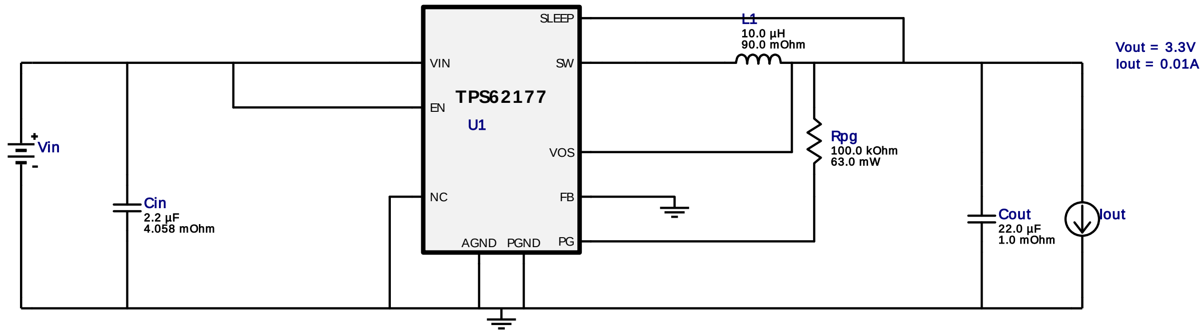
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 6.46V
VinMax = 7.0V
Vout = 3.3V
Iout = 0.01A

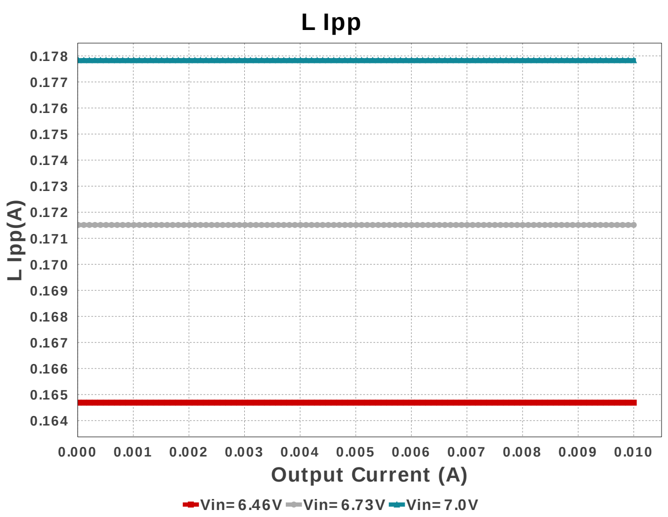
Device = TPS62177DQCR
Topology = Buck
Created = 2020-07-22 05:51:38.544
BOM Cost = $0.77
BOM Count = 5
Total Pd = 0.0W

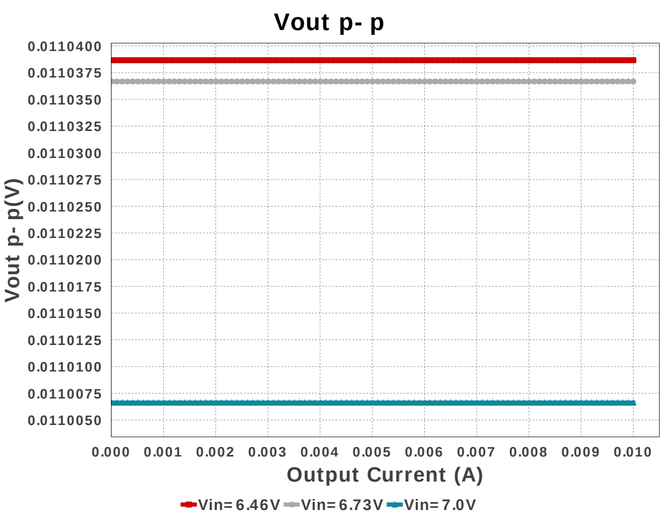
Design : 251 TPS62177DQCR
TPS62177DQCR 6.46V-7V to 3.30V @ 0.01A

