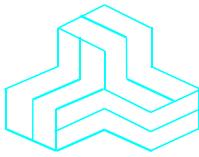


# ENGINEERING TEST REPORT



**myHABITAT Senses**  
**Model: MHS271828**  
**FCC ID: 2A4B5-MHS271828**

*Applicant:*

**LM Systems Corporation**  
206 Krieghoff Ave  
Unionville, ON L3R 1W5  
Canada

*In Accordance With*

**Federal Communications Commission (FCC)**  
**Part 15, Subpart C, Section 15.247**  
**Digital Modulation Systems (DTS) Operating in 2400 – 2483.5 MHz Band**

**UltraTech's File No.: 22LMS003\_FCC15C247**

This Test report is Issued under the Authority of  
Tri M. Luu  
Vice President of Engineering  
UltraTech Group of Labs

Date: February 16, 2022

Report Prepared by: Dan Huynh

Tested by: Nimisha Desai

Issued Date: February 16, 2022

Test Dates:  
February 3, 4 & 11, 2022

- The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
- This report must not be used by the client to claim product endorsement by any agency of the US Government.
- This test report shall not be reproduced, except in full, without a written approval from UltraTech

## UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4  
Tel.: (905) 829-1570 Fax.: (905) 829-8050  
Website: [www.ultratech-labs.com](http://www.ultratech-labs.com), Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Email: [tri@ultratech-labs.com](mailto:tri@ultratech-labs.com)



#0685  
ISO/IEC 17065  
Product Certification Body



APEC TEL CA0001



1309



CA0001-2049



AT-1945



SL2-IN-E-1119R



Korea KCC-RRA  
CA0001

## TABLE OF CONTENTS

<b>EXHIBIT 1. INTRODUCTION.....</b>	<b>1</b>
1.1. SCOPE .....	1
1.2. RELATED SUBMITTAL(S)/GRANT(S) .....	1
1.3. NORMATIVE REFERENCES .....	1
<b>EXHIBIT 2. PERFORMANCE ASSESSMENT .....</b>	<b>2</b>
2.1. CLIENT INFORMATION .....	2
2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION .....	2
2.3. EUT'S TECHNICAL SPECIFICATIONS.....	3
2.4. ASSOCIATED ANTENNA DESCRIPTIONS .....	3
2.5. LIST OF EUT'S PORTS.....	3
2.6. ANCILLARY EQUIPMENT.....	3
<b>EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS .....</b>	<b>4</b>
3.1. CLIMATE TEST CONDITIONS .....	4
3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS.....	4
<b>EXHIBIT 4. SUMMARY OF TEST RESULTS.....</b>	<b>5</b>
4.1. LOCATION OF TESTS .....	5
4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS .....	5
4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES .....	5
<b>EXHIBIT 5. TEST DATA.....</b>	<b>6</b>
5.1. OCCUPIED BANDWIDTH [§ 15.247(a)(2)].....	6
5.2. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)] .....	9
5.3. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205] .....	14
5.4. POWER SPECTRAL DENSITY [§ 15.247(e)].....	24
5.5. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091].....	27
<b>EXHIBIT 6. TEST EQUIPMENT LIST.....</b>	<b>29</b>
<b>EXHIBIT 7. MEASUREMENT UNCERTAINTY .....</b>	<b>30</b>

## EXHIBIT 1. INTRODUCTION

### 1.1. SCOPE

<b>Reference:</b>	FCC Part 15, Subpart C, Section 15.247
<b>Title:</b>	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
<b>Purpose of Test:</b>	Equipment Certification for Digital Modulation Systems (DTS) Operating Under §15.247
<b>Test Procedures:</b>	<ul style="list-style-type: none"><li>▪ ANSI C63.4</li><li>▪ ANSI C63.10</li><li>▪ FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02</li></ul>
<b>Environmental Classification:</b>	<input checked="" type="checkbox"/> Commercial, industrial or business environment <input checked="" type="checkbox"/> Residential environment

### 1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

### 1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2021	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC, KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02	2019	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

## EXHIBIT 2. PERFORMANCE ASSESSMENT

### 2.1. CLIENT INFORMATION

Applicant	
<b>Name:</b>	LM Systems Corporation
<b>Address:</b>	206 Krieghoff Ave Unionville, ON L3R 1W5 Canada

Manufacturer	
<b>Name:</b>	LM Systems Corporation
<b>Address:</b>	206 Krieghoff Ave Unionville, ON L3R 1W5 Canada

### 2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

<b>Brand Name:</b>	LM Systems Corporation
<b>Product Name:</b>	myHABITAT Senses
<b>Model Name or Number:</b>	MHS271828
<b>Serial Number:</b>	Test Sample
<b>Type of Equipment:</b>	Digital Transmission System (DTS)
<b>Input Power Supply Type:</b>	Battery
<b>Primary User Functions of EUT:</b>	Provide periodic room temperature and relative humidity readings to user via Bluetooth Low Energy connection with cellphone.

---

#### ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: 22LMS003\_FCC15C247

February 16, 2022

### 2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
<b>Equipment Type:</b>	Mobile
<b>Intended Operating Environment:</b>	Commercial, industrial or business environment Residential environment
<b>Power Supply Requirement:</b>	1.5 V battery
<b>RF Output Power Rating:</b>	5.27 dBm, maximum peak conducted power
<b>Operating Frequency Range:</b>	2402 - 2480 MHz
<b>RF Output Impedance:</b>	50 Ω
<b>Duty Cycle:</b>	65.3 %
<b>Modulation Type:</b>	GFSK
<b>Antenna Connector Types:</b>	Integral

### 2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Antenna Type	Maximum Gain (dBi)
PCB meander	1.95

### 2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
None				

### 2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

None.

## EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

### 3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	1.5 V Battery

### 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

<b>Operating Modes:</b>	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
<b>Special Test Software:</b>	Test software (STM32CubeMonitor, Version 2.8.1) provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
<b>Special Hardware Used:</b>	HP 820G2 Laptop with STLINK-V3SET used to program the EUT for testing configurations.
<b>Transmitter Test Antenna:</b>	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment as described with the test results.

<b>Transmitter Test Signals</b>	
<b>Frequency Band(s):</b>	2402 - 2480 MHz
<b>Frequency(ies) Tested:</b>	2402 MHz, 2440 MHz, 2480 MHz
<b>RF Power Output:</b> (measured maximum output power at antenna terminals)	5.27 dBm Peak
<b>Normal Test Modulation:</b>	GFSK
<b>Modulating Signal Source:</b>	Internal

## EXHIBIT 4. SUMMARY OF TEST RESULTS

### 4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

### 4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes*
15.207(a)	AC Power Line Conducted Emissions	N/A
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

\* The EUT complies with the requirement; it employs a unique (non-standard) antenna connector or integral antenna.

### 4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

---

#### ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: 22LMS003\_FCC15C247

February 16, 2022

## EXHIBIT 5. TEST DATA

### 5.1. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

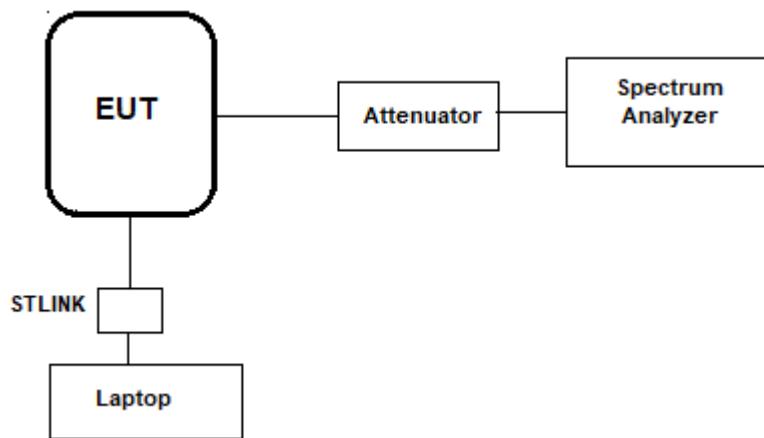
#### 5.1.1. Limit(s)

The minimum 6 dB bandwidth shall be at least 500 kHz.

#### 5.1.2. Method of Measurements

FCC KDB 558074 D01 15.247 Meas Guidance V05r02, Section 8.2, ANSI C63.10, 11.8.2 Option 2

