

Test Type: Emissions ☒ Immunity ☐

Product Type: Wireless Headphones

Product Name/Number: *Model Number: 423376*
FCC ID: A94423376
IC: 3232A-423376

Prepared For: *Design Assurance Engineering Department,*
Bose Corporation

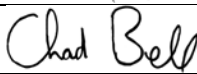
Test Results: Pass ☒ Fail ☐

Applicable Standards: FCC CFR 47 Part 15 Subpart C
 Industry Canada RSS-247 Issue 2
 Industry Canada RSS-GEN Issue 4

Report Number: *EMC.423376.18.68.1*

General Comments/Special Test Conditions:

This report relates only to the items tested. This report covers EMC marking requirements for
Enter product and any special modifications or test conditions.

	Print Name	Signature	Date
Prepared By:	Brent DeWitt		March 9, 2018
Electrical Engineer Review* By:	Chad Bell		March 29, 2018

* Since every test result is separately reviewed after its completion, the electrical engineer review indicated above represents a higher level review to ensure this report lists and contains all applicable and appropriate requirements.

If the report carries the "accredited" logo, the reviewer must verify all the tests in this report are covered under the current ISO17025 accreditation. The A2LA-accredited logo must be removed if any of the tests in the report are not performed under the current scope of accreditation. It is the responsibility of the reviewer to ensure the A2LA advertising policy is followed.



Table of Contents

Tests Performed (Table of Contents):

Test Report Summary	3
20dB and 99% Bandwidth	6
Conducted Output Power	18
Hopping Frequency Separation.....	24
Conducted Spurious Emissions	27
Average Time of Occupancy	38
Number of Hopping Channels	42



Test Report Summary

Product Information:

Description

The EUT is a wireless headphone that contains Bluetooth/BLE transceivers, manufactured by Cambridge Silicon Radio, CSR8670. The EUT uses Adaptive Frequency Hopping (AFH) mode, using a reduced hop set if interference is detected in band, however a maximum of 20 channels is always maintained..

Setup (Cables and Accessories)

Radiated emission and power line conducted emission were performed with the EUT playing IEC pink noise over the BT link. EUT is not sold with a power supply so when necessary a Bose model number PSA05F-050QBT1 power supply was used for charging. For radio tests the BT radio was configured with CSR Blue Suite software (details provided in SOFTWARE AND FIRMWARE section).

EUT Antenna Description

The antenna is an internal inverted F antenna with antenna gain of 3.8dBi formed by printed circuit board etch.

SOFTWARE AND FIRMWARE

*The firmware installed in the EUT during testing was version 0.1.5
The test utility software used during testing was Polycomm, version 0.2.1.0 and CSR Blue Suite version 2.6.2.*

Scope:

This report covers EMC requirements. Enter specific EMC requirements covered by this report (i.e. FCC).

Test Objective:

Verify product meets all applicable EMC requirements.

Measurement Method:

ANSI C63.10 (2013).

Results:

Product complies with all applicable EMC requirements. All final results represent worst-case emissions and/or immunity.

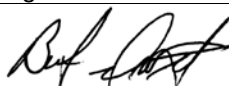
Conclusions:

The device under test (D.U.T.):

☒ meets all test standards selected in section 2 of this report.

☐ does not meet all test standards selected in section 2 of this report.

Affirmation of Test Results:

	Print Name	Signature	Date
Testing Engineer/Technician	Brent DeWitt		March 9, 2018





Test Standards

Emissions:

	Standard
☒	FCC Part 15C
☒	Canada RSS-247
☒	Canada RSS-GEN

Environmental Conditions

Ambient:

Temperature:	22±4°C
Humidity:	30-60%RH
Mains Voltage:	☒ 120VAC

20dB and 99% Bandwidth

Requirement:

None; for reporting purposes only. Test per FCC 15.247(a)(1); IC RSS-247 5.1 (1), RSS-Gen 6.6.

Test Procedure:

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

20dB Occupied Bandwidth

20 dB OBW Summary Table (Basic Rate: 1 Mbps)				
Channel	Frequency (MHz)	Mode	20 dB OBW (MHz)	Limit NA
Low	2402	DH5	0.844	-
Middle	2441	DH5	0.839	-
High	2480	DH5	0.839	-

20 dB OBW Summary Table (Enhanced Rate: 2 Mbps)				
Channel	Frequency (MHz)	Mode	20 dB OBW (MHz)	Limit NA
Low	2402	2-DH5	1.243	-
Middle	2441	2-DH5	1.243	-
High	2480	2-DH5	1.248	-

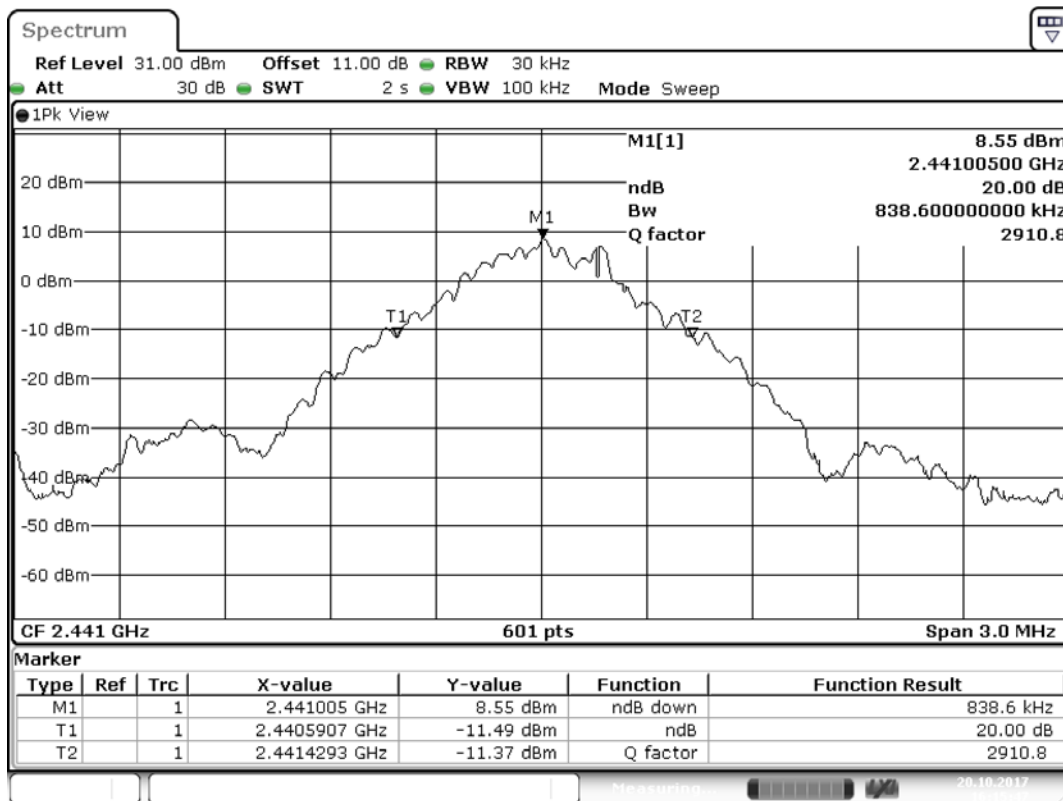
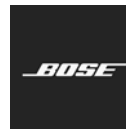
20 dB OBW Summary Table (Enhanced Rate: 3 Mbps)				
Channel	Frequency (MHz)	Mode	20 dB OBW (MHz)	Limit NA
Low	2402	3-DH5	1.263	-
Middle	2441	3-DH5	1.263	-
High	2480	3-DH5	1.268	-



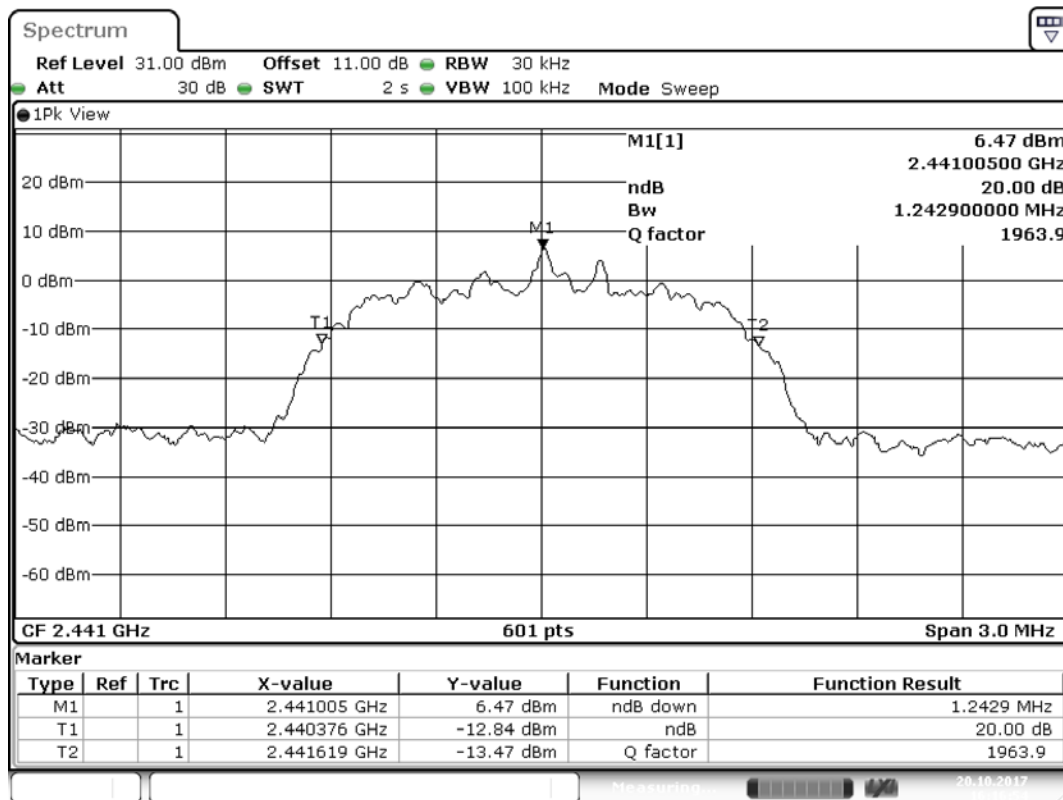
Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

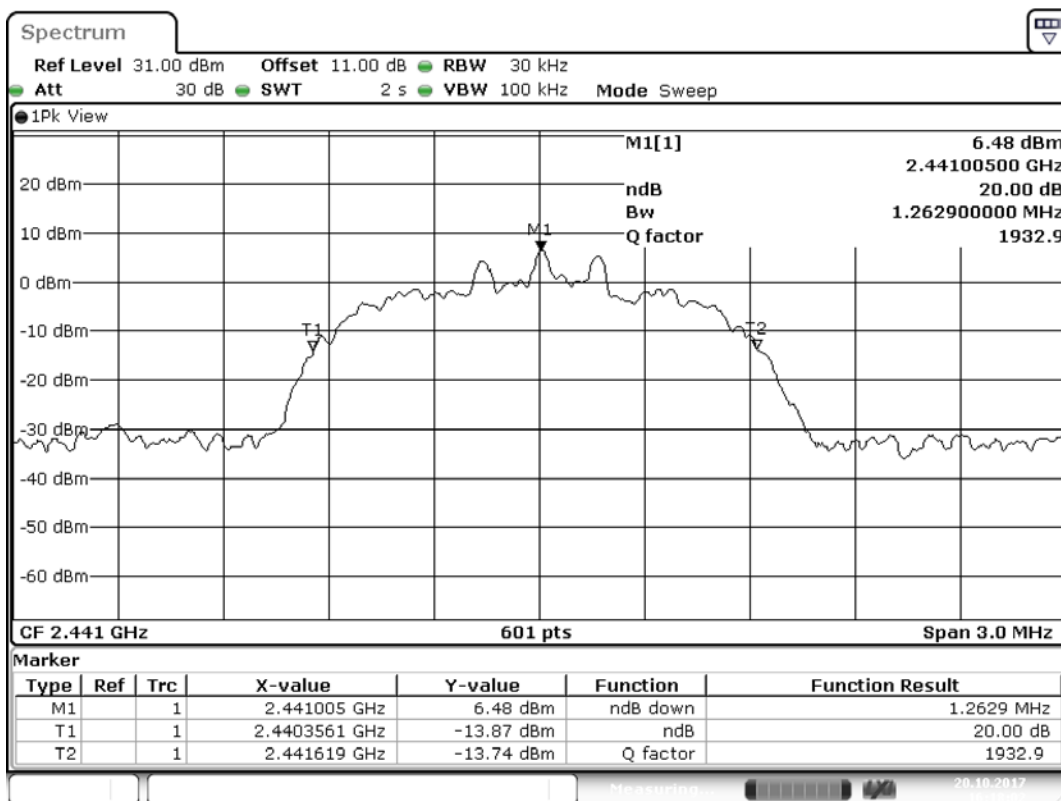
FCC ID: A94423376 IC: 3232A-423376



Plot2 20dB OBW DH5 2441 MHz



Plot5 20dB OBW 2DH5 2441 MHz

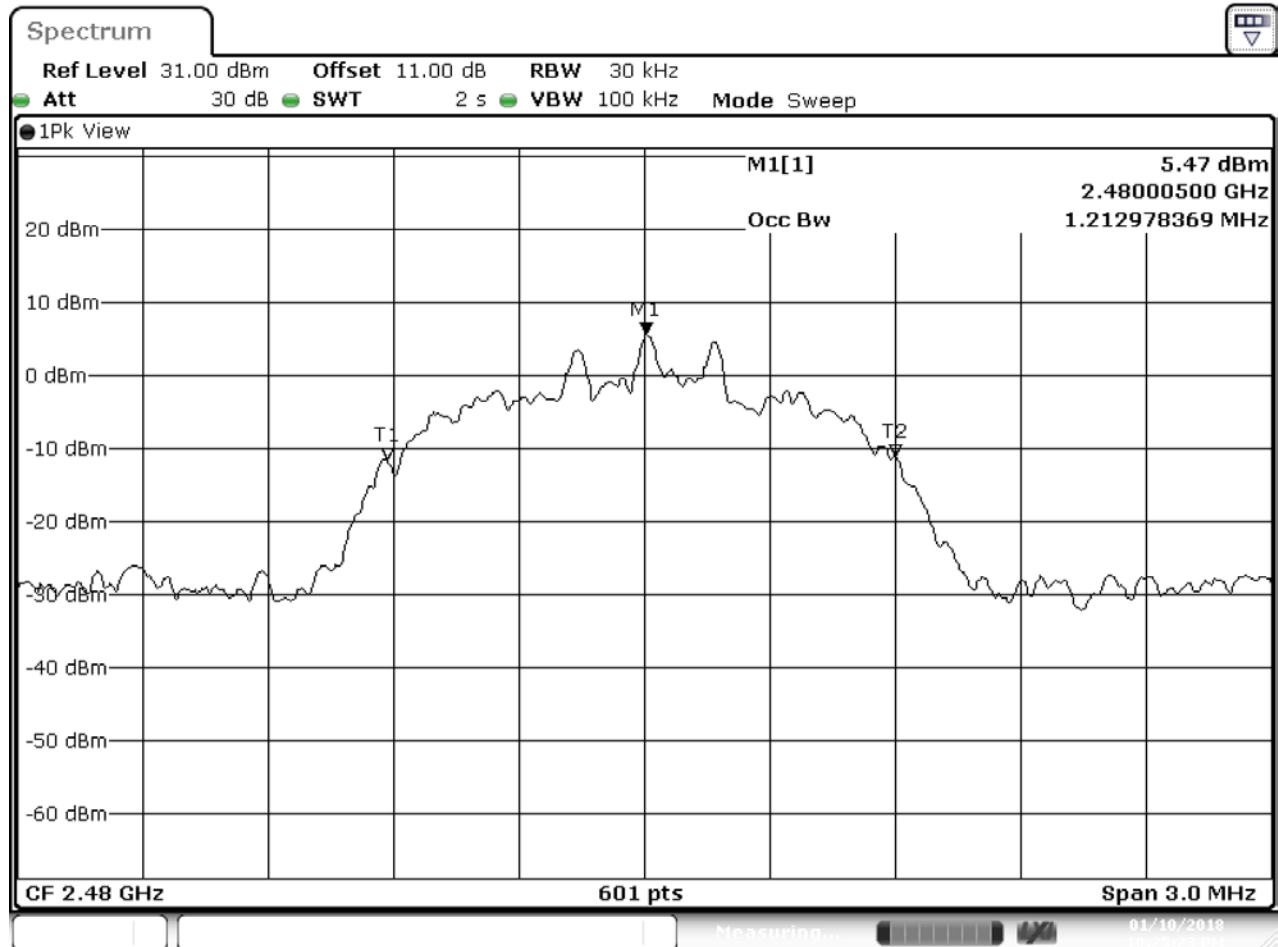


99% Occupied Bandwidth

99% OBW Summary Table (Basic Rate: 1 Mbps)				
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit NA
Low	2402	DH5	0.863	-
Middle	2441	DH5	0.863	-
High	2480	DH5	0.863	-

99% OBW Summary Table (Enhanced Rate: 2 Mbps)				
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit NA
Low	2402	2-DH5	1.178	-
Middle	2441	2-DH5	1.178	-
High	2480	2-DH5	1.223	-

99% OBW Summary Table (Enhanced Rate: 3 Mbps)				
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit NA
Low	2402	3-DH5	1.168	-
Middle	2441	3-DH5	1.173	-
High	2480	3-DH5	1.212	-



