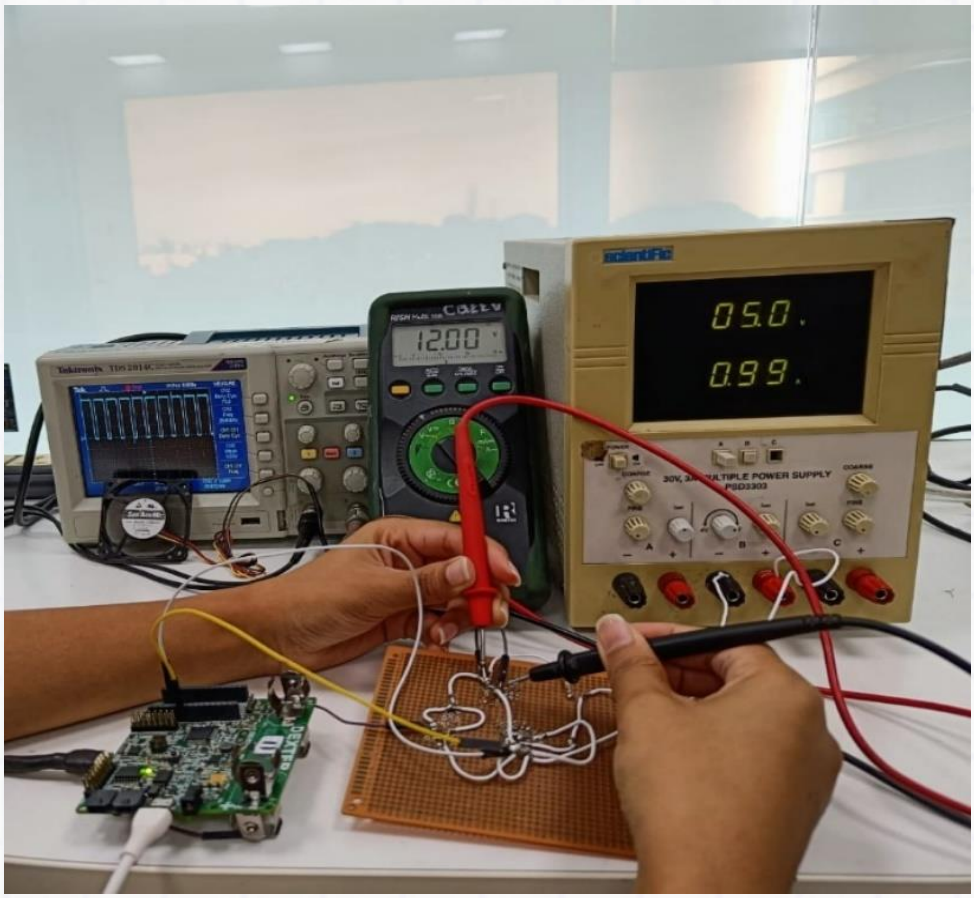
Build a simple low power DC-DC boost converter



Introduction to the course:	Very often a low power boost converter is used to convert low voltage to a higher voltage is required in a system. This build exercise is to learn to build one such simple converter, using an open loop.
What does this course aim to achieve?	• To drive an LED • To drive a single lithium-ion cell from low volt to high volt. • To drive automotive device such as a fan from 5V to 12 V
What is being built in this course:	Boost converter (5V DC input to 12V DC output).
How is it being tested:	Based on the design requirements, the components are mounted on dot board. With the required input supply, the output results are monitored using multimeter.
Course Prerequisites	• Principle of boost converter • Basics of RLC circuits • Soldering techniques

Contents

Prerequisites

Topic	Resources
Soldering technique	https://youtu.be/oqV2xU1fee8
Principle document of DC-to-DC converter manual	Build club website DC to DC project

Aim

Very often a low power boost converter used to convert some low voltage to a higher voltage is required in a system. This build exercise is to learn to build one such simple converter, using an open loop.

