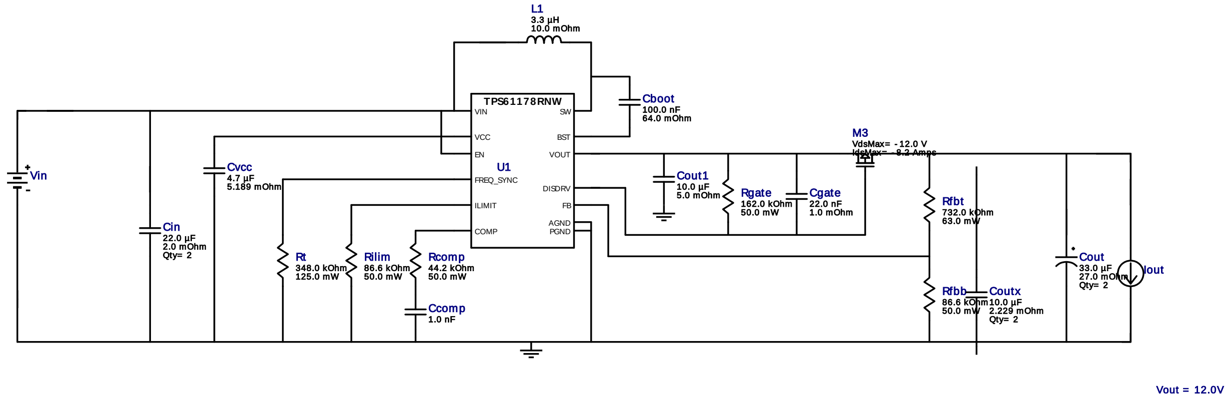
VinMin = 7.0V
VinMax = 8.8V
Vout = 12.0V
Iout = 3.0A

Device = TPS61178RNWR
Topology = Boost
Created = 2019-05-06 20:35:04.107
BOM Cost = NA
BOM Count = 20
Total Pd = 1.69W

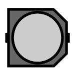
WEBENCH ® Design Report

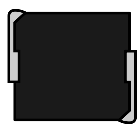
Design : 61 TPS61178RNWR
TPS61178RNWR 7V-8.8V to 12.00V @ 3A



