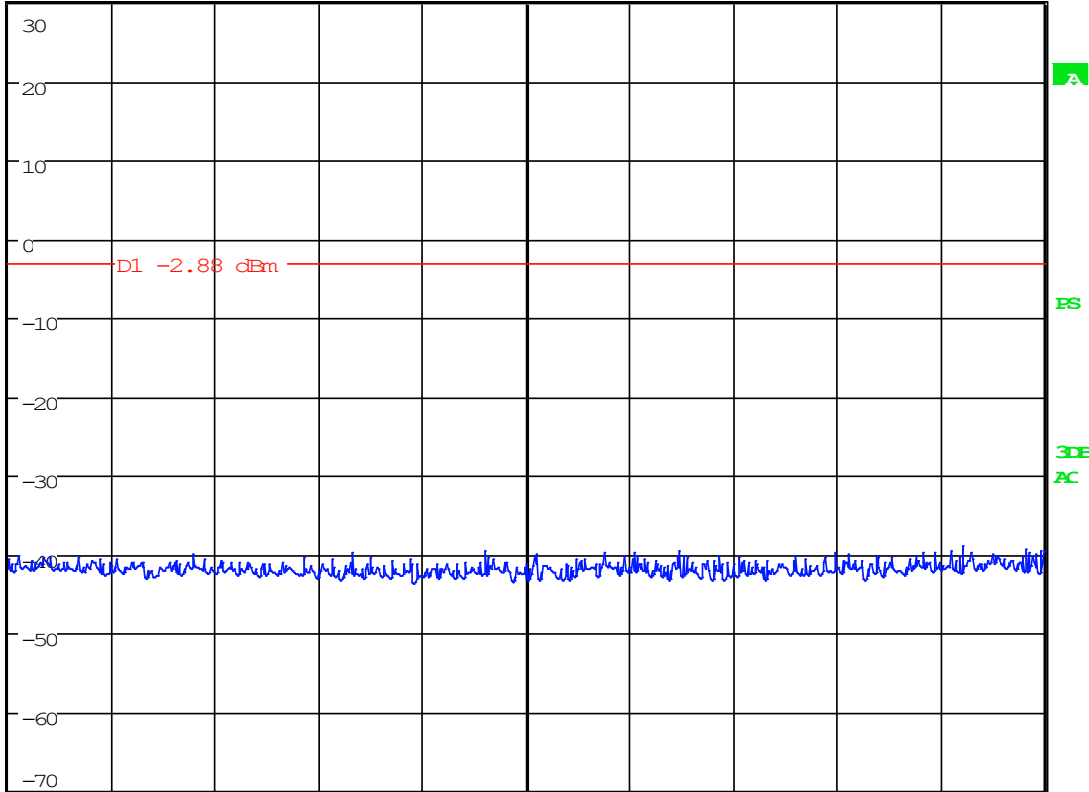


* RBW 100 kHz
* VBW 300 kHz
SWT 100 ms

Ref 30 dBm

Att 55 dB

1 ER
VITBW



Start 30 MHz

97 MHz/

Stop 1 GHz

Date: 4.DEC.2023 15:14:13

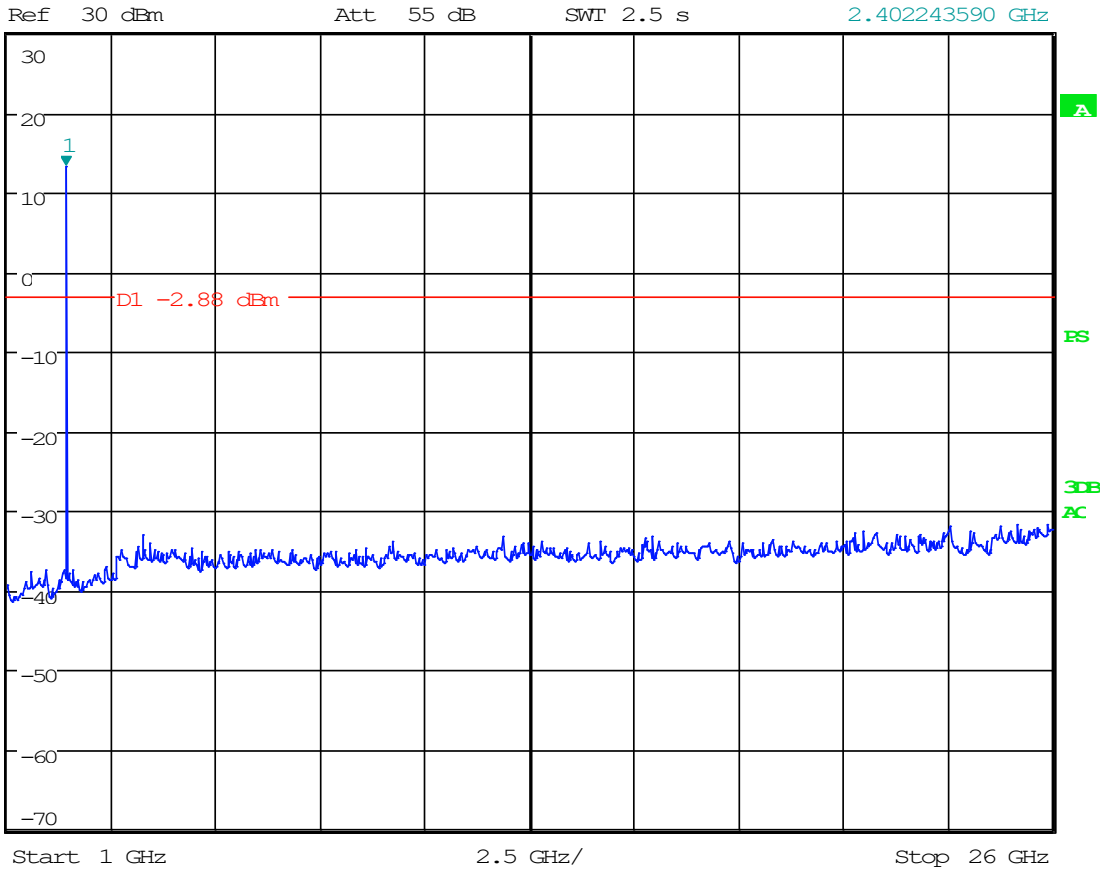


2Mb: Low Channel, 1 GHz to 26 GHz



1.0k
VIEW

* RBW 100 kHz Marker 1 [T1]
* VBW 300 kHz 13.24 dBc
SWI 2.5 s 2.402243590 GHz



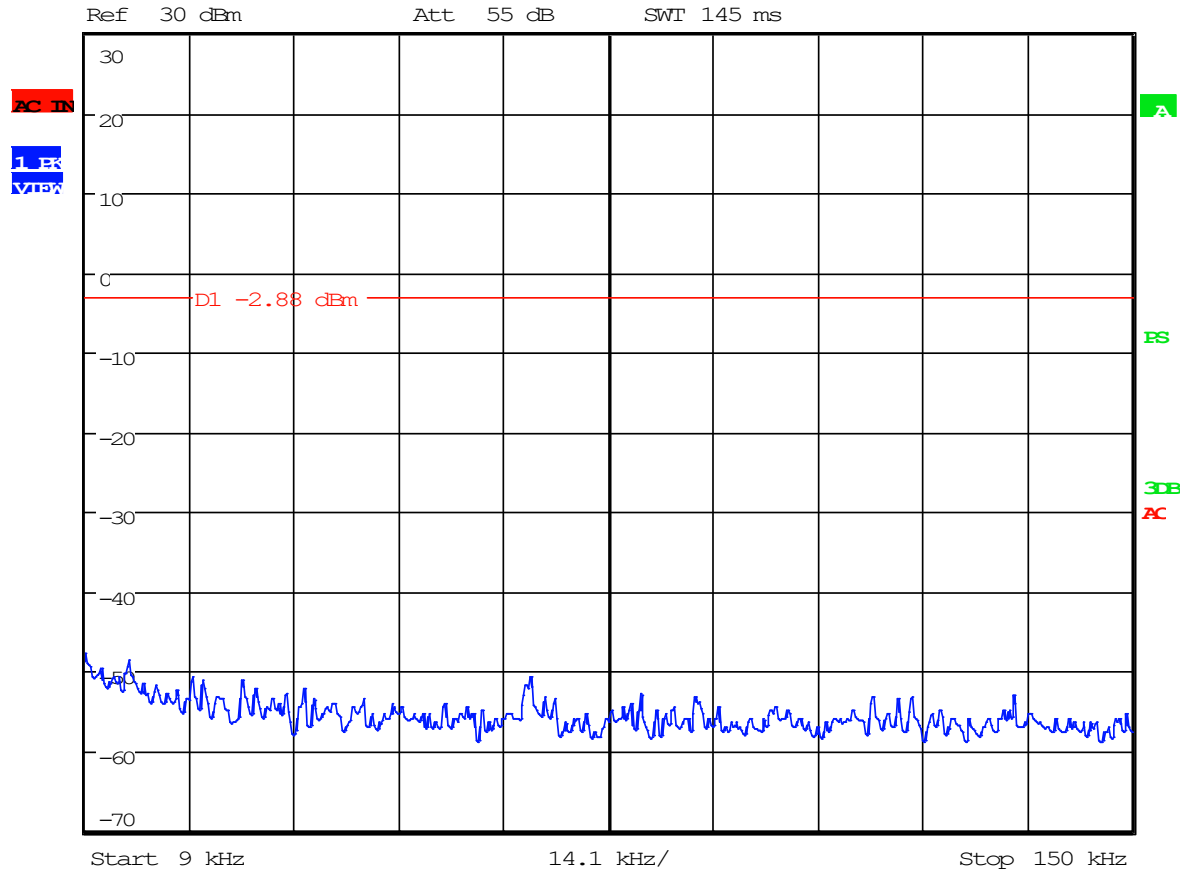
Date: 4.DEC.2023 15:14:40



2Mb: Mid Channel, 0.009 MHz to 0.15 MHz



REBW 1 kHz
REVBW 3 kHz
RESW 145 ms



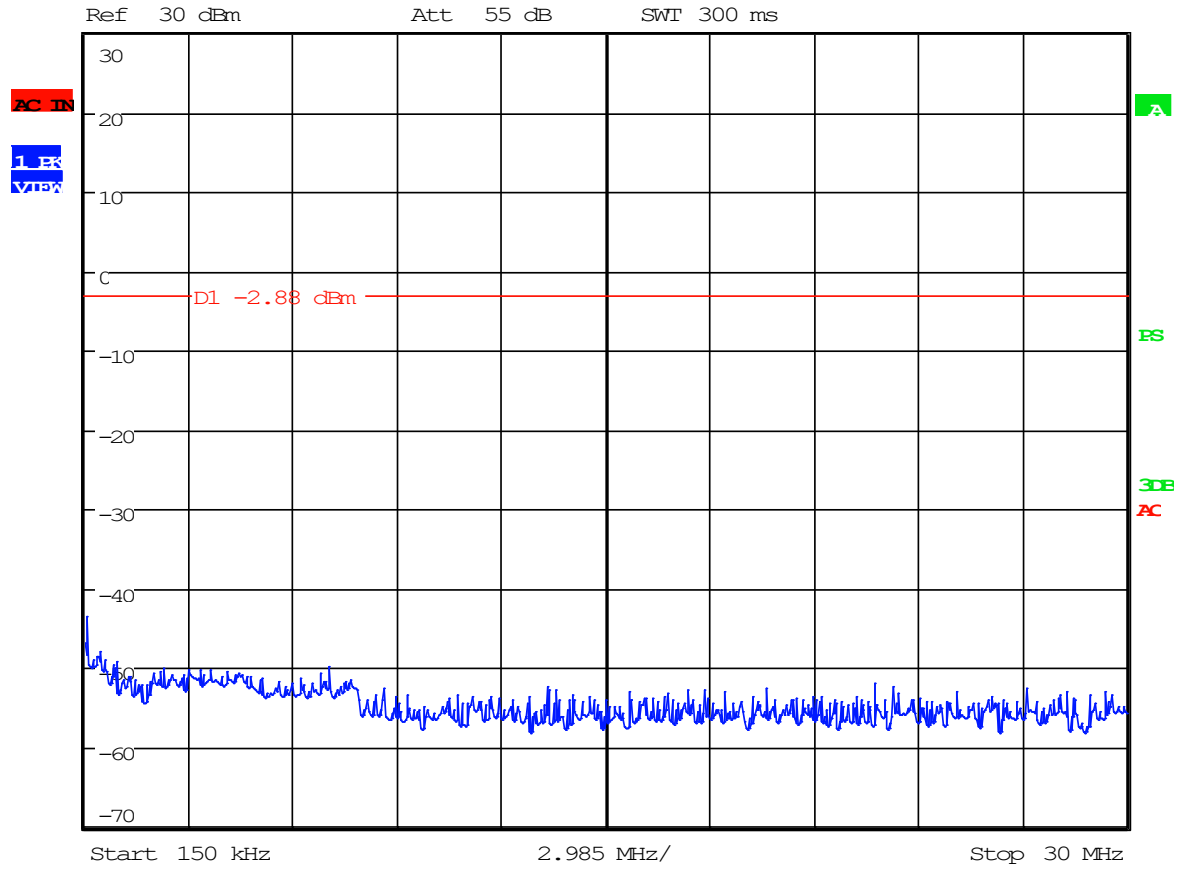
Date: 4.DEC.2023 15:12:28



2Mb: Mid Channel, 0.15 MHz to 30 MHz



▸ RBW 10 kHz
▸ VBW 30 kHz
SWT 300 ms



Date: 4.DEC.2023 15:11:59



2Mb: Mid Channel, 30 MHz to 1000 MHz

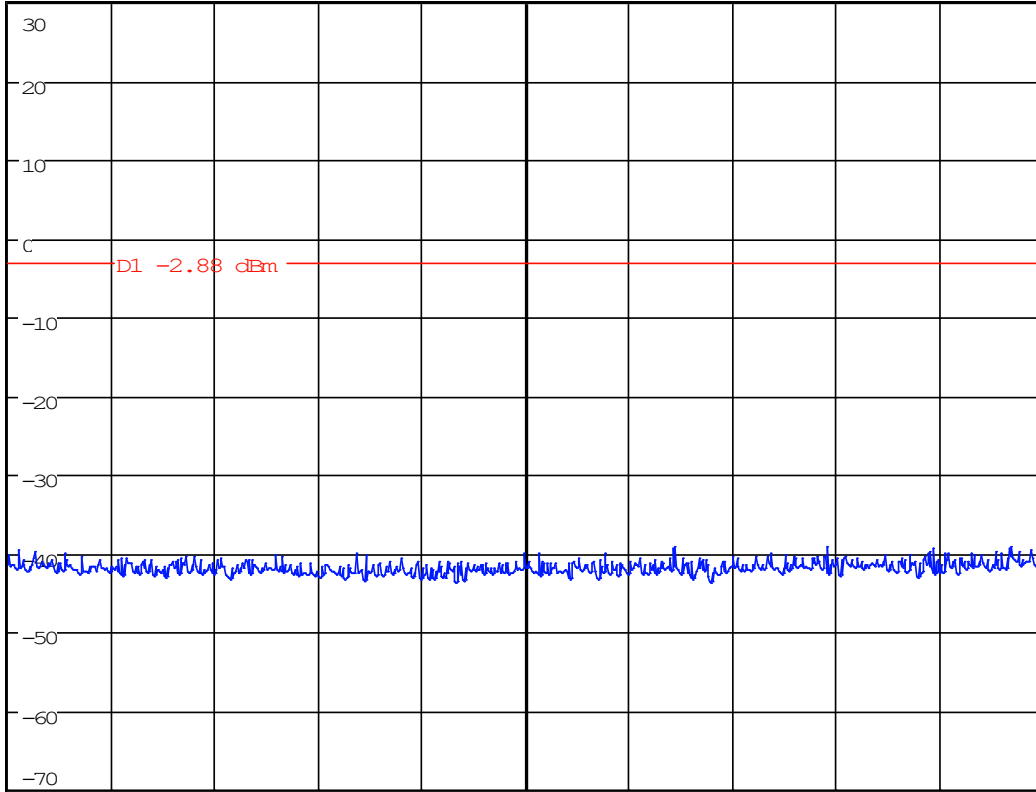


* RBW 100 kHz
* VBW 300 kHz
SWT 100 ms

Ref 30 dBm

Att 55 dB

1.00
VTPW



Start 30 MHz

97 MHz/

Stop 1 GHz

Date: 4.DEC.2023 15:11:28

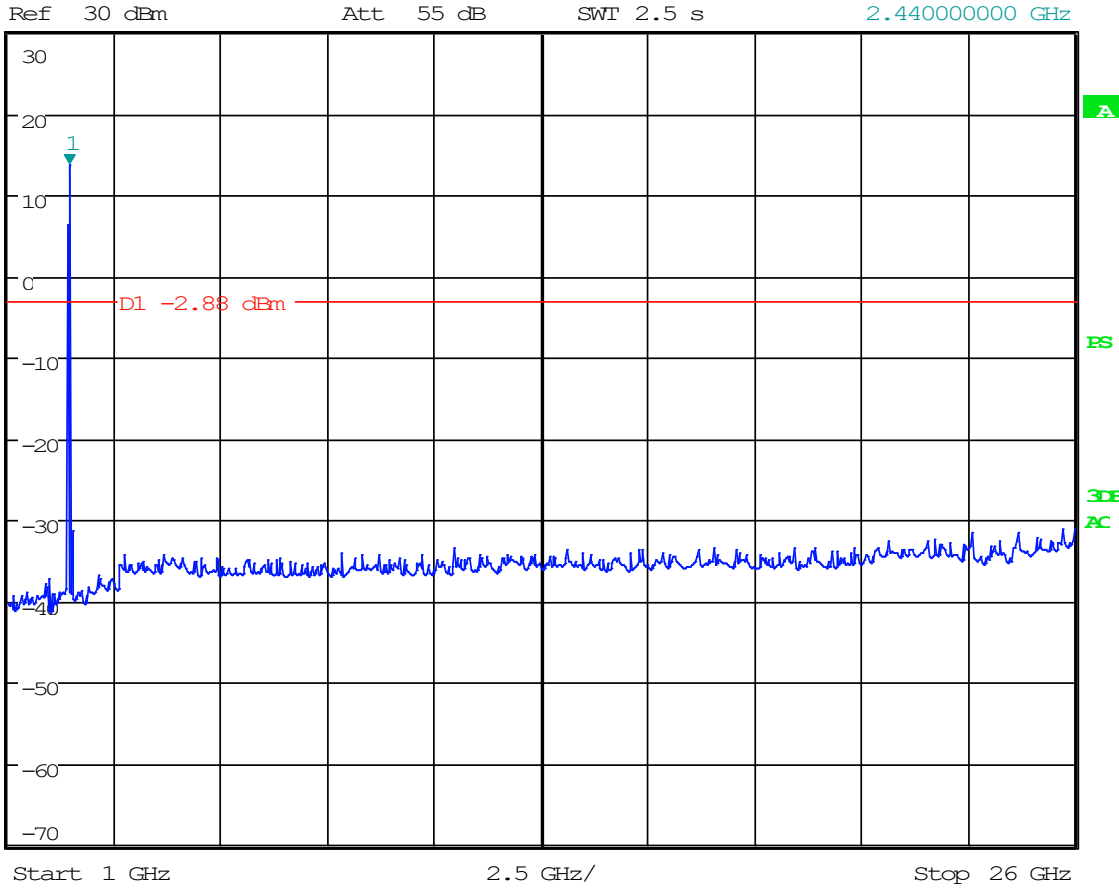


2Mb: Mid Channel, 1 GHz to 26 GHz



1 ER
V1000

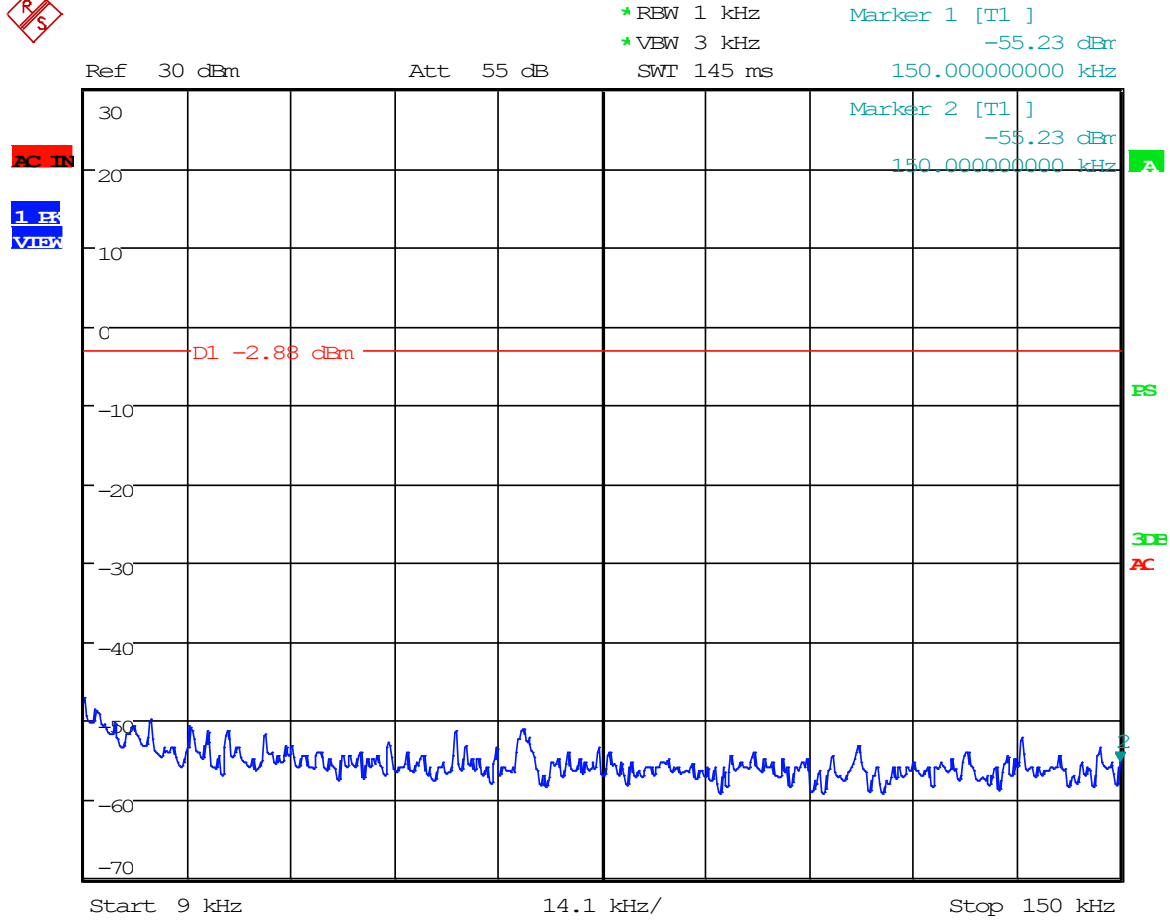
RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 13.67 dBm
SWI 2.5 s 2.44000000 GHz



Date: 4.DEC.2023 15:10:56



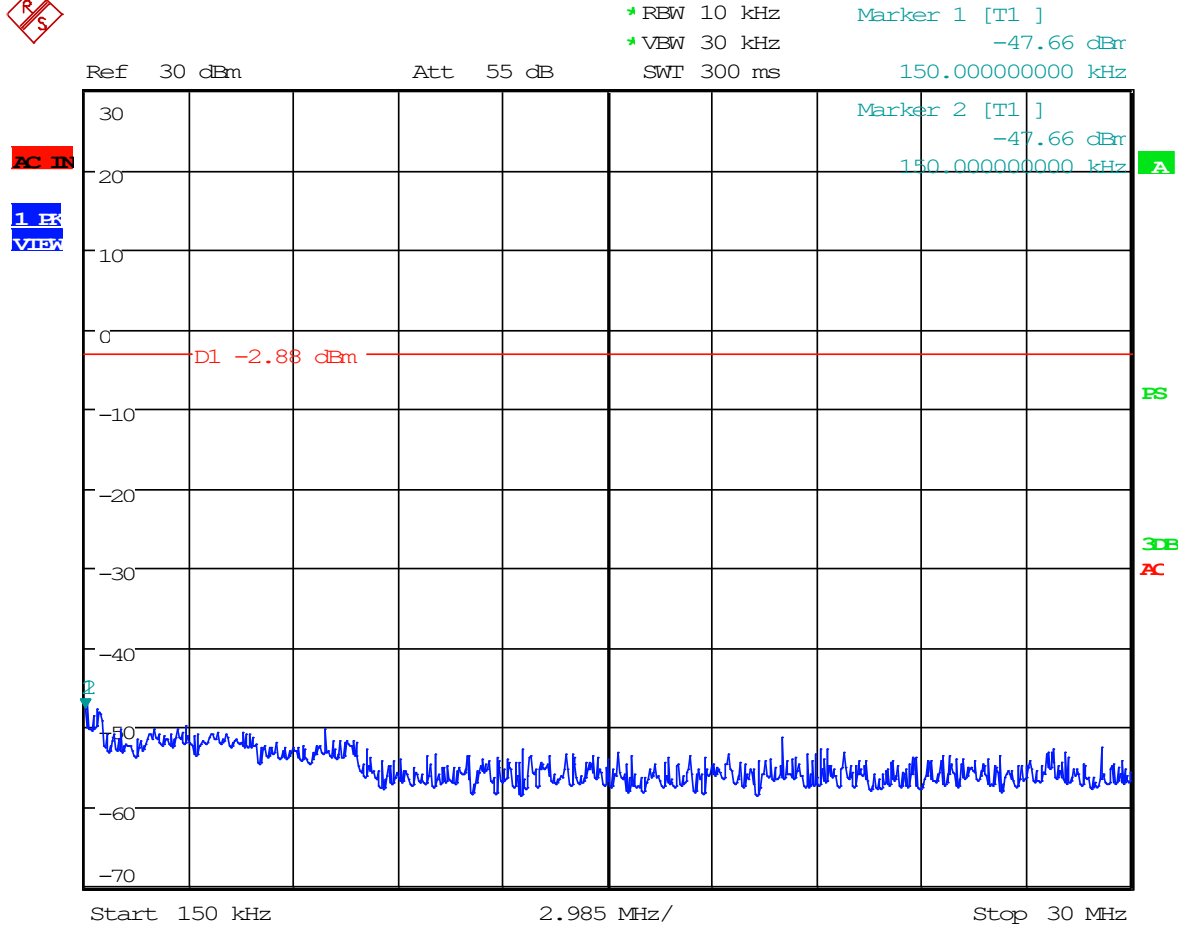
2Mb: High Channel, 0.009 MHz to 0.15 MHz



Date: 4.DEC.2023 15:08:16



2Mb: High Channel, 0.15 MHz to 30 MHz



Date: 4.DEC.2023 15:08:45

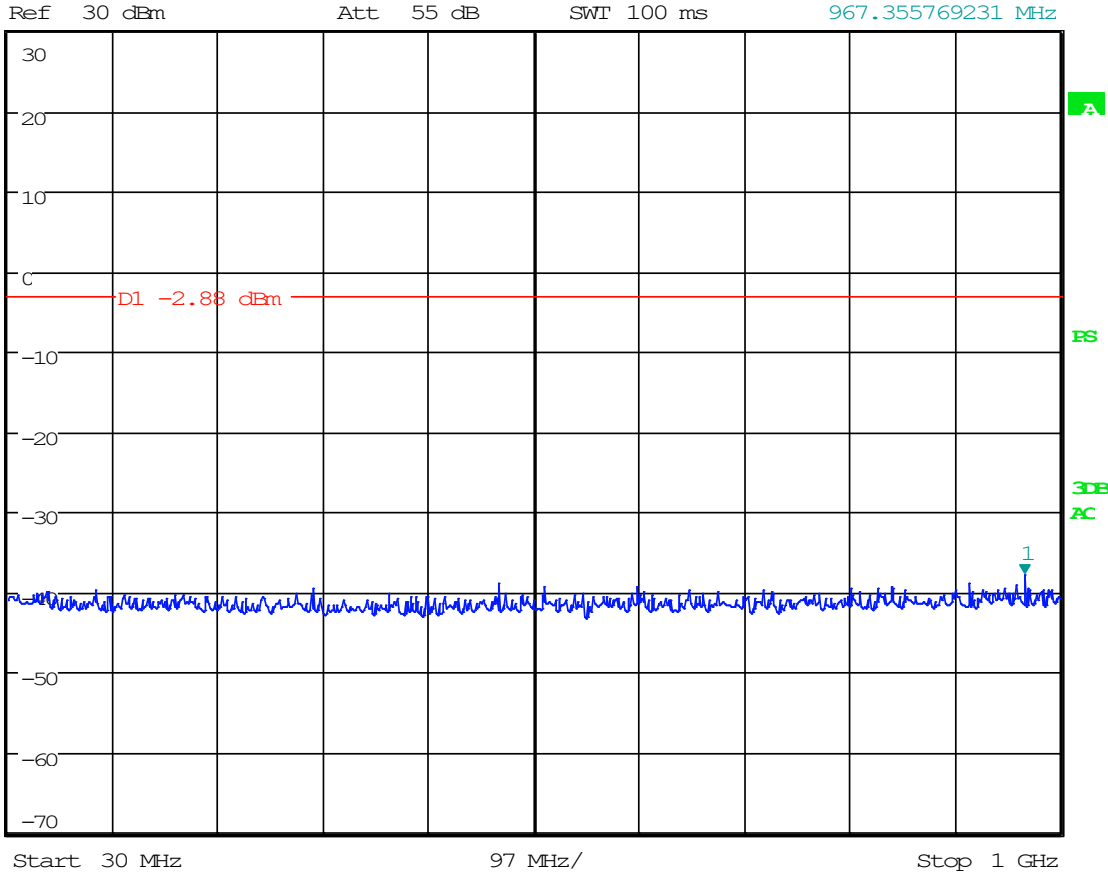


2Mb: High Channel, 30 MHz to 1000 MHz



REBW 100 kHz Marker 1 [T1]
VEBW 300 kHz -37.66 dBm
SWI 100 ms 967.355769231 MHz

1.8k
VIEW



Date: 4.DEC.2023 15:09:24

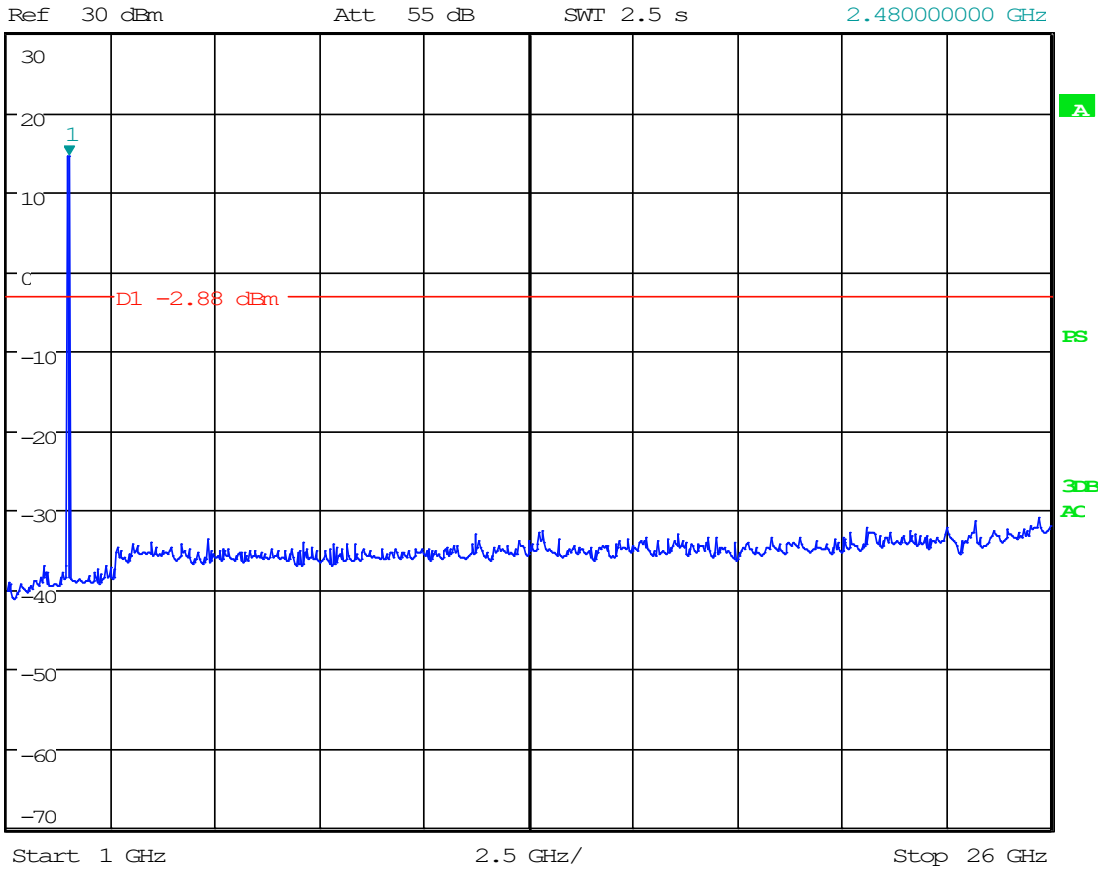


2Mb: High Channel, 1 GHz to 26 GHz



1.0k
VIEW

* RBW 100 kHz Marker 1 [T1]
* VBW 300 kHz 14.62 dBm
SWT 2.5 s 2.480000000 GHz



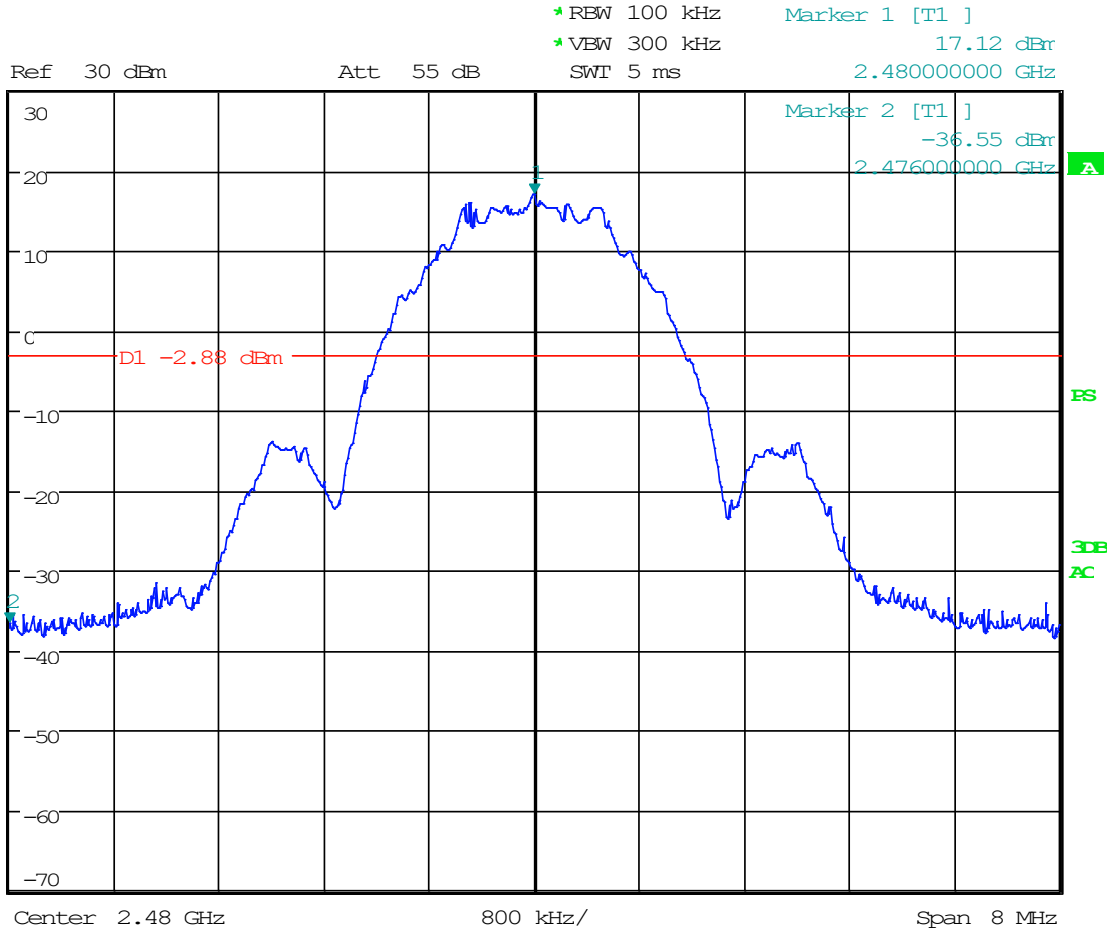
Date: 4.DEC.2023 15:10:13



2Mb: Spur Reference



1.8k
VIEW



Date: 4.DEC.2023 13:50:30



11 RADIATED SPURIOUS EMISSIONS

The EUT antenna port was fitted with its integral/internal antenna. Radiated emissions were measured in a Semi-Anechoic Chamber. All emissions that fall in the restricted bands per FCC Part 15.205 were examined.

