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CERTIFICATION TEST REPORT

Manufacturer: Giesecke+Devrient Mobile Security GmbH
Prinzregentenstrasse 159
81677 Munich
GERMANY

Applicant: Same as Above

Product Name: StarSign® Key Fob

Product Description: The StarSign Key Fob is a full featured biometric identity and authentication device. It allows users the one touch ability to access, approvals, payments.

Operating Voltage/Freq. of EUT During Testing: Battery-Operated

Model: ST-10

FCC ID: TIJ-KEYFOBST10

Testing Commenced: 2021-08-24

Testing Ended: 2021-09-02

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.

Standards:

- ❖ **FCC Part 15 Subpart C, Section 15.249**
- ❖ **FCC Part 15 Subpart C, Section 15.215(c) – Additional provisions to the general radiated emission limitations**
- ❖ **FCC Part 15 Subpart A, Section 15.31(e) – Measurement Standards**



Evaluation Conducted by:

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Report Reviewed by:

Ken Littell, Vice President of EMC

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TABLE OF CONTENTS

Section	Title	Page
1	ADMINISTRATIVE INFORMATION	4
2	SUMMARY OF TEST RESULTS/MODIFICATIONS	7
3	TABLE OF MEASURED RESULTS	8
4	ENGINEERING STATEMENT	9
5	EUT INFORMATION AND DATA	10
6	LIST OF MEASUREMENT INSTRUMENTATION	11
7	OCCUPIED BANDWIDTH	12
8	FIELD STRENGTH OF EMISSIONS	19
9	PHOTOGRAPHS, TEST SETUPS	29



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 the 2013 version of ANSI C63.10 and recommended FCC procedure of measurement of DXT operating under Section 15.249. 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 using a coverage factor of $k=2$. The Uncertainty for a laboratory is referred to as U_{lab} . For Radiated and Conducted Emissions, the Expanded Uncertainty is compared to the U_{cispr} values to determine if a specific margin is required to deem compliance.

U_{lab}

Measurement Range	Combined Uncertainty	Expanded Uncertainty
Radiated Emissions <1 GHz @ 3m	2.54	5.07dB
Radiated Emissions <1 GHz @ 10m	2.55	5.09dB
Radiated Emissions 1 GHz to 2.7 GHz	1.81	3.62dB
Radiated Emissions 2.7 GHz to 18 GHz	1.55	3.10dB
AC Power Line Conducted Emissions, 150kHz to 30 MHz	1.38	2.76dB
AC Power Line Conducted Emissions, 9kHz to 150kHz	1.66	3.32dB

U_{cispr}

Measurement Range	Expanded Uncertainty
Radiated Emissions <1 GHz @ 3m	5.2dB
Radiated Emissions <1 GHz @ 10m	5.2dB
Radiated Emissions 1 GHz to 2.7 GHz	Under Consideration
Radiated Emissions 2.7 GHz to 18 GHz	Under Consideration
AC Power Line Conducted Emissions, 150kHz to 30 MHz	3.6dB
AC Power Line Conducted Emissions, 9kHz to 150kHz	4.0dB

If U_{lab} is less than or equal to U_{cispr} , then:

- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} in table 1, then:

- compliance is deemed to occur if no measured disturbance, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit.

Note: Only measurements listed in the tables above that relate to tests included in this Test Report are applicable.



1.4 Document History:

Document Number	Description	Issue Date	Approved By
F2P25620C-01E	First Issue	2021-09-13	K. Littell



2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
99% Occupied Bandwidth	CFR 47 Part 15.215(c)	Complies
-20dB Occupied Bandwidth	CFR 47 Part 15.215(c)	Complies
Field Strength of Emissions	CFR 47 Part 15.249(a)(d)	Complies
Variation of the Input Power	CFR 47 Part 15.231(e)	Complies*
Conducted Emissions	CFR 47 Part 15.207(a)	N/A

**Requirements were met by using new batteries.*

Modifications Made to the Equipment
None

3 TABLE OF MEASURED RESULTS

Test	Low Channel 2402 MHz	Mid Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength of Fundamental	70.4dB μ V/m, 3.3mV/m	71.3dB μ V/m, 3.7mV/m	69.1dB μ V/m, 2.85mV/m
Average Limit for Fundamental	50 millivolts/meter (93.97 dB μ V/m)	50 millivolts/meter (93.97 dB μ V/m)	50 millivolts/meter (93.97 dB μ V/m)
Peak Field Strength of Fundamental	76.1 dB μ V/m 6.3 mV/m	77.0dB μ V/m 7.1 mV/m	74.5dB μ V/m 5.3 mV/m
Peak Limit for Fundamental	113.97 dB μ V/m	113.97 dB μ V/m	113.97 dB μ V/m
-20dB Occupied Bandwidth	1.009 MHz	1.097 MHz	1.065 MHz
99% Occupied Bandwidth (MHz)	1.037 MHz	1.037 MHz	1.013 MHz

The -20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.



4 ENGINEERING STATEMENT

This report has been prepared on behalf of Giesecke+Devrient Mobile Security GmbH to provide documentation for the testing described herein. This equipment has been tested and found to comply with part 15.249 of the FCC Rules using ANSI C63.10 2013 standard. 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: **StarSign® Key Fob**

Model: ST10

Serial No.: 0064

Firmware: 1.0.1

Hardware: 1.2L

FCC ID: TIJ-KEYFOBST10

5.2 Trade Name:

Giesecke+Devrient Mobile Security GmbH

5.3 Power Supply:

Battery-Operated

5.4 Applicable Rules:

CFR 47, Part 15.249, subpart C

5.5 Equipment Category:

Radio Transmitter-DXT

5.6 Antenna:

Integral Antenna, 0.5dBi Gain

5.7 Accessories:

Device	Manufacturer	Model Number	Serial Number
Laptop	Dell	7490	25215332294
Charger	Apple	A1385	None Specified
UART Interface	Deek-Rodot	None Specified	None Specified

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was set up to transmit a modulated signal on the lowest, mid and highest frequency in the 2.4 GHz band. The EUT was tested with a fully charged battery.



6 LIST OF MEASUREMENT INSTRUMENTATION

Equipment Type	Asset Number	Manufacturer	Model	Serial Number	Calibration Due Date
Shielded Chamber 2014	CL166-E	AlbatrossProjects	B83117-DF435-T261	US140023	2022-03-09
Temp/Hum. Recorder	CL232	Extech	445814	01	2022-03-04
Spectrum Analyzer	0141	Hewlett Packard	8591E	3520A04145	2022-05-07
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2022-07-08
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	2021-11-05
Horn Antenna	CL098	Emco	3115	9809-5580	2022-01-08
Horn Antenna	CL114	A.H. Systems, Inc.	SASs-572	237	2023-07-30
Pre-Amplifier	CL153	Agilent	83006-69007	MY57280115	2022-02-12
Preamplifier	CL285	A.H. Systems, Inc.	PAM-0207	322	2022-07-08
Amplifier w/Monopole & 18" Loop	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	2021-10-15
Software:	Tile Version 3.4.B.3.		Software Verified: 2021-08-24 to 2021-09-02		
Software:	EMC 32, Version 8.53.0		Software Verified: 2021-08-24 to 2021-09-02		
Temp/Hum. Recorder	CL234	Extech	445814	03	2022-03-08
Transient Limiter	0202	Hewlett Packard	11947A	3107A00729	2022-02-04
LISN	CL181	Com-Power	LI-125A	191226	2023-12-01
LISN	CL182	Com-Power	LI-125A	191225	2023-12-01



7 FCC PART 15.215(e), OCCUPIED BANDWIDTH

7.1 Requirements:

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the -20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

