Title: Power Tune up procedure for HE910 Products Family

Contents

1 Introduction

1.1 Scope

The aim of this document is the description of Tune Up Procedure for the HE910 Products family.

1.2 Applicability

This Technical Note is related to the following products:

Product	Supported 2G Bands	Supported 3G bands
HE910	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B4, B5, B8
HE910-D	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B4, B5, B8
HE910-G1	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B4, B5, B8
HE910-GA	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B2, B5, B8
HE910-EUR	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B5, B8
HE910-EUD	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B5, B8
HE910-EUG	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B1, B5, B8
HE910-NAR	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B2, B4, B5
HE910-NAD	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B2, B4, B5
HE910-NAG	GSM 850, GSM 900, DCS1800, PCS 1900	FDD B2, B4, B5

2 RF power structure and function

2.1 WCDMA TX Tune Up

The TX path consists of a Low gain open loop mode covering the TX output power range from -56 dBm till +14 dBm and a High gain close loop mode where a PA stage amplifies and cover the range from -1 till +25 dBm. In Low gain mode a variable PA Bias is added in order to reduce the current consumption and thereby optimize battery life.

The total amount of adjustments can be divided into the following tasks:
- High gain close loop Power Detector adjustment
- Low gain open loop adjustment in both WCDMA and HSDPA
- Bias characterization
- Linearity over frequency on High

2.1.1 High Gain Close Loop Power Detector (PD) Adjustment (WCDMA)

The characterization of high gain close loop should be done from -1 to 25 dBm. This is done by issuing a list of TX DAC (pa_gain) values with a constant PA Bias level (pa_bias) and measure their corresponding TX output power and Power detector value. Then do a PD calculation based on the measured PD value and measured TX Power to find the exact TX PD value giving the exact integer output Power value and store the PD value.

Procedure:

1. Setup target with Frequency, Band.
2. Setup TX gain with variable pa_gain and a constant pa_bias.
3. Fetch the close loop_gain Power Detector value reported by target
4. Measure the output power from target
5. Stop the TX on target
6. Repeat 1 → 5 until the range -1 till +25 is covered by increasing the Tx DAC values with 32 for each iteration
10. Store the calculated list of PD values to the mirror

Calculations:

The Power Detector values are calculated by applying Linear Interpolation to the measured TX power (X) and the according PD value readout (Y) held up against a user defined power range to find from -1dBm to 25 dBm with a step size of 1 dB (findvalue):

$$Y_{PD} = Y_{n-1} + (findvalue - Xn)*(Y_n - Y_{n-1} / Xn - X_{n-1})$$

2.1.2 PA Bias Characterization

For current consumption improvement, especially in low gain mode, the PA's bias current can be reduced. This is done by using a DC/DC converter to improve PA efficiency by adjusting the PA supply voltage.

2.1.3 Linearity over Frequency

The linearity over frequency is done both on PA High Gain and on PA Low gain. On high gain this is done on 22 dBm to ensure that the PA is not saturated and in the un-linearity area. In Low gain the internal PA stage is linearized over frequency in order to ensure smooth transition from low to high gain and vice versa on all frequencies.

2.1.4 Range of operating RF Power for WCDMA

The HE910, HE910-G1 and HE910-D support 5 WCDMA Bands.
The nominal power levels and tolerances are indicated in the following table:

WCDMA Band	Max Output Power	Tolerances	
	dBm	-	+
1	23	1.5	0.5
2	23	1.5	0.5
4	23	1.5	0.5
5	23	1.5	0.5
8	23	1.5	0.5

The HE910-GA supports 4 WCDMA Bands
The nominal power levels and tolerances are indicated in the following table:

WCDMA Band	Max Output Power	Tolerances	
	dBm	-	+
1	23	1.5	0.5
2	23	1.5	0.5
5	23	1.5	0.5
8	23	1.5	0.5

The HE910-EUR, HE910-EUD and HE910-EUG support 3 WCDMA Bands
The nominal power levels and tolerances are indicated in the following table:

WCDMA Band	Max Output Power	Tolerances	
	dBm	-	+
1	23	1.5	0.5
5	23	1.5	0.5
8	23	1.5	0.5

The HE910-NAR, HE910-NAD and HE910-NAG support 3 WCDMA Bands
The nominal power levels and tolerances are indicated in the following table:

WCDMA Band	Max Output Power	Tolerances	
	dBm	-	+
2	23	1.5	0.5
4	23	1.5	0.5
5	23	1.5	0.5

2.2 GSM/EDGE TX Tune Up

In normal mode uses a power detector (PD) with an automatic power control loop. But for calibration the Phone will be switched to operate in open loop mode. This gives the possibility to obtain additional performance information of the forward characteristic of the transmitter.
For normal operation uses a calibration table for power vs. detector characteristics and a frequency correction table with power offset dependent on frequency. These two tables shall be adjusted.

Procedure:
1. Start transmit on the low band centre ARFCN, using first rampscale index value 15, Tx enabled for one slot, and training sequence matching instrument
2. Record the PD_readback. The raw readback value is the sum of 4 measurements during the burst, so a floating point representation is assumed as a quarter of the readback value:
PD[i] = 0.25 * PD_readback.
3. Measure the power with the instrument, in calculation section referred to as dBm
4. Repeat 1 to 3 for all the required rampscale_index from 15 down to 4, and repeat for high band
5. Stop transmit

Calibration of power vs. frequency is done on 5 frequencies on each of the 4 GSM bands. This is done using rampscale index 0 of the calibration mode rampscale tables but operated in closed loop.

Procedure:
1. Change from open loop calibration mode to closed loop calibration mode
2. Initialize instrument for power measurement
3. Start transmit on the first ARFCN, using closed loop rampscale index 0, Tx enabled for one slot, and training sequence matching instrument
4. Measure the power with the instrument, in calculation section referred to as dBm at Frequency
5. Repeat 3 and 4 for all frequencies on all bands
6. Change from closed loop calibration mode to open loop calibration mode, as this is the default for calibration mode

2.2.1 Range of operating RF Power for GSM/EDGE

The nominal power levels and tolerances are indicated in the following table:

GSM Band	Max Output Power	Tolerances	
	dBm	-	+
GSM 850 (LB)	32.5	1	0.5
GSM 900 (LB)	32.5	1	0.5
DCS1800 (HB)	29.5	1	0.5
PCS 1900 (HB)	29.5	1	0.5