11.1 Requirements:

All emissions that fall in the restricted bands defined in FCC Part 15.205 shall not exceed the maximum field strength listed in FCC Part 15.209(a).

Scans were performed from 9kHz to 26 GHz at the low, mid, and high channels and the high channel was determined to be the worst case. The tables of measured results follow. The data presented includes measurements from all channels.



11.2 Radiated Spurious Emissions Test Data

Test Date(s):	2023-11-29; 2024-02-13	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(d); Part 15.209 / KDB558074	Air Temperature:	22.9°C
		Relative Humidity:	34%

Notes: Plots are peak, max hold prescan data included only to determine what frequencies to investigate and measure. The EUT was initially placed in a semi-anechoic chamber, and rotated in all three orthogonal positions to maximize the emissions. Characterization measurements were then performed to determine at which frequencies significant emissions occurred. These graphs are shown below.

The equipment was fully exercised with all cabling attached to the EUT and was positioned on the turntable in the Semi-Anechoic Chamber for maximum emissions. While the equipment was energized, the receiving antenna was scanned from 1.0 meter to 4.0 meters in both vertical and horizontal polarities while the turntable was adjusted 360 degrees to determine the maximum field strength. The tables of measured results can be found below.

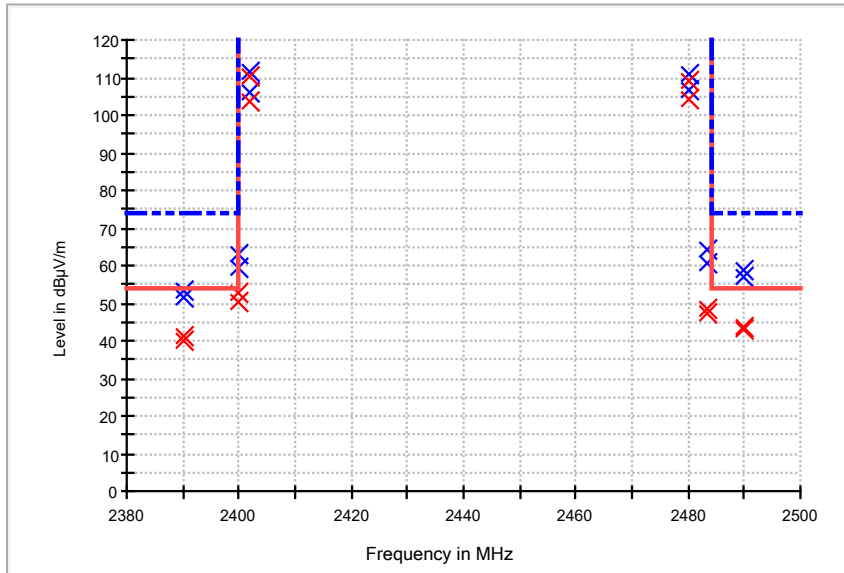
In the following plots, the black trace indicates the active scan and the green trace indicates the MaxPk emission reached during testing. Emissions to be found by the EUT were measured and listed in tables. The plots are for reference only and the limit lines are not actual limit lines but merely a guide.



Band Edge, 1Mb: Measurements

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2390.000000	53.2	41.3	1000.0	1000.000	150.0	V	0.0	8.2	12.7	54.0	
2390.000000	51.6	40.0	1000.0	1000.000	150.0	H	0.0	8.2	14.0	54.0	
2400.000000*	59.3	50.4	1000.0	1000.000	150.0	H	0.0	8.2	40.2	90.6	-20 dBc
2400.000000*	63.2	52.9	1000.0	1000.000	150.0	V	3.0	8.2	37.7	90.6	-20 dBc
2402.000000	111.5	110.6	1000.0	1000.000	150.0	V	0.0	8.2	-----	-----	
2402.000000	106.1	103.5	1000.0	1000.000	150.0	H	0.0	8.2	-----	-----	
2480.000000	106.8	104.3	1000.0	1000.000	160.0	H	137.0	8.3	-----	-----	
2480.000000	110.9	108.8	1000.0	1000.000	160.0	V	233.0	8.3	-----	-----	
2483.500000	60.5	47.1	1000.0	1000.000	160.0	H	137.0	8.3	6.9	54.0	
2483.500000	64.2	48.7	1000.0	1000.000	160.0	V	233.0	8.3	5.3	54.0	
2490.000000	57.1	43.6	1000.0	1000.000	160.0	H	137.0	8.4	10.4	54.0	
2490.000000	58.6	43.1	1000.0	1000.000	160.0	V	233.0	8.4	10.9	54.0	

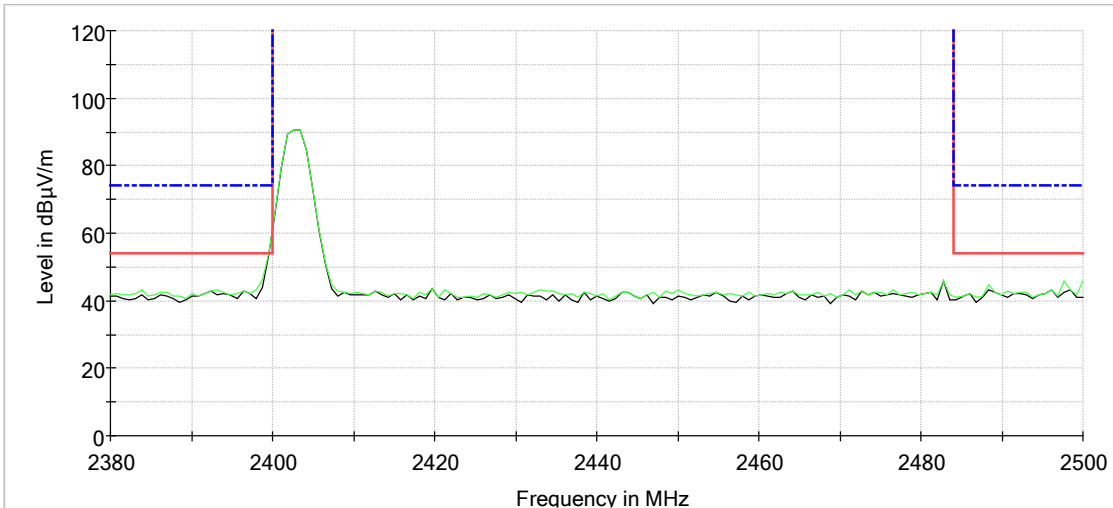
**Not a restricted band.*



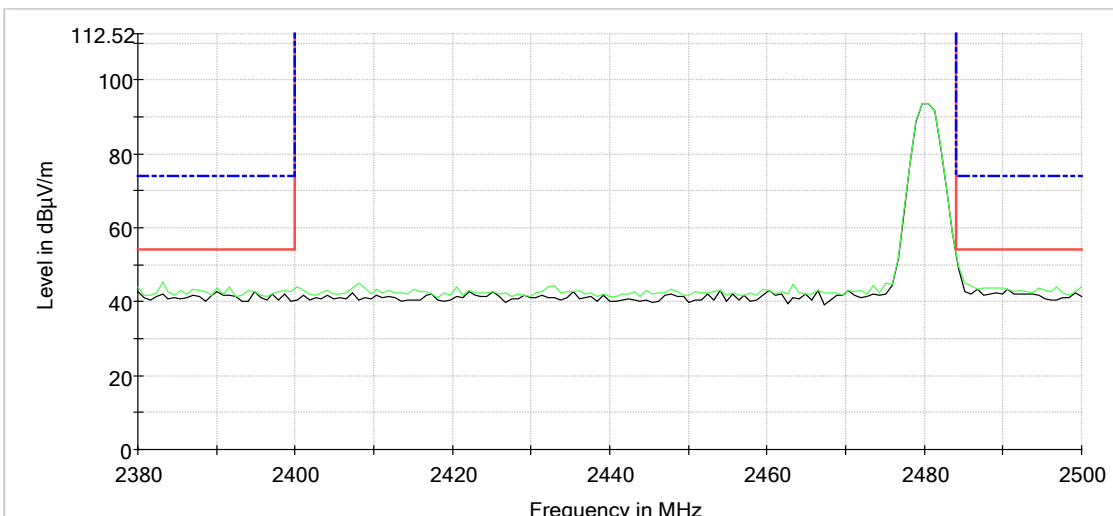


Note: Plots below are peak, max-hold pre-scan data included only to determine which frequencies to investigate and measure. The blue limit line is the Peak limit line which emissions on the graph do not exceed, and the table of FINAL measurements on page 70 shows compliance.

Band Edge, 1Mb: Vertical – Lower Band Edge



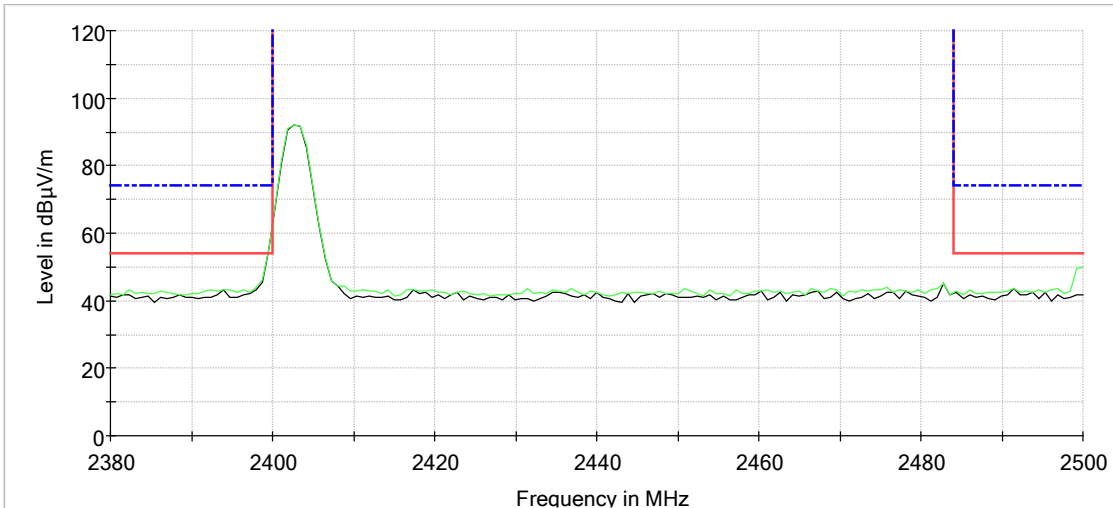
Band Edge, 1Mb: Vertical – Upper Band Edge



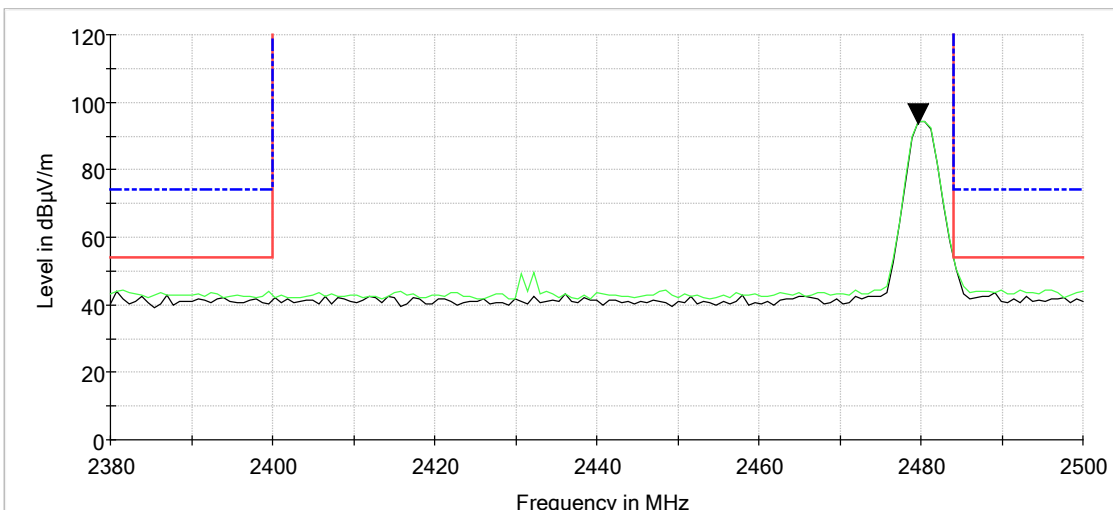


Note: Plots below are peak, max-hold pre-scan data included only to determine which frequencies to investigate and measure. The blue limit line is the Peak limit line which emissions on the graph do not exceed, and the table of FINAL measurements on page 70 shows compliance.

