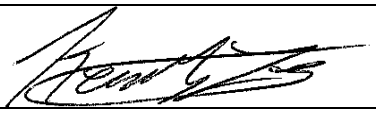
Certificate # 1514.1

PRODUCT ASSURANCE ENGINEERING
COMPLIANCE
EMC TEST REPORT

Test Type:	Emissions
Product Type:	*Wireless Earbud*
Product Name/Number:	*Model 408R*
FCC ID: IC:	*A94408R* *3232A-408R*
Prepared For:	*Product Assurance Engineering Department, Bose Corporation*
Name of manufacturing agency applying for equipment type approval	Bose Corporation
Postal Address of manufacturing Agency	The Mountain Framingham MA 01701 USA
Test Results:	Pass
Applicable Standards:	*FCC 47 CFR PART 15 SUBPART C* *ISED RSS-247 ISSUE 2* *ISED RSS-GEN ISSUE 5*
Report Number:	*EMC.441408.23.167.6*

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:	Bryan Cerqua	Bryan H Cerqua	8/15/2023
Electrical Engineer Review* By:	Kenneth Lee		8/16/2023

* 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 or the reviewer to ensure the A2LA advertising policy is followed.

Table of Contents

Tests Performed (Table of Contents):

Test Report Summary

Product Information:

Description

Truly Wireless In Ear (TWIE) earbud. The bud uses Bluetooth classic (BT) Bluetooth Low Energy (BLE), and Qualcomm High Speed (QHS). The QHS is used for bud-to-bud communications. The role of master/puppet can be changed to best meet radio link conditions during operation. The unit is not supplied with an AC to USB adapter. The antenna is an inverted F with a maximum gain of 0.58 dBi (Left Earbud) and 0.86 dBi (Right Earbud) formed by Laser Direct Sequence on the inside of the top cover of the earbud.

EUT Condition

Product was as built in the factory. For the conducted measurements the antenna was removed, and coaxial cable was installed in its place. Where necessary USB debug wires were added to allow control of the Radio.

Scope:

This report covers EMC requirements. *FCC or ISED, FHSS low power transceiver.*

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.):
[**X**] meets all test standards on page 1 of this report.

Test Results Summary

TEST NAME	TEST RESULT PASS or N/A	COMMENT(S)
On Time and Duty Cycle	N/A	
99% Occupied Bandwidth	N/A	
20dB Occupied Bandwidth	Pass	
Hopping Frequency Separation	Pass	
Number of Hopping Channels	Pass	
Average Time of Occupancy	Pass	
Output Power	Pass	
Conducted Spurious Emissions	Pass	
RF Conducted Emissions – AC Mains	Pass	
RF Radiated Emissions 30MHz -1GHz	Pass	
Radiated RF Emissions 1-25GHz	Pass	
Radiated Band Edge	Pass	

Environmental Conditions

Ambient:

Temperature:	22±4°C
Humidity:	30-60%RH
Mains Voltage:	120VAC, 5VDC USB

FCC Test Site Accreditation:

Firm Name	Location	Expiration Date	Accreditation	MRA	Designation Number	Contact	Contact Title	Address	PO Box	Mail Stop	City	State	Zip Code	Country	Email	Phone	Fax
Bose Corporation	1 New York Avenue, Framingham, MA	07/31/2024	American Association for Laboratory Accreditation	N/A	US1088	Mr. Cable Best	Quality Manager	Mail Stop 450 The Mountain	N/A	450	Framingham	Massachusetts	01701	United States	Cable_Best@bose.com	1 508 766 6137	508 766 1145

Canadian Test Site Registration:

BOSE CORPORATION 1 New York Avenue Framingham, MA 01701 UNITED STATES **Company Number: 3232A** Contact: Mario Espinal mario_espinal@bose.com	US0210	RSS-GEN (2019-02-11) RSS-210 (2019-02-11) RSS-247 (2019-02-11) RSS-248 (2021-11-19)	**RECOGNIZED UNTIL:** **2024-07-31** A2LA ISO/IEC 17025:2017 Expires: 2024-07-31

RF Conducted Measurements

On Time and Duty Cycle

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 12, 2023	
Requirements Standard(s):			**Referenced Standard(s):**	ANSI C62.10:2013-11.6-b	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

This test is for information only.

Limits:

None; for reporting purposes only.

Procedure:

ANSI C63.10, Section 11.6: Zero-Span Spectrum Analyzer Method.

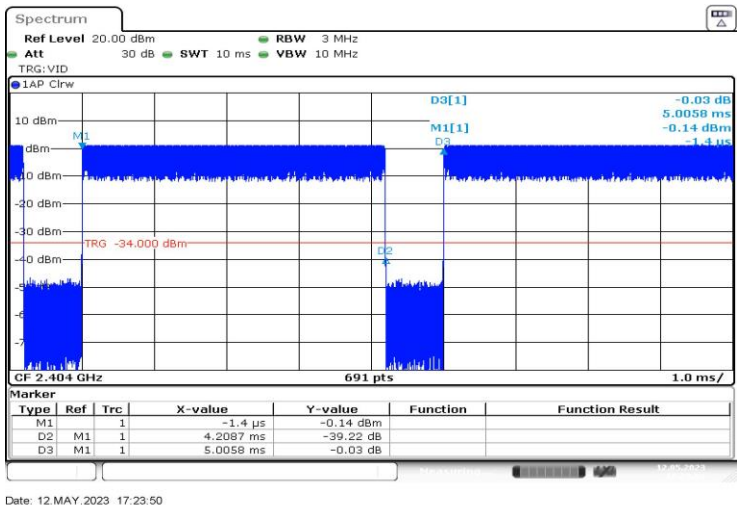
Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

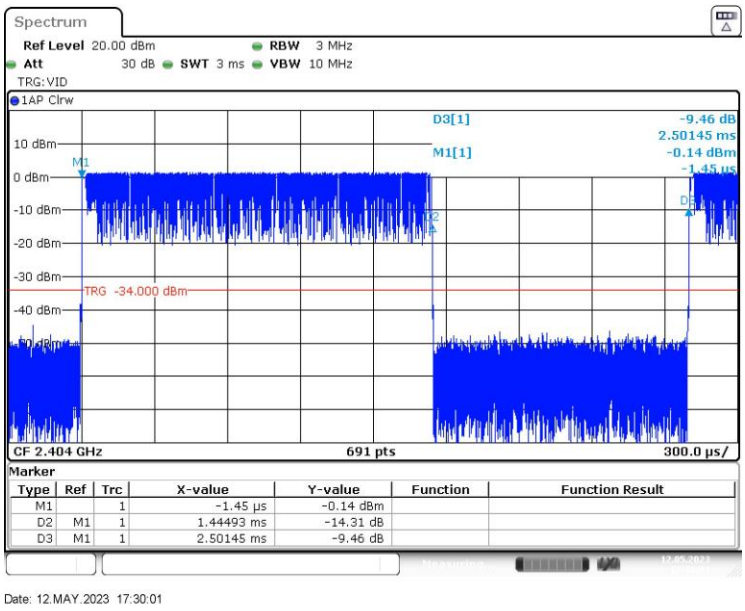
Data Collection:

Duty cycles shown in the table below represent maximum duty cycle in test mode using maximum packet length.

Mode	ON Time (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
QHS-P2	4.209	5.006	0.841	84	237.6
QHS-P6	1.445	2.501	0.577	58	692.0



QHS-P2



QHS-P6

99% Occupied Bandwidth

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 15, 2023	
Requirements Standard(s):			**Referenced Standard(s):**	ANSI C63.10:2013-6.9.3	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

This test is for information only.

Limits:

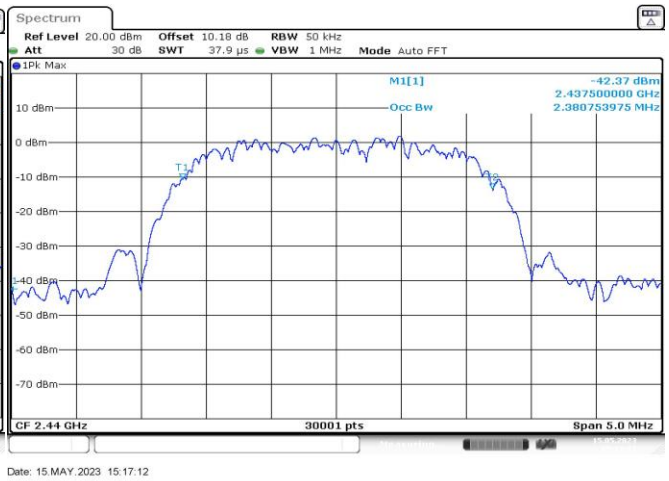
None; for reporting purposes only.

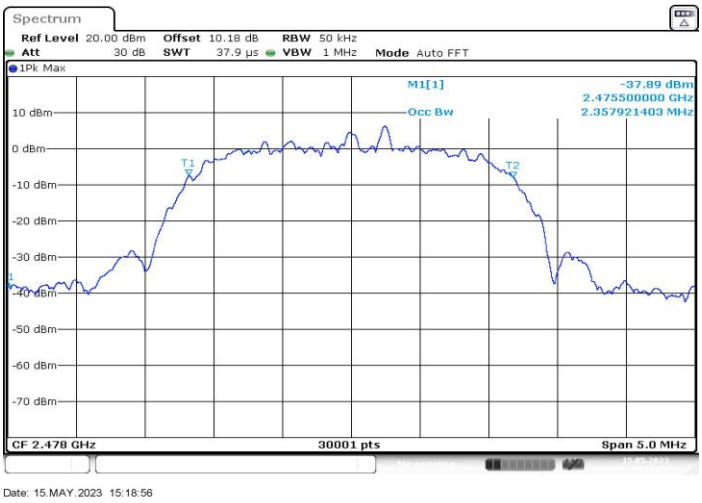
Procedure:

The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1-5% of the 99% Occupied Bandwidth. The VBW is set to ≥ RBW.

