Garmin International, Inc.
1200 East 151st Street
Olathe, Kansas 66062
P: 913-397-8200 F: 913-397-8282

03-Feb-26

Manufacturer:	Garmin International, Inc.
Address:	1200 E. 151st St. Olathe, KS 66062-3426 U.S.A.
Chile Representative:	Matías Rodríguez Correa Rosario Norte 660 piso 24, Las Condes Santiago Province CP 7550083, Chile
Contact Email:	matias.rodriguez@garmin.com
Subject:	SUBTEL, Chile (Resolution 737) Certification Compliance 2026
Commercial Name:	Forerunner 965

	Información (Information)
Tipo de equipo (Equipment type)	Portable Digital Transceiver
Marca (Brand)	Garmin GARMIN.
Modelo (Model)	A04578
Tecnología o modulación (Technology or modulation)	ASK for NFC / GFSK for ANT/ GFSK for BLE / GFSK for BTBR / π/4-DQPSK, 8DPSK for BTEDR / 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 –3.6 dBi / BLE –3.6 dBi / 802.15.1 –3.6 dBi / 802.15.1 –3.6 dBi / 802.11b/g/n –3.6 dBi
P.i.r.e. (E.I R P.)	-36.00 dBm, 0.0002mW /-0.81 dBm, 0.82mW / -0.81 dBm, 0.82mW /5.42 dBm, 3.48 mW / 5.88 dBm, 3.87 mW /14.96 dBm, 31.33mW
Módulos (Modules)	NFC, ANT, BLE, BTBR, BTEDR, 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:	**45461774 R1.0**
Test Report Date:	**16 December 2022**
Project Number:	**1603**

EMC Test Report - New Certification

Applicant:

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

FCC ID:	IC Registration Number
IPH-04578	**1792A-04578**
Product Model Number / HVIN	Product Marketing Name / PMN
A04578	**A04578**

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.249), (§15.225), Part 15 Subpart B

Part 15 Low Power Communication Device Transmitter (DXX)

RSS-Gen, RSS-210 Issue 10

Licence-Exempt Radio Apparatus: Category I Equipment

Approved By:

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

Test Lab Certificate: 2470.01 **IC Registration 3874A** **FCC Registration: CA3874**

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See Appendix K thru P

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:		Art Voss, P.Eng.	Date(s) of Evaluation:		17 Sep - 3 Nov, 2022
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 December 2022
1.0	Initial Release		n/a	Art Voss	16 December 2022

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-04578**
	ISED ID:	**1792A-04578**
Device Model(s) / HVIN:	A04578	
Device Marketing Name / PMN:	A04578	
Test Sample Serial No.:	3361277594 - Conducted, 3361277722 - OTA	
Device Type:	Extremity Worn Digital Transceiver	
Equipment Class:	Wideband Transmission Systems	
	Short Range Devices (SRD)	
	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): 18.56dBm	
	BlueTooth - Spread Spectrum Transmitter (DSS): 9.48dBm	
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 2.79dBm	
	NFC - Low Power Communication Device Transmitter (DXX): -36dBm	
Antenna Type and Gain:	-3.46dBi Max	
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7	
	BT BR: GFSK	
	BT EDR: Pi/4-DQPSK	
	BLE: GMSK	
	ANT: GFSK	
	NFC: ASK	
DUT Power Source:	3VDC Rechargeable Li-Ion	
DUT Dimensions [LxWxH]	H x W x D: 65mm 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: A04578 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, ISED: RSS-Gen, RSS-210 and RSS-247. As per FCC 47 CFR §2.1093 and Health Canada Safety Code 6, 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)	16, 17, 21 Sep 2022	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)	3 Nov 2022	Pass
9.0	20dB BW	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	16, 17, 21 Sep 2022	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)	21 Sep 2022	Pass
11.0	Restricted Bands	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	3 Nov 2022	Pass
12.0	Radiated Rx Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	3 Nov 2022	Pass
13.0	Frequency Stability	ANSI C63.10-2013 KDB 558074 D01v05	§15.225	RSS-G210 B.6	26 Nov 2022	Pass
14.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	ICES-003(6.1)	26 Nov 2022	Pass

Test Station Day Log

Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
16 Sep 2022	22.1	18	101.2	**EMC**	**7, 9**
17 Sep 2022	22.8	17	101.3	**EMC**	**7, 9**
21 Sep 2022	23.5	17	101.6	**EMC**	**10,**
2 Nov 2022	0.0	87	101.5	**OATS**	**8, 11, 12**
3 Nov 2022	-2.0	80	102.4	**OATS**	**8, 11, 12**
26 Nov 2022	22.6	16	103.3	**LISN**	**14**
26 Nov 2022	22.6	16	103.3	**TC**	**13**

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 Deccember 2022
Date

PROFESSIONAL
PROVINCE OF
A. F. VOSS
31327
BRITISH COLUMBIA
ENGINEER

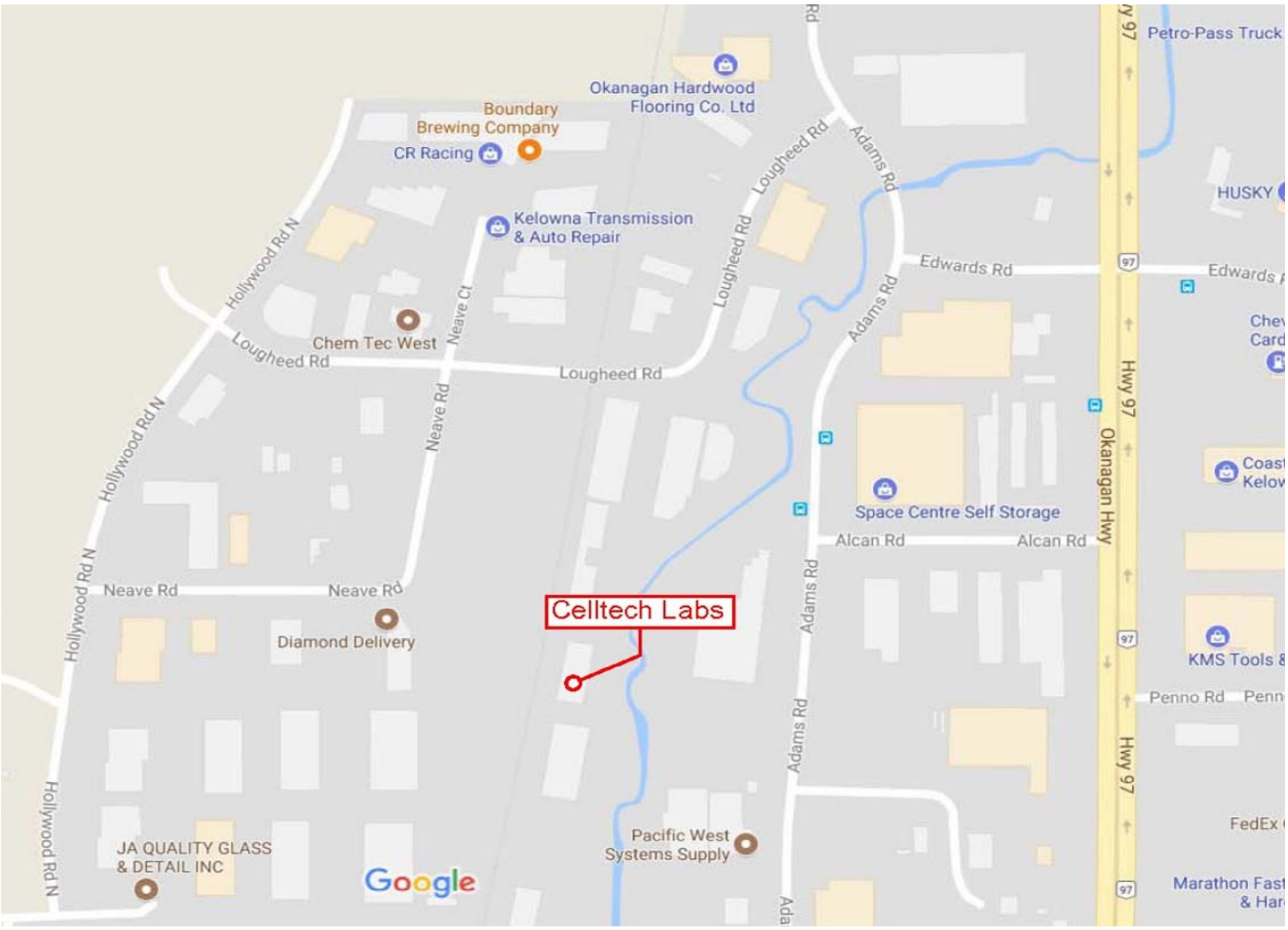
5.0 NORMATIVE REFERENCES

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 Title 47: Part 2:	Code of Federal Regulations Telecommunication Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47: Part 15: Sub Part C (15.225)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
CFR Title 47: Part 15: Sub Part C (15.249)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
ISED RSS-Gen Issue 5A1: March 2019	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment
ISED RSS-210 Issue 10A1: December 2029	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Licence-Exempt Radio Apparatus: Category I Equipment
ISED RSS-247 Issue 2: February 2017	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licensed-Exempt Local Area Network (LE_LAN) Devices
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 Reference	FCC 47 CFR §2.1046, RSS-Gen (6.1.2), RSS-247 (5.4)(d),
	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: 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.

Table 7.1 - Summary of Occupied Bandwidth Measurements (DXX)

See Appendix K for measurement plots

Occupied Bandwidth Measurement Results: BlueTooth						
Mode	**Channel Number**	**Channel Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured Occupied Bandwidth (MHz)**	**Emission Designator**
BLE1	0	2402	GMSK	1	1.29	1M29D1D
	19	2440			1.98	1M98D1D
	39	2480			1.31	1M31D1D
BLE2	0	2402	GMSK	2	2.52	2M52D1D
	19	2440			2.75	2M75D1D
	39	2480			2.56	2M56D1D
ANT	2	2402	GFSK	-	1.23	1M22D1D
	41	2440			1.23	1M22D1D
	80	2480			1.30	1M30D1D
					Result:	**Complies**

Table 7.2 - Summary of Occupied Bandwidth Measurements (NFC)

See Appendix K for measurement plots

Occupied Bandwidth Measurement Results: NFC						
Mode	**Channel Number**	**Channel Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured Occupied Bandwidth (Hz)**	**Emission Designator**
NFC	-	13.56	ASK	-	77.000	77HK1D
					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.

Test Setup	**Appendix A**	**Figure A.2**

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 L for Measurement Plots

FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	Detector	Antenna Polarization	Measured Field Strength [FS_{Meas}] (dBuV @ 3m)	Cable Loss(1) [L_C] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS_{Corr}] (dBuV @3m)	Limit (dBuV)	Margin (dB)
2402.0	BLE2	GMSK	2	RMS	Horizontal	59.58	0	28.28	87.86	94.0	**6.1**
2440.0					Horizontal	62.35	0	28.28	90.63		**3.4**
2480.0					Horizontal	57.50	0	28.28	85.78		**8.2**
2402.0					Vertical	50.81	0	28.28	79.09		**14.9**
2440.0					Vertical	50.76	0	28.28	79.04		**15.0**
2480.0					Vertical	45.80	0	28.28	74.08		**19.9**
2402.0				Peak	Horizontal	62.94	0	28.28	91.22	114.0	**22.8**
2440.0					Horizontal	63.83	0	28.28	92.11		**21.9**
2480.0					Horizontal	59.34	0	28.28	87.62		**26.4**
2402.0					Vertical	50.66	0	28.28	78.94		**35.1**
2440.0					Vertical	52.28	0	28.28	80.56		**33.4**
2480.0					Vertical	47.70	0	28.28	75.98		**38.0**
									Result:	**Complies**	

(1) Cable loss accounted for in instrument transducer factor

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

Margin = Limit - FS_{Corr}

Table 8.2 - Summary of Field Strength Measurements (ANT)

See Appendix L for Measurement Plots

FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	Detector	Antenna Polarization	Measured Field Strength [FS_{Meas}] (dBuV @ 3m)	Cable Loss(1) [L_C] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS_{Corr}] (dBuV @3m)	Limit (dBuV)	Margin (dB)
2402.0	ANT	GFSK	-	RMS	Horizontal	59.53	0	28.28	87.81	94.0	**6.2**
2440.0			-			63.59	0	28.28	91.87		**2.1**
2480.0			-			62.69	0	28.28	90.97		**3.0**
2402.0			-		Vertical	49.55	0	28.28	77.83		**16.2**
2440.0			-			50.24	0	28.28	78.52		**15.5**
2480.0			-			50.11	0	28.28	78.39		**15.6**
2402.0			-	Peak	Horizontal	60.25	0	28.28	88.53	114.0	**25.5**
2440.0			-			64.25	0	28.28	92.53		**21.5**
2480.0			-			63.51	0	28.28	91.79		**22.2**
2402.0			-		Vertical	50.14	0	28.28	78.42		**35.6**
2440.0			-			50.99	0	28.28	79.27		**34.7**
2480.0			-			50.91	0	28.28	79.19		**34.8**
									Result:	**Complies**	

(1) Cable loss accounted for in instrument transducer factor

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

Margin = Limit - FS_{Corr}

Table 8.3 - Summary of Field Strength Measurements (NFC)

See Appendix L for Measurement Plots

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 (dB)
13.56	NFC	ASK	RMS	Front	15.33	0.5	10.65	**26.48**	84.00	124.0	**97.5**
				Side	7.91			19.06			**104.9**
			Peak	Front	24.41			**35.56**	104.00	144.0	**108.4**
				Side	21.81			32.96			**111.0**
								Result:		**Complies**	

* 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 (dB)
13.56	NFC	ASK	RMS	Front	15.33	0.5	-40.85	**-25.02**	84.00	72.5	**97.5**
				Side	7.91			-32.44			**104.9**
			Peak	Front	24.41			**-15.94**	104.00	92.5	**108.4**
				Side	21.81			-18.54			**111.0**
								Result:		**Complies**	

** 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 (dBΩ)

Where Z_0 = Free-Space Impedance = 120πΩ = 377Ω => 20Log377Ω = 51.5dBΩ

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

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

Measurement Correction

H_{Corr}(dBuA/m) = E_{Meas}(dBuV) + ACF^H(dB/Ωm) + 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.
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.

[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

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.

Table 9.1 - Summary of 20dB BW Measurements

See Appendix M for Measurement Plots

20dB BW Bandwidth Measurement Results					
Mode	**Channel Number**	**Channel Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured 20dB Bandwidth (MHz)**
BLE1	0	2402	GMSK	1	1.33
	39	2480			1.36
BLE2	1	2404	GMSK	2	2.71
	38	2478			2.48
ANT	2	2402	GFSK	-	1.41
	80	2480			2.15
Result:					**Complies**

Compliance to §15.215(c):
Largest Measured 20dB BW < 2.48MHz, 50% BW < 1.24MHz
LBE = 2402MHz - 1.24MHz = 2400.79MHz > 2400MHz
UBE = 2480MHz + 1.24MHz = 2481.2MHz < 2483.5MHz

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 and13.567-13.710 MHz (iii)106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110-13.410 MHz and13.710-14.010 MHz (iv)RSS-Gen general field strength limits for frequencies outside the band13.110-14.010 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.

Test Setup	Appendix A	Figure A.2

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 10.1 – Summary of Field Strength Measurements (NFC)

See Appendix N for Measurement Plots

Radiated Field Strength

Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Frequency Range (MHz)	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 (dB)
13.56	NFC	ASK	RMS	Front	13.410 - 13.553	10.68	0.5	10.65	21.83	50.50	90.5	**68.7**
					13.567 - 13.710	10.07			21.22			**69.3**
					13.110 - 13.410	-0.24			10.91	40.50	80.5	**69.6**
					13.710 - 14.010	-1.06			10.09			**70.4**
									Result:		**Complies**	

* Limit @ 3m = Limit @ 30m + 40dB/decade = 50.5dBuV/m + 40dB = 90.5dBuV/m
* Limit @ 3m = Limit @ 30m + 40dB/decade = 40.5dBuV/m + 40dB = 80.5dBuV/m
$FS_{Corr} = FS_{Meas} + ACF + L_C$
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 (dB)
13.56	NFC	ASK	RMS	Front	13.410 - 13.553	10.68	0.5	-40.85	-29.67	50.50	39.0	**68.7**
					13.567 - 13.710	10.07			-30.28			**69.3**
					13.110 - 13.410	-0.24			-40.59	40.50	29.0	**69.6**
					13.710 - 14.010	-1.06			-41.41			**70.4**
									Result:		**Complies**	

** Limit @ 3m = Limit @ 30m + 40dB/decade = 50.5dBuV/m + 40dB = 90.5dBuV/m
** Limit @ 3m = Limit @ 30m + 40dB/decade = 40.5dBuV/m + 40dB = 80.5dBuV/m
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 (dBΩ)
Where Z_0 = Free-Space Impedance = 120πΩ = 377Ω => 20Log377Ω = 51.5dBΩ
$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 90.5dBuV/m - 51.5dBΩ = 39dBuA/m @ 3m
$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 180.5dBuV/m - 51.5dBΩ = 29dBuA/m @ 3m

Measurement Correction

H_{Corr}(dBuA/m) = E_{Meas}(dBuV) + ACF^H(dB/Ωm) + 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 = $Limit_{3m} - H_{Corr}$

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:

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 Emissions, Restricted Band (DXX)

See Appendix O 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**
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 Amplier not used

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

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

See Appendix O 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 Amplier not used

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

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.

Test Setup	Appendix A	Figure A.2

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 P for Measurement Plots

Measurement Results				
Frequency Range	Antenna Polarization	Measured Emission [E_{Meas}] (dBm)	Limit e.r.p./e.r.i.p. [A_L] (dBm)	Margin (dB)
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

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 ±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° 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:

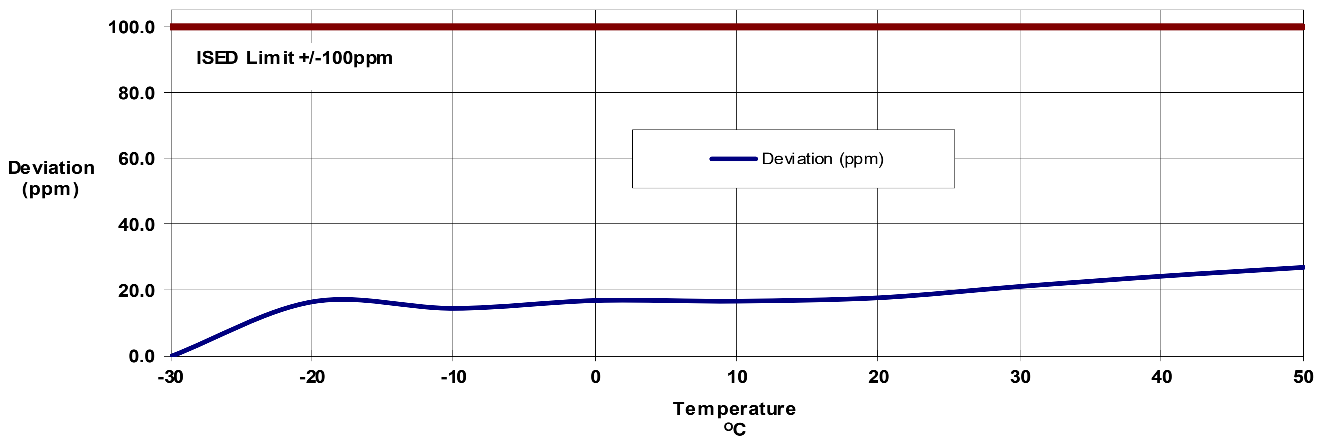
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Setup	**Appendix A**	**5**

Table 13.1 – Summary of Frequency Stability Measurements – FCC

Frequency Stability

Nominal Frequency (MHz):	13.56
Nominal Channel BW (KHz):	CW
Nominal Voltage (VDC):	3
Nominal Temperature (°C):	20



Frequency Stability Measurements (Temperature)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
-20	13.560000	13.560224	224	16.51
-10		13.560197	197	14.51
0		13.560229	229	16.88
10		13.560226	226	16.69
20		13.560240	240	17.72
30		13.560287	287	21.15
40		13.560329	329	24.26
50		13.560365	365	26.92
			Maximum Deviation:	26.92
			Maximum Limit:	100.00
			Result:	Complies

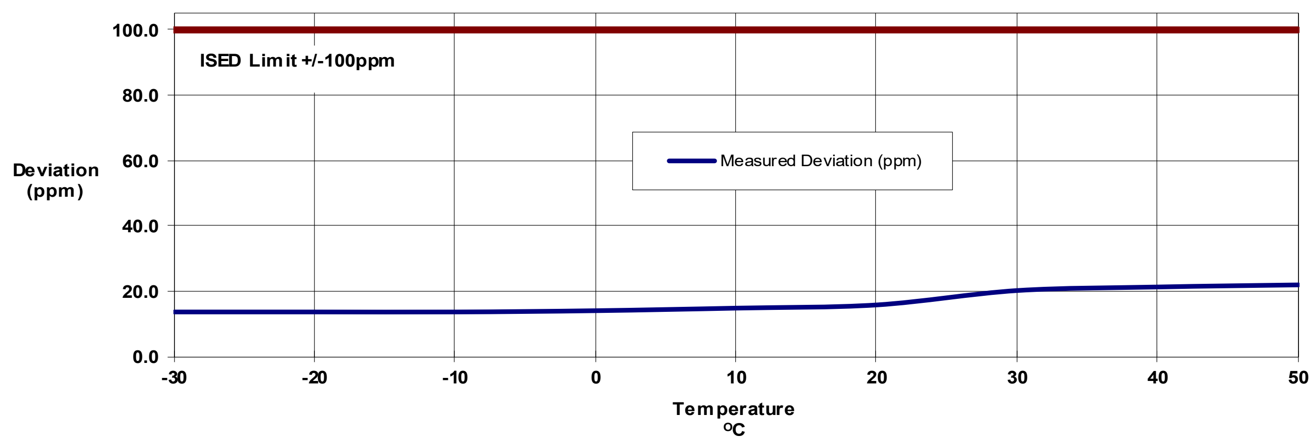
Frequency Stability Measurements (Voltage)

Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
3	**13.560000**	13.560240	240	17.72
			Maximum Deviation:	17.72
			Maximum Limit:	100.00
			Result:	Complies

Table 13.2 – Summary of Frequency Stability Measurements – ISED

Frequency Stability

Nominal Frequency (MHz):	13.56
Nominal Channel BW (KHz):	CW
Nominal Voltage (VDC):	3
Nominal Temperature (°C):	20



Frequency Stability Measurements (Temperature)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
-30	13.560000	13.5601831	183	13.50
-20		13.5601832	183	13.51
-10		13.5601833	183	13.52
0		13.5601885	189	13.90
10		13.5601993	199	14.70
20		13.5602132	213	15.72
30		13.5602734	273	20.16
40		13.5602882	288	21.25
50		13.5602975	298	21.94
			Maximum Deviation:	21.94
			Maximum Limit:	100.00
			Result:	Complies

Frequency Stability Measurements (Voltage)

Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
3	13.560000	13.560220	220	16.22
			Maximum Deviation:	16.22
			Maximum Limit:	100.00
			Result:	Complies

14.0 POWER LINE CONDUCTED EMISSIONS

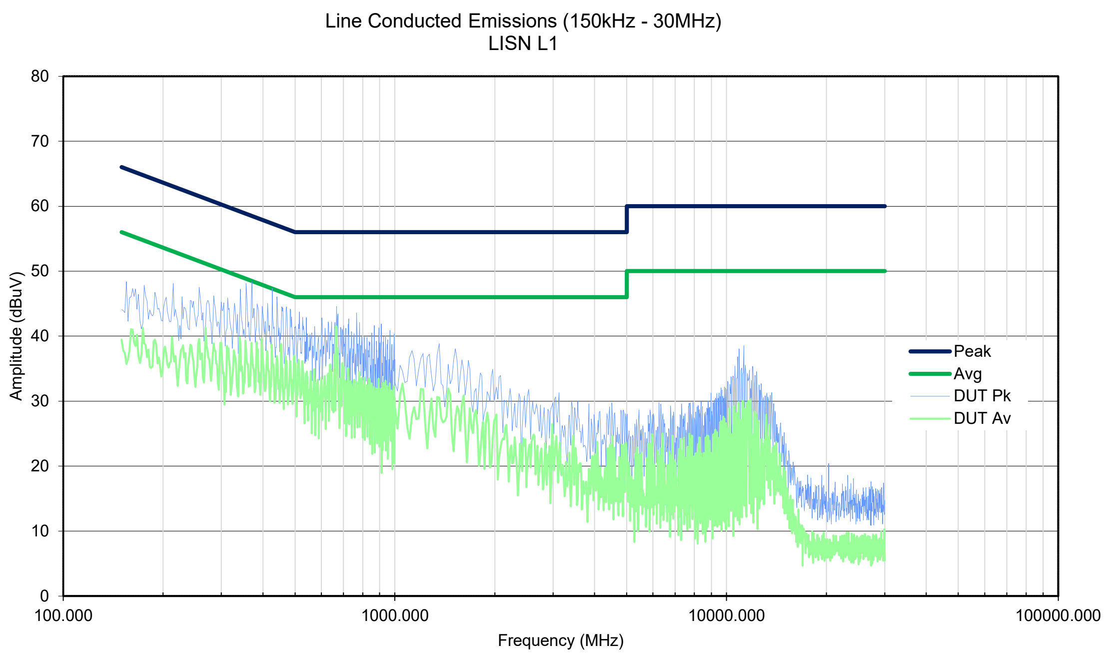
Test Procedure	
Normative Reference	**FCC 47 CFR §15.107, ICES-003(6.1)** **ANSI C63.4-2014**

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 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges. 0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logrithm 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 logrithm 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**

Plot 14.1 – Power Line Conducted Emissions, Line 1

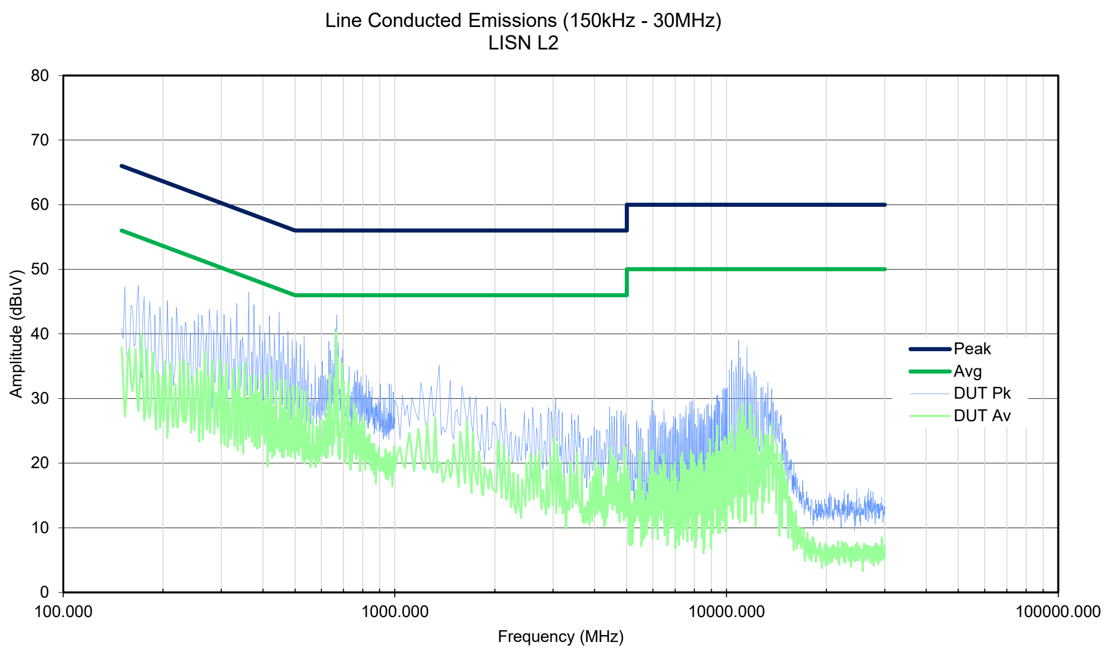
Power Line Conducted Emissions - L1



Blue Limit: **Quasi Peak**	Blue Trace: **Peak**	Frequency Range: **0.15 - 30** MHz
Green Limit: **Average**	Green Trace: **RMS**	Measured Emission:

Plot 14.2 – Power Line Conducted Emissions, Line 2

Power Line Conducted Emissions - L1



Blue Limit: **Quasi Peak**	Blue Trace: **Peak**	Frequency Range: **0.15 - 30** MHz
Green Limit: **Average**	Green Trace: **RMS**	Measured Emission:

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}]	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	2442.0	L1	666.80 kHz	40.71	Average	0.30	0.26	0.00 (3)	41.27 (2)	46.0	**4.7**
										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 Amplier 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

Margin = 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}]**	**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	2442.0	L2	666.80 kHz	39.91	Average	0.30	0.26	0.00 (3)	40.47 (2)	46.0	**5.5**
									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 Amplier 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

Margin = 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

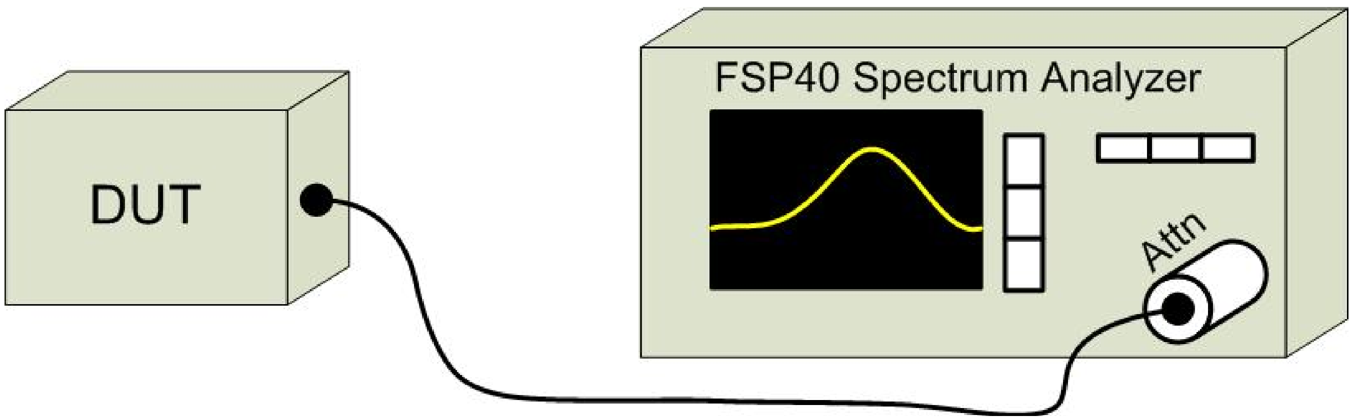


Figure A.1 – Test Setup Conducted Measurements

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

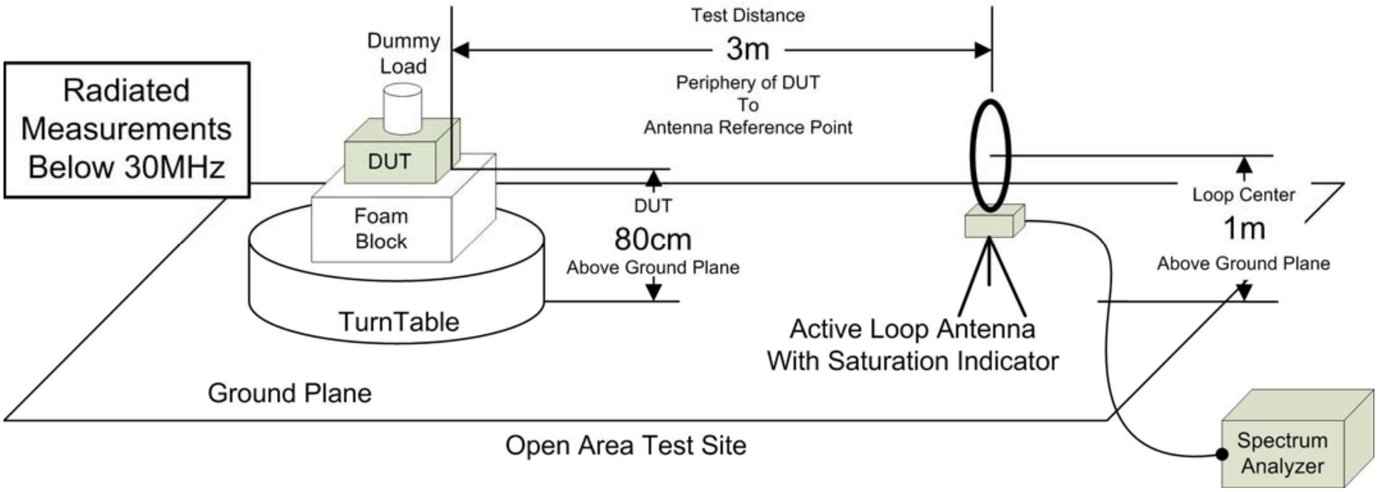


Figure A.2 – Test Setup Radiated Emissions Measurements Below 30MHz

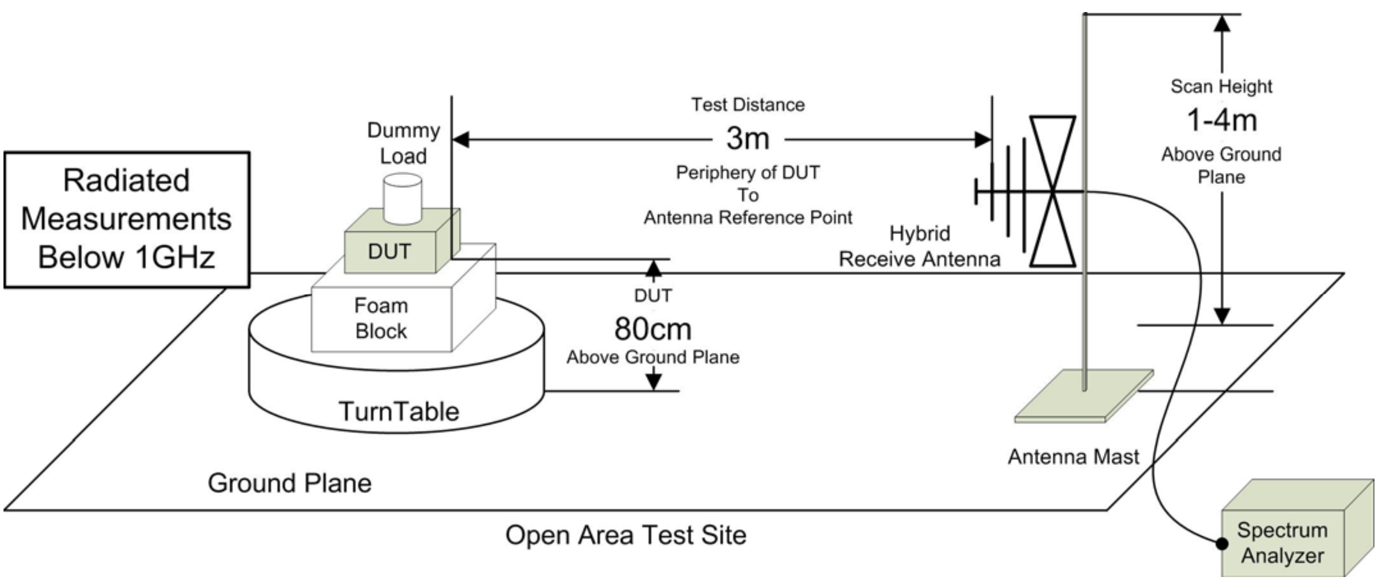


Figure A.3 – Test Setup Radiated Emissions Measurements 30 – 1000MHz

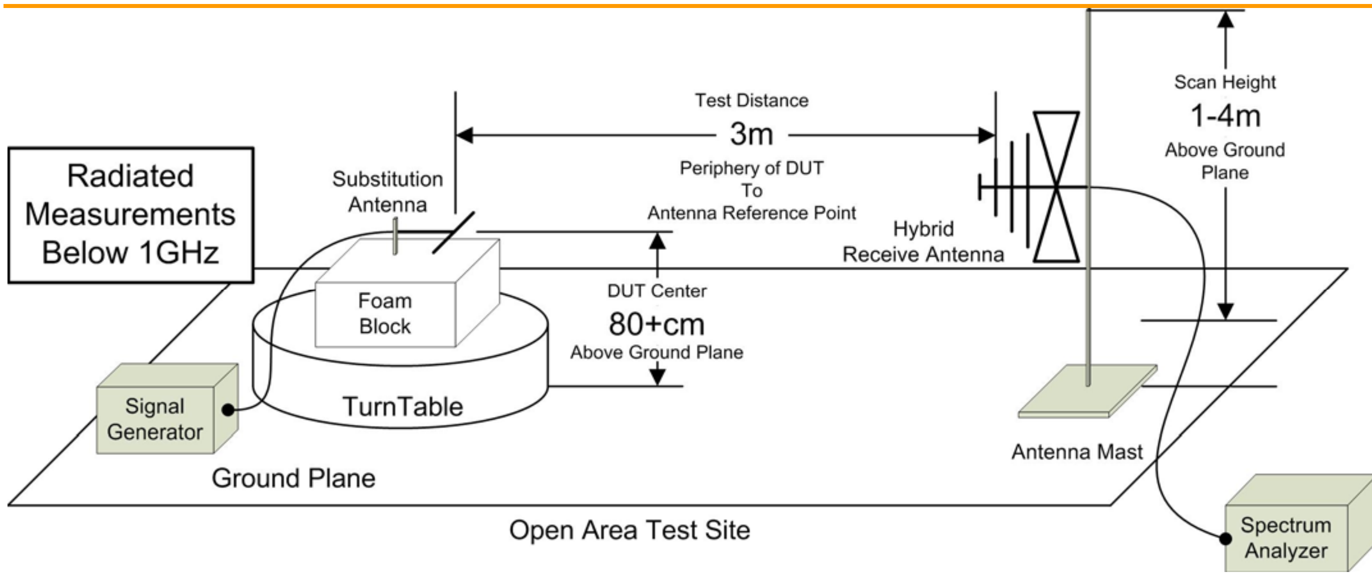


Figure A.4 – Test Setup Radiated Emissions Measurements 30 – 1000MHz Signal Substitution

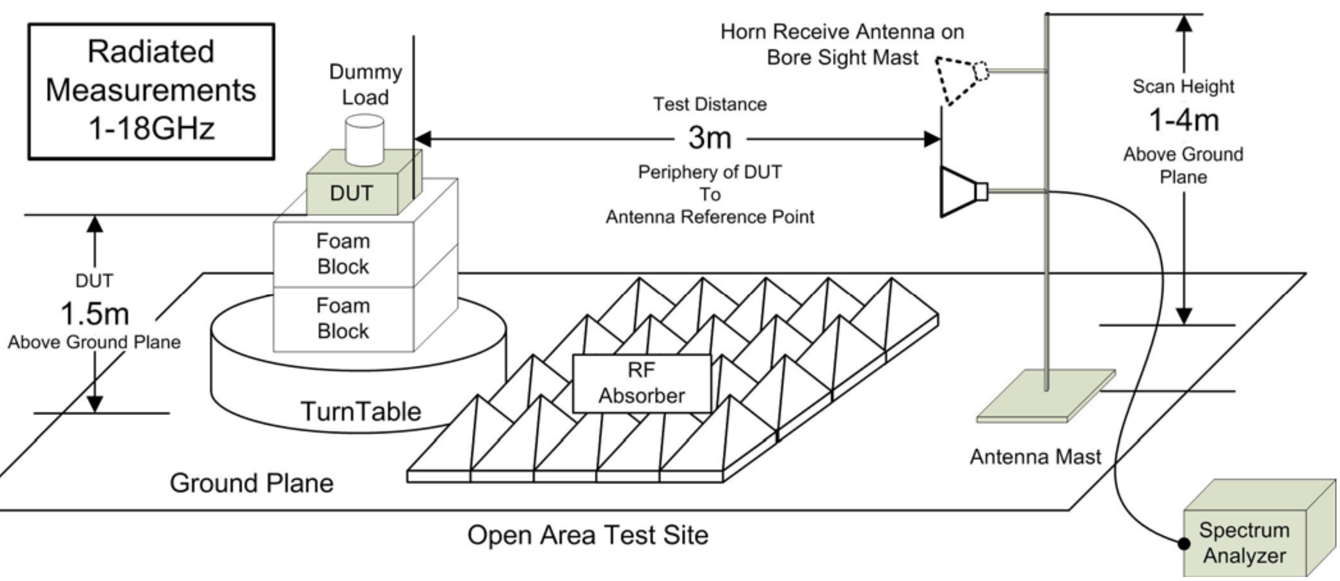


Figure A.5 – Test Setup Radiated Emissions Measurements 1 – 18GHz

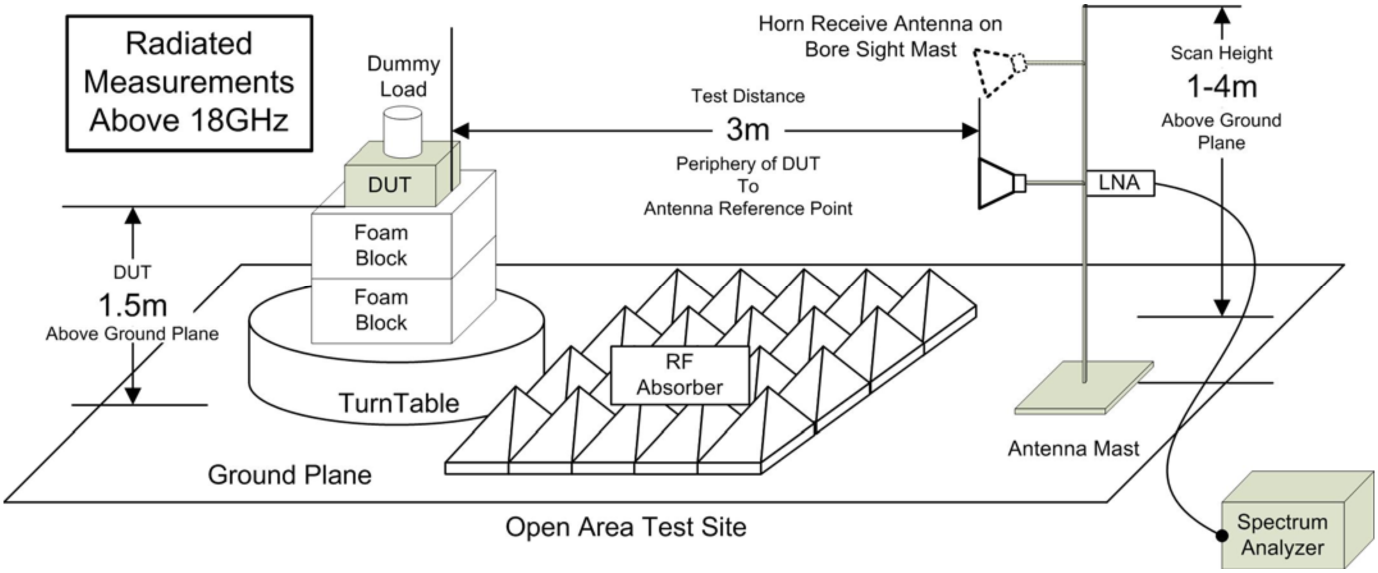


Figure A.6 – Test Setup Radiated Emissions Measurements Above 18 GHz

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

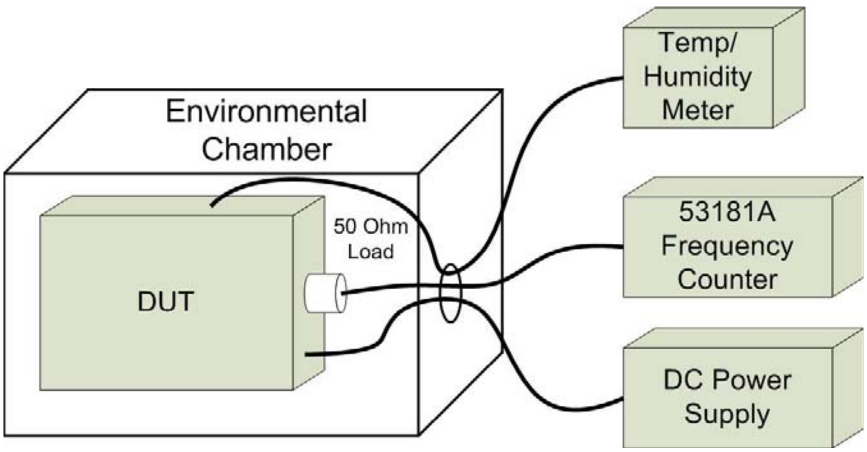


Figure A.7 – Frequency Stability

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
00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2018	Triennial	26 Nov 2021
00085	EMCO	6502	9203-2724	Loop Antenna	6 Sep 2022	Triennial	6 Sep 2025
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
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
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
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m 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} = 5.14dB U_{CISPR} = 6.3dB	
Radiated Emissions 200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
Radiated Emissions 1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
Radiated Emissions 6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
Power Line Conducted Emissions 9kHz to 150kHz	
U_{LAB} = 2.96dB U_{CISPR} = 3.8dB	
Power Line Conducted Emissions 150kHz to 30MHz	
U_{LAB} = 3.12dB U_{CISPR} = 3.4dB	
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} = 1.0dB U_{CISPR} = n/a
Frequency/Bandwidth 9kHz - 40GHz
U_{LAB} = 0.1ppm U_{CISPR} = n/a
Temperature
U_{LAB} = 1^{O}C U_{CISPR} = n/a

END OF REPORT

APPENDIX K – OCCUPIED BANDWIDTH MEASUREMENT PLOTS

APPENDIX L – FIELD STRENGTH MEASUREMENT PLOTS

APPENDIX M– 20DB BW (DXX) MEASUREMENT PLOTS

APPENDIX N– FIELD STRENGTH/20DB BW (NFC) MEASUREMENT PLOTS

APPENDIX O– RADIATED TX EMISSIONS MEASUREMENT PLOTS

APPENDIX P– RADIATED RX MEASUREMENT PLOTS

Test Report Serial Number:	**45461773 R1.0**
Test Report Date:	**16 December 2022**
Project Number:	**1603**

EMC Test Report - New Certification

Applicant:

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

FCC ID:	IC Registration Number
IPH-04578	**1792A-04578**
Product Model Number / HVIN	Product Marketing Name / PMN
A04578	**A04578**

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.247), Part 15 Subpart B

Digital Transmission System (DTS)

RSS-Gen, RSS-247 Issue 2

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Approved By:

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

Test Lab Certificate: 2470.01 **IC Registration 3874A-1** **FCC Registration: CA3874**

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:	Art Voss, P.Eng.		**Date(s) of Evaluation:**		17 Sep - 3 Nov, 2022
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 December 2022
1.0	Initial Release		n/a	Art Voss	16 December 2022

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-04578
	ISED ID:	1792A-04578
Device Model(s) / HVIN:	A04578	
Device Marketing Name / PMN:	A04578	
Test Sample Serial No.:	3361277594 - Conducted, 3361277722 - OTA	
Device Type:	Extremity Worn Digital Transceiver	
Equipment Class:	Wideband Transmission Systems	
	Short Range Devices (SRD)	
	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): 18.56dBm	
	BlueTooth - Spread Spectrum Transmitter (DSS): 9.48dBm	
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 2.79dBm	
	NFC - Low Power Communication Device Transmitter (DXX): -36dBm	
Antenna Type and Gain:	-3.46dBi Max	
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7	
	BT BR: GFSK	
	BT EDR: Pi/4-DQPSK	
	BLE: GMSK	
	ANT: GFSK	
	NFC: ASK	
DUT Power Source:	3VDC Rechargeable Li-Ion	
DUT Dimensions [LxWxH]	H x W x D: 65mm 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: A04578 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, ISED: RSS-Gen, RSS-210 and RSS-247. As per FCC 47 CFR §2.1093 and Health Canada Safety Code 6, 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**	**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)	16, 17, 21 Sep 2022	Pass
8.0	DTS Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(a)(2)	RSS-Gen (6.7) RSS-247 (5.2)(a)	16, 17, 21 Sep 2022	Pass
9.0	Duty Cycle and Transmission Duration	ANSI C63.10-2013 KDB 558074 D01v05	n/a	n/a	6 Oct 2022	n/a
10.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	RSS-Gen (6.12) RSS-247 (5.4)(d)	16, 17 Sep 2022	Pass
11.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(1)	RSS-Gen (6.12) RSS-247 (5.4)(b)	16, 17 Sep 2022	Pass
12.0	Power Spectral Density	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(e)	RSS-247 (5.2)(b)	17, 21 Sep 2022	Pass
13.0	FHSS Hopping Characteristics	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	RSS-247 (5.1)(d)	21 Sep 2022	Pass
14.0	FHSS Channel Separation	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)	RSS-247 (5.1)(b)	21 Sep 2022	Pass
15.0	FHSS Time of Occupancy	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	RSS-247 (5.1)(d)	21 Sep 2022	Pass
16.0	Conducted Tx Spurious Emissions Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen (6.13) RSS-247 (5.5)	21 Sep 2022	Pass
17.0	Conducted Tx Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen (6.13) RSS-247 (5.5)	21 Sep 2022	Pass
18.0	Radiated Tx Spurious Emissions And Restricted Band	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	RSS-Gen (6.13)	3 Nov 2022	Pass
19.0	Radiated Rx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109	RSS-Gen (7.4) ICES-003(6.2)	3 Nov 2022	Pass
20.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	ICES-003(6.1)	26 Nov 2022	Pass

Test Station Day Log					
Date	**Ambient Temp (°C)**	**Relative Humidity (%)**	**Barometric Pressure (kPa)**	**Test Station**	**Tests Performed Section(s)**
16 Sep 2022	22.1	18	101.2	**EMC**	**7, 8, 11, 12**
17 Sep 2022	22.8	17	101.3	**EMC**	**7, 8, 10, 11, 12**
21 Sep 2022	23.5	17	101.6	**EMC**	**7, 8, 12, 13-17**
2 Nov 2022	0.0	87	101.5	**OATS**	**18, 19**
3 Nov 2022	-2.0	80	102.4	**OATS**	**18, 19**
26 Nov 2022	22.6	16	103.3	**LISN**	**20**
6 Oct 2022	22.5	16	102.5	**EMC**	**9**

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 December 2022
Date

PROFESSIONAL
PROVINCE OF
A. F. VOSS
31327
BRITISH COLUMBIA
ENGINEER

5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR Title 47: Part 2:	Code of Federal Regulations Telecommunication Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47: Part 15: Sub Part C (15.247)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
CFR Title 47: Part 15: Subpart B:	Code of Federal Regulations Telecommunication Radio Frequency Devices Unintentional 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
ISED RSS-Gen Issue 5: Amendment 1: March 2019	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment
ISED RSS-247 Issue 2: February 2017	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licensed-Exempt Local Area Network (LE_LAN) Devices

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 Reference	**FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),** **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).

Table 7.1 – Summary of Occupied Bandwidth Measurements (DTS)

See Appendix D for Measurement Plots

Occupied Bandwidth Measurement Results: 802.11						
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Occupied Bandwidth (MHz)	Emission Designator
802.11b	6	2437	CCK	1	15.6	15M6D1D
	6	2437	CCK	2	15.1	15M1D1D
	6	2437	DSSS	5.5	14.4	14M4D1D
	6	2437	DSSS	11	14.6	14M6D1D
802.11g	6	2437	OFDM	6	16.5	16M5D1D
802.11n	6	2437	MCS0	-	17.5	17M5D1D
					Result:	Complies

Table 7.3 – Summary of Occupied Bandwidth Measurements (DSS)

See Appendix D for Measurement Plots

Occupied Bandwidth Measurement Results: BlueTooth						
Mode	**Channel Number**	**Channel Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured Occupied Bandwidth (MHz)**	**Emission Designator**
BT BR	2	2402	GFSK	-	0.916	916KD1D
	40	2440	GFSK	-	0.908	908KD1D
	80	2480	GFSK	-	0.908	908KD1D
BT EDR2	2	2402	P1/4-DQPSK	2	1.09	1M09D1D
	40	2440	P1/4-DQPSK	2	1.08	1M08D1D
	80	2480	P1/4-DQPSK	2	1.09	1M09D1D
BT EDR3	2	2402	8-DPSK	3	1.10	1M10D1D
	40	2440	8-DPSK	3	1.09	1M08D1D
	80	2480	8-DPSK	3	1.08	1M08D1D
					Result:	**Complies**

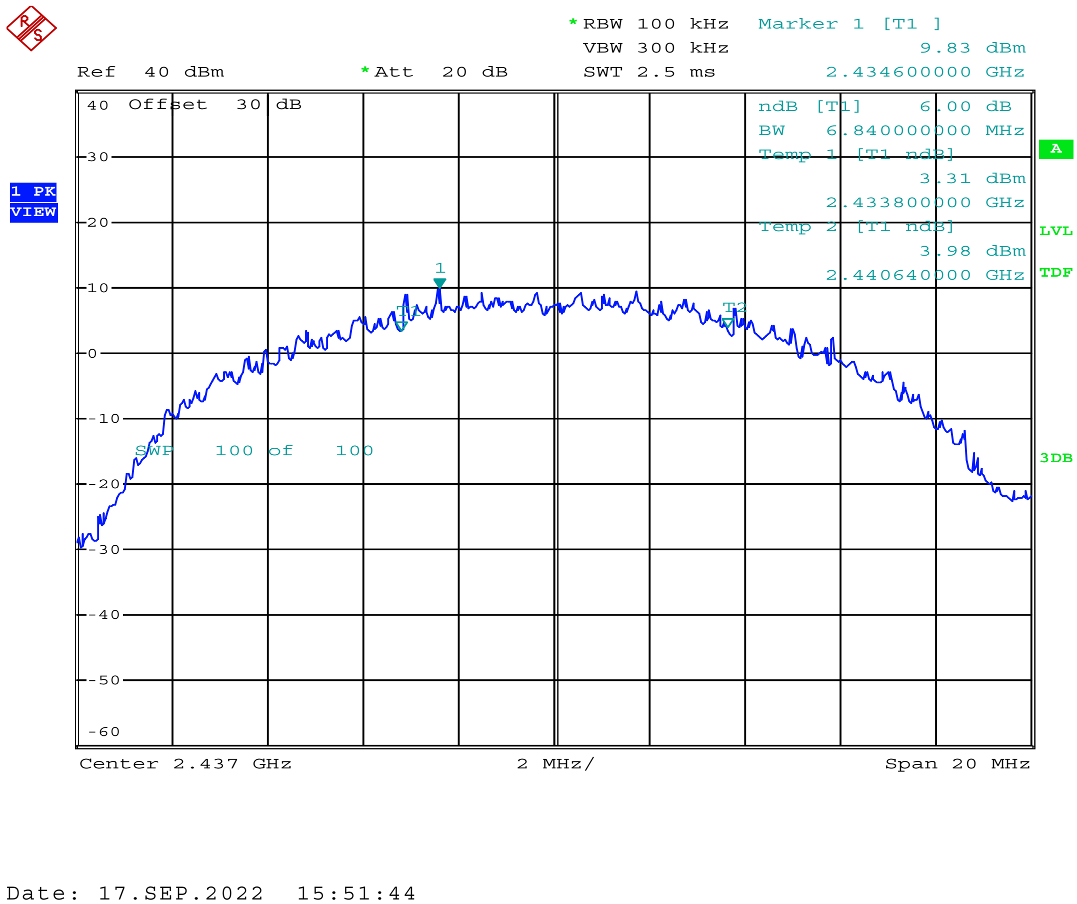
8.0 DTS BANDWIDTH

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)**
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**

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

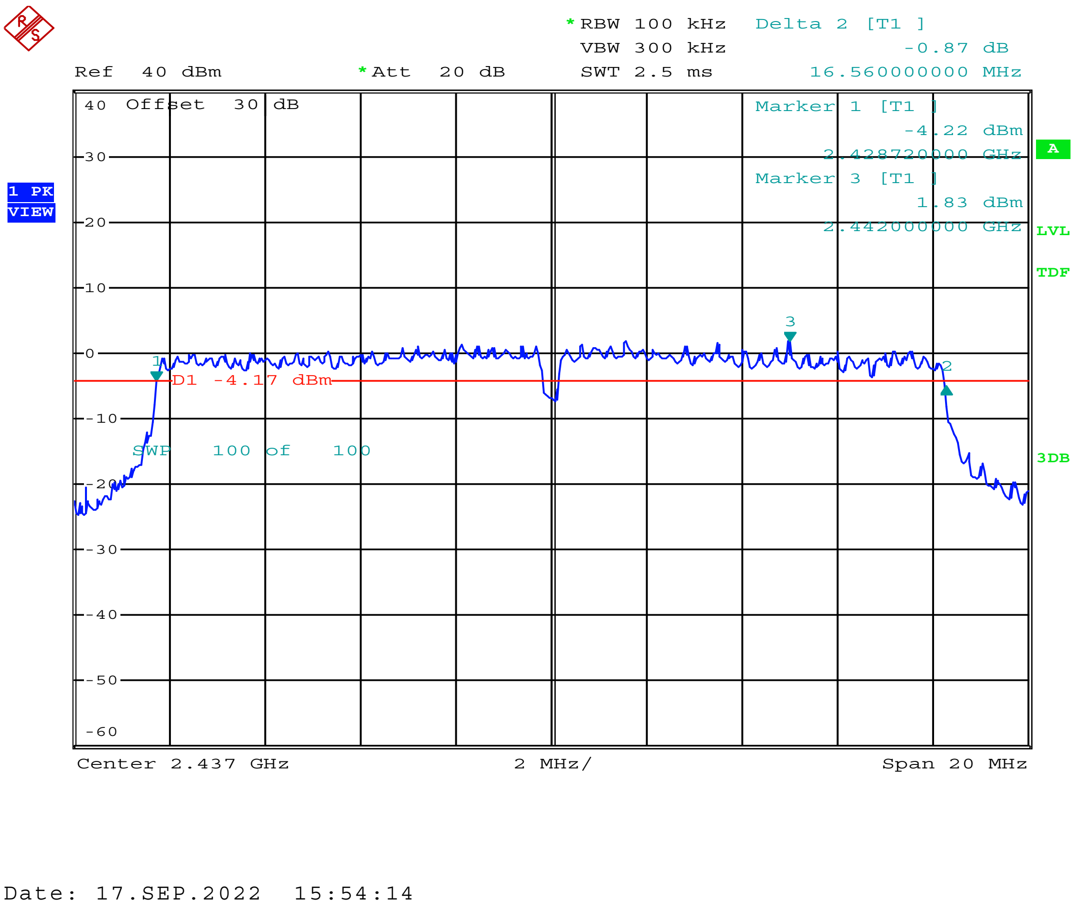
DTS Bandwidth: 802.11b



Channel Number:	6	Channel Frequency (MHz):	2437	DTS Bandwidth (MHz):	6.84
Modulation:	DSSS	Bit Rate (Mbps):	5.5		

Plot 8.2 – 6dB DTS Bandwidth 802.11b

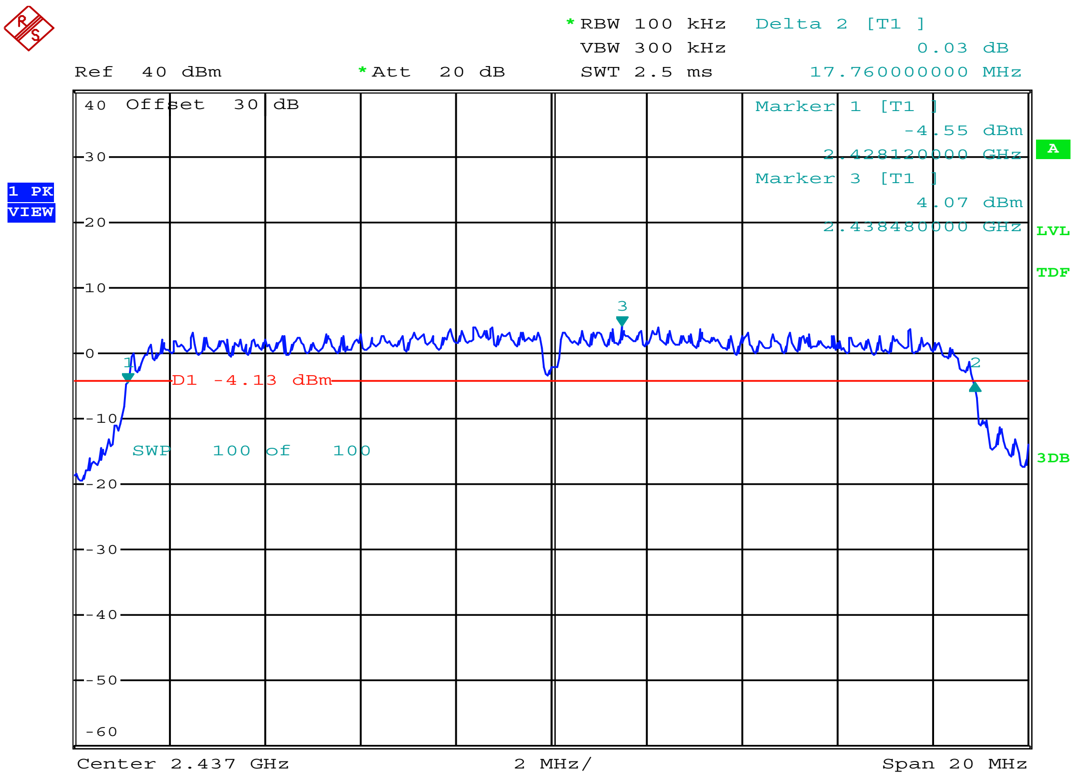
DTS Bandwidth: 802.11g



Channel Number:	6	Channel Frequency (MHz):	2437	DTS Bandwidth (MHz):	16.56
Modulation:	OFDM	Bit Rate (Mbps):	6		

Plot 8.3 – 6dB DTS Bandwidth 802.11g

DTS Bandwidth: 802.11n



Date: 17.SEP.2022 15:48:51

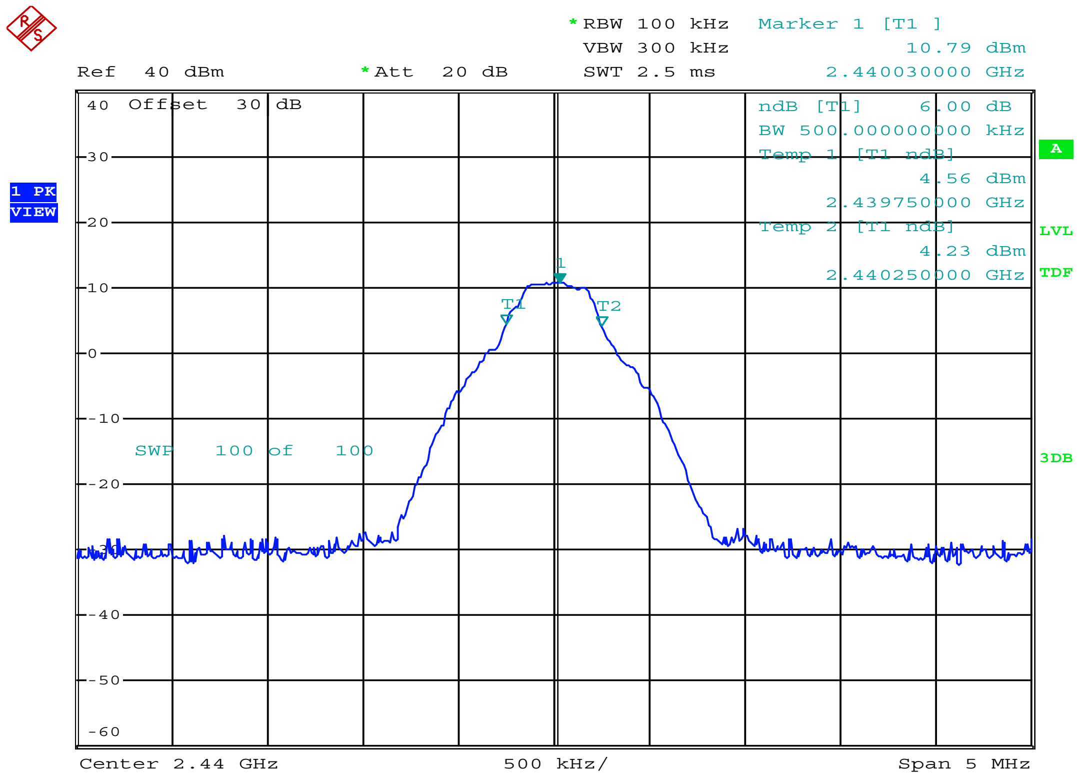
Channel Number:	6	Channel Frequency (MHz):	2437	DTS Bandwidth (MHz):	17.76
Modulation:	OFDM	Bit Rate (Mbps):	MCS0		

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

Occupied Bandwidth Measurement Results: 802.11							
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured DTS Bandwidth (MHz)	Minimum DTS Bandwidth (MHz)	Margin (MHz)
802.11b	6	2437	DSSS	6	6.84	0.5	6.3
802.11g	6	2437	OFDM	6	16.6	0.5	16.1
802.11n	6	2437	OFDM	MCS0	17.8	0.5	17.3
						Result:	Complies

Plot 8.4 – 6dB DTS Bandwidth BT BR, 2440MHz

DTS Bandwidth: BlueTooth

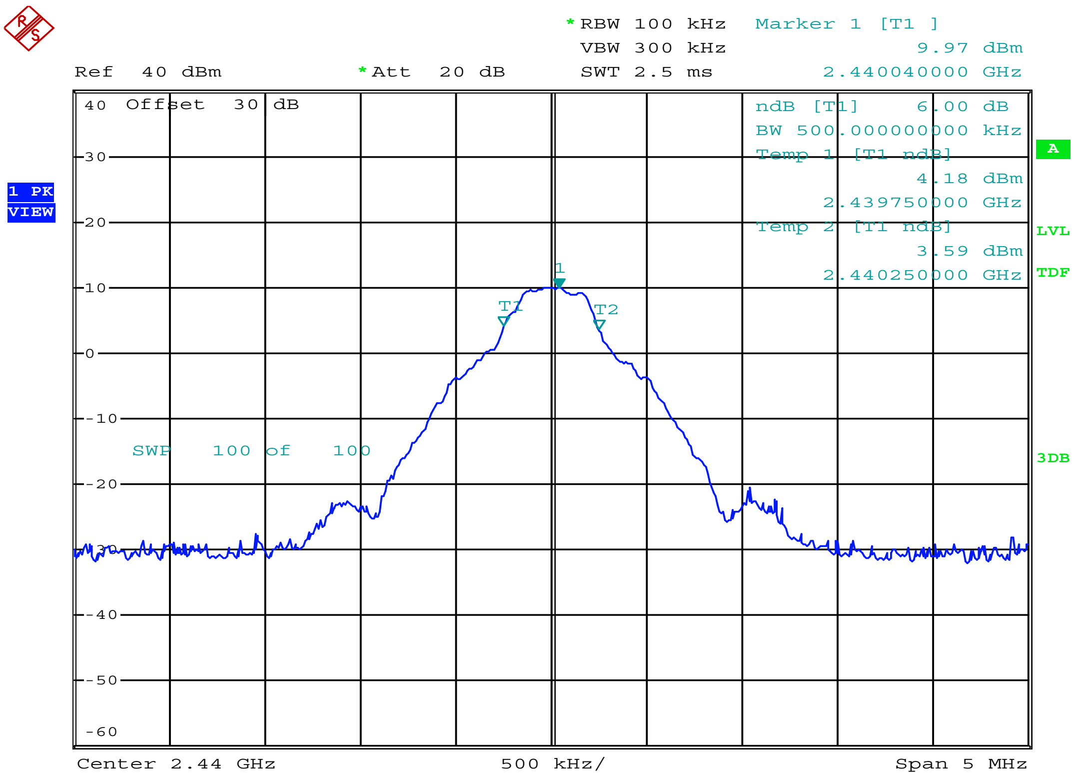


Date: 21.SEP.2022 10:50:35

Channel Number:	40	Channel Frequency (MHz):	2440	DTS Bandwidth (MHz):	0.50
Modulation:	GFSK	Bit Rate (Mbps):	-		

Plot 8.5 – 6dB DTS Bandwidth BT EDR2 2MB, 2440MHz

DTS Bandwidth: BlueTooth

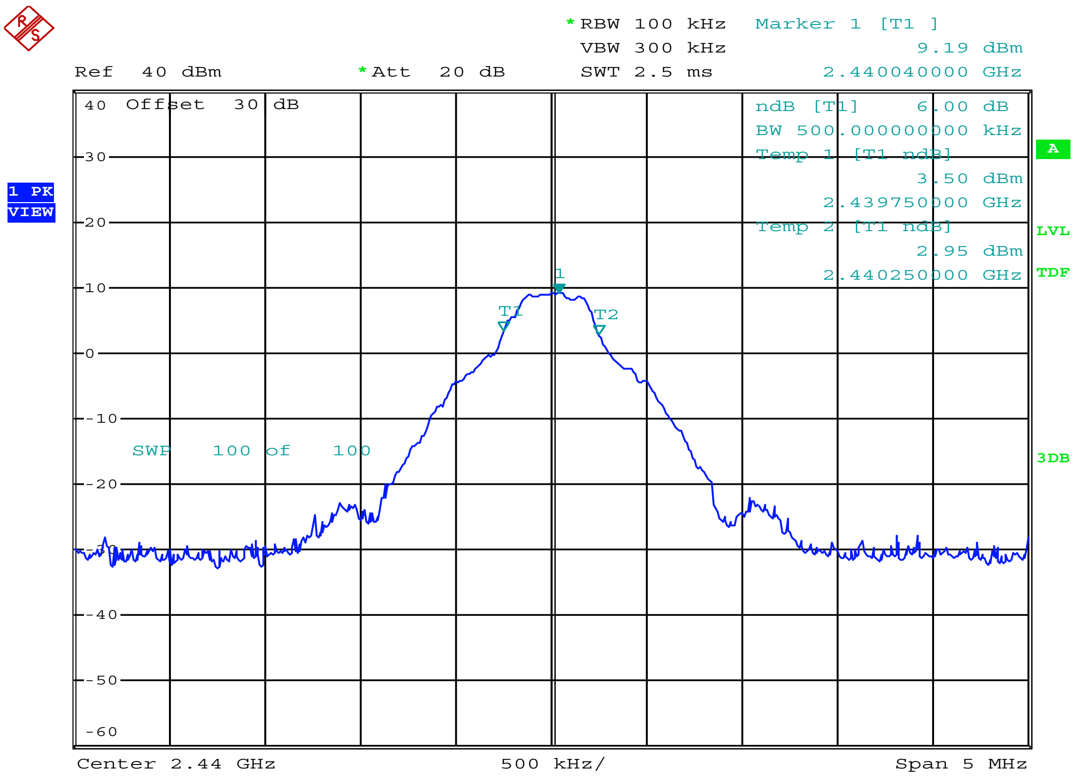


Date: 21.SEP.2022 10:44:50

Channel Number:	40	Channel Frequency (MHz):	2440	DTS Bandwidth (MHz):	0.50
Modulation:	Pi/4-DQPSK	Bit Rate (Mbps):	2		

Plot 8.6 – 6dB DTS Bandwidth BT EDR3 3MB, 2440MHz

DTS Bandwidth: BlueTooth



Date: 21.SEP.2022 10:47:31

Channel Number:	**40**	Channel Frequency (MHz):	**2440**	DTS Bandwidth (MHz):	**0.50**
Modulation:	**8-DPSK**	Bit Rate (Mbps):	**3**		

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

Occupied Bandwidth Measurement Results: 802.11							
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured DTS Bandwidth (MHz)	Minimum DTS Bandwidth (MHz)	Margin (MHz)
BT BR	40	2440	GFSK	-	0.50	0.5	0.0
BT EDR2			Pi/4-DQPSK	2	0.50		0.0
BT EDR3			8-DPSK	3	0.50		0.0
						Result:	Complies

9.0 DUTY CYCLE AND TRANSMISSION DURATION

Table 9.2 – Summary Duty Cycle Measurement

Transmit Duty Cycle Results DTS		
Frequency (MHz)	Modulation	Measured Duty Cycle Cycle (%)
2437.00	DSSS	100
2437.00	OFDM	100
2437.00	MCS0	100

Transmit Duty Cycle = 100%. Duty Cycle Correction not Required

Transmit Duty Cycle Results DSS		
Frequency (MHz)	Modulation	Measured Duty Cycle Cycle (%)
2440.00	BR GFSK	100
2440.00	EDR Pi/4-DQPSK	100
2440.00	EDR 8-DPSK	100

10.0 ANTENNA PORT CONDUCTED POWER, (DTS)

Test Procedure	
Normative Reference	**FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),**
	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 10.1 – Summary of Conducted Power Measurements, (DTS)

See Appendix E for Measurement Plots

Conducted Power Measurement Results: 802.11													
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured Power [P_{Meas}] (dBm)	Conducted Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain [G_T] (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)	Result
802.11b	6	2437.00	CCK	1	100.00	18.30	30	11.7	-3.6	14.70	36	21.3	Complies
	6	2437.00	CCK	2		18.34	30	11.7	-3.6	14.74	36	21.3	Complies
	6	2437.00	DSSS	6		**18.56**	30	11.4	-3.6	**14.96**	36	21.0	Complies
	1	2412.00	DSSS	6		15.76	30	14.2	-3.6	12.16	36	23.8	Complies
	2	2417.00	DSSS	6		16.44	30	13.6	-3.6	12.84	36	23.2	Complies
	3	2422.00	DSSS	6		16.59	30	13.4	-3.6	12.99	36	23.0	Complies
	4	2427.00	DSSS	6		18.26	30	11.7	-3.6	14.66	36	21.3	Complies
	5	2432.00	DSSS	6		18.35	30	11.7	-3.6	14.75	36	21.3	Complies
	7	2442.00	DSSS	6		18.34	30	11.7	-3.6	14.74	36	21.3	Complies
	8	2447.00	DSSS	6		17.15	30	12.9	-3.6	13.55	36	22.5	Complies
	9	2452.00	DSSS	6		17.28	30	12.7	-3.6	13.68	36	22.3	Complies
	10	2457.00	DSSS	6		16.13	30	13.9	-3.6	12.53	36	23.5	Complies
	11	2462.00	DSSS	6		15.47	30	14.5	-3.6	11.87	36	24.1	Complies
	12	2467.00	DSSS	6		15.41	30	14.6	-3.6	11.81	36	24.2	Complies
	13	2472.00	DSSS	6		15.54	30	14.5	-3.6	11.94	36	24.1	Complies
802.11g	6	2437.00	OFDM	6		15.84	30	14.2	-3.6	12.24	36	23.8	Complies
	6	2437.00	OFDM	9		15.79	30	14.2	-3.6	12.19	36	23.8	Complies
	6	2437.00	OFDM	12		16.08	30	13.9	-3.6	12.48	36	23.5	Complies
	6	2437.00	OFDM	36		13.90	30	16.1	-3.6	10.30	36	25.7	Complies
	6	2437.00	OFDM	54		13.03	30	17.0	-3.6	9.43	36	26.6	Complies
802.11n	6	2437.00	OFDM	MCS0		17.10	30	12.9	-3.6	13.50	36	22.5	Complies
	6	2437.00	OFDM	MCS3		16.23	30	13.8	-3.6	12.63	36	23.4	Complies
	6	2437.00	OFDM	MCS7		11.67	30	18.3	-3.6	8.07	36	27.9	Complies

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

EIRP Margin = E_{Limit} - E_{Meas}

EIRP E_{Meas}= P_{Meas} + G_T

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

EIRP Margin = E_{Limit} - E_{Meas}

* Antenna Gain information provided by applicant.

11.0 ANTENNA PORT CONDUCTED POWER, (DSS)

Test Procedure	
Normative Reference	**FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),** **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 11.1 – Summary of Conducted Power Measurements, (DSS)

See Appendix E for Measurement Plots

Conducted Power Measurement Results: BlueTooth													
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Transmit Duty Cycle (%)**	**Measured Power [P_{Meas}] (dBm)**	**Conducted Limit [P_{Lim}] (dBm)**	**Conducted Margin (dB)**	**Antenna Gain (dBi)**	**EIRP [E_{Meas}] (dBm)**	**EIRP Limit [E_{Lim}] (dBm)**	**EIRP Margin (dB)**	**Result**
BT BR	2	2402.00	GFSK	-	100.00	8.44	30	21.6	-3.6	4.84	36	31.2	Complies
	40	2440.00	GFSK	-		9.02		21.0		5.42		30.6	Complies
	80	2480.00	GFSK	-		8.89		21.1		5.29		30.7	Complies
BT EDR2	2	2402.00	P1/4-DQPSK	2		8.51		21.5		4.91		31.1	Complies
	40	2440.00	P1/4-DQPSK	2		9.21		20.8		5.61		30.4	Complies
	80	2480.00	P1/4-DQPSK	2		9.48		20.5		5.88		30.1	Complies
BTEDR3	2	2402.00	8-DPSK	3		7.99		22.0		4.39		31.6	Complies
	41	2441.00	8-DPSK	3		8.45		21.6		4.85		31.2	Complies
	80	2480.00	8-DPSK	3		8.78		21.2		5.18		30.8	Complies

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

EIRP Margin = E_{Limit} - E_{Meas}

12.0 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)**
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 AVGPSD-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 ≥ 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 X OBW. c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. . d) Set VBW ≥ 3 X RBW. e) Detector = RMS f) Ensure that the number of measurement points in the sweep ≥ 2 X 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 ≥ 2 X Span / RBW = 2 X (1.5MHz / 3kHz) = 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.	

Table 12.1 – Summary of Power Spectral Density Measurements, (DTS)

See Appendix F for Power Density Measurement Plots

Power Spectral Density Measurement Results: 802.11							
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured PSD [P_{Meas}] (dBm)	PSD Limit [P_{Lim}] (dBm)	Conducted Margin (dB)
802.11b	6	2437	DSSS	5.5	-4.34	8	12.3
802.11g	6	2437	OFDM	6	-8.28	8	16.3
802.11n	6	2437	OFDM	MCS0	-8.16	8	16.2
					Result:	Complies	

Margin = P_{Limit} - P_{Meas}

Table 12.2 – Summary of Power Spectral Density Measurements, (DSS)

See Appendix F for Power Density Measurement Plots

Power Spectral Density Measurement Results: BlueTooth							
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured PSD [P_{Meas}] (dBm)**	**PSD Limit [P_{Lim}] (dBm)**	**Conducted Margin (dB)**
BT BR	40	2440	GFSK	-	1.80	8	6.2
BT EDR2			P1/4-DQPSK	2.0	1.57	8	6.4
BT EDR3			8-DPSK	3.0	1.26	8	6.7
					Result:	**Complies**	

Margin = P_{Limit} - P_{Meas}

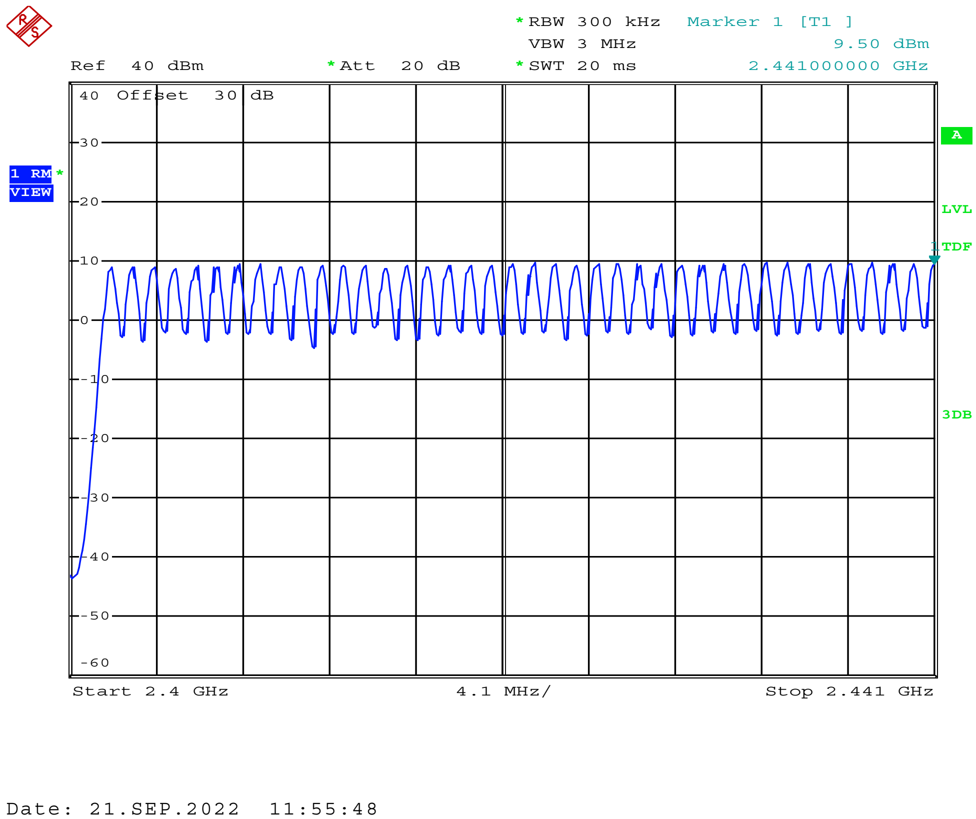
13.0 FHSS NUMBER OF HOPPING CHANNELS

Test Procedure	
Normative Reference	**FCC 47 CFR §15.247, RSS-247**
	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 13.1 – Number of Hopping Channels, EDR 2MB, 2400-2441MHz

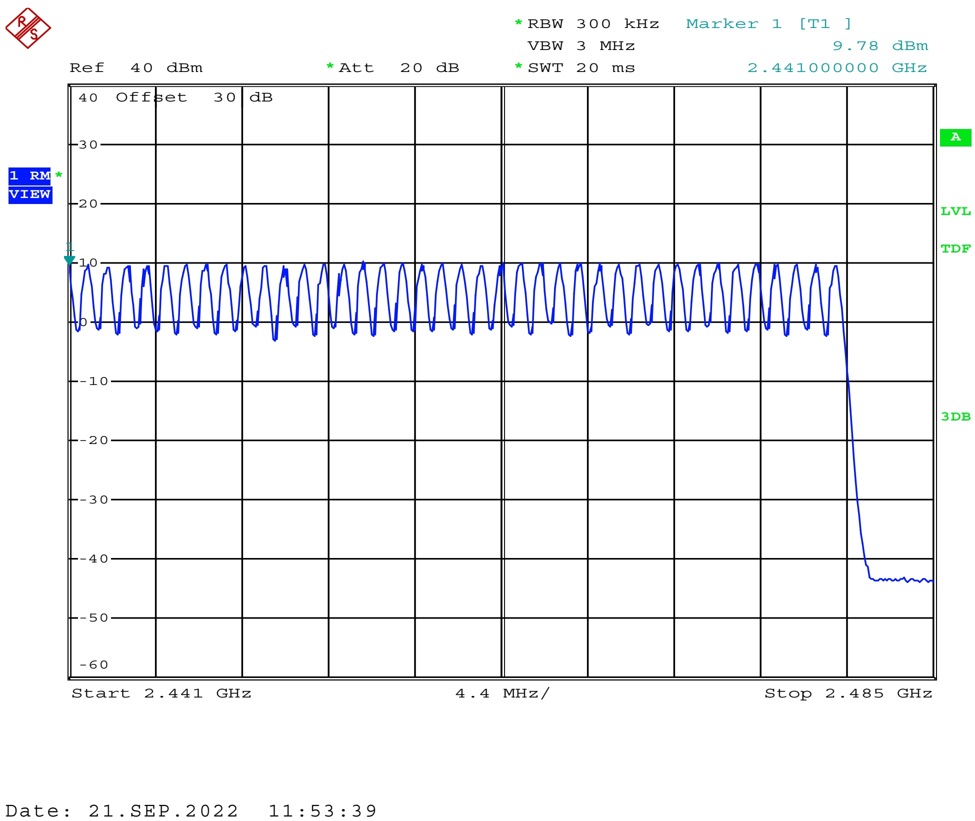
Number of Hopping Channels



Frequency Range:	Modulation Setting:	Number of Hopping Channels:
2400-2441 MHz	**Pi/4-DQPSK**	**40**

Plot 13.2 – Number of Hopping Channels, EDR 2MB, 2441-2485MHz

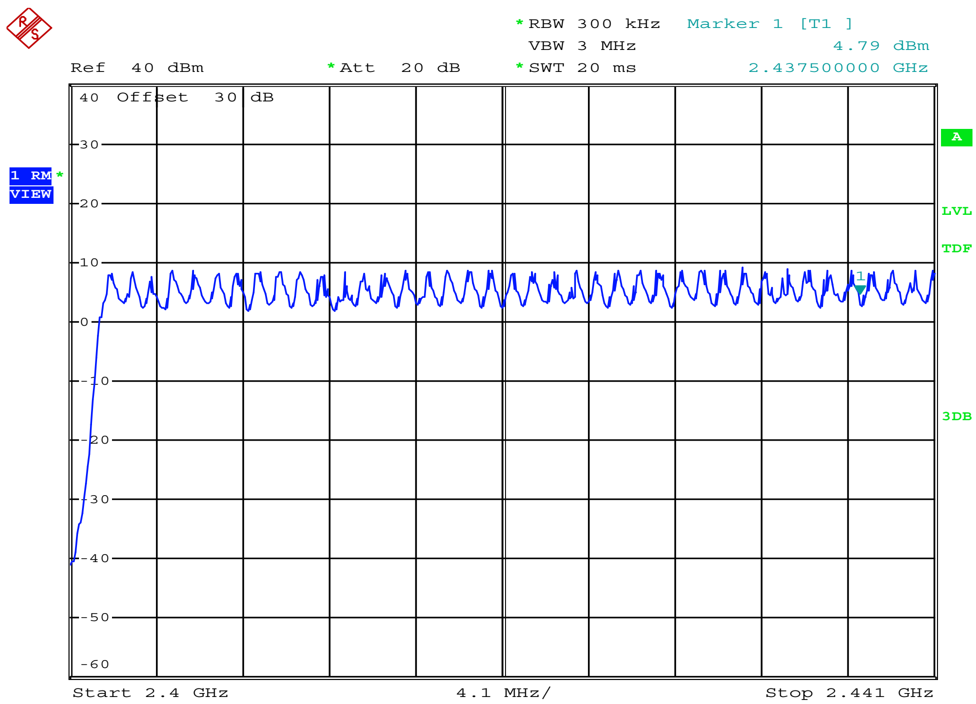
Number of Hopping Channels



Frequency Range:	Modulation Setting:	Number of Hopping Channels:
2441-2485 MHz	**Pi/4-DQPSK**	**39**

Plot 13.3 – Number of Hopping Channels, EDR 3MB, 2400 - 2441MHz

Number of Hopping Channels

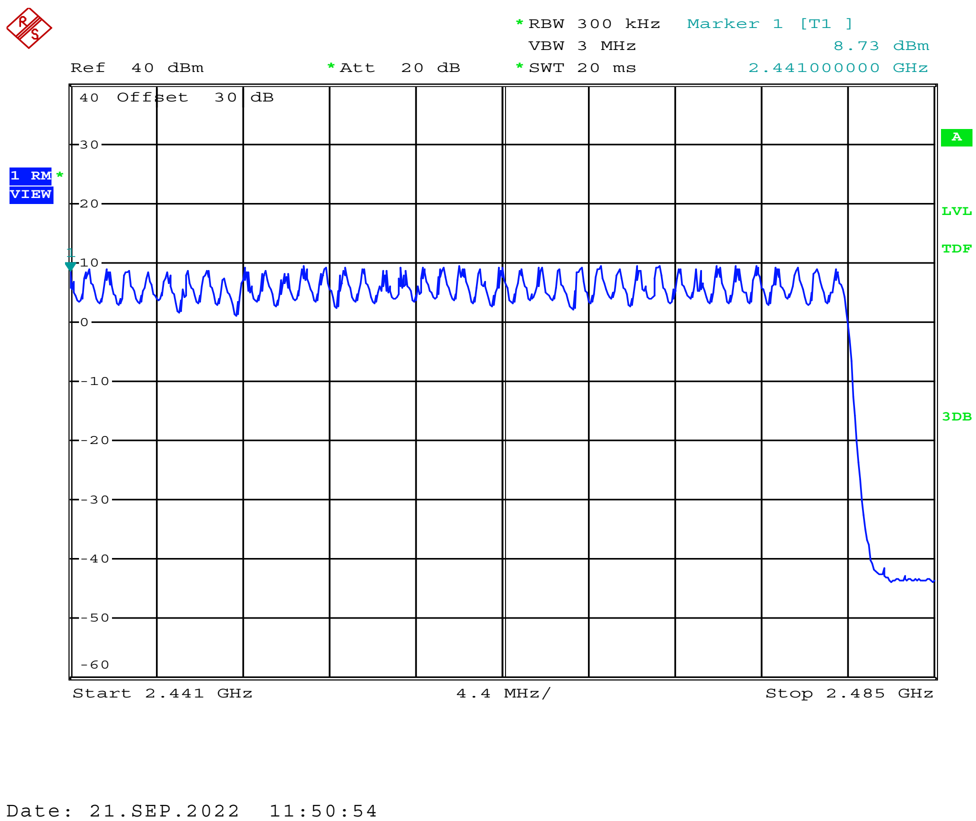


Date: 21.SEP.2022 11:48:19

Frequency Range:	Modulation Setting:	Number of Hopping Channels:
2400-2441 MHz	**GFSK**	**40**

Plot 13.4 – Number of Hopping Channels, EDR 3MB, 2441 - 2485MHz

Number of Hopping Channels



Frequency Range:	Modulation Setting:	Number of Hopping Channels:
2441-2485 MHz	**GFSK**	**39**

Table 13.2 – 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**

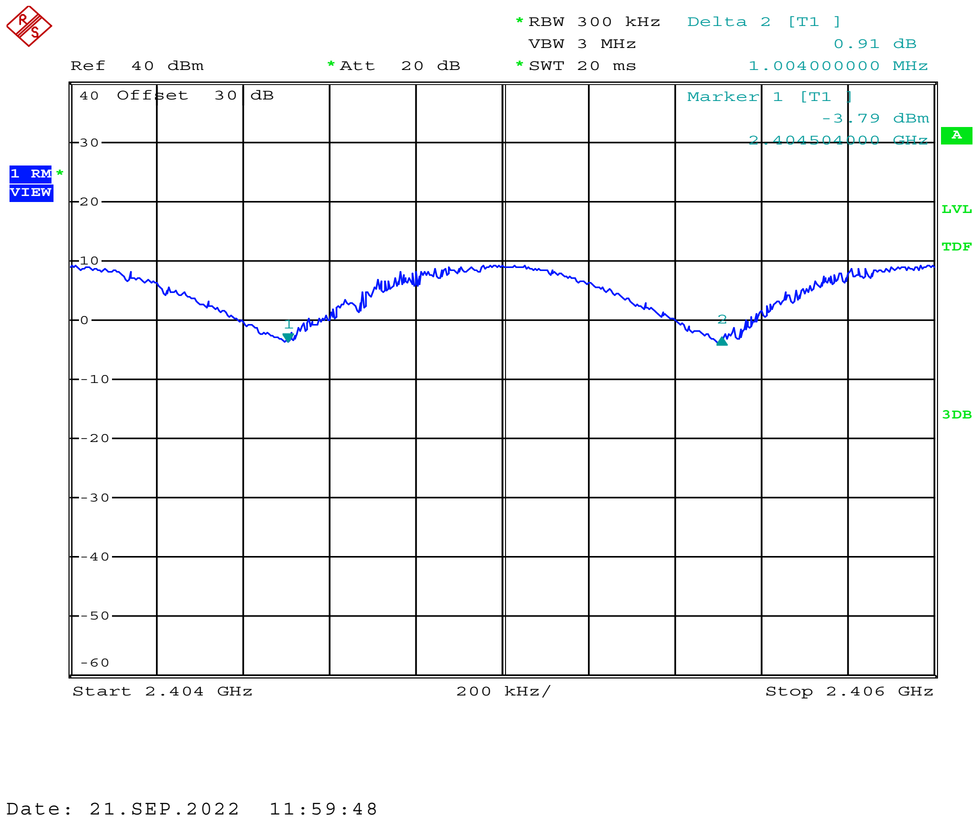
14.0 FHSS CHANNEL SEPARATION

Test Procedure	
Normative Reference	**FCC 47 CFR §15.247, RSS-247**
	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 14.1 – Channel Separation, BT EDR 2MB

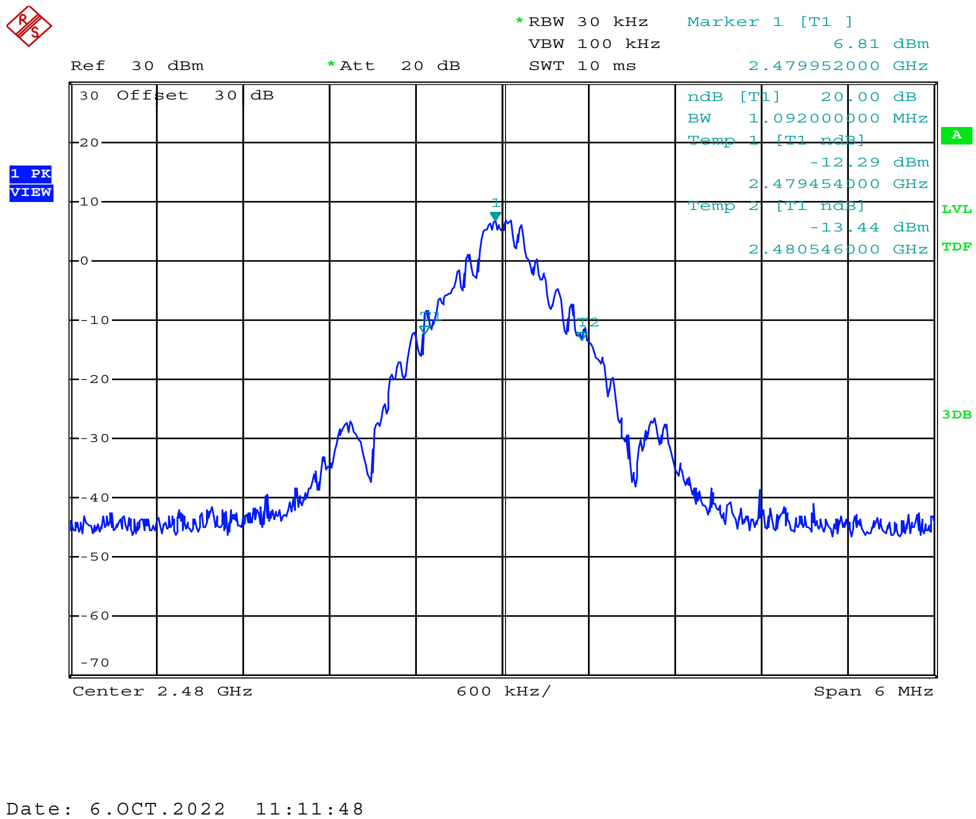
Channel Separation



Channel Frequency:	Modulation Setting:	Channel Bandwidth:
2405.00 MHz	**Pi/4-DQPSK**	**1.004** MHz

Plot 14.2 – BT EDR 2MB 20dB BW

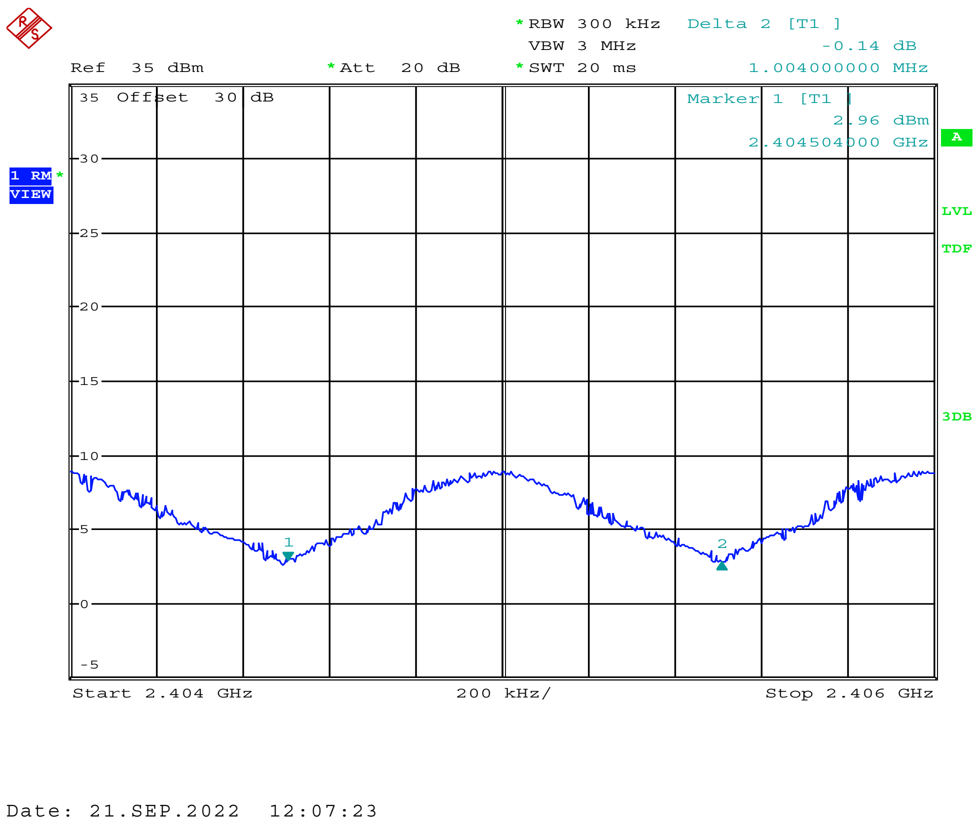
20dB Bandwidth



Channel Frequency:	Modulation Setting:	Channel Bandwidth:
2480.00 MHz	**Pi/4-DQPSK**	**1.092** MHz

