Test Report Serial Number:	**45461521 R1.0**
Test Report Date:	**22 May 2020**
Project Number:	**1457**

EMC Test Report - New Filing

Applicant:

Garmin International Inc.
1200 E. 151st. Street
Olathe, KS, 66062
USA

FCC ID:	IC Registration Number
IPH-03699	**1792A-03699**
Product Model Number / HVIN	Product Name / PMN
A03699	**A03699**

In Accordance With:

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

Part 15 Low Power Communication Device Transmitter (DXX)

RSS-Gen, RSS-210 Issue 9

Low Power Transmitter (2400-2483.5MHz)

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:**	29 July - 22 August, 2019	
Report Prepared By:	Art Voss, P.Eng.		**Report Reviewed By:**	Ben Hewson	
Report Revision	**Description of Revision**		**Revised Section**	**Revised By**	**Revision Date**
0.2	Initial Draft Release		n/a	Art Voss	23 August 2019
0.3	Revised FCC 731 Form, ISED Annex I-II Form		n/a	Art Voss	3 September 2019
	Deleted Duplicate Exhibit 17 - *DUT Photos*		n/a		
	Revised Test Report Section 2.0, DUT Info		2.0		
0.4	Revised Test Report Section 2.0, DUT Info		2.0	Art Voss	7 October 2019
0.5	Revised DUT Battery Info		7.0	Art Voss	21 October 2019
	Revised Term n/a for None Detected		12.0		
1.0	Initial Release		n/a	Art Voss	22 May 2020

2.0 CLIENT AND DUT INFORMATION

Client Information		
Applicant Name	**Garmin International Inc.**	
Applicant Address	1200 East 151st. Street	
	Olathe, KS	
	66062	
	USA	
DUT Information		
Device Identifier(s):	**FCC ID:**	**IPH-03699**
	ISED ID:	**1792A-03699**
Device Type:	Digital BLE/ANT Transceiver	
Equipment Class (FCC):	Part 15 Low Power Communication Device Transmitter (DXX)	
Equipment Class (ISED):	Low Power Transmitter (2400-2483.5MHz)	
Device Model(s) / HVIN:	A03699	
Device Marketing Name / PMN:	A03699	
Firmware Version ID Number / FVIN:	-	
Host Marketing Name / HMN:	-	
Test Sample Serial No.:	T/A Sample - Identical Prototype	
Transmit Frequency Range:	2402 - 2480MHz	
Test Channels:	79 Channel Programmable	
Manuf. Max. Rated Output Power:	8dBm	
Manuf. Max. Rated BW/Data Rate:	ANT: 920kHz & BLE: 1.07MHz	
Antenna Make and Model:	PCB Single Ended Whip	
Antenna Type and Gain:	0dBi	
Modulation:	ANT: GFSK, BLE: GMSK	
Mode:	Simplex	
Emission Designator:	See Section 8.0	
DUT Power Source:	3VDC Non-Rechargeable Battery Coin(Type: CR2032)	
DUT Dimensions [HxWxD] (mm)	H x W x D: 10mm x 50mm x 30mm	
Deviation(s) from standard/procedure:	None	
Modification of DUT:	None	

3.0 SCOPE

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 CFR 47 Part §2.1091 and §2.1093 and Health Canada Safety Code 6, an RF Exposure evaluation report is required for this *Equipment* and the results of the RF Exposure evaluation appear in a separate exhibit from this report.

The Receiver of this *Equipment* is subject to Equipment Certification or Supplier's Declaration of Conformity (SDoC) in accordance with 47 CFR Part §15.101. The Receiver was evaluated in accordance with 47 CFR Part §15 Subpar B and ICES-003. A statement of the application the SDoC procedure appears in a separate exhibit from this report.

Application:

This application is for a new certification of a low power BLE/ANT Body Worn Health and Fitness transceiver.

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. 21 August 2019 Date

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	Duty Cycle and Transmission Duration	ANSI C63.10-2013 KDB 558074 D01v05	§15.35(c)	n/a	12 Aug 2019	n/a
8.0	Occupied Bandw idth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	RSS-Gen (6.7)	12 Aug 2019	Pass
9.0	6dB Bandw idth	ANSI C63.10-2013 KDB 558074 D01v05	n/a	RSS-Gen (6.7)	12 Aug 2019	Pass
10.0	Field Strength (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	30 July 2019	Pass
11.0	Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	12 Aug 2019	Pass
12.0	Restricted Bands	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	13 Aug 2019	Pass

Test Station Day Log					
Date	**Ambient Temp (°C)**	**Relative Humidity (%)**	**Barometric Pressure (kPa)**	**Test Station**	**Tests Performed Section(s)**
9 July 2019	24.0	28	101.6	**OATS**	**10**
10 July 2019	24.0	22	101.3	**OATS**	**10**
30 July 2019	27.3	14	101.1	**EMC**	**7, 8, 9**
12 Aug 2019	24.9	21	102.0	**EMC**	**7, 8, 9**
13 Aug 2019	27.1	46	101.9	**OATS**	**11**

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

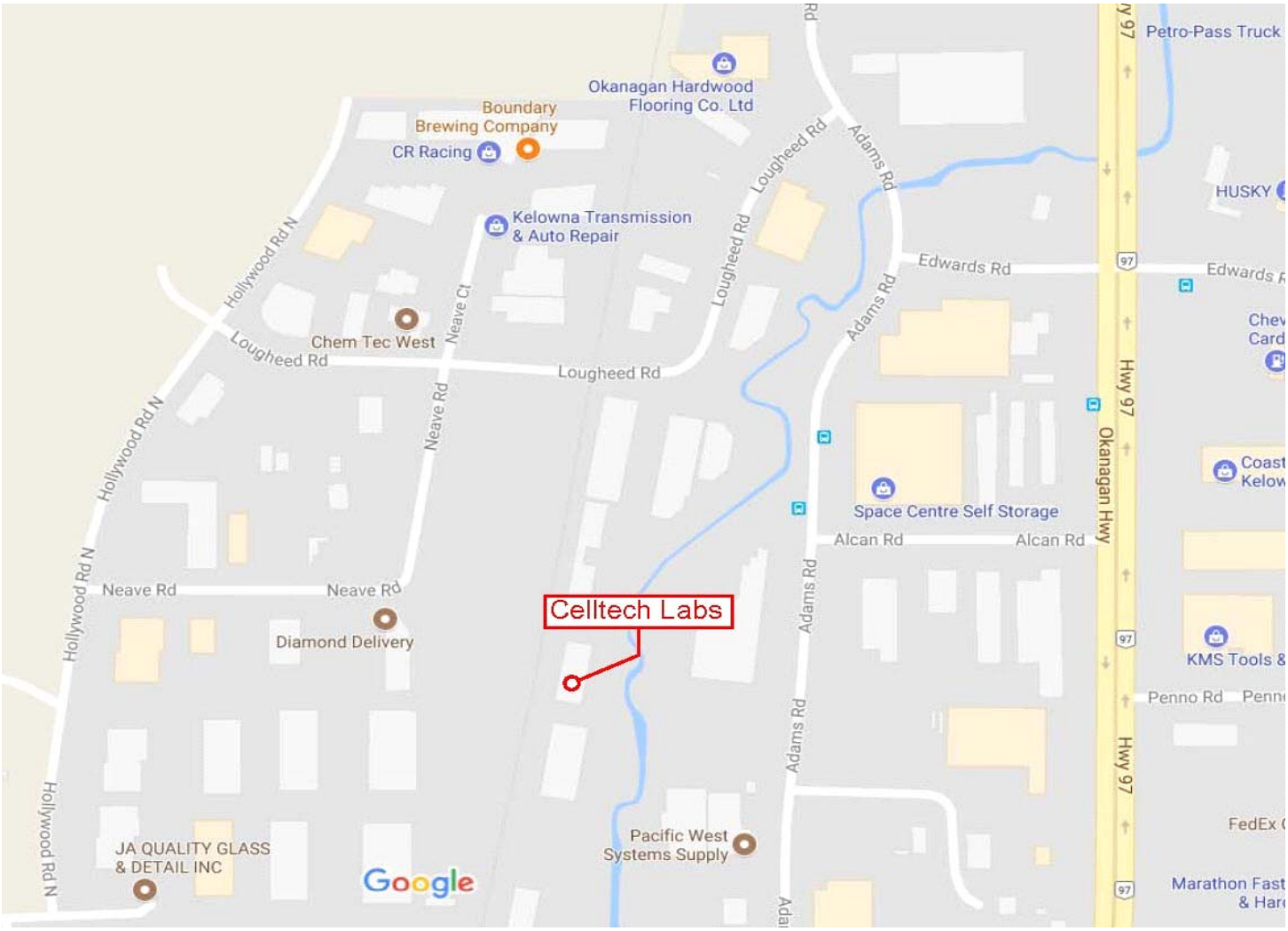
5.0 NORMATIVE REFERENCES

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 (15.249)	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
ISED RSS-Gen Issue 5:	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 9:	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Licence-Exempt Radio Apparatus: Category I Equipment
FCC KDB 558074 D01v05	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-1. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 DUTY CYCLE EVALUATION

Test Procedure	
Normative Reference	**KDB 558074 (6.0), ANSI C63.10 (11.6)**

Limits	
KDB 558074 (6.0) C63.10 (11.6)	**6.0 Duty cycle, transmission duration and maximum power control level** b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal. 1) Set the center frequency of the instrument to the center frequency of the transmission. 2) Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. 3) Set detector = peak or average. 4) The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

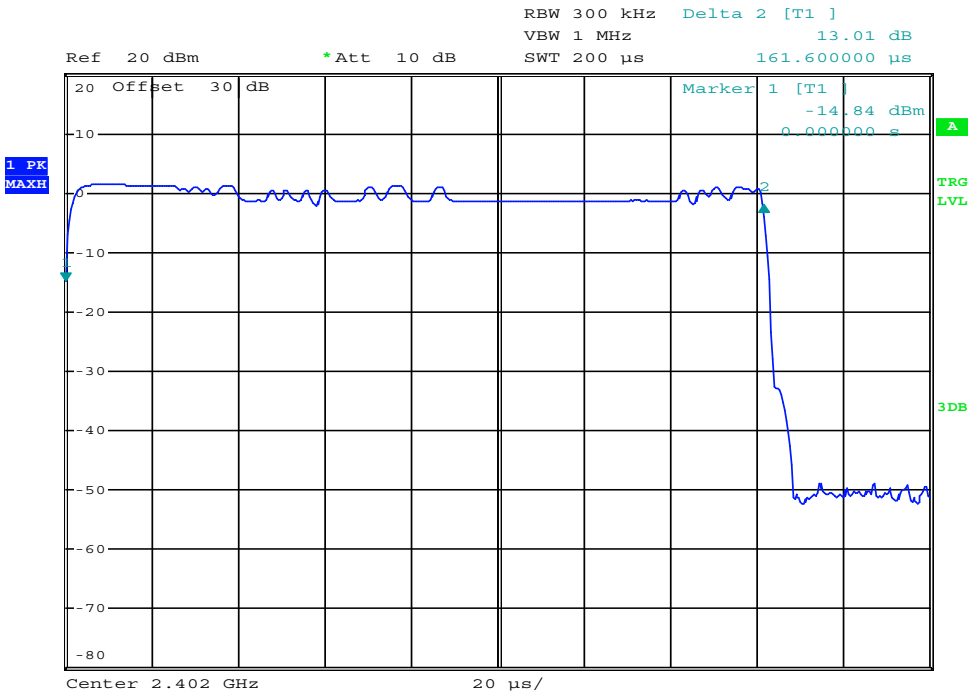
Test Setup	Appendix A Figure A.1

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 Zero Span and Positive Trigger. The output power of the DUT was set to the manufacturer's highest output power setting at the Mid frequency channel as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The variation in Duty Cycle was determined to be less than +/- 2%.

Plot 7.1 – Duty Cycle – Normal Operation, ANT, On-Time

Transmit Duty Cycle (Transmitter On-Time)

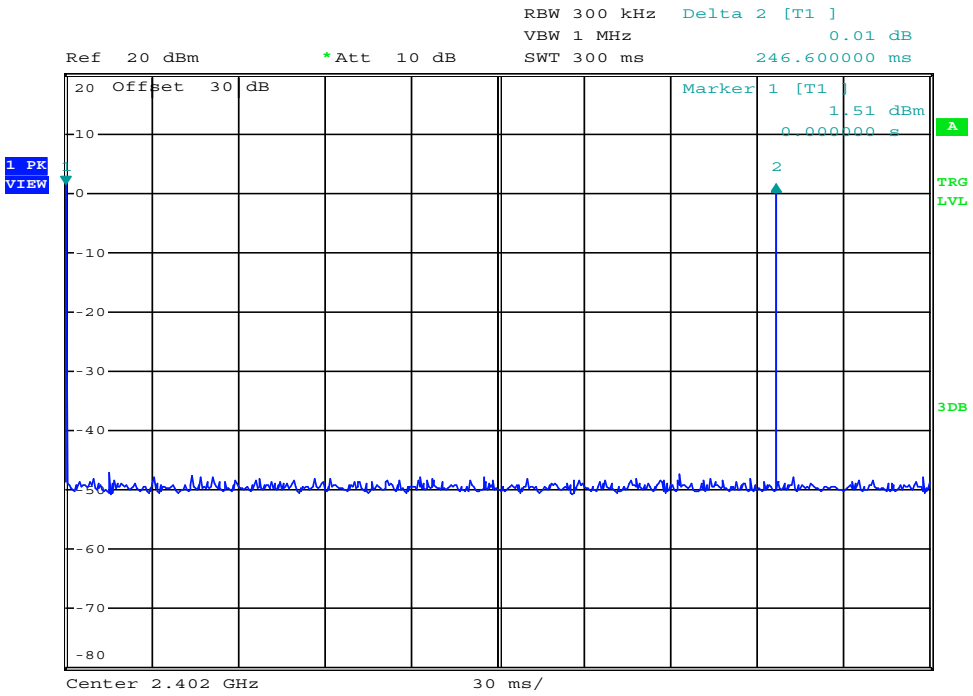


Date: 30.JUL.2019 15:19:01

Channel Frequency:	Channel Bandwidth:	Mode:
2402.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured On-Time:
		161 uSec

Plot 7.2 – Duty Cycle – Normal Operation, ANT, Total-Time

Transmit Duty Cycle (Transmitter Total-Time)

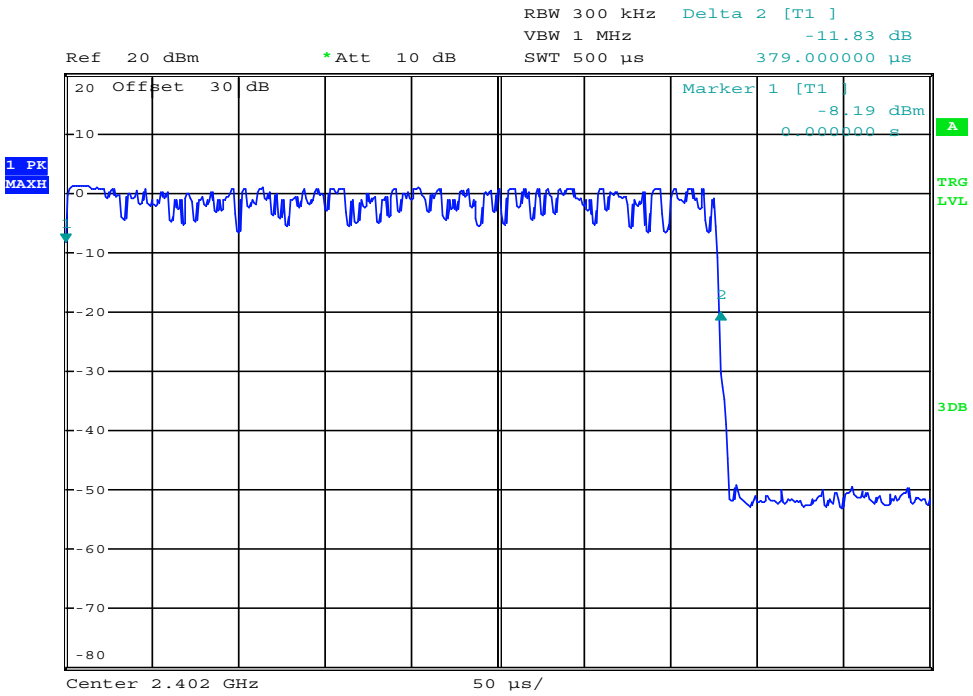


Date: 30.JUL.2019 15:19:57

Channel Frequency:	Channel Bandwidth:	Mode:
2402.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
	Measured Total-Time:	**Duty Cycle:**
	247 mSec	**0.067** %

Plot 7.3 – Duty Cycle – Normal Operation, BLE, On-Time

Transmit Duty Cycle (Transmitter On-Time)

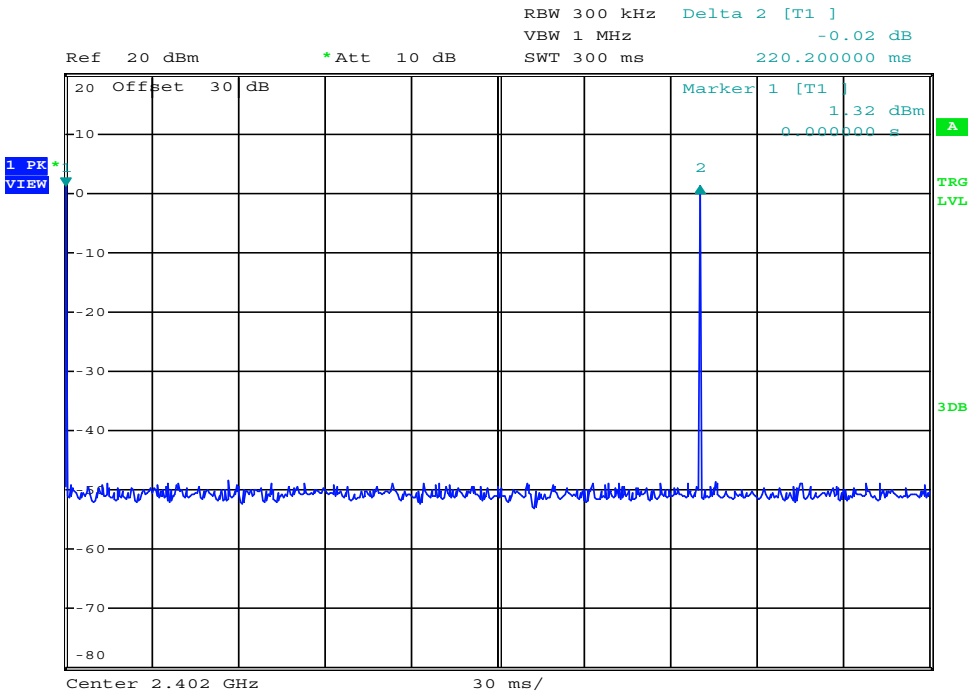


Date: 30.JUL.2019 15:25:17

Channel Frequency:	Channel Bandwidth:	Mode:
2402.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured On-Time:
		379 uSec

Plot 7.4 – Duty Cycle – Normal Operation, BLE, Total-Time

Transmit Duty Cycle (Transmitter Total-Time)

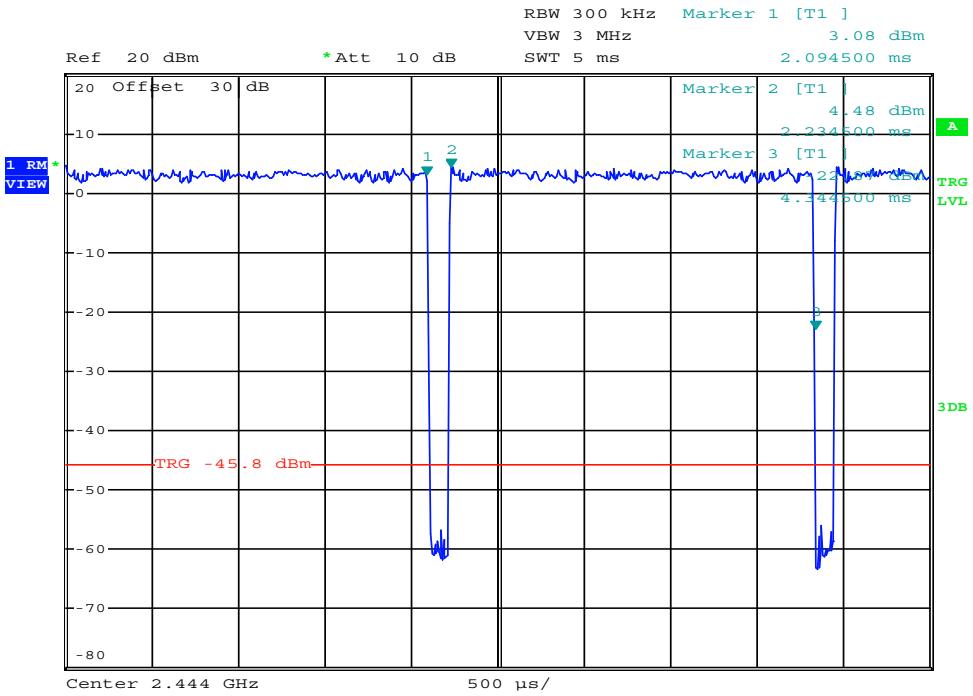


Date: 30.JUL.2019 15:24:12

Channel Frequency:	Channel Bandwidth:	Mode:
2402.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
	Measured Total-Time:	**Duty Cycle:**
	220 mSec	**0.170** %

