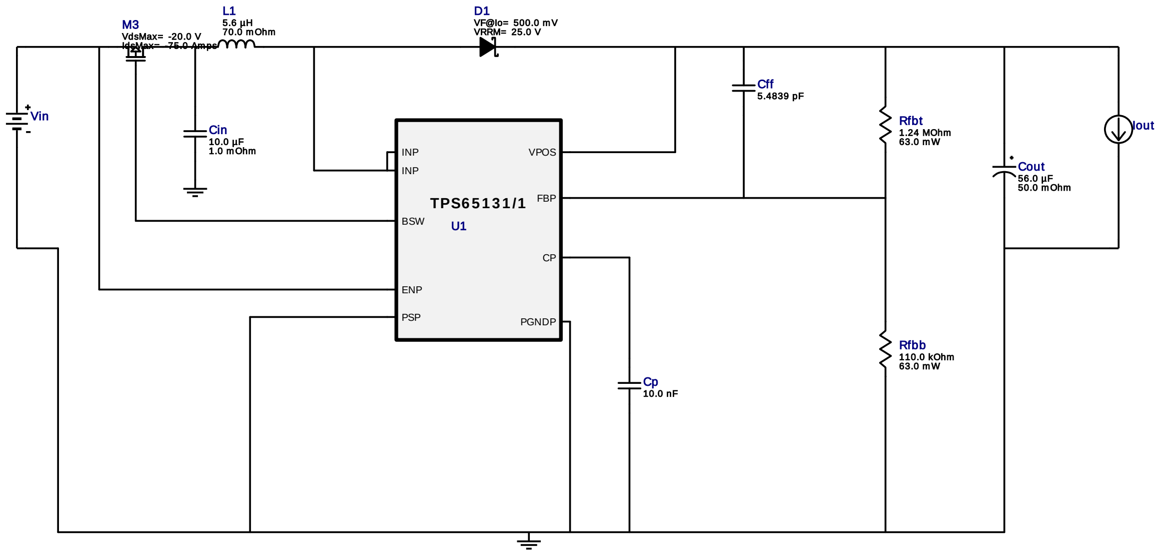
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 5.0V
VinMax = 5.0V
Vout = 15.0V
Iout = 0.2A

Device = TPS65131RGER
Topology = Boost
Created = 2024-11-19 00:58:58.371
BOM Cost = NA
BOM Count = 10
Total Pd = 0.53W

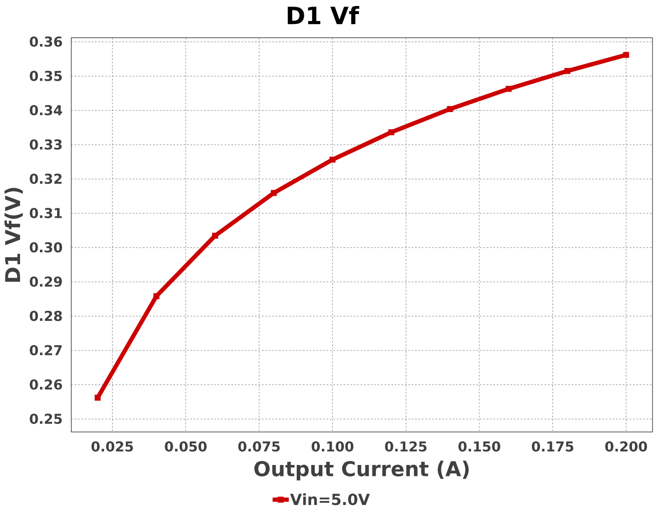
Design : 176 TPS65131RGER
TPS65131RGER 5V-5V to 15.00V @ 0.2A

