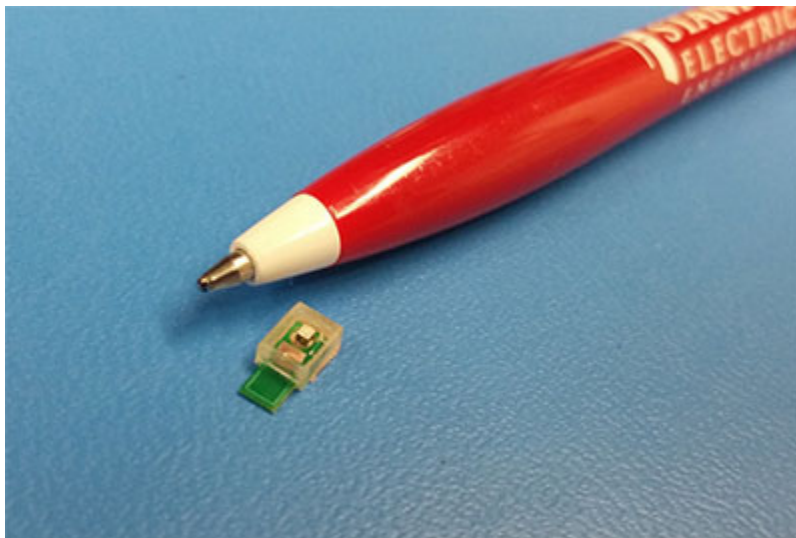


**Docket #:** S13-173

# Wireless, Ultra-Low Power Implantable Device

Stanford researchers have built a sound powered, wireless medical implant. The implant contains a piezoelectric energy receiver, an integrated circuit chip, and a loop antenna. It converts ultrasound to energy, executes medical commands, and relays results all without the need for wires or battery. The device has a higher efficiency, longer range, better performance, and is less invasive than current RF implants of the same frequency. This low-power sensor has a wide range of medical applications from health monitoring to nerve, muscle, or brain stimulation treatments.



## Stage of Research

Researchers have built and tested devices with various data links and power levels. Plans for an optogenetic stimulator implant are underway.

## Applications

- Low-power sensors with end user applications in:
  - Medical implants such as pacemakers, continuous glucose monitoring, etc.

- Deep tissue implants
- Nerve stimulation (muscle or brain)
- Optogenetic implants that can be programmed wirelessly
- Brain implants

## Advantages

- More energy efficient
- Longer range of operation (e.g. deep tissue implants)
- Less invasive - much smaller than RF implants of same frequency
- 1/10 penetration losses in tissue
- Better energy capture capability for sensor (wavelength and aperture)
- Improved bandwidth and data-rate
- Improved energy recovery for applications that need deep electrical stimulation
- Improved multi-access capability for many-sensor scenarios

## Publications

- M. J. Weber, A. Bhat, T. C. Chang, J. Charthad, and A. Arbabian, "[A Miniaturized Ultrasonically Powered Programmable Optogenetic Implant Stimulator System](#)," in IEEE Biomed. Wireless Technol., Networks, Sens. Syst. Top. Conf., Austin, TX, USA, Jan. 2016.
- T. C. Chang, M. Weber, J. Charthad, A. Nikoozadeh, B. T. Khuri-Yakub, and A. Arbabian, "[Design of High-Efficiency, Miniaturized Ultrasonic Receivers for Powering Medical Implants with Reconfigurable Power Levels](#)," IEEE IUS, Taipei, Oct. 21-24, 2015.
- J. Charthad, M. J. Weber, T. C. Chang, M. Saadat, and A. Arbabian, "[A mm-Sized Implantable Device with Ultrasonic Energy Transfer and RF Data Uplink for High-Power Applications](#)," Custom Integrated Circuits Conference (CICC), 2014 IEEE Proceedings of the, 15-17 Sept. 2014.
- J. Charthad, M.J. Weber, T.C. Chang, and A. Arbabian, "[A mm-Sized Implantable Medical Device \(IMD\) With Ultrasonic Power Transfer and a Hybrid Bi-Directional Data Link](#)," IEEE Journal of Solid-State Circuits, vol. 50, no. 8, Aug. 2015.
- Arbabian, Mohammad Amin, Marcus Weber, and Jayant Charthad. "[Hybrid communication system for implantable devices and ultra-low power sensors](#)." U.S. Patent Application No. 14/276,827.

- [STANFORD ENGINEERS DEVELOP TINY, SOUND-POWERED CHIP TO SERVE AS MEDICAL DEVICE](#) October 14, 2014.
- [Stanford engineers develop tiny, sound-powered chip to serve as medical device](#) Stanford Report, October 15, 2014.

## Patents

- Published Application: [20140336474](#)
- Issued: [9,544,068 \(USA\)](#)
- Issued: [10014570 \(USA\)](#)

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