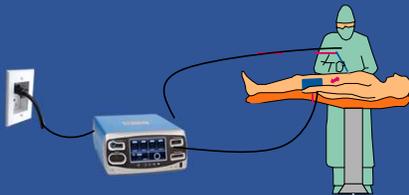


## Background

Electrosurgical generators (ESGs) are the driving force behind modern electrosurgery procedures. ESGs have two delivery methods, monopolar (desiccation and coagulation) and bipolar (vessel sealing). Medtronic's current testing methods do not replicate the clinically relevant loading conditions of human tissues on the ESG



Electrosurgery

**Our goal is to design and manufacture an electromechanical test fixture that realistically loads the ESG**

## Requirements

### Monopolar:

- ✓ Electrode range of motion  $\geq 1$  cm
- ✓ Velocity  $\geq 1$  cm/sec
- ✓ Control electrode position with  $\leq 0.5$  mm precision
- ✓ Eye protection

### Bipolar:

- ✓ Impedance range of 5-500  $\Omega$
- ✓ Min. to max., or vice versa, impedance in 100 ms
- ✓ Control electrode position by 20% of current impedance value
- ✓ Dissipate 300 W for 10 seconds
- ✓ Min. corrosive effects of the saline solution

## Functionality

- Monopolar: Ferrite clamps were attached to the motor power leads to block EMI noise, generated by the monopolar arc, that interfered with motor control
- Bipolar: Empirically derived impedance vs. position model used to generate movement profiles that can mimic a vessel sealing procedure

### Lead Screw Linear Actuator

- Minimize motor RPMs (1 in/rev ACME thread)
- High precision and repeatable
- Durable
- Cost effective

### NEMA 17 Stepper motor

- High precision ( $.016$  mm/ $\mu$ step)
- High torque ( $\geq 5.2$  Ncm at 1500 RPM)
- Native Trinamic driver

### Limit Switches

- Calibration
- Physical limits
- Powered by motor driver

### Delrin parts (electrode arm)

- Electrically isolates actuator
- Lightweight

### Electrode arm carrier

### Tungsten Electrode

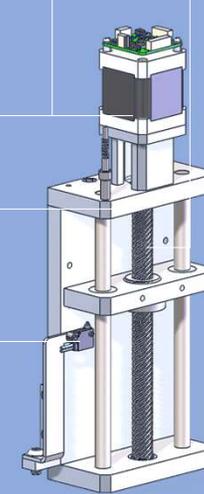
- Durable
- Cheap off-the-shelf parts

### Return Pad

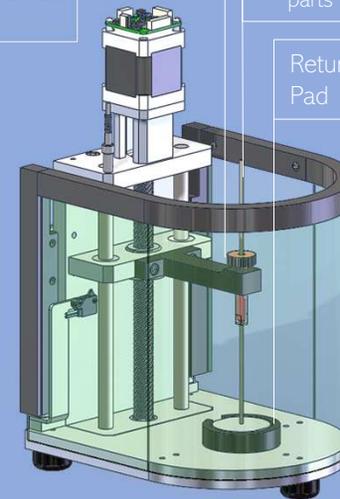
### Tapered Aluminum Tube Electrodes

### Saline solution (.5g/L)

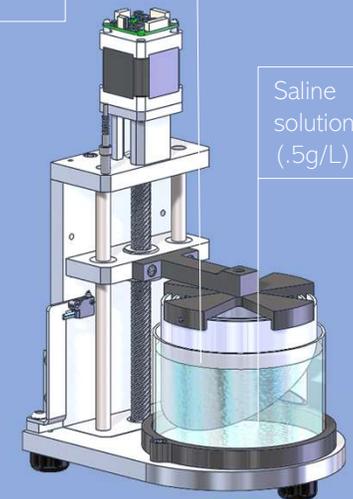
"The tools created by this team will improve the safety and robustness of the Ligasure and Monopolar family product lines which are key to Medtronic's company mission to improve the quality of healthcare"  
- Medtronic's R&D Engineering Staff



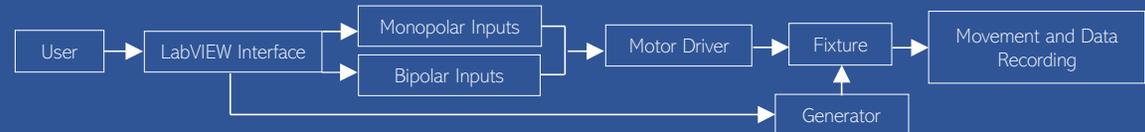
Lead Screw Linear Actuator



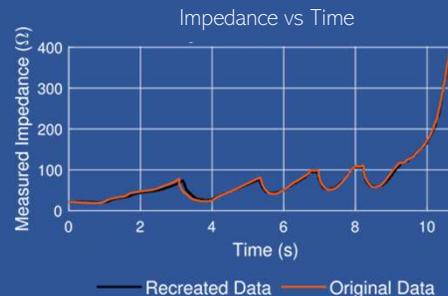
Fixture in Monopolar Mode



Fixture in Bipolar Mode



Control's Overview



Impedance Testing Results

## Lessons Learned and Future Work

- Use CNC programs to manufacture parts that require repeatable high precision
- Perform more thorough research of parts before purchasing
- Use real-time measurements from the ESG to directly control linear motion
- Incorporate baffles in the solution to increase rates of impedance change without turbulence concerns