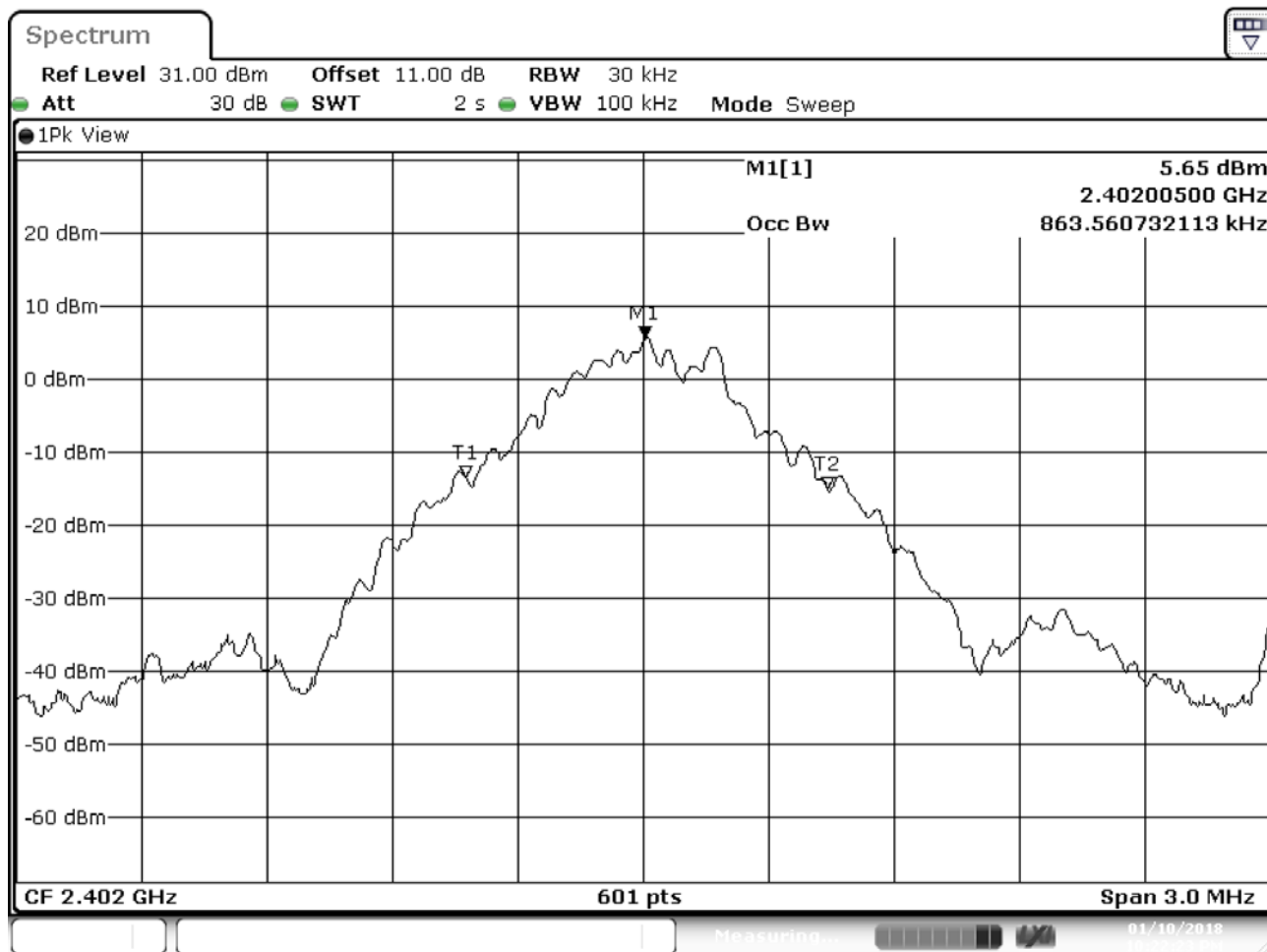
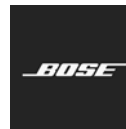
Plot9 99P OBW 3DH5 2480 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot1 99P OBW DH5 2402 MHz

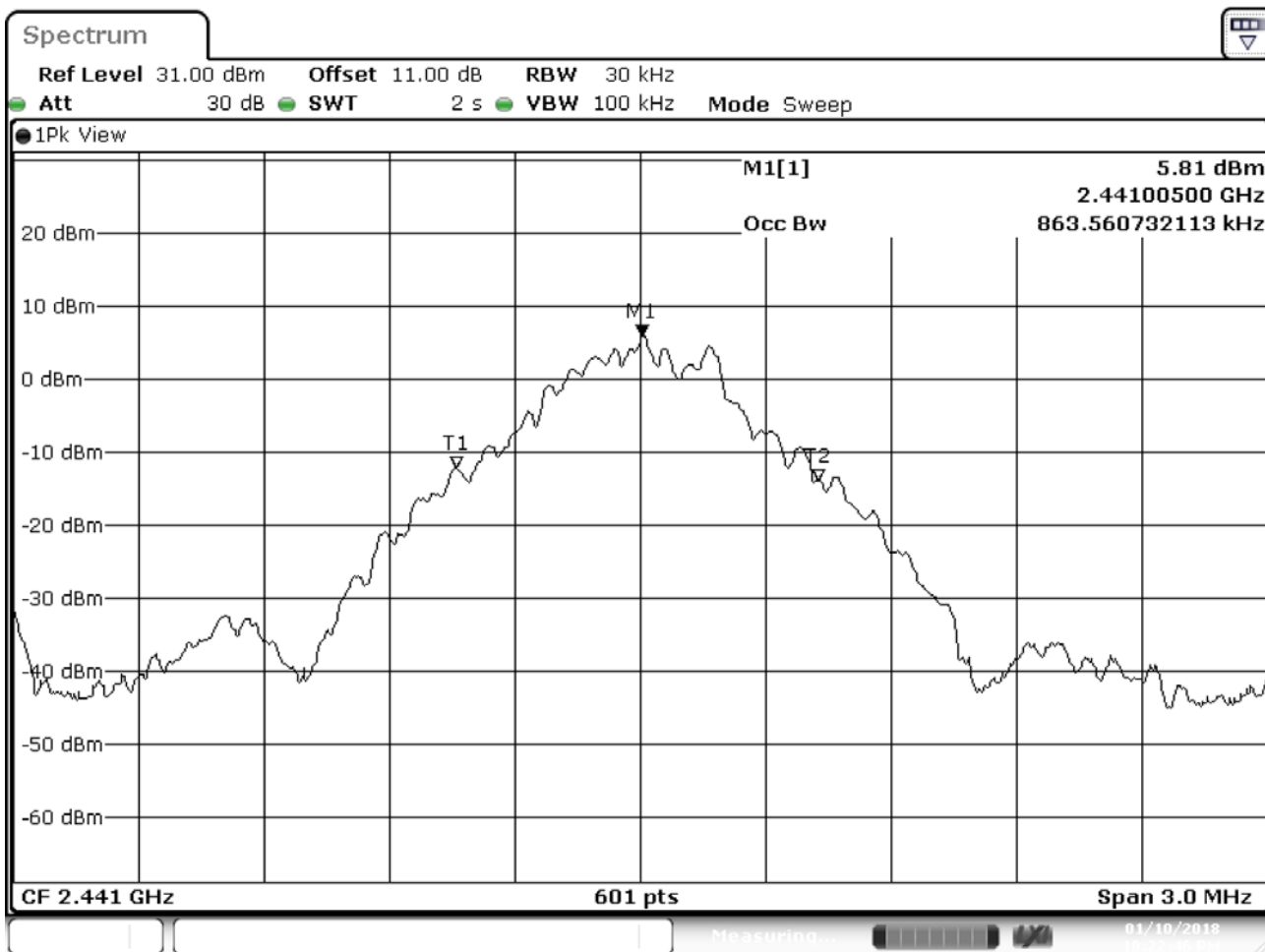
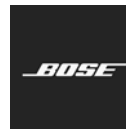
Z



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



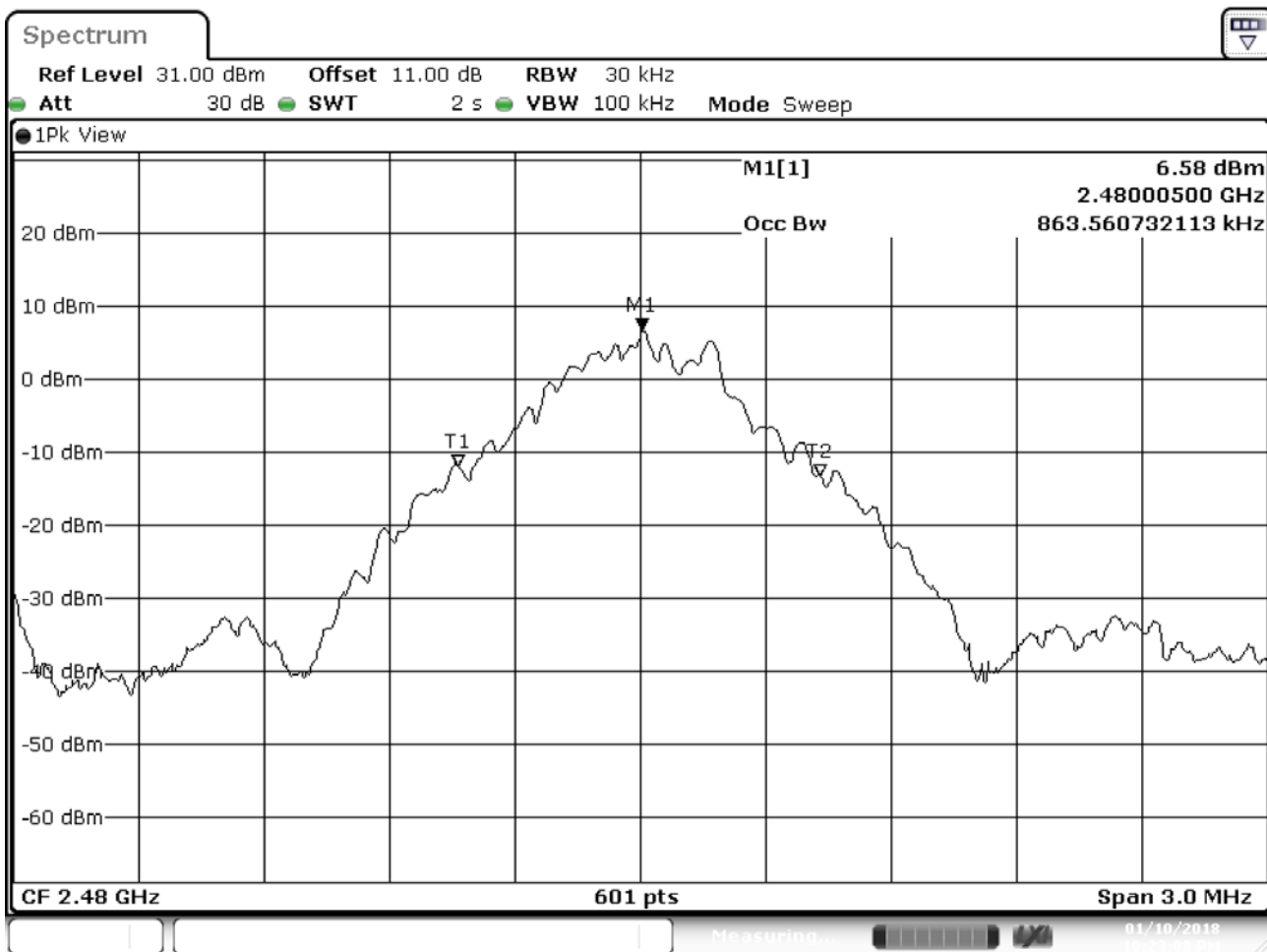
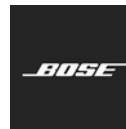
Plot2 99P OBW DH5 2441 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



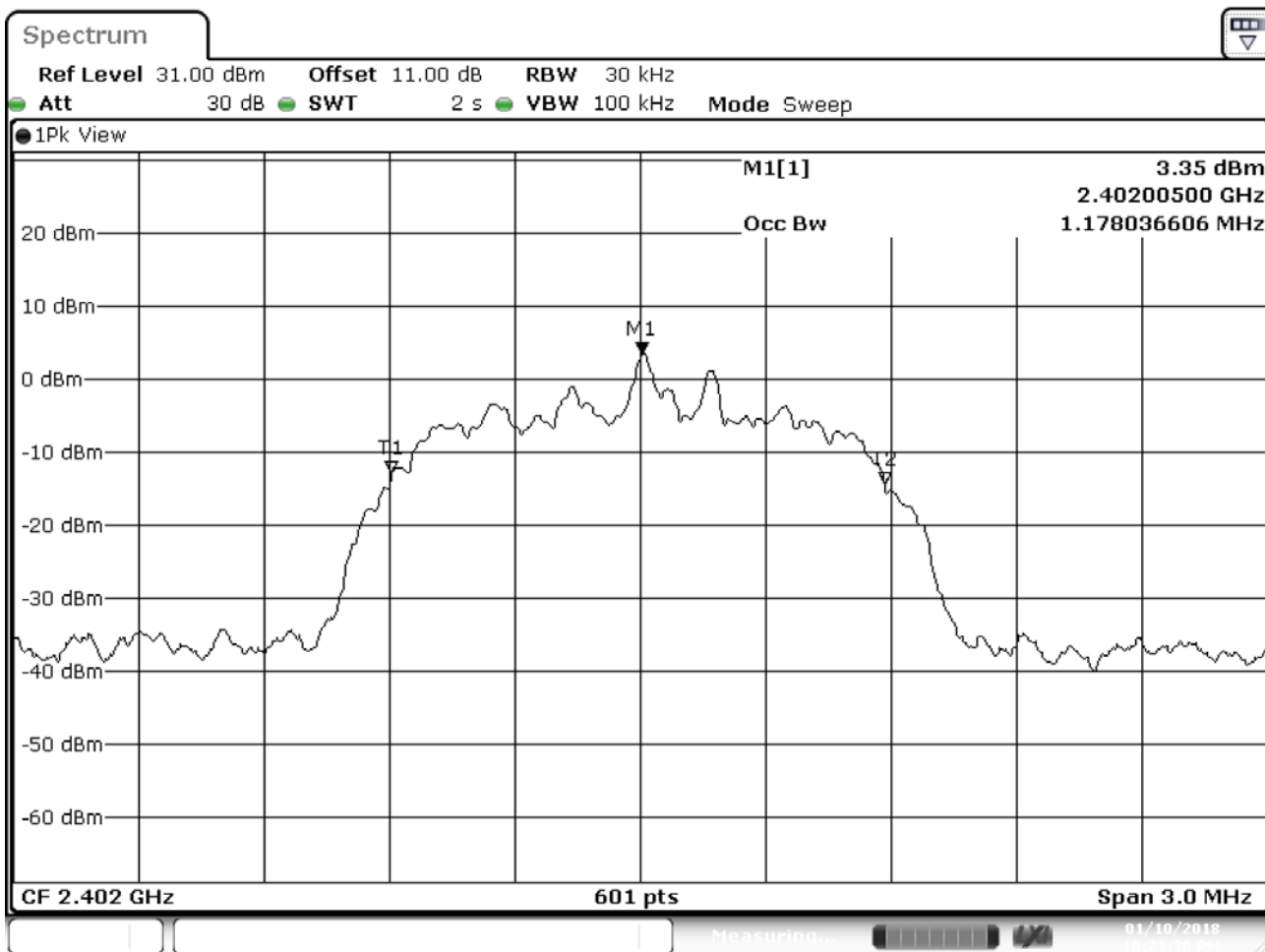
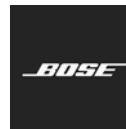
Plot3 99P OBW DH5 2480 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



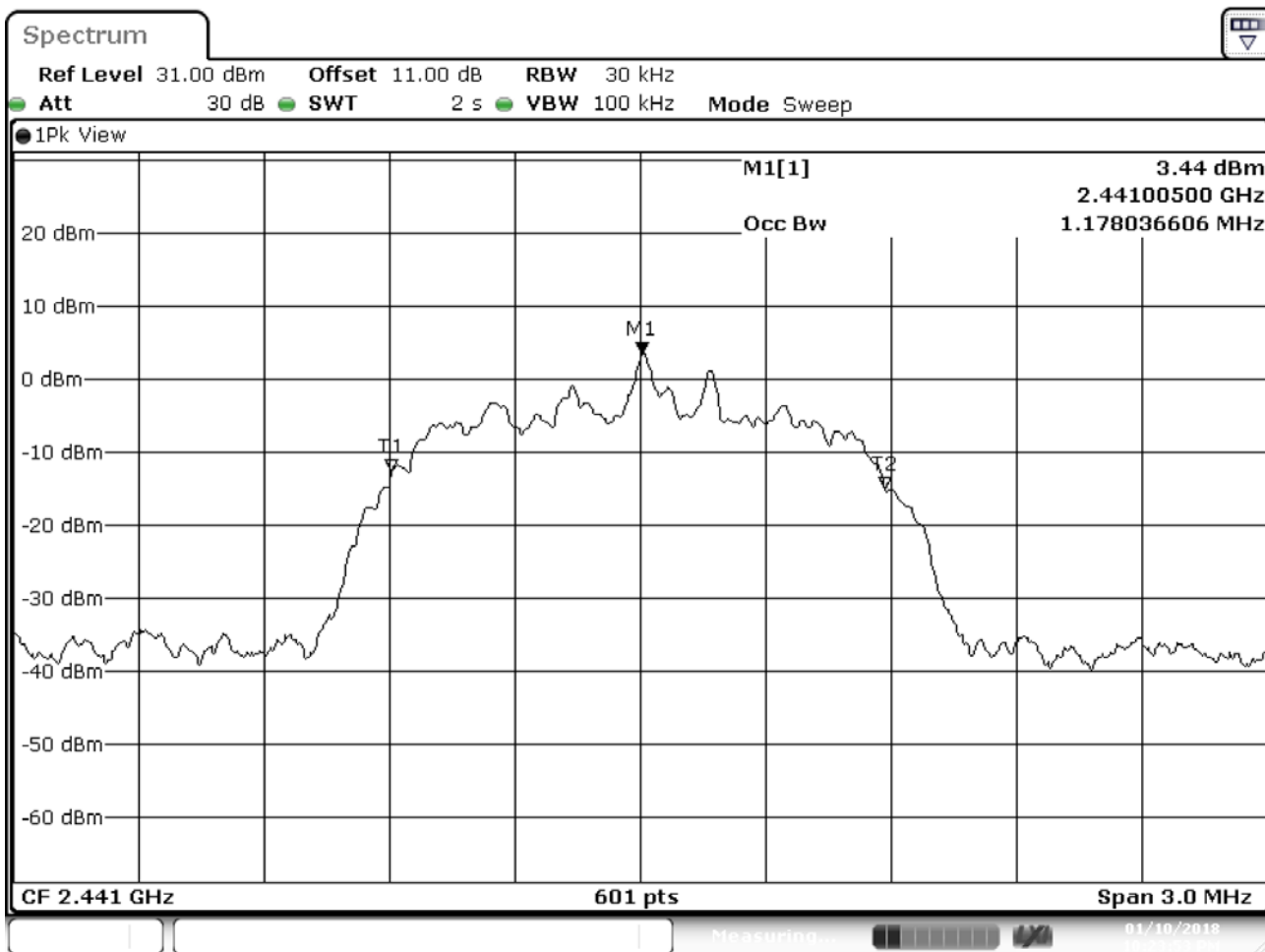
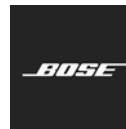
Plot4 99P OBW 2DH5 2402 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



