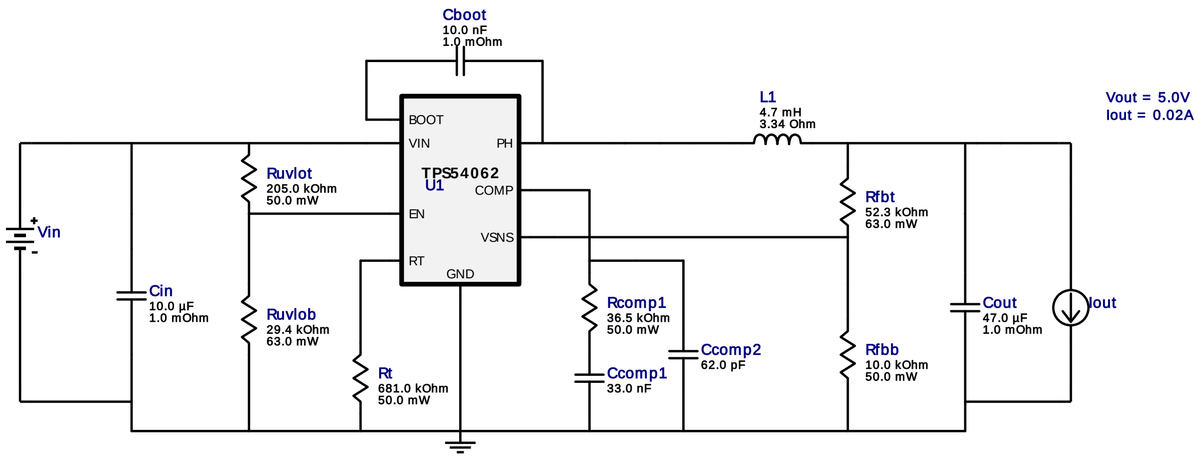
TEXAS INSTRUMENTS

WEBENCH ® Design Report

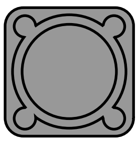
VinMin = 10.0V
VinMax = 40.0V
Vout = 5.0V
Iout = 0.02A

Device = TPS54062DGKR
Topology = Buck
Created = 2021-03-02 01:47:30.743
BOM Cost = $2.32
BOM Count = 13
Total Pd = 0.03W

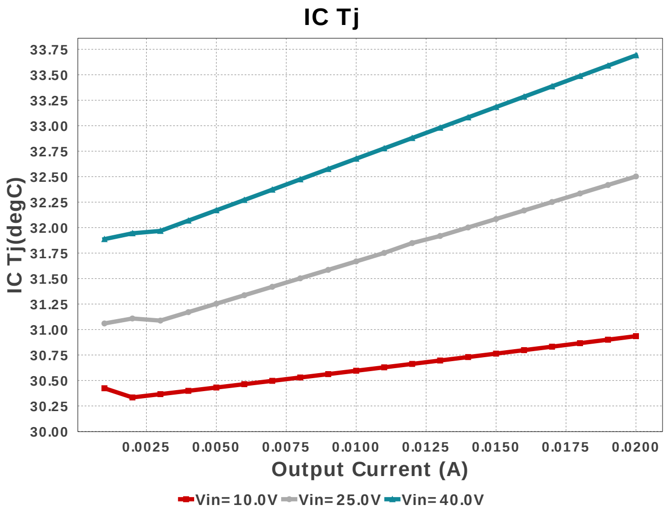
Design : 2 TPS54062DGKR
TPS54062DGKR 10V-40V to 5.00V @ 0.02A

