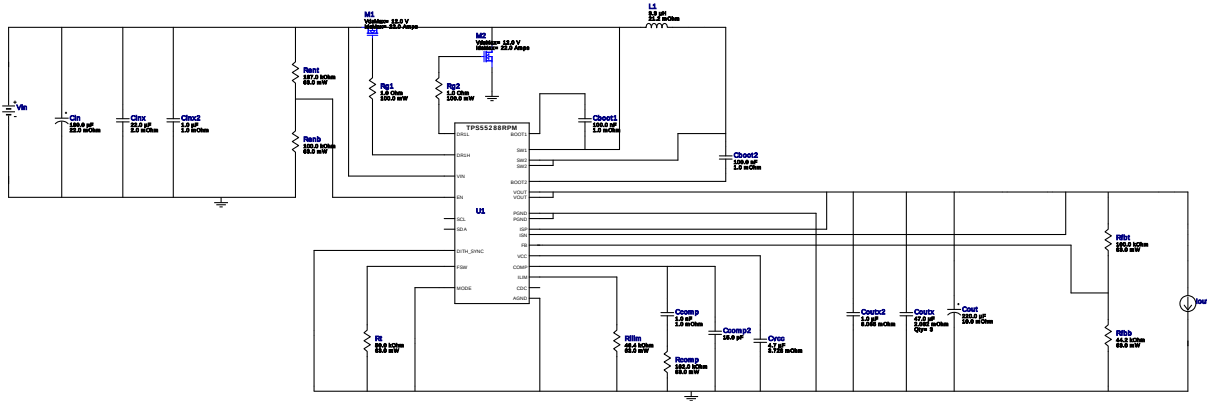


WEBENCH® Design Report

Design : 13 TPS55288RPMR
TPS55288RPMR 3V-8V to 3.70V @ 3.5A

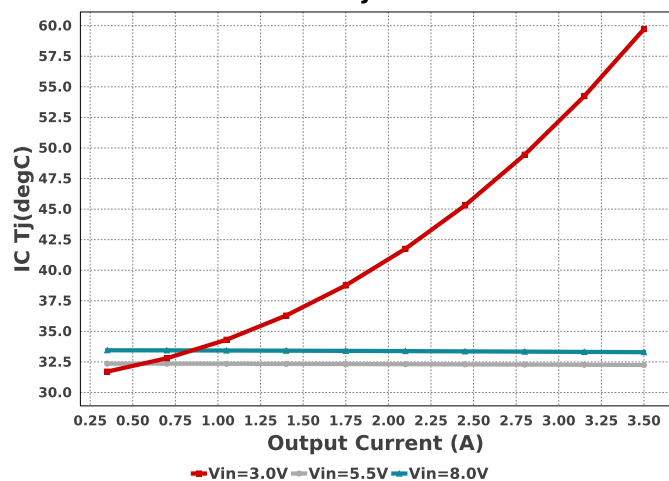


Electrical BOM

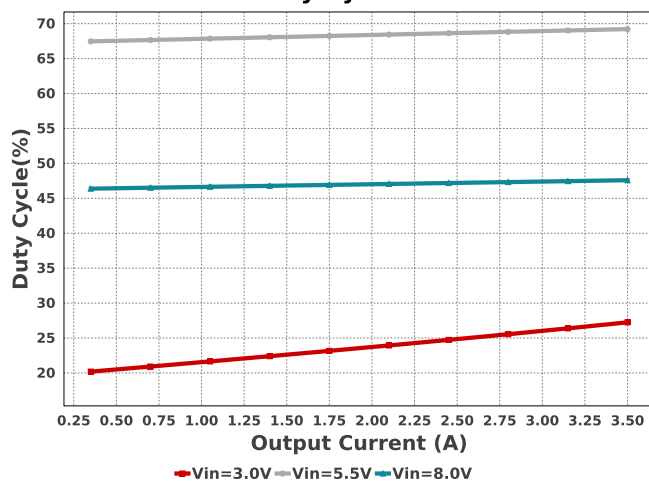
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm²
Cboot2	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm²
Ccomp	MuRata	GRM155R71C102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
Ccomp2	Kemet	C0402C150J4GACTU Series= C0G/NP0	Cap= 15.0 pF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
Cin	Panasonic	16SVPF180M Series= SVPF	Cap= 180.0 uF ESR= 22.0 mOhm VDC= 16.0 V IRMS= 3.3 A	1	\$0.57	 CAPSMT_62_F61 74 mm²
Cinx	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	1	\$0.67	 1210 15 mm²
Cinx2	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 mm²
Cout	Chemi-Con	APXF6R3ARA221MF61G Series= PXF	Cap= 220.0 uF ESR= 10.0 mOhm VDC= 6.3 V IRMS= 3.9 A	1	\$0.26	 CAPSMT_62_F61 74 mm²
Coutx	TDK	C3216X6S1A476M160AC Series= X6S	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 10.0 V IRMS= 5.0279 A	3	\$0.26	 1206_180 11 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM188R60J105KA01D Series= X5R	Cap= 1.0 uF ESR= 6.065 mOhm VDC= 6.3 V IRMS= 1.36934 A	1	\$0.01	 0603 5 mm ²
Cvcc	TDK	C1608X6S1C475K080AC Series= X6S	Cap= 4.7 uF ESR= 3.728 mOhm VDC= 16.0 V IRMS= 2.69359 A	1	\$0.08	 0603 5 mm ²
L1	Coilcraft	XAL5030-332MEB	L= 3.3 uH 21.2 mOhm	1	\$0.63	 XAL5030 54 mm ²
M1	Texas Instruments	CSD13202Q2	VdsMax= 12.0 V IdsMax= 22.0 Amps	1	\$0.09	DQK0006C 9 mm ²
M2	Texas Instruments	CSD13202Q2	VdsMax= 12.0 V IdsMax= 22.0 Amps	1	\$0.09	DQK0006C 9 mm ²
Rcomp	Yageo	AC0402FR-07162KL Series= ?	Res= 162.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 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	CRCW0402137KFKED Series= CRCW..e3	Res= 137.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfbb	Yageo	AC0402FR-0744K2L Series= ?	Res= 44.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rg1	Vishay-Dale	CRCW06031R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rg2	Vishay-Dale	CRCW06031R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rilim	Vishay-Dale	CRCW040246K4FKED Series= CRCW..e3	Res= 46.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rt	Vishay-Dale	CRCW040250K0FKED Series= 0402	Res= 50.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
U1	Texas Instruments	TPS55288RPMR	Switcher	1	\$2.52	RPM0026A 22 mm ²

