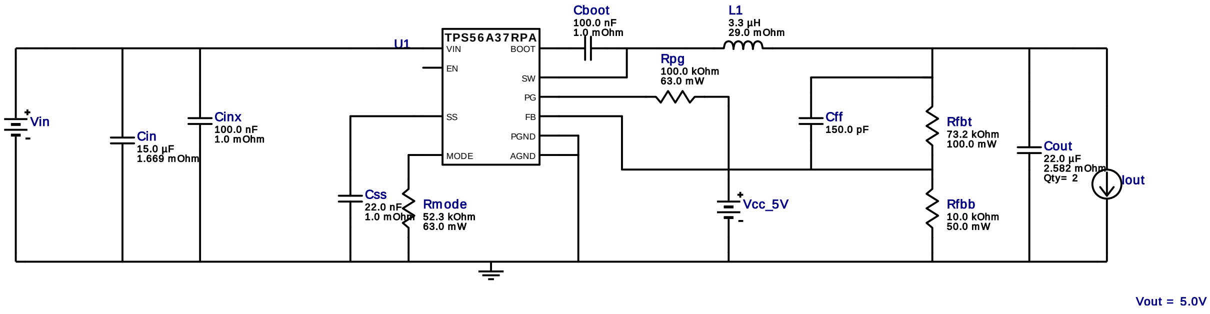
WEBENCH® Design Report

VinMin = 7.0V
VinMax = 12.0V
Vout = 5.0V
Iout = 5.0A

Device = TPS56A37RPAR
Topology = Buck
Created = 2025-07-13 02:45:01.770
BOM Cost = $2.84
BOM Count = 13
Total Pd = 1.61W

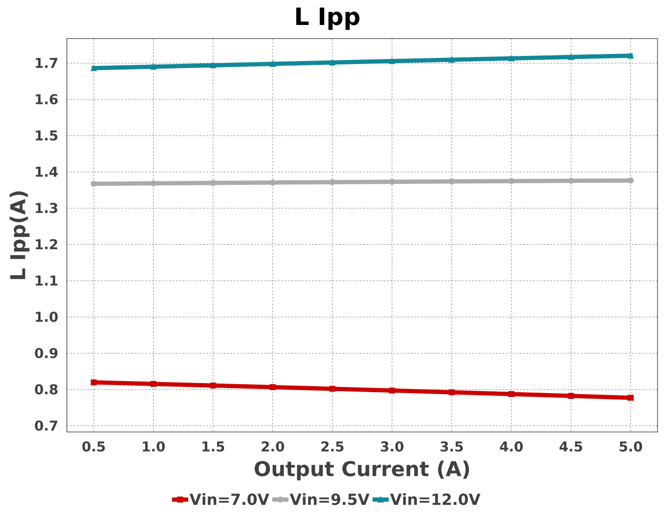
Design : 3 TPS56A37RPAR
TPS56A37RPAR 7V-12V to 5.00V @ 5A