Plot 14.3 – Channel Separation, BT EDR 3MB

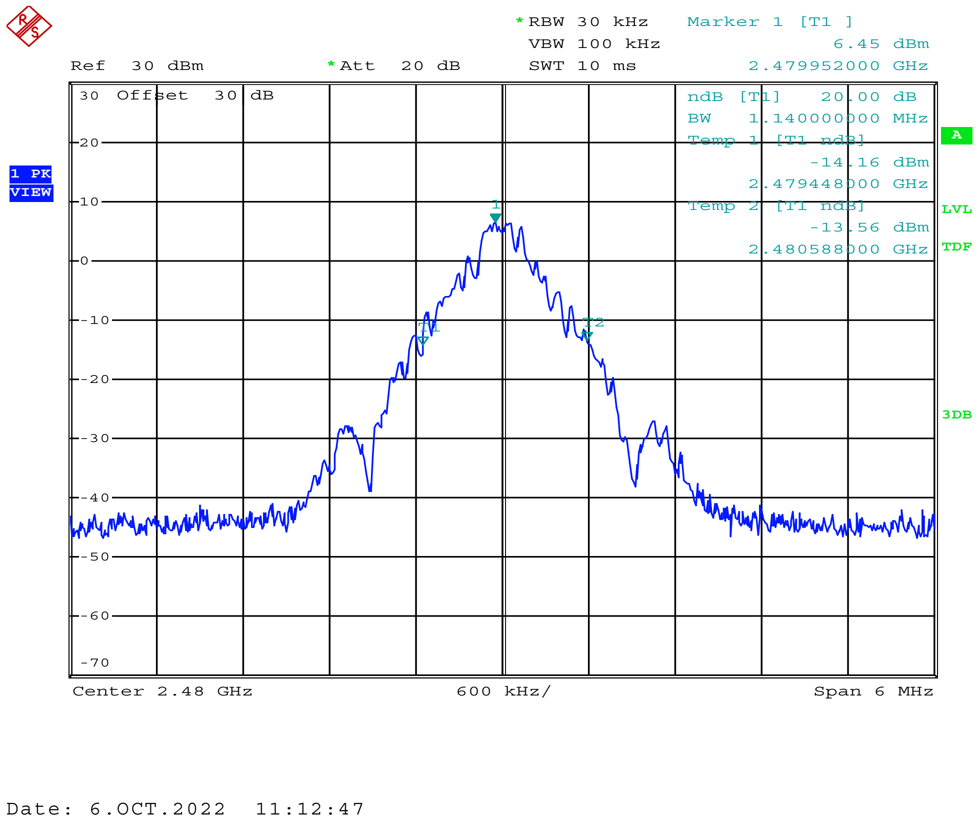
Channel Separation



Channel Frequency:	Modulation Setting:	Channel Bandwidth:
2442.00 MHz	**8 DPSK**	**1.004** MHz

Plot 14.4 – BT EDR 3MB 20dB BW

20dB Bandwidth



Channel Frequency:	Modulation Setting:	Channel Bandwidth:
2480.00 MHz	**8-DPSK**	**1.140** MHz

Table 14.1 – Summary of FHSS Channel Separation

Hopping Channel Separation Results DSS				
Channel Frequency (MHz)	Modulation	Channel Separation (MHz)	Minimum Bandwidth (MHz)	Margin (MHz)
2403.00	Pi/4-DQPSK	1.004	0.760	0.244
2441.00	8-DPSK	1.004	0.612	0.392
			Result:	Complies

Minimum Bandwidth = 20dB BW X 2/3

Margin = Channel Separation - Minimum Bandwidth

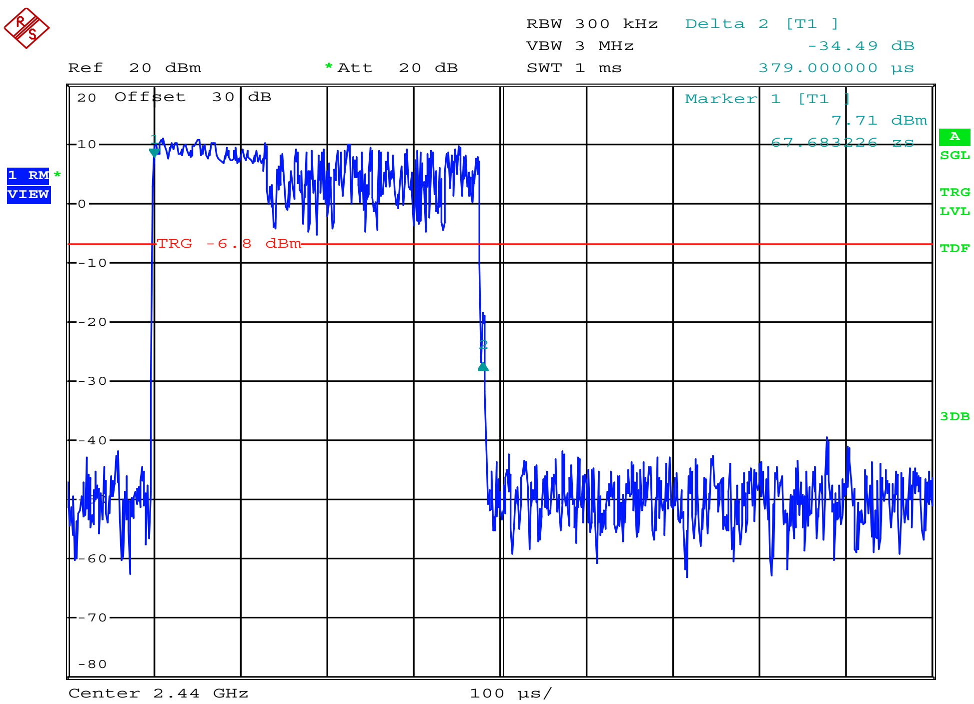
15.0 FHSS TIME OF OCCUPANCY

Test Procedure	
Normative Reference	**FCC 47 CFR §15.247, RSS-247**
	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 15.1 – Time of Occupancy, DH1, 2-DH1, 3-DH1, DM1

Time of Occupancy

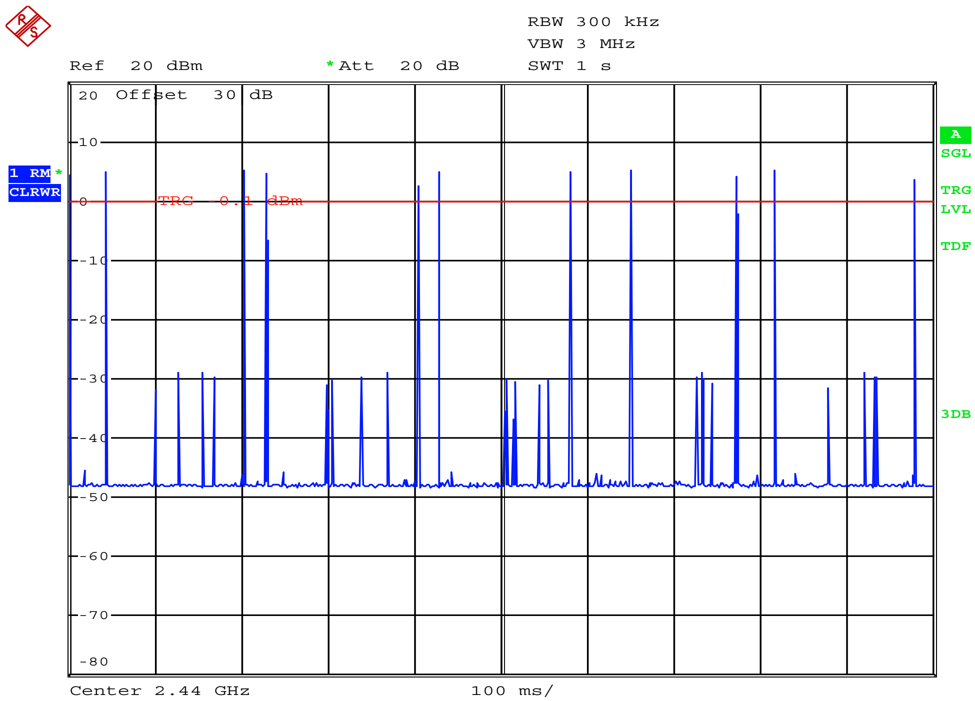


Date: 21.SEP.2022 15:39:24

Channel Frequency:	Packet:	Channel On Time:
2440.00 MHz	**DH1, 2-DH1, 3-DH1, DM1**	**379.0** uSec

Plot 15.2 – Time of Occupancy, DH1, 2-DH1, 3-DH1, DM1

Time of Occupancy

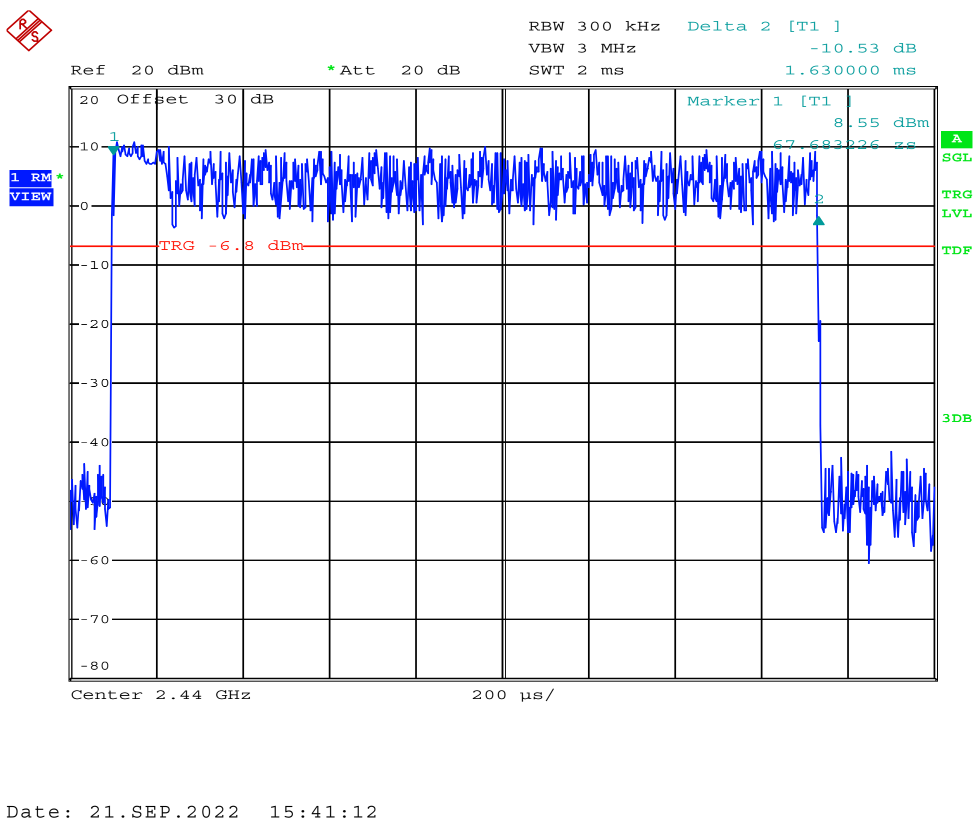


Date: 21.SEP.2022 16:01:34

Channel Frequency:	Packet:	Transmit Count per 1000mSec Period:
2440.00 MHz	**DH1, 2-DH1, 3-DH1, DM1**	**10**

Plot 15.3 – Time of Occupancy, DH3, 2-DH3, 3-DH3, DM3

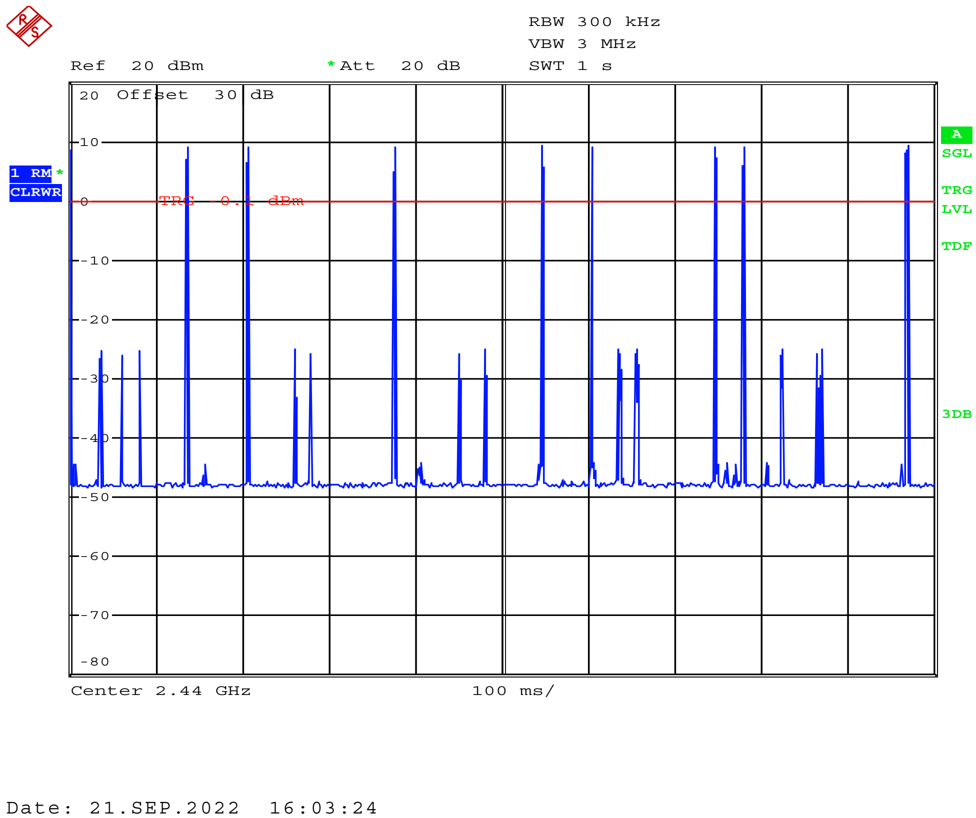
Time of Occupancy



Channel Frequency:	Packet:	Channel On Time:
2440.00 MHz	**DH3, 2-DH3, 3-DH3, DM3**	**1630.0** uSec

Plot 15.3 – Time of Occupancy, DH3, 2-DH3, 3-DH3, DM3

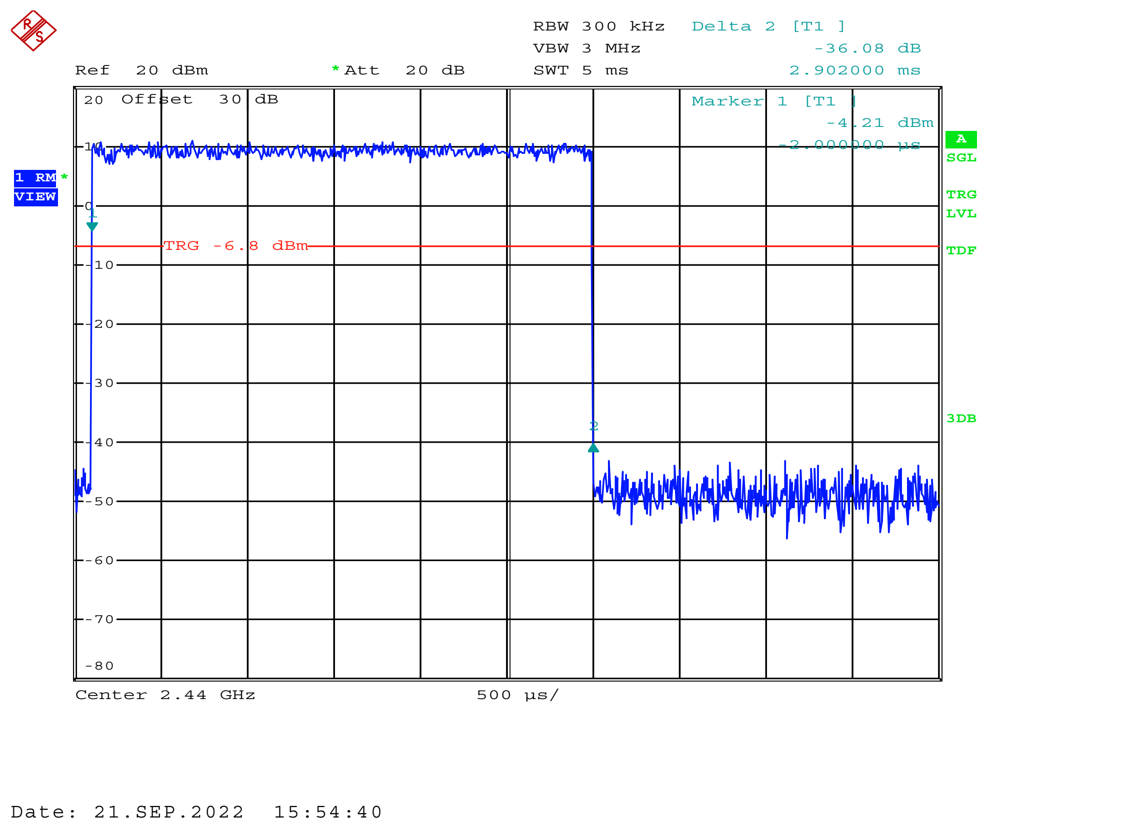
Time of Occupancy



Channel Frequency:	Packet:	Transmit Count per 1000mSec Period:
2440.00 MHz	**DH3, 2-DH3, 3-DH3, DM3**	**8**

Plot 15.3 – Time of Occupancy, DH5, 2-DH5, 3-DH5, DM5

Time of Occupancy



Channel Frequency:	Packet:	Channel On Time:
2440.00 MHz	**DH5, 2-DH5, 3-DH5, DM5**	**2902.0** uSec

Table 15.1 – 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)
2440.00	DH1	0.379	10	3.790	1000	79	31600	119.76	400	280
	DH3	1.630	7	11.410				360.56		39
	DH5	2.902	4	11.608				366.81		33
									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 Peroid [T_{Rqd}] / Observation Period [T_P]
Margin = Limit - [T_{Acc}]

16.0 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.
RSS-247 (5.5)	**5.5 Unwanted emissions** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required. 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.
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 ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X 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 Spurious Emission Measurements – Band Edge, (DTS)

See Appendix G for Measurement Plots

Band Edge Measurement Results: 802.11														
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Transmit Duty Cycle (%)**	**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	2412.00	DSSS	5.5	100.00	-30.90	0.6	-30.30	3.11	3.71	34.01	30	4.0	
	11	2462.00				-45.05		-44.45	1.15	1.75	46.20		16.2	
802.11g	1	2412.00	OFDM	6		-42.33		-41.73	-4.65	-4.05	37.68		7.7	
	11	2462.00				-43.76		-43.16	-4.36	-3.76	39.40		9.4	
802.11n	1	2412.00	OFDM	MCS0		-44.19		-43.59	-5.38	-4.78	38.81		8.8	
	11	2462.00				-50.33		-49.73	-5.95	-5.35	44.38		14.4	
											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

Table 16.2 – Summary of Spurious Emission Measurements – Band Edge, DSS

See Appendix G for Measurement Plots

Band Edge Measurement Results: FHSS														
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Transmit Duty Cycle (%)**	**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	2	2402.00	GFSK	1.0	100.00	-47.22	0.6	-46.62	0.88	1.48	48.10	30	18.1
	80	2480.00				-63.87		-63.27	1.99	2.59	65.86		35.9
BT EDR2	2	2402.00	Pi/4-DQPSK	2		-45.50		-44.90	0.95	1.55	46.45		16.5
	80	2480.00				-64.20		-63.60	2.13	2.73	66.33		36.3
BT EDR3	2	2402.00	8-DPSK	3		-45.07		-44.47	0.12	0.72	45.19		15.2
	80	2480.00				-63.58		-62.98	1.34	1.94	64.92		34.9
												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

17.0 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.
RSS-247 (5.5)	**5.5 Unwanted emissions** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required. 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.
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 ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X 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 17.1 – Summary of Conducted Spurious Emissions, (DTS)

See Appendix H for Measurement Plots

Conducted Spurious Emissions Measurement Results: 802.11										
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Reference Measurement [P_{Ref}] (dBm)	Measured Emission [P_{Em}] (dBm)	Emission Frequency (MHz)	Attenuation [Attn] (dBi)	Limit (dB)	Margin (dB)
802.11b	6	2437.00	DSSS	5.5	10.5	-33.2	9020	43.7	30	13.7
						-22.2	16425	32.7		2.7
						-21.5	24972	32.0		2.0
									Results:	Complies

Attenuation = [P_{Ref}] - [P_{Em}]
Margin = Attn - Limit
* Reference Measurement

Table 17.2 – Summary of Conducted Spurious Emissions, DSS

See Appendix H for Band Edge Measurement Plots

Conducted Spurious Emissions Measurement Results: FHSS										
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Reference Measurement [P_{Ref}] (dBm)	Measured Emission [P_{Em}] (dBm)	Emission Frequency (MHz)	Attenuation [Attn] (dBi)	Limit (dB)	Margin (dB)
BT EDR2	41	2441.00	Pi/4-DQPSK	2	6.88	-53.6	3148	60.4	30	30.4
						-42.3	15456	49.2		19.2
						-41.7	24874	48.6		18.6
									Results:	Complies

Attenuation = [P_{Ref}] - [P_{Em}]
Margin = Attn - Limit

18.0 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:

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

See Appendix I Radiated Tx Spurious 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)	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 Amplier not used

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

Table 18.2 – Summary of Radiated Tx Spurious Emissions, Restricted Band, DSS

See Appendix I Radiated Tx Spurious 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**
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 Amplier not used

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

19.0 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 19.1 – Summary of Radiated Rx Spurious Emissions

See Appendix J Radiated Rx Spurious Measurement Plots

Measurement Results				
Frequency Range	**Antenna Polarization**	**Measured Emission [E_{Meas}] (dBm)**	**Limit e.r.p./e.r.i.p. [A_L] (dBm)**	**Margin (dB)**
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

20.0 POWER LINE CONDUCTED EMISSIONS

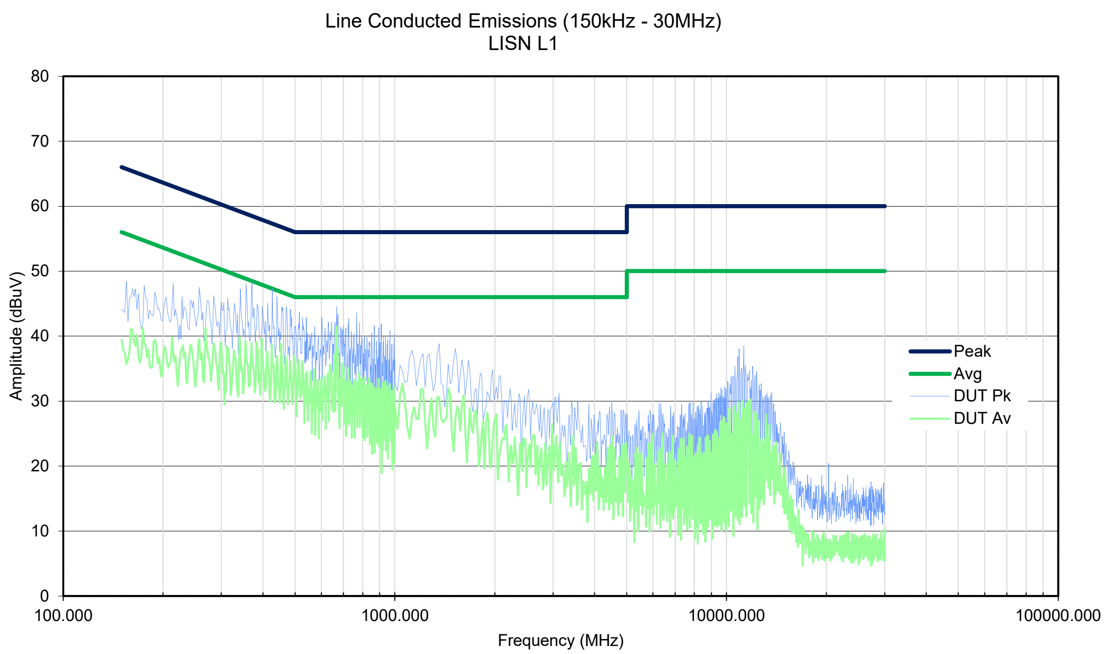
Test Procedure	
Normative Reference	**FCC 47 CFR §15.107, ICES-003(6.1)** **ANSI C63.4-2014**

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 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges. 0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logrithm 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 logrithm 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**

Plot 20.1 – Power Line Conducted Emissions, Line 1

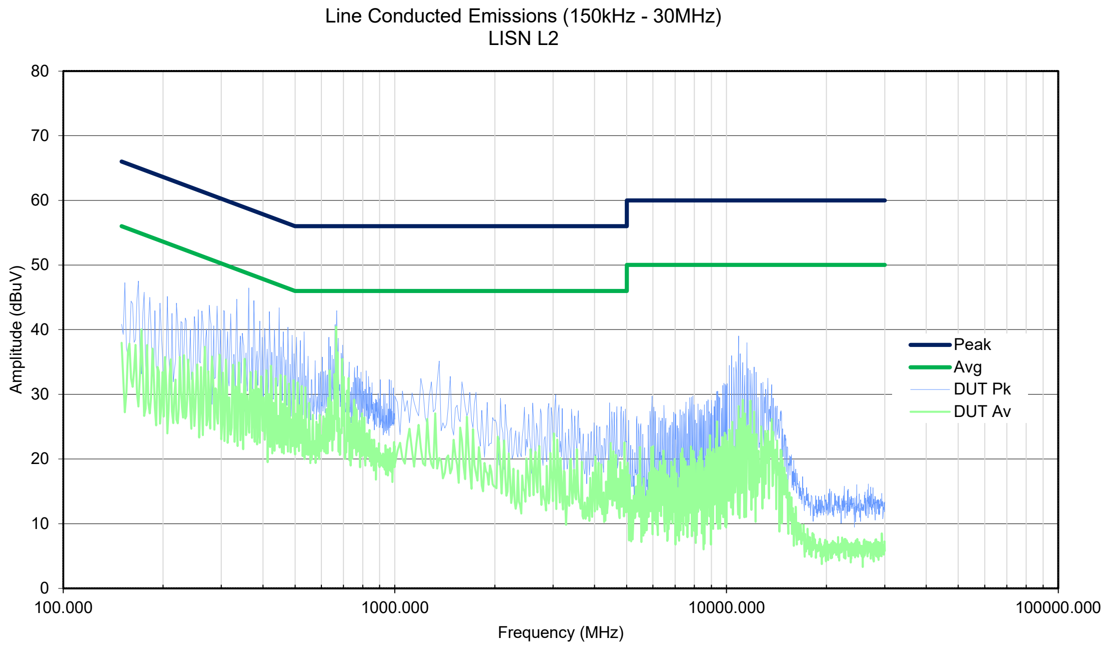
Power Line Conducted Emissions - L1



Blue Limit: **Quasi Peak**	Blue Trace: **Peak**	Frequency Range: **0.15 - 30** MHz
Green Limit: **Average**	Green Trace: **RMS**	Measured Emission:

Plot 20.2 – Power Line Conducted Emissions, Line 2

Power Line Conducted Emissions - L1



Blue Limit:	Blue Trace:	Frequency Range:
Quasi Peak	**Peak**	**0.15 - 30** MHz

Green Limit:	Green Trace:	Measured Emission:
Average	**RMS**	

Table 20.1 – 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}]	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	2442.0	L1	666.80 kHz	40.71	Average	0.30	0.26	0.00 (3)	41.27 (2)	46.0	**4.7**
									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 Amplier 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

Margin = Limit - E_{corr}

Table 20.1 – 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}]	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	2442.0	L2	666.80 kHz	39.91	Average	0.30	0.26	0.00 (3)	40.47 (2)	46.0	**5.5**
									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 Amplier 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

Margin = 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

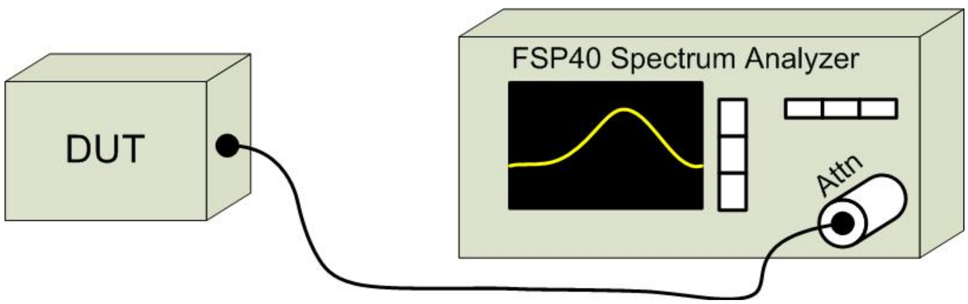


Table A.2 – Radiated Emissions Measurement Equipment

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

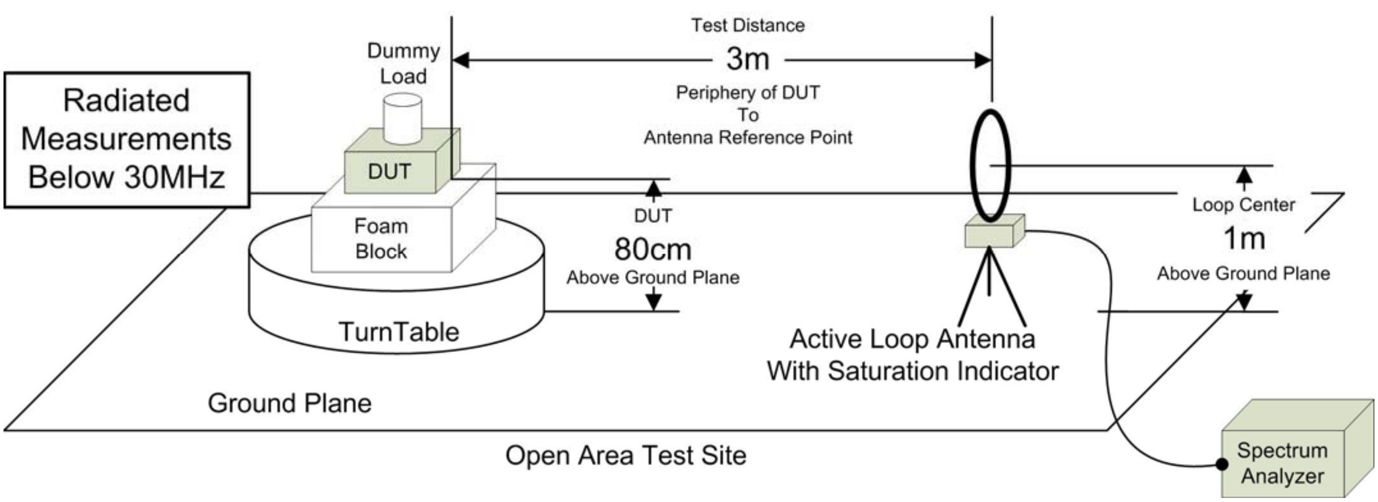


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

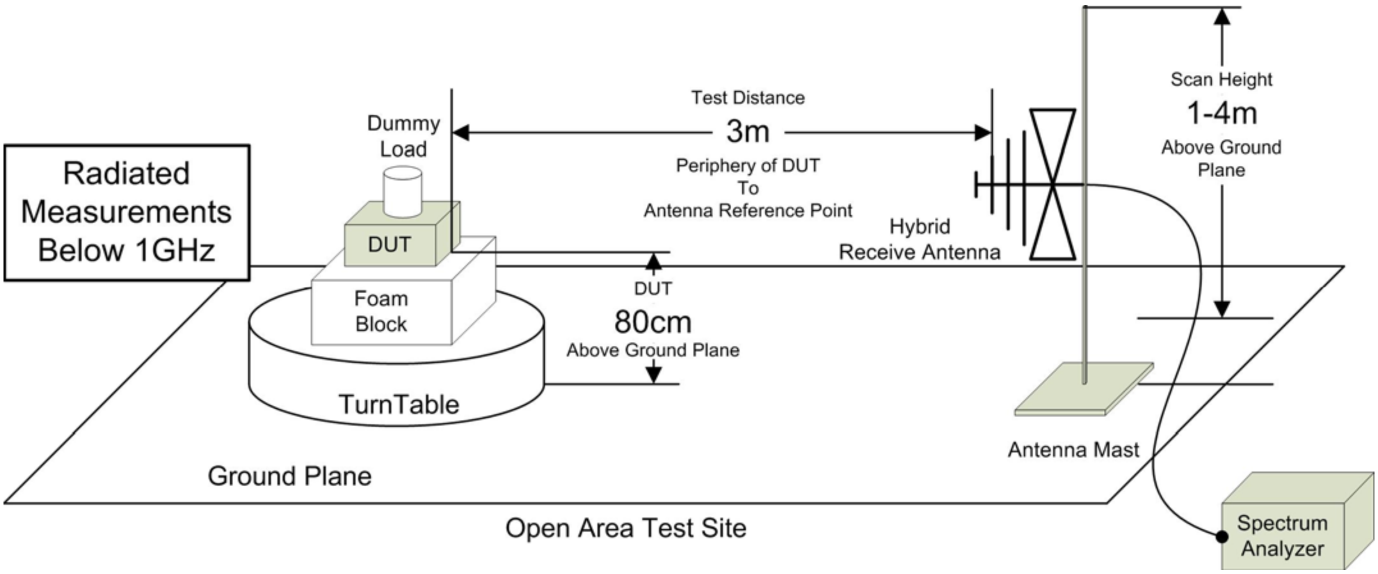


Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution

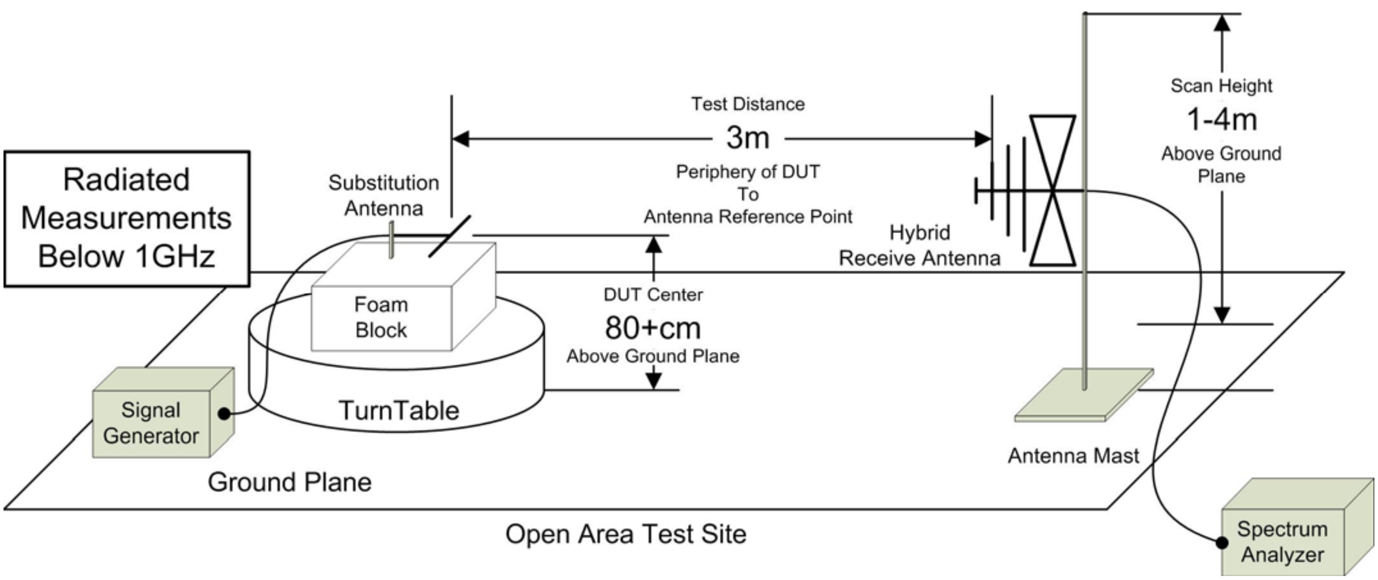


Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz,

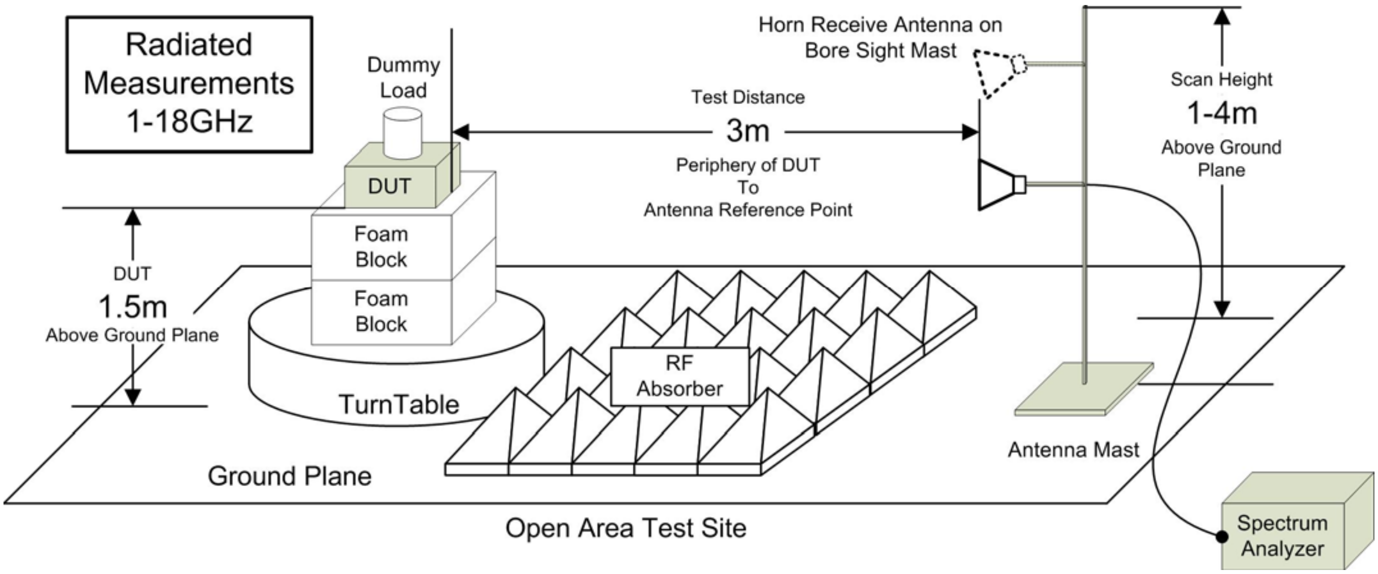


Figure A.6 – Test Setup Radiated Measurements 18 – 26.5GHz,

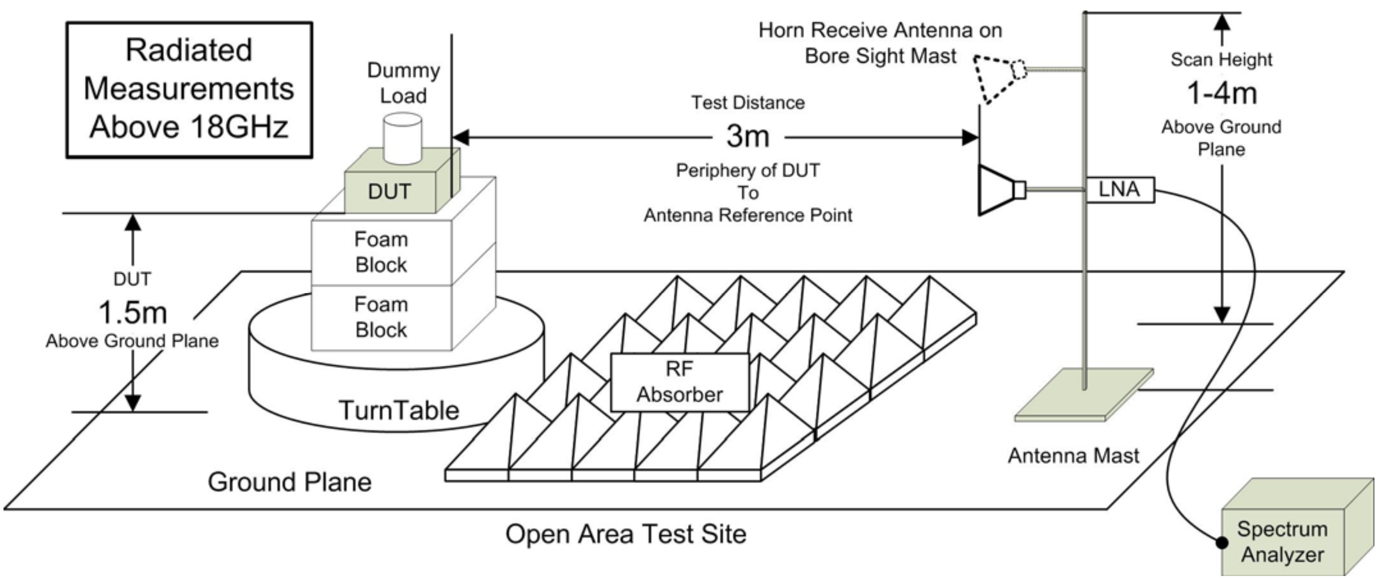


Table A.3 – Setup – Conducted Emissions Equipment List

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

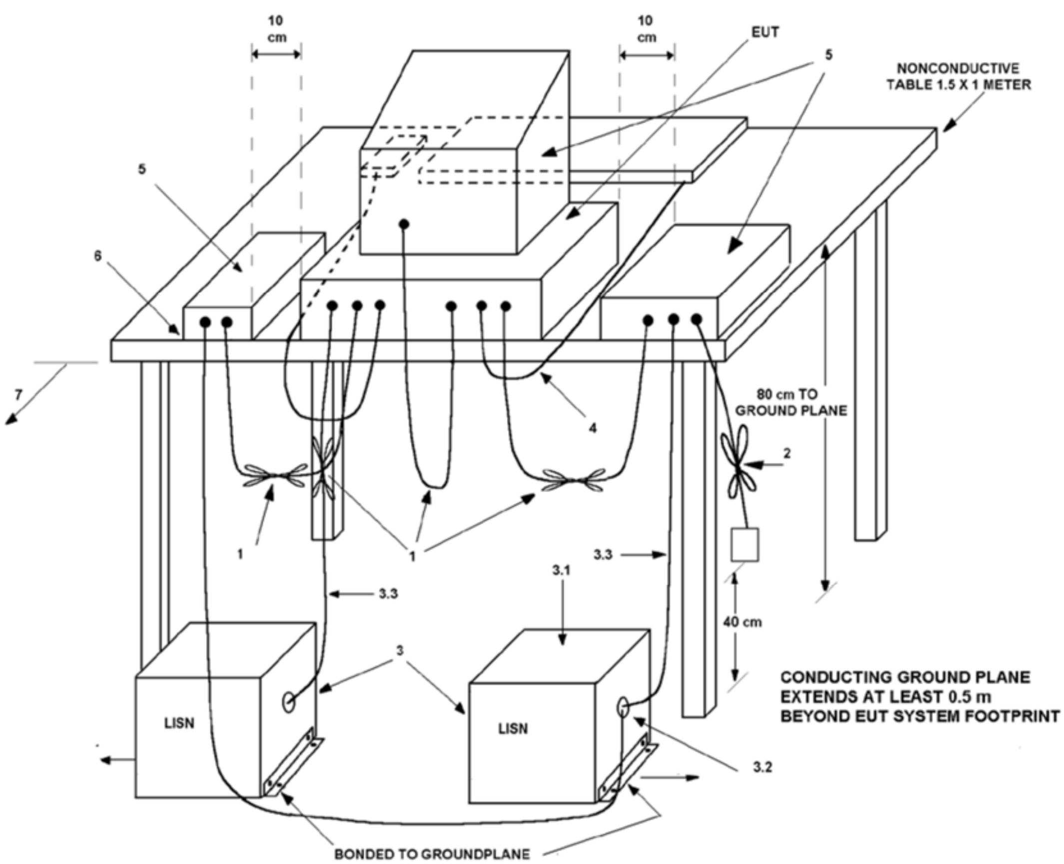


Figure A.7 – Test Setup Conducted Emissions Measurements

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
00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2018	Triennial	26 Nov 2021
00085	EMCO	6502	9203-2724	Loop Antenna	6 Sep 2022	Triennial	6 Sep 2025
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
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
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
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m 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} = 5.14dB U_{CISPR} = 6.3dB	
Radiated Emissions 200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
Radiated Emissions 1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
Radiated Emissions 6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
Power Line Conducted Emissions 9kHz to 150kHz	
U_{LAB} = 2.96dB U_{CISPR} = 3.8dB	
Power Line Conducted Emissions 150kHz to 30MHz	
U_{LAB} = 3.12dB U_{CISPR} = 3.4dB	
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} = 1.0dB U_{CISPR} = n/a
Frequency/Bandwidth 9kHz - 40GHz
U_{LAB} = 0.1ppm U_{CISPR} = n/a
Temperature
U_{LAB} = $1^{O}C$ U_{CISPR} = n/a

END OF REPORT

APPENDIX D – OCCUPIED BANDWIDTH MEASUREMENT PLOTS

APPENDIX E – ANTENNA PORT CONDUCTED POWER MEASUREMENT PLOTS

APPENDIX F – POWER SPECTRAL DENSITY MEASUREMENT PLOTS

APPENDIX G – CONDUCTED SPURIOUS EMISSIONS, BAND EDGE MEASUREMENT PLOTS

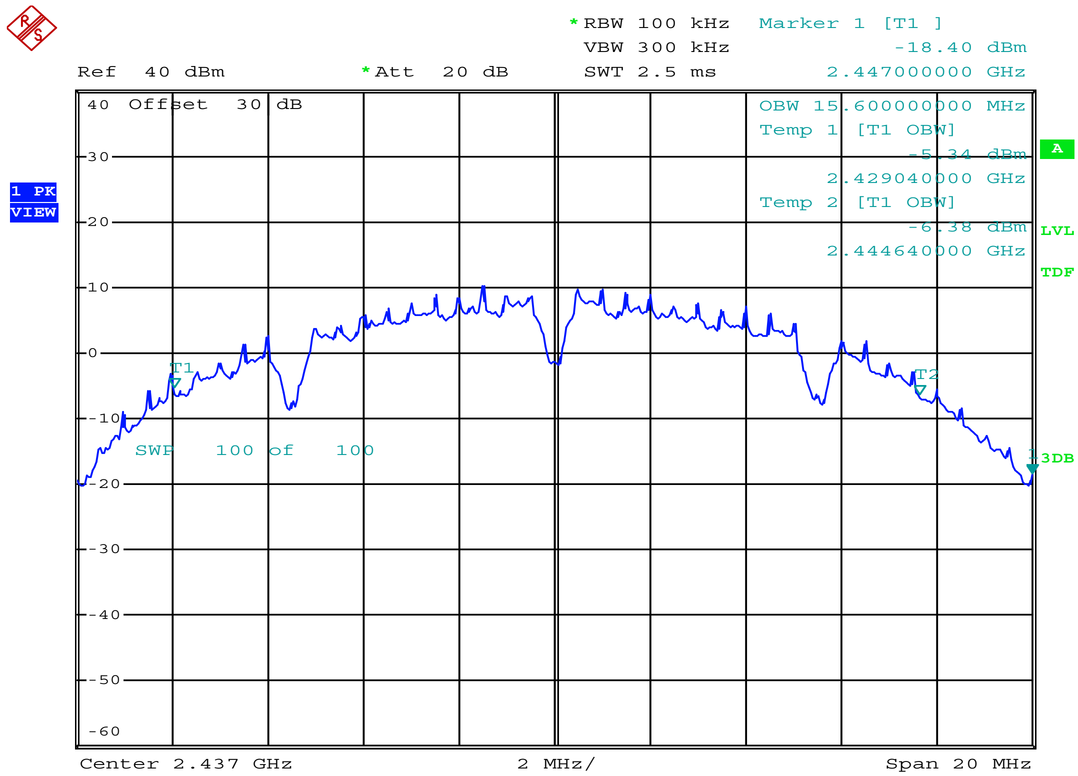
APPENDIX H – CONDUCTED SPURIOUS EMISSIONS

APPENDIX I – RADIATED TX SPURIOUS EMISSIONS, RESTRICTED BAND MEASUREMENT PLOTS

APPENDIX J – RADIATED RX SPURIOUS EMISSIONS MEASUREMENT PLOTS

Occupied Bandwidth Measurement Results: 802.11						
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Occupied Bandwidth (MHz)	Emission Designator
802.11b	6	2437	CCK	1	15.6	15M6D1D
	6	2437	CCK	2	15.1	15M1D1D
	6	2437	DSSS	5.5	14.4	14M4D1D
	6	2437	DSSS	11	14.6	14M6D1D
802.11g	6	2437	OFDM	6	16.5	16M5D1D
802.11n	6	2437	MCS0	-	17.5	17M5D1D
					Result:	Complies

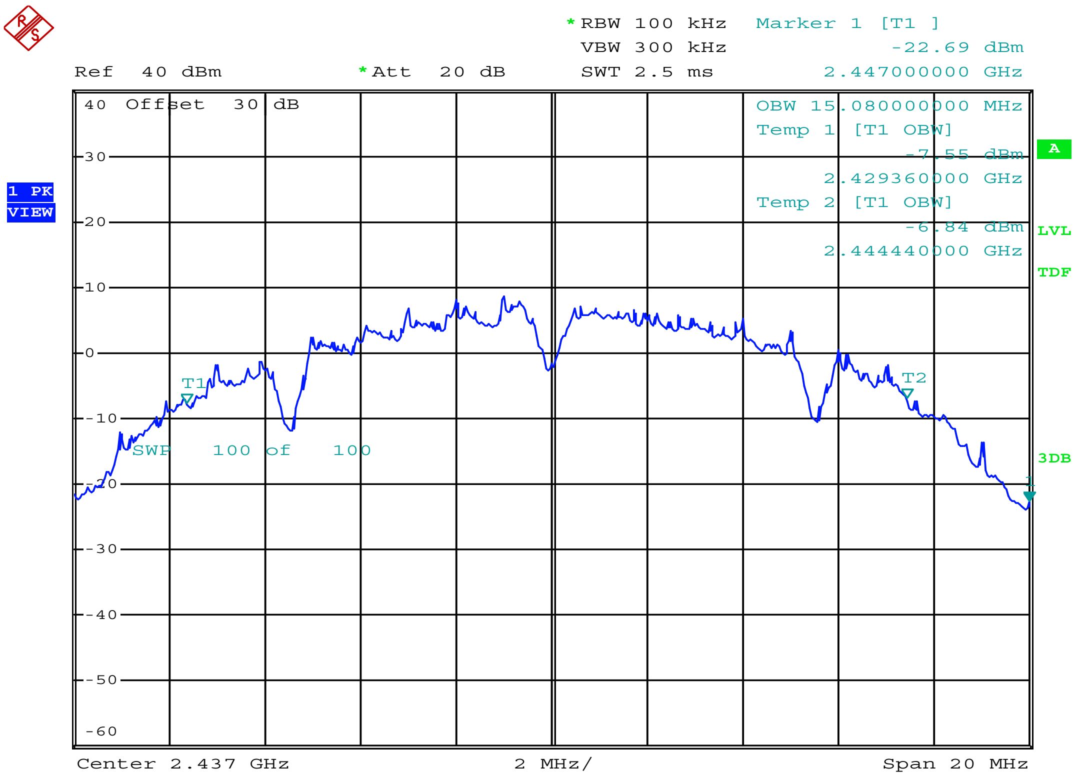
Occupied Bandwidth: 802.11b



Date: 17.SEP.2022 13:49:31

Channel Number:	6	Channel Frequency (MHz):	2437	Occupied Bandwidth (MHz):	15.60
Modulation:	CCK	Bit Rate (Mbps):	1		

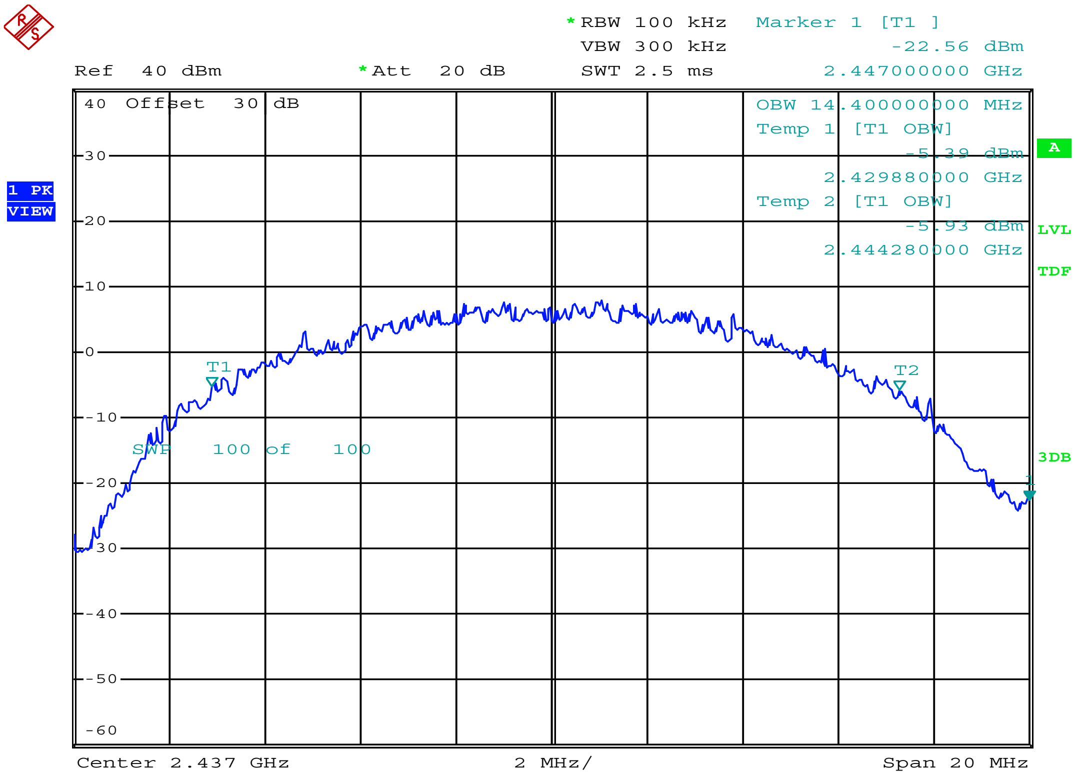
Occupied Bandwidth: 802.11b



Date: 17.SEP.2022 13:50:42

Channel Number:	6	Channel Frequency (MHz):	2437	Occupied Bandwidth (MHz):	15.08
Modulation:	CCK	Bit Rate (Mbps):	2		

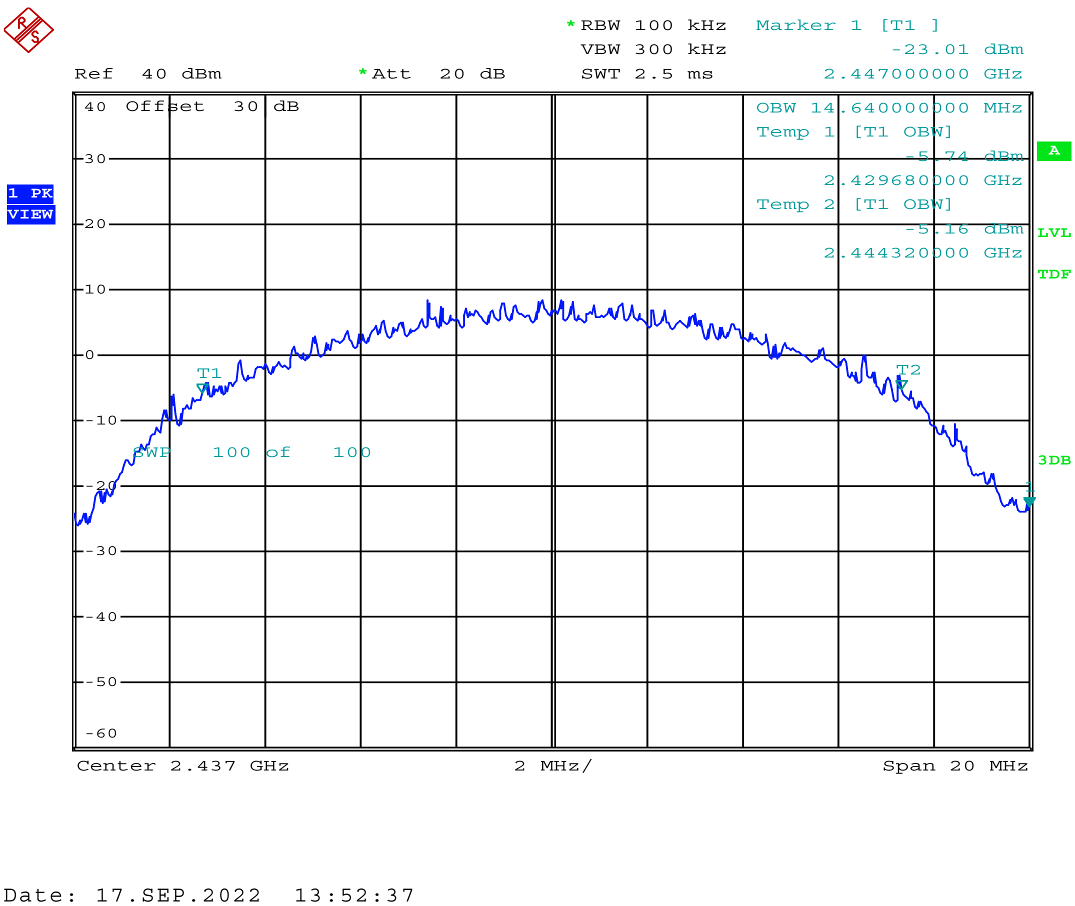
Occupied Bandwidth: 802.11b



Date: 17.SEP.2022 13:51:47

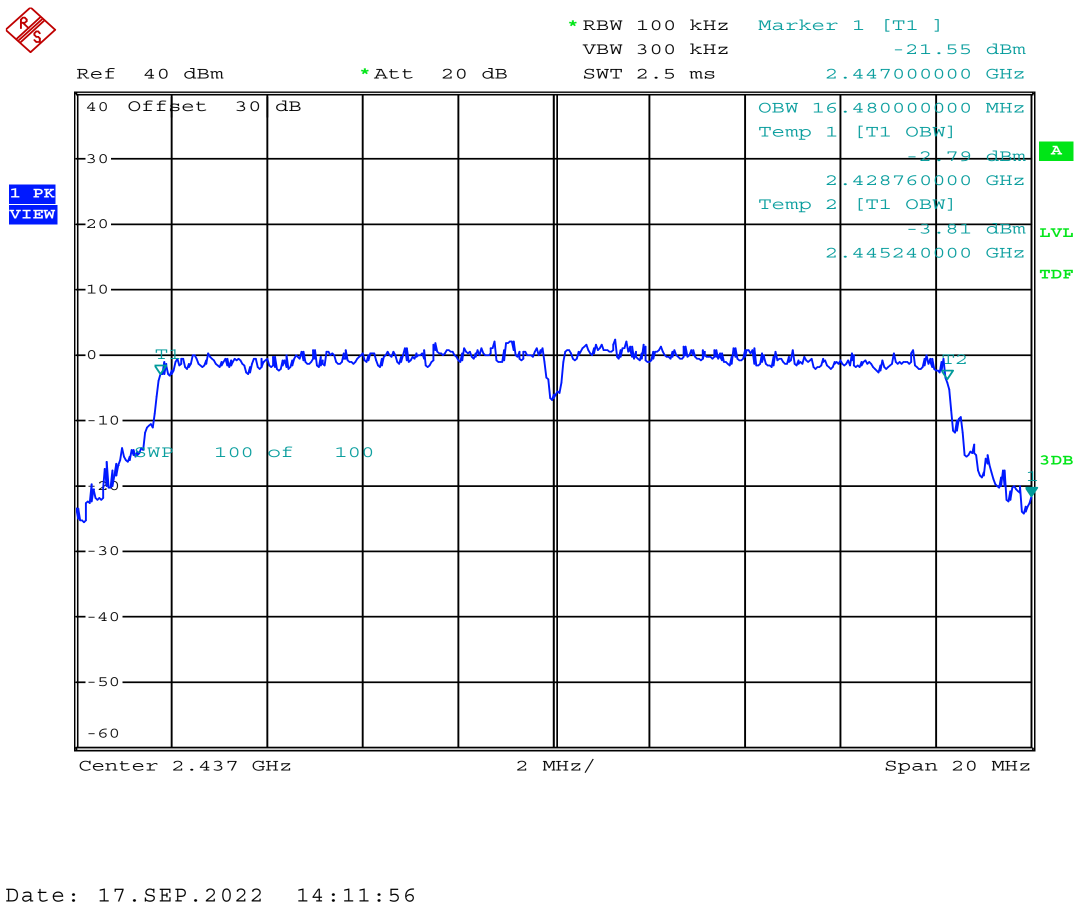
Channel Number:	6	Channel Frequency (MHz):	2437	Occupied Bandwidth (MHz):	14.40
Modulation:	DSSS	Bit Rate (Mbps):	5.5		

Occupied Bandwidth: 802.11b



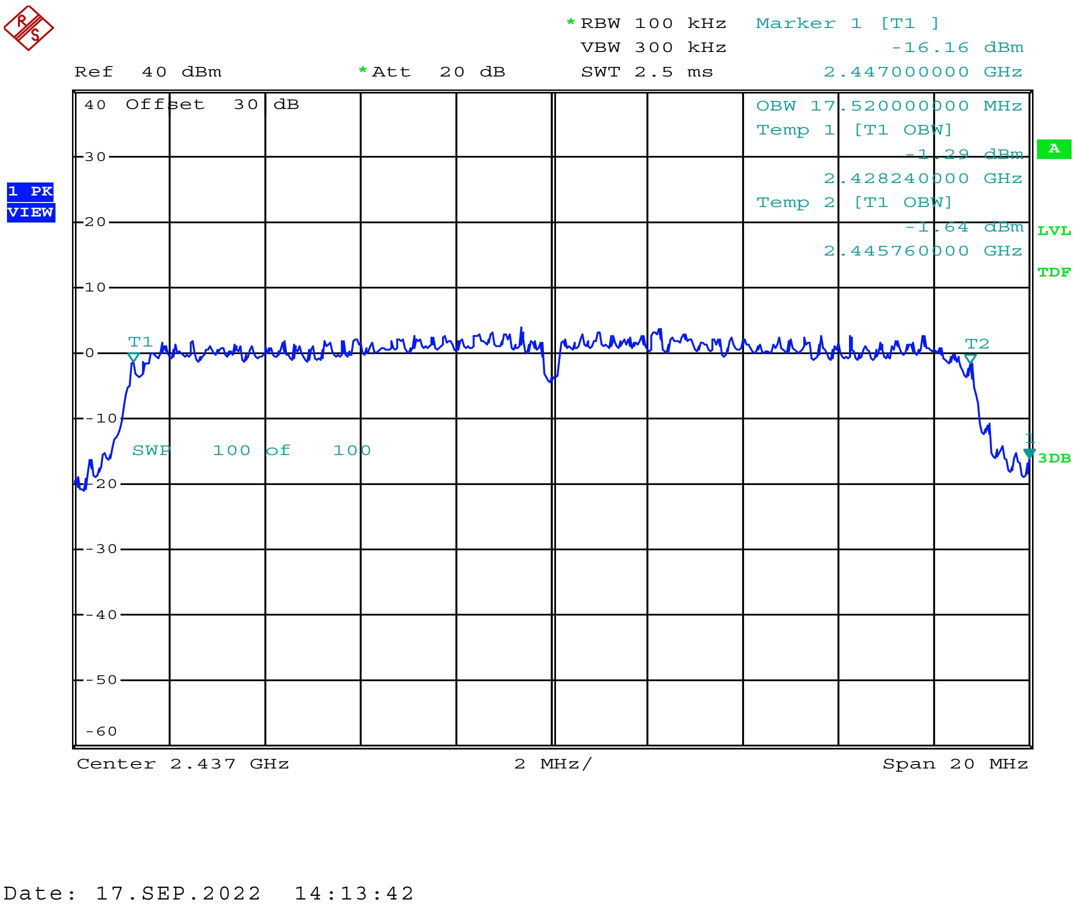
Channel Number:	6	Channel Frequency (MHz):	2437	Occupied Bandwidth (MHz):	14.64
Modulation:	DSSS	Bit Rate (Mbps):	11		

Occupied Bandwidth: 802.11b



Channel Number: **6**	Channel Frequency (MHz): **2437**	Occupied Bandwidth (MHz):	**16.48**
Modulation: **OFDM**	Bit Rate (Mbps): **6**		

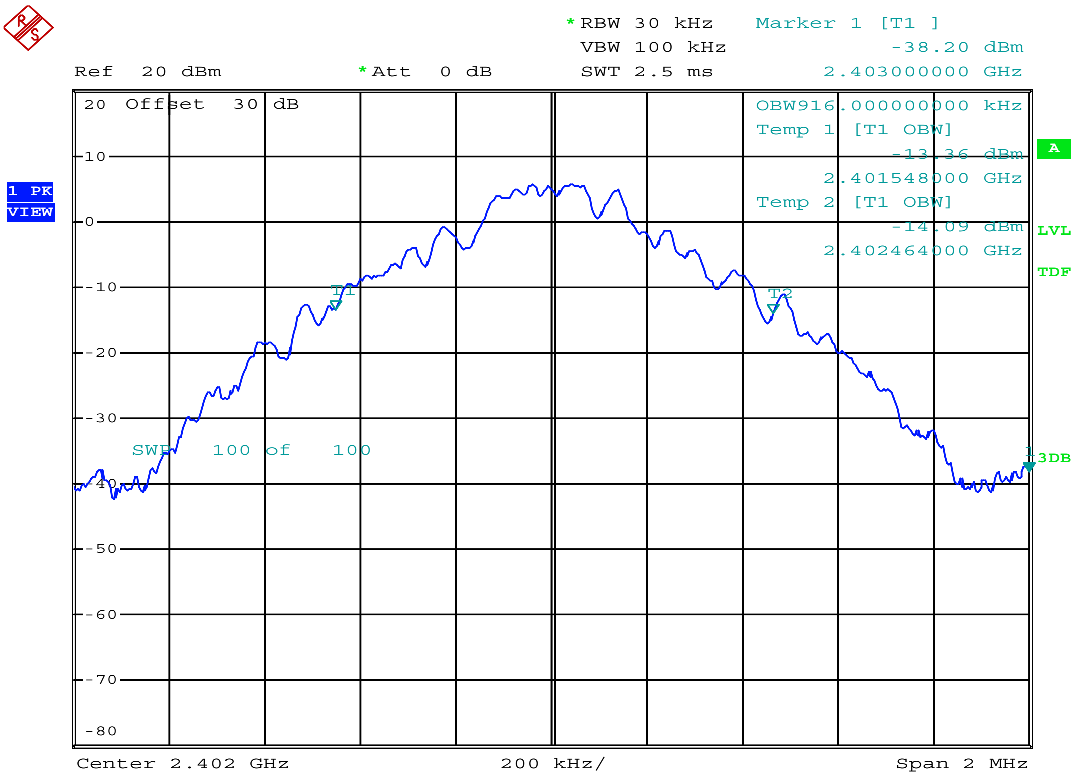
Occupied Bandwidth: 802.11b



Channel Number: 6	Channel Frequency (MHz): 2437	Occupied Bandwidth (MHz):	17.52
Modulation: MCS0	Bit Rate (Mbps): -		

Occupied Bandwidth Measurement Results: BlueTooth						
Mode	**Channel Number**	**Channel Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured Occupied Bandwidth (MHz)**	**Emission Designator**
BT BR	2	2402	GFSK	-	0.916	916KD1D
	40	2440	GFSK	-	0.908	908KD1D
	80	2480	GFSK	-	0.908	908KD1D
BT EDR2	2	2402	P1/4-DQPSK	2	1.09	1M09D1D
	40	2440	P1/4-DQPSK	2	1.08	1M08D1D
	80	2480	P1/4-DQPSK	2	1.09	1M09D1D
BT EDR3	2	2402	8-DPSK	3	1.10	1M10D1D
	40	2440	8-DPSK	3	1.09	1M08D1D
	80	2480	8-DPSK	3	1.08	1M08D1D
					Result:	Complies

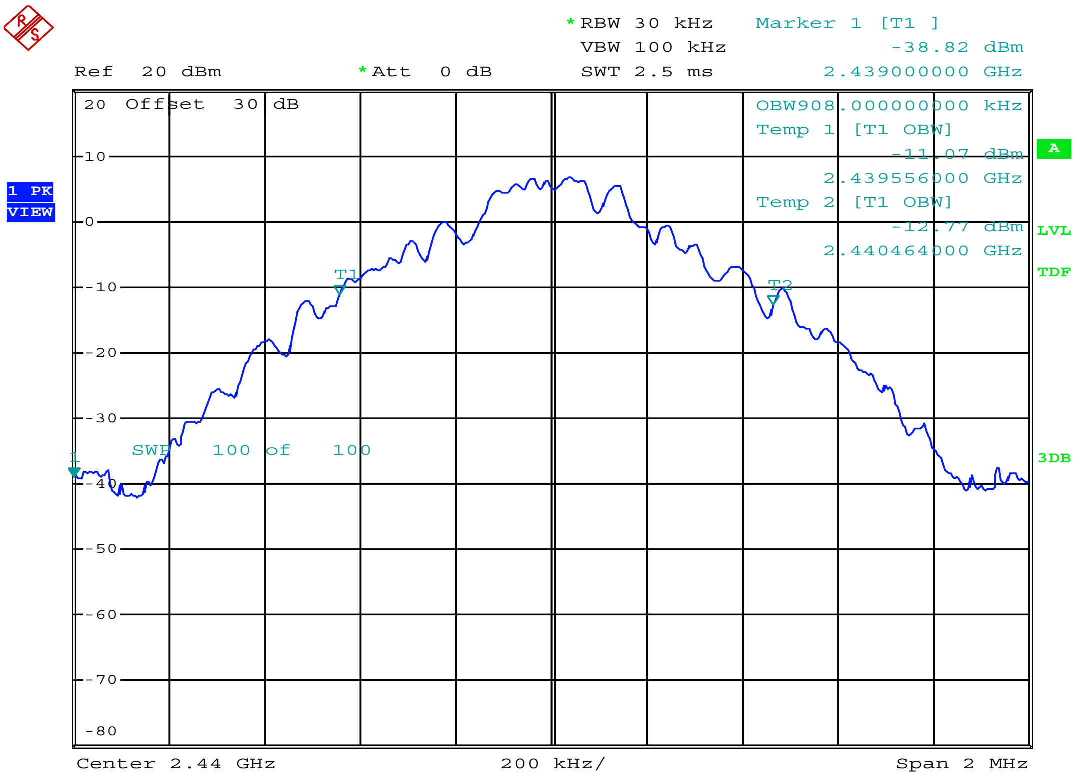
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 14:37:42

Channel Number:	2	Channel Frequency (MHz):	2402	Occupied Bandwidth (MHz):	0.916
Modulation:	GFSK	Bit Rate (Mbps):	-		

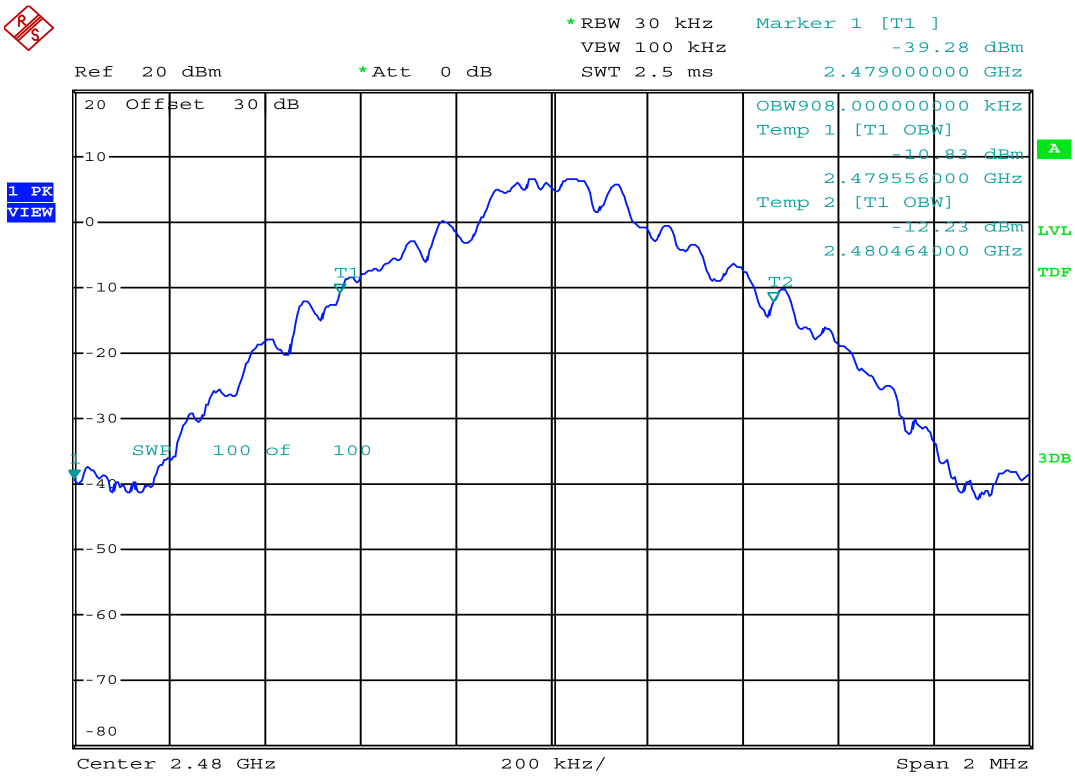
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 14:34:10

Channel Number:	**40**	Channel Frequency (MHz):	**2440**	Occupied Bandwidth (MHz):	**0.908**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**		

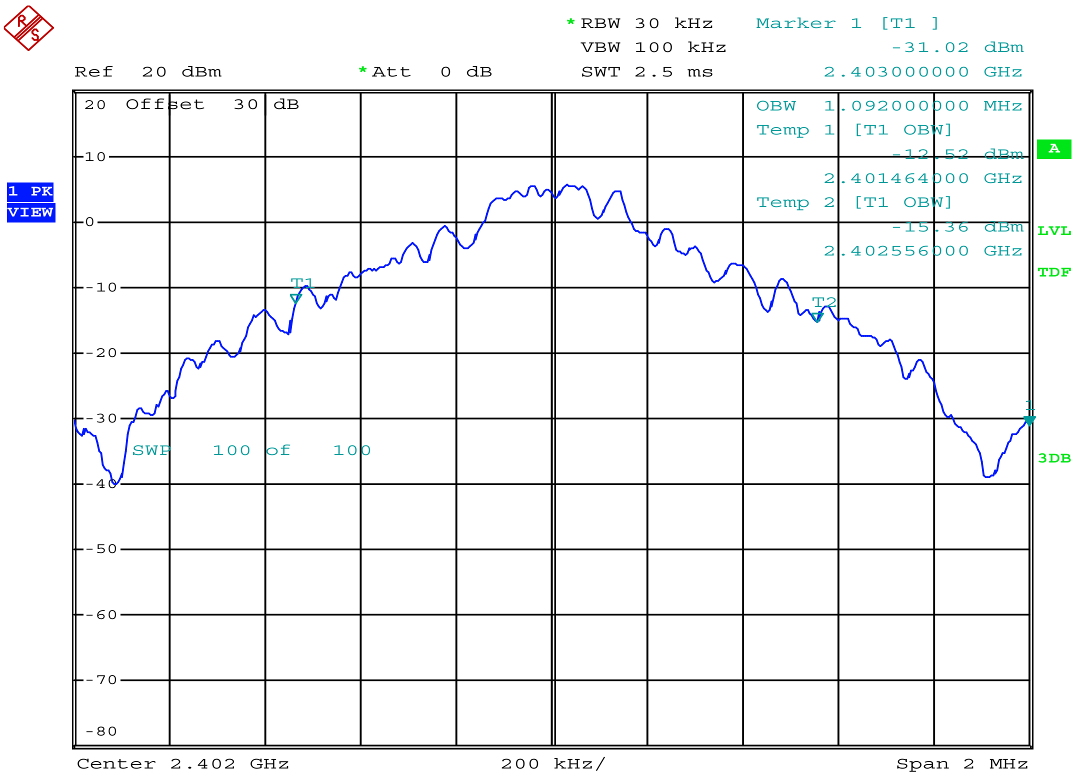
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 14:36:33

Channel Number:	80	Channel Frequency (MHz):	2480	Occupied Bandwidth (MHz):	0.908
Modulation:	GFSK	Bit Rate (Mbps):	-		

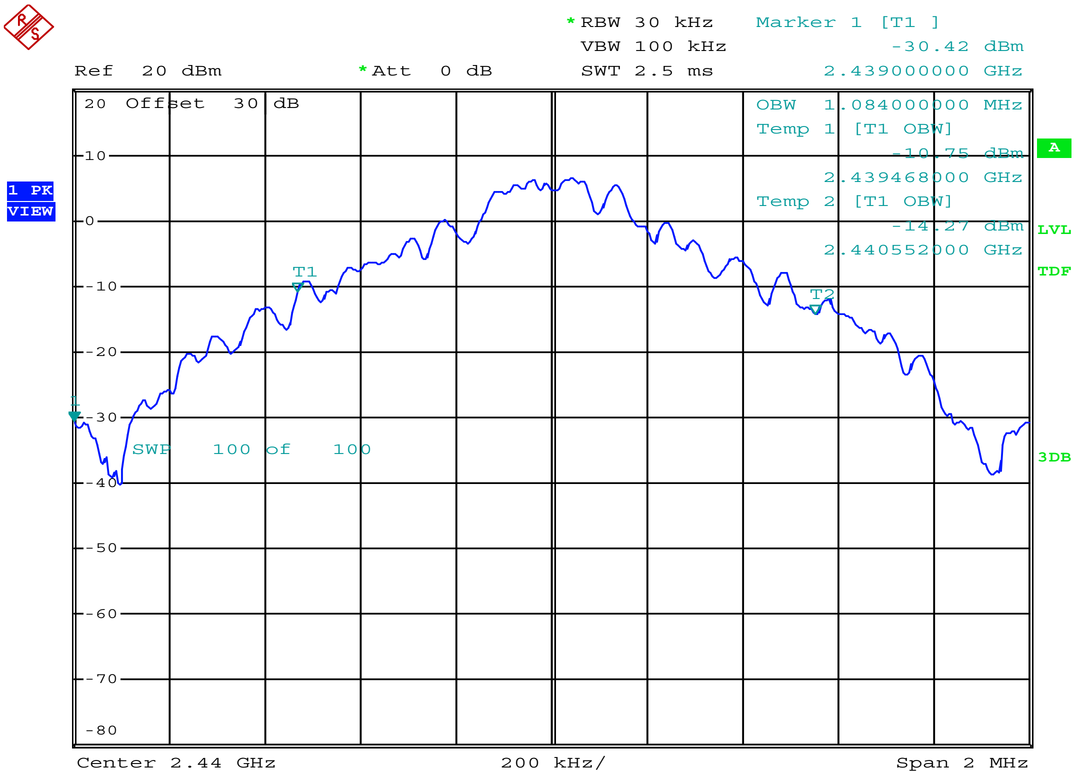
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 14:54:48

Channel Number:	2	Channel Frequency (MHz):	2402	Occupied Bandwidth (MHz):	1.09
Modulation:	P1/4-DQPSK	Bit Rate (Mbps):	2		

Occupied Bandwidth: BlueTooth

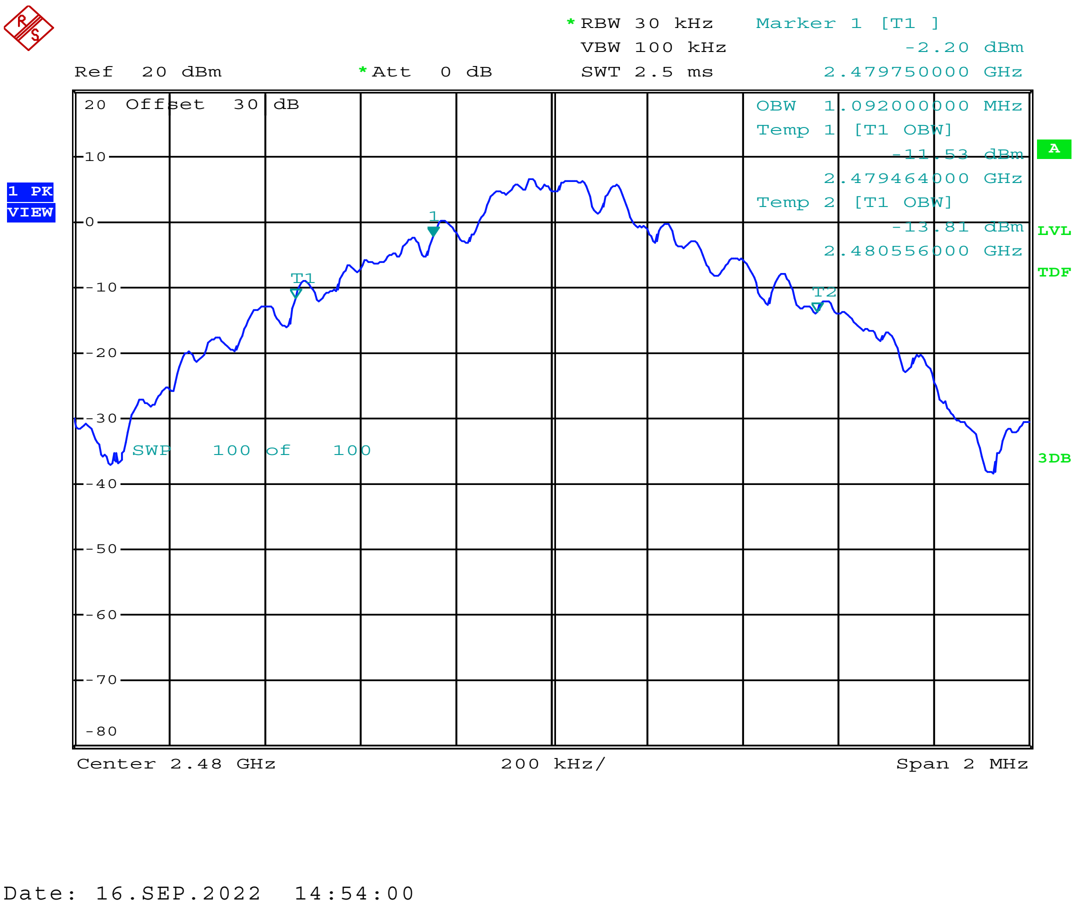


Date: 16.SEP.2022 14:56:22

Channel Number:	40	Channel Frequency (MHz):	2440
Modulation:	P1/4-DQPSK	Bit Rate (Mbps):	2

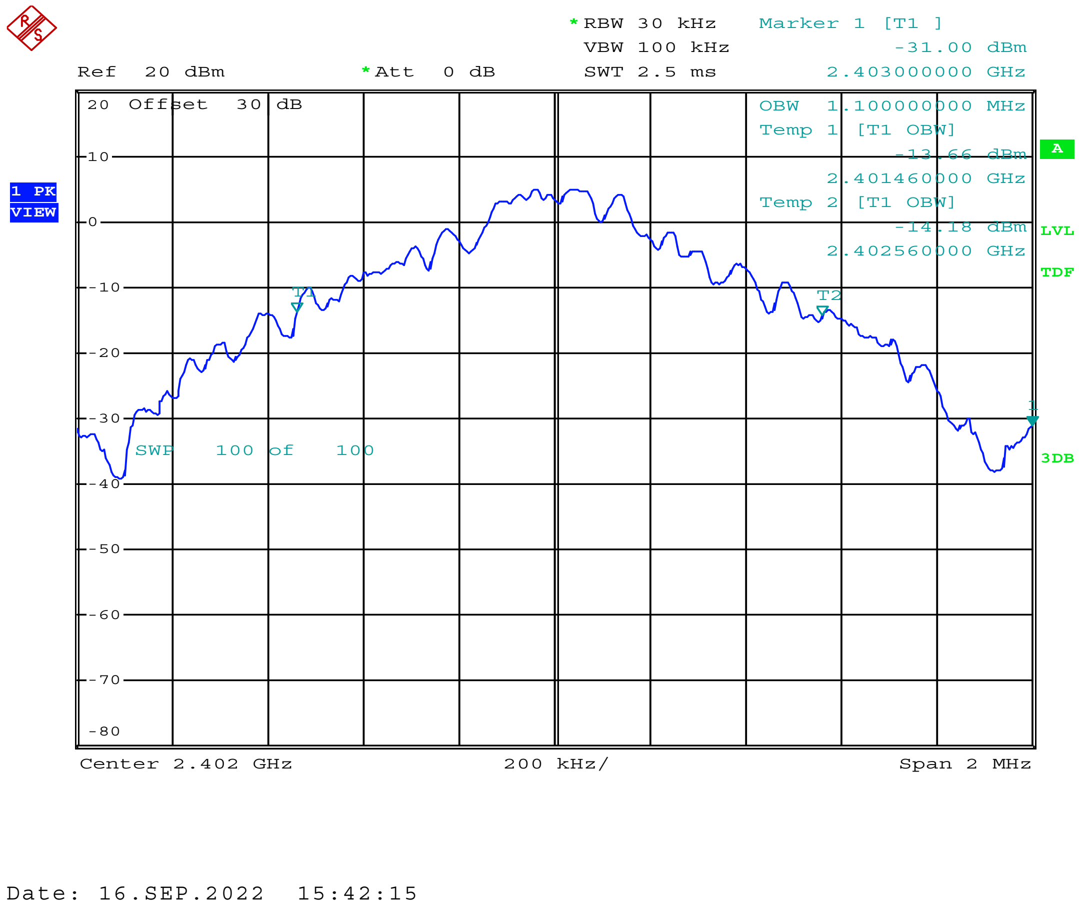
Occupied Bandwidth (MHz):	1.08

Occupied Bandwidth: BlueTooth



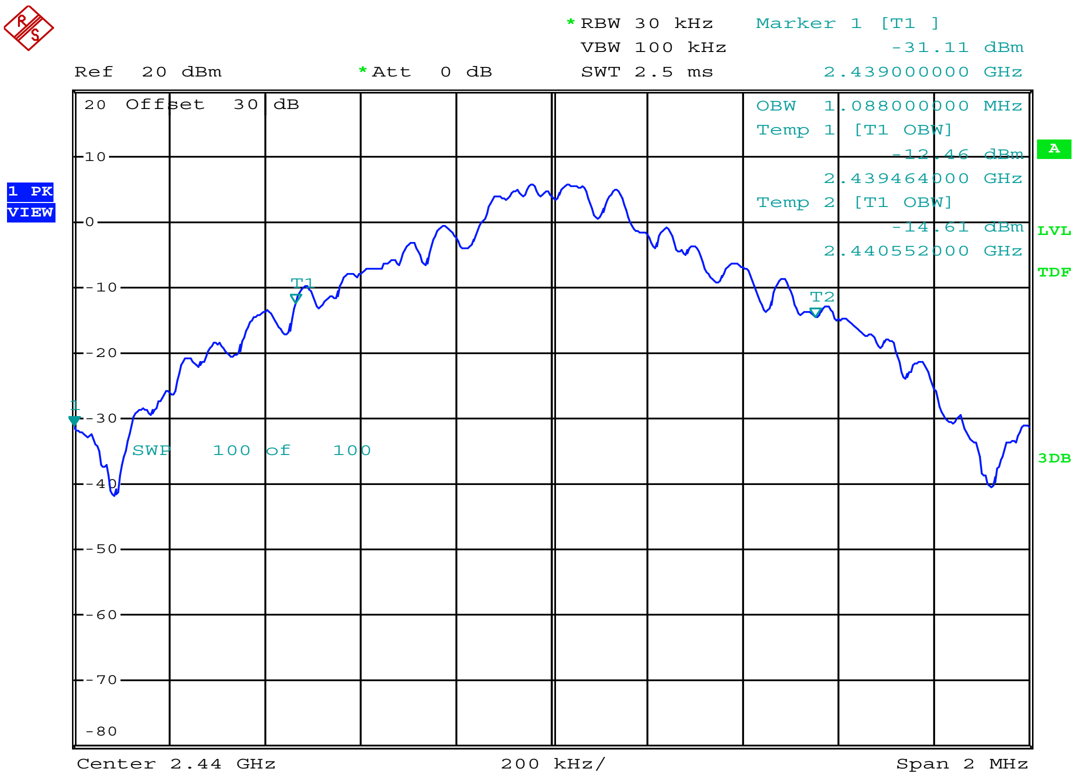
Channel Number:	80	Channel Frequency (MHz):	2480	Occupied Bandwidth (MHz):	1.09
Modulation:	P1/4-DQPSK	Bit Rate (Mbps):	2		

Occupied Bandwidth: BlueTooth



Channel Number:	2	Channel Frequency (MHz):	2402	Occupied Bandwidth (MHz):	1.10
Modulation:	8-DPSK	Bit Rate (Mbps):	3		

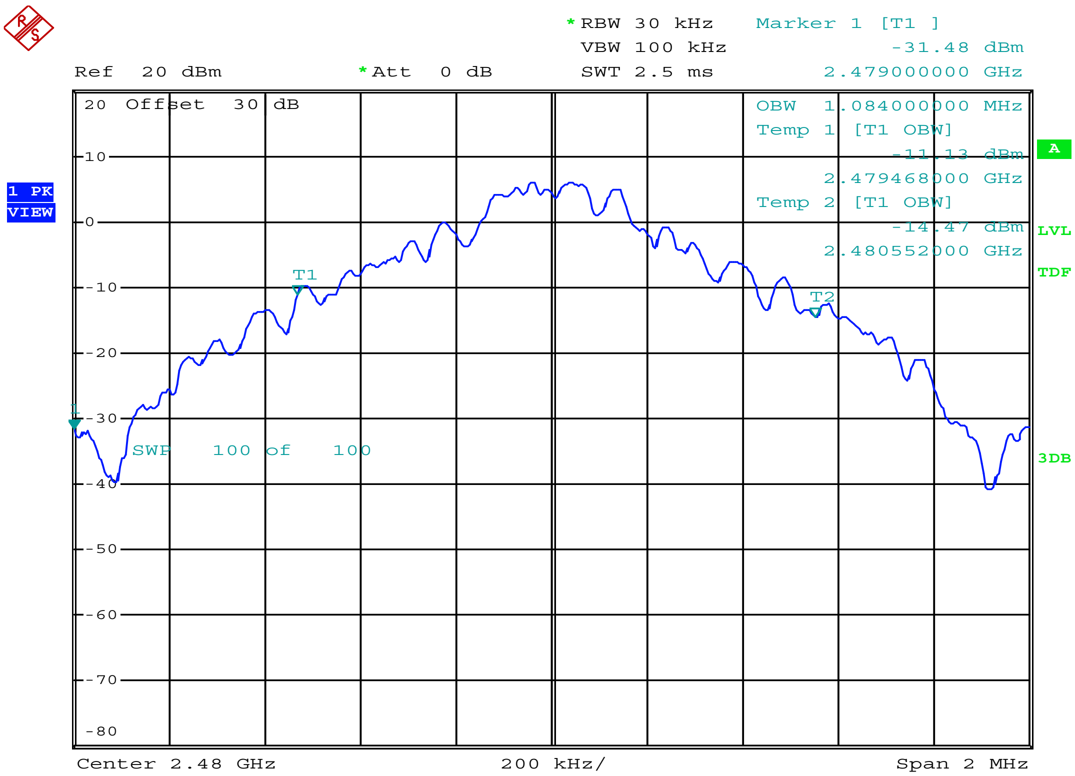
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 15:43:03

Channel Number:	40	Channel Frequency (MHz):	2440	Occupied Bandwidth (MHz):	1.09
Modulation:	8-DPSK	Bit Rate (Mbps):	3		

Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 15:43:49

Channel Number:	80	Channel Frequency (MHz):	2480	Occupied Bandwidth (MHz):	1.08
Modulation:	8-DPSK	Bit Rate (Mbps):	3		

Conducted Power Measurement Results: 802.11													
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Transmit Duty Cycle (%)**	**Measured Power [P_{Meas}] (dBm)**	**Conducted Limit [P_{Lim}] (dBm)**	**Conducted Margin (dB)**	**Antenna Gain [G_T] (dBi)**	**EIRP [E_{Meas}] (dBm)**	**EIRP Limit [E_{Lim}] (dBm)**	**EIRP Margin (dB)**	**Result**
	6	2437.00	CCK	1		18.30	30	11.7	-3.6	14.70	36	21.3	Complies
	6	2437.00	CCK	2		18.34	30	11.7	-3.6	14.74	36	21.3	Complies
	6	2437.00	DSSS	6		**18.56**	30	11.4	-3.6	**14.96**	36	21.0	Complies
	1	2412.00	DSSS	6		15.76	30	14.2	-3.6	12.16	36	23.8	Complies
	2	2417.00	DSSS	6		16.44	30	13.6	-3.6	12.84	36	23.2	Complies
	3	2422.00	DSSS	6		16.59	30	13.4	-3.6	12.99	36	23.0	Complies
	4	2427.00	DSSS	6		18.26	30	11.7	-3.6	14.66	36	21.3	Complies
802.11b	5	2432.00	DSSS	6		18.35	30	11.7	-3.6	14.75	36	21.3	Complies
	7	2442.00	DSSS	6		18.34	30	11.7	-3.6	14.74	36	21.3	Complies
	8	2447.00	DSSS	6		17.15	30	12.9	-3.6	13.55	36	22.5	Complies
	9	2452.00	DSSS	6		17.28	30	12.7	-3.6	13.68	36	22.3	Complies
	10	2457.00	DSSS	6	100.00	16.13	30	13.9	-3.6	12.53	36	23.5	Complies
	11	2462.00	DSSS	6		15.47	30	14.5	-3.6	11.87	36	24.1	Complies
	12	2467.00	DSSS	6		15.41	30	14.6	-3.6	11.81	36	24.2	Complies
	13	2472.00	DSSS	6		15.54	30	14.5	-3.6	11.94	36	24.1	Complies
	6	2437.00	OFDM	6		15.84	30	14.2	-3.6	12.24	36	23.8	Complies
	6	2437.00	OFDM	9		15.79	30	14.2	-3.6	12.19	36	23.8	Complies
802.11g	6	2437.00	OFDM	12		16.08	30	13.9	-3.6	12.48	36	23.5	Complies
	6	2437.00	OFDM	36		13.90	30	16.1	-3.6	10.30	36	25.7	Complies
	6	2437.00	OFDM	54		13.03	30	17.0	-3.6	9.43	36	26.6	Complies
	6	2437.00	OFDM	MCS0		17.10	30	12.9	-3.6	13.50	36	22.5	Complies
802.11n	6	2437.00	OFDM	MCS3		16.23	30	13.8	-3.6	12.63	36	23.4	Complies
	6	2437.00	OFDM	MCS7		11.67	30	18.3	-3.6	8.07	36	27.9	Complies

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

EIRP Margin = E_{Limit} - E_{Meas}

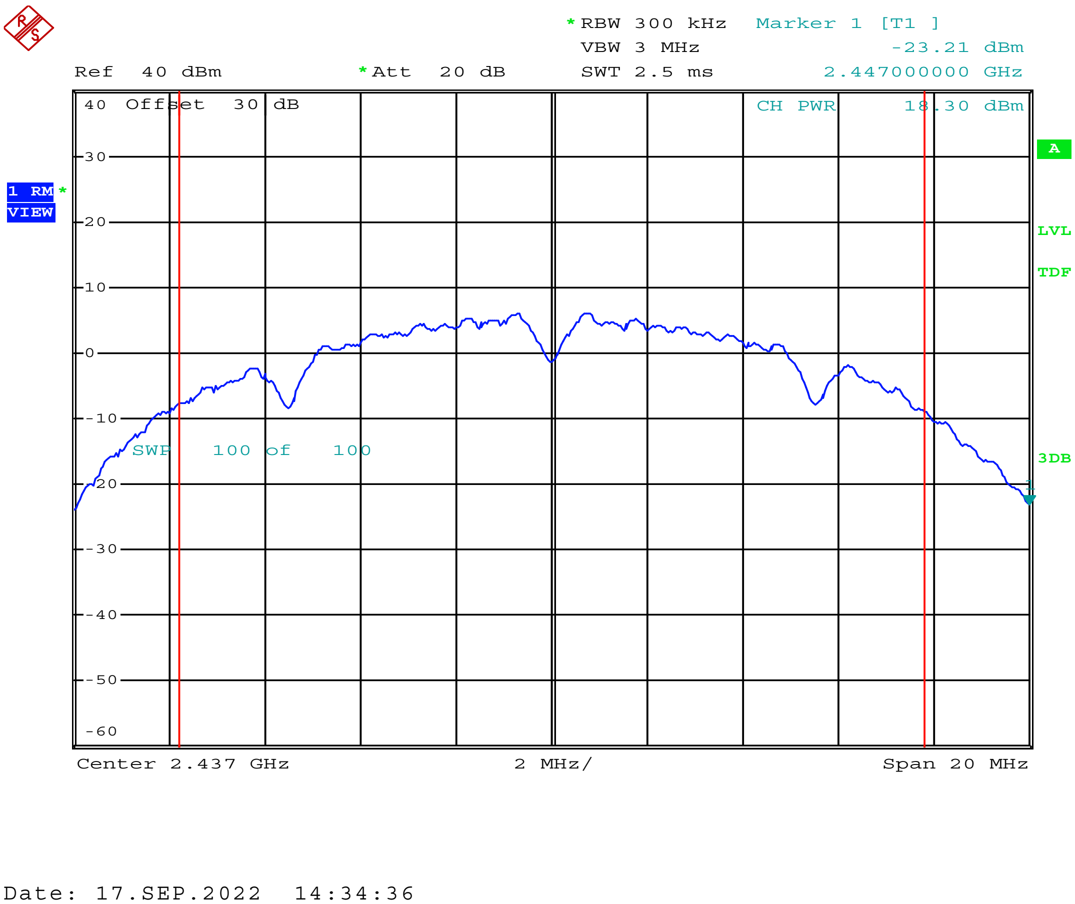
EIRP E_{Meas}= P_{Meas} + G_T

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

EIRP Margin = E_{Limit} - E_{Meas}

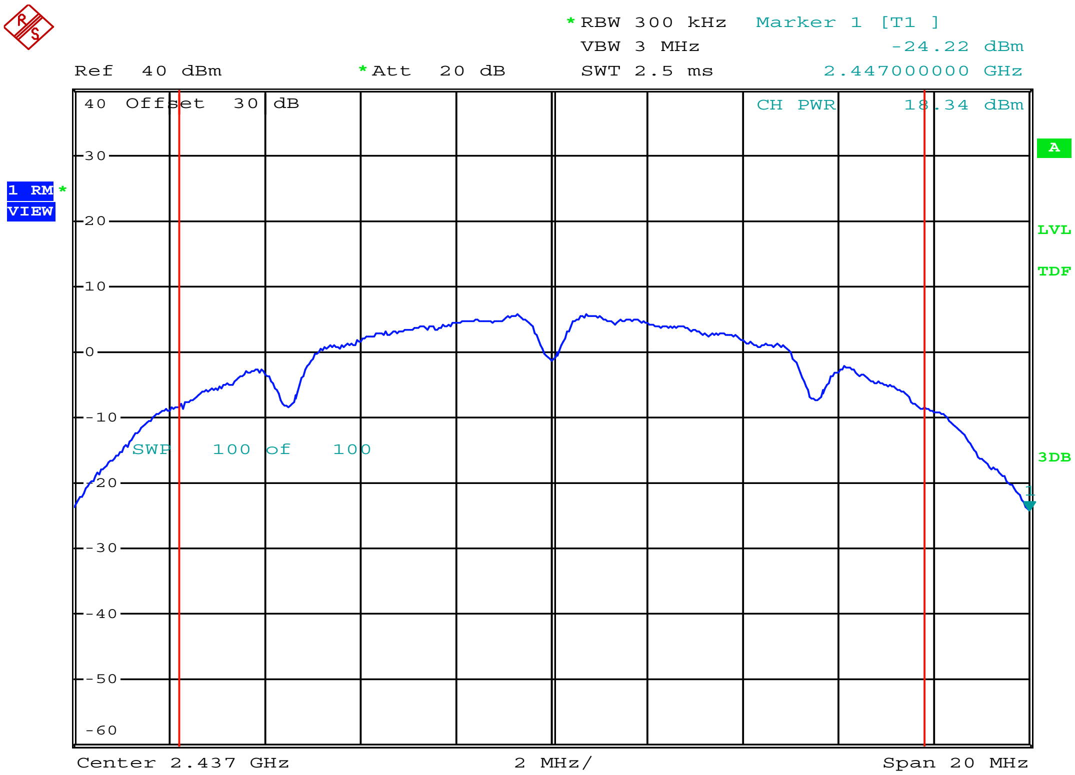
* Antenna Gain information provided by applicant.