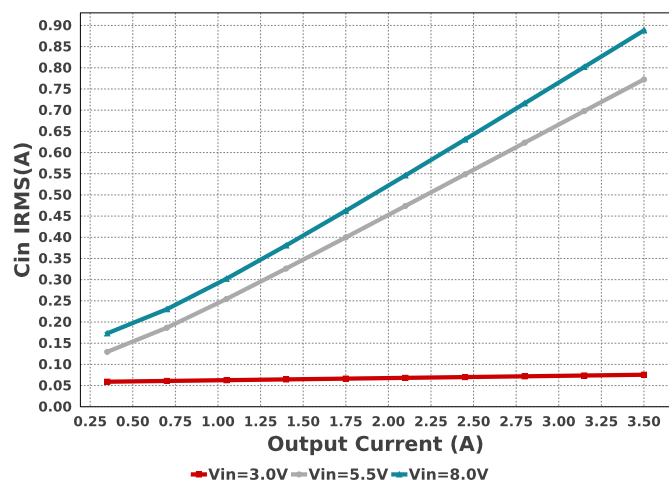
IC Tj



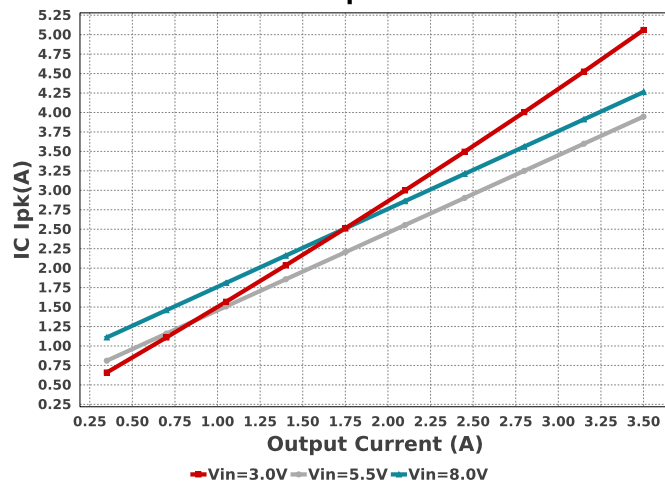
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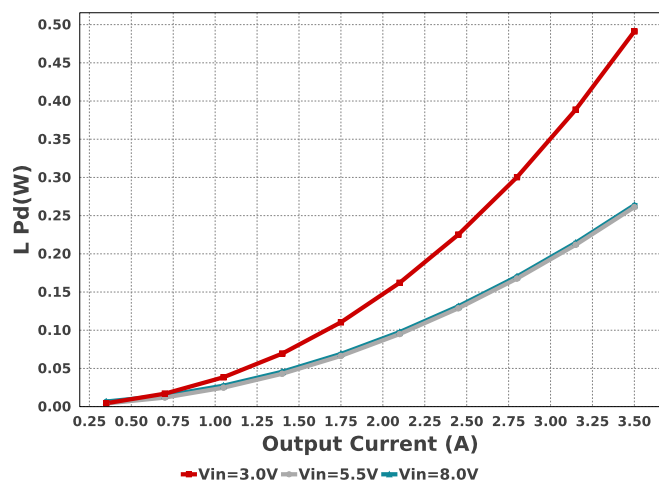
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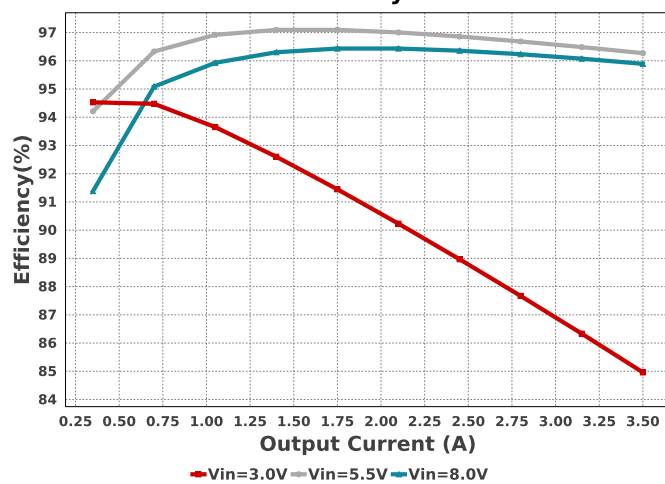
IC Ipk