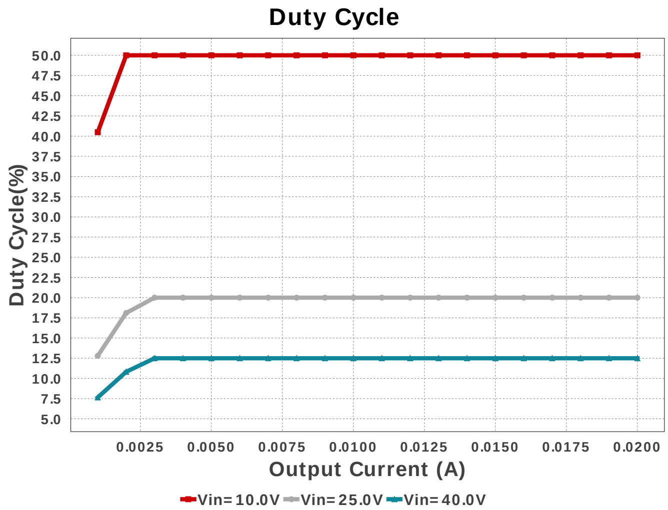


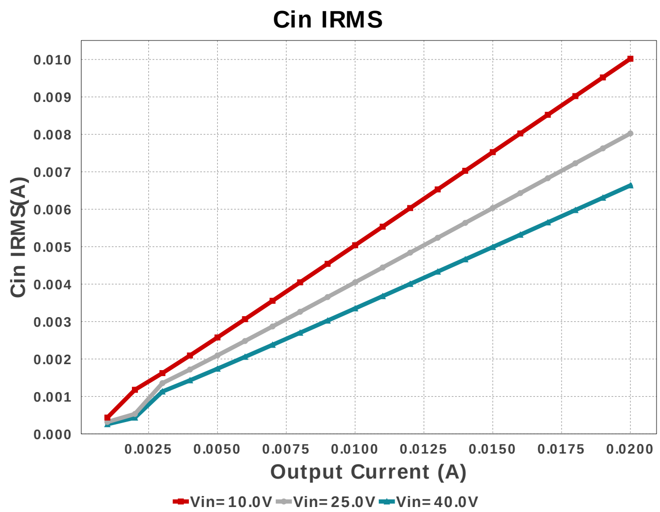
Electrical BOM

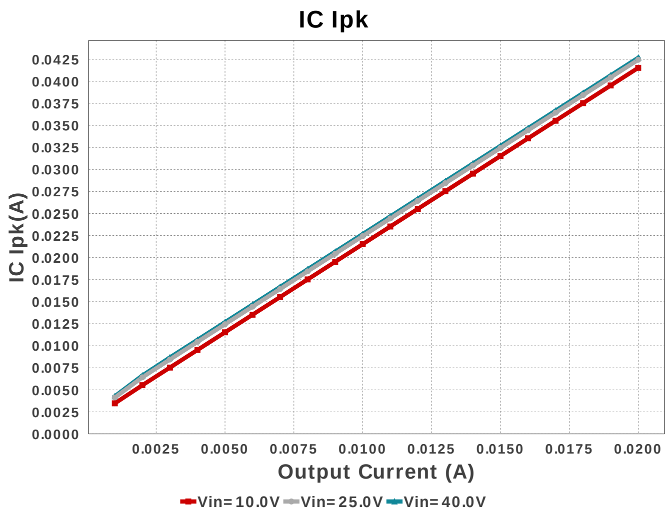
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp1	TDK	CGA4J2C0G1H333J125AA Series= C0G/NP0	Cap= 33.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.09	0805 7 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C620JBANNNC Series= C0G/NP0	Cap= 62.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cin	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	1	$0.28	1210 15 mm²
Cout	MuRata	GCM32ER70J476KE19L Series= X7R	Cap= 47.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 2.9 A	1	$0.40	1210_270 15 mm²
L1	Coilcraft	MSS1210-475KEB	L= 4.7 mH 3.34 Ohm	1	$0.81	 MSS1210 204 mm²
Rcomp1	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbb	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbt	Vishay-Dale	CRCW040252K3FKED Series= CRCW..e3	Res= 52.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

