



ELECTROMAGNETIC EMISSIONS TEST REPORT

Apple, Inc.

Bluetooth Device
Model No A1657

July 20, 2015

Engineering Contact:

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Date 7/21/15

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Date 7/20/2015

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1. General EUT Information

1.1. Introduction

This report documents the Class B conducted and radiated emissions test results for the Bluetooth Device.

1.2. Test Information

Emissions testing were performed using NVLAP accredited processes according to the procedures described in Apple, Inc. procedure number 080-0811 and the relevant standards listed in sections 2 and 3. All testing is NVLAP accredited - NVLAP Accredited Lab # 200071-0.

1.3. Product General and Technical Descriptions

*** See Technical Information, Appendix D**

1.4. Product Photographs

*** See Technical Information, Appendix D**

1.5. Product Block Diagram

*** See Technical Information, Appendix D**

1.6. Product Label

Designed by Apple in California
Assembled in China Model: A1657 EMC 2923
FCC ID: BCGA1657 IC: 579C-A1657 5V $\equiv$ 1A
CAN ICES-3 (B)/NMB-3(B) PPPYWWDDSSSSEEEERX



2. Electromagnetic Emissions

All references to standards in Section 2 of this report are to the dated versions in the following list:

FCC CFR 47, Part 15.

ICES-003, Issue 5, CAN/CSA-CEI/IEC CISPR 22-10

CISPR 22:2008

2.1. Test Facilities Used for Emissions Testing Conducted Emissions Facilities

Apple, Inc. EMC Compliance Laboratory
123 East Evelyn, Mountain View, California 94041
NVLAP Accredited Lab # 200071-0
VCCI Registration No. A-0016

AND/OR

Apple, Inc. EMC Compliance Laboratory
18920 Forge Drive, Cupertino, California 95014
NVLAP Accredited Lab # 200071-0
VCCI Registration No. A-0016

Radiated Emissions Facilities

Apple, Inc. Test Site ALTS #1 OR #2
123 East Evelyn Ave., Mountain View, California 94041.
NVLAP Accredited Lab # 200071-0
VCCI Registration No. A-0016

Note: The emissions data in this report was recorded at the Apple, Inc. EMC facilities listed above. If data were recorded at a subcontracted test laboratory it would be noted in this test report with the name, contact information, and location of the subcontracted test facility.

2.2. Measurement Equipment Used for Emissions**2.2.1. Measurement Equipment Used for Conducted Emissions**

Description	Manufacturer	Model No	Identification No	Last Cal	Next Cal
Receiver	R&S	ESR	101669	4/15/2015	4/15/2016
LISN	Fischer	LISN-50/250-16-2-07	4003	5/11/2015	5/11/2016
Cable	Pasternack	RG223	E2-CE	12/10/2014	12/10/2015

2.2.2. Measurement Equipment Used for Radiated Emissions

Description	Manufacturer	Model No	Identification No	Last Cal	Next Cal
Receiver	R&S	ESU	100354	4/15/2015	4/15/2016
Receiver	R&S	ESIB	100105	4/21/2015	4/21/2016
Antenna	Sunol	JB1	A031705	7/17/2014	7/17/2015
Antenna	Sunol	JB1	A031805	7/17/2014	7/17/2015
Amplifier	Sonoma	310N	186758	7/29/2014	7/29/2015
Amplifier	Sonoma	310N	186761	7/29/2014	7/29/2015
Cable	Pasternack	RG214	E2T2	12/1/2014	12/1/2015
Cable	Huber Suhner	Sucoflex	E2T1	12/1/2014	12/1/2015

Notes: HP is an abbreviation for Hewlett Packard.
 AR is an abbreviation for Amplifier Research.
 R&S is an abbreviation for Rohde & Schwarz.
 Ca. Inst. is an abbreviation for California Instruments
 N/A is an abbreviation for Not Applicable.

The above equipment is traceable to NVLAP calibration standards.

2.3. Measurement Procedures Utilized for Emissions Testing

2.3.1. Pre-Testing

Prior to taking the formal emissions data collected in this report comprehensive pre-testing has been performed. The selection of the worst case system documented in this report was based upon this pre-testing.

2.3.2. Measurement Procedures Utilized for Conducted Emissions

The EUT was placed on a non-metallic table, 80 cm above the floor. Power to the EUT was supplied through 50 μ H LISNs bonded to the ground-plane 80 centimeters from the EUT. The ground-plane was electrically bonded to the shield room ground system and all power-lines entering the shielded room were filtered. Mains power was supplied for various voltage levels and power-line frequencies. A more detailed description can be found in procedure document 080-0811 on file at Apple, Inc.

