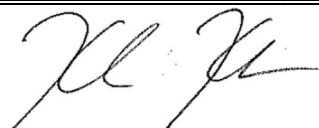



DESIGN ASSURANCE ENGINEERING EMC COMPLIANCE JUSTIFICATION REPORT



Report Number:	EMC.JR.427528.17.277.1		
1. Product Information			
NEW PRODUCT			
Name/Model Number:	Bose Hearphones, FCC ID: A94TR1		
Description:	Wireless Headset		
REFERENCE PRODUCT 1			
Name/Model Number:	Bose Hearphones, FCC ID: A94TR1		
Description:	Wireless Headset		
Test Lab:	Bose Corporation 1 New York Ave Framingham, MA 01701		
Test Report Number:	EMC.422850.16.301.3		
Date of Issue:	November 4, 2016		
Standards:	FCC Part 15.247, ANSI C63.10, KDB 558074d01 V03R05		
2. Differences between reference product and new product:			
<ul style="list-style-type: none"> A new antenna for the mainboard (PIFA type, 2.9 dBi) Minor PCB layout change to accommodate matching components and new antenna Inductor change to replace EOL component Swap of the positive and negative solder pads of the battery leads on the interconnect board shielding for the feedback microphones to eliminate audio hum 			
3. Rational to justify new product EMC compliance:			
The New Product was evaluated for requirements which would be impacted by the component changes listed above to verify continued compliance.			
4. Required testing to verify new product EMC compliance:			
Test Type and Conditions:	Test Lab:		
<i>FCC Part 15.247: Maximum Conducted Output Power, Restricted Band Emissions, Non-restricted Band Emissions</i> <i>FCC KDB 447498 D01: RF Exposure</i>	Bose Corporation 1 New York Ave Framingham, MA 01701		
5. Test Results: (See attached Reference Product Test Report(s) itemized above)			
Test results show that the radio performance of the New Product complies with regulatory requirements.			
6. Conclusions:			
Based on the reference test report and the attached new test results, the New Product has demonstrated continued compliance with the regulatory requirements.			
	Print Name:	Signature:	Date:
Prepared By:	Karl Klemm		05-Oct-17
Reviewed By:	Chad Bell		05-Oct-17



DESIGN ASSURANCE ENGINEERING
EMC COMPLIANCE JUSTIFICATION REPORT



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Maximum Conducted Output Power

SN:	074251Z71920057AE	SW:	1.5.0.
Tested by:	K. Klemm	Date:	05-Oct-17
Equipment (TN):	2409		
Test Result	PASS		

Requirements:

FCC 15.247(b) (1)

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(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.

Test Method:

ANSI C63.10, Section 11.9.1.1

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW \geq [3 \times RBW].
- c) Set span \geq [3 \times RBW].
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

Test setup details:

The EUT is software controlled via the USB cable with software which is used to set the test modes of the Bluetooth device. The EUT antenna is disconnected and replaced with a 0.2 m long piece of flexible coax cable with an SMA connector at the measurement end. The cable has a W.FL2 connector at the product end. A 10 dB attenuator is also used. The EUT is transmitting in DH5 mode (worst case) on either the low (2402 MHz), mid (2441 MHz or 2442 MHz), or high (2480 MHz) channel.

A spectrum analyzer is connected to the antenna port (through the 10 dB pad). The peak output power is measured on the low, mid, and high channels. Basic Data Rate and Enhanced Data Rate as well as BLE are measured.

