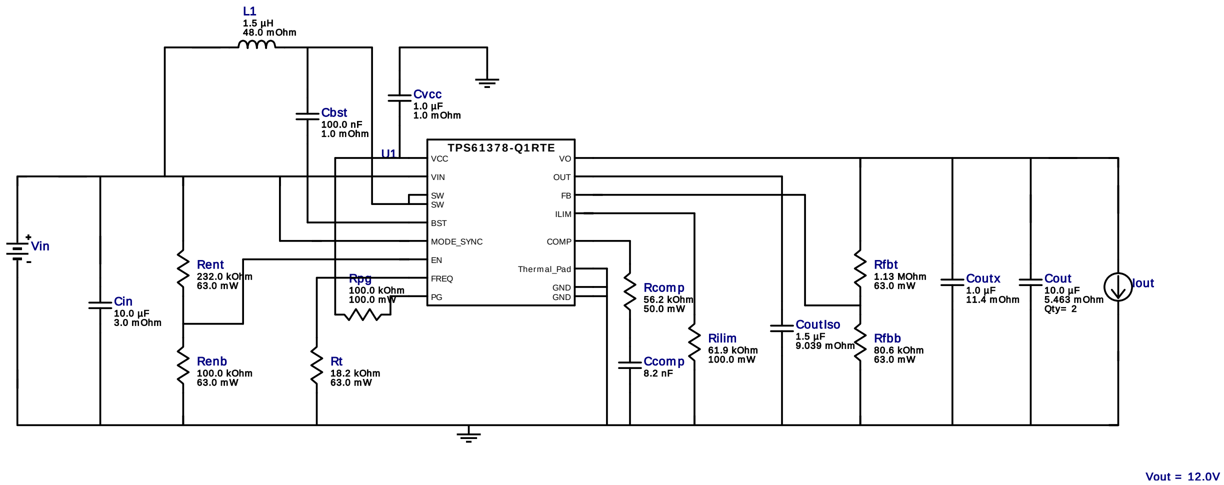
VinMin = 4.0V
VinMax = 6.0V
Vout = 12.0V
Iout = 0.3A

Device = TPS61378QWRTERQ1
Topology = Boost
Created = 2025-10-31 09:06:32.214
BOM Cost = $2.28
BOM Count = 18
Total Pd = 0.37W

