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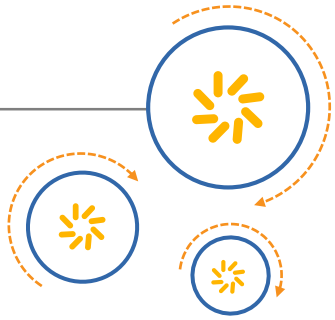

Power Consumption Measurement Procedure for MSM (Android-Based)/MDM Devices

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Revision history

Revision	Date	Description
A	July 2011	Initial release
B	September 2011	Updated Chapter 1 and numerous changes in Chapter 2
C	January 2012	Numerous changes were made to Chapter 2. It should be read in its entirety.
D	November 2012	Numerous changes were made to Chapter 2. It should be read in its entirety.
E	November 2012	Added Section 2.13
F	February 2013	Updated Sections 2.5.3, 2.8.4, 2.10.5, and 2.11.6
G	March 2013	Added Sections 2.2.2 and 2.2.3
H	July 2013	Updated Section 2.4.1.1, Section 2.6, Section 2.10.1, Section 2.10.2, Section 2.10.5, Section 2.10.6, Section 2.11, Section 2.13, Section 2.13.2, Section 2.13.5, Section 2.13.6, Section 2.15.7, and Section 2.17.1; added Section 2.12 and Section 2.16
J	November 2013	Updated Sections 1.4, 2.5, 2.5.2, 2.5.3, 2.5.4, 2.6.2, 2.11.1, 2.12.1, 2.13.1, 2.15 and 2.16.3; added Sections 2.18 through 2.29, 2.34, and 2.35
K	February 2014	Updated Section 2.15.2
L	February 2014	Updated Section 2.15.2
M	June 2014	Updated Table 1-1 and Sections 1.1 and 2.15.2; added Sections 2.34, 2.35, and 2.36
N	August 2014	Updated Tables 1-1 and 2-7; added Sections 2.11, 2.15, 2.19, 2.40, 2.41.4, 2.41.5, and 2.42.4
P	December 2014	Updated Sections 2.19.2 and 2.41.6.1; Updated template
R	March 2015	Added the following sections: ▪ 2.18.1 LTE Cat 3 CA 10 MHz + 10 MHz, 100/25 Mbps, 0 dBm (LTE8E) ▪ 2.19.1 LTE Cat 6 CA 20 MHz + 20 MHz, 300/50 Mbps, 0 dBm (LTE10E) ▪ 2.19.2 CMW 500 Settings for Primary Component Carrier (PCC) ▪ 2.19.3 CMW 500 Settings for Secondary Component Carrier (SCC) ▪ 2.19.4 Setup call box RF connections and UE physical connections Updated the following sections: ▪ 2.10.1 LTE standby, 2.56 sec (LS1)/LTE Cat3, 68/23 Mbps, Band 13, 0 dBm, 10 MHz BW (LTE1E) ▪ 2.12.1 LTE Cat 3 (100/50 Mbps, 0 dBm, Band 7), 20 MHz BW, (LTE6E) ▪ 2.13.1 LTE Cat 4 (150/50 Mbps, 0 dBm, Band 7), 20 MHz BW, (LTE7E ▪ 2.14.1 TD-LTE standby, 2.56 sec (LS3)/LTE TDD Cat 3 DL + UL (60/18 Mbps) 0 dBm, 20 MHz bandwidth, B38, DLUL Config 1 (LTE5E) ▪ 2.5.2 HSDPA DL 7.2 Mbps ▪ 2.32.2 GNSS 1 Hz tracking high sensitivity with WCDMA standby 2.56 sec (GNSS1) ▪ 2.33.2 GPS 1 Hz tracking (DPO) with WCDMA standby 2.56 sec (GPS2)

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Revision	Date	Description
T	July 2015	Updated the following sections under Multimedia use cases: ▪ 2.38.1 Prerequisites ▪ 2.38.3 Audio decode use case (AU4) ▪ 2.38.6 Video playback (QTCxx) ▪ 2.38.8 Graphics PowerLift (QGC23A) ▪ 2.38.9 Gaming Egypt (QGC26A)
U	September 2015	Added the following sections: ▪ 2.20 LTE FDD Cat9, 3xCA, 20 MHz + 20 MHz + 20 MHz (450/50 DL/UL, B3 (Tx) + B7 + B20), embedded, 0 dBm ▪ 2.41 Flatland (QGC30A) ▪ 2.42 Camera preview (QMC38A) ▪ 2.43 Web browsing over Wi-Fi (Lorem with UI) (WB10A) ▪ 2.44.1 T-rex HD 1080p, at 30 fps at full screen resolution at Vsync (QGC31AT) ▪ 2.44.2 T-rex HD 1080p, at 60 fps at full screen resolution at Vsync (QGC29AT) ▪ 2.44.3 Manhattan 3.0, 1080p, single frame at 30 fps, off screen (Tj=75C) (QGC33AT) ▪ 2.44.4 UHD 30 fps, 8b, H264 local video playback + UHD 30 fps WFD mirroring, Miracast, 11n, 2 x 2 MCS7 HT20 (Tj = 65°C) (VS12T) ▪ 2.44.5 UHD Asphalt8 (Tj = 65°C) (QGC53) ▪ 2.44.6 30 fps at UHD, H.264 42 Mbps encode, 8 MP, AAC 128 kbps 44.1 KHz stereo (Tj = 65° C) (QMC35AT) Updated the following sections under Multimedia use cases: ▪ 2.39.1 Prerequisites ▪ 2.39.3 Audio decode use case (AU4) ▪ 2.39.4 Listen – 100% silence (AU34A) ▪ 2.39.5 Listen – 100% speech (AU35A) ▪ 2.39.6 Video playback (QTCxx) ▪ 2.39.7 1080p video encoding (QMC31) ▪ 2.39.10 Browser (WB1A) ▪ 2.39.11 Video Streaming (VSX) Updated Sensors use case Section 2.40.4 Procedure for MSM8996, MSM8994, and MSM8992
V	November 2015	Reorganized use cases into separate chapters. Reorganized additional content into Chapter 2 Overview and made Airplane mode Chapter 3. Updated the following sections under Multimedia use cases for MSM8956/MSM8976: ▪ 9.1 Prerequisites ▪ 9.3 Audio decode use case (AU4) ▪ 9.4 Listen – 100% silence (AU34A) ▪ 9.5 Listen – 100% speech (AU35A) ▪ 9.6 Video playback (QTCxx) ▪ 9.7 1080p video encoding (QMC31,QMC38-1) ▪ 9.9 Gaming Egypt (QGC26A) ▪ 9.11 Video Streaming (VSX) ▪ 9.12 Camera preview ▪ Chapter 11 Performance use cases

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Revision	Date	Description
W	February 2016	Added the following sections: ▪ 5.9 Modem use case (VoLTE6) ▪ 11.5 Performance use case (VS12T/VS13T) Updated the following sections: ▪ 3.1 AIR1 use case test procedure ▪ 5.12 Modem use case (LTE21E) – Section title change only ▪ 9.6 Video playback (QTC106A) ▪ 10.1.4 Procedure for MSM8996, MSM8994, MSM8992, MSM8952/56/76, MSM8937, and MSM8953

Note: There is no Rev. I, O, Q, S, X, or Z per Mil. standards.

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1 Introduction

1.1 Purpose

This document provides handset configuration and power measurement instructions for specific features on Android devices.

This document is intended for customers who need instructions on handset power measurement in specific modes.

1.2 Conventions

Function declarations, function names, type declarations, attributes, and code samples appear in a different font, for example, `#include`.

Code variables appear in angle brackets, for example, `<number>`.

Commands to be entered appear in a different font, for example, **`copy a:*.* b:`**.

Shading indicates content that has been added or changed in this revision of the document.

1.3 Technical assistance

For assistance or clarification on information in this document, submit a case to Qualcomm Technologies, Inc. (QTI) at https://createpoint.qti.qualcomm.com/.

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2 Overview

2.1 System connectivity (QTI reference setup)

Figure 2-1 illustrates the system connectivity setup for power measurement.

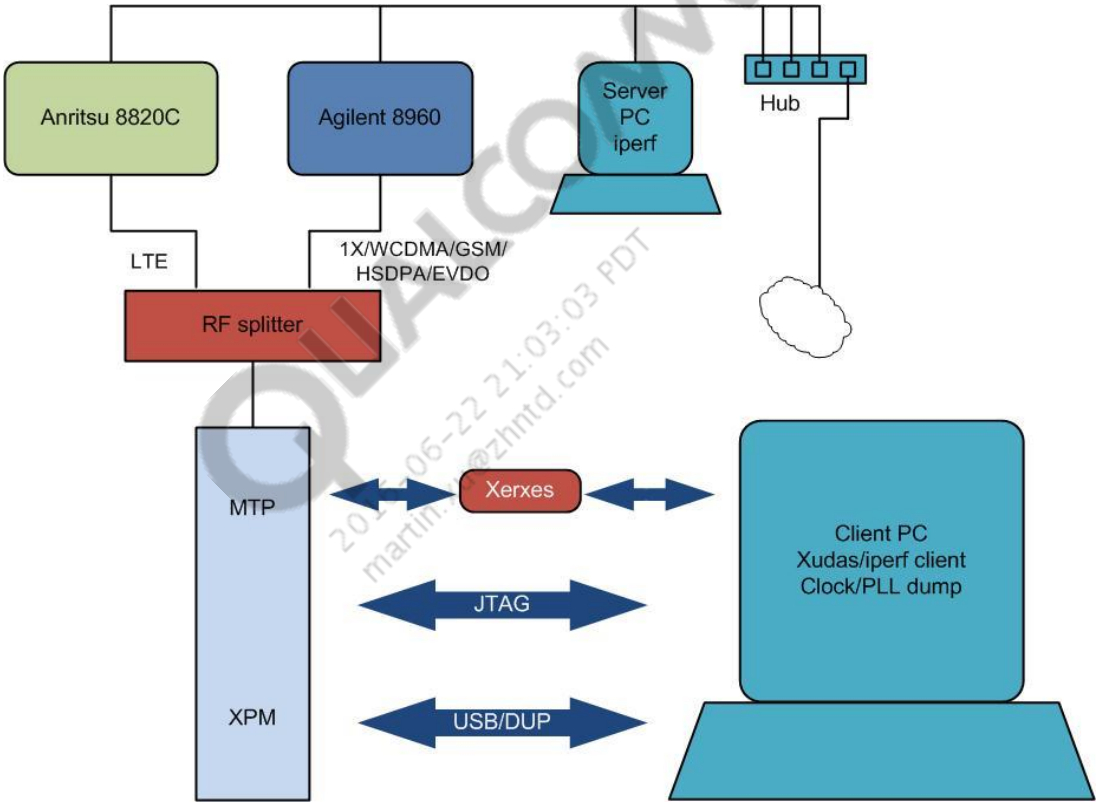

Figure 2-1 System connectivity setup

Table 2-1 Block descriptions

Block	Description
Anritsu 8820C	System emulator of LTE
Agilent 8960	System emulator of 1X/WCDMA/GSM/HSDPA/ EV-DO
MTP/XPM	Unit for power measurement
Xerxes/	Complete hardware platform where XPM resides to provide many channels for voltage/current measurement

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Block	Description
Client PC	Roles for client PC include: ▪ Running XUDAS software to control Xerxes for making measurement ▪ Running as iperf client ▪ Running T32 script to get clock/PLL dump via JTAG connection
Server PC	▪ Iperf server, responsible for pumping data stream to client PC via Internet to system emulator, directing to MTP/XPM through radio interface

2.2 General settings

2.2.1 NV items

Configure the NV items as shown.

- For better standby current

1027	Enable MDSP logging	0
1892	Enable logging	0
1895	Enable logging	0
1962	Enable logging	0

- For network preference, based on user test modes

10	WCDMA only	14
10	GSM only	13
10	GSM and WCDMA only	17
10	CDMA only	9
10	CDMA + HDR only	19

- For WCDMA Receive Diversity (RxD), disabled by default

3851	WCDMA RxD	0
3852	WCDMA equalizer	6

- DCVS is enabled by default. Since DCVS is no longer adjusted through the QXDM Professional™ (QXDM Pro) NV item, if the user must disable DCVS, update Algorithm.txt from EFS as follows:
  - To enable DVCS, in nv\item_files\CoreCpu\CoreAll\Startup\Algorithm.txt, enter **Classic**.
  - To disable DCVS, in nv\item_files\CoreCpu\CoreAll\Startup\Algorithm.txt, enter **Disabled**.

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2.2.2 Disabling the data monitor

To disable the data monitor Netstats for Jelly Bean (JB)/Ice Cream Sandwich (ICS):

1. Open the ADB shell and run the following command to disable data monitor.

```
adb shell ndc bandwidth disable
```

   This command must be run every time the system reboots.

2. To check whether the data monitor is disabled, run the following command:

```
adb shell iptables –L

Sample output generated from the command:

Chain bw_INPUT (1 references)
target prot opt source destination
all -- anywhere anywhere          ! quota globalAlert: 2097152 bytes
RETURN all -- anywhere anywhere
all -- anywhere anywhere owner socket exists
Chain bw_OUTPUT (1 references)
target prot opt source destination
all -- anywhere anywhere          ! quota globalAlert: 2097152 bytes
RETURN all -- anywhere anywhere
all – anywhere anywhere owner socket exists
```

   If the data monitor is disabled, the globalAlert message does not appear in the output.

2.2.3 Performance boot image

QTI uses a performance boot image with the metabuild for all the power measurements. Make sure that the performance boot image is used (to disable all the debug and other logging) before power measurements.

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3 Airplane mode use cases

3.1 Airplane mode (AIR1)

3.1.1 Agilent 8960 settings

N/A

3.1.2 Phone settings

To set Airplane mode:

1. Enable Airplane mode by selecting Settings→Wireless & Networks→Airplane mode.
2. Disable sensor by selecting Qualcomm Setting→Sensor→Disable (unclick).
3. Settings→Wireless & network→Mobile networks→Network setting→Airplane Mode.
4. Settings→Location Services→GPS Satellites→Disable (unclick).
5. Settings→Display→Auto-rotate screen→Disable (unclick).
6. Disable WLAN/Bluetooth/Data Services.

3.1.3 Power measurement procedure (Android)

For power measurement:

1. Power up the phone.
2. Ensure that the airplane icon is displayed on the top of the UI.
3. Wait until LCD/BL is off; start the power measurement after 2 min to ensure that the current has stabilized.

3.1.4 Power measurement procedure (MDM)

For power measurement:

1. Power up the phone.
2. Ensure that the airplane icon is displayed at the top of the UI.

Start power measurement after 2 min to ensure that the current has stabilized.

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4 3G use cases

This chapter includes test equipment settings for WCDMA, GSM/GPRS/EDGE, CDMA, LTE, HSDPA, HSPA, EV-DO modes.

Chapter 6 includes the following technology-related sections:

- DSDA WCDMA talk 0 dBm + GSM standby 0.47 sec (WTGS1)
- DSDA GSM talk 5 dBm + HSDPA 7.2 Mbps 0 dBm (No RxD) (GTHS21E1)/DSDA GSM talk 5 dBm + HSDPA 21 Mbps 0 dBm (No RxD) (GTHS41E1)/DSDA GSM talk 5 dBm + DC HSDPA DL 42 Mbps +0 dBm, IMT (No RxD) (GTHS62E1)
- DSDA GSM talk 5 dBm + EVDO DL 3.1 Mbps 0 dBm (no RxD) (GTDD2E1)

4.1 WCDMA standby, 2.56 sec (WS1)/WCDMA talk 0 dBm, IMT (WT1)

4.1.1 Agilent 8960 settings

For the Agilent 8960 setting:

- Ensure the RF In/Out Amplitude Offset state is turned on.
- Correctly specify cable losses.
- System Config→Control→Format Switch (F2)→WCDMA.

4.1.2 Call parameters

- Cell power – 50 dBm
- Channel type – 12.2 k RMC + HSDPA
- Paging service – AMR Voice
- Channel (UARFCN) Parameters (F12) – DL Channel – 10700 [UL Channel – 9750 or Auto]
- UE target power (3 of 3) – 0 dBm

4.1.2.1 Call control

- Paging parameters – Paging IMSI; TMSI – Off
- Cell information (2 of 6→F2) – Cell parameters

The MCC/MNC value depends on the SIM you are using; the following example is for the Agilent test SIM.

MCC	440

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MNC	79
DRx cycle length (CN domain)	256 frames (2.56 sec)

- Generator information – AWGN power – Off
- Device Under Test (DUT) IP setup (values shown are examples for Agilent)

DUT IP address	xx.xx.xx.xx
DUT primary DNS server IP address	xxx.xx.xx.xx
DUT secondary DNS server IP address	xxx.xx.xx.xx
Route xxx.xxx.xxx.x/24 traffic to DUT	Off

- Security information (4 of 6 →F1) – Security parameters (F1)

Security operations	None

If you are using a valid Agilent test SIM, you could configure as follows and enable identity and authentication features in the phone as well.

Security operations	Auth & Int

- SIB11 cell information list – Cell information list – Absent (default)
- System config – RF cable loss – Use the calculated cable loss number
- Voice call – AMR setup

AMR radio access bearer	12.2 k voice [default]
AMR source	Echo
Speech echo loopback delay	500.0 ms

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4.1.2.2 Measurement

- Measurement selection – Thermal power – Thermal power setup

Multi-measurement count	600
Trigger ARM	Continuous
Measurement timeout	Off

4.1.3 Phone settings

Modify the following NV items:

- 3851→0 (Rx diversity functionality disabled)
- 3852→6 (WCDMA equalizer)
- 10→WCDMA only

Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→WCDMA only.
2. Settings→Location Services→GPS Satellites→Disable (unclick).

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3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth/Data services.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Settings→Display→Screen Timeout to 15 sec.

4.1.4 Power measurement procedure for WCDMA standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized.

4.1.5 Power measurement procedure for WCDMA talk (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Make an MT call from Agilent 8960 and answer the call.
4. Mute the phone.
5. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized.

4.1.6 Power measurement procedure for WCDMA standby (MDM)

For power measurement:

1. Power up the UE.
2. Wait until the UE camps on the network.
3. Start measurement after 2 min to ensure that the current has stabilized.

4.1.7 Power measurement procedure for WCDMA talk (MDM)

For power measurement:

1. Power up the UE.
2. Wait until the UE camps on the network.
3. Make an MT call from Agilent 8960 and answer the call.

Start power measurement after 2 min to ensure that the current has stabilized.

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4.2 HSDPA DL 7.2 Mbps + 0 dBm, IMT (HS21E/HS22E)/HSDPA DL 21 Mbps + 0dBm, IMT (HS41E/HS42E)

4.2.1 Agilent 8960 settings

For Agilent 8960 settings:

1. Ensure the RF In/Out Amplitude Offset state is turned on.
2. Correctly specify cable losses.
3. System Config→Format Switch (F2)→WCDMA.

NOTE: To achieve 7.2 Mbps, several necessary settings must be made on top of the WCDMA settings. Configure Agilent 8960 and the phone as shown in the following sections.

4.2.1.1 Call control

- Paging parameters
  - CS paging identity type – IMSI
  - TMSI assignment – Off
- Cell information (2 or 6→F2) – Cell parameters (F2)

Item	Value
DRx cycle length (UTRAN)	8 frames

- Generator Information – Downlink Channel Codes (F2) – HSDPA/HSPA DL Channel Codes (F4)

Item	Value
PS data first HS-PDSCH channel code	5
RB Test mode first HS-PDSCH channel code	5

- DUT IP setup (examples only)

NOTE: The iperf server calls the DUP IP address.

Item	Value
DUT IP version	IPv4
DUT IP Address 1	10.52.72.137
DUT IP Address 2	10.52.72.138
DUT Primary DNS Server IP address	129.46.50.7
DUT Secondary DNS Server IP address	10.52.72.129
Route xxx.xxx.xxx.x/24 Traffic to DUT	Off

- Voice call (3 of 6→F5) – AMR setup (F1)

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Item	Value
AMR radio access bearer	12.2 k voice [default]
AMR source	Echo
Speech echo loopback delay	500.0 ms

- Data channels (3 of 6→F4) – Packet data setup (F1)

Item	Value
GPRS radio access bearer	384 kbps UL/HSDPA DL PS

- SIB11 information (4 of 6→F3) – SIB11 cell information list – Cell information list – Absent (default)
- SIB11 information – SIB11 FACH measurement occasion information

Item	Value
FACH measurement occasion information control	Absent

4.2.1.2 Call parameters

- Cell power – - 45 dBm
- Channel type – 12.2 k + HSDPA (for data)
- HSPA parameters – HSDPA parameters (F10) – HSDPA PS data setup (F7)

Item	Value
HS-DSCH configuration type	CQI value
CQI value	25

- HSPA parameters – HSDPA parameters (F10) – HSDPA RB Test mode setup (F7)

Item	Value
HS-DSCH configuration type	User-defined
PS data HS-DSCH MAC-d PDU size	656
Number of active HS-PDSCHs	10
Transport block size index	48
Modulation type	16 QAM
Inter-TTI interval	1
Number of HARQ processes	6
User-defined UE IR buffer allocation	Implicit
Uplink 64k DTCH for HSDPA Loopback state	Off

- HSPA parameters – HSDPA parameters – UE category parameters (F9)

Item	Value
UE HS-DSCH category control	Manual

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Item	Value
UE HS-DSCH category	8

- Channel (UARFCN) parameters (F12)

Item	Value
DL channel	10700
UL channel	Auto [– 9750]
Transmit SIB5bis	Std bands

- RLC reestablish (2 of 3→F9) – Auto
- UE target power (3 of 3→F7) – 0 dBm

4.2.2 Phone settings

Modify the following NV items:

- 4118
  - →8 (HS21E/HS22E)
  - →14 (HS41E/HS42E)
- 3649
  - →2 (HS21E/HS22E)
  - →4 (HS62E)
- 3851
  - 0→RxD functionality disabled (HS21E/HS41E)
  - 5→RxD functionality enabled (HS22E/HS42E)
- 3852→6 (WCDMA equalizer)
- 10→WCDMA only

Phone UI settings (Android only)

1. Settings→Location Services→GPS Satellites→Disable (unclick).
2. Settings→Display→Auto-rotate screen→Disable (unclick).
3. Disable WLAN/Bluetooth.
4. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
5. Setting→Wireless & network→Mobile networks→Network setting→Network mode→WCDMA only.
6. Settings→Display→Screen Timeout to 15 sec.
7. Enable data.

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4.2.3 Power measurement procedure, embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp on the network.
4. On the client (phone is the client here instead of the PC), push the embedded iperf application to the phone through ADB (iperfApp.apk is available in the Android market):

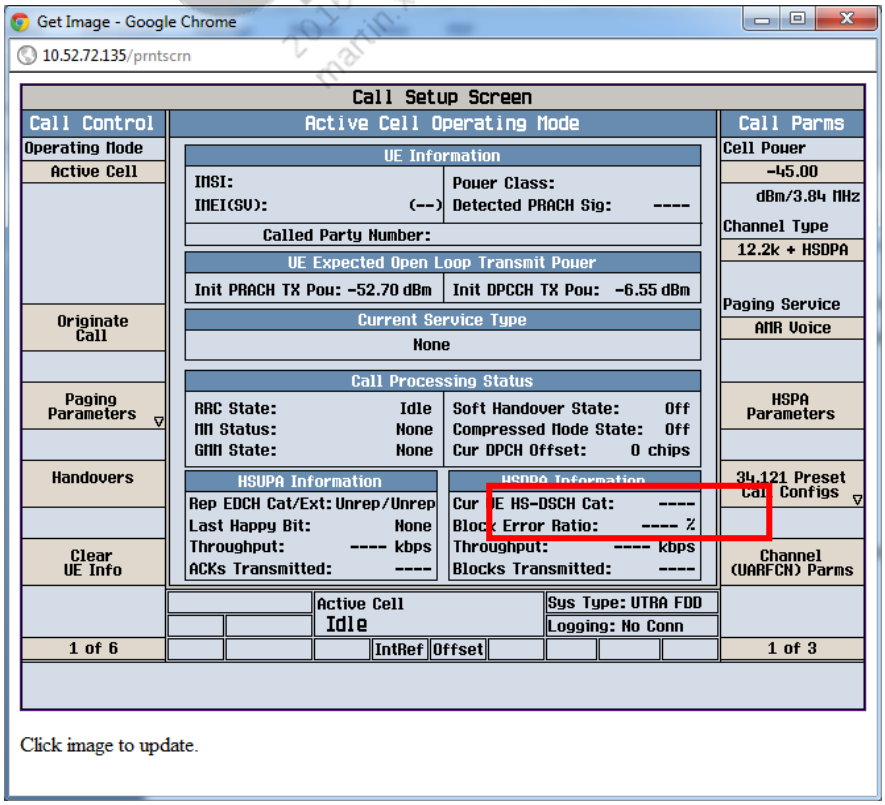
```
adb install bin/iPerfApp.apk
adb push config.txt /data/data/com.android.iperfapp/config/config.txt
```

NOTE: A different iperf APK is required for 64-bit chipsets.

5. Disconnect the USB from the phone to the PC.
6. Open the iperf application on the phone and run the command:
   a. Unselect the **disp on** and **file On** buttons.
   b. Press **run** to execute the following command, which exists by default in the iperf command window.

```
-s -u -i2
```

7. Make sure that the UE HS-DSCH Category is 8 on the Agilent call box.



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8. On the server PC, open a command window and execute:

```
cd c:\iperf
```

For HS21E/HS22E:

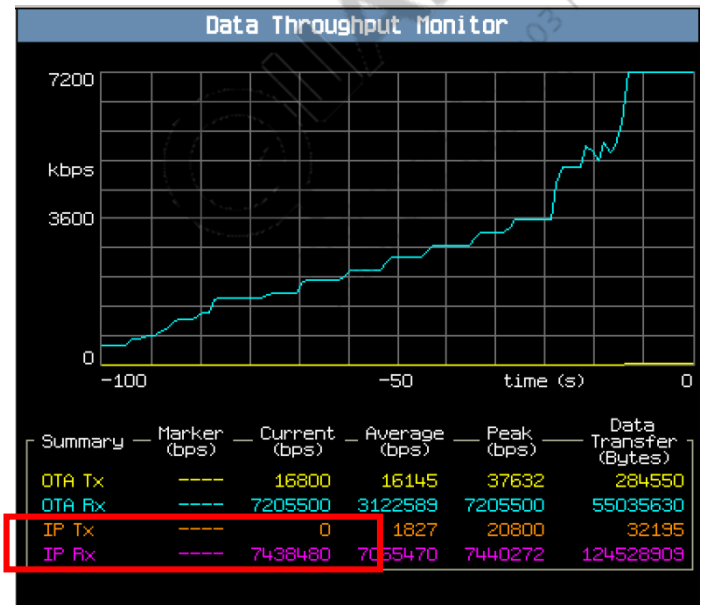
```
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200  -b 7M
```

For HS41E/HS42E:

```
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200 -b 21M
```

NOTE: 10.52.72.137 is the DUT IP address we set up in Agilent. Modify it according to your system configuration.

9. Make sure that the throughput is correctly climbing to around 7.2 Mbps/21 Mbps.



10. Start power measurement using the power monitor.
11. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
12. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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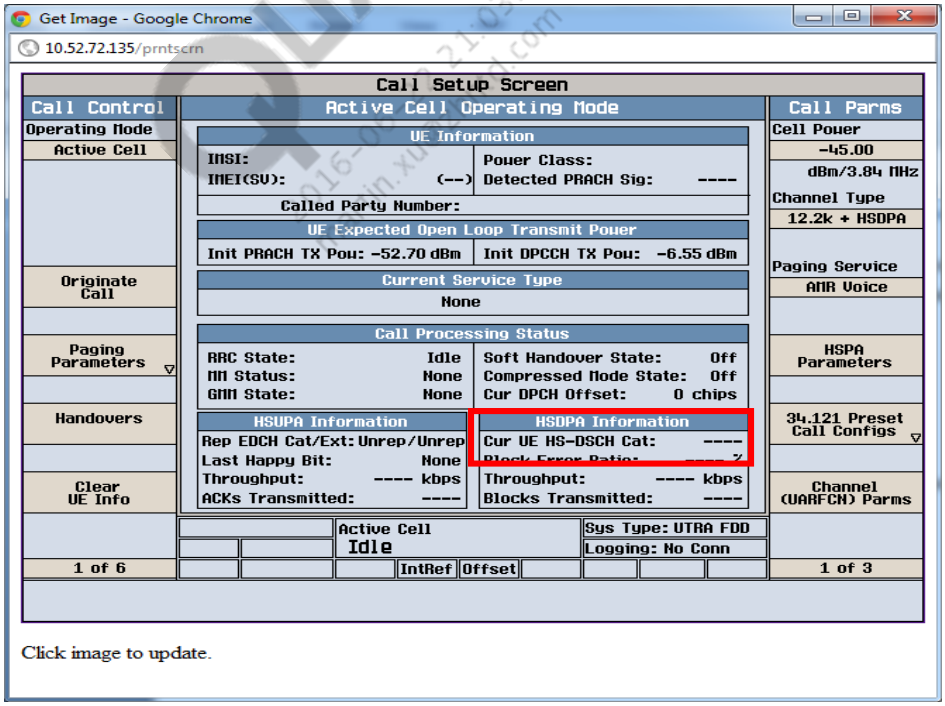
4.2.4 Power measurement procedure USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the UE to camp on the network.
4. On the client PC:
   a. Connect the handset with a USB.
   b. Disable USB charging.
5. Open QMI Test Pro/QMICM to connect to the handset.
6. Open a command window and execute:

```
cd c:\iperf
iperf -s -f k -I 2 -u
```

7. Make sure that the UE HS-DSCH Category is 7/8 on the Agilent call box.



8. On the server PC, open a command window and execute.

   For HS21E/HS22E:

```
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200  -b 7M
```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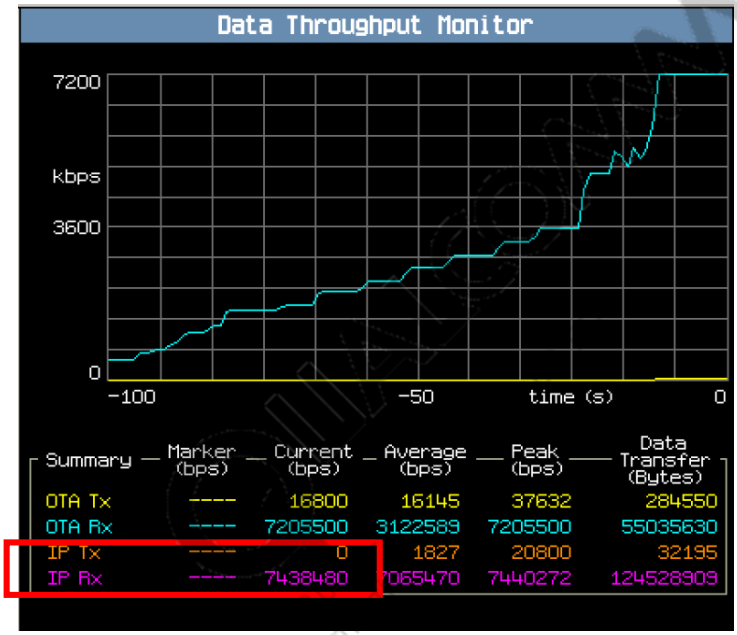
For HS41E/HS42E:

```
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200  -b 21M
```

NOTE: 10.52.72.137 is the DUT IP address we set up in Agilent. Modify it according to your system configuration.