DESIGN ASSURANCE ENGINEERING EMC COMPLIANCE JUSTIFICATION REPORT

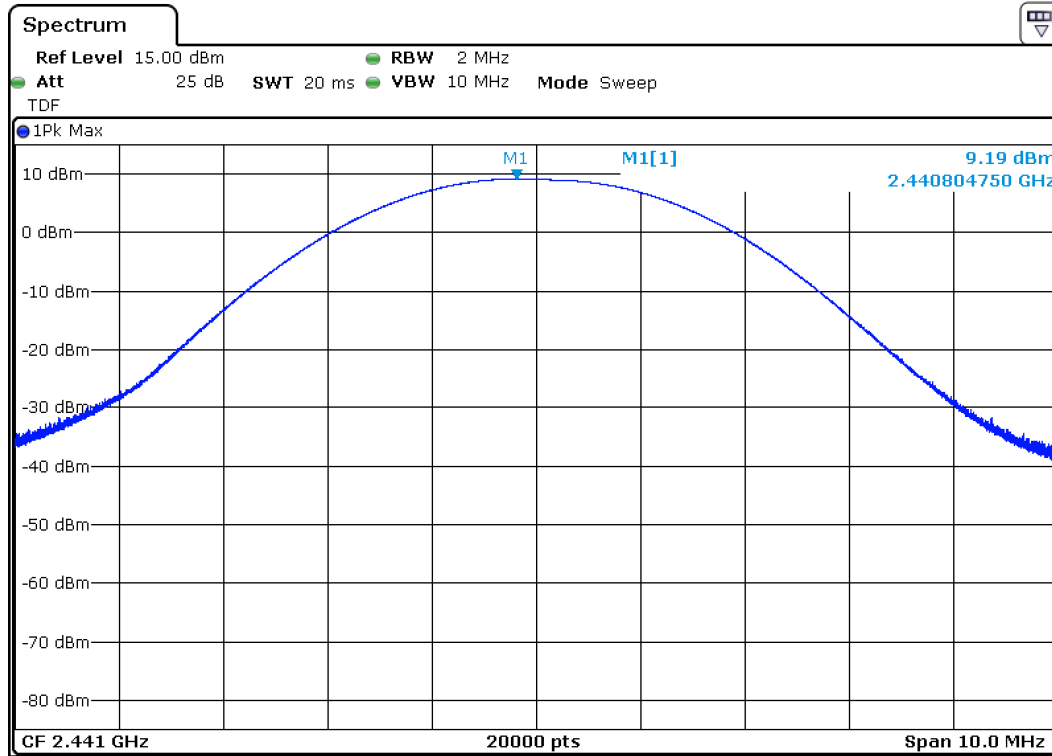


Results:

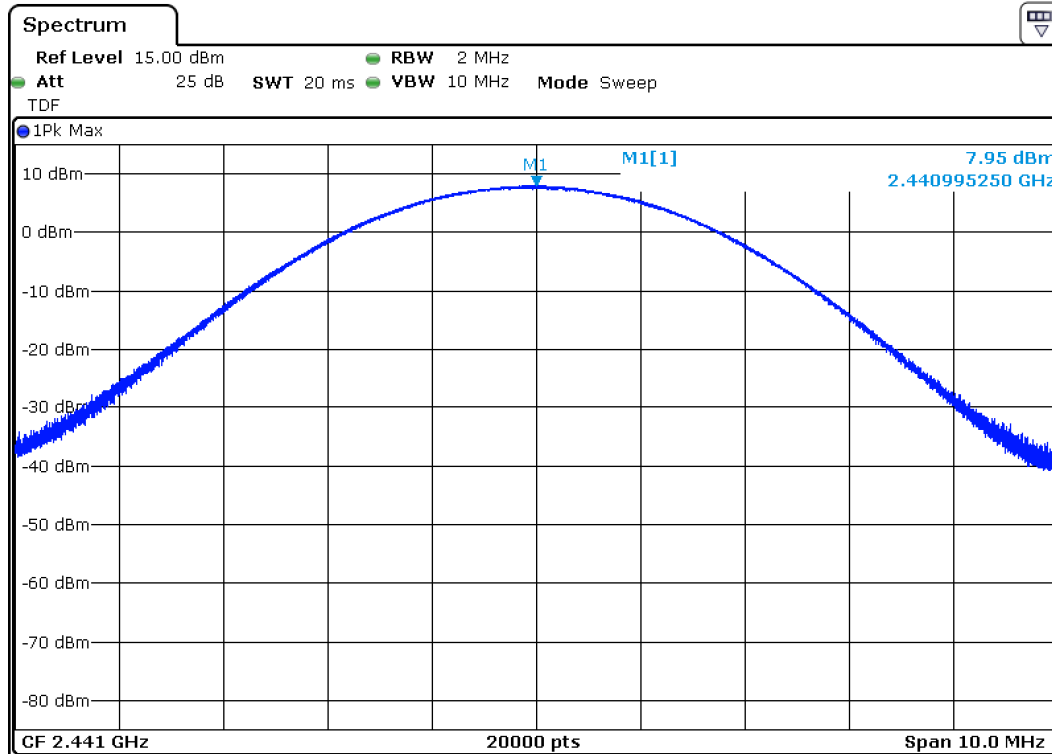
Output Power						
Channel	Frequency (MHz)	Mode	Reading (dBm)	Limit (dBm)	Margin (dB)	Result
0	2402	DH5	5.5	30	-24.5	PASS
39	2441	DH5	9.2	30	-20.8	PASS
78	2480	DH5	6.8	30	-23.2	PASS

