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02-Feb-26

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U.S.A.
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Subject: SUBTEL, Chile (Resolution 737) Certification Compliance 2026
Commercial Name: EPIX PRO (g2), 51mm

	Información (Information)
Tipo de equipo (Equipment type)	Portable Digital Transceiver
Marca (Brand)	Garmin 
Modelo (Model)	A04597
Tecnología o modulación (Technology or modulation)	ASK for NFC / GFSK for ANT/ GFSK for BTBR / $\pi/4$ -DQPSK, 8DPSK for BTEDR / GFSK for BLE/ DSSS for 802.11b / OFDM for 802.11g/n
Frecuencias (Frequencies)	13.56 MHz / 2402-2480 MHz / 2402-2480 MHz / 2402-2480 MHz / 2402-2480 MHz / 2412-2462 MHz
Ganancia de antena (dBi) (Antenna gain (dBi))	ANT -5.26 dBi / 802.15.1 -5.26 dBi / 802.15.1 -5.26 dBi / BLE -5.26 dBi / 802.11b/g/n - 5.26 dBi
P.i.r.e. (E.I R P.)	-29.70 dBm, 0.001mW / -10.11 dBm, 0.09 mW / 6.41 dBm, 4.40 mW / 5.51 dBm, 3.60 mW / -5.77 dBm, 0.26 mW / 13.09 dBm, 20.37 mW
Módulos (Modules)	NFC, ANT, BTBR, BTEDR, BLE, WiFi

As all measurements for NFC are made in radiated mode to comply with the field strength limits, gain information is not required to be noted in the reports or any additional documentation.

Declaration of Conformity Statement: the equipment previously identified complies with the provisions established in the Technical Standard for Small Range Equipment, approved by Exempt Resolution No.1,985 of 2017, of the Undersecretary of Telecommunications. Declaración de conformidad: El equipo anteriormente identificado cumple con las disposiciones establecidas en la Norma Técnica para Equipos de Corto Alcance, aprobada mediante la Resolución Exenta N° 1.985 de 2017, de la Subsecretaría de Telecomunicaciones.



Test Report Serial Number:	45461812 R1.0
Test Report Date:	1 March 2023
Project Number:	1620

EMC Test Report - New Certification

Applicant:



Garmin International Inc.
1200 East 151 St
Olathe, KS, 66062
USA

FCC ID:

IPH-A04597

Product Model Number / HVIN

A04597

IC Registration Number

-

Product Marketing Name / PMN

A04597

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.247), Part 15 Subpart B
Digital Transmission System (DTS)

Approved By:

Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada



Test Lab Certificate: 2470.01



**Industry
Canada**

IC Registration 3874A



FCC Registration: CA3874

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1.0 REVISION HISTORY

Revision History					
Samples Tested By:		Art Voss, P.Eng.	Date(s) of Evaluation:		15 January - 13 February, 2023
Report Prepared By:		Art Voss, P.Eng.	Report Reviewed By:		Ben Hewson
Report Revision	Description of Revision		Revised Section	Revised By	Revision Date
0.1	Draft		n/a	Art Voss	14 February 2023
1.0	Initial Release		n/a	Art Voss	1 March 2023

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name	Garmin International Inc.
Applicant Address	1200 East 151 St
	Olathe, KS, 66062
	USA
DUT Information	
Device Identifier(s):	FCC ID: IPH-A04597
Device Model(s) / HVIN:	A04597
Device Marketing Name / PMN:	A04597
Test Sample Serial No.:	3430501782 - Conducted, 3430501693 - OTA
Device Type:	Extremity Worn Digital Transceiver
Equipment Class:	Digital Transmission Systems (DTS)
	Spread Spectrum Transmitter (DSS)
	Low Power Communication Device (DXX)
	Global Navigation Satellite System (GNSS) Receivers
	NFC - Low Power Communication Device Transmitter (DXX)
Transmit Frequency Range:	WiFi (DTS): 2412-2462MHz
	BT/BLE/ANT: 2402-2480MHz
	NFC: 13.56MHz
Manuf. Max. Rated Output Power:	WiFi - Digital Transmission System (DTS): 18.35dBm
	BlueTooth - Spread Spectrum Transmitter (DSS): 11.11dBm
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 2.10dBm
	NFC - Low Power Communication Device Transmitter (DXX): 55.19dBuV/m
Antenna Type and Gain:	-4.72dBi Max
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7
	BT BR: GFSK
	BT EDR: Pi/4-DQPSK, 8DPSK
	BLE: GMSK
	ANT: GFSK
	NFC: ASK
DUT Power Source:	3VDC Rechargeable Li-Ion
DUT Dimensions [LxWxH]	H x W x D: 42mm dia x 4.5mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE

Preface:

This Certification Report was prepared on behalf of:

Garmin International Inc.

, (the '*Applicant*'), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and, unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

Device:

The Garmin Model/HVIN: A04597 is an extremity worn digital transceiver device consisting of a WiFi, Bluetooth (BT), Bluetooth Low Energy (BLE), Adaptive Network Topology (ANT) and Near Field Communication (NFC) transceivers. The WiFi and BT/BLE/ANT transceivers share the same antenna and cannot simultaneously transmit.

Requirement:

The transceivers of this *equipment* are subject to emissions evaluation in accordance with FCC: 47 CFR 2, 15C. As per FCC 47 CFR §2.1093, an RF Exposure (SAR) evaluation is required for this *Equipment* and the results of the RF Exposure (SAR) evaluation appear in a separate report.

Application:

This is an application for a New Certification.

Scope:

The scope of this investigation is limited to the evaluation and reporting of the wanted and spurious emissions in accordance with the rule parts cited in Normative References section of this report.

4.0 TEST SUMMARY

TEST SUMMARY					
Section	Description of Test	Procedure Reference	Applicable Rule Part(s) FCC	Test Date	Result
7.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	15, 21 Jan 2023	Pass
8.0	DTS Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(a)(2)	22 Jan 2023	Pass
9.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	15 Jan, 8 Feb 2023	Pass
10.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(1)	15 Jan, 8 Feb 2023	Pass
11.0	Power Spectral Density	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(e)	19, 23 Jan 2023	Pass
12.0	FHSS Hopping Characteristics	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	20 Jan, 9 Feb 2023	Pass
13.0	FHSS Channel Separation	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)	20 Jan, 9 Feb 2023	Pass
14.0	FHSS Time of Occupancy	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	20 Jan, 9 Feb 2023	Pass
15.0	Conducted Tx Spurious Emissions Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	20 Jan, 13 Feb 2023	Pass
16.0	Conducted Tx Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	22 Jan 2023	Pass
17.0	Radiated Tx Spurious Emissions And Restricted Band	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	31 Jan 2023	Pass
18.0	Radiated Rx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109	31 Jan 2023	Pass
19.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	25 Jan 2023	Pass

Test Station Day Log					
Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
15 Jan 2023	21.6	17	101.6	EMC	7, 9, 10,
19 Jan 2023	22.1	18	101.2	EMC	11
20 Jan 2023	22.6	16	101.5	EMC	12, 13, 14, 15
21 Jan 2023	21.9	18	101.4	EMC	7
22 Jan 2023	22.1	18	101.3	EMC	8, 16
23 Jan 2023	22.5	17	101.1	EMC	11
25 Jan 2023	17.2	52	102.1	LISN	19
31 Jan 2023	0.0	87	101.5	OATS	17, 18
8 Feb 2023	22.5	16	101.0	EMC	9
9 Feb 2023	22.1	17	101.4	EMC	12, 13, 14
13 Feb 2023	21.9	18	102.4	EMC	15

EMC - EMC Test Bench

OATS - Open Area Test Site

LISN - LISN Test Area

IMM - Immunity Test Area

SAC - Semi-Anechoic Chamber

TC - Temperature Chamber

ESD - ESD Test Bench

RI - Radiated Immunity Chamber

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.



Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

14 February 2023

Date



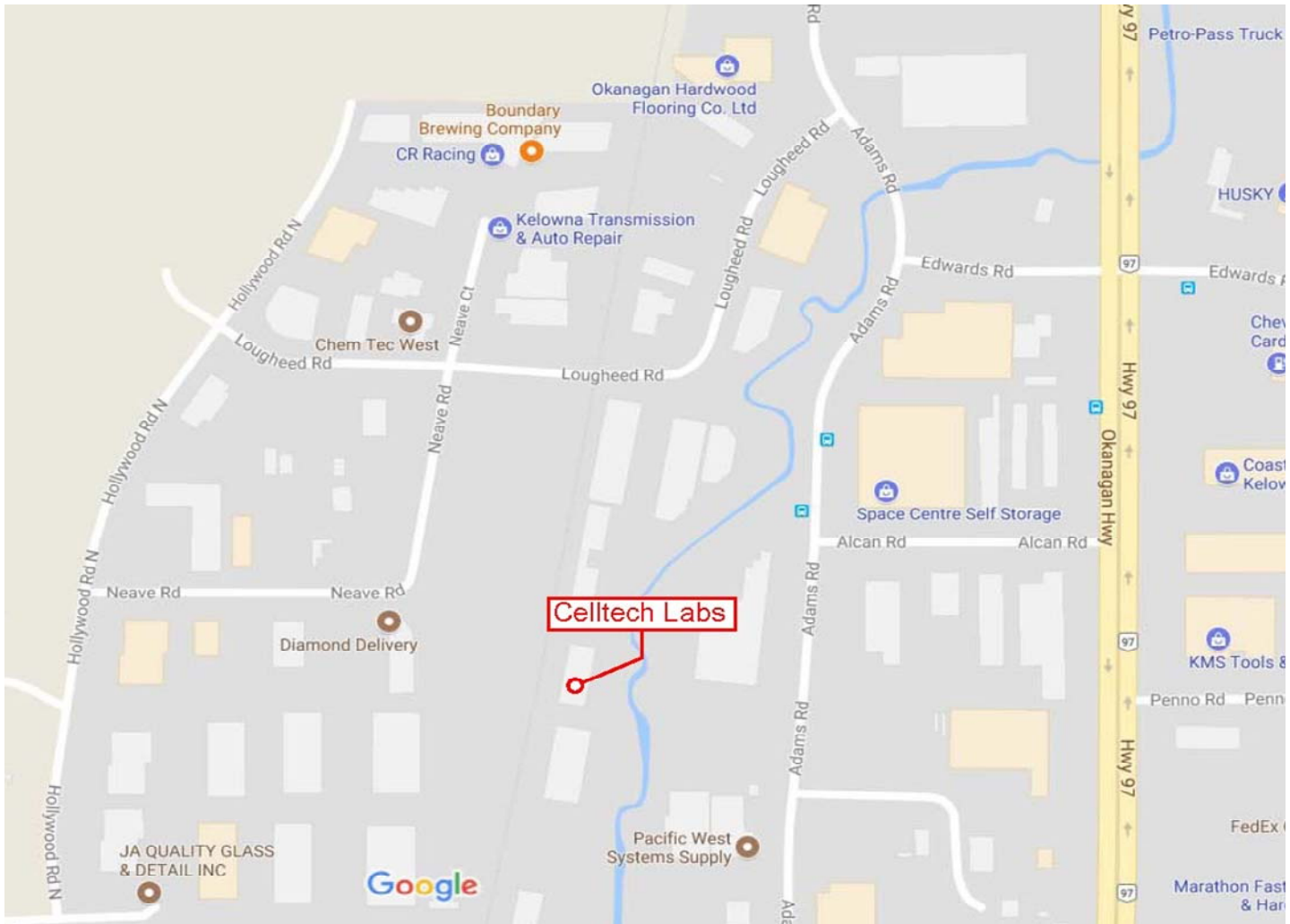
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.4-2014	American National Standard of Procedures for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electric and Electronic Equipment in the Range of 9kHz to 40GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR	Code of Federal Regulations Title 47: Telecommunication Part 2: Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Subpart B: Unintentional Radiators
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Sub Part C (15.247) Intentional Radiators
FCC KDB 558074 D01v05r02	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874 and Innovation, Science and Economic Development Canada under Test Site File Number ISED 3874A. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 OCCUPIED BANDWIDTH

Test Procedure

Normative	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),
Reference	KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3)

General Procedure

KDB 558074 (8.3.2.1)	8.3.2.1 General Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.
C63.10 (6.9.3)	6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth: a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW. b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement. c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2. d) Step a) through step c) might require iteration to adjust within the specified range. e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

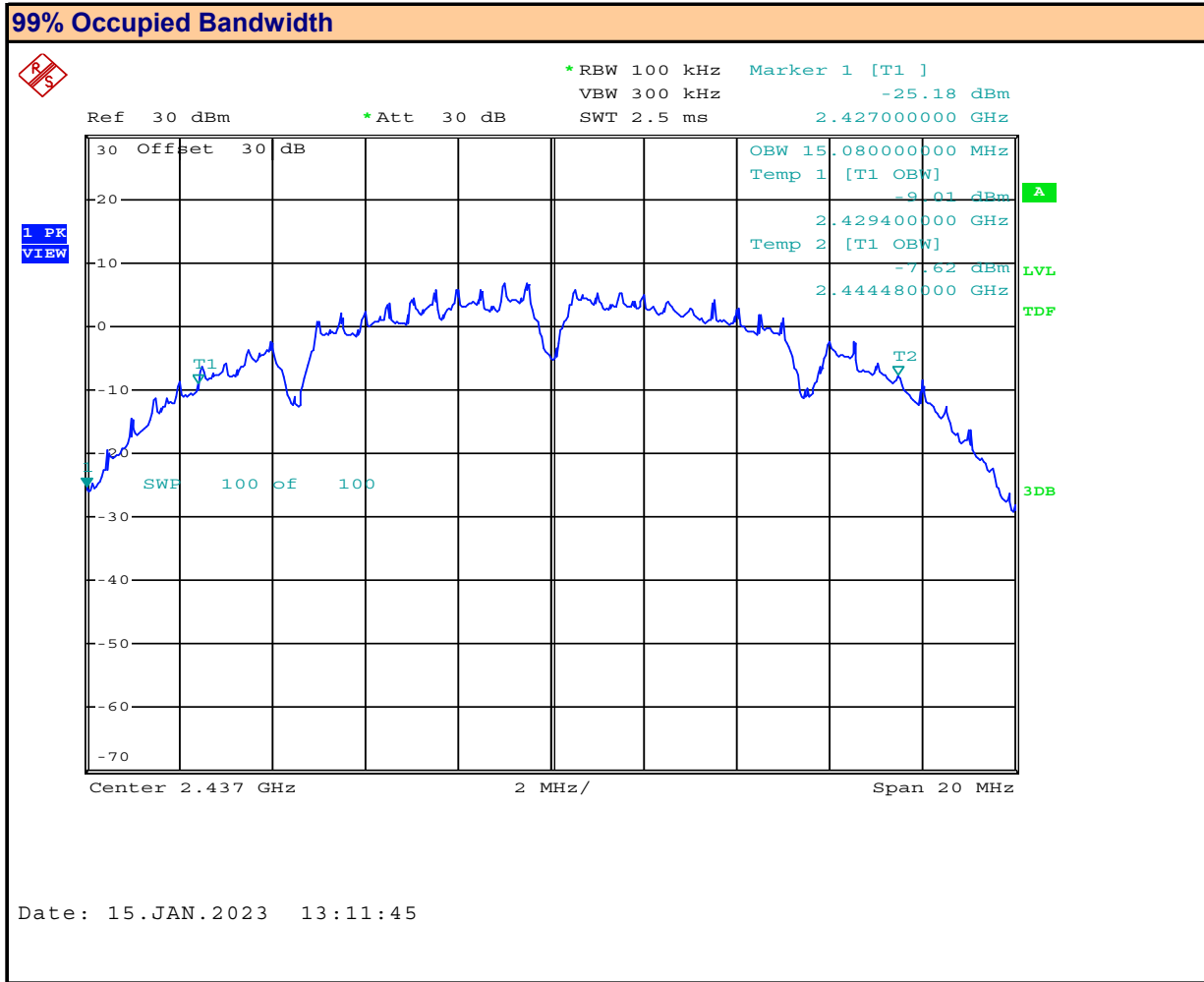
Test Setup

Appendix A - Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above using the 99% Occupied Bandwidth function. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The 99% Occupied Bandwidth was measured and recorded and used for the basis for measuring the Conducted Output Power (See Section 10.0) and Power Spectral Density (See Section 11.0).

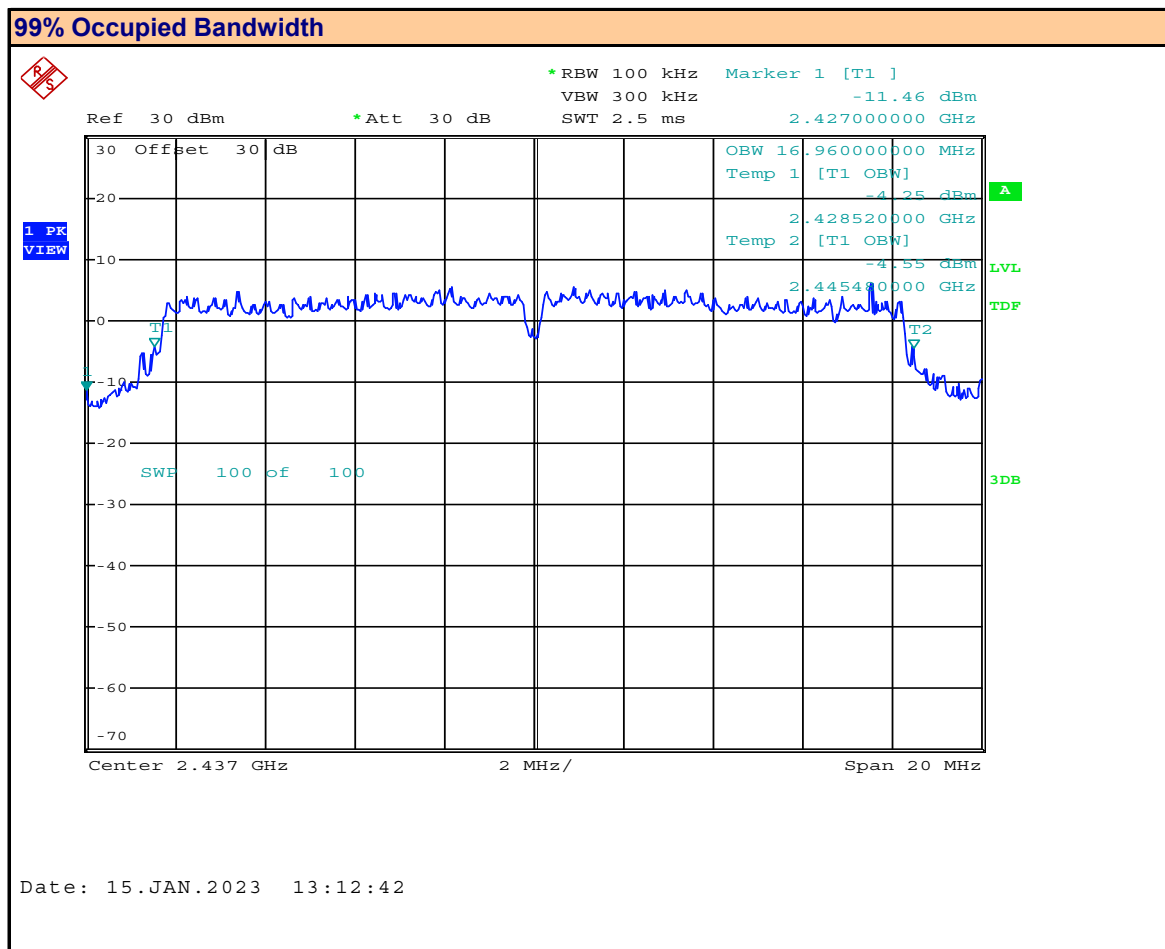
Plot 7.1 – Occupied Bandwidth, 802.11b



Channel: **6**
Mode: **802.11b**

Channel Frequency: **2437** MHz
Modulation: **DSSS 5.5**
Measured Occupied Bandwidth: **15.08** MHz

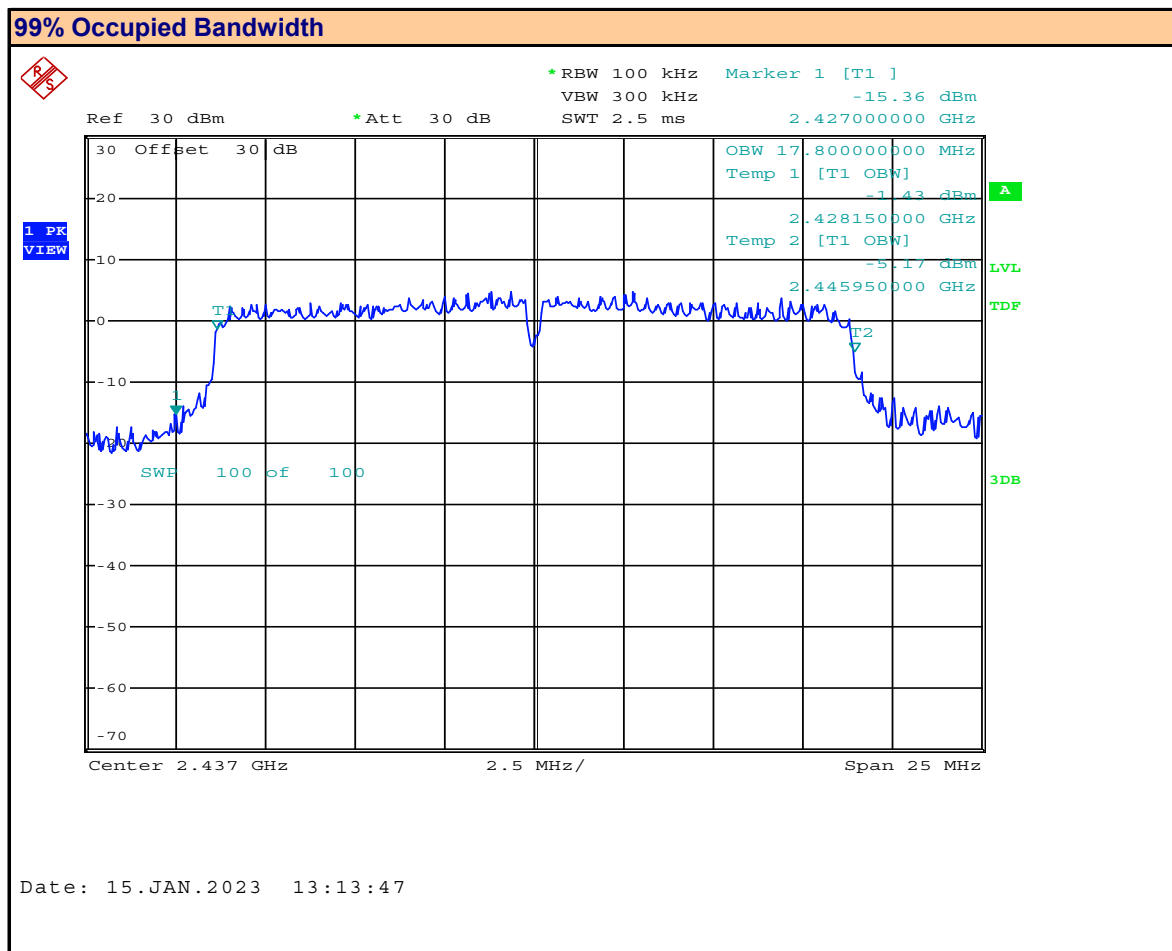
Plot 7.2 – Occupied Bandwidth, 802.11g



Channel: **6**
Mode: **802.11g**

Channel Frequency: **2437** MHz
Modulation: **OFDM12**
Measured Occupied Bandwidth: **16.96** MHz

Plot 7.3 – Occupied Bandwidth, 802.11n



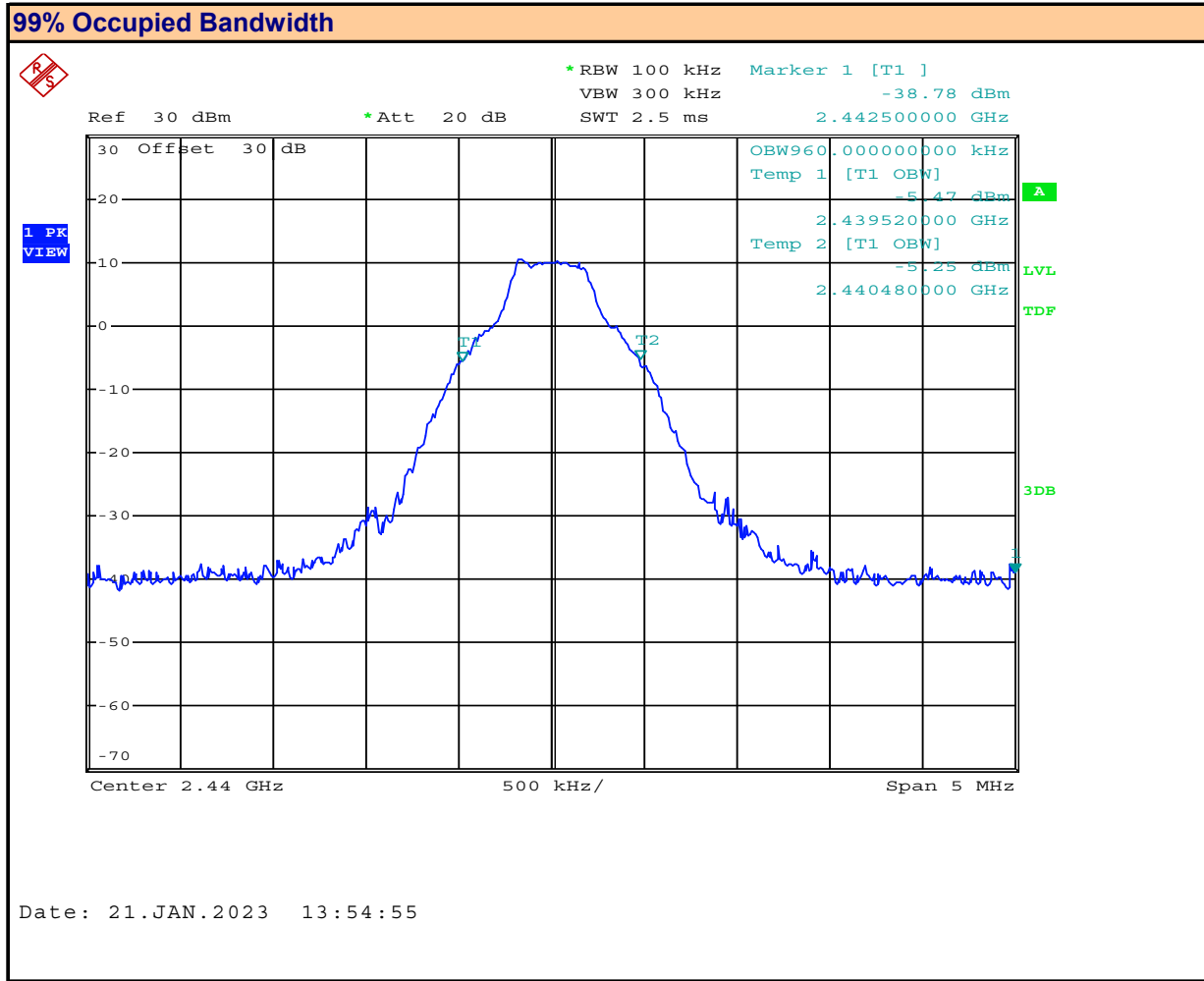
Channel: **6**
Mode: **802.11n**

Channel Frequency: **2437** MHz
Modulation: **MCS0**
Measured Occupied Bandwidth: **17.8** MHz

Table 7.1 – Summary of Occupied Bandwidth Measurements, (DTS)

99% Occupied Bandwidth Results:					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Occupied Bandwidth (MHz)	Emission Designator
6	2437.0	802.11b	DSSS 5.5	15.1	15M1D1D
6	2437.0	802.11g	OFDM12	17.0	17M0D1D
6	2437.0	802.11n	MCS0	17.8	17M8D1D
Result:				Complies	

Plot 7.4 – Occupied Bandwidth, BT BR

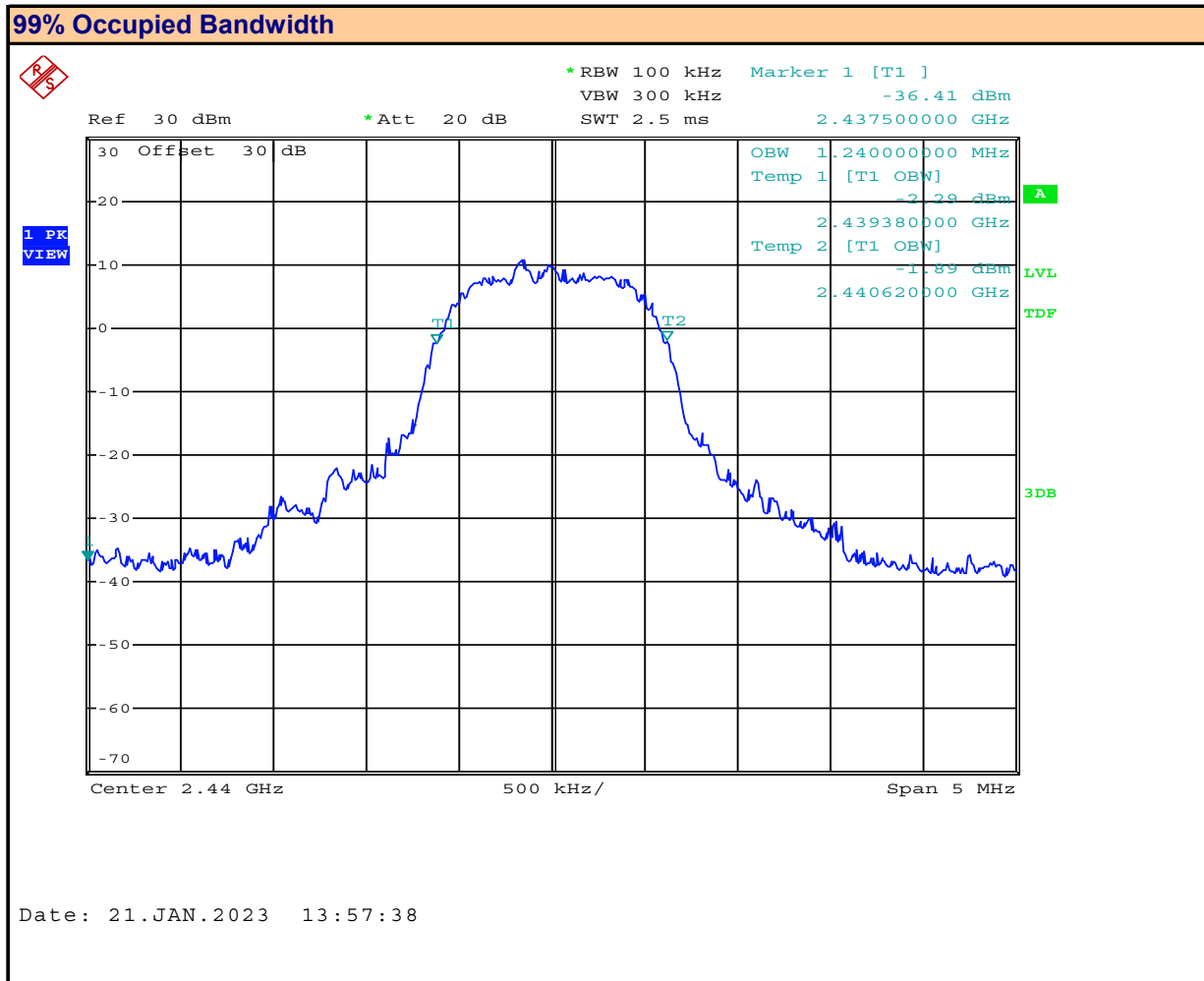


Channel: **38**
Mode: **BT BR**

Channel Frequency: **2440** MHz
Modulation: **GFSK**

Measured Occupied Bandwidth: **0.96** MHz

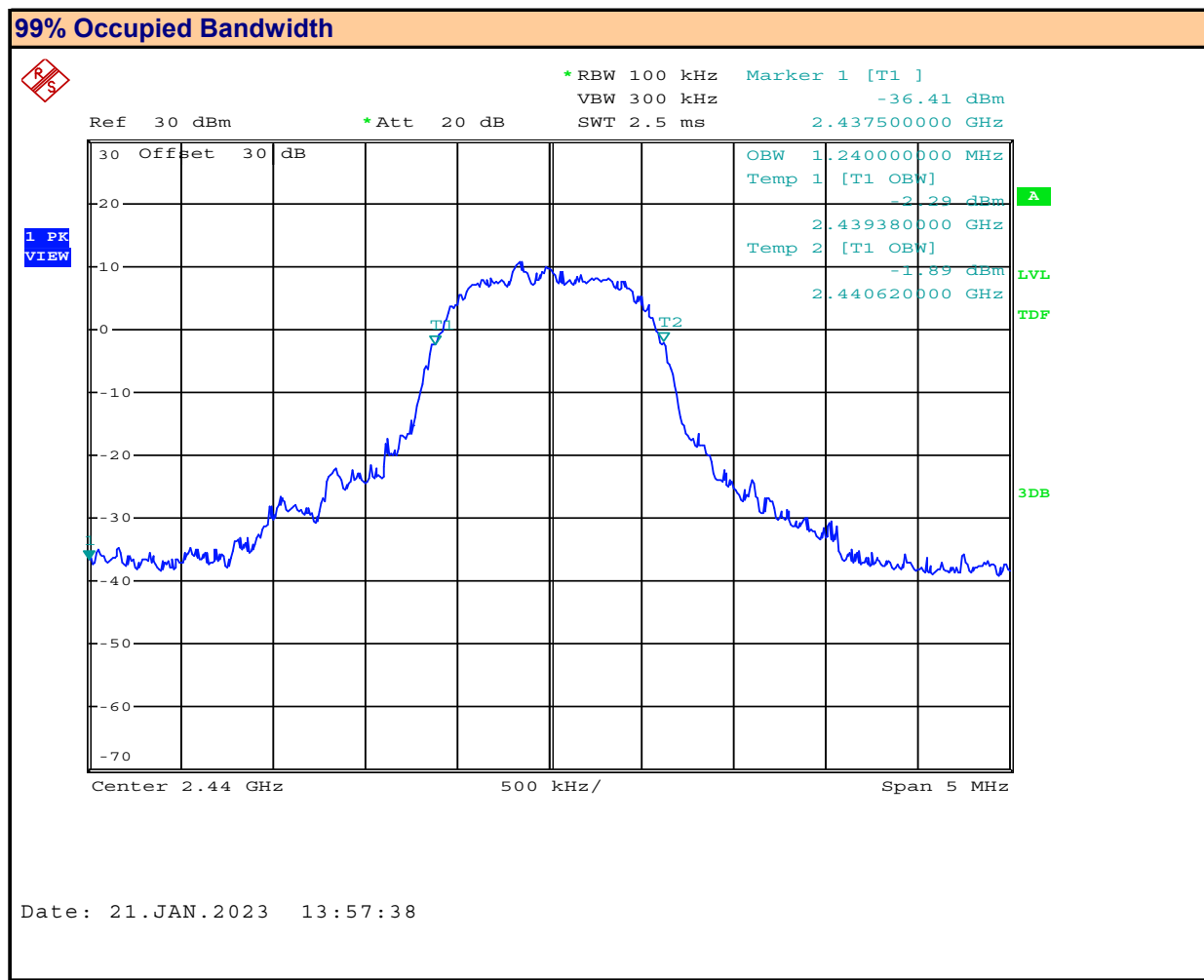
Plot 7.5 – Occupied Bandwidth, BT 2EDR



Channel: **38**
Mode: **BT 2EDR**

Channel Frequency: **2440** MHz
Modulation: **Pi/4-DQPSK**
Measured Occupied Bandwidth: **1.24** MHz

Plot 7.6 – Occupied Bandwidth, BT 3EDR



Channel: **38**
Mode: **BT 3EDR**

Channel Frequency: **2440** MHz
Modulation: **8-DSPK**
Measured Occupied Bandwidth: **1.24** MHz

Table 7.2 – Summary of Occupied Bandwidth Measurements (DSS)

99% Occupied Bandwidth Results:					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Occupied Bandwidth (MHz)	Emission Designator
38	2440.0	BT BR	GFSK	0.960	960KF1D
38	2440.0	BT 2EDR	Pi/4-DQPSK	1.240	1M24G1D
38	2440.0	BT 3EDR	8-DSPK	1.240	1M24G1D
Result:					Complies

8.0 DTS BANDWIDTH

Test Procedure

Normative Reference	FCC 47 CFR §2.1049, §15.247(a)(2), RSS-Gen (6.7), RSS-247 (5.2)(a), KDB 558074 (8.2), ANSI C63.10 (11.8.2)
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Limits

47 CFR §15.247(a)(2)	(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
RSS-247 (5.2)(a)	5.2 Digital transmission systems DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400 - 2483.5 MHz: a) The minimum 6 dB bandwidth shall be 500 kHz.
KDB 558074 (8.2) C63.10 (11.8.2)	8.2 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 X 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.

Test Setup	Appendix A Figure A.1
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Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as above using the Automatic 6dB Cursor Bandwidth measurement. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle.

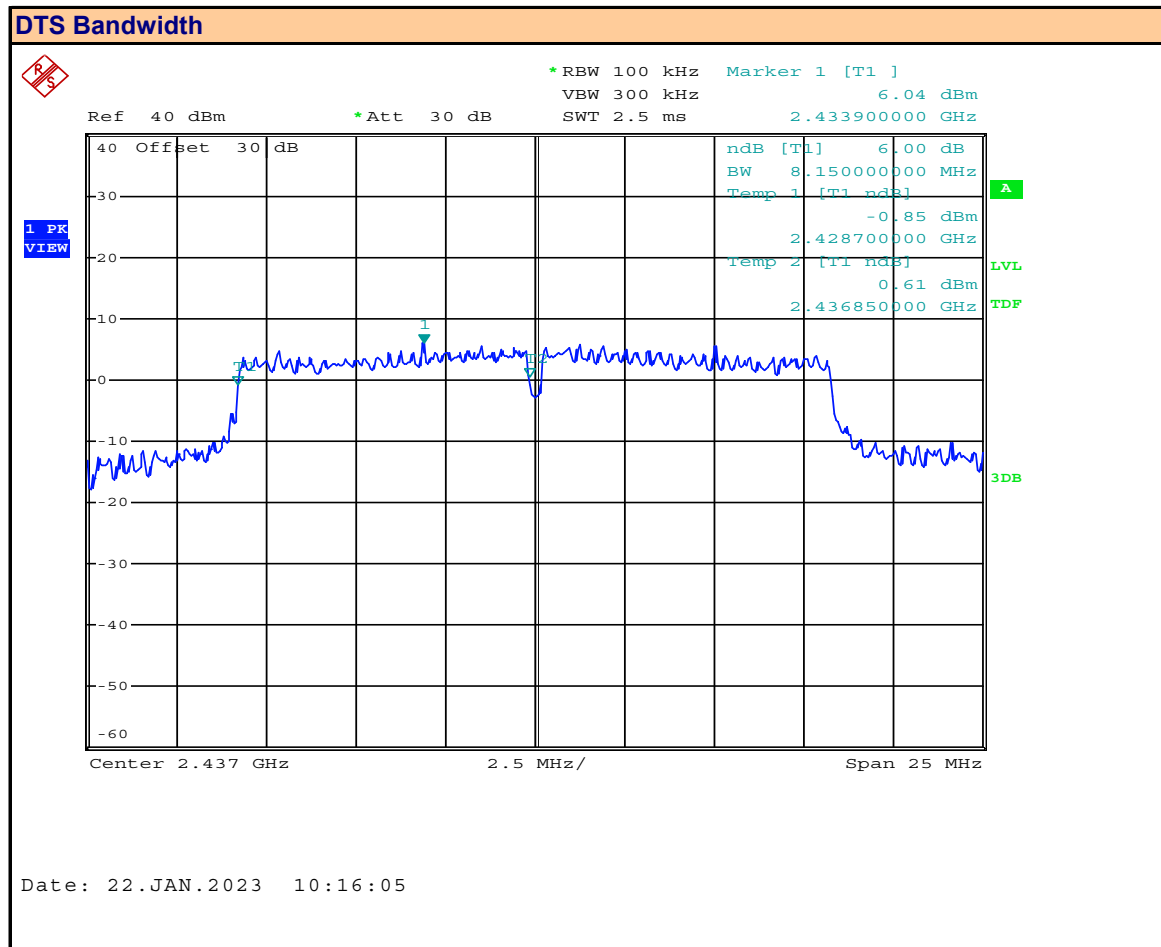
Plot 8.1 – 6dB DTS Bandwidth 802.11b



Channel: **6**
Mode: **802.11b**

Channel Frequency: **2437** MHz
Modulation: **DSSS 5.5**
Measured DTS Bandwidth: **7.55** MHz

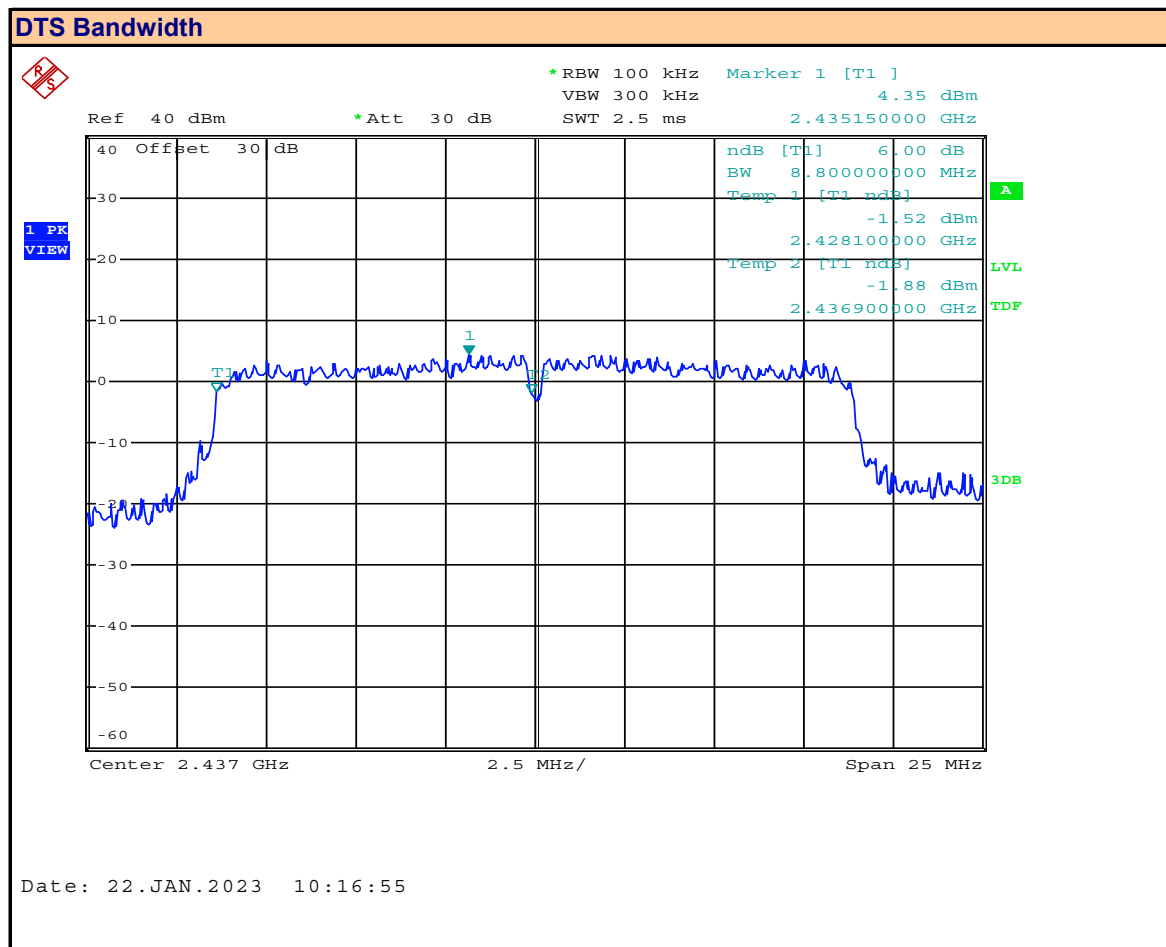
Plot 8.2 – 6dB DTS Bandwidth 802.11g



Channel: **6**
Mode: **802.11g**

Channel Frequency: **2437** MHz
Modulation: **OFDM12**
Measured DTS Bandwidth: **16.3** MHz

Plot 8.3 – 6dB DTS Bandwidth 802.11n



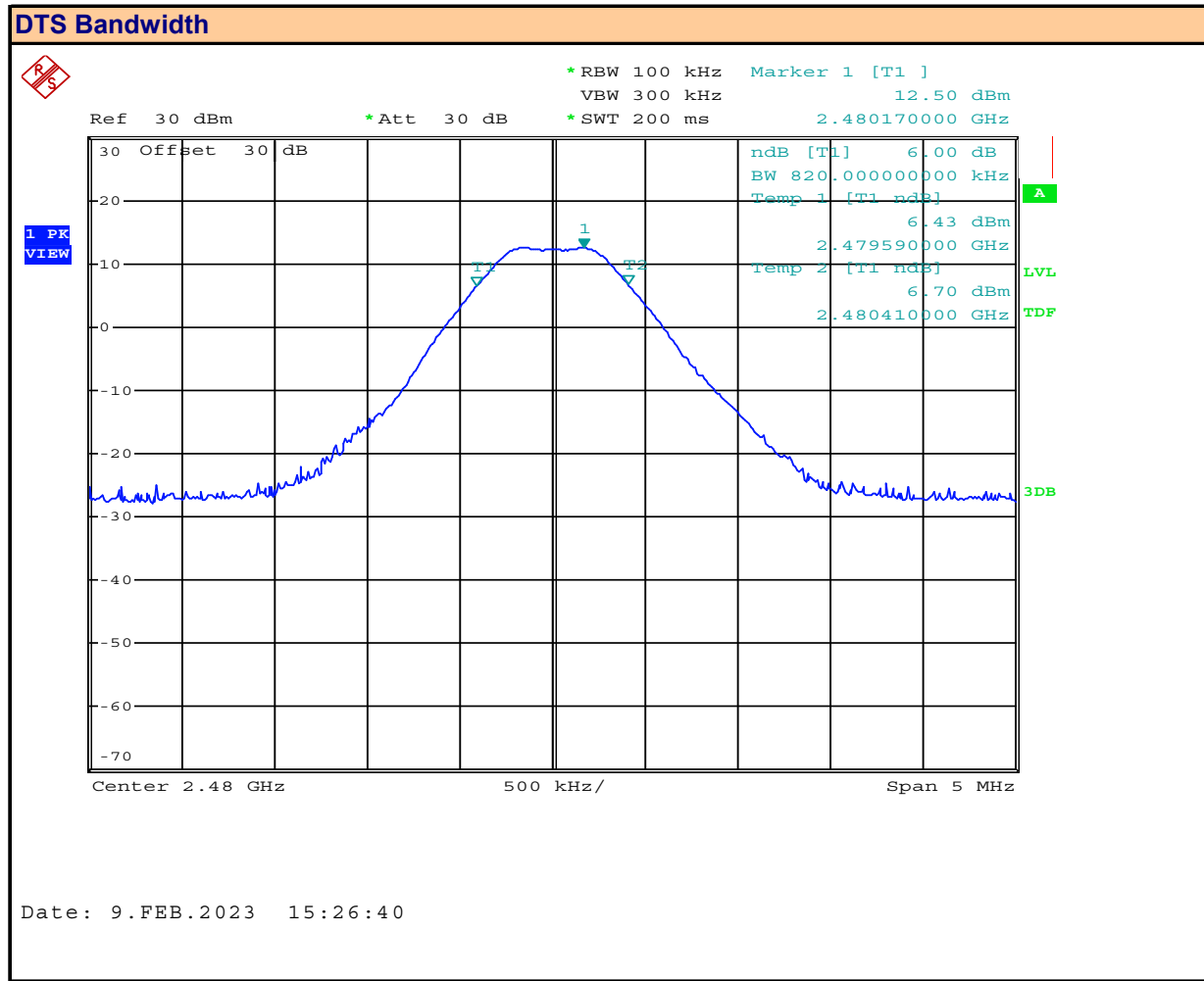
Channel: **6**
Mode: **802.11n**

Channel Frequency: **2437** MHz
Modulation: **MCS0**
Measured DTS Bandwidth: **17.6** MHz

Table 8.1 – Summary of 6dB DTS Bandwidth Measurements, (DTS

DTS Bandwidth Results:						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured DTS Bandwidth (MHz)	Minimum DTS Bandwidth (MHz)	Margin (MHz)
6	2437.0	802.11b	DSSS 5.5	7.6	0.50	7.1
6	2437.0	802.11g	OFDM12	16.3		15.8
6	2437.0	802.11n	MCS0	17.6		17.1
Result:					Complies	

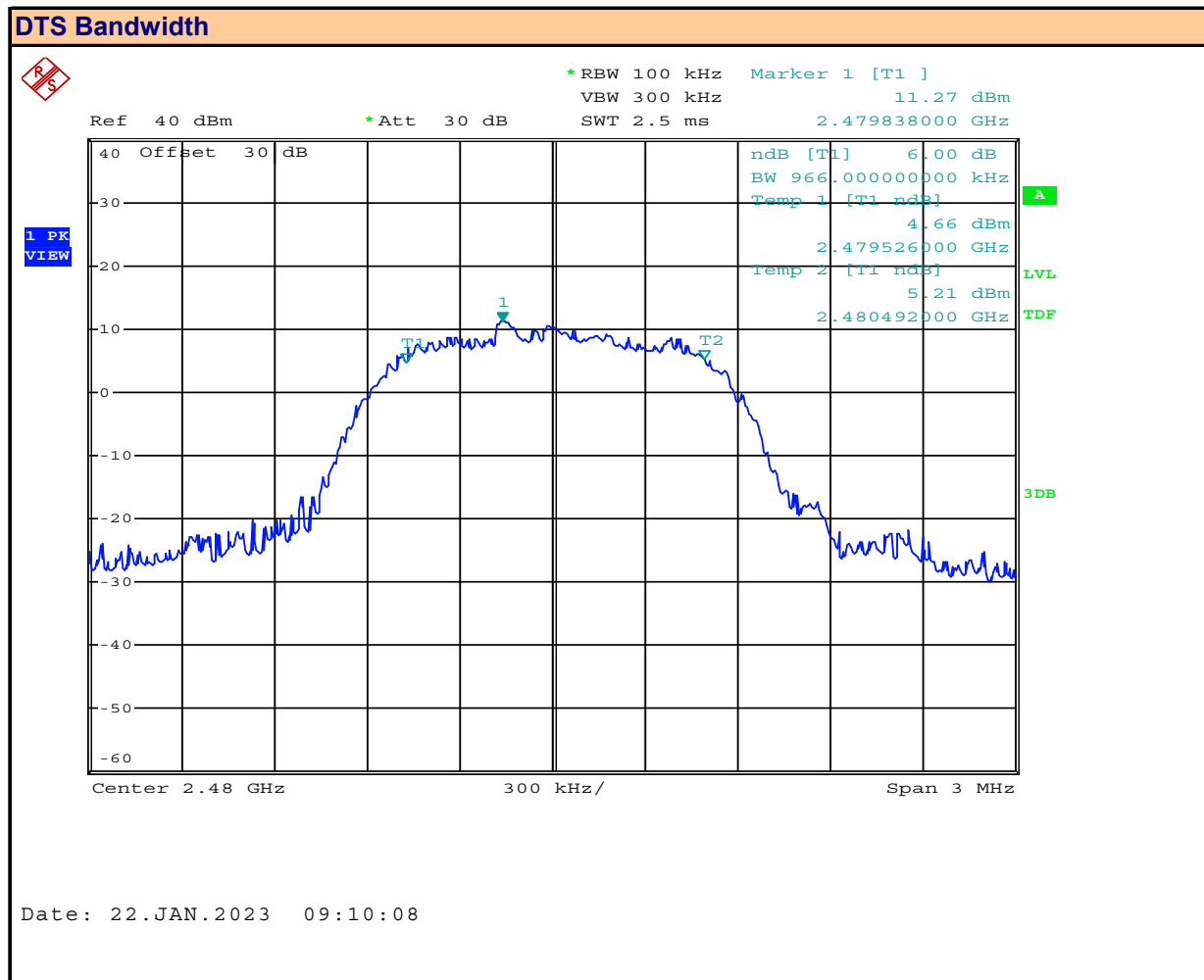
Plot 8.4 – 6dB DTS Bandwidth, BT BR



Channel: **78**
Mode: **BT BR**

Channel Frequency: **2480** MHz
Modulation: **GFSK**
Measured DTS Bandwidth: **0.82** MHz

Plot 8.5 – 6dB DTS Bandwidth, BT 2EDR



Channel: **78**
Mode: **BT 2EDR**

Channel Frequency: **2480** MHz
Modulation: **Pi/4-DQPSK**
Measured DTS Bandwidth: **0.966** MHz

Plot 8.6 – 6dB DTS Bandwidth, BT 3EDR



Channel: **78**
Mode: **BT 3EDR**

Channel Frequency: **2480** MHz
Modulation: **8-DPSK**
Measured DTS Bandwidth: **0.96** MHz

Table 8.2 – Summary of 6dB DTS Bandwidth Measurements, (DSS)

DTS Bandwidth Results:						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured DTS Bandwidth (MHz)	Minimum DTS Bandwidth (MHz)	Margin (MHz)
78	2480.0	BT BR	GFSK	0.468	0.500	0.820
78	2480.0	BT 2EDR	Pi/4-DQPSK	0.966		0.466
78	2480.0	BT 3EDR	8-DPSK	0.960		0.460
					Result:	Complies

9.0 ANTENNA PORT CONDUCTED POWER, (DTS)

Test Procedure

Normative	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),
Reference	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits

47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) Devices shall comply with the following requirements, where applicable: d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Table 9.1 – Summary of Conducted Power Measurements, (DTS)

See Appendix D for Measurement Plots

Conducted Power Measurement Results:												
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P _{Meas}] (dBm)	Measured Power (W)	Conducted Limit [P _{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E _{Meas}] (dBm)	EIRP (W)	EIRP Limit [E _{Lim}] (dBm)	EIRP Margin (dB)
6	2437.00	802.11b	CCK 1MB	17.28	0.0535	30.00	12.7	-5.26	12.02	0.0159	36	24.0
6	2437.00		CCK 2MB	17.33	0.0541		12.7		12.07	0.0161		23.9
6	2437.00		DSSS 5.5	17.38	0.0547		12.6		12.12	0.0163		23.9
6	2437.00		DSSS 11	17.17	0.0521		12.8		11.91	0.0155		24.1
1	2412.00		DSSS 5.5	14.91	0.0310		15.1		9.65	0.0092		26.4
11	2462.00		DSSS 5.5	15.59	0.0362		14.4		10.33	0.0108		25.7
1	2412.00	802.11g	OFDM12	10.89	0.0123		19.1		5.63	0.0037		30.4
6	2437.00			18.35	0.0684		11.7		13.09	0.0204		22.9
11	2462.00			13.66	0.0232		16.3		8.40	0.0069		27.6
1	2412.00	802.11n	MCS0	10.94	0.0124		19.1		5.68	0.0037		30.3
6	2437.00			16.80	0.0479		13.2		11.54	0.0143		24.5
11	2462.00			12.85	0.0193		17.2		7.59	0.0057		28.4
Result:												Complies

$$\text{Conducted Margin} = P_{\text{Limit}} - P_{\text{Meas}}$$

$$\text{Conducted Margin} = E_{\text{Lim}} - E_{\text{Meas}}$$

10.0 ANTENNA PORT CONDUCTED POWER, (DSS)

Test Procedure

Normative	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),
Reference	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits

47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) Devices shall comply with the following requirements, where applicable: d) For DTSSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Table 10.1 – Summary of Conducted Power Measurements, (DSS)

See Appendix D for Measurement Plots

Conducted Power Measurement Results:												
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P _{Meas}] (dBm)	Measured Power (W)	Conducted Limit [P _{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E _{Meas}] (dBm)	EIRP (W)	EIRP Limit [E _{Lim}] (dBm)	EIRP Margin (dB)
0	2402.00	BT BR	GFSK	11.04	0.0127	30.00	19.0	-4.72	6.32	0.0043	36	29.7
38	2440.00			11.11	0.0129		18.9		6.39	0.0044		29.6
78	2480.00			11.13	0.0130		18.9		6.41	0.0044		29.6
0	2402.00	BT EDR2	Pi/4-DQPSK	10.11	0.0103		19.9		5.39	0.0035		30.6
38	2440.00			10.21	0.0105		19.8		5.49	0.0035		30.5
78	2480.00			10.23	0.0105		19.8		5.51	0.0036		30.5
0	2402.00	BT EDR3	8-DPSK	10.11	0.0103		19.9		5.39	0.0035		30.6
38	2440.00			10.11	0.0103		19.9		5.39	0.0035		30.6
78	2480.00			10.12	0.0103		19.9		5.40	0.0035		30.6
Result:											Complies	

$$\text{Conducted Margin} = P_{\text{Lim}} - P_{\text{Meas}}$$

$$\text{Conducted Margin} = E_{\text{Lim}} - E_{\text{Meas}}$$

11.0 POWER SPECTRAL DENSITY

Test Procedure

Normative Reference	FCC 47 CFR §15.247(e), RSS-247 (5.2)(b), KDB 558074 (10.3), ANSI C63.10 (11.10.3)
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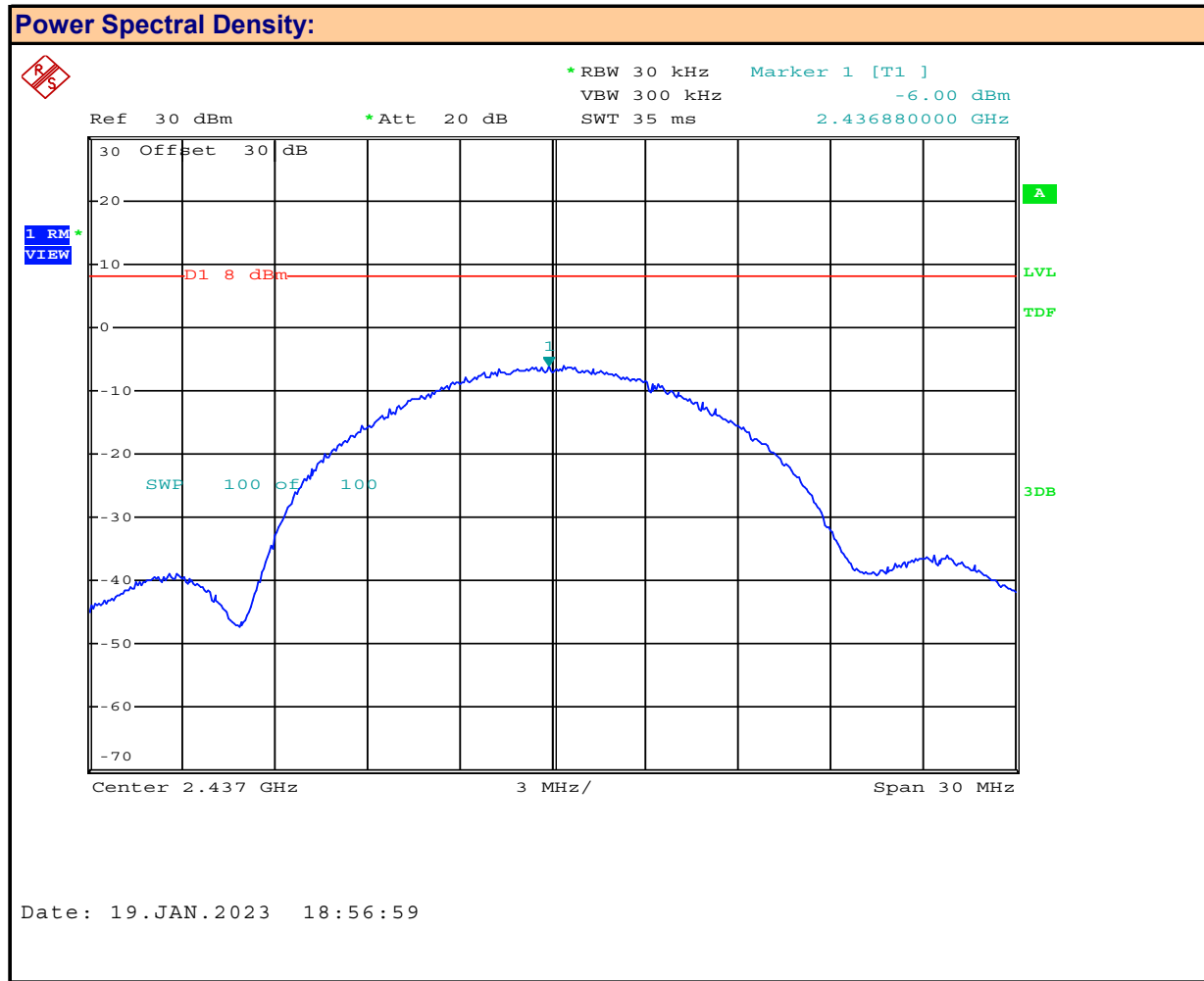
Limits

47 CFR §15.247(e)	(e) For digitally modulated systems, 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
RSS-247 (5.2)(b)	b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).
KDB 558074 (10.3) C63.10 (11.10.3)	Method AVGPS-1 (trace averaging with EUT transmitting at full power throughout each sweep) This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle $\geq 98\%$); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered). a) Set instrument center frequency to DTS channel center frequency. b) Set span to at least $1.5 \times \text{OBW}$. c) Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$. d) Set VBW $\geq 3 \times \text{RBW}$. e) Detector = RMS f) Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$. g) Sweep time = auto couple. h) Employ trace averaging (RMS) mode over a minimum of 100 traces. i) Use the peak marker function to determine the maximum amplitude level. j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).
Test Setup	Appendix A Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above. Number of Sweep Points $\geq 2 \times \text{Span} / \text{RBW} = 2 \times (1.5\text{MHz} / 3\text{kHz}) = 1000$, the SA was configured for 1001 Points. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. The Power Spectral Density was measured and recorded.

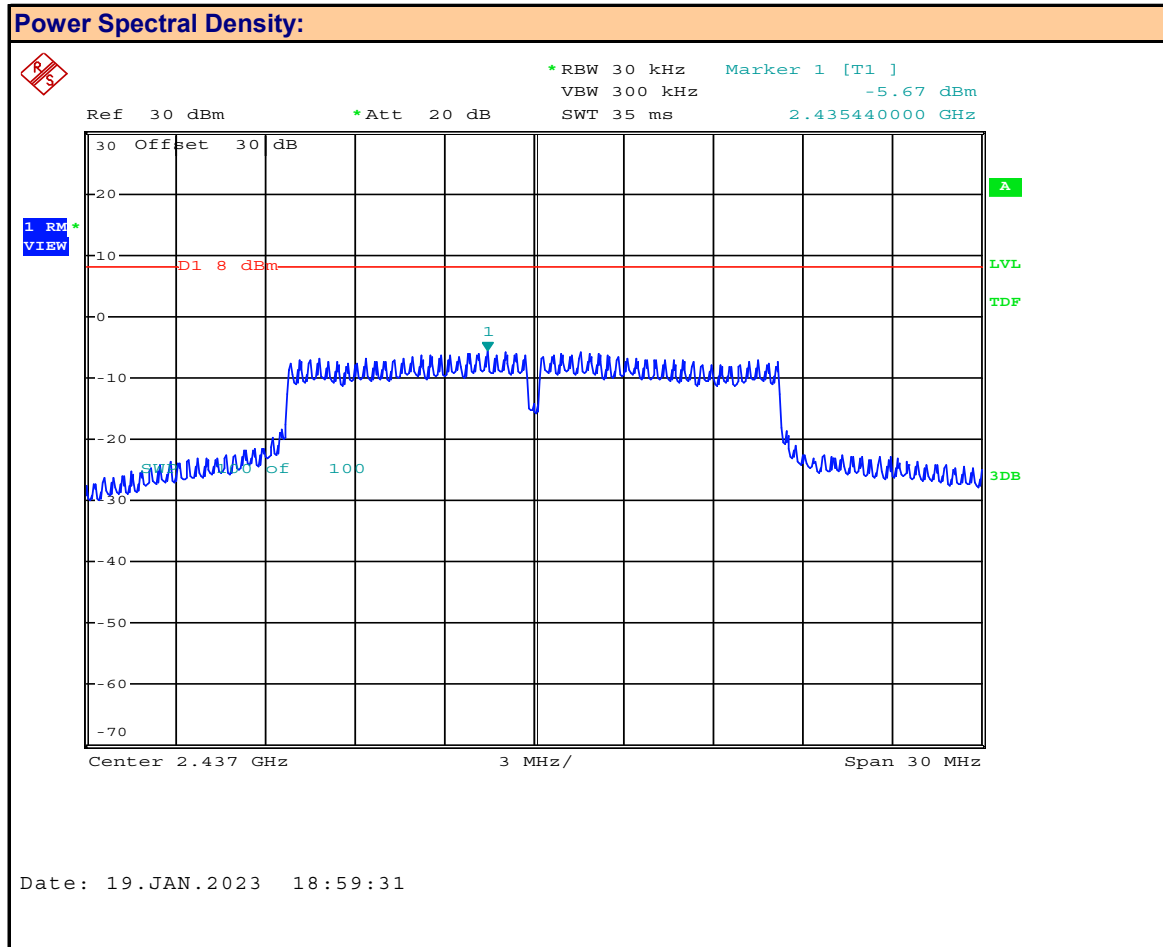
Plot 11.1 – Power Spectral Density, 802.11b



Channel: **6**
Mode: **802.11b**

Channel Frequency: **2437** MHz
Modulation: **DSSS 5.5**
Measured PSD: **-6.0** dBm

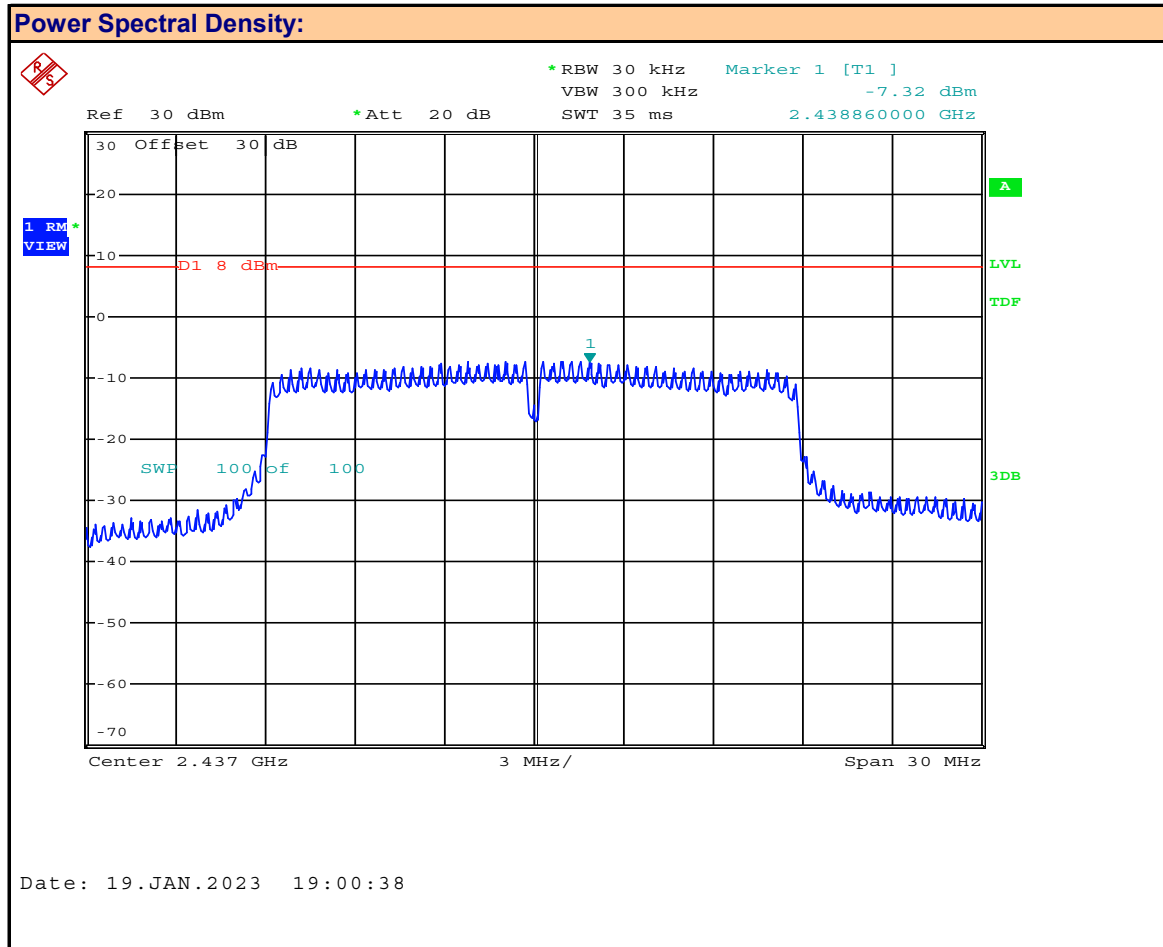
Plot 11.2 – Power Spectral Density, 802.11g



Channel: **6**
Mode: **802.11g**

Channel Frequency: **2437** MHz
Modulation: **OFDM 12**
Measured PSD: **-5.67** dBm

Plot 11.3 – Power Spectral Density, 802.11n



Channel: **6**
Mode: **802.11n**

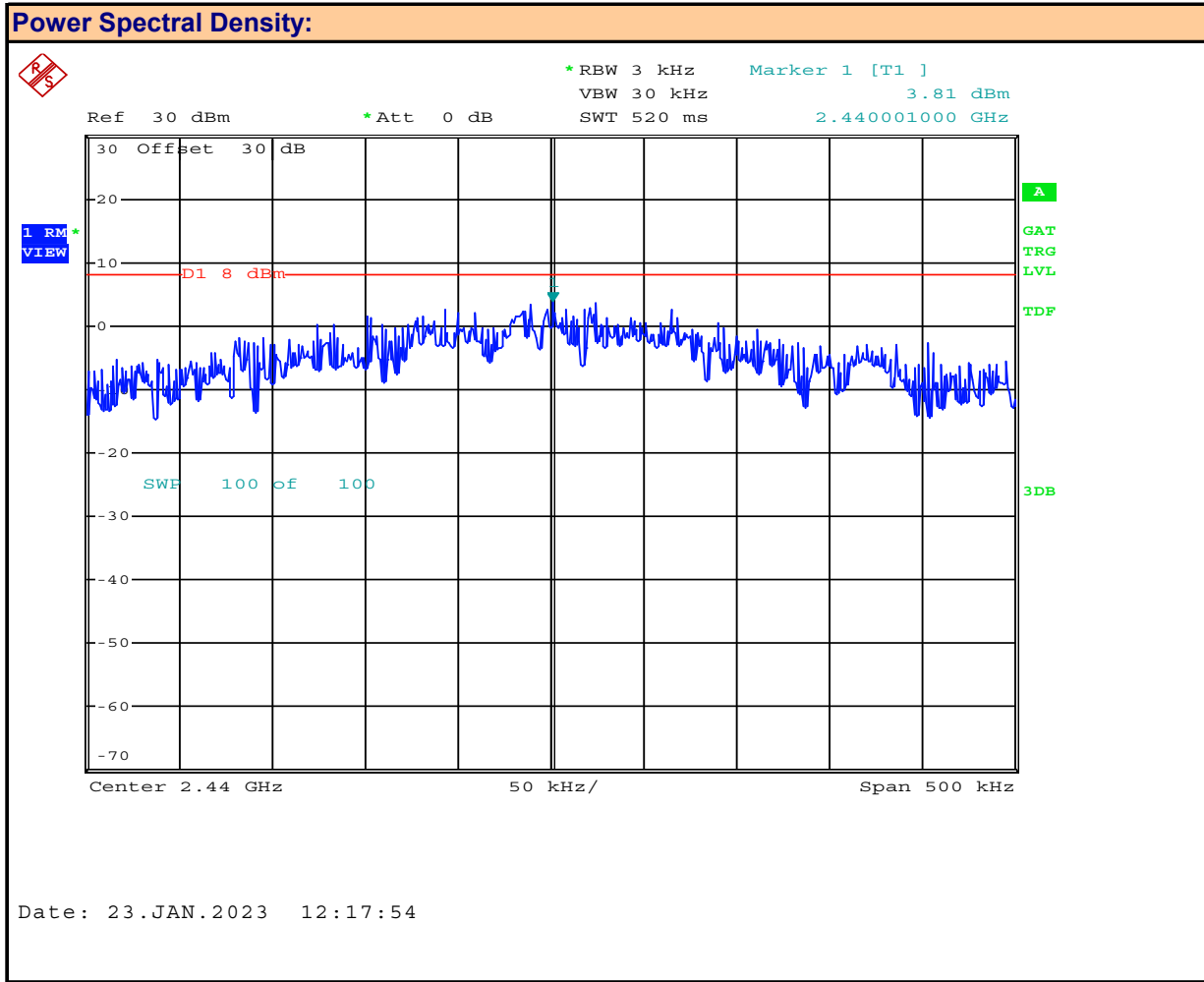
Channel Frequency: **2437** MHz
Modulation: **MCS0**
Measured PSD: **-7.32** dBm

Table 11.1 – Summary of Power Spectral Density Measurements, (DTS)

Conducted Power Measurement Results:						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured PSD [P _{Meas}] (dBm)	Conducted Limit [P _{Lim}] (dBm)	Margin (dB)
6	2437.00	802.11b	DSSS 5.5	-6.00	8.00	14.0
6	2437.00	802.11g	OFDM 12	-5.67		13.7
6	2437.00	802.11n	MCS0	-7.32		15.3
					Result:	Complies

Conducted Margin = $P_{\text{Limit}} - P_{\text{Meas}}$

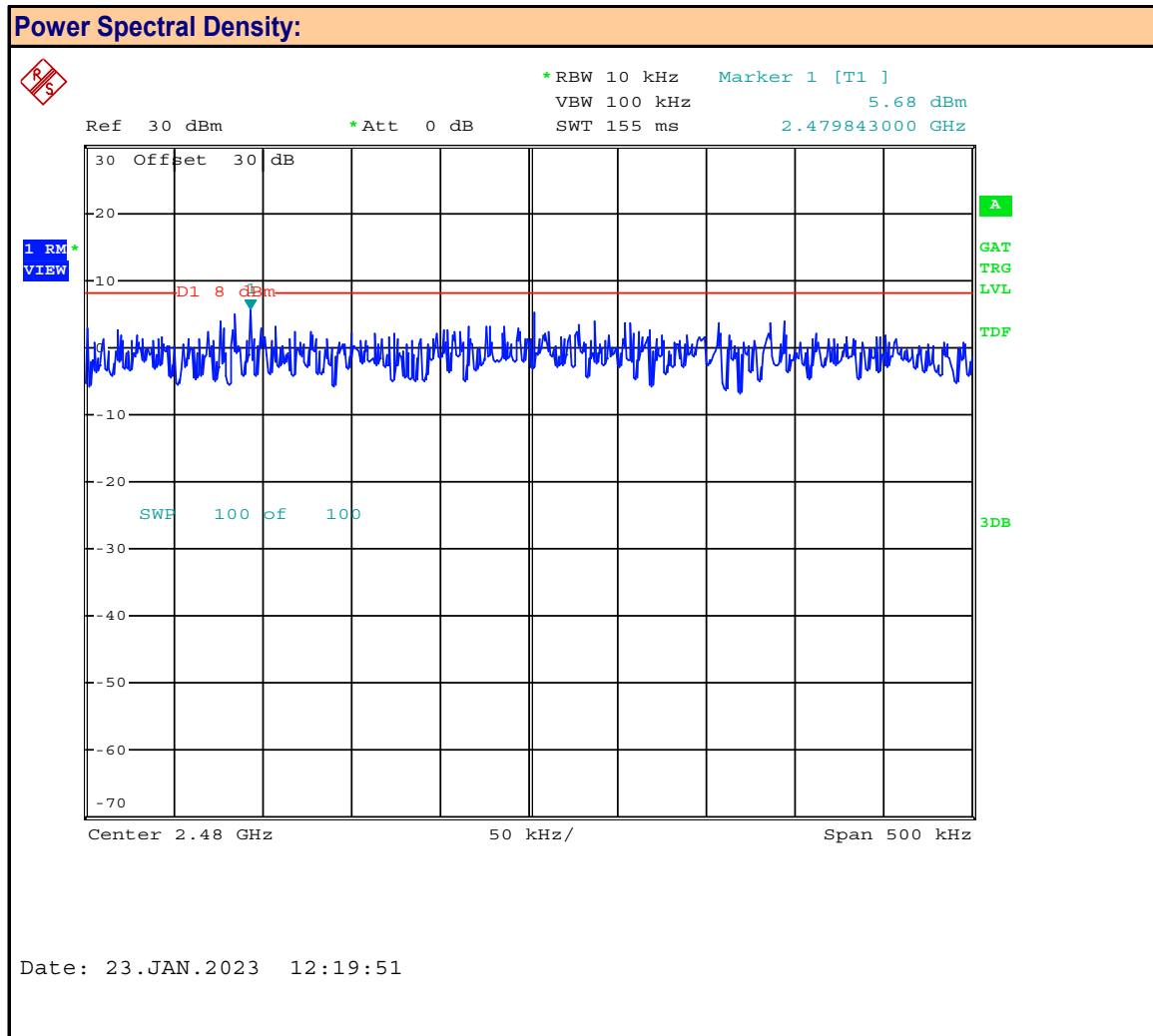
Plot 11.4 – Power Spectral Density, BT BR



Channel: **38**
Mode: **BT BR**

Channel Frequency: **2440** MHz
Modulation: **GFSK**
Measured PSD: **3.81** dBm

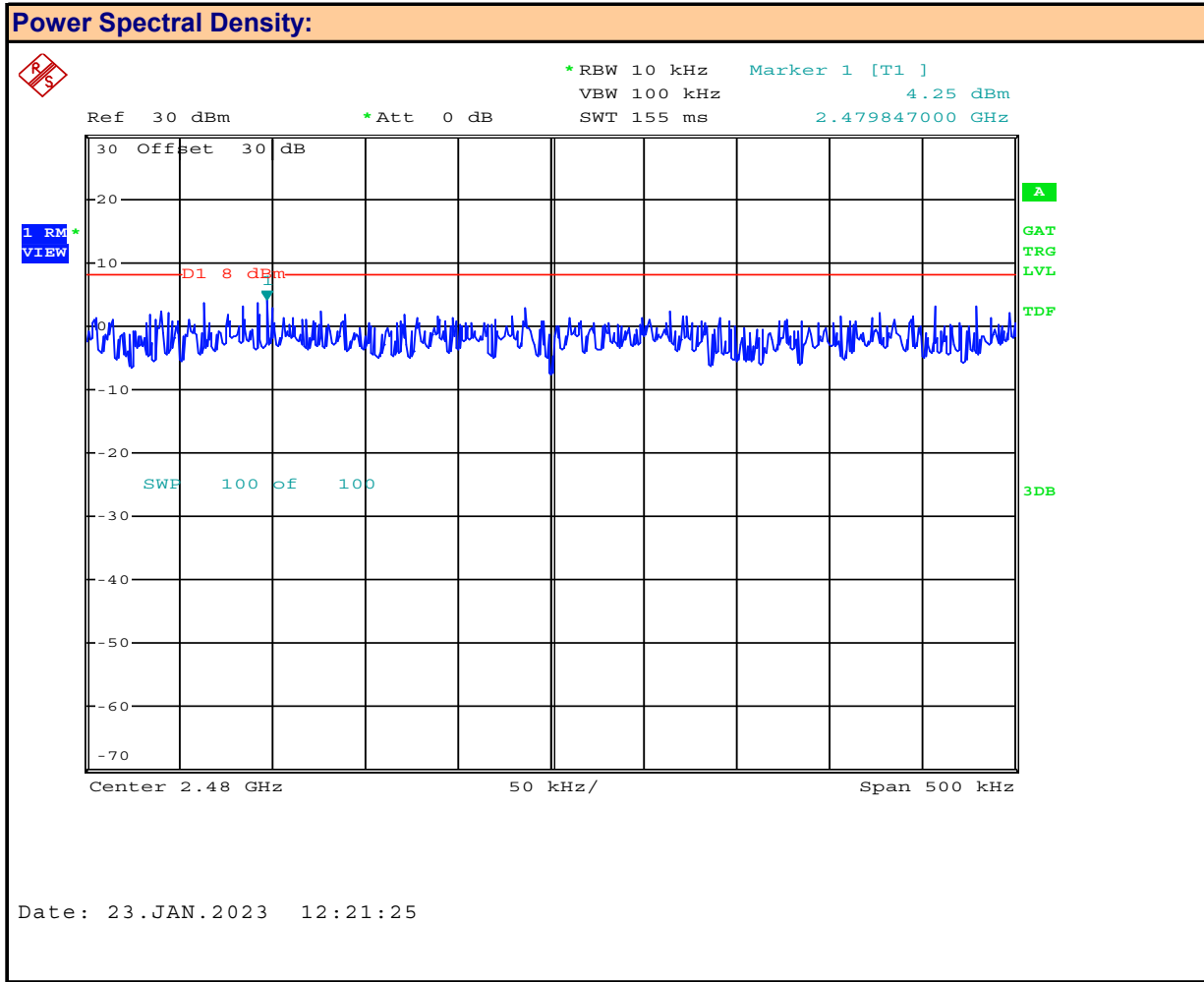
Plot 11.5 – Power Spectral Density, BT 2EDR



Channel: **78**
Mode: **BT 2EDR**

Channel Frequency: **2480** MHz
Modulation: **pi/4-DQPSK**
Measured PSD: **5.68** dBm

Plot 11.6 – Power Spectral Density, BT 3EDR



Channel: **78**
Mode: **BT 3EDR**

Channel Frequency: **2480** MHz
Modulation: **8-DPSK**
Measured PSD: **4.25** dBm

Table 11.2 – Summary of Power Spectral Density Measurements, (DSS)

Conducted Power Measurement Results:						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured PSD [P _{Meas}] (dBm)	Conducted Limit [P _{Lim}] (dBm)	Margin (dB)
38	2440.00	BT BR	GFSK	3.81	8.00	4.2
78	2480.00	BT 2EDR	pi/4-DQPSK	5.68		2.3
78	2480.00	BT 3EDR	8-DPSK	4.25		3.8
Result:						Complies

Conducted Margin = $P_{Limit} - P_{Meas}$

12.0 FHSS NUMBER OF HOPPING CHANNELS

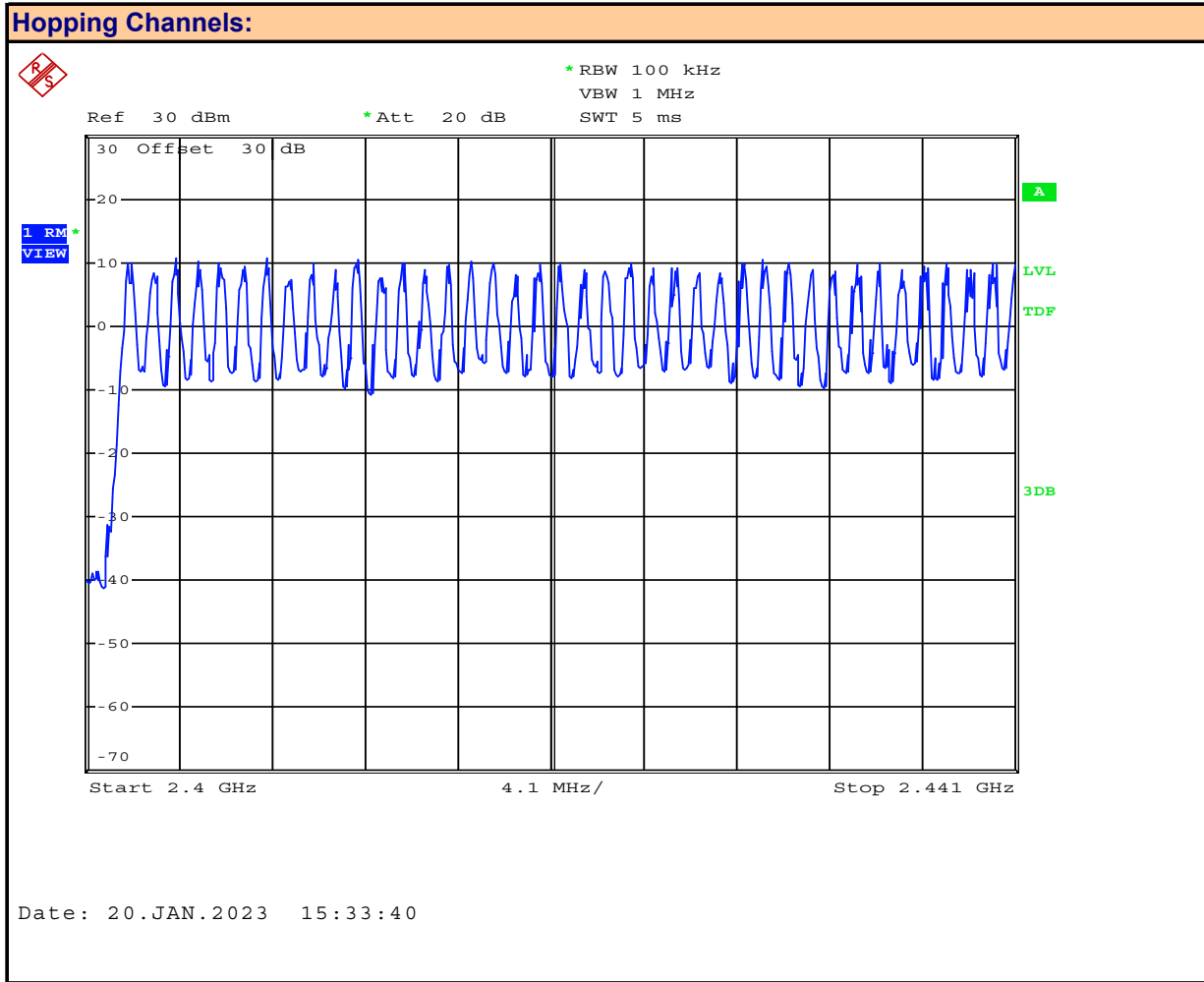
Test Procedure

Normative	FCC 47 CFR §15.247, RSS-247
Reference	KDB 558074, ANSI C63.10

Limits

47 CFR §15.247(a)(1)	(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
RSS-247 (5.1)(d)	5.1 Frequency hopping systems (FHS) The following applies to FHSs in each of the three bands: FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Plot 12.1 – Number of Hopping Channels, BT BR



Channel:

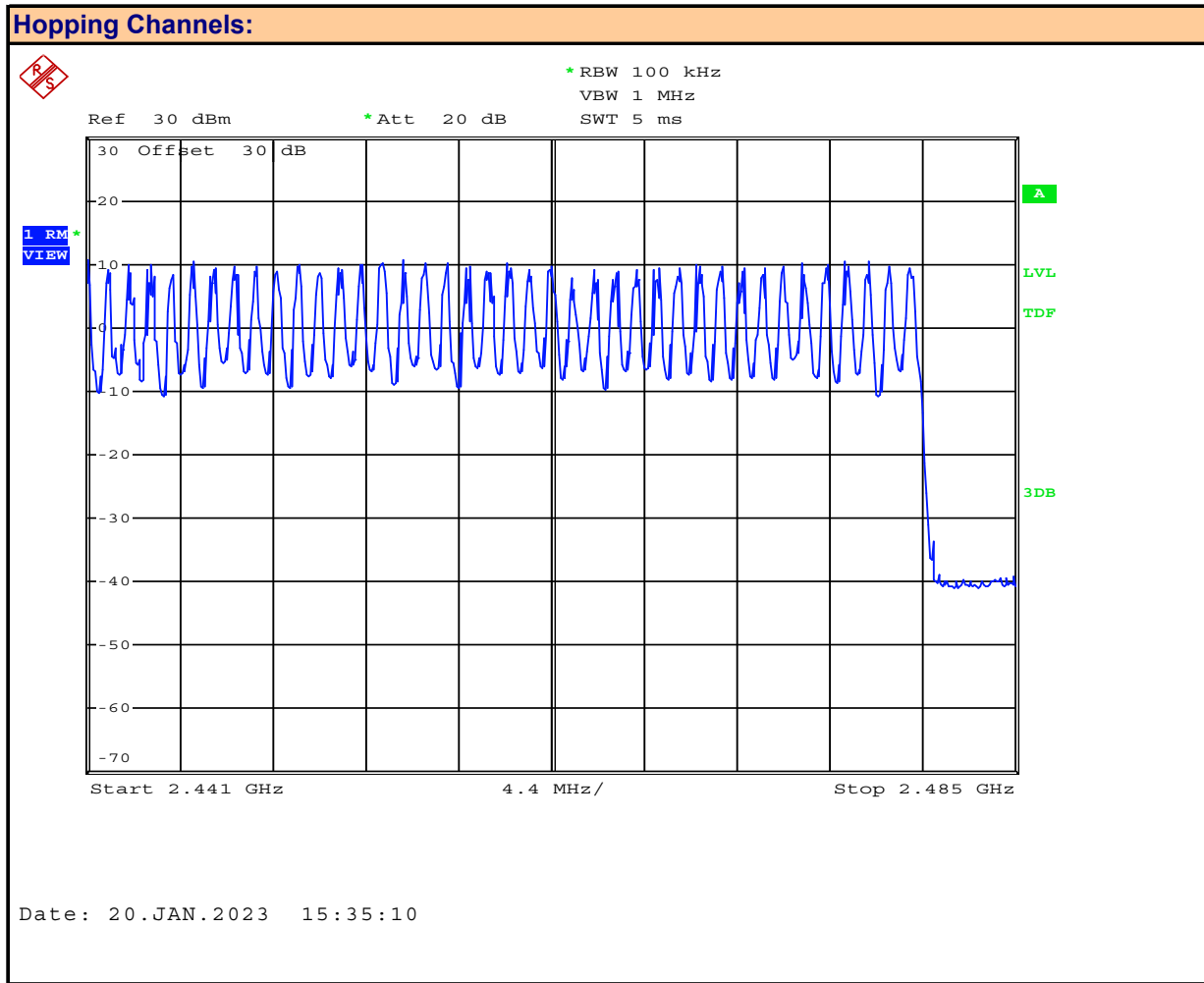
Mode:

Channel Frequency: MHz

Modulation:

Number of Hopping Channels

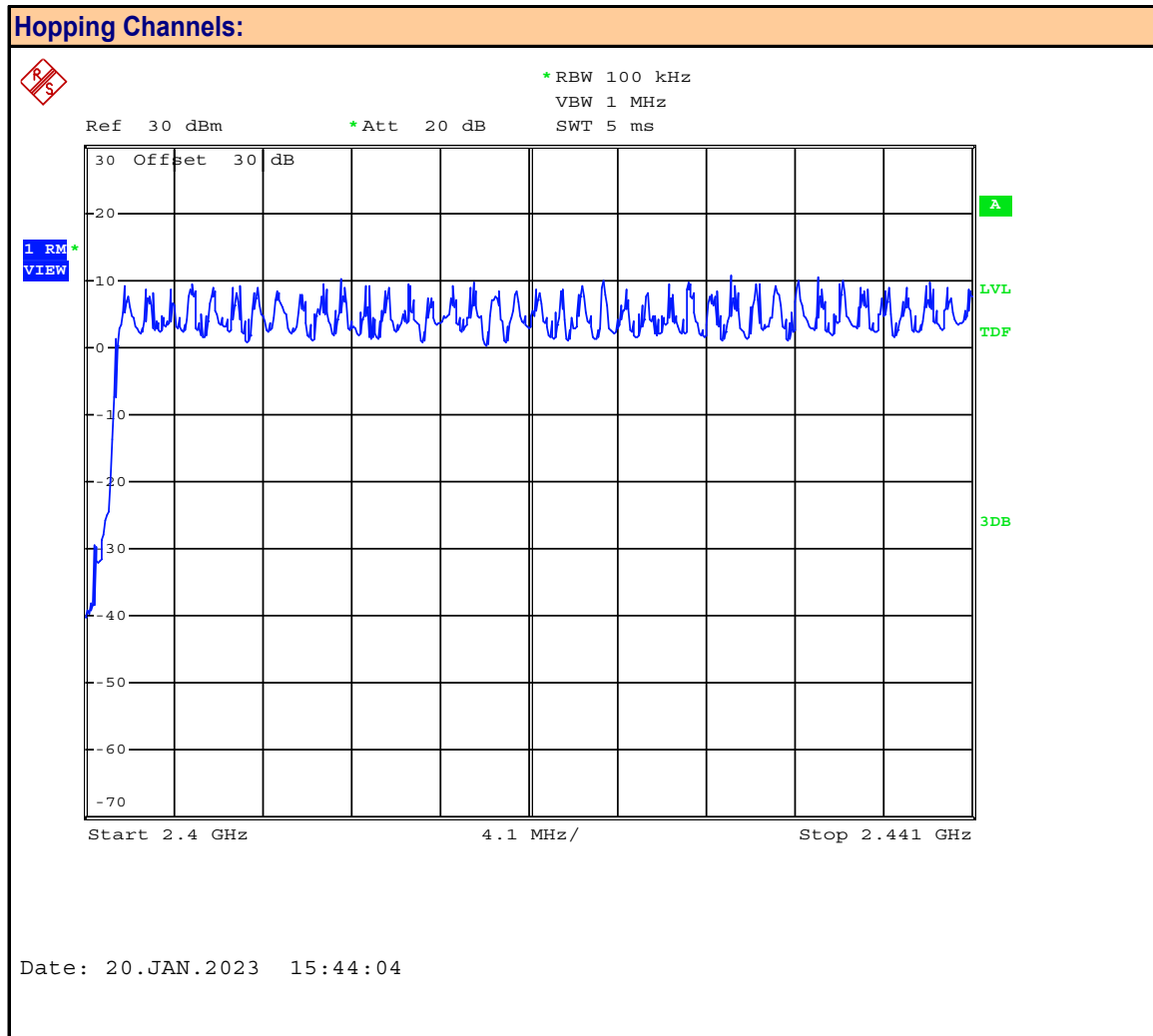
Plot 12.2 – Number of Hopping Channels, BT BR



Channel:
Mode:

Channel Frequency: MHz
Modulation:
Number of Hopping Channels

Plot 12.3 – Number of Hopping Channels, BT 2EDR



Channel:

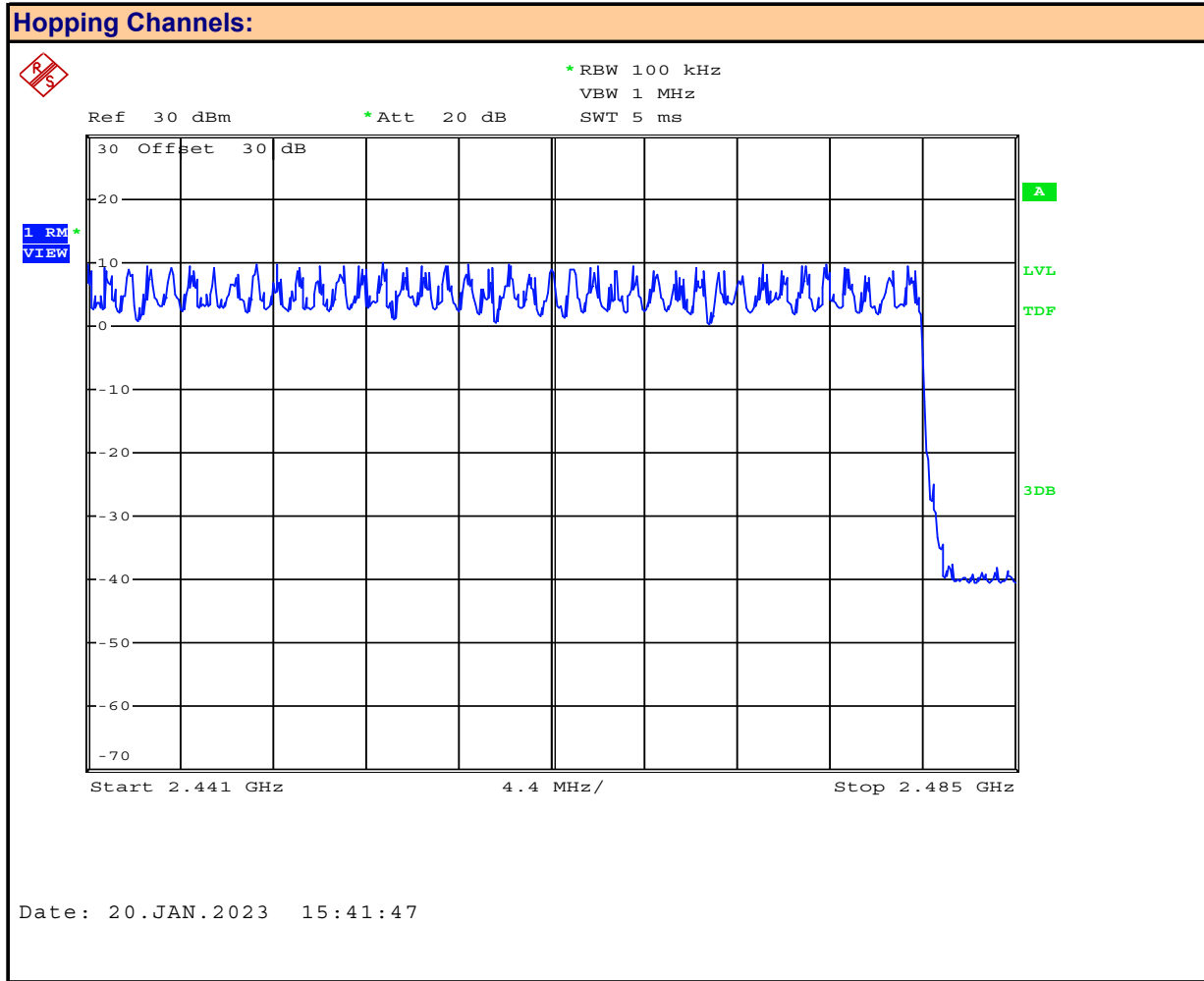
Channel Frequency: MHz

Mode:

Modulation:

Number of Hopping Channels

Plot 12.4 – Number of Hopping Channels, BT 2EDR



Channel:
Mode:

Channel Frequency: MHz
Modulation:
Number of Hopping Channels

Table 12.2 – Summary of FHSS Number of Hopping Channels

Hopping Channel Results DSS		
Frequency Range (MHz)	Modulation	Number of Hopping Channels
2400-2441	Pi/4-DQPSK	40
2441-2485	Pi/4-DQPSK	39
Total:		79
2400-2441	GFSK	40
2441-2485	GFSK	39
Total:		79
Result:		Complies

13.0 FHSS CHANNEL SEPARATION

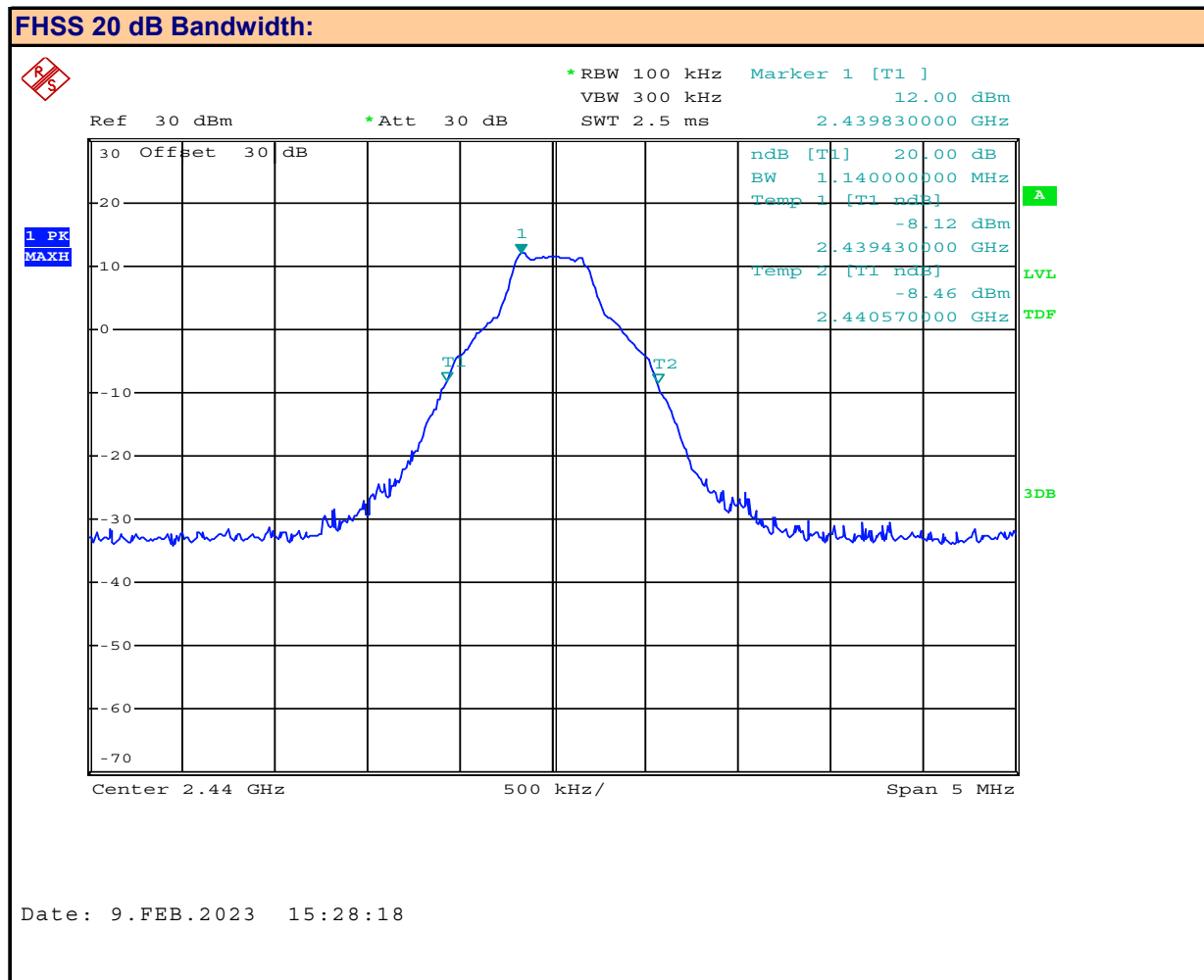
Test Procedure

Normative	FCC 47 CFR §15.247, RSS-247
Reference	KDB 558074, ANSI C63.10

Limits

47 CFR §15.247(a)(1)	(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400- 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
RSS-247 (5.1)(db)	5.1 Frequency hopping systems (FHS) The following applies to FHSs in each of the three bands: FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

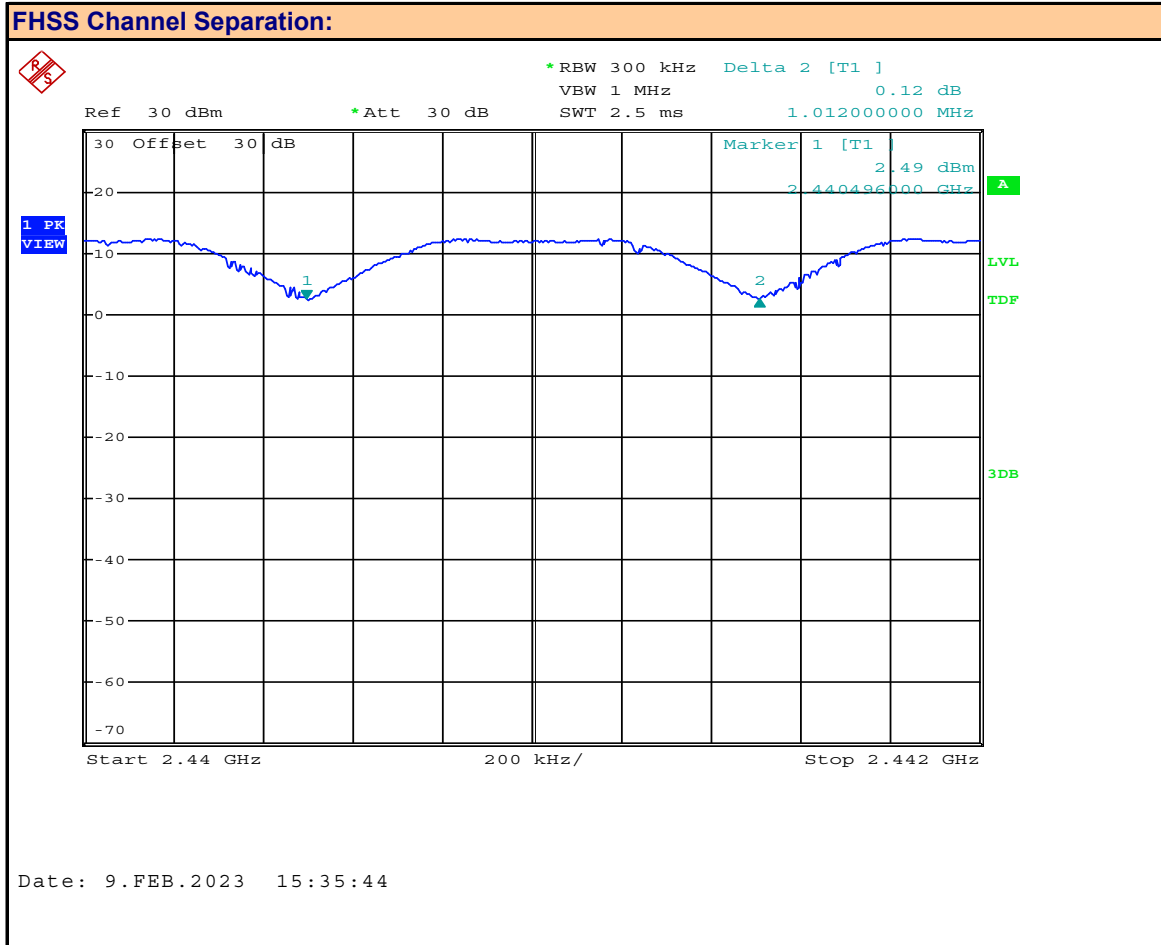
Plot 13.1 – 20dB BW, BT BR



Channel: **38**
Mode: **BT BR**

Channel Frequency: **2440** MHz
Modulation: **GFSK**
Measured 20dB Bandwidth: **1.14** MHz

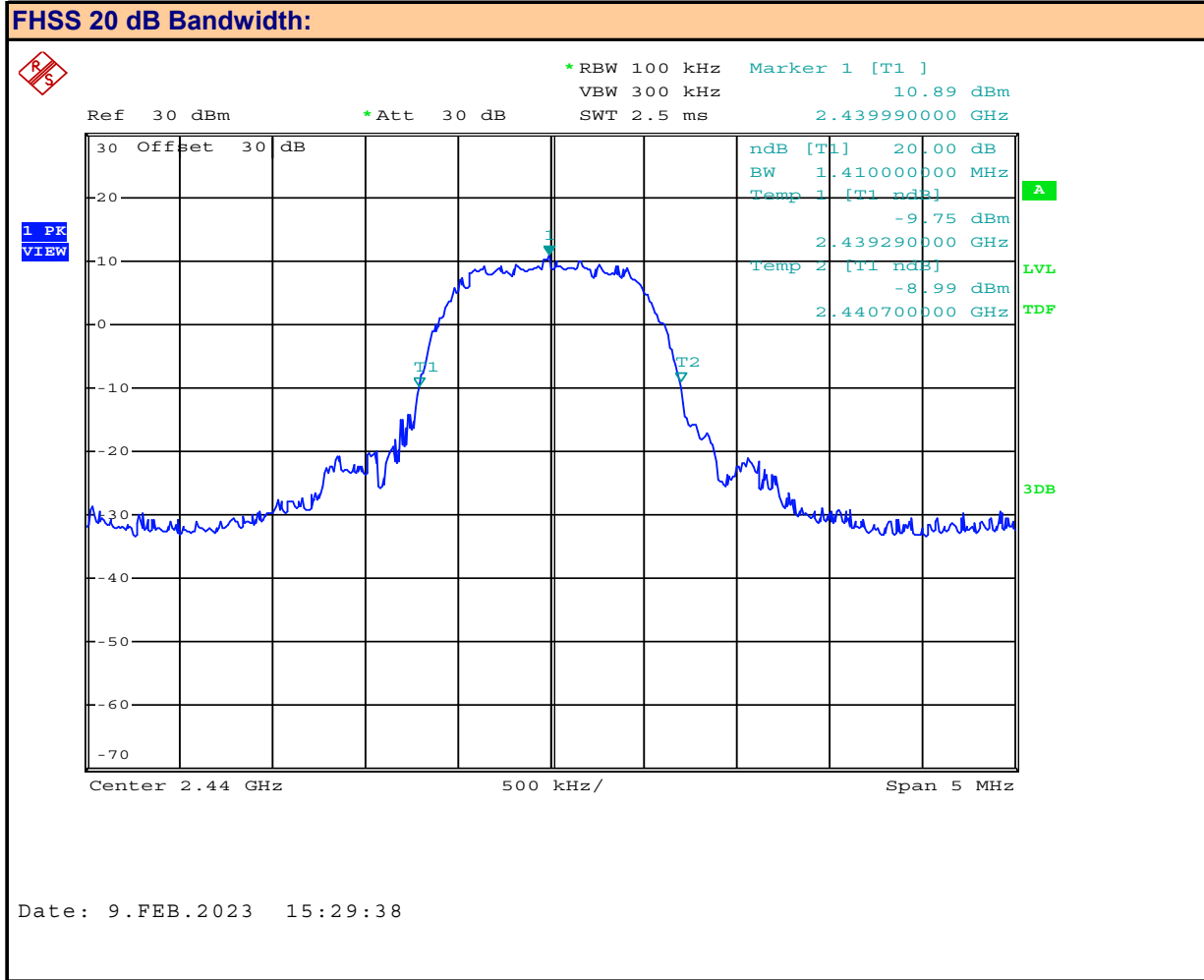
Plot 13.2 – FHSS Channel Separation, BT BR



Channel:
Mode:

Channel Frequency: MHz
Modulation:
Measured Channel Separation: MHz

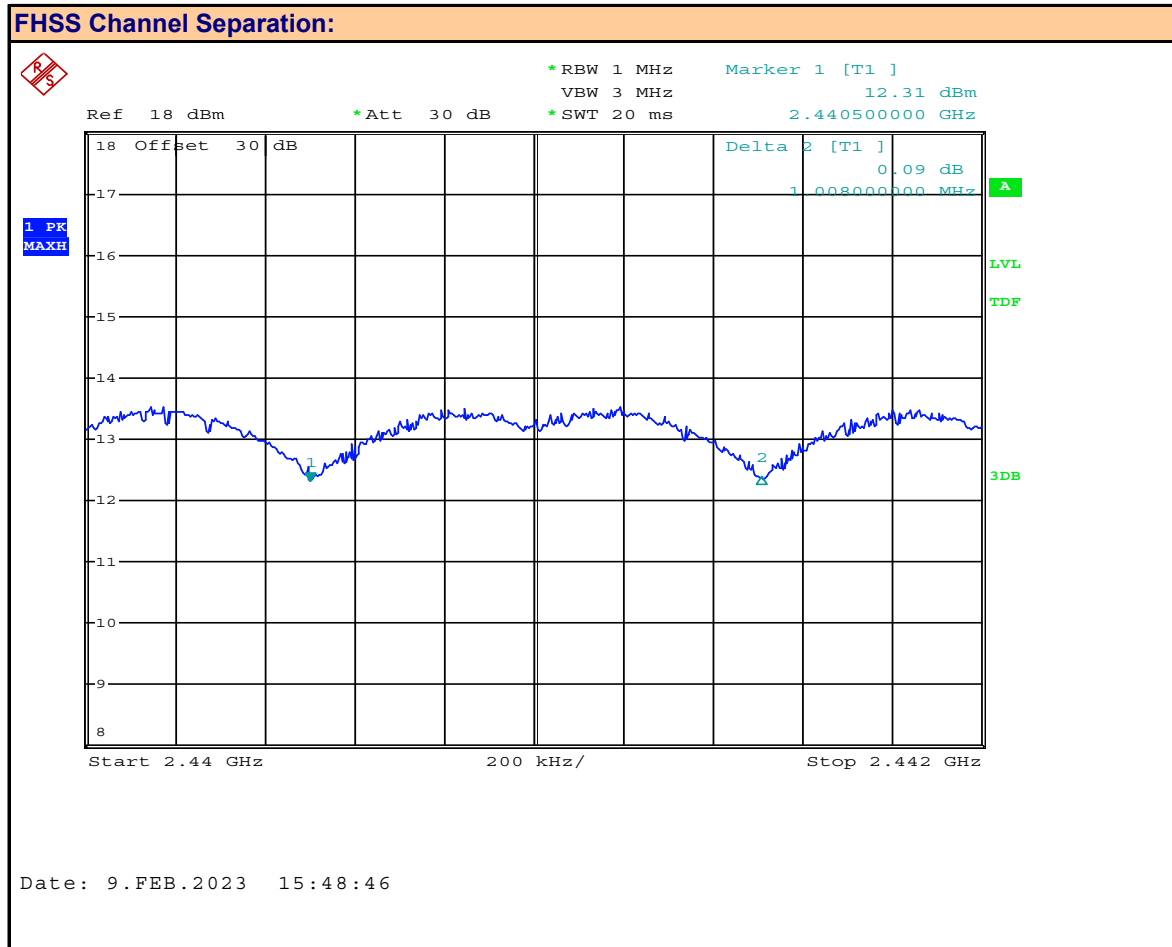
Plot 13.3 – 20dB BW, BT 2EDR



Channel: **38**
Mode: **BT EDR**

Channel Frequency: **2440** MHz
Modulation: **Pi/4-DQPSK**
Measured 20dB Bandwidth: **1.41** MHz

Plot 13.4 – FHSS Channel Separation, BT 2EDR



Channel:
Mode:

Channel Frequency: MHz
Modulation:
Measured Channel Separation: MHz

Table 13.1 – Summary of FHSS Channel Separation

Hopping Channel Separation Results DSS				
Modulation	20dB BW (MHz)	Channel Separation (MHz)	Minimum Bandwidth (MHz)	Margin (MHz)
8-DPSK	1.14	1.012	0.760	0.252
Pi/4-DQPSK	1.41	1.008	0.940	0.068
Result:				Complies

Minimum Bandwidth = 20dB BW X 2/3

Margin = Channel Separation - Minimum Bandwidth

14.0 FHSS TIME OF OCCUPANCY

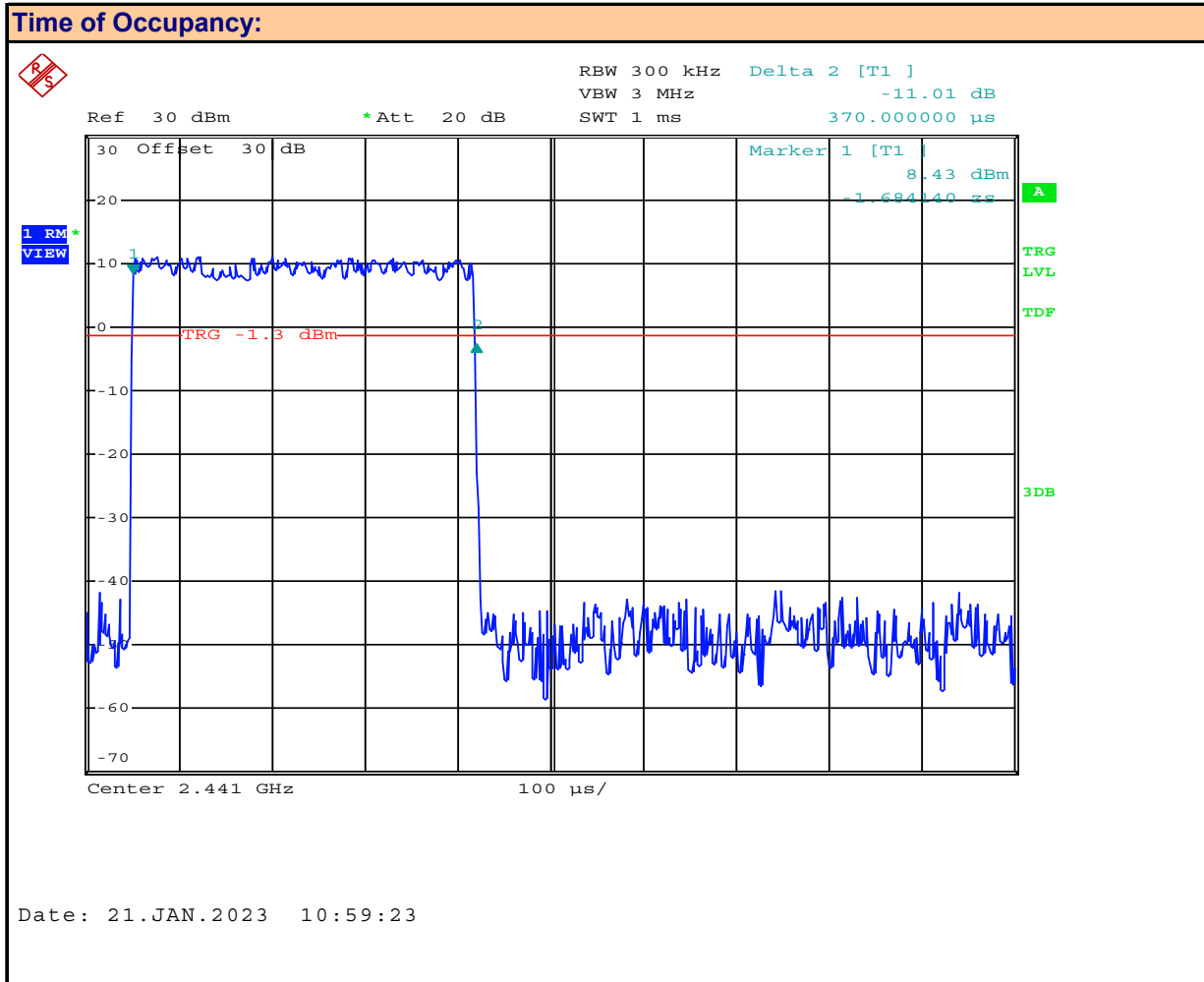
Test Procedure

Normative	FCC 47 CFR §15.247, RSS-247
Reference	KDB 558074, ANSI C63.10

Limits

47 CFR §15.247(a)(1)	(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
RSS-247 (5.1)(d)	5.1 Frequency hopping systems (FHS) FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

