



TEST REPORT

Report Number: 14282067-E5V1

Applicant : APPLE, INC
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

Model : A2649, A2881, A2882, A2883, And A2884

Brand : APPLE

FCC ID : BCG-E8142A, BCG-E8143A, AND BCG-E8144A

EUT Description : SMARTPHONE

Test Standard(s) : FCC CFR47 PART 22H, 24E, AND 27L

Date Of Issue:
JUNE 30, 2022

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888




Revision History

| Rev. | Issue Date | Revisions | Revised By |
|------|---------------|----------------|------------|
| V1 | 06/30/2022 | Initial Review | Eric Ting |

TABLE OF CONTENTS

| | |
|------------------------------------------------------------------------|-----------|
| 1. ATTESTATION OF TEST RESULTS | 4 |
| 2. TEST METHODOLOGY | 5 |
| 3. FACILITIES AND ACCREDITATION | 5 |
| 4. DECISION RULES AND MEASUREMENT UNCERTAINTY | 6 |
| 4.1. METROLOGICAL TRACEABILITY..... | 6 |
| 4.2. DECISION RULES..... | 6 |
| 4.3. MEASUREMENT UNCERTAINTY..... | 6 |
| 4.4. SAMPLE CALCULATION..... | 6 |
| 5. EQUIPMENT UNDER TEST | 7 |
| 5.1. DESCRIPTION OF EUT..... | 7 |
| 5.2. INTRODUCTION..... | 7 |
| 5.3. MODEL DIFFERENCES..... | 7 |
| 5.4. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2631..... | 8 |
| 5.5. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2882..... | 9 |
| 5.6. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR AA2883 AND A2884..... | 10 |
| 5.7. REFERENCE DETAIL..... | 11 |
| 5.8. SOFTWARE AND FIRMWARE..... | 11 |
| 5.9. MAXIMUM ANTENNA GAIN..... | 11 |
| 5.9. DESCRIPTION OF TEST SETUP..... | 12 |
| 6. TEST AND MEASUREMENT EQUIPMENT | 13 |
| Appendix A – Reference Test Report | 14 |

1. ATTESTATION OF TEST RESULTS

| | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Applicant Name and Address | APPLE, INC 1 APPLE PARK WAY CUPERTINO, CA 95014, U.S.A. | |
| Model | A2649, A2881, A2882, A2883, And A2884 | |
| Brand | APPLE | |
| FCC | BCG-E8142A, BCG-E8143A, AND BCG-E8144A | |
| EUT Description | SMARTPHONE | |
| Serial Number | MODEL (A2881, A2882, A2883, A2884): C07151400D11J163, C07151200K61JRJ2, C07151200JG1JRJ2 (CONDUCTED) P9KQM57X9J, XXP2C0H75V, DT24NDFYXD (RADIATED) | |
| Sample Receipt Date | 1/27/2022 | |
| Date Tested | APRIL 06, 2021 | |
| Applicable Standards | FCC CFR47 2, 22H, 24E, 27, 90S, 90R, AND 96 | |
| Test Results | COMPLIES | |
| <p>UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p>The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.</p> <p>This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.</p> | | |
| Approved & Released By: | Prepared By: | |
|  |  | |
| Dan Corona Lead Test Engineer UL Verification Services Inc. | Eric Ting Test Engineer UL Verification Services Inc. | |

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the following:

- ANSI C63.26:2015
- FCC CFR 47 Part 2, Part 22, Part 27 and Part 96
- [FCC KDB 971168 D01 v03r01](#): Power Meas License Digital Systems
- [FCC KDB 971168 D02 v02r01](#): Misc Rev Approv License Devices
- [FCC KDB 412172 D01 v01r01](#): Determining ERP and EIRP

3. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0, for all testing performed within the scope of this report. Testing was performed at the locations noted below

| | Address | ISED CABID | ISED Company Number | FCC Registration |
|-------------------------------------|----------------------------------------------------------|------------|---------------------|------------------|
| <input checked="" type="checkbox"/> | Building 1: 47173 Benicia Street, Fremont, CA 94538, USA | US0104 | 2324A | 550739 |
| <input checked="" type="checkbox"/> | Building 2: 47266 Benicia Street, Fremont, CA 94538, USA | US0104 | 22541 | 550739 |
| <input type="checkbox"/> | Building 4: 47658 Kato Rd, Fremont, CA 94538, USA | US0104 | 2324B | 550739 |

4. DECISION RULES AND MEASUREMENT UNCERTAINTY

4.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

4.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | U _{Lab} |
|-----------------------------------------------------|------------------|
| Worst Case Radiated Disturbance, 9KHz to 30 MHz | 2.84 dB |
| Worst Case Radiated Disturbance, 30 to 1000 MHz | 6.01 dB |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz | 4.73 dB |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.51 dB |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.29 dB |
| Occupied Channel Bandwidth | ±1.22 % |
| Temperature | ±2.26% |
| Supply voltages | ±0.57 % |
| Time | ±3.39 % |

Uncertainty figures are valid to a confidence level of 95%.

