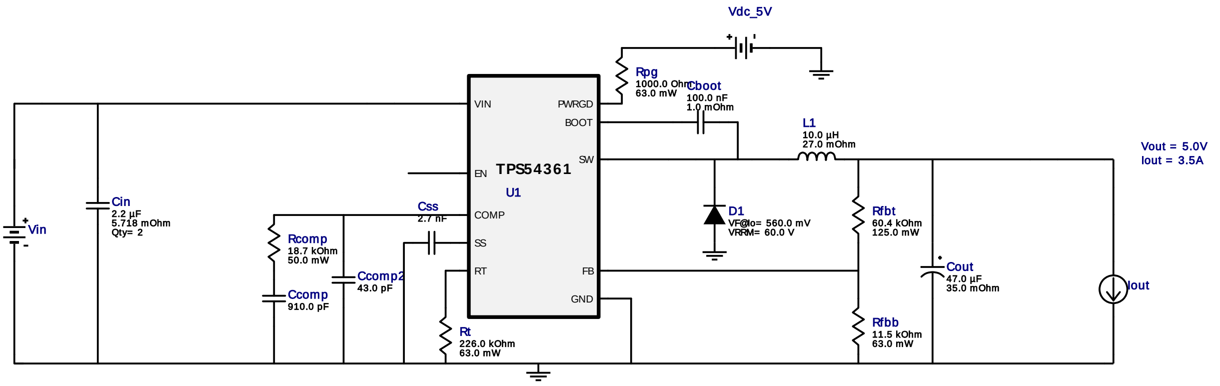
VinMin = 46.0V
VinMax = 48.0V
Vout = 5.0V
Iout = 3.5A

Device = TPS54361DPRR
Topology = Buck
Created = 2018-09-24 09:57:08.733
BOM Cost = $4.46
BOM Count = 15
Total Pd = 2.85W

WEBENCH ® Design Report

Design : 343 TPS54361DPRR
TPS54361DPRR 46.0V-48.0V to 5.00V @ 3.5A

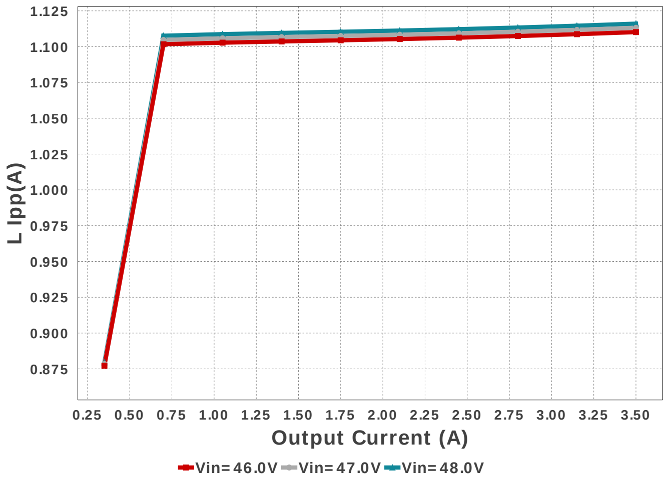


Electrical BOM

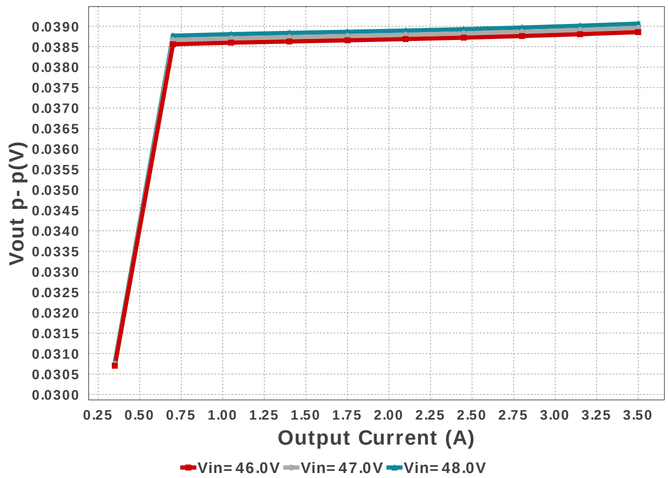
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp	Samsung Electro-Mechanics	CL21C911JBCNNNC Series= C0G/NP0	Cap= 910.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C430JBANNNC Series= C0G/NP0	Cap= 43.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cin	TDK	C3216X7S2A225K160AB Series= X7S	Cap= 2.2 uF ESR= 5.718 mOhm VDC= 100.0 V IRMS= 3.03632 A	2	$0.22	1206_180 11 mm²
Cout	Panasonic	10TPE47MAZB Series= TPE	Cap= 47.0 uF ESR= 35.0 mOhm VDC= 10.0 V IRMS= 1.4 A	1	$0.39	3528-21 17 mm²
Css	TDK	C2012C0G1H272K060AA Series= C0G/NP0	Cap= 2.7 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
D1	Diodes Inc.	PDS760-13	VF@Io= 560.0 mV VRRM= 60.0 V	1	$0.66	PowerDI5 50 mm²
L1	Coilcraft	XAL6060-103MEB	L= 10.0 µH DCR= 27.0 mOhm	1	$0.82	XAL6060 72 mm²
Rcomp	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbb	Vishay-Dale	CRCW040211K5FKED Series= CRCW..e3	Res= 11.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Panasonic	ERJ-6ENF6042V Series= ERJ-6E	Res= 60.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rpg	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rt	Vishay-Dale	CRCW0402226KFKED Series= CRCW..e3	Res= 226.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS54361DPRR	Switcher	1	$2.00	DPR0010A 25 mm^2

