



DESIGN ASSURANCE ENGINEERING
Wireless Transceiver Bluetooth Test Report



FCC ID: A94423816 IC: 3232A-423816

Test Type: Emissions Immunity

Product Type: Wireless Speaker

Product Name/Number: *Model Number: 423816*
FCC ID: A94423816
IC: 3232A-423816

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.423816.17.41.1*

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:	Chad Bell	<i>Chad Bell</i>	February 10, 2017
Electrical Engineer Review* By:	Michael Royer	<i>Michael A. Royer</i>	<i>April 6, 2017</i>

* 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.



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Test Report Summary

Product Information:

Description

The EUT is a wireless speaker 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 part number 745559-0030 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 3.574dBi formed by printed circuit board etch.

SOFTWARE AND FIRMWARE

*The firmware installed in the EUT during testing was version 0.1.4.5437
The test utility software used during testing was Polycomm, version 0.2.0.0 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.

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	Chad Bell	<i>Chad Bell</i>	February 10, 2017



Test Standards

Emissions:

- | | Standard |
|-------------------------------------|----------------|
| <input checked="" type="checkbox"/> | FCC Part 15C |
| <input checked="" type="checkbox"/> | Canada RSS-247 |
| <input checked="" type="checkbox"/> | Canada RSS-GEN |

Environmental Conditions

Ambient:

- | | |
|----------------|--|
| Temperature: | 22±4°C |
| Humidity: | 30-60%RH |
| Mains Voltage: | <input checked="" type="checkbox"/> 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	0.839	-
Middle	2441	DH5	0.844	-
High	2480	DH5	0.844	-

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	1.243	-

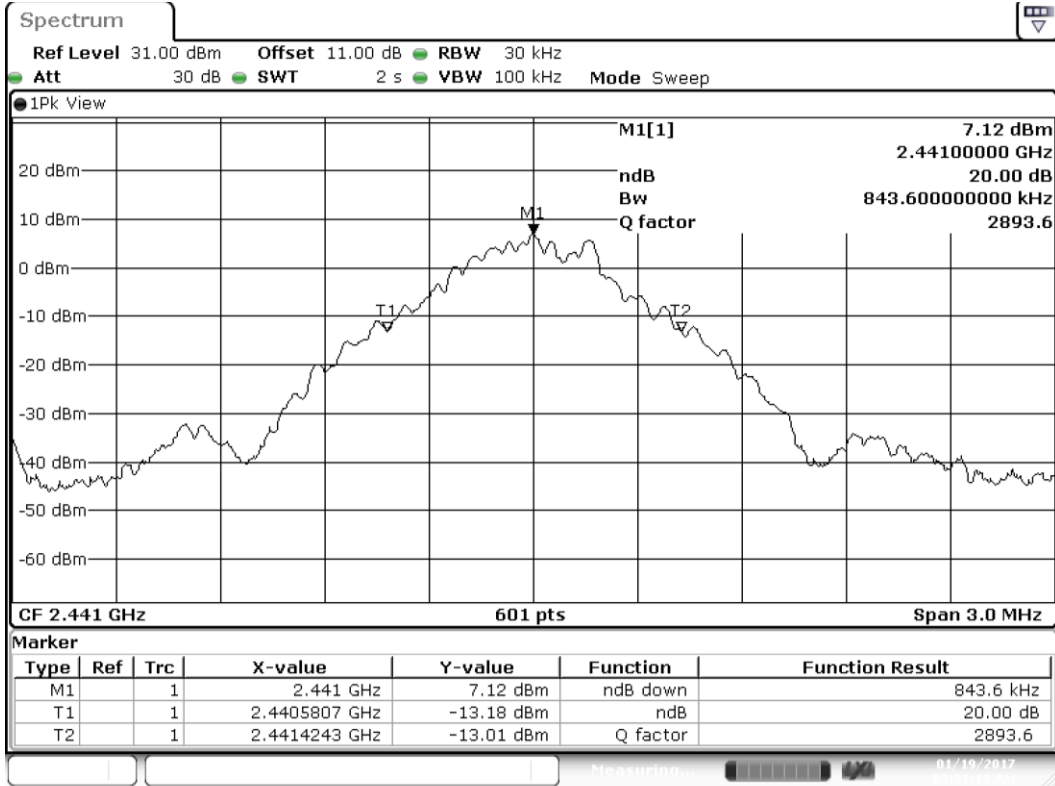
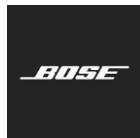
20 dB OBW Summary Table (Enhanced Rate: 3 Mbps)				
Channel	Frequency (MHz)	Mode	20 dB OBW (MHz)	Limit NA
Low	2402	3-DH5	1.263	-
Middle	2441	3-DH5	1.263	-
High	2480	3-DH5	1.263	-



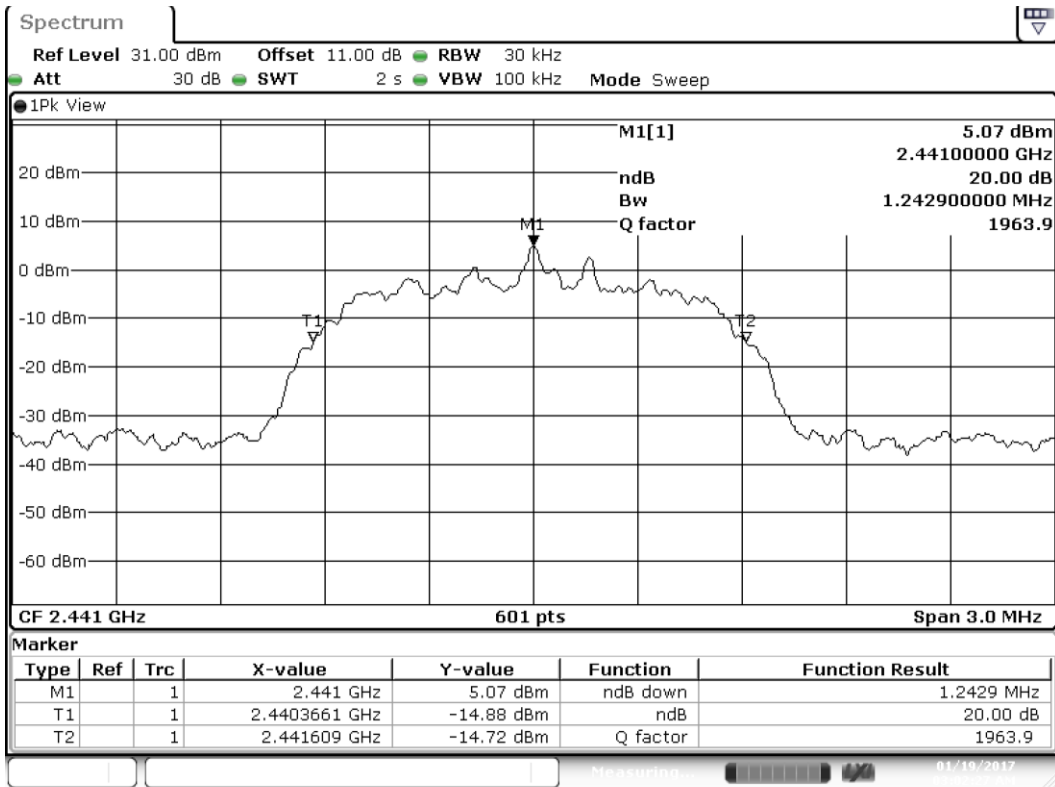
Certificate # 1514.1

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Plot2 20dB OBW DH5 2441 MHz



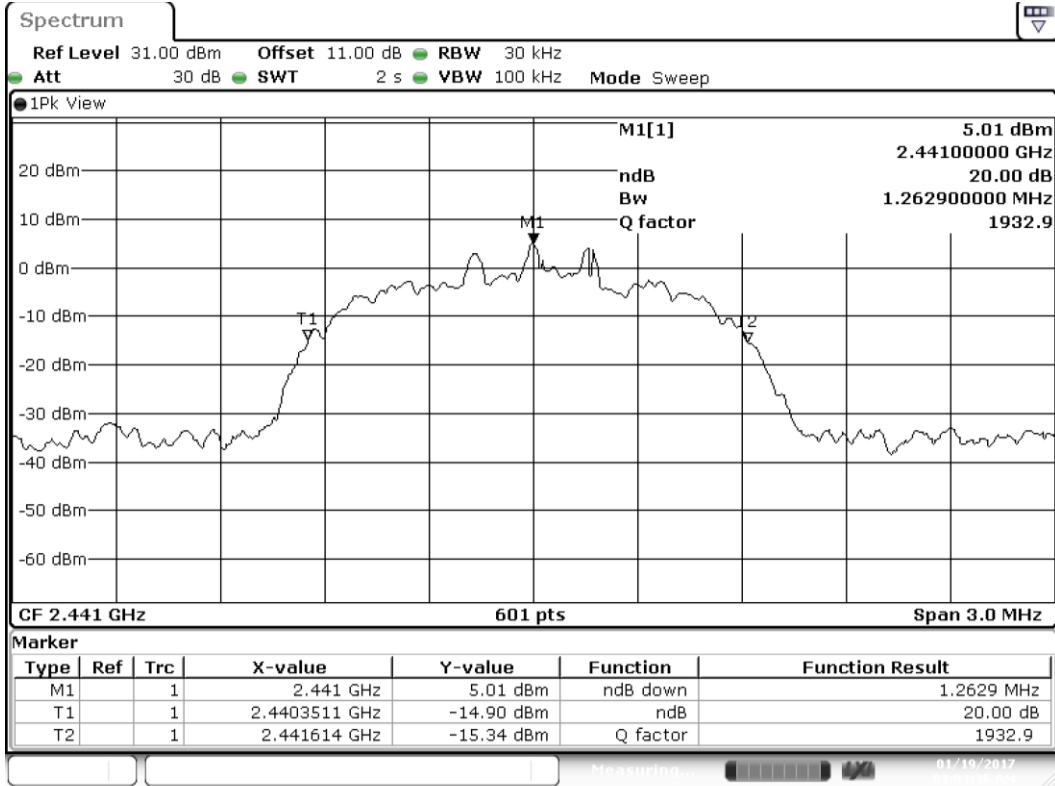
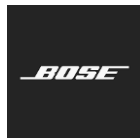
Plot5 20dB OBW 2DH5 2441 MHz