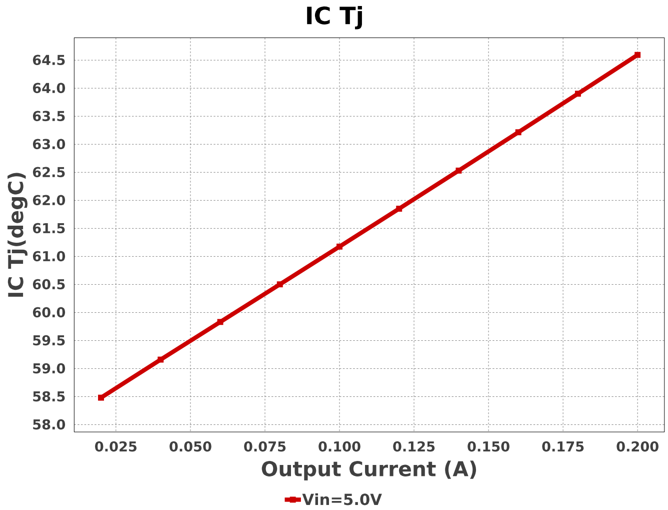


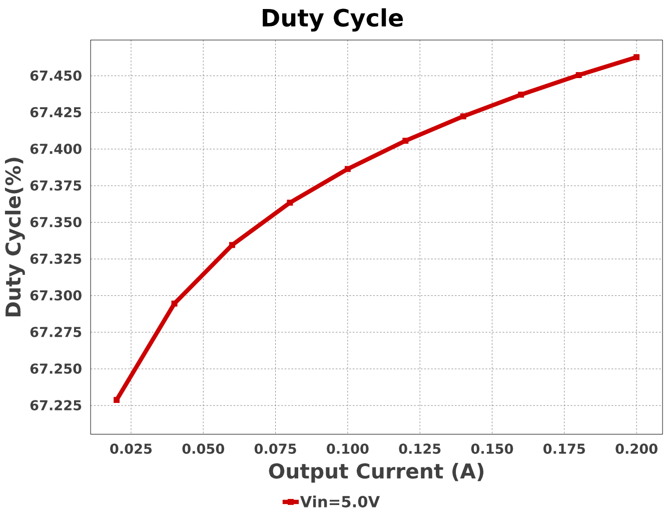
Electrical BOM

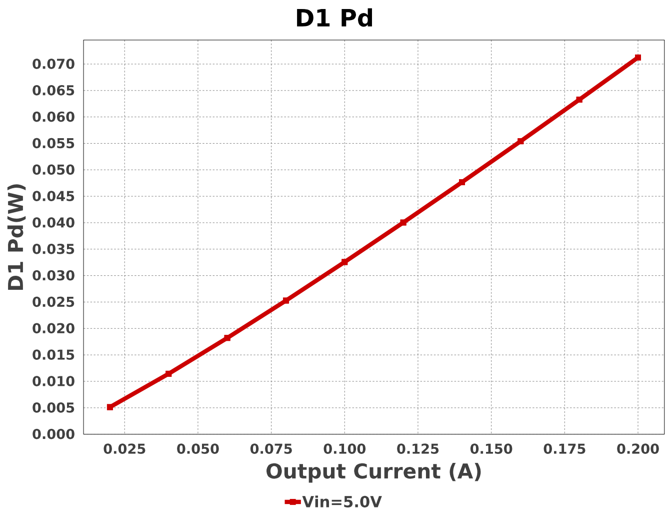
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cff	CUSTOM	CUSTOM Series= ?	Cap= 5.4839 pF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Cin	TDK	C2012X7R1A106M125AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.10	0805 7 mm^2
Cout	Panasonic	EEHZC1E560P Series= ZC	Cap= 56.0 uF ESR= 50.0 mOhm VDC= 25.0 V IRMS= 900.0 mA	1	$0.29	SM_RADIAL_6.3AMM 80 mm^2
Cp	Samsung Electro-Mechanics	CL10C103JA8NNNC Series= C0G/NP0	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.04	0603 5 mm^2
D1	Vishay-Semiconductor	BYS10-25-E3/TR	VF@Io= 500.0 mV VRRM= 25.0 V	1	$0.11	SMA 37 mm^2
L1	NIC Components	NPI54C5R6MTRF	L= 5.6 µH 70.0 mOhm	1	$0.09	IND_NPI54C 61 mm^2
M3	Texas Instruments	CSD25402Q3A	VdsMax= -20.0 V IdsMax= -75.0 Amps	1	$0.22	DNH0008A 18 mm^2
Rfbb	Vishay-Dale	CRCW0402110KFKED Series= CRCW..e3	Res= 110.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW04021M24FKED Series= CRCW..e3	Res= 1.24 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