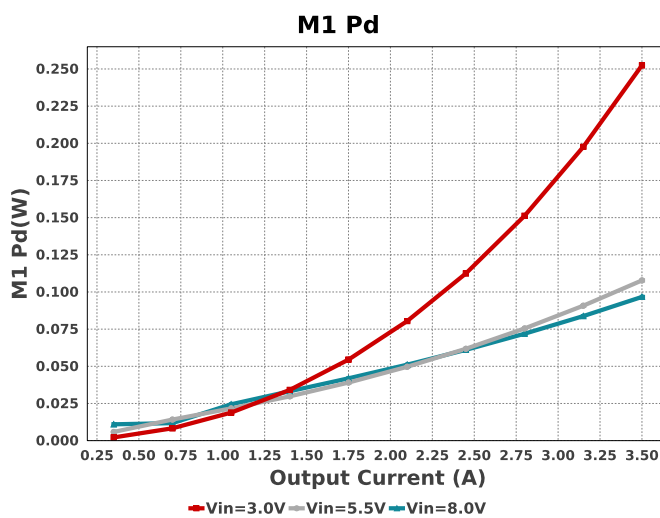
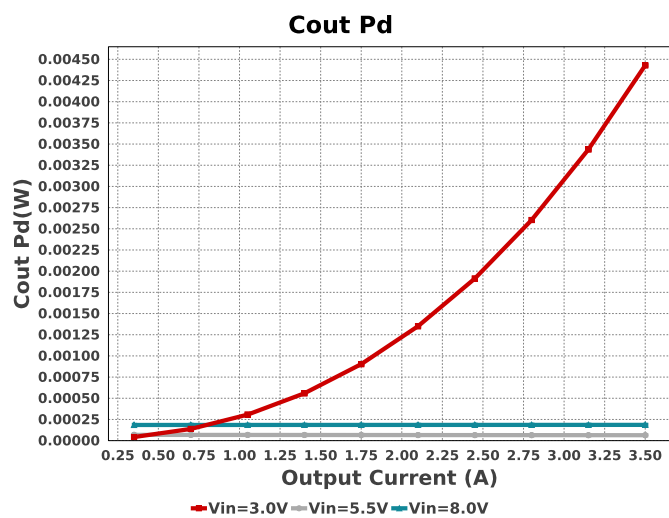
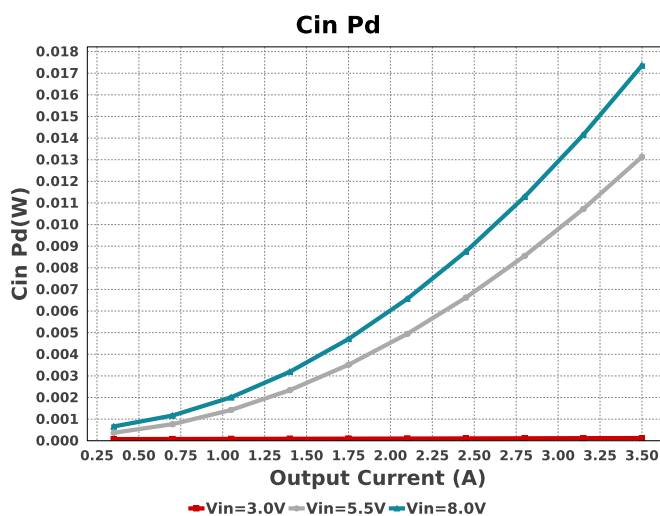