Conducted Output Power WiFi 802.11b



Channel Number:	6	Channel Frequency (MHz):	2437	Channel Power (dBm):	18.30
Modulation:	CCK	Bit Rate (Mbps):	1		

Conducted Output Power WiFi 802.11b

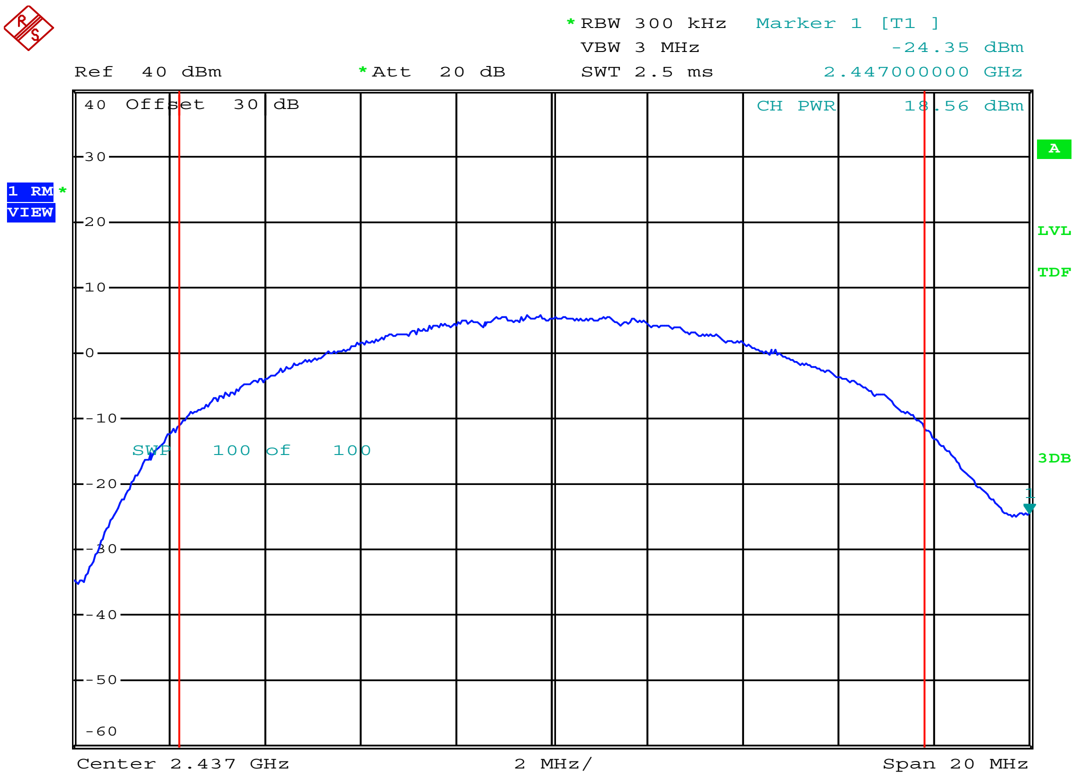


Date: 17.SEP.2022 14:35:29

Channel Number:	6	Channel Frequency (MHz):	2437
Modulation:	CCK	Bit Rate (Mbps):	2

Channel Power (dBm):	18.34

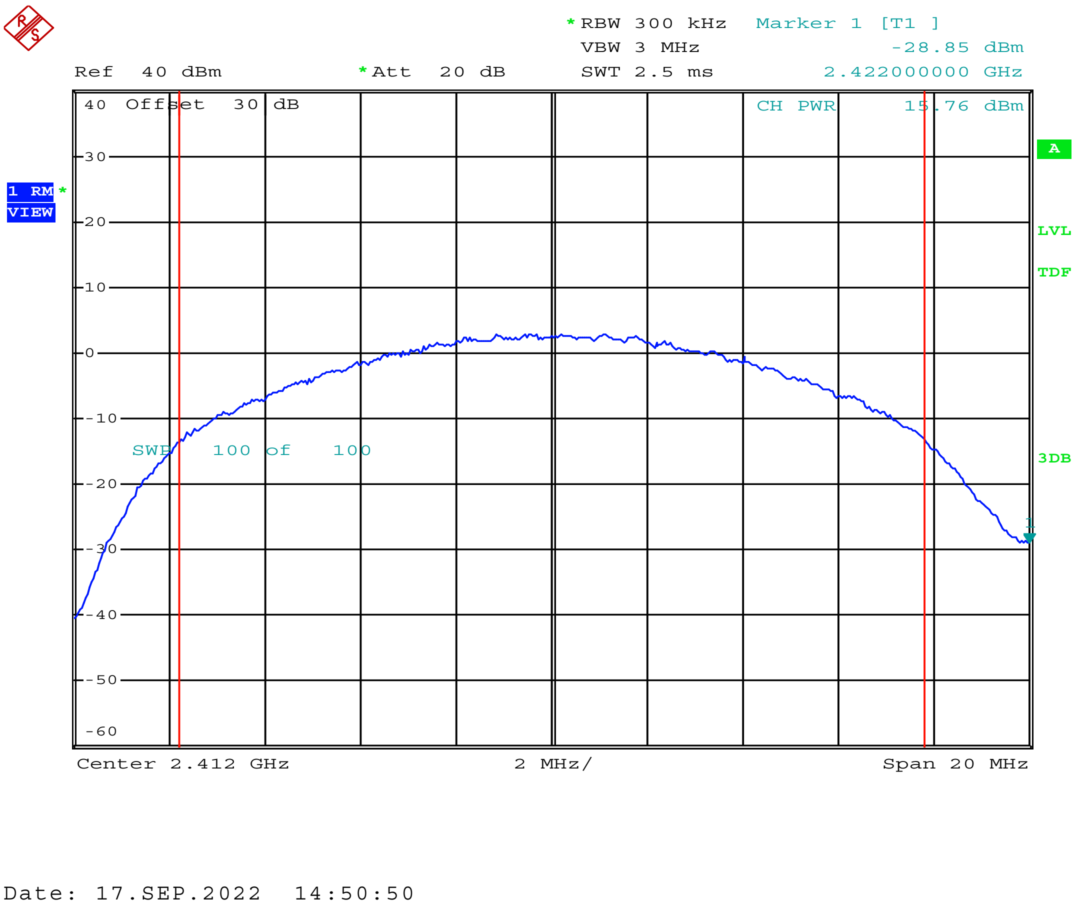
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:36:17

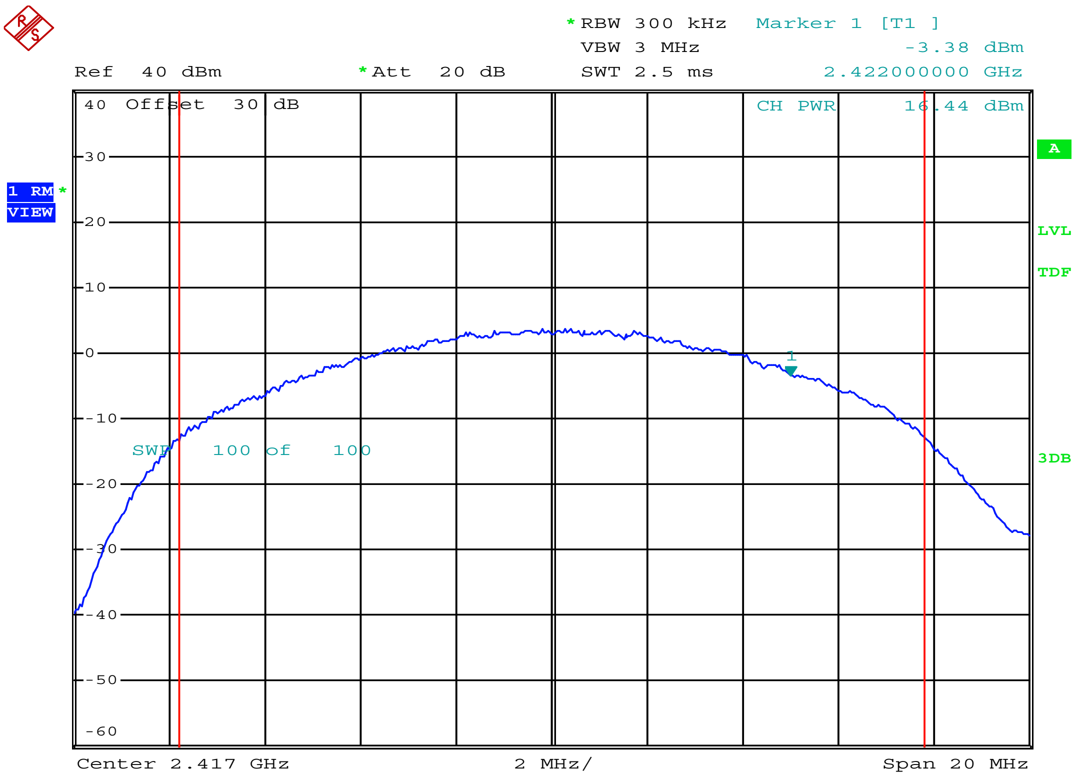
Channel Number: **6**	Channel Frequency (MHz): **2437**	Channel Power (dBm):	**18.56**
Modulation: **DSSS**	Bit Rate (Mbps): **5.5**		

Conducted Output Power WiFi 802.11b



Channel Number:	**1**	Channel Frequency (MHz):	**2412**	Channel Power (dBm):	**15.76**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

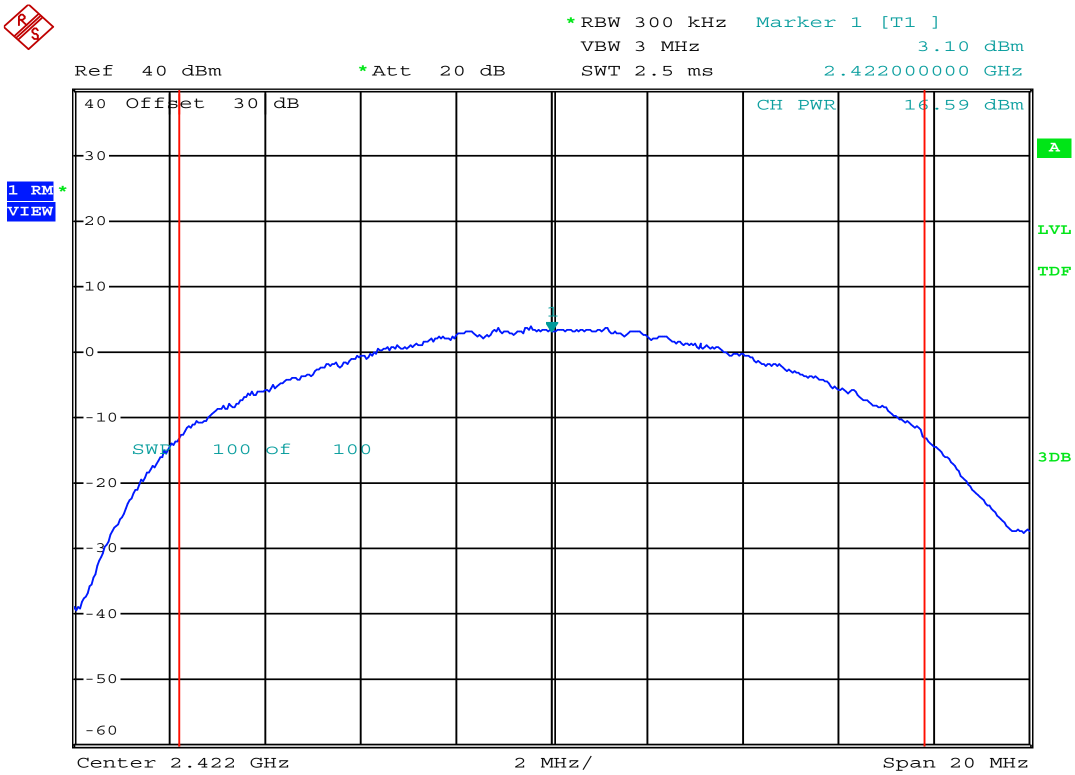
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:51:39

Channel Number:	2	Channel Frequency (MHz):	2417	Channel Power (dBm):	16.44
Modulation:	DSSS	Bit Rate (Mbps):	5.5		

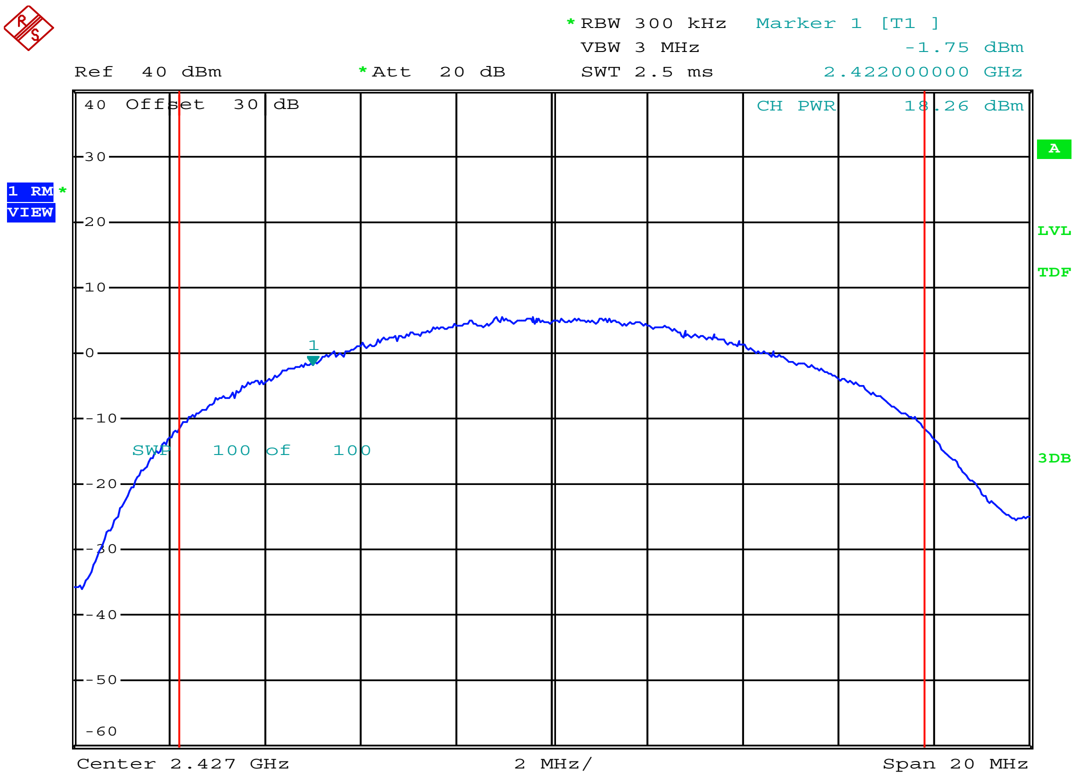
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:52:22

Channel Number:	**3**	Channel Frequency (MHz):	**2422**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**
Channel Power (dBm):	**16.59**		

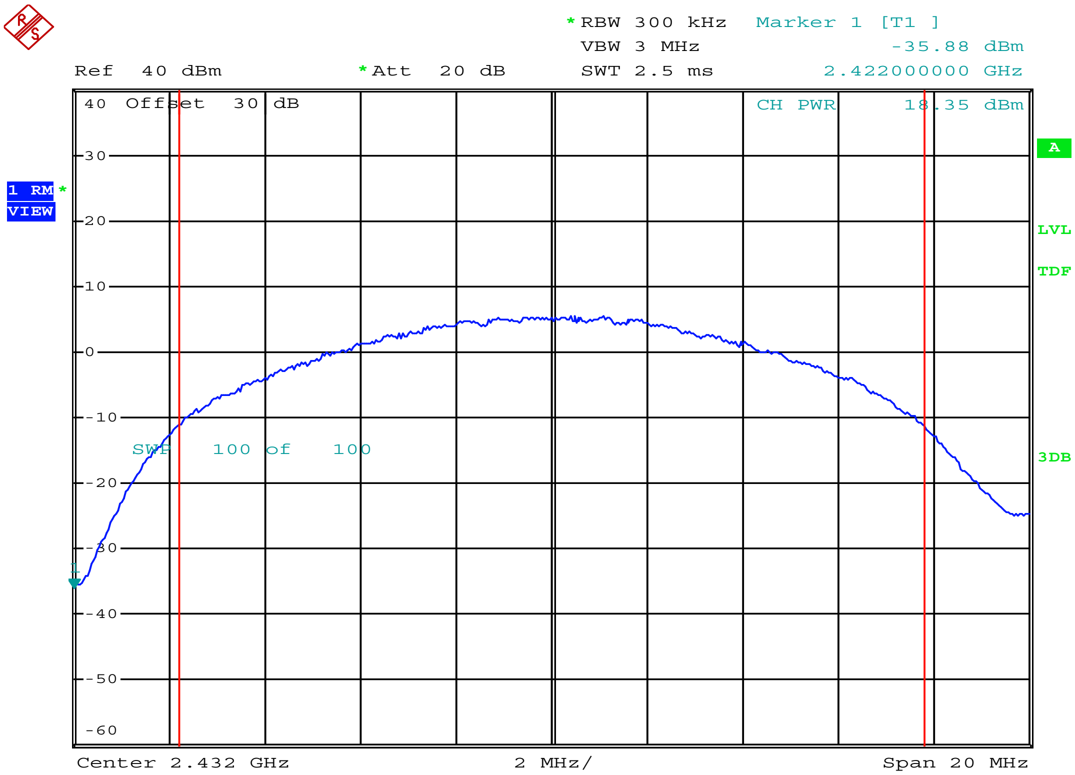
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:53:05

Channel Number:	**4**	Channel Frequency (MHz):	**2427**	Channel Power (dBm):	**18.26**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

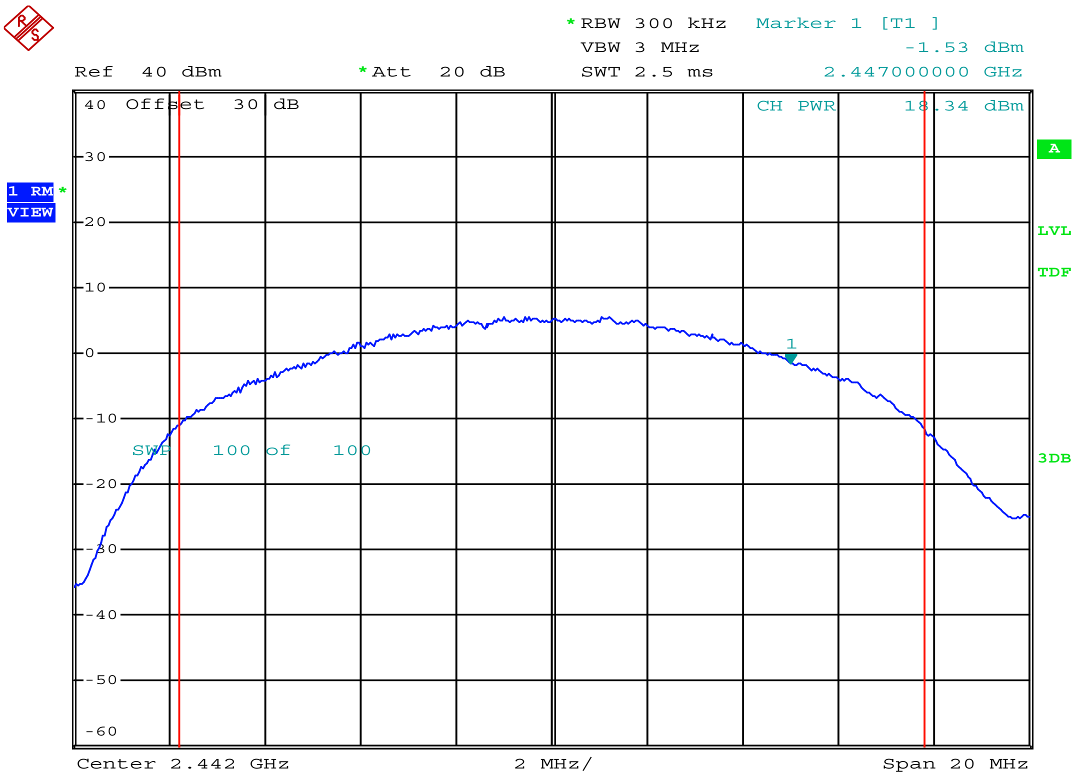
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:53:54

Channel Number:	**5**	Channel Frequency (MHz):	**2432**	Channel Power (dBm):	**18.35**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

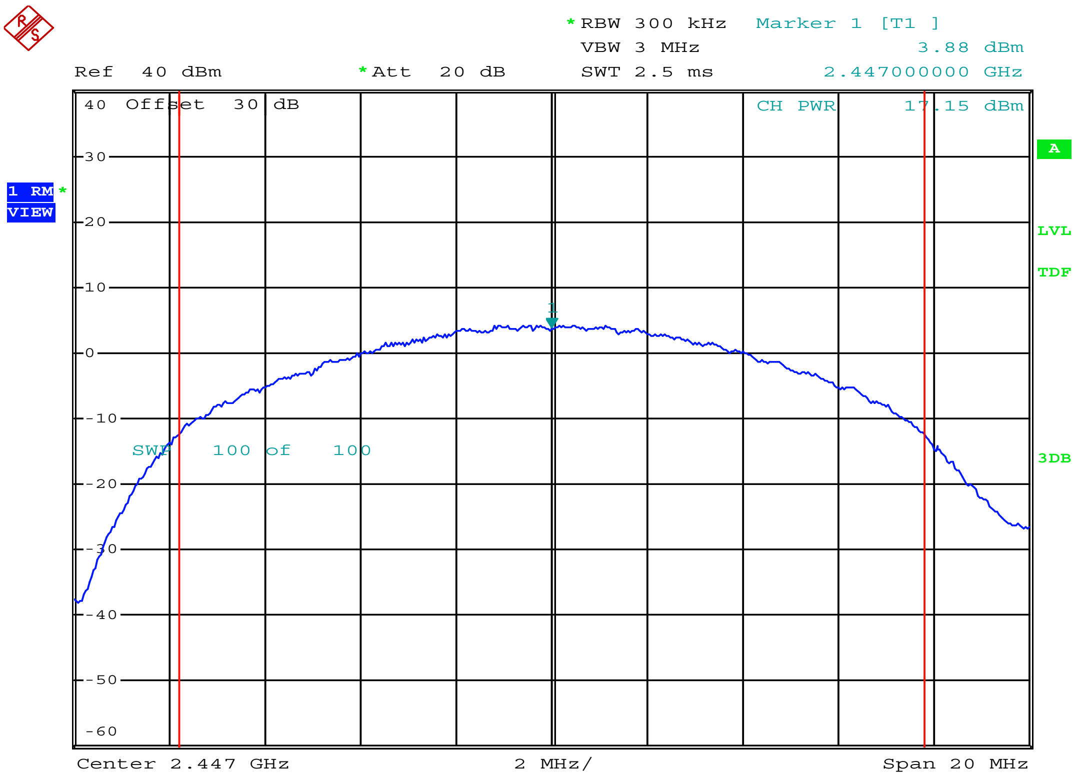
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:40:59

Channel Number:	**7**	Channel Frequency (MHz):	**2442**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**
Channel Power (dBm):	**18.34**		

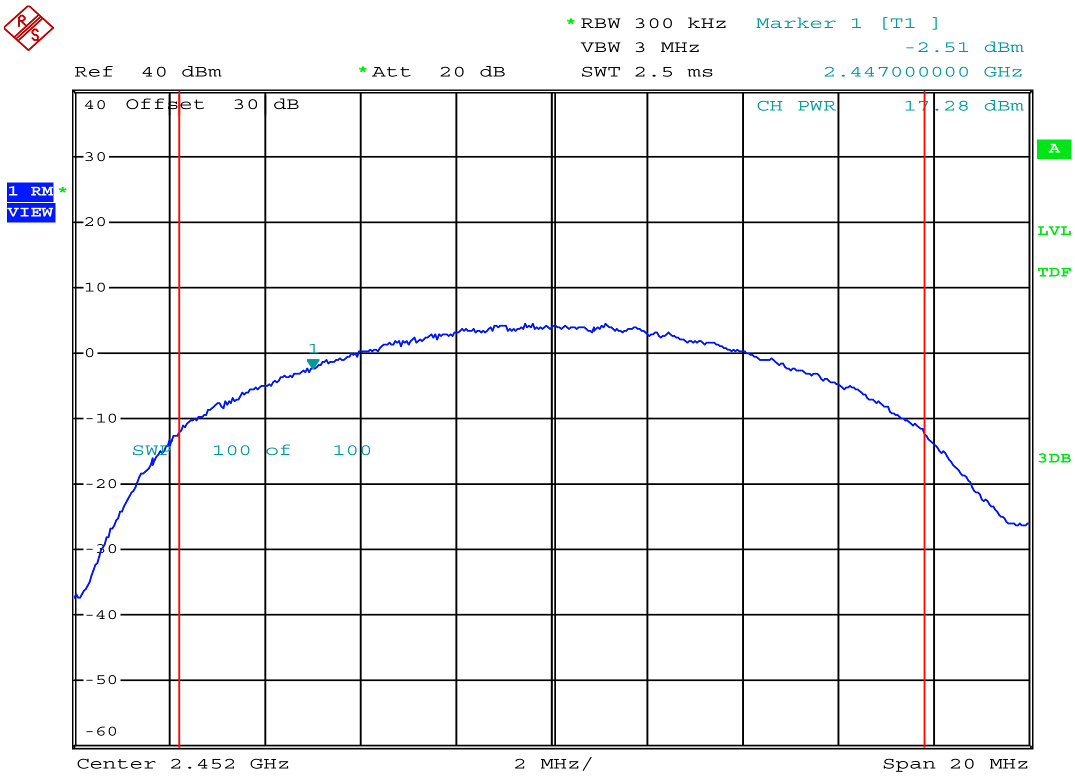
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:45:27

Channel Number:	8	Channel Frequency (MHz):	2447	Channel Power (dBm):	17.15
Modulation:	DSSS	Bit Rate (Mbps):	5.5		

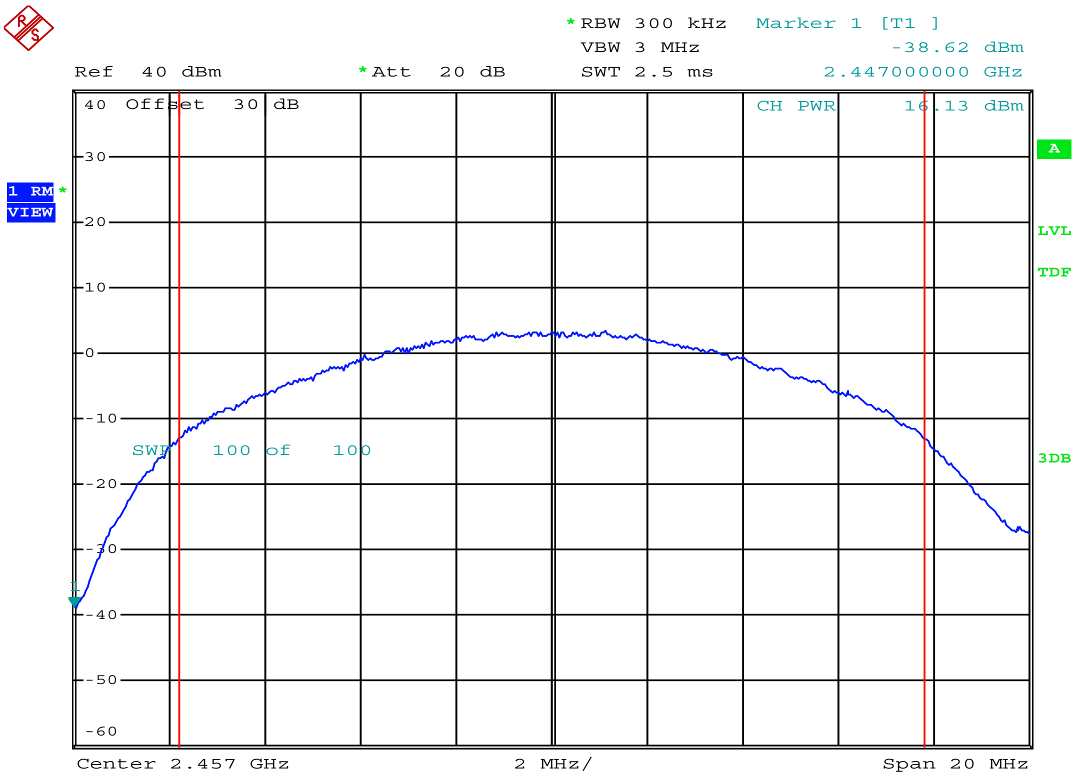
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:46:30

Channel Number:	**9**	Channel Frequency (MHz):	**2452**	Channel Power (dBm):	**17.28**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

Conducted Output Power WiFi 802.11b

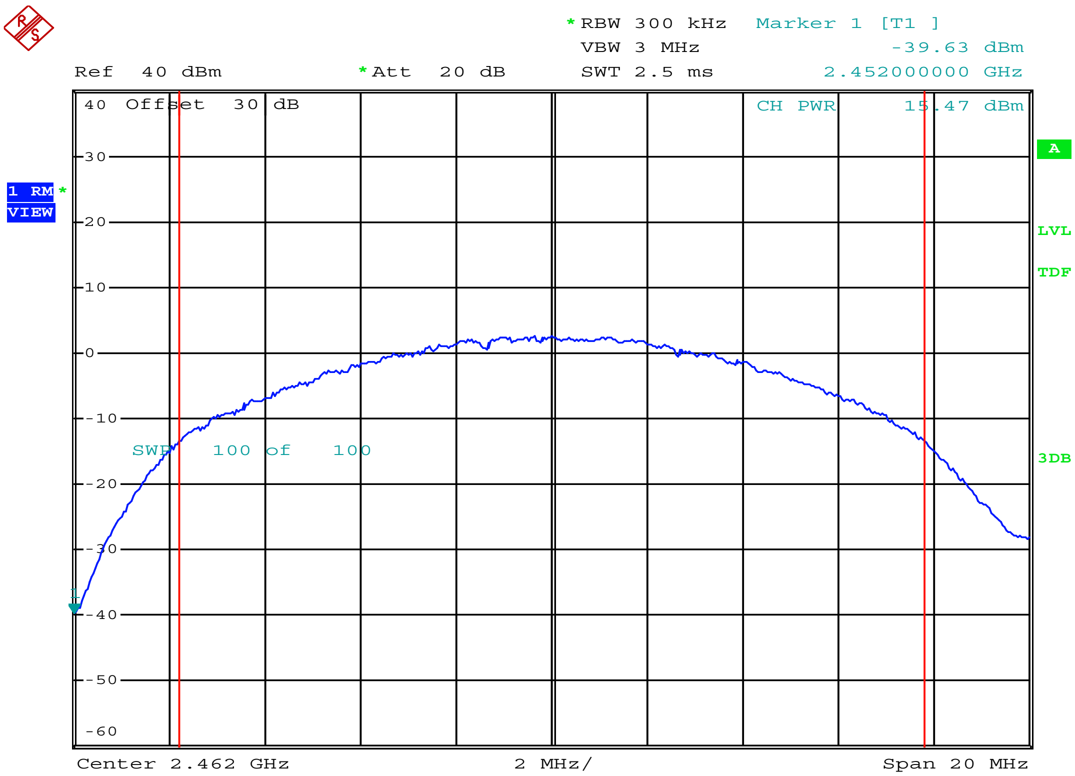


Date: 17.SEP.2022 14:47:17

Channel Number:	10	Channel Frequency (MHz):	2457
Modulation:	DSSS	Bit Rate (Mbps):	5.5

Channel Power (dBm):	16.13

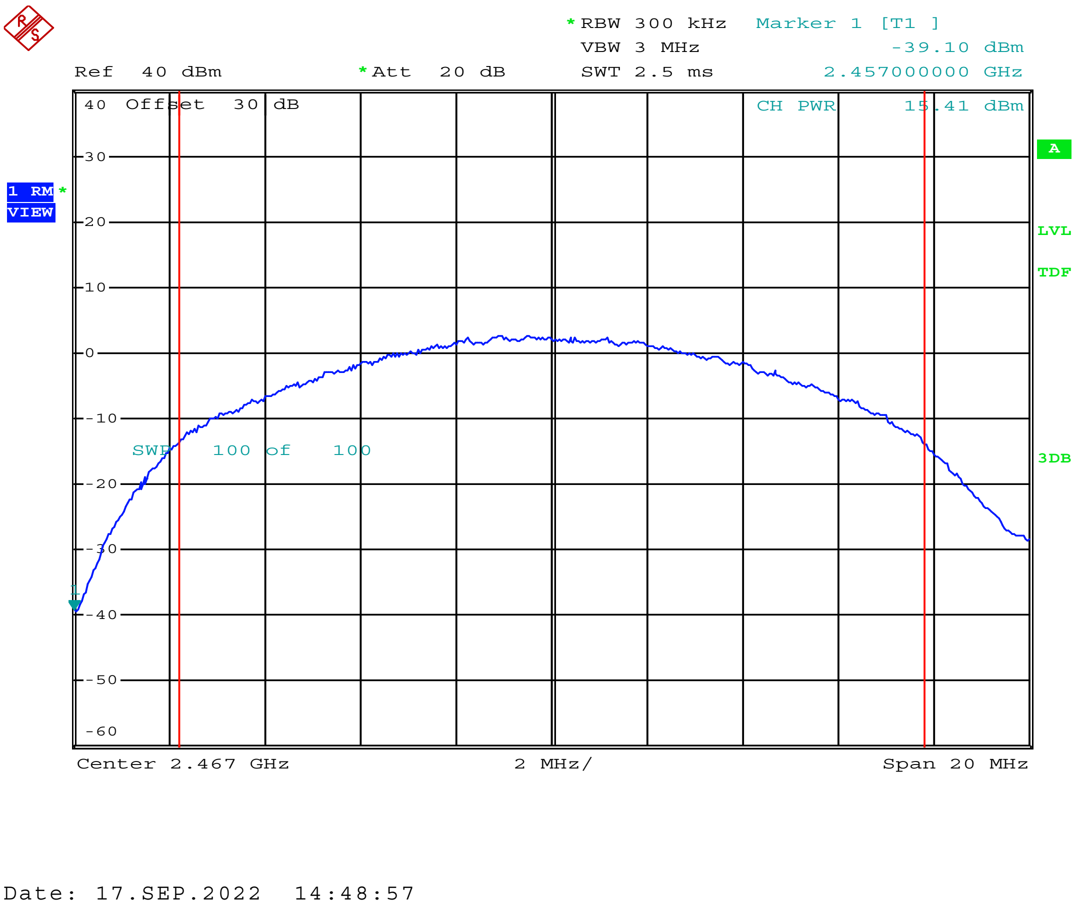
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:48:08

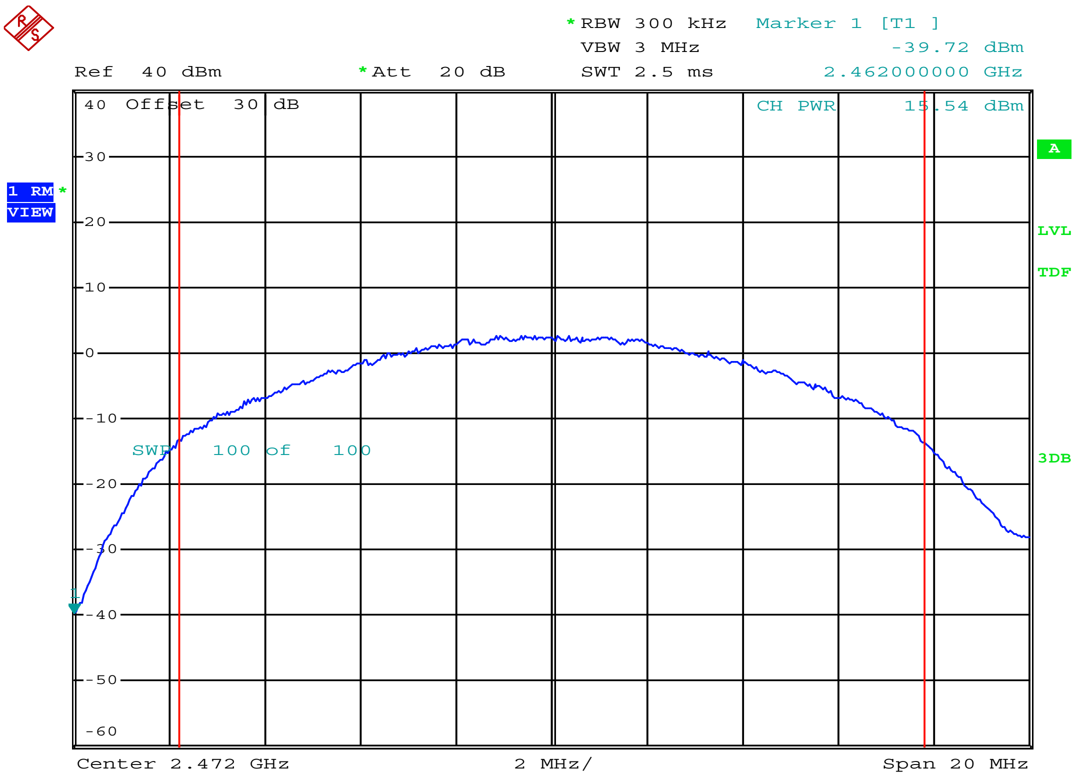
Channel Number:	**11**	Channel Frequency (MHz):	**2462**	Channel Power (dBm):	**15.47**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

Conducted Output Power WiFi 802.11b



Channel Number:	**12**	Channel Frequency (MHz):	**2467**	Channel Power (dBm):	**15.41**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

Conducted Output Power WiFi 802.11b

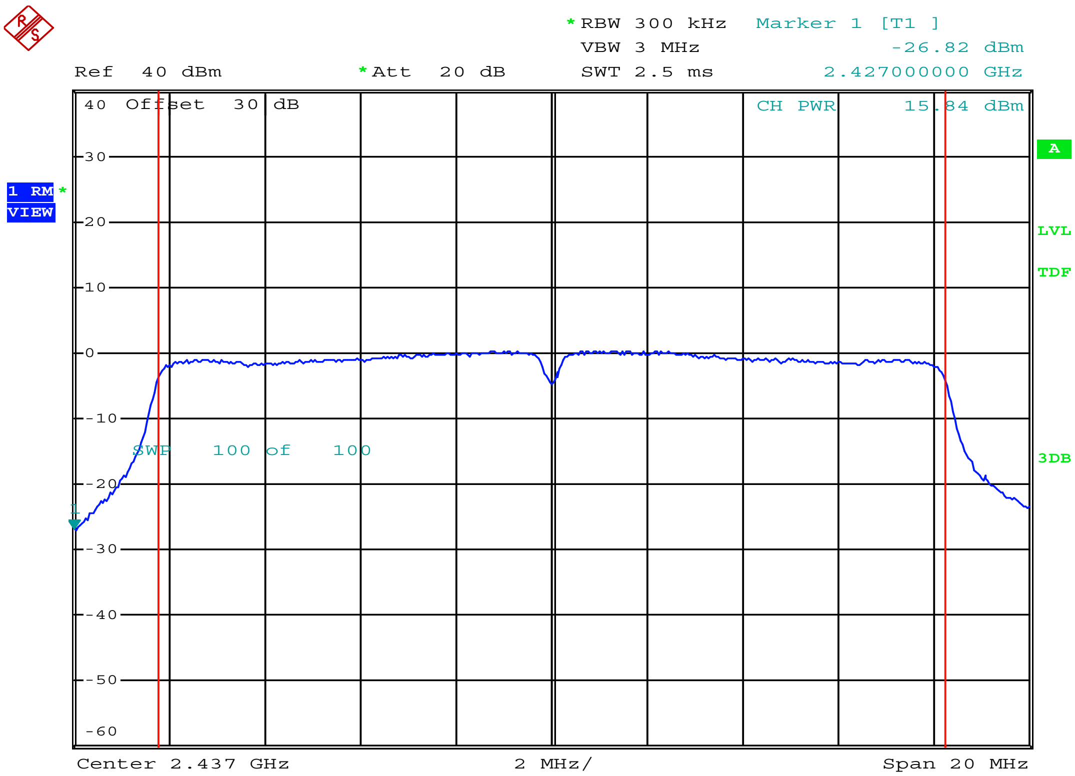


Date: 17.SEP.2022 14:49:40

Channel Number:	**13**	Channel Frequency (MHz):	**2472**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**

Channel Power (dBm):	**15.54**

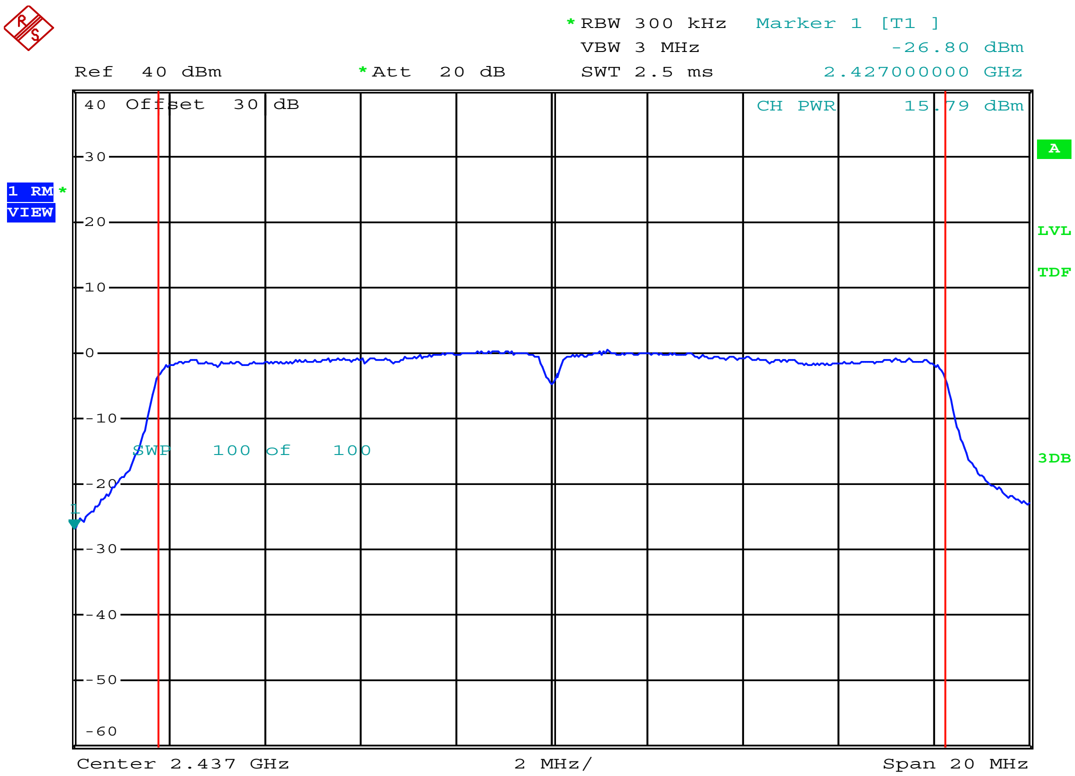
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:56:37

Channel Number:	6	Channel Frequency (MHz):	2437	Channel Power (dBm):	15.84
Modulation:	OFDM	Bit Rate (Mbps):	6		

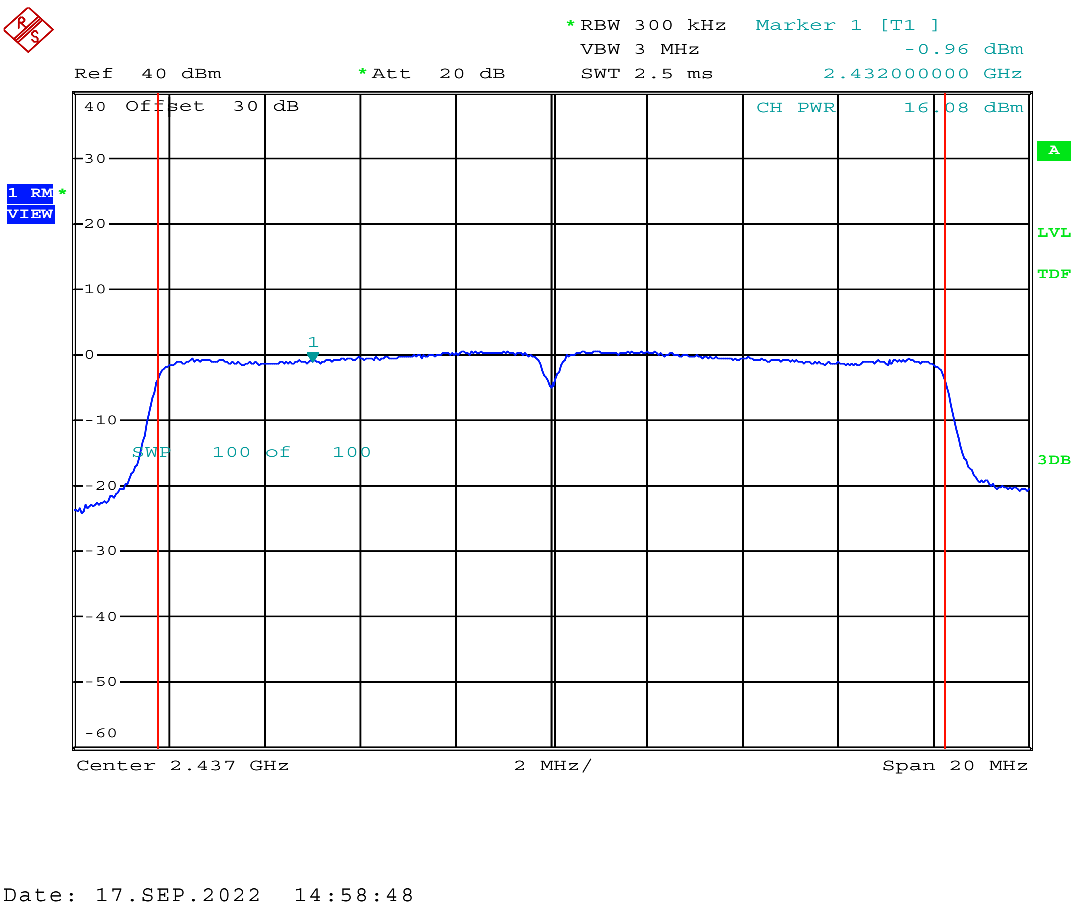
Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 14:57:32

Channel Number: 6	Channel Frequency (MHz): 2437	Channel Power (dBm):	15.79
Modulation: OFDM	Bit Rate (Mbps): 9		

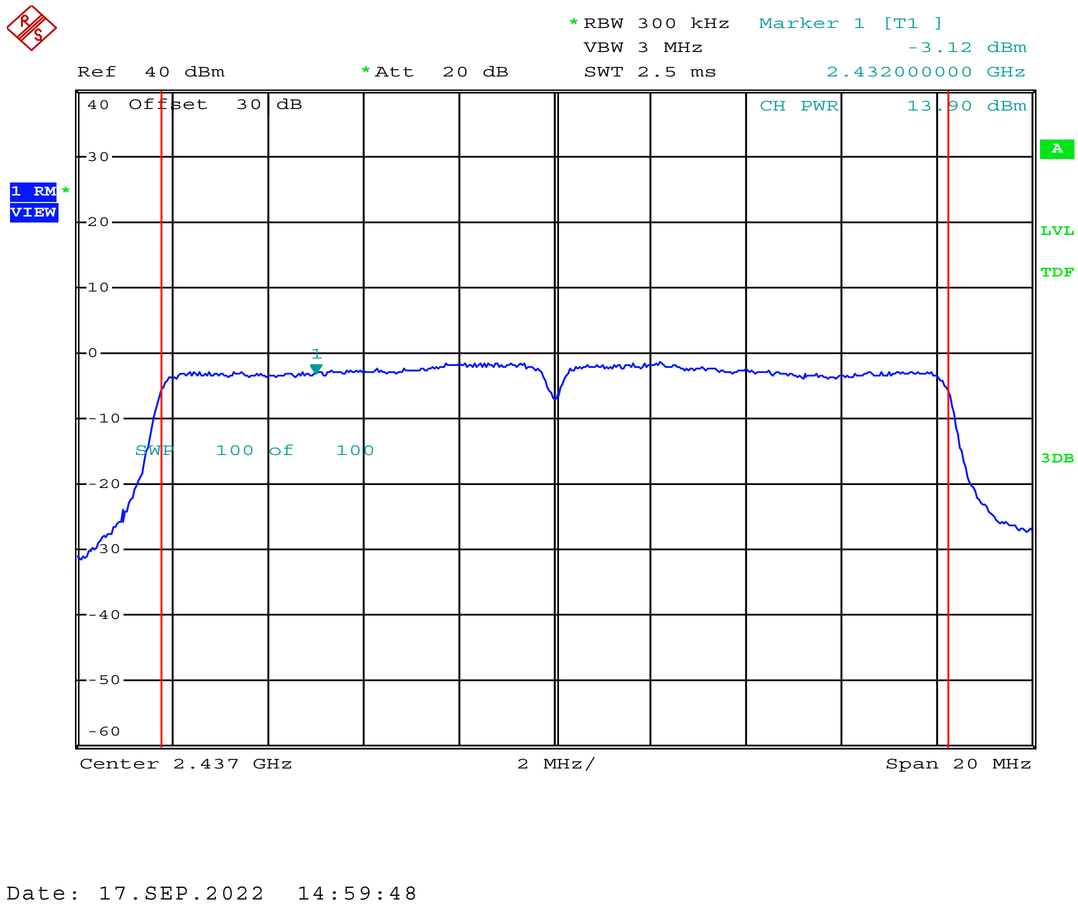
Conducted Output Power WiFi 802.11b



Channel Number:	6	Channel Frequency (MHz):	2437
Modulation:	OFDM	Bit Rate (Mbps):	12

Channel Power (dBm):	16.08

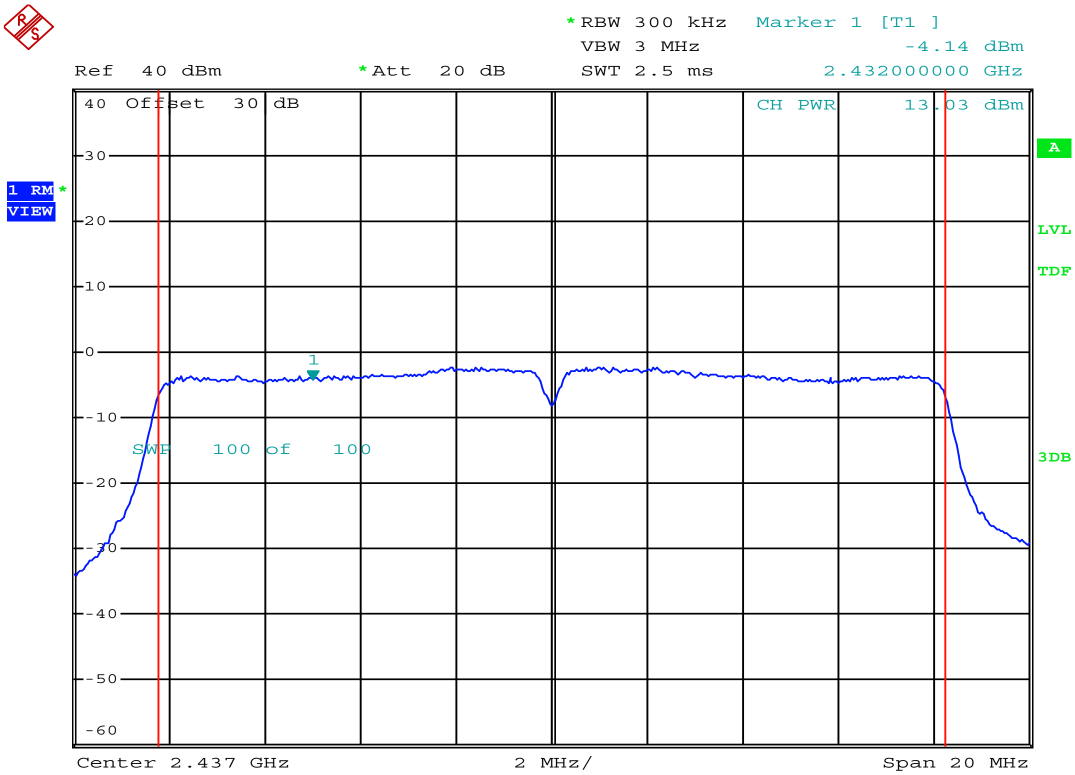
Conducted Output Power WiFi 802.11b



Channel Number:	6	Channel Frequency (MHz):	2437
Modulation:	OFDM	Bit Rate (Mbps):	36

Channel Power (dBm):	13.90

Conducted Output Power WiFi 802.11b

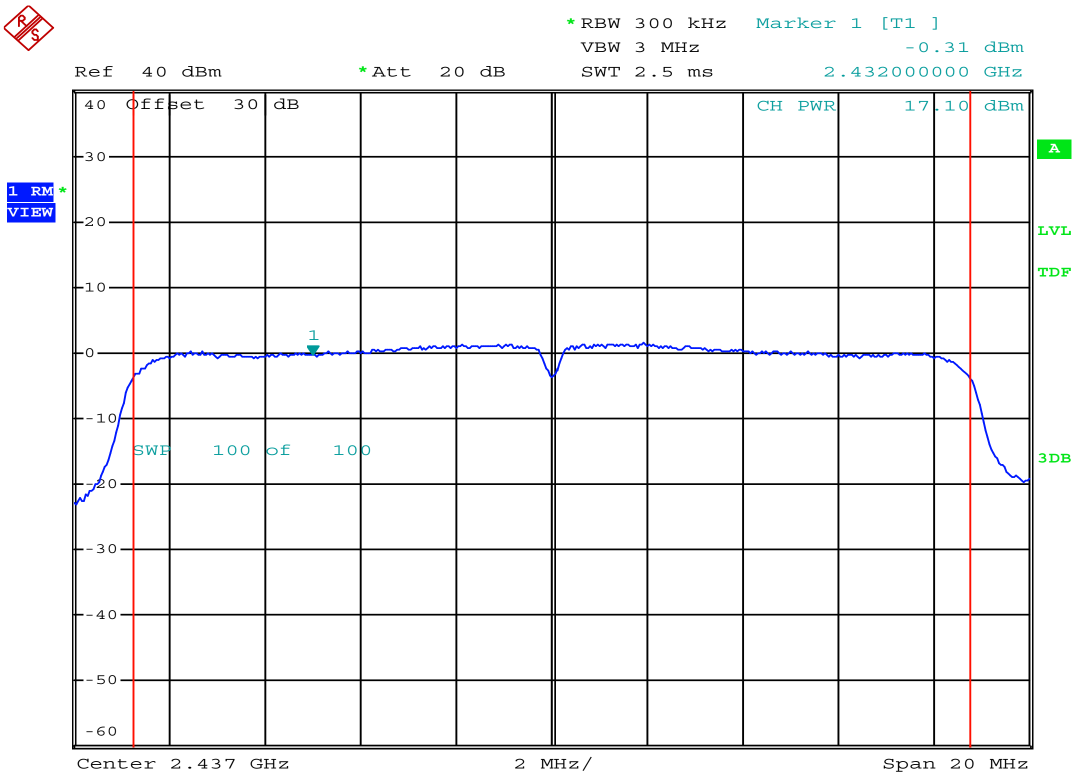


Date: 17.SEP.2022 15:00:35

Channel Number:	6	Channel Frequency (MHz):	2437
Modulation:	OFDM	Bit Rate (Mbps):	54

Channel Power (dBm):	13.03

Conducted Output Power WiFi 802.11b

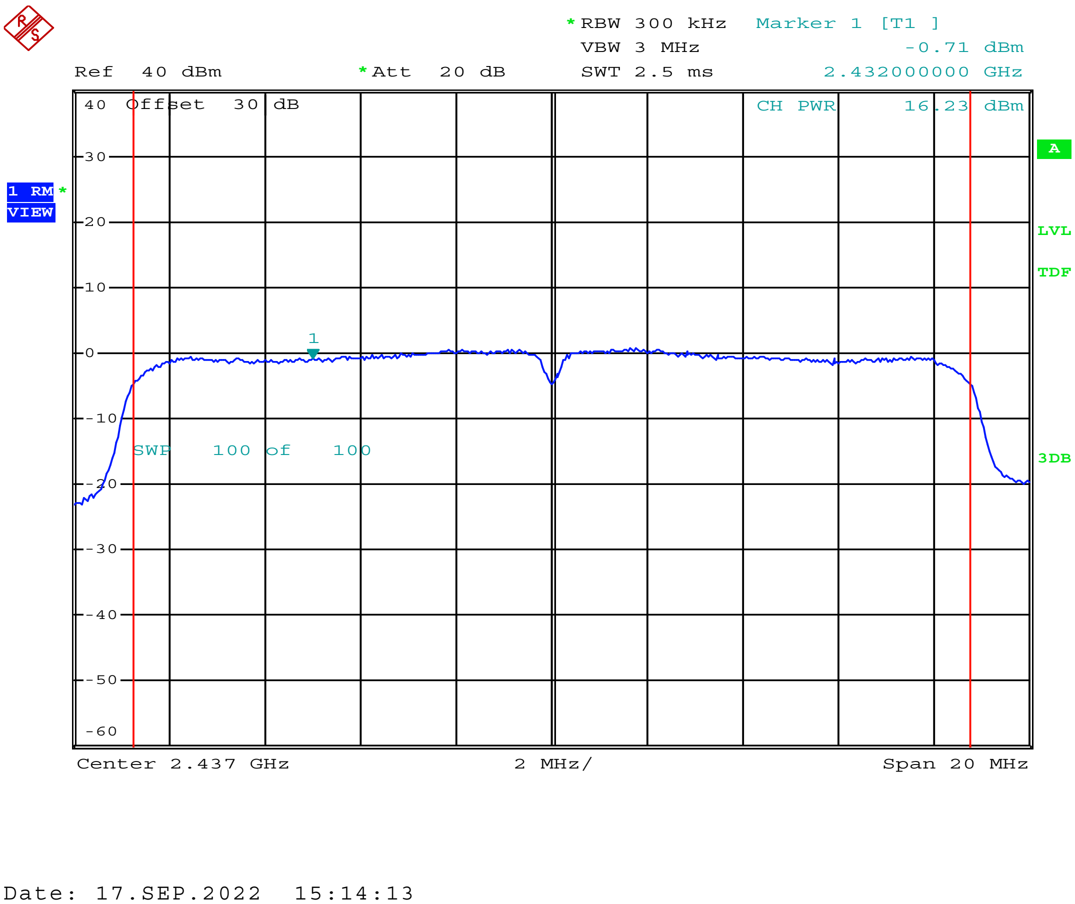


Date: 17.SEP.2022 15:13:23

Channel Number:	**6**	Channel Frequency (MHz):	**2437**
Modulation:	**OFDM**	Bit Rate (Mbps):	**MCS0**

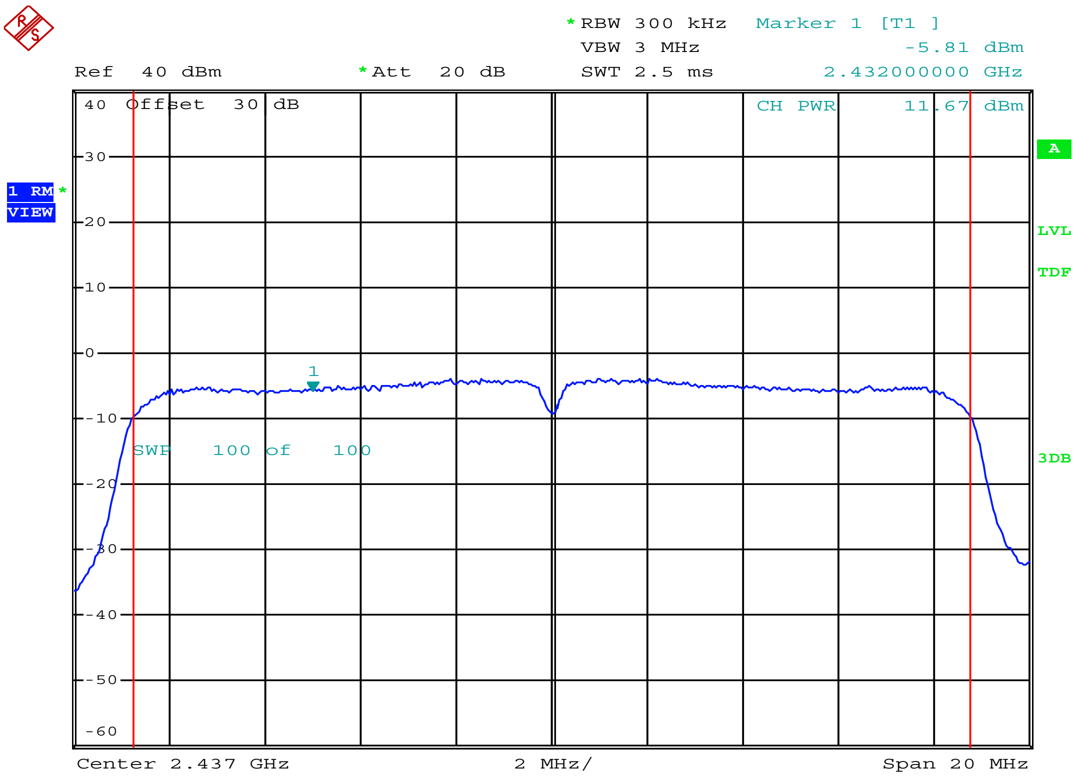
Channel Power (dBm): **17.10**

Conducted Output Power WiFi 802.11b



Channel Number:	6	Channel Frequency (MHz):	2437	Channel Power (dBm):	16.23
Modulation:	OFDM	Bit Rate (Mbps):	MCS3		

Conducted Output Power WiFi 802.11b



Date: 17.SEP.2022 15:14:58

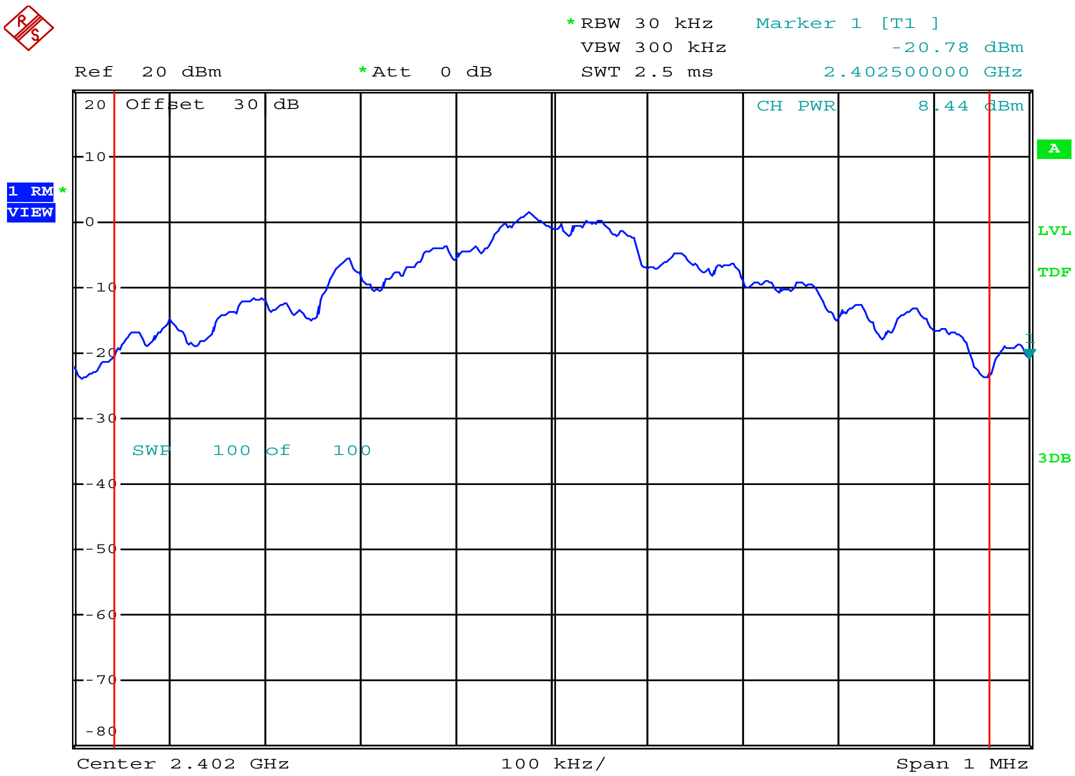
Channel Number:	6	Channel Frequency (MHz):	2437	Channel Power (dBm):	11.67
Modulation:	OFDM	Bit Rate (Mbps):	MCS7		

Conducted Power Measurement Results: BlueTooth														
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Transmit Duty Cycle (%)**	**Measured Power [P_{Meas}] (dBm)**	**Conducted Limit [P_{Lim}] (dBm)**	**Conducted Margin (dB)**	**Antenna Gain (dBi)**	**EIRP [E_{Meas}] (dBm)**	**EIRP Limit [E_{Lim}] (dBm)**	**EIRP Margin (dB)**	**Result**
BT BR	2	2402.00	GFSK	-	100.00	8.44	30	21.6	-3.6	4.84	36	31.2	Complies
	40	2440.00	GFSK	-		9.02		21.0		5.42		30.6	Complies
	80	2480.00	GFSK	-		8.89		21.1		5.29		30.7	Complies
BT EDR2	2	2402.00	P1/4-DQPSK	2		8.51		21.5		4.91		31.1	Complies
	40	2440.00	P1/4-DQPSK	2		9.21		20.8		5.61		30.4	Complies
	80	2480.00	P1/4-DQPSK	2		9.48		20.5		5.88		30.1	Complies
BTEDR3	2	2402.00	8-DPSK	3		7.99		22.0		4.39		31.6	Complies
	41	2441.00	8-DPSK	3		8.45		21.6		4.85		31.2	Complies
	80	2480.00	8-DPSK	3		8.78		21.2		5.18		30.8	Complies

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

EIRP Margin = E_{Limit} - E_{Meas}

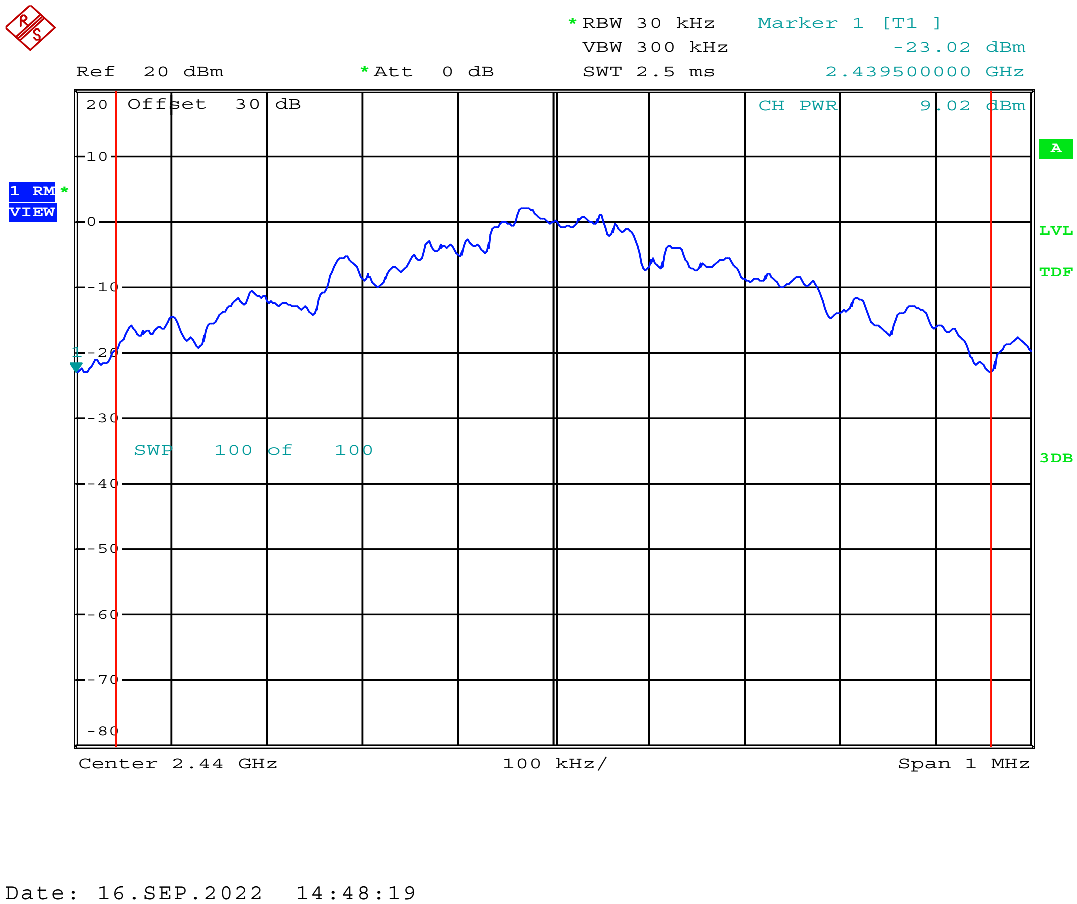
Conducted Output Power: BlueTooth



Date: 16.SEP.2022 14:45:45

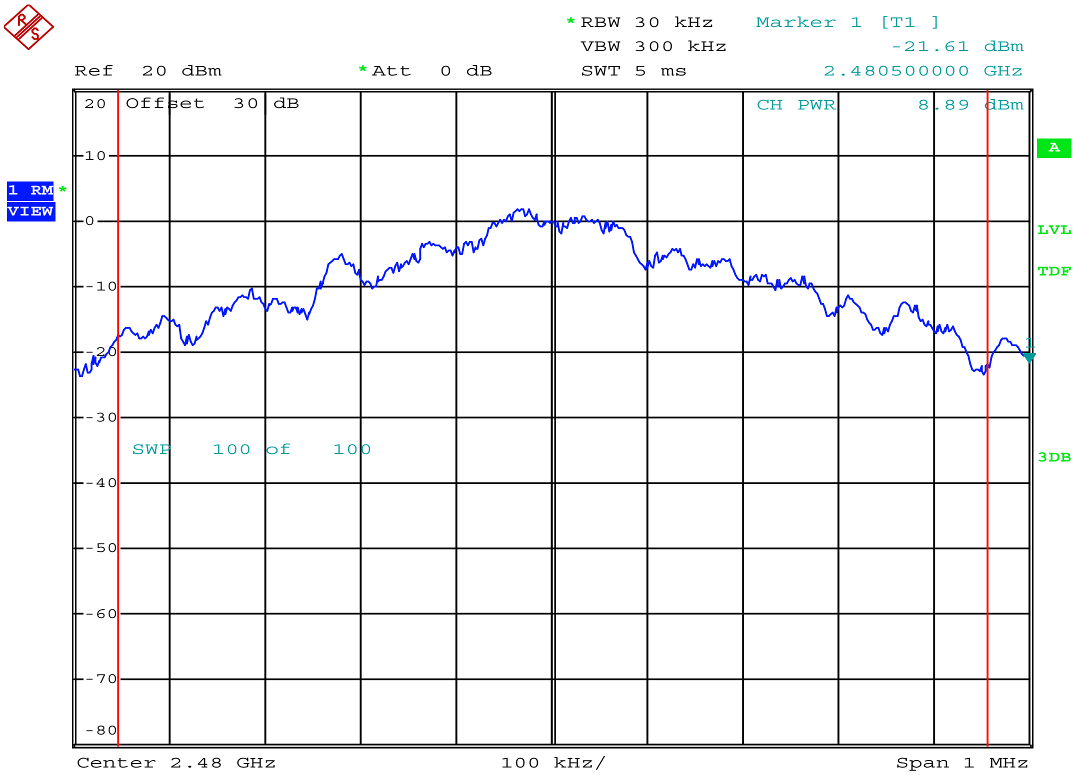
Channel Number:	2	Channel Frequency (MHz):	2402	Channel Power (dBm):	8.44
Modulation:	GFSK	Bit Rate (Mbps):	-		

Conducted Output Power: BlueTooth



Channel Number:	40	Channel Frequency (MHz):	2440	Channel Power (dBm):	9.02
Modulation:	GFSK	Bit Rate (Mbps):	-		

Conducted Output Power: BlueTooth

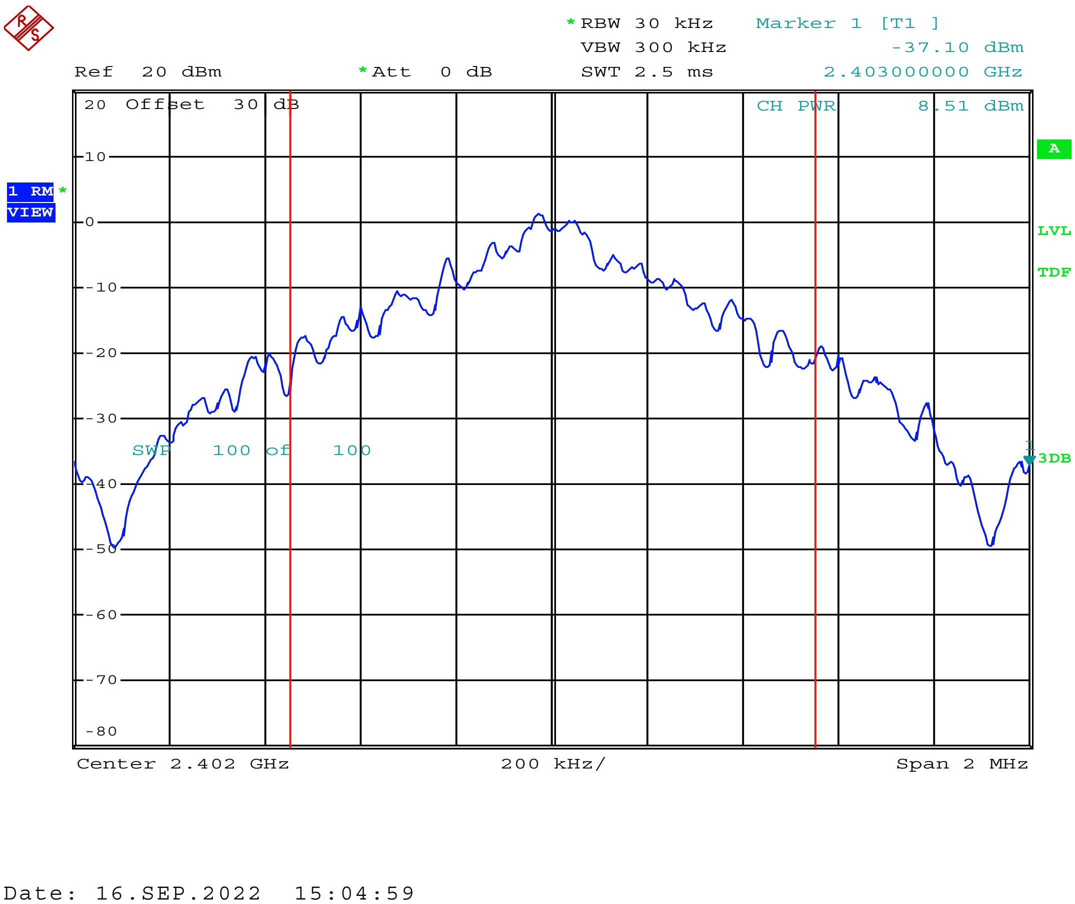


Date: 30.OCT.2022 10:42:42

Channel Number:	**80**	Channel Frequency (MHz):	**2480**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**

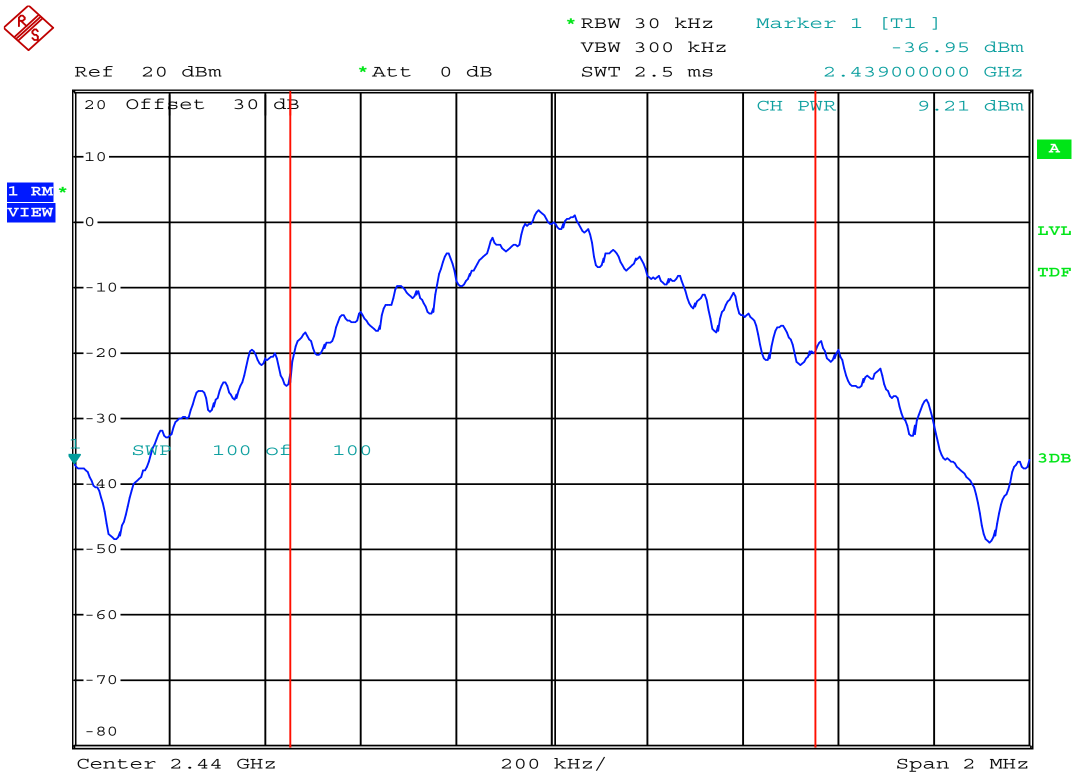
Channel Power (dBm):	**8.89**

Conducted Output Power: BlueTooth



Channel Number: 2	Channel Frequency (MHz): 2402	Channel Power (dBm):	8.51
Modulation: P1/4-DQPSK	Bit Rate (Mbps): 2		

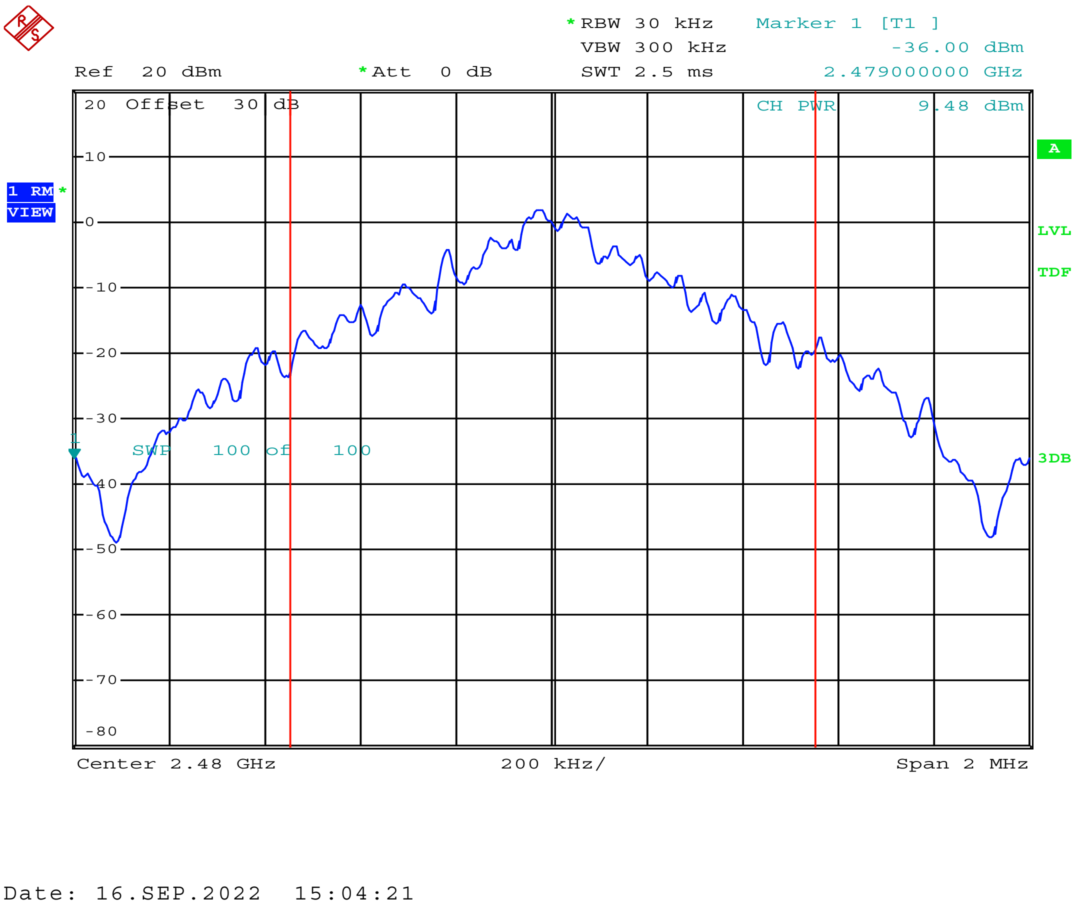
Conducted Output Power: BlueTooth



Date: 16.SEP.2022 15:03:33

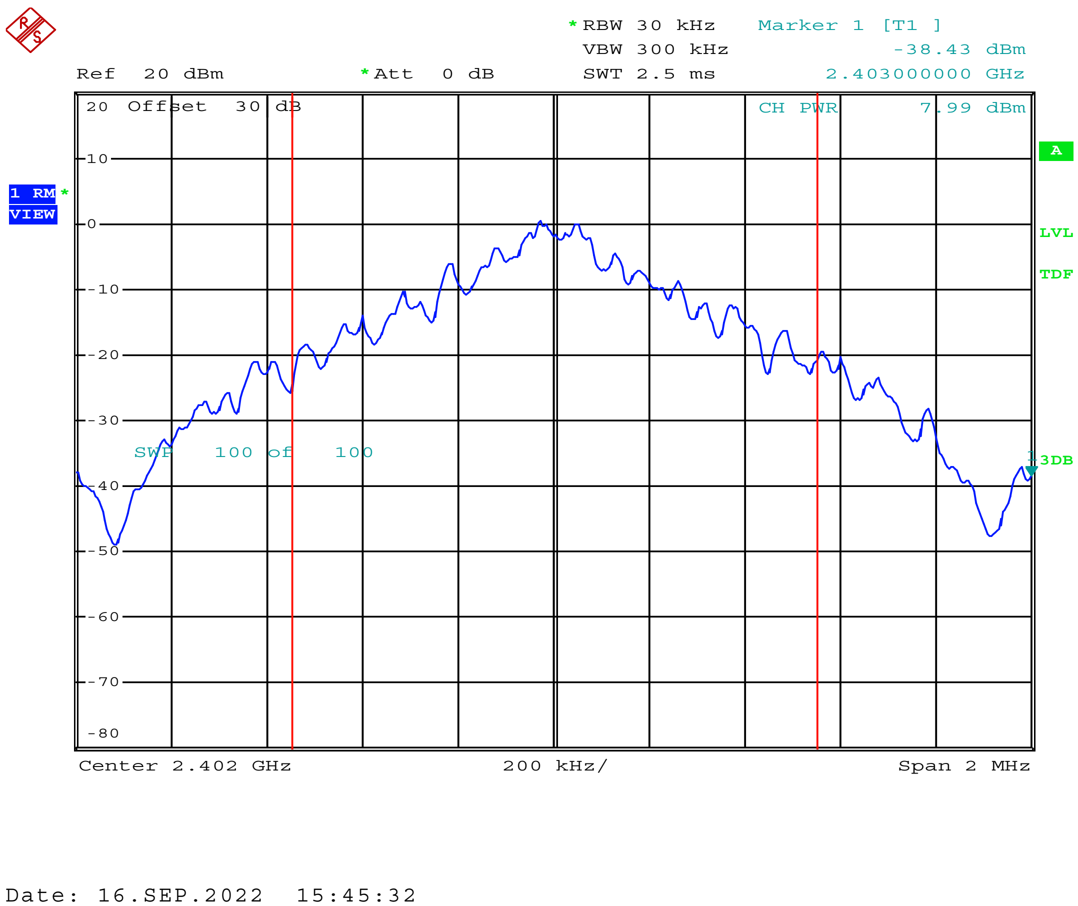
Channel Number:	**40**	Channel Frequency (MHz):	**2440**	Channel Power (dBm):	**9.21**
Modulation:	**P1/4-DQPSK**	Bit Rate (Mbps):	**2**		

Conducted Output Power: BlueTooth



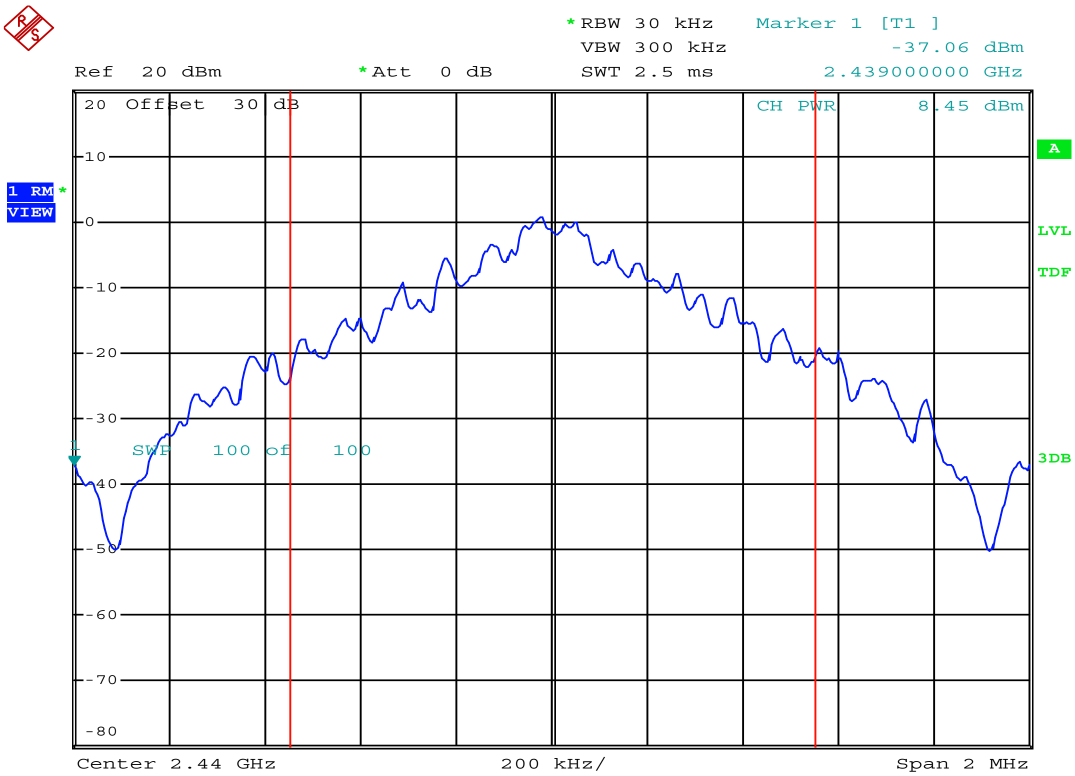
Channel Number:	80	Channel Frequency (MHz):	2480	Channel Power (dBm):	9.48
Modulation:	P1/4-DQPSK	Bit Rate (Mbps):	2		

Conducted Output Power: BlueTooth



Channel Number: 2	Channel Frequency (MHz): 2402	Channel Power (dBm):	7.99
Modulation: 8-DPSK	Bit Rate (Mbps): 3		

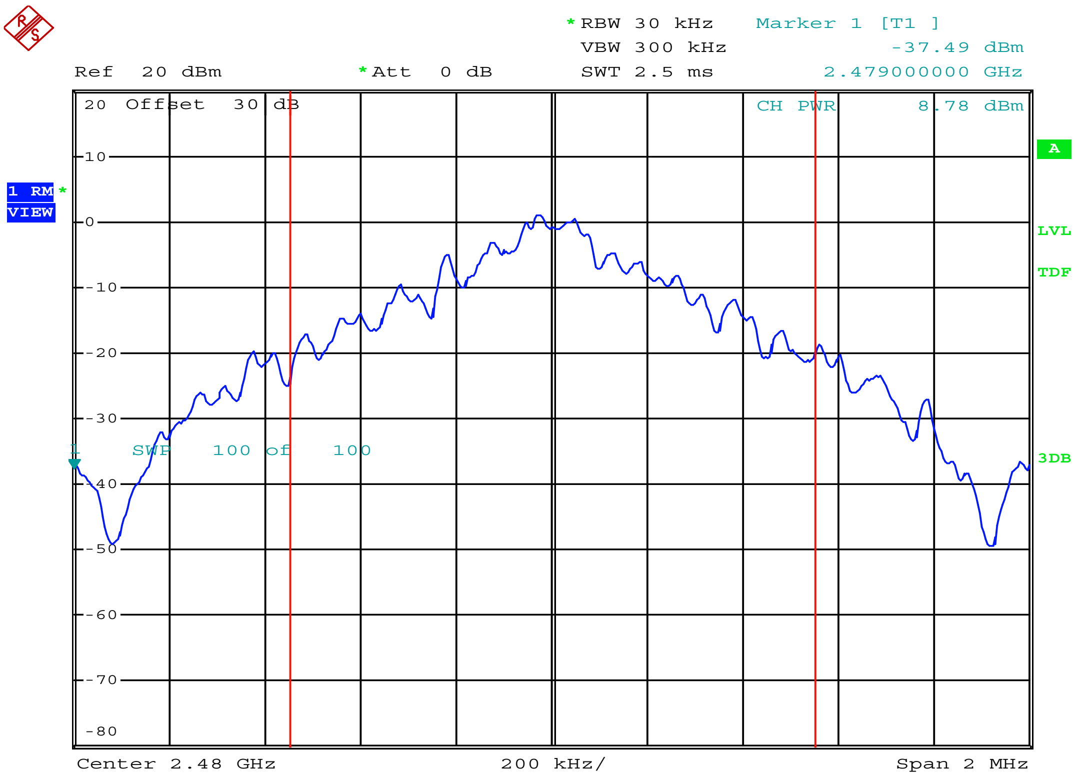
Conducted Output Power: BlueTooth



Date: 16.SEP.2022 15:46:12

Channel Number:	40	Channel Frequency (MHz):	2440	Channel Power (dBm):	8.45
Modulation:	8-DPSK	Bit Rate (Mbps):	3		

Conducted Output Power: BlueTooth



Date: 16.SEP.2022 15:45:02

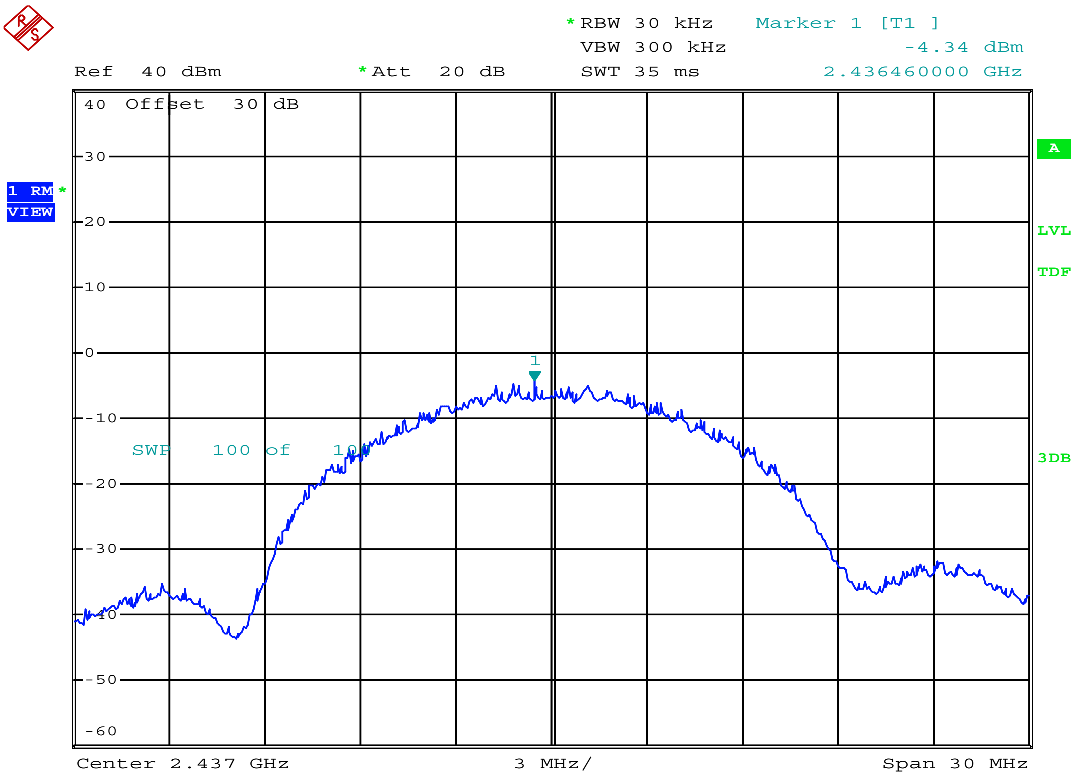
Channel Number:	**80**	Channel Frequency (MHz):	**2480**
Modulation:	**8-DPSK**	Bit Rate (Mbps):	**3**

Channel Power (dBm): **8.78**

Power Spectral Density Measurement Results: 802.11							
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured PSD [P_{Meas}] (dBm)	PSD Limit [P_{Lim}] (dBm)	Conducted Margin (dB)
802.11b	6	2437	DSSS	5.5	-4.34	8	12.3
802.11g	6	2437	OFDM	6	-8.28	8	16.3
802.11n	6	2437	OFDM	MCS0	-8.16	8	16.2
					Result:	Complies	

Margin = P_{Limit} - P_{Meas}

Power Spectral Density: WiFi

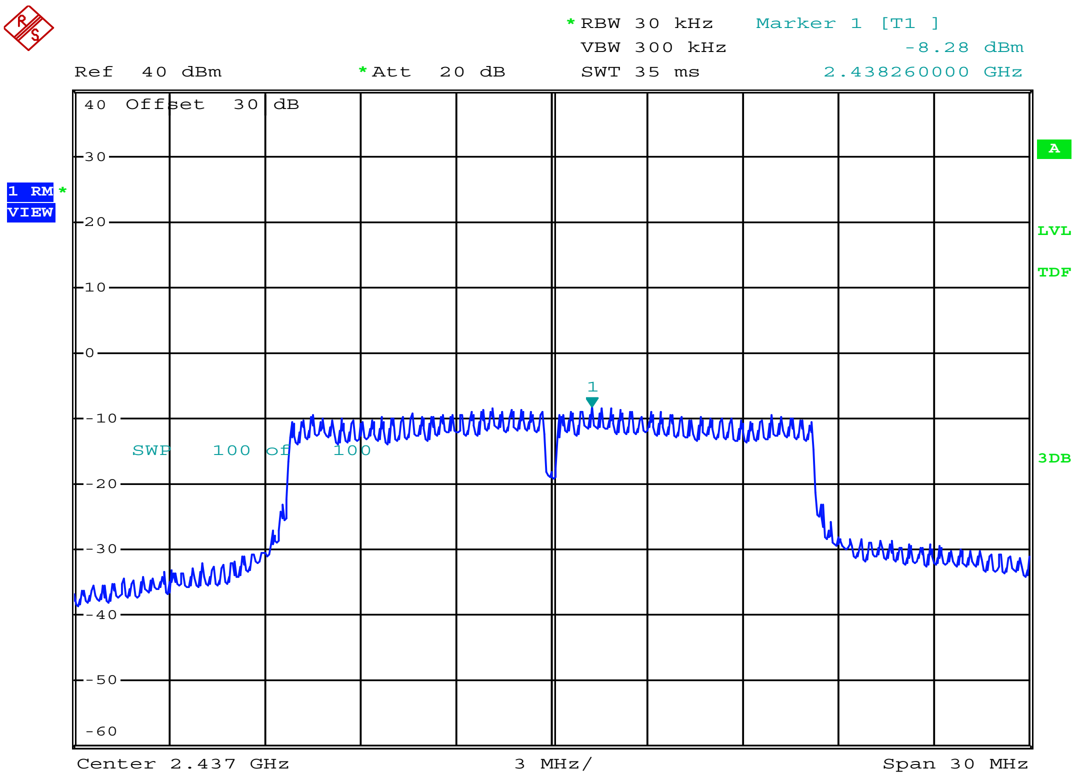


Date: 17.SEP.2022 16:13:42

Channel Number:	6	Channel Frequency (MHz):	2437
Modulation:	DSSS	Bit Rate (Mbps):	5.5

Measured PSD (dBm):	-4.34

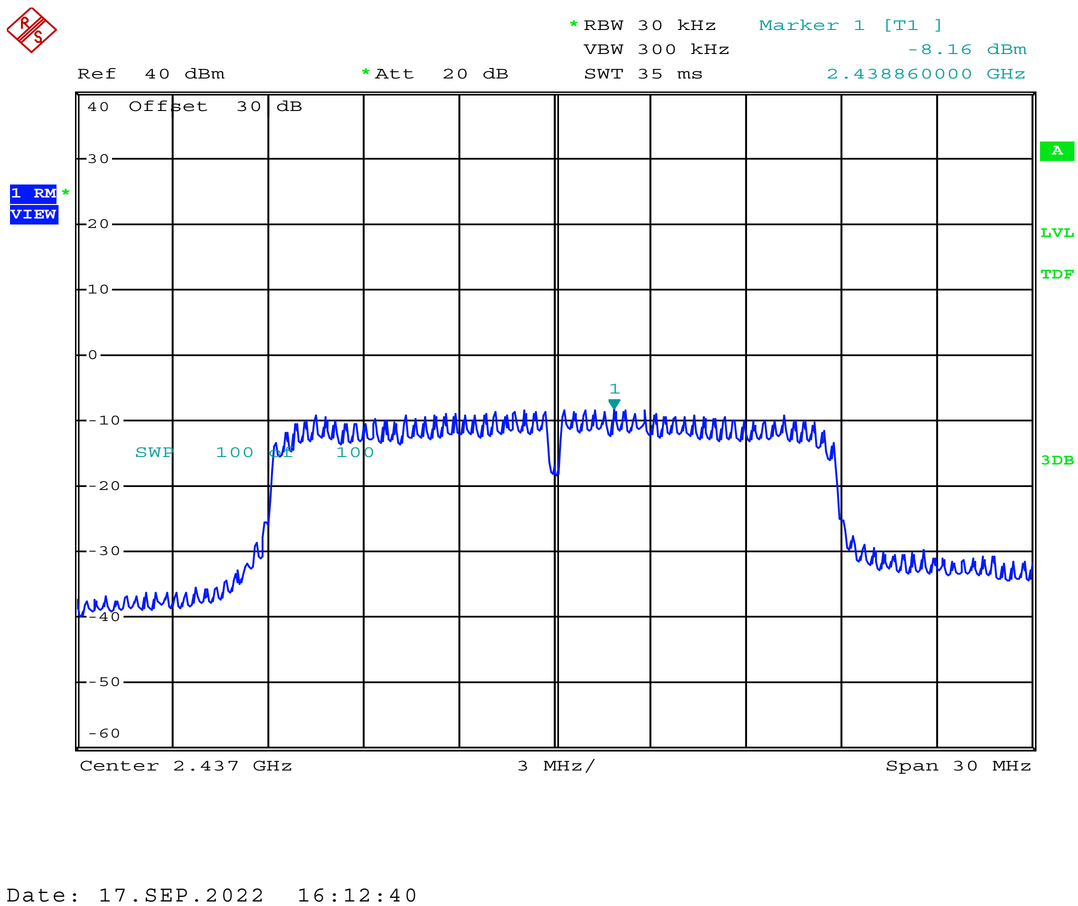
Power Spectral Density: WiFi



Date: 17.SEP.2022 16:11:40

Channel Number:	**6**	Channel Frequency (MHz):	**2437**	Measured PSD (dBm):	**-8.28**
Modulation:	**OFDM**	Bit Rate (Mbps):	**12**		