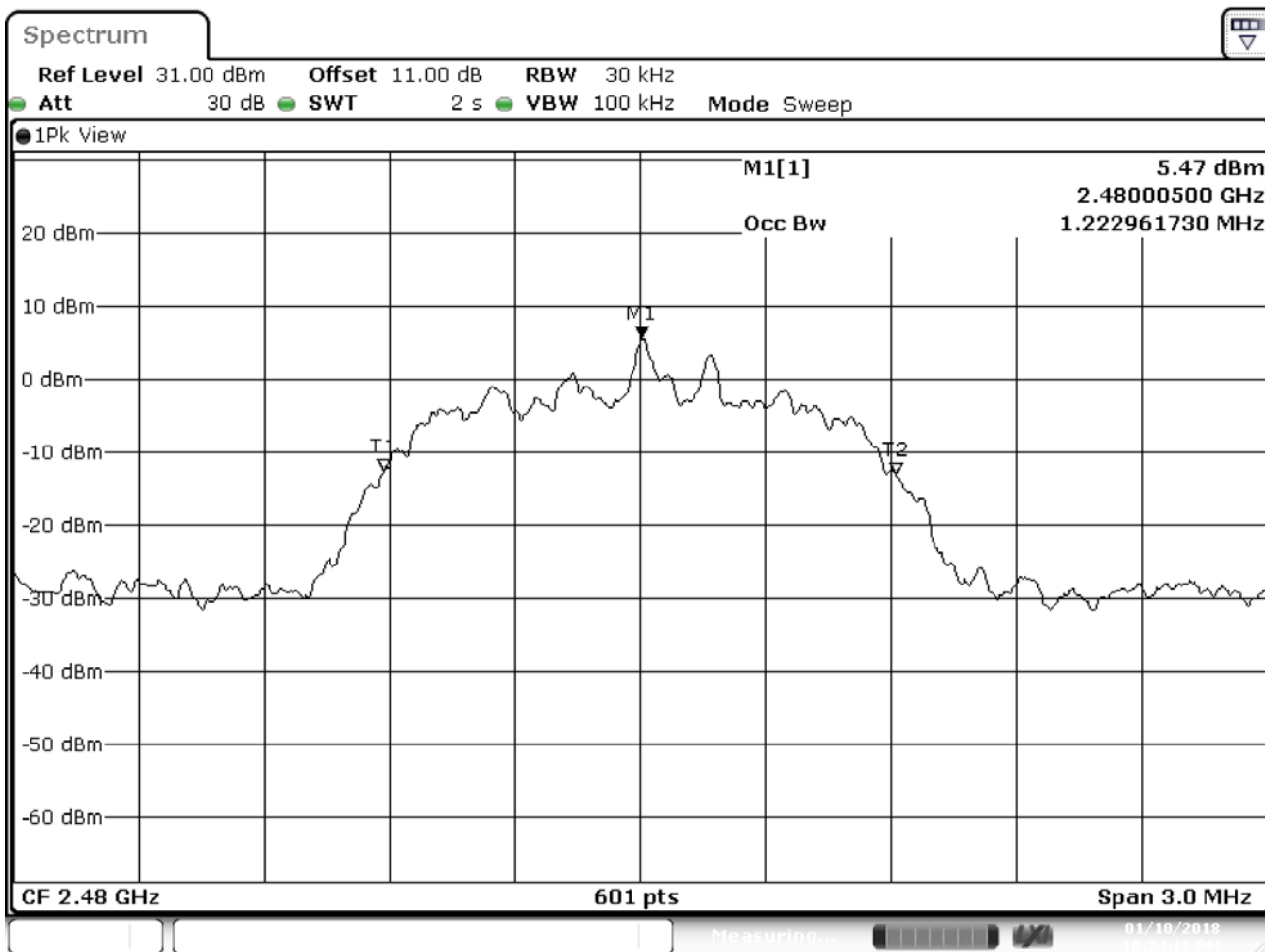
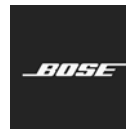
Plot5 99P OBW 2DH5 2441 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot6 99P OBW 2DH5 2480 MHz



FCC ID: A94423376 IC: 3232A-423376



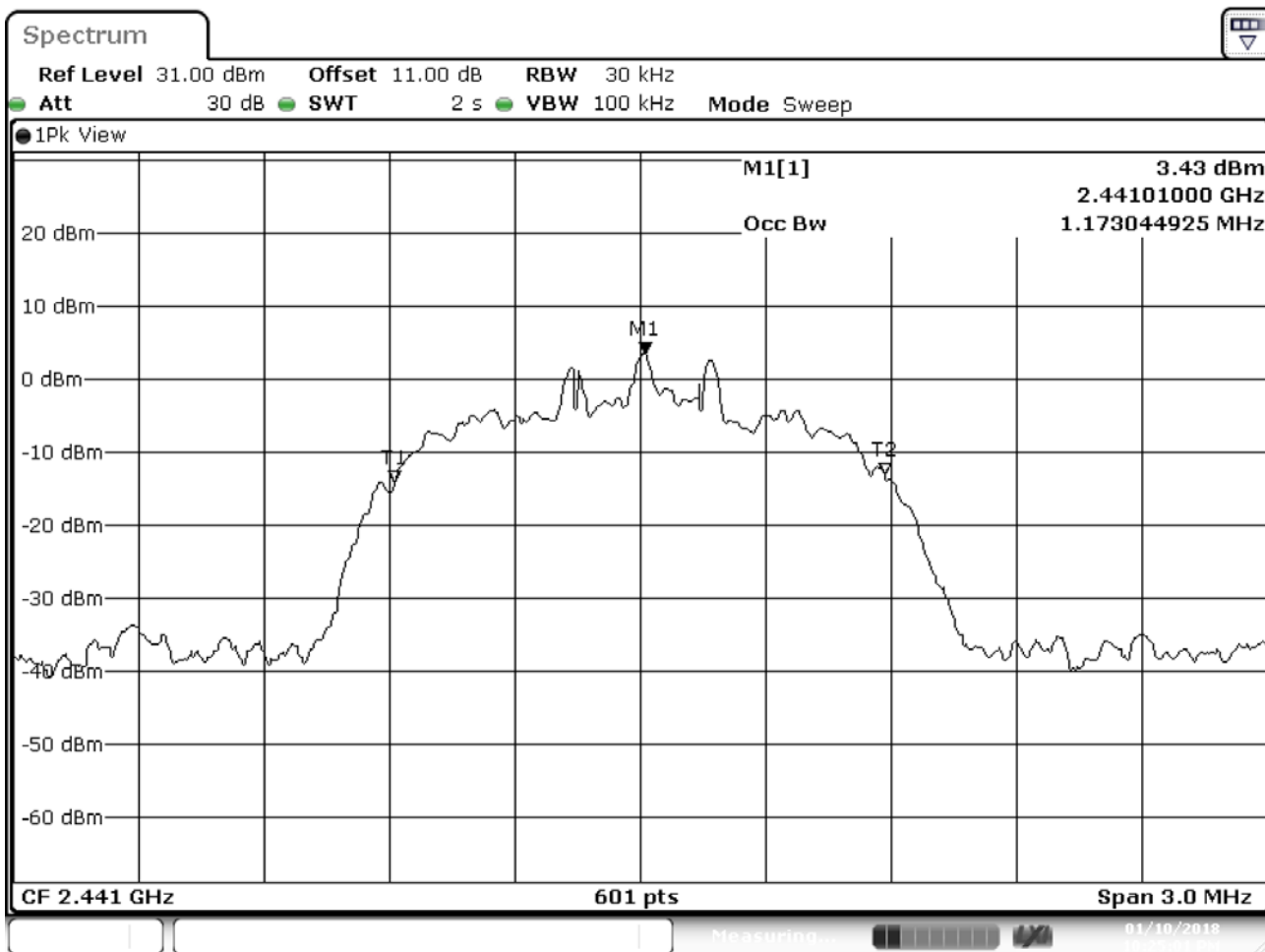
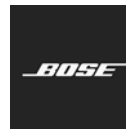
Plot7 99P OBW 3DH5 2402 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot8 99P OBW 3DH5 2441 MHz

Conducted Output Power

Requirements:

FCC 15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247 5.4 (2)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

Test setup details:

The EUT is controlled via the USB port with CSR's Blue Suite software which is used to set the test modes of the Bluetooth device. The EUT antenna is disconnected. A temporary test connector is mounted to the PCB. An 8 inch u.FL to SMA adapter cable with 1 dB loss was used for all conducted measurements. To compensate for the cable loss, the reference level offset feature of the spectrum analyzer was used. The EUT is programmed to operate on fixed frequencies at the low, middle, and high end of the authorized frequency band. The spectrum analyzer resolution bandwidth is set to 3 MHz (higher than the occupied bandwidth), peak detector and max hold. The maximum output power is recorded for each of the three frequencies in both basic and enhanced data rates.

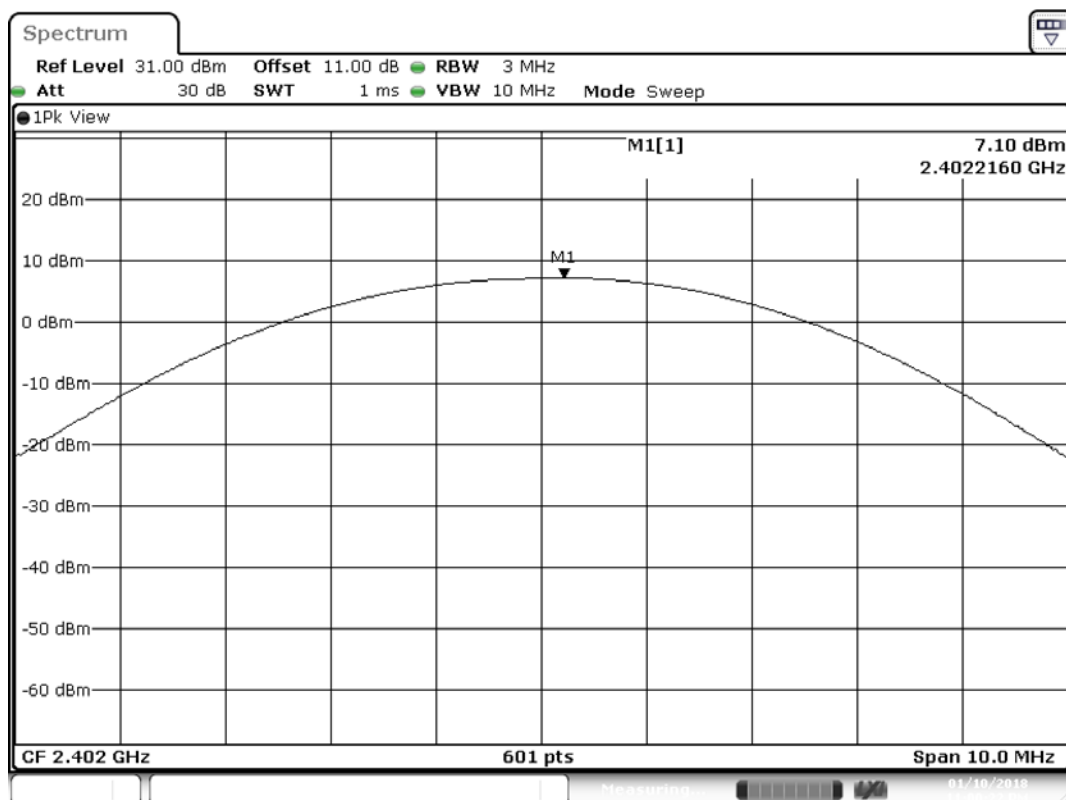
Test Results:

Output Power Summary Table (Basic Rate: 1 Mbps)							
Channel	Frequency (MHz)	Mode	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2402	DH5	7.10	3.8	30	19.10	Pass
Middle	2441	DH5	7.32	3.8	30	18.88	Pass
High	2480	DH5	7.83	3.8	30	18.37	Pass

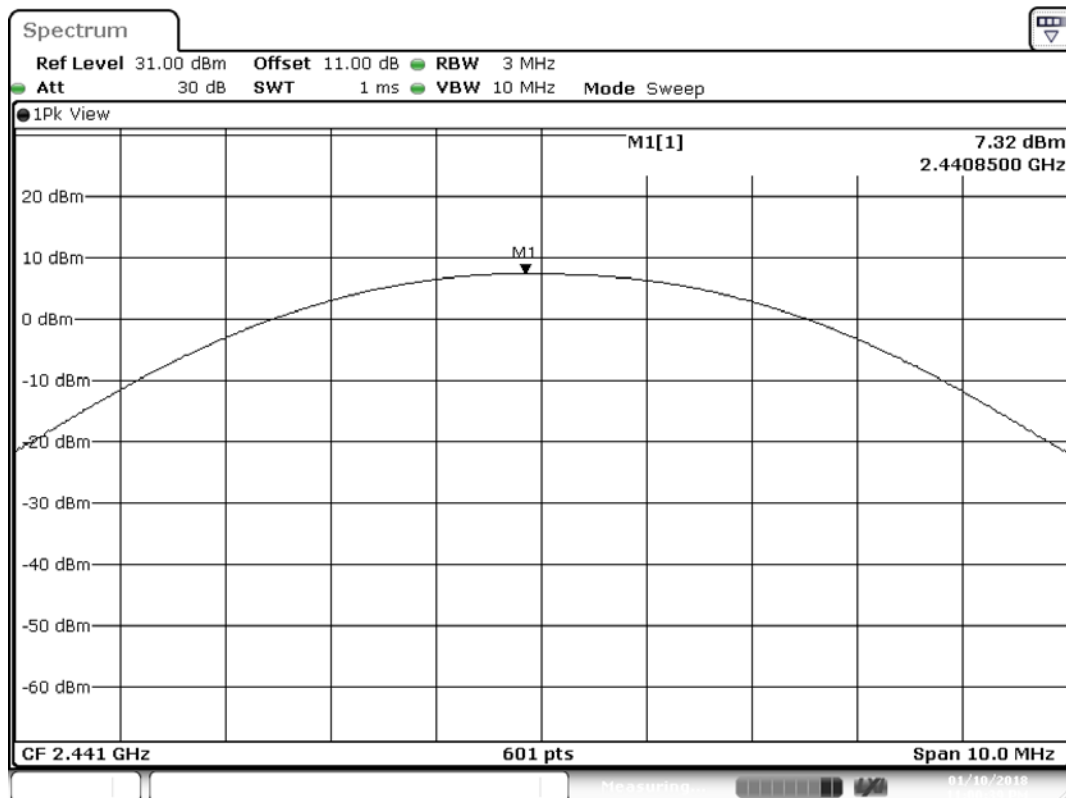
Output Power Summary Table (Enhanced Rate: 2 Mbps)							
Channel	Frequency (MHz)	Mode	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2402	2-DH5	5.63	3.8	30	20.57	Pass
Middle	2441	2-DH5	5.74	3.8	30	20.46	Pass
High	2480	2-DH5	7.12	3.8	30	19.08	Pass

Output Power Summary Table (Enhanced Rate: 3 Mbps)							
Channel	Frequency (MHz)	Mode	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2402	3-DH5	5.99	3.8	30	20.21	Pass
Middle	2441	3-DH5	6.12	3.8	30	20.08	Pass
High	2480	3-DH5	7.31	3.8	30	18.89	Pass

Model 423376 meets the conducted power limit of 1W (30dBm) by 18.3dB in DH5 mode at 2480MHz.



