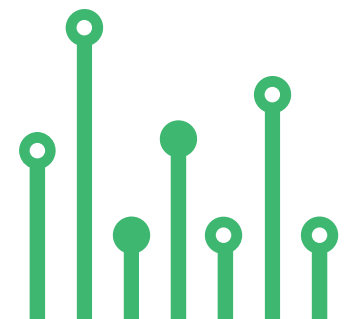


THE  
**electronics-lab**  
.com  
from ideas to  
**boards**

[electronics-lab - Projects](#) | [Embedded News](#) | [Online Community](#) | [e-Shop](#)

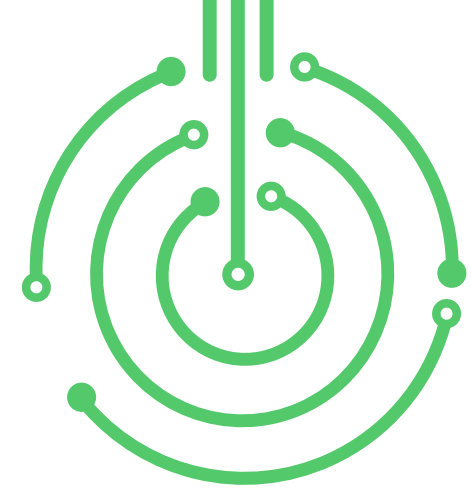
Open Source Hardware Electronics Projects

[electronics-lab.com /projects](https://electronics-lab.com/projects)





POWER SUPPLY



# 48V DC INPUT TO 12V OUTPUT DC-DC CONVERTER



SKU: EL139104

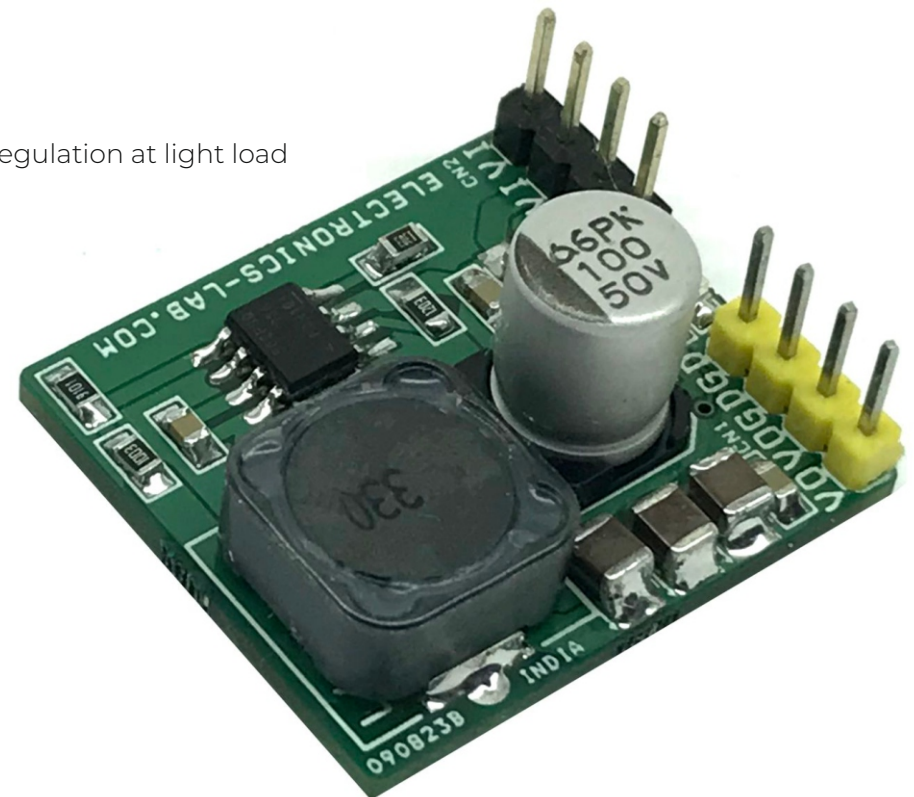
# 48V DC Input to 12V Output DC-DC Converter



This DC/DC buck regulator project is based on LMR38020 chip that employs synchronous rectification to achieve high conversion efficiency on a small board. The project operates over a wide input voltage range of 14V to 48V to provide a regulated 12Vdc output at 400kHz switching frequency. The output voltage has better than 1.5% setpoint accuracy. Enable pin is connected to VIN using resistor R2. The device has built-in protection features such as cycle-by-cycle current limit, hiccup mode short-circuit protection, and thermal shutdown in case of excessive power dissipation.

