NEXASENSEE

EE40190 Senior Design II

Design Review 3

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Name	NDID
Jeff M. Mwathi	902182754
Katherine Davila	902167325
AnnahMarie Behn	902172819
Kyle Crean	902180910
Jeffrey Yang	902179486

Description of Demonstrated Features Based on System Requirements:

1. Collection of environment characteristics via a sensor suite.
    a. We demonstrate a sensitivity to temperature, humidity, atmospheric pressure, gas concentration, sound, and light based on calibrated or normalized scales. Temperature and humidity are measured in degrees Celsius and percentage relative humidity, respectively. Atmospheric pressure is recorded in hectopascals (hPa), and gas concentration is measured in relative gas resistance (ohms) as provided by the BME680 sensor. Light intensity is recorded in lux. Sound levels are quantified using a 1–10 scale, where 1 represents minimal background noise and 10 represents the loudest detectable sounds. This approach provides a lightweight and consistent way to monitor environmental changes across multiple sensing domains.

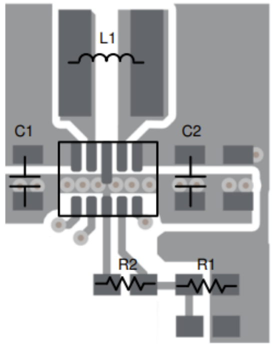
2. Transmission and reception over infrared link.
    a. We show the amplified UART voltage signal measured by the photodiode on an oscilloscope.
    b. We show that information can be transmitted at regular intervals.
        i. The main purpose of this was power maximization.
3. Encoding and decoding of collected data.
    a. We demonstrate successful implementation of (8,4) Hamming codes for encoding and decoding sensor data for transmission over the IR link.
    b. We demonstrate robustness to artificially introduced bit errors.
4. Transmission of decoded data over Ethernet.
    a. We demonstrate that data collected on the receiver hub is transmitted over Ethernet to varied wall ports in Stinson 205.
5. Display of data on a central console.
    a. GUI demonstration, including a data recording feature.
6. Power subsystem and rationale
    a. TPS63802DLAR - DCDC Converter for Transmitter
        i. Steps our input 3.7 V battery down to 3.3 V to match the requirements for our sensors and ESP32S2. (From JST PSR 2 Pin Connector)
        ii.

Table 10-5. Resistor Selection for Typ. Voltages

V_O [V]	R1 [kΩ]	R2 [kΩ]
2.5	365	91
3.3	511	91
3.6	562	91
5	806	91

        iii. Board design requirements based on the datasheet:
            1. Input and output capacitors as close as possible to the IC. Traces short. Wide and direct traces are routed to input and output capacitor, resulting in low trace resistance and low parasitic inductance.
            2. Common ground node is used for power ground. A different ground is used one for control ground to minimize the effects of ground noise. The nodes are connected to any place close to one of the ground pins of the IC.

3. Separate traces for the supply voltage of the power stage and the supply voltage of the analog stage.



iv. **Figure 12-1. TPS63802 Layout**

v. All specific inductor and capacitor models were selected based on the datasheet recommendations.

1. Make zones for copper pour around the traces and components

b. AZ1117CH-3.3TRG1 - Voltage Regulator for receiver

i. Based on the datasheet, following an input voltage of 5 V (that of the USB-C connector used to power the receiver hub) and output voltage of 3.3 V (required by other on-board components, we are using a C_{in} of 10 uF and C_{out} of 22 uF.

ii. This is the same regulator and layout used last semester for our board design projects.

c. LM27762 - Charge pump for receiver

i. The op-amps used in the receiver circuitry require a dual power supply. Based on the datasheet, the LM27762 is an IC that can convert 5V (from USB) or 3.7 V (from a Li-ion battery) to stable ±3V for the op-amps. Additionally, the LM27762 is low noise and thus will not introduce significant noise into the amplified signal.

ii.

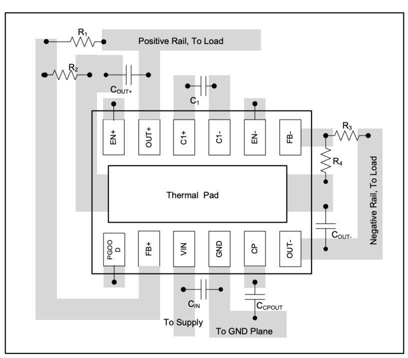
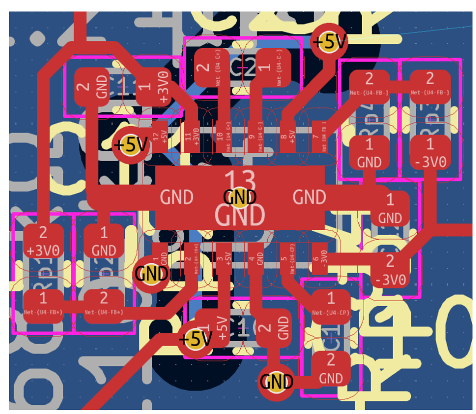


Figure 16. LM27762 Layout Example
(Note: Pullup resistor for PGOOD not shown in example.)



iii. Based on the datasheet, standard X5R capacitors will allow for stable, low-noise supply. Standard 0402 parts are used, as no specific part names are mentioned in the datasheet

d. W5500 Circuitry - Based on the schematic linked here.