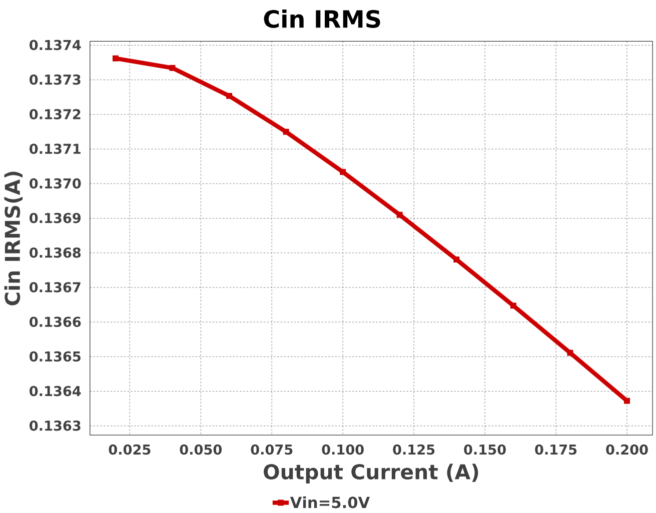
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	TPS65131RGER	Switcher	1	$1.07	RGE0024B 25 mm^2

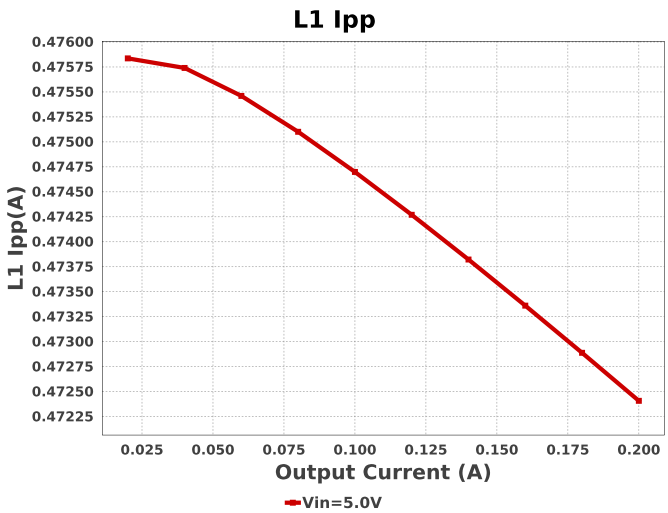




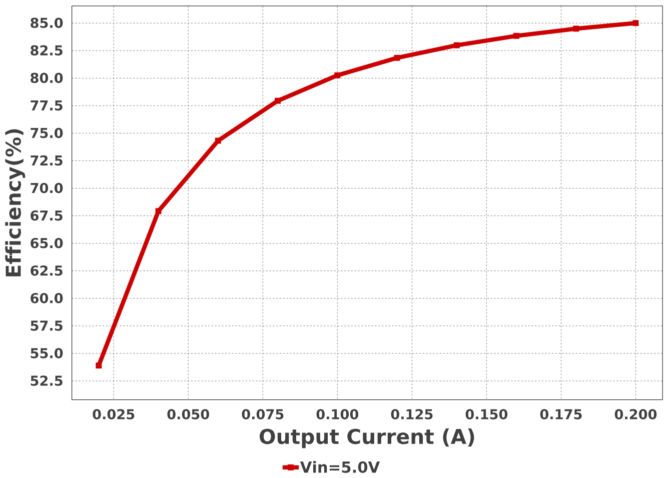




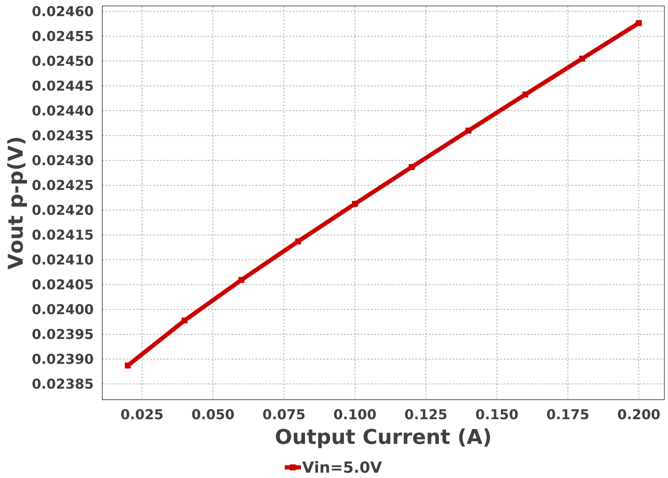