Band Edge, 1Mb: Horizontal – Lower Band Edge

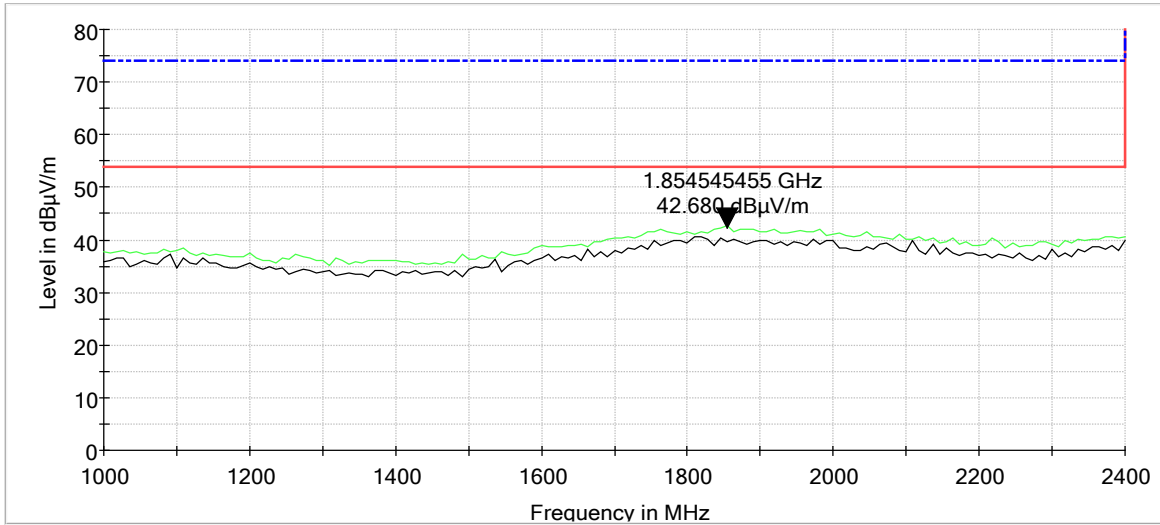


Band Edge, 1Mb: Horizontal – Upper Band Edge

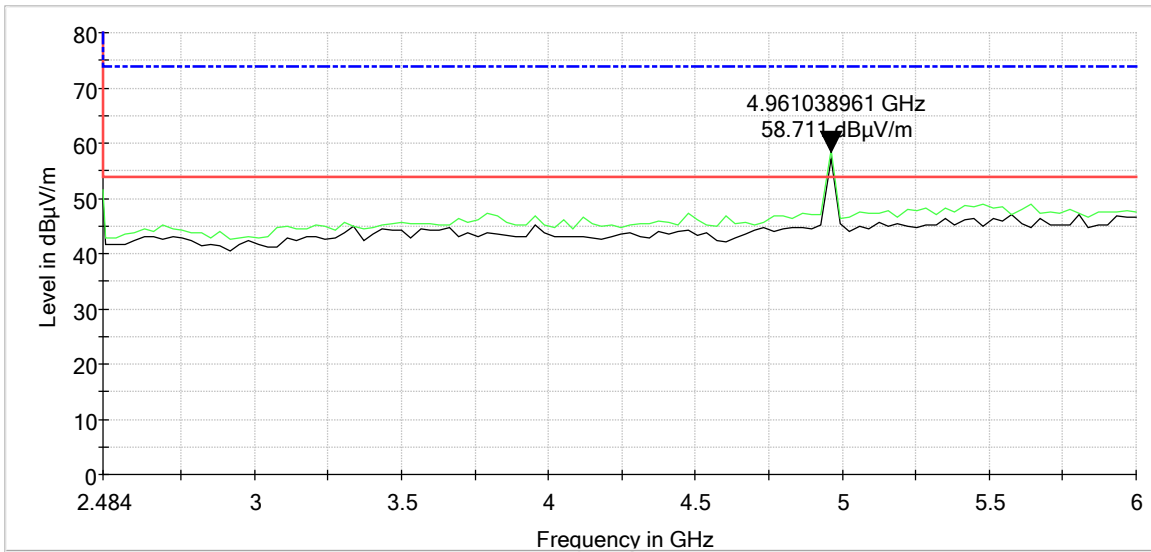




1Mb, Characterization Scan: 1 GHz to 2.4 GHz - Vertical

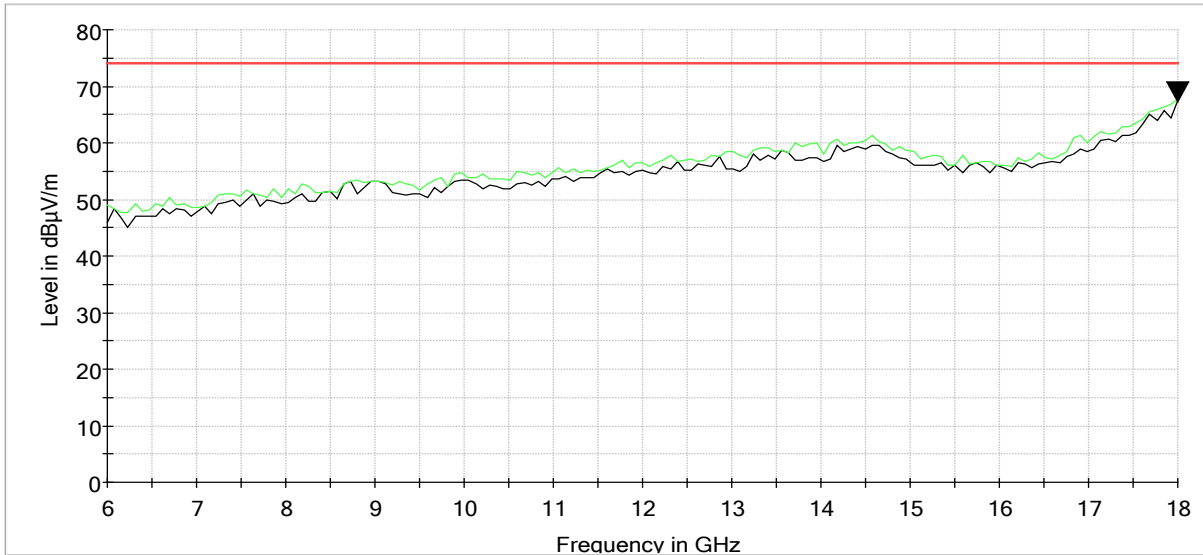


1Mb, Characterization Scan: 2.48 GHz to 6 GHz – Vertical

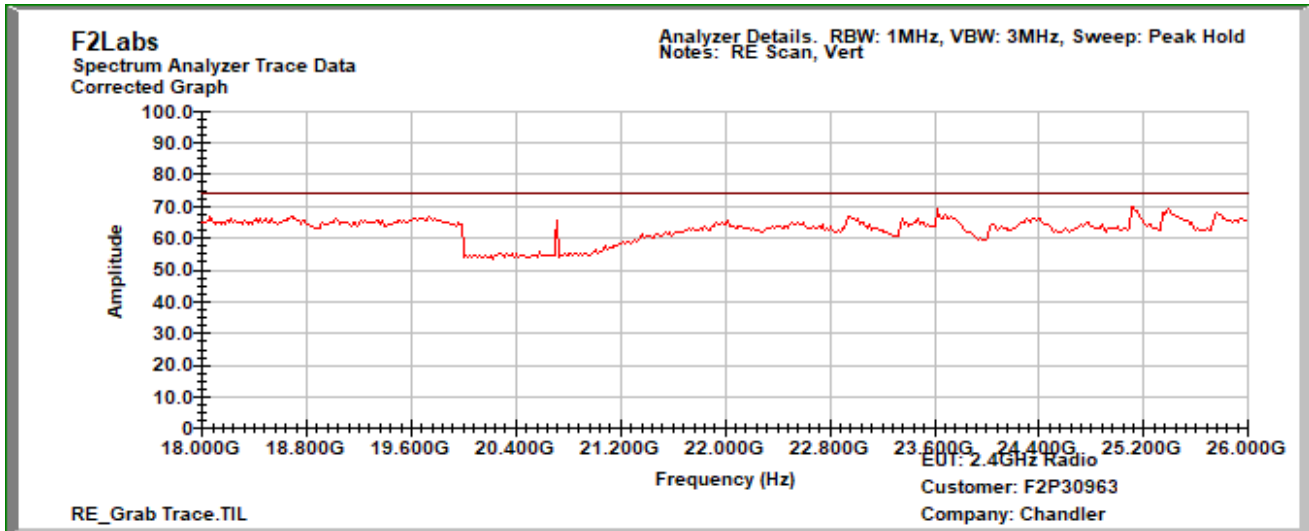




1Mb, Characterization Scan, 6 GHz to 18 GHz - Vertical

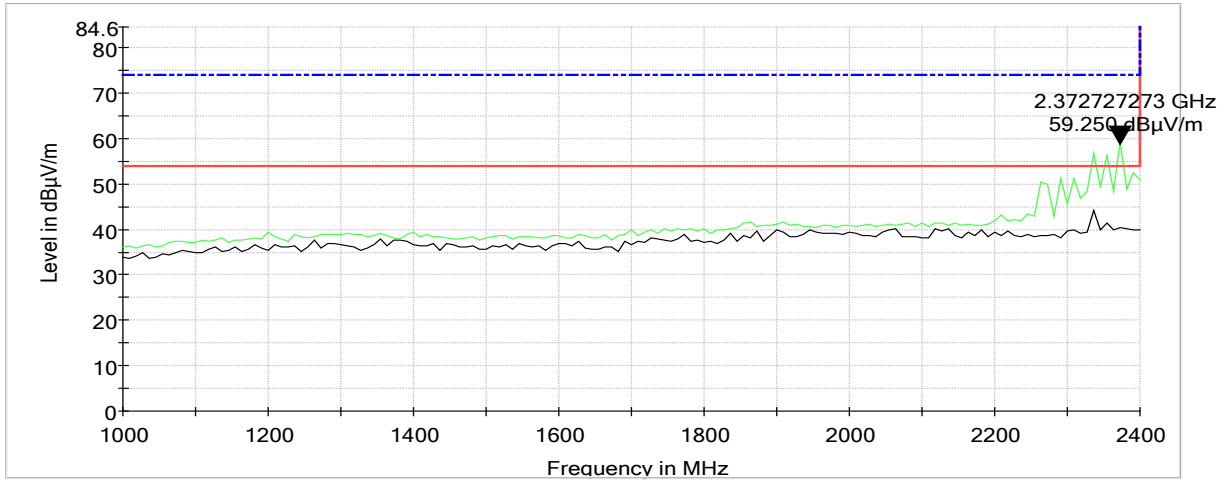


1Mb, Characterization Scan: 18 GHz to 26 GHz – Vertical





1 Mb, Characterization Scan: 1 GHz to 2.4 GHz - Horizontal

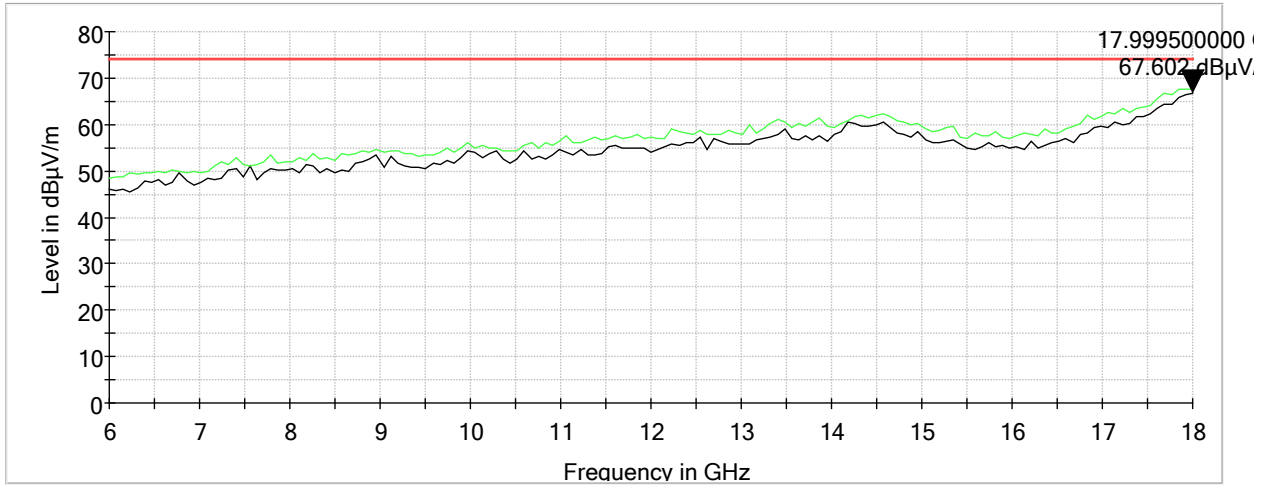


1 Mb, Characterization Scan: 2.48 GHz to 6 GHz – Horizontal

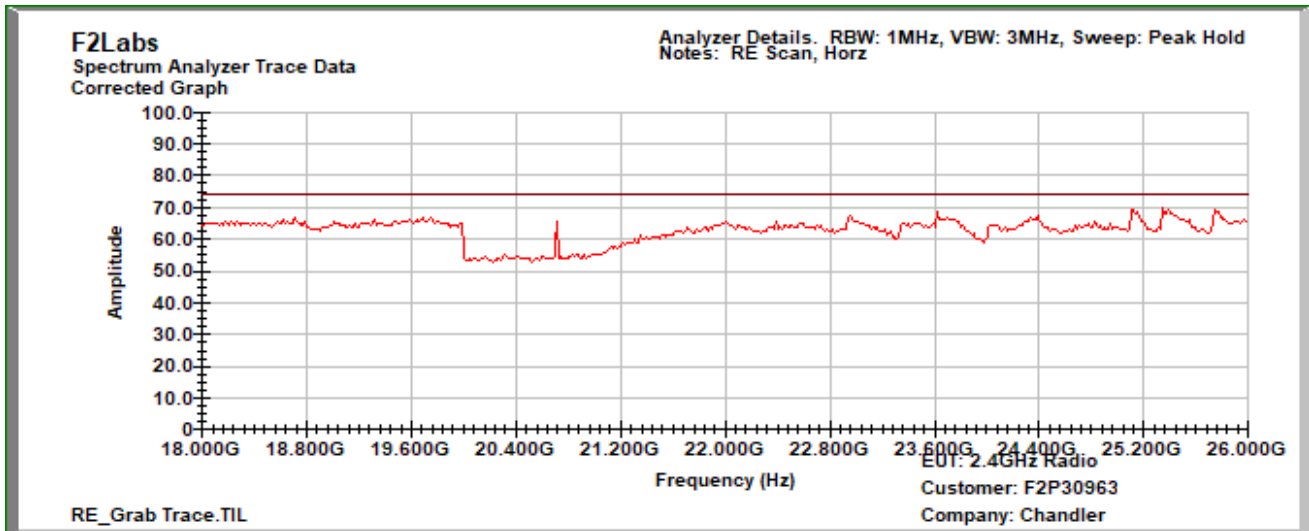




1Mb, Characterization Scan: 6 GHz to 18 GHz - Horizontal



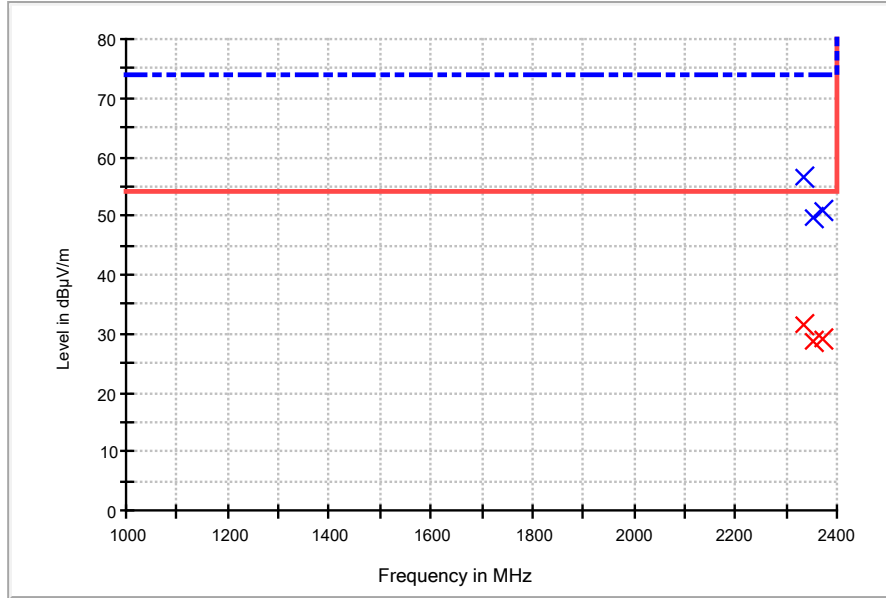
1Mb, Characterization Scan: 18 GHz to 26 GHz – Horizontal





1Mb: Measurements, 1 GHz to 2.4 GHz

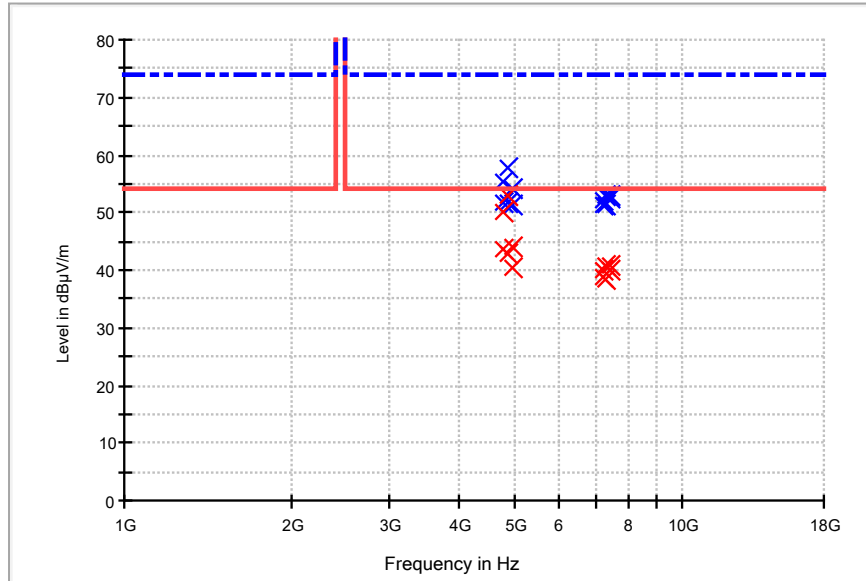
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2336.363636	56.7	31.5	1000.0	1000.000	150.0	H	0.0	6.5	22.5	54.0	
2354.545455	49.8	28.7	1000.0	1000.000	150.0	H	0.0	6.7	25.3	54.0	
2372.000000	51.1	28.9	1000.0	1000.000	150.0	H	0.0	6.8	25.1	54.0	
---	---	---	---	---	---	---	---	---	---	---	





1Mb: Measurements, 2.4 GHz BT - Harmonics

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
4804.000000	55.5	50.0	1000.0	1000.000	150.0	V	7.0	11.6	4.0	54.0	
4804.000000	51.6	43.6	1000.0	1000.000	150.0	H	20.0	11.6	10.4	54.0	
4880.000000	57.8	52.9	1000.0	1000.000	150.0	V	0.0	11.8	1.1	54.0	
4880.000000	51.7	43.0	1000.0	1000.000	150.0	H	0.0	11.8	11.0	54.0	
4961.000000	51.5	40.4	1000.0	1000.000	150.0	H	0.0	12.0	13.6	54.0	
4961.000000	54.0	44.0	1000.0	1000.000	150.0	V	0.0	12.0	10.0	54.0	
7206.000000	52.0	39.8	1000.0	1000.000	150.0	V	0.0	15.8	14.2	54.0	
7206.000000	51.4	39.0	1000.0	1000.000	150.0	H	233.0	15.8	15.0	54.0	
7320.000000	51.2	38.2	1000.0	1000.000	150.0	H	0.0	16.3	15.8	54.0	
7320.000000	53.1	40.8	1000.0	1000.000	150.0	V	0.0	16.3	13.2	54.0	
7440.000000	53.0	40.6	1000.0	1000.000	150.0	V	0.0	16.5	13.4	54.0	
7440.000000	52.4	39.9	1000.0	1000.000	150.0	H	0.0	16.5	14.1	54.0	

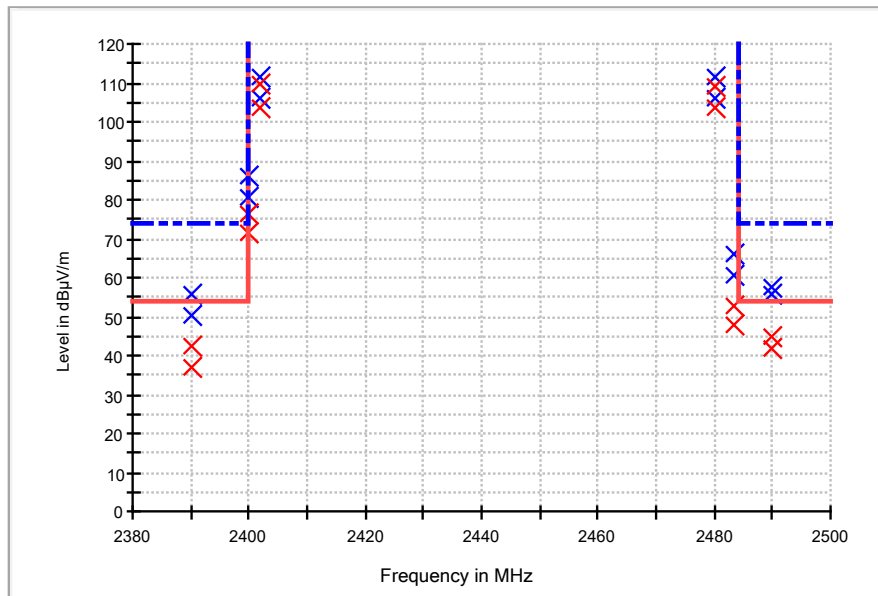




Band Edge, 2Mb: Measurements

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBµV/m)	Comment
2390.000000	55.6	42.5	1000.0	1000.000	150.0	V	341.0	6.9	11.5	54.0	
2390.000000	50.4	36.9	1000.0	1000.000	150.0	H	150.0	6.9	17.1	54.0	
2400.000000*	80.5	71.4	1000.0	1000.000	150.0	H	150.0	6.9	18.0	89.4	-20 dBc
2400.000000*	85.9	76.6	1000.0	1000.000	150.0	V	341.0	6.9	12.8	89.4	-20 dBc
2402.000000	111.5	109.4	1000.0	1000.000	150.0	V	341.0	6.9	-----	-----	
2402.000000	105.9	103.8	1000.0	1000.000	150.0	H	150.0	6.9	-----	-----	
2480.000000	111.2	109.1	1000.0	1000.000	150.0	V	210.0	6.9	-----	-----	
2480.000000	105.8	103.7	1000.0	1000.000	150.0	H	143.0	6.9	-----	-----	
2483.500000	66.0	52.8	1000.0	1000.000	150.0	V	210.0	6.9	1.2	54.0	
2483.500000	60.7	47.9	1000.0	1000.000	150.0	H	143.0	6.9	6.1	54.0	
2490.000000	57.5	44.6	1000.0	1000.000	150.0	V	210.0	7.0	9.4	54.0	
2490.000000	55.5	41.7	1000.0	1000.000	150.0	H	143.0	7.0	12.3	54.0	

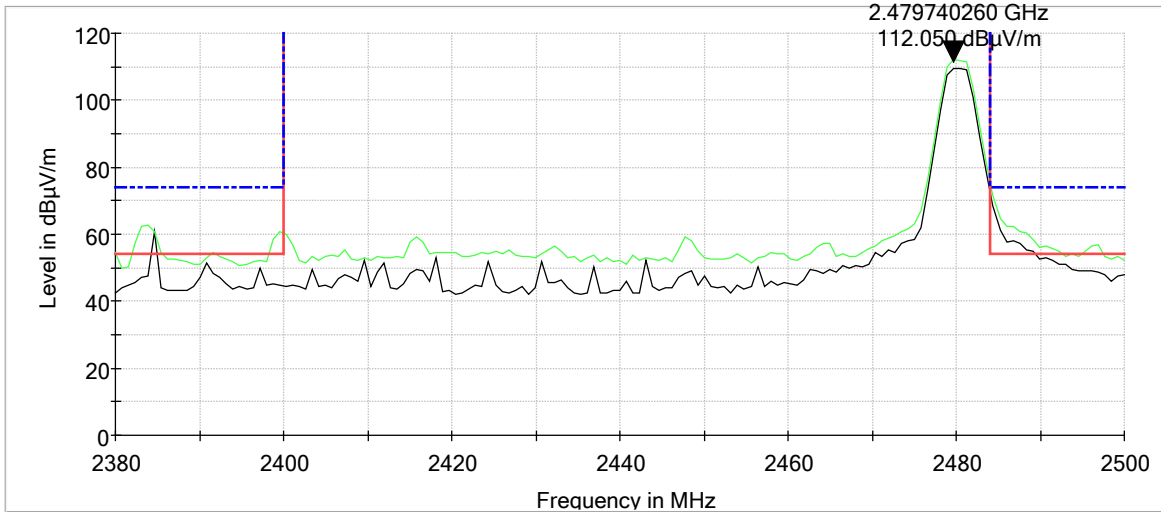
*Not a restricted band.