WEBENCH ® Design Report

Design : 81 TPS61378QWRTERQ1
TPS61378QWRTERQ1 4V-6V to 12.00V @ 0.3A



Design Alerts

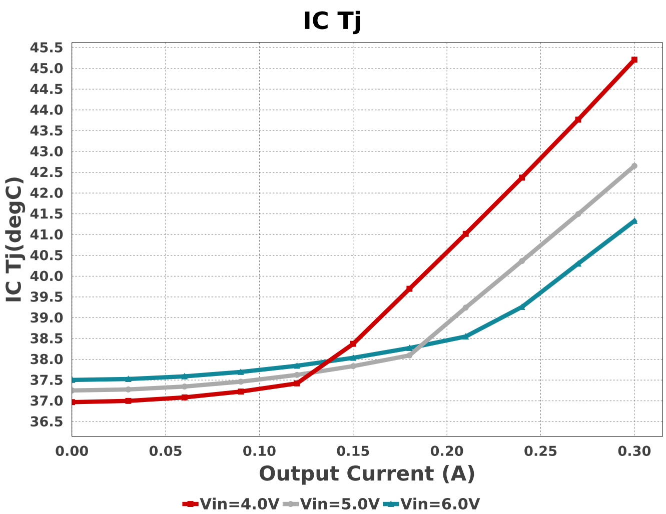
Component Selection Information

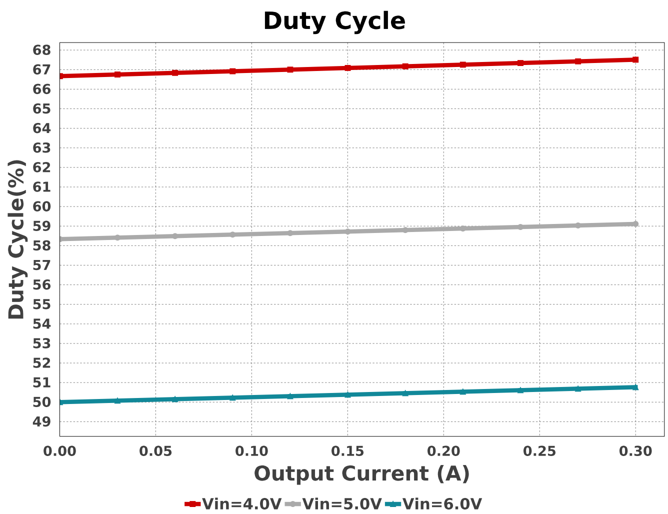
The TPS61378-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

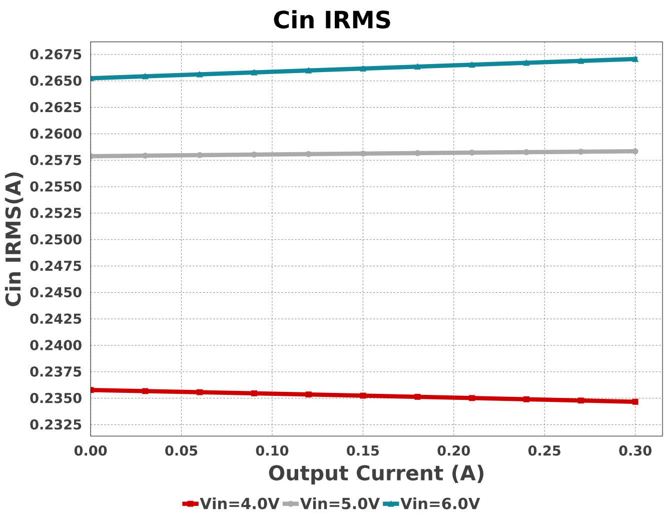
Electrical BOM

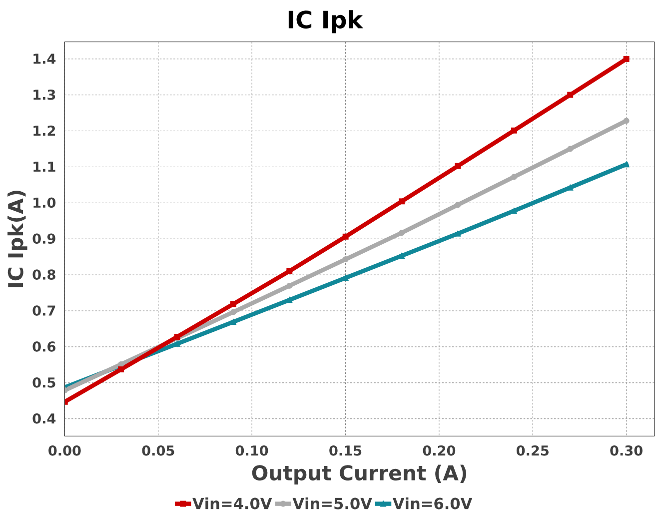
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp	TDK	CGA4C2C0G1H822J060AA Series= C0G/NP0	Cap= 8.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	1	$0.03	0805 7 mm^2
Cout	Taiyo Yuden	MSAST21GBB5106MTNA01 Series= X5R	Cap= 10.0 uF ESR= 5.463 mOhm VDC= 25.0 V IRMS= 2.36768 A	2	$0.04	0805 7 mm^2
CoutIso	TDK	C1608X5R1V155K080AC Series= X5R	Cap= 1.5 uF ESR= 9.039 mOhm VDC= 35.0 V IRMS= 1.73141 A	1	$0.07	0603 5 mm^2
Coutx	TDK	C1005X5R1E105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.4 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm^2
Cvcc	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
L1	Wurth Elektronik	74404032015	L= 1.5 µH 48.0 mOhm	1	$0.66	WE-LQS_3015 16 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rcomp	Yageo	RC0201FR-0756K2L Series= ?	Res= 56.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Renb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rent	Vishay-Dale	CRCW0402232KFKED Series= CRCW..e3	Res= 232.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW040280K6FKED Series= CRCW..e3	Res= 80.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW04021M13FKED Series= CRCW..e3	Res= 1.13 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rilim	Vishay-Dale	CRCW060361K9FKEA Series= CRCW..e3	Res= 61.9 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rpg	Vishay-Dale	CRCW0603100KFKEA Series= CRCW..e3	Res= 100.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rt	Vishay-Dale	CRCW040218K2FKED Series= CRCW..e3	Res= 18.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS61378QWRTERQ1	Switcher	1	$1.26	RTE0016C-IPC_A 16 mm^2