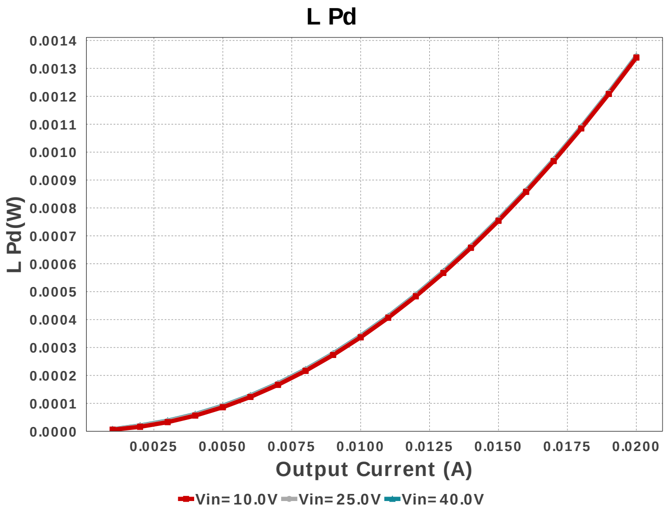
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rt	Yageo	RC0201FR-07681KL Series= ?	Res= 681.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Ruvlob	Vishay-Dale	CRCW040229K4FKED Series= CRCW..e3	Res= 29.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruvlot	Yageo	RC0201FR-07205KL Series= ?	Res= 205.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	TPS54062DGKR	Switcher	1	$0.66	MUA08A 24 mm^2

