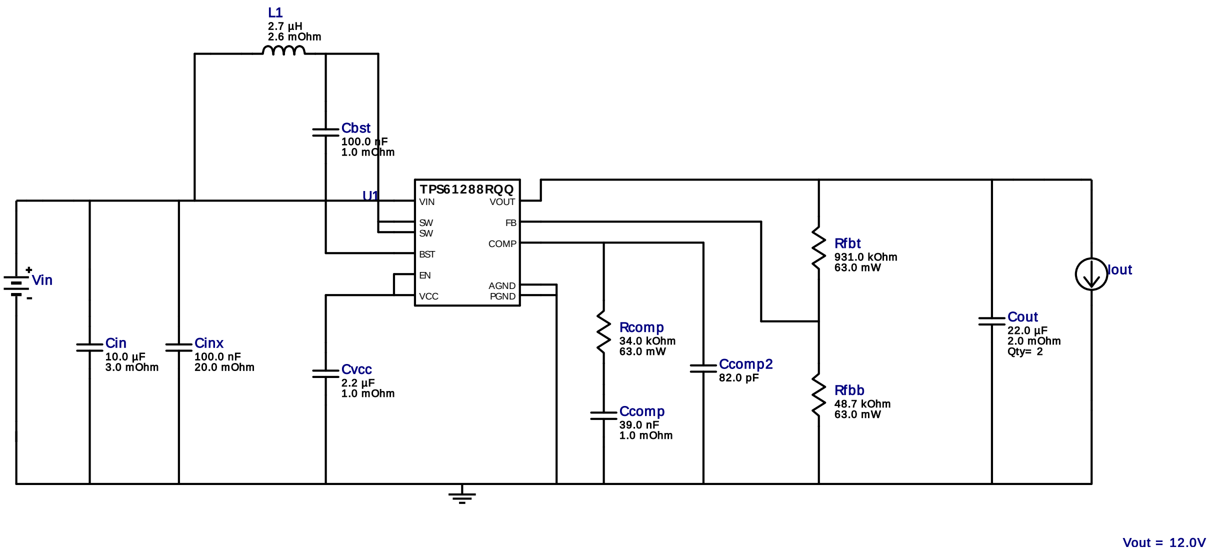
VinMin = 3.0V
VinMax = 5.0V
Vout = 12.0V
Iout = 2.0A

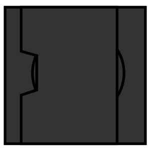
Device = TPS61288RQQR
Topology = Boost
Created = 2021-05-06 16:06:58.060
BOM Cost = $3.40
BOM Count = 13
Total Pd = 1.35W

WEBENCH ® Design Report

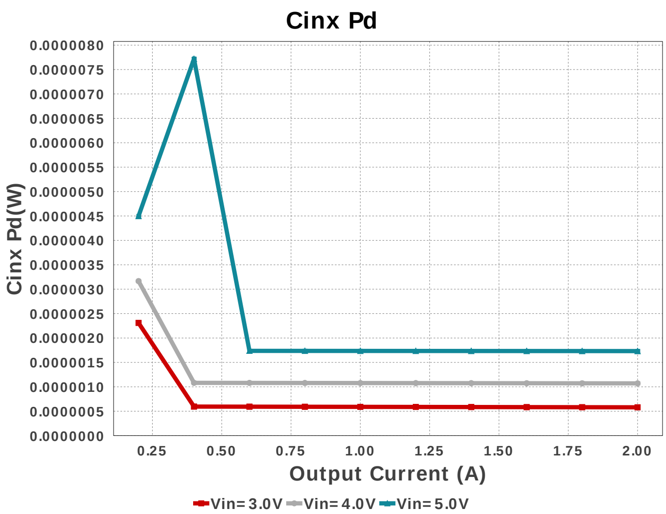
Design : 17 TPS61288RQQR
TPS61288RQQR 3V-5V to 12.00V @ 2A

