

Tune Up Procedure of SHARK KTUS-H0

FCC ID: 2A2ZHKTUS-H0

Each device is individually calibrated during manufacturing. Measurement is performed in a full calibrated setup using an CMU 200 base station simulator (system tester), MT8820C, UXM E7515B and Spectrum analyzer 9k-30GHz FSP.

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 GSM/UMTS/LTE/NR 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 (3.6 ~ 4.35Vdc) 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.

Conducted Power Table

ANT 1				
<u>Band</u>	<u>Mode</u>	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
GSM 850	GSM (GMSK, 1Tx-slot)	33.50	33.50	33.50
	GPRS (GMSK, 1Tx-slot)	33.50	33.50	33.50
	GPRS (GMSK, 2Tx-slot)	31.50	31.50	31.50
	GPRS (GMSK, 3Tx-slot)	29.00	29.00	29.00
	GPRS (GMSK, 4Tx-slot)	27.00	27.00	27.00
	EDGE (8PSK, 1Tx-slot)	27.50	27.50	27.50
	EDGE (8PSK, 2Tx-slot)	26.00	26.00	26.00
	EDGE (8PSK, 3Tx-slot)	24.50	24.50	24.50
	EDGE (8PSK, 4Tx-slot)	23.00	23.00	23.00
WCDMA V	RMC 12.2K	25.50	25.50	25.50
LTE Band 12	QPSK	23.00	23.00	23.00
	16QAM	22.50	22.50	22.50
LTE Band 26	QPSK	25.00	24.50	22.00
	16QAM	24.50	24.50	22.00
NR Band n5	DFT-s-OFDM	24.50	24.50	24.50
	CP-OFDM	24.50	24.50	24.50

ANT 2				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
GSM 850	GSM (GMSK, 1Tx-slot)	33.00	33.00	33.00
	GPRS (GMSK, 1Tx-slot)	33.00	33.00	33.00
	GPRS (GMSK, 2Tx-slot)	31.00	31.00	31.00
	GPRS (GMSK, 3Tx-slot)	29.00	29.00	29.00
	GPRS (GMSK, 4Tx-slot)	27.00	27.00	27.00
	EDGE (8PSK, 1Tx-slot)	27.00	27.00	27.00
	EDGE (8PSK, 2Tx-slot)	26.00	26.00	26.00
	EDGE (8PSK, 3Tx-slot)	24.50	24.50	24.50
	EDGE (8PSK, 4Tx-slot)	23.00	23.00	23.00
GSM 1900	GSM (GMSK, 1Tx-slot)	29.00	29.00	29.00
	GPRS (GMSK, 1Tx-slot)	29.50	29.50	29.50
	GPRS (GMSK, 2Tx-slot)	27.00	27.00	27.50
	GPRS (GMSK, 3Tx-slot)	25.00	25.00	25.00
	GPRS (GMSK, 4Tx-slot)	23.00	23.00	23.00
	EDGE (8PSK, 1Tx-slot)	25.50	25.50	25.50
	EDGE (8PSK, 2Tx-slot)	24.00	24.00	24.00
	EDGE (8PSK, 3Tx-slot)	23.00	23.00	23.00
	EDGE (8PSK, 4Tx-slot)	21.00	21.00	21.00
WCDMA V	RMC 12.2K	25.00	25.00	24.00
WCDMA IV	RMC 12.2K	25.00	25.00	25.00
WCDMA II	RMC 12.2K	24.50	24.50	24.50
LTE Band 2	QPSK	23.00	23.00	23.00
	16QAM	22.50	22.50	22.50
LTE Band 4	QPSK	24.50	24.50	24.50
	16QAM	23.50	23.50	23.50
LTE Band 7	QPSK	23.50	17.50	23.50
	16QAM	23.00	16.50	23.00
LTE Band 12	QPSK	23.00	23.00	23.00
	16QAM	22.00	22.00	22.00
LTE Band 26	QPSK	25.00	25.00	25.00
	16QAM	25.00	25.00	25.00
LTE Band 41	QPSK	25.00	16.50	25.00
	16QAM	25.00	16.50	25.00
NR Band n5	DFT-s-OFDM	24.00	24.00	24.00
	CP-OFDM	23.50	23.50	23.50
NR Band n41	DFT-s-OFDM	25.00	22.00	24.00
	CP-OFDM	25.00	22.00	24.00