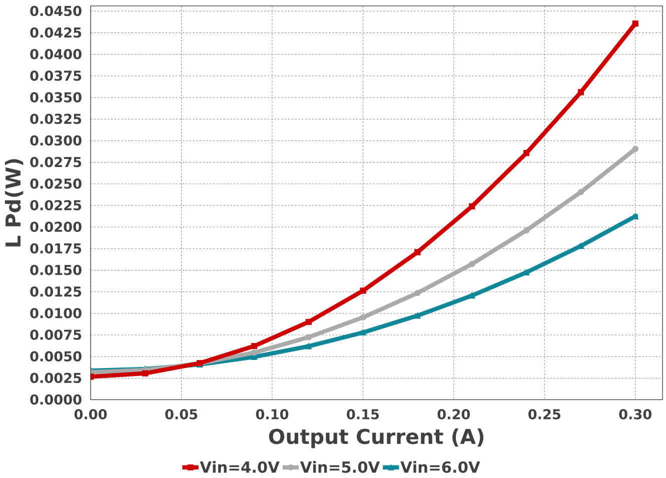




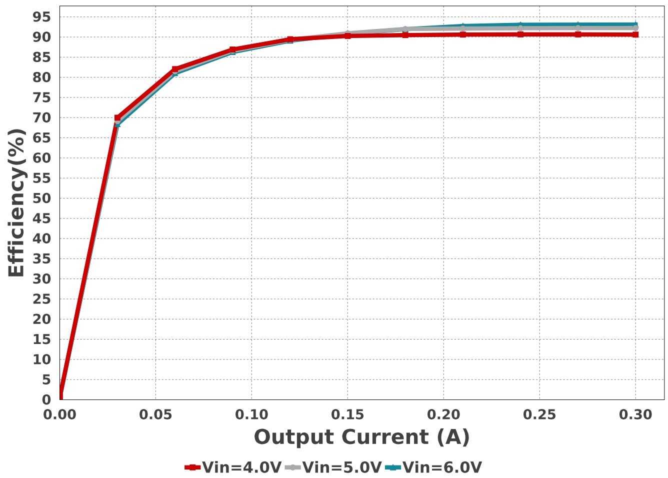




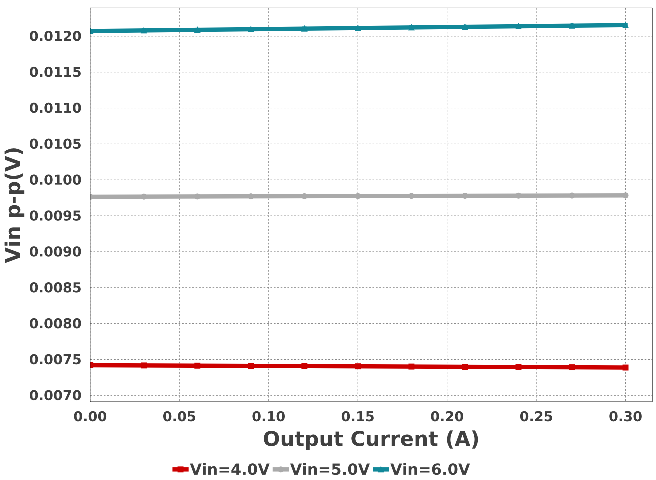
L Pd



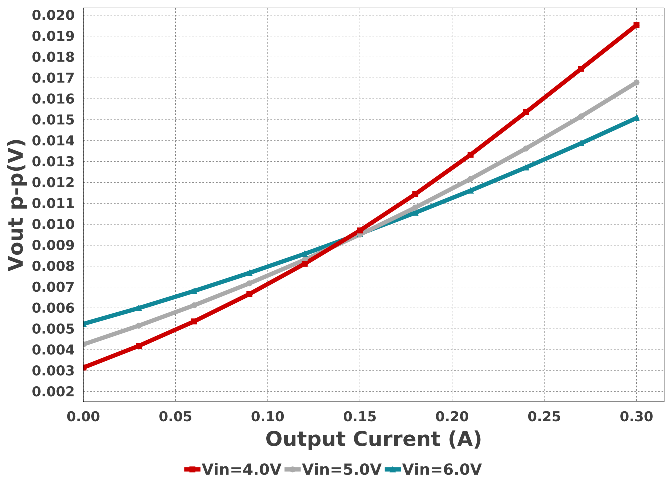
Efficiency



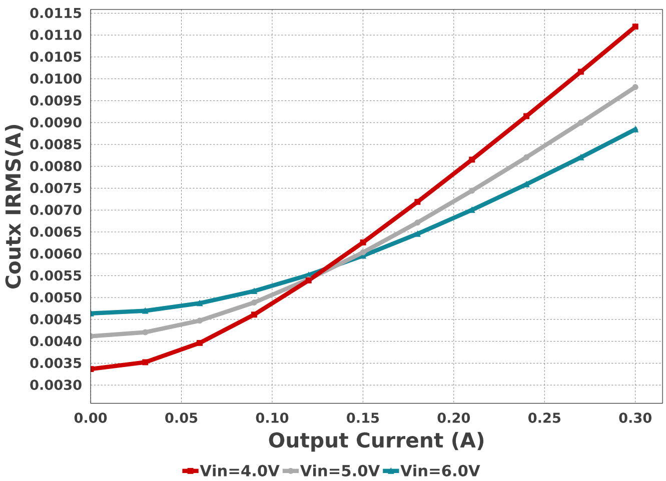
Vin p-p