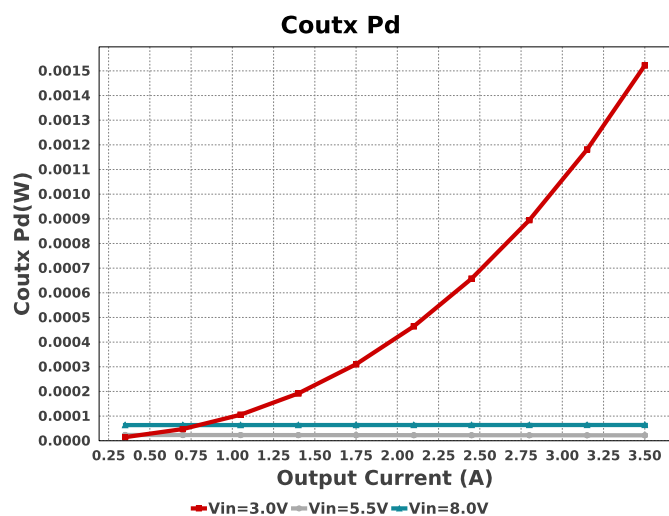
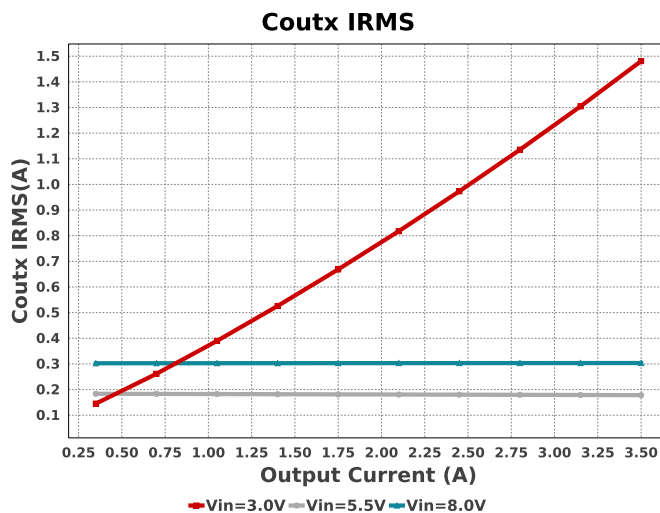
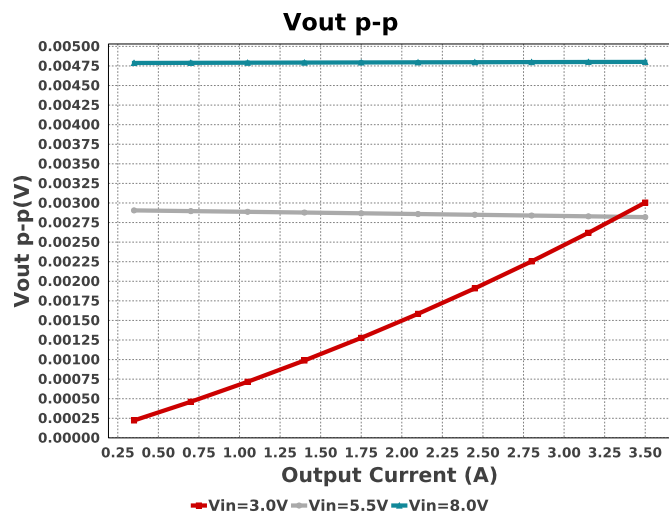