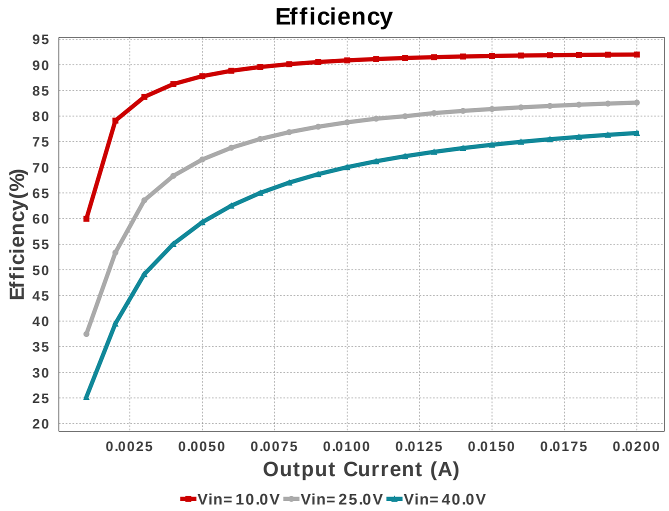


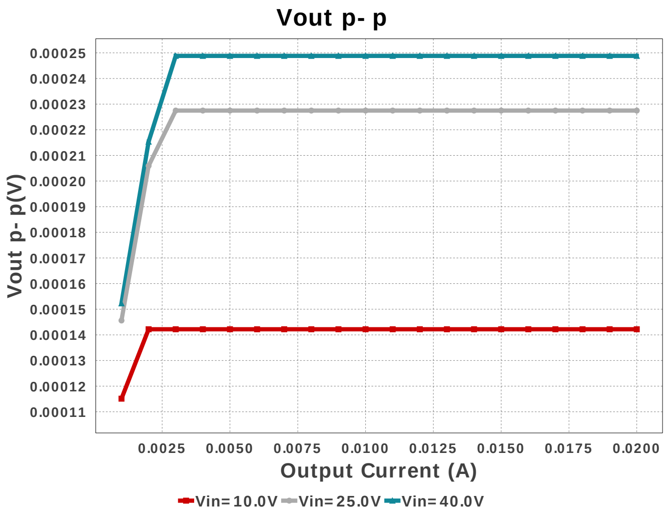


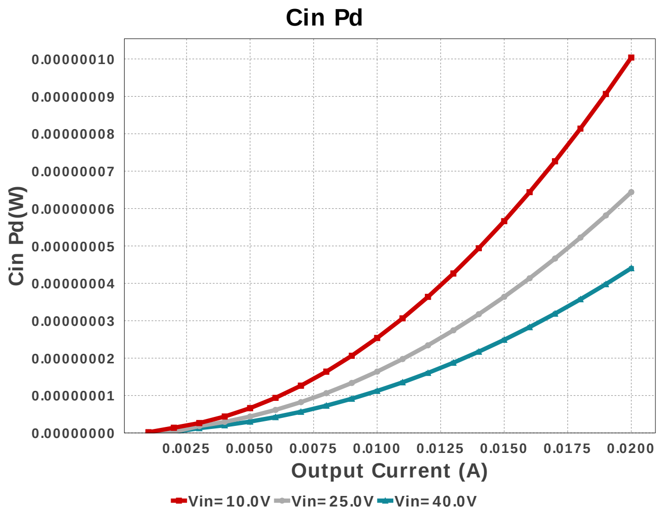


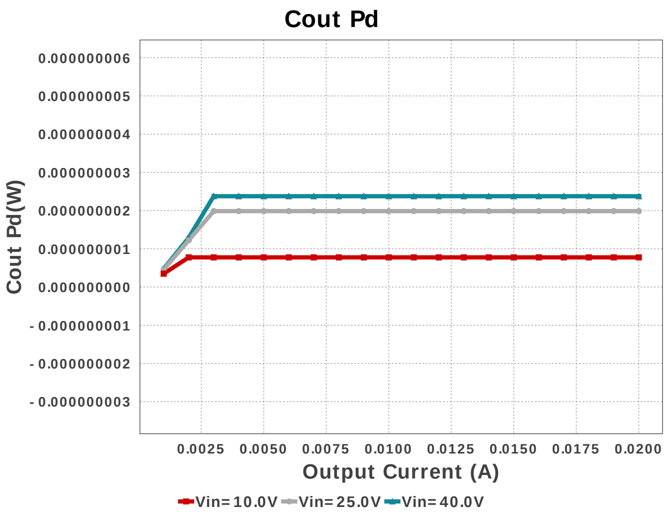


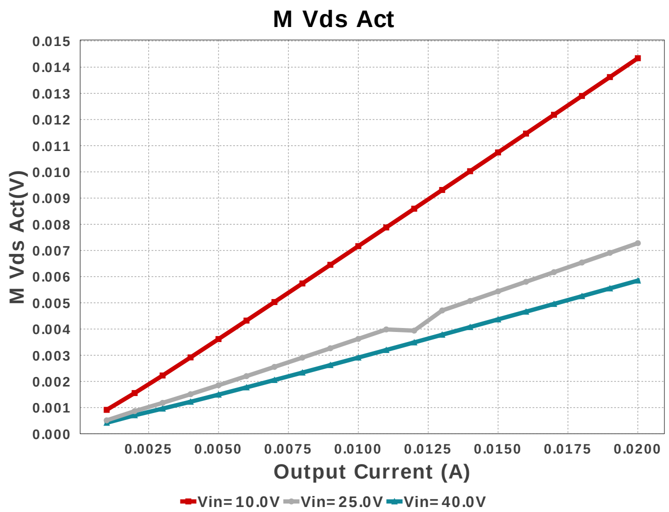

L Pd
L Pd(W)
Output Current (A)
Vin=10.0V
Vin=25.0V
Vin=40.0V

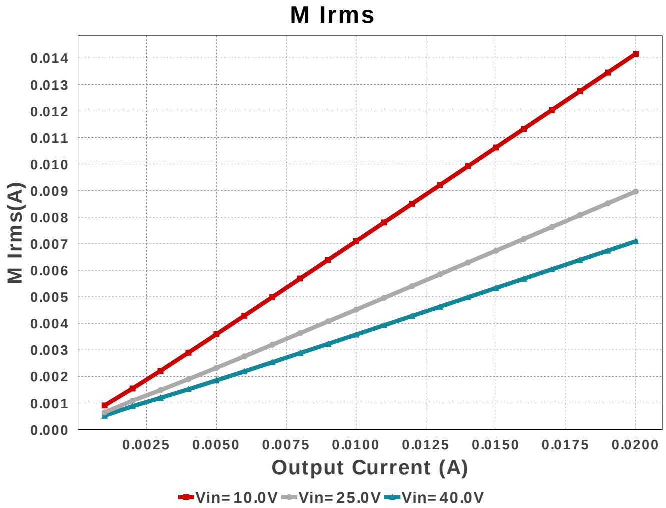

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.0V
Vin=25.0V
Vin=40.0V

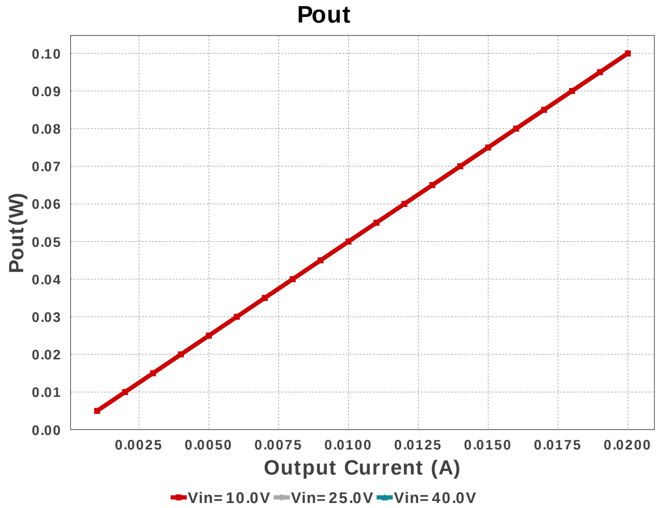

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.0V
Vin=25.0V
Vin=40.0V

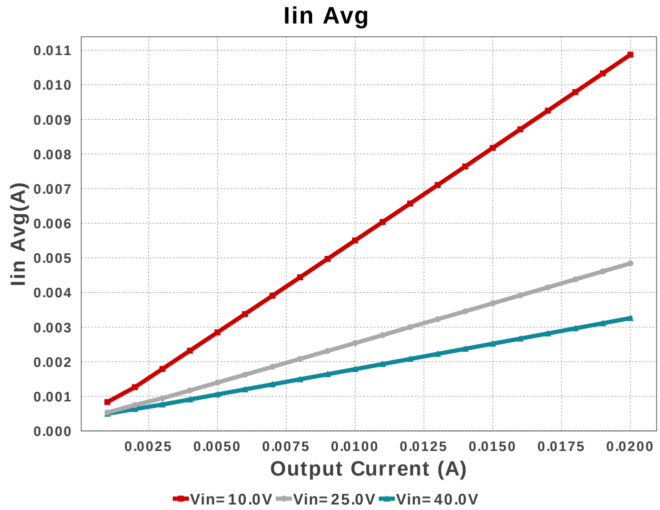

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V
Vin=25.0V
Vin=40.0V

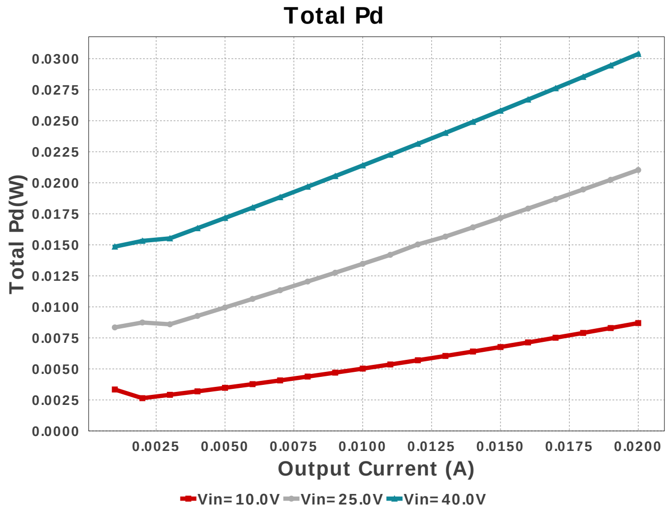

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.0V
Vin=25.0V
Vin=40.0V

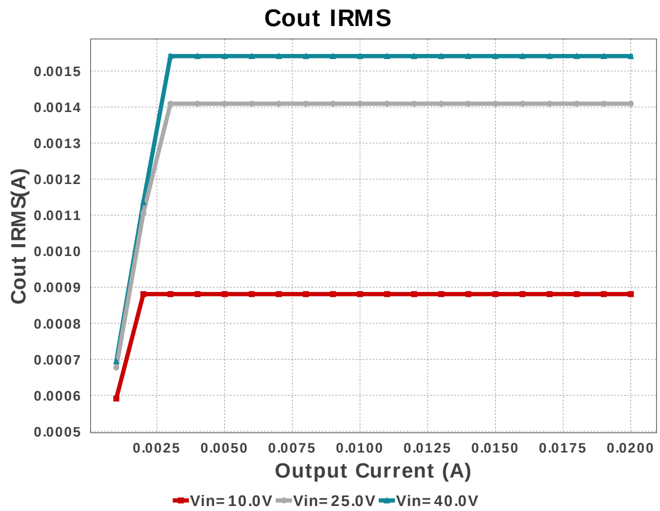

M Vds Act
M Vds Act(V)
Output Current (A)
Vin=10.0V
Vin=25.0V
Vin=40.0V

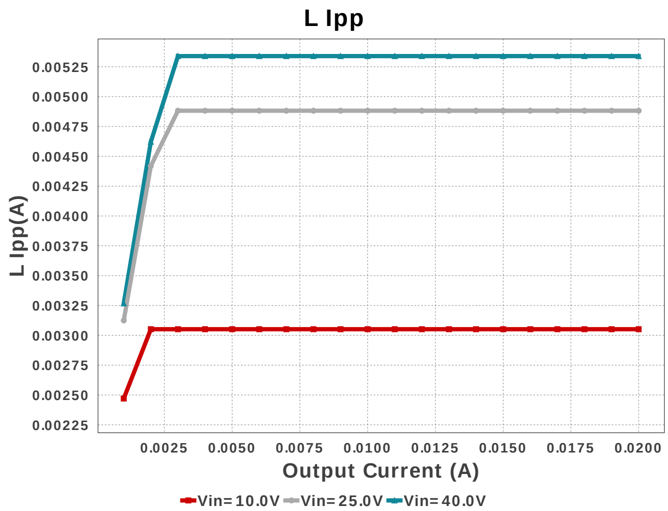

M Irms
M Irms(A)
Output Current (A)
Vin= 10.0V Vin= 25.0V Vin= 40.0V