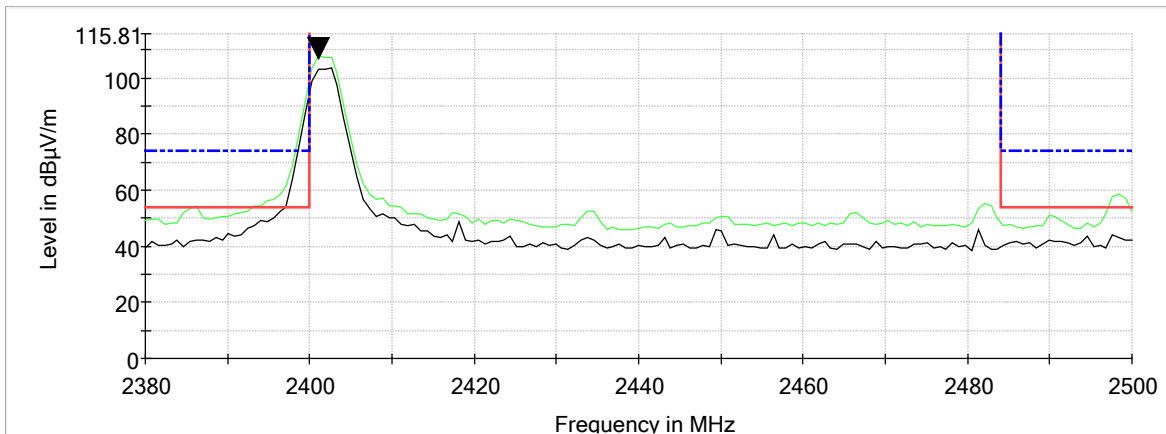


Note: Plots below are peak, max-hold pre-scan data included only to determine which frequencies to investigate and measure. The blue limit line is the Peak limit line which emissions on the graph do not exceed, and the table of FINAL measurements on page 79 shows compliance.

Band Edge, 2Mb: Vertical



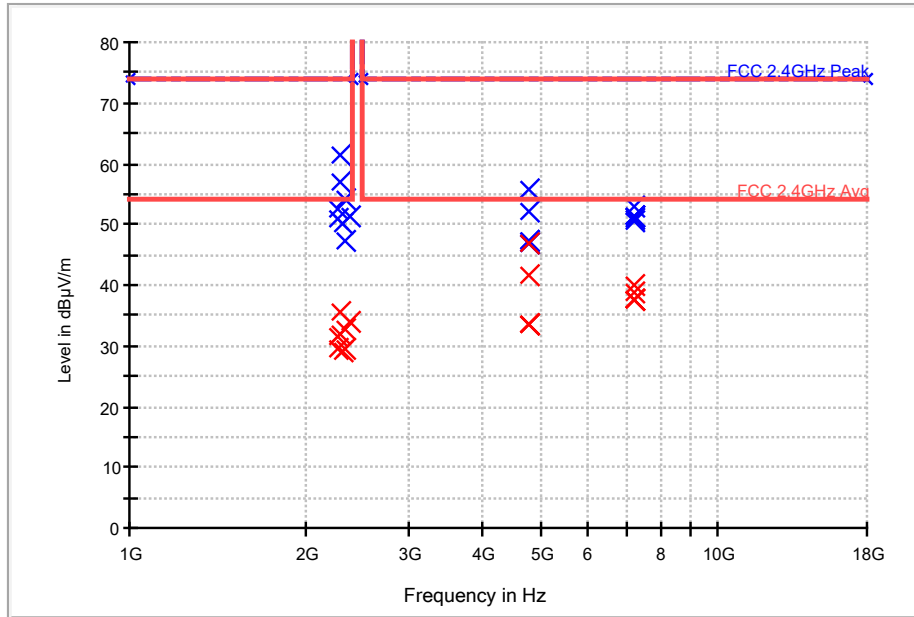
Band Edge, 2Mb: Horizontal





2Mb: Measurements, 1 GHz to 18 GHz

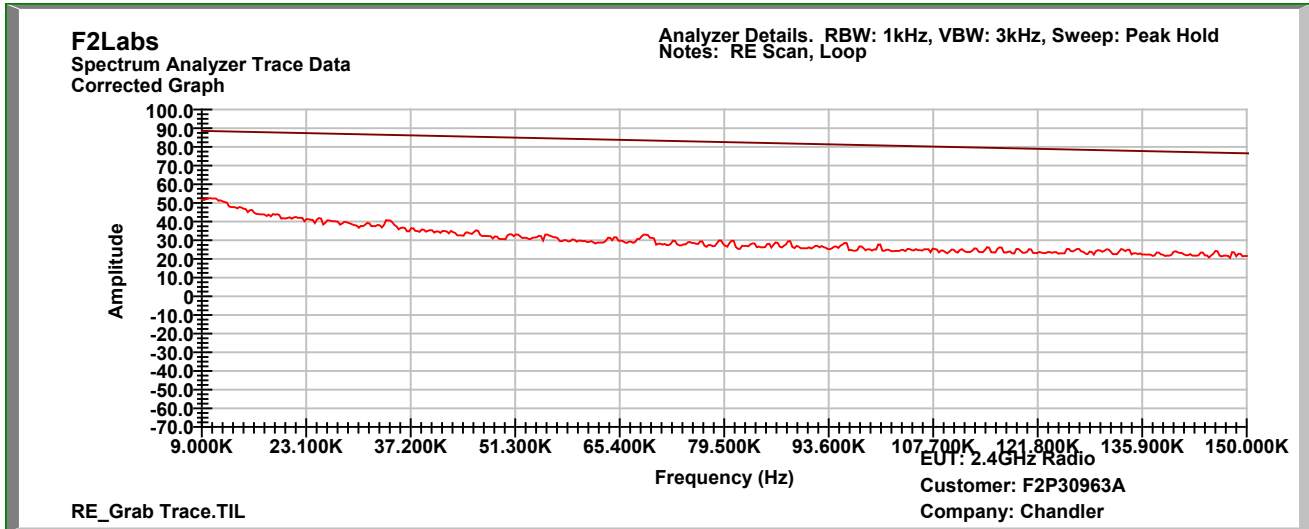
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
2263.636364	50.8	29.4	1000.0	1000.000	150.0	H	194.0	5.9	24.6	54.0
2263.636364	52.7	31.5	1000.0	1000.000	150.0	V	215.0	5.9	22.5	54.0
2290.909091	56.9	31.9	1000.0	1000.000	150.0	H	70.0	6.0	22.1	54.0
2290.909091	61.4	35.7	1000.0	1000.000	150.0	V	257.0	6.0	18.3	54.0
2309.090909	50.2	29.3	1000.0	1000.000	150.0	H	74.0	6.2	24.8	54.0
2327.272727	47.4	29.4	1000.0	1000.000	150.0	H	256.0	6.4	24.6	54.0
2327.272727	54.1	32.8	1000.0	1000.000	150.0	V	161.0	6.4	21.2	54.0
2372.727273	51.3	33.9	1000.0	1000.000	150.0	V	318.0	6.9	20.1	54.0
4804.000000	46.8	33.4	1000.0	1000.000	150.0	V	209.0	11.6	20.6	54.0
4804.000000	47.5	33.4	1000.0	1000.000	150.0	H	137.0	11.6	20.6	54.0
4804.000000	47.0	33.5	1000.0	1000.000	150.0	H	188.0	11.6	20.5	54.0
4804.000000	47.3	33.5	1000.0	1000.000	150.0	V	232.0	11.6	20.5	54.0
4804.000000	55.7	46.9	1000.0	1000.000	150.0	V	0.0	11.6	7.1	54.0
4804.000000	52.1	41.7	1000.0	1000.000	150.0	H	359.0	11.6	12.4	54.0
7206.000000	50.8	37.5	1000.0	1000.000	150.0	V	288.0	15.8	16.5	54.0
7206.000000	51.2	37.5	1000.0	1000.000	150.0	H	217.0	15.8	16.5	54.0
7206.000000	51.5	38.8	1000.0	1000.000	150.0	H	336.0	15.8	15.2	54.0
7206.000000	51.2	37.5	1000.0	1000.000	150.0	H	269.0	15.8	16.5	54.0
7206.000000	50.7	37.5	1000.0	1000.000	150.0	V	106.0	15.8	16.5	54.0
7206.000000	53.1	40.0	1000.0	1000.000	150.0	V	0.0	15.8	14.0	54.0



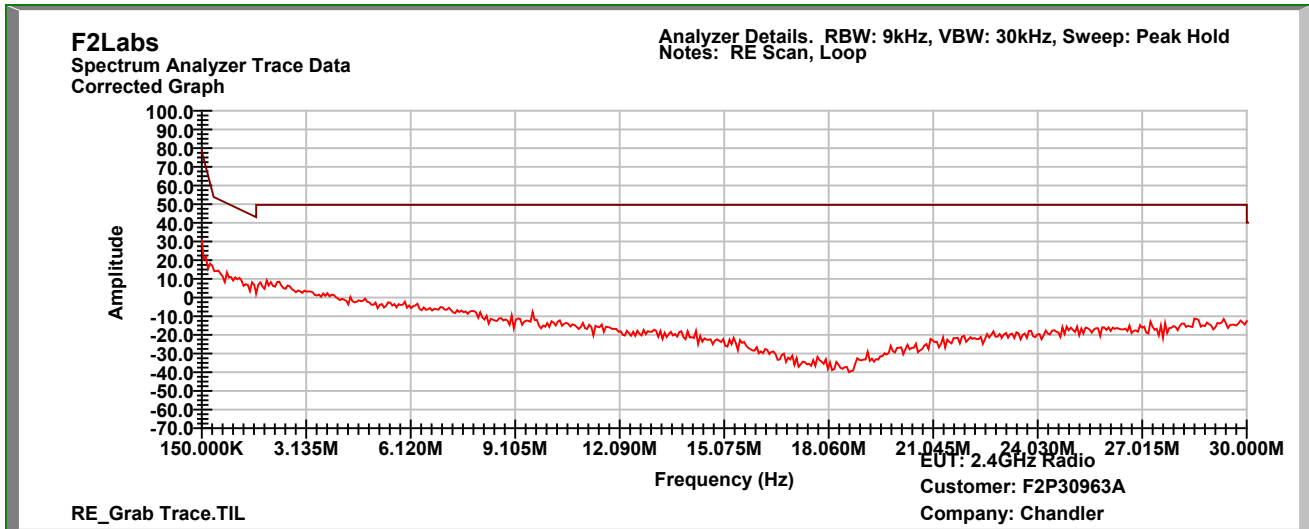


Note: Pre-scans were performed from 9kHz to 30 MHz in both 1Mbps and 2Mbps settings. The following graphs are worst-case scans from both 1Mbps and 2Mbps.

Characterization Scan: 0.009 MHz to 0.15 MHz



Characterization Scan: 0.15 MHz to 30 MHz

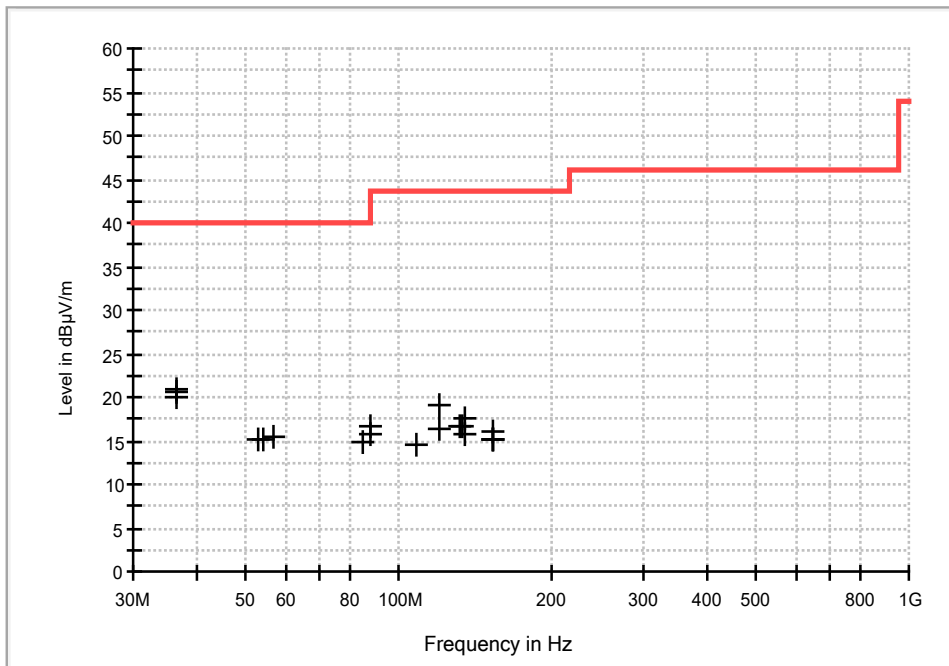




Note: The following includes measurements from both 1Mbps and 2Mbps settings.

Measurements, 30 MHz to 1000 MHz

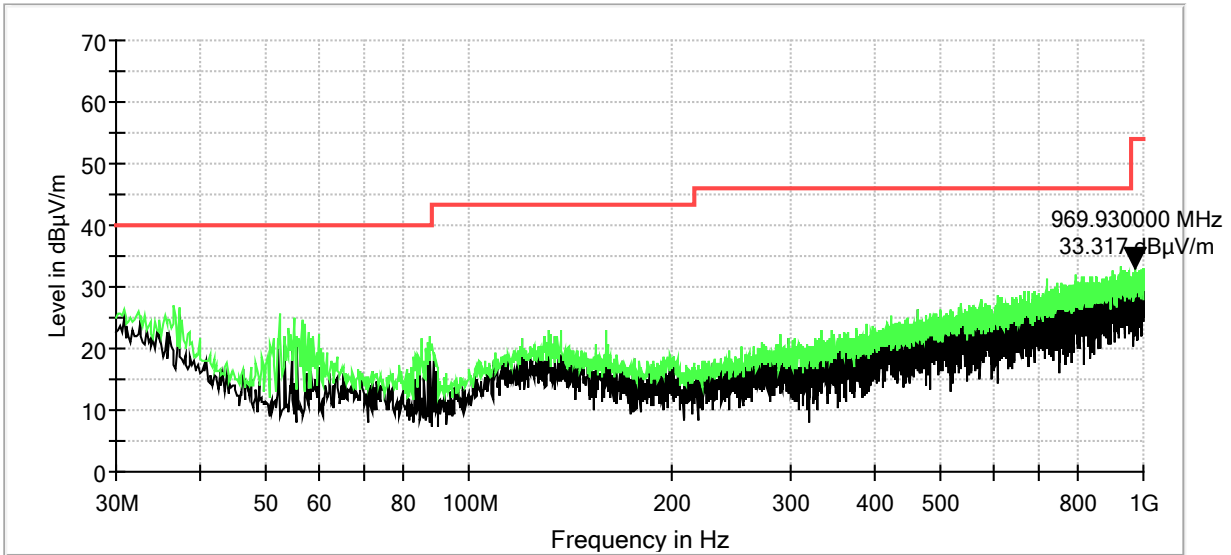
Frequency (MHz)	QuasiPeak (dBμV/m)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
36.600000	20.1	120.000	150.0	V	356.0	-24.2	19.9	40.0
36.600000	20.8	120.000	150.0	V	196.0	-24.2	19.2	40.0
36.600000	20.5	120.000	150.0	V	0.0	-24.2	19.5	40.0
52.520000	15.2	120.000	150.0	V	0.0	-32.8	24.8	40.0
54.040000	15.1	120.000	150.0	V	0.0	-32.9	24.9	40.0
56.560000	15.4	120.000	150.0	V	162.0	-32.9	24.6	40.0
85.080000	14.8	120.000	150.0	V	12.0	-32.7	25.2	40.0
87.600000	15.7	120.000	150.0	V	52.0	-32.8	24.3	40.0
87.600000	16.6	120.000	150.0	V	13.0	-32.8	23.4	40.0
108.000000	14.5	120.000	150.0	H	352.0	-27.8	29.0	43.5
119.840000	16.2	120.000	150.0	V	12.0	-26.1	27.3	43.5
120.000000	19.1	120.000	150.0	H	352.0	-26.1	24.4	43.5
131.280000	16.8	120.000	150.0	V	12.0	-26.0	26.7	43.5
132.440000	16.8	120.000	150.0	V	12.0	-26.0	26.7	43.5
133.800000	15.8	120.000	150.0	H	169.0	-26.1	27.7	43.5
133.800000	17.7	120.000	150.0	H	233.0	-26.1	25.8	43.5
152.040000	15.9	120.000	150.0	H	273.0	-27.0	27.6	43.5
152.040000	15.3	120.000	150.0	H	209.0	-27.0	28.2	43.5
152.040000	15.2	120.000	150.0	H	162.0	-27.0	28.3	43.5
152.040000	15.2	120.000	150.0	H	177.0	-27.0	28.3	43.5



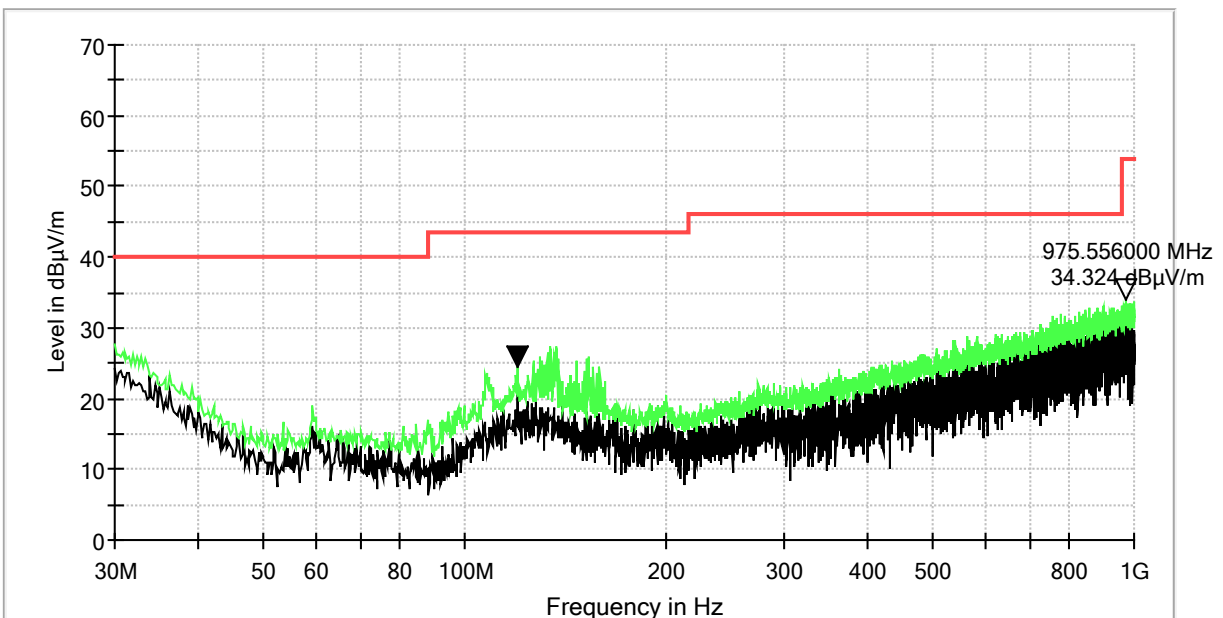


Note: Pre-scans were performed from 30 MHz to 1000 MHz in both 1Mbps and 2Mbps settings. The following graphs are worst-case scans from both 1Mbps and 2Mbps.

