



Appendix A Battery TCD Global Test Specification for Terminals for Performance Measurements (Performance TST)

Battery Life Measurements VFTST_1.041_Battery_V2.8

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this sense are: VF Global Network and Service Platform GN&SP, former IT&TM, Terminal Test Strategy: Peter Thornber (+44 16356 65495, UK, Newbury).

Since the purpose of the document is to define a measurement procedure for performance figures, it is hereby granted to unveil this document to such terminal suppliers, in case an appropriate NDA is in place and a business relation is existing or planned to become established in respect to launch a terminal in one or more of Vodafone operational companies.

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1 Document Information

1.1 Scope

Scope of the paper is to describe measurement methods for determining terminal battery talk time and stand by time. This TST shall serve as a description how to measure battery life time for certain applications subject to acceptance criteria. Since results depend on network and terminal parameter settings, those setting and conditions are presented within this document.

The document describes measurements in 2G and in 3G mode. The environments in those 2 modes must be equivalent, i.e.; giving the same user experience

Out of scope are the Vodafone acceptance criteria (limits) in respect to battery life time. Such values depend on terminal classification and VF release scheme. A special document (excel file) is available to provide appropriate data. See [2] chapter 13 at page 30. The acceptance criteria are controled using the measurement method given in the present document.

The battery life measurement is divided in two parts: Core and Supplementary part.

1.2 Document History

| Version | Date | Editor | Remarks |
|-----------|----------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.2 | 20.02.2004 | Istvan Lajtos, UK | Initial draft |
| 1.3 - 2.0 | 14.03.2004 - 21.06.2004 | Istvan Lajtos, UK | Changes according global requirements |
| 2.1 | 09.07.2004 | Peter Nevermann | Add 2G battery life time measurement. Reformat according to new Performance TST template; changes in section 1.1; update of 1.3; removed high interference mode VT test and add battery charging time test |
| 2.2 | 09.07.2004 | Virginia Amezaga | Add Bluetooth section: Error! Reference source not found. and Error! Reference source not found. |
| 2.3 | 12.08.2004 | Thomas Ziolkowsky | Editorial Re-work, adding tables, test scope, comments and further declarations in Chapter 2, 3, 4, 5 |
| 2.4 | 30.08.2004 | Peter Nevermann | Editorial |
| 2.5 | 09.09.2004 | Peter Nevermann | Correct common WCDMA rf output power to realistic average value (based on measurements and on [3]) : set to 10 dBm. |

| | | | |
|-----|---------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.6 | Decembre 2004 | Jean Hybre | Split of the document in two parts: core measurement and supplementary measurements |
| 2.7 | 04.02.2005 | Matteo Rigoni | Editorial, add 2 nd Battery testing, Internal clock, Power management settings and Battery information / labelling in sections 6.2, 6.3, 6.4 and Chapter 7, add Vendor information / labelling in sections 6.5. Review of Chapter 7. |
| 2.8 | 18.03.05 | Thomas Ziolkowsky | Test Result List included in Appendix |

1.3 Acceptance Criteria

The complete set of Vodafone global acceptance criteria is described in a separate document. Below an excerpt is given in respect to criteria related to performance KPI's:

Common Acceptance level for Technical Acceptance is:

- Zero (0) severity 1 faults
- Less than 50 severity 2 faults

Definition of Severity 1 Faults

A critical problem that makes the product unusable or unable to achieve service based on one or more of the following conditions:

- KPI under specification by more than 25%

Definition of Severity 2 Faults

Any fault which has less severe impact on service usability can be accepted for launch, but requiring resolution in the next maintenance release.

- KPI under specification by more than 10%

2 CORE MEASUREMENTS

3 Common Settings and Set Up

3.1 General Parameters

There are certain parameters that are common to all modes of operation. These common parameters can affect battery life performance and therefore testing should be commenced under these circumstances:

| | |
|-------------------------------------|----------------------------------|
| Room Temperature | 18-25°C |
| PLMN | Home / or Test System MNC-MCC |
| Backlight | Default settings |
| SIM | Supporting clock stop |
| Display | Set to highest quality |
| Speaker Volume | Maximum (but no hands free mode) |
| Keypad | No activity |
| Cell broadcast | Not used |
| Additional services ¹⁾ | Disabled |
| System Information 13 ²⁾ | Not present |

Tab 1: Common general parameter settings.

¹⁾ "Additional Services" is intended to cover new additions to the standards such as location services. These new features are generally optional. They are also difficult to arrange in a test configuration. In view of this, these features should be excluded from the standard testing scenarios.

²⁾ "System information 13" is an optional message which allows for more efficient decoding of BCCH. As support for this is optional, it should also be excluded from the standard testing scenario with a test system.

3.2 Common 2G - GSM Settings

| | |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------|
| TCH / BCCH | Mid channel (e.g.: ARFCN for GSM 850: 190 GSM: 62, GSM 1800: 710 and GSM 1900: 660) |
| PLMN | HPLMN (of test system) |
| AGBLK | 1 |
| RX level | -82 dBm |
| Output Power, PCL, (TCH) (MS-TX-Lev) | PCL = 7 (29 dBm GSM 850/900) PCL = 1 (28 dBm GSM 1800/1900) |
| Cell Reselection | NO |
| Paging interval (DRX or BS_PA_MFRMS or BSP or PAGP) | 5 multiframes |
| No of neighbour cells | 1 ¹⁾ |
| Cell broadcast | NO |
| Periodic LA timer CS | 2 hours |
| Periodic RA timer PS | 1 hour |
| MS DTX | OFF |

Tab 2: Common parameter settings for 2G GSM (see ECTEL, [3]).