Certificate # 1514.1

DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

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Plot8 20dB OBW 3DH5 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	0.864	-
Middle	2441	DH5	0.859	-
High	2480	DH5	0.864	-

99% OBW Summary Table (Enhanced Rate: 2 Mbps)				
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit NA
Low	2402	2-DH5	1.173	-
Middle	2441	2-DH5	1.173	-
High	2480	2-DH5	1.173	-

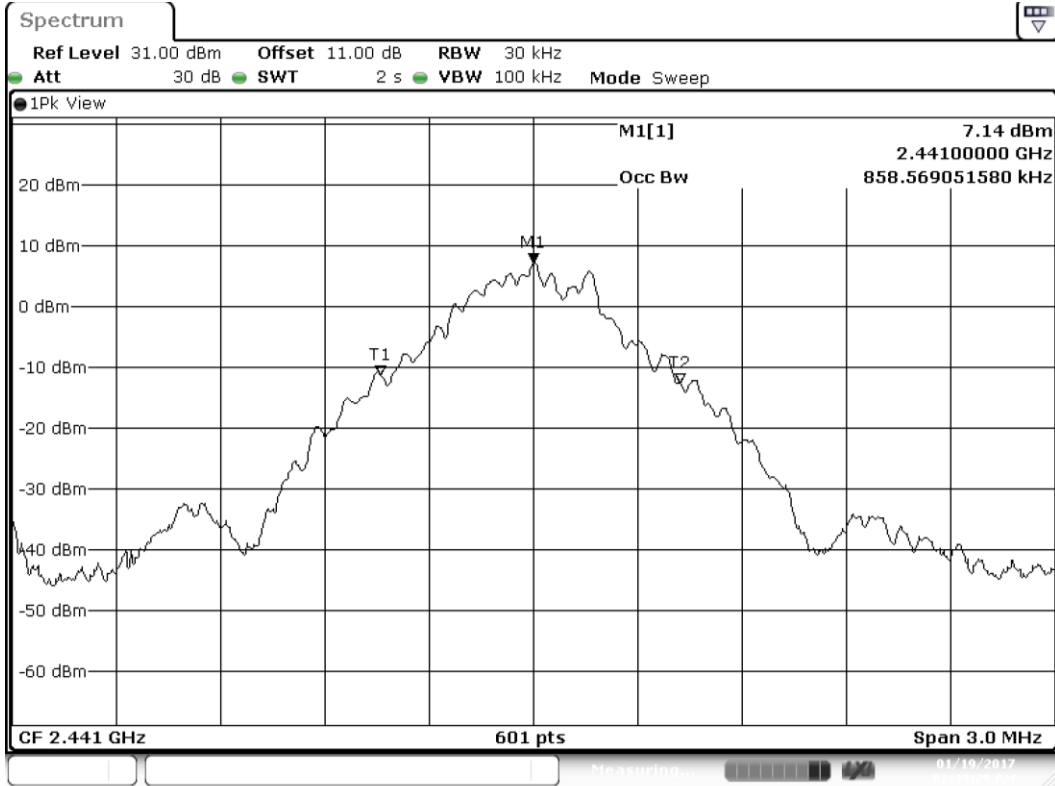
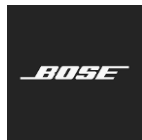
99% OBW Summary Table (Enhanced Rate: 3 Mbps)				
Channel	Frequency (MHz)	Mode	99% OBW (MHz)	Limit NA
Low	2402	3-DH5	1.168	-
Middle	2441	3-DH5	1.168	-
High	2480	3-DH5	1.168	-



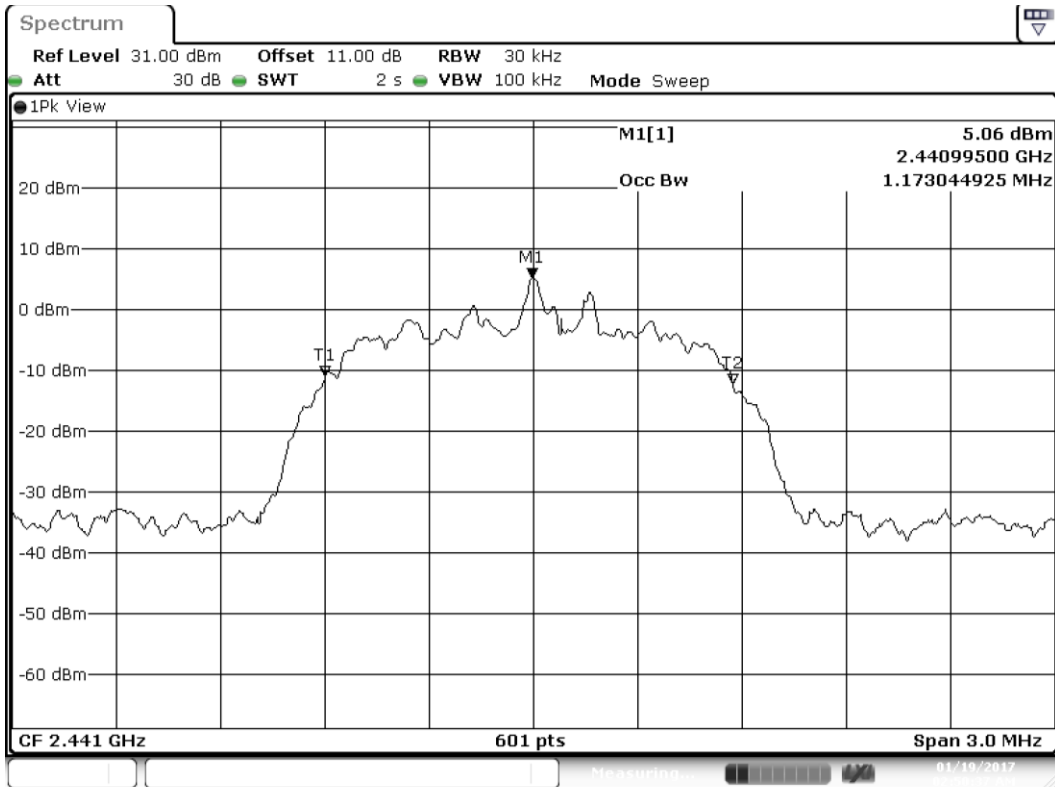
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Plot2 99P OBW DH5 2441 MHz



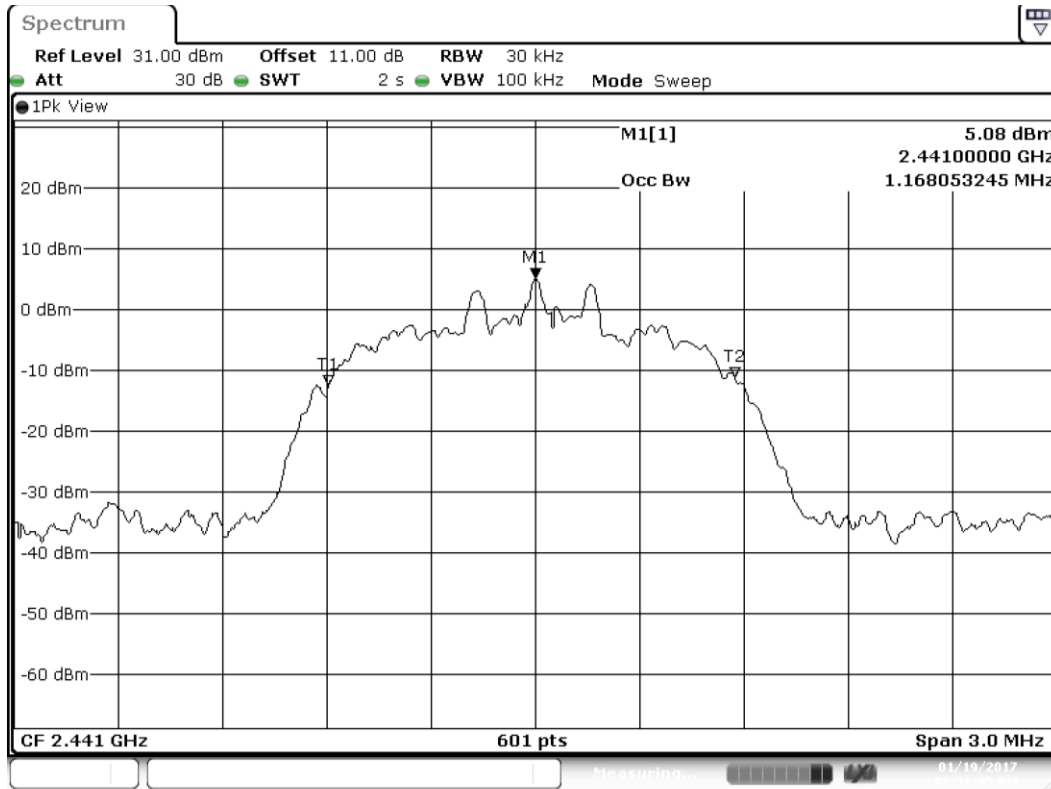
Plot5 99P OBW 2DH5 2441 MHz



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FCC ID: A94423816 IC: 3232A-423816