Plot1 Power DH5 2402 MHz



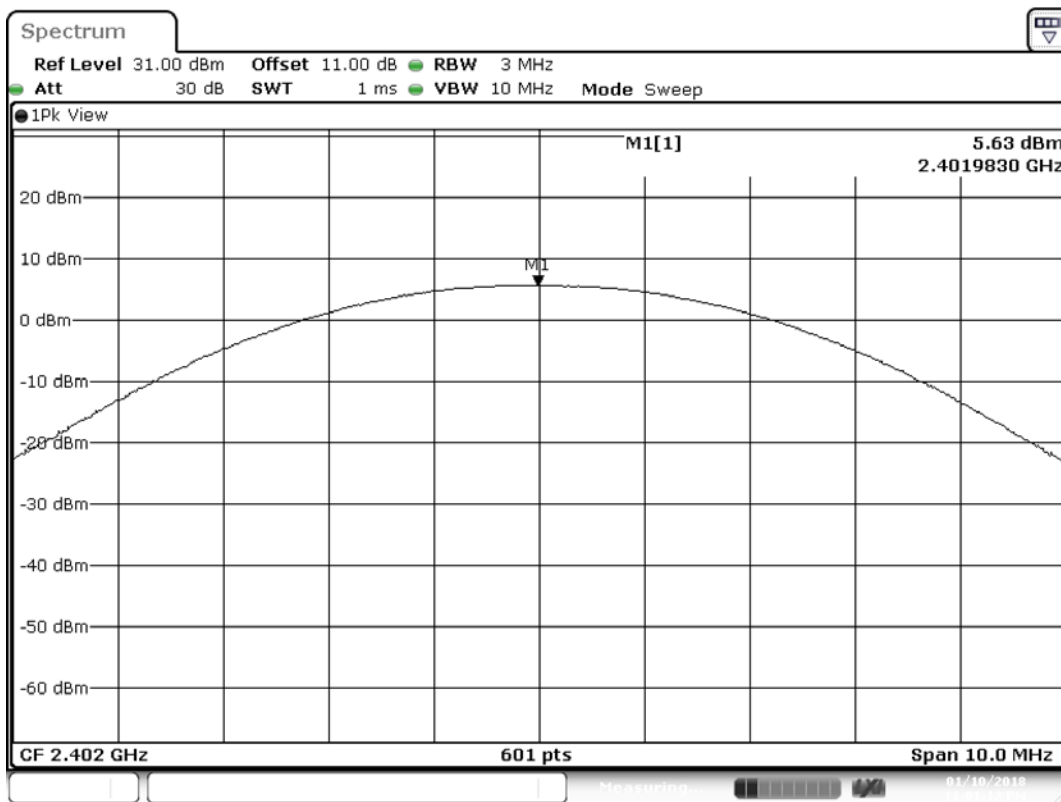
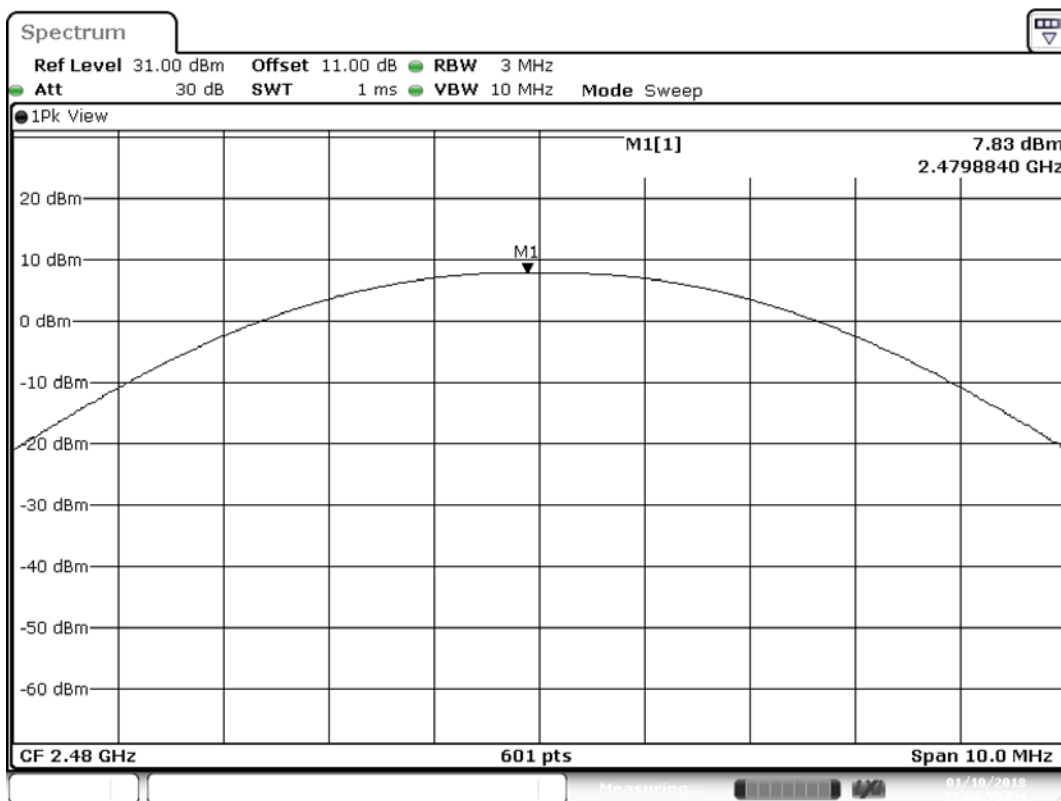
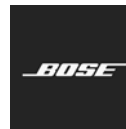
Plot2 Power DH5 2441 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

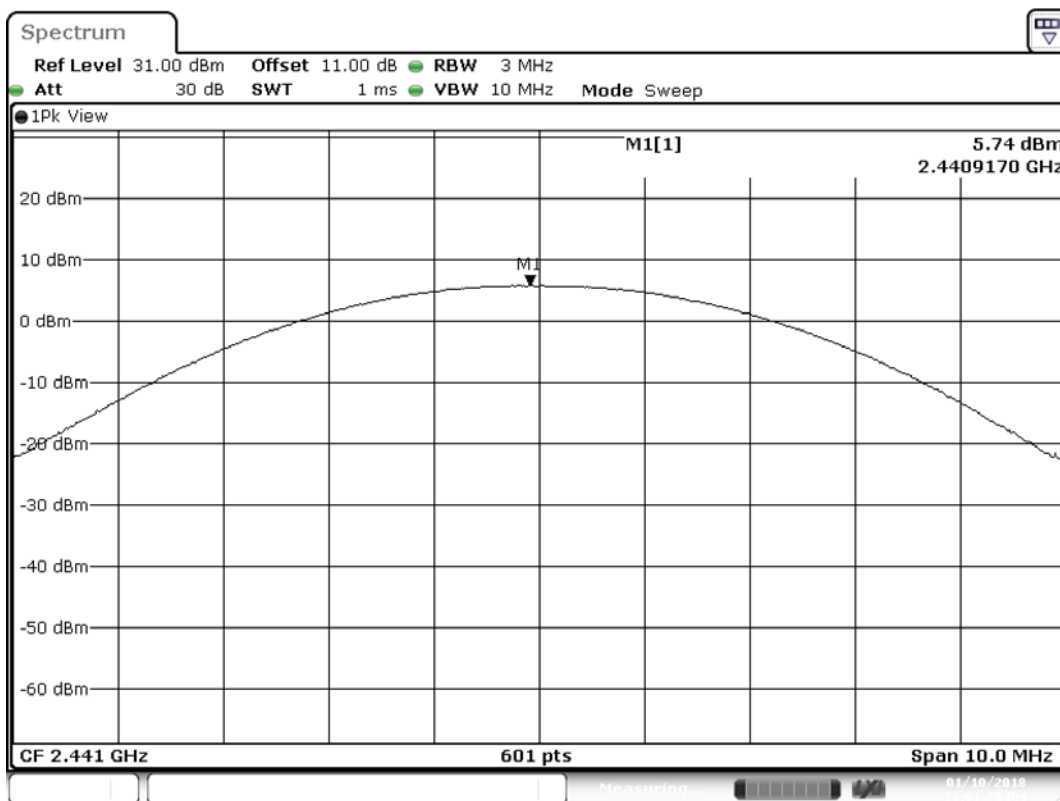
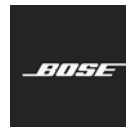




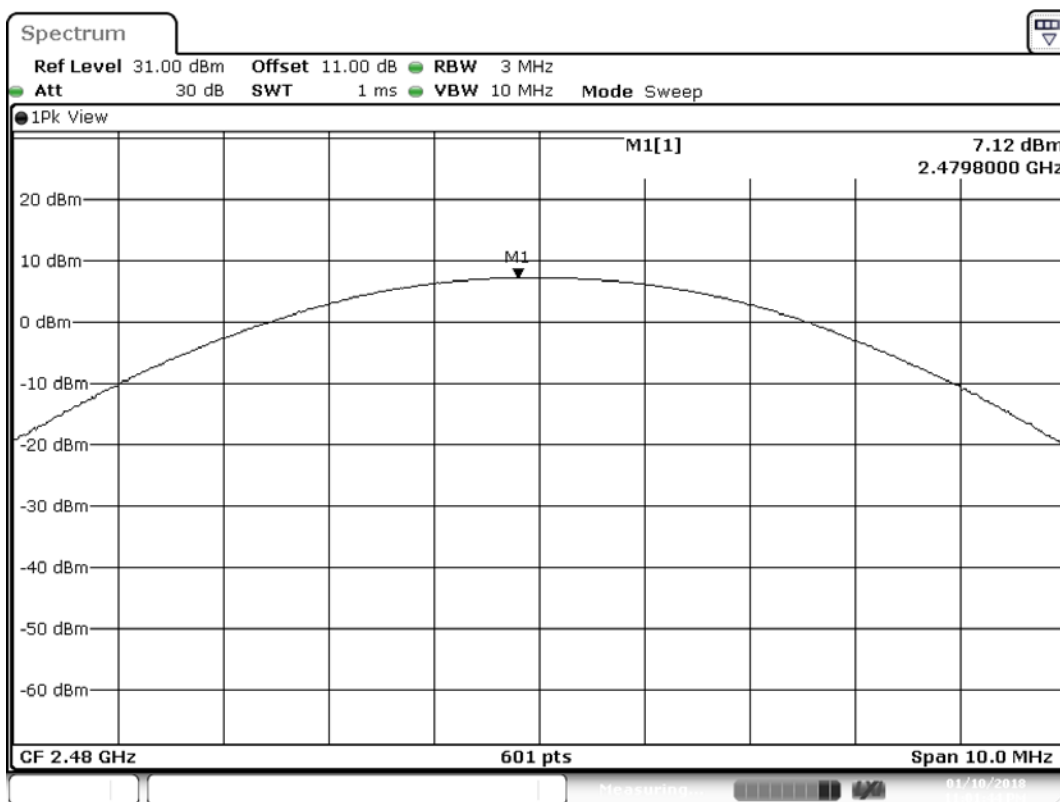
Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot5 Power 2DH5 2441 MHz



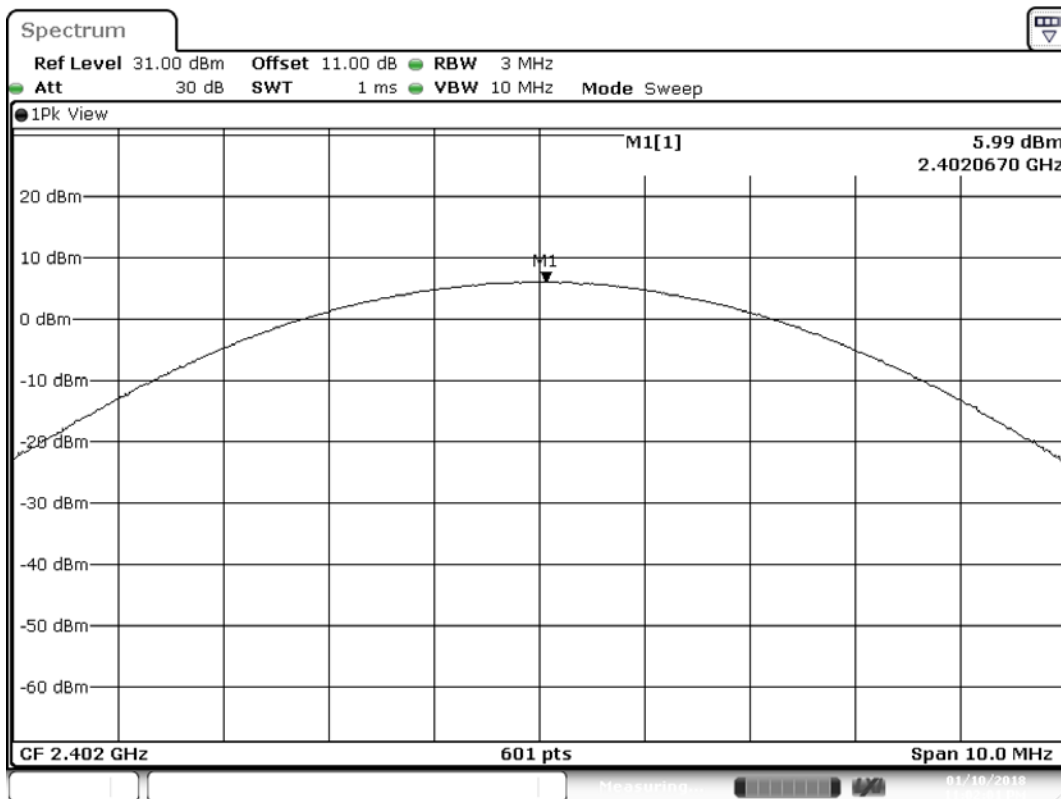
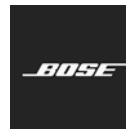
Plot6 Power 2DH5 2480 MHz



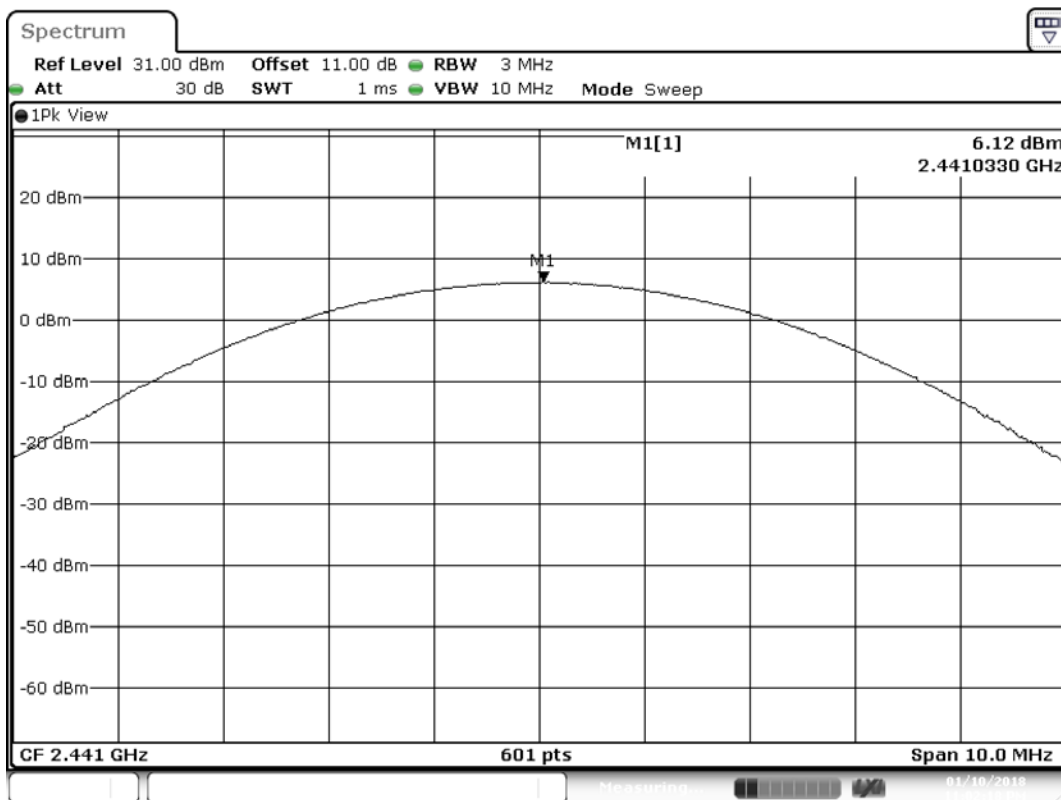
Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot7 Power 3DH5 2402 MHz



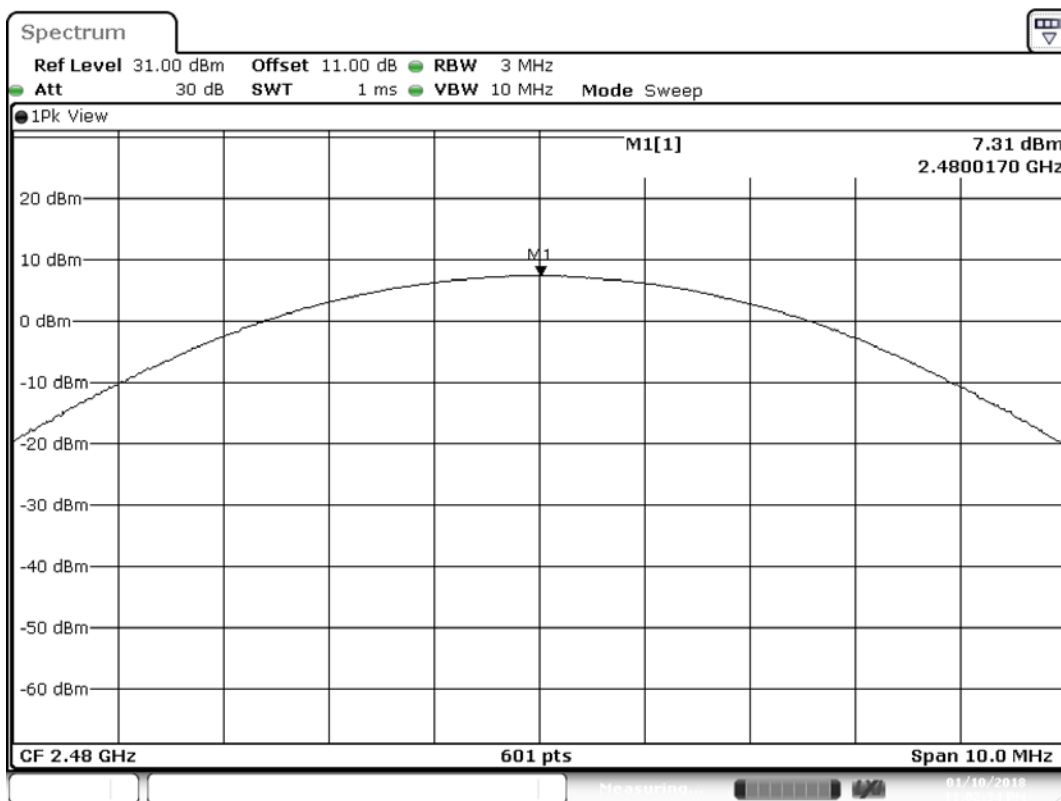
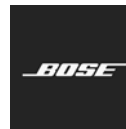
Plot8 Power 3DH5 2441 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot9 Power 3DH5 2480 MHz



Hopping Frequency Separation Requirements:

FCC 15.247 (a) (1), IC RSS-247 5.1 (2)