¹⁾ This neighbour cells have to be defined in System Information only. It is necessarily not needed to bring them up operational, cause it is enough to let the UE search for it. This prevents the UE to use deep sleep mode which is implemented in very different ways in UE's and doesn't show realistic timing behaviour when used cause operational networks without neighbour definition doesn't exist.

3.3 Common WCDMA Settings

| | |
|----------------------------------------------------|--------------------------------|
| Serving Cell UARFCN (downlink) | 10712 (2142.4 MHz) any carrier |
| Serving Cell UARFCN (downlink) – Region 2 | 9762 (1952.4 MHz) any carrier |
| Neighbour Cells on different frequencies | No |
| Number of neighbours, same frequency | 1 ¹⁾ |
| Serving Cell Scrambling Code | 10 |
| Paging Interval (DRX cycle length) CS | 0.640 seconds |
| Paging Interval (DRX cycle length) PS | 1.28 seconds (K=7) |
| Number of paging indicators PICH | 18 (internal to Ericsson) |
| BLER (Block Error Rate) quality target UL /per RAB | Speech 1%, VT 0.3 % |
| RF standard (average) output power (RACH) | +10 dBm ²⁾ |
| RF Receiving Level (DL, typical, urban) | -80dBm |
| Periodic Location update timer (T3212) deci-hours | 3 |
| TFC UL (DCH SRB 3.4) | (TF1, TF0) |
| TF DL (DCH SRB 3.4) | (TF1, TF0) |
| Setting of the PICH all indicators | -1 |

Tab 3: Common parameter settings for WDCMA.

¹⁾ This neighbour cells have to be defined in System Information only (SIB 11-12). It is necessarily not needed to bring them up operational, cause it is enough to let the UE search for it. This prevents the UE to use deep sleep mode which is implemented in very different ways in UE's and doesn't show realistic timing behaviour when used operational networks without neighbour definition doesn't exist.

²⁾ TBD

Nota: The Output power has to be defined

close to the worst case :+ 21dBm for instance (condition adopted for measurement in GSM mode)

or less if it appears that in real live the output power is really far from the maximum.

The influence of the output power in the overall power consumption have to be evaluated

3.4 General Procedure

3.4.1 Network environment

The measurement could be done either by the manufacturers, the operators, qualified laboratories as well as consumer electronics distributors or magazines.

Since the testing is conducted on a live network the conditions must be precisely described and as close as possible of the network simulator conditions described in Chapter 9.4 at Page 22.

3.4.2 Current consumption

The general procedure for the determination of a battery life time is based on the measurement of the average current consumption. The result in terms of a time is calculated using the nominal battery capacity.

3.4.2.1 Introduction:

- 1) A new battery (especially Lithium-Ion technology) needs several cycles of charging and recharging before reaching its nominal, full capacity. Therefore ensure full capacity by such deep recharge - charge cycle following manufacturer's information. Usually 2 complete cycles are sufficient. More (up to 4 could be normal) needed if nominal capacity isn't reached after 2 cycles. One cycle needs 1 day if the discharge – charging current is 20% (recommend) of nominal current.
- 2) Remove the battery from the terminal.
- 3) If the terminal was used recently, wait approximately ½ hour for cooling down.

3.4.2.2 If no dummy battery is available , installation of a resistor to measure the current

- Current measuring can be facilitated with a normal battery by chopping the positive line between battery and UE housing. This can be done easily by using short copper screens which will be isolated by adhesive tape. Look at Fig 3. The resistance should be nearly 0. The measurement resistor can be placed at the ends of the copper sheets. As well this procedure can be used to facilitate a dummy battery by isolating the original contacts and installing new contacts bypassing the original positive and negative poles.
- Connect a 0.1 ohms resistor (1%, 0.5watt, high precision metal film resistor) and measure current over this resistor. For more details see [3].

3.4.2.3 If dummy battery is available use of an external power supply

- Connect the phone to an external DC power supply using a dummy battery. Such a dummy battery provides access to the terminal battery connectors and includes usually also a capacitor to simulate the battery. Terminal vendors are able to provide such dummies, since they are used for standard GSM “extreme condition” test scenarios.
- Set the voltage to the “operating” value of a battery / UE combination (see battery label for calculation). This procedure can be bypassed by using the original battery instead of external power supply.

3.4.2.4 Measure average current consumption $I_{application}$

By using the set up (sense resistor) as described in the ECTEL document [3] or

A special power supply supporting direct current measurement. In case of pulsed or other non constant current consumption behaviour the number and distribution of samples must be adjusted accordingly in order to determine the correct average current.

This is the normal assumption current will behave if a UE operates.

For idle case the current should be measured over a minimum time period of 30 minutes with a measurement resolution of at least 5 (500 ? TBD) samples per sec. For active case the time should be 10 minutes.

In case of approximately constant current consumption, data should be collected every 2 minutes for 5 times in minimum.

