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**VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY**

**HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY**

**FACULTY OF COMPUTER SCIENCE AND ENGINEERING**

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**EEC REPORT PROJECT**

**Class: CC01**

**Instructor: Nguyễn Thiên Ân**

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| **Student** | **ID** |
| Nguyễn Đăng Duy | 2252116 |

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# Schematic Design

## 3.3V Regulator

A diagram of a circuit board

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## ESP32-WROOM32

A computer circuit board with many wires

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## Slide Switch for the MCU

A diagram of a circuit

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## Current Sensor using TA12 and TA17

A diagram of a circuit

Description automatically generated

## RS-485 and RJ-45

A diagram of a circuit

Description automatically generated

## High Current LED

A diagram of a circuit

Description automatically generated

# PCB Layout

A computer circuit board with many different colored lines

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A red circuit board with many different colored parts

Description automatically generated

A computer circuit board with many different colors

Description automatically generated

A close-up of a circuit board

Description automatically generated

A close-up of a circuit board

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A close-up of a circuit board

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A close-up of a circuit board

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A blue circuit board with yellow dots and small circles

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# Answering the question

***[1] Research on the Internet and list 5 different current sensors that you can find. Along with each current sensor, please (1) give a reference source, (2) maximum current that the sensor can measure, and (3) how to obtain its values (e.g, using ADC, UART, I2C or SPI and so on).***

These are 5 different current sensor that can be found in the market:

* **ACS712 Current Sensor:**

Reference Source: Allegro MicroSystems datasheet

Maximum Current: Typically available in 5A, 20A, and 30A versions.

How to Obtain Values: Analog output, usually interfaced with an ADC (Analog-to-Digital Converter).

* **LEM HAIS 200-P Current Transducer:**

Reference Source: LEM datasheet

Maximum Current: Up to 200A

How to Obtain Values: Typically provides a voltage or current output proportional to the measured current.

* **INA219 High-Side DC Current Sensor:**

Reference Source: Texas Instruments datasheet

Maximum Current: Up to 3.2A

How to Obtain Values: I2C interface, with built-in 12-bit ADC.

* **Allegro ACS758 Hall Effect-Based Linear Current Sensor:**

Reference Source: Allegro MicroSystems datasheet

Maximum Current: Ranges available up to 200A.

How to Obtain Values: Analog output, usually interfaced with an ADC.

* **LEM IT 205-S Current Transducer:**

Reference Source: LEM datasheet

Maximum Current: Up to 600A

How to Obtain Values: Provides a proportional current or voltage output.

***[2] In Figure 1.4, what is the voltage of SW1 when slide switch 1 is ON? and is OFF?***

In Figure 1.4, this circuit is called a pull-up resistor. Pull-up resistors are resistors which are used to ensure that a wire is pulled to a high logical level in the absence of an input signal. So, when the Switch 1 is at ON mode, the SW1 wire would be at low logical signal (approx. 0) and vice versa, when the Switch 1 is at OFF mode, the SW1 will have the high logical signal (3.3V).

***[3] In Figure 1.5, what is the voltage of ADC1\_CH7? of ADC1\_CH6?***

At the ADC1\_CH7, the first op-amp is a voltage follower, so .

Using the voltage divider, we can calculate the at U3B op-amp:

We can apply the voltage divider to calculate the at the U3A op-amp:

While at the U3A op-amp, this is a voltage follower with gain op-amp, so the should be calculated using this formula:

***[4] In Figure 1.5, we apply a low pass filter to the signal ADC\_IN. What is the cutoff frequency of this low pass filter? If we want to set a cutoff frequency is about 10kHz, what should we change in the circuit of U3A?***

The cut-off frequency when applying the low pass filter:

While the capacitor is not easy to replace and change because of its price, we can change the resistor by adding another resistor next to R16 in the figure or replace the R16 resistor with a higher value resistor accordingly.

At 10kHz cut-off frequency:

So, we can add another resistor, or we can change the R16 resistor to a higher value resistor at approx. .

***[5] How much do the currents go through each LED in Figure 1.7? What should we do if we want to control a 100mW LED?***

This LED is a complete diode which includes a rheostat at 330R and a diode, so the LED0 and LED1 should be similar and have the same value. Therefore, we just have to calculate 1 value of LED0 or LED1.

In this case, LED0 is used to calculate the value.

We can calculate the value of , which will be the current through LED0. We will calculate the value of and then, we will calculate the :

To control the 100mW LED, we will assume that Q1 transistor is saturated, the and should have the value at:

We will calculate the voltage at LED0:

Next, in order to calculate , we will need the resistance value of the rheostat:

In conclusion, the currents go through each LED is at , while when controlling a 100mW LED, we need to adjust the value of the rheostat at , the transistor will be in saturated mode, so the current go through the LED should be equal to the .

***[6] What is the main purpose of D2 in Figure 1.6?***

Operating as a reverse-voltage clamp and EMI filter, D2 safeguards the MAX3485. During low RS-485 EN, D2 forward-biases, diverting current from the SVO pin to ground, preventing negative voltage excursions that could harm the transceiver. Additionally, D2's impedance characteristics attenuate high-frequency EMI noise, ensuring clean signal transmission.