# Link<sup>TM</sup> 32-channel Recording Implant

Ripple's Link is a fully-implantable device for wirelessly recording up to 32 channels of biopotential data for real-time neurophysiology and neuroprosthesis research. The implant can be combined with a wide variety of electrode types and leads by wire bonding, laser welding, or soldering, and these connections

can be sealed with silicone or similar insulating materials. When the electrodes are implanted, the ceramic body of the Link<sup>TM</sup> is placed subcutaneously to allow access by an external transceiver placed directly above on the skin. During operation, the external transceiver wirelessly powers the implant through inductively coupled coils, and the implant wirelessly returns digitized data via transcutaneous infrared light. This telemetry approach robustly provides power and digital data rates (>20Mbps) sufficient for applications ranging from low-frequency EEG up to raw full-bandwidth signals from microelectrode arrays. The coupling between each implant and transceiver is highly localized, enabling operation of multiple implants in a single



subject, and multiple subjects in the same area. Ripple can provide assistance with electrode bonding and validation, as well as testing data and documentation support for IDE, IRB and other regulatory filings.

# Link-S<sup>TM</sup> 64-channel Stimulation and Recording Implant

Ripple is also developing the 64-channel Link-S system for investigators needing both neural stimulation and recording capabilities. Each channel of the Link-S provides highly configurable and dynamically adjustable waveforms with constant-current amplitudes from 1  $\mu$ A to 2.5 mA and voltage compliances up to  $\pm$  8 V. With proper reference and ground electrode configurations, the neural recording capabilities of each channel can also be quickly recovered following stimulation (as low as 1ms), allowing researchers the option of real-time closed-loop experiments with a single implantable device. As with the Link, the Link-S can be combined with a variety of electrodes for clinical research, and Ripple can provide testing and documentation support for IDE, IRB and other regulatory filings.

#### **Flexible electrodes**

Ripple has developed capabilities for 3D printing of highly flexible electrodes that can be combined with our Link implants or other percutaneous assemblies. In this additive manufacturing process, conductive materials are robotically dispensed to form circuits and electrode sites that are encapsulated by insulating materials dispensed onto a planar workspace. Ripple has materials that have been optimized and tested for robust flexural durability and long-term clinical performance, and these thin structures are highly conformable for cortical and other neurological applications. The process allows customized structures with multiple circuit layers, and economical production at low volumes.





### **Grapevine Neural Interface System**

The Link and Link-S are designed to communicate with Ripple's Grapevine Neural Interface System. This portable platform can digitize signals from a variety of surface and implanted electrode arrays, and process the signals for controlling prostheses and other devices. This system includes both recording and stimulation options for implanted The Grapevine arrays. features Ripple's Trellis software for data visualization and analysis, stimulation control, and system configuration. Investigators can control system performance via a real time MATLAB interface available for clinical research applications.



## **Implantable Medical Device Development**

Ripple was founded in 2004 to commercially develop neurotechnology for clinical research and implant products for small, high-need patient populations. The technologies in the Link and Grapevine research systems have been supported through a combination of NIH and DARPA grants and research product sales, and they are also being developed for use in medical devices for prosthesis users (see diagram below) and patients with a wide range of neurological diseases and disorders.

Ripple is eager to work with investigators as part of the NIH SPARC Public-Private Partnerships program to provide tools for investigators to explore new applications for this technology.