Output Power						
Channel	Frequency (MHz)	Mode	Reading (dBm)	Limit (dBm)	Margin (dB)	Result
0	2402	3DH5	3.8	21	-17.2	PASS
39	2441	3DH5	8	21	-13	PASS
78	2480	3DH5	5.9	21	-15.1	PASS

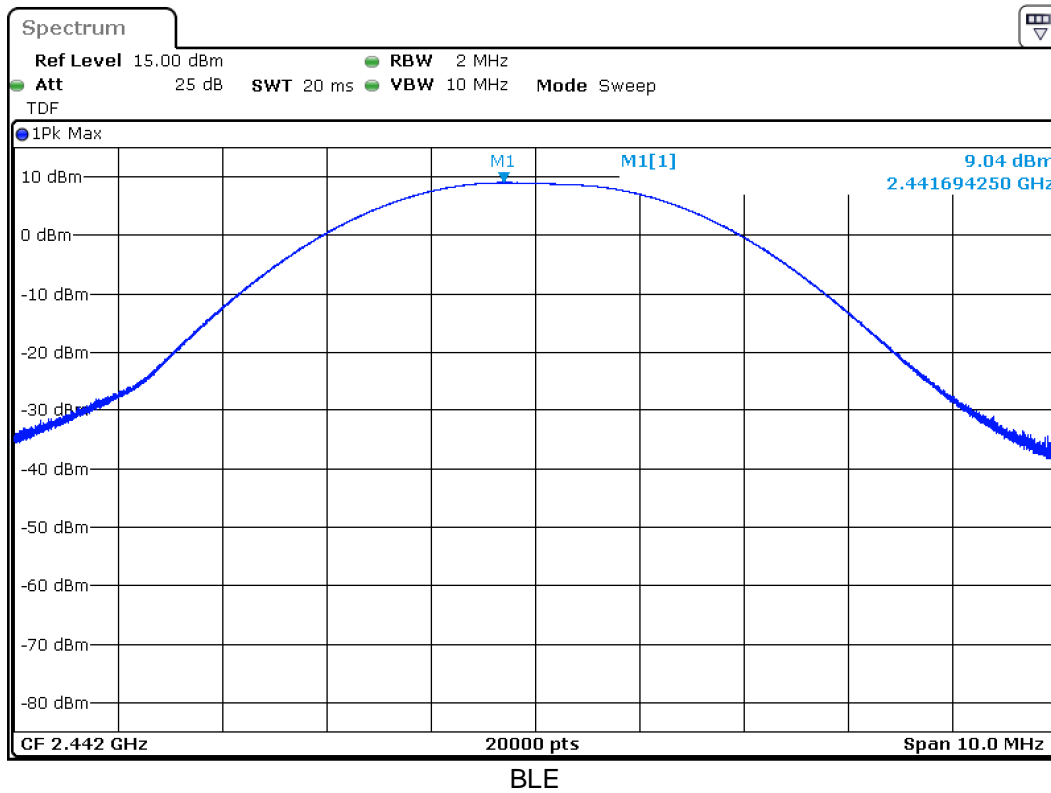
Output Power						
Channel	Frequency (MHz)	Mode	Reading (dBm)	Limit (dBm)	Margin (dB)	Result
0	2402	BLE	5.5	21	-15.5	PASS
20	2442	BLE	9	21	-12	PASS
39	2480	BLE	6.7	21	-14.3	PASS



DH5 (worst case)



3DH5



Test Equipment:

TN	Description	Model	S/N	Manufacturer	Most Recent Service	Service Due Date
2409	Signal and Spectrum Analyzer	FSV40	101413	Rohde & Schwarz	05-Apr-2017	05-Apr-2018

Test Setup Photos:





Restricted/Non-restricted Band Emissions

SN:	074251Z71920014AE	SW:	1.5.0.
Tested by:	K. Klemm	Date:	16-Aug-17
Equipment (TN):	1663, 2357, 2373, 2385, 2478, 2349, 2342, 2602		
Test Result	PASS		

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)).