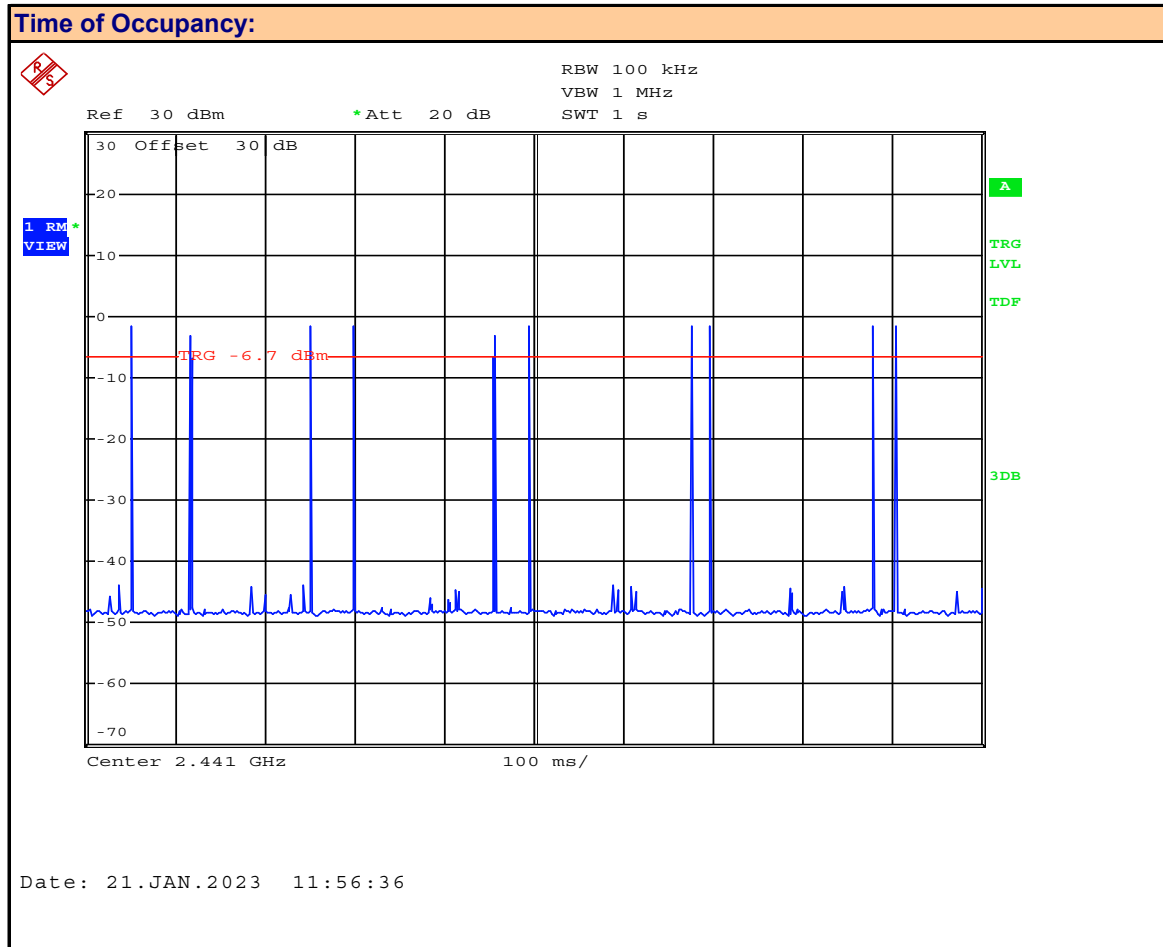
Plot 14.1 – Time of Occupancy, DH1, 2-DH1, 3-DH1, DM1



Packet: **DH1, DM1, 2-DH1, 3-DH1**

Measured On-Time: **370** µSec

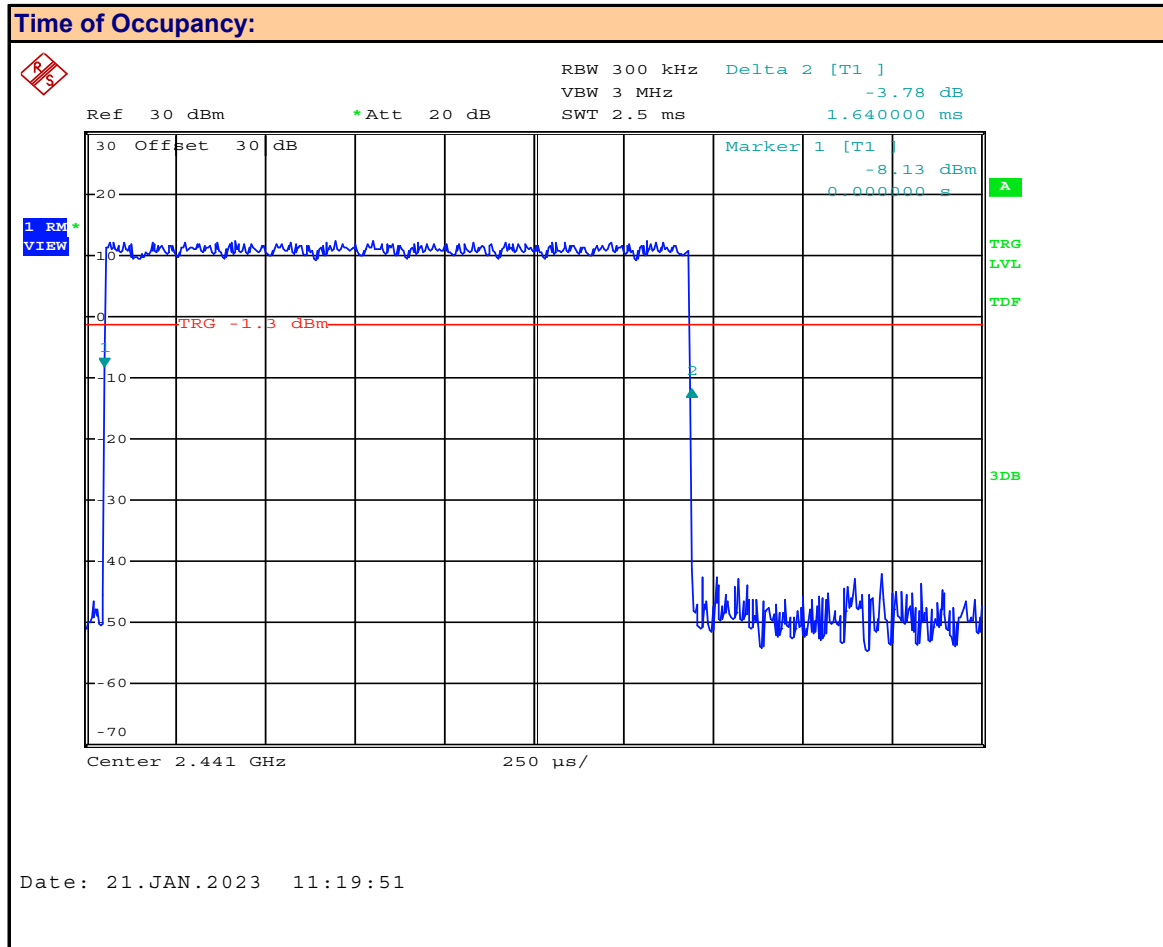
Plot 14.2 – Time of Occupancy, DH1, 2-DH1, 3-DH1, DM1



Packet: **DH1, DM1, 2-DH1, 3-DH1**

Transmit Count **10** /1000mSec

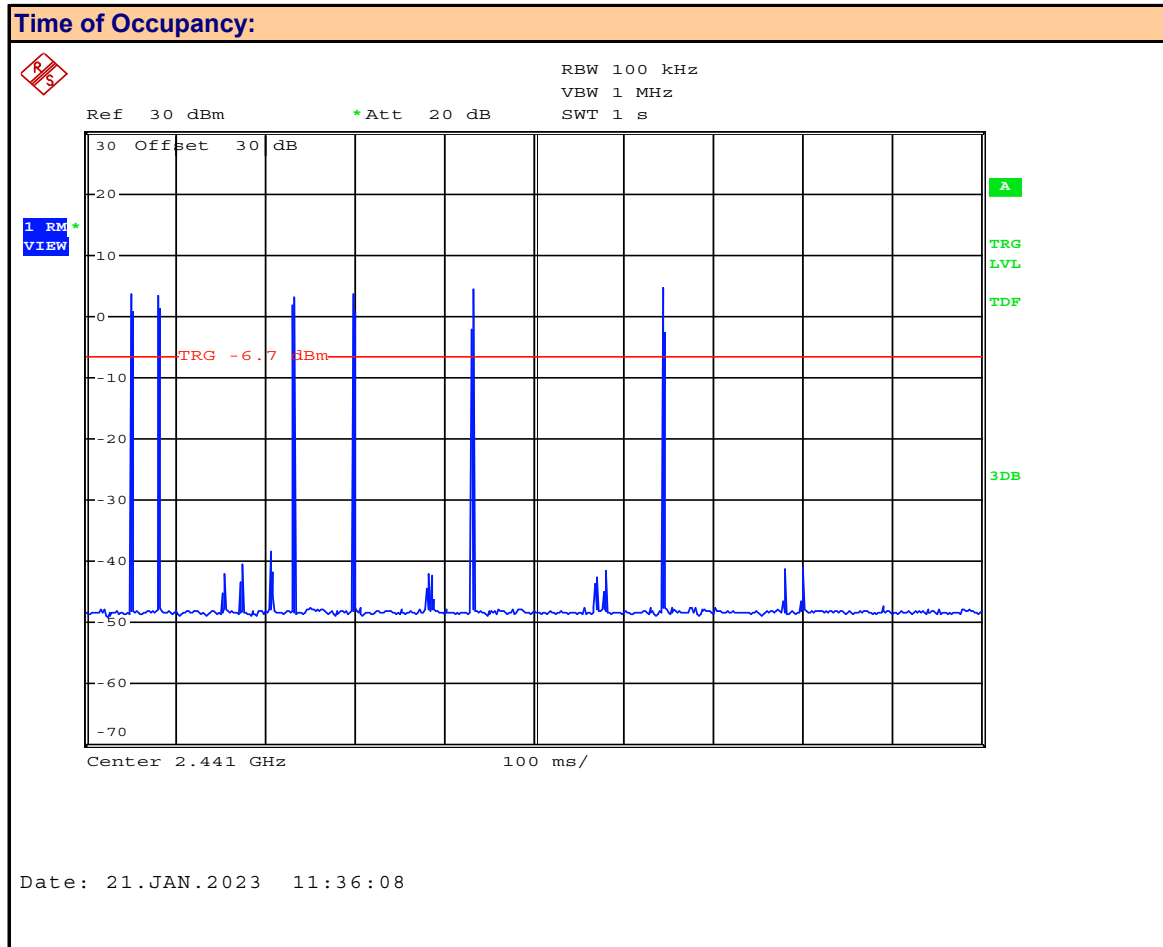
Plot 14.3 – Time of Occupancy, DH3, 2-DH3, 3-DH3, DM3



Packet: **DH3, DM3, 2-DH3, 3-DH3**

Measured On-Time: **1.64** mSec

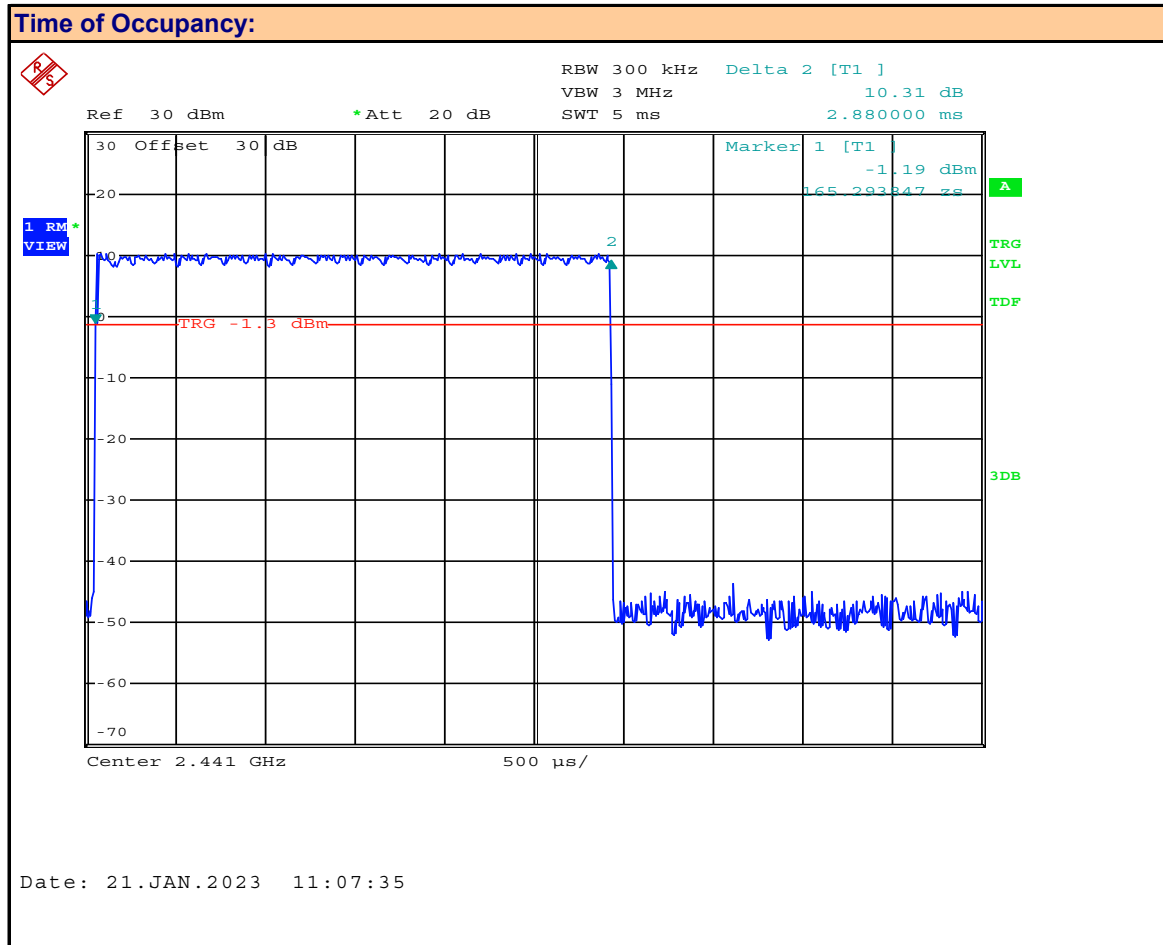
Plot 14.4 – Time of Occupancy, DH3, 2-DH3, 3-DH3, DM3



Packet: **DH3, DM3, 2-DH3, 3-DH3**

Transmit Count **6** /1000mSec

Plot 14.5 – Time of Occupancy, DH5, 2-DH5, 3-DH5, DM5



Packet: **DH5, DM5, 2-DH5, 3-DH5**

Measured On-Time: **2.88** mSec

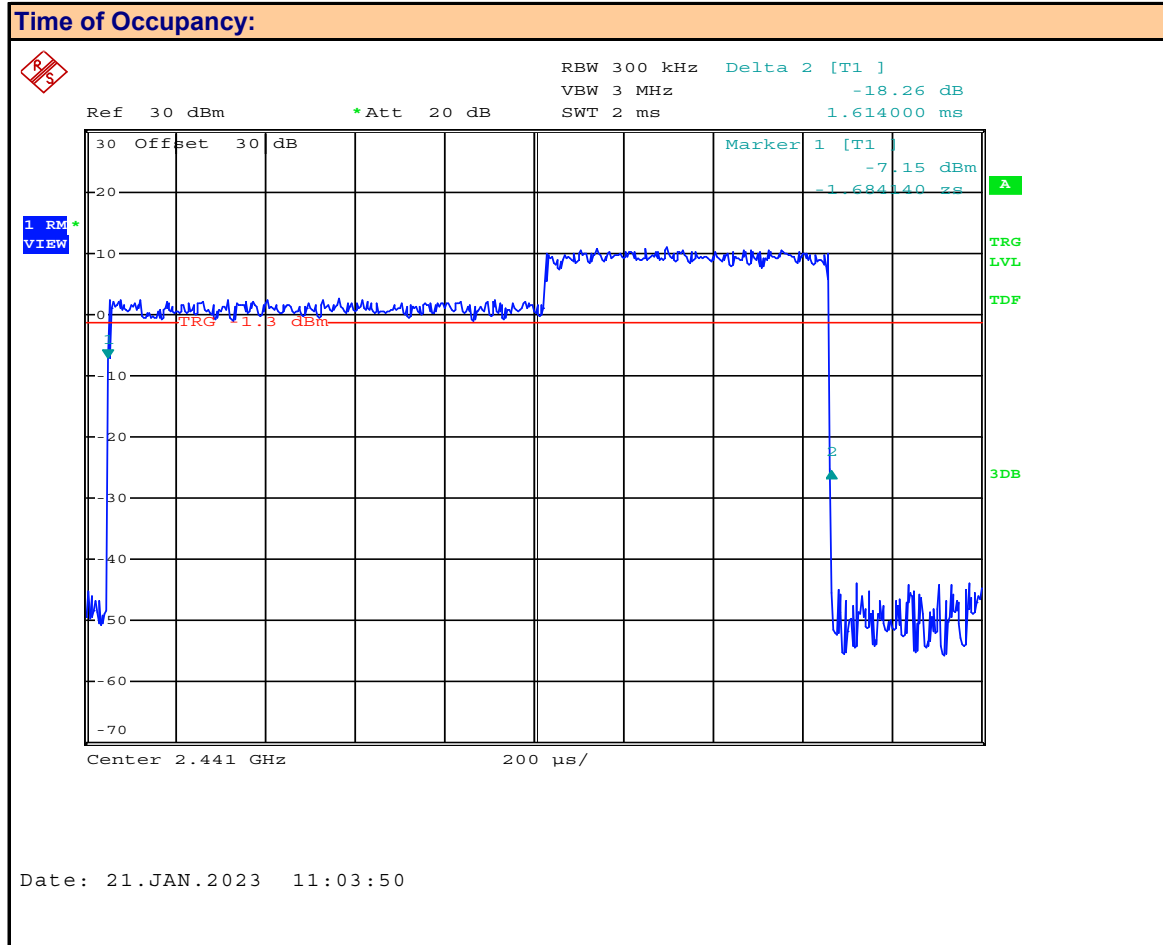
Plot 14.6 – Time of Occupancy, DH5, 2-DH5, 3-DH5, DM5



Packet: **DH5, DM5, 2-DH5, 3-DH5**

Transmit Count **4** /1000mSec

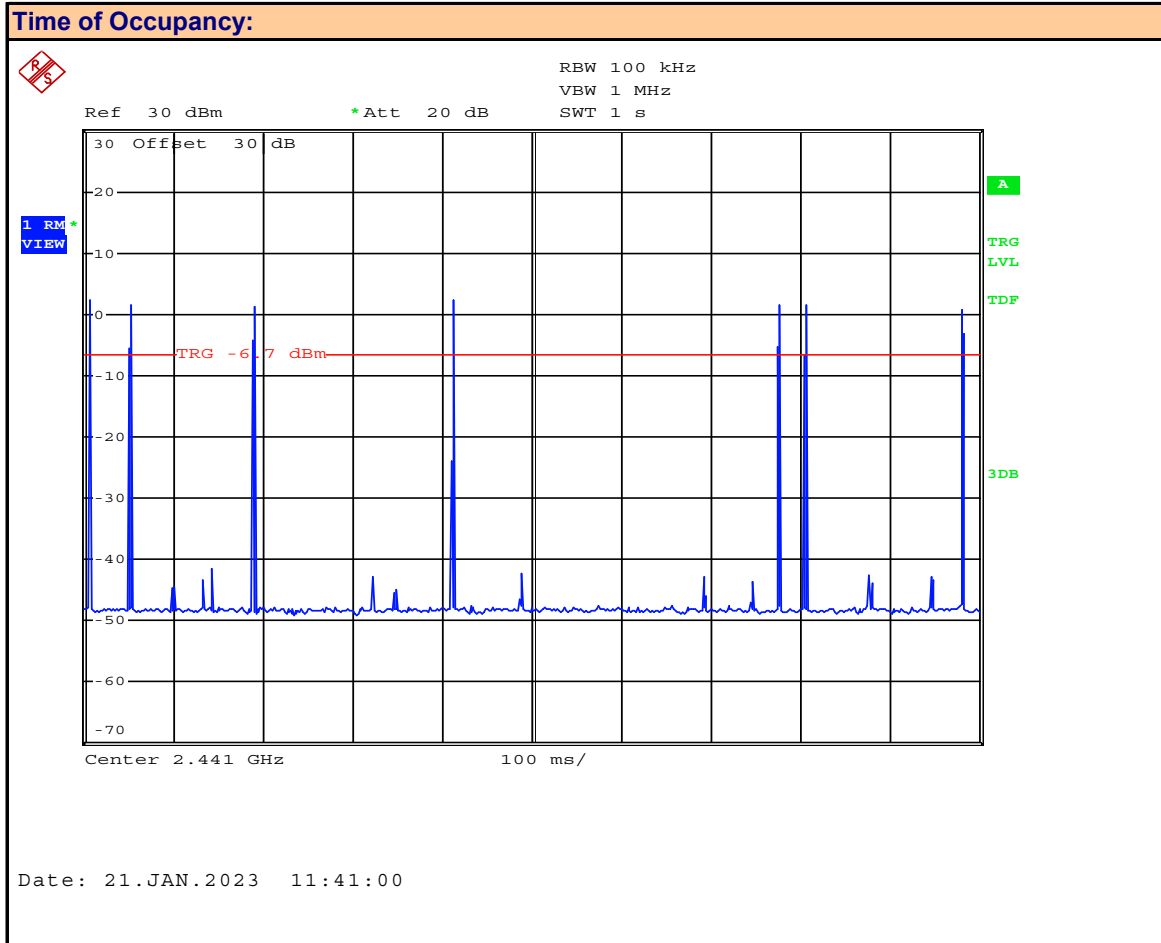
Plot 14.7 – Time of Occupancy, EV4



Packet: **EV4**

Measured On-Time: **1.614** mSec

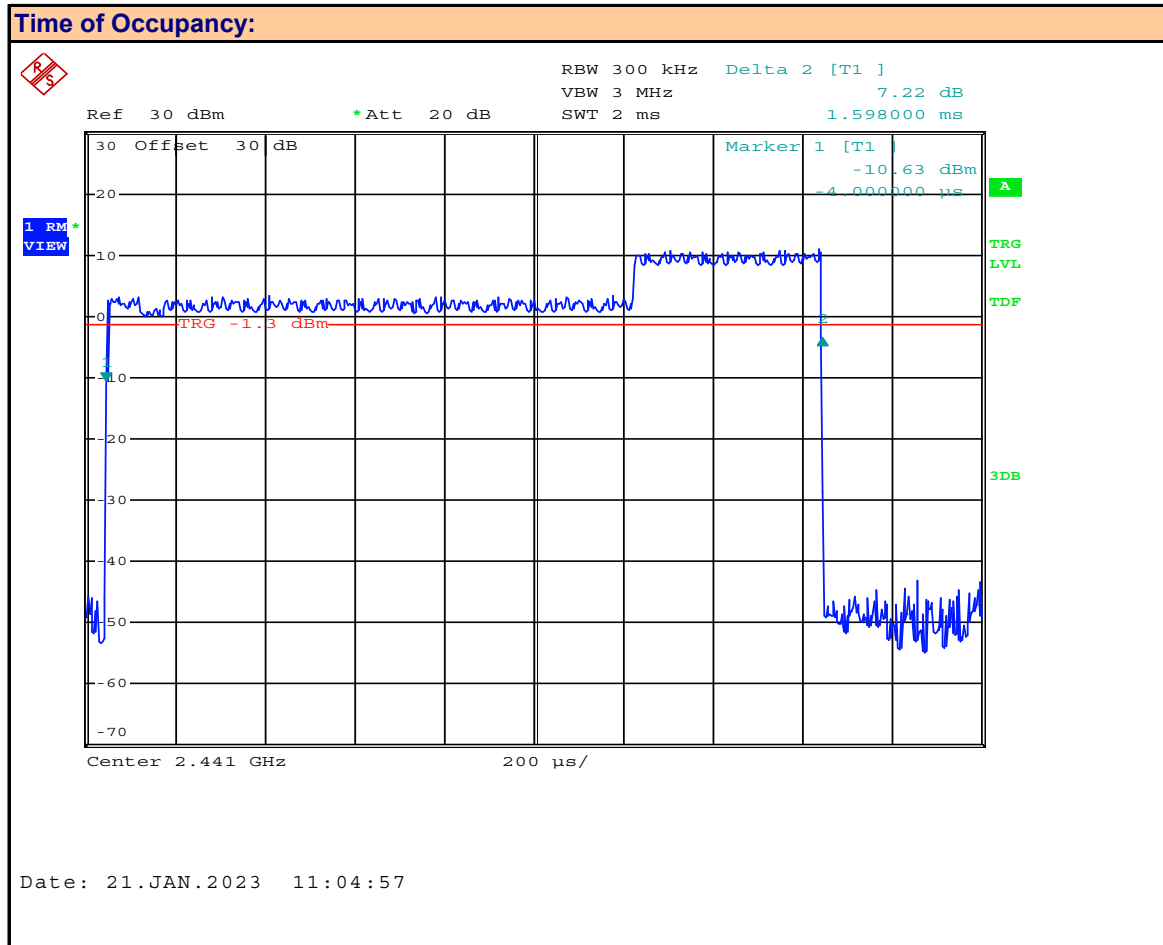
Plot 14.8 – Time of Occupancy, EV4



Packet: **EV4**

Transmit Count **7** /1000mSec

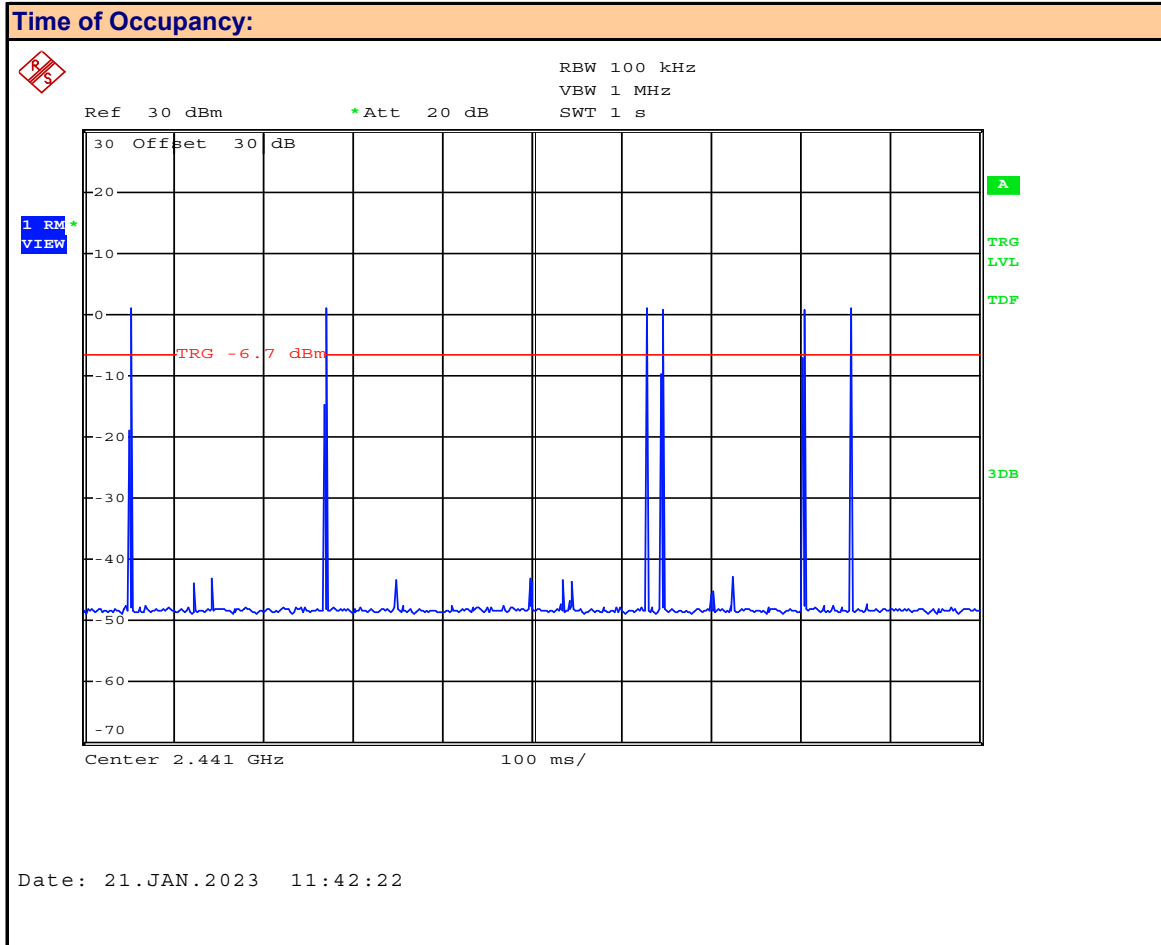
Plot 14.9 – Time of Occupancy, EV5



Packet: **EV5**

Measured On-Time: **1.598** mSec

Plot 14.10 – Time of Occupancy, EV5



Packet: **EV5**

Transmit Count **6** /1000mSec

Table 14.1 – Summary of FHSS Time of Occupancy

Accumulated Time of Occupancy										
Channel Frequency (MHz)	Packet	Channel On Time [t _{on}] (mSec)	Number of Transmits per Period [N _{Tx}]	Time of Period Occupancy [T _{Occ}] (mSec)	Observation Period [T _P] (mSec)	Number of Hopping Channels [N _{Hop}]	Required Observation Period [T _{Rqd}] (mSec)	Accumulated Time of Occupancy [T _{Acc}] (mSec)	Limit [Limit] (mSec)	Margin (mSec)
2441	DH1	0.370	10	3.700	1000	79	31600	116.92	400	283
	DH3	1.640	6	9.840				310.94		89
	DH5	2.880	4	11.520				364.03		36
	EV4	1.614	7	11.298				357.02		43
	DH5	1.598	6	9.588				302.98		97
Result:									Complies	

Time of Period Occupancy [T_{POcc}] = Channel On Time [t_{on}] x Number of Transmits per Period [N_{Tx}]

Required Observation Period [T_{Rqd}] = Number of Hopping Channels [N_{Hop}] x 0.4Sec (400mSec)

Accumulated Time of Occupancy [T_{Acc}] = Time of Period Occupancy [T_{Occ}] x Required Observation Period [T_{Rqd}] / Observation Period [T_P]

Margin = Limit - [T_{Acc}]

15.0 CONDUCTED SPURIOUS EMISSIONS -BAND EDGE

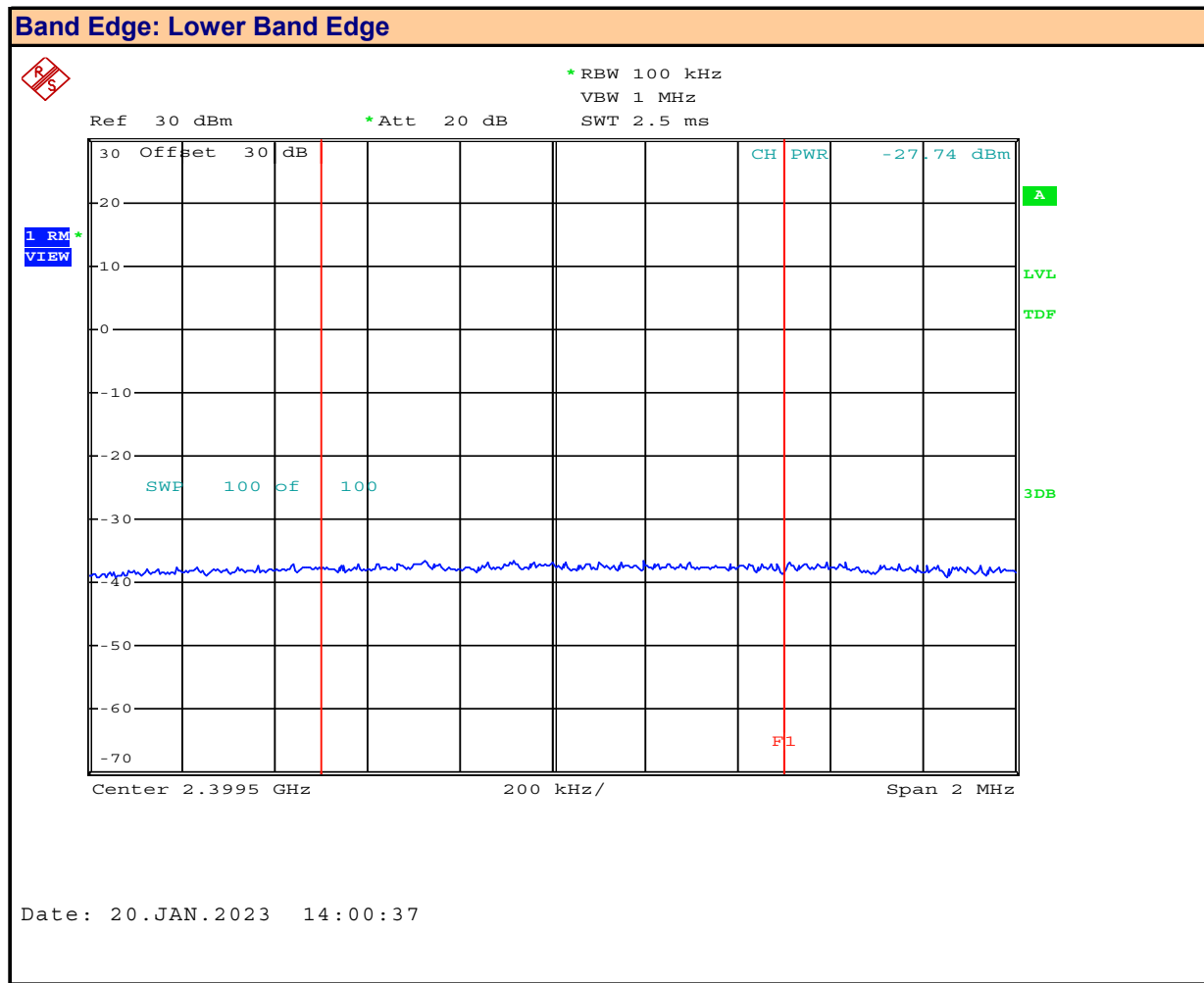
Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

Limits

47 CFR §15.247(d)	(d) 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 this section, 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.
KDB 558074 (11.3) C63.10 (11.11.3)	11.1 General The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). 11.2 Reference level measurement a) Set instrument center frequency to DTS channel center frequency. b) Set the span to $\geq 1.5 \times DTS \text{ bandwidth}$. c) Set the RBW = 100 kHz. d) Set the VBW $\geq 3 \times RBW$. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

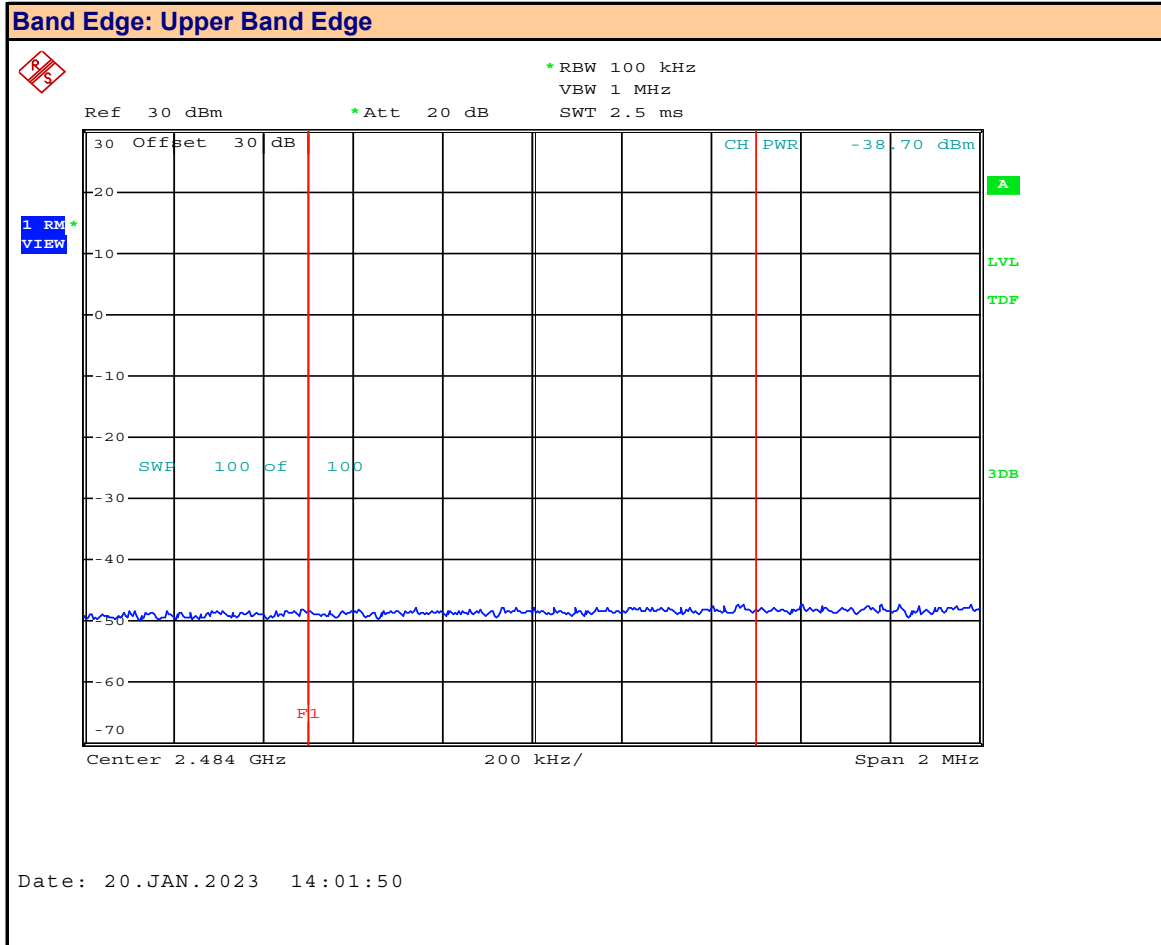
Plot 15.1 – Band Edge, 802.11b



Channel: **1**
Mode: **802.11b**

Channel Frequency: **2402** MHz
Modulation: **DSSS 5.5**
Emission Power: **-27.74** dBm

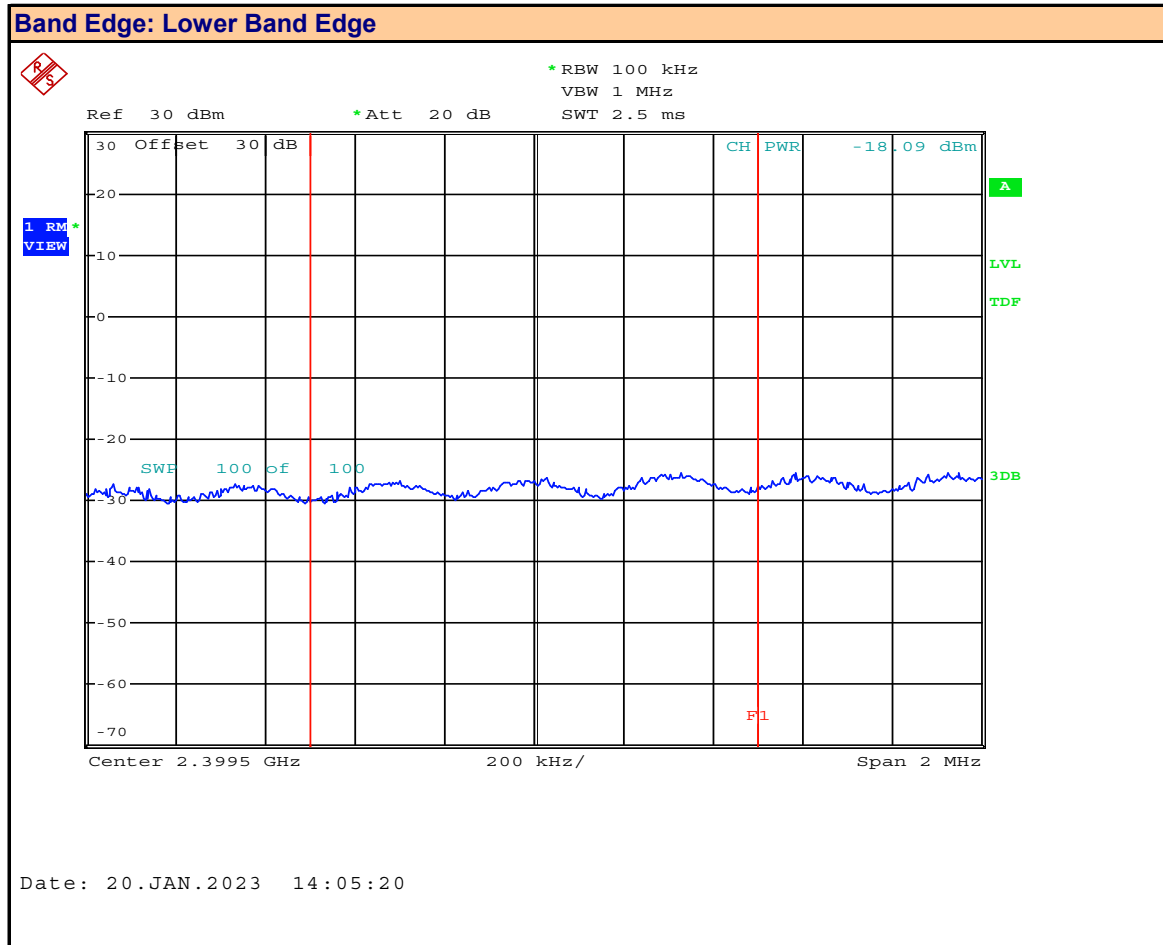
Plot 15.2 – Band Edge, 802.11b



Channel: **11**
Mode: **802.11b**

Channel Frequency: **2462** MHz
Modulation: **DSSS 5.5**
Emission Power: **-38.7** dBm

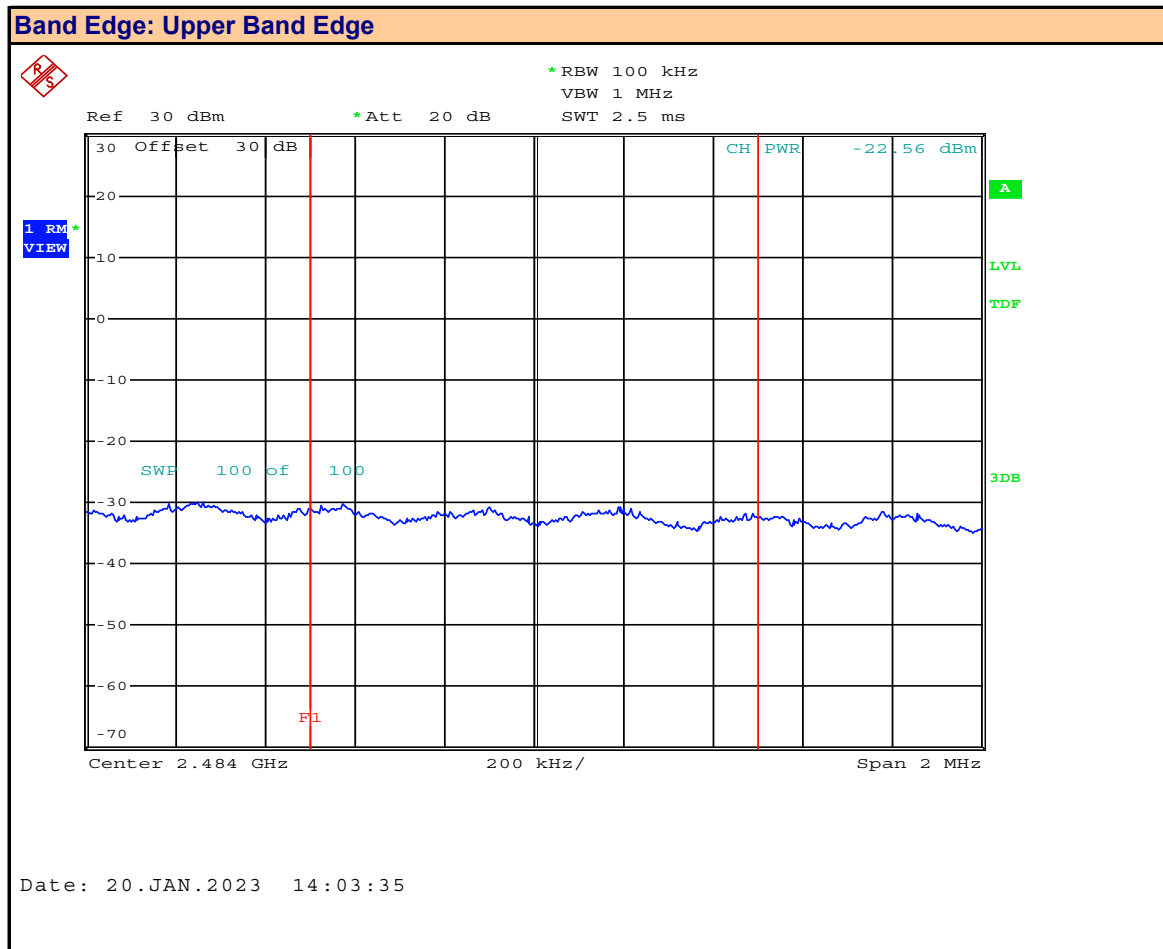
Plot 15.3 – Band Edge, 802.11g



Channel: **1**
Mode: **802.11g**

Channel Frequency: **2402** MHz
Modulation: **OFDM12**
Emission Power: **-18.09** dBm

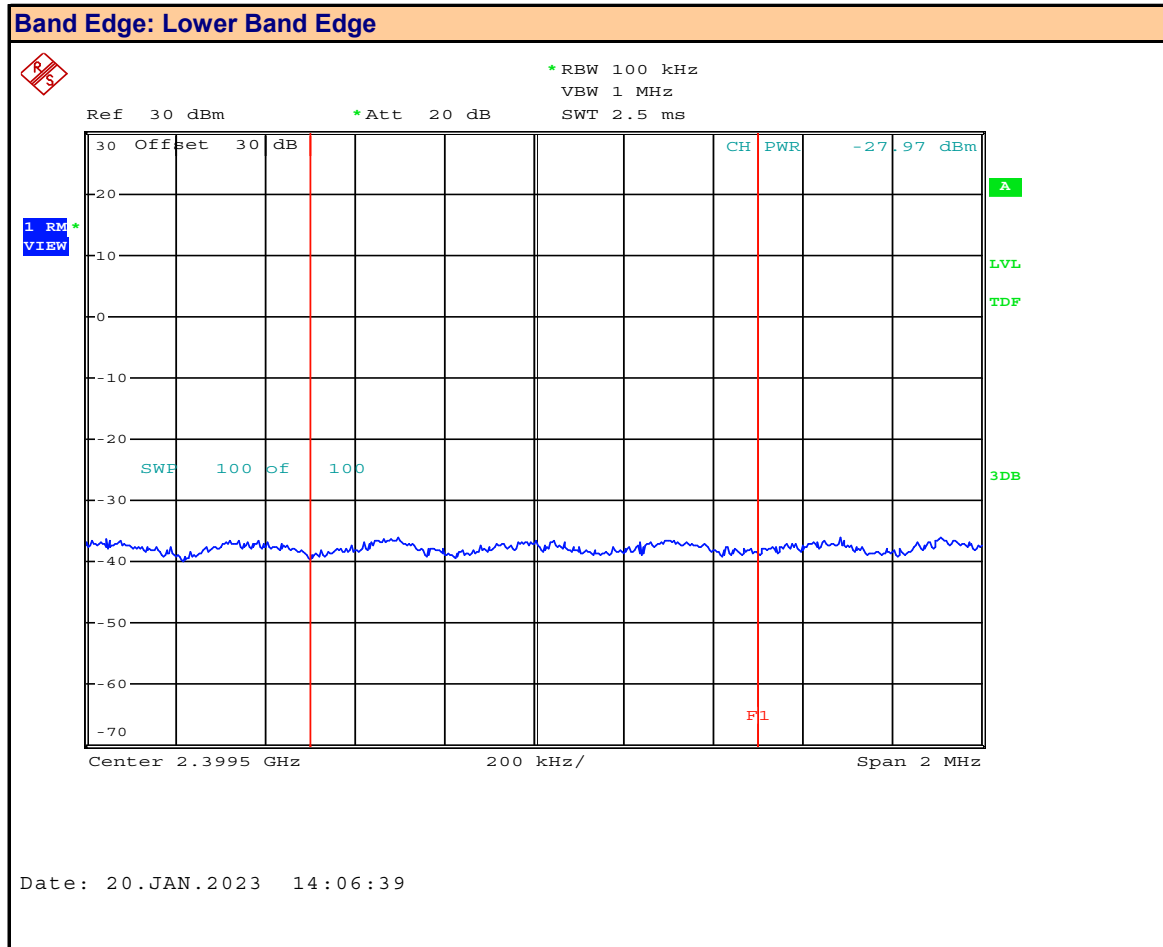
Plot 15.4 – Band Edge, 802.11g



Channel: **11**
Mode: **802.11g**

Channel Frequency: **2462** MHz
Modulation: **OFDM12**
Emission Power: **-22.56** dBm

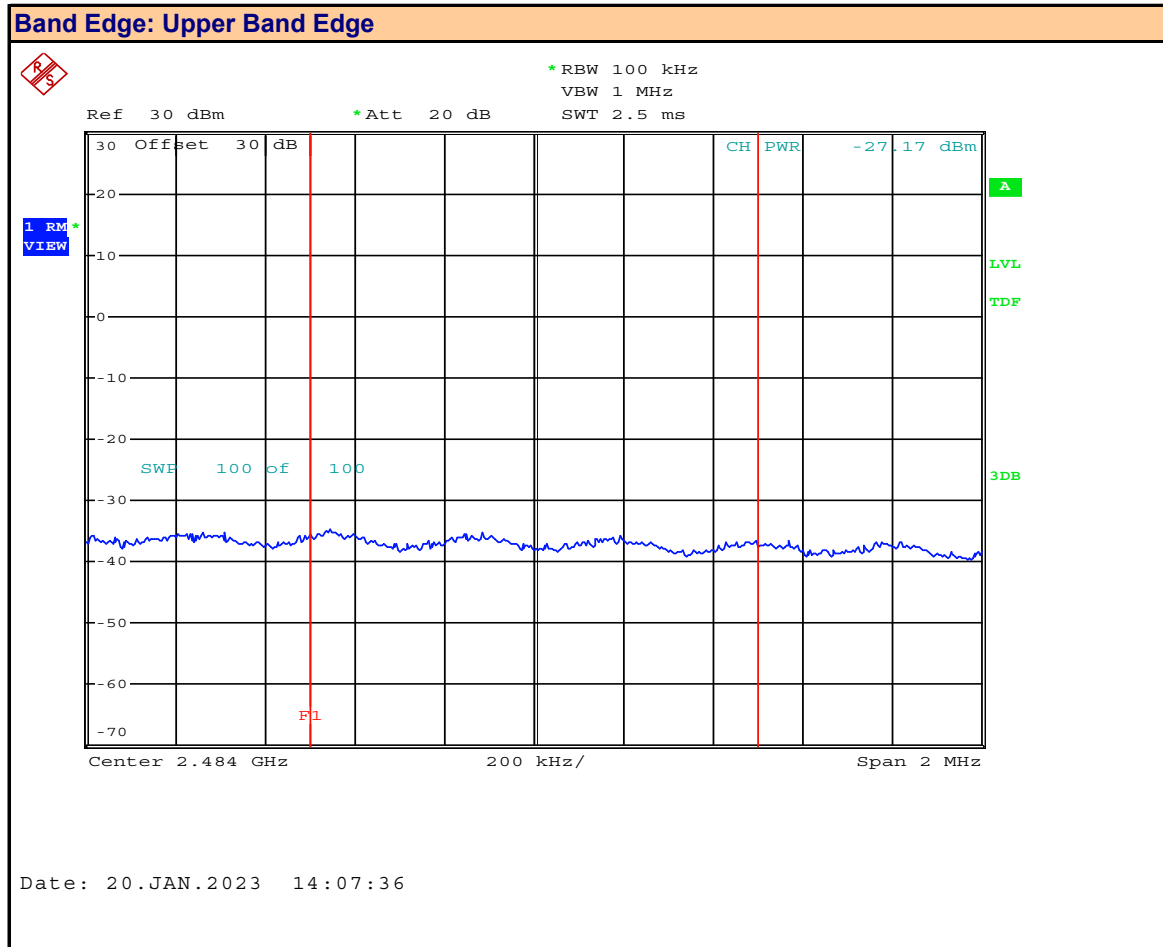
Plot 15.5 – Band Edge, 802.11n



Channel: **1**
Mode: **802.11n**

Channel Frequency: **2402** MHz
Modulation: **MCS0**
Emission Power: **-27.97** dBm

Plot 15.6 – Band Edge, 802.11n



Channel: **11**
Mode: **802.11n**

Channel Frequency: **2462** MHz
Modulation: **MCS0**
Emission Power: **-27.17** dBm

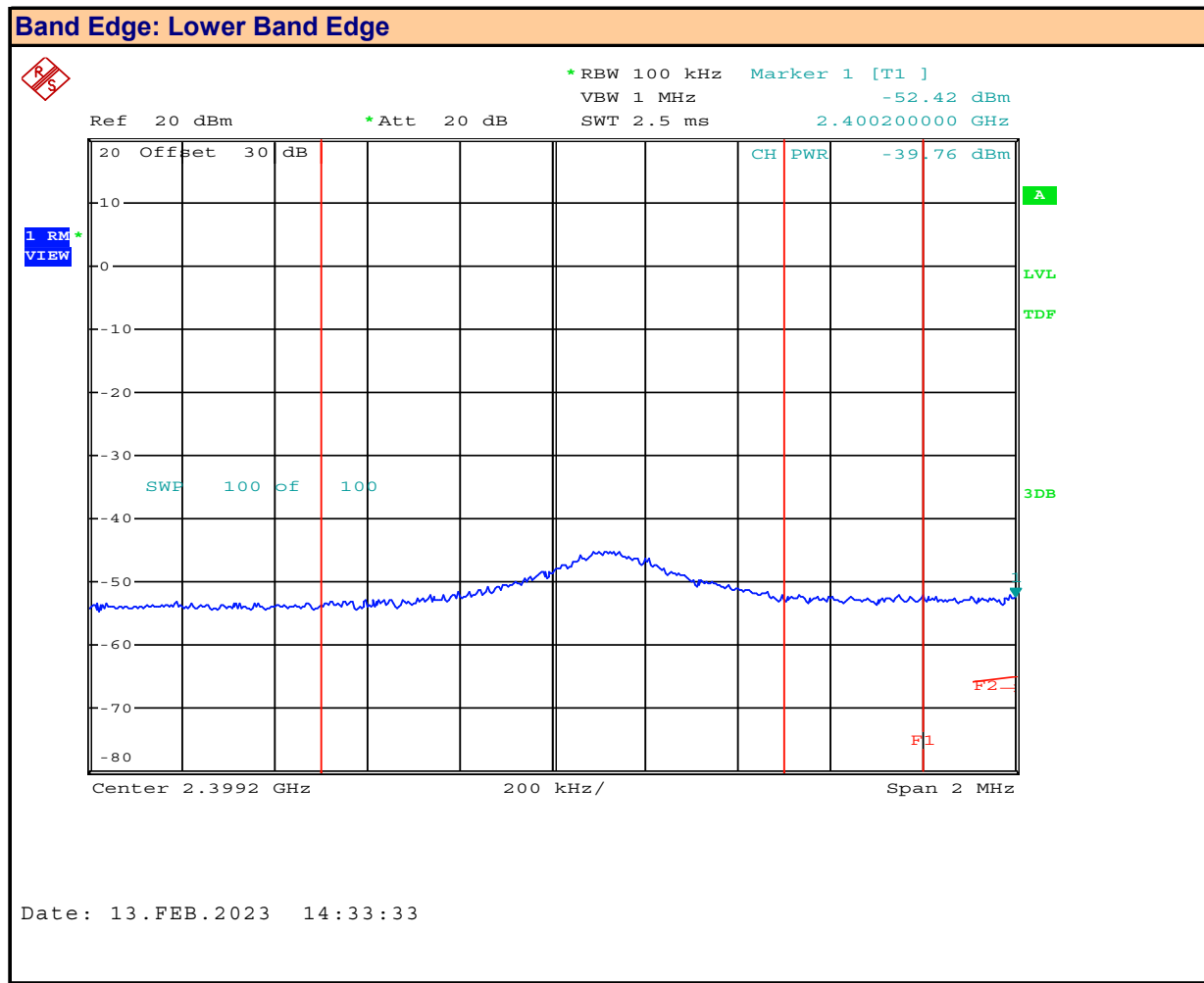
Table 15.1 – Summary of Spurious Emission Measurements – Band Edge, (DTS)

Band Edge Measurement Results: 802.11											
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P _{Em}] (dBm)	Antenna Gain [G _T] (dBi)	Emission EIRP [E _{Em}] (dBm)	Fundamental Power [P _{Fund}] (dBm)	Fundamental EIRP [E _{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
802.11b	1	2402.00	DSSS 5.5	-27.74	-5.26	-33.00	17.38	12.12	45.12	30	15.1
	11	2462.00		-38.70		-43.96		12.12	56.08		26.1
802.11g	1	2402.00	OFDM12	-18.09		-23.35	18.35	13.09	36.44		6.4
	11	2462.00		-22.56		-27.82		13.09	40.91		10.9
802.11n	1	2402.00	MCS0	-27.97		-33.23	16.80	11.54	44.77		14.8
	11	2462.00		-27.17		-32.43		11.54	43.97		14.0
Result:										Complies	

Emission [E_{Em}] = [P_{Em}] + [G_T]

Fundamental EIRP [E_{Fund}] = [P_{Fund}] + [G_T]

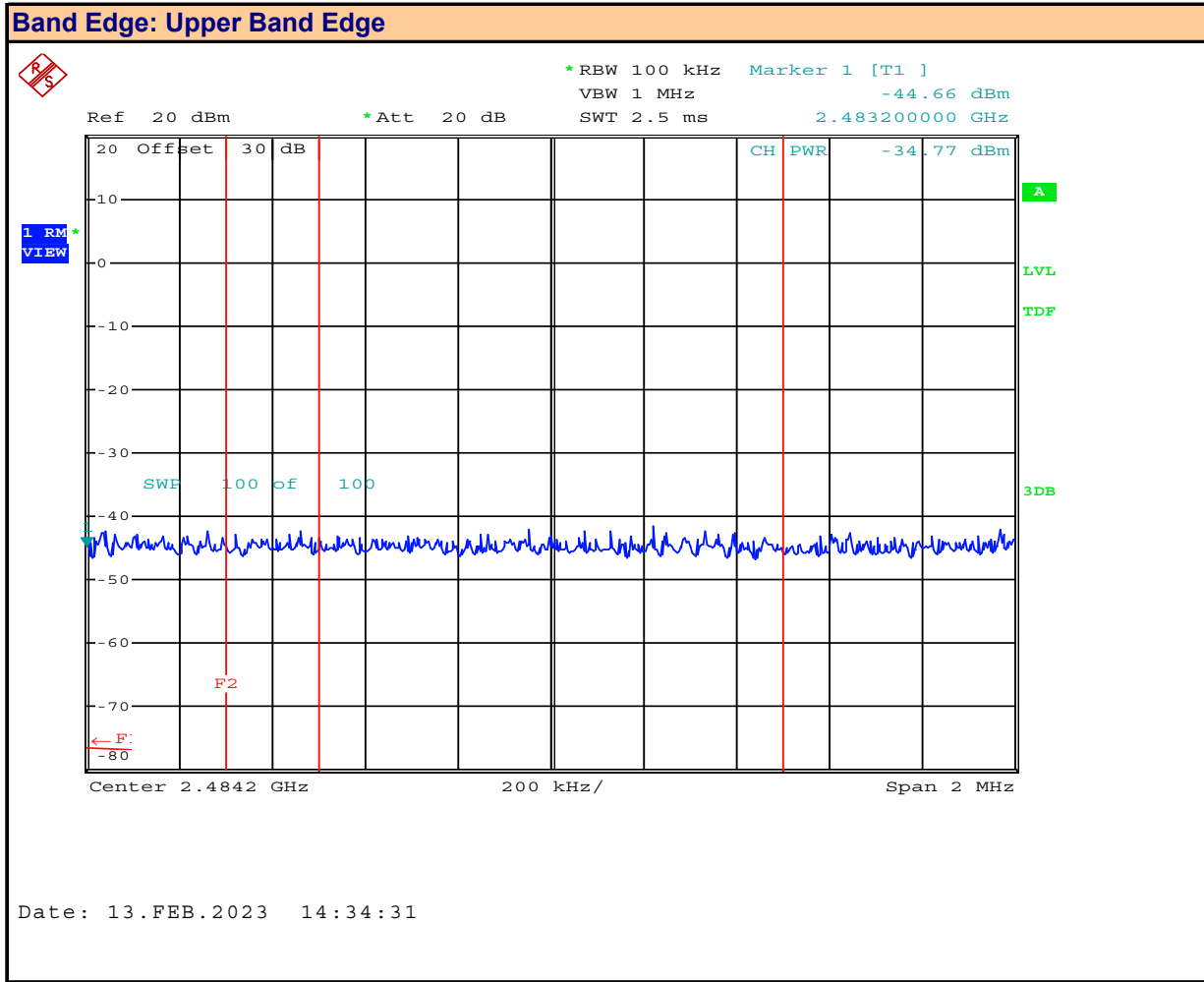
Plot 15.7 – Band Edge, BT BR



Channel: **0**
Mode: **BT BR**

Channel Frequency: **2402** MHz
Modulation: **GFSK**
Emission Power: **-39.76** dBm

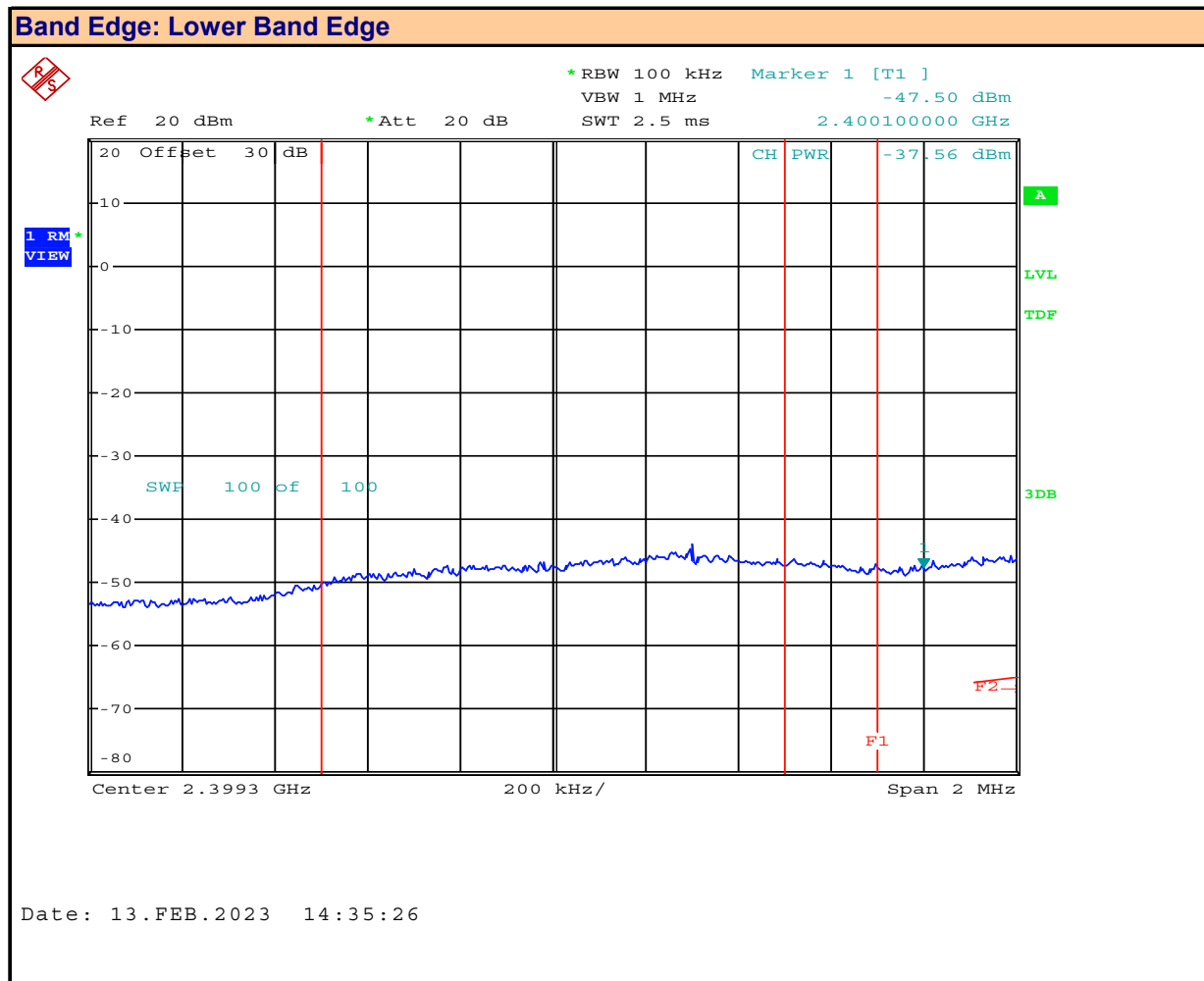
Plot 15.8 – Band Edge, BT BR



Channel: **78**
Mode: **BT BR**

Channel Frequency: **2480** MHz
Modulation: **GFSK**
Emission Power: **-34.77** dBm

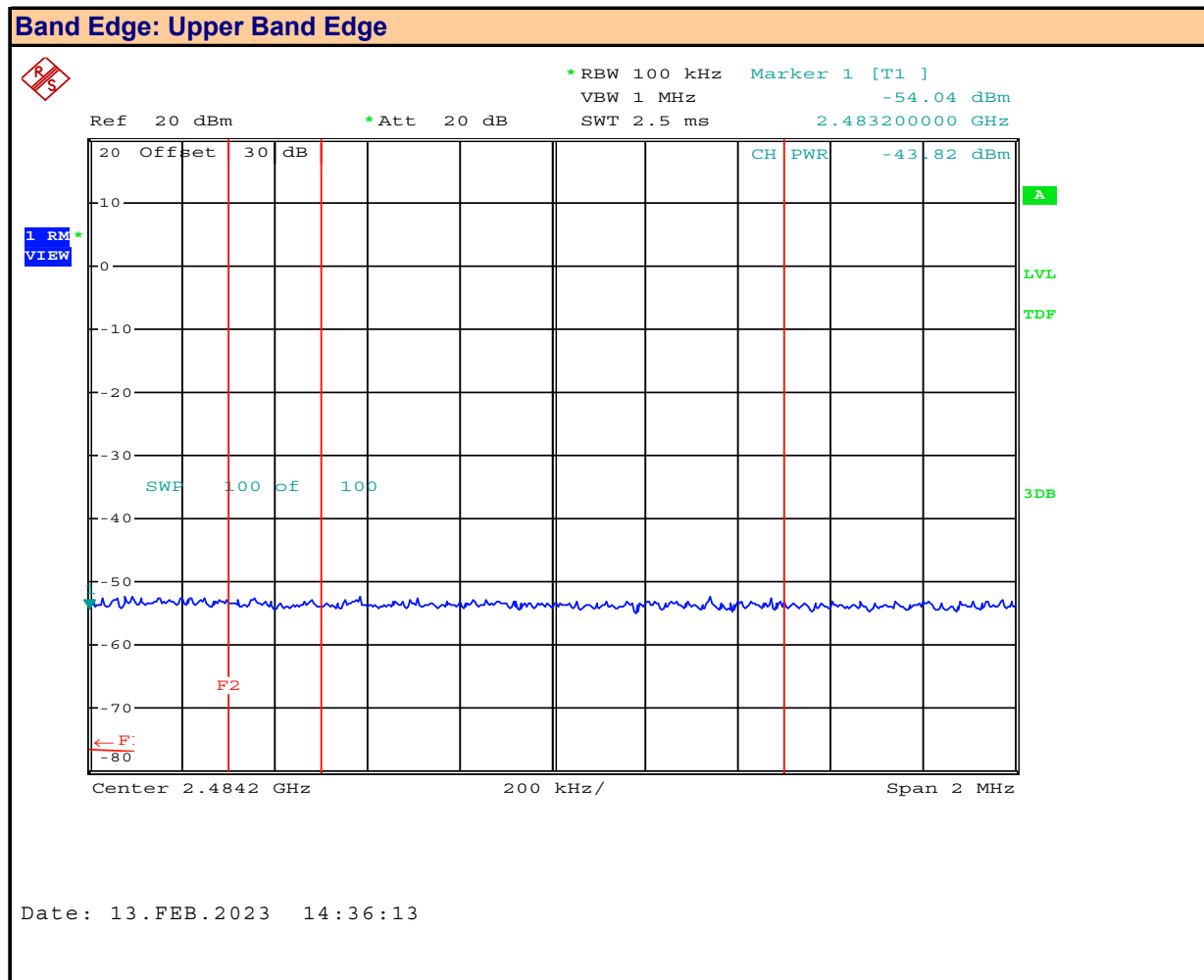
Plot 15.9 – Band Edge, BT 2EDR



Channel: **0**
Mode: **BT 2EDR**

Channel Frequency: **2402** MHz
Modulation: **pi/4-DQPSK**
Emission Power: **-37.56** dBm

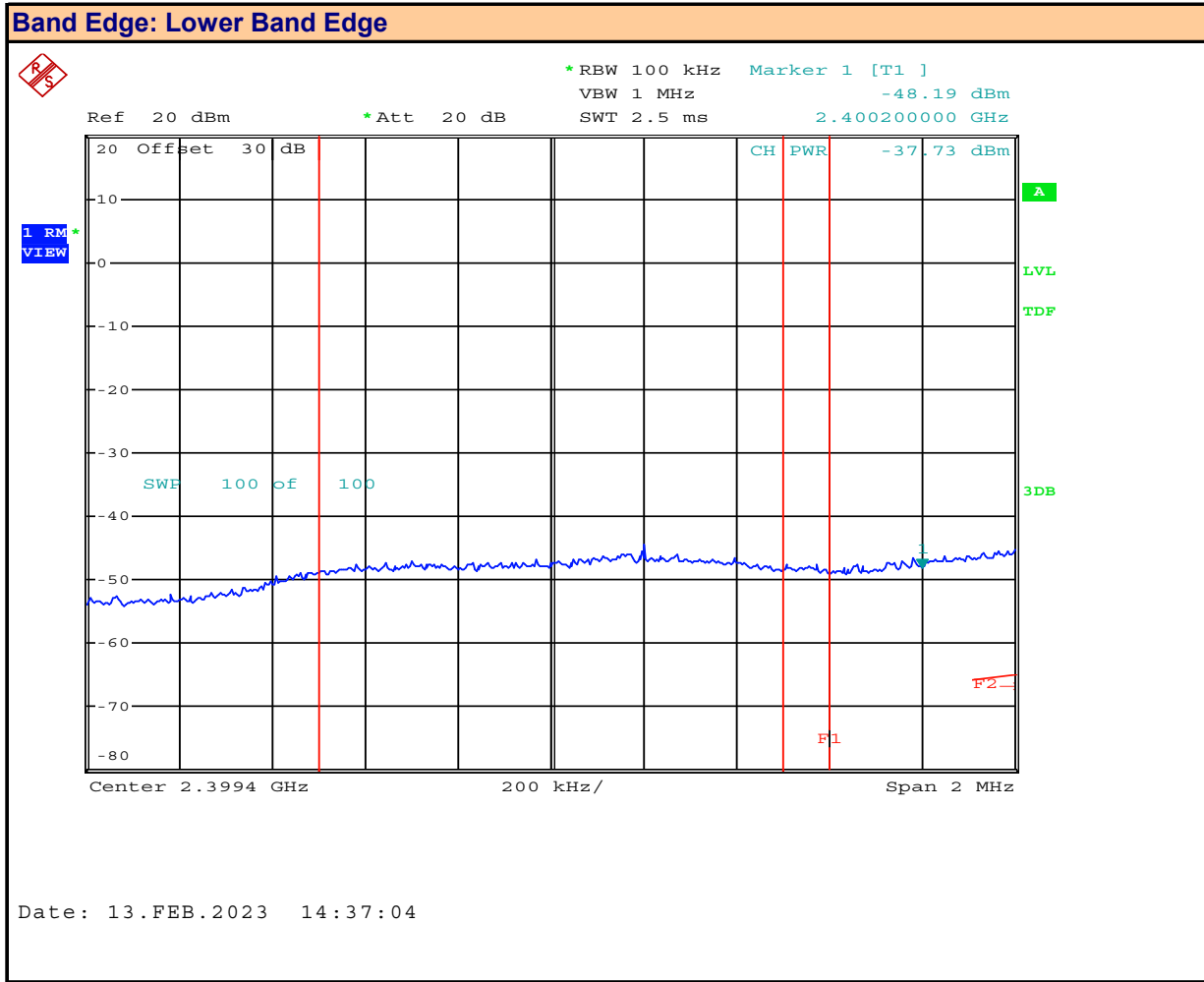
Plot 15.10 – Band Edge, BT 2EDR



Channel: **78**
Mode: **BT 2EDR**

Channel Frequency: **2480** MHz
Modulation: **Pi/4-DQPSK**
Emission Power: **-43.82** dBm

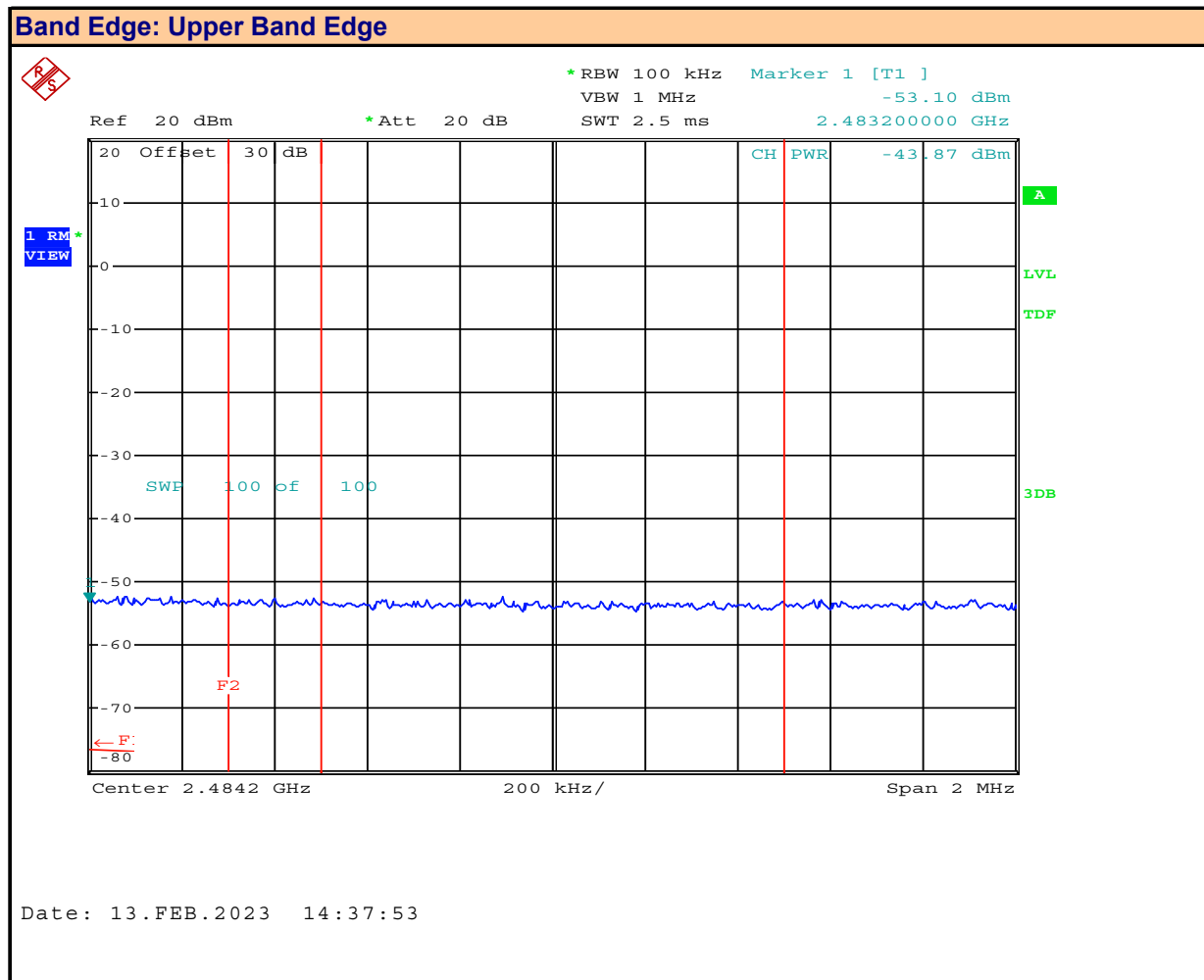
Plot 15.11 – Band Edge, BT 3EDR



Channel: **0**
Mode: **BT 3EDR**

Channel Frequency: **2402** MHz
Modulation: **8-DPSK**
Emission Power: **-37.73** dBm

Plot 15.12 – Band Edge, BT 3EDR



Channel: **78**
Mode: **BT 3EDR**

Channel Frequency: **2480** MHz
Modulation: **8-DPSK**
Emission Power: **-43.87** dBm

Table 15.2 – Summary of Spurious Emission Measurements – Band Edge, DSS

Band Edge Measurement Results: 802.11											
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P _{Em}] (dBm)	Antenna Gain [G _T] (dBi)	Emission EIRP [E _{Em}] (dBm)	Fundamental Power [P _{Fund}] (dBm)	Fundamental EIRP [E _{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
BT BR	0	2402.00	GFSK	-39.76	-4.72	-44.48	11.04	6.32	50.80	30	20.8
	78	2480.00		-34.77		-39.49	11.13	6.41	45.90		15.9
BT 2EDR	0	2402.00	Pi/4-DQPSK	-37.56		-42.28	10.11	5.39	47.67		17.7
	78	2480.00		-43.82		-48.54	10.23	5.51	54.05		24.1
BT 3EDR	0	2402.00	8-DPSK	-37.73		-42.45	10.11	5.39	47.84		17.8
	78	2480.00		-43.87		-48.59	10.12	5.40	53.99		24.0
Result:											Complies

Emission [E_{Em}] = [P_{Em}] + [G_T]

Fundamental EIRP [E_{Fund}] = [P_{Fund}] + [G_T]

Attenuation [Atten] = [E_{Fund}] - [E_{Em}]

Margin = Attenuation - Limit

16.0 CONDUCTED SPURIOUS EMISSIONS

Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

Limits

47 CFR §15.247(d)	(d) 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 this section, 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.
KDB 558074 (11.3) C63.10 (11.11.3)	11.1 General The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). 11.2 Reference level measurement a) Set instrument center frequency to DTS channel center frequency. b) Set the span to $\geq 1.5 \times DTS \text{ bandwidth}$. c) Set the RBW = 100 kHz. d) Set the VBW $\geq 3 \times RBW$. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

Table 16.1 – Summary of Conducted Spurious Emissions, (DTS)

See Appendix E for Measurement Plots

Conducted Spurious Emissions Measurement Results:									
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P _{Em}] (dBm)	Emission Frequency (MHz)	Reference Measurement [P _{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
802.11b	6	2437.00	DSSS 5.5	-32.09	58.9	10.00	42.09	30	12.1
				-31.07	235.6		41.07		11.1
				-30.92	500.8		40.92		10.9
				-31.05	728		41.05		11.1
				-31.53	926.4		41.53		11.5
Result:								Complies	

$$\text{Attenuation [Atten]} = [P_{\text{Fund}}] - [P_{\text{Em}}]$$

$$\text{Margin} = \text{Attenuation} - \text{Limit}$$

ND = None Detected

Table 16.2 – Summary of Conducted Spurious Emissions, (DSS)

See Appendix E for Measurement Plots

Conducted Spurious Emissions Measurement Results:									
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P _{Em}] (dBm)	Emission Frequency (MHz)	Reference Measurement [P _{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
BT BR	78	2480.00	GFSK	-31.95	189.12	9.93	41.88	30	11.9
				-31.89	394		41.82		11.8
				-31.99	467.2		41.92		11.9
				-31.63	754.4		41.56		11.6
				-31.90	996.8		41.83		11.8
Result:								Complies	

$$\text{Attenuation [Atten]} = [P_{\text{Fund}}] - [P_{\text{Em}}]$$

$$\text{Margin} = \text{Attenuation} - \text{Limit}$$

ND = None Detected

17.0 RADIATED TX SPURIOUS EMISSIONS, RESTRICTED BAND

Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits

47 CFR §15.247(d)	(d) 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 this section, 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)).																
47 CFR §15.209(a)	§15.209 Radiated emission limits; general requirements. (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table: <table> <tr> <th>Frequency (MHz)</th><th>Field Strength (microvolts/meter)</th></tr> <tr> <td>0.009 - 0.490</td><td>2400/F (kHz) @300m</td></tr> <tr> <td>0.490 - 1.705</td><td>24000/F (kHz) @30m</td></tr> <tr> <td>1.705 - 30</td><td>30 @ 30m</td></tr> <tr> <td>30 - 88</td><td>100 @3m</td></tr> <tr> <td>88 - 216</td><td>150 @3m</td></tr> <tr> <td>216 - 960</td><td>200 @3m</td></tr> <tr> <td>Above 960</td><td>500 @3m</td></tr> </table>	Frequency (MHz)	Field Strength (microvolts/meter)	0.009 - 0.490	2400/F (kHz) @300m	0.490 - 1.705	24000/F (kHz) @30m	1.705 - 30	30 @ 30m	30 - 88	100 @3m	88 - 216	150 @3m	216 - 960	200 @3m	Above 960	500 @3m
Frequency (MHz)	Field Strength (microvolts/meter)																
0.009 - 0.490	2400/F (kHz) @300m																
0.490 - 1.705	24000/F (kHz) @30m																
1.705 - 30	30 @ 30m																
30 - 88	100 @3m																
88 - 216	150 @3m																
216 - 960	200 @3m																
Above 960	500 @3m																

Table 17.1 – Summary of Radiated Tx Spurious Emissions, Restricted Band, (DTS)

Summary of Radiated Tx (Restricted Band) Measurements											
Mode	Modulation	Channel	Frequency (MHz)	Polarity	Emission Frequency (MHz)	Avg Power (dBuV/m)	Limit		Peak Power (dBuV/m)	Limit	
							Avg (dBuV/m)	Margin (dB)		Peak (dBuV/m)	Margin (dB)
802.11b	DSSS 5.5	1	2412	H	2390	49.47	54.00	4.53	59.23	74.00	14.77
				V		51.75	54.00	2.25	60.94	74.00	13.06
		11	2462	H	2483.5	51.00	54.00	3.00	60.00	74.00	14.00
				V		51.87	54.00	2.13	61.28	74.00	12.72
802.11g	OFDM12	1	2412	H	2390	52.99	54.00	1.01	63.02	74.00	10.98
				V		50.17	54.00	3.83	62.25	74.00	11.75
		2	2417	H		52.49	54.00	1.51	62.18	74.00	11.82
				V		50.34	54.00	3.66	60.82	74.00	13.18
		3	2422	H		51.80	54.00	2.20	61.83	74.00	12.17
				V		50.13	54.00	3.87	59.99	74.00	14.01
		4	2427	H		51.53	54.00	2.47	60.70	74.00	13.30
				V		53.32	54.00	0.68	59.75	74.00	14.25
		5	2432	H		53.66	54.00	0.34	68.82	74.00	5.18
				V		50.59	54.00	3.41	62.69	74.00	11.31
		6	2437	H		52.32	54.00	1.68	63.81	74.00	10.19
				V		50.33	54.00	3.67	61.55	74.00	12.45
		7	2442	H	2483.5	52.71	54.00	1.29	63.91	74.00	10.09
				V		50.72	54.00	3.28	60.95	74.00	13.05
		8	2447	H		53.57	54.00	0.43	65.30	74.00	8.70
				V		51.12	54.00	2.88	60.55	74.00	13.45
		9	2452	H		51.11	54.00	2.89	61.47	74.00	12.53
				V		50.67	54.00	3.33	60.95	74.00	13.05
		10	2457	H		51.80	54.00	2.20	63.02	74.00	10.98
				V		50.87	54.00	3.13	61.34	74.00	12.66
		11	2462	H		52.33	54.00	1.67	63.88	74.00	10.12
				V		50.56	54.00	3.44	60.95	74.00	13.05

No Other Emissions within 20dB of the limit observed.

Table 17.1 – Summary of Radiated Tx Spurious Emissions, Restricted Band, (DTS), Cont.

Summary of Radiated Tx (Restricted Band) Measurements											
Mode	Modulation	Channel	Frequency (MHz)	Polarity	Emission Frequency (MHz)	Avg Power (dBuV/m)	Limit		Peak Power (dBuV/m)	Limit	
							Avg (dBuV/m)	Margin (dB)		Peak (dBuV/m)	Margin (dB)
802.11n	MCS0	1	2412	H	2390	49.71	54.00	4.29	58.59	74.00	15.41
				V		52.43	54.00	1.57	63.35	74.00	10.65
		2	2417	H		49.96	54.00	4.04	60.21	74.00	13.79
				V		53.52	54.00	0.48	64.39	74.00	9.61
		3	2422	H		50.20	54.00	3.80	60.51	74.00	13.49
				V		51.11	54.00	2.89	62.31	74.00	11.69
		4	2427	H		50.33	54.00	3.67	60.36	74.00	13.64
				V		51.55	54.00	2.45	61.49	74.00	12.51
		8	2447	H	2483.5	50.56	54.00	3.44	61.13	74.00	12.87
				V		50.74	54.00	3.26	62.54	74.00	11.46
		9	2452	H		50.47	54.00	3.53	60.18	74.00	13.82
				V		50.37	54.00	3.63	60.15	74.00	13.85
		10	2457	H		50.60	54.00	3.40	59.33	74.00	14.67
				V		51.16	54.00	2.84	62.69	74.00	11.31
		11	2462	H		51.00	54.00	3.00	61.50	74.00	12.50
				V		51.01	54.00	2.99	60.86	74.00	13.14

No Other Emissions within 20dB of the limit observed.

Table 17.2 – Summary of Radiated Tx Spurious Emissions, (DTS)

See Appendix F for Measurement Plots

Summary of Radiated Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency (MHz)	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
30-1000MHz	2412.0	Horizontal	42.15	7.79	17.31	0.73	0.00 (3)	25.8 (2)	40.0	14.2	
30-1000MHz	2412.0	Horizontal	51.33	7.71	12.47	0.77	0.00 (3)	21.0 (2)	40.0	19.0	
30-1000MHz	2412.0	Horizontal	827.80	8.64	29.22	2.82	0.00 (3)	40.7 (2)	46.0	5.3	
30-1000MHz	2412.0	Vertical	908.30	8.26	29.50	2.94	0.00 (3)	40.7 (2)	46.0	5.3	
30-1000MHz	2412.0	Vertical	911.10	8.10	29.41	2.95	0.00 (3)	40.5 (2)	46.0	5.6	
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
3-13GHz	2412.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
3-13GHz	2412.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
13-18GHz	2412.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
13-18GHz	2412.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
18-26GHz	2412.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
18-26GHz	2412.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
Results:									Complies		

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

Table 17.2 – Summary of Radiated Tx Spurious Emissions, (DSS)

See Appendix F for Measurement Plots

Summary of Radiated Tx Emissions										
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	2412.0	Horizontal	32.43	8.63	22.64	0.68	0.00 (3)	32.0 (2)	40.0	8.0
30-1000MHz	2412.0	Horizontal	54.57	8.24	11.39	0.79	0.00 (3)	20.4 (2)	40.0	19.6
30-1000MHz	2412.0	Horizontal	68.07	7.82	11.21	0.85	0.00 (3)	19.9 (2)	40.0	20.1
30-1000MHz	2412.0	Horizontal	73.47	8.17	11.65	0.87	0.00 (3)	20.7 (2)	40.0	19.3
30-1000MHz	2412.0	Horizontal	841.10	9.54	29.60	2.84	0.00 (3)	42.0 (2)	46.0	4.0
30-1000MHz	2412.0	Horizontal	867.70	8.91	29.40	2.88	0.00 (3)	41.2 (2)	46.0	4.8
30-1000MHz	2412.0	Horizontal	920.90	9.10	29.80	2.97	0.00 (3)	41.9 (2)	46.0	4.2
30-1000MHz	2412.0	Horizontal	925.10	9.12	29.91	2.98	0.00 (3)	42.0 (2)	46.0	4.0
30-1000MHz	2412.0	Vertical	906.20	9.16	29.32	2.94	0.00 (3)	41.4 (2)	46.0	4.6
30-1000MHz	2412.0	Vertical	906.90	9.12	29.39	2.94	0.00 (3)	41.4 (2)	46.0	4.6
30-1000MHz	2412.0	Vertical	908.30	9.26	29.50	2.94	0.00 (3)	41.7 (2)	46.0	4.3
30-1000MHz	2412.0	Vertical	911.10	9.10	29.41	2.95	0.00 (3)	41.5 (2)	46.0	4.6
1 - 3GHz	2440.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	2440.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	2440.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	2440.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	2440.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	2440.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	2440.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	2440.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

- (1) No Emissions Detected (ND) above ambient or within 20dB of the limit
 (2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
 (3) External Amplifier not used

$$E_{Corr} = E_{Meas} + ACF + L_C - G_A$$

18.0 RADIATED RX SPURIOUS EMISSIONS

Test Procedure

Normative Reference FCC 47 CFR §15.109, ICES-003(6.2)
ANSI C63.4:2014

Limits

47 CFR §15.109	(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values: 30-88MHz: 40dBuV/m 88-216MHz: 43.5dBuV/m 216-960MHz: 46dBuV/m > 960MHz: 54dBuV/m
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 5 determined at a distance of 3 metres. 30-88MHz: 40dBuV/m 88-216MHz: 43.5dBuV/m 216-960MHz: 46dBuV/m > 960MHz: 54dBuV/m

Test Setup Appendix A Figure A.2

Measurement Procedure

The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions.

Table 18.1 – Summary of Radiated Rx Spurious Emissions, (DTS)

See Appendix G Measurement Plots

Summary of Radiated Rx Emissions											
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	46.0	n/a	
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	43.5	n/a	
1 - 3GHz	-	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
1 - 3GHz	-	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
3-13GHz	-	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
3-13GHz	-	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
13-18GHz	-	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
13-18GHz	-	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
18-26GHz	-	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
18-26GHz	-	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
Results:									Complies		

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

Table 18.2 – Summary of Radiated Rx Spurious Emissions, (DSS)

See Appendix G Measurement Plots

Summary of Radiated Rx Emissions											
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	46.0	n/a	
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	43.5	n/a	
1 - 3GHz	-	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
1 - 3GHz	-	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
3-13GHz	-	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
3-13GHz	-	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
13-18GHz	-	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
13-18GHz	-	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
18-26GHz	-	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
18-26GHz	-	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
Results:									Complies		

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{Corr} = E_{Meas} + ACF + L_C - G_A$$

19.0 POWER LINE CONDUCTED EMISSIONS

Test Procedure

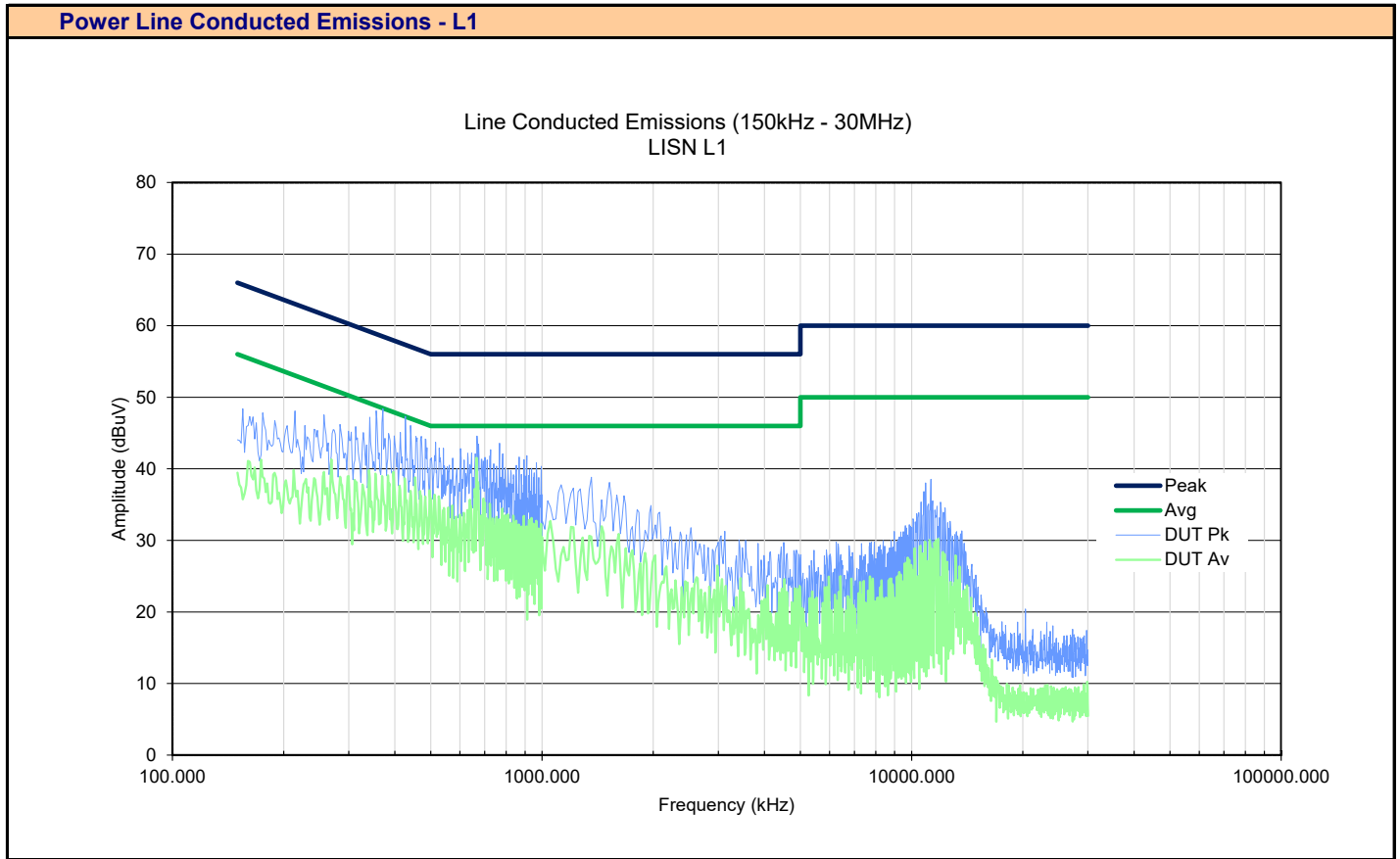
Normative Reference	FCC 47 CFR §15.107, ICES-003(6.1) ANSI C63.4-2014
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Limits

47 CFR §15.107	(a) Except for Class A digital devices, for equipment 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 μ H/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 band edges. 0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logarithm of the frequency 0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average 5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average
ICES-003(6.1)	6.1 - AC Power Line Conducted Emissions Limits Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 2. 0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logarithm of the 0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average 5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average

Test Setup	Appendix A Figure A.7
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Plot 19.1 – Power Line Conducted Emissions, Line 1



Channel: **6**

Mode: **802.11b**

Emission Frequency: **371kHz**

Channel Frequency: **2437** MHz

Modulation: **CCK 1MB**

Measured Channel Power: **48.38** dBuV

Plot 19.2 – Power Line Conducted Emissions, Line 2

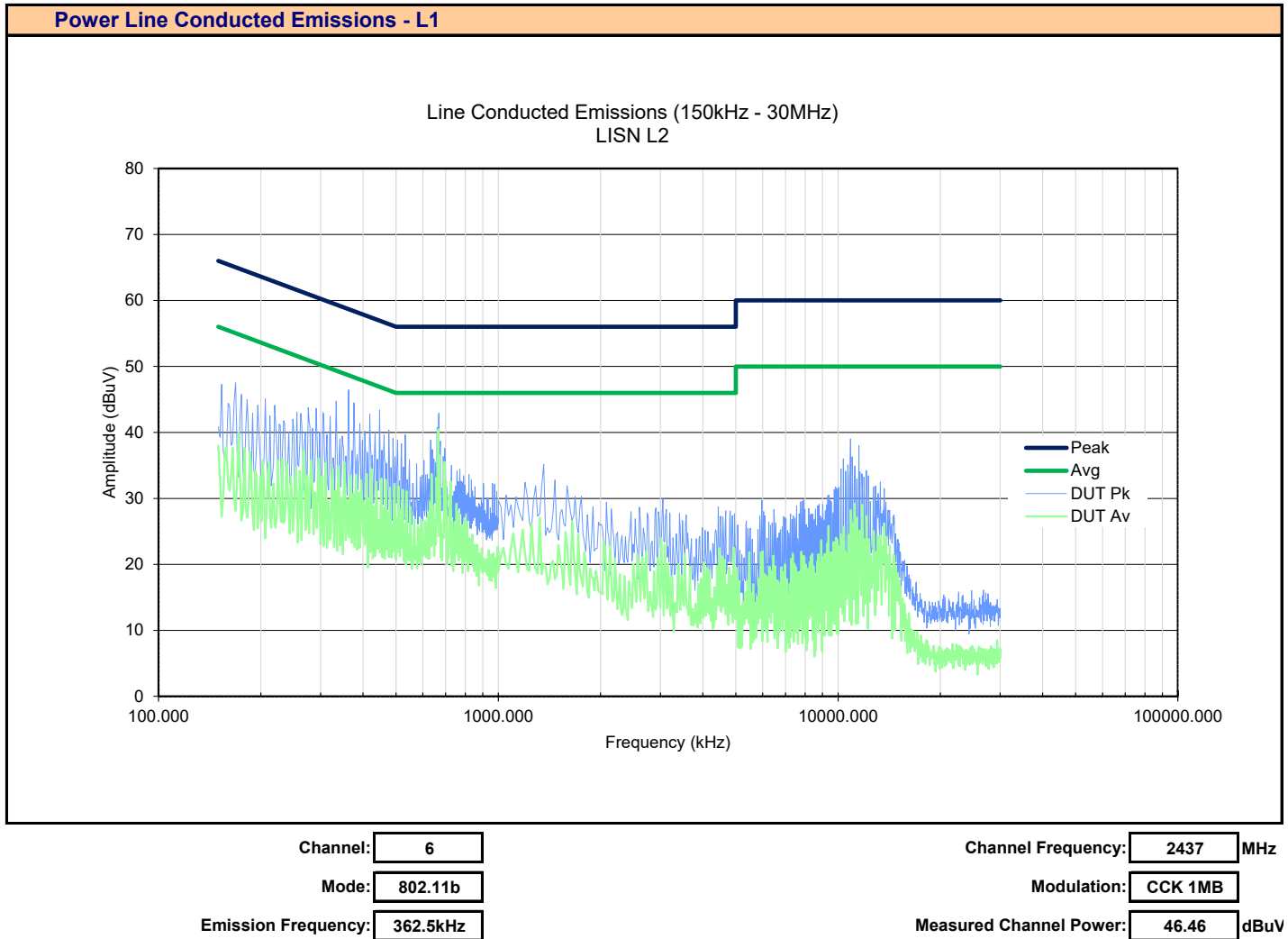


Table 19.1 – Summary of Power Line Conducted Emissions – L1

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f _{Emm}] (kHz)	Measured Emission [E _{Meas}] (dBuV)	Detector*	Insertion Loss [L _{LISN}] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	2437.0	L1	371.00 kHz	48.38	Peak	0.30	0.26	0.00 (3)	48.94 (2)	58.0	9.1
Results:										Complies	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ 9kHz.

(2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$$

Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz

Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz

$$\text{Margin} = \text{Limit} - E_{Corr}$$

Table 19.1 – Summary of Power Line Conducted Emissions – L2

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f _{Emm}] (kHz)	Measured Emission [E _{Meas}] (dBuV)	Detector*	Insertion Loss [L _{LISN}] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	2437.0	L2	362.50 kHz	46.46	Peak	0.30	0.26	0.00 (3)	47.02 (2)	58.6	11.6
Results:										Complies	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ 9kHz.

(2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$$

Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz

Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz

$$\text{Margin} = \text{Limit} - E_{Corr}$$

APPENDIX A – TEST SETUP DRAWINGS

Table A.1 – Conducted Measurement Setup

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00241	R&S	FSU40	100500	Spectrum Analyzer
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable

Figure A.1 – Test Setup – Conducted Measurements

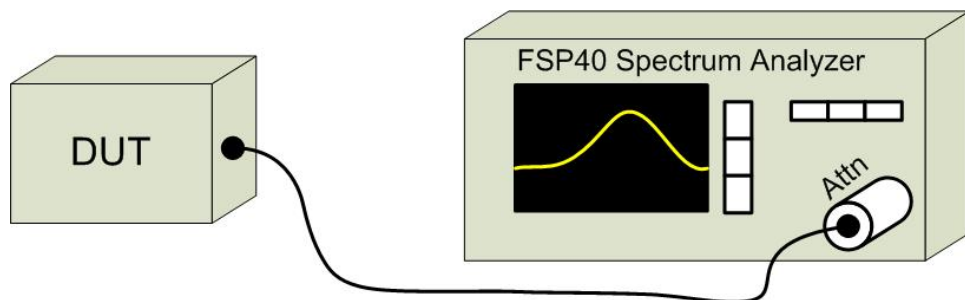


Table A.2 – Radiated Emissions Measurement Equipment

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00050	Chase	CBL-6111A	1607	Bilog Antenna
00034	ETS	3115	6267	Double Ridged Guide Horn
00035	ETS	3115	6276	Double Ridged Guide Horn
00085	EMCO	6502	9203-2724	Loop Antenna
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz
00162	Waveline Inc.	889		Standard Gain Horn 18-26GHz
00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
00166	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
00333	HP	85685A	3010A01095	RF Preselector
00049	HP	85650A	2043A00162	Quasi-peak Adapter
00051	HP	8566B	2747A05510	Spectrum Analyzer
00241	R&S	FSU40	100500	Spectrum Analyzer
00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier
00071	EMCO	2090	9912-1484	Multi-Device Controller
00072	EMCO	2075	0001-2277	Mini-mast
00073	EMCO	2080	0002-1002	Turn Table
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable
00275	TMS	LMR400	n/a	25m Cable
00278	TILE	34G3	n/a	TILE Test Software

Figure A.2 – Test Setup Radiated Measurements 9kHzMHz – 30MHz

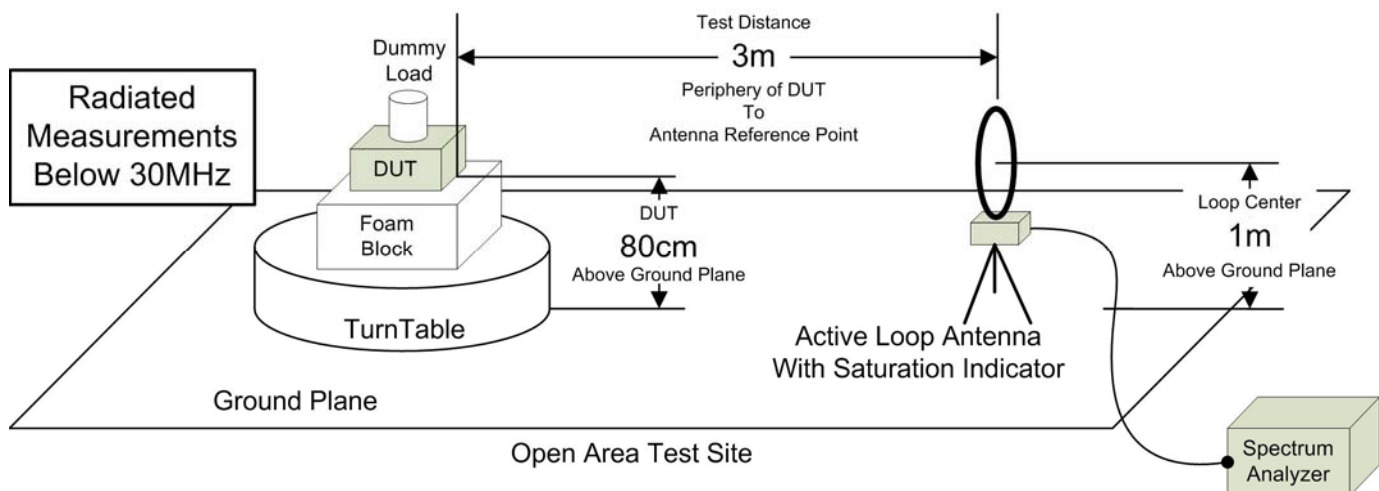


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

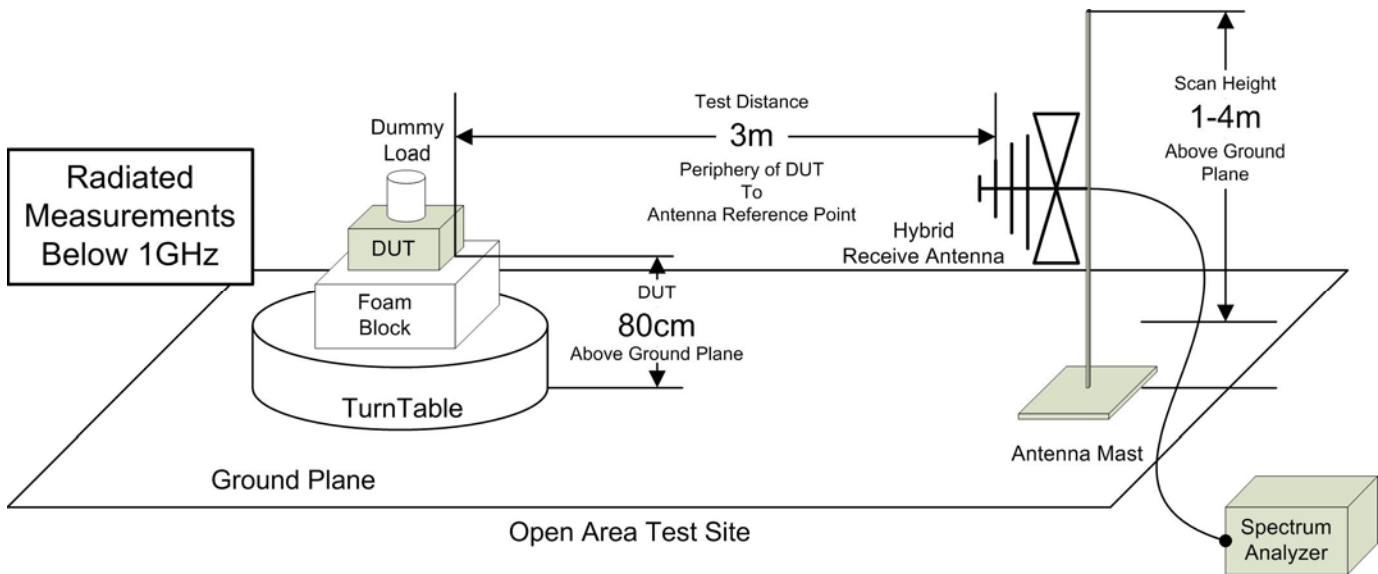


Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution

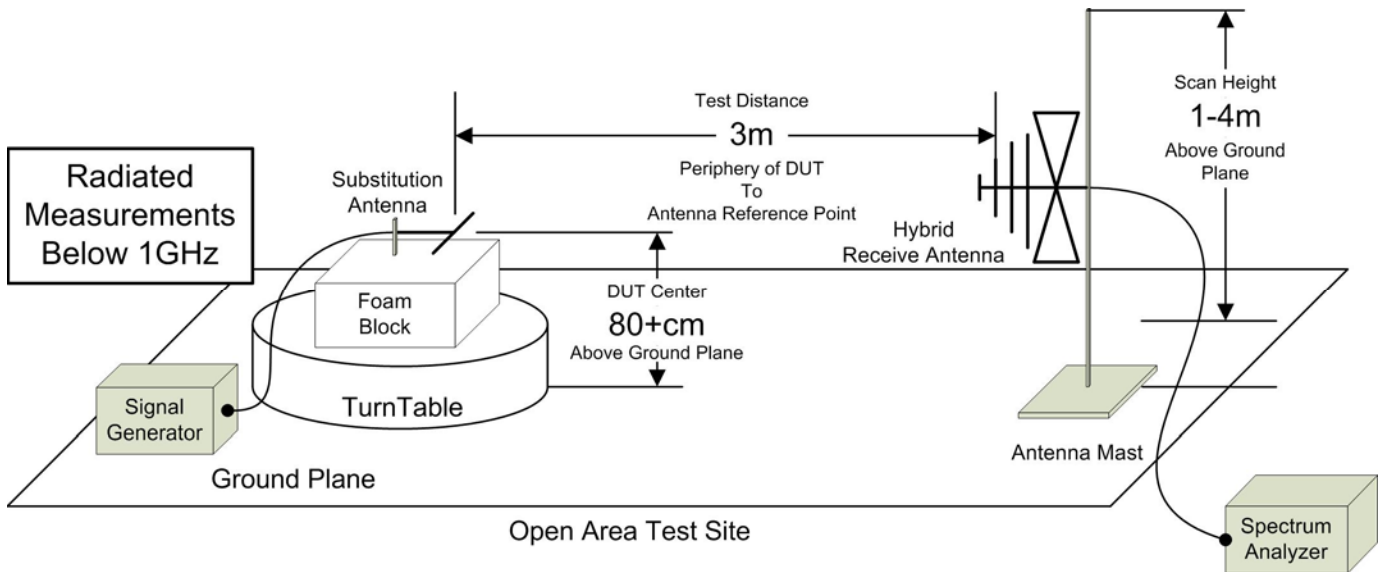


Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz,

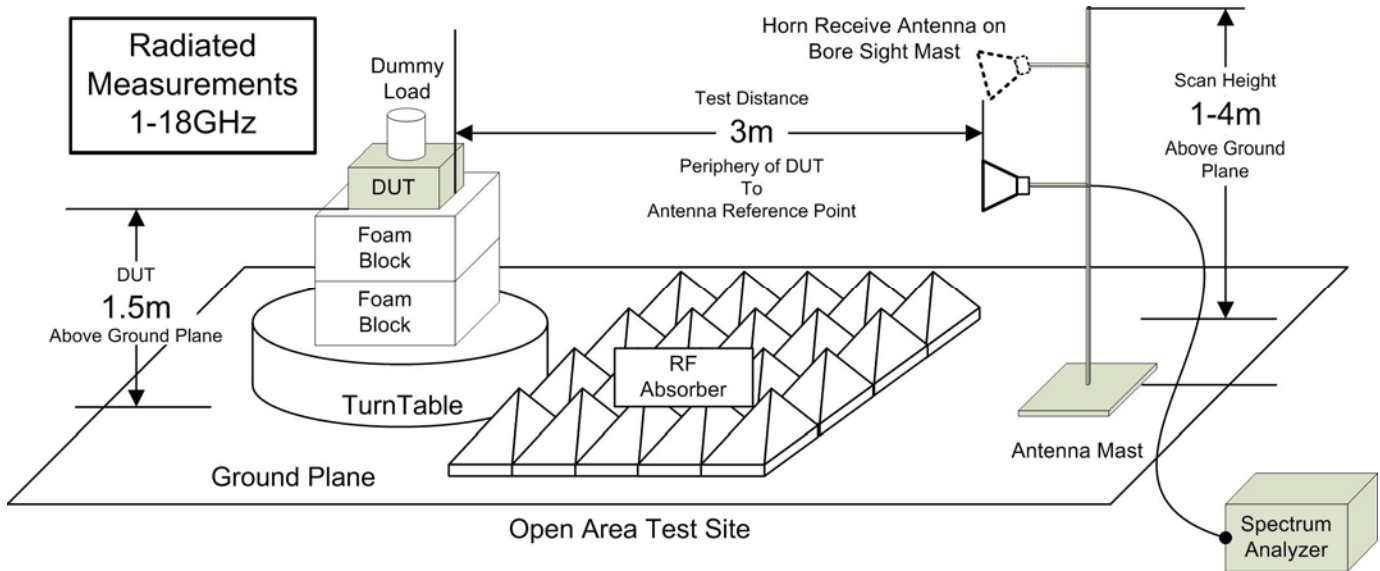


Figure A.6 – Test Setup Radiated Measurements 18 – 26.5GHz,

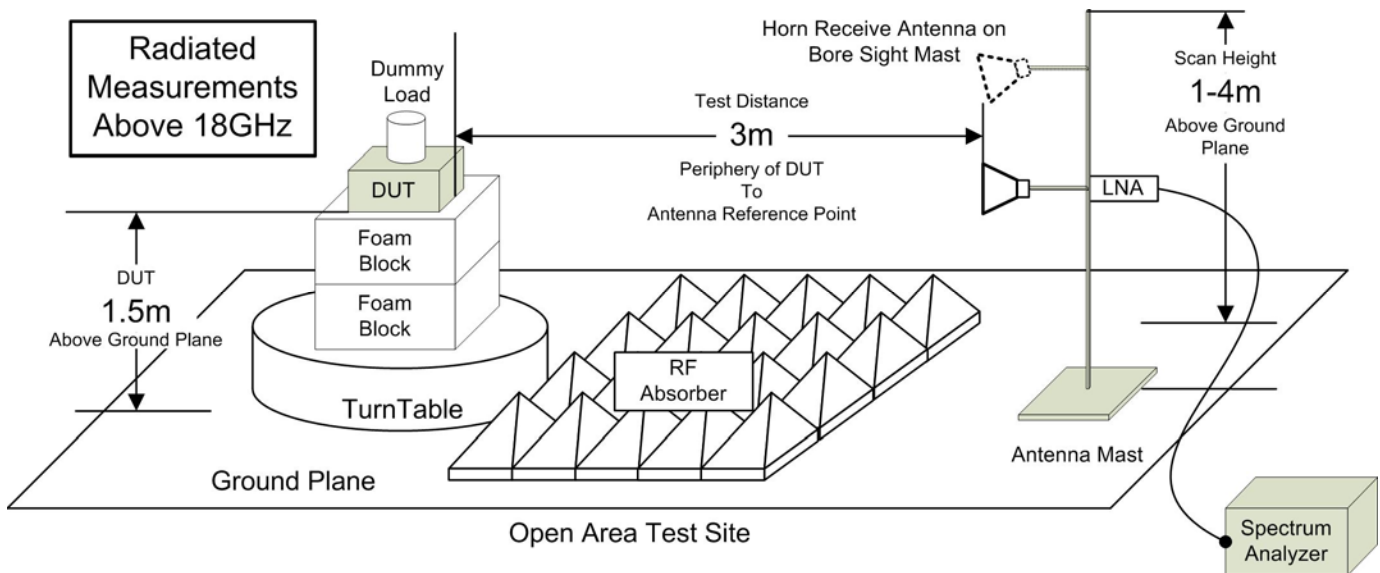


Table A.3 – Setup – Conducted Emissions Equipment List

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00333	HP	85685A	3010A01095	RF Preselector
00049	HP	85650A	2043A00162	Quasi-peak Adapter
00051	HP	8566B	2747A05510	Spectrum Analyzer
00223	HP	8901A	3749A07154	Modulation Analyzer
00257	Com-Power	LI-215A	191934	LISN
00276	TMS	LMR400	n/a	4m Cable

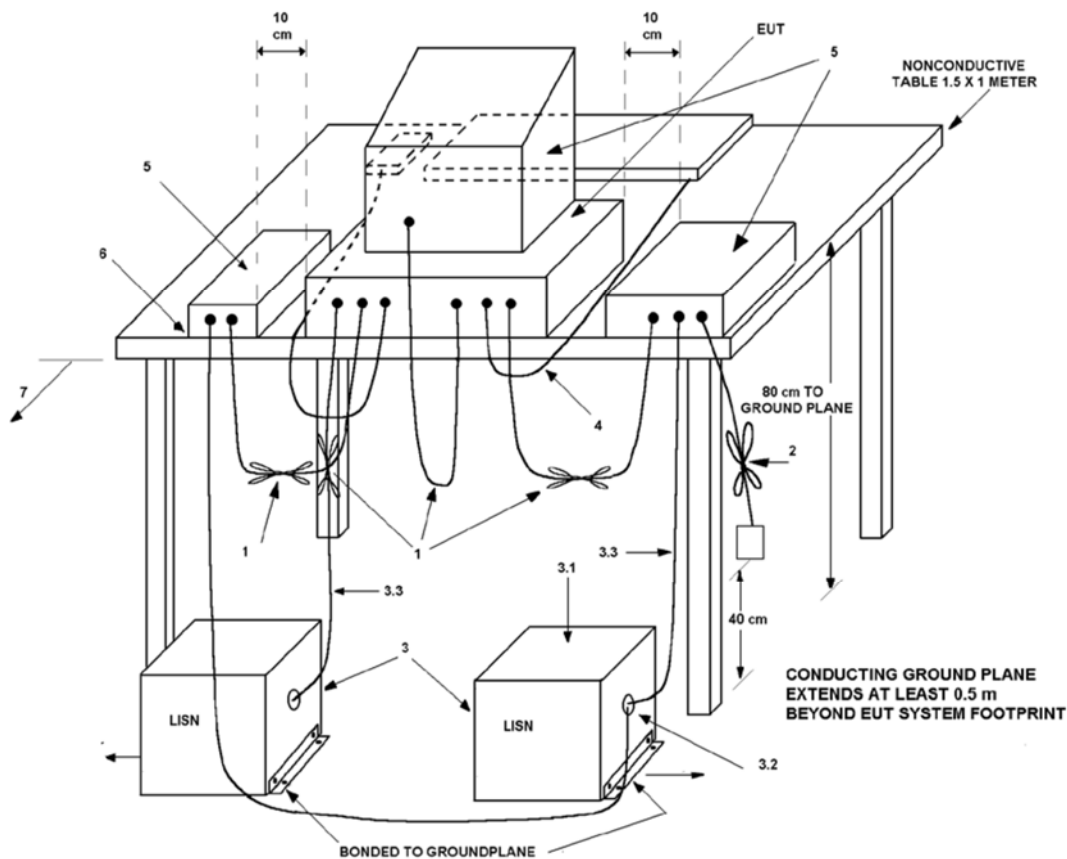


Figure A.7 – Test Setup Conducted Emissions Measurements

APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List							
Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00050	Chase	CBL-6111A	1607	Bilog Antenna	16 Nov 2020	Triennial	16 Nov 2023
00035	ETS	3115	6276	Double Ridged Guide Horn	4 Mar 2022	Triennial	4 Mar 2025
00085	EMCO	6502	9203-2724	Loop Antenna	6 Sep 2022	Triennial	6 Sep 2025
00333	HP	85685A	3010A01095	RF Preselector	23 Jun 2020	Triennial	30 Jun 2023
00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2020	Triennial	23 Jun 2023
00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2020	Triennial	23 Jun 2023
00241	R&S	FSU40	100500	Spectrum Analyzer	10 Aug 2021	Triennial	10 Aug 2024
00005	HP	8648D	3847A00611	Signal Generator	23 Jun 2020	Triennial	23 Jun 2023
00003	HP	53181A	3736A05175	Frequency Counter	23 Jun 2020	Triennial	23 Jun 2023
00257	Com-Power	LI-215A	191934	LISN	27 Dec 2021	Triennial	27 Dec 2024
00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
00081	ESPEC	ECT-2	0510154-B	Environmental Chamber	NCR	n/a	CNR
00234	VWR	61161-378	140320430	Temp/Humidity Meter	New	Triennial	New
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable	COU	n/a	COU
00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR

NCR: No Calibration Required

COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})

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

Radiated Emissions 30MHz - 200MHz

$U_{LAB} = 5.14\text{dB}$ $U_{CISPR} = 6.3\text{dB}$

Radiated Emissions 200MHz - 1000MHz

$U_{LAB} = 5.90\text{dB}$ $U_{CISPR} = 6.3\text{dB}$

Radiated Emissions 1GHz - 6GHz

$U_{LAB} = 4.80\text{dB}$ $U_{CISPR} = 5.2\text{dB}$

Radiated Emissions 6GHz - 18GHz

$U_{LAB} = 5.1\text{dB}$ $U_{CISPR} = 5.5\text{dB}$

Power Line Conducted Emissions 9kHz to 150kHz

$U_{LAB} = 2.96\text{dB}$ $U_{CISPR} = 3.8\text{dB}$

Power Line Conducted Emissions 150kHz to 30MHz

$U_{LAB} = 3.12\text{dB}$ $U_{CISPR} = 3.4\text{dB}$

If the calculated uncertainty U_{lab} is **less** than U_{CISPR} then:

- | | |
|---|---|
| 1 | Compliance is deemed to occur if NO measured disturbance exceeds the disturbance limit |
| 2 | Non-Compliance is deemed to occur if ANY measured disturbance EXCEEDS the disturbance limit |

If the calculated uncertainty U_{lab} is **greater** than U_{CISPR} then:

- | | |
|---|--|
| 3 | Compliance is deemed to occur if NO measured disturbance, increased by ($U_{lab} - U_{CISPR}$), exceeds the disturbance limit |
| 4 | Non-Compliance is deemed to occur if ANY measured disturbance, increased by ($U_{lab} - U_{CISPR}$), EXCEEDS the disturbance limit |

Other Measurement Uncertainties (U_{LAB})

RF Conducted Emissions 9kHz - 40GHz

$U_{LAB} = 1.0\text{dB}$ $U_{CISPR} = \text{n/a}$

Frequency/Bandwidth 9kHz - 40GHz

$U_{LAB} = 0.1\text{ppm}$ $U_{CISPR} = \text{n/a}$

Temperature

$U_{LAB} = 1^{\circ}\text{C}$ $U_{CISPR} = \text{n/a}$

END OF REPORT

APPENDIX D – CONDUCTED POWER MEASUREMENT PLOTS

APPENDIX E – CONDUCTED SPURIOUS EMISSIONS MEASUREMENT PLOTS

APPENDIX F – RADIATED TX EMISSIONS MEASUREMENT PLOTS

APPENDIX G – RADIATED RX EMISSIONS MEASUREMENT PLOTS

Conducted Power Measurement Results:

Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P _{Meas}] (dBm)	Measured Power (W)	Conducted Limit [P _{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E _{Meas}] (dBm)	EIRP (W)	EIRP Limit [E _{Lim}] (dBm)	EIRP Margin (dB)
6	2437.00	802.11b	CCK 1MB	17.28	0.0535	30.00	12.7	-5.26	12.02	0.0159	36	24.0
6	2437.00		CCK 2MB	17.33	0.0541		12.7		12.07	0.0161		23.9
6	2437.00		DSSS 5.5	17.38	0.0547		12.6		12.12	0.0163		23.9
6	2437.00		DSSS 11	17.17	0.0521		12.8		11.91	0.0155		24.1
1	2412.00		DSSS 5.5	14.91	0.0310		15.1		9.65	0.0092		26.4
11	2462.00		DSSS 5.5	15.59	0.0362		14.4		10.33	0.0108		25.7
1	2412.00	802.11g	OFDM12	10.89	0.0123		19.1		5.63	0.0037		30.4
6	2437.00			18.35	0.0684		11.7		13.09	0.0204		22.9
11	2462.00			13.66	0.0232		16.3		8.40	0.0069		27.6
1	2412.00	802.11n	MCS0	10.94	0.0124		19.1		5.68	0.0037		30.3
6	2437.00			16.80	0.0479		13.2		11.54	0.0143		24.5
11	2462.00			12.85	0.0193		17.2		7.59	0.0057		28.4
Result:												Complies

Conducted Margin = P_{Limit} - P_{Meas}Conducted Margin = E_{Lim} - E_{Meas}

Conducted Power:

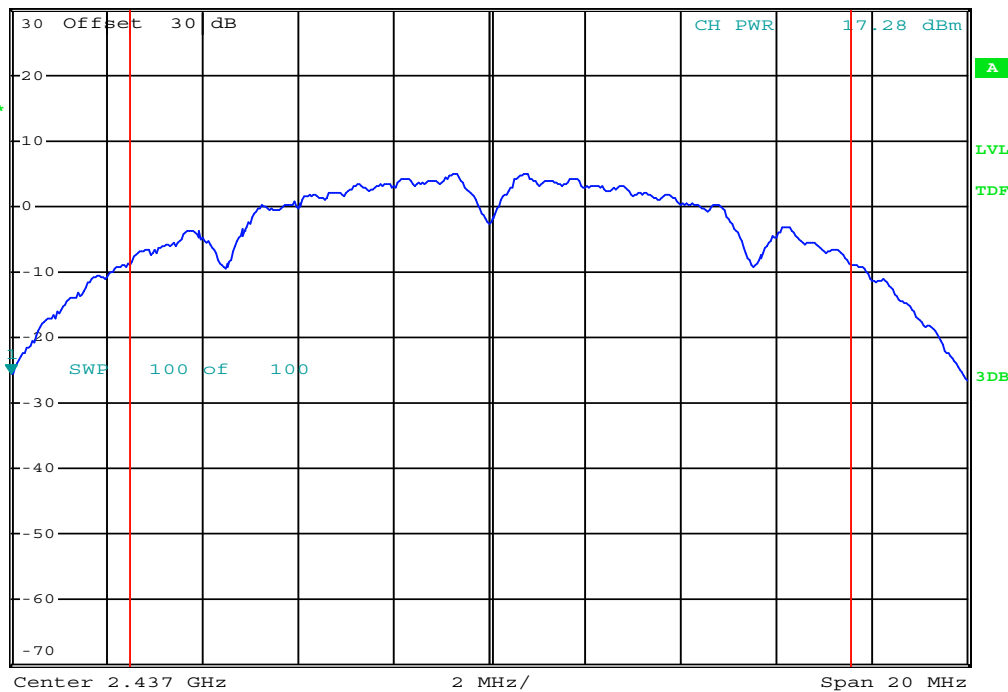


*RBW 300 kHz Marker 1 [T1]
VBW 3 MHz -25.41 dBm
SWT 2.5 ms 2.427000000 GHz

Ref 30 dBm

*Att 30 dB

1 RM*
VIEW



Date: 15.JAN.2023 13:15:46

Channel:

6

Channel Frequency:

2437

MHz

Mode:

802.11b

Modulation:

CCK 1MB

Measured Channel Power:

17.28

dBm

Conducted Power:

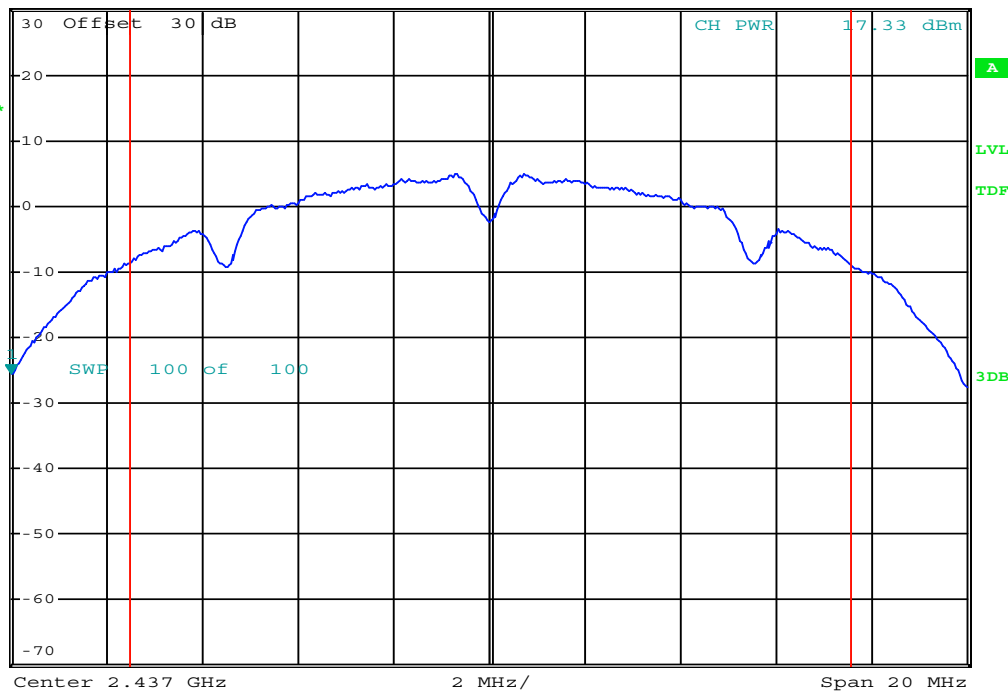


*RBW 300 kHz Marker 1 [T1]
VBW 3 MHz -25.60 dBm
SWT 2.5 ms 2.427000000 GHz

Ref 30 dBm

*Att 30 dB

1 RM*
VIEW



Date: 15.JAN.2023 13:16:40

Channel:

6

Channel Frequency:

2437

MHz

Mode:

802.11b

Modulation:

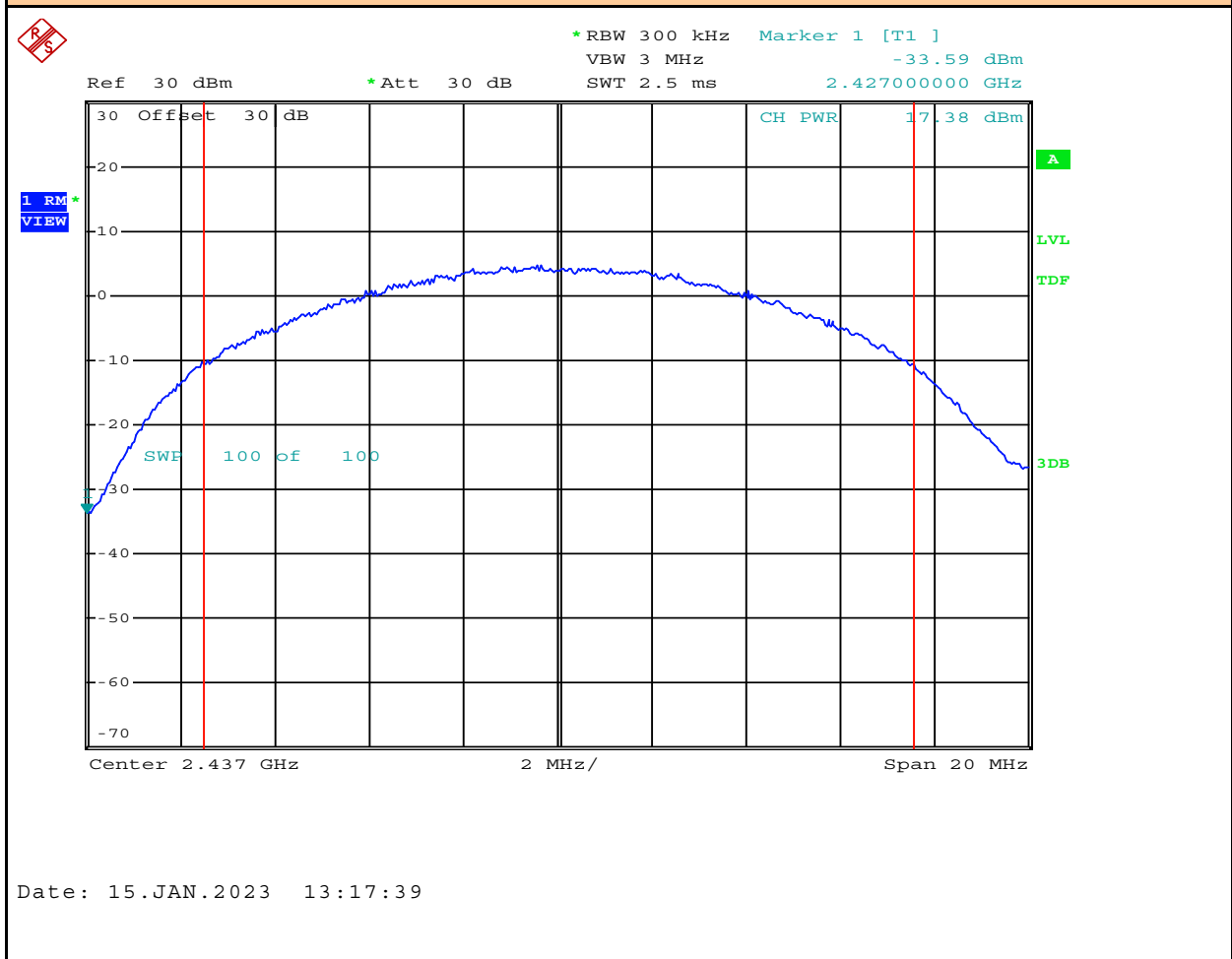
CCK 2MB

Measured Channel Power:

17.33

dBm

Conducted Power:



Channel: 6

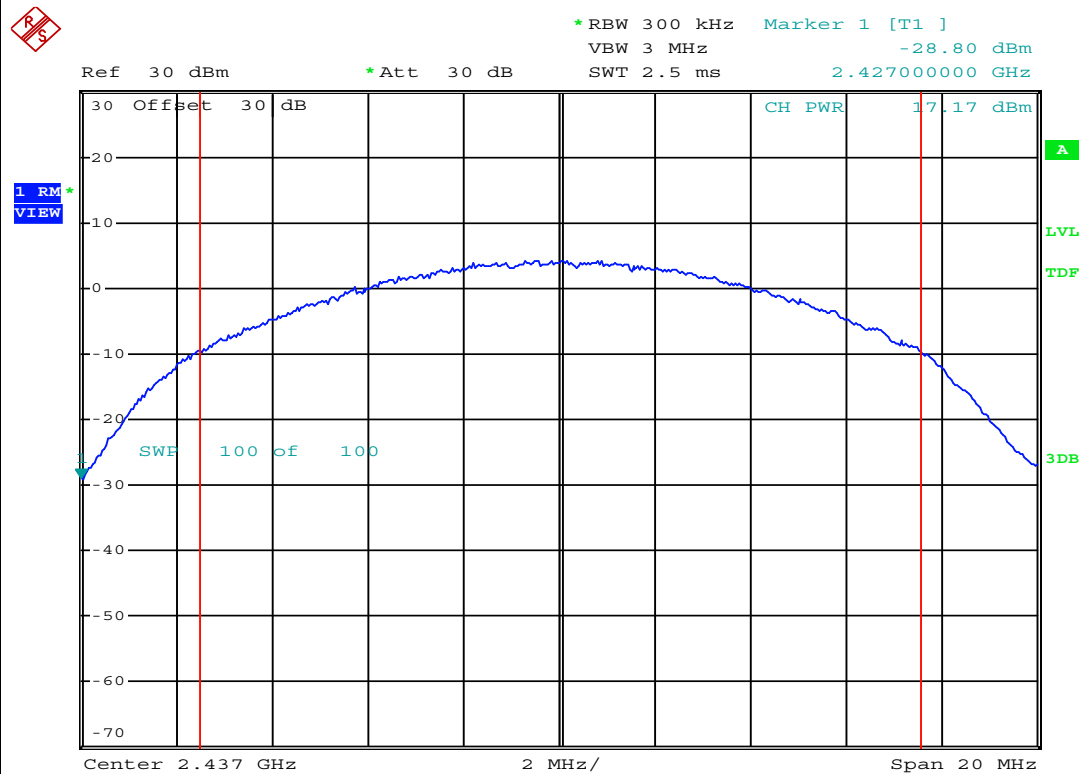
Mode: 802.11b

Channel Frequency: 2437 MHz

Modulation:	DSSS 5.5
-------------	----------

Measured Channel Power: 17.38 dBm

Conducted Power:



Date: 15.JAN.2023 13:18:33

Channel: 6

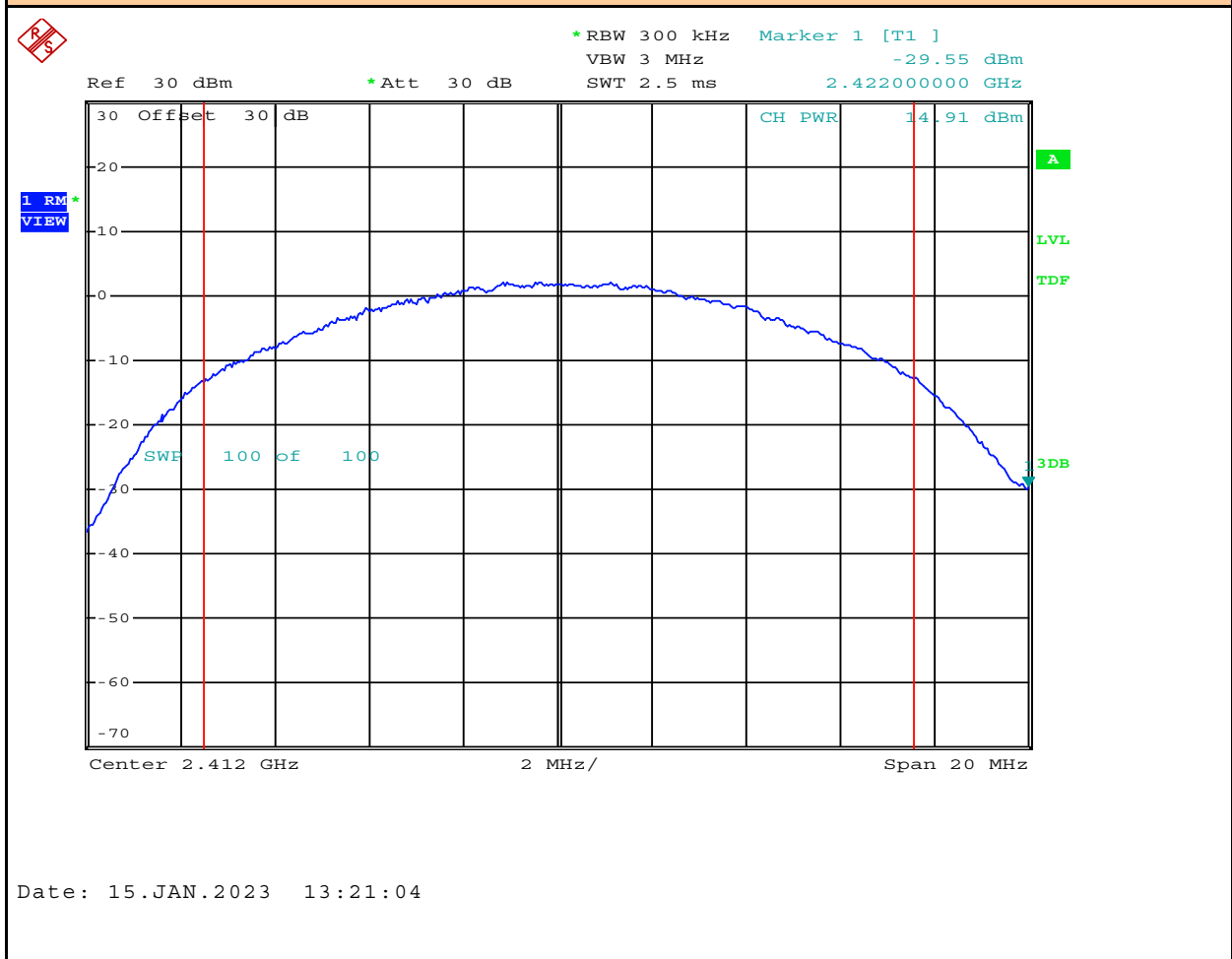
Mode: 802.11b

Channel Frequency: 2437 MHz

Modulation: **DSSS 11**

Measured Channel Power: 17.17 dBm

Conducted Power:



Channel: 1

Mode: 802.11b

Channel Frequency: 2412 MHz

Modulation:	DSSS 5.5
-------------	----------

Measured Channel Power: 14.91 dBm

Conducted Power:

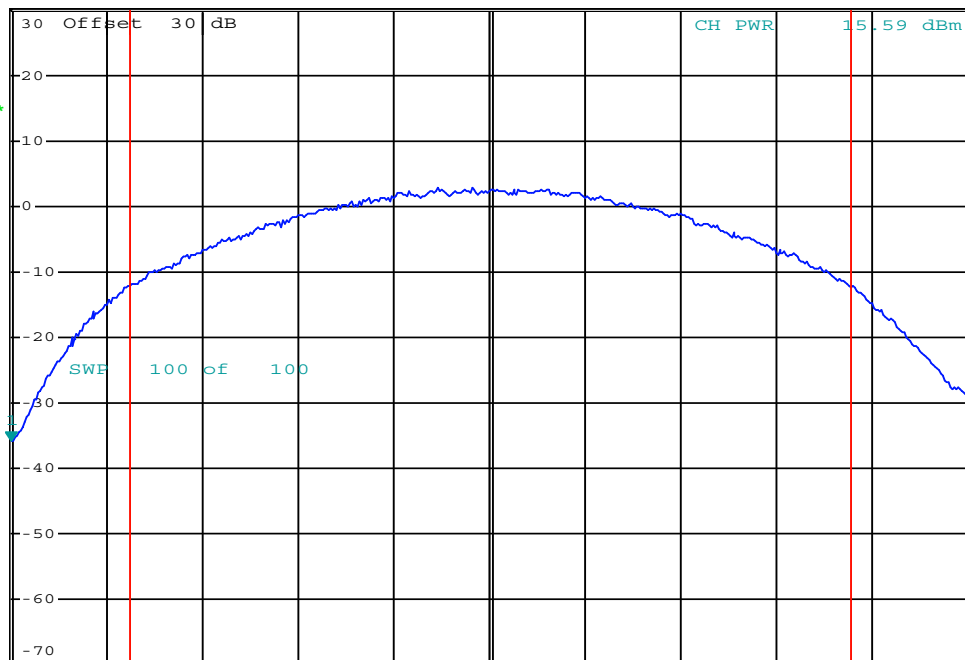


*RBW 300 kHz Marker 1 [T1]
VBW 3 MHz -35.86 dBm
SWT 2.5 ms 2.452000000 GHz

Ref 30 dBm

*Att 30 dB

1 RM*
VIEW



Center 2.462 GHz

2 MHz/

Span 20 MHz

Date: 15.JAN.2023 13:20:06

Channel:

11

Channel Frequency:

2462

MHz

Mode:

802.11b

Modulation:

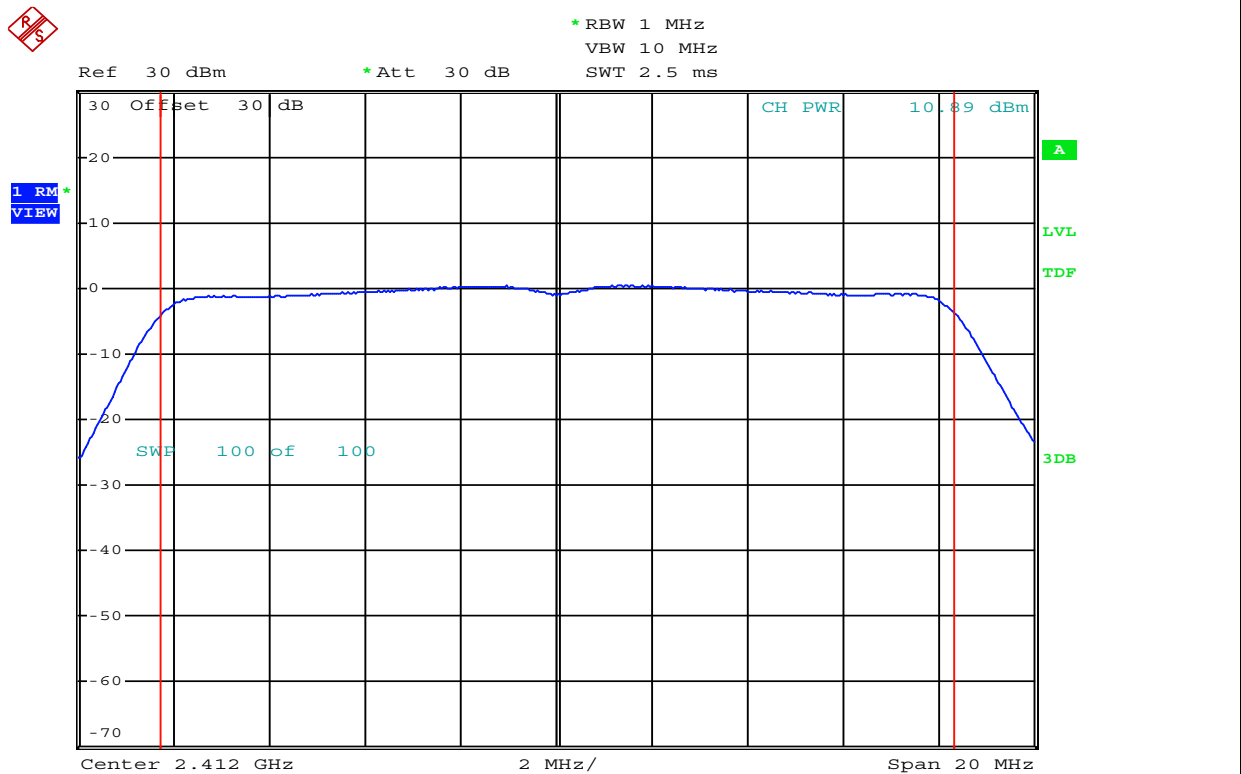
DSSS 5.5

Measured Channel Power:

15.59

dBm

Conducted Power:



Date: 8.FEB.2023 13:48:59

Channel: 1

Mode: 802.11g

Channel Frequency: 2412 MHz

Modulation: OFDM12

Measured Channel Power: 10.89 dBm

Conducted Power:

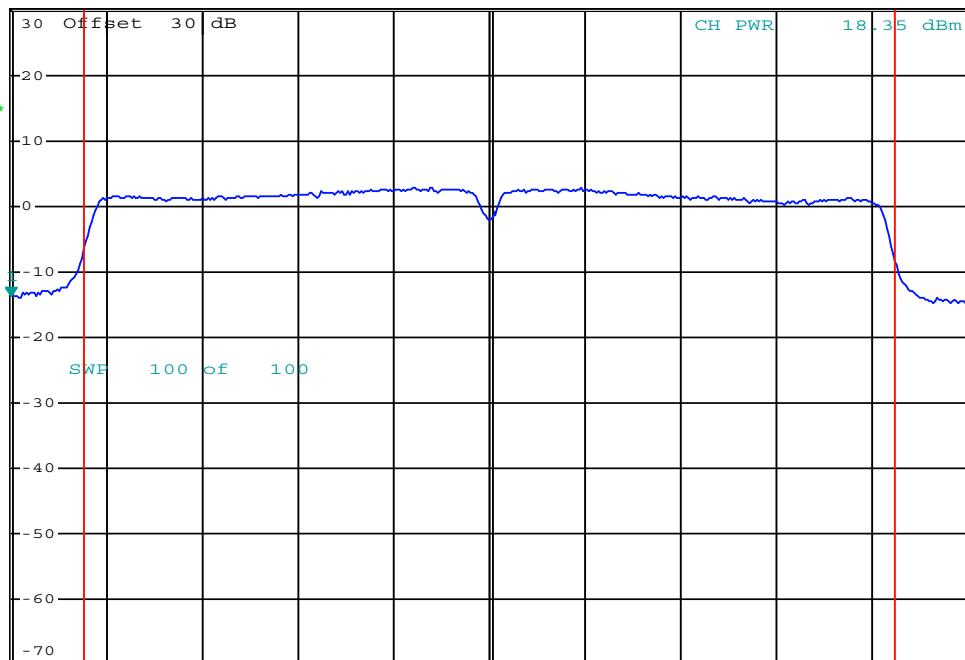


*RBW 300 kHz Marker 1 [T1]
VBW 3 MHz -13.65 dBm
SWT 2.5 ms 2.427000000 GHz

Ref 30 dBm

*Att 30 dB

1 RM*
VIEW



Center 2.437 GHz

2 MHz/

Span 20 MHz

Date: 15.JAN.2023 13:24:35

Channel:

6

Channel Frequency:

2437

MHz

Mode:

802.11g

Modulation:

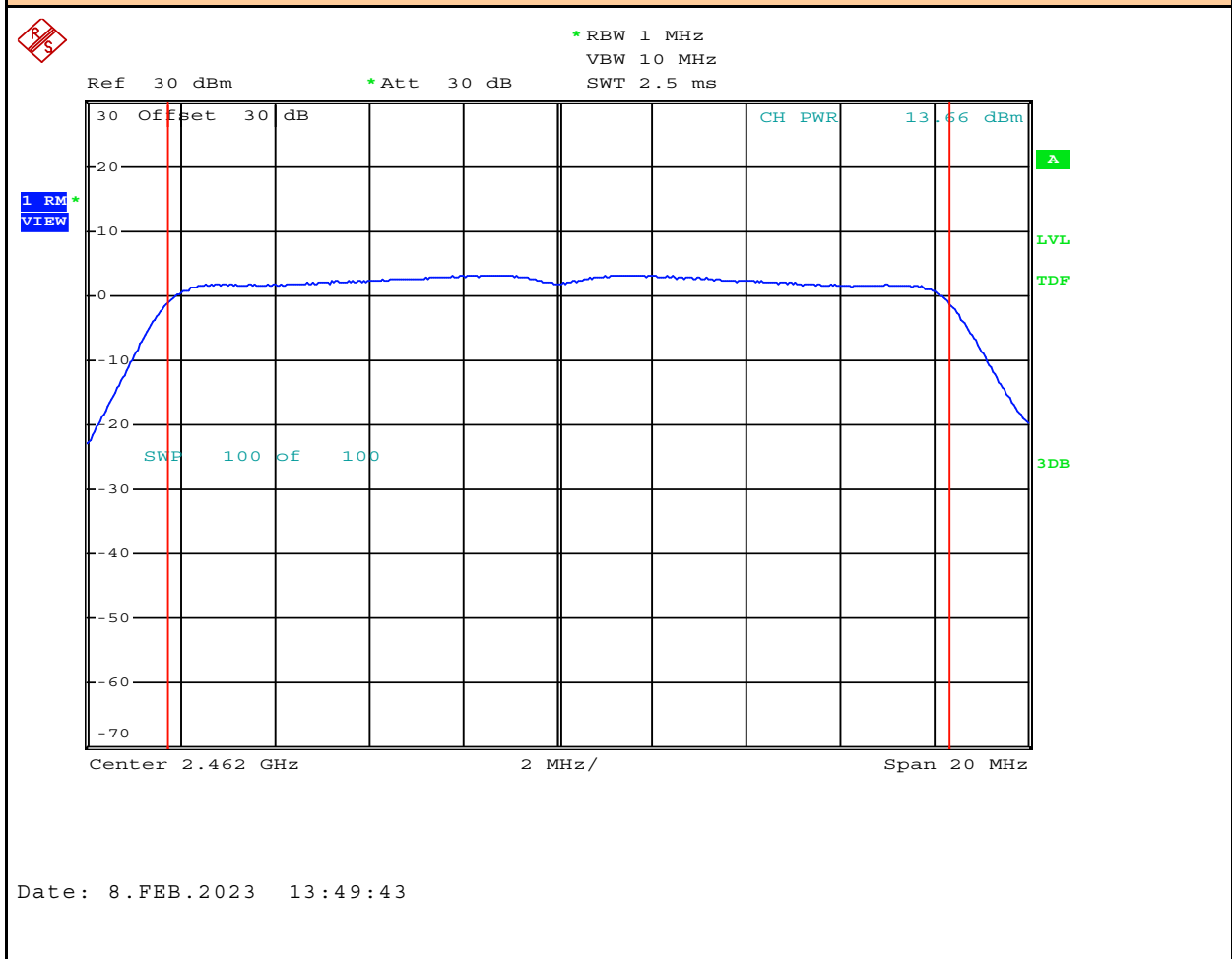
OFDM12

Measured Channel Power:

18.35

dBm

Conducted Power:



Channel: 11

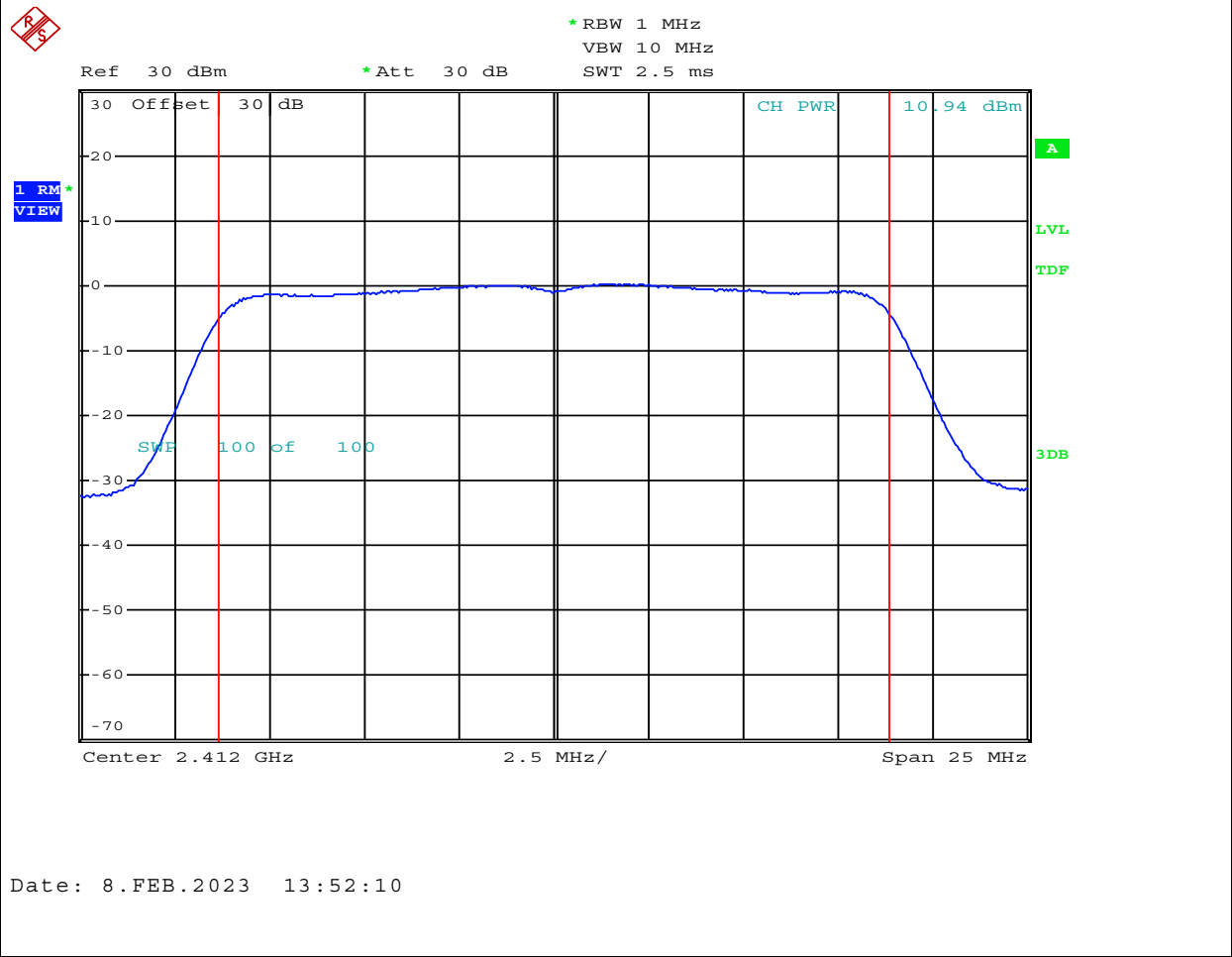
Mode: 802.11g

Channel Frequency: 2462 MHz

Modulation: OFDM12

Measured Channel Power: 13.66 dBm

Conducted Power:



Date: 8.FEB.2023 13:52:10

Channel: 1

Mode: 802.11n

Channel Frequency: 2412 MHz

Modulation: MCS0

Measured Channel Power: 10.94 dBm

Conducted Power:

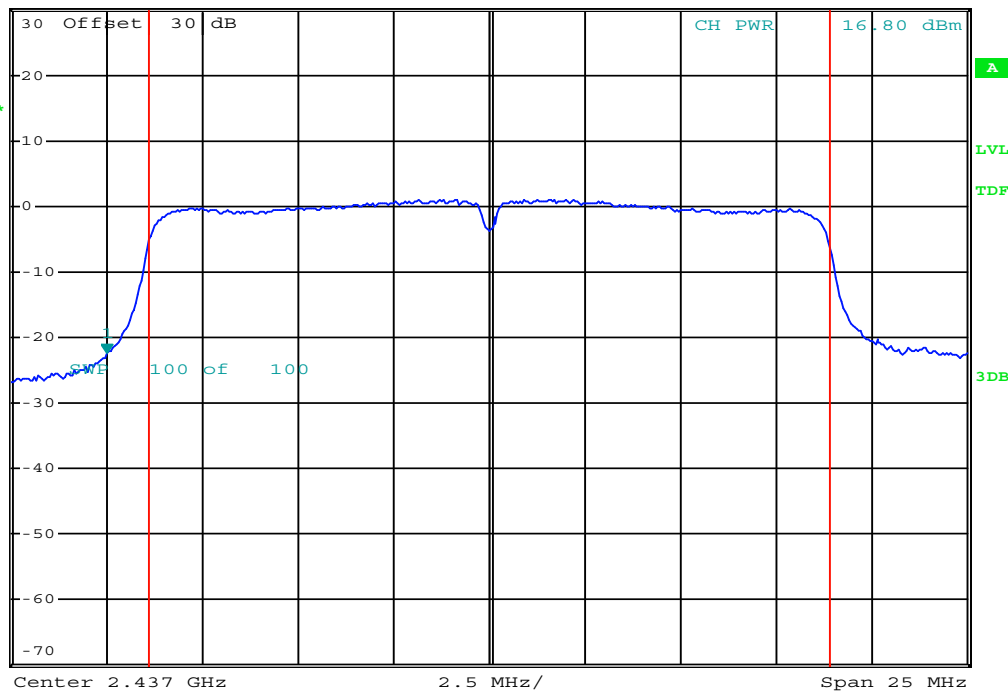


*RBW 300 kHz Marker 1 [T1]
VBW 3 MHz -22.44 dBm
SWT 2.5 ms 2.427000000 GHz

Ref 30 dBm

*Att 30 dB

1 RM*
VIEW



Date: 15.JAN.2023 13:31:14

Channel:

6

Channel Frequency:

2437

MHz

Mode:

802.11n

Modulation:

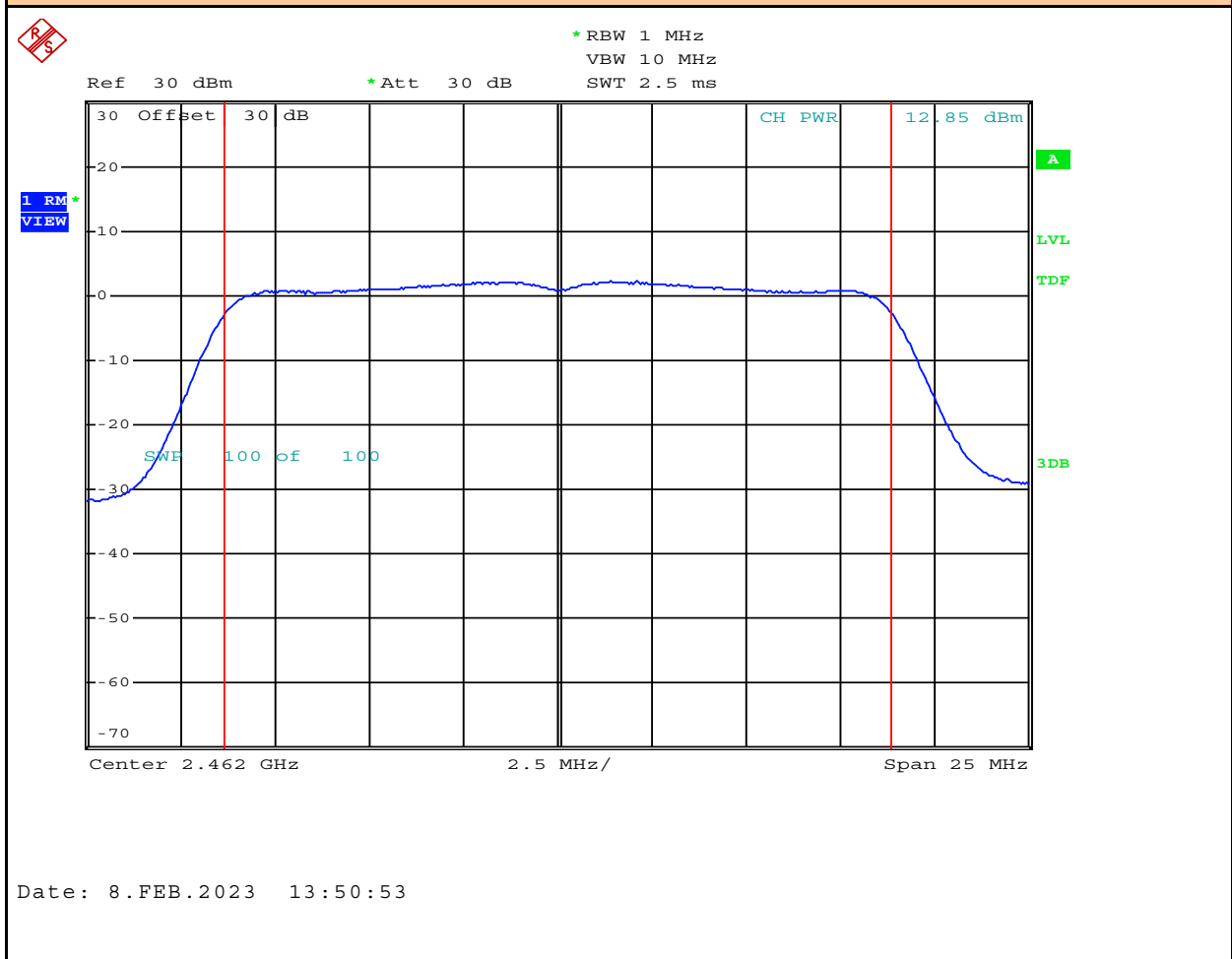
MCS0

Measured Channel Power:

16.8

dBm

Conducted Power:



Channel: 11

Mode: 802.11n

Channel Frequency: 2462 MHz

Modulation: MCS0

Measured Channel Power: 12.85 dBm

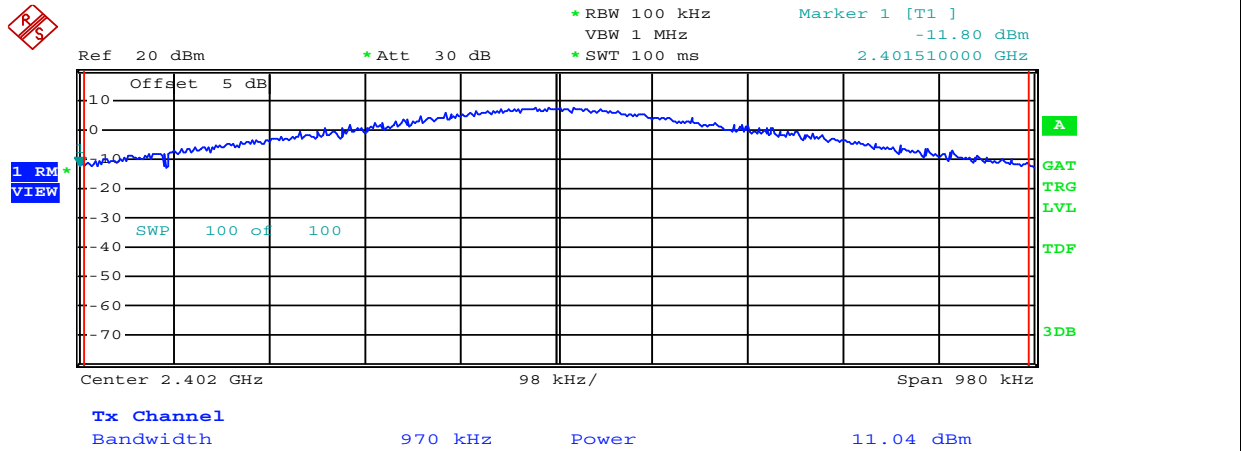
Conducted Power Measurement Results:

Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P _{Meas}] (dBm)	Measured Power (W)	Conducted Limit [P _{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E _{Meas}] (dBm)	EIRP (W)	EIRP Limit [E _{Lim}] (dBm)	EIRP Margin (dB)
0	2402.00	BT BR	GFSK	11.04	0.0127	30.00	19.0	-5.26	5.78	0.0038	36	30.2
38	2440.00			11.11	0.0129		18.9		5.85	0.0038		30.2
78	2480.00			11.13	0.0130		18.9		5.87	0.0039		30.1
0	2402.00	BT EDR2	Pi/4-DQPSK	10.11	0.0103		19.9		4.85	0.0031		31.2
38	2440.00			10.21	0.0105		19.8		4.95	0.0031		31.1
78	2480.00			10.23	0.0105		19.8		4.97	0.0031		31.0
0	2402.00	BT EDR3	8-DPSK	10.11	0.0103		19.9		4.85	0.0031		31.2
38	2440.00			10.11	0.0103		19.9		4.85	0.0031		31.2
78	2480.00			10.12	0.0103		19.9		4.86	0.0031		31.1
Result:											Complies	

Conducted Margin = P_{Lim} - P_{Meas}

Conducted Margin = E_{Lim} - E_{Meas}

Conducted Power:



Date: 21.JAN.2023 14:19:23

Channel: 0

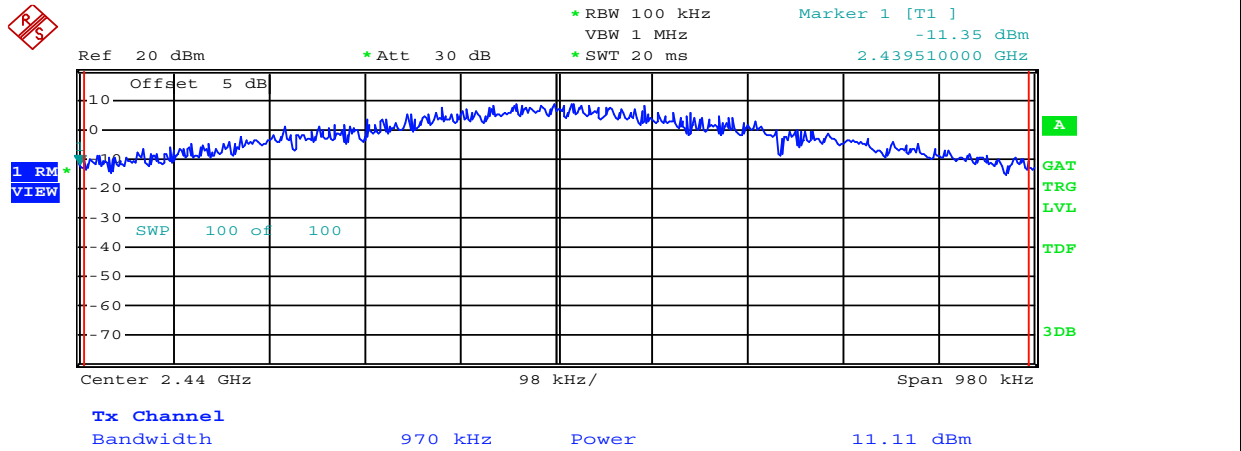
Mode:	BT BR
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Channel Frequency: 2402 MHz

Modulation:	GFSK
-------------	------

Measured Channel Power: 11.04 dBm

Conducted Power:



Date: 21.JAN.2023 14:20:38

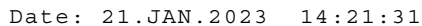
Channel: 38

Mode:	BT BR
-------	-------

Channel Frequency: **2440** MHz

Modulation:	GFSK
-------------	------

Measured Channel Power: 11.11 dBm

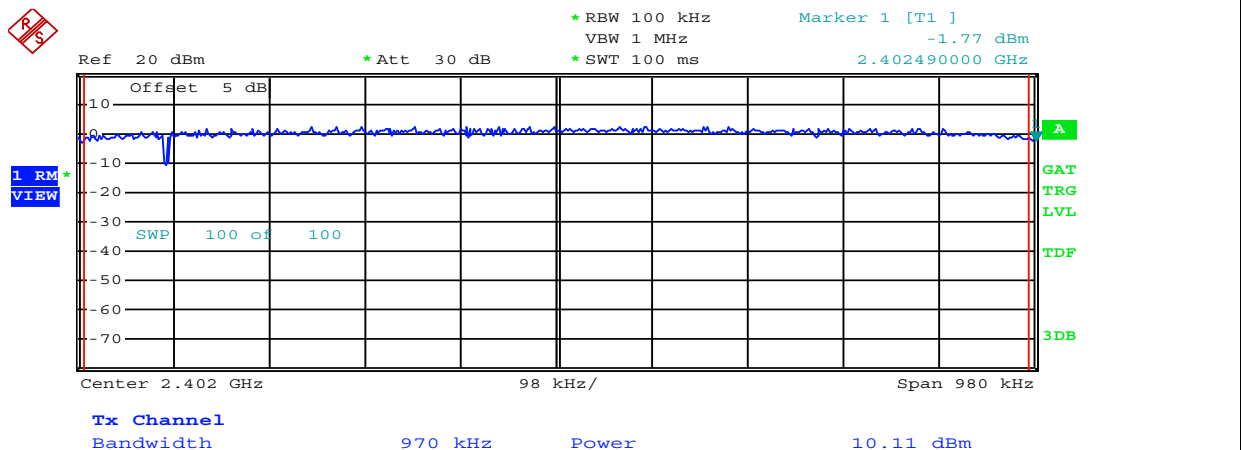


Channel Frequency: 2480 MHz

Modulation:	GFSK
-------------	------

Measured Channel Power: **11.13** dBm

Conducted Power:



Date: 21.JAN.2023 14:23:06

Channel: 0

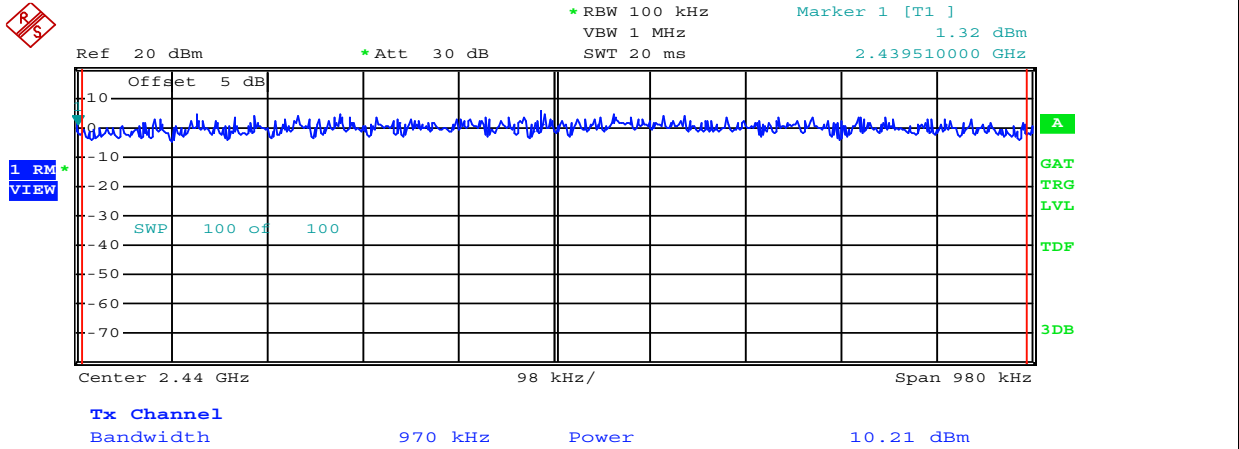
Mode: BT EDR2

Channel Frequency: 2402 MHz

Modulation: **Pi/4-DQPSK**

Measured Channel Power: 10.11 dBm

Conducted Power:



Date: 21.JAN.2023 14:24:07

Channel: 38

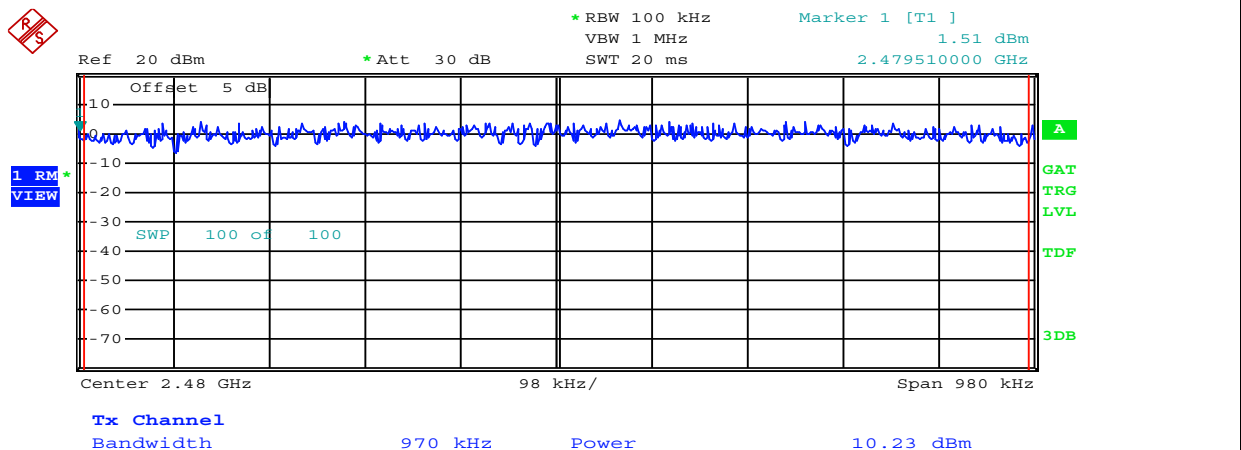
Mode: BT EDR2

Channel Frequency: **2440** MHz

Modulation: **Pi/4-DQPSK**

Measured Channel Power: 10.21 dBm

Conducted Power:



Date: 21.JAN.2023 14:24:59

Channel: 78

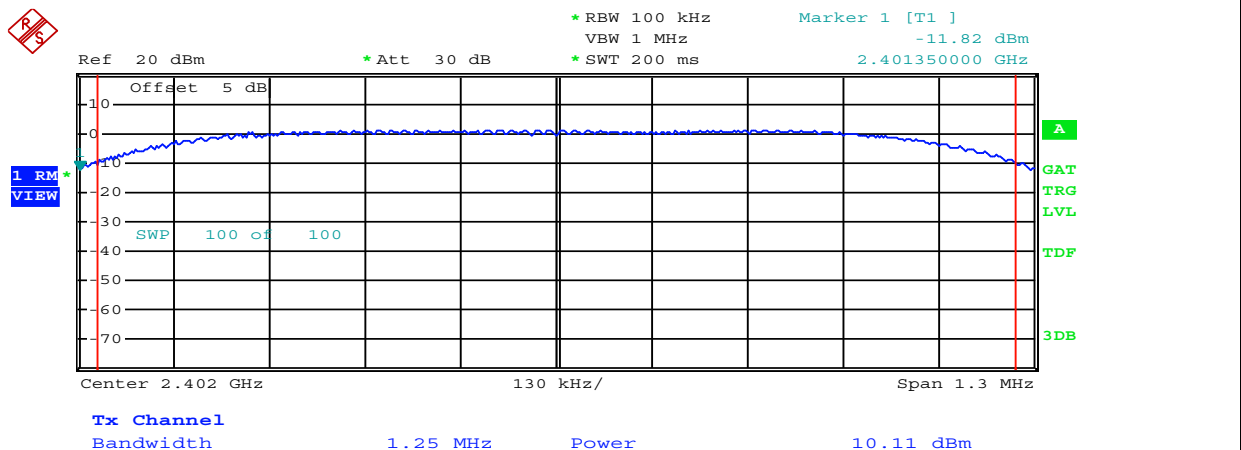
Mode: BT EDR2

Channel Frequency: 2480 MHz

Modulation: **Pi/4-DQPSK**

Measured Channel Power: 10.23 dBm

Conducted Power:



Date: 21.JAN.2023 14:27:09

Channel: 0

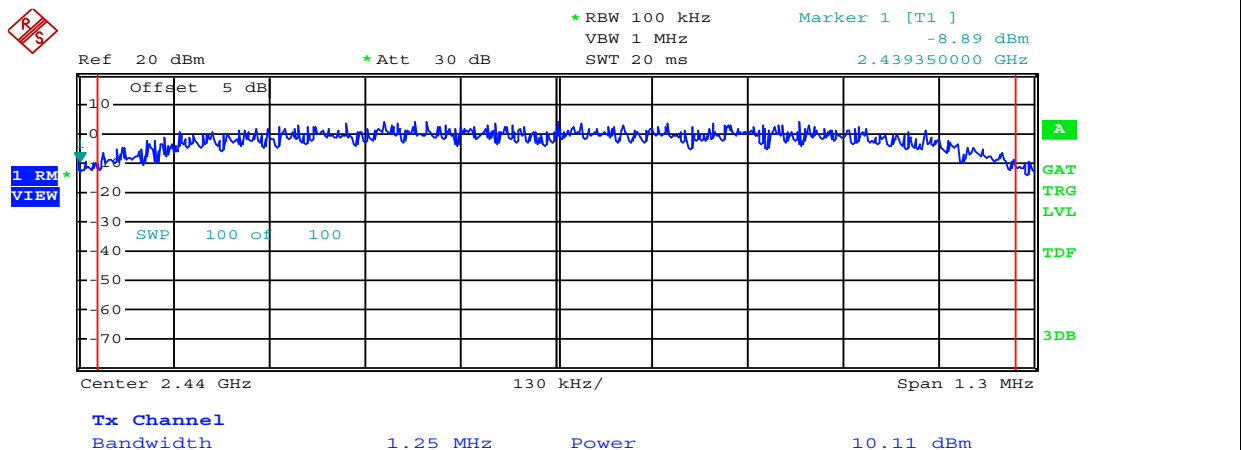
Mode: BT EDR3

Channel Frequency: 2402 MHz

Modulation: 8-DPSK

Measured Channel Power: 10.11 dBm

Conducted Power:



Date: 21.JAN.2023 14:28:09

Channel: 38

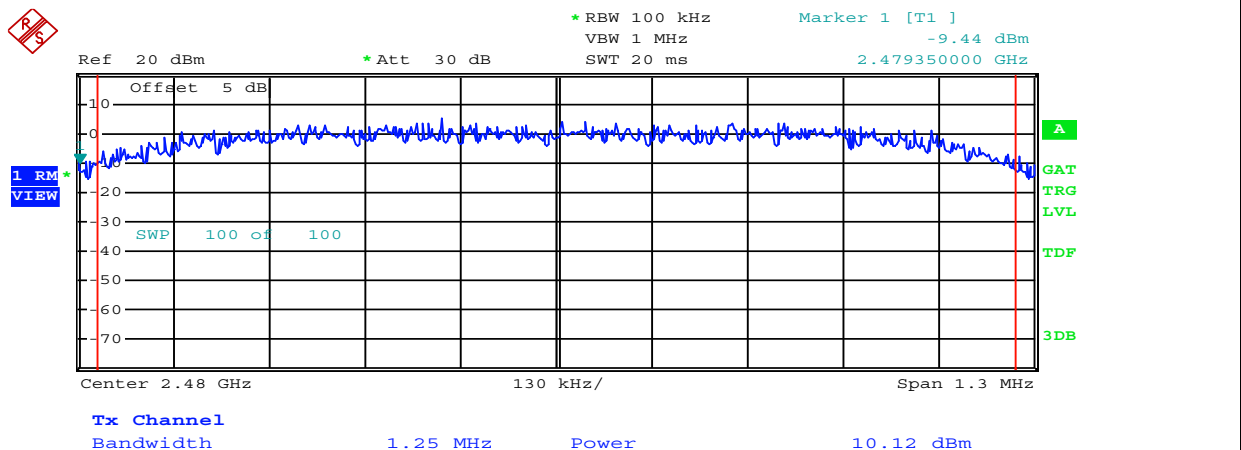
Mode: BT EDR3

Channel Frequency: 2440 MHz

Modulation: 8-DPSK

Measured Channel Power: 10.11 dBm

Conducted Power:



Date: 21.JAN.2023 14:29:16

Channel: 78

Mode: BT EDR3

Channel Frequency: 2480 MHz

Modulation: 8-DPSK

Measured Channel Power: 10.12 dBm

Conducted Spurious Emissions Measurement Results:

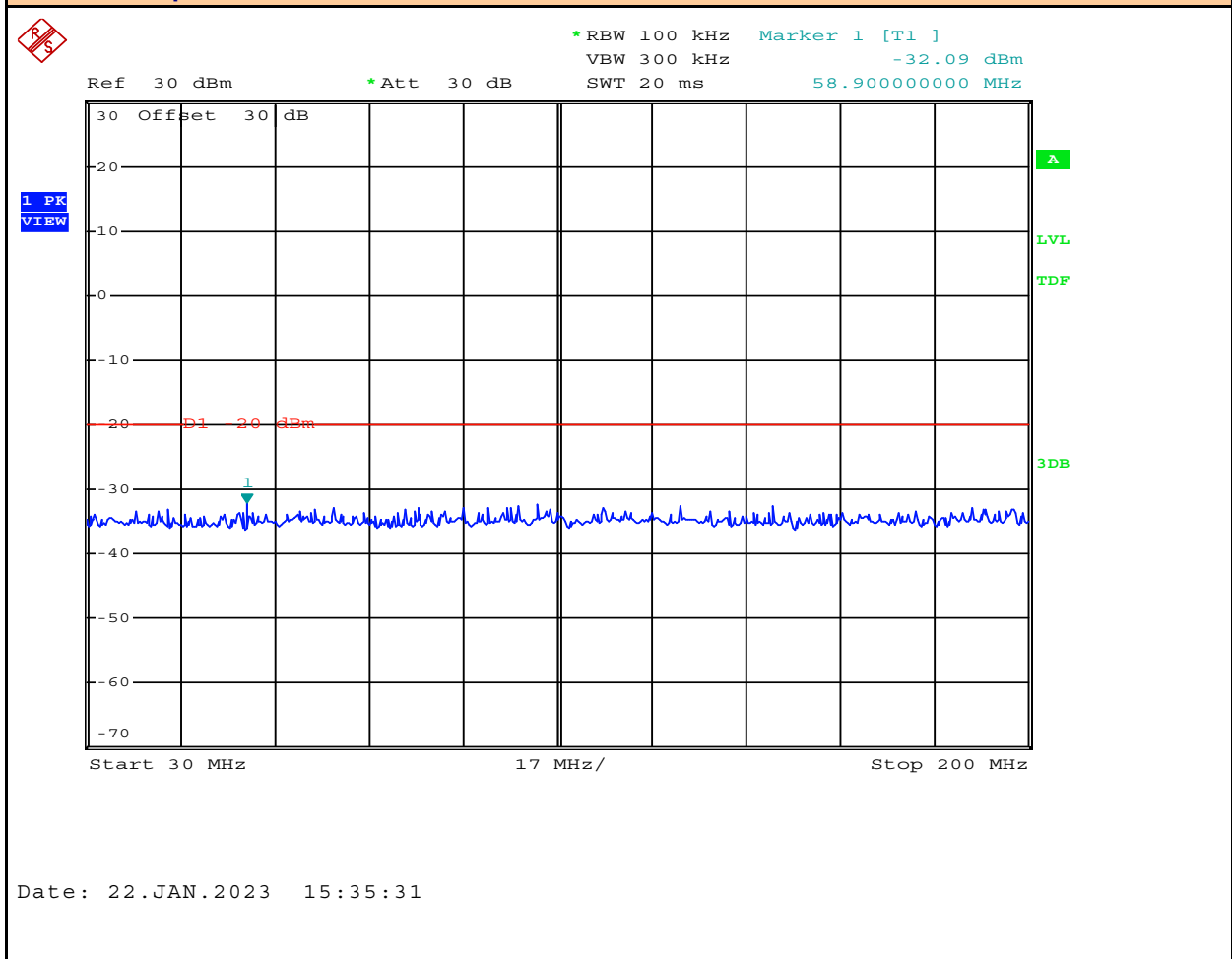
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P _{Em}] (dBm)	Emission Frequency (MHz)	Reference Measurement [P _{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
802.11b	6	2437.00	DSSS 5.5	-32.09	58.9	10.00	42.09	30	12.1
				-31.07	235.6		41.07		11.1
				-30.92	500.8		40.92		10.9
				-31.05	728		41.05		11.1
				-31.53	926.4		41.53		11.5
Result:								Complies	

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]

Margin = Attenuation - Limit

ND = None Detected

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

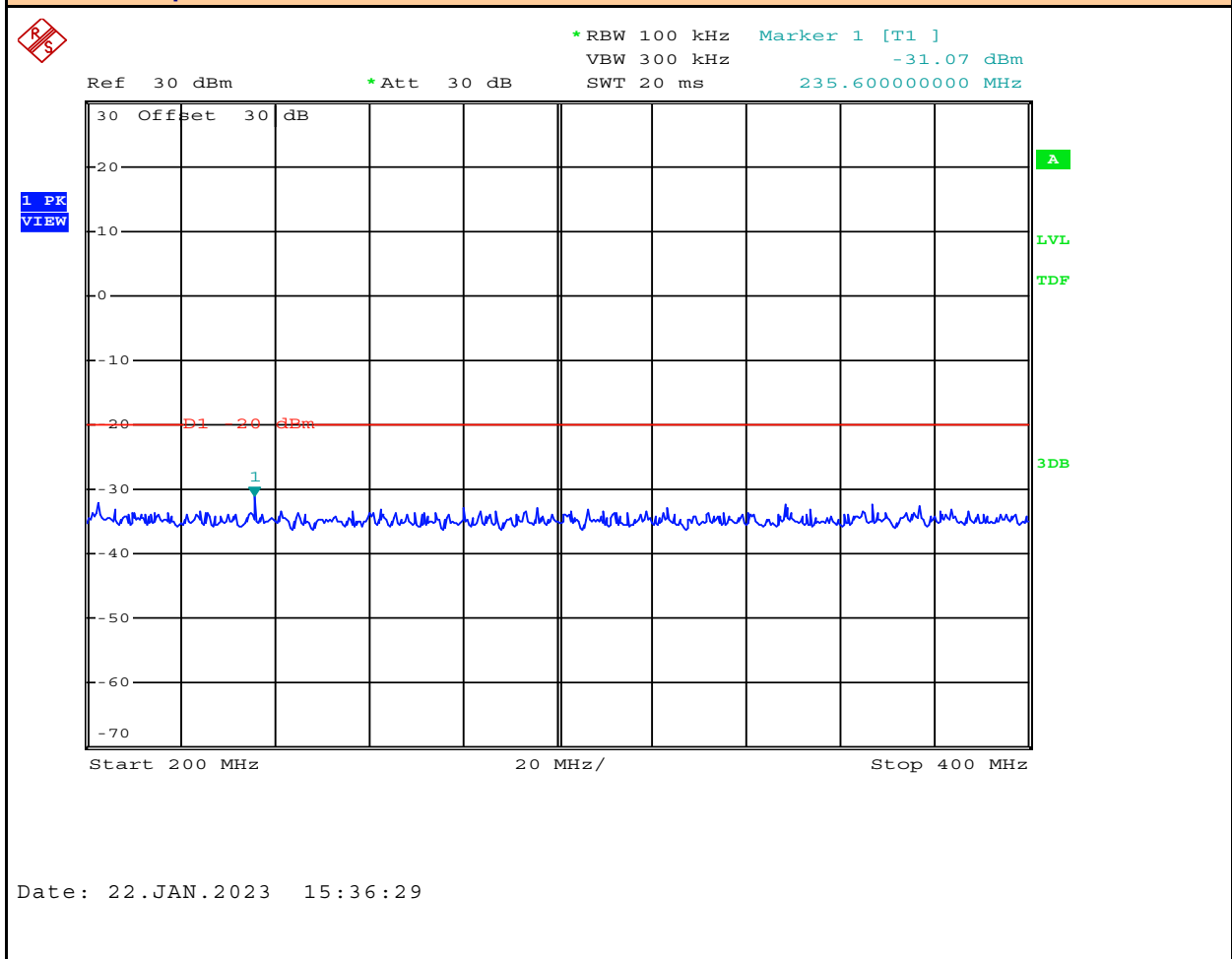
Emission Frequency: 58.9 MHz

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: **-32.09** dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

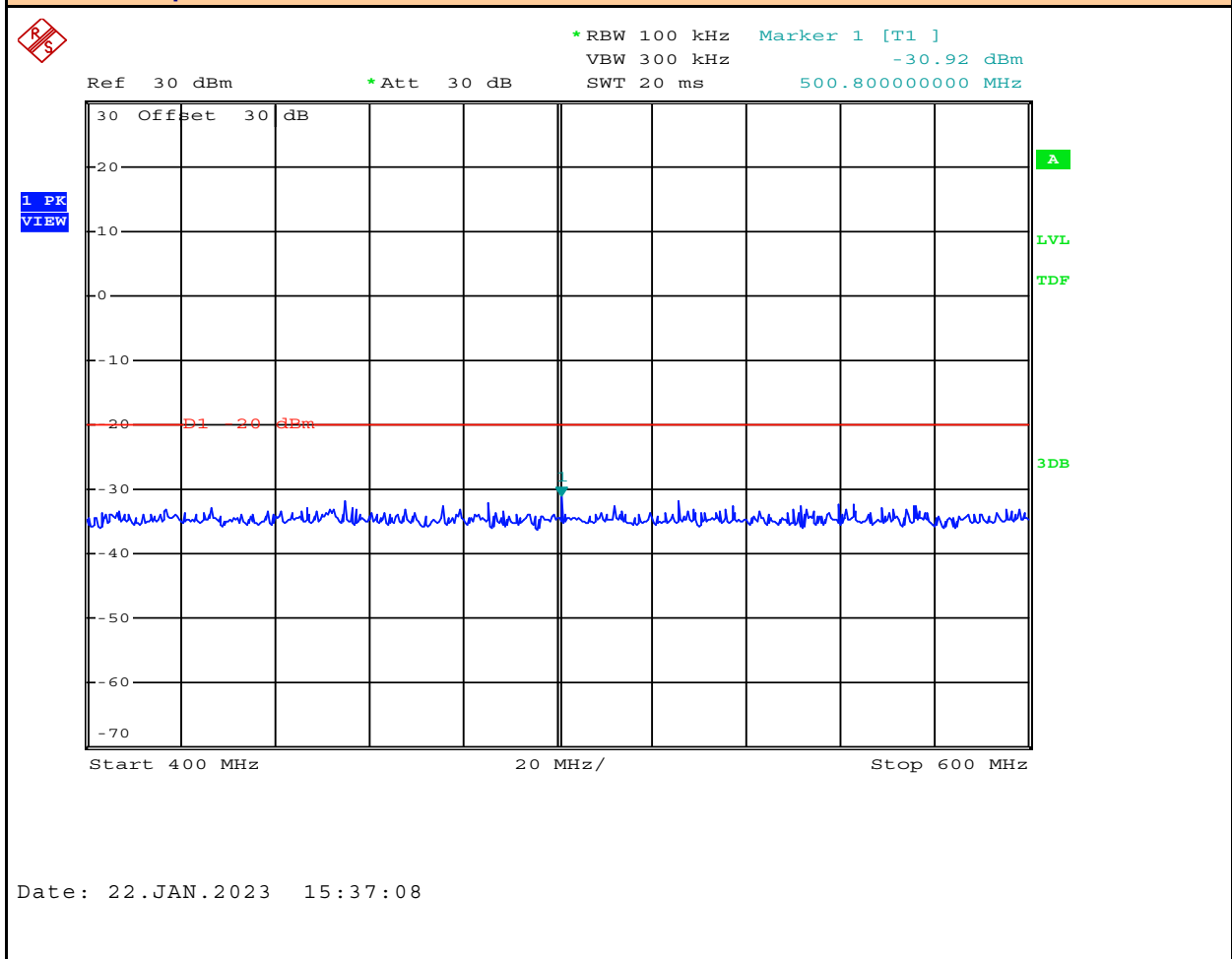
Emission Frequency: 235.6 MHz

Channel Frequency: 2437 MHz

Modulation: DSSS 5.5

Measured Emission: **-31.07** dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

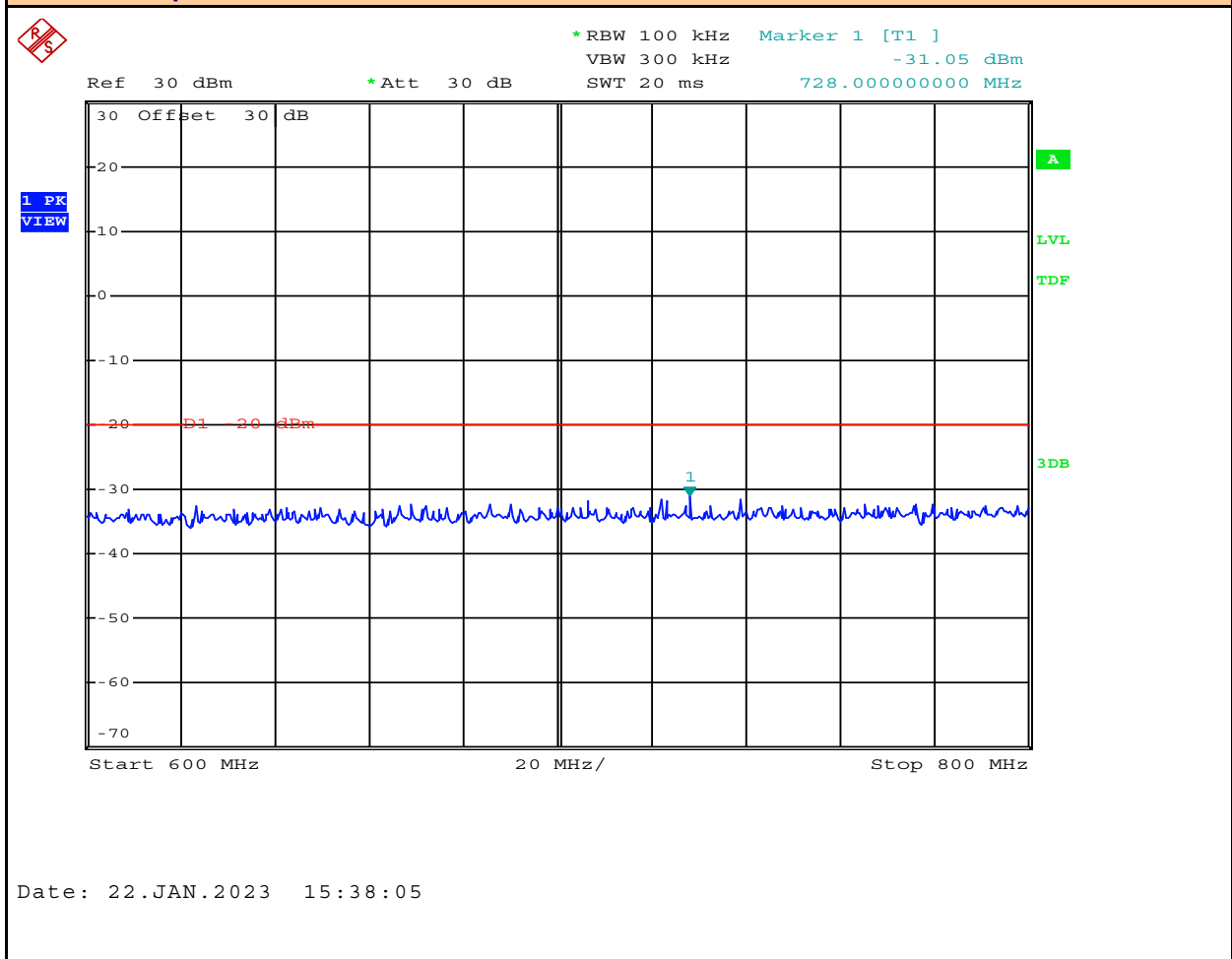
Emission Frequency: 500.8 MHz

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: -30.92 dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

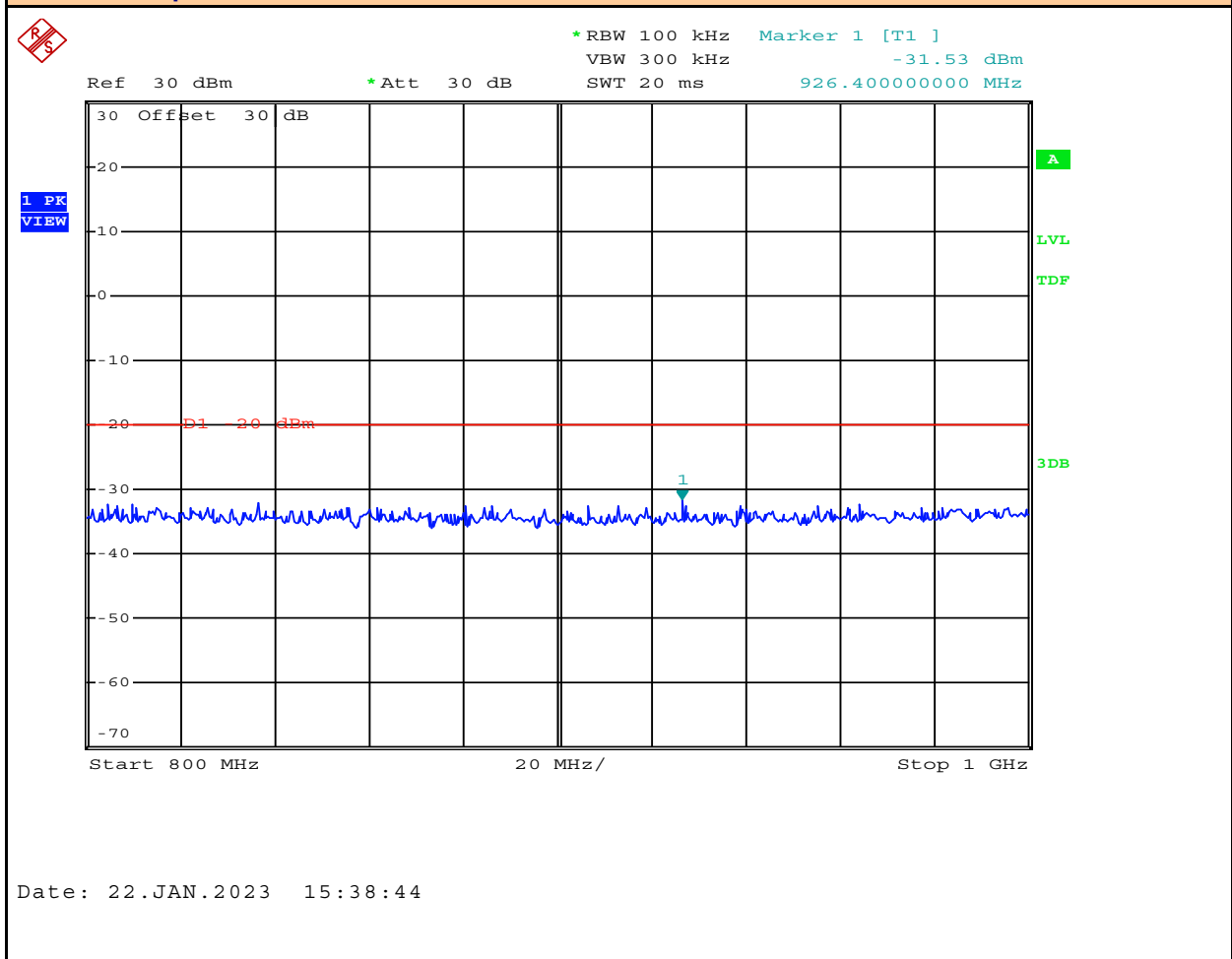
Emission Frequency: 728 MHz

Channel Frequency: 2437 MHz

Modulation: DSSS 5.5

Measured Emission: **-31.05** dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

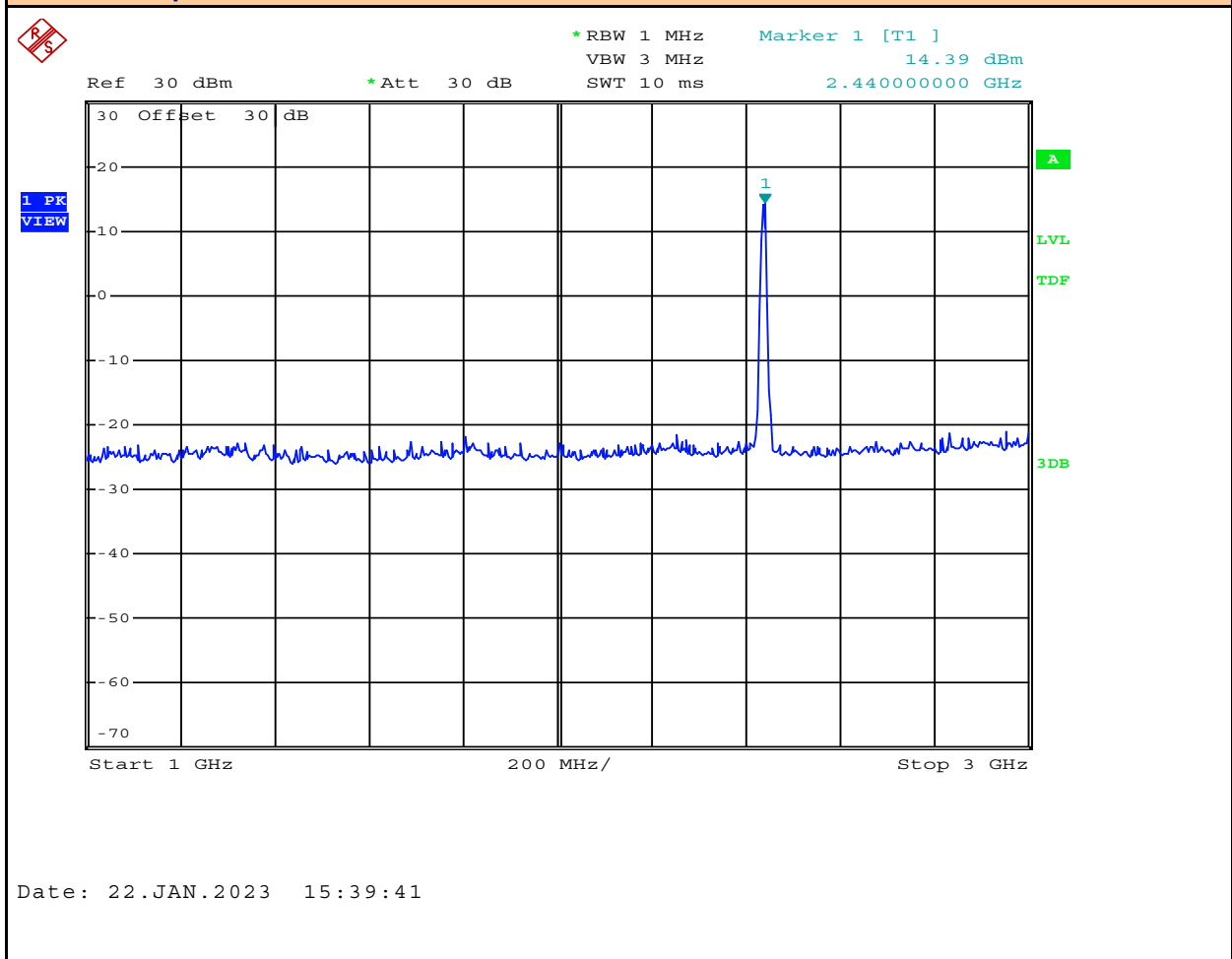
Emission Frequency: 926.4 MHz

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: **-31.53** dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

Emission Frequency: 2440 MHz

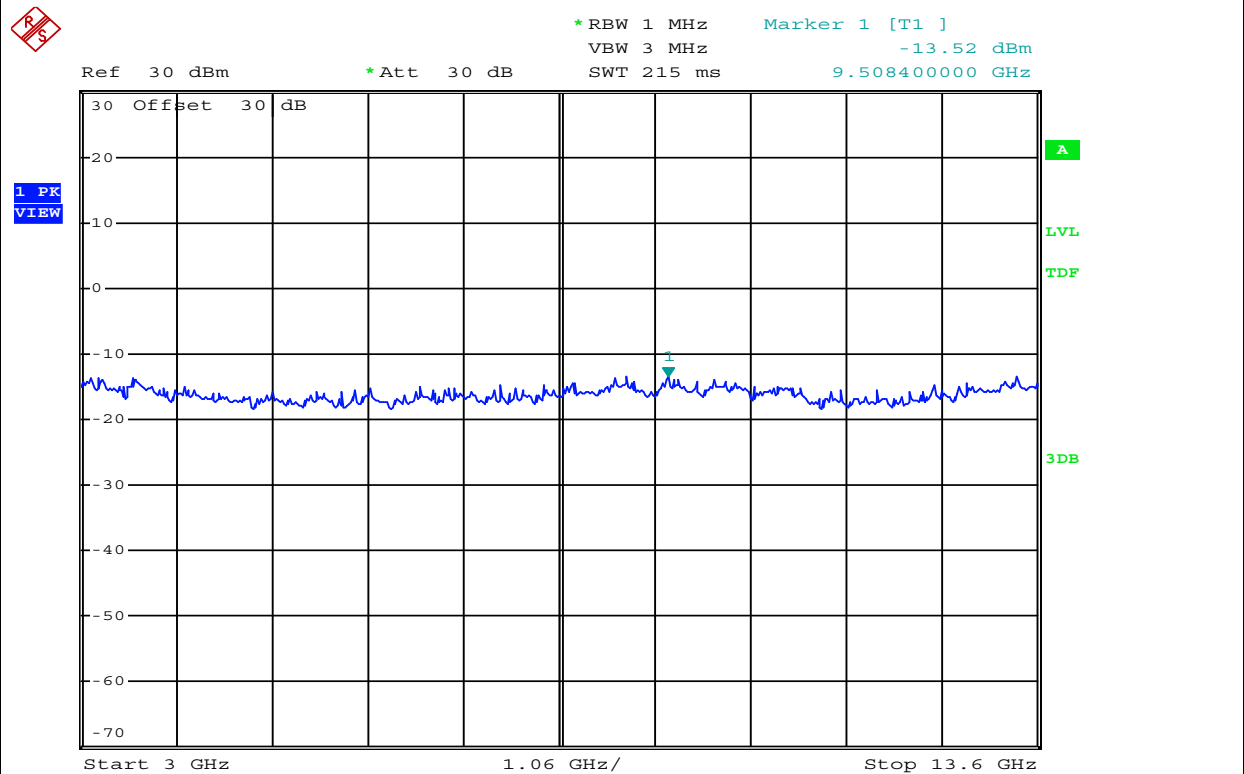
Marker 1 = Fundamental

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: 14.39 dBm

Conducted Spurious Emissions:



Date: 22.JAN.2023 15:40:22

Channel: 6

Mode: 802.11b

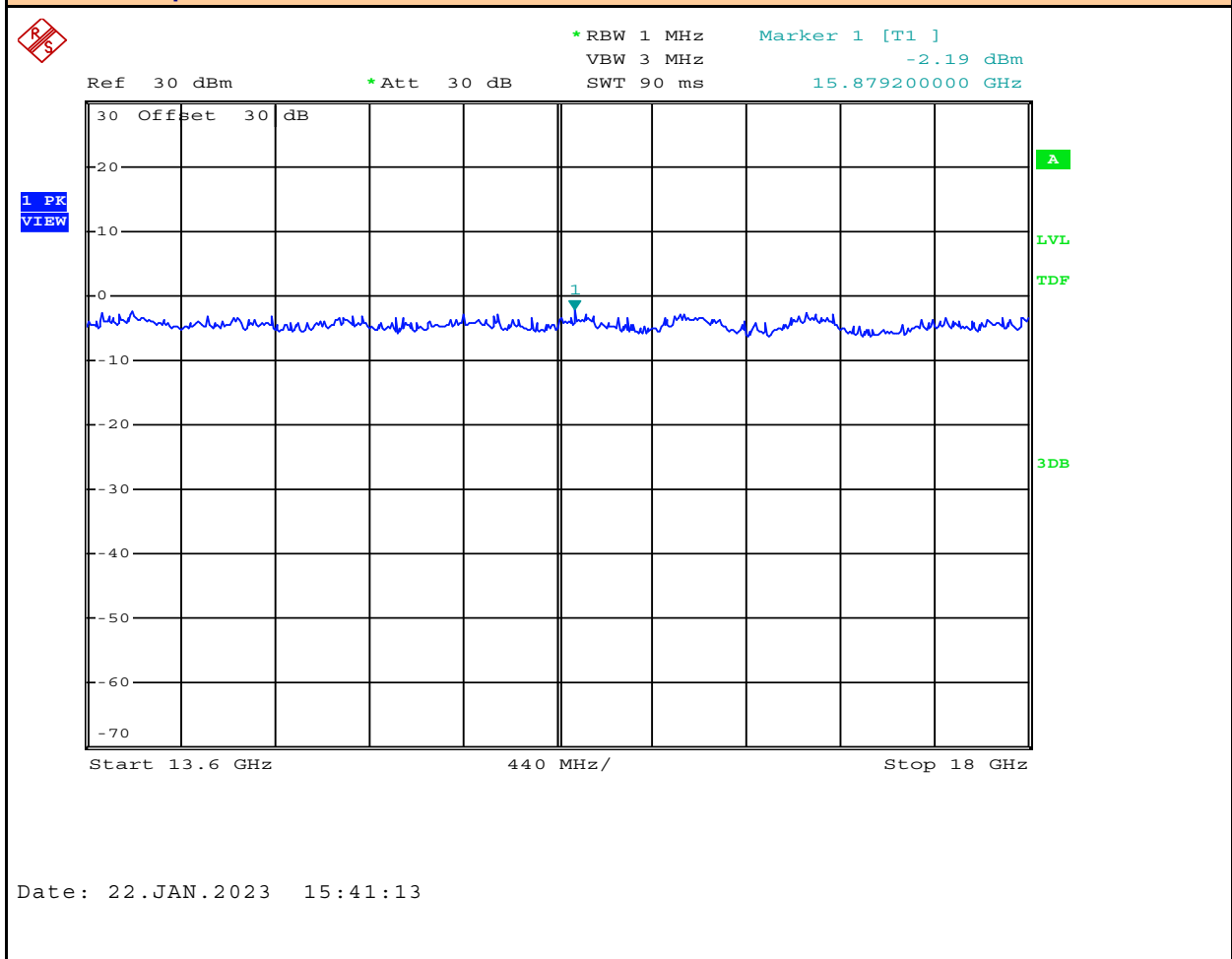
Emission Frequency: - MHz

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: ND dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

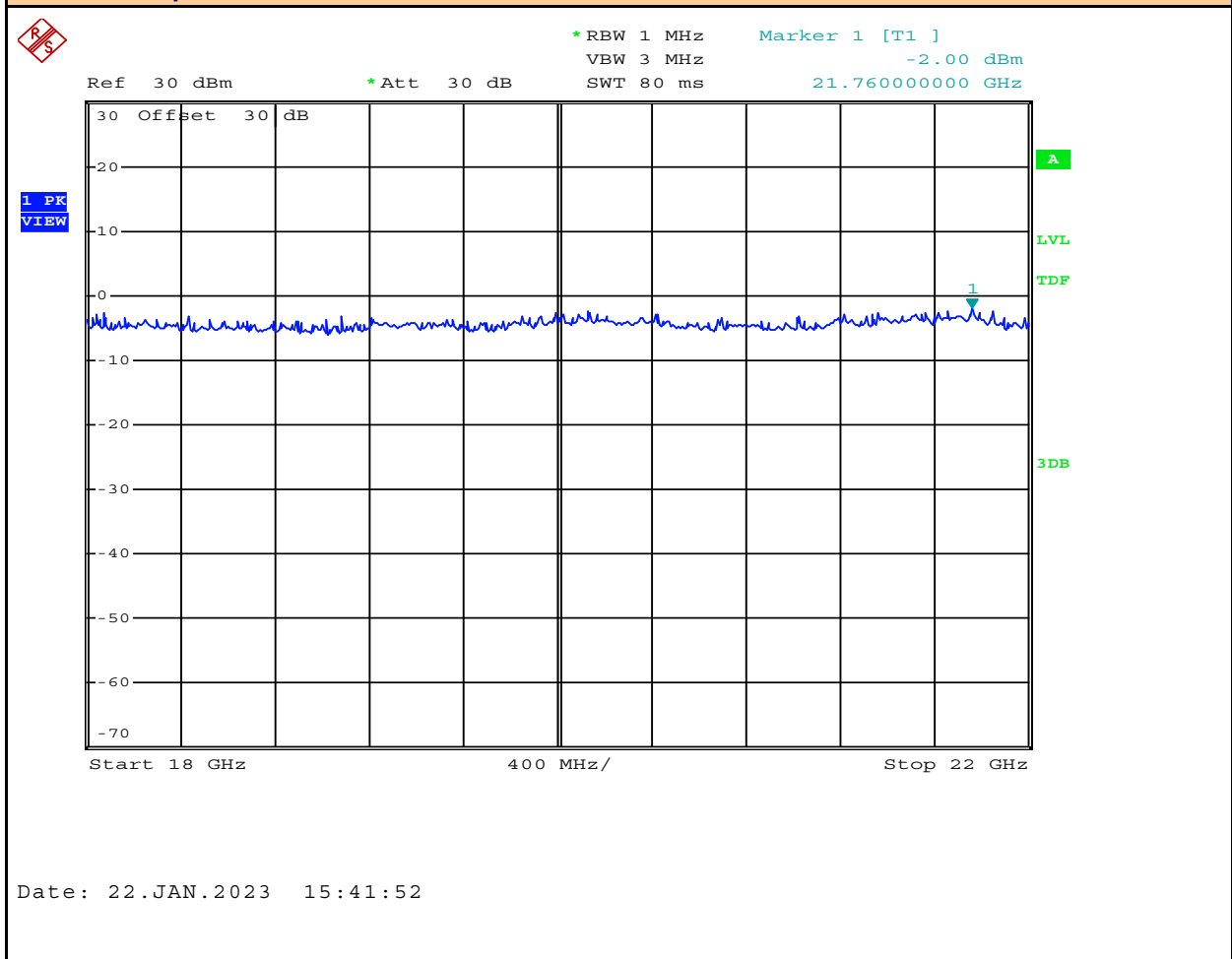
Emission Frequency: - MHz

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: ND dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

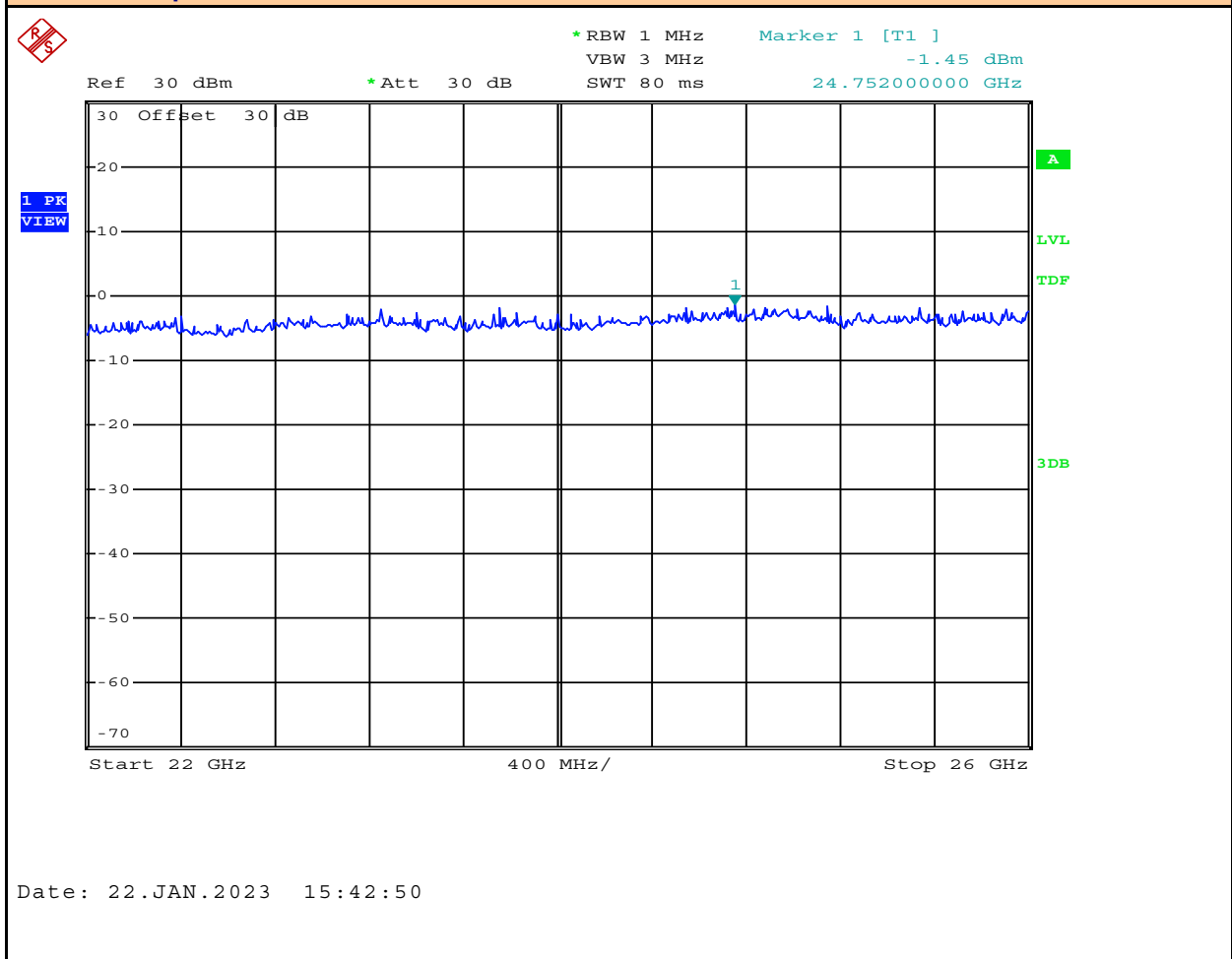
Emission Frequency: - MHz

Channel Frequency: 2437 MHz

Modulation: **DSSS 5.5**

Measured Emission: **ND** dBm

Conducted Spurious Emissions:



Channel: 6

Mode: 802.11b

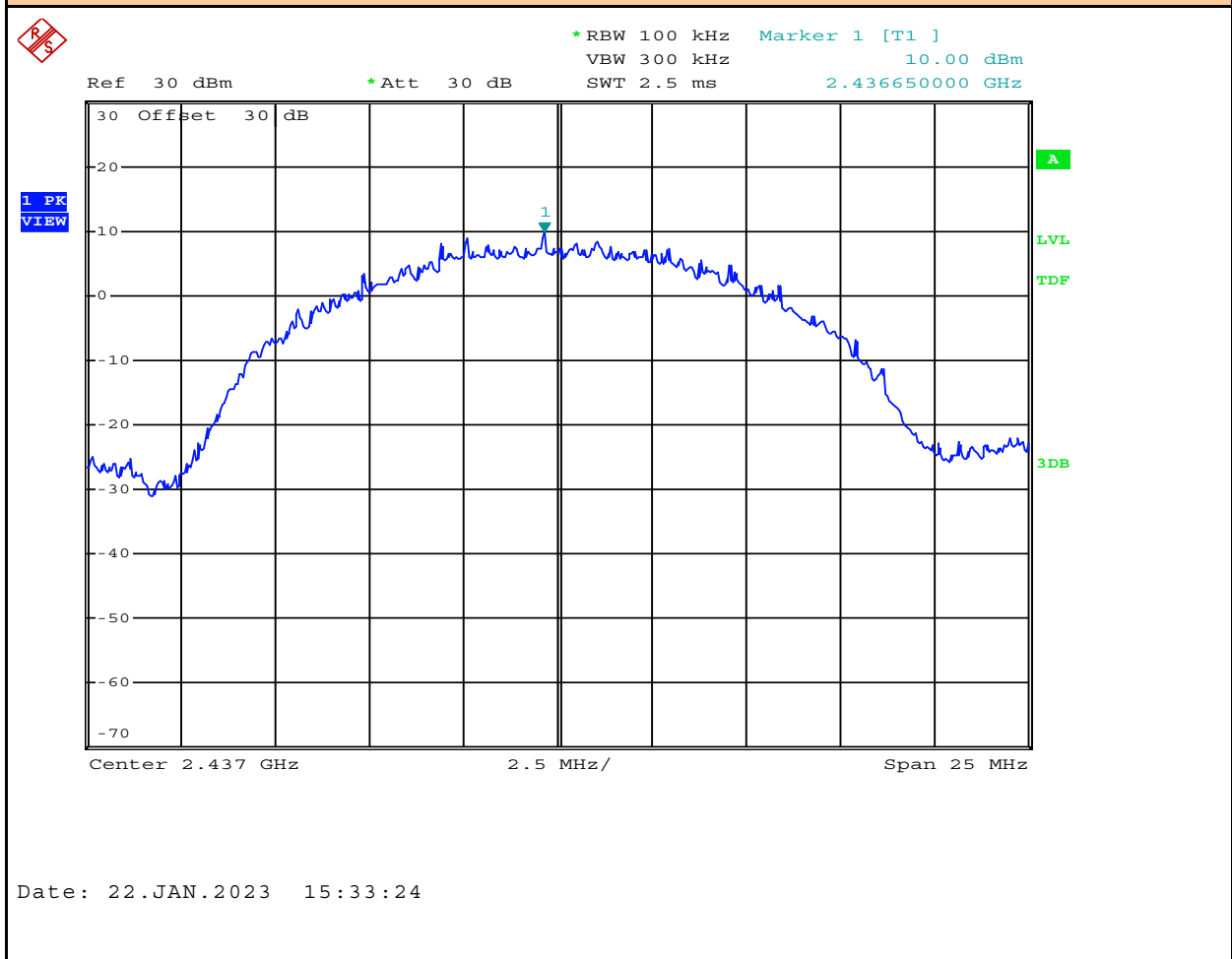
Emission Frequency: - MHz

Channel Frequency: 2437 MHz

Modulation: DSSS 5.5

Measured Emission: ND dBm

Reference Measurement



Channel: 6

Mode: 802.11b

Channel Frequency: 2437 MHz

Modulation:	DSSS 5.5
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Reference Measurement: 10 dBm

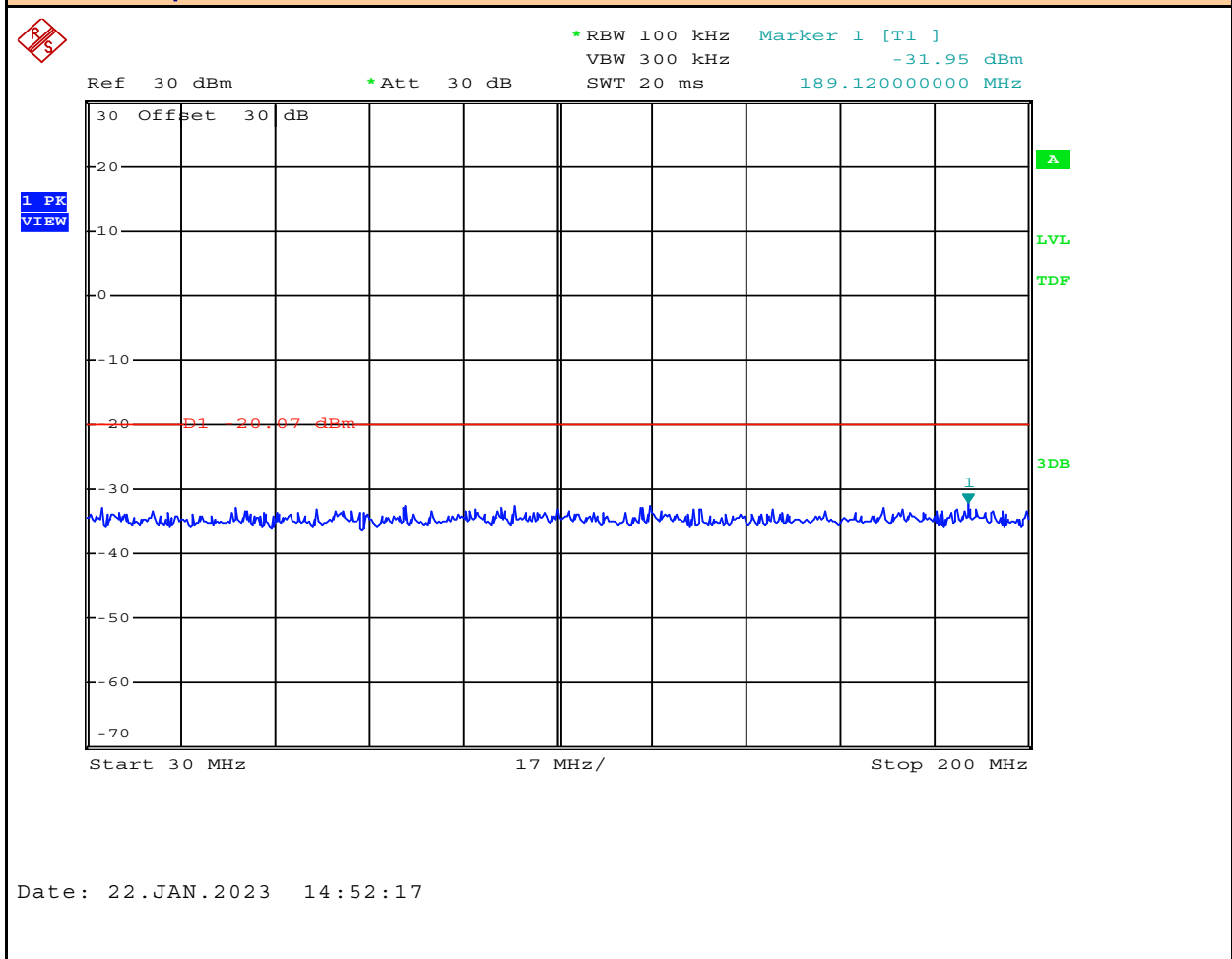
Conducted Spurious Emissions Measurement Results:									
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P _{Em}] (dBm)	Emission Frequency (MHz)	Reference Measurment [P _{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
BT BR	78	2480.00	GFSK	-31.95	189.12	9.93	41.88	30	11.9
				-31.89	394		41.82		11.8
				-31.99	467.2		41.92		11.9
				-31.63	754.4		41.56		11.6
				-31.90	996.8		41.83		11.8
Result:								Complies	

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]

Margin = Attenuation - Limit

ND = None Detected

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

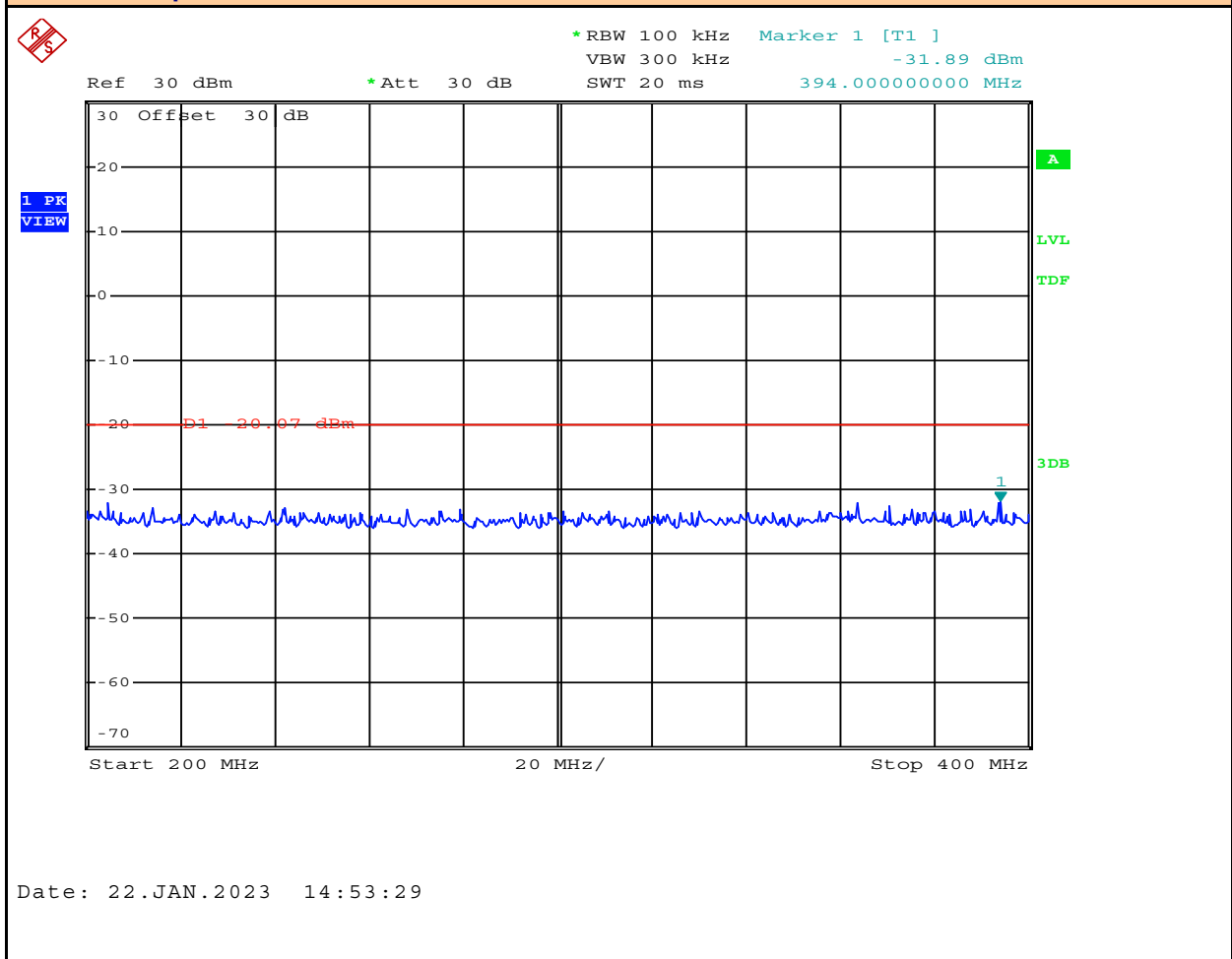
Emission Frequency: 189.12 MHz

Channel Frequency: 2480 MHz

Modulation: **GFSK**

Measured Emission: **-31.95** dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

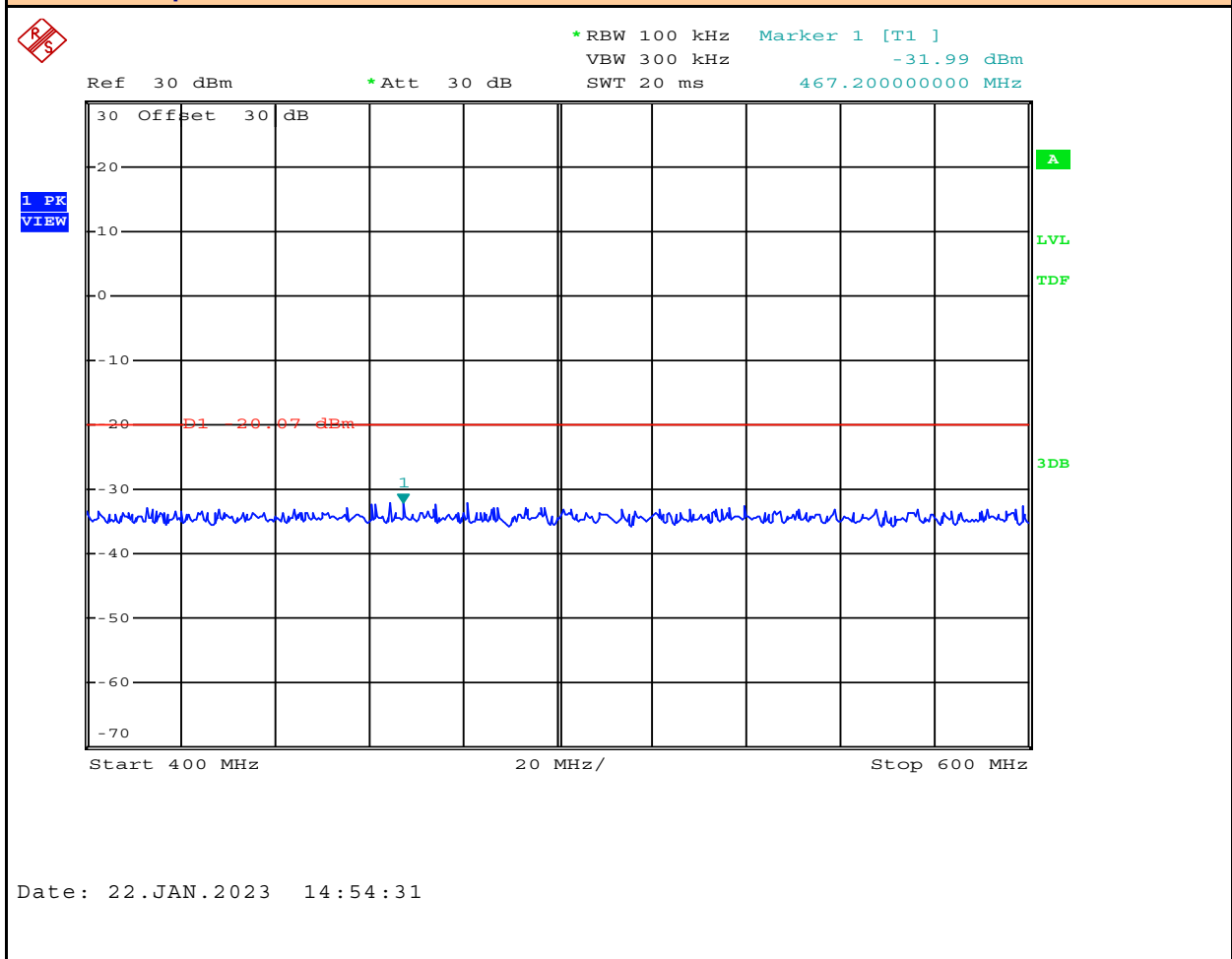
Emission Frequency: 394 MHz

Channel Frequency: 2480 MHz

Modulation: **GFSK**

Measured Emission: **-31.89** dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

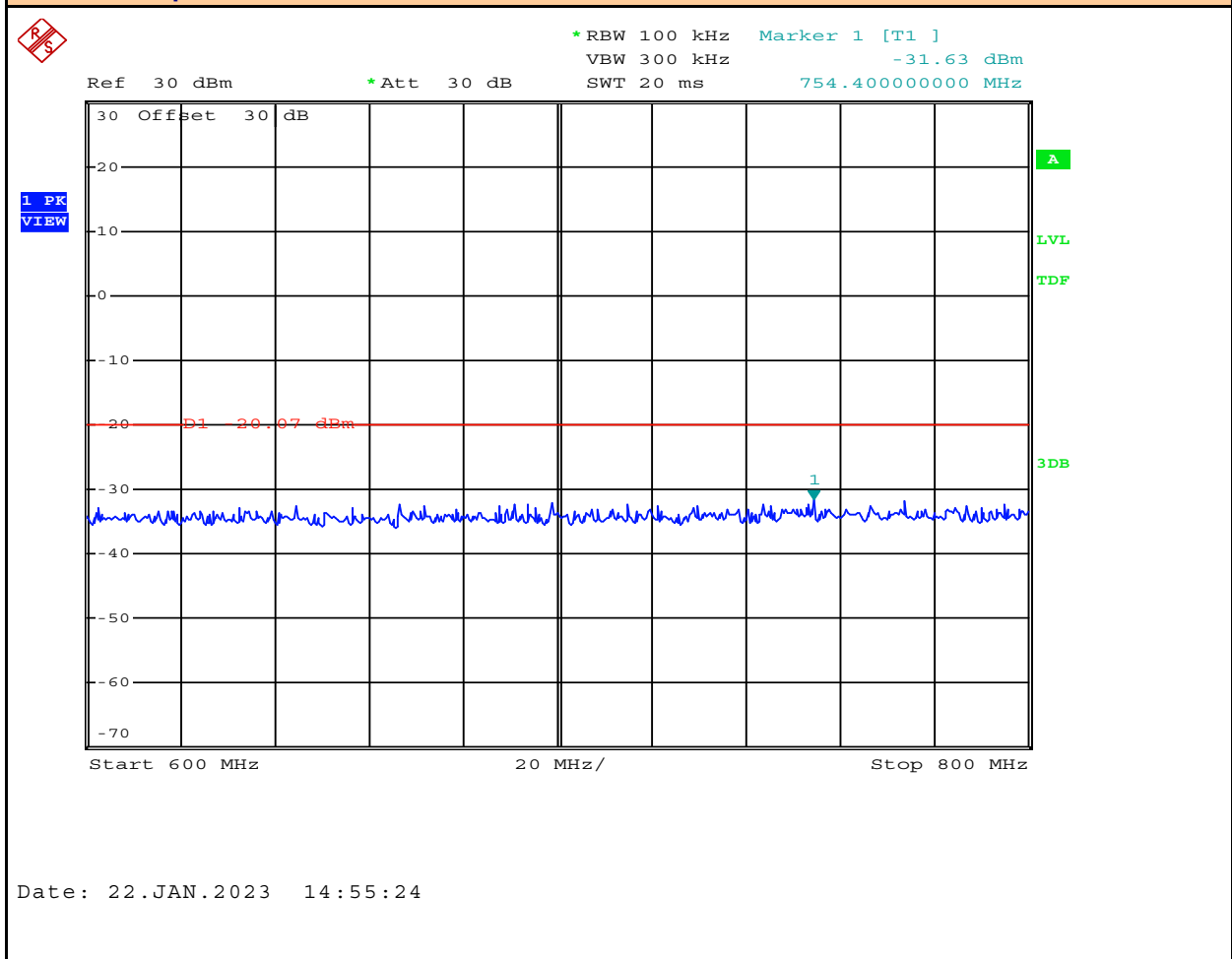
Emission Frequency: 467.2 MHz

Channel Frequency: 2480 MHz

Modulation: **GFSK**

Measured Emission: **-31.99** dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