- 4) Determine an estimated battery lifetime for each application in consideration by using the measured current consumption $I_{application}$ and the nominal battery capacity $Capacity$:

$$t_{application} = \frac{Capacity}{I_{application}} \quad (1)$$

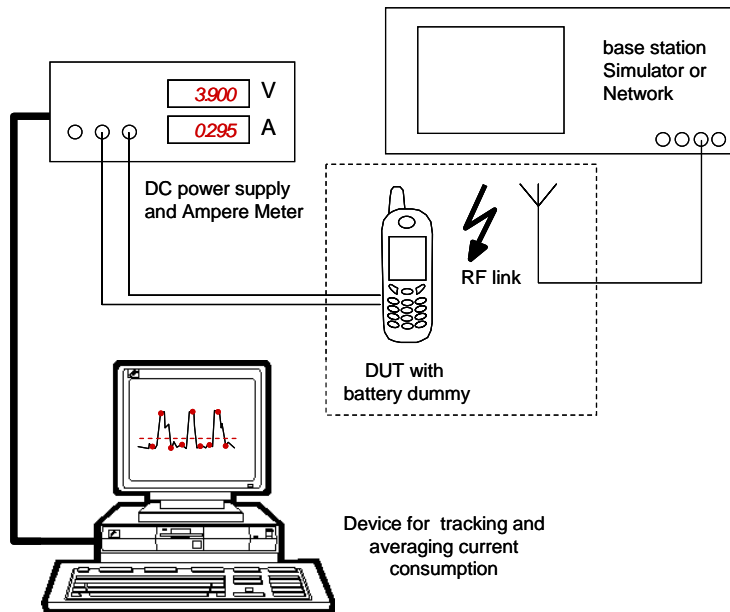


Fig 1: Set up with dummy battery for measurement of current consumption for talk mode or for Telephony.

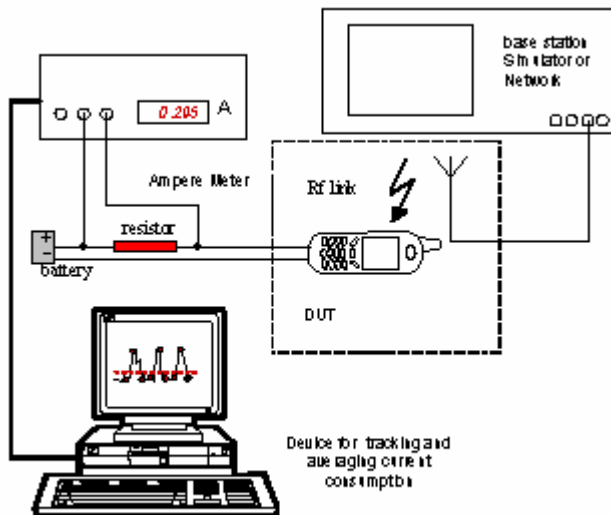


Fig 2: Set up without dummy battery but using an extra resistor.

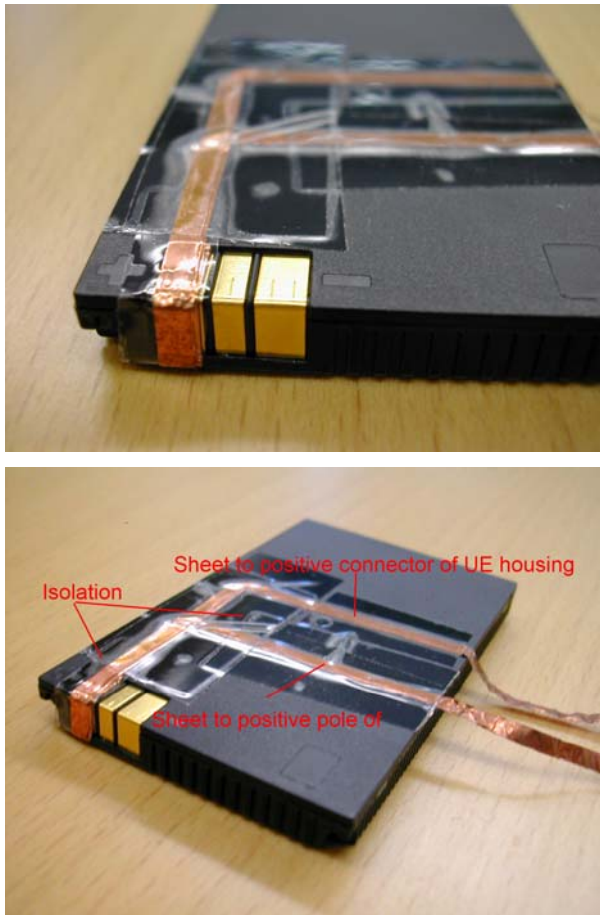


Fig 3: Example for a using an original battery and a special resistor to be uses for set up according to Fig. 2.