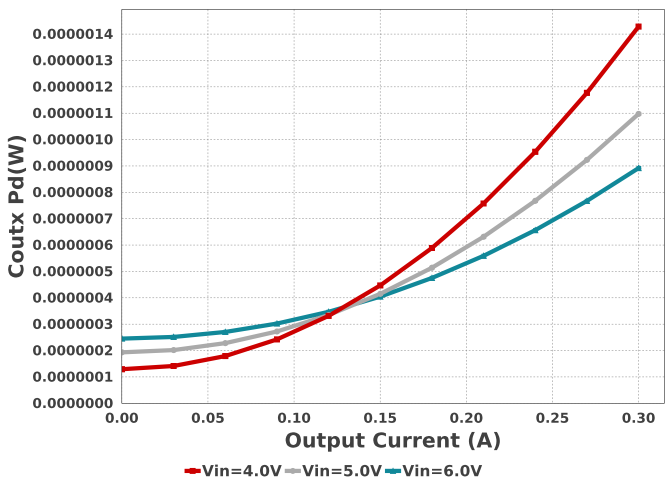
Vout p-p

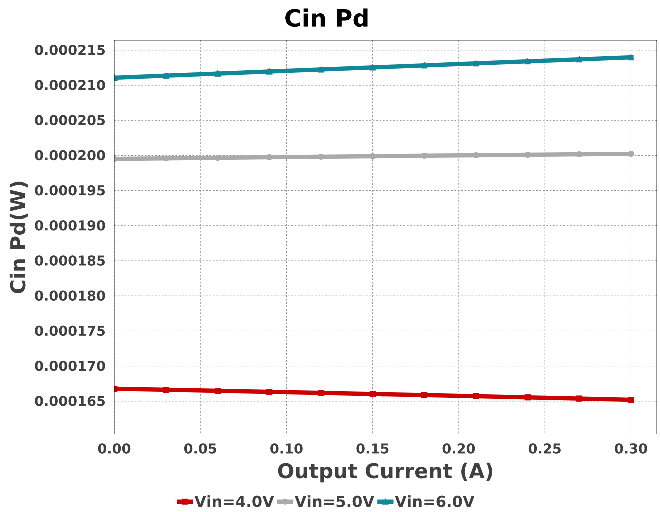


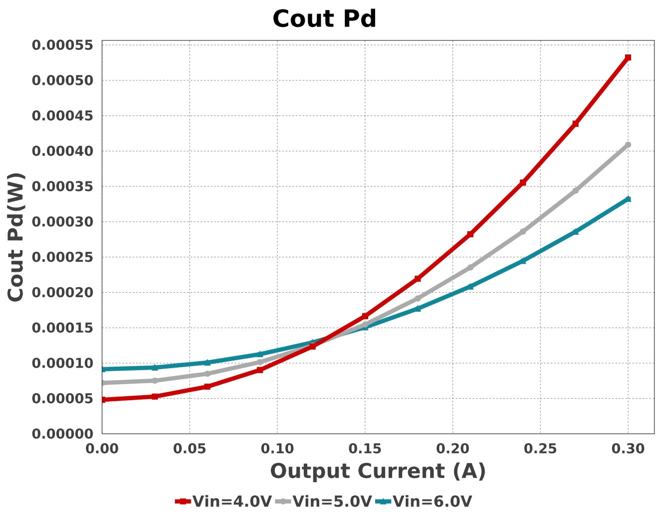
Coutx IRMS

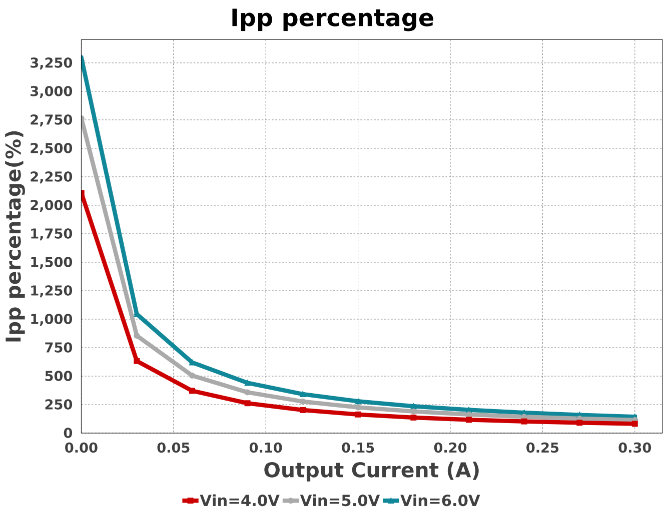


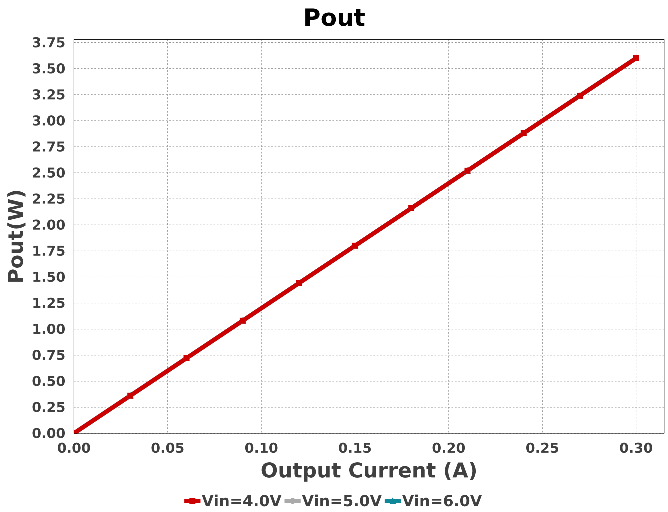
Coutx Pd

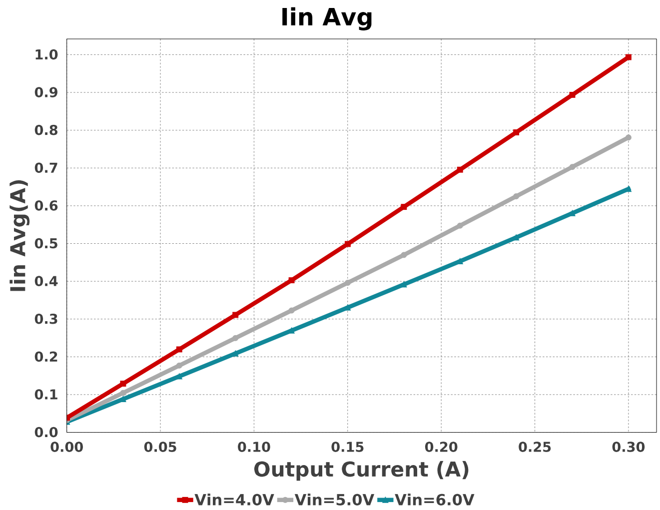