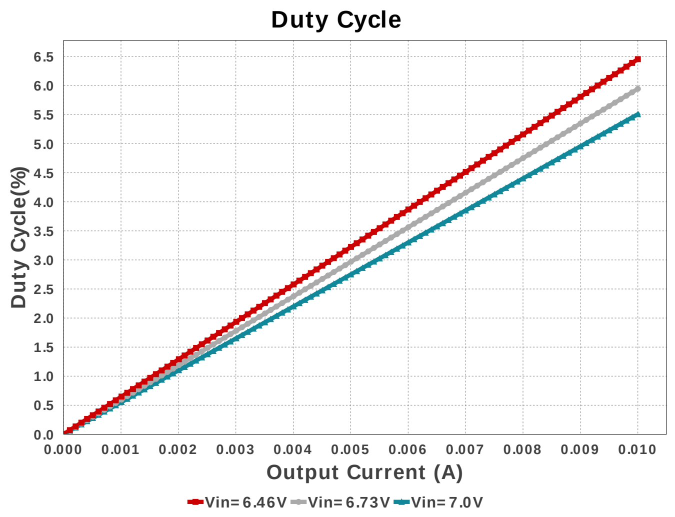


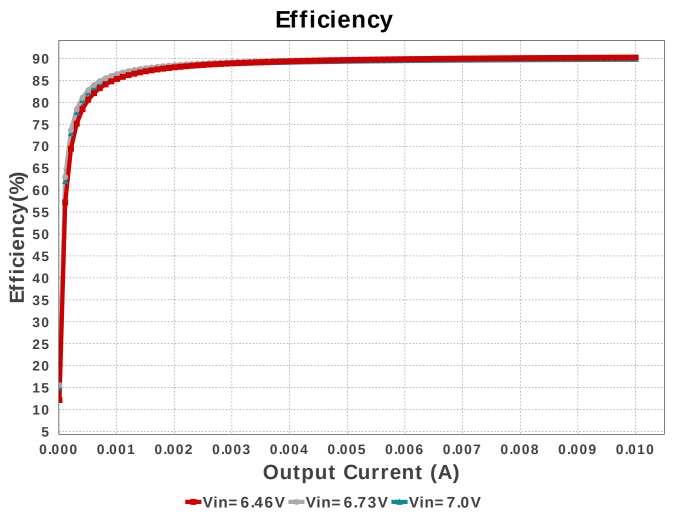
Electrical BOM

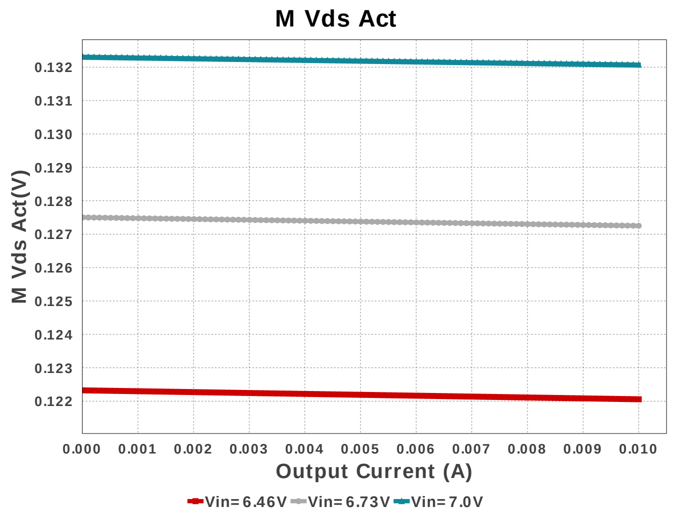
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	TDK	C1608X7R1A225K080AC Series= X7R	Cap= 2.2 uF ESR= 4.058 mOhm VDC= 10.0 V IRMS= 2.58266 A	1	$0.05	0603 5 mm²
Cout	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	$0.05	0603 5 mm²
L1	NIC Components	NPI54C100MTRF	L= 10.0 µH 90.0 mOhm	1	$0.18	IND_NPI54C 61 mm²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS62177DQCR	Switcher	1	$0.48	DQC0010A 12 mm²

