

ESTIMATING POWER SUPPLY REQUIREMENTS

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Introduction

In this document I will try to estimate the power requirements of our system, this will include the requirements for the different output voltages and also consider a significant overhead for precautionary reasons.

The +5V Rail

The +5V rail will be majorly used to power the electronics of the board, things such as the STM32F401, ADE7953 and the TFT SPI display (if connected) will be powered from this line after stepping it down from 5V to 3.3V by using a LD1117 LDO voltage regulator. We have not considered the AFE3010 IC here as it has its own rectifier and supply circuitry along with it.

1. STM32F401

The maximum current consumption of an STM32F401 MCU at a voltage supply of 3.3V is given by its datasheet to be **160mA**.

2. ADE7953

The maximum current consumption of the ADE7953 IC is given by its datasheet to be approximately **9mA**.

3. SPI Display

The maximum current consumption of the SPI display considering both the controller and the backlight is about **100mA** at 3.3V.

Considering a 30-35% overhead for components like the charging status signalling LEDs, we get a value of **350mA** from the 3.3V line. Also, at this current the power dissipation value of the LDO has been shown below :

$$(5V - 3.3V) \times 350 \text{ mA} = 1.7V \times 0.35A = 0.595 \text{ W}$$

Thus the +5V rail should supply at least **350-400mA**.

The +14V Rail

This value has been set to 14V specifically to operate the +12V regulator safely considering its dropout voltage of approximately 1.3V (LM2940). Now, the +12V line is used mainly by the Control Pilot Signalling circuit and to drive the main contactor relay.

1.AZEV 200 Main Contactor Relay

The AZEV200 datasheet defines the power requirements for power (both nominal and holding):

Power	(at 23°C)
nominal	2.6 W
holding power	420 mW

So , considering a coil voltage of +12V , this gives us about 216mA of nominal current and 35mA of holding current.

Since these values are for 23 deg. Temperature. We will consider some overhead so lets take 500mA as the power supply requirement for this.

2.Control Pilot Signalling Circuit

The control pilot signalling circuit consists of two major components, the comparator and the voltage divider circuit. The current consumed by the voltage divider circuit will be about 5mA which will flow through the opamp which is being used as a comparator.

For a safe estimate we can take about 700mA as the requirement for this.

The -14V Rail

The -14V rail is first stepped down to a value of -12V using a L7912 voltage regulator , the main purpose of this line is to power the comparator and provide the -12V required for Control Pilot Signalling.

The supply requirements for the -14V Rail are not much as it is only used to provide a voltage for the control pilot signalling comparator. We will take the current requirement to be only 50mA.