PCB Function List

Device Description

The device is a vaporizer intended to receive two separate cartridges, each having a heating coil with specific resistance value. The device will be able to operate with both simultaneously or individual cartridges inserted alone, through two separate temperature controlled circuits having positive / negative terminals for each cartridge (total of 4 terminals). The device will be vacuum switch activated such that an inhalation will trigger one or both of the inserted cartridges to be heated for a specific time duration, depending on the user settings. The user interface will have two buttons, one to control each cartridge setting. The cartridge settings will be to control the power wattage being consumed by each coil. The device has a female USB-C charge and data port. The device has a door which can be opened and closed by the user, and the device will detect when door opened / closed to provide visual or haptic feedback as described below.

Required Safety Functions

1. All necessary lithium battery protections including overcurrent, undervoltage, overcharge protections.
2. Pass through charging capability to allow device use while charging.
3. Zip charging capability

Coil Firing Functions

1. The device shall operate separate heating coils on separate temperature control logic circuits simultaneously for each cartridge present on the device.
2. The device shall also operate when only one of the two cartridges is engaged on either circuit.
3. PCB should allow for current discharge through one or both of the heating elements up to a combined amount of the safe battery limit discharge current or up to the required discharge current for the temperature control setpoint.
4. Temperature setpoints to be determined through prototype testing, need to allow for manufacturing adjustment.

5. PCB must be able to detect two different ranges of coil resistance, Coil A and Coil B, to allow correct discharge current to maintain the correct temperature setpoints. Coil A and Coil B resistance values will be determined during prototype testing. PCB must be able to control any combination of cartridges inserted (example: Left cartridge and Right cartridge with Coil A, Left Cartridge and Right Cartridge with Coil B, Left cartridge Coil A Right cartridge Coil B, Left Cartridge Coil A, Right Cartridge not inserted, etc.) The two options for coil resistance cartridges may be implemented based on prototype testing requirements.

Device User Feedback Methods

1. The device will have six (6) multicolor LEDs activated by different functions to display different information. LEDs labelled as LD1 LD2 LD3 RD1 RD2 RD3 as per diagram.
2. The device will have one (1) iPhone style “knock” vibration function. This will be used as either 1 “knock” or two “knocks”, time interval 200ms between 2 knocks, need to feel in hand as a noticeable impact style haptic feedback.
3. The device will have two (2) tactile switches for click, multiple click, or click and hold functions. A multiple click (e.g. double click) will be recognized as a second click within 0.1 - 0.5s of the first click.
4. The device will have two (2) vacuum switches to allow activation of the coil firing when inhalation is detected. The sensors should have a high sensitivity to be adjusted during prototype testing.
5. The device will **NOT** have any sound / audio feedback.
6. The device will **NOT** have any tap / accelerometer sensors.
7. The device will **NOT** have any capacitive touch sensors.

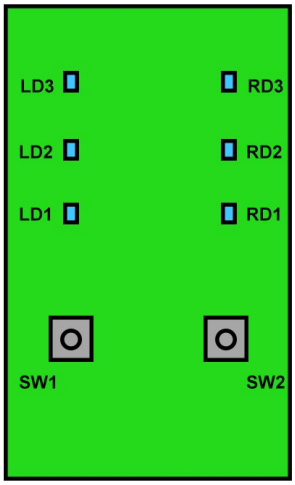

Figure A: Preliminary PCB Layout and Component Layout

User Interaction Functions

Charging Mode

1.
    a. When device connected to or disconnected from USB-C charger, 2 knocks feedback.
    b. Sinusoidal light intensity during charging with amplitude from 0% - 80% brightness, cycle length 3000ms.
    c. Begin sinusoidal light intensity from LED diodes LD1 RD1 in color red for 0% - 33% battery charge.
    d. Begin sinusoidal light intensity from LED diodes LD1 RD1 LD2 RD2 in color yellow for 34% - 66% battery charge.
    e. Begin sinusoidal light intensity from LED diodes LD1 RD1 LD2 RD2 LD3 RD3 in color green for 67% - 99% battery charge.
    f. Turn off all LED lights at 100% charge.