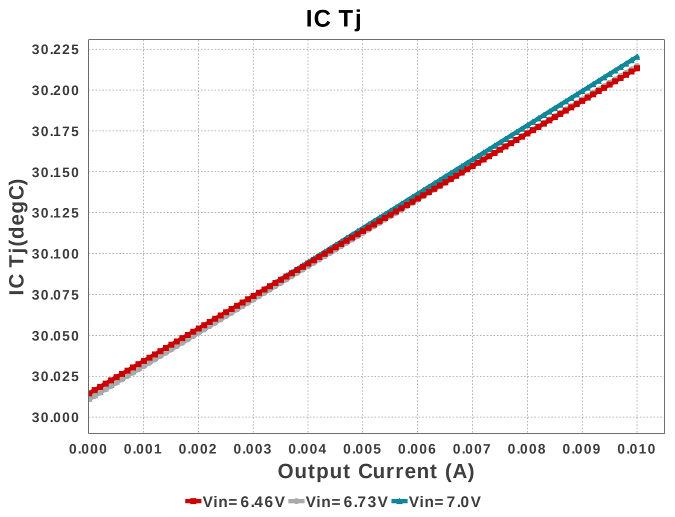


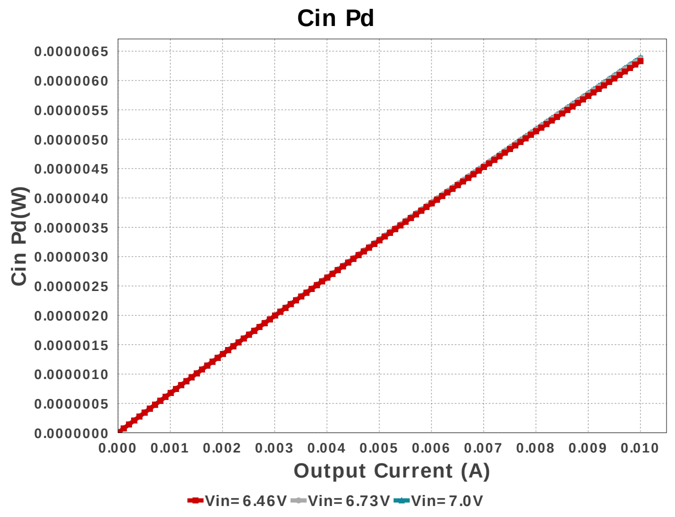


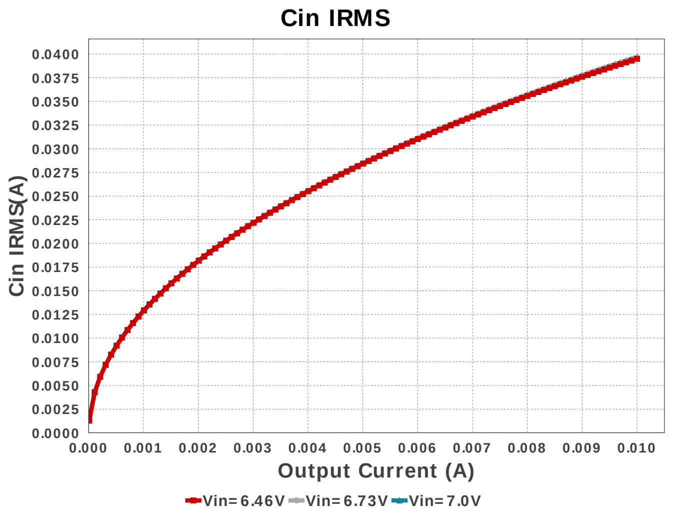

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

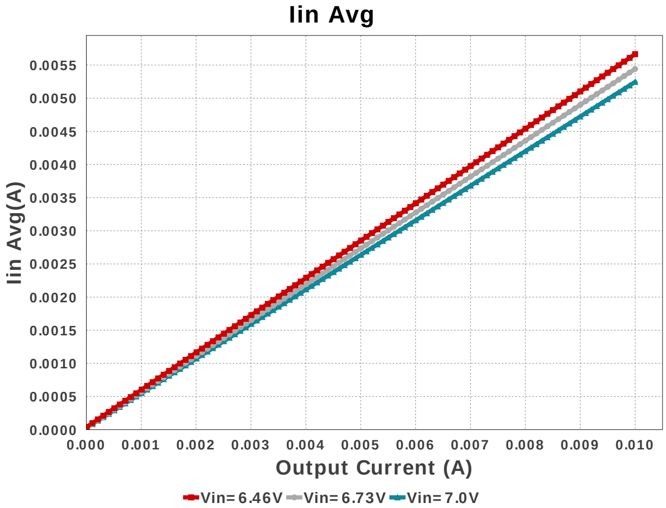

Efficiency
Efficiency(%)
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

