Mini Project Report

Project on:

Design file for DC-DC converter using C Programming

Submitted By:

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https://github.com/RajeshwariNavalur/M1_DCconverters-UTI-.git

Contents

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1. Requirements

i. Description

Designing or estimating the parameters of various DC-DC converters (buck converter, boost converter and buck-boost converter) based on their input voltage and output voltage which allows the users to analyse all the design considerations of the three converters in a single program.

ii. High level Requirements

- Classifying the converter based on the input and output voltage that is, whether it is a buck, boost or buck-boost converter.
- Calculating the duty ratio.
- Calculating the design parameters such as resistor, inductor and capacitor values.

iii. Low level Requirements

- Mapping the formulas based on the type of converter.
- Calculating inductor current which is further used to calculate resistor, inductor and capacitor values.
- Determining maximum and minimum inductor current.
- Verifying the current ripple using maximum and minimum inductor current.

iv. SWOT Analysis

Strengths

- Making the design process easy for a designer.
- Bringing together the design process of all the converters in one compacted program, instead of having a separate design file for each converter.
- Can be generalized to different converter by changing the basic formulas.

Weakness

- Has to take in many inputs.
- Should be careful about the formulas.

Opportunities

- This simple program can replace a huge design file(excel Sheet).
- Has a huge opportunities in power electronics domain.

Threats

- A slight change in formulas may lead to a huge problem.

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v. 4W and 1H

- It is applicable in power electronics industries while designing DC-DC Converters.
- It is also useful while designing charges for EV Application and other small level application also.
- This project is done in order to replace the design file. (i.e an Excel sheet)
- This is useful while designing a DC-DC converter to calculate parameters.
- This is also used while simulation and verification of the simulation result.