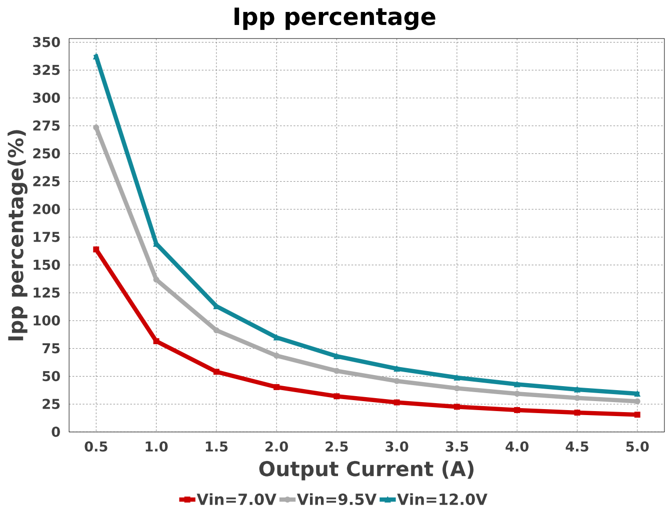


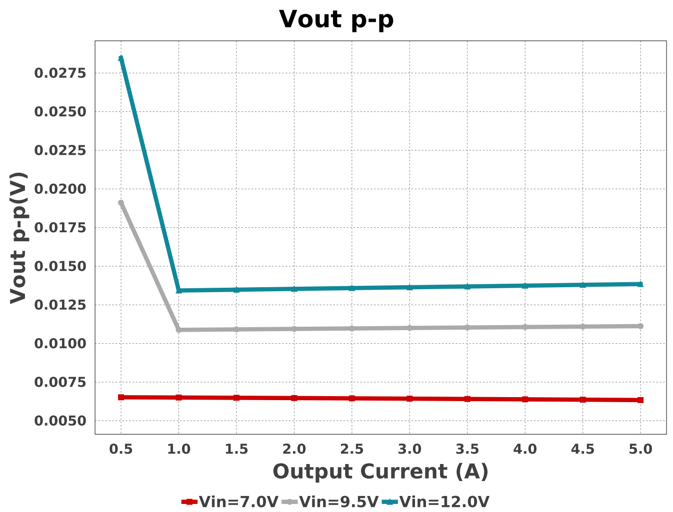
Electrical BOM

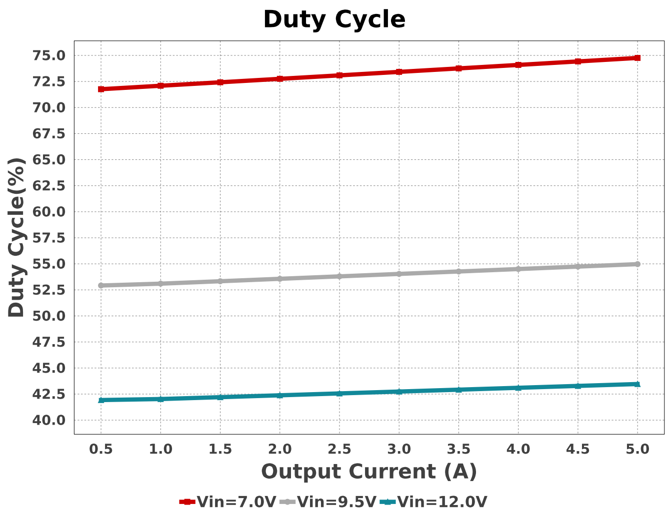
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cff	Kemet	C0603C151K3GACTU Series= C0G/NP0	Cap= 150.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0603 5 mm^2
Cin	TDK	C2012X5R1V156M125AC Series= X5R	Cap= 15.0 uF ESR= 1.669 mOhm VDC= 35.0 V IRMS= 5.0498 A	1	$0.20	0805 7 mm^2
Cinx	Kemet	C0603C104M3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cout	TDK	C3225X6S1C226M250AC Series= X6S	Cap= 22.0 uF ESR= 2.582 mOhm VDC= 16.0 V IRMS= 4.5756 A	2	$0.22	1210_280 15 mm^2
Css	MuRata	GRM155R71C223KA01D Series= X7R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
L1	Wurth Elektronik	74438357033	L= 3.3 µH 29.0 mOhm	1	$1.14	WE-MAPI_4030 26 mm^2
Rfbb	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rfbt	Vishay-Dale	CRCW060373K2FKEA Series= CRCW..e3	Res= 73.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rmode	Vishay-Dale	CRCW040252K3FKED Series= CRCW..e3	Res= 52.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