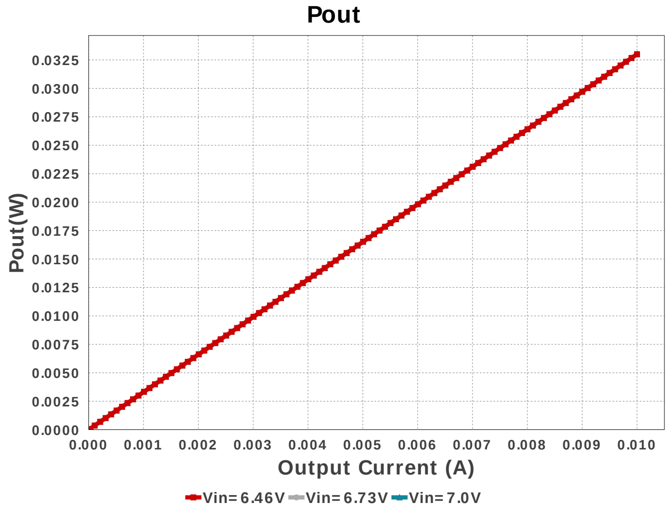

M Vds Act
M Vds Act(V)
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

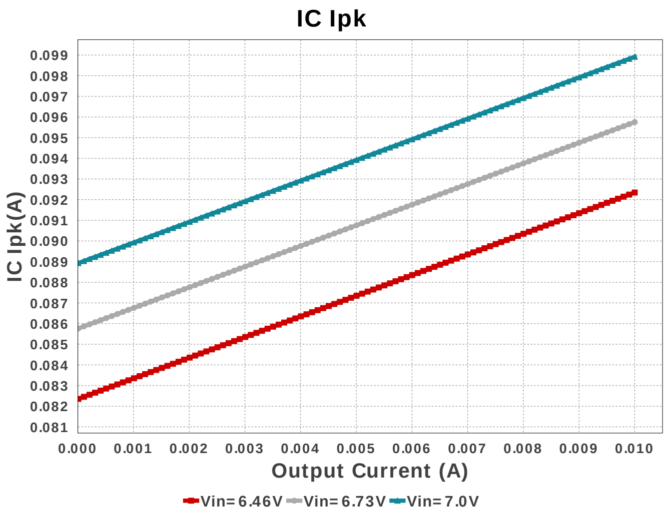

IC Tj
IC Tj(degC)
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

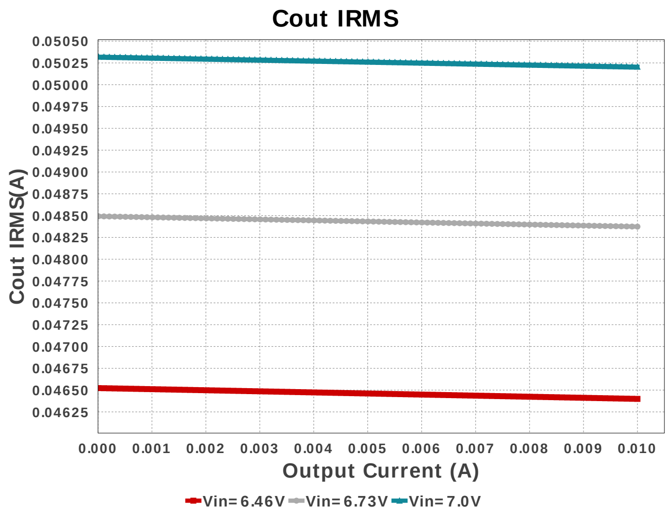

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