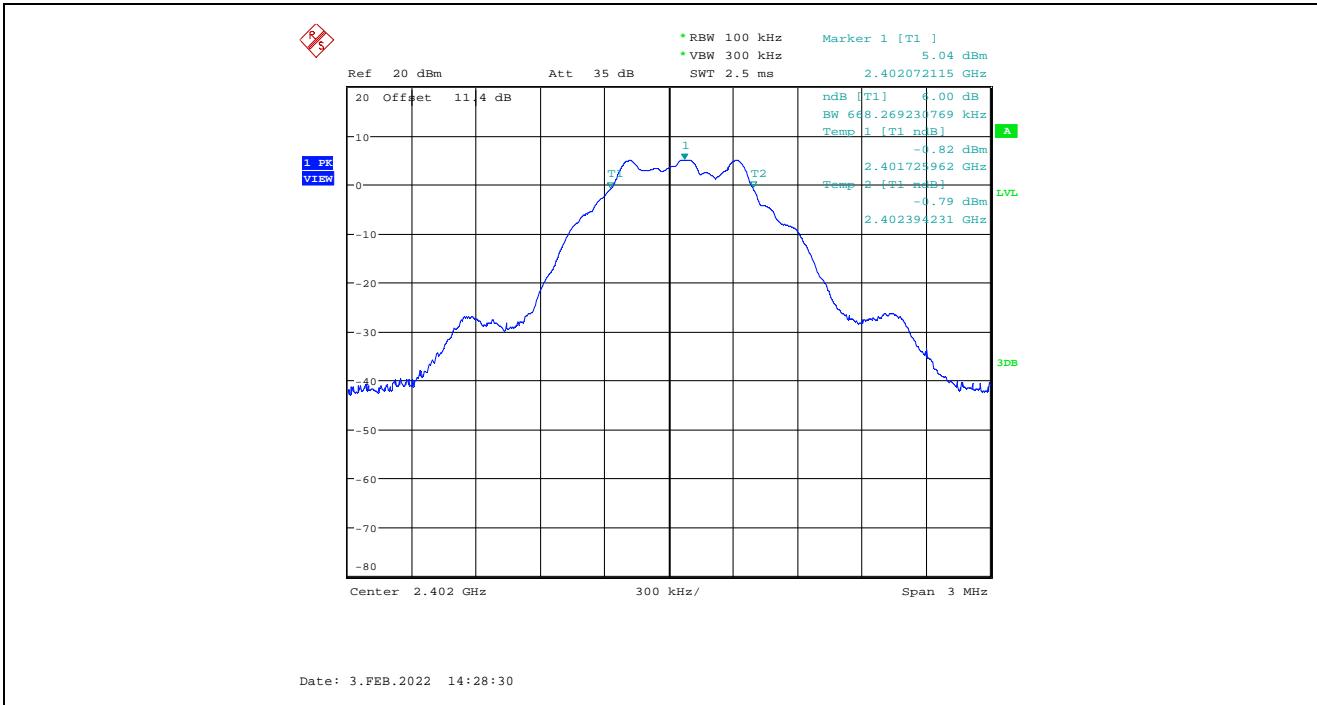
#### 5.1.3. Test Arrangement



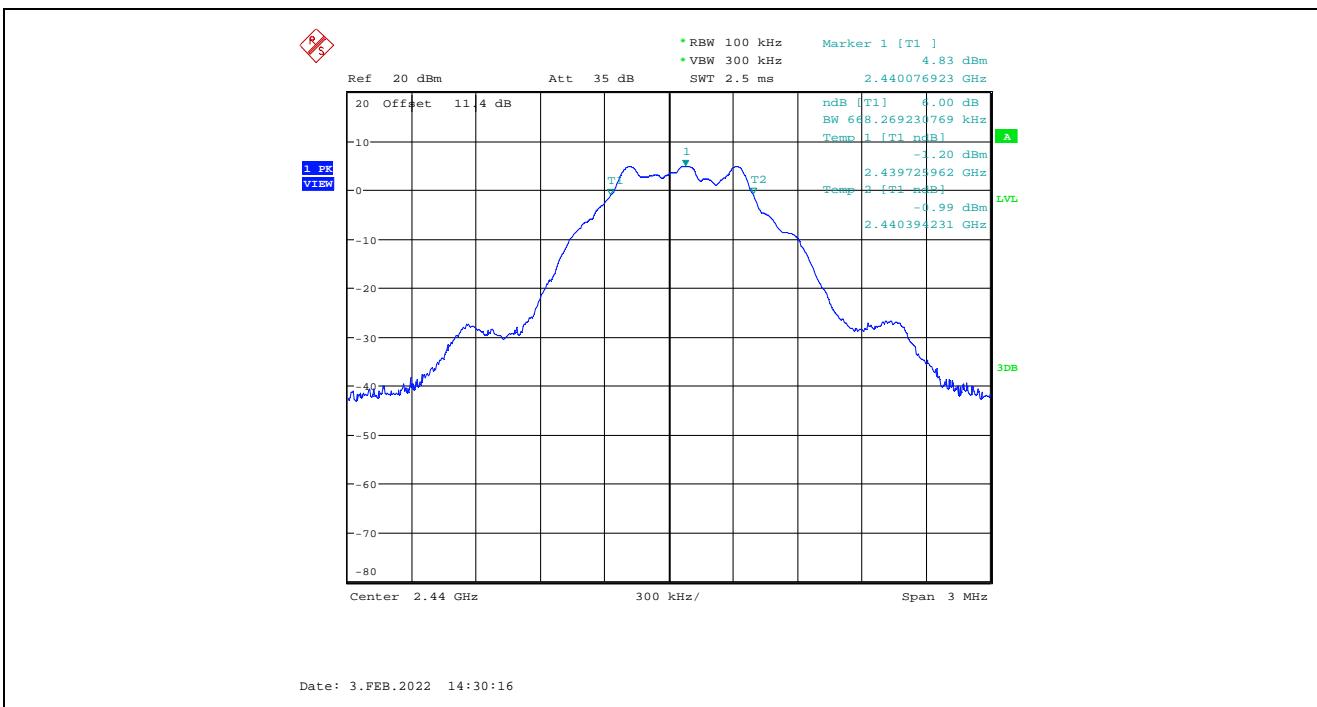
#### 5.1.4. Test Data

Modulation	Power Setting	Frequency (MHz)	6dB BW, 1Mbps (kHz)	Min. Limit (kHz)
GFSK	6 dBm	2402	668.269	500
		2440	668.269	500
		2480	668.269	500

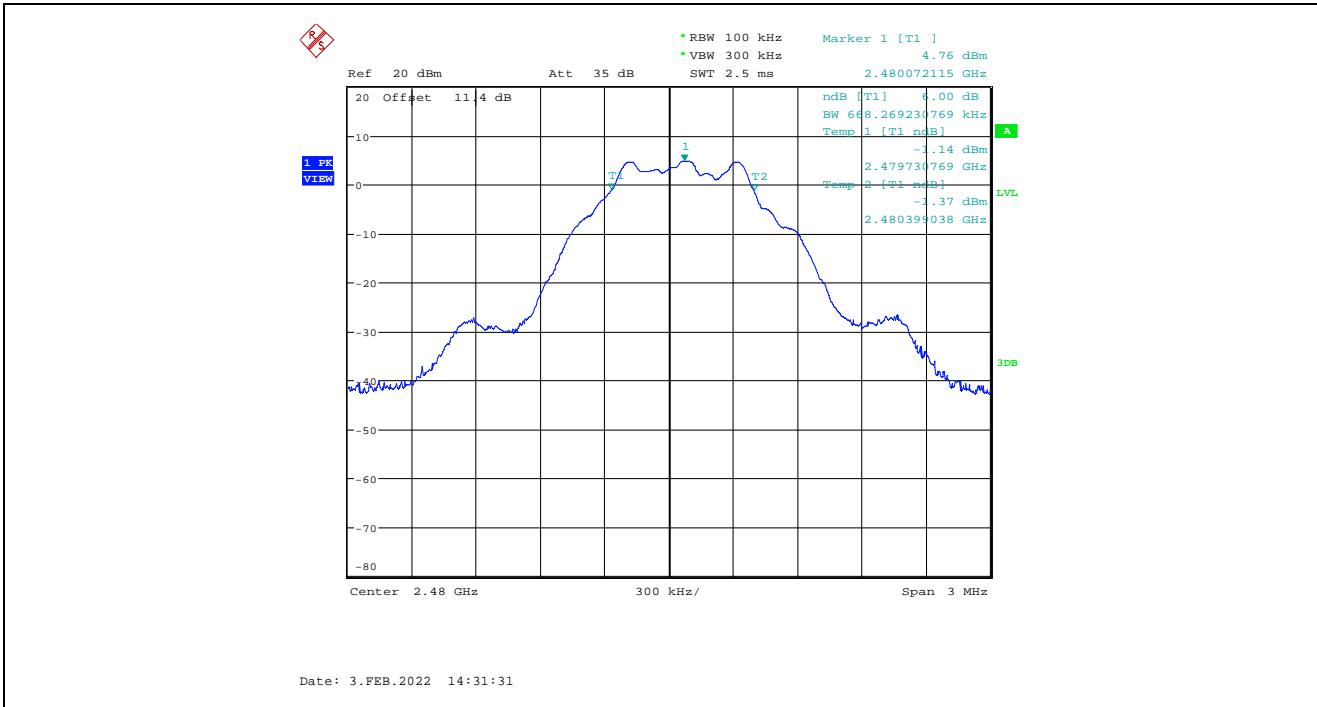
**Plot 5.1.4.1. 6 dB Bandwidth, GFSK Modulation, 6 dBm Power Setting, 2402 MHz, 1 Mbps**



**Plot 5.1.4.2. 6 dB Bandwidth, GFSK Modulation, 6 dBm Power Setting, 2440 MHz, 1 Mbps**



Plot 5.1.4.3. 6 dB Bandwidth, GFSK Modulation, 6 dBm Power Setting, 2480 MHz, 1 Mbps



## 5.2. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

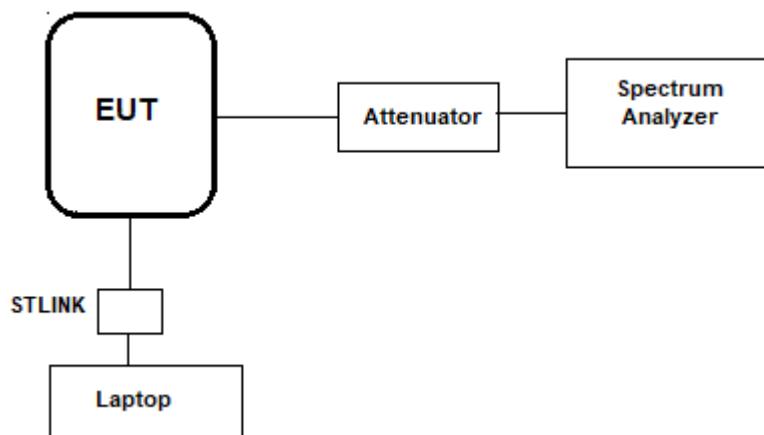
### 5.2.1. Limit(s)

**§ 15.247(b)(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. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