Components

Components	**Specification**	**Cost Per Quantity**	**Quantity**
PCB Dot board	10*15cm	40	1
Inductor	1mH	50	1
Capacitor	100-470uf (63V)	25	1
MOSFET	IRLZ24NPBF OR NVMFS6H818NL	160	1
Schottky Diode	STPSC406D OR NXPSC046506Q OR	150	1

	WNSC6D04650Q		
DC Fan (Load)	12V- 0.27A	95	1
Resistor	1K,2K,340K ohm (Through hole)	15	3 Each one
Soldering station (Lead, flux, IP)		250	1
Power supply	5V Phone Adapter	100	1
Connecting wires	26AWG	20	1(meter)
Bread board	400 pins	50	1
Digital multimeter		175	1
Jumper wire Male to male		15	6
Dexter board			1
USB cable	Type B	200	2

Note:

- All the components are reusable after desoldering.
- Measure the resistor values by multimeter.

Inductor

Capacitor

MOSFET

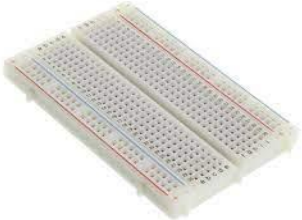
Schottky Diode

Jumper wires

USB cable

Power supply

Resistor



Bread Board

DOT Board

Soldering station

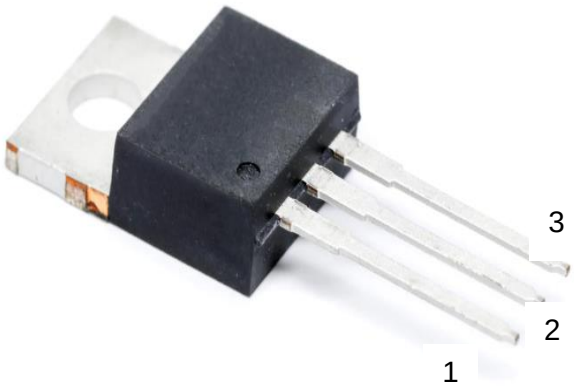
Dexter Board

MOSFET PINOUT:

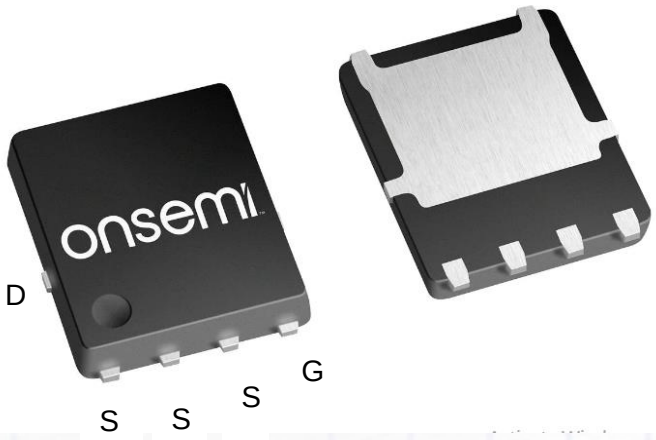
Pin 1 = gate

Pin 2 = drain

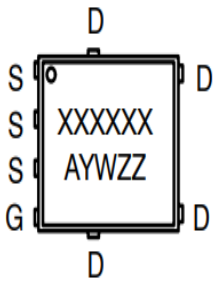
Pin 3 = source



IRLZ24NPBF



NVMFS6H818NL

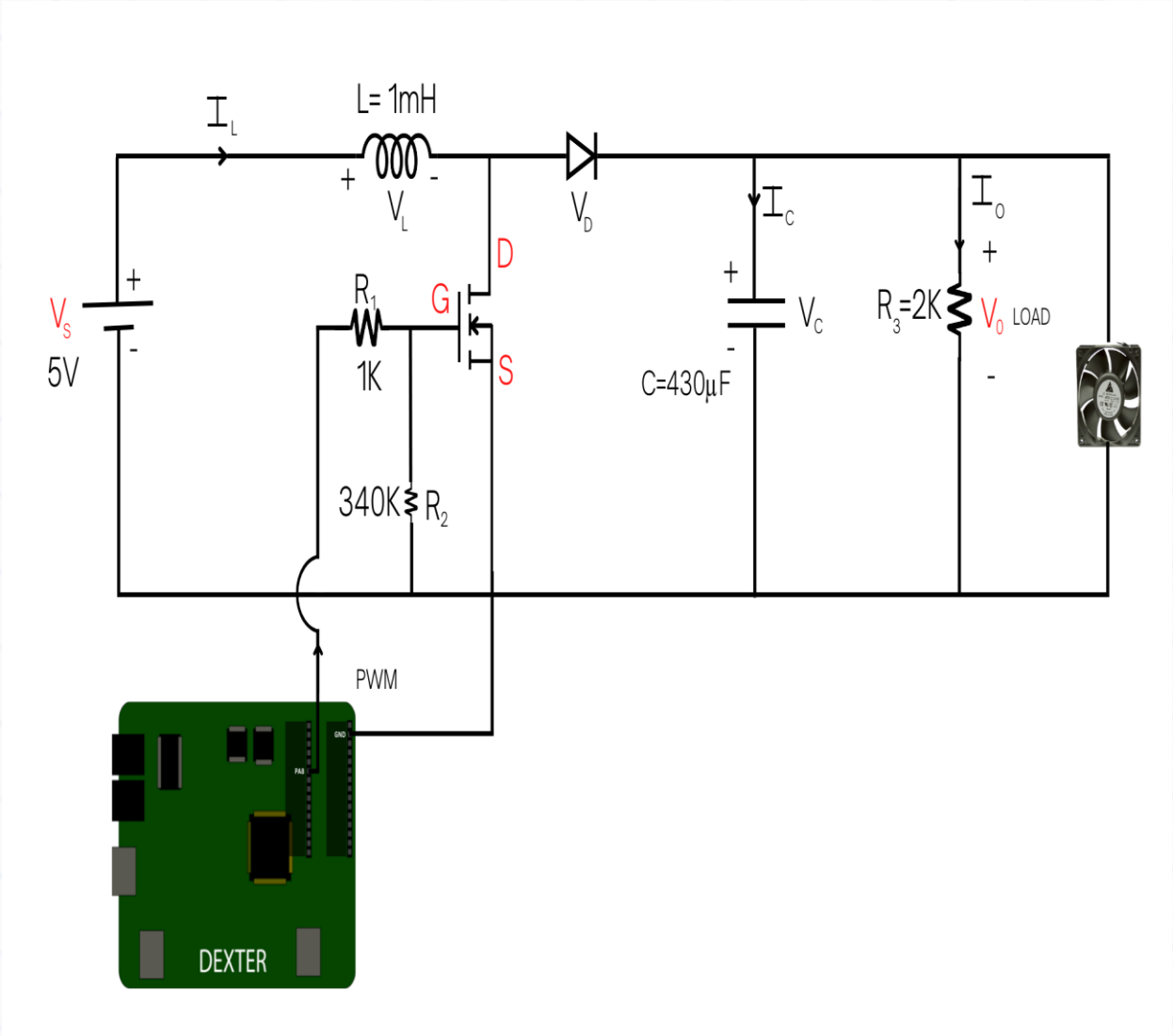


Note: While choosing the MOSFET, check from the datasheet that MOSFET Vgs should be less than 2.5V.

Connections

Circuit Diagram

NOTE: First make the circuit diagram in the Bread board and verify the connection properly once you got the output then only go for soldering. Do not touch the tip of the soldering iron, its temperature can be as high as 380ºC and can cause severe burns. Keep the cleaning sponge wet when soldering.



Detailed Connection Steps

Step 1: Connect or solder inductor, diode, capacitor, MOSFET and resistor on PCB dot board as per the circuit diagram fig1.