Test setup details:

The EUT is software controlled via the USB cable with software which is used to set the test modes of the Bluetooth device. The EUT antenna is connected, the measurements are made using a radiated emissions setup. The EUT is transmitting in DH5 mode (worst case) on either the low (2402 MHz), mid (2441 MHz), or high (2480 MHz) channel. Testing performed in the worst case "X" orientation.

Results:

It was determined that Bluetooth DH5 mode was representative of BLE mode and testing was performed in Bluetooth DH5 mode only.

All emissions measured met the restricted band limits, which are more stringent than the non-restricted band limit of -20 dBc. Therefore the EUT also meets the non-restricted band requirements.

DESIGN ASSURANCE ENGINEERING EMC COMPLIANCE JUSTIFICATION REPORT



Low Channel (CH 0, 2402 MHz)

FCC 15B Class B Product (Residential) @ 3 Meters											
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) AVG	Measured Amplitude (dBµV/m) Peak	FCC 15B				Table Azimuth (0° closest to)	Receiving Antenna		Measurement Bandwidth	Notes / Mode
			Limit (dBµV/m) AVG	Limit (dBµV/m) Peak	Margin (dB) AVG	Margin (dB) Peak		Pol (H/V)	Height (Meters)		
2402.000	92.70	101.90	--	--	--	--	199	V	3.3	100 kHz	Funamental
2402.000	96.90	105.80	--	--	--	--	178	H	3.4	100 kHz	Funamental
4803.976	48.700	54.20	54.0	74.0	5.3	19.8	305	H	3	1 MHz	
7205.976	36.70	47.80	54.0	74.0	17.3	26.2	29	H	1.1	1 MHz	
9608.000	31.00	45.00	54.0	74.0	23.0	29.0				1 MHz	noise floor
12010.000	34.00	47.80	54.0	74.0	20.0	26.2	323	H	3.0	1 MHz	
14412.000	33.50	47.80	54.0	74.0	20.5	26.2				1 MHz	noise floor
16814.000	35.40	49.60	54.0	74.0	18.6	24.4				1 MHz	noise floor

Mid channel (CH39, 2441 MHz)

FCC 15B Class B Product (Residential) @ 3 Meters											
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) AVG	Measured Amplitude (dBµV/m) Peak	FCC 15B				Table Azimuth (0° closest to)	Receiving Antenna		Measurement Bandwidth	Notes / Mode
			Limit (dBµV/m) AVG	Limit (dBµV/m) Peak	Margin (dB) AVG	Margin (dB) Peak		Pol (H/V)	Height (Meters)		
2441.000	96.10	104.80					192	V	3.1	100 kHz	Funamental
2441.000	100.40	109.50					176	H	1.3	100 kHz	Funamental
4882.000	45.10	51.00	54.0	74.0	8.9	23.0	319	H	1.5	1 MHz	
7322.964	41.80	52.50	54.0	74.0	12.2	21.5	49	V	3.5	1 MHz	
9763.964	38.10	52.30	54.0	74.0	15.9	21.7	34	V	1.3	1 MHz	
12204.900	35.20	49.10	54.0	74.0	18.8	24.9	311	H	3.7	1 MHz	
14646.000	33.10	47.40	54.0	74.0	20.9	26.6				1 MHz	noise floor
17087.000	36.20	50.40	54.0	74.0	17.8	23.6	267	H	1.4	1 MHz	

