

Project DC-DC Boost Converter

Boost Converter

a) Specifications: Input 10 V, Output 15 V, Switching frequency 15 kHz, Output current 1 A.

Waveforms of Inductor current and switch voltage in CCM.

b) Increase load resistance to demonstrate DCM.

1. Drive Circuit: The TL494 PWM generator IC

We will be using the TL494 board (courtesy: EE - IIT Dharwad), for generating the pulses for the DC-DC PE converters. The first step is to solder the components carefully, solder the IC holder first and not the TL494 directly !

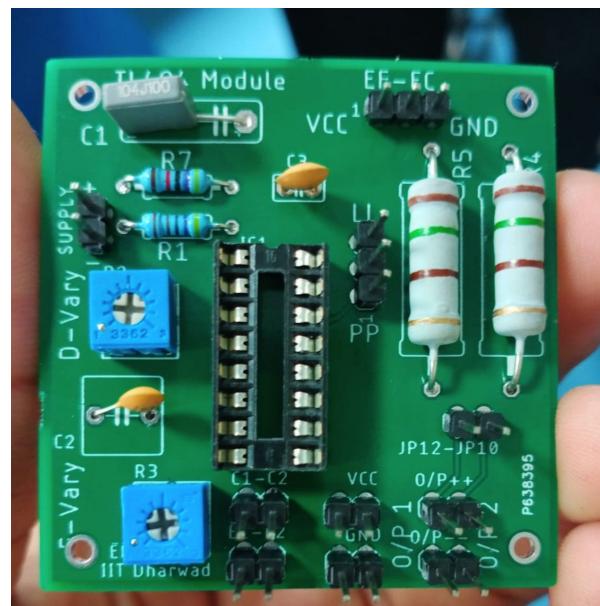
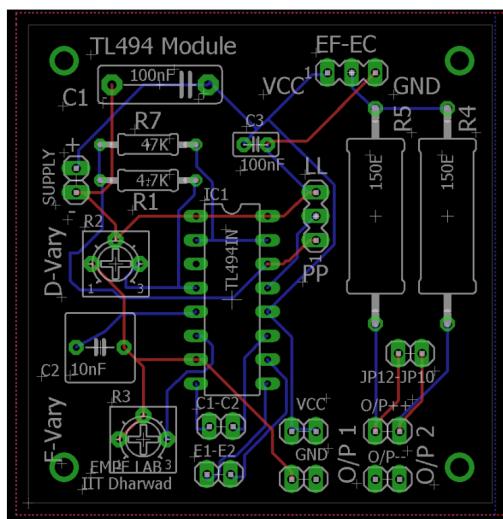


Fig: Schematic and Sample pic of board after soldering the components

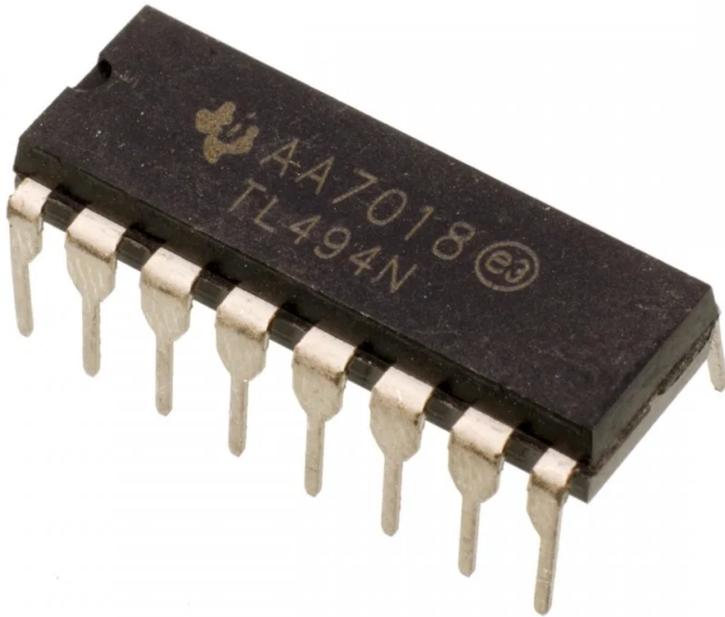
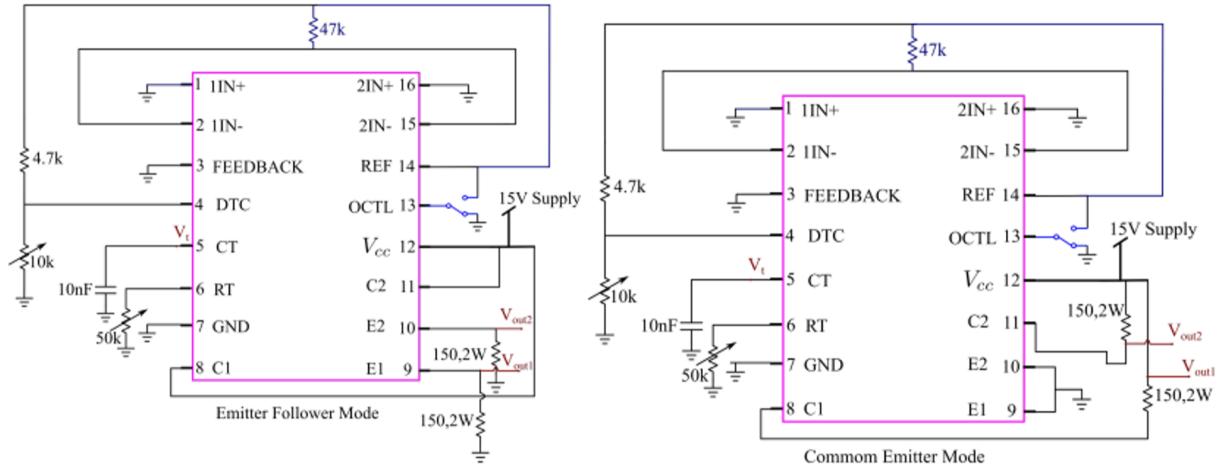
The details have been provided:

Qty	Value	Device	Package	Parts	Description
2	R2 10 kΩ, R3 50 kΩ	3362P	3362P	R2 (D-Vary), R3 (F-Vary) R2 use P103 AND R3 solder P503	Potentiometer 3362 Series
2		MA03-1	MA03-1	EMCM, PLL	PIN HEADER
8		PINHD-1X2	1X02	C1-C2, E1-E2, GND, JP12- JP10, O/P++, O/P--, SUPPLY, VCC	BERG STRIP PINS HEADER
1	100 nF	C10/4	C10B4	C1	CAPACITOR
1	10 nF	C2.5/2	C2.5-2	C3	CAPACITOR
1	10 nF	C5/7.2	C5B7.2	C2	CAPACITOR
2	150 Ω	R- EU_0617/22	0617/22	R4, R5	RESISTOR
1	4.7 kΩ	R- EU_0207/10	0207/10	R1	RESISTOR
1	47 kΩ	R- EU_0207/10	0207/10	R7	RESISTOR
1	TL494IN	TL494IN	DIL16	IC1	SWITCHMODE Pulse Width Modulation Control Circuit

The board has to be used in the emitter follower mode. Using the jumper wires connect the pins appropriately and check the pulses at the output pins by connecting them to an oscilloscope using voltage probes. The potentiometers D-vary and F-vary can be adjusted to change the duty cycle and switching frequency respectively.

2. Generation of Pulsed waveforms using PWM Controller(TL494).

Circuit Diagram / Experimental Setup:



Note : PCB - Printed circuit board

A printed circuit board (PCB) is a structure for assembling electronic components and their connections into a unified circuit that allows electrical current to pass between components.

3. The next step would be to interface the driver IC to the output obtained from the TL494 board. The circuit diagram for the same is provided below.

