# Certification Program Test Plan

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Section 1 Introduction

1.1 Purpose

The purpose of this test plan is to define the CTIA Certification Program requirements for testing and determining the expected battery life of smartphones.

1.2 Scope

This document makes use of the GSM Association document TS09: Battery Life Measurement and Current Consumption Technique and the 3GPP2 document C.R1013-0 v1.0: Battery Life Measurement Methodology of cdma2000 1x and cdma2000 HRPD Mobile Stations. Additional considerations and requirements are outlined in this test plan.

This document is applicable to smartphones supporting GSM, UMTS, cdma2000 and LTE RATs.

1.3 Applicable Documents

The following documents are referenced in this test plan:

Battery Life Certification Program Management Document, Latest Revision, CTIA

TS09: Battery Life Measurement and Current Consumption Technique, Version 8.0, GSM Association

C.R1013-0: Battery Life Measurement Methodology of cdma2000 1x and cdma2000 HRPD Mobile Stations, Latest Revision, 3GPP2


TS 44.014: Technical Specification Group GSM/EDGE Radio Access Network; Individual equipment type requirements and interworking; Special conformance testing functions, Latest Revision, 3GPP

TS 34.109: Technical Specification Group Radio Access Network; Terminal logical test interface; Special conformance testing functions, Latest Revision, 3GPP

TS 36.509: Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Special conformance testing functions for User Equipment (UE), Latest Revision, 3GPP

TS 36.508: Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Common test environments for User Equipment (UE) conformance testing, Latest Revision, 3GPP

1.4 Test Process

All testing shall be conducted at a CTIA Authorized Testing Laboratory (CATL). A current list of CATLs can be found at www.ctia.org/certification. Devices shall be submitted for testing in accordance with the instructions detailed in the CTIA Battery Life Certification Program Management Document.
## 1.5 Acronyms and Definitions

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>Automatic Brightness Control</td>
</tr>
<tr>
<td>APN</td>
<td>Access Point Name</td>
</tr>
<tr>
<td>Camped</td>
<td>DUT has registered with the network and is in idle mode, waiting to be paged</td>
</tr>
<tr>
<td>CATL</td>
<td>CTIA Authorized Testing Laboratory</td>
</tr>
<tr>
<td>CDMA</td>
<td>Code Division Multiple Access</td>
</tr>
<tr>
<td>CS</td>
<td>Circuit Switched</td>
</tr>
<tr>
<td>DUT</td>
<td>Device Under Test</td>
</tr>
<tr>
<td>E-UTRA</td>
<td>Evolved Universal Terrestrial Radio Access</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile</td>
</tr>
<tr>
<td>IMS</td>
<td>IP Multimedia Subsystem</td>
</tr>
<tr>
<td>Iteration</td>
<td>A measurement of average current drain of the activity defined by the test case</td>
</tr>
<tr>
<td>LTE</td>
<td>Long Term Evolution</td>
</tr>
<tr>
<td>NITS</td>
<td>A figure used to represent luminance</td>
</tr>
<tr>
<td>RAT</td>
<td>Radio Access Technology</td>
</tr>
<tr>
<td>RTSP</td>
<td>Real Time Streaming Protocol</td>
</tr>
<tr>
<td>SDP</td>
<td>Standard Discharge Profile</td>
</tr>
<tr>
<td>SG-SMS</td>
<td>SMS over SGs</td>
</tr>
<tr>
<td>Smartphone</td>
<td>A mobile phone built on a mobile operating system that includes, among other capabilities, Internet access, applications, email and camera.</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>TAE</td>
<td>Total Available Energy</td>
</tr>
<tr>
<td>UMTS</td>
<td>Universal Mobile Telecommunications System</td>
</tr>
<tr>
<td>VLC</td>
<td>VideoLAN Client</td>
</tr>
<tr>
<td>VoLTE</td>
<td>Voice over LTE</td>
</tr>
<tr>
<td>WCDMA</td>
<td>Wideband Code Division Multiple Access</td>
</tr>
</tbody>
</table>
Section 2 Test Conditions and Generic Setup

2.1 Ambient Test Conditions

Testing shall be performed at ambient temperature: 23 ± 5 °C.

The display of the DUT shall be configured per this section.

