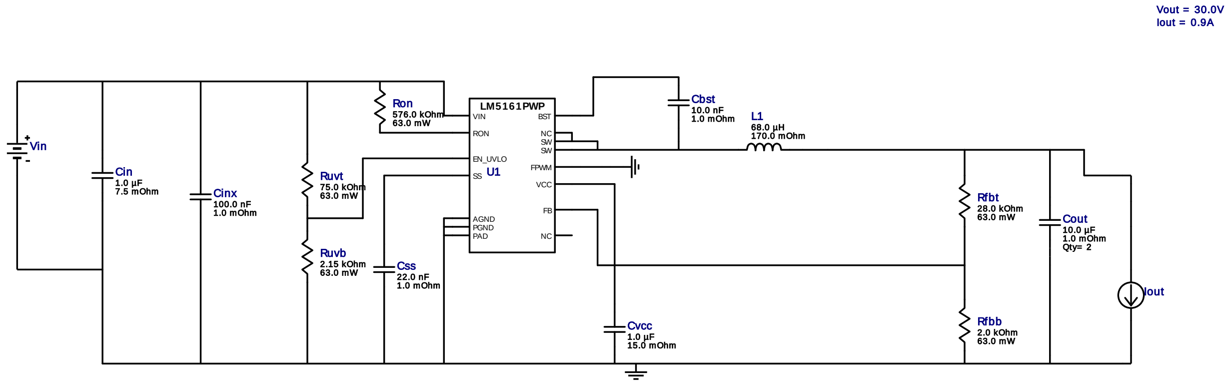
VinMin = 46.0V
VinMax = 49.0V
Vout = 30.0V
Iout = 0.9A

Device = LM5161PWPR
Topology = Buck
Created = 2020-11-03 01:47:27.922
BOM Cost = $2.69
BOM Count = 14
Total Pd = 1.44W