## Features

- Tightly regulated output voltage of 12 V with 1.5% setpoint accuracy
- Load Current 1Amp (Can provide Up to 2A), limited due to PCB thermal area.
- Wide input voltage operating range of 14 V to 48 V
- 98% maximum duty cycle
- Operating Frequency 400Khz
- Force PWM operation to achieve low output voltage ripple, tight output voltage regulation at light load
- Frequency synchronization to external clock
- Thermal Shutdown (Threshold 163 Degree Centigrade)
- Hiccup Mode Short-Circuit Protection
- Supports Start-up with Pre-Biased Output
- Cycle-by-cycle overcurrent protection
- PCB Dimensions 29.05 X 25.88 MM



The project provides 12V output with a maximum of 48V input. The input voltage is limited due to the input capacitor voltage rating. The input and output voltage can be changed with a few component adjustments. The IC has a wide input voltage range. The board can support a higher input power supply. Output also can be altered as per user requirements. Refer to the details below for various options. Also, refer to the datasheet of LMR38020 for more info.

## 12V DC Output, 48V DC Input

- Output Capacitor C2, C3, C4 10uF/10V Ceramic SMD Size 1210
- C5 1nF/10V Ceramic SMD Size 0805
- Resistor R5 100K 1% SMD Size 0805 (Output Feedback Divider Resistor)
- Resistor R4 9.09K 1% SMD Size 0805 (Output Feedback Divider Resistor)
- Resistor R3 64.5K 1% SMD Size (Frequency) 400Khz
- Inductor L1 33uH/5Amp 12X12MM SMD
- 

## 5V DC Output, 48V DC Input

- Output Capacitor C2, C3, C4 22uF/10V Ceramic SMD Size 1210
- C5 1nF/10V Ceramic SMD Size 0805
- Resistor R5 100K 1% SMD Size 0805 (Output feedback Divider Resistor)
- Resistor R4 24.9K 1% SMD Size 0805 (Output feedback Divider Resistor)
- Resistor R3 64.5K 1% SMD Size 0805 (Frequency) 400Khz
- Inductor L1 15uH/5Amp 12X12MM SMD
- 

## 24V DC Output, 48V DC Input

- Output Capacitor C2, C3, C4 10uF/10V Ceramic SMD Size 1210
- C5 1nF/10V Ceramic SMD Size 0805
- Resistor R5 100K 1% SMD Size 0805 (Output feedback Divider Resistor)
- Resistor R4 4.32K 1% SMD Size 0805 (Output feedback Divider Resistor)
- Resistor R3 52.3K 1% SMD Size 0805 (Frequency) 500Khz
- Inductor L1 47uH/5Amp 12X12MM SMD
- 

## Fore Higher input voltage up to 80V DC

Capacitor C6 Electrolytic 33-47uF/100V, C7 4.7uF/100V Ceramic SMD Size 1210, C8 10-100nF/100V Ceramic Size 0805

## Overcurrent and Short Circuit Protection

The LMR38020 is protected from overcurrent conditions by cycle-by-cycle current limits on both the peak and valley of the inductor current. Hiccup mode is activated if a fault condition persists to prevent overheating. High-side MOSFET overcurrent protection is implemented by the nature of the peak current mode control. The high-side switch current is sensed when the high-side is turned on after a set blanking time. The high-side switch current is compared to the output of the error amplifier (EA) minus slope compensation every switching cycle. The peak current of high-side switch is limited by a clamped maximum peak current threshold,  $I_{high\ side\ LIMIT}$ , which is constant. The current going through the low-side MOSFET is also sensed and monitored. When the low-side switch turns on, the inductor current begins to ramp down. The low-side switch is turned OFF at the end of a switching cycle if its current is above the low-side current limit,  $I_{LS\_LIMIT}$ . The low-side switch is kept on so that the inductor current keeps ramping down until the inductor current ramps below the  $I_{LS\_LIMIT}$ . Then the low-side switch is turned OFF and the high-side switch is turned on after a dead time.

## Thermal Shutdown

The LMR38020 provides an internal thermal shutdown to protect the device when the junction temperature exceeds 163°C. Both high-side and low-side FETs stop switching in thermal shutdown. Once the die temperature falls below 150°C, the device reinitiates the power-up sequence controlled by the internal soft-start circuitry.