Power Spectral Density: WiFi

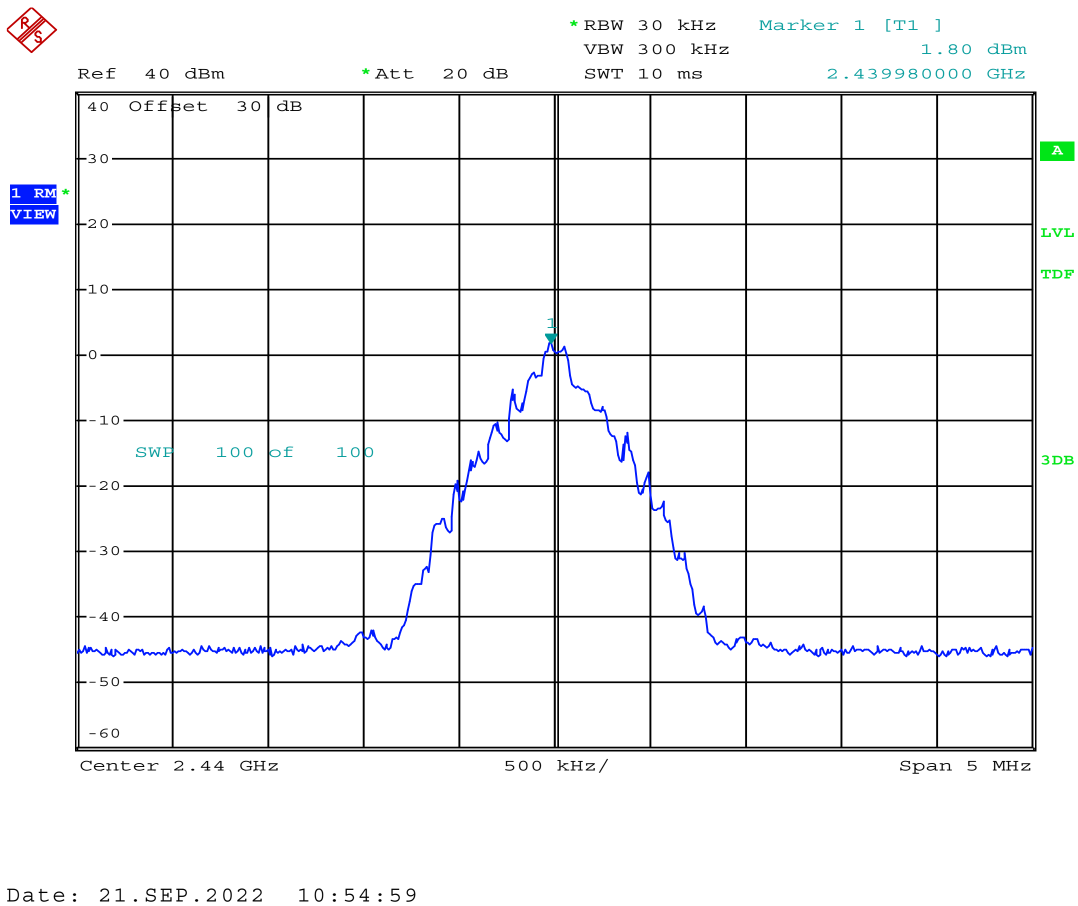


Channel Number:	**6**	Channel Frequency (MHz):	**2437**	Measured PSD (dBm):	**-8.16**
Modulation:	**OFDM**	Bit Rate (Mbps):	**MCS0**		

Power Spectral Density Measurement Results: BlueTooth							
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured PSD [P_{Meas}] (dBm)	PSD Limit [P_{Lim}] (dBm)	Conducted Margin (dB)
BT BR	40	2440	GFSK	-	1.80	8	6.2
BT EDR2			P1/4-DQPSK	2.0	1.57	8	6.4
BT EDR3			8-DPSK	3.0	1.26	8	6.7
					Result:	Complies	

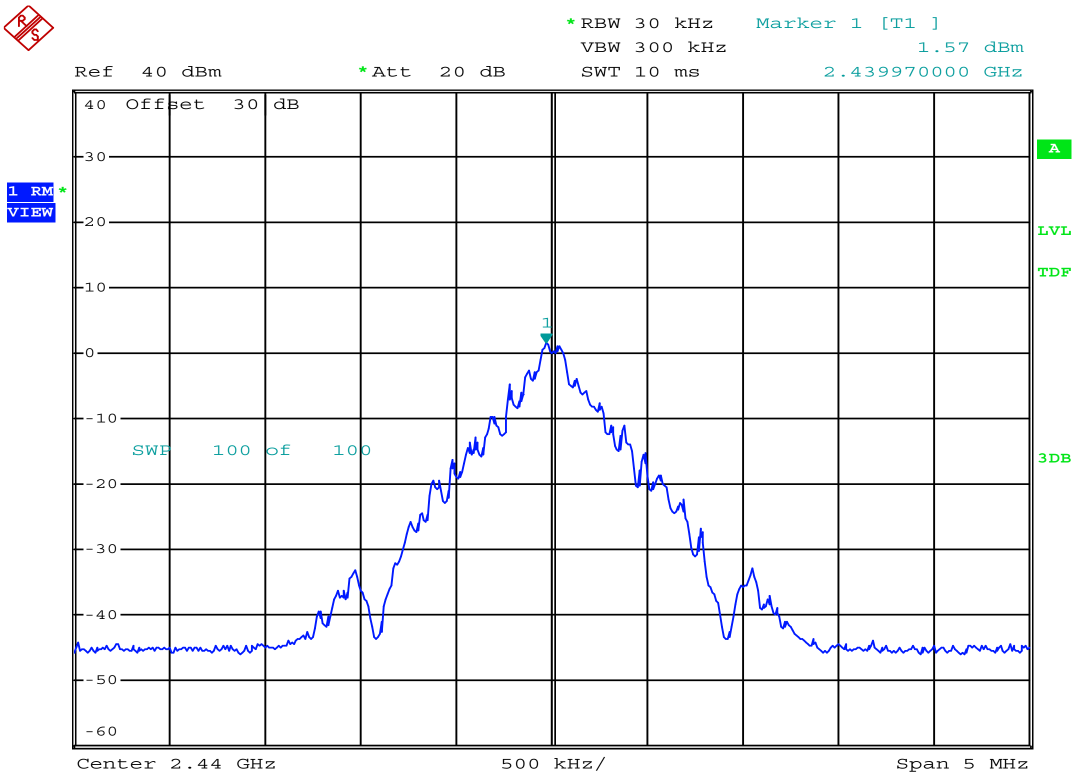
Margin = P_{Limit} - P_{Meas}

Power Spectral Density: BlueTooth



Channel Number:	40	Channel Frequency (MHz):	2440	Measured PSD (dBm):	1.80
Modulation:	GFSK	Bit Rate (Mbps):	-		

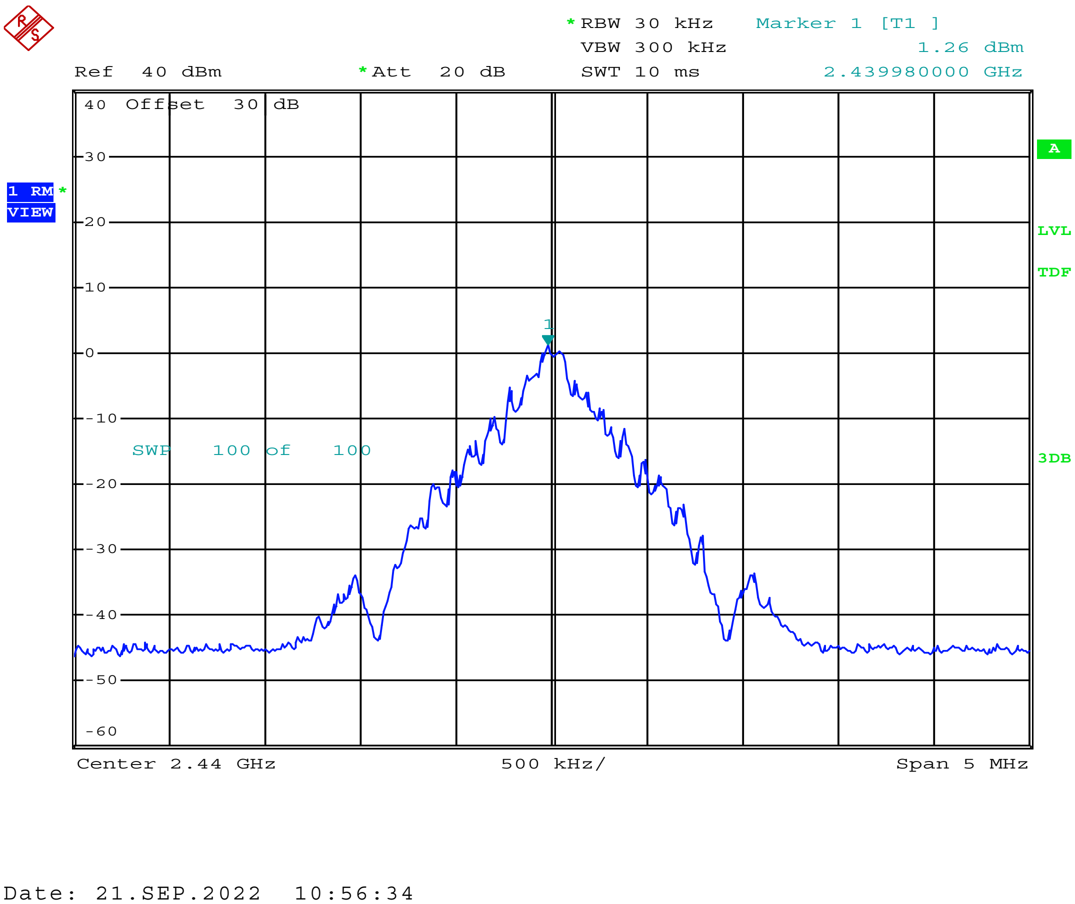
Power Spectral Density: BlueTooth



Date: 21.SEP.2022 10:55:59

Channel Number:	**40**	Channel Frequency (MHz):	**2440**
Modulation:	**P1/4-DQPSK**	Bit Rate (Mbps):	**2**
Measured PSD (dBm):	**1.57**		

Power Spectral Density: BlueTooth



Channel Number:	**40**	Channel Frequency (MHz):	**2440**	Measured PSD (dBm):	**1.26**
Modulation:	**8-DPSK**	Bit Rate (Mbps):	**3**		

Band Edge Measurement Results: 802.11														
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	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	2412.00	DSSS	5.5	100.00	-30.90	0.6	-30.30	3.11	3.71	34.01	30	4.0
	11	2462.00				-45.05		-44.45	1.15	1.75	46.20		16.2
802.11g	1	2412.00	OFDM	6		-42.33		-41.73	-4.65	-4.05	37.68		7.7
	11	2462.00				-43.76		-43.16	-4.36	-3.76	39.40		9.4
802.11n	1	2412.00	OFDM	MCS0		-44.19		-43.59	-5.38	-4.78	38.81		8.8
	11	2462.00				-50.33		-49.73	-5.95	-5.35	44.38		14.4
												Result:	Complies

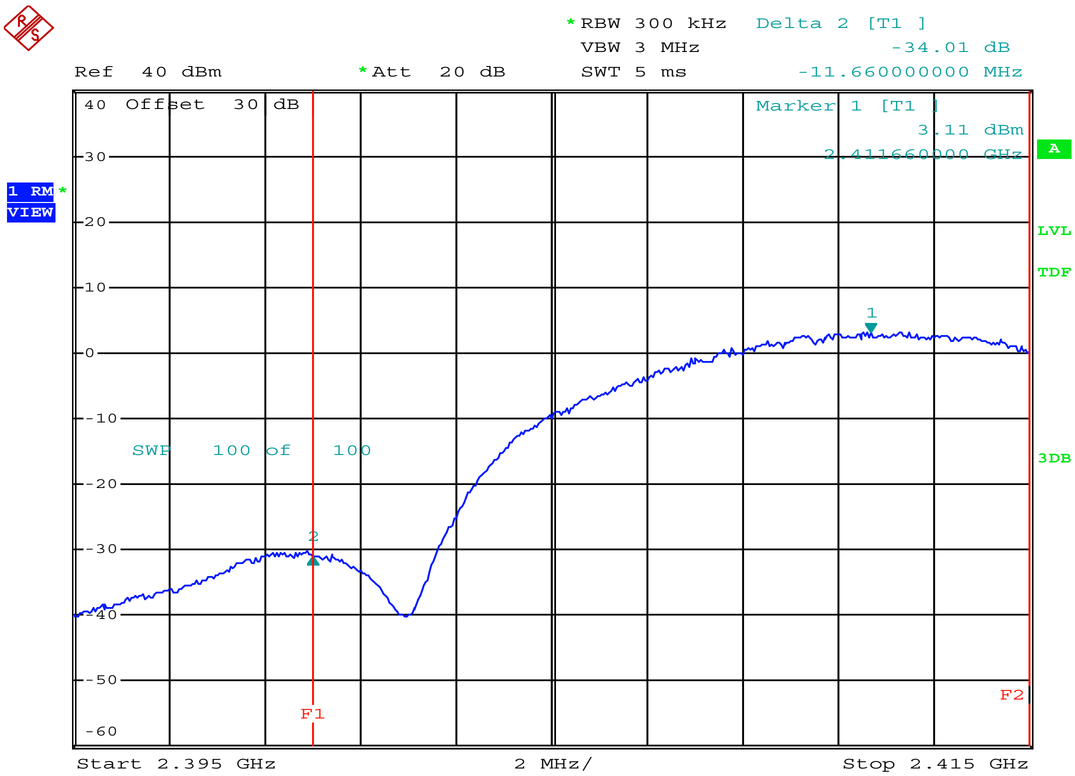
Emission $[E_{Em}] = [P_{Em}] + [G_T]$

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

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

Margin = Attenuation - Limit

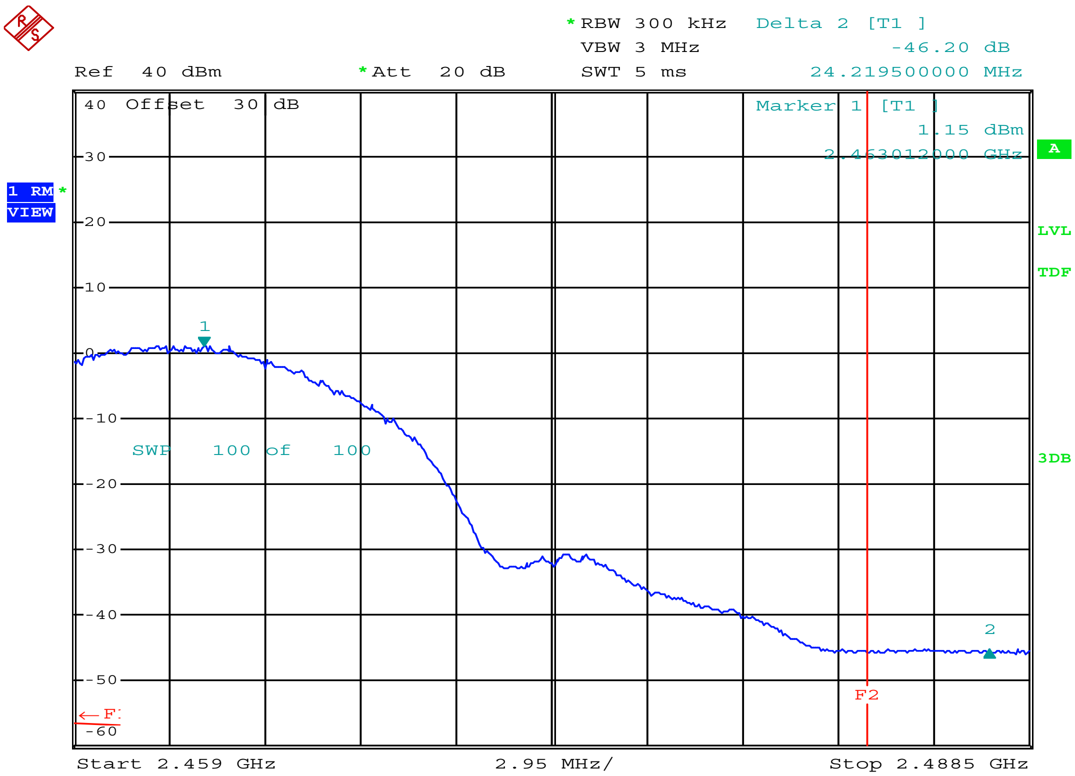
Lower Band Edge: 802.11b



Date: 6.OCT.2022 13:53:15

Channel Number: 1	Channel Frequency (MHz): 2412	Emission Power (dBm):	-30.90
Modulation: DSSS	Bit Rate (Mbps): 5.5		

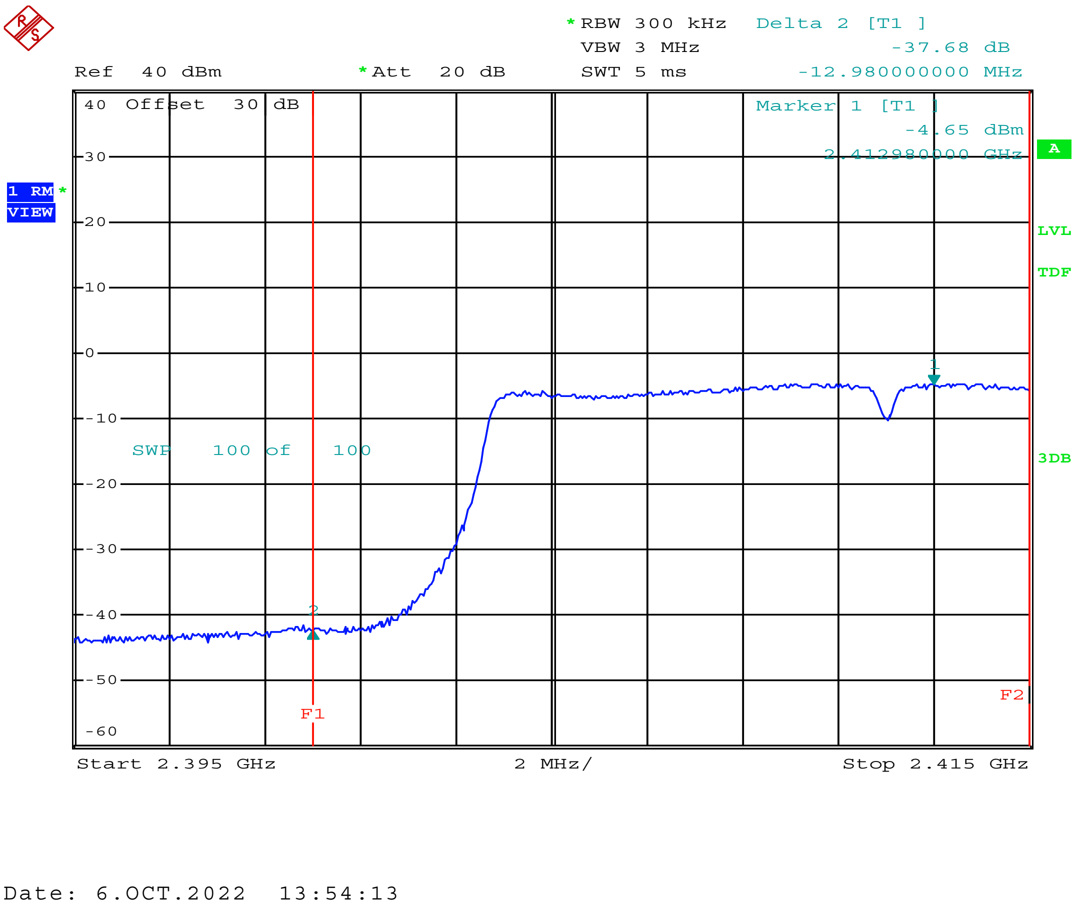
Upper Band Edge: 802.11b



Date: 6.OCT.2022 14:01:18

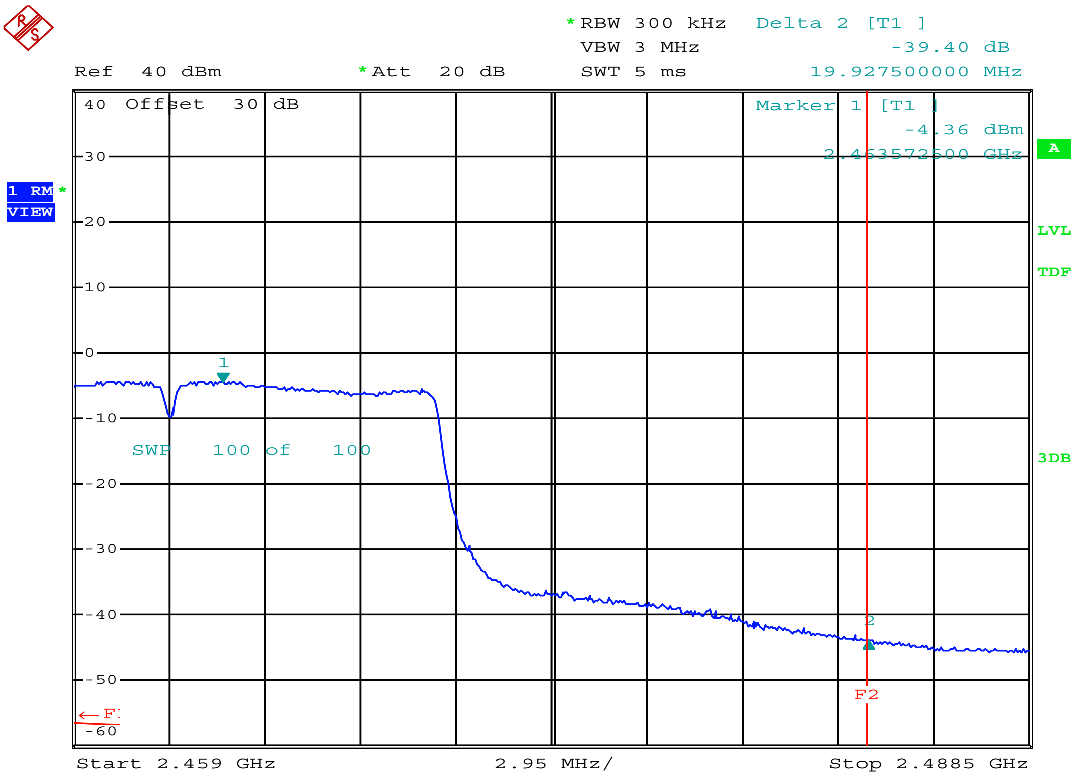
Channel Number:	**11**	Channel Frequency (MHz):	**2462**	Channel Power (dBm):	**-45.05**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**		

Lower Band Edge: 802.11g



Channel Number:	**1**	Channel Frequency (MHz):	**2412**	Channel Power (dBm):	**-42.33**
Modulation:	**OFDM**	Bit Rate (Mbps):	**6**		

Upper Band Edge: 802.11g

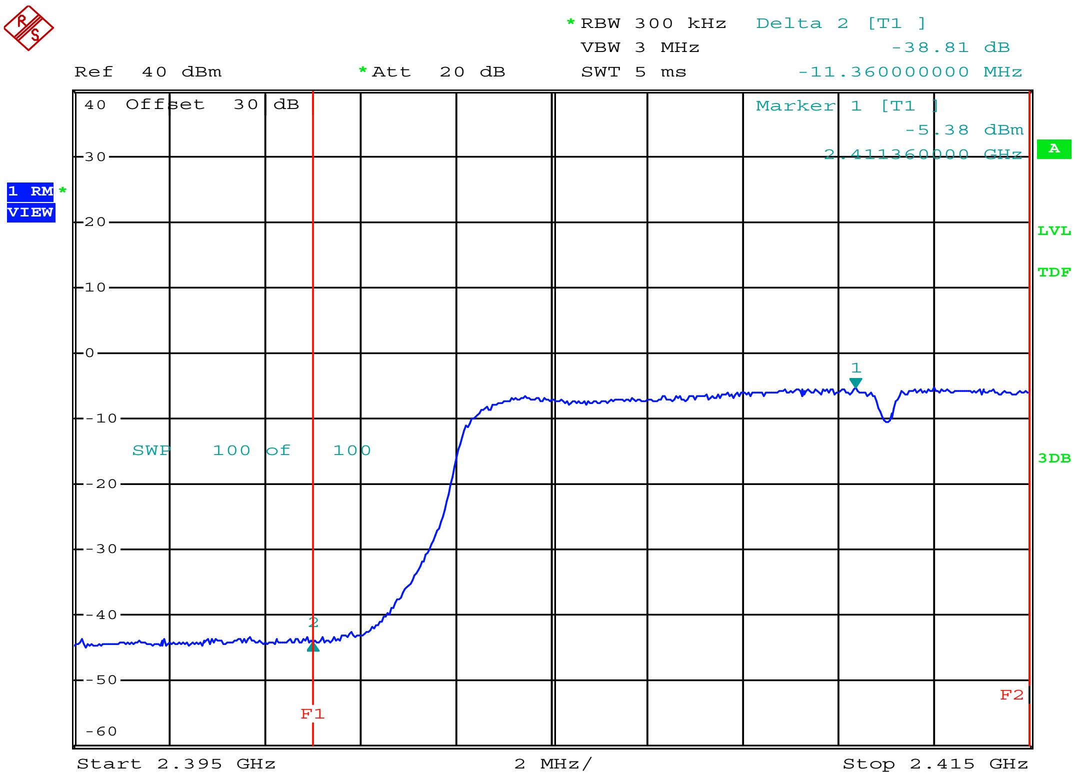


Date: 6.OCT.2022 14:00:16

Channel Number:	11	Channel Frequency (MHz):	2462
Modulation:	OFDM	Bit Rate (Mbps):	6

Channel Power (dBm): -43.76

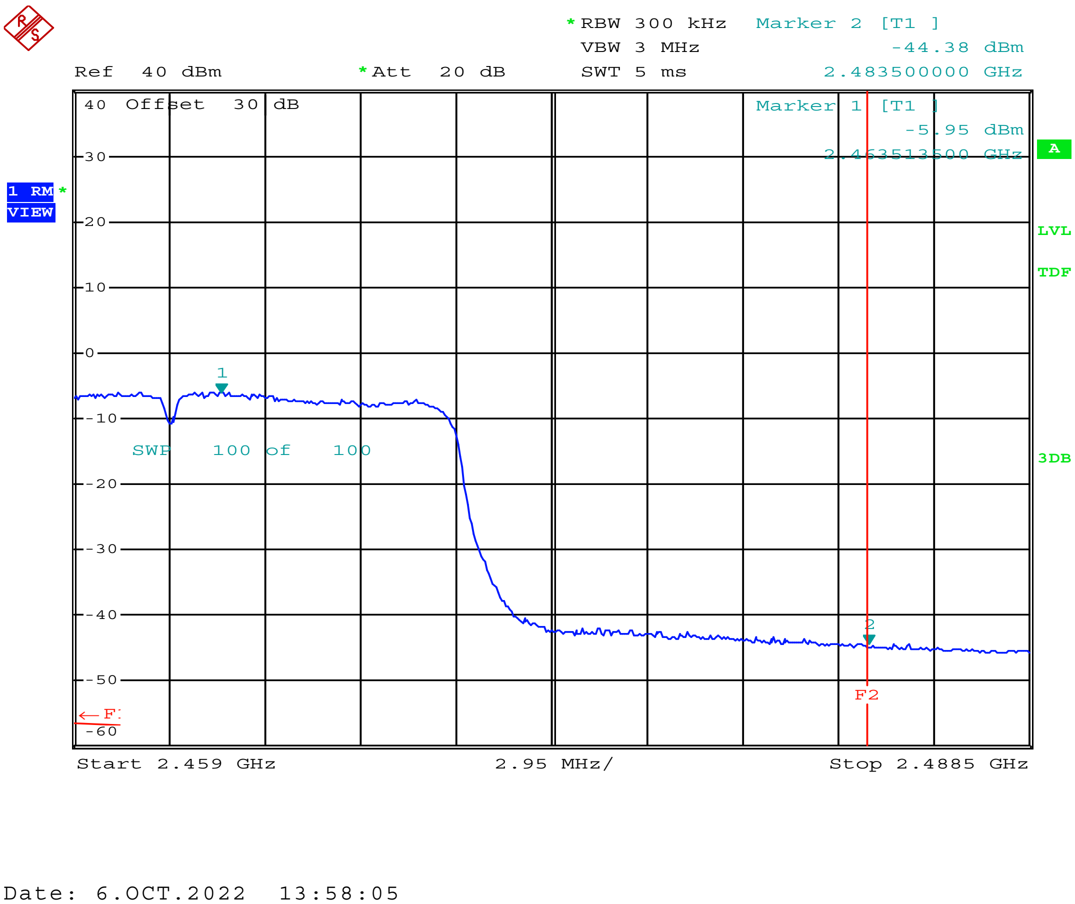
Lower Band Edge: 802.11n



Date: 6.OCT.2022 13:55:05

Channel Number:	**1**	Channel Frequency (MHz):	**2412**	Channel Power (dBm):	**-44.19**
Modulation:	**OFDM**	Bit Rate (Mbps):	**MCS0**		

Upper Band Edge: 802.11n



Channel Number:	**11**	Channel Frequency (MHz):	**2462**
Modulation:	**OFDM**	Bit Rate (Mbps):	**MCS0**

Channel Power (dBm): **-50.33**

Band Edge Measurement Results: FHSS													
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	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	2	2402.00	GFSK	1.0	100.00	-47.22	0.6	-46.62	0.88	1.48	48.10	30	18.1
	80	2480.00				-63.87		-63.27	1.99	2.59	65.86		35.9
BT EDR2	2	2402.00	Pi/4-DQPSK	2		-45.50		-44.90	0.95	1.55	46.45		16.5
	80	2480.00				-64.20		-63.60	2.13	2.73	66.33		36.3
BT EDR3	2	2402.00	8-DPSK	3		-45.07		-44.47	0.12	0.72	45.19		15.2
	80	2480.00				-63.58		-62.98	1.34	1.94	64.92		34.9
												Result:	Complies

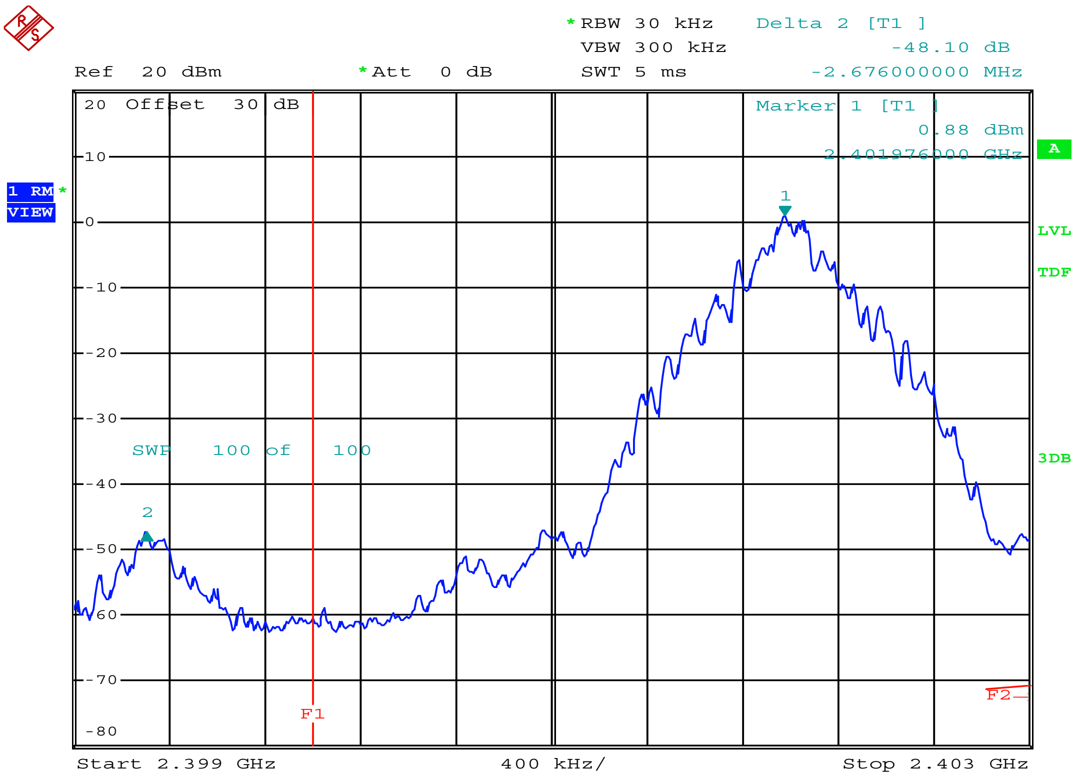
Emission $[E_{Em}] = [P_{Em}] + [G_T]$

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

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

Margin = Attenuation - Limit

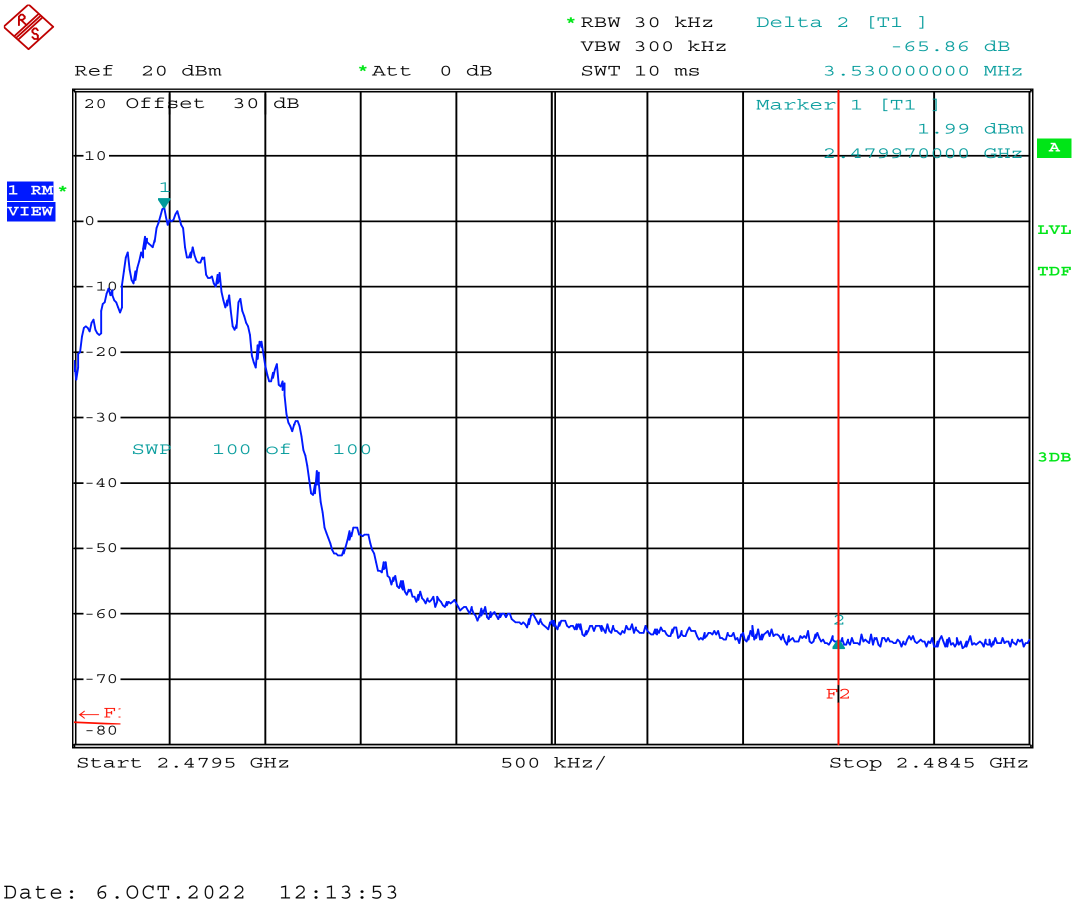
Lower Band Edge: BT BR



Date: 6.OCT.2022 12:21:28

Channel Number: 2	Channel Frequency (MHz): 2402	Emission Power (dBm):	-47.22
Modulation: GFSK	Bit Rate (Mbps): 2		

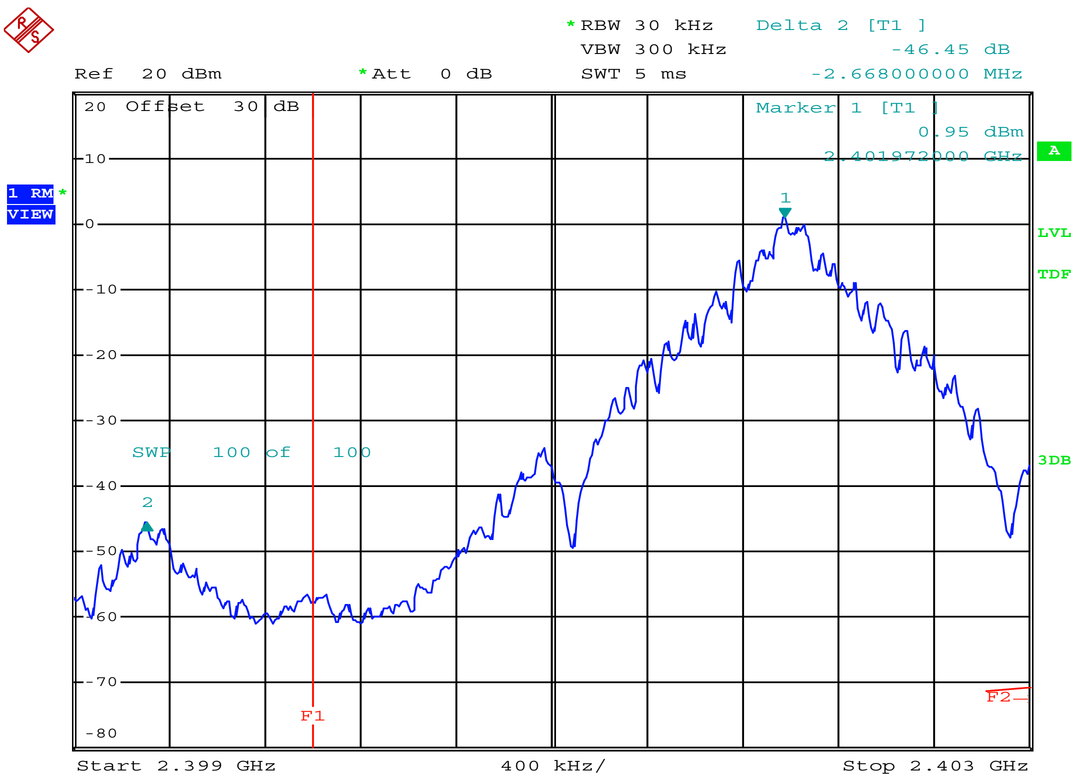
Upper Band Edge: BT EDR2



Channel Number:	80	Channel Frequency (MHz):	2480
Modulation:	GFSK	Bit Rate (Mbps):	2

Emission Power (dBm):	-63.87

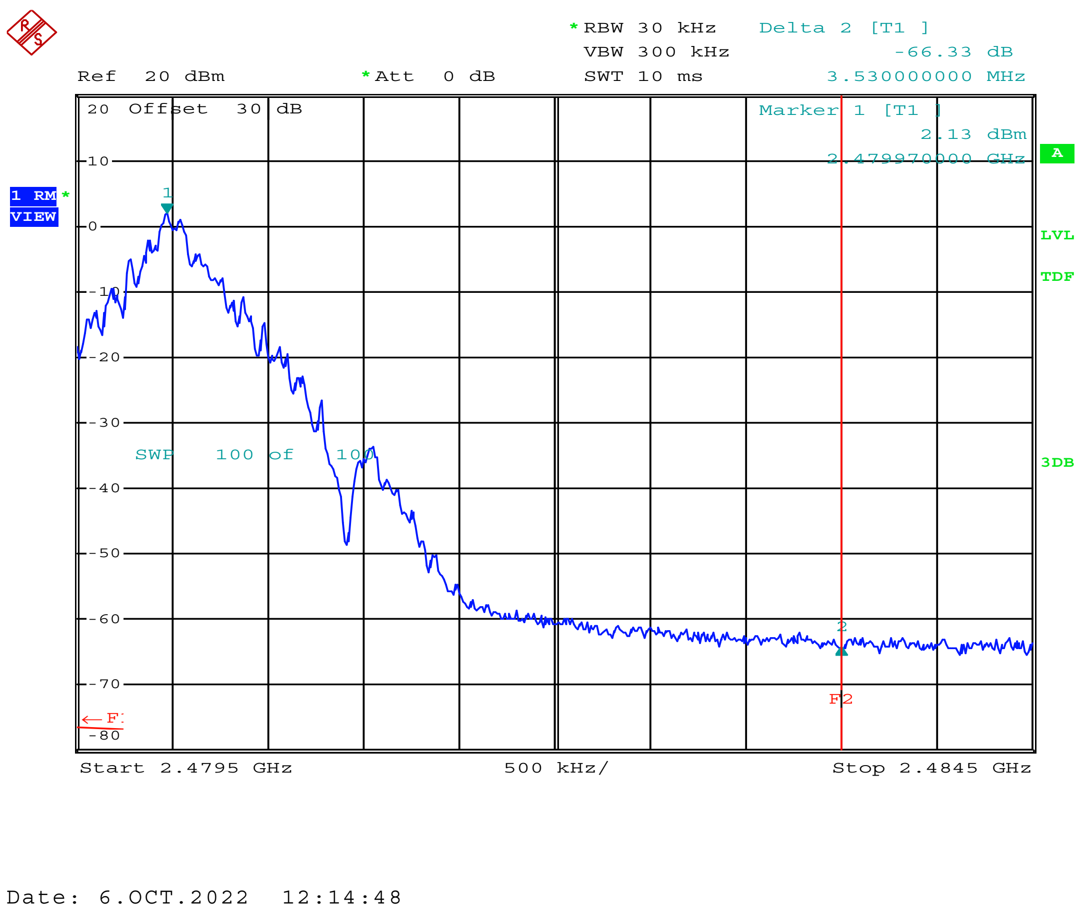
Lower Band Edge: BT EDR2



Date: 6.OCT.2022 12:16:22

Channel Number:	2	Channel Frequency (MHz):	2402	Emission Power (dBm):	-45.50
Modulation:	Pi/4-DQPSK	Bit Rate (Mbps):	2		

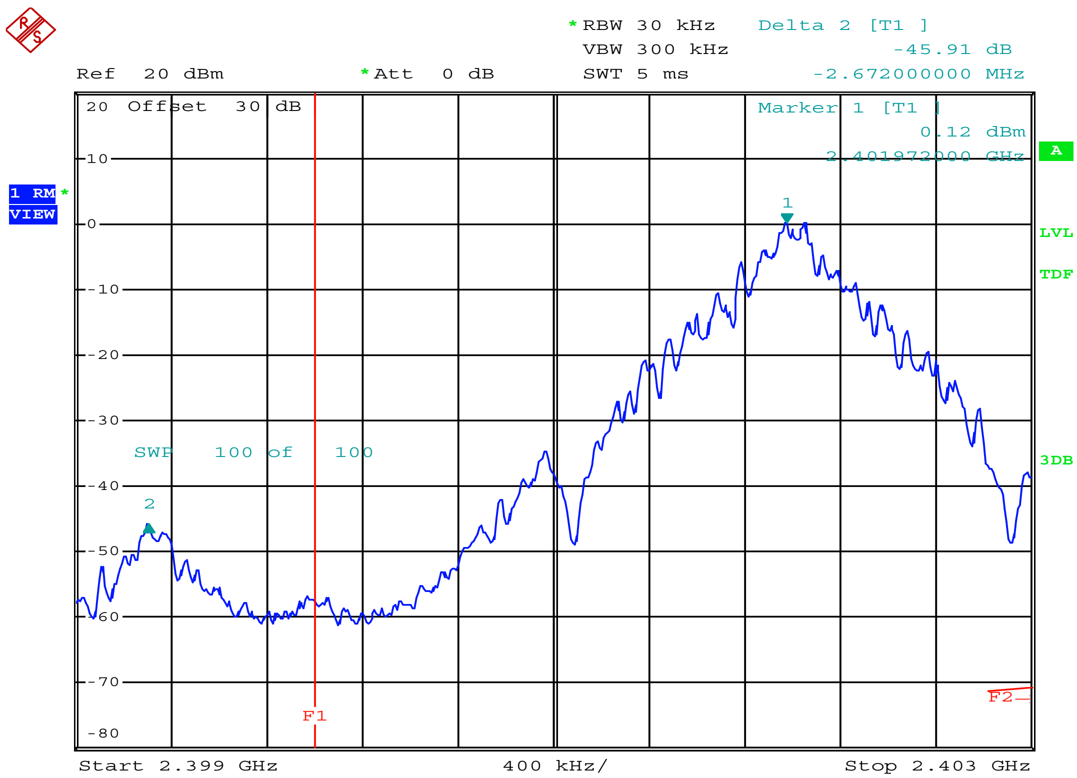
Upper Band Edge: BT EDR2



Channel Number:	**80**	Channel Frequency (MHz):	**2480**
Modulation:	**Pi/4-DQPSK**	Bit Rate (Mbps):	**2**

Emission Power (dBm):	**-64.20**

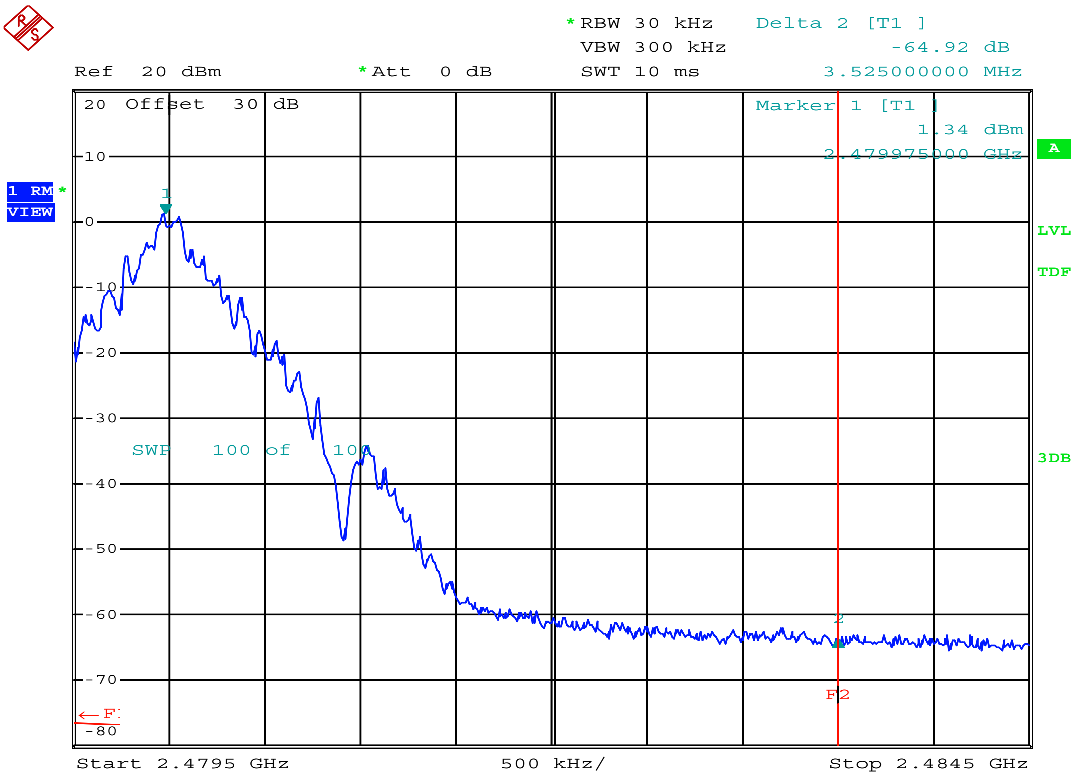
Lower Band Edge: BT EDR3



Date: 6.OCT.2022 12:17:18

Channel Number:	**2**	Channel Frequency (MHz):	**2402**	Emission Power (dBm):	**-45.07**
Modulation:	**8-DPSK**	Bit Rate (Mbps):	**2**		

Upper Band Edge: BT EDR3



Date: 6.OCT.2022 12:18:45

Channel Number:	80	Channel Frequency (MHz):	2480	Emission Power (dBm):	-63.58
Modulation:	8-DPSK	Bit Rate (Mbps):	2		

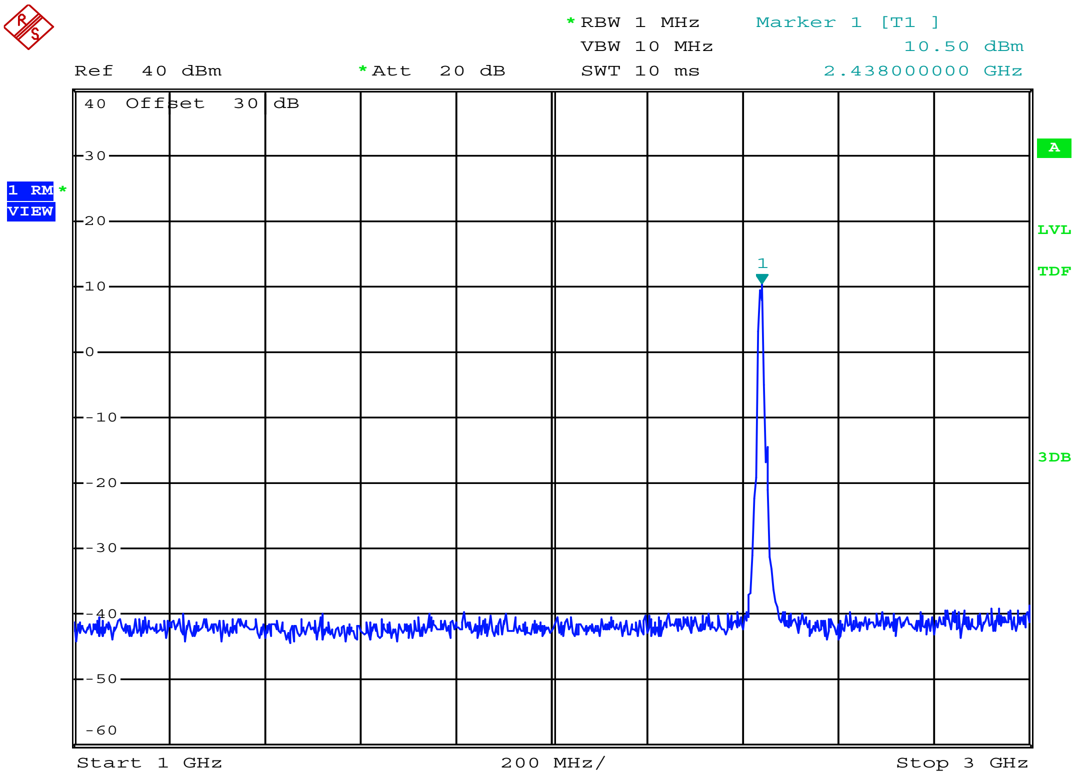
Conducted Spurious Emissions Measurement Results: 802.11										
Mode	**Channel Number**	**Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Reference Measurement [P_{Ref}] (dBm)**	**Measured Emission [P_{Em}] (dBm)**	**Emission Frequency (MHz)**	**Attenuation [Attn] (dBi)**	**Limit (dB)**	**Margin (dB)**
802.11b	6	2437.00	DSSS	5.5	10.5	-33.2	9020	43.7	30	13.7
						-22.2	16425	32.7		2.7
						-21.5	24972	32.0		2.0
									Results:	**Complies**

Attenuation = [P_{Ref}] - [P_{Em}]

Margin = Attn - Limit

* Reference Measurement

Conducted Spurious Emissions: 802.11b

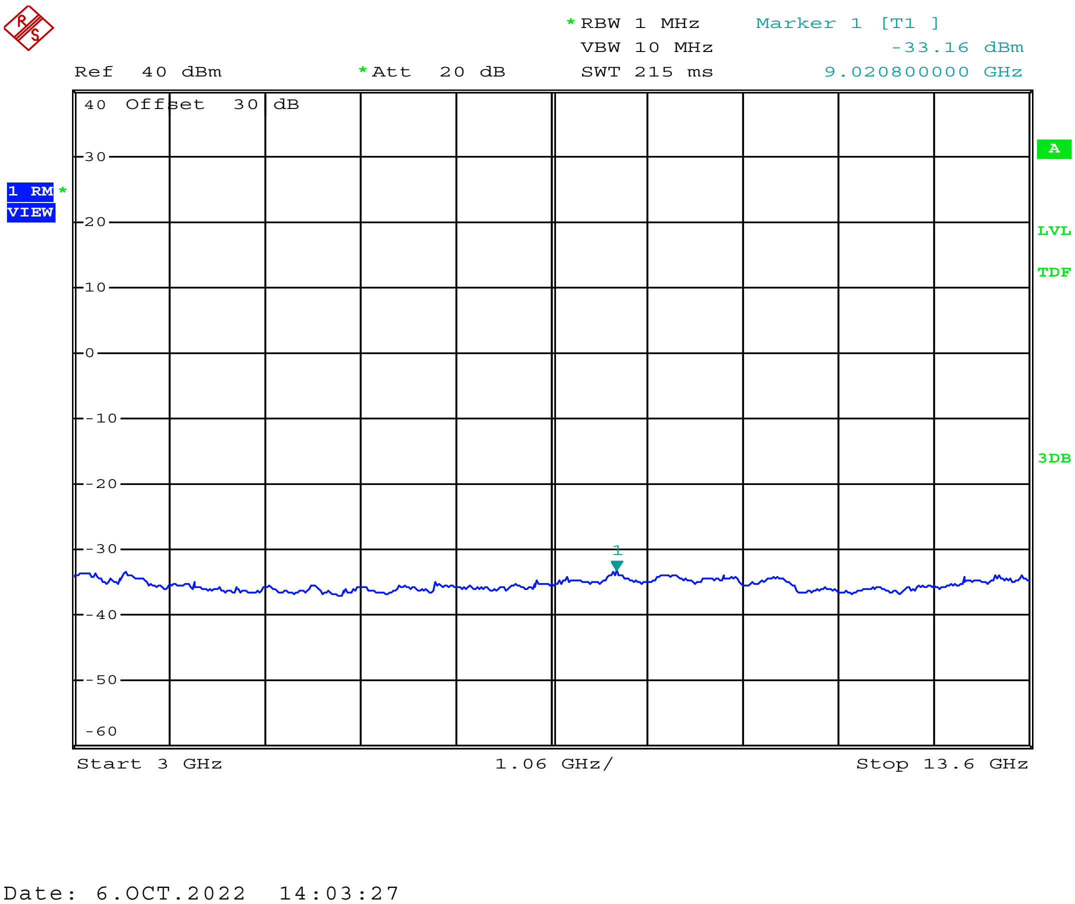


Date: 6.OCT.2022 14:02:35

Marker 1 = Fundamental

Channel Number:	**6**	Channel Frequency (MHz):	**2437**	Emission Frequency (MHz)	-
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**	Measured Emission (dBm):	-

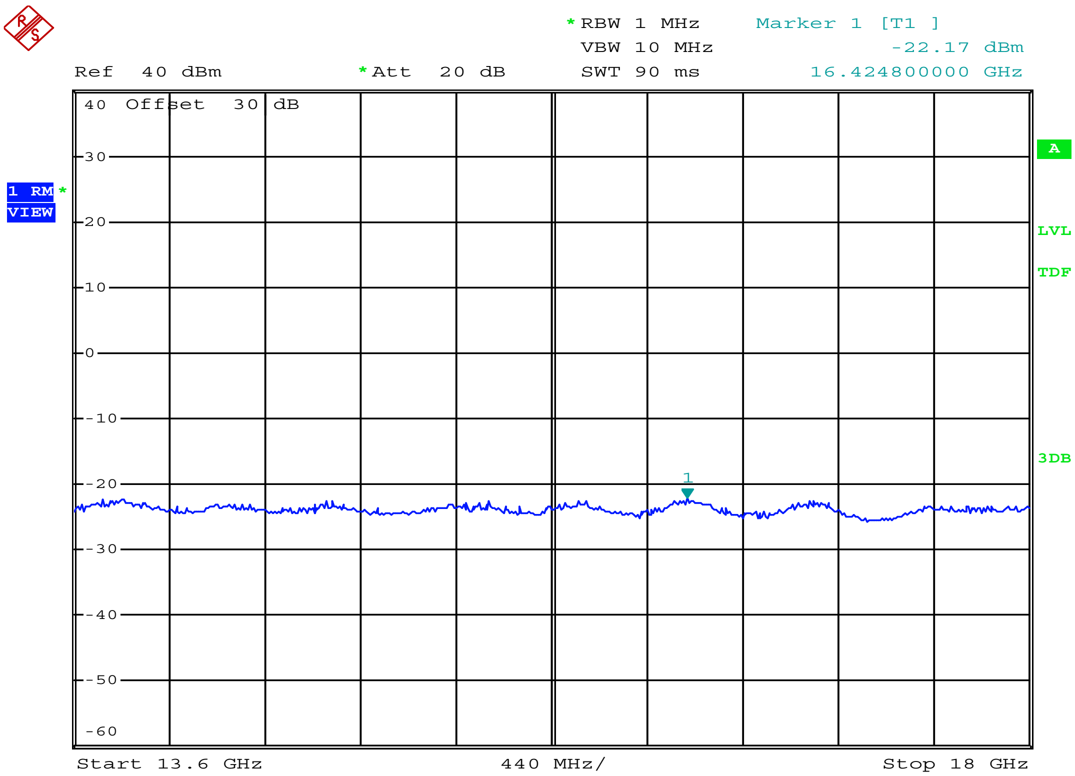
Conducted Spurious Emissions: 802.11b



Channel Number:	6	Channel Frequency (MHz):	2437
Modulation:	DSSS	Bit Rate (Mbps):	5.5

Emission Frequency (MHz)	9020.8
Measured Emission (dBm):	-33.16

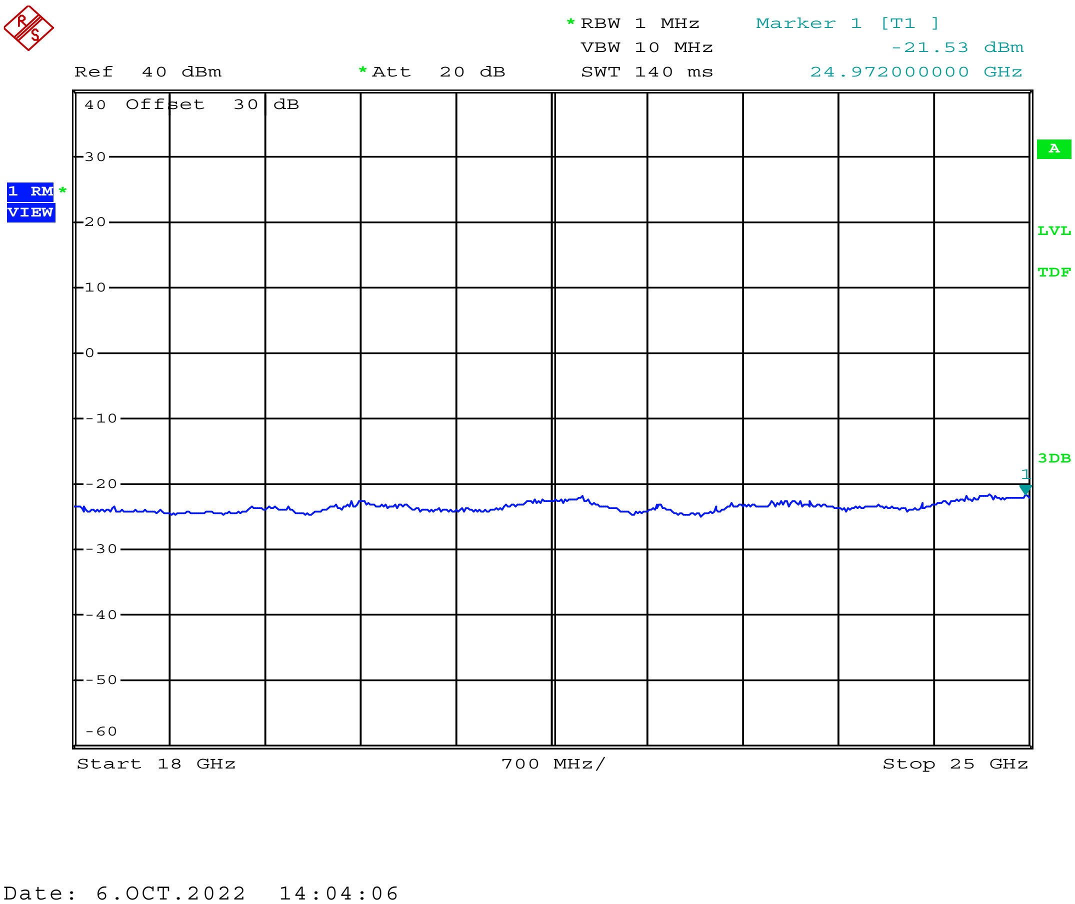
Conducted Spurious Emissions: 802.11b



Date: 6.OCT.2022 14:03:45

Channel Number:	6	Channel Frequency (MHz):	2437	Emission Frequency (MHz)	16425
Modulation:	DSSS	Bit Rate (Mbps):	5.5	Measured Emission (dBm):	-22.17

Conducted Spurious Emissions: 802.11b



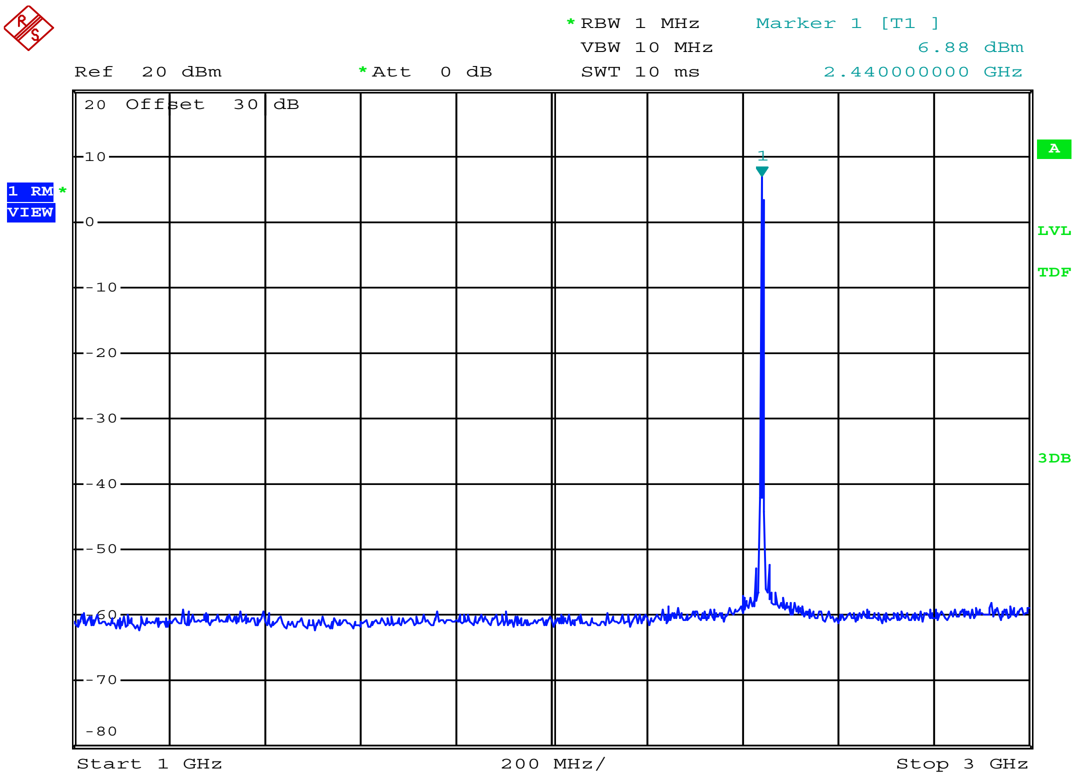
Channel Number:	**6**	Channel Frequency (MHz):	**2437**	Emission Frequency (MHz)	**24972**
Modulation:	**DSSS**	Bit Rate (Mbps):	**5.5**	Measured Emission (dBm):	**-21.53**

Conducted Spurious Emissions Measurement Results: FHSS										
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Reference Measurement [P_{Ref}] (dBm)	Measured Emission [P_{Em}] (dBm)	Emission Frequency (MHz)	Attenuation [Attn] (dBi)	Limit (dB)	Margin (dB)
BT EDR2	41	2441.00	Pi/4-DQPSK	2	6.88	-53.6	3148	60.4	30	30.4
						-42.3	15456	49.2		19.2
						-41.7	24874	48.6		18.6
									Results:	Complies

Attenuation = [P_{Ref}] - [P_{Em}]

Margin = Attn - Limit

Conducted Spurious Emissions: FHSS

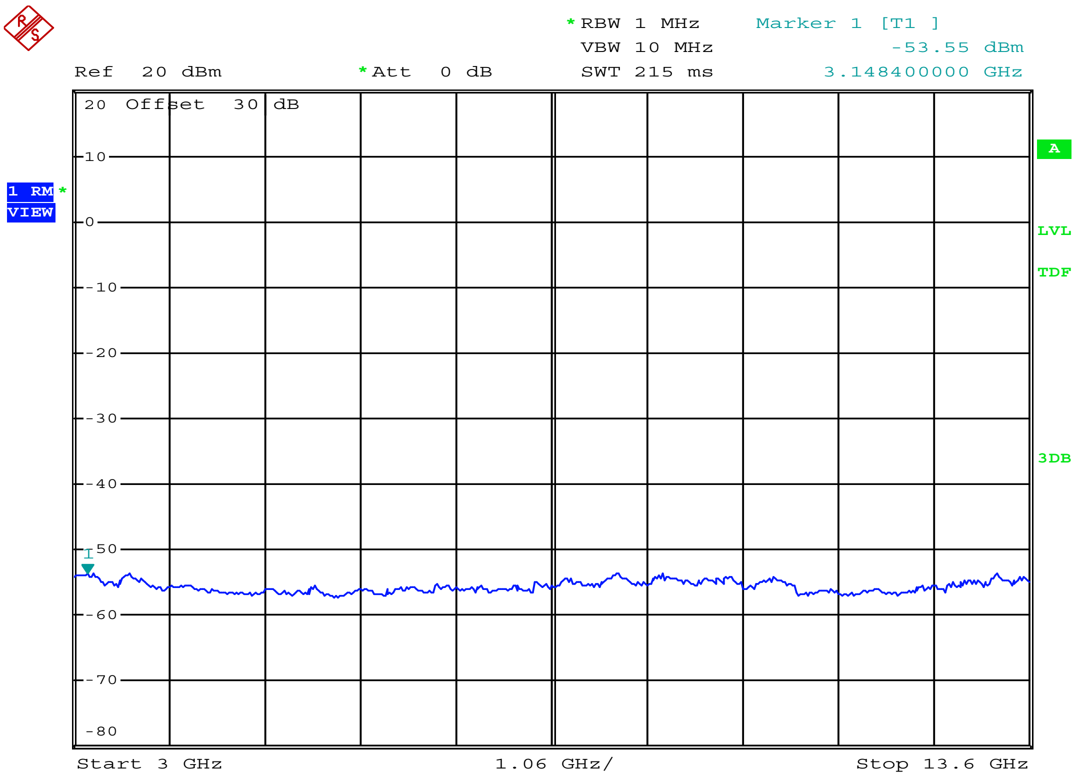


Date: 6.OCT.2022 12:42:09

Marker 1 = Fundamental

Channel Number:	**40**	Channel Frequency (MHz):	**2440**	Emission Frequency (MHz)	**2440**
Modulation:	**Pi/4-DQPSK**	Bit Rate (Mbps):	**2**	Measured Emission (dBm):	**6.88**

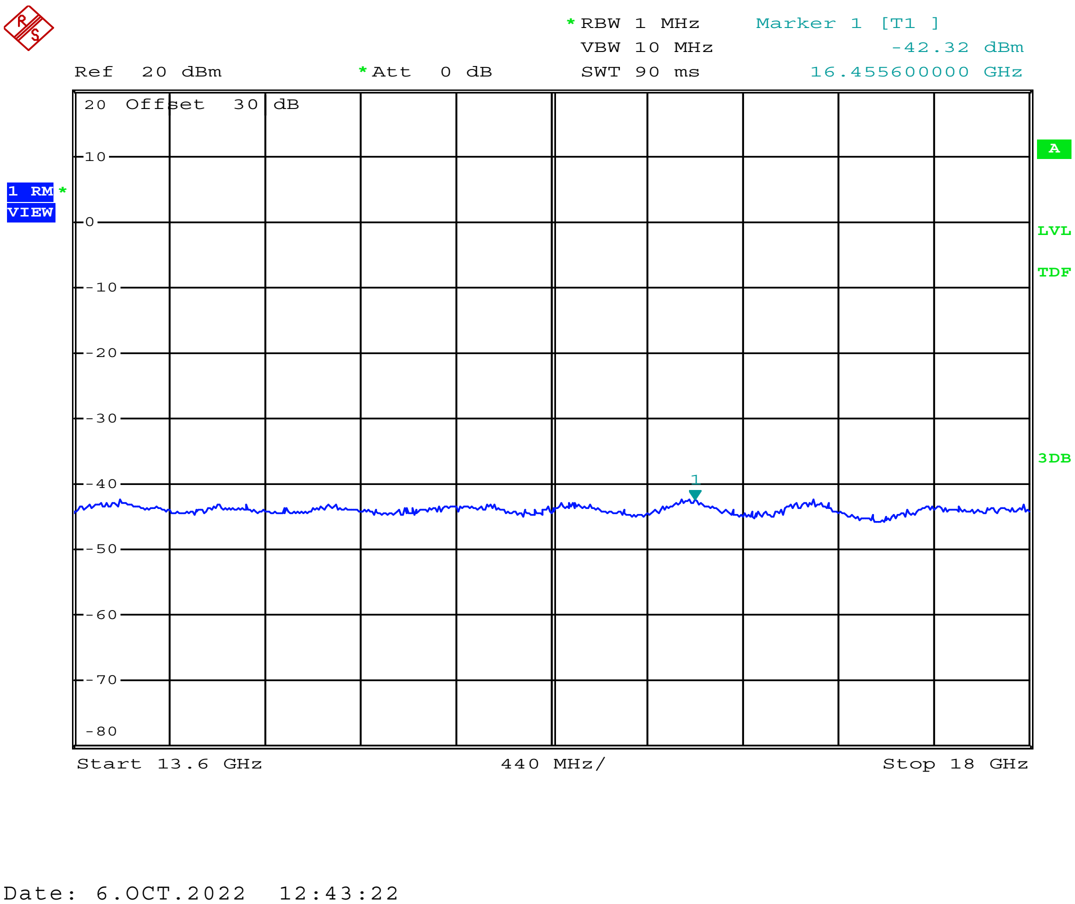
Conducted Spurious Emissions: FHSS



Date: 6.OCT.2022 13:43:33

Channel Number:	40	Channel Frequency (MHz):	2440	Emission Frequency (MHz)	3148
Modulation:	Pi/4-DQPSK	Bit Rate (Mbps):	2	Measured Emission (dBm):	-53.55

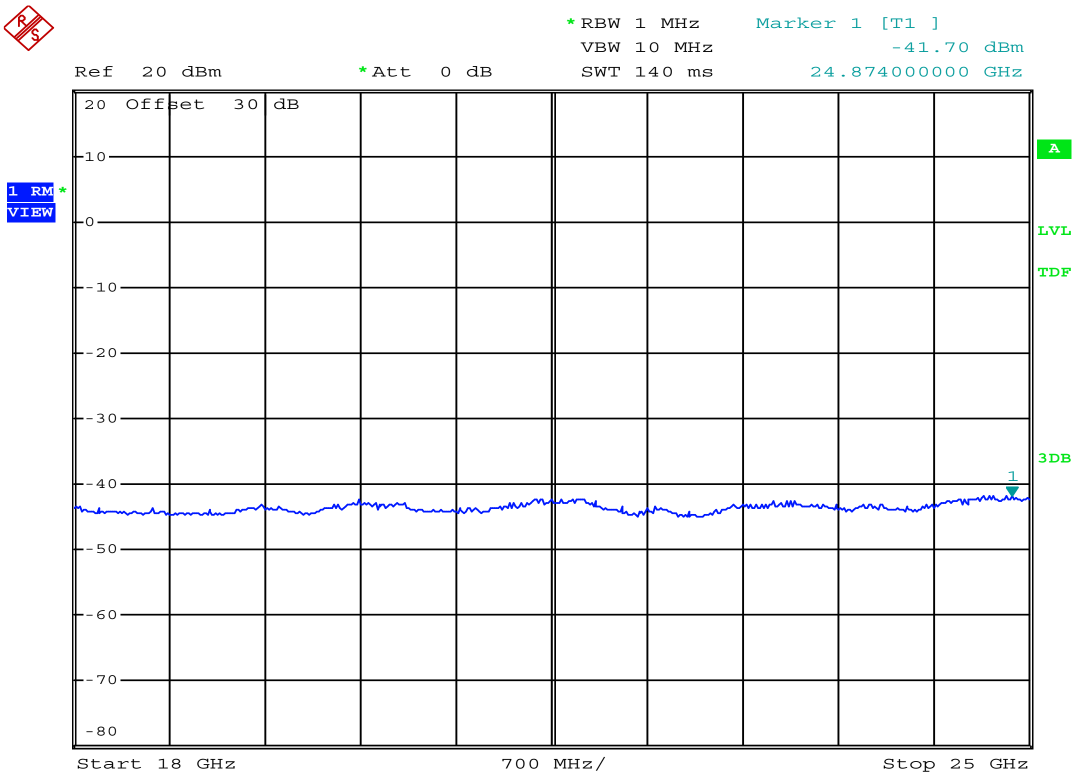
Conducted Spurious Emissions: FHSS



Channel Number:	41	Channel Frequency (MHz):	2441
Modulation:	Pi/4-DQPSK	Bit Rate (Mbps):	2

Emission Frequency (MHz)	16456
Measured Emission (dBm):	-42.32

Conducted Spurious Emissions: FHSS



Date: 6.OCT.2022 12:44:27

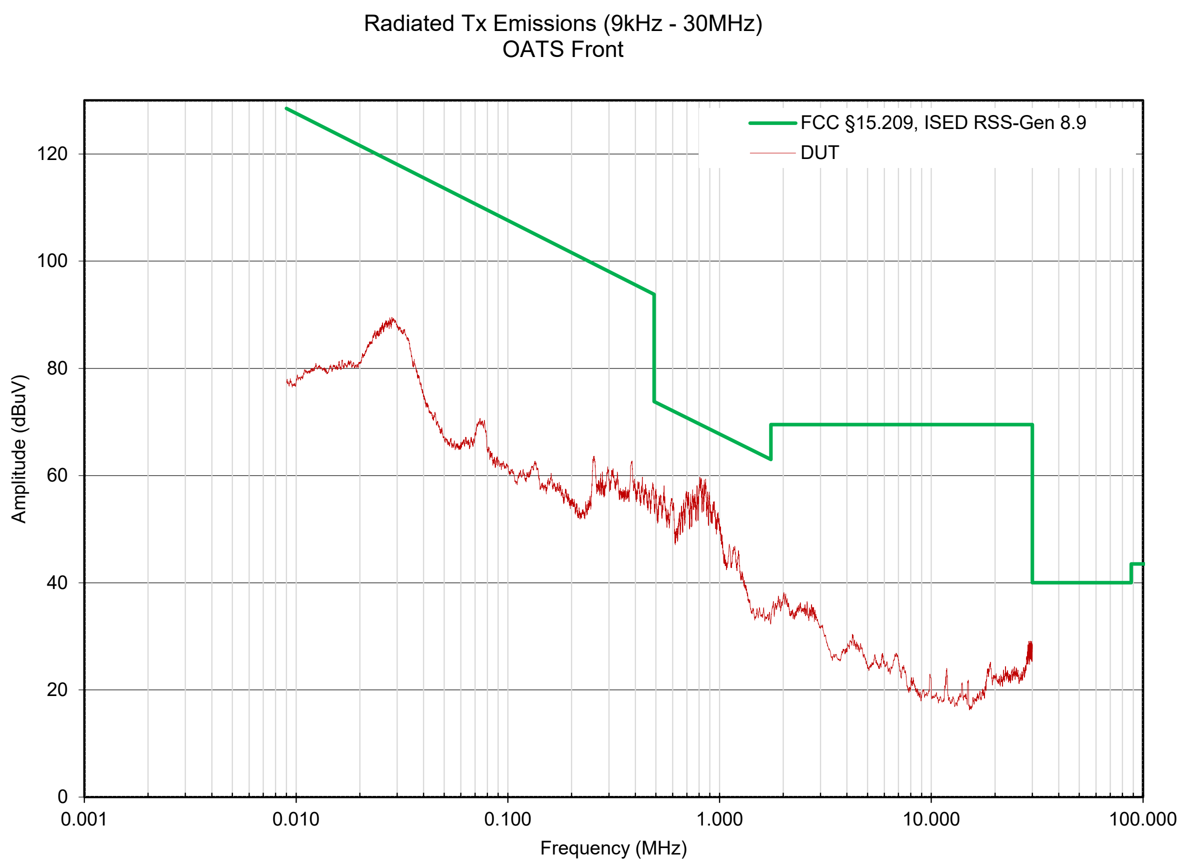
Channel Number:	41	Channel Frequency (MHz):	2441	Emission Frequency (MHz)	24874
Modulation:	Pi/4-DQPSK	Bit Rate (Mbps):	2	Measured Emission (dBm):	-41.70

Measurement Results

Frequency Range	Antenna Polarization	Measured Emission [E_{Meas}] (dBm)	Limit e.r.p./e.r.i.p. [A_L] (dBm)	Margin (dB)
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

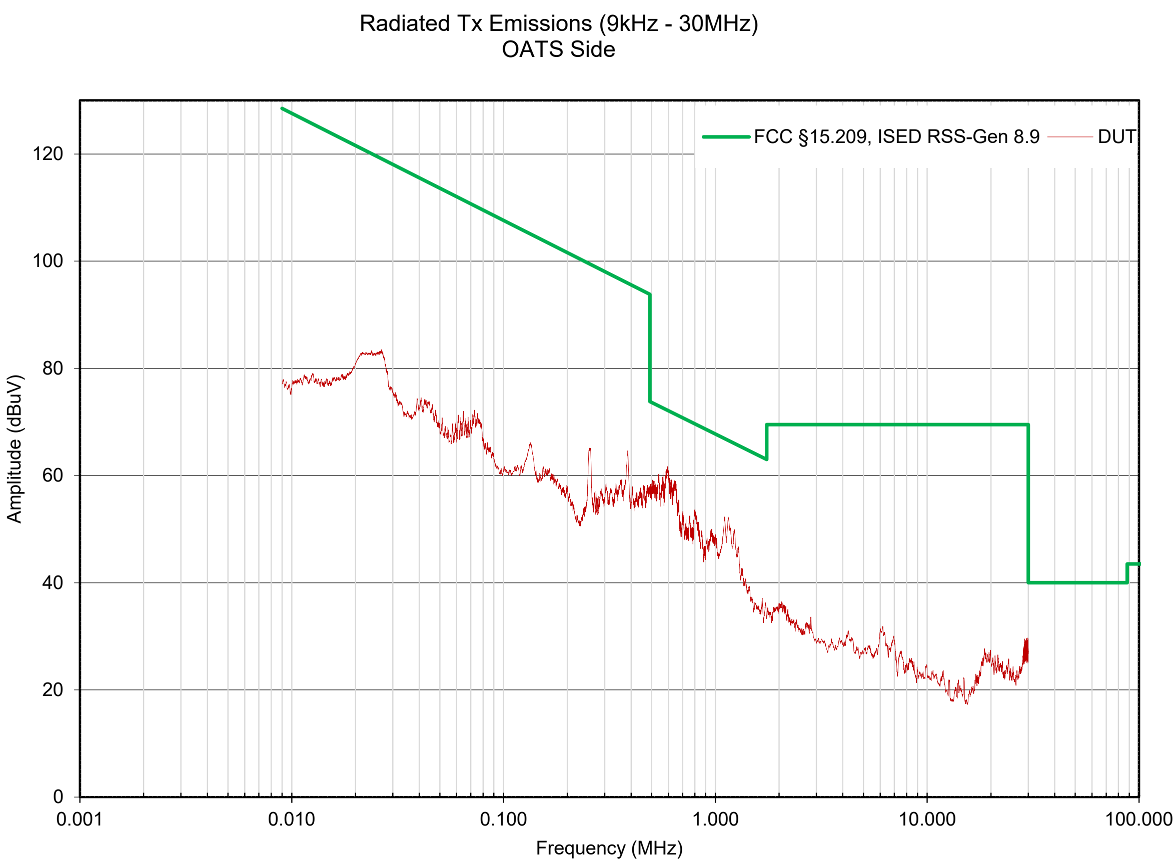
ND = None Detected

Radiated Tx Emissions:



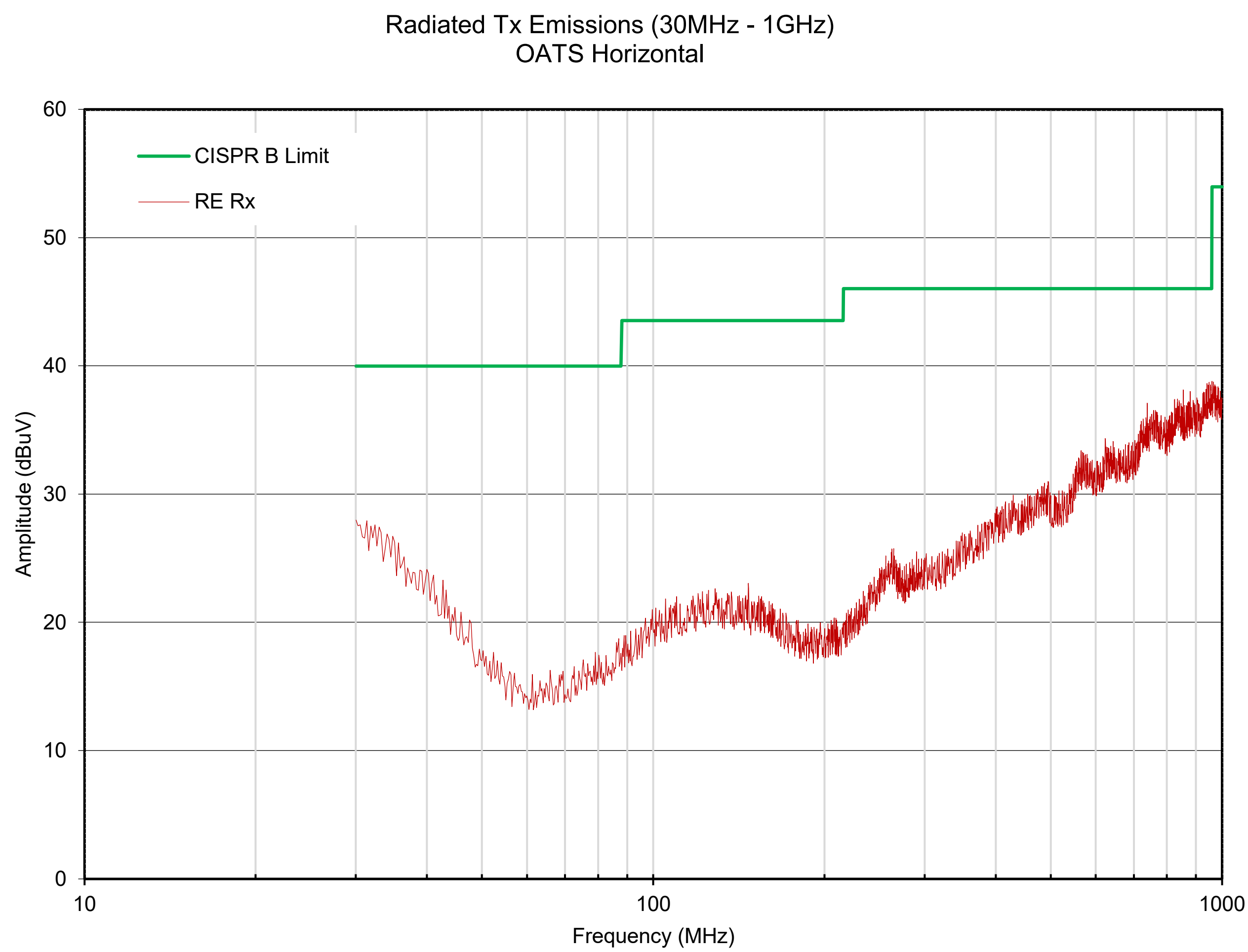
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Front	ND	ND

Radiated Tx Emissions:



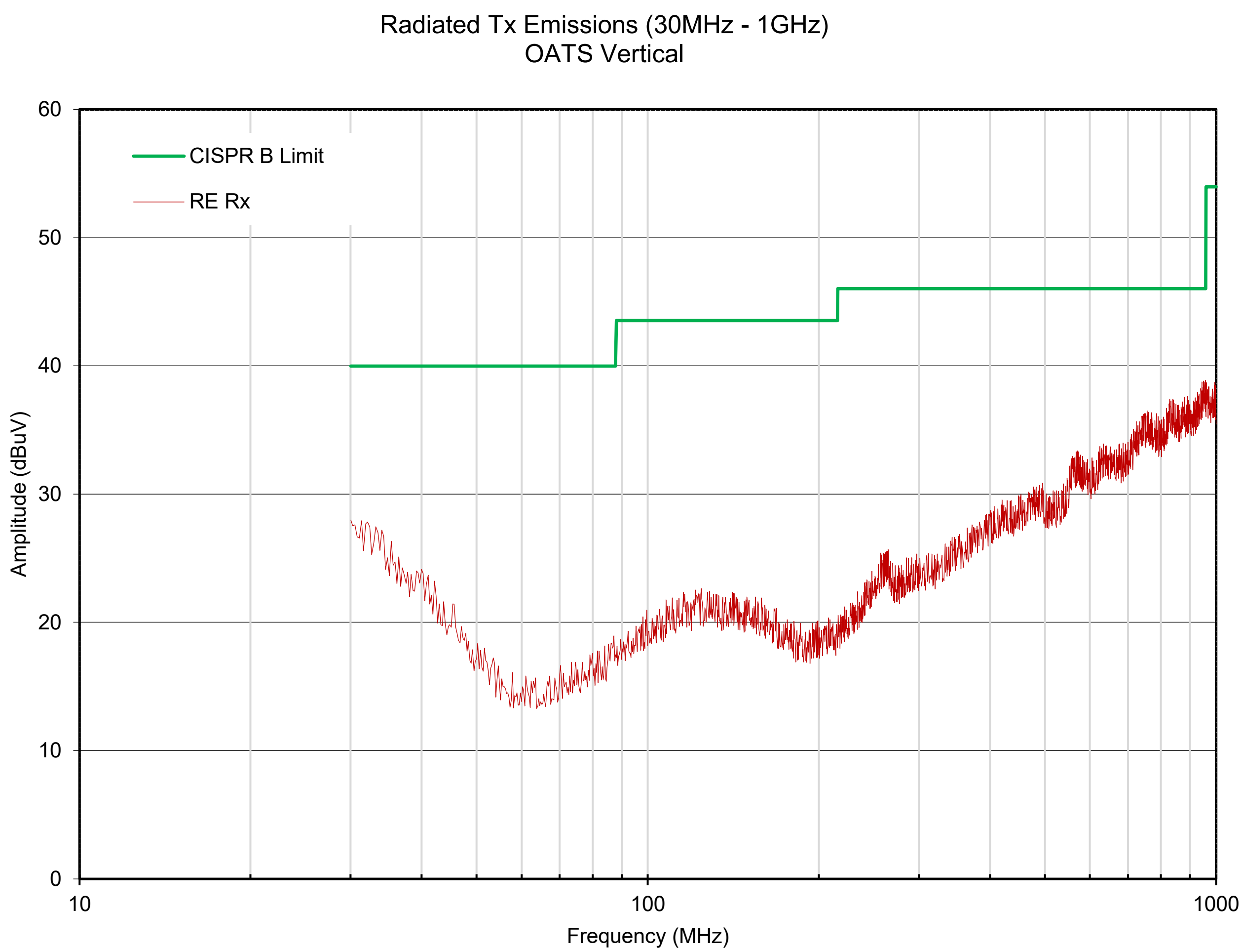
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Side	ND	ND

Radiated Tx Emissions



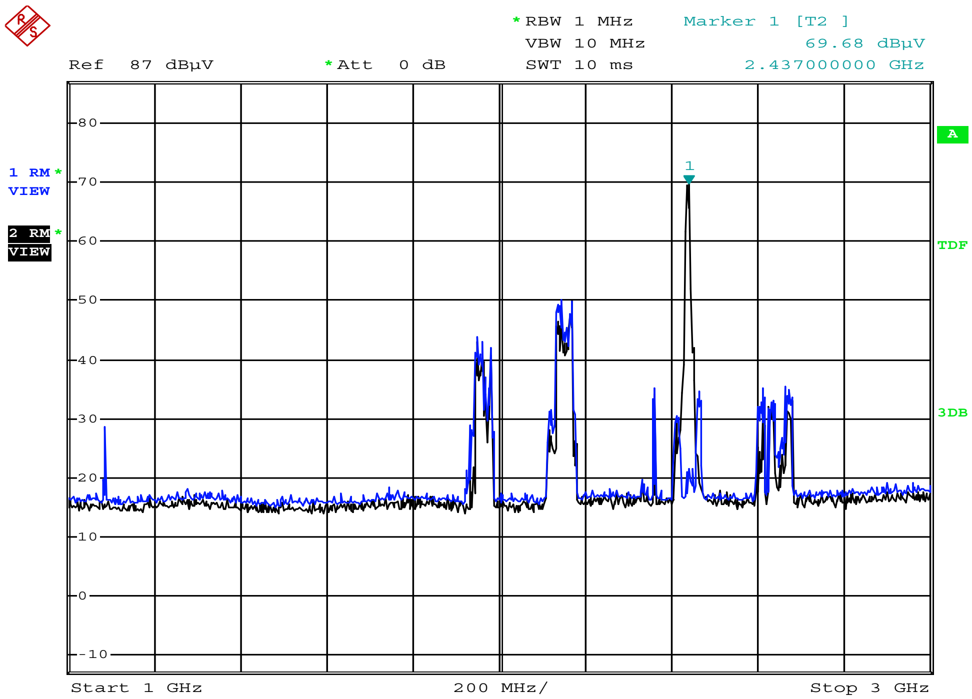
Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions

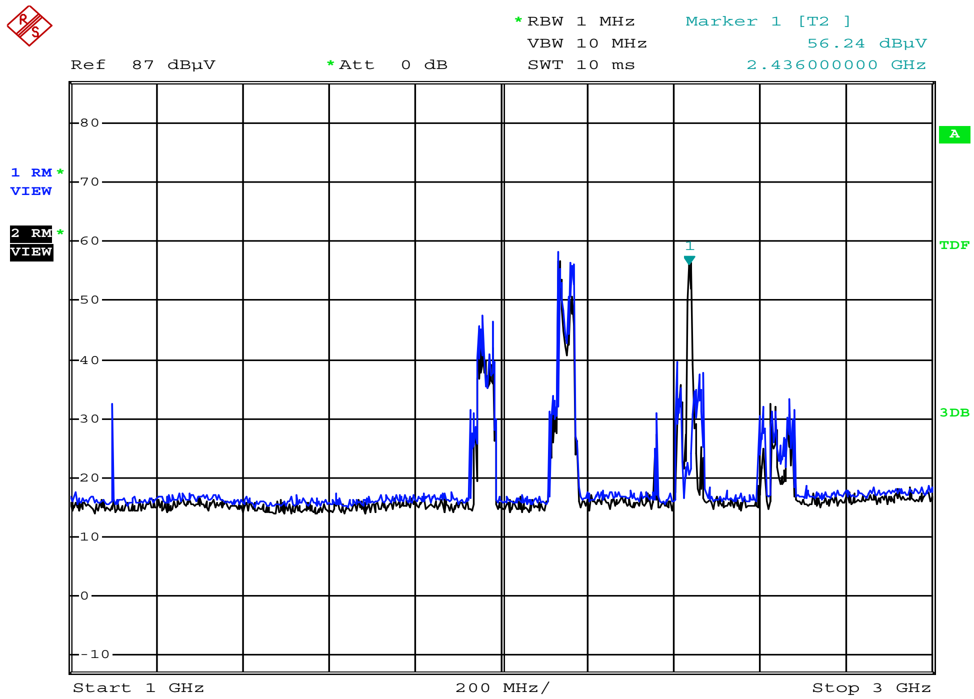


Date: 3.NOV.2022 15:02:10

Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Horizontal**	**None Detected (ND)** dBm

Marker 1: Fundamental

Radiated Tx Emissions

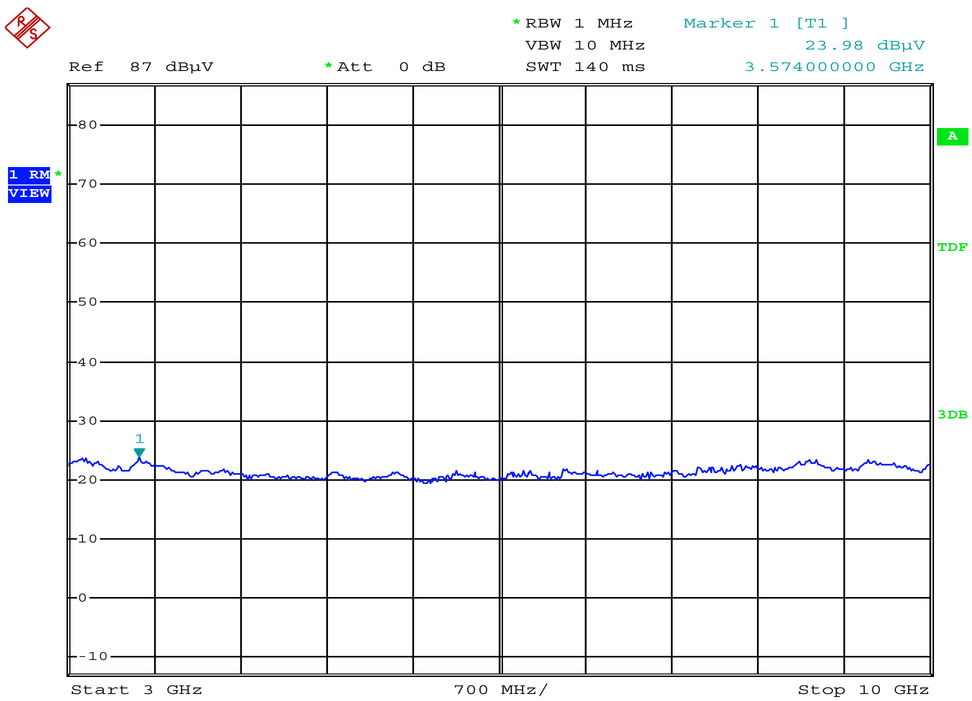


Date: 3.NOV.2022 15:06:44

Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Vertical**	**None Detected (ND)** dBm

Marker 1: Fundamental

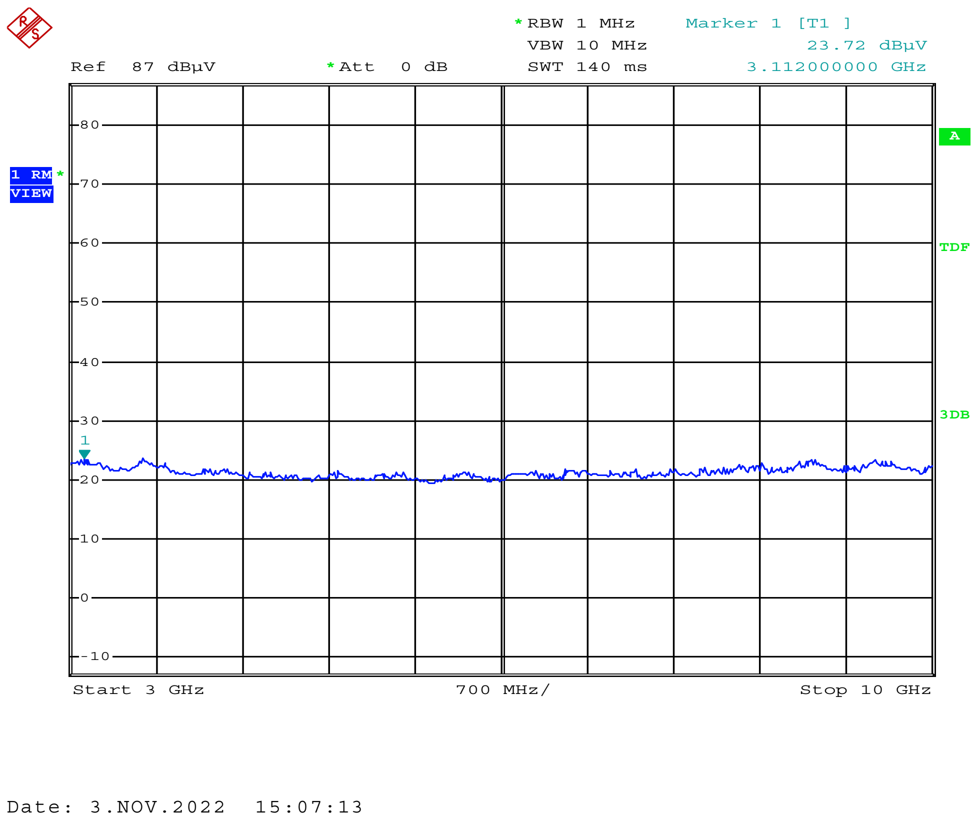
Radiated Tx Emissions



Date: 3.NOV.2022 15:02:37

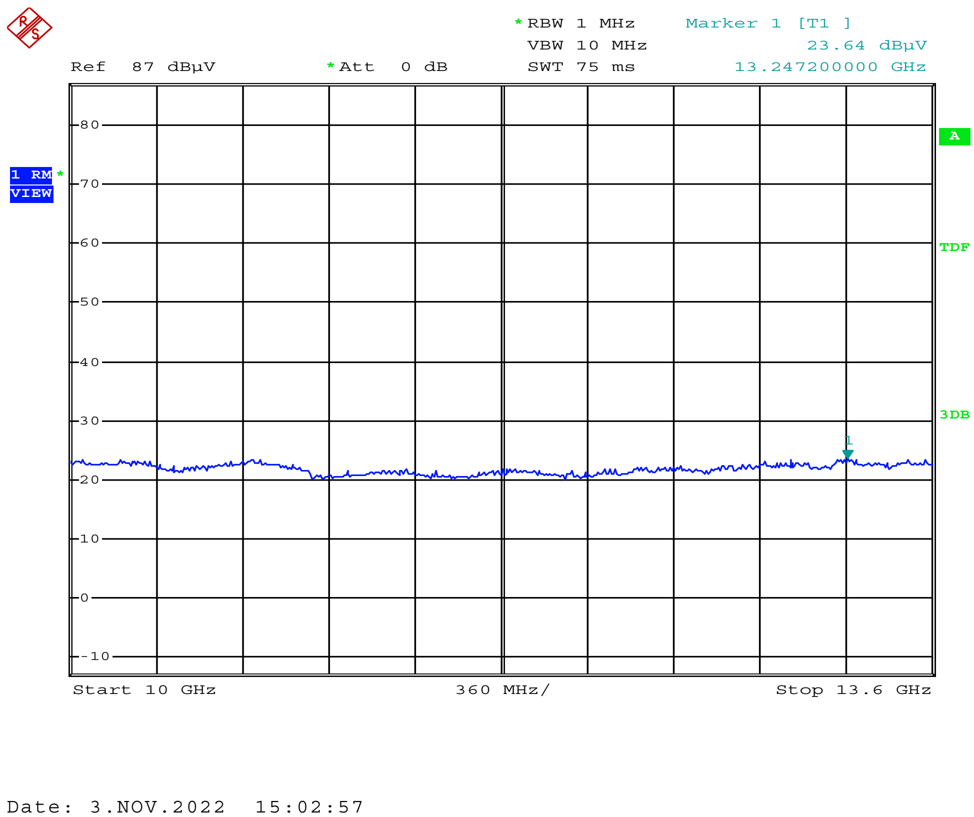
Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