WEBENCH ® Design Report

Design : 4 LM5161PWPR
LM5161PWPR 46V-49V to 30.00V @ 0.9A

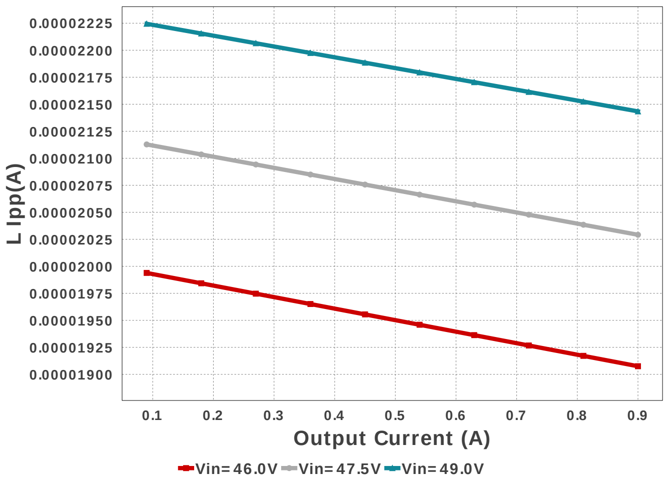


Electrical BOM

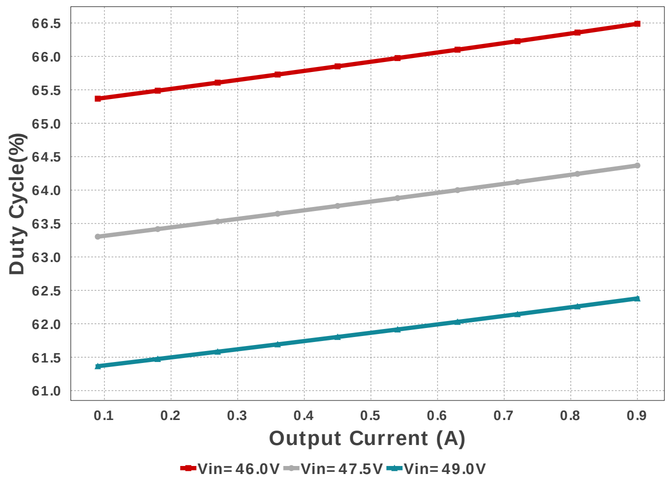
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM155R71H103KA88D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	TDK	C3216X7R2A105M160AA Series= X7R	Cap= 1.0 uF ESR= 7.5 mOhm VDC= 100.0 V IRMS= 5.9235 A	1	$0.12	1206 11 mm²
Cinx	MuRata	GRM188R72A104KA35D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 3.85 A	1	$0.05	0603 5 mm²
Cout	TDK	C3216X5R1H106K160AB Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.9 A	2	$0.26	1206_180 11 mm²
Css	MuRata	GRM155R71C223KA01D Series= X7R	Cap= 22.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cvcc	Kemet	C0805C105K4RACTU Series= X7R	Cap= 1.0 uF ESR= 15.0 mOhm VDC= 16.0 V IRMS= 8.19 A	1	$0.02	0805 7 mm²
L1	NIC Components	NPI34W680MTRF	L= 68.0 µH 170.0 mOhm	1	$0.32	IND_NPI34W 172 mm²
Rfbb	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW040228K0FKED Series= CRCW..e3	Res= 28.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Ron	Vishay-Dale	CRCW0402576KFKED Series= CRCW..e3	Res= 576.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Ruvb	Vishay-Dale	CRCW04022K15FKED Series= CRCW..e3	Res= 2.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Ruvt	Vishay-Dale	CRCW040275K0FKED Series= CRCW..e3	Res= 75.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LM5161PWPR	Switcher	1	$1.58	PWP0014A_N 59 mm²

