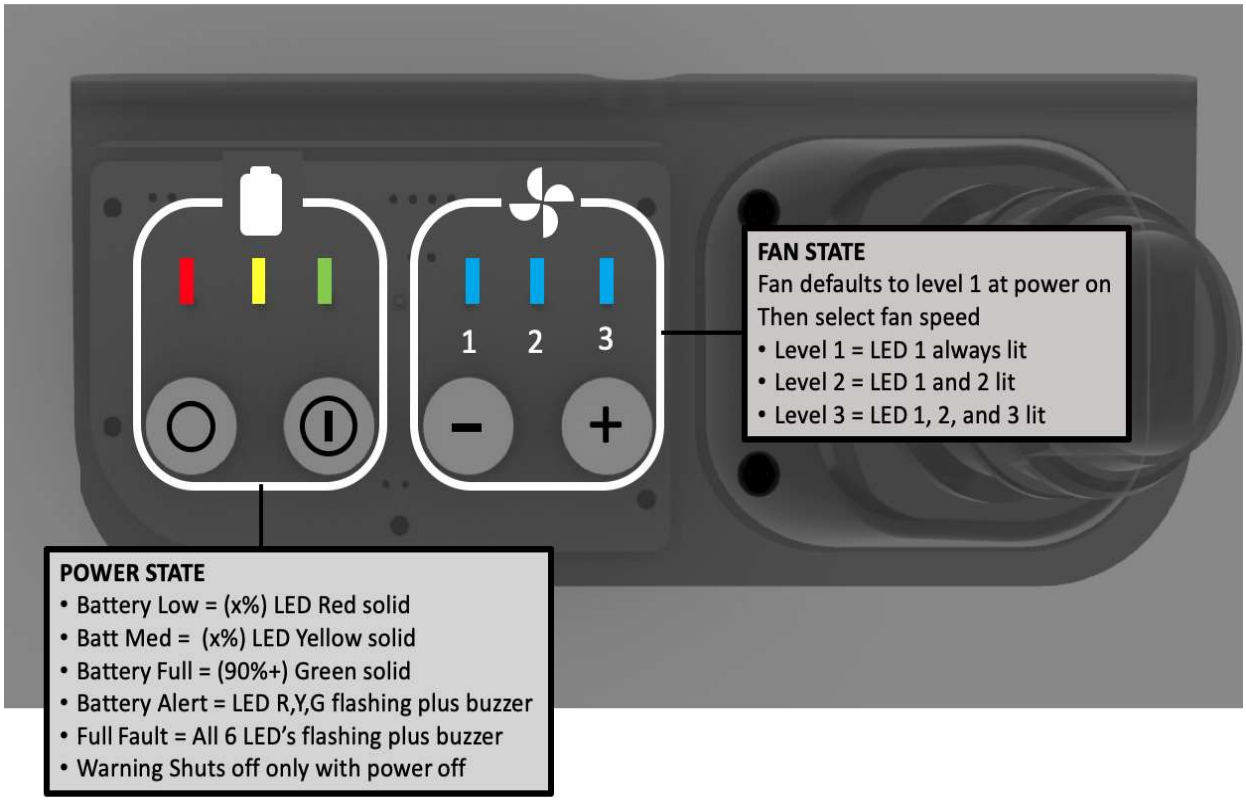
**PAPR Version 1 Spec Notes**
Mark Shepherd 1/12/2021

This document describes all the functionality of the Air-To-All PAPR Firmware, version 1. The description comes from several sources, as follows:

1. This drawing by Sheldon Phillips shows the main features of the UI/UX:




2. The spreadsheet *PQP_P005_PQP_Rev_1B_3_Dec_2020_Rev0.1.xlsx* has some requirements which affect the PAPR firmware:

   Section 12 PCB line 64 "Audible Warnings Responsive to Conditions" - Warnings for low battery and low-flow (if applicable) are triggered as input drops at and below specified input levels.

   Section 12 PCB line 65 "Command Responses are within Tolerances" - Alarms sound within Db tolerances, alarms deliver correct sound to spec's, shut-on and shut-off responses are within time spec's if specified, etc.

3. The spreadsheet *PAPR_Design_Review_8_June_2020.xlsx*, sheet NIOSH Design Requirements has some requirements which affect the PAPR firmware:

   Line 109 - The design must include a low-flow warning. It must actively and readily indicate when flow inside the respiratory inlet covering falls below the minimum air flow defined in §84.175. THIS DOES NOT APPLY to PAPR version 1. See "Additional details" below.

Line 111 - Warning devices must be configured so that they may not be de-energized while the blower is energized.

Line 112 - During use, warning devices must not switch off automatically and must not be capable of being switched off by the wearer.

Line 113 - Any warnings which require different reactions by the wearer must be distinguishable from one another.

4. Additional details:

   On power down the PAPR briefly turns on all the LEDs, and sounds the buzzer.

   There is a “Fault” LED, situated between the 3rd and 4th LED, that is not shown in the drawing above.

   PAPR provides a Low Battery alert and a Fan Speed alert. Currently there is no “Full Fault”.

   The Low Battery alert occurs when the battery voltage drops below a critical level. The Fault LED and all 3 battery LEDs flash, and the buzzer pulses on and off.

   The Fan Speed alert occurs if the fan RPM goes out of the expected range. This could happen, for example, if the airflow is blocked, if the fan malfunctions, etc. The Fault LED and all 3 blue fan speed LEDs flash, the buzzer pulses on and off, and the fan speed alternates between low and medium.

   There is no airflow sensor, therefore no airflow warnings. PAPR will not vary the fan speed to achieve constant airflow. As a result, PAPR version 1 does not meet the N requirements, only HE.

5. Open questions

   Should alert states pulse the fan?

   What are voltage levels for battery low/medium/high?

   What are RPM / dutycycle / airflow for fan low/medium/high?

   Should we have more than 3 fan levels? This is easy to do - each fan LED will represent multiple levels instead of just 1. Up and Down buttons go to the next level, the lights change only sometimes.

   When in alert state (with lights flashing, buzzer buzzing, and fan pulsing), should fan up/down buttons still work?