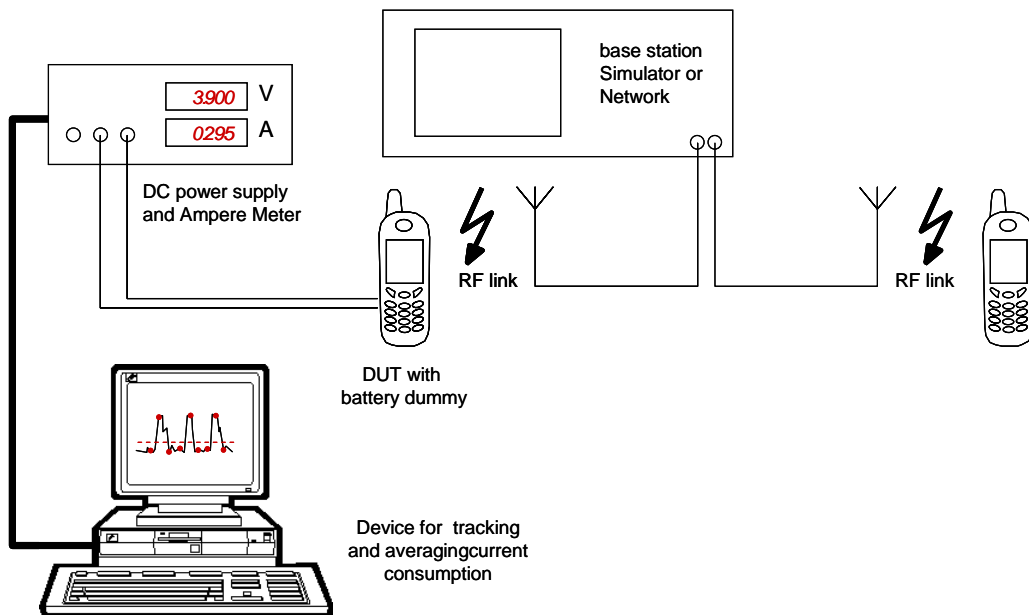


Fig 3: Set up for measurement of average current consumption for video telephony.

4 Idle Mode

4.1 2G Idle Mode Stand by Time

4.1.1 Test purpose

Determine battery life time for 2G GSM stand by mode for:

1. Normal case conditions: mandatory measurement.
2. Best case and Worst case conditions optional measurement.

4.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000001

4.1.3 Required equipment / initial conditions

Use set up as described in - “” and apply settings according to Tab. 1 and Tab. 2. Change paging interval DRX according to the following table:

| | |
|---------------------------|---|
| Normal case (GSMA/ECTEL) | 5 |
| Worst case | 2 |
| Best case | 9 |

Tab 4: Idle Mode DRX settings (2G).

4.1.4 Procedure

Apply the measurement procedure described in 3.4 for each DRX setting.

4.2 3G Idle Mode Stand by Time

4.2.1 Test purpose

Determine battery life time for stand by mode for a terminal camping on a WCDMA network.

4.2.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-003092

4.2.3 Required equipment / initial conditions

Use set ups described in - “**Error! Reference source not found.**” and apply settings according to Tab. 11 and Tab. 3. Change paging interval DRX Cycle Length according to the following table:

| | |
|-------------|-------------------|
| Normal case | 256 ¹⁾ |
| Worst case | 2 |
| Best case | 512 |

Tab 5: Idle mode DRX settings (3G) According 3GPP 25304

¹⁾ The value of DRX cycle is TBC

4.2.4 Procedure

Apply measurement procedure described in 3.4.

5 Active Mode

5.1 2G Active Mode

5.1.1 Talk Time-Standard

5.1.1.1 Test purpose

Determine battery life time by measuring average current consumption for talk mode in GSM 900.

Note: *GSM 900 band reflects usually the worst case scenario for battery times testing. Additionally other GSM bands (850, 1800, 1900) can be tested if required.*

5.1.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000002

5.1.1.3 Required equipment / initial conditions

Use the set up described in - and apply settings according to Tab. 1 and Tab. 2. Fig. 1 shows the equipment that should be used.

5.1.1.4 Procedure

Organise a call to/from the terminal and keep the call active during testing. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

5.2 3G Active Mode

5.2.1 Talk Time - Standard

5.2.1.1 Test purpose

Determine battery life time by measuring average current consumption for talk mode in WCDMA.

5.2.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-003093

5.2.1.3 Required equipment / initial conditions

Apply settings according to Tab. 1 and Tab. 3. Use the general set up described in - for a controlled testing environment. Fig. 1 shows the equipment that should be used.

Use bearer data rate of **12.2 kbps** for uplink and downlink.

5.2.1.4 Procedure

Organise a call to/from the device under test. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

5.2.2 Video telephony

5.2.2.1 Test purpose

Determine battery life time by measuring average current consumption for video talk mode in WCDMA.

5.2.2.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000003

5.2.2.3 Required equipment / initial conditions

A second video capable terminal is required to conduct the test. It should be from same vendor, same type. Fig. 3 shows the set up. Apply settings according to Tab. 1 and Tab. 3 to the terminal under test. Use bearer data rate of **64 kbps** for uplink and downlink (Signalling Radio Bearer: Conversational/Unknown / UL 64 DL 64 kbps / CS RAB+UL 3.4 DL 3.4kbps SRB for DCCH.). Provide and use for both parties a moving picture for testing, such as a computer screen with running Vodafone screen saver. Test screen saver is provided here.



matrix.exe

5.2.2.4 Procedure

Establish a video telephony call between the two terminals. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

6 Battery Properties

6.1 Charging Time

6.1.1 Test purpose

Determine time needed to fully charge an empty battery using the appropriate original charger.

6.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000006

6.1.3 Required equipment / initial conditions

Use original device and charger. Before starting test use device which has been not in operation just before or allow the device to cool down for ½ hour.