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 (GFSK)	7.62	3.574	30	18.80	Pass
Middle	2441	DH5 (GFSK)	8.64	3.574	30	17.79	Pass
High	2480	DH5 (GFSK)	8.72	3.574	30	17.70	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 (DQPSK)	6.09	3.574	30	20.33	Pass
Middle	2441	2-DH5 (DQPSK)	7.38	3.574	30	19.05	Pass
High	2480	2-DH5 (DQPSK)	7.22	3.574	30	19.21	Pass

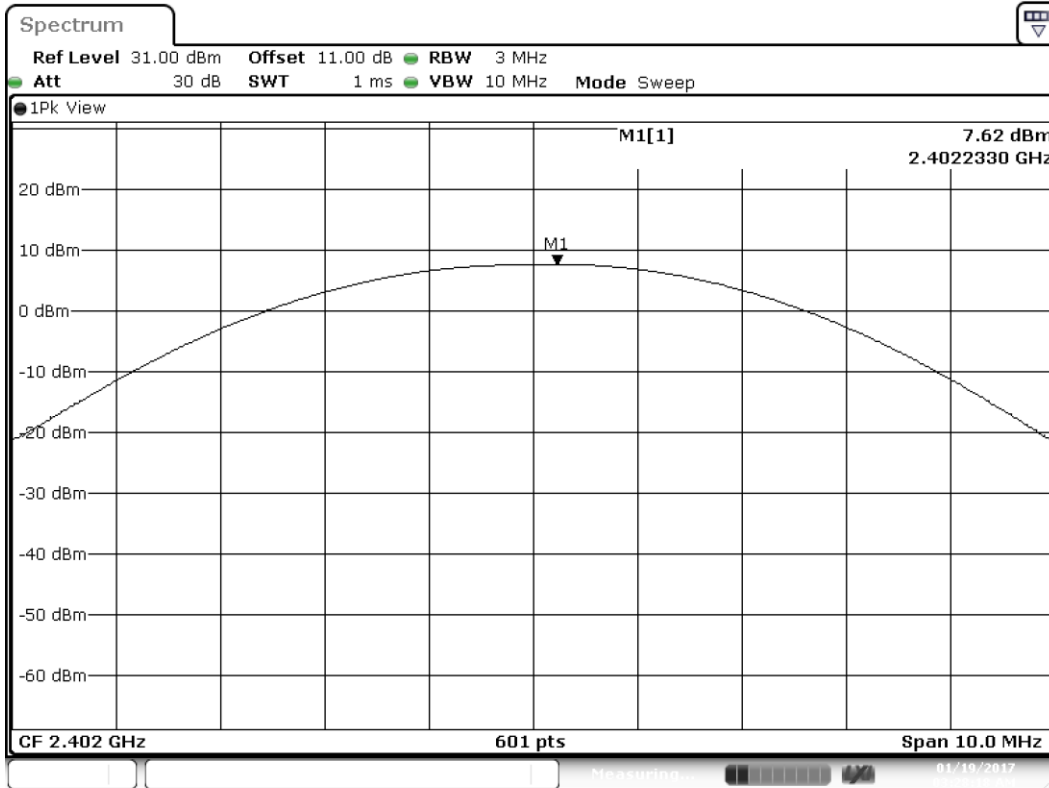
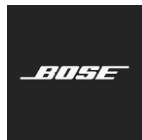
Output Power Summary Table (Enhanced Rate: 3 Mbps)							
Channel	Frequency (MHz)	Mode	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2402	3-DH5 (8PSK)	6.49	3.574	30	19.94	Pass
Middle	2441	3-DH5 (8PSK)	7.67	3.574	30	18.76	Pass
High	2480	3-DH5 (8PSK)	7.57	3.574	30	18.86	Pass



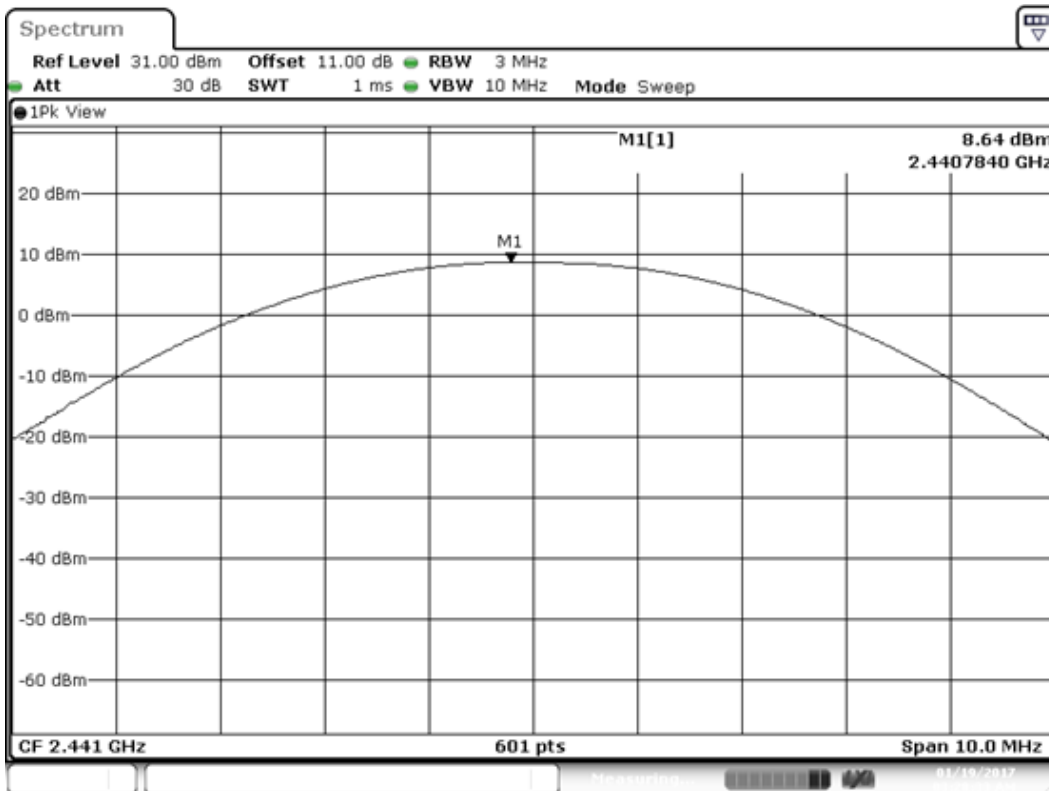
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Plot1 Power DH5 2402 MHz



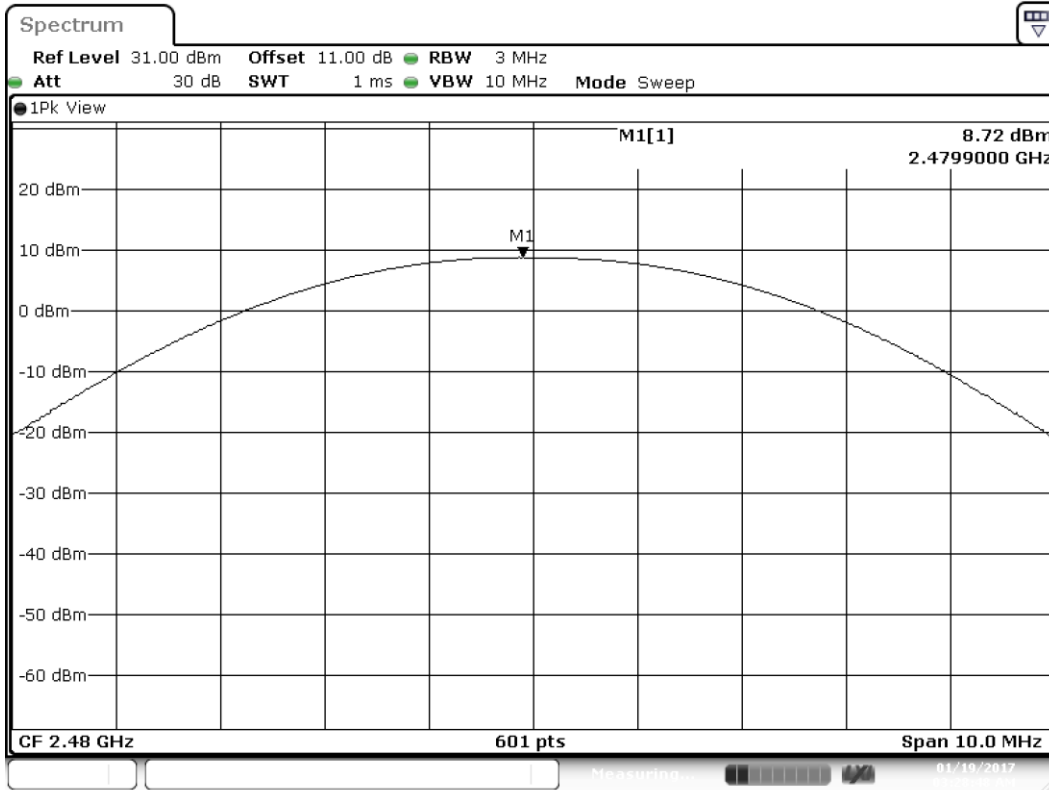
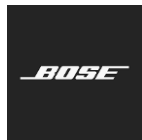
Plot2 Power DH5 2441 MHz