Characterization Scan: 30 MHz to 1000 MHz - Vertical

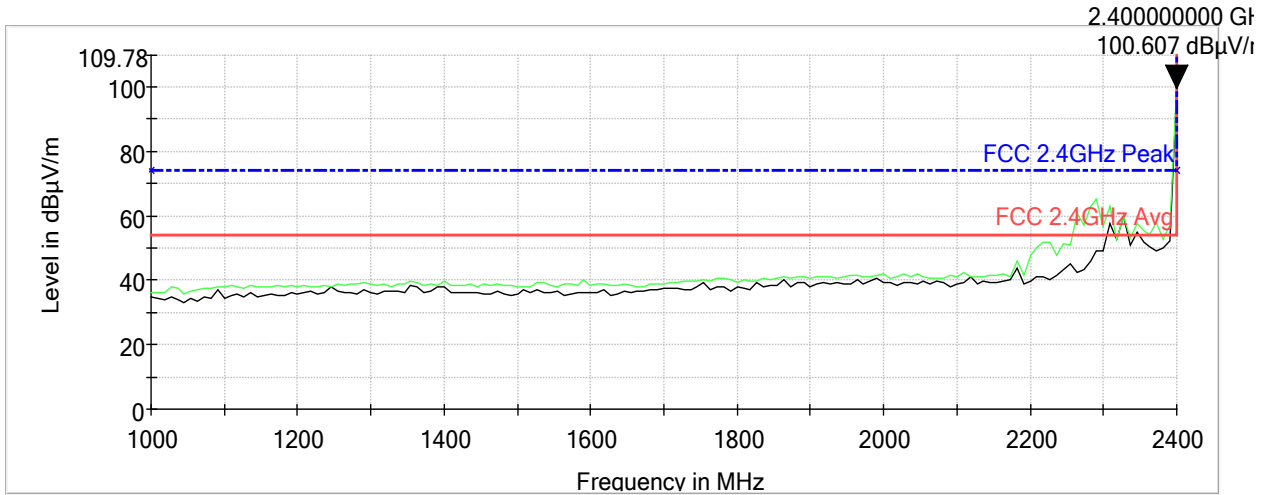


Characterization Scan: 30 MHz to 1000 MHz - Horizontal

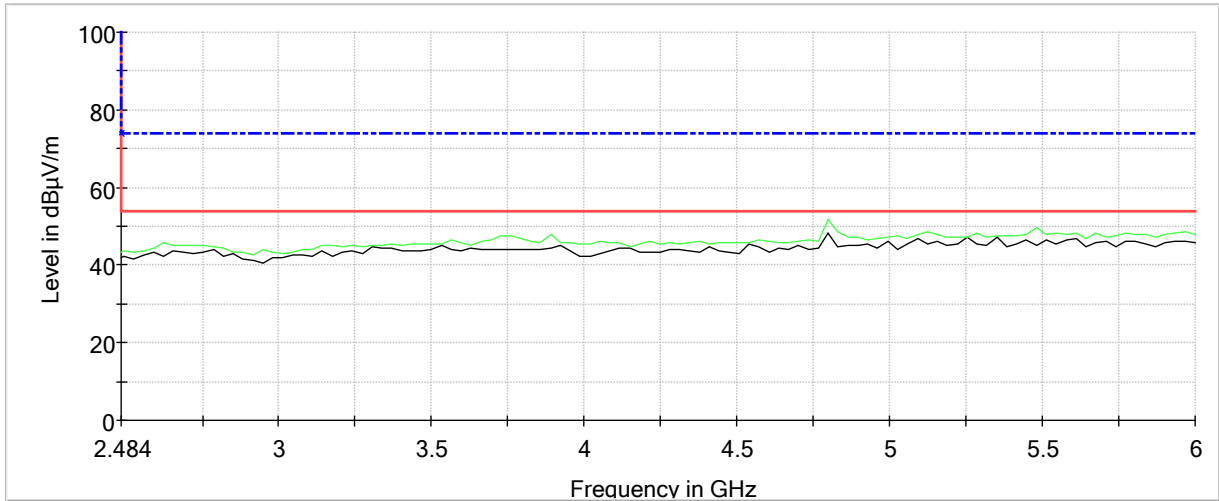




2Mb, Characterization Scan: 1 GHz to 2.4 GHz - Vertical

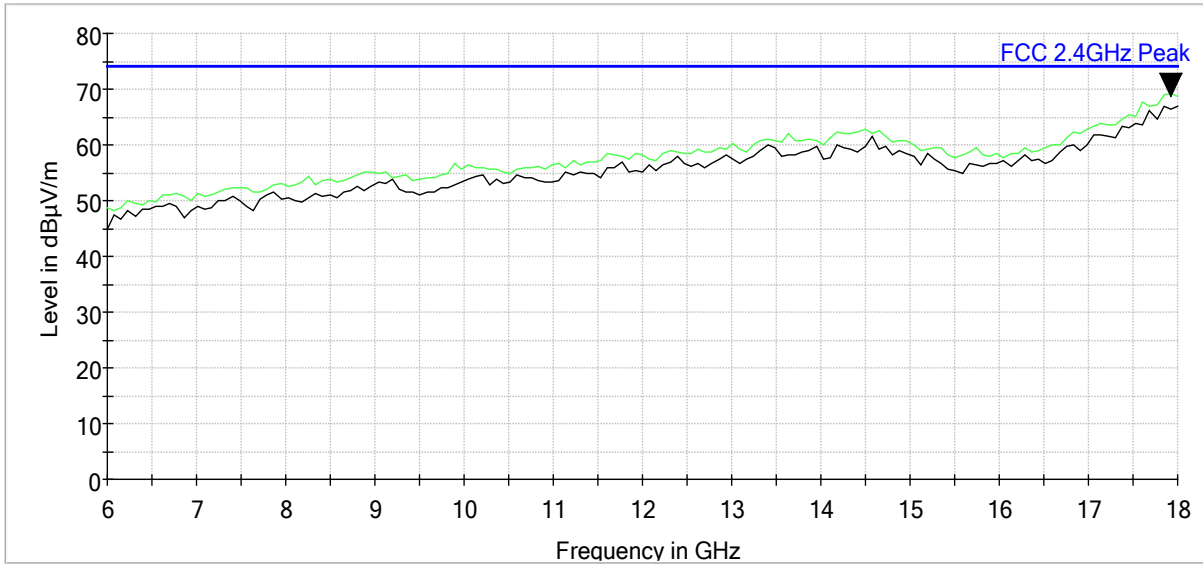


2Mb, Characterization Scan: 2.48 GHz to 6 GHz – Vertical

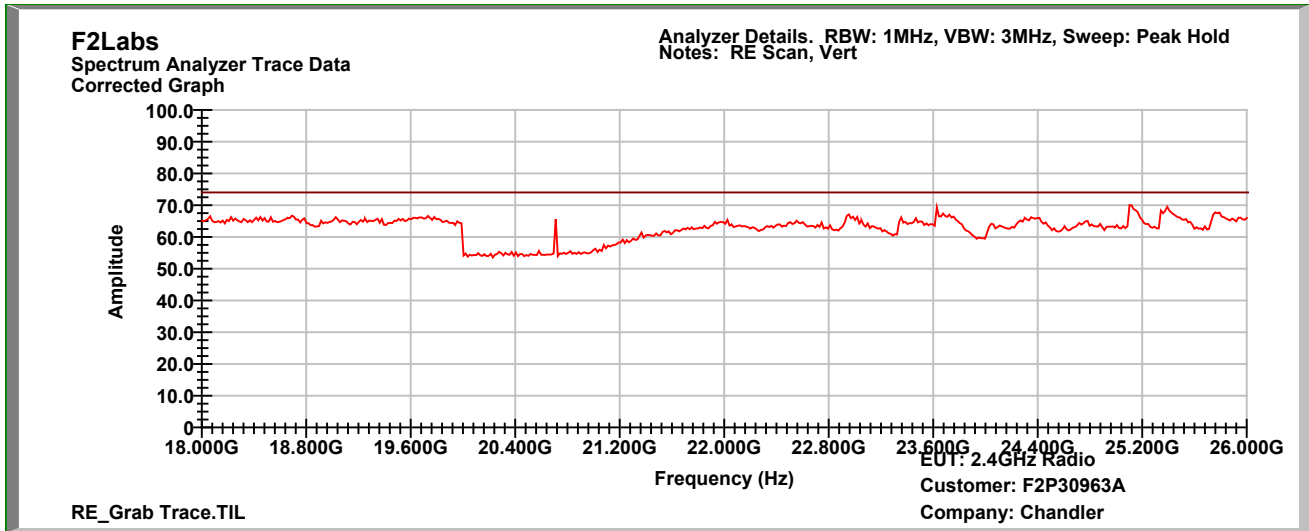




2Mb, Characterization Scan: 6 GHz to 18 GHz - Vertical

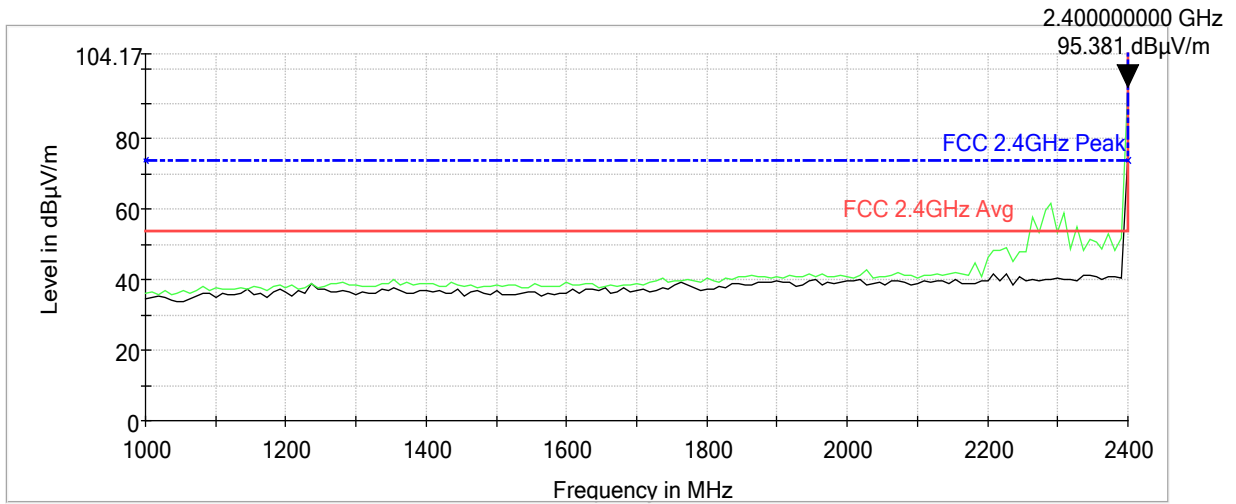


2Mb, Characterization Scan: 18 GHz to 26 GHz – Vertical

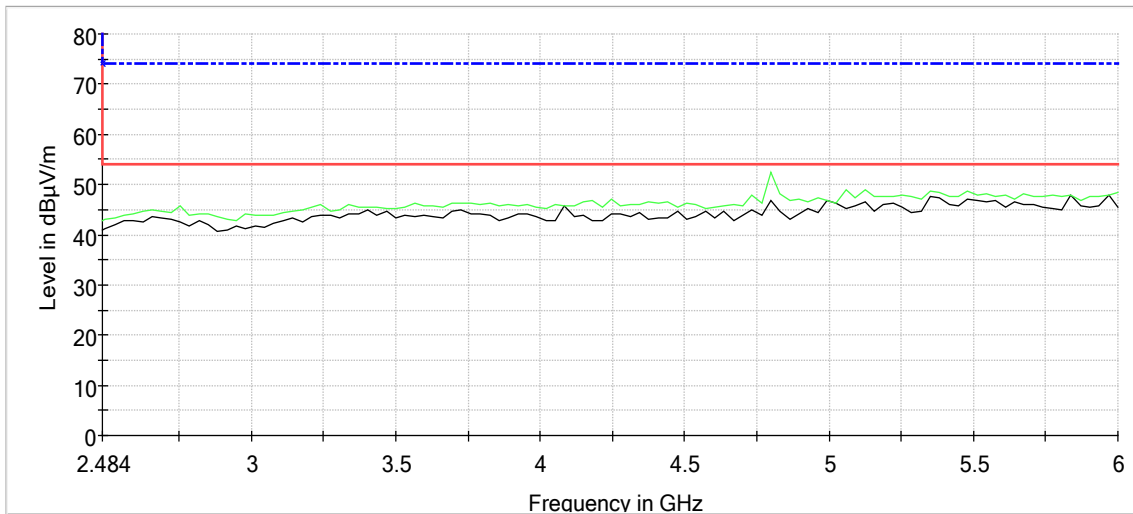




2Mb, Characterization Scan: 1 GHz to 2.4 GHz - Horizontal

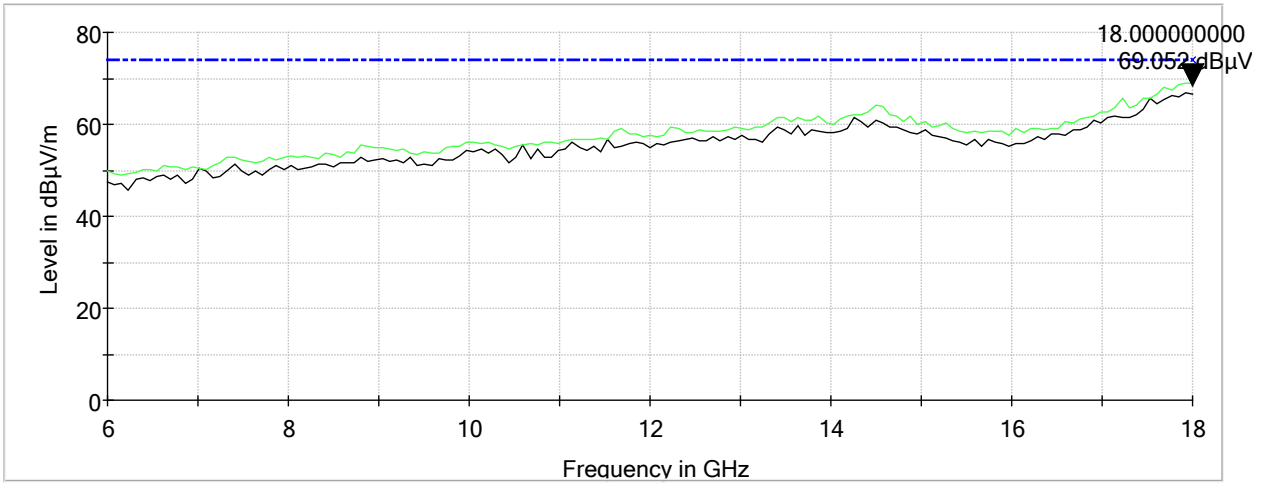


2Mb, Characterization Scan: 2.48 GHz to 6 GHz – Horizontal

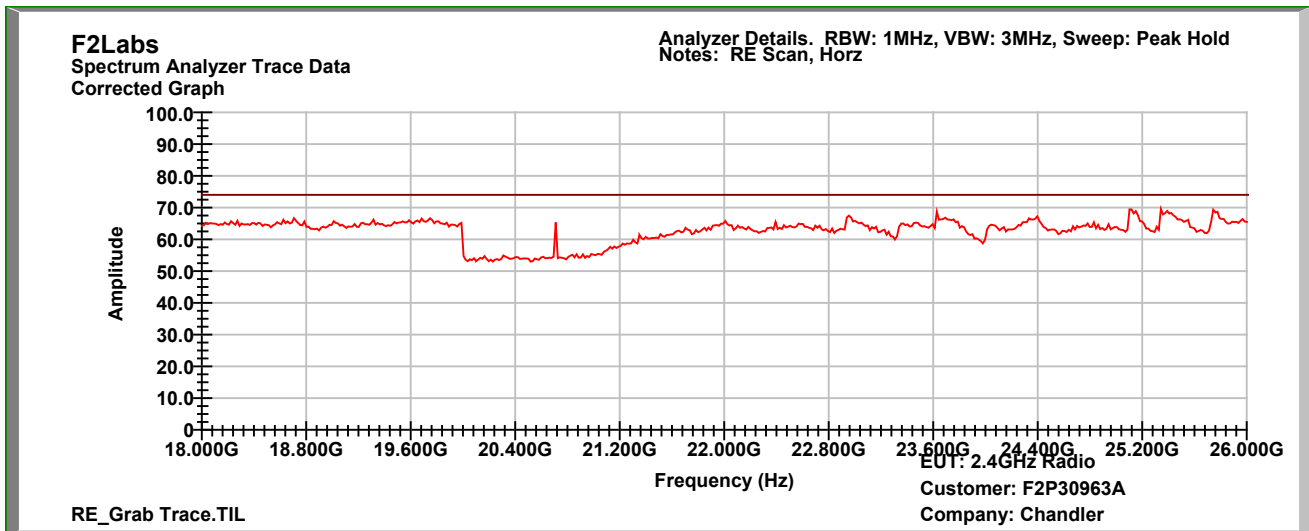




2Mb, Characterization Scan: 6 GHz to 18 GHz - Horizontal



2Mb, Characterization Scan: 18 GHz to 26 GHz – Horizontal





12 PEAK POWER SPECTRAL DENSITY (PSD)

Peak power spectral density measurements were performed.