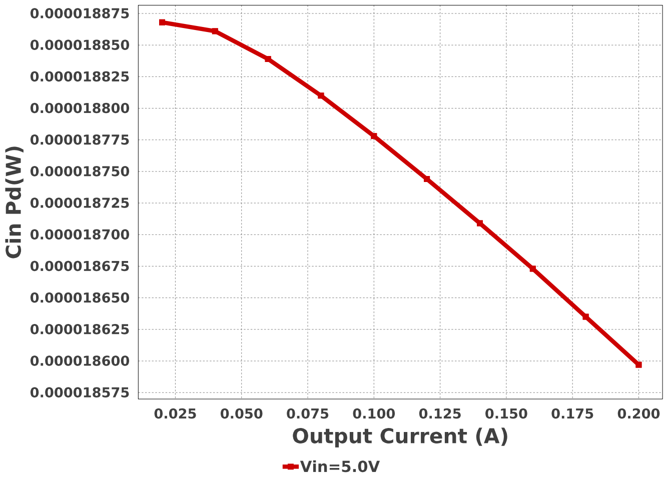
Efficiency



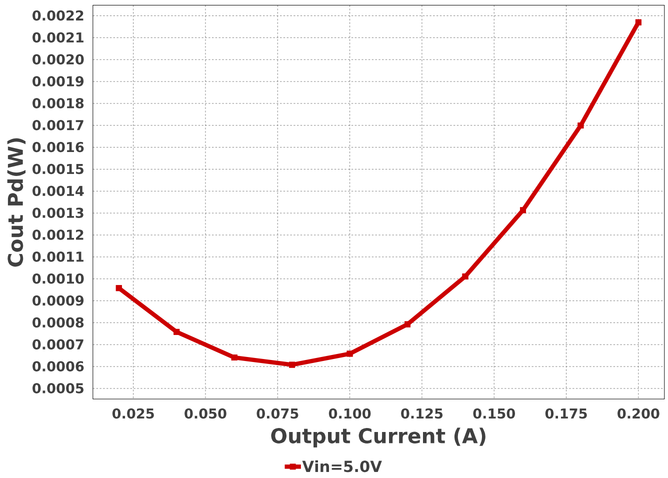
Vout p-p



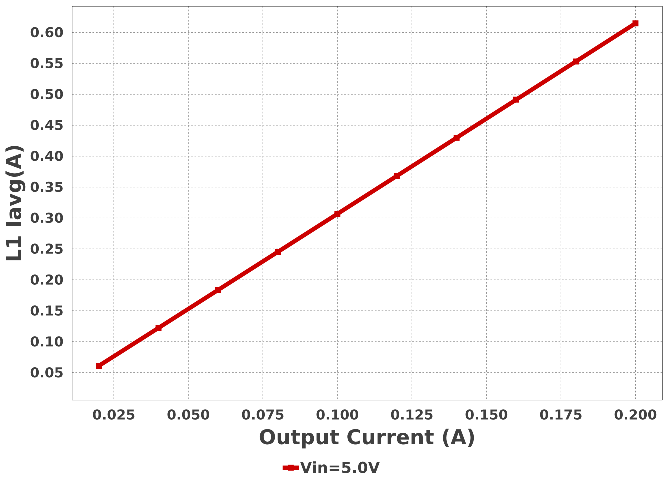
Cin Pd



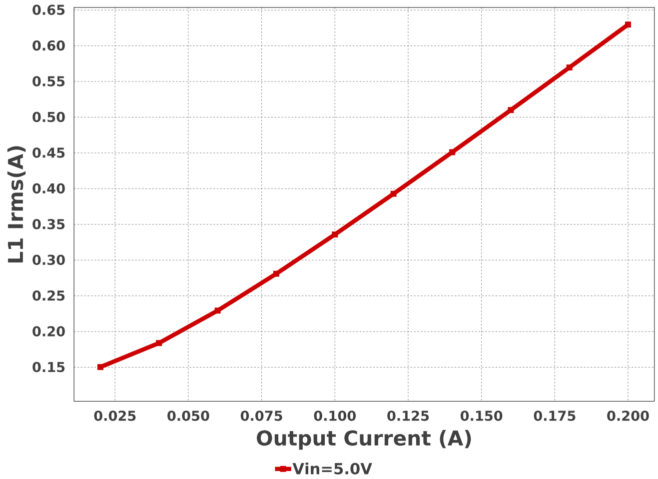
Cout Pd

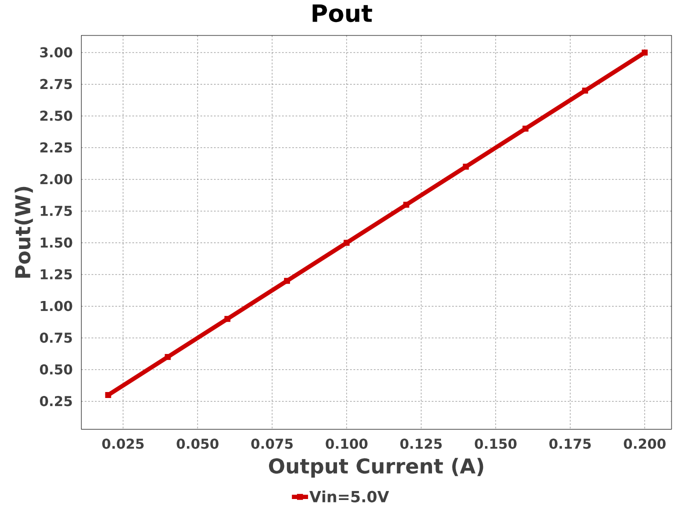