Standby Mode

1. If device is not in charging mode, default to standby mode.
2. In standby mode, no lights displayed and no haptic feedback.
3. From standby mode, the following modes can be entered based on specific user inputs:
    a. Battery Display Mode
    b. Cartridge Settings Menu
    c. Cartridge Settings View Mode
    d. Coil Firing Mode
    e. Door Open / Close

Battery Display Mode

1. When either switch SW1 or SW2 clicked twice (2 clicks) with device on standby, display battery level indication. Create 1 knock feedback.
    a. Sinusoidal light intensity during battery indication with amplitude from 0% to 100% to 0% brightness (0.5 cycles), cycle length 3000ms.
    b. Begin sinusoidal light intensity from LED diodes LD1 RD1 in color red for 0% - 33% battery charge.
    c. Begin sinusoidal light intensity from LED diodes LD1 RD1 LD2 RD2 in color yellow for 34% - 66% battery charge.
    d. Begin sinusoidal light intensity from LED diodes LD1 RD1 LD2 RD2 LD3 RD3 in color green for 67% - 100% battery charge.

2. When any other device mode or menu input detected, interrupt and exit battery display mode.

Cartridge Settings Menu

1. The intended purpose of the device will be to allow the user to create a customized experience of vapor by choosing to insert one or two different cartridges into the device simultaneously, and selecting the desired power level (0, 1, 2, 3) for both the left and right cartridges individually. To achieve this, the following method will be used:
    a. When device on standby mode, battery display mode, charging mode or cartridge settings view mode, holding either SW1 or SW2 for 2000ms will enter cartridge settings menu.
    b. If device is in coil firing mode, cartridge selection menu cannot be entered (Power level 0)
    c. If no cartridges detected, cartridge settings menu will not be entered.
    d. Entering the menu will cause 2 knocks feedback, and all six (6) LEDs will illuminate with blue color during the 2 knocks, 100% light intensity 50ms ON - 200ms OFF - 50ms ON, synchronized 200ms interval with the 2 knocks interval. All LEDs will turn OFF for 200ms after this sequence, and then display the last saved settings with continuous 100% intensity blue light.
    e. Power setting 0, left cartridge: No LEDs
    f. Power setting 1, left cartridge: LD1 100% intensity blue light
    g. Power setting 2, left cartridge: LD1 LD2 100% intensity blue light
    h. Power setting 3, left cartridge: LD1 LD2 LD3 100% intensity blue light
    i. Power setting 0, right cartridge: No LEDs
    j. Power setting 1, right cartridge: RD1 100% intensity blue light
    k. Power setting 2, right cartridge: RD1 RD2 100% intensity blue light
    l. Power setting 3, right cartridge: RD1 RD2 RD3 100% intensity blue light
    m. When left cartridge is detected and menu is entered, SW1 will control the settings adjustment for left cartridge.
    n. When right cartridge is detected and menu is entered, SW2 will control the settings adjustment for right cartridge.
    o. If no cartridge detected in left or right circuit, do not allow settings to be adjusted for that cartridge, display no lights for that cartridge.
    p. One click SW1 will cycle left cartridge settings through one (1) power level in the order 3, 2, 1, 0, 1, 2, 3, 2, 1, 0, 1, 2, 3, 2, 1, 0 for as long as SW1 is repeatedly clicked while inside the cartridge setting menu. For each click, 1 knock feedback.
    q. One click SW2 will cycle right cartridge settings through one (1) power level in the order 3, 2, 1, 0, 1, 2, 3, 2, 1, 0, 1, 2, 3, 2, 1, 0 for as long as SW2 is repeatedly clicked while inside the cartridge setting menu. For each click, 1 knock feedback.
    r. If SW1 or SW2 hold for 2000ms, 2 knocks feedback and settings saved. Cartridge settings menu is exited to standby mode with new settings.

s. If no input detected for 5000ms while in menu, save the displayed settings, exit menu and enter standby mode.
t. If vacuum switch activated while settings menu is open, save the displayed settings, exit settings menu and enter coil firing mode using the saved settings.
u. If no previous settings saved, default power setting 3 for any cartridge present.
v. If any cartridge removed or detected as open circuit, default the cartridge to power setting 3.