Plot 7.5 – Duty Cycle – Test Mode Operation, ANT

Test Mode - Transmit Duty Cycle (Transmitter Total-Time)

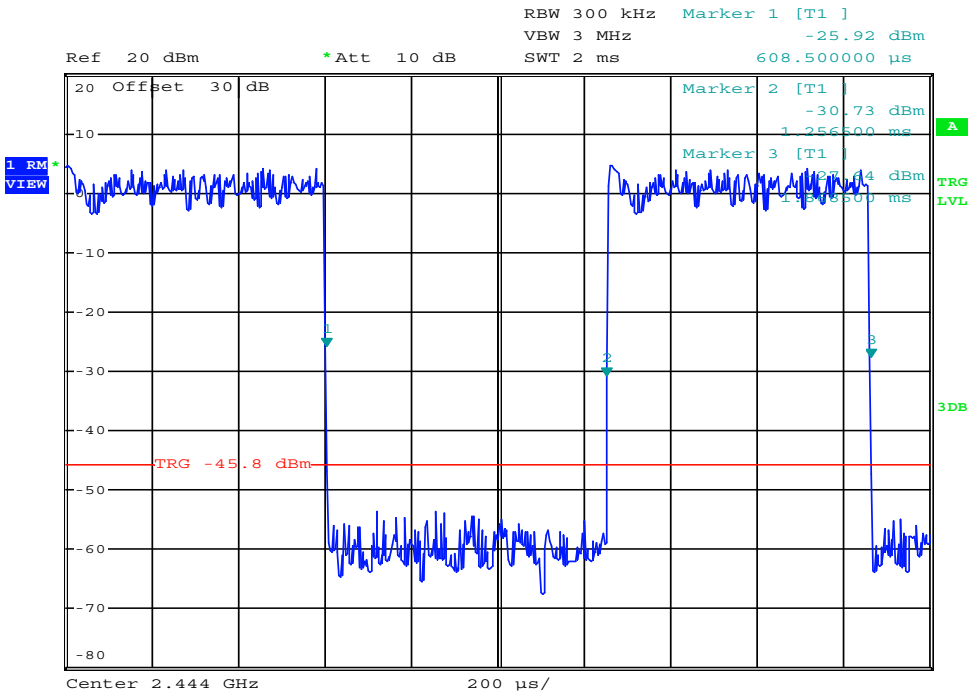


Date: 12.AUG.2019 13:43:04

Channel Frequency:	Channel Bandwidth:	Mode:
2402.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Duty Cycle:
		94 %

Plot 7.6 – Duty Cycle – Test Mode Operation, BLE

Test Mode - Transmit Duty Cycle (Transmitter Total-Time)



Date: 12.AUG.2019 14:02:18

Channel Frequency:	Channel Bandwidth:	Mode:
2402.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Duty Cycle:
		49 %

Table 7.1 - Summary of Duty Cycle Evaluation

Transmit Duty Cycle Results					
Frequency (MHz)	Bandwidth Setting (kHz)	Supply Voltage (VDC)	Mode	Operation	Measured Duty Cycle Cycle (%)
2402	Max	3	ANT	Normal	0.067
			BLE	Normal	0.170
			ANT	Test Mode	94
			BLE	Test Mode	49

The variation of the transmit duty cycle was less than 2%

8.0 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.

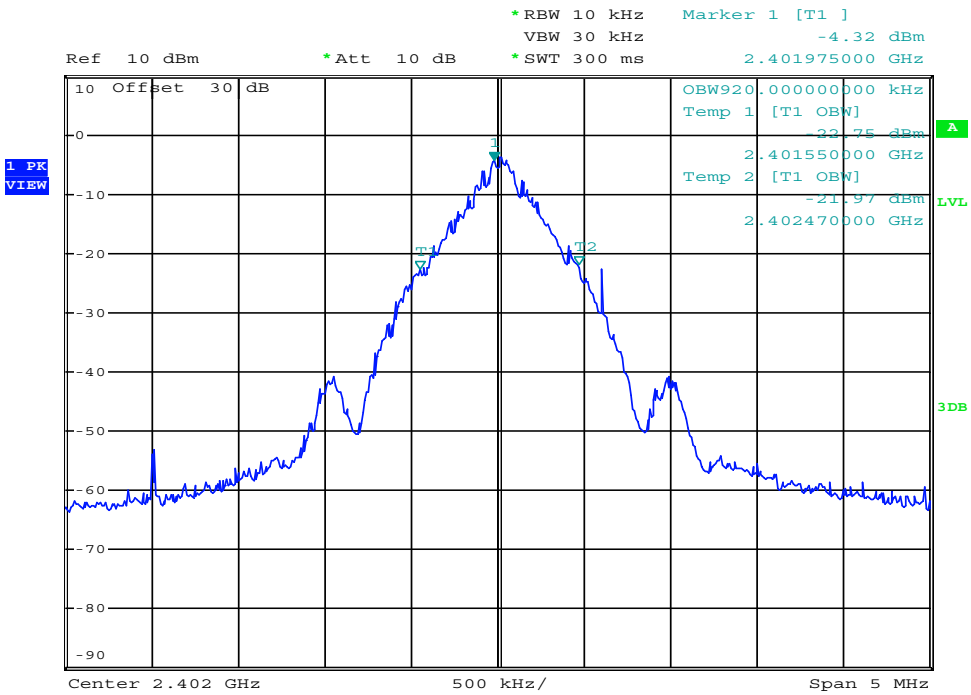
Test Setup	Appendix A - Figure A.1

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.

Plot 8.1 – Occupied Bandwidth – 2402MHz, ANT

Occupied Bandwidth

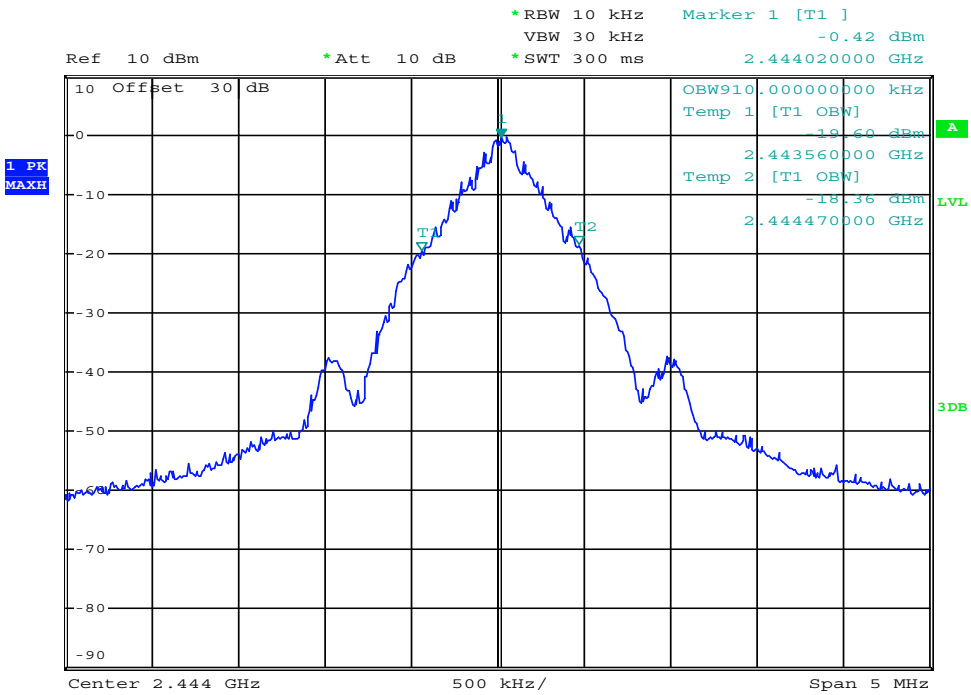


Date: 30.JUL.2019 15:30:15

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2402.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GFSK	**Max** dBm	**920.00** kHz

Plot 8.2 – Occupied Bandwidth – 2444MHz, ANT

Occupied Bandwidth

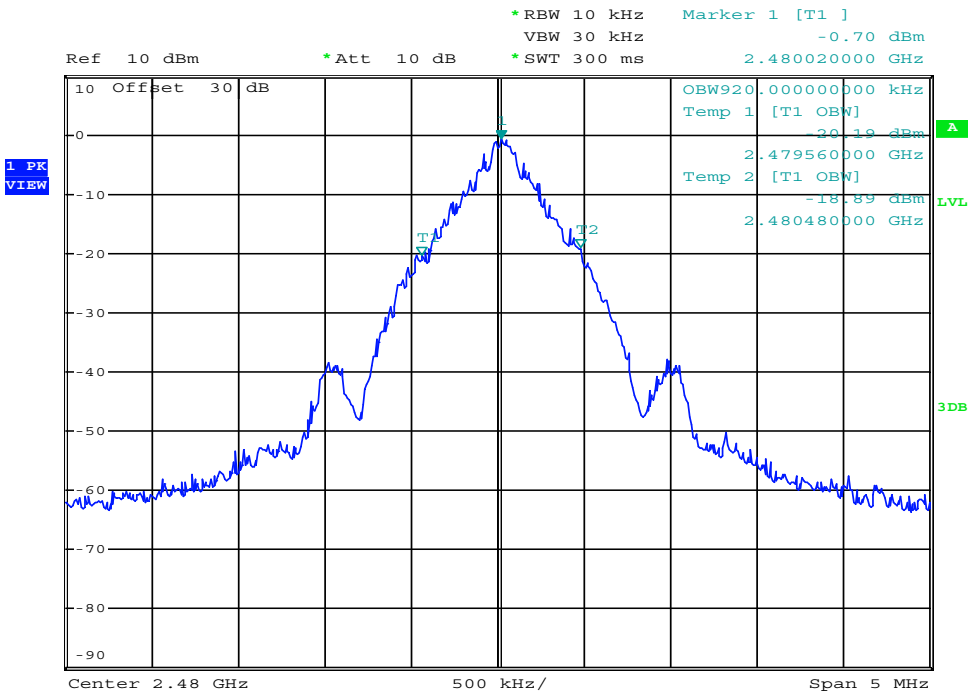


Date: 12.AUG.2019 12:37:29

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2444.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GFSK	**Max** dBm	**910.00** kHz

Plot 8.3 – Occupied Bandwidth – 2480MHz, ANT

Occupied Bandwidth

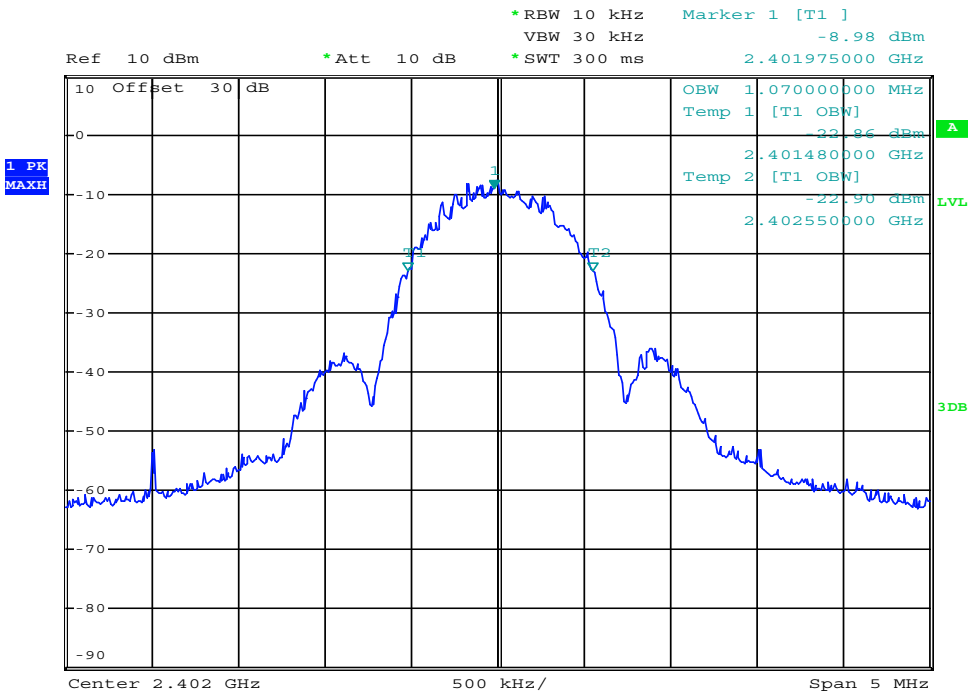


Date: 12.AUG.2019 12:41:27

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2480.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GFSK	**Max** dBm	**920.00** kHz

Plot 8.4 – Occupied Bandwidth – 2402MHz, BLE

Occupied Bandwidth

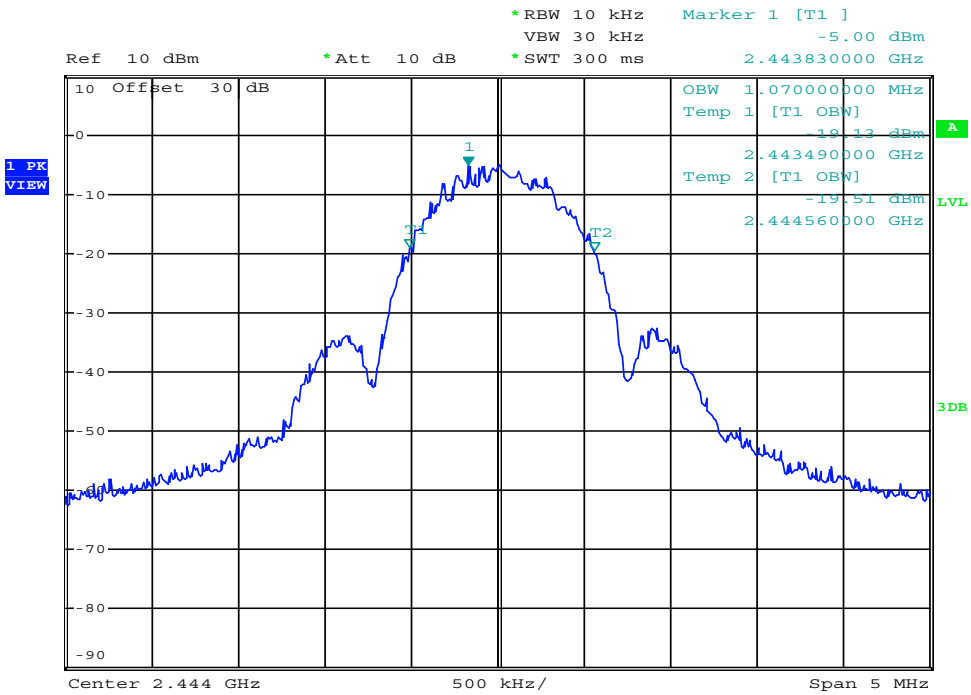


Date: 30.JUL.2019 15:34:20

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2402.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	Channel Power Setting:	Measured OBW:
GMSK	**Max** dBm	**1070.00** kHz

Plot 8.5 – Occupied Bandwidth – 2444MHz, BLE

Occupied Bandwidth

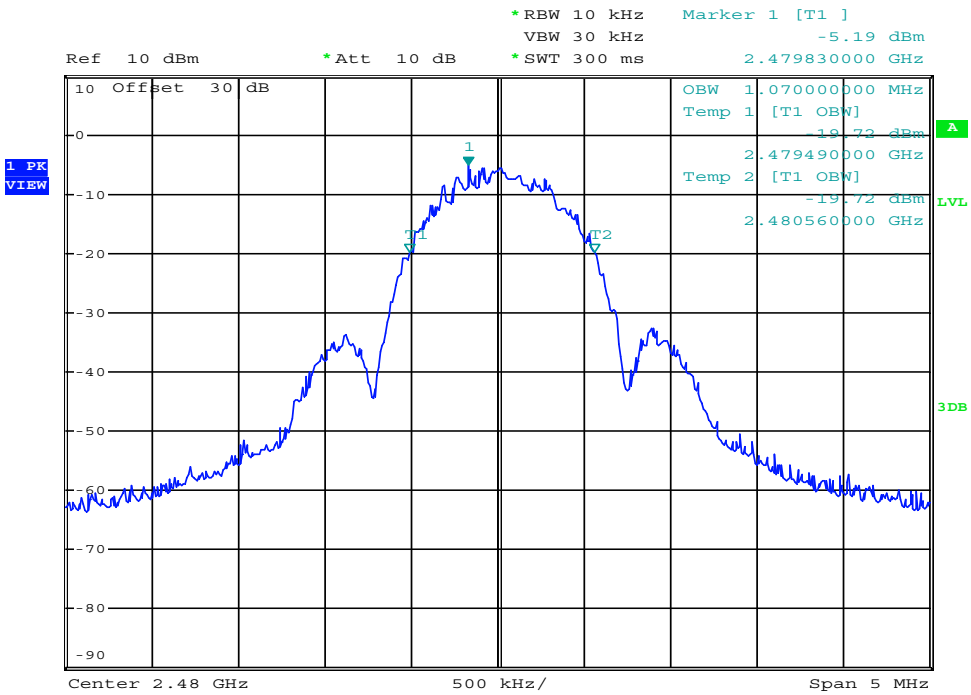


Date: 12.AUG.2019 12:39:08

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2444.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GMSK	**Max** dBm	**1070.00** kHz

Plot 8.6 – Occupied Bandwidth – 2480MHz, BLE

Occupied Bandwidth



Date: 12.AUG.2019 12:40:40

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2480.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GMSK	**Max** dBm	**1070.00** kHz

Table 8.1 - Summary of Occupied Bandwidth Measurements

Occupied Bandwidth Measurements					
Frequency (MHz)	**Bandwidth Setting (MHz)**	**Modulation**	**Mode**	**Measured OBW (kHz)**	**Emission Designator**
2405.00	Max	GFSK	ANT	920	920KF1D
2440.00				910	910KF1D
2480.00				920	920KF1D
2405.00		GMSK	BLE	1070	1M07F1D
2440.00				1070	1M07F1D
2480.00				1070	1M07F1D

9.0 6DB 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.

General Procedure	
KDB 558074 (8.2) C63.10 (11.8.2)	**11.8.2 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.

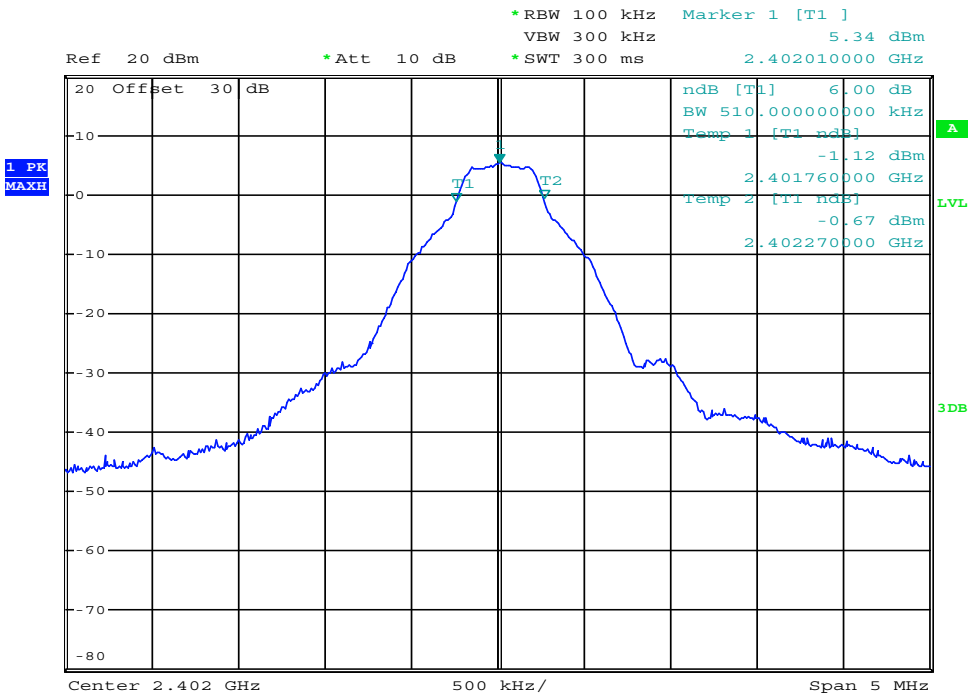
Test Setup	Appendix A - Figure A.1

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 its maximum Duty Cycle.