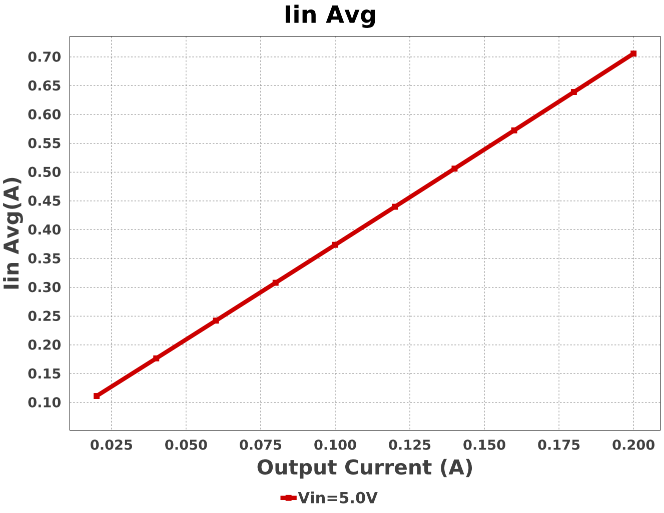
L1 Iavg

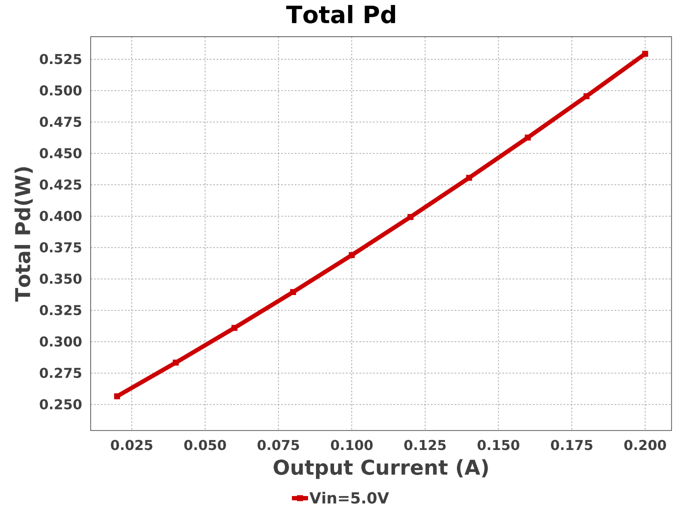


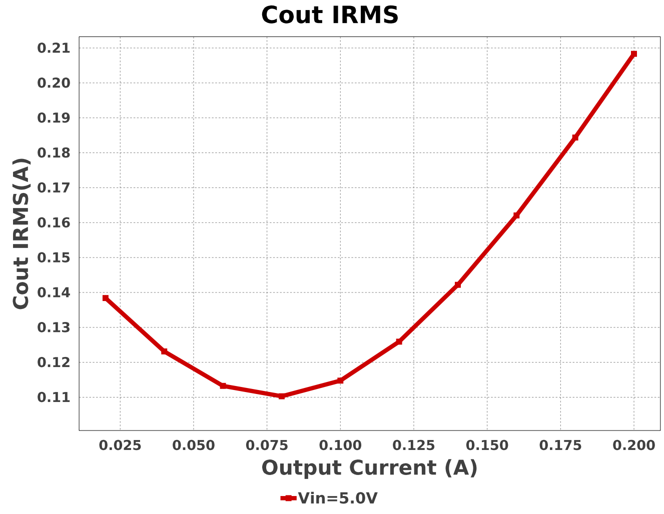
L1 Irms

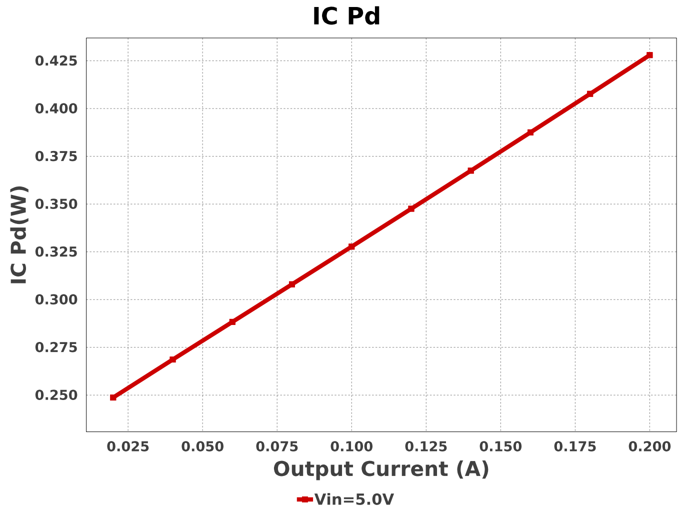


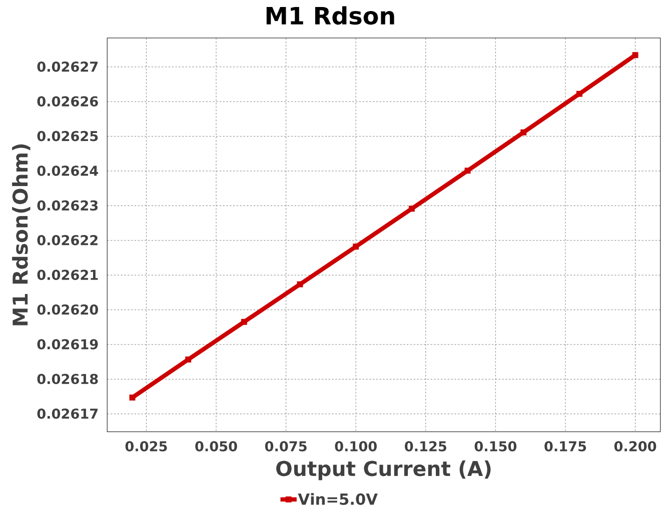

Pout
Pout(W)
Output Current (A)
Vin=5.0V

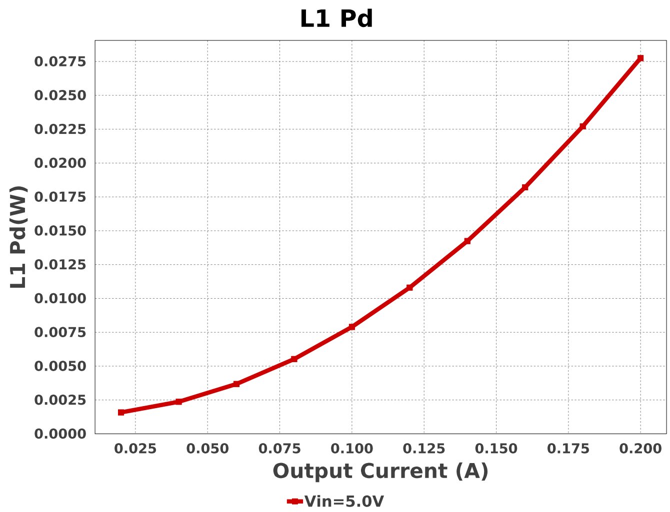

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=5.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=5.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=5.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=5.0V