9. Make sure that the throughput is correctly climbing to around 7.2 Mbps.



10. Start power measurement in the power monitor.
11. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
12. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

4.3 HSDPA DC 42 Mbps + 0 dBm, IMT (HS62E)

4.3.1 Agilent 8960 settings

For Agilent 8960 settings:

1. Ensure the RF In/Out Amplitude Offset state is turned on.
2. Correctly specify cable losses.

4.3.1.1 Call control

- Paging parameters

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- CS paging identity type – IMSI
- TMSI assignment – Off

- Cell information (2 or 6→F2) – Cell parameters (F2)

Item	Value
DRX cycle length (CN domain)	64 frames
DRX cycle length (UTRAN)	8 frames

- Generator Information – Downlink Channel Codes (F2) – HSDPA/HSPA DL Channel Codes (F4)

Item	Value
PS data first HS-PDSCH channel code	1
RB Test mode first HS-PDSCH channel code	1

- DUT IP setup (examples only)

NOTE: The iperf server calls the DUP IP address.

Item	Value
DUT IP version	IPv4
DUT IP Address 1	10.52.72.137
DUT IP Address 2	10.52.72.138
DUT Primary DNS Server IP address	129.46.50.7
DUT Secondary DNS Server IP address	10.52.72.129
Route xxx.xxx.xxx.x/24 Traffic to DUT	Off

- Voice call (3 of 6→F5) – AMR setup (F1)

Item	Value
AMR radio access bearer	12.2 k voice [default]
AMR source	Echo
Speech echo loopback delay	500.0 ms

- Data channels (3 of 6→F4) – Packet data setup (F1)

Item	Value
GPRS radio access bearer	384 kbps UL/HSDPA DL PS

- SIB11 information (4 of 6→F3) – SIB11 cell information list – Cell information list – Present
- SIB11 information – SIB11 FACH measurement occasion information

Item	Value
FACH measurement occasion information control	Absent

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4.3.1.2 Call parameters

- Cell power – -50 dBm
- Channel type – 12.2 k + HSDPA (for data)
- Paging service – RB Test mode
- HSPA parameters – HSDPA parameters (F10) – HSDPA PS data setup (F7) – HSDPA PS Data Parameters (F8)

Item	Value
DC-HSDPA state	On
HS-DSCH MAC-d PDU size control	Predefined
HS-DSCH MAC-d PDU size	336 bits
Number of HARQ processes	Auto
UE IR buffer allocation	Implicit
HS-DSCH MAC entity	MAC-ehs
Downlink AM RLC mode	Flexible
DL flexible RLC header extension special value	Exclude
DL Mac PDU payload size	1503

- HSPA parameters – HSDPA parameters (F10) – HSDPA RB Test mode setup (F7)

Item	Value
HS-DSCH configuration type	User-defined
User-Defined DC-HSDPA state	On
Mode DC-HSDPA DPCH Loopback state	On
UHS-DSCH MAC Entity	MAC-ehs
User-defined flexible RLC SDU size	300
Number of HARQ processes	6
User-defined UE IR buffer allocation	Implicit
Uplink 64k DTCH for HSDPA Loopback state	Off

- HSPA parameters – HSDPA parameters – UE category parameters (F9)

Item	Value
UE HS-DSCH category control	Auto

- Channel (UARFCN) parameters (F12)

Item	Value
DL channel	10700
UL channel	Auto
Transmit SIB5bis	Standard bands

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- RLC reestablish (2 of 3→F9) – Off
- UE target power (3 of 3→F7) – 0 dBm

4.3.2 Phone settings

NV settings are:

- 4118 – 24
- 3649 – 4
- 3851 – 3
- 3852 – 51

Phone UI settings

1. Settings→Location Services→GPS Satellites→Disable (unclick).
2. Settings→Display→Auto-rotate screen→Disable (unclick).
3. Disable WLAN/Bluetooth.
4. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
5. Setting→Wireless & network→Mobile networks→Network setting→Network mode→WCDMA only.
6. Settings→Display→Screen Timeout to 15 sec.
7. Enable data.

NOTE: These settings are applicable to Android only.

4.3.3 Power measurement procedure, embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp on the network.
4. On the client (phone is the client here instead of the PC), push the embedded iperf application to the phone through ADB (iperfApp.apk is available in the Android market):

```
adb install bin/iPerfApp.apk
adb push config.txt /data/data/com.android.iperfapp/config/config.txt
```

NOTE: A different iperf APK is required for 64-bit chipsets.

5. Disconnect the USB from the phone to the PC.

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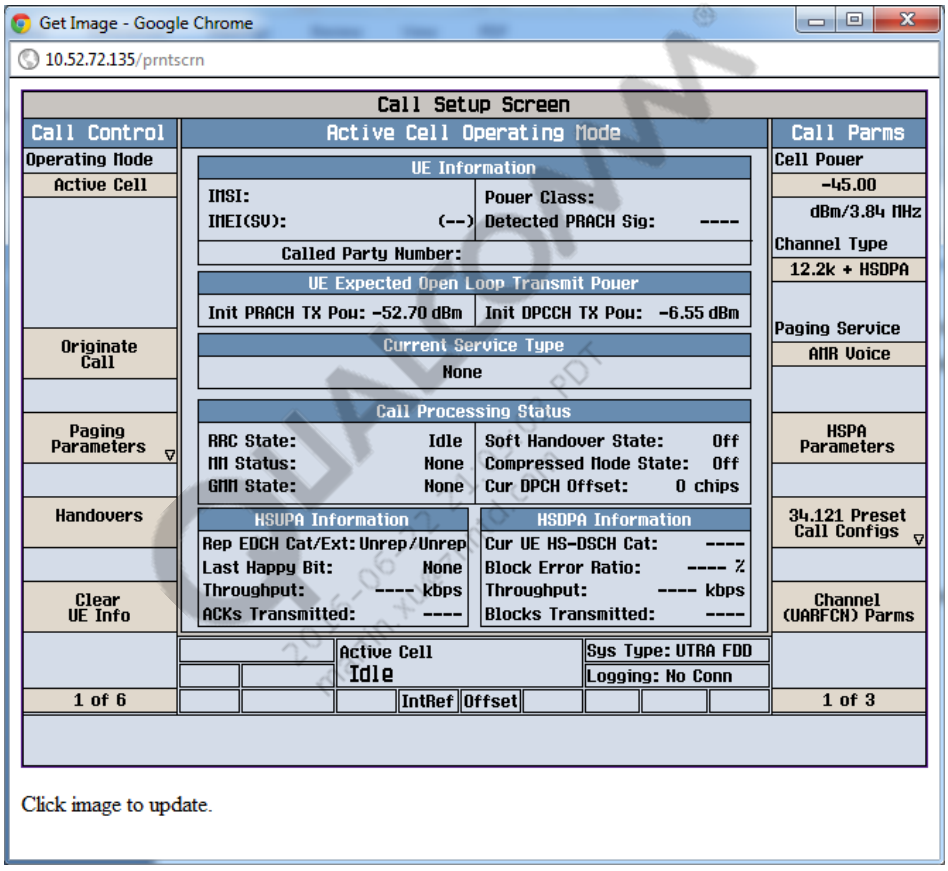
6. Open the iperf application on the phone and run the command:
   a. Unselect the **disp on** and **file On** buttons.
   b. Press **run** to execute the following command that exists by default in the iperf command window:

```
-s -u -i2
```

7. Make sure that the UE HS-DSCH Category is 24 on the Agilent call box.



8. On the server PC, open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200  -b 42M
```

NOTE: 10.52.72.137 is the DUT IP address that is set up in Agilent. Modify it according to your system configuration.

9. Start power measurement using the power monitor.
10. Measure current draw for 1024 sec. To ensure data integrity, confirm that the initial samples of the data capture are not included.

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11. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

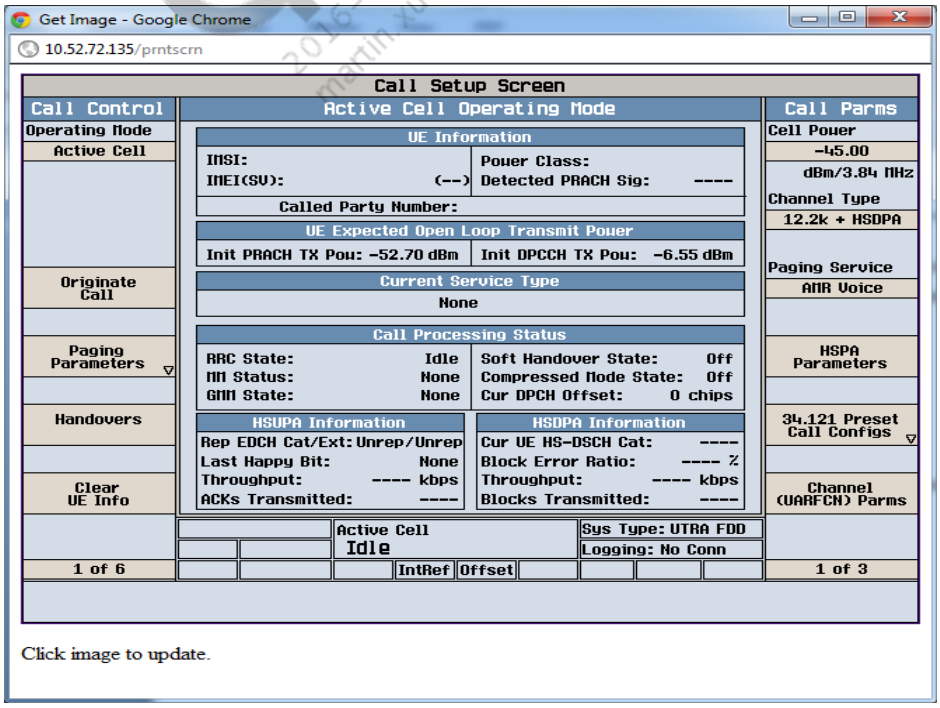
4.3.4 Power measurement procedure USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the UE to camp on the network.
4. On the client PC:
   a. Connect the handset with a USB.
   b. Disable USB charging.
5. Open QMI Test Pro/QMICM to connect to the handset.
6. Open a command window and execute:

```
cd c:\iperf
iperf -s -f k -I 2 -u
```

7. Make sure that the UE HS-DSCH Category is 24 on the Agilent call box.



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8. On the server PC, open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200 -b 42M
```

NOTE: 10.52.72.137 is the DUT IP address that is set up in Agilent. Modify it according to your system configuration.

9. Start power measurement in the power monitor.
10. Measure current draw for 1024 sec. To ensure data integrity, confirm that the initial samples of the data capture are not included.
11. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

4.4 CDMA QPCH 5.12 sec (CS2)/CDMA talk, 0 dBm CEL (CT1)

4.4.1 Agilent 8960 settings

For the Agilent 8960 settings:

- Ensure the RF In/Out Amplitude Offset state is turned on.
- Correctly specify cable losses.
- System Config→Format Switch (F2)→IS2000/IS-95/AMPS.

For Quick Paging Channel (QPCH) operation, follow the configurations shown in Table 4-1.

Table 4-1 cdma2000 base station settings for QPCH operation

Band class	0
Slot cycle index	2
Quick paging E_c/I_{or}	-7 dB
Quick paging channel rate	9600 bps
General page message position*	Second half frame
Configuration change indicator (CCI) bit	Off
Number of neighbors	20

*During QPCH operation, the handset does not monitor the paging channel unless the overhead information has changed or there is a page for the mobile. In the absence of either of these events, the handset can still be forced to monitor the paging channel if the QPCH bit is erroneously decoded as 1. To prevent this, ensure RF conditions are set per the values shown.

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4.4.1.1 Call control

- System type – IS 2000
- Generator information (2 of 5→F3) – AWGN power (F3) – Off
- Generator information (2 of 5→F3) – Code channel parameters (F2)

Item	Value
Cell 1 F-pilot level (E_c/I_{or})	-7.00 dB
Cell 1 F-sync level (E_c/I_{or})	-13.00 dB
Cell 1 F-paging level (E_c/I_{or})	-10.00 dB

- Cell information (F2) – Registration parameters

Item	Value
Timer-based registration	Off
Registration period	29
Power-up registration state	On

- Cell information (F2) – Registration parameters
- Paging channel MER (4 of 5→F6) – Paging channel MER ParmsCode channel parameters (F2)

Item	Value
Cell 1 F-pilot level (E_c/I_{or})	-7.00 dB
Cell 1 F-sync level (E_c/I_{or})	-13.00 dB
Cell 1 F-paging level (E_c/I_{or})	-10.00 dB

4.4.1.2 Call parameters

- Protocol Rev – 6 (IS-2000-0)
- Channel – 387
- Cell 1 power – -45 dBm/1.23 MHz
- Radio configuration – (fWD3,RVS3);S03(Voice)

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4.4.2 Phone settings

NV item to modify is:

- 10→CDMA only

Phone UI settings (Android only)

1. Setting→Wireless & Network→Mobile networks→Network setting→Network mode→CDMA.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth/Data Services.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Settings→Display→Screen Timeout to 15 sec.
7. In the Preferred Roaming List (PRL) of the handset, set the Home SID and NID to match the SID and NID of the base station. This helps the handset acquire the home network properly.
8. Disconnect any USB or other connector cables from the handset. Reset the handset after disconnecting any cables to ensure that all clocks in the handset are properly disabled.

4.4.3 Power measurement procedure for CDMA standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized.

4.4.4 Power measurement procedure for CDMA talk (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Make an MT call from the Agilent 8960 and answer the call.
4. Mute the phone.
5. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized.

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4.4.5 Power measurement procedure for CDMA standby (MDM)

For power measurement:

1. Power up the UE.
2. Wait until the UE camps on the network.
3. Start measurement after 2 min to ensure that the current has stabilized.

4.4.6 Power measurement procedure for CDMA talk (MDM)

For power measurement:

1. Power up the UE.
2. Wait until the UE camps on the network.
3. Make an MT call from the Agilent 8960 and answer the call.
4. Start power measurement after 2 min to ensure that the current has stabilized.

4.5 EV-DO DL 3.1 Mbps, 0 dBm, CEL (DD2E)

4.5.1 Agilent 8960 settings

For the Agilent 8960 settings:

1. Ensure the RF In/Out Amplitude Offset state is turned on.
2. Correctly specify cable losses.
3. System Config→Control→Format Switch (F2)→IS856.

EV-DO Standby mode configuration is:

- DRxcycle 5.12 sec (default is 40 sec after 1 min but must be set NV 4231 to remain on 5.12 sec)
- RxAGCat phone – -50 dBm
- Single sector, no neighbors
- Band – US Cellular at 800 MHz

4.5.1.1 Call parameters

- Application configuration (1 of 3→F10)

Item	Value
Session application type	Default packet application

- Protocol Rel (2 of 3→F11)

Item	Value
Session application type	A(1xEV-DO-A)

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4.5.2 Phone settings

NV item to modify is:

- 10→HDR only

Service programming

1. Launch QPST and connect the UE/device to the computer.
2. When detected in QPST, select Start Clients→Service Programming.
3. Select your UE/device in the dialog box that appears, and click **OK**.
4. Click the **Read from phone** option, and a pop-up dialog appears with some 0s, click **OK**.
5. On the Settings tab, set Slot Cycle Index to 2.
6. Under the CDMA tab, set the phone number as 8584048819 or any 10-digit number.
7. MCC as 310.
8. Check EVRC Enabled→EVRC for Home Page, Home Orig, and Roam Orig.
9. On the System tab is a column for Home SID/NID. Double-click the first row and set SID to 4 and NID to 65535.
10. Load PRL by clicking **Roam→Load from file** to select your PRL file.
11. Click the **Write to Phone** radio button to transfer these changes to the phone. This also sends the phone command to reset (if supported by your UE/device software).

Phone UI settings (Android only)

1. Setting→Wireless & network→ Mobile networks→Network setting→ Network mode→EVDO without CDMA.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data Services.
7. Settings→Display→Screen Timeout to 15 sec.

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4.5.3 Power measurement procedure USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. Wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client PC:
   a. Connect the handset with a USB.
   b. Disable USB charging. To do so, open a command window and execute:

```
adb shell setprop persist.usb.chgdisabled 1
adb shell "echo 1  > /sys/module/pm8921_charger/parameters/disabled"
adb shell sync
```

   c. Open QMICM to connect to the handset. Make sure the status shown in Agilent 8960 is Connected.
   d. Open a command window and execute:

```
cd c:\iperf
iperf -s -f k -I 2 -u
```

4. On the server PC, open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -b 3.1M
```

NOTE: 10.52.72.137 is the DUT IP address we set up in Agilent. Modify it according to your system configuration.

5. Ensure that the throughput is correctly climbing to around 3.1 Mbps.
6. Start power measurement on the correct channel in XUDAS.
7. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
8. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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4.5.4 Power measurement procedure embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp on the network.
4. On the client (phone is the client here instead of the PC):
   a. Push the embedded iperf application to the phone through ADB (iPerfApp.apk is available in the Android market):

      ```
      adb install bin/iPerfApp.apk
      adb push config.txt /data/data/com.android.iperfapp/config/config.txt
      ```

   b. Pause.

   NOTE: A different iperf APK is required for 64-bit chipsets.

5. Disconnect the USB from the phone to the PC.
6. Open the iperf application on the phone and run the command:
   a. Unselect **disp on** and **file on** buttons.
   b. Press **run** to execute the following command, which exists by default in the iperf command window.

      ```
      -s  -u -i2
      ```

7. On the server PC, open a command window and execute:

   ```
   cd c:\iperf
   iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200  -b 3.1M
   ```

NOTE: 10.52.72.137 is the DUT IP address we set up in Agilent. Modify it according to your system configuration.

8. Make sure that the throughput is correctly climbing to around 3.1 Mbps.
9. Start power measurement on the correct channel in XUDAS.
10. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
11. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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4.6 GSM standby, 1.18 sec, PGSM (GS1)/GSM talk, 5 dBm, no DTX (GT1)

4.6.1 Agilent 8960 settings

For the Agilent 8960 settings:

1. Ensure the RF In/Out Amplitude Offset state is turned on.
2. Correctly specify cable losses.
3. System Config→Control→Format Switch (F2)→GSM/GPRS.

4.6.1.1 Call parameters

On the Call Parameters screen, set the parameter values as shown in Table 4-2.

Table 4-2 Call parameter settings

BCH parameters	Cell power	-45 dBm
	Cell band	PGSM
	Broadcast channel	50
TCH parameters	Downlink traffic power	Default
	Traffic band	PGSM
	Traffic channel	50
	MS Tx level	19 (5 dBm) or 7 (29 dBm)
	Channel mode setup	Default
PDTCH parameters	Downlink traffic power	Default
	Traffic band	PGSM
	Traffic channel	55
	MS Tx level	Default
	Coding scheme	Default
	Multislot Config	Default
	Measured burst	Default
	First burst to loop	Default
	Timing advance control	Default
	Frequency hopping	Off (Default)
	DTM parameters	Default
Handover parameters	GSM Handover setup	Default
	GPRS Handover setup	Default
	DTM Handover setup	Default
	External Handover setup	Default
Receiver control	Expected power control	Auto (default)

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4.6.1.2 Control parameters

On the Control Parameters screen, set the parameter values as shown in Table 4-3.

Table 4-3 Control parameter settings

Operating mode		Active cell	GPRS, for idle	
		Active cell	GSM, for voice	
Data connection type		Auto		
Paging parameters		Paging multiframes	5	
		Paging mode	Normal	
		Paging identify type	IMSI	
Cell information	Cell operation	Mobile DTx state	Off	
		Downlink DTx state	Off	
		Persistent Attach state	Off	
		Tx Level FACCH signaling	On	
	Cell parameters	Band indicator	DCS (Default)	
		IMSI Attach state	Off (Default)	
	Cell identification	Set Operating mode to Cell Off before setting Cell ID		
		MCC	310	
		MNC	79	
		Cell identity	0 (Default)	
		After Cell ID changes, return Operating mode to Active Cell		
	Cell lists	GSM neighbors (BCH)	Off	
		GSM neighbors (PBBCH)	Off	
		CA table	Default	
		3G FDD neighbors	Off	
External trigger setup		Default		
Protocol logging		Default		
DUT PDP setup		DUT IP address	xx.xx.xx	
		DUT Primary DNS Server IP address	xx.xx.xx	
		DUT Secondary DNS Server IP address	xx.xx.xx	
		Route xxx.xxx.xxx.0/24 traffic to DUT	Off	
		All QoS profiles	Default	
Protocol control		Default		
Short Message Service (SMS)		Default		
Measurement reports		Default		
Digital audio interface		Default		
Real-time vocoder		Default		
Security information		Authentication parameters	Authentication state	Off
		Ciphering parameters	Off	
Calling party number parameters		Default		

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Turn off all GSM and 3G neighbors.

- Call Setup→Cell Information→Cell Lists→GSM Neighbors (BCH)→Ensure that all neighbors are off
- Call Setup→Cell Information→Cell Lists→GSM Neighbors (PBCCH)→Ensure that all neighbors are off
- Call Setup→Cell Information→Cell Lists→3G FDD Neighbors (PBCCH)→Ensure that all neighbors are off

4.6.2 Phone settings

NV item to modify is:

- 10→GSM only

Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→GSM only.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth/Data services.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Settings→Display→Screen Timeout to 15 sec.

4.6.3 Power measurement procedure GSM standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized.

4.6.4 Power measurement procedure for GSM talk (Android)

For power measurement:

1. Power on the phone and wait for the phone to camp to the network.
2. Make an MT call from the Agilent 8960 and answer the call.
3. Ensure that the call is connected.
4. Press **Mute**.
5. Wait until LCD/BL is off; start power measurement after about 2 min to ensure that the current has stabilized.

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4.6.5 Power measurement procedure for GSM standby (MDM)

For power measurement:

1. Power up the UE.
2. Wait until the UE camps on the network.
3. Start measurement after 2 min to ensure that the current has stabilized.

4.6.6 Power measurement procedure for GSM talk (MDM)

For power measurement:

1. Power up the UE.
2. Wait until the UE camps on the network.
3. Make an MT call from the Agilent 8960 and answer the call.
4. Start power measurement after 2 min to ensure that the current has stabilized.

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5 LTE use cases

Refer to Chapter 6 for TD-LTE and TDD LTE use cases.

5.1 LTE standby, 2.56 sec (LS1)/LTE Cat3, 68/23 Mbps, Band 13, 0 dBm, 10 MHz BW (LTE1E)

5.1.1 Anritsu MT8820C settings

Common parameters	
Test parameter	Normal
Call processing	On
Frequency (for band 13)	
Frame structure	FDD
Channel bandwidth	10 MHz
UL channel and frequency	23230
DL channel and frequency	5230
Operation band	13; changing the band in Anritsu automatically changes the frequency settings
Level	
Input level	0.0 dBm; adjust the input level of the UE Tx Power to 0 dBm in QXDM Pro
Output level	-30 dBm
AGWN level	-20 dB
External loss	On
Main UL	5 dB
Main DL	0 dB
Aux	0 dB
Signal	
Channel coding	Packet
Antenna configuration	2x2 MIMO (closed loop multilayer)
Propagation matrix	None
RMC configuration	PUSCH
UE category	3
DTCH data pattern	MAC padding bits
UL RMC	
Number of RB	50
Starting RB	0
MCS index	20 (16 QAM); change to get the desired throughput

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Common parameters	
DL RMC	
Number of RB	50
Starting RB	0
MCS index (1-4, 6-9)	28 (64 QAM); change to get the desired throughput
MCS index (5)	28 (64 QAM); change to get the desired throughput
MCS index (0)	28 (64 QAM); change to get the desired throughput
MCS index (-)	NA
CFI	1
Physical channel parameters	
PSS power	0 dB
SSS power	0 dB
PBCH power	-3 dB
PCFICH power	-3 dB
PDICH power	-3 dB
PDCCH power	-3 dB
P_A	-3 dB
P_B	1
Call processing parameters (depends on SIM card)	
Cell ID	0
MCC	01
MNC	001
Mobile Station Identity (MSI)	Depends on SIM card
Security	Depends on SIM card
RMC	
Target state	State 3A
Test mode	On
Loopback activation	Off
RRC release during registration	On
Preregistration	Off
Group hopping	On
Sequence hopping	Off
Measurement report	Off
Call drop	On
Level optimization before H0	On
PDN type	Auto
Power control	
TPC pattern	Auto
Power control offset	0 dB
p-Max	35
p0-Nominal PUSCH	-85
Additional spectrum emission	NS_01
filterCoefficient	Fc4

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Common parameters	
BCCH/PCCH parameter	
Modification period coefficient	n4
Default paging cycle	rf256
nB	T
RACH parameters	
Power ramping step	dB2
Preamble initial received target power	dBm -104
Preamble trans xax	N6
ra – Response window size	Sf10
Prach-config index	3
RAB connection	On
Random access response timing	1

5.1.2 Phone settings

NV settings are:

- 10→LTE only
- 65777→1
- 01896→1

EFS settings

- Add two blank hex files into the EFS to ensure that the phone always operates in Offline mode
  - This is to make sure that no neighbors are present; otherwise, by default the phone assumes 255 neighbor cells and keeps searching
- Add these two files to /nv/item_files/modem/lte/ML1 through EFS explorer
  - These blank files can be created using any hex editor or can be provided on request

Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→LTE.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data (For LTE-Cat3 only; disable for standby).
7. Settings→Display→Screen Timeout to 15 sec.
8. Make sure the APN is properly set on the phone; you can verify this in Settings→Wireless & Network→Mobile Networks→Access Point Names.

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5.1.3 Power measurement procedure for LTE standby (Android)

For power measurement:

1. Power up the handset and wait for the device to camp to the network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp to the network.
4. Press **End call** on Anritsu and then wait until the phone enters sleep.
5. Press the power key on the phone to turn off the backlight and LCD display.
6. Measure current draw for 1024 sec. To ensure data integrity, ensure the initial samples of the data capture do not include the period where the phone is awake to monitor the paging channel.
7. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.1.4 Power measurement procedure for LTE standby (MDM)

For power measurement:

1. Power up the UE and wait for the device to camp to the network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the UE to camp to the network.
4. Press **End call** on Anritsu and then wait until the UE enters sleep.
5. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture do not include the period where the UE is awake to monitor the paging channel.
6. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.1.5 Power measurement procedure for LTE Cat 3 embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client (the phone is the client here instead of the PC):
   a. Push the embedded iperf application to the phone through ADB (iPerfApp.apk is available in the Android market):

```
adb install bin/iPerfApp.apk
```


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```
adb push config.txt /data/data/com.android.iperfapp/config/config.txt
```

b. Pause.

NOTE: A different iperf APK is required for 64-bit chipsets.

4. Disconnect the USB from the phone to the PC.
5. Open the iperf application on the phone and run the command:
   a. Unselect the **disp on** and **file On** buttons.
   b. Press **run** to execute the following command, which exists by default in the iperf command window:

```
-s –u –i2
```

6. On the server PC, open a command window and execute:

```
cd c:\iperf
iperf -c 192.168.20.11 -u -t 3000 –l 1400 –i 2 –m 1200  -b 68M -w 256k –d
```

NOTE: 192.168.20.11 is the IP assigned by Anritsu to the DUT IP address that is set up in Agilent. Modify it according to your system configuration. The IP can be checked using the ADB shell **`netcfg`** command. The **`-d`** option is responsible for bidirectional data flow.