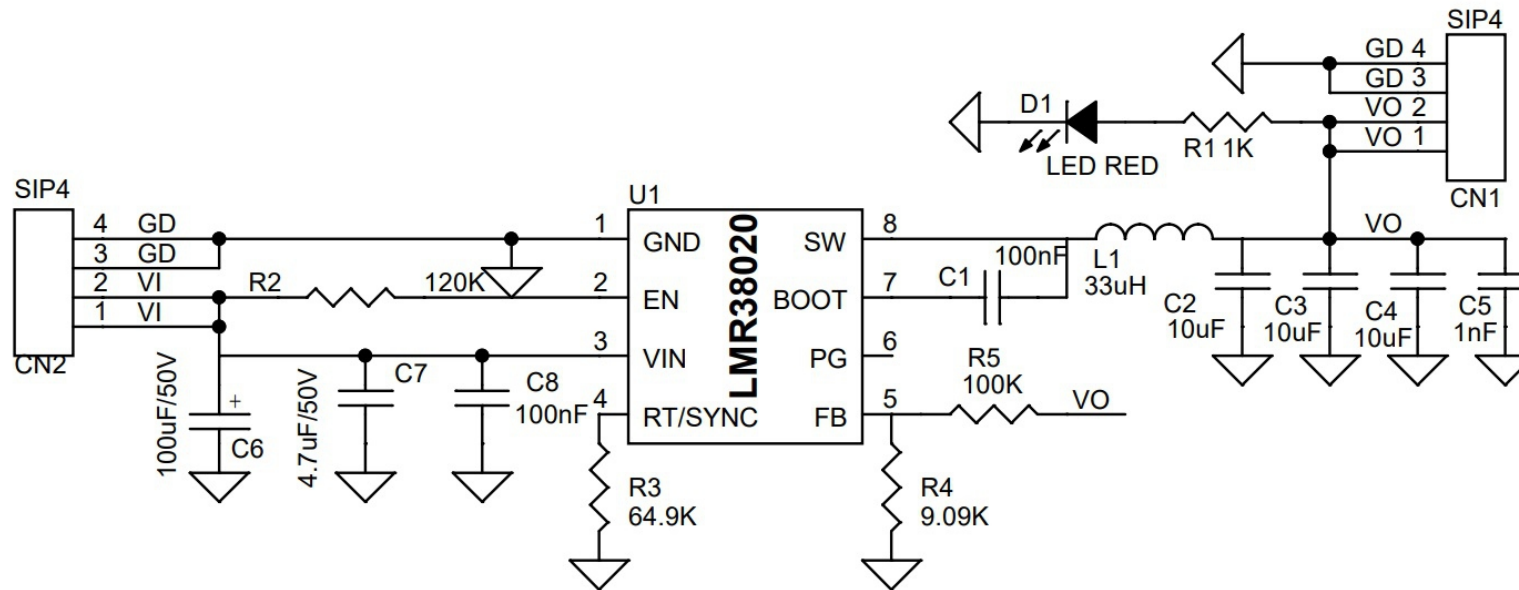
## Soft Start

The integrated soft-start circuit prevents input inrush current impacting the LMR38020 and the input power supply. Soft start is achieved by slowly ramping up the target regulation voltage when the device is first enabled or powered up. The typical soft-start time is 4.0 ms.

The LMR38020 synchronous buck converter is designed to regulate over a wide input voltage range, minimizing the need for external surge suppression components. The LMR38020 operates during input voltage dips as low as 4.2 V, at nearly 100% duty cycle if needed, making it an excellent choice for wide input industrial applications and MHEV/EV systems.

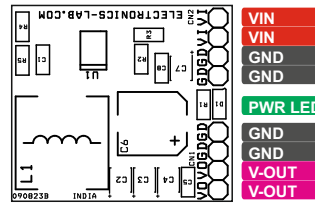
The LMR38020 uses precision enable to provide flexibility by enabling a direct connection to the wide input voltage or precise control over device start-up and shutdown. The power-good flag, with built-in filtering and delay, offers a true indication of system status, eliminating the need for an external supervisor. The device incorporates a pseudorandom spread spectrum for minimal EMI and the switching frequency can be configured between 200 kHz and 2.2 MHz to avoid noise-sensitive frequency bands. In addition, the frequency can be selected for improved efficiency at low operating frequency or smaller solution size at high operating frequency.