The ambient conditions, including the display configuration, shall be followed for all tests. In the DUT Details document, the Smartphone manufacturer shall define the NITS level and brightness setting of the DUT's display.

The CATL shall measure and record the NITS level and brightness setting provided by the manufacturer in the test report.

The CATL shall perform two checks of the display brightness settings:

1) The manufacturer shall provide the DUT brightness configuration and a figure of candelas per meter squared (NITS) (based on the DUT's response in ambient light conditions of 300 LUX) to the CATL.

   The automatic brightness control setting shall be disabled during this part of the display brightness testing.

   Using a light meter, the CATL shall verify the measured figure is within 10% of the manufacturer-declared NITS figure.

2) The CATL shall independently measure the DUT and document the NITS figure in an ambient light condition of 300 LUX in its test lab. Using a light meter, the CATL shall verify their measurement is within 10% of the measurement from (1) above.

   The automatic brightness control shall be ENABLED during this part of the display brightness testing.

In order to confirm the brightness settings, the CATL shall use a standardized picture. The picture shall be such that surface-area-wise it covers 70% of the display in black color and 30% of the display in white color. The interior section shall be white while the exterior section shall be black. The measurement shall be made in the white area only. The test operator shall target the center of the white area during this test step.

The preferred picture to use for the brightness testing is shown in Figure 2.1-1. The intent of the standardized picture is that it represents a white color of 0, 0, 0 and black color of 255, 255, 255 [RGB].

The picture in Figure 2.1-1 is for devices with a 16:9 aspect ratio. For displays with different aspect ratios, another picture may be used but it must fulfill the 70% black and 30% white criteria.
If the CATL is not able to confirm the information provided by the manufacturer, the manufacturer shall work with the CATL to resolve the issue or submit another set of brightness setting values. If the manufacturer does not resolve these issues with the CATL then the DUT will be rejected by the CATL.

2.2 Test Case Procedures

Unless otherwise specified in this document, the test case procedures are specified in GSMA TS09.

2.3 RF Parameters

Except where specified in this section, the RF parameters shall be as defined in 3GPP2 C.R1013-0 for CDMA devices and in GSMA TS09 for WCDMA and LTE devices.

For E-UTRA test cases, the parameters found in GSMA TS09 for E-UTRA standby shall be used. Additionally, RS EPRE level of -85dBm/15kHz shall be used, in alignment with 3GPP TS 36.521-1.

For LTE transmit power, the profile defined in Table 2.3-1 shall be used.

### Table 2.3-1 LTE Transmit Power Distribution Profile

<table>
<thead>
<tr>
<th>+24dBm</th>
<th>+18dBm</th>
<th>+8dBm</th>
<th>+2dBm</th>
<th>-20dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.66%</td>
<td>35.75%</td>
<td>27.66%</td>
<td>4.98%</td>
<td>6.95%</td>
</tr>
</tbody>
</table>
During the LTE test cases, the transmit power profile will be distributed over the test time to meet the distribution percentages defined in Table 2.3-1. This defines the % of test time that the DUT transmits at a particular output power level. Additionally, the transmit power profile will start at the lowest power level defined, and increase towards the maximum defined transmit power in order to mitigate any heating concerns. For WCDMA, only the power profile measurements are required, but not the fixed Tx RF power level.

For test cases where the test time is less than 5 minutes (per test iteration), a fixed power level of +10dBm shall be used instead of the LTE transmit power profile.

Table 2.3-2 defines the preferred frequency bands for testing the DUT.

### Table 2.3-2  Preferred Frequency Bands for Testing

<table>
<thead>
<tr>
<th>Operator</th>
<th>LTE</th>
<th>CDMA</th>
<th>WCDMA</th>
<th>GSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT&amp;T</td>
<td>12 / 17</td>
<td>N/A</td>
<td>2</td>
<td>1900</td>
</tr>
<tr>
<td>Sprint</td>
<td>25</td>
<td>1900</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>4</td>
<td>N/A</td>
<td>2</td>
<td>1900</td>
</tr>
<tr>
<td>Verizon</td>
<td>13</td>
<td>850</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### 2.4 Sampling Rate

The physical sampling frequency for current drain measurement for all test cases shall be a minimum of 50k samples per second.