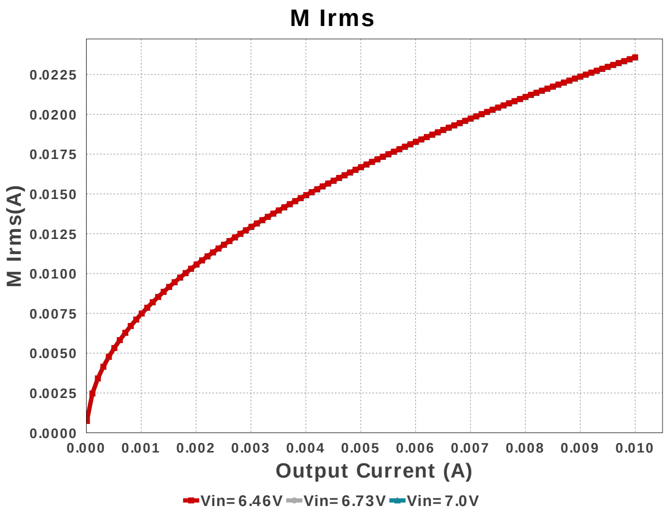

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

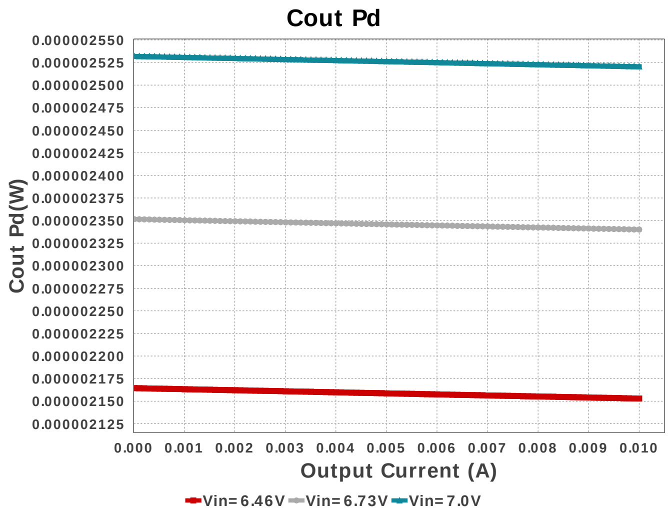

Iin Avg
Iin Avg(A)
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
0.0040
0.0045
0.0050
0.0055
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

