Tune-up procedure

Each device is individually calibrated during manufacturing. Measurement is performed in a full calibrated setup using CWM 500 base station simulator (system tester).

Measurement procedure is outlined below:

1. Set the device to operational voltage and on a predefined band class and channel.
2. The maximum output power is measured when the power control bit is set as all UP bits. The UMTS/GSM/LTE RF output power will be adjusted equal or lower than tested power shown in the test report.
3. The WIFI specific RF characteristics were measured by spectrum analyzer and power meter.

The user has no possibility to change these settings.

Tune up procedure shall be over the power range or at specific operating power levels.

1. It must provide an operational voltage (3.4 ~ 4.48Vdc) to turn on the device and on one certain channel in service mode by means of company proprietary software.
2. The Base station simulator measures the WWAN device specific RF characteristics.
3. The maximum gains of each individual device are adjusted until the target value met.
4. The following target Power values are average Power values

➢ Conducted Power Table -Full Power

Mode	GSM850	GSM1900
GSM (GMSK, 1Tx-slot)	32.0±1.0 dBm	24.5±1.0 dBm
GPRS (GMSK, 1Tx-slot)	32.0±1.0 dBm	24.5±1.0 dBm
GPRS (GMSK, 2Tx-slot)	31.0±1.0 dBm	23.5±1.0 dBm
GPRS (GMSK, 3Tx-slot)	30.0±1.0 dBm	22.5±1.0 dBm
GPRS (GMSK, 4Tx-slot)	29.0±1.0 dBm	21.5±1.0 dBm
EDGE (8PSK, 1Tx-slot)	27.0±1.0 dBm	21.5±1.0 dBm
EDGE (8PSK, 2Tx-slot)	26.0±1.0 dBm	20.5±1.0 dBm
EDGE (8PSK, 3Tx-slot)	24.0±1.0 dBm	18.5±1.0 dBm
EDGE (8PSK, 4Tx-slot)	23.0±1.0 dBm	16.5±1.0 dBm

Mode	WCDMA Band Ⅱ	WCDMA BandⅣ	WCDMA Band V
RMC 12.2K	19.5±1.0 dBm	19.5±1.0 dBm	23.5±1.0 dBm
HSDPA Subtest-1	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
HSDPA Subtest-2	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
HSDPA Subtest-3	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
HSDPA Subtest-4	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
DC-HSDPA Subtest-1	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
DC-HSDPA Subtest-2	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
DC-HSDPA Subtest-3	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
DC-HSDPA Subtest-4	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm
HSUPA Subtest-1	17.0±1.0 dBm	17.0±1.0 dBm	21.0±1.0 dBm
HSUPA Subtest-2	17.0±1.0 dBm	17.0±1.0 dBm	21.0±1.0 dBm
HSUPA Subtest-3	17.0±1.0 dBm	17.0±1.0 dBm	21.0±1.0 dBm
HSUPA Subtest-4	17.0±1.0 dBm	17.0±1.0 dBm	21.0±1.0 dBm
HSUPA Subtest-5	18.0±1.0 dBm	18.0±1.0 dBm	22.0±1.0 dBm
HSPA+ Subtest-1	19.0±1.0 dBm	19.0±1.0 dBm	23.0±1.0 dBm

Target Power and Tolerance for LTE (dBm)			
Band	**QPSK**	**16QAM**	**64QAM**
LTE B12	23.0±1.0 dBm	22.0±1.0 dBm	21.0±1.0 dBm
LTE B41	19.0±1.0 dBm	19.0±1.0 dBm	19.0±1.0 dBm
LTE B42	19.5±1.0 dBm	19.5±1.0 dBm	19.5±1.0 dBm
CA_41C	19.0±1.0 dBm	19.0±1.0 dBm	19.0±1.0 dBm
CA_42C	19.5±1.0 dBm	19.5±1.0 dBm	19.5±1.0 dBm

Target Power and Tolerance for WLAN2.4G (dBm)				
Band	**802. 11b**	**802. 11g**	**802. 11n20**	**802. 11n40**
WLAN 2.4G	12±2.0 dBm	12±2.0 dBm	12±2.0 dBm	12±2.0 dBm

Target Power and Tolerance for WLAN5G (dBm)						
Band	**802. 11a**	**802. 11n20**	**802. 11n40**	**802. 11ac20**	**802. 11ac40**	**802. 11ac80**
WLAN 5.2G	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm
WLAN 5.3G	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm
WLAN 5.5G	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm	12±2.5 dBm

Target Power and Tolerance for BT			
Mode	**1M**	**2M**	**3M**
BT BR	11±3 dBm	11±3 dBm	11±3 dBm
EDR	7±3 dBm	7±3 dBm	7±3 dBm
BT LE	3±3 dBm		

For HSUPA, the following table lists the MPR target values:

HSPA MPR Targets	
HSUPA 3GPP Subtest	**Band II/IV/V MPR Target (dB)**
1	2
2	2
3	2
4	2
5	2

When evaluating HSPA power reduction, HSPA transmit power measurements should be referenced to HSDPA subtest 1 (CM=1, MPR=0) per Note 2 of TS 3GPP 34.121 Table C.11.1.3.

Based on the hardware characteristics and HSUPA measurement error inherent in the 34.121 procedure, we expects HSUPA transmit power result to be within **+/-1.0 dB o**f the expected MPR target values.

Remark: the CM calculation is based on note2 of TS 3GPP 34.121, and the MPR is also based on the commercial Power Amplifier characteristic in this project. This is also traded off by transceiver setting and Power Amplifier tuning. Of course, we also could guarantee the mass production criteria will be in this setting.

The cubic metric (CM) below is defined by 3GPP [4] to be used for estimating the MPR. And the power reduction is computed as MAX (CM-1, 0), where

$$CM = CEIL\{ [20 * \log10 ((v\_norm^3)_{rms}) - 20 * \log10 ((v\_norm\_ref^3)_{rms})] / k, 0.5 \}.$$

The function CEIL{ x, 0.5 } means rounding upwards to the closest 0.5dB, i.e. CM $\in$ [0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5].

The computation of CM, as given above, depends on the HSUPA configuration. In particular, the configuration of DPDCH to DPCCH power ratio, the HS-DPCCH to DPCCH power ratio, the E-DPDCH to DPCCH power ratio, the number of E-DPDCH code channels, and the spreading factors on each E-DPDCH channel. These power ratios further depend on the mobility environment and power control behavior, etc.

2. HSUPA
   3GPP TS 34.121-1
   User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification
   Annex C (normative): Measurement channels
   C.11.1 UL reference measurement channel for E-DCH tests
   Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH
   Sub-test 1 (CM=1.0dB, MPR=0.0dB)

LTE Maximum Power Reduction (MPR)

The EUT enables maximum power reduction in accordance with 3GPP 36.101. The LTE MPR targets are shown in the table below and are within the values allowed by 3GPP 36.101. The MPR settings are configured during the manufacture process and are not configurable by the network, carrier, or end user.

Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]						3GPP 36.101 requirement MPR (dB)	MPR setting (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz		
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1	1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1	2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2	3

We expects LTE transmit power result to be within **0~1dB o**f the expected MPR target values.