



PRODUCT ASSURANCE ENGINEERING
SAR Exclusion Calculation

FCC ID: A94429358 IC: 3232A-429358



Test Type: SAR Exclusion Calculation

Product Type: Wireless Headphones

Product Name/Number: *Model Number(s): 429358*
FCC ID: A94429358
IC: 3232A-429358

Prepared For: *Product 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 5

Report Number: *EMC.429358.22.056.4*

General Comments/Special Test Conditions:

This report relates only to the items tested. This report covers EMC marking requirements for model 429358

	Print Name	Signature	Date
Prepared By:	Karl Klemm		10-Mar-2022
Electrical Engineer Review* By:	Bryan Cerqua		10-Mar-2022

* 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.

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PRODUCT ASSURANCE ENGINEERING
SAR Exclusion Calculation

FCC ID: A94429358 IC: 3232A-429358



Table of Contents

Tests Performed (Table of Contents):

Test Report Summary 3

Test Requirements: 5

Objective/Summary/Conclusion: 9

Test Setup Details: 10

Data Collection: 11

Equipment Used: 14



Test Report Summary

Product Information:

Description

The EUT is a wireless headphone that contains DSS/DTS transceivers, manufactured by Qualcomm Technologies, QCC5127. The EUT uses Adaptive Frequency Hopping (AFH) mode, using a reduced hop set if interference is detected in band, however a minimum of 20 channels is always maintained.

Setup (Cables and Accessories)

For radio tests the radio was configured with Qualcomm Blue Suite software (details provided in SOFTWARE AND FIRMWARE section).

EUT Antenna Description

The antenna is an SMD chip antenna with antenna gain of 2.2 dBi, Johanson Technology model 2450AT45A100.

SOFTWARE AND FIRMWARE

*The firmware installed in the EUT during testing was version 00.00.09
The test utility software used during testing was Blue Suite version 3.3.10.*

Scope:

This report covers EMC requirements. FCC CFR 47 PART 15 SUBPART C, Industry Canada RSS-247 Issue 2, and Industry Canada RSS-GEN Issue 5.

All measurements in this report were made with a direct connection to the antenna terminal, with the antenna disconnected.

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.



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FCC Test Site Accreditation.

<u>Firm Name</u>	<u>Location</u>	<u>Accreditation</u>	<u>MRA Designation</u>	<u>Expiration</u>	<u>Contact</u>	<u>Contact</u>
			<u>Number</u>	<u>Date</u>		<u>Title</u>
Bose Corporation	1 New York Avenue, Framingham, MA	American Association for Laboratory Accreditation	N/A US1088	07/31/2022	Mr. Cable Best	Quality Manager

Canadian Test Site Registration.

Organization	CAR identifier	Scope/Recognition Date (yyyy-mm-dd)	Expiration (yyyy-mm-dd)
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: 2022-07-31 A2LA ISO/IEC 17025:2017 Expires: 2022-07-31



Test Requirements:

From FCC KDB 447498 D04 Interim General RF Exposure Guidance v01:

Appendix B Exemptions for Single RF Sources

B.2 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of § 1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1 mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph § 1.1307(b)(3)(ii)(A).

The 1 mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

From 47 CFR 1.1307:

(3) Determination of exemption.

(i) For single RF sources (*i.e.*, any single fixed RF source, mobile device, or portable device, as defined in [paragraph \(b\)\(2\)](#) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in [paragraph \(b\)\(3\)\(ii\)\(A\)](#) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:



PRODUCT ASSURANCE ENGINEERING
SAR Exclusion Calculation



FCC ID: A94429358 IC: 3232A-429358

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to [§ 1.1307\(b\)\(3\)\(i\)\(C\)](#) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.



(ii) For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in [paragraph \(b\)\(3\)\(i\)\(A\)](#) of this section. Medical implant devices may only use this exemption and that in [paragraph \(b\)\(3\)\(i\)\(A\)](#).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using [paragraph \(b\)\(3\)\(i\)\(B\)](#) of this section for P_{th} , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using [paragraph \(b\)\(3\)\(i\)\(C\)](#) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

$P_{th,i}$ = the exemption threshold power (P_{th}) according to [paragraph \(b\)\(3\)\(i\)\(B\)](#) of this section for fixed, mobile, or portable RF source i .

ERP_j = the ERP of fixed, mobile, or portable RF source j .

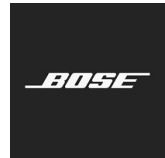
$ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$ according to the applicable formula of [paragraph \(b\)\(3\)\(i\)\(C\)](#) of this section.

$Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k , as applicable from [§ 1.1310 of this chapter](#).



