



CTIA Battery Life Test Plan

Version 1.1

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Table of Contents

Section 1	Introduction	3
1.1	Purpose	3
1.2	Scope	3
1.3	Applicable Documents.....	3
1.4	Test Process	3
1.5	Acronyms and Definitions.....	4
Section 2	Test Conditions and Generic Setup	5
2.1	Ambient Test Conditions	5
2.2	Test Case Procedures.....	6
2.3	RF Parameters	6
2.4	Sampling Rate	7
2.5	DUT Configuration Prior to Testing.....	7
2.6	DUT Wait Time Before Testing.....	8
2.7	DUT Configuration During Testing.....	8
Section 3	Total Available Energy	11
3.1	Test Setup and Definition of Standard Discharge Profile (SDP).....	11
3.2	Process to Charge the DUT	11
3.3	Determination of When the DUT Turns Off	11
3.4	Determination of Total Available Energy - Measurement Procedure	11
3.5	Connected Test Mode	12
3.6	Procedure to Calculate TAE	12
Section 4	Energy Use per Activity	13
4.1	Test Setup and Test Cases	13
4.2	Determination of Energy Use per Activity.....	13
4.2.1	Gaming	14
4.2.2	Compose, Send, Receive, Read SMS Message.....	15
4.2.3	Compose, Send, Receive, Read Email Message	19
4.2.4	Home Screen Display On	22
4.2.5	Audio Streaming/Music Playback	23
4.2.6	Video Streaming	23
4.2.7	Voice Call.....	24
4.2.8	Web Browsing.....	24
4.2.9	Standby.....	24
Section 5	User Profiles.....	25

5.1	Definition of User Profiles	25
Section 6	Battery Life Rating	26
6.1	Calculation of Battery Life Rating	26
Appendix A	DUT Configuration During Testing	27
Appendix B	Change History	28

List of Figures

Figure 2.1-1	Preferred Picture to use for the Brightness Testing	6
Figure 3.1-1	SDP Test Setup	11
Figure 4.1-1	Energy Use per Activity Test Setup	13

List of Tables

Table 2.3-1	LTE Transmit Power Distribution Profile	7
Table 2.3-2	Preferred Frequency Bands for Testing	7
Table 2.5-1	DUT Configuration Prior to Testing	8
Table 2.8-1	Power Supply	9
Table 2.8-2	Analyser	10
Table 4.2-1	Test Case Procedure Reference	14

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*. Additional considerations and requirements are outlined in this test plan.

The document is applicable to smartphones supporting WCDMA and LTE RATs. All tests are conducted in LTE, except voice calls which are conducted in WCDMA.

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

TS 36.521-1: *Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 1: Conformance Testing*, Latest Revision, 3GPP

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

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

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.