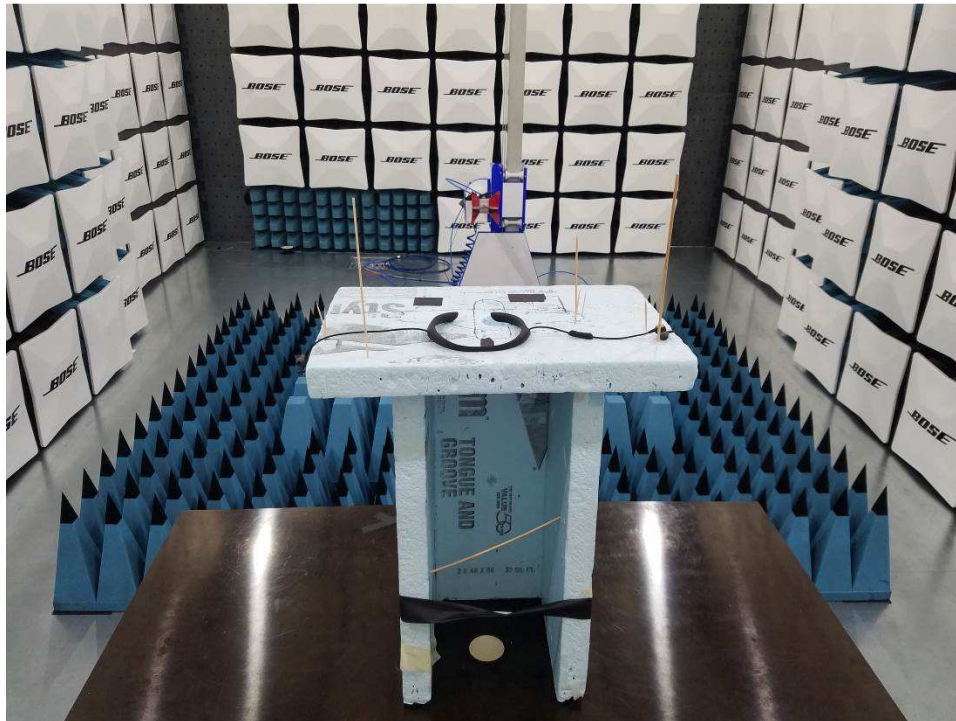
High channel (CH78, 2480 MHz)

FCC 15B Class B Product (Residential) @ 3 Meters											
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) AVG	Measured Amplitude (dBµV/m) Peak	FCC 15B				Table Azimuth (0° closest to)	Receiving Antenna		Measurement Bandwidth	Notes / Mode
			Limit (dBµV/m) AVG	Limit (dBµV/m) Peak	Margin (dB) AVG	Margin (dB) Peak		Pol (H/V)	Height (Meters)		
2480.000	90.60	100.20	--	--	--	--	60	V	2.0	100 kHz	Funamental
2480.000	96.00	105.00	--	--	--	--	169	H	1.9	100 kHz	Funamental
4959.926	48.10	53.40	54.0	74.0	5.9	20.6	316	H	1.3	1 MHz	
7439.953	38.90	49.10	54.0	74.0	15.1	24.9	276	H	3.9	1 MHz	
9920.000	30.80	45.10	54.0	74.0	23.2	28.9				1 MHz	noise floor
12399.947	34.60	48.70	54.0	74.0	19.4	25.3	311	H	1.0	1 MHz	
14880.000	32.20	46.40	54.0	74.0	21.8	27.6				1 MHz	noise floor
17360.000	37.70	51.90	54.0	74.0	16.3	22.1	331	H	2.8	1 MHz	

Test Equipment:

TN	Description	Model	S/N	Manufacturer	Most Recent Service	Service Due Date
1663	EMI Test Receiver	ESU40	100098	Rohde & Schwarz	05-Apr-2017	05-Apr-2018
2357	RF Cable 30MHz-18GHz	TRU-300	TRU-12707-03	TRU Corporation	03-Feb-2017	03-Feb-2018
2373	RF Cable 30MHz-18GHz - 25 feet "N"	TRU-300	N/A	TRU Corporation	Verify before use	
2385	Marconi Manor	3 Meter Semi Anechoic Chamber	N/A	AP Americas	15-Feb-2017	15-Feb-2019
2478	RF cable 30MHz-18GHz	257-257-3052640	N/A	SRC Haverhill	03-Feb-2017	03-Feb-2018
2349	Double Ridge Waveguide Horn Antenna 1-18GHz	3117	00152406	ETS Lindgren	23-Nov-2016	23-Nov-2017
2342	2.4GHz Band Reject Filter	BRM50702-07	001	Micro-Tronics	02-Mar-2017	02-Mar-2018
2602	Miteq pre-amp 1-18GHz 35dB	AFS42-01001800-28-10P-42	N/A	Miteq	03-Feb-2017	03-Feb-2018

Test Setup Photos:



Rear

DESIGN ASSURANCE ENGINEERING EMC COMPLIANCE JUSTIFICATION REPORT



Front



SAR Test Exclusion

SN:	074251Z71920029AE	SW:	1.5.0.
Tested by:	K. Klemm	Date:	11-Aug-17
Equipment (TN):	2404, 2405, 2151		
Test Result	Exempt from SAR testing		