Step 2: Set the power supply voltage to 5V or take a 5V phone adapter.

Step 3: Connect or solder positive side (A) of power supply to Inductor leg and negative side of the power supply to the ground (G).

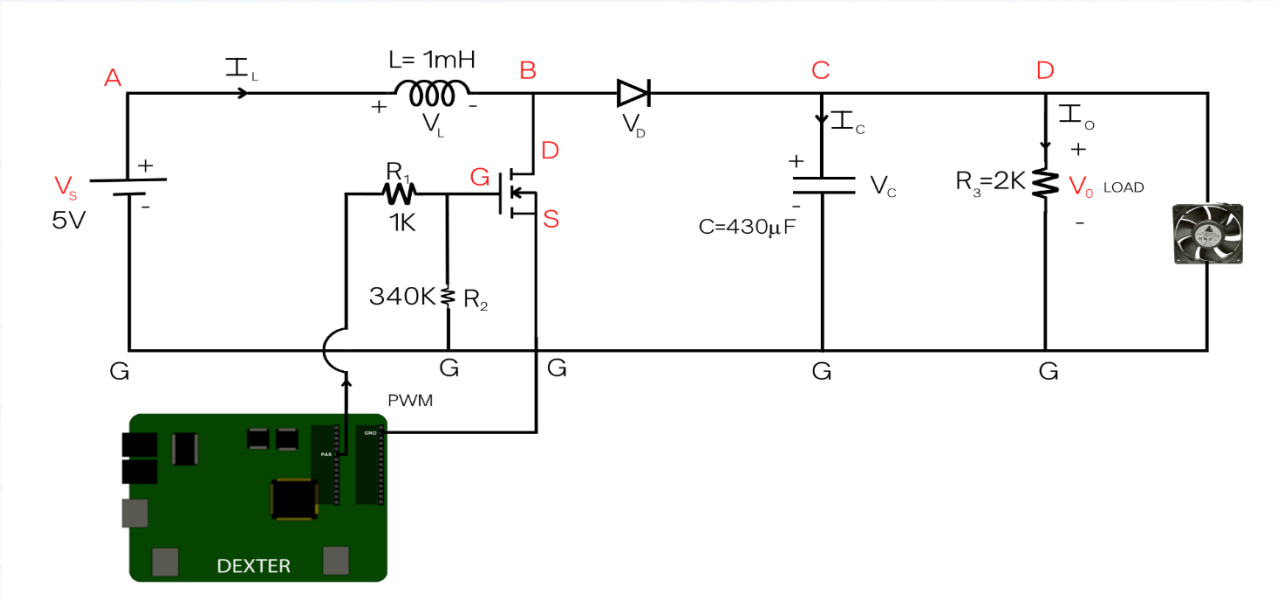


Fig 1.

Step 4: Connect or solder another inductor leg(B) to the drain of the MOSFET(D).

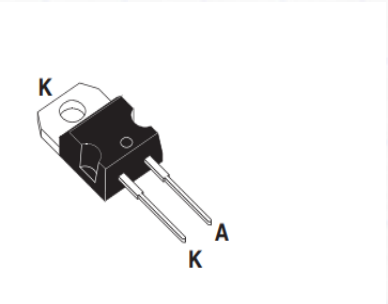
- Connect or Solder one male to male jumper wire to the MOSFET gate and connect another side of jumper wire to PA8 pin of Dexter.
- Connect or Solder one male to male jumper wire to the MOSFET source and connect another side of jumper wire to GND pin of Dexter.

Step 5: Connect 1K resistor between gate of the MOSFET and PA8 of the Dexter board.

Step 6: Connect 340K resistor between gate of the MOSFET and GND of the Bread board.

Step 7: Connect 2K resistor parallel to the capacitor.

Step 8: Connect or Solder anode of the diode to point B. And cathode C of the diode to positive of the capacitor.