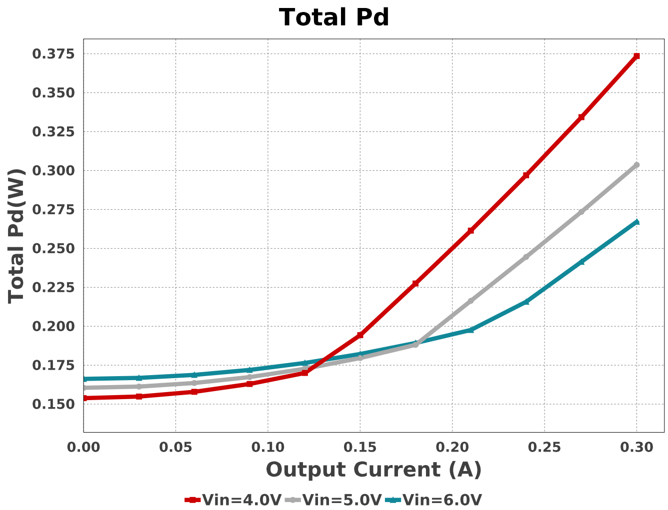

Cin Pd
Cin Pd(W)
0.000215 0.000210 0.000205 0.000200 0.000195 0.000190 0.000185 0.000180 0.000175 0.000170 0.000165
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Output Current (A)
Vin=4.0V Vin=5.0V Vin=6.0V