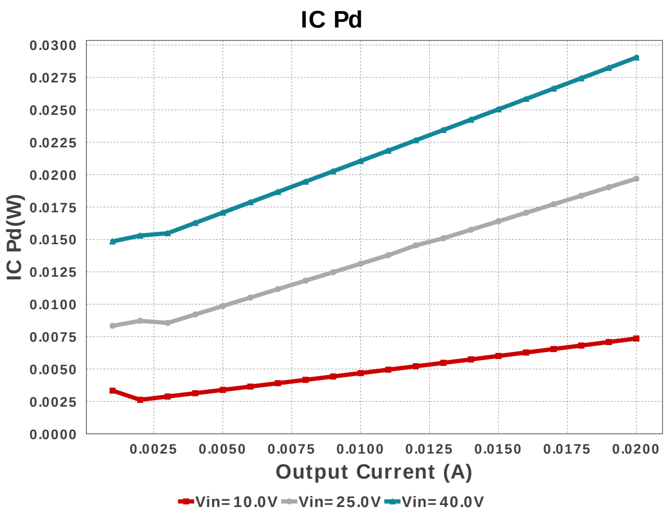

Pout
Pout(W)
Output Current (A)
Vin= 10.0V Vin= 25.0V Vin= 40.0V

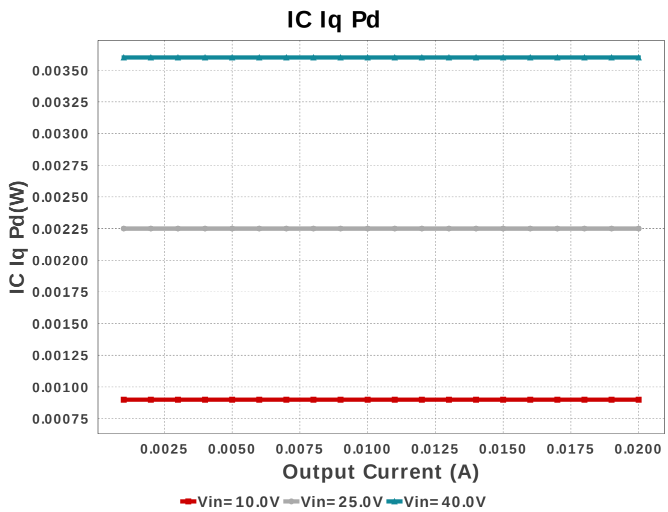

Iin Avg
Iin Avg(A)
Output Current (A)
Vin= 10.0V Vin= 25.0V Vin= 40.0V

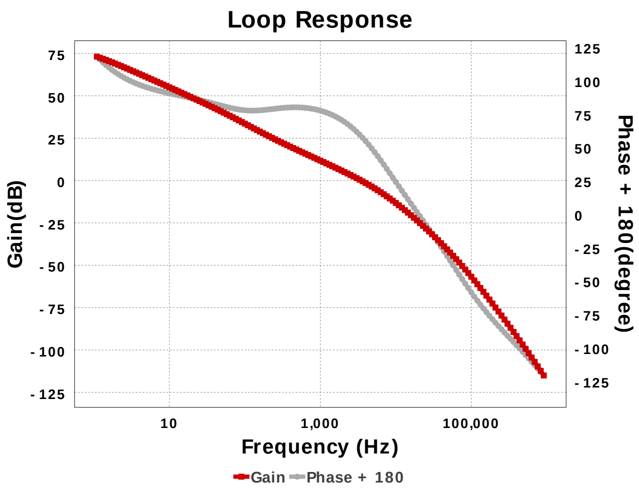

Total Pd
Total Pd(W)
Output Current (A)
Vin= 10.0V Vin= 25.0V Vin= 40.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin= 10.0V Vin= 25.0V Vin= 40.0V


L Ipp
L Ipp(A)
Output Current (A)
Vin= 10.0V Vin= 25.0V Vin= 40.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	6.637 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	44.047 nW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.541 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	2.376 nW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	42.67 mA	IC	Peak switch current in IC
6.	IC Iq Pd	3.6 mW	IC	IC Iq Pd
7.	IC Pd	29.04 mW	IC	IC power dissipation
8.	IC Tj	33.691 degC	IC	IC junction temperature