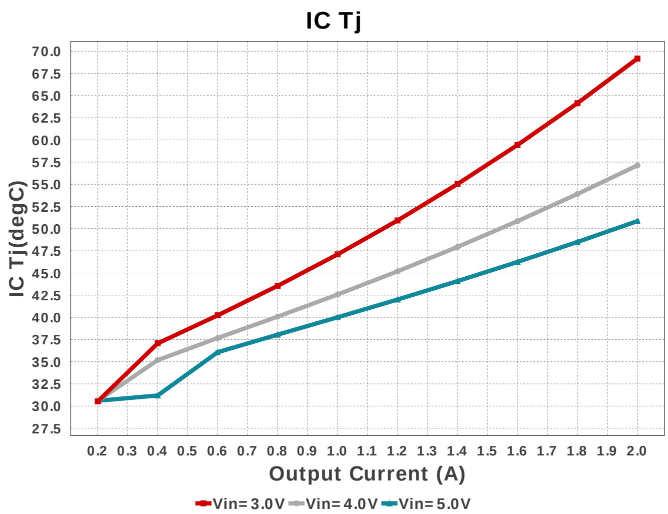


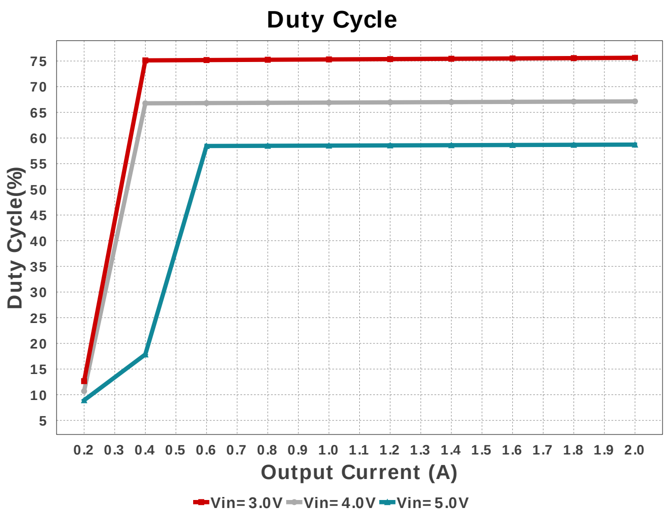
Electrical BOM

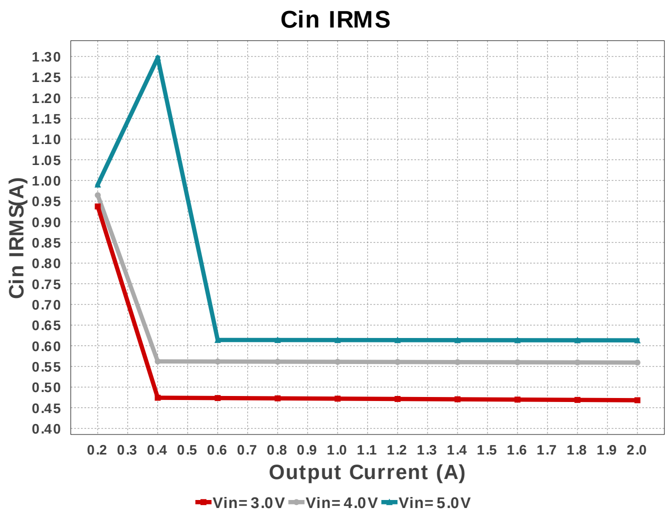
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp	MuRata	GRM033R60J393KE19D Series= X5R	Cap= 39.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C820JBANNNC Series= C0G/NP0	Cap= 82.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
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 mm²
Cinx	MuRata	GRM188R71H104KA93D Series= X7R	Cap= 100.0 nF ESR= 20.0 mOhm VDC= 50.0 V IRMS= 3.8 A	1	$0.02	0603 5 mm²
Cout	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	2	$0.55	1210 15 mm²
Cvcc	Kemet	C0603C225K8PACTU Series= X5R	Cap= 2.2 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.04	0603 5 mm²
L1	Coilcraft	SER1360-272KLB	L= 2.7 µH 2.6 mOhm	1	$0.74	 SER1360 225 mm²

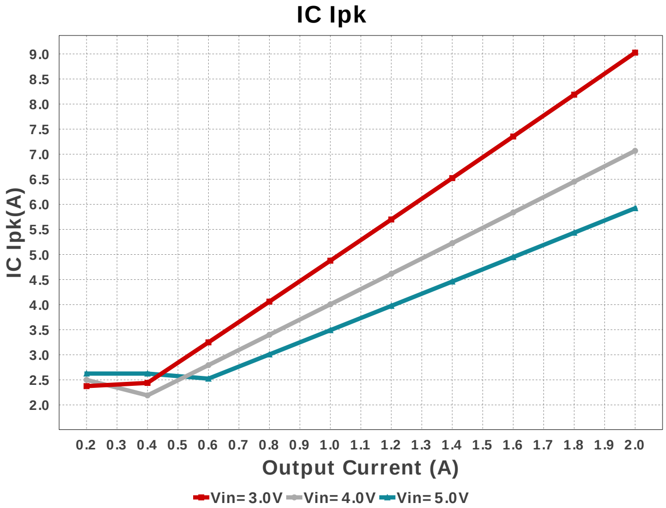
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rcomp	Vishay-Dale	CRCW040234K0FKED Series= CRCW..e3	Res= 34.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW040248K7FKED Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW0402931KFKED Series= CRCW..e3	Res= 931.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS61288RQQR	Switcher	1	$1.41	RQQ0011A-MFG 9 mm²