6.1.4 Procedure

Empty a battery e.g. by executing battery life test for talk mode as described in chapter 5. Measure the time between start of recharging the battery until the symbol in display indicate end of charging. If the UE doesn't show the end of charging display, by observing the charging current. The UE should be switched off during charging

6.2 Second Battery Testing

6.2.1 Test purpose

Determine second battery life time.

6.2.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000005

6.2.3 Required equipment / initial conditions

Refer to 2.4. Take as a reference the current measured with the main battery.

6.2.4 Procedure

Refer to 2.4.2 Determine an estimated battery lifetime for each application in consideration by using the measured current consumption $I_{application}$ and the nominal battery capacity $Capacity$:

$$t_{application} = \frac{Capacity}{I_{application}}$$

6.3 Internal Clock

6.3.1 Test purpose

Determine if the terminal can provide internal power to maintain internal clock for at least 7 days.

6.3.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000005

6.3.3 Required equipment / initial conditions

Use original device and main battery. Set the internal clock properly and keep the main battery on the terminal for at least 24 hours to ensure that the internal battery is fully charged. If is the case, fully charge the main battery first.

6.3.4 Procedure

Remove the main battery from the unit and leave the terminal in this condition for 7 days. After that time has expired, re-insert the main battery and check if the clock has been maintained.

6.4 Power Management Settings

6.4.1 Test purpose

Ensure that settings for power management are provided. Settings must be user changeable.

6.4.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000008

6.4.3 Required equipment / initial conditions

Use original device, keeping the default configuration. If necessary perform a Factory reset in order to revert to the out of the box original settings.

6.4.4 Procedure

Verify if, within the terminal menu, the default setting for power management (e.g. Display and keypad backlight, Screensaver, etc.) are user changeable and optimised for minimising the power consumption.

6.5 Vendor information

6.5.1 Test purpose

The terminal vendor shall provide information on battery characteristics and performance.

6.5.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000009

6.5.3 Required equipment / initial conditions

This verification is done during PDI, box opening.

6.5.4 Procedure

Verify that the terminal vendor is providing battery characteristics and performance such as:

- Battery type, e.g. Li-ion, Li-poly, Ni-cad
- Supported temperature, humidity conditions
- Voltage: Max Vol, Average Vol
- Discharge: Max discharge, Self discharge
- Internal resistance.

7 Physical Requirements

7.1 Battery information / Labelling

7.1.1 Test purpose

Determine if the battery label presents a description of battery's characteristic and provides sufficient space for the legally required warning messages.

7.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-PHY-000013 / TCD-BATT-PHY-000014

7.1.3 Required equipment / initial conditions

This verification is done during PDI, box opening. Use the battery provided with the terminal. This also applies to all the battery types coming with the terminal, such as the second battery.

7.1.4 Procedure

Using the battery provided with the terminal, check if the following:

1) Battery characteristics present on the label:

- Battery type and model (e.g. Li-Ion)
- Nominal Voltage
- Nominal Current

2) Space for the legally required warning messages.

Note: If warning messages cannot be placed on the battery, they must be printed outside of the box in which the terminal will be sold. However, we strongly prefer the warning to be placed on the battery itself.

8 SUPPLEMENTARY MEASUREMENTS

9 Common Settings and Set Up

9.1 General Parameters

There are certain parameters that are common to all modes of operation. These common parameters can affect battery life performance and therefore testing should be commenced under these circumstances:

| | |
|-------------------------------------|----------------------------------|
| Room Temperature | 18-25°C |
| PLMN | Home / or Test System MNC-MCC |
| Backlight | Default settings |
| SIM | Supporting clock stop |
| Display | Set to highest quality |
| Speaker Volume | Maximum (but no hands free mode) |
| Keypad | No activity |
| Cell broadcast | Not used |
| Additional services ¹⁾ | Disabled |
| System Information 13 ²⁾ | Not present |

Tab 6: Common general parameter settings.

¹⁾ “Additional Services” is intended to cover new additions to the standards such as location services. These new features are generally optional. They are also difficult to arrange in a test configuration. In view of this, these features should be excluded from the standard testing scenarios.

²⁾ “System information 13” is an optional message which allows for more efficient decoding of BCCH. As support for this is optional, it should also be excluded from the standard testing scenario with a test system.

9.2 Common 2G - GSM Settings

| | |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------|
| TCH / BCCH | Mid channel (e.g.: ARFCN for GSM 850: 190 GSM: 62, GSM 1800: 710 and GSM 1900: 660) |
| PLMN | HPLMN (of test system) |
| AGBLK | 1 |
| RX level | -82 dBm |
| Output Power, PCL, (TCH) (MS-TX-Lev) | PCL = 7 (29 dBm GSM 850/900) PCL = 1 (28 dBm GSM 1800/1900) |
| Cell Reselection | NO |
| Paging interval (DRX or BS_PA_MFRMS or BSP or PAGP) | 5 multiframes |
| No of neighbour cells | 1 ¹⁾ |
| Cell broadcast | NO |
| Periodic LA timer CS | 2 hours |
| Periodic RA timer PS | 1 hour |
| MS DTX | OFF |

Tab 7: Common parameter settings for 2G GSM (see ECTEL, [3]).

¹⁾ This neighbour cells have to be defined in System Information only. It is necessarily not needed to bring them up operational, cause it is enough to let the UE search for it. This prevents the UE to use deep sleep mode which is implemented in very different ways in UE's and doesn't show realistic timing behaviour when used cause operational networks without neighbour definition doesn't exist.

