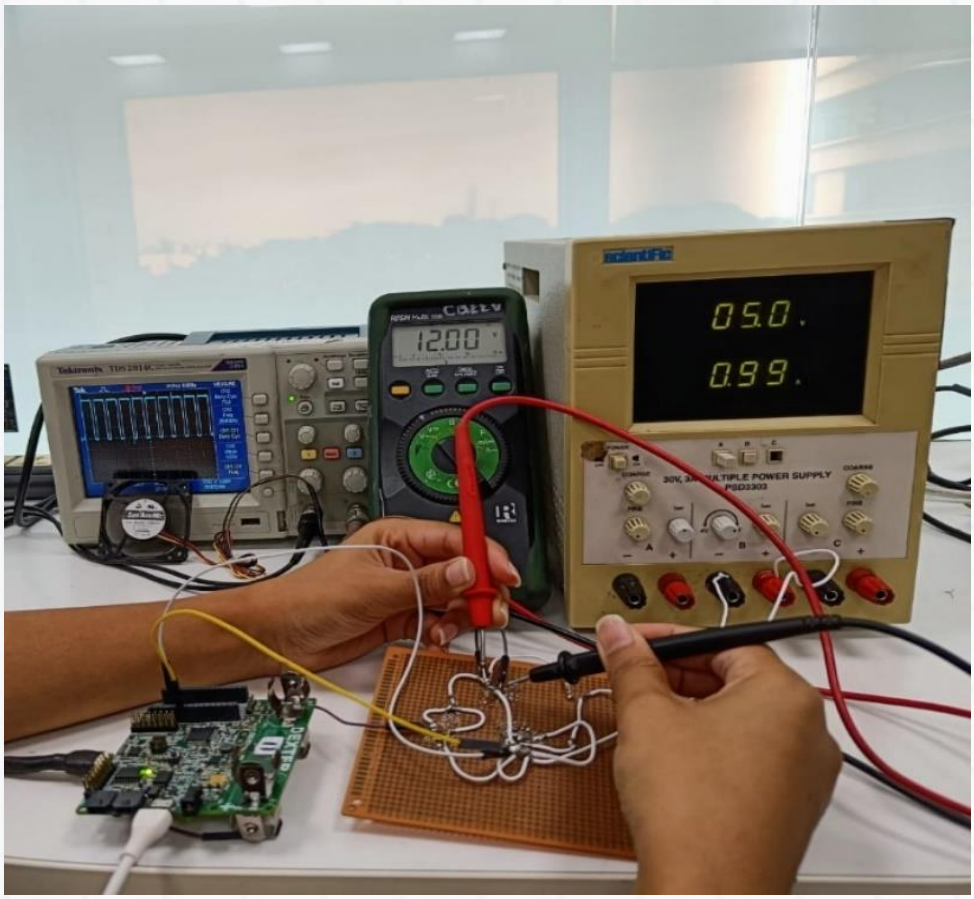
# Build a simple low power DC-DC boost converter



| | |
|---|---|
| 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<br>• To drive a single lithium-ion cell from low volt to high volt.<br>• 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<br>• Basics of RLC circuits<br>• 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<br>OR<br>NXPSC046506Q<br>OR<br>WNSC6D04650Q | 150 | 1 |
| 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) |
| 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

