5. Conclusions

5.1 Summary

A radio that complies with the radio specifications of the W-CDMA system was built. The design methodology and hardware implementation of the radio has been presented. The radio meets all the specifications except the adjacent channel power. The linear QPSK modulation and the zero guard band of the W-CDMA system imposed a stringent adjacent channel power specification on the transmitter design. The use of the single-stage power amplifier failed to meet this stringent specification. An peak-to-average factor simulation was performed. Based on the simulated peak-to-average factor, the analysis suggested a two-stage power amplifier design.

The traditional receiver design technique was found applicable to this radio. The W-CDMA test signals are not available in the laboratory. Therefore, the direct sensitivity measurement could not be conducted. However, using MDS to estimate the receiver performance provided a level of confidence that the receiver would perform well in the field. The TPC did not behave linearly. However, the objective of the 70dB power control range was achieved. The two stage AGC design successfully maintained the noise figure and the intermodulation sensitivity of the receiver. The smooth and linear transition between the back-end and the front-end AGCs was obtained and the 80dB control range was achieved. The use of a diode for voltage limiting performed well. The AFC provided the required ±2ppm tuning range.

The approach of this radio design is to study the system requirements up front and then to translate the system requirements into circuit level requirements. This design process was successful. Only two iterations of the hardware implementation were needed before meeting all the specifications except for the adjacent channel power. The sophisticated and expensive W-CDMA test equipment was not available. Therefore, some indirect

performance measurement techniques were introduced. These techniques successfully indicated the radio performance.

5.2 Recommendations

The problem of insufficient adjacent channel power suppression needs to be addressed. The proposed two-stage power amplifier approach needs to be verified.

The power amplifier is class A for high linearity and remains the bias condition regardless the output power level. The drawback of this scheme is inefficient. For mobile terminals, power amplifier efficiency is important for the battery life.

However, power amplifiers optimized for efficiency at maximum output power do not effectively increase battery life in W-CDMA systems. Due to the power control, the average output power is much less than the maximum power [24]. A suggestion for future research is the design of power amplifiers that can maximized the amplifier efficiency over the entire transmit power range. For the W-CDMA radio, the transmit power range is from –40dBm to 30dBm.