4.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB + 10.1 dB + 0 dB = 46.6 dBuV

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The Apple iPhone is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, 5G FR1, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, Ultra-Wideband, GPS, NFC and MSS. All models except reference model support at least one UICC based SIM. The second SIM is either an UICC based p-SIM (physical SIM) or e-SIM (electronic SIM). The device supports a built-in inductive charging transmitter and receiver. The rechargeable battery is not user accessible.

Testing was performed on the parent model and is used to support the application for the parent and variants identified in this report based on the test plan submitted and approved via KDB inquiry by the FCC and by ISED-Canada.

5.2. INTRODUCTION

This application for certification is leveraging the data reuse procedures from KDB 484596 D01 based on reference FCC: BCG-E8138A to cover variant model FCC: BCG- E8142A, BCG- E8143A, and BCG- E8144A. The major difference between the parent/reference model and the variant model is the depopulation in the variant model of the mmWave transmitter, and some LTE and 5G NR Bands. All other circuitry and features are identical. The data reuse test plan was approved via manufacturer KDB inquiry.

5.3. MODEL DIFFERENCES

The manufacturer hereby declares the following for models A2889, A2890, A2891.

A2482, A2631, A2633, A2634, and A2635 are highly similar, with the only differences being listed on the table below:

| Model | FCC ID | Model Changes |
|---------|-------------|--------------------------------------------------------------------------------|
| A2649 | BCG-E8138A | Main Reference: Model 1a |
| A2881 | BCG- E8142A | Model 1b: Remove mmW |
| A2882 | BCG- E8143A | Model 1c: Remove mmW, B11/ B21/ B14/ B29/ B71, DP Sub-6 + TBD |
| A2883/4 | BCG- E8144A | Model 1d: Remove mmW, B11/ B21/ B14/ B29/ B71, TBD/DE-stuff 0-ohms Resistor |

*Note:

They have the same PCB layout, design, common components, antennas, antenna locations and housing cases.

More specifically, their cellular modem, Wi-Fi, BT, NFC, WPT and UWB transmitters are identical, and removal of cellular bands is done by software and depopulation of band-specific components associated with the removed bands.

Spot check verification has been done on models A2889, A2890, A2891 in accordance with the test plan approved via KDB inquiry. Comparison of the models, upper deviation is within 3dB range and all tests are under FCC/ISED Technical Limits. The results documented for model A2650 may be applied as representative to models A2889, A2890, A2891.

5.4. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2631

| A2881 Spotcheck Results | | | | | | | | |
|-------------------------|-------------------------|------------|---------|-----------------|-------------------------|--------------------------|------------|---------|
| Technology | Worst Mode | Test Item | Channel | Measured | Original Model:A2649 | Sub Model: A2881 | Delta (dB) | Remarks |
| | | | | Frequency (MHz) | ICID: 579C-E8138A (dBm) | IC ID: 579C-E8142A (dBm) | | |
| LTE 5CA | QPSK @ 10MHz+10MHz z BW | Cond Power | Mid | 831.5/841.4 | 25.7 | 25.7 | 0.00 | |
| | | | | | | | | |
| LTE 7CA | QPSK @ 20MHz+20MHz z BW | Cond Power | Low | 2510/2529.8 | 25.7 | 25.7 | 0.00 | |
| | | | | | | | | |
| LTE 41CA | QPSK @ 20MHz+20MHz z BW | Cond Power | Mid | 2585.6/2602.7 | 28.7 | 28.7 | 0.00 | |
| | | | | | | | | |
| LTE 48CA | QPSK @ 20MHz+20MHz z BW | Cond Power | Mid | 3617.6/3634.7 | 25 | 25 | 0.00 | |
| | | | | | | | | |

5.5. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2882

| A2882 Spotcheck Results | | | | | | | | |
|-------------------------|-----------------------|------------|---------|-----------------|-------------------------|--------------------------|------------|---------|
| Technology | Worst Mode | Test Item | Channel | Measured | Original Model:A2649 | Sub Model: A2882 | Delta (dB) | Remarks |
| | | | | Frequency (MHz) | ICID: 579C-E8138A (dBm) | IC ID: 579C-E8142A (dBm) | | |
| LTE 5CA | QPSK @ 10MHz+10MHz BW | Cond Power | Mid | 831.5/ 841.4 | 25.7 | 25.7 | 0.00 | |
| | | | | | | | | |
| LTE 7CA | QPSK @ 20MHz+20MHz BW | Cond Power | Low | 2510/ 2529.8 | 25.7 | 25.7 | 0.00 | |
| | | | | | | | | |
| LTE 41CA | QPSK @ 20MHz+20MHz BW | Cond Power | Mid | 2585.6/ 2602.7 | 28.7 | 28.7 | 0.00 | |
| | | | | | | | | |
| LTE 48CA | QPSK @ 20MHz+20MHz BW | Cond Power | Mid | 3617.6/ 3634.7 | 25.0 | 25.0 | 0.00 | |
| | | | | | | | | |

