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Technology Transfer Office

Silicon-Based Atomic Clocks

Researchers at the University of South Florida have developed a novel silicon-based chip-size atomic clock that may be used for very accurate and precise time measurements.

The efficiency of many electronic devices is often limited by the performance of their internal clocks. In devices containing Global Positioning Systems (GPS), accurate timing is needed not only for the precise determination of distance, but also for fast acquisition of the satellite signal. Other examples where timing determines the ultimate performance of the system include parallel analog to digital converters, digital communications, synchronization of networks, and power distribution. Therefore, there is a crucial need to develop more accurate clocks that can be integrated with electronic devices.

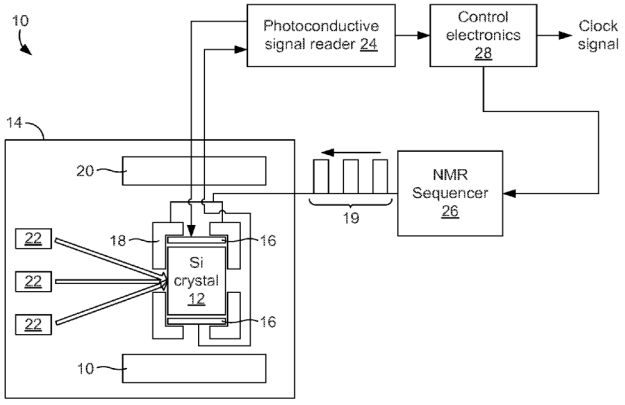
To meet this need, USF inventors are using the transitions of donors and acceptors in silicon as the frequency standard for atomic clocks. All the transitions of the donors and acceptors in natural and isotopically enriched silicon, including and most importantly their hyperfine splitting, can be used to build an atomic clock. The donor and acceptors in isotopically pure silicon become extremely narrow, 'atomic like' and therefore can serve as frequency standards. They can be optically excited using small laser diodes and electrically detected. For the phosphorus donor a resonance of 24 Hz FWHM was detected, leading to quality factors Q comparable to atomic clocks based on atomic gases. The discovery is important because it overcomes problems associated with size, power consumption, and the difficulty integrating atomic clocks with existing devices.

This invention is applicable to GPS network and satellite navigation, aviation, information technology, military communications, sensor systems, and many other applicable industries.

ADVANTAGES:

- **Improved speed and accuracy**
- **Easy integration into chip-sized devices**
- **Less power consumption**

Energy Level Transitions in Silicon as Frequency Standards for Atomic Clock



Block Diagram of a Silicon Based Atomic Clock

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