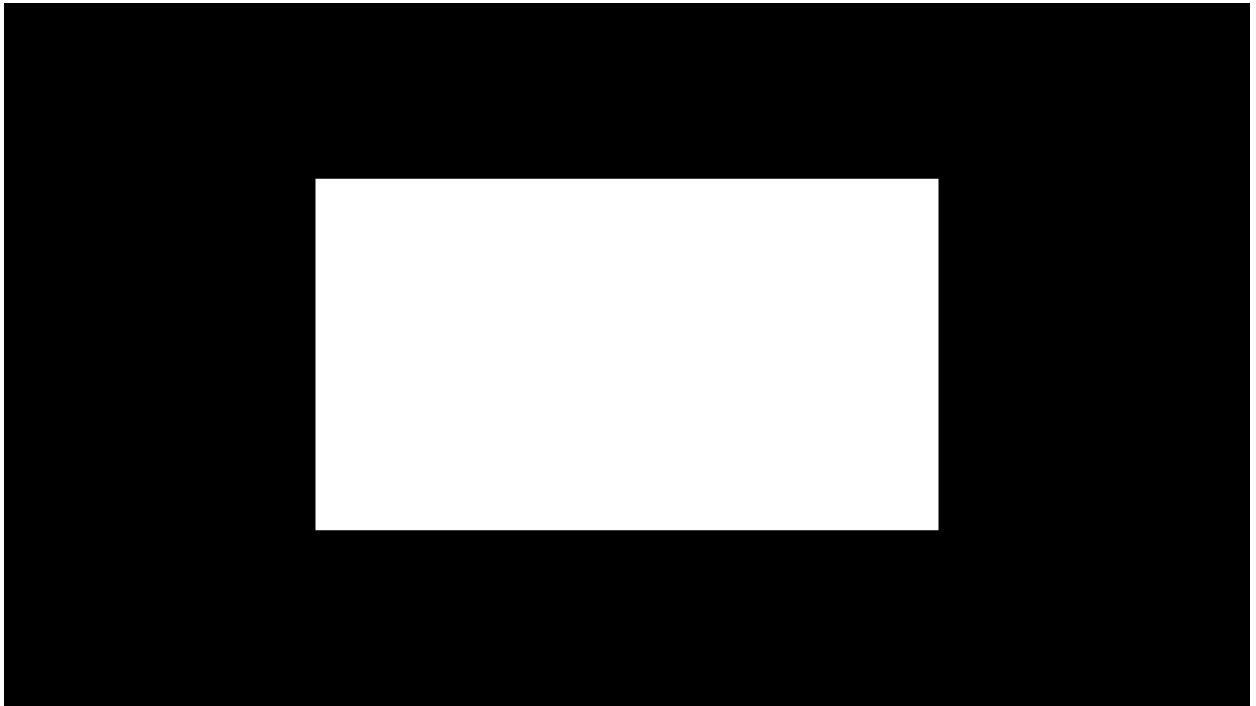
The automatic brightness control shall be ENABLED during this part of the display brightness testing.

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 CATL 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.

FIGURE 2.1-1 PREFERRED PICTURE TO USE FOR THE BRIGHTNESS TESTING



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 GSMA TS09 for WCDMA and LTE devices.

For LTE 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. Per Table 20 for download use case in GSMA TS09, for 10MHz BW allocation, web browsing, video streaming, audio streaming, and email test cases shall use 1 uplink resource block and 12 downlink resource blocks. The TBS shall be set to 19 on the downlink and 20 on the uplink. (MCS: 21 for downlink and 22 uplink).

The RRC inactivity timer shall be set to 10 seconds.

For LTE transmit power, the profile defined in [Table 2.3-1](#) shall be used.

TABLE 2.3-1 LTE TRANSMIT POWER DISTRIBUTION PROFILE

+24dBm	+18dBm	+8dBm	+2dBm	-20dBm
24.66%	35.75%	27.66%	4.98%	6.95%

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 5 minutes or less (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

Operator	LTE	WCDMA
AT&T	12 / 17	2
Sprint	25	N/A
T-Mobile	4	2
Verizon	13	N/A

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. The DUT configuration prior to testing is described in [Table 2.5-1](#).

TABLE 2.5-1 DUT CONFIGURATION PRIOR TO TESTING

Test Case	Comments
Audio Streaming	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.
Music Playback	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. 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.
Video Streaming	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.
Compose, Send, Receive, Read Email Message	Set up the test email account using the default email application. If the default email application does not support push, then an alternative email application may be used. The application and version information must be documented in the test reports.
Gaming	Install Angry Birds® game.
Compose, Send, Receive, Read SMS Message	Create one unique contact in the default messaging client.

2.6 DUT Wait Time Before Testing

For all tests, the CATL 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 minutes wait time can be skipped.

2.7 DUT Configuration During Testing

See [Appendix A](#) for the DUT configuration to be used during testing.

2.8 Power Supply and Analyser

Table 2.8-1 and Table 2.8-2 merge settings specified within GSMA TS.09 and provide the additional requirements for stability and accuracy.

It should be noted that the current validated Power Analyser meets these requirements.