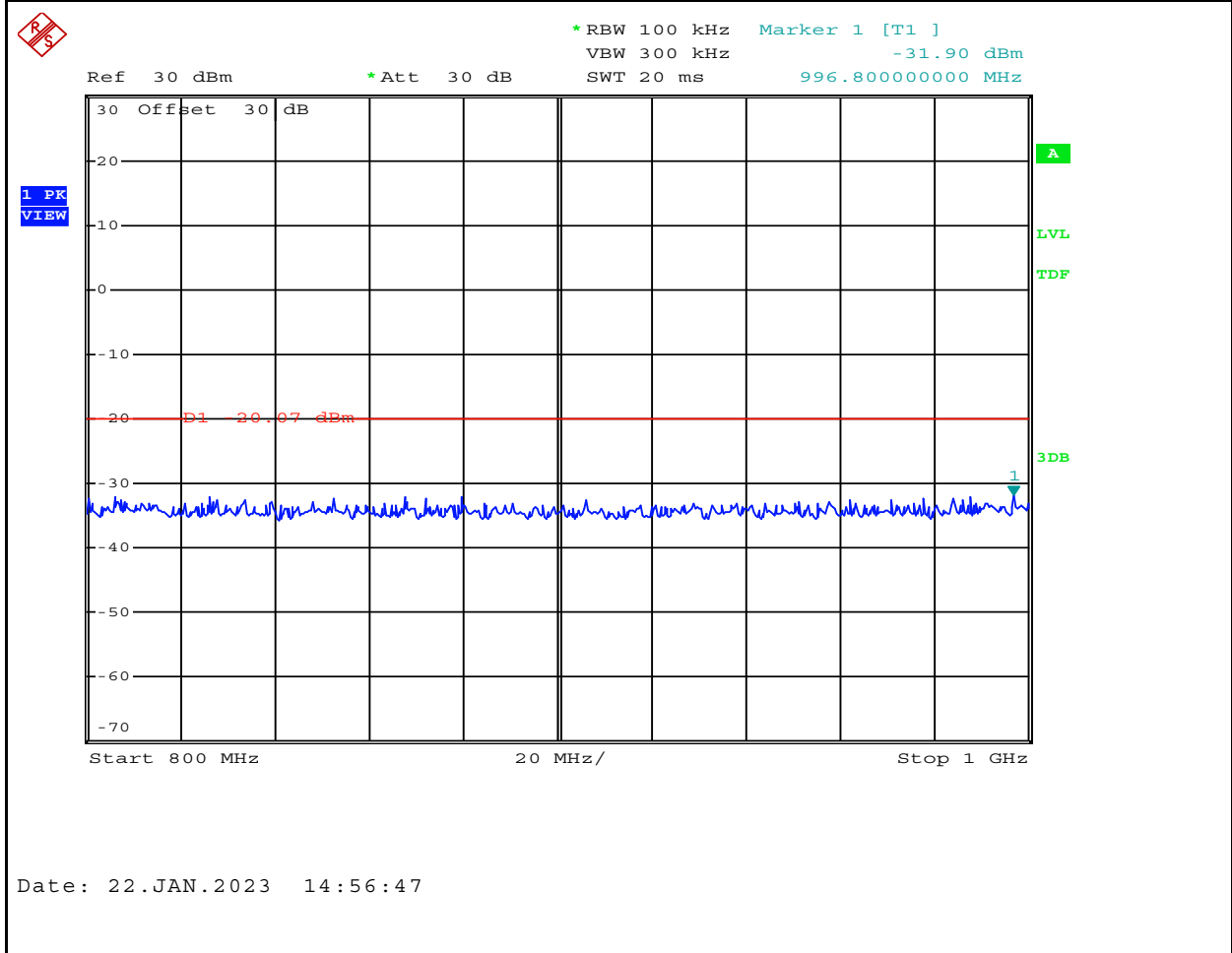
Emission Frequency: 754.4 MHz

Channel Frequency: 2480 MHz

Modulation: **GFSK**

Measured Emission: **-31.63** dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

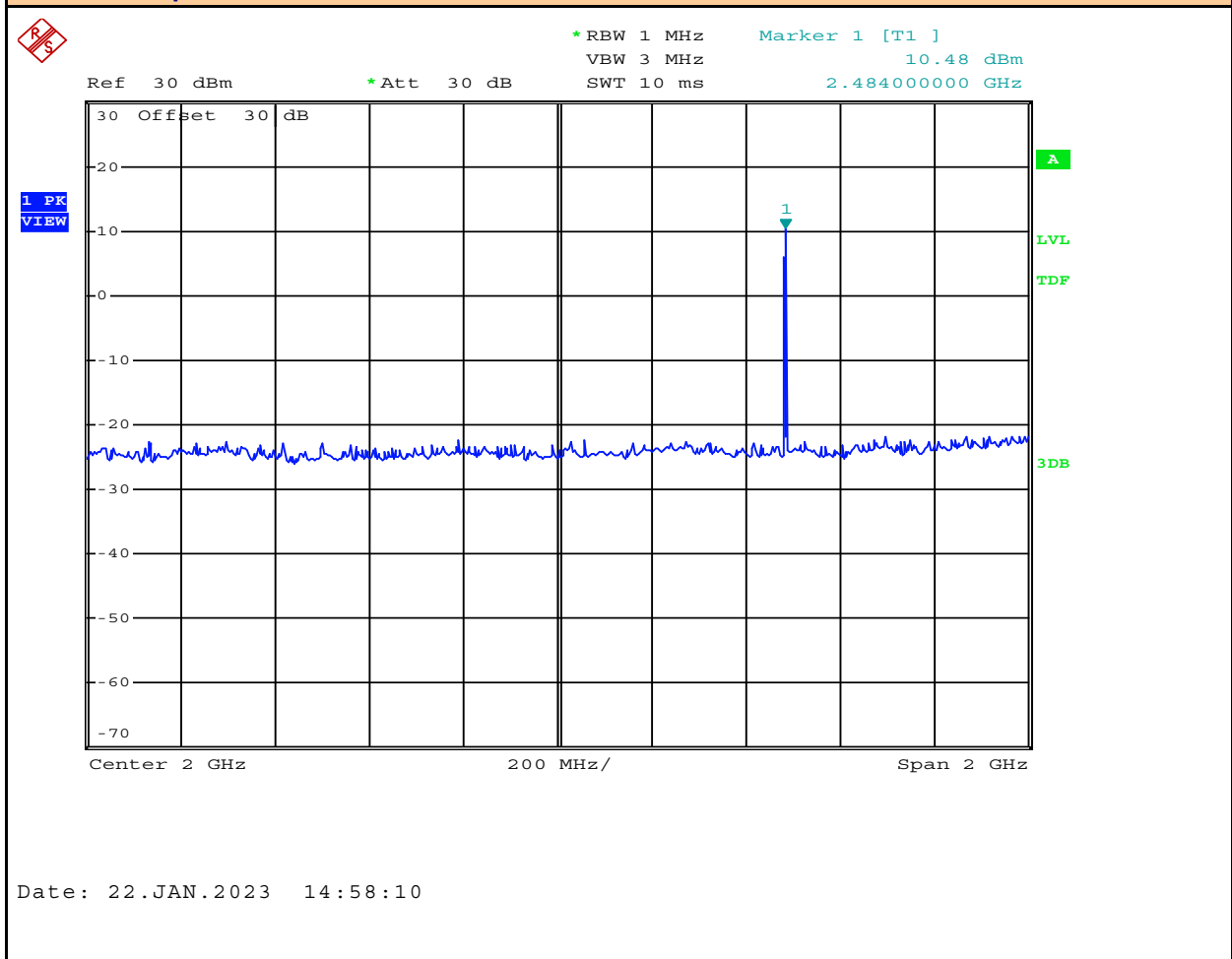
Emission Frequency: 996.8 MHz

Channel Frequency: 2480 MHz

Modulation: **GFSK**

Measured Emission: **-31.9** dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

Emission Frequency: 2484 MHz

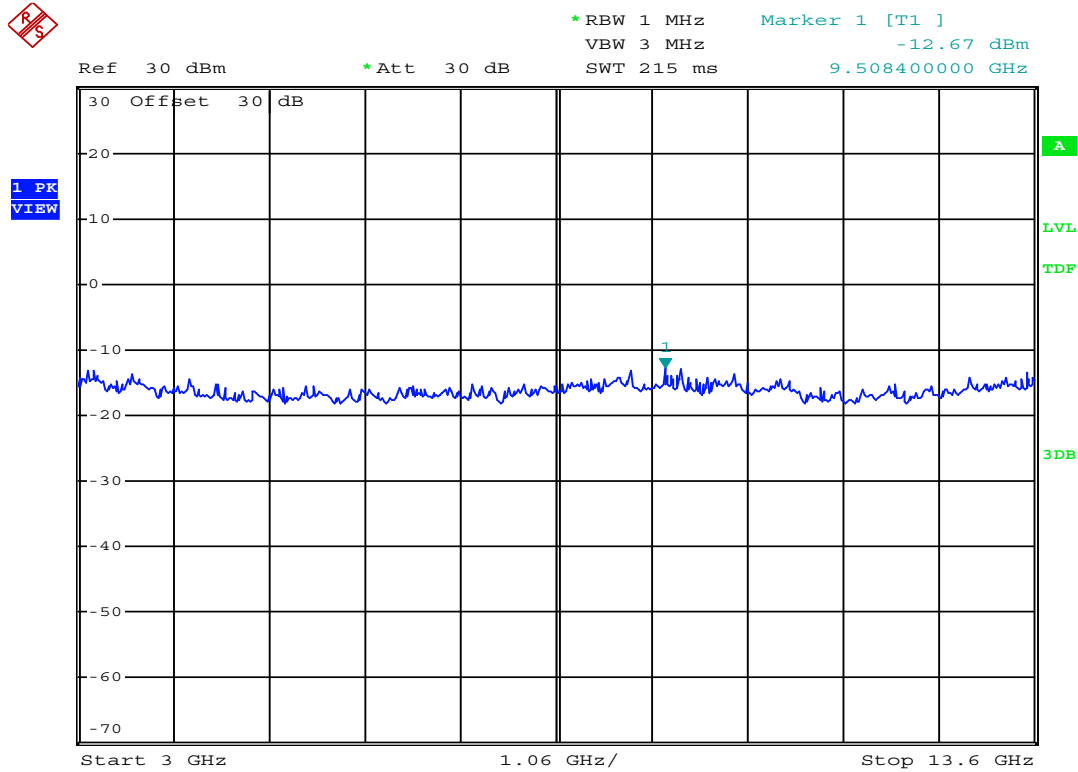
Marker 1 = Fundamental

Channel Frequency: 2480 MHz

Modulation: **GFSK**

Measured Emission: 10.48 dBm

Conducted Spurious Emissions:



Date: 22.JAN.2023 14:59:24

Channel: 78

Mode:	BT BR
-------	-------

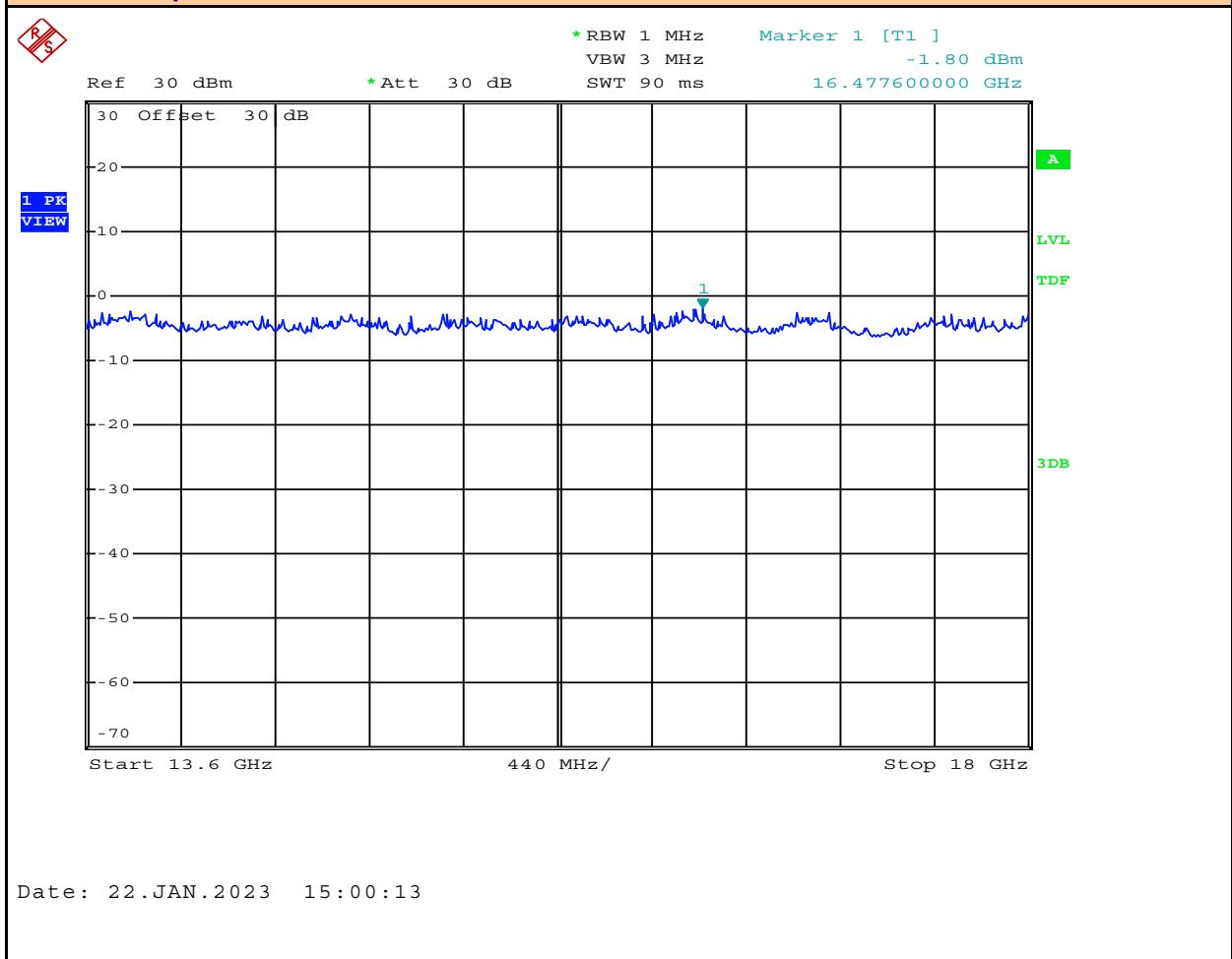
Emission Frequency: - MHz

Channel Frequency: **2480** MHz

Modulation:	GFSK
-------------	------

Measured Emission: **ND** dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

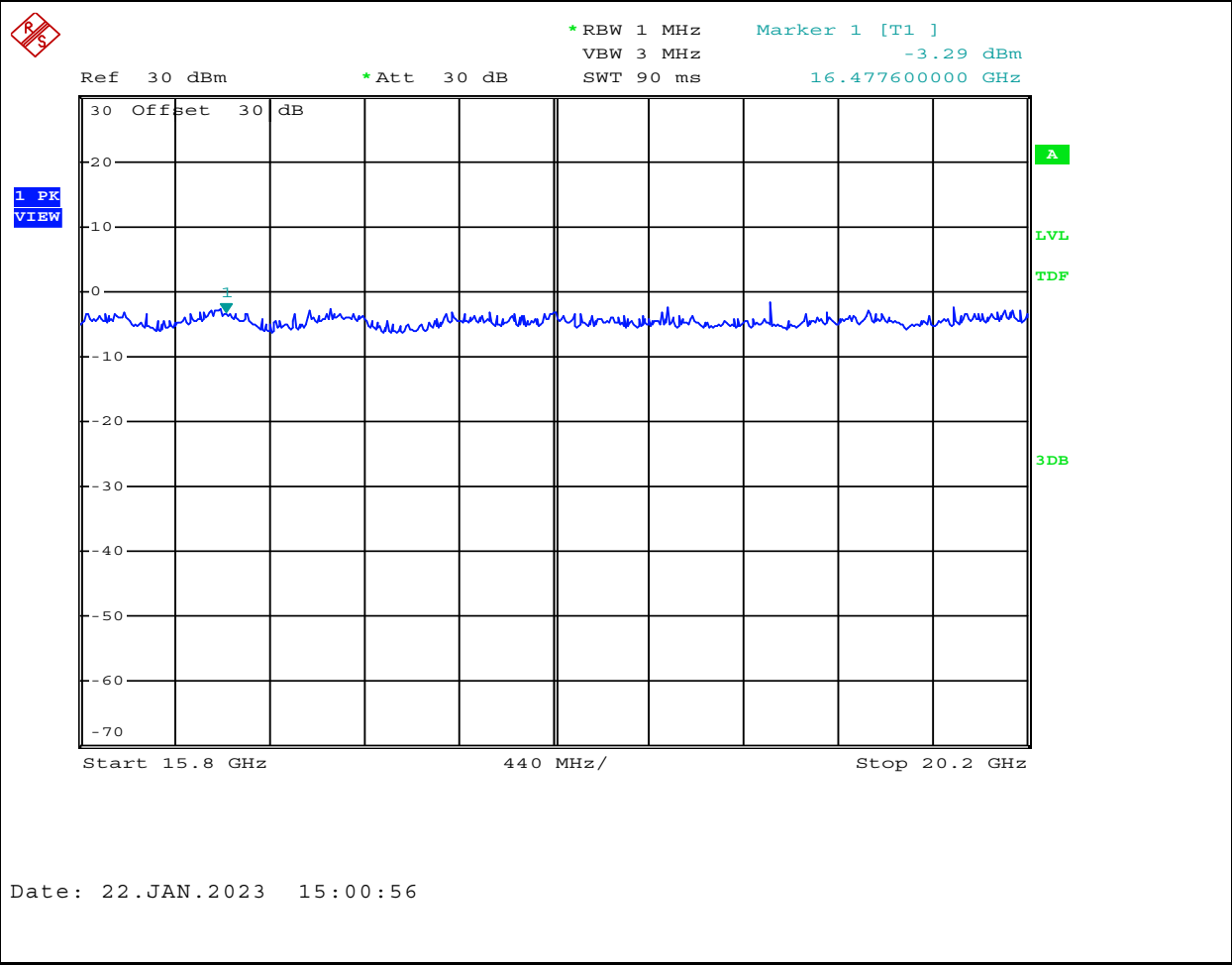
Emission Frequency: - MHz

Channel Frequency: 2480 MHz

Modulation: GFSK

Measured Emission: ND dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

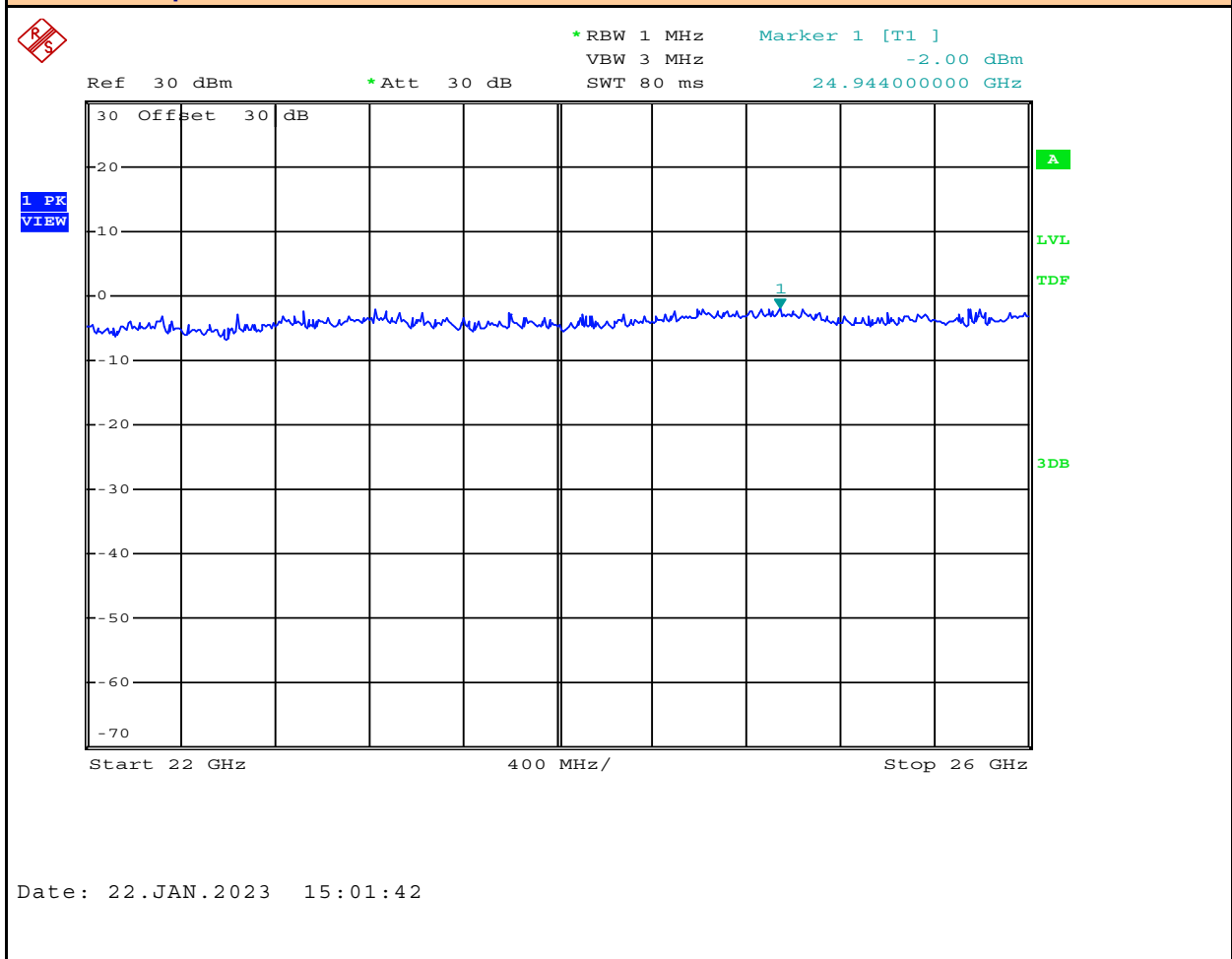
Emission Frequency: - MHz

Channel Frequency: 2480 MHz

Modulation: GFSK

Measured Emission: ND dBm

Conducted Spurious Emissions:



Channel: 78

Mode: BT BR

Emission Frequency: - MHz

Channel Frequency: 2480 MHz

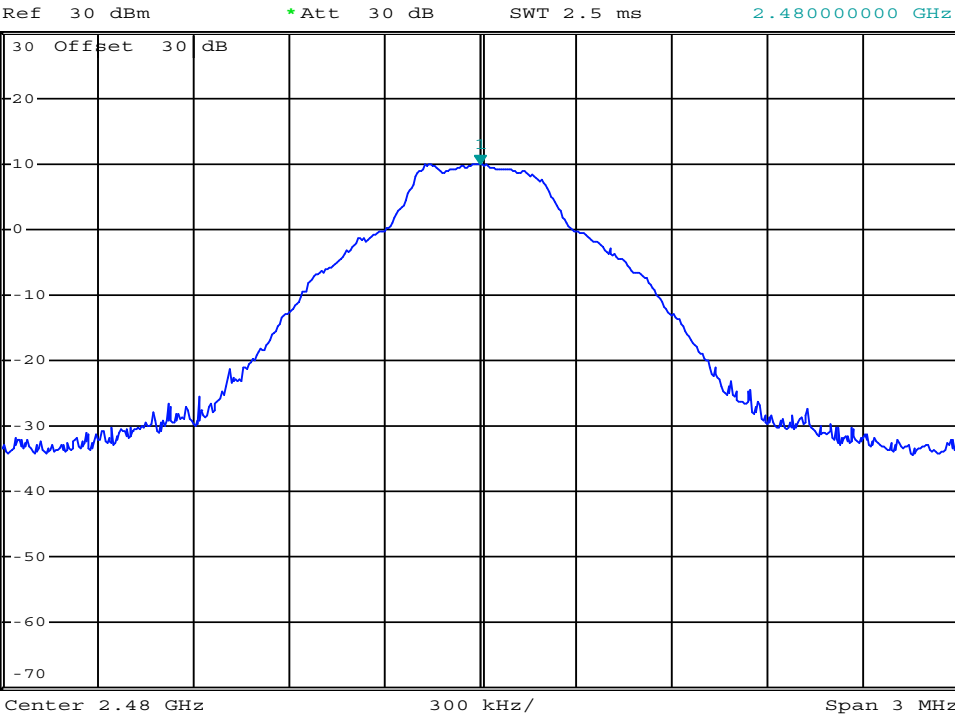
Modulation: **GFSK**

Measured Emission: ND dBm

Reference Measurement



*RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 9.93 dBm
SWT 2.5 ms 2.480000000 GHz



Date: 22.JAN.2023 14:50:21

Channel: 78
Mode: BT BR

Channel Frequency: 2480 MHz
Modulation: GFSK
Reference Measurement: 9.93 dBm

Summary of Radiated Tx Emissions

Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency (MHz)	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	2412.0	Horizontal	42.15	7.79	17.31	0.73	0.00 (3)	25.8 (2)	40.0	14.2
30-1000MHz	2412.0	Horizontal	51.33	7.71	12.47	0.77	0.00 (3)	21.0 (2)	40.0	19.0
30-1000MHz	2412.0	Horizontal	827.80	8.64	29.22	2.82	0.00 (3)	40.7 (2)	46.0	5.3
30-1000MHz	2412.0	Vertical	908.30	8.26	29.50	2.94	0.00 (3)	40.7 (2)	46.0	5.3
30-1000MHz	2412.0	Vertical	911.10	8.10	29.41	2.95	0.00 (3)	40.5 (2)	46.0	5.6
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	2412.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	2412.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	2412.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	2412.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	2412.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	2412.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

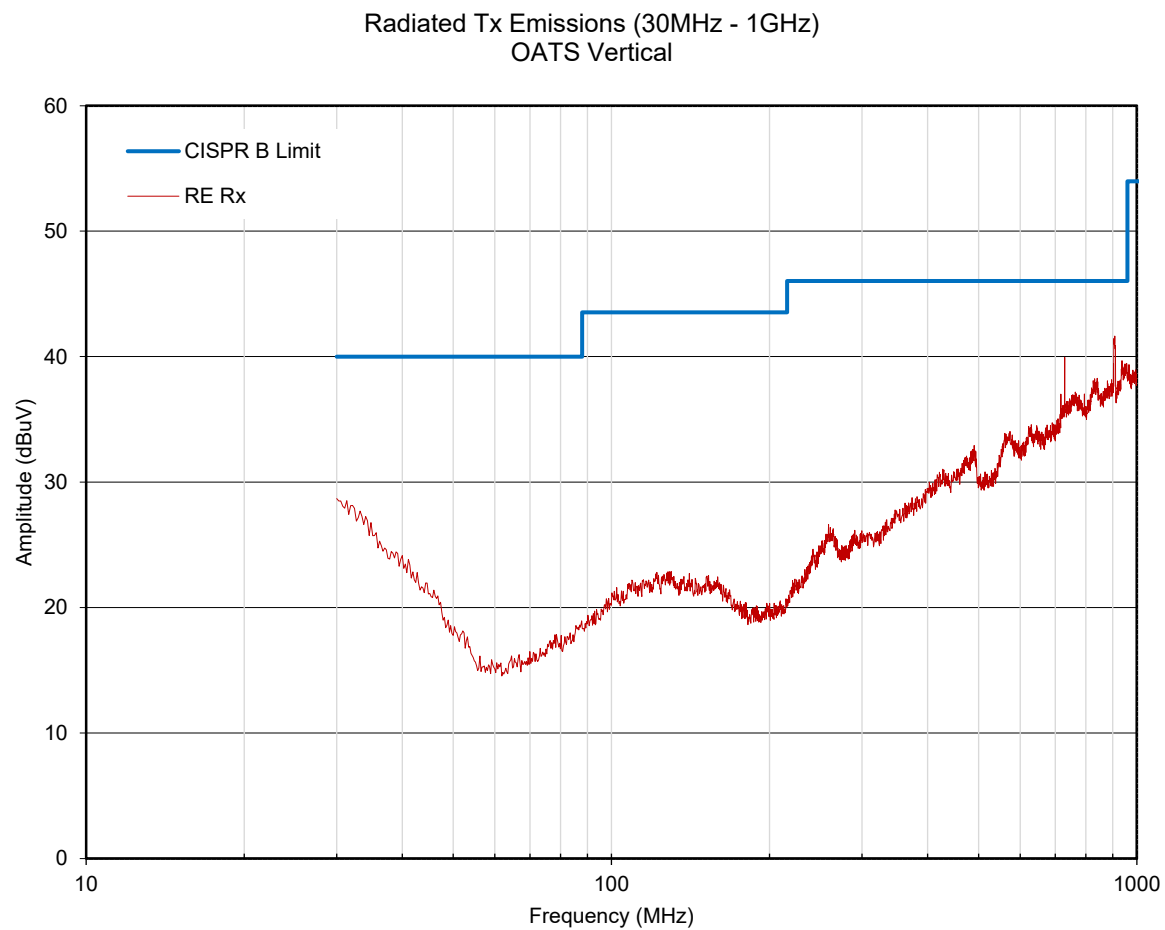
(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

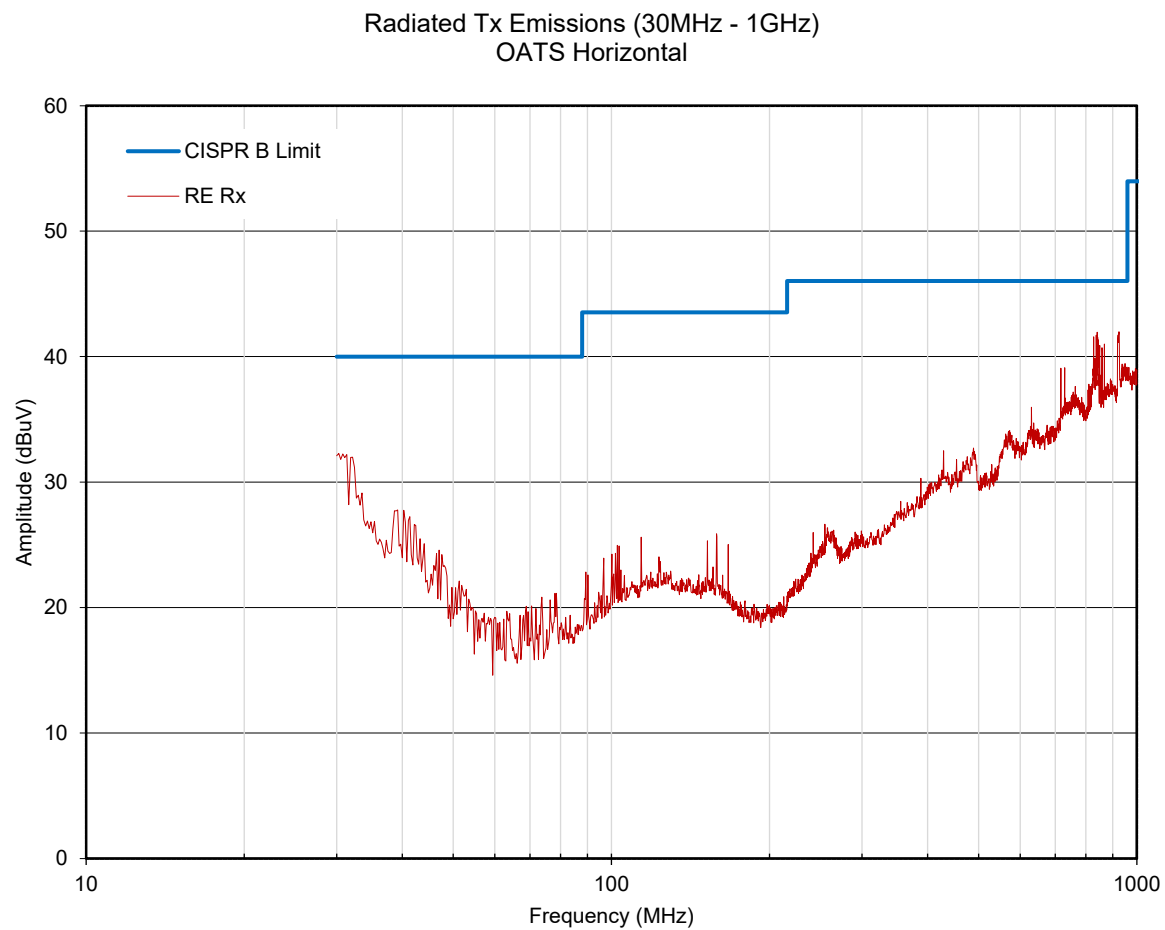
(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

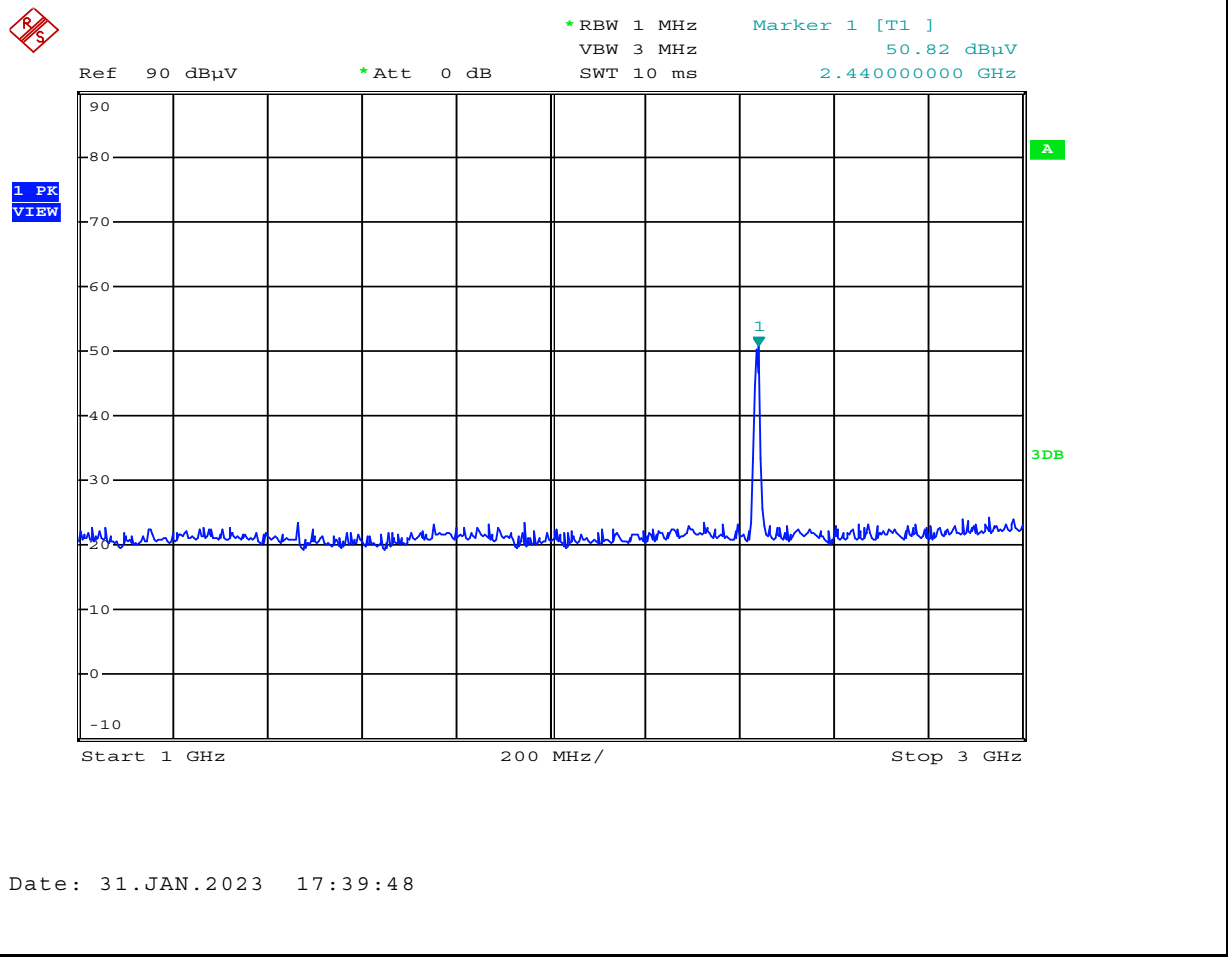
Radiated Tx Emissions:



Radiated Tx Emissions:



Radiated Tx Emissions:



Channel: 6

Mode: 802.11b

Polarization: Horizontal

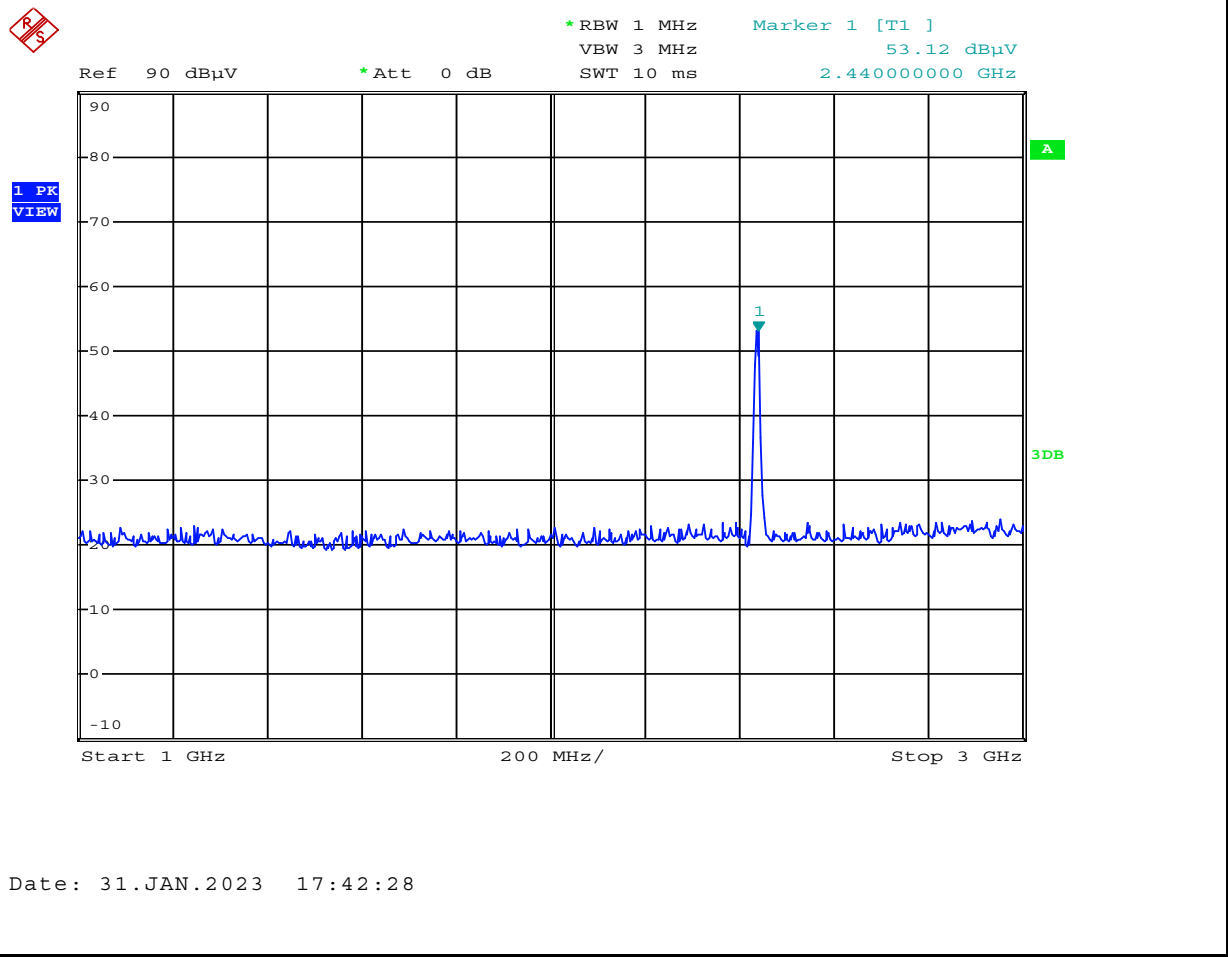
Marker 1 = Fundamental

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 6

Mode: 802.11b

Polarization: Vertical

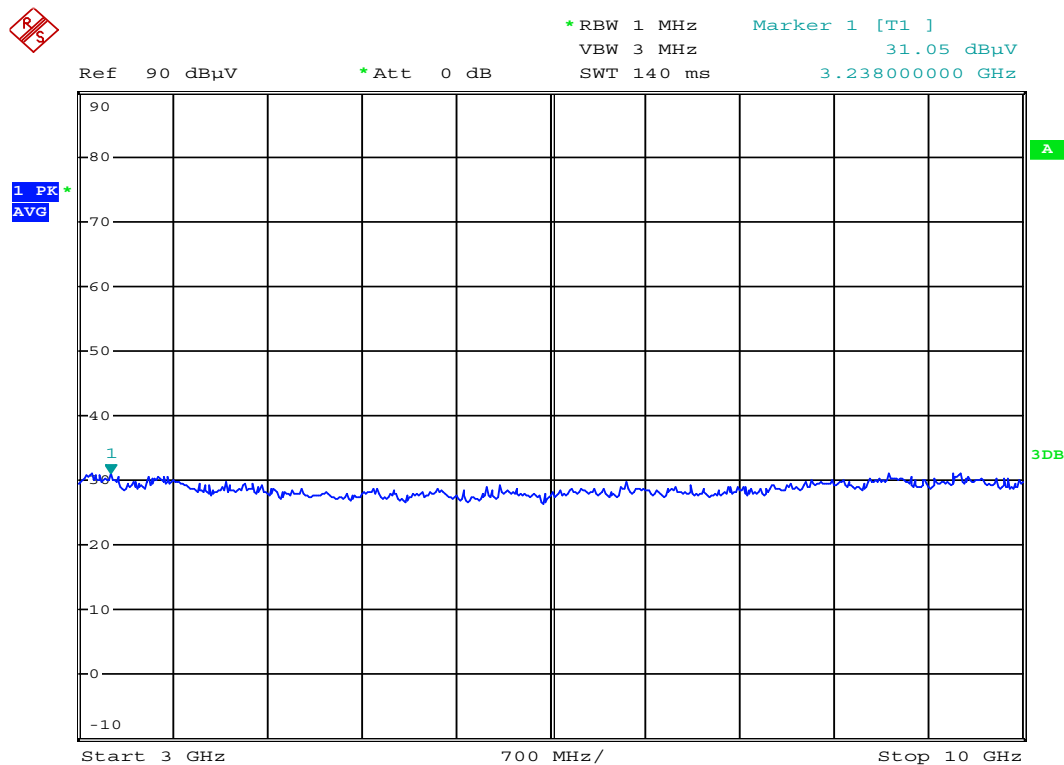
Marker 1 = Fundamental

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: ND dBm

Radiated Tx Emissions:



Date: 31.JAN.2023 17:40:39

Channel: 6

Mode: 802.11b

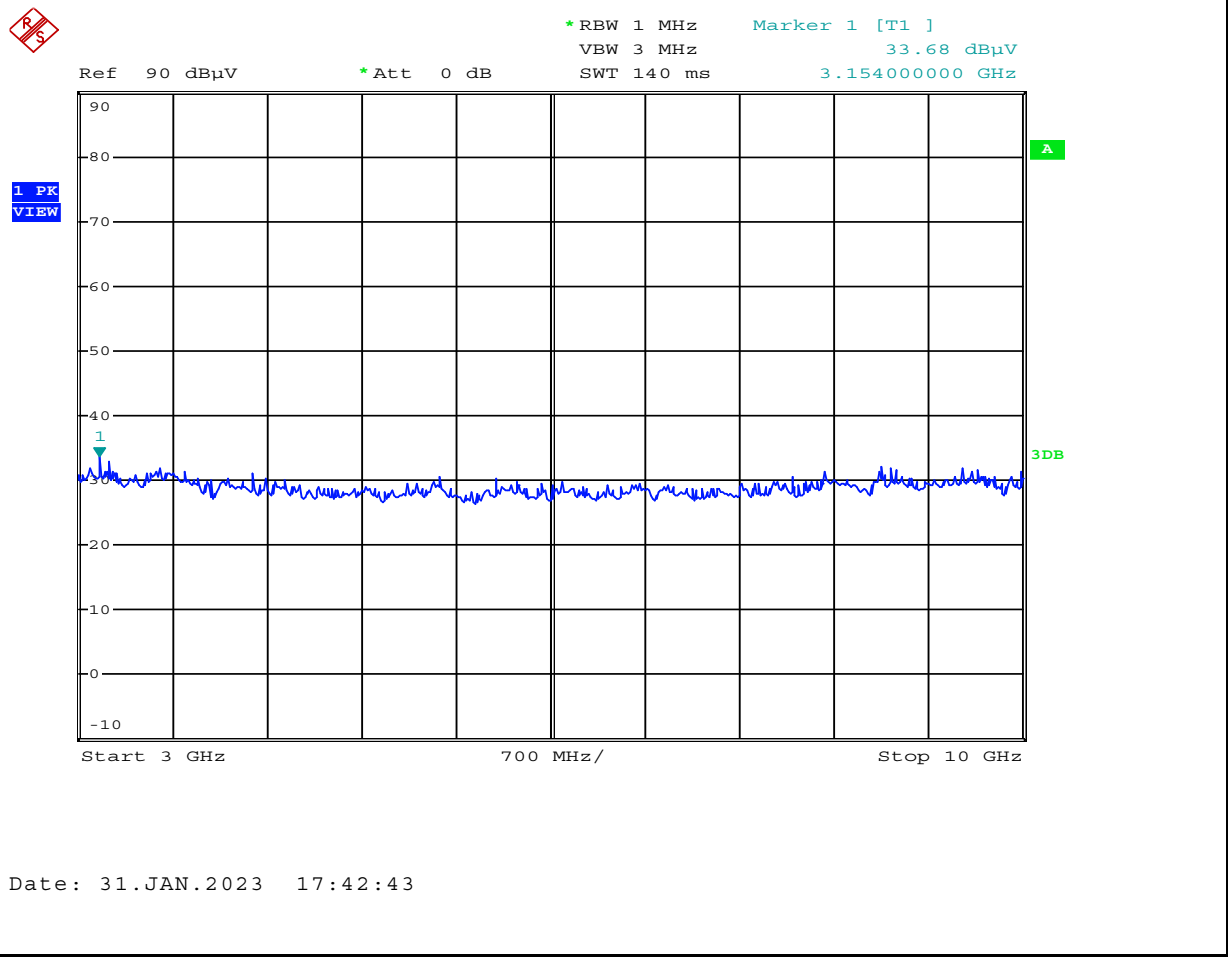
Polarization: Horizontal

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: ND dBm

Radiated Tx Emissions:



Date: 31.JAN.2023 17:42:43

Channel: 6

Mode: 802.11b

Polarization:

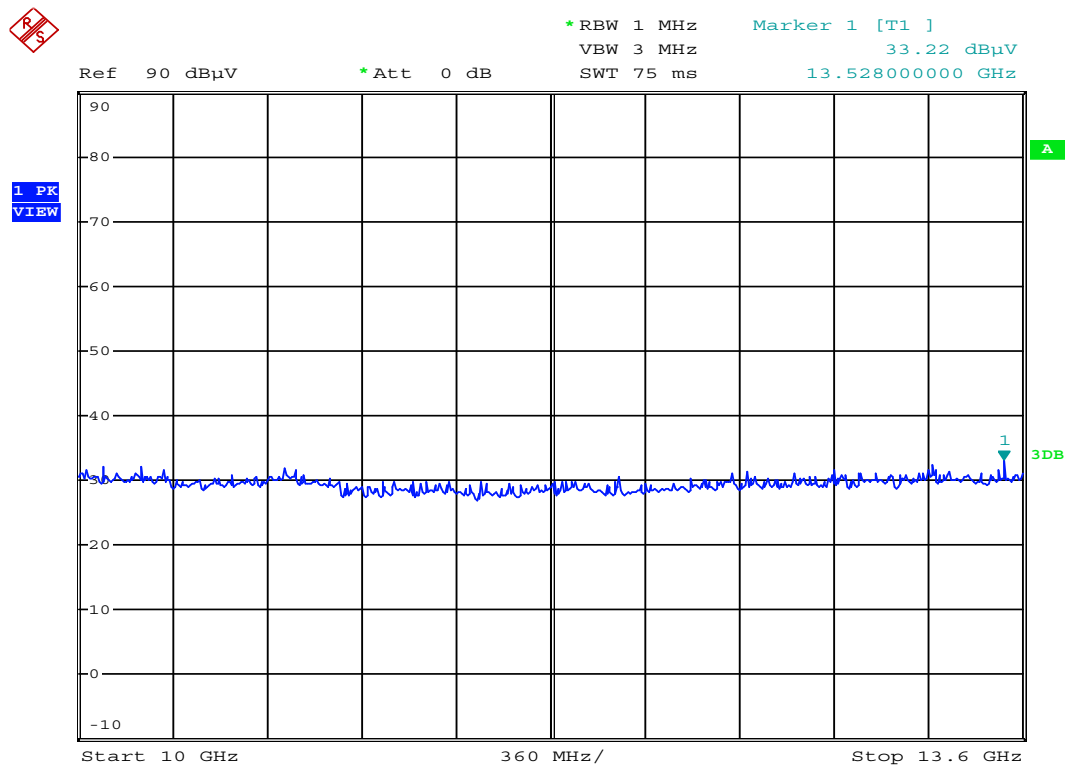
Vertical

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: **ND** dBm

Radiated Tx Emissions:



Date: 31.JAN.2023 17:40:54

Channel:

Mode:

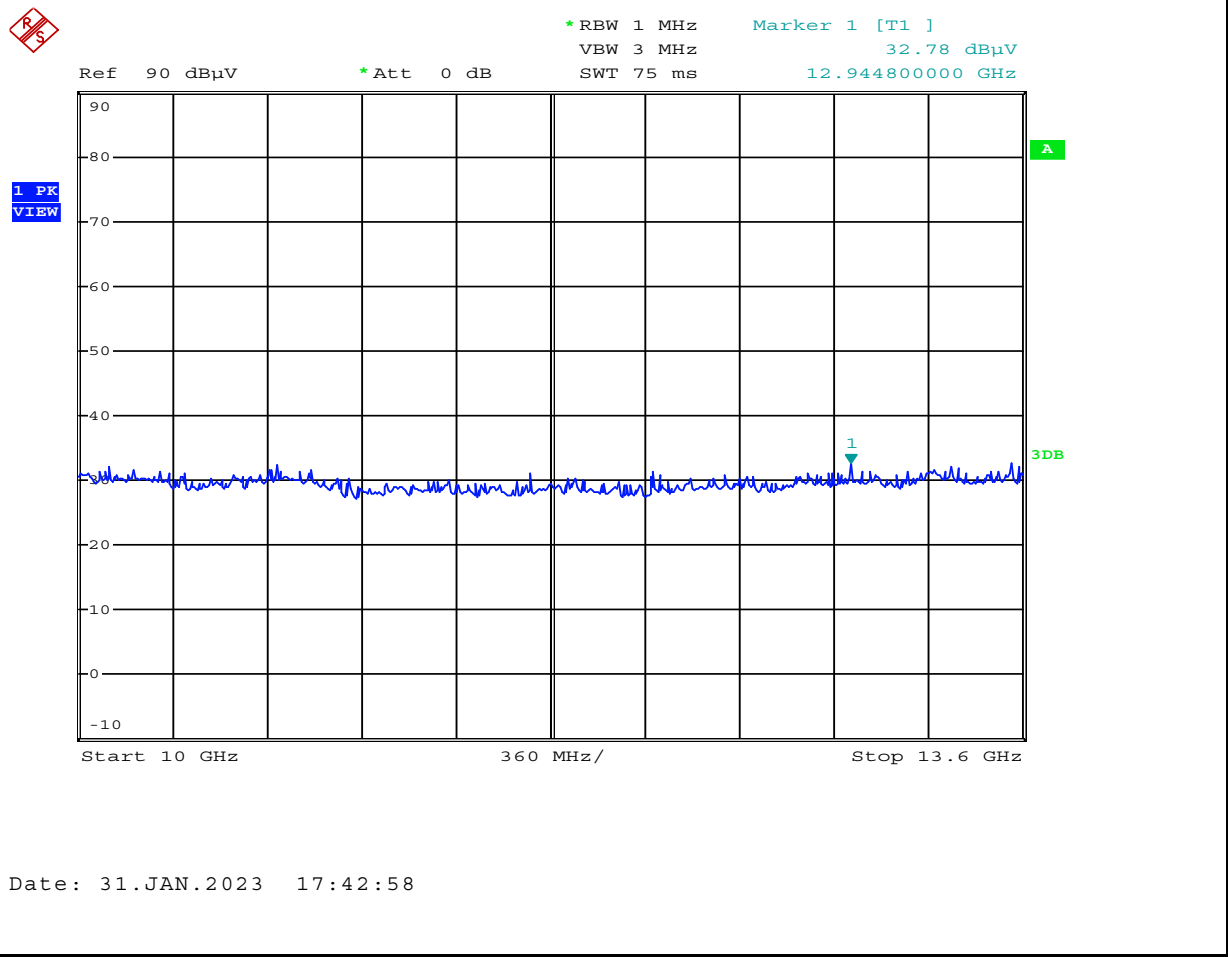
Polarization:

Channel Frequency: MHz

Modulation:

Measured Emission: dBm

Radiated Tx Emissions:



Date: 31.JAN.2023 17:42:58

Channel: 6

Mode: 802.11b

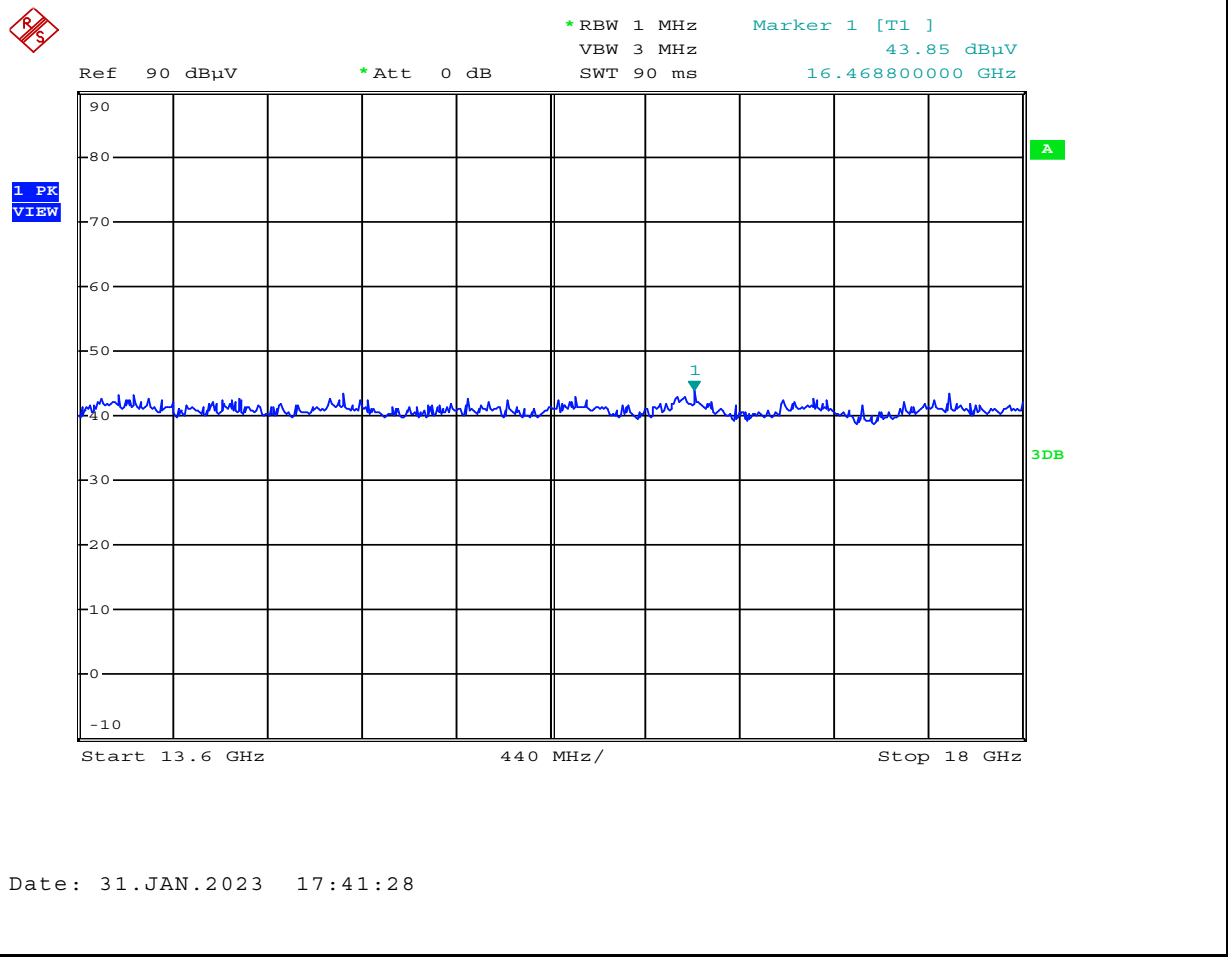
Polarization: Vertical

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: **ND** dBm

Radiated Tx Emissions:



Date: 31.JAN.2023 17:41:28

Channel: 6

Mode: 802.11b

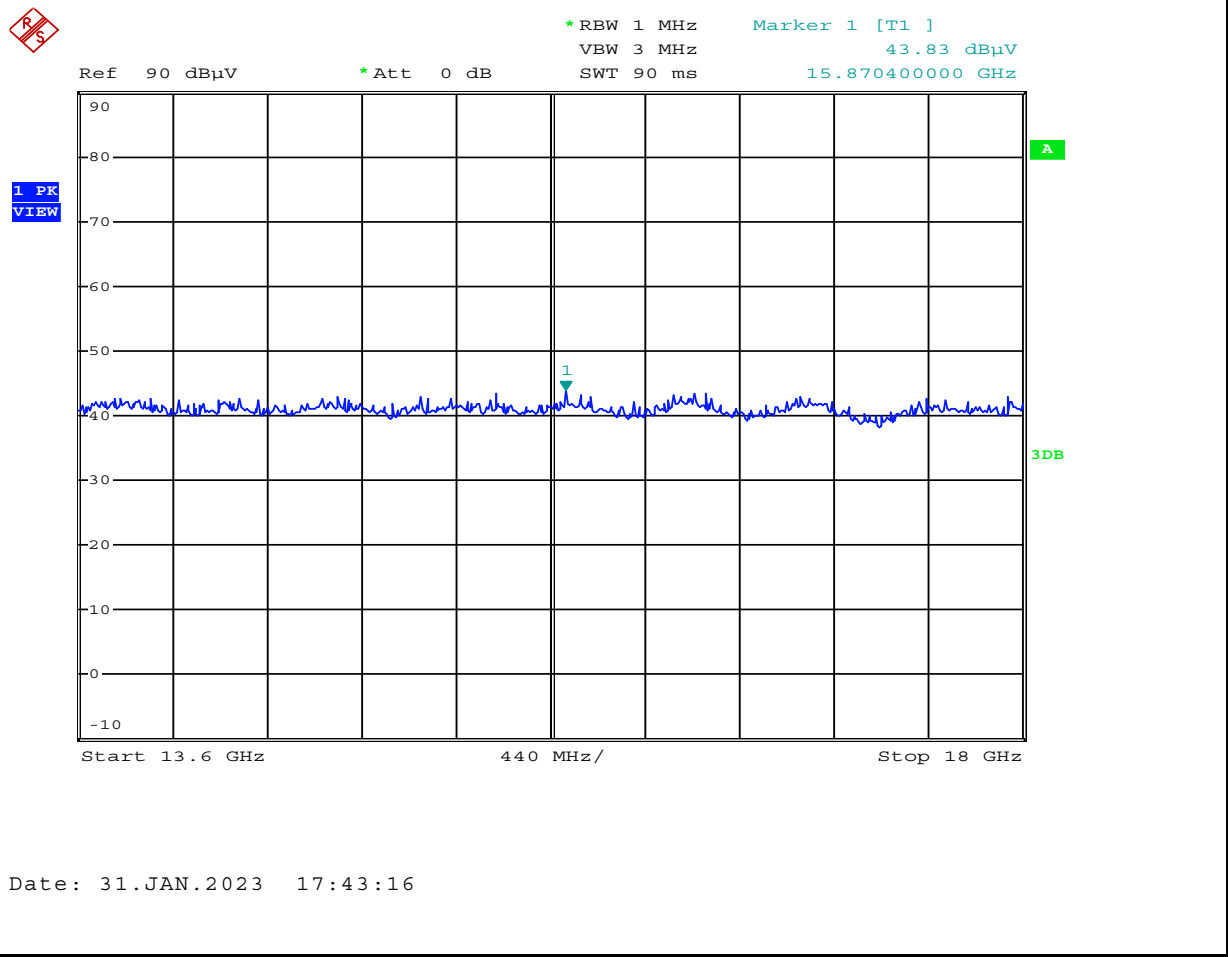
Polarization: **Horizontal**

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: **ND** dBm

Radiated Tx Emissions:



Channel:

Mode:

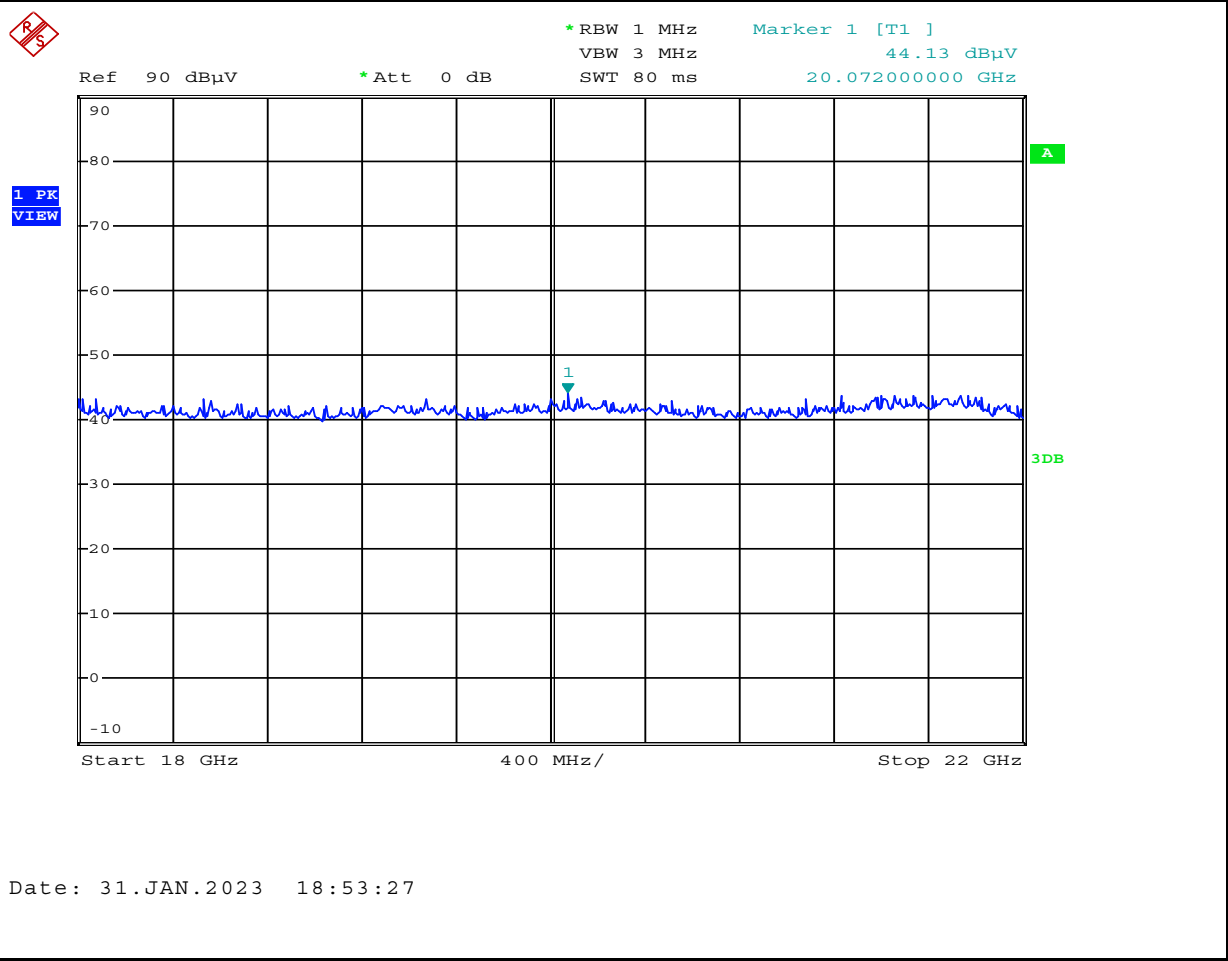
Polarization:

Channel Frequency: MHz

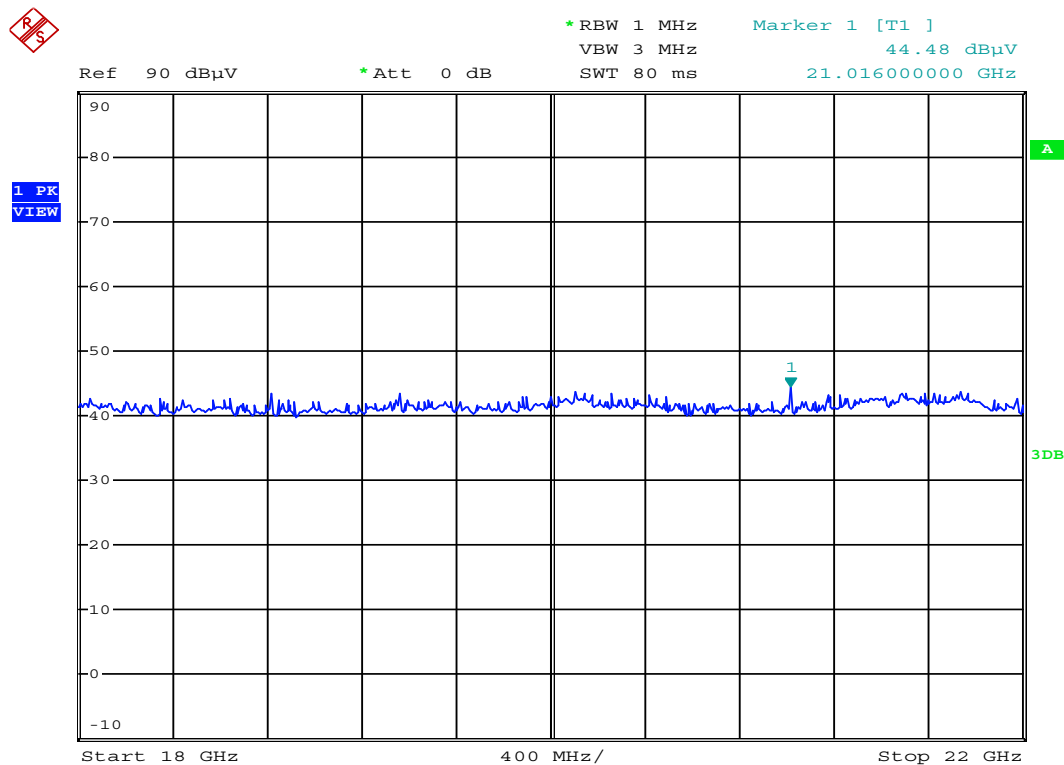
Modulation:

Measured Emission: dBm

Radiated Tx Emissions:



Radiated Tx Emissions:



Date: 31.JAN.2023 18:54:14

Channel: 6

Mode: 802.11b

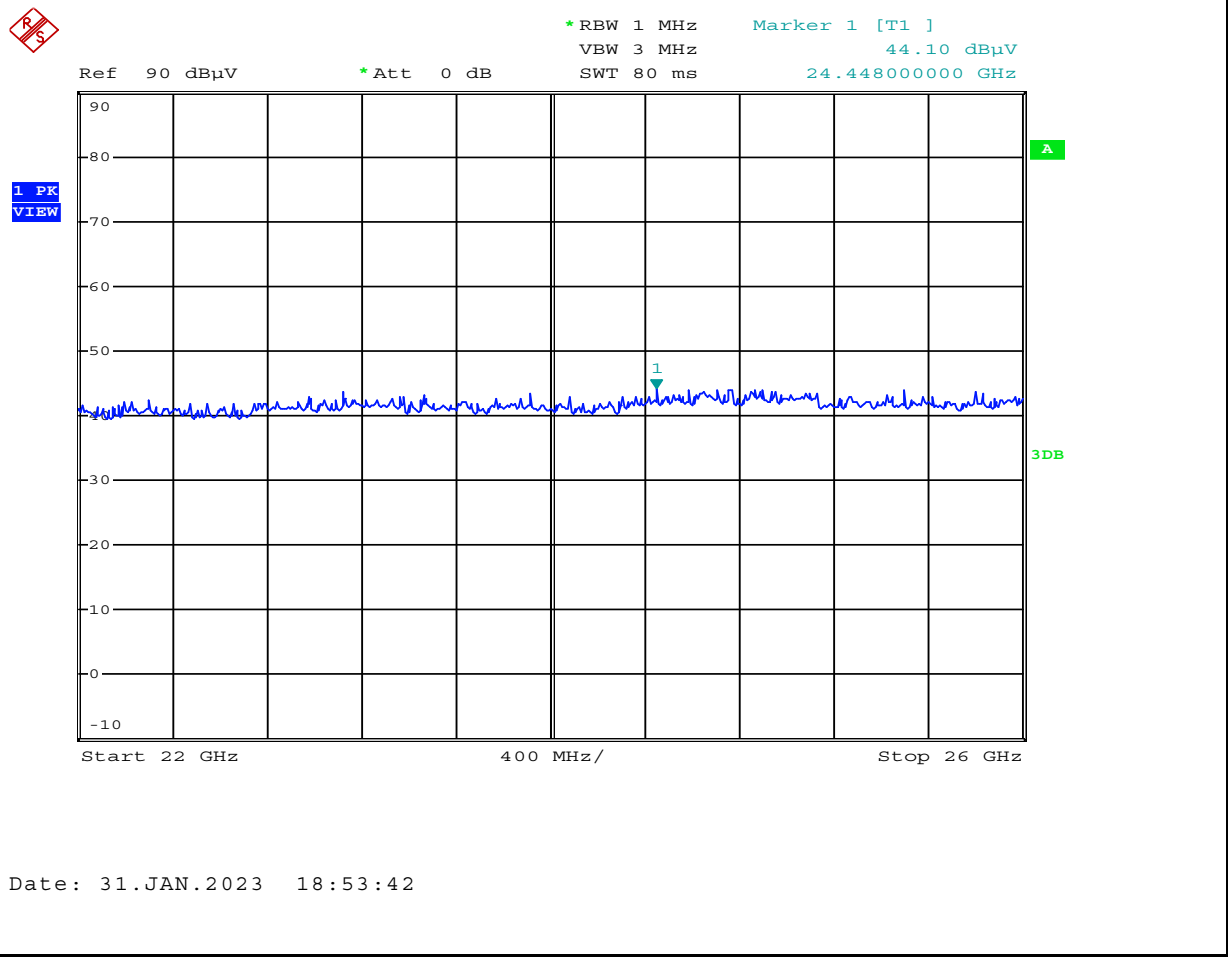
Polarization: Vertical

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel:

Mode:

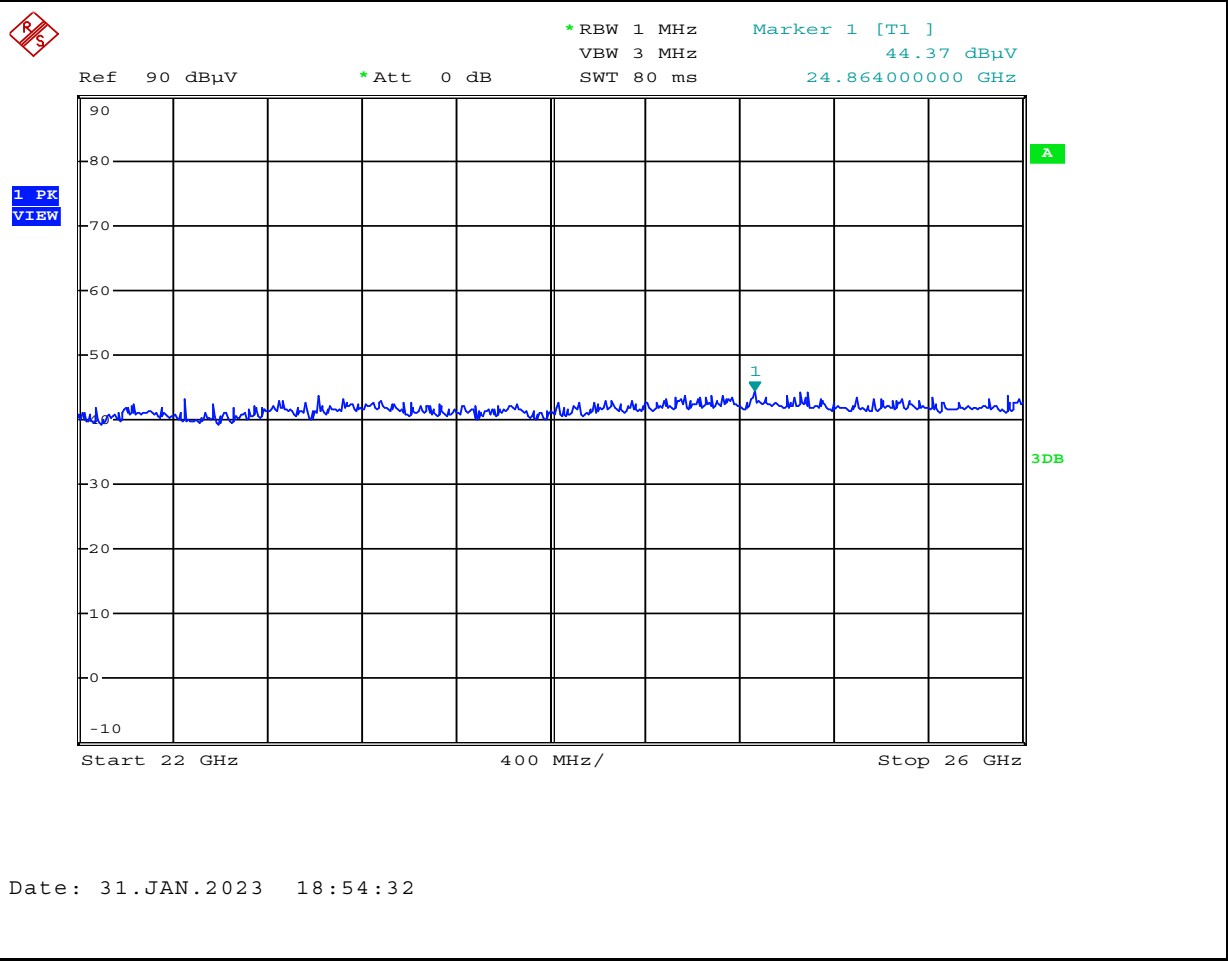
Polarization:

Channel Frequency: MHz

Modulation:

Measured Emission: dBm

Radiated Tx Emissions:



Channel: 6

Mode: 802.11b

Polarization: Vertical

Channel Frequency: 2437 MHz

Modulation: CCK 1MB

Measured Emission: ND dBm

Summary of Radiated Tx Emissions

Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	2412.0	Horizontal	32.43	8.63	22.64	0.68	0.00 (3)	32.0 (2)	40.0	8.0
30-1000MHz	2412.0	Horizontal	54.57	8.24	11.39	0.79	0.00 (3)	20.4 (2)	40.0	19.6
30-1000MHz	2412.0	Horizontal	68.07	7.82	11.21	0.85	0.00 (3)	19.9 (2)	40.0	20.1
30-1000MHz	2412.0	Horizontal	73.47	8.17	11.65	0.87	0.00 (3)	20.7 (2)	40.0	19.3
30-1000MHz	2412.0	Horizontal	841.10	9.54	29.60	2.84	0.00 (3)	42.0 (2)	46.0	4.0
30-1000MHz	2412.0	Horizontal	867.70	8.91	29.40	2.88	0.00 (3)	41.2 (2)	46.0	4.8
30-1000MHz	2412.0	Horizontal	920.90	9.10	29.80	2.97	0.00 (3)	41.9 (2)	46.0	4.2
30-1000MHz	2412.0	Horizontal	925.10	9.12	29.91	2.98	0.00 (3)	42.0 (2)	46.0	4.0
30-1000MHz	2412.0	Vertical	906.20	9.16	29.32	2.94	0.00 (3)	41.4 (2)	46.0	4.6
30-1000MHz	2412.0	Vertical	906.90	9.12	29.39	2.94	0.00 (3)	41.4 (2)	46.0	4.6
30-1000MHz	2412.0	Vertical	908.30	9.26	29.50	2.94	0.00 (3)	41.7 (2)	46.0	4.3
30-1000MHz	2412.0	Vertical	911.10	9.10	29.41	2.95	0.00 (3)	41.5 (2)	46.0	4.6
1 - 3GHz	2440.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	2440.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	2440.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	2440.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	2440.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	2440.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	2440.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	2440.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

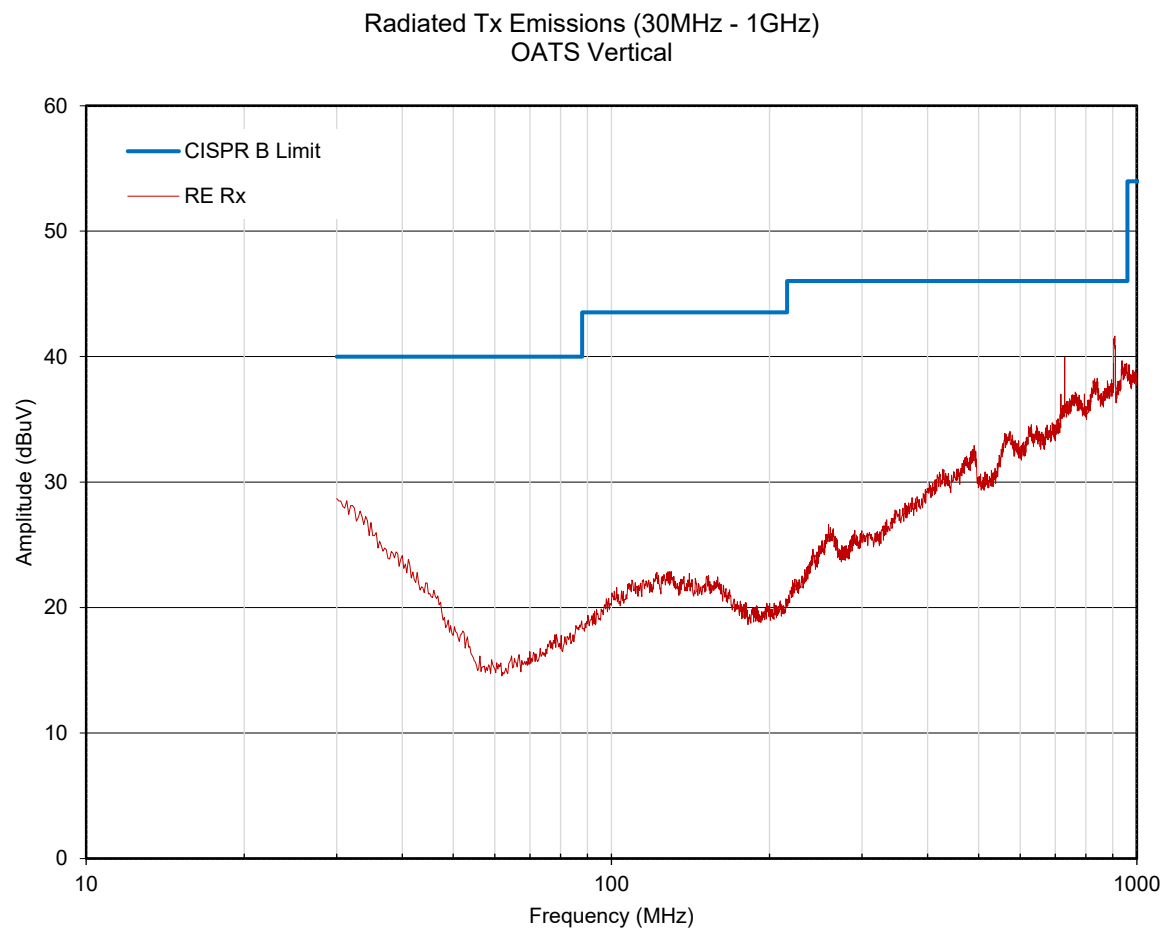
(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

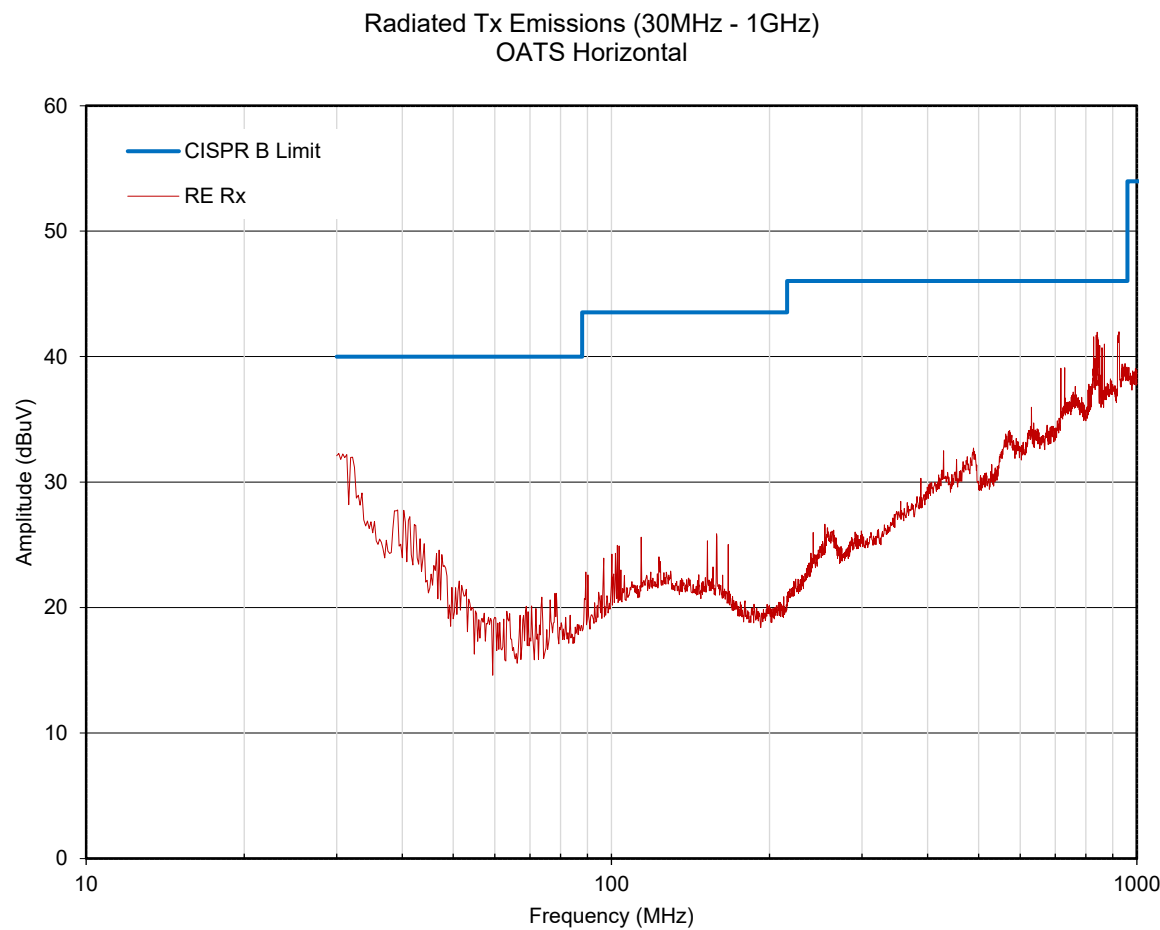
(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_{\text{C}} - G_{\text{A}}$$

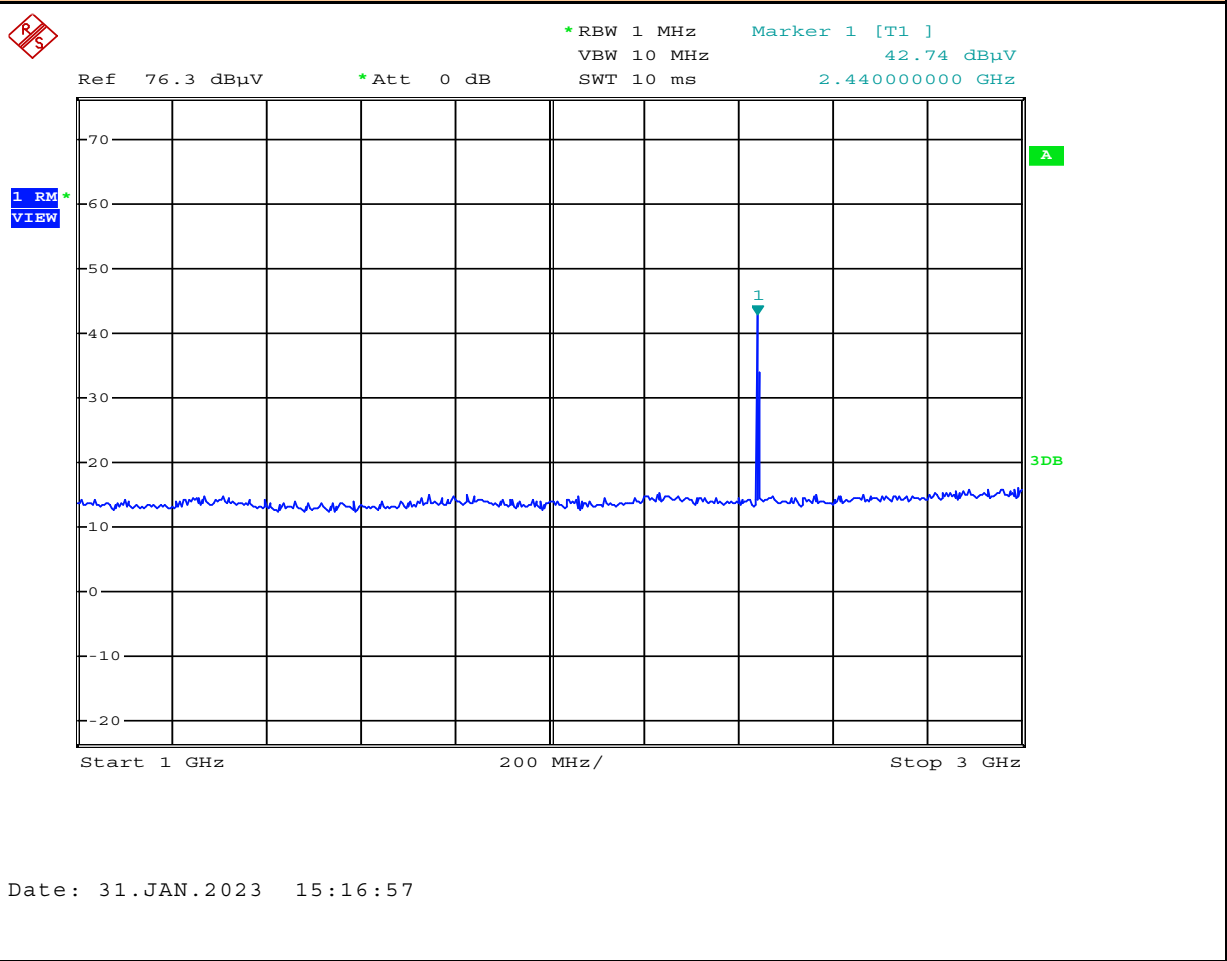
Radiated Tx Emissions:



Radiated Tx Emissions:



Radiated Tx Emissions:



Channel: 38

Mode: BT BR

Polarization: Horizontal

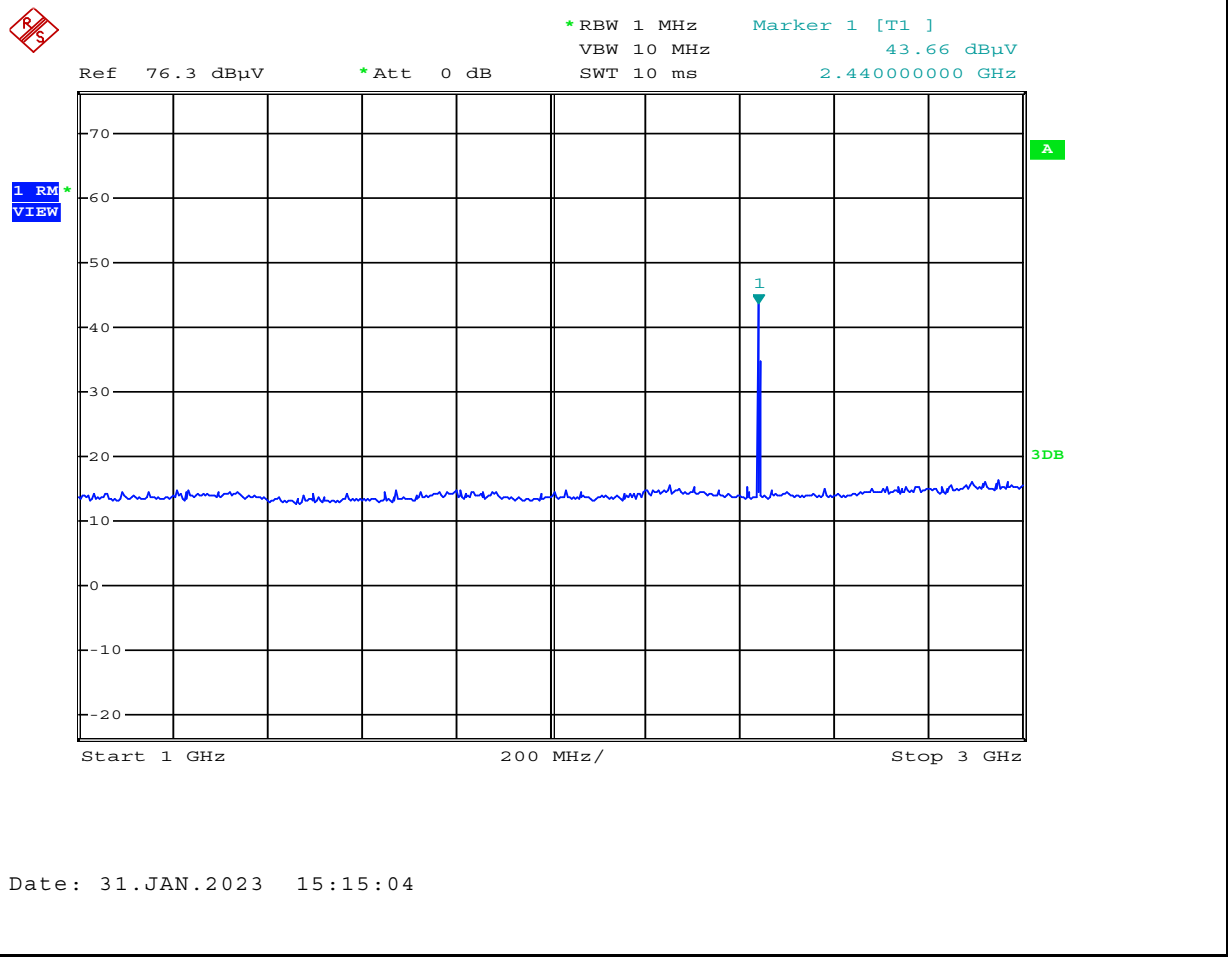
Marker 1 = Fundamental

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

Polarization: Vertical

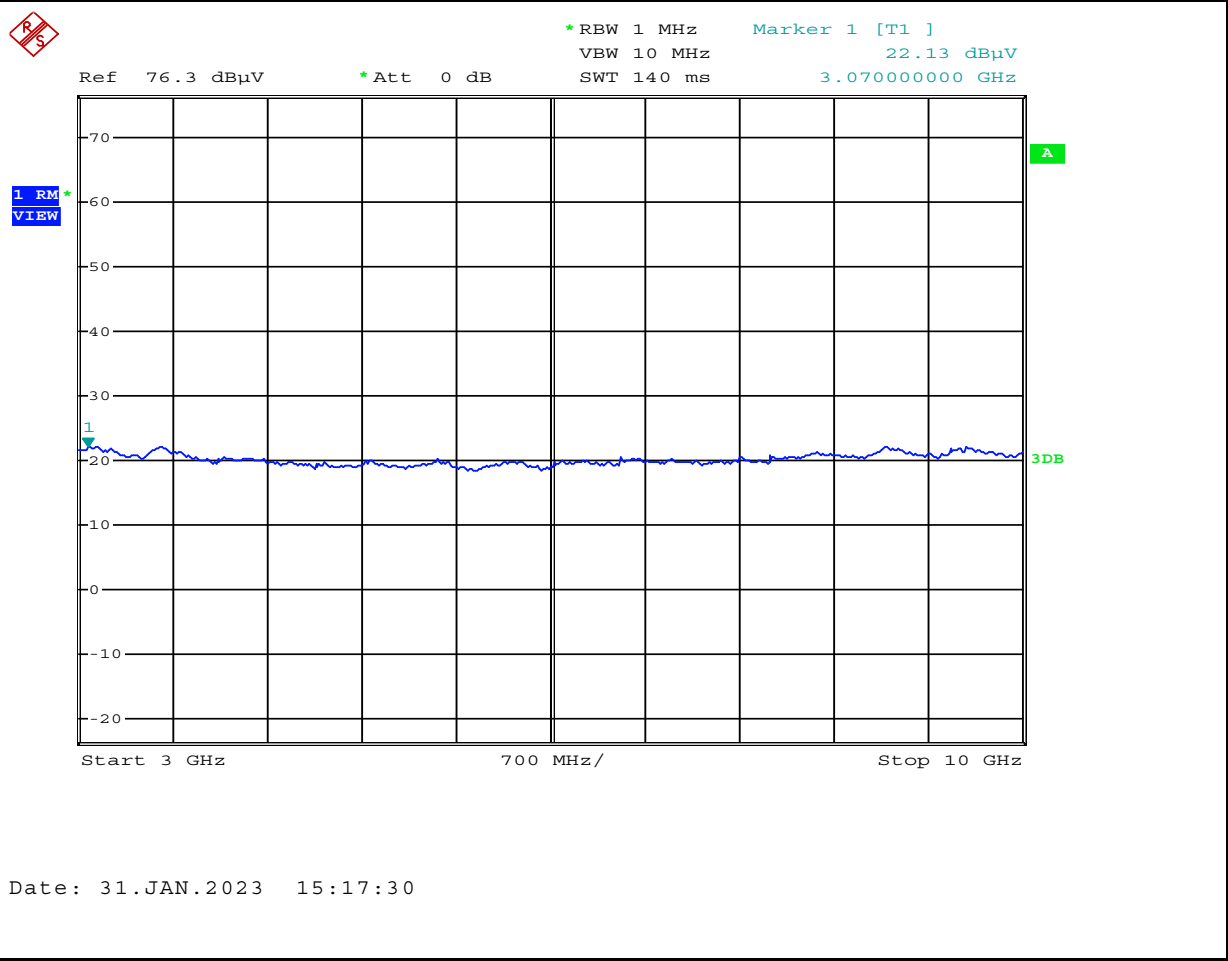
Marker 1 = Fundamental

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

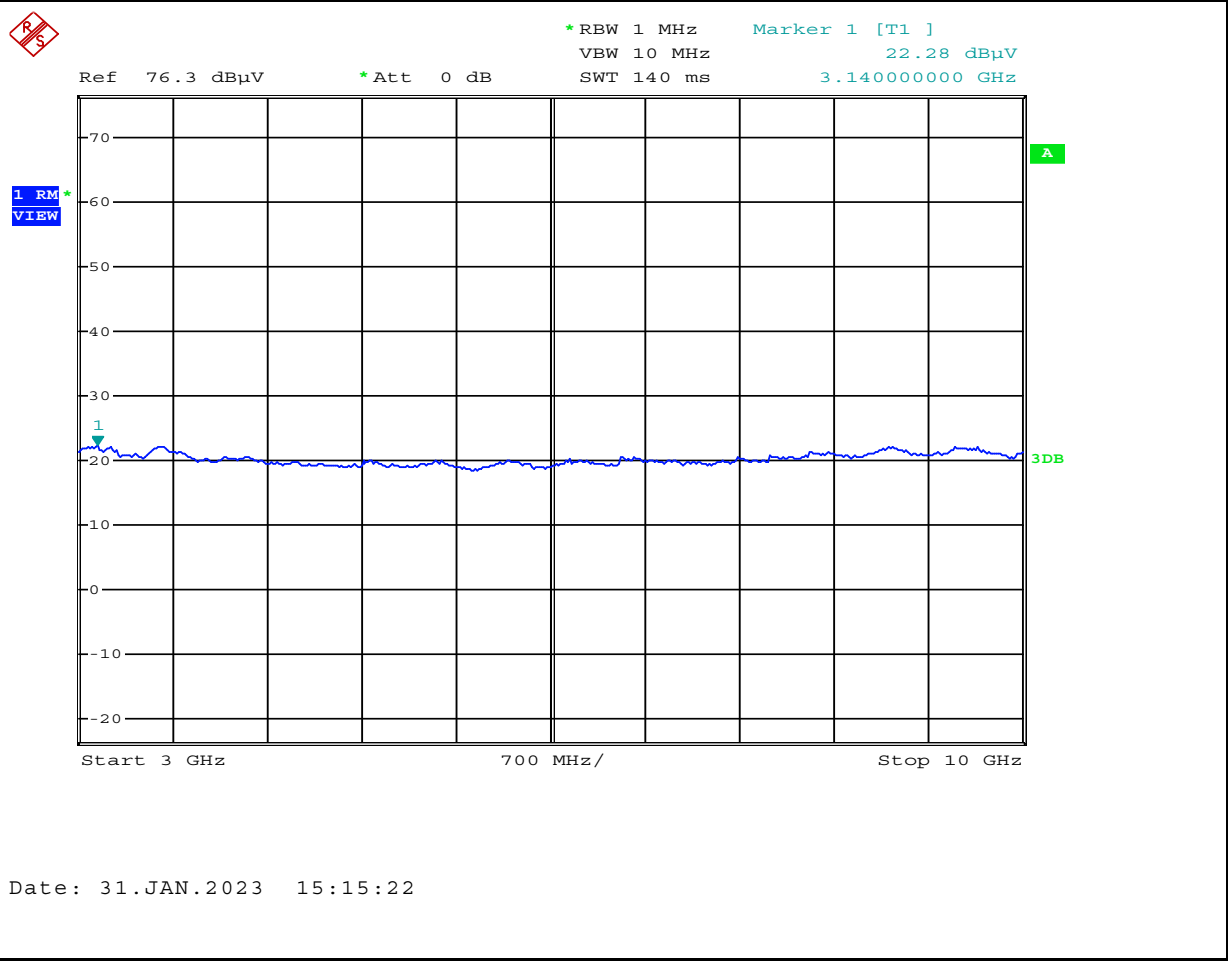
Polarization: Horizontal

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

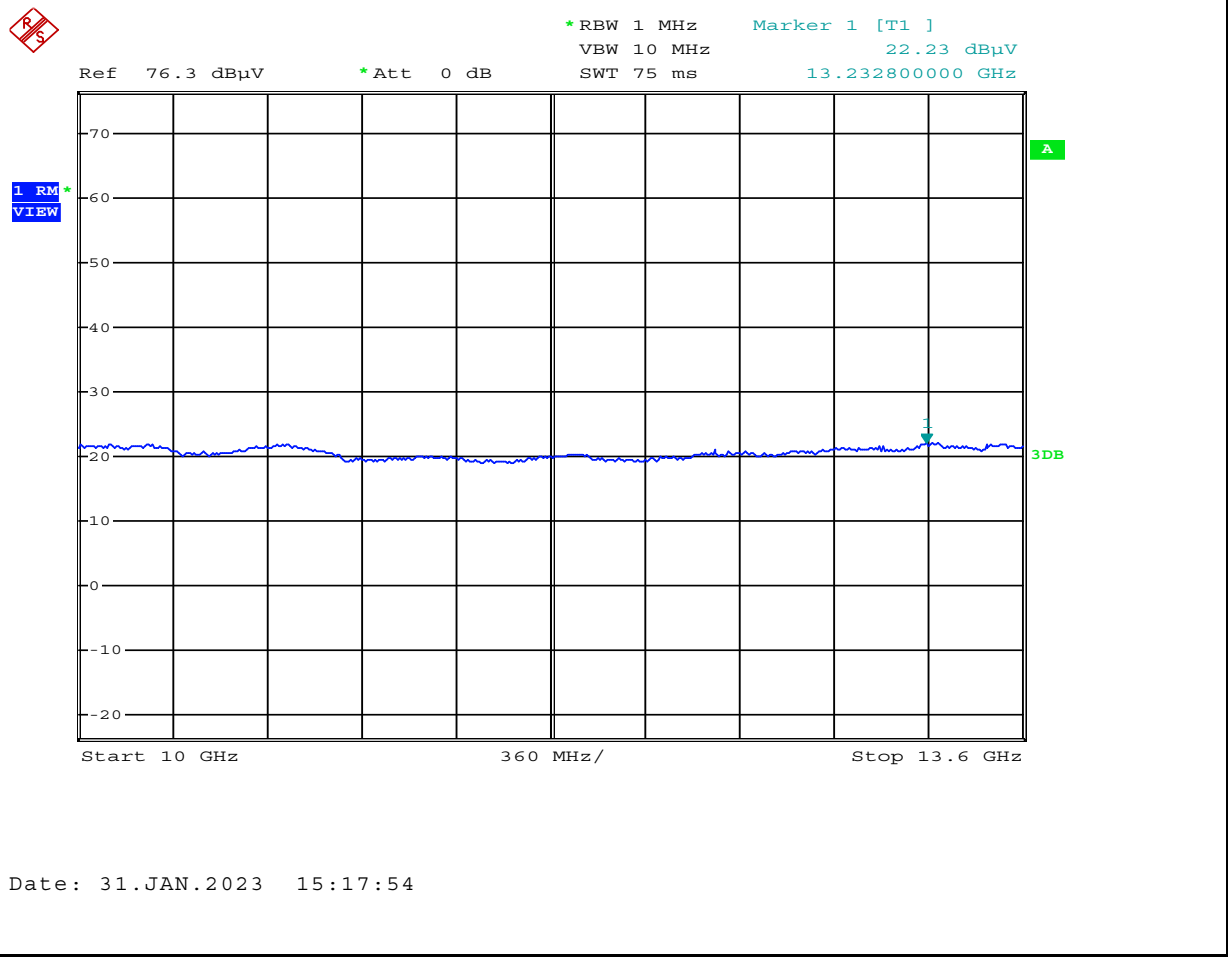
Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:

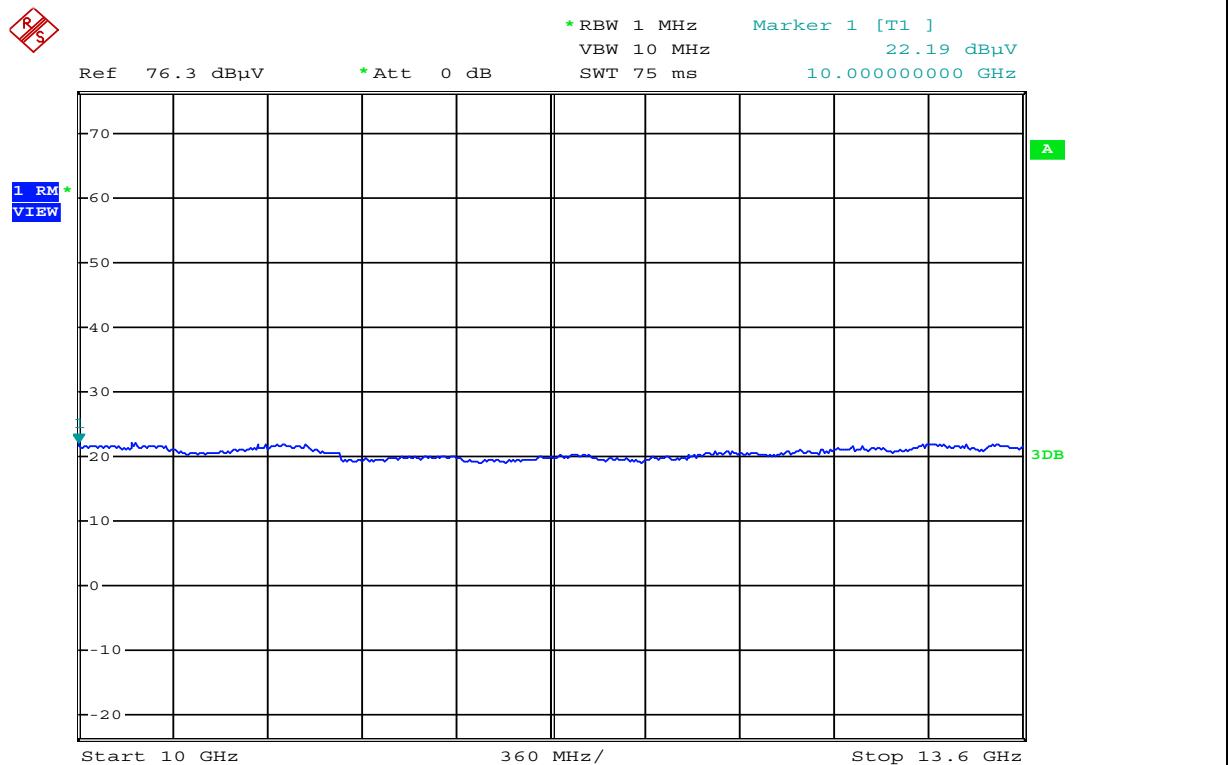


Date: 31.JAN.2023 15:17:54

Channel:	38
Mode:	BT BR
Polarization:	Horizontal

Channel Frequency:	2440	MHz
Modulation:	GFSK	
Measured Emission:	ND	dBm

Radiated Tx Emissions:

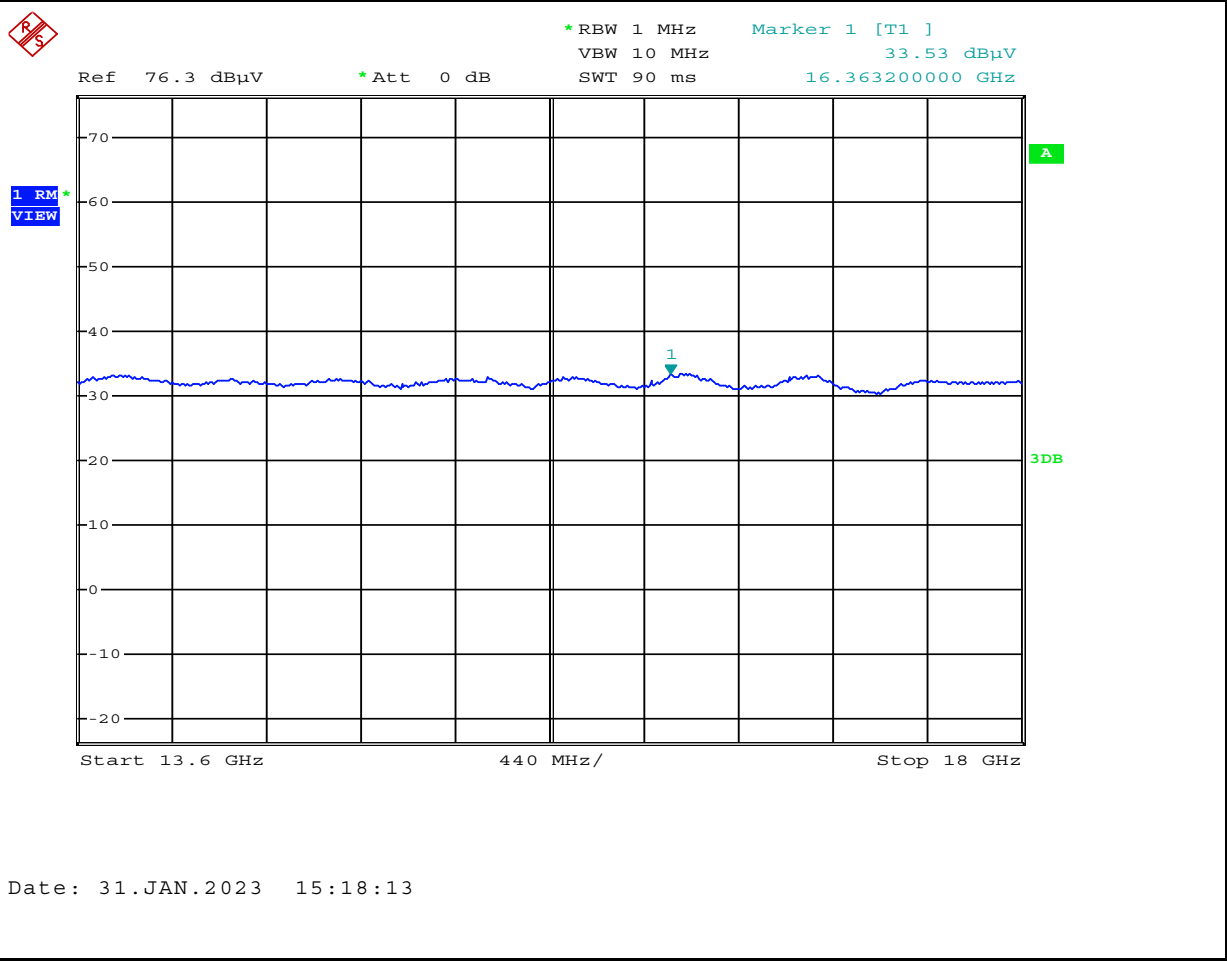


Date: 31.JAN.2023 15:15:40

Channel:	38
Mode:	BT BR
Polarization:	Vertical

Channel Frequency:	2440	MHz
Modulation:	GFSK	
Measured Emission:	ND	dBm

Radiated Tx Emissions:



Channel:

38

Channel Frequency:

2440

MHz

Mode:

BT BR

Modulation:

GFSK

Polarization:

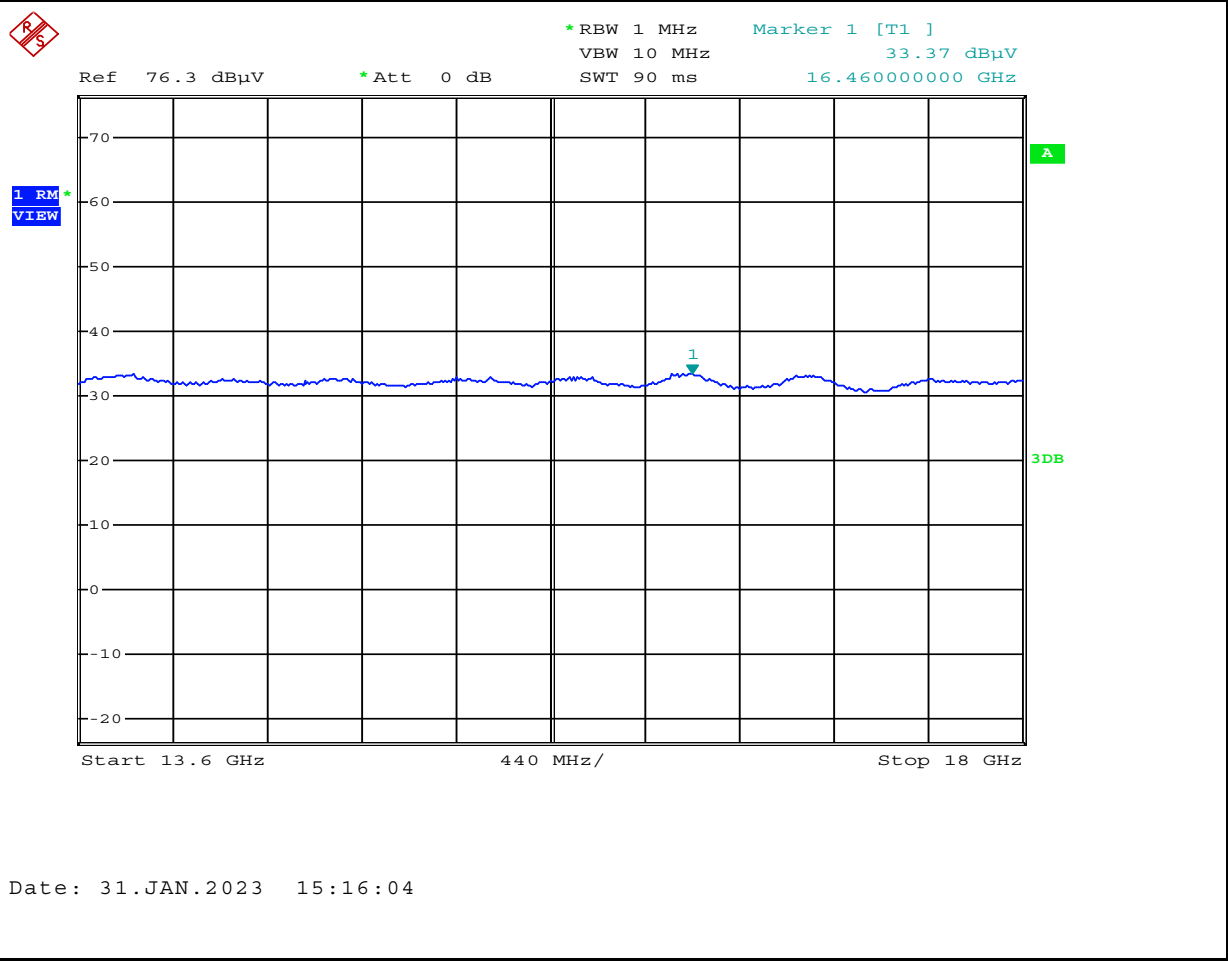
Horizontal

Measured Emission:

ND

dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

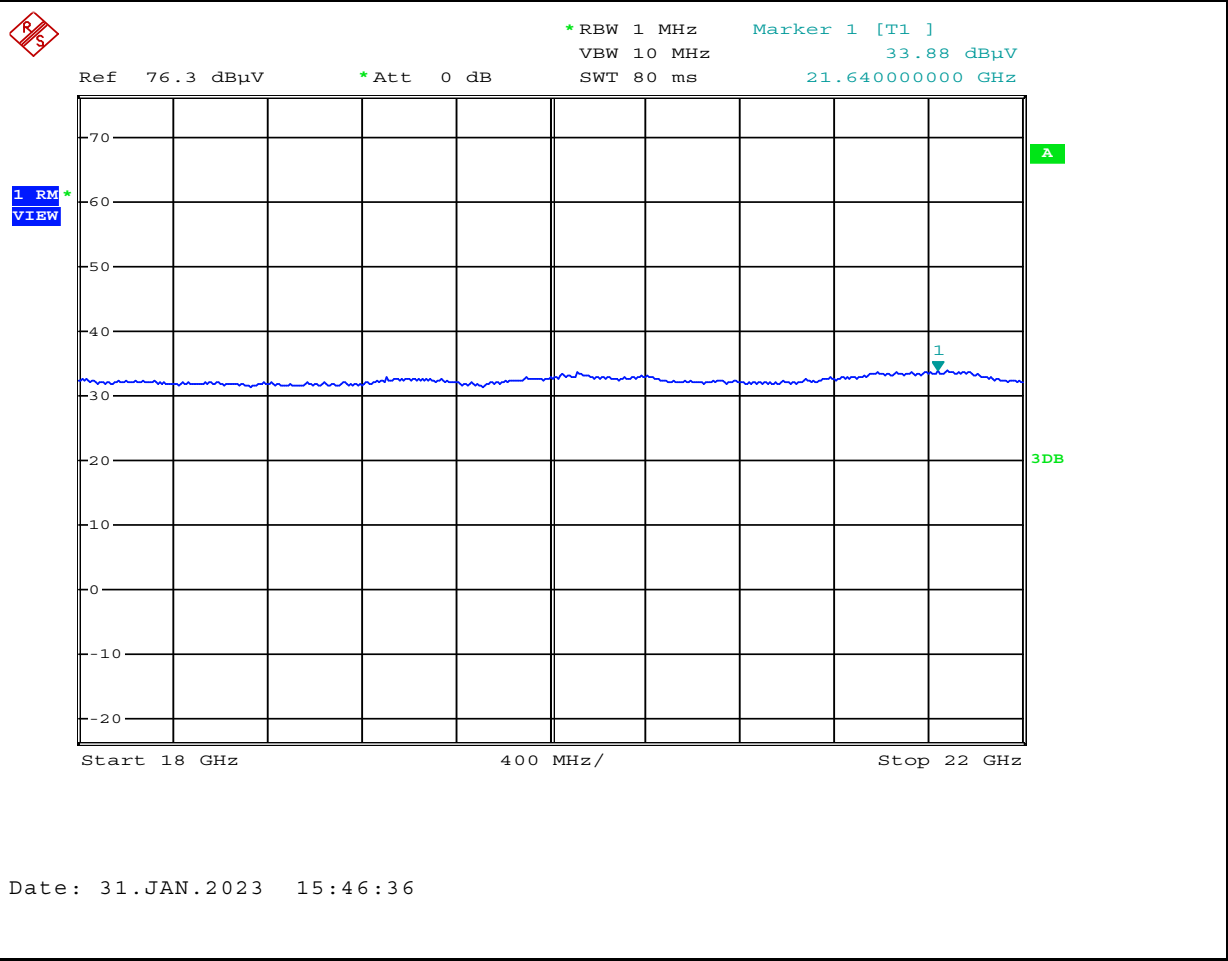
Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel:

38

Channel Frequency:

2440

MHz

Mode:

BT BR

Modulation:

GFSK

Polarization:

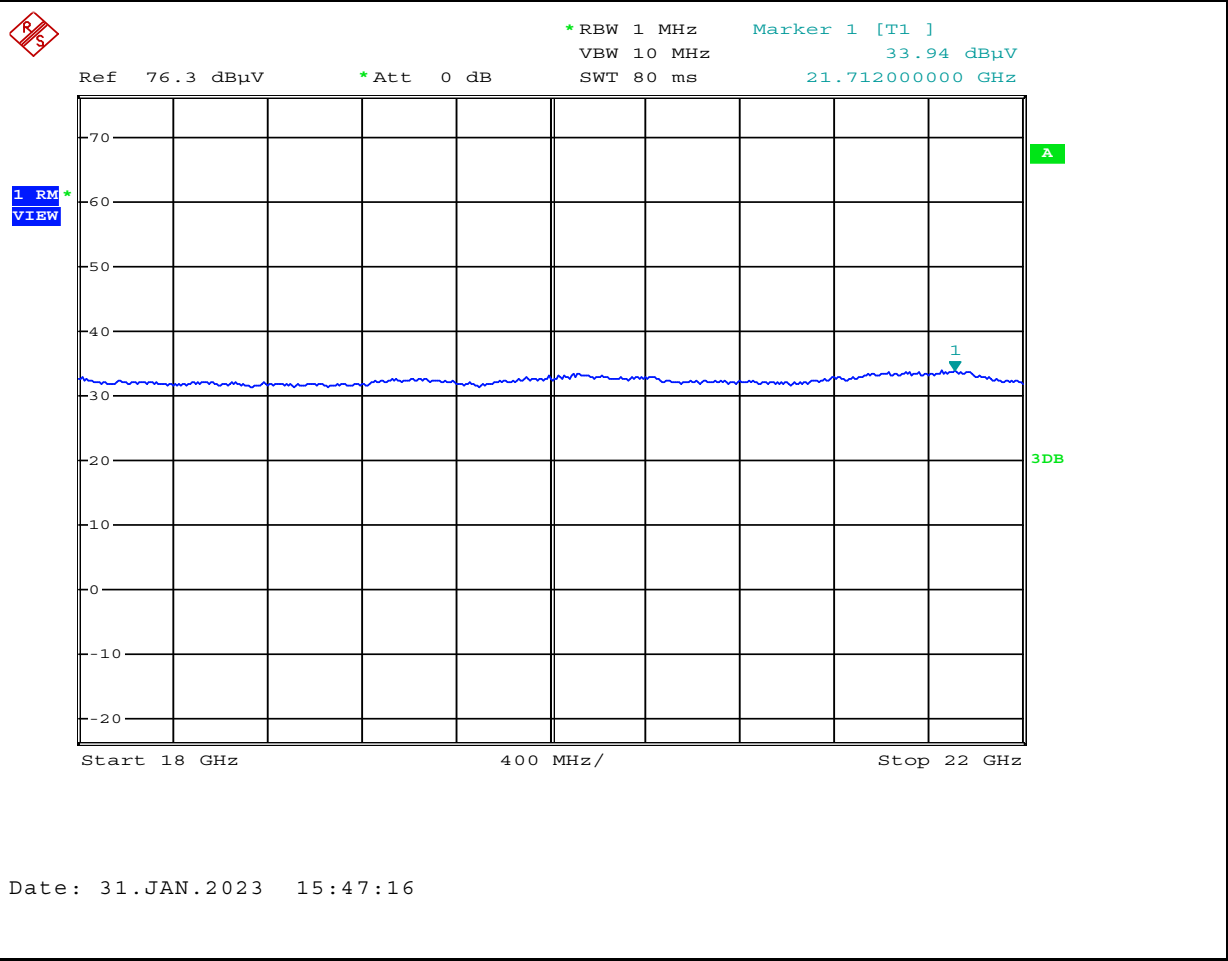
Horizontal

Measured Emission:

ND

dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

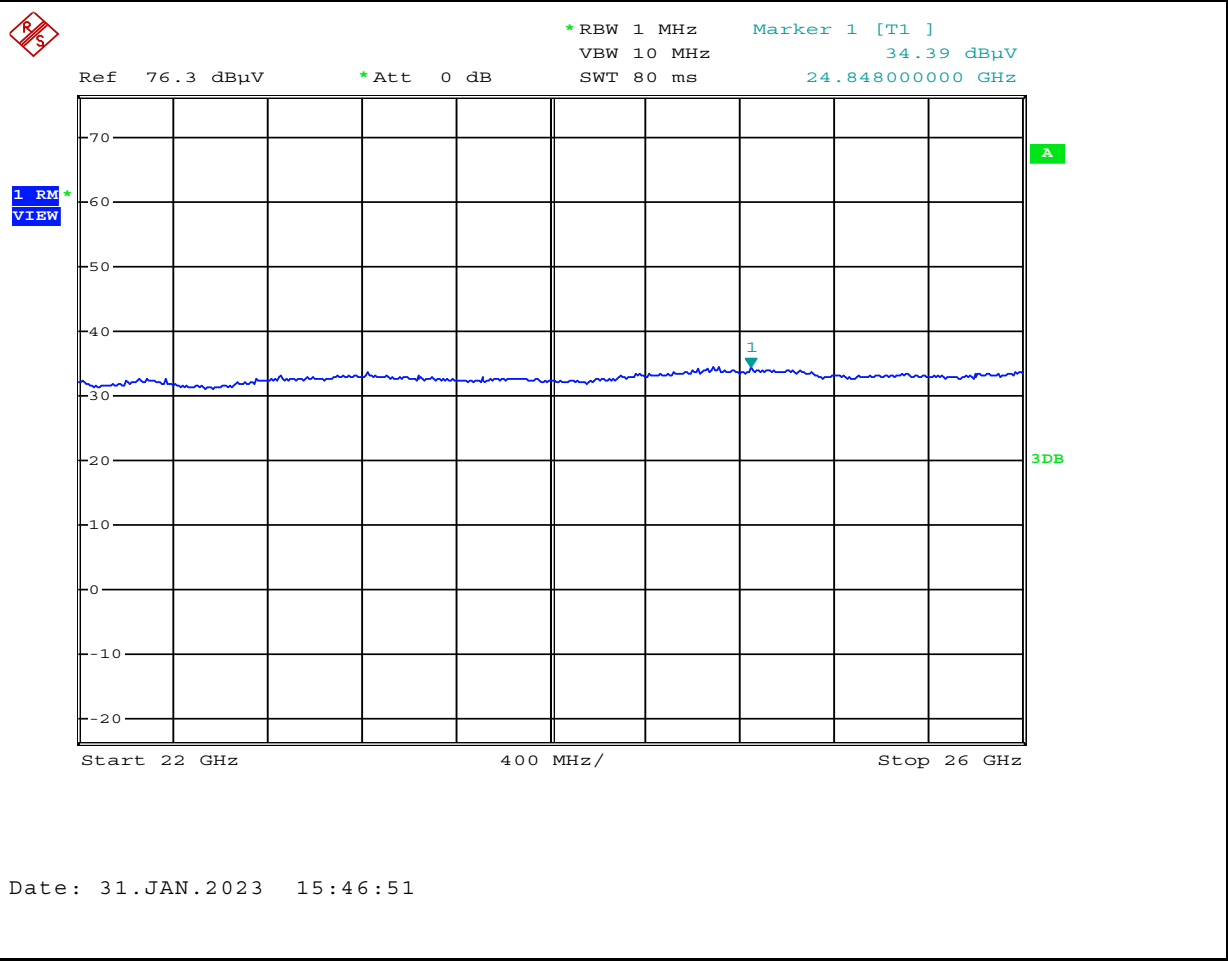
Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

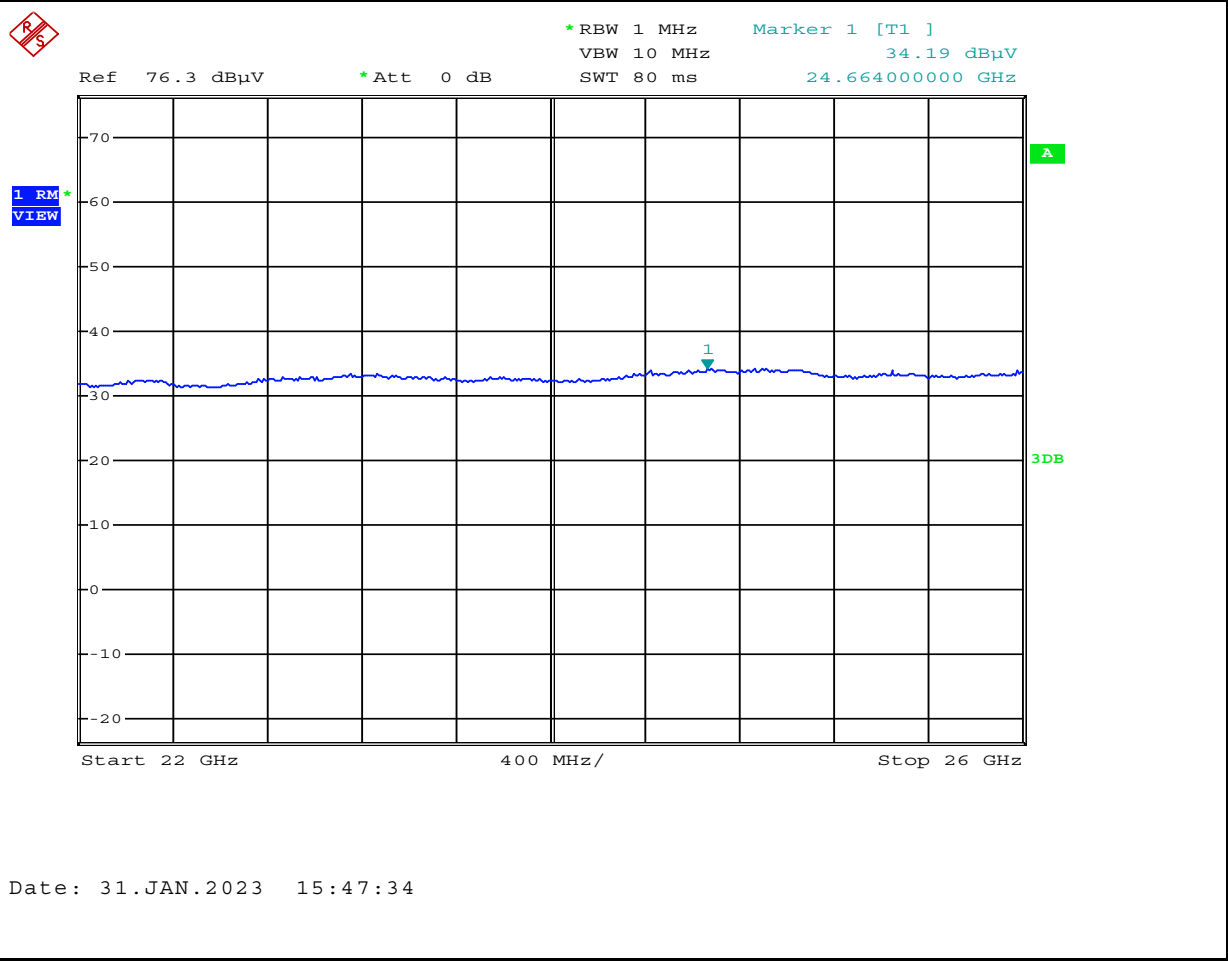
Polarization: Horizontal

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Summary of Radiated Rx Emissions

Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	46.0	n/a
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	43.5	n/a
1 - 3GHz	-	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	-	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	-	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	-	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	-	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	-	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	-	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	-	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

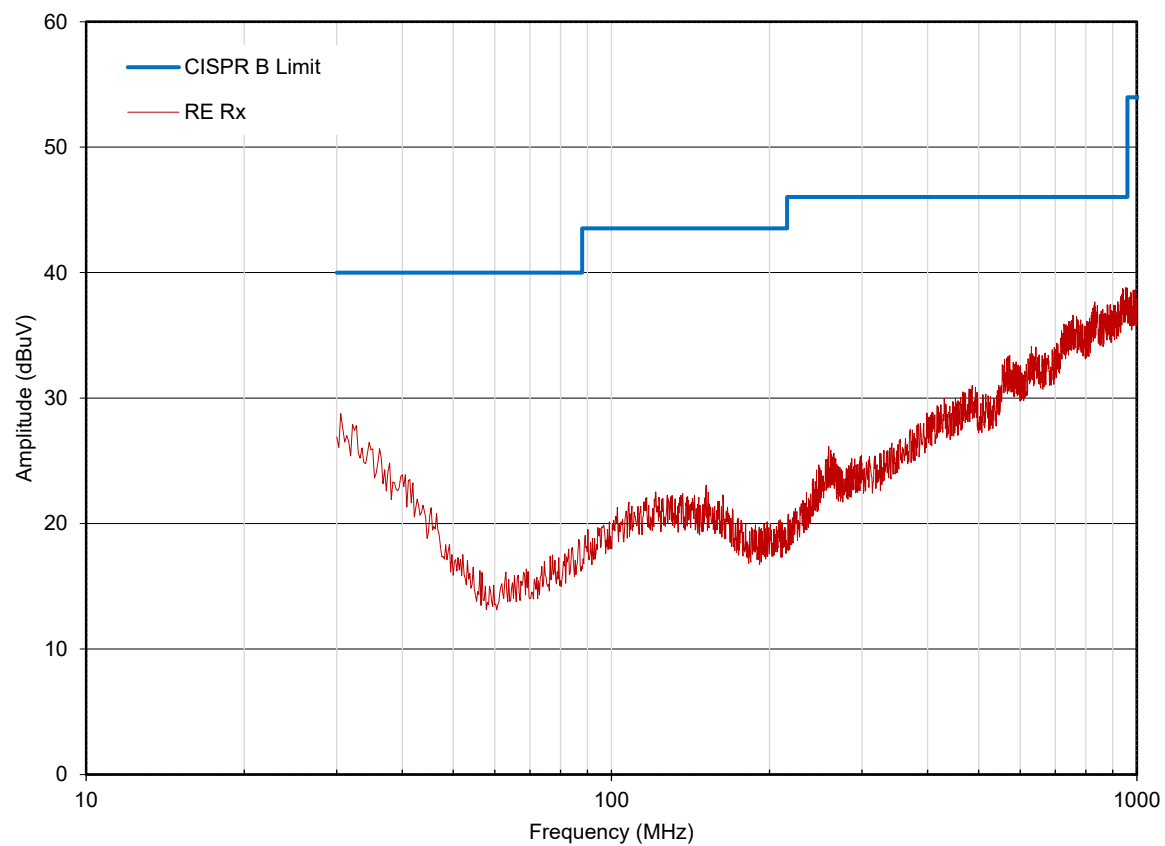
(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

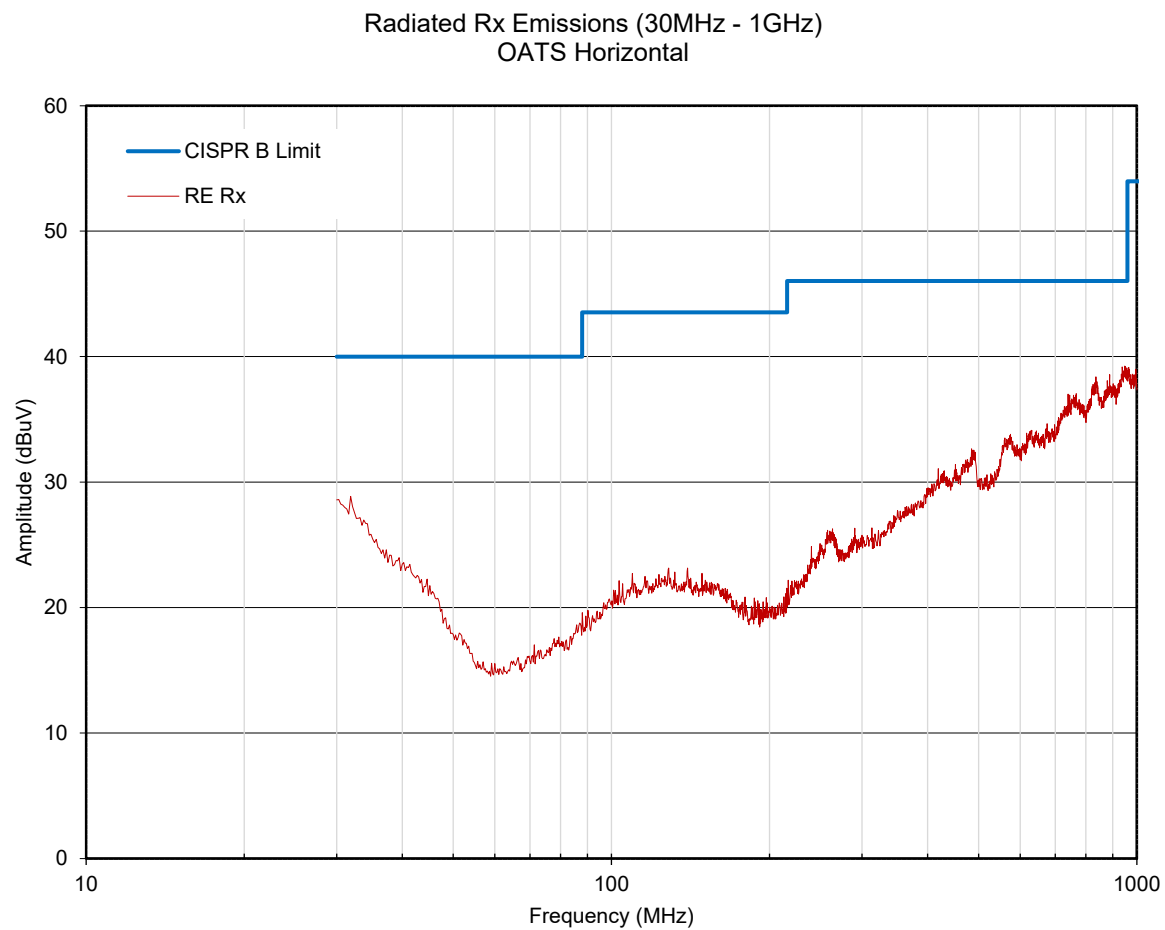
$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_{\text{C}} - G_{\text{A}}$$

Radiated Rx Emissions:

Radiated Rx Emissions (30MHz - 1GHz)
OATS Vertical



Radiated Rx Emissions:



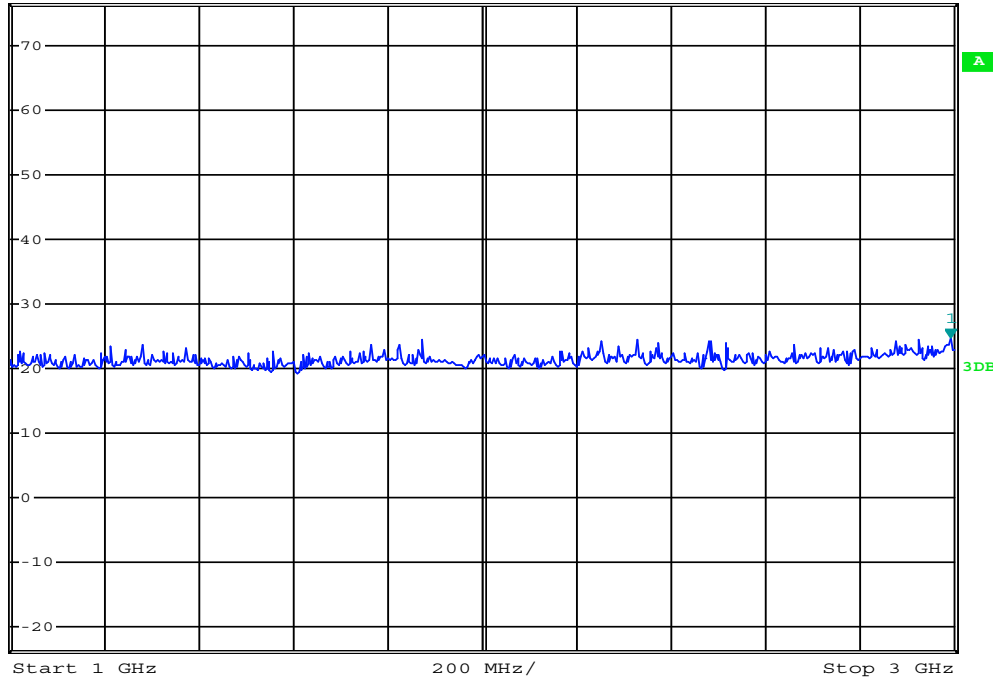
Radiated Rx Emissions:



```
*RBW 1 MHz      Marker 1 [T1 ]
VBW 3 MHz      24.61 dBμV
SWT 10 ms      2.992000000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



Date: 31.JAN.2023 16:16:30

Polarization:	Horizontal
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Measured Emission: **ND** dBm

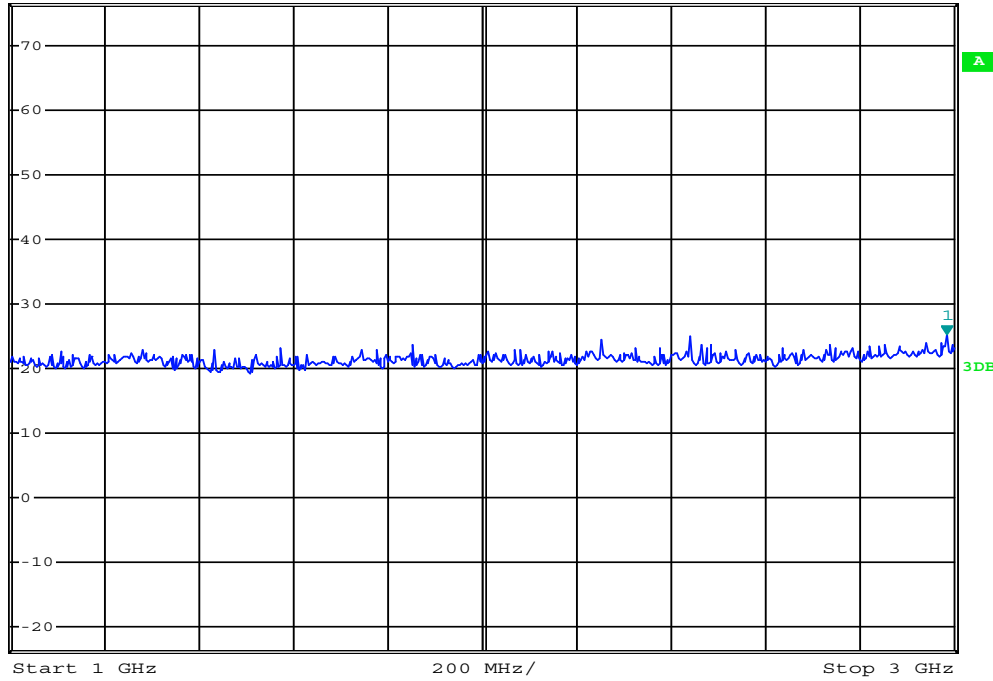
Radiated Rx Emissions:



```
*RBW 1 MHz      Marker 1 [T1 ]
VBW 3 MHz      25.15 dBμV
SWT 10 ms      2.984000000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



Date: 31.JAN.2023 16:18:11

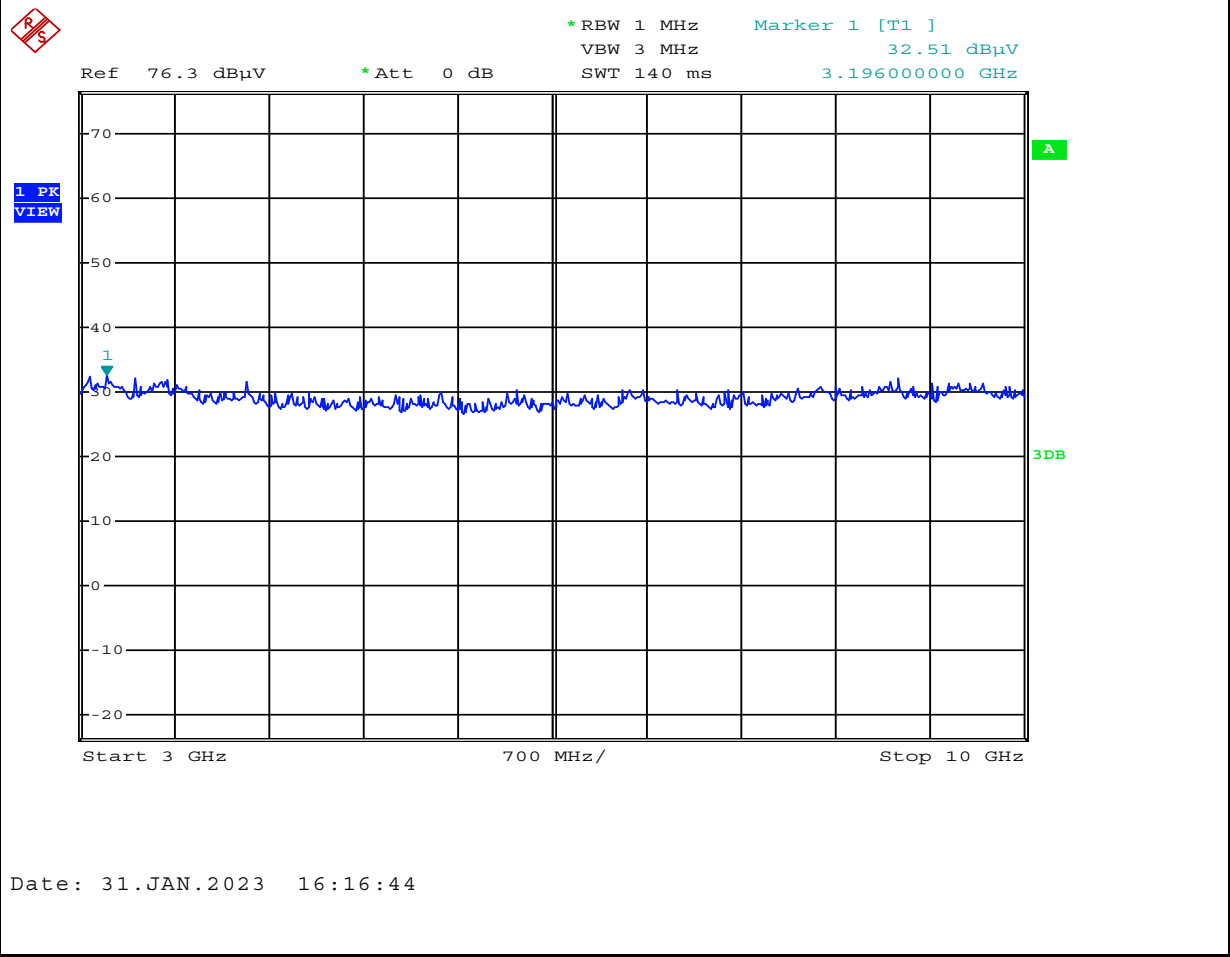
Polarization:	Vertical
---------------	----------

Measured Emission:

ND

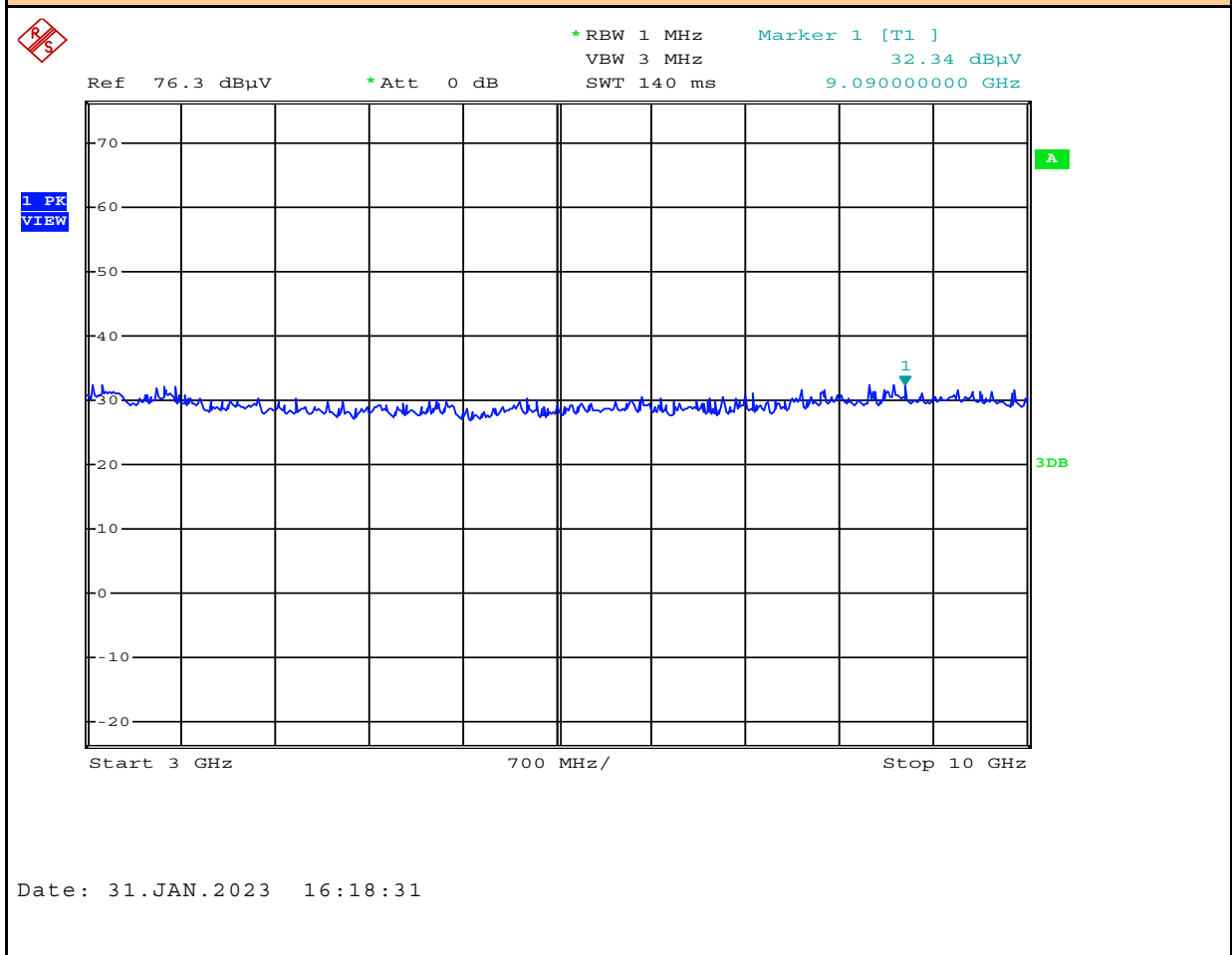
 dBm

Radiated Rx Emissions:

Polarization: **Horizontal**

Measured Emission: **ND** dBm

Radiated Rx Emissions:

Polarization: **Vertical**

Measured Emission: **ND** dBm

Marker 1 [T1]

* Att 0 dB

SWT 75 ms

10.093600000 GHz



A

3DB

Start 10 GHz	360 MHz/	Stop 13.6 GHz
--------------	----------	---------------

Polarization: Horizontal

Measured Emission:	ND	dBm
--------------------	----	-----

dBm

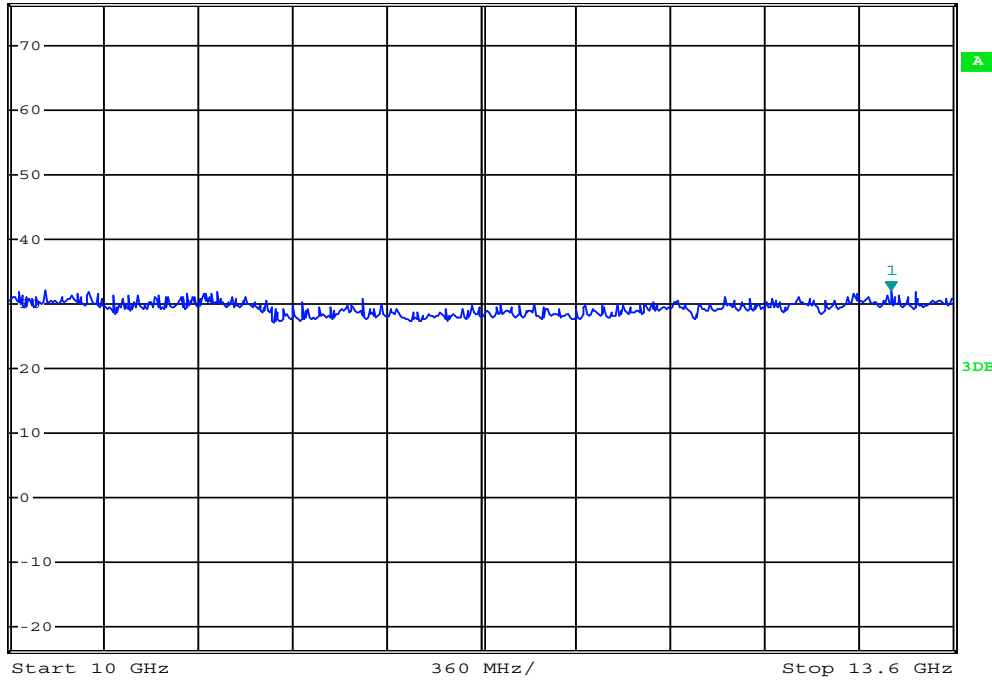
Radiated Rx Emissions:



```
* RBW 1 MHz      Marker 1 [T1 ]
  VBW 3 MHz      32.19 dBμV
  SWT 75 ms      13.362400000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



Date: 31.JAN.2023 16:18:51

Polarization: Vertical

Measured Emission:	ND	dBm
--------------------	----	-----

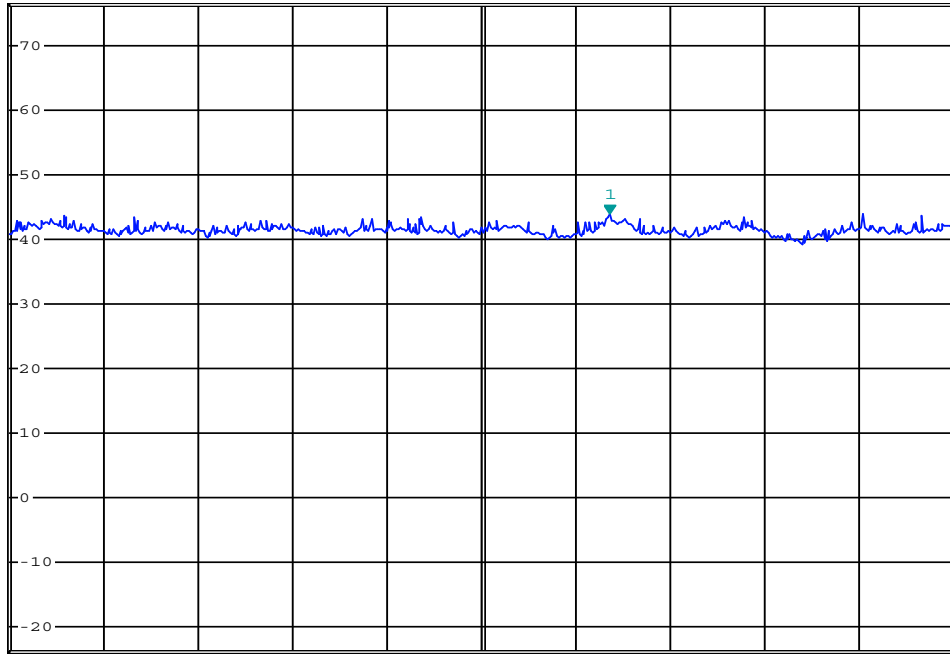
Radiated Rx Emissions:



```
* RBW 1 MHz      Marker 1 [T1 ]
  VBW 3 MHz      44.03 dBμV
  SWT 90 ms      16.398400000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



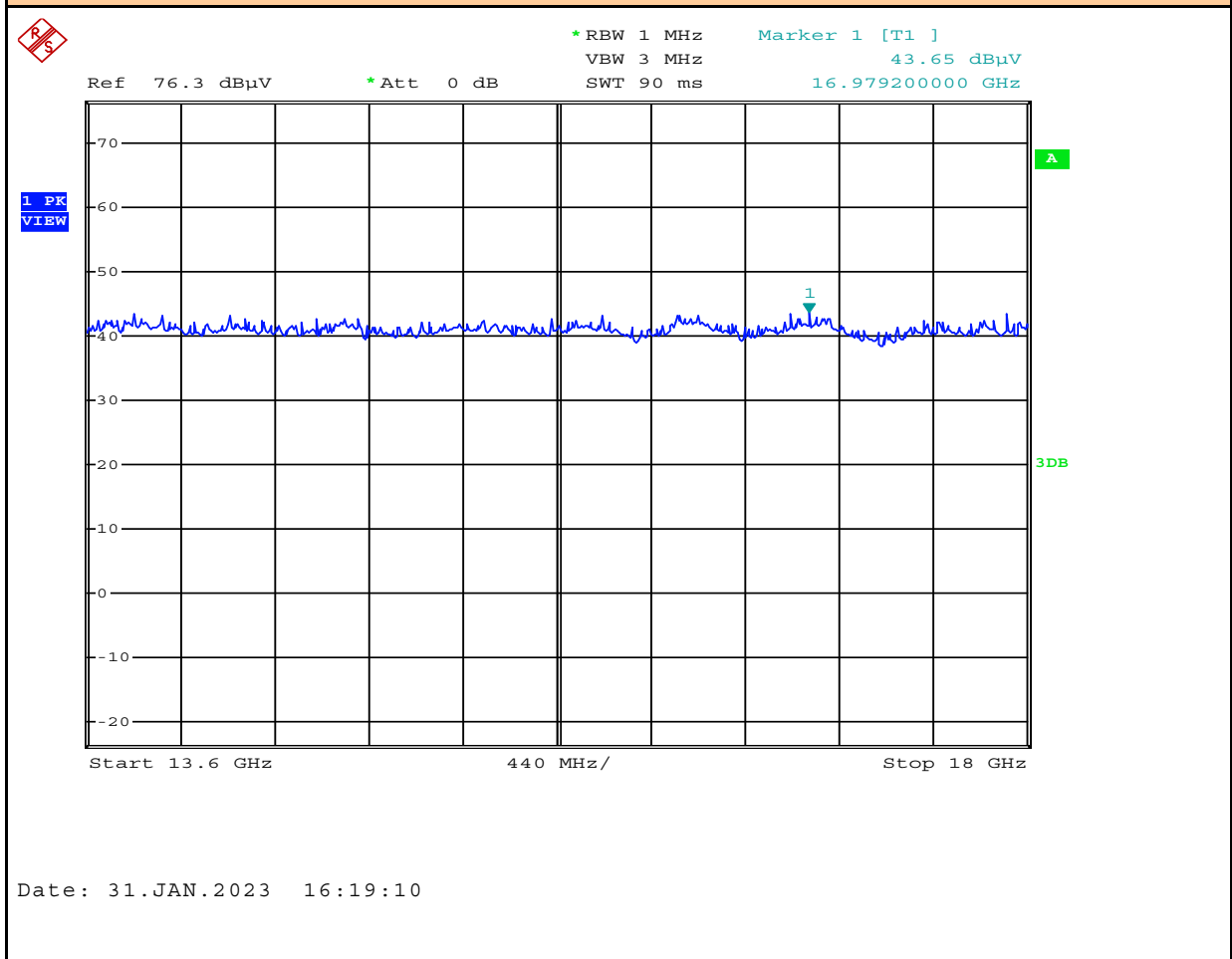
Start 13.6 GHz	440 MHz/	Stop 18 GHz
----------------	----------	-------------

Date: 31.JAN.2023 16:17:46

Polarization:	Horizontal
---------------	------------

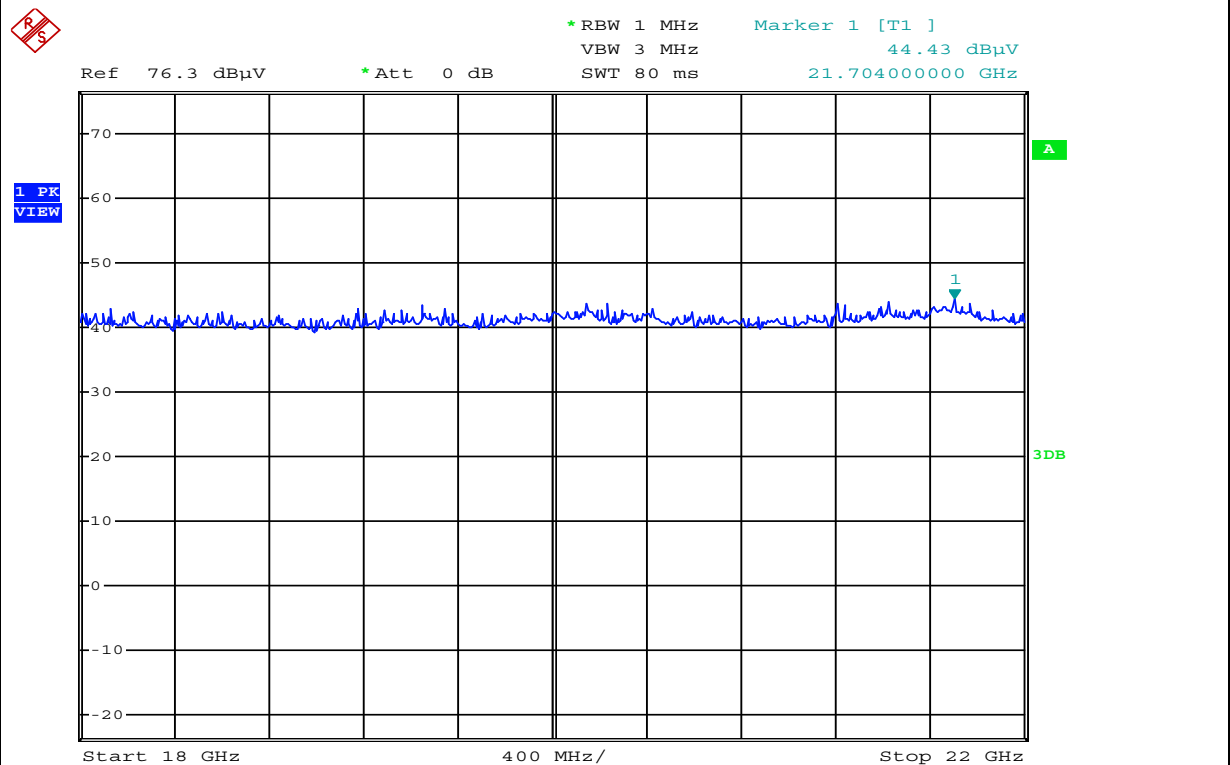
Measured Emission: **ND** dBm

Radiated Rx Emissions:

Polarization: **Vertical**

Measured Emission: **ND** dBm

Radiated Rx Emissions:



Date: 31.JAN.2023 17:13:34

Polarization: Horizontal

Measured Emission: **ND** dBm

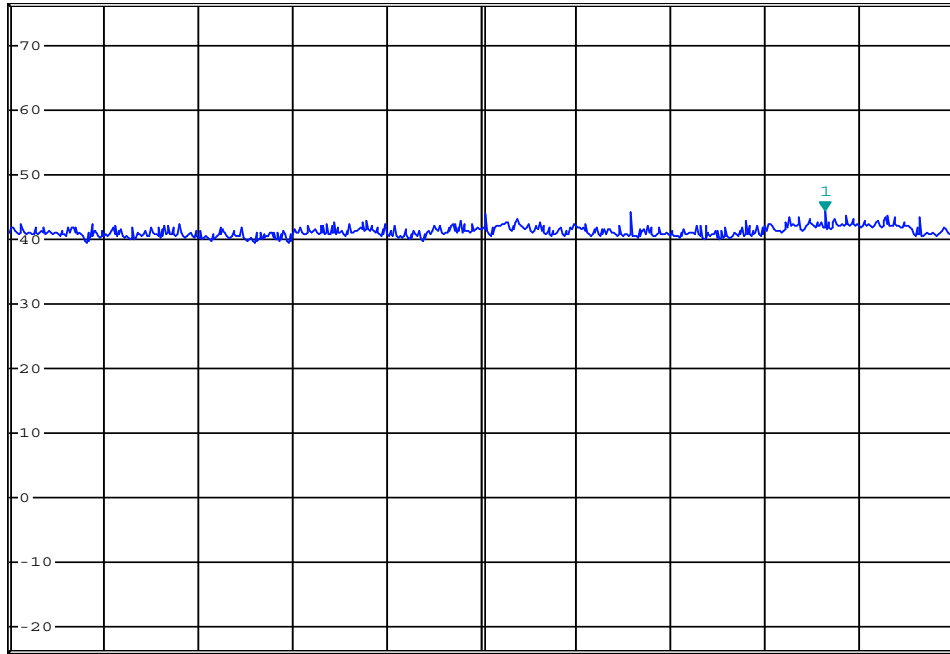
Radiated Rx Emissions:



```
* RBW 1 MHz      Marker 1 [T1 ]
  VBW 3 MHz      44.42 dBμV
  SWT 80 ms      21.456000000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



Start 18 GHz	400 MHz/	Stop 22 GHz
--------------	----------	-------------

Date: 31.JAN.2023 17:14:14

Polarization: Vertical

Measured Emission:	ND	dBm
--------------------	----	-----

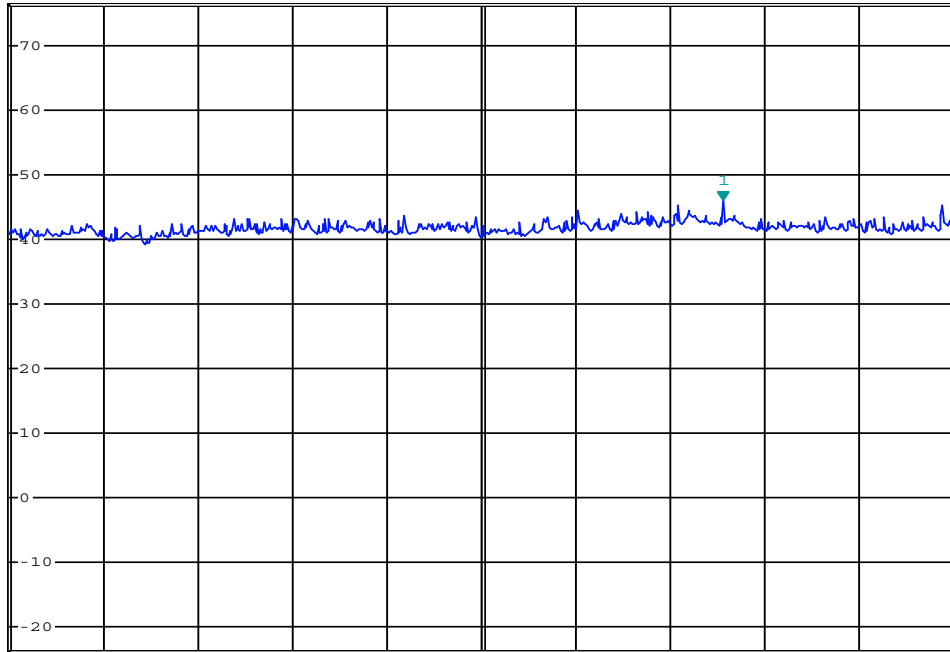
Radiated Rx Emissions:



```
* RBW 1 MHz      Marker 1 [T1 ]
  VBW 3 MHz      45.95 dBμV
  SWT 80 ms      25.024000000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



Start 22 GHz	400 MHz/	Stop 26 GHz
--------------	----------	-------------

Date: 31.JAN.2023 17:13:55

Polarization:	Horizontal
---------------	------------

Measured Emission: **ND** dBm

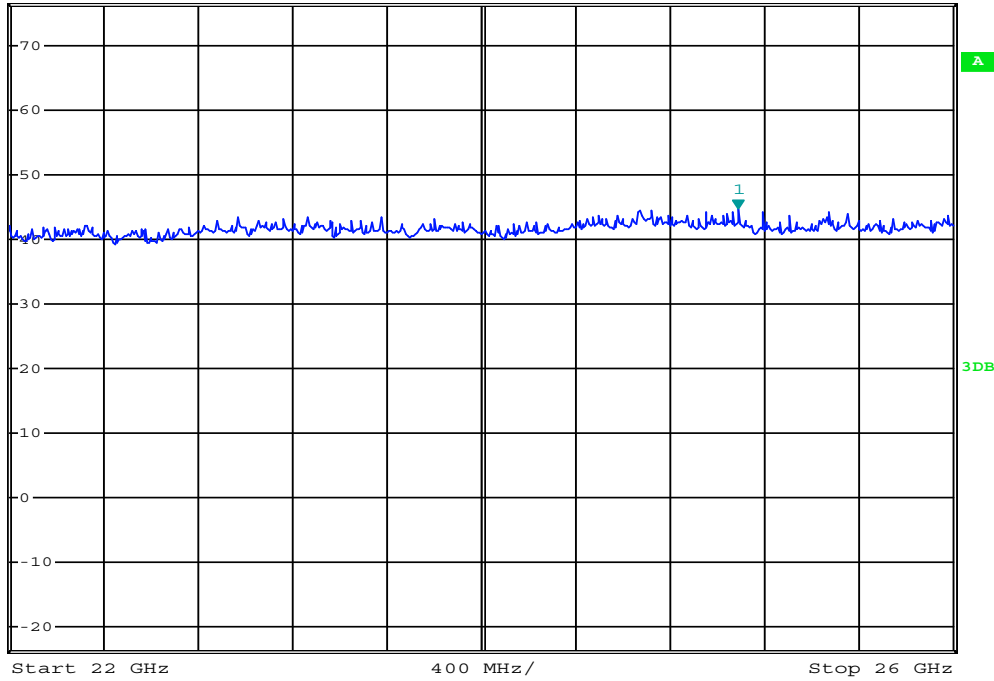
Radiated Rx Emissions:



```
* RBW 1 MHz      Marker 1 [T1 ]
  VBW 3 MHz      44.58 dBμV
  SWT 80 ms      25.088000000 GHz
```

Ref 76.3 dBμV * Att 0 dB

1 PK
VIEW



Date: 31.JAN.2023 17:14:32

Polarization: Vertical

Measured Emission:	ND	dBm
--------------------	----	-----

Summary of Radiated Rx Emissions

Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	46.0	n/a
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	43.5	n/a
1 - 3GHz	-	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	-	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	-	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	-	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	-	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	-	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	-	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	-	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

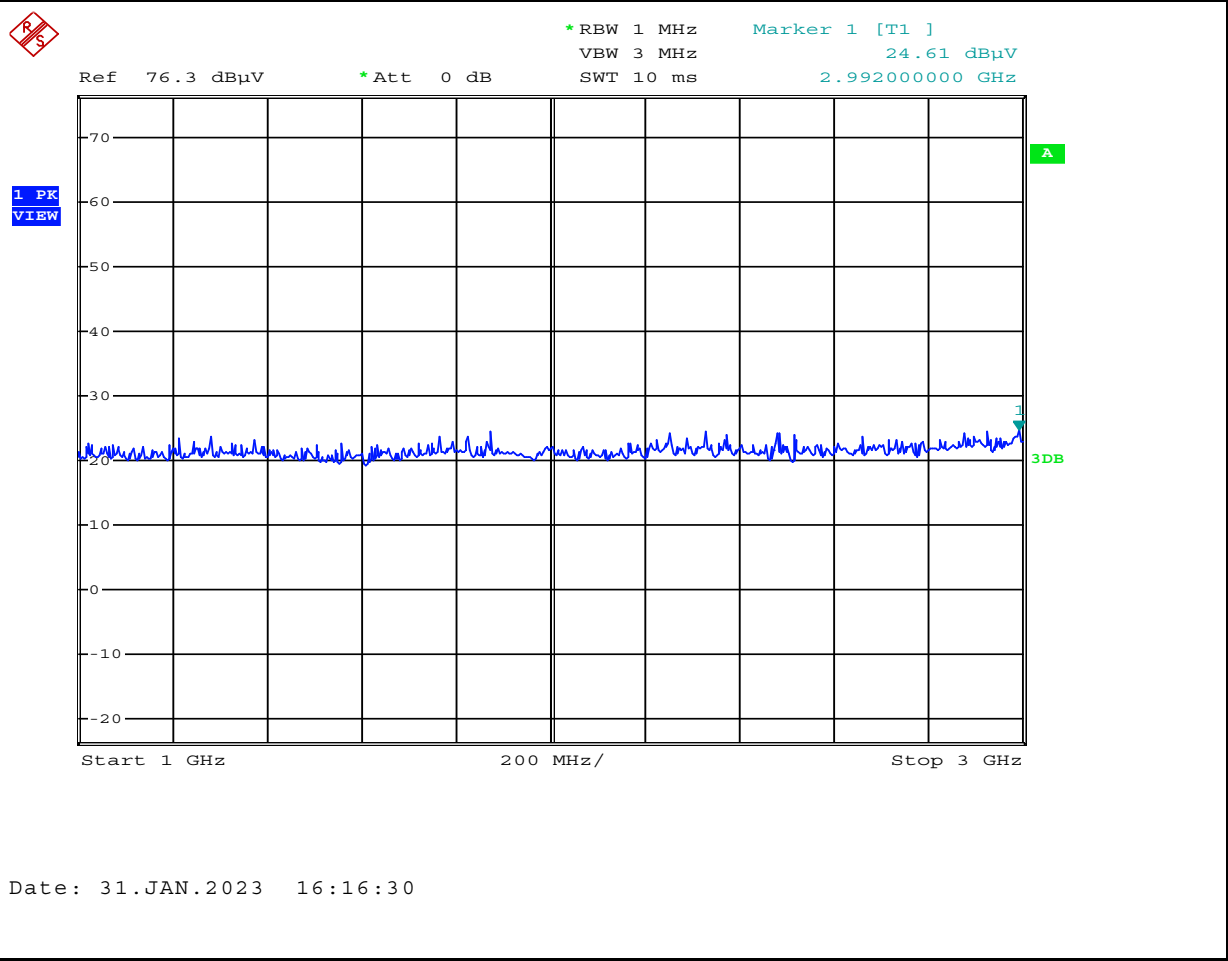
(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_{\text{C}} - G_{\text{A}}$$

Radiated Rx Emissions:

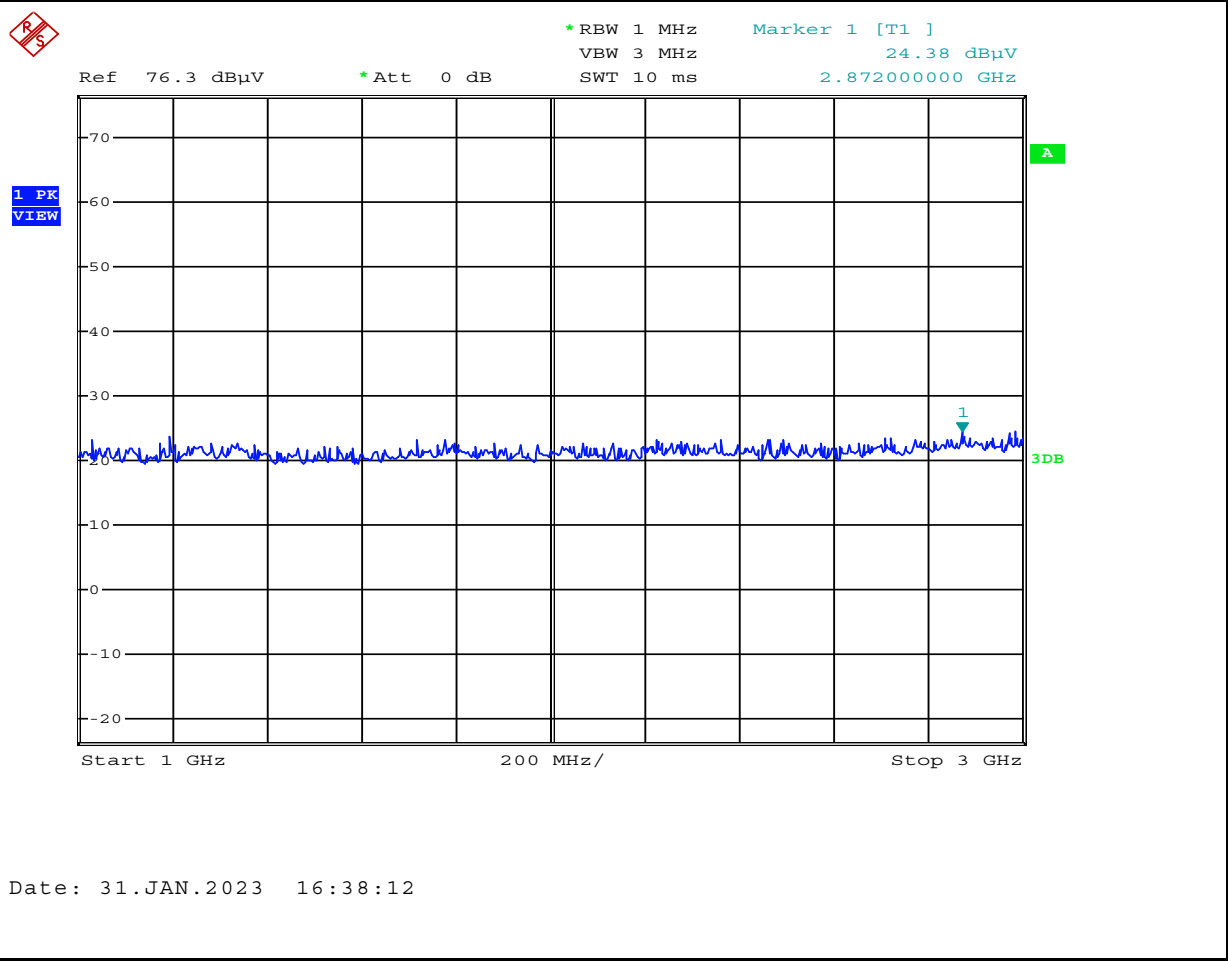


Polarization:

Marker 1 = Fundamental

Measured Emission: dBm

Radiated Rx Emissions:



Polarization:

Vertical

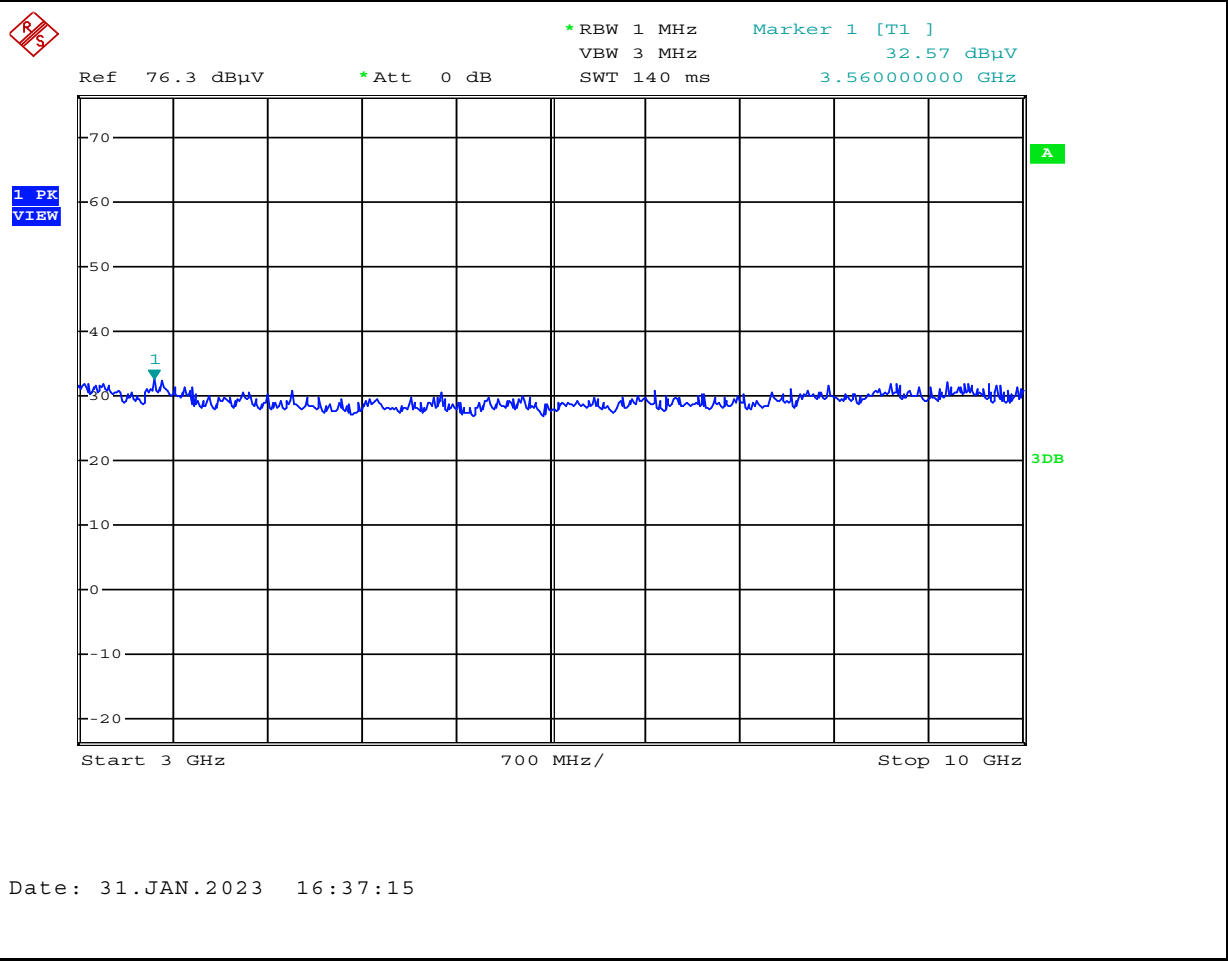
Marker 1 = Fundamental

Measured Emission:

ND

 dBm

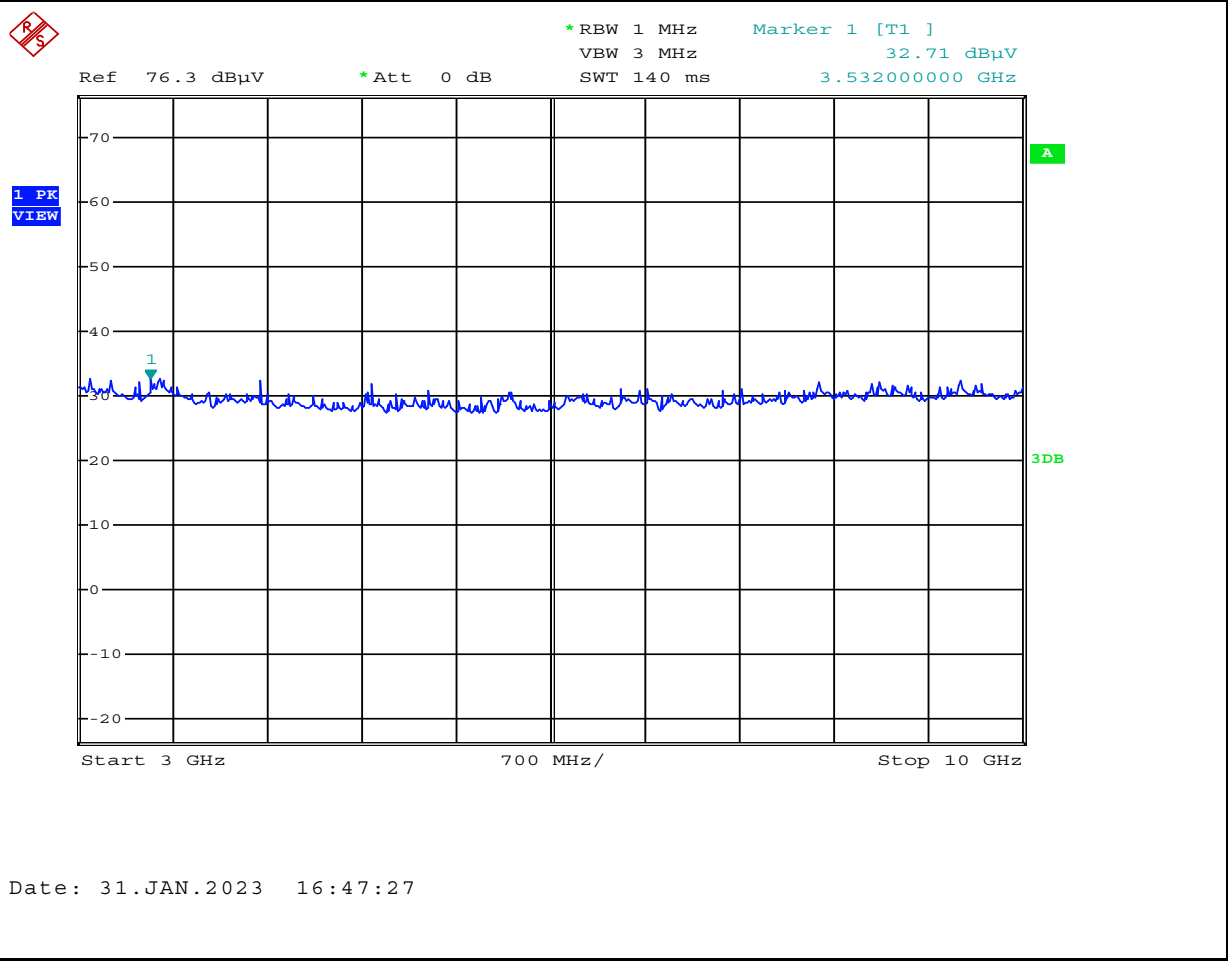
Radiated Rx Emissions:



Polarization:

Measured Emission: dBm

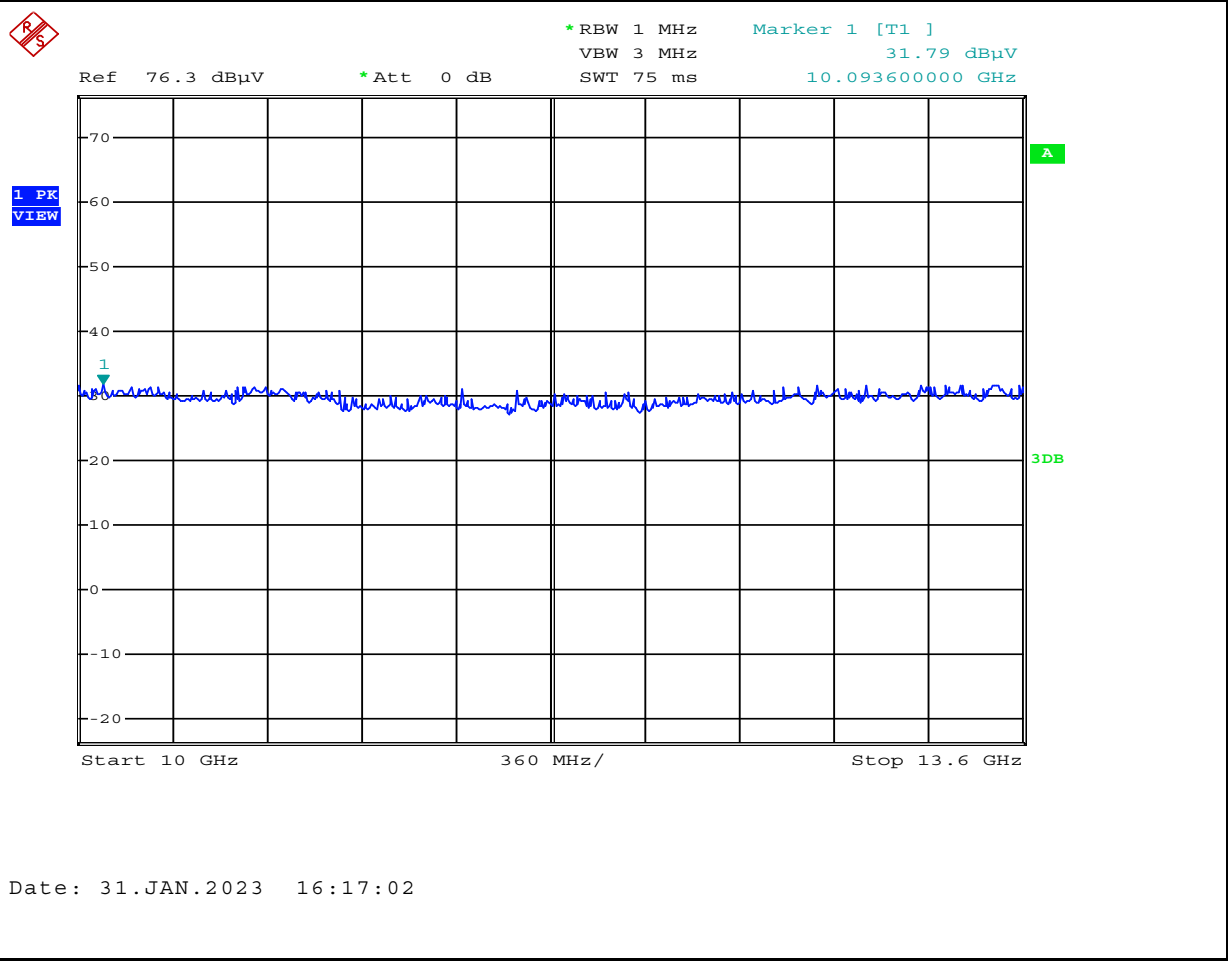
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

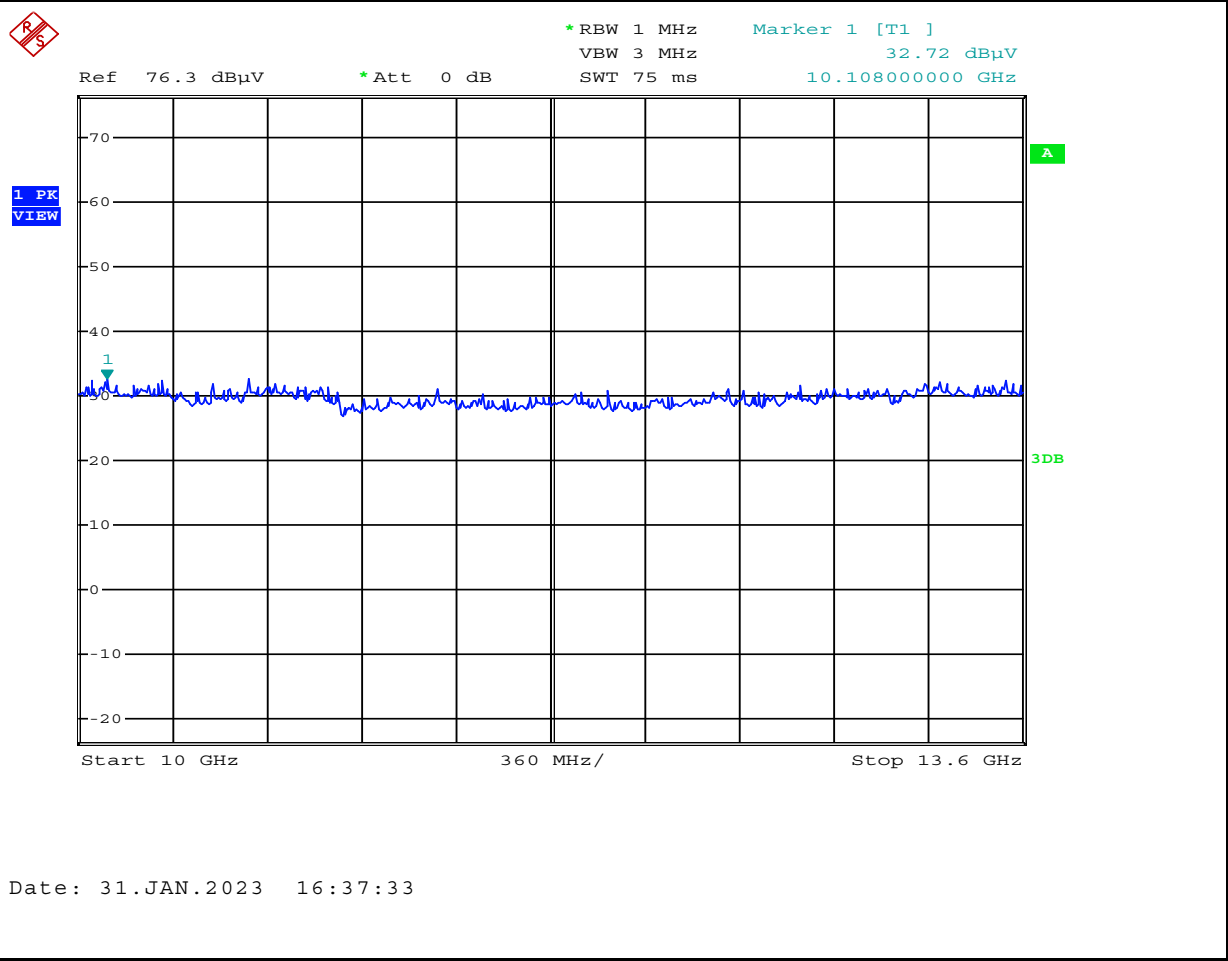
Radiated Rx Emissions:



Polarization: Horizontal

Measured Emission: ND dBm

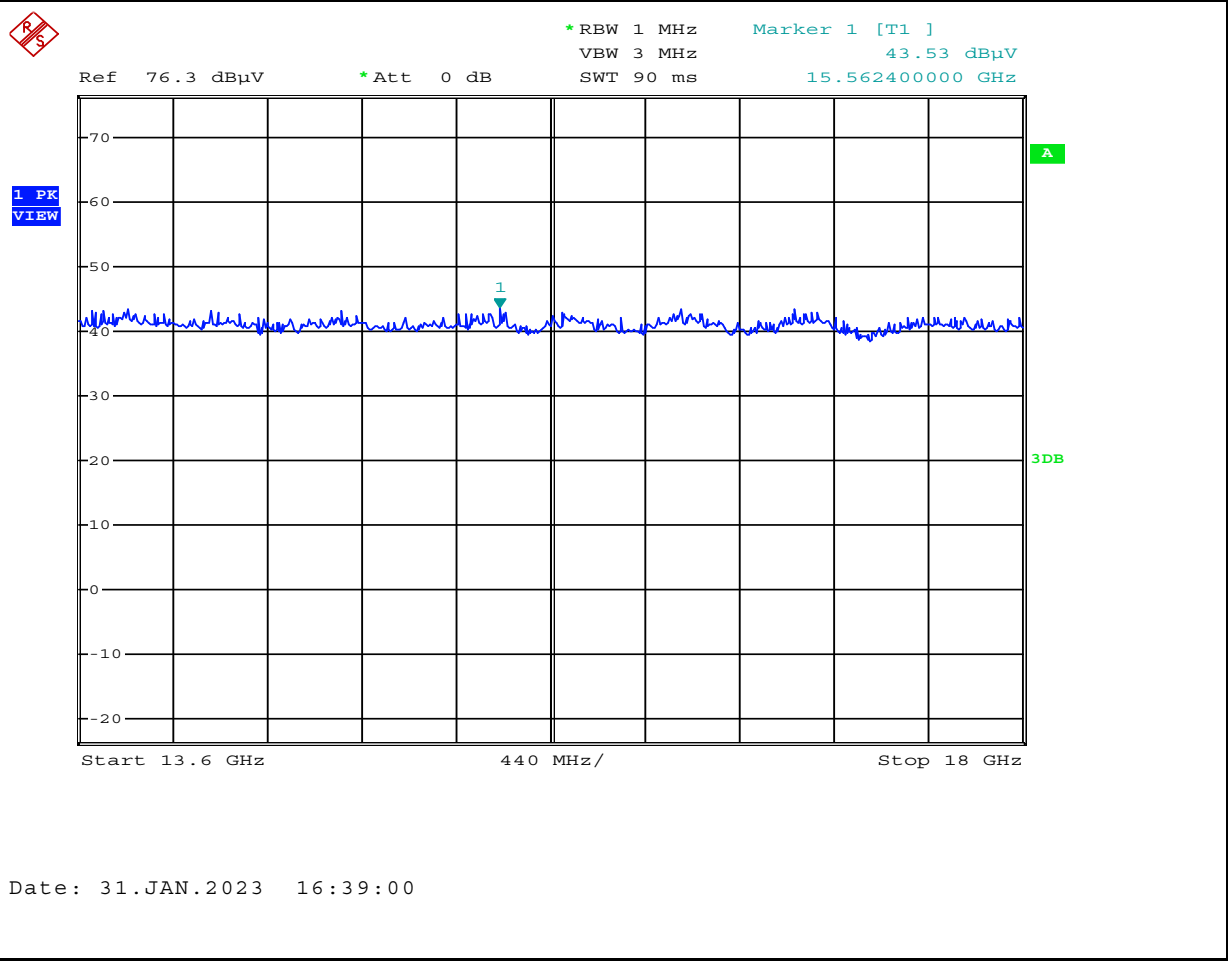
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

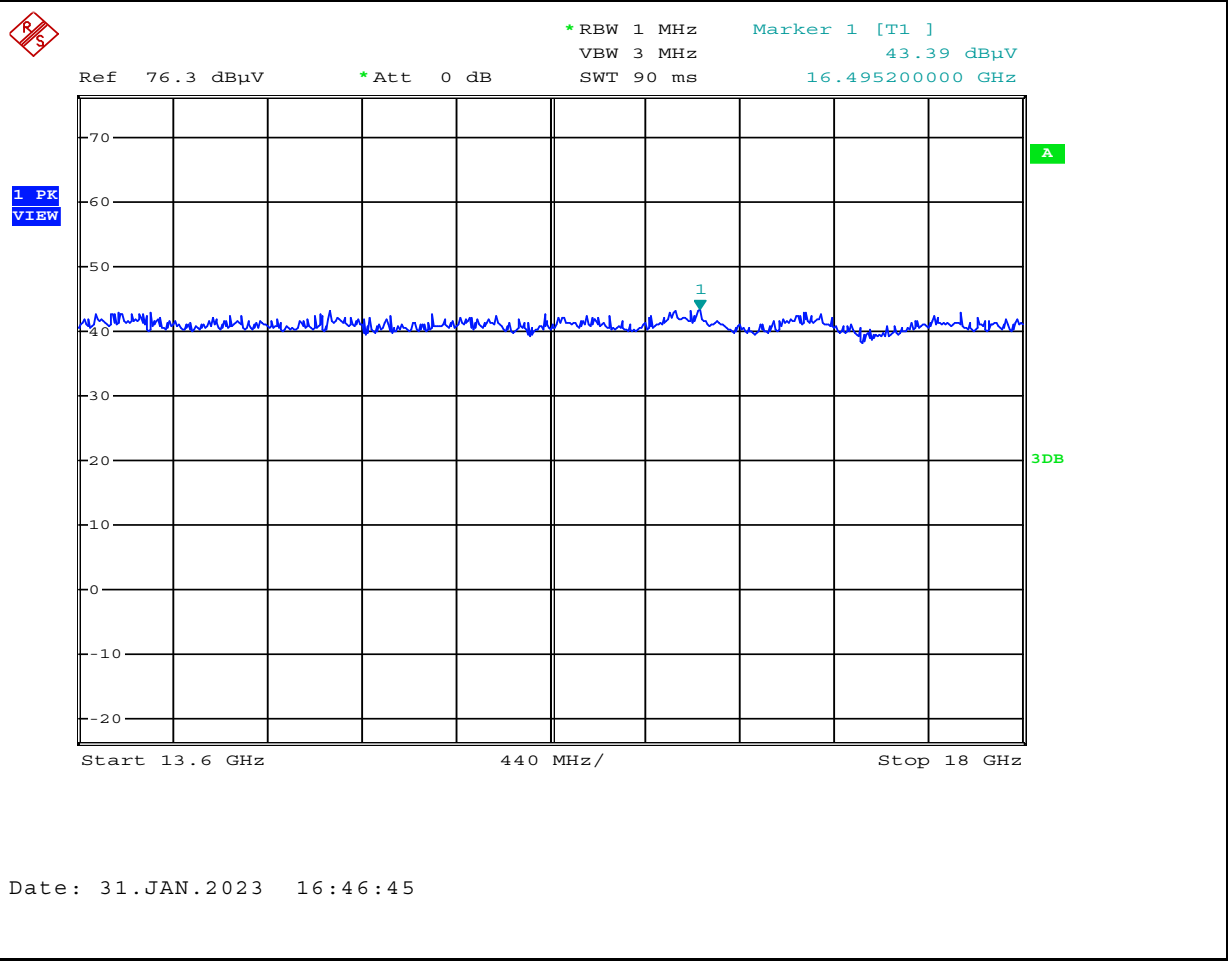
Radiated Rx Emissions:



Polarization:

Measured Emission: dBm

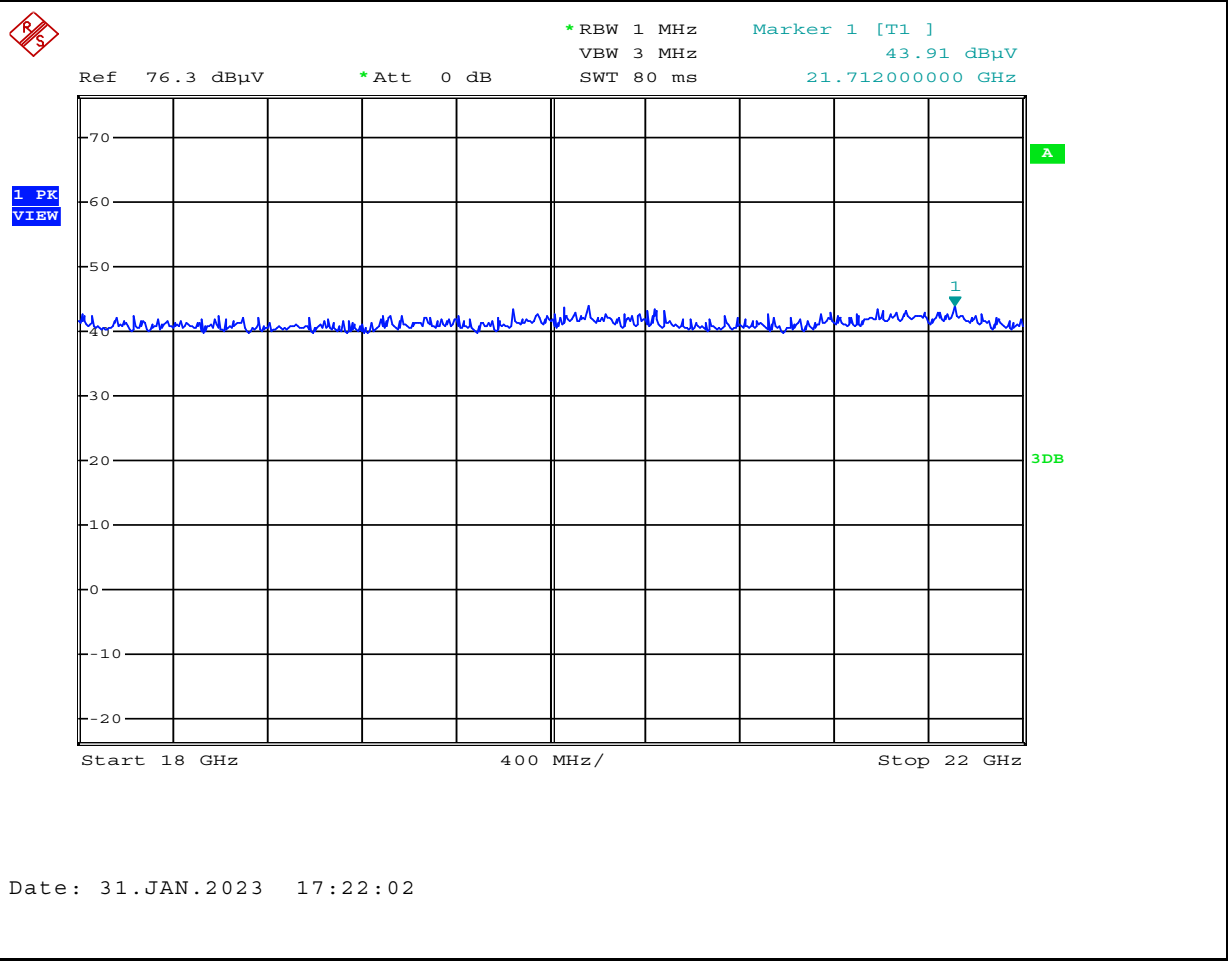
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

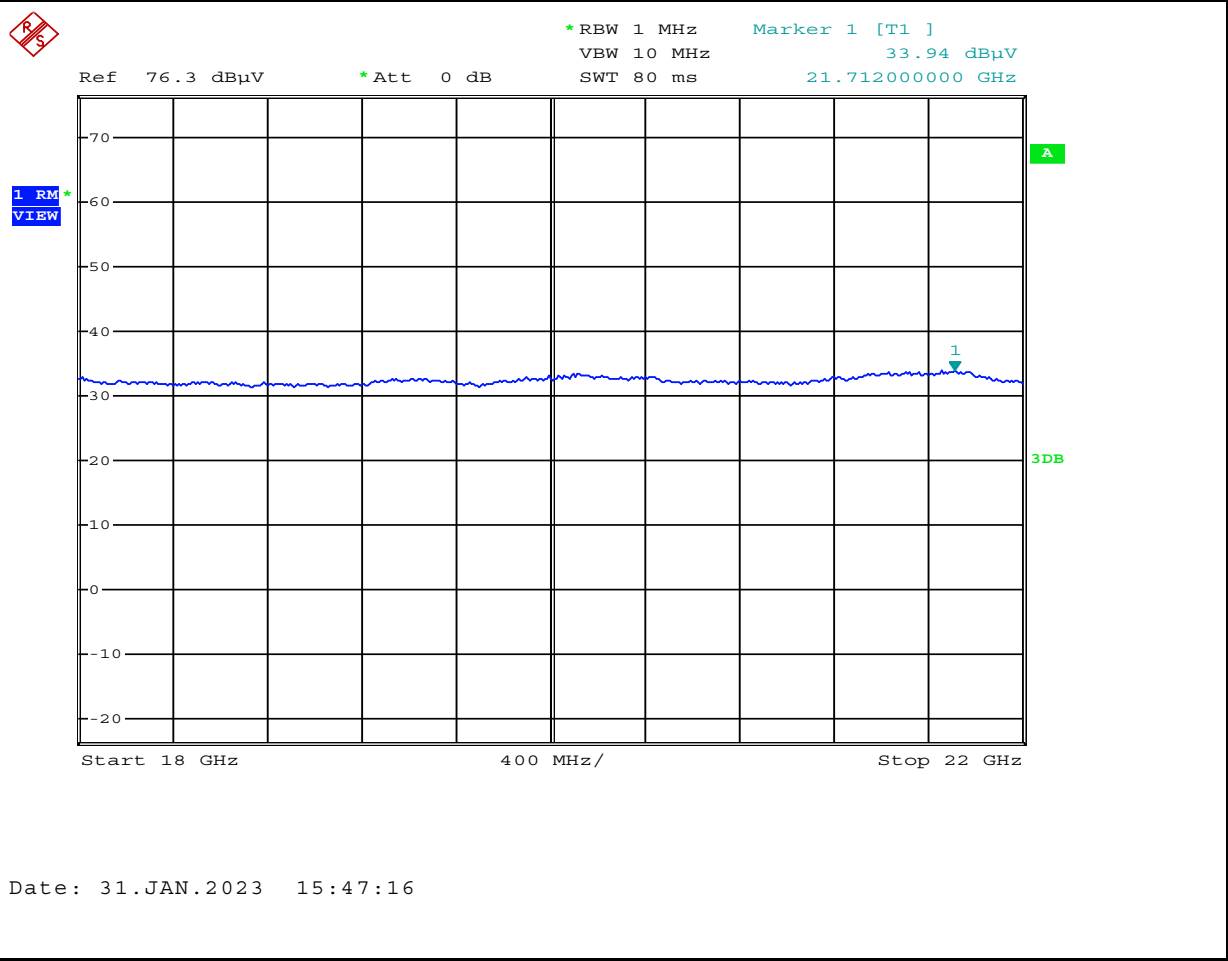
Radiated Rx Emissions:



Polarization: Horizontal

Measured Emission: ND dBm

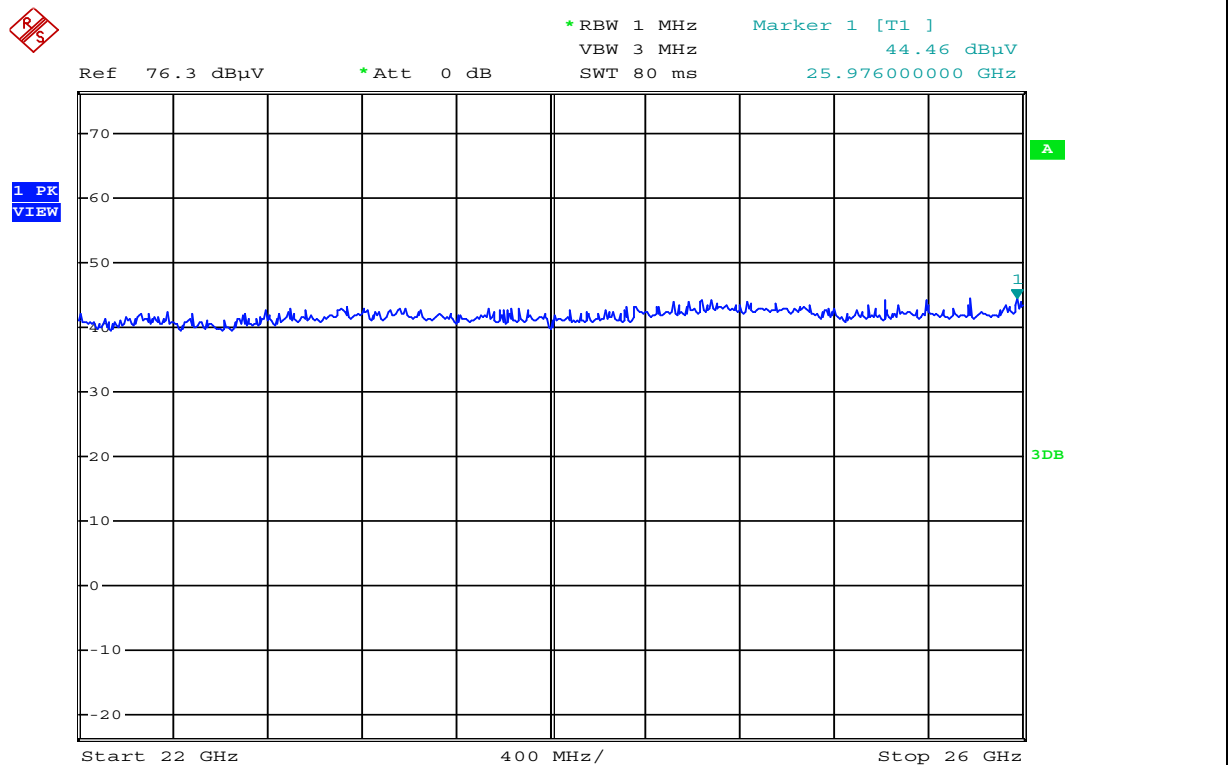
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

Radiated Rx Emissions:

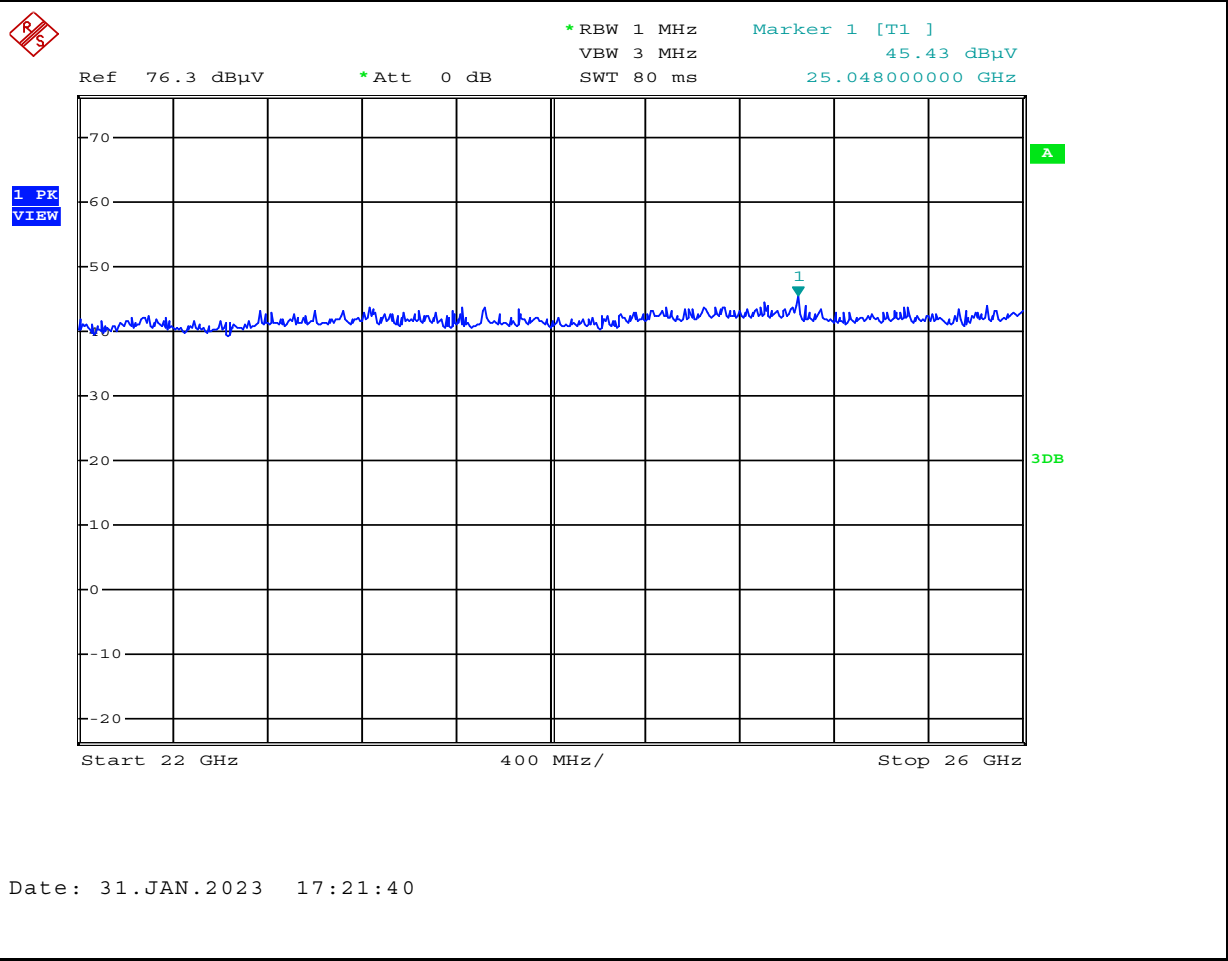


Date: 31.JAN.2023 17:31:11

Polarization: **Horizontal**

Measured Emission: **ND** dBm

Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm



Test Report Serial Number:	45461814 R1.0
Test Report Date:	1 March 2023
Project Number:	1620

EMC Test Report - New Certification

Applicant:



Garmin International Inc.
1200 East 151 St
Olathe, KS, 66062
USA

FCC ID:

IPH-A04597

Product Model Number / HVIN

A04597

IC Registration Number

-

Product Marketing Name / PMN

A04597

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.249), (§15.225), Part 15 Subpart
Part 15 Low Power Communication Device Transmitter (DXX)

Approved By:

Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada



Test Lab Certificate: 2470.01



**Industry
Canada**

IC Registration 3874A



FCC Registration: CA3874

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:		Art Voss, P.Eng.	Date(s) of Evaluation:		15 January - 13 February, 2023
Report Prepared By:		Art Voss, P.Eng.	Report Reviewed By:		Ben Hewson
Report Revision	Description of Revision		Revised Section	Revised By	Revision Date
0.1	Draft		n/a	Art Voss	14 February 2023
1.0	Initial Release		n/a	Art Voss	1 March 2023

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name	Garmin International Inc.
Applicant Address	1200 East 151 St
	Olathe, KS, 66062
	USA
DUT Information	
Device Identifier(s):	FCC ID: IPH-A04597
Device Model(s) / HVIN:	A04597
Device Marketing Name / PMN:	A04597
Test Sample Serial No.:	3430501782 - Conducted, 3430501693 - OTA
Device Type:	Extremity Worn Digital Transceiver
Equipment Class:	Digital Transmission Systems (DTS)
	Spread Spectrum Transmitter (DSS)
	Low Power Communication Device (DXX)
	Global Navigation Satellite System (GNSS) Receivers
	NFC - Low Power Communication Device Transmitter (DXX)
Transmit Frequency Range:	WiFi (DTS): 2412-2462MHz
	BT/BLE/ANT: 2402-2480MHz
	NFC: 13.56MHz
Manuf. Max. Rated Output Power:	WiFi - Digital Transmission System (DTS): 18.35dBm
	BlueTooth - Spread Spectrum Transmitter (DSS): 11.11dBm
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 2.10dBm
	NFC - Low Power Communication Device Transmitter (DXX): 55.19dBuV/m
Antenna Type and Gain:	-4.72dBi Max
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7
	BT BR: GFSK
	BT EDR: Pi/4-DQPSK, 8DPSK
	BLE: GMSK
	ANT: GFSK
	NFC: ASK
DUT Power Source:	3VDC Rechargeable Li-Ion
DUT Dimensions [LxWxH]	H x W x D: 42mm dia x 4.5mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE

Preface:

This Certification Report was prepared on behalf of:

Garmin International Inc.

,(the '*Applicant*'), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

Device:

The Garmin Model/HVIN: A04597 is an extremity worn digital transceiver device consisting of a WiFi, Bluetooth (BT), Bluetooth Low Energy (BLE), Adaptive Network Topology (ANT) and Near Field Communication (NFC) transceivers. The WiFi and BT/BLE/ANT transceivers share the same antenna and cannot simultaneously transmit.

Requirement:

The transceivers of this *equipment* are subject to emissions evaluation in accordance with FCC: 47 CFR 2, 15C. As per FCC 47 CFR §2.1093, an RF Exposure (SAR) evaluation is required for this *Equipment* and the results of the RF Exposure (SAR) evaluation appear in a separate report.

Application:

This is an application for a New Certification.

Scope:

The scope of this investigation is limited to the evaluation and reporting of the wanted and spurious emissions in accordance with the rule parts cited in Normative References section of this report.

4.0 TEST RESULT SUMMARY

TEST SUMMARY						
Section	Description of Test	Procedure Reference	Applicable Rule Part(s) FCC	Applicable Rule Part(s) ISED	Test Date	Result
7.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	RSS-Gen (6.7)	15, 21 Jan 2023	Pass
8.0	Field Strength (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	31 Jan 2023	Pass
9.0	20dB BW	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	31 Jan 2023	Pass
10.0	Band Edge (NFC)	ANSI C63.10-2013 KDB 558074 D01v05	§15.225(a)(c)	RSS-Gen (6.12) RSS-210 (B.10)	31 Jan 2023	Pass
11.0	Restricted Bands	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	31 Jan 2023	Pass
12.0	Radiated Rx Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	31 Jan 2023	Pass
13.0	Frequency Stability	ANSI C63.10-2013 KDB 558074 D01v05	§15.225	RSS-G210 B.6	26 Jan 2023	Pass
14.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	ICES-003(6.1)	25 Jan 2023	Pass

Test Station Day Log					
Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
15 Jan 2023	21.6	17	101.6	EMC	7
21 Jan 2023	21.9	18	101.4	EMC	7
25 Jan 2023	17.2	52	102.1	LISN	14
26 Jan 2023	14.6	35	102.7	TC	13
31 Jan 2023	0.0	87	101.5	OATS	8, 9, 10, 11, 12

EMC - EMC Test Bench

OATS - Open Area Test Site

LISN - LISN Test Area

IMM - Immunity Test Area

SAC - Semi-Anechoic Chamber

TC - Temperature Chamber

ESD - ESD Test Bench

RI - Radiated Immunity Chamber

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.



Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

14 February 2023

Date



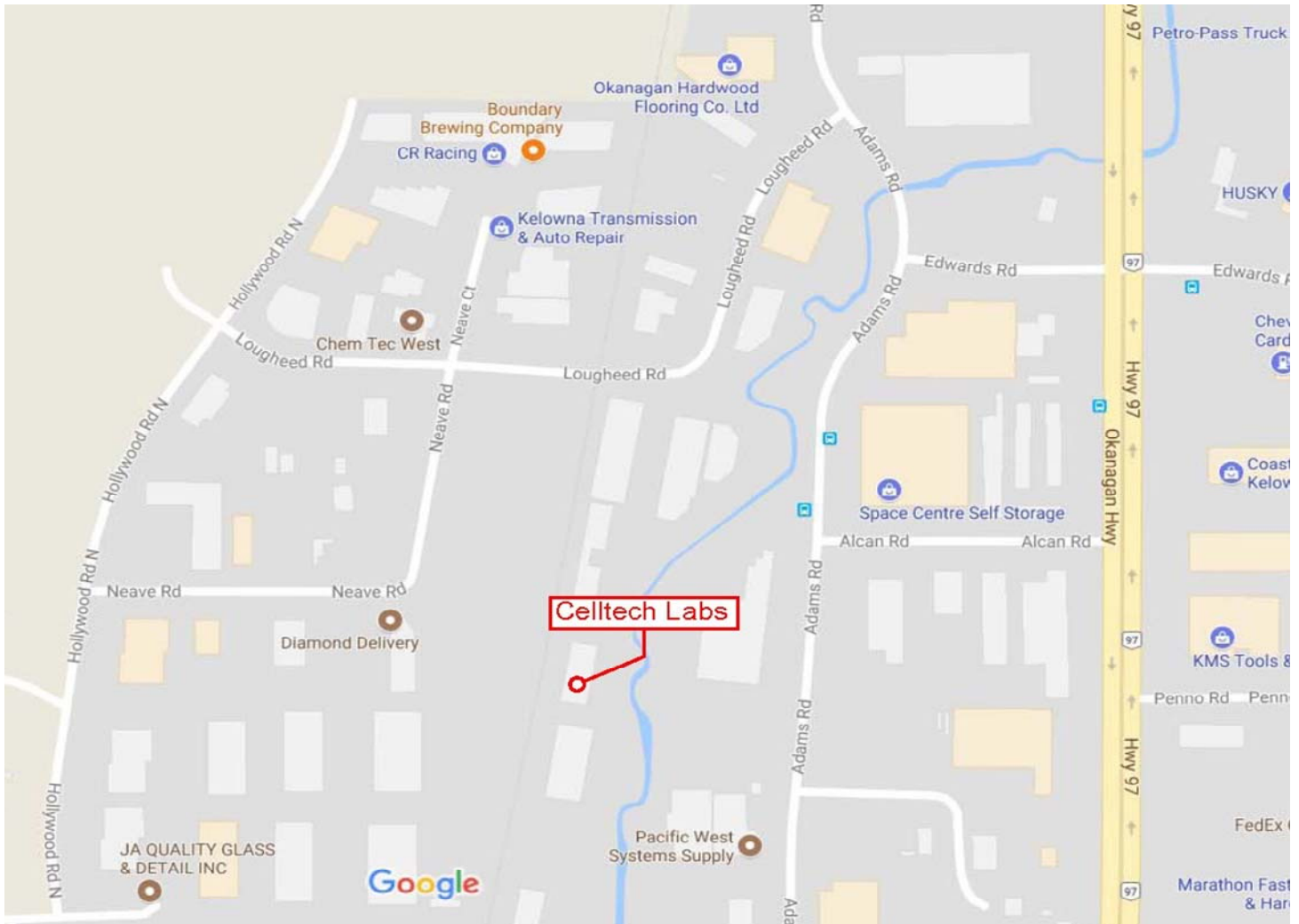
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.4-2014	American National Standard of Procedures for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electric and Electronic Equipment in the Range of 9kHz to 40GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR	Code of Federal Regulations Title 47: Telecommunication Part 2: Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Subpart B: Unintentional Radiators
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Sub Part C (15.225) Intentional Radiators
CFR	Code of Federal Regulations Title 47: Telecommunication Part 15: Radio Frequency Devices Sub Part C (15.249) Intentional Radiators
FCC KDB 558074 D01v05r02	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874A-1 and Industry Canada under Test Site File Number IC 3874A. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 OCCUPIED BANDWIDTH

Test Procedure

Normative	FCC 47 CFR §2.1046, RSS-Gen (6.1.2), RSS-247 (5.4)(d),
Reference	KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3)

General Procedure

C63.10 (6.9.3)

6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level. Specific guidance is given in 4.1.5.2.
- Step a) through step c) might require iteration to adjust within the specified range.
- Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

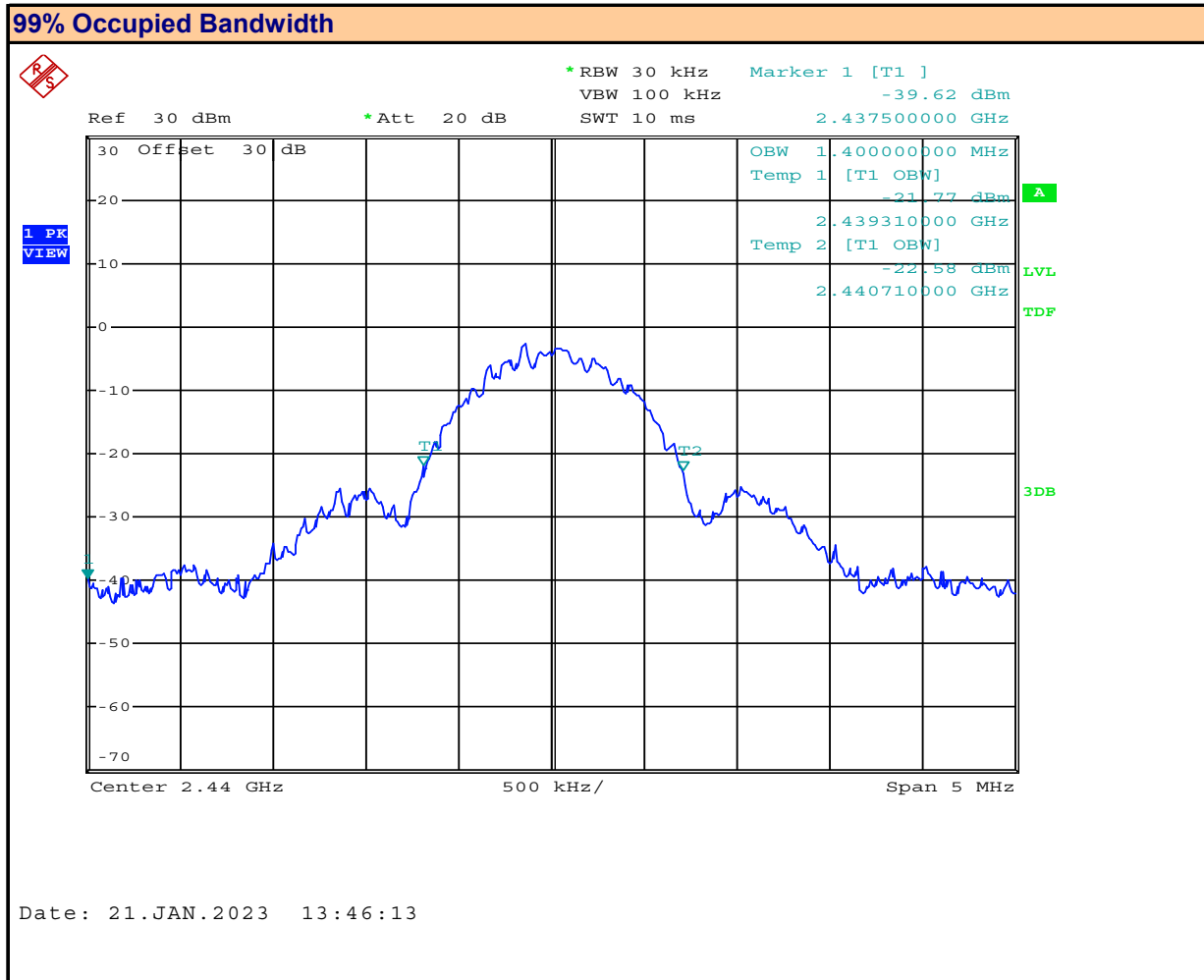
Test Setup

Appendix A - Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above using the 99% Occupied Bandwidth function. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The 99% Occupied Bandwidth was measured and recorded.

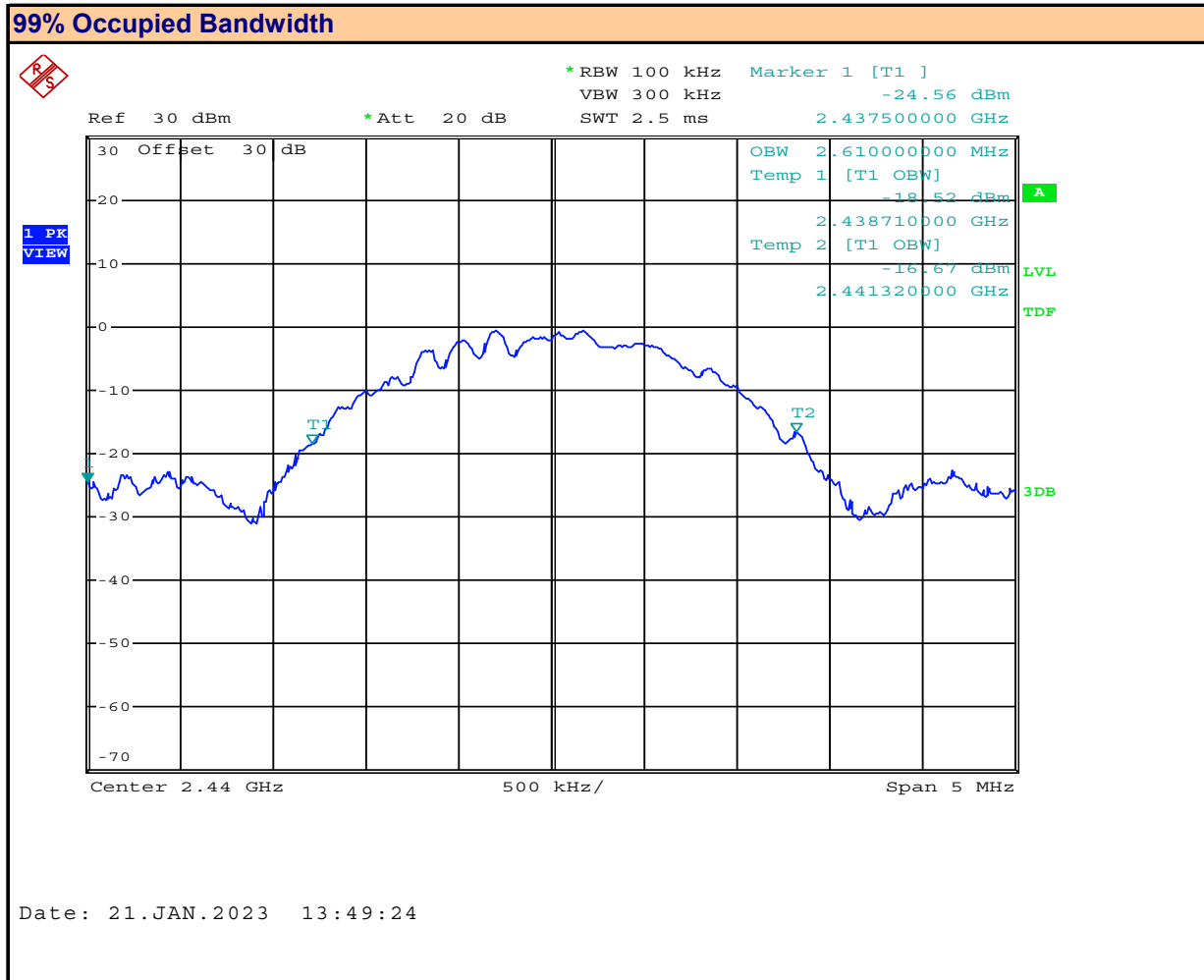
Plot 7.1 – Occupied Bandwidth, BLE1



Channel: **17**
Mode: **BT LE1**

Channel Frequency: **2440** MHz
Modulation: **GMSK**
Measured Occupied Bandwidth: **1.4** MHz

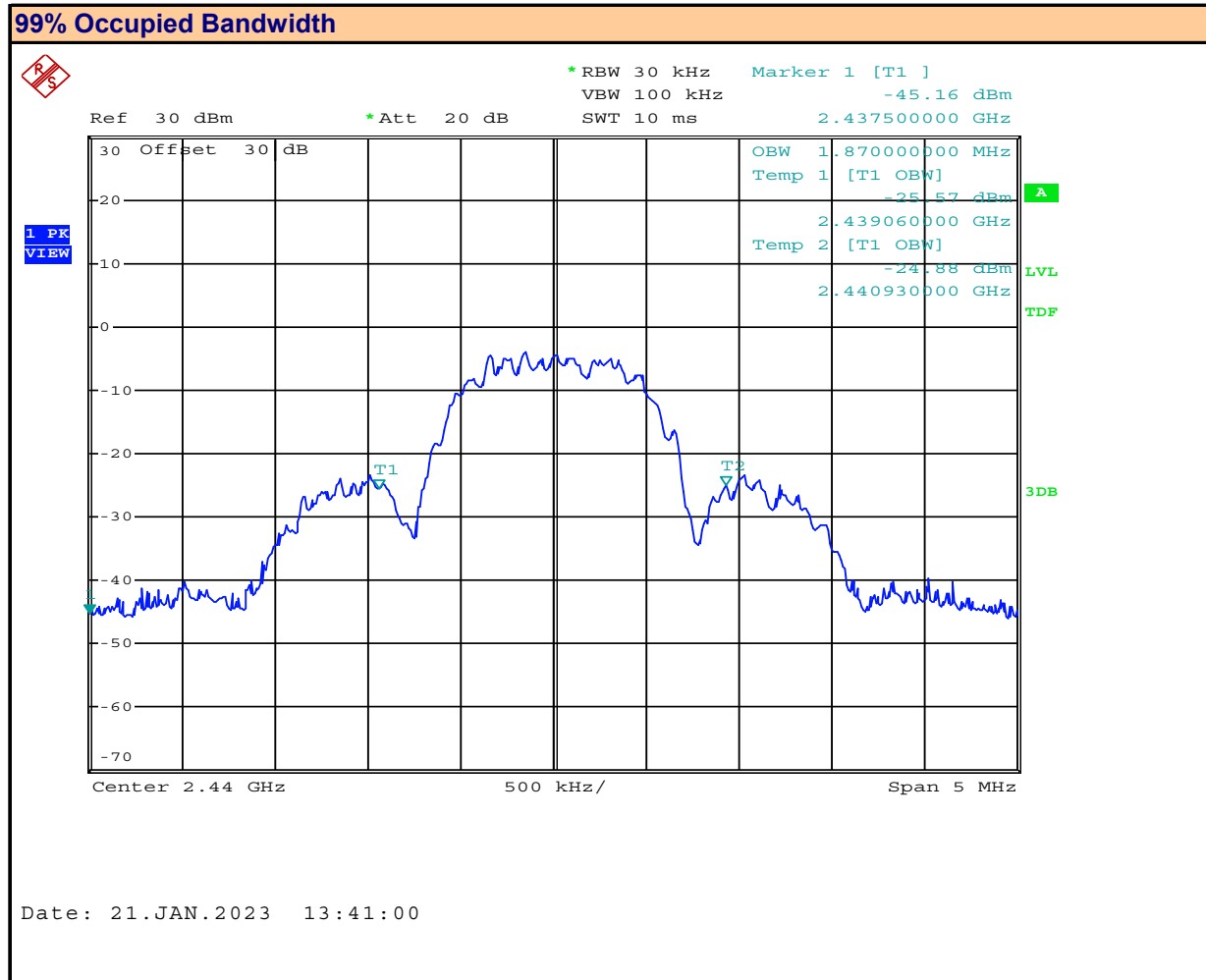
Plot 7.2 – Occupied Bandwidth, BLE2



Channel: **17**
Mode: **BT LE2**

Channel Frequency: **2440** MHz
Modulation: **GMSK**
Measured Occupied Bandwidth: **2.61** MHz

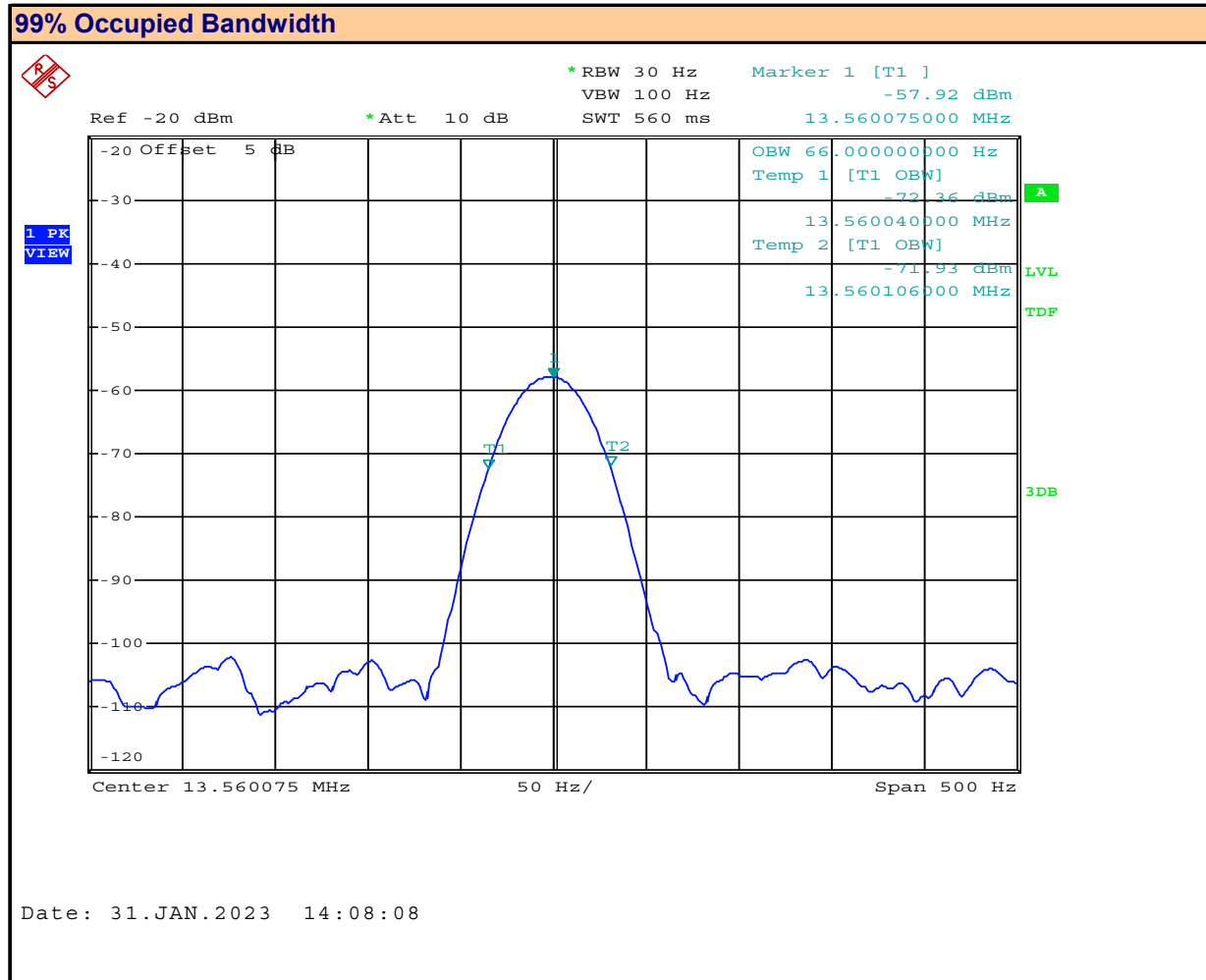
Plot 7.3 – Occupied Bandwidth, ANT



Channel: **38**
Mode: **ANT**

Channel Frequency: **2440** MHz
Modulation: **GFSK**
Measured Occupied Bandwidth: **1.87** MHz

Plot 7.4 – Occupied Bandwidth, NFC



Channel:
Mode:

Channel Frequency: MHz

Modulation:

Measured Occupied Bandwidth: Hz

Table 7.1 - Summary of Occupied Bandwidth Measurements (DXX)

99% Occupied Bandwidth Results:					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Occupied Bandwidth (MHz)	Emission Designator
17	2440.0	BT LE1	GMSK	1.400	1M40KF1D
17	2440.0	BT LE2	GMSK	2.610	2M61G1D
17	2440.0	ANT	GFSK	1.870	1M87F1D
-	13.6	NFC	ASK	66Hz	66HK1D
Result:					Complies

8.0 FIELD STRENGTH

Test Procedure

Normative Reference	FCC 47 CFR §2.1046, §15.249, RSS-210
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

Limits

§15.249(a)	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz. (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: 2400-2483.5MHz, Fundamental Field Strength: 50mV/m, Harmonic: 500uV/m
RSS-210 B.10(a)	Bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24-24.25 GHz (a) The field strength of fundamental and harmonic emissions measured at 3 m shall not exceed the limits in table B2. 2400-2483.5MHz, Fundamental Field Strength: 50mV/m, Harmonic: 500uV/m

General Procedure

C63.10 (6.5.4)	6.5.4 Final radiated emission tests Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported. Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.
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Test Setup	Appendix A	Figure A.2
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Measurement Procedure

The DUT place on a 80cm high turntable on an Open Area Test Site (OATS) at a distance of 3m from the measurement antenna. The DUT was set to transmit at maximum power and duty cycle. The DUT was rotated 360 degrees and scanned with the receive antenna elevated from 1 to 4m. The emissions were measured and recorded.