9.3 Common WCDMA Settings

| | |
|----------------------------------------------------|--------------------------------|
| Serving Cell UARFCN (downlink) | 10712 (2142.4 MHz) any carrier |
| Serving Cell UARFCN (downlink) – Region 2 | 9762 (1952.4 MHz) any carrier |
| Neighbour Cells on different frequencies | No |
| Number of neighbours, same frequency | 1 ¹⁾ |
| Serving Cell Scrambling Code | 10 |
| Paging Interval (DRX cycle length) CS | 0.640 seconds |
| Paging Interval (DRX cycle length) PS | 1.28 seconds (K=7) |
| Number of paging indicators PICH | 18 (internal to Ericsson) |
| BLER (Block Error Rate) quality target UL /per RAB | Speech 1%, VT 0.3 % |
| RF standard (average) output power (RACH) | +10 dBm ²⁾ |
| RF Receiving Level (DL, typical, urban) | -80dBm |
| Periodic Location update timer (T3212) deci-hours | 3 |
| TFC UL (DCH SRB 3.4) | (TF1, TF0) |
| TF DL (DCH SRB 3.4) | (TF1, TF0) |
| Setting of the PICH all indicators | -1 |

Tab 8: Common parameter settings for WDCMA.

¹⁾ This neighbour cells have to be defined in System Information only (SIB 11-12). It is necessarily not needed to bring them up operational, cause it is enough to let the UE search for it. This prevents the UE to use deep sleep mode which is implemented in very different ways in UE's and doesn't show realistic timing behaviour when used operational networks without neighbour definition doesn't exist.

²⁾ TBD

Nota: The Output power has to be defined

close to the worst case :+ 21dBm for instance (condition adopted for measurement in GSM mode)

or less if it appears that in real live the output power is really far from the maximum.

The influence of the output power in the overall power consumption have to be evaluated

9.4 General Procedure

9.4.1 Network environment

The measurement could be done either by the manufacturers, the operators, qualified laboratories as well as consumer electronics distributors or magazines.

The measurement must be reproduced with an acceptable precision.

In order to control network settings as well as terminal parameters, such as output power level, a link to a controlled environment is required. It must be possible to control all parameters outlined in Tab. 7 and Tab. 8. Such an environment could be a base station simulator or tester (such as a Rohde&Schwarz CMU 200, Anritsu MT8820A or MD8470A) or a network simulation plant,/ testfloor. The RF link could be established by a RF cable or over the air (antenna coupler).

On the other hand the environment must support the Telephony mode, and Video telephony to be tested. A sketch for such a set up is shown in Fig. 1, Fig. 2 and Fig. 4

Notes:

- In case of using testers a good adjustment to the frequency dependent external attenuation is required, since such testers usually need to see an input signal level in a rather limited power range.
- A shielded box or room may be required in order to avoid interference with a life network. Depending on the environment especially for stand by time measurements there might be an influence. The isolation of antenna connectors of mobile phones is typically in the range of 15dB. Therefore even in case of using an RF cable without a shielded box the phone could still “see” signals from life networks depending on local conditions.
- In case a sense resistor is used for measuring currents, the set up has to be as stated by the GSMA/ECTEL document [3]: “Measurements to GSM Association/ECTEL Battery Life Measurement Technique Document”.

9.4.2 Current consumption

The general procedure for the determination of a battery life time is based on the measurement of the average current consumption. The result in terms of a time is calculated using the nominal battery capacity.

9.4.2.1 Introduction:

- 5) A new battery (especially Lithium-Ion technology) needs several cycles of charging and recharging before reaching its nominal, full capacity. Therefore ensure full capacity by such deep recharge - charge cycle following manufacturer's information. Usually 2 complete cycles are sufficient. More (up to 4 could be normal) needed if nominal capacity isn't reached after 2 cycles. One cycle needs 1 day if the discharge – charging current is 20% (recommend) of nominal current.
- 6) Remove the battery from the terminal.
- 7) If the terminal was used recently, wait approximately ½ hour for cooling down.

9.4.2.2 If no dummy battery is available , installation of a resistor to measure the current

- Current measuring can be facilitated with a normal battery by chopping the positive line between battery and UE housing. This can be done easily by using short copper screens which will be isolated by adhesive tape. Look at Fig 3. The resistance should be nearly 0. The measurement resistor can be placed at the ends of the copper sheets. As well this procedure can be used to facilitate a dummy battery by isolating the original contacts and installing new contacts bypassing the original positive and negative poles.

- Connect a 0.1 ohms resistor (1%, 0.5Watt, high precision metal film resistor) and measure current over this resistor. For more details see [3].

9.4.2.3 If dummy battery is available use of an external power supply

- Connect the phone to an external DC power supply using a dummy battery. Such a dummy battery provides access to the terminal battery connectors and includes usually also a capacitor to simulate the battery. Terminal vendors are able to provide such dummies, since they are used for standard GSM "extreme condition" test scenarios.
- Set the voltage to the "operating" value of a battery / UE combination (see battery label for calculation). This procedure can be bypassed by using the original battery instead of external power supply.

9.4.2.4 Measure average current consumption $I_{application}$

By using the set up (sense resistor) as described in the ECTEL document [3] or

A special power supply supporting direct current measurement. In case of pulsed or other non constant current consumption behaviour the number and distribution of samples must be adjusted accordingly in order to determine the correct average current.