### 5.2.2. Method of Measurements & Test Arrangement

FCC KDB 558074 D01 15.247 Meas Guidance V05r02, Section 8.3.1.1

### 5.2.3. Test Arrangement

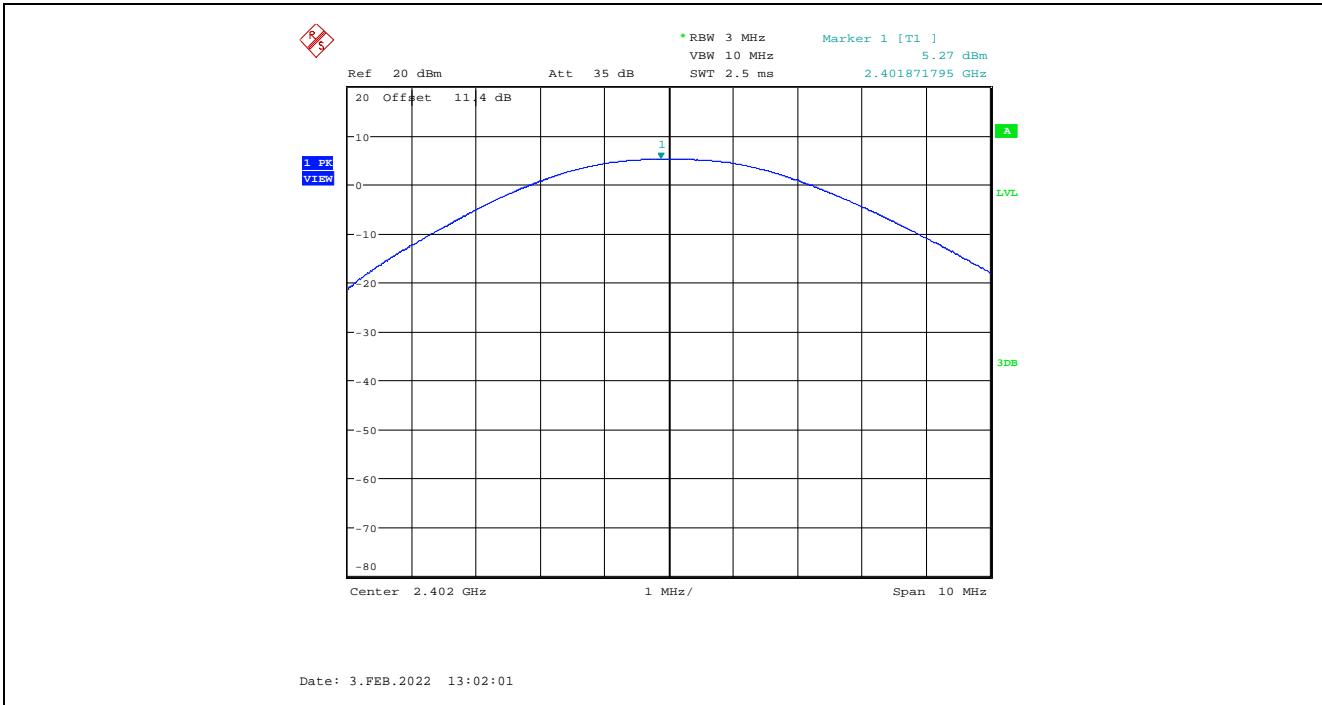


#### 5.2.4. Test Data

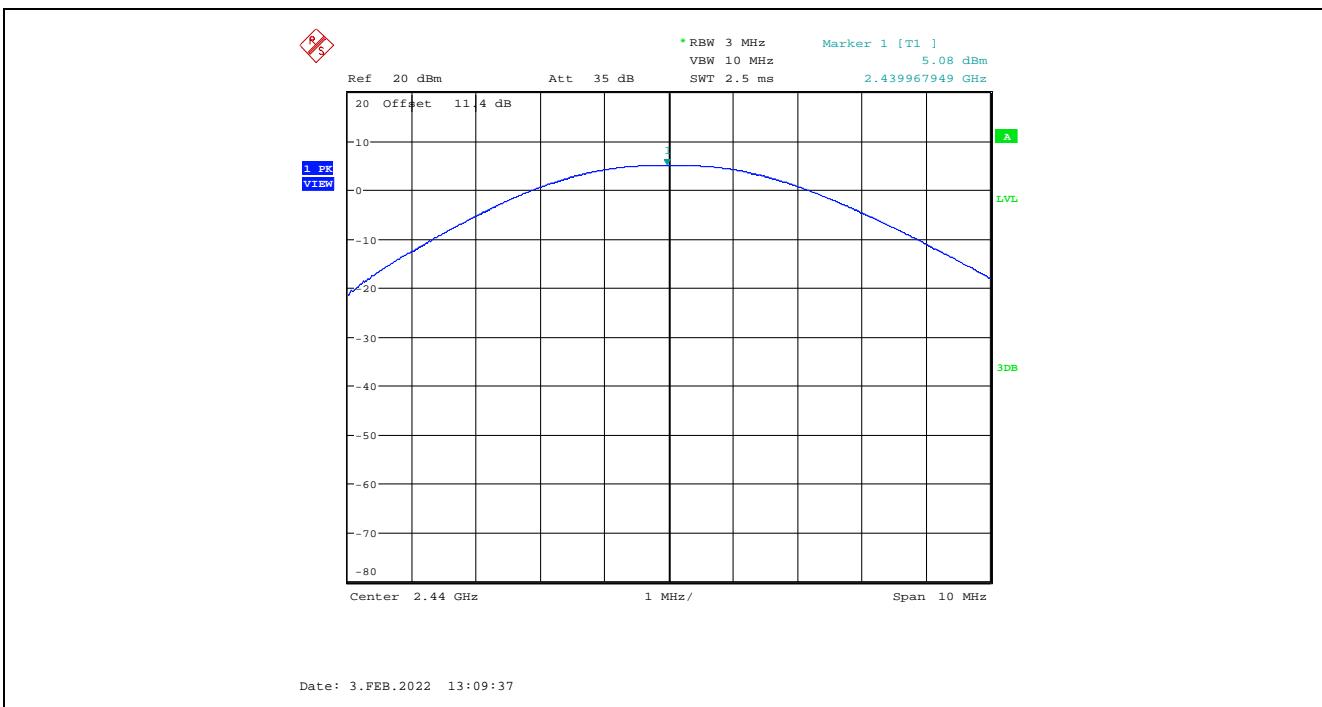
Modulation	Power Setting	Data Rate (Mbps)	Frequency (MHz)	Peak Power (dBm)	Maximum Antenna Gain (dBi)	EIRP (dBm)	Peak Power Limit (dBm)
GFSK	High Power (6 dBm)	1	2402	5.27	1.95	7.22	30
			2440	5.08	1.95	7.03	30
			2480	5.07	1.95	7.02	30
	Low Power (-0.15 dBm)	1	2402	-2.56	1.95	-0.61	30
			2440	-2.83	1.95	-0.88	30
			2480	-2.78	1.95	-0.83	30

See the following test data plots for detail.

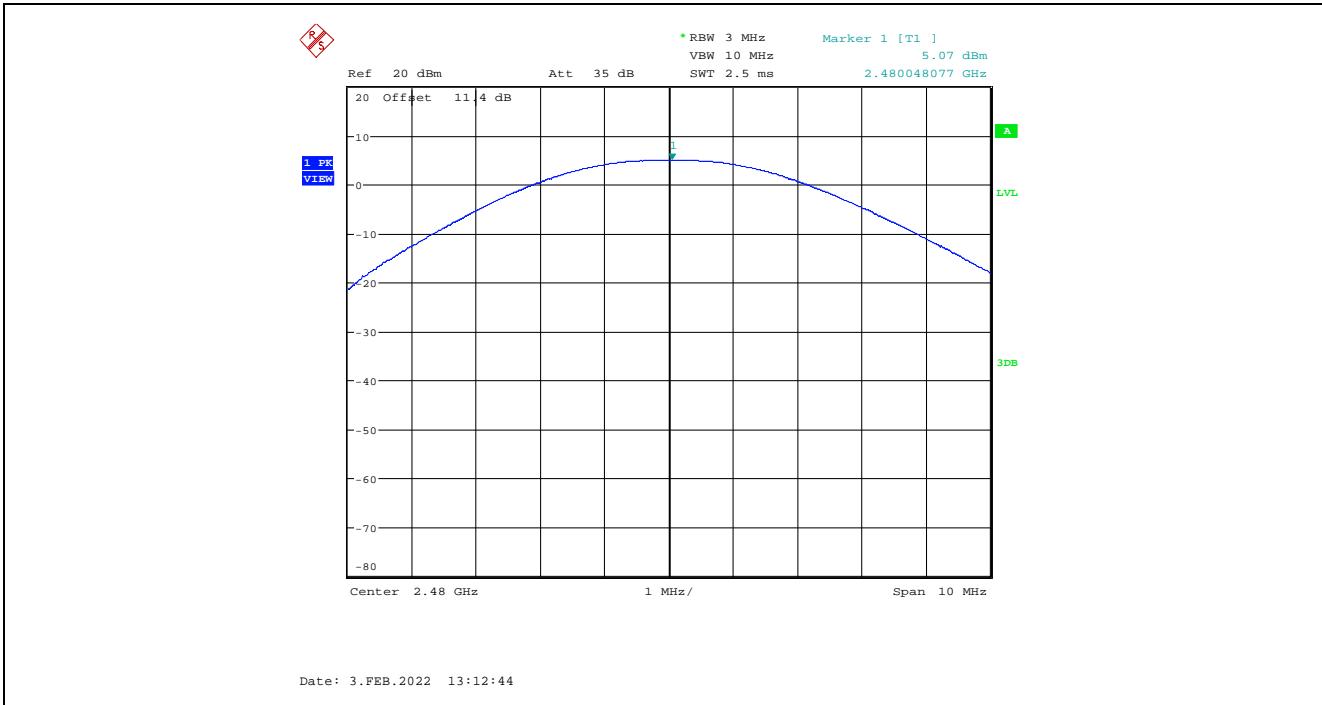
**Plot 5.2.4.1.** Maximum Peak Conducted Output Power, GFSK Modulation, 6 dBm Power Setting, 2402 MHz, 1 Mbps



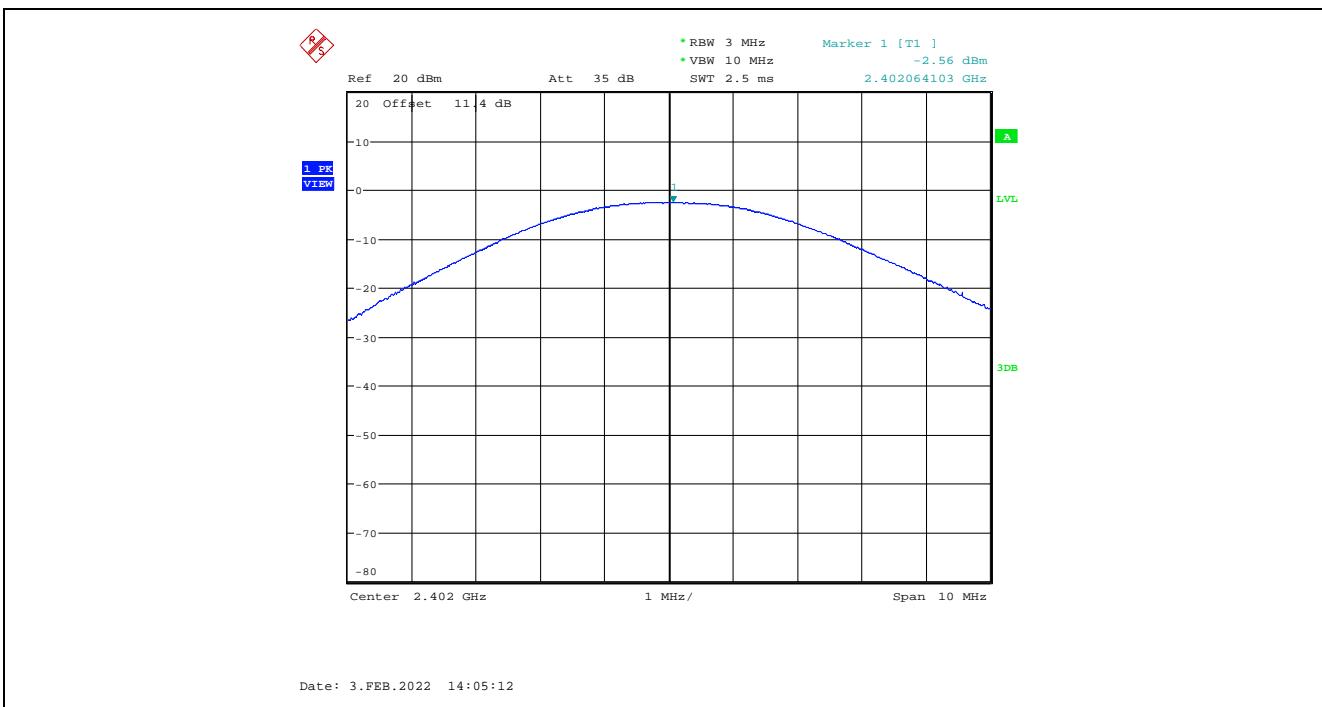
**Plot 5.2.4.2.** Maximum Peak Conducted Output Power, GFSK Modulation, 6 dBm Power Setting, 2440 MHz, 1 Mbps