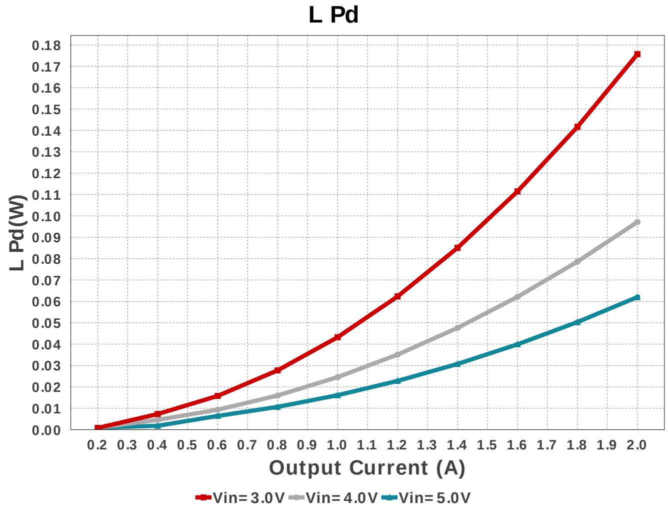


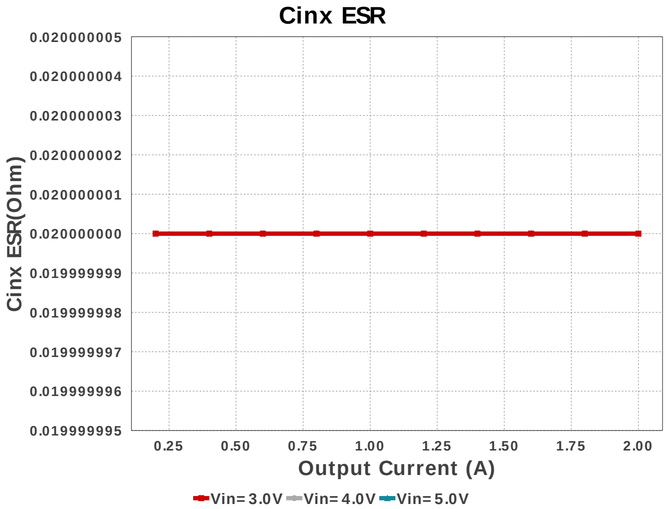


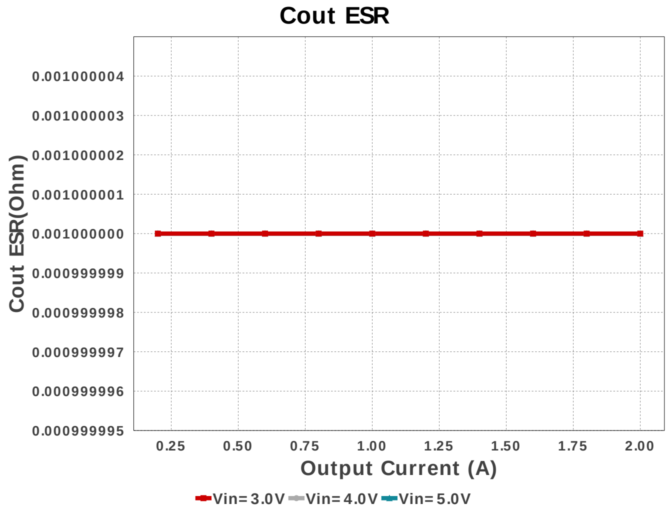


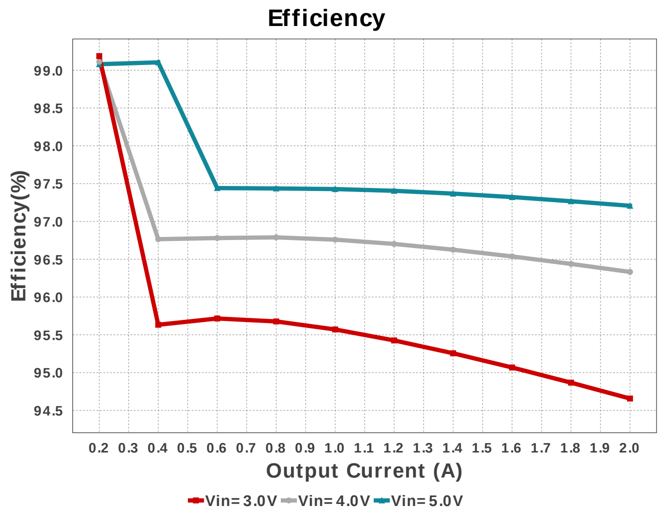


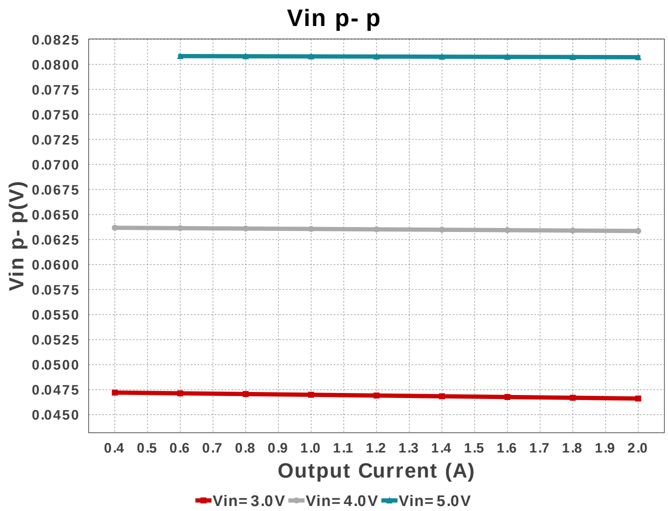

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

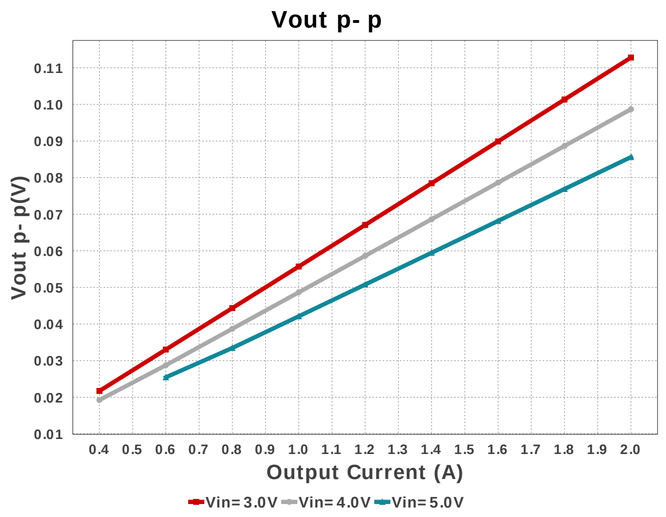

L Pd
L Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