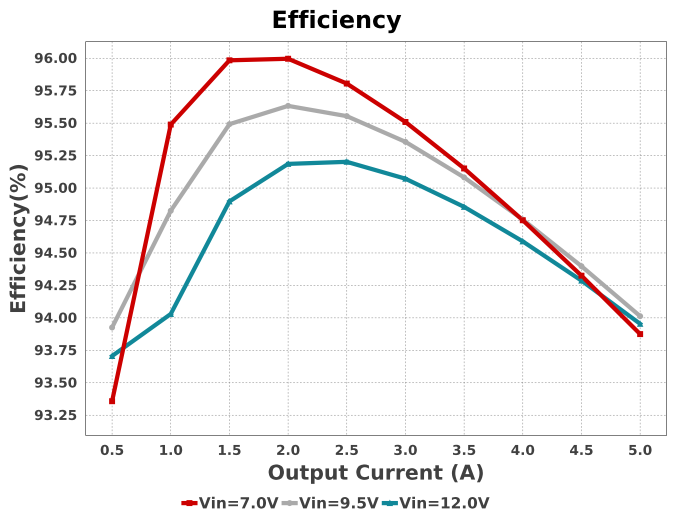
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	TPS56A37RPAR	Switcher	1	$0.97	RPA0010A 16 mm^2