QHS-P2 Data Collection:

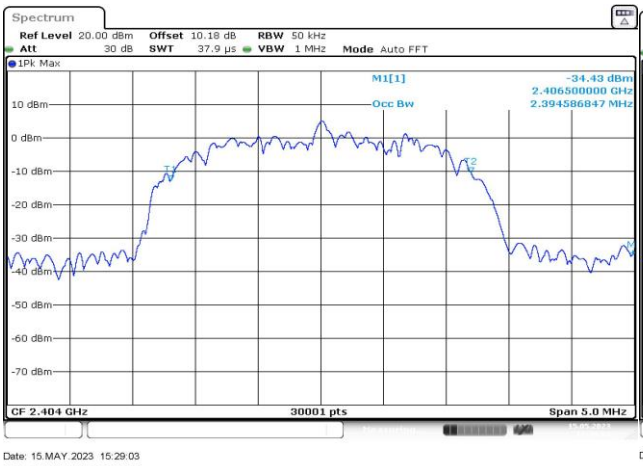
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	2.384
Middle	2440	2.381
High	2478	2.358

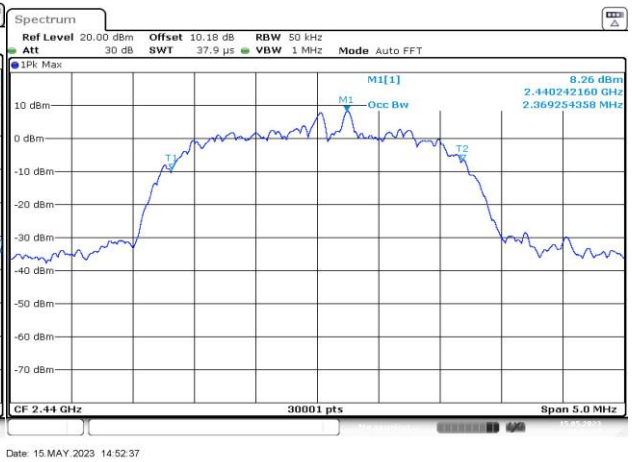


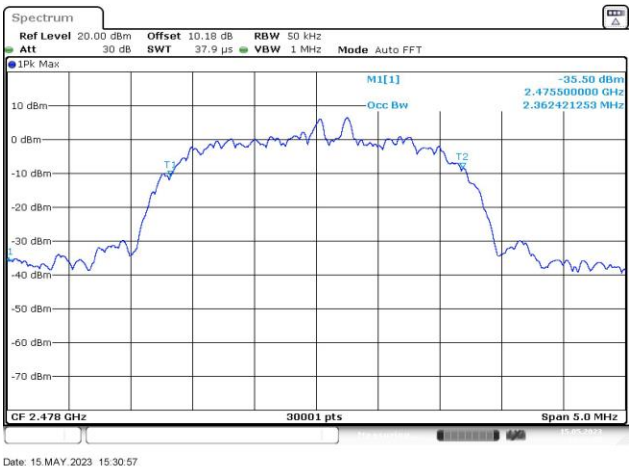


QHS-P6 Data Collection:

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	2.394
Middle	2440	2.369
High	2478	2.362







Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

20dB Occupied Bandwidth

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 12, 2023	
Requirements Standard(s):	FCC §15.247 (2) RSS-247 5.2 (a)		**Referenced Standard(s):**	ANSI 63.10:2013 - 6.9.2	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

This test is for information only.

Limits:

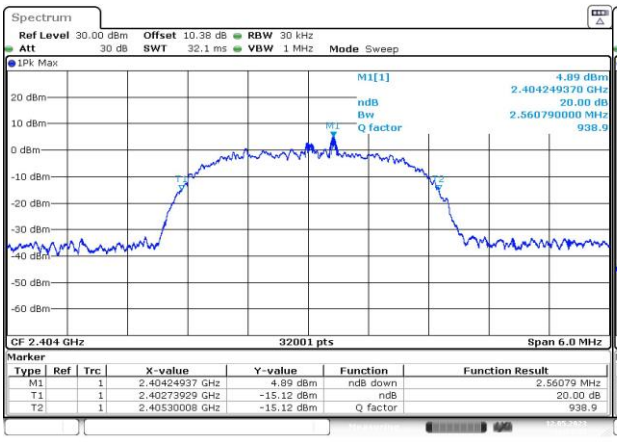
None; for reporting purposes only.

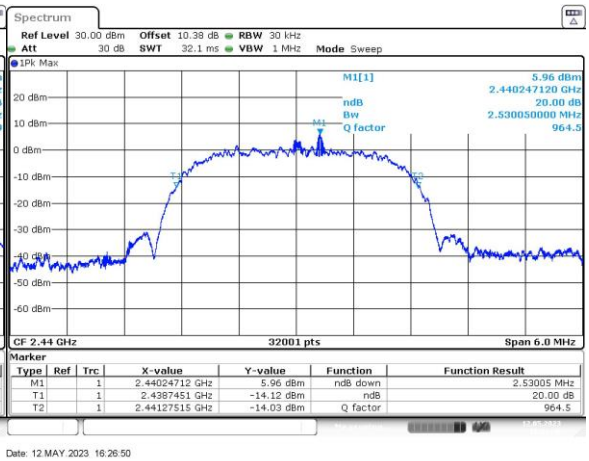
Procedure:

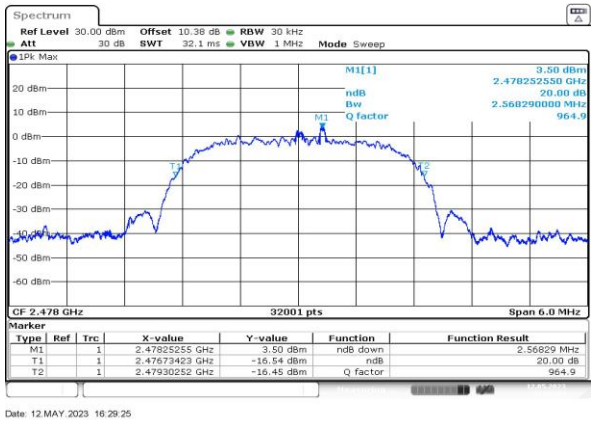
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1-5% of the 20dB bandwidth. The VBW is set to ≥ RBW.

QHS-P2 Data Collection:

Setting	BW MHz
Low	2.561
Mid	2.530
High	2.586

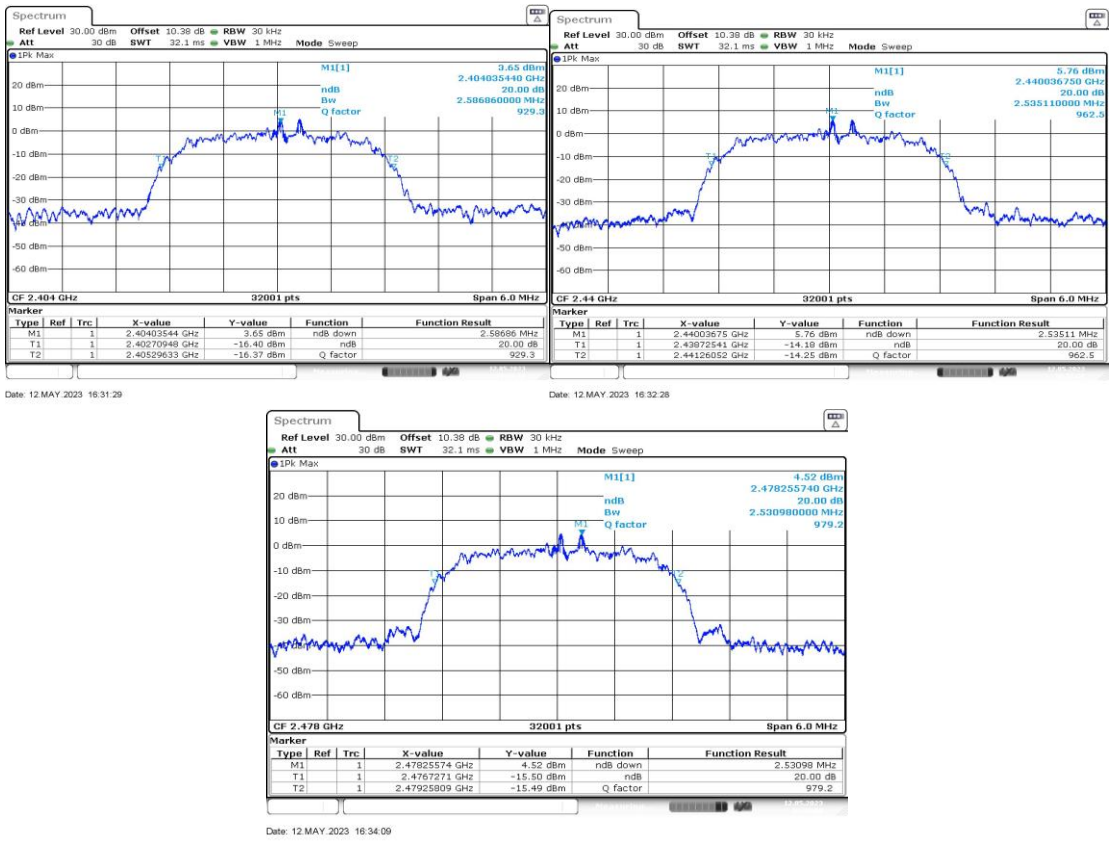






QHS-P6 Data Collection:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	2.587
Middle	2441	2.535
High	2480	2.531



Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

Hopping Frequency Separation

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 15, 2023	
Requirements Standard(s):	FCC 15.247 (a) (1), RSS-247 5.1 (b)		**Referenced Standard(s):**	ANSI C63.10-2013 7.8.2	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

Hopping frequencies are separated by 2 MHz 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 1.8 MHz.

Limits:

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

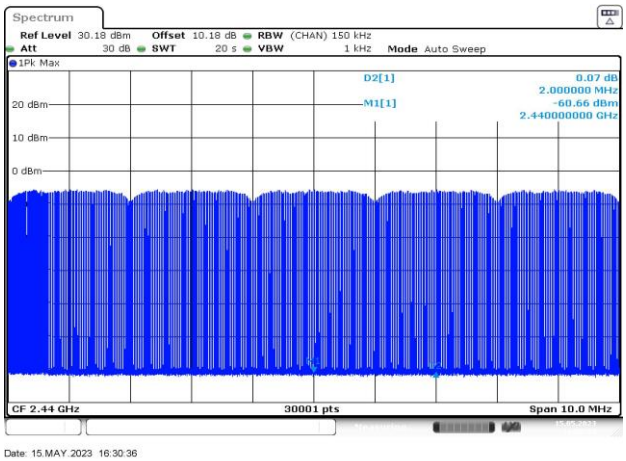
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hoping channel, whichever is greater.

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.