12.1 Requirements:

The peak power spectral density shall not exceed +8dBm in any 3 kHz band during any time interval of continuous transmission.

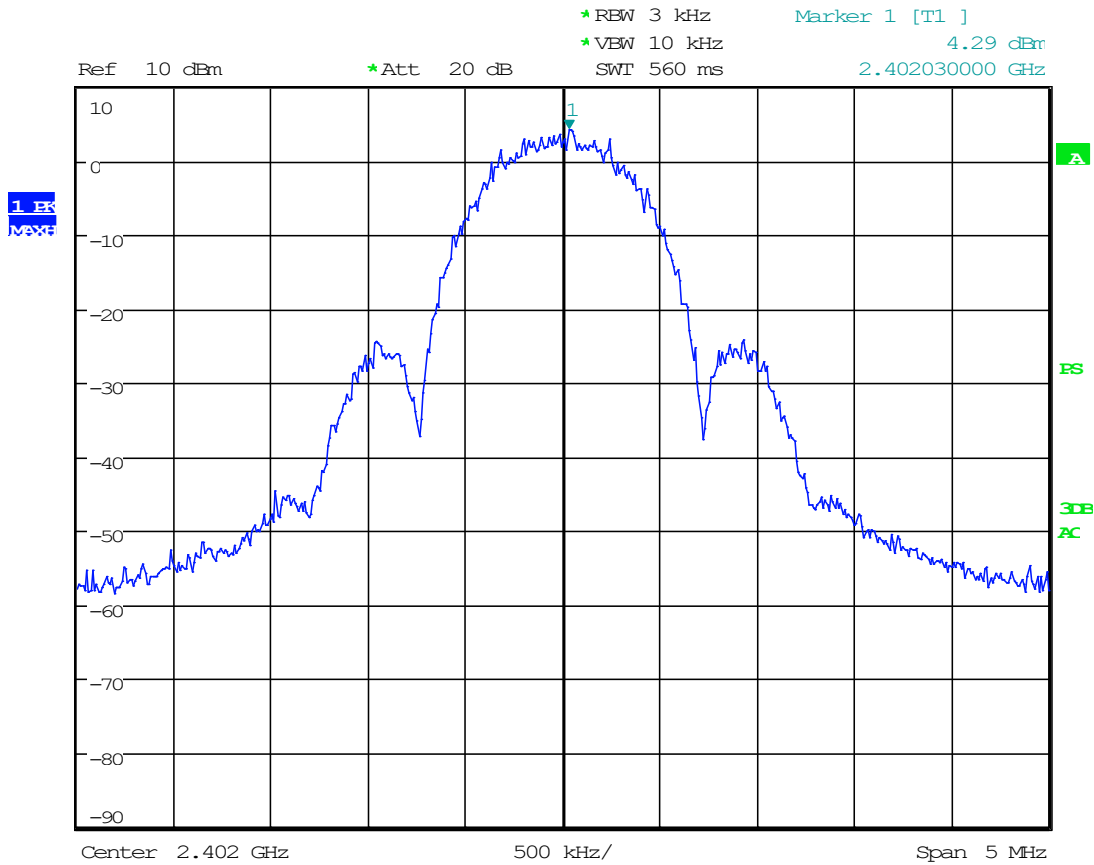
Power spectral density measurements were performed at a resolution bandwidth of 3 kHz (video bandwidth set at 10 KHz). The peak spectral densities were measured at the low, mid, and upper channels.



12.2 Peak Power Spectral Density Test Data

Test Date(s):	2023-12-04	Test Engineer:	J. Chiller
Standards:	CFR 47 Part 15.247(e); KDB558074	Air Temperature:	21.1°C
		Relative Humidity:	36%

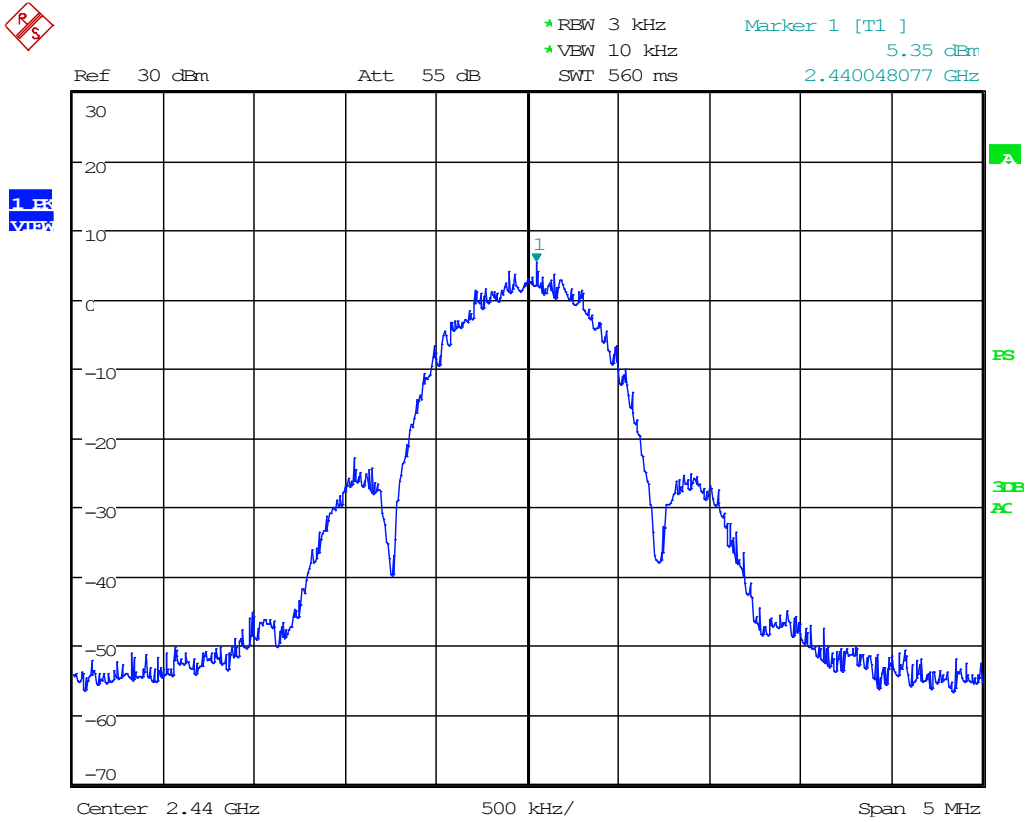
1Mb: Low Channel



Date: 8.DEC.2023 12:30:06



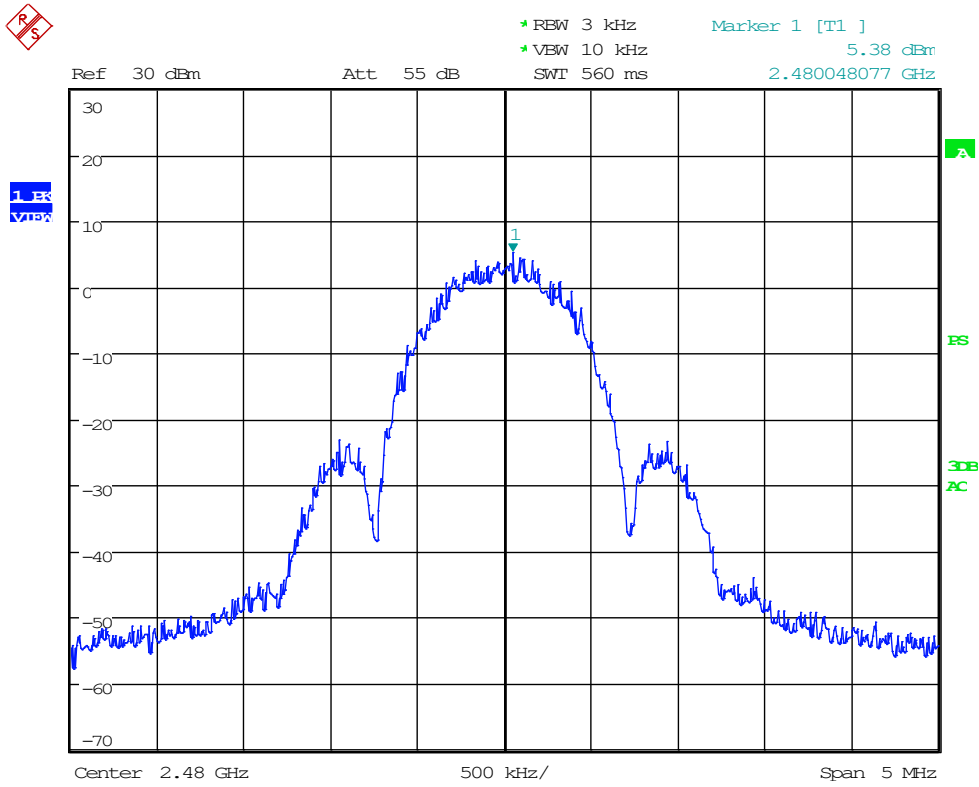
1Mb: Mid Channel



Date: 4.DEC.2023 10:32:59



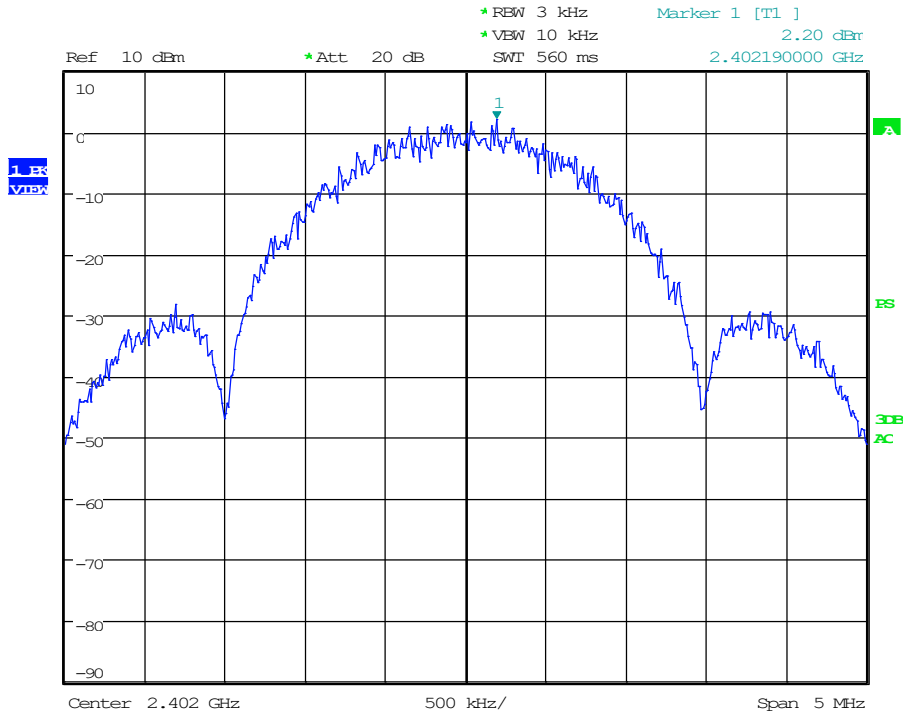
1Mb: High Channel



Date: 4.DEC.2023 10:33:47



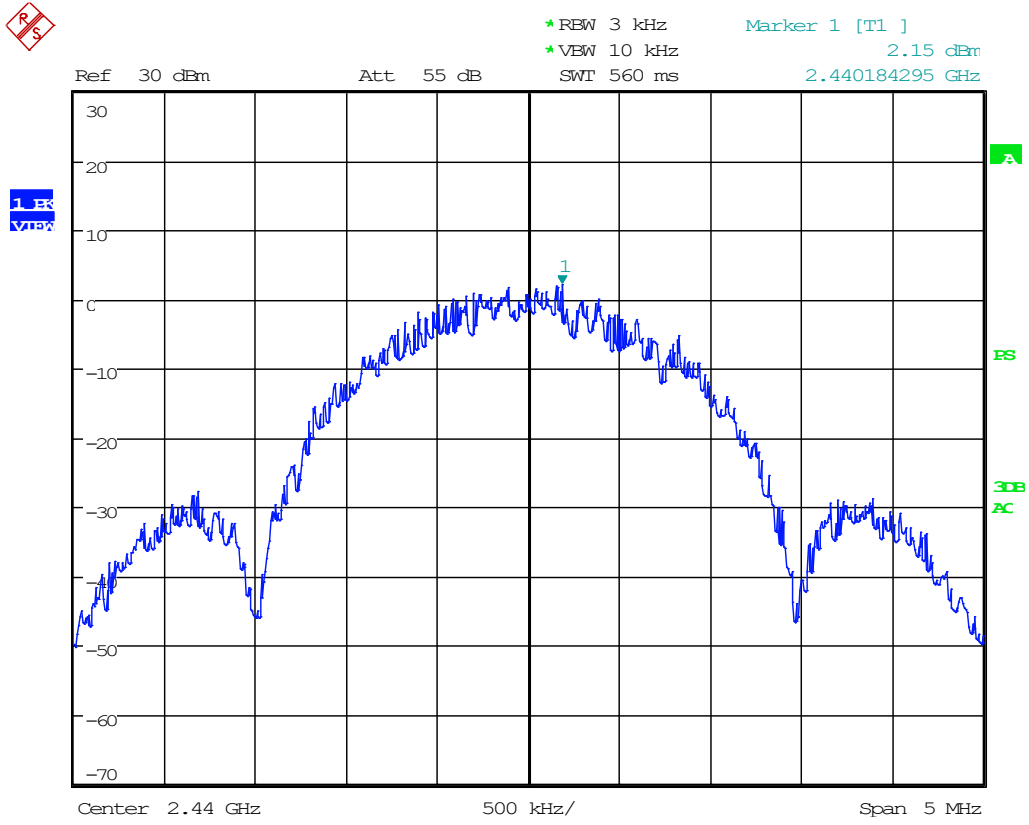
2Mb: Low Channel



Date: 8.DEC.2023 12:28:16



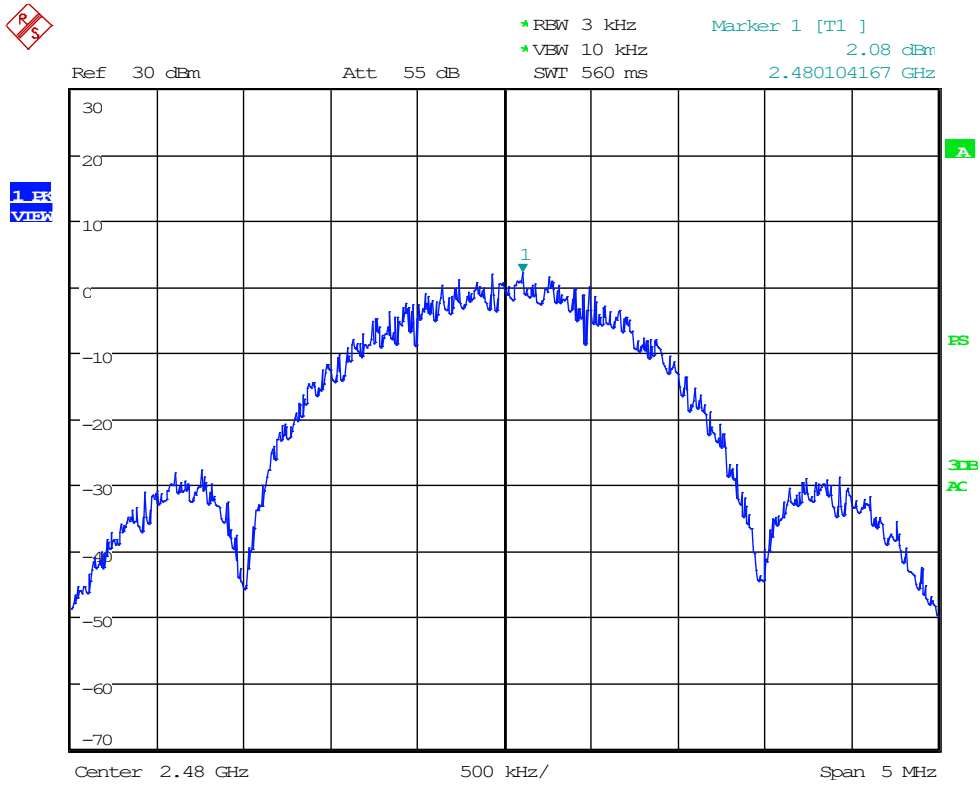
2Mb: Mid Channel



Date: 4.DEC.2023 10:40:36



2Mb: High Channel



Date: 4.DEC.2023 10:34:53



13 CONDUCTED EMISSIONS

13.1 Requirements

In accordance with FCC CFR 47 Part 15.207(a), "Except as shown in paragraphs (b) and (c) of this section, for 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 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

13.2 Procedure

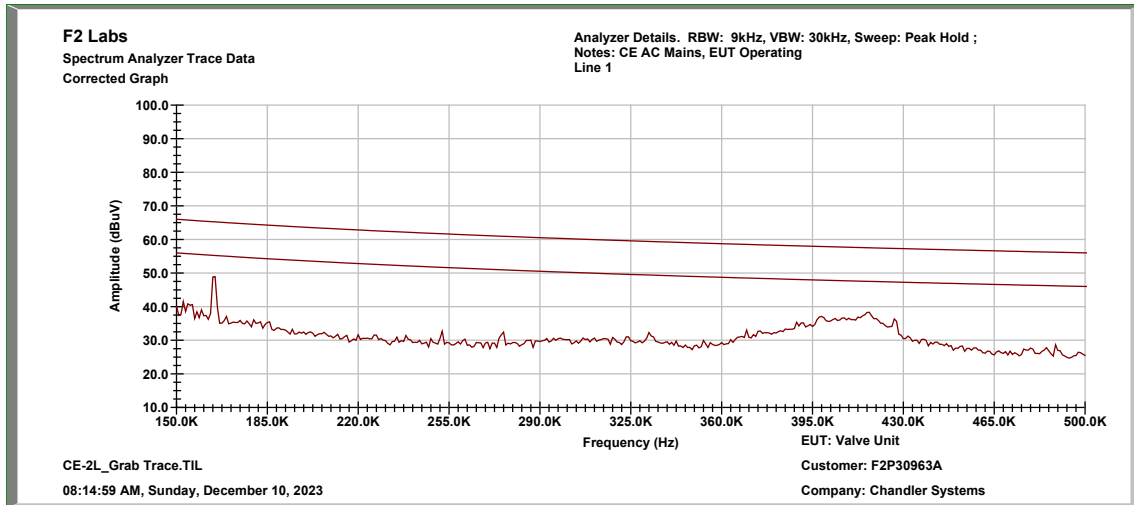
The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver via a transient limiter, and emissions in the range 150 kHz to 30 MHz were measured. The measurements were recorded using the quasi-peak and average detectors as directed by the standard, and the resolution bandwidth during testing was 9 kHz. The raw measurements were corrected to allow for attenuation from the LISN, transient limiter and cables.