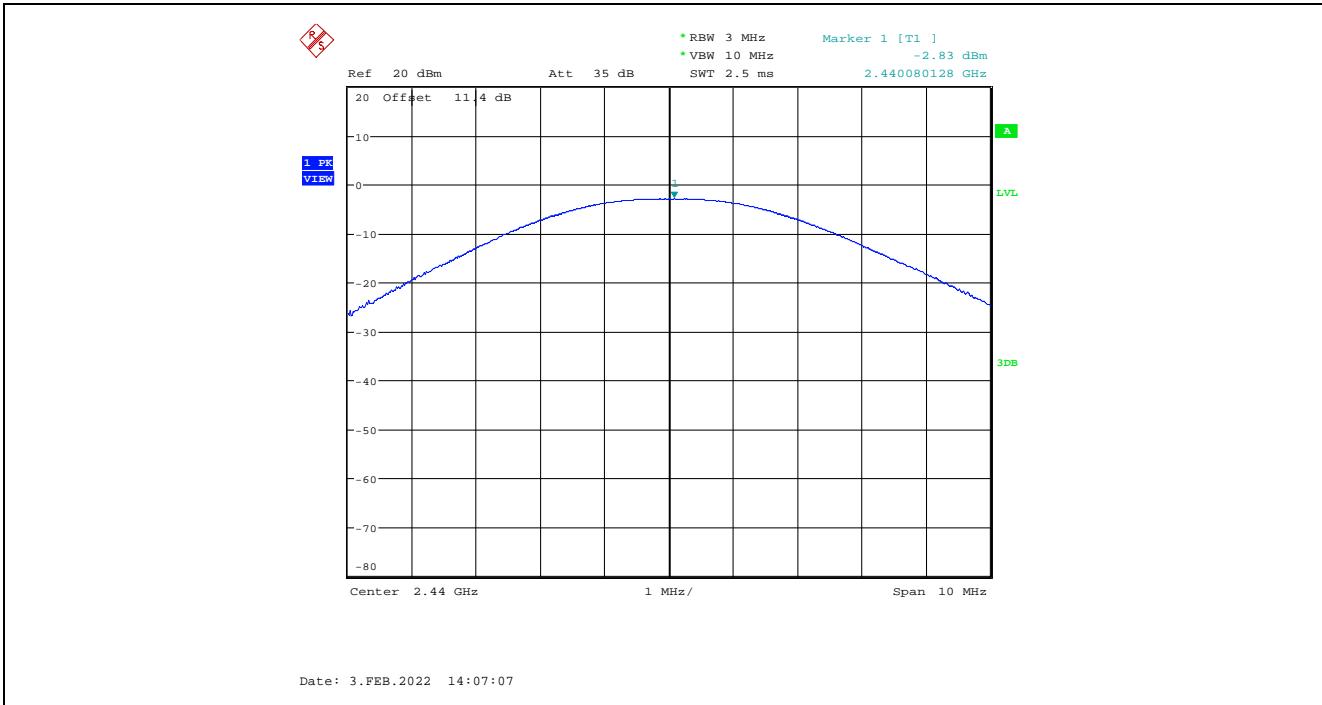
**Plot 5.2.4.3.** Maximum Peak Conducted Output Power, GFSK Modulation, 6 dBm Power Setting, 2480 MHz, 1 Mbps



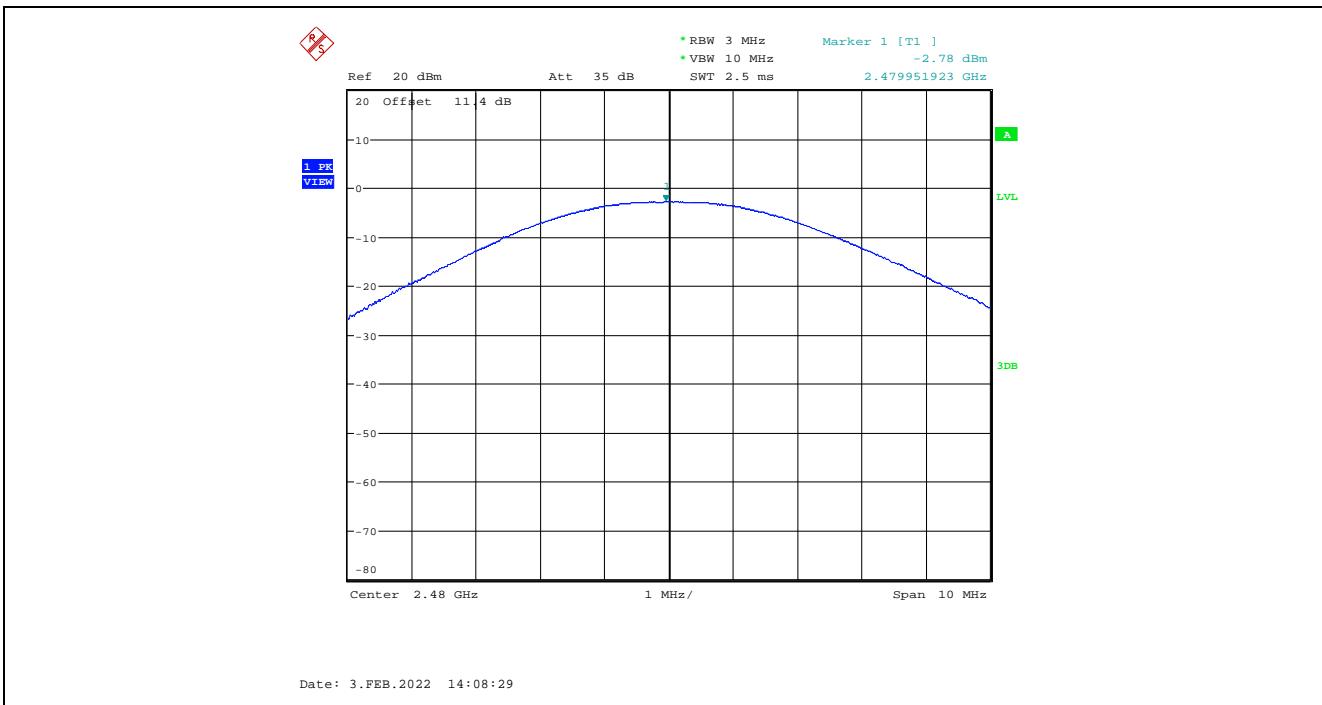
**Plot 5.2.4.4.** Maximum Peak Conducted Output Power, GFSK Modulation, -0.15 dBm Power Setting, 2402 MHz, 1 Mbps



**Plot 5.2.4.5.** Maximum Peak Conducted Output Power, GFSK Modulation, -0.15 dBm Power Setting, 2440 MHz, 1 Mbps



**Plot 5.2.4.6.** Maximum Peak Conducted Output Power, GFSK Modulation, -0.15 dBm Power Setting, 2480 MHz, 1 Mbps



### 5.3. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

#### 5.3.1. Limit(s)

§ 15.247 (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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

#### Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110 .....	16.42–16.423	399.9–410	4.5–5.15
1.0495–0.505 .....	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905 .....	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128 .....	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775 .....	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775 .....	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218 .....	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825 .....	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225 .....	123–138	2200–2300	14.47–14.5
8.291–8.294 .....	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366 .....	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675 .....	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475 .....	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293 .....	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025 .....	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725 .....	322–335.4	3600–4400	( <sup>2</sup> )
13.36–13.41.			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

<sup>2</sup> Above 38.6

#### Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

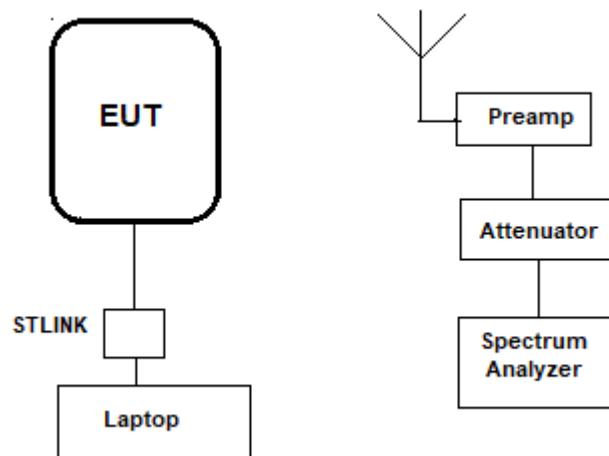
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

### 5.3.2. Method of Measurements

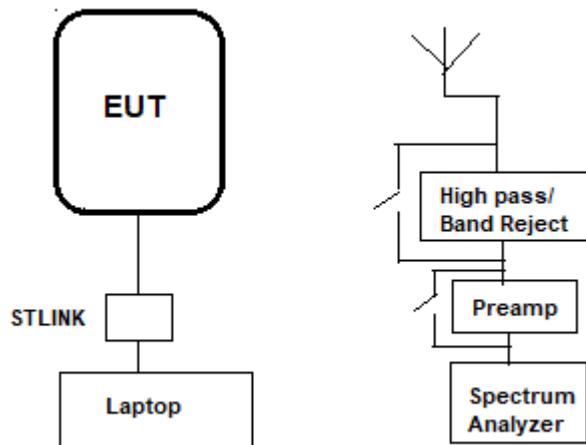
KDB 558074 D01 DTS Meas Guidance v05r02 Sections 8.5, 8.6, 8.7 and ANSI C63.10.

