Design and Implementation of HTS Technology for Cellular Base Stations:

An Investigation into Improving Cellular Communication

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ABSTRACT

When placed between the antenna and receiver electronics of a cellular base transceiver station, a Cryogenic Receiver Front End (CRFE), consisting of a High Temperature Superconducting (HTS) filter and modern Low Noise Amplifier (LNA), can significantly improve the base stations' coverage and capacity. Due to CRFEs being hurried to the telecommunications industry in a competitive market, the development of CRFEs and their performance have been classified. This left it to be pondered whether HTS filters could really have been beneficial or if they were always just of academic interest. It is the main objective of this thesis to ***investigate if and under what circumstances high temperature RF-superconductivity can prove to be an important technological contribution to current and future wireless communications***.

This dissertation presents the analysis of an existing CRFE developed by Cryoelectra GmbH and its performance characteristics measured in a field trial held in rural China. With the aid of a CDMA Uplink Model developed by the author, the data was analysed and several novel engineering improvements were made to create an advanced CRFE which was economical to deploy. The analysis of results from a field trial in Beijing city using the CDMA Uplink Model led to the exploration of alternative filter technologies which could achieve similar results to the HTS filter technology. This culminated in the development of dielectric resonators filters which could be used as an alternative and as a supplement to the HTS filters used in the CRFE. The design of two novel dielectric resonator duplexers and two advanced multi-operator combiner antenna sharing solutions followed the successful implementation of a high performance dielectric resonator filter.

The performed investigation and development described in this thesis suggest that HTS filter technology for terrestrial wireless communications can be beneficial in current cellular networks, but due to its high cost is economical for use only under certain conditions. However, HTS filter technology may be of great importance in the design and implementation of spectrum friendly wireless communications systems in the future.

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