Description of Radio Parameter Alignment for Wherify Personal Locator

The CDMA radio in the Wherify Locator has no manual tuning. All adjustments are made electronically using the capabilities of the analog section of the LSI ASIC. The following is a brief description of the setup, and the various alignment procedures required.

General Description

Alignment is done exclusively using the features of the E8285A CDMA Mobile Station Test Set (SW Ver. A.04.53 or later), a power supply capable of supplying 4V @ 2A, an interface board, and a PC running LSI's ETS application for control of the CDMA radio. The CDMA radio in the Wherify Locator is connected via an antenna cable to the RF IN/OUT port on the E8285A. The cable loss is entered in as RF Level Offsets under the Config screen. The PC is connected to the interface board through the RS232 interface. The interface board is then connected to the Wherify locator. For receiver alignment, the E8285A generates a receive signal using channel 600 on the US-PCS channel plan. This signal is a Full Rate CDMA signal using Service Mode 2 and the J-STD-008 protocol. The ETS application returns the received signal strength through it's interface with the radio. For Tx alignment, the E8285A is set to measure Channel Power on Channel 600 of the US-PCS plan. The CDMA radio in the Wherify Locator is set to produce a Full Rate CDMA signal using the ETS application. By adjusting the power level DAC with the ETS application, our set points are achieved. The following sections detail the specific alignments procedures.

RX AGC vs. RX Gain Alignment

For the receiver section, we inject a known reference signal at our calibration frequency into the antenna connector and read the Rx AGC HW Val. We record this DAC level with the known signal level in a table and jump to the next point, which is typically 5 or 10 dB away. The low gain range is between –25 dBm and –85 dBm. Then we enable the hardware amplification, and measure and record more points over a medium range of –75 dBm to –110 dBm. By design, we make sure to plot points that overlap in each range so when we switch from one range to the other, there is no extrapolation error. The hysterisis points are –85 dBm and –75 dBm for switching between low and med ranges. These points are recorded into the RX AGC vs. RX Gain table in flash for future use by the Call Processing Stack

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RX Gain vs. Channel Freq. Alignment

The next step is to set the frequency offsets. These are necessary to correct for any non-linearities in the receiver front end. A calibration signal from the Rx AGC calibration is injected into the antenna connector at a known fixed level. Then the Rx AGC ADC is read and recorded as the reference. Other frequencies are injected, and the signal power is adjusted until our Rx AGC ADC matches the reference value. These points are recorded in the Rx Gain vs Channel Freq. table for future use by the Call Processing Stack.

RX Temp Alignment

The method here is to read the Rx AGC ADC at different temperatures and provide a dB offset from the calibration temperature. Since the Rx AGC vs RX Gain alignment is done at room temperature, we take a Rx AGC ADC value recorded at a particular level and call that the reference. We then adjust the ambient temperature to several set points across the radio's operating temperature range and adjust the input level so that the Rx AGC ADC matches the reference. We then record the delta dB in the table with the temperature in Centigrade units. This forms the RX Temp table. Typically we do two measurements below 25C and two measurements above.

TX Power vs AGC Alignment

This is done in much the same way as the RX AGC alignment except that we have 3 ranges, and we adjust the output power generated by the radio to a set point. These set points are typically 10 dB but closer points are plotted for areas where there is more variation. The low range is –50 dBm to -20 dBm. The med range is –30 dBm to 0 dBm. The high range is –10 dBm to 20 dBm. Where the hysterisis points are –20 dBm and –30 dBm for low/med range, and 0 dBm and –10 dBm for med/high range. This forms the TX Power vs AGC table.

TX Gain vs Channel Freq Alignment

This is done by putting out a Tx AGC DAC value that gives us a known output power at the calibration frequency. The frequency is then changed to all the desired points across the band, and the delta dB level is recorded per frequency. This forms the Tx Gain vs Channel Freq table.

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TX Limit vs Channel Freq Alignment

We have a hard coded limit of 25 dBm in the Call Processing Stack firmware. This offset provides a limit above or below that. We currently set our limit to 20 dBm, thus this offset becomes –5 dB. It does not appear necessary to adjust this to frequency as the TX Gain vs Channel Freq does a good enough job. This value is uploaded to the unit at calibration forming the Tx Limit vs Channel Freq table.

TX Power Detection vs ADC Alignment

We do not align this setting as the PA is designed to operate in open loop mode, thus we simply upload 0xFFFF. A closed loop is made when in connection with the base station transceiver.

TX Temperature Alignment

The method here is similar to the RX Temperature Alignment. However we set the Tx AGC DAC to an ambient reference level, measure the power, and call this the reference. Then the temperature is adjusted to the required set points, and the transmitter is turned on with the ambient Tx AGC DAC level again. The difference between the ambient reference level and the temp. level are recorded in the Tx Temp table.