Plot 9.1 – 6dB Bandwidth, 2402MHz, ANT

6dB Bandwidth

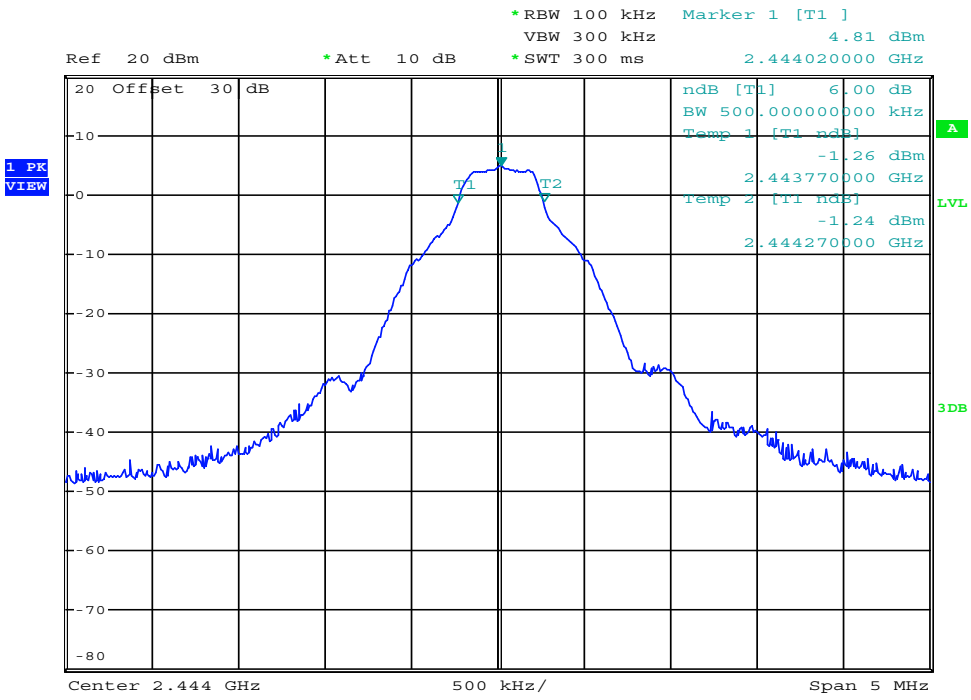


Date: 12.AUG.2019 12:48:31

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2402.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GFSK	**Max** dBm	**510.00** kHz

Plot 9.2 – 6dB Bandwidth, 2444MHz, ANT

6dB Bandwidth

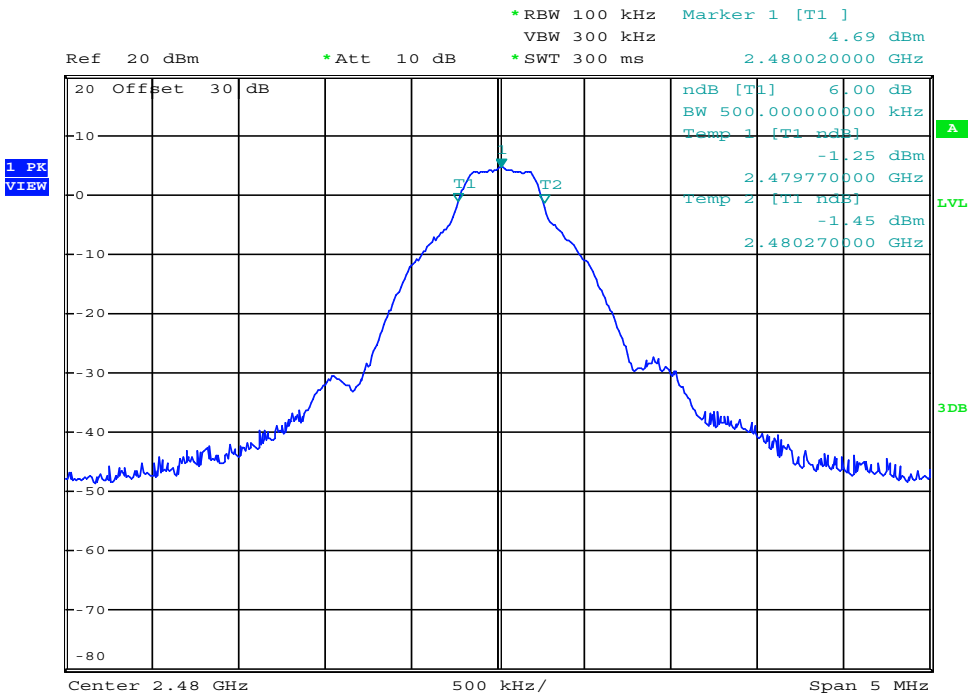


Date: 12.AUG.2019 12:51:00

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2444.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GFSK	**Max** dBm	**500.00** kHz

Plot 9.3 – 6dB Bandwidth, 2480MHz, ANT

6dB Bandwidth

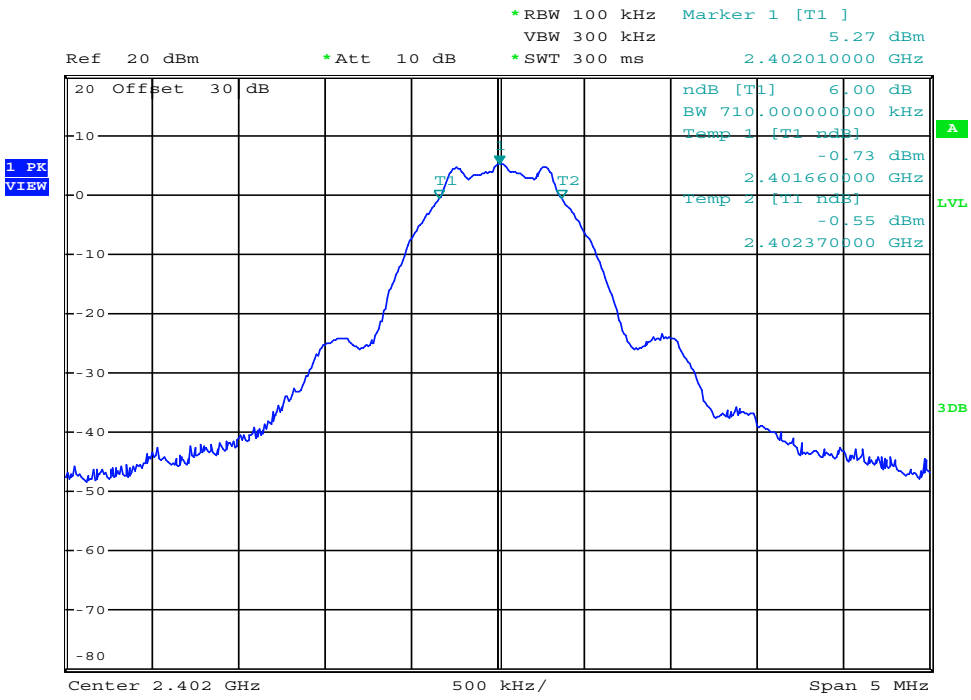


Date: 12.AUG.2019 12:51:54

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2480.00 MHz	**Max** kHz	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GFSK	**Max** dBm	**500.00** kHz

Plot 9.4 – 6dB Bandwidth, 2402MHz, BLE

6dB Bandwidth

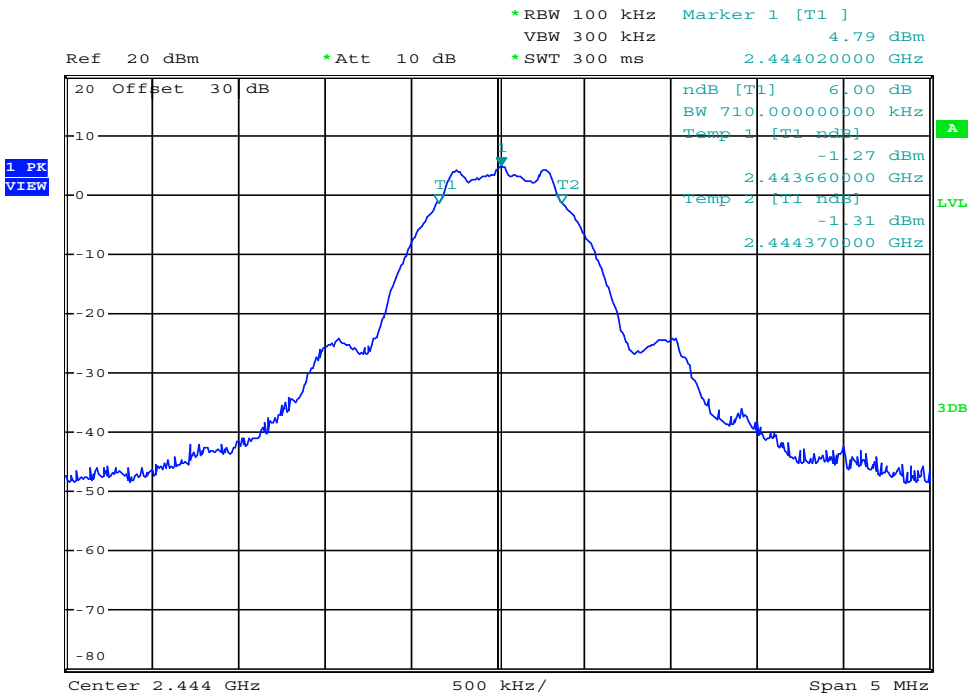


Date: 12.AUG.2019 12:49:18

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2402.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GMSK	**Max** dBm	**710.00** kHz

Plot 9.5 – 6dB Bandwidth, 2444MHz, BLE

6dB Bandwidth

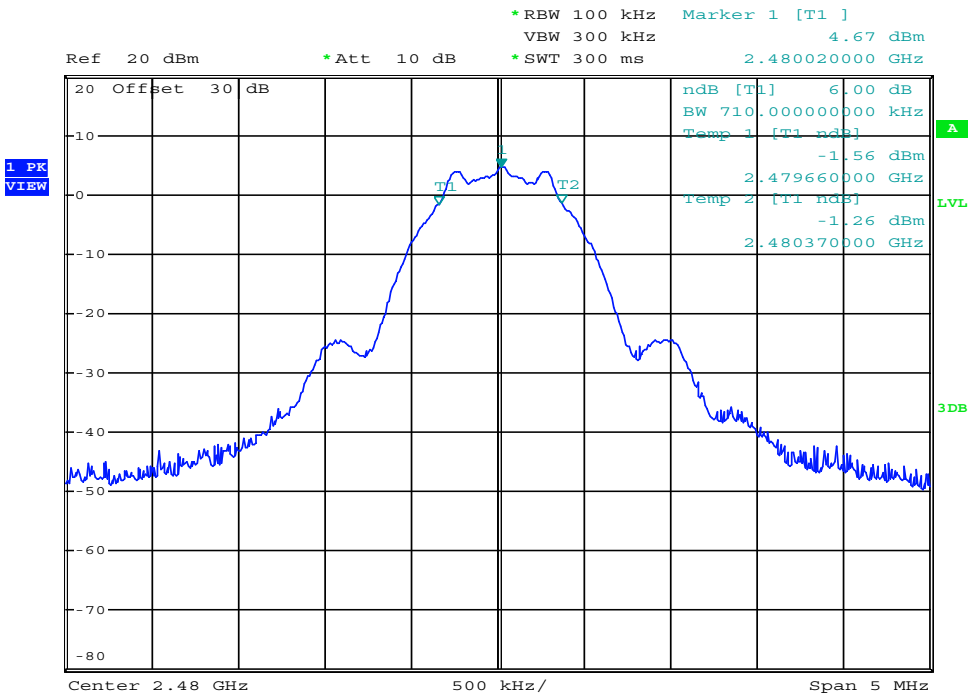


Date: 12.AUG.2019 12:50:08

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2444.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GMSK	**Max** dBm	**710.00** kHz

Plot 9.6 – 6dB Bandwidth, 2480MHz, BLE

6dB Bandwidth



Date: 12.AUG.2019 12:52:52

Channel Frequency:	Channel Bandwidth Setting:	Mode:
2480.00 MHz	**Max** kHz	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Measured OBW:**
GMSK	**Max** dBm	**710.00** kHz

Table 9.1 - Summary of 6dB Bandwidth Measurements

6dB Bandwidth Measurements				
Frequency (MHz)	**Bandwidth Setting (MHz)**	**Modulation**	**Mode**	**Measured OBW (kHz)**
2405.00	Max	GFSK	ANT	510
2440.00				500
2480.00				500
2405.00		GMSK	BLE	710
2440.00				710
2480.00				710

10.0 FIELD STRENGTH

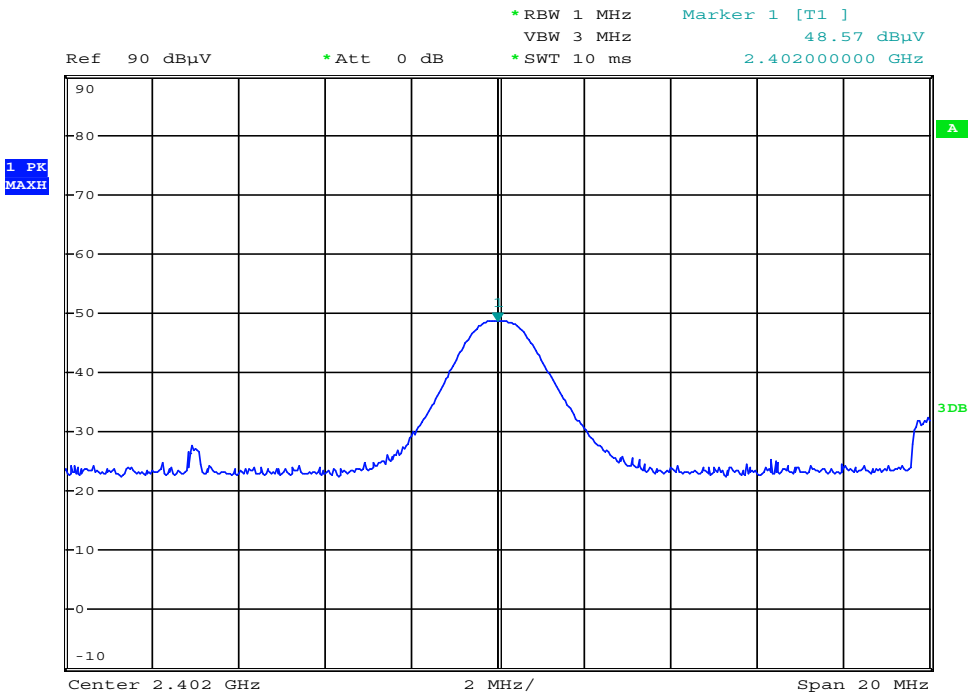
Test Procedure	
Normative Reference	FCC 47 CFR §2.1046
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

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.

Plot 10.1 – Field Strength, ANT, 2402MHz, Horizontal, Peak

Field Strength (Peak)

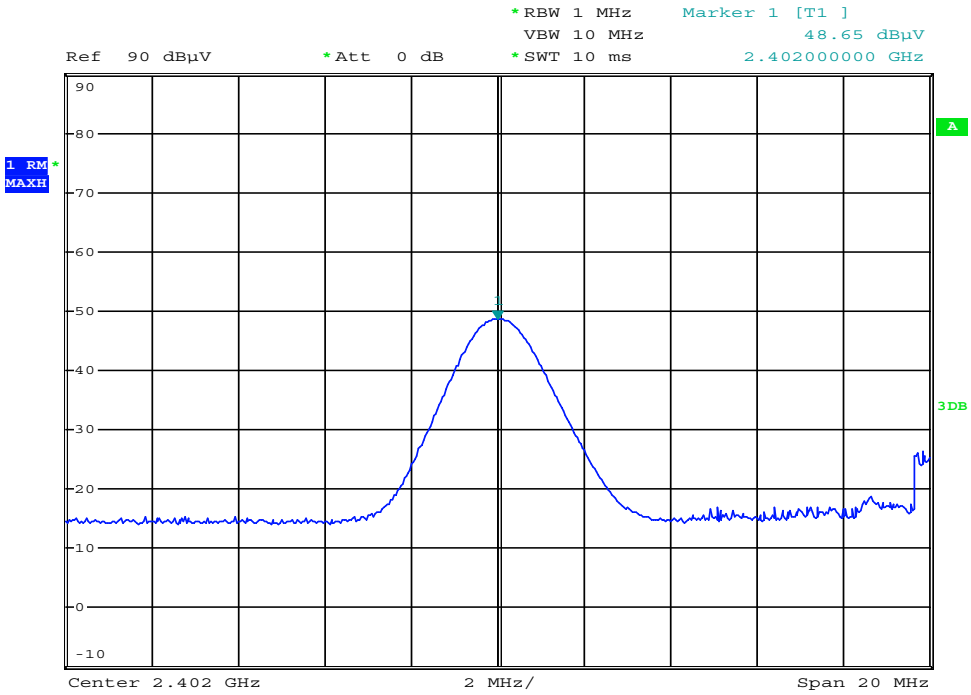


Date: 10.JUL.2019 13:32:33

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		48.57 dBuV

Plot 10.2 – Field Strength, ANT, 2402MHz, Horizontal, RMS

Field Strength (RMS)

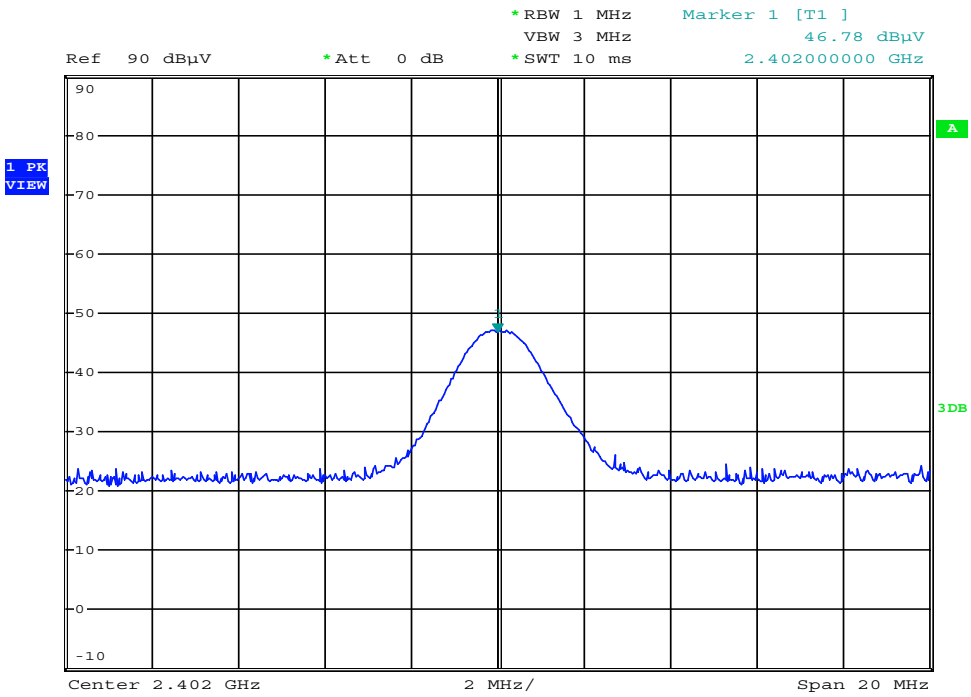


Date: 10.JUL.2019 13:33:05

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		48.65 dBuV

Plot 10.3 – Field Strength, ANT, 2402MHz, Vertical, Peak

Field Strength (Peak)

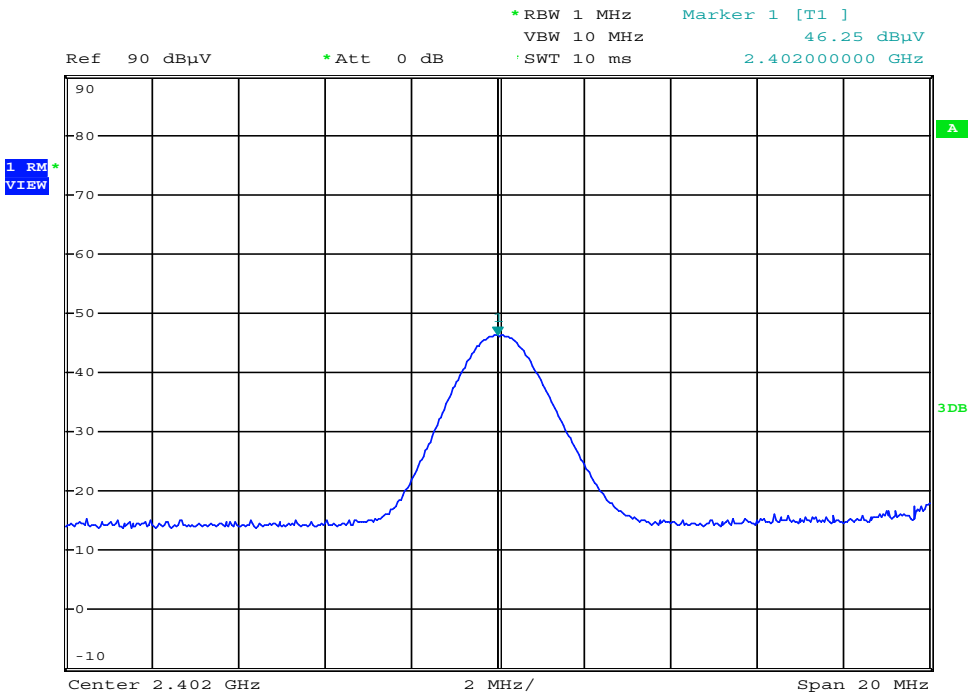


Date: 10.JUL.2019 13:36:04

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		46.78 dBuV

Plot 10.4 – Field Strength, ANT, 2402MHz, Vertical, RMS

Field Strength (RMS)