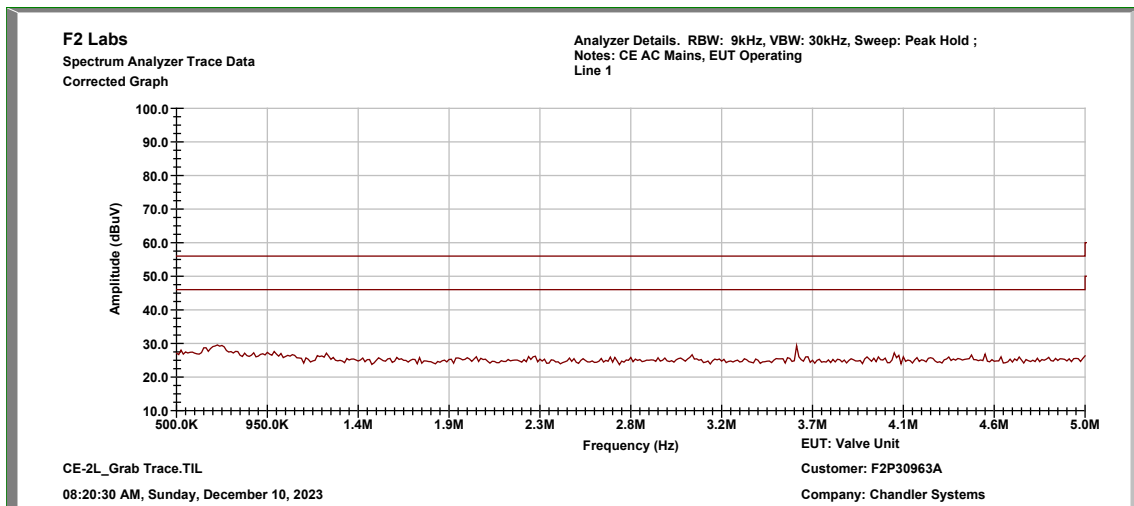
13.3 Conducted Emissions Test Data

Test Date:	2023-12-11	Test Engineer:	J. Chiller
Rule:	15.207	Air Temperature:	21.2° C
Test Results:	Pass	Relative Humidity:	44%

Conducted Test – Live: 0.15 MHz to 0.5 MHz

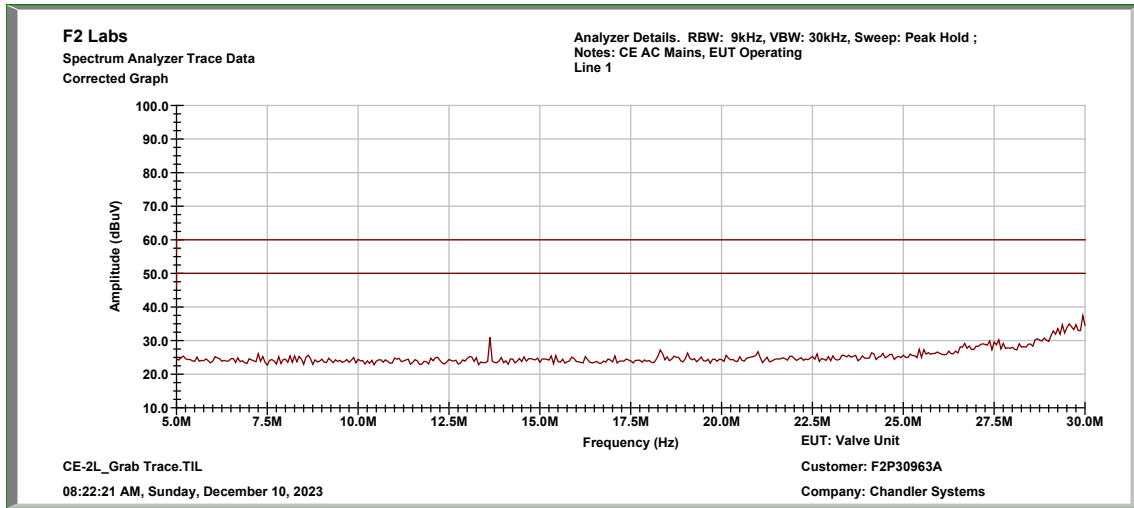


Conducted Test – Live: 0.5 MHz to 5.0 MHz





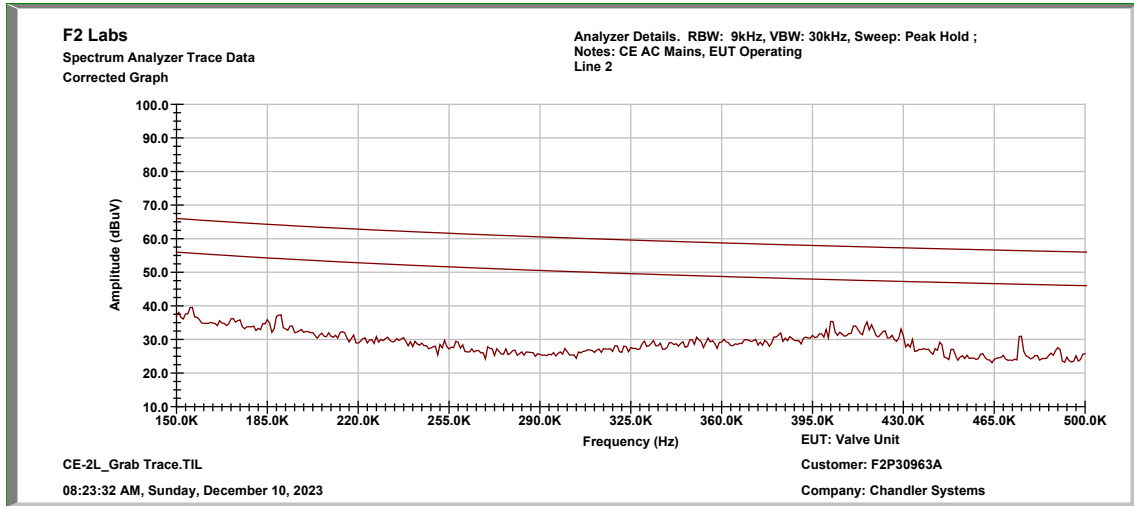
Conducted Test – Live: 5.0 MHz to 30.0 MHz



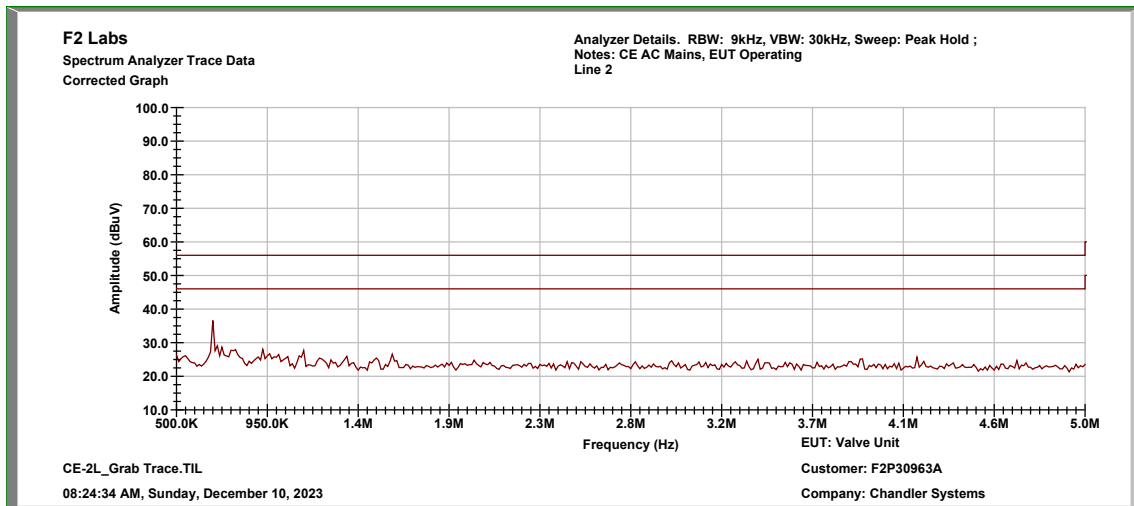
Note: Peak scans below AVG limit.



Conducted Test – Neutral: 0.15 MHz to 0.5 MHz

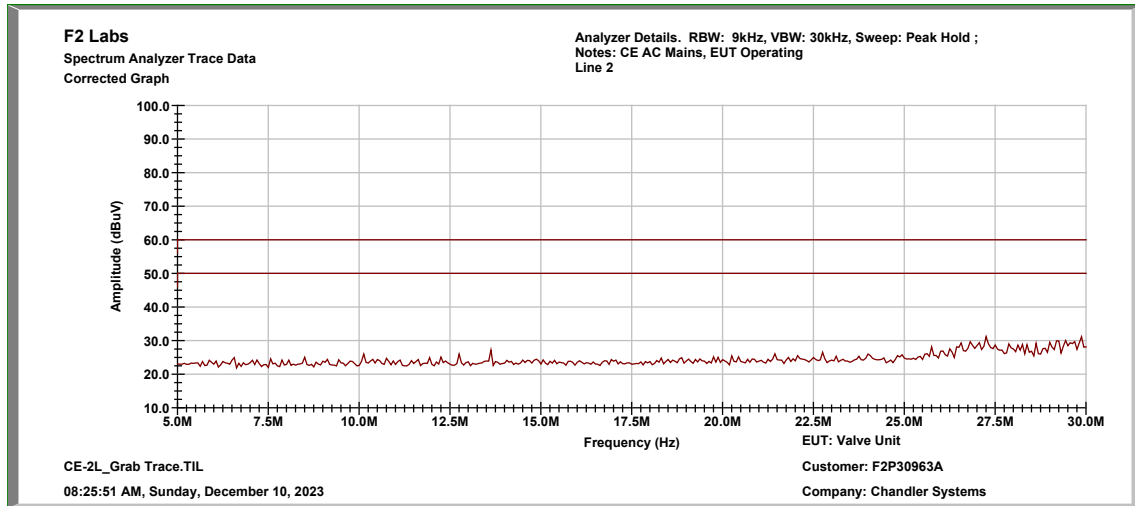


Conducted Test – Neutral: 0.5 MHz to 5.0 MHz





Conducted Test – Neutral: 5.0 MHz to 30.0 MHz



Note: Peak scans below AVG limit.



14 TEST SETUP PHOTOGRAPH(S)

Radiated Spurious Emission – Loop Antenna

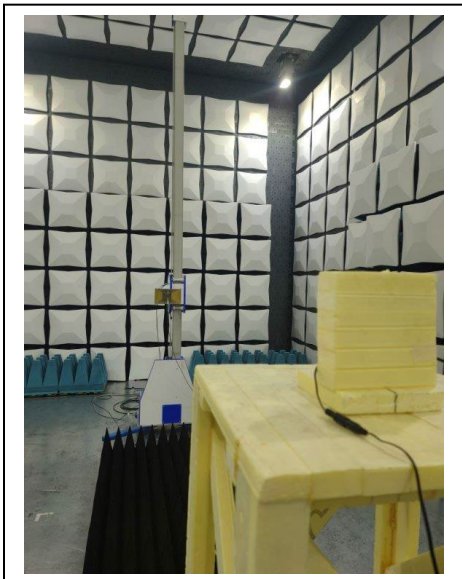


Radiated Spurious Emission – 30 MHz to 1000 MHz



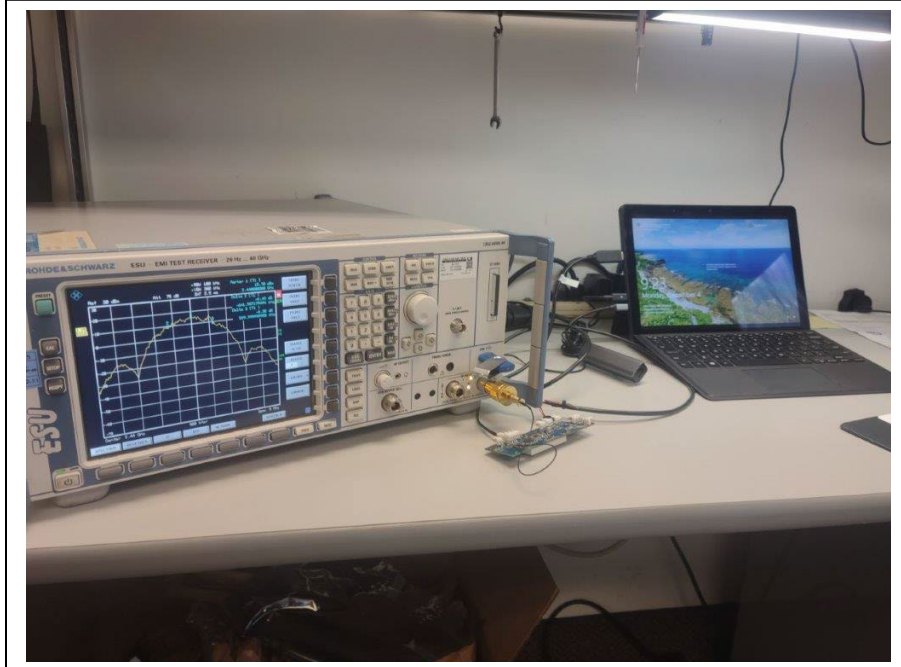
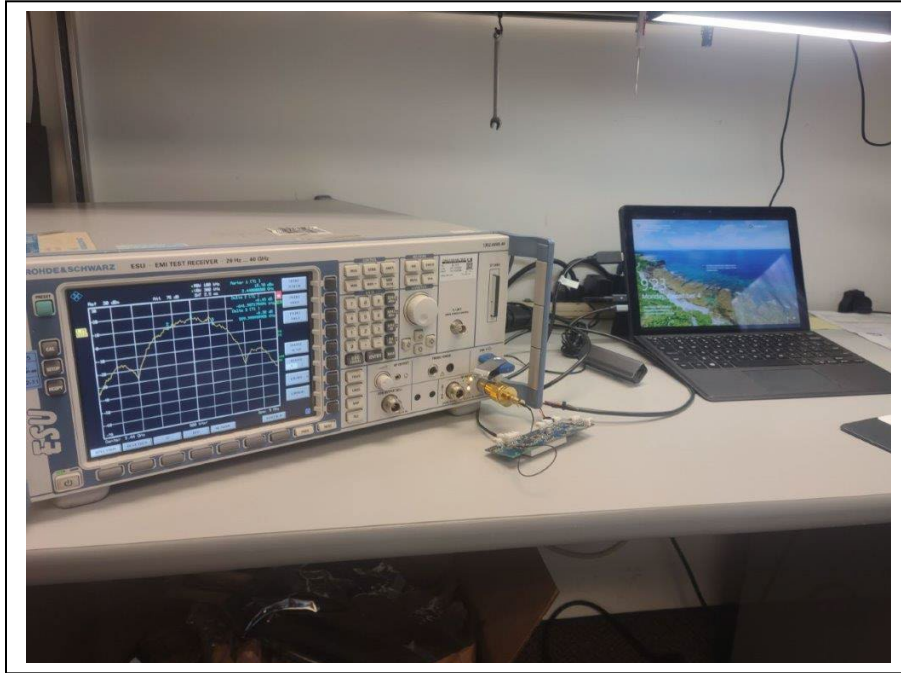


Radiated Spurious Emission – Above 1 GHz



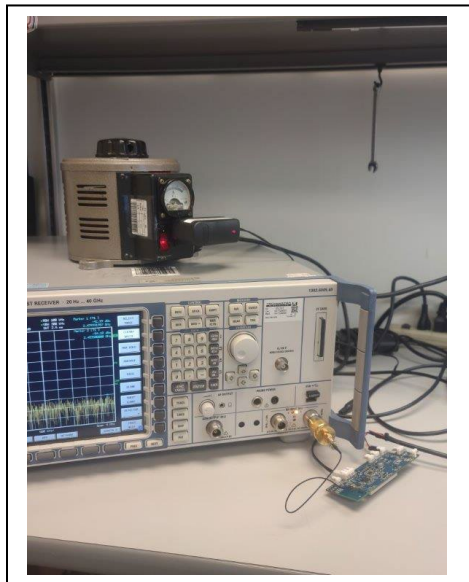
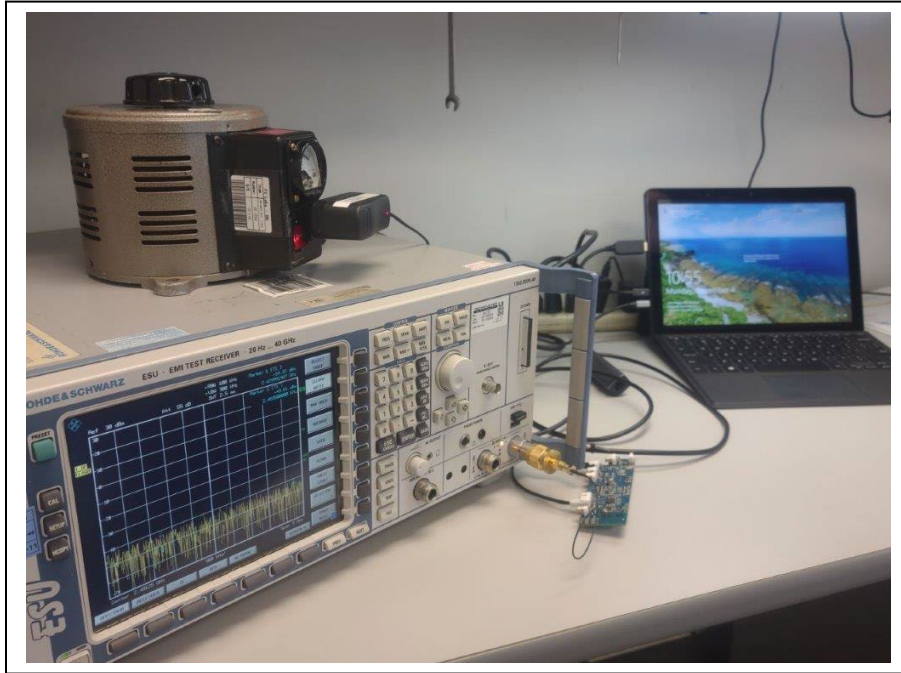


Conducted Output Power, Peak Power Spectral Density, Occupied Bandwidth, and Conducted Spurious Emissions





Voltage Variations





Conducted Emissions