ANT 3				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
GSM 1900	GSM (GMSK, 1Tx-slot)	30.50	26.50	26.50
	GPRS (GMSK, 1Tx-slot)	30.50	26.00	26.50
	GPRS (GMSK, 2Tx-slot)	28.00	24.50	24.50
	GPRS (GMSK, 3Tx-slot)	25.50	22.00	22.00
	GPRS (GMSK, 4Tx-slot)	24.00	20.00	20.00
	EDGE (8PSK, 1Tx-slot)	26.50	22.50	22.50
	EDGE (8PSK, 2Tx-slot)	25.00	21.00	21.00
	EDGE (8PSK, 3Tx-slot)	24.00	19.50	20.00
	EDGE (8PSK, 4Tx-slot)	22.00	18.00	18.00
WCDMA IV	RMC 12.2K	24.50	16.50	20.00
WCDMA II	RMC 12.2K	23.50	15.50	19.50
LTE Band 2	QPSK	23.00	16.50	20.00
	16QAM	22.00	15.50	19.50
LTE Band 4	QPSK	24.00	16.50	21.00
	16QAM	23.00	15.50	20.00
LTE Band 7	QPSK	23.50	14.00	19.50
	16QAM	22.50	13.00	18.50
LTE Band 41	QPSK	24.00	17.50	20.00
	16QAM	24.50	18.00	20.50
NR Band n41	DFT-s-OFDM	24.50	21.00	24.50
	CP-OFDM	24.50	21.00	24.50

ANT 5				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
WLAN 2.4GHz	802.11b	17.00	11.00	17.00
	802.11g	17.50	11.50	17.50
	802.11n HT20	16.50	10.50	16.50
	802.11n HT40	16.50	10.50	16.50
	802.11ax20	16.50	11.00	16.50
	802.11ax40	16.00	10.00	16.00
WLAN 5.3GHz	802.11a	16.00	10.50	16.00
	802.11ac20	16.00	10.50	16.00
	802.11ac40	16.00	10.50	16.00
	802.11ac80	15.00	9.50	15.00
	802.11ac160	11.50	6.00	11.50
	802.11ax20	13.50	8.00	13.50
	802.11ax40	12.50	7.00	12.50
	802.11ax80	11.50	6.50	11.50
	802.11ax160	9.50	4.00	9.50
	802.11n20	16.00	10.50	16.00
	802.11n40	16.00	10.50	16.00
WLAN 5.6GHz	802.11a	16.00	10.50	16.00
	802.11ac20	16.00	10.00	16.00
	802.11ac40	16.00	10.50	16.00
	802.11ac80	11.00	5.50	11.00
	802.11ax20	13.50	8.00	13.50
	802.11ax40	13.50	8.00	13.50
	802.11ax80	13.00	7.50	13.00
	802.11n20	16.00	10.50	16.00
	802.11n40	16.00	10.50	16.00
WLAN 5.8GHz	802.11a	16.50	11.00	16.50
	802.11ac20	15.50	10.00	15.50
	802.11ac40	15.00	10.00	15.00
	802.11ac80	15.50	10.00	15.50
	802.11ax20	13.50	8.50	13.50
	802.11ax40	13.00	7.50	13.00
	802.11ax80	11.50	6.00	11.50
	802.11n20	16.50	11.00	16.50
	802.11n40	16.00	11.00	16.00
BT	EDR/LE	4.50	4.50	4.50