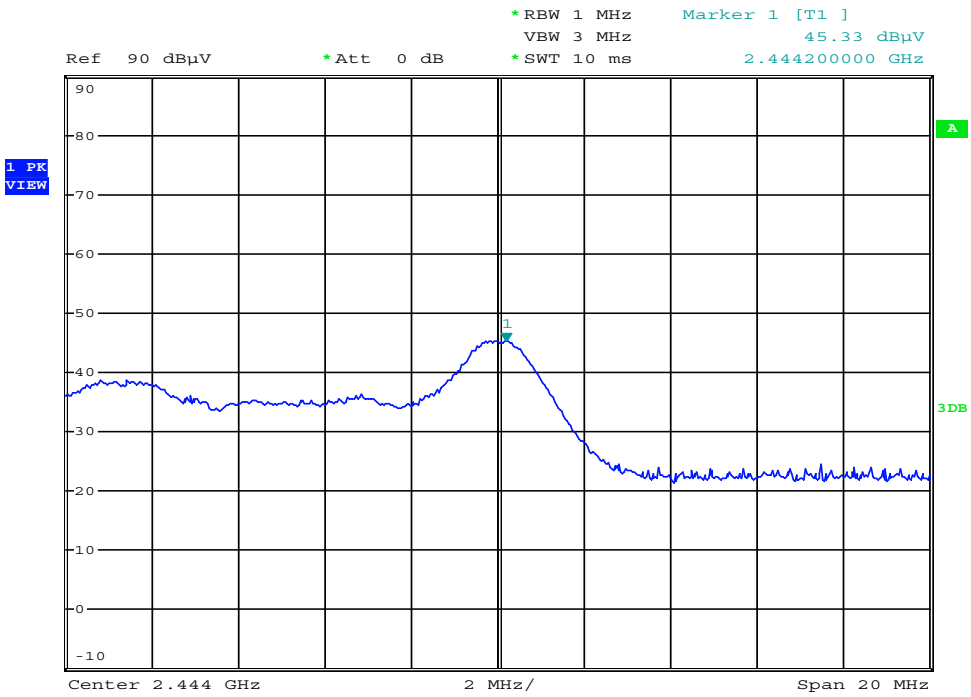


Date: 10.JUL.2019 13:29:38

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		46.25 dBuV

Plot 10.5 – Field Strength, ANT, 2444MHz, Horizontal, Peak

Field Strength (Peak)

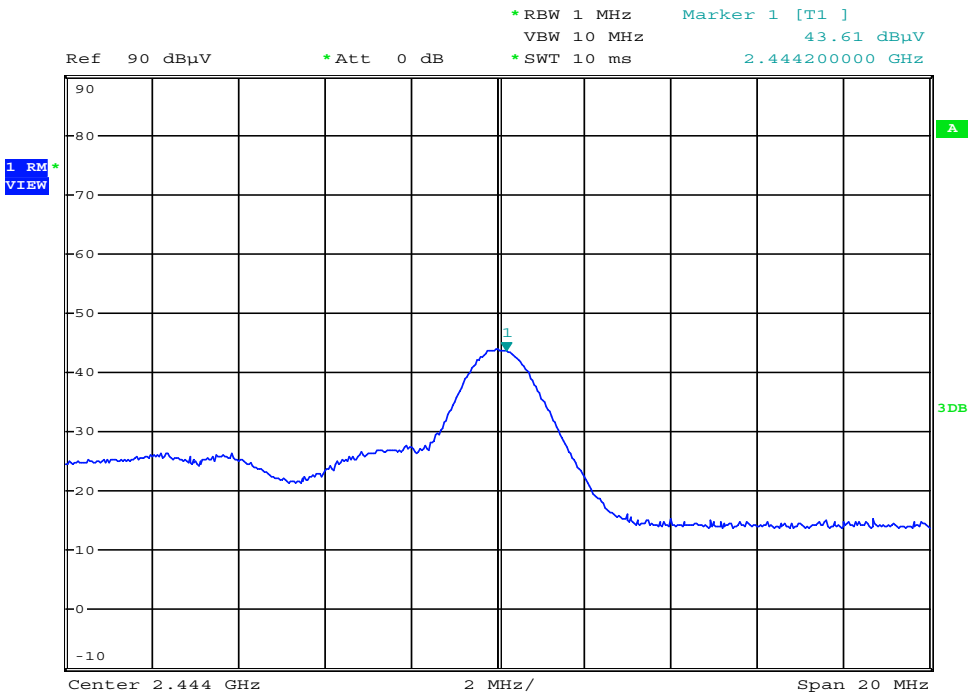


Date: 10.JUL.2019 14:25:05

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		45.33 dBuV

Plot 10.6 – Field Strength, ANT, 2444MHz, Horizontal, RMS

Field Strength (RMS)

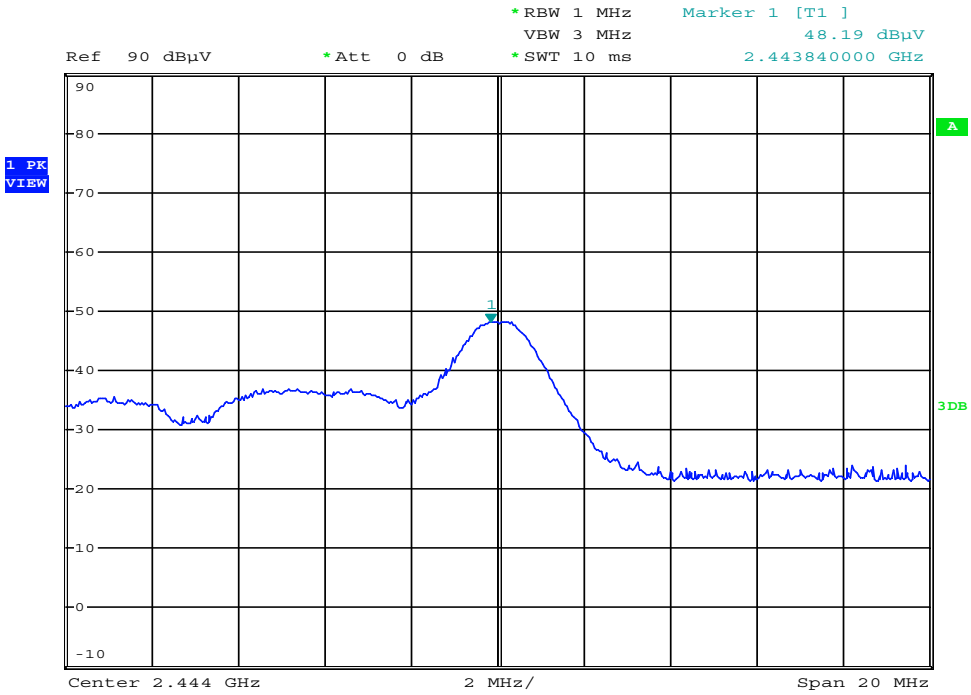


Date: 10.JUL.2019 14:25:39

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		43.61 dBuV

Plot 10.7 – Field Strength, ANT, 2444MHz, Vertical, Peak

Field Strength (Peak)

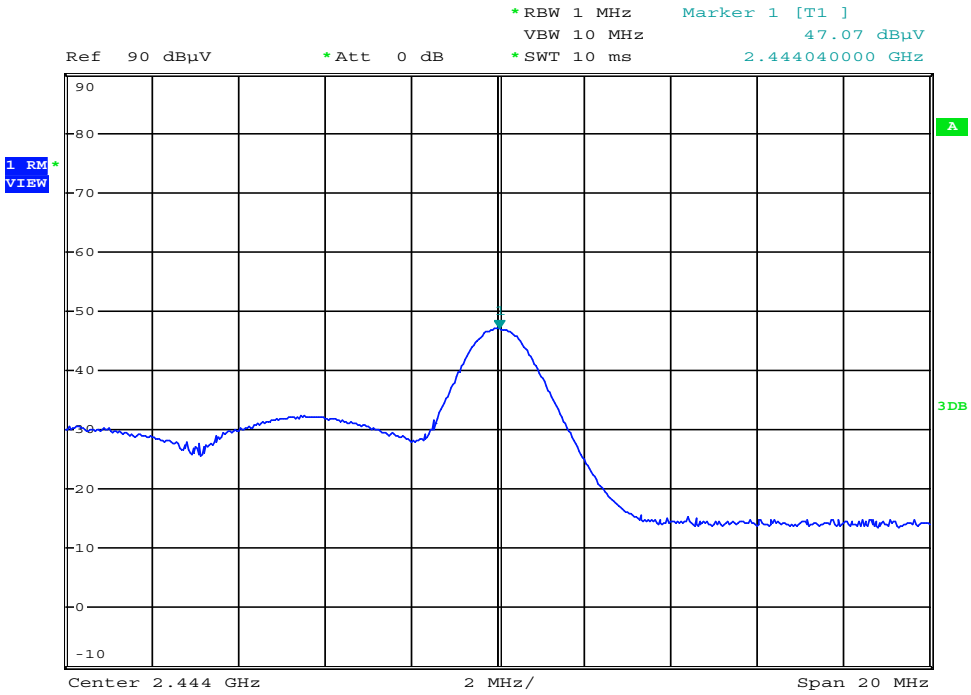


Date: 10.JUL.2019 14:33:30

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		48.19 dBuV

Plot 10.8 – Field Strength, ANT, 2444MHz, Vertical, RMS

Field Strength (RMS)

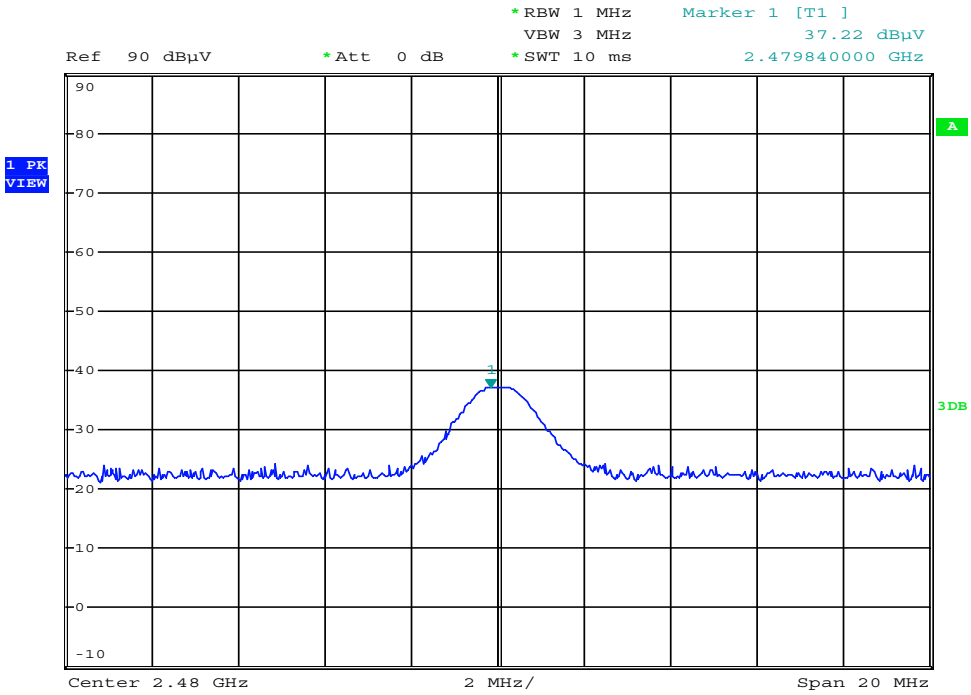


Date: 10.JUL.2019 14:33:05

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		47.07 dBuV

Plot 10.9 – Field Strength, ANT, 2480MHz, Horizontal, Peak

Field Strength (Peak)

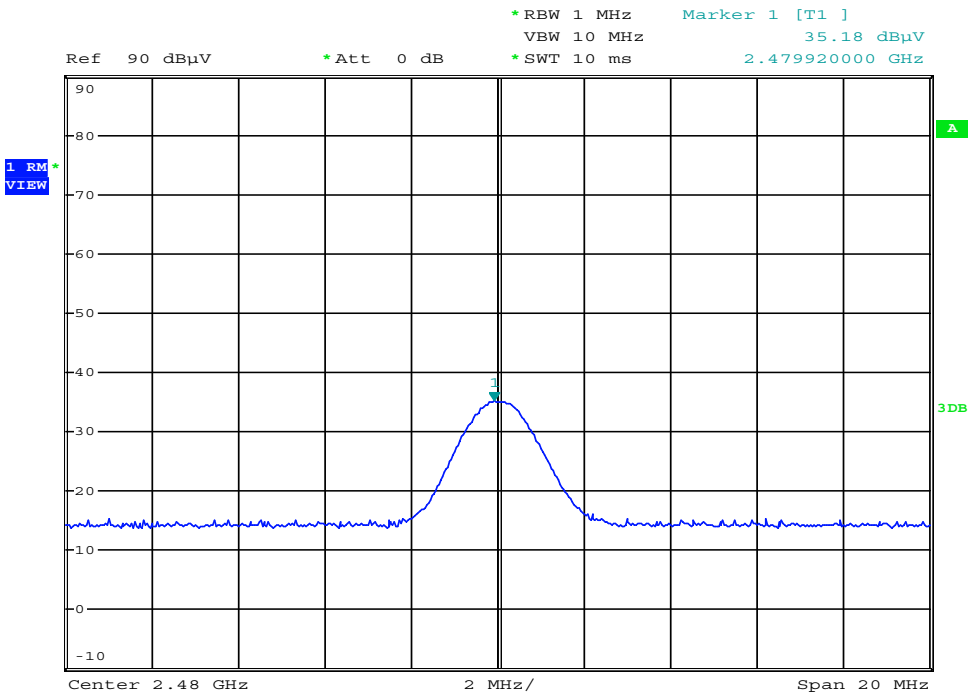


Date: 10.JUL.2019 14:46:23

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		37.22 dBuV

Plot 10.10 – Field Strength, ANT, 2480MHz, Horizontal, RMS

Field Strength (RMS)

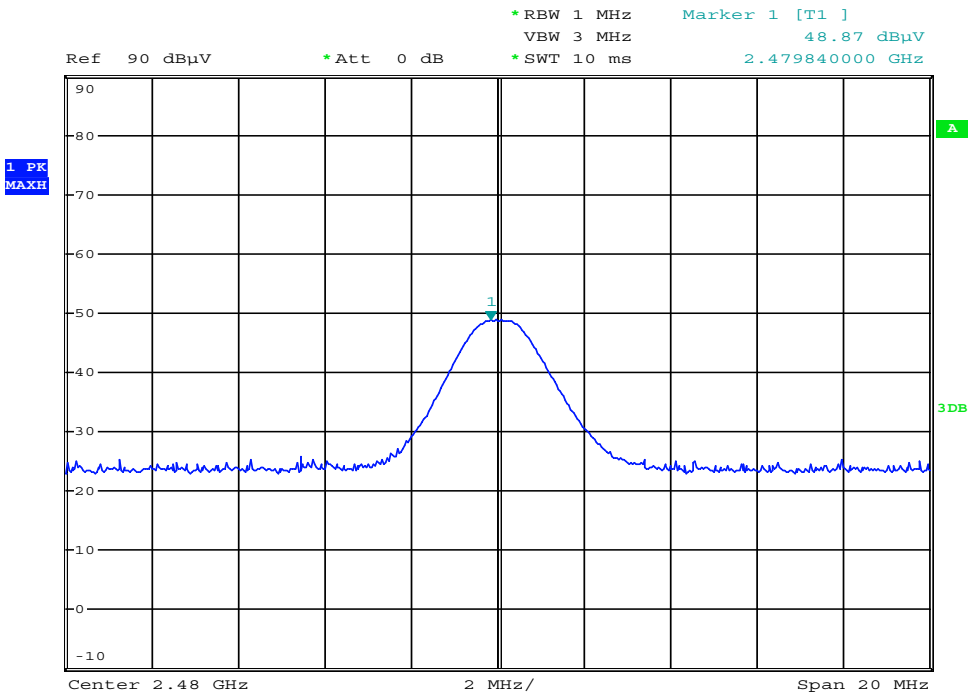


Date: 10.JUL.2019 14:45:38

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		35.18 dBuV

Plot 10.11 – Field Strength, ANT, 2480MHz, Vertical, Peak

Field Strength (Peak)

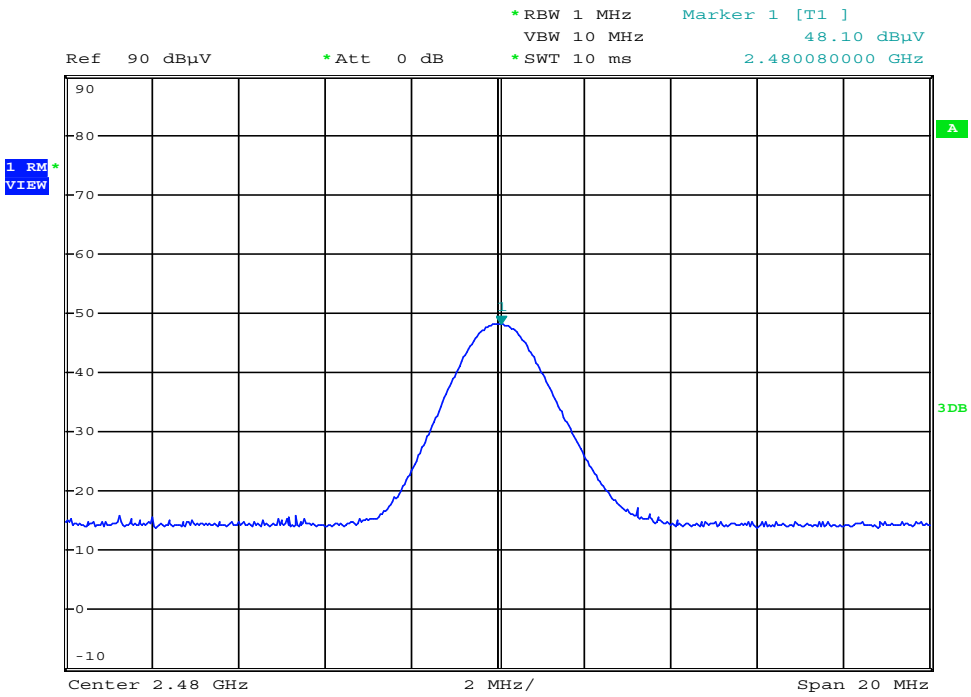


Date: 10.JUL.2019 14:43:21

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		48.87 dBuV

Plot 10.12 – Field Strength, ANT, 2480MHz, Vertical, RMS

Field Strength (RMS)

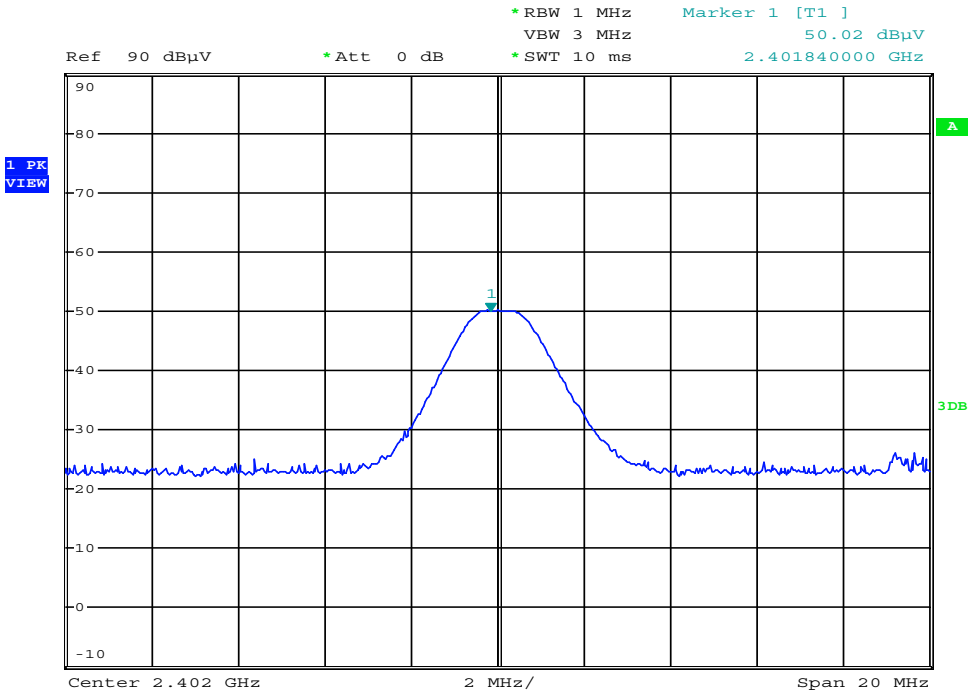


Date: 10.JUL.2019 14:43:51

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		48.10 dBuV

Plot 10.13 – Field Strength, BLE, 2402MHz, Horizontal, Peak

Field Strength (Peak)