7. Make sure that the throughput is correctly climbing to around 68 Mbps.
8. Start power measurement using the power monitor.
9. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
10. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.1.6 Power measurement procedure for LTE Cat 3 USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client PC (downlink):
   a. Connect the handset with a USB.
   b. Disable USB charging. To do so, open a command window and execute:

```
adb shell setprop persist.usb.chgdisabled 1
adb shell "echo 1 > /sys/module/pm8921_charger/parameters/disabled"
```


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```
adb shell sync
```

c. Open QMICM or QPST Pro to connect to the handset.

d. Open a command window and execute:

```
cd c:\iperf
iperf –s –f k –i 2 –u
```

4. On the server PC (downlink), open a command window and execute:

```
cd c:\iperf
iperf -c 192.168.20.11 -u -t 3000 –l 1400 -i 2 –m 1200 -b 68M
```

NOTE: 192.168.20.11 is the IP assigned by Anritsu to the DUT. Modify it according to your system configuration.

5. For the server PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf –s –f k –i 2 –u
```

6. For the client PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.xxx -u -t 3000 –l 1400 -i 2 –m 1200 -b 23M
```

NOTE: 10.52.72.xxx is the IP address of the server PC.

7. Start power measurement using the power monitor.
8. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
9. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.2 LTE FDD CDRX standby (10 MHz, 320 ms) (CDRXS1)

5.2.1 Anritsu MT8820C settings

All the settings are the same as the LTE standby use case in Section 0 except changes listed in Table 5-1.

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Table 5-1 LTE FDD CDRX standby – Unique Anritsu MT8820C settings

RMC	
Scheduling type	**Dynamic**
DRX parameters	
Long DRX	320 ms
onDuration timer	10 ms
Inactivity timer	200 ms
Retransmission timer	2 ms
Short DRX	OFF

5.2.2 Phone settings

NV settings are:

- Same as Section 5.1.2 except Enable Data

5.2.3 Power measurement procedure for LTE standby (Android)

For power measurement:

1. Power up the handset and wait for the device to camp to the network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp to the network.
4. Press the power key on the phone to turn off the backlight and LCD display.
5. Make sure that the device has entered CDRX mode by looking at the waveforms. UL and DL RBs might require reduction for the device to enter CDRX mode.
6. Measure the current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture do not include the period where the phone is awake to monitor the paging channel.
7. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.3 LTE Cat 3 (100/50 Mbps, 0 dBm, Band 7), 20 MHz BW, (LTE6E)

5.3.1 Anritsu MT8820C settings

Common parameters	
Test parameter	**Normal**
Call processing	On

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Common parameters	
Test parameter	**Normal**
Frequency (for band 7)	
Frame structure	FDD
Channel bandwidth	20 MHz
UL channel and frequency	23230
DL channel and frequency	5230
Operation Band	7; changing the band in Anritsu automatically changes the frequency settings
Level	
Input level	0.0 dBm; adjust the input level of the UE Tx Power to 0 dBm in QXDM Pro
Output level	-30 dBm
AGWN level	-20 dB
External loss	On
Main UL	5 dB
Main DL	0 dB
Aux	0 dB
Signal	
Channel coding	Packet
Antenna configuration	2x2 MIMO; closed loop multilayer
Propagation matrix	None
RMC configuration	PUSCH
UE category	4
DTCH data pattern	MAC padding bits
UL RMC	
Number of RBs	100
Starting RB	0
MCS index	23 (16 QAM); change to get the desired throughput
DL RMC	
Number of RBs	100
Starting RB	0
MCS index (1-4, 6-9)	28 (64 QAM); change to get the desired throughput
MCS index (5)	28 (64 QAM); change to get the desired throughput
MCS index (0)	28 (64 QAM); change to get the desired throughput
MCS index (-)	NA
CFI	1
Physical channel parameters	
PSS power	0 dB
SSS power	0 dB
PBCH power	-3 dB
PCFICH power	-3 dB

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Common parameters	
Test parameter	**Normal**
PDICH power	-3 dB
PDCCH power	-3 dB
P_A	-3 dB
P_B	1
Call processing parameters (depends on SIM card)	
Cell ID	0
MCC	01
MNC	001
Mobile Station Identity (MSI)	Depends on SIM card
Security	Depends on SIM card
RMC	
Target state	State 3A
Test mode	On
Loopback activation	Off
RRC release during registration	On
Preregistration	Off

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5.3.2 Phone settings

NV settings are:

- 10→LTE only
- 65777→1
- 01896→1

EFS settings

- Add two blank hex files into the EFS to ensure that the phone always operates in Offline mode. This is to make sure that no neighbors are present; otherwise, by default, the phone assumes 255 neighbor cells and keeps searching.
- Add these two files to /nv/item_files/modem/lte/ML1 through EFS explorer. These blank files can be created using any hex editor or can be provided on request.

Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→LTE.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data (For LTE-Cat3 only Disable for Standby).

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7. Settings→Display→Screen Timeout to 15 sec.
8. Make sure that APN is properly set on the phone; you can verify this in Settings→Wireless & Network→Mobile Networks→Access Point Names.

5.3.3 Power measurement procedure for LTE Cat 3 embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client (the phone is the client here instead of the PC):
   a. Push the embedded iperf application to the phone through ADB (iPerfApp.apk is available in the Android market):

```
adb install bin/iPerfApp.apk
adb push config.txt /data/data/com.android.iperfapp/config/config.txt
```

   b. Pause.

NOTE: A different iperf APK is required for 64-bit chipsets.

4. Disconnect the USB from the phone to the PC.
5. Open the iperf application on the phone and run the command:
   a. Unselect the **disp on** and **file on** buttons.
   b. Press **run** to execute the following command, which exists by default in the iperf command window:

```
-s –u –i2
```

6. On the server PC, open a command window and execute:

```
cd c:\iperf
iperf -c 192.168.20.11 -u -t 3000 –l 1400 -i 2 –m 1200  -b 100M -w 256k –d
```

NOTE: 192.168.20.11 is the IP assigned by Anritsu to the DUT. Modify it according to your system configuration. Use the ADB shell **`netcfg`** command to check the IP. The **`-d`** option takes care of bidirectional data flow.

7. Make sure that the throughput is correctly climbing to around 100 Mbps.
8. Start power measurement using power monitor.
9. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.

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10. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.3.4 Power measurement procedure for LTE Cat 3 USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client PC (downlink):
   a. Connect the handset with a USB.
   b. Disable USB charging. To do so, open a command window and execute:

```
adb shell setprop persist.usb.chgdisabled
adb shell "echo 1  > /sys/module/pm8921_charger/parameters/disabled"
adb shell sync
```

   c. Open QMICM or QPST Pro to connect to the handset.
   d. Open a command window and execute:

```
cd c:\iperf
iperf -s -f k -i 2 -u
```

4. On the server PC (downlink), open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.137 -u -t 3000 -l 1400 -i 2 -m 1200 -b 55M
```

NOTE: 10.52.72.137 is the DUT IP address we set up in MT8820C. Modify it according to your system configuration.

5. For the server PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf -s -f k -i 2 -u
```

6. For the client PC (uplink), open a command window and execute:

```
cd c:\iperf
```


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```
iperf -c 10.52.72.xxx -u -t 3000 –l 1400 -i 2 –m 1200  -b 4M
```

NOTE: 10.52.72.xxx is the IP address of the server PC.

7. Start power measurement using the power monitor.
8. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
9. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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5.4 LTE Cat 4 (150/50 Mbps, 0 dBm, Band 7), 20 MHz BW, (LTE7E)

5.4.1 Anritsu MT8820C settings

Common parameters	
Test parameter	**Normal**
Call processing	On
Frequency (for band 7)	
Frame structure	FDD
Channel bandwidth	20 MHz
UL channel and frequency	23230
DL channel and frequency	5230
Operation band	7; changing the band in Anritsu automatically changes the frequency settings
Level	
Input level	0.0 dBm; adjust the input level of the UE Tx Power to 0 dBm in QXDM Pro
Output level	-30 dBm
AGWN level	-20 dB
External loss	On
Main UL	5 dB
Main DL	0 dB
Aux	0 dB
Signal	
Channel coding	Packet
Antenna configuration	2x2 MIMO; closed loop multilayer
Propagation matrix	None
RMC configuration	PUSCH
UE category	4
DTCH data pattern	MAC padding bits
UL RMC	
Number of RBs	100
Starting RB	0
MCS index	23 (16 QAM); change to get desired throughput
DL RMC	
Number of RBs	100
Starting RB	0
MCS index (1-4, 6-9)	28 (64 QAM); change to get desired throughput
MCS index (5)	28 (64 QAM); change to get desired throughput
MCS index (0)	28 (64 QAM); change to get desired throughput

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Common parameters	
MCS index (-)	NA
CFI	1
Physical channel parameters	
PSS power	0 dB
SSS power	0 dB
PBCH power	-3 dB
PCFICH power	-3 dB
PDICH power	-3 dB
PDCCH power	-3 dB
P_A	-3 dB
P_B	1
Call processing parameters (depends on SIM card)	
Cell ID	0
MCC	01
MNC	001
Mobile Station Identity (MSI)	Depends on SIM card
Security	Depends on SIM card
RMC	
Target state	State 3A
Test mode	On
Loopback activation	Off
RRC release during registration	On
Preregistration	Off

5.4.2 Phone settings

NV settings are:

- 10→LTE only
- 65777→1
- 01896→1

EFS settings

- Add two blank hex files into the EFS to ensure that the phone always operates in Offline mode
  - This is to make sure that no neighbors are present, otherwise by default the phone assumes 255 neighbor cells and keeps searching
- Add these two files to /nv/item_files/modem/lte/ML1 through the EFS explorer
  - These blank files can be created using any hex editor or can be provided on request.

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Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→LTE.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data (For LTE-Cat4 only; disable for standby).
7. Settings→Display→Screen Timeout to 15 sec.
8. Make sure that the APN is properly set on the phone; you can verify this in Settings→Wireless & Network→Mobile Networks→Access Point Names.

5.4.3 Power measurement procedure for LTE Cat 4 embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client (the phone is the client here instead of the PC):
   a. Push the embedded iperf application to the phone through ADB (iPerfApp.apk is available in the Android market):

      ```
      adb install bin/iPerfApp.apk
      adb push config.txt /data/data/com.android.iperfapp/config/config.txt
      ```

   b. Pause.

   NOTE: A different iperf APK is required for 64-bit chipsets.

4. Disconnect the USB from the phone to the PC.
5. Open the iperf application on the phone and run the command:
   a. Unselect the **disp on** and **file on** buttons.
   b. Press **run** to execute the following command, which exists by default in the iperf command window:

      ```
      -s –u –i2
      ```

6. On the server PC, open a command window and execute:

   ```
   cd c:\iperf
   iperf -c 192.168.20.11 -u -t 3000 –l 1400 -i 2 –m 1200  -b 150M -w 256k -d
   ```

NOTE: 192.168.20.11 is the IP assigned by Anritsu to the DUT. Modify it according to your system configuration. Use the ADB shell **`netcfg`** command to check the IP. The **`-d`** option takes care of bidirectional data flow.

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7. Make sure that the throughput is correctly climbing to around 150 Mbps.
8. Start power measurement using power monitor.
9. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
10. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.4.4 Power measurement procedure for LTE Cat 4 USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client PC (downlink):
   a. Connect the handset with a USB.
   b. Disable USB charging. To do so, open a command window and execute:

```
adb shell setprop persist.usb.chgdisabled 1
adb shell "echo 1 > /sys/module/pm8921_charger/parameters/disabled"
adb shell sync
```

   c. Open QMICM or QPST Pro to connect to the handset.
   d. Open a command window and execute:

```
cd c:\iperf
iperf –s –f k –i 2 –u
```

4. On the server PC (downlink), open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.137 -u -t 3000 –l 1400 -i 2 –m 1200 -b 150M
```

NOTE: 10.52.72.137 is the DUT IP address in MT8820C. Modify it according to your system configuration.

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5. For the server PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf –s –f k –i 2 –u
```

6. For the client PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.xxx -u -t 3000 –l 1400 -i 2 –m 1200  -b 50M
```

NOTE: 10.52.72.xxx is the IP address of the server PC.

7. Start power measurement using the power monitor.
8. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
9. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.5 TD-LTE standby, 2.56 sec (LS3)/LTE TDD Cat 3 DL + UL (60/18 Mbps) 0 dBm, 20 MHz bandwidth, B38, DLUL Config 1 (LTE5E)

5.5.1 Anritsu MT8820C settings

Common parameters	
Test parameter	**Normal**
Call processing	On
Frequency (for band 13)	
Frame structure	TDD
Channel bandwidth	20 MHz
UL channel and frequency	38000
DL channel and frequency	38000
Operation Band	38; changing the band in Anritsu automatically changes the frequency settings
Level	
Input level	0.0 dBm; adjust the input level of the UE Tx Power to 0 dBm in QXDM Pro
Output level	-30 dBm
AGWN level	-20 dB
External loss	On

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Common parameters	
Main UL	5 dB
Main DL	0 dB
Aux	0 dB
Signal	
Channel coding	Packet
Antenna configuration	2x2 MIMO; closed loop multilayer
DCI format for single antenna	1A
Propagation matrix	None
RMC configuration	PUSCH
UE category	3
DTCH data pattern	MAC padding bits
UL RMC	
Number of RBs	100
Starting RB	0
MCS index	20 (16 QAM); change to get the desired throughput
DL RMC	
Number of RBs	100
Starting RB	0
MCS index (1-4, 6-9)	28 (64 QAM); change to get desired throughput
MCS index (5)	28 (64 QAM); change to get desired throughput
MCS index (0)	28 (64 QAM); change to get desired throughput
MCS index (-)	NA
CFI	1
TDD	
Uplink/downlink configuration	1 – (5 ms) D S U U D D D S U DU D
Special subframe configuration	7
Physical channel parameters	
PSS power	0 dB
SSS power	0 dB
PBCH power	-3 dB
PCFICH power	-3 dB
PDICH power	-3 dB
PDCCH power	-3 dB
P_A	-3 dB
P_B	1
Call processing parameters (depends on SIM card)	
Cell ID	0
MCC	01
MNC	001
MSI	Depends on SIM card
Security	Depends on SIM card
RMC	

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Common parameters	
Target state	State 3A
Test mode	On
Loopback activation	Off
RRC release during registration	On
Preregistration	Off
Group hopping	On
Sequence hopping	Off
Measurement report	Off
Call drop	On
Radio resource configuration common update	RRC message
Level optimization before H0	On
PDN type	Auto
Robust Connection mode	Off
Scheduling type	Static
Power control	
Group hopping	On
Sequence hopping	Off
Measurement report	Off
Call drop	On
Radio resource configuration common update	RRC message
Level optimization before H0	On
BCCH/PCCH parameter (changes paging cycle time)	
Modification period coefficient	n4
Default paging cycle	rf256
nB	T
RACH parameters	
Power ramping step	dB2
Preample initial received target power	dBm -104
Preamble trans max	N6
ra – Response window size	Sf10
Prach-config index	3
RAB connection	On
Random access response timing	1
PUCCH parameter	
nRB-CQI	4
TDD Ack Nack Feedback mode	Multiplexing

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5.5.2 Phone settings

NV settings are:

- 10→LTE only
- 65777 →1
- 01896 →1

EFS settings

- Add two blank hex files into the EFS to ensure that the phone always operates in Offline mode. This is to make sure that no neighbors are present; otherwise, by default, the phone assumes 255 neighbor cells and keeps searching.
- Add these two files to /nv/item_files/modem/lte/ML1 through EFS explorer. These blank files can be created using any hex editor or can be provided on request.

Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→LTE.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data (For LTE-Cat3 only Disable for Standby).
7. Settings→Display→Screen Timeout to 15 sec.
8. Make sure that APN is properly set on the phone; you can verify this in Settings→Wireless & Network→Mobile Networks→Access Point Names.

5.5.3 Power measurement procedure for LTE standby (Android)

For power measurement:

1. Power up the handset and wait for the device to camp to the network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp to the network.
4. Press **End call** on Anritsu and then wait until the phone enters sleep.
5. Press the power key on the phone to turn off the backlight and LCD display.
6. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture do not include the period where the phone is awake to monitor the paging channel.
7. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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5.5.4 Power measurement procedure for LTE standby (MDM)

For power measurement:

1. Power up the UE and wait for the device to camp to the network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the UE to camp to the network.
4. Press **End call** on Anritsu and then wait until the UE enters sleep.
5. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture do not include the period where the UE is awake to monitor the paging channel.
6. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.5.5 Power measurement procedure for LTE Cat 3 USB tethered (MDM)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client PC (downlink):
   a. Connect the handset with a USB.
   b. Disable USB charging. To do so, open a command window and execute:

```
adb shell setprop persist.usb.chgdisabled
adb shell "echo 1  > /sys/module/pm8921_charger/parameters/disabled"
adb shell sync
```

   c. Open QMICM or QPST Pro to connect to the handset.
   d. Open a command window and execute:

```
cd c:\iperf
iperf –s –f k –i 2 –u
```

4. On the server PC (downlink), open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.137 -u -t 3000 –l 1400 -i 2 –m 1200 -b 60M
```


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NOTE: 10.52.72.137 is the DUT IP address set up in MT8820C. Modify it according to your system configuration.

5. For the server PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf –s –f k –i 2 –u
```

6. For the client PC (uplink), open a command window and execute:

```
cd c:\iperf
iperf -c 10.52.72.xxx -u -t 3000 –l 1400 –i 2 –m 1200 -b 18M
```

NOTE: 10.52.72.xxx is the IP address of the server PC.

7. Start power measurement using the power monitor.
8. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
9. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.5.6 Power measurement procedure for LTE Cat 3 embedded (Android)

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client (phone is the client here instead of the PC):
   a. Push the embedded iperf application to the phone through ADB (iPerfApp.apk is available in the Android market):

```
adb install bin/iPerfApp.apk
adb push config.txt /data/data/com.android.iperfapp/config/config.txt
```

   b. Pause.

NOTE: A different iperf APK is required for 64-bit chipsets.

4. Disconnect the USB from the phone to the PC.

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5. Open the iperf application on the phone and run the command:
   a. Unselect the **disp on** and **file on** buttons.
   b. Press **run** to execute the following command, which exists by default in the iperf command window.

```
-s -u -i2
```

6. On the server PC, open a command window and execute:

```
cd c:\iperf
iperf -c 192.168.20.11 -u -t 3000 -l 1400 -i 2 -m 1200  -b 60M -w 256k -d
```

NOTE: 192.168.20.11 is the IP assigned by Anritsu to the DUT IP address we set up in Agilent. Modify it according to your system configuration. Use the ADB shell **`netcfg`** command to check the IP. The **`-d`** option takes care of bidirectional data flow.

7. Make sure that the throughput is correctly climbing to around 60 Mbps.
8. Start power measurement using power monitor.
9. Measure current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
10. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.6 LTE TDD CDRX standby (20 MHz, 320 ms) (CDRXS4)

5.6.1 Anritsu MT8820C settings

All the settings are the same as those for the LTE standby use case in Section 5.5.1 except changes listed in Table 5-2.

Table 5-2 LTE TDD CDRX standby – Unique Anritsu MT8820C settings

RMC	
Scheduling type	**Dynamic**
DRX parameters	
Long DRX	320 ms
onDuration timer	10 ms
Inactivity timer	200 ms
Retransmission timer	2 ms
Short DRX	OFF

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5.6.2 Phone settings

NV settings are:

- Same as Section 5.5.2 except Enable Data

5.6.3 Power measurement procedure for LTE standby (Android)

For power measurement:

1. Power up the handset and wait for the device to camp to the network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. Wait for the phone to camp to the network.
4. Press the power key on the phone to turn off the backlight and LCD display.
5. Make sure that the device has entered CDRX mode by looking at the waveforms. Sometimes, UL and DL RBs might have to be reduced for the device to enter CDRX mode.
6. Measure the current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture do not include the period where the phone is awake to monitor the paging channel.
7. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

5.7 SVLTE active, 1X talk, Cell + LTE Cat2 Band 13, embedded (L2CT1E)

5.7.1 Agilent 8960 and Anritsu setting

Agilent 8960 settings are the same as 1X mode. Anritsu settings are the same as LTE mode.

5.7.2 Phone settings

NV setting is:

- 10→Global mode

Phone UI settings (Android only)

1. The phone should be in Global mode.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data.
7. Settings→Display→Screen Timeout to 15 sec.

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8. Connect the primary channel out from Anritsu to the primary RF input on the phone.
9. Connect the 1X signal from the Agilent 8960 and secondary channel output from the Anritsu into a 2:1 splitter input respectively. Connect the splitter out to the secondary RF input of the phone.

5.7.3 Power measurement procedure (Android)

For power measurement:

1. After completing the procedure in Section 5.7.2, make sure that the phone is camped to 1X and LTE.
2. Initiate a 1X voice call and make sure that the voice call is connected.
3. Execute the client and PC data transfer for LTE Cat2 (only downlink) with downlink at 50 Mbps by following steps similar to LTE Cat3.
4. Wait for the LCD backlight to turn off. Start measuring power after waiting 2 min.

5.7.4 Power measurement procedure (MDM)

For power measurement:

1. After completing the procedure in Section 5.7.2, make sure the phone is camped to 1X and LTE.
2. Initiate a 1X voice call and make sure the voice call is connected.
3. Execute the client and PC data transfer for LTE Cat2 (only downlink) with downlink at 50 Mbps by following steps similar to LTE Cat3.
4. Start measuring power after waiting 2 min.

5.8 VoLTE talk 0 dBm, 50% DTX, 40 ms CDRX, dynamic scheduling (VoLTE1)

5.8.1 Agilent PXT settings

1. Set the CDRX settings:
   - Long DRx cycle – 40 ms
   - Inactivity timer – 2 ms
   - On duration – 2 ms
   - Short DRx – OFF
2. Maximum HARQ value – 1
3. Config – SR-Config Index is set according to DRx cycle
   - SR-Config Index = 35 for 40 ms
   - SR-Config Index = 15 for 20 ms

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5.8.2 Phone settings

1. IMS server setting
   - IPv6 for IMS
   - IMS VoIP configuration
   - IMS SMS configuration
2. Modify the following NV items:
   - Update this NV item on local copy of .scr file
   - 67261→0 0 0 **1** 0 0 0 0 (IMS DPL Configuration)
   - 67264→1 3 “VZWIMS” 0 0 0 1 “[**2002:c023:9c17:203::0a2a:5c21**]:5060” 10 0 0 0 0 “106” 0 “5,5,5” 0 “15” 3 “15” 0 0 (IMS Registration Module Configuration)
   - 67258→“sip:11111@test.3gpp.com” “11111” “11111@test.3gpp.com” “11111” **"test.3gpp.com"** "465b5ce8b199b49faa5f0a2ee238a6bc" 0 "5f1d289c5d354d0a140c2548f5f3e3ba (IMS Configuration)
   - 67259→“**11111**” 0 “+g.3gpp.smsip” “10” 0x00000600 “**vzwims**” 1
   - 69744→0 5060 7200 0 3000 16000 5000 30000 30000 1500 0 0 0 0 0 0 0 “” “”
   - 67257→0 1 1 “urn:urn-7:3gpp-service.ims.icsi.mmtel” 1800 600 0 "1234" 0 1800 0 0 “”
   - 01896→1 – IPv6 enabled
   - 00010→14 – Automatic mode
   - 00562→1 – Hybrid enabled
   - 04265→0 – Enable VoIP registration
   - 67218→1 – Enable IMS registration
   - 04230→0 – SIP URI
   - 65956→0 – SIP URI (new NV)
   - 67280→20000 – QIP call ringing timer
   - 67281→20000 – QIP call ringback timer
   - 67282→20 – QIP call RTP link aliveness timer
   - 67199→1 – Domain selection is enabled
   - 65959→0 – No privacy header
   - 65964→1 – HD voice on (AMR WB)
   - 66031→0 – Mode 0 of the audio codec selected
   - 66472→1 –PS SMS preferred

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- 66473→1 – SMS mandatory

  71527→ims_rate_apn_information[0].iRAT = 24

  →ims_rat_apn_information[0].iAPNType+APNindex = 17

  →ims_rat_apn_information[0].iIMSServiceInfo = 2047

  →ims_rat_apn_information[0].iAuth_SEecType = 200

  →ims_rat_apn_information[0].iIPTupeInfo = 64 (to work with IPv4, set it to 32)

  →ims_rat_apn_information[1].iRAT = 24

  →ims_rat_apn_information[1].iAPNType+APNindex = 34

  →rat_apn_fb_information[0].iRATAPNFallback = 20992

  →rat_apn_fb_information[1].iRATAPNFallback = 16896

  →iNVPriority = 1

  →iIMSServiceStatus = 34815

  →ims_apn_name_db[0].cAPNName = ‘vzwims”

  →ims_apn_name_db[1].cAPNName = ‘vzwinternet”

  →ims_apn_name_db[2].cAPNName = ‘”

  The remaining NV items are set to 0.

- 67300→[0].ft_quad_ind – 8

  →[0].state – 3

- Set APN profile using Putty
  - Delete profile1.xml and profile2.xml from \pdp_profiles\consl_profiles in EFS and reset the UE
  - Connect the Modem serial port (MyComputer→Device Manager→Modems→ Qualcomm HS-USB Android Modem) using SecureCRT/Hyperterminal or Putty.
  - Configure the "vzwims" PDN by running the following commands in the serial connection

```
OK
at+cgdcont=1,"ipv4v6","vzwims"
OK
at+cgdcont?
+CGDCONT: 1,"IPV4V6","vzwims","0.0.0.0",0,0
```

NOTE: Update parameters in **bold** typeface with the IP address, domain name, and user ID that are configured in your SIP.

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5.8.3 Voice-centric device configuration

1. 00850→0x1 – PS only
2. 65777→0 – Voice-centric
3. 66048→3 – IMS PS voice preferred

5.8.4 SMS-only device configuration

1. 00850→0x2 – CS PS
2. 65777→1 – Data-centric
3. 66048→0 – CS voice only

After you have done read/write for all, reset the device.

5.8.5 Making a VoLTE call using the Dialer application

1. Use the following given ADB commands:

```
adb shell setprop persist.radio.calls.on.ims true
adb shell setprop persist.radio.vrte_logic 1
```

   Additional configurations for JB are:

```
adb shell setprop persist.radio.jbims 1
```

2. Add an IMS account.
   a. Click the phone icon and then press **Menu** on the phone.
   b. Select Settings menu and scroll to the IMS Account menu.
3. Set the type of call (voice/video).
4. Set the checkbox **Use IMS Always** to tell Android to always place an IMS call.
5. Click **Save** or **Back** to save the settings.
6. Go to the Dialer app setting on the UE interface and then to IMS settings.
7. Enable IMS for voice call.
8. Dial a number using the Dialer app.

5.8.6 Phone UI settings

1. The phone should be in Global mode.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.

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5. Disable Sensor – Qualcomm Settings→Sensor→Disable (unclick).
6. Enable data.
7. Settings→Display→Screen Timeout to 15 sec.

5.8.7 Power measurement procedures

After the above connections are made, make sure that the phone is camped to LTE.

Three states are tested separately:

- Talk state – Audio clip [refer to *VoLTE Audio Test File for Power Measurement* (MH80-VR010-21)] is played at the UE DUT while the remote device is muted.
- Listen state – DUT is muted and the audio clip [refer to *VoLTE Audio Test File for Power Measurement* (MH80-VR010-21)] is played at the remote device.
- Silent state – Both the DUT and the remote device should be muted.

5.9 VoLTE TDD talk 0 dBm, 50% DTX, 40 ms CDRX, dynamic scheduling (VoLTE6)

NOTE: This section was added to this document revision.

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5.9.1 Agilent PXT settings

1. Set the CDRX settings:
   - Long DRx cycle – 40 ms
   - Inactivity timer – 2 ms
   - On duration – 2 ms
   - Short DRx – OFF
2. Maximum HARQ value – 1
3. Config – SR-Config Index is set according to DRx cycle:
   - SR-Config Index = 35 for 40 ms
   - SR-Config Index = 15 for 20 ms
4. Set the spectrum technology to TDD.
5. Switch the operation band to 38.

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5.9.2 Phone settings

1. IMS server setting:
   - IPv6 for IMS
   - IMS VoIP configuration
   - IMS SMS configuration
2. Modify the following NV items:
   - Update this NV item on the local copy of the .scr file
   - 67261→0 0 0 **1** 0 0 0 0 (IMS DPL Configuration)
   - 67264→1 3 “VZWIMS” 0 0 0 1 “[**2002:c023:9c17:203::0a2a:5c21**]:5060” 10 0 0 0 0 “106” 0 “5,5,5” 0 “15” 3 “15” 0 0 (IMS Registration Module Configuration)
   - 67258→“sip:11111@test.3gpp.com” “11111” “11111@test.3gpp.com” “11111” **"test.3gpp.com"** "465b5ce8b199b49faa5f0a2ee238a6bc" 0 "5f1d289c5d354d0a140c2548f5f3e3ba (IMS Configuration)
   - 67259→“**11111**” 0 “+g.3gpp.smsip” “10” 0x00000600 “**vzwims**” 1
   - 69744→0 5060 7200 0 3000 16000 5000 30000 30000 1500 0 0 0 0 0 0 0 “” “”
   - 67257→0 1 1 “urn:urn-7:3gpp-service.ims.icsi.mmtel” 1800 600 0 "1234" 0 1800 0 0 “”
   - 01896→1 – IPv6 enabled
   - 00010→14 – Automatic mode
   - 00562→1 – Hybrid enabled
   - 04265→0 – Enable VoIP registration
   - 67218→1 – Enable IMS registration
   - 04230→0 – SIP URI
   - 65956→0 – SIP URI (new NV)
   - 67280→20000 – QIP call ringing timer
   - 67281→20000 – QIP call ringback timer
   - 67282→20 – QIP call RTP link aliveness timer
   - 67199→1 – Domain selection is enabled
   - 65959→0 – No privacy header
   - 65964→1 – HD voice on (AMR WB)
   - 66031→0 – Mode 0 of the audio codec selected
   - 66472→1 – PS SMS preferred

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- 66473→1 – SMS mandatory

  71527→ims_rate_apn_information[0].iRAT = 24

  →ims_rat_apn_information[0].iAPNType+APNindex = 17

  →ims_rat_apn_information[0].iIMSServiceInfo = 2047

  →ims_rat_apn_information[0].iAuth_SEecType = 200

  →ims_rat_apn_information[0].iIPTupeInfo = 64 (to work with IPv4, set it to 32)

  →ims_rat_apn_information[1].iRAT = 24

  →ims_rat_apn_information[1].iAPNType+APNindex = 34

  →rat_apn_fb_information[0].iRATAPNFallback = 20992

  →rat_apn_fb_information[1].iRATAPNFallback = 16896

  →iNVPriority = 1

  →iIMSServiceStatus = 34815

  →ims_apn_name_db[0].cAPNName = ‘vzwims”

  →ims_apn_name_db[1].cAPNName = ‘vzwinternet”

  →ims_apn_name_db[2].cAPNName = ‘”

  The remaining NV items are set to 0.

- 67300→[0].ft_quad_ind – 8

  →[0].state – 3

- Set the APN profile using Putty:
  - Delete profile1.xml and profile2.xml from \pdp_profiles\consl_profiles in EFS and reset the UE
  - Connect the Modem serial port (MyComputer→Device Manager→Modems→ Qualcomm HS-USB Android Modem) using SecureCRT/Hyperterminal or Putty.
  - Configure the "vzwims" PDN by running the following commands in the serial connection

```
OK
at+cgdcont=1,"ipv4v6","vzwims"
OK
at+cgdcont?
+CGDCONT: 1,"IPV4V6","vzwims","0.0.0.0",0,0
```

NOTE: Update parameters in **bold** typeface with the IP address, domain name, and user ID that are configured in your SIP.

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5.9.3 Voice-centric device configuration

1. 00850→0x1 – PS only
2. 65777→0 – Voice-centric
3. 66048→3 – IMS PS voice preferred

5.9.4 SMS-only device configuration

1. 00850→0x2 – CS PS
2. 65777→1 – Data-centric
3. 66048→0 – CS voice only
4. Read/write on 00850, 65777, and 66040, and reset the device.

5.9.5 Making a VoLTE call using the Dialer application

1. Type the following given ADB commands:

```
adb shell setprop persist.radio.calls.on.ims true
adb shell setprop persist.radio.vrte_logic 1
```

   Additional configurations for JB are:

```
adb shell setprop persist.radio.jbims 1
```

2. Add an IMS account.
   a. Click the phone icon and then press **Menu** on the phone.
   b. Select Settings menu and scroll to the IMS Account menu.
3. Set the type of call (voice/video).
4. Set the checkbox **Use IMS Always** to tell Android to always place an IMS call.
5. Click **Save** or **Back** to save the settings.
6. Go to the Dialer app setting on the UE interface and locate IMS settings.
7. Enable IMS for voice call.
8. Dial a number using the Dialer app.

5.9.6 Phone UI settings

1. The phone must be in Global mode.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.

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5. Disable Sensor – Qualcomm Settings→Sensor→Disable (unclick).
6. Enable data.
7. Settings→Display→Screen Timeout to 15 sec.

5.9.7 Power measurement procedures

After the above connections are made, make sure that the phone is camped to LTE.

Three states are tested separately:

- Talk state – Audio clip is played at the UE DUT while the remote device is muted. Refer to *VoLTE Audio Test File for Power Measurement* (MH80-VR010-21).
- Listen state – DUT is muted and the audio clip is played at the remote device. Refer to *VoLTE Audio Test File for Power Measurement* (MH80-VR010-21).
- Silent state – DUT and the remote device both must be muted.

5.10 LTE Cat 3 CA 10 MHz + 10 MHz, 100/25 Mbps, 0 dBm (LTE8E)

5.10.1 CMW 500 settings

LTE Cat 3 CA settings are the same as Cat 6 with one exception – the channel bandwidth is 10 MHz instead of 20 MHz. The expected throughput for this test case is 100 Mbps for the downlink and 25 Mbps for the uplink.

5.10.2 Phone settings

NV settings are:

- 10→LTE only
- 65777→1
- 01896→1

EFS settings

- Add two blank hex files to the EFS to ensure that the phone always operates in Offline mode. This action ensures that no neighbors are present. Otherwise the phone assumes 255 neighbor cells and keeps searching by default.
- Add the two hex files to /nv/item_files/modem/lte/ML1 viea the EFS explorer. These blank files can be created using any hex editor, or can be provided on request.

Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→LTE.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.

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5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data (for LTE-Cat3 only; disable for standby).
7. Settings→Display→Screen Timeout to 15 sec.
8. Verify that the APN is properly set on the phone in Settings→Wireless & Network→Mobile Networks→Access Point Names.

5.10.3 Power measurement procedure

1. Power up the handset and verify that it is acquired on the intended LTE network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client (UE is client here):
   a. Install the embedded iperf application to the phone via ADB.
   b. Pause.
4. Open the iperf application on the phone.
   a. Click the **disp on** and **file on** buttons.
   b. Press **run** to execute the following command:

```
-s  -u -i2
```

5. On the server PC, open a command window and run the following commands:

```
cd c:\iperf
iperf -c 192.168.20.12 -u -p 5001 -t 3000 -i 2 -w 1000000 -b 100M -d
```

6. Ensure that the throughput displayed on the UE is showing the correct values:
   - 99 Mbps DL
   - 22 Mbps UL
7. Deselect the **disp on** and **file on** buttons for power measurement on the UE.
8. Run the following ADB commands to disable data monitoring:

```
adb root
adb remount
adb shell ndc bandwidth disable
adb shell sync
```

9. Disconnect the USB from the UE.
10. Start power measurement on the correct channel in XUDAS.
11. Measure the current drawn for 1024 sec. To ensure data integrity, make sure that the initial samples of the data capture are not included.

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12. Repeat the test three times to ensure stability of the test setup and repeatability of the test environments. If the test is calibrated and tightly controlled, variance should be less than 1%.

NOTE: 192.168.20.12 is the IP assigned by Anritsu to the DUT. Modify it according to your system configuration. Use the ADB shell **`netcfg`** command to check the IP. The **`-d`** option manages bidirectional data flow.

5.11 LTE Cat 6 CA 20 MHz + 20 MHz, 300/50 Mbps, 0 dBm (LTE10E)

5.11.1 CMW 500 settings

- R& S CMW 500 call box that supports CA is used
- PCC settings:
  - 20 MHz BW, Band 3
  - 2-antenna configuration
  - 64-QAM modulation
  - RBs 100
- SCC settings:
  - 20 MHz BW
  - Band 7
  - 2-antenna configuration
  - 64-QAM modulation
  - RBs 100
- RF configurations and connections change based on the call box being used and the phone RF hardware antenna configurations

Prerequisites

- CMW 500 call box:
  - Must support Carrier Aggregation
  - Must have LTE Signaling version 3.2.70.8 or newer.
- UE supports Cat 6 and has the following NV items set (besides the NV items used for general LTE Cat 3/4 camping):
  - NV 72524, HS USB Core Select = 1
  - NV 72525, HS USB Uplink BAM BYPASS = 1
  - NV 70310, UI Task Config = 1
- USB 3.0
  - Make sure that the USB 3.0-supported blue wire is connected to the 3.0 USB port on the CPU of the PC

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5.11.2 CMW 500 settings for primary component carrier (PCC)

Parameters		
Duplex Mode	FDD	
Scenario	2CC CA – 4 RF Out	
RF Settings		
RF Output (TX)	Out 1	Out 2
Connector	RF1COM	RF3COM
Converter	RFTX1	RFTX2
External Attenuation	0.00 dB	0.00 dB
RF Input (RX)		
Connector	RF1COM	
Converter	RFRX1	
External Attenuation	0.00 dB	
RF Frequency		
Operating Band	Band 3	
DL Channel/Frequency	1575 Ch /1842.5MHz	
DL Frequency Offset	0 Hz	
UL Channel/Frequency	19575 Ch /1747.5 MHz	
UL Frequency Offset	0 Hz	
Exp. Nominal Power Mode	According to UL Power Control Settings	
Exp. Nominal Power	-15.20 dBm Ref.Level: -3.20 dBm	
Margin	12 dB	
Mixer Level Offset	0 dB	
Downlink Power Levels		
RS EPRE	-65.0 dBm/ 15 KHz; Full Cell BW Power: -34.2 dBm	
PSS Power Offset	0.00 dB	
SSS Power Offset	0.00 dB	
PBCH Power Offset	0.00 dB	
PCFICH Power Offset	0.00 dB	
PHICH Power Offset	0.00 dB	
PDCCH Power Offset	0.00 dB	
OCNG	-	
Uplink Power Control		
Open Loop Nominal Power	-20 dBm @ Full RB Allocation	
Advanced PRACH/OL Power		
Enable Advanced Settings	-	
Reference Signal Power	-3 dBm	
Preamble Initial Received	-90 dBm	
P0 Nominal PUSCH	-40 dBm	
Pathloss Compensation Alpha	0	
Toggle P0-UE-PUSCH	-	
Pathloss	62 dBm	

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Parameters	
Expected PRACH Preamble	-28 dBm
Expected OL Power	-20.0 dBm
TX Power Control (TPC)	
Active TPC Setup	Closed Loop
Closed Loop Target Power	-20.0 dBm
Max Allowed Power P-Max	24 dBm
Physical Cell Setup	
DL Cell Bandwidth	20.0 MHz
UL Cell Bandwidth	20.0 MHz
Physical Cell ID	0
Cyclic Prefix	Normal
Sounding RS (SRS)	-
Uplink Downlink Configuration	1
Special Subframe	7
Network	
I Intra Search	32 dB
S NonIntraSearch	32 dB
ThreshServingLow	16 dB
Q rxlevmin	-132 dBm
MCC	440
MNC	79 (Two Digits)
TAC	1
Authentication	Yes
NAS Security	Yes
AS Security	Yes
Integrity Algorithm	SNOW3G (EIA1)
Mileage	Yes
OPc	0102 0304 0506 0708 0910 1112 1314 1516 hex
Security Key	0011 2233 4455 6677 8899 AABB CCDD EEFF hex
RAND Value	Even
Default IMSI	440790123456789
Connection	
Group Hopping	-
UE Category	Manual: 5 Use Reported (if available): Yes
Default Paging Cycle	#256
Additional Spectrum Emission	NS_01
UE Meas. Filter Coefficient	FC4
Connection Type	Data Application
Use “Activate Testmode”	Yes
RLC Mode	Unacknowledged
SIB Reconfiguration	SIB Paging

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Parameters		
Keep RRC Connection	Inactivity Timer	
Downlink MAC Padding	Yes	
Downlink MAC Error Insertion	0%	
Transmission Mode	TM 4	
DCI Format	2	
Antenna Configuration	2	
Precoding Matrix	PMI 0	
Scheduling type	User-defined Channels	
User-defined Channels (DL)	Stream 1	Stream 2
Use Stream 1 Settings	-	Yes
# Resource Block	100	100
Start Resource Block	0	0
Modulation Type	64-QAM	64-QAM
Transport Block Size Index	26	26
Transport Block Size	75376	75376
Throughput	75.376 Mbit/s	75.376 Mbit/s
Max Throughput	DL : 150.752 Mbit/s UL : 51.024 Mbit/s	
Reduced PDCCH	Yes	
# PDCCH Symbols	1	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (SI-RNTI)	4 CCE	
Operating Band Change	Redirection	
Frequency Change	Blind Handover	
Accept Multiple Def. Bearer	Yes	
DL HARQ	Yes	
Number of HARQ Transmission	2	
Redundancy Version Coding	TS 36.104 {0,2,3,1}	
User-Defined Sequence	Length: 4{ 0 0 0 0 }	
CQI Reporting		
Enable CQI Reporting	Off	
Format Indicator	Wideband	
CQI/PMI Config Index	FDD: 0 TDD: 3	
CQI/PMI Reporting Period	2 Subframes	
CQI/PMI Reporting Offset	0 Subframes	

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5.11.3 CMW 500 settings for secondary component carrier (SCC)

Parameters		
Duplex Mode	FDD	
Scenario	2CC CA – 4 RF Out	
RF Settings		
RF Output (TX)	Out 1	Out 2
Connector	RF1COM	RF3COM
Converter	RFTX3	RFTX4
External Attenuation	0.00 dB	0.00 dB
RF Input (RX)		
Connector	RF1COM	
Converter	RFRX1	
External Attenuation	0.00 dB	
RF Frequency		
Operating Band	Band 7	
DL Channel/Frequency	3102 Ch /2655.2 MHz	
DL Frequency Offset	0 Hz	
UL Frequency Offset	0 Hz	
Exp. Nominal Power Mode	According to UL Power Control Settings	
Exp. Nominal Power	-15.20 dBm Ref.Level: -3.20 dBm	
Margin	12.00 dB	
Mixer Level Offset	0 dB	
Downlink Power Levels		
RS EPRE	-65.0 dBm/ 15 KHz; Full Cell BW Power: -34.2 dBm	
PSS Power Offset	0.00 dB	
SSS Power Offset	0.00 dB	
PBCH Power Offset	0.00 dB	
PCFICH Power Offset	0.00 dB	
PHICH Power Offset	0.00 dB	
PDCCH Power Offset	0.00 dB	
OCNG	-	
Power Offset PA	0 dB	
Power Ratio Index PB	0	
Uplink Power Control		
Open Loop Nominal Power	-20 dBm @ Full RB Allocation	
Advanced PRACH/OL Power		
Enable Advanced Settings	-	
Reference Signal Power	-3 dBm	
Preamble Initial Received	-90 dBm	
P0 Nominal PUSCH	-40 dBm	
Pathloss Compensation Alpha	0	
Toggle P0-UE-PUSCH	-	

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Parameters	
Pathloss	62 dBm
Expected PRACH Preamble	-28 dBm
Expected OL Power	-20.0 dBm
TX Power Control (TPC)	
Active TPC Setup	Closed Loop
Closed Loop Target Power	-20.0 dBm
Max Allowed Power P-Max	24 dBm
Physical Cell Setup	
DL Cell Bandwidth	20.0 MHz
Physical Cell ID	0
Cyclic Prefix	Normal
Sounding RS (SRS)	-
Uplink Downlink Configuration	1
Special Subframe	7
Network	
S Intra Search	32 dB
S NonIntraSearch	32 dB
ThreshServingLow	16 dB
Q rxlevmin	-132 dBm
MCC	440
MNC	79 (Two Digits)
TAC	1
Authentication	Yes
NAS Security	Yes
AS Security	Yes
Integrity Algorithm	SNOW3G (EIA1)
Mileage	Yes
OPc	0102 0304 0506 0708 0910 1112 1314 1516 hex
Security Key	0011 2233 4455 6677 8899 AABB CCDD EEFF hex
RAND Value	Even
Default IMSI	440790123456789
Connection	
Group Hopping	-
UE Category	Manual: 5 Use Reported (if available): Yes
Default Paging Cycle	#256
Additional Spectrum Emission	NS_01
UE Meas. Filter Coefficient	FC4
Connection Type	Data Application
Use “Activate Testmode”	Yes
RLC Mode	Unacknowledged
SIB Reconfiguration	SIB Paging

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Parameters		
Keep RRC Connection	Inactivity Timer	
Downlink MAC Padding	Yes	
Downlink MAC Error Insertion	0%	
Transmission Mode	TM 4	
DCI Format	2	
Antenna Configuration	2	
Precoding Matrix	PMI 0	
Scheduling type	User-defined Channels	
User-defined Channels (DL)	Stream 1	Stream 2
Use Stream 1 Settings	-	Yes
# Resource Block	100	100
Start Resource Block	0	0
Modulation Type	64-QAM	64-QAM
Transport Block Size Index	26	26
Transport Block Size	75376	75376
Throughput	75.376 Mbit/s	75.376 Mbit/s
Max Throughput	DL : 150.752 Mbit/s UL : 51.024 Mbit/s	
Reduced PDCCH	Yes	
# PDCCH Symbols	1	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (SI-RNTI)	4 CCE	
Operating Band Change	Redirection	
Frequency Change	Blind Handover	
Accept Multiple Def. Bearer	Yes	
DL HARQ	Yes	
Number of HARQ Transmission	2	
Redundancy Version Coding	TS 36.104 {0,2,3,1}	
User Defined Sequence	Length: 4{ 0 0 0 0 }	
CQI Reporting		
Enable CQI Reporting	Off	
Format Indicator	Wideband	
CQI/PMI Config Index	FDD: 8 TDD: 11	
CQI/PMI Reporting Period	10 Subframes	
CQI/PMI Reporting Offset	1 Subframes	

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5.11.4 Setup call box RF connections and UE physical connections

Figure 5-1 shows how to map the RF port and configure RF1 COM as the Primary of PCC and SCC on the callbox. It also shows how to configure RF3 COM to the Secondary/ Diversity of PCC and SCC. For the UE, the two cables must split into four and connect to their respective ports on the RF card based on the bands used.

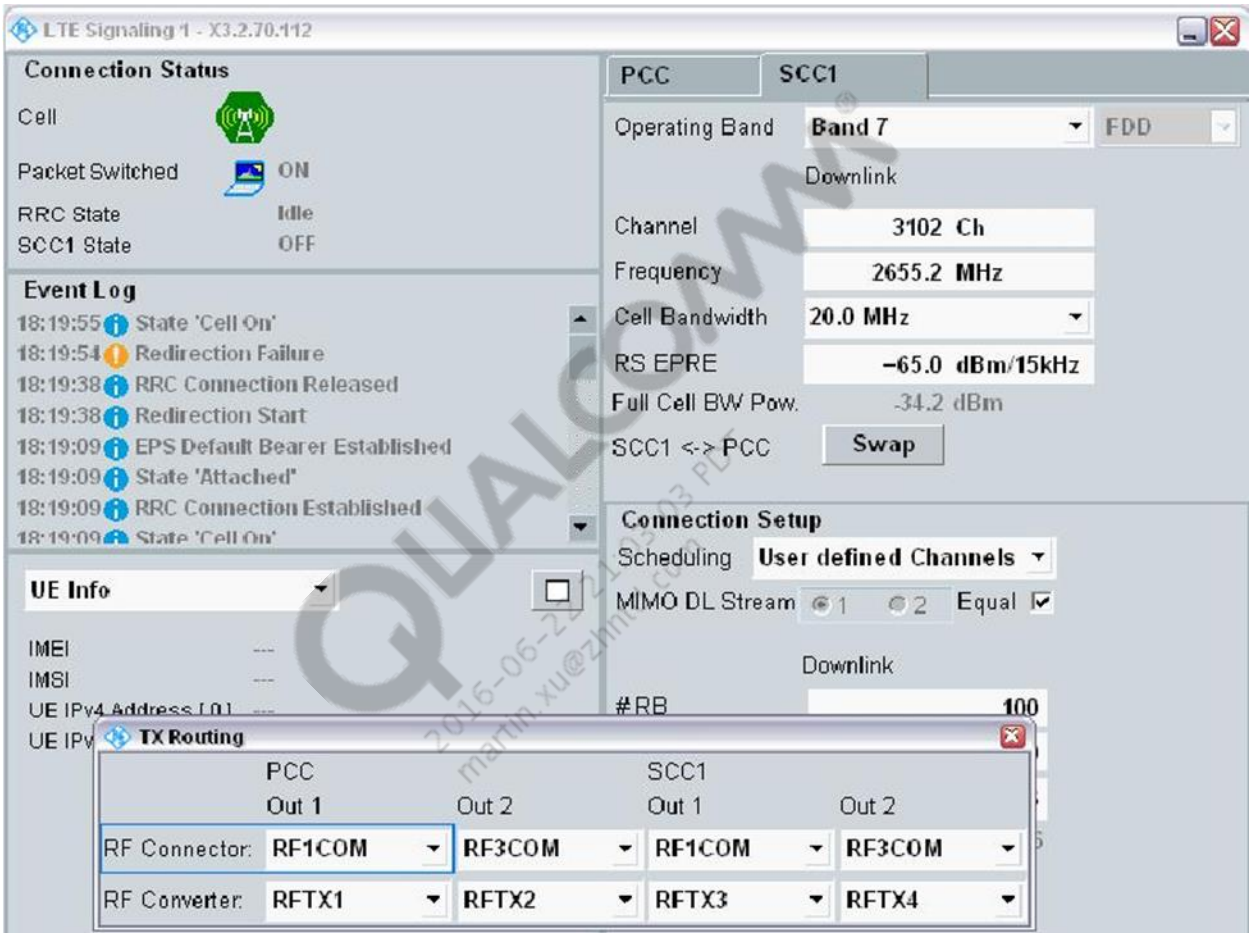

Figure 5-1 LTE Cat 6 – RF port mapping

Figure 5-2 shows how to configure RF1 COM for uplink.

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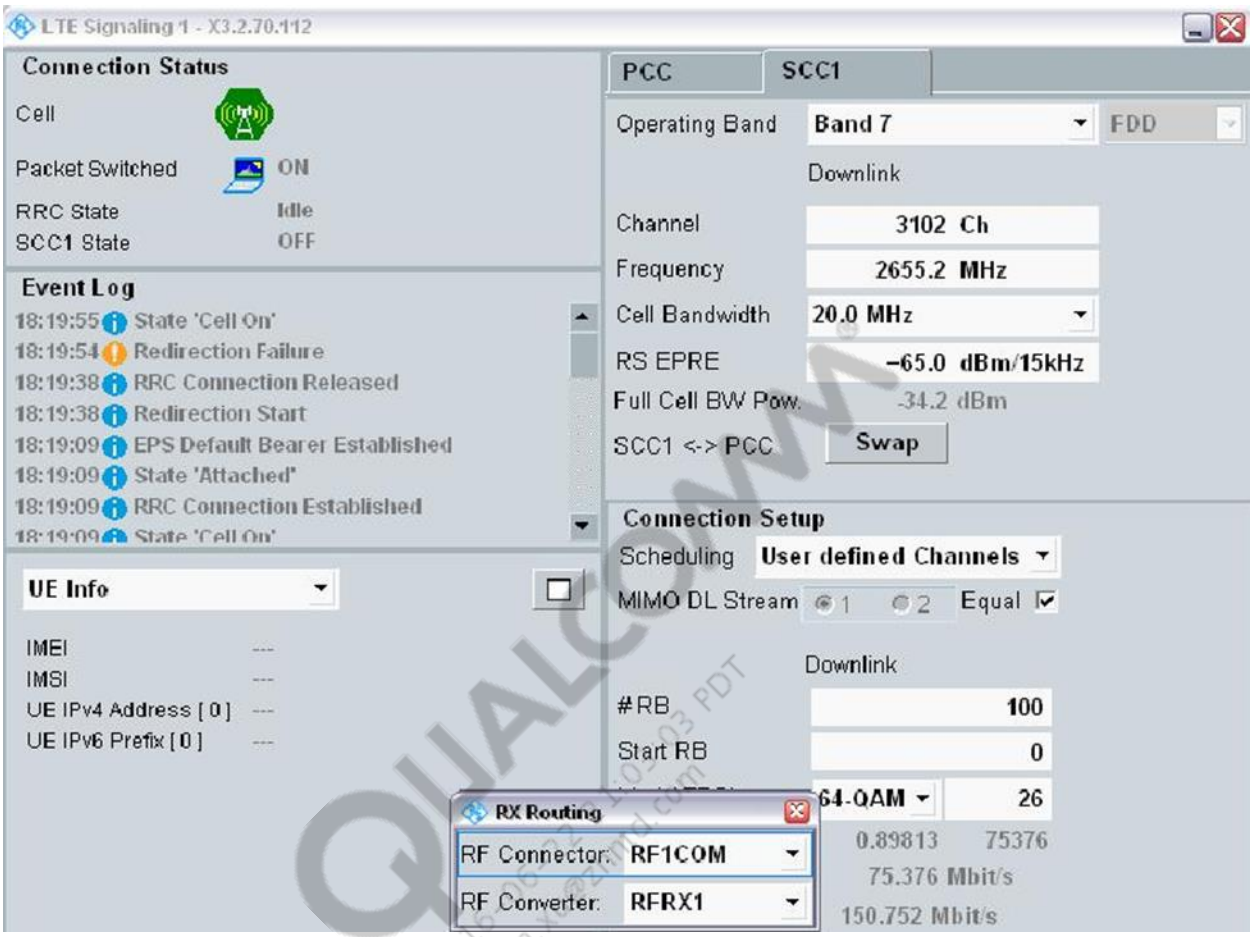

Figure 5-2 LTE Cat 6 – RF1 COM for uplink configuration

5.11.5 Phone settings

Apart from all of the EFS and NV settings described in Section 5.10.2, the following NV items must be changed:

- NV 06828 – LTE Band class Pref = (1237269952735) (or change it depending on the bands used; Band 3 for PCC and Band 7 for SCC is used for QTI dashboard power measurements)
- NV 70310 – UI Task Config = 1

NV settings required only for USB tethering Cat 6 use cases and need not be set for embedded data call use cases are:

- NV 72524 – HS USB Core Select = 1
- NV 72525 – HS USB Uplink BAM BYPASS = 1

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5.11.6 Power measurement procedure

For power measurement:

1. Power up the handset and verify that it is acquired on the intended LTE network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
3. On the client (UE is the client here):
   a. Install the embedded iperf application to the phone through ADB.
   b. Pause.
4. Open the iperf application on the phone.
   a. Click disp on and file on.
   b. Press **run** to execute the following command, which exists by default in the iperf command window:

```
-s  -u -i2
```

5. On the R&S callbox, set the iperf configuration to pump UDP packets to the UE's IP address at 300 Mbps.
6. Ensure that the throughput displayed on the UE is showing the correct values:
   - ~300 Mbps DL
   - ~50 Mbps UL
7. Deselect **disp on** and **file on** for the power measurement on the UE.
8. Run the following ADB commands to disable data monitoring:

```
adb root
adb remount
adb shell ndc bandwidth disable
adb shell sync
```

9. Disconnect the USB from the UE.
10. Start the power measurement on the correct channel in XUDAS.
11. Measure the current drawn for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
12. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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5.12 LTE FDD Cat9, 3xCA, 20 MHz + 20 MHz + 20 MHz (450/50 DL/UL, B3 (Tx) + B7 + B20), embedded, 0 dBm (LTE21E)

5.12.1 CMW 500 settings

- R& S CMW 500 call box that supports CA is used
- PCC settings:
  - 20 MHz BW, Band 3
  - 2-antenna configuration
  - 64-QAM modulation
  - RBs 100
- SCC1 settings:
  - 20 MHz BW
  - Band 7
  - 2-antenna configuration
  - 64-QAM modulation
  - RBs 100
- SCC2 settings:
  - 20 MHz BW
  - Band 20
  - 2-antenna configuration
  - 64-QAM modulation
  - RBs 100
- RF configurations and connections change based on the call box being used and the phone RF hardware antenna configurations

Prerequisites

- CMW 500 call box:
- Must support Carrier Aggregation
- Must have LTE Signaling version 3.5.20 or newer.
- UE supports Cat 9 and has the following NV items set (besides the NV items used for general LTE Cat 3/4 camping):
- NV 72524, HS USB Core Select = 1
- NV 72525, HS USB Uplink BAM BYPASS = 1
- NV 70310, UI Task Config = 1
- USB 3.0

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- Make sure that the USB 3.0-supported blue wire is connected to the 3.0 USB port on the CPU of the PC

5.12.2 CMW 500 settings for primary component carrier (PCC)

Parameters		
Duplex Mode	FDD	
Scenario	3CC CA – 6 RF Out	
RF Settings		
RF Output (TX)	Out 1	Out 2
Connector	RF1COM	RF3COM
Converter	RFTX1	RFTX2
External Attenuation	0.00 dB	0.00 dB
RF Input (RX)		
Connector	RF1COM	
Converter	RFRX1	
External Attenuation	0.00 dB	
RF Frequency		
Operating Band	Band 3	
DL Channel/Frequency	1575 Ch /1842.5MHz	
DL Frequency Offset	0 Hz	
UL Channel/Frequency	19575 Ch /1747.5 MHz	
UL Frequency Offset	0 Hz	
Exp. Nominal Power Mode	According to UL Power Control Settings	
Exp. Nominal Power	-15.20 dBm; Ref.Level: -3.20 dBm	
Margin	12 dB	
Mixer Level Offset	0 dB	
Downlink Power Levels		
RS EPRE	-65.0 dBm/ 15 KHz; Full Cell BW Power: -34.2 dBm	
PSS Power Offset	0.00 dB	
SSS Power Offset	0.00 dB	
PBCH Power Offset	0.00 dB	
PCFICH Power Offset	0.00 dB	
PHICH Power Offset	0.00 dB	
PDCCH Power Offset	0.00 dB	
OCNG	-	
Uplink Power Control		
Open Loop Nominal Power	-20 dBm @ Full RB Allocation	
Advanced PRACH/OL Power		
Enable Advanced Settings	-	
Reference Signal Power	-3 dBm	
Preamble Initial Received	-90 dBm	
P0 Nominal PUSCH	-40 dBm	

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Parameters	
Pathloss Compensation Alpha	0
Toggle P0-UE-PUSCH	-
Pathloss	62 dBm
Expected PRACH Preamble	-28 dBm
Expected OL Power	-20.0 dBm
TX Power Control (TPC)	
Active TPC Setup	Closed Loop
Closed Loop Target Power	-20.0 dBm
Max Allowed Power P-Max	24 dBm
Physical Cell Setup	
DL Cell Bandwidth	20.0 MHz
UL Cell Bandwidth	20.0 MHz
Physical Cell ID	0
Cyclic Prefix	Normal
Sounding RS (SRS)	-
Uplink Downlink Configuration	1
Special Subframe	7
Network	
I Intra Search	32 dB
S NonIntraSearch	32 dB
ThreshServingLow	16 dB
Q rxlevmin	-132 dBm
MCC	440
MNC	79 (Two Digits)
TAC	1
Authentication	Yes
NAS Security	Yes
AS Security	Yes
Integrity Algorithm	SNOW3G (EIA1)
Mileage	Yes
OPc	0102 0304 0506 0708 0910 1112 1314 1516 hex
Security Key	0011 2233 4455 6677 8899 AABB CCDD EEFF hex
RAND Value	Even
Default IMSI	440790123456789
Connection	
Group Hopping	-
UE Category	Manual: 5 Use Reported (if available): Yes
Default Paging Cycle	#256
Additional Spectrum Emission	NS_01
UE Meas. Filter Coefficient	FC4
Connection Type	Data Application

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Parameters		
Use “Activate Testmode”	Yes	
RLC Mode	Unacknowledged	
SIB Reconfiguration	SIB Paging	
Keep RRC Connection	Inactivity Timer	
Downlink MAC Padding	Yes	
Downlink MAC Error Insertion	0%	
Transmission Mode	TM 3	
DCI Format	2	
Antenna Configuration	2	
Scheduling type	User-defined Channels	
User-defined Channels (DL)	Stream 1	Stream 2
Use Stream 1 Settings	-	Yes
# Resource Block	100	100
Start Resource Block	0	0
Modulation Type	64-QAM	64-QAM
Transport Block Size Index	26	26
Transport Block Size	75376	75376
Throughput	75.376 Mbit/s	75.376 Mbit/s
Max Throughput	DL : 150.752 Mbit/s UL : 51.024 Mbit/s	
Reduced PDCCH	Yes	
# PDCCH Symbols	1	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (SI-RNTI)	4 CCE	
Operating Band Change	Redirection	
Frequency Change	Blind Handover	
Accept Multiple Def. Bearer	Yes	
DL HARQ	Yes	
Number of HARQ Transmission	2	
Redundancy Version Coding	TS 36.104 {0,2,3,1}	
User-Defined Sequence	Length: 4{ 0 0 0 0 }	
CQI Reporting		
Enable CQI Reporting	Off	
Format Indicator	Wideband	
CQI/PMI Config Index	FDD: 0 TDD: 3	
CQI/PMI Reporting Period	2 Subframes	
CQI/PMI Reporting Offset	0 Subframes	

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5.12.3 CMW 500 settings for Secondary Component Carrier 1 (SCC1)

Parameters		
Duplex Mode	FDD	
Scenario	3CC CA – 6 RF Out	
RF Settings		
RF Output (TX)	Out 1	Out 2
Connector	RF1COM	RF3COM
Converter	RFTX1	RFTX2
External Attenuation	0.00 dB	0.00 dB
RF Frequency		
Operating Band	Band 7	
DL Channel/Frequency	3102 Ch /2655.2 MHz	
DL Frequency Offset	0 Hz	
UL Frequency Offset	0 Hz	
Exp. Nominal Power Mode	According to UL Power Control Settings	
Exp. Nominal Power	-15.20 dBm; Ref.Level: -3.20 dBm	
Margin	12.00 dB	
Mixer Level Offset	0 dB	
Downlink Power Levels		
RS EPRE	-65.0 dBm/ 15 KHz; Full Cell BW Power: -34.2 dBm	
PSS Power Offset	0.00 dB	
SSS Power Offset	0.00 dB	
PBCH Power Offset	0.00 dB	
PCFICH Power Offset	0.00 dB	
PHICH Power Offset	0.00 dB	
PDCCH Power Offset	0.00 dB	
OCNG	-	
Power Offset PA	0 dB	
Power Ratio Index PB	0	
Uplink Power Control		
Open Loop Nominal Power	-20 dBm @ Full RB Allocation	
Advanced PRACH/OL Power		
Enable Advanced Settings	-	
Reference Signal Power	-3 dBm	
Preamble Initial Received	-90 dBm	
P0 Nominal PUSCH	-40 dBm	
Pathloss Compensation Alpha	0	
Toggle P0-UE-PUSCH	-	
Pathloss	62 dBm	
Expected PRACH Preamble	-28 dBm	
Expected OL Power	-20.0 dBm	
TX Power Control (TPC)		

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Parameters	
Active TPC Setup	Closed Loop
Closed Loop Target Power	-20.0 dBm
Max Allowed Power P-Max	24 dBm
Physical Cell Setup	
DL Cell Bandwidth	20.0 MHz
Physical Cell ID	0
Cyclic Prefix	Normal
Sounding RS (SRS)	-
Uplink Downlink Configuration	1
Special Subframe	7
Network	
S Intra Search	32 dB
S NonIntraSearch	32 dB
ThreshServingLow	16 dB
Q rxlevmin	-132 dBm
MCC	440
MNC	79 (Two Digits)
TAC	1
Authentication	Yes
NAS Security	Yes
AS Security	Yes
Integrity Algorithm	SNOW3G (EIA1)
Mileage	Yes
OPc	0102 0304 0506 0708 0910 1112 1314 1516 hex
Security Key	0011 2233 4455 6677 8899 AABB CCDD EEFF hex
RAND Value	Even
Default IMSI	440790123456789
Connection	
Group Hopping	-
UE Category	Manual: 5 Use Reported (if available): Yes
Default Paging Cycle	#256
Additional Spectrum Emission	NS_01
UE Meas. Filter Coefficient	FC4
Connection Type	Data Application
Use “Activate Testmode”	Yes
RLC Mode	Unacknowledged
SIB Reconfiguration	SIB Paging
Keep RRC Connection	Inactivity Timer
Downlink MAC Padding	Yes
Downlink MAC Error Insertion	0%
Transmission Mode	TM 3

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Parameters		
DCI Format	2	
Antenna Configuration	2	
Scheduling type	User-defined Channels	
User-defined Channels (DL)	Stream 1	Stream 2
Use Stream 1 Settings	-	Yes
# Resource Block	100	100
Start Resource Block	0	0
Modulation Type	64-QAM	64-QAM
Transport Block Size Index	26	26
Transport Block Size	75376	75376
Throughput	75.376 Mbit/s	75.376 Mbit/s
Max Throughput	DL : 150.752 Mbit/s	
Reduced PDCCH	Yes	
# PDCCH Symbols	1	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (SI-RNTI)	4 CCE	
Operating Band Change	Redirection	
Frequency Change	Blind Handover	
Accept Multiple Def. Bearer	Yes	
DL HARQ	Yes	
Number of HARQ Transmission	2	
Redundancy Version Coding	TS 36.104 {0,2,3,1}	
User Defined Sequence	Length: 4{ 0 0 0 0 }	
CQI Reporting		
Enable CQI Reporting	Off	
Format Indicator	Wideband	
CQI/PMI Config Index	FDD: 8 TDD: 11	
CQI/PMI Reporting Period	10 Subframes	
CQI/PMI Reporting Offset	1 Subframe	

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5.12.4 CMW 500 settings for Secondary Component Carrier 2 (SCC2)

Parameters		
Duplex Mode	FDD	
Scenario	3CC CA – 6 RF Out	
RF Settings		
RF Output (TX)	Out 1	Out 2
Connector	RF2COM	RF4COM
Converter	RFTX3	RFTX4
External Attenuation	0.00 dB	0.00 dB
RF Frequency		
Operating Band	Band 20	
DL Channel/Frequency	6304 Ch /806.4 MHz	
DL Frequency Offset	0 Hz	
UL Frequency Offset	0 Hz	
Exp. Nominal Power Mode	According to UL Power Control Settings	
Exp. Nominal Power	-15.20 dBm; Ref.Level: -3.20 dBm	
Margin	12.00 dB	
Mixer Level Offset	0 dB	
Downlink Power Levels		
RS EPRE	-65.0 dBm/ 15 KHz; Full Cell BW Power: -34.2 dBm	
PSS Power Offset	0.00 dB	
SSS Power Offset	0.00 dB	
PBCH Power Offset	0.00 dB	
PCFICH Power Offset	0.00 dB	
PHICH Power Offset	0.00 dB	
PDCCH Power Offset	0.00 dB	
OCNG	-	
Power Offset PA	0 dB	
Power Ratio Index PB	0	
Uplink Power Control		
Open Loop Nominal Power	-20 dBm @ Full RB Allocation	
Advanced PRACH/OL Power		
Enable Advanced Settings	-	
Reference Signal Power	-3 dBm	
Preamble Initial Received	-90 dBm	
P0 Nominal PUSCH	-40 dBm	
Pathloss Compensation Alpha	0	
Toggle P0-UE-PUSCH	-	
Pathloss	62 dBm	
Expected PRACH Preamble	-28 dBm	
Expected OL Power	-20.0 dBm	
TX Power Control (TPC)		

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Parameters	
Active TPC Setup	Closed Loop
Closed Loop Target Power	-20.0 dBm
Max Allowed Power P-Max	24 dBm
Physical Cell Setup	
DL Cell Bandwidth	20.0 MHz
Physical Cell ID	0
Cyclic Prefix	Normal
Sounding RS (SRS)	-
Uplink Downlink Configuration	1
Special Subframe	7
Network	
S Intra Search	32 dB
S NonIntraSearch	32 dB
ThreshServingLow	16 dB
Q rxlevmin	-132 dBm
MCC	440
MNC	79 (Two Digits)
TAC	1
Authentication	Yes
NAS Security	Yes
AS Security	Yes
Integrity Algorithm	SNOW3G (EIA1)
Mileage	Yes
OPc	0102 0304 0506 0708 0910 1112 1314 1516 hex
Security Key	0011 2233 4455 6677 8899 AABB CCDD EEFF hex
RAND Value	Even
Default IMSI	440790123456789
Connection	
Group Hopping	-
UE Category	Manual: 5 Use Reported (if available): Yes
Default Paging Cycle	#256
Additional Spectrum Emission	NS_01
UE Meas. Filter Coefficient	FC4
Connection Type	Data Application
Use “Activate Testmode”	Yes
RLC Mode	Unacknowledged
SIB Reconfiguration	SIB Paging
Keep RRC Connection	Inactivity Timer
Downlink MAC Padding	Yes
Downlink MAC Error Insertion	0%
Transmission Mode	TM 3

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Parameters		
DCI Format	2	
Antenna Configuration	2	
Scheduling type	User-defined Channels	
User-defined Channels (DL)	Stream 1	Stream 2
Use Stream 1 Settings	-	Yes
# Resource Block	100	100
Start Resource Block	0	0
Modulation Type	64-QAM	64-QAM
Transport Block Size Index	26	26
Transport Block Size	75376	75376
Throughput	75.376 Mbit/s	75.376 Mbit/s
Max Throughput	DL : 150.752 Mbit/s	
Reduced PDCCH	Yes	
# PDCCH Symbols	1	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (C-RNTI)	2 CCE	
Aggreg.Level DL DCI (SI-RNTI)	4 CCE	
Operating Band Change	Redirection	
Frequency Change	Blind Handover	
Accept Multiple Def. Bearer	Yes	
DL HARQ	Yes	
Number of HARQ Transmission	2	
Redundancy Version Coding	TS 36.104 {0,2,3,1}	
User Defined Sequence	Length: 4{ 0 0 0 0 }	
CQI Reporting		
Enable CQI Reporting	Off	
Format Indicator	Wideband	
CQI/PMI Config Index	FDD: 8 TDD: 11	
CQI/PMI Reporting Period	10 Subframes	
CQI/PMI Reporting Offset	1 Subframe	

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5.12.5 Setup call box RF connections and UE physical connections

Figure 5-3 shows how to map the RF port and configure RF1 COM as the Primary of PCC and SCC1 as well as RF2 COM as the primary for SCC2 on the callbox. It also shows how to configure RF3 COM to the Secondary/Diversity of PCC and SCC1, and RF4 COM to the Secondary/Diversity of SCC2. For the UE, the two cables must split into four and connect to their respective ports on the RF card based on the bands used.

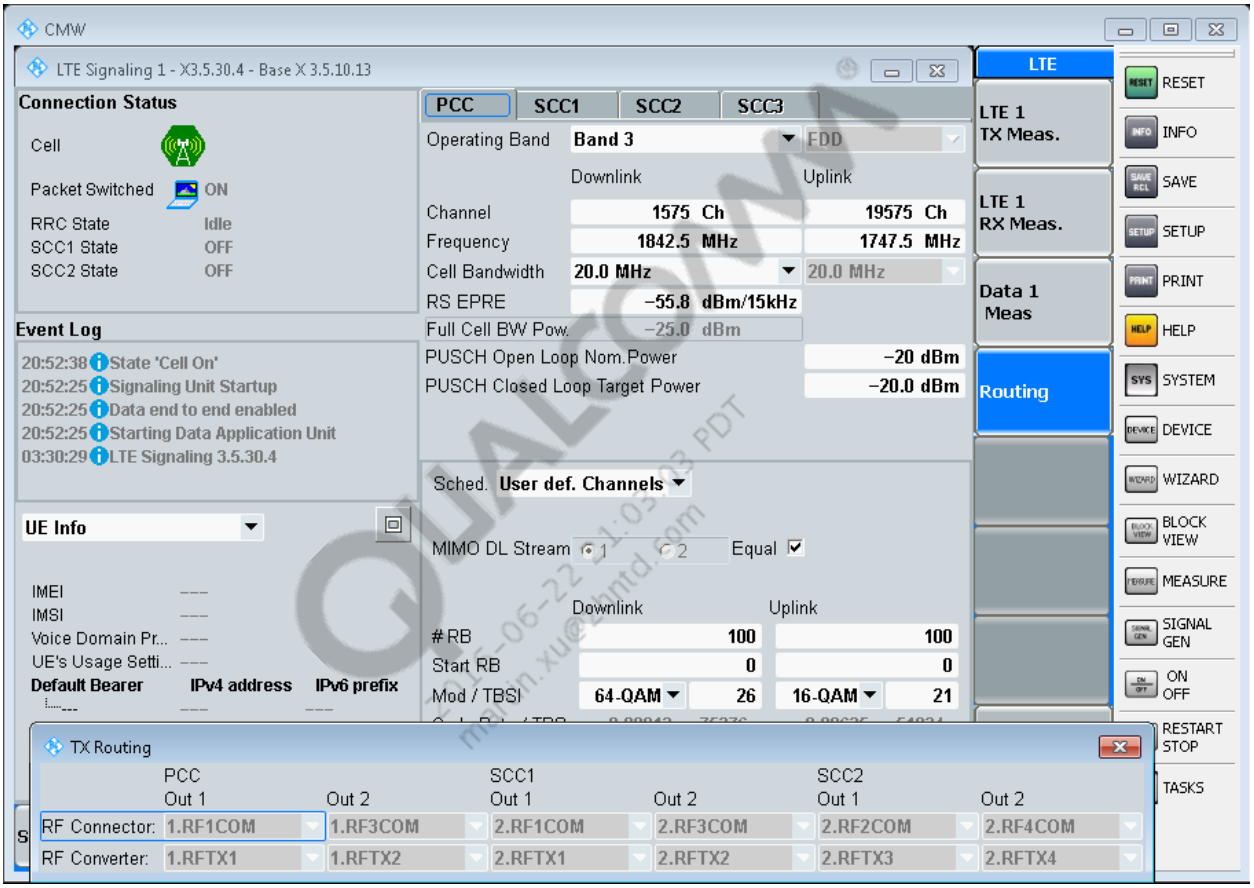

Figure 5-3 LTE Cat 9 – RF port mapping

Figure 5-4 shows how to configure RF1 COM for uplink.

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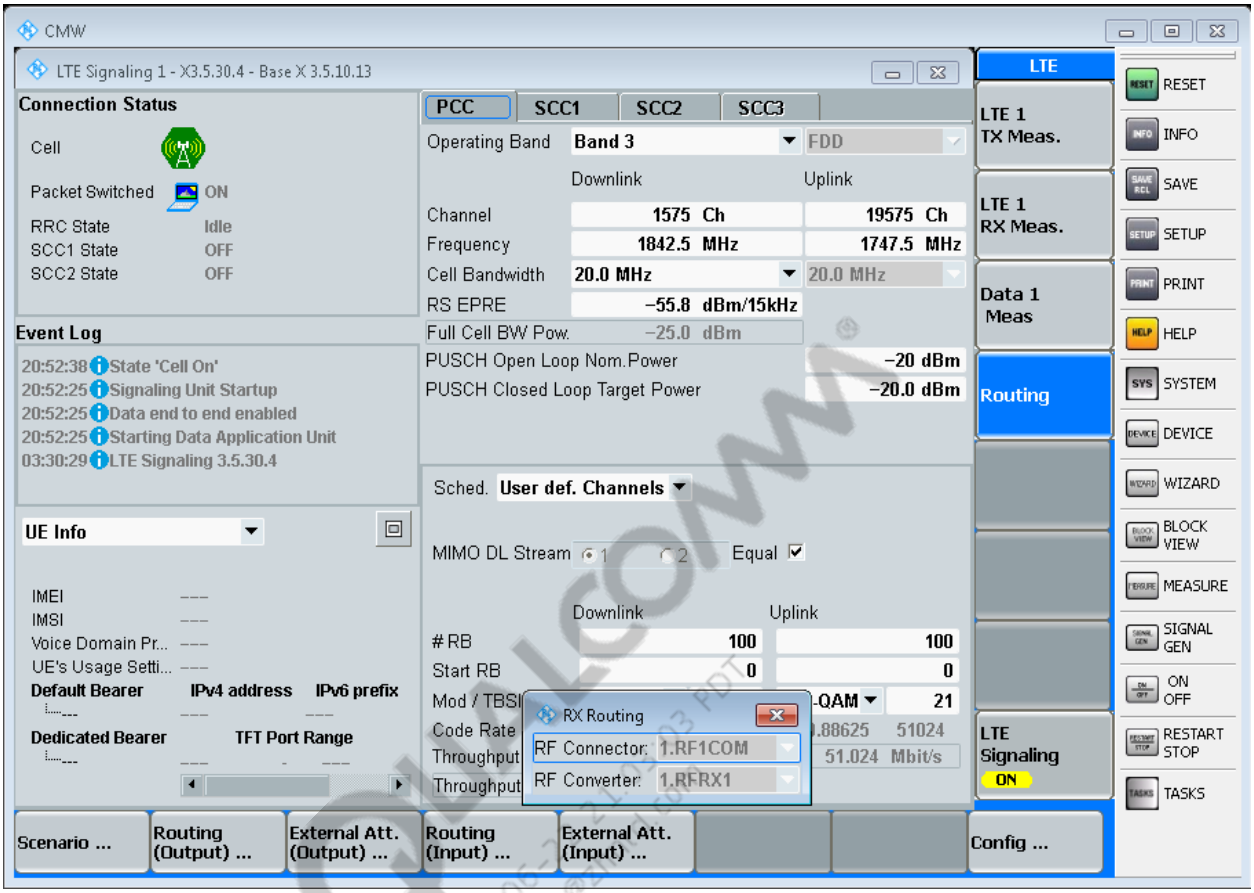

Figure 5-4 LTE Cat 6 – RF1 COM for uplink configuration

5.12.6 Phone settings

Apart from all of the EFS and NV settings described in Section 5.10.2, the following NV items must be changed:

- NV 06828 – LTE Band class Pref = (1237269952735) (or change it depending on the bands used; Band 3 for PCC and Band 7 for SCC is used for QTI dashboard power measurements)
- NV 70310 – UI Task Config = 1

NV settings required only for USB tethering Cat 6 use cases and need not be set for embedded data call use cases are:

- NV 72524 – HS USB Core Select = 1
- NV 72525 – HS USB Uplink BAM BYPASS = 1

5.12.7 Power measurement procedure

For power measurement:

1. Power up the handset and verify that it is acquired on the intended LTE network.
2. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.

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3. On the client (UE is the client here):
   a. Install the embedded iperf application to the phone through ADB.
   b. Pause.
4. Open the iperf application on the phone.
   a. Click disp on and file on.
   b. Press **run** to execute the following command, which exists by default in the iperf command window:

```
-s  -u -i2
```

5. On the R&S callbox, set the iperf configuration to pump UDP packets to the UE's IP address at 450 Mbps.
6. Ensure that the throughput displayed on the UE is showing the correct values:
   - ~450 Mbps DL
   - ~50 Mbps UL
7. Deselect **disp on** and **file on** for the power measurement on the UE.
8. Run the following ADB commands to disable data monitoring:

```
adb root
adb remount
adb shell ndc bandwidth disable
adb shell sync
```

9. Disconnect the USB from the UE.
10. Start the power measurement on the correct channel in XUDAS.
11. Measure the current drawn for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
12. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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5.13 SRLTE use case settings and measurement procedure

5.13.1 Settings

5.13.1.1 1xSRLTE specific NV items

NV item	Value	Description
72539	1	ESR support/CSFB support for dual Rx UEs: ▪ 1 – Supported ▪ 2 – Not supported
72550	500	LTE NAS 1xSRLTE ESR delay timer in ms
72538	(300, 10)	▪ sXLTE Timers – Hysteresis timers (in sec) to govern transition from 1xSRLTE to 1xCSFB mode ▪ Treturntocsfb and TwaitRRCidle tentative values are determined based on testing and characterization
72594	(LTE = 2, 1X = 5)	▪ PBR bias – Sets bias values per RAT for page blocking management algorithm; values are tentative and to be determined based on testing and characterization ▪ LTE loses five pages for every two pages lost by 1X
72608	Mask = 1, low timer = 100, high timer = 900	1X acquisition throttling duty cycle; tentative and to be determined based on testing and characterization

5.13.1.2 EFS settings for 1xSRLTE

1xSRLTE Connected state supervision timer

This file governs the configurable Tsupvconn timer that is used for connected state supervision when LTE has lost the RF chain in 1xSRLTE mode.

- EFS location in phone – /nv/item_files/modem/lte/ML1/
- EFS filename – spv_timer_connected
- File type – Binary

The EFS file has a default value of 8813.

In the above sample, the two bytes 8813 (read as 0x1388) indicate that the timer value is 5000 ms. This is a tentative value and is determined based on testing and performance characterization.

1xSRLTE Connected mode DRx collision parameters

This file governs the configurable LTE cDRx collision parameters that are used in a scenario of consecutive LTE cDRx and 1X idle wake-up collision instances.

- EFS location in phone – /nv/item_files/modem/lte/ML1
- EFS filename – cdrx_collision_parms

The mapping of the EFS file is:

- First uint8 field corresponds to NmaxCDRXblocking

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- Second uint8 field corresponds to NmaxRRCConnectionSetup
- Each parameter can take values of {1,3}
- Default value is 0303

NOTE: In this sample, NmaxCDRXblocking = 3 and NmaxRRCConnectionSetup = 3.

5.13.1.3 PolicyMan files for 1xSRLTE

In MPSS build releases, the Policy Manager .xml files can be found at <MPSS Build Path>\modem_proc\mmcp\policyman\configurations\1xSRLTE\test\csfb-pref\.

1. Go to the EFS explorer on the device and under root, create a folder named policyman.
2. Copy the carrier_policy.xml file into the policyman folder.
3. Power cycle the device.

The most common PLMN IDs in use are already populated in the files at the locations above. These .xml files can be modified to include the PLMN ID used in the setup or network in question in the section indicated below. The following example shows three PLMN IDs in red.

```
------------------------------------------------------------------------
<!-- These are the serving system PLMNs for which SXLTE will be allowed
-->
<!-- NOTE: Proper functioning of the SXLTE policy requires that there
be an PLMN list named "sxlte_plmns". Do NOT rename this list.
-->
<plmn_list name = "sxlte_plmns">
001-01 330-01 374-01
</plmn_list>
------------------------------------------------------------------------
```

The Policy Manager .xml file in \.... \csfb-pref\ is the default file for commercial use.

Other files in the \...\1xsrlteonly and \..\csfb-only folders can be used to force the UE into associated modes if needed, but are internal test modes and are *not* recommended for general configuration or testing.

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5.13.2 SRLTE [1X standby + LTE CAT2 data], 0 dBm, B13, embedded (SRLTED1E)

5.13.2.1 Agilent 8960 and Anritsu setting

Agilent 8960 settings are the same as 1X mode. Anritsu settings are the same as LTE mode.

5.13.2.2 Phone settings

NV setting is:

- 10→Global mode

Phone UI settings are:

1. The phone should be in Global mode.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data.
7. Settings→Display→Screen Timeout to 15 sec.
8. Connect the primary channel out from Anritsu to the primary RF input on the phone.
9. Connect the 1X signal from the Agilent 8960 and secondary channel output from the Anritsu into a 2:1 splitter input, respectively. Connect the splitter out to the secondary RF input of the phone (these RF port connections change based on the customer RF card design).

5.13.2.3 Power measurement procedure

For power measurement:

1. After the above connections are made, make sure the phone is camped to 1X and LTE.
2. Execute the client and PC data transfer for LTE Cat2 (only downlink) with downlink at 50 Mbps by following steps similar to LTE Cat3.
3. Make sure that 1X is still camped and doing paging cycles.
4. Wait for the LCD backlight to turn off. Start measuring power after waiting 2 min.

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5.13.3 SRLTE standby [1X QPCH 5.12 sec, LTE 2.56 sec] (SRLTES1)

5.13.3.1 Agilent 8960 and Anritsu setting

Agilent 8960 settings are the same as 1X mode. Anritsu settings are the same as LTE mode.

5.13.3.2 Phone settings

NV setting is:

- 10→Global mode

Phone UI settings are:

1. The phone should be in Global mode.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data.
7. Settings→Display→Screen Timeout to 15 sec.
8. Connect the primary channel out from Anritsu to the primary RF input on the phone.
9. Connect the 1X signal from the Agilent 8960 and secondary channel output from the Anritsu into a 2:1 splitter input, respectively. Connect the splitter out to the secondary RF input of the phone (these RF port connections change based on the customer RF card design).

5.13.3.3 Power measurement procedure

For power measurement:

1. After the above connections are made, make sure the phone is camped to 1X and LTE.
2. Wait for the LCD backlight to turn off. Start measuring power after waiting 2 min.

5.13.4 SRLTE [1X talk + LTE OoS], 0 dBm (SRLTET1)

5.13.4.1 Agilent 8960 and Anritsu settings

Agilent 8960 settings are the same as 1X mode. Anritsu settings are the same as LTE mode.

5.13.4.2 Phone settings

NV setting is:

- 10→Global mode

Phone UI settings are:

1. The phone should be in Global mode.
2. Settings→Location Services→GPS Satellites→Disable (unclick).

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3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth.
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Enable Data.
7. Settings→Display→Screen Timeout to 15 sec.
8. Connect the primary channel out from Anritsu to the primary RF input on the phone.
9. Connect the 1X signal from the Agilent 8960 and secondary channel output from the Anritsu into a 2:1 splitter input, respectively. Connect the splitter out to the secondary RF input of the phone (these RF port connections change based on the customer RF card design).

5.13.4.3 Power measurement procedure

For power measurement:

1. After the above connections are made, make sure the phone is camped to 1X and LTE.
2. Make a 1X call.

   LTE is suspended (OoS) state during 1X talk.

Wait for the LCD backlight to turn off. Start measuring power after waiting 2 min.

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6 TD use cases

6.1 TD-LTE standby (1.28 sec) + GSM standby (0.47 sec) (LSGS1)

6.1.1 Anritsu MT8820C settings (for TDD-LTE)

The Anritsu MT8820C settings are the same as those given in Section 5.5.1 except the DRx for TD-LTE is 1.28 sec under the control parameters.

BCCH/PCCH parameter (changes paging cycle time)	
Default paging cycle	rf128

6.1.2 Agilent 8960 settings (for GSM)

The Agilent call box settings are the same as those given in Section 4.6.1 except under the control parameters the DRx for GSM standby is 470 ms.

Paging parameters	Paging multiframes	2

6.1.3 Phone settings

NV settings are:

- 65777→1
- 0189→1

Phone UI settings

1. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
2. Setting→Wireless & network→Mobile networks→Network setting→Network mode→ TD-SCDMA/LTE/GSM/WCDMA/EV-DO/1X.
3. Go to Settings→Screen Timeout and set it to 30 min.

6.1.4 Test procedure for GSM + LTE standby

1. For the UE to operate in SGLTE mode, the policyman file must be copied to the policyman folder created in the root directory of the EFS location.

   The policyman file is located under \modem_proc\mmcp\policyman\configurations\ Carrier\CMCC\SGLTE\test.

2. Reboot the UE and verify that it camps on the intended network (GSM+LTE).

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3. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
4. Disconnect the USB from the UE.
5. Start power measurement.
6. Measure the current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
7. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

6.2 TDD LTE Cat 3, 20 MHz Cfg 1, B38 + GSM voice (LDEGT1)

6.2.1 Anritsu MT8820C settings (for TDD-LTE)

The Anritsu MT8820C settings are the same as those given in Section 5.5.1.

6.2.2 Agilent 8960 settings (for GSM)

The Agilent call box settings are the same as those given in Section 4.6.1.

6.2.3 Phone settings

NV settings are:

- 65777→1
- 01896→1

Phone UI settings

1. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
2. Setting→Wireless & network→Mobile networks→Network setting→Network mode→ TD-SCDMA/LTE/GSM/WCDMA/EV-DO/1X.
3. Go to Settings→Screen Timeout and set it to 30 min.

6.2.4 Test procedure for LTE Cat 3 (60/18), DLUL1, 0 dBm, MIMO, 20 MHz + GSM talk 5 dBm

1. For the UE to operate in SGLTE mode, the policyman file must be copied to the policyman folder created in the root directory of the EFS location.

   The policyman file is at \modem_proc\mmcp\policyman\configurations\Carrier\CMCC\SGLTE\test.
2. Reboot the UE and verify that it camps on the intended network (GSM+LTE). Ensure data is enabled on the UE.
3. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.

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4. On the client (the UE is the client here):
   a. Install the embedded iperf application to the phone through ADB.
   b. Pause.
5. Open the iperf application on the phone.
   a. Select **disp on** and **file on**.
   b. Press **run** to execute the following command, which exists by default in the iperf command window:

```
-s  -u -i2
```

6. On the server PC, open a command window and execute:

```
cd c:\iperf
```

For LTE:

```
iperf -c  192.168.20.12 -u -p 5001 -t 3000 -i 2 -w 1000000 -b 60M -d
```

For TDS:

```
iperf -c  192.168.20.12 -u -p 5001 -t 3000 -i 2 -w 1000000 -b 2.8M
```

7. Ensure that the throughput displayed on the UE shows the correct values; deselect **disp on** and **file on** for power measurement.
8. Run the following ADB commands to disable data monitoring:

```
adb root
adb remount
adb shell ndc bandwidth disable
adb shell sync
```

9. Disconnect the USB from the UE.
10. Start a GSM voice call; see Section 4.6.4 for more information.
11. Start power measurement.
12. Measure the current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.

To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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6.3 TD-SCDMA standby (TCS1)/talk 0 dBm (TCT1)/HSDPA 2.8 RB loopback (TDHS1)/HSUPA 2.2 RB loopback (TDHS2)

6.3.1 Anritsu MT8820C settings

Common parameters	
Test parameter	**Normal**
Call processing	On
Frequency	
Channel and frequency	10054
Level	
Input level	0.0 dBm; adjust as per cable loss
Output level	-50 dBm; adjust as per cable loss
AWGN level	-20 dB
External loss	Off
Main UL	0.0 dB
Aux	0.0 dB
Signal	
Channel coding	Voice or HSDPA RMC or HSUPA RMC (test-based)
HSDPA data rate	Category 15, max, VRC
HSUPA data rate	Peak data rate
DTCH	Echo
Physical channel parameters	
Scrambling code ID	0
Midamble Allocation mode	Default midamble
P-CCPCH power	-3.0 dB
DwPCH power	0.0 dB
Downlink power control	Off
HS-SCCH timeslot	0
#1 power	-10 dB
#2 – #4 power	-10 dB, off
HS-PDSCH power	0.0 dB
E-AGCH timeslot	0
power	0 dB
Absolute grant value	31
E-HICH timeslot	0
Power	0 dB
pattern	ACK
DPCH timeslot	1

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Common parameters	
Test parameter	**Normal**
Call processing parameters	
Base station identity	
MCC	460
MNC	02
LAC	001
Mobile station identity	
IMSI	001010123456789
Paging IMSI	Auto
Integrity protection	Off
Authentication key	Depends on SIM card
Registration mode	Combined
Measurement report	Off
Intra-frequency	On
Quality	Off
Call drop	On
RRC state	CELL_DCH
Handover type	Hard handover
UE timers	
T313	3 sec
N313	20
CN DRx cycle length	128 x 10 ms
Periodic location update	0
SIB7 repetition period	128
Maximum allowed UL Tx power	24 dBm
Cell selection and reselection information	
Sintrasearch	-53, off
Sintersearch	-53, off
Ssearch, RAT	-53, off
Qrxlevmin	-58
Qhyst1s	0
Open loop power control	
Primary CCPCH Tx power	24 dBm
PRXUpPCHdes	-100 dBm
Power ramp step Max Sync_UL transmissions	0 dB 1
RAB connection	On
Closed loop power control	
TPC step size	1 dB
TPC pattern	Closed loop power control

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Common parameters				
Test parameter	**Normal**			
HSDPA				
HS-SCCH UE identity #1	0000 H			
HS-SCCH UE identity #2	5555 H			
HS-SCCH UE identity #3	AAAA H			
HS-SCCH UE identity #4	FFFF H			
Max number of HARQ transmissions	1			
Redundancy and constellation version	6	2	1	5
HARQ memory size	Explicit			
HSUPA				
UE identity (E-RNTI)	AAAA H			
Packet parameter				
Server IP address	Based on configuration			
Client IP address	Based on configuration			
Audio parameters				
Mode	Voice codec			
Audio input/output	AF			
AF input				
Full scale	4000.00 mV			
Handset				
Microphone volume	3			
Speaker volume	3			

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6.3.2 Phone settings

Modify the following NV items:

- 10→53 (TD-SCDMA only)
- 1896→1 (IPv6 enabled)
- 66011→0 (TDS RRC integrity protection enabled)
- 66012→0 (TDS RRC ciphering enabled)
- 66013→1 (TDS RRC fake security status)
- 66017→2 (TDS RRC version)
- 66020→15 (TDS RRC HSDPA category)
- 66021→6 (TDS RRC HSUPA category)

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Phone UI settings (Android only)

1. Setting→Wireless & network→Mobile networks→Network setting→Network mode→ TD-SCDMA only.
2. Settings→Location Services→GPS Satellites→Disable (unclick).
3. Settings→Display→Auto-rotate screen→Disable (unclick).
4. Disable WLAN/Bluetooth/Data services (if measuring talk/standby current draw).
5. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
6. Settings→Display→Screen Timeout to 15 sec.

6.3.3 Power measurement procedure for TD-SCDMA standby (Android)

For power measurement:

1. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
2. Wait for the phone to camp to the network.
3. Press **End call** on Anritsu and then wait until the phone enters sleep.
4. Press the power key on the phone to turn off the backlight and LCD display.
5. Measure current draw for 64 sec.

6.3.4 Power measurement procedure for TD-SCDMA talk (Android)

For power measurement:

1. On Anritsu MT8820C select Voice from Common Parameters→Signal→ Channel Coding→Voice.
2. Power up the phone.
3. Wait until the phone camps on the network.
4. Make an MT call from Anritsu by pressing **Start Call** and answer the call.
5. Mute the phone.
6. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized. Measure current draw for 64 sec.

6.3.5 Power measurement procedure for TD-SCDMA HSDPA 2.8 Mbps, 0 dBm, RxD, RB call (Android)

For power measurement:

1. On Anritsu MT8820C select Voice from Common Parameters→Signal→ Channel Coding→HSDPA RMC.
2. Power up the phone.
3. Wait until the phone camps on the network.

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4. Start a data call by pressing **Start Call** on Anritsu MT8820C; the status should show **Connected** on the call box.
5. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized. Measure current draw for 64 sec.

6.3.6 Power measurement procedure for TD-SCDMA HSUPA 2.2 Mbps, 0 dBm, RxD, RB call (Android)

For power measurement:

1. On Anritsu MT8820C, select Voice from Common Parameters→Signal→Channel Coding→HSUPA RMC.
2. Power up the phone.
3. Wait until the phone camps on the network.
4. Start a data call by pressing **Start Call** on Anritsu MT8820C; the status should show **Connected** on the call box.
5. Wait until LCD/BL is off; start power measurement after 2 min to ensure that the current has stabilized. Measure current draw for 64 sec.

6.3.7 Power measurement procedure for TD-SCDMA standby (MDM)

For power measurement:

1. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
2. Wait for the UE to camp to the network.
3. Press **End call** on Anritsu and then wait until the UE enters sleep.
4. Measure current draw for 64 sec.

6.3.8 Power measurement procedure for TD-SCDMA talk (MDM)

For power measurement:

1. On Anritsu MT8820C, select Voice from Common Parameters→Signal→ Channel Coding→Voice.
2. Power up the UE.
3. Wait until the UE camps on the network.
4. Make an MT call from Anritsu by pressing **Start Call** and answer the call.
5. Start power measurement after 2 min to ensure that the current has stabilized. Measure current draw for 64 sec.

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6.3.9 Power measurement procedure for TD-SCDMA HSDPA 2.8 Mbps, 0 dBm, RxD, RB call (MDM)

For power measurement:

1. On Anritsu MT8820C, select Voice from Common Parameters→Signal→ Channel Coding→HSDPA RMC.
2. Power up the UE.
3. Wait until the UE camps on the network.
4. Start a data call by pressing **Start Call** on Anritsu MT8820C; the status should show **Connected** on the call box.
5. Start power measurement after 2 min to ensure that the current has stabilized. Measure current draw for 64 sec.

6.3.10 Power measurement procedure for TD-SCDMA HSUPA 2.2 Mbps, 0 dBm, RxD, RB call (MDM)

For power measurement:

1. On Anritsu MT8820C, select Voice from Common Parameters→Signal→ Channel Coding→HSUPA RMC.
2. Power up the UE.
3. Wait until the UE camps on the network.
4. Start a data call by pressing **Start Call** on Anritsu MT8820C; the status should show **Connected** on the call box.
5. Start power measurement after 2 min to ensure that the current has stabilized. Measure current draw for 64 sec.

6.4 TD-SCDMA standby (0.64 sec) + GSM standby (0.47 sec) (TCSGS1)

6.4.1 Anritsu MT8820C settings (for TD-SCDMA)

The Anritsu MT8820C settings are the same as those given in Section 6.3.1 except under the call processing parameters the DRx cycle for TD-SCDMA is 640 ms.

UE timers	
CN DRx cycle length	64 x 10 ms

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6.4.2 Agilent 8960 settings (for GSM)

The Agilent callbox settings are the same as those given in Section 4.6.1 except under the control parameters the DRx cycle for GSM is 470 ms.

Paging parameters	Paging multiframes	2

6.4.3 Phone settings

NV settings are:

- 1896→1 – IPv6 enabled
- 66011→0 – TDS RRC integrity protection enabled
- 66012→0 – TDS RRC ciphering enabled
- 66013→1 – TDS RRC fake security status
- 66017→2 – TDS RRC version
- 66020→15 – TDS RRC HSDPA category
- 66021→6 – TDS RRC HSUPA category

Phone UI settings

1. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
2. Setting→Wireless & network→Mobile networks→Network setting→Network mode→ TDSCDMA/LTE/GSM/WCDMA/EVDO/1x.
3. Go to Settings→Screen Timeout and set it to 30 min.

6.4.4 Test procedure for GSM + TDS standby

1. For the UE to operate in SGLTE mode, the policyman file must be copied to the policyman folder created in the root directory of the EFS location.

   The policyman file is at \modem_proc\mmcp\policyman\configurations\Carrier\CMCC\SGLTE\test.
2. Reboot the UE and verify that it camps on the intended network (GSM+TD-SCDMA).
3. After power-up, wait at least 90 sec to allow any software/initialization timers to expire and any initial processing to complete.
4. Disconnect the USB from the UE.
5. Start power measurement.
6. Measure the current draw for 1024 sec. To ensure data integrity, ensure that the initial samples of the data capture are not included.
7. To ensure stability of the test setup and repeatability of the test environment, repeat the test three times. If the test setup is calibrated and tightly controlled, the variance should be less than 1%.

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6.5 DSDA TD-SCDMA talk 0 dBm + GSM standby 0.47 sec (TCTGS1)

6.5.1 Agilent settings

For GSM subscription, the Agilent settings are the same as those given in Section 4.6.1 except under the control parameters paging multiframes is set to 2 for DRx to be 0.47 sec.

Paging parameters	Paging multiframes	2

For TD-SCDMA subscription, the Agilent settings are the same as those given in Section 6.3.1.

Use two separate call boxes, otherwise the standby power could be higher.

6.5.2 Phone settings

Modify the following NV items:

- 70266→2
- 4398→0
- 6876→5
- 67256→0
- 06907→1
- 10→53 – TD-SCDMA only
- 1896→1 – IPv6 enabled
- 66011→0 – TDS RRC integrity protection enabled
- 66012→0 – TDS RRC ciphering enabled
- 66013→1 – TDS RRC fake security status
- 66017→2 – TDS RRC version
- 66020→15 – TDS RRC HSDPA category
- 66021→6 – TDS RRC HSUPA category

Reset the phone with the indicated settings and then open the NV browser, click **Multi SIM**.

- Select subscription 0 and set NV 10 to TD-SCDMA only
- Select subscription 1 and set NV 10 to GSM only

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Phone UI settings (Android only)

1. Run the following ADB commands:

```
adb root
adb shell setprop persist.multisim.config dsda
```

2. Reboot the phone.
3. Go to Multi SIM Settings→Configure Subscriptions.
4. Turn on Subscription 1 and Subscription 2.
5. Settings→Location Services→GPS Satellites→Disable (unclick).
6. Settings→Display→Auto-rotate screen→Disable (unclick).
7. Disable WLAN/Bluetooth/Data Services.
8. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
9. Go to Settings→Display→Screen Timeout and set it to 15 sec.

6.5.3 Power measurement procedure GSM standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
4. Start power measurement.

6.5.4 Power measurement procedure for TD-SCDMA talk (Android)

For power measurement:

1. On Anritsu MT8820C select Voice from Common Parameters→Signal→Channel Coding→Voice.
2. Power up the phone.
3. Wait until the phone camps on the network.
4. Make an MT call from Anritsu by pressing **Start Call** and answer the call.
5. Mute the phone.
6. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
7. Start power measurement and measure the current draw for 64 sec.

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7 DSDS and DSDA use cases

Refer to Section 0 for the DSDA TD-SCDMA use case.

7.1 DSDS/DSDA G+G – 0.47 sec + 0.47 sec (GGS2)

7.1.1 Agilent settings

The Agilent settings for both GSM subscriptions are the same as those given in Section 4.6.1 except under the control parameters the paging multiframes must be set to 2 for DRx to equal 0.47 sec. Use two separate call boxes, otherwise the standby power could be higher. .

Paging parameters	Paging multiframes	2

Phone settings

NV items to modify for DSDS are:

- 70266→1
- 4398→0
- 6876→5
- 67256→0
- 06907→1

NV items to modify for DSDA are:

- 70266→2
- Other NVs are the same as for DSDS

Phone reset

Reset the phone with the settings indicated, open the NV browser, and click **Multi SIM**.

- Select subscription 0 and set NV 10 to GSM only
- Select subscription 1 and set NV 10 to GSM only

Phone UI settings (Android only)

1. Run the following ADB commands:

   ```
   adb root
   ```

   For DSDS:

   ```
   adb shell setprop persist.multisim.config dsds
   ```

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For DSDA:

```
adb shell setprop persist.multisim.config dsda
```

2. Reboot the phone.
3. Go to Multi SIM Settings→Configure Subscriptions.
4. Turn on both Subscription 1 and Subscription 2.
5. Settings→Location Services→GPS Satellites→Disable (unclick).
6. Settings→Display→Auto-rotate screen→Disable (unclick).
7. Disable WLAN/Bluetooth/Data Services.
8. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
9. Go to Settings→Display→Screen Timeout and set it to 15 sec.

7.1.2 Power measurement procedure for GSM standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
4. Start power measurement.

7.2 DSDS/DSDA W+G – 0.64 sec + 0.47 sec (WGS3)

7.2.1 Agilent settings

For GSM subscription, Agilent settings are the same as those given in Section 4.6.1 except under the control parameters the paging multiframes is set to 2 for DRx to be 0.47 sec.

Paging parameters	Paging multiframes	2

For WCDMA subscription, Agilent settings are the same as those given in Section 4.1.1 except under the cell parameters the DRx cycle is 640 ms.

MCC	440
MNC	79
DRx cycle length (CN domain)	64 frames (0.64 sec)

Use two separate call boxes, otherwise the standby power could be higher.

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7.2.2 Phone settings

NV items to modify for DSDS are:

- 70266→1
- 4398→0
- 6876→5
- 67256→0
- 06907→1

NV items to modify for DSDA are:

- 70266→2
- Other NVs are same as for DSDS

Phone reset

Reset the phone with the settings indicated, open the NV browser, and click **Multi SIM**.

- Select subscription 0 and set NV 10 to WCDMA only
- Select subscription 1 and set NV 10 to GSM only

Phone UI settings (Android only)

1. Run the following ADB commands:

   ```
   adb root
   ```

   For DSDS:

   ```
   adb shell setprop persist.multisim.config dsds
   ```

   For DADA:

   ```
   adb shell setprop persist.multisim.config dsda
   ```

2. Reboot the phone.
3. Go to Multi SIM Settings→Configure Subscriptions.
4. Turn on both Subscription 1 and Subscription 2.
5. Settings→Location Services→GPS Satellites→Disable (unclick).
6. Settings→Display→Auto-rotate screen→Disable (unclick).
7. Disable WLAN/Bluetooth/Data Services.
8. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
9. Go to Settings→Display→Screen Timeout and set it to 15 sec.

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7.2.3 Power measurement procedure for GSM standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
4. Start power measurement.

7.3 DSDA WCDMA talk 0 dBm + GSM standby 0.47 sec (WTGS1)

7.3.1 Agilent settings

For GSM subscription, the Agilent settings are the same as those given in Section 4.6.1 except under the control parameters paging multiframes is set to 2 for DRx to be 0.47 sec.

Paging parameters	Paging multiframes	2

For WCDMA subscription, the Agilent settings are the same as those given in Section 4.1.1.

Use two separate call boxes, otherwise the standby power could be higher.

7.3.2 Phone settings

Modify the following NV items:

- 70266→2
- 4398→0
- 6876→5
- 67256→0
- 06907→1
- 3851→0 – RxD functionality disabled
- 3852→6 – WCDMA equalizer
- 10→WCDMA only

Phone reset

Reset the phone with the modified NV items, open the NV browser, and click **Multi SIM**.

- Select subscription 0 and set NV 10 to WCDMA only
- Select subscription 1 and set NV 10 to GSM only

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Phone UI settings (Android only)

1. Run the following ADB commands:

```
adb root
adb shell setprop persist.multisim.config dsda
```

2. Reboot the phone.
3. Go to Multi SIM Settings→Configure Subscriptions.
4. Turn on Subscription 1 and Subscription 2.
5. Settings→Location Services→GPS Satellites→Disable (unclick).
6. Settings→Display→Auto-rotate screen→Disable (unclick).
7. Disable WLAN/Bluetooth/Data Services.
8. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
9. Go to Settings→Display→Screen Timeout and set it to 15 sec.

7.3.3 Power measurement procedure for GSM standby (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
4. Start power measurement.

7.3.4 Power measurement procedure for WCDMA talk (Android)

For power measurement:

1. Power up the phone.
2. Wait until the phone camps on the network.
3. Make an MT call from Agilent 8960 and answer the call.
4. Mute the phone.
5. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
6. Start power measurement.

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7.4 DSDA GSM talk 5 dBm + HSDPA 7.2 Mbps 0 dBm (No RxD) (GTHS21E1)/DSDA GSM talk 5 dBm + HSDPA 21 Mbps 0 dBm (No RxD) (GTHS41E1)/DSDA GSM talk 5 dBm + DC HSDPA DL 42 Mbps +0 dBm, IMT (No RxD) (GTHS62E1)

7.4.1 Agilent settings

For GSM subscription, the Agilent settings are the same as those given in Section 4.6.1.

For HSDPA subscription, the Agilent settings are the same as those given in Section 4.2.1.

7.4.2 Phone settings

Modify the following NV items:

- 70266→2
- 4398→0
- 6876→5
- 67256→0
- 06907→1

Reset the phone with the indicated settings and open the NV browser, click **Multi SIM**.

- Select subscription 0 and set NV 10 to GSM only
- Select subscription 1 and set NV 10 to WCDMA only

Phone UI settings (Android only)

1. Run the following ADB commands:

```
adb root
adb shell setprop persist.multisim.config dsda
```

2. Reboot the phone.
3. Go to Multi SIM Settings→Configure Subscriptions.
4. Turn on Subscription 1 and Subscription 2.
5. Settings→Location Services→GPS Satellites→Disable (unclick).
6. Settings→Display→Auto-rotate screen→Disable (unclick).
7. Disable WLAN/Bluetooth/Data Services.
8. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
9. Go to Settings→Display→Screen Timeout and set it to 15 sec.

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7.4.3 Power measurement procedure for GSM talk (Android)

For power measurement:

1. Power on the phone.
2. Wait for the phone to camp on the network.
3. Make an MT call from the Agilent 8960 and answer the call.
4. Ensure that the call is connected.
5. Mute the phone.
6. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
7. Start power measurement.

7.4.4 Power measurement procedure for HSDPA (Android)

For GTHS21E1/GTHS41E1, follow the procedure for HSDPA 7.2 Mbps/HSDPA 21 Mbps 0 dBm as given in Sections 4.2.1.2 and 4.2.3.

For GTHS62E1, follow the procedure for HSDPA 42 Mbps DC 0 dBm as given in Sections 4.3.2 and 4.3.3.

7.5 DSDA GSM talk 5 dBm + EVDO DL 3.1 Mbps 0 dBm (no RxD) (GTDD2E1)

7.5.1 Agilent settings

For GSM subscription, the Agilent settings are the same as those given in Section 4.6.1.

For EV-DO subscription, the Agilent settings are the same as those given in Section 4.5.1; see Section 4.5.2 for other settings.

7.5.2 Phone settings

Modify the following NV items:

- 70266→2
- 4398→0
- 6876→5
- 67256→0
- 06907→1

Reset the phone with the indicated settings and open the NV browser, click **Multi SIM**.

- Select subscription 0 and set NV 10 to GSM only
- Select subscription 1 and set NV 10 to EV-DO only

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Phone UI settings (Android only)

1. Run the following ADB commands:

```
adb root
adb shell setprop persist.multisim.config dsda
```

2. Reboot the phone.
3. Go to Multi SIM Settings→Configure Subscriptions.
4. Turn on Subscription 1 and Subscription 2.
5. Settings→Location Services→GPS Satellites→Disable (unclick).
6. Settings→Display→Auto-rotate screen→Disable (unclick).
7. Disable WLAN/Bluetooth/Data Services.
8. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
9. Go to Settings→Display→Screen Timeout and set it to 15 sec.

7.5.3 Power measurement procedure for GSM talk (Android)

For power measurement:

1. Power on the phone and wait for the phone to camp to the network.
2. Make an MT call from the Agilent 8960 and answer the call.
3. Ensure that the call is connected.
4. Mute the phone.
5. Wait until the LCD/BL is off and wait 2 min to ensure that the current has stabilized.
6. Start power measurement.

7.5.4 Power measurement procedure for EV-DO (Android)

See Section 4.5.4 for the detailed procedure.

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8 Connectivity use cases

8.1 BT Sniff+Scan with WCDMA standby 2.56 sec (BT2)

8.1.1 Agilent 8960 settings

Ensure that the phone is in WCDMA mode. All of the phone settings are similar to WCDMA settings.

8.1.2 Phone settings

Phone UI settings are:

1. Navigate to the Bluetooth menu. Go to Settings→Wireless Networks→Bluetooth Settings.
2. Turn on Bluetooth.
3. Setting→Wireless & network→Mobile networks→Network setting→Network mode→ WCDMA only.
4. Settings→Location Services→GPS Satellites→Disable (unclick).
5. Settings→Display→Auto-rotate screen→Disable (unclick).
6. Disable Data Services.
7. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
8. Settings→Display→Screen Timeout to 15 sec.

8.1.3 Power measurement procedure

For power measurement:

1. Make sure that a WCDMA signal is received and the phone is camped to the network.
2. Once Bluetooth is turned on, the phone starts searching for Bluetooth devices nearby.
3. Make sure that the Bluetooth headset is in Discover mode for the phone to find it.
4. Once the Bluetooth headset is found, click the device to pair and connect.
5. When the headset is connected, *Connected* displays under the Bluetooth device name on the phone.
6. Return to the main menu.

Wait until display is off or switch off the display and start taking measurements.

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8.2 Agilent 8960 setting

Ensure that the phone is in WCDMA mode. All the phone settings are similar to WCDMA Standby settings.

8.2.1 Phone settings

Phone UI settings are:

1. Navigate to the Wi-Fi menu. Go to Settings→Wireless Networks→Wi-Fi and turn on Wi-Fi.
2. Setting→Wireless & network→Mobile networks→Network setting→Network mode→ WCDMA only.
3. Settings→Location Services→GPS Satellites→Disable (unclick).
4. Settings→Display→Auto-rotate screen→Disable (unclick).
5. Disable Data Services.
6. Disable sensor – Qualcomm Setting→Sensor→Disable (unclick).
7. Settings→Display→Screen Timeout to 15 sec.

8.2.2 Power measurement procedure

For power measurement:

1. Make sure that a WCDMA signal is received and the phone is camped to the network.
2. Make sure that a wireless access point is available for the phone to connect.
3. Once the Wi-Fi is turned on, the phone searches for the networks. Connect to the network after the expected network is seen on the phone.
4. Go back to the main menu.
5. Wait until the display is off or switch off the display and start taking measurements.

8.3 GNSS 1 Hz tracking high sensitivity with WCDMA standby 2.56 sec (GNSS1)

8.3.1 Agilent 8960 setting

This is the same as WCDMA standby in Section 4.1.

8.3.2 Phone settings

Phone UI settings

1. Settings→Wireless & network→Mobile Networks→Network Setting→ Network Mode→WCDMA only.
2. Settings→Wireless & network→Mobile Networks – Uncheck the following items:

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- Data enabled
- Data roaming

3. Settings→Display→Screen Timeout to 15 sec.
4. Settings→Display→Auto-rotate Screen – Uncheck this item.
5. Settings→Location & Security – Uncheck the following items:
   - Use assisted GPS
   - Use GPS satellites
   - Visible passwords
6. From Qualcomm Settings, uncheck the following items:
   - Stay on Plugged
   - Sensors
   - Socket Data call (only available on Gingerbread (GB), removed in ICS)
7. Disable USB charging. To do so, open the command window.

```
adb shell setprop persist.usb.chgdisabled 1
adb shell "echo 1 > /sys/module/pm8921_charger/parameters/disabled"
adb shell sync
```

Phone NV settings

1. Make sure that XO is properly calibrated.
2. Execute CGPS_NV_Loader.pl from modem_proc\modem\gps\gnss_tools\pdapi_scripts directory and load the intended GPS-related NVs to the UE.
3. Additional NV configurations:
   - NV 5596 – Dynamic Power Optimization (DPO) control set to 0 to disable DPO
   - NV 70326 – Set to value 3
   - NV 70237 – Set to value 0
   - NV 06759 – Set to value 0 (enables IMEM for non-DPO)
   - NV 06760 – Set to value 1

8.3.3 Power measurement procedures

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. Open a DOS command prompt.
3. Navigate to the modem_proc\modem\gps\gnss_tools\pdapi_scripts directory and execute the following Perl commands:
   a. perl pd_startdiag.pl <com port>

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QXDM Pro automatically launches and connects to the specified COM port.

b. perl pd_delall.pl <com port> 9

Deletes all existing aiding data on the UE. This step is important when testing with a GPS simulator.

c. perl pd_PowerConsumptionAlmDownloadTrack.pl <com port>

Starts the GPS engine. Wait for the first GPS fix to occur.

4. After the first fix, wait an additional 13 min in order to acquire the full GNSS (GPS + Glonass) Almanac.
5. In the QXDM Item View window, verify that GPS has entered the Tracking state by look for a string similar to:

   MGP ME/PP Medium pp_msg.c 00081 PP processed time tick Fc=14760 Tracking:1

   Ignore information such as the line number (81) and the time tick Fc (14760). If Tracking is equal to 1, then GPS engine is in Tracking, and vice versa.

   If selected Message Packets include MGP ME/CC MISC, use the following message to determine if the engine is in Tracking:

   MGP ME/MC Misc mc_gnsssearchstrategy.c 05203 Tracking State 1, Acq/Track State Change 0, DPO State Change 0
6. Disconnect the phone from QXDM Options→Communications drop-down menu.

   Unexpected high current consumption might be observed if this step is not followed.
7. Disconnect the USB cable from the phone.
8. Wait 2 min then start the power measurement.

8.4 GPS 1 Hz tracking (DPO) with WCDMA standby 2.56 sec (GPS2)

8.4.1 Agilent 8960 settings

This is the same as WCDMA standby in Section 4.1.

8.4.2 Phone settings

Phone UI settings

1. Settings→Wireless & network→Mobile Networks→Network Setting→Network Mode→WCDMA only.
2. Settings→Wireless & network→Mobile Networks – Uncheck the following items:
   - Data enabled
   - Data roaming
3. Settings→Display→Screen Timeout to 15 sec.
4. Settings→Display→Auto-rotate Screen – Uncheck this item.

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5. Settings→Location & Security, uncheck the following items:
   - Use assisted GPS
   - Use GPS satellites
   - Visible passwords
6. From Qualcomm Settings, uncheck the following items:
   - Stay on Plugged
   - Sensors
   - Socket Data call (only available on GB, removed in ICS)
7. Disable USB charging. To do this, open the command window and execute:

```
adb shell setprop persist.usb.chgdisabled 1
adb shell "echo 1  > /sys/module/pm8921_charger/parameters/disabled"
adb shell sync
```

Phone NV settings

1. Make sure that XO is properly calibrated.
2. Execute CGPS_NV_Loader.pl from modem_proc\modem\gps\gnss_tools\pdapi_scripts directory and load the intended GPS-related NVs to the UE.
3. Additional NV configurations are:
   - NV 5596 –DPO control, set to 1 to enable DPO
   - NV 70326 – Set to value 3
   - NV 70237 – Set to value 0
   - NV 06759 – Set to value 2 for DPO (disables IMEM for DPO)
   - NV 06760 – Set to value 1

8.4.3 Power measurement procedures

For power measurement:

1. Power up the handset and verify that it is acquired on the intended network.
2. Open a DOS command prompt.
3. Navigate to the modem_proc\modem\gps\gnss_tools\pdapi_scripts directory and execute the following Perl commands:
   a. perl pd_startdiag.pl <com port>

      QXDM Pro automatically launches and connects to the specified COM port.

   b. perl pd_delall.pl <com port> 9

      Deletes all existing aiding data on the UE. This step is important when testing with a GPS simulator.

   c. perl pd_PowerConsumptionAlmDownloadTrack.pl <com port>

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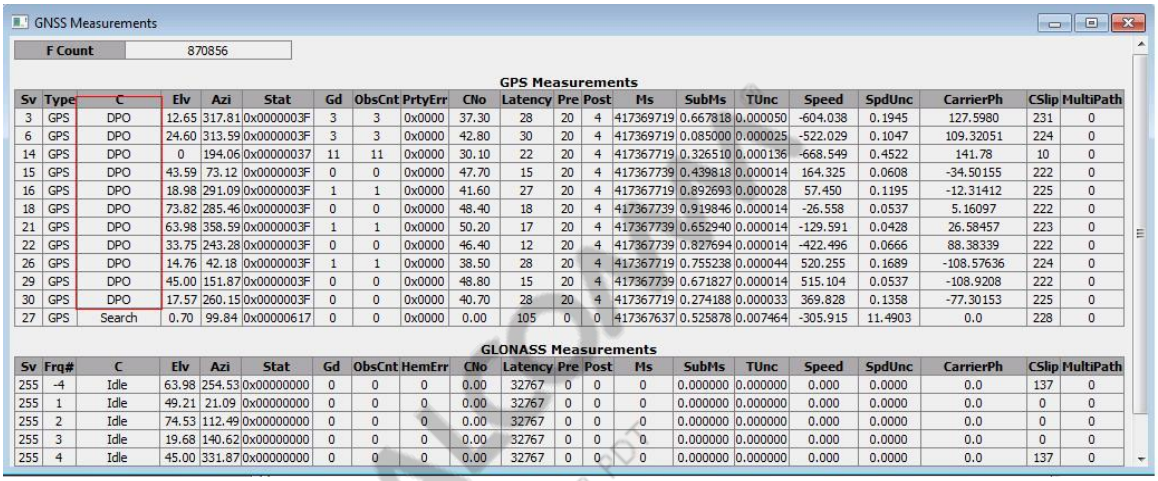
Starts the GPS engine. Wait for the first GPS fix to occur.

4. After the first fix, wait 13 min to acquire the full GNSS (GPS + Glonass) Almanac.
5. Ensure that the GPS engine is in DPO by looking at the QXDM GNSS Measurement window. If DPO (as opposed to Track) appears in the column circled below, the GPS engine is in DPO.



6. Disconnect the phone from QXDM Options→Communications drop-down menu.

   Unexpected high current consumption might be observed if this step is not followed.
7. Disconnect the USB cable from the phone.
8. Wait 2 min then start the actual power measurement.
9. MSM8x60 uses DPO2.0. Refer to *EXE, PowerLift 3D OpenGL ES Graphics Benchmark Tool V.4.6.01 for Linux Android-Enabled Devices* (72-N5481-1), integration time for DPO2.0 depends on the signal condition. To achieve power number listed in the dashboard, ensure that the signal is strong and the total wake-up time is slightly above 200 ms.

8.5 Wi-Fi hotspot and LTE standby 2.56 sec (WLLS1)

Refer to *QCA6174 Power Measurement Test Procedure* (80-Y7674-14) for the detailed test procedure for this use case.

8.6 Wi-Fi hotspot and LTE sustained perf (WLL1)

Refer to *QCA6174 Power Measurement Test Procedure* (80-Y7674-14) for the detailed test procedure for this use case.

8.7 Wi-Fi hotspot and LTE peak perf (WLLS2)

Refer to *QCA6174 Power Measurement Test Procedure* (80-Y7674-14) for the detailed test procedure for this use case.

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9 Multimedia use cases

9.1 Prerequisites

This section outlines the settings that must be applied before performing any multimedia use case procedure.

- The device must be rebooted every time a use case is executed.
- All multimedia use cases must be performed in Airplane mode.
- The software build to be tested must be loaded on the target.
- The USB must not be connected.
- The headset must not be connected.
- The camera sensor (if detachable) must not be connected.

Table 9-1 Standard UI settings

Standard UI settings		Setting state
a.	Brightness	Default
b.	Sync	Off
c.	Wi-Fi	Off
d.	Bluetooth	Off
e.	Airplane mode	On
f.	Screen timeout	30 min or maximum available
g.	Auto-rotate screen	Off
h.	Disable pad touch tones	Off
g.	Disable screen lock sound	Off
h.	Location/GPS	Off
i.	NFC	Off
j.	Auto Brightness	Off

1. From the Home screen, turn off sync.
2. Ensure the Display Brightness setting is not set to auto, e.g., on QTI XPM/MTP(s) it is 102. To check this through the ADB shell, run the following command:

```
cat /sys/class/leds/lcd-backlight/brightness
```

3. From the Home screen, go to the Main Menu and select **Settings**.
   a. Disable Wireless – Settings→Wi-Fi (deselect).
   b. Disable Bluetooth – Settings→Bluetooth (deselect).

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c. Disable NFC.

d. Enable Airplane mode – Settings→More→Airplane mode (select).

e. Set the display screen timeout to the max timeout value available – Settings→Display→ Screen timeout (30 min or the max available timeout).

f. Disable auto rotate screen – Settings→Display→Auto-rotate screen (deselect).

g. Disable pad touch tones – Settings→Sound→Disable pad touch tones (deselect).

h. Disable the screen lock sound – Settings→Sound→Disable screen lock sound (deselect).

i. Disable Location / GPS – Settings→Location & Security→Use GPS satellites (deselect).

Table 9-2 lists the QTI UI settings.

Table 9-2 QTI UI settings

QTI UI settings	Setting state
Stay on plugged	Off
Sensors	Off
Content adaptive backlight	Off

4. To disable the unnecessary features, from the Home screen, navigate to the Main menu and select Qualcomm Settings.

   a. Disable stay on plugged – Qualcomm Settings→Stay on plugged (deselect).

   b. Disable the sensors – Qualcomm settings→Sensors (deselect).

   c. Disable the content adaptive backlight option – Qualcomm settings→Content adaptive backlight option (deselect).

NOTE: The content adaptive backlight option can also be disabled by running the following ADB commands.