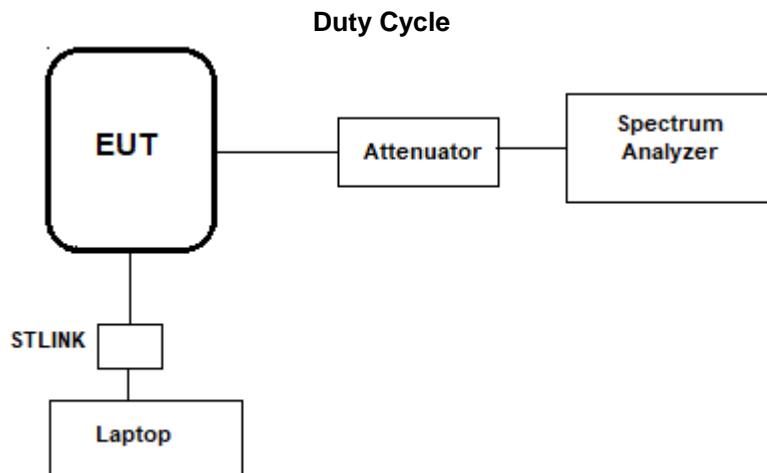
### 5.3.3. Test Arrangement

Transmitter Radiated Spurious Emission



Band-Edge RF Radiated Emission





### 5.3.4. Test Data

#### 5.3.4.1. Transmitter Radiated Spurious Emissions

##### Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The average radiated field strength is calculated by subtracting the Duty-Cycle Correction Factor (DCCF) from the measured peak radiated field strength level. Refer to section 5.3.4.3 of this report for DCCF calculation.

Fundamental Frequency: 2402 MHz							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB $\mu$ V/m)	RF Avg Level (dB $\mu$ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB $\mu$ V/m)	Limit 15.247 (dB $\mu$ V/m)	Margin (dB)	Pass/ Fail
2402	90.10	--	V	--	--	--	--
2402	98.26	--	H	--	--	--	--
4804	53.45	49.75	V	54.0	78.3	-4.3	Pass*
4804	56.34	52.64	H	54.0	78.3	-1.4	Pass*
12010	49.74	46.04	V	54.0	78.3	-8.0	Pass*
12010	50.27	46.57	H	54.0	78.3	-7.4	Pass*
19216	53.30	49.60	V	54.0	78.3	-4.4	Pass*
19216	54.80	51.10	H	54.0	78.3	-2.9	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2440 MHz Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB $\mu$ V/m)	RF Avg Level (dB $\mu$ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB $\mu$ V/m)	Limit 15.247 (dB $\mu$ V/m)	Margin (dB)	Pass/Fail
2440	89.58	--	V	--	--	--	--
2440	96.07	--	H	--	--	--	--
4880	52.10	48.40	V	54.0	76.1	-5.6	Pass*
4880	56.54	52.84	H	54.0	76.1	-1.2	Pass*
7320	56.15	52.45	V	54.0	76.1	-1.6	Pass*
7320	52.28	48.58	H	54.0	76.1	-5.4	Pass*
12200	51.11	47.41	V	54.0	76.1	-6.6	Pass*
12200	51.29	47.59	H	54.0	76.1	-6.4	Pass*
19520	50.43	46.73	V	54.0	76.1	-7.3	Pass*
19520	52.36	48.66	H	54.0	76.1	-5.3	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

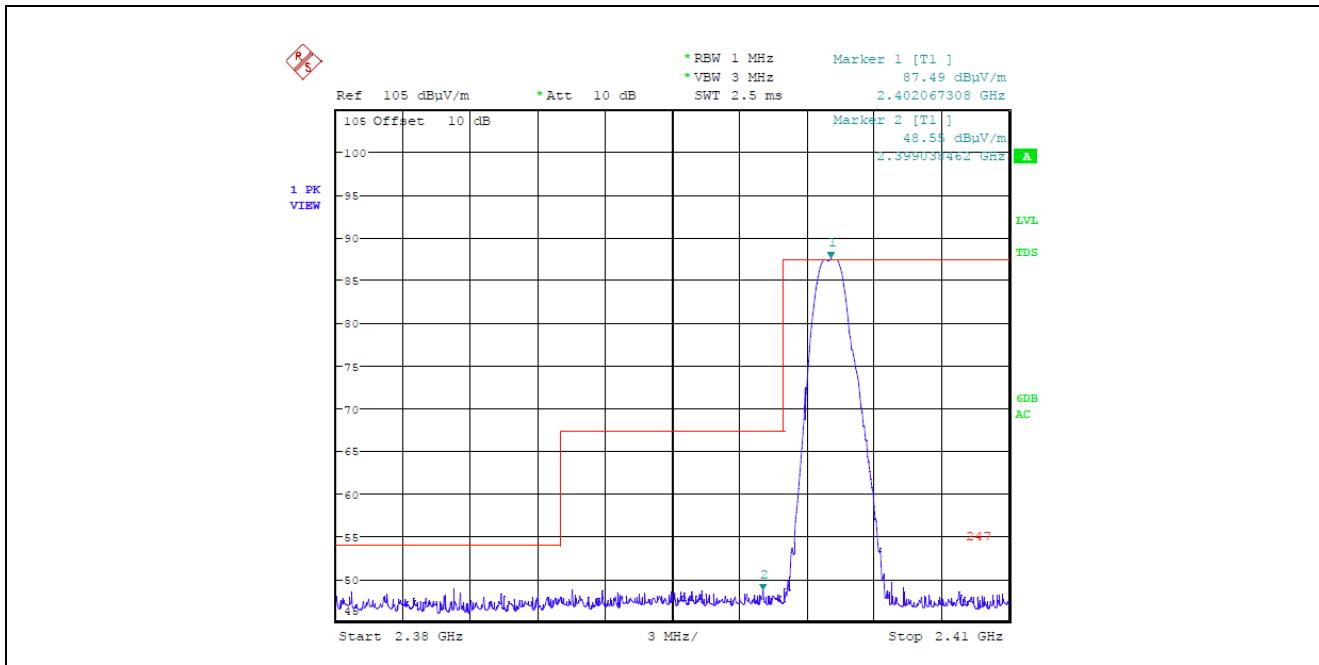
Fundamental Frequency: 2480 MHz Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB $\mu$ V/m)	RF Avg Level (dB $\mu$ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB $\mu$ V/m)	Limit 15.247 (dB $\mu$ V/m)	Margin (dB)	Pass/Fail
2480	90.63	--	V	--	--	--	--
2480	97.90	--	H	--	--	--	--
4960	54.87	51.17	V	54.0	77.9	-2.8	Pass*
4960	56.12	52.42	H	54.0	77.9	-1.6	Pass*
7440	56.94	53.24	V	54.0	77.9	-0.8	Pass*
7440	52.27	48.57	H	54.0	77.9	-5.4	Pass*
12400	50.28	46.58	V	54.0	77.9	-7.4	Pass*
12400	50.38	46.68	H	54.0	77.9	-7.3	Pass*
19840	50.82	47.12	V	54.0	77.9	-6.9	Pass*
19840	52.18	48.48	H	54.0	77.9	-5.5	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

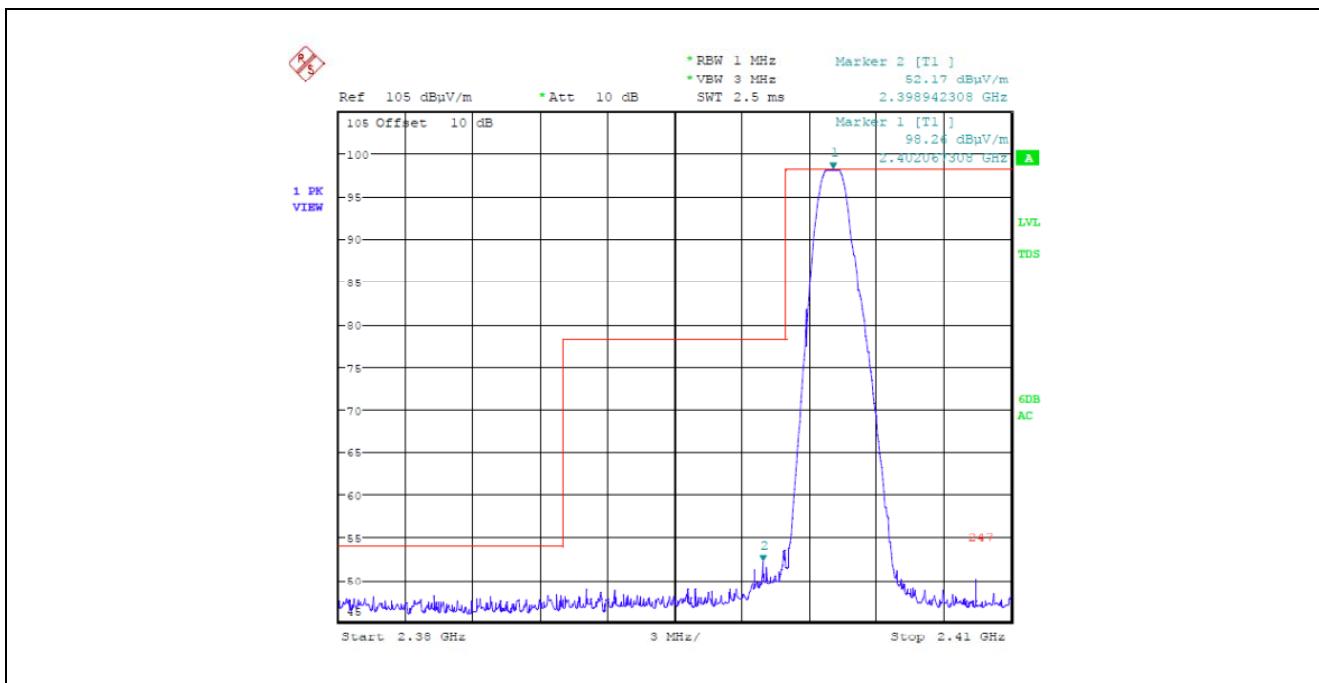
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

### 5.3.4.2. Band-Edge RF Radiated Emissions

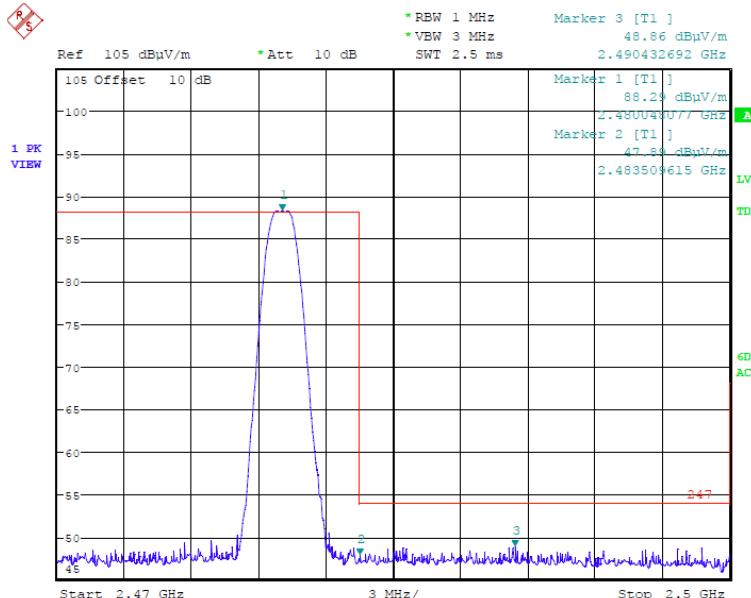
**Plot 5.3.4.2.1. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization  
2402 MHz, Low End of Frequency Band**