# Schematic



# Connections

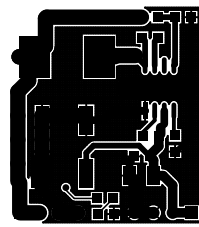
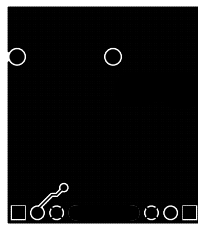
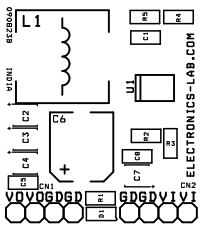
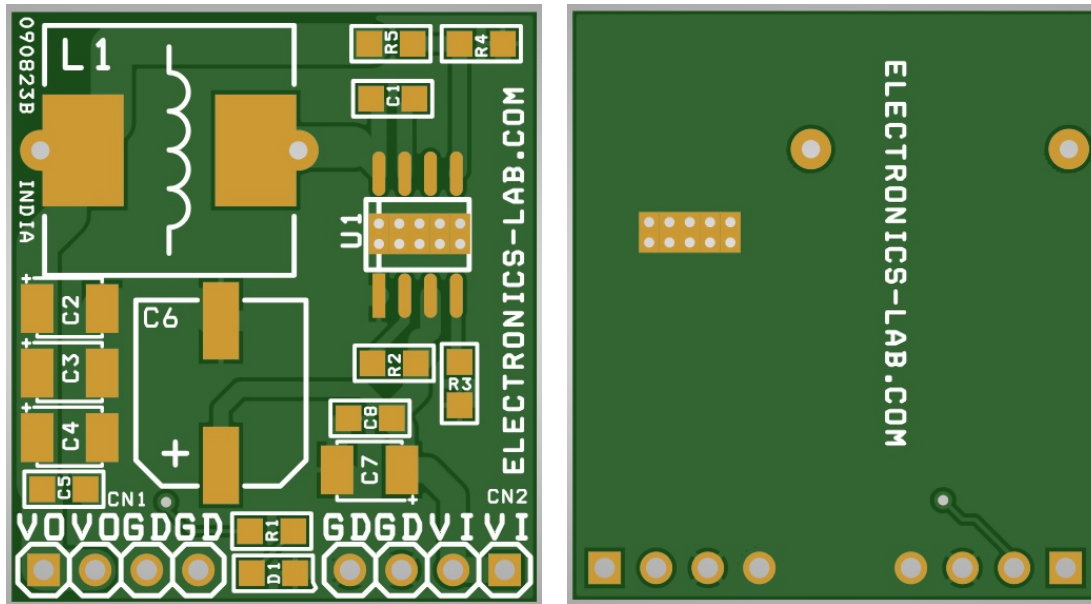
---



## Connection and Other Details

- CN1 Pin 1,2 = Output Voltage, Pin 3,4 = GND
- CN2 Pin 1,2 = +Input Power Supply 14 to 48V DC, Pin 3,4 = GND
- D1 Power LED

# PCB



PCB DIMENSIONS 29.05 X 25.88 MM



# Parts List

---

BOM						
NO	QNTY.	REF.	DESC.	MANUFACTURER	SUPPLIER	SUPPLIER PART NO
1	2	CN1,CN2	4 PIN MALE HEADER PITCH 2.54MM	WURTH	DIGIKEY	732-5317-ND
2	2	C1,C8	100nF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
3	3	C2,C3,C4	10uF/16V CERAMIC SMD SIZE 1210	YAGEO/MURATA	DIGIKEY	
4	1	C5	1nF/50V CERAMIC SMD 0805	YAGEO/MURATA	DIGIKEY	
5	1	C6	100uF/50V ELECTROLYTIC	RUBYCON	DIGIKEY	1189-2468-1-ND
6	1	C7	4.7uF/50V	YAGEO/MURATA	DIGIKEY	
7	1	D1	LED RED SMD SIZE 0805	LITE ON INC	DIGIKEY	160-1427-1-ND
8	1	L1	33uH/5A SMD 12X12MM	BOURNS	DIGIKEY	118-SRP1040VA-330MCT-ND
9	1	R1	1K 5% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
10	1	R2	120K 5% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
11	1	R3	64.9K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
12	1	R4	9.09K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
13	1	R5	100K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
14	1	U1	LMR38020 SOIC8	TI	DIGIKEY	296-LMR38020SDDARCT-ND





Keep  
In touch..

electronics-lab  
.com

info@electronics-lab.com  
www.electronics-lab.com

from ideas to **boards**