```
adb remount
adb pull /system/build.prop c:\build.prop
                  Edit the build.prop file to set ro.qualcomm.cabl=0
adb push build.prop /system/.
adb shell chmod 644 /system/build.prop

adb shell sync
adb reboot
```

5. (MSM8996 chipsets only) Enable LPM:

   a. Pull the mixer_paths_tasha.xml file from the device as follows:

```
adb root
adb remount
adb pull /etc/mixer_paths_tasha.xml
```


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b. Modify the mixer_paths_tasha.xml file as follows:

   Find section <ctl name="RX HPH Mode" value="CLS_H_HIFI" />, then update this line as follows: <ctl name="RX HPH Mode" value="CLS_H_LP" />

   Find section <path name="headphones">, and insert one line before </path> as follows: <ctl name="RX HPH Mode" value="CLS_H_LP" />

c. Push the modified mixer_paths_tasha.xml file into the device as follows:

```
adb push mixer_paths_tasha.xml /etc/
```

d. Reboot the device.

NOTE: Before starting any use case procedure, perform the Rock Bottom Standby Current (RBSC) and Static image display use cases. See Sections 9.1.1 and 9.2 for more information.

9.1.1 RBSC use case

Report the results and issues from the RBSC and Static image display use cases to QTI's multimedia customer engineering power team.

Perform the following use cases before starting multimedia active use cases:

- RBSC (also referred to as Airplane mode) – Screen is turned off
- Static image display – Screen is turned on

RBSC and static image display must be optimized against the number published by QTI. If the measured average power number is higher than the specified target range for a given use case, debug or report the issue.

NOTE: Include the power numbers of the RBSC and Static Image Display use cases in all reported multimedia issues. Include the power waveform with debugging data when reporting the issues.

Measure the RBSC

This procedure assumes that the prerequisite steps and conditions described in Section 9.1 have been followed and are TRUE. If not, ensure that all prerequisites are met before starting.

1. Turn off the device screen and wait 2 min to ensure that the current has stabilized to allow the device to go into Low Power Mode (LPM) or XO shutdown.
2. Take the power measurements.
3. Collect three different measurements on the three different runs. Repeat steps 1 and 2 every time a new measurement is taken.

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Troubleshooting

If the RBSC power numbers are not within the expected target range, check whether the device went to VDD min or XO shutdown.

1. Ensure NV 453 is set to 0 for XO shutdown and vdd_min to work.
2. To check if the device is in XO shutdown, run the following ADB commands before and after turning off the screen.

```
adb root
adb remount
adb shell cat d/rpm_stats
```

3. Compare the counter values. If the device goes into XO shutdown, the counter increments for vdd_min or XO.
   - RPM mode – XO shutdown
     - Count – 0
     - Total time (µs) – 0
   - RPM mode – vdd_min
     - Count – 1
     - Total time (µs) – 40870

9.2 Static image display (LCD04)

9.2.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Turn on the screen and wait 30 sec to let the system stabilize.
2. Start power measurement.
3. Collect three different measurements on three different runs. Repeat Steps 1 and 2 every time a new measurement is taken.
4. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1+ Measurement 2+ Measurement 3)/3.
5. MSM™ current contribution can be calculated by removing the LCD, backlight, and touchscreen contributions from the measured average battery power.

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9.3 Audio decode use case (AU4)

9.3.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Reboot the device.
2. Load the test clip on the device.
   a. The test clip used is AU4.

Test clip	Description
AU4.mp3	MP3 at 44.1 kHz 128 kbps stereo; refer to *MP3 at 44.1 kHz 128 kbps Stereo Clip for Power Measurements* (MH80-VR010-5)

   b. The clip can be downloaded from https://support.cdmatech.com/.
   c. Install the clip.
      i Connect a USB to the device.
      ii Push the clip to the devices using the following ADB command.

```
adb push <Clip Location>\Au4.mp3 /sdcard/
```

      iii Disconnect the USB once installation is complete.
      iv Reboot the device.
3. Plug in the headset; the headset calibration is at .1 mW (for FFAs and XPM).

Table 9-3 Audio testing modes

Audio decoding mode	Description	Property to set in build.prop
Compressed offload mode	Decoding on ADSP	audio.offload.disable=0 Offload is enabled by default. Offload mode property might not be present under build.prop.
Deep buffer mode	Decoding on CPU	audio.offload.disable=1

4. Set the correct mode.
   a. Connect the USB to the device.
   b. Change the settings in one of the following ways:
      – Change the property “audio.offload.disable”0 / 1 using **`setprop`** on the command line.

```
adb root
adb remount
adb shell setprop audio.offload.disable <0 / 1>
```


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This change does not persist after the device reboots.

– Change the property in the build.prop file. To do this, search for audio.offload.disable and set the value to 0 or 1.

```
adb root
adb remount
adb pull /system/build.prop
adb push (build.prop) /system/.
adb shell chmod 644 /system/build.prop
adb shell sync
```

CAUTION: Skipping the above two steps might brick the device. To unbrick the device, put the device into fastboot and reload the APSS image again.

```
adb reboot
```

5. If the audio.offload.disable property is changed under build.prop, after the device boots up:
   a. Check for the correct property value for audio.offload.disable.
   b. Run the following ADB command to ensure the device is set in the correct audio decoding mode:

   ```
   adb shell getprop audio.offload.disable
   ```

6. Set the buffer size using the following ADB commands:

   Use the default configuration for MSM8956 or MSM8976.

   ```
   adb root
   adb remount
   adb shell
   setprop audio.offload.buffer.size.kb 256
   sync
   exit
   ```

7. Disconnect the USB from the device.
8. Wait approximately 2 min to ensure that the current has stabilized.
9. Play the AU4 clip using the default Android music player.
10. Adjust the volume from mute so that it is set to 9/15.

    (MSM8996, MSM8956, or MSM8976) Adjust the volume from mute so that it is set to 7/15.
11. Make sure Repeat mode is *not* selected while playing the clip.
12. Press the power key to turn off the LCD and backlight.
13. After MP3 playback starts, wait 30 sec and then take the power measurements for 30 sec.

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14. Save the waveform and the power measurements.
15. Acquire the power numbers on three different runs; follow Steps 1 to 14 every time a measurement is taken.
16. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.

NOTE: The audio decode use case is based on the measurements taken while audio is playing. Therefore, it is advised to avoid taking measurements for the first 5 sec and for the last 5 sec of the audio clip. To compare the power numbers with the published target dashboard numbers, any special sound effects must be disabled to avoid any audio post processing. For the AU4 use case, the dashboard measurement is in compressed offload mode.

9.4 Listen – 100% silence (AU34A)

NOTE: This use case is applicable for MSM8996, MSM8994, MSM8992, MSM8956/MSM8976, and MSM8916 platforms.

9.4.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Reboot the device.
2. RBSC settings and ensure XO shutdown.
3. Start the Snapdragon™ Voice Activation (SVA) app [refer to *EXE, SVA 2.0 Reference App* (HK11-NR653-1)] and perform the following steps to enable Single Keyword Detection and no User Verification.
   a. Select **Settings** after pressing **Menu** on the toolbar.
   b. Switch OPTIONS: Listen and OPTIONS: Voice Activation to ON (if not already on).
   c. Switch REGISTRATION OPTIONS: User Verification to OFF.
   d. Select **Back** to go back to the SVA app main screen.
   e. Select **Select A Sound Model** on the screen.
   f. Select the checkbox for the “HeySnapdragon” sound model.
   g. Select **Back** to go back to the SVA app main screen.
   h. Select **Start Detection** on the screen (microphone icon at top left should be green, signifying detection is on).
   i. Test that detection is working by saying “Hey Snapdragon” (you should hear an alert tone and a green horizontal bar should briefly appear).
   j. At this time, detection is active and you can proceed with the test.
4. Maintain silence in the lab. Alternately, if the device includes the WCD9335 and WCD9330 codecs, such as on MSM8996 and MSM8994 respectively, set the HWMAD threshold to the maximum 0xFFFF through ADB commands.

   For MSM8994 or MSM8992, use the following ADB commands:

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```
adb shell "echo '0xE6 0xFF' > /sys/kernel/debug/asoc/msm8994-tomtom-mtp-
snd-card/tomtom_codec/codec_reg"
adb shell "echo '0xE7 0xFF' > /sys/kernel/debug/asoc/msm8994-tomtom-mtp-
snd-card/tomtom_codec/codec_reg"
```

For MSM8996, use the following ADB commands:

```
adb shell "echo '0x287 0xFF' > sys/kernel/debug/regmap/tasha*/registers"
adb shell "echo '0x288 0xFF' > sys/kernel/debug/regmap/tasha*/registers"
```

For MSM8996, use the following ADB commands:

```
adb shell "echo '0x287 0xFF' > sys/kernel/debug/regmap/tasha*/registers"
adb shell "echo '0x288 0xFF' > sys/kernel/debug/regmap/tasha*/registers"
```

For MSM8956/MSM8976, use the following XML changes:

```
adb root
adb remount
adb pull /etc/sound_trigger_platform_info.xml c:\Temp
<ctrl name="execution_type" value="CPE" /> (Change APE to CPE)
adb push C:\TEMP\sound_trigger_platform_info.xml /etc/
adb reboot
```

For MSM8956/MSM8976, use QACT to implement the following settings:

```
Threshold value is MAX (0X7F800000) 200ms periodic waveform on current
rail 106
Save the changed acdb file
adb push MTP_WCD9335_Handset_cal.acdb /etc/acdbdata/MTP/msm8976-tasha-
snd-card
adb shell stop media
adb reboot
```

5. Disconnect the USB and turn off the display.
6. Wait for 30 sec after turning off the display.
7. Measure the power waveform for 30 sec. If step 4 is not done, a selective average needs to be taken manually from the power waveforms over the silence regions.
8. Save the waveform and the power measurements.
9. Acquire the power numbers on three different runs; follow steps 1 to 8 every time a measurement is taken.
10. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.

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9.5 Listen – 100% speech (AU35A)

NOTE: This use case is applicable for MSM8996, MSM8994, MSM8992, MSM8956/MSM8976,and MSM8916 platforms.

9.5.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Reboot the device.
2. RBSC settings and ensure XO shutdown.
3. Start the SVA app [refer to *EXE, SVA 2.0 Reference App* (HK11-NR653-1)] and perform the following steps to enable Single Keyword Detection and no User Verification.
   a. Select **Settings** after pressing **Menu** on the toolbar.
   b. Switch OPTIONS: Listen and OPTIONS: Voice Activation to ON (if not already on).
   c. Switch REGISTRATION OPTIONS: User Verification to OFF.
   d. Select **Back** to go back to the SVA app main screen.
   e. Select **Select A Sound Model** on the screen.
   f. Select the checkbox for "HeySnapdragon" SoundModel.
   g. Select **Back** to go back to the SVA app main screen.
   h. Select **Start Detection** on the screen (microphone icon at top left should be green, signifying detection is on).
   i. Test that detection is working by saying "Hey Snapdragon" (you should hear an alert tone and a green horizontal bar should briefly appear).
   j. At this time, detection is active and you can proceed with the test.
4. If the device includes WCD9335 and WCD9330s codec, such as on MSM8996 and MSM8994 respectively, set the HWMAD threshold to the minimum 0x0 through ADB commands:

   For MSM8994 or MSM8992, use the following ADB commands:

   ```
   adb shell "echo '0xE6 0x00' > /sys/kernel/debug/asoc/msm8994-tomtom-mtp-snd-card/tomtom_codec/codec_reg"
   adb shell "echo '0xE7 0x00' > /sys/kernel/debug/asoc/msm8994-tomtom-mtp-snd-card/tomtom_codec/codec_reg"
   ```

   For MSM8996, use the following ADB commands:

   ```
   adb shell "echo '0x287 0x00' > sys/kernel/debug/regmap/tasha*/registers"
   adb shell "echo '0x288 0x00' > sys/kernel/debug/regmap/tasha*/registers"
   ```

   For MSM8956/MSM8976, use the following XML changes:

   ```
   adb root
   ```


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```
adb remount
adb pull /etc/sound_trigger_platform_info.xml c:\Temp
<ctrl name="execution_type" value="CPE" /> (Change APE to CPE)
adb push C:\TEMP\sound_trigger_platform_info.xml /etc/
adb reboot
```

For MSM8956/MSM8976, use QACT to implement the following settings:

```
Threshold value is MAX (0X00000000) 20ms periodic waveform on current
rail 143
Save the changed acdb file
adb push MTP_WCD9335_Handset_cal.acdb /etc/acdbdata/MTP/msm8976-tasha-
snd-card
adb shell stop media
adb reboot
```

5. Disconnect USB and turn off the display.
6. Wait for 30 sec after turning off the display.
7. Play Au35A.wav [refer to *Listen Keyword Detection Using 16 kHz Mono Speech, 100% Speech, User-Verification On, Single Keyword* (MH80-VR010-23)] in a loop with any lab speaker as close to the device as possible.
8. Use a volume level sufficient to trigger the SVA Keyword search activity.
9. Measure the power waveform for 30 sec. If step 4 is not done, a selective average needs to be taken manually from the power waveforms over the keyword detection activity regions.
10. Save the waveform and the power measurements.
11. Acquire the power numbers on three different runs; follow steps 1 to 10 every time a measurement is taken.
12. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.

9.6 Video playback (QTCxx)

9.6.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case. The QTI dashboard measurement for this use case is in Offload mode. For Offload mode, verify that av.offload.enable is set to True under build.prop.

1. Reboot the device.
2. Load the test clip on the device, e.g., to decode 720p format video, download clip “qtc77.”

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Available clips for testing are listed in Table 9-4.

Table 9-4 Video playback test clips

Test clip	Description
QTC48.mp4	30 fps at VGA H.264 2 Mbps AAC+ 96 kbps 44.1 kHz stereo; refer to *30 fps at VGA H.264 2 Mbps AAC+ 96 kbps 44.1 kHz Stereo (QTC48) Clip for Multimedia Power Measurement* (MH80-VR010-6)
QTC49a.mp4	Video: 30 fps at HD 720p 4 Mbps H.264 AAC+ 96 kbps 48 kHz stereo; refer to *Video: 720p 1280x720 30 fps H.264 HP 2.13 Mbps, AAC+ Stereo 44.1 kHz 128 kbps (YouTube 720p)* (MH80-VR010-11)
QTC77.mp4	30 fps at HD 720p H.264 10 Mbps AAC+ 96 kbps 44.1 kHz stereo; refer to *30 fps at HD 720p H.264 10 Mbps AAC+ 96 kbps 44.1 kHz Stereo (QTC77) Clip for MM Power Measurement* (MH80-VR010-7)
QTC88.mp4	30 fps at HD 1080p H.264 20 Mbps AAC+ 96 kbps 44 kHz stereo; refer to *30 fps AT HD 1080p H.264 20 Mbps AAC+ 96 kbps 44 kHz Stereo (QTC88) Clip for MM Power Measurement* (MH80-VR010-8)
QTC100.mp4	30 fps at HD 720p H.265 software solution 3 Mbps AAC + 96 kbps 44.1 kHz stereo; refer to *Video: 30 fps at HD 720p H.265 Software Solution 3 Mbps AAC + 96 kbps 44.1 kHz Stereo* (MH80-VR010-22)
QTC101A	QTC101A – 30 fps at UHD 8b H.264 42 Mbps Speedboat, AAC+ 128 kbps 44 kHz stereo; refer to *QTC101 – 30 fps at UHD 8b H.264 42 Mbps Speedboat, AAC+ 128 kbps 44 kHz Stereo* (MH80-VR010-27)
QTC102A	QTC102A – 30 fps at UHD 8b H.265, AAC+ 128 kbps 44 kHz stereo
QTC106A	QTC106A – 60 fps @ UHD 10b H.265 50 Mbps Speedboat AAC+ 128 kbps 44 kHz Stereo; refer to *QTC106 – 60 FPS at UHD 10B H.265 50 Mbps Speedboat AAC+ 128 kbps 44 kHz Stereo* (MH80-VR010-30)

a. Download the test clip from https://support.cdmatech.com/login/.

b. Connect a USB to the device.

c. From the command prompt using the ADB shell, push the clip to the device:

```
adb push <Clip Location>\<Clip> /sdcard/
```

d. Disconnect the USB once done.

e. Reboot the device.

3. Plug in the headset; the headset calibration is at .1 mW for FFAs and XPM.

4. Play the video clip using the Android Gallery application, Gallery2.apk. If the Gallery2.apk application is not installed by default, for QTI MTP/XPM, install the application:

```
adb shell mount -t ext4 -o remount,rw /dev/block/mmcblk0p12 /system
adb shell rm system/app/Gallery2.apk
adb shell rm -rf system/app/Gallery2
adb install -r -d <Gallery2.apk Location>\Gallery2.apk
adb shell sync
```

5. Set buffer size and offload mode minimum duration using the following ADB commands:

```
adb root
```


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```
adb remount
adb shell
setprop audio.offload.buffer.size.kb 256
setprop audio.offload.min.duration.secs 30
sync
exit
```

6. Make sure Repeat mode is *not* selected.
7. After the clip starts playing, adjust the volume to 0, and then increase the volume eight steps up.
8. Video playback must execute in Landscape mode using the Gallery2.apk application.
   a. After video playback starts, wait until the progress bar disappears.
   b. Take the power measurement for 30 sec.
   c. Verify that video is being played in Landscape mode on full screen and that autorotation is enabled.
9. Save the waveform and the battery power numbers measured.
10. Get the power number on three different runs. Follow steps 1 to 10 each time a new power measurement is taken.
11. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
12. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
13. Verification of the frame rate of decoded video can be done as a separate step, since enabling logging results in an increased power measurement. See Section 9.6.2.

9.6.2 Frame rate verification

There are two ways to confirm whether video is decoding at the same frame rate as it was encoded.

Method 1

1. To enable the FPS information logging for the test video clip through the ADB shell, set the persist.debug.sf.statistics parameter to 1.

```
adb shell setprop persist.debug.sf.statistics 1.
```

2. Disconnect the USB.
3. Play the video clip again.
4. After measurement is complete, connect the USB and save the output to a text file.

```
adb logcat  >  <filename>
```

or

```
adb logcat -v threadtime | tee <filename>
```


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5. Verify the frame rate by searching for FPS in the saved file or by grepping for the fps using the following ADB command.

```
adb logcat  | grep  - i "fps"
```

Method 2

1. Capture dumpsys media player information.
2. Connect the USB cable to the device.
3. Execute the following ADB command before playing the audio/video clip.

```
adb shell sleep 50 && dumpsys media.player >> data/local/fps.txt &
```

4. Disconnect the USB.
5. Take power measurements for 30 sec as described in Section 9.6.1, while waiting for 50 sec to expire. Save the waveform and the measured power numbers.
6. Connect the USB.
7. Using the ADB shell, **`cat`** the contents of the saved file and **`grep`** for the string "Average frames per second" to confirm the frame rate.

```
cat /data/local/fps.txt | grep "Average frames per second"
```

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9.7 1080p video encoding (QMC31, QMC38A-1)

9.7.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Reboot the device.
2. After boot up, wait 1 min to ensure that the current has stabilized.
3. Launch the Snapdragon Camera application.
4. Under Camera settings apply the settings shown in Table 9-5.

Table 9-5 Camera settings – 1080p video encoding (QMC31, QMC38A-1)

Parameter	Value
FD	Disabled
ZSL	Enabled

5. Switch to Camcorder mode and apply the settings shown in Table 9-6, which remains after rebooting the phone.

Table 9-6 Camcorder settings – 1080p video encoding (QMC31, QMC38A-1)

Field	Value
Resolution	1080p
Encoding	H.264
White balance	Auto
TNR	Enabled
IS	Disabled
Run the following ADB commands once (Note: Required for MSM 8996)	

`adb root`
`adb remount`
`adb shell`
`adb shell setprop persist.camera.mem.usecache 0`
`adb shell setprop persist.camera.is_type 0`
`adb shell setprop persist.camera.isp.dualisp 0`
`adb shell sync`
`adb reboot`	

6. To see all settings, select Redeye Reduction eight times to enable Developer mode in Camera. This step is required for MSM8996.
7. Enable Partial UI in Camcorder. This step is required for MSM8996.
8. Place a Macbeth color checker chart in front of the camera sensor in a well-lit area.
9. Ensure that the Macbeth color checker chart is the only object visible on screen and ensure that video is encoding at 30 fps.
10. Start video recording, ensure that it is encoding in Portrait mode, and that the LCD and backlight are on.

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11. After video encoding starts, wait approximately 5 sec and then measure power for 30 sec.
12. Save the waveform and the battery power numbers measured.
13. Get the power number on three different runs. Follow Steps 1 to 11 every time a new power measurement is taken.
14. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1+ Measurement 2+ Measurement 3)/3.
15. Remove the LCD, backlight, touchscreen, and camera sensor contributions from the battery power measurement to get the MSM contribution.

Verify the fps of the recorded video clip as follows:

1. Check fps information by viewing the recorded clip in QuickTime or VLC player.
2. Extract the clip using the following ADB command:

```
adb  pull  /sdcard/dcim/camera  c:\temp
```

9.8 Graphics PowerLift (QGC23A)

9.8.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Install Powerlift 3D version 5.2. Download the latest PowerLift tool from https://support.cdmatech.com/login/.

Test	Description
QGC23A	Exe, PowerLift 3D Linux Android Graphics Tool Release 5.2.00; refer to *EXE, PowerLift 3D Linux Android Graphics Tool Release 5.2.00* (HK11-NC876-1)

   a. Connect the USB to the device.
   b. On the DOS command prompt through the ADB shell, run the following:

```
adb uninstall com.qualcomm.powerlift
adb install <Powerlift location>\PowerLift.apk
adb shell chmod 777 /data/data/com.qualcomm.powerlift
adb shell mkdir /data/data/com.qualcomm.powerlift/files
adb shell chmod 777 /data/data/com.qualcomm.powerlift/files
adb push <Powerlift location>\config.txt
/data/data/com.qualcomm.powerlift/files/config.txt
```

   c. Change the following line in build.prop to remove the bottom navigation bar:

```
adb root
adb remount
adb pull /system/build.prop
```


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d. Search for qemu.hw.mainkeys and set it to 1.

e. Push the build.prop file on to the device.

```
adb push (build.prop) /system/.
adb shell chmod 644 /system/build.prop
adb shell sync
```

f. Disconnect the USB.

g. Reboot the device.

2. Run the following command for panel display resolution larger than 1080p:

```
adb root
adb remount
adb shell wm size 1080x1920
```

NOTE: The QTI dashboard measurement is based on 1080p GPU rendering.

3. Wait approximately 1 min to ensure that the current has stabilized.
4. Ensure that the configuration file frame rate is set to 30 fps.

   Go to the main menu and click **PowerLift**.
5. Ensure that PowerLift graphics plays in Portrait mode.
6. After PowerLift rendering starts, wait approximately 1 min and take the power measurements for 30 sec.
7. Save the waveform and power numbers.
8. Get the power number on three different runs. Follow steps 1 to 8 each time a new power measurement is taken.
9. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
10. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.

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9.9 Gaming Egypt (QGC26A)

9.9.1 Power measurement procedure

NOTE: This procedure is a part of the MSM8956/MSM8976 Thermal Power dashboard.

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Download the commercial version of Egypt 2.5 HD from the Android market.

NOTE: The Egypt version used varies based on the chipset used; refer to the respective chipset's Current Consumption Power document for details.

On QTI XPM/MTP(s), install Egypt 2.5 HD.

a. Connect the USB to the device.

b. Change the following line in build.prop to remove the navigation bar at the bottom:

```
adb root
adb remount
adb pull /system/build.prop
```

c. Search for qemu.hw.mainkeys and set it to 1.

d. Push the build.prop file on to the device.

```
adb push (build.prop) /system/.
adb shell chmod 644 /system/build.prop
adb shell sync
```

e. Disconnect the USB from the device.

2. Reboot the device.
3. After the device boots up, wait 1 min to ensure that the current has stabilized.
4. Run the following command for panel display resolution larger than 1080p:

```
adb root
adb remount
adb shell wm size 1080x1920
```

NOTE: The QTI dashboard measurement is based on 1080p GPU rendering.

5. To start Egypt, go to the main menu and click **GL Benchmark**. Under the performance tests option, select **GLBenchmark 2.X Egypt HD Onscreen**. Note that this option is subject to change.

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6. After Egypt rendering starts, wait approximately 1 min and take the power measurement for 30 sec.
7. Capture the power numbers.
8. Get the power numbers on three different runs. Follow steps 1 to 7 every time a new power measurement is taken.
9. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
10. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.

9.10 Browser (WB1A)

9.10.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Turn on Wi-Fi.
2. Go to Settings→Wireless & network settings→Wi-Fi settings.
3. Select the Wi-Fi connection and connect to the local Wi-Fi network through which the apache server is accessible.
4. Make sure a Wi-Fi access point is within 6 ft of the device and that the wireless router is of the 802.11g type; for server and hardware setup, refer to *MSM8960 LA Server and Hardware Component Setup for Video Streaming and Browser Test Cases* (80-N8520-1).
5. Connect the USB.
6. Launch the standard Android browser and click the address bar.
7. In the command prompt type the following ADB command to input the apache server HTTP address where the Ibench web page is stored:

```
adb shell
Input text "http:\\<server name> or <IP address>"
```

8. Bookmark the above HTTP address.
9. Disconnect the USB.
10. After the phone boots up, wait 1 min to ensure that the current has stabilized.
11. Connect to a local Wi-Fi network and from the bookmark, select the apache server HTTP URL where the Ibench web page is stored.

NOTE: If the Ibench web page cannot be accessed, follow the setup procedure described in *EXE, Ibench V.4.6.01 for Linux Android Enabled Devices*.

NOTE: Web page browsing should be done in Portrait mode.

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12. Select **Run Test (40 sec)** and ensure the display that the display is on while accessing the Ibench webpage.
13. After the web page appears onscreen, take the power measurement for 200 sec and capture the power numbers. This measurement takes five cycles, because the web pages get refreshed every 40 sec.
14. Get the power numbers on three different runs. Follow steps 1 through 14 every time a new power measurement is taken.
15. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
16. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.

9.11 Video Streaming (VSX)

9.11.1 Power measurement procedure

Ensure all prerequisites listed in Section 9.1 are met before starting this use case.

1. Turn on Wi-Fi.
2. Go to Settings→Wireless & network settings→Wi-Fi settings.
3. Select the Wi-Fi connection and connect to the local Wi-Fi network through which the server is accessible.
4. Make sure the Wi-Fi access point is within 6 ft of the device and that the wireless router is of the 802.11g type.
5. For Linux Android video streaming server and hardware setup, refer to *MSM8960 LA Server and Hardware Component Setup for Video Streaming and Browser Test Cases* (80-N8520-1).
6. Connect the USB.
7. Launch the standard Android browser and click the address bar.
8. In the command prompt, type the following ADB command to input the apache server HTTP address where the video clip is stored:

```
adb shell
Input text Error! Hyperlink reference not valid.
```

9. Use the appropriate method by chipset as follows:
   - Bookmark the above HTTP address (non-MSM8956/MSM8976 chipsets only).
   - For MSM8956/MSM8976, play the clip using gallery and run the clip in landscape mode:

     ```
     adb shell am start -a "android.intent.action.VIEW" -d
     "http://192.xxxxxxxxx/Users/abcd/qtc77.720p.mp4" -t "video/3gp"
     ```
10. Disconnect the USB.
11. Plug in the headset; headset calibration is at 1 mW for XPM.

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12. After the phone boots up, wait 1 min to ensure that the current has stabilized.
13. When video streaming starts, adjust the volume to mute and then increase the volume eight times from mute.
14. Connect to a local Wi-Fi network and from the bookmark select the apache server HTTP URL where the clip is stored.
15. Select the video streaming clip according to the use case; see Table 9-7.

Table 9-7 Video streaming clips

Test clip	Description
VS4	Video: 514 Kbps, 640 * 360 (16:9), AVC (Baseline @ L3.0) (1 Ref Frame), 96.0 Kbps, 44.1 kHz, 2 channels, AAC (LC); refer to *Video: 514 kbps, 640 * 360 (16:9), AVC (Baseline at L3.0) (1 Ref Frame), 96.0 kbps, 44.1 kHz, 2 Channels, AAC (LC)* (MH80-VR010-10)
VS6	Video: 720p 1280x720 30 fps H.264 HP 2.13 Mbps, AAC+ Stereo 44.1 kHz 128 Kbps (YouTube 720p); refer to *Video: 720p 1280x720 30 fps H.264 HP 2.13 Mbps, AAC+ Stereo 44.1 kHz 128 kbps (YouTube 720p)* (MH80-VR010-11)
VS7	Video Streaming over Wi-Fi (1080p 3.5 Mbps) 2 GHz, 11n, 2x2 MCS7 HT20; refer to *Video Streaming over Wi-Fi (1080p 3.5 Mbps) 2 GHz, 11n, 2x2 MCS7 HT20 – VS7A* (MH80-VR010-29)

16. After video streaming playback starts, wait until the progress bar disappears and take the power measurement for 90 sec.
17. Get the power number on three different runs. Follow steps 1 to 17 every time a new power measurement is taken.
18. Calculate the average battery power after 3 runs.

    Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3

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9.12 Camera preview (QMC38A, QMC31A-1)

9.12.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

The QMC38A use case applies to MSM8996 and the QMC31A-1 use case applies to MSM8956/MSM8976.

1. Make sure the headset is not connected. Reboot the device.
2. After boot up, wait 1 min to ensure that the current has stabilized.
3. Launch the Snapdragon Camera application.
4. Under Camera settings apply the settings shown in Table 9-8.

Table 9-8 Camera settings – Camera preview (QMC38A)

Parameter	Value
FD	Disabled
ZSL	Enabled
Touch AF/AEC, HDR, and other effects	Disabled
TNR mode	Enabled Select Redeye Reduction eight times to enable Developer mode.
Camera picture size	21 MP (for MSM8996)

NOTE: The following table was added to this document revision.

Table 9-9 Camera settings – Camera preview (QMC31A-1)

Parameter	Value
FD	Disabled
Red eye reduction	Disabled
Picture quality	Normal
ZSL	Enabled
Touch AF/AEC, HDR, and other effects	Disabled
Store location	Disabled
Flash	Off
Camera picture size	16.9
Wavelet denoise mode	Off

5. Switch to Camcorder mode and apply the settings shown in Table 9-10, which remains after rebooting the phone.

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Table 9-10 Camcorder settings – Camera preview (QMC38A)

Parameter	Value
Video quality	1080p
White balance	Auto
IS	Unchecked

6. Place a Macbeth color checker chart in front of the camera sensor in a well-lit area.
7. Ensure that the Macbeth color checker chart is the only object visible on screen and ensure preview fps is 24.
8. Start the camera preview use case. Ensure that the device is in Portrait mode,
9. Wait approximately 5 sec and then measure power for 30 sec.
10. Save the waveform and the battery power numbers measured.
11. Get the power number on three different runs.