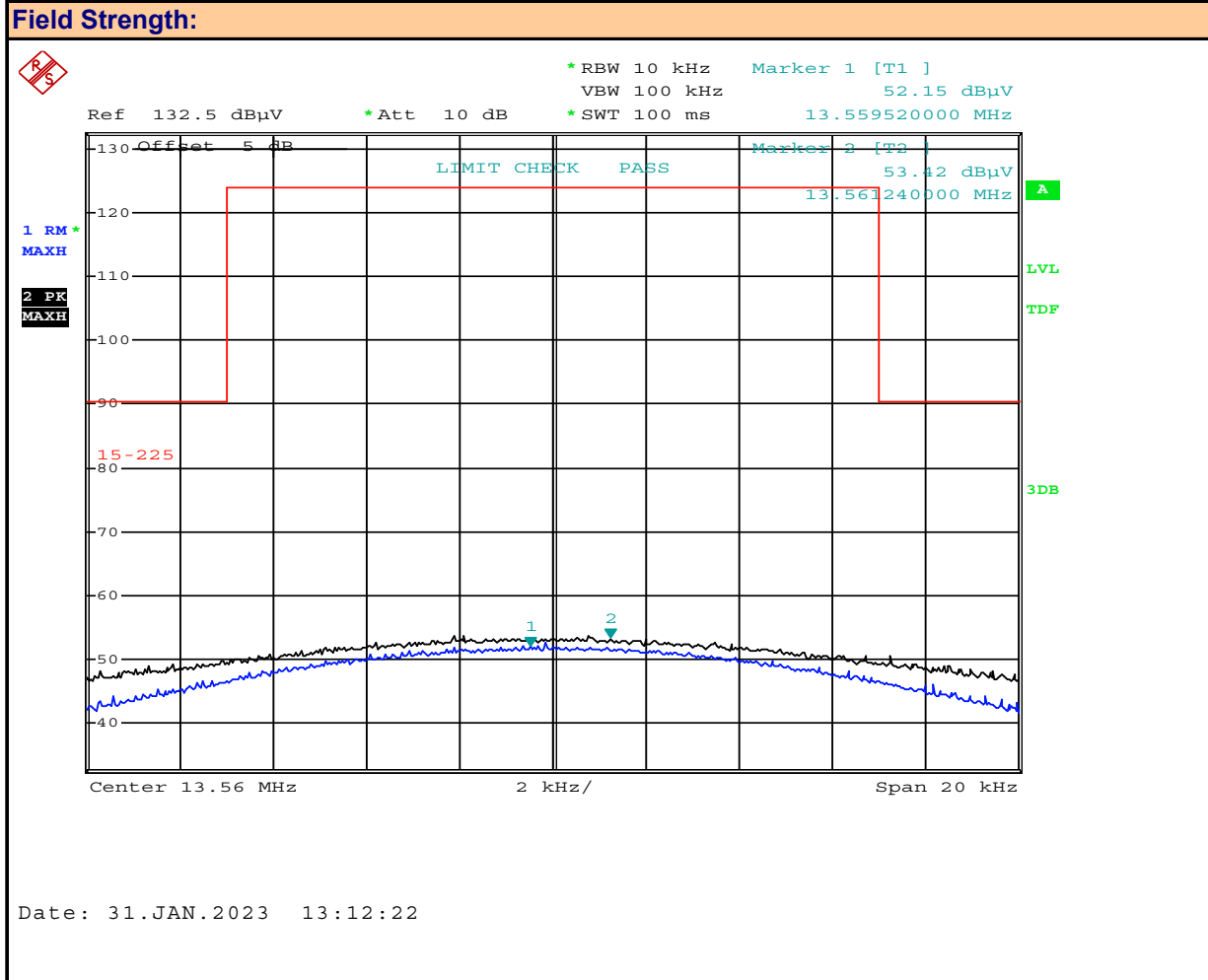
Table 8.1 - Summary of Field Strength Measurements (BT BLE)

See Appendix H for Measurement Plots

Conducted Power Measurement Results:											
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Antenna Polarization	Measured Field Strength [Avg] (dBuV/m)	Measured Field Strength [Peak] (dBuV/m)	Avg Limit (dBuV/m)	Avg Margin (dB)	Peak Limit (dBuV/m)	Peak Margin (dB)	
37	2402.00	BT LE1	GMSK	Horizontal	84.76	87.06	94.0	9.24	114	26.94	
				Vertical	87.41	89.17		6.59		24.83	
17	2440.00			Horizontal	85.33	87.37		8.67		26.63	
				Vertical	89.46	91.07		4.54		22.93	
39	2480.00			Horizontal	80.13	83.19		13.87		30.81	
				Vertical	83.12	85.79		10.88		28.21	
0	2404.00	BT LE2	GMSK	Horizontal	84.09	86.97		9.91		27.03	
				Vertical	83.12	92.13		10.88		21.87	
17	2440.00			Horizontal	81.97	85.51		12.03		28.49	
				Vertical	83.12	86.44		10.88		27.56	
36	2478.00			Horizontal	77.26	82.10		16.74		31.90	
				Vertical	79.75	84.14		14.25		29.86	
0	2402.00	ANT	GFSK	Horizontal	82.28	84.77		11.72		29.23	
				Vertical	84.70	86.88		9.30		27.12	
38	2440.00			Horizontal	81.34	84.35		12.66		29.65	
				Vertical	85.12	87.32		8.88		26.68	
78	2480.00			Horizontal	75.21	80.14		18.79		33.86	
				Vertical	81.59	84.48		12.41		29.52	
Result:									Complies		

Conducted Margin = $P_{Lim} - P_{Meas}$

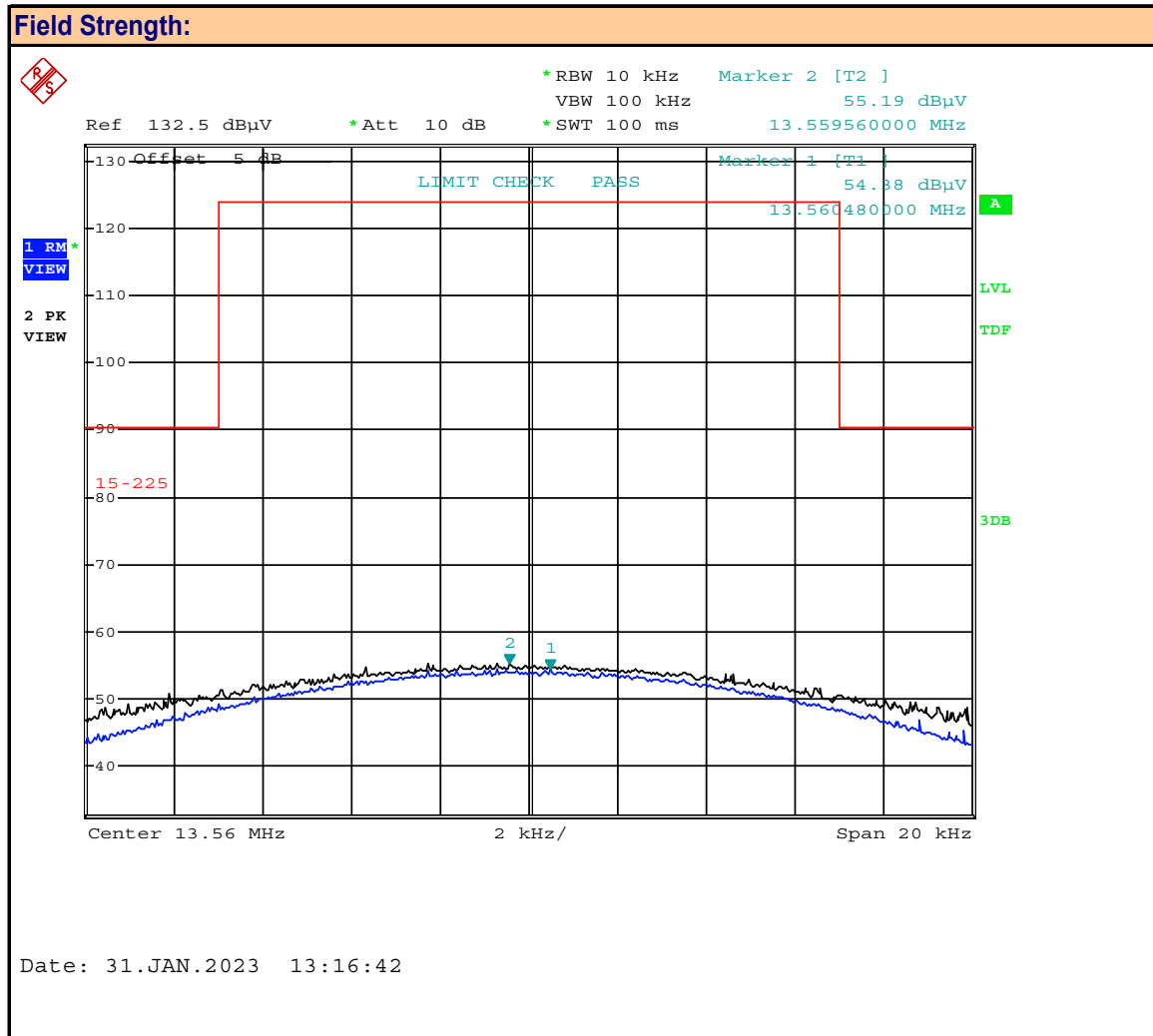
Plot 8.1 – Field Strength, NFC



Channel:
Mode:
Polarization:

Channel Frequency: MHz
Modulation:
Measured Field Strength (Avg): dBuV/m
Measured Field Strength (Pk): dBuV/m

Plot 8.1 – Field Strength, NFC



Channel:	-	Channel Frequency:	13.56 MHz
Mode:	NFC	Modulation:	ASK
Polarization:	Side	Measured Field Strength (Avg):	54.38 dBuV/m
		Measured Field Strength (Pk):	55.19 dBuV/m

Table 8.3 - Summary of Field Strength Measurements (NFC)

Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Measured Field Strength [FS _{Meas}] (dBuV @ 3m)	Cable Loss [L _C] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS _{Corr}] (dBuV/m @3m)	Limit @30m [Lim _{30m}] (dBuV/m)	Limit* @3m [Lim _{3m}] (dBuV/m)	Margin
13.56	NFC	ASK	RMS	Front	52.15	0.5	10.65	63.30	84.00	124.0	60.7
				Side	54.38			65.53			58.5
			Peak	Front	54.38			65.53	104.00	144.0	78.5
				Side	55.19			66.34			77.7
				Result:							

* Limit @ 3m = Limit @ 30m + 40dB/decade = 84dBuV/m + 40dB = 124dBuV/m (Average)

* Limit @ 3m = Limit @ 30m + 40dB/decade = 104dBuV/m + 40dB = 144dBuV/m (Peak)

$FS_{Corr} = FS_{Meas} + ACF + L_C$

$Margin = Limit_{3m} - FS_{Corr}$

Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Measured Field Strength [FS _{Meas}] (dBuV @ 3m)	Cable Loss [L _C] (dBm)	Receive Antenna [ACF ^H] (dBuA/m)	Corrected Field Strength [H _{Corr}] (dBuA/m @3m)	Limit @30m [Lim _{30m}] (dBuV/m)	Limit** @3m [Lim _{3m}] (dBuA/m)	Margin
13.56	NFC	ASK	RMS	Front	52.15	0.5	-40.85	11.80	84.00	72.5	60.7
				Side	54.38			14.03			58.5
			Peak	Front	54.38			14.03	104.00	92.5	78.5
				Side	55.19			14.84			77.7
				Result:							

** Limit @ 3m = Limit @ 30m + 40dB/decade = 84dBuV/m + 40dB = 124dBuV/m (Average)

** Limit @ 3m = Limit @ 30m + 40dB/decade = 104dBuV/m + 40dB = 144dBuV/m (Peak)

In accordance with ISED Notice 2020 - DRS0023:

"Guidance on Magnetic Field Strength Radiated Emissions Measurements 9kHz - 30MHz"

Limit Correction

$Limit^H (dBuA/m) = Limit^E (dBuV/m) - Z_0 (dB\Omega)$

Where Z_0 = Free-Space Impedance = $120\pi\Omega = 377\Omega \Rightarrow 20\log 377\Omega = 51.5dB\Omega$

$Limit^H (dBuA/m) = Limit^E (dBuV/m) - Z_0 (dB\Omega) = 124dBuV/m - 51.5dB\Omega = 72.5dBuA/m @ 3m$ (Average)

$Limit^H (dBuA/m) = Limit^E (dBuV/m) - Z_0 (dB\Omega) = 144dBuV/m - 51.5dB\Omega = 92.5dBuA/m @ 3m$ (Peak)

Measurement Correction

$H_{Corr} (dBuA/m) = E_{Meas} (dBuV) + ACF^H (dB/\Omega m) + L_C - G_A$

Where ACF^H is the Magnetic Antenna Correction Factor, L_C is Cable Loss, G_A is Pre-Amplifier Gain

External Pre-Amplifier (G_A) not used

$Margin = Limit_{3m} - H_{Corr}$

9.0 20DB BW

Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.215
	ANSI C63.10 (6.10.3)

Limits

§15.215(c)	Additional provisions to the general radiated emission limitations. (c) 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 20 dB 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.
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General Procedure

C63.10 (6.3.10)	6.10.3 Unlicensed wireless device operational configuration Set the EUT to operate at 100% duty cycle or equivalent “normal mode of operation.”⁵⁴ Testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.⁵⁵ Testing shall be performed for each frequency with every applicable unlicensed wireless device configuration. If more than one power output level is available, then testing shall be done with the appropriate maximum power output for each antenna combination or modulation, as recorded in the unlicensed wireless device conducted power measurement results. The highest gain of each antenna type shall be used for this test.
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⁵⁴ For unlicensed wireless devices unable to be configured for 100% duty cycle even in test mode, configure the system for the longest duration duty cycle supported.

⁵⁵ Some radios operating, for example, in the 2.4 GHz band, have hardware capability to operate at frequencies outside the band permitted by the regulatory authority. Testing shall only be done at the lowest and highest frequencies within the allowed frequency band (see Annex A for examples of regulatory requirements and frequency ranges).

Test Setup	Appendix A	Figure A.1
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Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above. The output power of the DUT was set to the manufacturer's highest output power setting at the Low and High frequency channels as permitted by the device. The unwanted band edge emissions were measured and recorded.

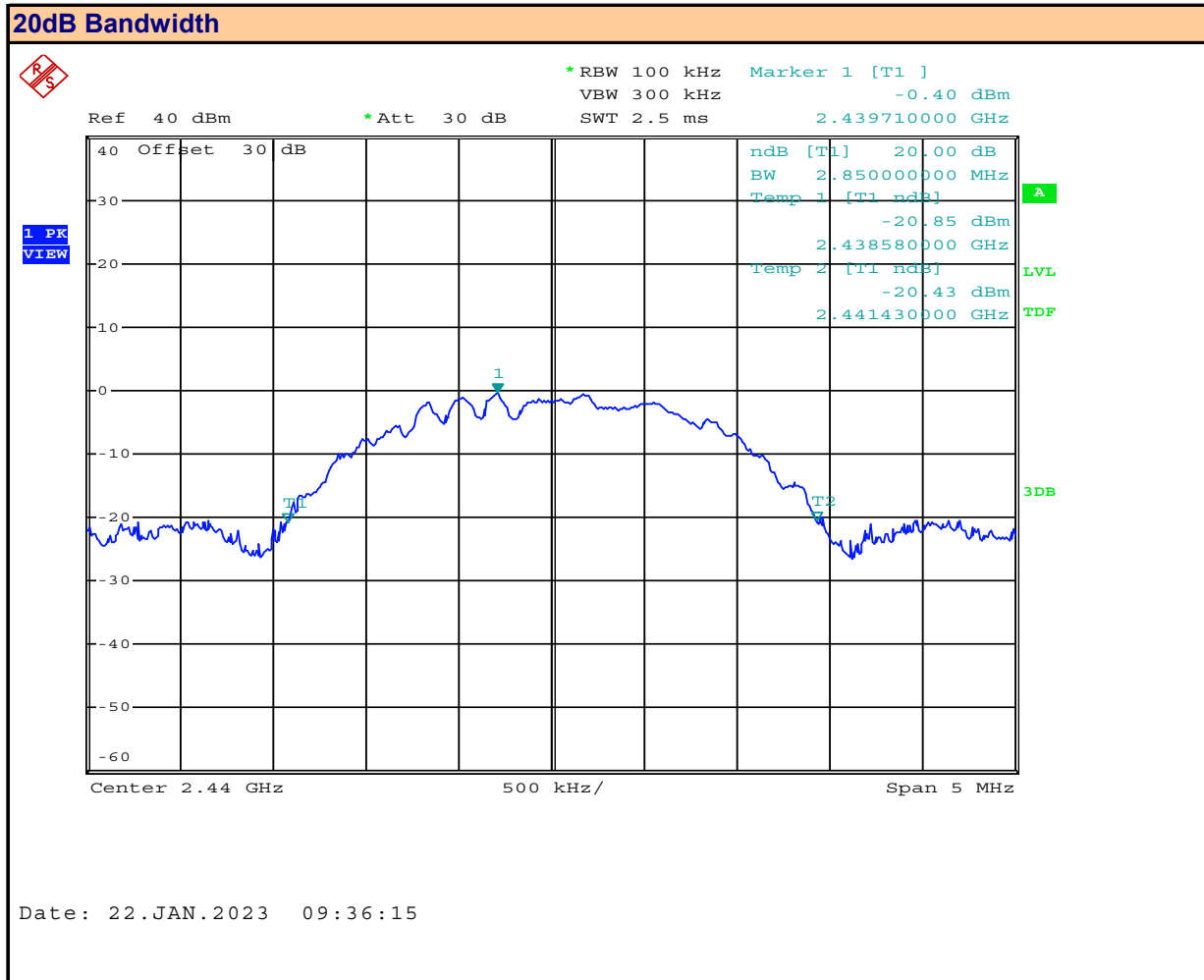
Plot 9.1 – 20dB Bandwidth, BLE1



Channel: **17**
Mode: **BT LE1**

Channel Frequency: **2440** MHz
Modulation: **GMSK**
Measured 20dB Bandwidth: **1.476** MHz

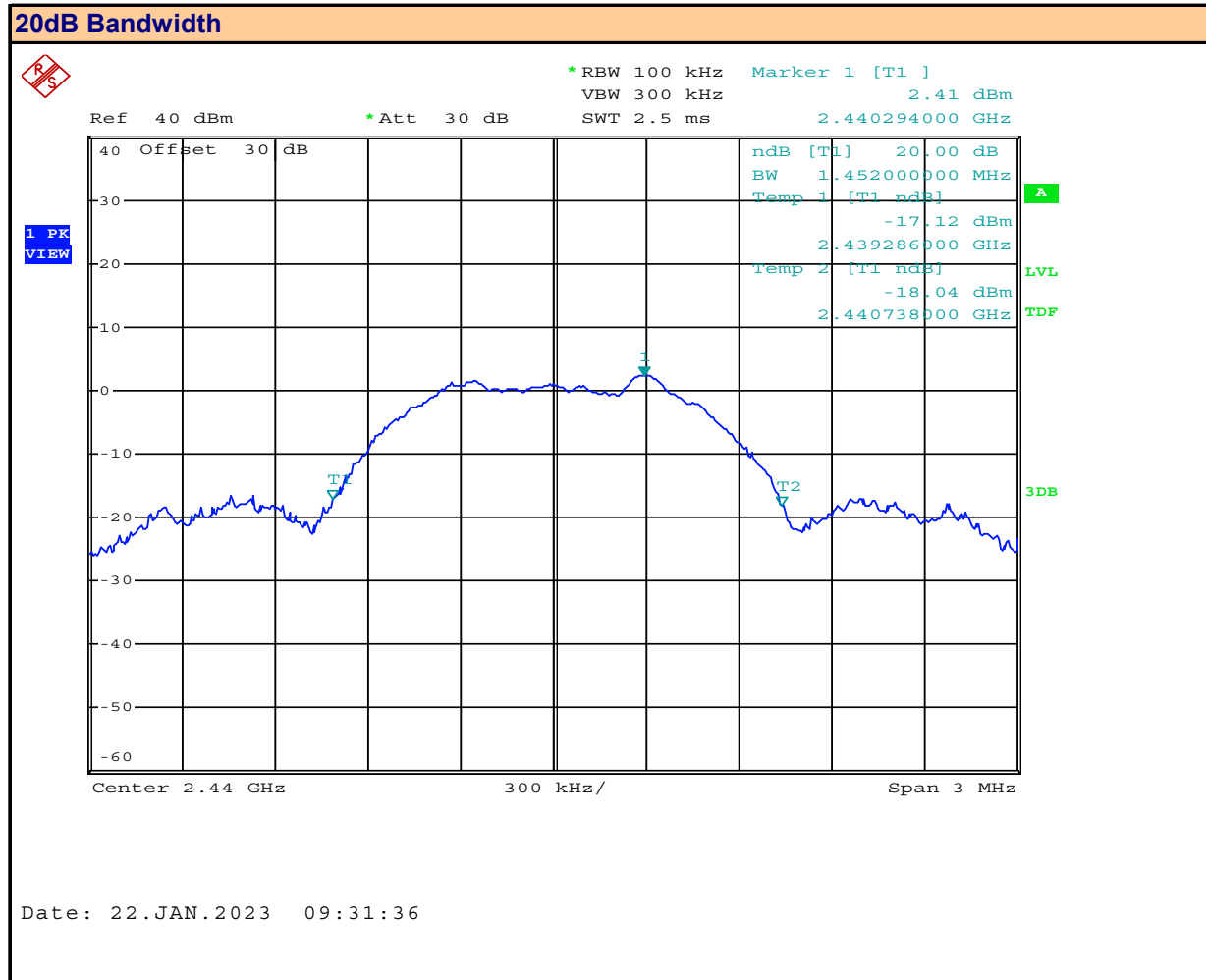
Plot 9.2 – 20dB Bandwidth, BLE2



Channel: **17**
Mode: **BT LE2**

Channel Frequency: **2440** MHz
Modulation: **GMSK**
Measured 20dB Bandwidth: **2.85** MHz

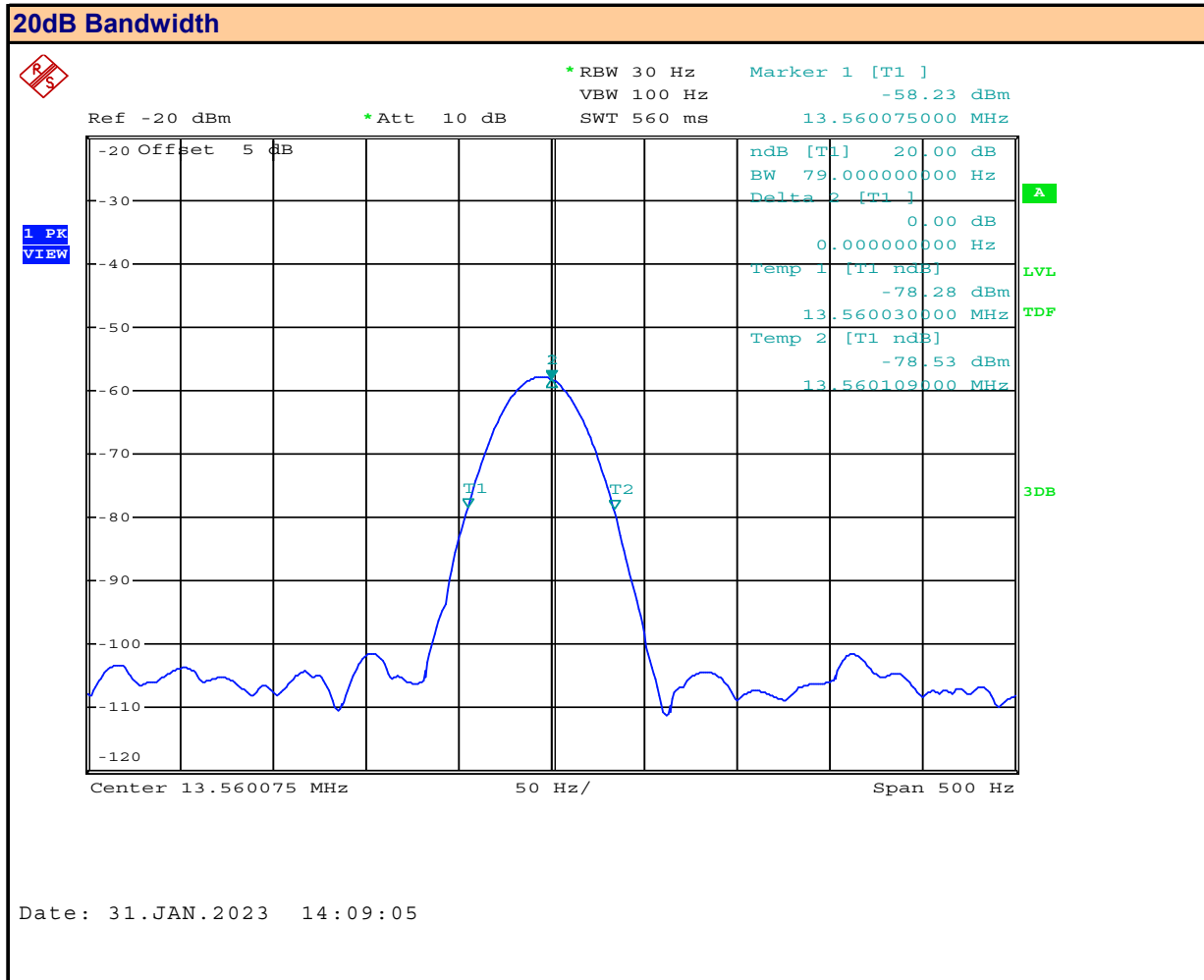
Plot 9.3 – 20dB Bandwidth, ANT



Channel: **38**
Mode: **ANT**

Channel Frequency: **2440** MHz
Modulation: **GFSK**
Measured 20dB Bandwidth: **1.452** MHz

Plot 9.4 – 20dB Bandwidth, NFC



Channel:
Mode:

Channel Frequency: MHz
Modulation:
Measured 20dB Bandwidth: Hz

Table 9.1 - Summary of 20dB BW Measurements

20dB Bandwidth Results:				
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured 20dB Bandwidth (MHz)
17	2440.0	BT LE1	GMSK	1.476
17	2440.0	BT LE2	GMSK	2.850
38	2440.0	ANT	GFSK	1.452
-	13.6	NFC	ASK	79Hz
Result:				Complies

10.0 OUT-OF-BAND EMISSIONS- NFC

Test Procedure

Normative Reference	FCC 47 CFR §2.1046, §15.225, RSS-210
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

Limits

§15.225	Operation within the band 13.110-14.010 MHz. (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters. (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters. (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters. (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.
RSS-210 B.10(6)	Band 13.110-14.010 MHz (a) the field strength of any emission shall not exceed the following limits: (i) 15.848 mV/m (84 dBµV/m) at 30 m, within the band 13.553-13.567 MHz (ii) 334 µV/m (50.5 dBµV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz (iii) 106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz (iv) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz

General Procedure

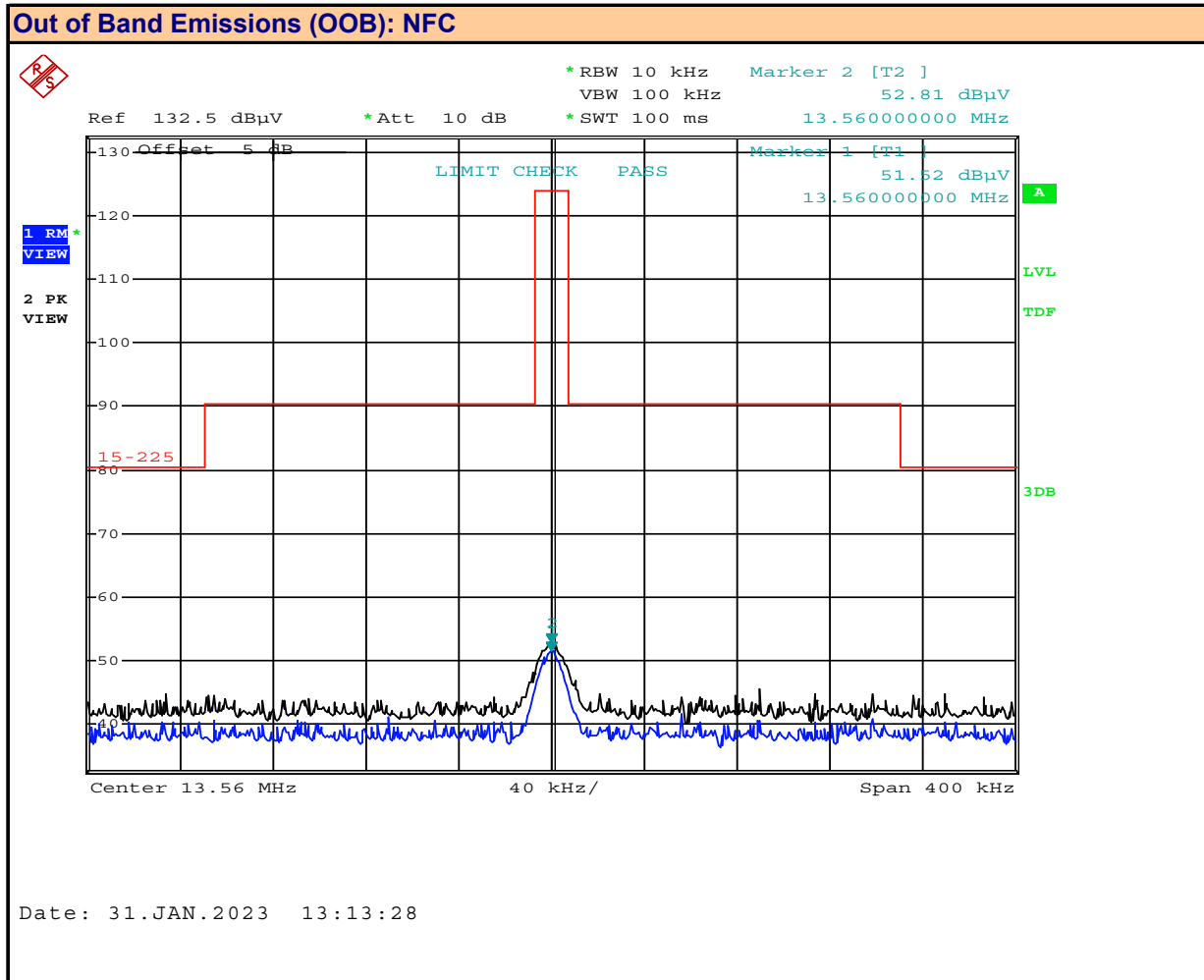
C63.10 (6.5.4)	6.5.4 Final radiated emission tests Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported. Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.
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Test Setup	Appendix A	Figure A.2
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Measurement Procedure

The DUT place on a 80cm high turntable on an Open Area Test Site (OATS) at a distance of 3m from the measurement antenna. The DUT was set to transmit at maximum power and duty cycle. The DUT was rotated 360 degrees and scanned with the receive antenna elevated from 1 to 4m. The emissions were measured and recorded.

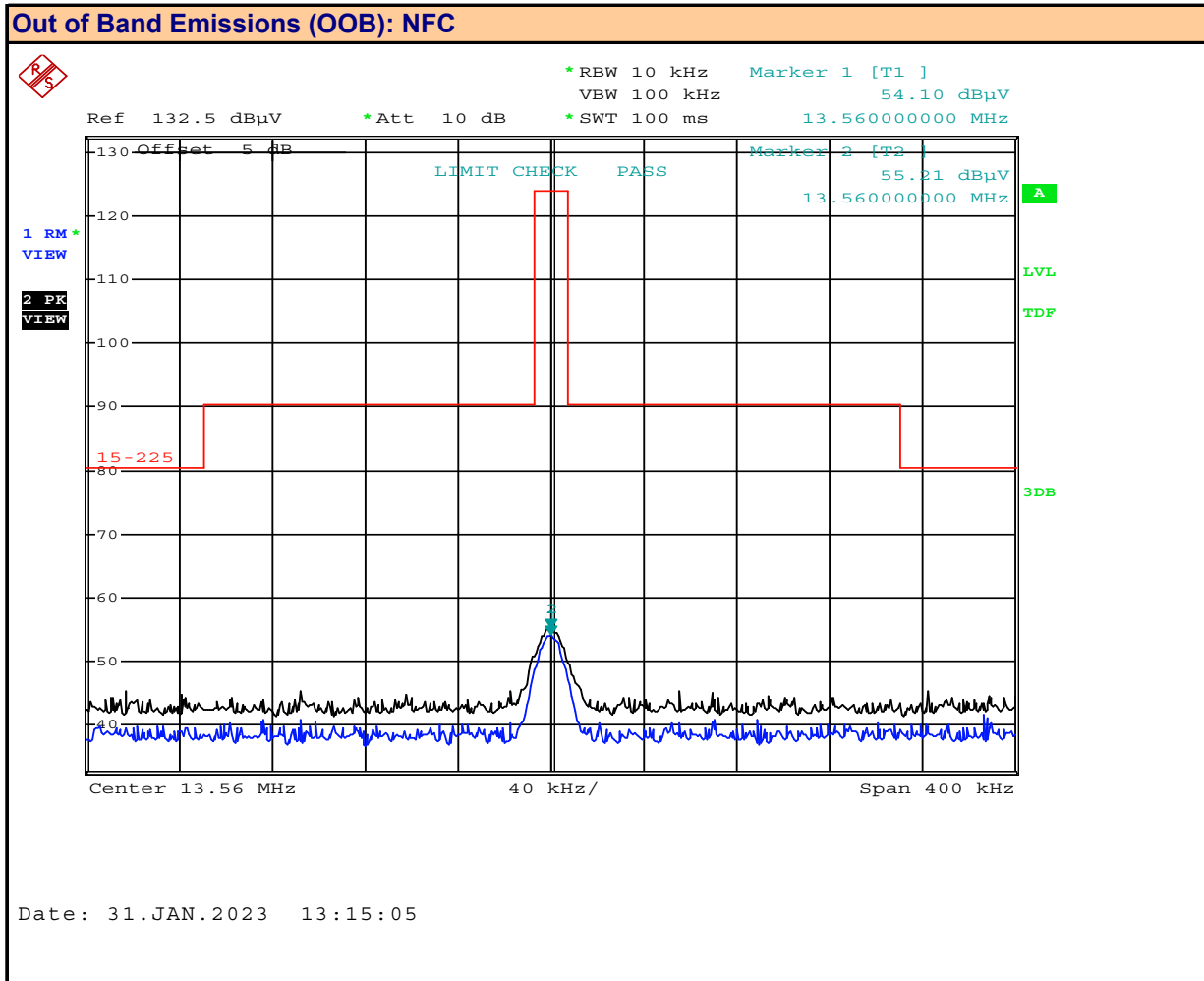
Plot 10.1 – Out of Band Emissions, NFC



Channel: -
Mode: NFC
Polarization: Front

Channel Frequency: 13.56 MHz
Modulation: ASK
Measured OOB Emissions (Avg): - dBuV/m
Measured OOB Emissions (Pk): - dBuV/m

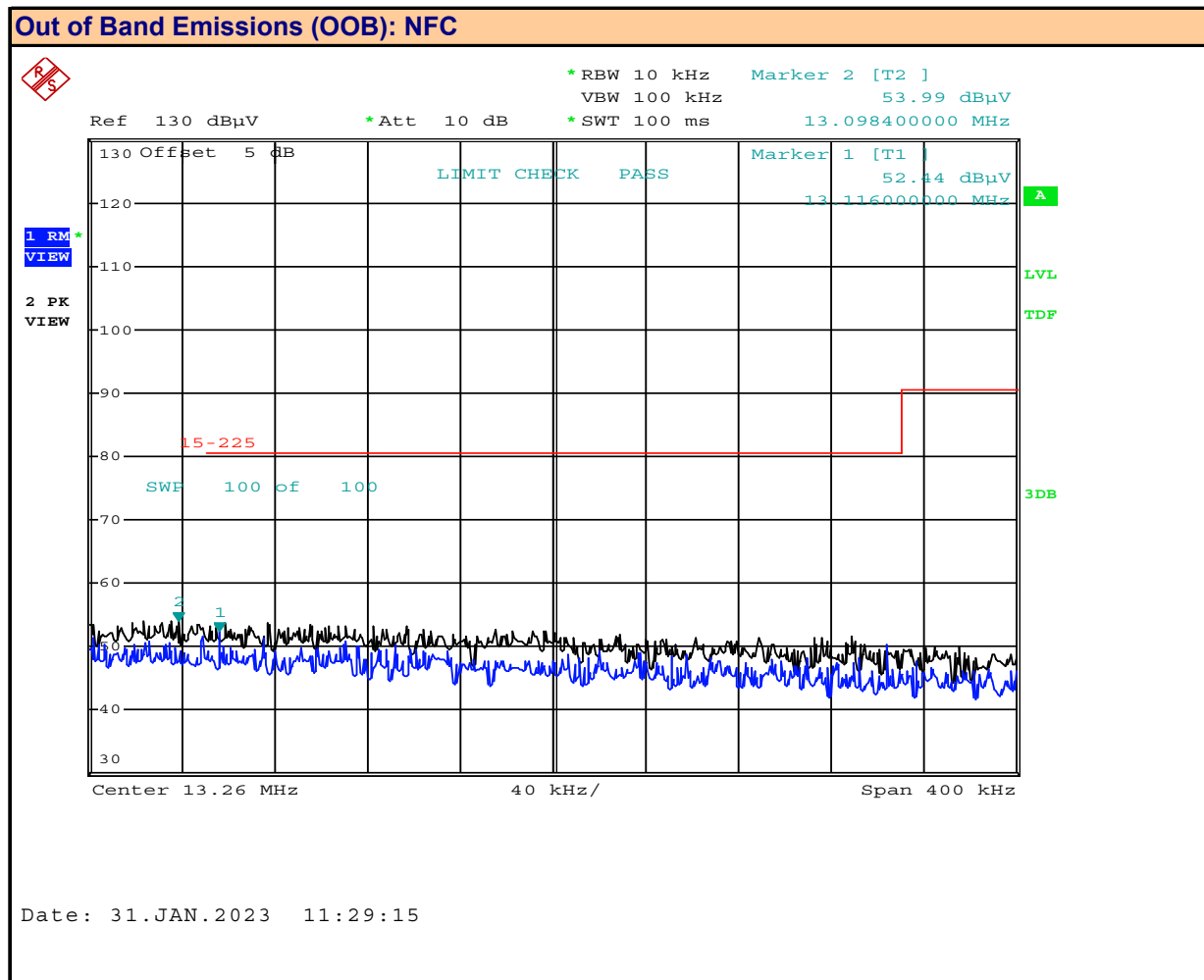
Plot 10.2 – Out of Band Emissions, NFC



Channel: -
Mode: NFC
Polarization: Front

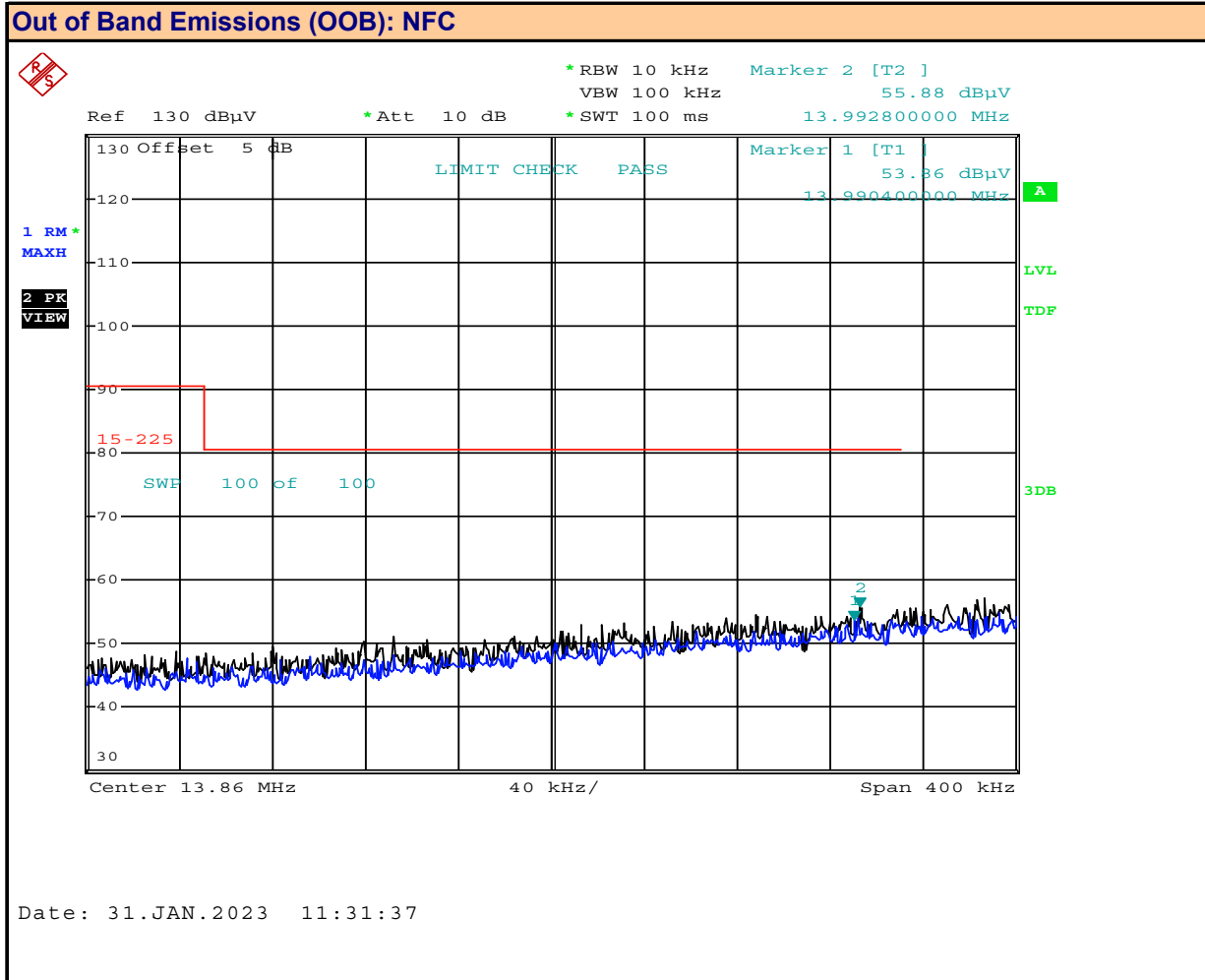
Channel Frequency: 13.56 MHz
Modulation: ASK
Measured OOB Emissions (Avg): - dBuV/m
Measured OOB Emissions (Pk): - dBuV/m

Plot 10.3 – Out of Band Emissions, NFC



Channel:	-	Channel Frequency:	13.56 MHz
Mode:	NFC	Modulation:	ASK
Polarization:	Front	Measured OOB Emissions (Avg):	- dBuV/m
		Measured OOB Emissions (Pk):	- dBuV/m

Plot 10.1 – Out of Band Emissions, NFC



Channel:	-	Channel Frequency:	13.56	MHz
Mode:	NFC	Modulation:	ASK	
Polarization:	Front	Measured OOB Emissions (Avg):	-	dBuV/m
		Measured OOB Emissions (Pk):	-	dBuV/m

Table 10.1 – Summary of Field Strength Measurements (NFC)

Out of Band Emissions Summary									
Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Measured Emissions [FS _{Meas}] (dBuV @ 3m)	Cable Loss [L _c] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS _{Corr}] (dBuV/m @3m)	Margin (dB)
13.56	NFC	ASK	RMS	Front	ND	0.5	10.65	-	-
				Side	ND			-	-
			Peak	Front	ND			-	-
				Side	ND			-	-
				Result:					

* Limit @ 3m = Limit @ 30m + 40dB/decade = 84dBuV/m + 40dB = 124dBuV/m (Average)

* Limit @ 3m = Limit @ 30m + 40dB/decade = 104dBuV/m + 40dB = 144dBuV/m (Peak)

$FS_{Corr} = FS_{Meas} + ACF + L_c$

$Margin = Limit_{3m} - FS_{Corr}$

ND: None Detected

11.0 RADIATED SPURIOUS EMISSIONS – RESTRICTED BANDS

Test Procedure

Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits

47 CFR §15.247(d)	(d) 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 this section, 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)).																
47 CFR §15.209(a)	§15.209 Radiated emission limits; general requirements. (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table: <table> <tr> <th>Frequency (MHz)</th><th>Field Strength (microvolts/meter)</th></tr> <tr> <td>0.009 - 0.490</td><td>2400/F (kHz) @300m</td></tr> <tr> <td>0.490 - 1.705</td><td>24000/F (kHz) @30m</td></tr> <tr> <td>1.705 - 30</td><td>30 @ 30m</td></tr> <tr> <td>30 - 88</td><td>100 @3m</td></tr> <tr> <td>88 - 216</td><td>150 @3m</td></tr> <tr> <td>216 - 960</td><td>200 @3m</td></tr> <tr> <td>Above 960</td><td>500 @3m</td></tr> </table>	Frequency (MHz)	Field Strength (microvolts/meter)	0.009 - 0.490	2400/F (kHz) @300m	0.490 - 1.705	24000/F (kHz) @30m	1.705 - 30	30 @ 30m	30 - 88	100 @3m	88 - 216	150 @3m	216 - 960	200 @3m	Above 960	500 @3m
Frequency (MHz)	Field Strength (microvolts/meter)																
0.009 - 0.490	2400/F (kHz) @300m																
0.490 - 1.705	24000/F (kHz) @30m																
1.705 - 30	30 @ 30m																
30 - 88	100 @3m																
88 - 216	150 @3m																
216 - 960	200 @3m																
Above 960	500 @3m																

Table 11.1 – Summary of Radiated Tx Emissions

See Appendix I for Measurement Plots

Summary of Radiated Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
30-1000MHz	2412.0	Horizontal	42.15	7.59	17.31	0.73	0.00 (3)	25.6 (2)	40.0	14.4	
30-1000MHz	2412.0	Horizontal	51.33	7.51	12.47	0.77	0.00 (3)	20.8 (2)	40.0	19.2	
30-1000MHz	2412.0	Horizontal	827.80	8.44	29.22	2.82	0.00 (3)	40.5 (2)	46.0	5.5	
30-1000MHz	2412.0	Vertical	908.30	8.46	29.50	2.94	0.00 (3)	40.9 (2)	46.0	5.1	
30-1000MHz	2412.0	Vertical	911.10	8.30	29.41	2.95	0.00 (3)	40.7 (2)	46.0	5.4	
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
3-13GHz	2412.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
3-13GHz	2412.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
13-18GHz	2412.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
13-18GHz	2412.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
18-26GHz	2412.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
18-26GHz	2412.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
Results:									Complies		

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

Table 11.2 – Summary of Radiated Emissions, Restricted Band (NFC)

See Appendix I for Measurement Plots

Summary of Radiated Tx Emissions (Restricted Band)											
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
9kHz - 30MHz	2412.0	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
9kHz - 30MHz	2412.0	Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
30-1000MHz	2412.0	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
30-1000MHz	2412.0	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	n/a	
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
Results:									Complies		

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

12.0 RADIATED RX SPURIOUS EMISSIONS

Test Procedure

Normative Reference	FCC 47 CFR §2.1046
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

General Procedure

C63.10 (6.5.4)	6.5.4 Final radiated emission tests Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported. Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.
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Test Setup	Appendix A	Figure A.2
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Measurement Procedure

The DUT place on a 80cm high turntable on an Open Area Test Site (OATS) at a distance of 3m from the measurement antenna. The DUT was set to transmit at maximum power and duty cycle. The DUT was rotated 360 degrees and scanned with the receive antenna elevated from 1 to 4m. The emissions were measured and recorded.

Table 12.1 – Summary of Radiated Rx Emissions

See Appendix J for Measurement Plots

Summary of Radiated Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)	
30-1000MHz	2412.0	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	46.0	n/a	
30-1000MHz	2412.0	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	43.5	n/a	
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a	
3-13GHz	2412.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
3-13GHz	2412.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a	
13-18GHz	2412.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
13-18GHz	2412.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a	
18-26GHz	2412.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
18-26GHz	2412.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a	
Results:									Complies		

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

13.0 FREQUENCY STABILITY (NFC)

Test Conditions

Normative Reference FCC 47 CFR §2.1055, §15.225, RSS-Gen, RSS-210

Limits

47 CFR §15.225	(e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.
RSS-210 B.6	(b) the carrier frequency stability shall not exceed ± 100 ppm

Measurement Procedure

47 CFR §2.1055 Frequency Stability

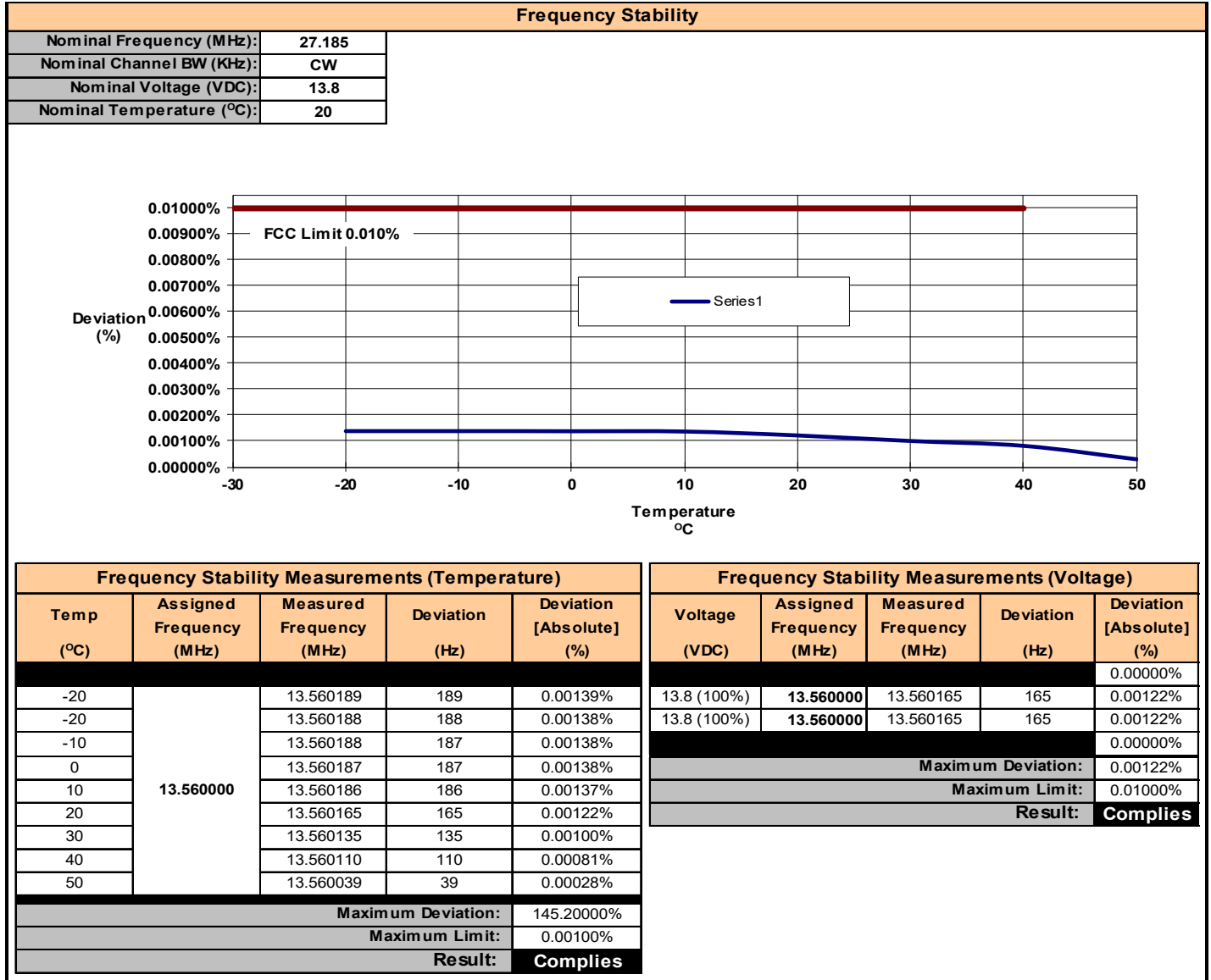
- (a) The frequency stability shall be measured with variation of ambient temperature as follows:
- (1) From -30° to $+50^{\circ}$ centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
 - (b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement.
 - (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
 - (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Setup

Appendix A

5

Table 13.1 – Summary of Frequency Stability Measurements – FCC



14.0 POWER LINE CONDUCTED EMISSIONS

Test Procedure

Normative Reference

FCC 47 CFR §15.107, ICES-003(6.1)
ANSI C63.4-2014

Limits

47 CFR §15.107

(a) Except for Class A digital devices, for equipment 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 μ H/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 band edges.

0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logarithm of the frequency

0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average

5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average

ICES-003(6.1)

6.1 - AC Power Line Conducted Emissions Limits

Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 2.

0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logarithm of the frequency

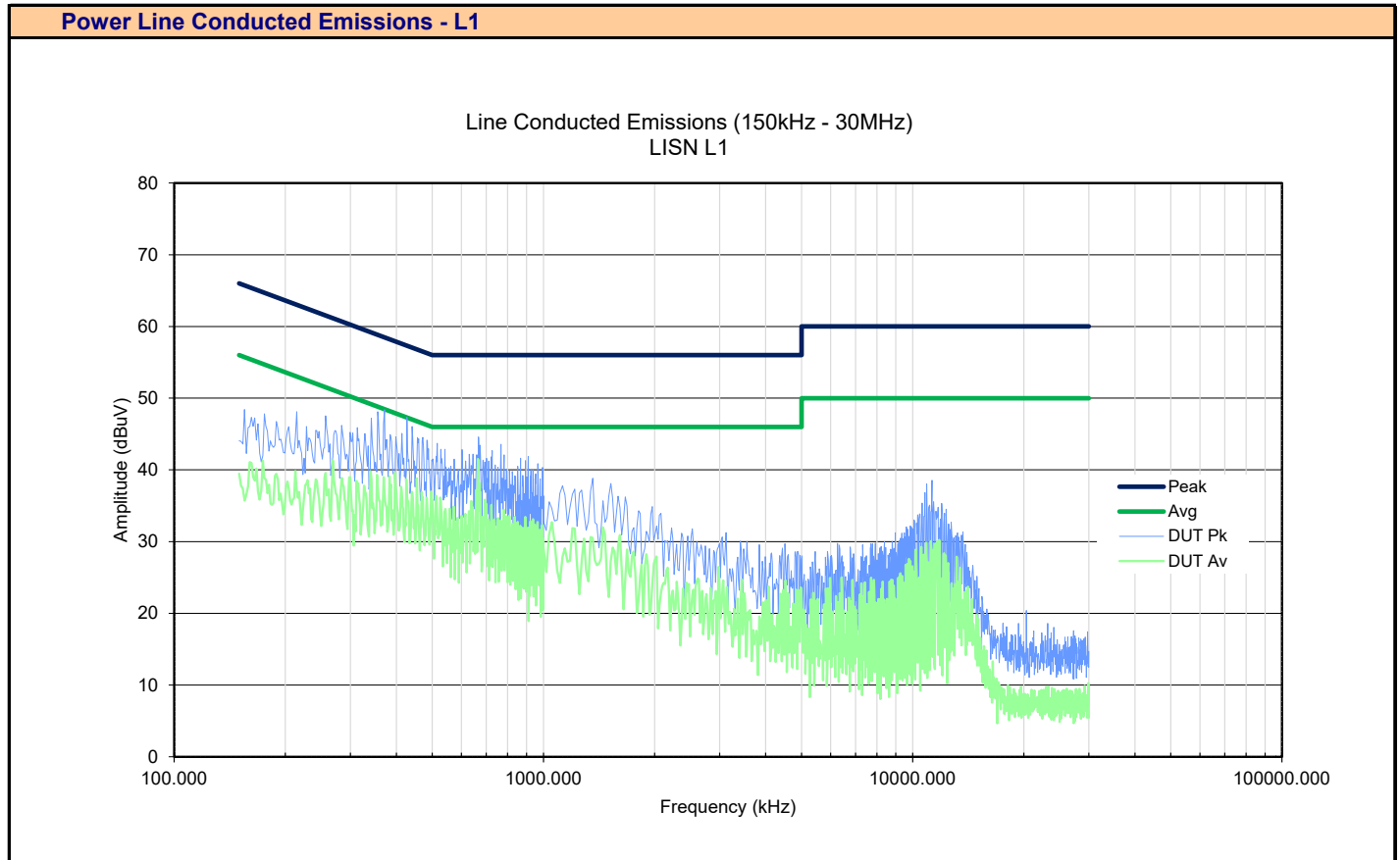
0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average

5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average

Test Setup

Appendix A Figure A.7

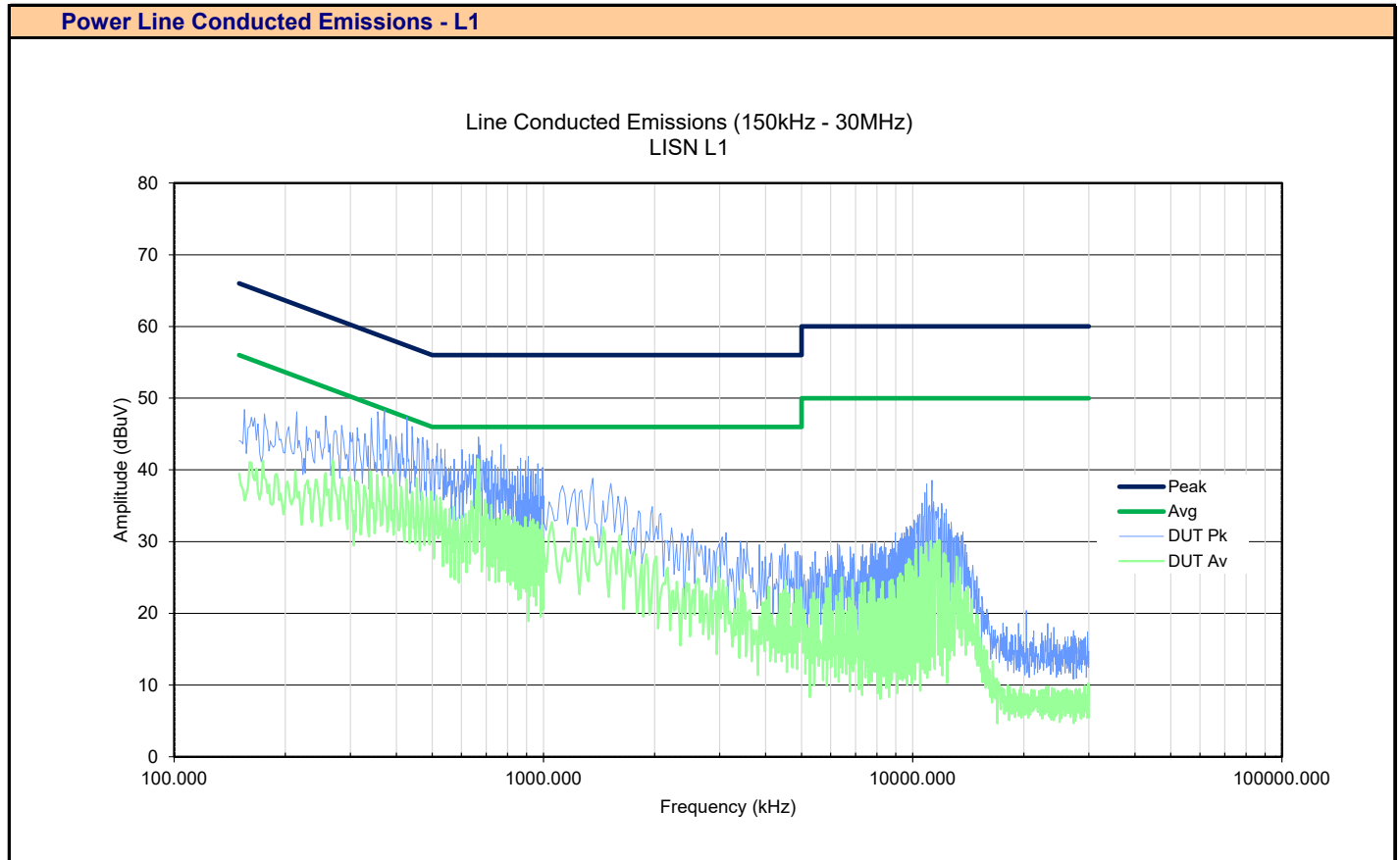
Plot 14.1 – Power Line Conducted Emissions, Line 1



Channel: **6**
Mode: **802.11b**
Emission Frequency: **371kHz**

Channel Frequency: **2437** MHz
Modulation: **CCK 1MB**
Measured Channel Power: **48.38** dBuV

Plot 14.2 – Power Line Conducted Emissions, Line 2



Channel: **6**
Mode: **802.11b**
Emission Frequency: **371kHz**

Channel Frequency: **2437** MHz
Modulation: **CCK 1MB**
Measured Channel Power: **48.38** dBuV

Table 14.1 – Summary of Power Line Conducted Emissions – L1

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f _{Emm}] (kHz)	Measured Emission [E _{Meas}] (dBuV)	Detector*	Insertion Loss [L _{LISN}] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	2437.0	L1	371.00 kHz	48.38	Peak	0.30	0.26	0.00 (3)	48.94 (2)	58.0	9.1
Results:										Complies	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ 9kHz.

(2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$$

Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz

Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz

$$\text{Margin} = \text{Limit} - E_{Corr}$$

Table 14.1 – Summary of Power Line Conducted Emissions – L2

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f _{Emm}] (kHz)	Measured Emission [E _{Meas}] (dBuV)	Detector*	Insertion Loss [L _{LISN}] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	2437.0	L2	362.50 kHz	46.46	Peak	0.30	0.26	0.00 (3)	47.02 (2)	58.6	11.6
Results:										Complies	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ 9kHz.

(2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

$$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$$

Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz

Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz

Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz

$$\text{Margin} = \text{Limit} - E_{Corr}$$

APPENDIX A – TEST SETUP DRAWINGS AND EQUIPMENT

Table A.1 – Setup - Conducted Measurements Equipment List

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00241	R&S	FSU40	100500	Spectrum Analyzer
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable

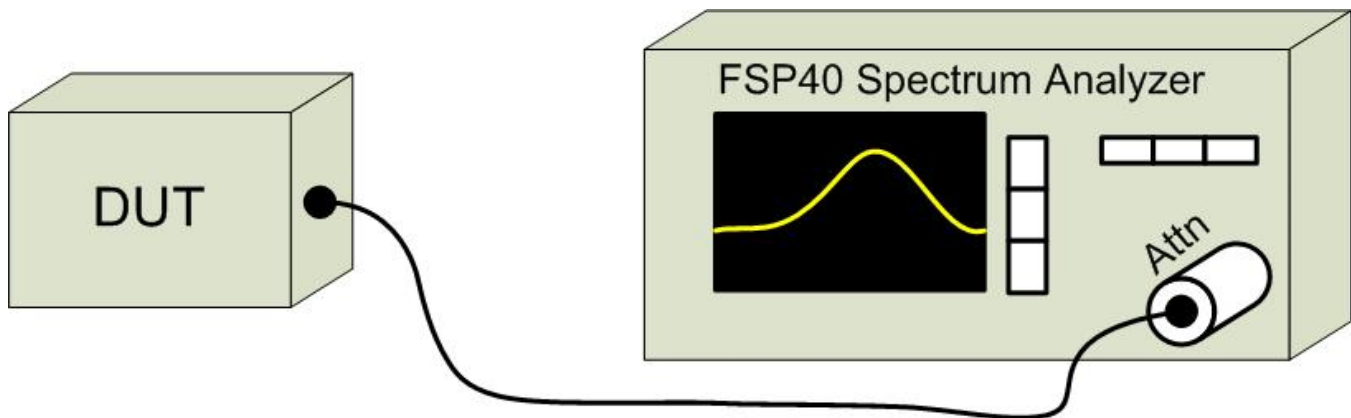


Figure A.1 – Test Setup Conducted Measurements

Table A.2 – Setup - Radiated Emissions Equipment List

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00050	Chase	CBL-6111A	1607	Bilog Antenna
00034	ETS	3115	6267	Double Ridged Guide Horn
00035	ETS	3115	6276	Double Ridged Guide Horn
00085	EMCO	6502	9203-2724	Loop Antenna
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz
00162	Waveline Inc.	889		Standard Gain Horn 18-26GHz
00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
00166	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
00333	HP	85685A	3010A01095	RF Preselector
00049	HP	85650A	2043A00162	Quasi-peak Adapter
00051	HP	8566B	2747A05510	Spectrum Analyzer
00241	R&S	FSU40	100500	Spectrum Analyzer
00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier
00071	EMCO	2090	9912-1484	Multi-Device Controller
00072	EMCO	2075	0001-2277	Mini-mast
00073	EMCO	2080	0002-1002	Turn Table
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable
00275	TMS	LMR400	n/a	25m Cable
00278	TILE	34G3	n/a	TILE Test Software

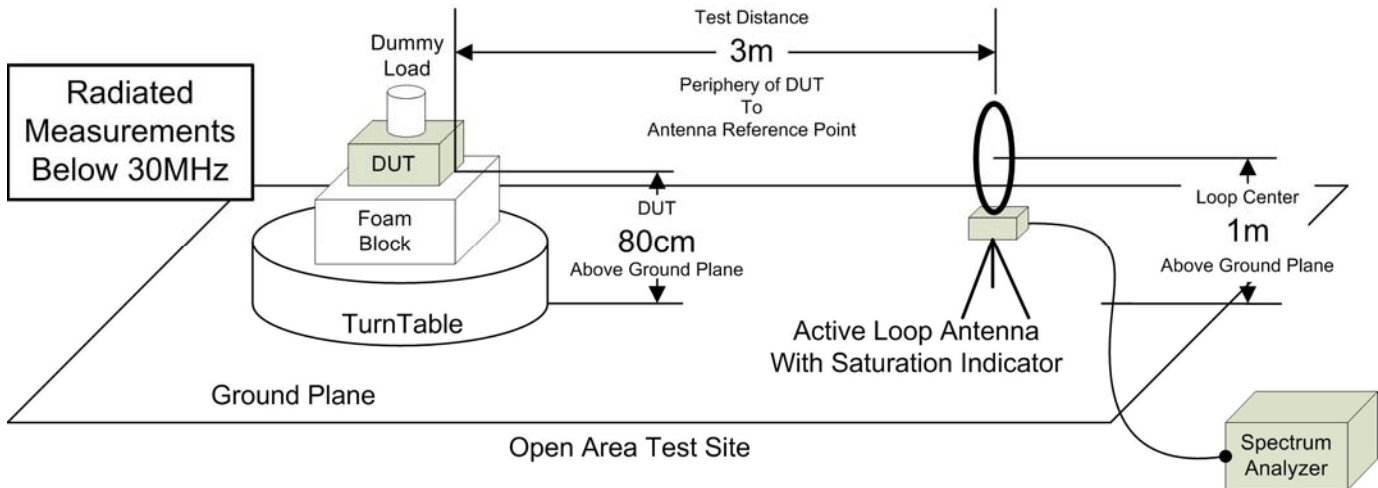


Figure A.2 – Test Setup Radiated Emissions Measurements Below 30MHz

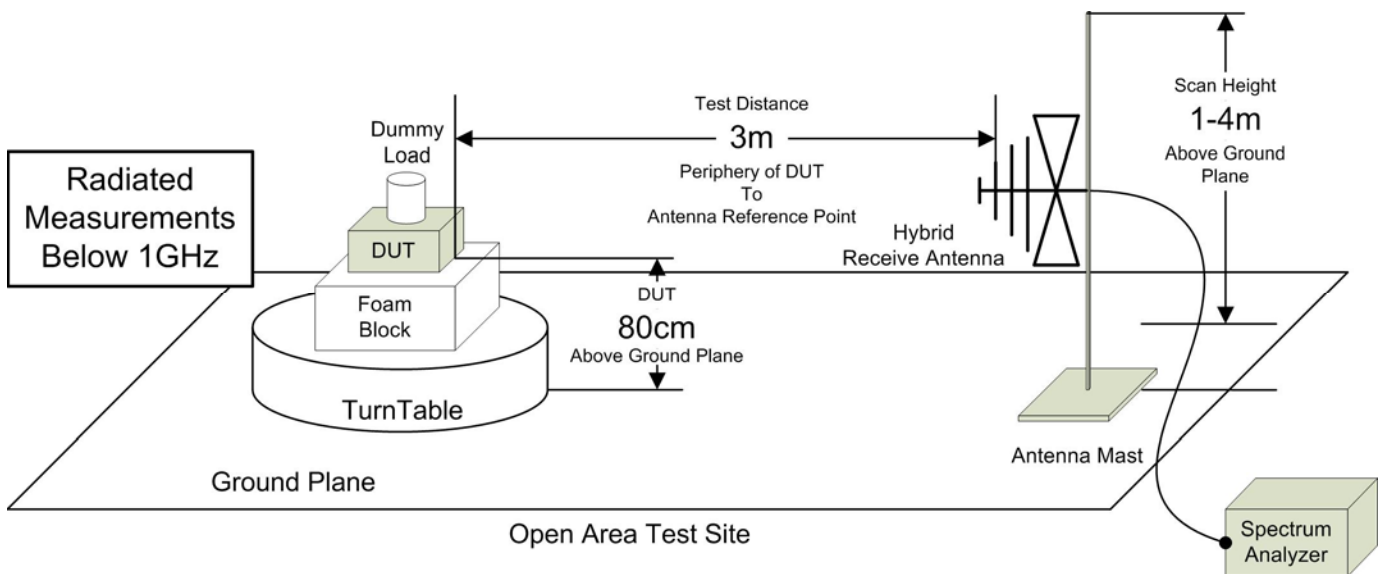


Figure A.3 – Test Setup Radiated Emissions Measurements 30 – 1000MHz

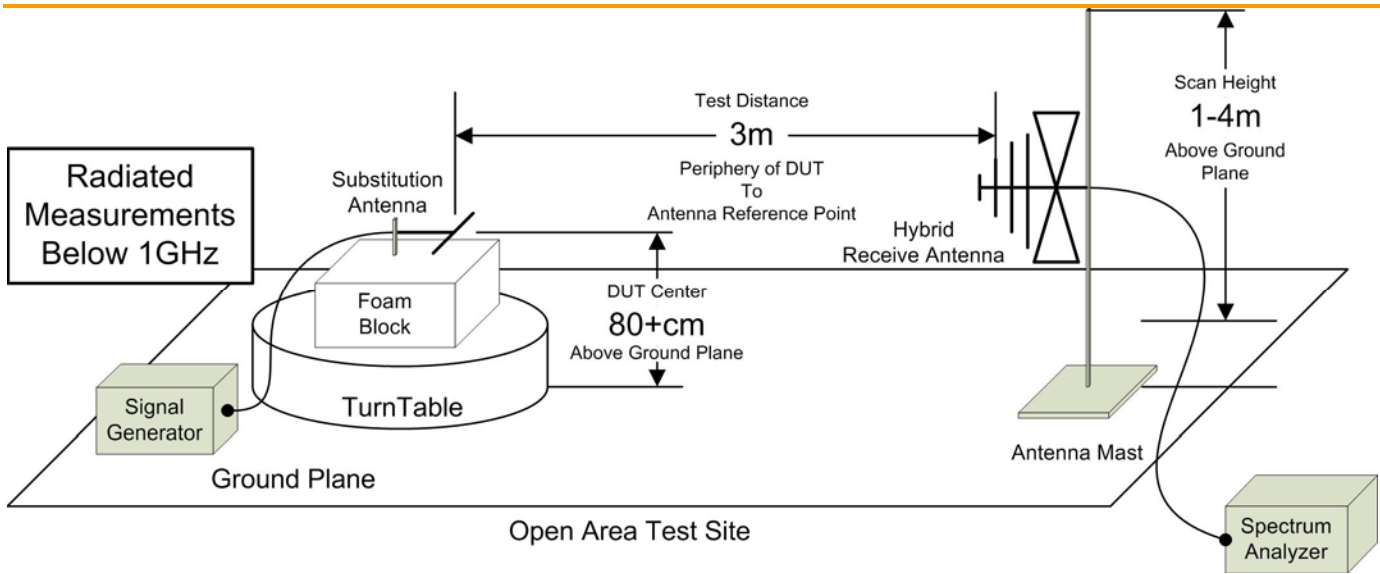


Figure A.4 – Test Setup Radiated Emissions Measurements 30 – 1000MHz Signal Substitution

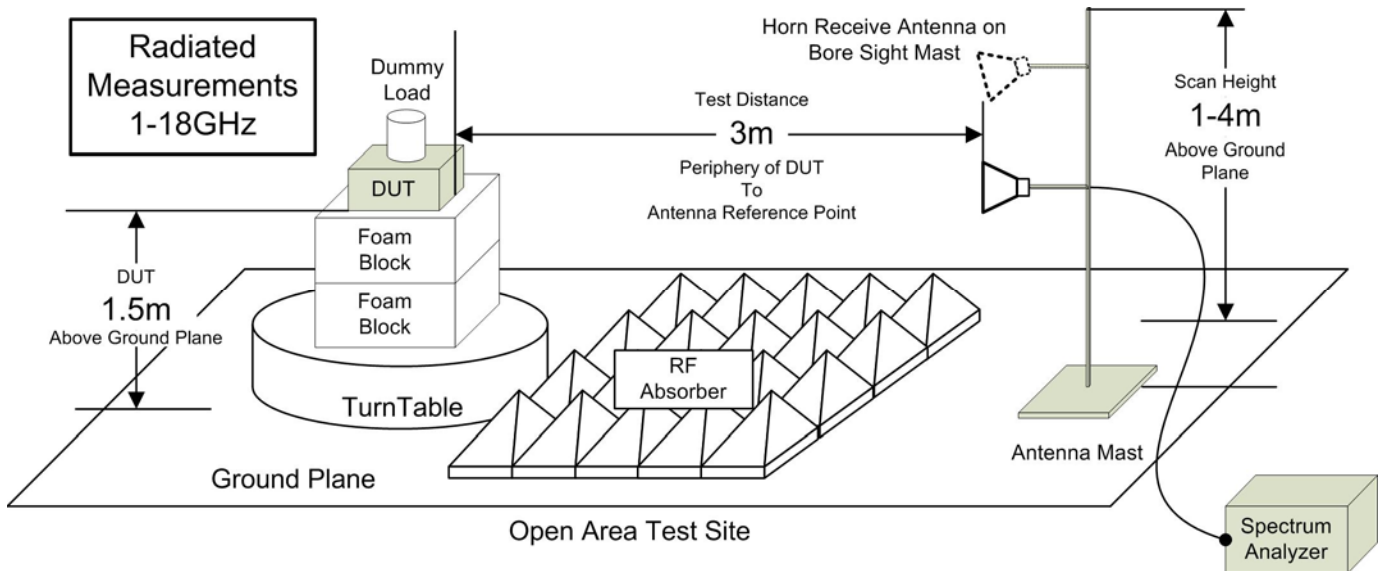


Figure A.5 – Test Setup Radiated Emissions Measurements 1 – 18GHz

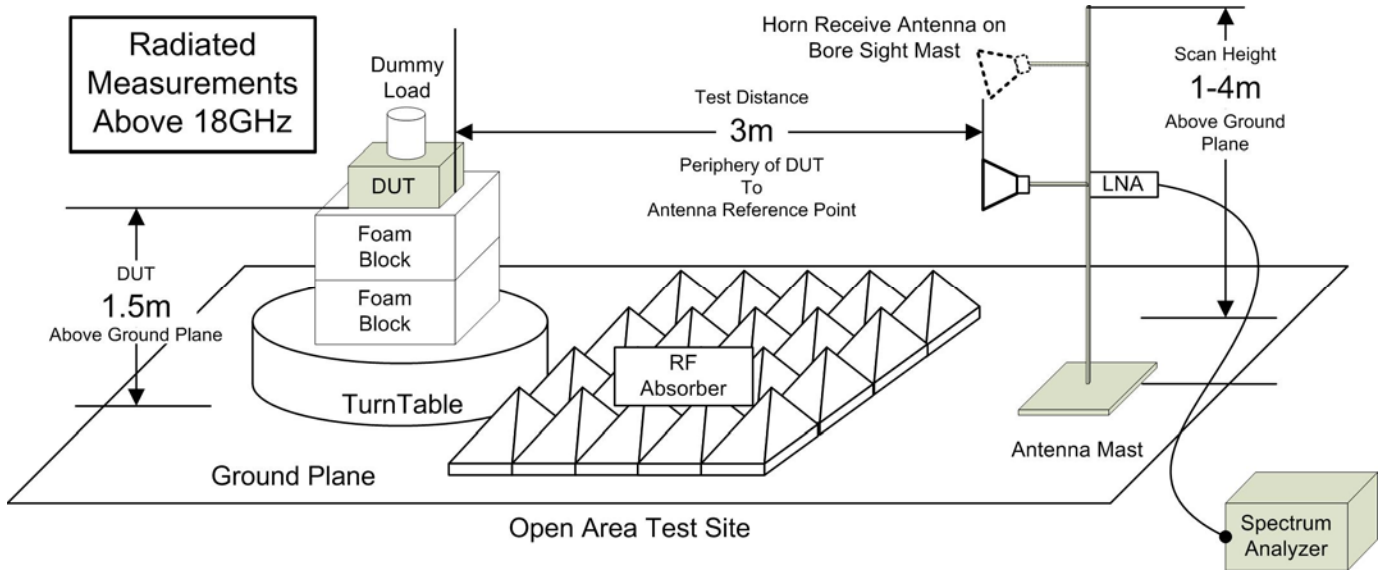


Figure A.6 – Test Setup Radiated Emissions Measurements Above 18 GHz

Table A.3 – Setup – Frequency Stability Equipment List

Equipment List				
Asset Number	Manufacturer	Model Number	Serial Number	Description
00241	R&S	FSU40	100500	Spectrum Analyzer
00081	ESPEC	ECT-2	0510154-B	Environmental Chamber
00234	VWR	61161-378	140320430	Temp/Humidity Meter

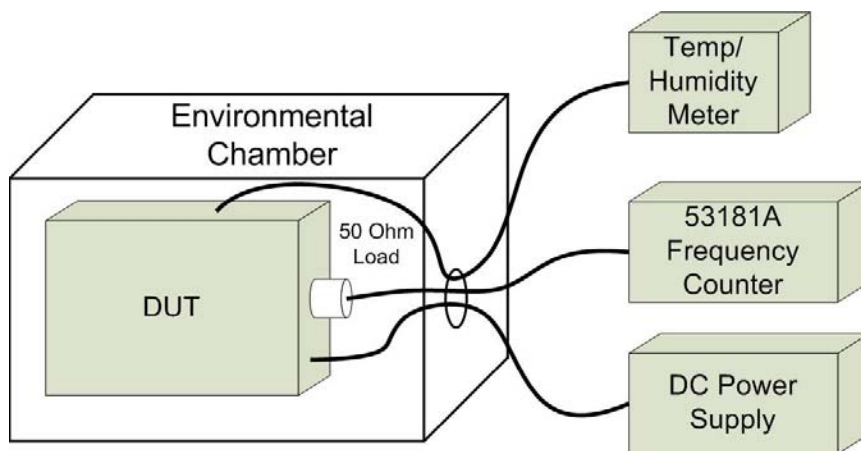


Figure A.7 – Frequency Stability

APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List							
Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00050	Chase	CBL-6111A	1607	Bilog Antenna	16 Nov 2020	Triennial	16 Nov 2023
00035	ETS	3115	6276	Double Ridged Guide Horn	4 Mar 2022	Triennial	4 Mar 2025
00085	EMCO	6502	9203-2724	Loop Antenna	6 Sep 2022	Triennial	6 Sep 2025
00333	HP	85685A	3010A01095	RF Preselector	23 Jun 2020	Triennial	30 Jun 2023
00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2020	Triennial	23 Jun 2023
00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2020	Triennial	23 Jun 2023
00241	R&S	FSU40	100500	Spectrum Analyzer	10 Aug 2021	Triennial	10 Aug 2024
00005	HP	8648D	3847A00611	Signal Generator	23 Jun 2020	Triennial	23 Jun 2023
00003	HP	53181A	3736A05175	Frequency Counter	23 Jun 2020	Triennial	23 Jun 2023
00257	Com-Power	LI-215A	191934	LISN	27 Dec 2021	Triennial	27 Dec 2024
00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
00081	ESPEC	ECT-2	0510154-B	Environmental Chamber	NCR	n/a	CNR
00234	VWR	61161-378	140320430	Temp/Humidity Meter	New	Triennial	New
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable	COU	n/a	COU
00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR

NCR: No Calibration Required

COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})

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

Radiated Emissions 30MHz - 200MHz

$$U_{LAB} = 5.14\text{dB} \quad U_{CISPR} = 6.3\text{dB}$$

Radiated Emissions 200MHz - 1000MHz

$$U_{LAB} = 5.90\text{dB} \quad U_{CISPR} = 6.3\text{dB}$$

Radiated Emissions 1GHz - 6GHz

$$U_{LAB} = 4.80\text{dB} \quad U_{CISPR} = 5.2\text{dB}$$

Radiated Emissions 6GHz - 18GHz

$$U_{LAB} = 5.1\text{dB} \quad U_{CISPR} = 5.5\text{dB}$$

Power Line Conducted Emissions 9kHz to 150kHz

$$U_{LAB} = 2.96\text{dB} \quad U_{CISPR} = 3.8\text{dB}$$

Power Line Conducted Emissions 150kHz to 30MHz

$$U_{LAB} = 3.12\text{dB} \quad U_{CISPR} = 3.4\text{dB}$$

If the calculated uncertainty U_{lab} is **less** than U_{CISPR} then:

- | | |
|---|---|
| 1 | Compliance is deemed to occur if NO measured disturbance exceeds the disturbance limit |
| 2 | Non-Compliance is deemed to occur if ANY measured disturbance EXCEEDS the disturbance limit |

If the calculated uncertainty U_{lab} is **greater** than U_{CISPR} then:

- | | |
|---|--|
| 3 | Compliance is deemed to occur if NO measured disturbance, increased by ($U_{lab} - U_{CISPR}$), exceeds the disturbance limit |
| 4 | Non-Compliance is deemed to occur if ANY measured disturbance, increased by ($U_{lab} - U_{CISPR}$), EXCEEDS the disturbance limit |

Other Measurement Uncertainties (U_{LAB})

RF Conducted Emissions 9kHz - 40GHz

$$U_{LAB} = 1.0\text{dB} \quad U_{CISPR} = \text{n/a}$$

Frequency/Bandwidth 9kHz - 40GHz

$$U_{LAB} = 0.1\text{ppm} \quad U_{CISPR} = \text{n/a}$$

Temperature

$$U_{LAB} = 1^{\circ}\text{C} \quad U_{CISPR} = \text{n/a}$$

END OF REPORT

APPENDIX H – FIELD STRENGTH MEASUREMENT PLOTS

APPENDIX I– RADIATED TX EMISSIONS MEASUREMENT PLOTS

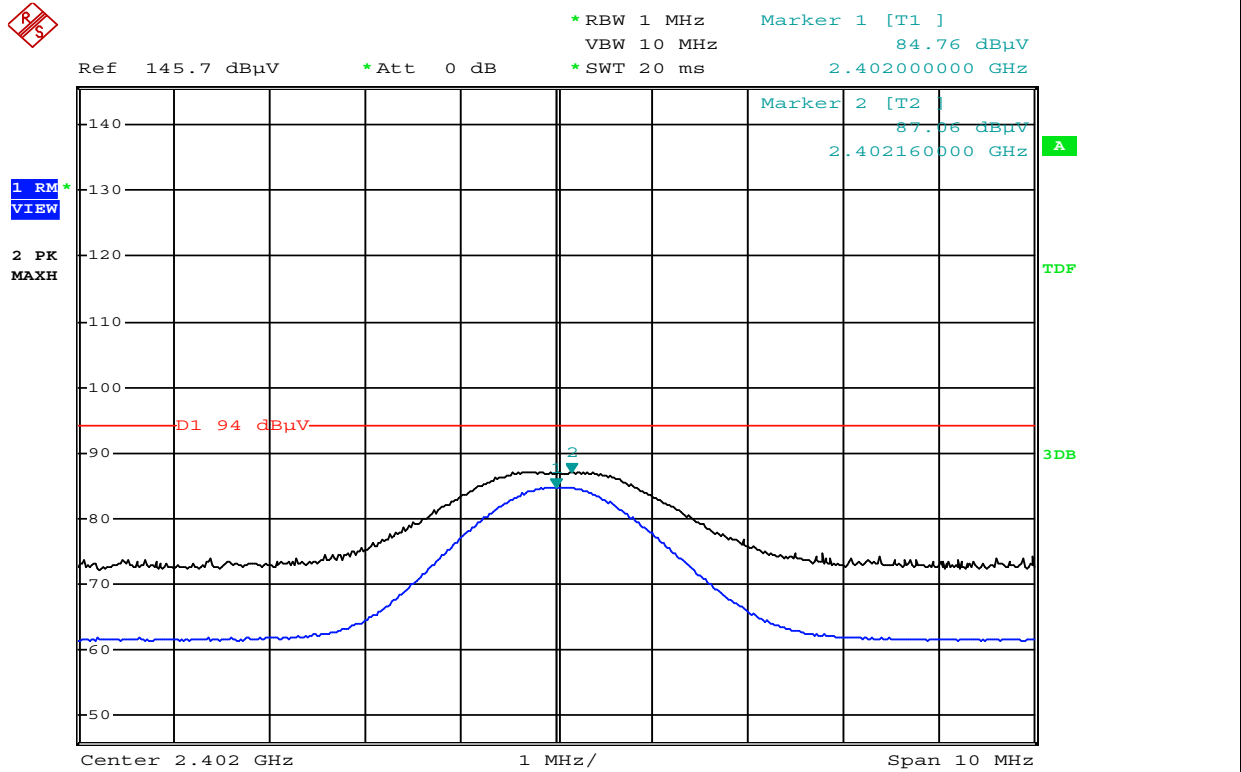
APPENDIX J– RADIATED RX MEASUREMENT PLOTS

Conducted Power Measurement Results:

Channel	Channel	Mode	Modulation	Antenna	Measured	Measured	Avg	Avg	Peak	Peak
Number	Frequency (MHz)			Polarization	Field Strength [Avg] (dBuV/m)	Field Strength [Peak] (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Margin (dB)
37	2402.00	BT LE1	GMSK	Horizontal	84.76	87.06	94.0	9.24	114	26.94
				Vertical	87.41	89.17		6.59		24.83
17	2440.00			Horizontal	85.33	87.37		8.67		26.63
				Vertical	89.46	91.07		4.54		22.93
39	2480.00			Horizontal	80.13	83.19		13.87		30.81
				Vertical	83.12	85.79		10.88		28.21
0	2404.00	BT LE2	GMSK	Horizontal	84.09	86.97		9.91		27.03
				Vertical	83.12	92.13		10.88		21.87
17	2440.00			Horizontal	81.97	85.51		12.03		28.49
				Vertical	83.12	86.44		10.88		27.56
36	2478.00			Horizontal	77.26	82.10		16.74		31.90
				Vertical	79.75	84.14		14.25		29.86
0	2402.00	ANT	GFSK	Horizontal	82.28	84.77		11.72		29.23
				Vertical	84.70	86.88		9.30		27.12
38	2440.00			Horizontal	81.34	84.35		12.66		29.65
				Vertical	85.12	87.32		8.88		26.68
78	2480.00			Horizontal	75.21	80.14		18.79		33.86
				Vertical	81.59	84.48		12.41		29.52
Result:										Complies

Conducted Margin = $P_{Lim} - P_{Meas}$

Field Strength:

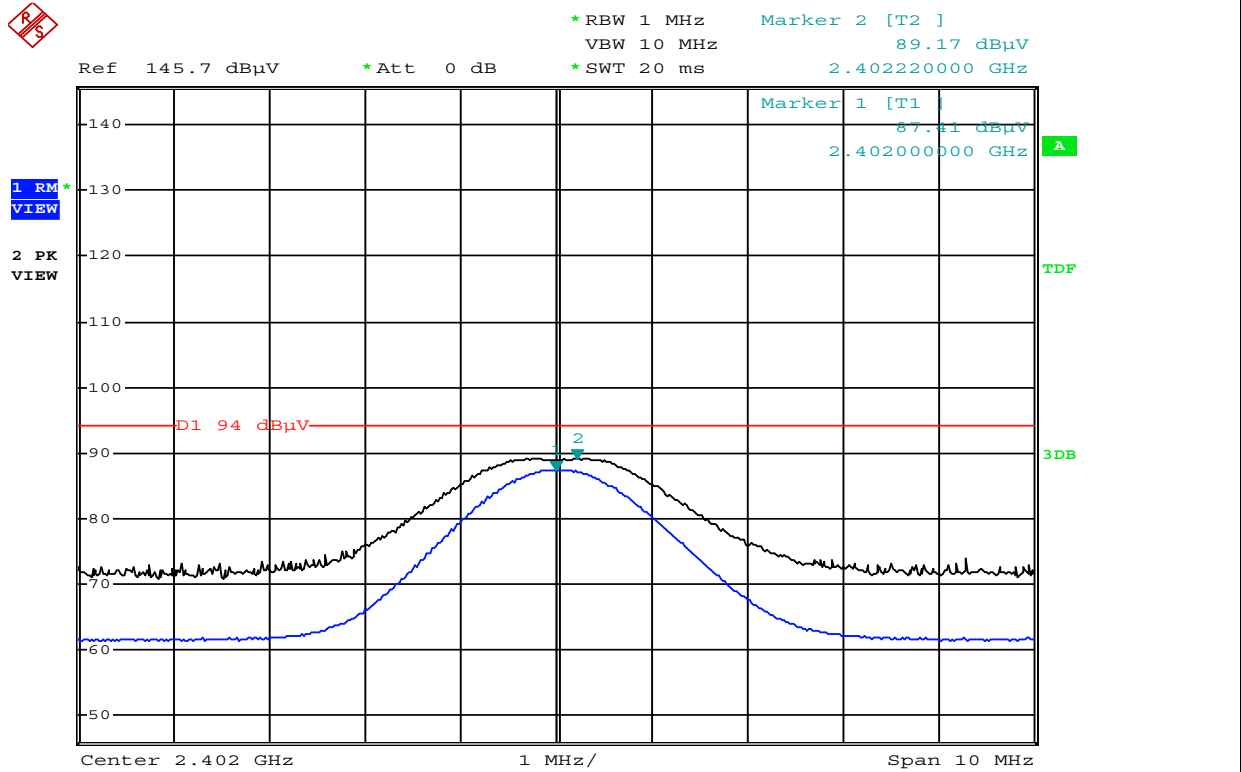


Date: 10.JAN.2023 15:34:33

Channel:	37
Mode:	BT LE1
Polarization:	Horizontal

Channel Frequency:	2402	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	84.76	dBuV/m
Measured Field Strength (Pk):	87.06	dBuV/m

Field Strength:

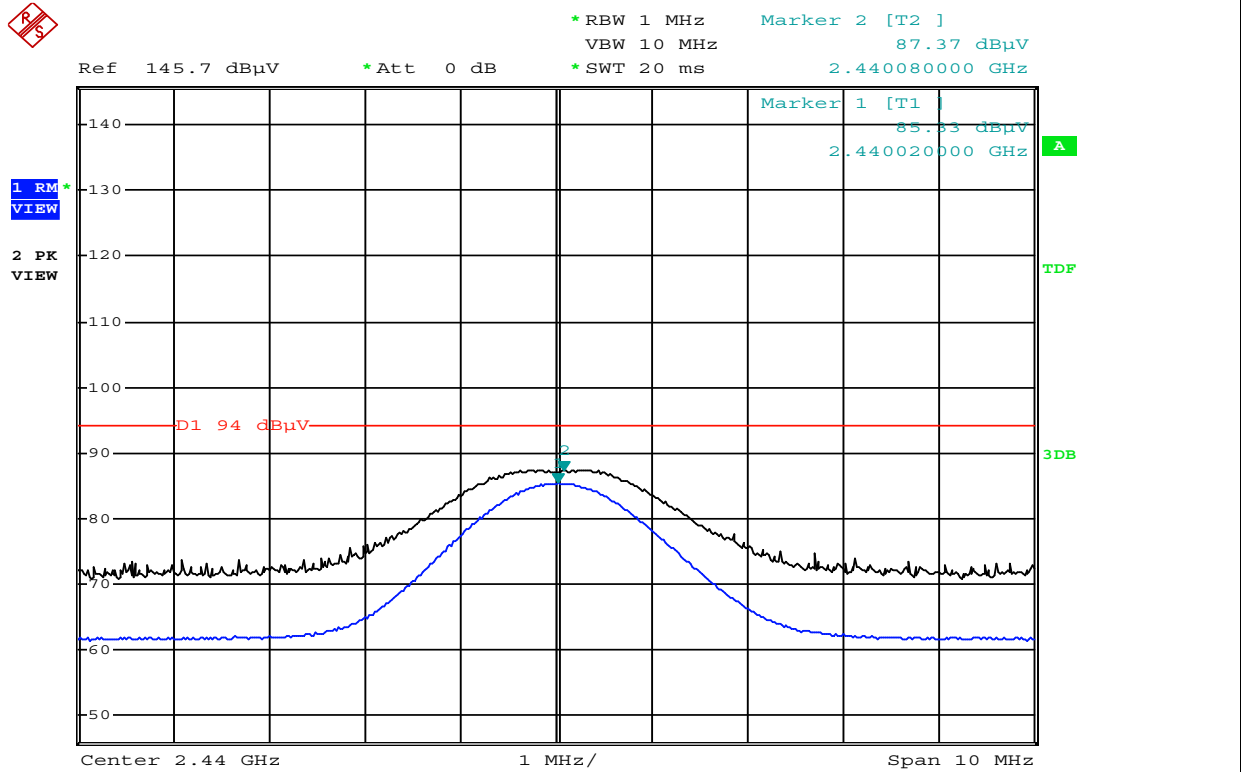


Date: 10.JAN.2023 15:35:37

Channel:	37
Mode:	BT LE1
Polarization:	Vertical

Channel Frequency:	2402	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	87.41	dBuV/m
Measured Field Strength (Pk):	89.17	dBuV/m

Field Strength:

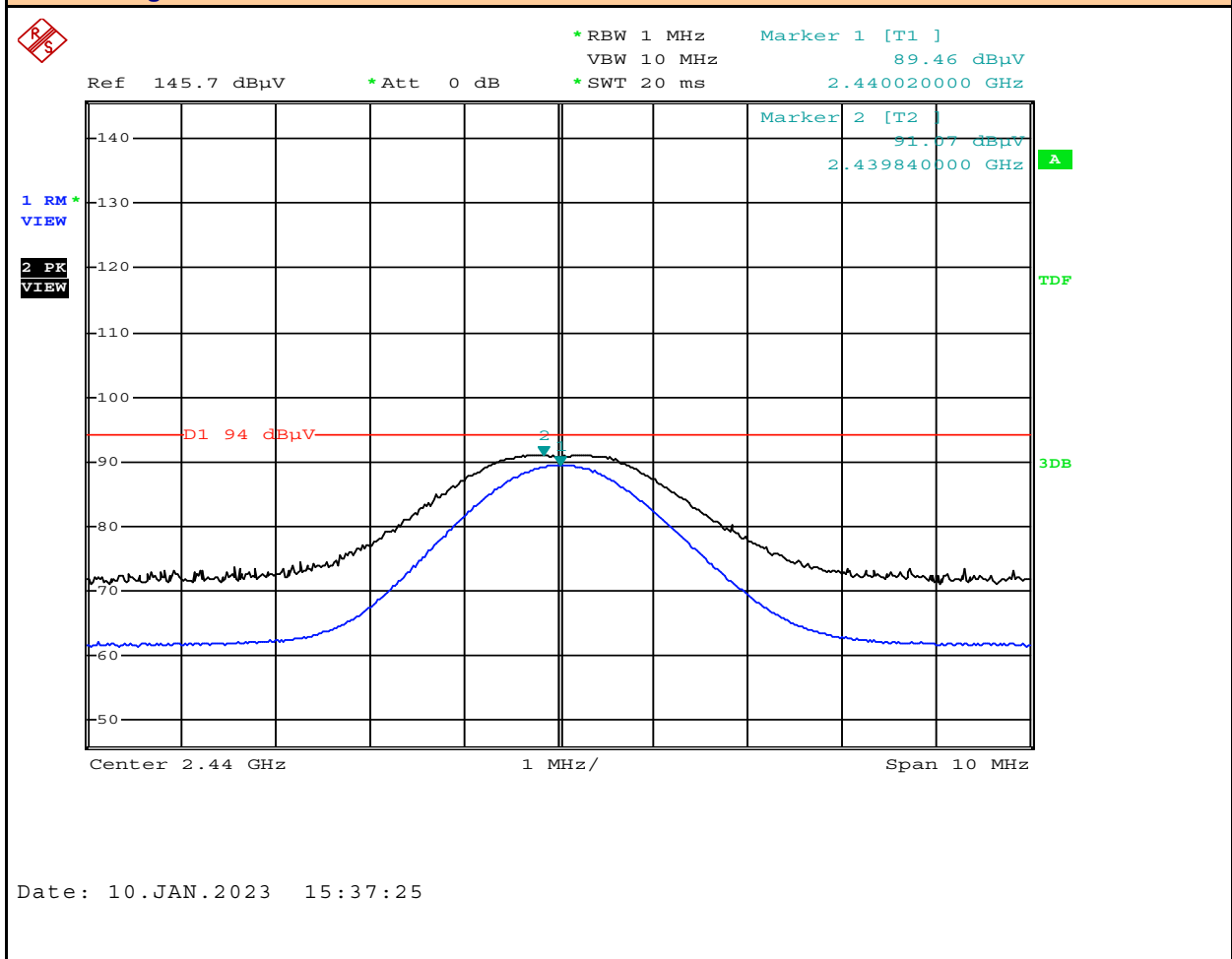


Date: 10.JAN.2023 15:38:26

Channel:	17
Mode:	BT LE1
Polarization:	Horizontal

Channel Frequency:	2440	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	85.33	dBuV/m
Measured Field Strength (Pk):	87.37	dBuV/m

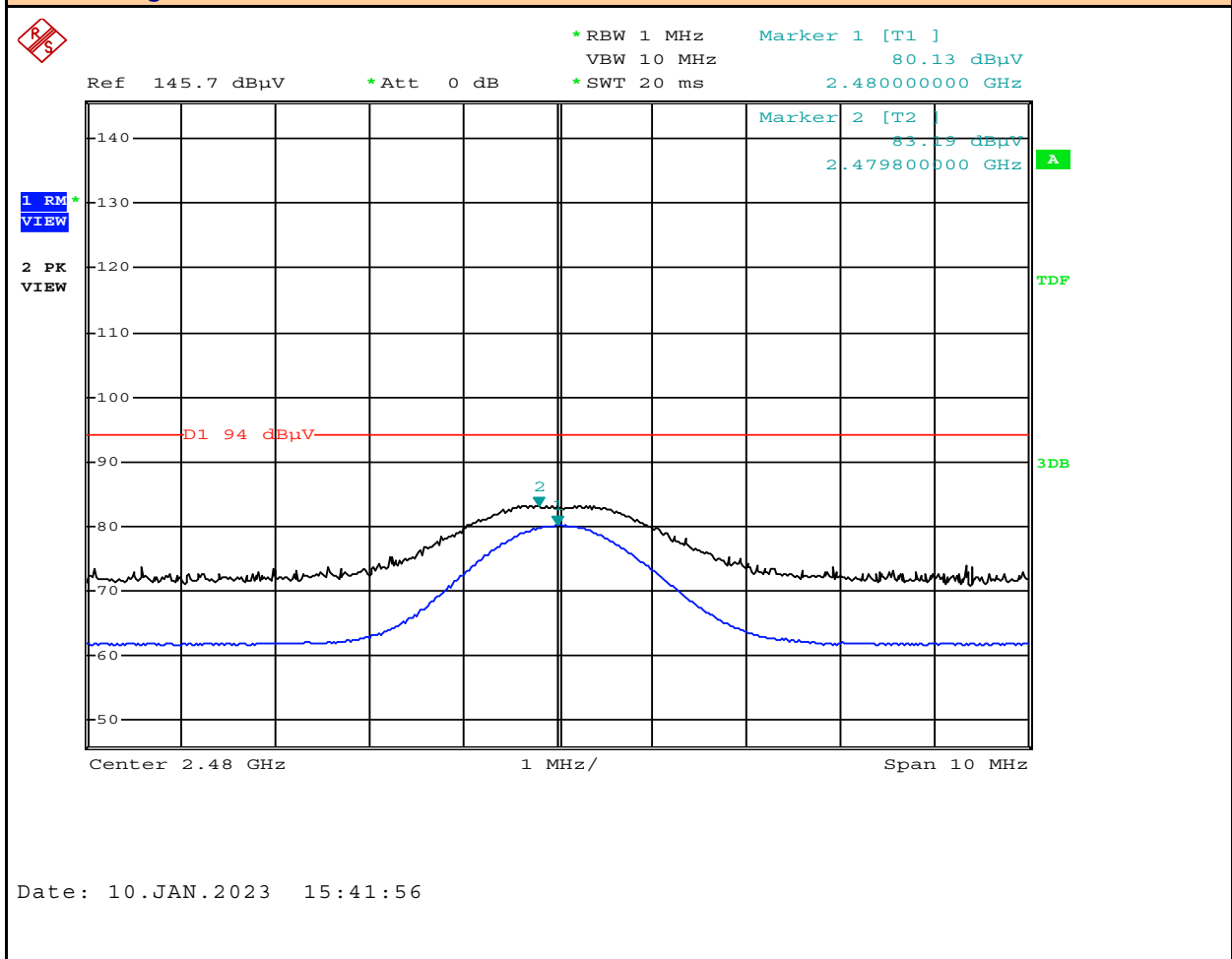
Field Strength:



Channel:	17
Mode:	BT LE1
Polarization:	Vertical

Channel Frequency:	2440	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	89.46	dBuV/m
Measured Field Strength (Pk):	91.07	dBuV/m

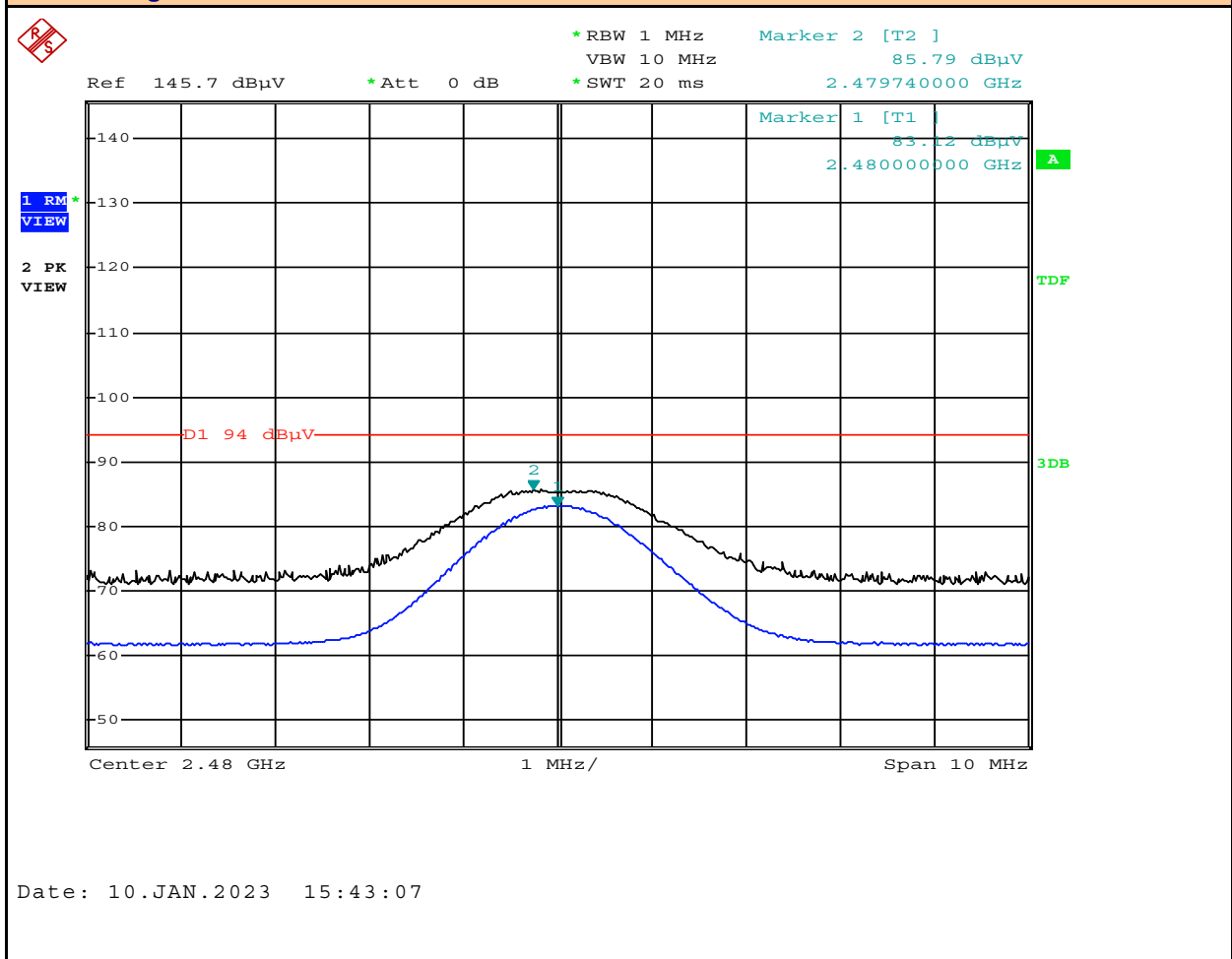
Field Strength:



Channel:	39
Mode:	BT LE1
Polarization:	Horizontal

Channel Frequency:	2480	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	80.13	dBuV/m
Measured Field Strength (Pk):	83.19	dBuV/m

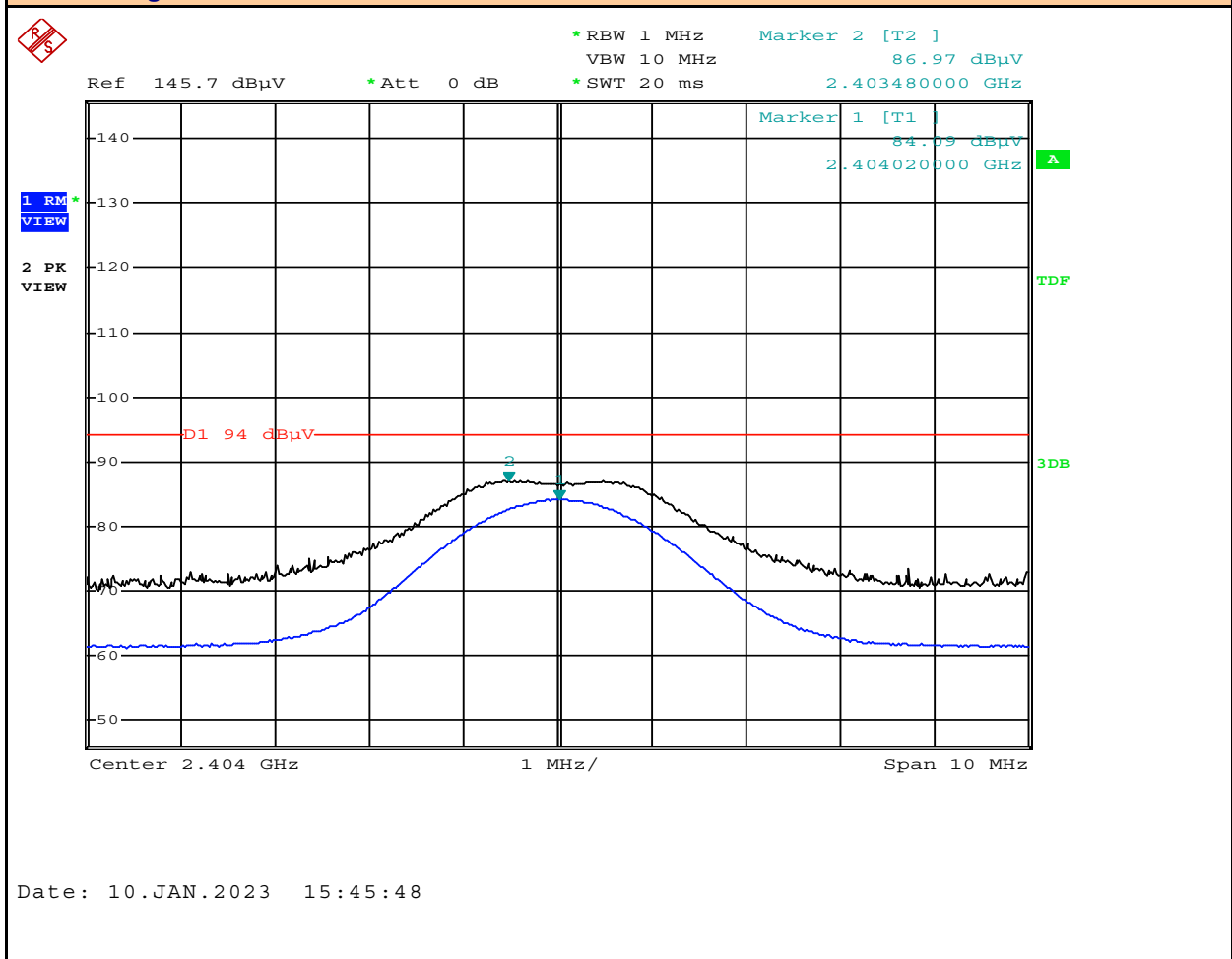
Field Strength:



Channel:	39
Mode:	BT LE1
Polarization:	Vertical

Channel Frequency:	2480	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	83.12	dBuV/m
Measured Field Strength (Pk):	85.79	dBuV/m

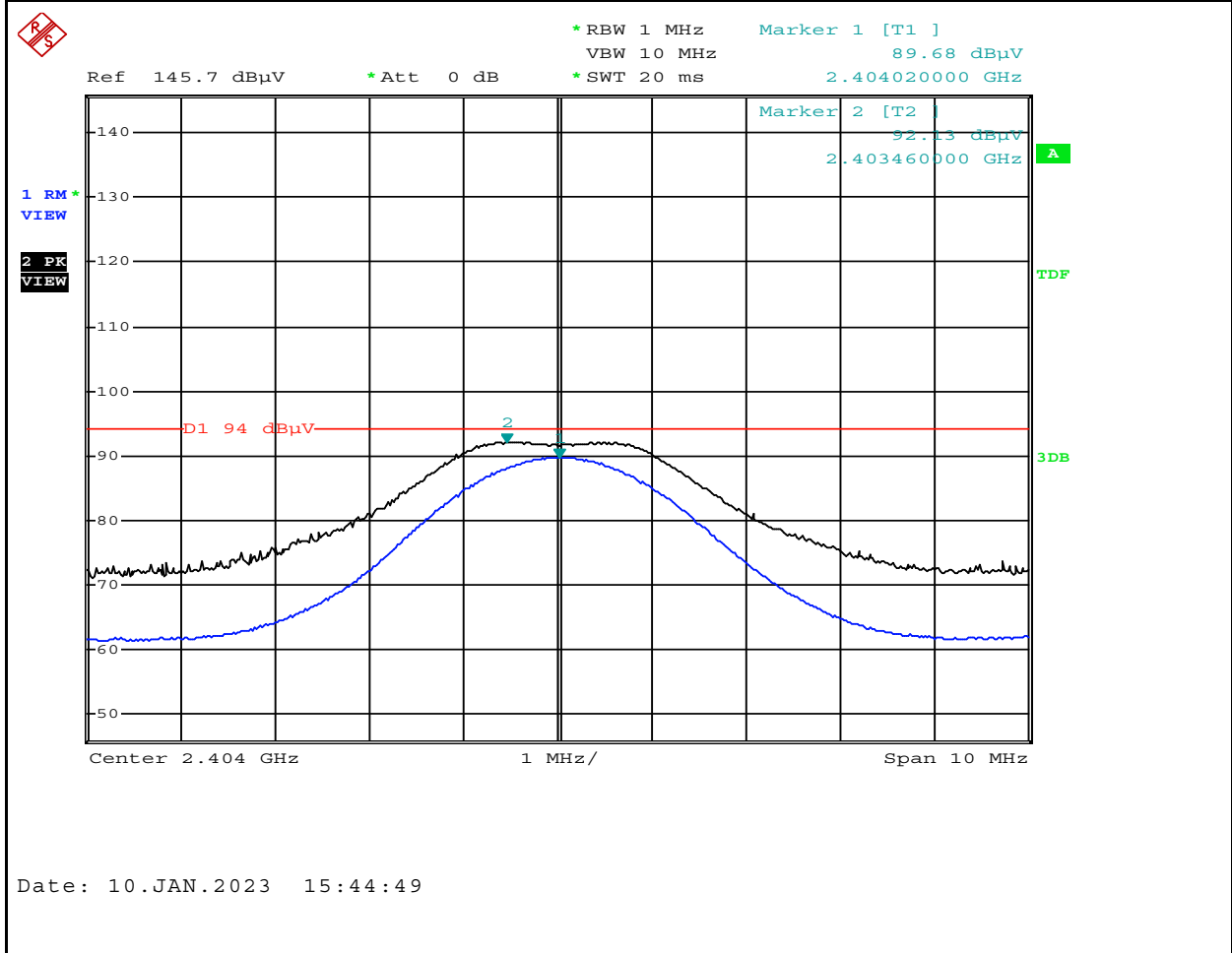
Field Strength:



Channel:	0
Mode:	BT LE2
Polarization:	Horizontal

Channel Frequency:	2404	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	84.09	dBuV/m
Measured Field Strength (Pk):	86.97	dBuV/m

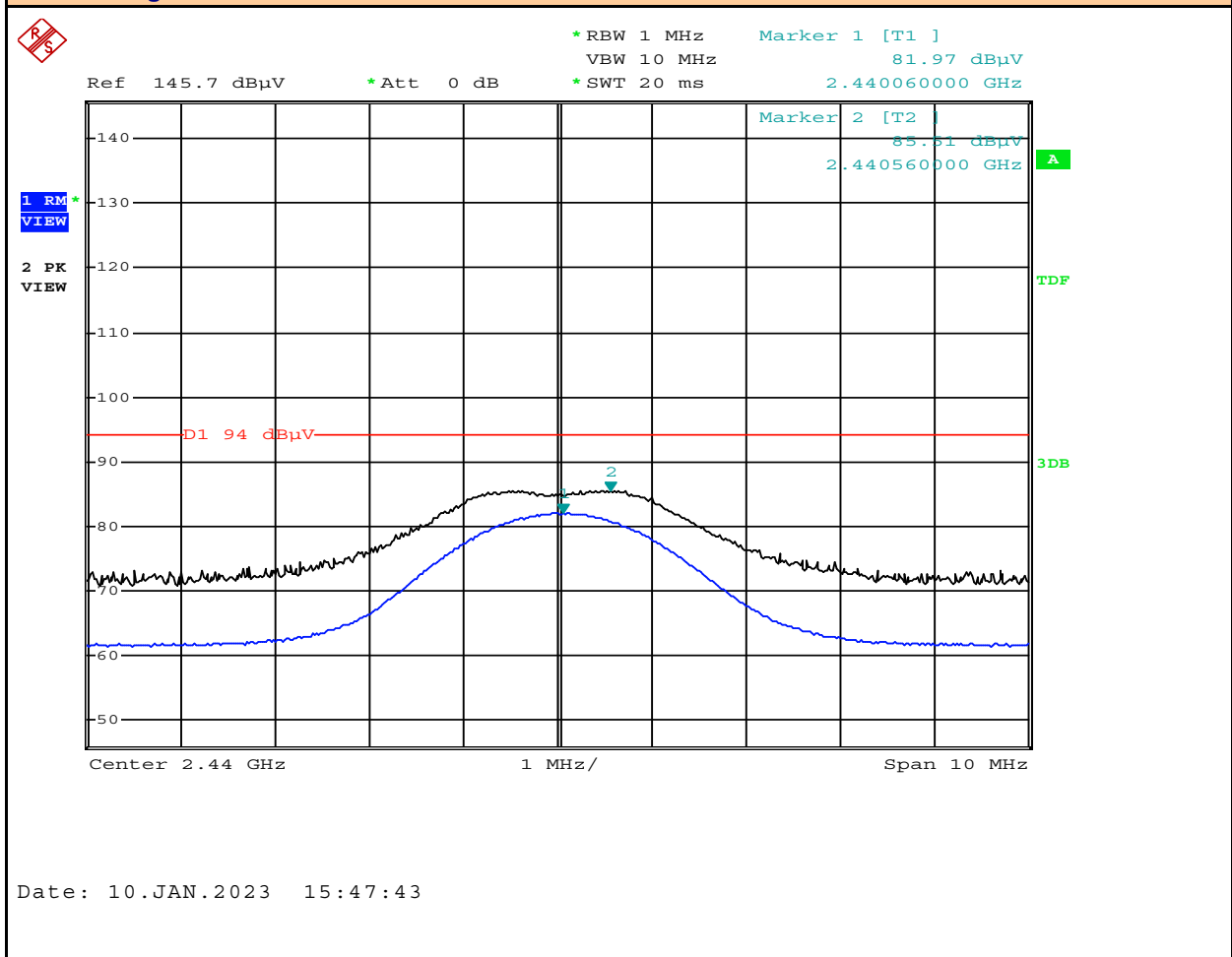
Field Strength:



Channel:	0
Mode:	BT LE2
Polarization:	Vertical

Channel Frequency:	2404	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	83.12	dBuV/m
Measured Field Strength (Pk):	92.13	dBuV/m