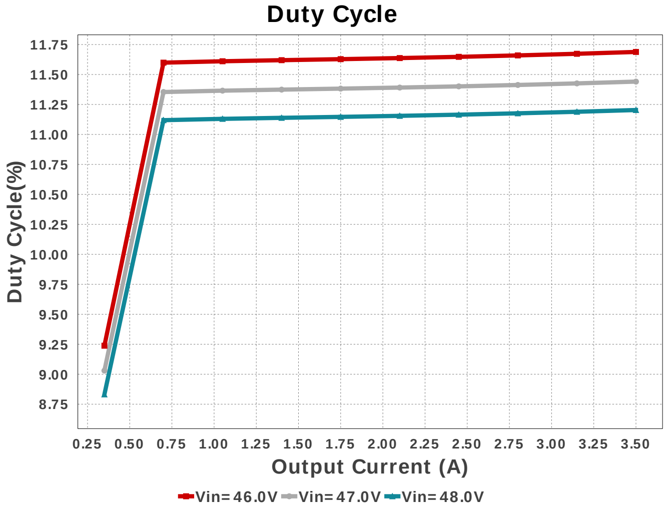
L Ipp



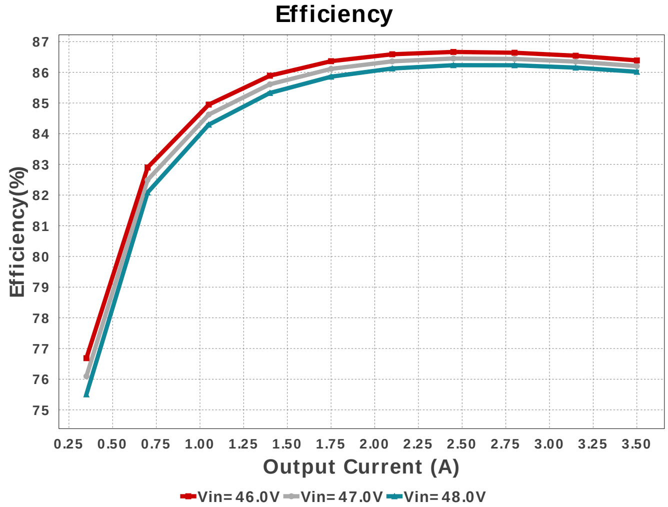
Vout p- p



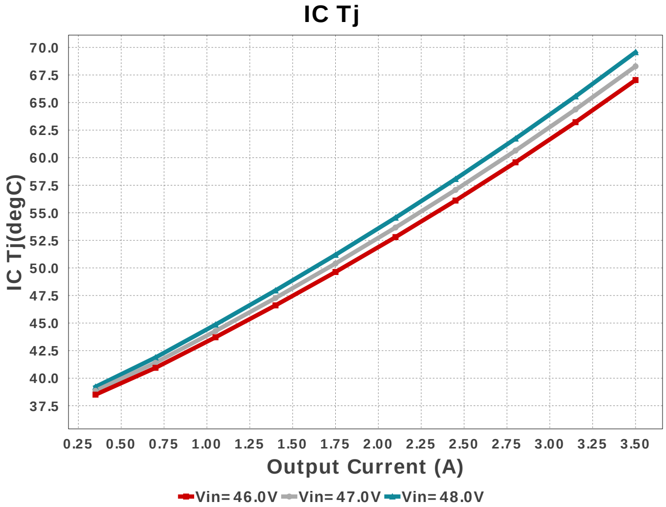
Duty Cycle



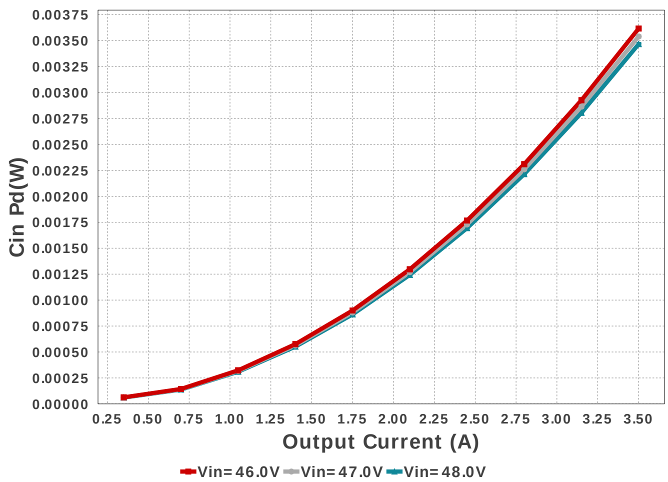
Efficiency



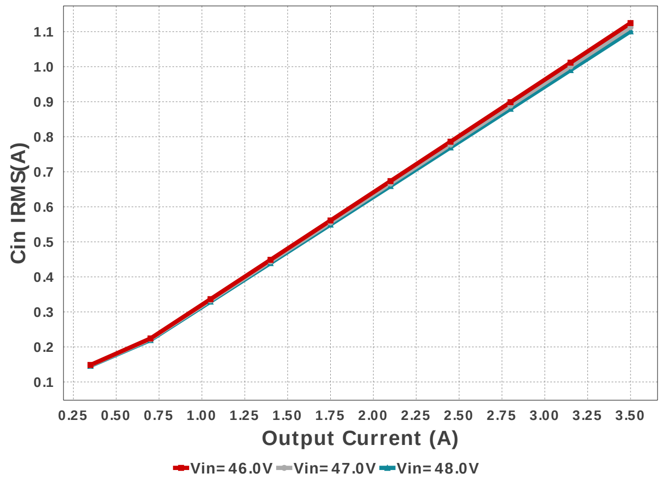
IC Tj



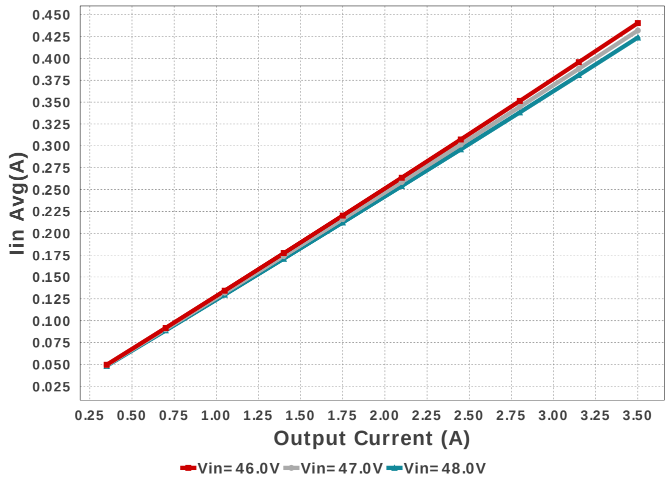
Cin Pd



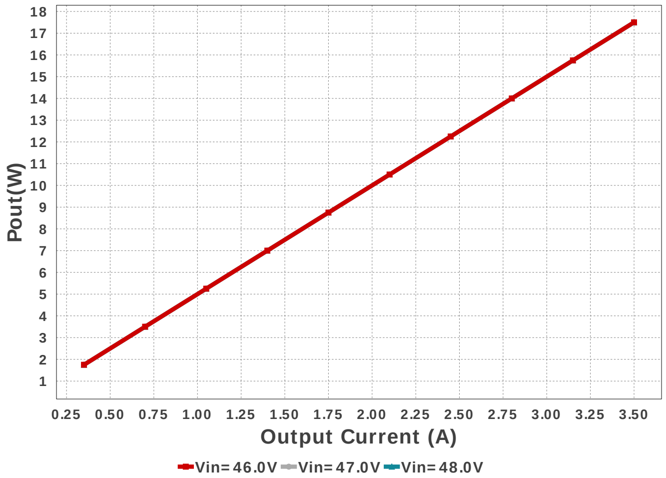
Cin IRMS



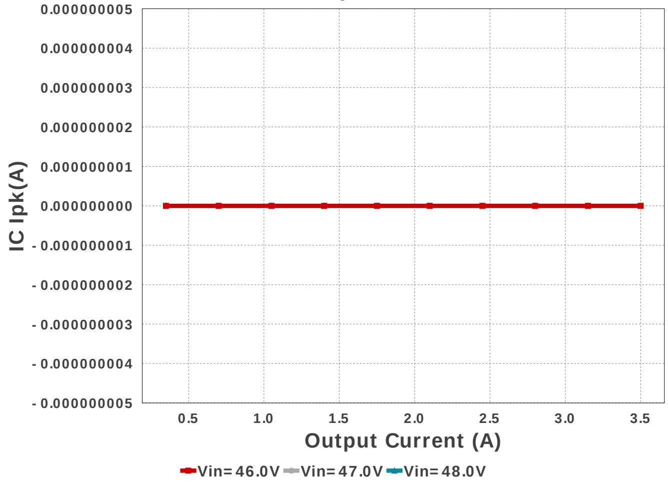
Iin Avg



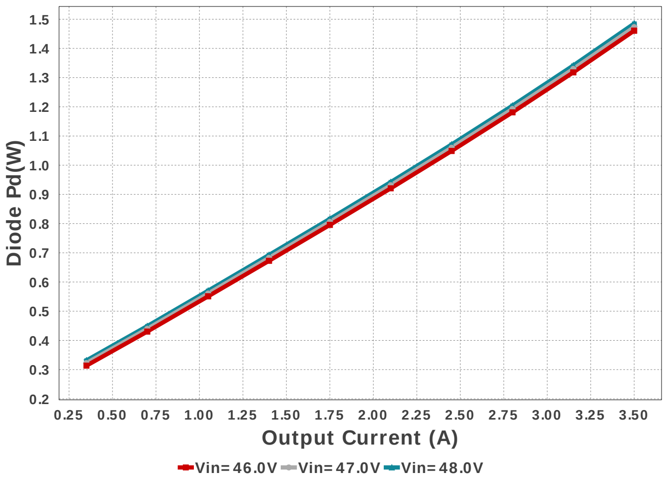
Pout



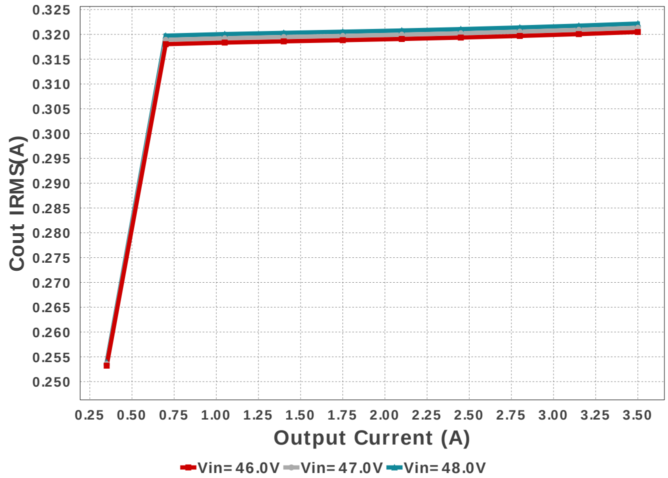
IC Ipk

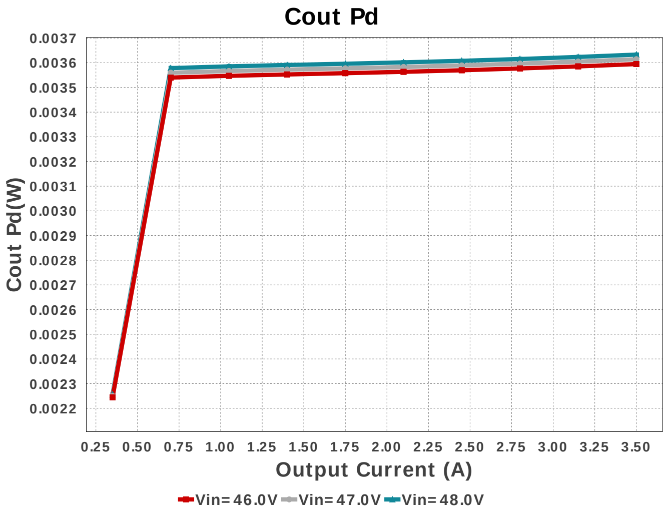


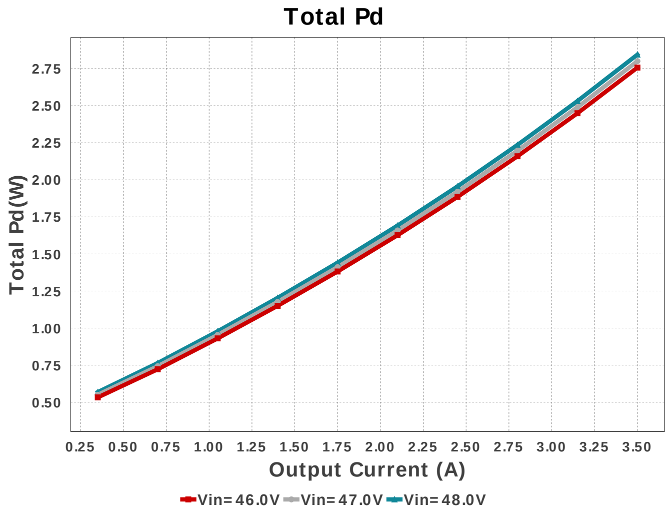
Diode Pd

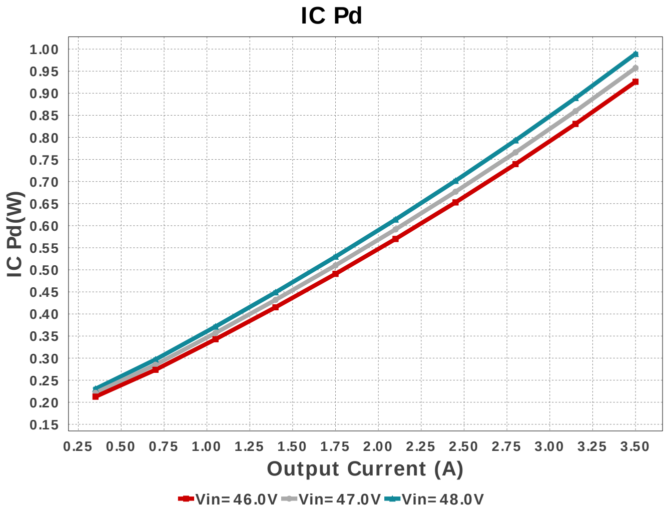