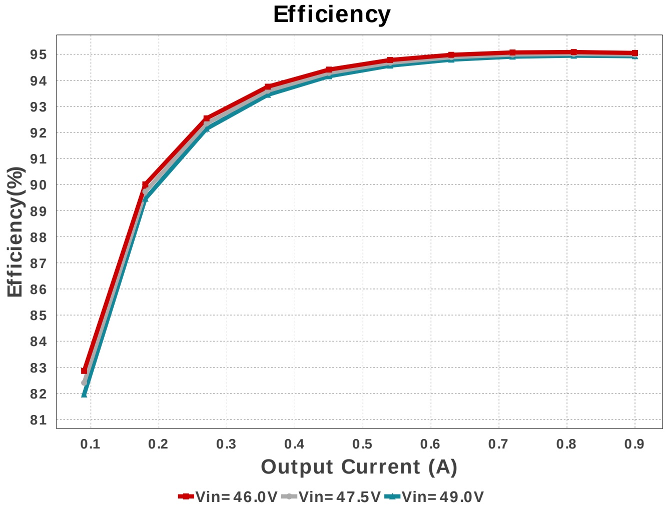
L Ipp



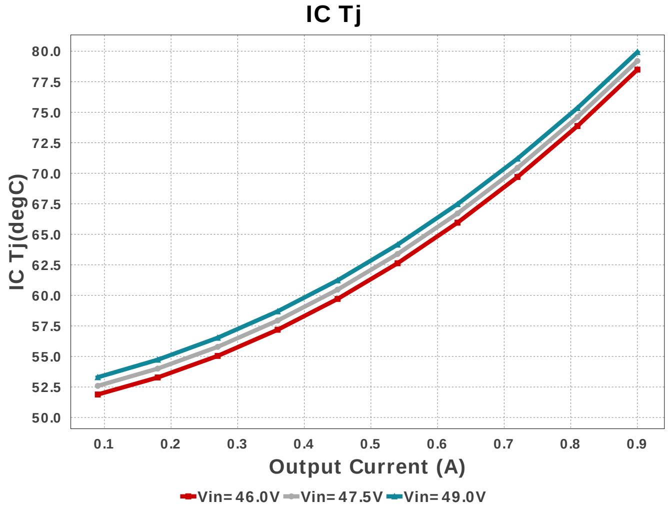
Duty Cycle



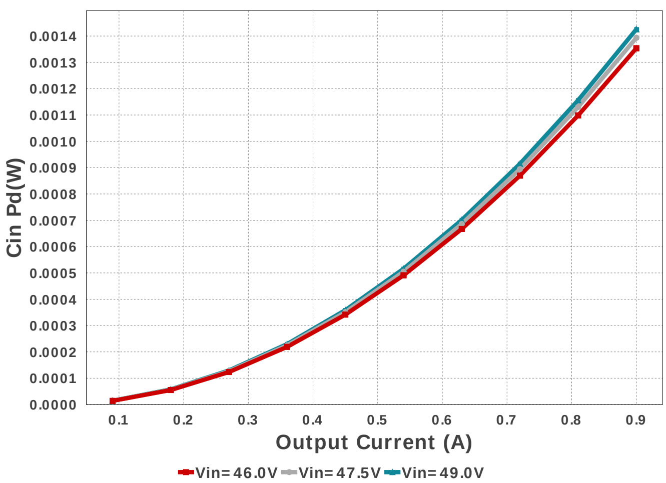
Efficiency



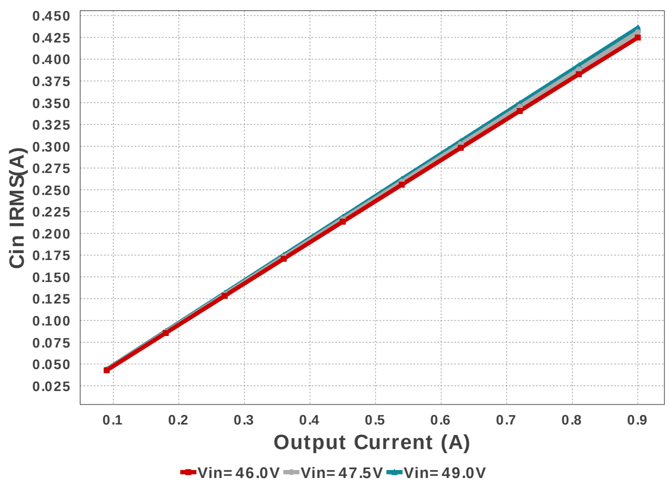
IC Tj



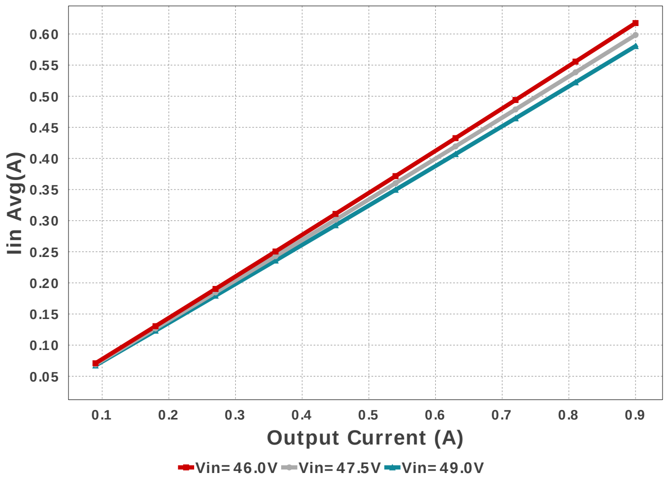
Cin Pd



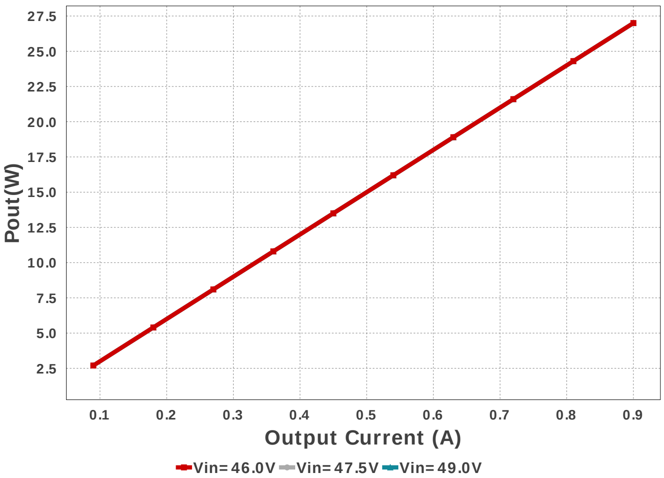
Cin IRMS



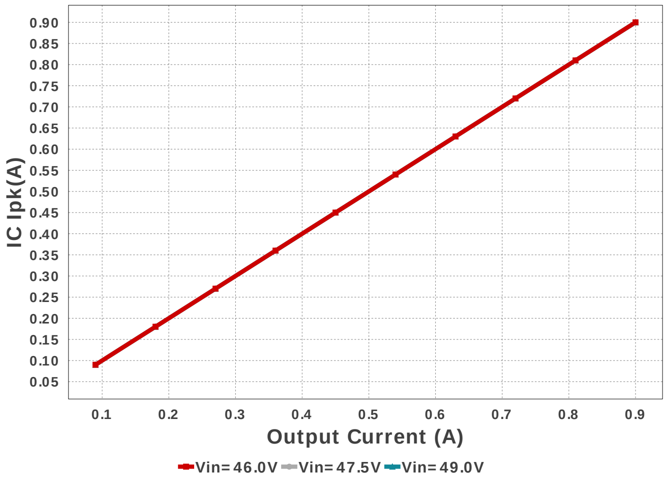
Iin Avg



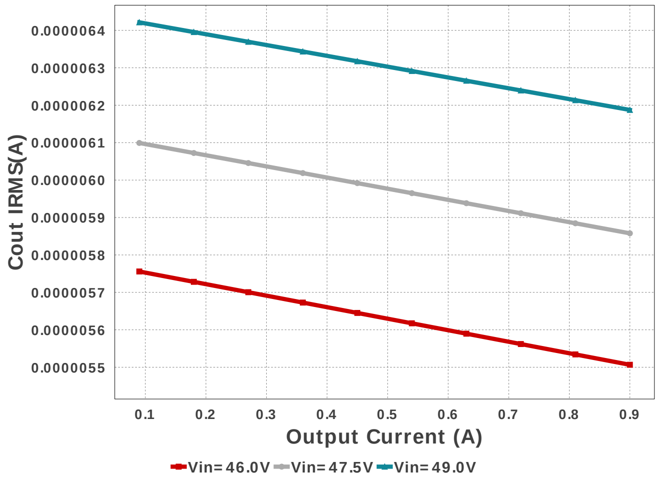
Pout



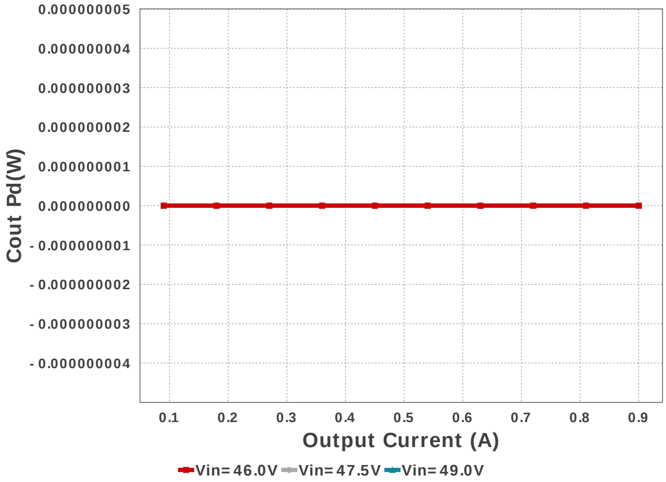
IC Ipk



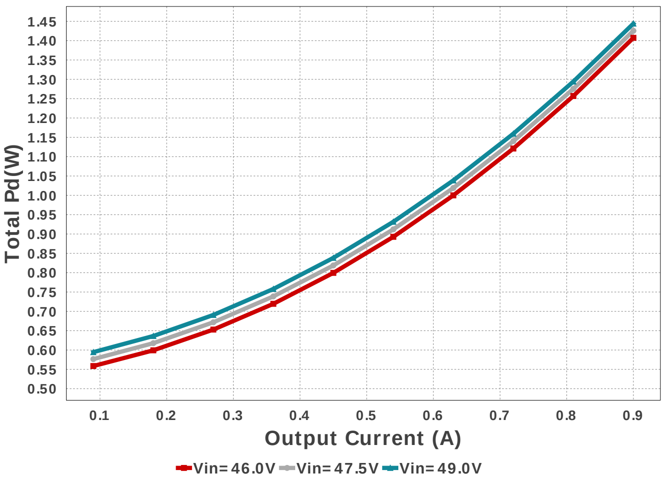
Cout IRMS

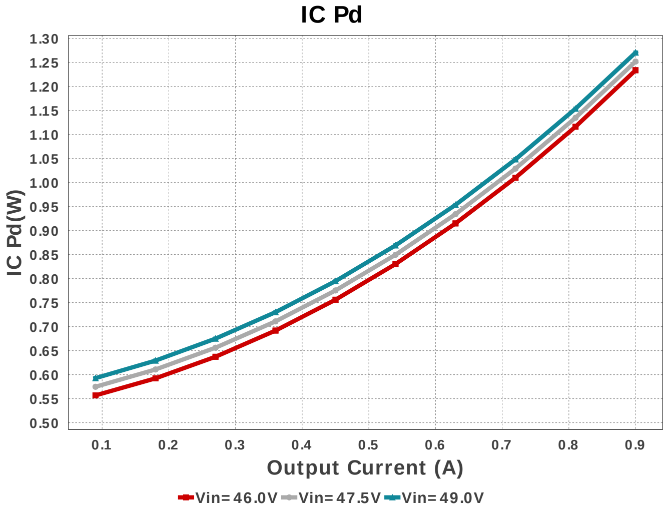


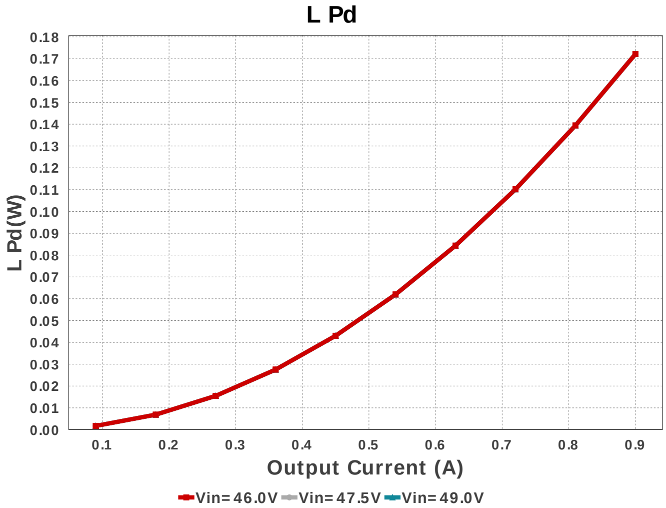
Cout Pd



Total Pd







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	435.991 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	1.426 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	6.187 µA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	19.142 fW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	900.011 mA	IC	Peak switch current in IC