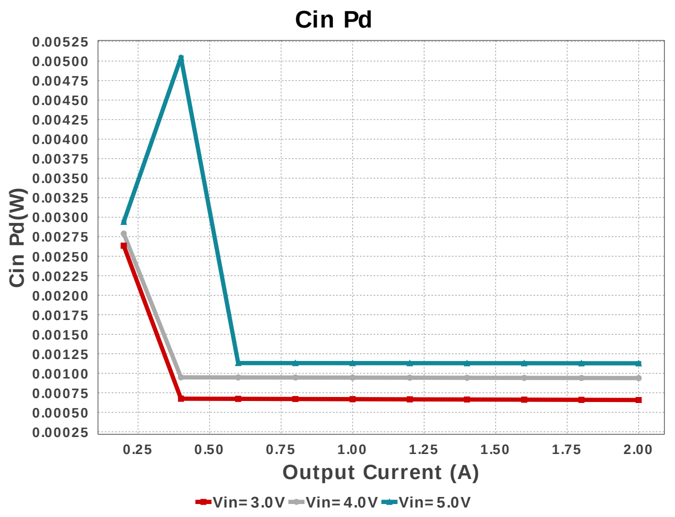

Cinx ESR
Cinx ESR(Ohm)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

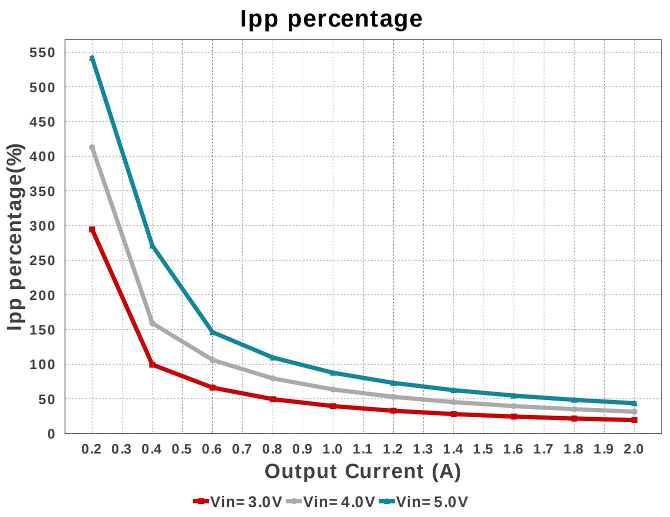

Cout ESR
Cout ESR(Ohm)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

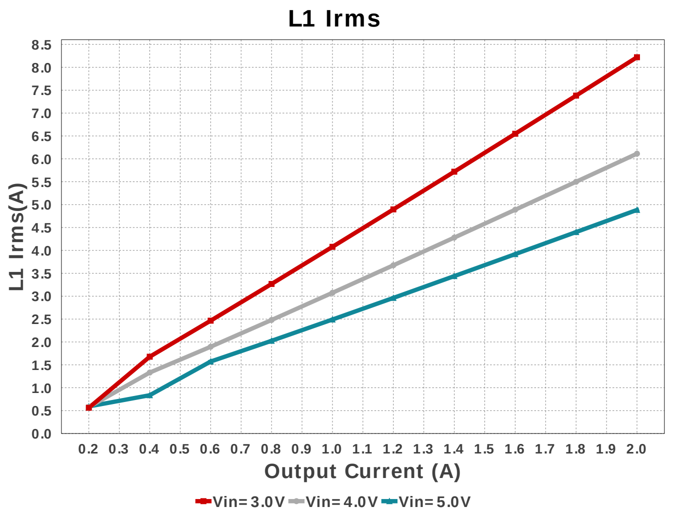

Efficiency
Efficiency(%)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

