Bulk Acoustic Filters for 5G and Beyond

TECHNOLOGY NUMBER: 2020-318

OVERVIEW

A technology to optimize acoustic filtering capabilities between metal electrodes

- Activates a device resonance frequency which, eliminates the need for external switchplexers
- Function at a large range up to mm-wave frequencies designated for 5G data transfer

BACKGROUND

In today's wireless devices, the number of band-select radio frequency filters has exceeded fifty, which is a testament to the complexity and sophistication of modern wireless technology. These filters play a crucial role in allowing mobile devices to achieve high data throughput without being affected by interference from the crowded electromagnetic spectrum. With an increasing array of wireless devices and technologies competing for bandwidth, these filters have become essential to ensure that wireless signals can be transmitted and received without interference. The filters work by selectively filtering out unwanted signals from the surrounding environment, leaving only the desired signals to pass through. As a result, mobile devices can maintain reliable and high-speed wireless connections even in densely populated areas.

Surface acoustic wave (SAW) and bulk acoustic wave (BAW) filters based on piezoelectric materials are the primary technologies used for selecting the frequency of operation in communication systems, including mobile phones. With the introduction of 5G technologies, multiple millimeter (mm) wave frequency bands up to 30 GHz have been designated for very high data rate communications. However, the operation frequency of the current BAW and SAW filters is limited to sub 6 GHz frequency bands, and they can barely meet the performance requirements for wireless bands even at 5.8 GHz. As such, a need exists for a method to improve existing acoustic filtering capabilities.

INNOVATION

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Category

Hardware
Engineering & Physical Sciences
Semiconductor and Electronics

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Researchers have invented a technology which exceeds existing acoustic filtering capabilities by alternating piezoelectric and ferroelectric materials between metal electrodes. The induction of negative piezoelectricity in specific layers activates a device resonance frequency and is intrinsically switchable, eliminating the need for external switchplexers commonly used in cell phones. The resonance frequency is dictated by layer thickness, not number of layers. So, filters using this technology will likely be easier to manufacture and may have more granular filter ranges than previously available. This technology overcomes the fundamental limit of the acoustic resonator's ever-decreasing electromechanical coupling factors (kt2) as their frequency of operation increases. The resulting Kt2 is independent of frequency, extending the operation frequency from ~6GHz to 26GHz, which is essential for 5G networks. The innovators have therefore created filtering capabilities that can function at a large frequency range up to mm-wave frequencies designated for 5G, providing solutions for efficient spectrum access at frequency bands for the current and future communication systems.

References

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