TABLE 2.8-1 POWER SUPPLY

Parameter	Requirement	Comments
Range	Nominal Voltage of device	Additional headroom to compensate for any cabling losses
Resolution	$\leq 10\text{mV}$	
Deviation	$\leq 10\text{mV}$	
Temporary Voltage Drop	60mV	Transient Voltage drop as a result of transient loads
Recovery/Settling Time	50uS	Time to recover to within 30 mV of the final voltage value following a load current transient
Current Source	The DC source should have sufficient output current capability, both continuous and peak, to adequately supply the MS during all measurements.	Current limiting of the power supply shall not function during a measurement
Sense Lines	Remote sensing to allow the effects of resistance of the supply cables to be compensated for, and to allow maintenance of the nominal voltage at the MS battery terminals	Should be connected as close as possible to the device under test

TABLE 2.8-2 ANALYSER

Parameter	Requirement	Comments
Measurement Resistance	≤ 0.1 Ohms	
Sampling Frequency	≥ 50 ksps	Measurement shall be continuous
Voltage Measurement Range	4.5V to 2.5V	
Voltage Resolution	1mV	
Voltage Deviation	0.3%	Of measured value across Voltage Measurement Range
Current Resolution	≤ 0.1 mA Idle Mode ≤ 0.5 mA Dedicated Mode	
Current Deviation	2%	Of measured value across full operating range of the device under test
Noise floor	Less than the lowest ADC step	

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.

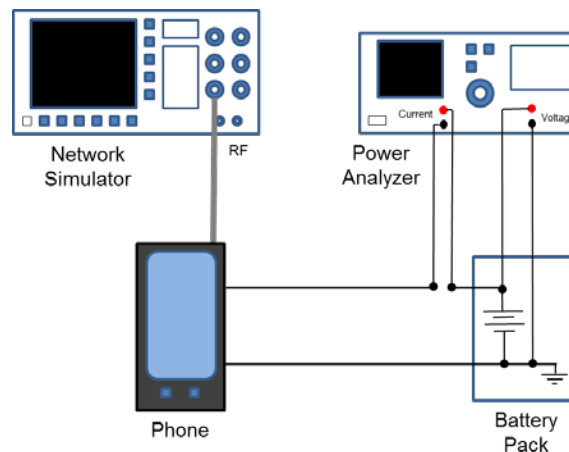
The SDP procedures require the capability to measure both instantaneous current and voltage. Using a sense resistor circuit is not an acceptable solution for this process because that requires the measurement of two voltage signals.

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](#).

FIGURE 3.1-1 SDP TEST SETUP



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 WCDMA (3GPP 34.109) and LTE (3GPP 36.509, 36.508).

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.

3.7 Procedure to handle multiple cell vendors or battery packs

In the instance where the DUT manufacturer submits more than 1 battery pack or there is more than 1 cell vendor, then the TAE for all of the cell and pack vendors shall be measured. All of the TAE figures shall be reported by the CATL. The lowest TAE measured from the different cells and packs shall be used in the customer profile calculation to determine the estimated hours of operation.

Section 4 Energy Use per Activity

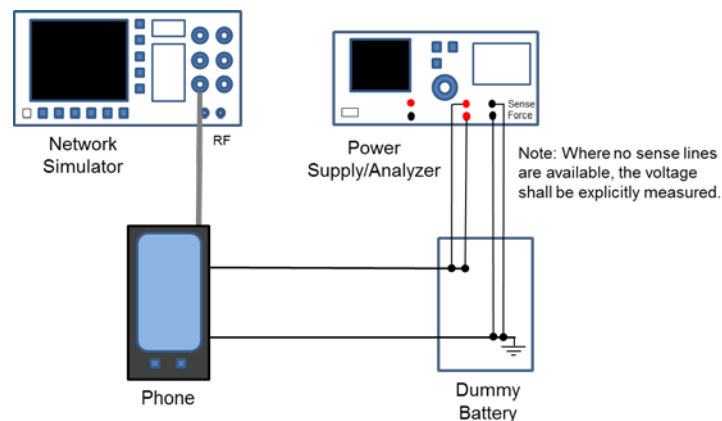
4.1 Test Setup and Test Cases

Testing shall be performed per GSMA TS09 for all test cases where test procedures are defined, as noted in [Table 4.2-1](#). 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 $P = V * I$. 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 CATL 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

Test Case	Refer to GSMA TS09 for Test Procedures	Refer to this Document for Test Procedures
Gaming		X
Compose, Send, Receive, Read SMS Message		X
Compose, Send, Receive, Read Email Message		X
Home Screen Display On		X
Audio Streaming	X	
Music Playback	X	
Video Streaming	X	
Voice Call	X	
Web Browsing	X	
Standby	X	

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.
- The CATL 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 CATL 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 represents 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.