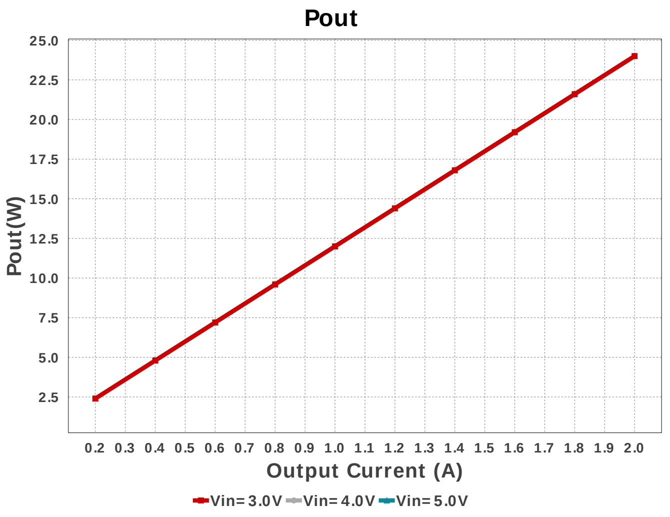

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

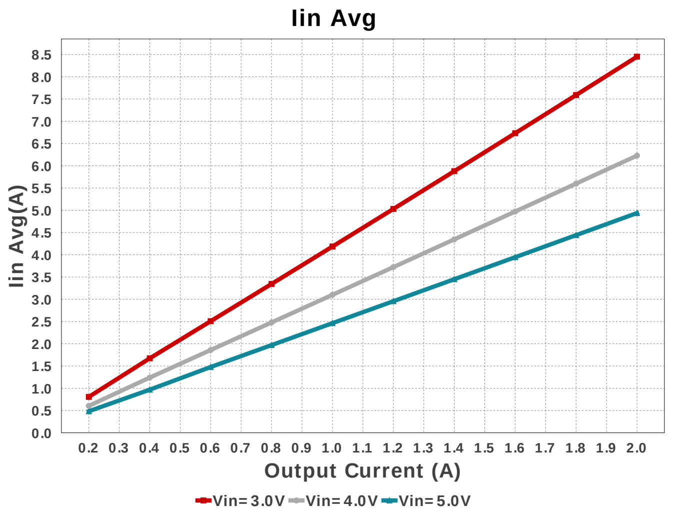

Vout p- p
Vout p- p(V)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

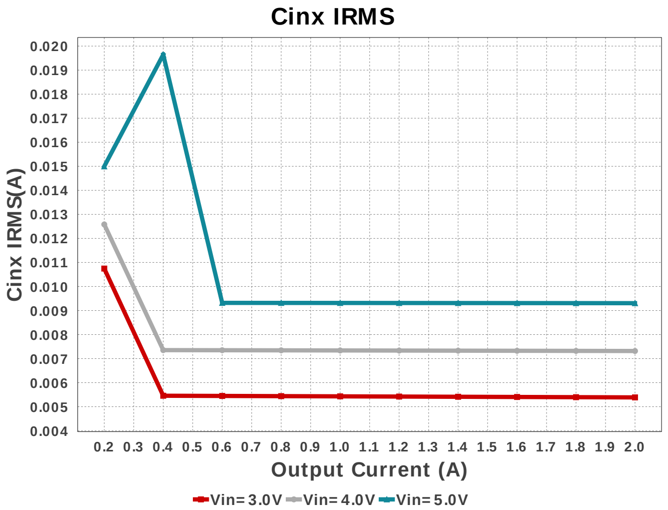

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

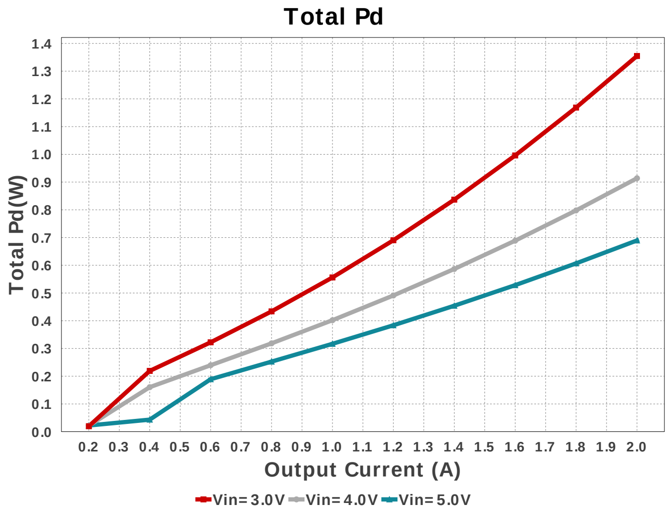

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