2. Architecture

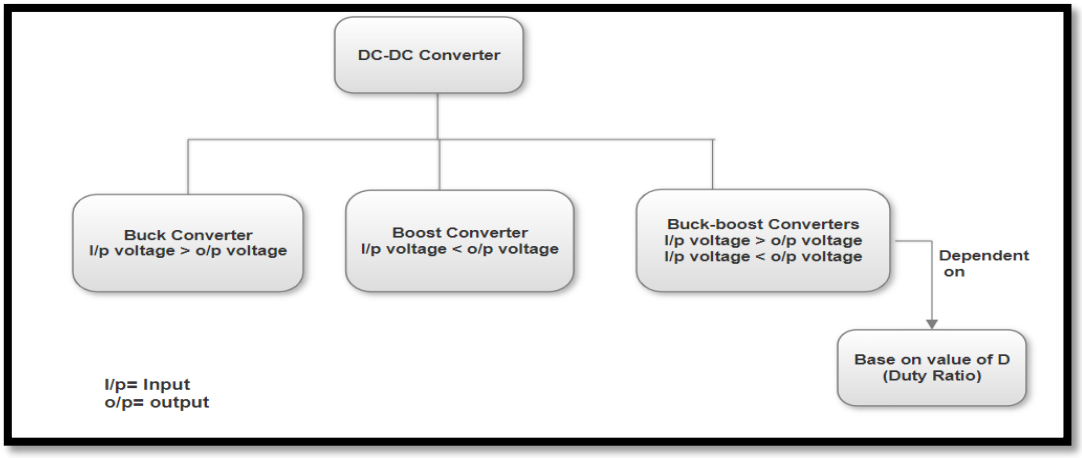

Fig 1. Basic diagram of Project

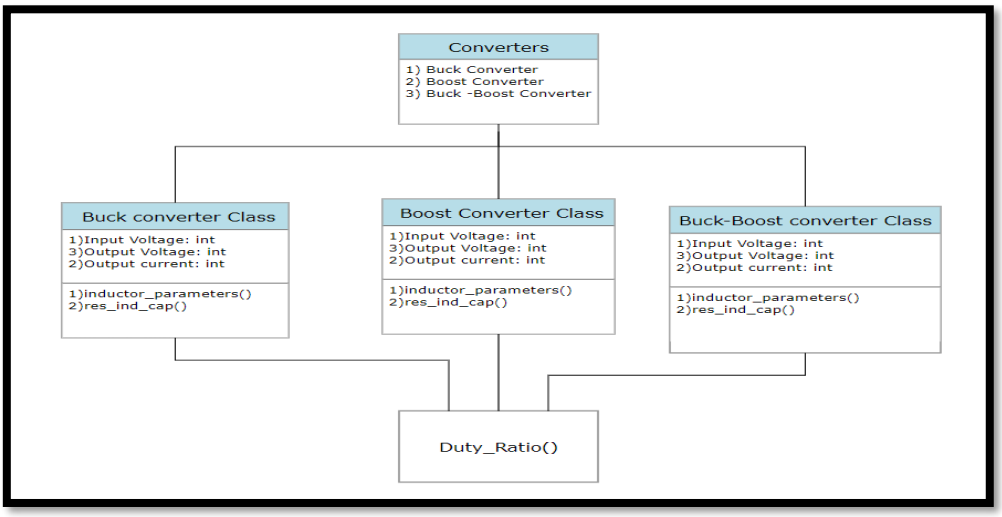

Fig 2. Class diagram

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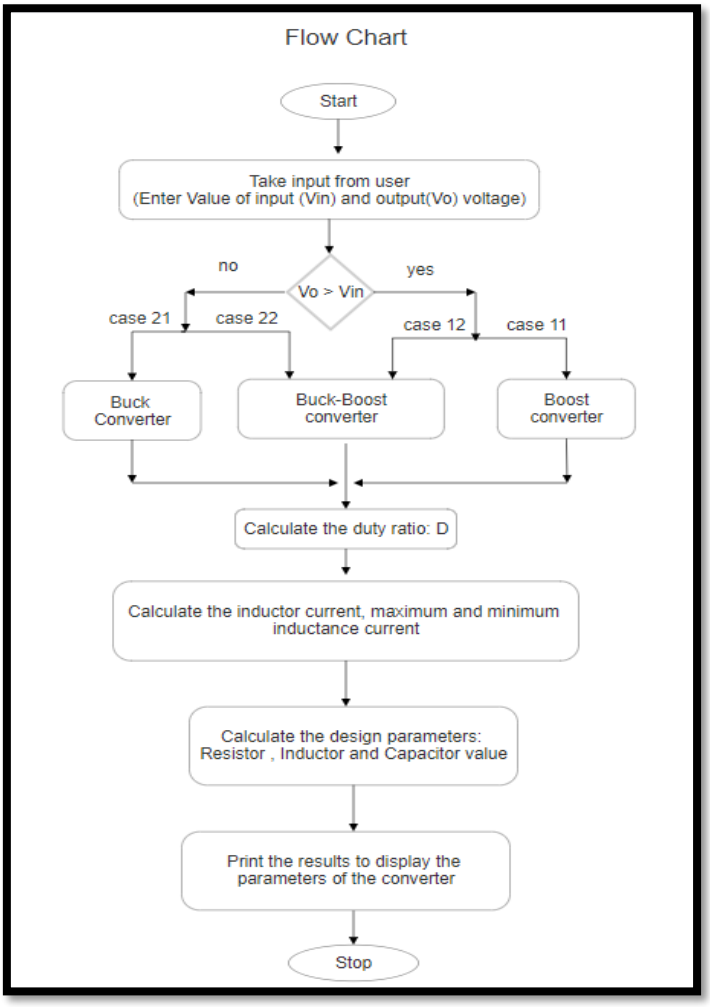

Fig 3. Flow Chart

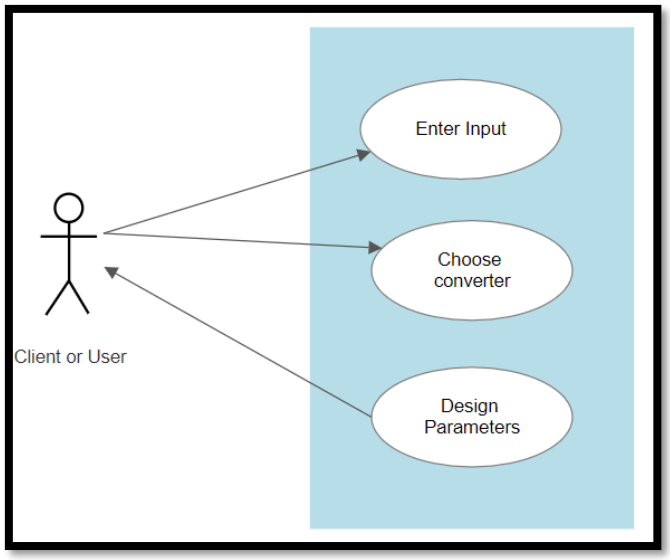

Fig 4. Use Case Diagram

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3. Implementation

i. Code idea

In main function user have to enter the input and output voltage and select the converter based on these values