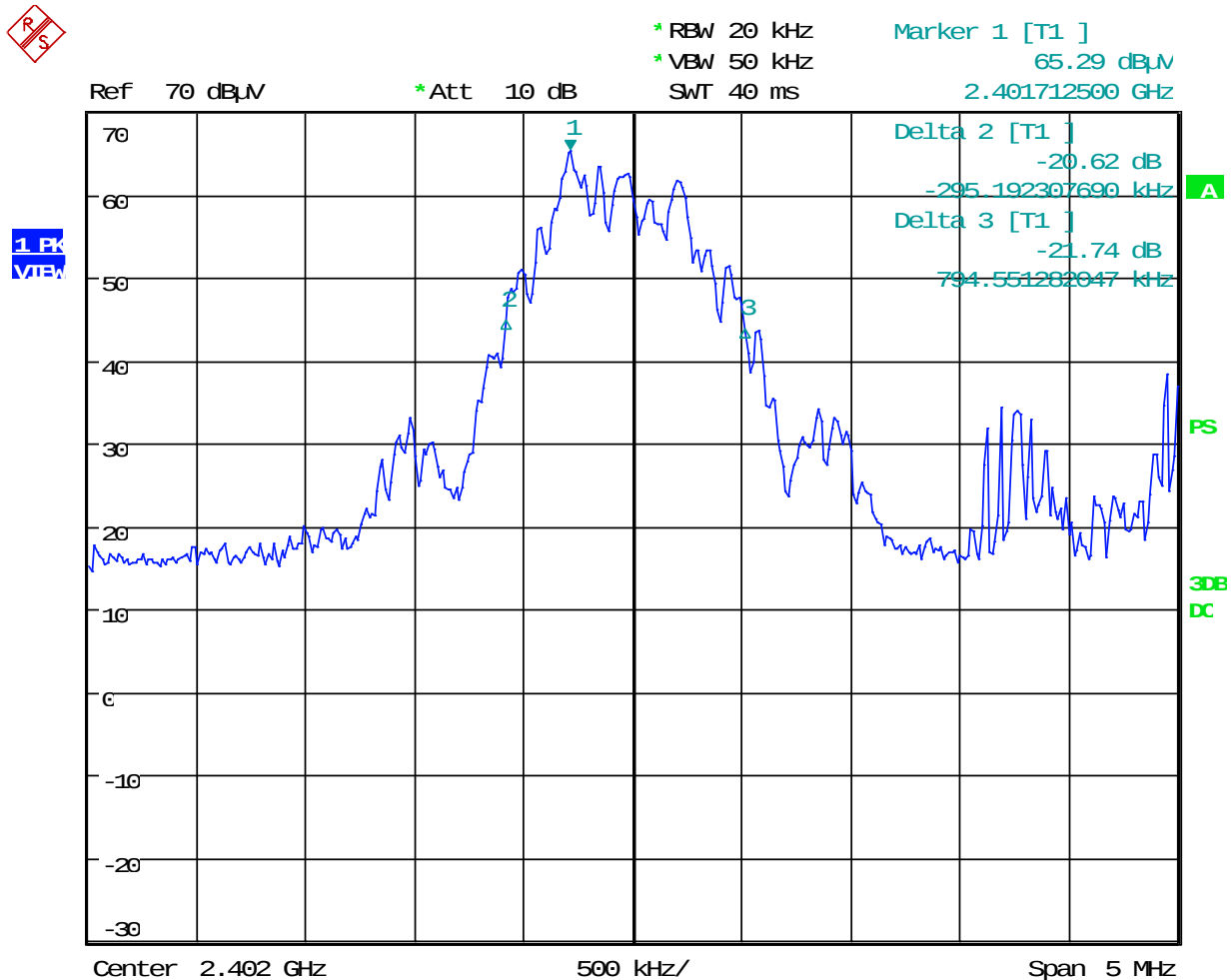
Bandwidth measurements were made at the low (2.402 GHz), mid (2.440 GHz) and upper (2.480 GHz) frequencies. The -20dB bandwidth was measured using the marker delta method.



7.2 Occupied Bandwidth Test Data

Test Date(s):	2021-08-24	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.215(c)	Air Temperature:	23.4°C
		Relative Humidity:	50%