2.3.3. Measurement Procedures Utilized for Radiated Emissions

The EUT was placed on a non-metallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered main supply.

The frequency spectrum from 30 MHz to ≤ 1000 MHz was scanned and the emission levels maximized at each frequency recorded. The antenna was varied in height between 1.0 and 4.0 meters and the system was rotated 360 degrees while scanning for maximum emission amplitudes. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

In the frequency range 1 to 6 GHz, the antenna Beam Width (w) varies from a maximum of 5.79m at 1 GHz to a minimum of 2.92m at 6 GHz.

During maximization the position of the cables was varied and the scanning repeated until the worst-case emission was found. The data recorded in this report are the maximum emission levels measured. A more detailed description can be found in procedure document 080-0811 on file at Apple, Inc.

2.4. Radiated Emissions Measurement Distance

FCC Part 15 measurements were performed at an EUT to antenna distance of 3 meters. Optionally as may be indicated in the report the FCC data may be taken at 10 meters as allowed by the FCC. CISPR 22 measurements were performed at an EUT to antenna distance of 10 meters.

2.5. Emissions Measurement Uncertainty

The measurement uncertainty (see Apple procedure 080-0835) has been determined to be the following:

Emissions Tests	Frequency Range	Polarization	Measurement Uncertainties
Conducted	150 kHz – 30 MHz		3.50 dB
Radiated	30 – 200MHz	Horizontal	4.48 dB
Radiated	30 – 200MHz	Vertical	4.60 dB
Radiated	0.2 – 1 GHz	Horizontal	4.60 dB
Radiated	0.2 – 1 GHz	Vertical	4.60 dB
Radiated	1 – 6 GHz		4.80 dB

In Apple procedure 080-0835 the uncertainty has been calculated in accordance with CISPR 16-4-2:2003. Measurement uncertainty is not used in determining pass / fail criteria of the EUT.

2.6. Related Submittals and Grants of Certification

None.

2.7. EUT Exercise Software

*** See Technical Information**

2.8. Special Accessories

There were no special accessories used during these tests.

2.9. Equipment Modifications and Deviations

The Bluetooth Device achieved compliance with the FCC CFR47 Part 15, ICES-003, CAN/CSA-CEI/IEC CISPR 22, CISPR 22 with no modifications.

2.10. EUT Test Configuration

The EUT was tested in the worst-case mode as determined from the pre-testing described in section 2.3.1.

Diagram of Test Configuration

***See Technical Information, Appendix F**

2.11. Cable Description and Information

The following interconnect cables were used:

***See Technical Information, Appendix F**

2.12. Test Setup Photos

2.12.1. Conducted Emissions Test Setup Photos

***See Technical Information, Appendix F**

2.12.2. Radiated Emissions Test Setup Photos

***See Technical Information, Appendix F**

2.13. Emissions Data

2.13.1. Conducted Emissions Data

The following data was collected with a spectrum analyzer in Peak detection mode, unless otherwise noted. Test Date: July 15, 2015.

110VAC 60Hz Mains

Frequency (MHz)	Measured Line 1 (dBμV)	Agency Limit (dBμV)	Frequency (MHz)	Measured Line 2 (dBμV)	Agency Limit (dBμV)
0.152	46.8 QP	61.9	0.152	46.4 QP	61.9
0.233	44.9 QP	58.3	0.233	44.2 QP	58.3
4.103	37.0 QP	52.0	0.386	34.8 QP	54.1
0.231	44.2 AV	48.4	0.231	43.5 AV	48.4
0.233	42.6 AV	48.3	0.233	41.9 AV	48.3
0.384	34.7 AV	44.2	0.384	33.6 AV	44.2

Note: Conducted emissions data was also taken at 100VAC, 60Hz. This data was found to be equivalent or lower than the data listed above.

Conducted Emissions Environmental Conditions

	EUT Location	Measurement Equipment Location
Temperature	22°C	22°C
Humidity	42%	42%

2.13.2. FCC Radiated Emissions Test Data

The following data was collected at a 10 meter distance ≤ 1 GHz and at a 3 meter distance ≥ 1 GHz with a spectrum analyzer in peak detection mode, unless otherwise noted. Test Date: July 15, 2015.