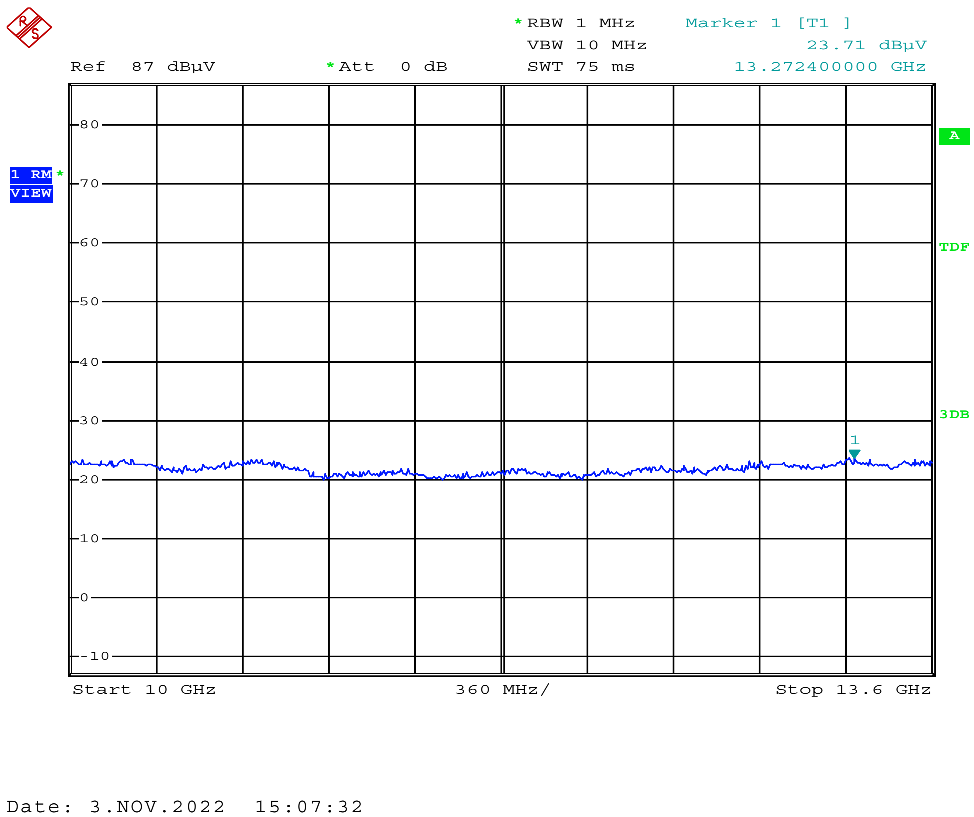
Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions



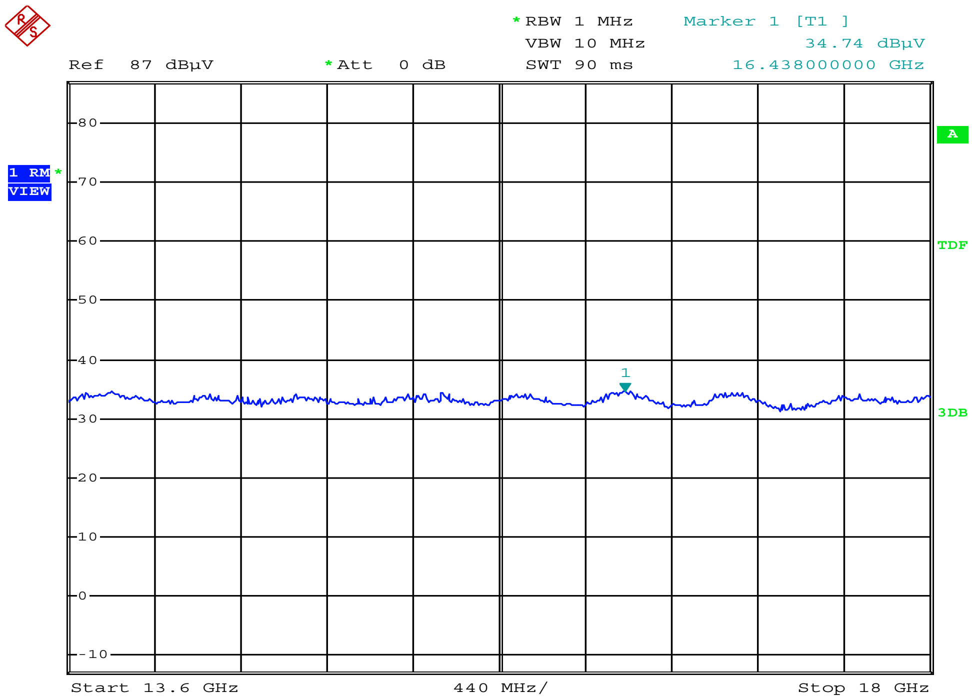
Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Vertical**	**None Detected (ND)** dBm

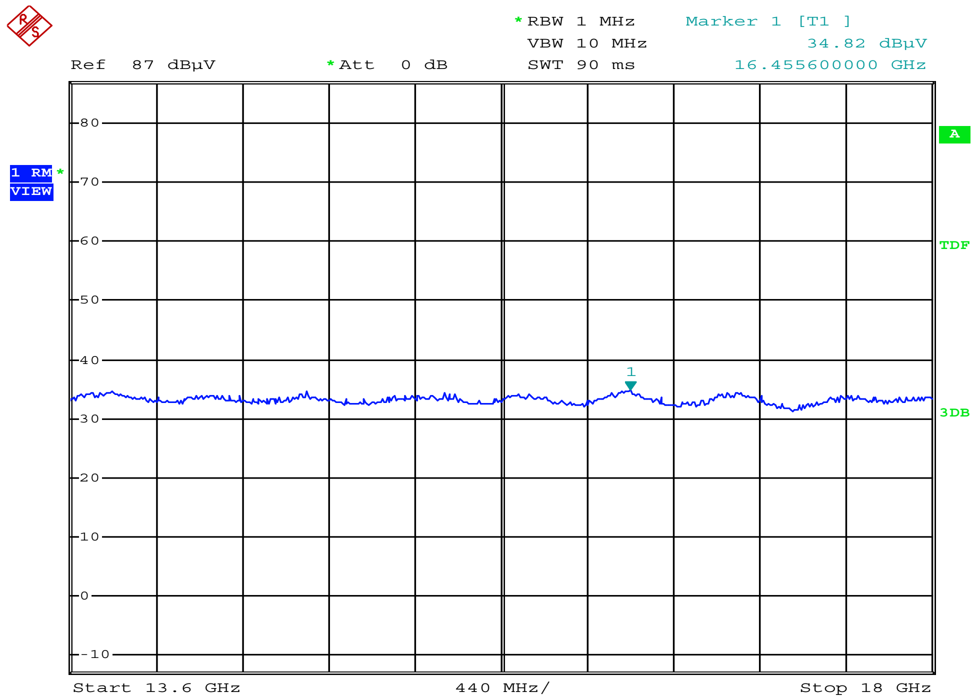
Radiated Tx Emissions



Date: 3.NOV.2022 15:03:16

Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Horizontal**	**None Detected (ND)** dBm

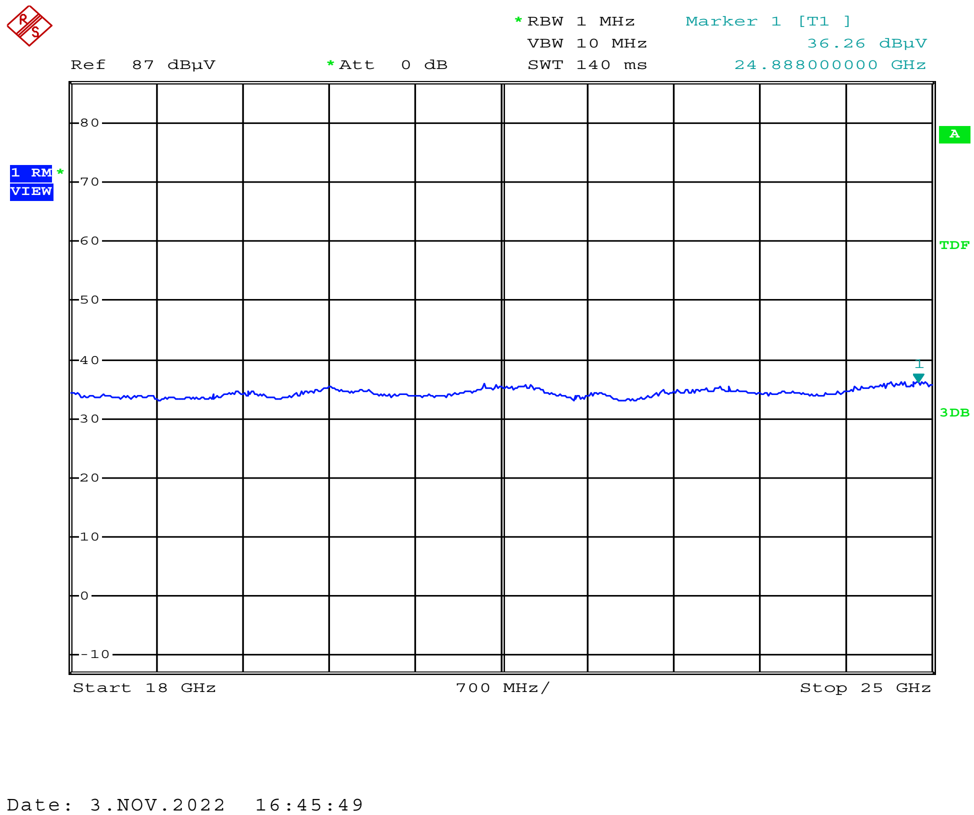
Radiated Tx Emissions



Date: 3.NOV.2022 15:08:02

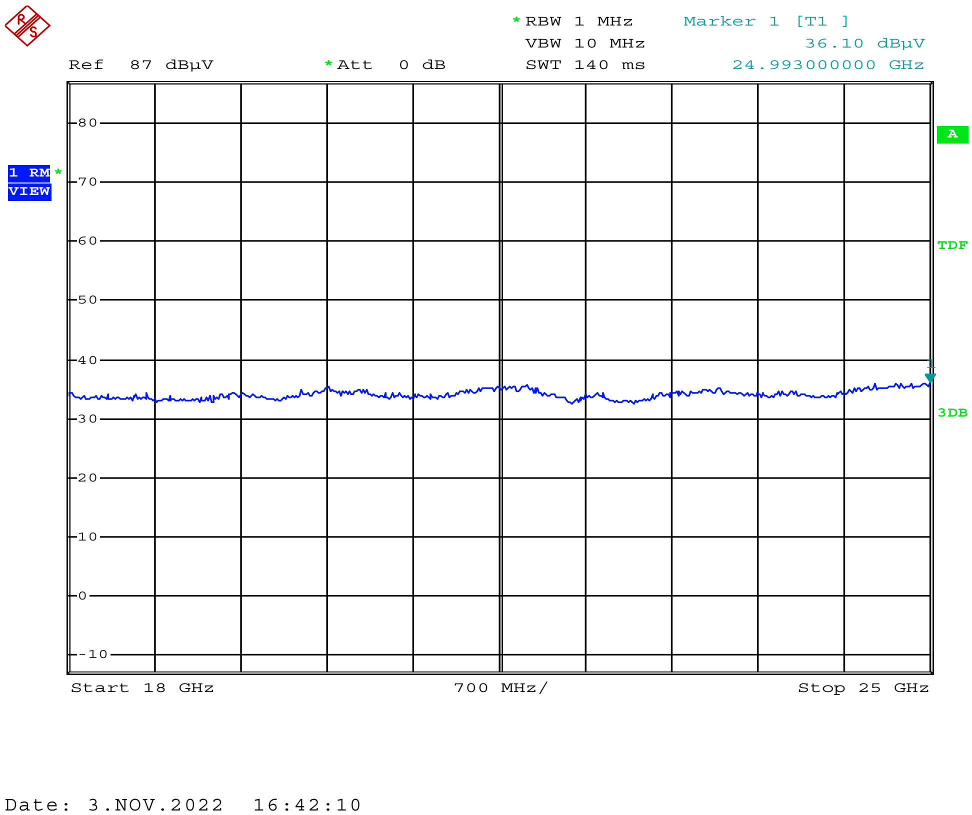
Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



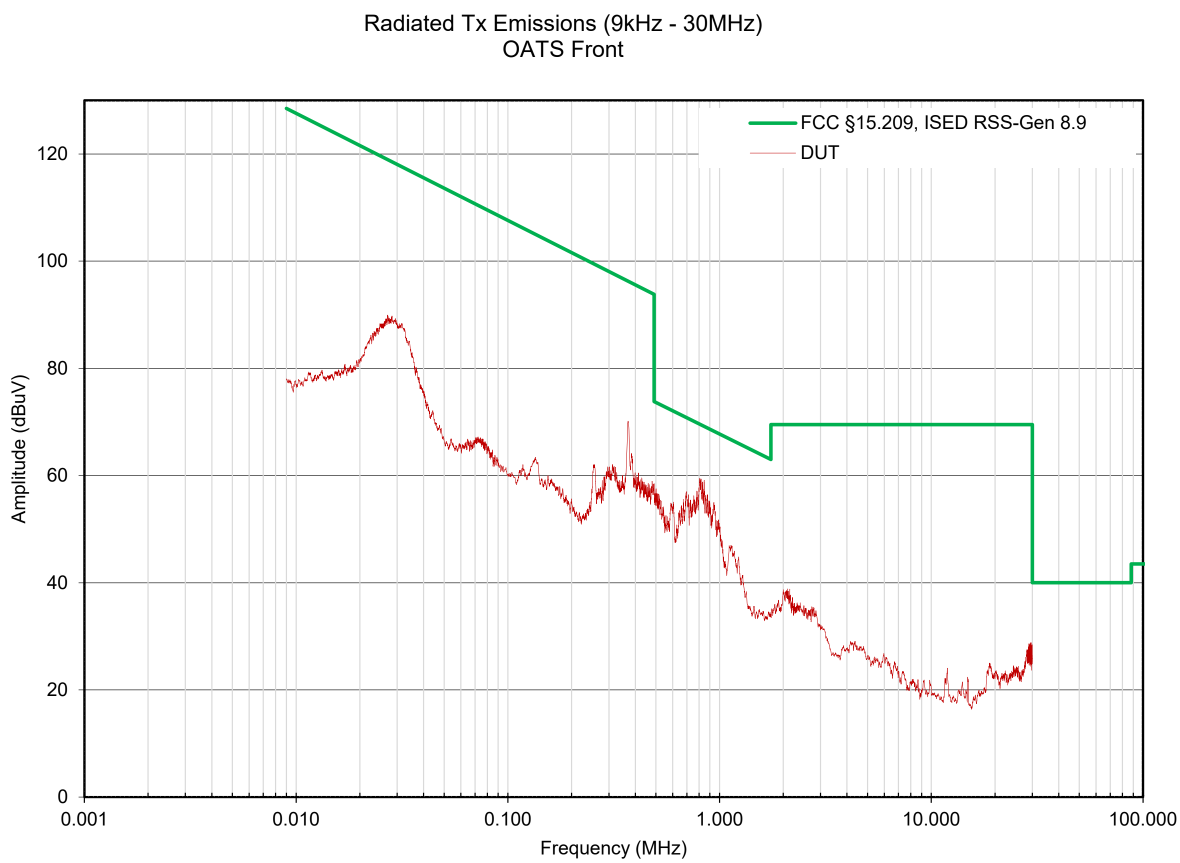
Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Vertical**	**None Detected (ND)** dBm

Measurement Results

Frequency Range	Antenna Polarization	Measured Emission [E_{Meas}] (dBm)	Limit e.r.p./e.r.i.p. [A_L] (dBm)	Margin (dB)
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

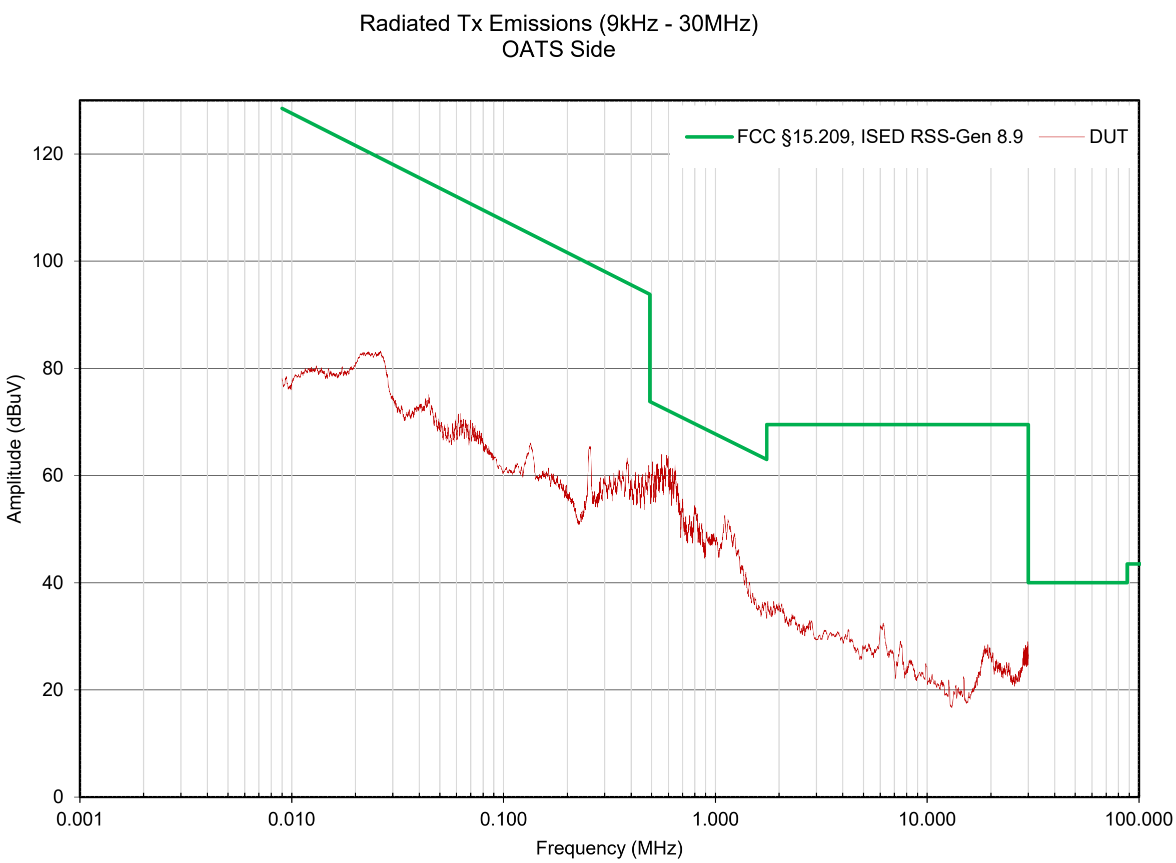
ND = None Detected

Radiated Tx Emissions:



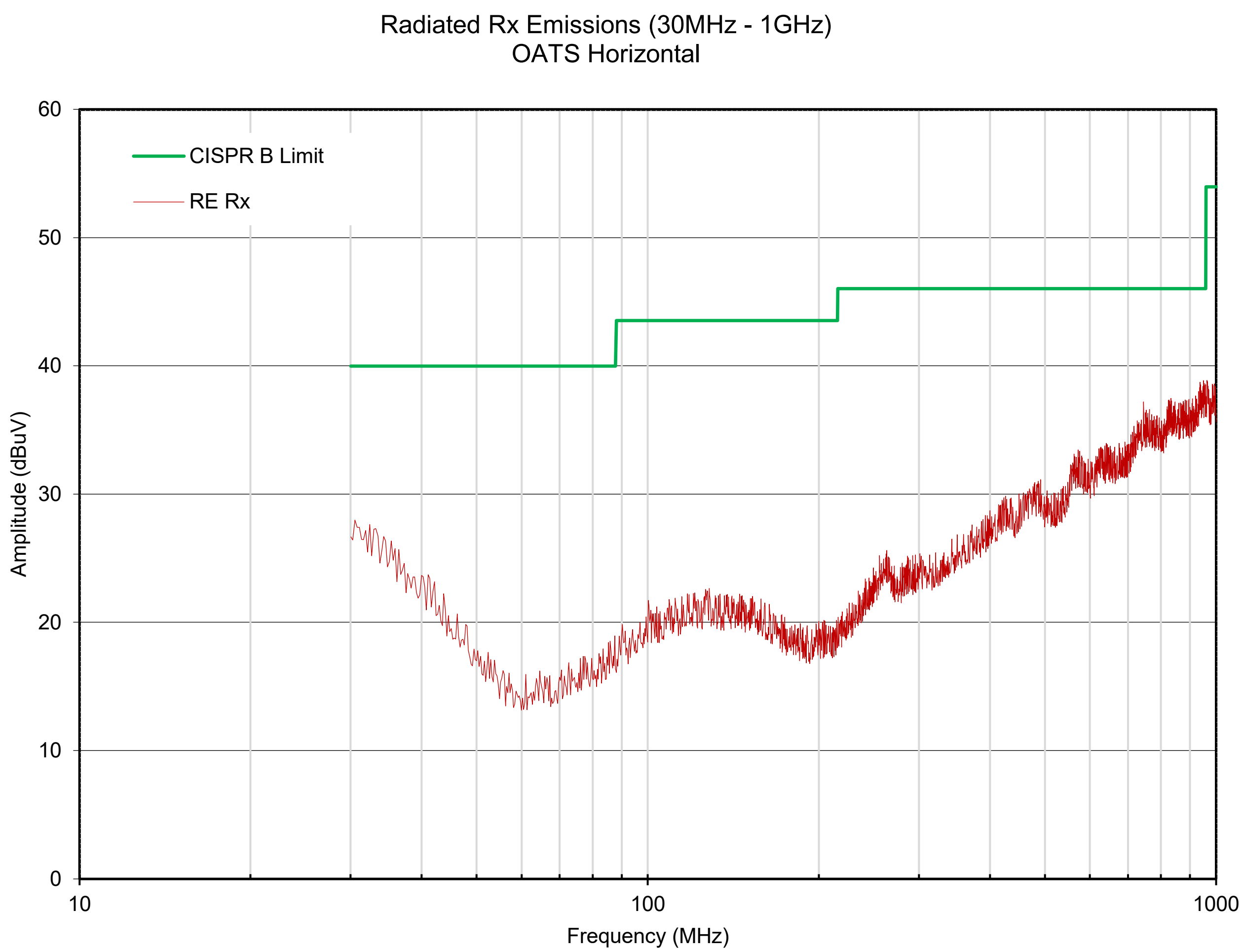
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Front	ND	ND

Radiated Tx Emissions:



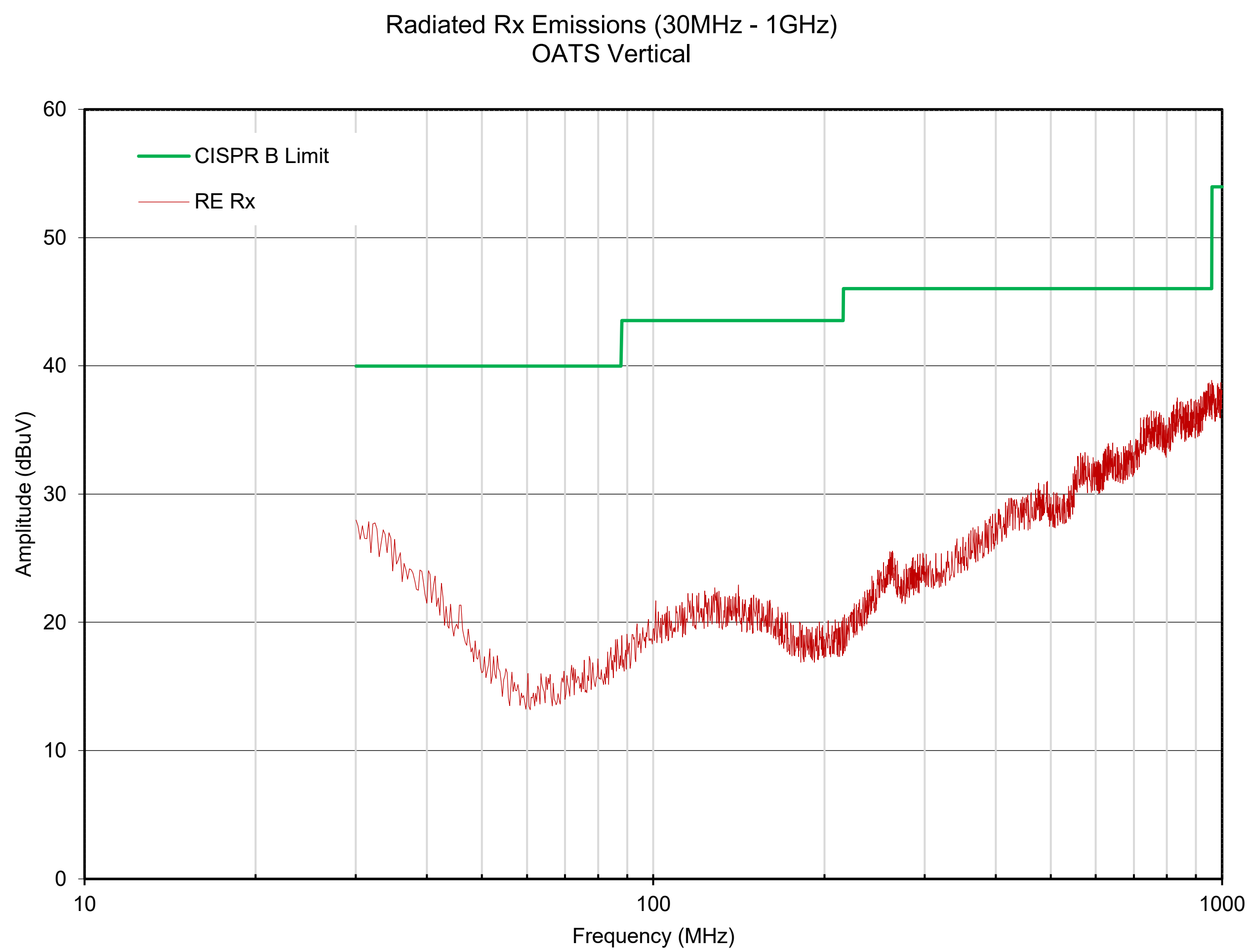
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Side	ND	ND

Radiated Tx Emissions



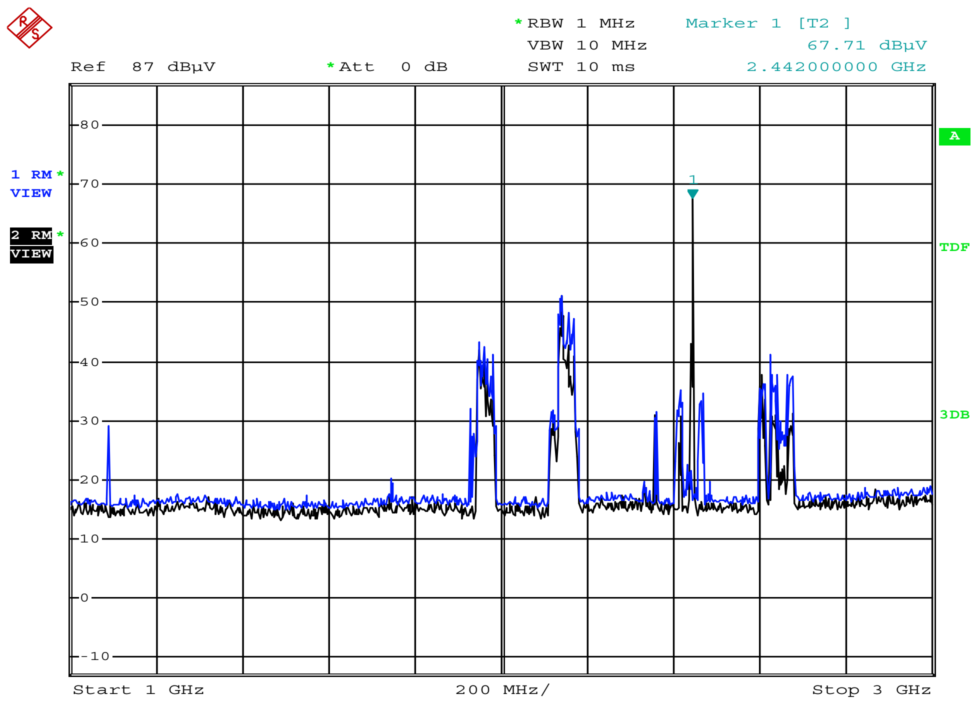
Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions

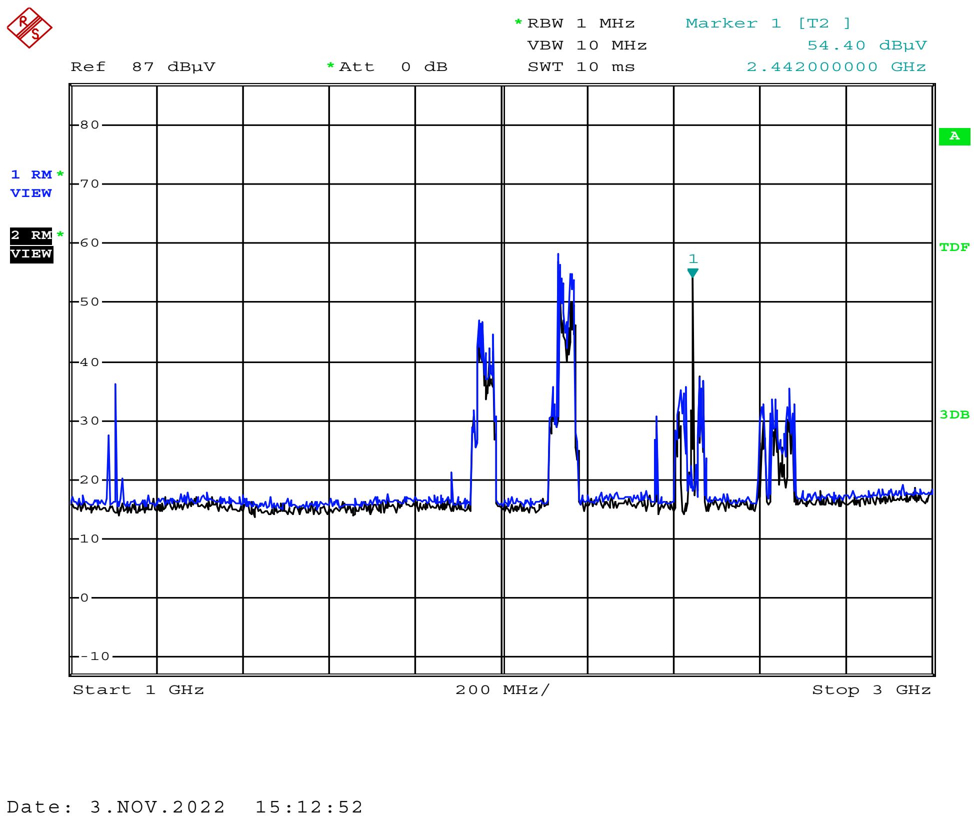


Date: 3.NOV.2022 15:17:28

Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Horizontal**	**None Detected (ND)** dBm

Marker 1: Fundamental

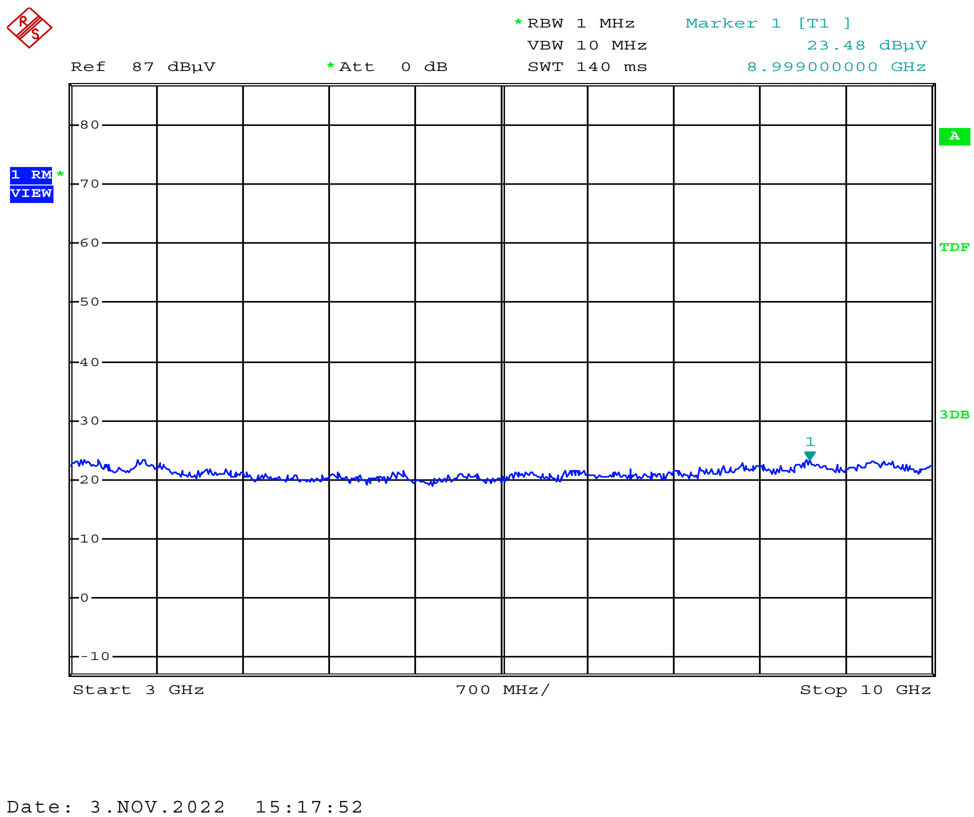
Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Vertical**	**None Detected (ND)** dBm

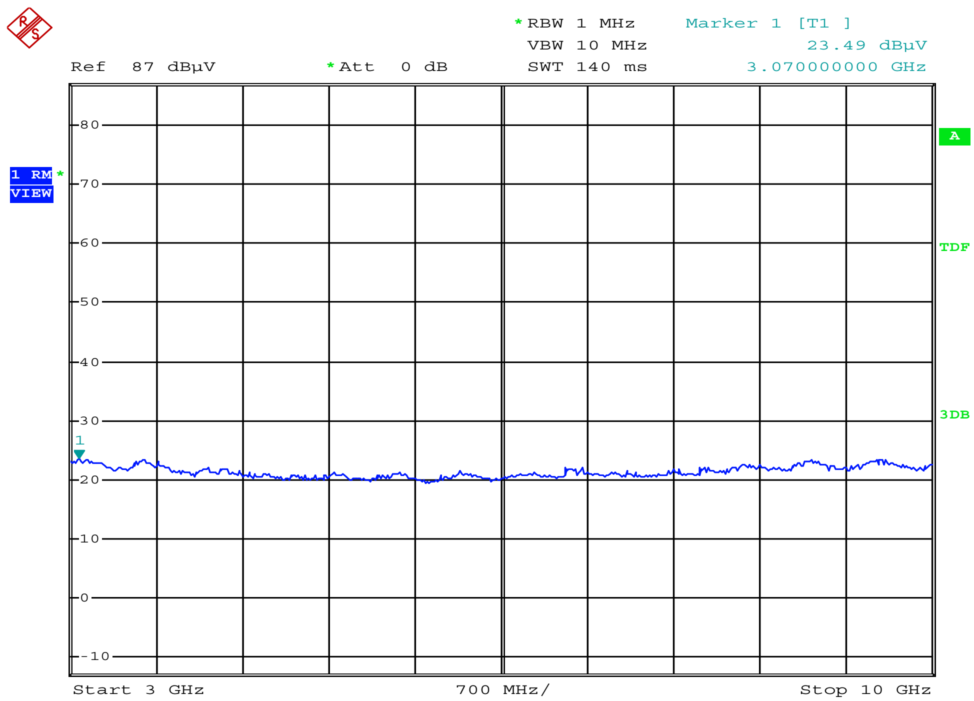
Marker 1: Fundamental

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Horizontal**	**None Detected (ND)** dBm

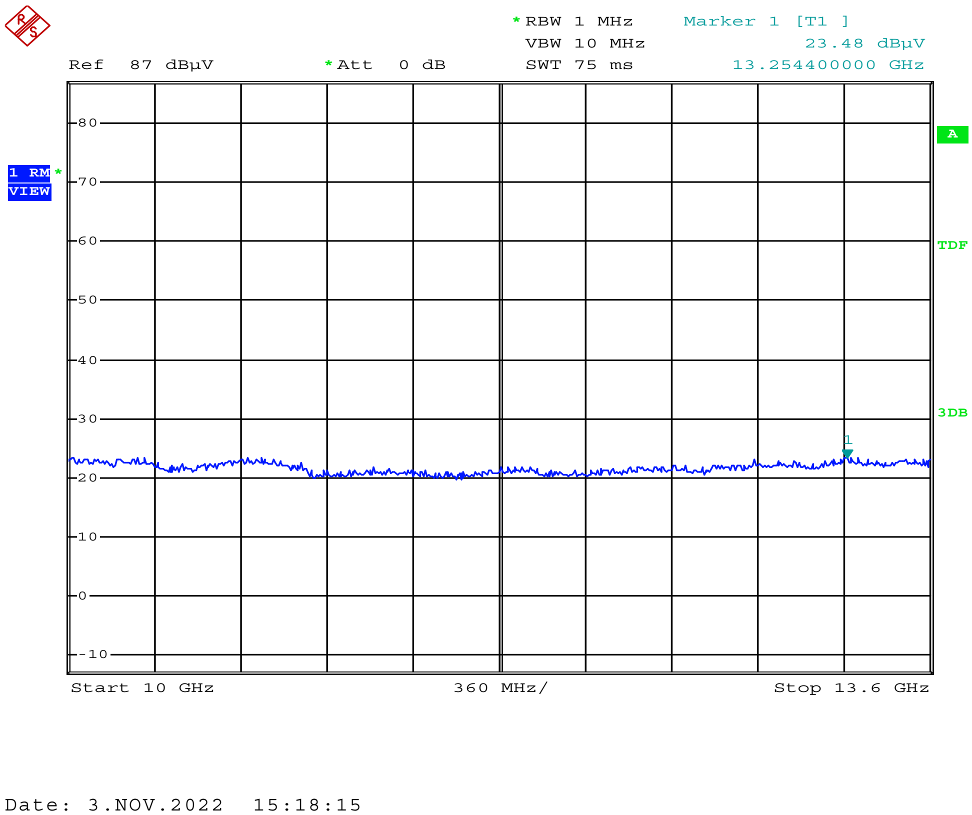
Radiated Tx Emissions



Date: 3.NOV.2022 15:13:17

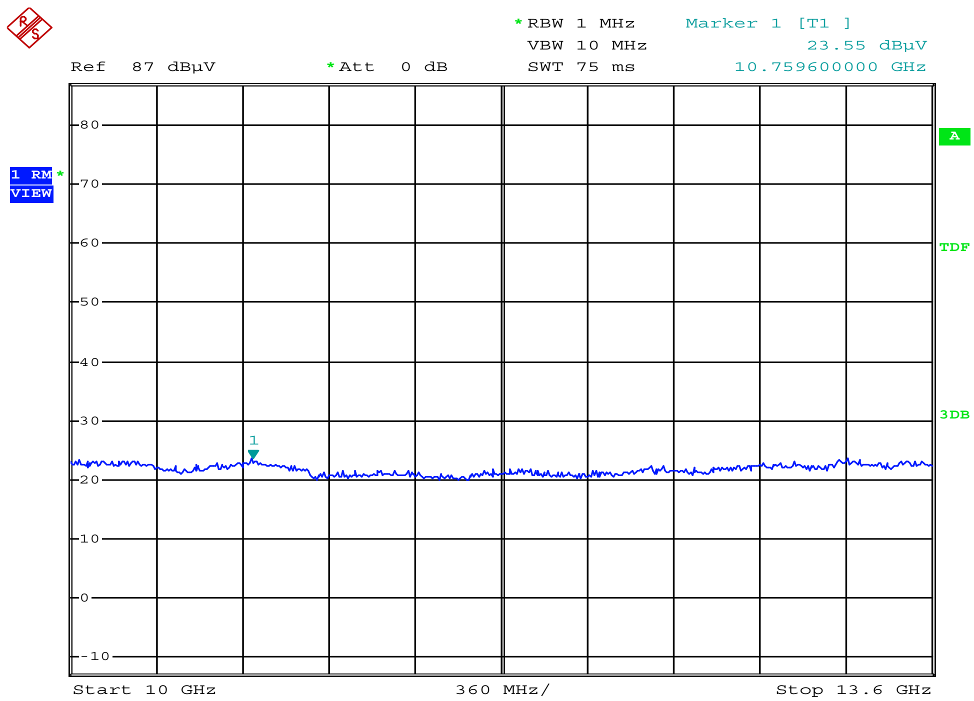
Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Horizontal**	**None Detected (ND)** dBm

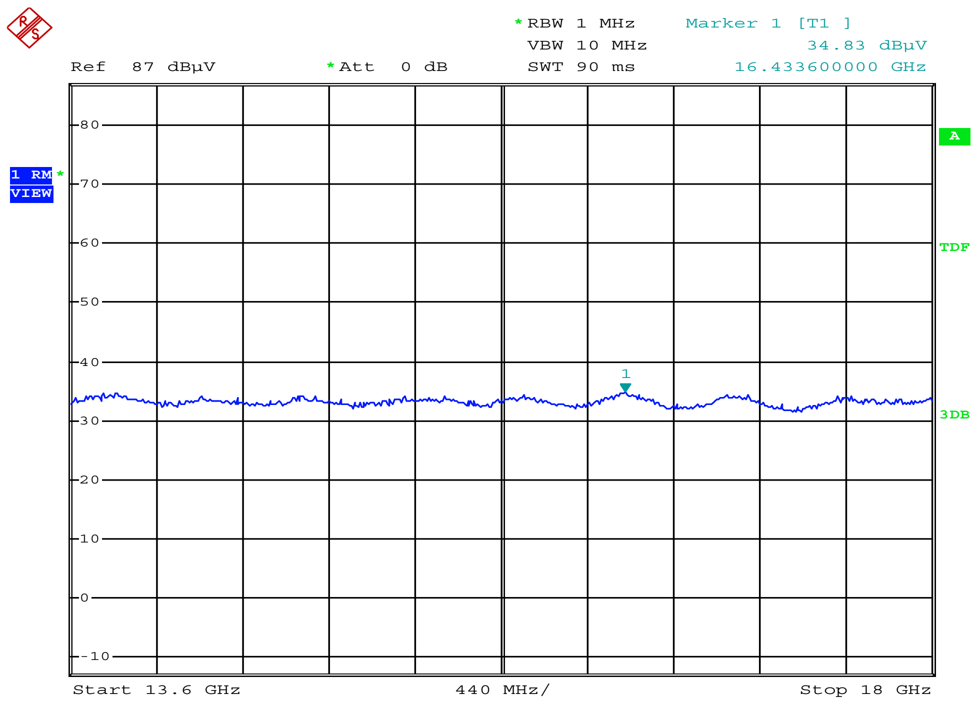
Radiated Tx Emissions



Date: 3.NOV.2022 15:13:32

Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Vertical**	**None Detected (ND)** dBm

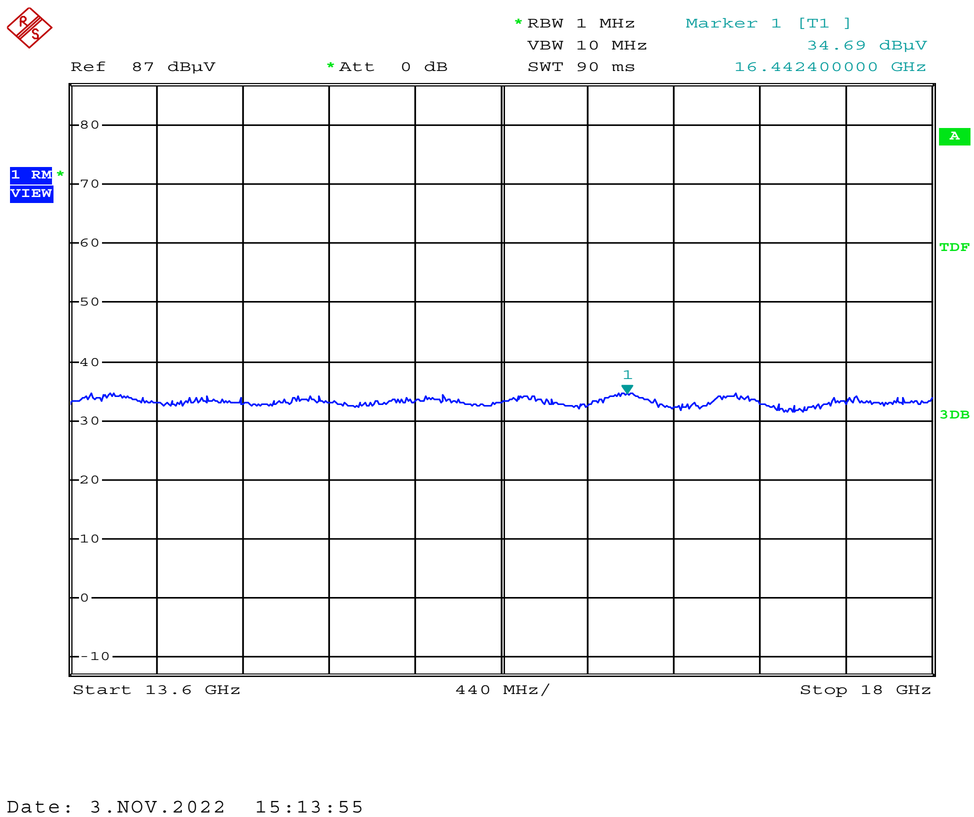
Radiated Tx Emissions



Date: 3.NOV.2022 15:18:30

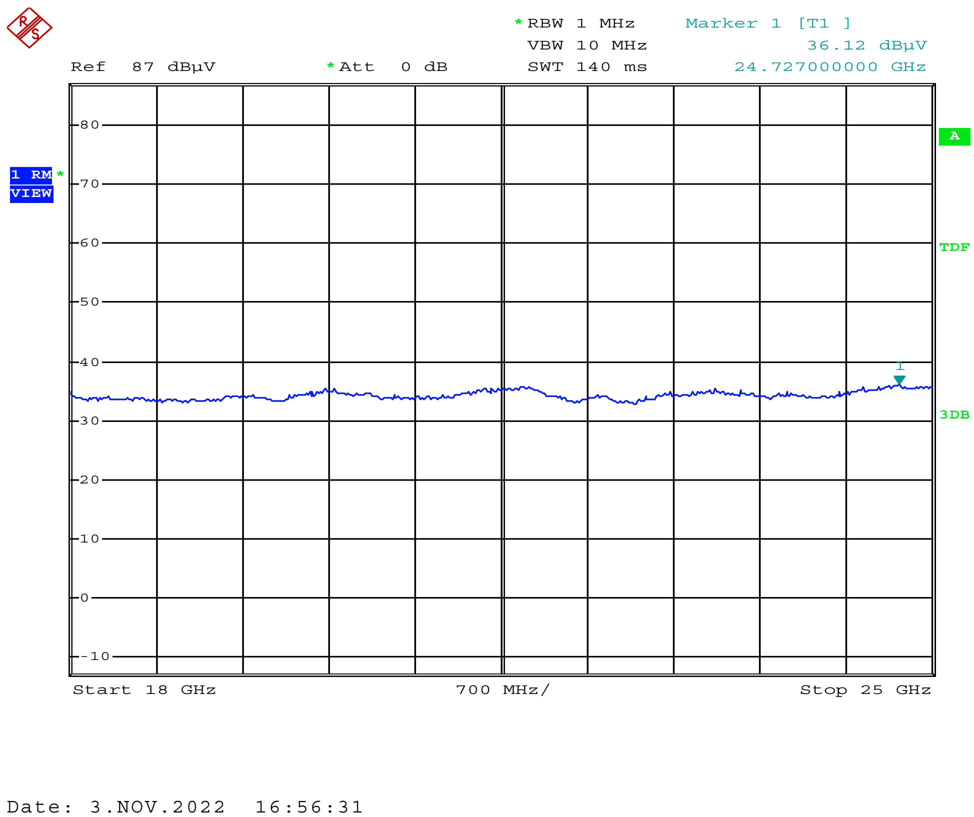
Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



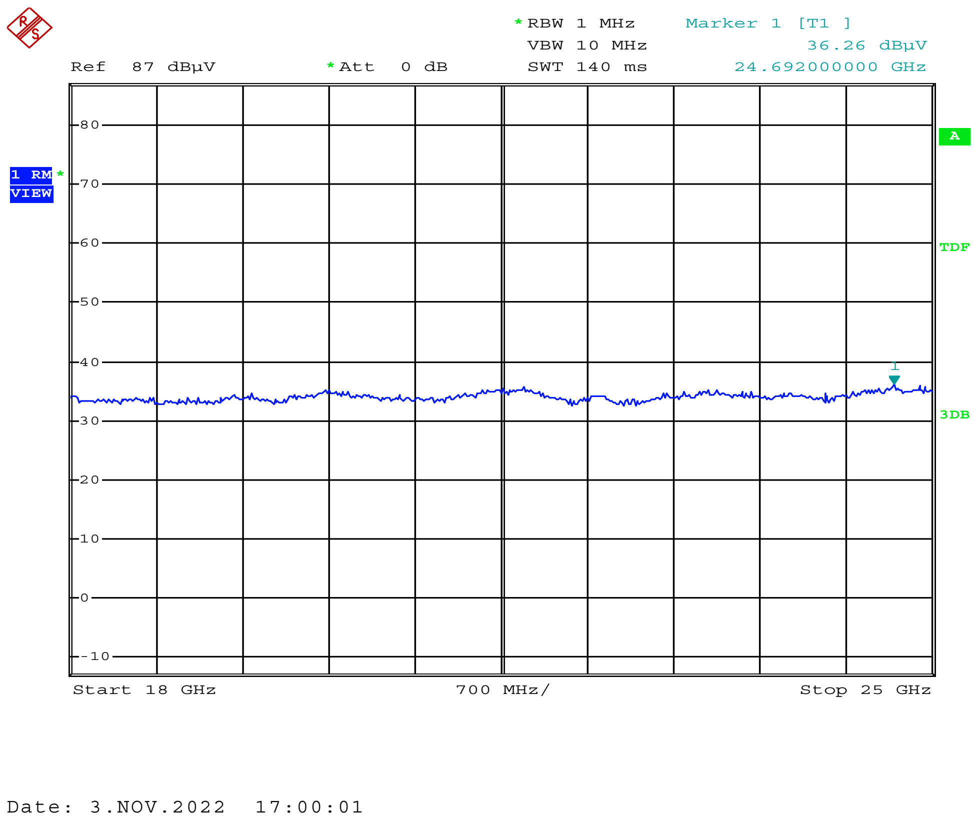
Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions

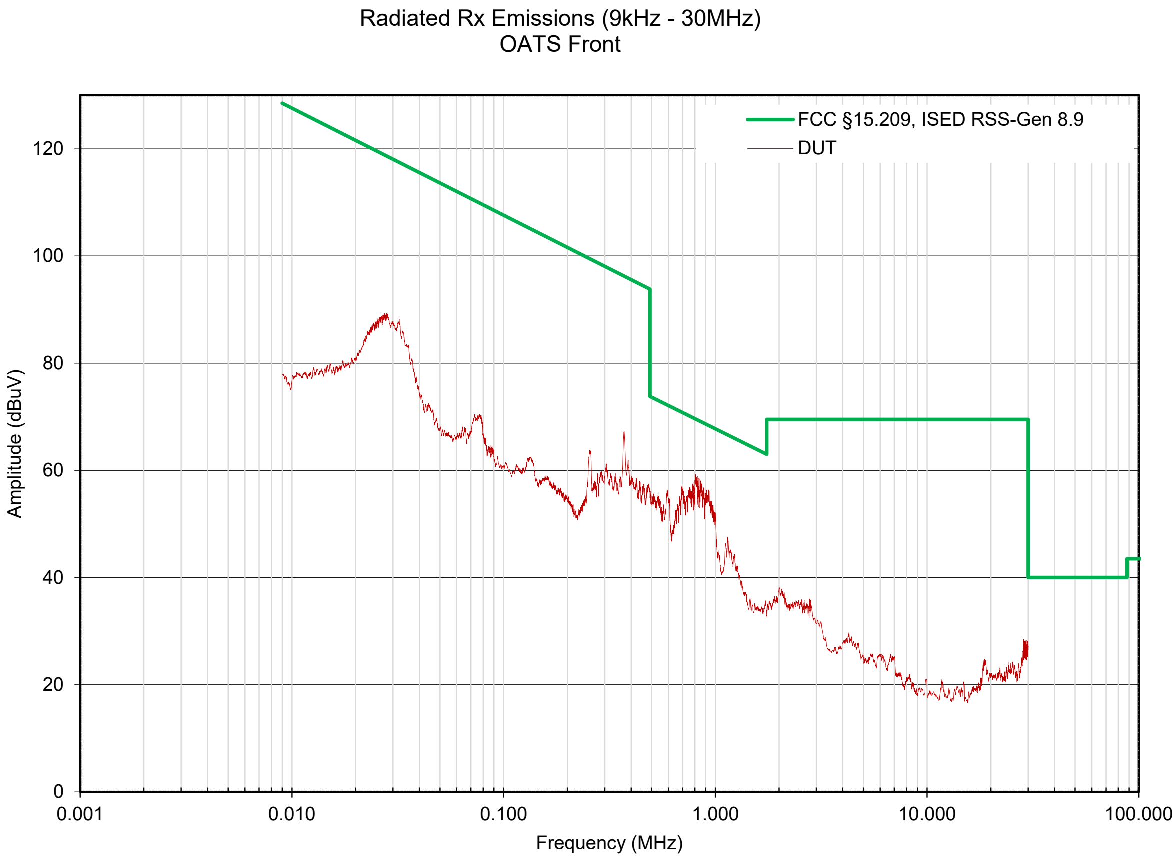


Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Vertical**	**None Detected (ND)** dBm

Measurement Results

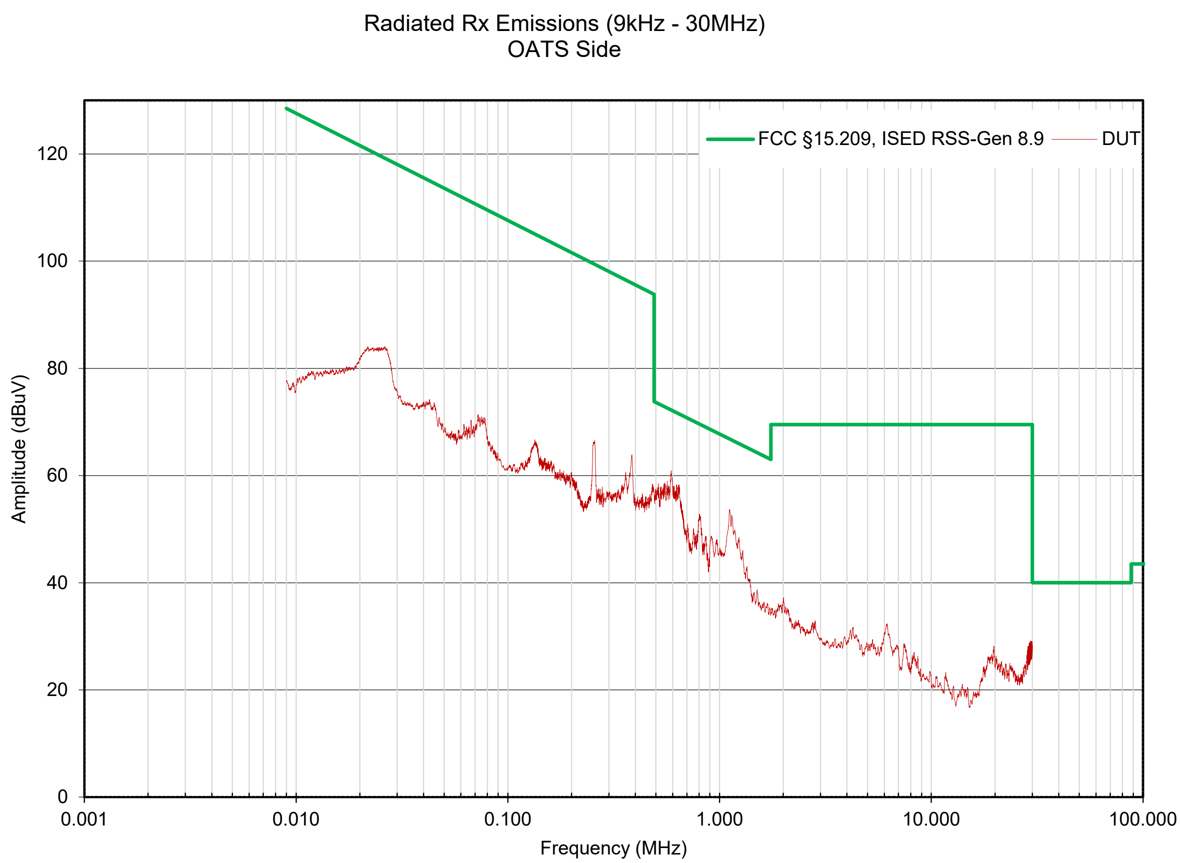
Frequency Range	Antenna Polarization	Measured Emission $[E_{Meas}]$ (dBm)	Limit e.r.p./e.r.i.p. $[A_L]$ (dBm)	Margin (dB)
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

Radiated Rx Emissions:



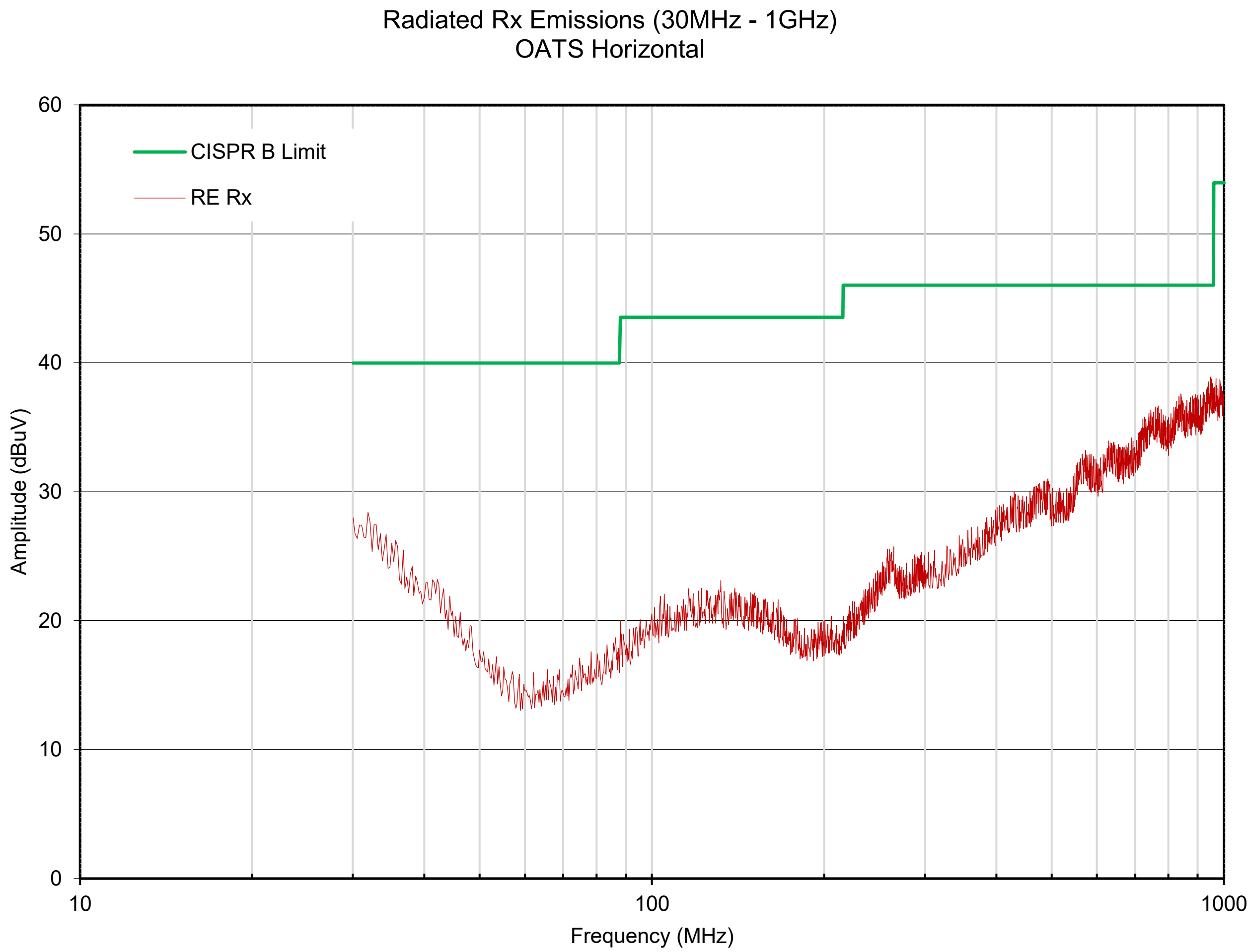
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Front	ND	ND

Radiated Rx Emissions:



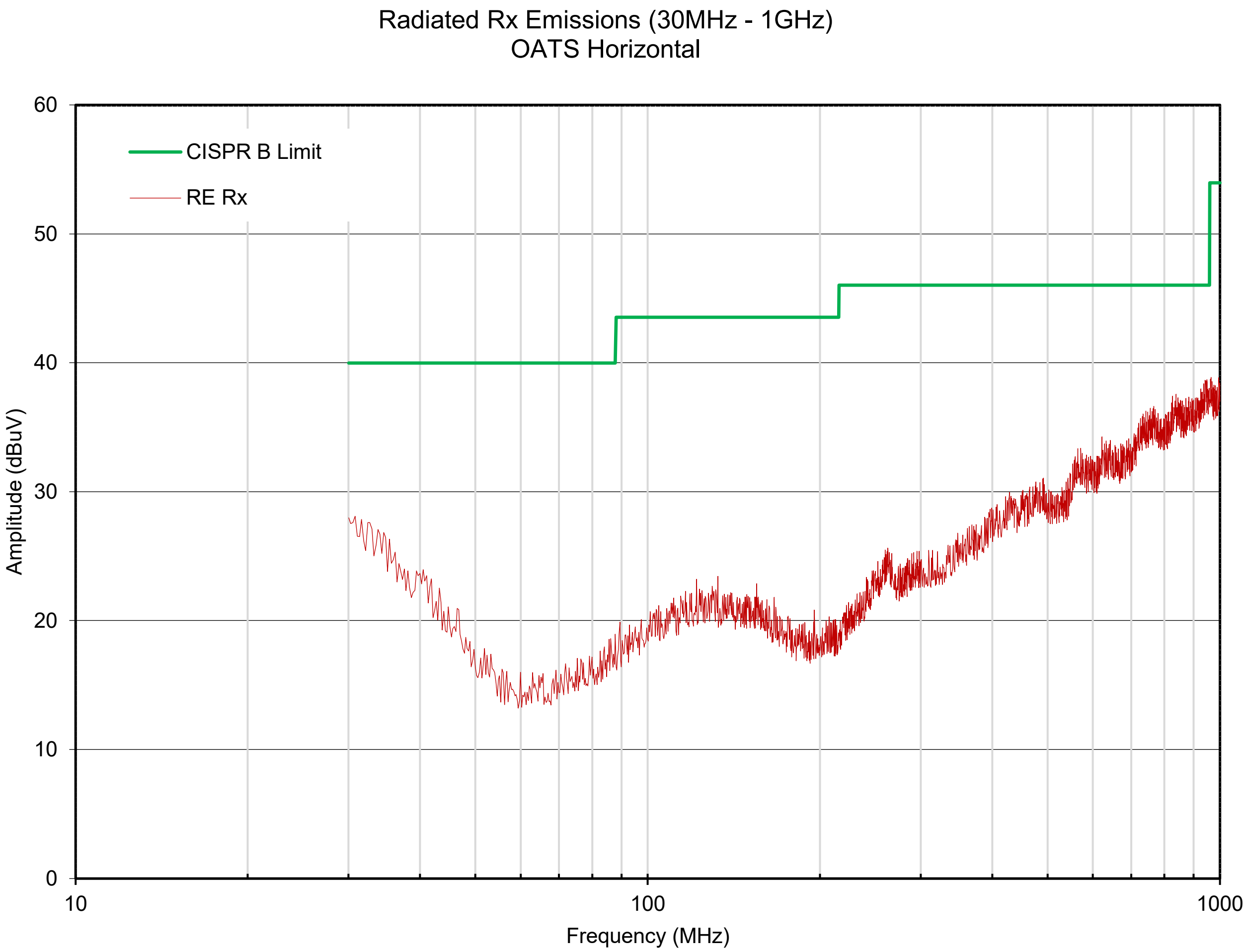
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Side	ND	ND

Radiated Rx Emissions



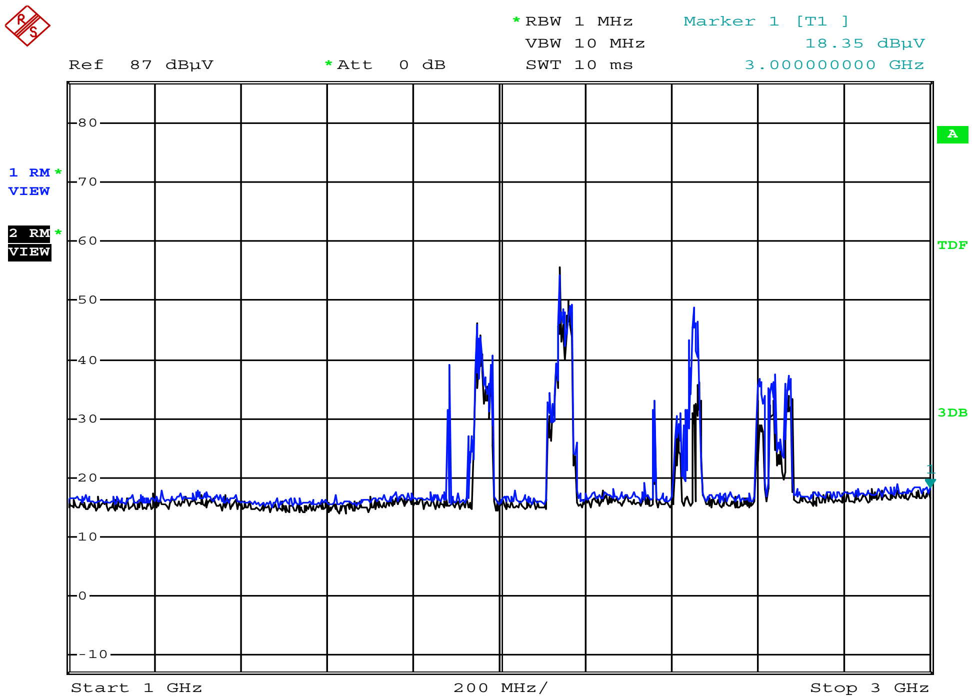
Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Vertical**	**None Detected (ND)** dBm

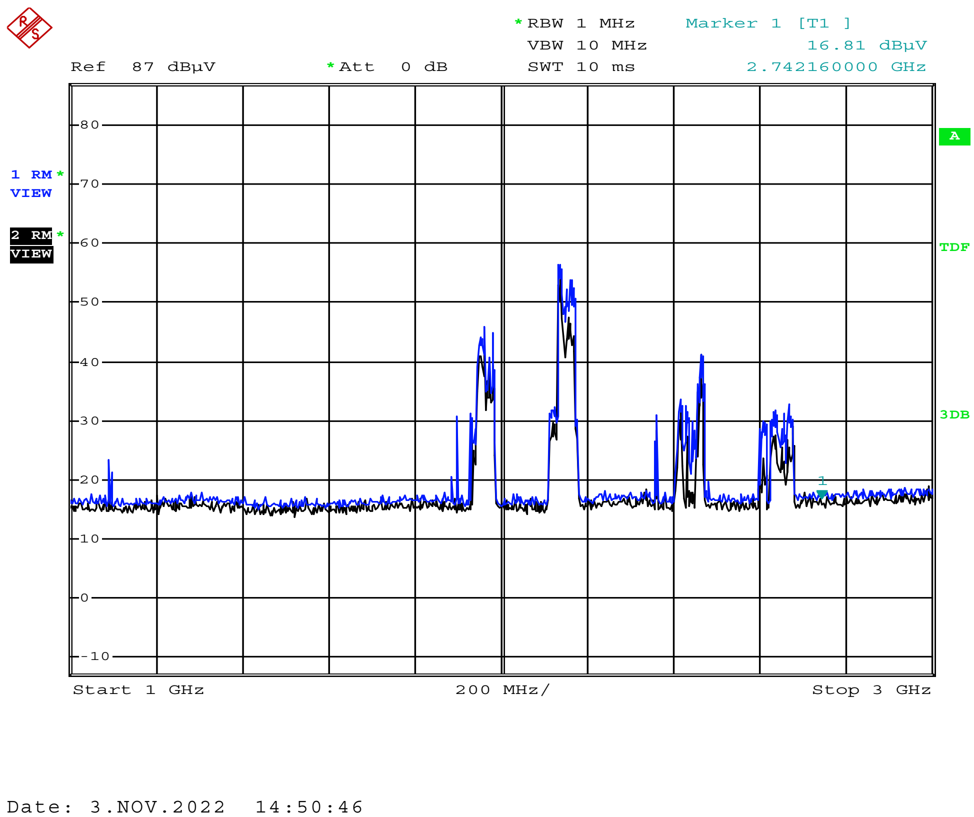
Radiated Rx Emissions



Date: 3.NOV.2022 14:53:56

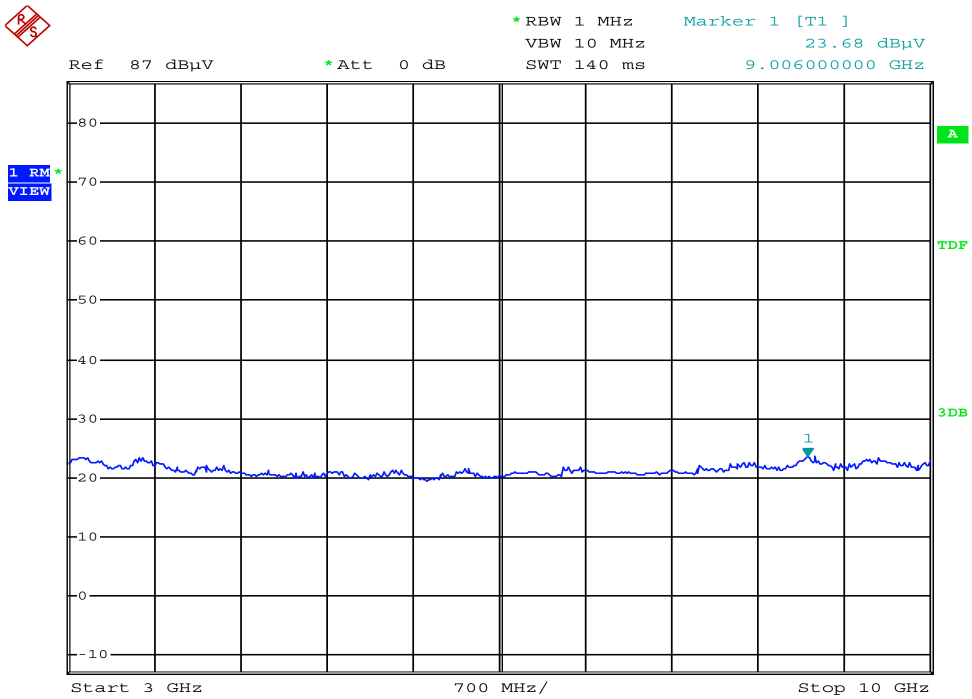
Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Vertical**	**None Detected (ND)** dBm

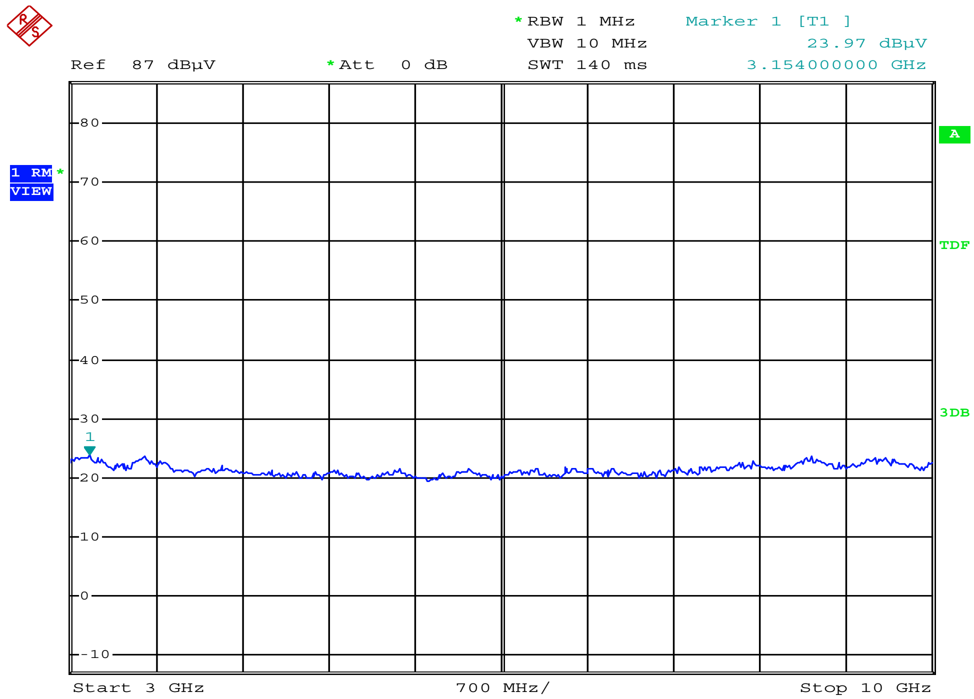
Radiated Rx Emissions



Date: 3.NOV.2022 14:54:23

Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Horizontal**	**None Detected (ND)** dBm

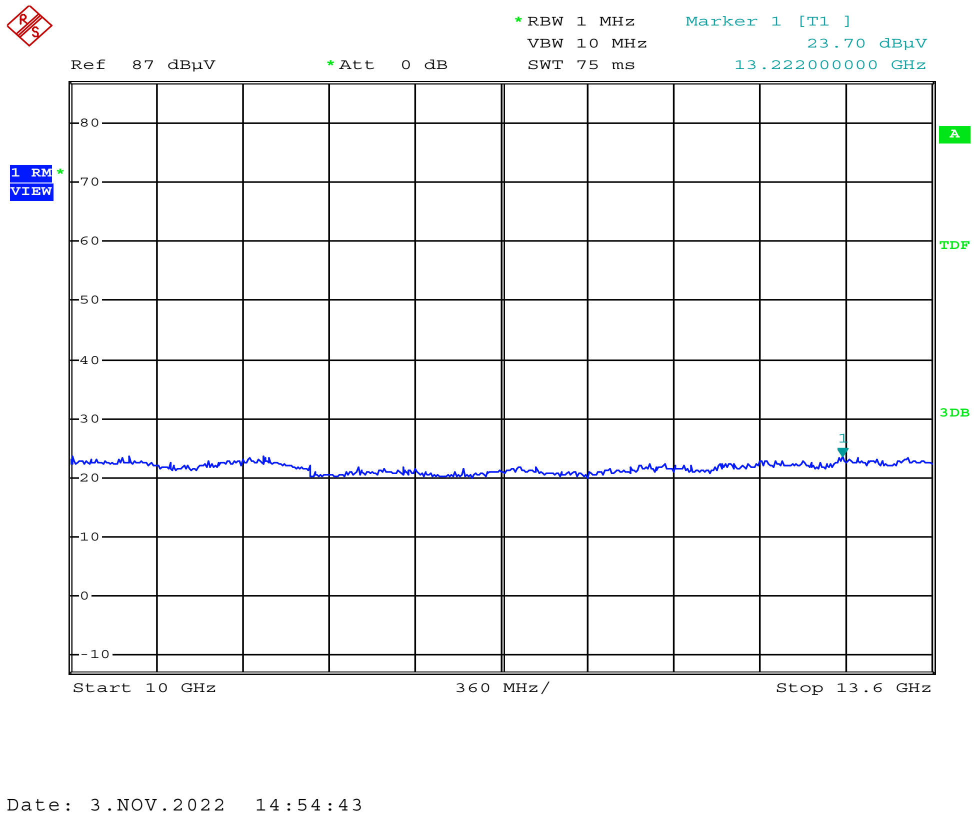
Radiated Rx Emissions



Date: 3.NOV.2022 14:51:10

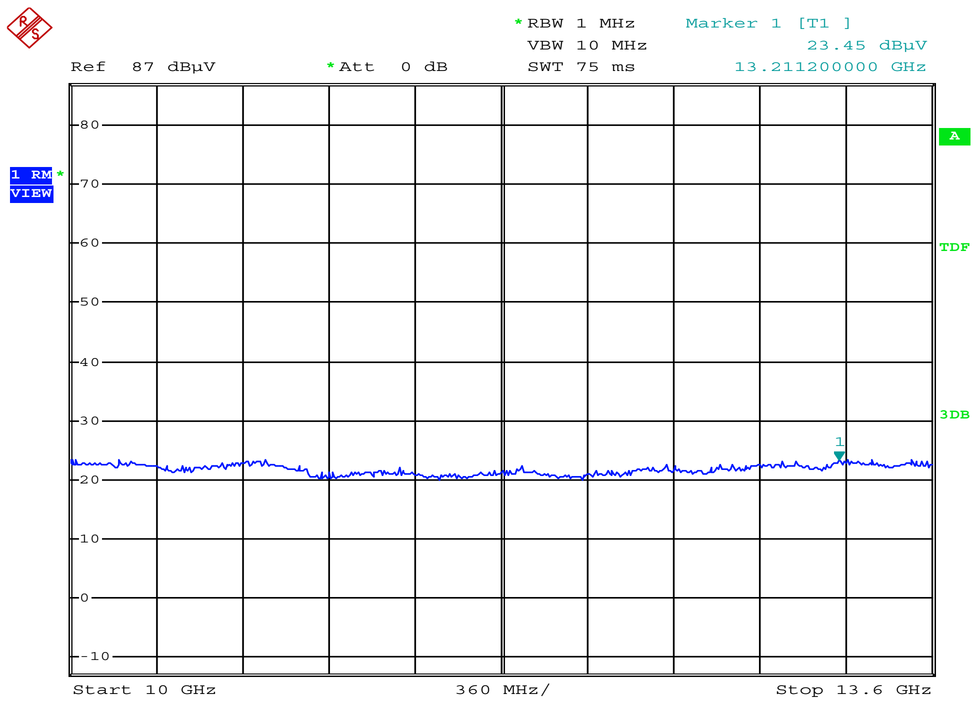
Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Horizontal**	**None Detected (ND)** dBm

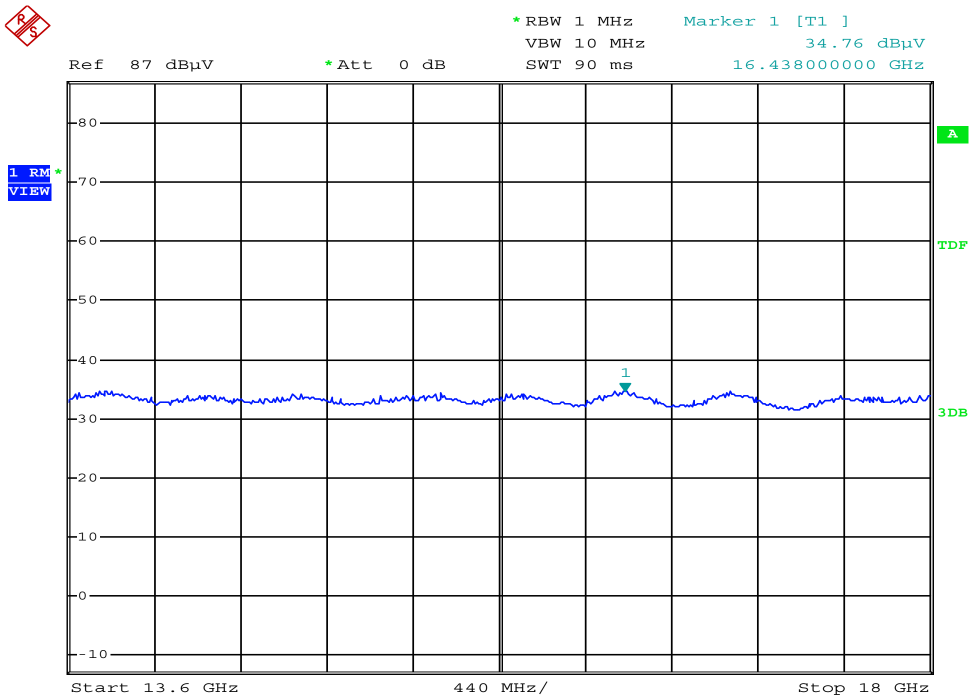
Radiated Rx Emissions



Date: 3.NOV.2022 14:51:34

Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Vertical**	**None Detected (ND)** dBm

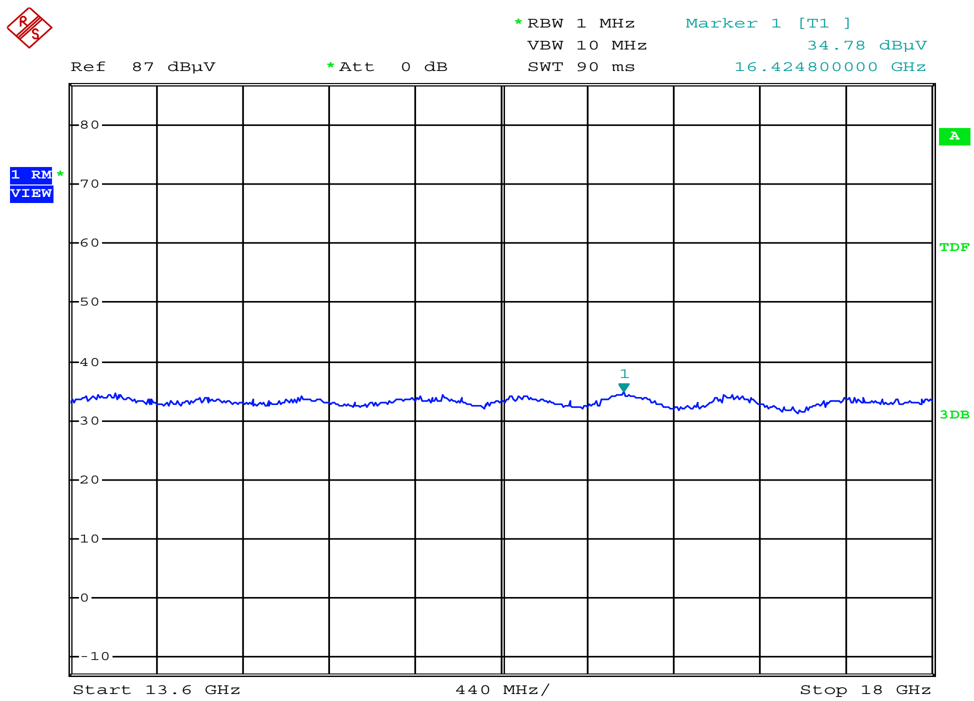
Radiated Rx Emissions



Date: 3.NOV.2022 14:54:57

Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Horizontal**	**None Detected (ND)** dBm

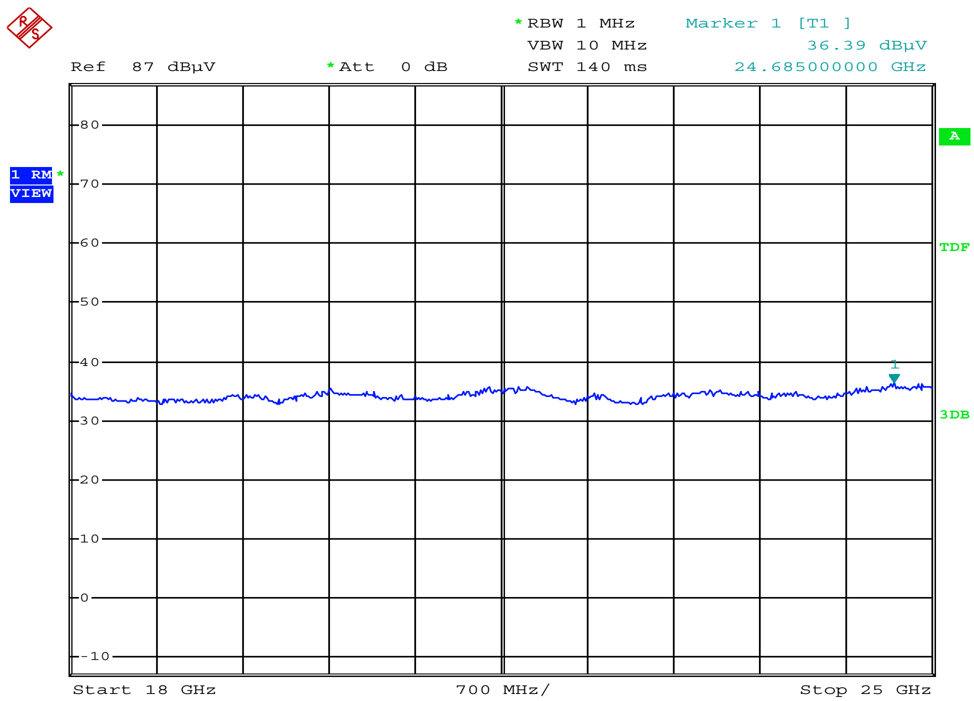
Radiated Rx Emissions



Date: 3.NOV.2022 14:51:53

Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Vertical**	**None Detected (ND)** dBm

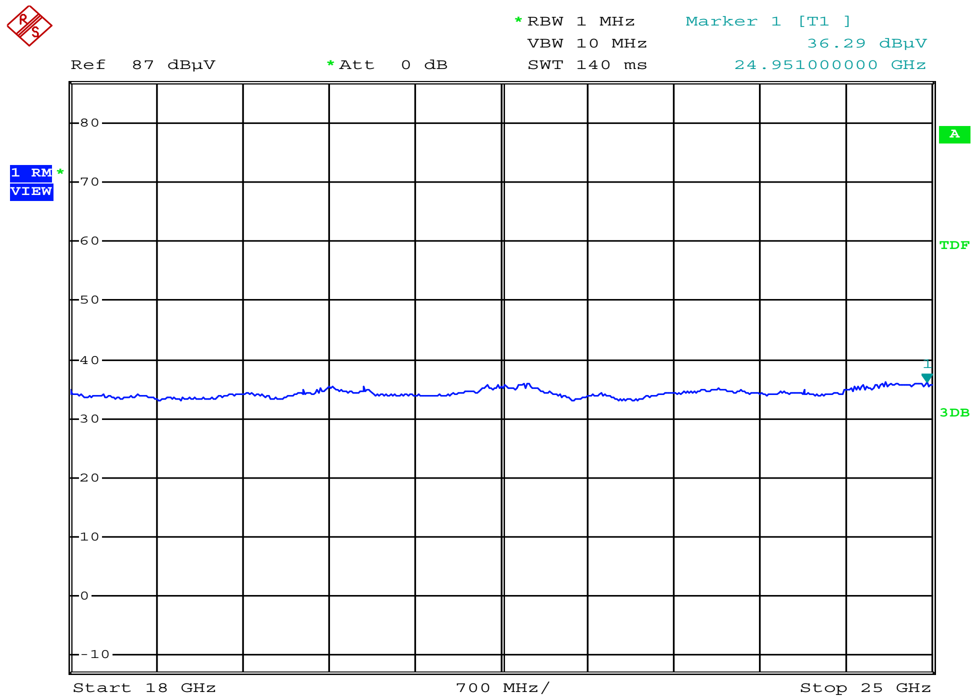
Radiated Rx Emissions



Date: 3.NOV.2022 16:36:22

Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions

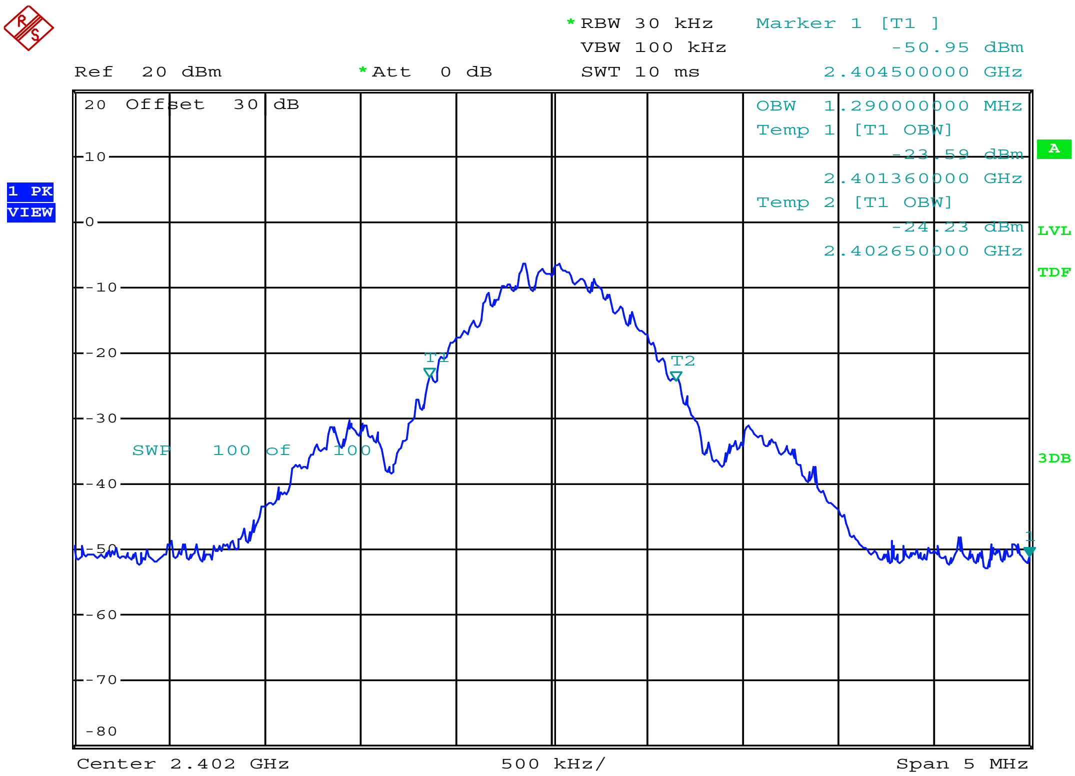


Date: 3.NOV.2022 16:37:40

Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Vertical**	**None Detected (ND)** dBm

Occupied Bandwidth Measurement Results: BlueTooth						
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Occupied Bandwidth (MHz)	Emission Designator
BLE1	0	2402	GMSK	1	1.29	1M29D1D
	19	2440			1.98	1M98D1D
	39	2480			1.31	1M31D1D
BLE2	0	2402	GMSK	2	2.52	2M52D1D
	19	2440			2.75	2M75D1D
	39	2480			2.56	2M56D1D
ANT	2	2402	GFSK	-	1.23	1M22D1D
	41	2440			1.23	1M22D1D
	80	2480			1.30	1M30D1D
					Result:	Complies

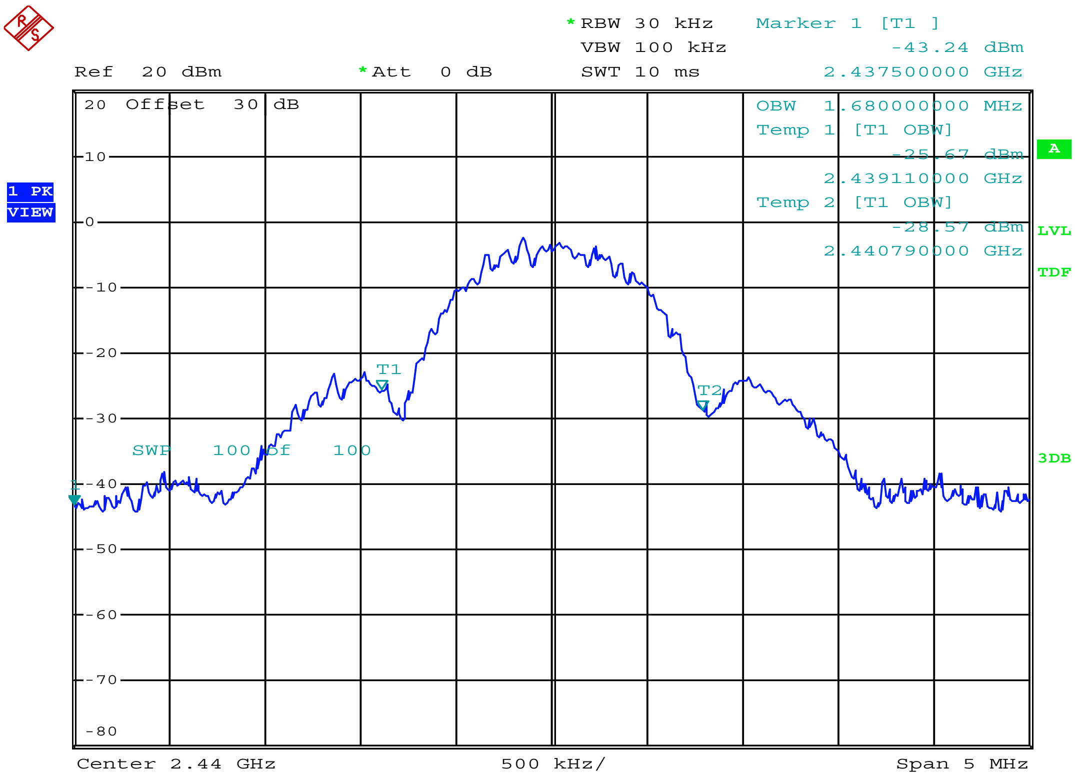
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 12:54:00

Channel Number:	**0**	Channel Frequency (MHz):	**2402**	Occupied Bandwidth (MHz):	**1.29**
Modulation:	**GMSK**	Bit Rate (Mbps):	**1**		

Occupied Bandwidth: BlueTooth

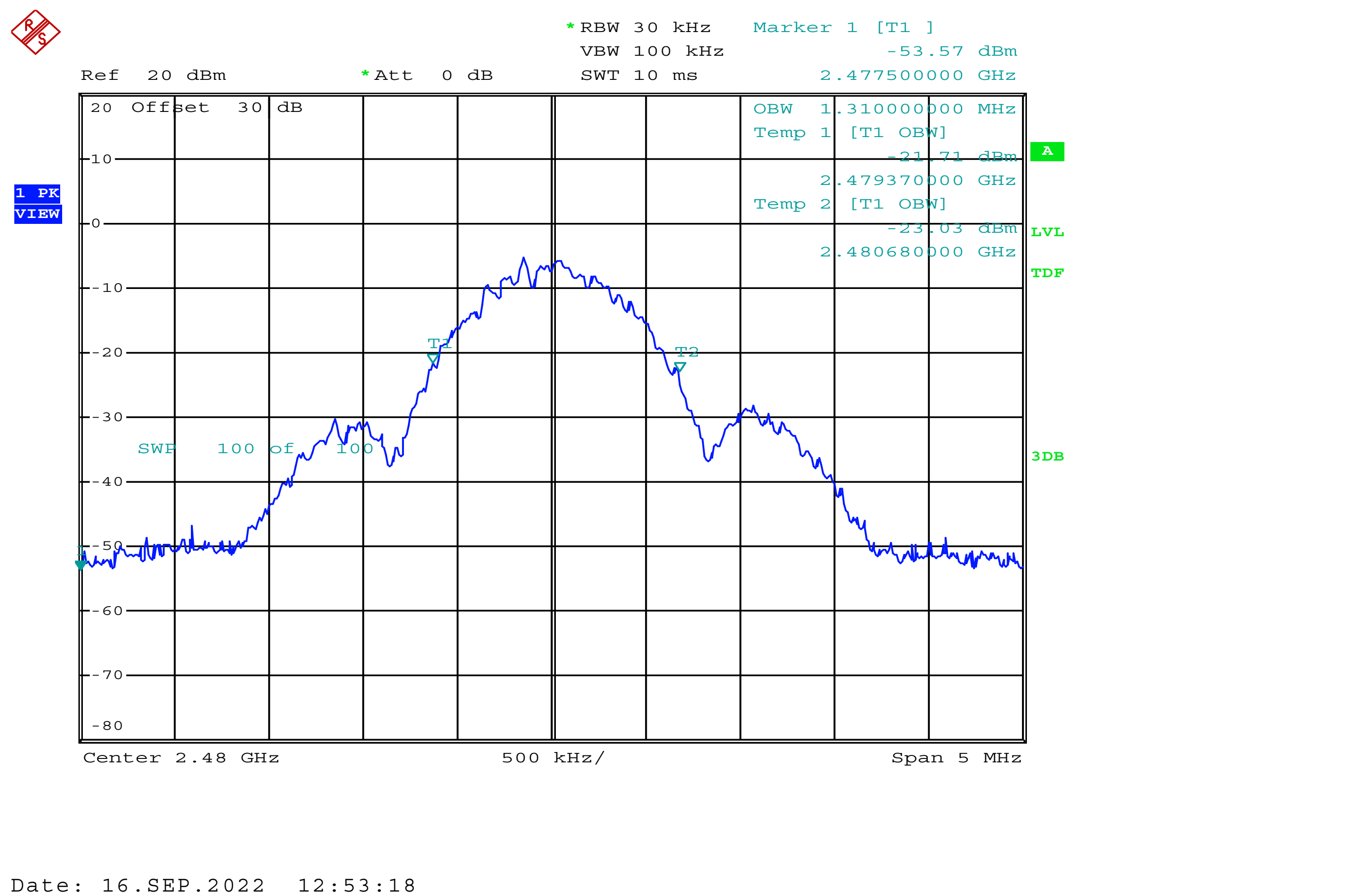


Date: 16.SEP.2022 12:54:53

Channel Number:	**19**	Channel Frequency (MHz):	**2440**
Modulation:	**GMSK**	Bit Rate (Mbps):	**1**