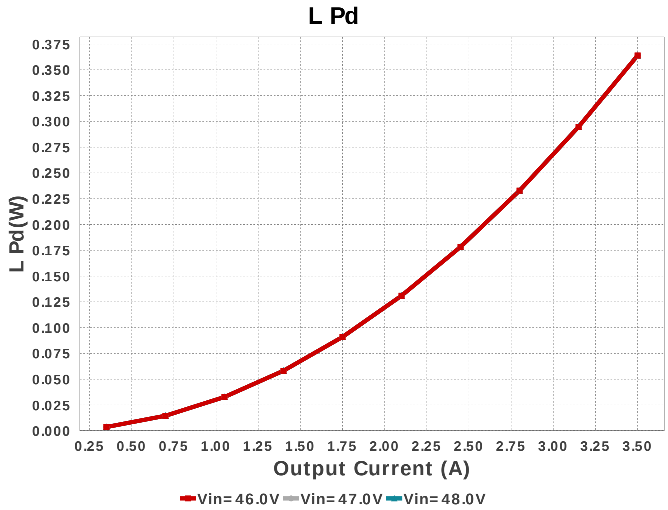
Cout IRMS

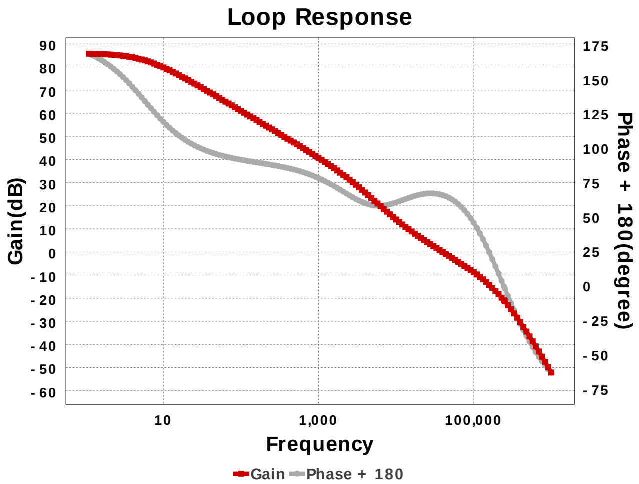












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.101 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	3.465 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	322.179 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	3.633 mW	Capacitor	Output capacitor power dissipation
5.	Diode Pd	1.485 W	Diode	Diode power dissipation
6.	IC Ipk	0.0 A	IC	Peak switch current in IC
7.	IC Pd	989.14 mW	IC	IC power dissipation
8.	IC Tj	69.566 degC	IC	IC junction temperature
9.	ICThetaJA Effective	40.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	423.86 mA	IC	Average input current