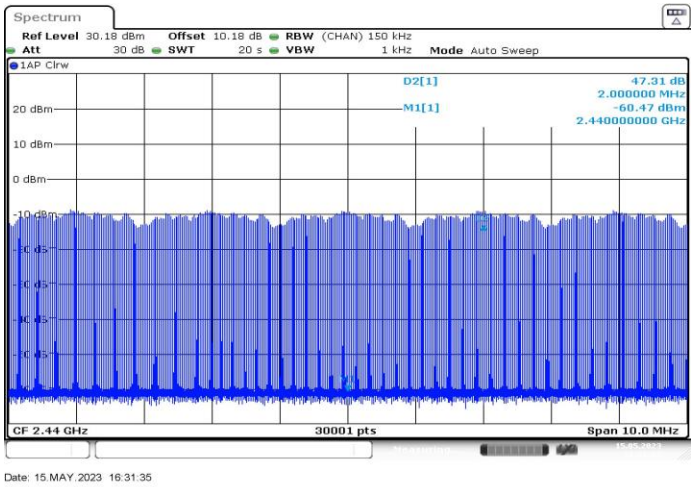
Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

Data Collection:



QHS-P2 hopping



QHS-P6 hopping

Note: slight dips in the profile are visible every 2 divisions.

Number of Hopping Channels

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 15, 2023	
Requirements Standard(s):	FCC 15.247 (a) (1) (iii) RSS-247 5.1 (d)		**Referenced Standard(s):**	ANSI C63.10-2013 7.8.3	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

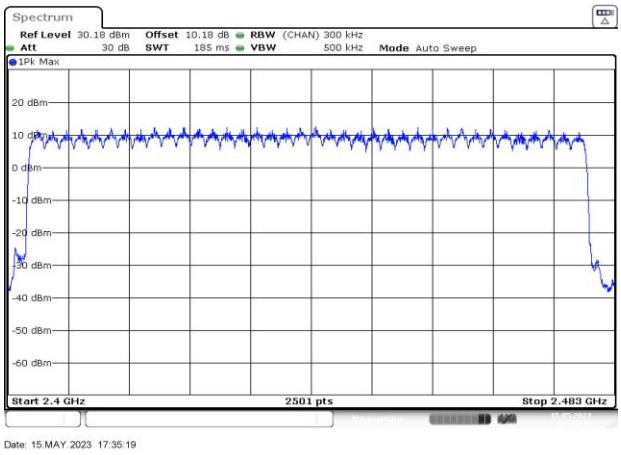
Conclusion:

Bose Model 408R uses 38 hopping channels in normal operation and always uses at least 20, both of which are more than the required 15.

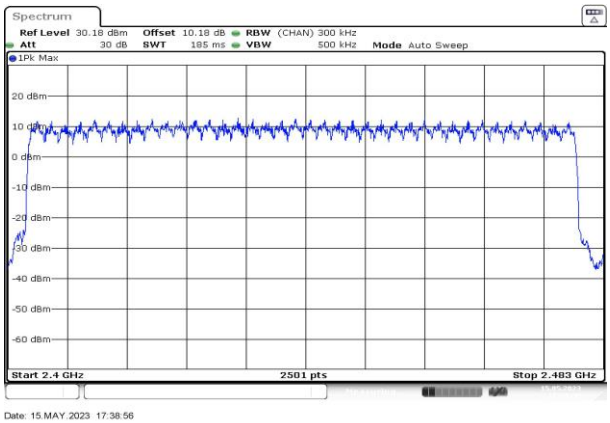
Limits:

FCC 15.247 (a) (1) (iii), RSS-247 5.1 (d)
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

Data Collection:



38 hopping Channels QHS-P2



38 hopping Channels QHS-P6

Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

Average Time of Occupancy

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 22, 2023	
Requirements Standard(s):	FCC 15.247 (a) (1) (iii) RSS-247 5.1 (d)		**Referenced Standard(s):**	ANSI C63.10-2013 7.8.4	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

The highest time of occupancy in any mode is 276 mS which meets the 400mS limit by 124mS.

Limit:

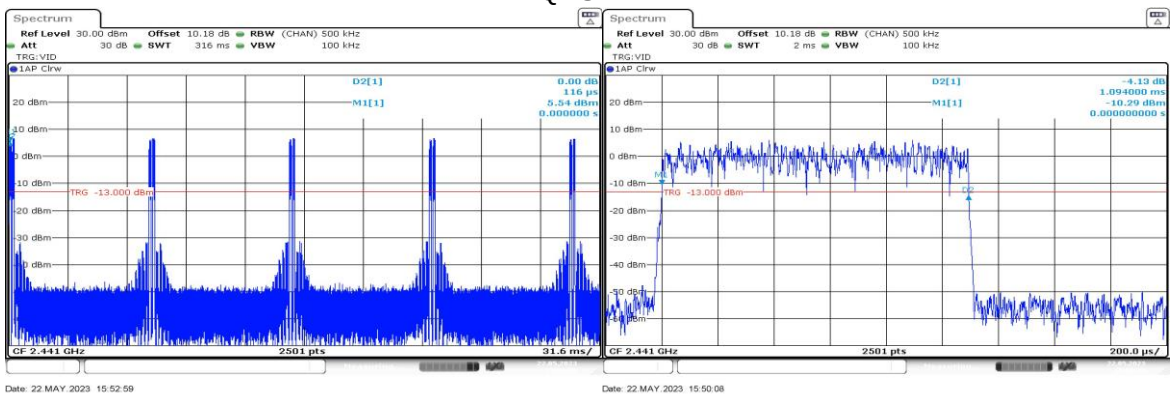
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

When hopping with Bluetest3 as in this test, there are 40 hopping channels * 400 mS = 16 seconds. Set the observation time to 0.316 seconds and count the pulses. Then multiply by 16/0.316=50.6 to get the number of pulses in 16 seconds.

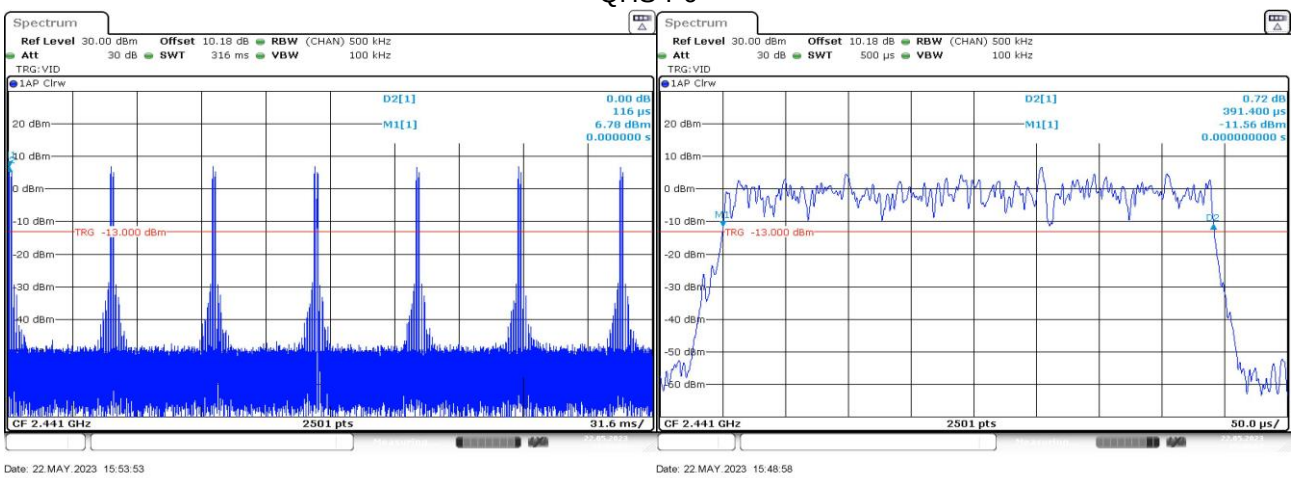
Data Collection:

Channel	Frequency (MHz)	Mode	Pulse Width (mS)	Number of pulses in 0.316 S	Number of pulses in 16S (X 50.6)	Time of occupancy (Pulse Width X Number of pulses) (mS)	Limit (mS)	Margin (mS)	Result
Middle	2440	QHS-P2	1.094	5	253	276	400	124	Pass
Middle	2440	QHS-P6	0.391	7	354	138	400	262	Pass

QHS-P2



QHS-P6



Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

Output Power

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 17, 2023	
Requirements Standard(s):	FCC 15.247 (b) (3) RSS-247 5.4 (b)		**Referenced Standard(s):**	ANSI 63.10:2013 – 11.9.1.1	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

The unit passes output power by 8.41 dB.

Limits:

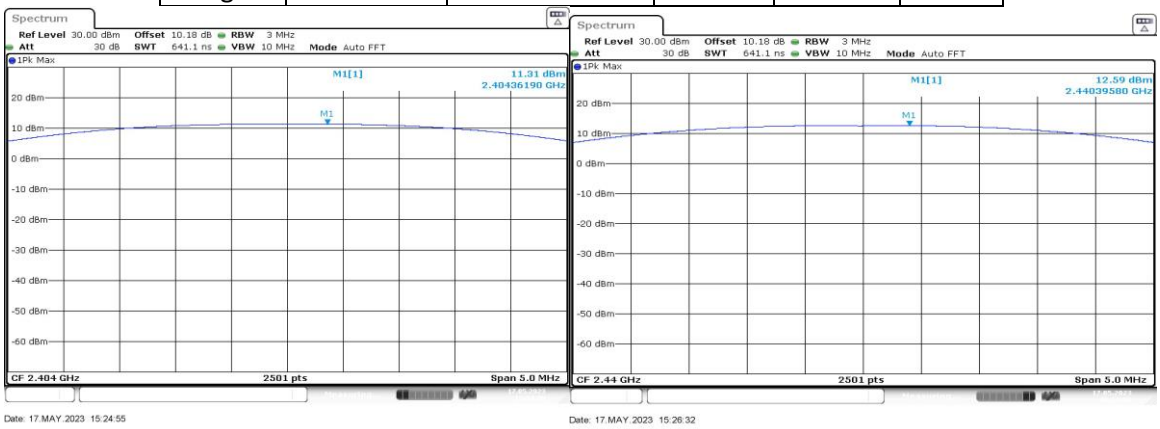
FCC §15.247 (b) (1)

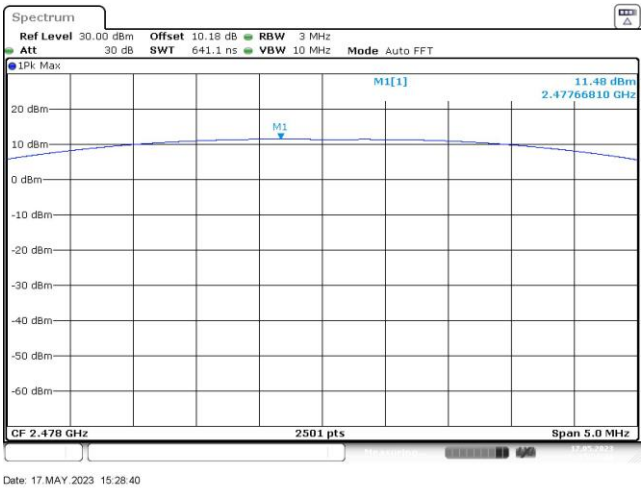
RSS-247 5.4 (b)

The device maintains a minimum of 20 hopping channels. The limit is 21 dBm.