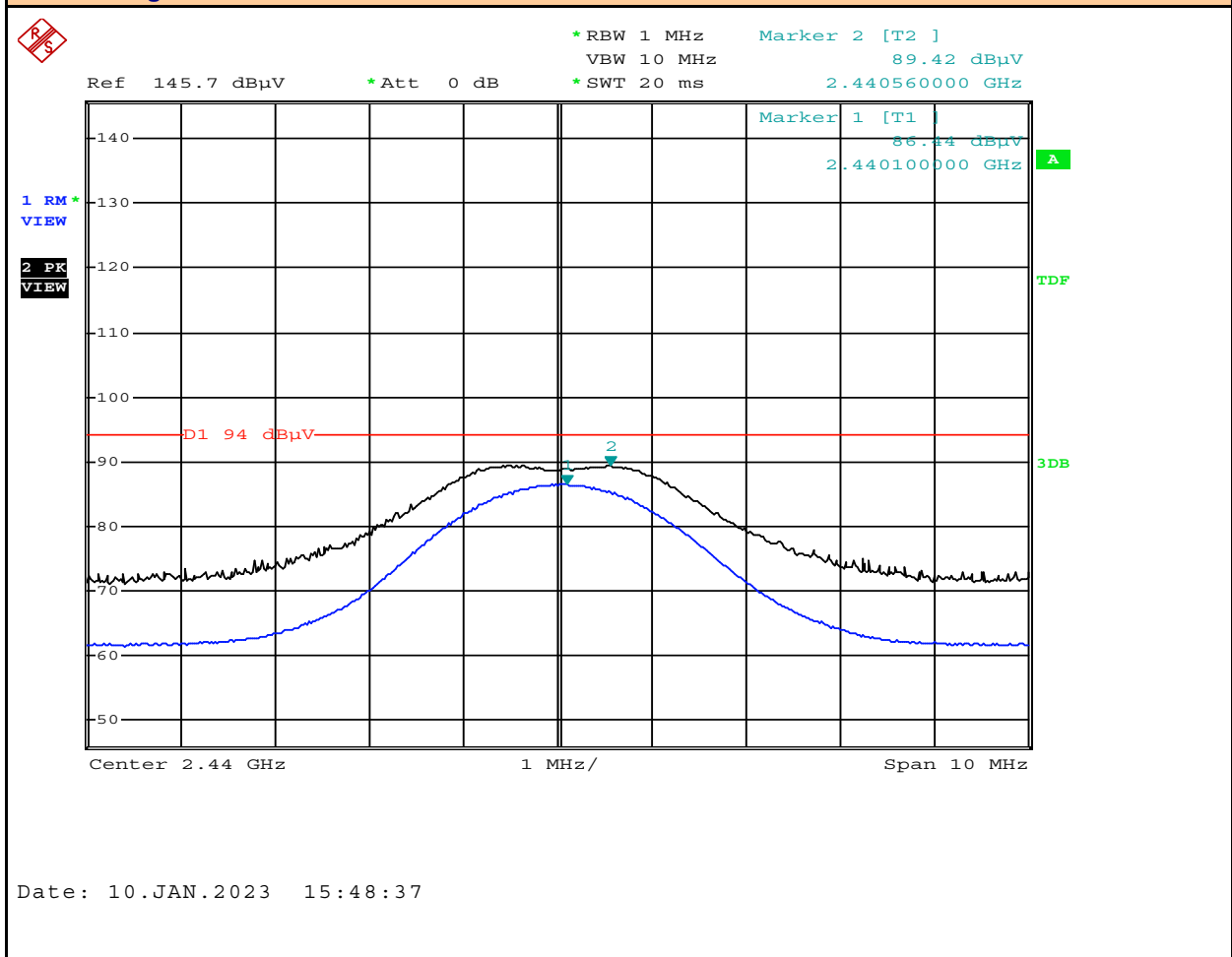
Field Strength:



Channel:	17
Mode:	BT LE2
Polarization:	Horizontal

Channel Frequency:	2440	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	81.97	dBuV/m
Measured Field Strength (Pk):	85.51	dBuV/m

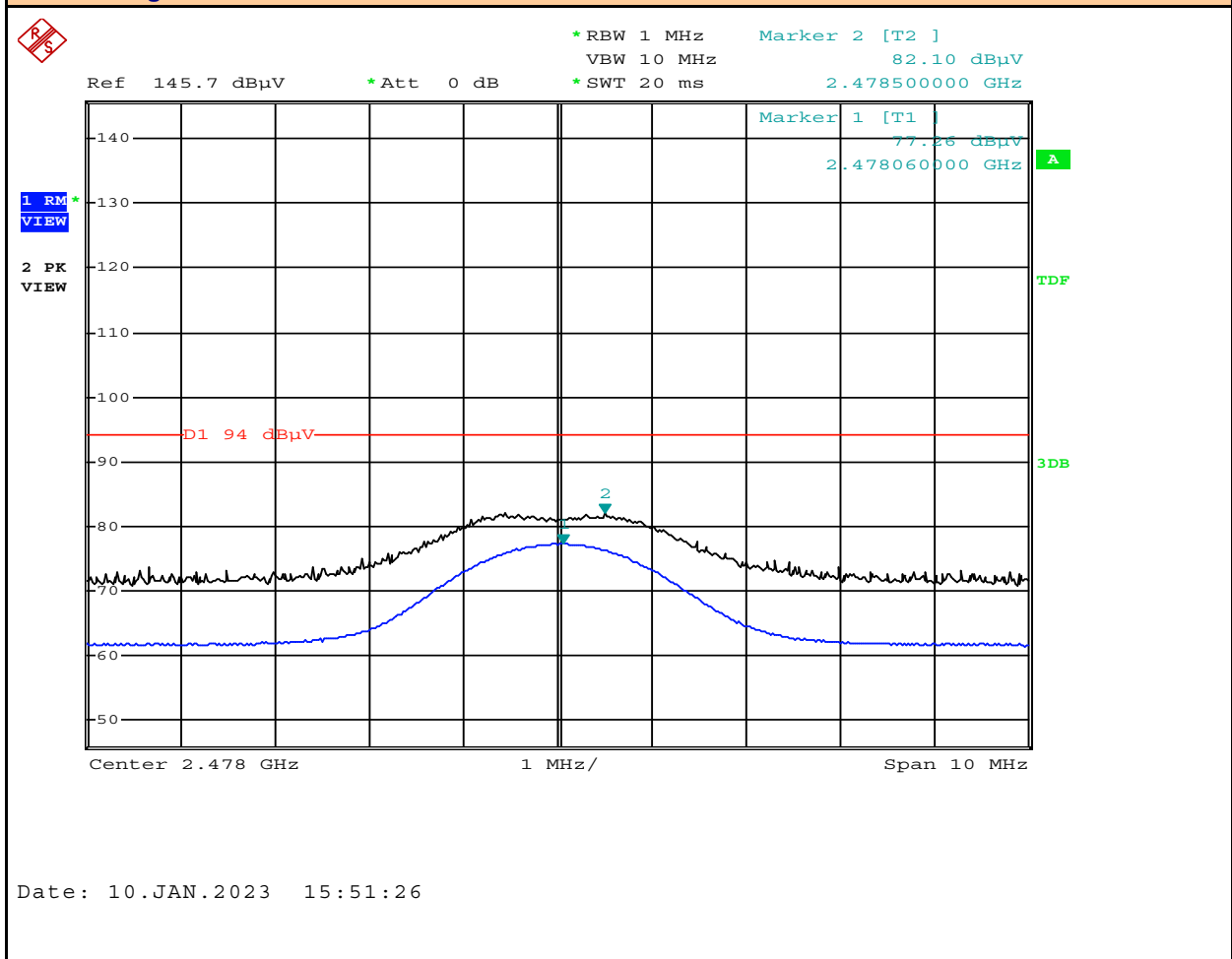
Field Strength:



Channel:	17
Mode:	BT LE2
Polarization:	Vertical

Channel Frequency:	2440	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	83.12	dBuV/m
Measured Field Strength (Pk):	86.44	dBuV/m

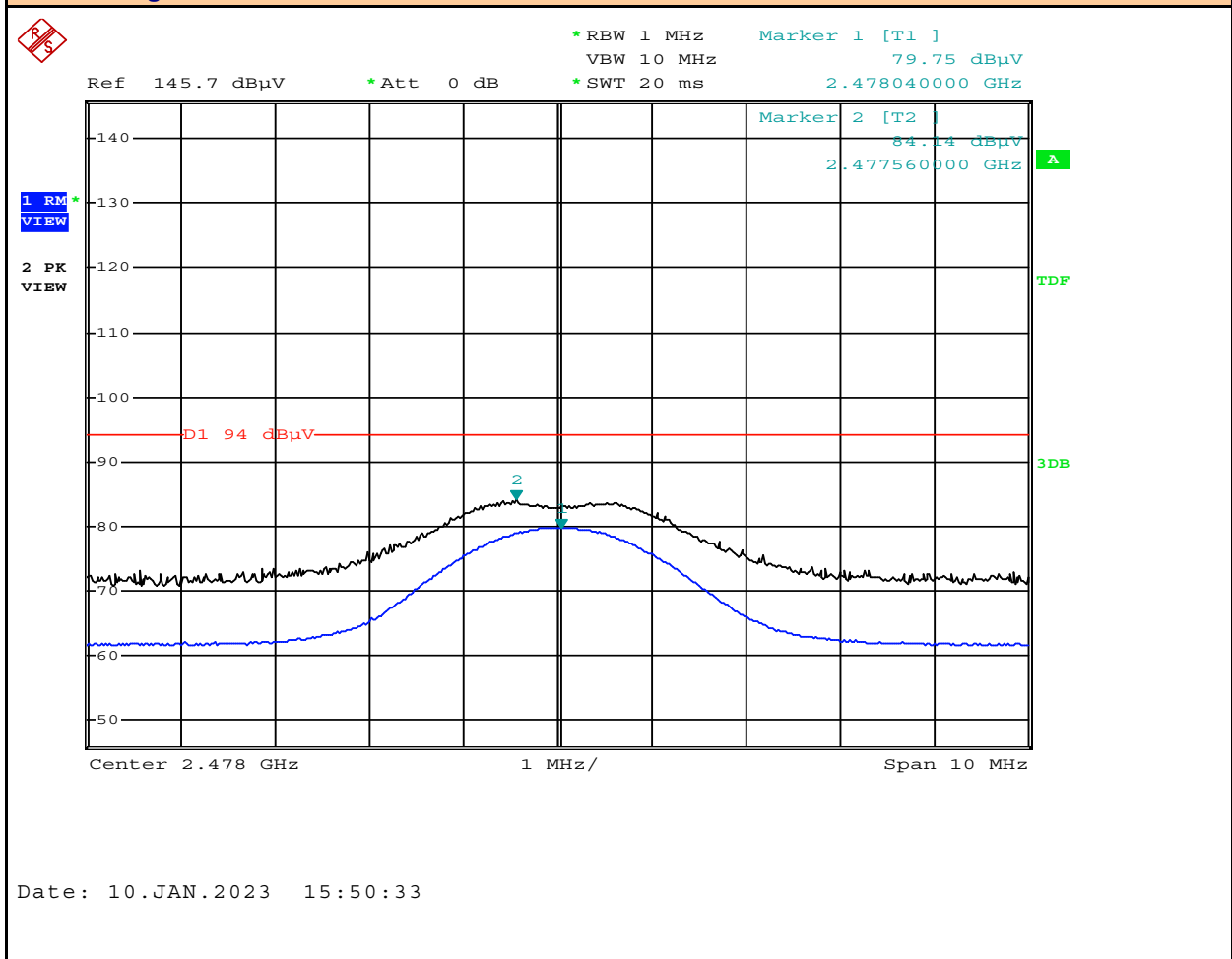
Field Strength:



Channel:	36
Mode:	BT LE2
Polarization:	Horizontal

Channel Frequency:	2478	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	77.26	dBuV/m
Measured Field Strength (Pk):	82.1	dBuV/m

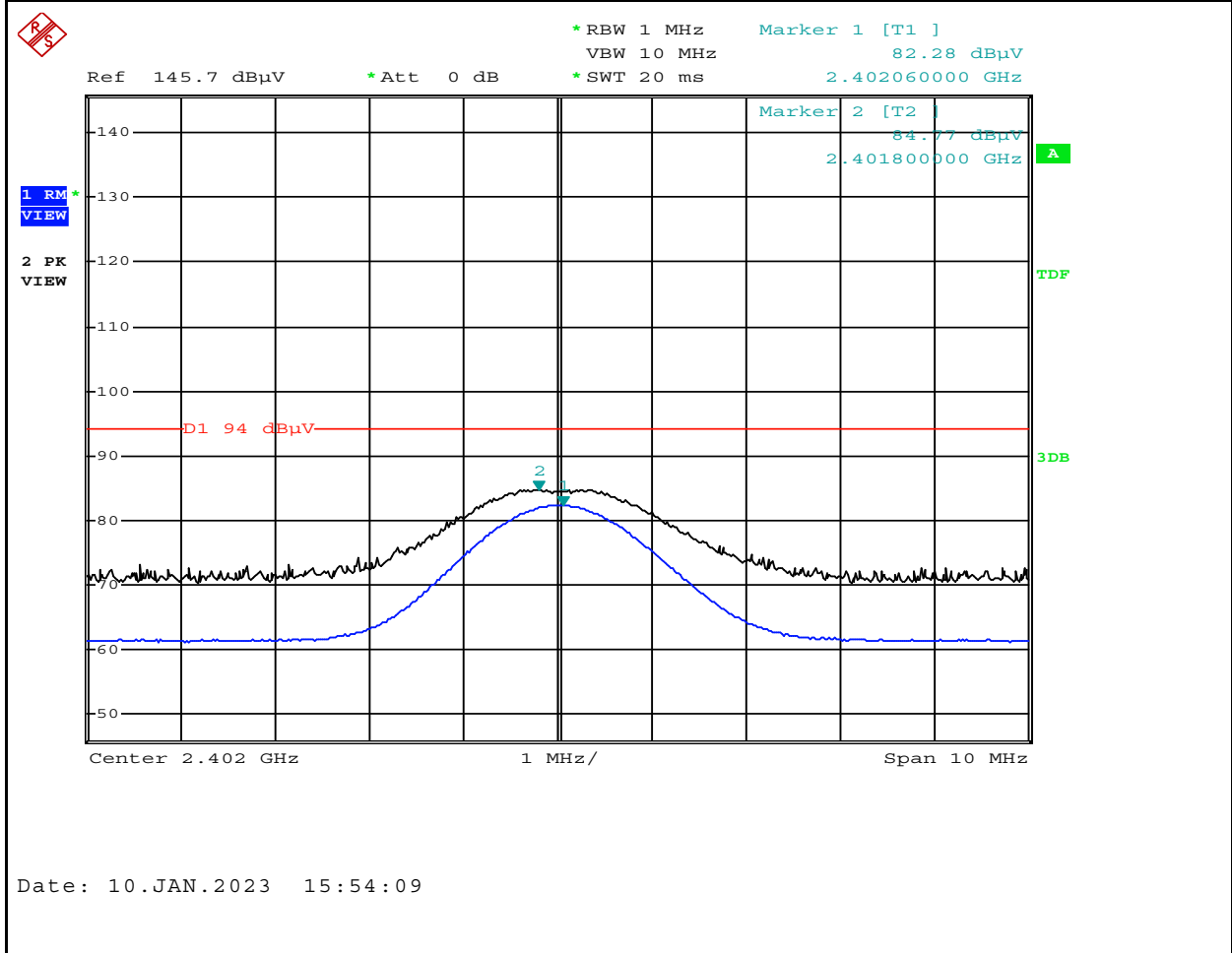
Field Strength:



Channel:	36
Mode:	BT LE2
Polarization:	Vertical

Channel Frequency:	2478	MHz
Modulation:	GMSK	
Measured Field Strength (Avg):	79.75	dBuV/m
Measured Field Strength (Pk):	84.14	dBuV/m

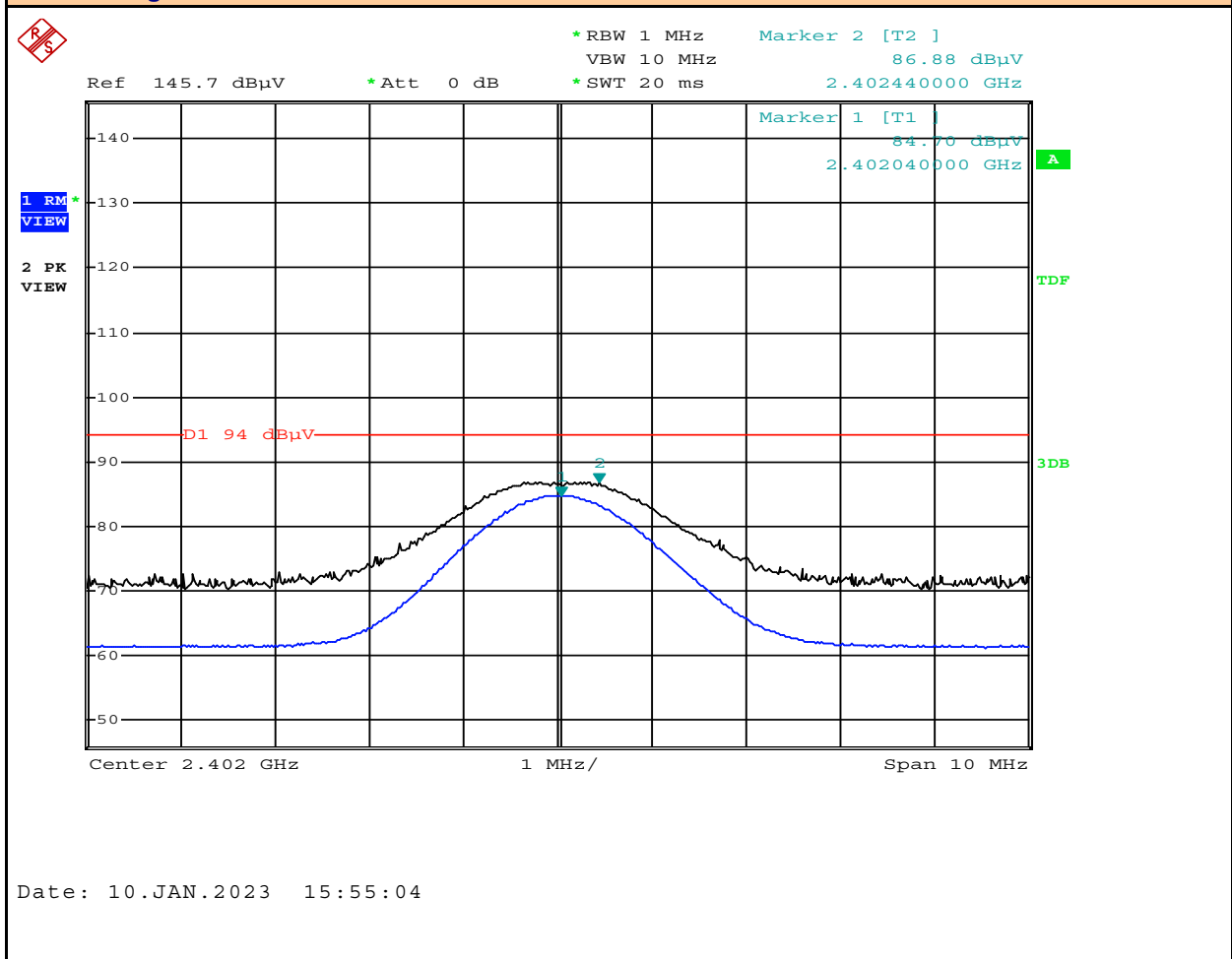
Field Strength:



Channel:	0
Mode:	ANT
Polarization:	Horizontal

Channel Frequency:	2402	MHz
Modulation:	GFSK	
Measured Field Strength (Avg):	82.28	dBuV/m
Measured Field Strength (Pk):	84.77	dBuV/m

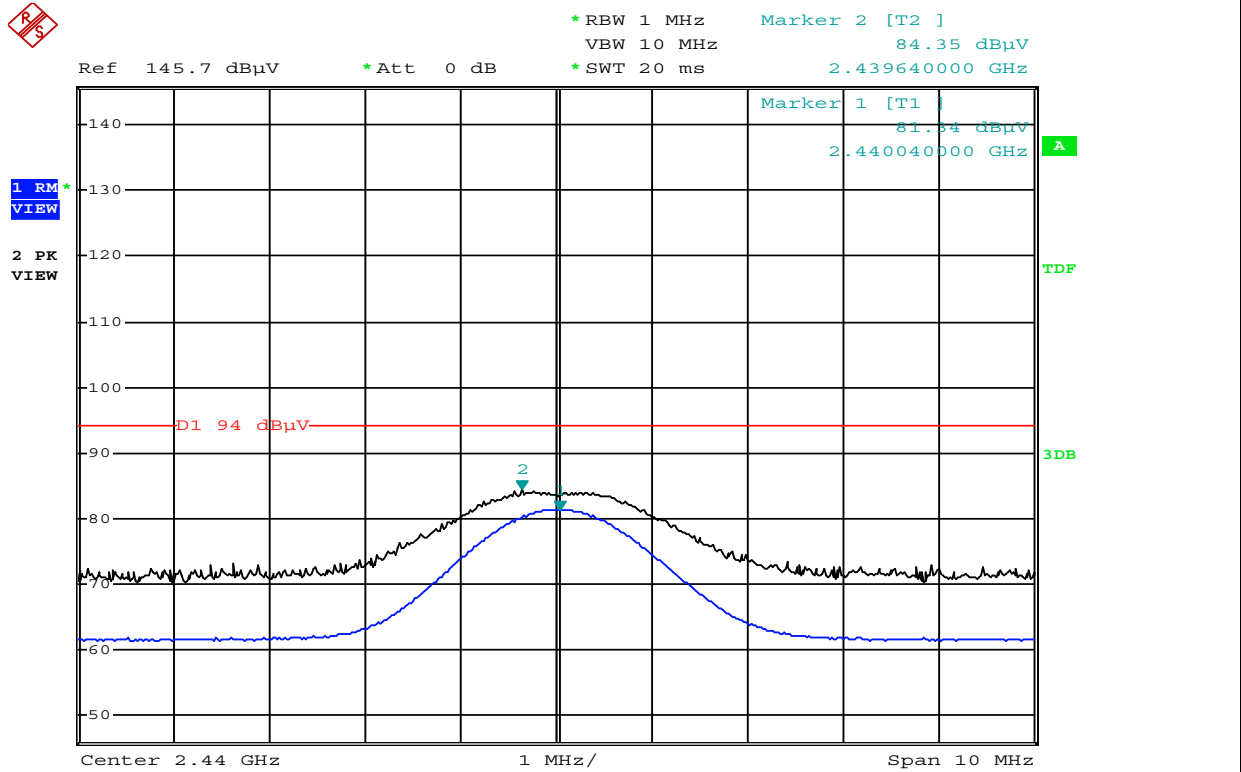
Field Strength:



Channel:	0
Mode:	ANT
Polarization:	Vertical

Channel Frequency:	2402	MHz
Modulation:	GFSK	
Measured Field Strength (Avg):	84.7	dBuV/m
Measured Field Strength (Pk):	86.88	dBuV/m

Field Strength:

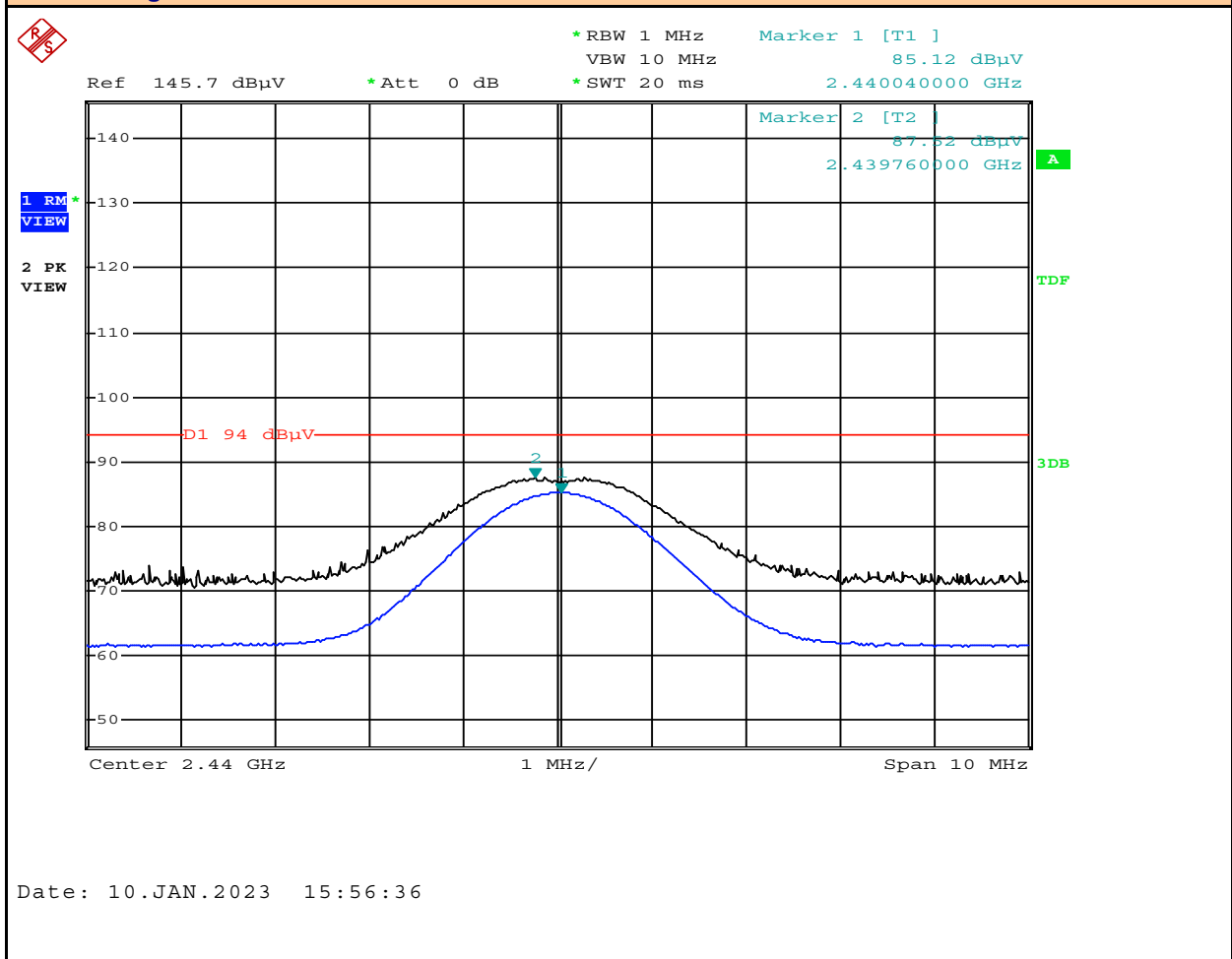


Date: 10.JAN.2023 15:57:42

Channel:	38
Mode:	ANT
Polarization:	Horizontal

Channel Frequency:	2440	MHz
Modulation:	GFSK	
Measured Field Strength (Avg):	81.34	dBuV/m
Measured Field Strength (Pk):	84.35	dBuV/m

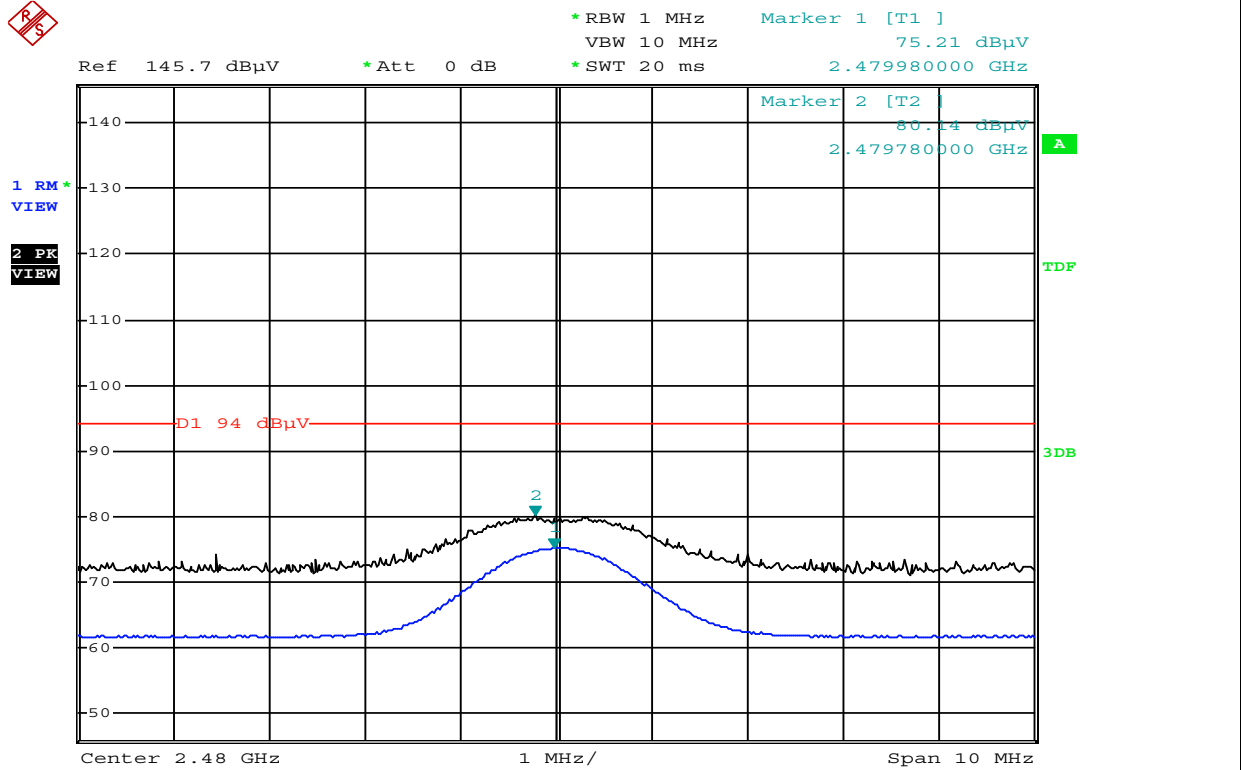
Field Strength:



Channel:	38
Mode:	ANT
Polarization:	Vertical

Channel Frequency:	2440	MHz
Modulation:	GFSK	
Measured Field Strength (Avg):	85.12	dBuV/m
Measured Field Strength (Pk):	87.32	dBuV/m

Field Strength:

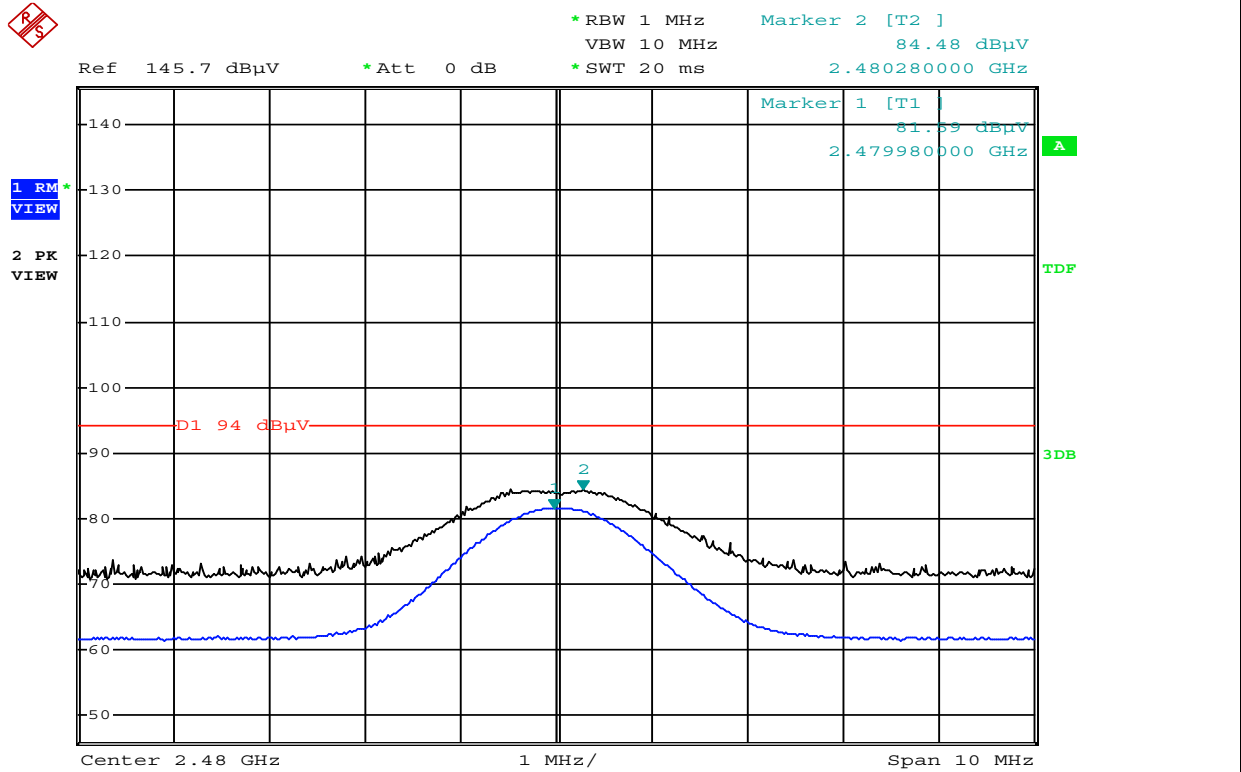


Date: 10.JAN.2023 15:59:15

Channel:	78
Mode:	ANT
Polarization:	Horizontal

Channel Frequency:	2480	MHz
Modulation:	GFSK	
Measured Field Strength (Avg):	75.21	dBuV/m
Measured Field Strength (Pk):	80.14	dBuV/m

Field Strength:



Date: 10.JAN.2023 16:00:09

Channel:	78
Mode:	ANT
Polarization:	Vertical

Channel Frequency:	2480	MHz
Modulation:	GFSK	
Measured Field Strength (Avg):	81.59	dBuV/m
Measured Field Strength (Pk):	84.48	dBuV/m

Summary of Radiated Tx Emissions

Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	2412.0	Horizontal	42.15	7.59	17.31	0.73	0.00 (3)	25.6 (2)	40.0	14.4
30-1000MHz	2412.0	Horizontal	51.33	7.51	12.47	0.77	0.00 (3)	20.8 (2)	40.0	19.2
30-1000MHz	2412.0	Horizontal	827.80	8.44	29.22	2.82	0.00 (3)	40.5 (2)	46.0	5.5
30-1000MHz	2412.0	Vertical	908.30	8.46	29.50	2.94	0.00 (3)	40.9 (2)	46.0	5.1
30-1000MHz	2412.0	Vertical	911.10	8.30	29.41	2.95	0.00 (3)	40.7 (2)	46.0	5.4
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	2412.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	2412.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	2412.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	2412.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	2412.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	2412.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

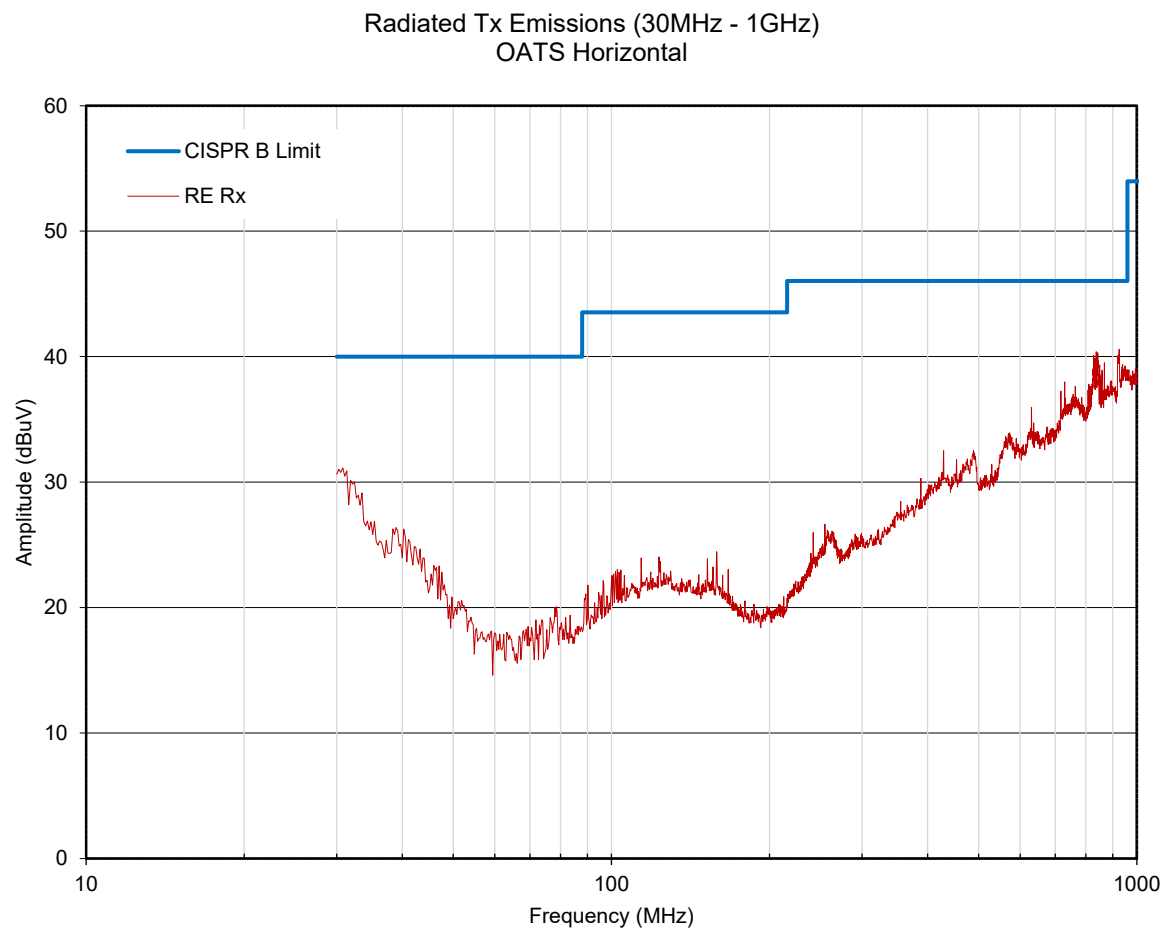
(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

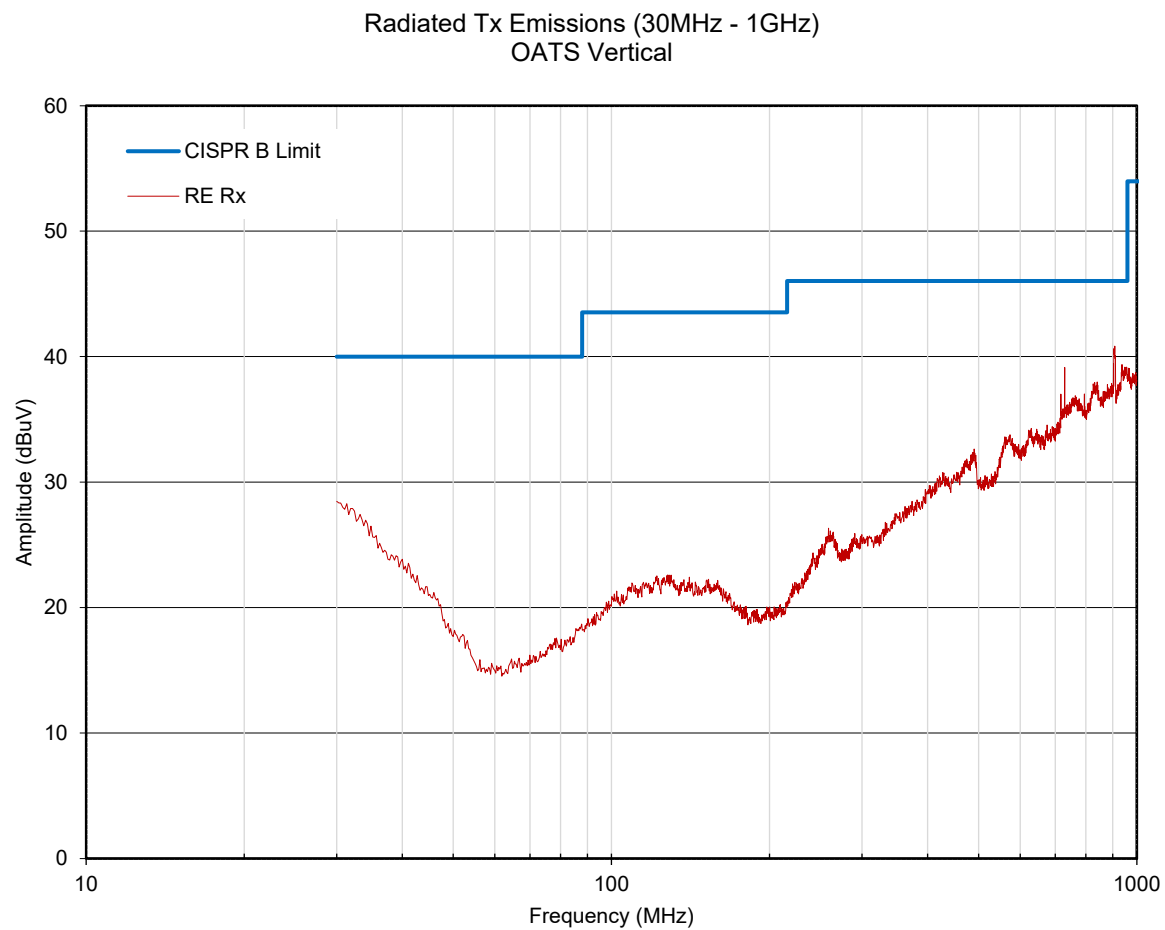
(3) External Amplifier not used

$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_C - G_A$$

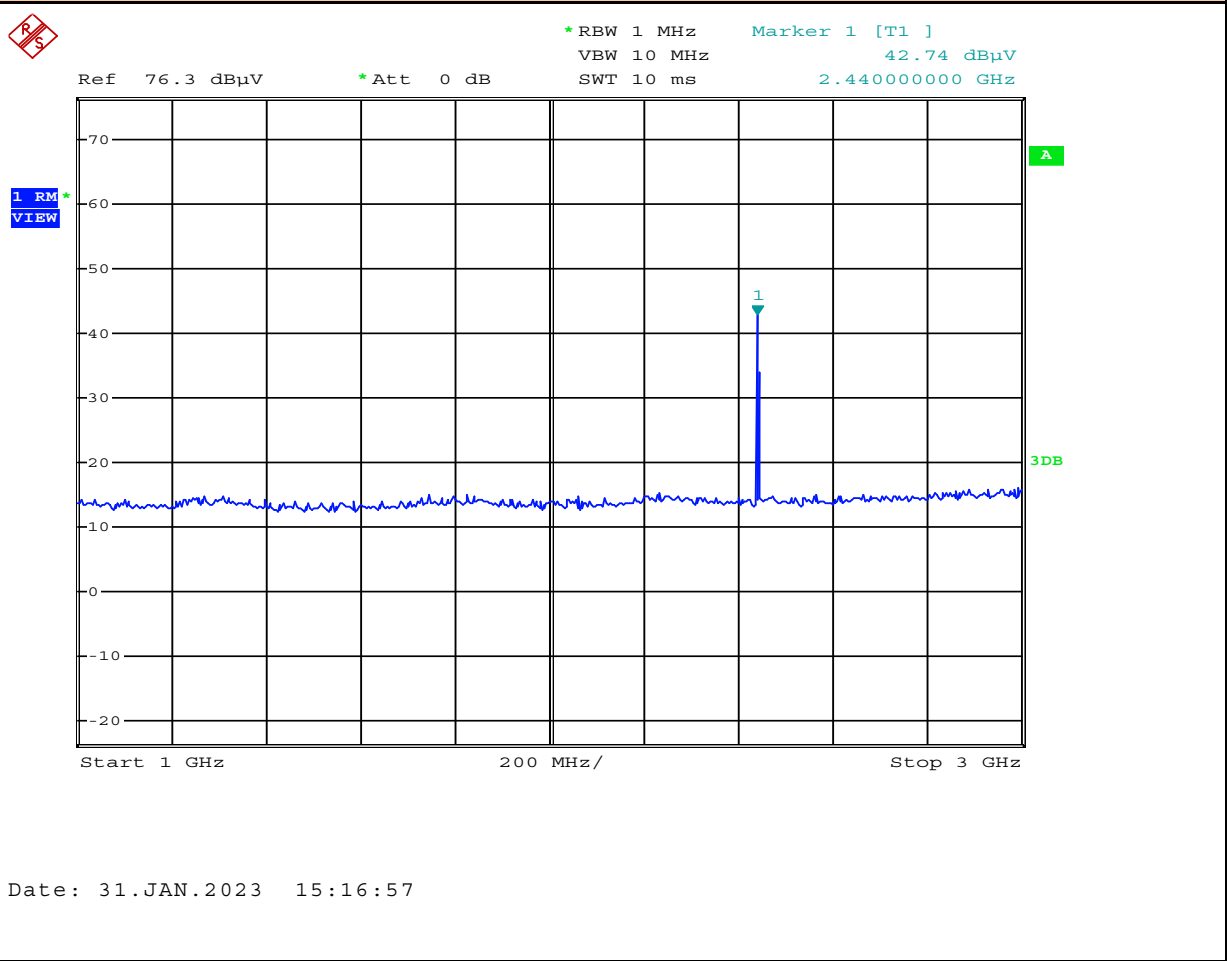
Radiated Tx Emissions:



Radiated Tx Emissions:



Radiated Tx Emissions:



Channel: 38

Mode: BT BR

Polarization: Horizontal

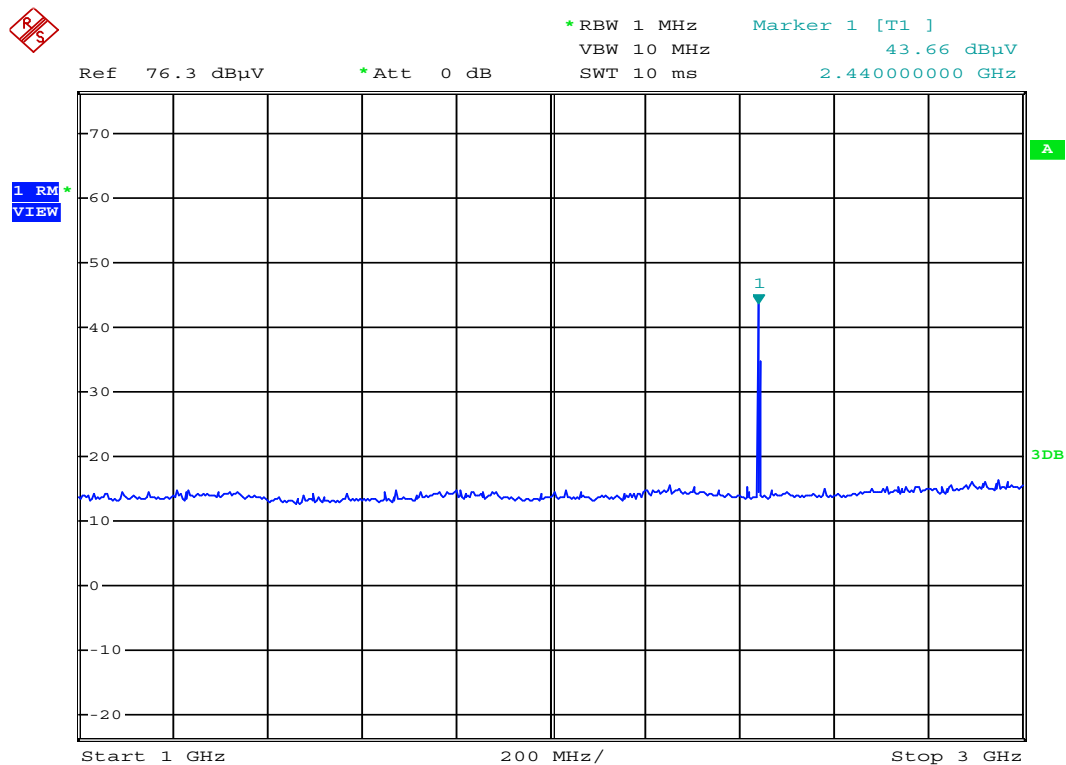
Marker 1 = Fundamental

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Date: 31.JAN.2023 15:15:04

Channel: 38

Mode: BT BR

Polarization: Vertical

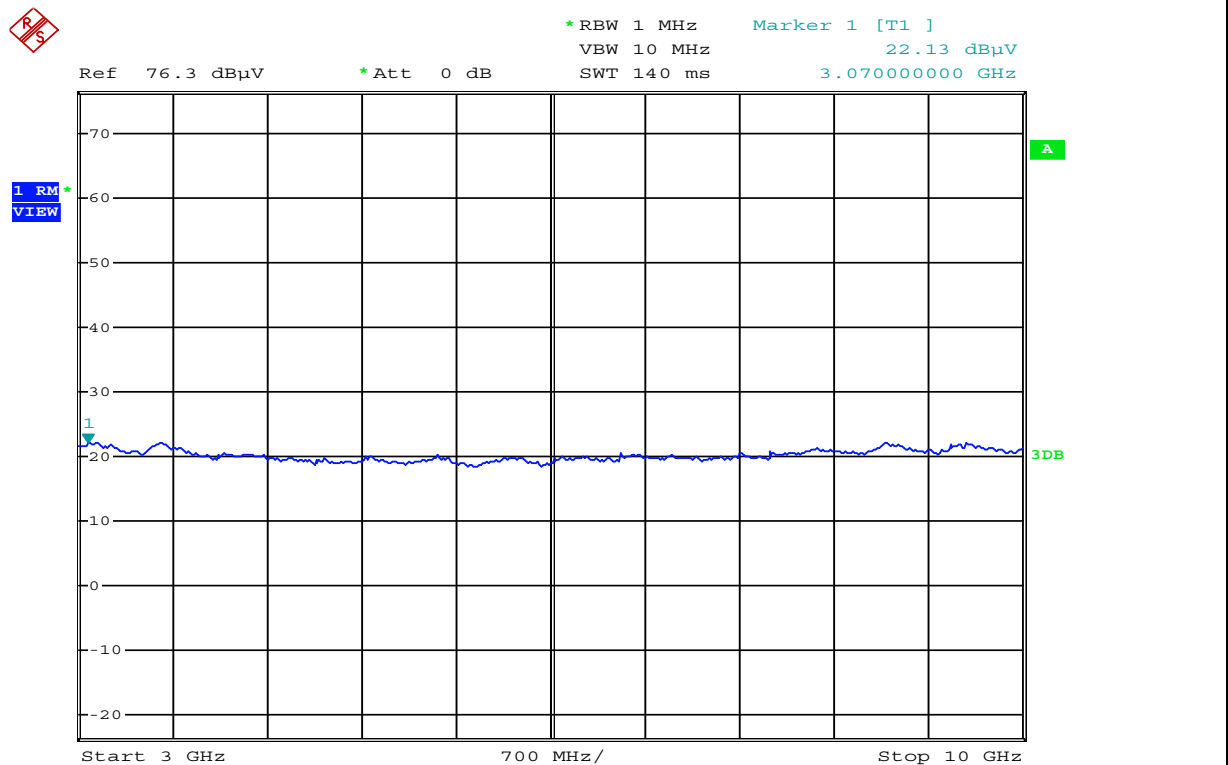
Marker 1 = Fundamental

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:

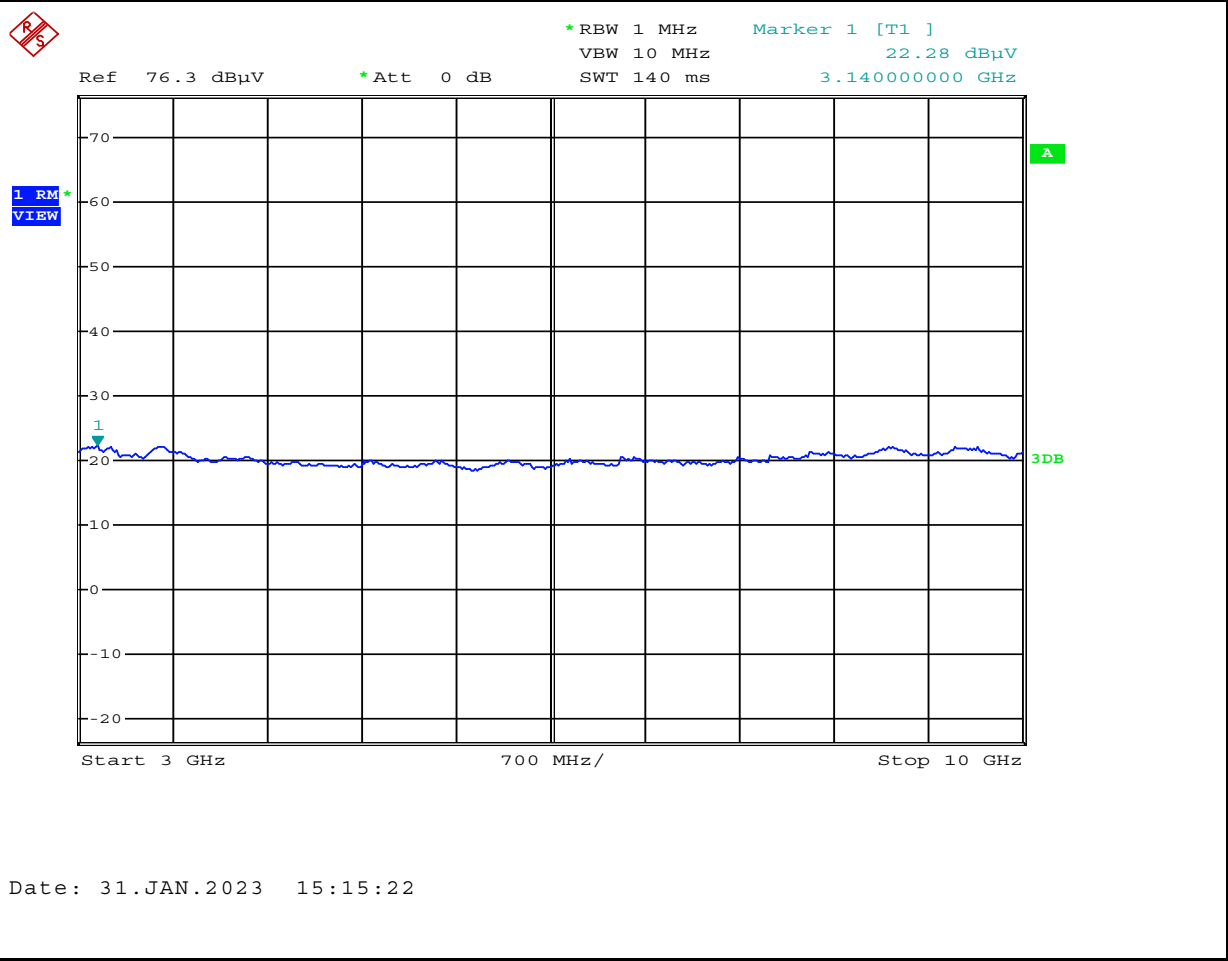


Date: 31.JAN.2023 15:17:30

Channel:	38
Mode:	BT BR
Polarization:	Horizontal

Channel Frequency:	2440	MHz
Modulation:	GFSK	
Measured Emission:	ND	dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

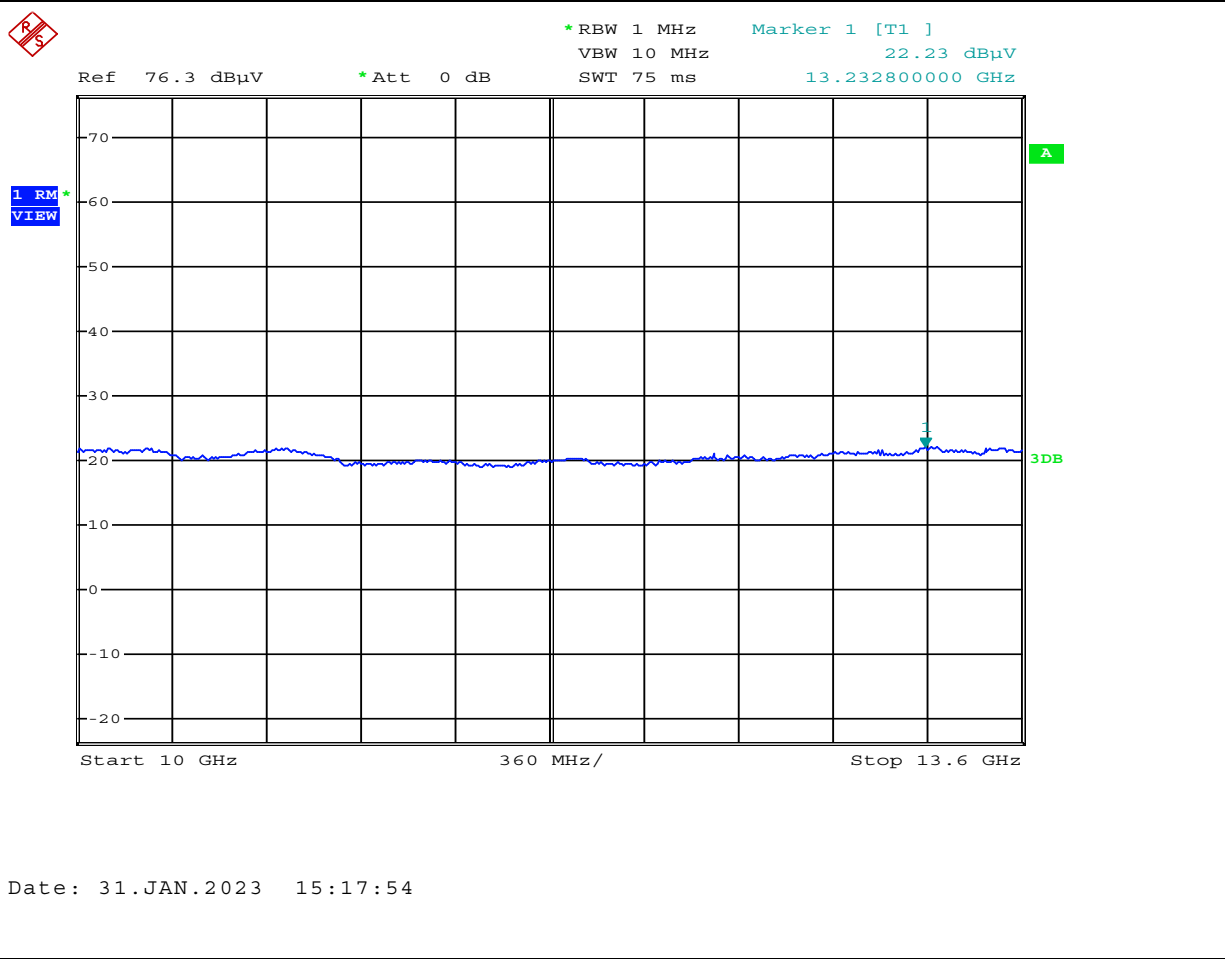
Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

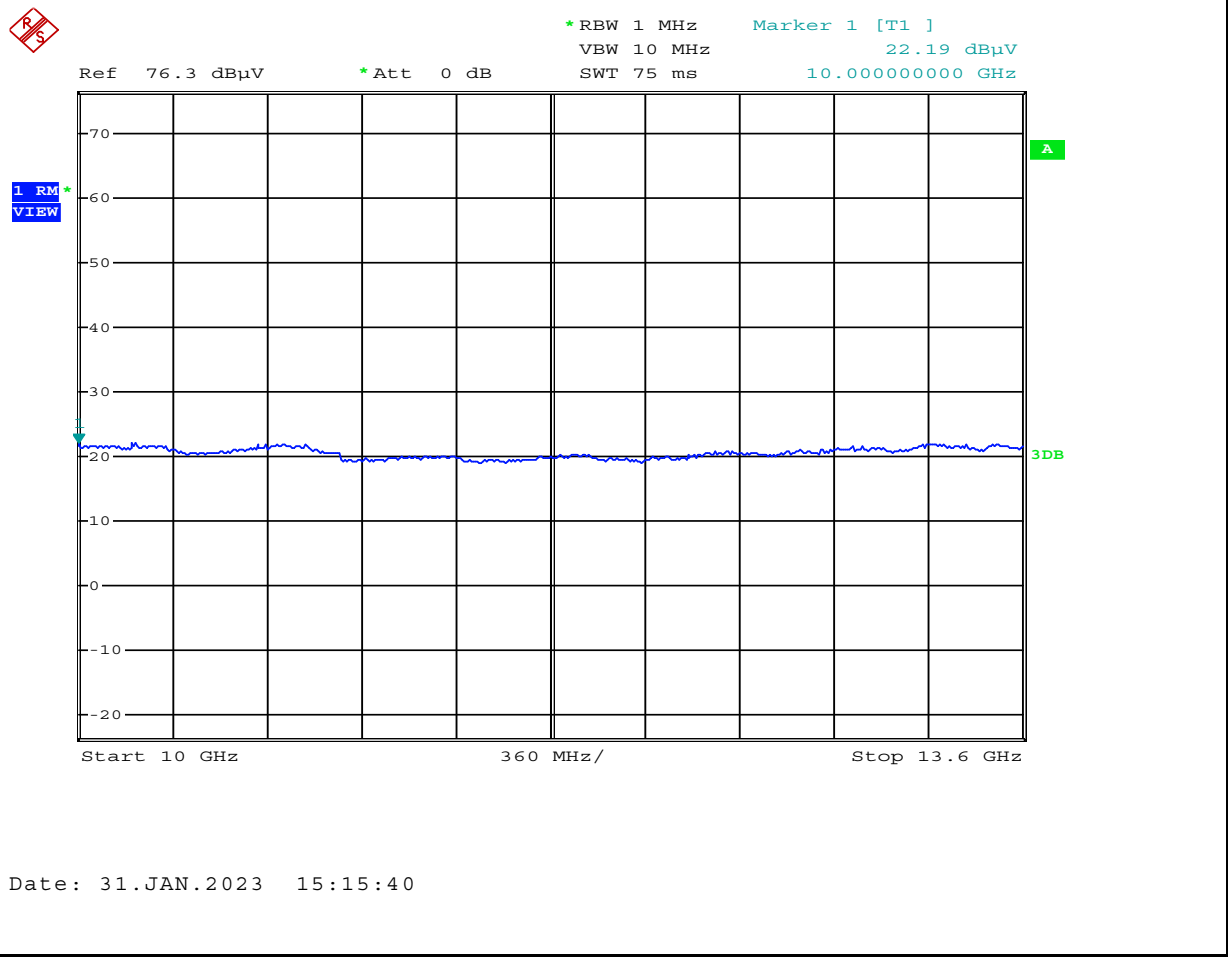
Polarization: Horizontal

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:

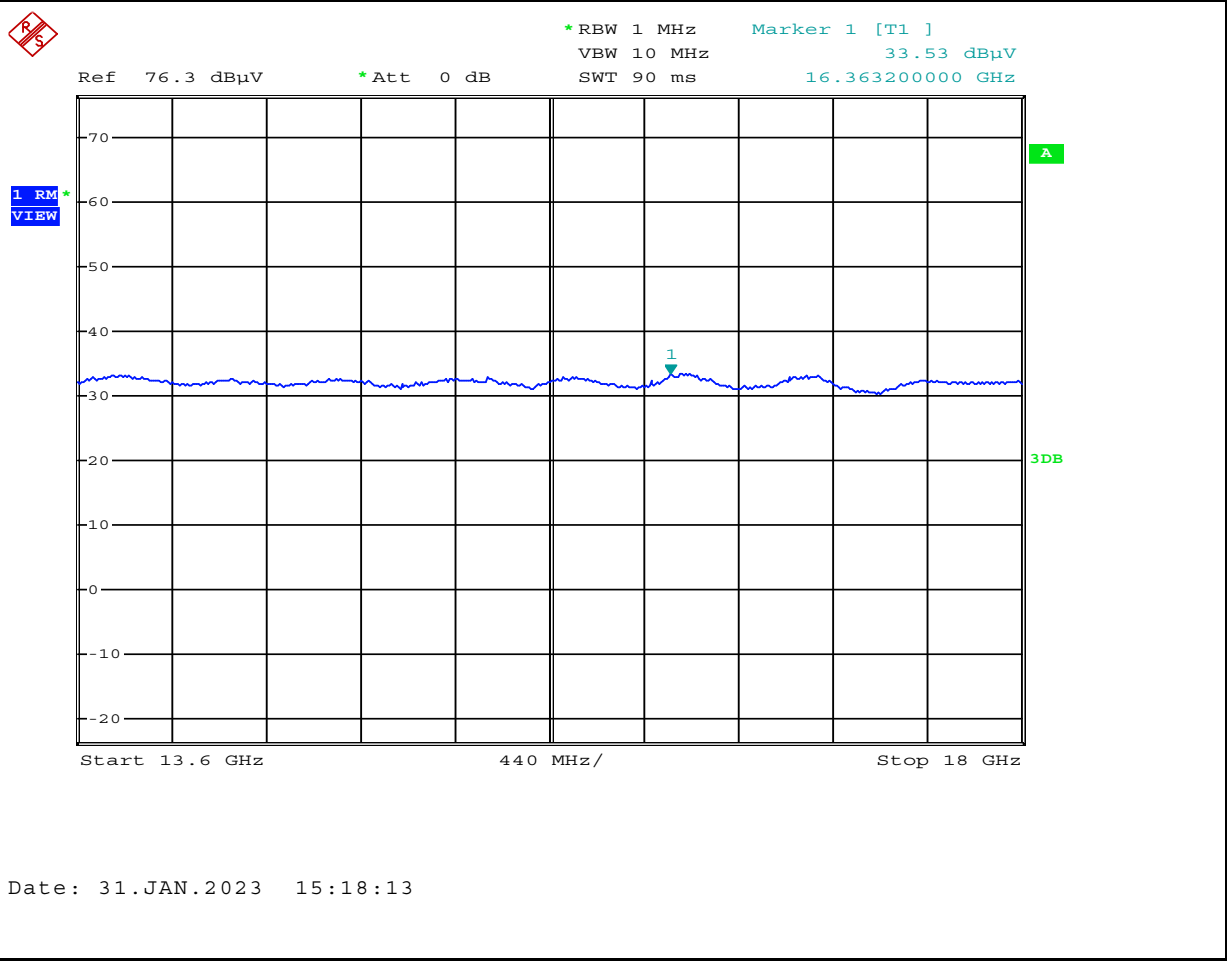


Date: 31.JAN.2023 15:15:40

Channel:	38
Mode:	BT BR
Polarization:	Vertical

Channel Frequency:	2440	MHz
Modulation:	GFSK	
Measured Emission:	ND	dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

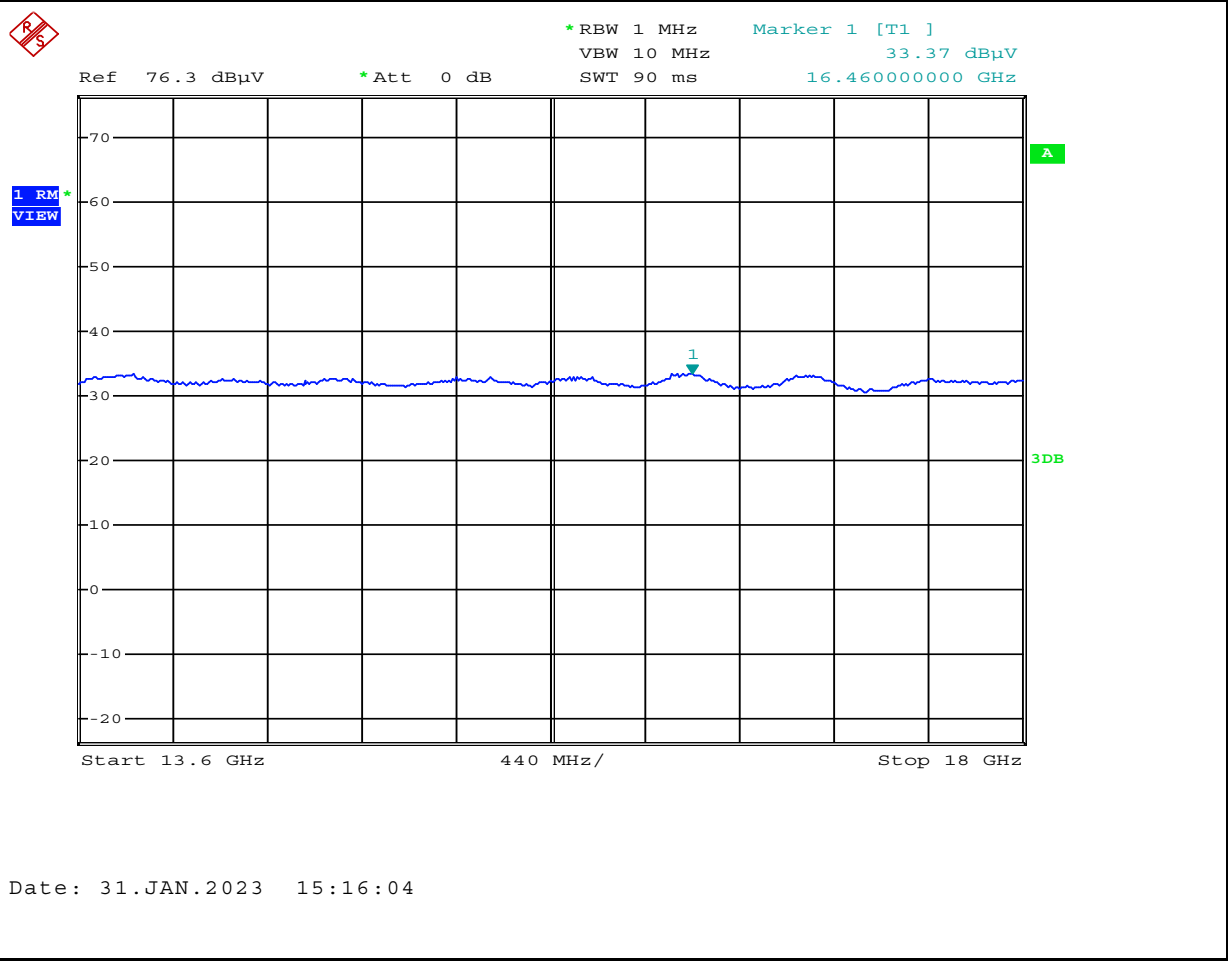
Polarization: Horizontal

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

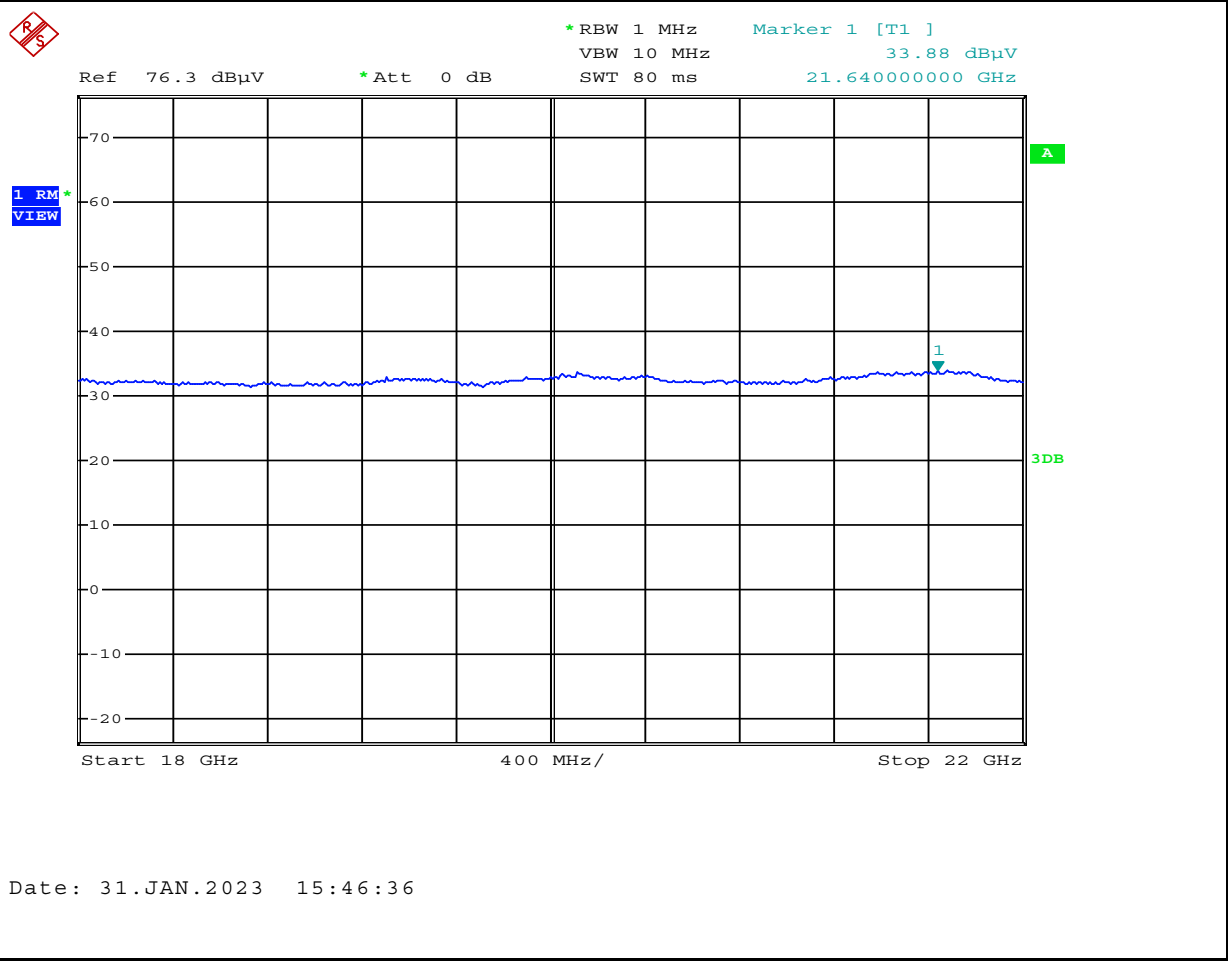
Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

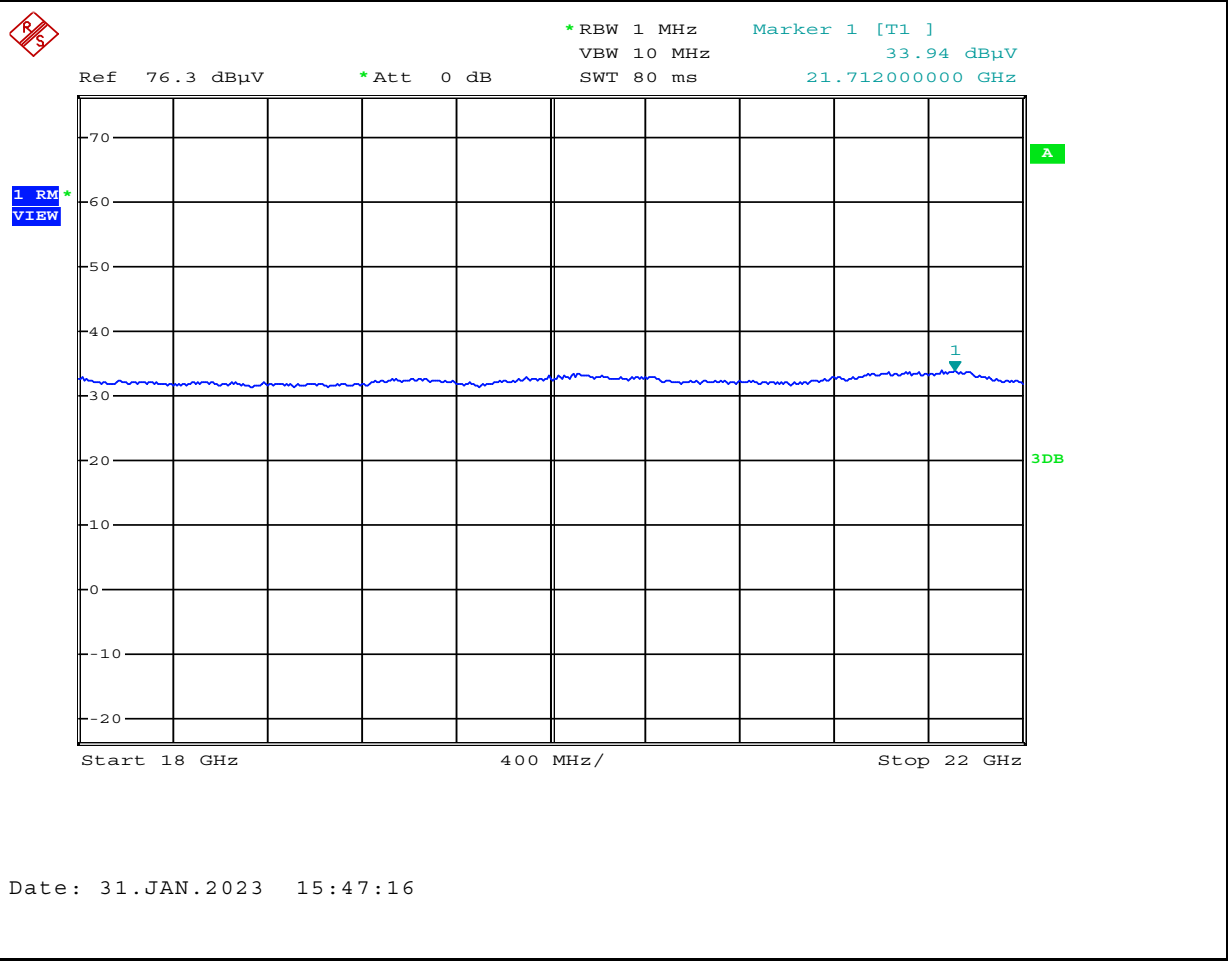
Polarization: Horizontal

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

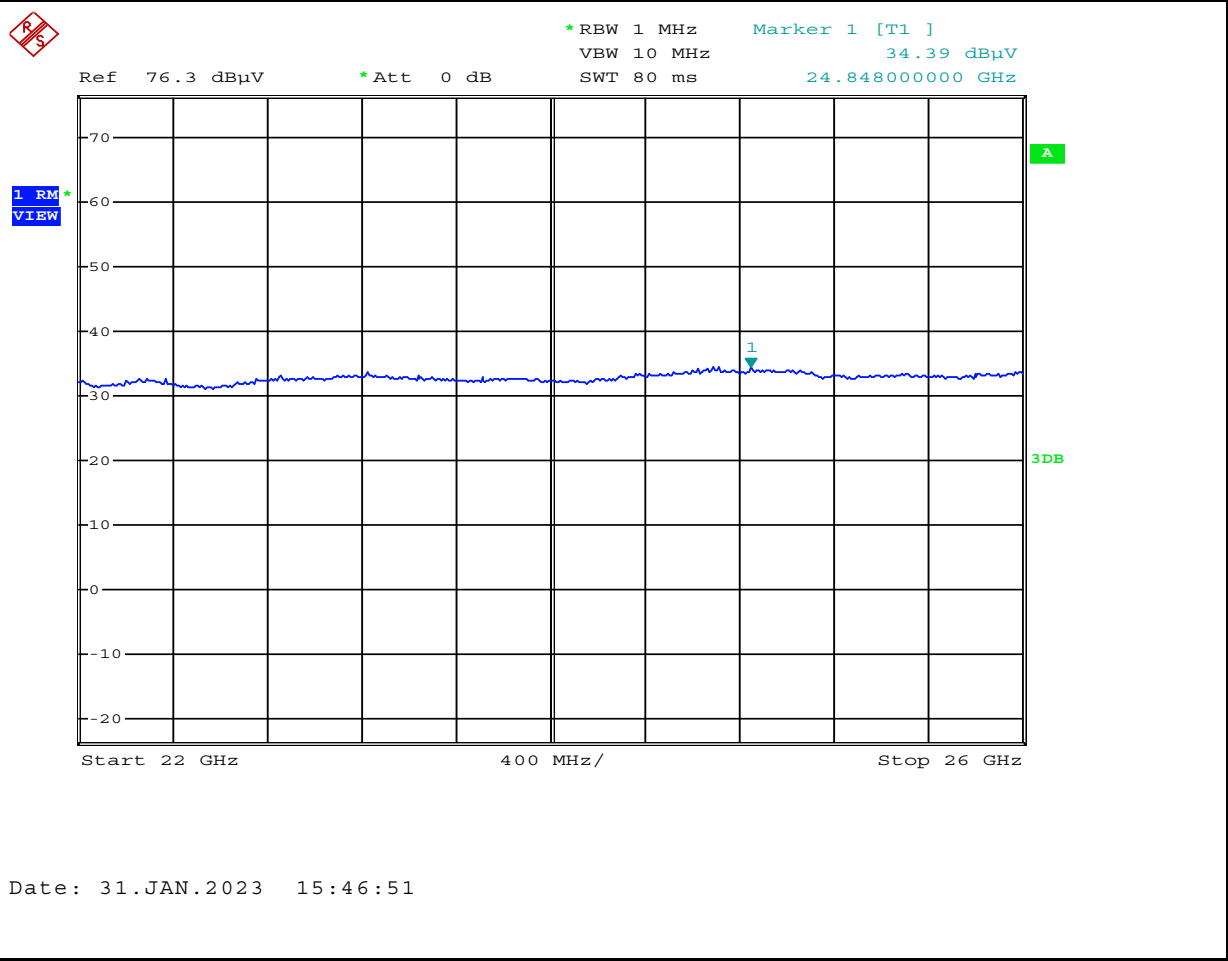
Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

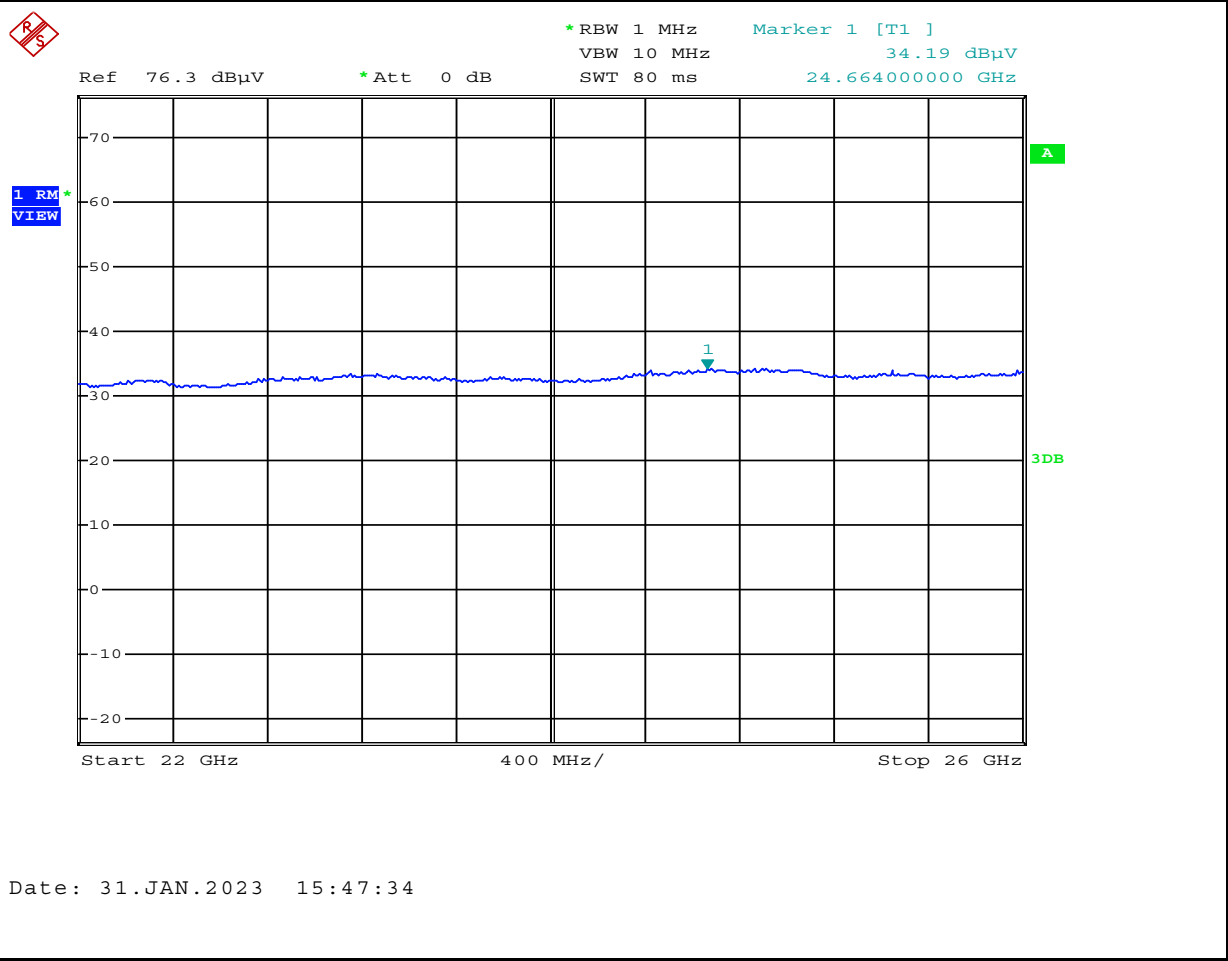
Polarization: Horizontal

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Radiated Tx Emissions:



Channel: 38

Mode: BT BR

Polarization: Vertical

Channel Frequency: 2440 MHz

Modulation: GFSK

Measured Emission: ND dBm

Summary of Radiated Rx Emissions

Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	Measured Emission [E _{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L _C] (dB)	Amplifier Gain [G _A] (dB)	Corrected Emission [E _{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000MHz	-	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	46.0	n/a
30-1000MHz	-	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	43.5	n/a
1 - 3GHz	-	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
1 - 3GHz	-	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	n/a
3-13GHz	-	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
3-13GHz	-	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	n/a
13-18GHz	-	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
13-18GHz	-	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	n/a
18-26GHz	-	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
18-26GHz	-	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	n/a
Results:									Complies	

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit

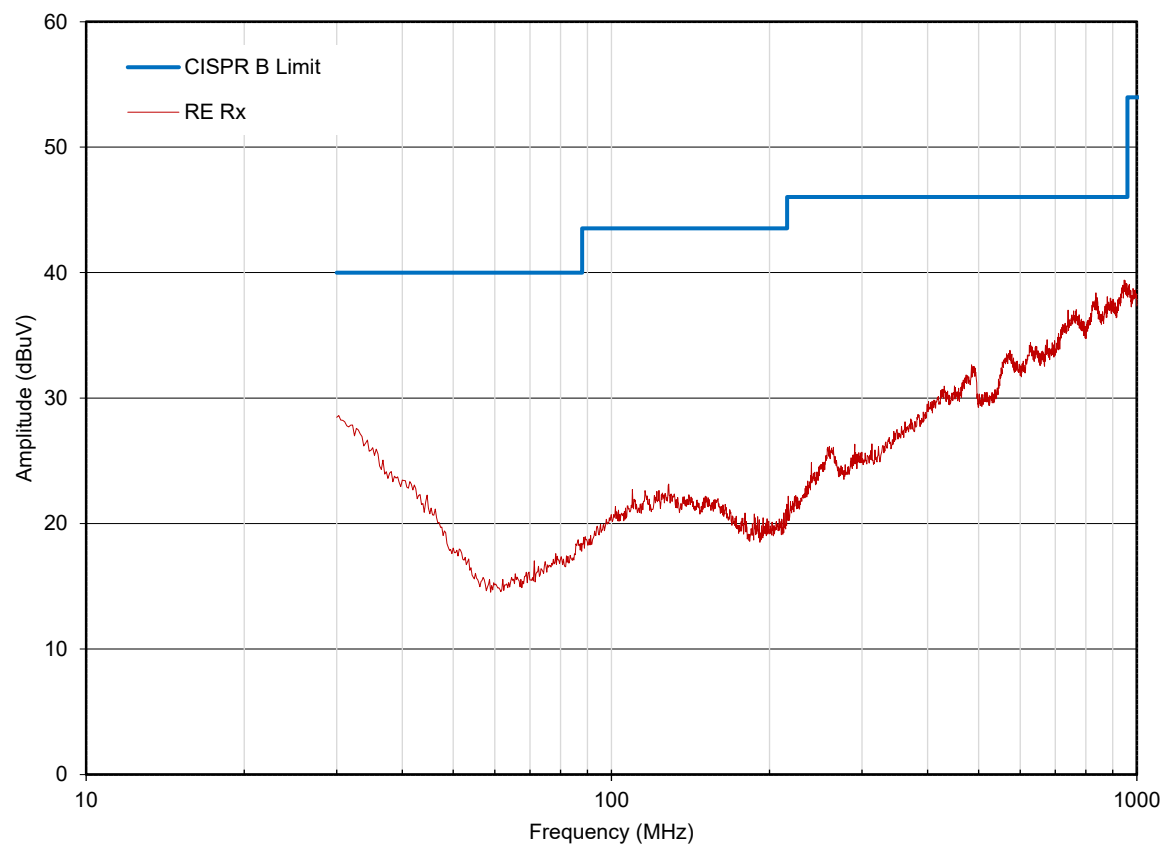
(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor

(3) External Amplifier not used

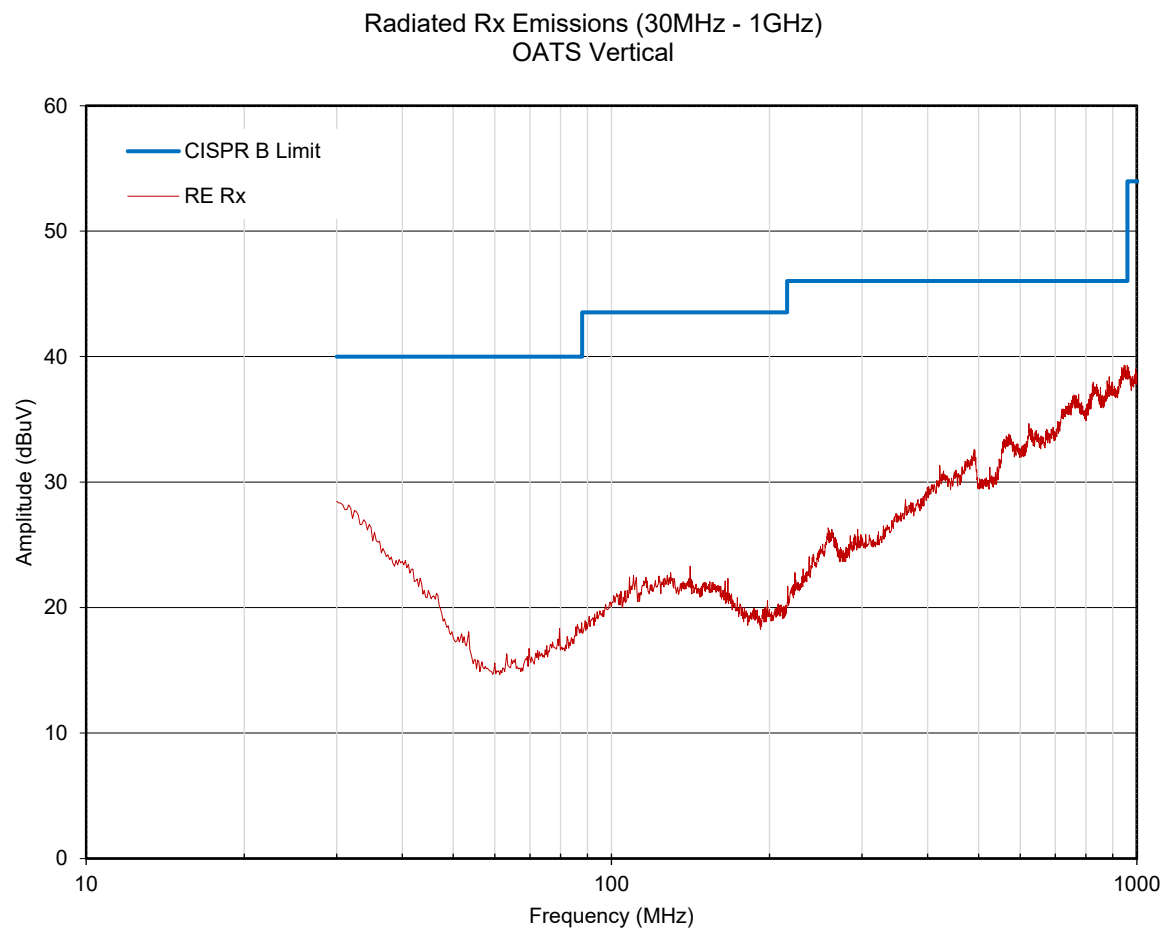
$$E_{\text{Corr}} = E_{\text{Meas}} + \text{ACF} + L_{\text{C}} - G_{\text{A}}$$

Radiated Rx Emissions:

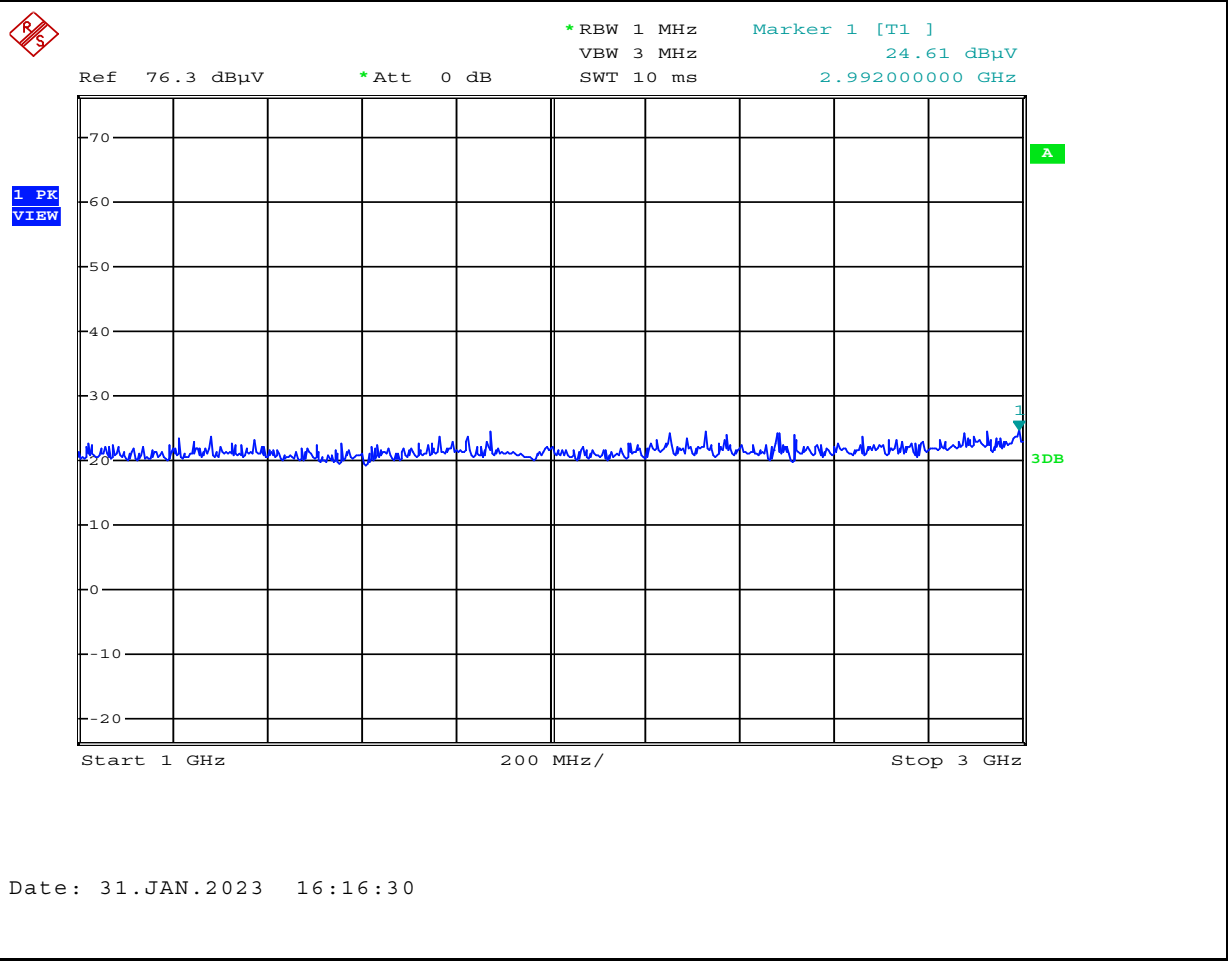
Radiated Rx Emissions (30MHz - 1GHz)
OATS Horizontal



Radiated Rx Emissions:



Radiated Rx Emissions:

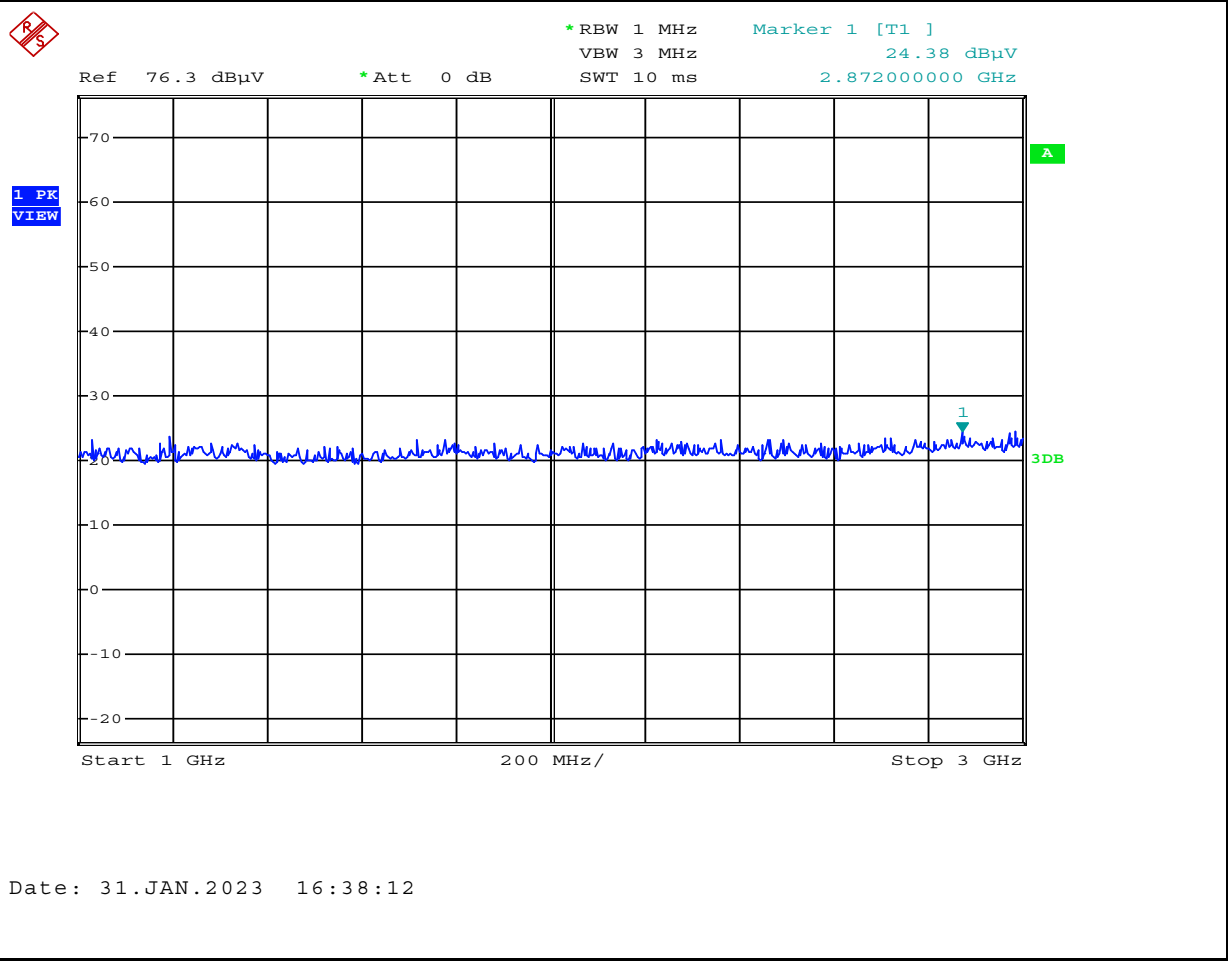


Polarization:

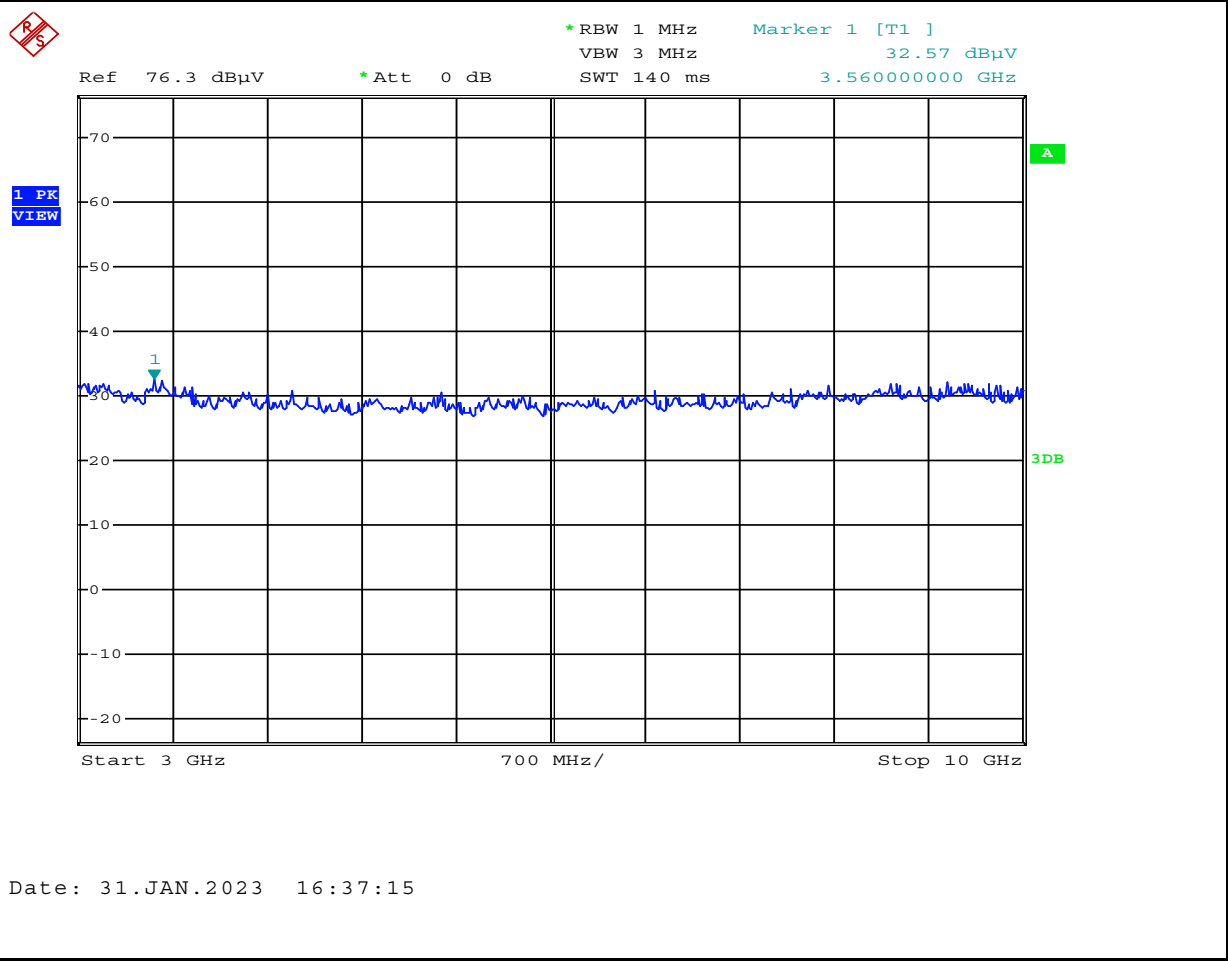
Marker 1 = Fundamental

Measured Emission: dBm

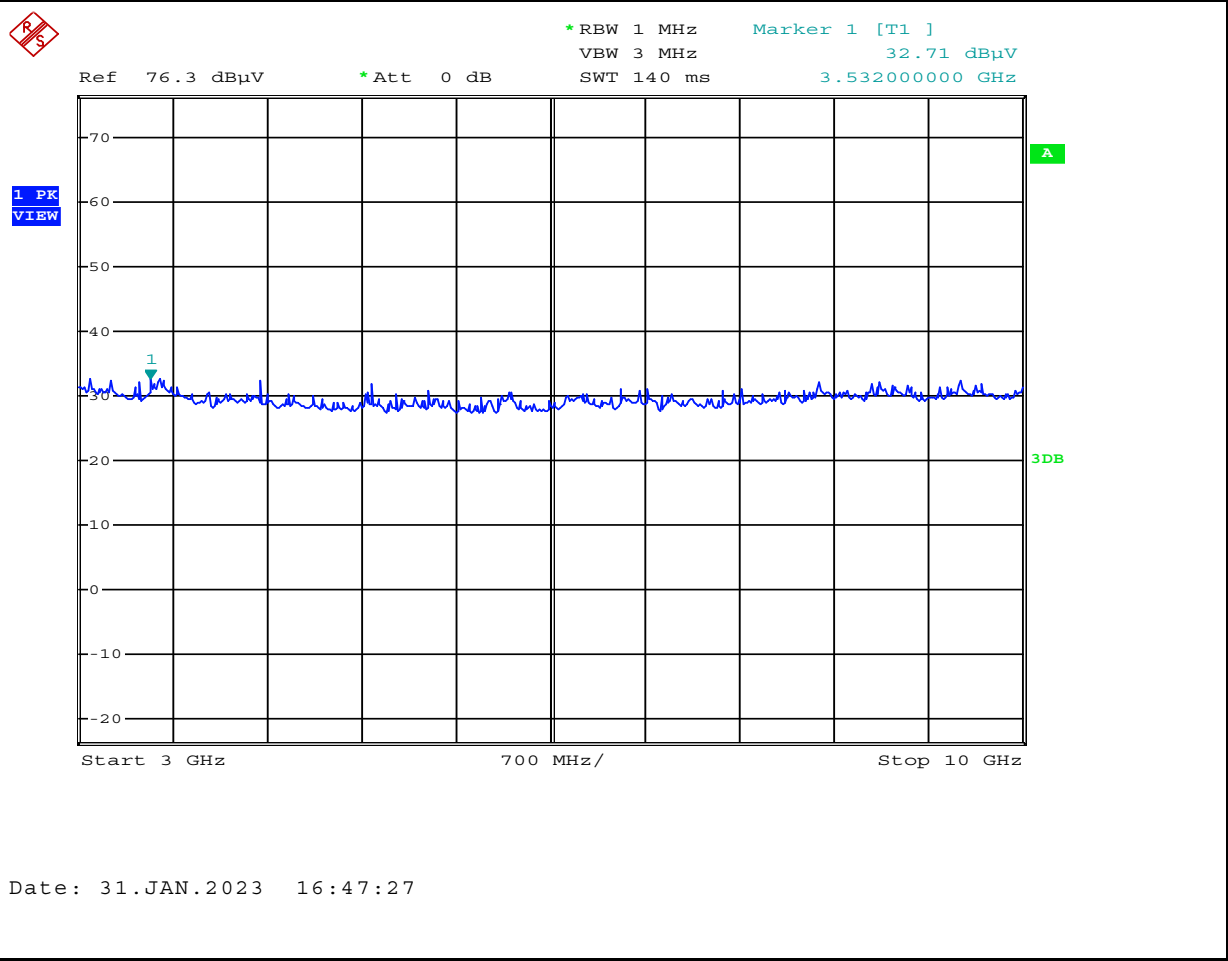
Radiated Rx Emissions:



Radiated Rx Emissions:



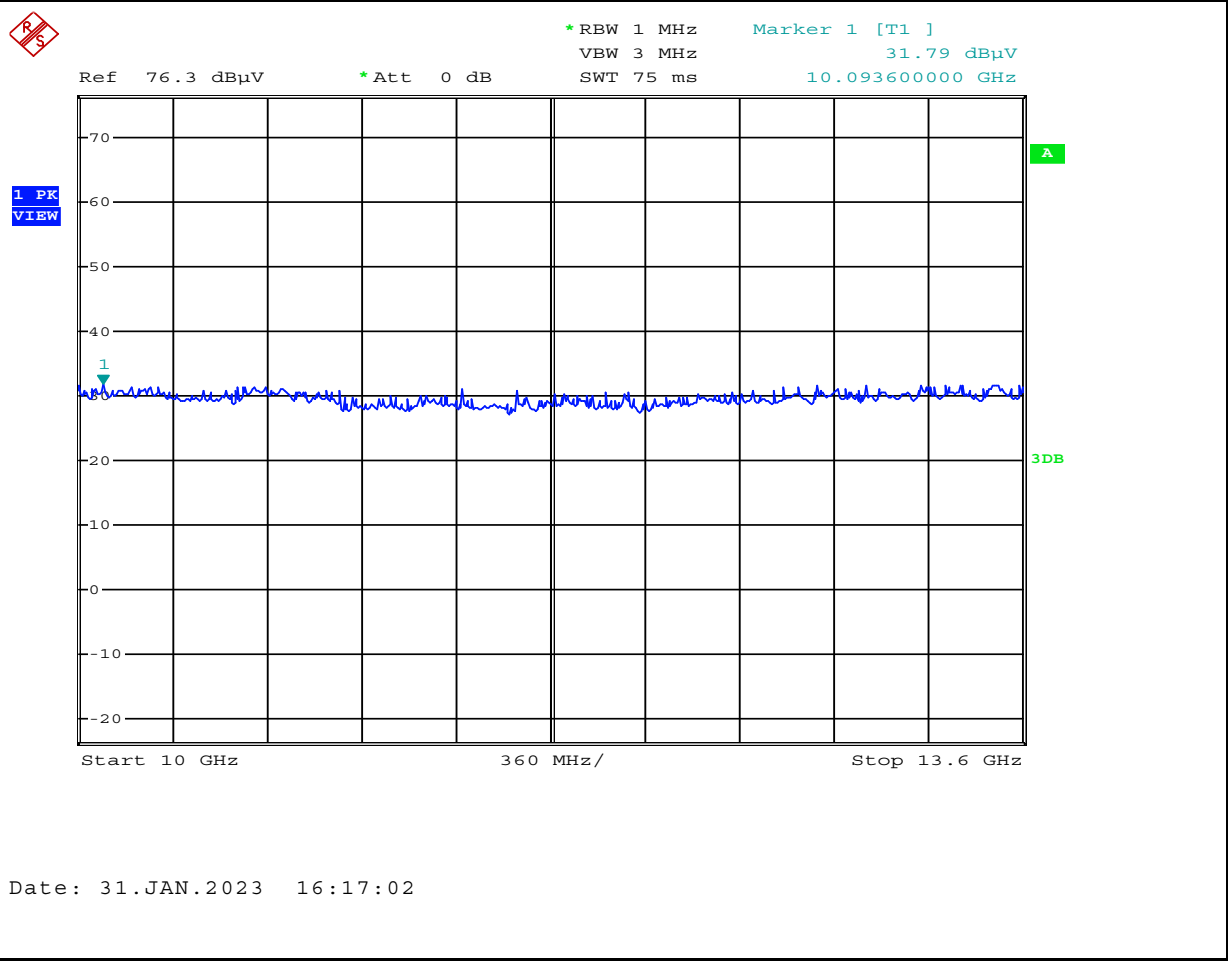
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

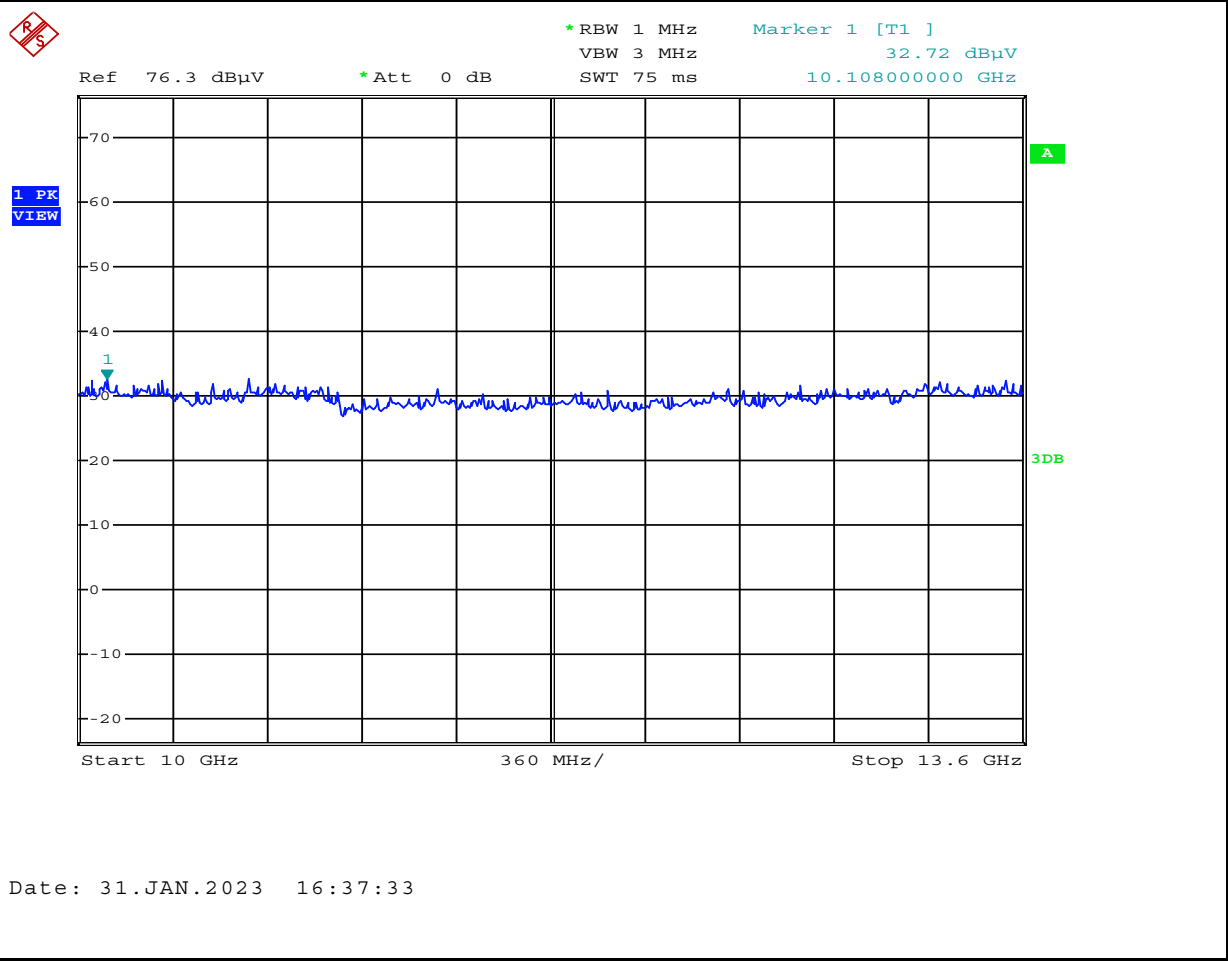
Radiated Rx Emissions:



Polarization: Horizontal

Measured Emission: ND dBm

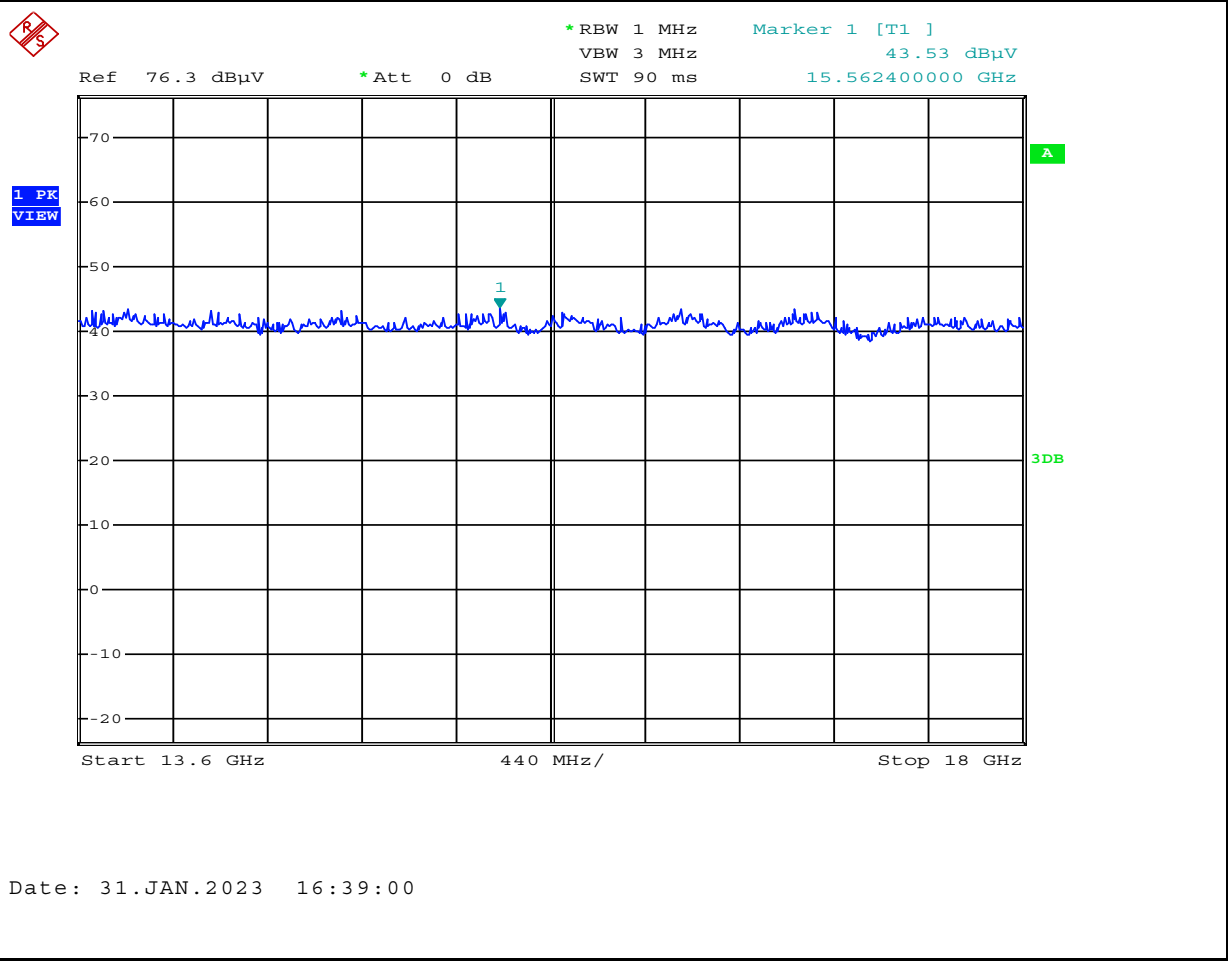
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

Radiated Rx Emissions:



Polarization:

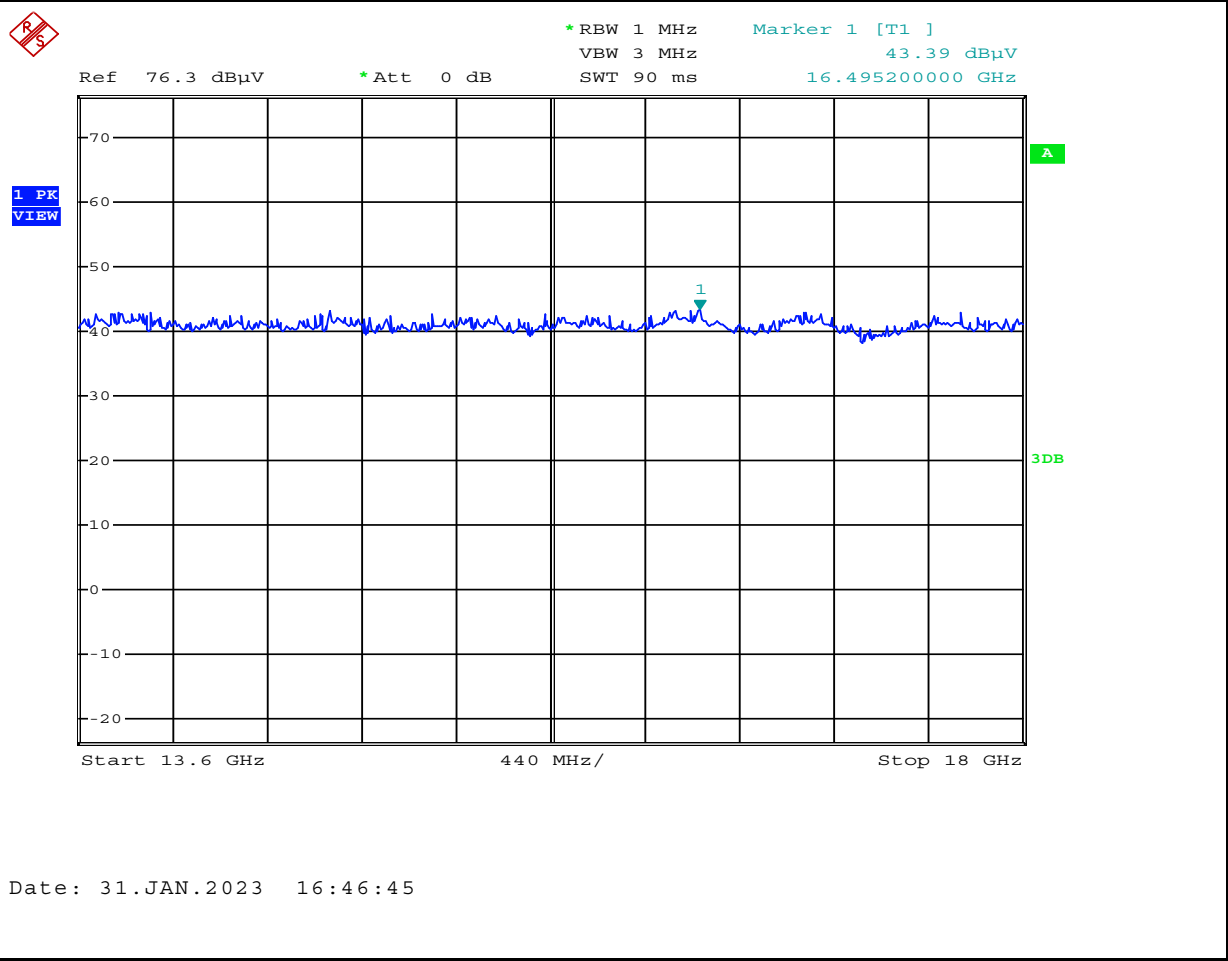
Horizontal

Measured Emission:

ND

 dBm

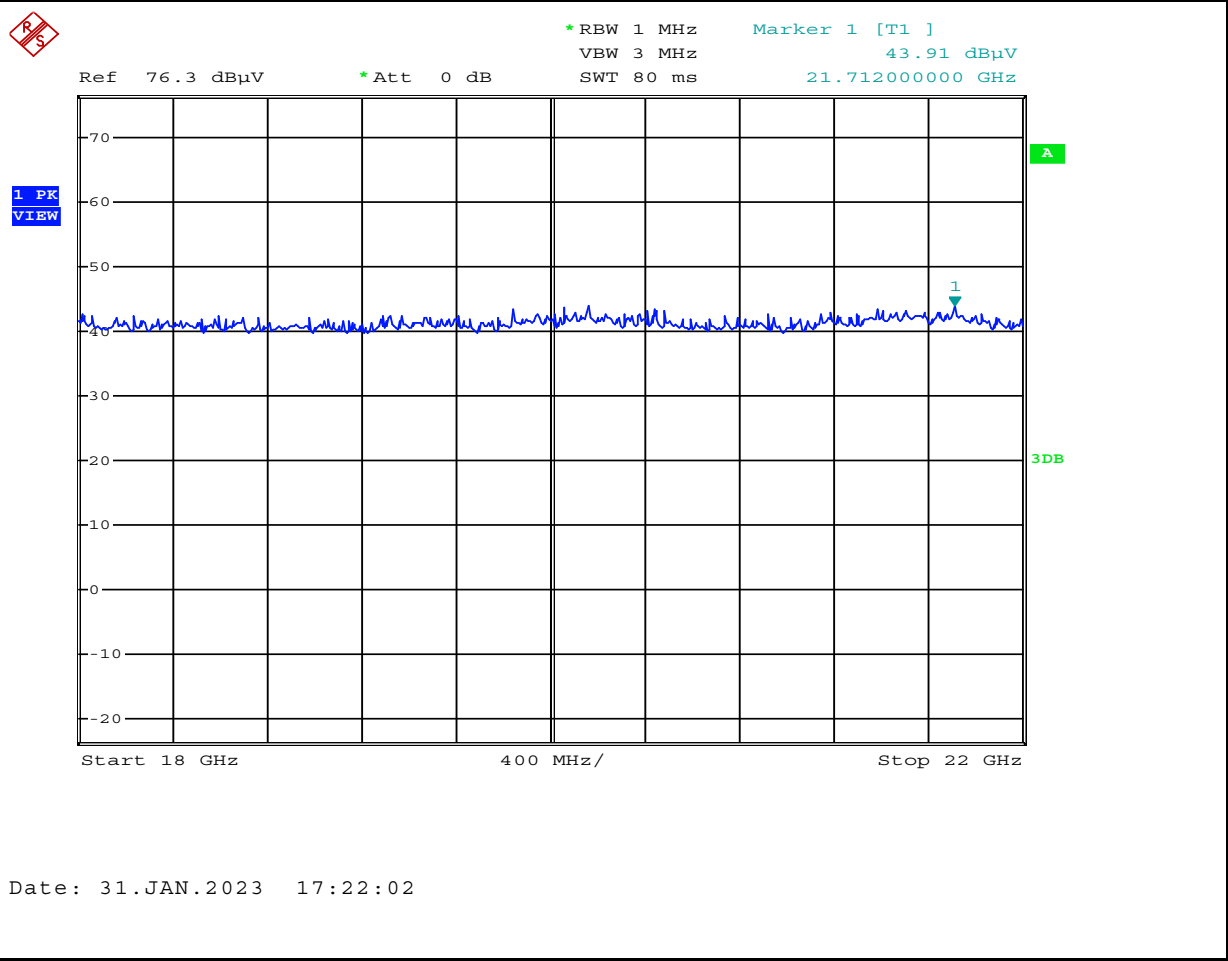
Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

Radiated Rx Emissions:



Polarization:

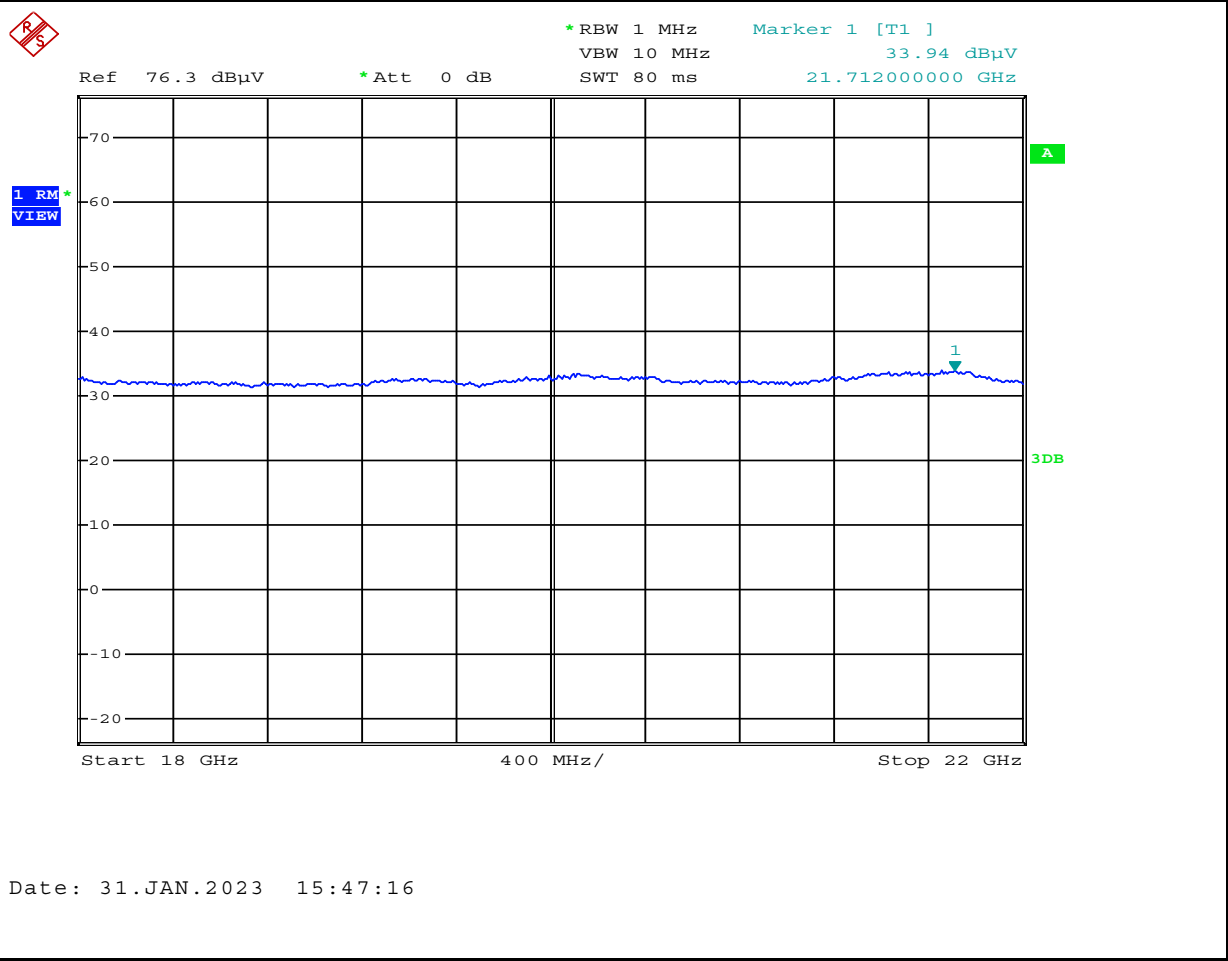
Horizontal

Measured Emission:

ND

 dBm

Radiated Rx Emissions:



Polarization:

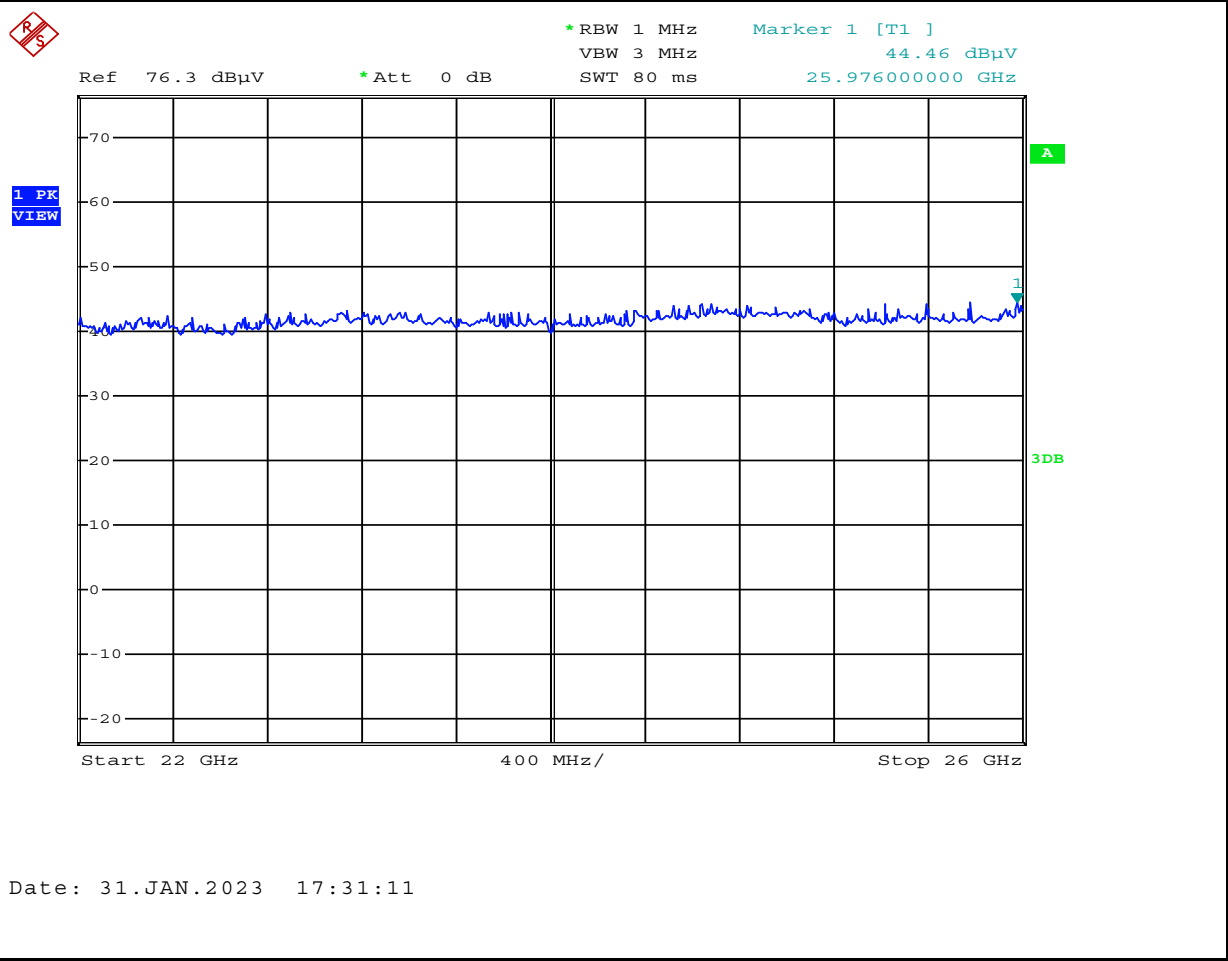
Vertical

Measured Emission:

ND

 dBm

Radiated Rx Emissions:



Polarization:

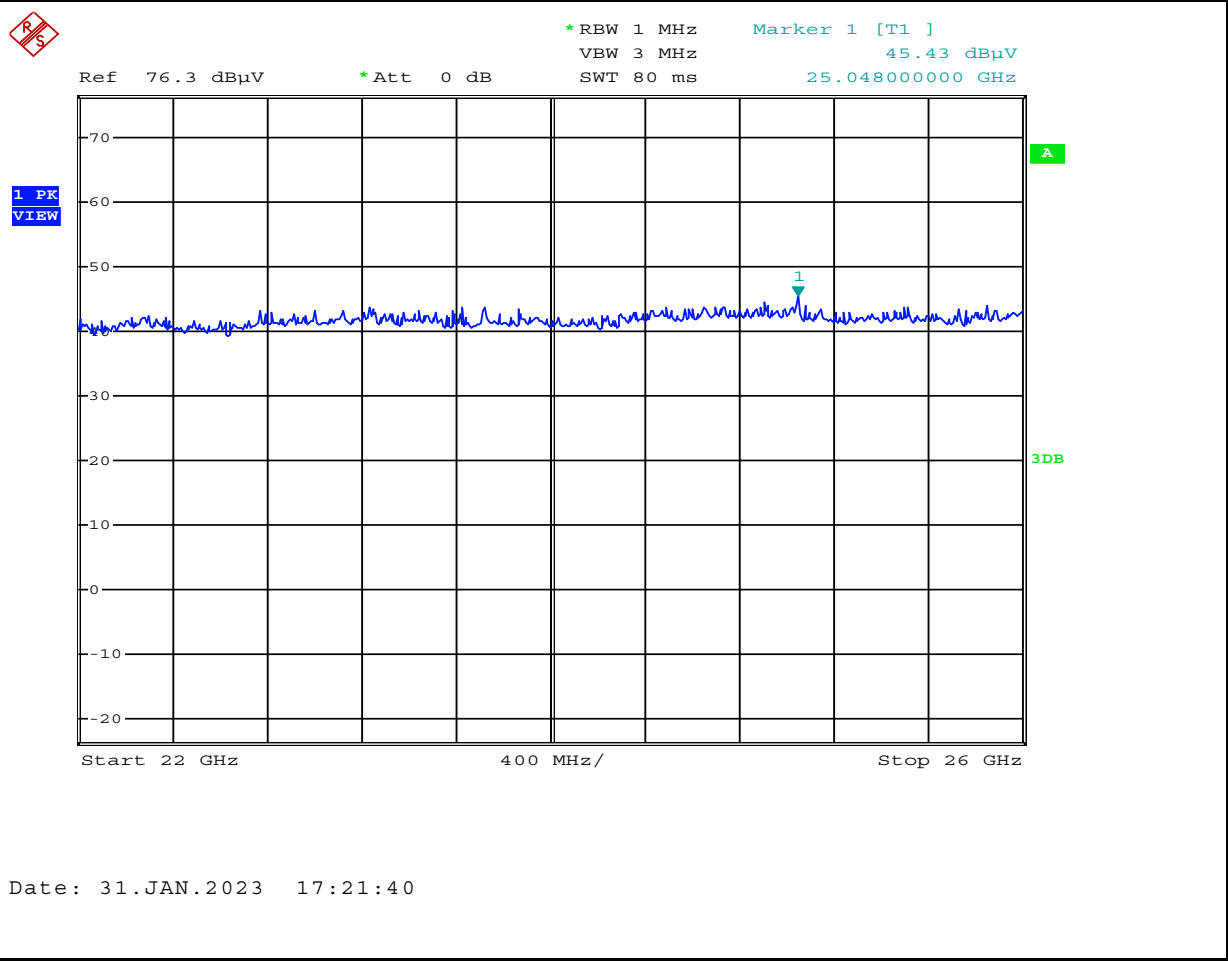
Horizontal

Measured Emission:

ND

 dBm

Radiated Rx Emissions:



Polarization: Vertical

Measured Emission: ND dBm

SAR Test Report - New Application

Applicant:



Garmin International Inc.
Olathe, KS, 66062
USA

Maximum Reported 10g SAR			
Extremity (wrist)	Wifi (DTS)	0.41	W/kg
	BT/BLE (DSS)	<0.1	
General Pop. Limit:		4.00	

FCC ID:

IPH-A04597

Product Model Number / HVIN

A04597

IC Registration Number

Product Name / PMN

A04597

In Accordance With:

FCC 47 CFR §2.1093

Radiofrequency Radiation Exposure Evaluation: Portable Devices

Approved By:



Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada



Test Lab Certificate: 2470.01



Industry
Canada

IC Registration 3874A



FCC Registration: CA3874

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:		Ben Hewson/Trevor Whillock	Date(s) of Evaluation:		15 December 2022 & 4,5 January 2023
Report Prepared By:		Ben Hewson	Report Reviewed By:		Art Voss
Report Revision	Description of Revision		Revised Section	Revised By	Revision Date
0.1	Draft		n/a	Ben Hewson	13 Feb 2023
1.0	Initial Release		n/a	Ben Hewson	23 Feb 2023

2.0 CLIENT AND DEVICE INFORMATION

Client Information	
Applicant Name	Garmin International Inc.
Applicant Address	1200 East 151 St
	Olathe, KS, 66062
	USA
DUT Information	
Device Identifier(s):	FCC ID: IPH-A04597
	ISED ID:
Device Model(s) / HVIN:	A04597
EUT Name:	A04597
Test Sample Serial No.:	3432588081 - Conducted, 3432588122 - OTA
Device Type:	Extremity Worn Digital Device
Equipment Class	Digital Transmission System (DTS)
	Spread Spectrum Transmission System (DSS)
	Low Power Communication Device (DXX)
	Global Navigation Satellite System (GNSS) Receivers
	NFC - Low Power Communication Device Transmitter (DXX)
Transmit Frequency Range:	ANT (DXX): 2402-2480MHz
	BT (DTS, DSS): 2402-2480MHz
	WiFi (DTS): 2412-2462MHz
Manuf. Max. Rated Output Power:	ANT (DXX): 1.6mW (2.1dBm)
	BT BR (DSS): 12.97mW (11.13dBm)
	BT 2EDR (DTS): 10.5mW (10.23dBm)
	BT 3EDR (DTS): 10.3mW (10.12dBm)
	BT LE1 (DTS): 1.5mW (1.65dBm)
	BT LE2 (DTS): 1.6mW (1.95dBm)
	802.11b (DTS): 0.04W (17.38dBm)
	802.11g (DTS): 0.05W (18.35dBm)
	802.11n (DTS): 0.04W (16.80dBm)
Antenna Type and Gain:	2.4GHz -3.21 dBi PIFA
Modulation:	ANT: GFSK
	BT BR: GFSK
	BT 2EDR: $\pi/4$ -DQPSK
	BT 3EDR: 8DPSK
	BLE: GMSK
	WiFi: CCK, DSSS, OFDM, MCS
DUT Power Source:	5V USB, Internal Li-Ion Battery
DUT Dimensions [LxWxH]	L x W x H: 53mm x 49mm x 11mm
Deviation(s) from standard/procedure:	None

3.0 SCOPE OF EVALUATION

This Certification Report was prepared on behalf of:
Garmin International Inc.

.(the '*Applicant*'), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

As per FCC 47 CFR Part §2.1091 and §2.1093, an RF Exposure evaluation report is required for this *Equipment* and the results of the RF Exposure evaluation appear in this report.

The A04597 FCC ID: IPH-A04597, is a wrist-worn transceiver that is capable of operating in the 2.4GHz WiFi and Bluetooth frequency bands and has an additional NFC feature that operates at a fixed transmit frequency of 13.56MHz. The device is not capable of simultaneous transmission between transmitters. The device is intended for General Population Use. The product operates from an internal proprietary Li-ion rechargeable battery which can be connected to a compliant USB interface port, AC or DC adapter for charging. Test samples provided by the manufacturer were capable of transmitting at select frequencies and modulations preset by the manufacturer. An additional antenna modification was prepared for one sample allowing the ability to connect test equipment for antenna port conducted power analysis.

4.0 NORMATIVE REFERENCES

Normative References*	
ANSI / ISO 17025	General Requirements for competence of testing and calibration laboratories
FCC CFR Title 47 Part 2	Code of Federal Regulations
Title 47:	Telecommunication
Part 2.1093:	Radiofrequency Radiation Exposure Evaluation: Portable Devices
IEC International Standard /IEEE International Committee on Electromagnetic Safety	
IEC/IEEE 62209-1528	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528; Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)
FCC KDB	
KDB 865664 D01v01r04	SAR Measurement Requirements for 100MHz to 6GHz
FCC KDB	
KDB 447498 D01v06	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
FCC KDB	
KDB 248227 D01v02r02	SAR Guidance for IEEE 802.11 (WiFi) Transmitters
* When the issue number or issue date is omitted, the latest version is assumed.	

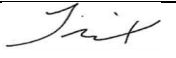
5.0 STATEMENT OF COMPLIANCE

This measurement report demonstrates that samples of the product model(s) were evaluated for Specific Absorption Rate (SAR) on the date(s) shown, in accordance with the Measurement Procedures cited and were found to comply with the Standard(s) Applied based on the Exposure Limits of the Use Group indicated for which the product is intended to be used.

Applicant: Garmin International Inc.		Model / HVIN: A04597	
Standard(s) Applied: FCC 47 CFR §2.1093		Measurement Procedure(s): FCC KDB 865664, FCC KDB 447498, FCC KDB 248227 IEC/IEEE Standard 62209-1528	
Reason For Issue: ☒ New Certification ☐ Class I Permissive Change ☐ Class II Permissive Change		Use Group: ☒ General Population / Uncontrolled ☐ Occupational / Controlled	
Reason for Change:		Limits Applied: ☐ 1.6W/kg - 1g Volume ☐ 8.0W/kg - 1g Volume ☒ 4.0W/kg - 10g Volume	
		Date(s) Evaluated: 15-16 December 2022 & 4 January 2023	

The results of this investigation are based solely on the test sample(s) provided by the applicant which was not adjusted, modified or altered in any manner whatsoever except as required to carry out specific tests or measurements. A description of the device, operating configuration, detailed summary of the test results, methodologies and procedures used during this evaluation, the equipment used and the various provisions of the rules are included in this test report.

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.


Trevor Whillock
Test Lab Engineer
Celltech Labs Inc.
10 February 2023
Date

6.0 SAR MEASUREMENT SYSTEM

SAR Measurement System

Celltech Labs Inc. SAR measurement facility employs a Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY6 measurement system is comprised of the measurement server, a robot controller, a computer, a near-field probe, a probe alignment sensor, an Elliptical Planar Phantom (ELI) phantom and a specific anthropomorphic mannequin (SAM) phantom for Head and/or Body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller and a teach pendant (Joystick) to control the robot's servo motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical form the DAE to digital electronic signal and transfers data to the DASY6 measurement server. The DAE4 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter, a command decoder and a control logic unit. Transmission to the DASY6 measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot utilizes a controller with built in VME-bus computer.



DASY 6 SAR System with SAM Phantom



DASY 6 Measurement Controller

7.0 RF CONDUCTED POWER MEASUREMENT

Table 7.0 Conducted Power Measurements – 2.4GHz WiFi

A04597-Conducted Power Measurements									
Channel	Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Delta (dB)	SAR Test Channel (Y/N)	Mode	BW (MHz)	Modulation	
6	2437	17.28			-	WLAN 2.4G	20	DSSS-1Mbps	802.11b
		17.33			-			DSSS-2Mbps	
		17.38			-			DSSS-5.5Mbps	
		17.17			-			DSSS-11Mbps	
1	2412	14.91	17.38	-2.47	Y	WLAN 2.4G	20	DSSS-5.5Mbps	802.11b
6	2437	17.33	17.38	-0.05	Y				
11	2462	15.59	17.38	-1.79	Y				
1	2412	10.89	18.35	-7.46	-	WLAN 2.4G	20	OFDM-12Mbps	802.11g
6	2437	18.35	18.35	0.00	-				
11	2462	13.66	18.35	-4.69	-				
1	2412	10.94	16.80	-5.86	-	WLAN 2.4G	20	MCS-0	802.11n
6	2437	16.80	16.80	0.00	-				
11	2462	12.85	16.80	-3.95	-				

Table 7.1 Conducted Power Measurements – BT

A04597- Conducted Power Measurements								
Mode	Modulation	Channel	Frequency (MHz)	Measured Power (dBm)	Measured Power (mW)	Rated Power (mW)	Delta (mW)	SAR test Channel
ANT	GFSK	0	2402.00	-1.06	0.8	1.6	0.82	-
		39	2440.00	2.10	1.6	1.6	-0.02	-
		79	2480.00	-1.22	0.8	1.6	0.84	-
BT BR	GFSK	0	2402.00	11.04	12.70	12.97	0.27	Y
		38	2441.00	11.11	12.90	12.97	0.07	Y
		78	2480.00	11.13	12.97	12.97	0.00	Y
BT 2EDR	$\pi/4$ -DQPSK	3	2402.00	10.11	10.30	10.50	0.20	-
		38	2441.00	10.21	10.50	10.50	0.00	-
		78	2480.00	10.23	10.50	10.50	0.00	-
BT 3EDR	8DPSK	3	2402.00	10.11	10.30	10.30	0.00	-
		38	2441.00	10.11	10.30	10.30	0.00	-
		78	2480.00	10.12	10.30	10.30	0.00	-
BT 3EDR	8DPSK	3	2402.00	10.11	10.30	10.30	0.00	-
		38	2441.00	10.11	10.30	10.30	0.00	-
		78	2480.00	10.12	10.30	10.30	0.00	-
BT LE1	GMSK	37	2402.00	-1.88	0.7	1.5	0.82	-
		17	2440.00	1.65	1.5	1.5	0.04	-
		39	2480.00	-1.50	0.7	1.5	0.79	-
BT LE2	GMSK	37	2402.00	1.95	1.6	1.6	0.00	-
		17	2440.00	1.75	1.5	1.6	0.10	-
		39	2480.00	-2.00	0.6	1.6	1.00	-

The rated power and tolerance are stated for typical transmission modes and data rates. Some modes and data rates may produce lower than rated conducted power levels. Power measurements taken across the various channels, modes and data rates did not produce levels in excess of the Rated Power plus Tolerance. SAR was evaluated using the power level setting and duty cycle specified by the manufacturer to be the max output power and produce the most conservative SAR. SAR was evaluated at the maximum average tune up tolerance. See section 2.0 Client and Device Information for details. The reported SAR was not scaled down.

8.0 NUMBER OF TEST CHANNELS (N_c)

WiFi SAR Evaluation:

SAR was evaluated in DSSS mode with a sample rate of 5.5 Mbps at a 100% duty cycle. The power level setting selected was specified by the manufacturer to be the max output power and produce the most conservative SAR.

As per FCC KDB 248227, the required 802.11 test channels are Ch 1, Ch 6 and Ch 11.
When applicable, SAR test reduction methods may be utilized.

802.11b DSSS SAR test reduction is determined according to the following:

- When the reported SAR of the highest measured maximum output power channel is $\leq$ to 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel.

While 1-g SAR thresholds are specified in the procedures for SAR test reduction and exclusion, these thresholds should be multiplied by 2.5 when 10-g extremity SAR is considered.

2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

- When KDB Publication 248227 SAR test exclusion applies to the OFDM configuration.
- When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

When applying this formula to EU Extremity limits the adjusted SAR is ≤ 1.5 W/kg, and for Body limits is ≤ 3.0 W/kg.

See 13.1 for details.

BT/BLE/ANT SAR Test Evaluation:

Bluetooth was evaluated for SAR at a transmit duty cycle of 100 % in the worst-case configuration from the WiFi test evaluation. The duty cycle cannot be altered in test mode or by the user.

General SAR Test Reduction Considerations:

As per KDB 447498D01 4.4.1,

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 Mhz

BLE/ANT was not evaluated for SAR.

Per FCC KDB 447498 4.3.1 the BLE/ANT transmitter meets the standalone SAR test exclusion criteria. See section 11.0 for details.

NOTE: This device is not capable of simultaneous transmission between the BT/BLE/ANT and WiFi transmitters. Due to the nature of this device, WiFi and Bluetooth were evaluated for standalone SAR only.

NFC:

The RFID transmitter is a low power communication device transmitter and does not require standalone SAR evaluation. Simultaneous transmission evaluation with it and the 802.11b/g/n is not required

9.0 ACCESSORIES EVALUATED

Table 9.0 Accessories Evaluated

Accessory List				
Test Report ID Number	Manufacturer's Part Number	Description	SAR Evaluated	SAR Tested
B1	010-13117-00	Silicone Band	Y	Y
B2	010-12864-08	Metal Band	Y	Y

10.0 SAR MEASUREMENT SUMMARY

Table 10.0: Measured Results

Measured 10g SAR Results - EXTREMITY Configuration																
Date	Plot ID	Test Frequency (MHz)	DUT Configuration					Accessories	Spacing		Measured SAR (W/kg)	SAR Drift (dB)	Delta Power (dB)	Crest Factor n	Fluid Sensitivity n	reported SAR (W/kg)
			Pos	Mode	BW	Mod	BR		DUT (mm)	Antenna (mm)						
12/15/2022	E1	2412	Extremity	802.11b	20	DSSS	5.5	n/a n/a B1 n/a	0	1	0.230	0.210	-2.470	1.000	1.000	0.406
1/4/2023	E2	2437	Extremity	802.11b	20	DSSS	5.5	n/a n/a B1 n/a	0	1	0.261	-0.420	-0.050	1.000	1.000	0.291
1/5/2023	E3	2462	Extremity	802.11b	20	DSSS	5.5	n/a n/a B1 n/a	0	1	0.215	-0.450	0.000	1.000	1.000	0.238
1/5/2023	E4	2462	Extremity	802.11b	20	DSSS	5.5	n/a n/a B2 n/a	0	1	0.359	0.220	0.000	1.000	1.000	0.359
1/4/2023	E6	2402	Extremity	BT Classic	1	BT-GFSK	-	n/a n/a B1 n/a	0	1	0.038	0.040	-0.090	1.000	1.000	0.038
1/4/2023	E7	2440	Extremity	BT Classic	1	BT-GFSK	-	n/a n/a B1 n/a	0	1	0.042	-0.270	-0.020	1.000	1.000	0.045
1/4/2023	E8	2480	Extremity	BT Classic	1	BT-GFSK	-	n/a n/a B1 n/a	0	1	0.037	0.110	0.000	1.000	1.000	0.037
Applicable SAR Limit								Use Group					Limit			
FCC CFR 2.1093			Health Canada Safety Code 6					General Population/User Unaware					4 W/kg			

11.0 SCALING OF MAXIMUM MEASURE SAR

Table 11.0 SAR Scaling – Extremity

Scaling of Maximum Measured SAR (10g)				
Measured Parameters		Configuration		
		Extremity	Extremity	
Plot ID		E1	E7	
Maximum Measured SAR _M		0.230	0.042	(W/kg)
Frequency		2412	2440	(MHz)
Drift	Power Drift	0.210 (1)	-0.270	(dB)
Conducted Power		14.910	11.110	(dBm)
DC	Transmit Duty Cycle	100.000	100.0	(%)
Fluid Deviation from Target				
Δe	Permittivity	-7.33%	-7.34%	
Δσ	Conductivity	3.18%	3.91%	

Note(1): Power Drift is Positive, Drift Adjustment not Required.

Fluid Sensivity Calculation (10g)			IEC/IEEE 62209-1528 7.8.2	
Delta SAR = Ce * Δe + Cσ * Δσ (8)				
Ce = (0.003456*f³) - (0.03531*f²) + (0.07675*f) - 0.186 (11)				
Cσ = (0.004479*f³) - (0.01586*f²)- (0.1972*f) + 0.7717 (12)				
f	Frequency (GHz)	2.412	2.44	
Ce		-0.158	-0.159	
Cσ		0.267	0.261	
Ce * Δe		0.012	0.012	
Cσ * Δσ		0.008	0.010	
ΔSAR		0.020 (3)	0.022 (3)	(%)

Note(3): Delta SAR is Positive, SAR Adjustment for Fluid Sensitivity is not Required, in accordance with ISED Notice 2012-DRS0529

Manufacturer's Tuneup Tolerance				
Measured Conducted Power		14.910	11.110	(dBm)
Rated Conducted Power		17.380	11.130	(dBm)
ΔP		-2.470	-0.020	(dB)

Note(4): SAR was Evaluated at the Maximum Tuneup Tolerance. SAR Adjustment is not Required.

Crest Factor				
Transmit Duty Cycle (DC)		100.000	100.0	(%)
CF (1/DC)		1.000 (5)	1.00 ###	

Note(5): Crest Factor = 1 (100% Duty Cycle), Crest Factor Adjustment not Required.

SAR Adjustment for Fluid Sensitivity				
SAR ₁ = SAR _M X [ΔSAR]		0.230	0.042	(W/kg)
SAR Adjustment for Tuneup Tolerance				
SAR ₂ = SAR ₁ + [ΔP]		0.406	0.042	(W/kg)
SAR Adjustment for Drift				
SAR ₃ = SAR ₂ + [Drift]		0.406	0.045	(W/kg)
SAR Adjustment for Crest Factor				
SAR ₄ = SAR ₃ x [CF]		0.406	0.045	(W/kg)
reported 10g SAR				
SAR ₄		0.41	0.04	(W/kg)

The SAR test exclusion threshold for the BLE/ANT transmitter as per FCC KDB 447498 4.3.1 is as follows:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] \leq 7.5 \text{ for 10-g SAR} \\ [1.9)/(5)] \times [\sqrt{2.441}] = 0.496 \leq 7.5$$

Where:

max. power of channel, including tune-up tolerance, mW = 1.6 mW

min. test separation distance, mm = 5mm

f(GHz) = 2.402 GHz

Therefore; the BLE/ANT Transmitter meets the SAR test exclusion criteria.

NOTE: This device is not capable of simultaneous transmission between the BT/BLE/ANT and WiFi transmitters. Due to the nature of this device, WiFi and Bluetooth were evaluated for standalone SAR only.

The NFC transmitter is a low power communication device transmitter and does not require standalone SAR evaluation. Simultaneous transmission evaluation with it and the 802.11b/g/n or BT 802.15 is not required. When applying this formula to EU Extremity limits the adjusted SAR is $\leq 1.5\text{W/kg}$, and for Body limits is $\leq 3.0\text{W/kg}$.

NOTES to Table 11.0	
(1) Scaling of the Maximum Measured SAR is based on the highest, 100% duty cycle, Face, Body and/or Head SAR measured of ALL test channels, configurations and accessories used during THIS evaluation. The Measured Fluid Deviation parameters apply only to deviation of the tissue equivalent fluids used at the frequencies which produced the highest measured SAR. The Measured Conducted Power applies to the Conducted Power measured at the frequencies producing the highest Face and Body SAR. The Measured Drift is the SAR drift associated with that specific SAR measurement. The Reported SAR is the accumulation of all SAR Adjustments from the applicable Steps 1 through 4. The Plot ID is for identification of the SAR Measurement Plots in Annex A of this report. NOTE: Some of the scaling factors in Steps 1 through 4 may not apply and are identified by light gray text.	
Step 1	Per IEC/IEEE 62209-1528 and FCC KDB 865664. Scaling required only when Measured Fluid Deviation is greater than 5%. If the Measured Fluid Deviation is greater than 5%, Table 9.1 will be shown and will indicate the SAR scaling factor in percent (%). SAR is MULTIPLIED by this scaling factor only when the scaling factor is positive (+).
Step 2	Per KDB 447498. Scaling required only when the difference (Delta) between the Measured Conducted Power and the Manufacturer's Rated Conducted Power is (-) Negative. The absolute value of Delta is ADDED to the SAR.
Step 3	Per IEC/IEEE 62209-1528. Scaling required only when Measured Drift is (-) Negative. The absolute value of Measured Drift is added to Reported or Simultaneous Reported SAR.
Step 4	Per KDB 447498 4.3.2. The SAR, either measured or calculated, of ANY and ALL simultaneous transmitters must be added together and includes all contributors.
Step 5	The Reported SAR is the Maximum Final Adjusted Cumulative SAR from the applicable Steps 1 through 4 and are reported on Page 1 of this report.

12.0 SAR EXPOSURE LIMITS

Table 12.0 Exposure Limits

SAR RF EXPOSURE LIMITS			
FCC 47 CFR§2.1093	Health Canada Safety Code 6	General Population / Uncontrolled Exposure ⁽⁴⁾	Occupational / Controlled Exposure ⁽⁵⁾
Spatial Average ⁽¹⁾ (averaged over the whole body)		0.08 W/kg	0.4 W/kg
Spatial Peak ⁽²⁾ (Head and Trunk averaged over any 1 g of tissue)		1.6 W/kg	8.0 W/kg
Spatial Peak ⁽³⁾ (Hands/Wrists/Feet/Ankles averaged over 10 g)		4.0 W/kg	20.0 W/kg
(1) The Spatial Average value of the SAR averaged over the whole body.			
(2) The Spatial Peak value of the SAR averaged over any 1 gram of tissue, defined as a tissue volume in the shape of a cube and over the appropriate averaging time.			
(3) The Spatial Peak value of the SAR averaged over any 10 grams of tissue, defined as a tissue volume in the shape of a cube and over the appropriate averaging time.			
(4) Uncontrolled environments are defined as locations where there is potential exposure to individuals who have no knowledge or control of their potential exposure.			
(5) Controlled environments are defined as locations where there is potential exposure to individuals who have knowledge of their potential exposure and can exercise control over their exposure.			

13.0 DETAILS OF SAR EVALUATION

13.0 Day Log

DAY LOG					Fluid Dielectric	SPC	Test	Task
Date	Ambient Temp (°C)	Fluid Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)				
15 Dec 2022	23.6	23.7	19%	102.8	X	X	X	2450H
4 Jan 2023	25.4	23.6	18%	102.0	X	X	X	2450H
5 Jan 2023	24.5	24.1	19%	101.1			X	2450H

*Per IEC/IEEE 62209-1528, test series was started within 24 hours of Fluid Parameter Measurement

13.1 DUT Setup and Configuration

DUT Setup and Configuration	
1	The device was evaluated for Extremity (wrist worn), from a flat phantom filled with head tissue-equivalent medium. The DUT was evaluated for SAR in accordance with the procedures as described in FCC KDB 447498, 248227, 865664 and IEC/IEEE 62209-1528, ACMA Radiocommunications and ICNIRP.
2	2.4GHz 802.11g/n OFDM SAR Test Exclusion As Per KDB 248227 D01v02r02 - 5.2.2, b) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is $\leq 1.2\text{W/kg}$ When applying this formula to EU Extremity limits the adjusted SAR is $\leq 1.5\text{W/kg}$, and for Body limits is $\leq 3.0\text{W/kg}$. Maximum 802.11g/n OFDM specified power(POFDM)= 18.35 dBm (68.39mW) Maximum 802.11b DSSS specified power (PDSSS)= 17.38 dBm (54.70mW) Ratio OFDM/DSSS power = 0.97 dBm (1.06%) Highest reported SAR (SARMAX)= 0.41W/kg POFDM/PDSSS X SARMAX = 0.44 W/kg $\leq 3.0\text{ W/kg}$ (Extremity) and $\leq 1.5\text{ W/kg}$ (Body) and SAR test exclusion applies.
3	The Device was capable of transmitting at various modulations, data rates and duty cycles. The Conducted Power was highest when measured in DSSS Mode-5.5 Mbps at 100% Duty cycle than any other configuration in the 2.4GHz Band. The DUT was evaluated for SAR at the maximum conducted output power level, preset by the manufacturer.
4	Bluetooth was evaluated for SAR in BT BR (GFSK) mode with a transmit duty cycle of 100% in the worst-case configuration from the WiFi test evaluation. The Duty cycle could not be altered in test mode or by the user. The DUT was evaluated for SAR at the maximum conducted output power level, preset by the manufacturer.
5	Each SAR evaluation was performed with a fully charged battery.

13.2 DUT Positioning

DUT Positioning	
Positioning	The DUT Positioner was securely fastened to the Phantom Platform. Registration marks were placed on the DUT and the Positioner to ensure consistent positioning of the DUT for each test evaluation.
FACE Configuration	Devices that are designed to be worn on the wrist and may operate with in speaker mode for voice communication, with the device positioned next to the mouth. When next-to-mouth SAR evaluation is required, the device is positioned at 10mm from a flat phantom filled with head tissue-equivalent medium.
BODY Configuration	The DUT was securely clamped into the device holder with the surface of the DUT being 2mm from bottom of the phantom in the Body configuration.
HEAD Configuration	This device is not intended to be held to the ear and was not tested in the HEAD configuration.
Limb Worn Configuration	The DUT was positioned with the back side directly against the phantom surface with the strap opened to allow direct contact or 0mm of the DUT and watch band to the phantom surface.

13.3 General Procedures and Report

General Procedures and Reporting	
General Procedures	The fluid dielectric parameters of the Active Tissue Simulating Liquid (TSL) were measured as described in this Section, recorded and entered into the DASY Measurement Server. Active meaning the TSL used during the SAR evaluation of the DUT. The temperature of the Active TSL was measured and recorded prior to performing a System Performance Check (SPC). An SPC was performed with the Active TSL prior to the start of the test series. The temperature of the Active TSL was measured throughout the day and the Active TSL temperature was maintained to $\pm 0.5^{\circ}\text{C}$. The Active TSL temperature was maintained to within $\pm 2.0^{\circ}\text{C}$ throughout the test series. The liquid parameters shall be measured within 24 hours before the start of a test series and if it takes longer than 48 hours, the liquid parameters shall also be measured at the end of the test series. An Area Scan exceeding the length and width of the DUT projection was performed and the locations of all maximas within 2dB of the Peak SAR recorded. A Zoom Scan centered over the Peak SAR location(s) was performed and the 1g and 10g SAR values recorded. The resolutions of the Area Scan and Zoom Scan are described in the Scan Resolution table(s) in this Section. A Power Reference Measurement was taken at the phantom reference point immediately prior to the Area Scan. A Power Drift measurement was taken at the phantom reference point immediately following the Zoom Scan to determine the power drift. A Z-Scan from the <u>Maximum Distance to Phantom Surface</u> to the fluid surface was performed following the power drift measurement.
Reporting	The 1g SAR, 10g SAR and power drift measurements are recorded in the SAR Measurement Summary tables in the SAR Measurement Summary Section of this report. The SAR values shown in the 100% DC (Duty Cycle) column are the SAR values reported by the SAR Measurement Server with the DUT operating at 100% transmit duty cycle. These tables also include other information such as transmit channel and frequency, modulation, accessories tested and DUT-phantom separation distance. In the Scaling of Maximum Measured SAR Section of this report, the highest measured SAR in the BODY configuration, within the entire scope of this assessment, are, when applicable, scaled for Fluid Sensitivity, Manufacturer's Tune-Up Tolerance, Simultaneous Transmission and Drift. With the exception of Duty Cycle correction/compensation, SAR values are <u>ONLY</u> scaled up, not down. The final results of this scaling is the <u>reported SAR</u> which appears on the Cover Page of this report.

13.4 Fluid Dielectric and Systems Performance Check

Fluid Dielectric and Systems Performance Check	
Fluid Dielectric Measurement Procedure	The fluid dielectric parameters of the Tissue Simulating Liquid (TSL) are measured using the Open-Ended Coax Method connected to an Agilent 8753ET Network Analyzer connected to a measurement server running Aprel Dielectric Property Measurement System. A frequency range of $\pm 100\text{MHz}$ for frequencies $> 300\text{MHz}$ and $\pm 50\text{MHz}$ for frequencies $\leq 300\text{MHz}$ with frequency step size of 10MHz is used. The center frequency is centered around the SAR measurement probe's calibration point for that TSL frequency range. A calibration of the setup is performed using a short-open-deionized water (at 23°C in a 300ml beaker) method. A sample of the TSL is placed in a 300ml beaker and the open-ended coax is submerged approximately 8mm below the fluid surface in the approximate center of the beaker. A check of the setup is made to ensure no air is trapped under the open-ended coax. The sample of TSL is measured and compared to the FCC KDB 865664 targets for HEAD or BODY for the entire fluid measurement range. Fluid adjustment are made if the dielectric parameters are $> 5\%$ in range that the DUT is to be tested. If the adjustments fail to bring the parameters to $\leq 5\%$ but are $< 10\%$, the SAR Fluid Sensitivity as per IEC\IEEE 62209-1528 and FCC KDB 865664 are applied to the highest measured SAR. A TSL with dielectric parameters $> 10\%$ in the DUT test frequency range are not used.
Systems Performance Check	The fluid dielectric parameters of the Active TSL are entered into the DASY Measurement Server at each of the 10MHz step size intervals. Active meaning the TSL used during the SAR evaluation of the DUT. The DASY Measurement System will automatically interpolate the dielectric parameters for DUT test frequencies that fall between the 10MHz step intervals. A Systems Performance Check (SPC) is performed in accordance with IEC\IEEE 62209-1528 "System Check" and FCC KDB 865664 "System Verification". A validation source, dipole or Confined Loop Antenna (CLA), is placed under the geometric center of the phantom and separated from the phantom in accordance to the validation source's Calibration Certificate data. A CW signal set to the frequency of the validate source's and SAR measurement probe's calibration frequency with a forward power set to the validation source's Calibration Certificate data power setting is applied to the validation source. An Area Scan is centered over the projection of the validation source's feed point and an Area Scan is taken. A Zoom Scan centered over the Peak SAR measurement of the Area Scan and the 1g and 10g SAR is measured. The measured 1g and 10g SAR is compared to the 1g and 10g SAR measurements from the validation source's Calibration Certificate. When required, the measured SAR is normalized to 1.0W and compared to the normalized SAR indicated on the validation source's Calibration Certificate. The SPC is considered valid when the measured and normalized SAR is $\leq 10\%$ of the measured and normalize SAR of the validation source's Calibration Certificate. The fluid dielectric parameters of the Active TSL and SPC are repeated when the Active TSL has been in use for greater than 84 hours or if the Active TSL temperature has exceed $\pm 1^{\circ}\text{C}$ of the initial fluid analysis.

13.5 Scan Resolution 100MHz to 2GHz

Scan Resolution 100MHz to 2GHz	
Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)	$4 \pm 1 \text{ mm}$
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	$5^{\circ} \pm 1^{\circ}$
Area Scan Spatial Resolution $\Delta X, \Delta Y$	15 mm
Zoom Scan Spatial Resolution $\Delta X, \Delta Y$	7.5 mm
Zoom Scan Spatial Resolution ΔZ (Uniform Grid)	5 mm
Zoom Scan Volume X, Y, Z	30 mm
Phantom	ELI
Fluid Depth	$150 \pm 5 \text{ mm}$
An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima.	
A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR	

13.6 Scan Resolution 2GHz to 3GHz

Scan Resolution 2GHz to 3GHz	
Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)	4 ± 1 mm
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	$5^\circ \pm 1^\circ$
Area Scan Spatial Resolution $\Delta X, \Delta Y$	12 mm
Zoom Scan Spatial Resolution $\Delta X, \Delta Y$	5 mm
Zoom Scan Spatial Resolution ΔZ (Uniform Grid)	5 mm
Zoom Scan Volume X, Y, Z	30 mm
Phantom	ELI
Fluid Depth	150 ± 5 mm
An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima.	
A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR	

13.7 Scan Resolution 5GHz to 6GHz

Scan Resolution 5GHz to 6GHz	
Maximum distance from the closest measurement point to phantom surface: (Geometric Center of Probe Center)	4 ± 1 mm
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	$5^\circ \pm 1^\circ$
Area Scan Spatial Resolution $\Delta X, \Delta Y$	10 mm
Zoom Scan Spatial Resolution $\Delta X, \Delta Y$	4 mm
Zoom Scan Spatial Resolution ΔZ (Uniform Grid)	2 mm
Zoom Scan Volume X, Y, Z	22 mm
Phantom	ELI
Fluid Depth	100 ± 5 mm
An Area Scan with an area extending beyond the device was used to locate the candidate maximas within 2dB of the global maxima.	
A Zoom Scan centered over the peak SAR location(s) determined by the Area Scan was used to determine the 1-gram and 10-gram peak spatial-average SAR	

14.0 MEASUREMENT UNCERTAINTIES

Table 14.0 Measurement Uncertainty

Measurement uncertainty table is not required per KDB 865664 D01 v01r04 section 2.8.2 page 12. SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR.21 The equivalent ratio (1.5/1.6) should be applied to extremity and occupational exposure conditions. The highest reported SAR value is less than 1.5W/kg. Therefore, the measurement uncertainty table is not required.

15.0 FLUID DIELECTRIC PARAMETERS

Table 15.0 Fluid Dielectric Parameters 2450MHz HEAD TSL

Aprel Laboratory
Test Result for UIM Dielectric Parameter
Tue 15/Dec/2022 04:40:03
Freq Frequency(GHz)
FCC_eHFCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sHFCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

Freq	FCC_eHFCC	sHFCC	Test_e	Test_s
2.4000	39.29	1.76	36.24	1.80
2.4100	39.27	1.76	36.37	1.81
2.4200	39.25	1.77	36.45	1.85
2.4300	39.24	1.78	36.22	1.83
2.4400	39.22	1.79	36.17	1.82
2.4500	39.20	1.80	36.13	1.85
2.4600	39.19	1.81	35.83	1.86
2.4700	39.17	1.82	35.89	1.89
2.4800	39.16	1.83	35.94	1.92

FLUID DIELECTRIC PARAMETERS								Fluid Sensitivity Calculation IEC/IEEE 62209-1528 7.8.2				
Date:	15-Dec-2022	Fluid Temp:		23.7	Frequency:	2450MHz	Tissue:	Head	ΔSAR 1g	ΔSAR 10g	SAR Correction	
Freq (MHz)		Test ε	Test σ (S/m)	Target ε	Target σ (S/m)	Deviation Permittivity	Deviation Conductivity	Factor (1)				
								1g			10g	
2400.0000		36.2400	1.8000	39.2900	1.76	-7.76%	2.27%	0.029	0.018	1.000	1.000	
2402.0000	*	36.2660	1.8020	39.2860	1.76	-7.69%	2.39%	0.029	0.019	1.000	1.000	
2410.0000		36.3700	1.8100	39.2700	1.76	-7.38%	2.84%	0.031	0.019	1.000	1.000	
2412.0000	*	36.3860	1.8180	39.2660	1.76	-7.33%	3.18%	0.032	0.020	1.000	1.000	
2420.0000		36.4500	1.8500	39.2500	1.77	-7.13%	4.52%	0.038	0.023	1.000	1.000	
2430.0000		36.2200	1.8300	39.2400	1.78	-7.70%	2.81%	0.031	0.020	1.000	1.000	
2437.0000	*	36.1850	1.8230	39.2260	1.79	-7.75%	2.01%	0.027	0.018	1.000	1.000	
2440.0000	*	36.1700	1.8200	39.2200	1.79	-7.78%	1.68%	0.026	0.017	1.000	1.000	
2450.0000		36.1300	1.8500	39.2000	1.80	-7.83%	2.78%	0.031	0.020	1.000	1.000	
2460.0000		35.8300	1.8600	39.1900	1.81	-8.57%	2.76%	0.032	0.021	1.000	1.000	
2462.0000	*	35.8420	1.8660	39.1860	1.81	-8.53%	2.98%	0.033	0.021	1.000	1.000	
2470.0000		35.8900	1.8900	39.1700	1.82	-8.37%	3.85%	0.037	0.023	1.000	1.000	
2480.0000	*	35.9400	1.9200	39.1600	1.83	-8.22%	4.92%	0.042	0.026	1.000	1.000	

*Channel Frequency Tested

Table 15.1 Fluid Dielectric Parameters 2450MHz HEAD TSL

Aprel Laboratory
Test Result for UIM Dielectric Parameter
Wed 04/Jan/2023 15:57:42
Freq Frequency(GHz)
FCC_eHFCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sHFCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

Freq	FCC_eHFCC	sHFCC	Test_e	Test_s
2.4000	39.29	1.76	36.44	1.81
2.4100	39.27	1.76	36.39	1.81
2.4200	39.25	1.77	36.32	1.83
2.4300	39.24	1.78	36.13	1.83
2.4400	39.22	1.79	36.34	1.86
2.4500	39.20	1.80	36.31	1.88
2.4600	39.19	1.81	36.25	1.88
2.4700	39.17	1.82	36.32	1.88
2.4800	39.16	1.83	36.34	1.88

FLUID DIELECTRIC PARAMETERS								Fluid Sensitivity Calculation IEC/IEEE 62209-1528 7.8.2							
Date:	4-Jan-2023		Fluid Temp:	23.6		Frequency:	2450MHz		Tissue:	Head		ΔSAR 1g	ΔSAR 10g	SAR Correction	
Freq (MHz)		Test ε	Test σ (S/m)	Target ε	Target σ (S/m)	Deviation Permittivity	Deviation Conductivity	Factor (1)							
2400.0000			36.4400	1.8100	39.2900	1.76	-7.25%	2.84%	0.030	0.019	1.000	1.000			
2402.0000		*	36.4300	1.8100	39.2860	1.76	-7.27%	2.84%	0.030	0.019	1.000	1.000			
2410.0000			36.3900	1.8100	39.2700	1.76	-7.33%	2.84%	0.030	0.019	1.000	1.000			
2412.0000		*	36.3760	1.8140	39.2660	1.76	-7.36%	2.95%	0.031	0.019	1.000	1.000			
2420.0000			36.3200	1.8300	39.2500	1.77	-7.46%	3.39%	0.033	0.021	1.000	1.000			
2430.0000			36.1300	1.8300	39.2400	1.78	-7.93%	2.81%	0.031	0.020	1.000	1.000			
2437.0000		*	36.2770	1.8510	39.2260	1.79	-7.52%	3.58%	0.034	0.021	1.000	1.000			
2440.0000		*	36.3400	1.8600	39.2200	1.79	-7.34%	3.91%	0.035	0.022	1.000	1.000			
2450.0000			36.3100	1.8800	39.2000	1.80	-7.37%	4.44%	0.038	0.023	1.000	1.000			
2460.0000			36.2500	1.8800	39.1900	1.81	-7.50%	3.87%	0.035	0.022	1.000	1.000			
2462.0000		*	36.2640	1.8800	39.1860	1.81	-7.46%	3.75%	0.035	0.022	1.000	1.000			
2470.0000			36.3200	1.8800	39.1700	1.82	-7.28%	3.30%	0.032	0.020	1.000	1.000			
2480.0000		*	36.3400	1.8800	39.1600	1.83	-7.20%	2.73%	0.029	0.018	1.000	1.000			

*Channel Frequency Tested

16.0 SYSTEM VERIFICATION TEST RESULTS

Table 16.0 System Verification Results 2450MHz HEAD TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N	S/N	
15 Dec 2022		2450	D2450V2	825	
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Head	23.7	24	19%	250	10
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
36.13	39.20	-7.83%	1.85	1.80	2.78%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
12.60	13.18	-4.40%	5.70	6.01	-5.08%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
50.40	52.72	-4.40%	22.80	24.02	-5.06%
Prior to the SAR evaluations, system checks were performed on the planar section of the phantom and a SPEAG validation dipole in accordance with the procedures described in IEC\IEEE 62209-1528, FCC KDB 846224. The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using a Dielectric Probe Kit and a Network Analyzer. The forward power was applied to the dipole and the system was verified to a tolerance of +10% from the system manufacturer's dipole calibration target SAR value. The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.					

Table 16.1 System Verification Results 2450MHz HEAD TSL

System Verification Test Results					
Date		Frequency (MHz)	Validation Source		
			P/N	S/N	
4 Jan 2023		2450	D2450V2	825	
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Head	23.6	25	18%	250	10
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
36.31	39.20	-7.37%	1.88	1.80	4.44%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
14.00	13.18	6.22%	6.38	6.01	6.24%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
56.00	52.72	6.22%	25.52	24.02	6.27%
Prior to the SAR evaluations, system checks were performed on the planar section of the phantom and a SPEAG validation dipole in accordance with the procedures described in IEC/IEEE 62209-1528, FCC KDB 846224. The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using a Dielectric Probe Kit and a Network Analyzer. The forward power was applied to the dipole and the system was verified to a tolerance of +10% from the system manufacturer's dipole calibration target SAR value. The forward power applied was same forward power applied by the calibration lab during the calibration of this validation source.					

17.0 SYSTEM VALIDATION SUMMARY

Table 17.0 System Validation Summary

SAR Validation SummaryChart							
Validation Date	Validation Source	Source S/N	Validation Frequency	Tissue	Linearity	Isotropy	Extrapolation
3-May-22	D2450V2	825	2450	Head	✓	✓	✓

18.0 MEASUREMENT SYSTEM SPECIFICATIONS

Table 18.0 Measurement System Specifications

Measurement System Specification	
Specifications	
Positioner	Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability	+/- 0.035 mm
No. of axis	6.0
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor	Intel(R) Core(TM) i7-7700
Clock Speed	3.60 GHz
Operating System	Windows 10 Professional
Data Converter	
Features	Signal Amplifier, multiplexer, A/D converter, and control logic
Software	Measurement Software: DASY6, V 6.4.0.12171 / DASY52 V10.2(1504)
	Postprocessing Software: SEMCAD X, V14.6.12(7470)
Connecting Lines	Optical downlink for data and status info., Optical uplink for commands and clock
DASY Measurement Server	
Function	Real-time data evaluation for field measurements and surface detection
Hardware	Intel ULV Celeron CPU 400 MHz; 128 MB chip disk; 128 MB RAM
Connections	COM1, COM2, DAE, Robot, Ethernet, Service Interface
E-Field Probe	
Model	EX3DV4
Serial No.	3600
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 6 GHz
Linearity	±0.2 dB (30 MHz to 3 GHz)
Phantom	
Type	ELI Elliptical Planar Phantom
Shell Material	Fiberglass
Thickness	2mm +/- .2mm
Volume	> 30 Liter

Table 18.1

Measurement System Specification (Continued)		
Probe Specification		
Construction:	Symmetrical design with triangular core; Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents (e.g. DGBE)	
Calibration:	ISO/IEC 17025	
Frequency:	4 MHz - 10 GHz; Linearity: ± 0.2 dB (30 MHz - 10 GHz)	
Directivity:	± 0.1 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range:	10 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically <1 mW/g)	
Dimensions:	Overall length: 337 mm; (tip: 20 mm) Tip diameter: 2.5 mm; Tip (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better than 30%	EX3DV4 E-Field Probe
Phantom Specification		
The ELI V5.0 phantom is an elliptical planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEC/IEEE 62209-1528.		
		ELI Phantom
Phantom Specification		
The SAM V4.0 phantom is a flat planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEC/IEEE 62209-1528.		
		SAM Phantom
Phantom Specification		
The MFP V5.1C phantom is a flat planar fiberglass shell phantom with a shell thickness of 2.0mm +/- .2mm at the planar area. This phantom conforms to OET Bulletin 65, Supplement C, IEC/IEEE 62209-1528.		
		MFP Phantom
Device Positioner Specification		
The DASY device positioner has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.		
		Device Positioner

19.0 TEST EQUIPMENT LIST

Table 19.0 Equipment List and Calibration

Test Equipment List				
DESCRIPTION	ASSET NO.	SERIAL NO.	DATE CALIBRATED	CALIBRATION DUE
Schmid & Partner DASY 6 System	-	-	-	-
-DASY Measurement Server	00158	1078	CNR	CNR
-Robot	00046	599396-01	CNR	CNR
-DAE4	00019	353	14-Apr-22	14-Apr-23
-EX3DV4 E-Field Probe	00213	3600	20-Apr-22	20-Apr-23
-D2450V2 Validation Dipole	00219	825	24-Apr-21	24-Apr-24
MFP Phantom	00355	1177/2	CNR	CNR
HP 85070C Dielectric Probe Kit	00033	none	CNR	CNR
HP 8753ET Network Analyzer	00134	US39170292	6-Jan-21	6-Jan-24
Rohde & Schwarz SMR20 Signal Generator	00006	100104	11-Aug-20	11-Aug-23
Amplifier Research 10W1000C Power Amplifier	00041	27887	CNR	CNR
Amplifier Research 5S1G4 Power Amplifier	00106	26235	CNR	CNR
Narda Directional Coupler 3020A	00064	-	CNR	CNR
Kangaroo VWR Humidity/Thermometer	00334	192385455	5-Aug-19	5-Jan-23
Digital Multi Meter DMR-1800	00250	TE182	23-Jun-20	23-Jun-23
Bipolar Power Supply 6299A	00086	1144A02155	CNR	CNR
DC-18G 10W 30db Attenuator	00102	-	COU	COU
R&S FSP40 Spectrum Analyzer	00241	100500	9-Aug-21	9-Aug-24
HP 8566B Spectrum Analyzer	00051	2747A055100	29-Jun-20	29-Jun-23
RF Cable-SMA	00311	-	CNR	CNR
HP Calibration Kit	00145	-	CNR	CNR

CNR = Calibration Not Required

COU = Calibrate on Use

Note: Per KDB 865664, Dipoles are evaluated annually for return loss and impedance. The dipole's SAR target can only be assessed by the SAR equipment manufacturer and remains the target until the dipole is recalibrated by the manufacturer. The dipole's SAR is evaluated and compared to this target during each and every System Verification which is performed prior to and/or during each DUT SAR evaluation. The results of these verifications are shown in Section 16.0

20.0 FLUID COMPOSITION

Table 20.0 Fluid Composition 2450MHz HEAD TSL

Tissue Simulating Liquid (TSL) Composition				2450MHz Head
Component by Percent Weight				
Water	Glycol	Salt ⁽¹⁾	HEC ⁽²⁾	Bacteriacide ⁽³⁾
52.0	48.0	0.0	0.0	0.0

(1) Non-Iodinized

(2) HydroxyEthyl-Cellulose: Sigma-Aldrich P/N 54290-500g

(3) Dow Chemical DOWICIL 75 Antimicrobial Preservative

END OF REPORT

APPENDIX A – SYSTEM VERIFICATION PLOTS

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:825
Procedure Name: SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_2 2

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 36.13$; $\rho = 1000$ kg/m³
Phantom section: Left Section

Date/Time: 12/15/2022 6:42:11 PM

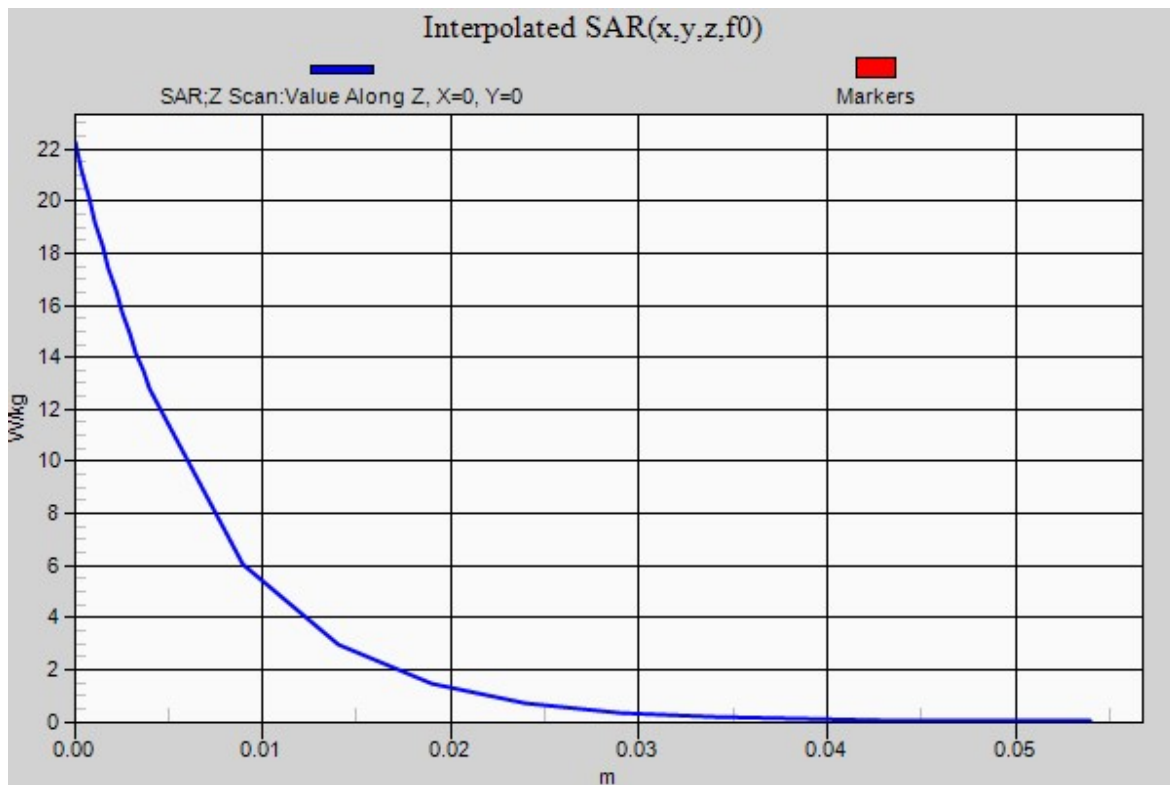
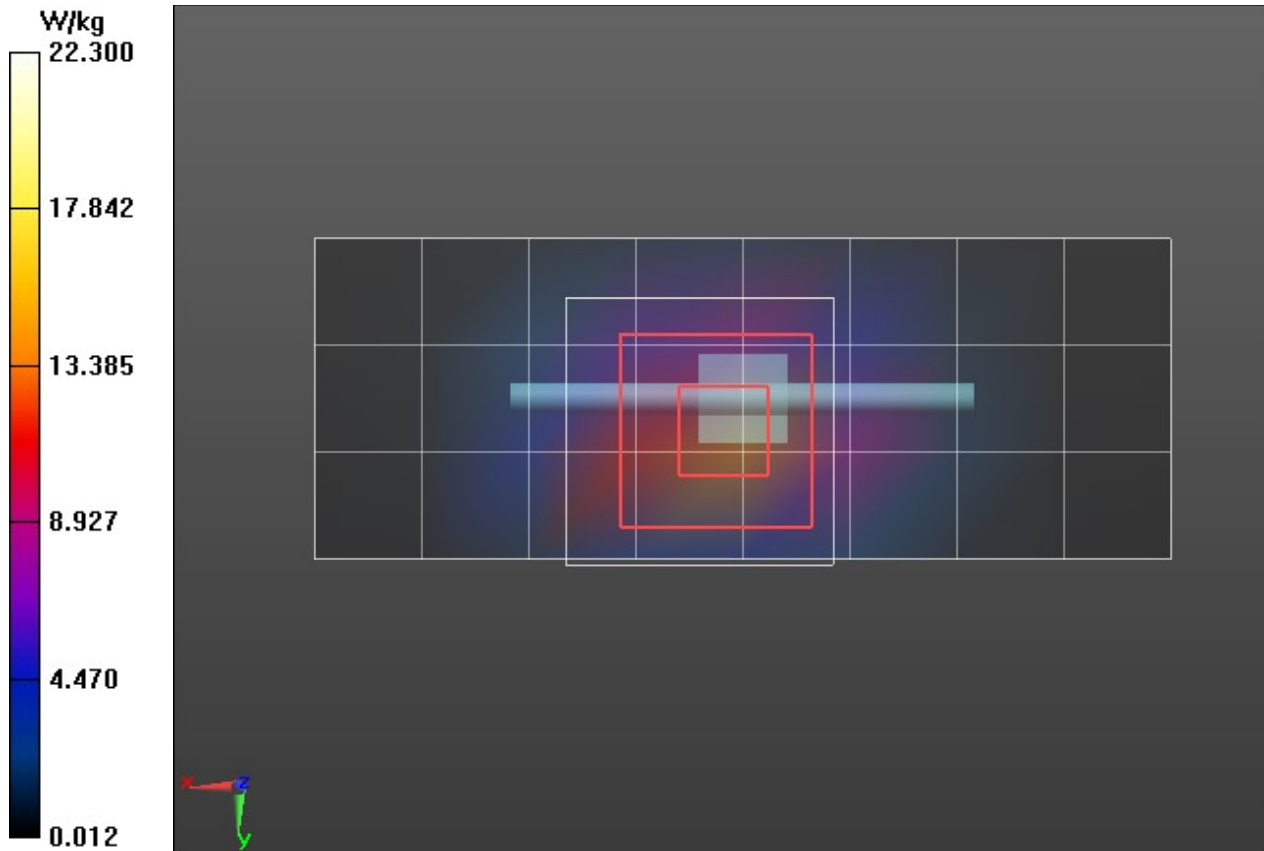
DASY5 Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2450 MHz; Calibrated: 4/20/2022
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 4/14/2022
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 00355
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_2 2/Area Scan (9x4x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 13.4 W/kg

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_2 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 83.16 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.7 W/kg
Smallest distance from peaks to all points 3 dB below = 10.4 mm
Ratio of SAR at M2 to SAR at M1 = 46.3%
Maximum value of SAR (measured) = 14.1 W/kg

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_2 2/Z Scan (1x1x22): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Penetration depth = 6.885 (6.712, 6.948) [mm]
Maximum value of SAR (interpolated) = 22.3 W/kg



DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:825
Procedure Name: SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_ 2 2 2

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.88$ S/m; $\epsilon_r = 36.31$; $\rho = 1000$ kg/m³
Phantom section: Left Section

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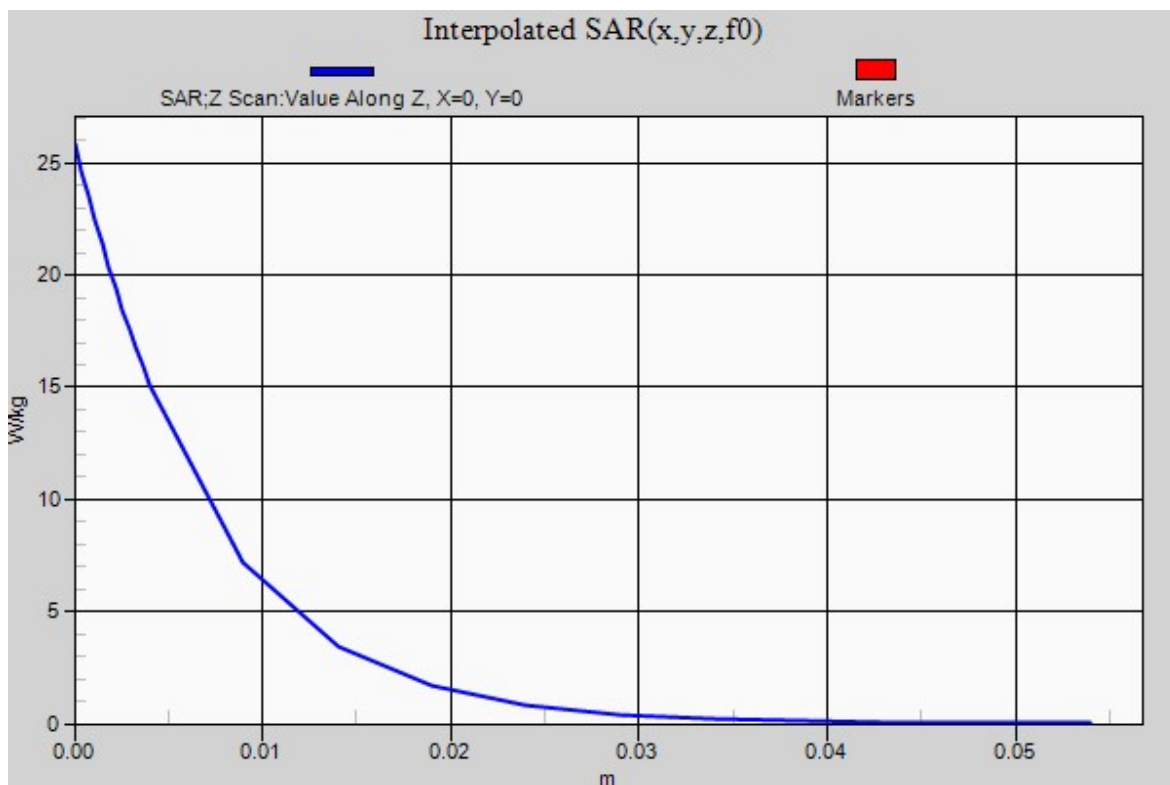
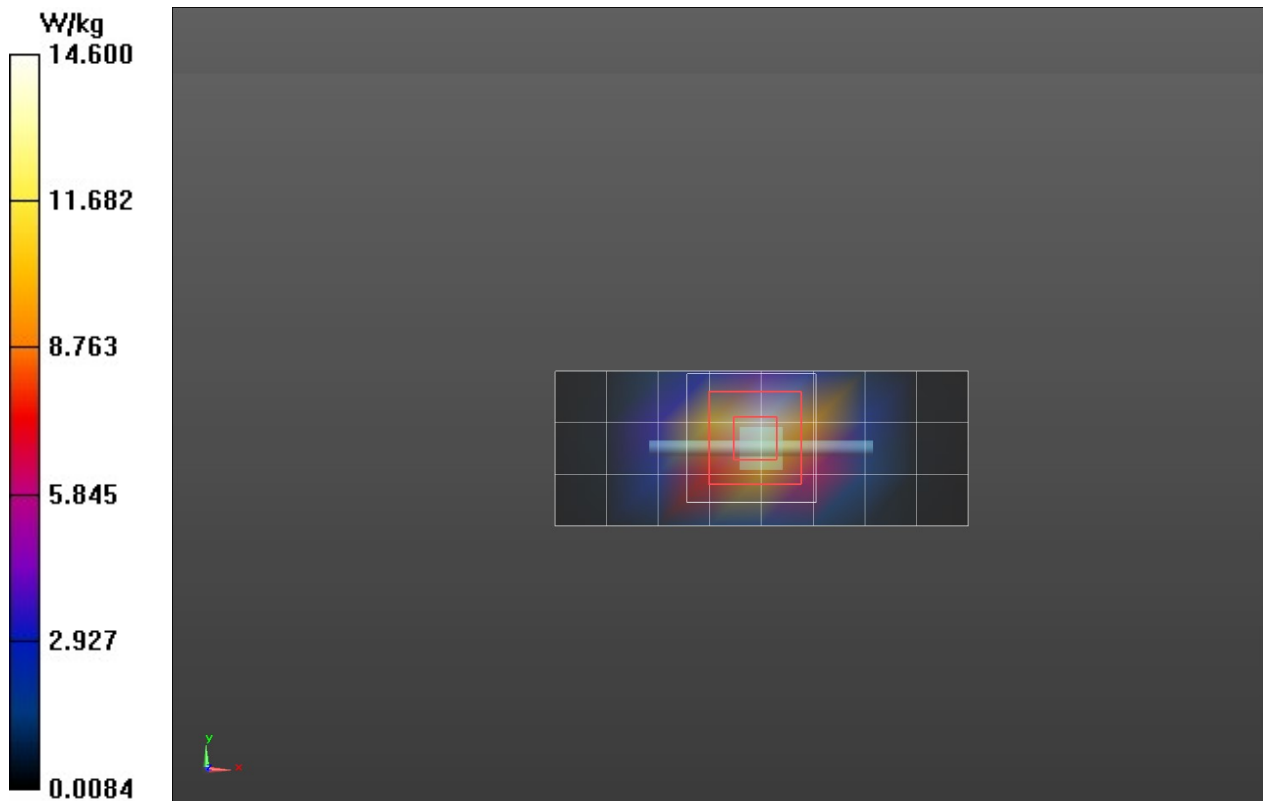
DASY5 Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2450 MHz; Calibrated: 4/20/2022
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 4/14/2022
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 00355
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_ 2 2 2/Area Scan (9x4x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 14.6 W/kg

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_ 2 2 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.07 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 14 W/kg; SAR(10 g) = 6.38 W/kg
Smallest distance from peaks to all points 3 dB below = 10.8 mm
Ratio of SAR at M2 to SAR at M1 = 46.8%
Maximum value of SAR (measured) = 15.8 W/kg

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18[14.50]W/kg_ 2 2 2/Z Scan (1x1x22): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Penetration depth = 6.919 (6.667, 7.038) [mm]
Maximum value of SAR (interpolated) = 25.8 W/kg



APPENDIX B – MEASUREMENT PLOTS OF MAXIMUM MEASURED SAR

Plot E1

DUT: A04597; Type: Extremity Worn Transmitter; Serial: 3432588122

Procedure Name: E1-A04597,Extremity-Back Side, 2412 MHz, Silicone Band-WIFI, DSSS-5.5Mbps

Communication System: UID 0, CW (0); Frequency: 2412 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.818$ S/m; $\epsilon_r = 36.386$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Date/Time: 12/15/2022 7:46:19 PM

DASY5 Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2412 MHz; Calibrated: 4/20/2022
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 4/14/2022
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 00355
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

2450H/E1-A04597,Extremity-Back Side, 2412 MHz, Silicone Band-WIFI, DSSS-5.5Mbps/Area Scan (8x8x1):

Measurement grid: dx=12mm, dy=12mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.574 W/kg

2450H/E1-A04597,Extremity-Back Side, 2412 MHz, Silicone Band-WIFI, DSSS-5.5Mbps/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 18.75 V/m; Power Drift = 0.21 dB

Peak SAR (extrapolated) = 1.22 W/kg

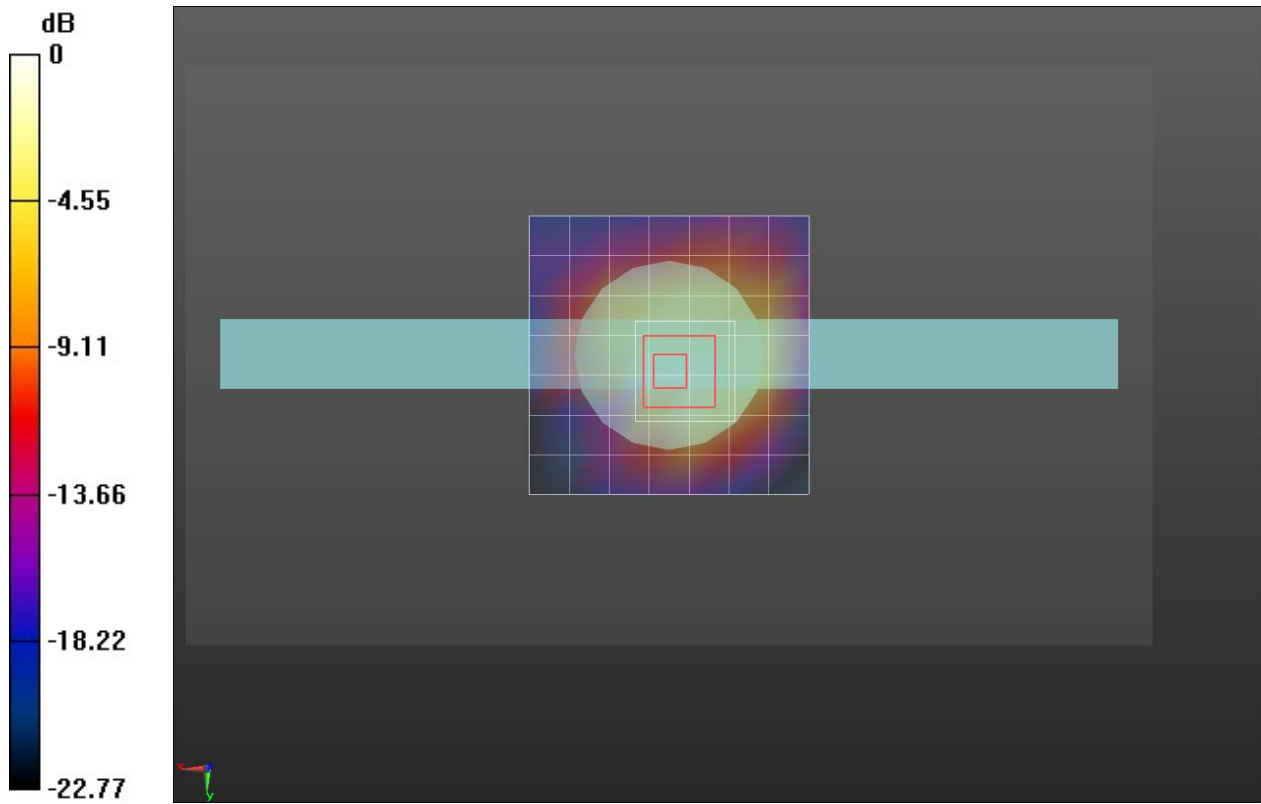
SAR(1 g) = 0.534 W/kg; SAR(10 g) = 0.230 W/kg

Smallest distance from peaks to all points 3 dB below = 7.8 mm

Ratio of SAR at M2 to SAR at M1 = 47.7%

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.658 W/kg



0 dB = 0.658 W/kg = -1.82 dBW/kg

Plot E7

DUT: A04597; Type: Extremity Worn Transmitter; Serial: 3432588122
Procedure Name: E7-A04597,Extremity-Back Side,ch-38 2440 MHz, B1, BT, GFSK

Communication System: UID 0, CW (0); Frequency: 2440 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2440$ MHz; $\sigma = 1.86$ S/m; $\epsilon_r = 36.34$; $\rho = 1000$ kg/m³
Phantom section: Left Section

Date/Time: 1/4/2023 7:03:00 PM

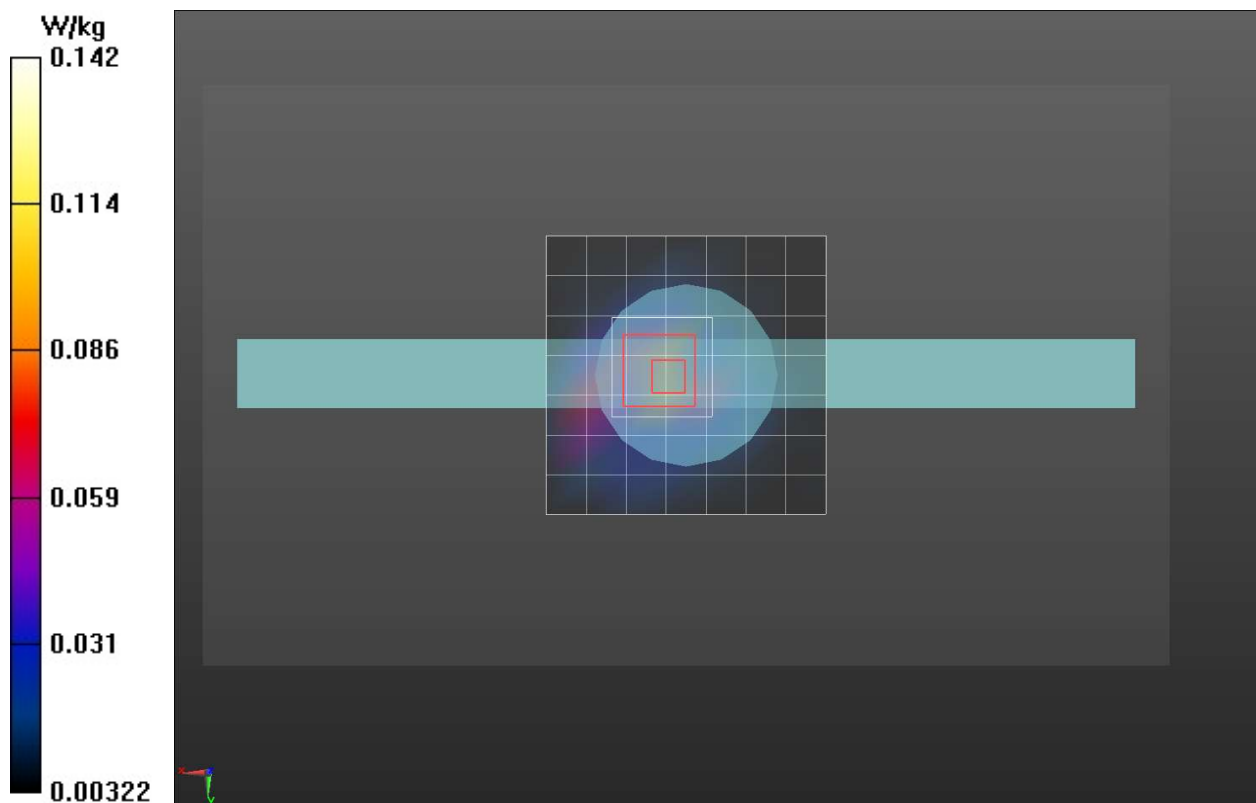
DASY5 Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2440 MHz; Calibrated: 4/20/2022
- Sensor-Surface: 4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 4/14/2022
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 00355
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

2450H A04597- /E7-A04597,Extremity-Back Side,ch-38 2440 MHz, B1, BT, GFSK/Area Scan (8x8x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0850 W/kg

2450H A04597- /E7-A04597,Extremity-Back Side,ch-38 2440 MHz, B1, BT, GFSK/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.353 V/m; Power Drift = -0.27 dB
Peak SAR (extrapolated) = 0.197 W/kg
SAR(1 g) = 0.090 W/kg; SAR(10 g) = 0.042 W/kg
Smallest distance from peaks to all points 3 dB below = 7.1 mm
Ratio of SAR at M2 to SAR at M1 = 50.4%
Maximum value of SAR (measured) = 0.104 W/kg

2450H A04597- /E7-A04597,Extremity-Back Side,ch-38 2440 MHz, B1, BT, GFSK/Z Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=20mm
Penetration depth = n/a (n/a, 7.762) [mm]
Maximum value of SAR (interpolated) = 0.142 W/kg



APPENDIX D – PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Celltech**

Certificate No: **EX3-3600_Apr22**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3600**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v6, QA CAL-23.v5,
QA CAL-25.v7
Calibration procedure for dosimetric E-field probes**

Calibration date: **April 20, 2022**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
DAE4	SN: 660	13-Oct-21 (No. DAE4-660_Oct21)	Oct-22
Reference Probe ES3DV2	SN: 3013	27-Dec-21 (No. ES3-3013_Dec21)	Dec-22
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	
Issued: April 20, 2022			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3600

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.48	0.48	0.38	± 10.1 %
DCP (mV) ^B	101.6	98.8	101.6	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	147.6	± 2.5 %	± 4.7 %
		Y	0.0	0.0	1.0		140.0		
		Z	0.0	0.0	1.0		146.8		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).
^B Numerical linearization parameter: uncertainty not required.
^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3600

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-124
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3600

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
30	55.0	0.75	12.25	12.25	12.25	0.00	1.00	± 13.3 %
150	52.3	0.76	9.65	9.65	9.65	0.00	1.00	± 13.3 %
450	43.5	0.87	8.78	8.78	8.78	0.16	1.30	± 13.3 %
750	41.9	0.89	8.23	8.23	8.23	0.46	0.86	± 12.0 %
835	41.5	0.90	8.11	8.11	8.11	0.51	0.80	± 12.0 %
900	41.5	0.97	7.99	7.99	7.99	0.47	0.80	± 12.0 %
1640	40.2	1.31	7.45	7.45	7.45	0.28	0.86	± 12.0 %
1810	40.0	1.40	7.35	7.35	7.35	0.35	0.86	± 12.0 %
1900	40.0	1.40	7.30	7.30	7.30	0.33	0.86	± 12.0 %
2300	39.5	1.67	6.79	6.79	6.79	0.36	0.90	± 12.0 %
2450	39.2	1.80	6.58	6.58	6.58	0.33	0.90	± 12.0 %
2600	39.0	1.96	6.49	6.49	6.49	0.38	0.90	± 12.0 %
5250	35.9	4.71	4.55	4.55	4.55	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.18	4.18	4.18	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.16	4.16	4.16	0.40	1.80	± 13.1 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3600

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
6500	34.5	6.07	4.75	4.75	4.75	0.20	2.50	± 18.6 %

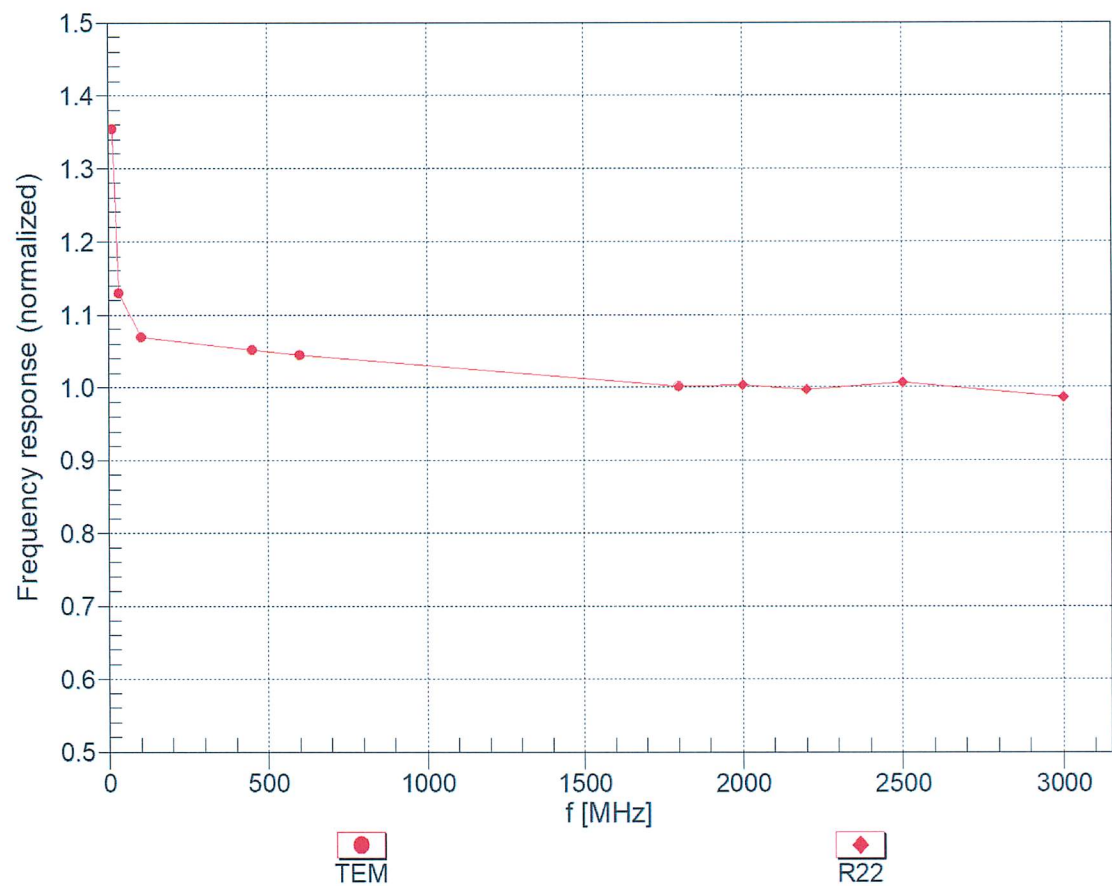
^C Frequency validity at 6.5 GHz is -600/+700 MHz, and ± 700 MHz at or above 7 GHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies 6-10 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz; below ± 2% for frequencies between 3-6 GHz; and below ± 4% for frequencies between 6-10 GHz at any distance larger than half the probe tip diameter from the boundary.

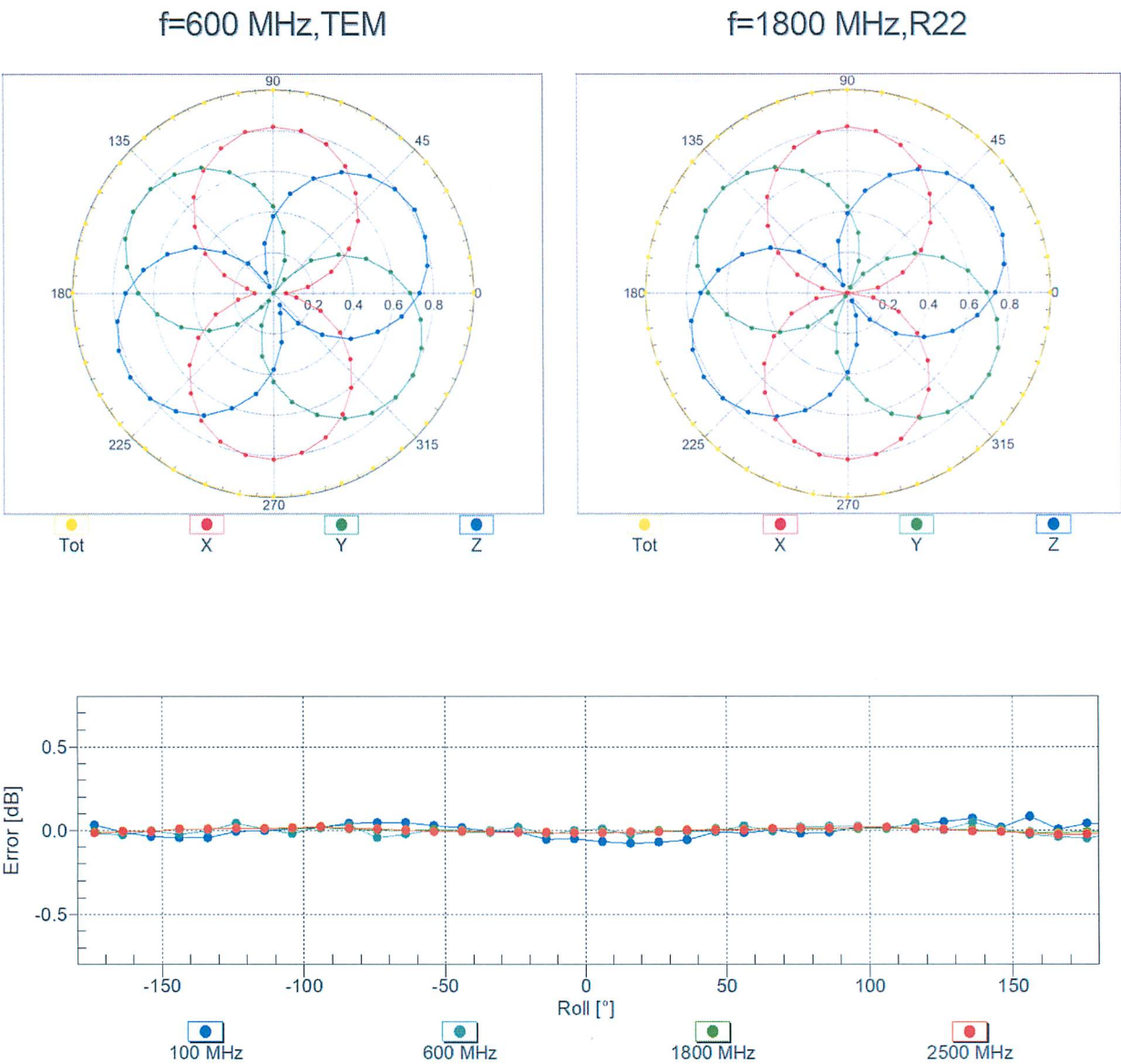
Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



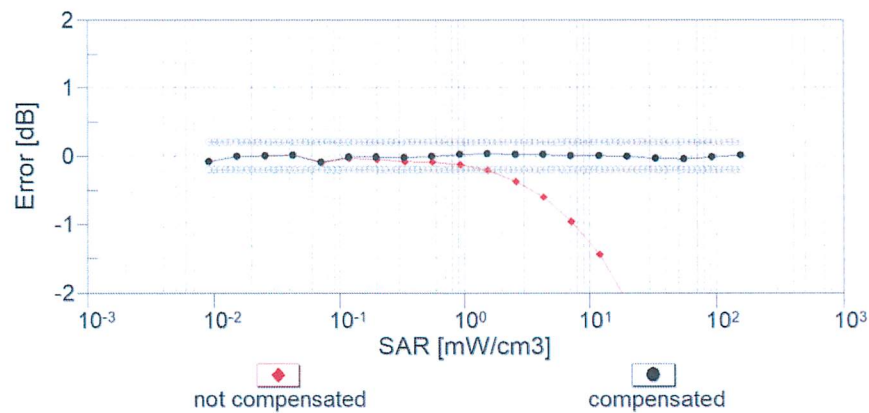
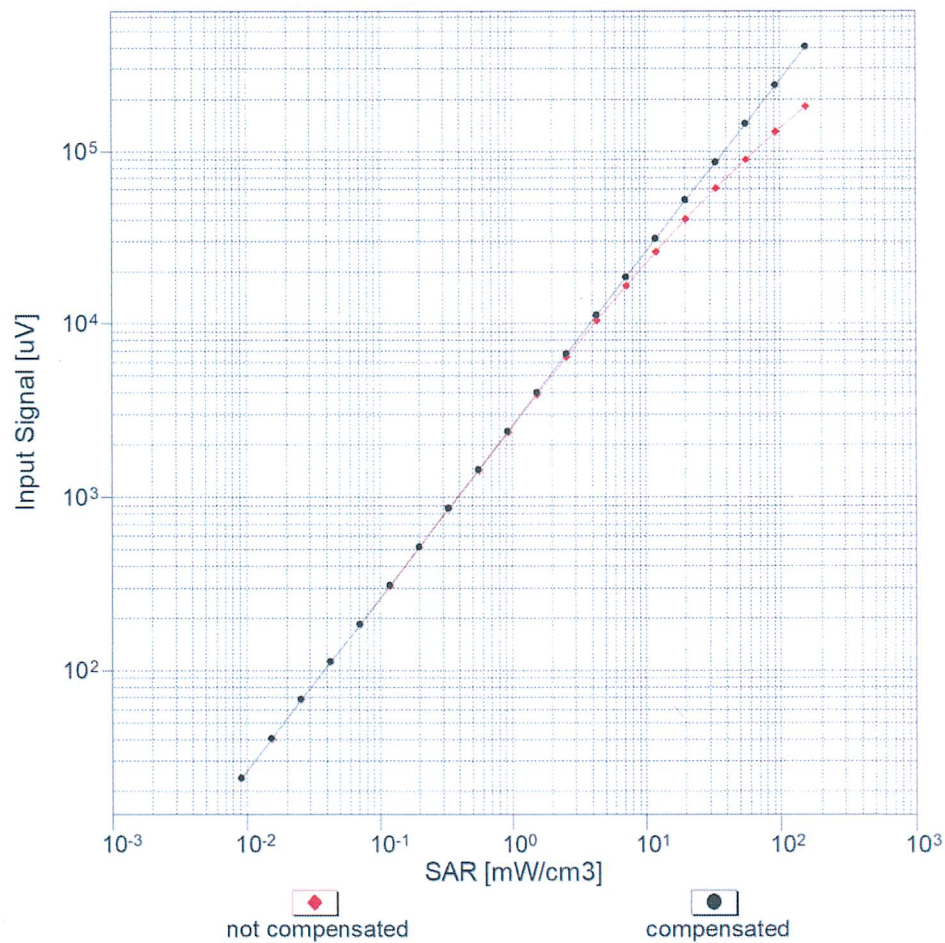
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



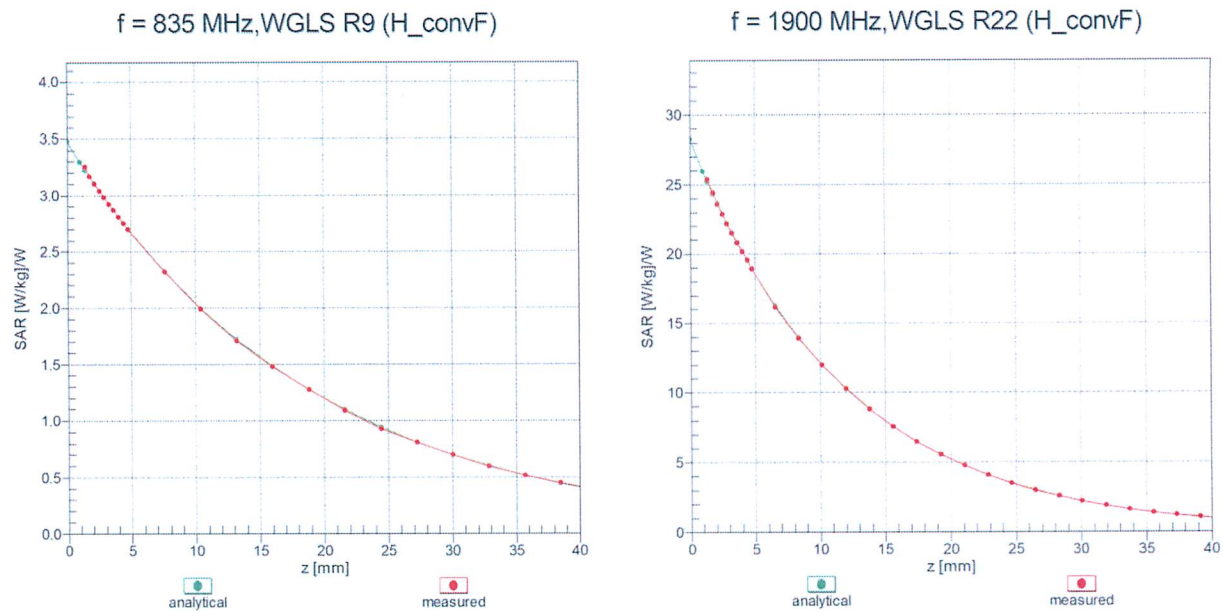
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

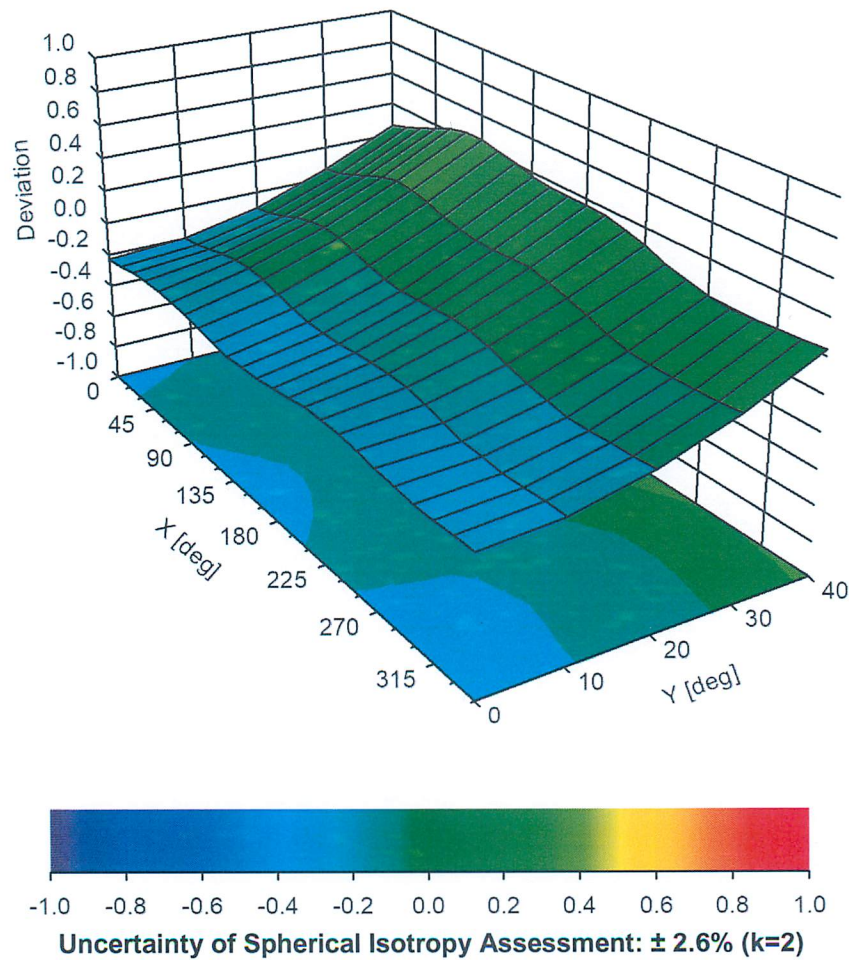


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid
Error (ϕ , ϑ), f = 900 MHz



APPENDIX E – DIPOLE CALIBRATION

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1904

Project Number: 5921

Client.: Celltech

Address: 21 – 364 Lougheed Road, Kelowna, BC V1X 7R8, Canada

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the
NCL CALIBRATION LABORATORIES by qualified personnel following recognized
procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole (Head)

Manufacturer: SPEAG

Part number: D2450V2

Frequency: 2450 MHz

Serial No: 825

Calibrated: 27/04/2021

Released on: 05/05/2021

This Calibration Certificate is incomplete unless accompanied by the Calibration Results Summary

Released by: _____

Pieter Erasmus, Quality Manager

NCL Calibration Laboratories

Suite 102, 303 Terryfox Dr.
Ottawa, Ontario, K2K 3J1
Canada

Division of APREL Lab.
Tel: (613) 435-8300
Fax: (613) 435-8306

Conditions

Dipole SN 825 was a re-calibration.

Ambient Temperature of the Laboratory: 21 °C +/- 0.5°C

Temperature of the Tissue: 21 °C +/- 0.5°C

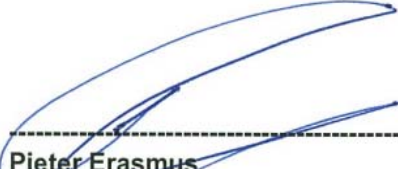
Primary Measurement Standards

Instrument		Serial Number		Cal due date
Signal Generator	HP	83640B	3844A00689	Sept. 17, 2022
Network Analyzer	Keysight	E5063A	MY54502902	Mar. 9, 2023
Spectrum Analyzer	Keysight	N9030B	MY57140772	Apr. 20, 2023

Attestation

The below named signatories have conducted the calibration and review of the data which is presented in this calibration report.

We the undersigned attest that to the best of our knowledge the calibration has been accurately conducted and that all information contained within this report has been reviewed for accuracy and any uncertainties if applicable disclosed.



Pieter Erasmus
Quality Manager

Maryna Nesterova
Test and Calibration Engineer

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Tissue Validation

Tissue	Frequency	Dielectric constant, ϵ_r	Conductivity, σ [S/m]
Head	2450 MHz	40.73	1.86

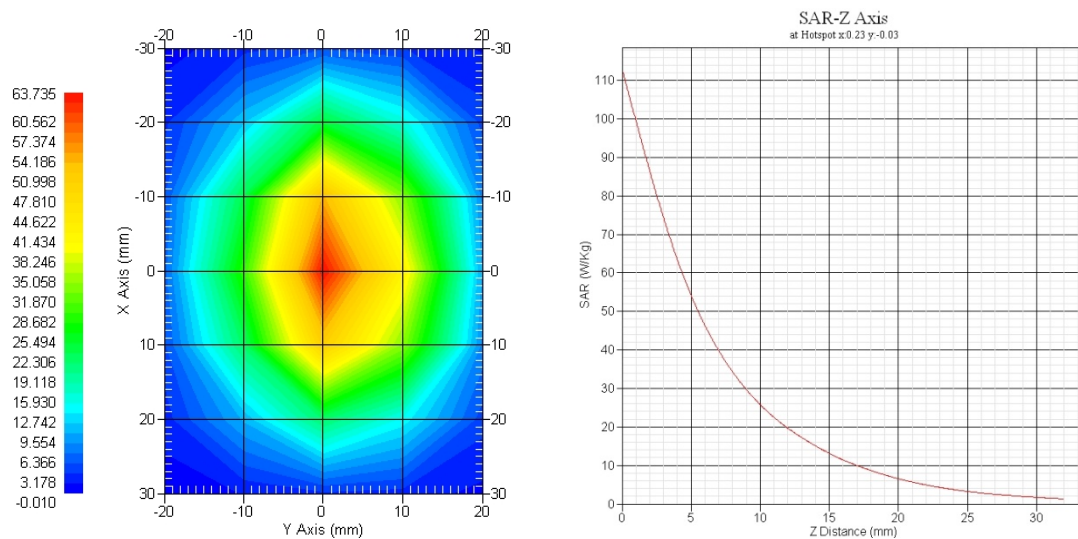
Electrical Specification

Tissue	Frequency	Return Loss	Impedance	SWR:
Head	2450 MHz	-19.83 dB	43.26 Ω	1.23U

System Validation Results

Tissue	Frequency	1-Gram SAR	10-Gram SAR	Uncertainty
Head	2450 MHz	52.719 W/kg	24.015 W/kg	19.8%

Head



Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole SN 825. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 30 MHz to 6 GHz E-Field Probe Serial Number 225.

References

- o IEEE Standard 1528:2013
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- o EN 62209-1:2016
Human Exposure to RF Fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to measure the Specific Absorption Rate (SAR) for hand-held mobile wireless devices
- o IEC 62209-2:2019
Human exposure to RF fields from hand-held and body-mounted wireless devices - Human models, instrumentation, and procedures - Part 2: specific absorption rate (SAR) for wireless communication devices (30 MHz - 6 GHz)
- o D22-012-Tissue dielectric tissue calibration procedure
- o D28-002-Dipole procedure for validation of SAR system using a dipole
- o IEEE 1309 Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40 GHz

Conditions

Ambient Temperature of the Laboratory: 21 °C +/- 0.5°C

Temperature of the Tissue: 21 °C +/- 0.5°C

Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

	Tolerance, %
Mechanical	2.00
Positioning Error	0.10
Electrical	0.37
Tissue Permittivity	3.88
Tissue Conductivity	3.56
Dipole Validation	1.70
Combined Uncertainty, k=2	4.81

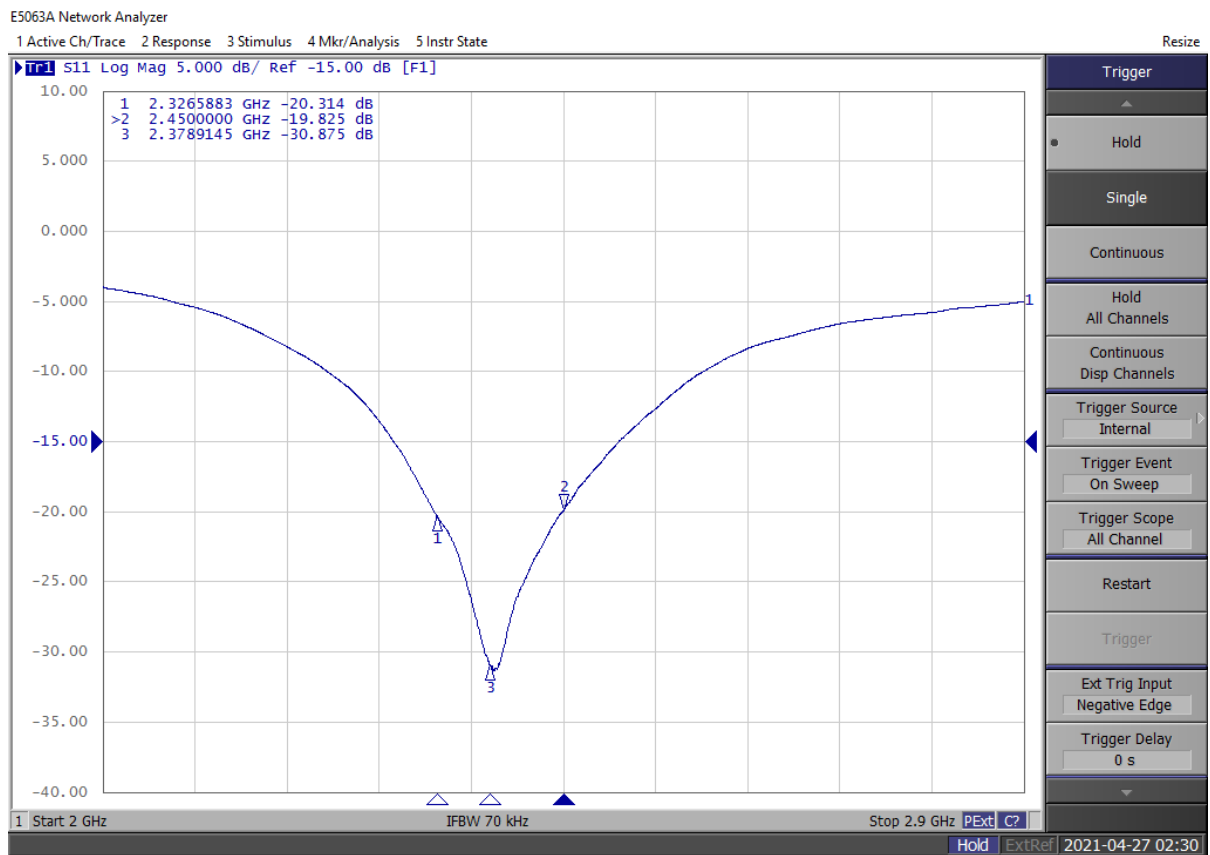
The Following Graphs are the results as displayed on the Vector Network Analyzer.
Electrical Calibration

Test	Head
S11 R/L	-19.83 dB
Impedance	43.26 Ω
SWR	1.23 U

S11 Parameter Return Loss

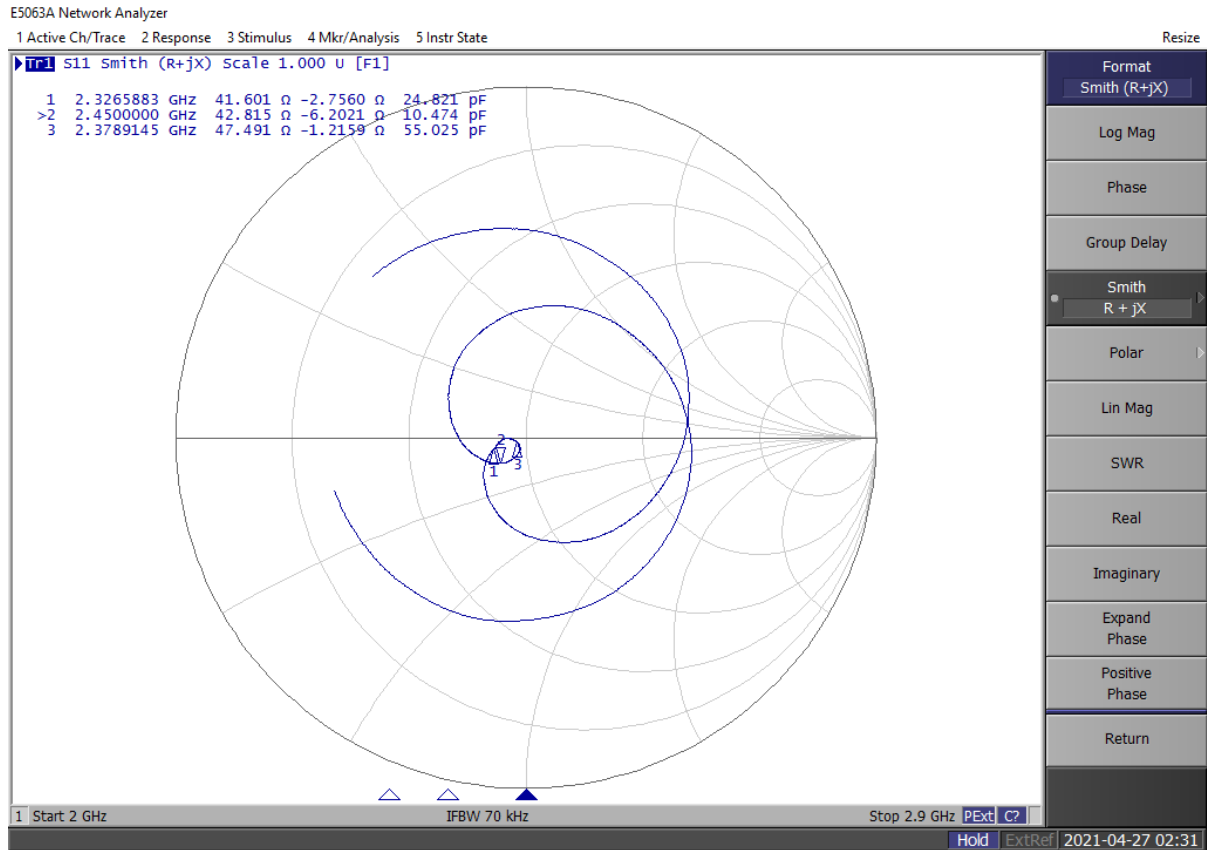
Head

Frequency Range 2326.59 MHz to 2450 MHz



Smith Chart Dipole Impedance

Head



SWR

Head



APPENDIX F - PHANTOM

Certificate of conformity / First Article Inspection

Item	Triple Modular Flat Phantom V5.1
Type No	QD 000 P51 C
Series No	1100 and higher
Manufacturer / Origin	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland

Tests

The sub-units of item 1100 are identified with the designation 1100/1, 1100/2 and 1100/3. Tests were conducted on all 3 sub-units of this phantom.

Test	Requirement	Details	Units tested
Material thickness	Compliant with the standard requirements.	2 mm +/- 0.2 mm 30 points over the bottom area	all
Material parameters	Dielectric parameters for required frequencies	200 MHz – 6 GHz - Relative permittivity 3 - 5 Loss tangent < 0.05.	Material sample
Material resistivity	The material is compatible with the liquids defined in the standards if handled and cleaned according to the instructions.	DGBE based simulating liquids. Observe Technical Note for material compatibility.	Material Samples
Shape	Internal dimensions	Internal height: > 175 mm Bottom internal length: 280 mm Bottom internal width: 175 mm Nominal filling height: 155 mm Nominal volume: 9.2 l	Pre-series, design
Sagging	Depending on standard	No initial sagging (negative preshaped, change < 0.5 mm)	1100/2

Standards

- [1] IEEE 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- [2] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
- [3] IEC 62209 – 2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures, Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", March 2010
- [4] KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Conformity

Based on the dimensions and sample tests above, we certify that this item is in compliance with the standards [1] to [4] for frequencies > 700 MHz, if operated according to the specific requirements.

Date 16.07.2015

Signature / Stamp

s p e a g

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