### 2.5 DUT Configuration Prior to Testing

When possible, the DUT shall be factory reset prior to the start of testing. Instructions on how to set up the DUT prior to testing shall be found in the DUT Details document, completed by the manufacturer. This includes whether the DUT needs access to a Wi-Fi connection in order to download any updates. If Wi-Fi is used to download game, application, VLC, music file or other, then the Wi-Fi connection is to be forgotten/deleted prior to execution of any test. The Wi-Fi shall then be turned on or off, depending on how the DUT is to be configured by default. All GPS/location based services shall be disabled on the DUT.

After the DUT has been factory reset and setup, the DUT shall be powered on and allowed to settle for a duration which is specified by the manufacturer.

The default audio settings shall be used for all tests unless otherwise specified.

The manufacturer-provided setting for APN shall be used.

The CATL shall indicate in the DUT Details document the DUT configuration used.
TABLE 2.5-1  DUT CONFIGURATION PRIOR TO TESTING

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio Streaming</td>
<td>Install the VLC player application by copying it to the DUT hard drive or downloading it from the online store. VLC version for Android devices shall be 1.7.5.</td>
</tr>
<tr>
<td>Music Playback</td>
<td>Install the VLC player application by copying it to the DUT hard drive or downloading it from the online store. VLC version for Android devices shall be 1.7.5.</td>
</tr>
<tr>
<td></td>
<td>Copy the music source file to the DUT. These may be copied to the DUT hard drive if you have OEM-provided USB drivers. Per the GSMA TS09, download the reference music file from the GSMA website and store it onto the DUT.</td>
</tr>
<tr>
<td>Video Streaming</td>
<td>Install the VLC player application by copying it to the DUT hard drive or downloading it from the online store. VLC version for Android devices shall be 1.7.5.</td>
</tr>
<tr>
<td>Compose, Send, Receive, Read Email Message</td>
<td>Set up the test email account using the default email application.</td>
</tr>
<tr>
<td>Gaming</td>
<td>Install Angry Birds® game.</td>
</tr>
<tr>
<td>Compose, Send, Receive, Read SMS Message</td>
<td>Create one unique contact in the default messaging client.</td>
</tr>
</tbody>
</table>

2.6  DUT WAIT TIME BEFORE TESTING

For all tests, the test operator shall wait a minimum of 5 minutes after activation for DUT boot processes to be completed. If the DUT was not rebooted, the 5 minute wait time can be skipped.

2.7  DUT CONFIGURATION DURING TESTING

See Appendix A for the DUT configuration to be used during testing.
Section 3  Total Available Energy

3.1 Test Setup and Definition of Standard Discharge Profile (SDP)

A battery will be used for the determination of Total Available Energy (TAE). In order to determine the TAE, simultaneous measurements of voltage and current are performed until the DUT switches off.

The SDP procedures require the capability to measure both instantaneous current and voltage. Using a sense resistor circuit is not an acceptable solution for this process because that requires the measurement of two voltage signals.

See Figure 3.1-1 for the test setup.

On completion of the test, average current, voltage and energy will be calculated (per the procedure described in Section 3.6) and the test time will be made available. The TAE shall be recorded in the test report, along with the average current and average voltage.

The average voltage measured in this section of the test plan will be used as the fixed voltage setting in Section 4.

3.2 Process to Charge the DUT

The process to charge the DUT shall be defined by the manufacturer in the DUT Details document.

3.3 Determination of When the DUT Turns Off

The process to determine when the DUT has turned off shall be defined by the manufacturer in the DUT Details document.

3.4 Determination of Total Available Energy - Measurement Procedure

Fully charge the battery using the DUT and following the manufacturer charging instructions stated in the DUT Details document, using the manufacturer-specified charger.
Connect the fully charged battery with the analyzer so that both instantaneous current and instantaneous voltage measurements can be performed.

Activate the network simulator in the desired RAT. All testing will be performed using the highest RAT supported by the DUT.

Switch the DUT on and start the instantaneous voltage and instantaneous current measurements.

Wait for the DUT to register with the simulator.

Place the DUT in the appropriate Connected Test Mode State.

Continue performing the measurements until the DUT has powered off per the DUT Details document.

Stop the measurement and record the time, average voltage, current and calculate the usable battery capacity and the TAE (per the process defined in Section 3.6).

