



FCC PART 15.247

TEST REPORT

For

Grush Inc,

3301 Lyons St. San Francisco, California, United States

FCC ID:2AEZMGC01

Report Type: Original Report	Product Type: Smart Toothbrush
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Report Date:	<u>2015-09-14</u>
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Grush Inc.*'s product, model number: *GRSH-001 (FCC ID: 2AEZMGC01)* (the "EUT") in this report was a *Smart Toothbrush*, which was measured approximately: 17.4 cm (L) x 2.6 cm (W) x 1.9 cm (H), rated input voltage: DC 1.5V from battery.

All measurement and test data in this report was gathered from production sample serial number: 150605050 (Assigned by BACL, Dongguan). The EUT was received on 2015-06-05.

Objective

This report is prepared on behalf of *Grush Inc.*, in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communications Commission's rules

The tests were performed in order to determine the compliance of the EUT with FCC Part 15-Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

N/A

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communications Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in testing mode, which was provided by manufacturer.

For Bluetooth LE mode, 40 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404
...
...
..	...	38	2478
19	2440	39	2480

EUT was tested with channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

The software “Engineer mode-TX” was used, which was provided by manufacturer, the maximum power with 100% duty cycle was configured as default value by the software.

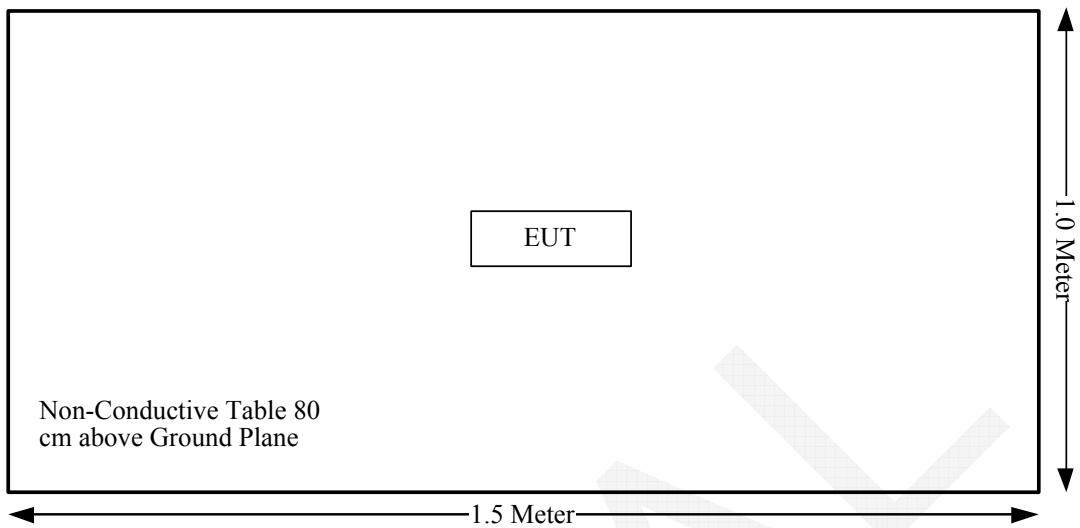
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

External Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1093	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.247(d)	Spurious Emissions at Antenna Port	Compliance*
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance*
§15.247(b)(3)	Maximum conducted output power	Compliance*
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance*
§15.247(e)	Power Spectral Density	Compliance*

Not Applicable: The EUT powered by battery.

Compliance*: The requirements have been certified, please refer to the FCC ID: QDS-BRCM1078.

FCC §15.247 (i) & §1.1310 & §2.1093- RF EXPOSURE

Applicable Standard

According to §15.247(i) and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

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

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 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 5) in section 4.1 is applied to determine SAR test exclusion.

Measurement Result

The output power is $2+/-1\text{dBm}$, so the maximum power is 3dBm (2mW).