M1 Rdson
M1 Rdson(Ohm)
Output Current (A)
Vin=5.0V



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	136.372 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	18.597 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	208.328 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	2.17 mW	Capacitor	Output capacitor power dissipation
5.	D1 Pd	71.239 mW	Diode	Output Diode Power Dissipation
6.	IC Pd	427.98 mW	IC	IC power dissipation
7.	IC Tj	64.594 degC	IC	IC junction temperature
8.	ICThetaJA	34.1 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	705.87 mA	IC	Average input current
10.	L1 Iavg	614.68 mA	Inductor	Inductor average current
11.	L Ipp	472.408 mA	Inductor	Inductor 1 peak to peak current
12.	L1 Irms	629.626 mA	Inductor	Inductor ripple current
13.	L Pd	27.75 mW	Inductor	Power Dissipation in the Inductor
14.	M1 Rdson	26.273 mOhm	Mosfet	
15.	Cin Pd	18.597 µW	Power	Input capacitor power dissipation
16.	Cout Pd	2.17 mW	Power	Output capacitor power dissipation
17.	D1 Pd	71.239 mW	Power	Output Diode Power Dissipation
18.	IC Pd	427.98 mW	Power	IC power dissipation
19.	L Pd	27.75 mW	Power	Power Dissipation in the Inductor
20.	Total Pd	529.332 mW	Power	Total Power Dissipation
21.	BOM Count	10	System Information	Total Design BOM count
22.	Duty Cycle	67.463 %	System Information	Duty cycle
23.	Efficiency	85.002 %	System Information	Steady state efficiency
24.	FootPrint	244.0 mm^2	System Information	Total Foot Print Area of BOM components
25.	Frequency	1.26 MHz	System Information	Switching frequency
26.	Iout	200.0 mA	System Information	Iout operating point
27.	Mode	PWM CCM	System Information	PWM/PFM Mode
28.	Pout	3.0 W	System Information	Total output power
29.	Total BOM	NA	System Information	Total BOM Cost
30.	Vin	5.0 V	System Information	Vin operating point
31.	Vout Actual	14.887 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	3.871 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	24.577 mV	System Information	Peak-to-peak output ripple voltage
34.	D1 Vf	356.197 mV		

Design Inputs

Name	Value	Description
Iout	200.0 m	Maximum Output Current

Name	Value	Description
VinMax	5.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	15.0	Output Voltage
base_pn	TPS65131/1	Base Product Number
source	DC	Input Source Type
Ta	50.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

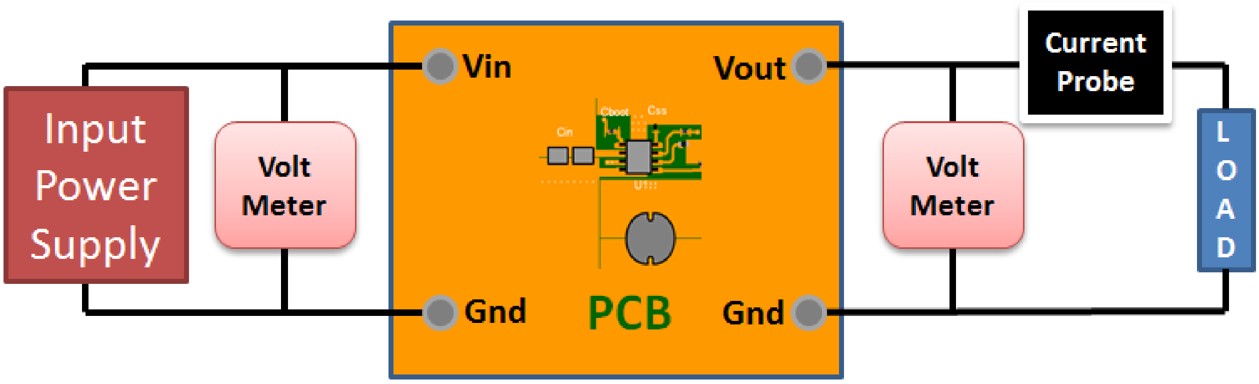
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 5.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. Master key : B813C5D1755B3B11[v1]

2. **TPS65131/1** Product Folder : http://www.ti.com/product/TPS65131 : contains the data sheet and other resources.

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