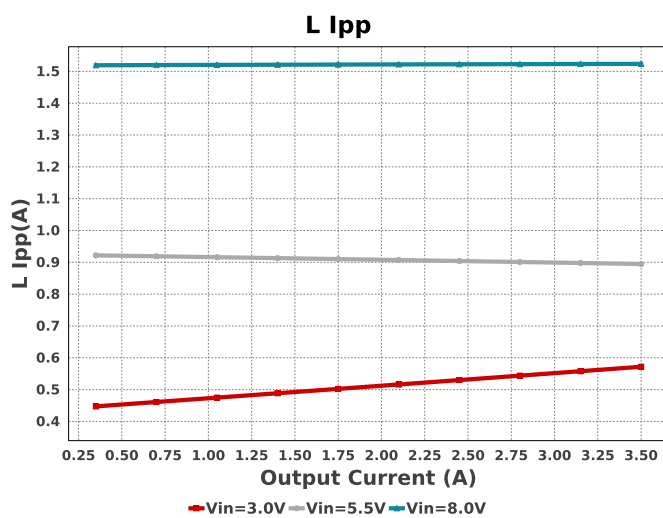
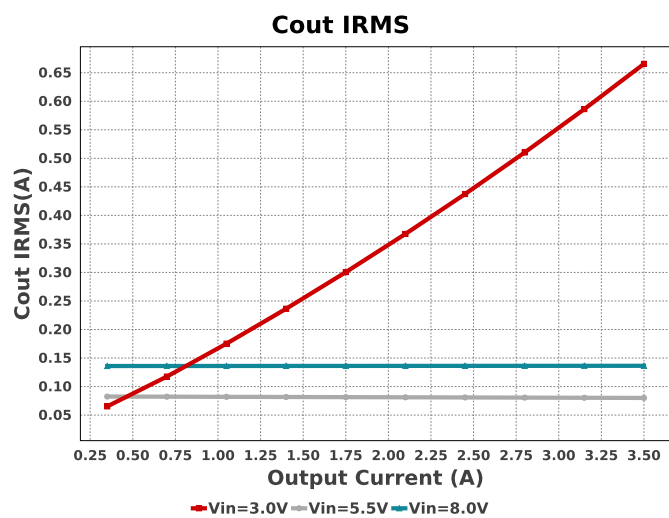
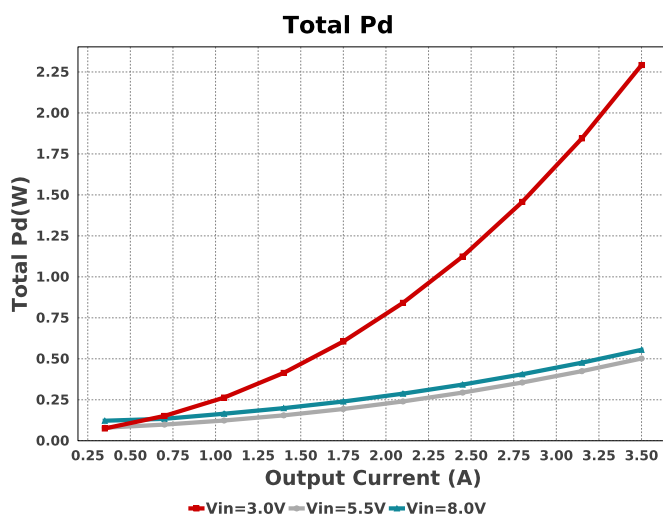