Throughout the measurement, the Uplink DUT Power shall be continuously changed according to the Power Distribution Profile specified for the used RAT as defined in Section 2.3. The Power Distribution Profile shall be repeated in 10-minute cycles for the SDP portion of the testing.

### 3.5 Connected Test Mode

Test Modes are defined in the core specifications to allow for testing data connections with no requirement for any U-Plane connection (i.e. no Application Layers). These Test Modes are defined for GSM/(E)GPRS (3GPP 44.014), WCDMA (3GPP 34.109), LTE (3GPP 36.509, 36.508) and CDMA (3GPP2 C.R1013-0).

### 3.6 Procedure to Calculate TAE

The current drain figures from Section 3.4 shall be multiplied by the voltage figures for every measurement sample to calculate the instantaneous power. That instantaneous power shall be integrated over the entire data set by using the integration time period in order to calculate the TAE from the battery and the DUT. The figure that is derived is the TAE and this figure shall be recorded in the test report.
Section 4  Energy Use per Activity

4.1 Test Setup and Test Cases

Testing shall be performed per GSMA TS09 for all test cases where test procedures are defined, as noted in Table 4.2-1. For CDMA devices, the parameters in 3GPP2 C.R1013-0 v1.0 shall be used. Test cases and procedures not defined in the GSMA TS09 document are specified here.

The average voltage figure which was recorded in Section 3 will be used as the fixed voltage setting in this section of the test plan. It is required that the dummy battery shall have sense line connections. The standby time test case shall be proceeded by rebooting the DUT and waiting for the required settling time prior to performing that test.

See Figure 4.1-1 for the test setup.

FIGURE 4.1-1  ENERGY USE PER ACTIVITY TEST SETUP

4.2 Determination of Energy Use per Activity

In order to determine the energy use per activity, current drain measurements shall be performed. A dummy battery shall be used for all energy use per activity items. The current drain shall be used, along with the voltage, to determine overall power consumed by these activities.

The current drain (I) and the voltage (V) figures shall be recorded in the test report for each test case. The power consumed per activity shall be calculated using the formula $P = V \times I$. The power consumed by each activity shall be recorded in the test report and shall be used in Section 5.1.

If possible, prior to testing, the test operator shall confirm that there is no current drain due to the dummy battery being connected to the power supply while the DUT is not connected. Current drain measurements shall be performed on the following list of activities. The power consumed for each activity shall be determined based on the current drain measurements for each individual activity. Then, the power consumed shall be converted to a figure of energy. The energy used for the different activities shall be subtracted from the TAE figure from Section 3.6.
TABLE 4.2-1 TEST CASE PROCEDURE REFERENCE

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Refer to GSMA TS09 for Test Procedures</th>
<th>Refer to this Document for Test Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaming</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Compose, Send, Receive, Read SMS Message</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Compose, Send, Receive, Read Email Message</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Home Screen Display On</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Audio Streaming</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Music Playback</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Video Streaming</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Voice Call</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Web Browsing</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Standby</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

4.2.1 Gaming

The purpose of this test is to measure the power consumed while performing gaming activities.

Test setup:

- No Internet connection shall be available for this test case.

DUT Configuration:

- For the gaming test case, the DUT shall be set to Airplane/Flight mode.
- Connect manufacturer-provided headset to the DUT’s audio headset socket and set Headset Volume to DUT default setting.
- Download and install the latest version of the Angry Birds Mobile App
- The version of the Angry Birds application shall be recorded in the test report
- Open Angry Birds
- Display shall be ON and in landscape mode during the entire duration of this test
Test Procedure:

- Open Angry Birds, go to the “Play” sign, select “Poached Eggs”, select the First Level, and fast forward the preview screen to get to the game ready mode.
- Test operator shall manage the time properly during the measurement of game play.
- Play the game by launching each of the 3 birds at the 5, 10 and 15 second time mark of every 20 second interval of gameplay. Launch the birds to the opposite side (Left Side) of the target so it DOES NOT hit the target pigs. After the game is failed, select “Replay” to repeat the same level with the same procedure. Play the same level 6 times. Pace yourself to use approximately 20 seconds for each round of the game.
- Begin the current drain measurement and immediately begin game play, following the previously given guidelines.
- If during gameplay the test operator is offered an upgrade, assistance, pop-up box or other similar disruption, the message/upgrade shall be acknowledged/dismissed, that data shall be thrown out, and that iteration shall be run again.
- The test equipment will stop the current drain measurement after 2 minutes. This presents one iteration of the data.
- Record the average voltage, average current drain and duration measurement results for the test.
- Run this test for a total of 5 iterations and average the results.
- Calculate the average power consumed for this activity.