QHS-P2 Data Collection:

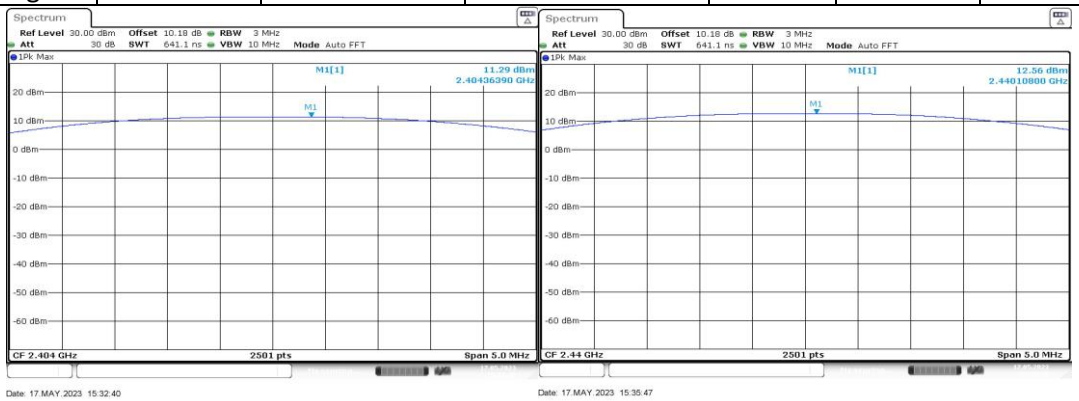
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dB)	Margin (dB)	Result
Low	2404	11.31	21	9.69	Pass
Middle	2440	12.59	21	8.41	Pass
High	2478	11.48	21	9.52	Pass

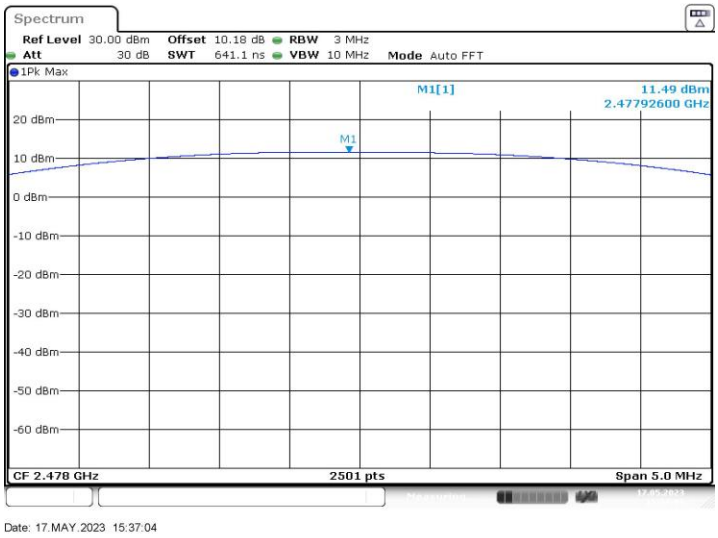




QHS-P6Data Collection:

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dB)	Margin (dB)	Result
Low	2404	11.29	1	21	8.71	Pass
Middle	2440	12.56	1	21	7.44	Pass
High	2478	11.49	1	21	8.51	Pass





Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	22-Mar-2023	21-Mar-2024

Conducted Spurious Emissions

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	May 22, 2023	
Requirements Standard(s):	FCC §15.247 (d) RSS-247 5.5		**Referenced Standard(s):**	ANSI 63.10 (7.8.8)	
EUT powered with:	5V USB	**Temp / Humidity:**	n/a	**Test location:**	Braun Room
Test equipment used TN's:	2409				
EUT Serial number(s):	084808M3051E012A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	Product was tested as built except the antenna was disconnected and a coaxial cable was installed.				

Conclusion:

The Bose Model 408R passes Conducted Spurious Emissions by more than 10dB.

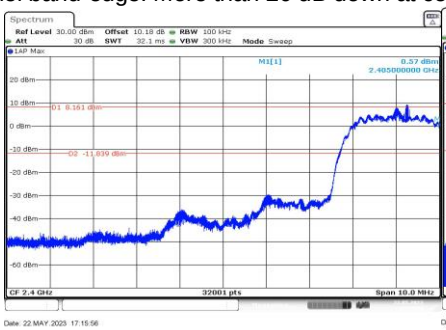
Limits

FCC §15.247 (d), RSS-247 5.5

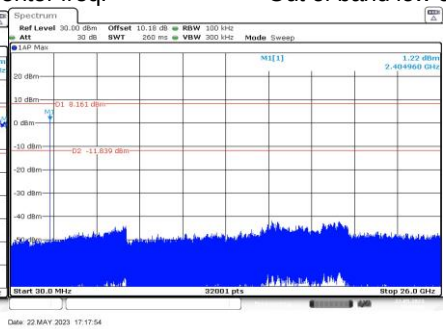
Output power was measured based on the use of a peak measurement; therefore, the required attenuation is 20 dB.

Data Collection:

QHS-P2 low channel band-edge. More than 20 dB down at center freq.

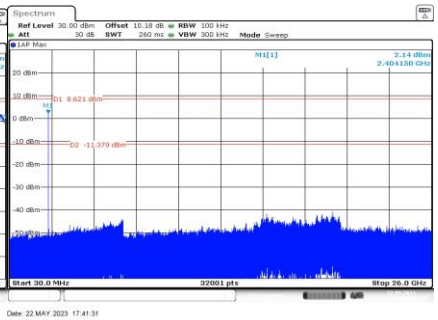


Out of band low channel (2402MHz)

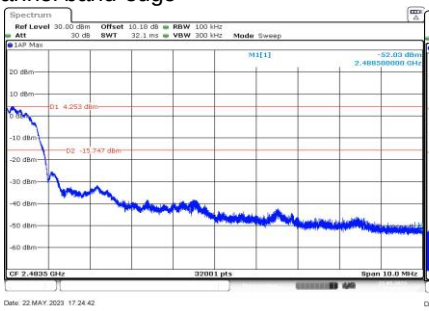


QHS-P6 low channel band-edge

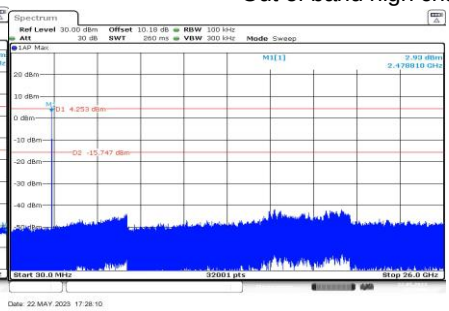
Out of band low channel (2404MHz)



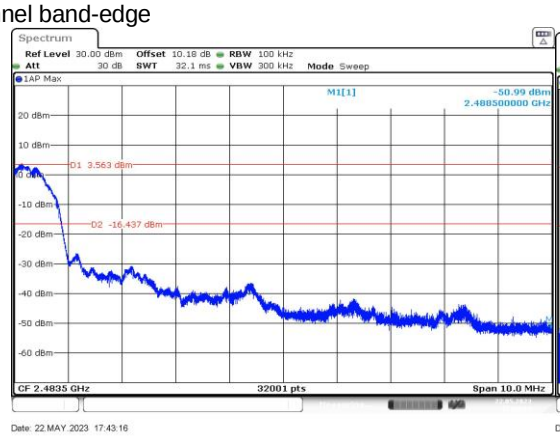
QHS-P2 high channel band-edge



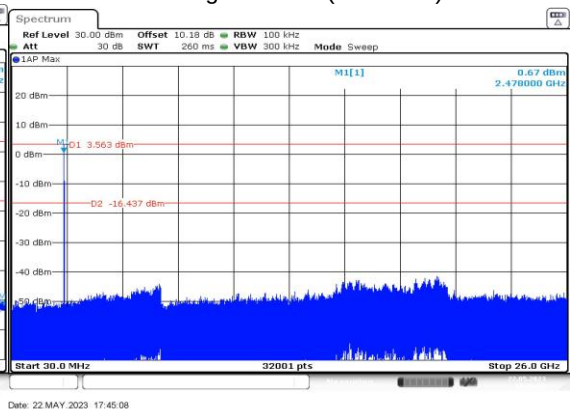
Out of band high channel (2480MHz)



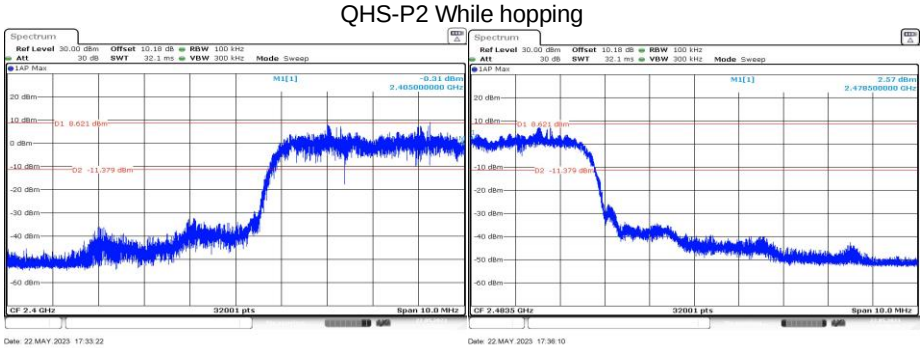
QHS-P6 high channel band-edge



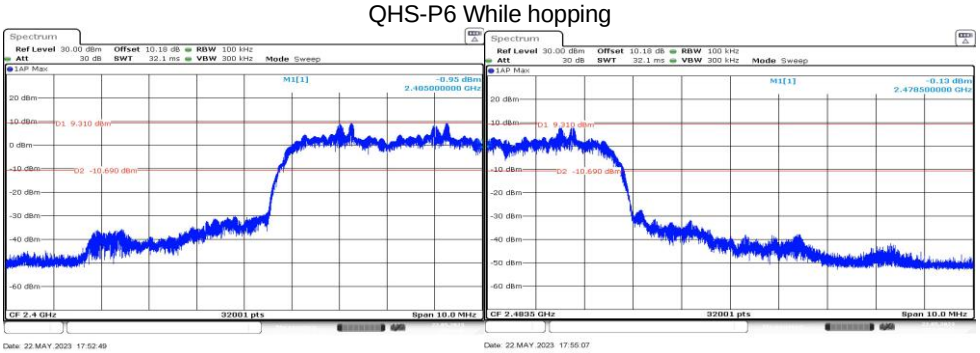
Out of band high channel (2478MHz)



QHS-P2 While hopping



QHS-P6 While hopping



Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	21-Mar-2023	22-Mar-2024

RF Radiated Emissions 30MHz -1GHz

Test Information:

Project number (Integrity):		**Build Phase:**	Pre-C1		
Tested by:	M. Mehrmann		**Date:**	8+9 February 2023	
Requirements Standard(s):	FCC §15.247 (d) and RSS-247 section 5.5		**Referenced Standard(s):**		
EUT powered with:		**Temp / Humidity:**		**Test location:**	Maxwell House
Test equipment used TN's:	644,2319,1541,2077,1277-22				
EUT Serial number(s):	Left; 084803M3003B005A Right: 084803M3003B004A				
EUT Software installed:	0.0.19 diag code				
EUT Modification(s):	None				

Objective/Summary/Conclusion:

Passes FCC 15.247 and RSS-247 Section 5.5 requirements with a worst-case passing margin of 16.0 dB at 700 MHz.