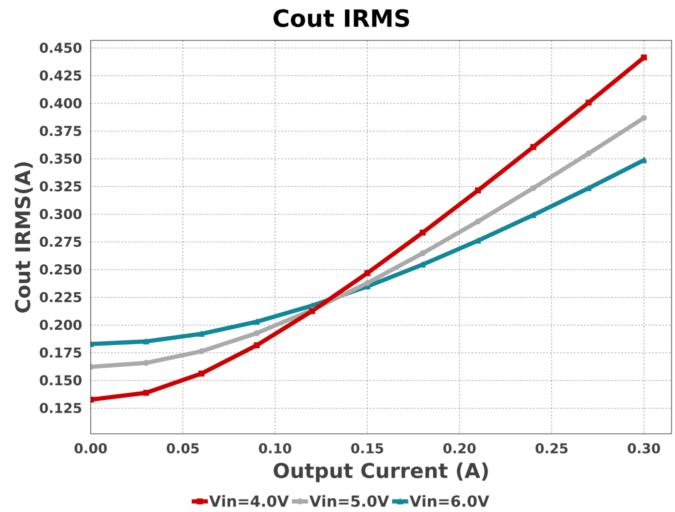

Cout Pd
Cout Pd(W)
0.00055 0.00050 0.00045 0.00040 0.00035 0.00030 0.00025 0.00020 0.00015 0.00010 0.00005 0.00000
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Output Current (A)
Vin=4.0V Vin=5.0V Vin=6.0V