11.	L Ipp	1.116 A	Inductor	Peak-to-peak inductor ripple current

#	Name	Value	Category	Description
12.	L Pd	363.83 mW	Inductor	Inductor power dissipation
13.	Cin Pd	3.465 mW	Power	Input capacitor power dissipation
14.	Cout Pd	3.633 mW	Power	Output capacitor power dissipation
15.	Diode Pd	1.485 W	Power	Diode power dissipation
16.	IC Pd	989.14 mW	Power	IC power dissipation
17.	L Pd	363.83 mW	Power	Inductor power dissipation
18.	Total Pd	2.845 W	Power	Total Power Dissipation
19.	BOM Count	15	System Information	Total Design BOM count
20.	Cross Freq	39.566 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	11.204 %	System Information	Duty cycle
22.	Efficiency	86.016 %	System Information	Steady state efficiency
23.	FootPrint	226.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	431.663 kHz	System Information	Switching frequency
25.	Gain Marg	-20.937 dB	System Information	Bode Plot Gain Margin
26.	Iout	3.5 A	System Information	Iout operating point
27.	Low Freq Gain	85.762 dB	System Information	Gain at 1Hz
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	66.332 deg	System Information	Bode Plot Phase Margin
30.	Pout	17.5 W	System Information	Total output power
31.	Total BOM	$4.46	System Information	Total BOM Cost
32.	Vin	48.0 V	System Information	Vin operating point
33.	Vout	5.0 V	System Information	Operational Output Voltage
