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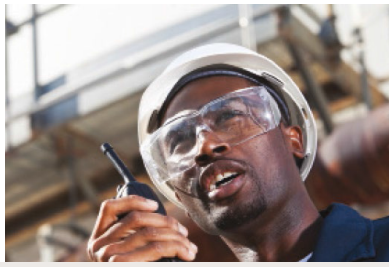
للعلوم والتقنية
King Abdullah University of
Science and Technology

TECHNOLOGY OPPORTUNITY



Miniaturized Filter for GPS and Emerging Low-RF Applications

Leveraging system-on-package technology to decrease GPS size and temperature sensitivity

A miniaturized filter employs novel packaging materials and integrated circuit designs to decrease the size and temperature sensitivity of global positioning system (GPS) devices. This innovation combines a liquid crystal polymer (LCP) technology, 3-dimensional (3D) inter-digital capacitors, and spiral inductors to reduce overall bandpass filter size and enhance performance.

The resulting system-on-package (SoP) approach reduces temperature sensitivity and filter size by 80 percent, as compared with conventional planar implementation of circuitry, and represents the next generation of integration architecture.

Benefits

- **High performance:** Leverages SoP technology to decrease GPS size and temperature sensitivity
- **Miniaturized:** Enables an unprecedented 4.2 millimeter (mm) x 3.9 mm x 0.1 mm compact filter for use in GPS-enabled and low-radio frequency (RF) instruments
- **Unique:** Employs a novel LCP material system and 3D inter-digital capacitors to achieve SoP capability
- **Reliable:** Alleviates performance variability with temperature flux due to thermal compatibility of LCP and printed circuit board (PCB) materials
- **Efficient:** Enhances performance and Quality-factor (Q-factor) for low frequencies in GPS

Applications

The technology can be used in chipsets for GPS-enabled and low-RF instruments, including:

- Personal navigation devices (GPS systems)
- Smart phones
- Mobile RF handsets
- Bluetooth
- Wi-Fi
- Sports and outdoor equipment
- Military handheld RF devices
- Radio-frequency identification (RFID)

Opportunity

This technology is part of KAUST's technology commercialization program that seeks to stimulate development and commercial use of KAUST-developed technologies.

Opportunities exist for joint development, patent licensing, or other mutually beneficial relationships.

For More Information

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Technology Details

Integrated circuits (IC) comprise just 10 percent of overall GPS systems, having been miniaturized significantly already. The remaining 90 percent involve so-called passive components, which are basic inductors and capacitors, antennas, and power sources that are often combined to form higher-order circuits such as amplifiers, oscillators, and filters. By embedding IC and passive components (which are integrated on PCBs) within the system's packaging materials, further miniaturization is achieved. This emerging SoP concept works to reduce size on a system level.

How It Works

To achieve SoP, KAUST's patent-pending innovation employs a novel LCP material system, which inherently matches the coefficient of thermal expansion of PCB materials better than more conventional low-temperature co-fired ceramics (LTCCs).

The innovation employs four layers of conductors with LCP layer separations. The capacitors and inductors are etched into the conductor layer. The filter design uses 3D horizontal and vertical inter-digital capacitors in a novel multilayer scheme. Two circular spiral inductors are interleaved for high mutual coupling. The SoP technology enables unprecedented levels of miniaturization: 4.2 mm x 3.9 mm x 0.1 mm (versus centimeters of conventional capacitors). The bandpass filter can be used in GPS devices, mobile phones, personal digital assistants, and emerging low-RF applications.

Why It Is Better

The most common technology for SoP implementation is LTCC. These filters are small, but in order to be used in today's systems, they have to be connected to the PCB, where the rest of the system resides. PCB is an organic material, and its coefficient of temperature expansion is different than that of LTCCs, causing assembly and operation problems when the temperature rises or falls.

LCP technology has better characteristics at higher frequencies and temperatures, while permittivity remains constant for frequencies up to 100 GHz. Being organic, it is also more compatible with existing PCBs than are LTCCs. Integration between LCP and conventional PCB is more reliable, allowing LCP to outperform LTCC at temperature variations.

IP Protection

KAUST has several patents pending for this technology.

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INNOVATION AND ECONOMIC DEVELOPMENT

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