- 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.
- The CATL test operator shall not use the text auto correction feature, or the text auto completion feature, on the DUT, if possible.
- Mobile data shall be turned off.

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 represents 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.
- Mobile data shall be turned off.

Test Procedure:

- Begin measuring current drain (do not let display timeout before starting measurement).
- Press the send icon to send the text: "Are you going to the party tonight? I will be there at eight" in the message body.)
- Send the text to whatever number is required by the network simulator/test script.
- The test equipment will stop the current drain measurement 15 seconds after the measurement started. This represents 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

4.2.2.3 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.
- Mobile data shall be turned off.

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. The CATL test operator shall confirm that the text is in the inbox of the DUT AFTER the measurement has stopped. This represents 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 represents 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.
- The CATL 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 represents 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 represents 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 DUT should start this test case in idle mode.
- 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.
- If the DUT does not support push email or does not fetch the email, then this test case must be performed such that the CATL test operator manually fetches the email per the

manufacturer provided instructions. The current drain will be recorded using this alternate method.

- 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.
- Email application will be killed (force stop or clear all applications for example) before testing.
- RRC idle state should be the initial condition.
- The CATL test operator shall push home screen icon (e.g. house, circle) one time in order to set the DUT to the home screen.
- 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 represents one iteration of the data.
- The CATL 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 represents 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.
- The CATL 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 CATL 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 CATL 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 represents 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:

- The CATL 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.
- The LTE power profile shall be applied for this test case, with the distribution spread evenly for the total test time.
- The media may be played using the hard drive of the DUT and does not have to be played from an external SD card/media source.
- Navigate to the media file and click on it to open it. Select the option to open the media file using the preferred media player/VLC player.
- For music play back, launch VLC player, select the song to be played, and start listening to the audio media clip.
- Mobile data shall be turned off for music playback

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 CATL test operator shall start playing the video on the DUT and then begin the measurement.
- This test shall be executed for a 10-minute duration in alignment with GSMA TS09 section 5.3
- The approved 720p video source file will be provided by the authorized test system vendors. If the DUT does not support 720p, then the 480p file will be provided by the authorized test system vendor.

4.2.7 Voice Call

Use the GSMA TS09 test procedures.

- The CATL 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.
- The audio shall be routed through the normal audio path, not the speakerphone and no headset is to be connected to the DUT.

4.2.8 Web Browsing

Use the GSMA TS09 test procedures.

- Run this test 3 times and average the results.
- Swiping/scrolling guidelines:

At the 20 second mark, using one continuous touching movement, scroll down to the bottom of the page by swiping the finger up from the bottom to the top of the screen.

At the 40 second mark, using one continuous touching movement, scroll up to the top of the page by swiping the finger down from the top to the bottom of the screen.

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).

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 TAE 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 estimated hours of operation shall be reported as the final result.

Appendix A DUT Configuration During Testing

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

Appendix B Change History

Date	Revision	Description
April 2016	1.0	Initial release
February 2017	1.1	<ul style="list-style-type: none"> • Section 1.2: WCDMA added. Removed references to GSM and cdma2000. • Section 1.5: Added additional definitions. <ul style="list-style-type: none"> • Section 2.3: Updated text to remove reference to CDMA test plan 3GPP2 c.R1013_0. • Table 2.5-1: Updated DUT configuration for compose, send, receive, read email message test cases. • Section 2.8: Created a new section for power supply and analyser settings. • Section 4.2.2.1, 4.2.2.2, 4.2.2.3: Added additional instruction to Test Setup. • Section 4.2.3.3: Added additional instruction to Test Setup and Test Procedure. • Section 4.2.5, 4.2.7: Added additional instruction. • Section 4.2.6: Modified the location of the video source files. • Section 4.2.8: Modified swiping/scrolling guidelines.