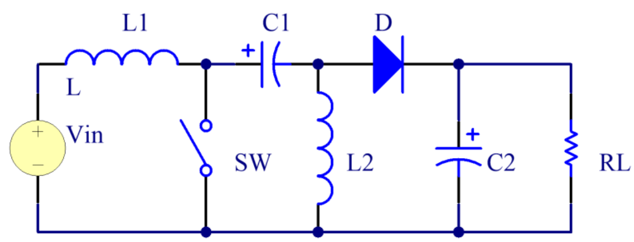
DC-DC SEPIC CONVERTER

The Single-Ended Primary-Inductance Converter (SEPIC) is a DC-DC converter which delivers an output voltage greater than or equal to the input voltage. Its topology consists of two inductances, two capacitors, a diode and a switch whose duty cycle modifies the average output voltage, which we will demonstrate in a later analysis.

The converter topology can be seen in figure below



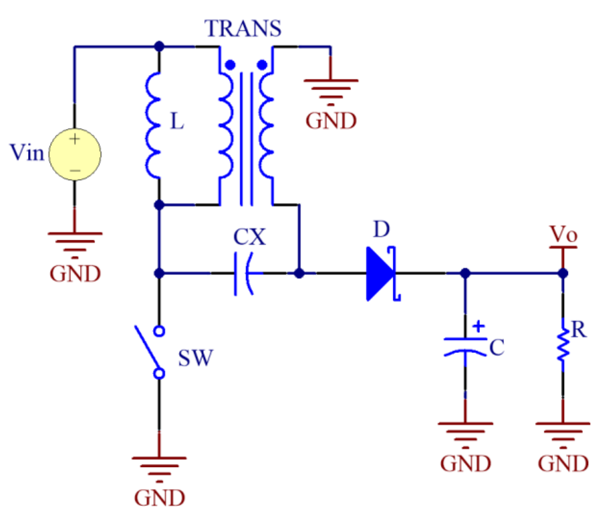
SEPIC converter topology

SEPIC ANALYSIS

Because the inductances in the SEPIC converter can be replaced by a coupled transformer to increase the efficiency and the available area on the printed circuit, we will use a transformer with a 1: 1 turn ratio whose model It is an ideal parallel transformer with a magnetizing inductance.

Figure below nverter efficiency comparison with coupled and decoupled inductors

Taking into account the above, our circuit is as follows:

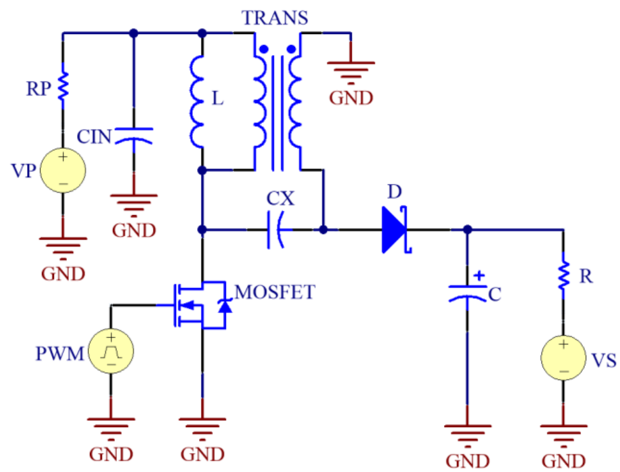


SEPIC converter with 1: 1 transformer as coupled inductors

Because our goal is to power the drive with a solar panel, we will use a decoupling capacitor parallel to the input in order to decouple the panel impedance and thus model the input as a constant voltage source. For the load and input we will use the corresponding models of our project for a proper analysis: the load of the converter is a battery (voltage source in series with a resistor) and the input is a solar panel (voltage source in series with resistor).

The switching will be done by a MOSFET transistor whose gate signal will control its opening and closing.

With the proposed modifications, the converter with which the project will be developed is the following:



Equivalent circuit with panel model and battery

PURPOSE OF THE PROJECT

This work contains the analysis and modeling of the DC - DC SEPIC converter from its topology and the elements that compose it, the control system in its different possible radiation conditions from the solar panel and its way of charging the battery. This method can be carried out in vehicles as a safety measure.

Efficiency tests were carried out at different control currents and it was possible to overcome an 80% efficiency threshold.

The objective of charging the 12V and 7.5 Ah lithium Ion battery to a maximum current of 1000 mA was met, as we are limited by the technology of solar panel.

Two controllers were implemented to charge the battery, which ensure an output power directly proportional to the possible variations of the input (the solar panel).

In order to achieve adequate efficiency and greater stability, an integral proportional type controller with compensation ramp (CPM) was implemented whose reference to be followed is determined by the

MPPT algorithm, with this it was possible to charge the battery first at constant current until it reaches the float voltage and then at constant voltage until the current decreases to a certain threshold.

Further and deeper analysis can be carried out for higher voltages and charging at higher currents.