K = cathode

A = anode

- Negative side of capacitor to the ground (G).
- Connect (C) with one leg of resistor and another with (G).

Step 9: Connect or solder two male to male jumper wire across the capacitor and connect to the 12V DC load fan.

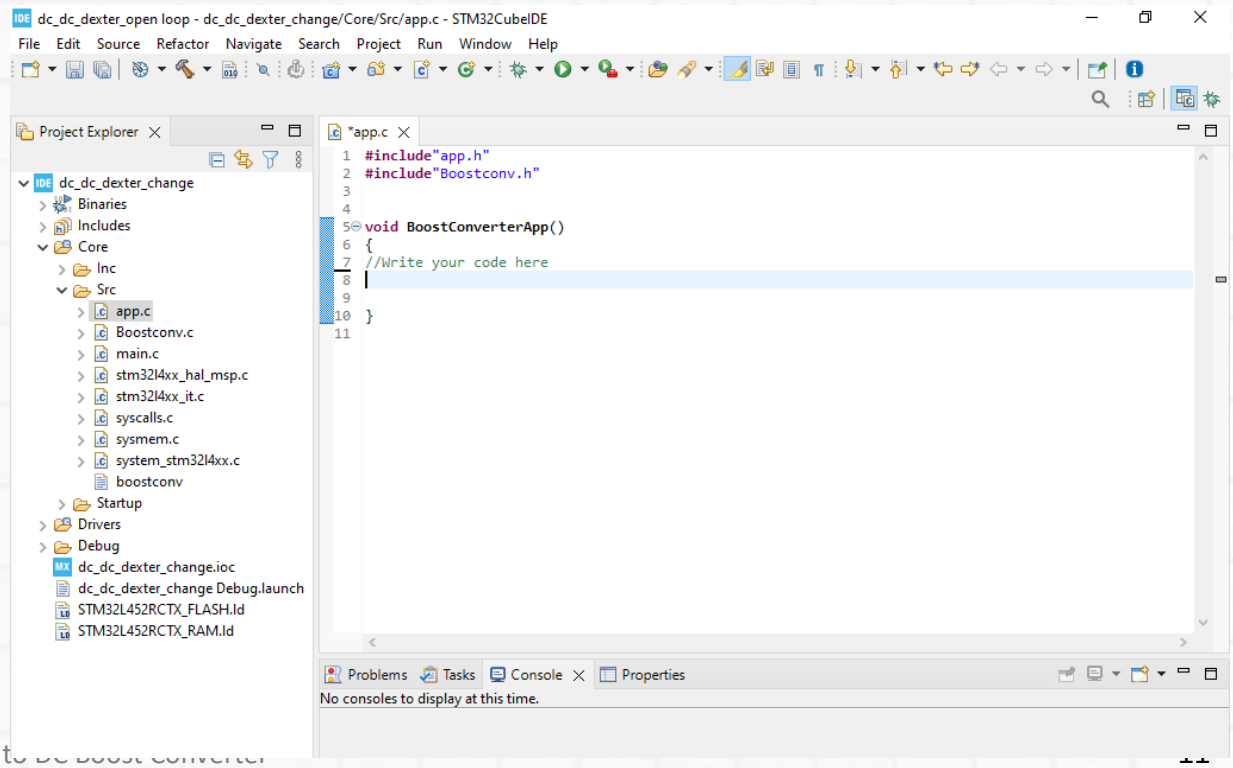
Step 10: Switch ON the power supply and measure the output voltage using digital multimeter across the capacitor.

Step 11: To change the duty cycle write two commands in STM IDE.