6.	IC Pd	1.27 W	IC	IC power dissipation
7.	IC Tj	79.929 degC	IC	IC junction temperature
8.	ICThetaJA	39.3 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	580.49 mA	IC	Average input current
10.	L Ipp	21.434 µA	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	172.13 mW	Inductor	Inductor power dissipation
12.	Cin Pd	1.426 mW	Power	Input capacitor power dissipation
13.	Cout Pd	19.142 fW	Power	Output capacitor power dissipation
14.	IC Pd	1.27 W	Power	IC power dissipation
15.	L Pd	172.13 mW	Power	Inductor power dissipation
16.	Total Pd	1.444 W	Power	Total Power Dissipation
17.	BOM Count	14	System Information	Total Design BOM count
18.	Duty Cycle	62.379 %	System Information	Duty cycle
19.	Efficiency	94.923 %	System Information	Steady state efficiency
20.	FootPrint	296.0 mm^2	System Information	Total Foot Print Area of BOM components
21.	Frequency	520.833 kHz	System Information	Switching frequency
22.	Iout	900.0 mA	System Information	Iout operating point
23.	Mode	CCM	System Information	Conduction Mode
24.	Pout	27.0 W	System Information	Total output power
25.	Total BOM	$2.69	System Information	Total BOM Cost
26.	Vin	49.0 V	System Information	Vin operating point
27.	Vout	30.0 V	System Information	Operational Output Voltage
28.	Vout Actual	30.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
29.	Vout Tolerance	3.159 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

Name	Value	Description
Iout	900.0 m	Maximum Output Current
VinMax	49.0	Maximum input voltage
VinMin	46.0	Minimum input voltage
Vout	30.0	Output Voltage
base_pn	LM5161	Base Product Number
source	DC	Input Source Type