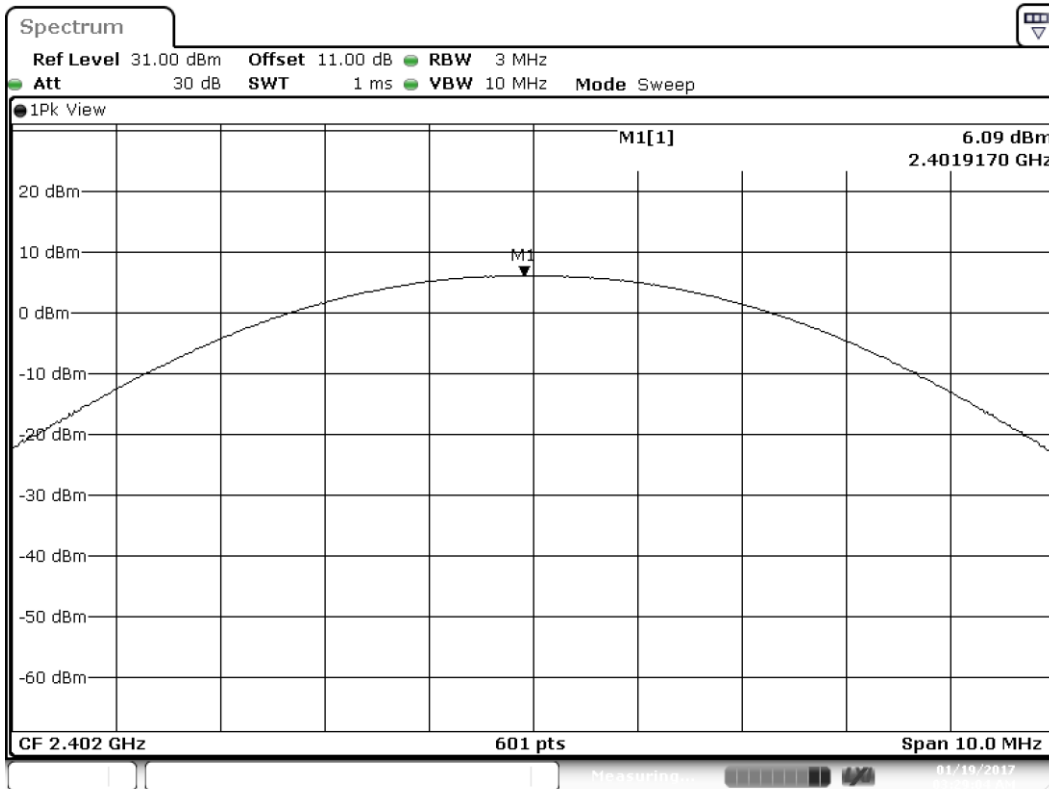
Certificate # 1514.1

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FCC ID: A94423816 IC: 3232A-423816



Plot3 Power DH5 2480 MHz



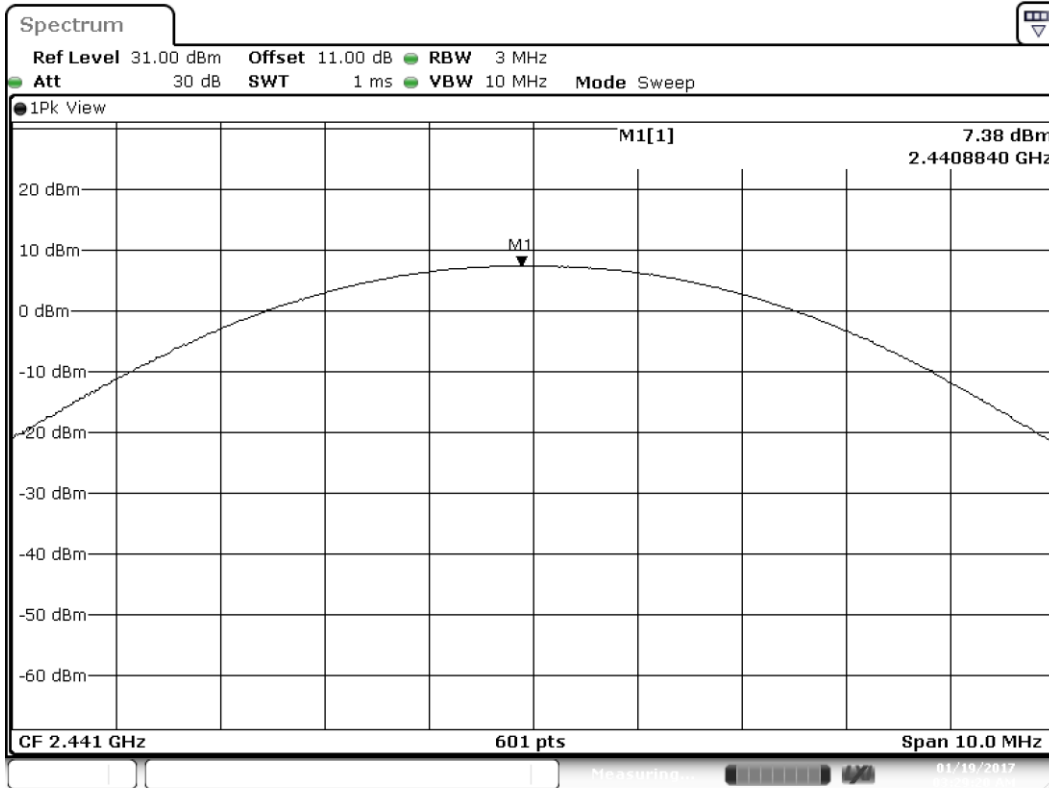
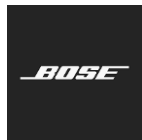
Plot4 Power 2DH5 2402 MHz



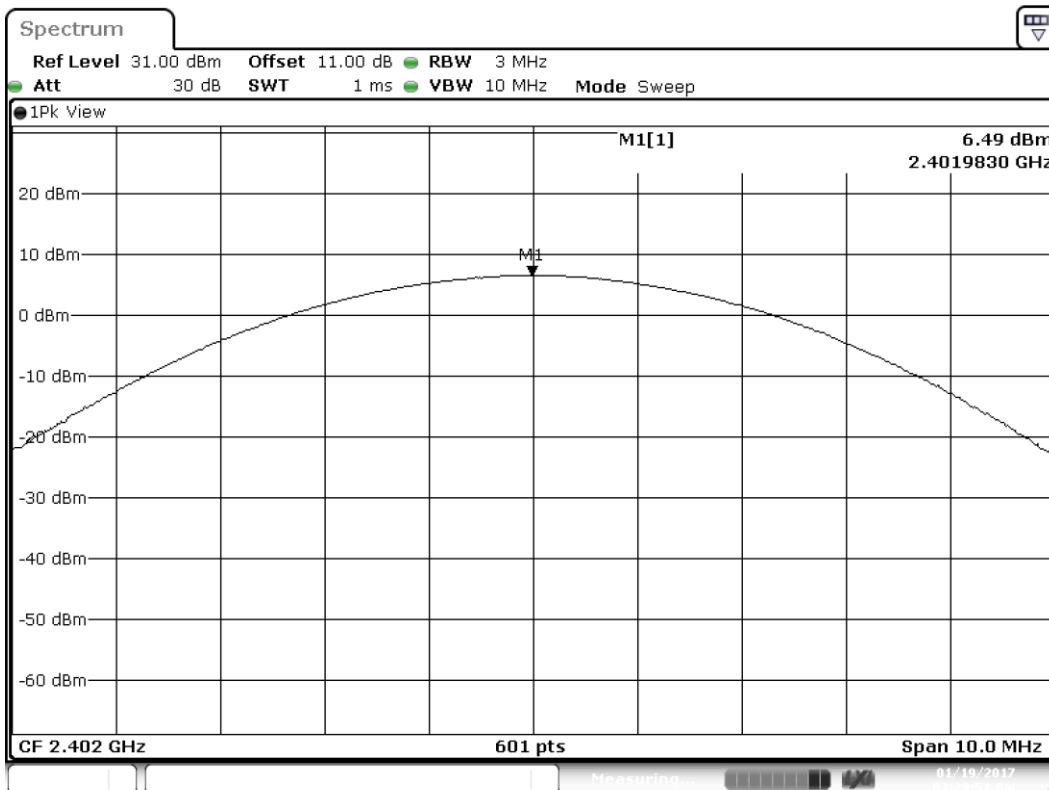
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FCC ID: A94423816 IC: 3232A-423816



Plot5 Power 2DH5 2441 MHz



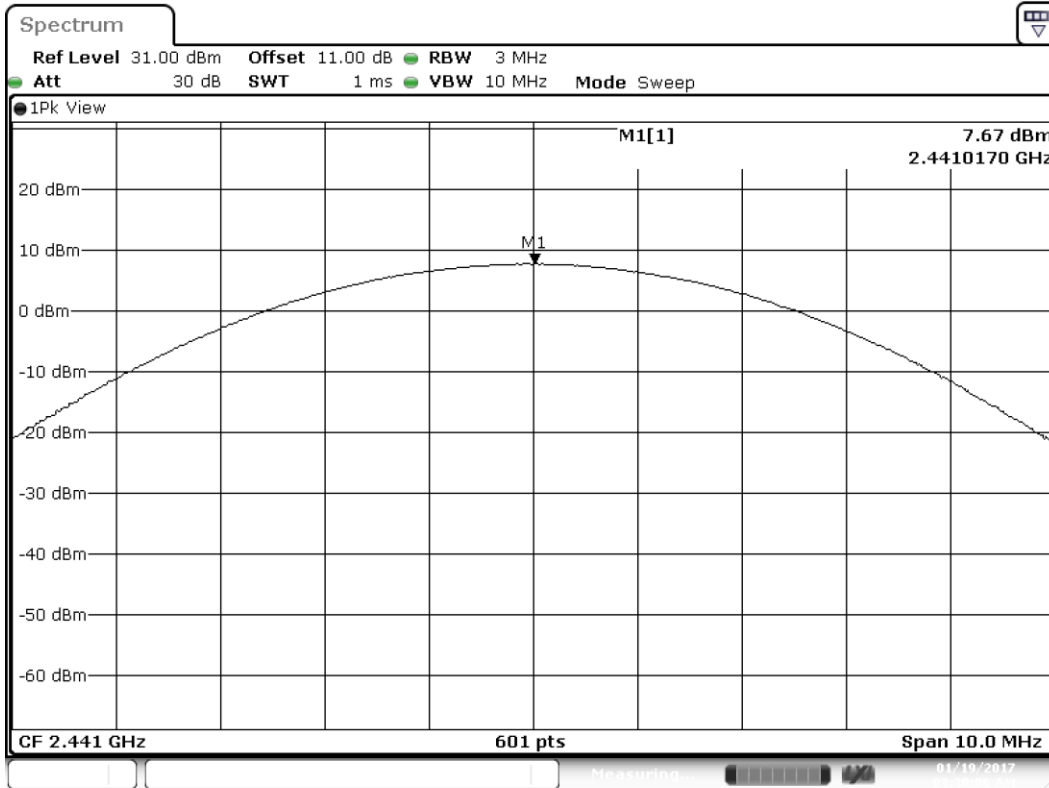
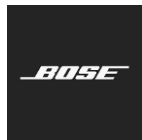
Plot7 Power 3DH5 2402 MHz