Cartridge Settings View Mode

1.
    a. When either switch SW1 or SW2 clicked once (1 click) with device on standby, display cartridge power settings. Create 1 knock feedback.
    b. Sinusoidal light intensity during power settings view with amplitude from 0% to 100% to 0% brightness (0.5 cycles), cycle length 3000ms.
    c. Begin sinusoidal light intensity from LED diode LD1 in color blue for power setting 1 of left cartridge.
    d. Begin sinusoidal light intensity from LED diodes LD1 LD2 in color blue for power setting 2 of left cartridge.
    e. Begin sinusoidal light intensity from LED diodes LD1 LD2 LD3 in color blue for power setting 3 of left cartridge.
    f. Begin sinusoidal light intensity from LED diode RD1 in color blue for power setting 1 of right cartridge.
    g. Begin sinusoidal light intensity from LED diodes RD1 RD2 in color blue for power setting 2 of right cartridge.
    h. Begin sinusoidal light intensity from LED diodes RD1 RD2 RD3 in color blue for power setting 3 of right cartridge.
2. When any other device mode or menu input detected, interrupt and exit cartridge settings view mode.
3. If no cartridges detected, do not enter cartridge setting view mode, display no lights, provides 1 knock feedback.

Coil Firing Mode

1. Coil firing mode is activated by vacuum switch and provides 1 knock feedback when entered.
2. When coil firing mode completed, create 2 knocks feedback and enter standby mode.
3. Coil firing mode begins current discharge to each cartridge coil based on the last saved power settings, within a fixed “inhalation” time period of 3000ms. This “inhalation” time value needs to be adjustable during prototype testing.
4. When Coil firing begins, after first knock feedback, LD1/2/3/RD1/2/3 should illuminate according to the current saved power settings, using the same pattern as during the Cartridge Settings View Mode.
5. The LED brightness intensity will be matching the vacuum intensity, with the minimum cutoff brightness of 30%. For example, when minimal vacuum is detected, the LEDs will immediately illuminate at 30% brightness, and as vacuum increases to above 30% of the sensor range, brightness will match the vacuum % up to 100%. This is to indicate the inhalation strength to the user during the inhalation time period.
6. Power level setting 1, 2, 3 activate left or right cartridge coil for 1000ms, 2000ms, or 3000ms based on the last saved power settings. These time periods need to be adjustable during prototype testing.
7. Temperature control setpoint for power level 1, 2, 3 need to be adjustable during prototype testing.
8. The halfway point of the activated time of 1000ms, 2000ms or 3000ms shall be equal to the halfway point of the 3000ms “inhalation” period as shown in Figure B below.