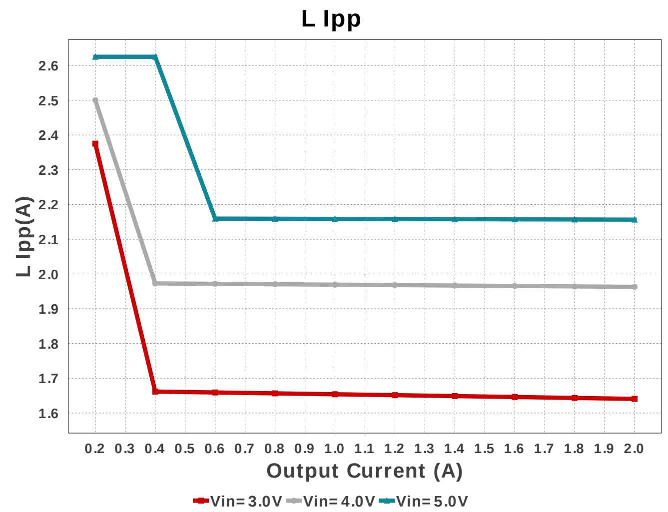

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

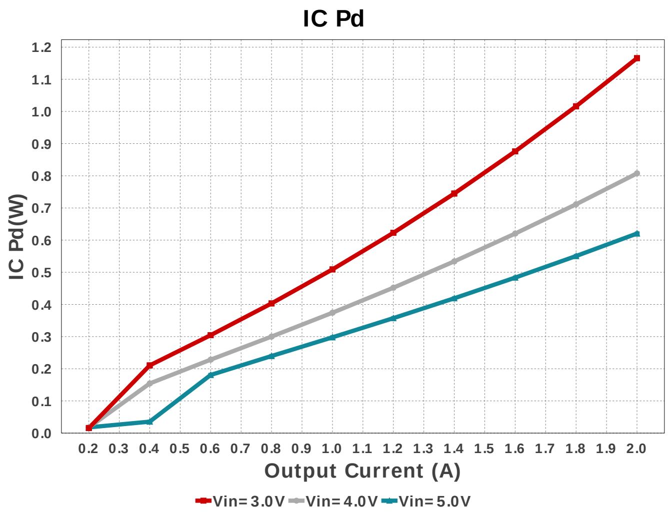

Pout
Pout(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

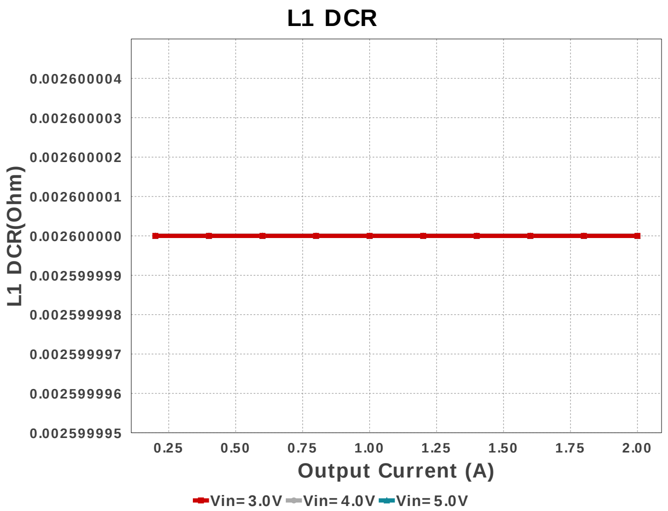

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

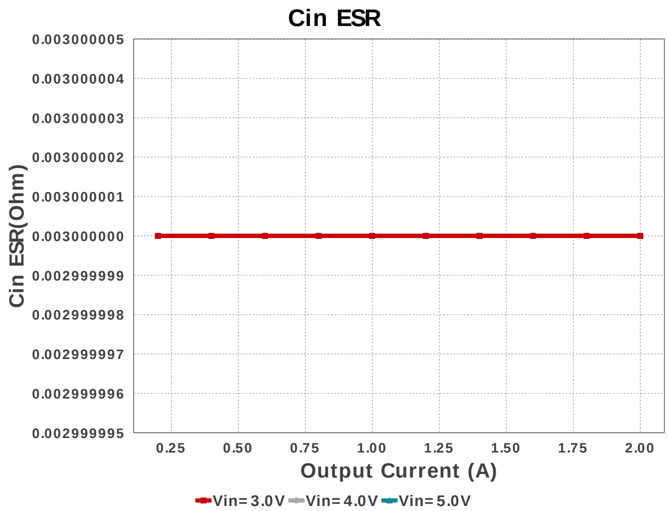

