2. In reference to your previous proposed IPO/block model in Modules 1 and 2, design the

appropriate power supply system. Present the following requirements:

• Schematic circuit design

• Computational solution/s for each electronic component, including

justification if necessary.

A diagram of a diagram

AI-generated content may be incorrect.

A Direct Current (DC) voltage regulator takes in an analog voltage signal and converts it into a stable, regulated, DC voltage. This is achieved through various components: The transformer that steps down (or steps up depending on the engineer) a given Alternating Current (AC) voltage to a much lower voltage peak. The rectifier that converts the stepped down voltage into pulsating DC. A Filter which is usually in the form of a capacitor is then utilized to try and smoothen out the rectified DC signal. Lastly, an IC Regulator that would stabilize the filtered pulsating DC into a pure and stable DC ouptut. For this circuit, a step down transformer with a 12 VAC secondary winding would be utilized. The transformer type to be used is a center—tapped, (6-0-6) transformer. The IC Regulator to be utilized is Texas Instruments’ LM1117, 800mA that would output 3.3v. From the revised proposed IPO Model with respect to the tasks from Module 1 and 2, the load would be Espressif System’s ESP32-WROOM-32UE.

|  |  |
| --- | --- |
| 3.3V Regulated DC Fixed Power Supply | |
| Step 1: Transformer -> Rectifier | |
| Transformer Peak Voltage | **Peak Voltage Formula:**  VMP​ = Vm​√2  **Solution:**  VMP **=** 12.0×1.41421356  VMP= 16.97V |
| Calculate VDC | **VDC Formula:**  VDC=0.636×(Vmp​−2Vk​)  **Solution:**  VDC= 0.636×(16.97−1.4)  VDC= 9.9V  **Justification:**  VDC= 9.9V gives enough headroom for the LM1117 to regulate voltage to 3.3v. According to the Texas Instrument LM1117, 800mA data sheet, the dropout voltage is 1.2v at VTYPICAL and 1.3v at VMAX. |
| Transformer Current Rating | **Transformer Current =** 800mA  **Justification:**  According to the Espressif Systems ESP32-WROOM-32UE data sheet, the recommended current delivered by an external power supply to the ESP32 module is 500mA at minimum with the typical and maximum to be desired by the engineer. Since this is the case, an additional 300mA increase would be ample headroom in the case of sudden power draws. Furthermore, the IC to be utilized is rated at 800mA. |
| Step 2: Bridge Rectifier | |
| Bridge Rectifier Details | The Rectifier would host a bridge-type system composing of 4 silicon diodes with 0.7v of voltage drop each. The silicon diode model to be utilized is the 1N4007.  **Justification:**  The aforementioned diode model would be utlized since the diode can survive reverse voltage of up to 1000v. |
| Step 3: Filter Capacitor | |
| Calculate the Capacitor Value (Capacitance) | **Filter Capacitance Formula:**  C= (IT)/V  Where in:  T= 8.33ms (Full Wave)  V= 0.5Vpp  **Solution:**  C= (0.3 x 0.00833)/0.5  C= 0.004998F  C= 4998 μF  **Justification:**  A 25V electrolytic capacitor for safety as the filter should be higher or equal to the VDC. |
| Step 4: Input Decoupling After Filter Capacitor | |
| 0.33µF Film/Ceramic Capacitor | **Justification:**  This functions as a small high frequency component that by passes the ground to remove HF spikes that large electrolytics miss. The voltage rating for this capacitor is also equal to C3 which is 25V electrolytic. |
| Step 5: IC Voltage Regulator | |
| LM1117 Detailso | According to Texas Instruments’ LM1117, 800mA Data Sheet, the LM1117 is a voltage regulator that steps down and regulates a pulsating DC voltage into a stable 3.3V. It’s input voltage max is 20v and a dropout voltage of 1.2V at VTYPICAL and 1.3v at VMAX. Furthermore, it is rated at 800mA.  **Justification:**  Since the load requires a voltage input of 3.3v and also has a current draw of 800mA, the LM1117 serves as the best voltage regulator component that fits the requirements needed to properly run the load. |
| Step 6: Load | |
| Espressif Systems ESP32-WROOM-32UE | From the revised proposed IPO Model with respect to the tasks from Module 1 and 2, the load would be Espressif System’s ESP32-WROOM-32UE. This microcontroller would be utilized for the proposed Room-Level Fire Prediction System that would utilized various components for room fire prediction. According to the Espressif System’s ESP32-WROOM-32UE Data Sheet, the recommended operating conditions of the microcontroller are the following: VMIN= 3V  VTYPICAL= 3.3V  VMAX= 3.6V  IMIN= 500mA  From these operating conditions alone, the following computations and components utilized for the 3.3v Regulated Power Supply are justified. With this, the 3.3V Regulated DC Fixed Power Supply has the following output.  **Vo=** *3.3V*  **Io=** *800mA* |

**References:**

* Espressif Systems. (2021). *ESP32-D0WD-V3 Datasheet*. ALLDATASHEET.COM. <https://www.alldatasheet.com/datasheet-pdf/pdf/1242996/ESPRESSIF/ESP32-D0WD-V3.html>
* Texas Instruments. (2023, January). TI.com. <https://www.ti.com/lit/ds/symlink/lm1117.pdf?ts=1759082277413&ref_url=https%253A%252F%252Fwww.mouser.in%252F>