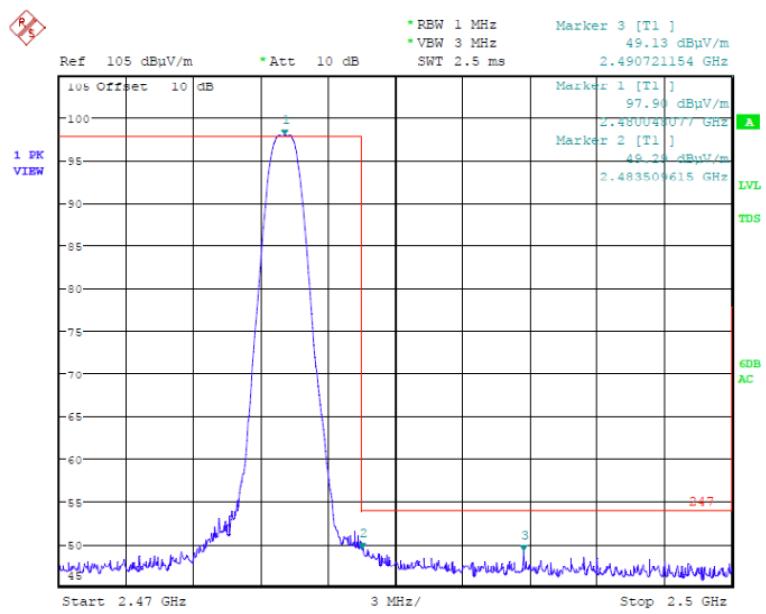
**Plot 5.3.4.2.2. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization  
2402 MHz, Low End of Frequency Band**



**Plot 5.3.4.2.3. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization  
2480 MHz, High End of Frequency Band**



**Plot 5.3.4.2.4. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization  
2480 MHz, High End of Frequency Band**



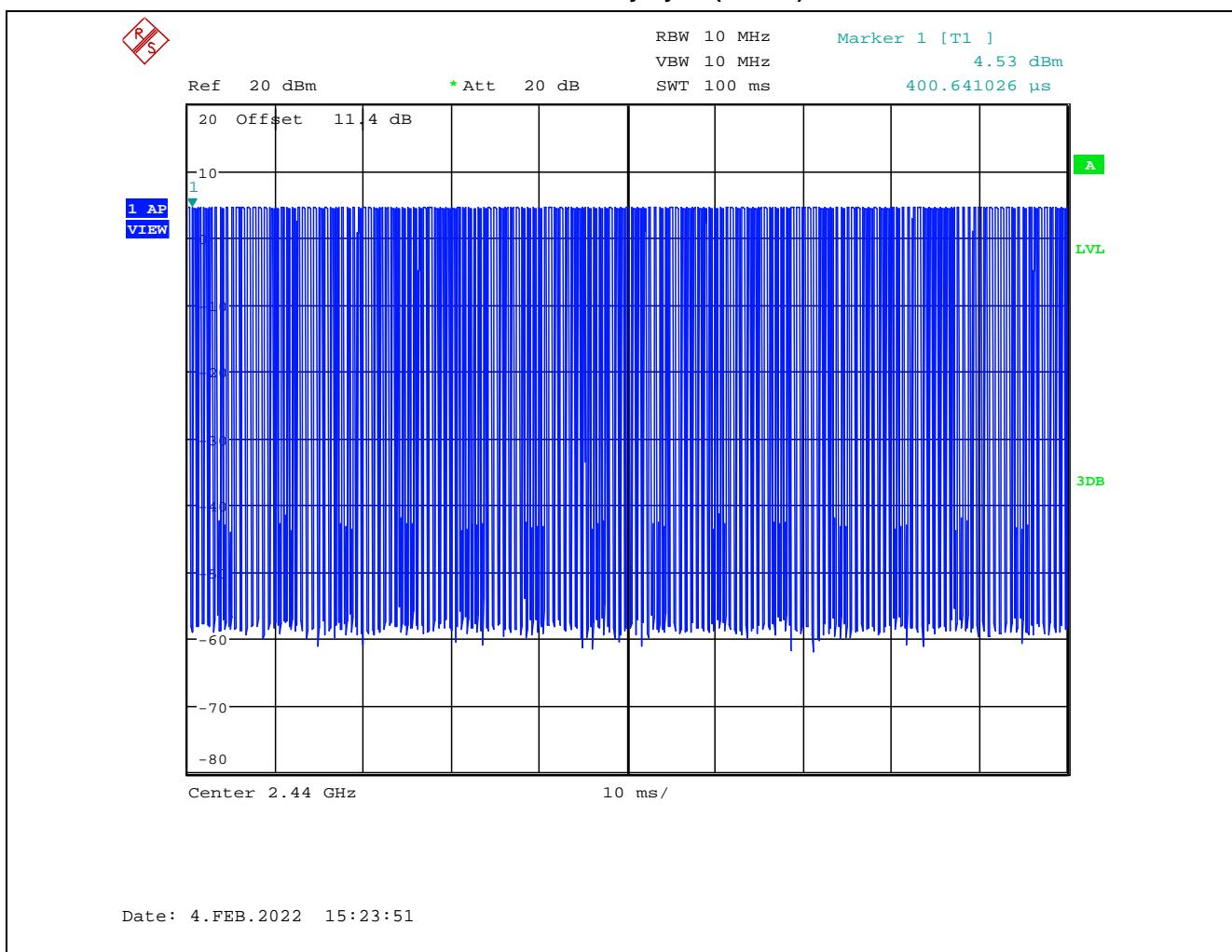
### 5.3.4.3. Duty-Cycle Correction Factor

The duty cycle correction factor is the total “on time” divided by the period of the pulse train (or 100 ms).

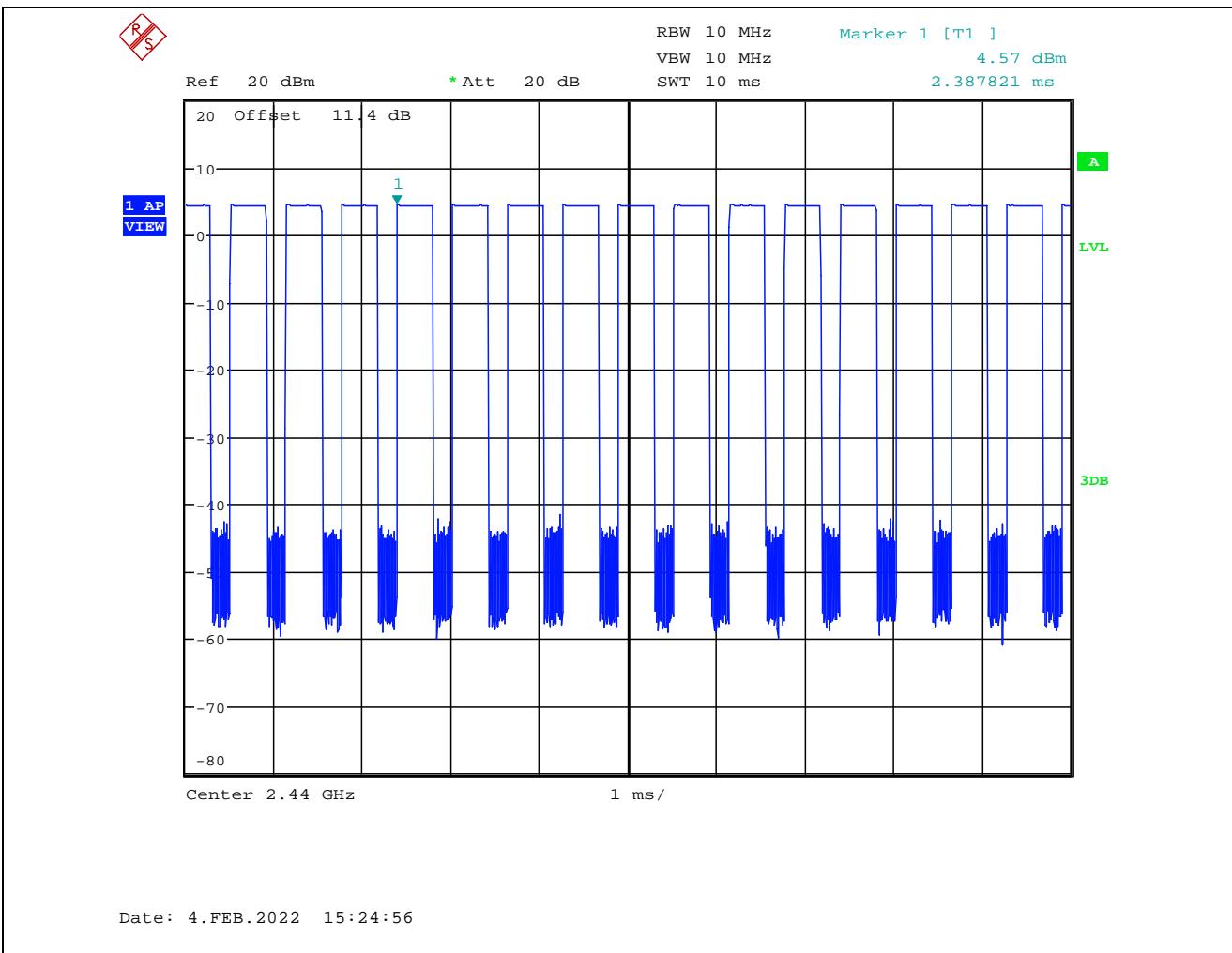
#### Computation of duty-cycle correction factor

Sub-Pulse	Duration (μs)	Number of pulses	Sub-Pulse “On Time” (μs)
1	410.256	1	410.256
		TOTAL ON TIME:	410.256
Duty cycle correction factor: $20 \log (T_{ON}/\text{Period}) = 20 \log (410.256 \mu\text{s} / 628.205 \mu\text{s}) = -3.70 \text{ dB}$			