9.	IC Tolerance	20.0 mV	IC	IC Feedback Tolerance
10.	ICThetaJA	127.1 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	3.26 mA	IC	Average input current
12.	L Ipp	5.34 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	1.344 mW	Inductor	Inductor power dissipation
14.	M1 Irms	7.092 mA	Mosfet	Q Iavg
15.	M Vds Act	5.85 mV	Mosfet	Voltage drop across the MosFET
16.	Cin Pd	44.047 nW	Power	Input capacitor power dissipation
17.	Cout Pd	2.376 nW	Power	Output capacitor power dissipation
18.	IC Pd	29.04 mW	Power	IC power dissipation
19.	L Pd	1.344 mW	Power	Inductor power dissipation
20.	Total Pd	30.383 mW	Power	Total Power Dissipation
21.	BOM Count	13	System Information	Total Design BOM count
22.	Cross Freq	3.474 kHz	System Information	Bode plot crossover frequency
23.	Duty Cycle	12.5 %	System Information	Duty cycle
24.	Efficiency	76.697 %	System Information	Steady state efficiency
25.	FootPrint	288.0 mm^2	System Information	Total Foot Print Area of BOM components
26.	Frequency	174.328 kHz	System Information	Switching frequency

#	Name	Value	Category	Description
27.	Iout	20.0 mA	System Information	Iout operating point
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	59.299 deg	System Information	Bode Plot Phase Margin
30.	Pout	100.0 mW	System Information	Total output power
31.	Total BOM	$2.32	System Information	Total BOM Cost
32.	Vin	40.0 V	System Information	Vin operating point
33.	Vout	5.0 V	System Information	Operational Output Voltage
34.	Vout Actual	4.984 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	4.238 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	248.821 µV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	20.0 m	Maximum Output Current
VinMax	40.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS54062	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

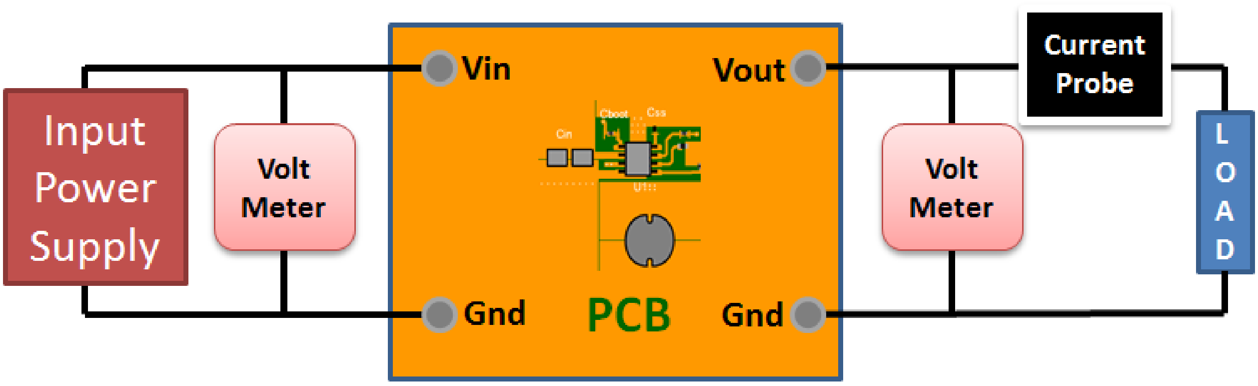
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.0V 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.