Requirements:

From FCC KDB 447498 D01 General RF Exposure Guidance v06:

4.3. General SAR test exclusion guidance

4.3.1. Standalone SAR test exclusion considerations

Unless specifically required by the *published RF exposure KDB procedures*, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding *SAR Test Exclusion Threshold* condition(s), listed below, is (are) satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum *test separation distance* required for the exposure conditions.²⁸ The minimum *test separation distance* defined in 4.1 f) is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. To qualify for SAR test exclusion, the *test separation distances* applied must be fully explained and justified, typically in the SAR measurement or SAR analysis report, by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, according to the required *published RF exposure KDB procedures*. When no other RF exposure testing or reporting are required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for SAR test exclusion. When required, the device specific conditions described in the other *published RF exposure KDB procedures* must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops and tablets, etc.²⁹

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation³¹
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as *numeric thresholds* in step b) below

The test exclusions are applicable only when the minimum *test separation distance* is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

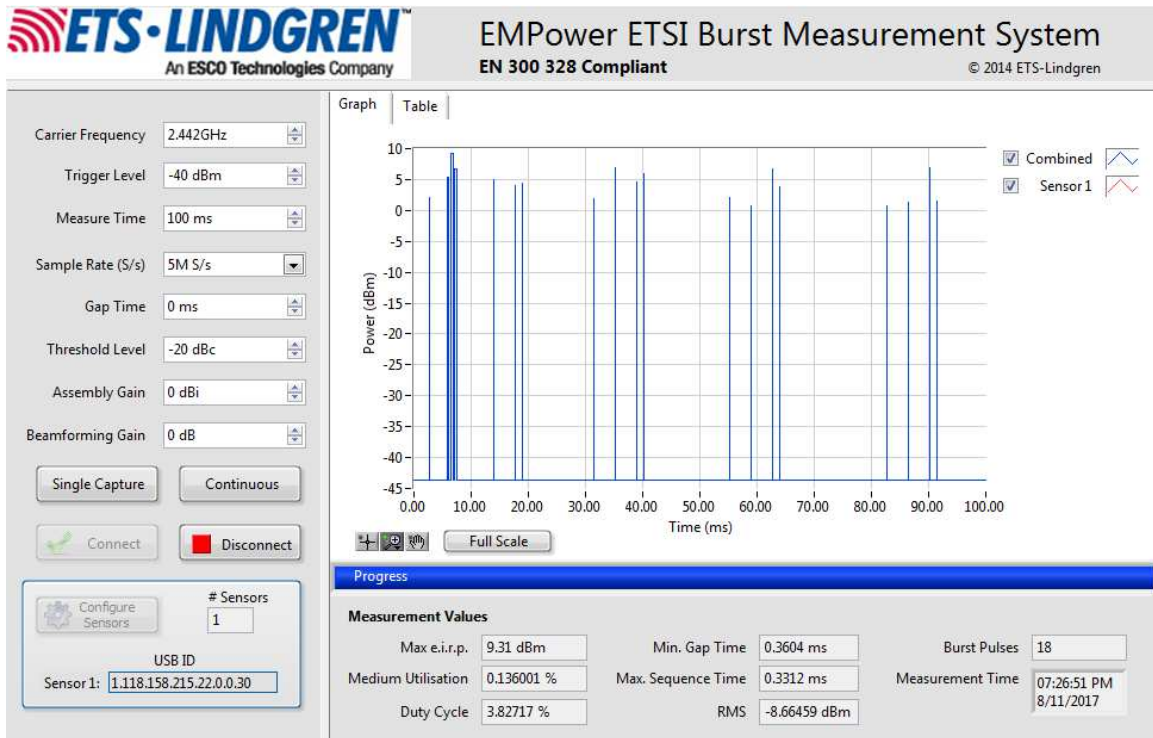
Test setup details:

The EUT is connected to a CBT (test set) in A2DP (sink) mode. 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.