4.2.2 Compose, Send, Receive, Read SMS Message

Options:

- **Primary**: If DUT supports SG-SMS, then SG-SMS shall be used.
- **Secondary**: All DUTs shall support SMS over CS. This is the last option which is to be used and only if no other options are supported by the DUT.
- **Future**: Until this document specifies the configuration which is required to send SMS over IMS for each network operator, SMS over CS and SG-SMS shall be used.

4.2.2.1 Compose SMS Message

The purpose of this test is to measure the power consumed to compose a single SMS message 60 bytes in length.

**Test setup:**

- No Internet connection shall be available for this test case.
- Mobile data shall be turned off.
- DUT shall be camped to the highest RAT with the display ON.
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- DUTs support a variety of different text messaging applications. The default messaging application shall be used for this test.

- The default SMS application shall be set up to add 1 recipient prior to testing. The default SMS application shall be opened with recipient information filled out and cursor positioned for message-body text entry.

- All notification settings shall be set to the default state.

- Test operator shall not use the text auto correction feature, or the text auto completion feature, on the DUT, if possible.

**Test Procedure:**

- Begin measuring current drain (do not let display timeout before starting measurement).

- Type 60 characters at a rate of 2 characters per second for 30 seconds until the test stops. Any two alternating characters may be used for this test. The test equipment will stop the current drain measurement 30 seconds after the measurement started. This presents one iteration of the data.

- Record the average voltage, average current drain and duration measurement results for the test.

- Run this test for a total 5 of iterations and average the results.

- Calculate the average power consumed for this activity

**4.2.2.2 Send SMS Message**

The purpose of this test is to measure the power consumed to send a single SMS message 60 bytes in length.

**Test setup:**

- No Internet connection shall be available for this test case.

- DUT shall be camped to the highest RAT with the display ON.

- DUTs support a variety of different text messaging applications. The default messaging application shall be used for this test.

- The default SMS application shall be set up to add 1 recipient prior to testing. The default SMS application shall be opened with recipient information filled out and cursor positioned for message-body text entry.

- Enter 60 characters of text: “Are you going to the party tonight? I will be there at eight” in the message body.

- All notification settings shall be set to the default state.

**Test Procedure:**

- Begin measuring current drain (do not let display timeout before starting measurement).
4.2.2.3 Receive SMS Message

The purpose of this test is to measure the power consumed to receive a single SMS message 60 bytes in length.

Test setup:
- No Internet connection shall be available for this test case.
- DUT shall be camped to the highest RAT with the display off.
- All notification settings shall be set to the default state.
- DUTs support a variety of different text messaging applications. The default messaging application shall be used for this test.
- On a network simulator, open a test message application and fill out the recipient information for sending a message to the DUT. Enter 60 characters of text: “Are you going to the party tonight? I will be there at eight” in the message body but do not yet send the text.

Test Procedure:
- Begin measuring current drain.
- Send text from the network simulator to the DUT.
- DO NOT touch/wake the DUT.
- The test equipment will stop the current drain measurement 30 seconds after the measurement started. Test operator shall confirm that the text is in the inbox of the DUT AFTER the measurement has stopped. This presents one iteration of the data.
- Record the average voltage, average current drain and duration measurement results for the test.
- Run this test for a total of 5 iterations and average the results.
- Calculate the average power consumed for this activity.
4.2.2.4 Read SMS Message

The purpose of this test is to measure the power consumed to read a single SMS message 60 bytes in length.

Test setup:

- No Internet connection shall be available for this test case.
- DUT shall be camped to the highest RAT with the display ON.
- DUTs support a variety of different text messaging applications. The default messaging application shall be used for this test.
- On a network simulator, open a test message application and fill out the recipient information for sending a message to the DUT. Enter 60 characters of text: “Are you going to the party tonight? I will be there at eight” in the message body but do not yet send the text.
- Send 5 texts to the DUT such that the default text application has 5 or more text threads. This means that there are 5 different senders sending text messages to the DUT.
- Mobile data shall be turned off.
- The default SMS application shall be opened.