**PRODUCT ASSURANCE ENGINEERING
SAR Exclusion Calculation**



FCC ID: A94429358 IC: 3232A-429358

RSS-102, Section 2.5.1

Exemption Limits for Routine Evaluation – SAR Evaluation

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Notes:

4 The exemption limits in Table 1 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

5 Transmitters operating between 0.003-10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in Section 4.

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.



Objective/Summary/Conclusion:

FCC Calculation

Mod of Operation	Enter Frequency (MHz)	Enter separation distance(cm)	Enter TX Power (dBm)	Enter Duty Cycle (%)	Enter Antenna Gain (dBi)
BT (A2DP sink)	2450	<0.5	8.7	0.97	2.2
BT (Speakerphone)	2450	<0.5	8.7	6.16	2.2
BLE	2450	<0.5	6.8	0.88	2.2

Duty cycle corrected values

Mod of Operation	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)	Greater of Power or EIRP (mW)	1 mW exemption (mW)	SAR Exempt
BT (A2DP sink)	-11.4	0.07	-9.2	0.12	0.1	1	Yes
BT (Speakerphone)	-3.4	0.46	-1.2	0.76	0.8	1	Yes
BLE	-13.8	0.04	-11.6	0.07	0.1	1	Yes

Conclusion: EUT is exempt from SAR testing.

RSS-102 Calculation

Operating Mode	Duty Cycle (%)	Max Conducted Output Power		EIRP (dBm)	Max Output Power (mW e.i.r.p.)	Time-averaged Output Power ¹ (mW e.i.r.p.)	Limit from Table 1 for <5 mm (mW e.i.r.p.)	Result
		(dBm)	(mW)					
BT (A2DP sink)	0.97	8.70	7.41	10.90	12.30	0.12	4.00	Exempt
BT (Speakerphone)	6.16					0.76		
BLE	0.88	6.80	4.79	9.00	7.94	0.07	4.00	Exempt

Antenna Gain (dBi): 2.2

Note 1: Maximum output power corrected by duty cycle

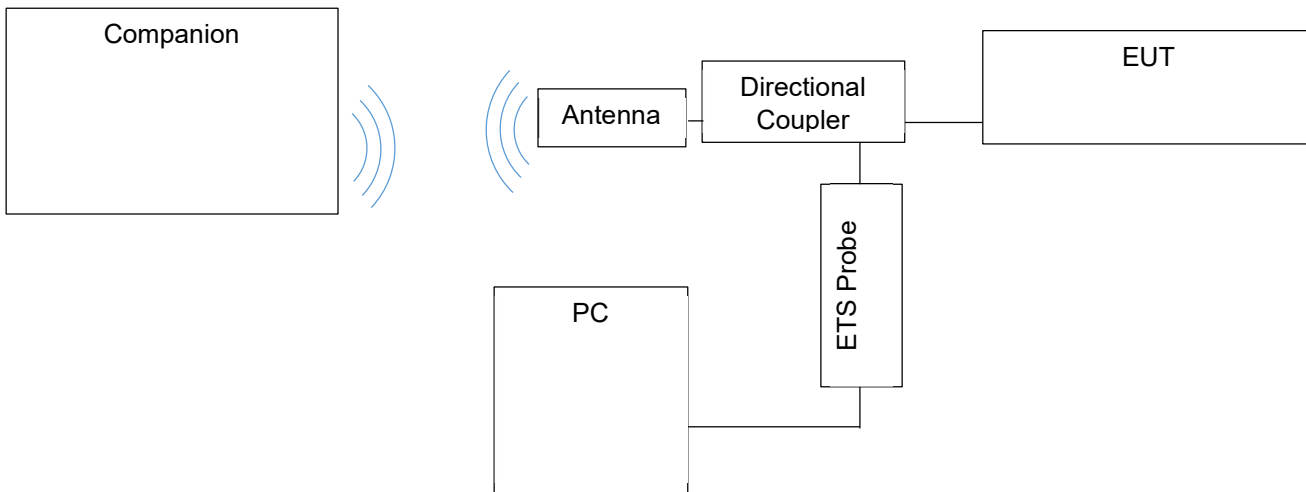
Conclusion: EUT is exempt from SAR testing.

Test Setup Details:

The EUT is connected to a companion device in either A2DP (sink) mode or speakerphone (handsfree) mode, or in BLE mode sending link data to the companion device. The connection is made through a directional coupler with a power meter attached to monitor the transmissions from the EUT. Transmitter output power and duty cycle are monitored using an ETS power meter probe.

Maximum output power was measured conducted with the antenna disconnected; the antenna gain is added to the conducted output power to determine e.i.r.p, as appropriate. Data is taken from the Output Power sections in the DSS and DTS reports.

