

Product Design Specifications (PDS)

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Multi-Channel Brain Tissue Stimulator

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Function: Our objective is to develop a multi-channel brain stimulator. This device must generate stimulation current of 250-500 μA on 16 separate channels, filter out external electrical noise, and allow each channel to be independently gated on and off as well as adjust the current amplitude on each channel. Such devices are available but exist as a hardware/software packages and are expensive. These packages include many elements that are not necessary for our client's research.

Client Requirements:

- The device should take a signal from a 16-bit analog to digital converter using a 25-pin parallel connection.
- As the parallel logic data bits are turned on and off, current on the corresponding electrode should be turned on and off. There should be very small lag time.
- The device must be isolated; electrical noise (60 Hz) must be minimized.
- There should be an independent gain adjustment for each channel; the current available on each channel should be adjustable between 0.1 to 10 mA.
- When the data bit is turned on, the corresponding electrode should get a square pulse of current with a very fast rise time. When the data bit is turned off, the current should stop almost immediately.
- The square pulse should have a time length of 25 to 200 microseconds, controlled with the computer.
- The impedance of the electrodes is between 0.2 and 1.2 MOhms on each channel. The top end of this impedance range has been decreased significantly due to a technique known as "electrode activation." This technique is described in detail in the body of this report.

Design Requirements

1. Physical and Operational Characteristics

- a. Performance Requirements: Once the device is charged to full capacity (approximately 5 minutes) each channel should fire independently to its corresponding electrode.
- b. Safety: The user must take safety precautions when using the device by keeping themselves grounded when touching electrical components because of its high voltage. The circuit should be enclosed in a order to prevent arcing of current.
- c. Accuracy and Reliability: Our client's requirements are very specific, and are on the order of milli and even micro. This means that our device must be very accurate and fall within the time range and voltage output range that he has indicated.
- d. Life in Service: The device must be able to send a current pulse for several hours at a time. However, this will not normally be the case. It must also be able to withstand daily use for up to ten years.
- e. Shelf Life: The device should be stored in a dry, moderate temperature. If the device is run using batteries, they should be changed occasionally.
- f. Operating Environment: The device must be kept in a dry environment as the circuitry should not be exposed to water.
- g. Ergonomics: The final prototype must have clearly labeled dials or buttons for each of the 16 channels. They should be easy to manipulate in order to send the stimulation current.
- h. Materials: All the materials used must be able to withstand high voltage. The circuitry should be encased in steel in order to prevent safety issues with the high voltage to the user.

2. Production Characteristics

- a. Quantity: One device is needed with 16 operating channels.
- b. Target Product Cost: No price was set however expenses should be kept to a minimum and should be approved by the client.

3. Miscellaneous

- a. Competition: There are commercial products available that create the current stimulus desired in our proposed project. These products, however, come at a great cost and include many features, as well as software, that is not needed by our client.