

Radio Frequency Acoustic Wave Devices in RF Front-End in Mobile Communications --- Why Unavoidable?

Abstract—Several tens of radio frequency devices based on surface and bulk acoustic wave technologies are installed in each smartphone as filters, duplexers, and multiplexers. The number is still growing and expected to be more than one hundred near future. IC industries attempted to realize most of all functionalities on Si. It is also true for high speed communications. Nevertheless, why are acoustic wave devices still used? The biggest obstacle is non-linearity. RF filters must be quite linear to avoid unnecessary signal generation equivalent to noise. Although acoustic wave devices are quite linear, further linearity improvement is strongly requested. This is due to introduction of the inter-band carrier aggregation and recent trend of increasing the transmit power. Self-mixing of transmit signals may be cancelled in some extent by circuit design and/or digital signal processing. However, they are not usable for mixture including outcoming jummer signals. To replace acoustic wave devices with those based on another technology, they must fulfill various tough specifications given to current acoustic wave devices in addition to the linearity: low insertion loss in the passband, good out-of-band rejection, narrow transition bandwidth, small passband ripples, temperature stability, power durability, small size, and low price. This paper reviews current status of RF SAW/BAW devices used in high-speed mobile communications. Typical device performances are presented, and discussions are given on why such tough specifications are enforced. Nonlinearity in RF frontend and its impact to high-speed communications are detailed.