Name	Value	Description
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

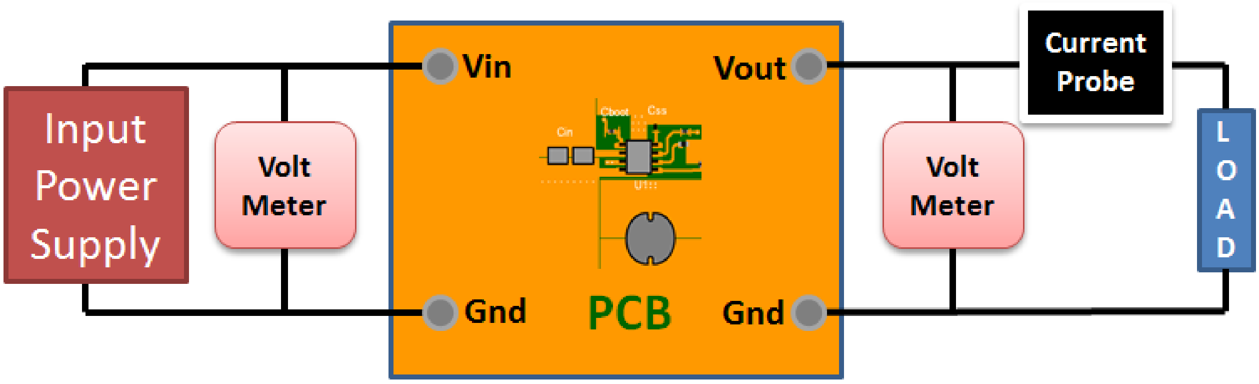
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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