FCC Radiated Emissions - 110VAC 60 Hz Mains Vertical Polarization

Frequency (MHz)	Corrected Level (dB μ V/m)	Limit (dB μ V)	Measured Value (dB μ V)	Antenna Factor (dB/m)	Cable Factor	Amplifier Gain (dB)
30.97	18.3	30	28.23	20.71	0.84	31.49
46.49	20.3	30	41.14	9.56	1.04	31.44
166.77	19.2	30	36.32	12.20	2.06	31.41
261.83	30.2	37	46.54	12.48	2.67	31.45
967.02	27.6	37	29.83	22.48	6.33	31.04
998.06	27.5	37	28.74	23.16	6.39	30.79

Horizontal Polarization

Frequency (MHz)	Corrected Level (dB μ V/m)	Limit (dB μ V)	Measured Value (dB μ V)	Antenna Factor (dB/m)	Cable Factor	Amplifier Gain (dB)
168.02	20.7	30	38.7	11.90	1.75	31.62
261.32	27.7	37	44.56	12.43	2.35	31.59
807.56	29.2	37	34.41	21.45	5.04	31.71
826.99	31.2	37	36.25	21.40	5.27	31.68
844.49	33.0	37	38.32	21.01	5.25	31.55
968.90	31.2	37	32.98	23.20	5.9	30.65

Note: Radiated emissions data was also taken at 100VAC, 60Hz. This data was found to be equivalent to or lower than the data listed above.

Radiated Emissions Environmental Conditions

	EUT Location	Measurement Equipment Location
Temperature	22°C	23°C
Humidity	42%	44%

2.13.3. FCC Compliance Summary

The Bluetooth Device has met the Class B requirements as specified in CFR47, Part 15, Subpart B for unintentional radiators.

2.13.4. NVLAP Note

Although the data in this report has been obtained at a NVLAP accredited facility, the United States Government does not certify, approve, or endorse the product described herein.

3. Appendix A

Regulatory Compliance Information

FCC Compliance Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. See instructions if interference to radio or television reception is suspected.

Radio and Television Interference

This computer equipment generates, uses, and can radiate radio-frequency energy. If it is not installed and used properly—that is, in strict accordance with Apple's instructions—it may cause interference with radio and television reception.

This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in Part 15 of FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

You can determine whether your computer system is causing interference by turning it off. If the interference stops, it was probably caused by the computer or one of the peripheral devices.

If your computer system does cause interference to radio or television reception, try to correct the interference by using one or more of the following measures:

- Turn the television or radio antenna until the interference stops.
- Move the computer to one side or the other of the television or radio.
- Move the computer farther away from the television or radio.
- Plug the computer into an outlet that is on a different circuit from the television or radio. (That is, make certain the computer and the television or radio are on circuits controlled by different circuit breakers or fuses.)

If necessary, consult an Apple Authorized Service Provider or Apple. See the service and support information that came with your Apple product. Or, consult an experienced radio/television technician for additional suggestions.

Important: Changes or modifications to this product not authorized by Apple Inc. could void the EMC compliance and negate your authority to operate the product.

This product has demonstrated EMC compliance under conditions that included the use of compliant peripheral devices and shielded cables between system components. It is important that you use compliant peripheral devices and shielded cables (including Ethernet network cables) between system components to reduce the possibility of causing interference to radios, television sets, and other electronic devices. Turn the television or radio antenna until the interference stops.

Responsible party (contact for FCC matters only):

Apple Inc. Corporate Compliance
1 Infinite Loop, MS 91-1EMC
Cupertino, CA 95014

4. Appendix B

EMC Control Components

Item	Location	Manufacturer	Part No	QTY
NIL				

5. Appendix C

Revision History Sheet

Test Report No	2923
Model No	A1657
Model Name	Bluetooth Device
Responsible Engineer	Keng Kok Khoo
Original Signature Date	July 20, 2015

Revision History

Test Report No	Revision Description	Date

Notes:

1. Appendix C documents the original test report and all amendments to the test report. The serial number of the report is the Apple File Number printed on each page of the report. Amended reports will show the Apple File Number and are denoted with a dash (-) followed by the revision letter designation.
2. Revisions or amendments to the Test Report will include the statement "Supplement to the Test Report" in the Revision Description.
3. This report was generated using EMC Report Template 042815-ITE

6. Appendix D

***See Technical Information Document**

7. Appendix E

***See Technical Information Document**

8. Appendix F

***See Technical Information Document**