$[(\text{max. power of channel, mW}) / (\text{min. test separation distance, mm})] [\sqrt{f(\text{GHz})}]$
 $= 2/5 * (\sqrt{2.480}) = 0.63 < 3.0$

So the stand-alone SAR evaluation is not necessary.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one integral antenna arrangement, which was permanently attached in the chip and the antenna gain is -1.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cisp} of Table 2, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cisp} of Table 2, then:

- compliance is deemed to occur if no measured disturbance level, increased by $(U_{\text{lab}} - U_{\text{cisp}})$, exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by $(U_{\text{lab}} - U_{\text{cisp}})$, exceeds the disturbance limit.

Based on CISPR 16-4-2-2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is:

30M~200MHz: 5.0 dB

200M~1GHz: 6.2 dB

1G~6GHz: 4.45 dB

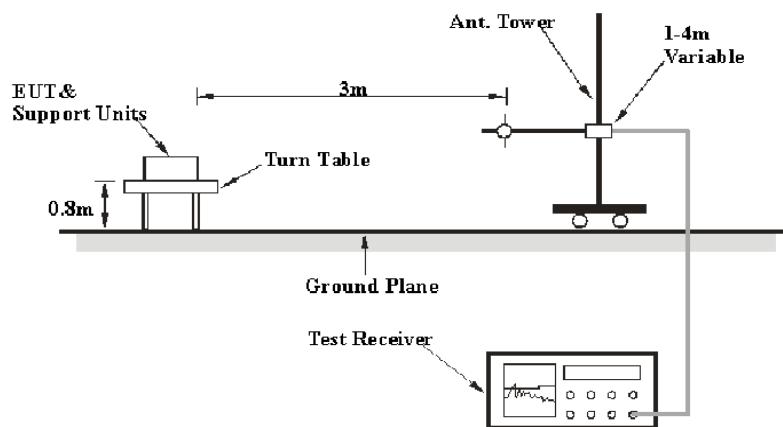
6G~18GHz: 5.23 dB

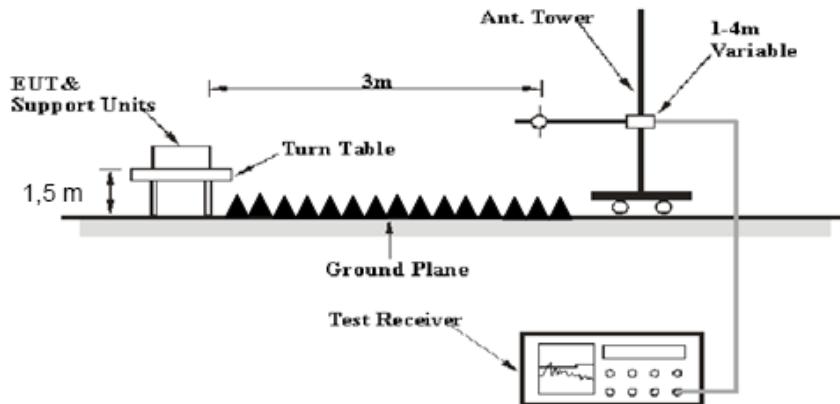
Table 2 – Values of U_{cisp}

Measurement	U_{cisp}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

EUT Setup

Below 1GHz:



Above 1GHz:

The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits. The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Loss and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Loss} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2015-05-09	2016-05-09
Sunol Sciences	Antenna	JB3	A060611-3	2014-07-28	2017-07-27
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
R&S	Spectrum Analyzer	FSEM	DE31388	2015-05-09	2016-05-09
ETS LINDGREN	Horn Antenna	3115	000 527 35	2015-09-06	2018-09-06
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2015-02-15	2016-02-19
R&S	Spectrum Analyzer	FSP 38	100478	2015-05-09	2016-05-09
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2014-06-16	2017-06-15
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2015-09-06	2016-09-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Section 15.205, 15.209 and 15.247, with the worst margin reading of:

10.47 dB at 2483.5 MHz in the Vertical polarization

Test Data

Environmental Conditions

Temperature:	27.5°C
Relative Humidity:	54 %
ATM Pressure:	100.1 kPa

The testing was performed by Allen Qiao on 2015-09-10.