Additional EUT Information:

The EUT was tested in a 3m Semi Anechoic Chamber on an insulating turntable 80 cm high.

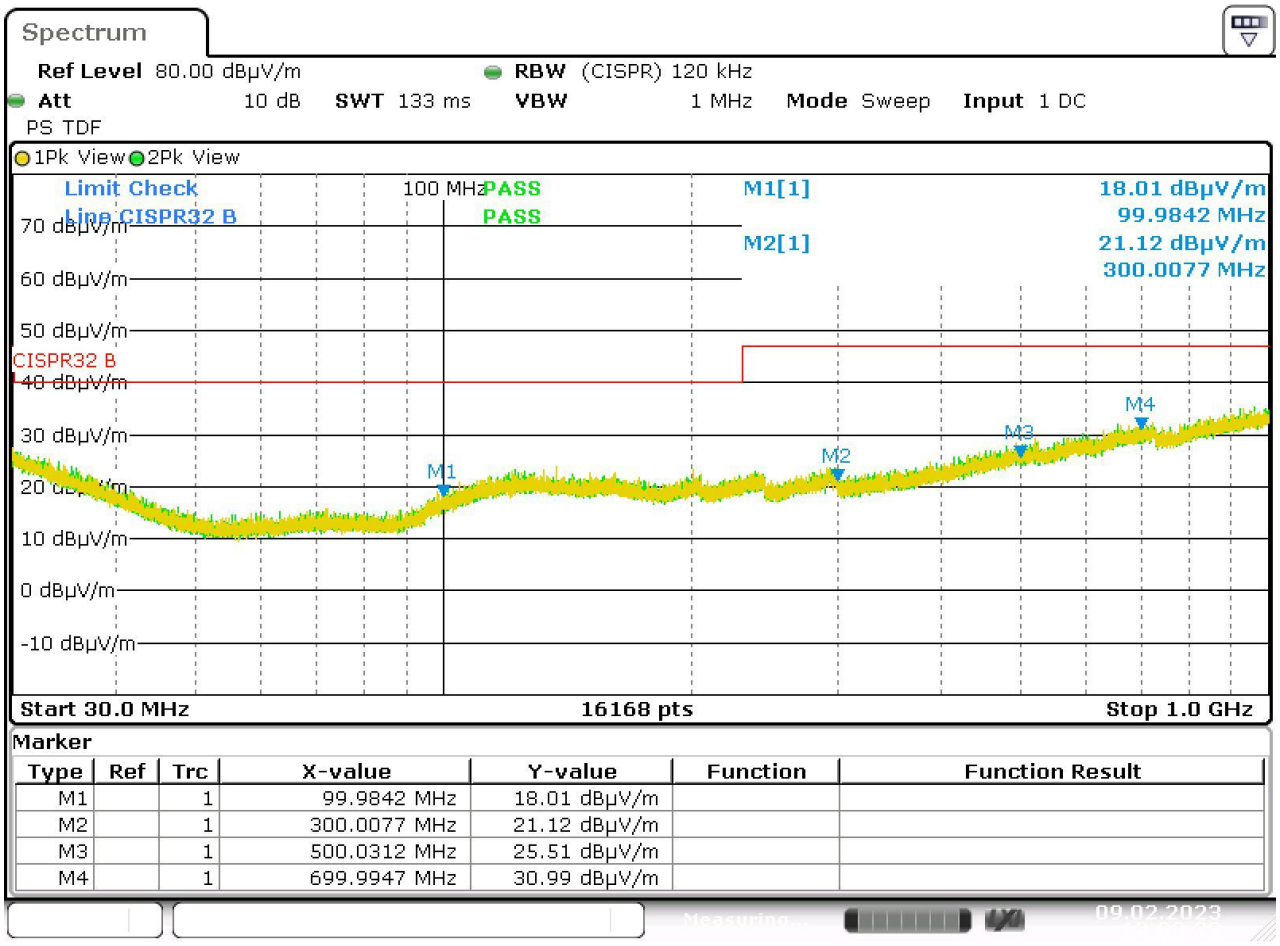
The device was scanned in three orthogonal axis and no signals were detected.

Test Setup Details:

EUT Emissions levels contained within this report are calculated on the following basis:
Radiated Emission Level (dBµV/m) = EMI Receiver Reading (dBµV) + Antenna Correction Factor (dB/m) – Preamplifier Gain (dB) + Cable Loss (dB)

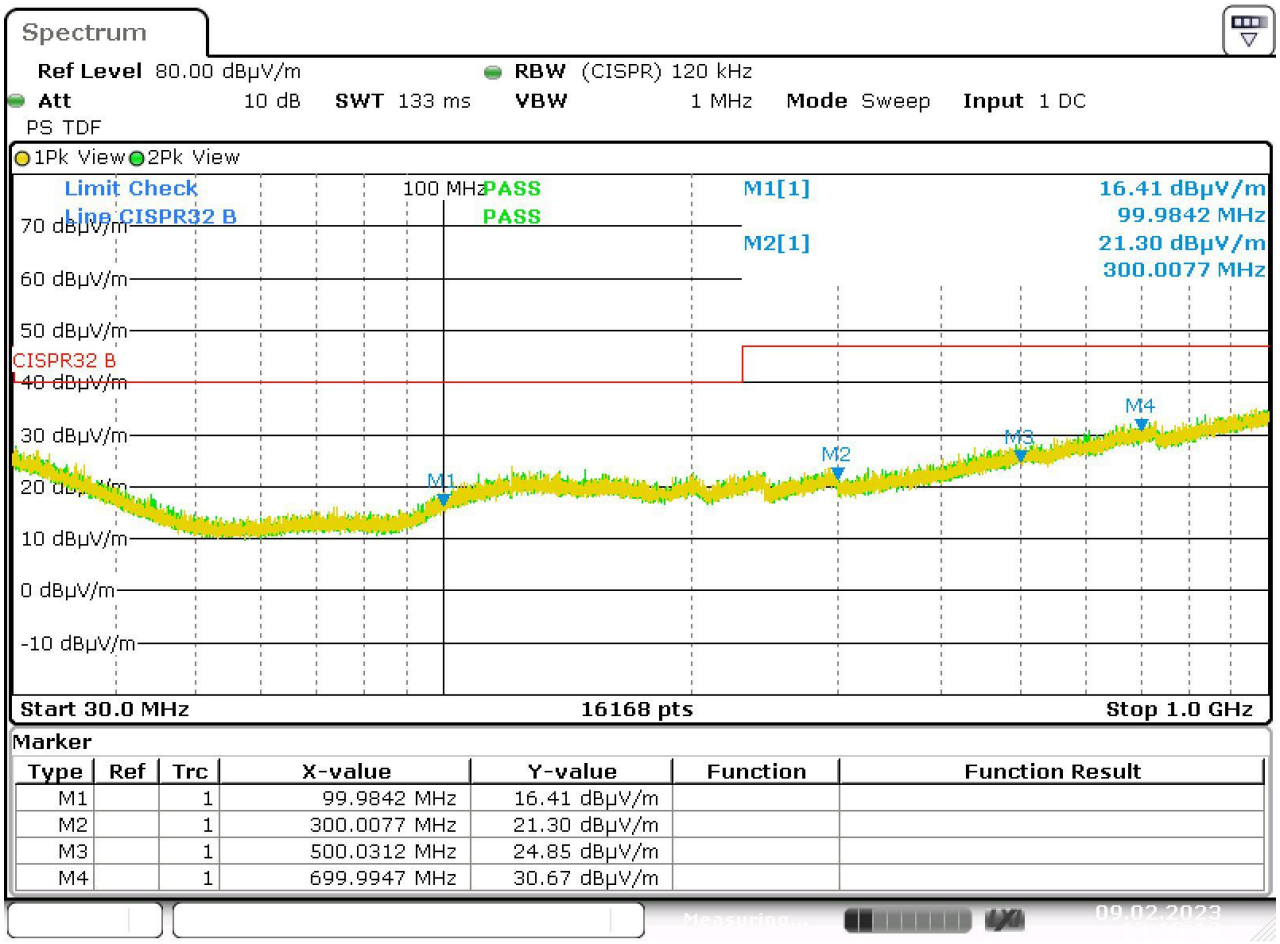
Data Collection:

EUT S/N:	Right Bud	**Power applied:**				**Plot#**	1
EUT Mods:							
EUT Setup:							
Comments:	Position X						