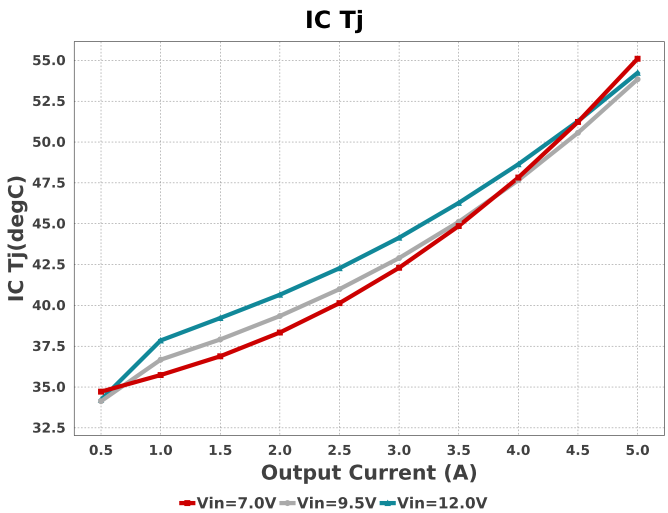


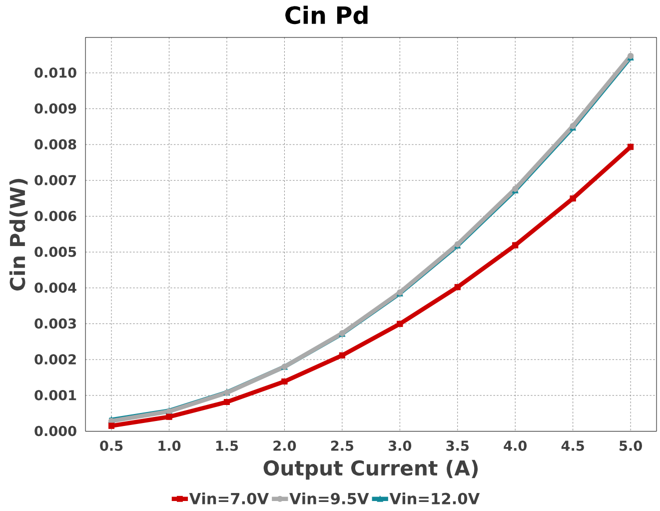


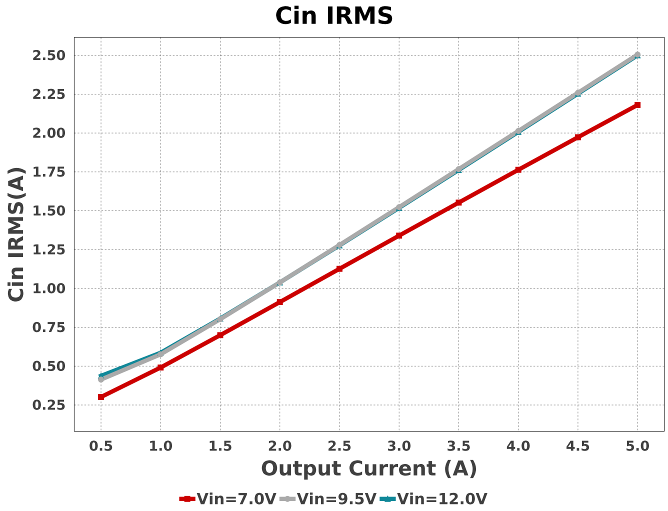


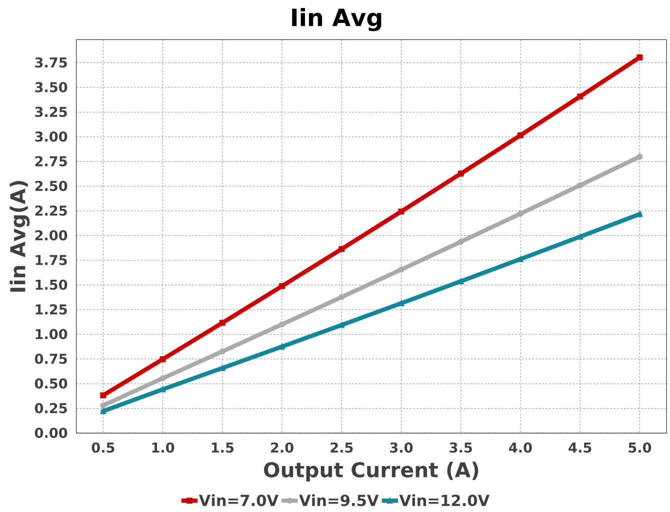


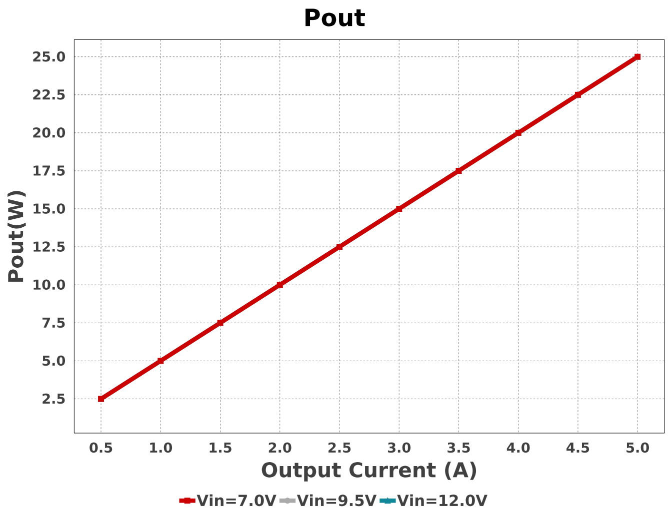


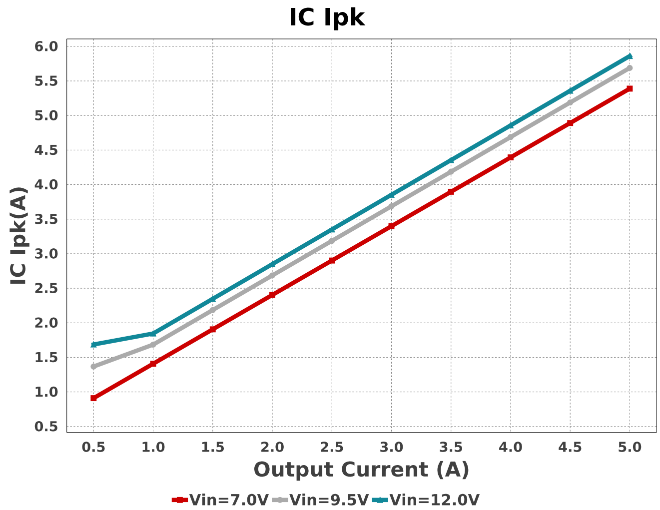


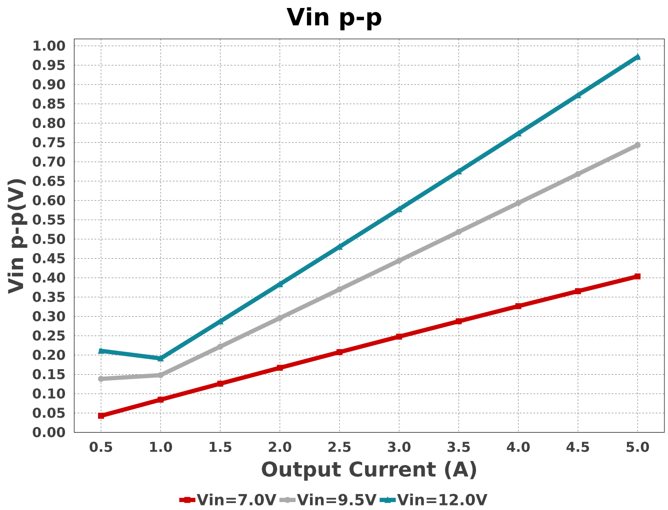

Cin Pd
Cin Pd(W)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=7.0V Vin=9.5V Vin=12.0V