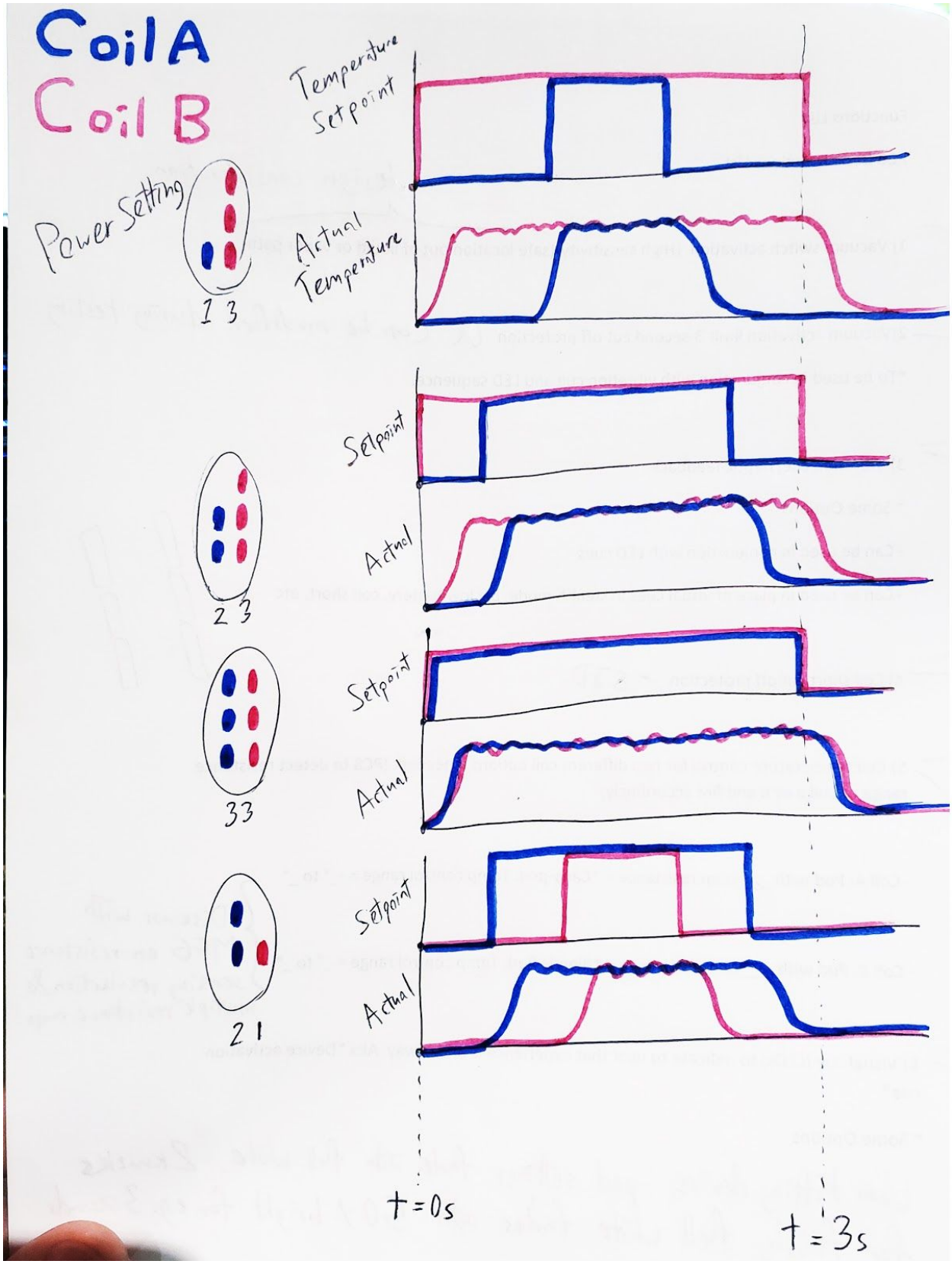

Figure B: Power Level 1, 2, 3 time periods during coil firing mode.

Door Open / Close

1. Door open / close will be detected when pods are detached from the power circuit, because the pods move with the door as it opens.
2. When door open or close detected, 5 knocks and 5 LED pulses.
3. LED pulses will be synchronized with knock intervals, with 50ms ON, 200ms OFF sequence on LD1 RD1 at 100% intensity blue light.
4. Standby mode entered after door opened or closed. If door open, cartridges will be disconnected from PCB, therefore cartridge setting menu cannot be entered.
5. Cartridge settings (Power Level) must remain the same as last saved settings when door open / pod disconnected.
6. Cartridge Settings View Mode and Battery Display Mode shall be accessible when Door is OPEN.