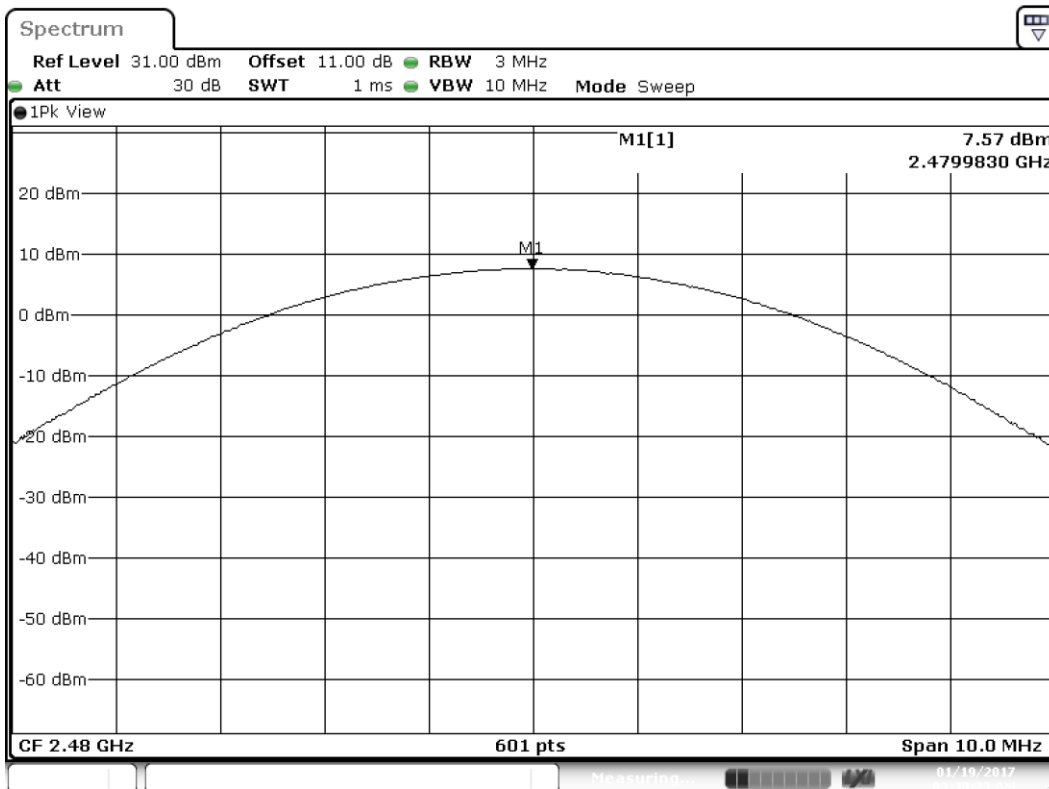
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DESIGN ASSURANCE ENGINEERING Wireless Transceiver Bluetooth Test Report

FCC ID: A94423816 IC: 3232A-423816



Plot8 Power 3DH5 2441 MHz



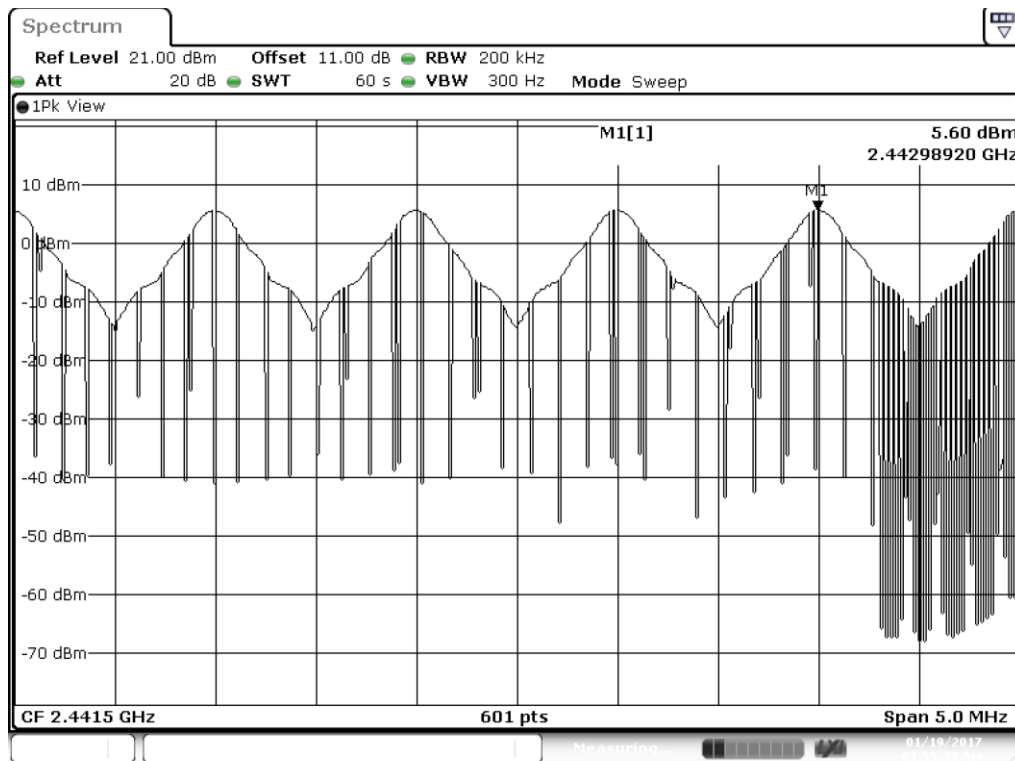
Plot9 Power 3DH5 2480 MHz

Model 423816 meets the conducted power limit of 1W (30dBm) by 17.70dB in DH5 mode at 2480MHz.

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.



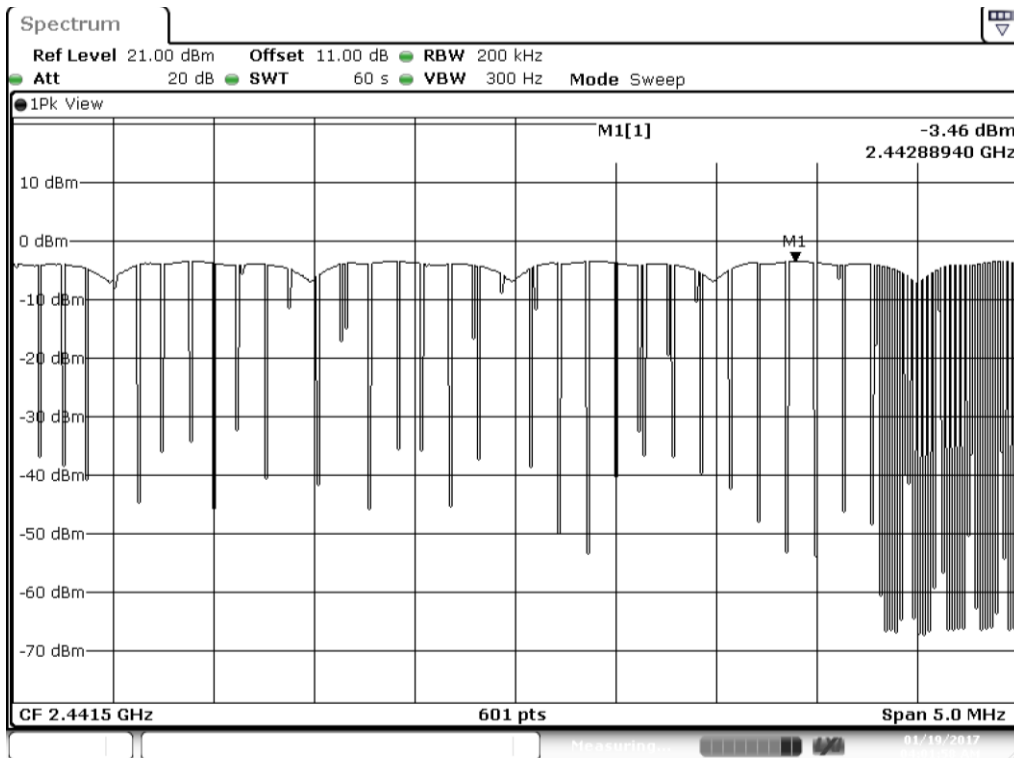
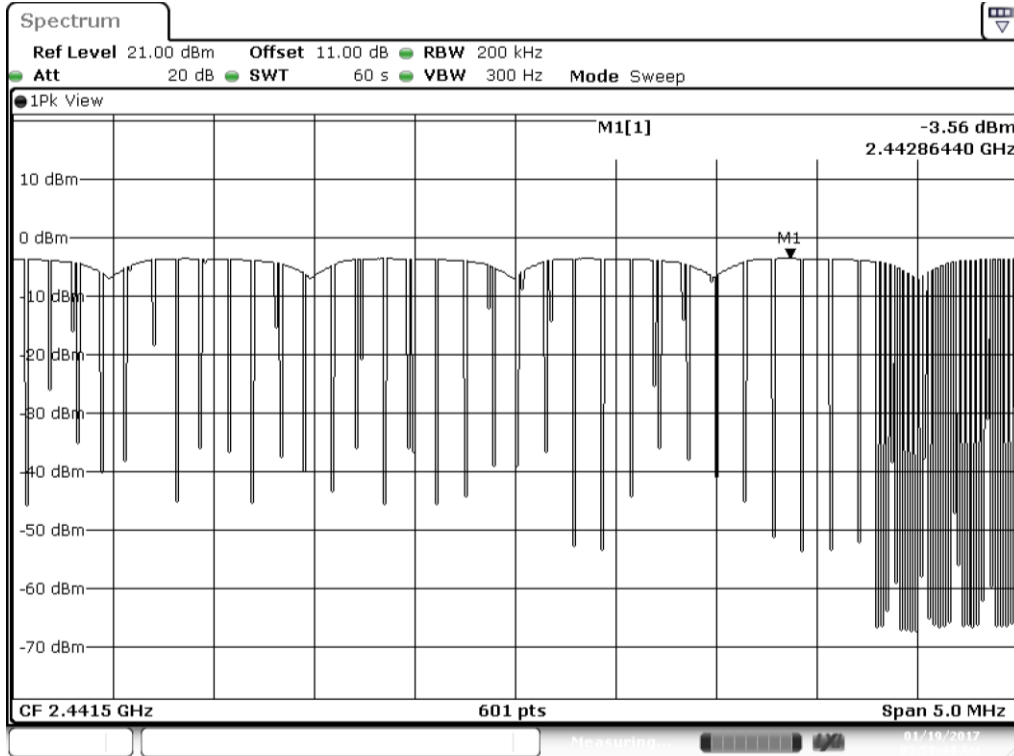
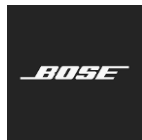
Plot1 Frequency Separation DH5 Hopping