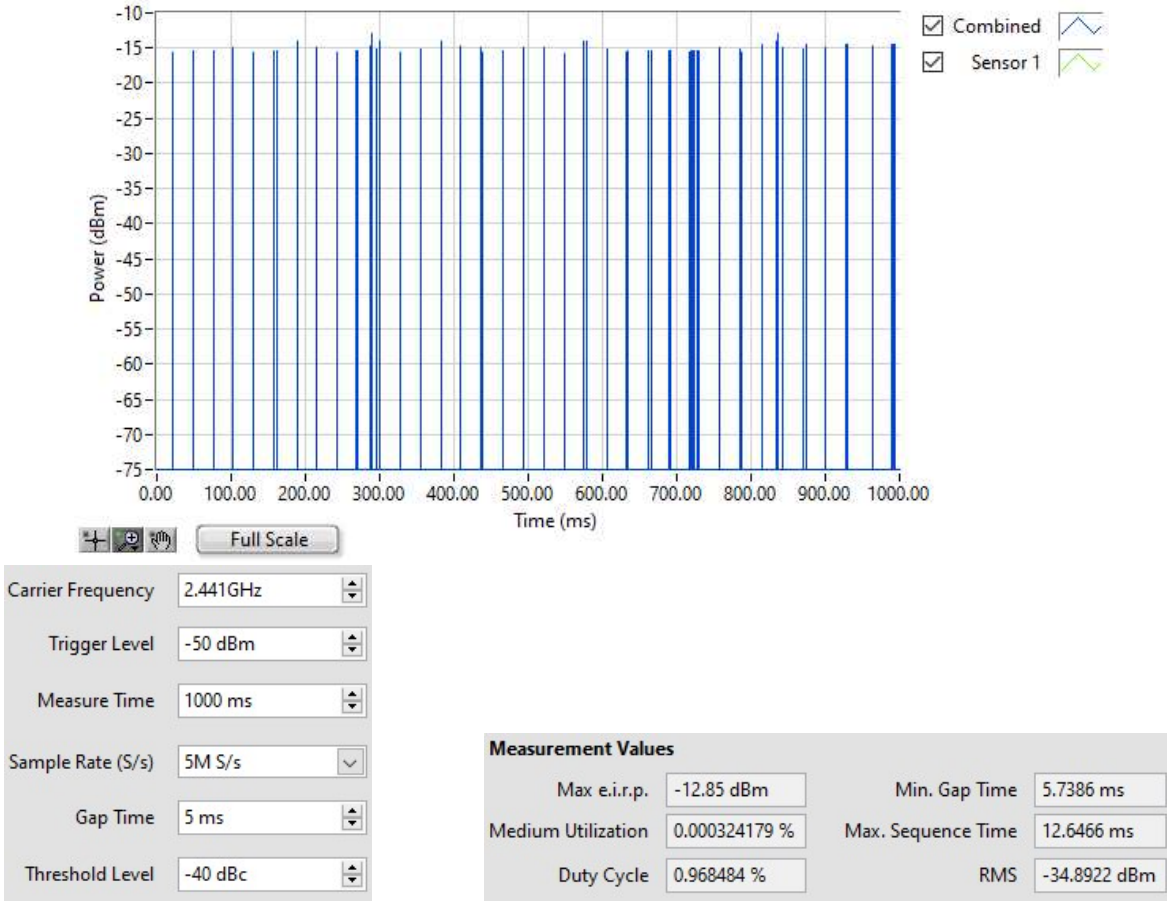
The duty cycle is used with the e.i.r.p. measurement to calculate the time-averaged output power.





Data Collection:

Duty Cycle Measurements

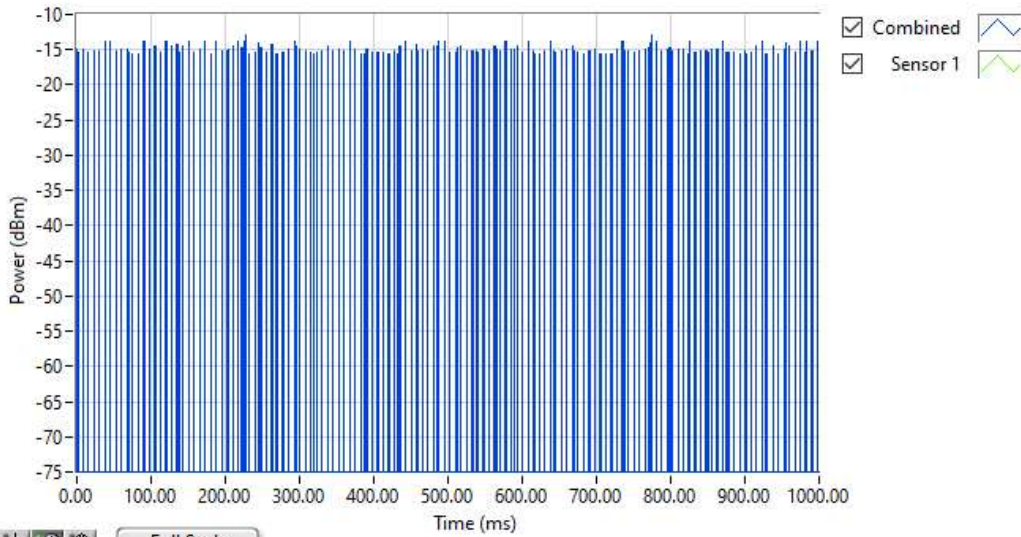


A2DP mode



PRODUCT ASSURANCE ENGINEERING
SAR Exclusion Calculation

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Full Scale

Carrier Frequency: 2.441GHz

Trigger Level: -50 dBm

Measure Time: 1000 ms

Sample Rate (S/s): 5M S/s

Gap Time: 5 ms

Threshold Level: -40 dBc

Measurement Values			
Max e.i.r.p.	-12.84 dBm	Min. Gap Time	5.1322 ms
Medium Utilization	0.00203787 %	Max. Sequence Time	9.8676 ms
Duty Cycle	6.15998 %	RMS	-26.9082 dBm

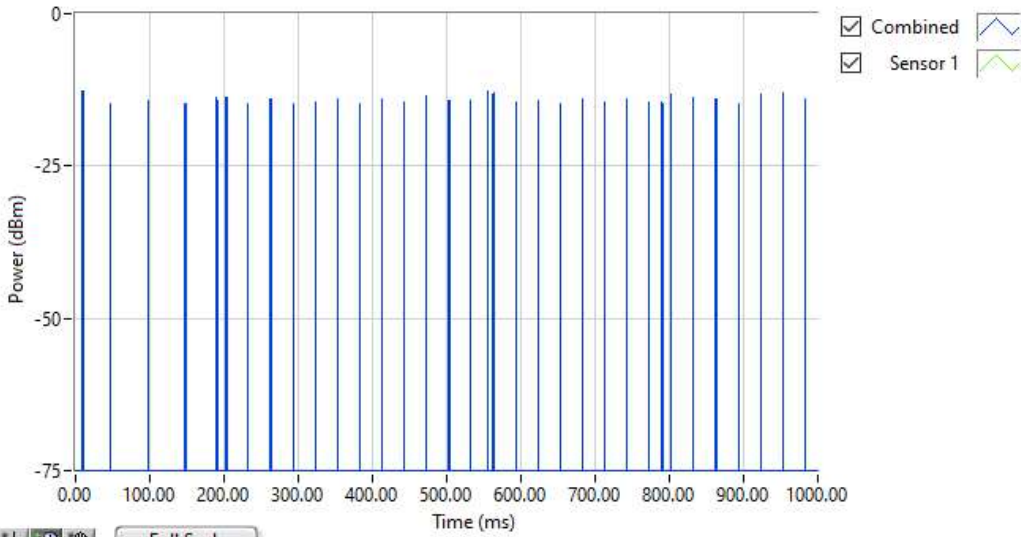
HF mode



PRODUCT ASSURANCE ENGINEERING SAR Exclusion Calculation



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Full Scale

Carrier Frequency: 2.44GHz

Trigger Level: -50 dBm

Measure Time: 1000 ms

Sample Rate (S/s): 5M S/s

Gap Time: 5 ms

Threshold Level: -40 dBc

Measurement Values	
Max e.i.r.p.	-12.7 dBm
Min. Gap Time	6.5272 ms
Medium Utilization	0.000347781 %
Max. Sequence Time	1.8484 ms
Duty Cycle	0.877194 %
RMS	-34.5869 dBm

BLE



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SAR Exclusion Calculation

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Equipment Used:

TN	Description	Model	S/N	Manufacturer	Most Recent Service	Service Due Date
2408	Signal and Spectrum Analyzer	FSV40	101414	Rohde & Schwarz	25-Mar-2020	25-Mar-2022
2403	USB RF Power Sensor	7002-006	160036	ETS Lindgren	28-Sep-2021	28-Sep-2022

Date(s) of test: 08-Feb-2022



PRODUCT ASSURANCE ENGINEERING
SAR Exclusion Calculation

FCC ID: A94429358 IC: 3232A-429358



End of Report