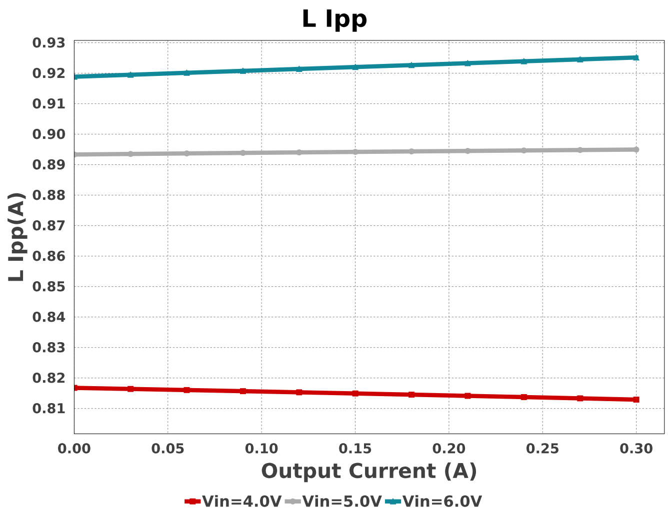

Ipp percentage
Ipp percentage(%)
3,250 3,000 2,750 2,500 2,250 2,000 1,750 1,500 1,250 1,000 750 500 250 0
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Output Current (A)
Vin=4.0V Vin=5.0V Vin=6.0V

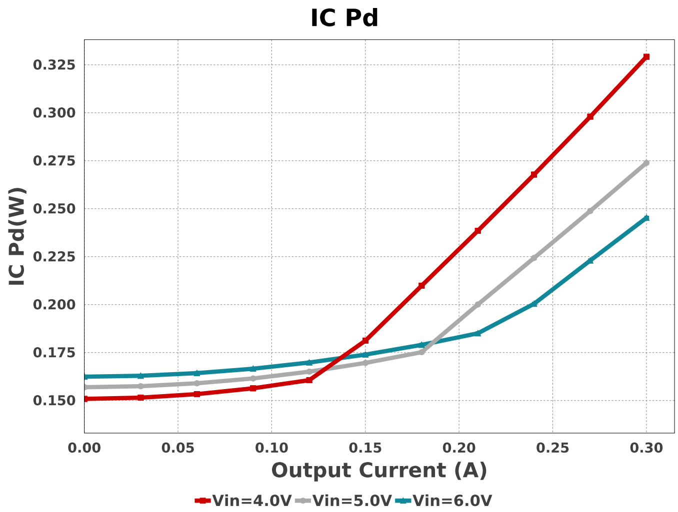

Pout
Pout(W)
3.75 3.50 3.25 3.00 2.75 2.50 2.25 2.00 1.75 1.50 1.25 1.00 0.75 0.50 0.25 0.00
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Output Current (A)
Vin=4.0V Vin=5.0V Vin=6.0V

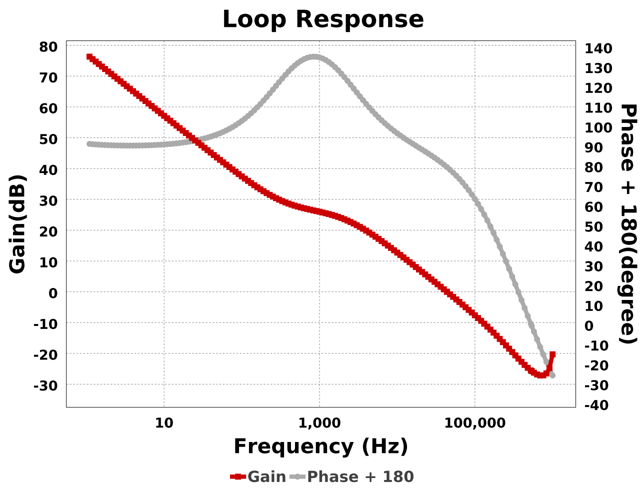

Iin Avg
Iin Avg(A)
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Output Current (A)
Vin=4.0V Vin=5.0V Vin=6.0V


Total Pd
Total Pd(W)
0.375 0.350 0.325 0.300 0.275 0.250 0.225 0.200 0.175 0.150
0.00 0.05 0.10 0.15 0.20 0.25 0.30
Output Current (A)
Vin=4.0V Vin=5.0V Vin=6.0V









