

Smart Air Quality Regulator

CS335 - Inside the Box: How Computers Work

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What it Does

This project measures Total Volatile Organic Compounds (TVOC) concentration (in parts per million, or ppm) in the air and converts the measurements into an equivalent carbon-dioxide (eCO₂) concentration. Using known levels of CO₂ concentration from the Occupational Health and Safety Administration, the regulator is able to determine if the observed levels of CO₂ concentration are dangerous and flash lights/play sounds to alert those in the vicinity. The different thresholds the regulator can measure are the following:

CO ₂ Concentration (ppm)	Description
250	Background (normal) outdoor air level
350	Typical level found in occupied spaces with good air exchange
1,000	Level associated with complaints of drowsiness and poor air.
2,000	Level associated with headaches, sleepiness, and stagnate, stale, stuffy air; poor concentration, loss of attention, increased heart rate and slight nausea may also be present
5,000	This indicates unusual air conditions where high levels of other gases also could be present. Toxicity or oxygen deprivation could occur. This is the permissible exposure limit for daily workplace exposures.
40,000	This level is immediately harmful due to oxygen deprivation

*Table information from OHS Article, *Carbon Dioxide Detection and Indoor Air Quality Control*

Unfortunately, I was unable to get the “Smart” features of the Regulator working due to time constraints. My goal was to bring internet connectivity to the LPC1768 allowing for emails to be sent to users when harmful levels of CO₂ were detected. The email would have allowed users to better manage a large number of Air Quality Regulators thus allowing for easier air quality control.

How to Run

Press the Reset button on the mbed LPC1768 to start the Regulator. Use the black buttons to increase/decrease the threshold. Observe the various lights, sounds, and output of the Regulator.

- The button to increase CO₂ threshold will turn the LEDs green. The button to decrease turns the LEDs blue. The default threshold is 1000ppm and the threshold cycles through the tiers from the table.
- When the Regulator detects harmful concentrations of CO₂, the LEDs will blink red and a siren will be played.
- The LEDs on the mbed LPC1768 are useful status lights.
 - LED 1 (the LED over the word “mbed”) is lit when the Regulator is warming up. This occurs when first starting the Regulator and during this time, interaction is disabled.
 - LEDs 2-4 indicate various errors within the Regulator. See output for error and press the reset button on the mbed LPC1768 to restart the Regulator.

For a fun test, try blowing into the SGP30 sensor at various thresholds to try and set off the Regulator!

What I Learned

I learned a lot on pulse width modulation as this was how I operated the speaker and warning lights. I got to play around with various periods and duty cycles to get the siren noise observed in the project. Additionally, I played with the I2C serial protocol as the SGP30 sensor relied on this protocol to communicate with the mbed LPC1768.

Equipment Used

mbed LPC1768 Microcontroller

Adafruit SGP30 Air Quality Sensor Breakout - VOC and eCO2

mini metal speaker

4 RGB tri-color LEDs

2 tactile switch buttons

1k Ω resistor

TIP102 NPN transistor