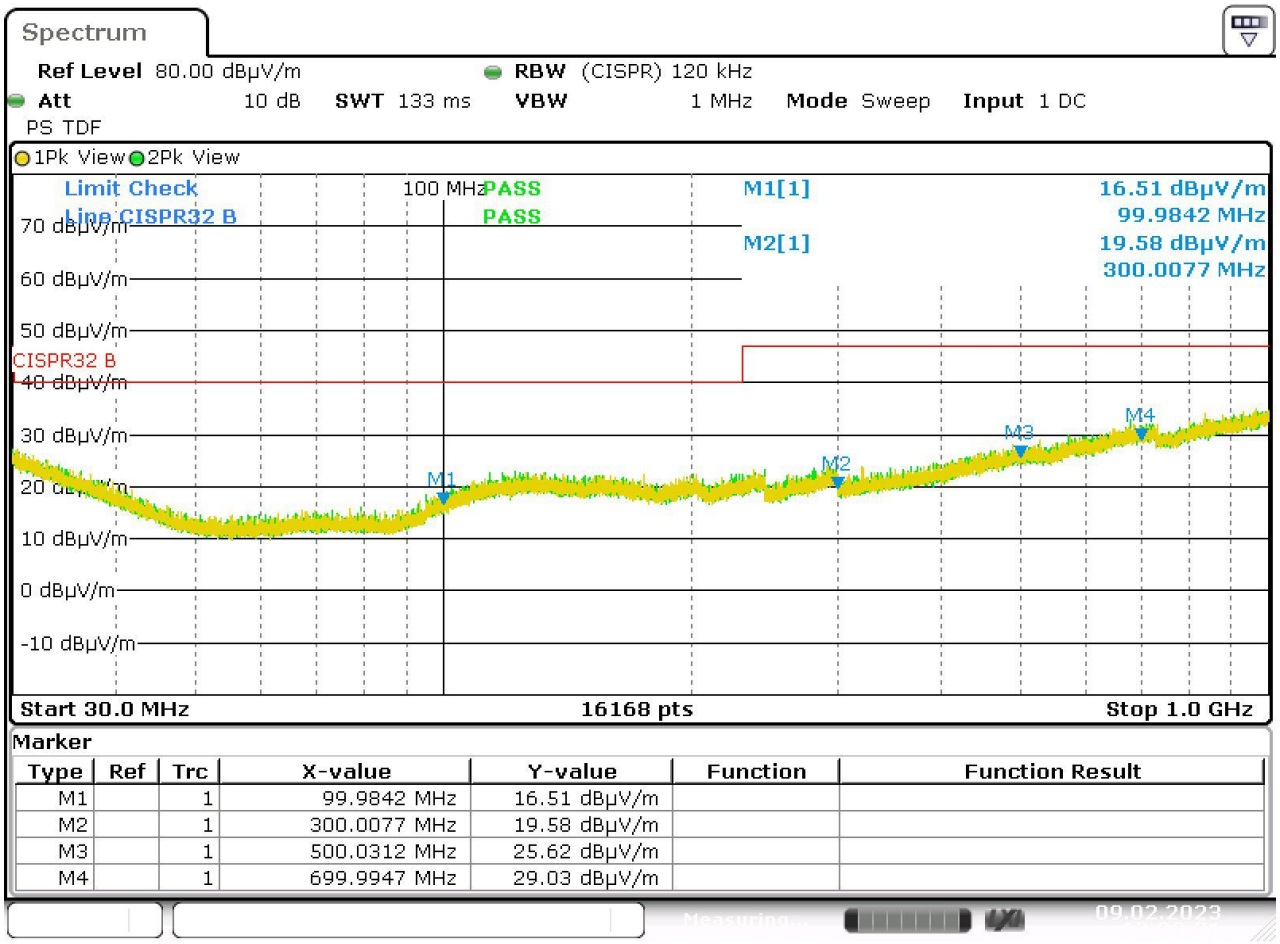
Date: 9.FEB.2023 13:00:32

EUT S/N:	Right bud	**Power applied:**				**Plot#**	2
EUT Mods:							
EUT Setup:							
Comments:	Position Y						



Date: 9.FEB.2023 13:10:18

EUT S/N:	Right bud	**Power applied:**				**Plot#**	3
EUT Mods:							
EUT Setup:							
Comments:	Position Z						



Date: 9.FEB.2023 13:20:21

Limits:

Standard	Freq Range (MHz)	Limits (dBuV QP[1])			**Comments**
		Class A		Class B	Measurements above 1 GHz are made using average and peak detectors.
		10 m	3 m [2]	3 m	
FCC §15.247 (d) RSS-247 Section 5.5	30-88	39	49	40	Mains cables draped to floor, not bundled. ***For measurements above 1 GHz, peak limits must also be met that are 20 dB higher than average limits.**
	88-216	43.5	53.5	43.5	
	216-960	46.5	56.5	46	
	>960	49.5*	59.5*	54*	

andwidth and Detector Settings:			
Freq. Range (MHz)	RBW (kHz)	VBW (kHz)	Detector
30 – 1000	120	>300	QP
> 1000	1000	>1000	Pk and AVG

Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date	Most Recent Verification	Verification Due Date
1541	Antenna 30MHz - 6GHz	JB6	A050807	Sunol Sciences Corp	14-Dec-2021	14-Dec-2023		
3062	RF Cable 10MHz-18GHz, low loss LL142 coax, 26 feet, "N" connectors	SCE18110505-312	N/A	Fairview Microwave[2]			01-Sep-2022	01-Sep-2023
2077	Maxwell House RE Pre-amp (20MHz-3GHz)	N/A	N/A	Bose Corporation			01-Sep-2022	01-Sep-2023
2319	EMI Test Receiver	ESR26	101276	Rohde & Schwarz	29-Mar-2023	28-Mar-2024		

Uncertainty:

Uncertainty Budget				
Title:	Radiated RF Emissions (30MHz-1GHz)			
Source of Uncertainty	Value units:± dB	Distribution	Divisor	Uncertainty (± dB)
Receiver - absolute level	0.3	Rect.	1.73	0.17
Receiver - frequency response	0.8	Rect.	1.73	0.46
Receiver - attenuator switching	0.2	Rect.	1.73	0.12
Receiver - bandwidth switching	0.2	Rect.	1.73	0.12
Receiver - display	0.5	Rect.	1.73	0.29
Antenna factor	0.8	Norm.	2.00	0.38
Antenna directivity	1.0	Norm.	2.00	0.50
Preamp correction factor	0.5	Norm.	2.00	0.25
Cable correction factor	0.5	Norm.	2.00	0.25
Site imperfection - NSA	4.0	Triang.	2.45	1.63
Test table impact	1.1	Rect.	1.73	0.64
			Combined uncertainty (RSS):	1.98
			Coverage factor (2 sigma):	2.00
			Extended uncertainty (95% confidence):	**3.97**

Radiated Spurious Emissions 1-25GHz

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	June 12, 2023	
Requirements Standard(s):	FCC §15.247 (d) RSS-247 Section 5.5		**Referenced Standard(s):**	ANSI C63.10-2013	
EUT powered with:	Battery	**Temp / Humidity:**	N/A	**Test location:**	Marconi Manor
Test equipment used TN's:	1663,3685,2349,2602,2414				
EUT Serial number(s):	Left Right	084803M3051D038A1 084808M3051D019A1			
EUT Software installed:	0.4.10				
EUT Modification(s):	USB Debug wires were attached to the earbud to allow control of the radio.				

Conclusion:

The Bose model 408R passes radiated emissions from 1-25GHz.

The peak emissions maximum is below the average limit in all cases.
1-18 GHz, the maximum emission was 53.1 dBuV/m peak, noise floor. The limit is 54 dBuV/m and the margin is 0.9 dB.
18-25 GHz. The maximum emission was 59.2. The limit is 74 dBuV/m, and the margin is 14.8 dB.

Procedure:

Per 558074 D01 15.247 Meas Guidance v05r02:

Each mode tested was measured at all 10 Harmonics, at the low, middle, and high transmit frequencies.
EUT was taped to a bamboo skewer and stuck into the test support at 150cm above the floor. From there the table was rotated and the antenna scanned up down and horizontal and vertical polarizations.
A notch filter was used to block the fundamental emission from overloading the measurement equipment including the pre-amplifier and the spectrum analyzer.

The signal duty cycle was set to 100%

Limit calculation:
The E field in the far field observes the inverse square law. So that the difference in field strength difference in decibels is;

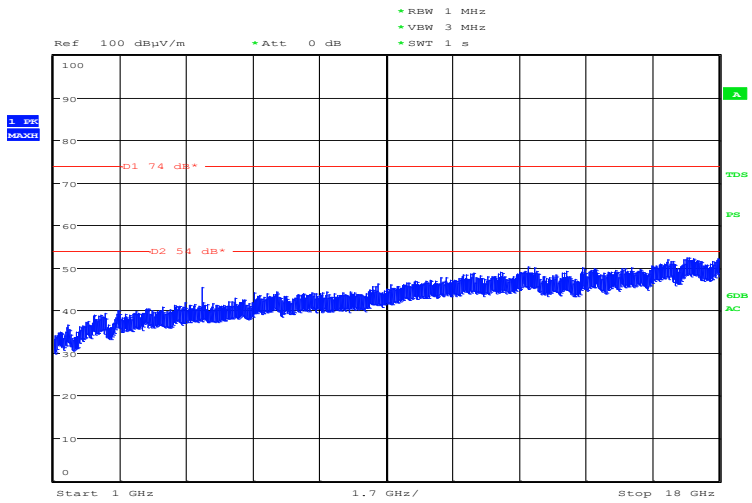
$$20\ Log\left(\frac{D1}{D2}\right) = 20Log10 = 20$$

Peak limit of 74 becomes 94 dBuV at 30cm.

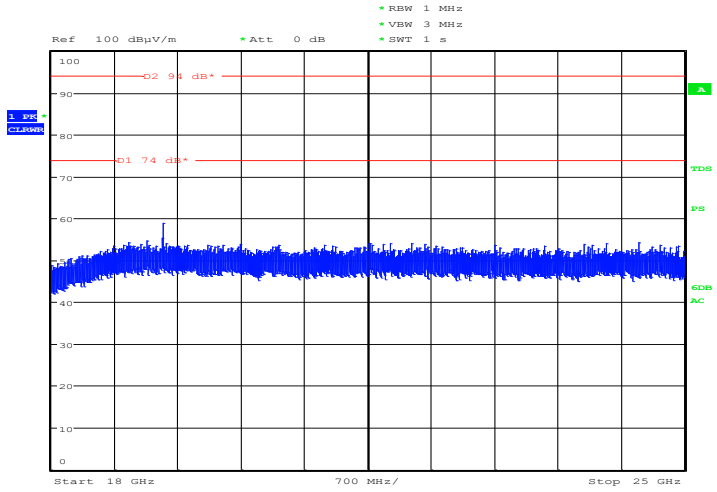
Average limit of 54 becomes 74 dBuV at 30cm.

Data Collection:

EUT S/N:	Right	**Power applied:**	Battery			**Plot#**	1
EUT Mods:							
EUT Setup:	QHS P2 Low channel						
Comments:	1-18 GHz measured at 3m distance. 18-25 GHz measured at 30cm distance.						