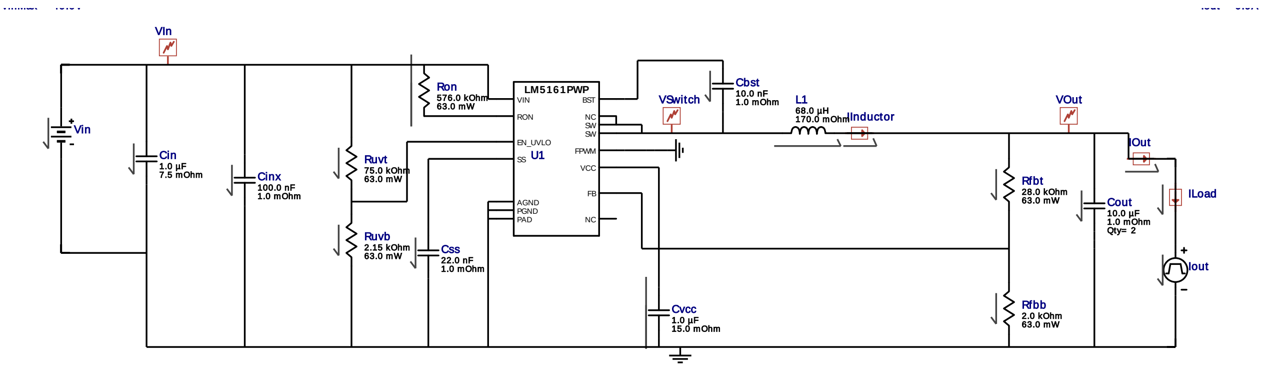


WEBENCH® Electrical Simulation Report

Design Id = 4

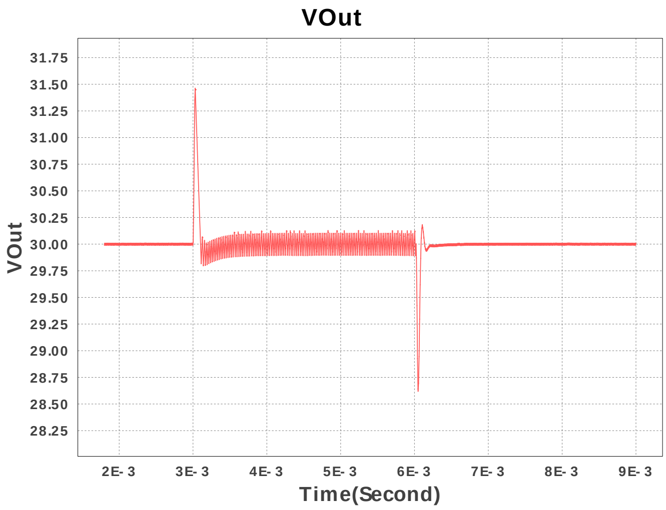
sim_id = 1

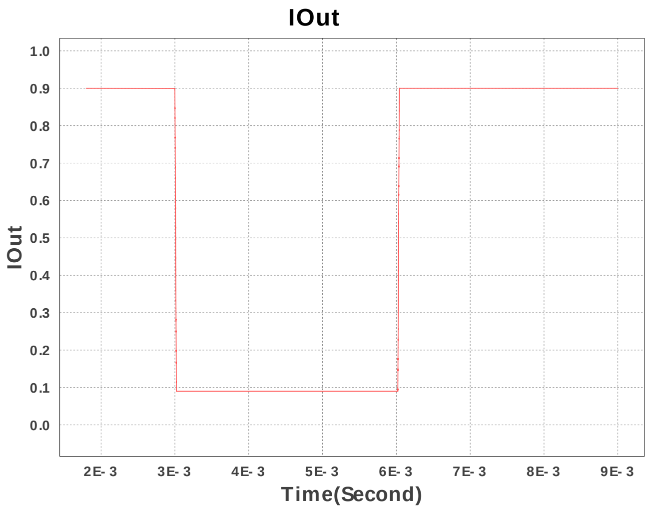
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Css	IC	Initial Voltage	1.96 V
2.	L1	IC	Initial Current	-0.9 V
3.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	0.9 A
		I2	Minimum Load Current	0.09 A
		Td	Initial Time Delay	0.003 s
		Tf	Fall Time	20u s
		Tr	Rise Time	20u s
		Pw	Pulse Width	0.003 s

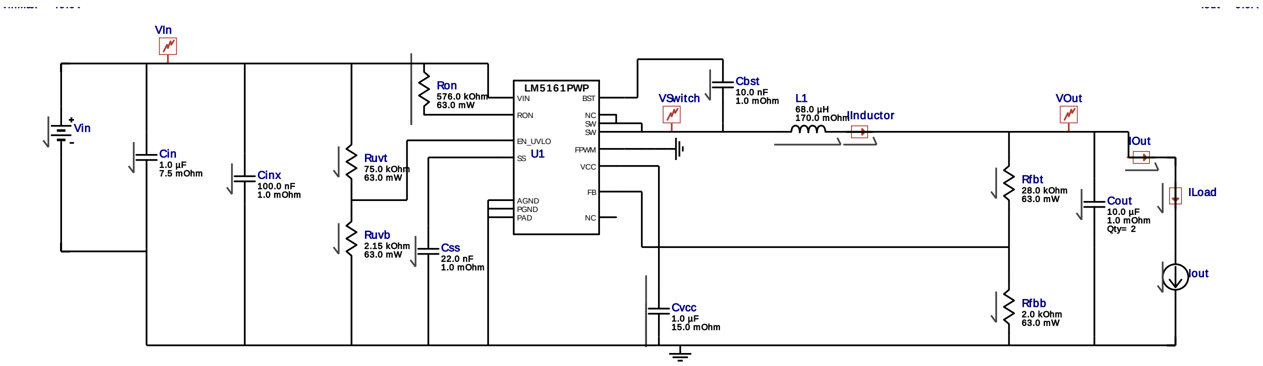




Design Id = 4

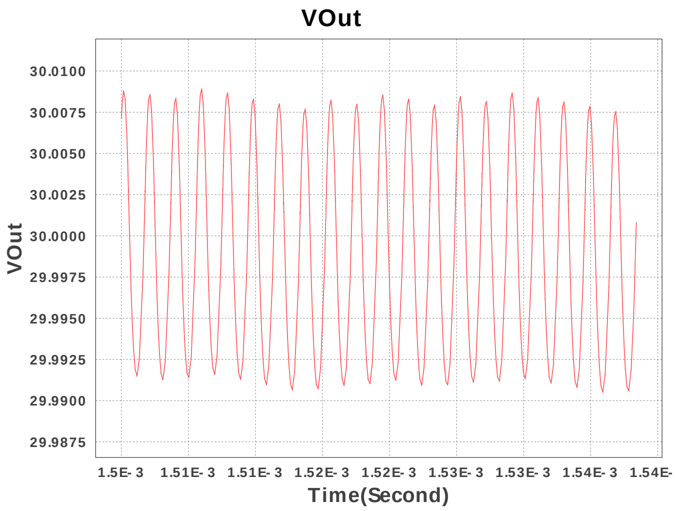
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Css	IC	Initial Voltage	1.96 V
2.	L1	IC	Initial Current	-0.9 A
3.	Iout	I	Load Current	0.9 A



Design Assistance

1. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'Optimal Solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple.

2. Master key : 6306BADE0F5211DD[v1]

3. **LM5161** Product Folder : http://www.ti.com/product/LM5161 : contains the data sheet and other resources.

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