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin= 3.0V Vin= 4.0V Vin= 5.0V

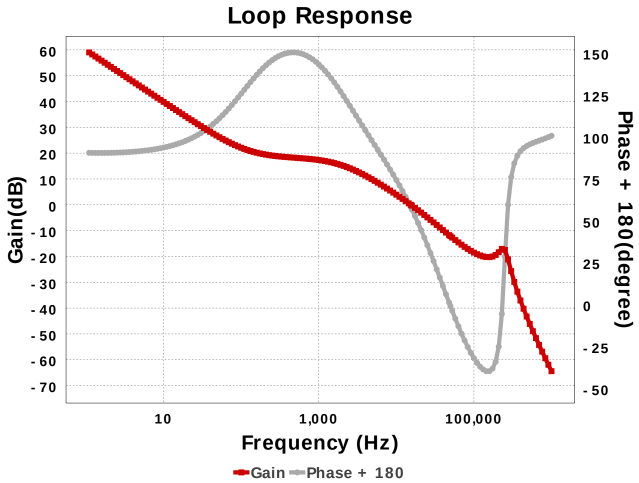

Total Pd
Total Pd(W)
Output Current (A)
Vin= 3.0V Vin= 4.0V Vin= 5.0V

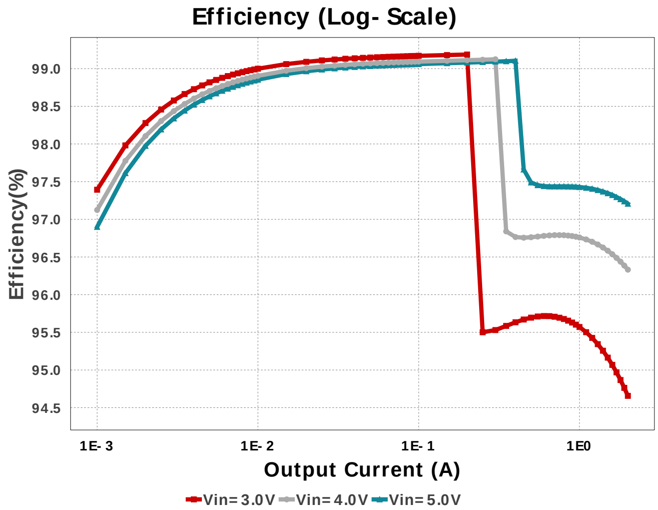

L Ipp
L Ipp(A)
Output Current (A)
Vin= 3.0V Vin= 4.0V Vin= 5.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin= 3.0V Vin= 4.0V Vin= 5.0V