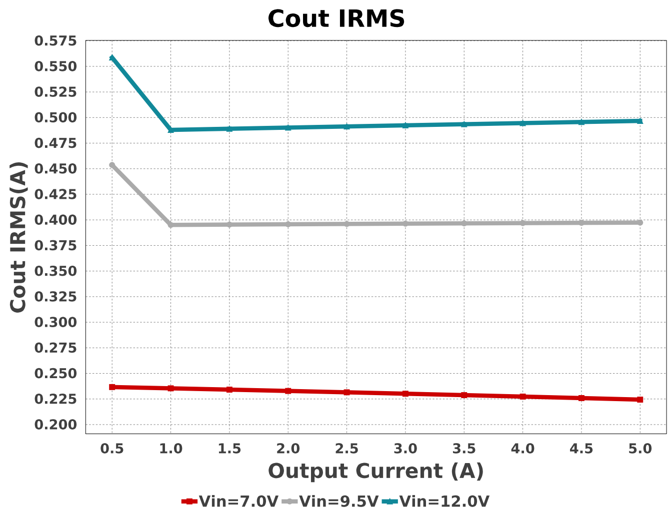

Cin IRMS
Cin IRMS(A)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=7.0V Vin=9.5V Vin=12.0V

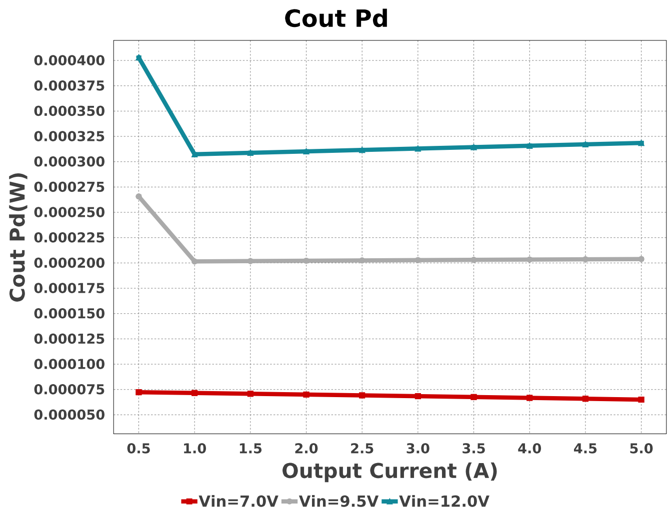

Iin Avg
Iin Avg(A)
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50 3.75
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=7.0V Vin=9.5V Vin=12.0V