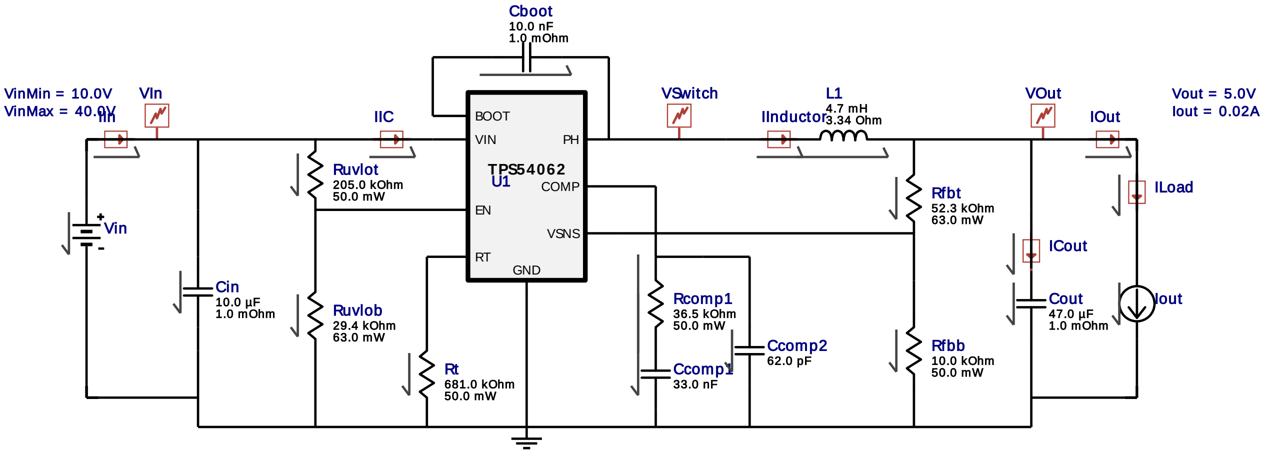


WEBENCH® Electrical Simulation Report

Design Id = 2

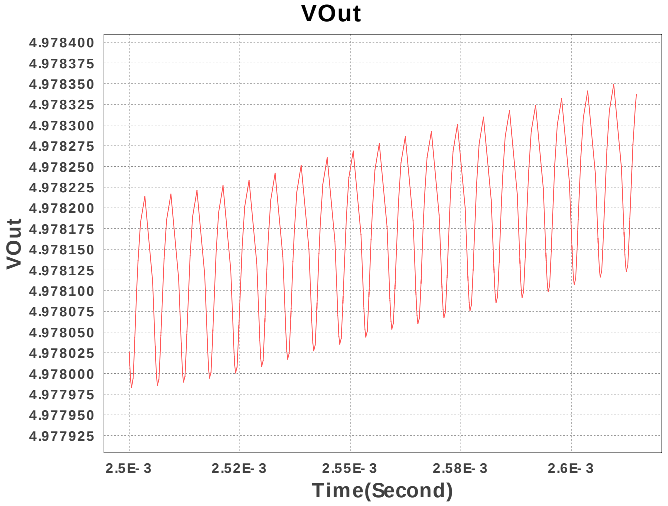
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	Initial Voltage	25.0
2.	L1	IC	Initial Condition	0.02
3.	Iout	I	Output Current	0.02 A



Design Assistance

1. Master key : D1E1B60D0D7FA94A[v1]

2. **TPS54062** Product Folder : http://www.ti.com/product/TPS54062 : contains the data sheet and other resources.

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