This is the normal assumption current will behave if a UE operates.

For idle case the current should be measured over a minimum time period of 30 minutes with a measurement resolution of at least 5 (500 ? TBD) samples per sec. For active case the time should be 10 minutes.

In case of approximately constant current consumption, data should be collected every 2 minutes for 5 times in minimum.

- 8) Determine an estimated battery lifetime for each application in consideration by using the measured current consumption $I_{application}$ and the nominal battery capacity $Capacity$:

$$t_{application} = \frac{Capacity}{I_{application}} \quad (1)$$

Please refer to the Core Part, section 3.4.2.4 for the set up.

10 Idle Mode

10.1 2G Idle Mode Stand by Time (if not already done on network simulator)

10.1.1 Test purpose

Determine battery life time for 2G GSM stand by mode for:

3. Normal case conditions: mandatory measurement.
4. Best case and Worst case conditions optional measurement.

10.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000001

10.1.3 Required equipment / initial conditions

Use set up as described in - “” and apply settings according to Tab. 6 and Tab. 2. Change paging interval DRX according to the following table:

| | |
|---------------------------|---|
| Normal case (GSMA/ECTEL) | 5 |
| Worst case | 2 |
| Best case | 9 |

Tab 9: Idle Mode DRX settings (2G).

10.1.4 Procedure

Apply the measurement procedure described in 3.4 for each DRX setting.

10.2 3G Idle Mode Stand by Time (if not already done on network simulator)

10.2.1 Test purpose

Determine battery life time for stand by mode for a terminal camping on a WCDMA network.

10.2.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-003092

10.2.3 Required equipment / initial conditions

Use set ups described in - “**Error! Reference source not found.**” and apply settings according to Tab. 61 and Tab. 8. Change paging interval DRX Cycle Length according to the following table:

| | |
|-------------|-------------------|
| Normal case | 256 ¹⁾ |
| Worst case | 2 |
| Best case | 512 |

Tab 10: Idle mode DRX settings (3G) According 3GPP 25304

¹⁾ The value of DRX cycle is TBC

10.2.4 Procedure

Apply measurement procedure described in 3.4.

11 Active Mode

11.1 2G Active Mode

11.1.1 Talk Time-Standard (if not already done on network simulator)

11.1.1.1 Test purpose

Determine battery life time by measuring average current consumption for talk mode in GSM 900.

Note: *GSM 900 band reflects usually the worst case scenario for battery times testing. Additionally other GSM bands (850, 1800, 1900) can be tested if required.*

11.1.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000002

11.1.1.3 Required equipment / initial conditions

Use the set up described in - and apply settings according to Tab. 6 and Tab. 7. Fig. 3 shows the equipment that should be used.

11.1.1.4 Procedure

Organise a call to/from the terminal and keep the call active during testing. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.1.2 Talk time-Bluetooth ON

11.1.2.1 Test purpose

Determine battery life time by measuring average current consumption for talk mode in GSM 900 when Bluetooth functionality is activated. The Bluetooth device should be from same vendor then the UE which will be checked, DuT. It should be out of the current accessory catalogue. Take care that in principle two kind of Bluetooth devices are available 1) Device always connected. 2) Device connected on demand / request of a service. The device should be handled in a range of up to 2-3 meters. The device which has been taken should be noted.

11.1.2.2 Related Vodafone Requirement or International Specifications

Compile data

11.1.2.3 Required equipment / initial conditions

Use the set up described in - and apply settings according to Tab. 6 and Tab. 7 for a controlled test environment. Fig. 3 shows the equipment that should be used.

11.1.2.4 Procedure

Bluetooth shall be switched ON and a connection should be established with another Bluetooth device (e.g. Bluetooth headset). When the two devices are paired together organise a call to/from the device under test. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.2 3G Active Mode

11.2.1 Talk Time - Standard (if not already done on network simulator)

11.2.1.1 Test purpose

Determine battery life time by measuring average current consumption for talk mode in WCDMA.

11.2.1.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-003093

11.2.1.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use the general set up described in - for a controlled testing environment. Fig. 3 shows the equipment that should be used.

Use bearer data rate of **12.2 kbps** for uplink and downlink.

11.2.1.4 Procedure

Organise a call to/from the device under test. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.2.2 Talk Time- Bluetooth ON

11.2.2.1 Test purpose

Determine battery life time by measuring average current consumption for talk mode in WCDMA when Bluetooth is activated. The Bluetooth device should be from same vendor then the UE which will be checked, DuT. It should be out of the current accessory catalogue. Take care that in principle two kind of Bluetooth devices are available 1) Device always connected. 2) Device connected on demand / request of a service. The device which has been taken should be noted.

11.2.2.2 Related Vodafone Requirement or International Specifications

Compile data

11.2.2.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use the general set up described in - for a controlled testing environment. Fig. 3 shows the equipment that should be used.

Use bearer data rate of **12.2 kbps** for uplink and downlink.

11.2.2.4 Procedure

Bluetooth shall be switched ON and a connection should be established with another Bluetooth device (e.g. Bluetooth headset). When the two devices are paired together organise a call to/from the device under test. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.2.3 Video telephony (if not already done on network simulator)

11.2.3.1 Test purpose

Determine battery life time by measuring average current consumption for video talk mode in WCDMA.