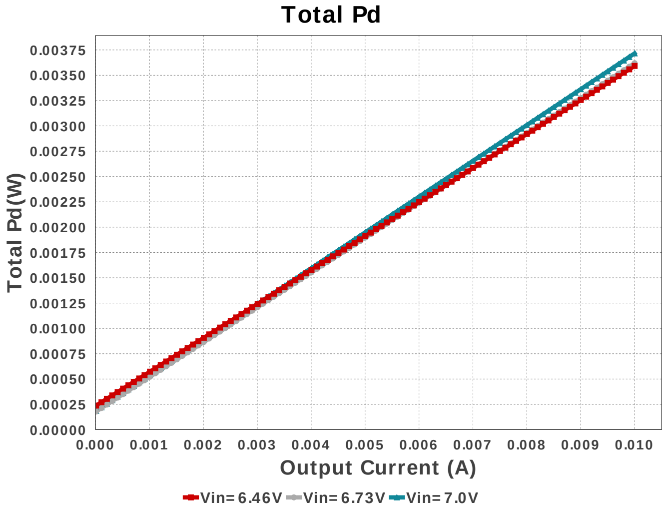

Pout
Pout(W)
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
0.0225
0.0250
0.0275
0.0300
0.0325
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

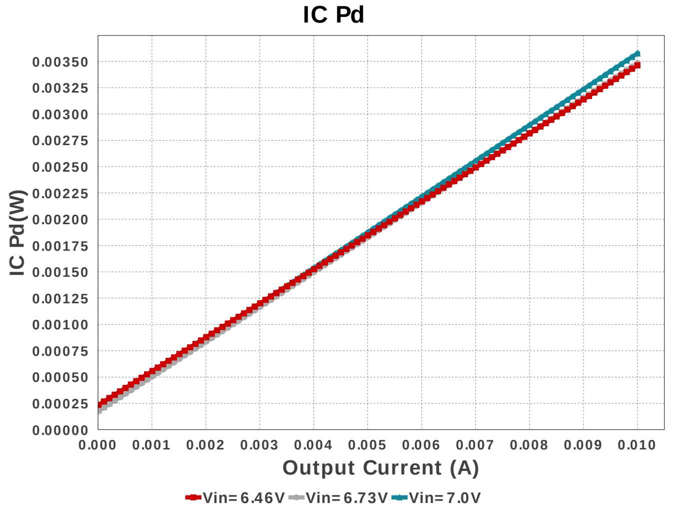

IC Ipk
IC Ipk(A)
0.081
0.082
0.083
0.084
0.085
0.086
0.087
0.088
0.089
0.090
0.091
0.092
0.093
0.094
0.095
0.096
0.097
0.098
0.099
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

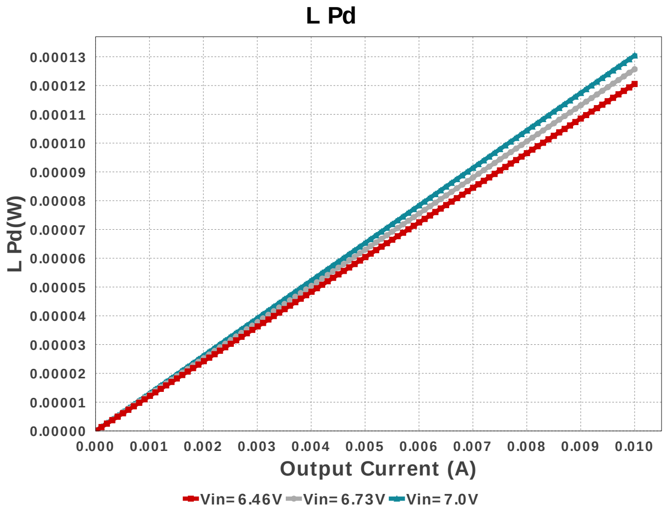

Cout IRMS
Cout IRMS(A)
0.04625
0.04650
0.04675
0.04700
0.04725
0.04750
0.04775
0.04800
0.04825
0.04850
0.04875
0.04900
0.04925
0.04950
0.04975
0.05000
0.05025
0.05050
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V