Test Mode: Transmitting

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB)					
Low Channel: 2402 MHz									
2402	59.85	PK	H	25.65	3.66	0.00	89.16	N/A	N/A
2402	48.01	AV	H	25.65	3.66	0.00	77.32	N/A	N/A
2402	66.98	PK	V	25.65	3.66	0.00	96.29	N/A	N/A
2402	55.55	AV	V	25.65	3.66	0.00	84.86	N/A	N/A
2390	26.14	PK	V	25.61	3.63	0.00	55.38	74.00	18.62
2390	13.4	AV	V	25.61	3.63	0.00	42.64	54.00	11.36
4804	37.13	PK	V	30.59	5.06	27.41	45.37	74.00	28.63
4804	21.95	AV	V	30.59	5.06	27.41	30.19	54.00	23.81
7206	32.93	PK	V	34.09	6.61	25.91	47.72	74.00	26.28
7206	18.37	AV	V	34.09	6.61	25.91	33.16	54.00	20.84
9608	30.28	PK	V	35.96	8.53	27.55	47.22	74.00	26.78
9608	17.79	AV	V	35.96	8.53	27.55	34.73	54.00	19.27
3730	33.31	PK	V	29.31	4.58	27.34	39.86	74.00	34.14
3730	20.14	AV	V	29.31	4.58	27.34	26.69	54.00	27.31
279.25	32.2	QP	H	13.77	2.02	21.51	26.48	46.00	19.52
Middle Channel: 2440 MHz									
2440	59.28	PK	H	25.74	3.76	0.00	88.78	N/A	N/A
2440	42.55	AV	H	25.74	3.76	0.00	72.05	N/A	N/A
2440	66.67	PK	V	25.74	3.76	0.00	96.17	N/A	N/A
2440	55.05	AV	V	25.74	3.76	0.00	84.55	N/A	N/A
4880	36.77	PK	V	30.79	5.18	27.42	45.32	74.00	28.68
4880	21.72	AV	V	30.79	5.18	27.42	30.27	54.00	23.73
7320	32.61	PK	V	34.37	6.75	25.88	47.85	74.00	26.15
7320	18.28	AV	V	34.37	6.75	25.88	33.52	54.00	20.48
9760	30.14	PK	V	36.32	8.62	27.21	47.87	74.00	26.13
9760	17.56	AV	V	36.32	8.62	27.21	35.29	54.00	18.71
3730	32.82	PK	V	29.31	4.58	27.34	39.37	74.00	34.63
3730	19.71	AV	V	29.31	4.58	27.34	26.26	54.00	27.74
3760	32.44	PK	V	29.37	4.56	27.36	39.01	74.00	34.99
3760	19.35	AV	V	29.37	4.56	27.36	25.92	54.00	28.08
279.25	32.4	QP	V	13.77	2.02	21.51	26.68	46.00	19.32
High Channel: 2480 MHz									
2480	59.3	PK	H	25.85	3.68	0.00	88.83	N/A	N/A
2480	47.89	AV	H	25.85	3.68	0.00	77.42	N/A	N/A
2480	66.12	PK	V	25.85	3.68	0.00	95.65	N/A	N/A
2480	54.67	AV	V	25.85	3.68	0.00	84.20	N/A	N/A
2483.5	26.89	PK	V	25.86	3.67	0.00	56.42	74.00	17.58
2483.5	14	AV	V	25.86	3.67	0.00	43.53	54.00	10.47
4960	36.01	PK	V	31.00	5.34	27.43	44.92	74.00	29.08
4960	21.32	AV	V	31.00	5.34	27.43	30.23	54.00	23.77
7440	33.78	PK	V	34.66	6.89	25.97	49.36	74.00	24.64
7440	18.7	AV	V	34.66	6.89	25.97	34.28	54.00	19.72
9920	29.74	PK	V	36.71	8.71	26.66	48.50	74.00	25.50
9920	17.47	AV	V	36.71	8.71	26.66	36.23	54.00	17.77
3730	33.01	PK	V	29.31	4.58	27.34	39.56	74.00	34.44
3730	19.98	AV	V	29.31	4.58	27.34	26.53	54.00	27.47
279.25	32.8	QP	V	13.77	2.02	21.51	27.08	46.00	18.92

***** END OF REPORT *****