Operating Values

#	Name	Value	Category	Description
1.	BOM Count	18		Total Design BOM count
2.	Total BOM	$2.279		Total BOM Cost
3.	Cin IRMS	234.666 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	165.2 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	441.445 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	532.3 µW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	11.194 mA	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	1.428 µW	Capacitor	Output capacitor_x power loss
9.	IC Ipk	1.4 A	IC	Peak switch current in IC
10.	IC Pd	329.19 mW	IC	IC power dissipation
11.	IC Tj	45.208 degC	IC	IC junction temperature
12.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA	46.2 degC/W	IC	IC junction-to-ambient thermal resistance
14.	Iin Avg	993.39 mA	IC	Average input current
15.	Ipp percentage	81.831 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
16.	L Ipp	812.906 mA	Inductor	Peak-to-peak inductor ripple current
17.	L Pd	43.562 mW	Inductor	Inductor power dissipation
18.	Cin Pd	165.2 µW	Power	Input capacitor power dissipation
19.	Cout Pd	532.3 µW	Power	Output capacitor power dissipation
20.	Coutx Pd	1.428 µW	Power	Output capacitor_x power loss
21.	IC Pd	329.19 mW	Power	IC power dissipation
22.	L Pd	43.562 mW	Power	Inductor power dissipation
23.	Total Pd	373.554 mW	Power	Total Power Dissipation
24.	Cross Freq	29.06 kHz	System Information	Bode plot crossover frequency
25.	Duty Cycle	67.508 %	System Information	Duty cycle
26.	Efficiency	90.599 %	System Information	Steady state efficiency
27.	FootPrint	101.0 mm^2	System Information	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
28.	Frequency	2.177 MHz	System Information	Switching frequency
29.	Gain Marg	-25.931 dB	System Information	Bode Plot Gain Margin
30.	Iout	300.0 mA	System Information	Iout operating point
31.	Low Freq Gain	74.621 dB	System Information	Gain at 1Hz
32.	Mode	CCM	System Information	Conduction Mode
33.	Phase Marg	83.256 deg	System Information	Bode Plot Phase Margin
34.	Pout	3.6 W	System Information	Total output power
35.	Vin	4.0 V	System Information	Vin operating point
36.	Vin p-p	7.388 mV	System Information	Peak-to-peak input voltage
37.	Vout	12.0 V	System Information	Operational Output Voltage
38.	Vout Actual	12.016 V	System Information	Vout Actual calculated based on selected voltage divider resistors
39.	Vout Tolerance	2.447 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout p-p	19.525 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	300.0 m	Maximum Output Current
VinMax	6.0	Maximum input voltage
VinMin	4.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS61378-Q1	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	2.177 M	Customer Selected Frequency

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

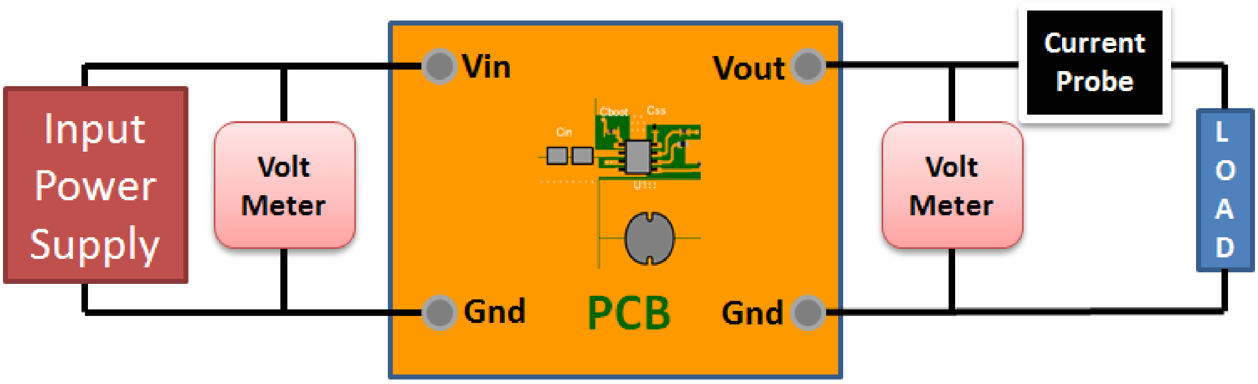
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.0V 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 : 54B5C53A26260A66802834F560EFDE7D[v1]

2. **TPS61378-Q1** Product Folder : http://www.ti.com/product/TPS61378%2DQ1 : contains the data sheet and other resources.