Test Procedure:

- Begin measuring current drain.
- Read a new text from the application list view at the 10, 20, 30, 40, 50 second time mark for the entire measurement time.
- The test equipment will stop the current drain measurement 60 seconds after measurement was started. This presents one iteration of the data.
- Record the average voltage, average current drain and duration measurement results for the test.
- Run this test for a total of 5 iterations and average the results.
- Calculate the average power consumed for this activity

4.2.3 Compose, Send, Receive, Read Email Message

4.2.3.1 Compose Email Message

The purpose of this test is to measure the power consumed to send a single email message 60 bytes in length.

Test setup:

- No Internet connection shall be available for this test case.
• DUT device shall be camped to the highest RAT with the display ON.
• Mobile data shall be turned off.
• The default email application shall be set up to add 1 recipient prior to testing.
• The default email application shall be opened with recipient information filled out and cursor positioned for message-body text entry.
• Configure the DUT’s native email client with an email service account (e.g., Gmail, Yahoo, Exchange). Do not use the over-the-top applications of these email services.
• All notification settings shall be set to the default state.
• Test operator shall not use the text auto-correction feature, or the text auto-completion feature, on the DUT, if possible.

Test Procedure:
• Begin measuring current drain (do not let display timeout before starting measurement).
• Type 60 characters at a rate of 2 characters per second for 30 seconds until the test stops. Any two alternating characters may be used for this test.
• The test equipment will stop the current drain measurement 30 seconds after measurement started. This presents one iteration of the data.
• Record the average voltage, average current drain and duration measurement results for the test.
• Run this test for a total of 5 iterations and average the results.
• Calculate the average power consumed for this activity.

4.2.3.2 Send Email Message

The purpose of this test is to measure the power consumed to send a single email message 60 bytes in length.

Test setup:
• No Internet connection shall be available for this test case.
• DUT device shall be camped to the highest RAT with the display ON.
• The default email application shall be set up to add 1 recipient prior to testing.
• The default email application shall be opened with recipient information filled out and cursor positioned for message-body text entry.
• Enter 60 characters of text: “Are you going to the party tonight? I will be there at eight” in the message body.
• All notification settings shall be set to the default state.
**Test Procedure:**

- Begin measuring current drain (do not let display timeout before starting measurement).
- Press the send icon to send the email message.
- Send the email to whatever email address is required by the network simulator/test script.
- The test equipment will stop the current drain measurement 15 seconds after the measurement started. This presents one iteration of the data.
- Record the average voltage, average current drain and duration measurement results for the test.
- Run this test for a total of 5 iterations and average the results.
- Calculate the average power consumed for this activity

4.2.3.3 **Receive Email Message**

The purpose of this test is to measure the power consumed to receive a single email message 60 bytes in length.

**Test setup:**

- No Internet connection shall be available for this test case. There shall be no other applications receiving updates nor performing activities in the background, except for the email client.
- DUT shall be camped to the highest RAT with the display off.
- DUTs support a variety of different email messaging applications. The default email messaging application shall be used for this test.
- The test shall be executed in such a way that the DUT push settings (synch schedule) shall be configured such that the DUT will immediately fetch the email once it receives a notification.
- On a network simulator, open a test email message application and fill out the recipient information for sending an email message to the DUT. Enter 60 characters of text: “Are you going to the party tonight? I will be there at eight” in the message body but do not yet send the email message.

**Test Procedure:**

- All notification settings shall be set to the default state.
- Begin measuring current drain.
- Send email message from the network simulator the DUT.
- Wait a total of 30 seconds for the email to be received but DO NOT touch/wake the DUT.
- The test equipment will stop the current drain measurement 30 seconds after measurement was started. This presents one iteration of the data.
• Test operator shall confirm receipt of the email message by verifying that the email is in the DUT inbox AFTER the measurement has stopped.

• Record the average voltage, average current drain and duration measurement results for the test.

• Run this test for a total of 5 iterations and average the results.