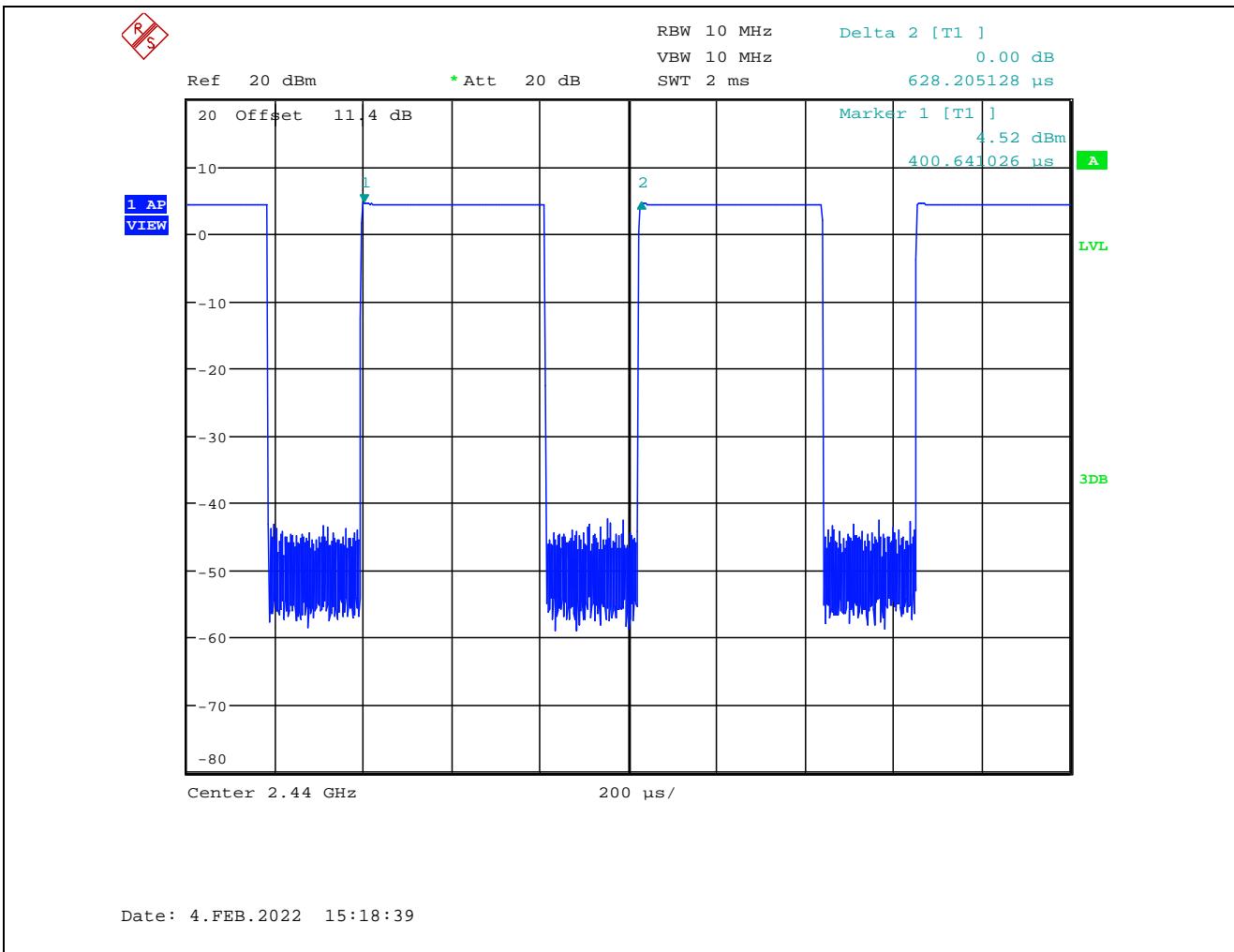
Plot 5.3.4.3.1. Duty Cycle (100 ms)



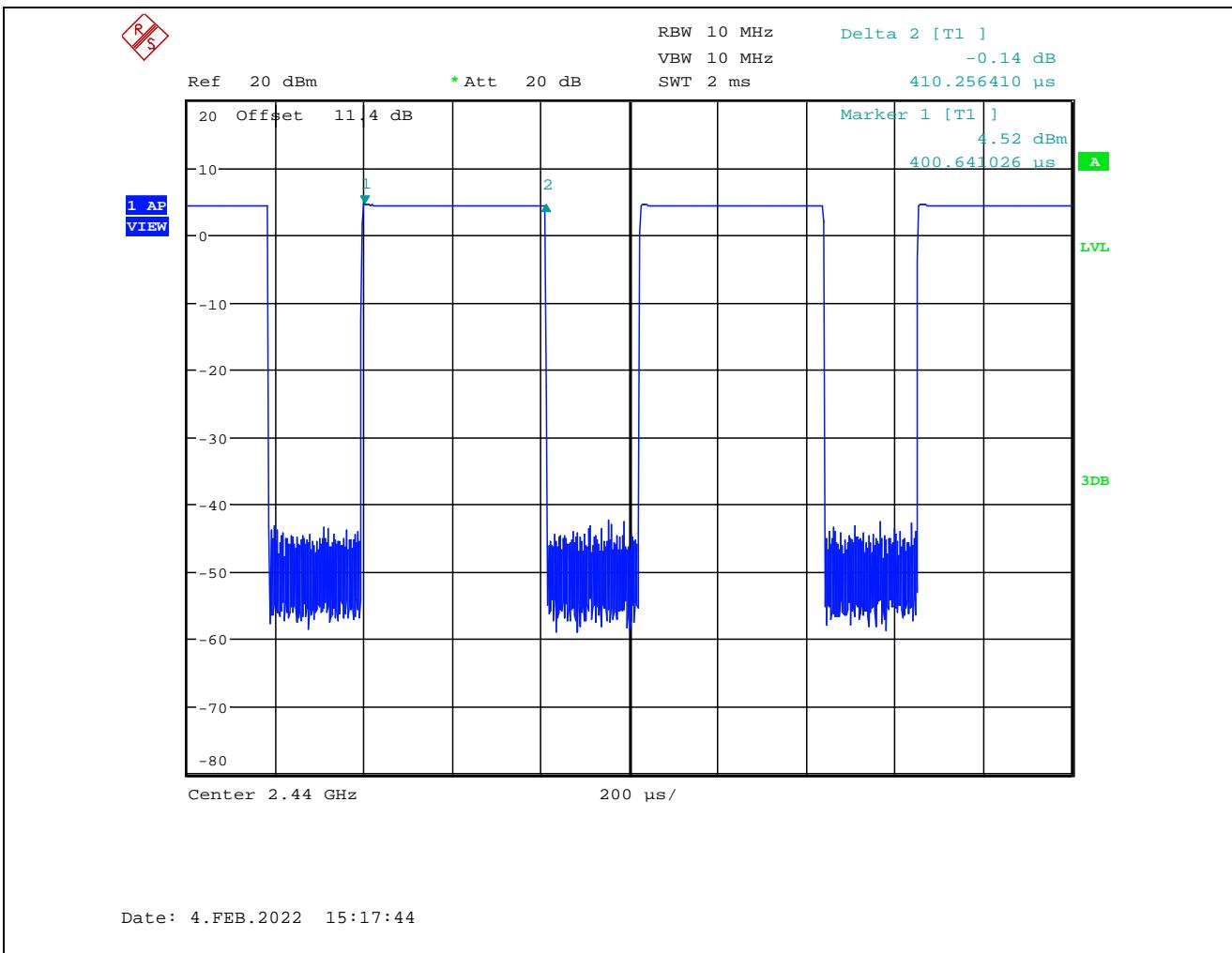
Plot 5.3.4.3.2. Duty Cycle (10 ms)



Plot 5.3.4.3.3. Duty Cycle (period of the pulse train)



Plot 5.3.4.3.4. Duty Cycle (Pulse)



## 5.4. POWER SPECTRAL DENSITY [§ 15.247(e)]

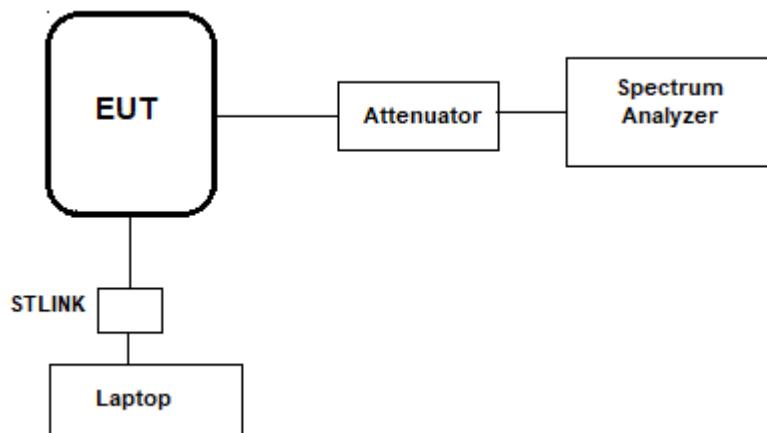
### 5.4.1. Limit(s)

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.

### 5.4.2. Method of Measurements

FCC KDB 558074 D01 15.247 Meas Guidance V05r02, Section 8.4 and ANSI C63.10, 11.10.2 PKPSD