5.6. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR AA2883 AND A2884

| A2883 Spotcheck Results | | | | | | | | |
|-------------------------|-------------------------|------------|---------|-----------------|-------------------------|--------------------------|------------|---------|
| Technology | Worst Mode | Test Item | Channel | Measured | Original Model:A2649 | Sub Model: A2883 | Delta (dB) | Remarks |
| | | | | Frequency (MHz) | ICID: 579C-E8138A (dBm) | IC ID: 579C-E8142A (dBm) | | |
| LTE 5CA | QPSK @ 10MHz+10MHz z BW | Cond Power | Mid | 831.5/841.4 | 25.7 | 25.7 | 0.00 | |
| | | | | | | | | |
| LTE 7CA | QPSK @ 20MHz+20MHz z BW | Cond Power | Low | 2510/2529.8 | 25.7 | 25.7 | 0.00 | |
| | | | | | | | | |
| LTE 41CA | QPSK @ 20MHz+20MHz z BW | Cond Power | Mid | 2585.6/2602.7 | 28.7 | 28.7 | 0.00 | |
| LTE 48CA | QPSK @ 20MHz+20MHz z BW | Cond Power | Mid | 3617.6/3634.7 | 25.0 | 25.0 | 0.00 | |

5.7. REFERENCE DETAIL

Reference application that contains the reused reference data.

| Equipment Class | Reference FCC ID | Reference Application | Variant model FCC ID | Report Title/Section |
|-----------------|------------------|-----------------------|----------------------|---------------------------------------------------|
| PCE, TNE | BCG-E8138A | 14040867-E7 | BCG-E8142A | FCC_LTE Carrier Aggregation Report / All Sections |
| PCE, TNE | | | BCG-E8143A | FCC_LTE Carrier Aggregation Report / All Sections |
| PCE, TNE | | | BCG-E8144A | FCC_LTE Carrier Aggregation Report / All Sections |

5.8. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was version: 0.15.02.

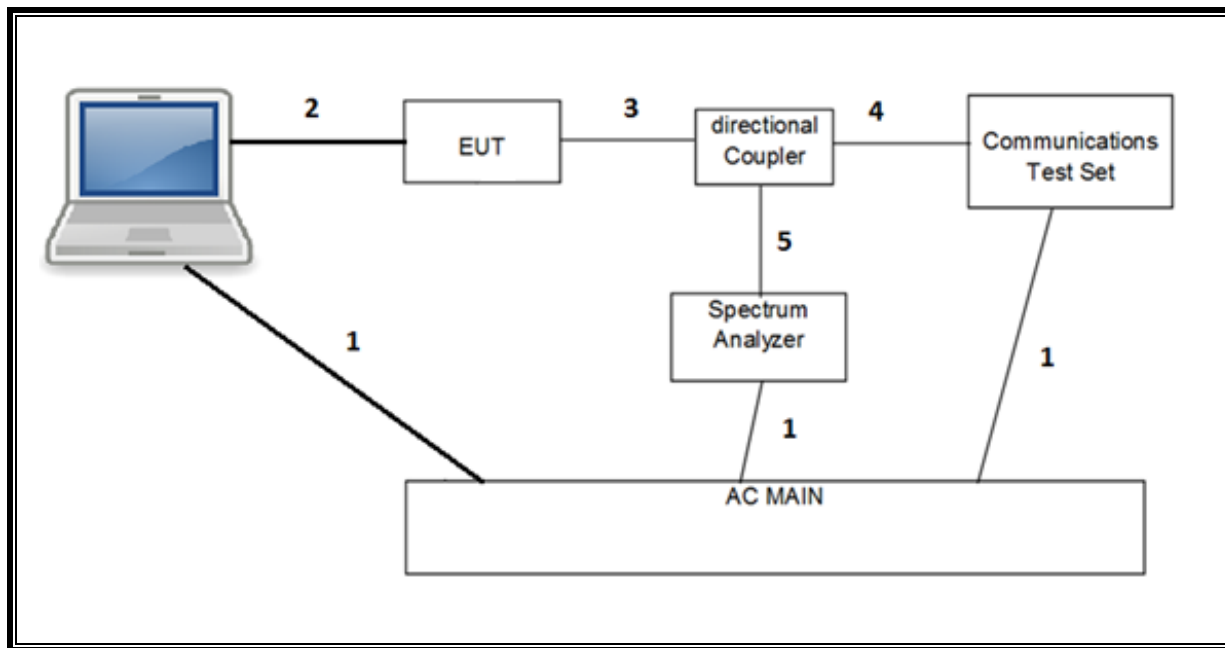
5.9 MAXIMUM ANTENNA GAIN

The spot checks were performed on the worst case configurations based on the parent model of reference report.