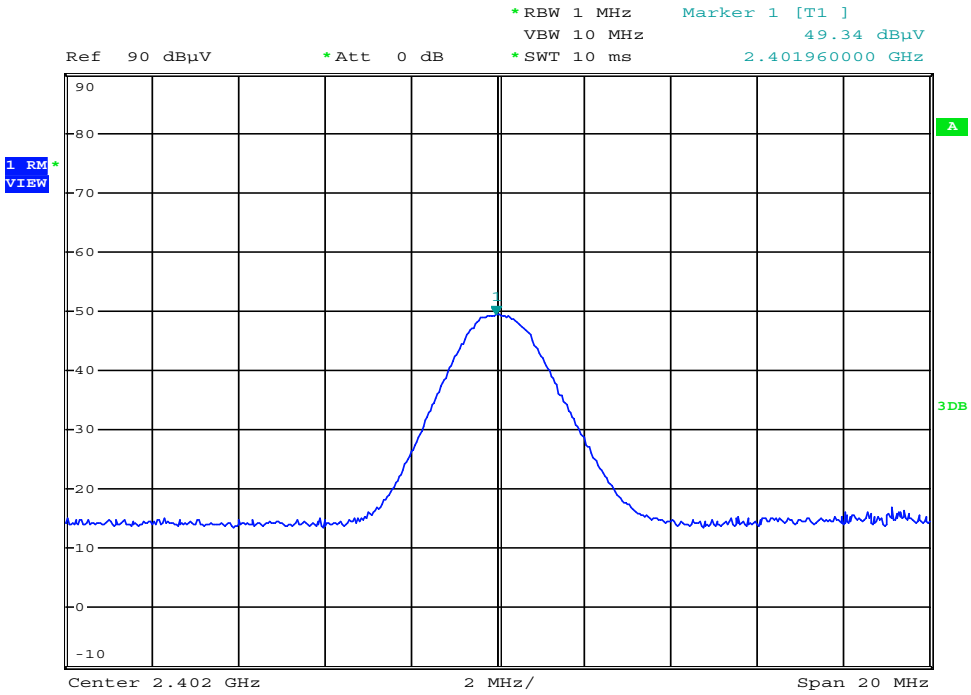


Date: 10.JUL.2019 14:08:03

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**BLE**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		50.02 dBuV

Plot 10.14 – Field Strength, BLE, 2402MHz, Horizontal, RMS

Field Strength (RMS)

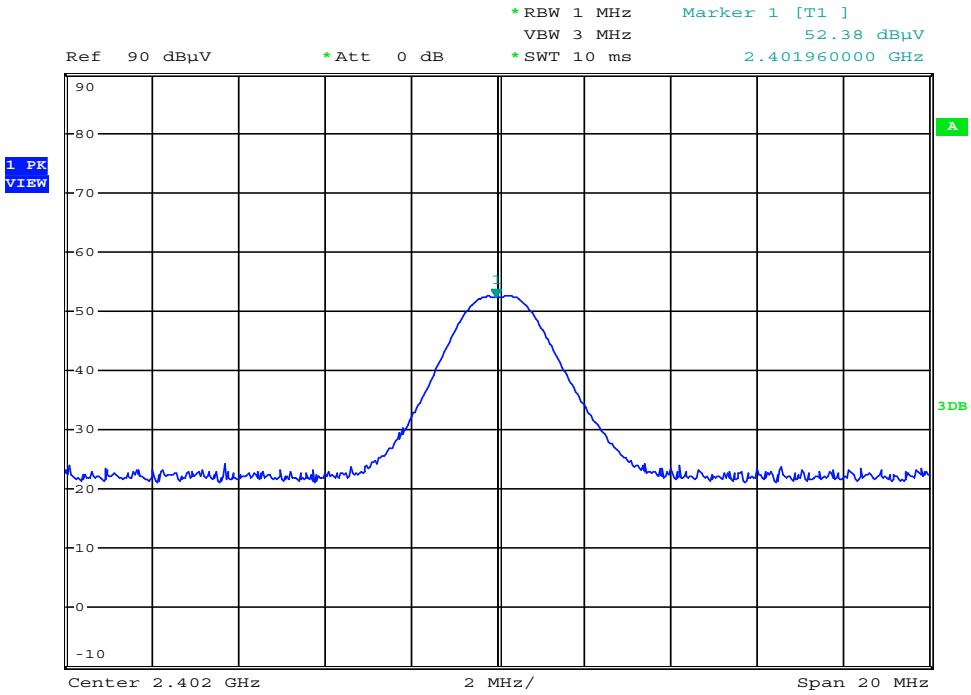


Date: 10.JUL.2019 14:08:32

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**BLE**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		49.34 dBuV

Plot 10.15 – Field Strength, BLE, 2402MHz, Vertical, Peak

Field Strength (Peak)

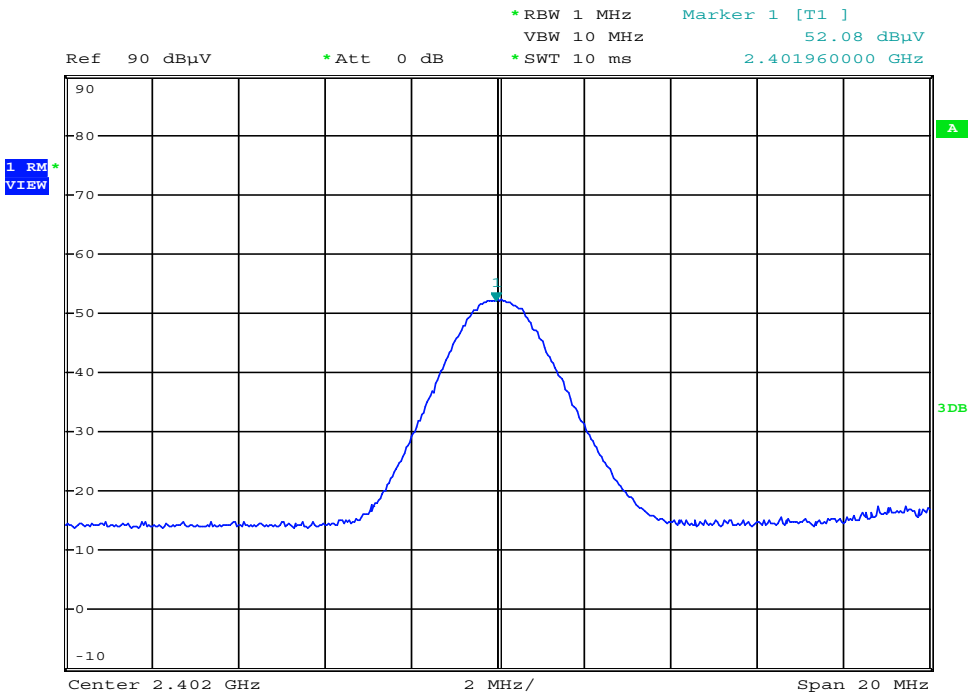


Date: 10.JUL.2019 14:10:37

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**BLE**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		52.38 dBuV

Plot 10.16 – Field Strength, BLE, 2402MHz, Vertical, RMS

Field Strength (RMS)

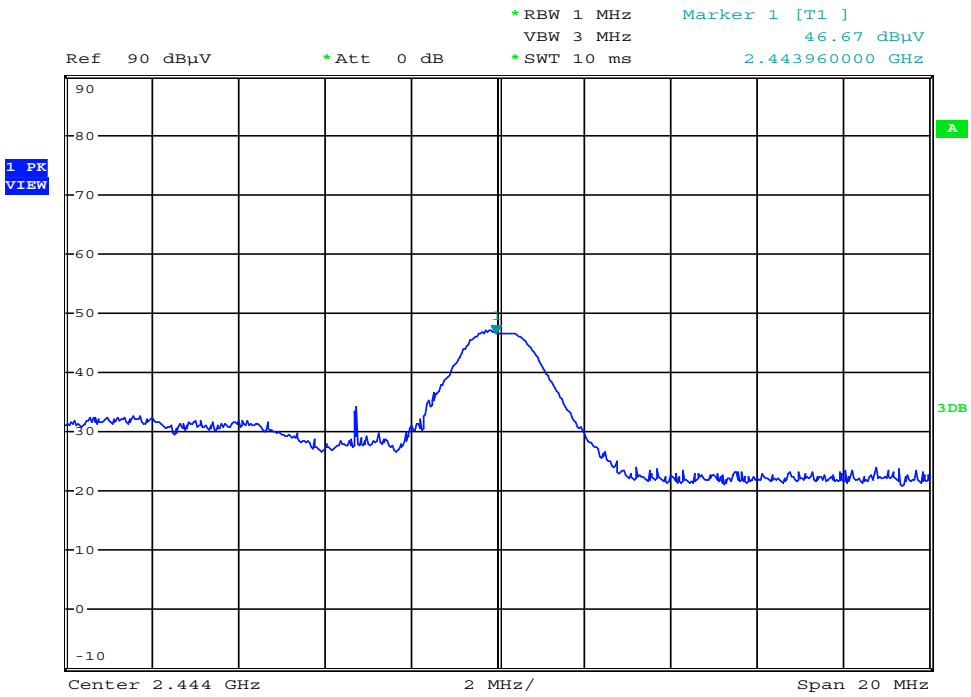


Date: 10.JUL.2019 14:10:11

Channel Frequency:	Protocol:	Antenna Polarization:
2402.00 MHz	**BLE**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		52.08 dBuV

Plot 10.17 – Field Strength, BLE, 2444MHz, Horizontal, Peak

Field Strength (Peak)

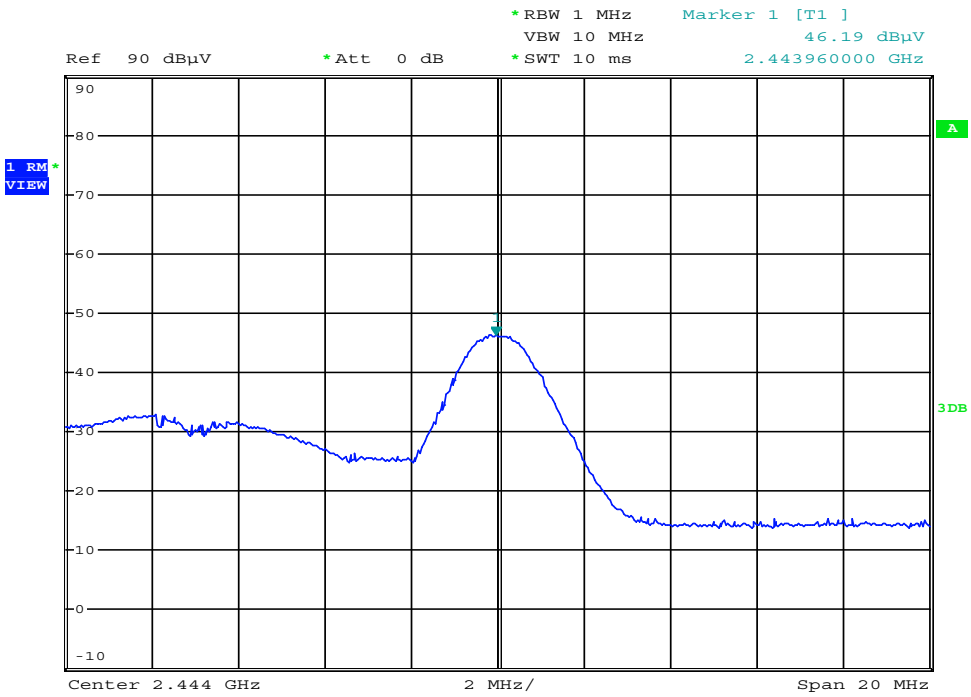


Date: 10.JUL.2019 14:20:10

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**BLE**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		46.67 dBuV

Plot 10.18 – Field Strength, BLE, 2444MHz, Horizontal, RMS

Field Strength (RMS)

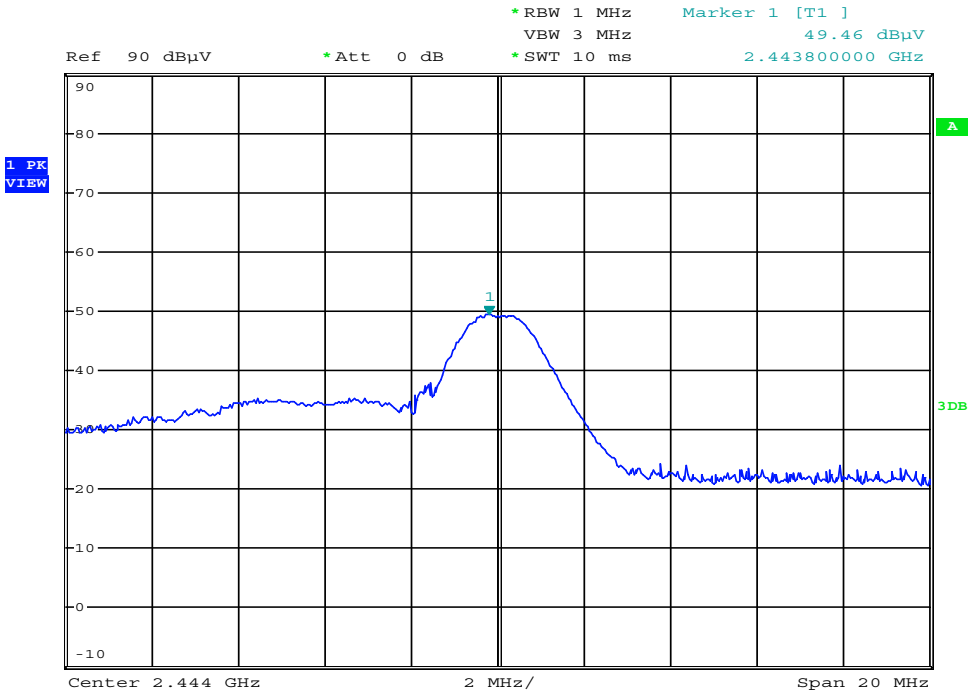


Date: 10.JUL.2019 14:19:42

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**BLE**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		46.19 dBuV

Plot 10.19 – Field Strength, BLE, 2444MHz, Vertical, Peak

Field Strength (Peak)

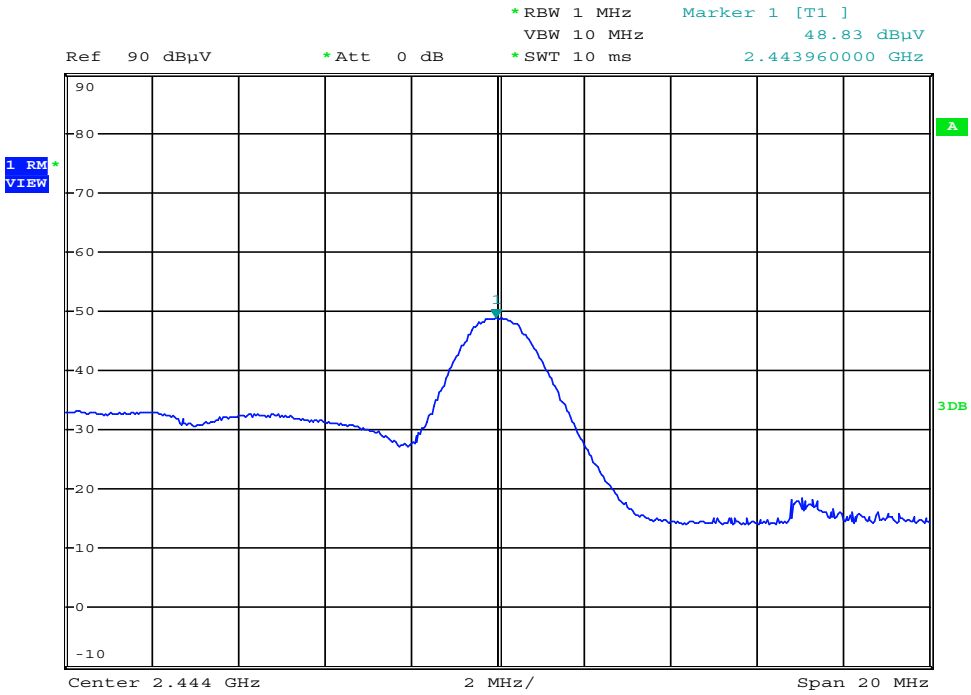


Date: 10.JUL.2019 14:16:37

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**BLE**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		49.46 dBuV

Plot 10.20 – Field Strength, BLE, 2444MHz, Vertical, RMS

Field Strength (RMS)

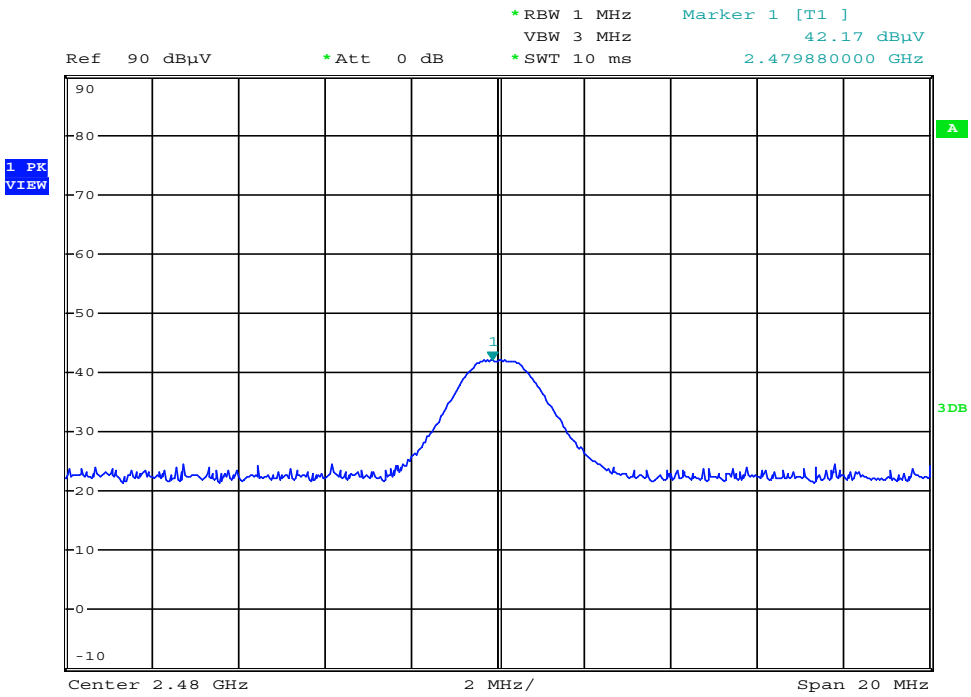


Date: 10.JUL.2019 14:18:21

Channel Frequency:	Protocol:	Antenna Polarization:
2444.00 MHz	**BLE**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		48.83 dBuV

Plot 10.21 – Field Strength, BLE, 2480MHz, Horizontal, Peak

Field Strength (Peak)

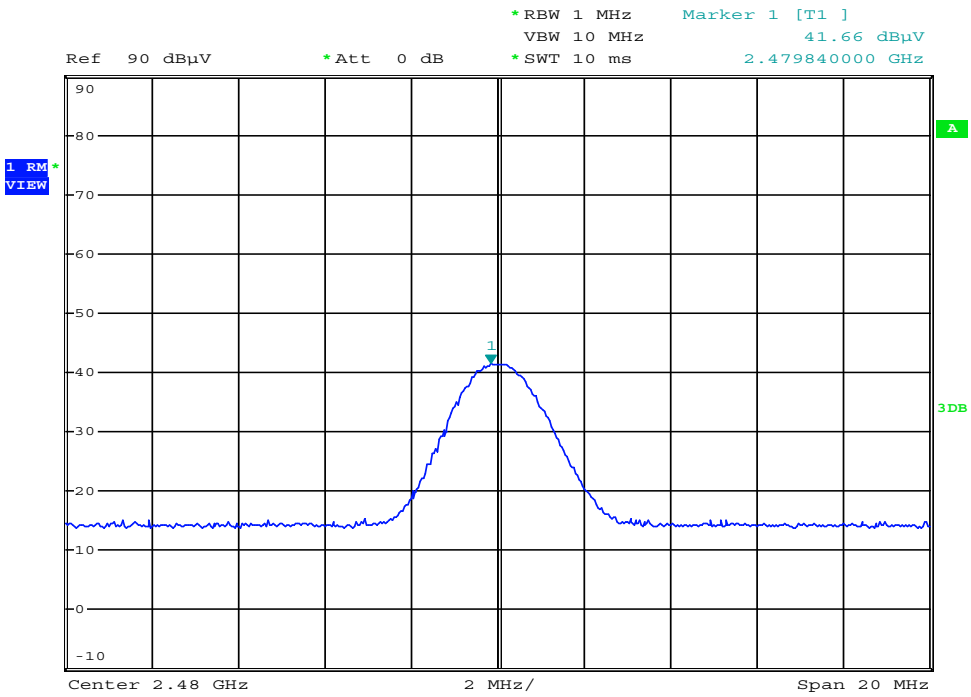


Date: 10.JUL.2019 14:50:03

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**BLE**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		42.17 dBuV

Plot 10.22 – Field Strength, BLE, 2480MHz, Horizontal, RMS

Field Strength (RMS)