In the next stem the parameters of converter are calculated as follow:

a) Buck Converter

```
D =vo/vin;
R= vo/io;
Il = vo/R;
Ilmin= 0.25*(Il);
L=(vo*(1-D))*(R))/( (  vo-((R)*(Ilmin))  )*2*f );
Ilmax= bc.Il + (vo*(1-D)/(.L * f* 2));
C=(1-bc.D)/(8*L*(dvo/vo)*f*f);
```

b) Boost Converter

```
  D= 1-(vin/vo);
 R=vo/io;
 Il=vo*io/vin;
 L=R*(D)*(1-(D))*(1-(D))/(2*f);
 Ilmin= (vin /((R)*(1-(D))*(1-(D)))) - ( (vin* (D))/(2*(L) * f) );
 Ilmax= (vin /((R)*(1-(D))*(1-(D)))) + ( (vin* D))/(2*(L) * f) );
 C= (D)/ ((R)*f* (dvo/vo));
```

c)Buck-Boost Converter

```
 D= vo/(vo+vin);
 R=vo/io;
 Il =vin* (bb.D)/((bb.R)*(1-(bb.D))*(1-(bb.D)));
 L= ((bb.R)*(1-(bb.D))*(1-(bb.D))) /(2*f);
 Ilmin = ((vin*(bb.D) )/((bb.R)*(1-(bb.D))*(1-(bb.D)))) - ( (vin* (bb.D))/(2*(bb.L) * f) );
 Ilmax = ((vin*(bb.D) )/((bb.R)*(1-(bb.D))*(1-(bb.D)))) + ( (vin* (bb.D))/(2*(bb.L) * f) );
 C= (bb.D)/ ((bb.R)* f * (dvo/vo));
```

The output will be presented to the user as per the convenient to closely represent a design file(excel file) base on the converter selected

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4. Test Planning

Test id	Description	Input	Expected Output	Actual Output	Type
1	Buck Converter	Vin= 50,Vo= 20 Choice=1 Io= 1, F=20000 Delta Vo= 0.0469	D= 0.4, Il=1 Ilmax=1.751, Ilmin=0.25, R=20, L= 0.0004, C=0.002	D= 0.4, Il=1 Ilmax=1.751, Ilmin=0.25, R=20, L= 0.0004, C=0.001999	Requriment
2	Boost Converter	Vin= 12,Vo= 30 Choice=1 Io= 0.6, F=25000 Delta Vo= 0.01	D= 0.6, Il=1.5 Ilmax=3, Ilmin= 0, R=50, L= 0.000096, C=0.00144	D= 0.6, Il=1.5 Ilmax=3,Ilmin=- 0, R=49.9999, L= 0.000096, C=0.00144	Requriment
3	Buck-Boost Converter	Vin= 24,Vo= 16 Choice=2 Io= 3.2, F=100000 Delta Vo= 0.01	D= 0.4, Il=5.33 Ilmax=10.667, Ilmin= 0, R=5, L= 0.000009, C=0.00128	D= 0.4, Il=5.3333 Ilmax=10.66667, Ilmin= 0, R=5, L= 0.000009, C=0.00128	Requriment

5. Output

```
Enter Input voltage Value12
Enter output voltage Value30
select the converter: 1-boost converter and 2-buck-boost converter
1
Enter output current Value: 0.6
Enter Frequency Value:25000
Enter Voltage ripple Value(delta vo):0.01

BOOST CONVERTER
Input voltage Vin= 12.000000
 output Voltage Vo= 30.000000
duty ratio D= 0.600000
Inductor Current Il= 1.500000
Minimum Inductor Current Il min= -0.000000
maximum Inductor Current Il max= 3.000001
Resistor value R= 49.999996
Inductor value L= 0.000096
capacitor value C= 0.001440
```


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```
Enter Input voltage Value50
Enter output voltage Value20
select the converter: 1-buck converter and 2-buck-boost converter
1
Enter output current Value: 1
Enter Frequency Value:20000
Enter Voltage ripple Value(delta vo):0.00469

BUCK CONVERTER
Input voltage Vin= 50.000000
 output Voltage Vo= 20.000000
duty ratio D= 0.400000
Inductor Current Il= 1.000000
Minimum Inductor Current Il min= 0.250000
maximum Inductor Current Il max= 1.750000
Resistor value R= 20.000000
Inductor value L= 0.000400
capacitor value C= 0.001999
```

```
Enter Input voltage Value24
Enter output voltage Value16
select the converter: 1-buck converter and 2-buck-boost converter
2
Enter output current Value:3.2

Enter Frequency Value:100000

Enter Voltage ripple Value(delta vo):0.01

BUCK-BOOST CONVERTER
Input voltage Vin= 24.000000
 output Voltage Vo= 16.000000
duty ratio D= 0.400000
Inductor Current Il= 5.333333
Minimum Inductor Current Il min= 0.000000
maximum Inductor Current Il max= 10.666667
Resistor value R= 5.000000
Inductor value L= 0.000009
capacitor value C= 0.001280
```

Referances:

- Book: Power electronics

  Author: Daniel W. Hart

  Purpose of reference: Understanding of DC-DC Converter concept and for For

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