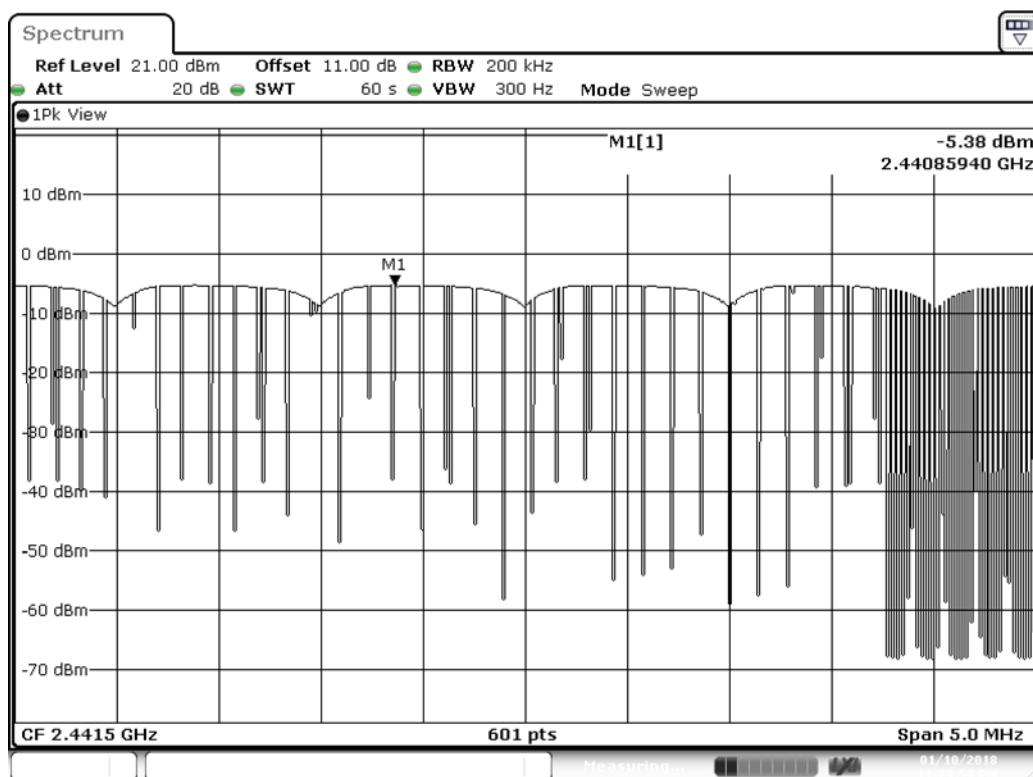
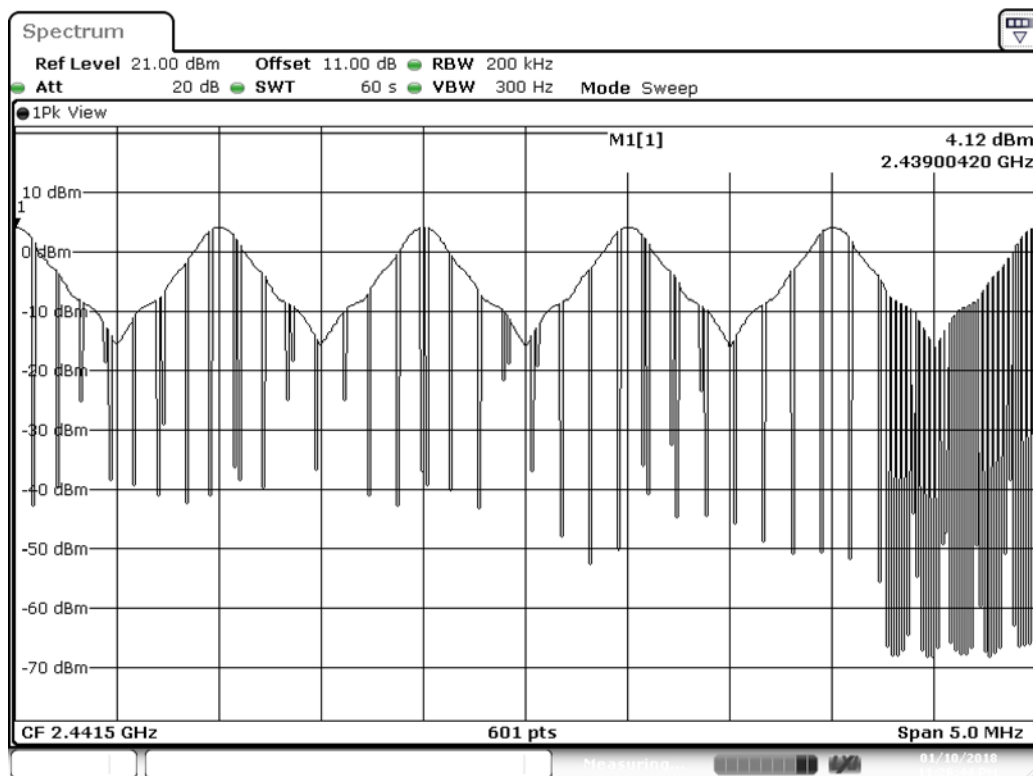
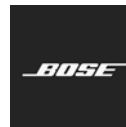
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

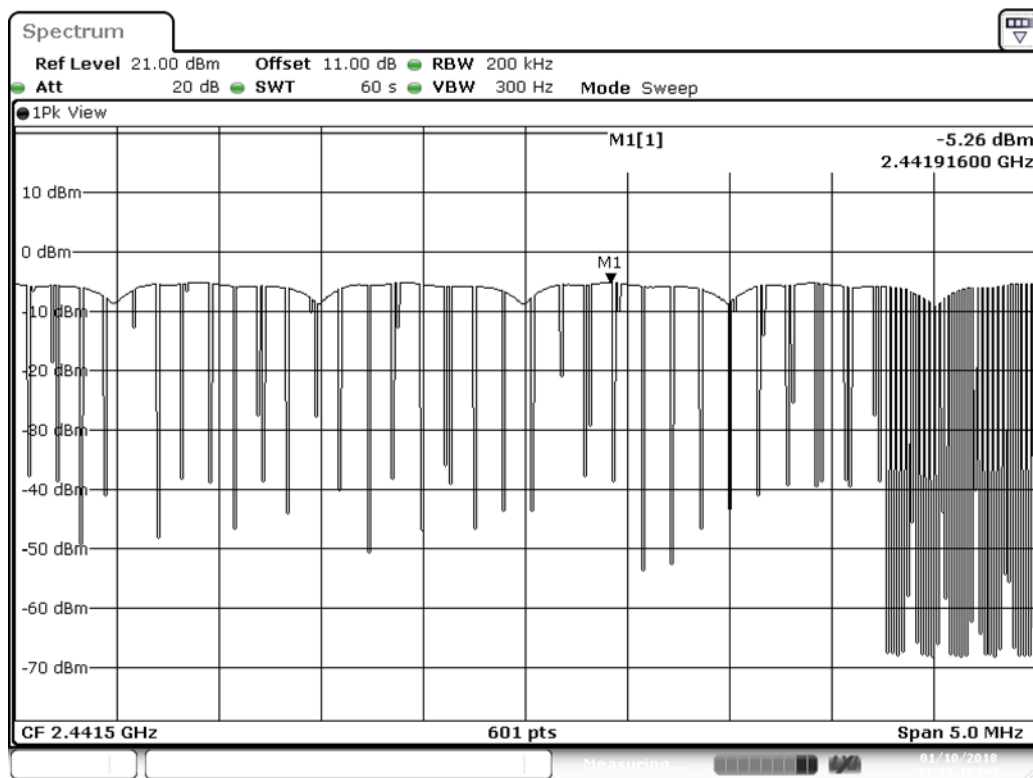
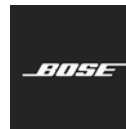




Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



Plot3 Frequency Separation 3DHS Hopping

Hopping frequencies are separated by 1MHz which is more than the required minimum of 25kHz and more than 2/3 of the 20dB bandwidth of the hopping channel which would be 842kHz.

Conducted Spurious Emissions Requirements:

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

IC RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

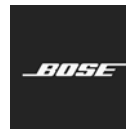
Note: Antenna gain outside of the wanted band was assumed to be zero. The conducted spurious readings are for additional information as the radiated readings take precedence.



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



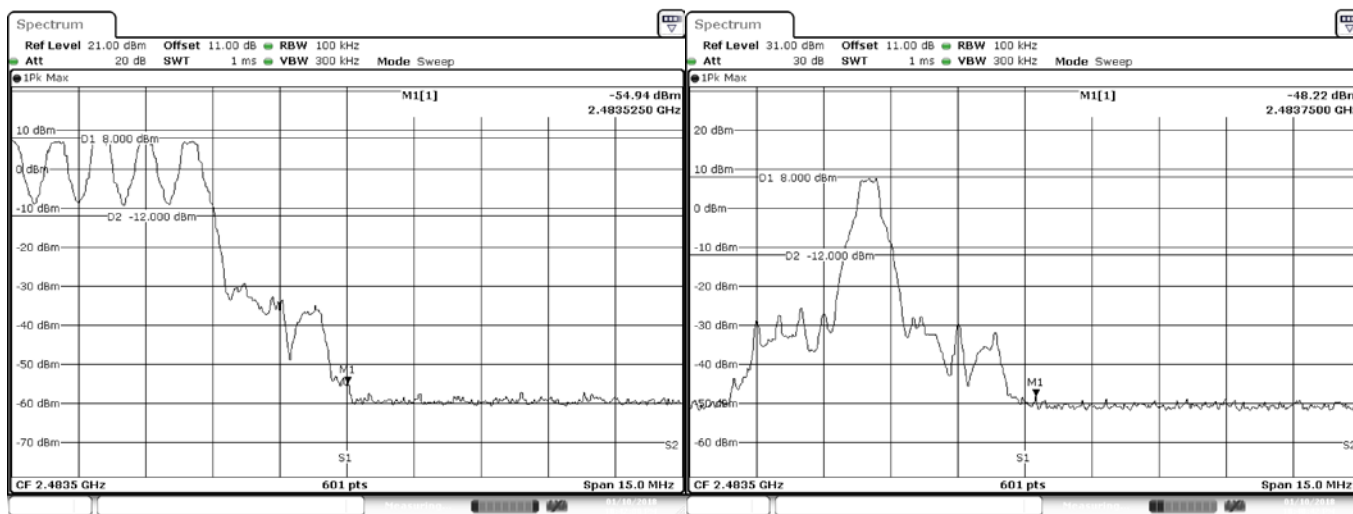
Spurious Band-edge Emissions

Upper Band Edge (Basic Rate: 1 Mbps) (Hopping Mode)

Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	DH5	62.94	20	42.94	Pass

Upper Band Edge (Basic Rate: 1 Mbps) (Non-Hopping Mode)

Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
High	2480	DH5	56.22	20	36.22	Pass



Plot1 Upper Band Edge DH5 Hopping

Plot1 Upper Band Edge DH5 2480 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

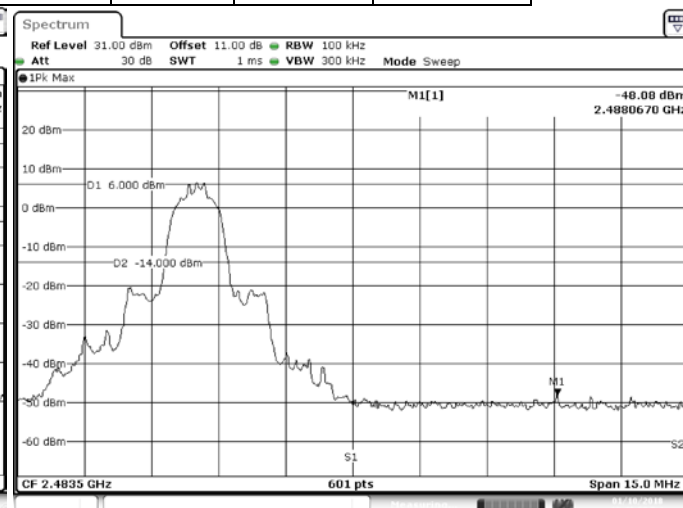


Upper Band Edge (Enhanced Rate: 2 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	2-DH5	62.39	20	42.39	Pass

Upper Band Edge (Enhanced Rate: 2 Mbps) (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
High	2480	2-DH5	54.08	20	34.08	Pass



Plot2 Upper Band Edge 2DH5 Hopping



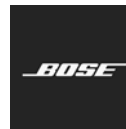
Plot2 Upper Band Edge 2DH5 2480 MHz



Certificate # 1514.1

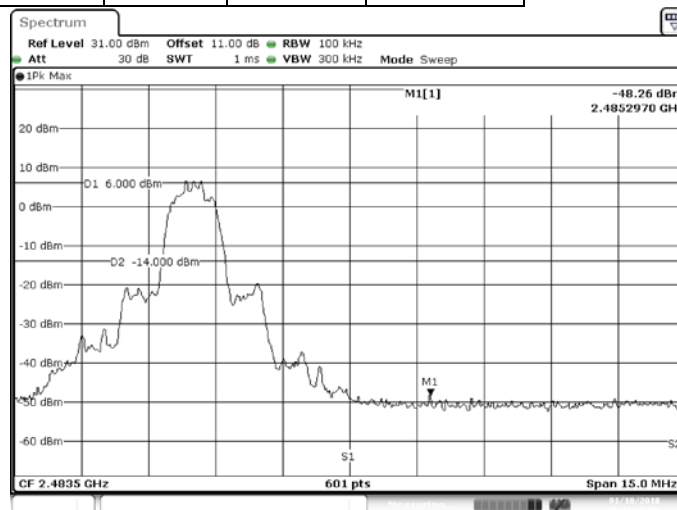
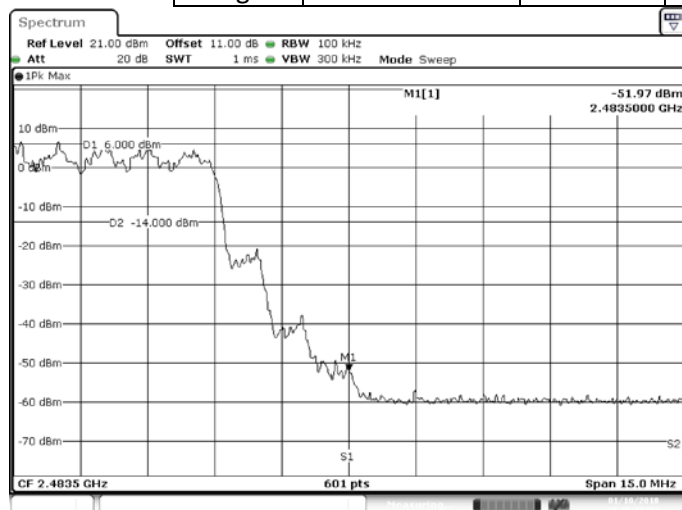
DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376



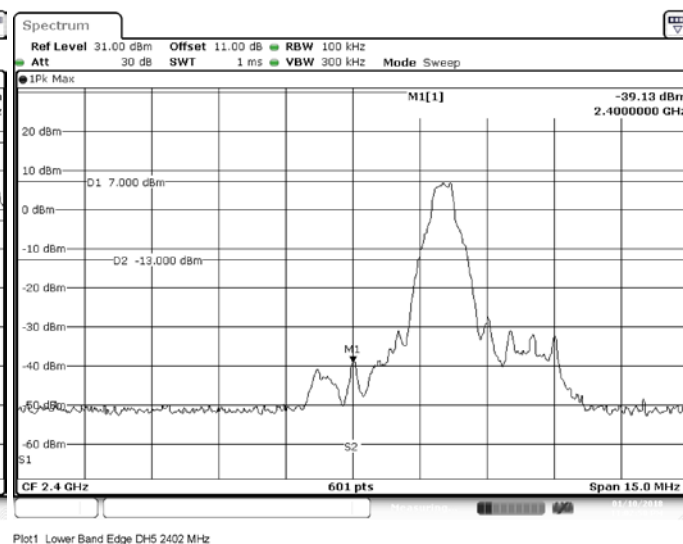
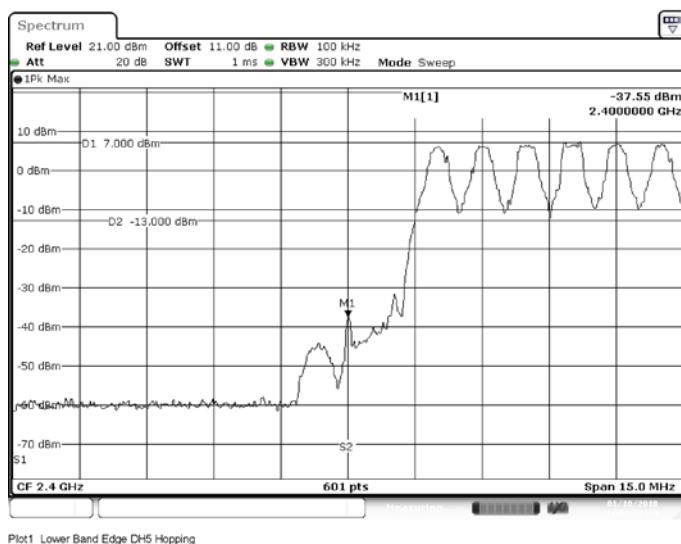
Upper Band Edge (Enhanced Rate: 3 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	3-DH5	57.97	20	37.97	Pass

Upper Band Edge (Enhanced Rate: 3 Mbps) (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
High	2480	3-DH5	54.26	20	34.26	Pass



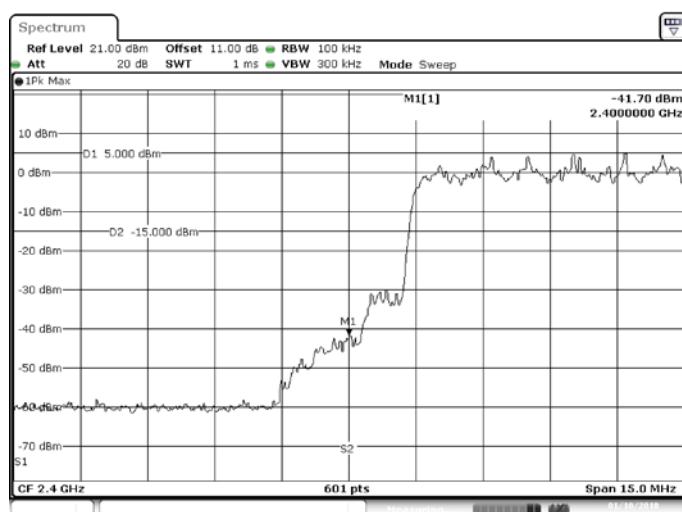
Lower Band Edge (Basic Rate: 1 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	DH5	44.55	20	24.55	Pass

Lower Band Edge (Basic Rate: 1 Mbps) (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Low	2402	DH5	46.13	20	26.13	Pass