5.9. DESCRIPTION OF TEST SETUP

| SUPPORT TEST EQUIPMENT | | | | | | |
|--------------------------------|--------------|----------------------|------------------------|-------------|------------------|---------|
| Description | Manufacturer | Model | Serial Number | FCC ID/ DoC | | |
| Laptop | Apple | MacBook Pro | C02VD7SAH22 | BCGA1708 | | |
| AC/DC adapter | Apple | A1718 | C4H714302LCGN8RA5 | N/A | | |
| I/O CABLES (RF CONDUCTED TEST) | | | | | | |
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | AC | 3 | US 115V | Un-shielded | 2.0 | N/A |
| 2 | USB | 1 | DC | Un-shielded | 1.0 | N/A |
| 3 | RF In/Out | 1 | EUT | Un-shielded | 0.6 | N/A |
| 4 | RF In/Out | 1 | Communication Test Set | Un-shielded | 1.2 | N/A |
| 5 | RF In/Out | 1 | Barrel | N/A | N/A | N/A |

CONDUCTED SETUP



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| TEST EQUIPMENT LIST | | | | |
|----------------------------------------------------|-------------------|--------|---------------------------|------------|
| Description | Manufacturer | Model | Asset | Cal Due |
| Spectrum Analyzer, PXA 3Hz to 44GHz | Keysight | N9030A | 85212 | 0/30/2023 |
| Spectrum Analyzer, PSA, 3Hz to 44GHz | Keysight | N9030A | 85213 | 01/19/2023 |
| Spectrum Analyzer, PSA, 3Hz to 44GHz | Keysight | N9030A | 125178 | 01/24/2023 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight | N9030A | 85201 | 02/01/2023 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight | N9030A | 85214 | 02/02/2023 |
| Spectrum Analyzer, PXA 3Hz to 44GHz | Keysight | N9030A | 80400 | 02/01/2023 |
| Spectrum Analyzer, PXA 3Hz to 44GHz | Keysight | N9030A | 80397 | 02/01/2023 |
| Spectrum Analyzer, PXA, 3Hz to 50GHz w/Ext. Mixer | Keysight | N9030A | T342 | 02/01/2023 |
| Spectrum Analyzer, PSA 3Hz to 44GHz | Keysight | E4440A | 81311 | 02/02/2023 |
| Directional Coupler | KRYTAR | 152610 | T1161 | 09/23/2022 |
| Directional Coupler | KRYTAR | 152610 | T1536 | 09/23/2022 |
| Directional Coupler | KRYTAR | 152610 | T1537 | 09/23/2022 |
| Power Meter, P-series single channel | Keysight | N1912A | 90630 | 01/24/2023 |
| Power Meter, P-series single channel | Keysight | N1912A | 90719 | 01/24/2023 |
| Power Meter, P-series single channel | Agilent | N1911A | 82174 | 01/24/2023 |
| Power Sensor, P – series, 50MHz to 18GHz, Wideband | Keysight | N1921A | 90389 | 01/25/2023 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight | N9030A | 80397 | 02/01/2023 |
| Wideband Communication Test Set, Call Box | R&S GmbH & Co. KG | CMW500 | 85827 | 02/21/2023 |
| Wideband Communication Test Set, Call Box | R&S GmbH & Co. KG | CMW500 | 80105 | 02/21/2023 |
| Wideband Communication Test Set, Call Box | R&S GmbH & Co. KG | CMW500 | 159994 | 02/23/2023 |
| Wideband Communication Test Set, Call Box | R&S GmbH & Co. KG | CMW500 | 85806 | 02/22/2023 |
| Wideband Communication Test Set, Call Box | R&S GmbH & Co. KG | CMW500 | 85943 | 02/20/2023 |
| UL AUTOMATION SOFTWARE | | | | |
| CLT Software | UL | UL RF | Ver 3.4, May 20, 2022 | |
| Power Measurement Software | UL | UL RF | Ver 3.1.4, April 29, 2022 | |

NOTES:

- * Testing is completed before equipment expiration date.

Appendix A – Reference Test Report

Attached is the test report (13571607-E11) containing the reference data from the parent model as detailed in section 5.7.