Design Project:

Test Data

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### Linear Power Supply – Parameter Test [2]

Recall the Non-Ideal Voltage Supply and DC Voltage Minimum Equation

This test finds the values for and to model this power supply.

1. Power the power supply using 12.5 V from the 120/25V CT transformer.
2. Place an Ammeter between the Unregulated Voltage Out of the Power Supply and the load.
3. Use an oscilloscope across the load to measure the average and cursors to measure the peaks.

Table 1: Linear Power Supply - Parameter Test Data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  | 0 | 16.27 |  | 16.55 | 15.89 |  |
|  | 162 | 15.26 | 5.432 | 16.14 | 14.48 | 0.01024 |
|  | 310 | 14.77 | 3.742 | 15.93 | 13.46 | 0.00797 |

Average = 4.437

Average = 0.009107

|  |  |
| --- | --- |
| Notes: | Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Voltage Regulator – Limits Test [2]

This test collects data on the voltage and current limit ranges.

1. Power the Voltage Regulator with .
2. Place a voltmeter across the Voltage Regulator Output and an ammeter at the input.
3. Measure and record and by adjusting the potentiometer. Ensure the voltage regulating LED is on for both limits.
4. Measure the Quiescent current at each limit.
5. Decrease .
6. Replace the voltmeter with an ammeter. This will short the output.
7. Measure and record and by adjusting the potentiometer. Ensure the current regulating LED is on for both limits.

Table 2: Voltage Regulator -Limits Test Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| 6.85 | 25.03 | 19.19 | 3.60 | 52.75 | 57.40 |

|  |  |
| --- | --- |
| Notes: | Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Voltage Regulator - Voltage Regulation Test [2]

This test validates the operation of voltage regulation at under varying input power.

1. Power the Voltage Regulator with .
2. Place one voltmeter across the Voltage Regulator Output and one voltmeter across the input.
3. Set using the potentiometer.
4. Record the voltage output for each voltage input target.

Table 3: Voltage Regulation Test Data at

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | 30.38 | 14.98 | 15.4 |
|  | 27.00 | 14.44 | 12.89 |
|  | 23.96 | 13.97 | 10.02 |
|  | 20.96 | 13.47 | 7.47 |
|  | 17.97 | 12.92 | 5.06 |
|  | 14.90 | 12.22 | 2.68 |
|  | 11.92 | 11.03 | 0.87 |
|  | 9.04 | 8.47 | 0.54 |
|  | 5.97 | 5.42 | 0.51 |
|  | 3.08 | 2.64 | 0.44 |

|  |  |
| --- | --- |
| Notes: | Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Dynamic Loading Test [4]

**WARNING:**

Do not let the Voltage Regulator overheat.

Take measurements quickly and turn-off between measurements .

This test validates the operation of the voltage and current regulation with varying load.

1. Power the power supply circuit with the 12.5 V from the 120/25V CT transformer.
2. Power the Voltage Regulator with the unregulated voltage and set , and .
3. Add a voltmeter and ammeter to the output along with one oscilloscope probe at the input and another at the output.
4. Record the voltage output, current output, and the input and output ripple.
5. Add two 470 Ω resistors in parallel to the output and repeat step 3.
6. Repeat step 3 and 4 to complete the table.

Table 6: Dynamic Loading Test Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  | 10.0 | 0 | 0.805 | 0.615 |
|  |  | 9.60 | .040 | 1.007 | 0.823 |
|  |  | 9.33 | .072 | 1.410 | 0.823 |
|  |  | 9.09 | .110 | 1.410 | 0.823 |
|  |  | 9.37 | .154 | 1.812 | 0.823 |
|  |  | 8.48 | .180 | 1.811 | 0.823 |
|  |  | 7.24 | .183 | 1.813 | 0.823 |
|  |  | 6.29 | .187 | 2.018 | 0.823 |
|  |  | 5.60 | .189 | 2.018 | 0.612 |

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| --- | --- |
| Notes: | Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Motor Driver Operation Test [3]

This test validates the operation of the voltage and current regulation.

1. Connect the load to the motor driver output.
2. Arrange the meter such that they read positive when = 0.
3. Toggle the signals B, D, and S and record the power in and out.
4. Record any observations in motor behavior.

Table 7: Motor Driver Operation Test Data

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  | 12.38 | 1.62 | 0.599 | 0.49 | 19.76209 | 1.46% | No turning, no brake torque |
|  |  |  | 12.36 | 99.50 | 10.29 | 80.38 | 402.7098 | 67.25% | Motor turns |
|  |  |  | 12.37 | 1.67 | 0.592 | -0.52 | 20.35006 | 1.49% | No turning, no brake torque |
|  |  |  | 12.36 | 117.18 | -9.10 | -100.69 | 532.0658 | 63.26% | Motor turns in opposite direction |
|  |  |  | 12.39 | 1.70 | 0.589 | 0 | 21.063 | 0.00% | Motor Stop hard to turn in one direction by hand |
|  |  |  | 12.39 | 1.70 | 0.589 | 0 | 21.063 | 0.00% | Motor Stop hard to turn in one direction by hand |
|  |  |  | 12.39 | 1.77 | 0.589 | 0 | 21.9303 | 0.00% | Motor Stop hard to turn in the other direction by hand |
|  |  |  | 12.39 | 1.78 | 0.590 | 0 | 22.0542 | 0.00% | Motor Stop hard to turn in the other direction by hand |

|  |  |
| --- | --- |
| Notes: | For cases when the motor isn’t moving. Spin the motor by hand to verify if braking torque is present.  Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Maximum PWM Frequency Test [2]

This test validates the maximum PWM frequency.

1. Connect the load to the motor driver output.
2. Use a function generator to generate a Pulse signal from 0 V to 3.3 V at 1 kHz.
3. Using an oscilloscope, measure S and either M1 or M2 (one will toggle with S).
4. Adjust the frequency to match duty cycle error.

Table 8: Maximum PWM Frequency Test Data

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | 50.0 | 51.4 | 862 |
|  | 50.0 | 52.2 | 1718 |
|  | 50.0 | 54.8 | 4300 |
|  | 50.0 | 57.2 | 6022 |
|  | 50.0 | 60.0 | 8596 |

|  |  |
| --- | --- |
| Notes: | Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Control Signal Current Draw Test [1]

This test measures the current draw from the control signals intended to be provided by the MSP430.

1. Connect the load to the motor driver output.
2. Using an ammeter, measure the current drawn by each signal when high.
3. Have all control signals and the 3v3 input provided by one source. Place an ammeter in series.

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| Notes: | Collaborated with Damon Park, Justin Tan, Data collected by Enze Xu. |

### Photo of the Power Supply [1]

A hand holding a circuit board

Description automatically generated

### Photo of the Voltage Regulator [1]

A hand holding a green circuit board

Description automatically generated

### Photo of the Motor Driver [1]

A hand holding a green circuit board

Description automatically generated

### Photo of the Full System [1]

Several green circuit boards with wires

Description automatically generated

|  |  |
| --- | --- |
| Notes: |  |