Power supply

Resistor

DOT Board

Soldering station

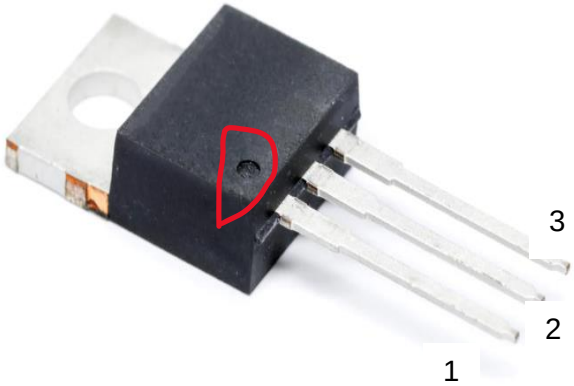
Dexter Board

## MOSFET PINOUT:

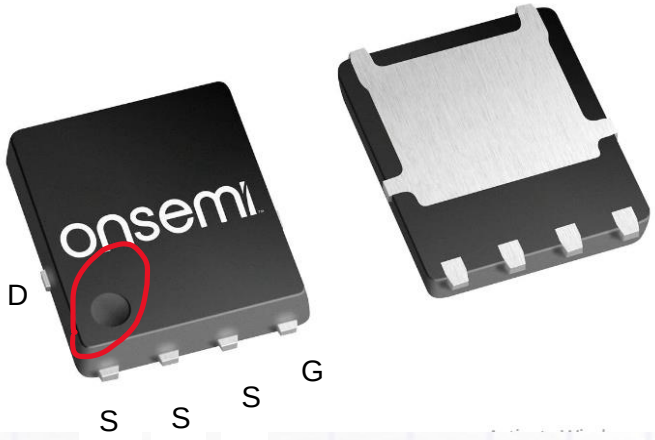
Pin 1 = gate

Pin 2 = drain

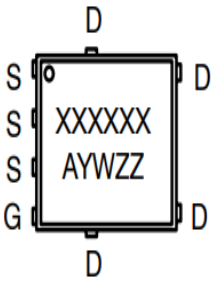
Pin 3 = source




IRLZ24NPBF




NVMFS6H818NL

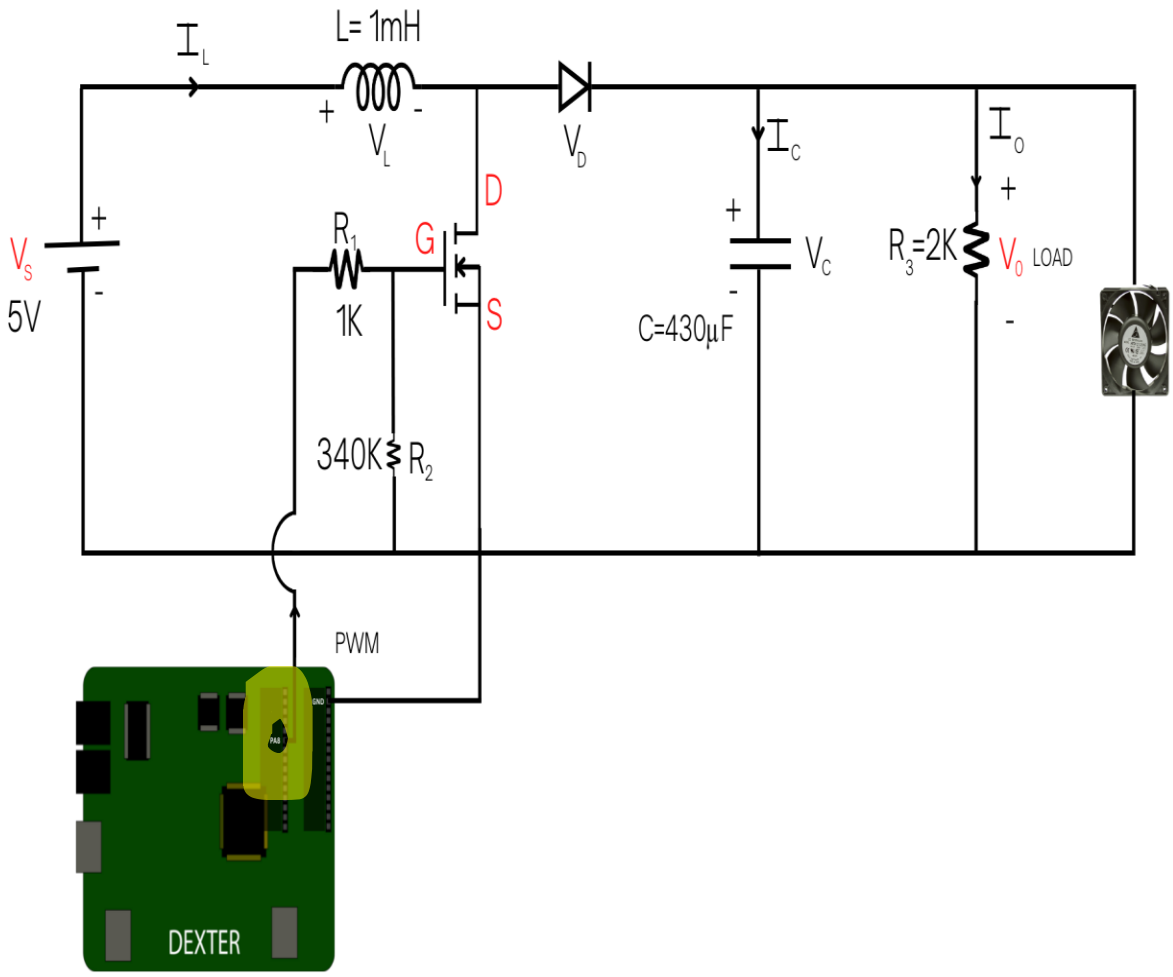


Note: While choosing the MOSFET, check from the datasheet that MOSFET Vgs should be less than 2.5V.

## Connections

Circuit Diagram

**NOTE**: Do not touch the tip of the soldering iron, its temperature can be as high as 380°C and can cause severe burns. Keep the cleaning sponge wet when soldering.