-20dB, Low Channel



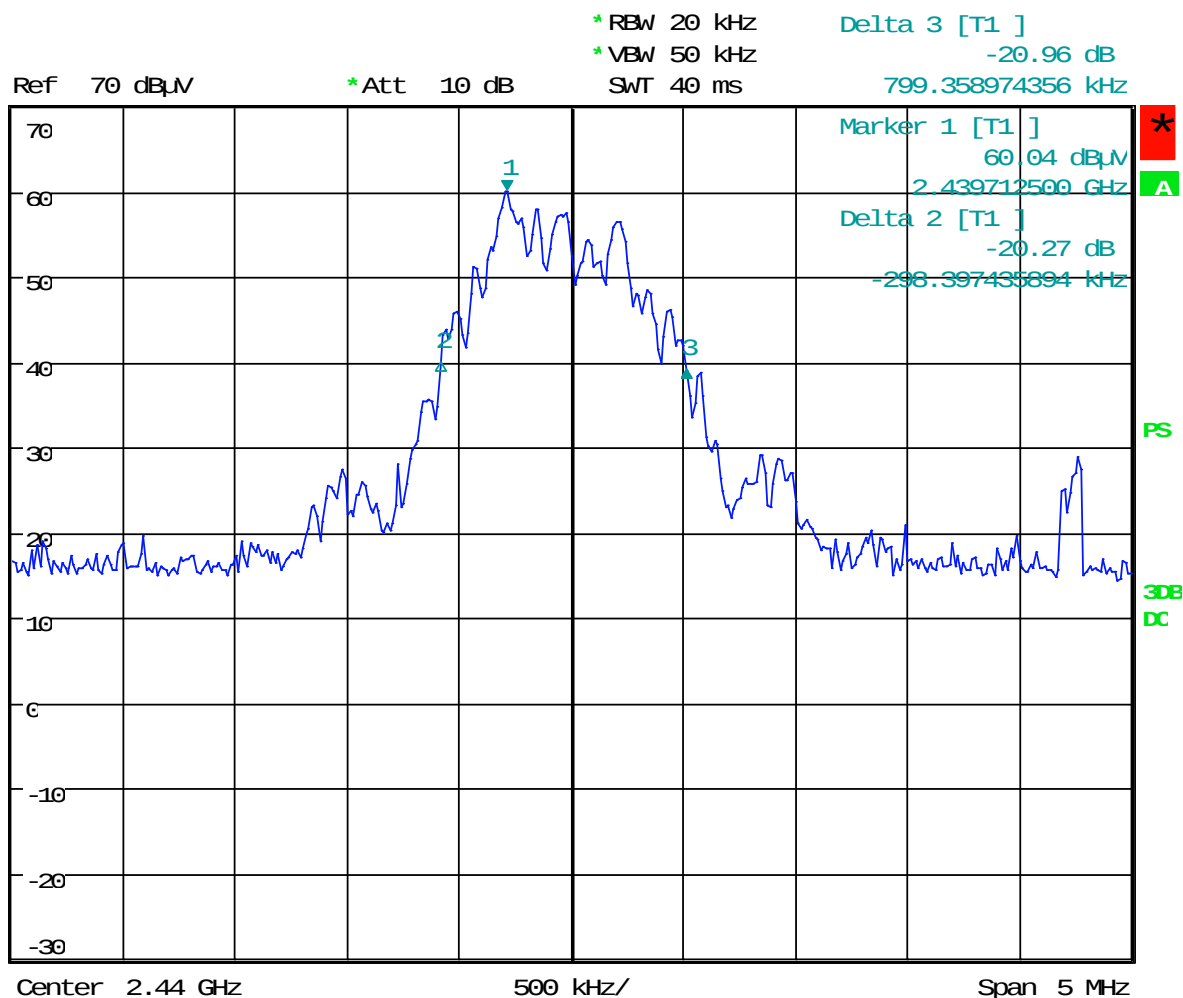
Date: 24.AUG.2021 18:15:12



-20dB, Mid Channel



1 PK
VIEW



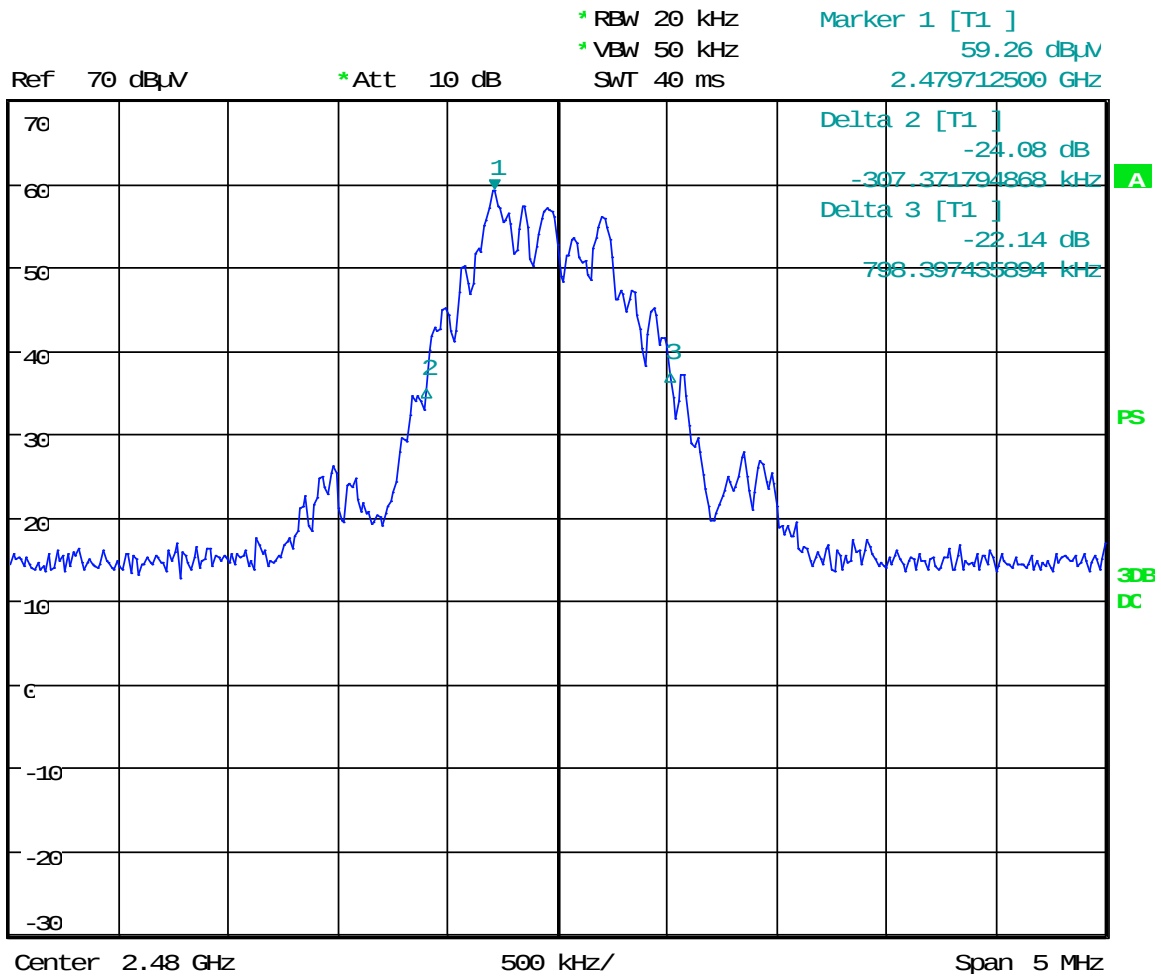
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-20dB, High Channel