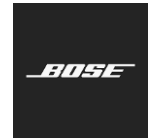
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Hopping frequencies are separated by 1MHz which is more than the required minimum of 25kHz and more than 2/3 of the 20dB bandwidth of the hopping channel which would be 842kHz.



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)).

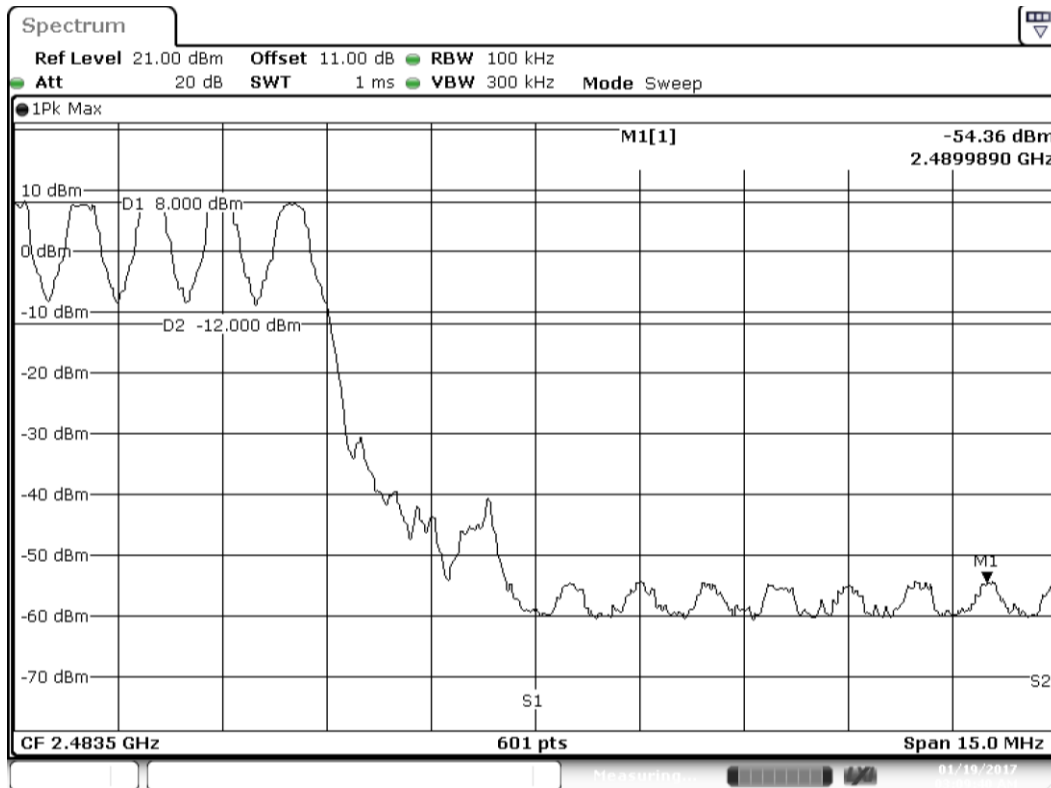
IC RSS-247 5.5

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.

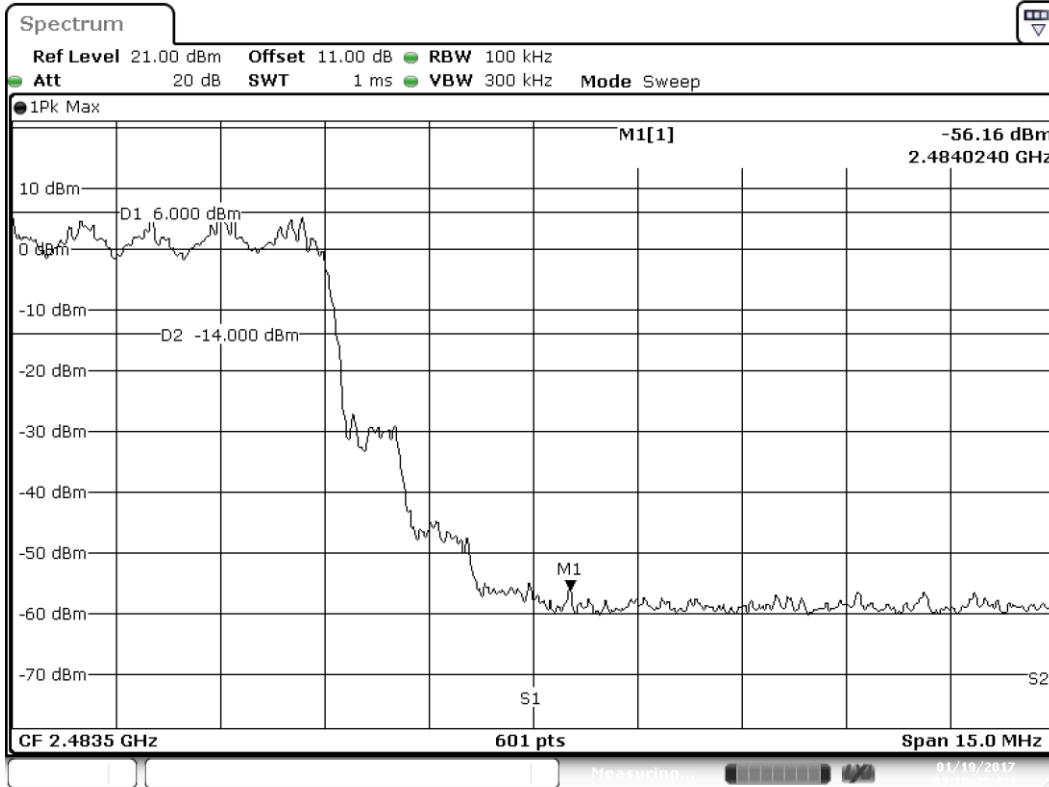
Spurious Band-edge Emissions

Upper Band Edge (Basic Rate: 1 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	DH5	62.36	20	42.36	Pass