• Calculate the average power consumed for this activity

4.2.3.4 Read Email Message

The purpose of this test is to measure the power consumed to read a single email message 60 bytes in length.

**Test setup:**

• No Internet connection shall be available for this test case.

• DUT shall be camped to the highest RAT with the display ON.

• On a network simulator, open a test email message application and fill out the recipient information for sending an email message to the DUT. Enter 60 characters of text: “Are you going to the party tonight? I will be there at eight” in the message body but do not yet send the email.

• Send 5 email messages to the DUT.

• Mobile data shall be turned off.

• The default email application shall be opened.

**Test Procedure:**

• Begin measuring current drain (do not let display timeout before starting measurement).

• Read a new email from the application list view at the 10, 20, 30, 40, 50 second time mark for the entire measurement time.

• The test equipment will stop the current drain measurement 60 seconds after measurement was started. This presents one iteration of the data.

• Record the average voltage, average current drain and duration measurement results for the test.

• Run this test for a total of 5 iterations and average the results.

• Calculate the average power consumed for this activity.

4.2.4 Home Screen Display On

The purpose of this test is to measure the power consumed while the display is on and the DUT is idle on the home screen.
Test setup:

- No Internet connection shall be available for this test case.
- Mobile data shall be turned off for this test case. The call box shall allow the DUT to go to an RRC idle state after the initial attach.
- DUT shall be camped to the highest RAT with the display ON.
- All notification settings shall be set to the default state.
- Test operator shall disable screen timeout and screen setting options in the DUT software menu. The DUT shall not dim nor blank the display during this test.
- Test case begins and ends with DUT on the home screen. The test operator shall push the home screen icon (e.g., house, circle) one time in order to set the DUT to the home screen. After that, the test operator shall not touch the DUT.

Test Procedure:

- Make sure that the DUT is on the home screen and that the display is ON.
- Begin measuring current drain.
- The test equipment will stop the current drain measurement 5 minutes after measurement was started. This presents one iteration of the data.
- Record the average voltage, average current drain and time duration measurement results for the test.
- Run this test for a total of 3 iterations and average the results.
- Calculate the average power consumed for this activity.

Post Test Procedure:

- Test operator shall restore the DUT backlight and display timeout settings to the default settings after completion of the home screen display on test.

4.2.5 Audio Streaming/Music Playback

Use the GSMA TS09 test procedures.

- When performing the audio streaming test case, the audio shall be played using the manufacturer-provided headset, which is defined in the DUT Details document.
- The volume shall be set to the default setting, in accordance with the DUT Details document.
- The preferred media player to be used is the VLC player. If there are issues which do not allow the VLC player to be used, then an alternative solution for measuring the current drain for audio streaming may be used, but it is necessary to use a RTSP which may be verified through monitoring the IP traffic.
4.2.6 Video Streaming

Use the GSMA TS09 test procedures.

- When performing the video streaming test case, the audio shall be played using the manufacturer-provided headset, which is defined in the DUT Details document.

- The volume shall be set to the default setting, in accordance with the DUT Details document.

- The preferred media player to be used is the VLC player. If there are issues which do not allow the VLC player to be used, then an alternative solution for measuring the current drain for video streaming may be used, but it is necessary to use a RTSP which may be verified through monitoring the IP traffic.

- The LTE power profile shall be applied, with the distribution spread evenly for the total test time.

- For measurements of current drain, the backlight shall be ON. The test operator shall start playing the video on the DUT and then begin the measurement.

- Test is shall be executed for a 10-minute duration in alignment with GSMA TS09 section 5.3

- 720p and 1080p video source files will be provided by CTIA battery working group. The CATL should use this file. If the DUT does not support 1080p, then the 480p, 240p files from the GSMA must be used.

4.2.7 Voice Call

Use the GSMA TS09 test procedures.

- The test operator shall turn off the DUT display after starting the talk time voice call, before starting the current drain measurement.

- Current drain measurement shall begin once the DUT display is off.

- If the highest RAT supported for voice is VoLTE, test shall be executed by using CS voice test case from section 4.2 of the GSMA TS09 test document.

- Specifications for VoLTE test case will be defined in version 2.0 of this document.

4.2.8 Web Browsing

Use the GSMA TS09 test procedures.
• Run this test 3 times and average the results.