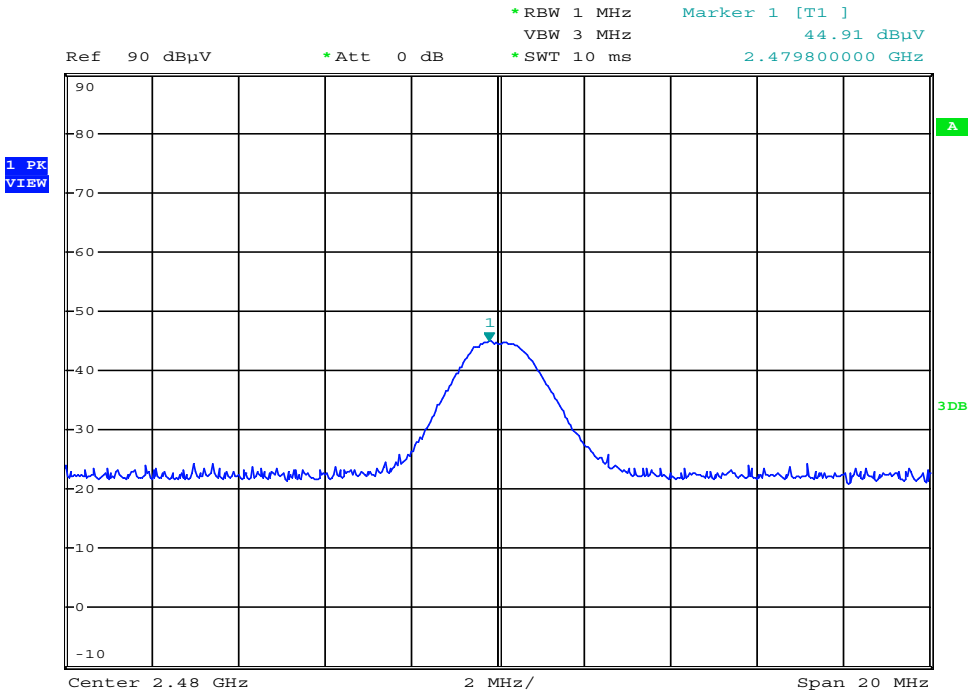


Date: 10.JUL.2019 14:50:33

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**BLE**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		41.66 dBuV

Plot 10.23 – Field Strength, BLE, 2480MHz, Vertical, Peak

Field Strength (Peak)

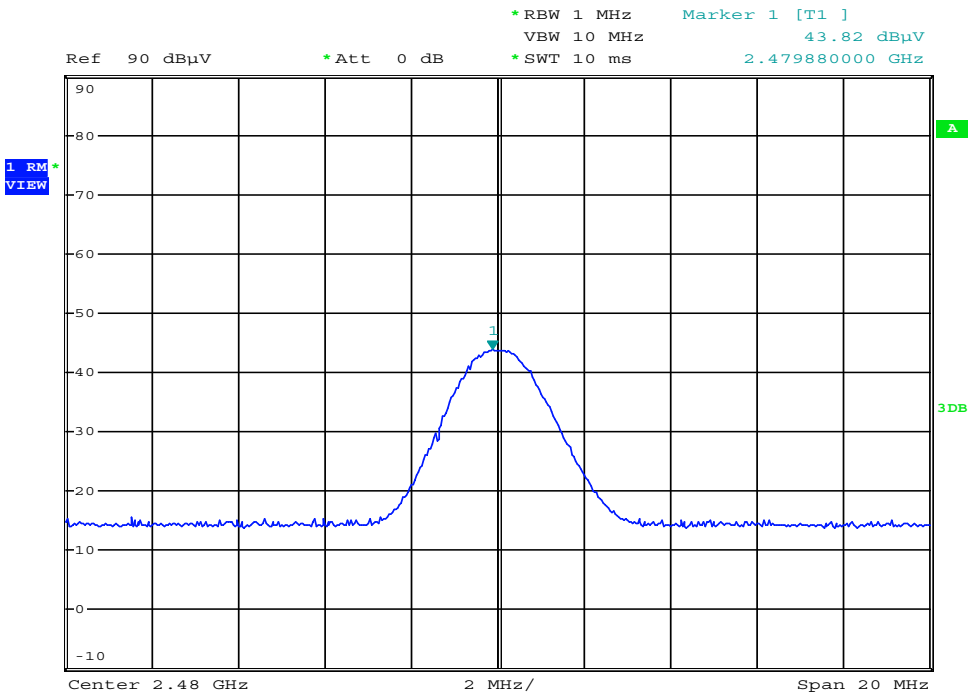


Date: 10.JUL.2019 14:52:19

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**BLE**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		44.91 dBuV

Plot 10.24 – Field Strength, BLE, 2480MHz, Vertical, RMS

Field Strength (RMS)



Date: 10.JUL.2019 14:51:51

Channel Frequency:	Protocol:	Antenna Polarization:
2480.00 MHz	**BLE**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Field Strength:
		43.82 dBuV

Table 10.1 - Summary of Field Strength Measurements, ANT

FCC §15.249(a), RSS-210 Radiated Field Strength													
Frequency (MHz)	Mode	OBW (kHz)	Modulation	Power Setting[1] (dBm)	Supply Voltage (VDC)	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 @3m)	Limit (dBuV)	Margin (dB)
2402.0	ANT	920	GFSK	Max	3.0	Peak	Horizontal	48.57	4.6	28.3	81.47	114.0	32.5
2444.0								45.33			78.23		35.8
2480.0								37.22			70.12		43.9
2402.0							Vertical	46.78			79.68		34.3
2444.0								48.19			81.09		32.9
2480.0								48.87			81.77		32.2
2402.0						RMS	Horizontal	48.65			81.55	94.0	12.5
2444.0								43.61			76.51		17.5
2480.0								35.18			68.08		25.9
2402.0							Vertical	46.25			79.15		14.9
2444.0								47.07			79.97		14.0
2480.0								48.10			81.00		13.0
											Result:		Complies

$FS_{Corr} = FS_{Meas} + ACF + L_C$
Margin = Limit - FS_{Corr}
(1) The output power is factory set to maximum

Table 10.2 - Summary of Field Strength Measurements, BLE

FCC §15.249(a), RSS-210 Radiated Field Strength													
Frequency (MHz)	Mode	OBW (kHz)	Modulation	Power Setting[1] (dBm)	Supply Voltage (VDC)	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 @3m)	Limit (dBuV)	Margin (dB)
2402.0	BLE	1000	GMSK	Max	3.0	Peak	Horizontal	50.02	4.6	28.3	82.92	114.0	31.1
2444.0								46.67			79.57		34.4
2480.0								42.17			75.07		38.9
2402.0							Vertical	52.38			85.28		28.7
2444.0								49.46			82.36		31.6
2480.0								44.91			77.81		36.2
2402.0						RMS	Horizontal	49.34			82.24	94.0	11.8
2444.0								46.19			79.09		14.9
2480.0								41.66			74.56		19.4
2402.0							Vertical	52.08			84.98		9.0
2444.0								48.83			81.73		12.3
2480.0								43.82			76.72		17.3
											Result:		Complies

$FS_{Corr} = FS_{Meas} + ACF + L_C$
Margin = Limit - FS_{Corr}
(1) The output power is factory set to maximum

11.0 BAND EDGE

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.249(d)(e), RSS-Gen (6.12), RSS-210 (B.10)
	ANSI C63.10 (6.10.3)

Limits	
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).

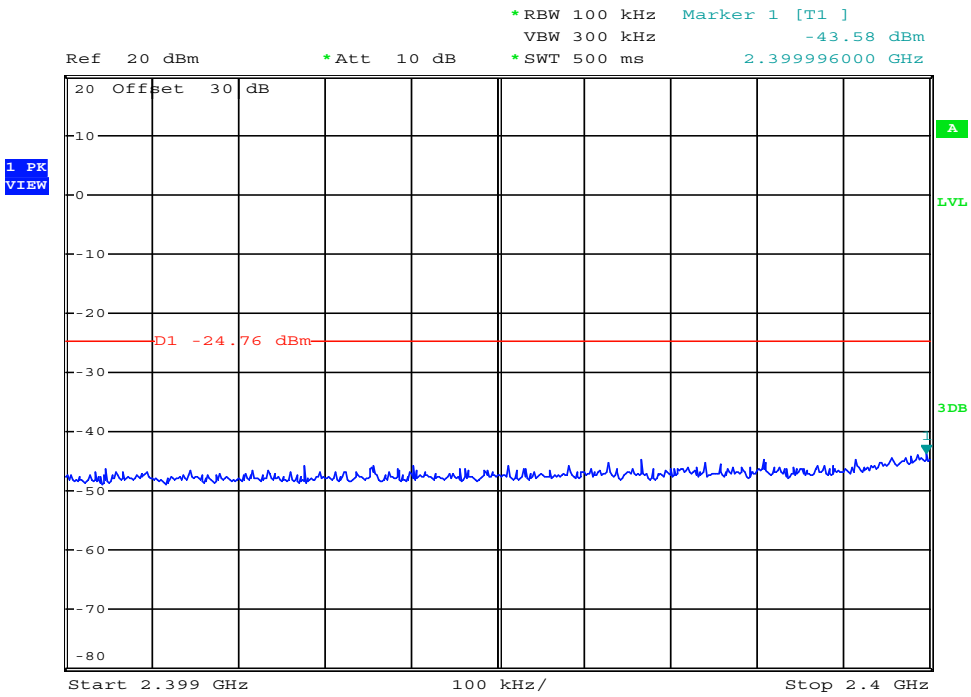
Test Setup	Appendix A Figure A.1

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.

Plot 11.1 – 2402MHz, ANT, Lower Band Edge

Lower Band Edge

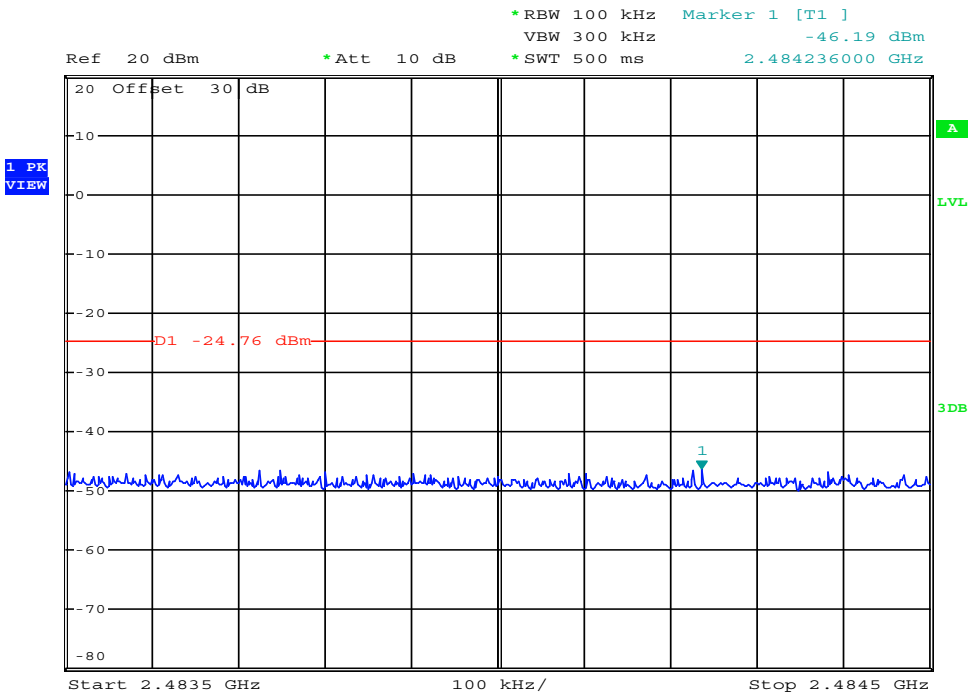


Date: 12.AUG.2019 15:33:58

Channel Frequency:	Transmit Duty Cycle:	Mode:
2402.00 MHz	**94** %	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level: **-43.58** dBm

Plot 11.2 – 2480MHz, ANT, Upper Band Edge

Upper Band Edge

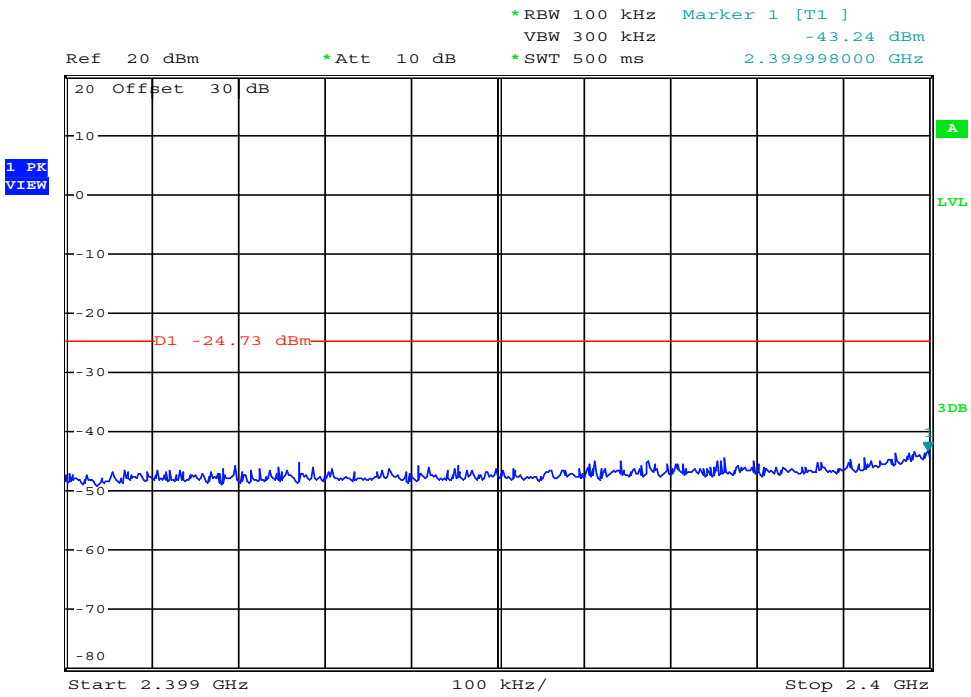


Date: 12.AUG.2019 15:37:05

Channel Frequency:	Transmit Duty Cycle:	Mode:
2480.00 MHz	**94** %	**ANT**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level: **-46.19** dBm

Plot 11.3 – 2402MHz, BLE, Lower Band Edge

Lower Band Edge

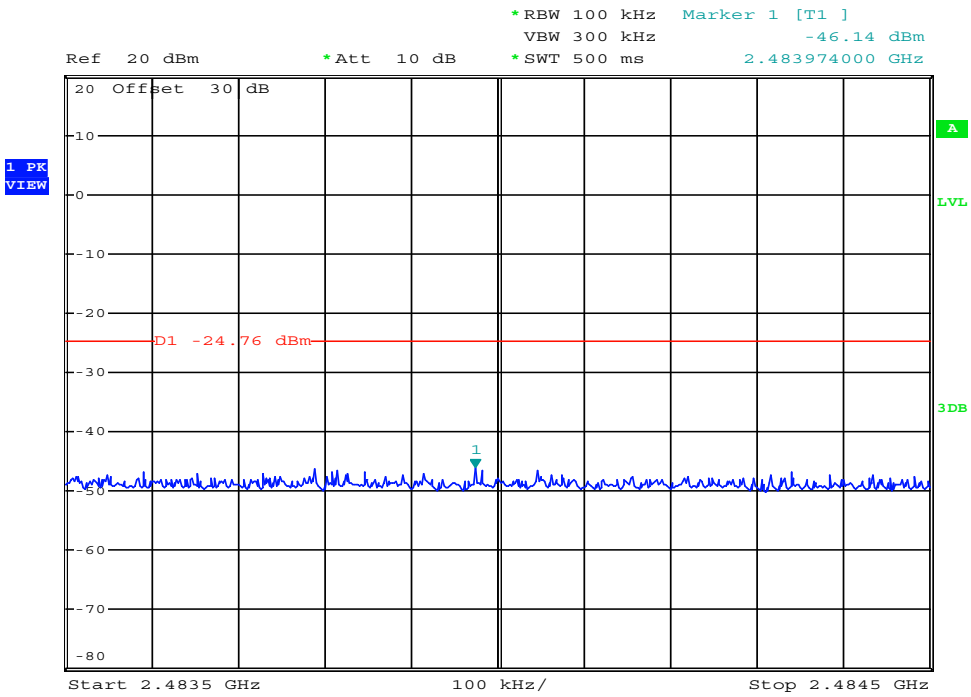


Date: 12.AUG.2019 15:31:32

Channel Frequency:	Transmit Duty Cycle:	Mode:
2402.00 MHz	**49** %	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Emission Level: **-43.24** dBm

Plot 11.4 – 2480MHz, BLE, Upper Band Edge

Upper Band Edge



Date: 12.AUG.2019 15:37:47

Channel Frequency:	Transmit Duty Cycle:	Mode:
2480.00 MHz	**49** %	**BLE**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GMSK	**Max** dBm	**3.0** VDC
		Measured Emission Level: **-46.14** dBm

Table 11.1 – Summary of Band Edge Measurements

Band Edge Emission Measurement								
Frequency Range (MHz)	Mode	Modulation	Power Setting[1] (dBm)	Supply Voltage (VDC)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Limit Line [A_L] (dBm)	Margin (dB)
2399- 2400	ANT	GFSK	Max	3.0	94	-43.58	-24.76	**18.82**
2483.5 - 2485.5						-46.19		**21.43**
2399- 2400	BLE	GMSK			49	-43.24	-24.76	**18.48**
2483.5 - 2485.5						-46.14		**21.38**
						Result:	**Complies**	

(1) The output power is factory set to maximum

Margin = A_L - E_{MEAS}

12.0 RADIATED SPURIOUS EMISSIONS – RESTRICTED BANDS

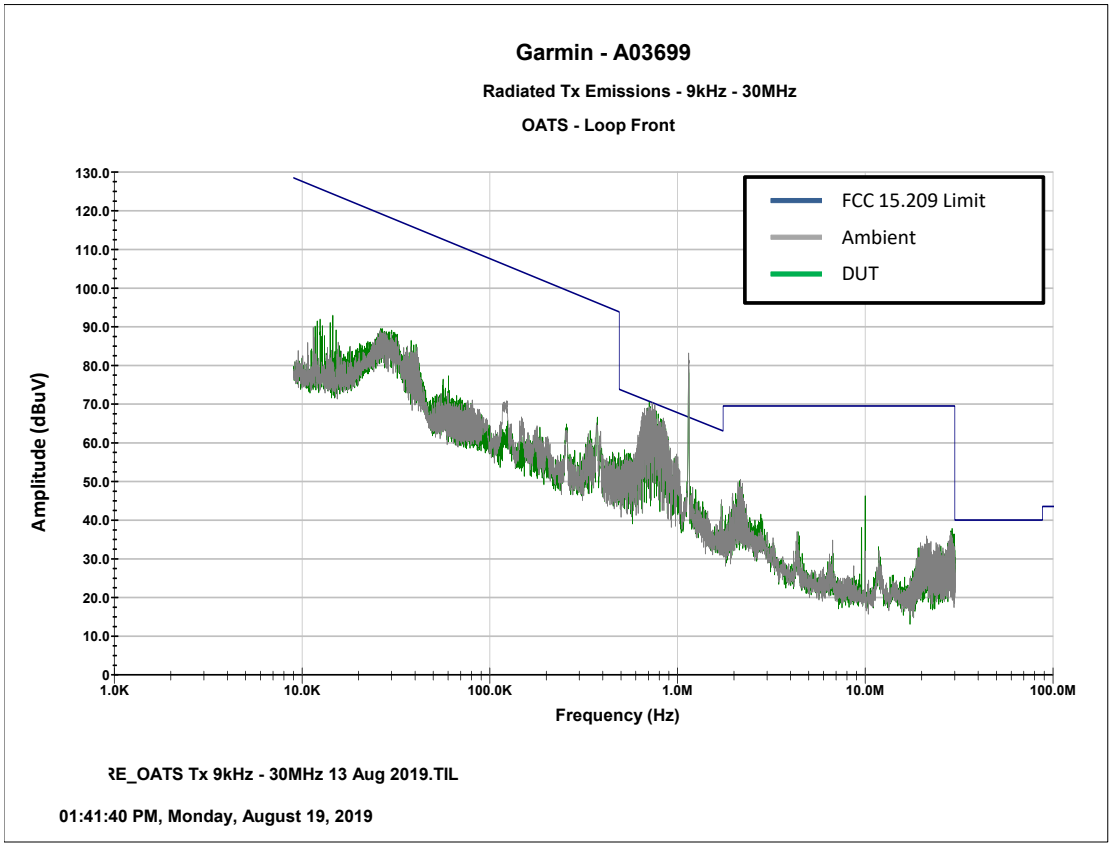
Test Procedure	
Normative Reference	FCC 47 CFR §2.1046
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

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 to the 10th harmonic and recorded.