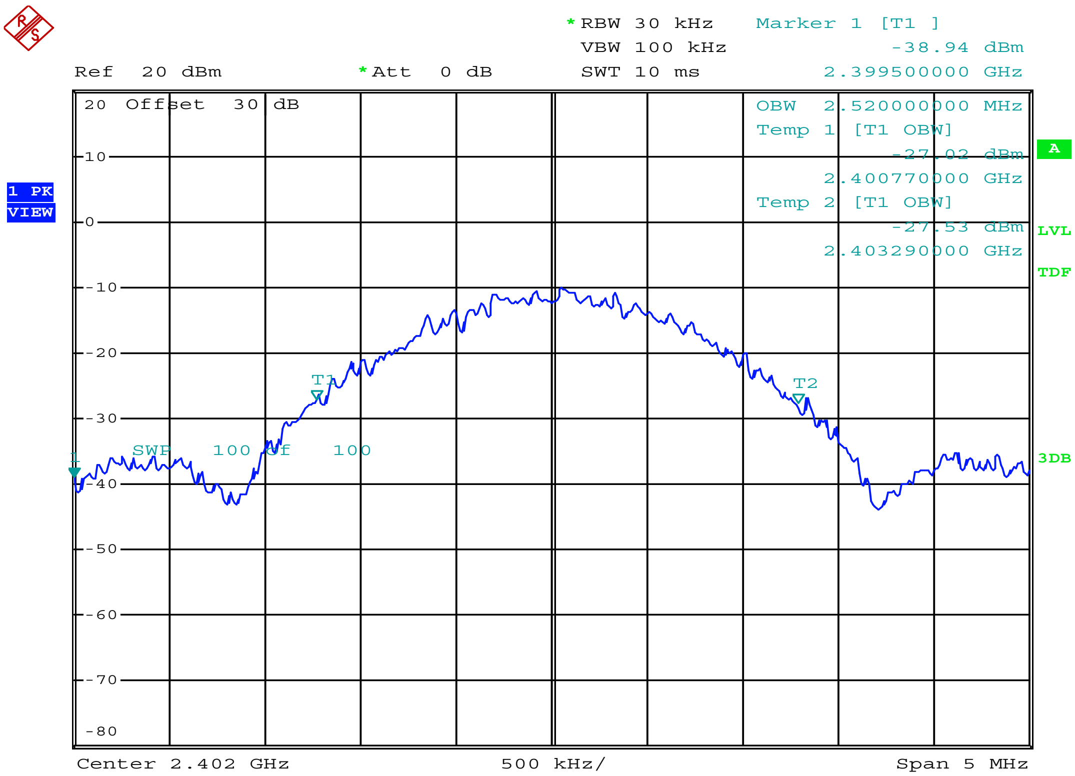
Occupied Bandwidth (MHz):	**1.98**

Occupied Bandwidth: BlueTooth



Channel Number:	39	Channel Frequency (MHz):	2480	Occupied Bandwidth (MHz):	1.31
Modulation:	GMSK	Bit Rate (Mbps):	1		

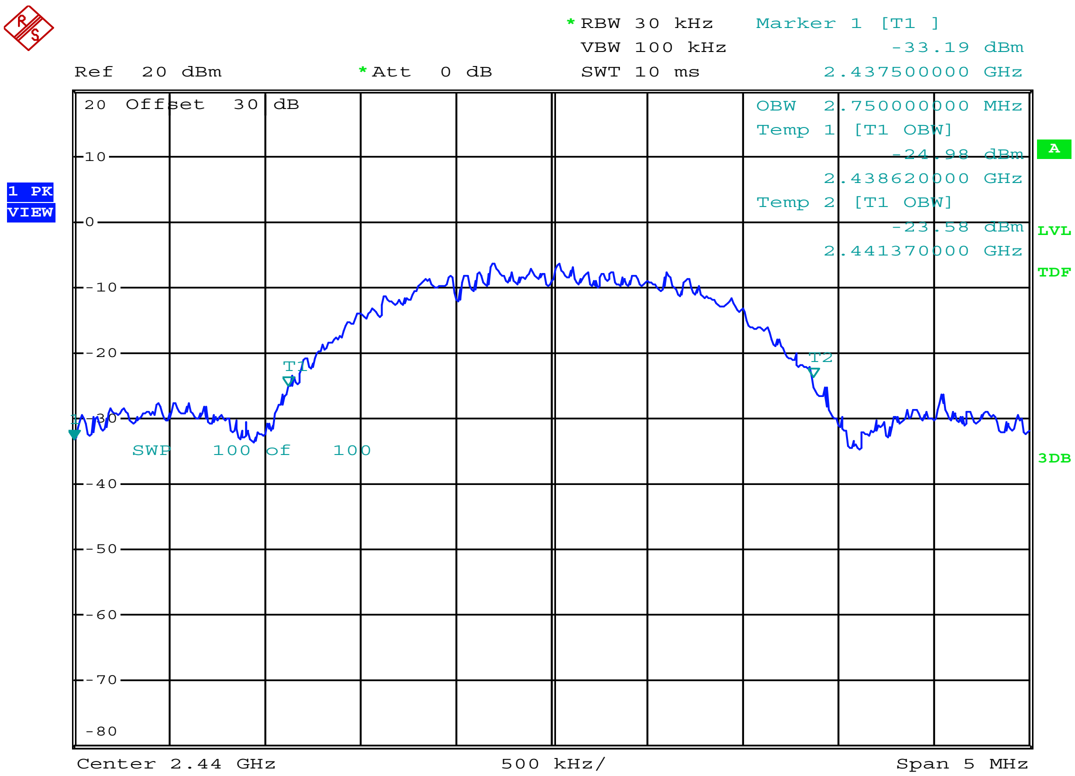
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 12:29:02

Channel Number:	0	Channel Frequency (MHz):	2402	Occupied Bandwidth (MHz):	2.52
Modulation:	GMSK	Bit Rate (Mbps):	2		

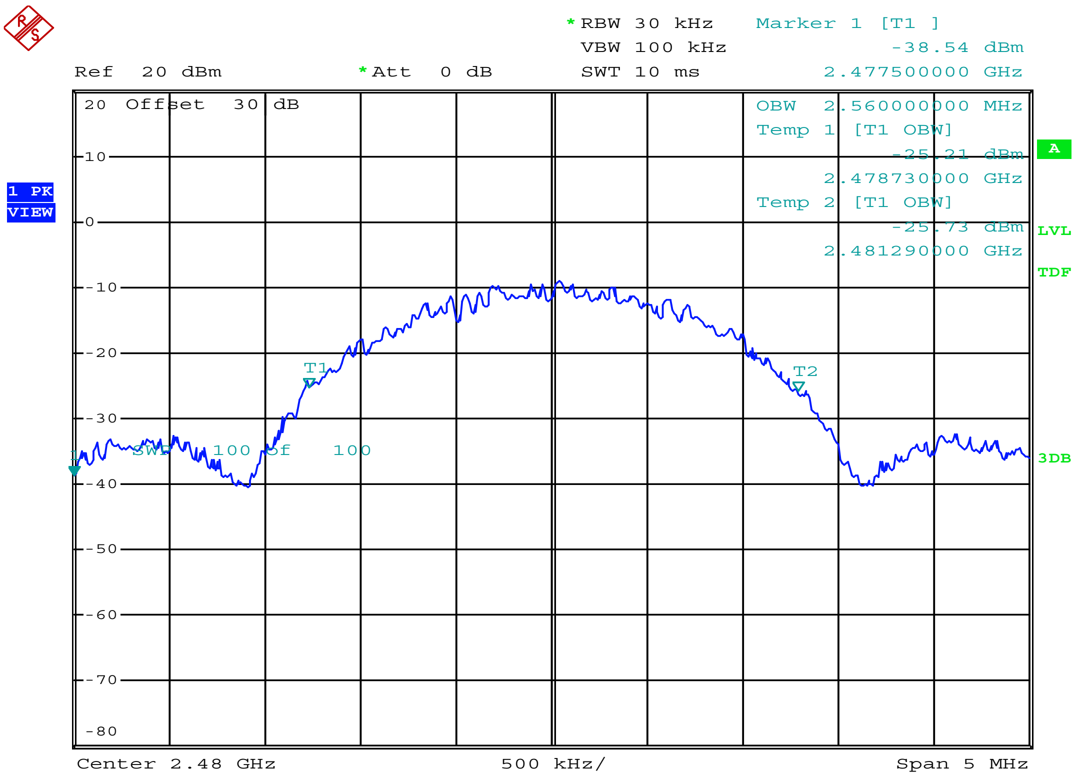
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 12:30:20

Channel Number:	19	Channel Frequency (MHz):	2440	Occupied Bandwidth (MHz):	2.75
Modulation:	GMSK	Bit Rate (Mbps):	2		

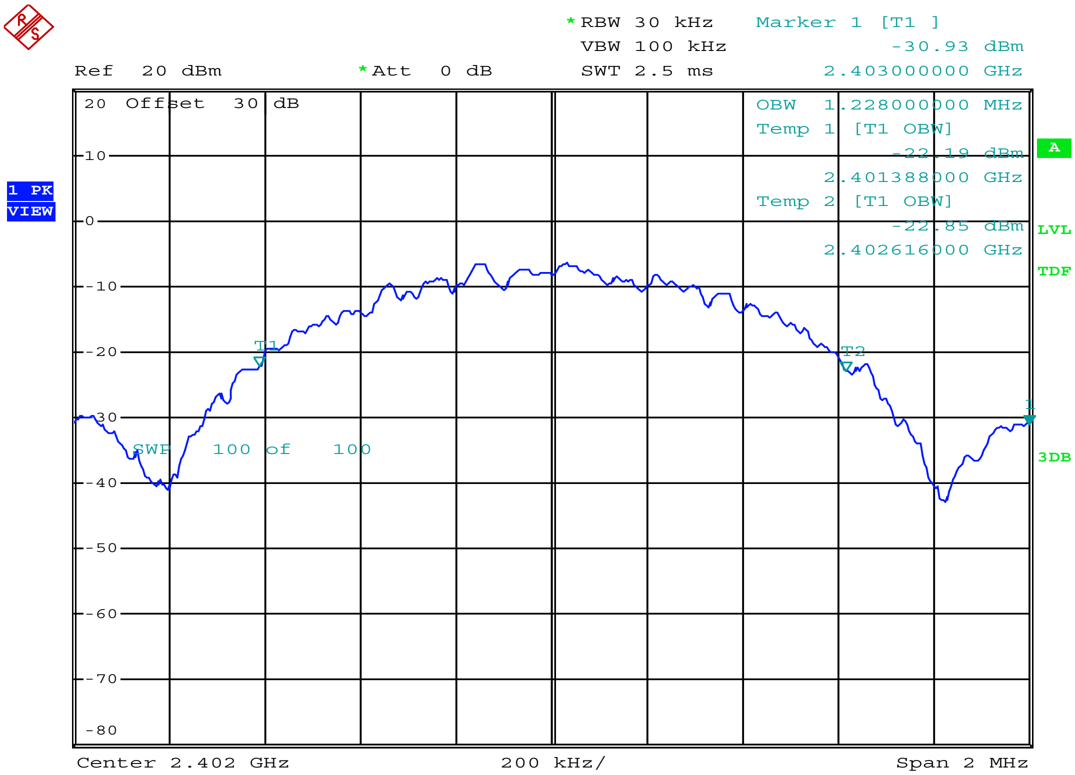
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 12:28:03

Channel Number:	**39**	Channel Frequency (MHz):	**2480**	Occupied Bandwidth (MHz):	**2.56**
Modulation:	**GMSK**	Bit Rate (Mbps):	**2**		

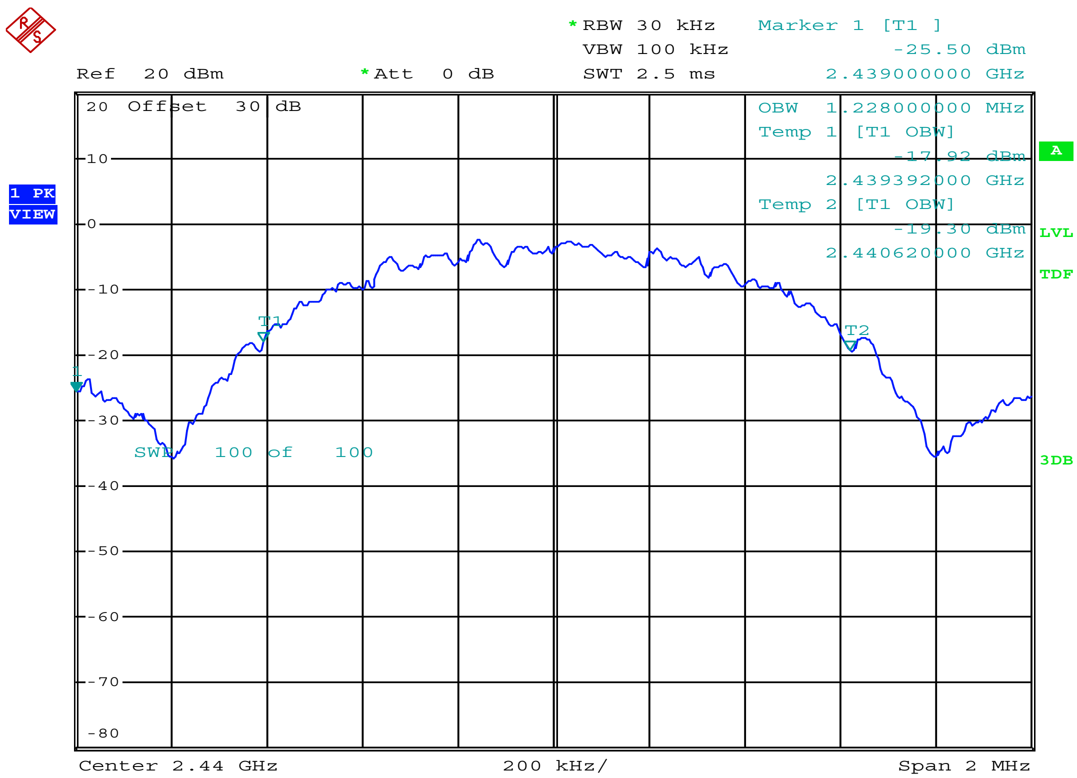
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 15:51:46

Channel Number:	2	Channel Frequency (MHz):	2402	Occupied Bandwidth (MHz):	1.228
Modulation:	GFSK	Bit Rate (Mbps):	-		

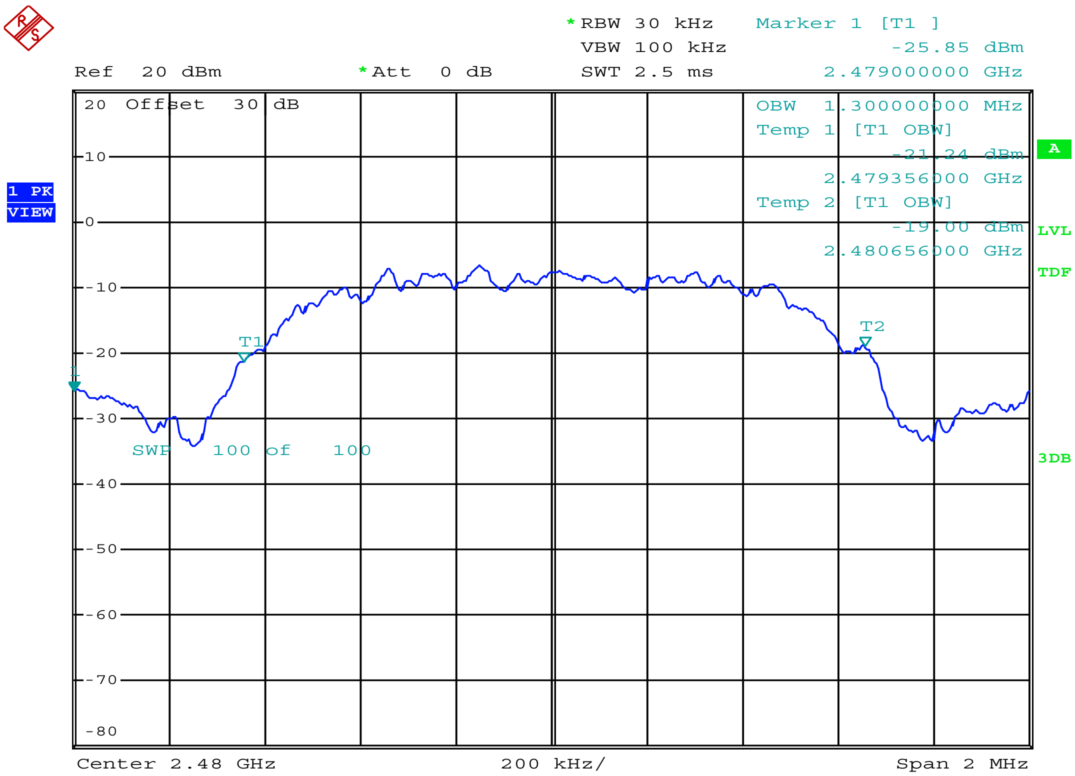
Occupied Bandwidth: BlueTooth



Date: 16.SEP.2022 15:48:14

Channel Number:	41	Channel Frequency (MHz):	2440	Occupied Bandwidth (MHz):	1.228
Modulation:	GFSK	Bit Rate (Mbps):	-		

Occupied Bandwidth: BlueTooth

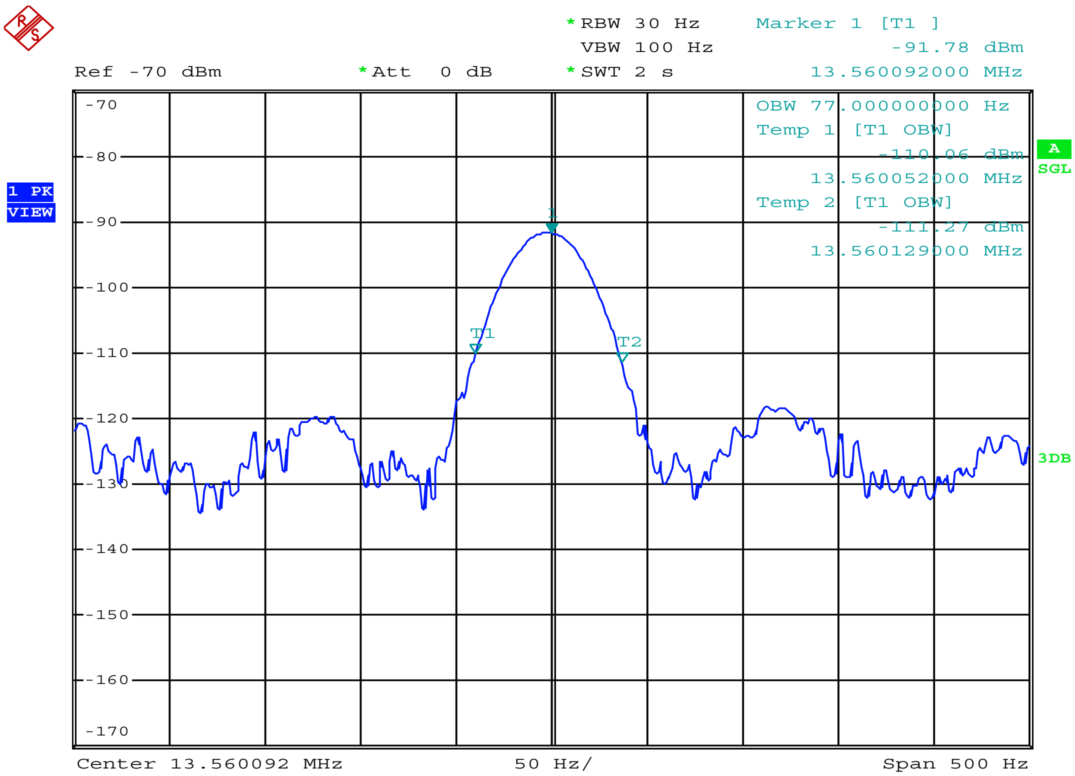


Date: 16.SEP.2022 15:51:10

Channel Number:	80	Channel Frequency (MHz):	2480	Occupied Bandwidth (MHz):	1.300
Modulation:	GFSK	Bit Rate (Mbps):	-		

Occupied Bandwidth Measurement Results: NFC						
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Occupied Bandwidth (Hz)	Emission Designator
NFC	-	13.56	ASK	-	77.000	77HK1D
					Result:	Complies

Occupied Bandwidth: BlueTooth



Date: 31.OCT.2022 14:12:57

Channel Number:	-	Channel Frequency (MHz):	13.56	Occupied Bandwidth (Hz):	77.000
Modulation:	ASK	Bit Rate (Mbps):	-		

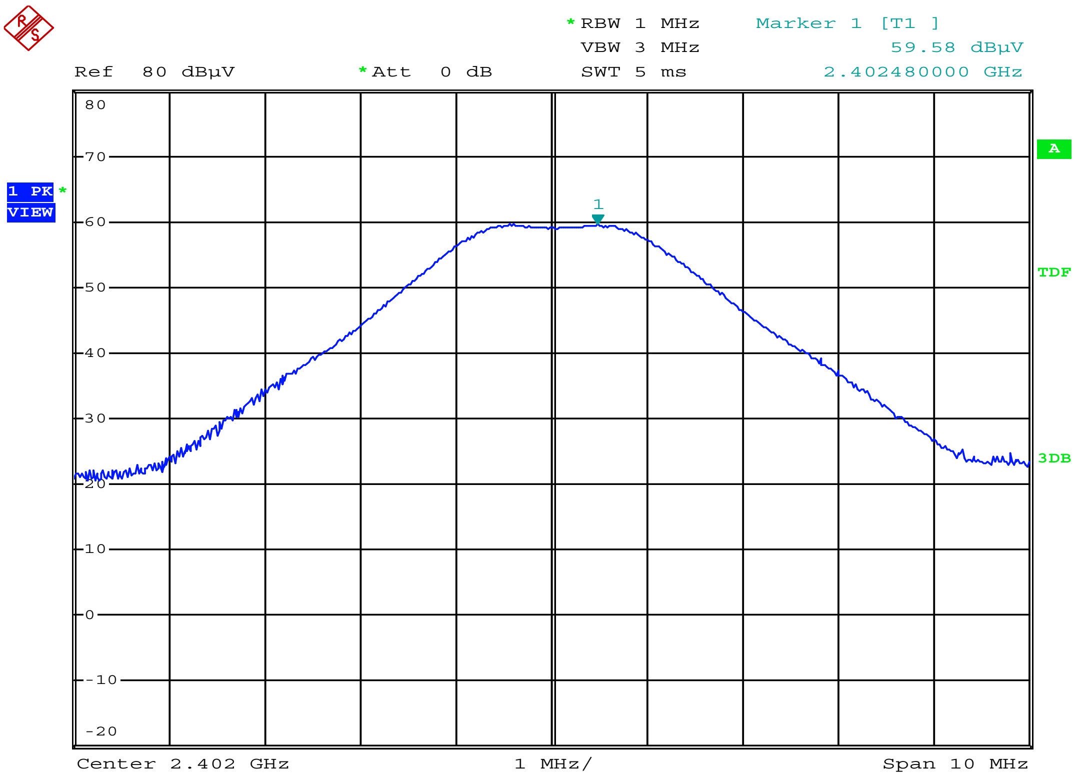
FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	Detector	Antenna Polarization	Measured Field Strength [FS_{Meas}] (dBuV @ 3m)	Cable Loss(1) [L_C] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS_{Corr}] (dBuV @3m)	Limit (dBuV)	Margin (dB)
2402.0	BLE2	GMSK	2	RMS	Horizontal	59.58	0	28.28	87.86	94.0	**6.1**
2440.0					Horizontal	62.35	0	28.28	90.63		**3.4**
2480.0					Horizontal	57.50	0	28.28	85.78		**8.2**
2402.0					Vertical	50.81	0	28.28	79.09		**14.9**
2440.0					Vertical	50.76	0	28.28	79.04		**15.0**
2480.0					Vertical	45.80	0	28.28	74.08		**19.9**
2402.0				Peak	Horizontal	62.94	0	28.28	91.22	114.0	**22.8**
2440.0					Horizontal	63.83	0	28.28	92.11		**21.9**
2480.0					Horizontal	59.34	0	28.28	87.62		**26.4**
2402.0					Vertical	50.66	0	28.28	78.94		**35.1**
2440.0					Vertical	52.28	0	28.28	80.56		**33.4**
2480.0					Vertical	47.70	0	28.28	75.98		**38.0**
									Result:	**Complies**	

(1) Cable loss accounted for in instrument transducer factor

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

Margin = Limit - FS_{Corr}

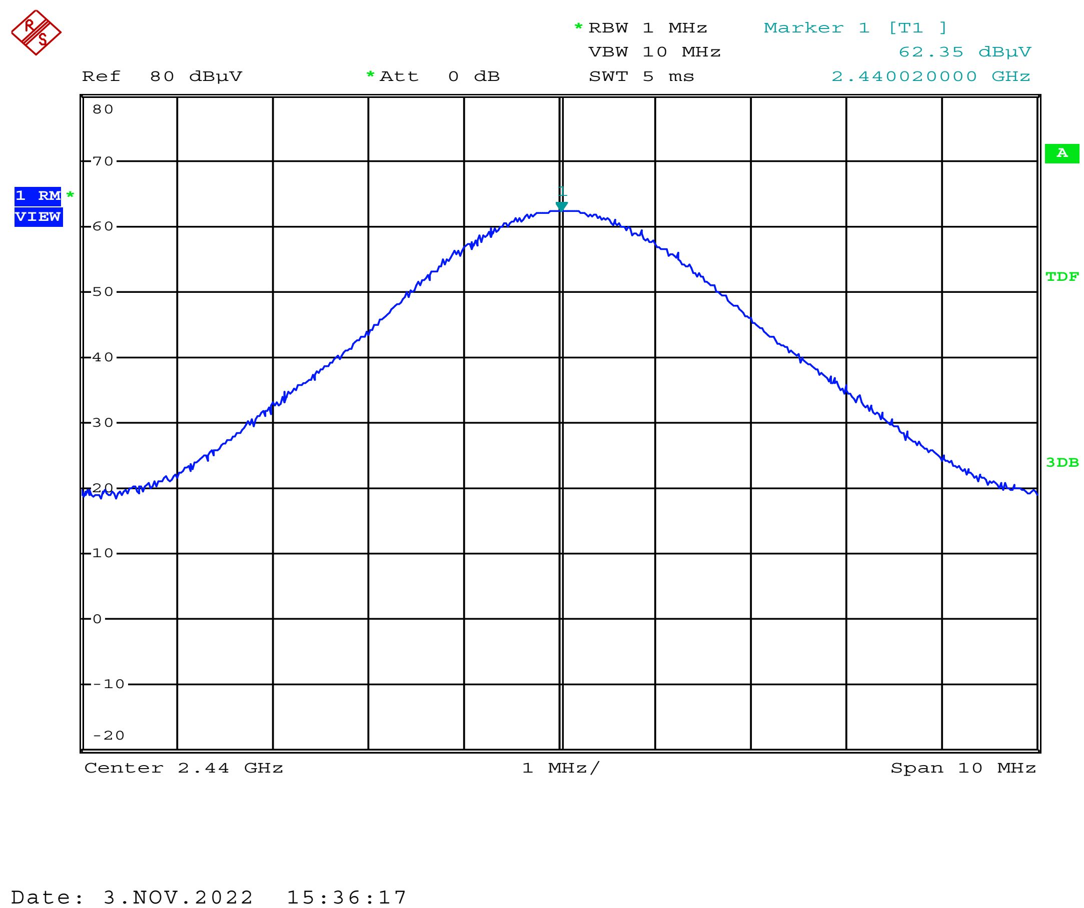
Field Strength (Average)



Date: 3.NOV.2022 15:43:00

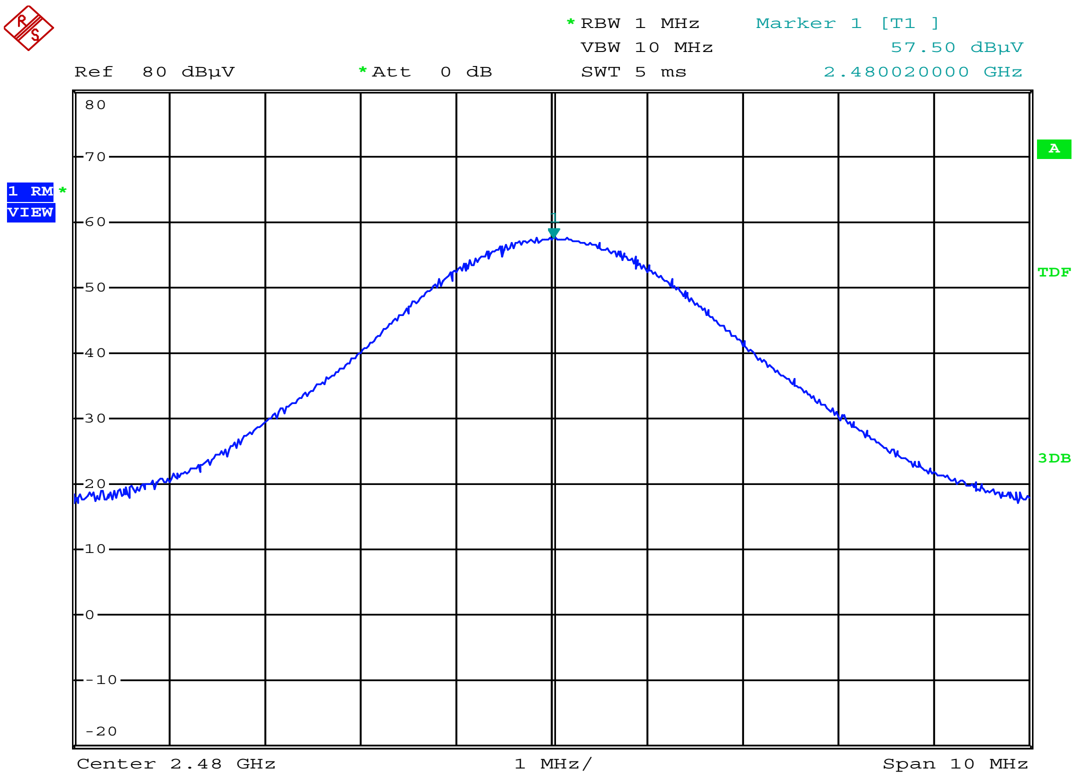
Channel Frequency (MHz):	2402	Antenna Polarization:	H	Channel Power (dBuV):	59.58
Modulation:	GMSK	Bit Rate (Mbps):	-		

Field Strength (Average)



Channel Frequency (MHz):	2440	Antenna Polarization:	H	Channel Power (dBuV):	62.35
Modulation:	GMSK	Bit Rate (Mbps):	-		

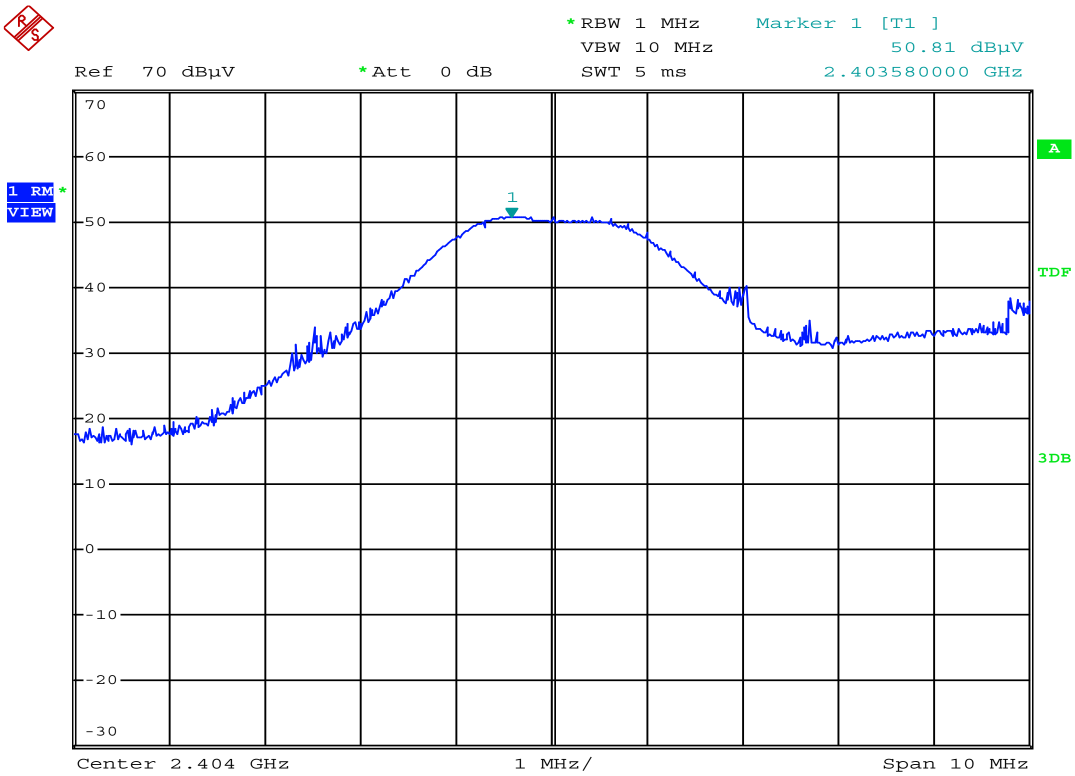
Field Strength (Average)



Date: 3.NOV.2022 15:45:04

Channel Frequency (MHz):	2480	Antenna Polarization:	H	Channel Power (dBuV):	57.50
Modulation:	GMSK	Bit Rate (Mbps):	-		

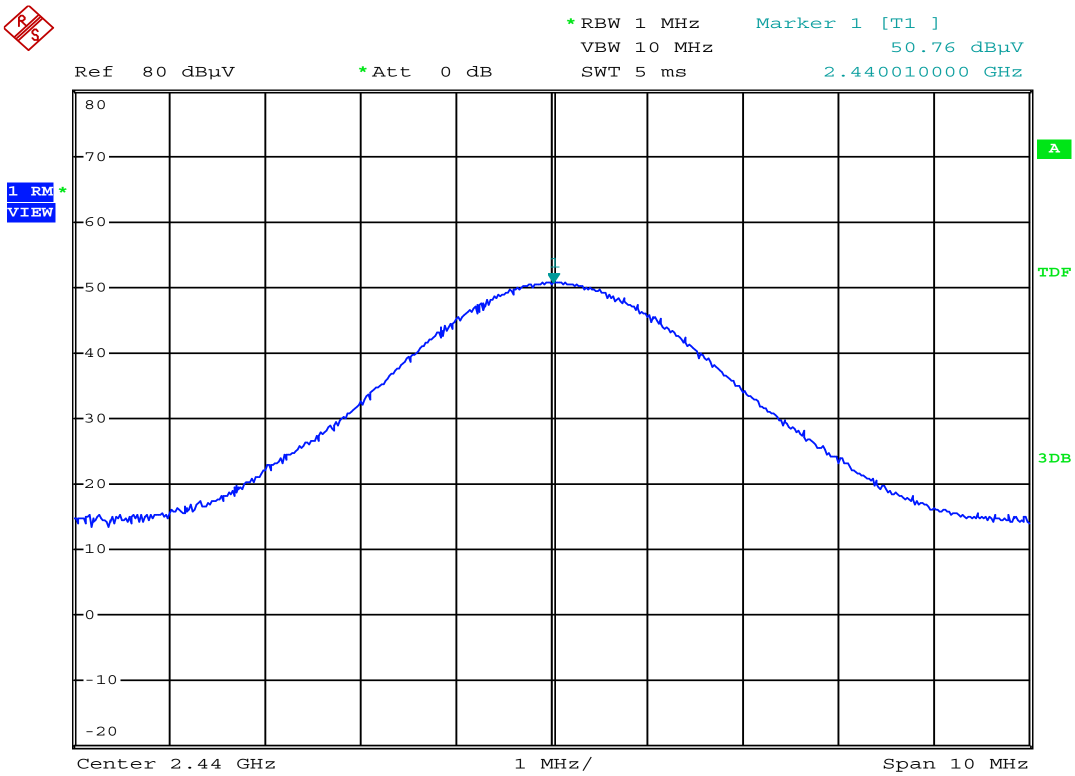
Field Strength (Average)



Date: 3.NOV.2022 15:32:48

Channel Frequency (MHz):	2402	Antenna Polarization:	V	Channel Power (dBuV):	50.81
Modulation:	GMSK	Bit Rate (Mbps):	-		

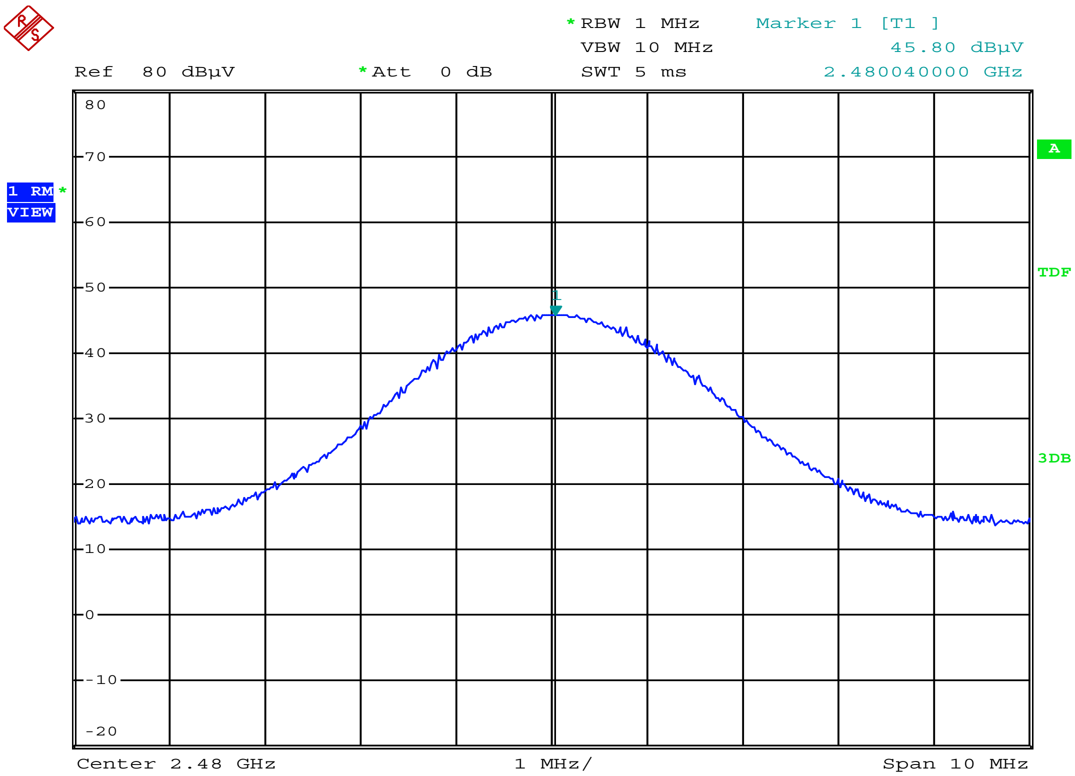
Field Strength (Average)



Date: 3.NOV.2022 15:38:36

Channel Frequency (MHz):	**2440**	Antenna Polarization:	**V**	Channel Power (dBuV):	**50.76**
Modulation:	**GMSK**	Bit Rate (Mbps):	**-**		

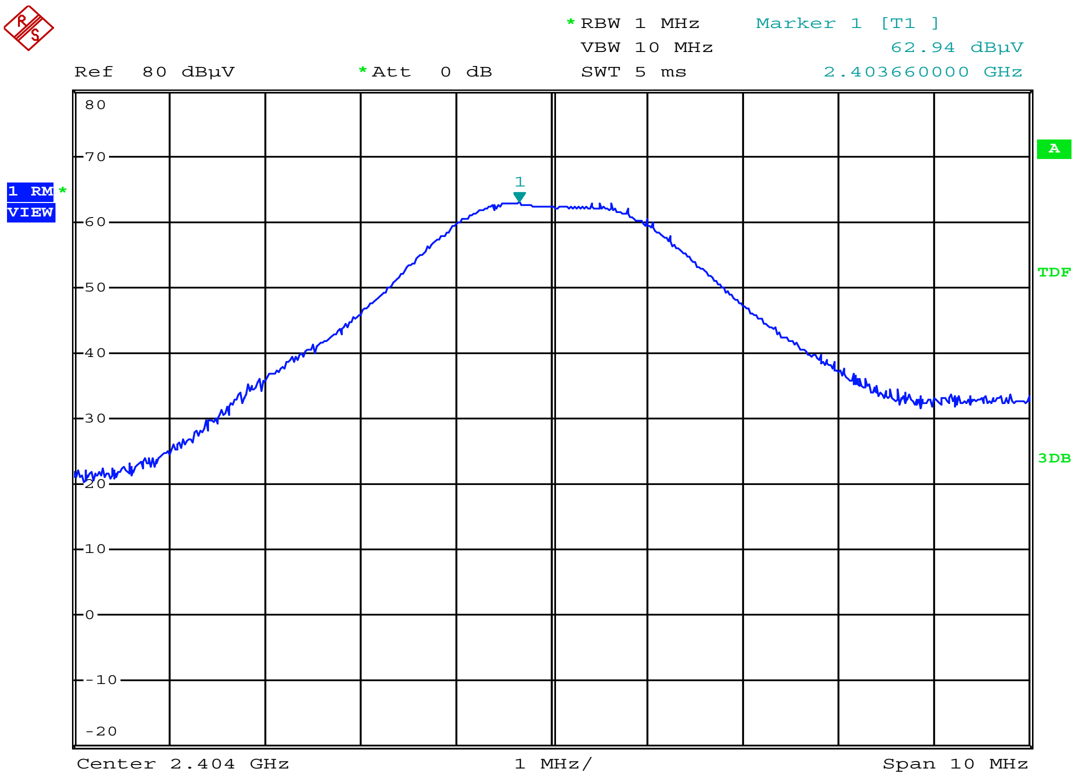
Field Strength (Average)



Date: 3.NOV.2022 15:46:17

Channel Frequency (MHz):	2480	Antenna Polarization:	V	Channel Power (dBuV):	45.80
Modulation:	GMSK	Bit Rate (Mbps):	-		

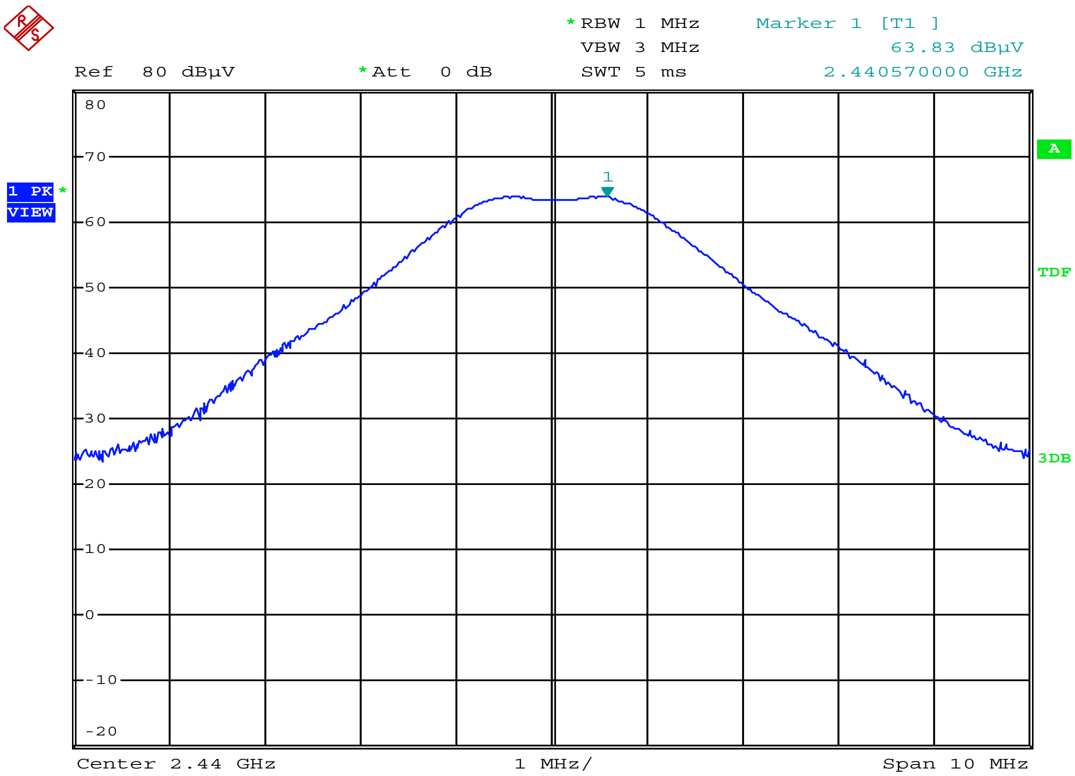
Field Strength (Peak)



Date: 3.NOV.2022 15:34:16

Channel Frequency (MHz):	**2402**	Antenna Polarization:	**H**	Channel Power (dBuV):	**62.94**
Modulation:	**GMSK**	Bit Rate (Mbps):	**-**		

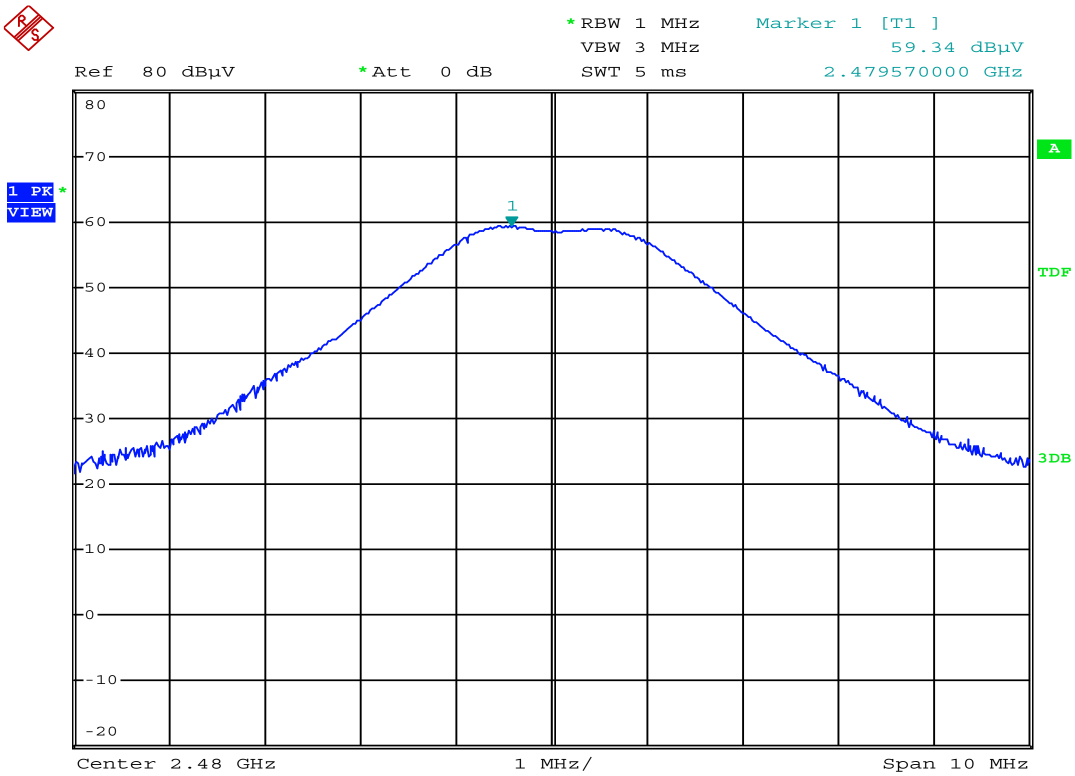
Field Strength (Peak)



Date: 3.NOV.2022 15:36:45

Channel Frequency (MHz):	2440	Antenna Polarization:	H	Channel Power (dBuV):	63.83
Modulation:	GMSK	Bit Rate (Mbps):	-		

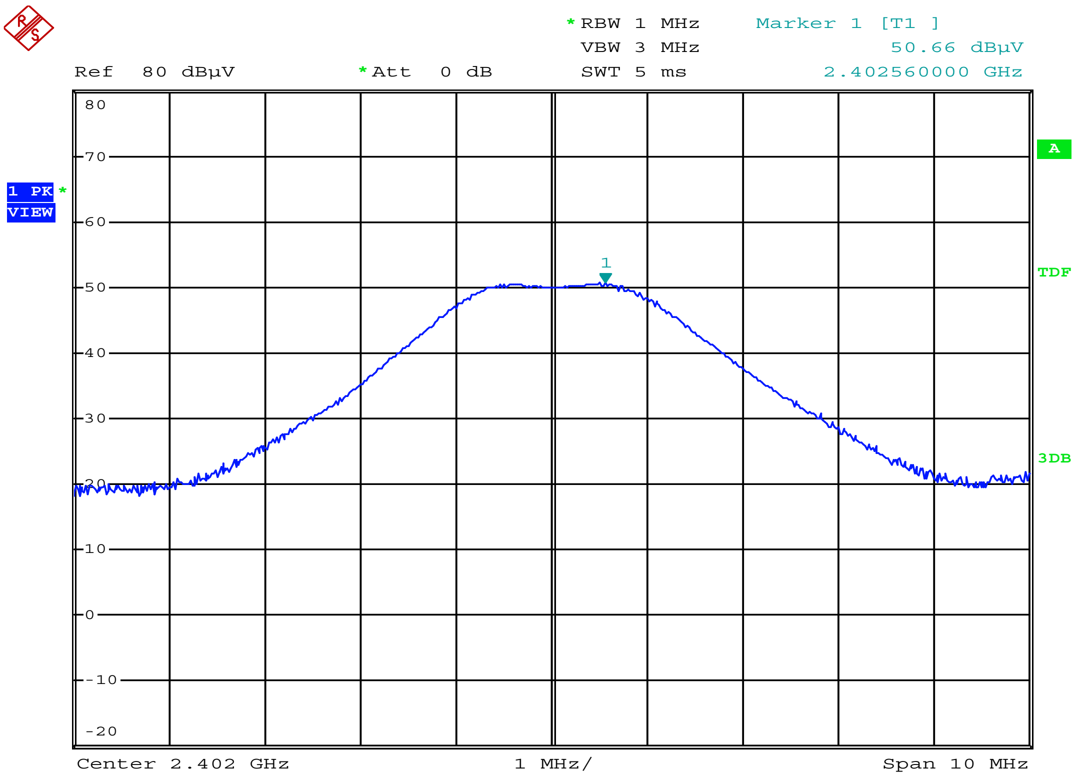
Field Strength (Peak)



Date: 3.NOV.2022 15:44:43

Channel Frequency (MHz):	**2480**	Antenna Polarization:	**H**	Channel Power (dBuV):	**59.34**
Modulation:	**GMSK**	Bit Rate (Mbps):	**-**		

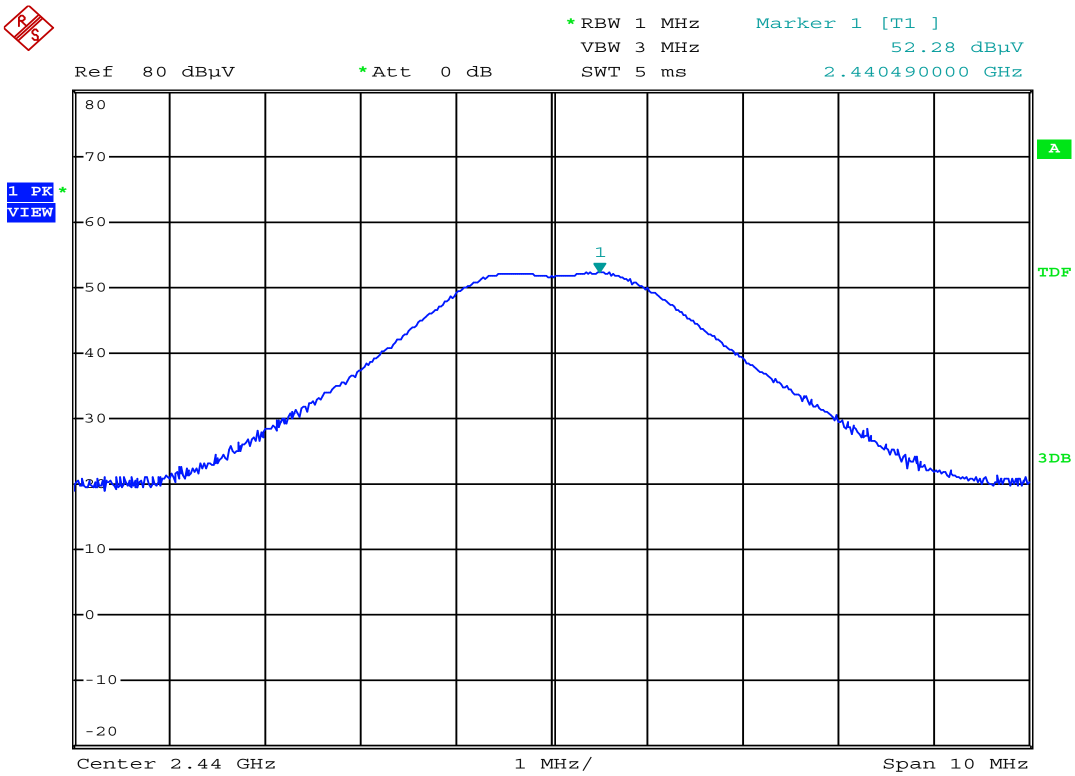
Field Strength (Peak)



Date: 3.NOV.2022 15:41:43

Channel Frequency (MHz):	**2402**	Antenna Polarization:	**V**	Channel Power (dBuV):	**50.66**
Modulation:	**GMSK**	Bit Rate (Mbps):	**-**		

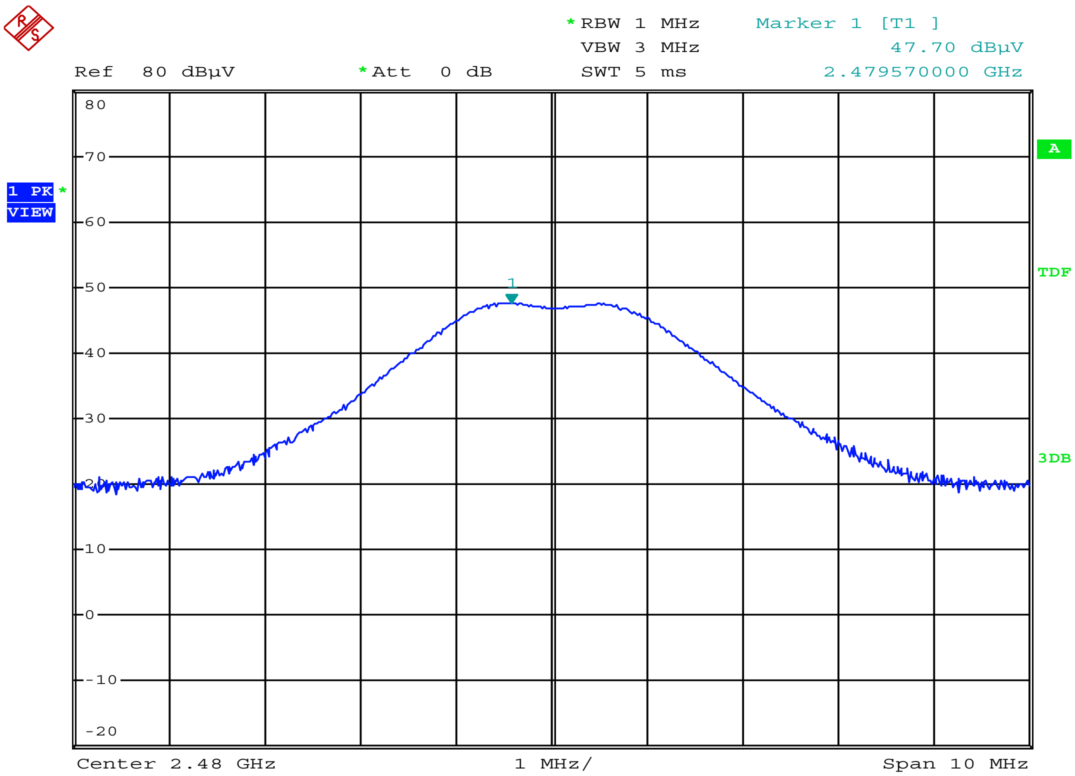
Field Strength (Peak)



Date: 3.NOV.2022 15:38:11

Channel Frequency (MHz):	2440	Antenna Polarization:	V	Channel Power (dBuV):	52.28
Modulation:	GMSK	Bit Rate (Mbps):	-		

Field Strength (Peak)



Date: 3.NOV.2022 15:46:35

Channel Frequency (MHz):	2480	Antenna Polarization:	V	Channel Power (dBuV):	47.70
Modulation:	GMSK	Bit Rate (Mbps):	-		

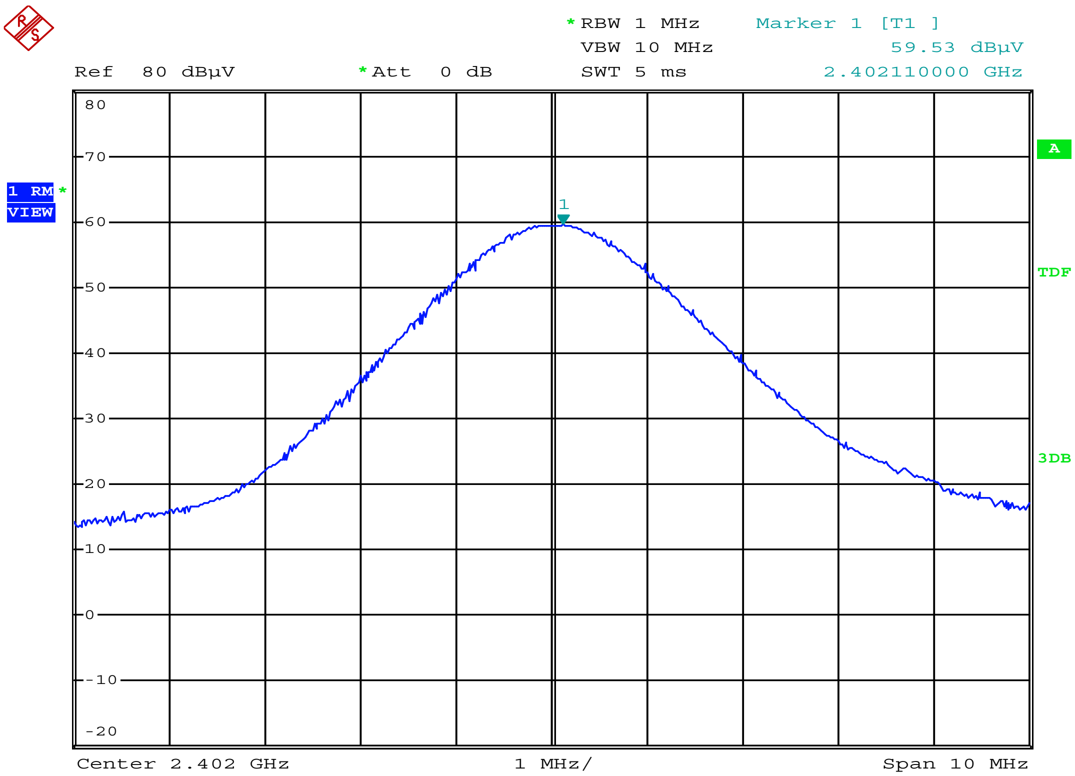
FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	Detector	Antenna Polarization	Measured Field Strength [FS_{Meas}] (dBuV @ 3m)	Cable Loss(1) [L_C] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS_{Corr}] (dBuV @3m)	Limit (dBuV)	Margin (dB)
2402.0	ANT	GFSK	-	RMS	Horizontal	59.53	0	28.28	**87.81**	94.0	**6.2**
2440.0			-			63.59	0	28.28	**91.87**		**2.1**
2480.0			-			62.69	0	28.28	**90.97**		**3.0**
2402.0			-		Vertical	49.55	0	28.28	**77.83**		**16.2**
2440.0			-			50.24	0	28.28	**78.52**		**15.5**
2480.0			-			50.11	0	28.28	**78.39**		**15.6**
2402.0			-	Peak	Horizontal	60.25	0	28.28	**88.53**	114.0	**25.5**
2440.0			-			64.25	0	28.28	**92.53**		**21.5**
2480.0			-			63.51	0	28.28	**91.79**		**22.2**
2402.0			-		Vertical	50.14	0	28.28	**78.42**		**35.6**
2440.0			-			50.99	0	28.28	**79.27**		**34.7**
2480.0			-			50.91	0	28.28	**79.19**		**34.8**
									Result:	**Complies**	

(1) Cable loss accounted for in instrument transducer factor

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

Margin = Limit - FS_{Corr}

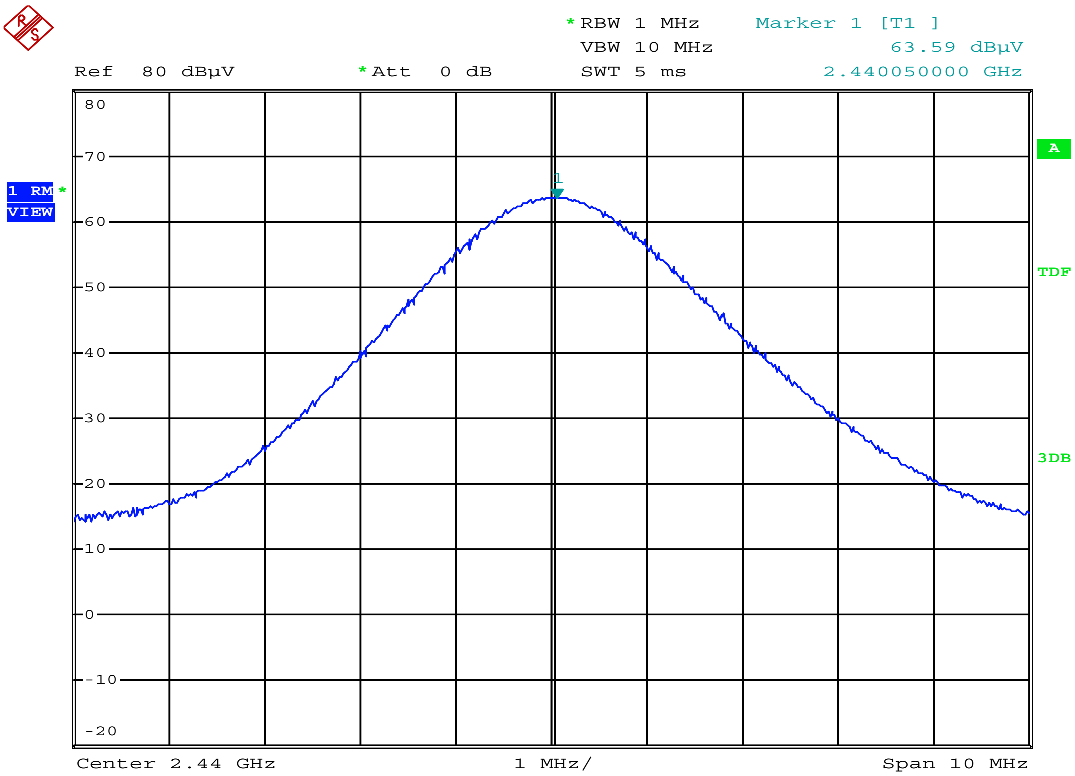
Field Strength (Average)



Date: 3.NOV.2022 15:52:26

Channel Frequency (MHz):	**2402**	Antenna Polarization:	**H**	Channel Power (dBuV):	**59.53**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**		

Field Strength (Average)

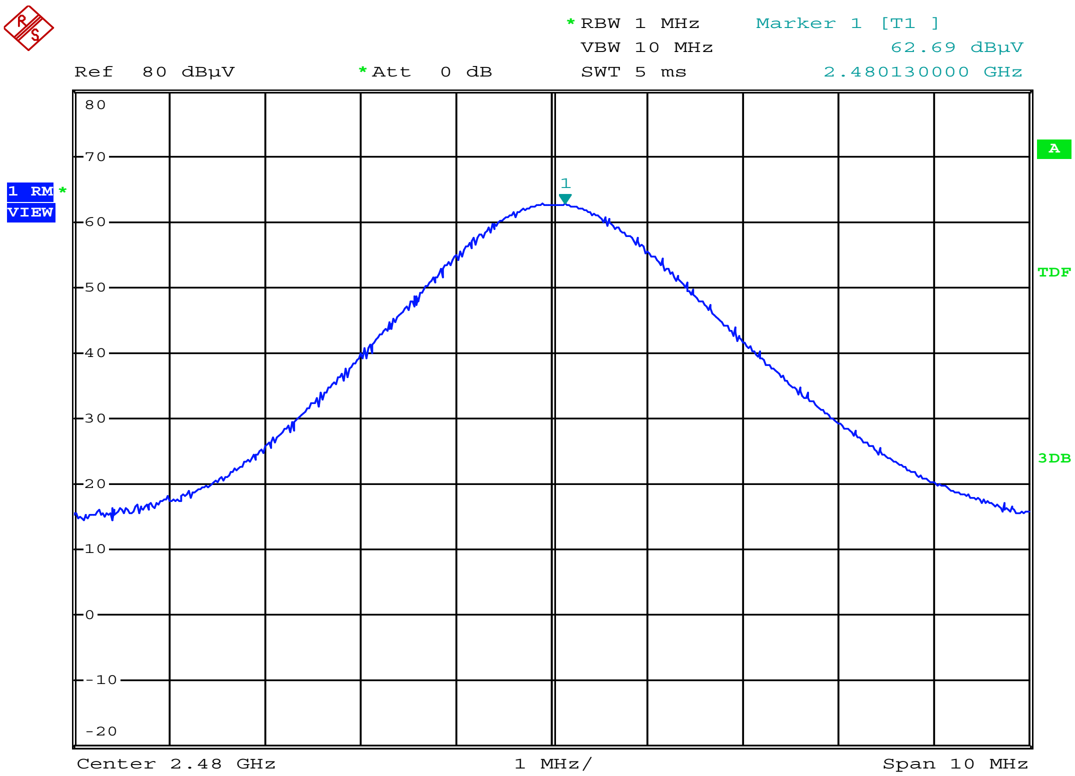


Date: 3.NOV.2022 15:57:13

Channel Frequency (MHz):	2440	Antenna Polarization:	H
Modulation:	GFSK	Bit Rate (Mbps):	-

Channel Power (dBuV):	63.59

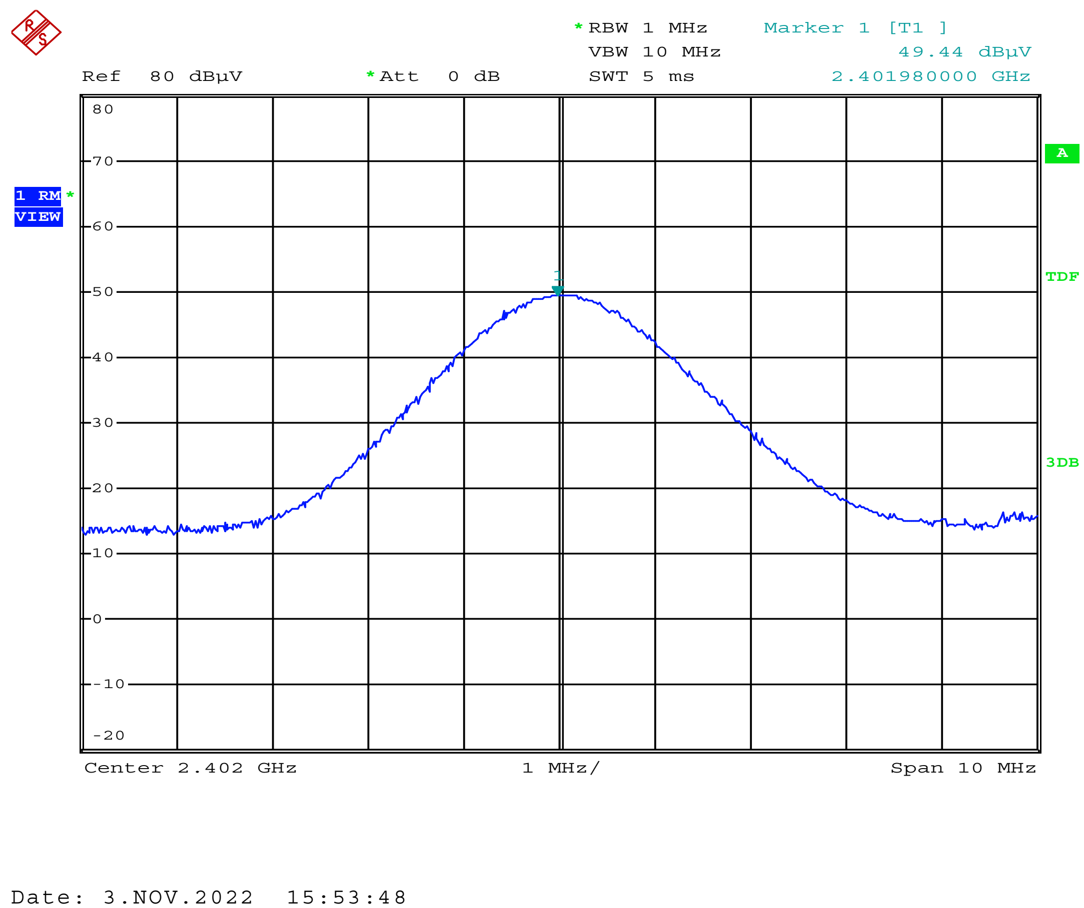
Field Strength (Average)



Date: 3.NOV.2022 15:50:20

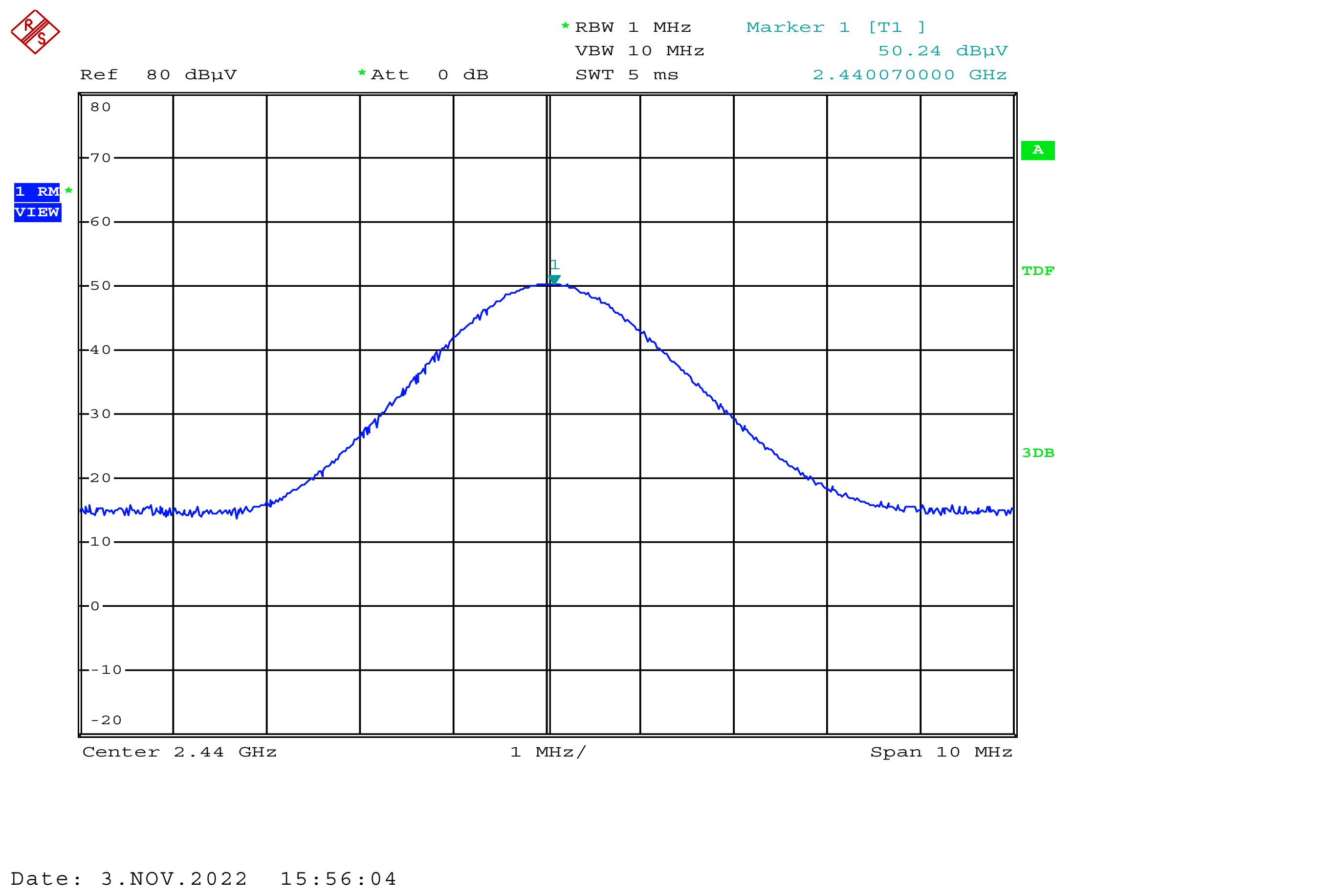
Channel Frequency (MHz):	**2480**	Antenna Polarization:	**H**	Channel Power (dBuV):	**62.69**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**		

Field Strength (Average)



Channel Frequency (MHz):	**2402**	Antenna Polarization:	**V**	Channel Power (dBuV):	**49.55**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**		

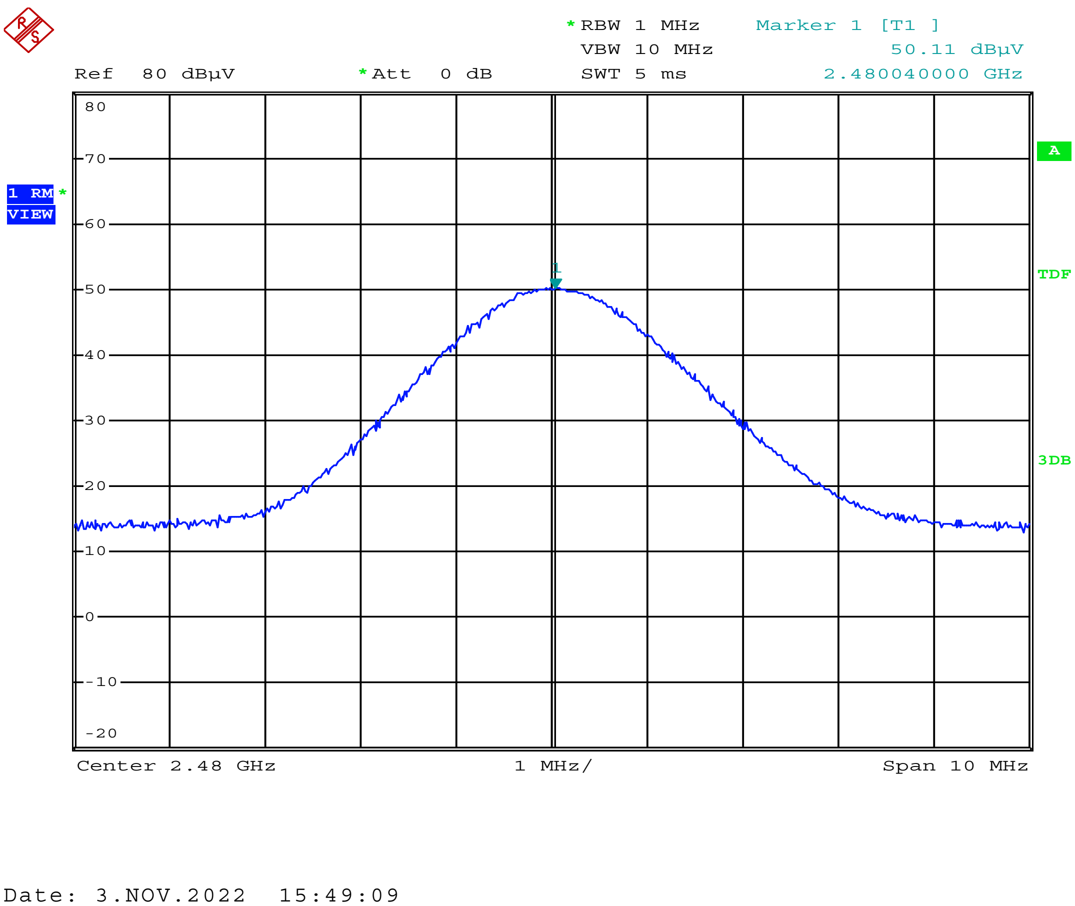
Field Strength (Average)



Channel Frequency (MHz):	2440	Antenna Polarization:	V
Modulation:	GFSK	Bit Rate (Mbps):	-

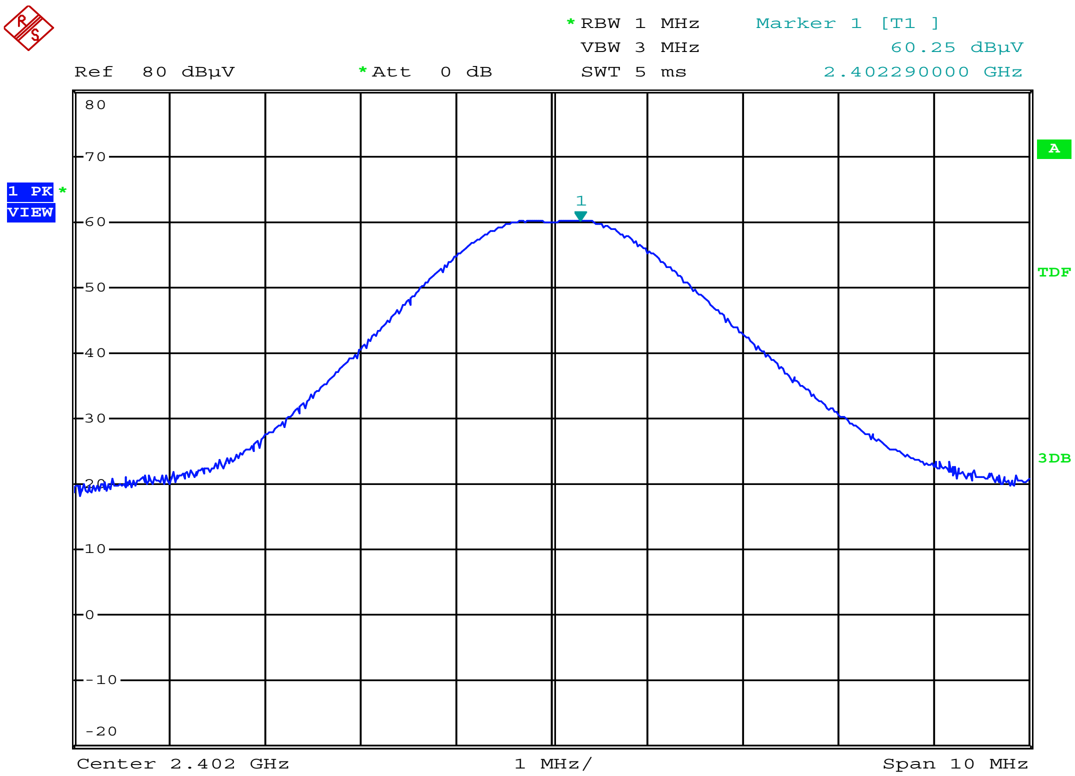
Channel Power (dBuV):	50.24

Field Strength (Average)



Channel Frequency (MHz):	2480	Antenna Polarization:	V	Channel Power (dBuV):	50.11
Modulation:	GFSK	Bit Rate (Mbps):	-		

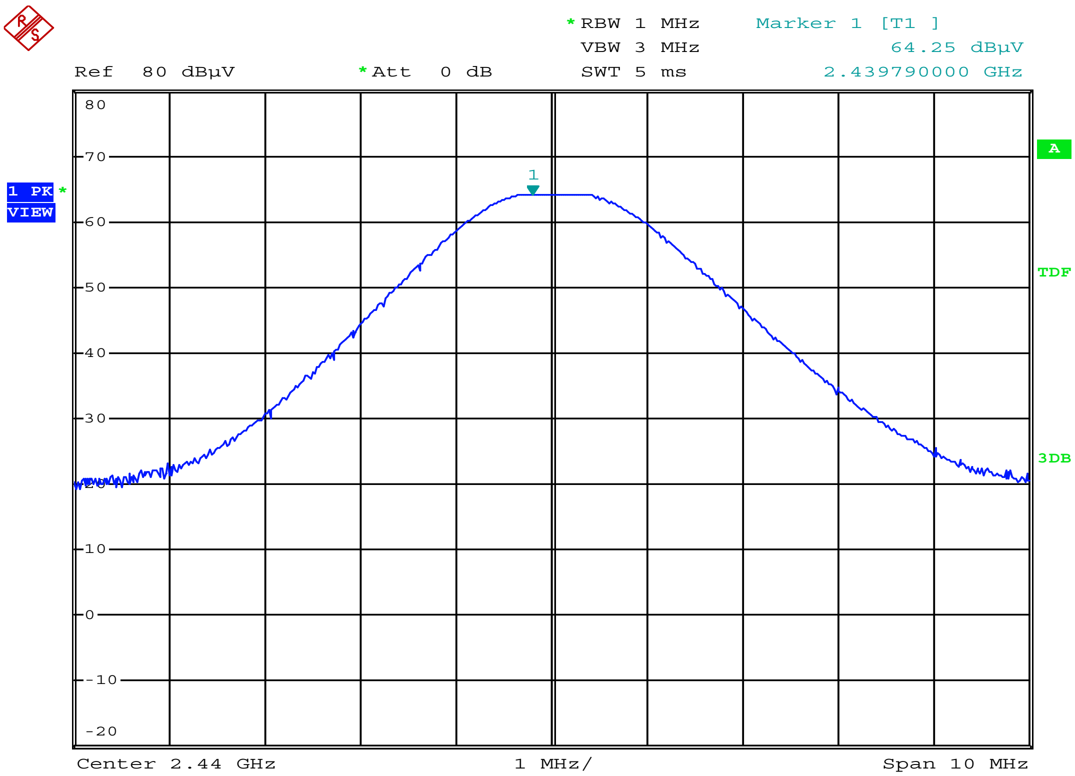
Field Strength (Peak)



Date: 3.NOV.2022 15:52:09

Channel Frequency (MHz):	**2402**	Antenna Polarization:	**H**	Channel Power (dBuV):	**60.25**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**		

Field Strength (Peak)

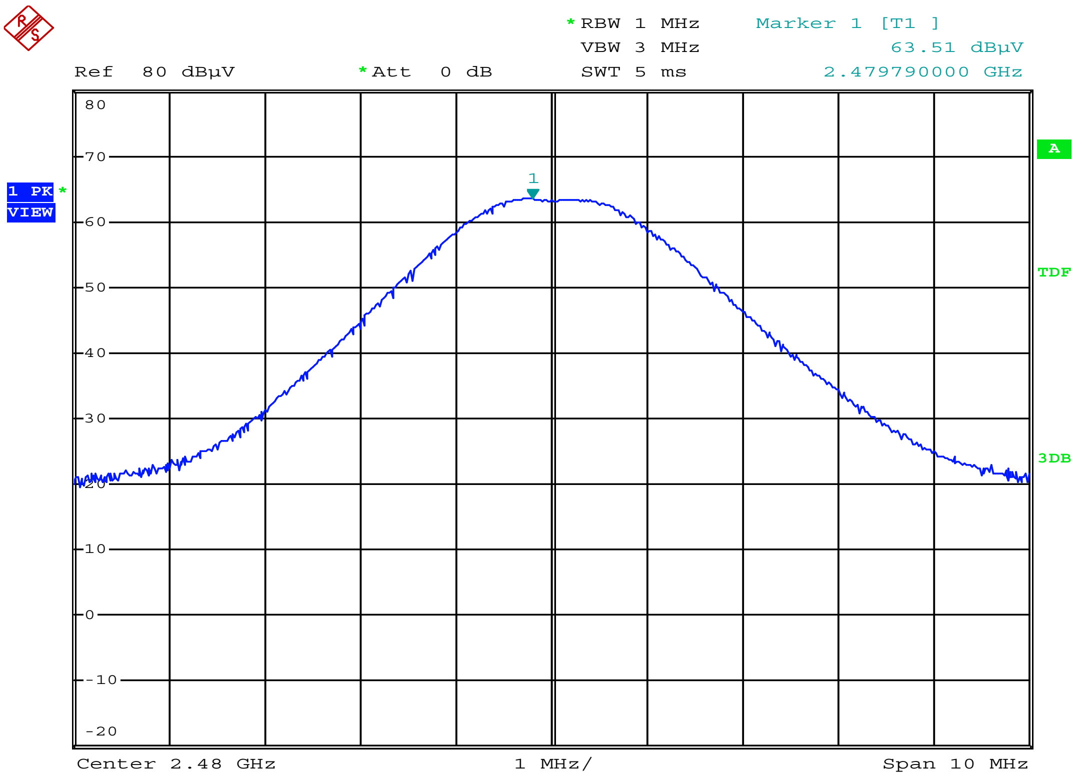


Date: 3.NOV.2022 15:57:31

Channel Frequency (MHz):	2440	Antenna Polarization:	H
Modulation:	GFSK	Bit Rate (Mbps):	-

Channel Power (dBuV):	64.25

Field Strength (Peak)

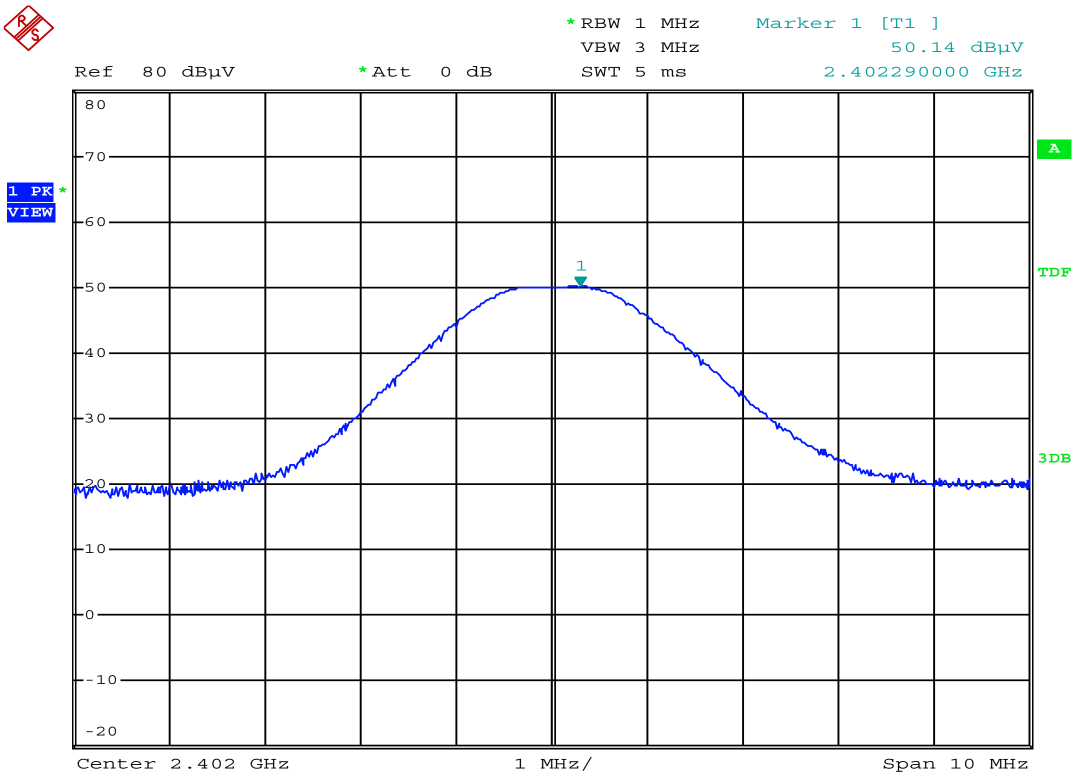


Date: 3.NOV.2022 15:50:41

Channel Frequency (MHz):	**2480**	Antenna Polarization:	**H**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**

Channel Power (dBuV):	**63.51**

Field Strength (Peak)

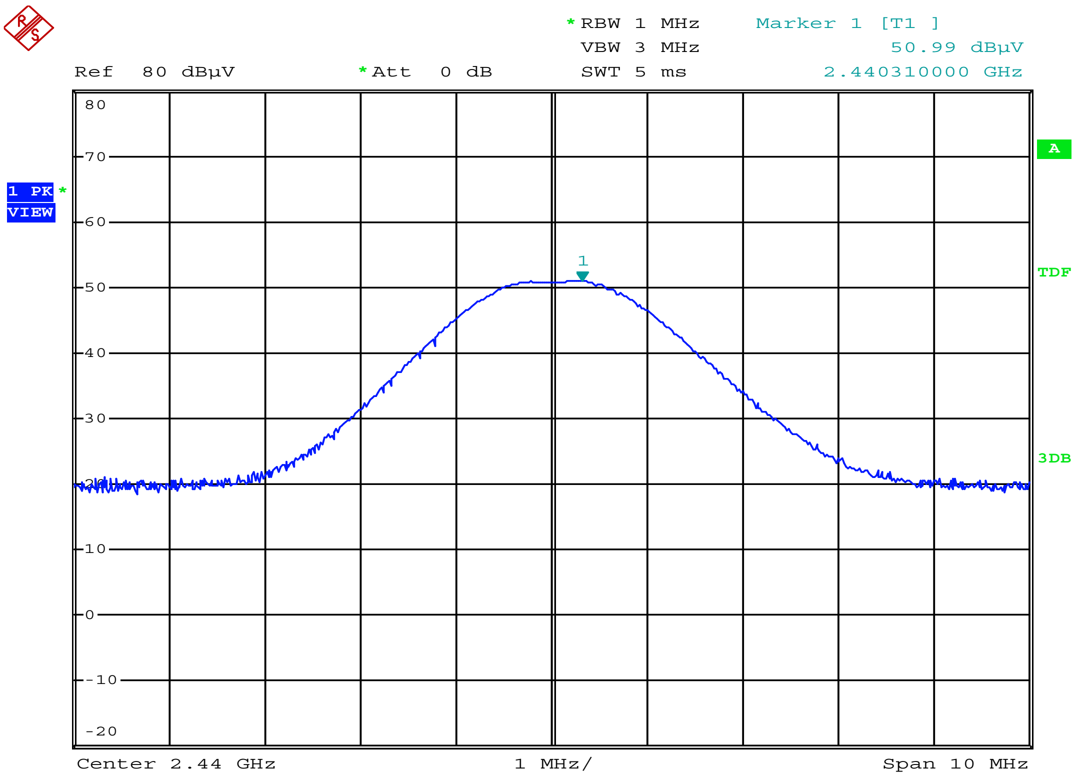


Date: 3.NOV.2022 15:54:07

Channel Frequency (MHz):	**2402**	Antenna Polarization:	**V**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**

Channel Power (dBuV):	**50.14**

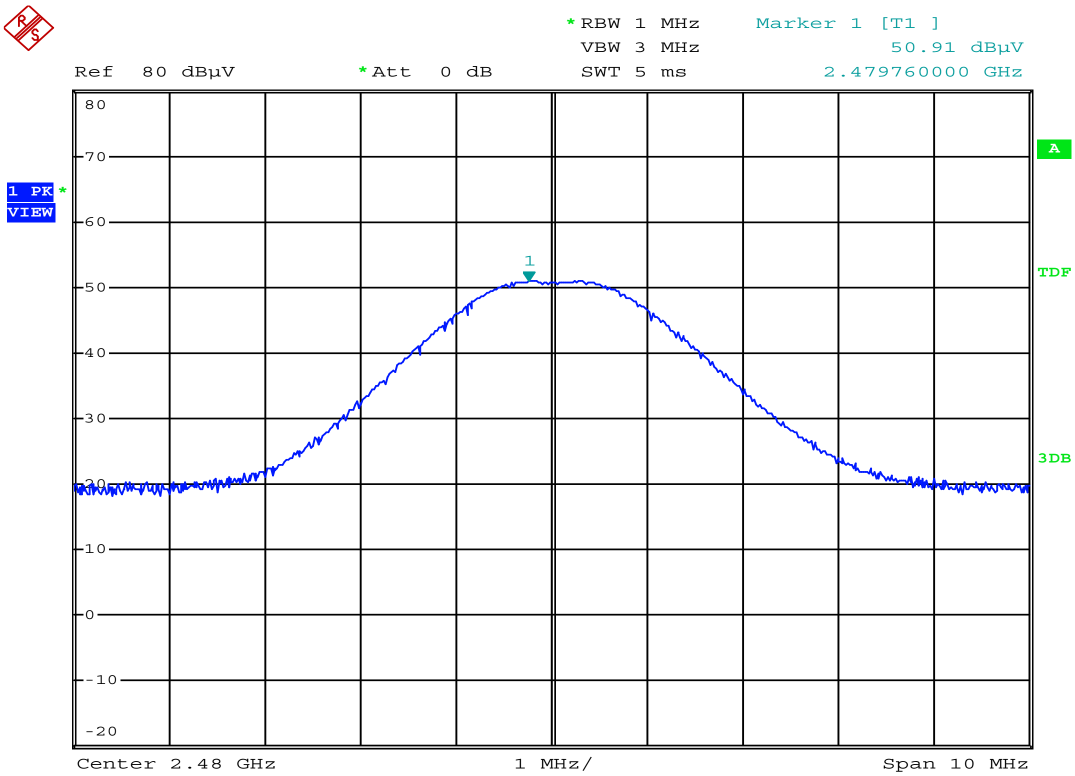
Field Strength (Peak)



Date: 3.NOV.2022 15:55:41

Channel Frequency (MHz): **2440**	Antenna Polarization: **V**	Channel Power (dBuV):	**50.99**
Modulation: **GFSK**	Bit Rate (Mbps): **-**		

Field Strength (Peak)



Date: 3.NOV.2022 15:48:44

Channel Frequency (MHz):	2480	Antenna Polarization:	V
Modulation:	GFSK	Bit Rate (Mbps):	-

Channel Power (dBuV):	50.91

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 (dB)
13.56	NFC	ASK	RMS	Front	15.33	0.5	10.65	**26.48**	84.00	124.0	**97.5**
				Side	7.91			19.06			**104.9**
			Peak	Front	24.41			**35.56**	104.00	144.0	**108.4**
				Side	21.81			32.96			**111.0**
								Result:		**Complies**	

* 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 (dB)
13.56	NFC	ASK	RMS	Front	15.33	0.5	-40.85	**-25.02**	84.00	72.5	**97.5**
				Side	7.91			-32.44			**104.9**
			Peak	Front	24.41			**-15.94**	104.00	92.5	**108.4**
				Side	21.81			-18.54			**111.0**
								Result:		**Complies**	

** 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 (dBΩ)

Where Z_0 = Free-Space Impedance = 120πΩ = 377Ω => 20Log377Ω = 51.5dBΩ

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

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

Measurement Correction

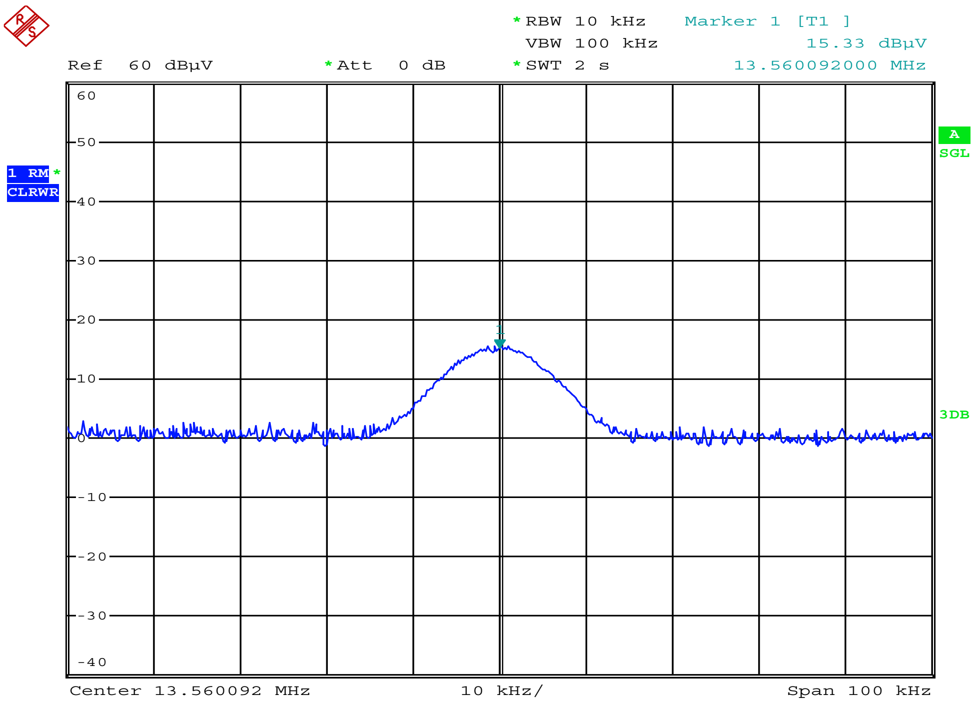
H_{Corr}(dBuA/m) = E_{Meas}(dBuV) + ACF^H(dB/Ωm) + L_C - G_A