    Follow steps 1 to 11 every time a new power measurement is taken.
12. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2+ Measurement 3)/3.
13. Remove the LCD, backlight, touchscreen, and camera sensor contributions from the battery power measurement to get the MSM contribution.

The procedure to verify the preview fps is as follows:

1. Run the following command before starting the Camera app:

```
adb shell setprop persist.camera.hal.debug 1
adb shell setprop persist.camera.logs 1
adb shell setprop persist.debug.sf.showfps 1
```

2. Launch the Camera app and run the following command to get the fps information:

```
adb logcat | grep PROFILE_PREVIEW_FRAMES_PER_SECOND
```

3. Make sure to disable all the above logs and reboot the device before doing a power measurement.

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9.13 Flatland (QGC30A)

9.13.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Install Powerlift 3D version 7.0.6. Download the Flatland application by its DCN # [TBD].

Test	Description
QGC30A	Flatland Omnibox Powerlift [60:27] offscreen, 60 fps [DCN # [TBD]]

   a. Connect the USB to the device.

   b. On the DOS command prompt through the ADB shell, run the following:

```
adb install -r PowerLift-debug.apk
adb push Config.txt  /sdcard/powerlift/config.txt
adb shell sync
```

2. Wait approximately 1 min to ensure that the current has stabilized.
3. Ensure that the configuration file frame rate is set to 60 fps.
4. Ensure that the device is in Portrait mode.
5. After the Flatland use case starts, wait approximately 1 min and take the power measurements for 30 sec.
6. Save the waveform and power numbers.
7. Get the power number on three different runs.

   Follow steps 1 to 6 each time a new power measurement is taken.
8. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
9. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.

9.14 Web browsing over Wi-Fi (Lorem with UI) (WB10A)

9.14.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Turn on Wi-Fi.
2. Go to Settings→Wireless & network settings→Wi-Fi settings.
3. Select the Wi-Fi connection and connect to the local Wi-Fi network through which the apache server is accessible.

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4. Make sure a Wi-Fi access point is within 6 ft of the device and that the wireless router is of the 802.11g type; for server and hardware setup, refer to *MSM8960 LA Server and Hardware Component Setup for Video Streaming and Browser Test Cases* (80-N8520-1).
5. Get the Lorem release content [refer to *HTML, Web Browsing over Wi-Fi (Lorem with UI) (WB10A)* (HT11-NT721-1)].
   a. Copy the Lorem content under C:\program files\Apache Software Foundation\ Apache2.2\htdocs\.
6. Connect the USB.
7. Launch the SWE Browser (based on chromium –m42) and click the address bar. For power measurement, QTI is using SWE Browser based on chromium-m42.

   To make the SWE browser, refer to the following link: https://www.codeaurora.org/xwiki/bin/Chromium+for+Snapdragon/Build.
8. In the command prompt type the following ADB command to input the apache server HTTP address where the Lorem web page is stored:

```
adb shell
Input text "http:\\<server name> or <IP address>"
```

9. Bookmark the above HTTP address.
10. Disconnect the USB and reboot the device.
11. After the phone boots up, wait 1 min to ensure that the current has stabilized.
12. Connect to a local Wi-Fi network and, from the bookmark, select the apache server HTTP URL where the Lorem is stored.

    Follow steps a through e to run the use case.

NOTE: Web page browsing should be done in Portrait mode.

   a. Open the index.html WB10A file located on your internal server and start measuring the power.
   b. Open the browser bookmarks UI. Click the WB10A the test.php bookmark.
   c. Wait 10 sec, and scroll five times (each scroll per second), down-up-down-up-down in sequence. Scroll only 30% of the screen each time.

      These five scrolls should be done in 5 sec.
   d. Go back to index.html and wait 5 sec.

      Steps b through d should take 20 sec.
   e. Repeat steps b through d three times, for a total of 60 secs.
13. Get the power numbers on three different runs.
14. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.

Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.

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10 Sensor use cases

10.1.1 Basic setup

To replicate the test setup for the SSC power measurements:

1. Ensure the QSensorTest Android application is installed.
2. Ensure that sensor streaming works on the device, either by running QSensorTest or through logs.
3. Ensure that no sensors logging is enabled during any of the measurements.
4. If QXDM Pro is connected, disconnect both QXDM Pro and the USB.
5. Apply these settings:
   - Enable Airplane mode – Settings→More→Airplane mode (select)
   - Disable auto rotate – Settings→Display→Auto rotate screen (deselect)
   - Disable pad touch tones – Settings→Sound→Dial pad touch tones (deselect)
   - Disable touch sounds – Settings→Sound→Touch sounds (deselect)
   - Disable screen lock sound – Settings→Sound→Screen lock sound (deselect)
   - Disable GPS – Settings→Location access→GPS satellites (deselect)
   - Disable screen on while charging – Qualcomm settings→Stay on plugged (deselect)
   - Disable the adaptive backlight option – Qualcomm settings→Enable content adaptive backlight (deselect)
   - Disable data – Settings→Wireless and networks→Mobile networks→Data enabled (deselect)
   - Disable data roaming – Settings→Wireless and networks→Mobile networks→ Data roaming (deselect)

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10.1.2 Procedure for MSM8974, MSM8x26, and MSM8916

10.1.2.1 Active processing

To perform SSC power measurements:

1. Set the screen timeout to a high number (Settings→Display→Sleep), e.g., 30 min.
2. Ensure that the USB is not connected.
3. Wait 60 sec with the display up in the Home screen, and then collect power measurement. This measurement is referred to as the active baseline measurement.
4. Start the QSensorTest application; refer to *gpsOne Power Consumption Test Procedure* (80-VR003-1) for details on using QSensorTest.
5. Disable UI update and wake lock holding.
   - Menu→Screen update (deselect)
   - Menu→Wake lock held (deselect)
6. Select the Set Listener tab corresponding to Accel.
7. Select the UI for sensor stream rate. This starts sensor streaming to HAL at 15 Hz.
8. Keep the UI (home screen) on during measurement.
9. Wait for 60 sec.
10. Collect the power measurement. This measurement is referred to as the active sensors measurement.
11. Calculate the sensors delta. Active sensors measurement – Active baseline measurement.

    The calculated delta includes sensor hardware consumption and SSC consumption.

10.1.2.2 Background processing

To perform background processing:

1. Set the screen timeout to a small number, such as sec.
2. Ensure that the USB is not connected.
3. Wait 60 sec after the device goes into XO shutdown and then collect power measurement. This measurement is referred to as the XO baseline measurement.
4. Wake up the device and start the QSensorTest application; refer to *gpsOne Power Consumption Test Procedure* (80-VR003-1) for details on using QSensorTest.
5. Disable UI update and wake lock holding.
   - Menu→Update screen (deselect)
   - Menu→Wake lock held (deselect)
6. In the threshold menu, submit a listener for Accel. Verify that the threshold values are X:32767, Y:32767, and Z:32767 and that the streaming rate (Hz) is set to 10 (indicates 10 Hz); these should be the default values.

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7. Wait 60 sec after the screen turns off, indicating XO shutdown has been achieved, with sensors background use case continuing to run on ADSP.
8. Collect the power measurement. This measurement is referred to as the background sensors measurement.
9. Calculate sensors delta. Background sensors measurement - XO baseline measurement.

   The calculated delta includes sensor hardware consumption and SSC consumption.
10. This number should be adjusted for power consumption of the sensor part being used and present on the device.
11. To verify that the sensors' threshold algorithm is continuing to operate during XO shutdown, enable sensors logging and repeat steps 1 to 7. Connect the USB. In QXDM Pro, select **SNS** and **QDSP6** (Hexagon Multimedia) in the F3 Config menu, and observe the F3 log to make sure the sensors' threshold algorithm is continuing to operate.
12. For any subsequent power measurements after this use case, ensure that QXDM Pro is not running, the USB is disconnected, and that sensors logging has been disabled.

10.1.3 Procedure for MSM8960 and APQ8064

10.1.3.1 Active processing

To perform DSPS power measurements:

1. Set the screen timeout to a high number (Settings→Display→Screen), e.g., 30 min.
2. Ensure that the USB is not connected.
3. Wait 60 sec with the display on in the Home screen, and collect the power measurement. This measurement is referred to as the active baseline measurement.
4. Start the QSensorTest application; refer to *gpsOne Power Consumption Test Procedure* (80-VR003-1) for details on using QSensorTest.
5. Navigate to the menu. There should be a Disable UI update tab; select it.
6. Select the Set Listener tab corresponding to Accel.
7. Select Normal for sensor stream rate. This starts sensor streaming to HAL at 5 Hz.
8. Keep the UI on during measurement.
9. Wait 60 sec.
10. Turn the display off, wait 60 sec, and collect the power measurement. This measurement is referred to as the XO baseline measurement.
11. Calculate the sensors delta. Active sensors measurement – Active baseline measurement.

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10.1.3.3 Background processing

To perform background processing:

1. Set the screen timeout to a small number, such as sec.
2. Turn the display off, wait 60 sec, and collect the power measurement. This measurement is referred to as the XO baseline measurement.
3. Plug in the USB, and connect the port in QXDM Pro.
4. To request Accel data at 1 Hz, send the following diagnostic command.

```
send_data 128 64 2 0 1 0 2 0 0 40 33 0 0 0 40 0 1 1 0 8 2 1 0 1 3 2 0 1
0 4 1 0 0 5 20 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

5. Disconnect QXDM Pro and unplug the USB.
6. Ensure that the display is turned off before proceeding (manually turn off the display or let the display time out).
7. Wait 60 sec.
8. Collect the power measurement. This measurement is referred to as the background sensors measurement.
9. Calculate the sensors delta. Background sensors measurement – XO baseline measurement.

10.1.4 Procedure for MSM8996, MSM8994, MSM8992, MSM8952/56/76, MSM8937, and MSM8953

NOTE: Numerous changes were made in this section.

10.1.4.1 Background buffering of accelerometer data with 1 Hz ADSP wake-up (SNS6A)

To perform background processing:

1. Reboot the device and make sure the headset is not connected.
2. Turn the display off, wait 60 sec, and make sure that the device enters XO shutdown.
3. Start the QSensorTest application, go to the Options menu and select **Optimize for Power**, deselect **Wake Lock Held** and **Update Screen**.
4. Go to the QSensorTest application, select the Streaming menu, and press **ACCEL** for a couple of seconds. The Sensors Stream Rate window displays.
5. Set Sample Period (ms) and Report Period (ms) as follows, and click **Submit**.

Chipset	Sample period (ms)	Report period (ms)
MSM8996	50	1000
MSM8994	50	1000

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Chipset	Sample period (ms)	Report period (ms)
MSM8992	50	1000
MSM8952	50	1000
MSM8956/76	50	1000
MSM8937	67	1000
MSM8953	50	1000

6. Ensure that the display is turned off and wait until the device goes to XO shutdown with ACCEL running in the background.
7. Wait 60 sec.
8. Collect the power measurement for 30 sec.

Calculate the current consumption for SNS6A

The current consumption value can be used for accelerometer batch background processing.

Calculate the current consumption for the SNS6A use case as follows:

1. Get the AIR1 current measurement. See Section 3.1 for instructions.
2. Subtract the current measured for AIR1 scenario (airplane mode with display off, i.e., rock bottom current) from the measured value of SNS6A use case.
3. Deduct the sensor power value from the SNS6A-measured value.

10.1.4.2 Active processing (SNS4A)

1. Reboot the device and make sure the headset and USB are not connected.
2. Set the screen timeout to a high number (Settings→Display→Sleep), e.g., 30 min.
3. Turn the display off and make sure that the device enters XO shutdown.
4. Turn on the display and start the QSensorTest application, go to the Options menu and select **Optimize for Power**, and disable UI update and wake lock held.
   - Menu→Screen update (deselect)
   - Menu→Wake lock held (deselect)
5. Under the Stream menu, press **ACCEL** for a couple of seconds until the Sensor Stream Rate menu pops up.
6. Set Sample Period (ms) and Report Period (ms) as follows, and click **Submit**.

Chipset	Sample period (ms)	Report period (ms)
MSM8996	100	100
MSM8994	67	67
MSM8992	67	67
MSM8952	67	67
MSM8956/76	100	100
MSM8937	67	67

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Chipset	Sample period (ms)	Report period (ms)
MSM8953	100	100

7. Keep the UI (home screen) on during measurement.
8. Wait for 60 sec.
9. Collect the power measurement for 30 sec. This measurement is referred to as the active sensors measurement.
10. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.

MSM current contribution can be calculated by removing the LCD, backlight, and touchscreen contributions from the measured average battery power.

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11 Performance use cases

The following performance use cases apply to MSM8996, and MSM8956/MSM8976.

NOTE: An external setup is required to control the junction temperature.

11.1 T-rex HD 1080p, at 30 fps at full screen resolution at Vsync (QGC31AT)

11.1.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. If a corporate license for Kishonti is available, obtain version 3.0.22 to ensure that the commands provided in this procedure work.
2. Stop the thermal engine by using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```

3. Change the display resolution to 1080p using the following ADB command:

```
adb shell wm size 1080x1920
```

4. To start the use case at 30 fps, run the following ADB command. The command only works if you have the license from Kishonti.

```
adb shell am broadcast -a net.kishonti.testfw.ACTION_RUN_TESTS -n
com.glbenchmark.glbenchmark27.corporate/net.kishonti.benchui.corporate.C
ommandLineSession -e test_ids "gl_trex" --ei -single_frame 13300 --ef
-fps_limit 30 --ei -fps_log_window 1
```


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5. Using the TJ controller interface, set the Tsense15 junction temperature to 35° C. Tsense15 is for GPU.
6. Check the fps by enabling the following property. FPS should be 30.

NOTE: Do not forget to disable the property while doing a power measurement.

```
adb shell setprop debug.gr.calcfps 1
adb shell setprop debug.gr.calcfps.period 60
adb shell logcat | grep FPS
```

7. Using the TJ controller interface, set the GPU temperature (Tsense15) at 45° C. Wait for approximately 2 min until the temperature is stabilized at 45° C.
8. Disable the fps property.
9. When the temperature is stabilized at 45° C, stop the TJ controller and unplug the USB.
10. Measure the power for 30 sec.
11. Repeat steps 6 through 10 and measure the power for two more runs.
12. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
13. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
14. When the power measurement is done, return to the Home screen and kill the application.
15. Set the Tsense15 temperature to 30° C and reset the size using the following ADB command:

```
adb shell wm size reset.
```

16. Reboot the device.

11.2 T-rex HD 1080p, at 60 fps at full screen resolution at Vsync (QGC29AT)

11.2.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. If a corporate license for Kishonti is available, obtain version 3.0.22 to ensure that the commands provided in this procedure work.
2. Stop the thermal engine by using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```


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3. Change the display resolution to 1080p using the following ADB command:

```
adb shell wm size 1080x1920
```

4. To start the use case at 60 fps, run the following ADB command. The command only works if you have the license from Kishonti.

```
adb shell am broadcast -a net.kishonti.testfw.ACTION_RUN_TESTS -n
com.glbenchmark.glbenchmark27.corporate/net.kishonti.benchui.corporate.C
ommandLineSession -e test_ids "gl_trex" --ei -single_frame 13300 --ef
-fps_limit 60 --ei -fps_log_window 1
```

5. Using the TJ controller interface, set the Tsense15 temperature at 45° C.
6. Check the fps by enabling the following property. FPS should be 60.

NOTE: Do not forget to disable the property while doing a power measurement.

```
adb shell setprop debug.gr.calcfps 1
adb shell setprop debug.gr.calcfps.period 60
adb shell logcat | grep FPS
```

7. Using the TJ controller interface, set the GPU temperature (Tsense15) at 65° C. Wait for approximately 2 min until the temperature is stabilized at 65° C.
8. Disable the fps property.
9. When the temperature is stabilized at 65° C, stop the TJ controller and unplug the USB.
10. Measure the power for 30 sec.
11. Repeat steps 6 through 10 and measure the power for two more runs.
12. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
13. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
14. When the power measurement is done, return to the Home screen and kill the launch application.
15. Set the Tsense15 temperature to 40° C and reset the size using the following ADB command:

```
adb shell wm size reset.
```

16. Reboot the device.

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11.3 Manhattan 3.0, 1080p, single frame at 30 fps, off screen (Tj=75C) (QGC33AT)

11.3.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. If a corporate license for Kishonti is available, obtain version 3.0.22 to ensure that the commands provided in this procedure work.
2. Stop the thermal engine by using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```

3. Change the display resolution to 1080p using the following ADB command:

```
adb shell wm size 1080x1920
```

4. To start the use case at 30 fps, run the following ADB command. The command only works if you have the license from Kishonti.

```
adb shell am broadcast -a net.kishonti.testfw.ACTION_RUN_TESTS -n
com.glbenchmark.glbenchmark27.corporate/net.kishonti.benchui.corporate.C
ommandLineSession -e test_ids "gl_manhattan" --ei -single_frame 34500
--ef -fps_limit 30 --ei -fps_log_window 1
```

5. Using the TJ controller interface, set the Tsense15 temperature at 45° C.
6. Check the fps by enabling the following property. FPS should be 60.

NOTE: Do not forget to disable the property while doing a power measurement.

```
adb shell setprop debug.gr.calcfps 1
adb shell setprop debug.gr.calcfps.period 60
adb shell logcat | grep FPS
```

7. Using TJ controller interface, set the GPU temperature (Tsense15) at 75° C. Wait for approximately 2 min until the temperature is stabilized at 75° C.
8. Disable the fps property.
9. When the temperature is stabilized at 75° C, stop the TJ controller and unplug the USB.

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10. Measure the power for 30 sec.
11. Repeat steps 6 through 10 and measure the power for two more runs.
12. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
13. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
14. When the power measurement is done, return to the Home screen and kill the launch application.
15. Set the Tsense15 temperature to 40° C and reset the size using the following ADB command:

```
adb shell wm size reset.
```

16. Reboot the device.

11.4 UHD 30 fps, 8b, H264 local video playback + UHD 30 fps WFD mirroring, Miracast, 11n, 2 x 2 MCS7 HT20 (Tj = 65°C) (VS12T)

11.4.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Stop the thermal engine by using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```

2. Turn on Wi-Fi from the Settings menu option.
3. Enable the wireless display from Settings→Display→Cast Screen menu option.
4. Push the video clip to internal memory using the following ADB commands:

```
adb push QTC101.mp4  /sdcard/Movies
adb shell sync
adb reboot
```

5. Reboot the device.
6. Get the clip; refer to [*QTC101 - 30 fps at UHD 8b H.264 42 Mbps Speedboat, AAC+ 128 kbps 44 kHz Stereo* (MH80-VR010-27)].

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7. When the device is booted up, set the buffer size and offload mode duration:

```
adb root
adb remount
adb shell
setprop audio.offload.buffer.size.kb 256
setprop audio.offload.min.duration.secs 30
```

8. Using the TJ controller interface, set the Tsense11 (CPU junction temperature) temperature at 45° C.
9. Launch the WFD client app and do the following:
   a. Click the magnifier on top right corner.
   b. Click the **connect** button.
   c. Click **Start Session**.
   d. Make sure the connection is established successfully.
   e. Press the **home** button and return to the Home screen.

      Do not press the **return** button; otherwise, you will tear down the connection.
10. Using the TJ controller interface, set the Tsense11 temperature at 65° C.
11. To verify FPS, run the following command before playing the video clip:

```
adb root
adb shell setprop persist.debug.sf.statistics 1
adb shell setprop persist.debug.sf.extendedstats 1
adb shell getprop persist.debug.sf.statistics
```

12. Play the video and capture the logcat logs using the following command:

```
adb shell logcat -v threadtime > logcat.txt
```

13. Search for “awesome player” and look for frame per second.
14. Make sure to disable the logs shown in step 12 while measuring the power.
15. Play the video from the Gallery app in Landscape (full screen mode).
16. When the temperature is stabilized at 65° C, stop the TJ controller and unplug the USB.
17. Measure the power for 30 sec.
18. Repeat steps 8 through 17 and measure the power for two more runs.
19. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
20. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.

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21. When the power measurement is done, return to the Home screen and kill the launch application.
22. Set the Tsense11 temperature to 40° C and reset the size using the following ADB command:

```
adb shell wm size reset.
```

23. Reboot the device.

11.5 UHD 60 fps, 10b, H265 local video playback + 1080P 60 fps WFD mirroring, Miracast, 11n, 2 x 2 MCS7 HT20 (Tj = 65°C) (VS13T)

NOTE: This section was added to this document revision.

11.5.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Stop the thermal engine using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```

2. Turn on Wi-Fi from the Settings menu.
3. Enable the wireless display from the Settings→Display→Cast Screen menu.
4. Push the video clip to internal memory using the following ADB commands:

```
adb push QTC101.mp4  /sdcard/Movies
adb shell sync
adb reboot
```

5. Reboot the device.
6. Get the clip. For instructions, refer to *QTC101 – 30 fps at UHD 8b H.264 42 Mbps Speedboat, AAC+ 128 kbps 44 kHz Stereo* (MH80-VR010-27).

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7. When the device is booted up, run the following commands to set the buffer size and offload mode duration:

```
adb root
adb remount
adb shell
setprop audio.offload.buffer.size.kb 256
setprop audio.offload.min.duration.secs 30
```

8. Using the TJ controller interface, set the Tsense11 (CPU junction temperature) temperature at 45° C.
9. Launch the WFD client app, and do the following:
   a. Click the magnifier on top right corner.
   b. Click **connect**.
   c. Click **Start Session**.
   d. Make sure the connection is established successfully.
   e. Press the **home** button and return to the Home screen.

      Do not press the **return** button. Pressing the return button tears down the connection.
10. Using the TJ controller interface, set the Tsense11 temperature to 65° C.
11. To verify FPS, run the following commands before playing the video clip:

```
adb root
adb shell setprop persist.debug.sf.statistics 1
adb shell setprop persist.debug.sf.extendedstats 1
adb shell getprop persist.debug.sf.statistics
```

12. Run the following command to play the video and capture the logcat logs:

```
adb shell logcat -v threadtime > logcat.txt
```

13. Search for “awesome player” and look for frames per second.
14. Make sure to disable the logs shown in step 12 while measuring the power.
15. Play the video from the Gallery app in Landscape (full screen mode).
16. When the temperature is stabilized at 65° C, stop the TJ controller and disconnect the USB.
17. Measure the power for 30 sec.
18. Repeat steps 8 through 17 and measure the power for two more runs.
19. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.

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20. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
21. When the power measurement is done, return to the Home screen and kill the launch application.
22. Set the Tsense11 temperature to 40° C and reset the size using the following ADB command:

```
adb shell wm size reset.
```

23. Reboot the device.

11.6 UHD Asphalt8 (Tj = 65°C) (QGC53)

11.6.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Install ASPHALT 8 from Google play store.
2. Stop the thermal engine by using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```

3. Using the TJ controller interface, set the Tsense15 temperature at 45° C.
4. Launch the game.

   After it launches, it asks for your age. Enter your age and accept.
5. The game shows adds. Click **Next** for five times.
6. The game takes you to the Daily Bonus screen. Click **OK**.
7. Click **Play**.
8. The game asks you to learn to drive. Click **NO**.
9. The game takes you to different game location. Select the NEVADA Classic.
10. Click **Next** two times.
11. Using the TJ controller interface, set the GPU temperature (Tsense15) at 65° C.

    When the temperature reaches 65° C, get ready to launch the race.
12. Click **Start Race** and wait until the game loads the required settings and graphics.
13. When the temperature is stabilized at 65° C, stop the TJ controller and unplug the USB.
14. When you see the 3-2-1 countdown and as soon as car race begins, start measuring the power for 180 sec.
15. Repeat steps 3 through 14 and measure the power for two more runs.

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16. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
17. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
18. When the power measurement is done, return to the Home screen and kill the launch application.
19. Set the Tsense15 temperature to 40° C.
20. Reboot the device.

11.7 30 fps at UHD, H.264 42 Mbps encode, 8 MP, AAC 128 kbps 44.1 KHz stereo (Tj = 65° C) (QMC35AT)

11.7.1 Power measurement procedure

Ensure that all prerequisites described in Section 9.1 are met before starting this use case.

1. Stop the thermal engine by using the following ADB commands:

```
adb root
adb remount
adb shell stop thermal-engine
adb shell "ps | grep" thermal
```

2. Enable power save more by using the following ADB commands:

```
adb root
adb wait-for-device
adb shell setprop vidc.debug.perf.mode 2
adb shell setprop vidc.enc.dcvs.extra-buff-count 2
adb shell sync
```

3. Launch the Camera app and enable and disable the Redeye Reduction approximately 10 times in Camera mode until the Developer mode is activated and a pop-up appears.
4. After activating Developer mode, do the following from the Settings menu.
   a. Disable FD.
   b. Enable ZSL in Camera mode.

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5. Switch to Camcorder mode and apply the following settings:
   - Set the video quality to 4K UHD
   - Enable partial UI
   - Set the white balance to Auto
   - Disable IS
   - Enable TNR
6. Using the TJ controller interface, set the Tsense11 (CPU junction temperature) temperature at 45° C.
7. Launch the Snapdragon Camera app.
8. Place a Macbeth color checker chart in front of the camera sensor in a well-lit area.
9. Ensure that the Macbeth color checker chart is the only object visible on screen and ensure video is encoding at 30 fps.
10. Start recording. Using the TJ controller interface, set the CPU temperature (Tsense11) at 65° C
11. When the temperature is stabilized at 65° C, stop the TJ controller and unplug the USB.
12. Start measuring the power for 30 sec of duration.
13. Repeat steps 6 through 12 and measure power for two more runs.
14. Calculate the average battery power after 3 runs. Average battery power = (Measurement 1 + Measurement 2 + Measurement 3)/3.
15. Remove the LCD, backlight, and touchscreen contributions from the battery power measurement to get the MSM contribution.
16. When the power measurement is done, return to the Home screen and kill the launch application.
17. Set the Tsense11 temperature to 40° C.
18. Pull out the recorded clip and use the QuickTime player to check the fps.
19. When you are done, reboot the device.

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A Related documents

A.1 References

Document	
Qualcomm Technologies	
EXE, PowerLift 3D OpenGL ES Graphics Benchmark Tool V.4.6.01 for Linux Android-Enabled Devices	72-N5481-1
EXE, Ibench V.4.6.01 for Linux Android-Enabled Devices	72-N7696-1
MSM8960 LA Server and Hardware Component Setup for Video Streaming and Browser Test Cases	80-N8520-1
gpsOne Power Consumption Test Procedure	80-VR003-1
QCA6174 Power Measurement Test Procedure	80-Y7674-14
EXE, PowerLift 3D Linux Android Graphics Tool Release 5.2.00	HK11-NC876-1
EXE, SVA 2.0 Reference App	HK11-NR653-1
HTML, Web Browsing over Wi-Fi (Lorem with UI) (WB10A)	HT11-NT721-1
MP3 at 44.1 kHz 128 kbps Stereo Clip for Power Measurements	MH80-VR010-5
30 fps at VGA H.264 2 Mbps AAC+ 96 kbps 44.1 kHz Stereo (QTC48) Clip for Multimedia Power Measurement	MH80-VR010-6
30 fps at HD 720p H.264 10 Mbps AAC+ 96 kbps 44.1 kHz Stereo (QTC77) Clip for MM Power Measurement	MH80-VR010-7
30 fps AT HD 1080p H.264 20 Mbps AAC+ 96 kbps 44 kHz Stereo (QTC88) Clip for MM Power Measurement	MH80-VR010-8
*Video: 514 kbps, 640 * 360 (16:9), AVC (Baseline at L3.0) (1 Ref Frame), 96.0 kbps, 44.1 kHz, 2 Channels, AAC (LC)*	MH80-VR010-10
Video: 720p 1280x720 30 fps H.264 HP 2.13 Mbps, AAC+ Stereo 44.1 kHz 128 kbps (YouTube 720p)	MH80-VR010-11
VoLTE Audio Test File for Power Measurement	MH80-VR010-21
Listen Keyword Detection Using 16 kHz Mono Speech, 100% Speech, User-Verification On, Single Keyword	MH80-VR010-23
Video: 30 fps at HD 720p H.265 Software Solution 3 Mbps AAC + 96 kbps 44.1 kHz Stereo	MH80-VR010-22
QTC101 - 30 fps at UHD 8b H.264 42 Mbps Speedboat, AAC+ 128 kbps 44 kHz Stereo	MH80-VR010-27
Video Streaming over Wi-Fi (1080p 3.5 Mbps) 2 GHz, 11n, 2x2 MCS7 HT20 – VS7A	MH80-VR010-29
60 FPS at UHD 10B H.265 50 Mbps Speedboat AAC+ 128 kbps 44 kHz Stereo	MH80-VR010-30

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Document	
Resources	
Sync and Build	https://www.codeaurora.org/xwiki/bin/Chromium+for+Snapdragon/Build

A.2 Acronyms and terms

Term	Definition
ADB	Android Debug Bridge
AMR	adaptive multirate codec
ARM	Advanced RISC Machines
AWGN	additive white Gaussian noise
CCI	configuration change indicator
CDRX	connected discontinuous reception
CQI	channel-quality indication
DCVS	dynamic clock and voltage scaling
DPO	dynamic power optimization
DRX	discontinuous reception
DSCH	downlink shared channel
DSDS	dual SIM dual standby
DUT	device under test
EFS	error-free seconds
EV-DO	evolution data optimized
EVRC	enhanced variable rate coder
FACH	forward access channel
GB	Gingerbread
GPRS	general packet radio services
HSDPA	high-speed downlink packet access
HSUPA	high-speed uplink packet access
ICS	Ice Cream Sandwich
IMSI	International Mobile Station Identity
JB	Jelly Bean
MIMO	multiple input, multiple output
MSI	Mobile Station Identity
NV	nonvolatile
PDSCH	physical downlink shared channel
PSS	panda scripting server
QAM	quadrature amplitude modulation
QMI	Qualcomm MSM interface
QMICM	Qualcomm MSM interface connection manager
QPCH	quick paging channel
QXDM	Qualcomm extensible diagnostic monitor

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Term	Definition
RBSC	rock bottom standby current (also referred to as Airplane mode)
RMC	reference measurement channel
RxD	receive diversity
SIB	system information block
SRLTE	Single Radio LTE
SVA	Snapdragon Voice Activation
UARFCN	UTRA absolute radio frequency channel number
UTRAN	UMTS terrestrial radio access network
WLAN	wireless local area network

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