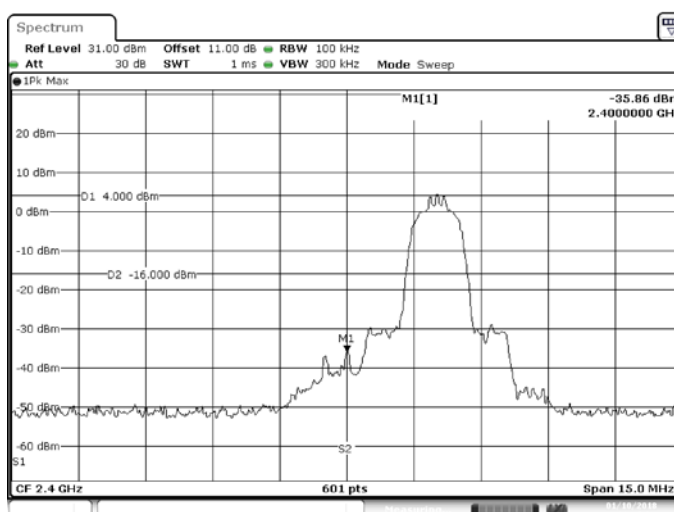


Lower Band Edge (Enhanced Rate: 2 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	2-DH5	46.70	20	26.70	Pass

Lower Band Edge (Enhanced Rate: 2 Mbps) (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Low	2402	2-DH5	39.86	20	19.86	Pass



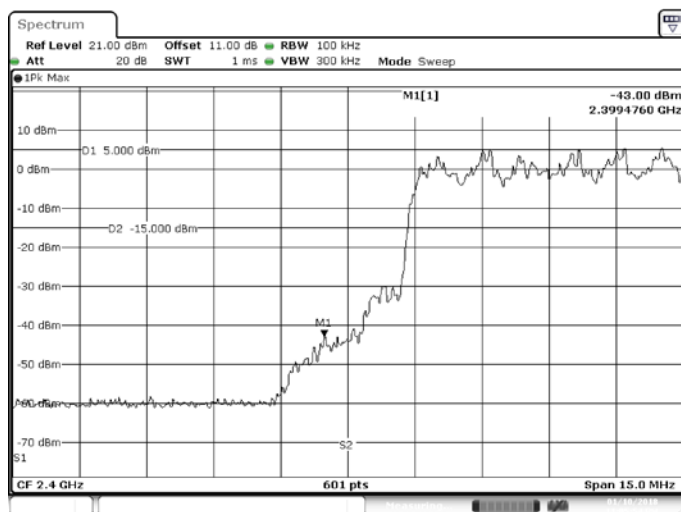
Plot2 Lower Band Edge 2DH5 Hopping



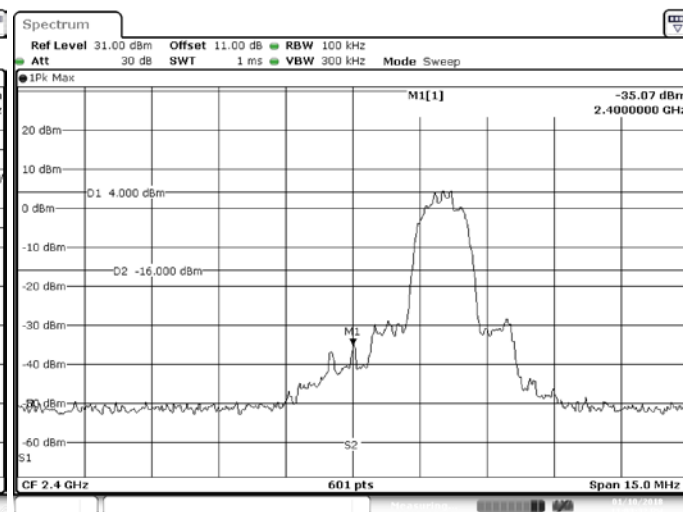
Plot2 Lower Band Edge 2DH5 2402 MHz

Lower Band Edge (Enhanced Rate: 3 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	3-DH5	48.00	20	28.00	Pass

Lower Band Edge (Enhanced Rate: 3 Mbps) (Non-Hopping Mode)						
Channel	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Low	2402	3-DH5	40.31	20	20.31	Pass



Plot3 Lower Band Edge 3DH5 Hopping



Plot3 Lower Band Edge 3DH5 2402 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

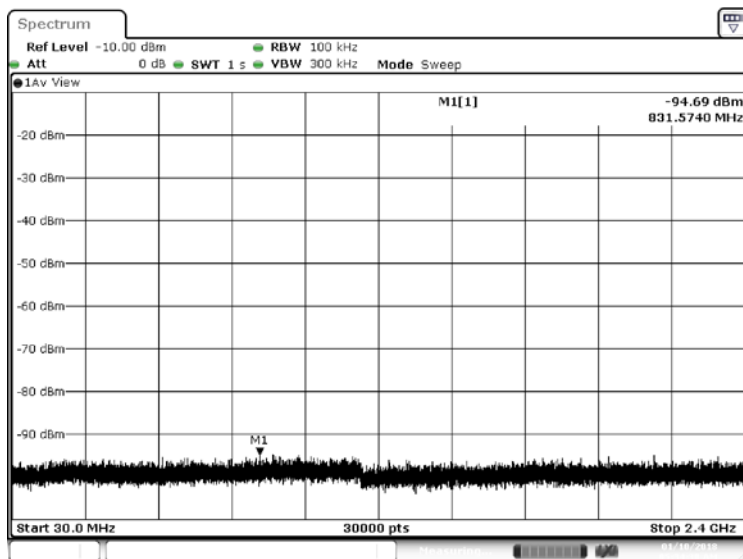


Spurious Emissions

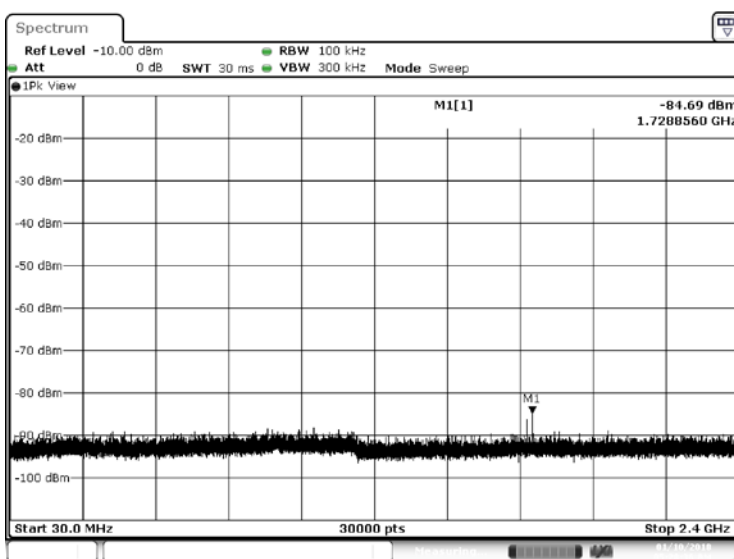
For these readings, a notch filter was used to protect the EMI receiver from overload. A correction factor was applied to account for the effect of the notch filter.

Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
Low	30 To 1000	DH5	-94.7	1.0	10.0	0.0	-83.7	11.54	54	42.46	Pass
Low	2483.5 To 25000	DH5	-85.3	1.0	10.0	0.0	-74.3	20.91	54	33.09	Pass

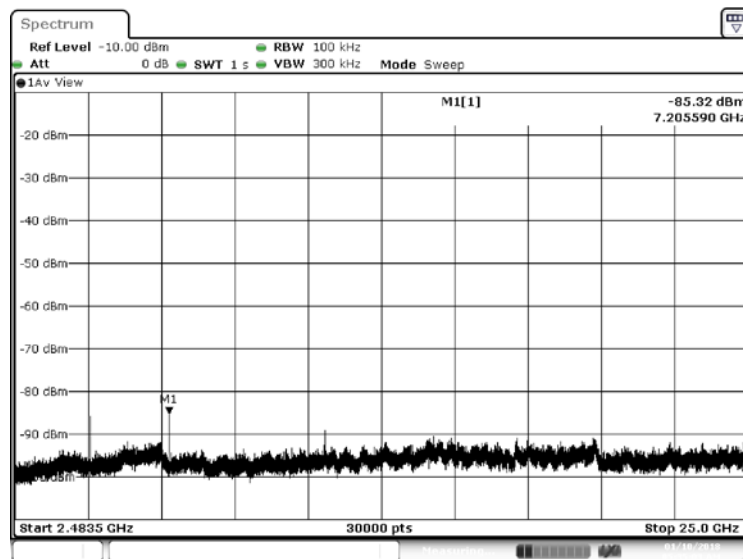
Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Result
Low	30 To 1000	DH5	-84.7	1.0	10.0	0.0	-73.7	21.54	74	52.46	Pass
Low	2483.5 To 25000	DH5	-76.4	1.0	10.0	0.0	-65.4	29.85	74	44.15	Pass



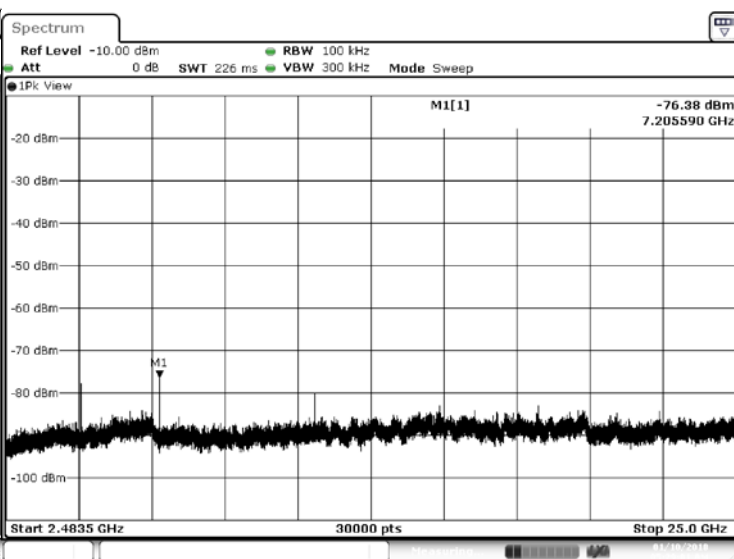
Plot1 DH5 2402 MHz Average Band 1



Plot1 DH5 2402 MHz Peak Band 1



Plot2 DH5 2402 MHz Average Band 2



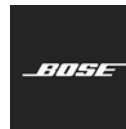
Plot2 DH5 2402 MHz Peak Band 2



Certificate # 1514.1

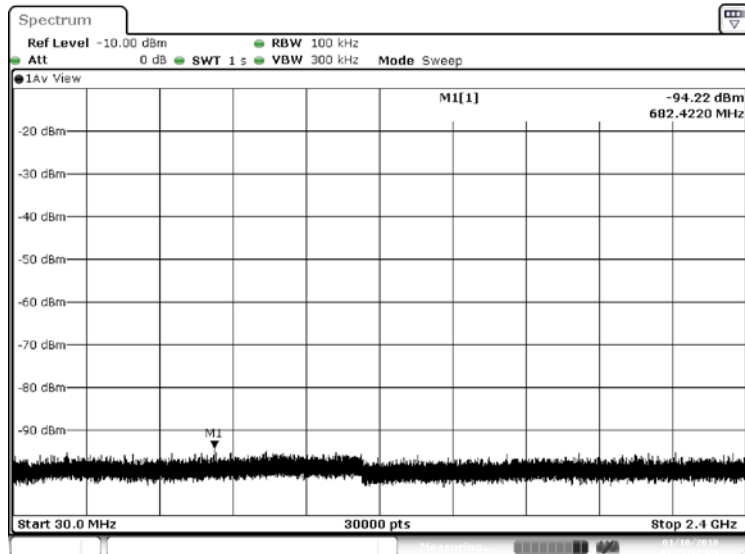
DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

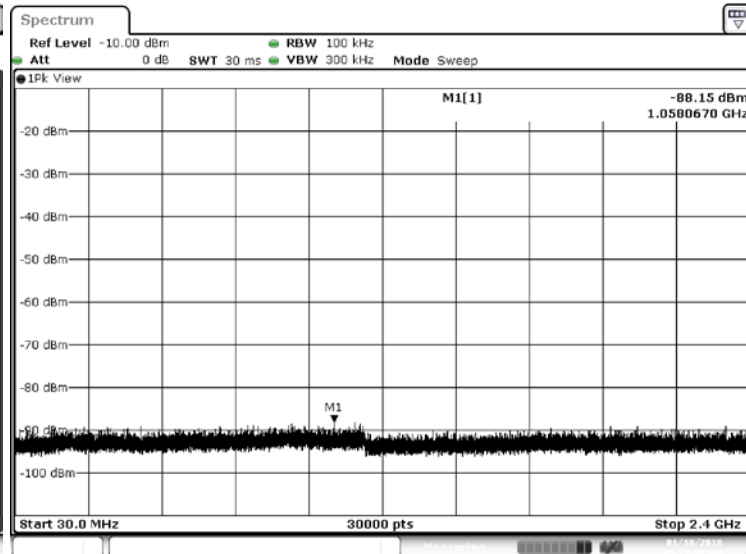


Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
Mid	30 To 1000	DH5	-94.2	1.0	10.0	0.0	-83.2	12.01	54	41.99	Pass
Mid	2483.5 To 25000	DH5	-83.7	1.0	10.0	0.0	-72.7	22.51	54	31.49	Pass

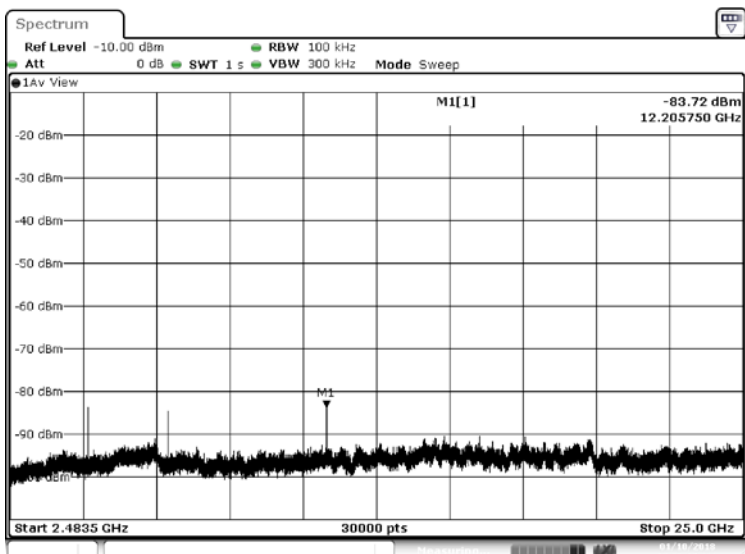
Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Result
Mid	30 To 1000	DH5	-88.1	1.0	10.0	0.0	-77.1	18.08	74	55.92	Pass
Mid	2483.5 To 25000	DH5	-75.1	1.0	10.0	0.0	-64.1	31.17	74	42.83	Pass



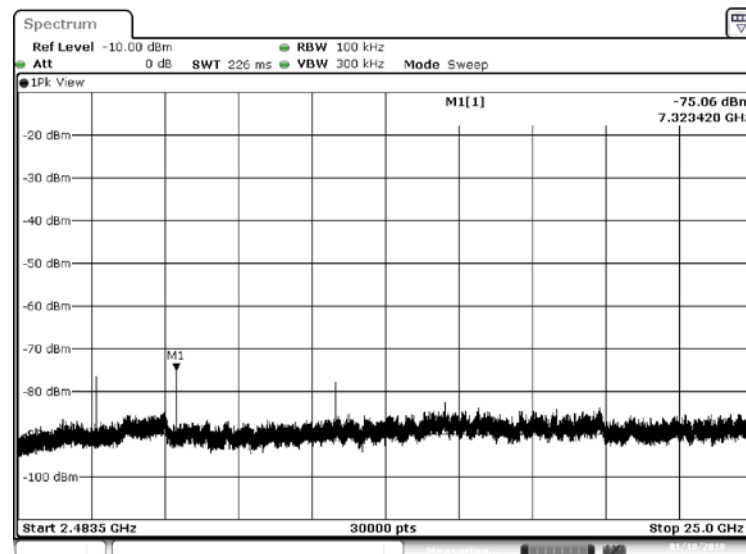
Plot1 DH5 2441 MHz Average Band 1



Plot1 DH5 2441 MHz Peak Band 1



Plot2 DH5 2441 MHz Average Band 2



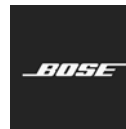
Plot2 DH5 2441 MHz Peak Band 2



Certificate # 1514.1

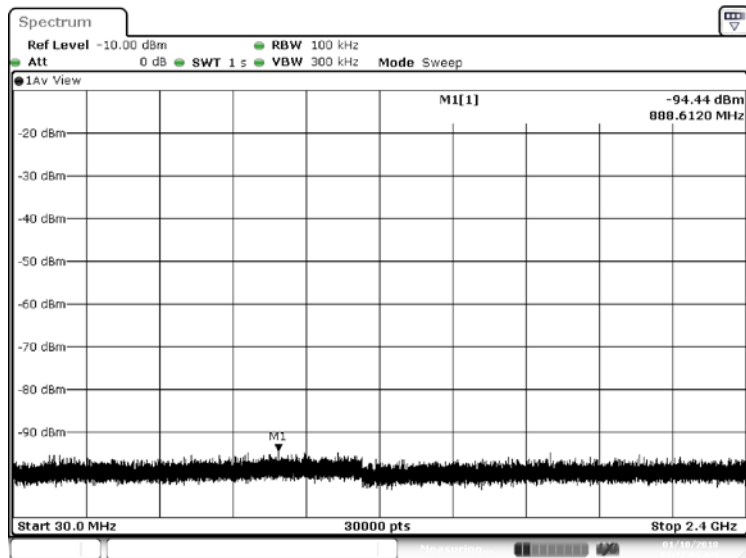
DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

