ECEN 5833-001

Assignment 3: LTspice and TI simulation assignment

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Part 1: LTSpice

1. What amplitude is the piezoelectric device initially set to?

Answer: 24V

2. What frequency is the piezoelectric device initially set to?

Answer: 41Hz

3. What is the RMS voltage across the piezoelectric device at its initial settings?

Answer: 12.382V

4. What is the RMS current of the piezoelectric device at its initial settings?

Answer: 43.592µA

5. What is the Average power (not RMS) that the piezoelectric device is providing at its initial settings?

Answer: -431.56µW

6. What is the RMS voltage across the piezoelectric device at 48v and 41Hz?

Answer: 18.384V

7. What is the RMS current of the piezoelectric device at 48v and 41Hz?

Answer: 138.32µA

8. What is the Average power (not RMS) power that the piezoelectric device is providing at 48v and 41Hz?

Answer: -2.1643mW

9. What is the RMS voltage across piezoelectric device at 24v and 82Hz?

Answer: 12.384V

10. What is the RMS current of the piezoelectric device at 24v and 82Hz?

Answer: 43.601µA

11. What is the Average power (not RMS) power that the piezoelectric device is providing at 24v and 82Hz?

Answer: -430.96µW

12. What results in a greater change in power delivered to the LTC3588 from the piezoelectric device, amplitude of the AC power waveform or frequency?

Answer: Amplitude of the AC power results in a greater change in the power delivered.

Part 2: Introduction to TI WebBench

1. With your design setup for 'Balanced Optimization'. Hover cursor over the appropriate point on the efficiency and duty cycle charts:

   a. What is the efficiency when the output is at 3.00mA with an input voltage of 2.75v?

   Answer: 90.704%

   b. What is the duty cycle at 3.00mA and a Vin = 2.75v?

   Answer: 1.792%

   c. What is the efficiency when the output is at 3.00mA with an input voltage of 2.4v?

   Answer: 92.182%

   d. What is the duty cycle at 3.00mA and a Vin = 2.4v?

   Answer: 2.756%

   e. What is the relationship of Vin to efficiency?

   Answer: Keeping current constant, as the value of Vin increases, efficiency increases.

2. Now, change the optimization of the design for "highest efficiency design".

   a. What is the efficiency when the output is at 3.00mA with an input voltage of 2.75v?

   Answer: 92.663%

   b. What is the duty cycle at 3.00mA and a Vin = 2.75v?

   Answer: 1.939%

   c. What is the efficiency when the output is at 3.00mA with an input voltage of 2.4v?

   Answer: 93.678%

   d. What is the duty cycle at 3.00mA and a Vin = 2.4v?

   Answer: 2.518%

   e. Is the efficiency optimized design more efficient?

   Answer: Yes

Part 3: Evaluation of TI TPS62160DSGR

1. What are the upper and lower feedback resistors recommended by WeBench?
Answer: Upper FB Resistor: 715kOhm; Lower FB Resistor: 180kOhm

2. Read the Charts to determine: With Vin =11V, what is the efficiency at Iout= 0.1 A?
Answer: 88.018%