## Detailed Connection Steps

**Step 1:** 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:** Solder positive side (A) of power supply to Inductor leg and negative side of the power supply to the ground (G).

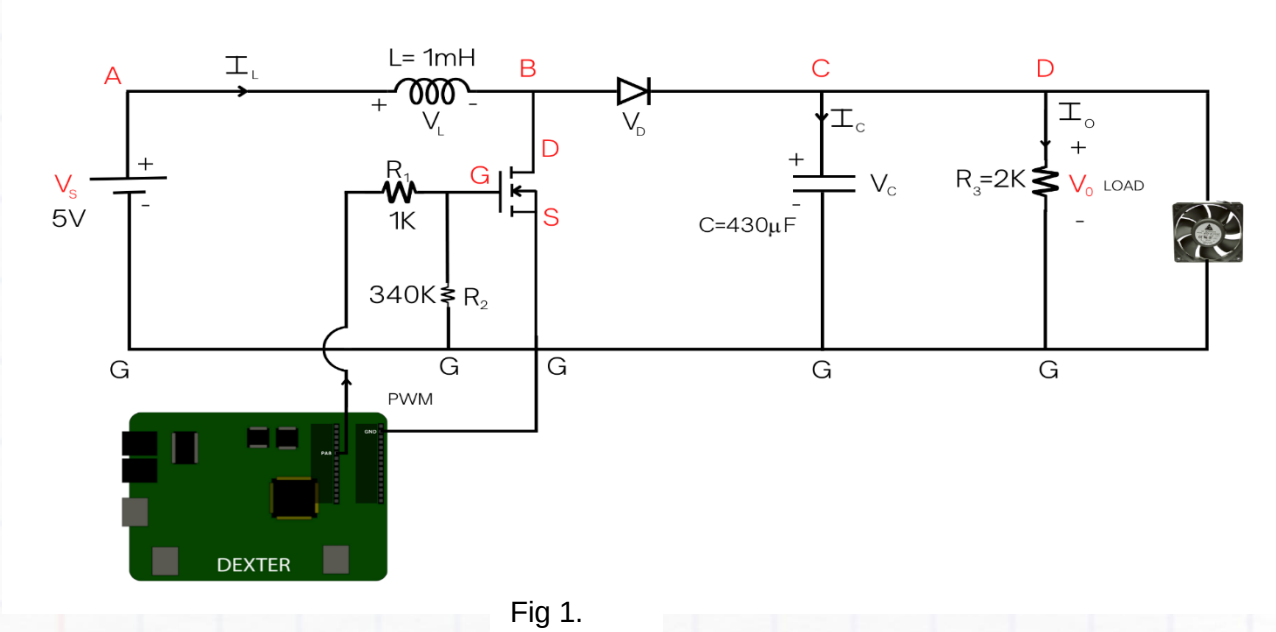
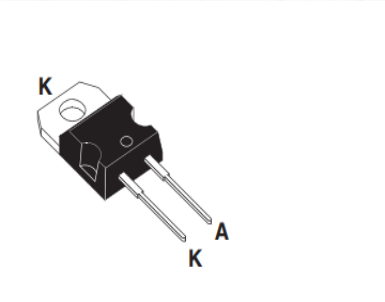



Fig 1.

**Step 4:** Solder another inductor leg(B) to the drain of the MOSFET(D).

- Solder one male to male jumper wire to the MOSFET gate and connect another side of jumper wire to PA8 pin of Dexter.
- 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:** 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 6:** Solder two male to male jumper wire across the capacitor and connect to the 12V DC load fan.