1. F6
VIEW



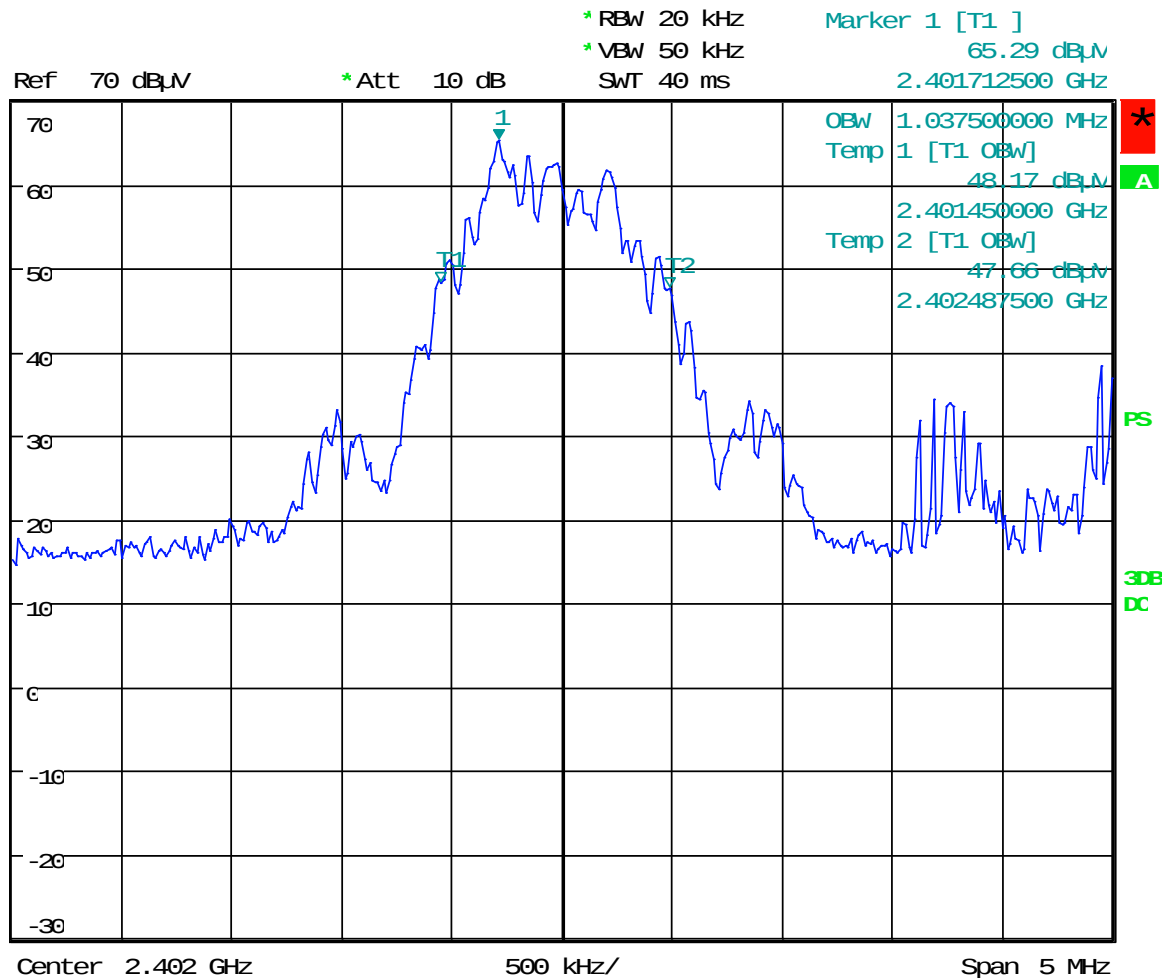
Date: 24 AUG 2021 10:10:22



99%, Low Channel



1 PK
VIEW

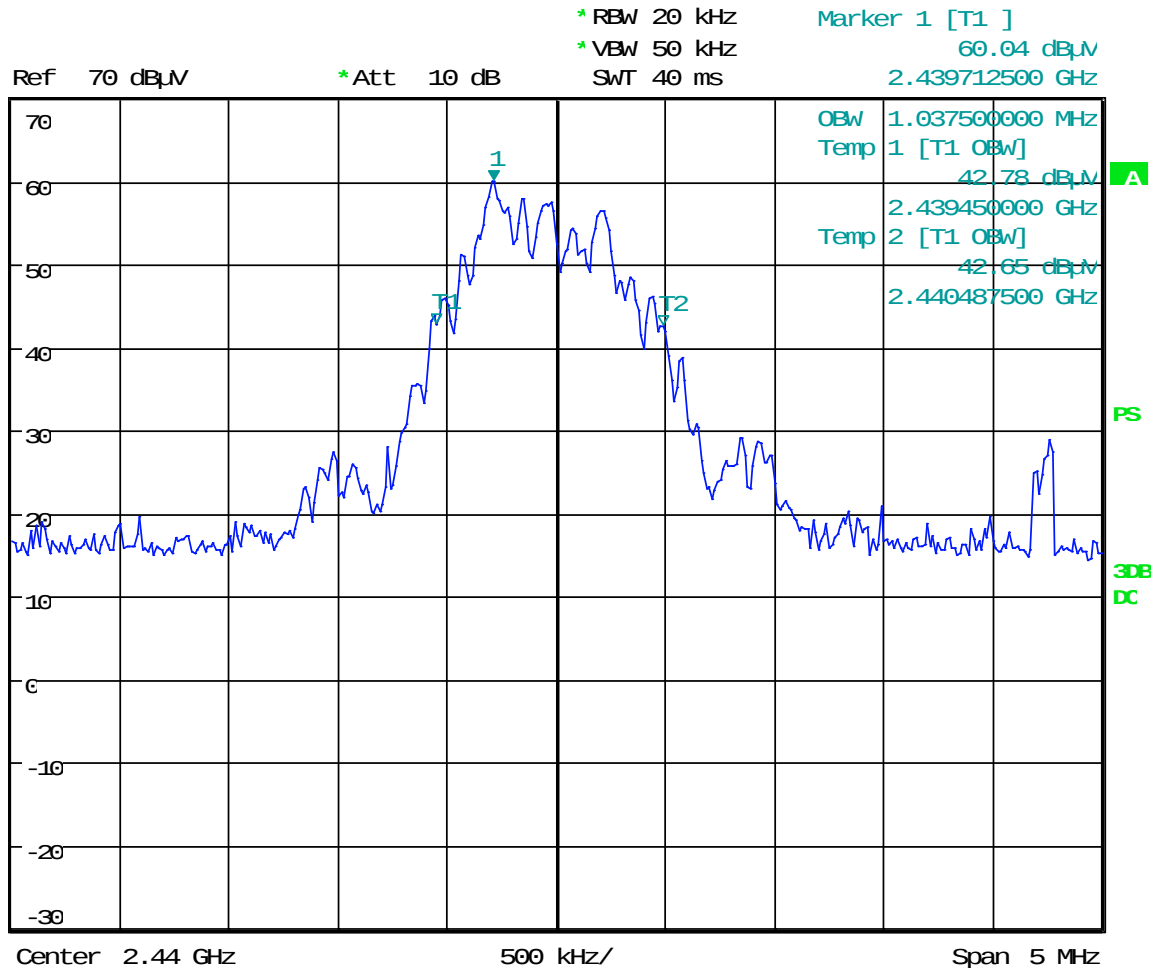




99%, Mid Channel



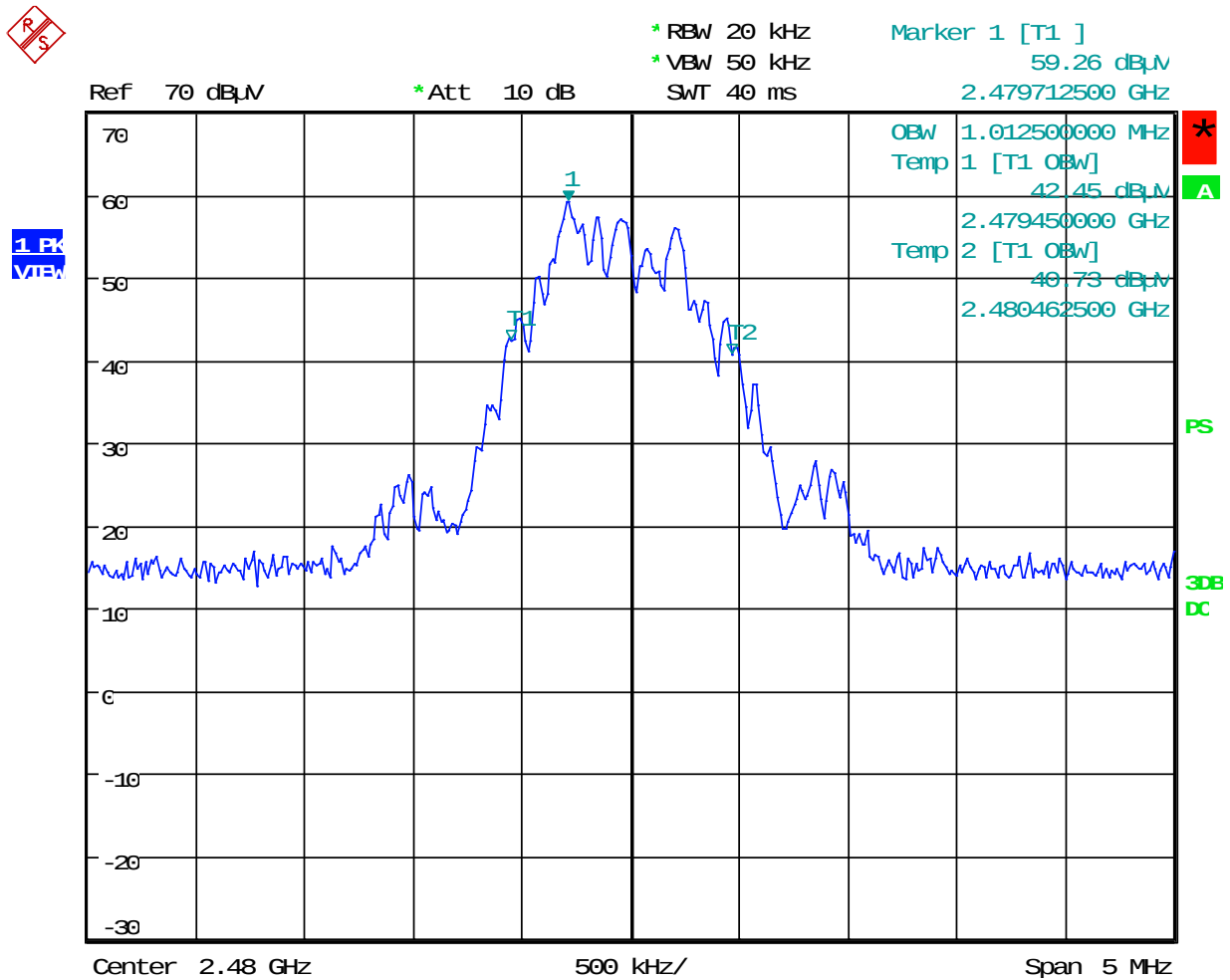
1 PK
VIEW



Date: 24.AUG.2021 18:16:44



99%, High Channel



Date: 24.AUG.2021 18:19:40



8 FIELD STRENGTH OF EMISSIONS FROM INTENTIONAL RADIATORS

- (a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

- (d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

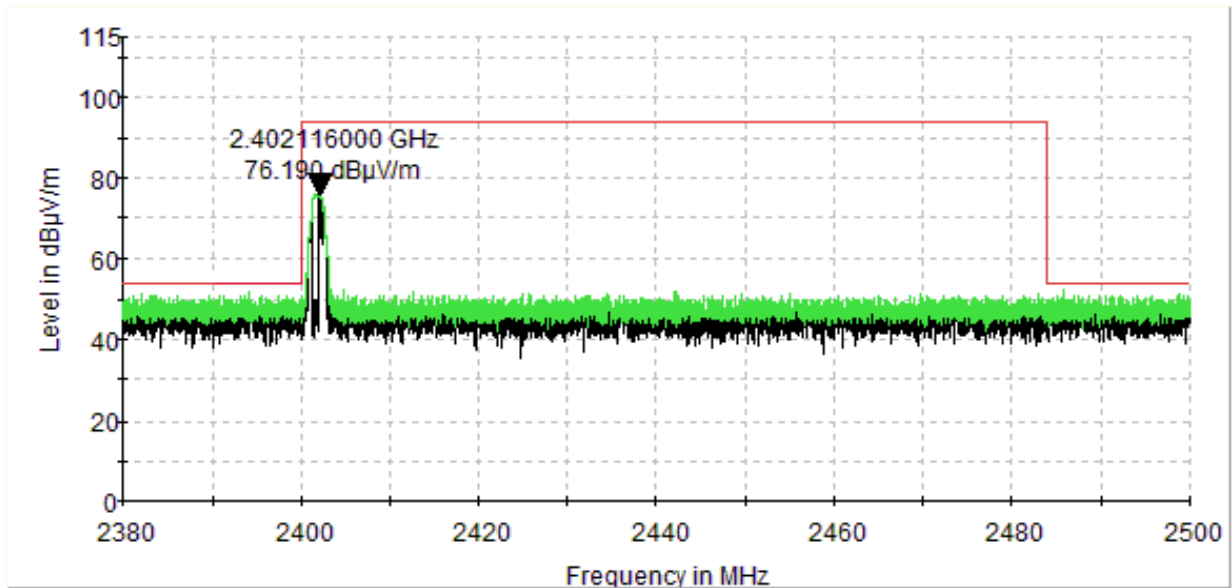
NOTE: During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions.



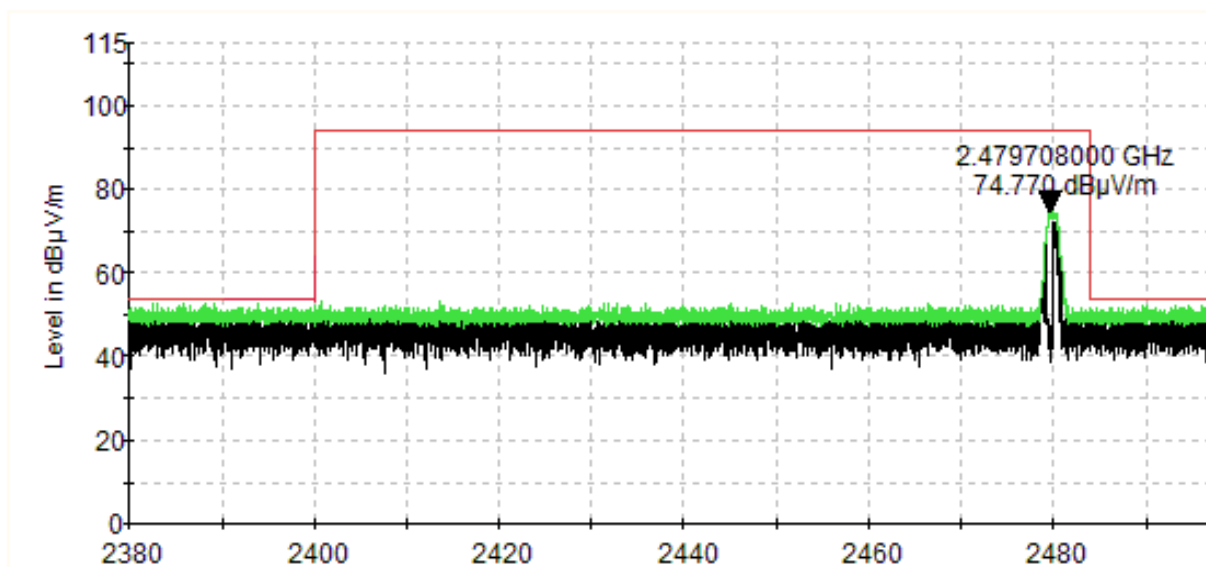
8.1 Test Data - Field Strength of Emissions from Intentional Radiators

