What is Antenna Tuning?

Because of the increase in new features, functionality and industrial design requirements, the space available for the mobile system antenna is shrinking at a rapid rate. As antennas are wrapped and repathed, they lose efficiency. Some of this lost performance can be recovered with antenna tuning, in which the system uses dynamic impedance tuning techniques to optimize the antenna performance for both the frequency of operation and the environmental conditions.

Industry Trends Drive Performance

LTE-Advanced Network and Carrier Aggregation specifications are pushing RFF Front End performance demands higher. This often requires additional antennas or a multi-feed antenna to be added to the handset which place further demands on antenna size or tuning selectivity. Tunable devices have proved highly valuable to supporting the increased bandwidth demanded by LTE handsets by enabling small antennas that are efficient across the entire LTE bands from 700MHz to 3GHz, saving battery power and enabling slim and thin designs.

The UltraCMOS Advantage

One of the most significant challenges facing the mobile handset designers is the poor antenna performance for multi-band multi-mode handsets. Dynamically tuning the antenna to compensate for the increasing bandwidth requirements and environmental effects will significantly improve the antenna performance. Further, as the market demands new wideband services in the handset, such DVB-H and ISDB-T for mobile TV, the use of antenna tuning becomes a necessity. Until now, no tunable element met the needs of the mobile products industry in power handling, reliability, high volume production and integration. Peregrine’s DuNE Technology is the key to unlocking the future of digital tunability in mobile RF systems.
Antenna Tuning Methods

**Impedance Matching:** For fine RF Tuning on a limited tuning range, Impedance Tuning, sometimes referred to as Matching, can be employed. This solution tunes the antenna to the entire system, creating a tuned matching network which is added to the antenna input. This solution is easy to implement; tunable components are used in shunt or series.

**Aperture Tuning:** For a wider tuning range, Aperture Tuning is incorporated into the antenna design. In this design solution, the tunable component is added to antenna structure itself, requiring modifications to antenna. The electrical length of the antenna element is adjusted to shift its resonance to the desired frequency band of operation. Band-switching has the advantage of being able to achieve higher levels of performance than input tuning since the actual radiating element is being tuned. Tuning is achieved by loading with a Digitally Tunable Capacitor (DTC), or by using a tunable control/shorting switch. In both cases, the tuning components must have low loss to avoid degrading the radiating efficiency of the antenna.

Additional RF Tuning Applications

**Filter Tuning**

Digital Tunable Capacitors can be employed to replace varactor diodes in tunable filters. The DTCs enable higher performance filter designs with significantly higher linearity, fewer components for a lower filter cost and less integration complexity with a SPI or FC control interface.

**Phase Shifter**

Digitally Tunable Capacitors and other DuNE-enhanced RF Tuning products can also be employed to implement a high-performance hybrid Phase Shifter for antenna beam steering, delivering state-of-art power handling, linearity, insertion loss, phase-shift resolution, operational bandwidth, and small size for any phase-shifter topologies and fabrication technologies.