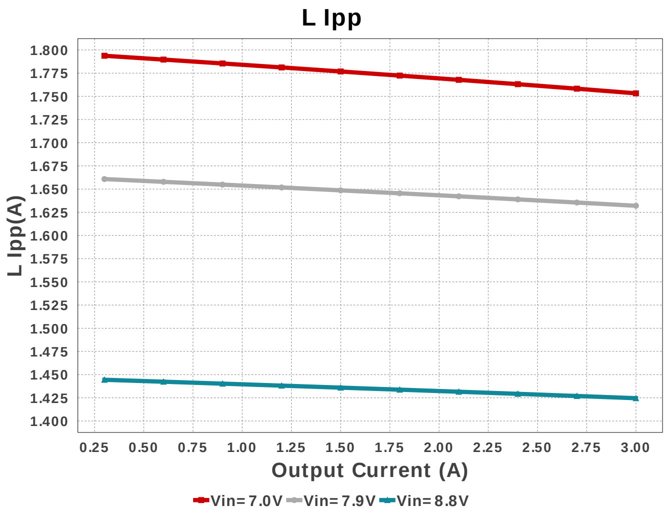
Electrical BOM

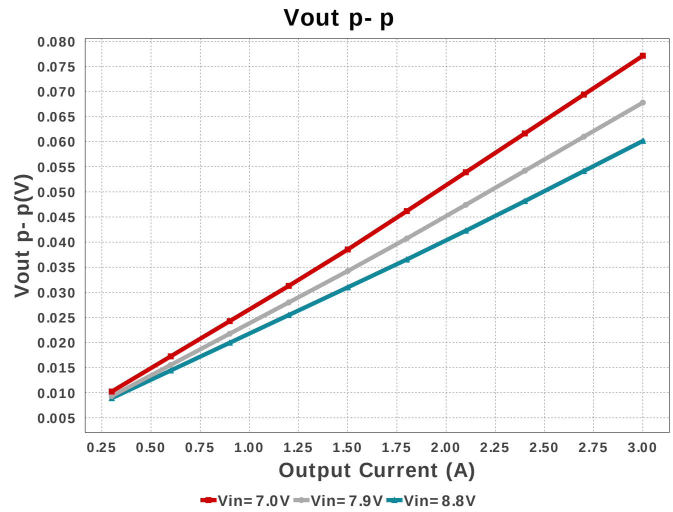
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Ccomp	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cgate	MuRata	GRM155R71E223KA61D Series= X7R	Cap= 22.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cin	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	2	$0.61	1210 15 mm^2
Cout	Panasonic	20SVPG33M Series= SVPG	Cap= 33.0 uF ESR= 27.0 mOhm VDC= 20.0 V IRMS= 3.0 A	2	$0.40	CAPSMT_62_B45 53 mm^2
Cout1	Samsung Electro-Mechanics	CL32B106KBJNNWE Series= X7R	Cap= 10.0 uF ESR= 5.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.18	1210_270 15 mm^2
Coutx	TDK	C3216X6S1V106K160AC Series= X6S	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	2	$0.18	1206_180 11 mm^2
Cvcc	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.05	0805 7 mm^2
L1	Bourns	SRP1040-3R3M	L= 3.3 µH 10.0 mOhm	1	$0.72	SRP1040 172 mm^2