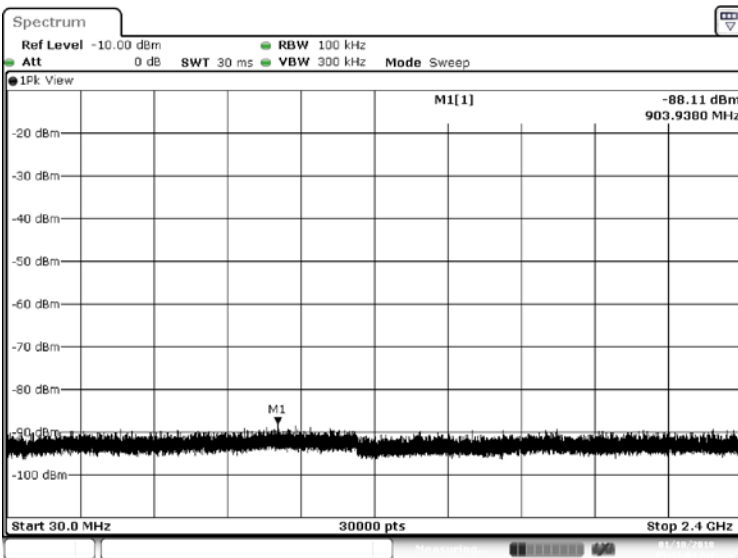


Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
High	30 To 1000	DH5	-94.4	1.0	10.0	0.0	-83.4	11.79	54	42.21	Pass
High	2483.5 To 25000	DH5	-80.3	1.0	10.0	0.0	-69.3	25.89	54	28.11	Pass

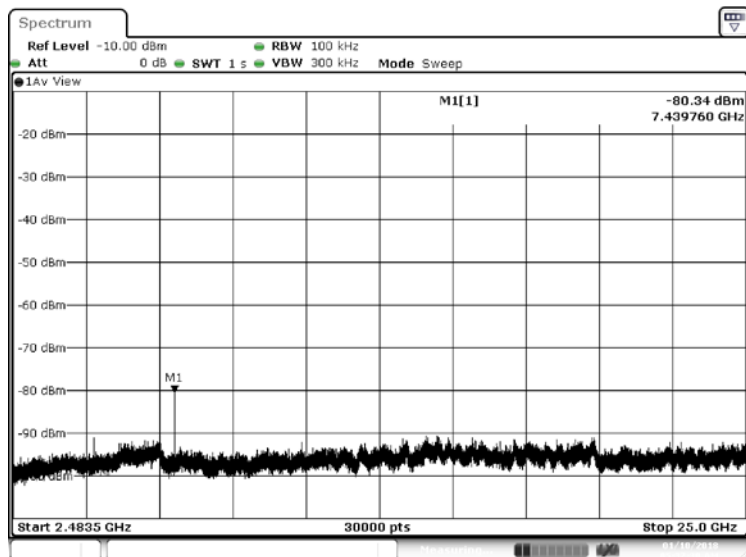
Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Result
High	30 To 1000	DH5	-88.1	1.0	10.0	0.0	-77.1	18.12	74	55.88	Pass
High	2483.5 To 25000	DH5	-73.5	1.0	10.0	0.0	-62.5	32.77	74	41.23	Pass



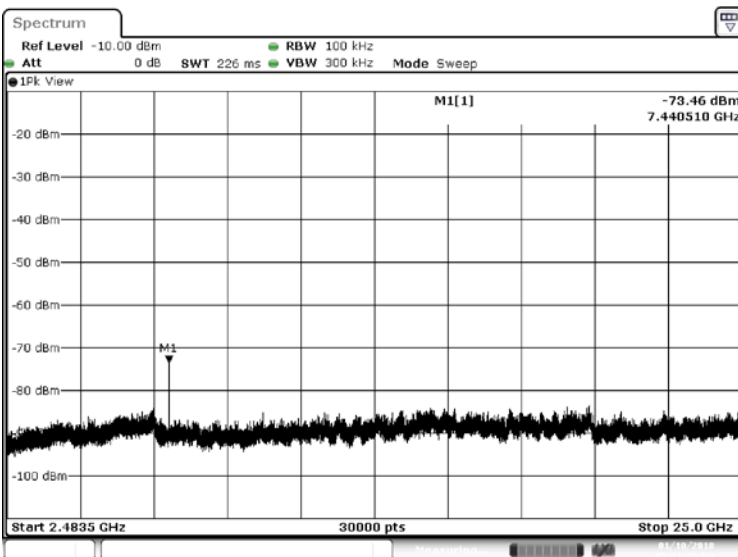
Plot1 DH5 2480 MHz Average Band 1



Plot1 DH5 2480 MHz Peak Band 1



Plot2 DH5 2480 MHz Average Band 2



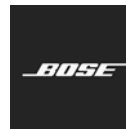
Plot2 DH5 2480 MHz Peak Band 2



Certificate # 1514.1

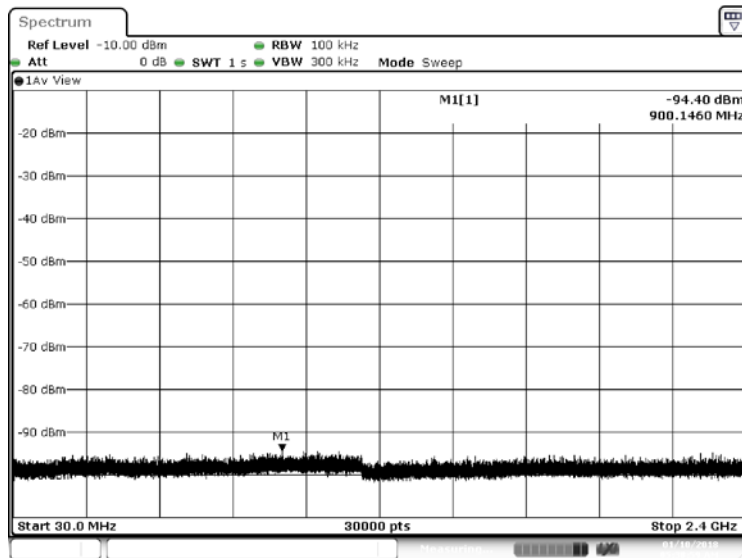
DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376

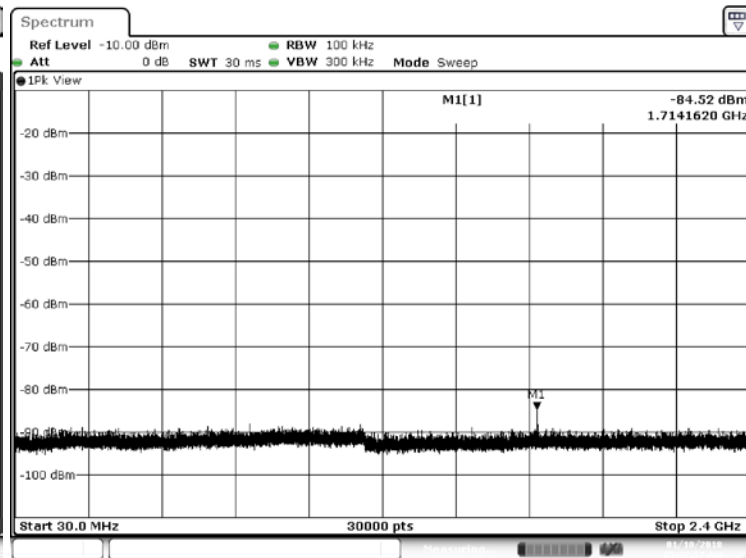


Spurious Summary Table (Basic Rate: 1Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
Hopping	30 To 1000	DH5	-94.4	1.0	10.0	0.0	-83.4	11.83	54	42.17	Pass
Hopping	2483.5 To 25000	DH5	-82.7	1.0	10.0	0.0	-71.7	23.52	54	30.48	Pass

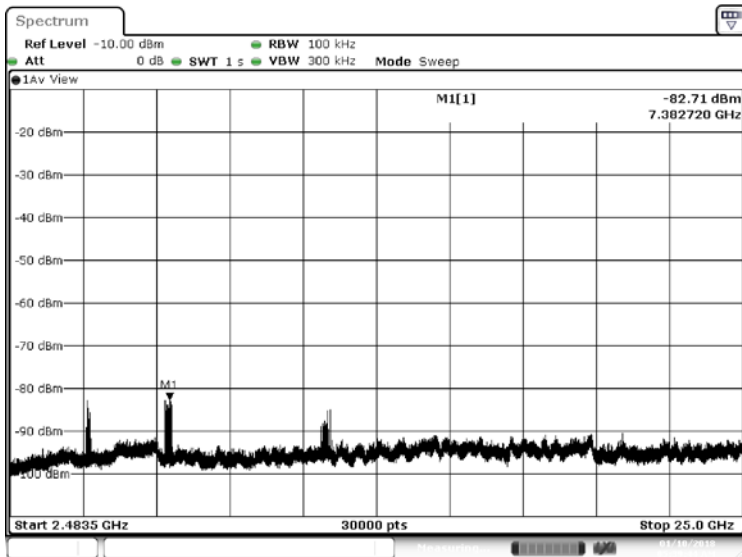
Spurious Summary Table (Basic Rate: 1Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Result
Hopping	30 To 1000	DH5	-84.5	1.0	10.0	0.0	-73.5	21.71	74	52.29	Pass
Hopping	2483.5 To 25000	DH5	-74.3	1.0	10.0	0.0	-63.3	31.89	74	42.11	Pass



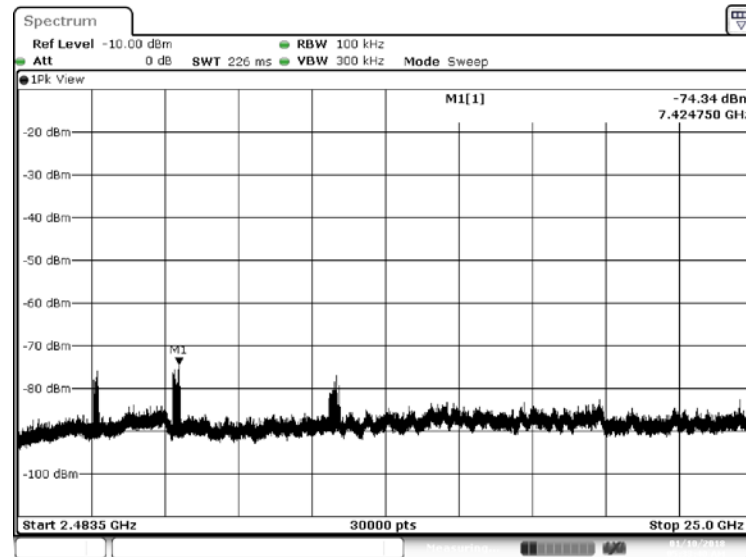
Plot1 DH5 Hopping Average Band 1



Plot1 DH5 Hopping Peak Band 1



Plot2 DH5 Hopping Average Band 2



Plot2 DH5 Hopping Peak Band 2

Average Time of Occupancy Requirements:

FCC 15.247 (a) (1) (iii), IC RSS-247 5.1 (4)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test setup details

The EUT is controlled via the USB cable with CSR's Blue Suite software which is used to set the test modes of EUT. The EUT is programmed to operate at fixed frequencies at the low, middle, and high end of the authorized frequency band.

Using zero span mode on the channel center frequency the transmit pulse width was measured for each of the following modes, DH1, DH3 & DH5 with the maximum payload size for basic and enhanced data rates.

$$\begin{aligned}\text{Dwell Time} &= (\text{TX Pulse Width}) * (\text{Hop Rate}) / (\# \text{ of Channels}) / (\# \text{ of slots}) * 31.6 \\ &= (\text{TX Pulse Width}) * 1600 / 79 / (\# \text{ of Slots}) * 31.6 \\ &= (\text{TX Pulse Width}) * 640 / (\# \text{ Slots})\end{aligned}$$

$$\text{Hop Rate} = 1600 \text{ hops / S}$$

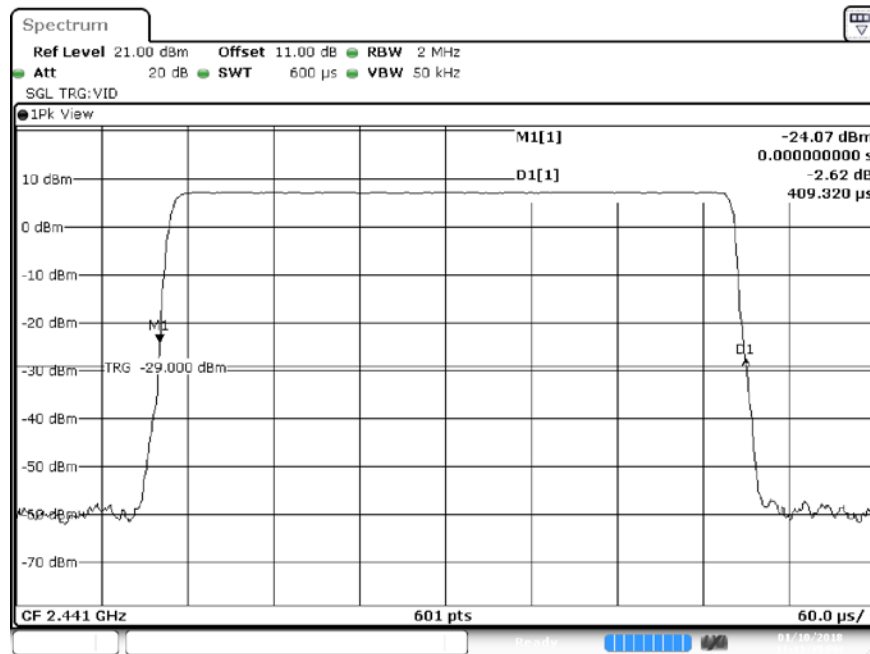
$$\# \text{ of channels} = 79$$

$$\# \text{ of slots} = \text{number of slots used per packet in a given mode: DH1} = 2, \text{ DH3} = 4, \text{ DH5} = 6$$

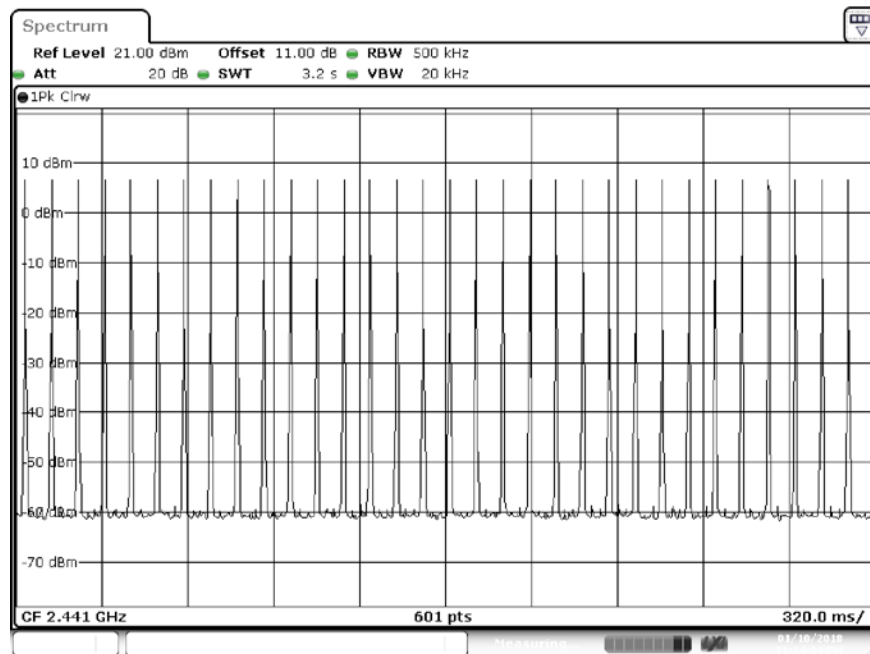
$$31.6 \text{ Seconds} = (79 \text{ channels}) * 0.4 \text{ Seconds}$$

$$8 \text{ Seconds} = (20 \text{ channels}) * 0.4 \text{ Seconds}$$

Test Results:

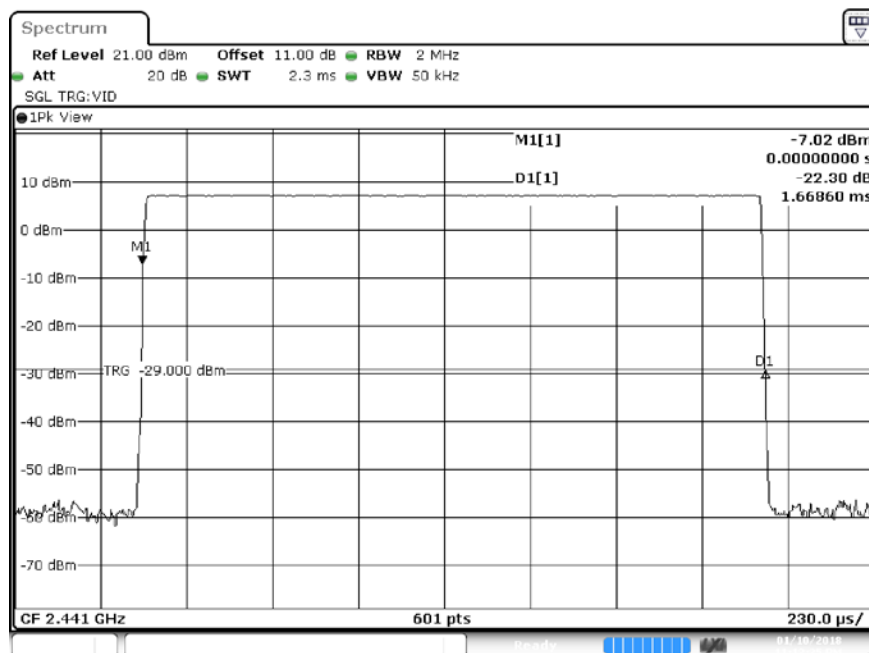


Plot1 2441 TX pulse width DH1

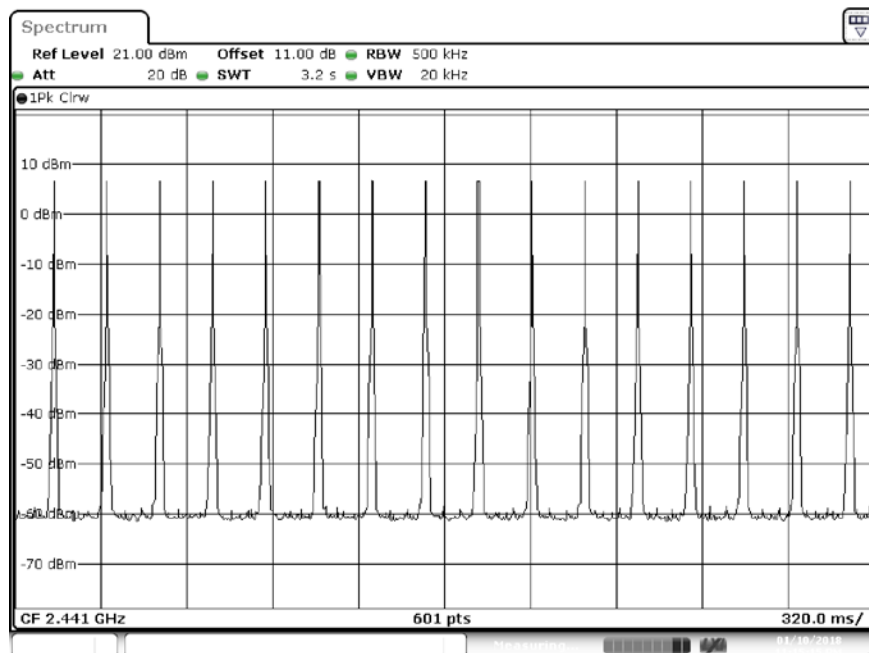


Plot10 2441 TX pulse count DH1

TX Pulse Width (xDH1)									
Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 3.16 S	Number of pulses in 31.6 S (X 10)	Time of occupancy (Pulse Width X Number of pulses) (mS)	Limit (mS)	Margin (mS)	Result
Middle	2441	DH1	0.409	33	330	135.1	400	264.93	Pass
Middle	2441	2-DH1	0.421	33	330	139.0	400	260.97	Pass
Middle	2441	3-DH1	0.421	33	330	139.0	400	260.97	Pass

