

## Operational Description (Theory of Operation)

The HS-Stim is a functional electrical stimulator (FES), designed to generate electrical impulses to cause muscle contraction on an arm to facilitate hand open/close and thumb open/close functions. The electrical pulses are charge balanced, asymmetrical and current controlled. The current pulses can be adjusted up to 40 mA with 1 mA increments. User can generate hand functions such as hand-open, hand close and thumb-close using the “tap” option by gently tapping the HS-Stim unit with his/her unaffected hand. The same functions can also be generated using the Head Motion Sensor, which is an accessory to HS-Stim Unit. The HS-Stim unit also has an exercise option where the hand-open, hand-close, thumb-close functions are automatically applied to the user's hand up to 20 minutes. User can select one of two exercise options for therapy and the HS-Stim unit applies charge balanced pulses according to chosen exercise option.

HS-Stim unit consists of the following components:

**Microcontroller:** for analysis of accelerometer data for tap detection, controlling and maintaining all the external devices and internal peripherals as well as compliance voltage generation and pulse delivery.

**Compliance voltage generator--** necessary for generation of adjustable current pulses.

**Pulse delivery system-** It is used for charge balancing.

**Radio :** operating at 2.4 GHz band, using ANT protocol to maintain a communication link between the HMS and HS-Stim units. Any messages that need to be transferred to HMS unit is passed to communication layer through the processor and gets transmitted by the radio using one of three frequencies in the range of 2403 and 2481 MHz. The operating frequencies are determined during pairing with the HMS unit. The HS-Stim and HMS units both utilize a frequency agility algorithm where the frequency of the communication is changed by both units if congestion is detected in the operating frequency.

**Lithium/ion battery:** for providing power to whole unit. The units are charged with a custom charge dock connected to the mains through a medical grade wall adapter

**OLED-** Used for displaying the menu items.

**Garment-**Used to hold the HS-Stim unit and provide connections to the electrodes.

**Electrodes-** used to make electrical contact to user's skin.