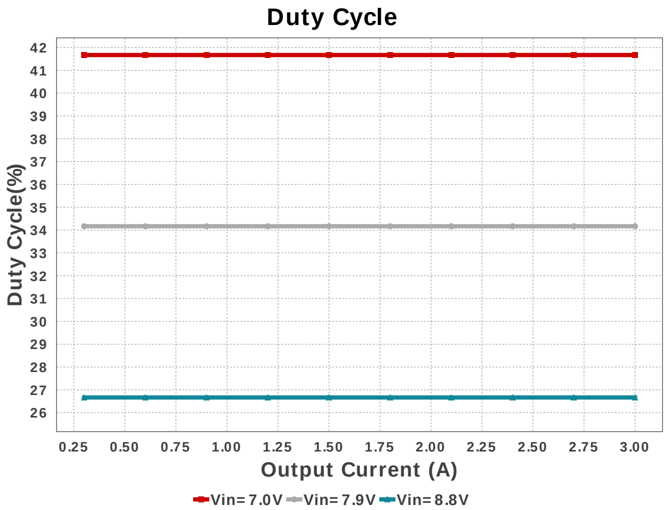


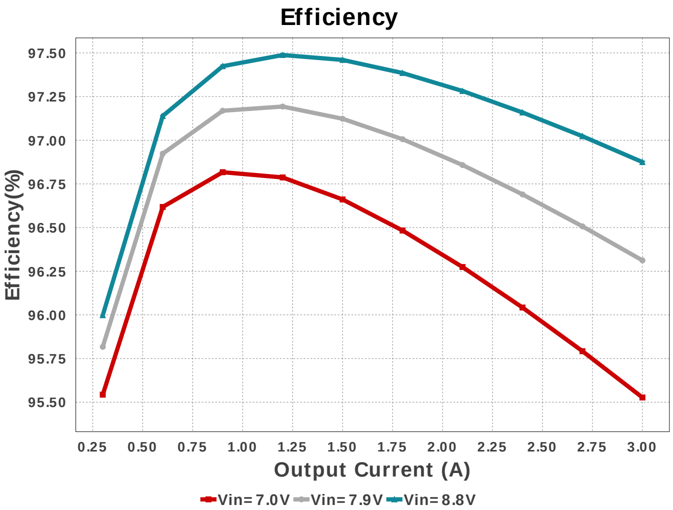


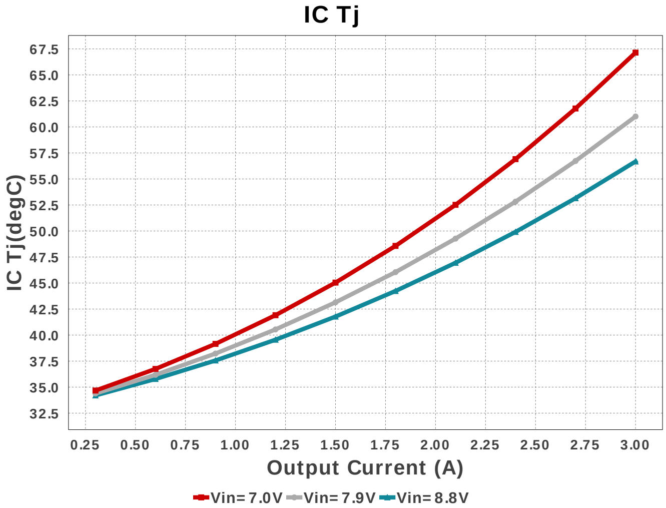
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
M3	Vishay-Siliconix	SI6423DQ	VdsMax= -12.0 V IdsMax= -8.2 Amps	1	NA	TSSOP-8 42 mm^2
Rcomp	Yageo	RC0201FR-0744K2L Series= ?	Res= 44.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rfbb	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rfbt	Vishay-Dale	CRCW0402732KFKED Series= CRCW..e3	Res= 732.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rgate	Yageo	RC0201FR-07162KL Series= ?	Res= 162.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rilim	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rt	Panasonic	ERJ-6ENF3483V Series= ERJ-6E	Res= 348.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
U1	Texas Instruments	TPS61178RNWR	Switcher	1	$1.80	RNW0013A 18 mm^2