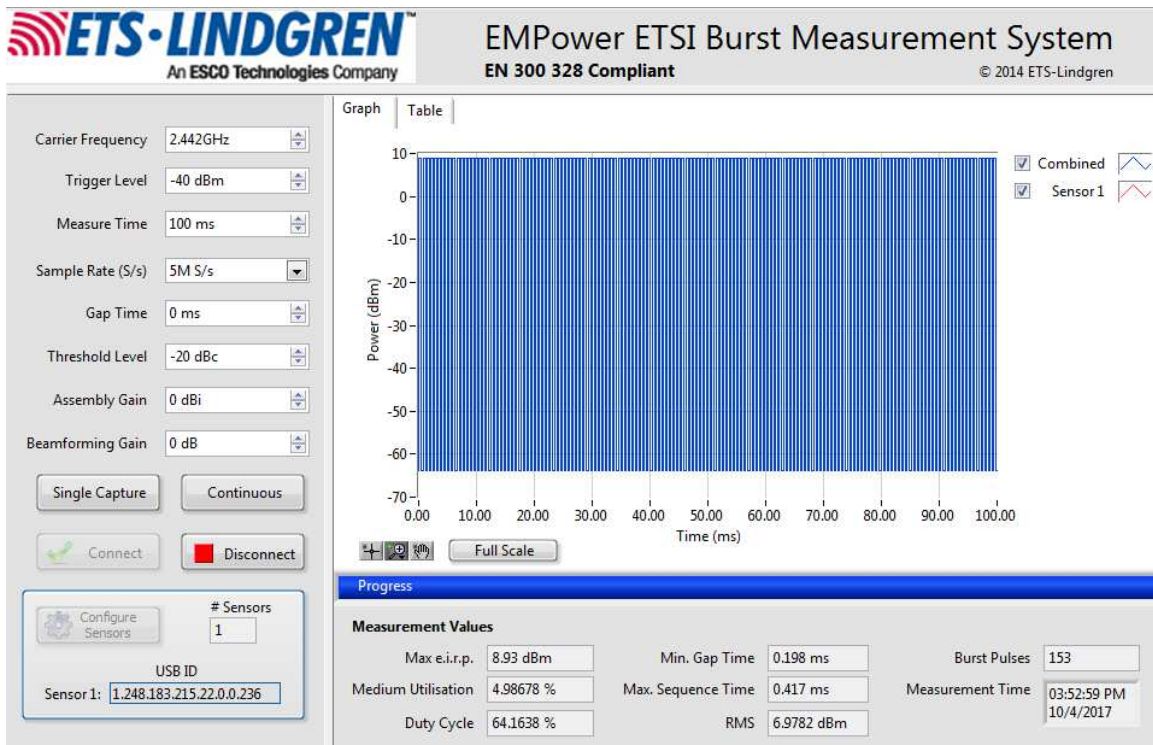
Results:

Operating Mode	Duty Cycle	Max Output Power		D.C. Corrected Power	
	(%)	(dBm)	(mW)	(dBm)	(mW)
BT (A2DP sink)	3.83	9.20	8.32	-4.97	0.32
BLE (test mode)	64.17	9.00	7.94	8.14	5.10

Operating Mode	D.C. Corrected	Min. Separation	Frequency	Exclusion		Result
	Power (mW)			Calculation	Threshold	
BT (A2DP sink)	0	3*	2.45	0.0	3	Exempt
BLE (test mode)	5			1.6		Exempt
*per KDB 447498, for separations <5 mm, use 5 mm						
D.C. Corrected power is rounded to the nearest mW						
Exclusion Calculation = (D.C. Corrected Power / Min. Separation) * √Frequency						



BT (A2DP sink)



BLE (test mode)



Measured Distance from the inner surface of the antenna to the body side of the enclosure