11.2.3.2 Related Vodafone Requirement or International Specifications

TCD-BATT-GEN-000003

11.2.3.3 Required equipment / initial conditions

A second video capable terminal is required to conduct the test. It should be from same vendor, same type. Fig. 3 shows the set up. Apply settings according to Tab. 6 and Tab. 8 to the terminal under test. Use bearer data rate of **64 kbps** for uplink and downlink (Signalling Radio Bearer: Conversational/Unknown / UL 64 DL 64 kbps / CS RAB+UL 3.4 DL 3.4kbps SRB for DCCH.). Provide and use for both parties a moving picture for testing, such as a computer screen with running Vodafone screen saver.

11.2.3.4 Procedure

Establish a video telephony call between the two terminals. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.2.4 Streaming

11.2.4.1 Test purpose

Determine battery life time by measuring average current consumption for streaming application in WCDMA.

11.2.4.2 Related Vodafone Requirement or International Specifications

Compile data.

11.2.4.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use set for average current measurement according to Fig. 3. Fig. 3Fig. 3Fig. 3Fig. 3Fig. 3Use bearer data rate of **115 kbps** for downlink. No PS Streaming 12/64 bearer required.

11.2.4.4 Procedure

Connect to VEAP (Vendor Early Access Portal) to obtain the video content. The actual playing time should be 10 minutes. After successfully established connection to the streaming server, start watching the clip. Streaming can be used with different playback speeds and it is dependant on the mobile device capability. Use the default speed. The currently available 3G terminal do support 115kbps playback but some of them do have limitation to 64 kbps. Terminal capabilities should be checked prior to streaming testing and stated together with the result.

Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.2.5 FTP File Transfer

11.2.5.1 Test purpose

Determine battery life time for FTP file download application at maximum data throughput.

11.2.5.2 Related Vodafone Requirement or International Specifications

Compile data.

11.2.5.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use set up shown in Fig. 3 Fig. 3Fig. 3. Use maximum bearer data rate of **384 kbps** for downlink. 64 kbps for Uplink.

11.2.5.4 Procedure

Establish a FTP connection to an external FTP server and start downloading a file size of approximately 30 MB. Apply measurement procedure described in 3.4 to obtain the battery lifetime. Take as much downloads as needed for 10 minutes.

11.2.6 Music Player

11.2.6.1 Test purpose

Determine battery life time for music player application.

11.2.6.2 Related Vodafone Requirement or International Specifications

Compile data.

11.2.6.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use set up shown in Fig. 3. Use original or recommended stereo Headset and full volume.

11.2.6.4 Procedure

Connect to VEAP (Vendor Early Access Portal) to obtain the music content. Start playing the music file. The file should be playing throughout testing. Apply measurement procedure described in 3.4 to obtain the battery lifetime

11.2.7 Camera Application

11.2.7.1 Test purpose

Determine battery life time for when using the camera taking photos.

11.2.7.2 Related Vodafone Requirement or International Specifications

Compile data.

11.2.7.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use set up for average current measurement according to Fig. 3. Use no flash and normal light conditions (bright daylight). Set picture resolution to maximum.

11.2.7.4 Procedure

Start taking photos and store them immediately. Take photos at maximum speed (rate) without pausing and store each photo preferred in the phone memory. Ensure different currents for taking pictures and storing them are covered correctly. Take in minimum 10 pictures. Apply measurement procedure described in 3.4 to obtain the battery lifetime. Use the UE in Idle mode. Accessories e.g. camera lamp should be switched off.

11.2.8 Gaming

11.2.8.1 Test purpose

Determine battery lifetime when playing a JAVA game.

11.2.8.2 Related Vodafone Requirement or International Specifications

Compile data.

11.2.8.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use set up for average current measurement according to Fig. 3. Start a JAVA game (test game can be obtained from the VEAP (Vendor Early Access Portal). The game should use high quality and 3D graphics, sound and vibrator mode and demo mode to ensure same activities are running during gaming and no need to operate the UE / game). Use the game in Idle mode.

11.2.8.4 Procedure

Start playing the Java game. Ensure different currents during sound and vibrator activities are covered correctly. Apply measurement procedure described in 3.4 to obtain the battery lifetime.

11.2.9 Browser Applications

11.2.9.1 Test purpose

Determine battery lifetime when browsing the Vodafone live! portal.

11.2.9.2 Related Vodafone Requirement or International Specifications

Compile data.

11.2.9.3 Required equipment / initial conditions

Apply settings according to Tab. 6 and Tab. 8. Use set up showed in Fig. 3. Connect to VEAP (Vendor Early Access Portal), select “news” and go to test area.

11.2.9.4 Procedure

Start browsing and execute text formatting test: “ticker mode”. Ensure different currents during loading some information and executing tests are covered correctly. Apply measurement procedure described in 3.4 to obtain the battery lifetime

12 Appendix

12.1 Test Result Table

Following Test Result Table should be taken to report the battery measurement test results.



Battery KPI
Reporting V0_3.xls

13 Reference

- [1]: Measurements to GSM Association / ECTEL Battery Life Measurement Technique Document, Oct 1998.
- [2]: Overview about Vodafone live! battery related key performance indicators, Excel file: VFTST_1.041_batteryKPI, July 2004.
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- [4]: Draft PRD on Battery Life Measurement Technique version 3.1.0 2/12/2004.