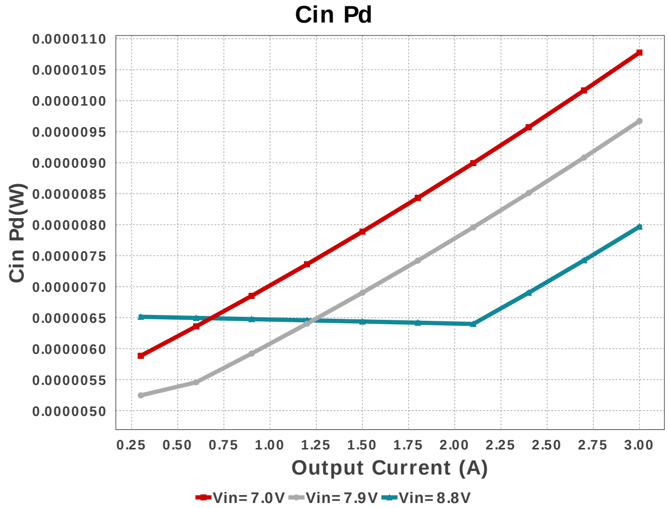


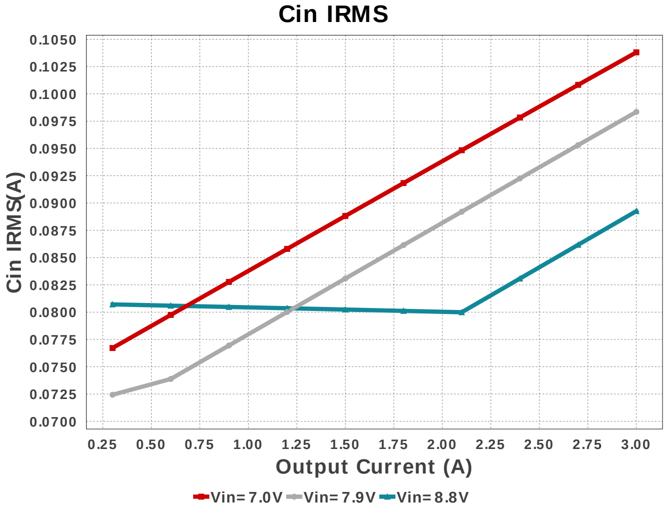


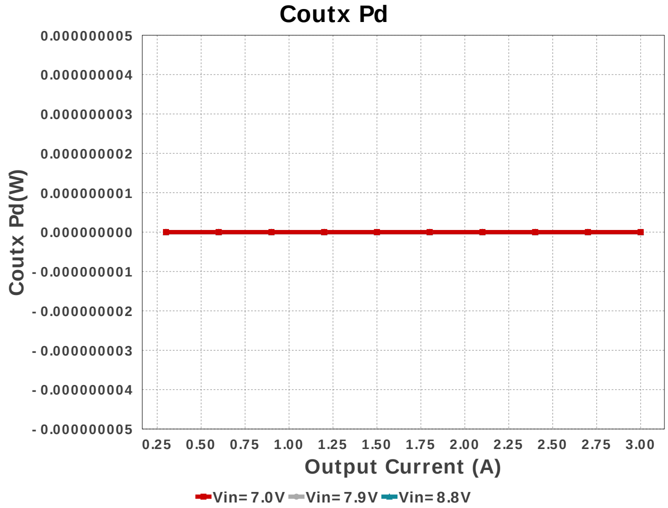


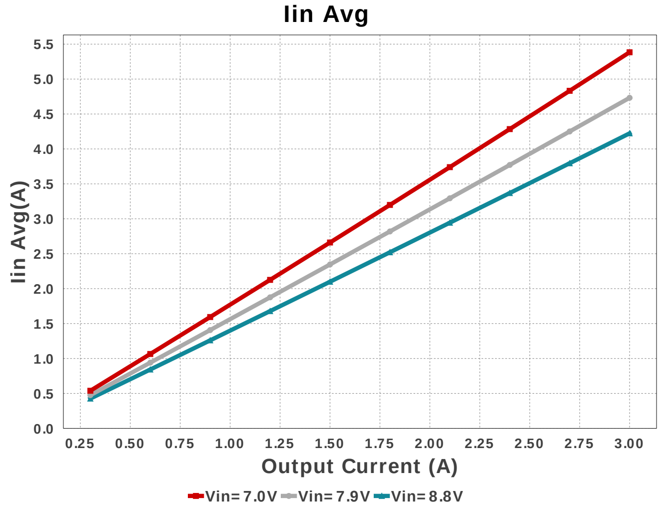


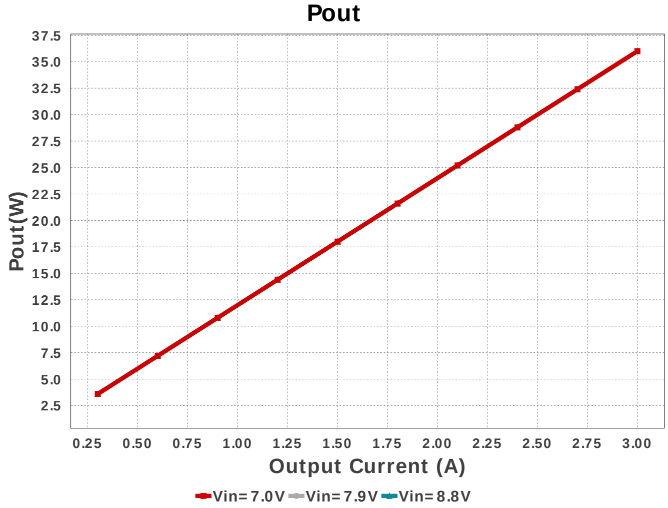

IC Tj
IC Tj(degC)
Output Current (A)
Vin= 7.0V Vin= 7.9V Vin= 8.8V


Cin Pd
Cin Pd(W)
Output Current (A)
Vin= 7.0V Vin= 7.9V Vin= 8.8V

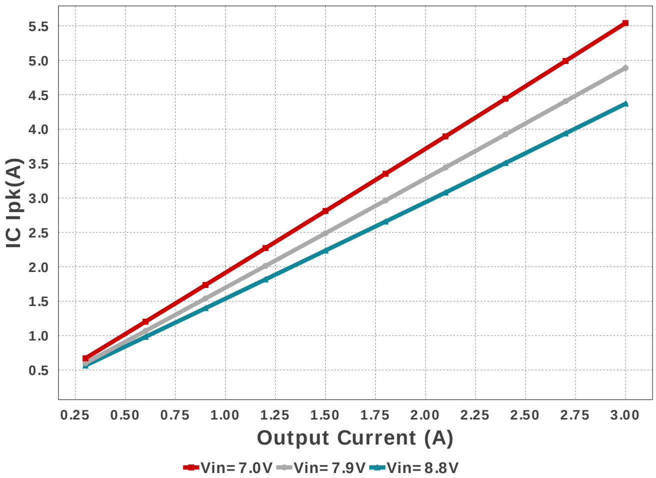

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin= 7.0V Vin= 7.9V Vin= 8.8V


Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin= 7.0V Vin= 7.9V Vin= 8.8V