Outward side of the antenna



Body side of the antenna

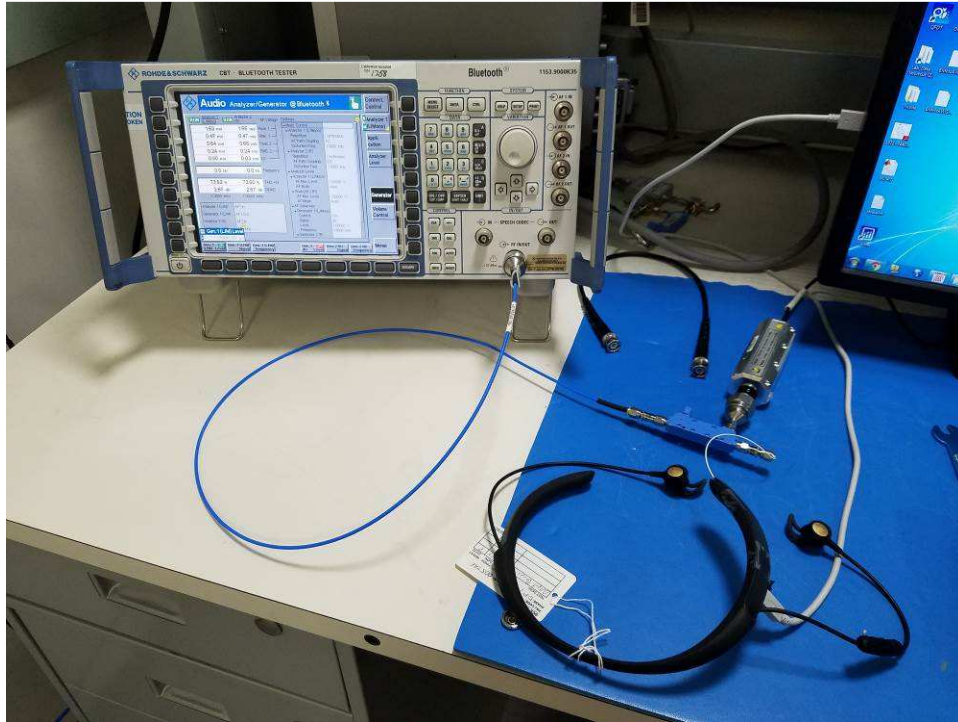
DESIGN ASSURANCE ENGINEERING EMC COMPLIANCE JUSTIFICATION REPORT



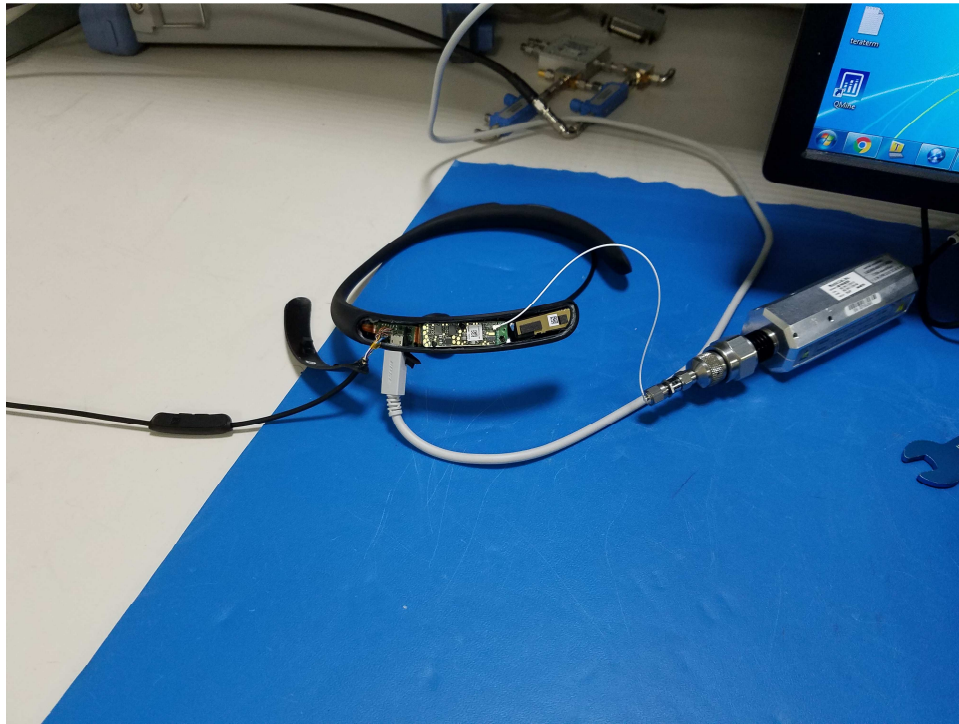
Test Equipment:

TN	Description	Model	S/N	Manufacturer	Most Recent Service	Service Due Date
2404	USB RF Power Sensor	7002-006	160035	ETS Lindgren	07-Feb-2017	07-Feb-2018
2405	USB RF Power Sensor	7002-006	160033	ETS Lindgren	07-Feb-2017	07-Feb-2018
2151	Digital Caliper	CD-6	12257904	Mitutoyo	Verify before use	

Test Setup Photos:



Bluetooth A2DP sink mode



BLE test mode