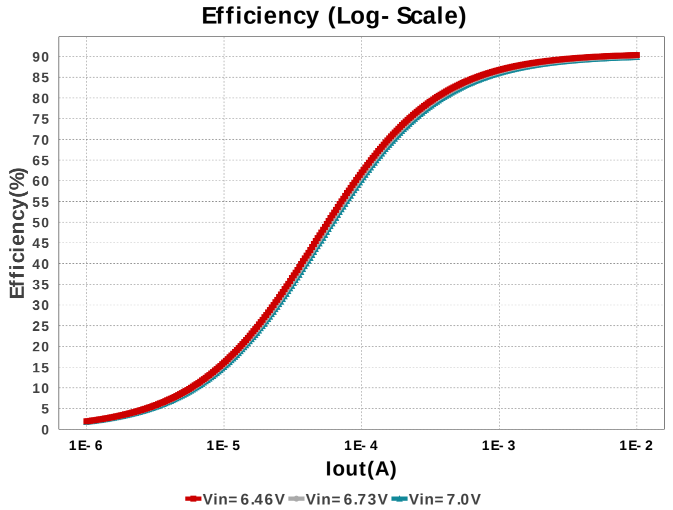

M Irms
M Irms(A)
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
0.0225
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V


Cout Pd
Cout Pd(W)
0.000002125
0.000002150
0.000002175
0.000002200
0.000002225
0.000002250
0.000002275
0.000002300
0.000002325
0.000002350
0.000002375
0.000002400
0.000002425
0.000002450
0.000002475
0.000002500
0.000002525
0.000002550
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010
Output Current (A)
Vin=6.46V Vin=6.73V Vin=7.0V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	39.676 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	6.388 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	50.206 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	2.521 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	98.917 mA	IC	Peak switch current in IC
6.	IC Pd	3.576 mW	IC	IC power dissipation
7.	IC Tj	30.22 degC	IC	IC junction temperature
8.	ICThetaJA	61.6 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	5.245 mA	IC	Average input current
10.	L Ipp	177.83 mA	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	130.44 µW	Inductor	Inductor power dissipation
12.	M1 Irms	23.565 mA	Mosfet	Q Iavg
13.	M Vds Act	132.074 mV	Mosfet	Voltage drop across the MosFET
14.	Cin Pd	6.388 µW	Power	Input capacitor power dissipation
15.	Cout Pd	2.521 µW	Power	Output capacitor power dissipation
16.	IC Pd	3.576 mW	Power	IC power dissipation
17.	L Pd	130.44 µW	Power	Inductor power dissipation
18.	Total Pd	3.716 mW	Power	Total Power Dissipation
19.	BOM Count	5	System Information	Total Design BOM count
20.	Duty Cycle	5.508 %	System Information	Duty cycle
21.	Efficiency	89.879 %	System Information	Steady state efficiency
22.	FootPrint	85.0 mm^2	System Information	Total Foot Print Area of BOM components
23.	Frequency	114.593 kHz	System Information	Switching frequency
24.	Iout	10.0 mA	System Information	Iout operating point
25.	Mode	DCM	System Information	Conduction Mode

#	Name	Value	Category	Description
26.	Pout	33.0 mW	System Information	Total output power
27.	Total BOM	$0.77	System Information	Total BOM Cost
28.	Vin	7.0 V	System Information	Vin operating point
29.	Vout	3.3 V	System Information	Operational Output Voltage
30.	Vout Tolerance	2.0 %	System Information	Vout Tolerance based on IC Tolerance (full load) and voltage divider resistors if applicable
31.	Vout p-p	11.007 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	10.0 m	Maximum Output Current
VinMax	7.0	Maximum input voltage
VinMin	6.46	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS62177	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