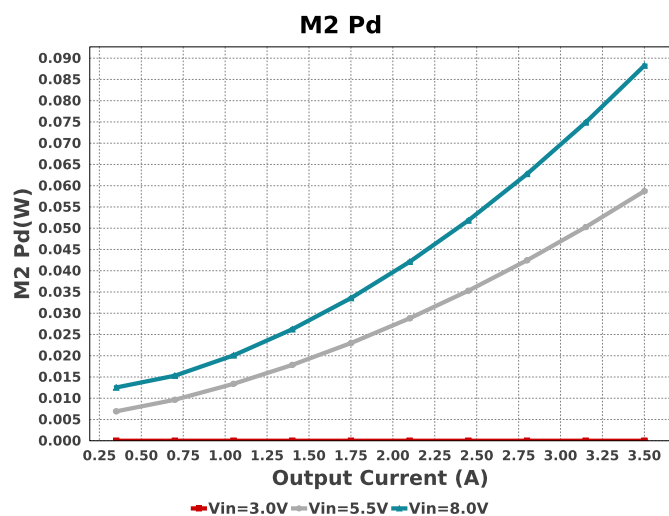
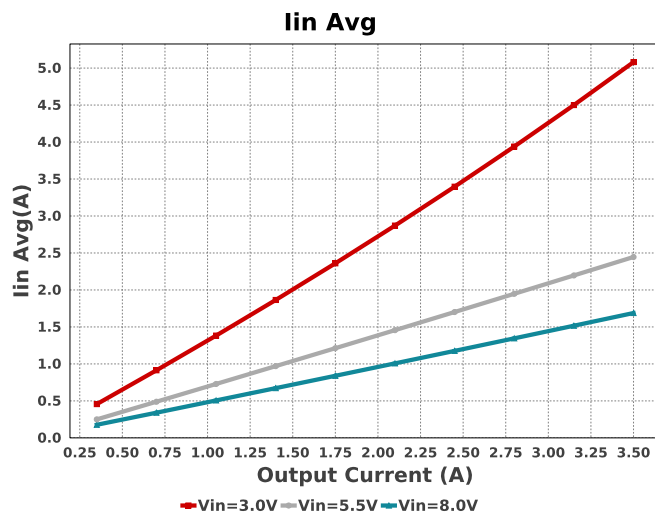
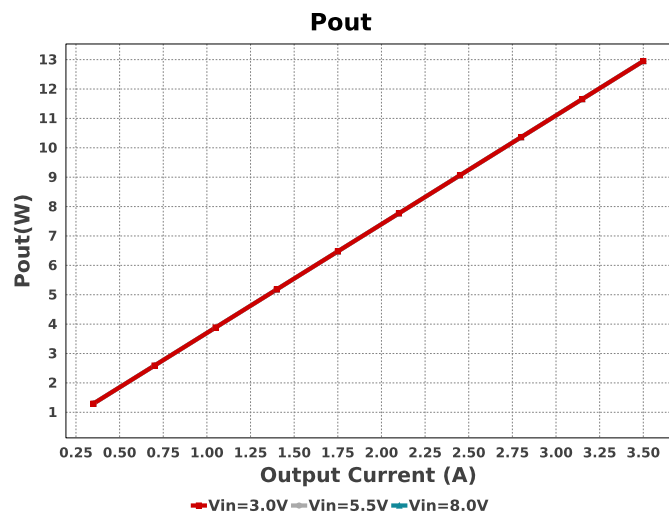
L Pd