L1 DCR
L1 DCR(Ohm)
Output Current (A)
Vin= 3.0V Vin= 4.0V Vin= 5.0V


Cin ESR
Cin ESR(Ohm)
Output Current (A)
Vin= 3.0V Vin= 4.0V Vin= 5.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin ESR	3.0 mOhm	Capacitor	Cin Capacitor ESR
2.	Cin IRMS	468.218 mA	Capacitor	Input capacitor RMS ripple current
3.	Cin Pd	657.69 µW	Capacitor	Input capacitor power dissipation
4.	Cinx ESR	20.0 mOhm	Capacitor	Cin Capacitor ESR
5.	Cinx IRMS	5.387 mA	Capacitor	Bulk capacitor RMS ripple current
6.	Cinx Pd	580.3 nW	Capacitor	Bulk capacitor power dissipation
7.	Cout ESR	1.0 mOhm	Capacitor	Cout Capacitor ESR
8.	IC Ipk	9.026 A	IC	Peak switch current in IC
9.	IC Pd	1.166 W	IC	IC power dissipation
10.	IC Tj	69.168 degC	IC	IC junction temperature
11.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
12.	ICThetaJA Effective	33.6 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
13.	Iin Avg	8.452 A	IC	Average input current
14.	Ipp percentage	19.412 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
15.	L Ipp	1.641 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	175.67 mW	Inductor	Inductor power dissipation
17.	L1 DCR	2.6 mOhm	Inductor	L1 DCR
18.	L1 Irms	8.22 A	Inductor	Inductor ripple current
19.	Cin Pd	657.69 µW	Power	Input capacitor power dissipation
20.	Cinx Pd	580.3 nW	Power	Bulk capacitor power dissipation
21.	IC Pd	1.166 W	Power	IC power dissipation
22.	L Pd	175.67 mW	Power	Inductor power dissipation
23.	Total Pd	1.355 W	Power	Total Power Dissipation
24.	BOM Count	13	System Information	Total Design BOM count
25.	Cross Freq	10.475 kHz	System Information	Bode plot crossover frequency
26.	Duty Cycle	75.628 %	System Information	Duty cycle
27.	Efficiency	94.657 %	System Information	Steady state efficiency
28.	FootPrint	300.0 mm^2	System Information	Total Foot Print Area of BOM components
29.	Frequency	500.0 kHz	System Information	Switching frequency
30.	Gain Marg	-7.572 dB	System Information	Bode Plot Gain Margin
31.	Iout	2.0 A	System Information	Iout operating point
32.	Iout transient step used for Cout calculations	1.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
33.	Low Freq Gain	55.028 dB	System Information	Gain at 1Hz
34.	Mode	CCM	System Information	Conduction Mode
35.	Overshoot Value	16.364 mV	System Information	Theoretical Vout Overshoot Value
36.	Phase Marg	57.839 deg	System Information	Bode Plot Phase Margin
37.	Pout	24.0 W	System Information	Total output power

#	Name	Value	Category	Description
38.	Total BOM	$3.4	System Information	Total BOM Cost
39.	Undershoot Value	11.615 mV	System Information	Theoretical Vout Undershoot Value
40.	Vin	3.0 V	System Information	Vin operating point
41.	Vin p-p	46.614 mV	System Information	Peak-to-peak input voltage
42.	Vout	12.07 V	System Information	Operational Output Voltage
43.	Vout Actual	12.07 V	System Information	Vout Actual calculated based on selected voltage divider resistors
44.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
45.	Vout Tolerance	3.958 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
46.	Vout p-p	112.792 mV	System Information	Peak-to-peak output ripple voltage
47.	Vout transient requirement used for Cout calculations	3.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	3.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS61288	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

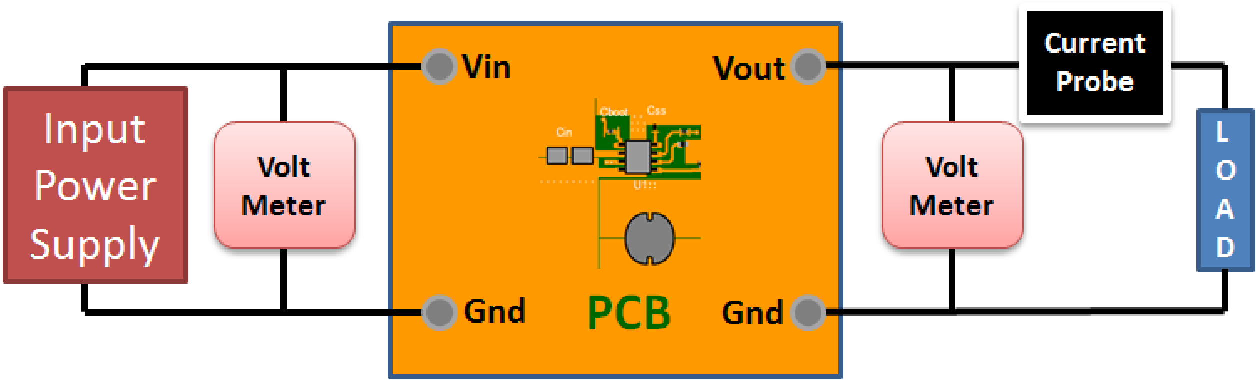
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.0V 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 : 3772F8B254884A20[v1]

2. **TPS61288** Product Folder : https://www.ti.com/product/TPS61288 : contains the data sheet and other resources.

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