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

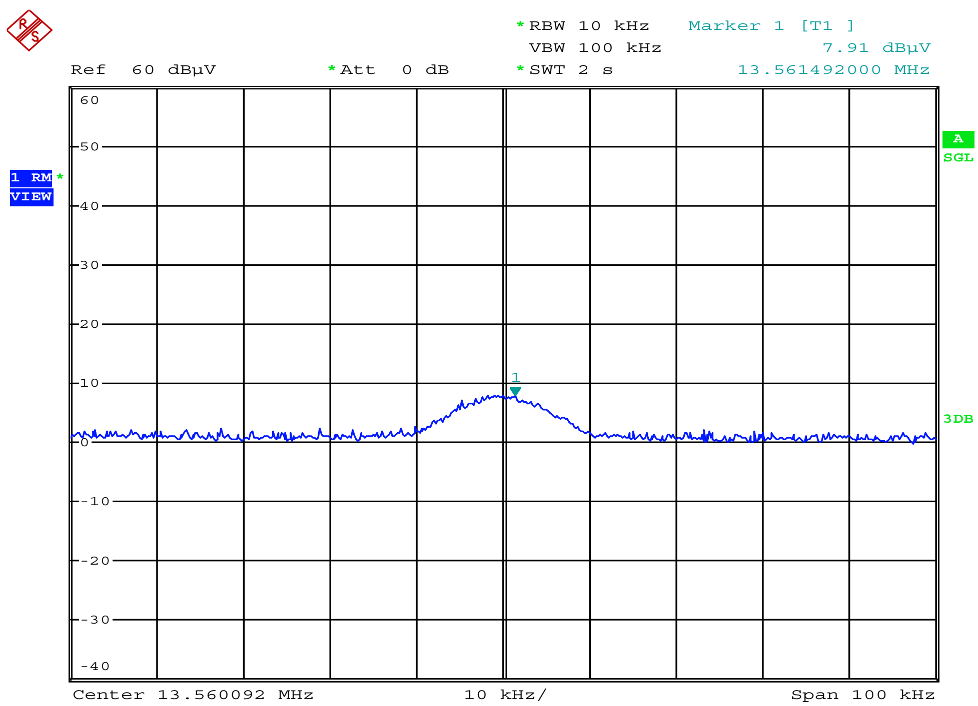
Field Strength (Average)



Date: 31.OCT.2022 14:16:06

Channel Frequency: **13.56** MHz	Detector: **RMS**	Antenna Polarization: **Front**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **15.33** dBuV

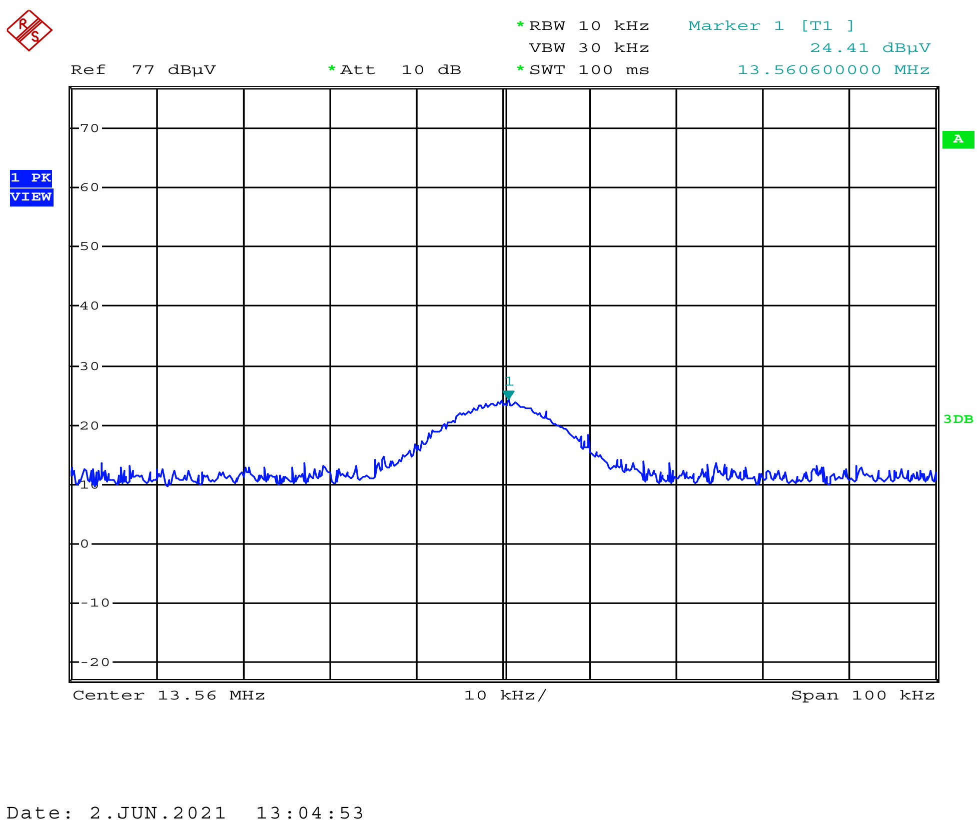
Field Strength (Average)



Date: 31.OCT.2022 14:17:49

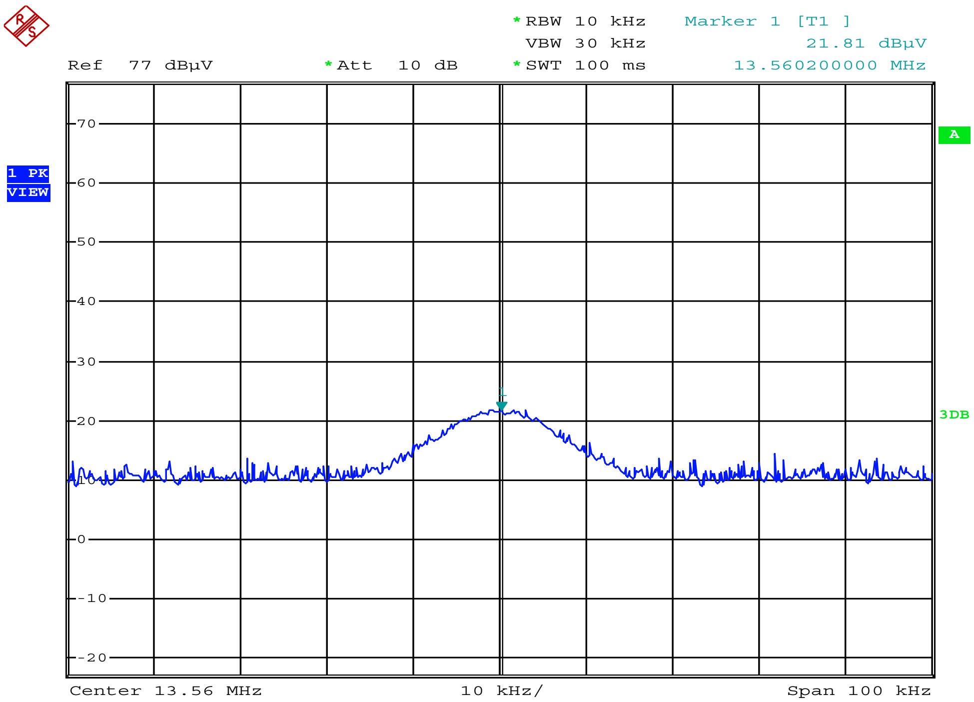
Channel Frequency: **13.56** MHz	Detector: **RMS**	Antenna Polarization: **Side**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **7.91** dBuV

Field Strength (Peak)



Channel Frequency: **13.56** MHz	Detector: **Peak**	Antenna Polarization: **Front**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **24.41** dBuV

Field Strength (Peak)



Date: 2.JUN.2021 13:06:34

Channel Frequency: **13.56** MHz	Detector: **Peak**	Antenna Polarization: **Side**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **21.81** dBuV

20dB BW Bandwidth Measurement Results					
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured 20dB Bandwidth (MHz)
BLE1	0	2402	GMSK	1	1.33
	39	2480			1.36
BLE2	1	2404	GMSK	2	2.71
	38	2478			2.48
ANT	2	2402	GFSK	-	1.41
	80	2480			2.15
Result:					**Complies**

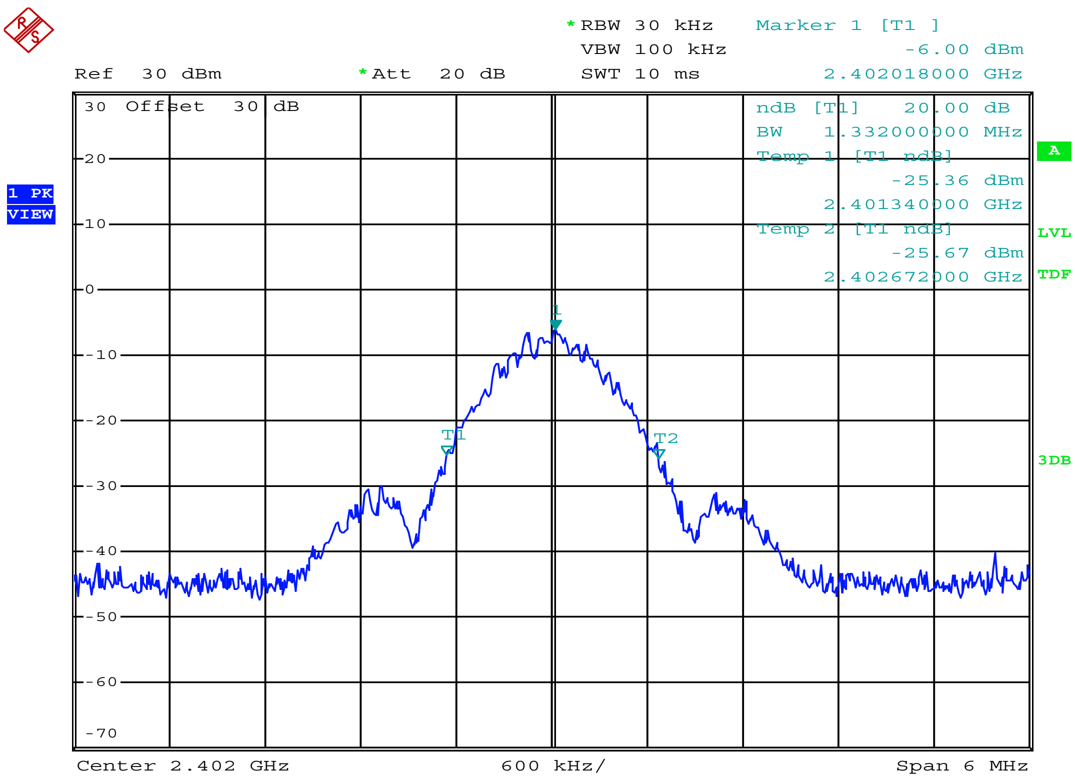
Compliance to §15.215(c):

Largest Measured 20dB BW < 2.48MHz, 50% BW < 1.24MHz

LBE = 2402MHz - 1.24MHz = 2400.79MHz > 2400MHz

UBE = 2480MHz + 1.24MHz = 2481.2MHz < 2483.5MHz

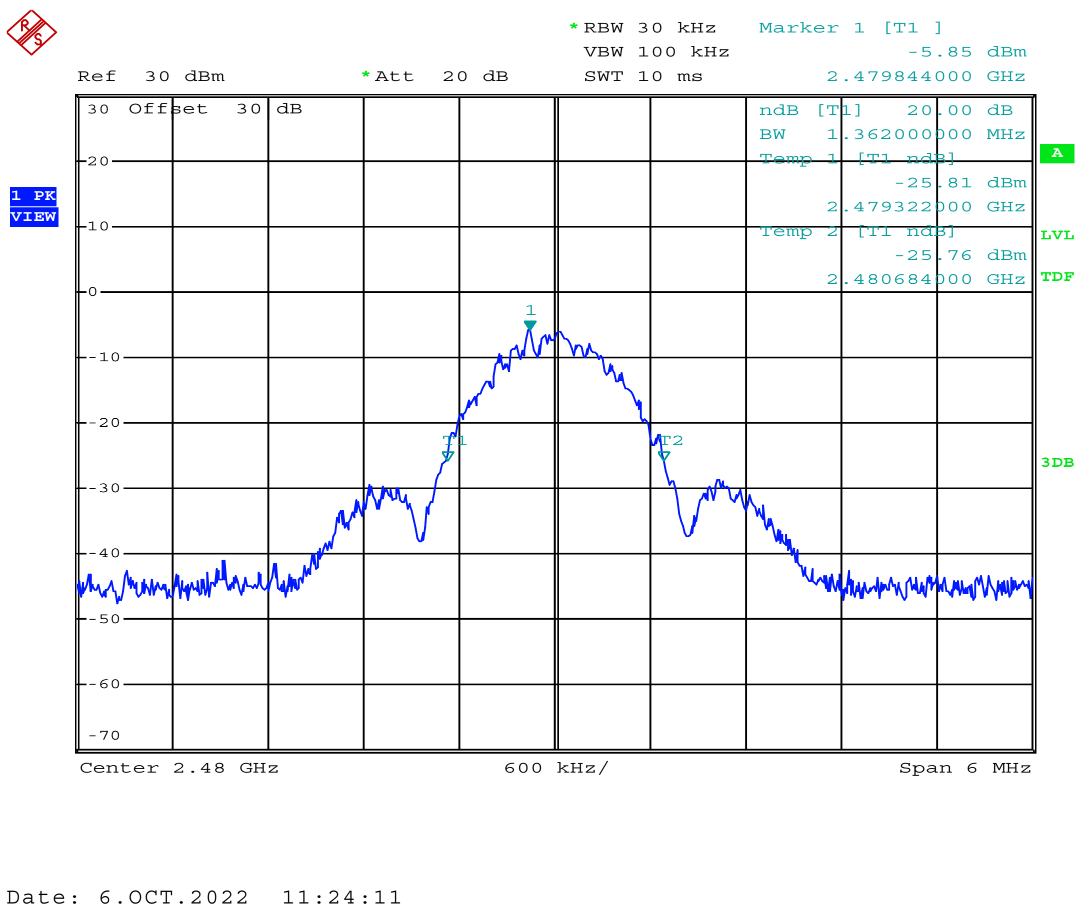
20dB Bandwidth: BlueTooth BLE 1



Date: 6.OCT.2022 11:24:59

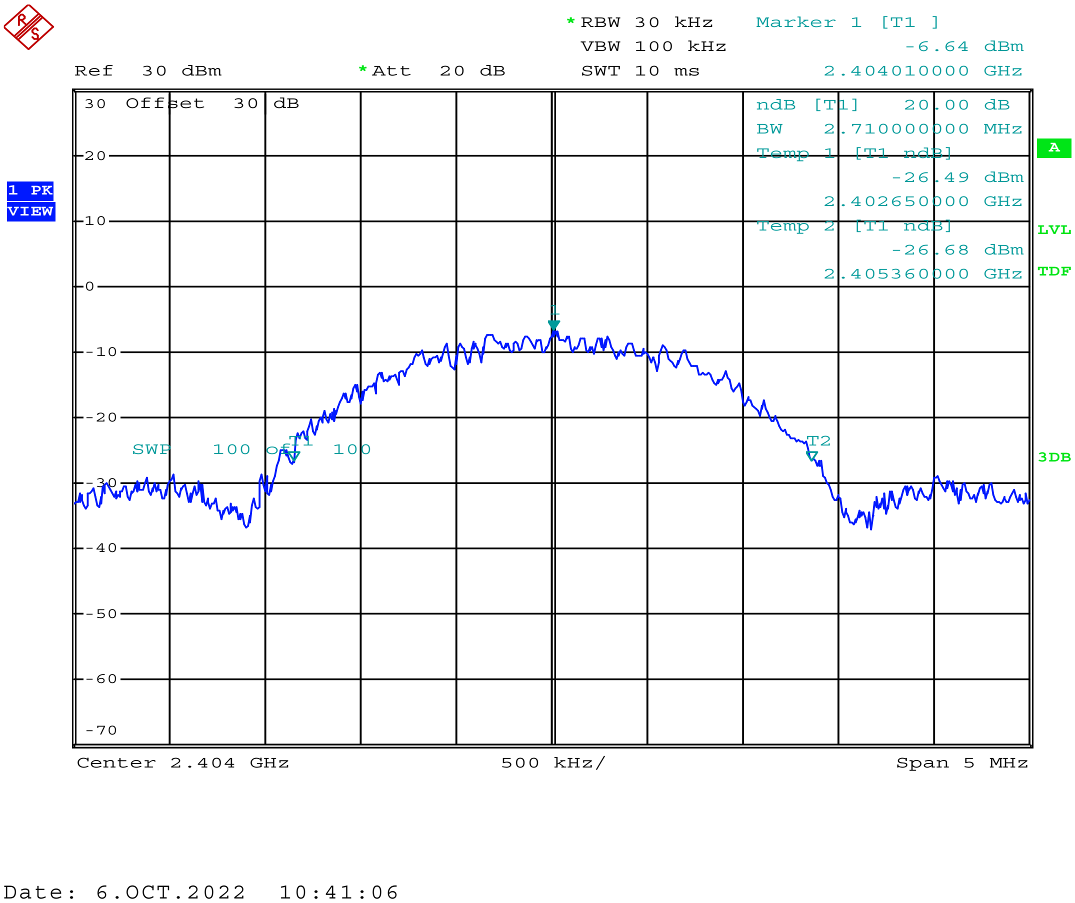
Channel Number: 0	Channel Frequency (MHz): 2402	20dB Bandwidth (MHz):	1.330
Modulation: GMSK	Bit Rate (Mbps): 1		

20dB Bandwidth: BlueTooth BLE 1



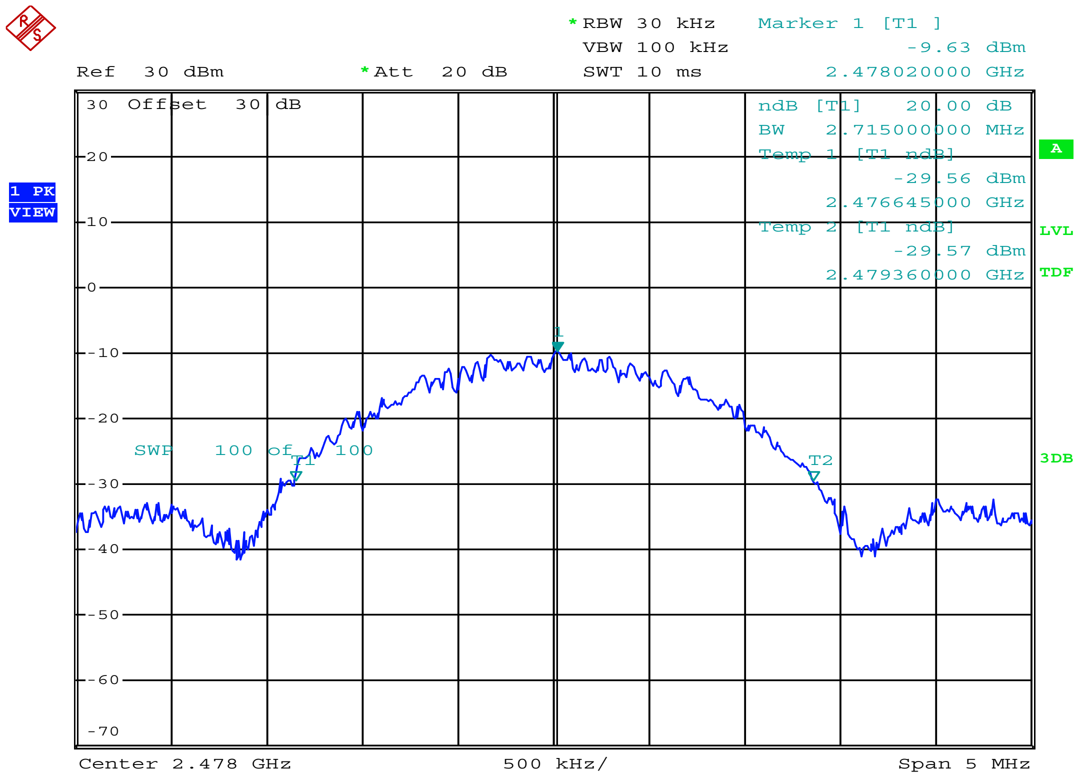
Channel Number:	**39**	Channel Frequency (MHz):	**2480**	20dB Bandwidth (MHz):	**1.360**
Modulation:	**GMSK**	Bit Rate (Mbps):	**1**		

20dB Bandwidth: BlueTooth BLE 2



Channel Number: **1**	Channel Frequency (MHz): **2404**	20dB Bandwidth (MHz):	**2.710**
Modulation: **GMSK**	Bit Rate (Mbps): **2**		

20dB Bandwidth: BlueTooth BLE 2

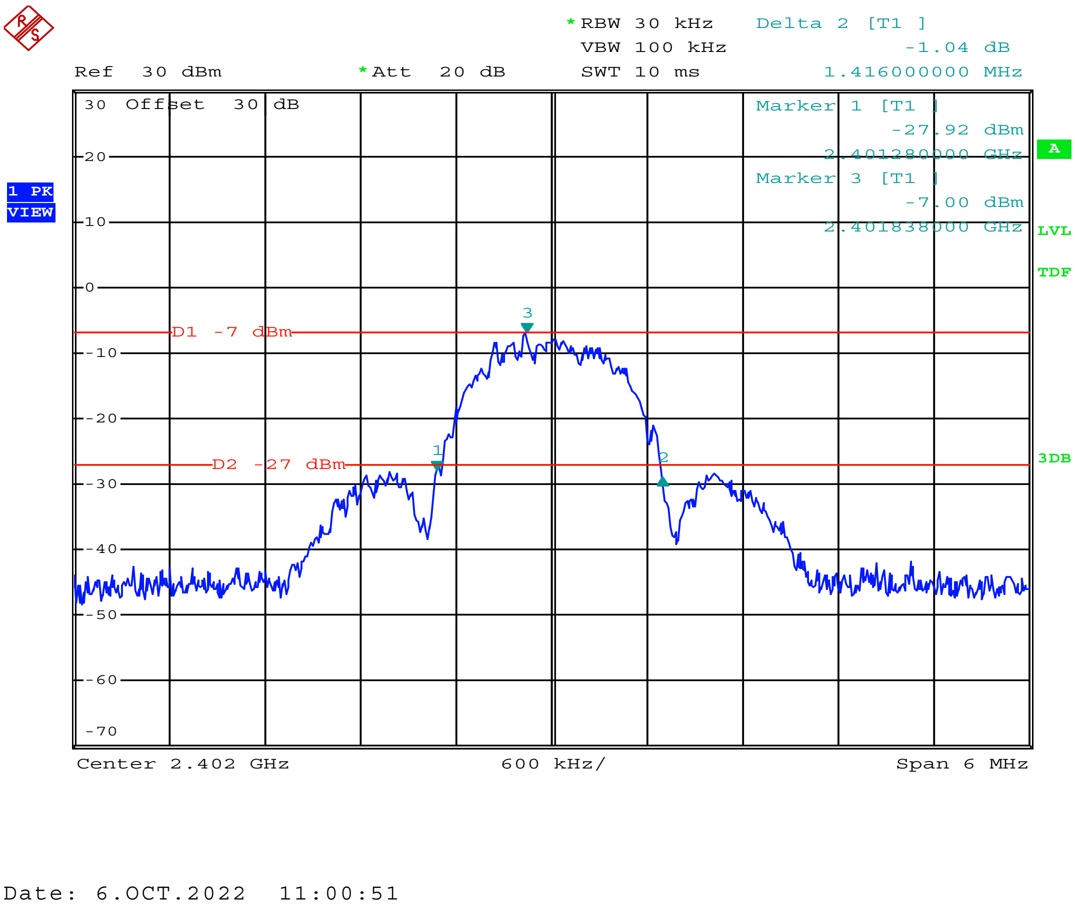


Date: 6.OCT.2022 10:42:50

Channel Number:	**38**	Channel Frequency (MHz):	**2478**
Modulation:	**GMSK**	Bit Rate (Mbps):	**2**

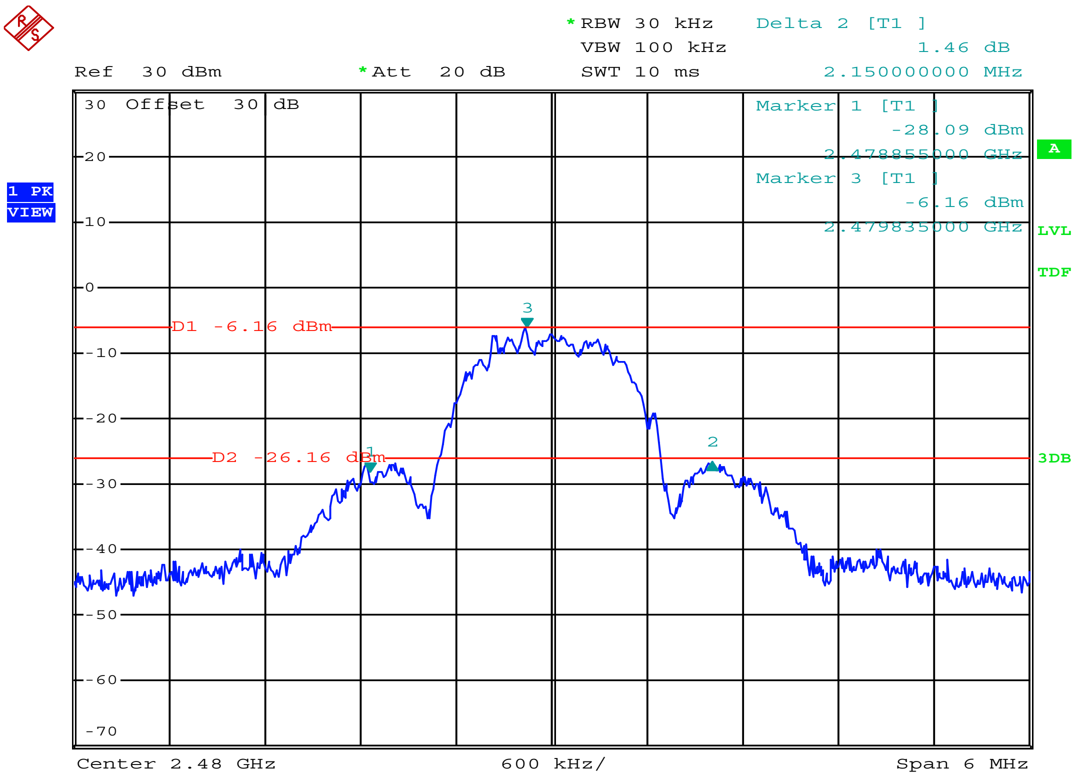
20dB Bandwidth (MHz):	**2.480**

20dB Bandwidth: BlueTooth ANT



Channel Number:	2	Channel Frequency (MHz):	2402	20dB Bandwidth (MHz):	1.410
Modulation:	GFSK	Bit Rate (Mbps):	-		

20dB Bandwidth: BlueTooth ANT



Date: 6.OCT.2022 10:58:59

Channel Number:	**80**	Channel Frequency (MHz):	**2480**	20dB Bandwidth (MHz):	**2.150**
Modulation:	**GFSK**	Bit Rate (Mbps):	**-**		

Radiated Field Strength

Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Frequency Range (MHz)	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 (dB)
13.56	NFC	ASK	RMS	Front	13.410 - 13.553	10.68	0.5	10.65	21.83	50.50	90.5	**68.7**
					13.567 - 13.710	10.07			21.22			**69.3**
					13.110 - 13.410	-0.24			10.91	40.50	80.5	**69.6**
					13.710 - 14.010	-1.06			10.09			**70.4**
									Result:		**Complies**	

* Limit @ 3m = Limit @ 30m + 40dB/decade = 50.5dBuV/m + 40dB = 90.5dBuV/m
* Limit @ 3m = Limit @ 30m + 40dB/decade = 40.5dBuV/m + 40dB = 80.5dBuV/m
$FS_{Corr} = FS_{Meas} + ACF + L_C$
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 (dB)
13.56	NFC	ASK	RMS	Front	13.410 - 13.553	10.68	0.5	-40.85	-29.67	50.50	39.0	**68.7**
					13.567 - 13.710	10.07			-30.28			**69.3**
					13.110 - 13.410	-0.24			-40.59	40.50	29.0	**69.6**
					13.710 - 14.010	-1.06			-41.41			**70.4**
									Result:		**Complies**	

** Limit @ 3m = Limit @ 30m + 40dB/decade = 50.5dBuV/m + 40dB = 90.5dBuV/m
** Limit @ 3m = Limit @ 30m + 40dB/decade = 40.5dBuV/m + 40dB = 80.5dBuV/m
In accordance with ISED Notice 2020 - DRS0023:
"Guidance on Magnetic Field Strength Radiated Emissions Measurements 9kHz - 30MHz"

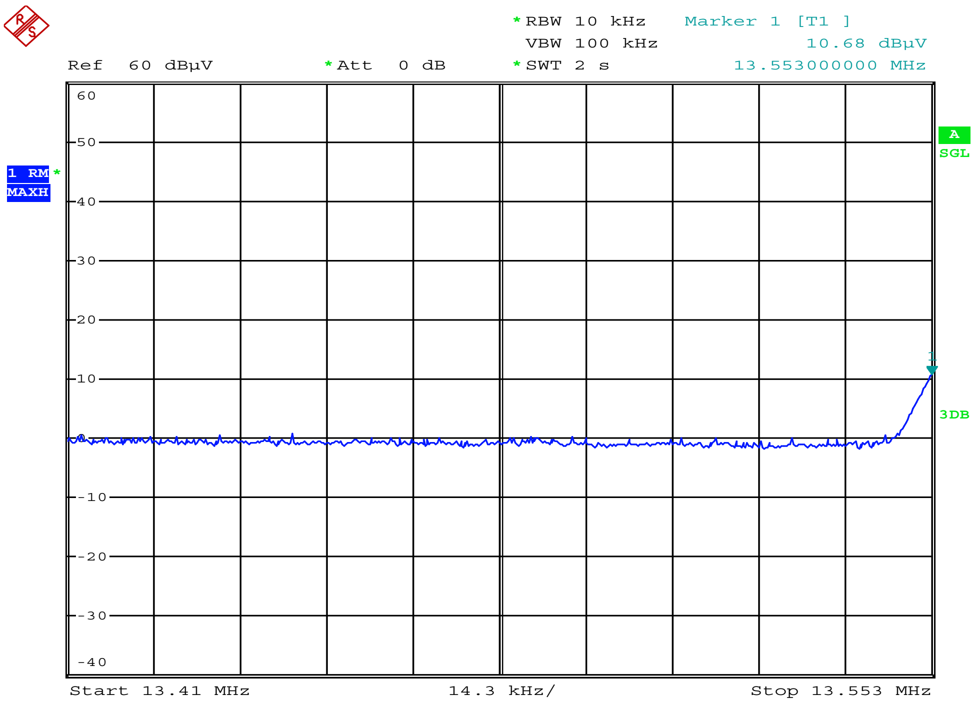
Limit Correction

$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ)
Where Z_0 = Free-Space Impedance = 120πΩ = 377Ω => 20Log377Ω = 51.5dBΩ
$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 90.5dBuV/m - 51.5dBΩ = 39dBuA/m @ 3m
$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 180.5dBuV/m - 51.5dBΩ = 29dBuA/m @ 3m

Measurement Correction

H_{Corr}(dBuA/m) = E_{Meas}(dBuV) + ACF^H(dB/Ωm) + 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 = $Limit_{3m} - H_{Corr}$

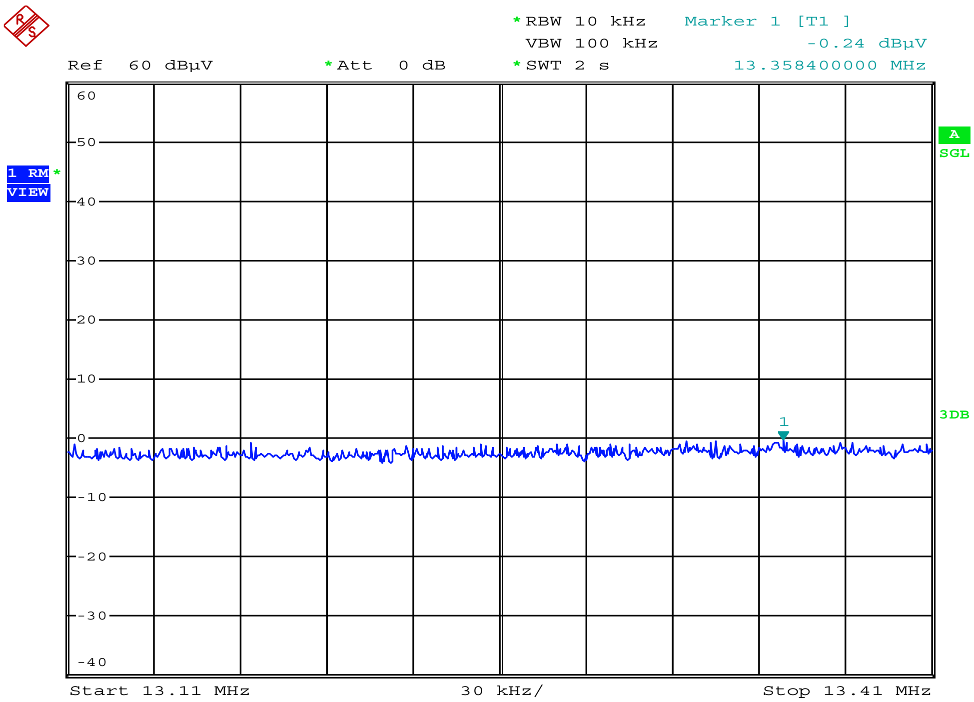
Out-Of-Band Field Strength



Date: 31.OCT.2022 14:23:59

Channel Frequency:	Frequency Range:	Antenna Polarization:
13.56 MHz	**13.410 - 13.533** MHz	**Front**
Modulation Setting:	Protocol:	Measured Field Strength:
ASK	**NFC**	**10.68** dBuV

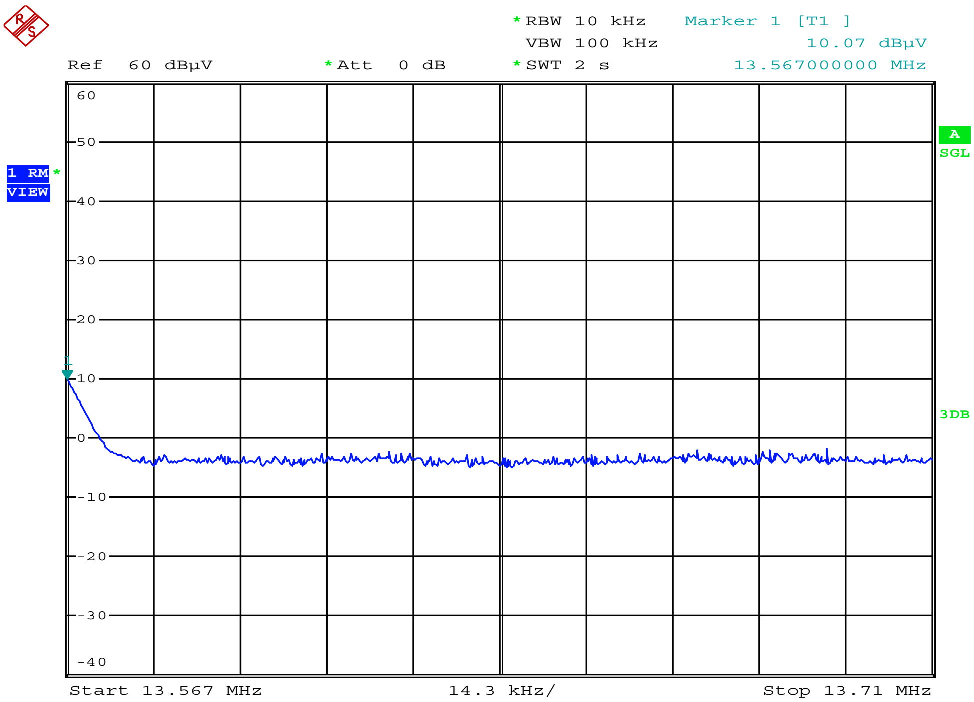
Out-Of-Band Field Strength



Date: 31.OCT.2022 14:26:21

Channel Frequency: **13.56** MHz	Frequency Range: **13.110 - 13.410** MHz	Antenna Polarization: **Front**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **-0.24** dBuV

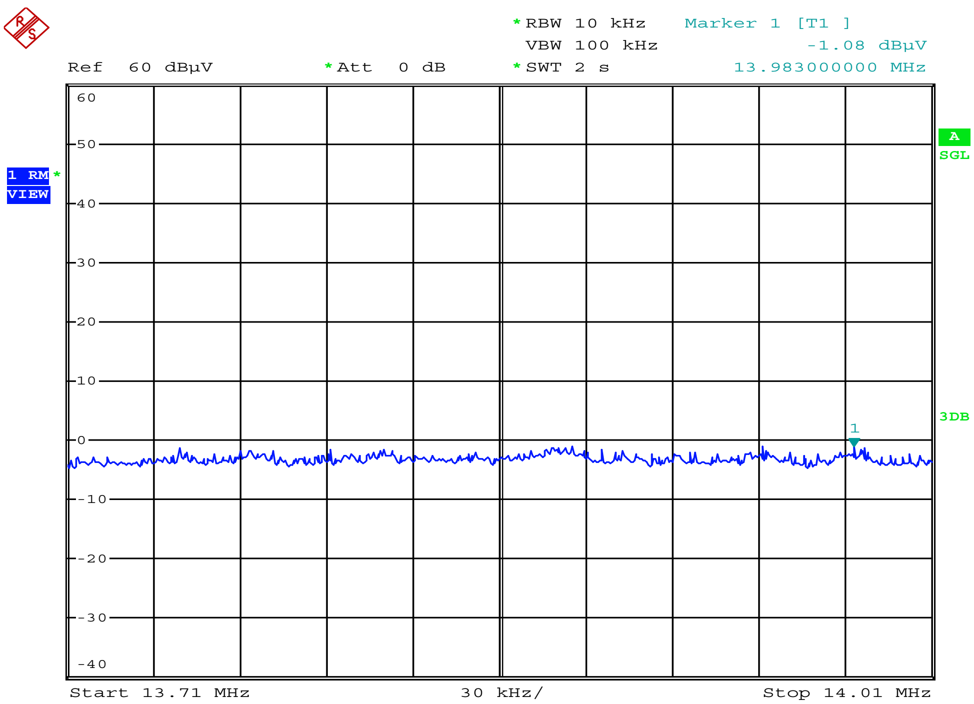
Out-Of-Band Field Strength



Date: 31.OCT.2022 14:24:53

Channel Frequency: **13.56** MHz	Frequency Range: **13.567 - 13.710** MHz	Antenna Polarization: **Front**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **10.07** dBuV

Out-Of-Band Field Strength



Date: 31.OCT.2022 14:25:37

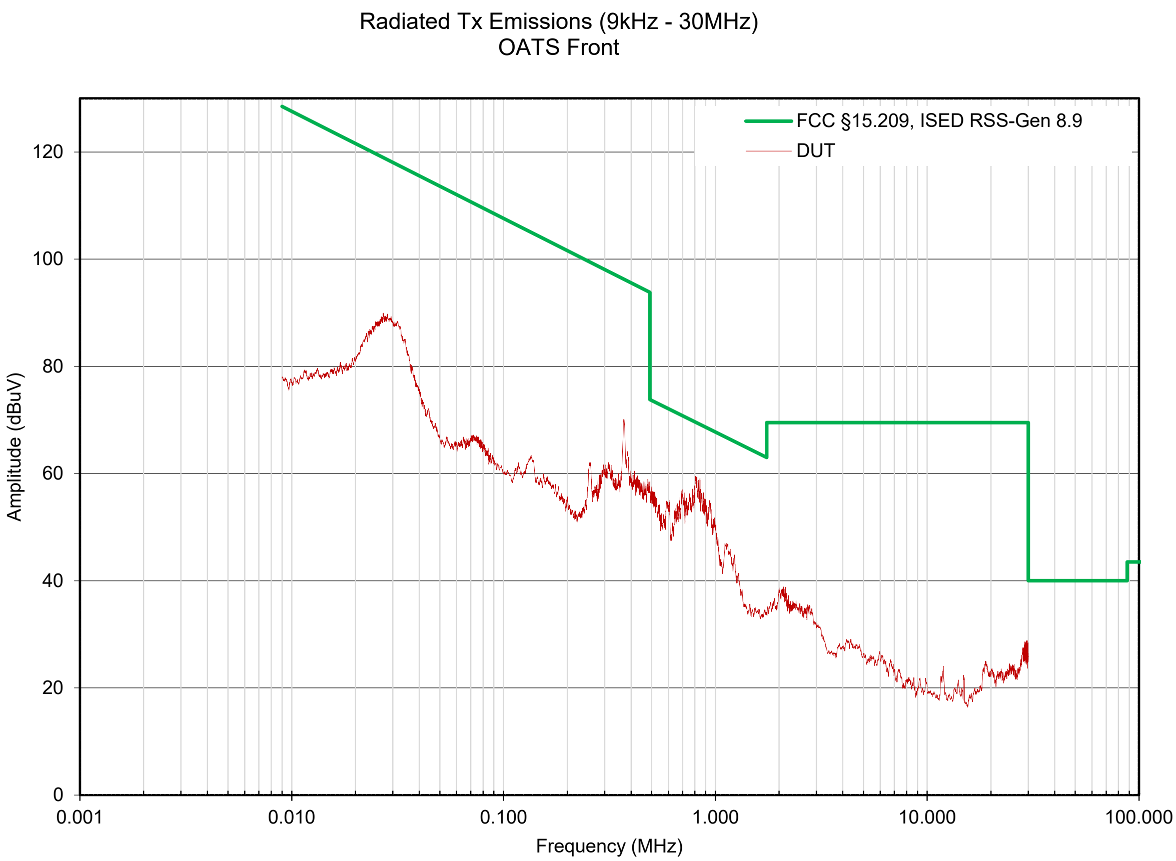
Channel Frequency: **13.56** MHz	Frequency Range: **13.710 - 14.010** MHz	Antenna Polarization: **Front**
Modulation Setting: **ASK**	Protocol: **NFC**	Measured Field Strength: **-1.08** dBuV

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**
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 Amplier not used

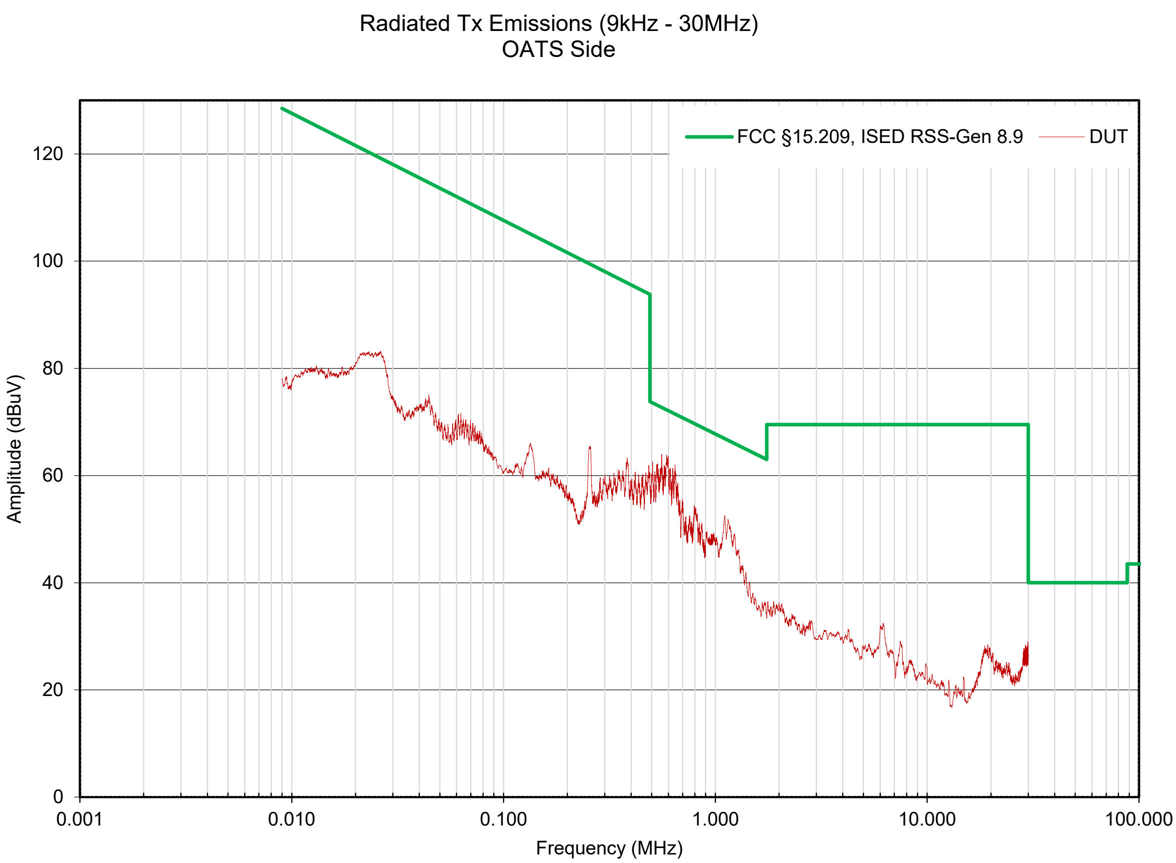
$E_{Corr} = E_{Meas} + ACF + L_C - G_A$

Radiated Tx Emissions:



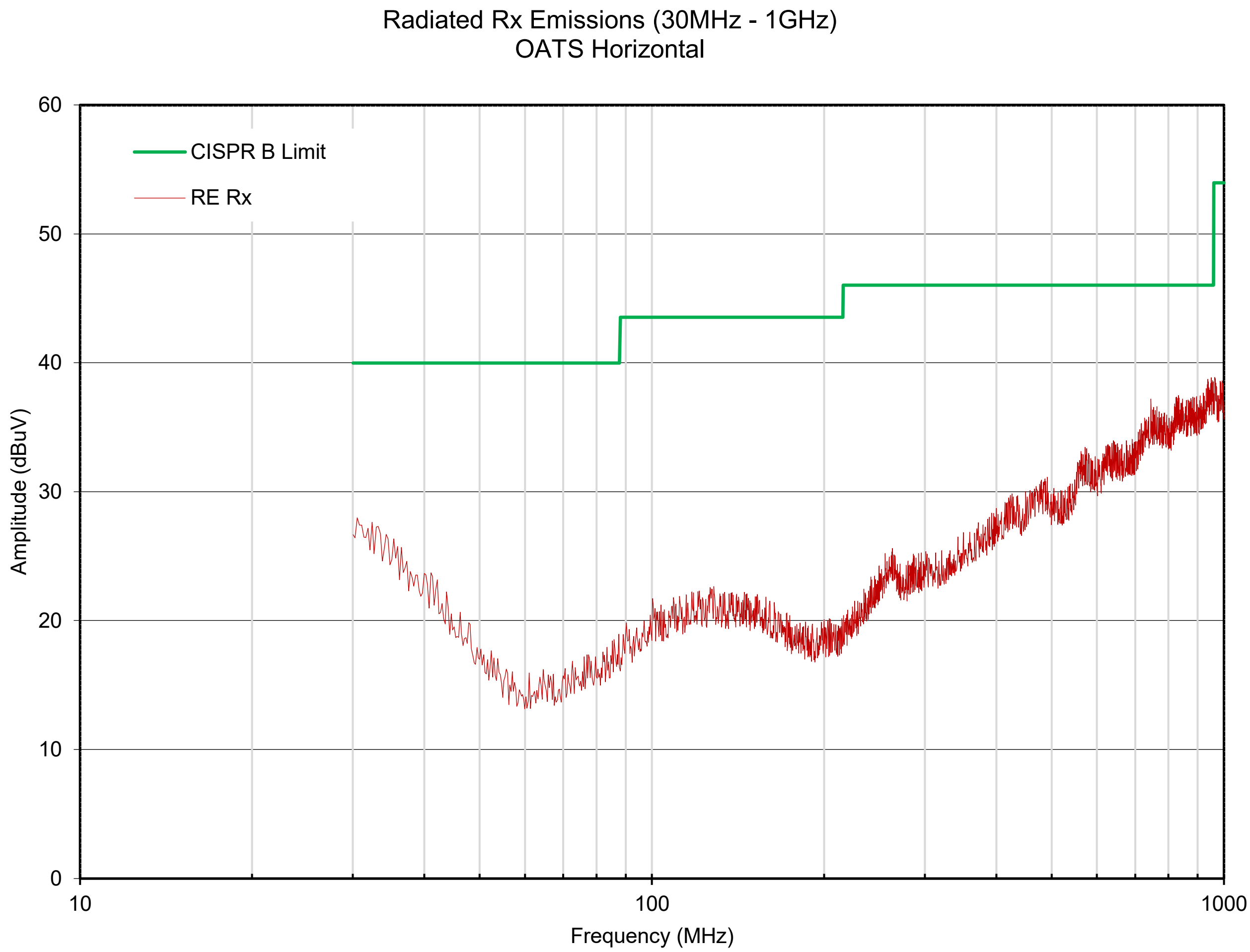
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Front	ND	ND

Radiated Tx Emissions:



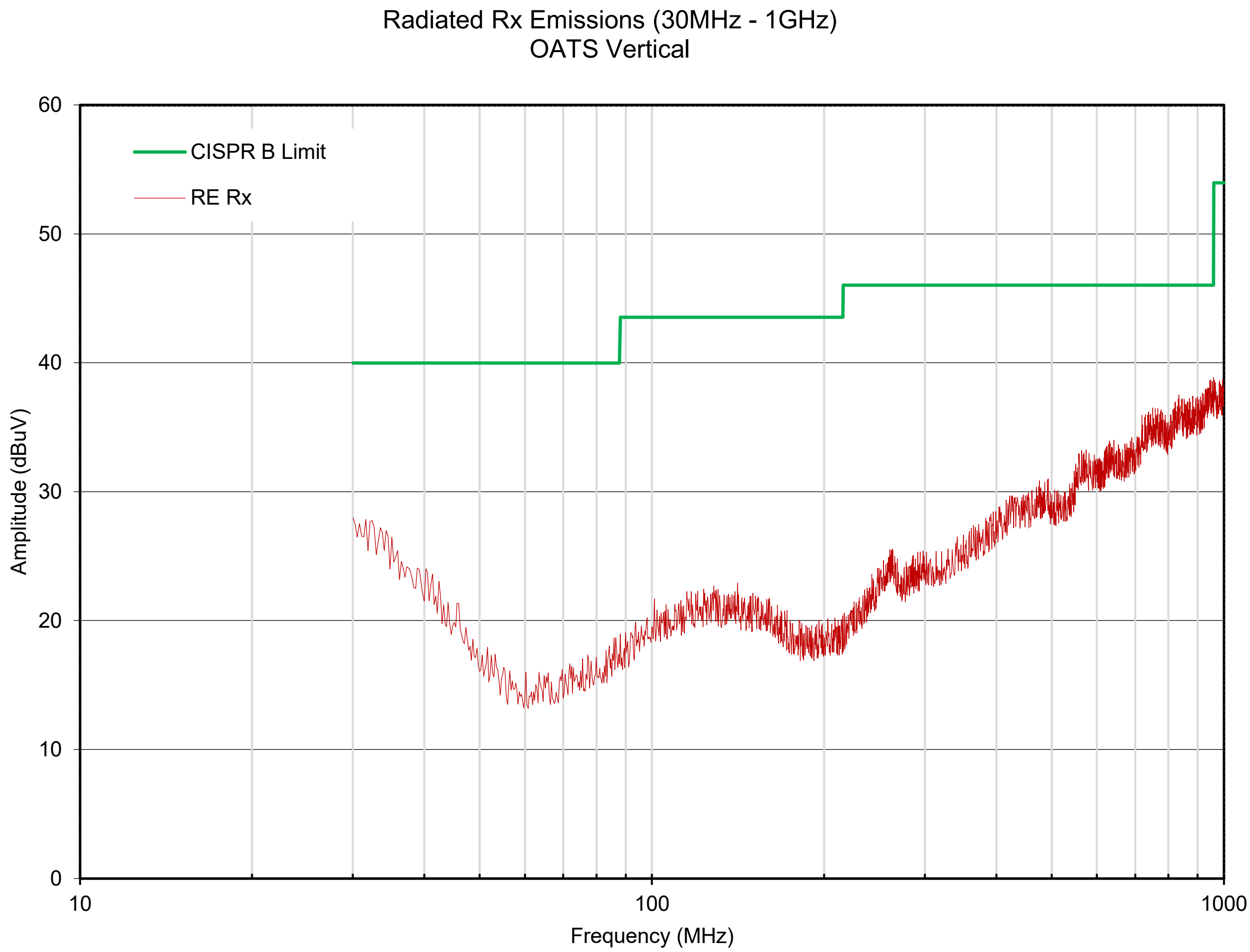
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Side	ND	ND

Radiated Tx Emissions



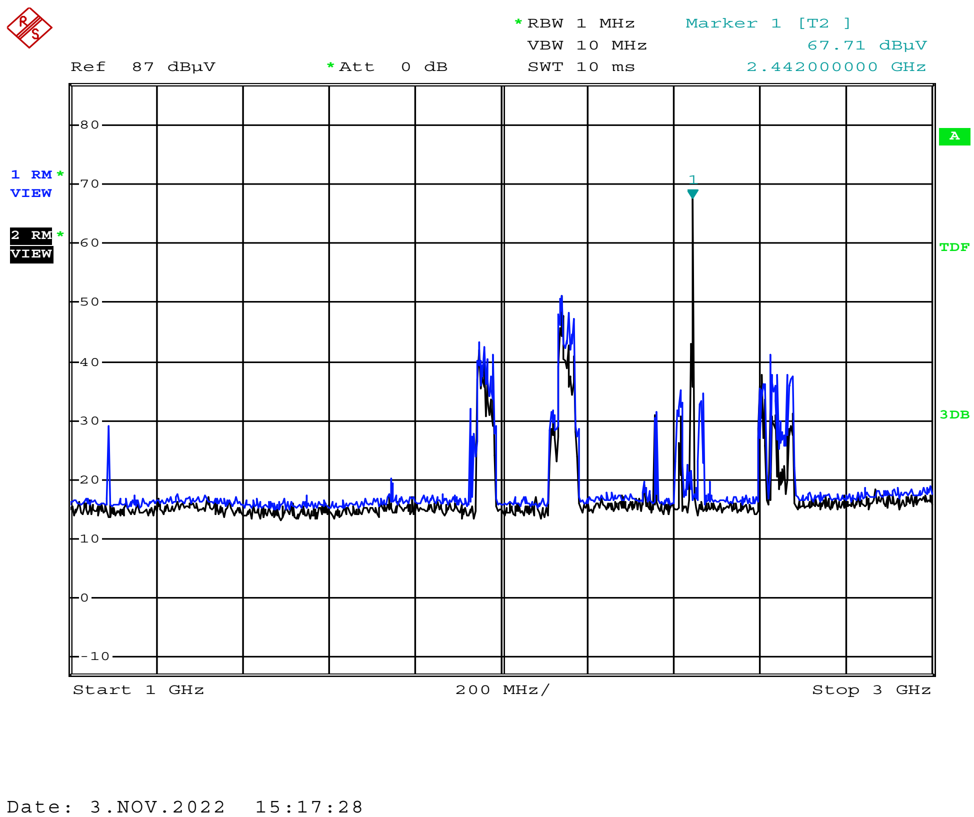
Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Vertical**	**None Detected (ND)** dBm

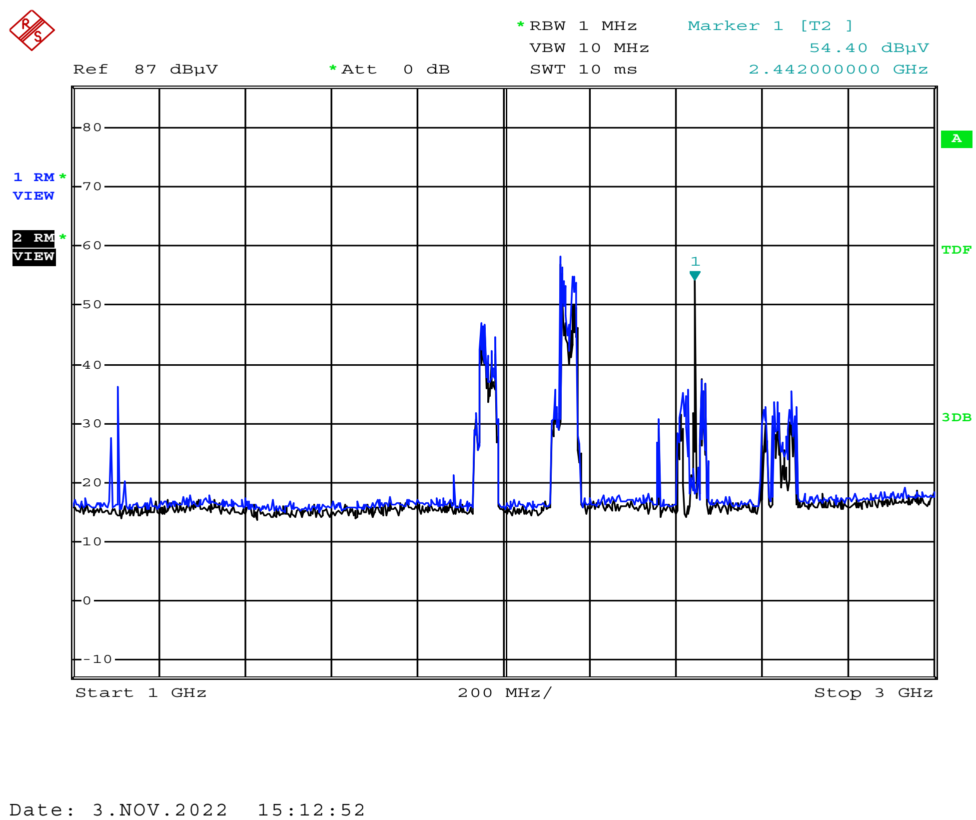
Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Horizontal**	**None Detected (ND)** dBm

Marker 1: Fundamental

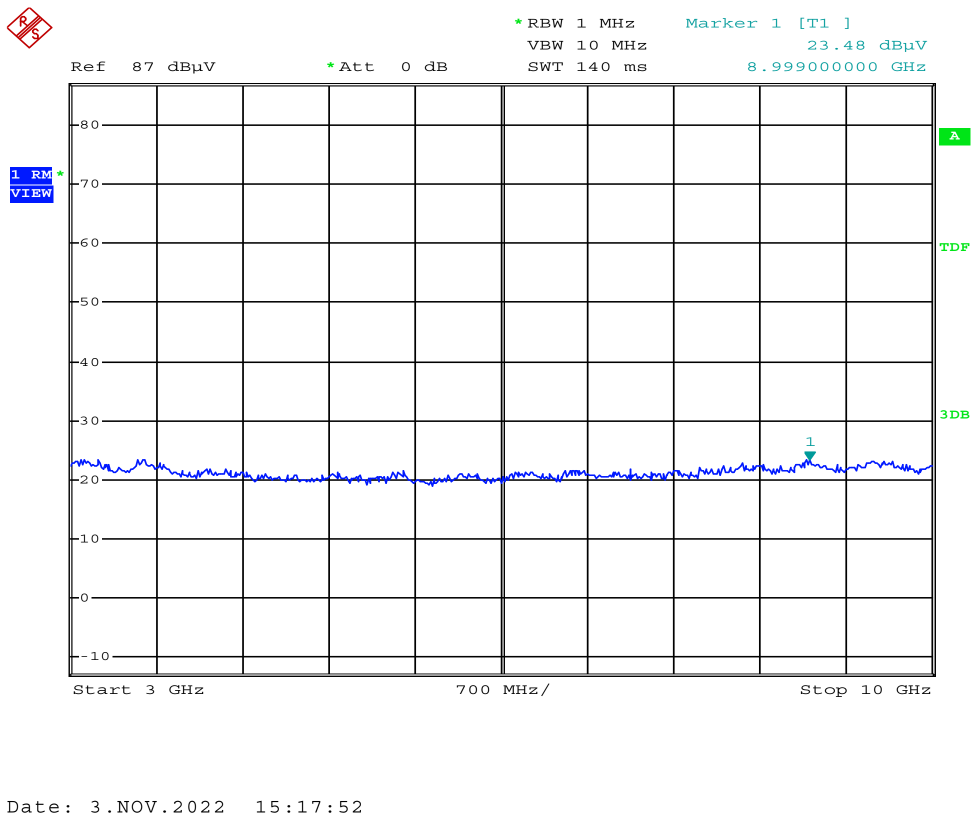
Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Vertical**	**None Detected (ND)** dBm

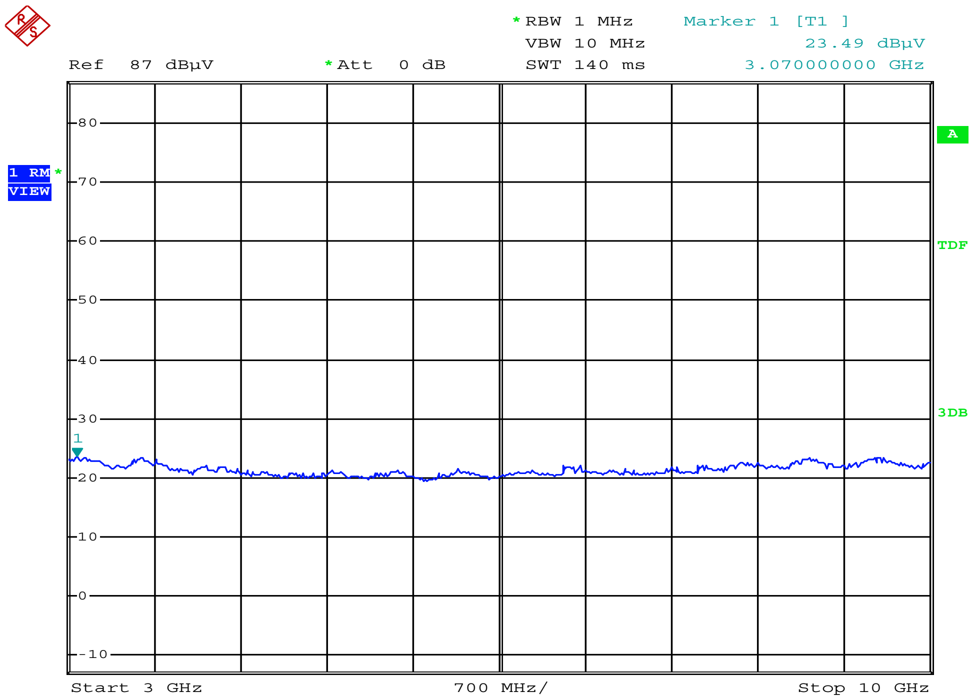
Marker 1: Fundamental

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Horizontal**	**None Detected (ND)** dBm

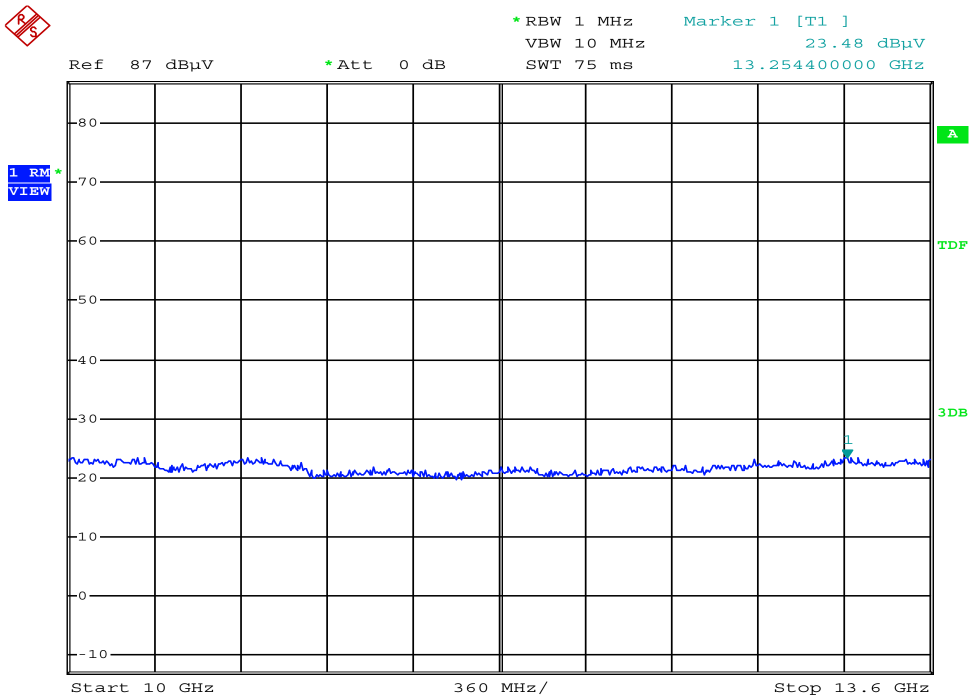
Radiated Tx Emissions



Date: 3.NOV.2022 15:13:17

Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Vertical**	**None Detected (ND)** dBm

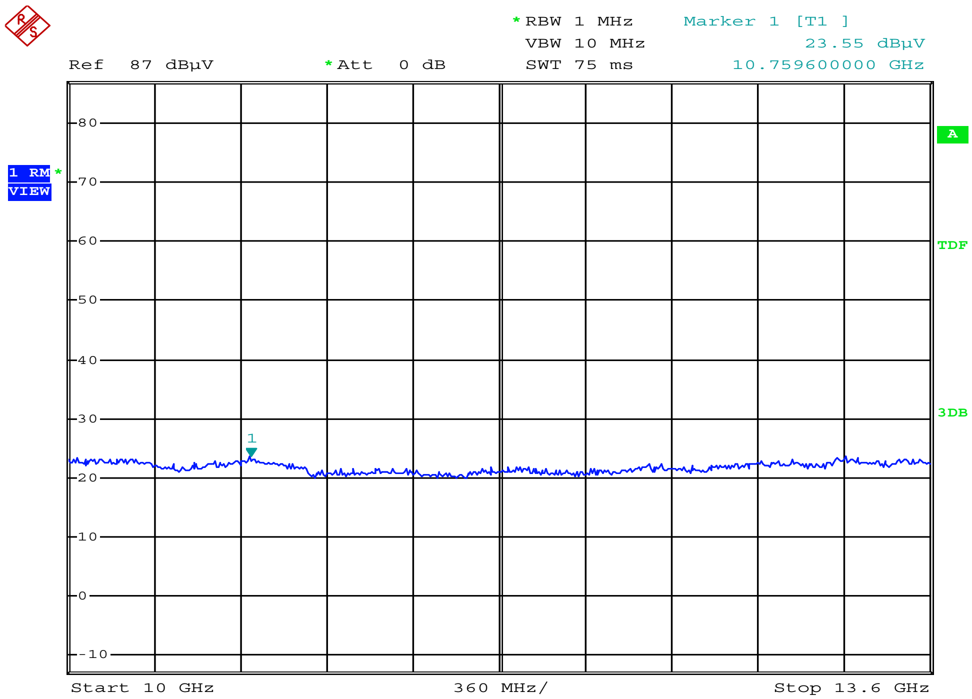
Radiated Tx Emissions



Date: 3.NOV.2022 15:18:15

Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Horizontal**	**None Detected (ND)** dBm

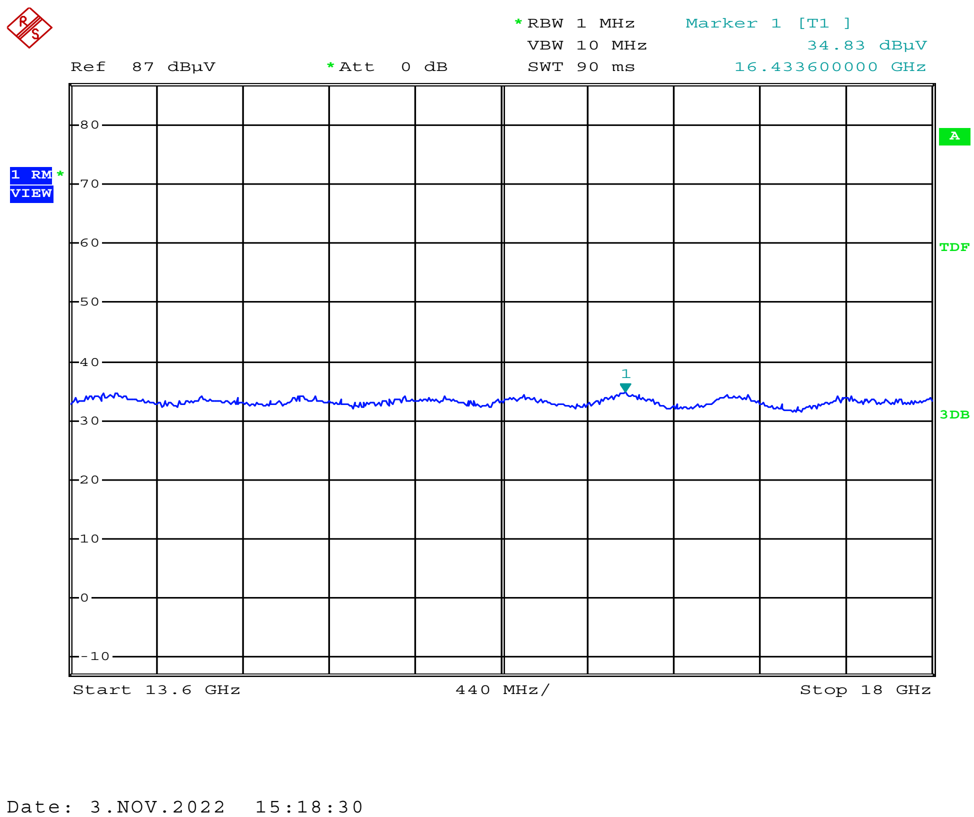
Radiated Tx Emissions



Date: 3.NOV.2022 15:13:32

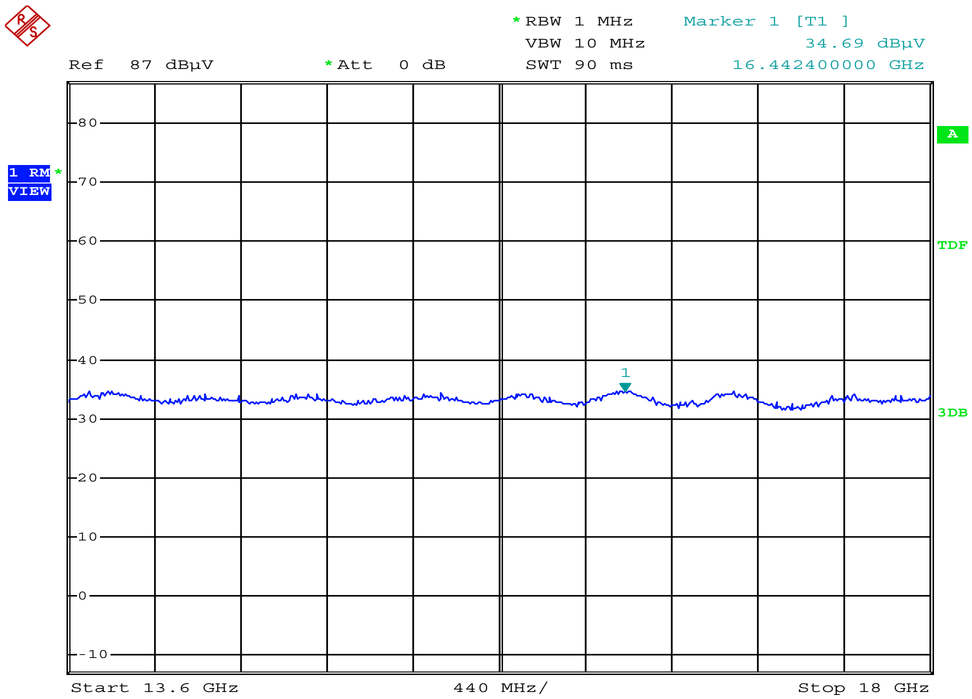
Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Tx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Horizontal**	**None Detected (ND)** dBm

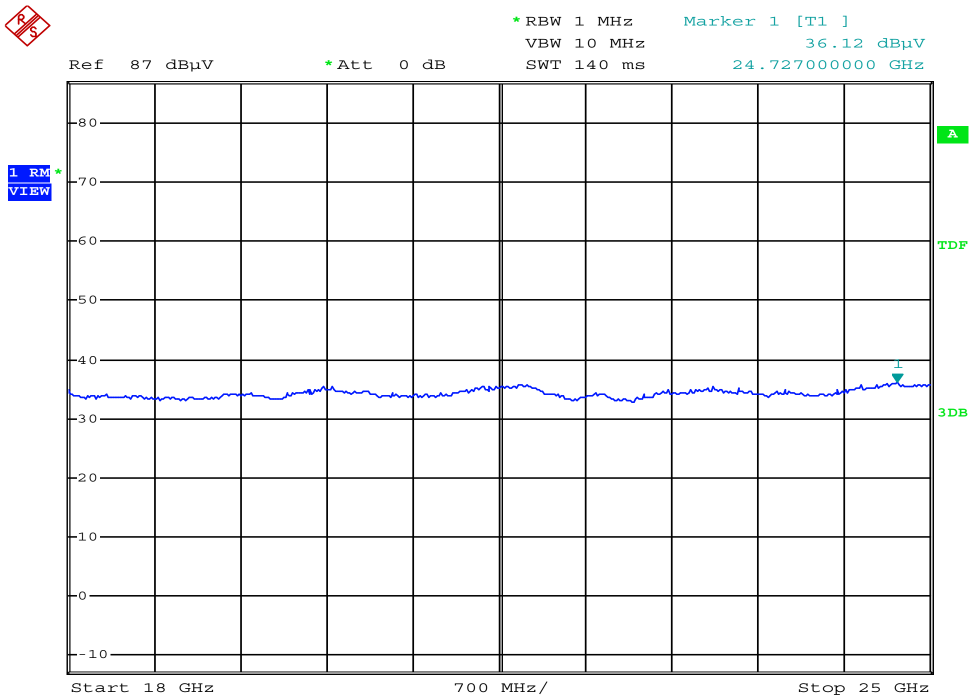
Radiated Tx Emissions



Date: 3.NOV.2022 15:13:55

Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Vertical**	**None Detected (ND)** dBm

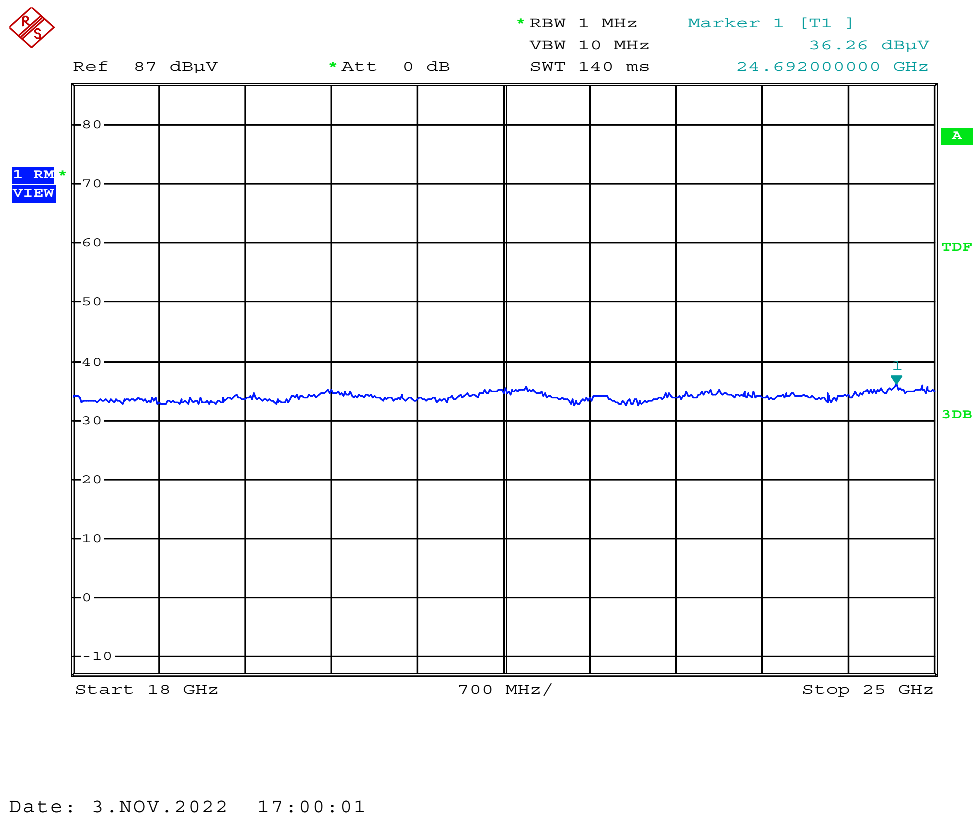
Radiated Tx Emissions



Date: 3.NOV.2022 16:56:31

Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Tx Emissions



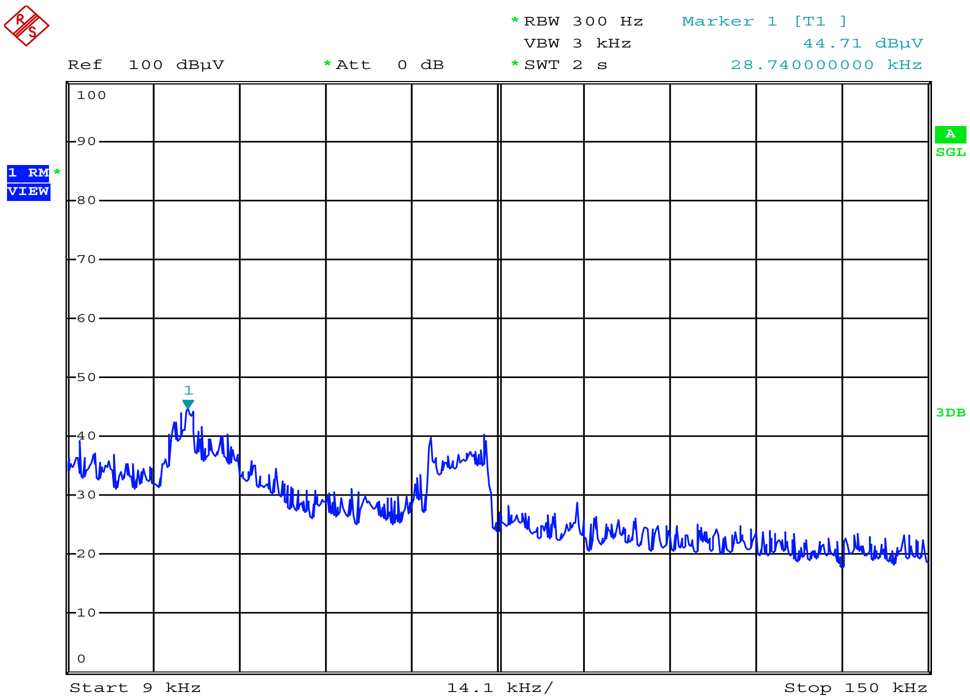
Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Vertical**	**None Detected (ND)** dBm

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) within 20dB of the limit
(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
(3) External Amplier not used

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

Radiated Tx Emissions NFC



Date: 31.OCT.2022 15:26:31

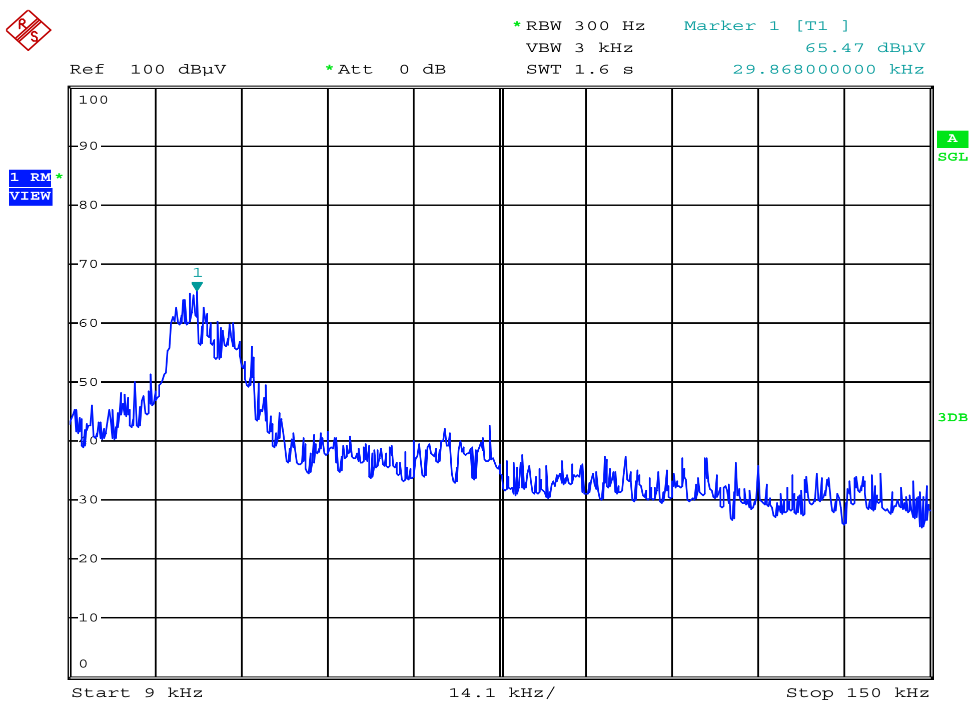
Frequency Range:	Antenna Polarization	Measured Emission:
9kHz - 150kHz	**Front**	**-** dBm

Radiated Tx Emissions NFC

Date: 31.OCT.2022 15:27:50

Frequency Range:	Antenna Polarization	Measured Emission:
150kHz - 30MHz	**Front**	- dBm

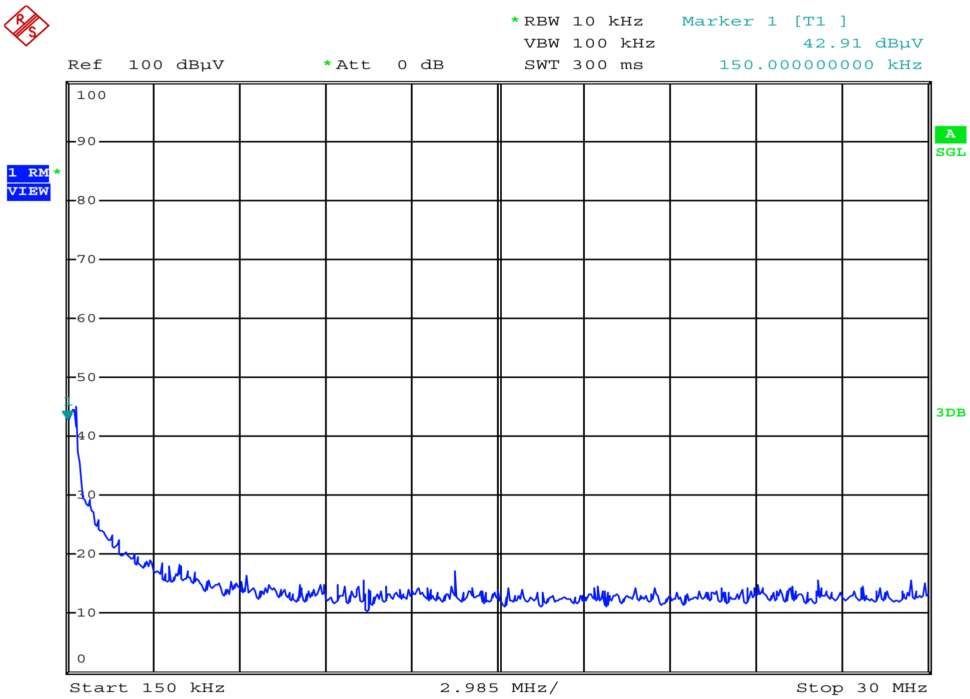
Radiated Tx Emissions NFC



Date: 31.OCT.2022 15:29:32

Frequency Range:	Antenna Polarization	Measured Emission:
9kHz - 150kHz	**Side**	- dBm

Radiated Tx Emissions NFC



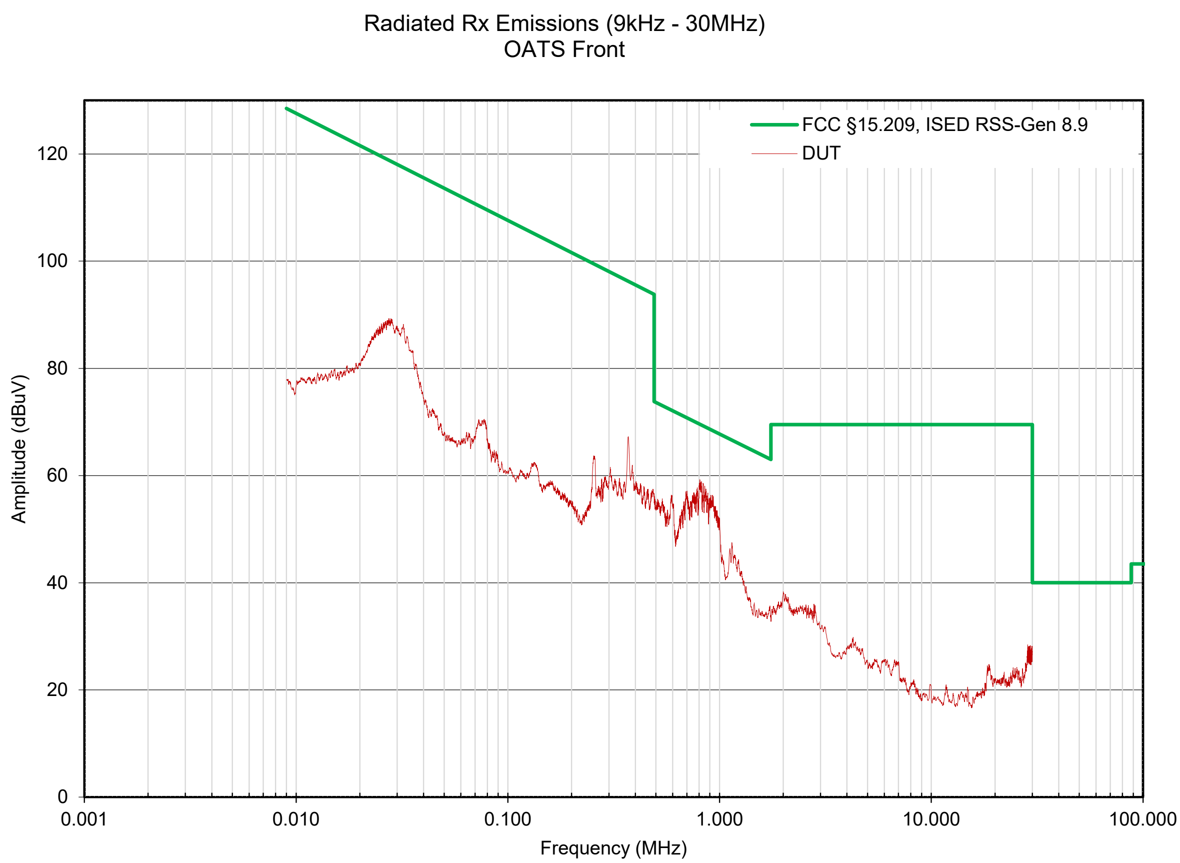
Date: 31.OCT.2022 15:28:47

Frequency Range:	Antenna Polarization	Measured Emission:
150kHz - 30MHz	**Side**	- dBm

Measurement Results

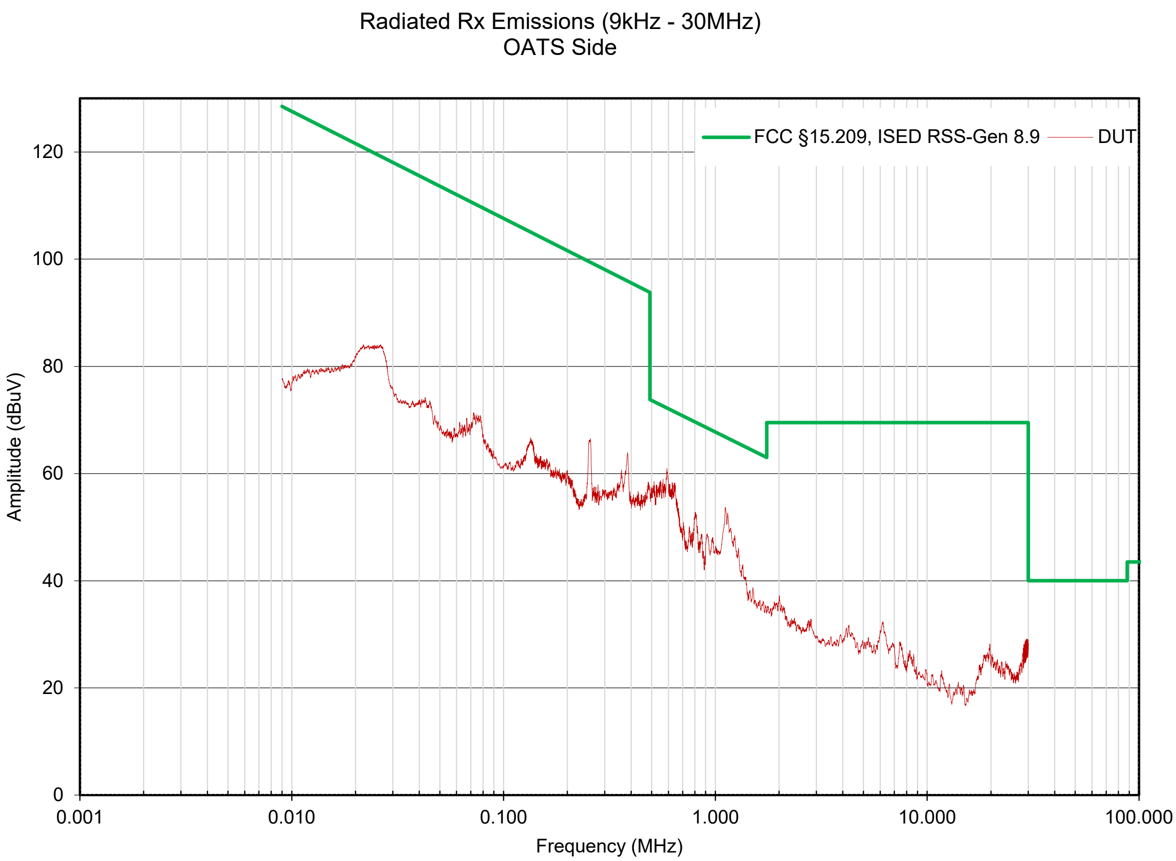
Frequency Range	Antenna Polarization	Measured Emission [E_{Meas}] (dBm)	Limit e.r.p./e.r.i.p. [A_L] (dBm)	Margin (dB)
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

Radiated Rx Emissions:



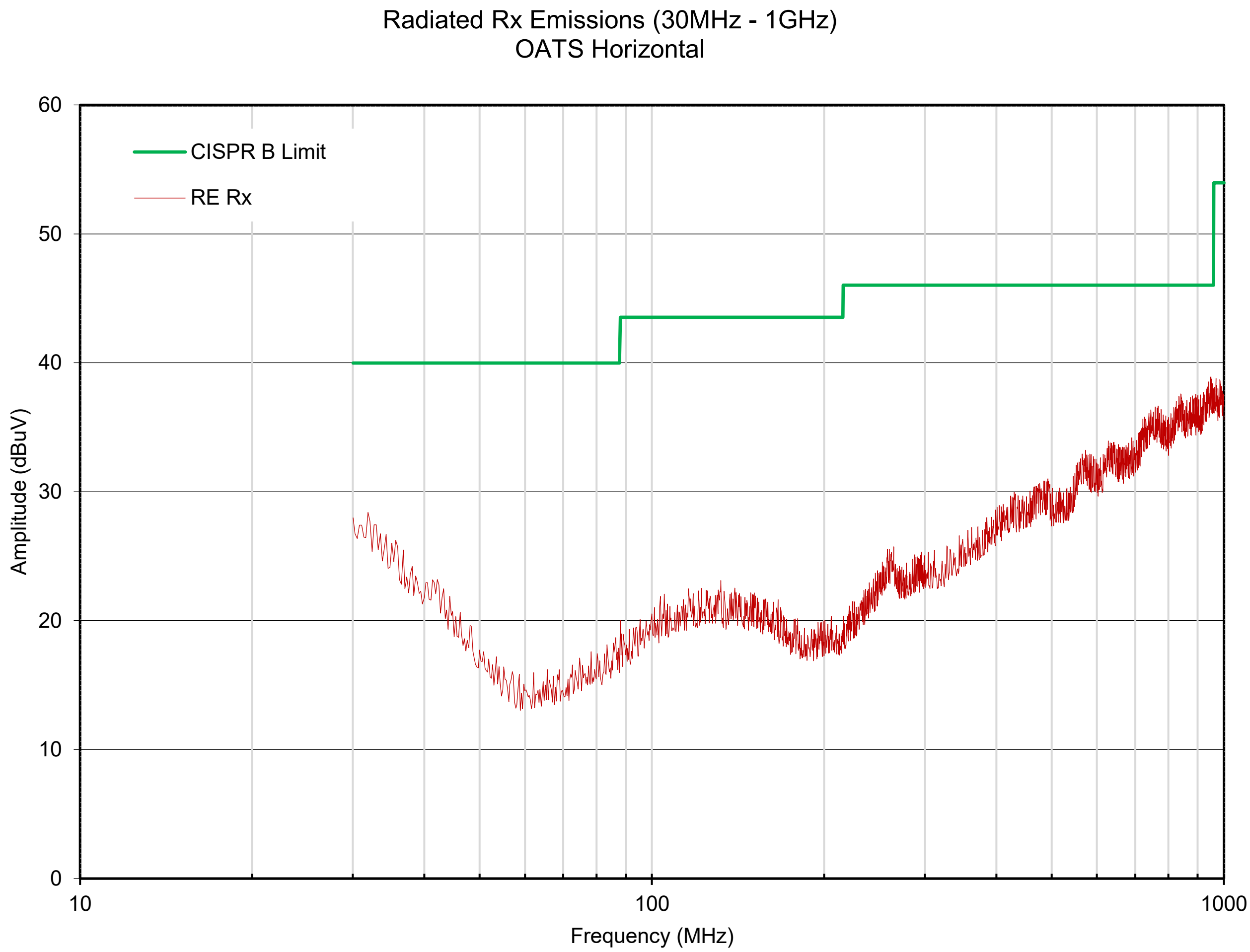
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Front	ND	ND

Radiated Rx Emissions:



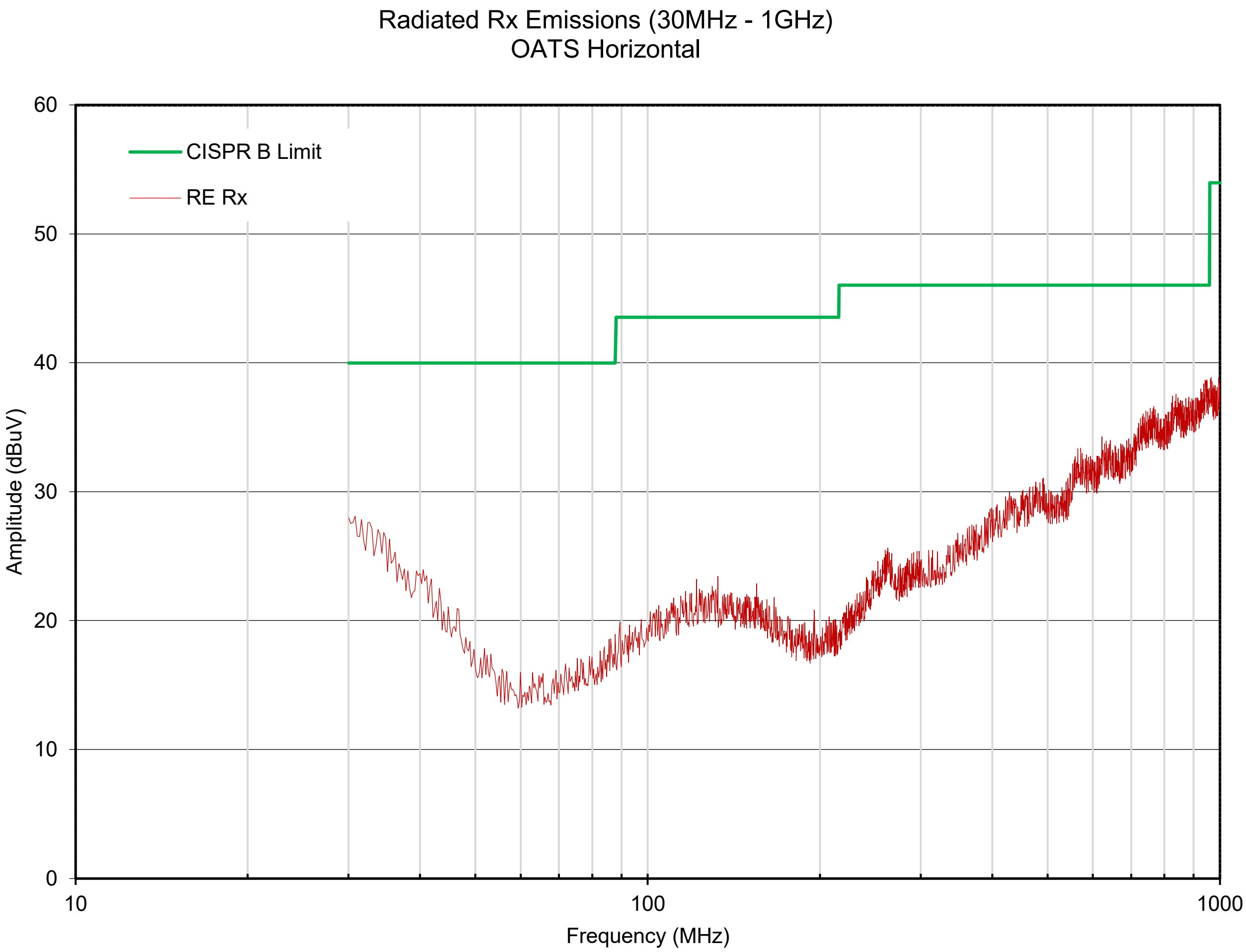
Antenna Polarization	Emission Frequency *(MHz)*	Measured Emission *(dBm)*
Side	ND	ND

Radiated Rx Emissions



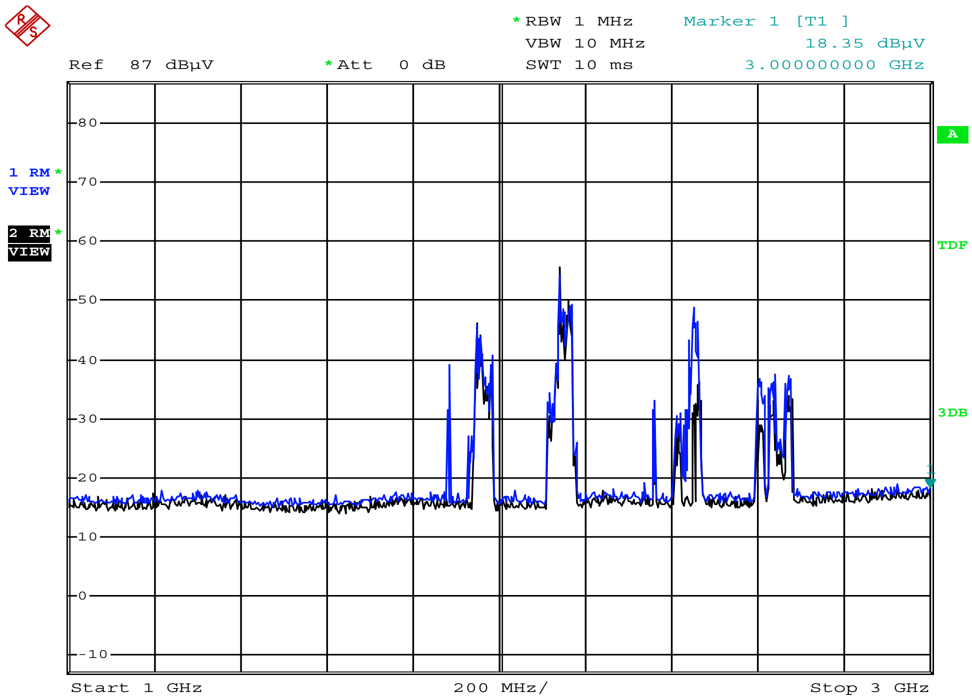
Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
30 - 1000MHz	**Vertical**	**None Detected (ND)** dBm