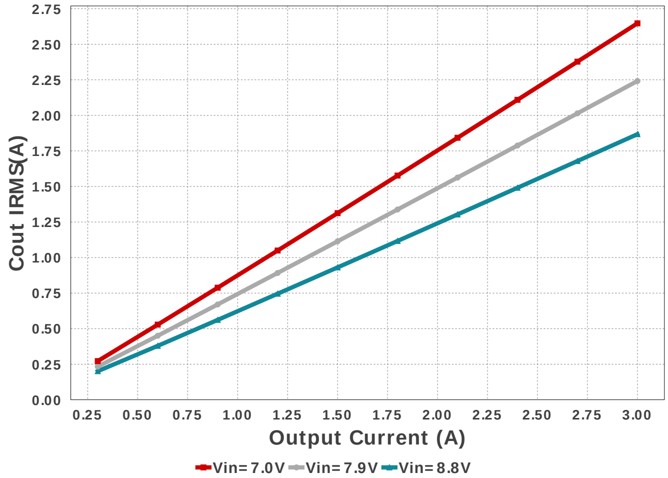

Iin Avg
Iin Avg(A)
Output Current (A)
Vin= 7.0V Vin= 7.9V Vin= 8.8V


Pout
Pout(W)
Output Current (A)
Vin= 7.0V Vin= 7.9V Vin= 8.8V

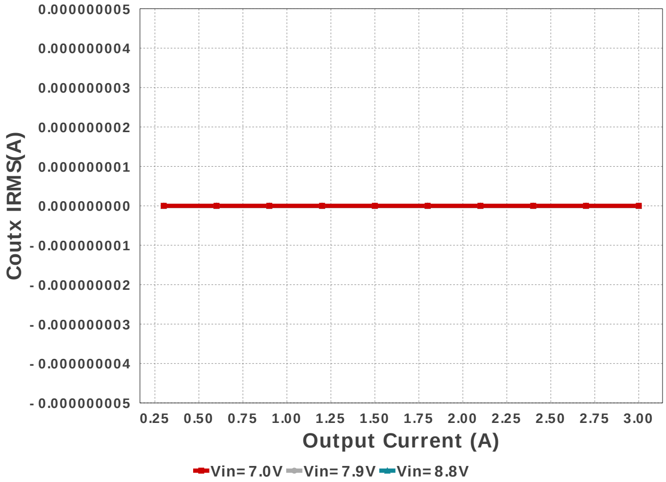
IC Ipk



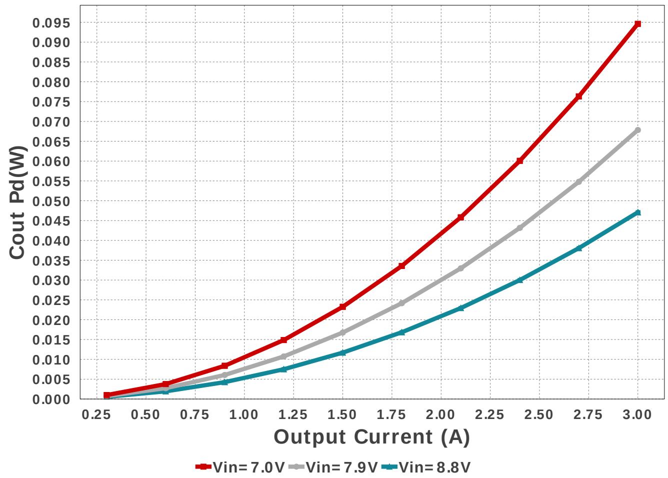
Cout IRMS



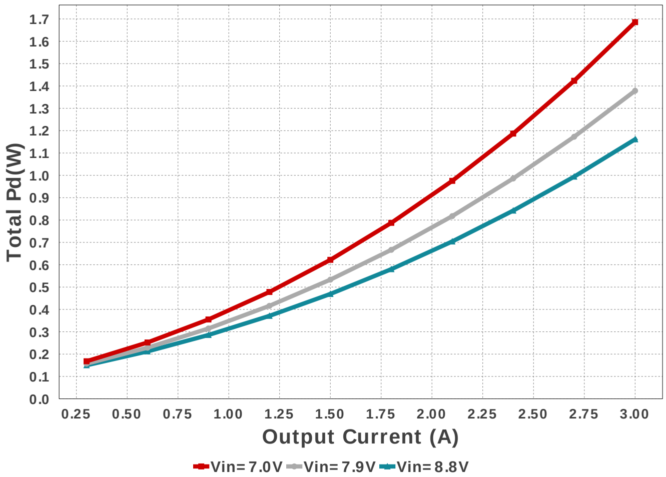
Coutx IRMS



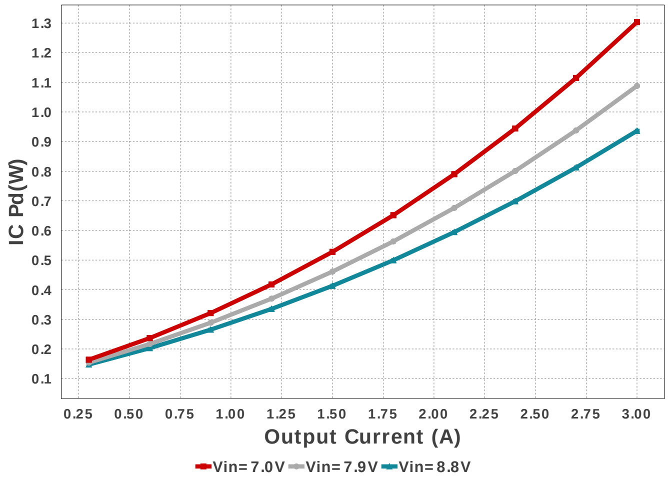
Cout Pd

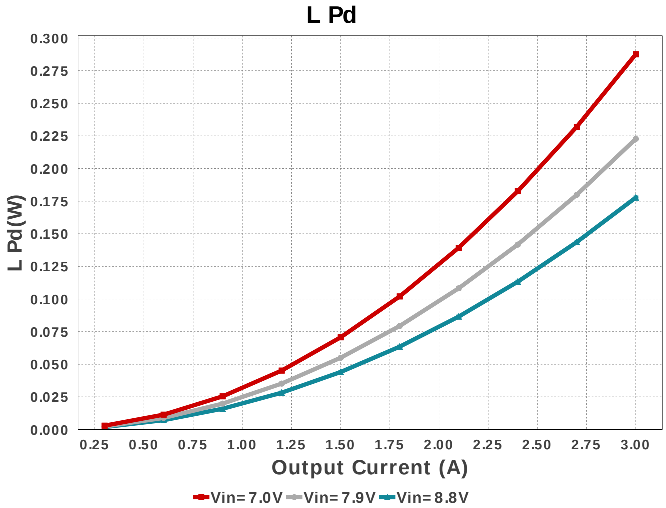


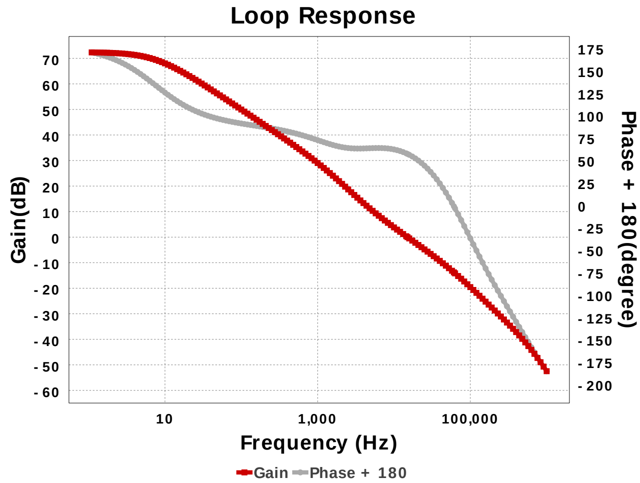
Total Pd

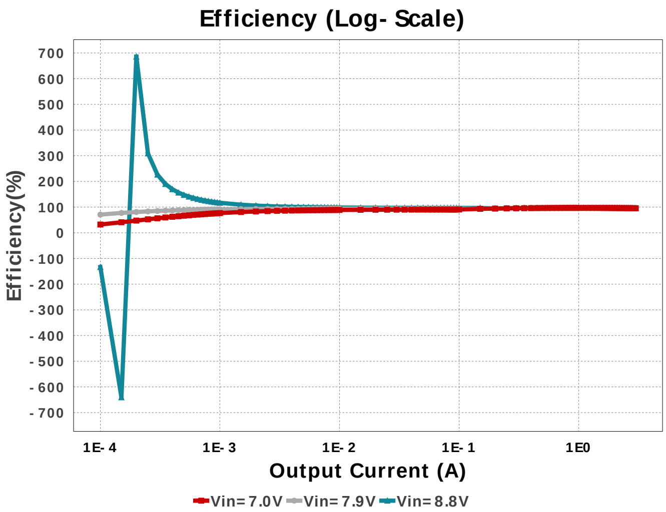


IC Pd









Operating Values

#	Name	Value	Category	Description
1.	BOM Count	20		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	103.806 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	10.776 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	2.647 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	94.604 mW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	0.0 A	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	0.0 W	Capacitor	Output capacitor_x power loss
9.	IC Ipk	5.541 A	IC	Peak switch current in IC
10.	IC Pd	1.303 W	IC	IC power dissipation