ANT 6				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
WLAN 5.3GHz	802.11a	16.00	16.00	13.00
	802.11ac20	16.00	16.00	13.00
	802.11ac40	15.50	15.50	12.50
	802.11ac80	15.00	15.00	11.50
	802.11ac160	11.00	11.00	8.00
	802.11ax20	13.00	13.00	10.00
	802.11ax40	12.50	12.50	9.50
	802.11ax80	11.50	11.50	9.00
	802.11ax160	9.00	9.00	6.00
	802.11n20	16.00	16.00	13.00
802.11n40	15.50	15.50	12.50	
WLAN 5.6GHz	802.11a	16.50	16.50	14.00
	802.11ac20	16.50	16.50	13.50
	802.11ac40	16.50	16.50	13.50
	802.11ac80	15.00	15.00	12.00
	802.11ax20	14.50	14.50	11.50
	802.11ax40	13.50	13.50	11.00
	802.11ax80	13.00	13.00	10.00
	802.11n20	16.00	16.00	13.00
	802.11n40	16.50	16.50	14.00
WLAN 5.8GHz	802.11a	15.00	15.00	12.00
	802.11ac20	16.50	16.50	13.00
	802.11ac40	16.00	16.00	13.00
	802.11ac80	13.50	13.50	10.50
	802.11ax20	12.00	12.00	9.00
	802.11ax40	12.00	12.00	9.00
	802.11ax80	11.00	11.00	8.00
	802.11n20	15.00	15.00	12.00
	802.11n40	14.50	14.50	11.50

ANT 7				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
NR Band n77 3450-3550MHz	DFT-s-OFDM	22.00	17.00	18.50
	CP-OFDM	20.00	15.50	17.00
NR Band n77 3700-3980MHz	DFT-s-OFDM	21.50	17.50	18.50
	CP-OFDM	20.00	15.50	17.00
WLAN 2.4GHz	802.11b	17.50	11.50	17.50
	802.11g	17.50	11.50	17.50
	802.11n HT20	16.50	10.50	16.50
	802.11n HT40	16.00	10.00	16.00
	802.11ax20	16.50	10.50	16.50
	802.11ax40	15.50	9.50	15.50
BT	EDR/LE	4.50	4.50	4.50

ANT 8				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
NR Band n41	DFT-s-OFDM	22.50	13.50	16.00
	CP-OFDM	22.50	13.50	16.00
NR Band n77 3450-3550MHz	DFT-s-OFDM	26.00	16.50	26.00
	CP-OFDM	24.00	15.00	24.00
NR Band n77 3700-3980MHz	DFT-s-OFDM	26.00	16.50	26.00
	CP-OFDM	24.50	15.00	24.50

ANT 9				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
NR Band n41	DFT-s-OFDM	23.50	23.50	22.50
	CP-OFDM	23.50	23.50	22.50
NR Band n77 3450-3550MHz	DFT-s-OFDM	19.50	19.50	19.50
	CP-OFDM	18.00	18.00	18.00
NR Band n77 3700-3980MHz	DFT-s-OFDM	18.00	18.00	18.00
	CP-OFDM	16.50	18.00	16.50

ANT 10				
Band	Mode	Target Power and Tolerance (dBm)		
		Full Power	Head Scene	Body Scene
NR Band n77 3450-3550MHz	DFT-s-OFDM	25.50	19.00	18.00
	CP-OFDM	24.00	17.50	16.50
NR Band n77 3700-3980MHz	DFT-s-OFDM	27.00	20.50	19.50
	CP-OFDM	25.50	19.00	18.00

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

HSPA MPR Targets	
HSUPA 3GPP Subtest	Band II/IV/V MPR Target (dB)
1	0
2	2
3	1
4	2
5	0

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 expect HSUPA transmit power result to be within **+/-1.0 dB** of 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

$$CM = \text{CEIL} \{ [20 * \log_{10} ((v_norm^3)_{rms}) - 20 * \log_{10} ((v_norm_ref^3)_{rms})] / k, 0.5 \}.$$

The function CEIL { x, 0.5 } means rounding upwards to the closest 0.5dB, i.e. CM ∈ [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	1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2	2

We expect LTE transmit power result to be within **0~1dB** of the expected MPR target values.