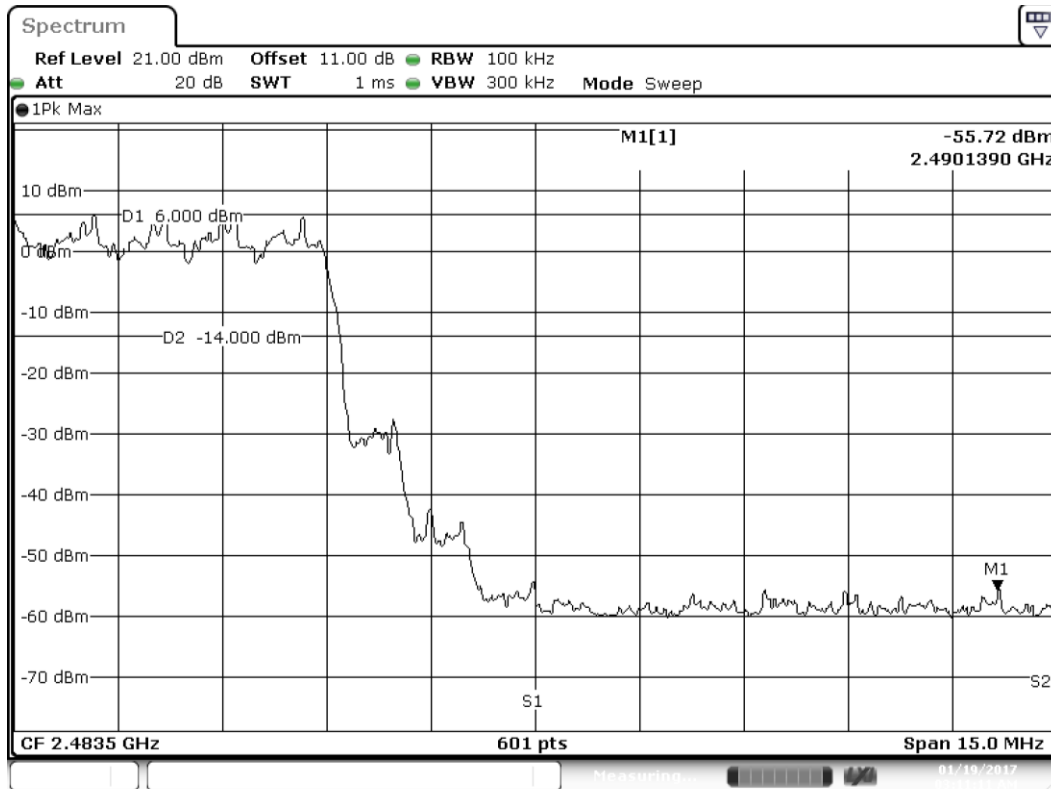
Plot1 Upper Band Edge DH5 Hopping

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	62.16	20	42.16	Pass

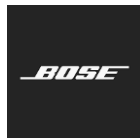


Plot2 Upper Band Edge 2DH5 Hopping

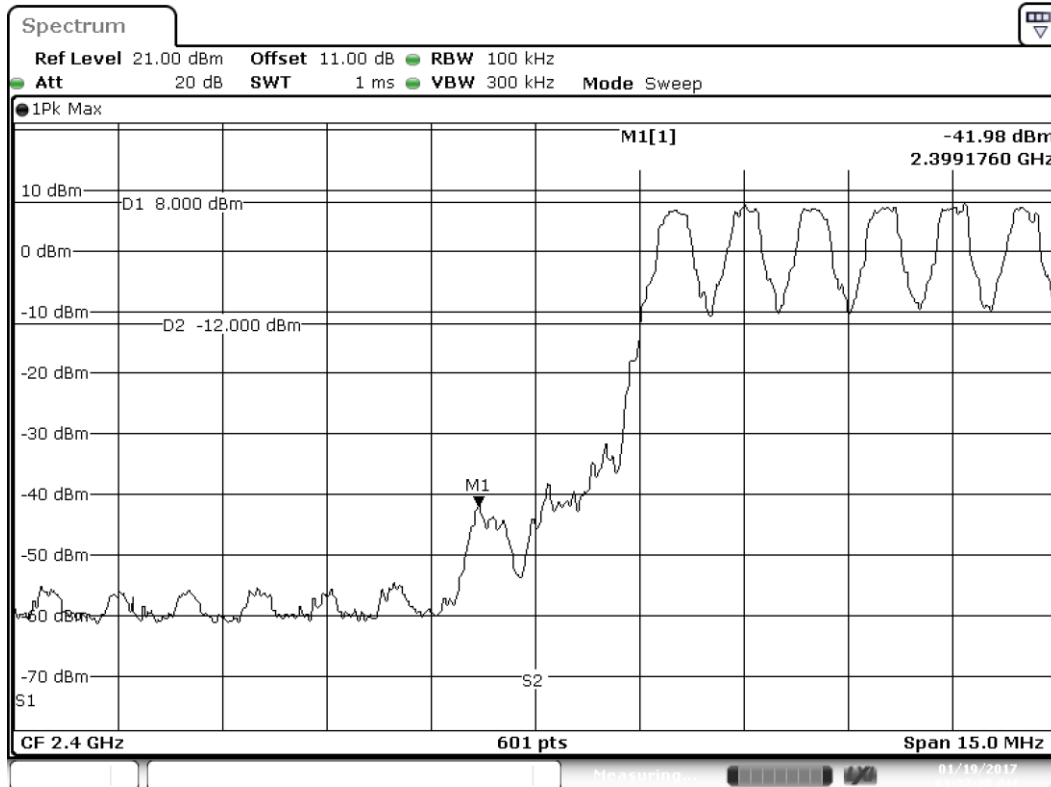
Upper Band Edge (Enhanced Rate: 3 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	3-DH5	61.72	20	41.72	Pass



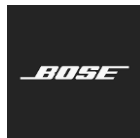
Plot3 Upper Band Edge 3DH5 Hopping



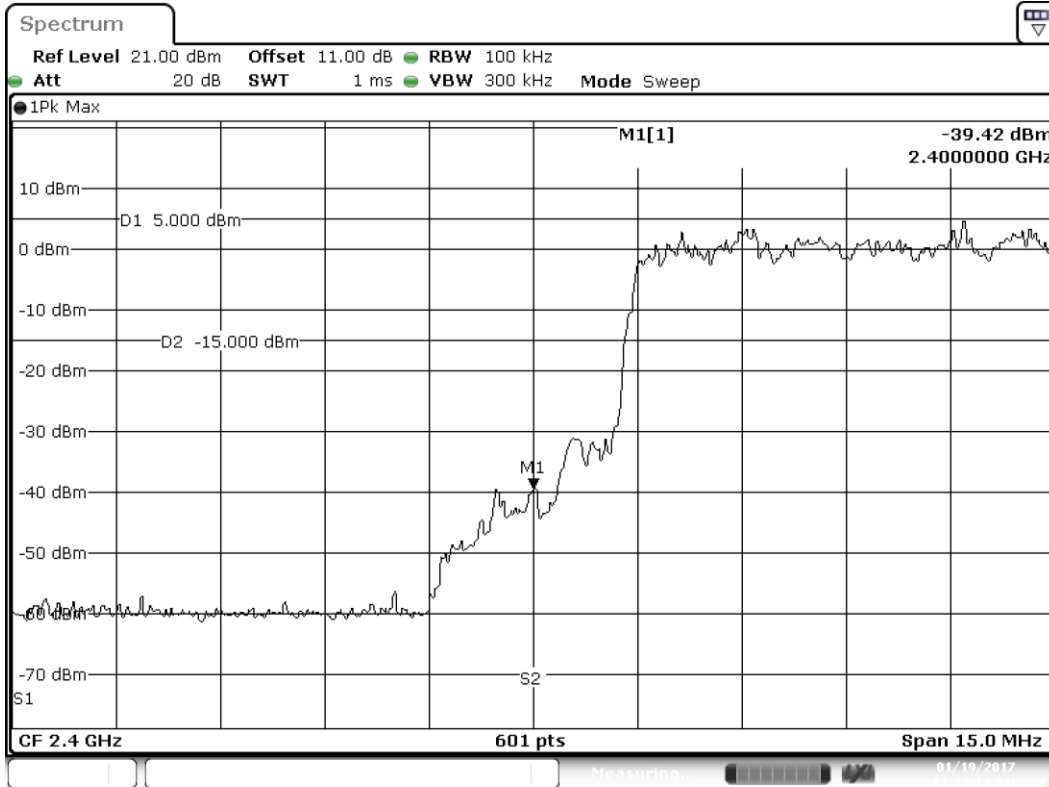
Lower Band Edge (Basic Rate: 1 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	DH5	49.98	20	29.98	Pass



Plot1 Lower Band Edge DH5 Hopping

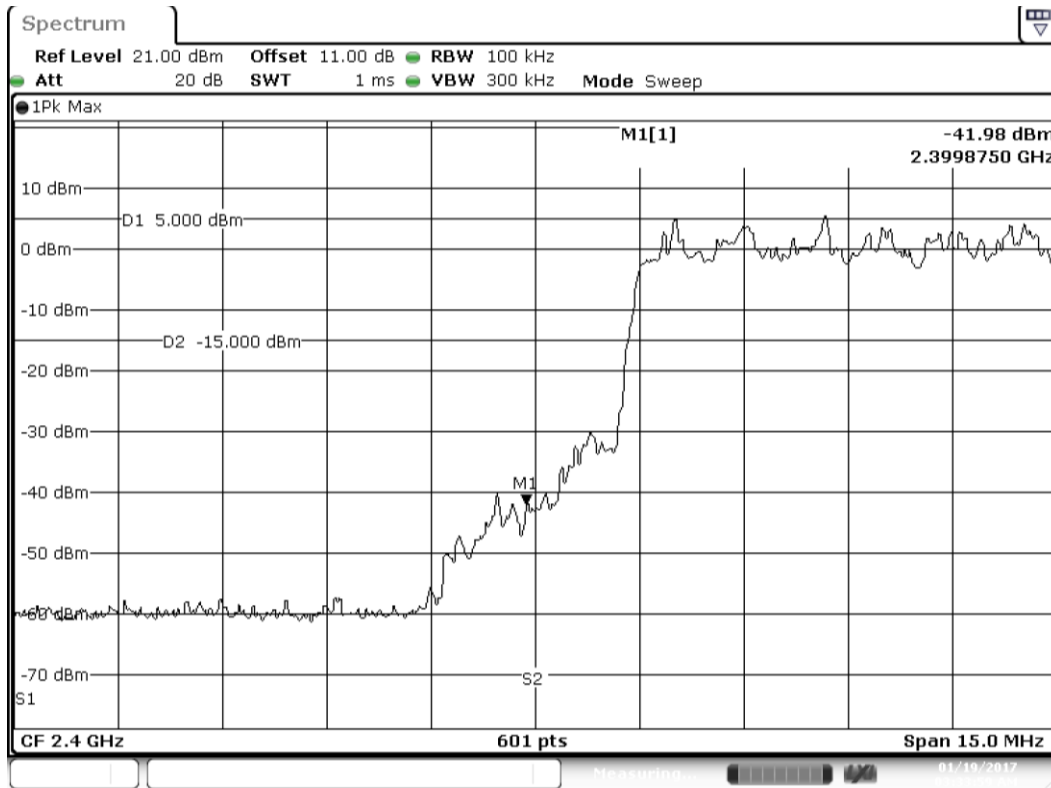


Lower Band Edge (Enhanced Rate: 2 Mbps) (Hopping Mode)						
Mode	Frequency (MHz)	Mode	Worst Case (dBc)	Limit (dBc)	Margin (dB)	Result
Hopping	All	2-DH5	44.42	20	24.42	Pass



