PLEASE READ: The purpose of this document is to provide examples of project specification write up. The designs, calculations, values, and any other technical aspects of this document will probably not be suitable for your design.

6.2. AC Rectifier

Overview

The AC Rectifier converts the sinusoidal wall input at $120V_{RMS}$ into DC with 52V on the positive side and -52V on the negative side. The DC output from the Rectifier still has a periodic ripple with maximum peak-to-peak amplitude of 5V when the load is drawing 1A of current.

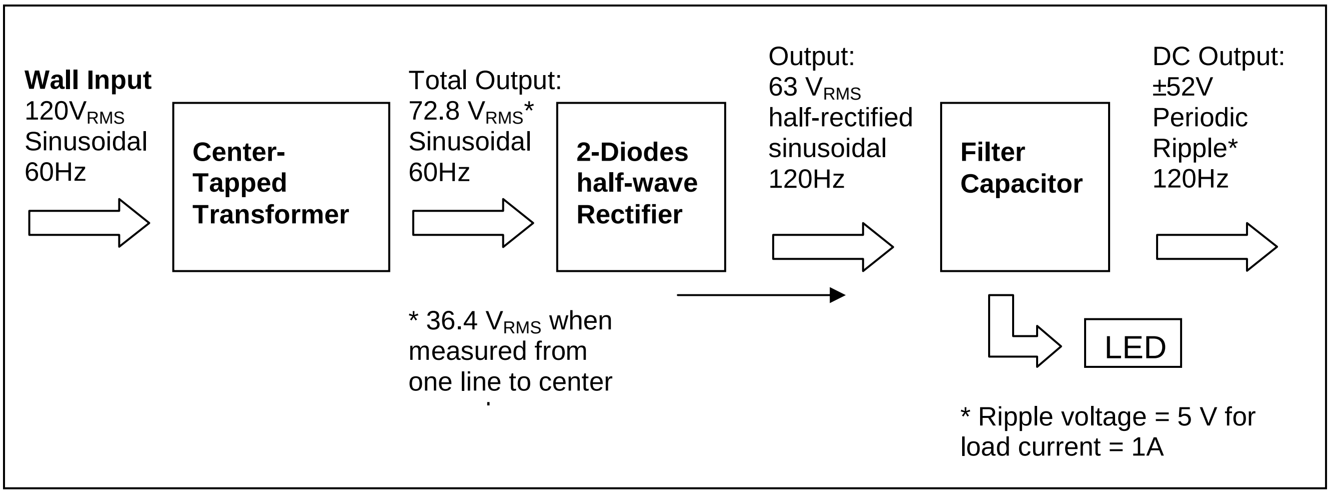

Figure 2: AC Rectifier Block Image

6.2.1. AC Rectifier Interface Definition

Name	Type	Description
AC Input	Input	Frequency: 60Hz Voltage: 120VAC Maximum Current: 1 Amp
V+	Internal Power Output	Nominal Voltage: 52VDC Max current: 1A Max Ripple Voltage: $5V_{pp}$
V-	Internal Power Output	Nominal Voltage: -52VDC Max current: 1A Max Ripple Voltage: $5V_{pp}$
LED	Indicator	ON if power supply is on OFF if power supply is on

Figure 3: AC Rectifier Interface Definition

6.2.2. AC Rectifier Schematic and Theory of Operation

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Figure 4: AC Rectifier Schematic

<u>Explanation of the AC Rectifier Circuit</u>

1. The input to the transformer is a $120V_{RMS}$, 60Hz sinusoidal AC coming from [redacted]

2. The transformer [redacted] ferromagnetic [redacted] on the primary [redacted]

3. The center tapped transformer splits the [redacted]

4. [redacted] rectifier network allows only the positive cycle of the [redacted] the filter capacitor and the load. The current from the negative [redacted] to V-). The [redacted] sinusoidal with a frequency of 120Hz.

5. The center tap wire, or the center ground line, is place between the two [redacted]

6. The increasing half of the full-rectified [redacted] up th [redacted] capa [redacted] load. The cycle continues until the [redacted] and V- [redacted] capacitor.

7. The ripple voltage on the output is determined by the following equation:
$$V_{RIPPLE} = \frac{I_{LOAD}\Delta t}{C} \approx \frac{I_{LOAD}}{2f \cdot C} = \frac{V_{PEAK}}{2f(R_{LOAD}C)}$$
   This equation makes perfect sense because higher load resistance will result a lower load current, and the ripple voltage will be smaller. On the other [redacted]

capacitors will be longer, and the rate of discharge will slow down. The result will be similar to that of increasing load resistance, a smaller ripple voltage. A [redacted] ass filters. T [redacted] he higher fundamental frequencies until only the DC component is left.

8. Base on the ripple voltage equation, we would obtain a ripple voltage of about:

$$V_{RIPPLE} = \frac{I_{LOAD}}{2f \cdot C} = \frac{900mA}{2(60)(15000\mu F)} = 0.5V$$

Therefore the theoretical ripple voltage should be 0.5V base on a load current of [redacted] 5 as an upper bond for uncertainties in the capacitors.

Additional Considerations

- The indicator LED is connected from the V+ node to the ground in series with a 1kΩ [redacted] 5mA and th [redacted] least 720Ω. Therefore, a 1kΩ resistor in this case would suffice.

- There will be source resistance in the wall outlet and in the transformer output. These resistances are modeled in the schematic as Rs1 and Rs2. We estimate [redacted]. Because [redacted] ad, a value would significantly reduce the voltage available across the load.

- The 1N4004 diodes are designed to operate best under an ambient temperature of 80ºC, so that the average rectified for [redacted] forwa [redacted] exce [redacted]