Date: 12.JUN.2023 12:44:06



Date: 13.JUN.2023 15:49:10

FCC 15.247d and RSS-247 Section 5.5 @ 3 Meters											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) QP/AVG	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	4806	36.70	48.70	54.0	74.0	17.3	25.3	0	V	1.50	Signal Maximized
2	7212	31.30	44.50	54.0	74.0	22.7	29.5	0	H	1.50	Noise floor
3	9611	41.70	51.80	54.0	74.0	12.3	22.2	0	H	1.50	Signal Maximized
4	12020	34.80	48.20	54.0	74.0	19.2	25.8	0	V	1.50	Noise floor
5	14424	34.70	48.20	54.0	74.0	19.3	25.8	0	H	1.50	Noise floor
6	16828	38.20	51.80	54.0	74.0	15.8	22.2	0	V	1.50	Noise floor

FCC 15.247d and RSS-247 Section 5.5 @ 30 cm											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) QP/AVG	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	19230	46.80	59.20	74.0	94.0	27.2	34.8				Signal Maximized
2	21636	40.70	54.20	74.0	94.0	33.3	39.8				Noise floor
3	24040	40.90	54.40	74.0	94.0	33.1	39.6				Noise floor

EUT S/N:	Right	**Power applied:**	Battery			**Plot#**	2
EUT Mods:							
EUT Setup:	QHS P2 Mid channel						
Comments:							

FCC 15.247d and RSS-247 Section 5.5 @ 3 Meters											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) QP/AVG	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	4880	36.80	48.80	54.0	74.0	17.2	25.2	0	V	1.50	Signal Maximized
2	7320	31.90	45.00	54.0	74.0	22.1	29.0	0	H	1.50	Noise floor
3	9761	41.90	52.20	54.0	74.0	12.1	21.8	0	H	1.50	Signal Maximized
4	12200	36.40	49.80	54.0	74.0	17.6	24.2	0	V	1.50	Noise floor
5	14640	36.10	49.50	54.0	74.0	17.9	24.5	0	H	1.50	Noise floor
6	17080	38.80	52.20	54.0	74.0	15.2	21.8	0	V	1.50	Noise floor

FCC 15.247d and RSS-247 Section 5.5 @ 30 cm											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) QP/AVG	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	19518	45.20	58.80	74.0	94.0	28.8	35.2				Signal Maximized
2	21960	41.60	55.50	74.0	94.0	32.4	38.5				Noise floor
3	24400	44.60	57.20	74.0	94.0	29.4	36.8				Noise floor

EUT S/N:	Right	**Power applied:**	Battery			**Plot#**	3
EUT Mods:							
EUT Setup:	QHS P2 High channel						
Comments:							

FCC 15.247d and RSS-247 Section 5.5 @ 3 Meters											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	Margin (dB) QP/AVG	Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	4957	33.00	45.50	54.0	74.0	21.0	28.5	0	V	1.50	Signal Maximized
2	7434	32.00	45.10	54.0	74.0	22.0	28.9	0	H	1.50	Noise floor
3	9913	40.10	51.50	54.0	74.0	13.9	22.5	0	H	1.50	Signal Maximized
4	12390	35.10	48.10	54.0	74.0	18.9	25.9	0	V	1.50	Noise floor
5	14868	37.30	50.50	54.0	74.0	16.7	23.5	0	H	1.50	Noise floor
6	17346	39.50	53.10	54.0	74.0	14.5	20.9	0	V	1.50	Noise floor

FCC 15.247d and RSS-247 Section 5.5 @ 30 cm											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	Margin (dB) QP/AVG	Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	19822	43.80	56.80	74.0	94.0	30.2	37.2				Signal Maximized
2	22302	40.40	53.70	74.0	94.0	33.6	40.3				Noise floor
3	24780	40.70	53.90	74.0	94.0	33.3	40.1				Noise floor

EUT S/N:	Right	**Power applied:**	Battery			**Plot#**	4
EUT Mods:							
EUT Setup:	QHS P6 Low channel						
Comments:							

FCC 15.247d and RSS-247 Section 5.5 @ 3 Meters											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	Margin (dB) QP/AVG	Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	4808	36.60	47.80	54.0	74.0	17.4	26.2	0	V	1.50	Signal Maximized
2	7212	31.30	44.90	54.0	74.0	22.7	29.1	0	H	1.50	Noise floor
3	9616	38.00	51.30	54.0	74.0	16.0	22.7	0	H	1.50	Signal Maximized
4	12020	35.30	48.40	54.0	74.0	18.7	25.6	0	V	1.50	Noise floor
5	14424	34.80	47.70	54.0	74.0	19.2	26.3	0	H	1.50	Noise floor
6	16828	38.20	51.90	54.0	74.0	15.8	22.1	0	V	1.50	Noise floor

FCC 15.247d and RSS-247 Section 5.5 @ 30 cm											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	Margin (dB) QP/AVG	Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	19232	41.70	55.30	74.0	94.0	32.3	38.7				Signal Maximized
2	21636	41.20	54.70	74.0	94.0	32.8	39.3				Noise floor
3	24040	41.70	55.20	74.0	94.0	32.3	38.8				Noise floor

EUT S/N:	Right	**Power applied:**	Battery			**Plot#**	5
EUT Mods:							
EUT Setup:	QHS P6 Mid channel						
Comments:							

FCC 15.247d and RSS-247 Section 5.5 @ 3 Meters											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) QP/AVG	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	4880	35.90	47.40	54.0	74.0	18.1	26.6	0	V	1.50	Signal Maximized
2	7320	31.80	45.10	54.0	74.0	22.2	28.9	0	H	1.50	Noise floor
3	9760	39.40	51.90	54.0	74.0	14.6	22.1	0	H	1.50	Signal Maximized
4	12200	36.60	49.70	54.0	74.0	17.4	24.3	0	V	1.50	Noise floor
5	14640	36.20	49.80	54.0	74.0	17.8	24.2	0	H	1.50	Noise floor
6	17080	38.80	52.20	54.0	74.0	15.2	21.8	0	V	1.50	Noise floor

FCC 15.247d and RSS-247 Section 5.5 @ 30 cm											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) QP/AVG	FCC 15.247d and RSS-247 Section 5.5 Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	19520	41.00	54.40	74.0	94.0	33.0	39.6				Noise floor
2	21960	40.50	53.80	74.0	94.0	33.5	40.2				Noise floor
3	24400	40.50	53.50	74.0	94.0	33.5	40.5				Noise floor

EUT S/N:	Right	**Power applied:**	Battery			**Plot#**	6
EUT Mods:							
EUT Setup:	QHS P6 High channel						
Comments:							

FCC 15.247d and RSS-247 Section 5.5 @ 3 Meters											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	Margin (dB) QP/AVG	Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	4960	33.60	45.10	54.0	74.0	20.4	28.9	0	V	1.50	Signal Maximized
2	7434	32.00	45.50	54.0	74.0	22.0	28.5	0	H	1.50	Noise floor
3	9920	38.90	51.40	54.0	74.0	15.1	22.6	0	H	1.50	Signal Maximized
4	12390	34.90	48.00	54.0	74.0	19.1	26.0	0	V	1.50	Noise floor
5	14868	36.80	50.10	54.0	74.0	17.2	23.9	0	H	1.50	Noise floor
6	17346	39.50	52.90	54.0	74.0	14.5	21.1	0	V	1.50	Noise floor

FCC 15.247d and RSS-247 Section 5.5 @ 30 cm											
MK #	Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) QP/AVG*	FCC 15.247d and RSS-247 Section 5.5 Limit (dBµV/m) Peak	Margin (dB) QP/AVG	Margin (dB) Peak	Table Azimuth (0°closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes/Mode
1	19824	41.00	54.30	74.0	94.0	33.0	39.7				Noise floor
2	22302	40.60	54.20	74.0	94.0	33.4	39.8				Noise floor
3	24780	40.40	53.90	74.0	94.0	33.6	40.1				Noise floor

Limits:

Standard	Freq Range (MHz)	Limits (dBuV QP[1])			**Comments**
		Class A		Class B	Measurements above 1 GHz are made using average and peak detectors.
		10 m	3 m	3 m	
FCC 15.247d and RSS-247 Section 5.5	30-88	39	49	40	Mains cables draped to floor, not bundled. ***For measurements above 1 GHz, peak limits must also be met that are 20 dB higher than average limits.**
	88-216	43.5	53.5	43.5	
	216-960	46.5	56.5	46	
	>960	49.5*	59.5*	54*	

Bandwidth and Detector Settings:			
Freq. Range (MHz)	RBW (kHz)	VBW (kHz)	Detector
30 – 1000	120	>300	QP
> 1000	1000	>1000	Pk and AVG

Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Calibration	Calibration Due Date	Most Recent Verification	Verification Due Date
1663	EMI Test Receiver	ESU40	100098	Rohde & Schwarz	20-Mar-2023	19-Mar-2024		
3685	Marconi Manor 3M mast position RE cable set	3 cables (TN's 2373, 2479, 2357)					28-Mar-2023	27-Mar-2024
2349	Double Ridge Waveguide Horn Antenna 1-18GHz	3117	00152406	ETS Lindgren	24-Feb-2023	23-Feb-2025		
2602	Miteq pre-amp 1-18GHz 35dB	AFS42-01001800-28-10P-42	N/A	Miteq			07-Jul-2022	07-Jul-2023
2414	Band Reject Filter (2.4GHz)	BRM50702-07	003	Micro-Tronics	13-Jan-2015		28-Mar-2023	27-Mar-2024
1757	18GHz-40GHz Preamp	JS4018004000-30-8P-A1	1406279	Miteq			07-Jul-2022	07-Jul-2023
1596	Horn Antenna 18GHz - 26.5GHz	AT4640	309234	Amplifier Research				
2368	RF Cable 30MHz-26.5GHz	TRU-210	TRU-12767-35	TRU Corporation			28-Mar-2023	27-Mar-2024

Uncertainty:

Uncertainty Budget				
Title:	Radiated Emissions (>1GHz)			
Source of Uncertainty	Value units:± dB	Distribution	Divisor	Uncertainty (± dB)
Receiver - absolute level	0.3	Rect.	1.73	0.17
Receiver - frequency response	2.0	Rect.	1.73	1.16
Receiver - attenuator switching	0.2	Rect.	1.73	0.12
Receiver - bandwidth switching	0.2	Rect.	1.73	0.12
Receiver - display	0.5	Rect.	1.73	0.29
Antenna factor	0.4	Norm.	2.00	0.20
Antenna directivity	1.0	Norm.	2.00	0.50
Preamp correction factor	0.5	Norm.	2.00	0.25
Cable correction factor	0.5	Norm.	2.00	0.25
Site imperfection - NSA	3.0	Triang.	2.45	1.22
Test table impact	1.7	Rect.	1.73	0.98
			Combined uncertainty (RSS):	2.09
			Coverage factor (2 sigma):	2.00
			Extended uncertainty (95% confidence):	**4.17**

Radiated Band Edge

Project number (Integrity):	408R	**Build Phase:**	C1.5		
Tested by:	Mike Royer		**Date:**	2 June, 2023	
Requirements Standard(s):	FCC §15.247 (d) RSS -247 Section 5.5		**Referenced Standard(s):**	ANSI C63.10-2013	
EUT powered with:	Battery	**Temp / Humidity:**	N/A	**Test location:**	Marconi Manor
Test equipment used TN's:	1663,2929,2349,3685				
EUT Serial number(s):	084803M3051E021A1				
EUT Software installed:	1.4.10+g2edc594				
EUT Modification(s):	USB Debug wires were attached to the earbud to allow control of the radio.				