11.	IC Tj	67.143 degC	IC	IC junction temperature
12.	ICThetaJA	28.5 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	5.384 A	IC	Average input current
14.	L Ipp	1.753 A	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	287.51 mW	Inductor	Inductor power dissipation
16.	Cin Pd	10.776 µW	Power	Input capacitor power dissipation
17.	Cout Pd	94.604 mW	Power	Output capacitor power dissipation
18.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
19.	IC Pd	1.303 W	Power	IC power dissipation
20.	L Pd	287.51 mW	Power	Inductor power dissipation
21.	Total Pd	1.686 W	Power	Total Power Dissipation
22.	Cross Freq	12.32 kHz	System Information	Bode plot crossover frequency
23.	Duty Cycle	41.667 %	System Information	Duty cycle
24.	Efficiency	95.527 %	System Information	Steady state efficiency
25.	FootPrint	443.0 mm^2	System Information	Total Foot Print Area of BOM components
26.	Frequency	491.591 kHz	System Information	Switching frequency

#	Name	Value	Category	Description
27.	Gain Marg	-12.687 dB	System Information	Bode Plot Gain Margin
28.	Iout	3.0 A	System Information	Iout operating point
29.	Low Freq Gain	71.56 dB	System Information	Gain at 1Hz
30.	Mode	BOOST PWM CCM	System Information	PWM/PFM Mode
31.	Phase Marg	56.743 deg	System Information	Bode Plot Phase Margin
32.	Pout	36.0 W	System Information	Total output power
33.	Vin	7.0 V	System Information	Vin operating point
34.	Vout Actual	11.324 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	2.826 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	77.11 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	8.8	Maximum input voltage
VinMin	7.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS61178	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	500.0 k	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

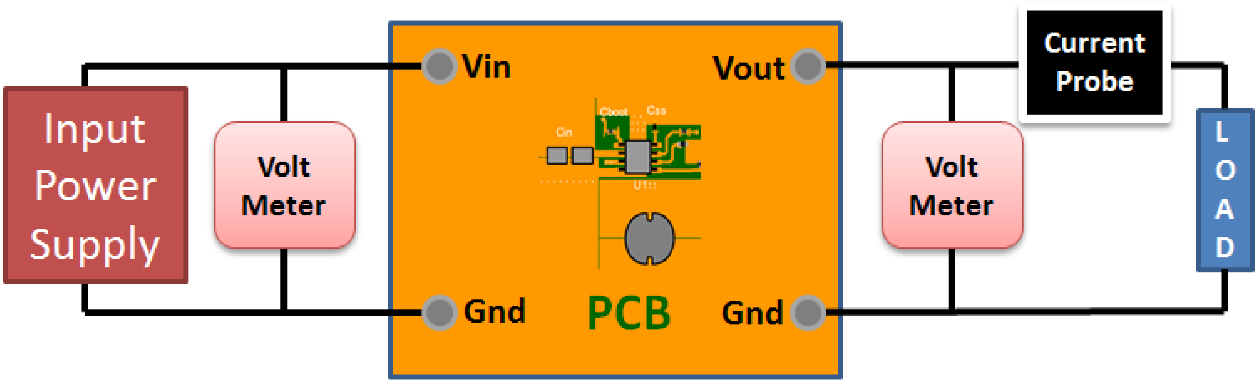
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 7.0V 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 : 382DECFE86D40E2A[v1]

2. **TPS61178** Product Folder : http://www.ti.com/product/TPS61178 : contains the data sheet and other resources.

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