• Swiping/scrolling guidelines:

• Swipe the screen from the top to the bottom at the 20 second mark and from the bottom to the top at the 40 second mark, using one motion and one continuous touch

4.2.9 **Standby**

Use the GSMA TS09 test procedures.

• During the idle mode measurement per GSMA TS09, mobile data shall be switched off.
Section 5  User Profiles

5.1 Definition of User Profiles

Power consumption figures for individual activities from Section 4 shall be used, in conjunction with the user profile weighting factors (# of times per day and duration of activities), to calculate the user profile result(s). Note: the user profile weighting factors will be included in a future revision of this test plan.

The list of activities for current drain measurement from Section 4 shall each be assigned a weighting factor. The weighted activities which drain the smartphone battery shall be processed mathematically in order to arrive at a figure of expected hours of operation for the device.

The energy consumed will be subtracted from the overall total available energy as determined in Sections 3.4 and 3.6.
Section 6  Battery Life Rating

6.1  Calculation of Battery Life Rating

Once the user profiles are processed, a figure of hours of operation will be reported as the final result.
## Appendix A  DUT Configuration During Testing

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Title</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL TEST CASES</td>
<td>Brightness Setting</td>
<td>For ABC-enabled devices the DUT brightness level shall be set to &quot;X&quot;, corresponding to a 300 LUX condition. The automatic brightness control shall be disabled. For DUT which do not support ABC, or ABC is off by default, the brightness level shall be set to the manufacturer default level as defined in the DUT Details document.</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>Mobile Data</td>
<td>Mobile data shall be turned on unless otherwise specified in the test case.</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>Volume Setting</td>
<td>List the default status of the Volume setting.</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>Backlight Off After X sec</td>
<td>List the default status of the backlight turns off after (X Sec / min).</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>Wi-Fi Status</td>
<td>List the default status of the Wi-Fi setting (on/off).</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>Bluetooth Status</td>
<td>List the default status of the Bluetooth setting (on/off).</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>GPS Status</td>
<td>List the default status of the GPS setting (on/off).</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>GPS Location Mode Status</td>
<td>List the default status of the GPS location mode setting (on/off). (Also may be battery saving, high accuracy, or device only mode settings).</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>NFC Status</td>
<td>List the default status of the NFC setting (on/off).</td>
</tr>
<tr>
<td>ALL TEST CASES</td>
<td>Email Push/Synch Settings</td>
<td>Manufacturer shall detail how the DUT will fetch emails and how the CATL shall execute the 'receive email' test procedures.</td>
</tr>
<tr>
<td>Home Screen On</td>
<td>Backlight Off Disabled</td>
<td>Disable Backlight Off (e.g., screen timeout).</td>
</tr>
<tr>
<td>Voice Call</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is OFF before measurement for the voice call test case.</td>
</tr>
<tr>
<td>Audio Streaming</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is OFF for audio streaming test case.</td>
</tr>
<tr>
<td>Music Playback</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is OFF for music playback test case.</td>
</tr>
<tr>
<td>Video Streaming</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for video streaming test case.</td>
</tr>
<tr>
<td>Compose SMS</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for the compose SMS test case.</td>
</tr>
<tr>
<td>Send SMS</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for the send SMS test case and that the display does not timeout before starting the measurement.</td>
</tr>
<tr>
<td>Read SMS</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for the read SMS test case and that the display does not timeout before starting the measurement.</td>
</tr>
<tr>
<td>Receive SMS</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is OFF as the initial condition for the Receive SMS test case.</td>
</tr>
<tr>
<td>Compose Email</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for the compose email test case.</td>
</tr>
<tr>
<td>Send Email</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for the send email test case and that the display does not timeout before starting the measurement.</td>
</tr>
<tr>
<td>Read Email</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is ON for the read email test case and that the display does not timeout before starting the measurement.</td>
</tr>
<tr>
<td>Receive Email</td>
<td>Backlight Setting</td>
<td>Confirm that the backlight is OFF as the initial condition for the Receive Email test case.</td>
</tr>
</tbody>
</table>
### Appendix B Change History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 2016</td>
<td>1.0</td>
<td>• First revision of the document.</td>
</tr>
</tbody>
</table>