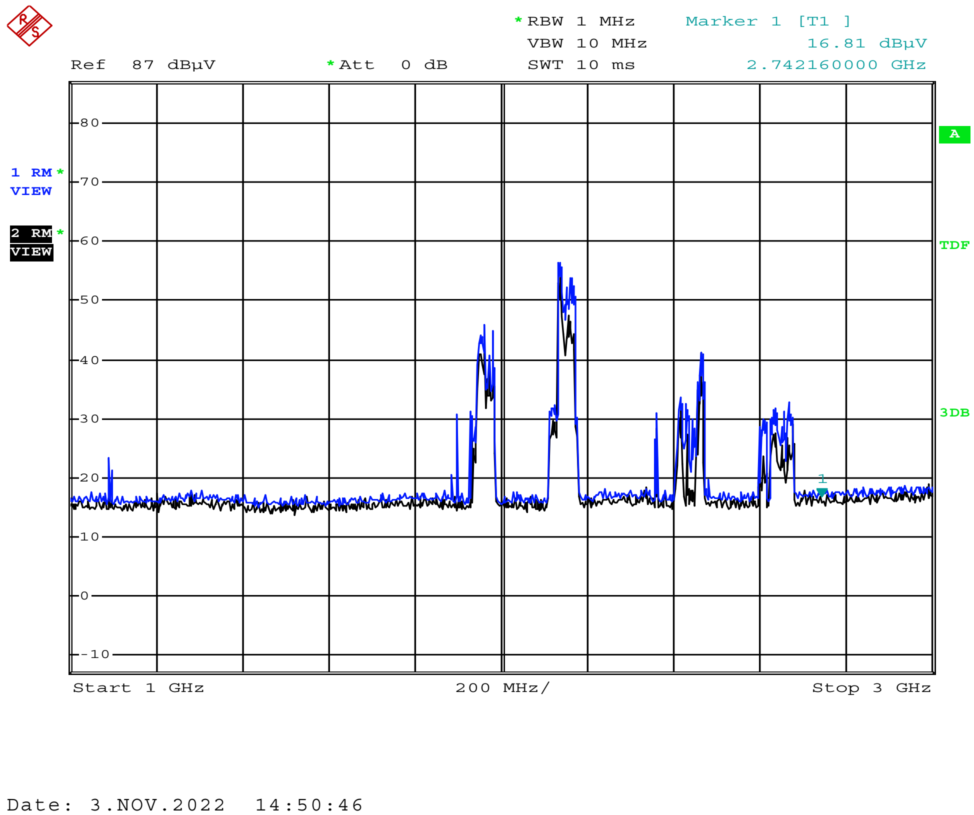
Radiated Rx Emissions



Date: 3.NOV.2022 14:53:56

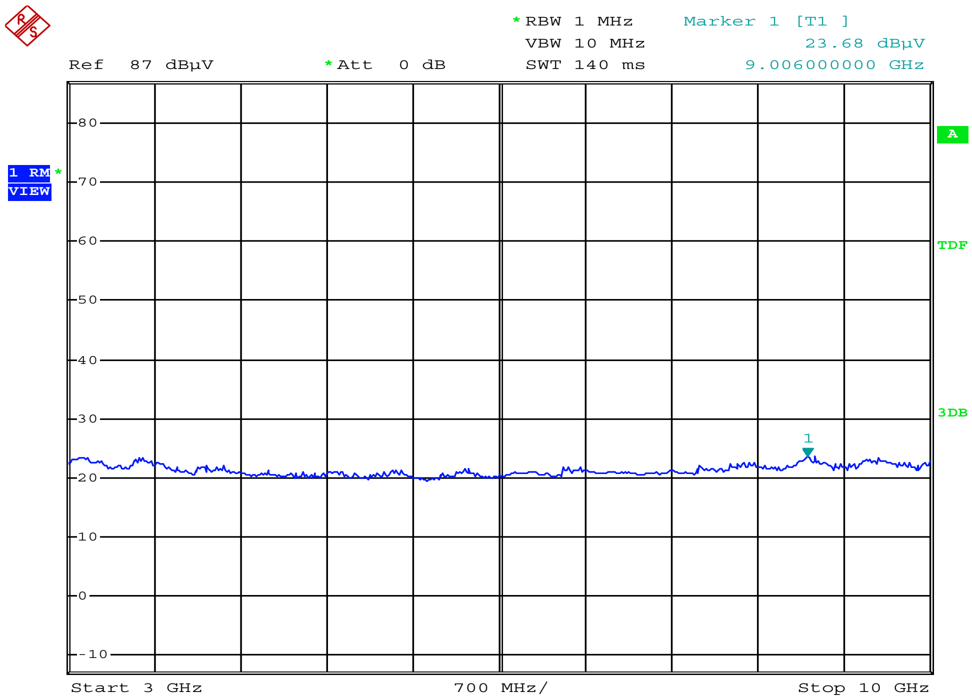
Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
1 - 3GHz	**Vertical**	**None Detected (ND)** dBm

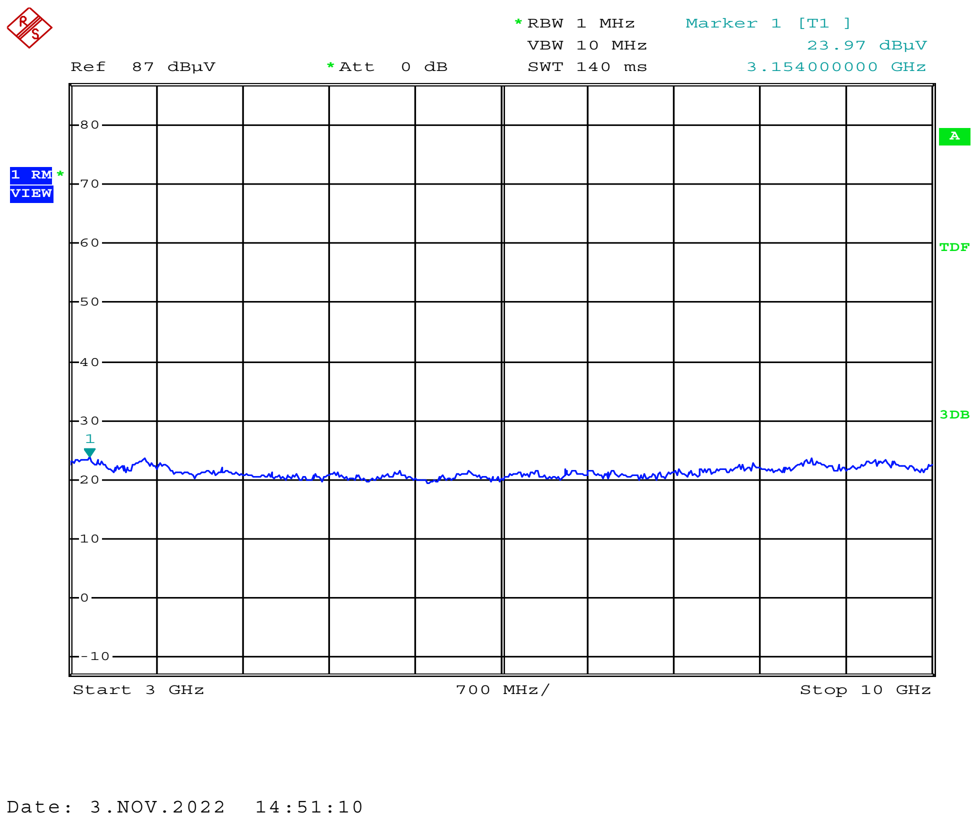
Radiated Rx Emissions



Date: 3.NOV.2022 14:54:23

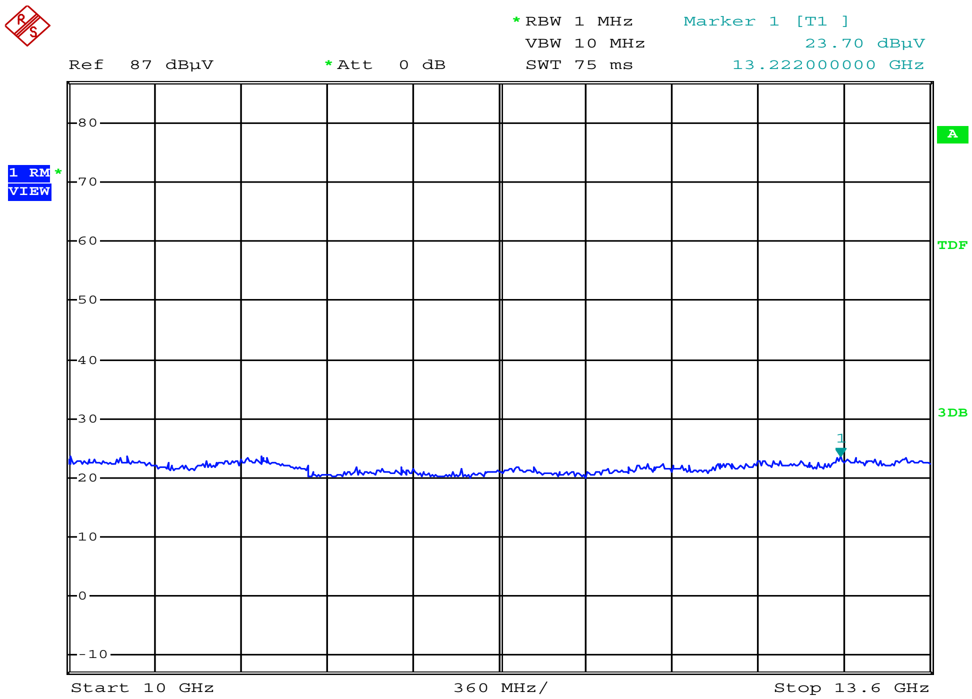
Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
3 - 10GHz	**Vertical**	**None Detected (ND)** dBm

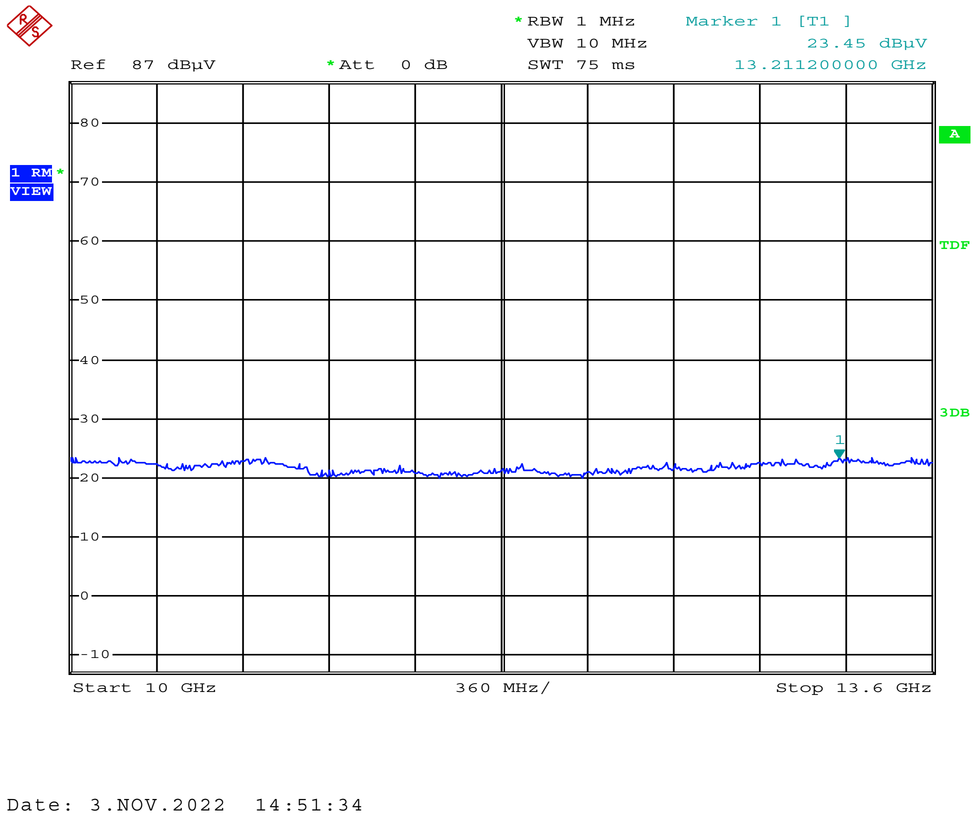
Radiated Rx Emissions



Date: 3.NOV.2022 14:54:43

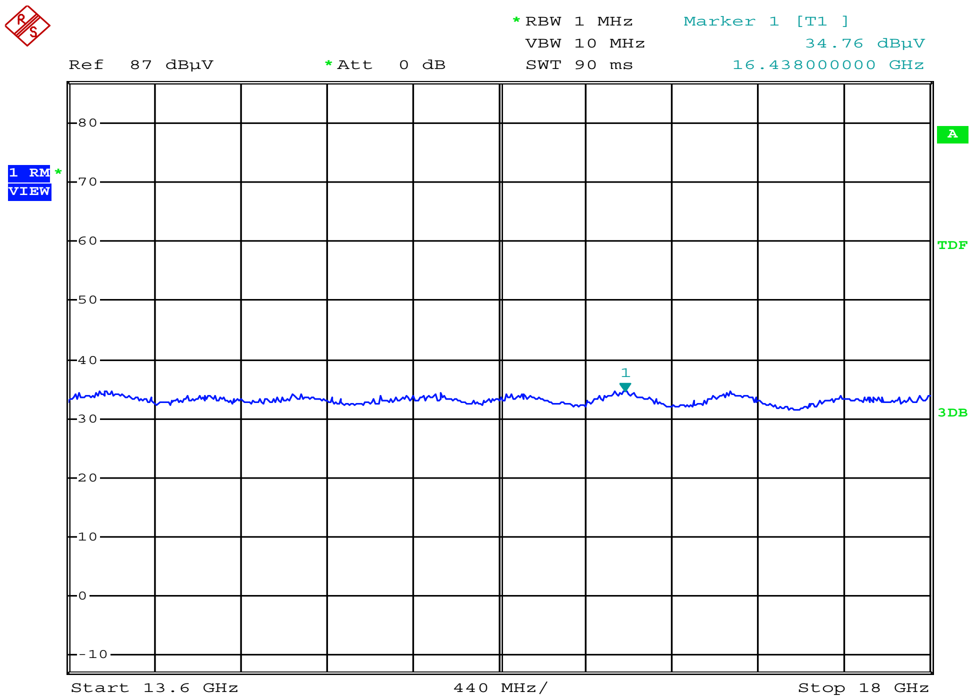
Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
10 - 13.6GHz	**Vertical**	**None Detected (ND)** dBm

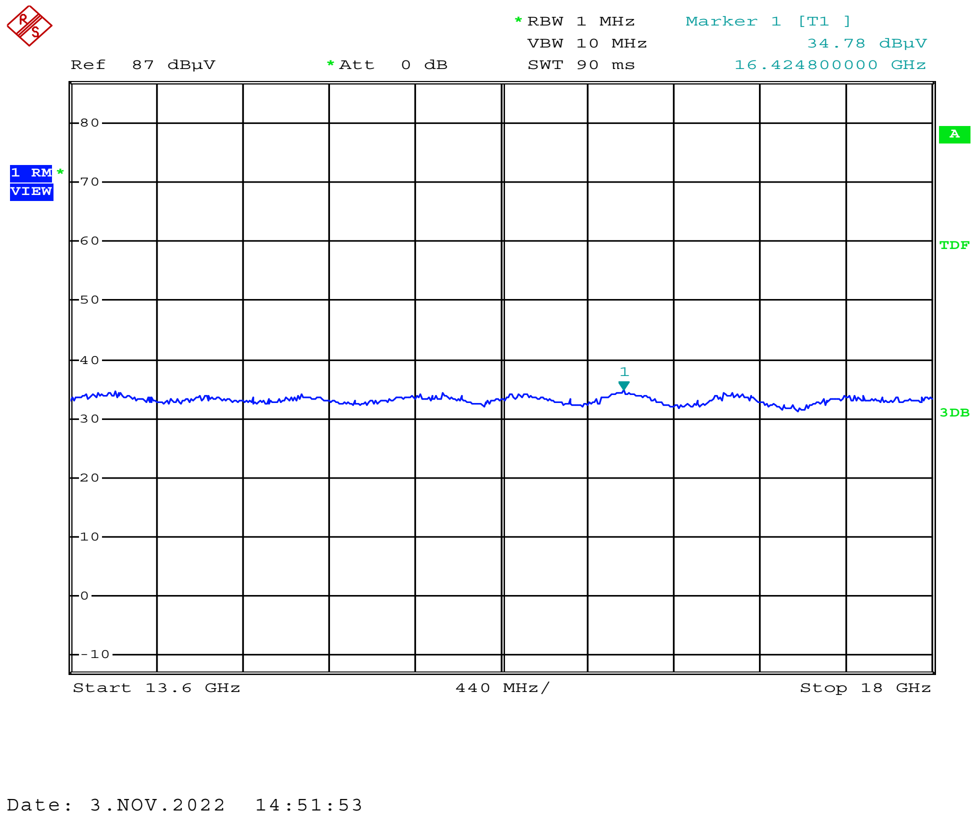
Radiated Rx Emissions



Date: 3.NOV.2022 14:54:57

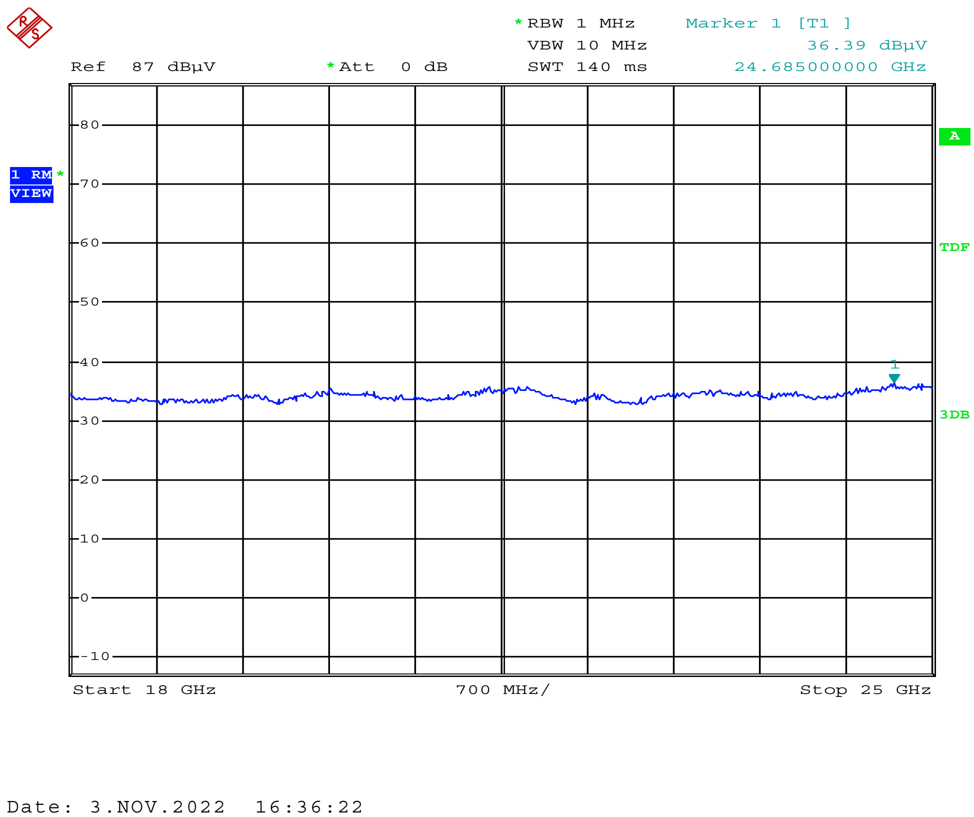
Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



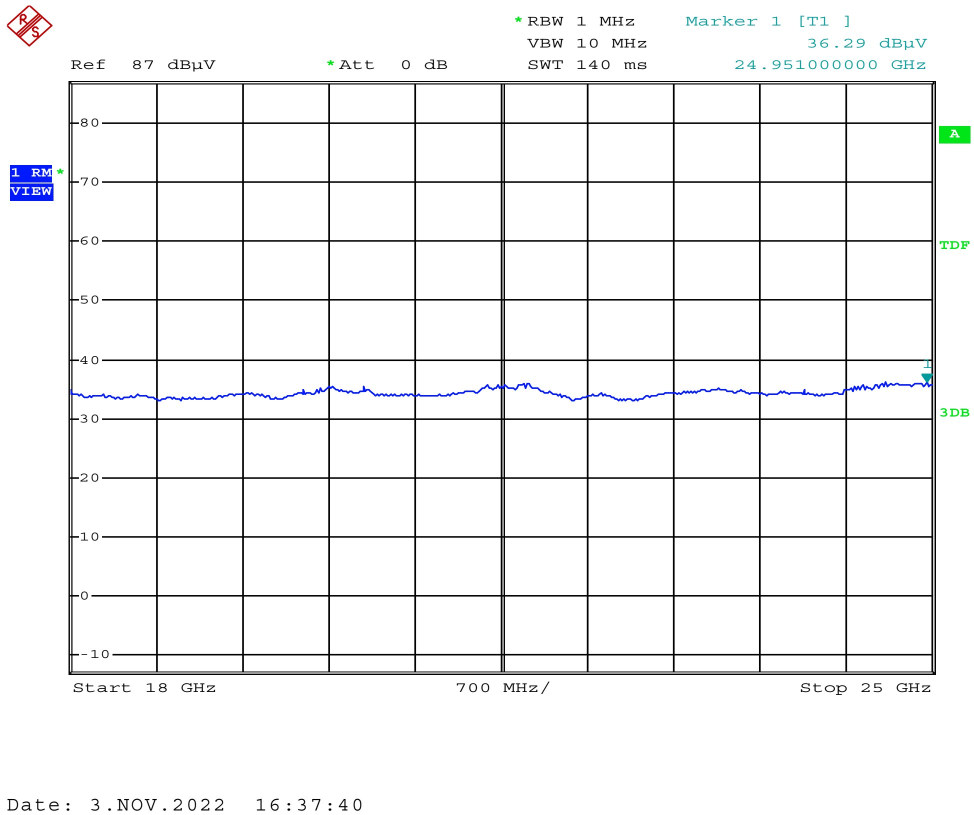
Frequency Range:	Antenna Polarization	Measured Emission:
13 - 18GHz	**Vertical**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Horizontal**	**None Detected (ND)** dBm

Radiated Rx Emissions



Frequency Range:	Antenna Polarization	Measured Emission:
18 - 25GHz	**Vertical**	**None Detected (ND)** dBm

Test Report Serial Number:	**45461765 R2.0**
Test Report Date:	**20 December 2022**
Project Number:	**1603**

SAR Test Report - New Certification

Applicant:

Garmin International Inc.

1200 East 151 St.
Olathe, KS, 66062
USA

Maximum Reported 10g SAR			
Extremity (wrist)	Wifi (DTS)	0.25	W/kg
	BT/BLE (DSS)	<0.1	
General Pop. Limit:		4.00	

FCC ID:	ISED Registration Number
IPH-04578	
Product Model Number / HVIN	Product Name / PMN
A04578	**A04578**

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 **IC Registration 3874A** **FCC Registration: CA3874**

Table of Contents

1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:		Trevor Whillock/ Ben Hewson	Date(s) of Evaluation:		19 & 20 Sep 2022
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	24 November 2022
1.0	Initial Release		n/a	Art Voss	6 December 2022
2.0	Revised Rated Power		2, 7	Art Voss	20 December 2022

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-04578**
	ISED ID:	
Device Model(s) / HVIN:	A04578	
Device Marketing Name / PMN:	A04578	
Test Sample Serial No.:	3361277594 - Conducted, 3361277722 - 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): 18.60dBm	
	BlueTooth - Spread Spectrum Transmitter (DSS): 9.50dBm	
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 2.80dBm	
	NFC - Low Power Communication Device Transmitter (DXX): -36dBm	
Antenna Type and Gain:	-3.6dBi 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: 65mm dia x 4.5mm	
Deviation(s) from standard/procedure:	None	
Modification of DUT:	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 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.

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 A04578, FCC ID: IPH-04578, 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 17025:2005	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 62209-1528-2020:	Measurement procudeure for the assessment of sepcific absorption rate of human expoure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528; Human models, insturmentation, and procedures (Frequency range of 4 MHz to 10 GHz)
IEC International Standard	
IEC 62209-2 2010	Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 2
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 Test Guidane 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:	Model / HVIN:	
Garmin International Inc.	A04578	
Standard(s) Applied:	**Measurement Procedure(s):**	
FCC 47 CFR §2.1093	FCC KDB 865664, FCC KDB 447498, FCC KDB 248227 IEEE Standard 1528-2013, IEC 62209-2	
Reason For Issue:	**Use Group:**	**Limits Applied:**
[x] New Certification	[x] General Population / Uncontrolled	[ ] 1.6W/kg - 1g Volume
[ ] Class I Permissive Change		[ ] 8.0W/kg - 1g Volume
[ ] Class II Permissive Change	[ ] Occupational / Controlled	[x] 4.0W/kg - 10g Volume
Reason for Change:		**Date(s) Evaluated:**
		September 19 & 20, 2022

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.

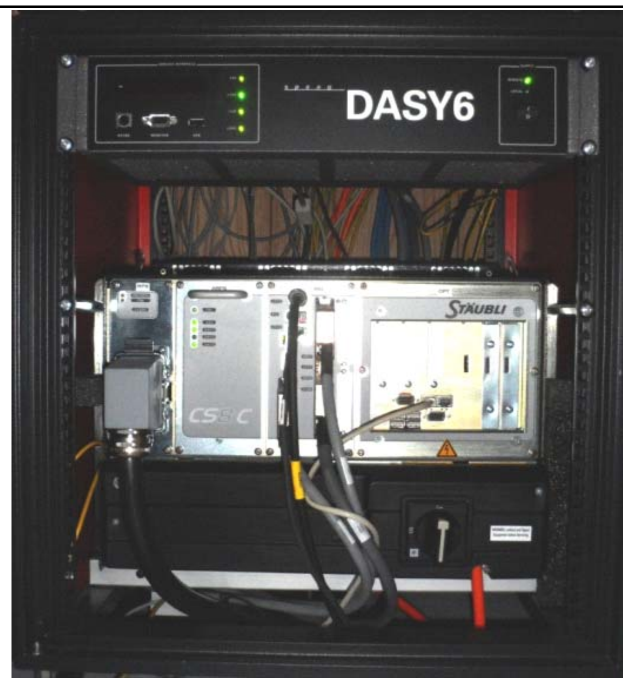
I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel 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. 2 November 2022 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

A04578-Conducted Power Measurements-Average										
Channel	Frequency (MHz)	Measured Power (dBm)	Max* Rated Power (dBm)	Max* Rated Power (W)	Delta (dB)	SAR Test Channel (Y/N)	Mode	BW (MHz)	Modulation	
6	2437	18.30					WLAN 2.4G	20	DSSS-1Mbps	802.11b
		18.34							DSSS-2Mbps	
		18.56							DSSS-5.5Mbps	
		18.31							DSSS-11Mbps	
1	2412	15.76	18.60	0.07	-2.84	-			DSSS-5.5Mbps	
6	2437	18.56	18.60	0.07	-0.04	Y				
11	2462	15.47	18.60	0.07	-3.13	-				
6	2437	15.84							OFDM-6Mbps	802.11g
		15.79							OFDM-9Mbps	
		16.08							OFDM-12Mbps	
		13.90							OFDM-36Mbps	
		13.03							OFDM-54Mbps	
1	2412	11.43	16.10	0.04	-4.67	-			OFDM-12Mbps	
6	2437	16.08	16.10	0.04	-0.02					
11	2462	11.01	16.10	0.04	-5.09	-				
6	2437	17.10							MCS-0	802.11n
		16.23							MCS-3	
		11.67							MCS-7	
1	2412	11.19	17.10	0.05	-5.91	-			MCS-0	
6	2437	17.10	17.10	0.05	0.00	-				
11	2462	9.85	17.10	0.05	-7.25	-				

* Including Tune-Up Tolerance

Table 7.1 Conducted Power Measurements

Conducted Power Measurement Results: BlueTooth									
Mode	Channel Number	Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Power [P_{Meas}] (dBm)	Max* Rated Power *(dBm)*	Max* Rated Power *(W)*	Delta (dB)	SAR Test Channel (Y/N)
BT BR	2	2402.00	GFSK	-	8.44	9.10	0.008	-0.66	-
	40	2440.00	GFSK		9.02	9.10	0.008	-0.08	-
	80	2480.00	GFSK		8.89	9.10	0.008	-0.21	-
BT EDR2	2	2402.00	P1/4-DQPSK	2	8.51	9.50	0.009	-0.99	-
	40	2440.00	P1/4-DQPSK		9.21	9.50	0.009	-0.29	-
	80	2480.00	P1/4-DQPSK		9.48	9.50	0.009	-0.02	**Y**
BT EDR3	2	2402.00	8-DPSK	3	7.99	8.80	0.008	-0.81	-
	40	2440.00	8-DPSK		8.45	8.80	0.008	-0.35	-
	80	2480.00	8-DPSK		8.78	8.80	0.008	-0.02	-
BLE1	0	2402.00	GMSK	1	-1.75	2.60	0.002	-4.35	-
	19	2440.00	GMSK		2.59	2.60	0.002	-0.01	-
	39	2480.00	GMSK		-0.43	2.60	0.002	-3.03	-
BLE2	0	2402.00	GMSK	2	-1.76	2.80	0.002	-4.56	-
	19	2440.00	GMSK		2.79	2.80	0.002	-0.01	-
	39	2480.00	GMSK		-0.91	2.80	0.002	-3.71	-
ANT	2	2402.00	GFSK	-	-2.39	2.00	0.002	-4.39	-
	40	2440.00	GFSK		1.80	2.00	0.002	-0.20	-
	80	2480.00	GFSK		-2.39	2.00	0.002	-4.39	-

* Including Tune-Up Tolerance

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:

a) When the *reported* SAR of the highest measured maximum output power channel is ≤ to 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

b) 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

a) When KDB Publication 248227 SAR test exclusion applies to the OFDM configuration.

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 ≤ 1.2 W/kg.

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

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

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 or BT 802.15 is not required

9.0 ACCESSORIES EVALUATED

Table 9.0 Accessories Evaluated

Manufacturer's Accessory List				
Test Report ID Number	Manufacturer's Part Number	Description	SAR Evaluated	SAR Tested
B1	010-13111-02	Silicone Band	**Y**	**Y**
B2	010-12496.20	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				DUT Spacing		Measured SAR (*W/kg*)	SAR Drift (*dB*)
			Pos	Mode	BW	Mod	BR	Antenna ID	Battery ID	Body ID	Audio ID	DUT (*mm*)	Antenna (*mm*)		
20 Sep 2022	E55	2437	Back Side	802.11b	20	DSSS	5.5	-	Li-ion	B1	-	0	0	0.244	-0.110
20 Sep 2022	E57	2437	Back Side	802.11b	20	DSSS	5.5	-	Li-ion	B2	-	0	0	0.179	0.890
20 Sep 2022	E60	2480	Back Side	BT	2	EDR	2	-	Li-ion	B1	-	0	0	0.046	-0.060
Applicable SAR Limit								Use Group						Limit	
FCC 2.1093			Canada Health 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- WiFi	Extremity -BT		
Plot ID		E55	E60		
Maximum Measured SAR_M		0.244	0.046		(W/kg)
Frequency		2437	2480		(MHz)
Drift	Power Drift	-0.110	-0.060		(dB)
Conducted Power		18.560	9.480		(dBm)
DC	Transmit Duty Cycle	100.000	100.0		(%)
Fluid Deviation from Target					
Δe	Permitivity	-7.46%	-8.27%		
Δσ	Conductivity	-1.90%	0.00%		

Fluid Sensitivity Calculation (10g)		IEC 62209-2 Annex F			
Delta SAR = Ce * Δe + Cσ * Δσ				(F.1)	
Ce = $(0.003456*f^3) - (0.03531*f^2) + (0.07675*f) - 0.186$				(F.4)	
Cσ = $(0.004479*f^3) - (0.01586*f^2) - (0.1972*f) + 0.7717$				(F.5)	
f	Frequency (GHz)	2.437	2.48		
Ce		-0.159	-0.160		
Cσ		0.262	0.253		
Ce * Δe		0.012	0.013		
Cσ * Δσ		-0.005	0.000		
ΔSAR		0.007 (3)	0.013 (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	18.560	9.480		(dBm)
Rated Conducted Power	18.600	9.500		(dBm)
ΔP	-0.040	-0.020		(dB)

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]	0.244	0.046		(W/kg)

SAR Adjustment for Tuneup Tolerance				
$SAR_2 = SAR_1$ + [ΔP]	0.246	0.046		(W/kg)

SAR Adjustment for Drift				
$SAR_3 = SAR_2$ + [Drift]	0.252	0.047		(W/kg)

SAR Adjustment for Crest Factor				
$SAR_4 = SAR_3$ x [CF]	0.252	0.047		(W/kg)

reported 10g SAR				
SAR_4	**0.25**	**0.05**		(W/kg)

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

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] X [√f(GHz)] ≤ 7.5 for 10-g SAR
[1.9)/(5)] X [√2.441] = 1.237≤ 7.5

Where:
max. power of channel, including tune-up tolerance, mW = 1.9 mW
min. test separation distance, mm = 5mm
f(GHz) = 2.441 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 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 or BT 802.15 is not required. When applying this formula to EU Extremity limits the adjusted SAR is ≤ 1.5W/kg, and for Body limits is ≤ 3.0W/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 indentification 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-62209-1 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 62209-1. 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								
Date	Ambient Temp (° C)	Fluid Temp (° C)	Relative Humidity (%)	Barometric Pressure (kPa)	Fluid Dielectric	SPC	Test	Task
19 Sep 2022	22.4	24.2	34%	101.4	X	X	X	2450H Fluids, SPC & SAR Eval
20 Sep 2022	21.9	21.3	32%	101.4			X	2450H SAR Testing

*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	This device although the intended use is to be wrist-worn with the back side of the device in contact with the human skin. The device was evaluated for Extremity (wrist worn), from a flat phantom filled with head tissue-equivalent medium.The DUT evaluated in combination with accessory P/N: 010-13111-02 was found to be the worst case setup configuration and produced the highest SAR. The DUT was evaluated for SAR in accordance with the procedures described IEC/IEEE 62209-1528, IEC 62209-1, IEC 62209-2, 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 ≤ 1.2W/kg When applying this formula to EU Extremity limits the adjusted SAR is ≤ 1.5W/kg, and for Body limits is ≤ 3.0W/kg. Maximum 802.11g/n OFDM specified power(POFDM)= 16.08 dBm Maximum 802.11b DSSS specified power (PDSSS)= 18.56 dBm Ratio OFDM/DSSS power = -2.48 dBm (56.49%) Highest reported* SAR (SARMAX)= 0.250 W/kg POFDM/PDSSS X SARMAX = 0.14 W/kg ≤ 3.0 W/kg (Extremity) and ≤ 1.5 W/kg (Body) Since the ratio of the ODFM/DSSS specified power is less than one (0dB), the reported SAR would not exceed 3.0 W/kg (Extremity) or 1.5 W/kg (Body) *The reported SAR in this case is the measured SAR adjusted for fluid sensitivity.
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-EDR2 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 ± 0.5°C. The Active TSL temperature was maintained to within ±2.0°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 *Maximum Distance to Phantom Surface* 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 ONLY scaled up, not down. The final results of this scaling is the *reported SAR* 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 ± 100MHz for frequencies > 300MHz and ± 50MHz for frequencies ≤ 300MHz 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 ≤ 5% but are < 10%, the SAR Fluid Sensitivity as per IEC 62201-1 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 IEEE 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 ≤ 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 ± 1°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 ± 1 mm**
Maximum probe angle normal to phantom surface. (Flat Section ELI Phantom)	**5° ± 1°**
Area Scan Spatial Resolution ΔX, ΔY	**15 mm**
Zoom Scan Spatial Resolution ΔX, ΔY	**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 ± 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	

13.6 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° ± 1°
Area Scan Spatial Resolution ΔX, ΔY	12 mm
Zoom Scan Spatial Resolution ΔX, ΔY	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° ± 1°
Area Scan Spatial Resolution ΔX, ΔY	10 mm
Zoom Scan Spatial Resolution ΔX, ΔY	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

UNCERTAINTY BUDGET FOR DEVICE EVALUATION (IEC/IEEE 62209-1528, Table 9)									
Source of Uncertainty	IEEE 1528 Section	Toler ±%	Prob Dist	Div	c_i	c_i	Stand Unct ±%	Stand Unct ±%	V_i or V_{eff}
Measurement System					(1g)	(10g)	(1g)	(10g)	
EX3DV4 Probe Calibration** (*k*=1)	E.2.1	6.7	N	1	1	1	**6.7**	**6.7**	∞
Axial Isotropy** (*k*=1)	E.2.2	0.6	R	√3	0.7	0.7	**0.2**	**0.2**	∞
Hemispherical Isotropy** (*k*=1)	E.2.2	3.2	R	√3	0.7	0.7	**1.3**	**1.3**	∞
Boundary Effect*	E.2.3	1.0	R	√3	1	1	0.6	0.6	∞
Linearity** (*k*=1)	E.2.4	**0.5**	R	√3	1	1	**0.3**	**0.3**	∞
System Detection Limits*	E.2.4	1.0	R	√3	1	1	0.6	0.6	∞
Modulation Response** (*k*=1)	E.2.5	**8.3**	R	√3	1	1	**4.8**	**4.8**	∞
Readout Electronics*	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time*	E.2.7	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time*	E.2.8	2.6	R	√3	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	**0.0**	R	√3	1	1	0.0	0.0	**10**
RF Ambient Conditions - Reflection	E.6.1	**0.0**	R	√3	1	1	0.0	0.0	**10**
Probe Positioner Mechanical Tolerance*	E.6.2	0.0	R	√3	1	1	0.0	0.0	∞
Probe Positioning wrt Phantom Shell*	E.6.3	0.4	R	√3	1	1	0.2	0.2	∞
Post-processing*	E.5	2.0	R	√3	1	1	1.2	1.2	∞
Test Sample Related									
Test Sample Positioning	E.4.2	**2.2**	N	1	1	1	2.2	2.2	**5**
Device Holder Uncertainty*	E.4.1	3.6	N	1	1	1	3.6	3.6	∞
SAR Drift Measurement(2)	E.2.9	0.0	R	√3	1	1	0.0	0.0	∞
SAR Power Scaling(3)	E.6.5	0.0	R	√3	1	1	0.0	0.0	∞
Phantom and Tissue Parameters									
Phantom Uncertainty*	E.3.1	6.1	R	√3	1	1	3.5	3.5	∞
SAR Correction Uncertainty	E.3.2	**1.6**	N	1	1	0.84	1.6	1.3	∞
Liquid Conductivity (measurement)	E.3.3	**5.0**	N	1	0.78	0.71	3.9	3.6	**10**
Liquid Permittivity (measurement)	E.3.3	**5.0**	N	1	0.23	0.26	1.2	1.3	**10**
Liquid Conductivity (Temperature)	E.3.2	**0.4**	R	√3	0.78	0.71	0.2	0.2	**10**
Liquid Permittivity Temperature)	E.3.2	**0.2**	R	√3	0.23	0.26	0.0	0.0	**10**
Effective Degrees of Freedom(1)								V_{eff} =	**1141**
Combined Standard Uncertainty			**RSS**				**11.1**	**11.0**	
Expanded Uncertainty (95% Confidence Interval)			**k=2**				**22.2**	**21.9**	
Measurement Uncertainty Table in accordance with IEC/IEEE 62209-1528									

(1) The Effective Degrees of Freedom is > 30

Therefore a coverage factor of k=2 represents an approximate confidence level of 95%.

(2) The SAR Value is compensated for Drift

(3) SAR Power Scaling not Required

* Provided by SPEAG for DASY

** Standard Uncertainty Calibration Data Provided by SPEAG for EX3DEV4 Probe

Table 14.1 Calculation of Degrees of Freedom

Calculation of the Degrees and Effective Degrees of Freedom	
$v_i = n - 1$	$$v_{eff} = \frac{u_c^4}{\sum_{i=1}^{m} \frac{c_i^4 u_i^4}{v_i}}$$

15.0 FLUID DIELECTRIC PARAMETERS

Table 15.0 Fluid Dielectric Parameters 2450MHz HEAD TSL

****
Aprel Laboratory
Test Result for UIM Dielectric Parameter
Mon 19/Oct/2022 15:24:05
Freq Frequency(GHz)
FCC_eH FCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.3500	39.38	1.71	38.25	1.76
2.3600	39.36	1.72	38.37	1.78
2.3700	39.34	1.73	38.34	1.77
2.3800	39.32	1.74	38.31	1.81
2.3900	39.31	1.75	38.23	1.81
2.4000	39.29	1.76	38.42	1.82
2.4100	39.27	1.76	38.34	1.82
2.4200	39.25	1.77	38.33	1.84
2.4300	39.24	1.78	38.28	1.84
2.4400	39.22	1.79	38.25	1.84
2.4500	39.20	1.80	38.06	1.84
2.4600	39.19	1.81	38.20	1.87
2.4700	39.17	1.82	38.13	1.87
2.4800	39.16	1.83	38.06	1.89
2.4900	39.15	1.84	37.99	1.91
2.5000	39.14	1.85	38.15	1.91
2.5100	39.12	1.87	38.06	1.94
2.5200	39.11	1.88	38.11	1.95
2.5300	39.10	1.89	37.96	1.92
2.5400	39.09	1.90	37.83	1.95
2.5500	39.07	1.91	37.92	1.98

FLUID DIELECTRIC PARAMETERS							
Date:	19 Sep 2022	Fluid Temp:	24.2	Frequency:	2450MHz	Tissue:	Head
Freq (MHz)		Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
2350.0000		36.5000	1.7000	39.3800	1.71	-7.31%	-0.58%
2360.0000		36.4900	1.6800	39.3600	1.72	-7.29%	-2.33%
2370.0000		36.6500	1.6800	39.3400	1.73	-6.84%	-2.89%
2380.0000		36.4700	1.6800	39.3200	1.74	-7.25%	-3.45%
2390.0000		36.3400	1.6900	39.3100	1.75	-7.56%	-3.43%
2400.0000		36.5000	1.7000	39.2900	1.76	-7.10%	-3.41%
2410.0000		36.2700	1.6900	39.2700	1.76	-7.64%	-3.98%
2420.0000		36.2300	1.7300	39.2500	1.77	-7.69%	-2.26%
2430.0000		36.3000	1.7600	39.2400	1.78	-7.49%	-1.12%
2437.0000	*	36.3000	1.7530	39.2260	1.79	-7.46%	-1.90%
2440.0000		36.3000	1.7500	39.2200	1.79	-7.45%	-2.23%
2450.0000		36.1000	1.7600	39.2000	1.80	-7.91%	-2.22%
2460.0000		36.0800	1.8000	39.1900	1.81	-7.94%	-0.55%
2470.0000		36.2400	1.8100	39.1700	1.82	-7.48%	-0.55%
2480.0000	*	35.9200	1.8300	39.1600	1.83	-8.27%	0.00%
2490.0000		36.0500	1.8300	39.1500	1.84	-7.92%	-0.54%
2500.0000		36.0000	1.8400	39.1400	1.85	-8.02%	-0.54%
2510.0000		35.9500	1.8500	39.1200	1.87	-8.10%	-1.07%
2520.0000		35.8800	1.8500	39.1100	1.88	-8.26%	-1.60%
2530.0000		35.8700	1.8700	39.1000	1.89	-8.26%	-1.06%
2540.0000		35.6300	1.8800	39.0900	1.90	-8.85%	-1.05%
2550.0000		35.6500	1.8900	39.0700	1.91	-8.75%	-1.05%

*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
19 Sep 2022		2450	D2450V2		825
Fluid Type	Fluid Temp °C	Ambient Temp °C	Ambient Humidity (%)	Forward Power (mW)	Source Spacing (mm)
Head	24.2	22	34%	250	10
Fluid Parameters					
Permittivity			Conductivity		
Measured	Target	Deviation	Measured	Target	Deviation
36.10	39.20	-7.91%	1.76	1.80	-2.22%
Measured SAR					
1 gram			10 gram		
Measured	Target	Deviation	Measured	Target	Deviation
13.80	13.18	4.70%	6.25	6.01	4.08%
Measured SAR Normalized to 1.0W					
1 gram			10 gram		
Normalized	Target	Deviation	Normalized	Target	Deviation
55.20	52.72	4.71%	25.00	24.02	4.10%

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 IEEE 1528-2013, FCC KDB 846224, IEC 62209-1 and IEC 62209-1528.

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

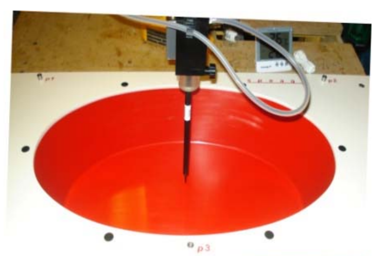
Table 18.1

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, glycol)	
Calibration:	In air from 10 MHz to 2.5 GHz In head simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy ± 8%)	
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)	
Directivity:	± 0.2 dB in head tissue (rotation around probe axis) ± 0.4 dB in head tissue (rotation normal to probe axis)	
Dynamic Range:	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB	
Surface Detect:	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces	
Dimensions:	Overall length: 330 mm; Tip length: 16 mm; Body diameter: 12 mm; Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm	
Application:	General dosimetry up to 3 GHz; Compliance tests of mobile phone	**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, IEC 62209-1 and IEC 62209-2.	 **ELI 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^{O}. 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
-CLA 30 Validation Dipole	00300	1005	18-Mar-20	18-Mar-23
-CLA150 Validation Dipole	00251	4007	18-Mar-20	18-Mar-23
-D450V3 Validation Dipole	00221	1068	27-Apr-21	27-Apr-24
-D835V2 Validation Dipole	00217	4D075	27-Apr-21	27-Apr-24
-D900V2 Validation Dipole	00020	54	16-Mar-20	16-Mar-23
ALS-D-01640-S-2	00299	207-00102	15-Dec-20	15-Dec-23
-D1800V2 Validation Dipole	00222	247	16-Mar-20	16-Mar-23
-D1900V2 Validation Dipole	00218	5d107	16-Mar-20	16-Mar-23
-D2450V2 Validation Dipole	00219	825	24-Apr-21	24-Apr-24
-D5GHzV2 Validation Dipole	00126	1031	27-Apr-21	27-Apr-24
ELI Phantom	00247	1234	CNR	CNR
SAM Phantom	00154	1033	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	6-Aug-22
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

Table 20.0

Tissue Simulating Liquid (TSL) Composition				
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) **H**ydroxy**E**thyl-**C**ellulose: Sigma-Aldrich P/N 54290-500g
(3) Dow Chemical Dowicil 75 Antimicrobial Perservative

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 1G target = 52.719 2 2

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.76 S/m; ε_r = 36.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

Date/Time: 9/19/2022 11:39:45 AM

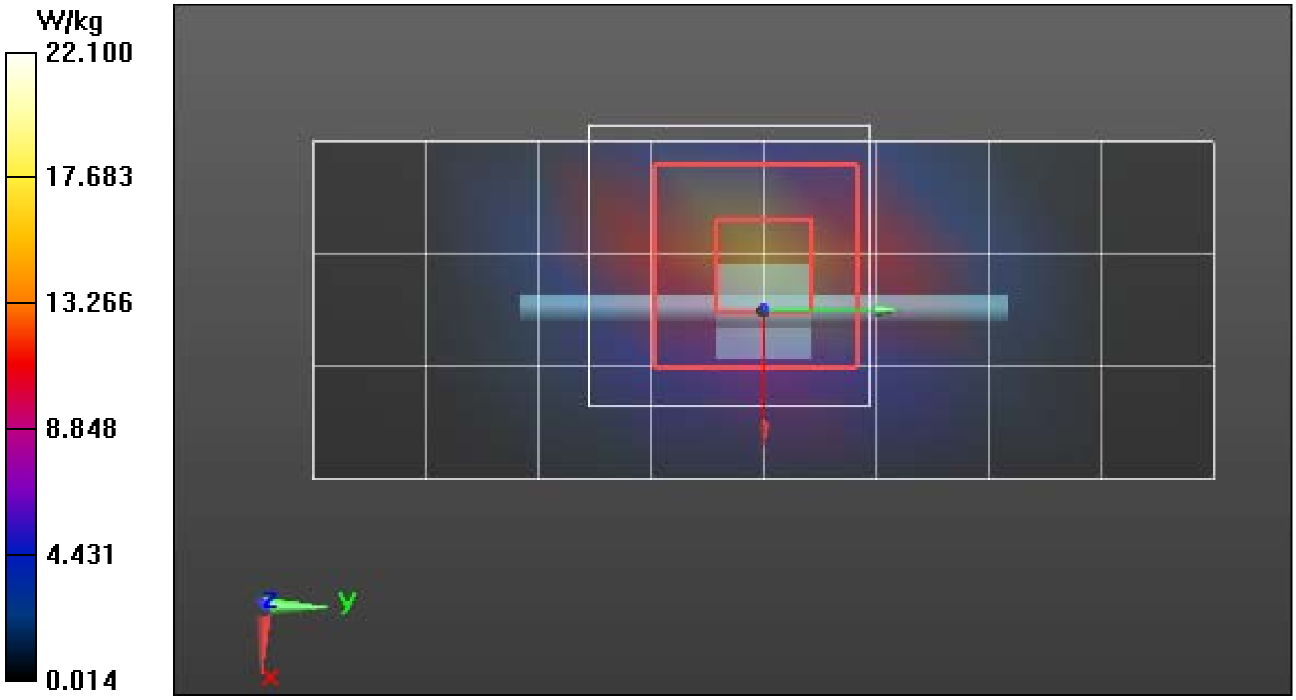
DASY5 Configuration:

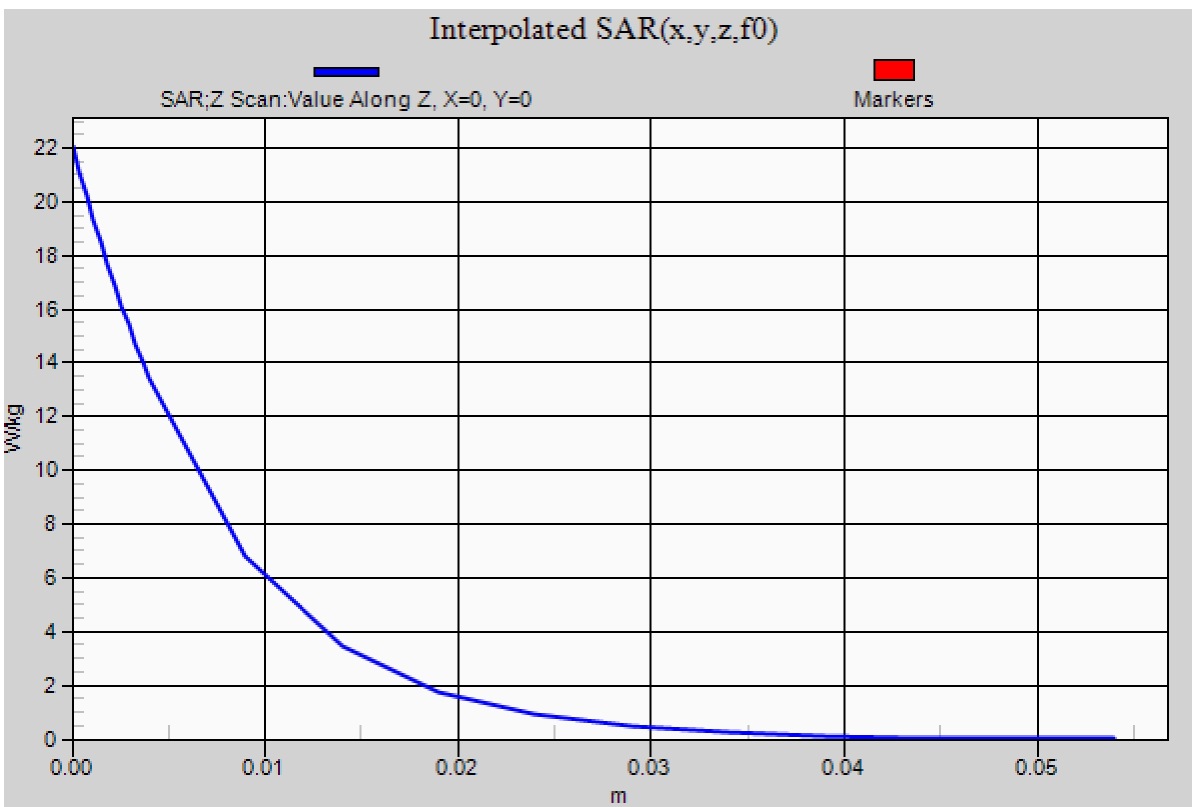
- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2450 MHz; Calibrated: 4/20/2022
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 4/14/2022
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18][14.50]W/kg 1G target = 52.719 2 2/Area Scan (4x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 15.7 W/kg

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18][14.50]W/kg 1G target = 52.719 2 2/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.36 V/m; Power Drift = 0.25 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.25 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 48.7%
Maximum value of SAR (measured) = 15.7 W/kg

SPC/SPC 2450H_Input=250mw, Target=[11.86]13.18][14.50]W/kg 1G target = 52.719 2 2/Z Scan (1x1x22): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Penetration depth = 7.344 (7.325, 7.436) [mm]
Maximum value of SAR (interpolated) = 22.1 W/kg


W/kg
22.100
17.683
13.266
8.848
4.431
0.014
z
y
x


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
22
20
18
16
14
12
10
8
6
4
2
0
0.00
0.01
0.02
0.03
0.04
0.05
m

APPENDIX B – MEASUREMENT PLOTS OF MAXIMUMUM MEASURED SAR

Plot E55

DUT: A04578 - SN 3425573111; Type: Body Worn Transmitter; Serial: Sample Prototype
Procedure Name: E55-A04578,Body-Back Side, 2437 MHz,5.5 bits B1- Silcone Band-WIFI 2

Communication System: UID 0, CW (0); Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.753 S/m; ε_r = 36.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

Date/Time: 9/20/2022 3:59:08 PM

DASY5 Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2437 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: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

2450H/E55-A04578,Body-Back Side, 2437 MHz,5.5 bits B1- Silcone Band-WIFI 2/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm

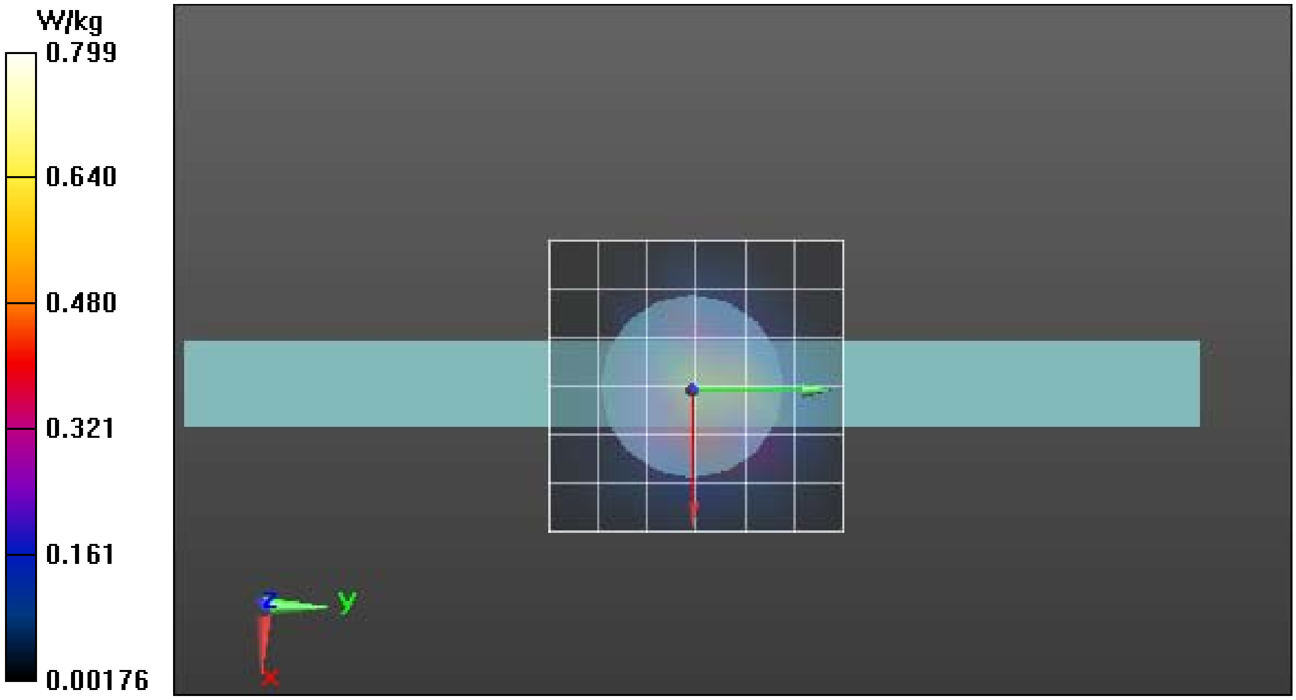
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.563 W/kg

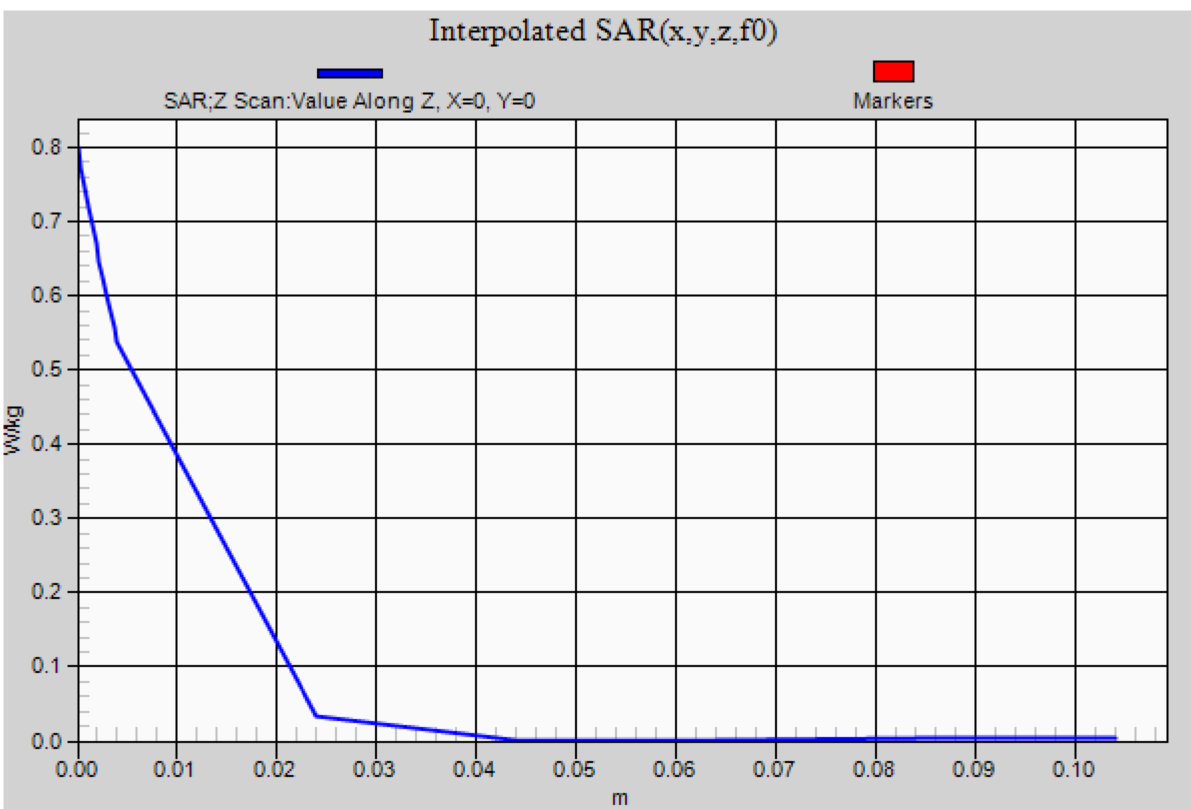
2450H/E55-A04578,Body-Back Side, 2437 MHz,5.5 bits B1- Silcone Band-WIFI 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.82 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 1.04 W/kg
SAR(1 g) = 0.505 W/kg; SAR(10 g) = 0.243 W/kg
Smallest distance from peaks to all points 3 dB below = 12 mm
Ratio of SAR at M2 to SAR at M1 = 48.4%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.562 W/kg

2450H/E55-A04578,Body-Back Side, 2437 MHz,5.5 bits B1- Silcone Band-WIFI 2/Z Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=20mm

Info: Interpolated medium parameters used for SAR evaluation.
Penetration depth = n/a (n/a, 7.290) [mm]
Maximum value of SAR (interpolated) = 0.799 W/kg


W/kg
0.799
0.640
0.480
0.321
0.161
0.00176
z
y
x


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

Plot E60

DUT: A04578 - SN 3425573111; Type: Body Worn Transmitter; Serial: Sample Prototype
Procedure Name: E60-A04578,Body-Touch Back Side, 2480MHz, 2 bits Silicone Band-BT-EDR2

Communication System: UID 0, CW (0); Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.753 S/m; ε_r = 36.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

Date/Time: 9/20/2022 7:08:35 PM

DASY5 Configuration:

- Probe: EX3DV4 - SN3600; ConvF(6.58, 6.58, 6.58) @ 2437 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: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1234
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

2450H/E60-A04578,Body-Touch Back Side, 2480MHz, 2 bits Silicone Band-BT-EDR2/Area Scan (7x7x1): Measurement grid: dx=12mm, dy=12mm

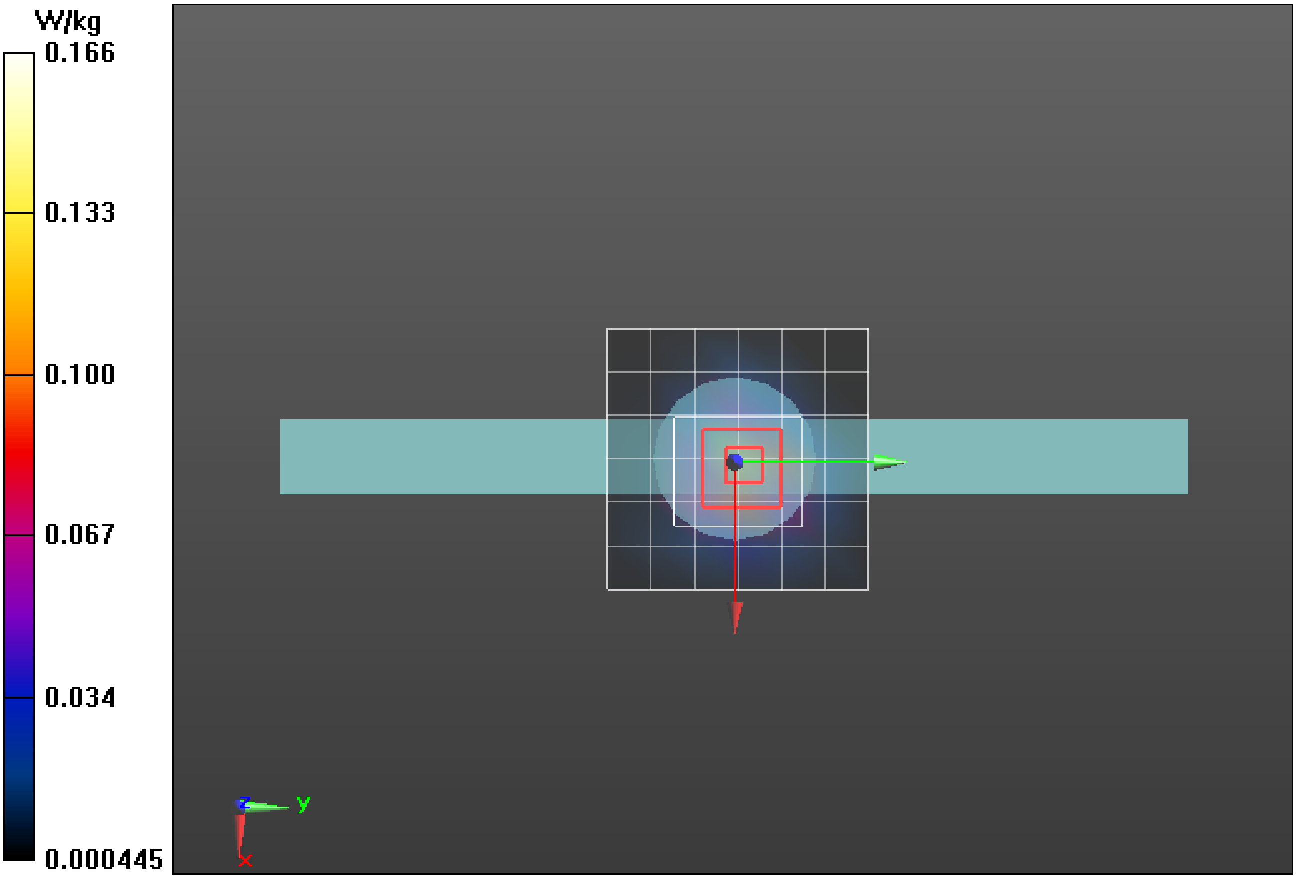
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.115 W/kg

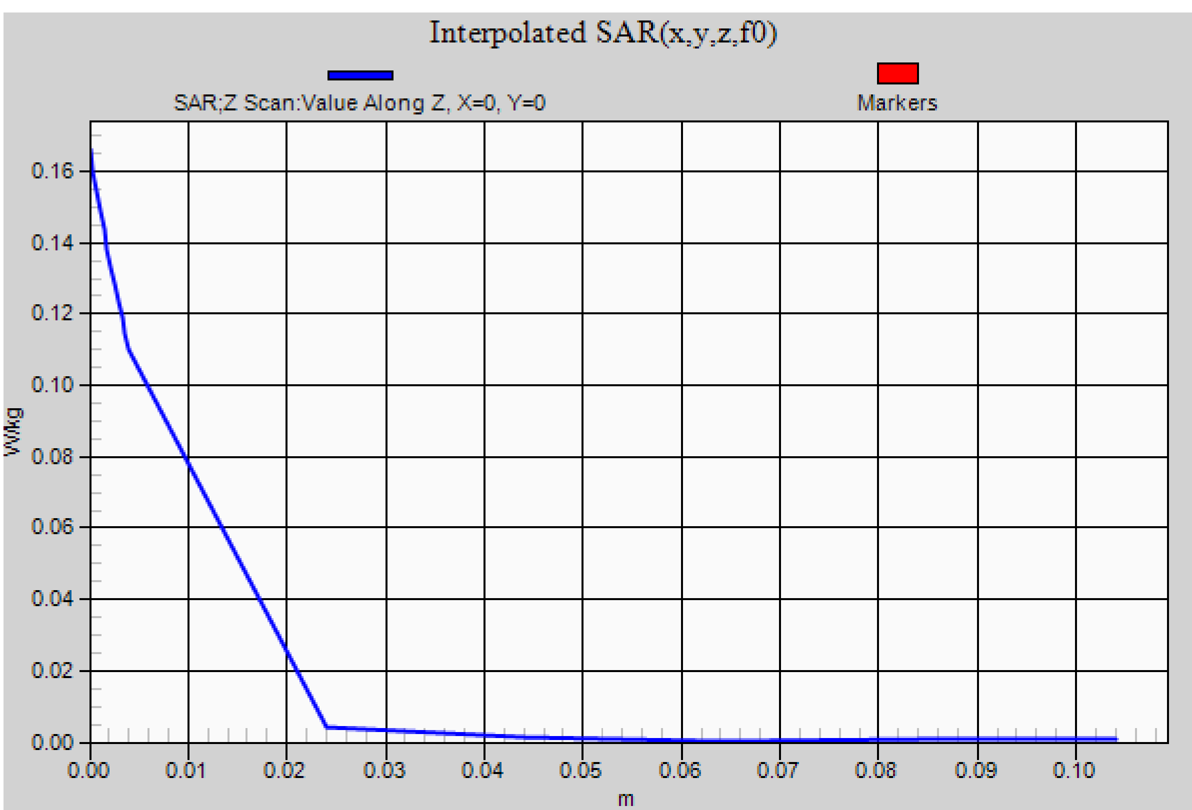
2450H/E60-A04578,Body-Touch Back Side, 2480MHz, 2 bits Silicone Band-BT-EDR2/Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.875 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.203 W/kg
SAR(1 g) = 0.097 W/kg; SAR(10 g) = 0.046 W/kg
Smallest distance from peaks to all points 3 dB below = 9.9 mm
Ratio of SAR at M2 to SAR at M1 = 50.4%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.108 W/kg

2450H/E60-A04578,Body-Touch Back Side, 2480MHz, 2 bits Silicone Band-BT-EDR2/Z Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=20mm

Info: Interpolated medium parameters used for SAR evaluation.
Penetration depth = n/a (n/a, 6.181) [mm]
Maximum value of SAR (interpolated) = 0.166 W/kg


W/kg
0.166
0.133
0.100
0.067
0.034
0.000445
z
y
x


Interpolated SAR(x,y,z,f0)
SAR;Z Scan:Value Along Z, X=0, Y=0
Markers
W/kg
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

APPENDIX D – PROBE CALIBRATION

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

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	Leif Klysner
Approved by:	Sven Kühn	Deputy Manager	S. K

Issued: April 20, 2022

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
S **Servizio svizzero di taratura**
Swiss Calibration Service

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**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 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:

a) 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.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 ≤ 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 *NORMx,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 *NORMx* (no uncertainty required).

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[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$\sqrt{\mu V}$	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 E^2-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

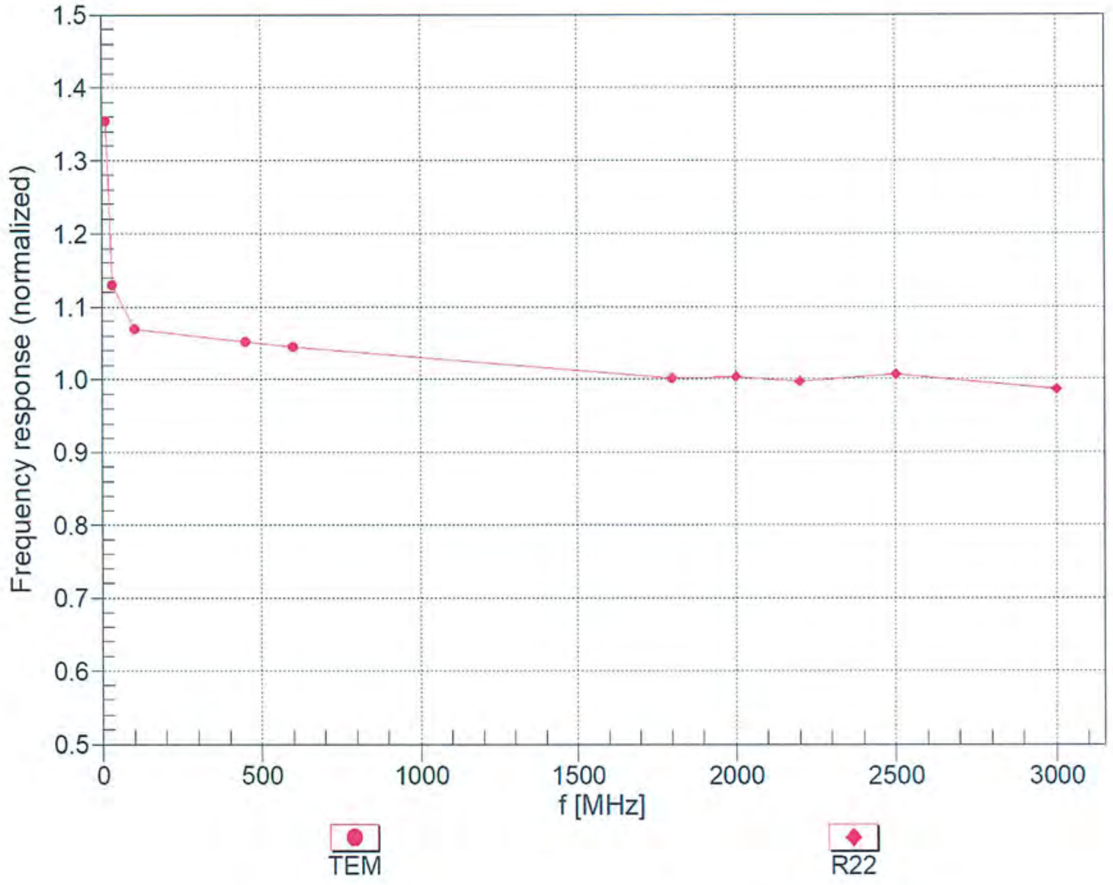
Calibration Parameter Determined in Head Tissue Simulating Media

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

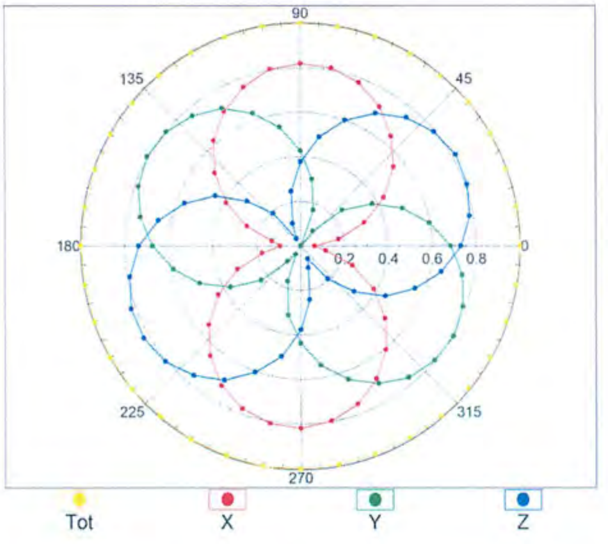
(TEM-Cell:ifi110 EXX, Waveguide: R22)



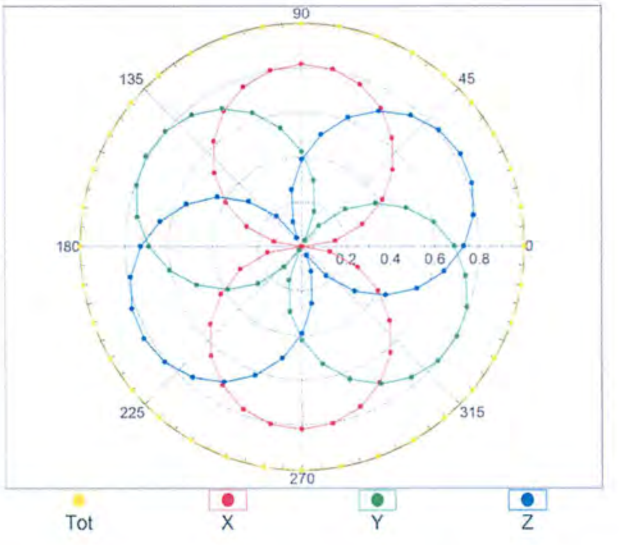
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

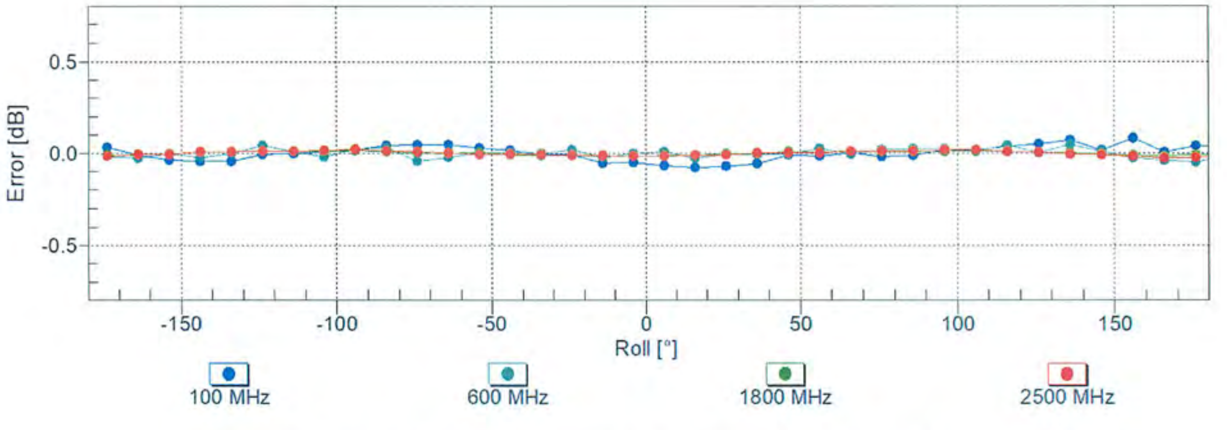
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



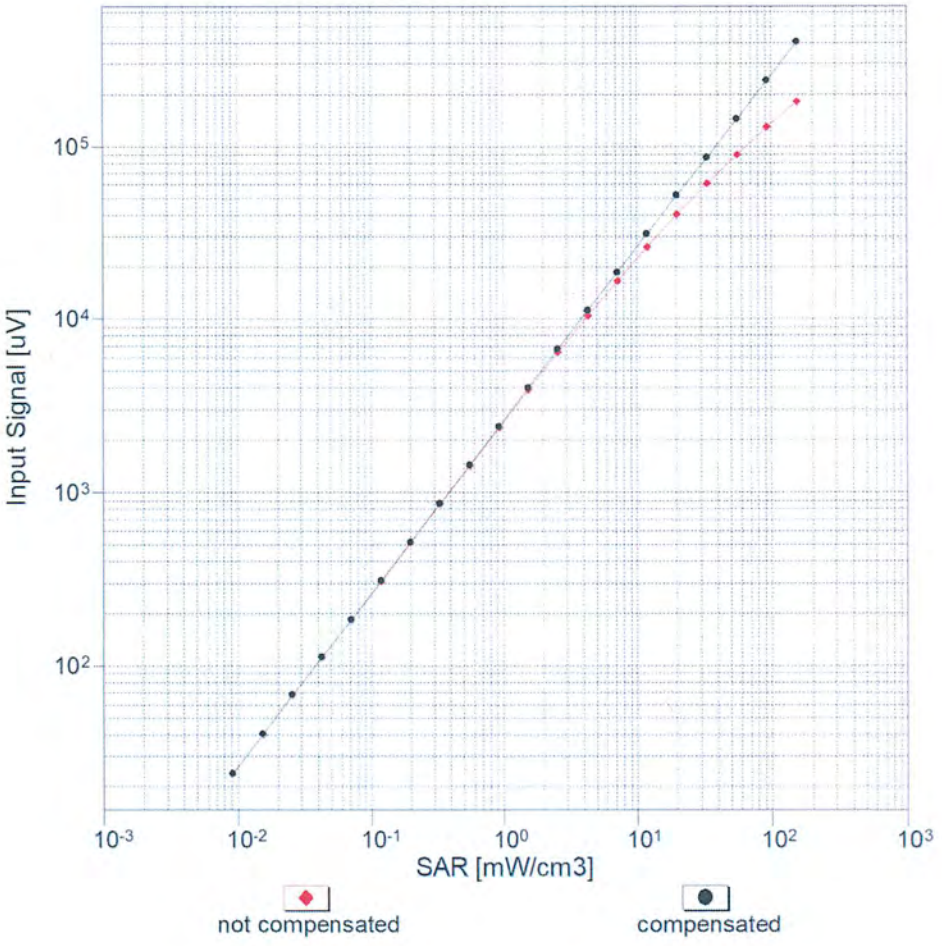
f=1800 MHz,R22

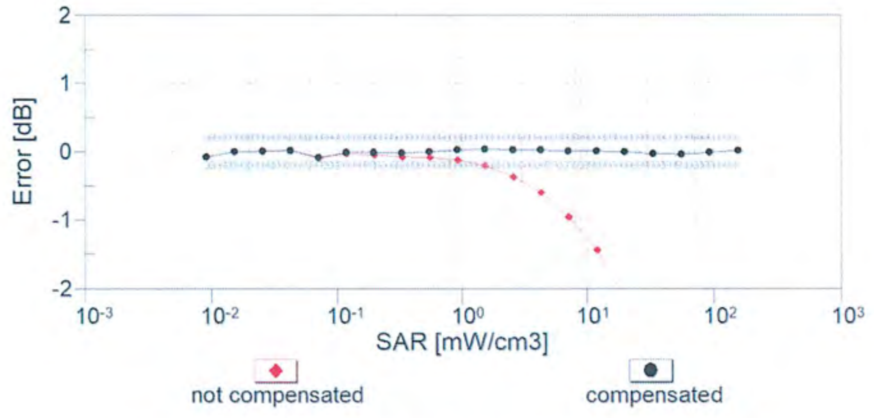




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

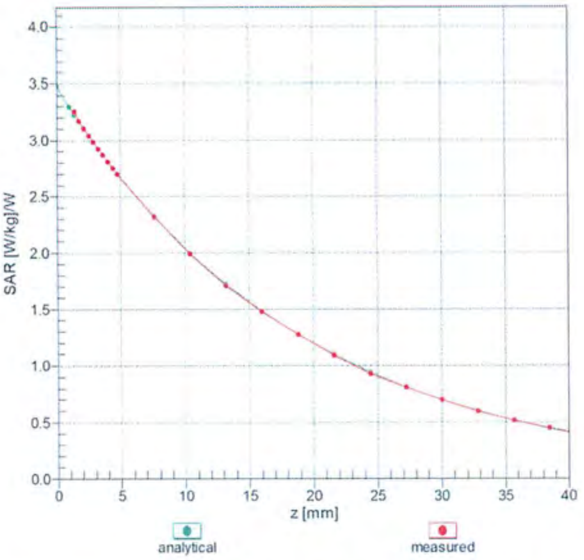
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

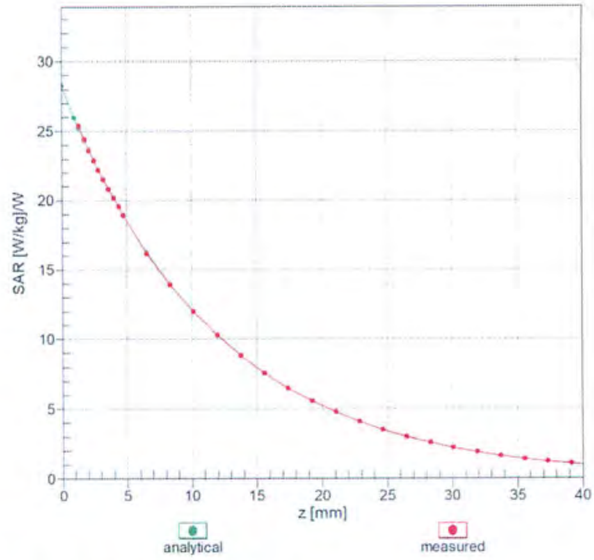




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

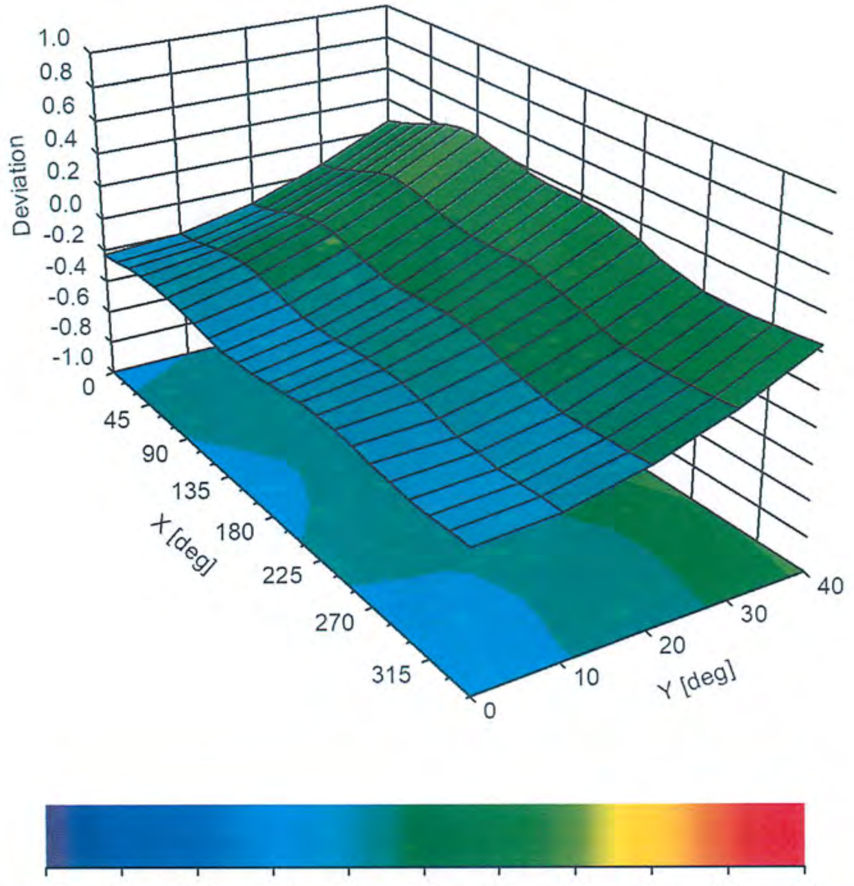
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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, εr	Conductivity, σ [S/m]
Head	2450 MHz	40.73	1.86

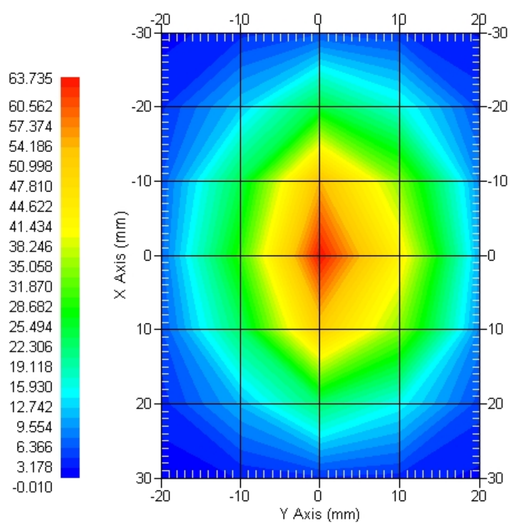
Electrical Specification

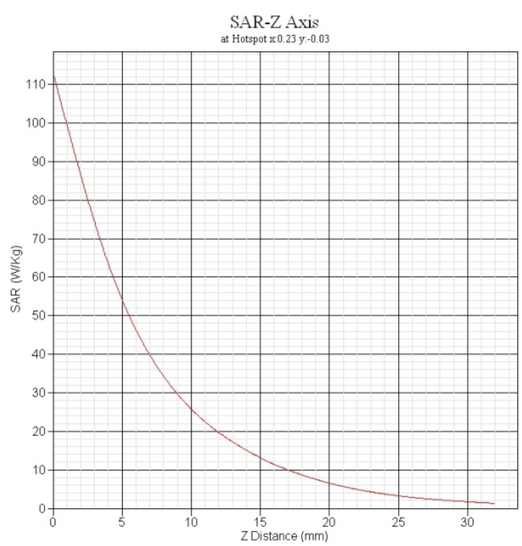
Tissue	Frequency	Return Loss	Impedance	SWR:
Head	2450 MHz	-19.83 dB	43.26 Ω	1.23U

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

- 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
- 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
- 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)
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- 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.

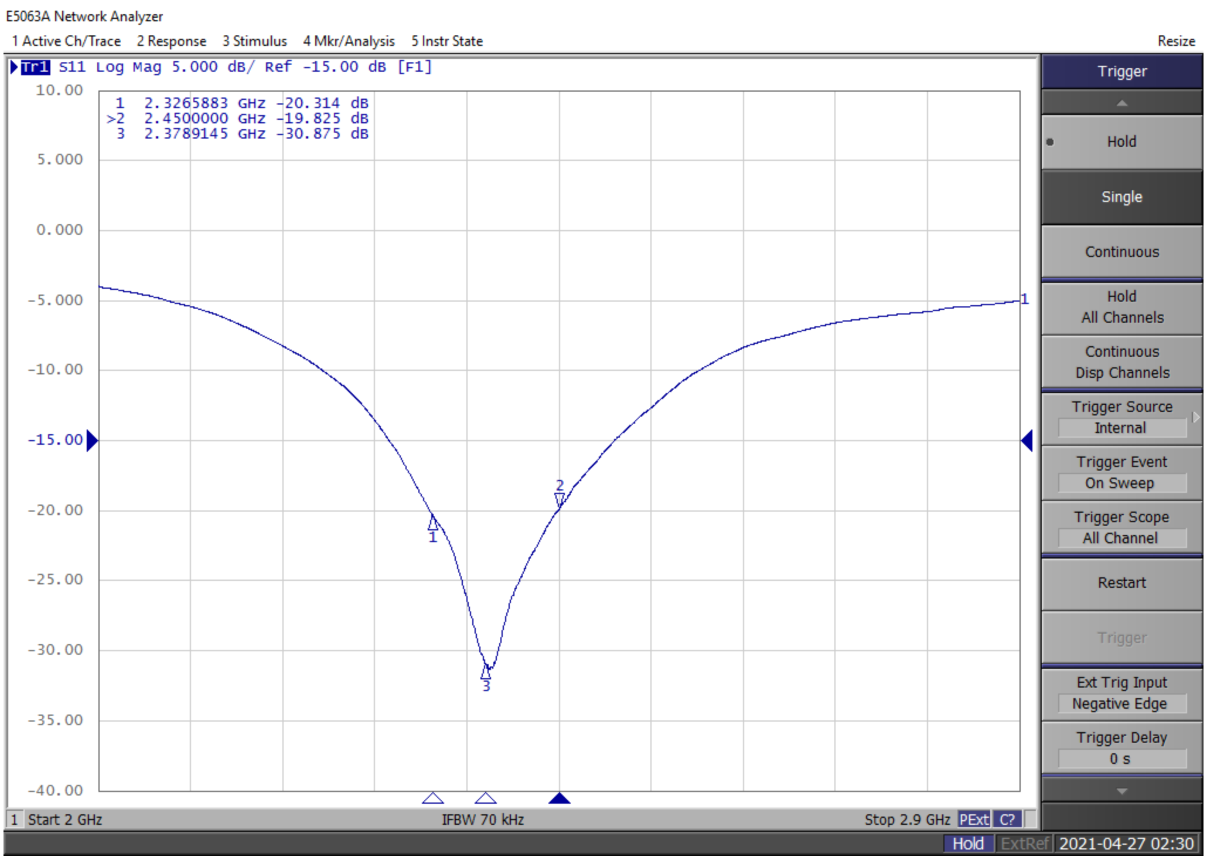
Electrical Calibration

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

S11 Parameter Return Loss

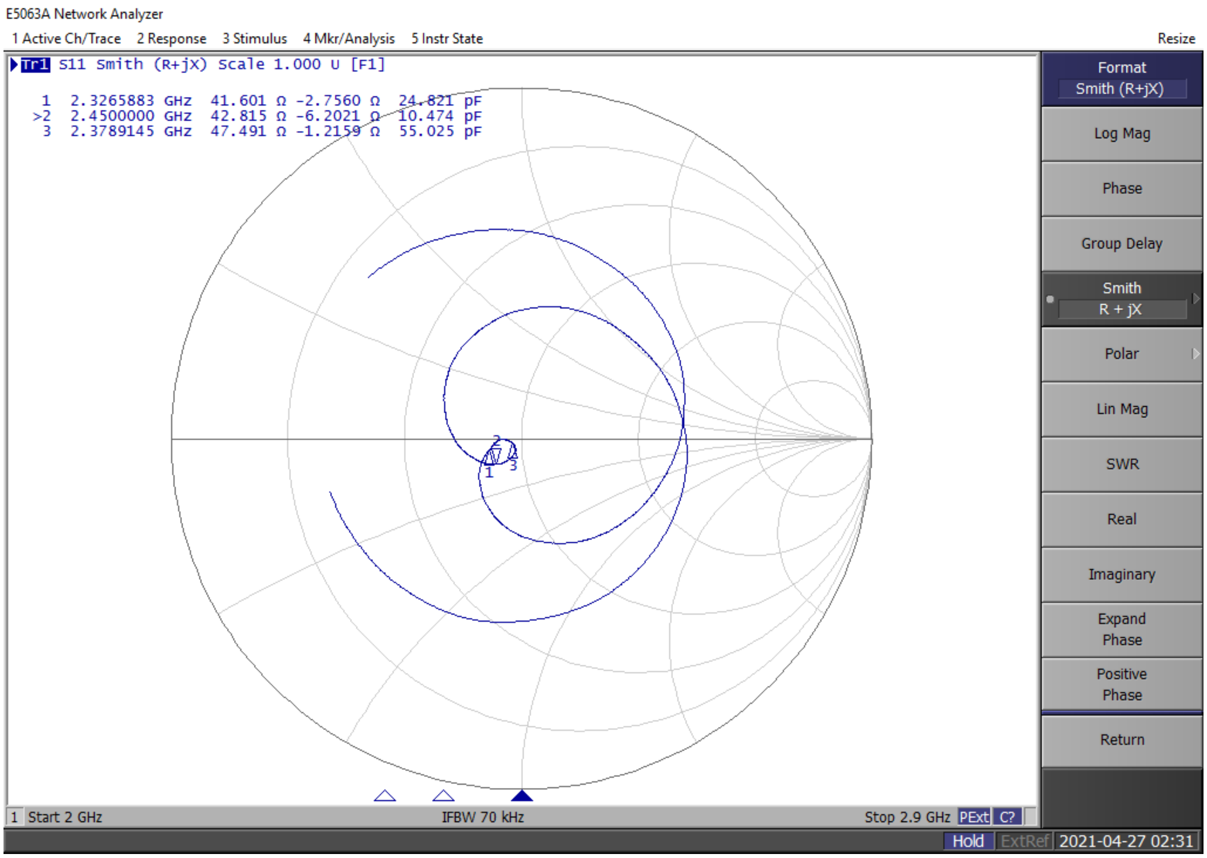
Head

Frequency Range 2326.59 MHz to 2450 MHz



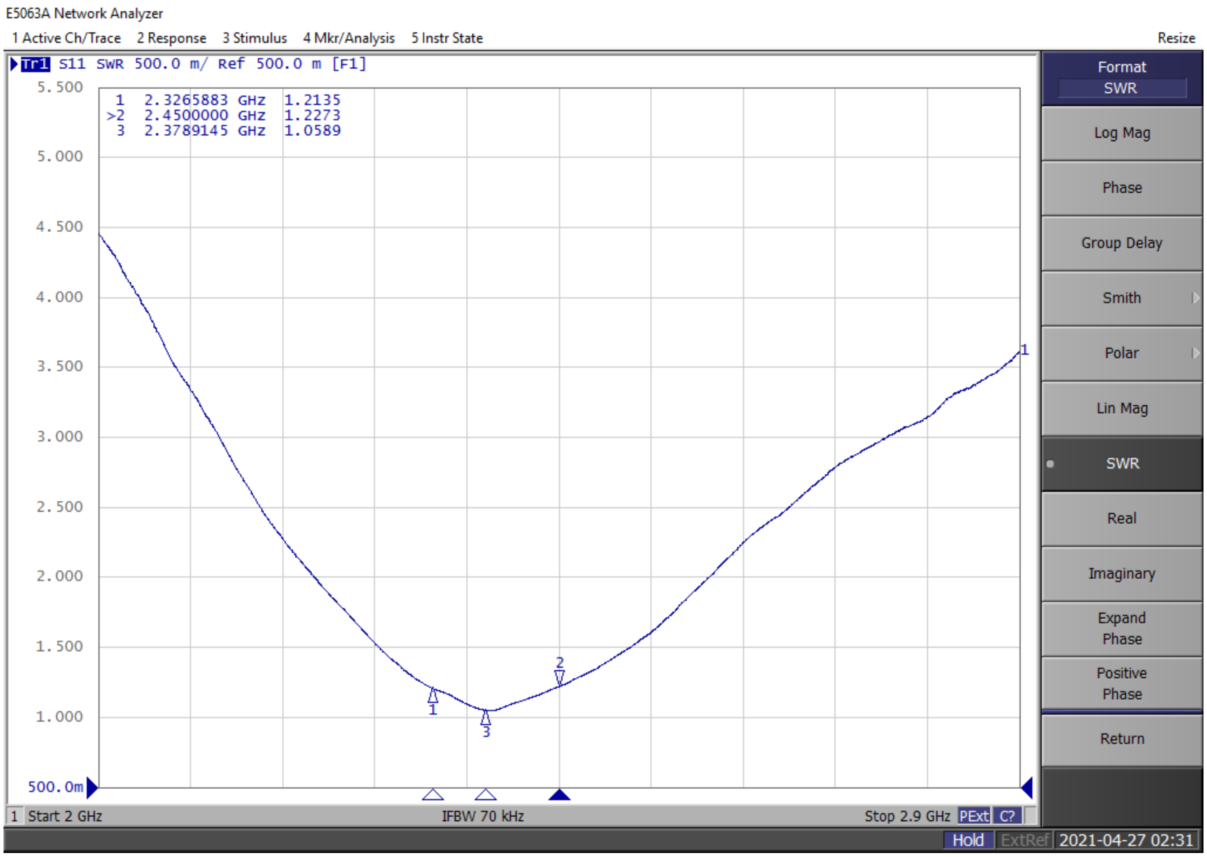
Smith Chart Dipole Impedance

Head



SWR

Head



This page has been reviewed for content and attested to on Page 2 of this document.

APPENDIX F - PHANTOM

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Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 5.0
Type No	QD OVA 002 A
Series No	1108 and higher
Manufacturer	Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland

Tests
Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

Test	Requirement	Details	Units tested
Shape	Internal dimensions, depth and sagging are compatible with standards	Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for f > 375 MHz	Prototypes
Material thickness	Bottom: 2.0mm +/- 0.2mm	dimension compliant with [3] for f > 800 MHz	all
Material parameters	rel. permittivity 2 – 5, loss tangent ≤ 0.05, at f ≤ 6 GHz	rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05	Material samples
Material resistivity	Compatibility with tissue simulating liquids .	Compatible with SPEAG liquids. **	Phantoms, Material sample
Sagging	Sagging of the flat section in tolerance when filled with tissue simulating liquid.	within tolerance for filling height up to 155 mm	Prototypes, samples

** Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100. Observe technical note on material compatibility.

Standards

[1] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
[2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
[3] IEC 62209–1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 2005-02-18
[4] IEC 62209–2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", 2010-03-30

Conformity
Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of **body-worn** SAR measurements and system performance checks as specified in [1 – 4] and further standards.

Date 25.7.2011

Signature / Stamp

s p e a g
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