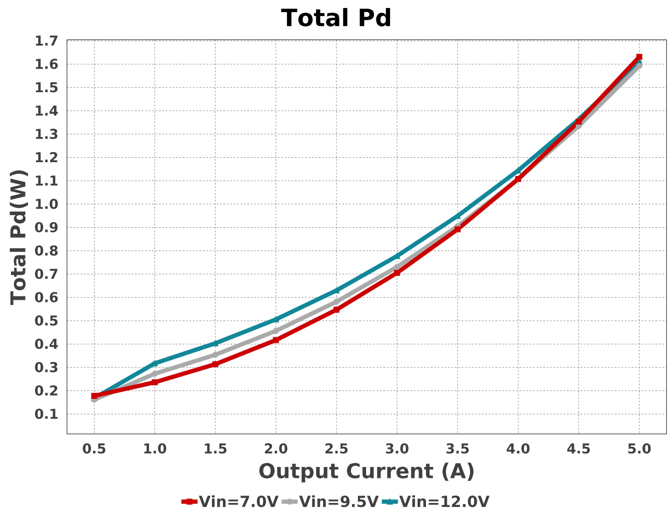

Pout
Pout(W)
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=7.0V Vin=9.5V Vin=12.0V

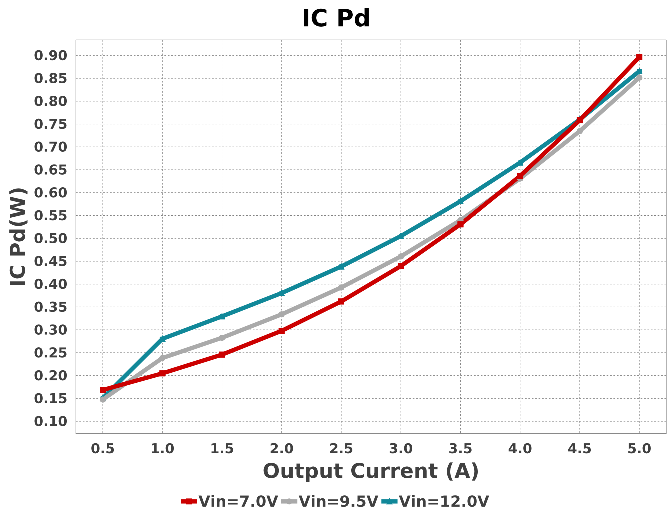

IC Ipk
IC Ipk(A)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=7.0V Vin=9.5V Vin=12.0V

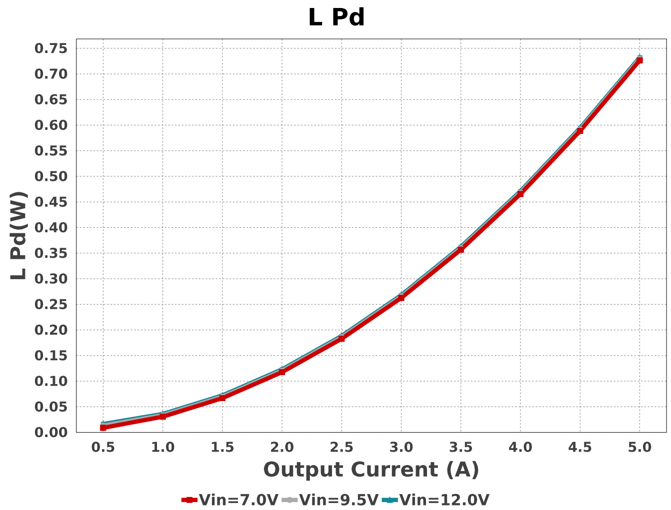

Vin p-p
Vin p-p(V)
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=7.0V Vin=9.5V Vin=12.0V