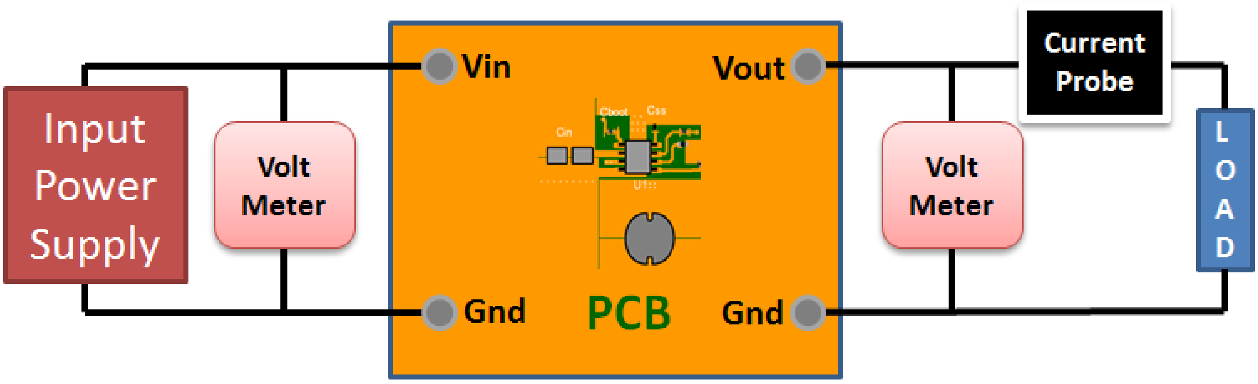
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 6.46V 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.

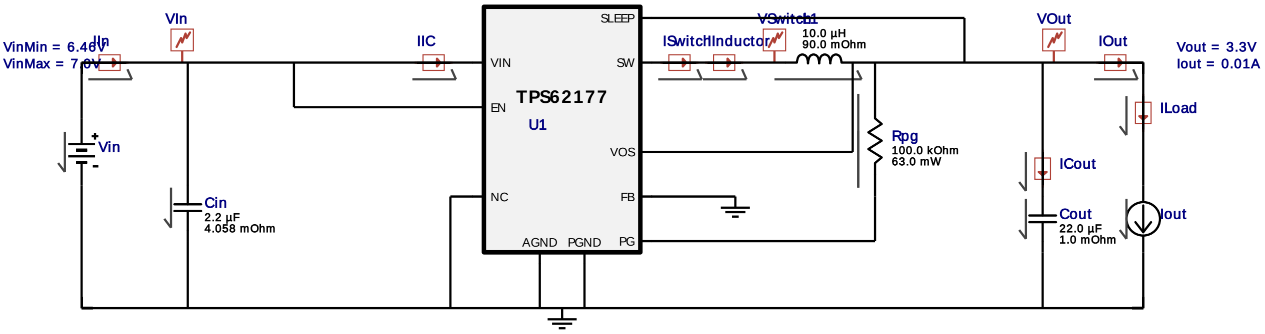


WEBENCH® Electrical Simulation Report

Design Id = 251

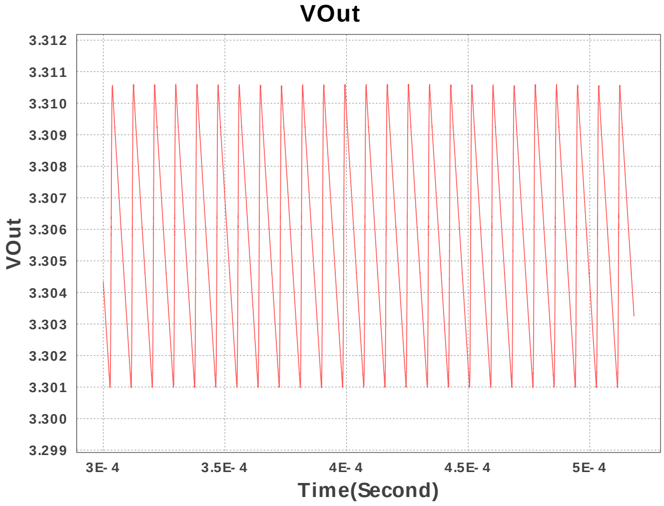
sim_id = 1

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	-0.01 V
2.	Iout	I	Load Current	0.01 A



Design Assistance

1. Master key : AAAA7BB5CA410B0C[v1]

2. **TPS62177** Product Folder : http://www.ti.com/product/TPS62177 : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.