Test Date(s):	2021-08-24	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(a)	Air Temperature:	24.1°C
		Relative Humidity:	47%

Band Edge: Low



Band Edge: Upper



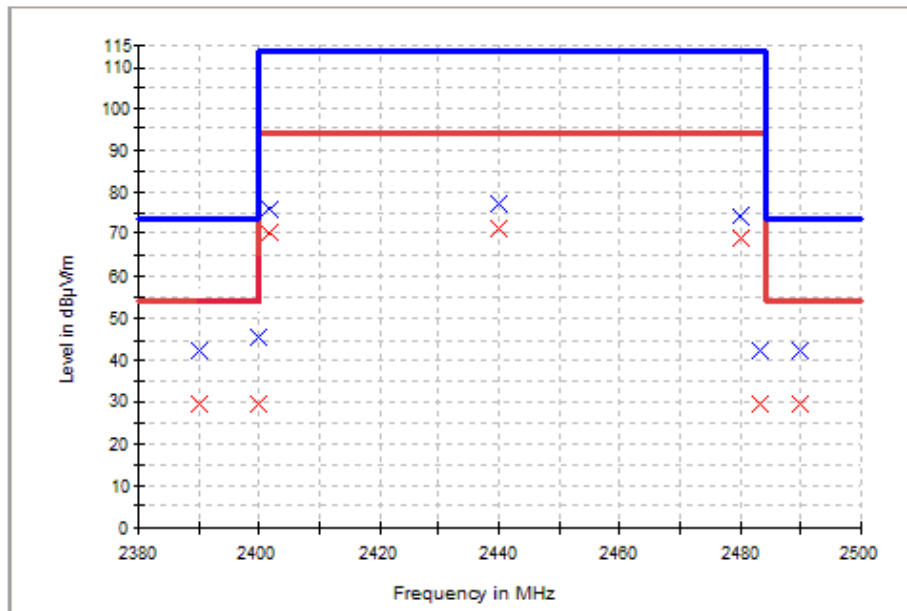
Band Edge and Field Strength of the Fundamentals

MaxPeak

Frequency (MHz)	Antenna Polarization	Bandwidth (kHz)	Antenna Height (cm)	Azimuth (deg)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.00	H	1000.00	160.00	173.00	36.6	5.9	42.50	74.0	-31.5
2400.00	H	1000.00	160.00	173.00	39.3	5.8	45.10	74.0	-28.9
2402.00	H	1000.00	160.00	173.00	70.3	5.8	76.10	74.0	-
2440.00	H	1000.00	160.00	204.00	71.3	5.7	77.00	74.0	-
2480.00	H	1000.00	150.00	357.00	68.8	5.7	74.50	74.0	-
2483.50	H	1000.00	160.00	183.00	36.7	5.8	42.50	74.0	-31.5
2490.00	H	1000.00	160.00	183.00	36.3	5.8	42.10	74.0	-31.9