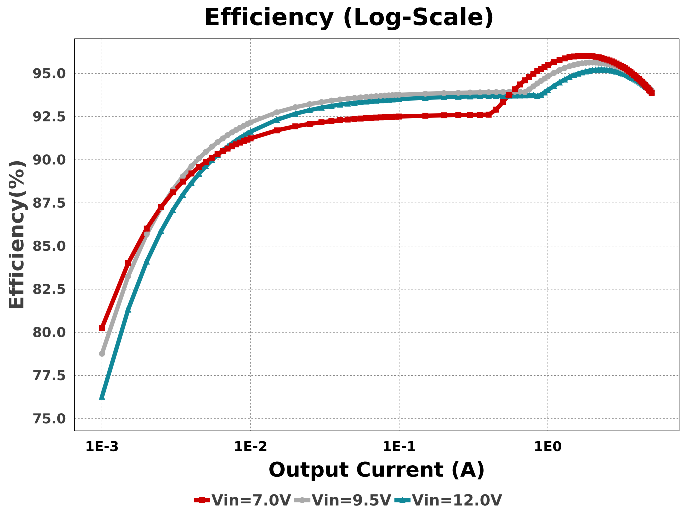












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	2.5 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	10.432 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	496.713 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	318.52 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	5.86 A	IC	Peak switch current in IC
6.	IC Pd	865.6 mW	IC	IC power dissipation
7.	IC Tj	54.237 degC	IC	IC junction temperature
8.	IC Tolerance	6.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA Effective	28.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	2.217 A	IC	Average input current

#	Name	Value	Category	Description
11.	Ipp percentage	34.413 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	1.721 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	732.15 mW	Inductor	Inductor power dissipation
14.	Cin Pd	10.432 mW	Power	Input capacitor power dissipation
15.	Cout Pd	318.52 µW	Power	Output capacitor power dissipation
16.	IC Pd	865.6 mW	Power	IC power dissipation
17.	L Pd	732.15 mW	Power	Inductor power dissipation
18.	Total Pd	1.609 W	Power	Total Power Dissipation
19.	BOM Count	13	System Information	Total Design BOM count
20.	Duty Cycle	43.466 %	System Information	Duty cycle
21.	Efficiency	93.954 %	System Information	Steady state efficiency
22.	FootPrint	108.0 mm^2	System Information	Total Foot Print Area of BOM components
23.	Frequency	516.925 kHz	System Information	Switching frequency
24.	Iout	5.0 A	System Information	Iout operating point
25.	Mode	CCM	System Information	Conduction Mode
26.	Pout	25.0 W	System Information	Total output power
27.	Total BOM	$2.84	System Information	Total BOM Cost
28.	Vin	12.0 V	System Information	Vin operating point
29.	Vin p-p	971.524 mV	System Information	Peak-to-peak input voltage
30.	Vout	5.0 V	System Information	Operational Output Voltage
31.	Vout Actual	4.992 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	2.795 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	13.846 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
VinMax	12.0	Maximum input voltage
VinMin	7.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS56A37	Base Product Number
source	DC	Input Source Type
Ta	30.0	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

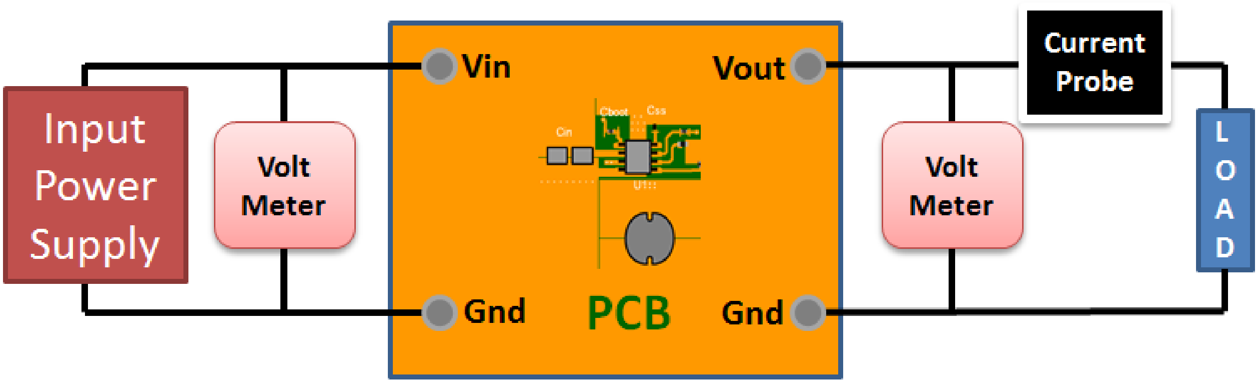
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 7.0V 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 : 2B3DC8C05B3E75DED962F6DD676F5323[v1]

2. **TPS56A37** Product Folder : http://www.ti.com/product/TPS56A37 : contains the data sheet and other resources.

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