Conclusion:

The Bose model 408R passes Radiated Band Edge.

Procedure:

The EUT was taped to a bamboo skewer and stuck into the test support at 150cm above the floor. From there the table was rotated and the antenna scanned up down and horizontal and vertical polarizations.

A high dynamic range pre-amp was used to ensure that overloading was avoided.

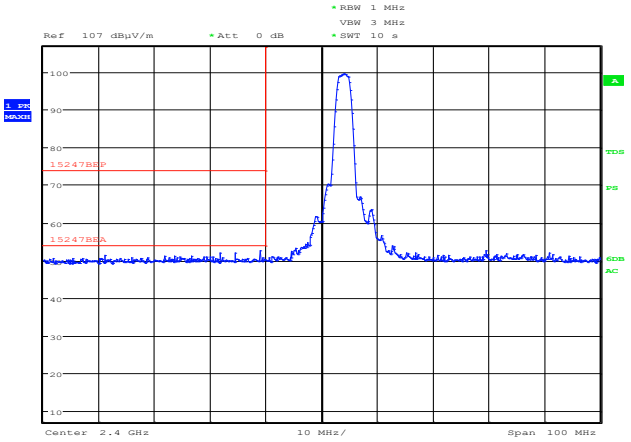
For lower band edge measurements, the transmit frequency was 2404 MHz.

For upper band edge measurements, the transmit frequency was 2478 MHz.

Data Collection:

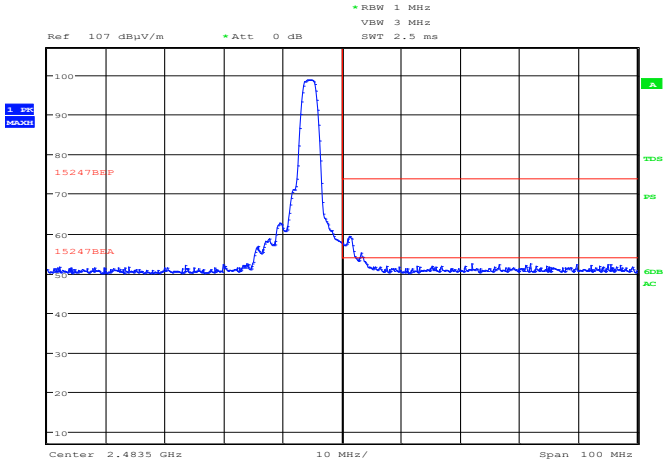
QHS-P2 low channel band edge

Peak emissions below the average limit.



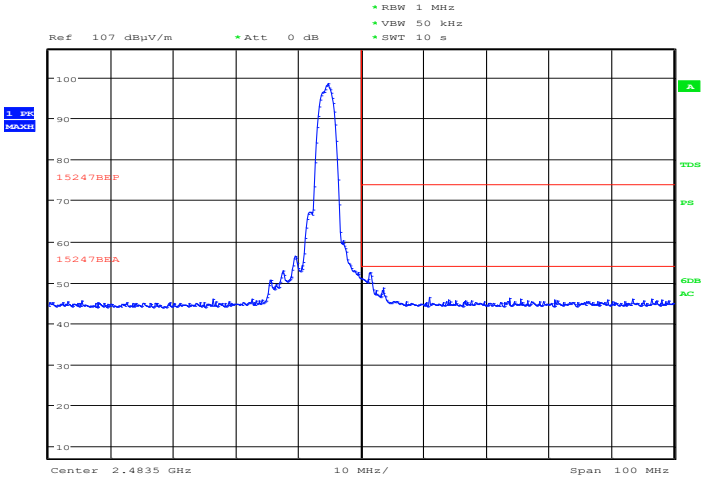
QHS-P2 high channel band edge Peak measurement

Peak emissions not below the average limit, see next page for reduced video bandwidth method.



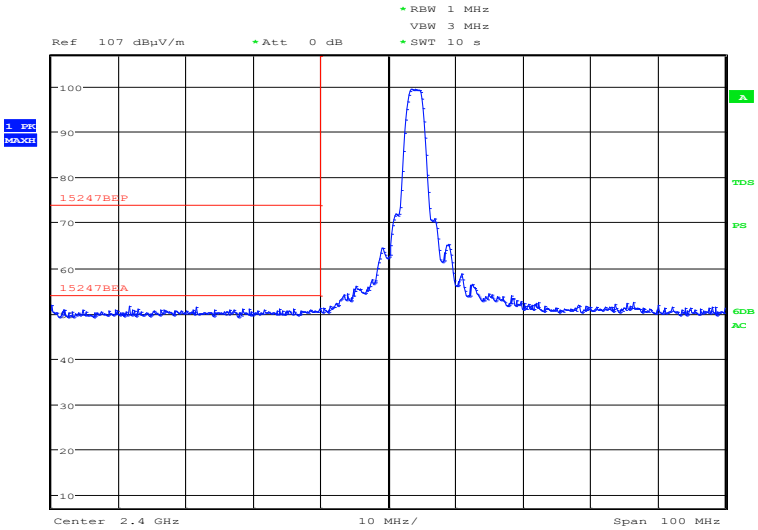
QHS-P2 high channel band edge Average measurement

Reduced video bandwidth method. (VBW = 50 kHz > 1/Ton).



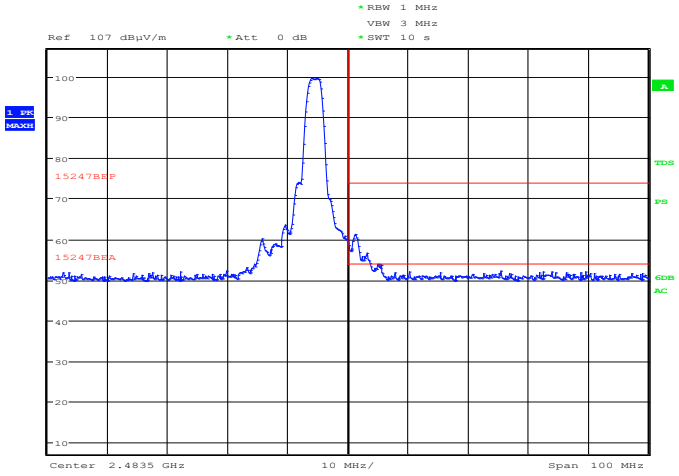
QHS-P6 low channel band edge

Peak emissions below the average limit.



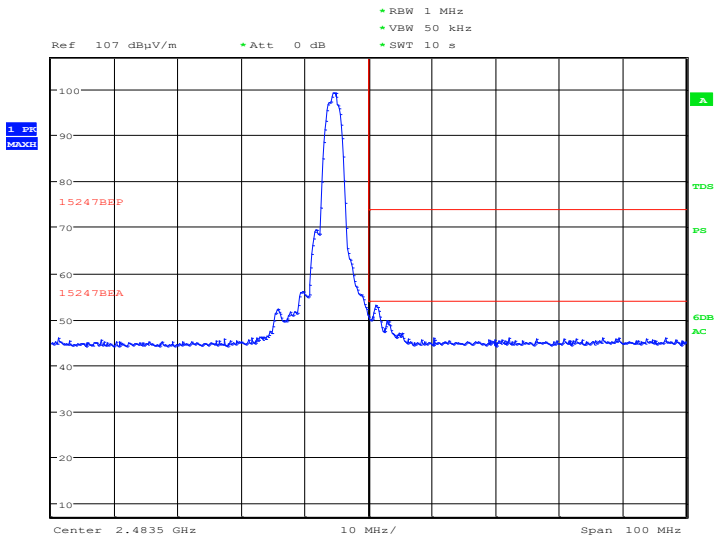
QHS-P6 high channel band edge Peak Measurement

Peak emissions not below average limit, see plot below using reduced video bandwidth method.



QHS-P6 high channel band edge Average Measurement.

Reduced video bandwidth method. (VBW = 50 kHz > 1/Ton).



Limits:

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		Class A		Class B	Measurements above 1 GHz are made using average and peak detectors.
		10 m	3 m	3 m	
or RSS-GEN	30-88	39	49	40	Mains cables draped to floor, not bundled. ***For measurements above 1 GHz, peak limits must also be met that are 20 dB higher than average limits.**
	88-216	43.5	53.5	43.5	
	216-960	46.5	56.5	46	
	>960	49.5*	59.5*	54*	
CISPR 32			Class A	Class B	Mains cables bundled not draped to floor. ***For measurements above 1 GHz, peak limits must also be met that are 20 dB higher than average limits.**
			3 m	3 m	
	30-230		50	40	
	230-1000		57	47	
	Freq Range (GHz)				
	1-3		56*	50*	
	3-6		60*	54*	

Bandwidth and Detector Settings:			
Freq. Range (MHz)	RBW (kHz)	VBW (kHz)	Detector
30 – 1000	120	>300	QP
> 1000	1000	>1000	Pk and AVG

Equipment Used:

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2929	Mini-circuits band-edge pre-amp 300 MHz - 8 GHz 20 dB	ZX60HV-83LN+	N/A	Mini-Circuits			28-Mar-2023	27-Mar-2024
2349	Double Ridge Waveguide Horn Antenna 1-18GHz	3117	00152406	ETS Lindgren	24-Feb-2023	23-Feb-2025		
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Test table impact	1.7	Rect.	1.73	0.98
			Combined uncertainty (RSS):	2.09
			Coverage factor (2 sigma):	2.00
			Extended uncertainty (95% confidence):	**4.17**

End of report