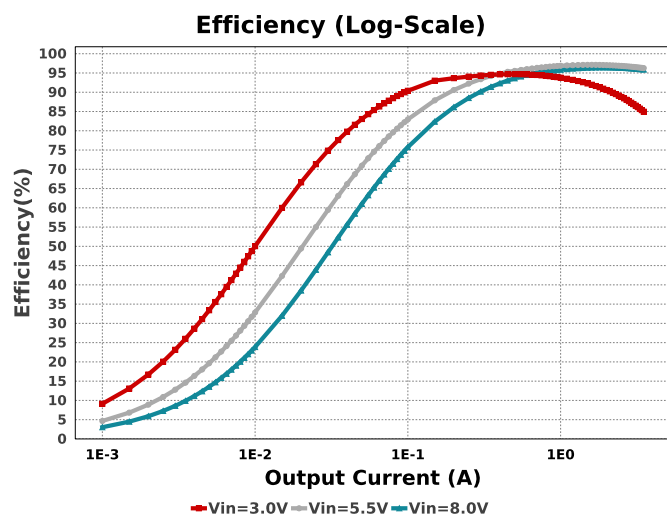
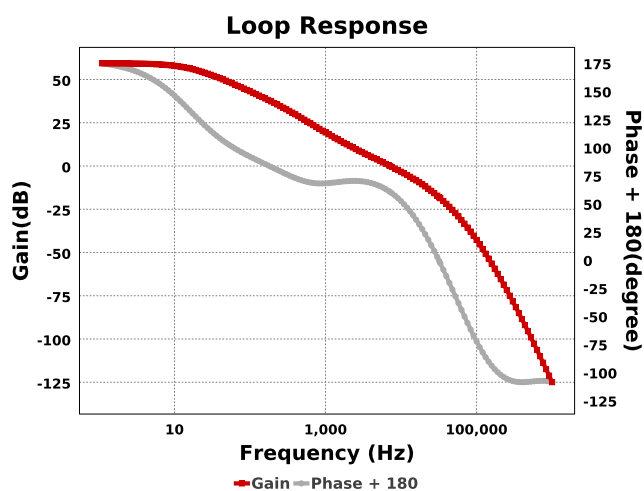
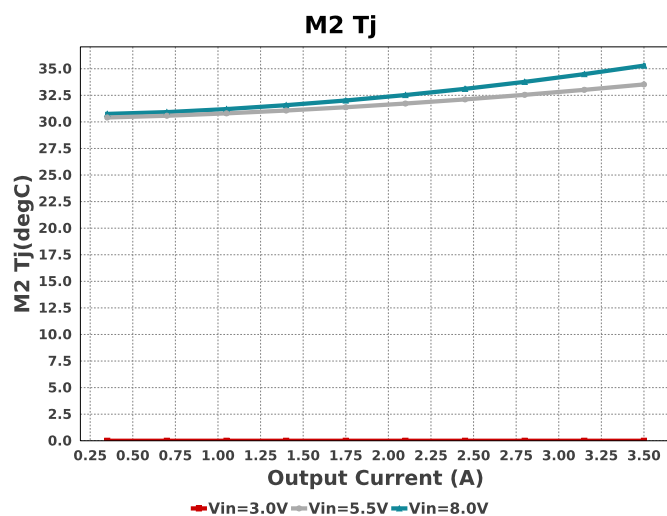
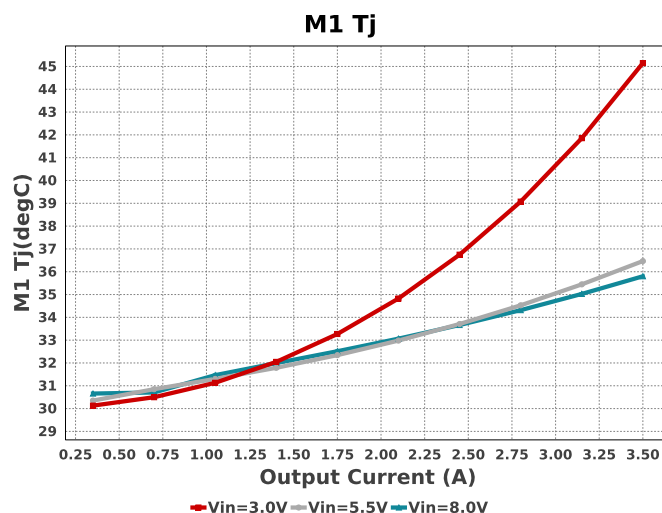
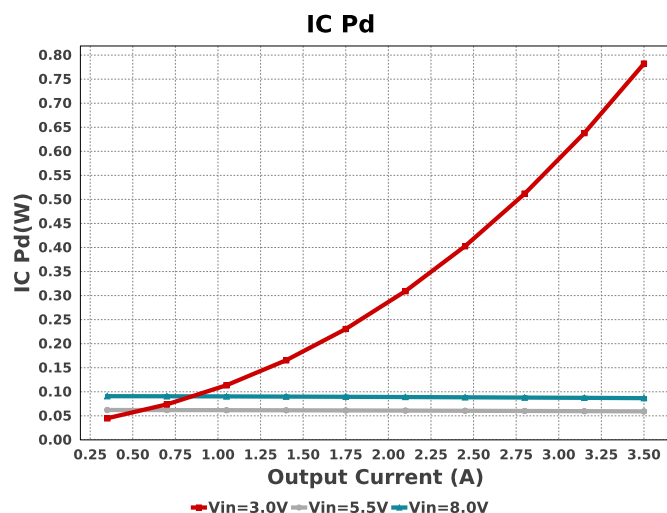


