Specifications Document – SBWF01

# Electical System Specification

1. Power Supply
   1. The main power supply of the system will be at least 12 volts, but no more than 24 volts DC. The power supply should be capably of suppling at least 5 amps of current.
   2. The main power supply will be used to feed current directly to the LED display.
   3. A local 3.3v supply for logic is required. This will supply at least 2 amps current. This will power the WiFi/Main controller block as well as the display controller block.
2. WiFi/Controller Block
   1. WiFi connectivity is supplied by a Bluegiga WF121 all in one WiFi module, with internal antenna. The module contains full network stack, so software implementation is not needed.
   2. This module also contains a PIC32 microcontroller that will serve as the main system controller.
   3. The board will break out the PicKit3 compatible in circuit programming header, the module JTAG header, as well as UART serial connection for debugging and programming purposes.
   4. The board will also expose unused GPIOs for debugging and extensibility purposes.
   5. The board will break out an external antenna connector. The module is certified for use with the internal antenna as well as compatible external antenna. External anteanna may be used if reception becomes an issue.
   6. Data sheet for WF121 contains detailed PCB layout recommendations.
3. Display Controller Block
   1. The display controller block will be implemented using a FPGA. The controller will implement a serial interface for setting addressable numbers in 7 segment display mode. Optionally the controller may support a dot mode for supporting other types of displays.
   2. The implementation will target the ICE40 series FPGA by Lattice. Implementation will use the most cost effective, hand solderable package that is capable of implementing the design.
   3. The controller will interface with the LED power drive in a serial mode to conserve pin count.
4. LED Power Driver Block
   1. The LED drive block will provide a logic level interface for switching the main power supply directly to the LED matrix.
   2. The power driver block will implement high side and low side MOSFET switching. Each channel must be capable of sourcing or sinking at least 1 amp.
   3. The block will implement BJT gate drive to ensure complete MOSFET switching.
   4. The block will use standard latching shift registers to implement a 3 wire serial interface. High side and low side blocks can be run in parallel using only 4 wires.
   5. The high and low side drivers will implement 16 channels per side, to allow for extending the display.
   6. The drivers will break out the cascading outputs of the shift registers so that additional modules may be chained together for very large displays.
5. LED Display
   1. The chosen LEDs for the display come in a cutable strip, with 3 LEDs per cutable segment. Each group draws 14.3mA at 12V. These LEDs are current limited by resistors. Using 2 groups per segment, each segment will draw approximately 28.6mA per segment. A display with 13 digits will draw a maximum of 371mA per source channel (each source channel has 13 possible drains), and 200mA per drain channel (each drain has 7 possible sources) . That’s an average of 53mA per source (multiplexed for 13 digits) and 15mA per drain (multiplexed for 7 segments) for this configuration. The maximum average total current for the fully lit display is 371mA. The design allows for larger power supply, up to 24 volts, in case multiplexing results in too dim of a display.

# Physical Specifications

1. Front Panel
   1. The front panel will provide the main structural component as well as a polished cosmetic finish.
   2. The front panel will be black to allow for high visibility of displayed numbers.
   3. The front panel will contain cutouts in which the 7 segment display modules can be seen through.
   4. The 7 segment modules will mount to the back of the front panel.
   5. All electrical components, with the exception of the system power supply, will be mounted to the back of the front panel.
   6. Any descriptive text, team logos, or other graphics will be applied to the front panel.
2. 7 Segment Display Module
   1. The segments will be made of ‘diamond’ shaped plastic compartments where the LEDs will be mounted.
   2. The segments will be covered with a diffuser material to create an even light.
   3. Each segment will have holes where power can be run between segments.
   4. 7 Segments will be arranged into a digit, and wired with a common ground.
   5. Each assembled digit will be mountable to the front panel.
   6. The digits will be wired in parallel along a 7 wire bus to reduce the amount of wire require.
3. Cabinet
   1. The front panel will mount to a shallow cabinet to enclose the wiring and electronics
4. Stand
   1. The main assembly will present as a flat piece and will require legs to be free standing. The unit will stand ‘easel’ style.
   2. The folding stand legs will lay flat for easy storage.

# Software Specifications

1. TBD