Plot 12.1 – Spurious Emissions - 9kHz – 30MHz, Front Polarization

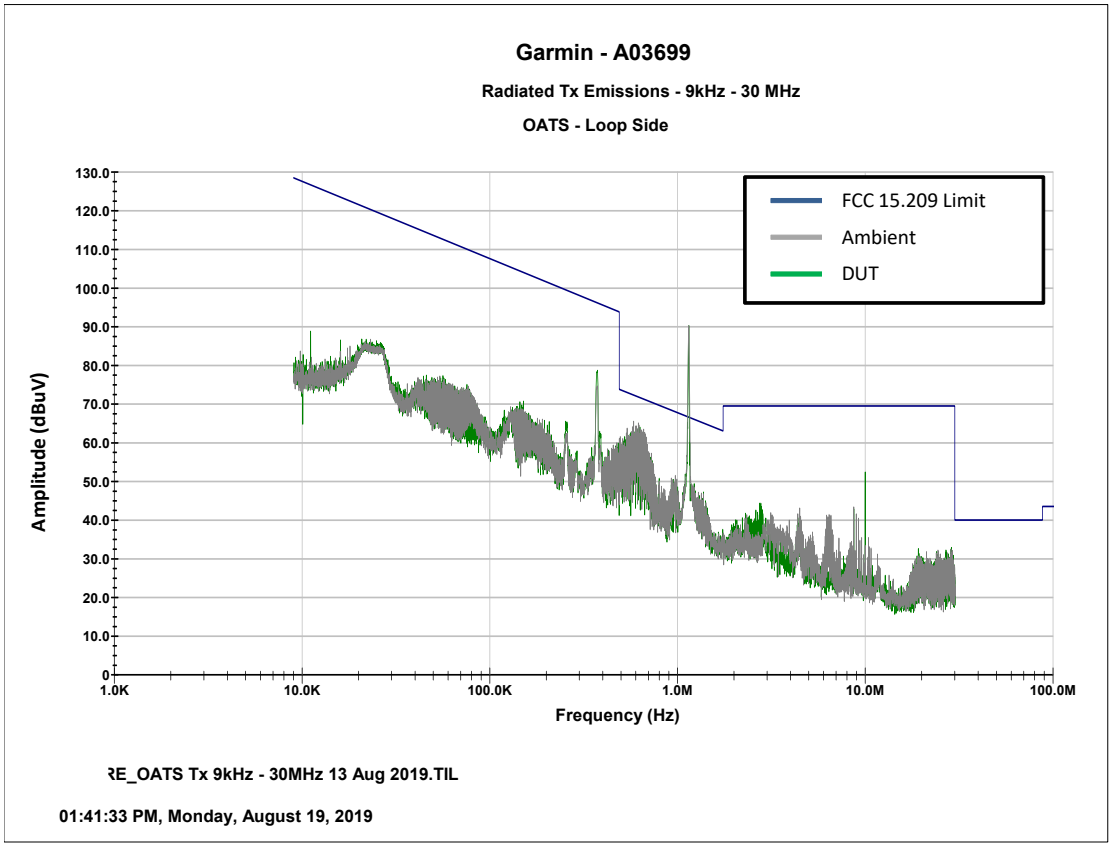
Radiated Spurious Emissions - 9kHz to 30MHz



Channel Frequency:	Mode:	Antenna Polarization
2440.00 MHz	**ANT**	**Front**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level: **46.30** dBm

Plot 12.2 – Spurious Emissions - 9kHz – 30MHz, Side Polarization

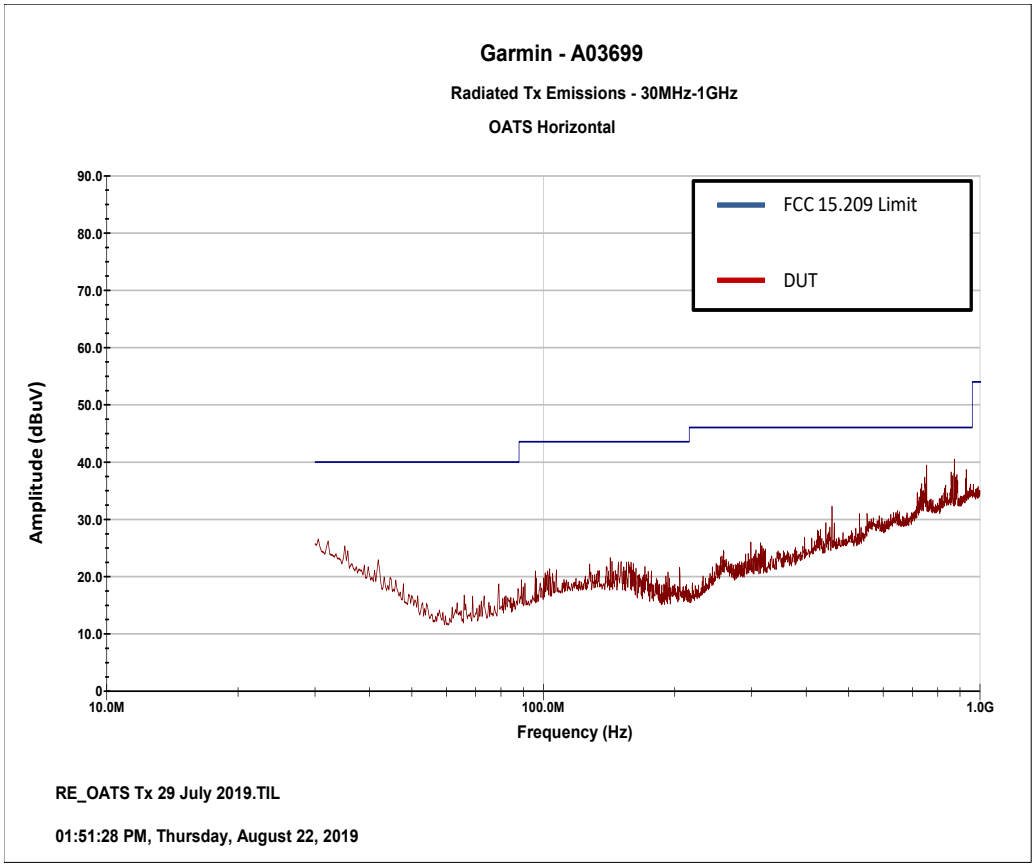
Radiated Spurious Emissions - 9kHz to 30MHz



Channel Frequency:	Mode:	Antenna Polarization
2440.00 MHz	**ANT**	**Side**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level: **55.00** dBuV

Plot 12.3 – Spurious Emissions - 30MHz – 1000MHz, Horizontal

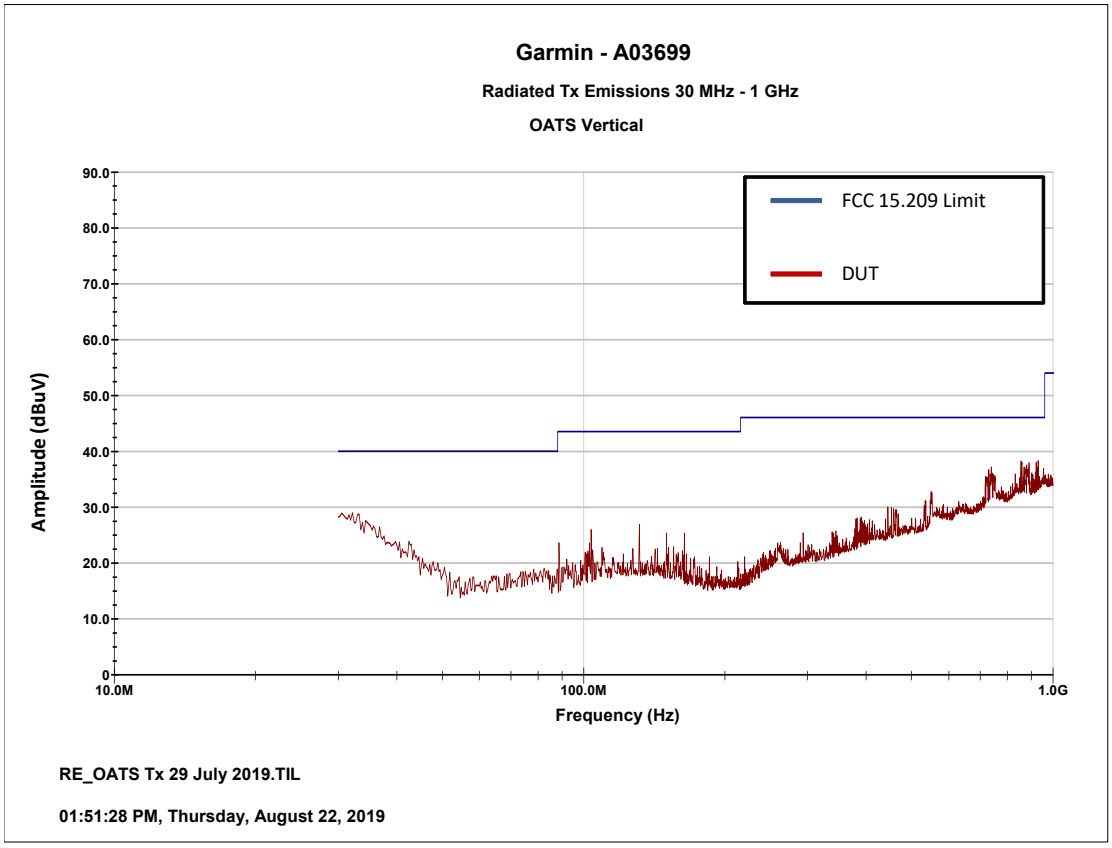
Radiated Spurious Emissions - 30MHz to 1000MHz



Channel Frequency: **2440.00** MHz	Mode: **ANT**	Antenna Polarization **Horizontal**
Modulation Setting: **GFSK**	Channel Power Setting: **Max** dBm	Nominal Input Voltage: **3.0** VDC
		Measured Emission Level: **41.00** dBuV

Plot 12.4 – Spurious Emissions - 30MHz – 1000MHz, Vertical

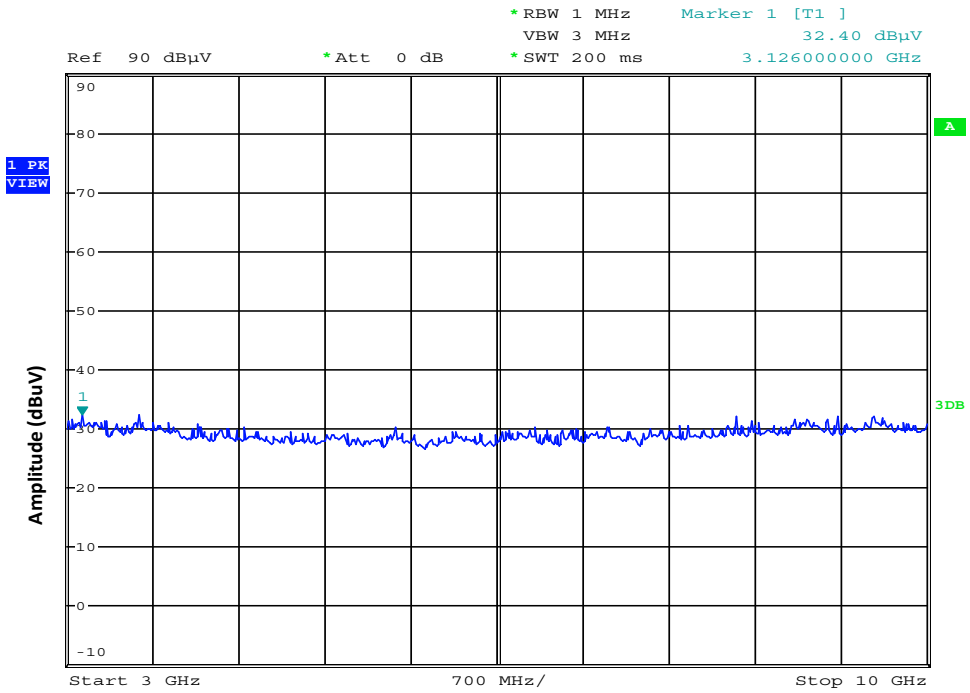
Radiated Spurious Emissions - 30MHz to 1000MHz



Channel Frequency: **2440.00** MHz	Mode: **ANT**	Antenna Polarization **Vertical**
Modulation Setting: **GFSK**	Channel Power Setting: **Max** dBm	Nominal Input Voltage: **3.0** VDC
		Measured Emission Level: **35.00** dBuV

Plot 12.5 – Spurious Emissions - 3GHz – 10GHz, Horizontal

Radiated Spurious Emissions - 3GHz to 10GHz

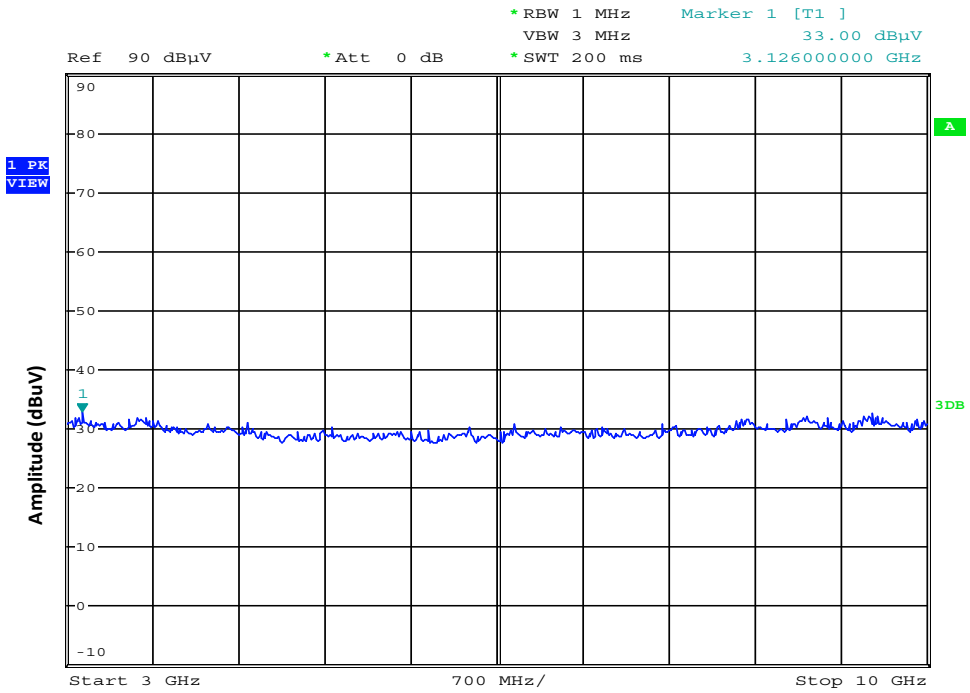


Date: 10.JUL.2019 14:58:07

Channel Frequency: **2440.00** MHz	Mode: **ANT**	Antenna Polarization **Horizontal**
Modulation Setting: **GFSK**	Channel Power Setting: **Max** dBm	Nominal Input Voltage: **3.0** VDC
		Measured Emission Level: **None Detected** dBuV

Plot 12.6 – Spurious Emissions - 3GHz – 10GHz, Vertical

Radiated Spurious Emissions - 3GHz to 10GHz

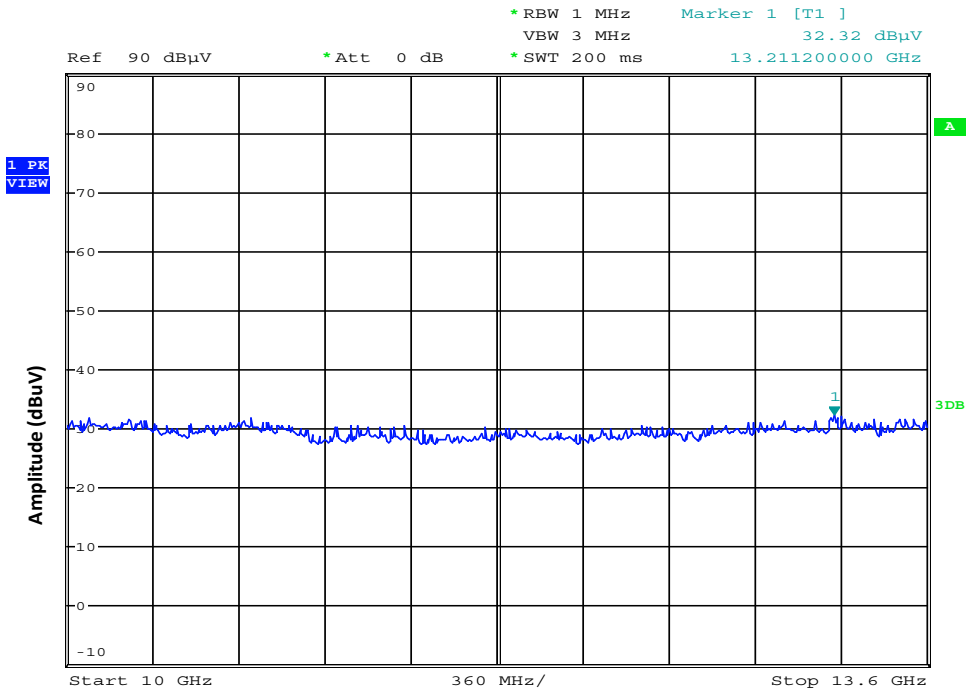


Date: 10.JUL.2019 14:54:27

Channel Frequency: **2440.00** MHz	Mode: **ANT**	Antenna Polarization **Vertical**
Modulation Setting: **GFSK**	Channel Power Setting: **Max** dBm	Nominal Input Voltage: **3.0** VDC
		Measured Emission Level: **None Detected** dBuV

Plot 12.7 – Spurious Emissions - 10GHz – 13.6GHz, Horizontal

Radiated Spurious Emissions - 10GHz to 13.6GHz

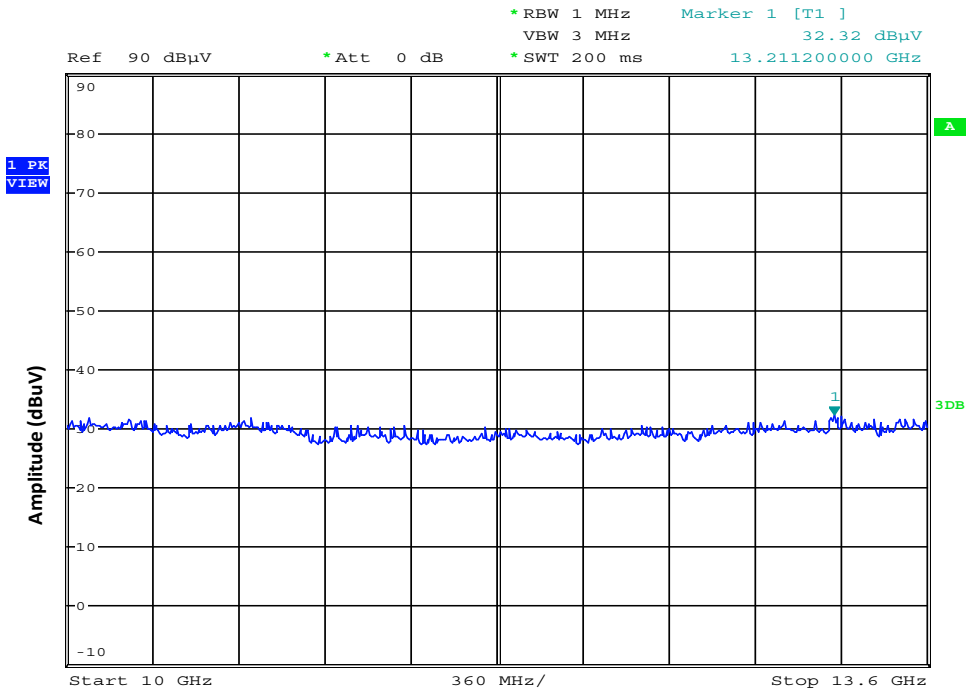


Date: 10.JUL.2019 14:58:45

Channel Frequency:	Mode:	Antenna Polarization
2440.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		None Detected dBuV

Plot 12.8 – Spurious Emissions - 10GHz – 13.6GHz, Vertical

Radiated Spurious Emissions - 10GHz to 13.6GHz

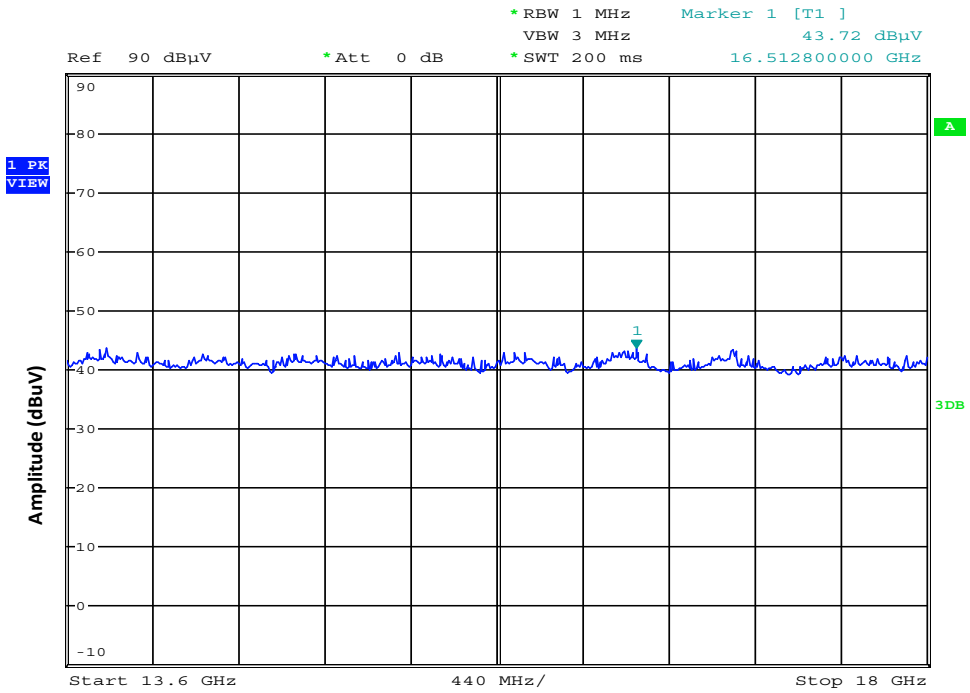


Date: 10.JUL.2019 14:58:45

Channel Frequency: **2440.00** MHz	Mode: **ANT**	Antenna Polarization **Horizontal**
Modulation Setting: **GFSK**	Channel Power Setting: **Max** dBm	Nominal Input Voltage: **3.0** VDC
		Measured Emission Level: **None Detected** dBuV