AVG

Frequency (MHz)	Antenna Polarization	Bandwidth (kHz)	Antenna Height (cm)	Azimuth (deg)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2390.00	H	1000.00	160.00	173.00	23.7	5.9	29.60	54.0	-24.4
2400.00	H	1000.00	160.00	173.00	23.7	5.8	29.50	54.0	-24.5
2402.00	H	1000.00	160.00	173.00	64.6	5.8	70.40	54.0	-
2440.00	H	1000.00	160.00	204.00	65.6	5.7	71.30	54.0	-
2480.00	H	1000.00	150.00	357.00	63.4	5.7	69.10	54.0	-
2483.50	H	1000.00	160.00	183.00	23.6	5.8	29.40	54.0	-24.6
2490.00	H	1000.00	160.00	183.00	23.6	5.8	29.40	54.0	-24.6





8.2 Test Data – Spurious Emissions

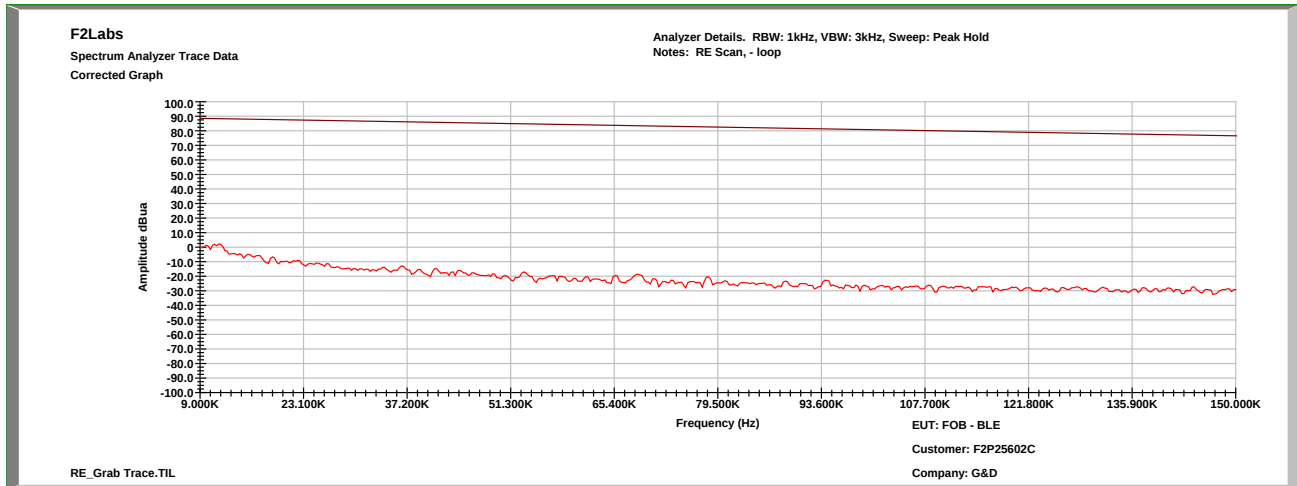
Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. At some frequencies, no emissions from the EUT were measurable over the ambient noise floor. The readings did not change with EUT on and EUT off.

At least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1 GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit. Frequencies were scanned from 9kHz to 26 GHz and the highest emissions are listed below.

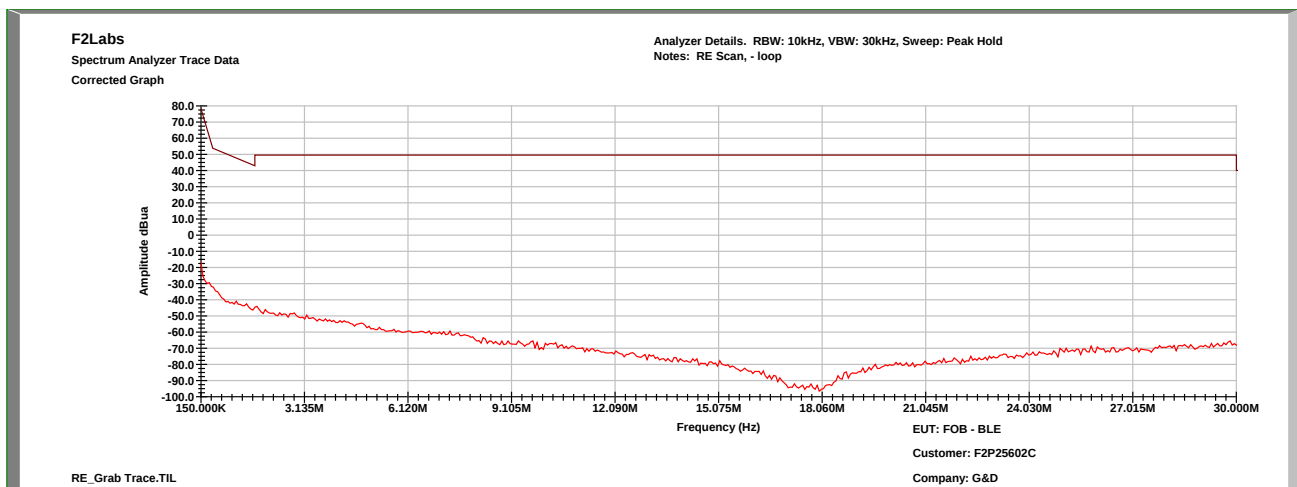


Test Date(s):	2021-08-25	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.209	Air Temperature:	23.2°C
		Relative Humidity:	50%

Characterization Scan, 9 kHz to 150 kHz



Characterization Scan, 150 kHz to 30 MHz

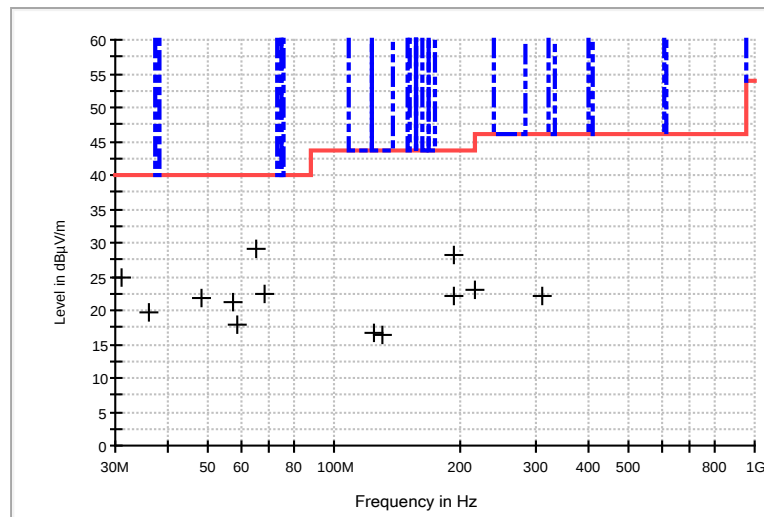




30 MHz to 1000 MHz

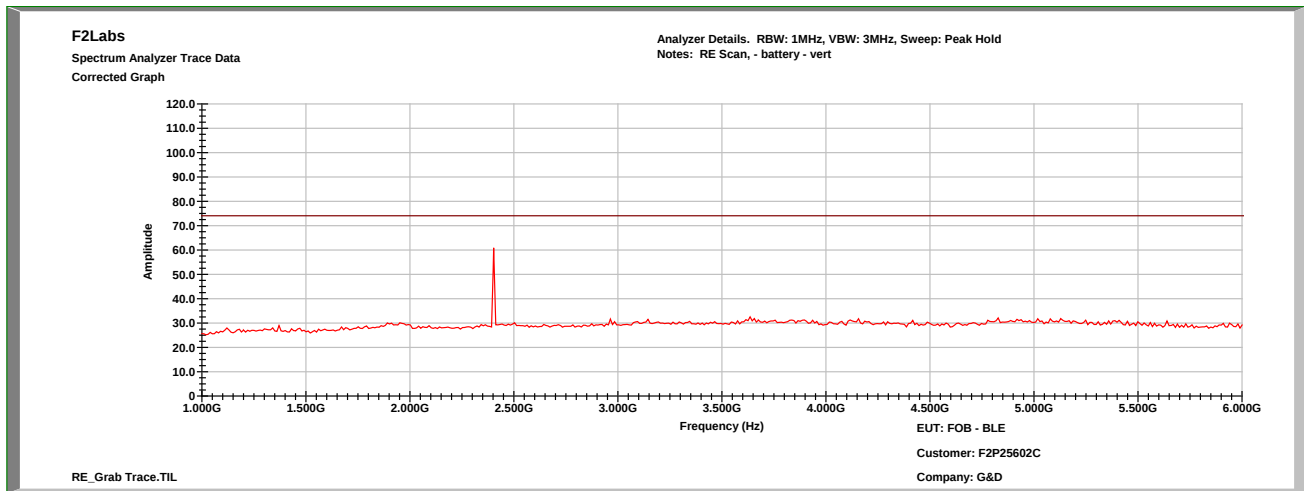
Note: Chart below includes data from all three channels.