Efficiency









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	75.567 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	125.63 μ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	665.513 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	4.429 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	1.481 A	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	1.522 mW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	5.06 A	IC	Peak switch current in IC
8.	IC Pd	782.13 mW	IC	IC power dissipation
9.	IC Tj	59.721 degC	IC	IC junction temperature
10.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA Effective	38.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	5.081 A	IC	Average input current
13.	L Ipp	571.75 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	491.19 mW	Inductor	Inductor power dissipation
15.	M1 Pd	252.44 mW	Mosfet	M1 MOSFET total power dissipation
16.	M1 Tj	45.147 degC	Mosfet	M1 MOSFET junction temperature
17.	M2 Pd	172.72 mW	Mosfet	M2 MOSFET total power dissipation
18.	M2 Tj	36.909 degC	Mosfet	M2 MOSFET junction temperature
19.	Cin Pd	125.63 µW	Power	Input capacitor power dissipation
20.	Cout Pd	4.429 mW	Power	Output capacitor power dissipation
21.	Coutx Pd	1.522 mW	Power	Output capacitor_x power loss
22.	IC Pd	782.13 mW	Power	IC power dissipation
23.	L Pd	491.19 mW	Power	Inductor power dissipation
24.	M1 Pd	252.44 mW	Power	M1 MOSFET total power dissipation
25.	M2 Pd	172.72 mW	Power	M2 MOSFET total power dissipation
26.	Total Pd	2.292 W	Power	Total Power Dissipation
27.	BOM Count	26	System Information	Total Design BOM count
28.	Cross Freq	5.914 kHz	System Information	Bode plot crossover frequency
29.	Duty Cycle	27.245 %	System Information	Duty cycle
30.	Efficiency	84.961 %	System Information	Steady state efficiency
31.	FootPrint	350.0 mm ²	System Information	Total Foot Print Area of BOM components
32.	Frequency	396.825 kHz	System Information	Switching frequency
33.	Gain Marg	-11.544 dB	System Information	Bode Plot Gain Margin
34.	Iout	3.5 A	System Information	Iout operating point
35.	Low Freq Gain	51.505 dB	System Information	Gain at 1Hz
36.	Mode	CCM	System Information	Conduction Mode
37.	Phase Marg	59.728 deg	System Information	Bode Plot Phase Margin
38.	Pout	12.95 W	System Information	Total output power
39.	Total BOM	\$5.84	System Information	Total BOM Cost
40.	Vin	3.0 V	System Information	Vin operating point
41.	Vout	3.7 V	System Information	Operational Output Voltage
42.	Vout Actual	920.009 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
43.	Vout Tolerance	5.716 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
44.	Vout p-p	3.005 mV	System Information	Peak-to-peak output ripple voltage
45.	Vref	91.0 h;	System Information	Register VREF

Design Inputs

Name	Value	Description
Iout	3.5	Maximum Output Current
VinMax	8.0	Maximum input voltage
VinMin	3.0	Minimum input voltage
Vout	3.7	Output Voltage
base_pn	TPS55288	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 C_{in} and C_{out} , 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

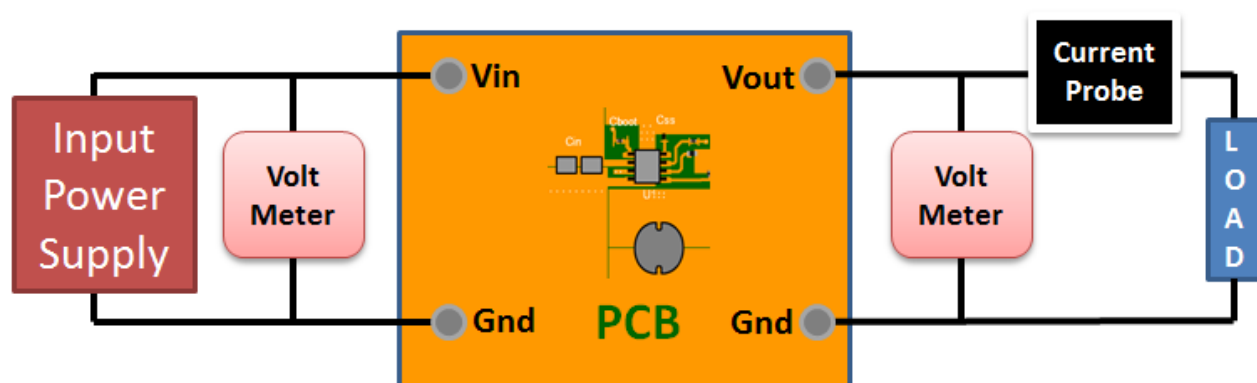
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down 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 V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} 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 V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} 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 : BA16CC9C5ECD14D75692673C37EA3B52[v1]
2. **TPS55288** Product Folder : <http://www.ti.com/product/TPS55288> : contains the data sheet and other resources.

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