Software

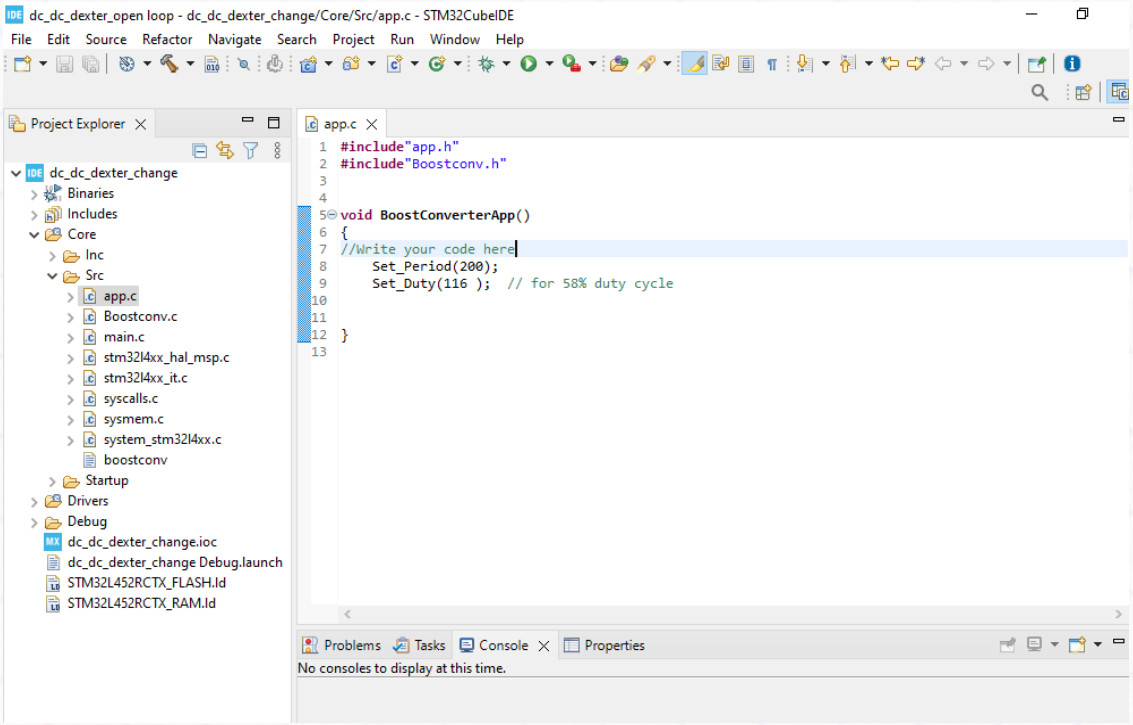
Downloads & Installation

1) Download the Project Workspace file '**dc_dc_dexter_open loop.zip**' given in the project page on the Build Club website.
2) Then go in downloads and extract all.
3) i) Launch the STM IDE, ii) click on Import project iii)Now click on the directory and select the extracted file **dc_dc_dexter_open loop** iv) Click on **dc_dc_dexter_change** then **core** then **src** and then **app.c**



Implementing the Code

Write the following command to change the period and duty cycle and run the code.



- The **Set_Period( )** function allows you to change the frequency.
  To change Period = $\frac{\text{system clock frequency}}{\text{required frequency}}$

  Note: system clock frequency will always be 4MHz

  Example: Change frequency to 20KHz

  $$\text{Period} = \frac{4\text{MHz}}{20\text{KHz}} = 200$$

```
Set_Period(200);   // for 20KHz frequency
```

- The **Set_Duty( )** function allows you to change the duty cycle.

To change Duty = period ×(%percentage of duty cycle)

Example: Change duty cycle to 58%

Duty = 200*(58/100)

= 116

Set_Duty(116); // for 58% duty cycle

Hurray you have learnt how to drive a boost circuit!!!!!!!

Tasks: for open loop

1. On the same boost converter change the duty cycle 50%, 60% and 70% keeps the frequency 20Khz and measure the voltage.
2. Measure the output voltage keeping R =12ohm. Compute the expected voltage using mathematical formula for each of the duty cycle. Check measure voltage and compute voltage are matching.

Exercise:

1. Calculate the losses and the efficiency using the formula.
2. Make a graph
    - between ripple voltage and duty
    - between ripple voltage and load