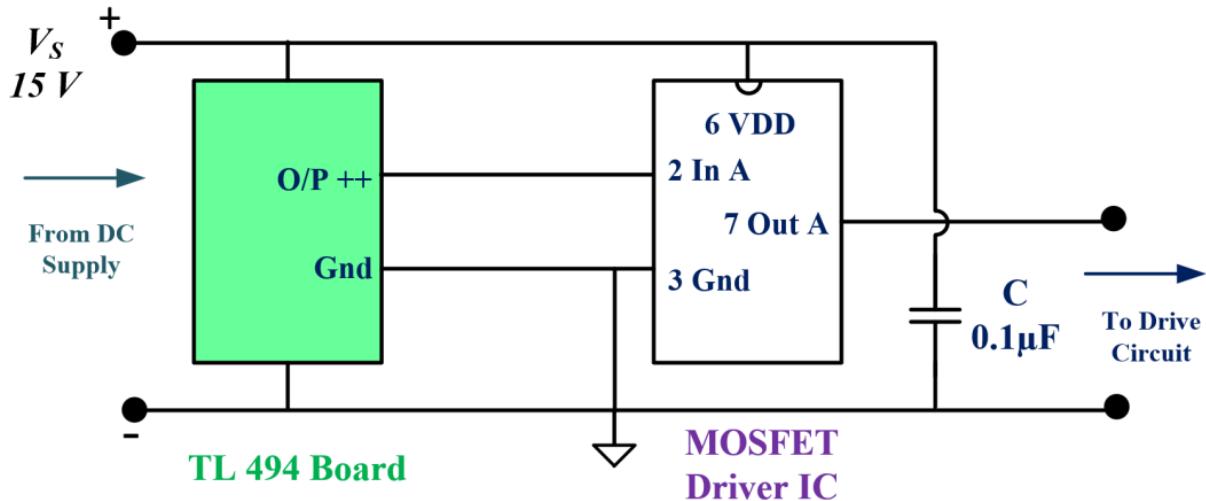


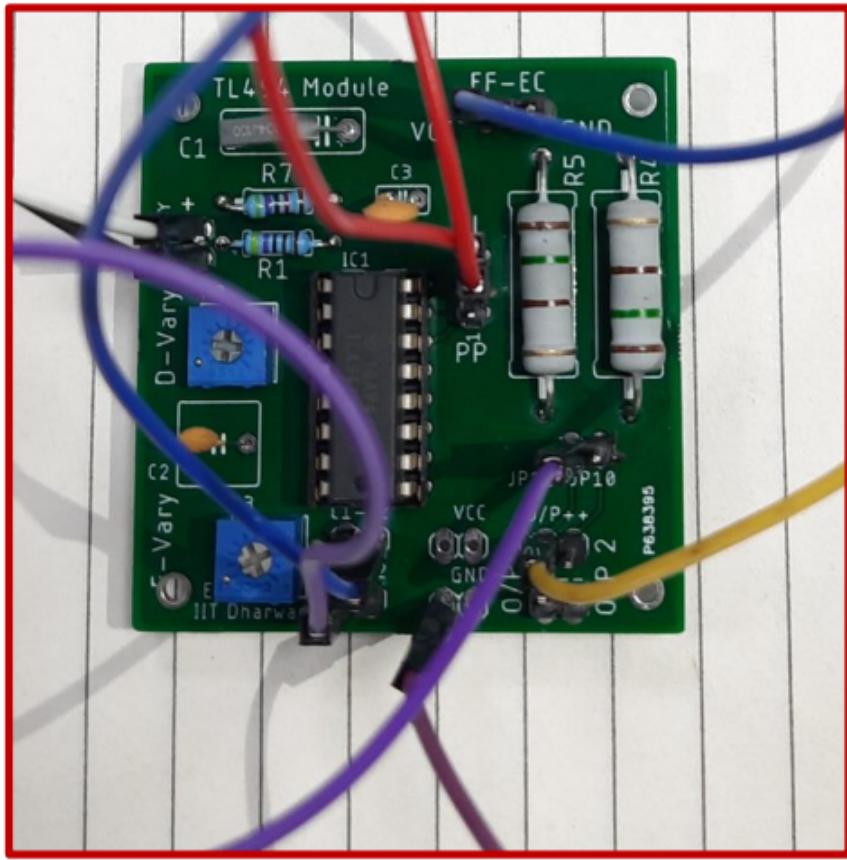
Fig: Interface circuit to driver IC

Note : MOSFET Driver IC is TC4427.

After checking the gating pulses at the output of the driver IC, you can proceed to provide the pulses to the power MOSFET gate and source terminals. Ensure that the rest of the power circuit is soldered and connected up properly as per the desired converter configuration before this is done.

Note the following details with respect to the TL494 circuit connections (refer figure below):

- Pins C1 and C2 are to be shorted (soldered at the bottom side) and connected to Vcc (pin 1 of EF-EC) using jumper wire. (blue colour wire in pic)
- Pin 13 has to be connected to ground (jumper connector/ wire) – black connector is used in pic.
- E1 to be connected to R5 (JP12) using jumper wire – violet wire in pic
- O/P to be taken between O/P ++ and Gnd Pins: yellow and brown wires shown in pic
- I/p is supply + and ground from DC supply (use max 18 V!!).



4. Power Circuit: The other components

Power Electronic switches:

The power MOSFET provided is IRFZ44NPbF from International Rectifiers (IR) having a maximum current rating of 49 A and can block 55 V. It has to be mounted on the heat sink after applying the heat sink paste (and then screwed to the heat sink).

The Power Diode provided is QH08TZ600 a hyperfast switching diode from Power Integrations having a maximum current rating of 8 A and can block 600 V. This can be soldered directly.

The MOSFET driver (TC4427AEPA IC from Microchip: Dual MOSFET IC, 4.5V-18V Supply, 1.5A, 30ns Delay) is to be connected between the TL494 output and the Gate to Source of the power MOSFET. The power supply for the complete gate drive – TL494 board and the MOSFET driver is to be the same (common ground). The ground of the DC-DC converter is to be different - ISOLATED.

Filter components:

- The inductance given is a 1 mH toroidal inductor with a maximum current rating of 2.4 A.
- Ensure that while testing the load rheostat resistance is set such that the current through the inductor never exceeds 1.5 A.
- The electrolytic capacitance given is a 470 μ F, 63 V Capacitor. Be careful about the polarity while connecting it up

The load resistance is a variable rheostat of 40Ω and 3 A capacity.