**Step 7:** Switch ON the power supply and measure the output voltage using digital multimeter across the capacitor.

**Step 8:** To change the duty cycle write two commands in STM IDE.

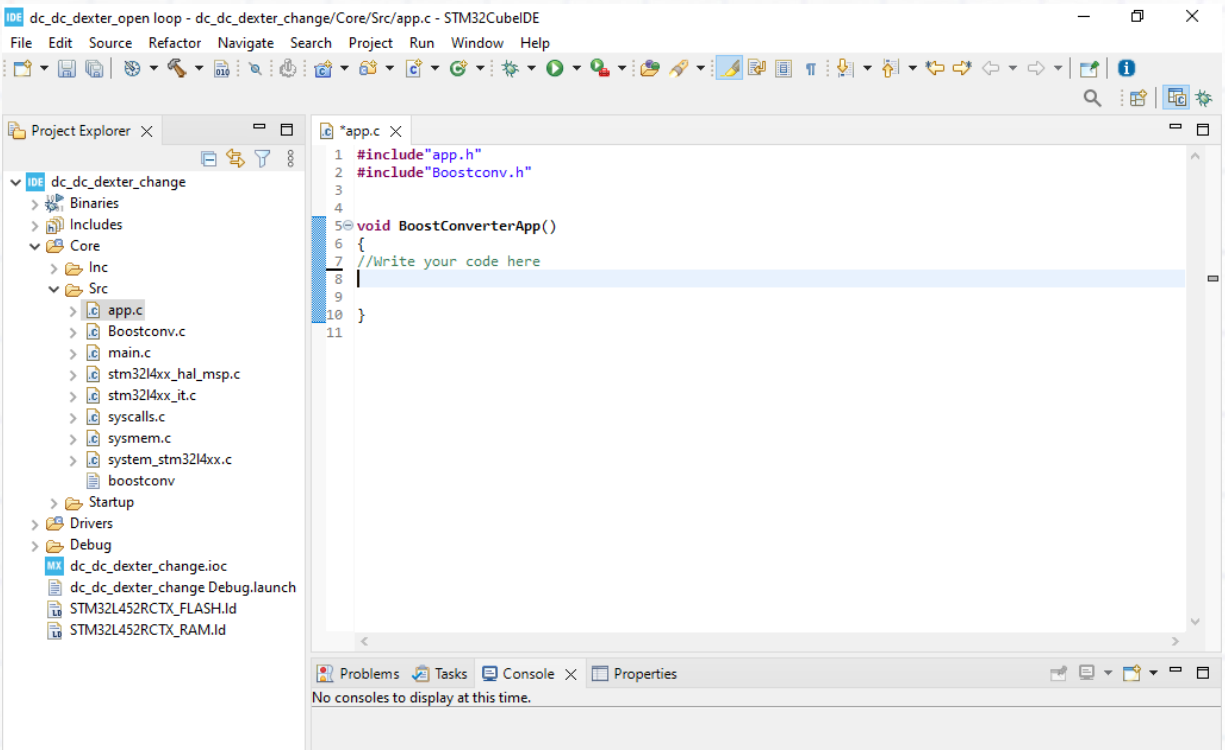
## Software

### Downloads & Installation

1) Download the Project Workspace file '**dc_dc_dexter_open loop.zip**' given in the project page on the Build Club website.

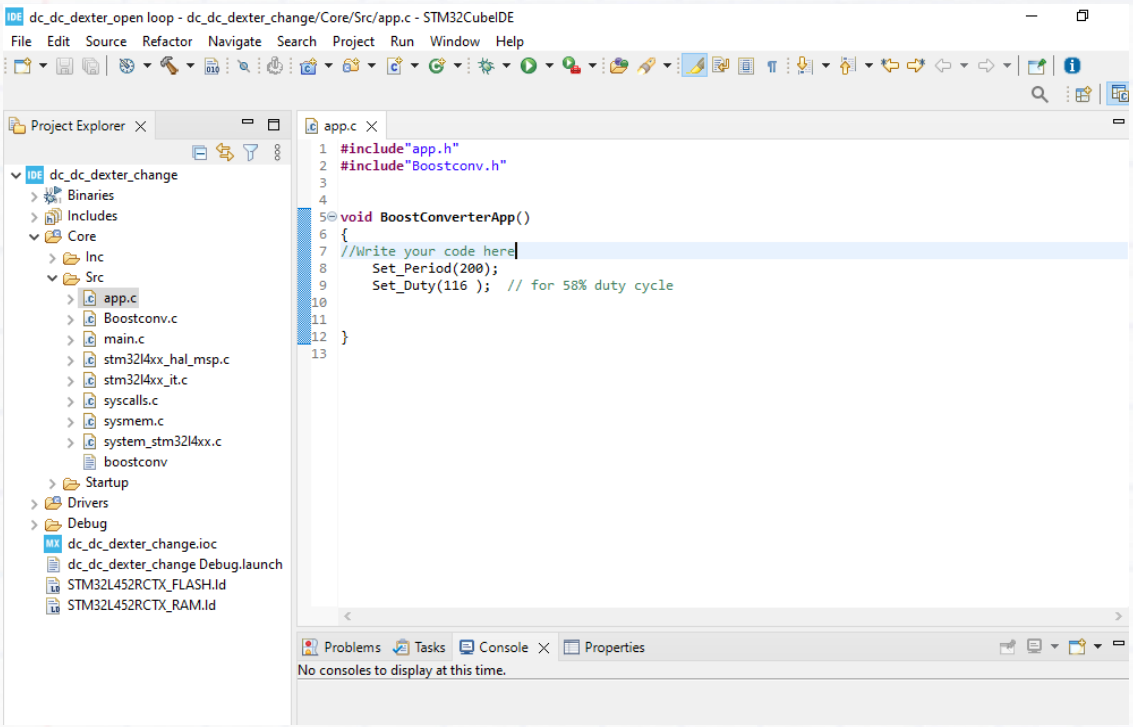
2) Then go in downloads and extract all.

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