Plot2 Lower Band Edge 2DH5 Hopping

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	46.98	20	26.98	Pass

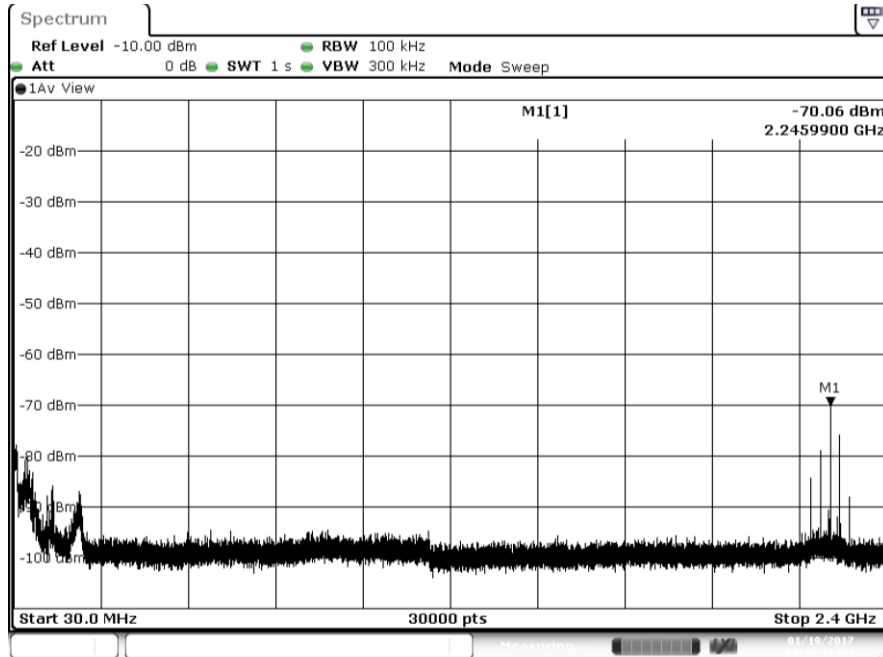


Plot3 Lower Band Edge 3DH5 Hopping

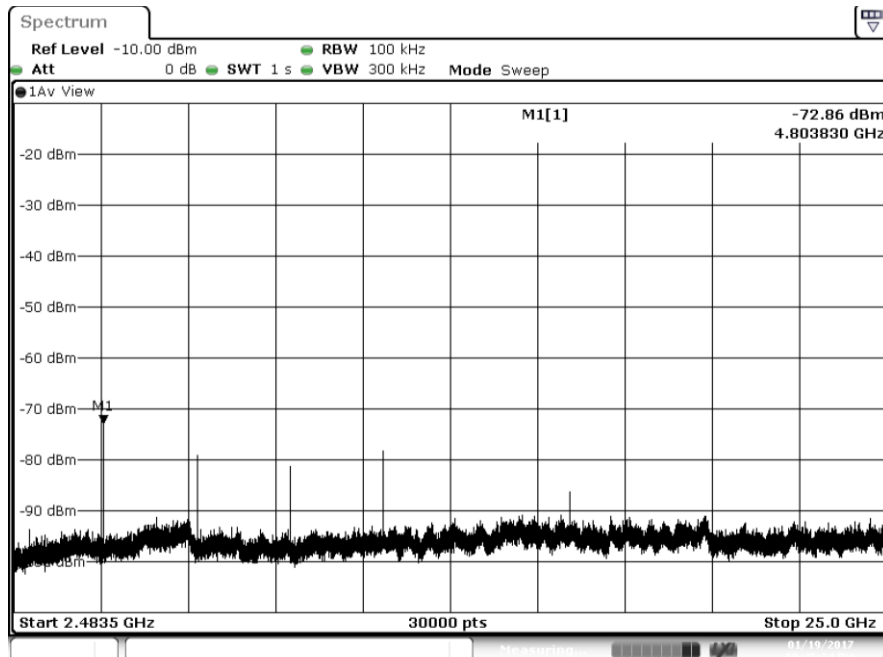
Spurious Emissions

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.

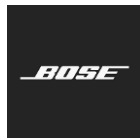
Spurious Summary Table (Basic Rate: 1 Mbps)											
Channel	Band Range (MHz)	Mode	Raw Measurement (dBm)	Test Cable Loss (dB)	Pad ATTN (dB)	EUT Antenna Gain At Harmonic Frequency (dBi)	Corrected Reading (dBm)	Convert to E-Field at 3 meters (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Result
Low	30 To 1000	DH5	-70.1	1.0	10.0	0.0	-59.1	36.17	54	17.83	Pass
Low	2483.5 To 25000	DH5	-72.9	1.0	10.0	0.0	-61.9	33.37	54	20.63	Pass



Plot1 DH5 2402 MHz Average Band 1

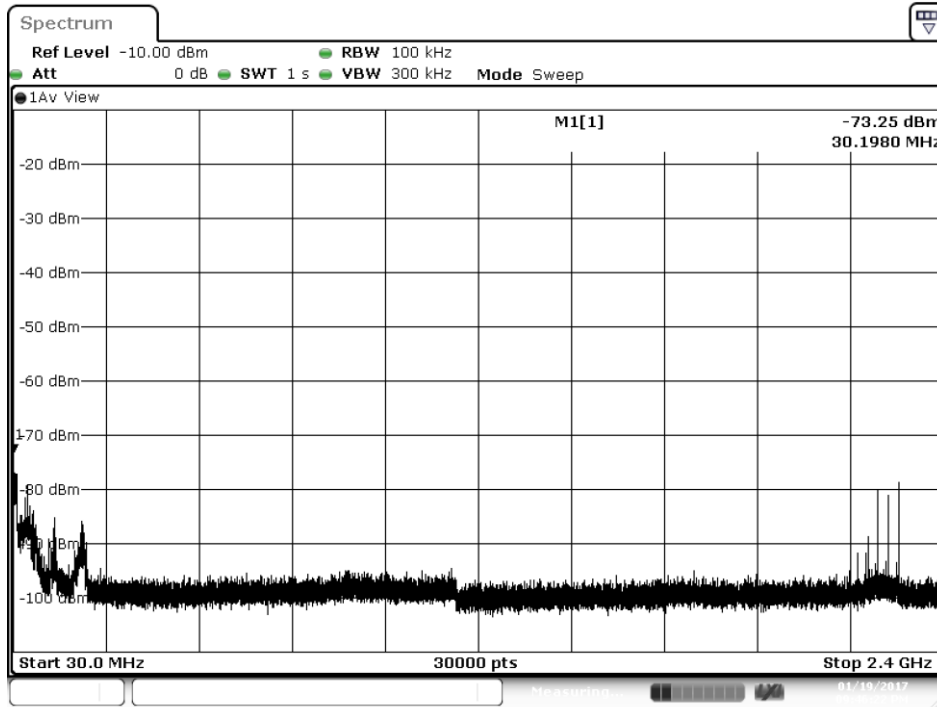


Plot2 DH5 2402 MHz Average Band 2

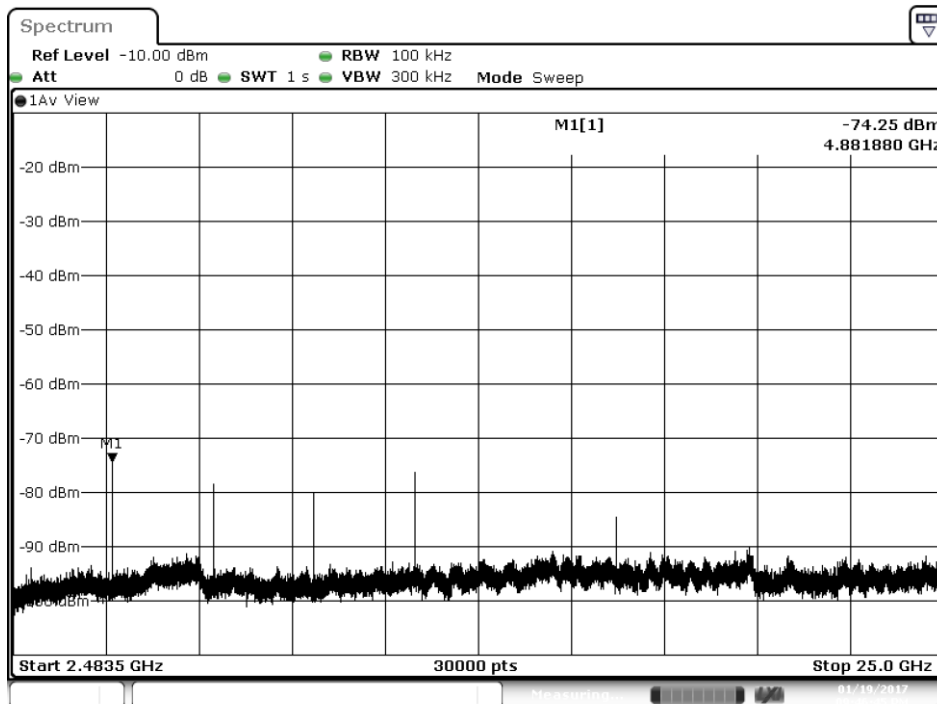


Spurious Summary Table (Basic Rate: 1 Mbps)

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	-73.2	1.0	10.0	0.0	-62.2	32.98	54	21.02	Pass
Mid	2483.5 To 25000	DH5	-74.3	1.0	10.0	0.0	-63.3	31.98	54	22.02	Pass



Plot1 DH5 2441 MHz Average Band 1



Plot2 DH5 2441 MHz Average Band 2