34.	Vout Actual	5.002 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	2.714 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	39.062 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.5	Maximum Output Current
VinMax	48.0	Maximum input voltage
VinMin	46.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS54361	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

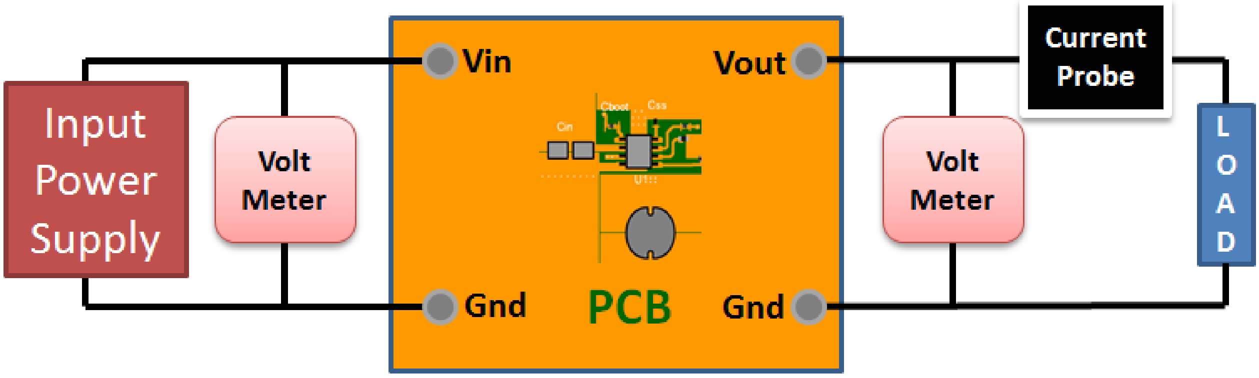
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 46.0V 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 : DC9BE5AA912B6F5A[v1]

2. **TPS54361** Product Folder : http://www.ti.com/product/TPS54361 : contains the data sheet and other resources.