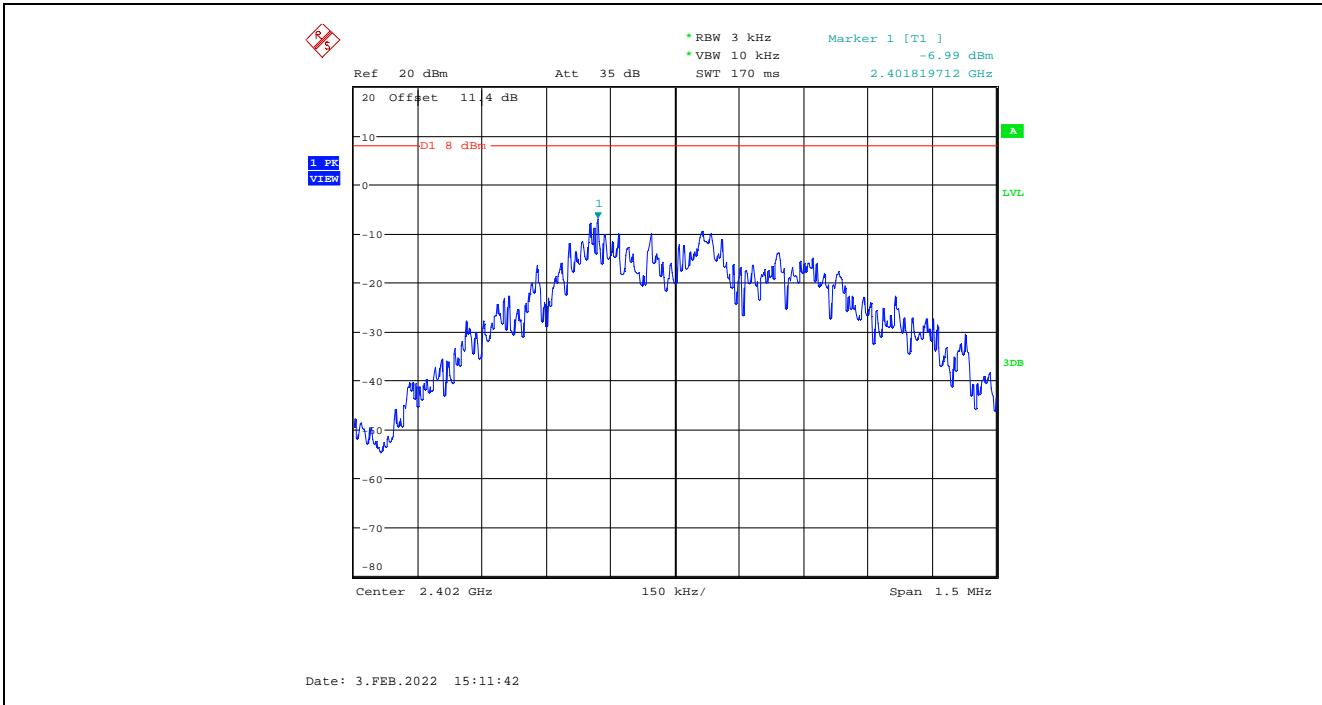
### 5.4.3. Test Arrangement



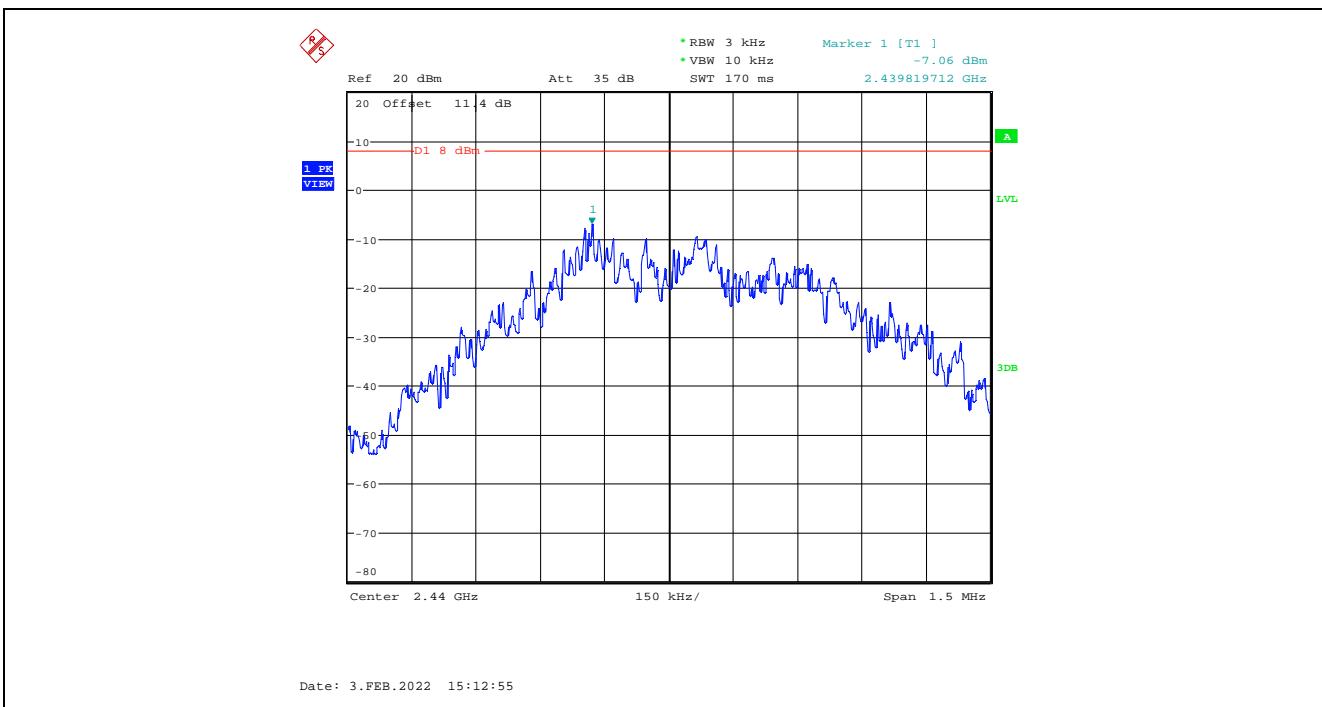
### 5.4.4. Test Data

Modulation	Power Setting	Data Rate (Mbps)	Frequency (MHz)	PSD (dBm)	Max. Limit (dBm)	Margin (dBm)
GFSK	High Power (6 dBm)	1	2402	-6.99	8	-14.99
			2440	-7.06	8	-15.06
			2480	-7.26	8	-15.26

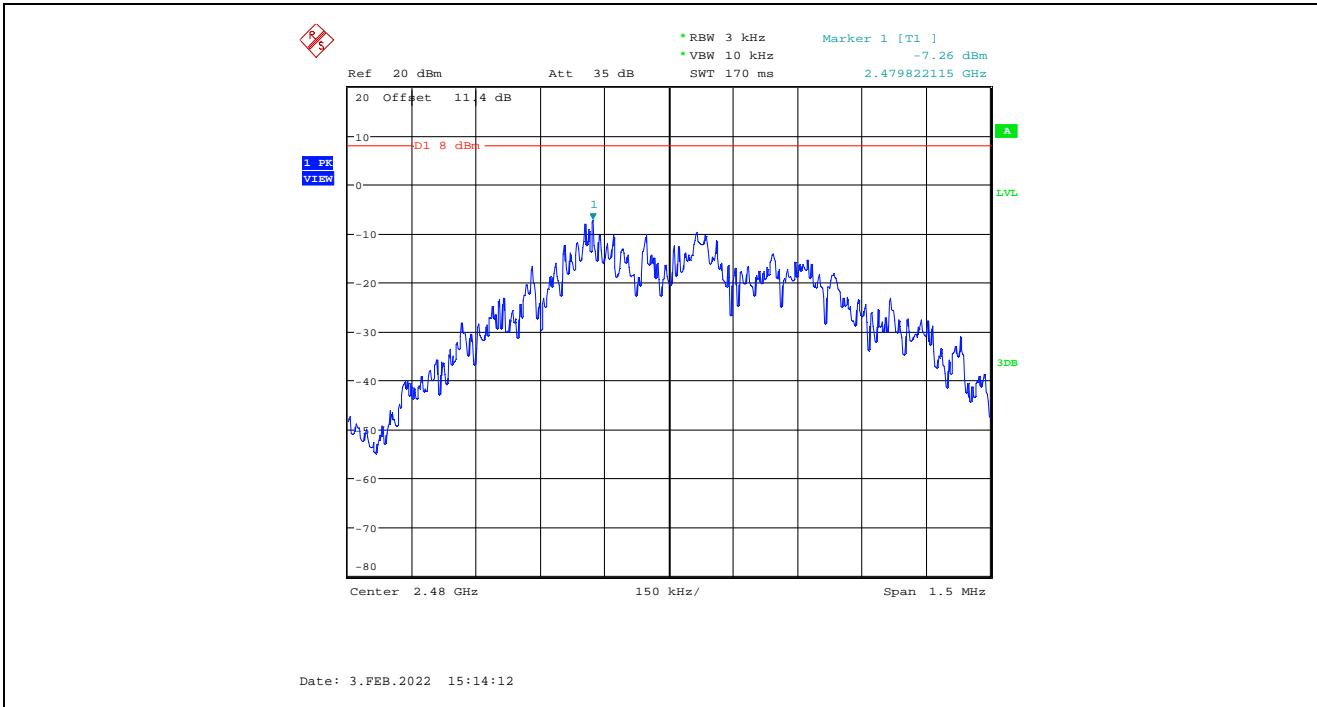
**Plot 5.4.4.1.** Power Spectral Density, GFSK Modulation, High Power, 2402 MHz, 1 Mbps



**Plot 5.4.4.2.** Power Spectral Density, GFSK Modulation, High Power, 2440 MHz, 1 Mbps



Plot 5.4.4.3. Power Spectral Density, GFSK Modulation, High Power, 2480 MHz, 1 Mbps



**ULTRATECH GROUP OF LABS**

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4  
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: 22LMS003\_FCC15C247

February 16, 2022

*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

## 5.5. RF EXPOSURE REQUIREMENTS [§§ 15.247(i), 1.1310 & 2.1091]

### 5.5.1. Limits

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

#### Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

### 5.5.2. Method of Measurements

#### Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where,

P: power input to the antenna in mW

EIRP: Equivalent (effective) isotropic radiated power.

S: power density mW/cm<sup>2</sup>

G: numeric gain of antenna relative to isotropic radiator

r: distance to centre of radiation in cm

### 5.5.3. RF Evaluation

MPE Evaluation for EUT with 1.95 dBi Antenna							
Frequency (MHz)	Maximum Conducted Power (dBm)	Maximum Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
2402	5.27	1.95	7.22	5.272	20	0.00105	1.0

## EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	100398	20Hz–26.5 GHz	20 Sep 2023
Attenuator	Hewlett Packard	8493C	0461	DC–26.5 GHz	See Note 1
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	01 Sep 2022
Biconilog Antenna	EMCO	3142C	00034792	26-2000MHz	16 May 2022
Horn Antenna	ETS	3115	5955	1-18GHz	12 Oct 2022
Horn Antenna	ETS	3160-09	00118385	18-26GHz	22 Jan 2023
Preamp	Com-Power	PAM-118A	551052	500MHz-18GHz	11 Sep 2022
Preamp	Com-Power	PAM-840A	18050002	18-40GHz	28 Sep 2022
Band Reject Filter	Microtronics	BRM50701	105	Cut off 2.170-3 GHz	See Note 1
High Pass Filter	K & L	11SH-10- 4000/T 12000	4	Cut off 2.4GHz	See Note 1
Attenuator	Hewlett Packard	8493C	0461	DC–26.5 GHz	See Note 1
Spectrum Analyzer	Rohde & Schwarz	FSU26	100398	20Hz–26.5 GHz	20 Sep 2023
Note 1: Internal Verification/Calibration check					

## EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

Test Description	Expanded Uncertainty, K=2 for 95% Confidence Level
Conducted Output Power	$\pm 0.62$ dB
Power Spectral Density	$\pm 0.20$ Hz / $\pm 0.63$ dB
Occupied Bandwidth	$\pm 0.20$ Hz / $\pm 0.63$ dB
Transmitter Spurious Radiated Emissions	$\pm 4.20$ dB (30 MHz – 1 GHz) $\pm 2.70$ dB (1 – 18 GHz)