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
31.160000	V	100.00	355.00	26.8	-2.0	24.80	40.0	-15.2
36.010000	H	100.00	0.00	25.4	-5.7	19.70	40.0	-20.3
48.040000	V	100.00	355.00	35.6	-13.6	22.00	40.0	-18.0
57.550000	V	100.00	355.00	36.1	-15.0	21.10	40.0	-18.9
58.320000	H	100.00	0.00	32.8	-15.0	17.80	40.0	-22.2
64.730000	V	100.00	355.00	43.9	-14.7	29.20	40.0	-10.8
68.410000	V	100.00	355.00	37.0	-14.6	22.40	40.0	-17.6
124.280000	H	100.00	0.00	24.9	-8.3	16.60	43.5	-26.9
130.300000	V	100.00	355.00	24.7	-8.3	16.40	43.5	-27.1
191.990000	H	100.00	0.00	32.0	-10.0	22.00	43.5	-21.5
191.990000	V	100.00	355.00	38.0	-10.0	28.00	43.5	-15.5
216.050000	V	100.00	355.00	33.6	-10.5	23.10	46.0	-22.9
311.880000	H	100.00	0.00	29.0	-6.9	22.10	46.0	-23.9

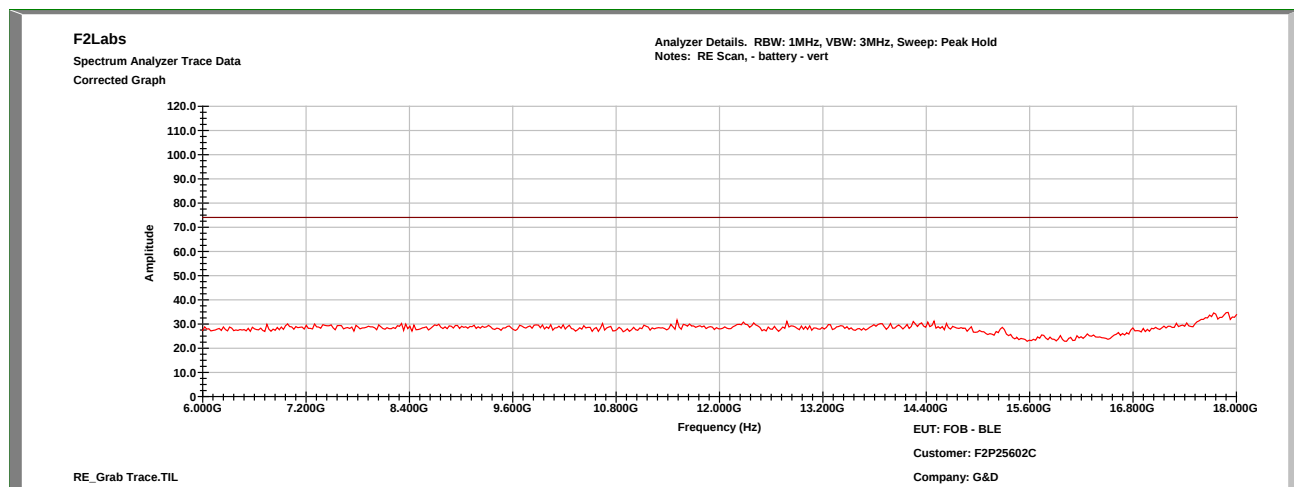




Low Channel, 1 GHz to 6 GHz, Vertical

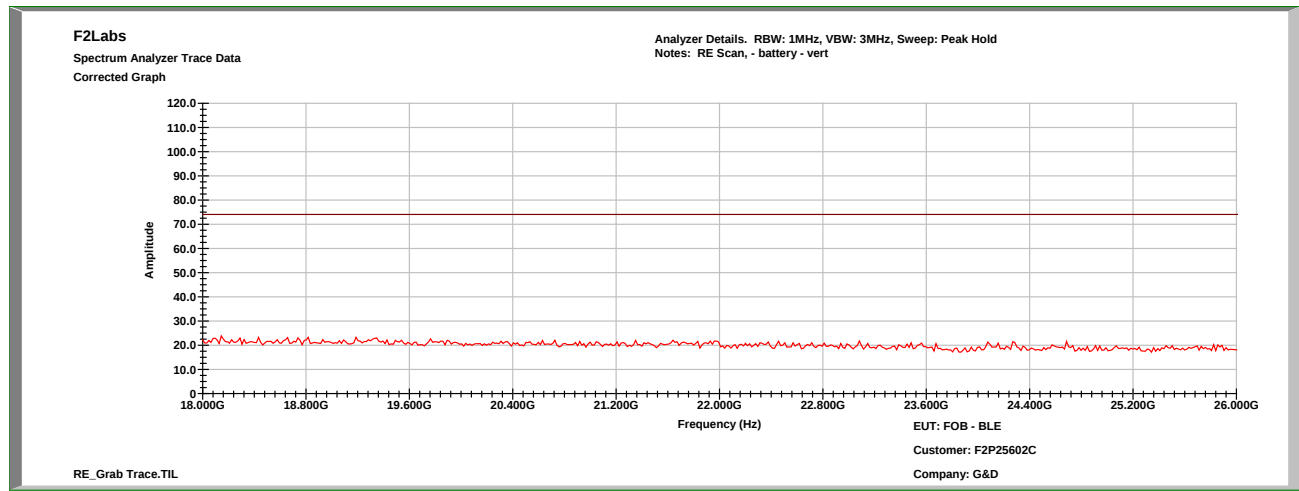


Low Channel, 6 GHz to 18 GHz, Vertical



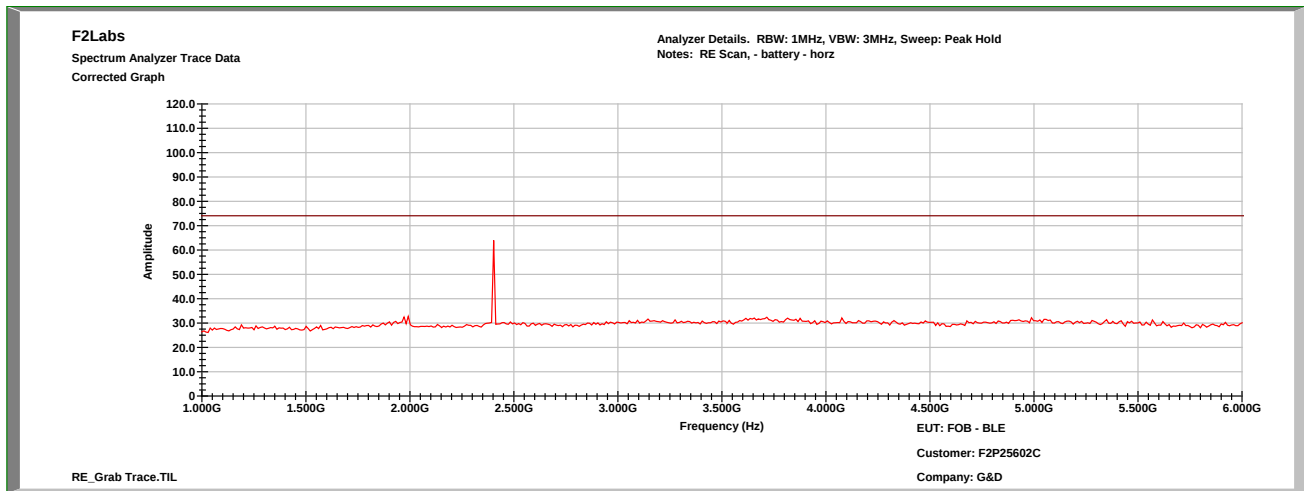


Low Channel, 18 GHz to 26 GHz, Vertical

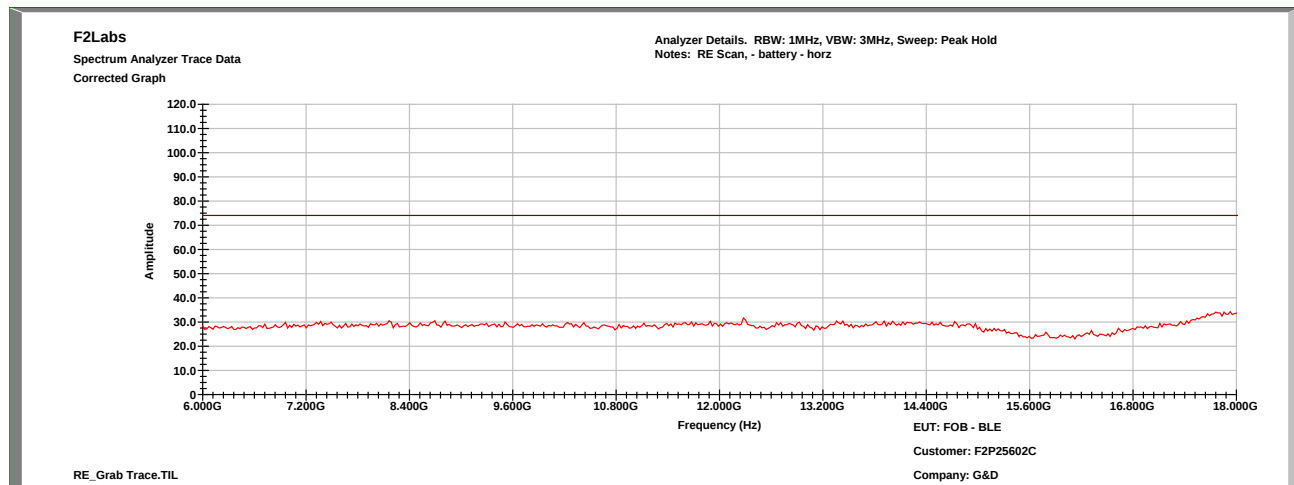




Low Channel, 1 GHz to 6 GHz, Horizontal

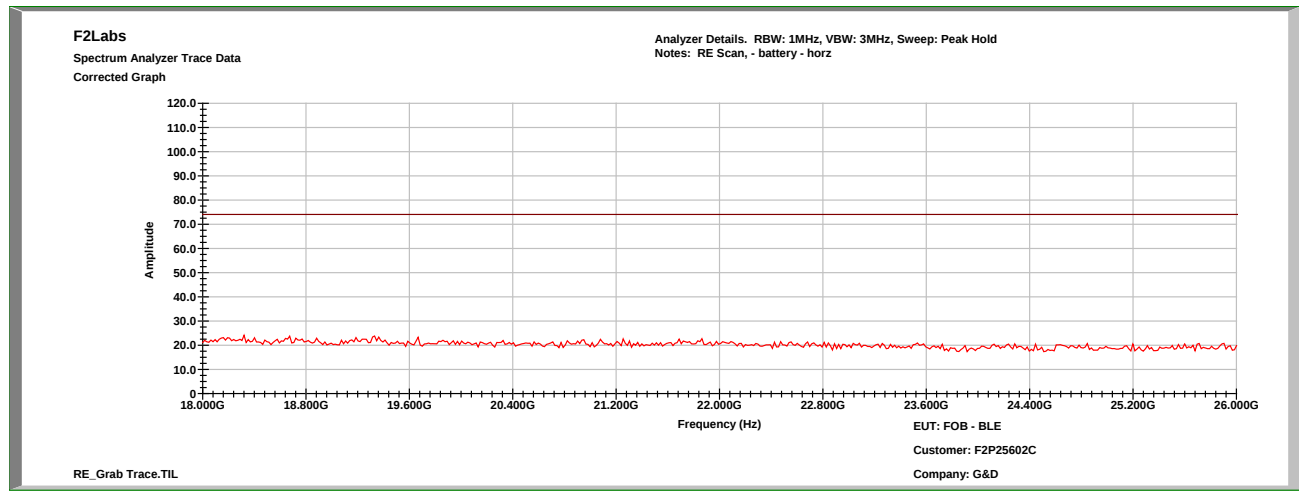


Low Channel, 6 GHz to 18 GHz, Horizontal





Low Channel, 18 GHz to 26 GHz, Horizontal

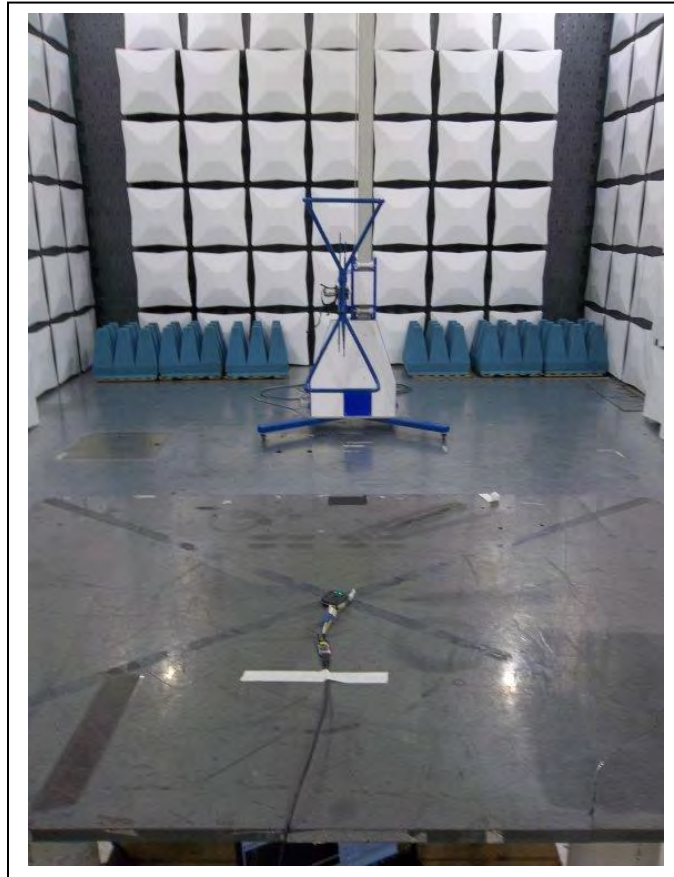


9 PHOTOGRAPHS, TEST SETUPS

Radiated Spurious Emissions, 9kHz to 30 MHz



Radiated Spurious Emissions, 30 MHz to 1000 MHz



**Field Strength of Emissions, Occupied Bandwidth,
Radiated Spurious Emissions, Greater Than 1 GHz**