Plot 12.9 – Spurious Emissions - 13.6GHz – 18GHz, Horizontal

Radiated Spurious Emissions - 13.6GHz to 18GHz

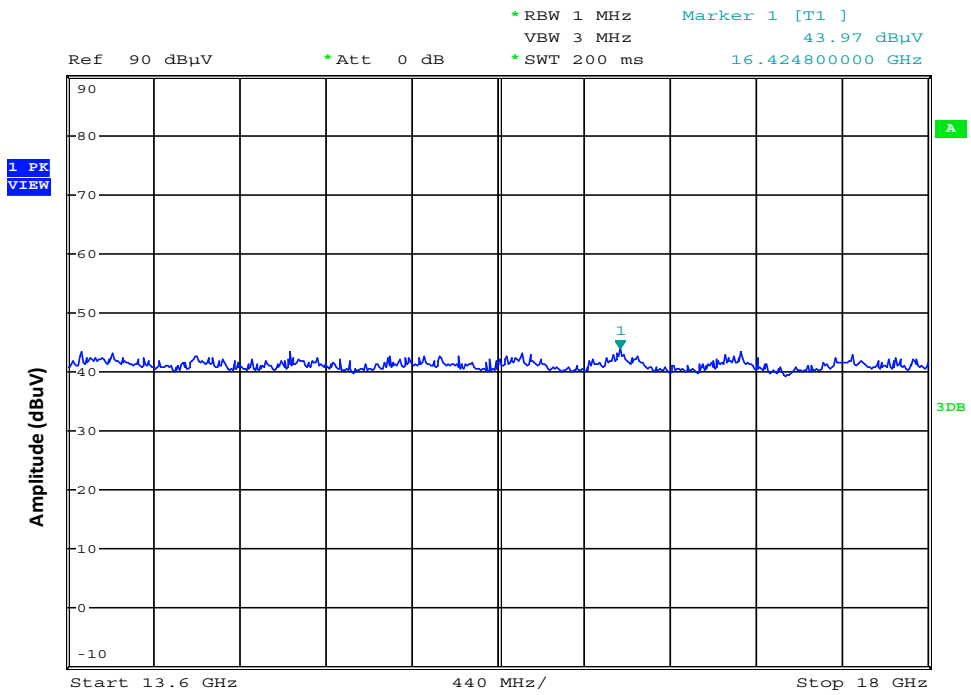


Date: 10.JUL.2019 14:59:20

Channel Frequency: **2440.00** MHz	Mode: **ANT**	Antenna Polarization **Horizontal**
Modulation Setting: **GFSK**	Channel Power Setting: **Max** dBm	Nominal Input Voltage: **3.0** VDC
		Measured Emission Level: **None Detected** dBuV

Plot 12.10 – Spurious Emissions - 13.6GHz – 18GHz, Vertical

Radiated Spurious Emissions - 13.6GHz to 18GHz

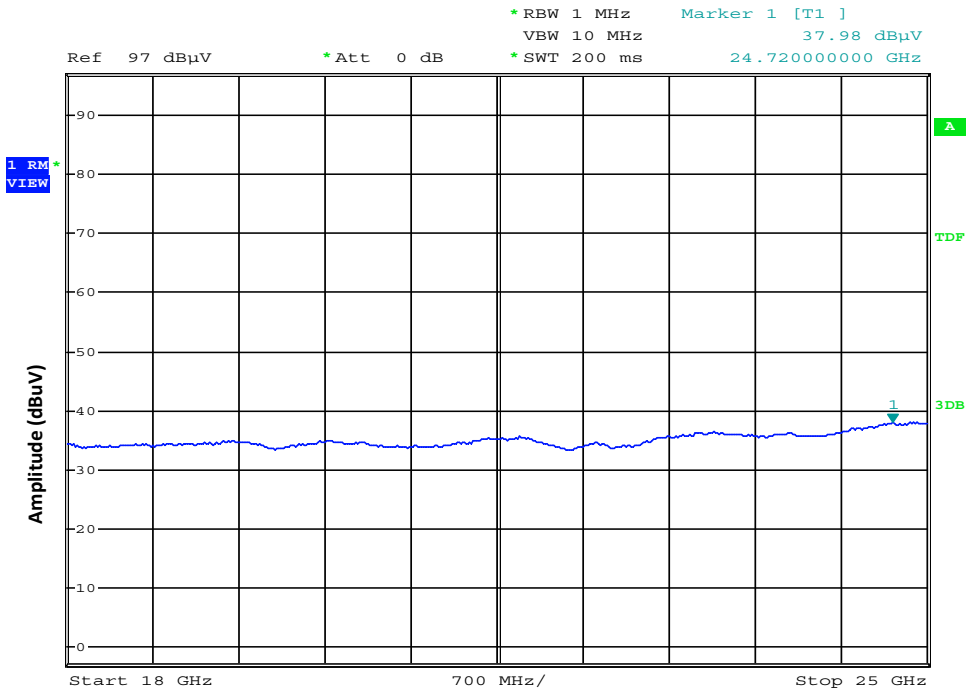


Date: 10.JUL.2019 14:56:21

Channel Frequency:	Mode:	Antenna Polarization
2440.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		None Detected dBuV

Plot 12.11 – Spurious Emissions - 18GHz – 25GHz, Horizontal

Radiated Spurious Emissions - 18GHz to 25GHz

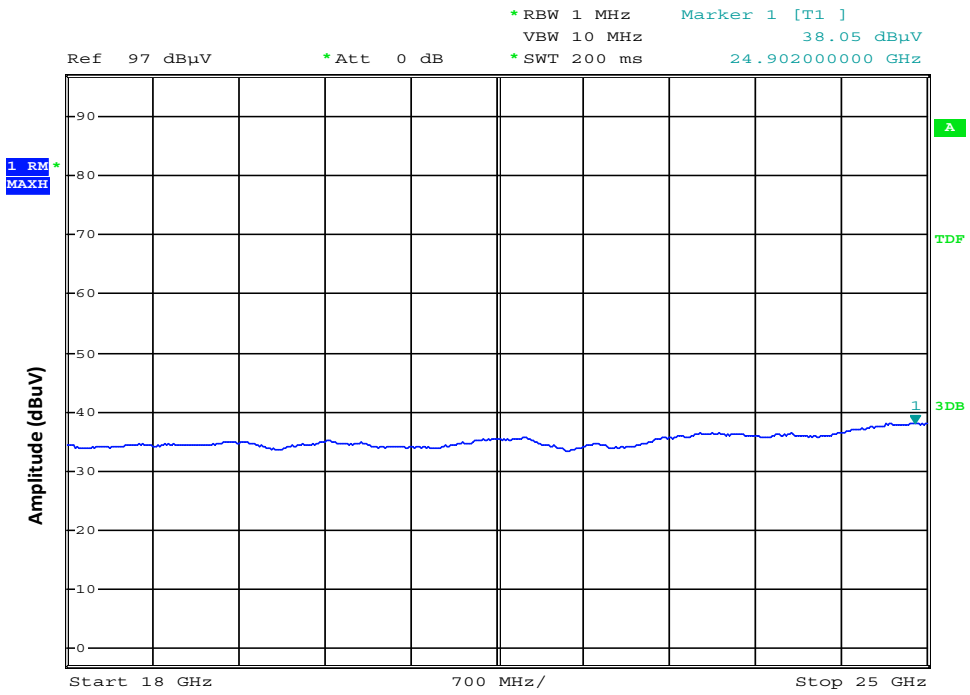


Date: 10.JUL.2019 15:31:27

Channel Frequency:	Mode:	Antenna Polarization
2440.00 MHz	**ANT**	**Horizontal**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		None Detected dBuV

Plot 12.12 – Spurious Emissions - 18GHz – 25GHz, Vertical

Radiated Spurious Emissions - 18GHz to 25GHz



Date: 10.JUL.2019 15:32:26

Channel Frequency:	Mode:	Antenna Polarization
2440.00 MHz	**ANT**	**Vertical**
Modulation Setting:	**Channel Power Setting:**	**Nominal Input Voltage:**
GFSK	**Max** dBm	**3.0** VDC
		Measured Emission Level:
		None Detected dBuV

Table 12.1 – Summary of Radiated Emissions – Restricted Band

Emission Level Measurement					
Frequency Range	Emission Frequency	Antenna Polarization	Measured Emission(1) [E_{Meas}] (dBuV)	Limit Line [A_L] (dBm)	Margin (dB)
9kHz - 30MHz	9.992MHz	Front	46.3	69.5	23.2
9kHz - 30MHz	9.992MHz	Side	52.4	69.6	17.2
30MHz - 1GHz	874	Horizontal	40.5	46.0	5.5
30MHz - 1GHz	930	Vertical	38.4	46.0	7.6
			Result:	Complies	

(1) Antenna Correction Factors (ACF) and cable loss corrected.

Margin = A_L - E_{MEAS}

No other spurious emissions within 20dB of the limit or above the ambient emissions were detected

APPENDIX A – TEST SETUP DRAWINGS AND EQUIPMENT

Table A.1 – Setup - Conducted Measurements Equipment

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00241	R&S	FSU40	Spectrum Analyzer

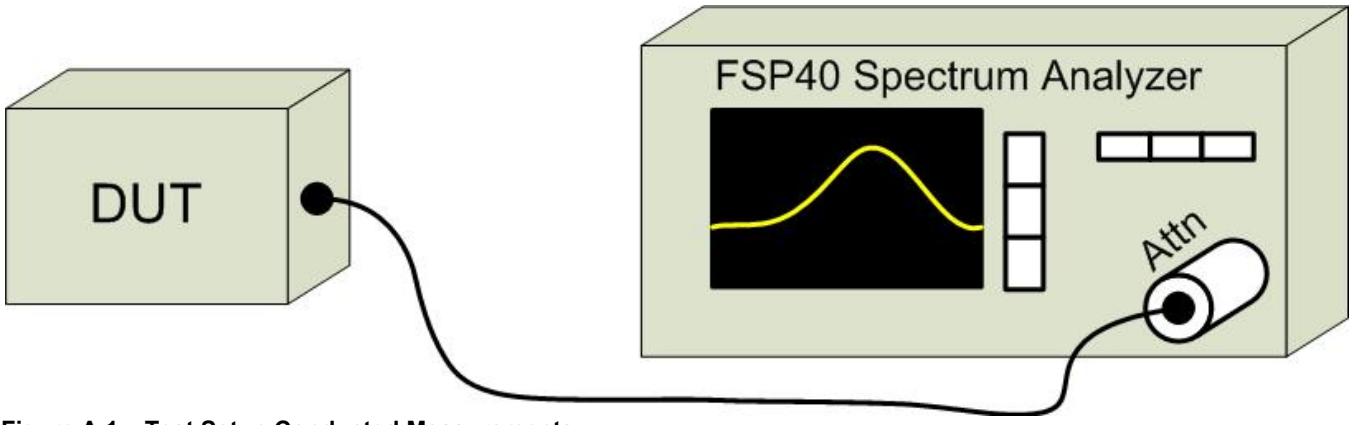


Figure A.1 – Test Setup Conducted Measurements

Table A.2 – Setup - Radiated Emissions Equipment

Equipment List			
Asset Number	**Manufacturer**	**Model Number**	**Description**
00051	HP	8566B	Spectrum Analyzer
00049	HP	85650A	Quasi-peak Adapter
00047	HP	85685A	RF Preselector
00072	EMCO	2075	Mini-mast
00073	EMCO	2080	Turn Table
00071	EMCO	2090	Multi-Device Controller
00265	Miteq	JS32-00104000-58-5P	Microwave L/N Amplifier
00241	R&S	FSU40	Spectrum Analyzer
00050	Chase	CBL-6111A	Bilog Antenna
00275	Coaxis	LMR400	25m Cable
00276	Coaxis	LMR400	4m Cable
00278	TILE	34G3	TILE Test Software
00034	ETS	3115	Double Ridged Guide Horn
00085	EMCO	6502	Loop Antenna
00161	Waveline Inc.	889	Standard Gain Horn 18-26GHz
00162	Waveline Inc.	889	Standard Gain Horn 18-26GHz
00163	Waveline Inc.	1099	Standard Gain Horn 26-40GHz
00164	Waveline Inc.	1099	Standard Gain Horn 26-40GHz
00165	Waveline Inc.	801-KF	Waveguide Adapter 18-26GHz
00166	Waveline Inc.	801-KF	Waveguide Adapter 18-26GHz
00167	Waveline Inc.	1001-KF	Waveguide Adapter 26-40GHz
00168	Waveline Inc.	1001-KF	Waveguide Adapter 26-40GHz

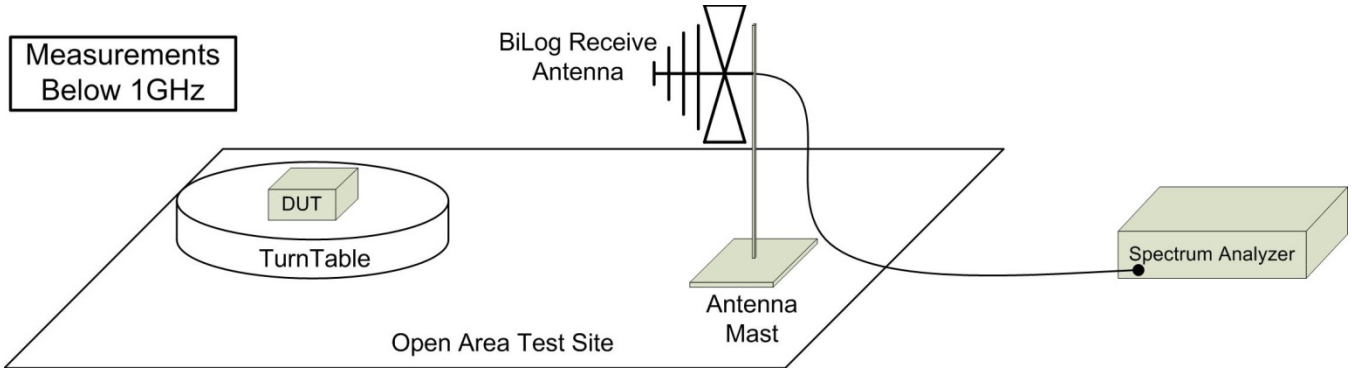


Figure A.2 – Test Setup Radiated Emissions Measurements 30-1000MHz

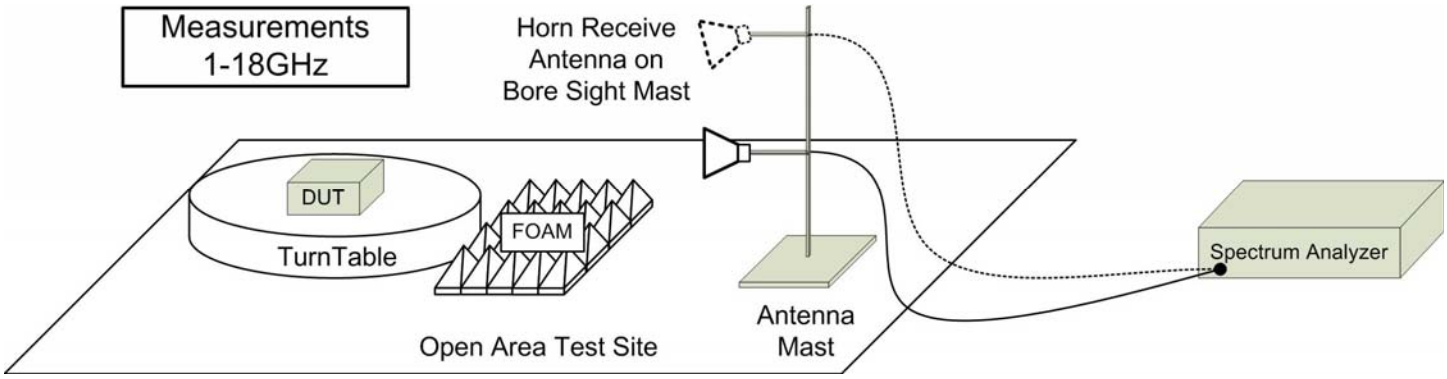


Figure A.3 – Test Setup Radiated Emissions Measurements 1-18GHz

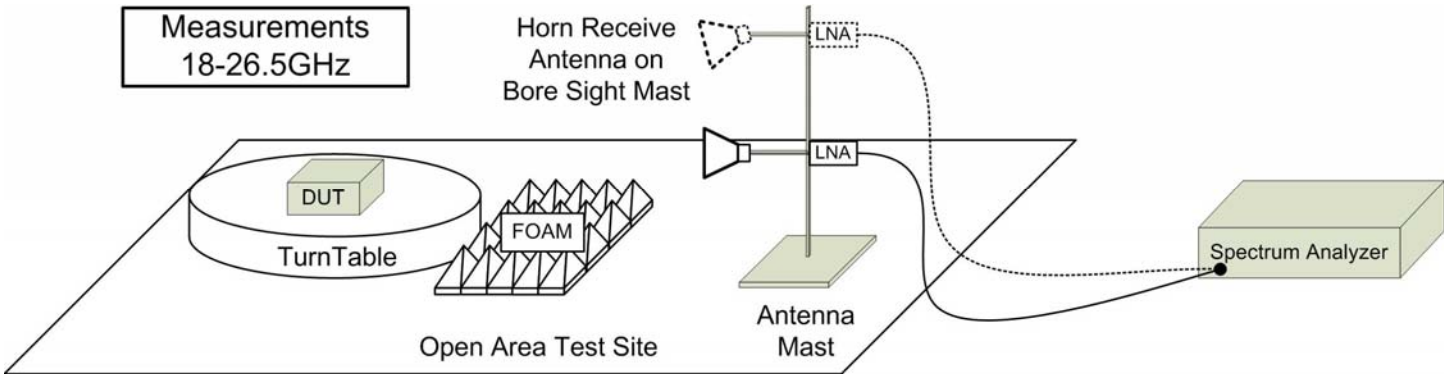


Figure A.4 – Test Setup Radiated Emissions Measurements 18-26.5GHz

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	3 Jan 2019	Triennial	3 Jan 2022
*	00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2018	Triennial	26 Nov 2021
	00035	ETS	3115	6276	Double Ridged Guide Horn	22 Mar 2019	Triennial	21 Mar 2022
*	00085	EMCO	6502	9203-2724	Loop Antenna	11 Jun 2019	Triennial	11 Jun 2022
*	00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
	00162	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
	00163	Waveline Inc.	1099		Standard Gain Horn 26-40GHz	NCR	n/a	NCR
	00164	Waveline Inc.	1099		Standard Gain Horn 26-40GHz	NCR	n/a	NCR
*	00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
	00166	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
	00167	Waveline Inc.	1001-KF		Waveguide Adapter 26-40GHz	NCR	n/a	NCR
	00168	Waveline Inc.	1001-KF		Waveguide Adapter 26-40GHz	NCR	n/a	NCR
*	00047	HP	85685A	2837A00826	RF Preselector	23 Jun 2017	Triennial	23 Jun 2020
*	00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2017	Triennial	23 Jun 2020
*	00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2017	Triennial	23 Jun 2020
	00223	HP	8901A	3749A07154	Modulation Analyzer	27 Dec 2017	Triennial	27 Dec 2020
	00224	HP	8903B	3729A18691	Audio Analyzer	28 Dec 2017	Triennial	28 Dec 2020
*	00241	R&S	FSU40	100500	Spectrum Analyzer	15 May 2018	Triennial	15 May 2021
*	00005	HP	8648D	3847A00611	Signal Generator	21 Jun 2017	Triennial	21 Jun 2020
	00006	R&S	SMR20	100104	Signal Generator	29 May 2017	Triennial	29 May 2020
	00243	Rigol	DS1102E	DS1ET150502164	Oscilloscope	7 Nov 2017	Triennial	7 Nov 2020
	00254	LeCroy	WM8600A	532	Oscilloscope	NCR	n/a	NCR
	00110	Gigatronics	8652A	1875801	Power Meter	26 Mar 2019	Triennial	26 Mar 2022
	00237	Gigatronics	80334A	1837001	Power Sensor	26 Mar 2019	Triennial	26 Mar 2022
	00232	ETS Lindgren	HI-6005	91440	Isotropic E-Field Probe	18 Dec 2017	Triennial	18 Dec 2020
	00003	HP	53181A	3736A05175	Frequency Counter	21 Jun 2017	Triennial	21 Jun 2020
	00257	Com-Power	LI-215A	191934	LISN	5 Jan 2018	Triennial	5 Jan 2021
	00041	AR	10W1000C	27887	Power Amplifier	NCR	n/a	NCR
	00106	AR	5SIG4	26235	Power Amplifier	NCR	n/a	NCR
	00280	AR	25A250AM6	22702	Power Amplifier	NCR	n/a	NCR
*	00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier	COU	n/a	COU
	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
	00236	Nokia	-	236	ESD Table	NCR	n/a	NCR
	00255	Expert ESD	A4001	A4001-155	ESD Target	COU	n/a	COU
	00064	NARDA	3020A	n/a	Bi-Directional Coupler	COU	n/a	COU
	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
*	00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable	COU	n/a	COU
*	00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
*	00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00277	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR
Rented Equipment								

* Used during the course of this investigation
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	
30MHz - 200MHz	
U_{LAB} = 5.14dB U_{CISPR} = 6.3dB	
200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
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