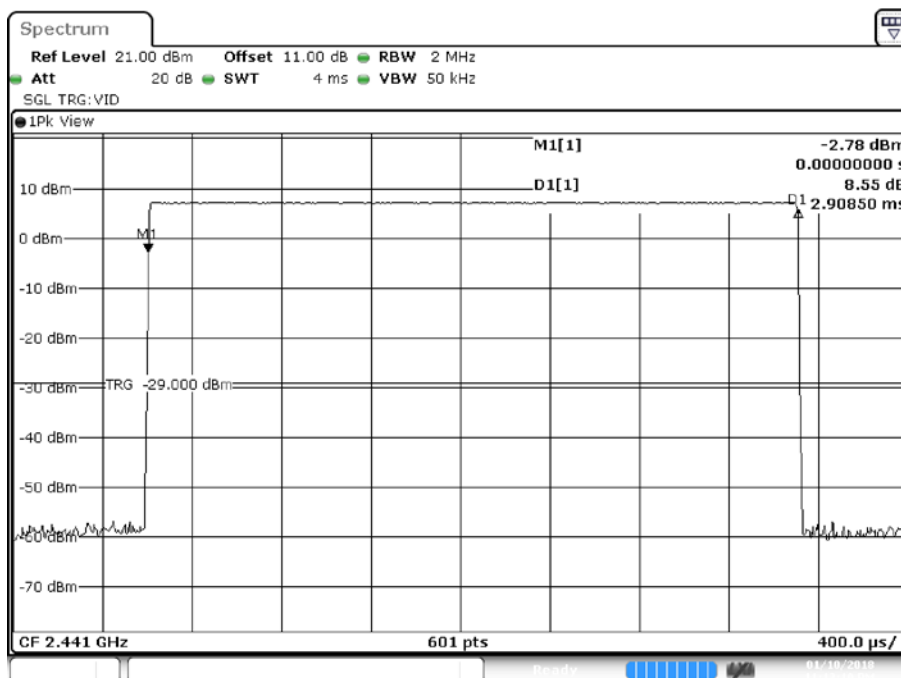


Plot4 2441 TX pulse width DH3

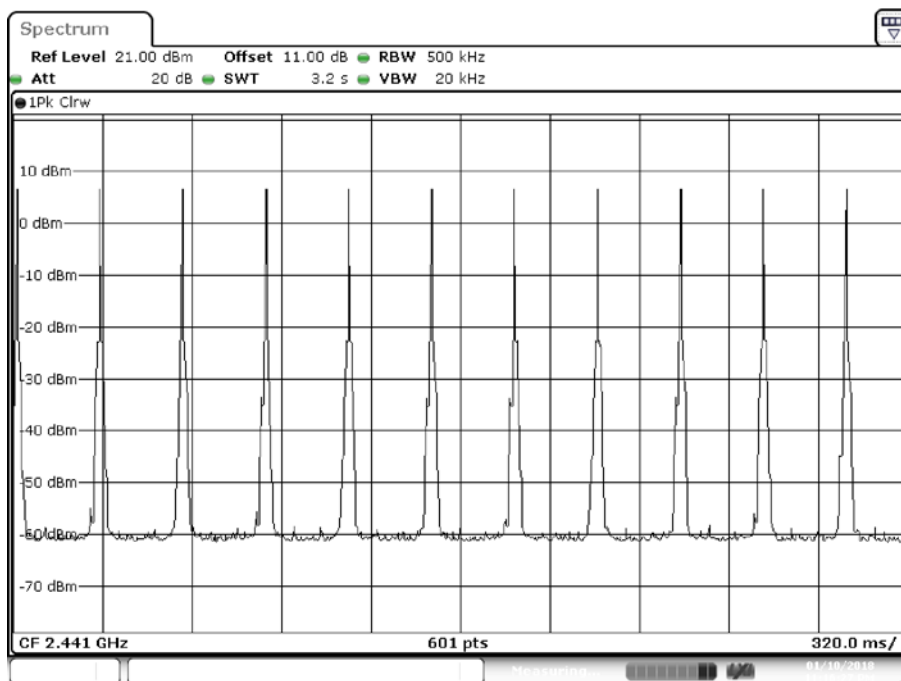


Plot13 2441 TX pulse count DH3

TX Pulse Width (xDH3)									
Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 3.16 S	Number of pulses in 31.6 S (X 10)	Time of occupancy (Pulse Width X Number of pulses) (mS)	Limit (mS)	Margin (mS)	Result
Middle	2441	DH3	1.669	17	170	283.7	400	116.35	Pass
Middle	2441	2-DH3	1.676	17	170	285.0	400	115.04	Pass
Middle	2441	3-DH3	1.672	16	160	267.6	400	132.42	Pass



Plot7 2441 TX pulse width DH5



Plot16 2441 TX pulse count DH5

TX Pulse Width (xDH5)				Time of occupancy					
Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 3.16 S	Number of pulses in 31.6 S (X 10)	(Pulse Width X Number of pulses) (mS)	Limit (mS)	Margin (mS)	Result
Middle	2441	DH5	2.908	11	110	319.9	400	80.07	Pass
Middle	2441	2-DH5	2.915	11	110	320.7	400	79.33	Pass
Middle	2441	3-DH5	2.922	11	110	321.4	400	78.60	Pass

Number of Hopping Channels

Requirements:

FCC 15.247 (a) (1) (iii), IC RSS-247 5.1 (4)

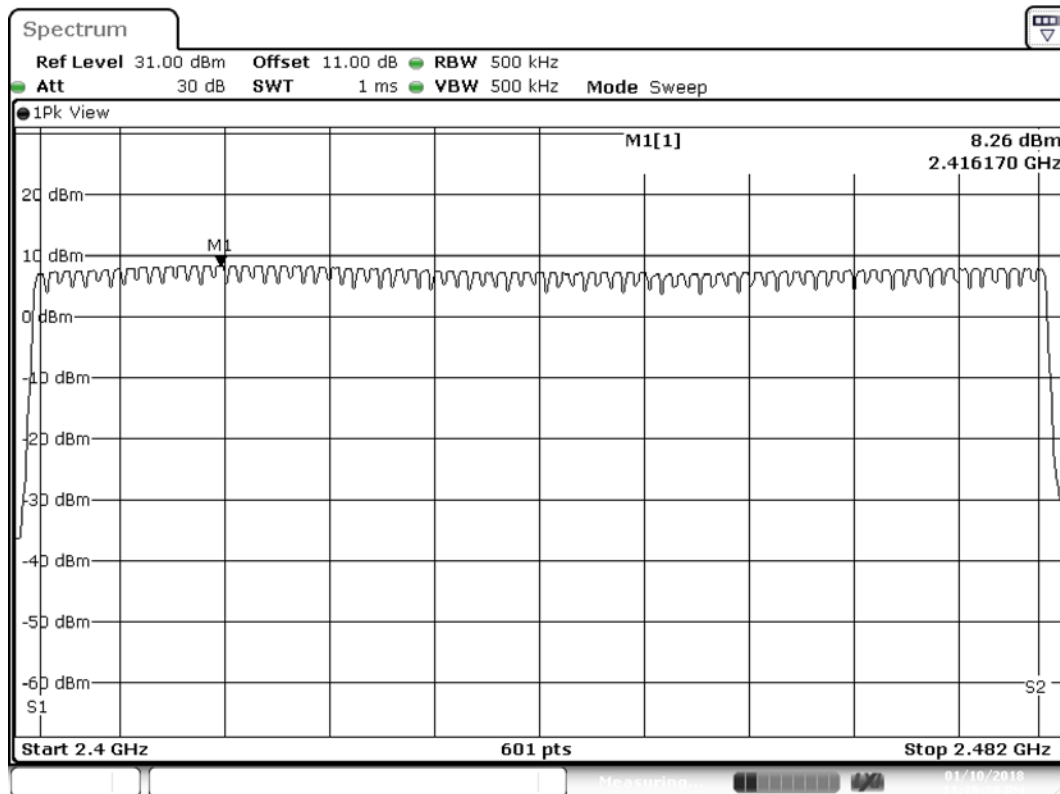
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

Test Setup:

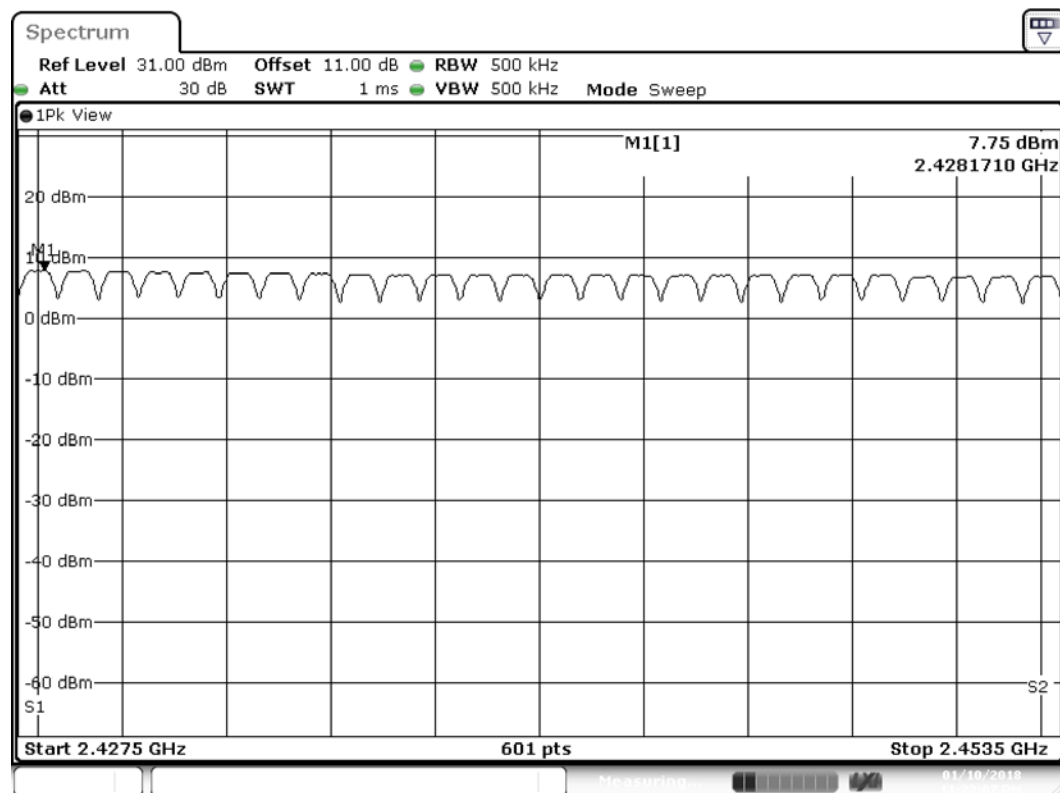
EUT is controlled by CSR's Blue Suite software to enable testing of the spurious output in specific operational modes.

Measurements are made with the EUT in normal operation (hopping through all available channels) in basic and enhanced data rate modes.

Test Results:



Plot1 79 Hopping Frequency DH5



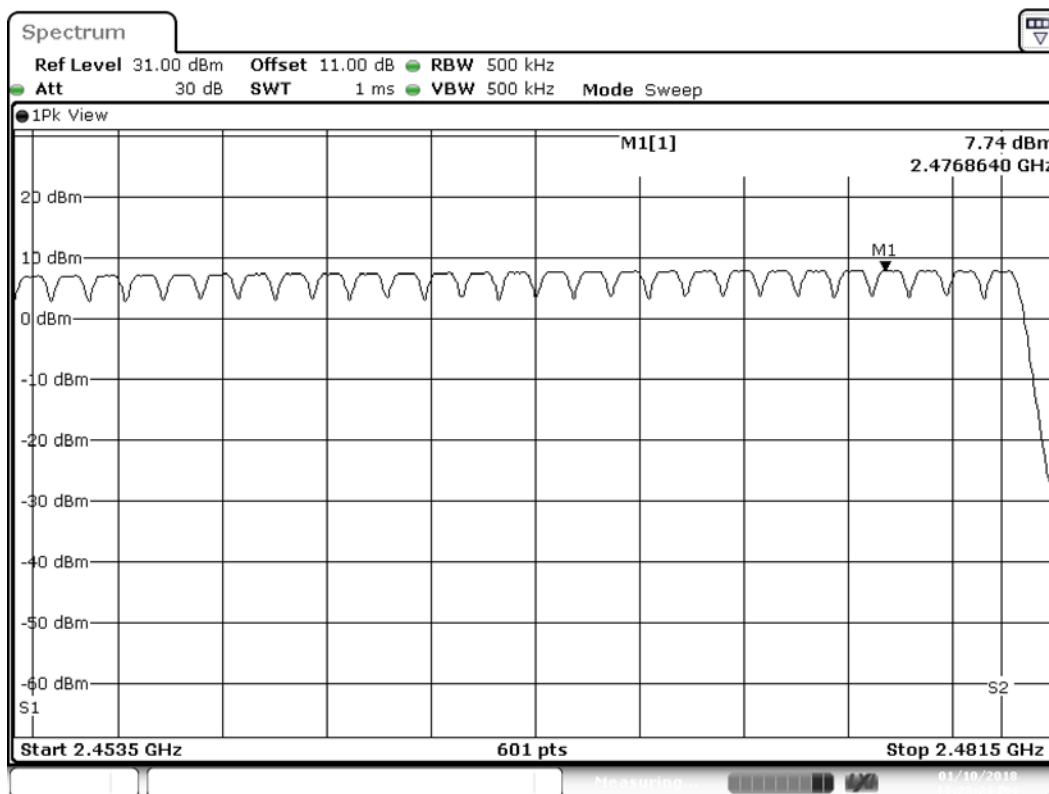
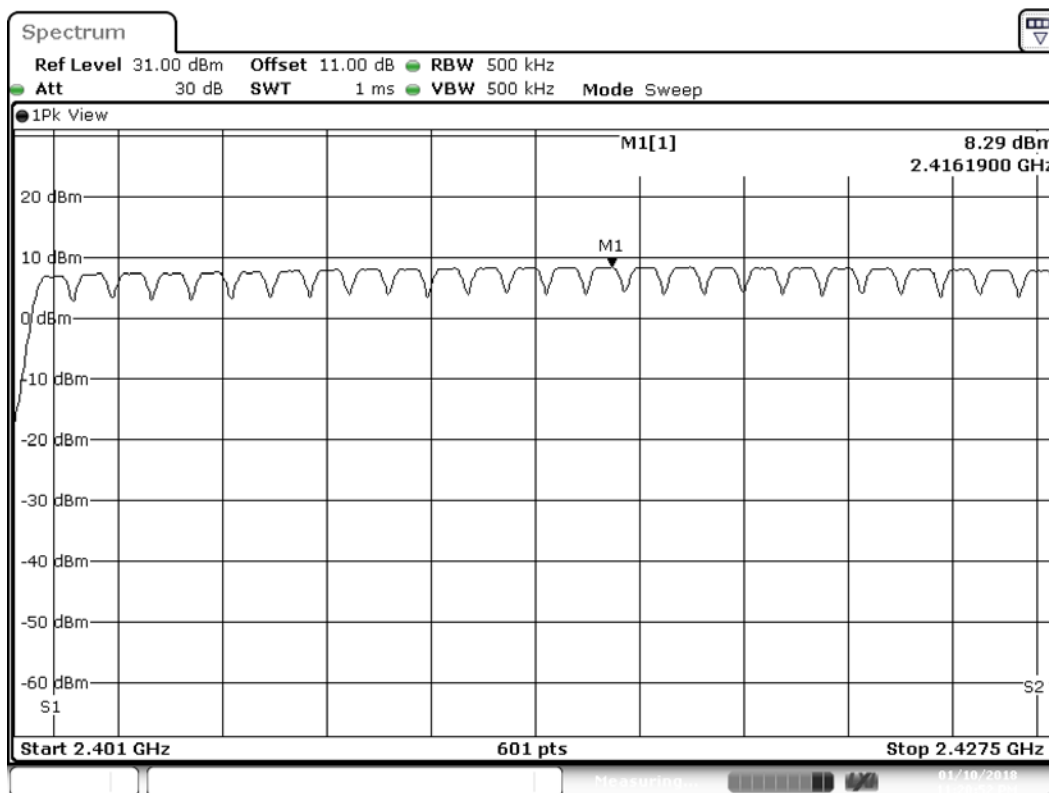
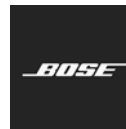
Plot3 2nd segment DH5 (26 Frequencies)



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423376 IC: 3232A-423376





Conducted Measurements Resources Used

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date	Most Recent Verification	Verification Due Date
2409	Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	05-Apr-2017	05-Apr-2018	n/a	n/a
2342	Band Reject Filter	BRM50702-07	001	Micro-Tronics	n/a	n/a	29-Mar-2017	29-Mar-2018



End of Report