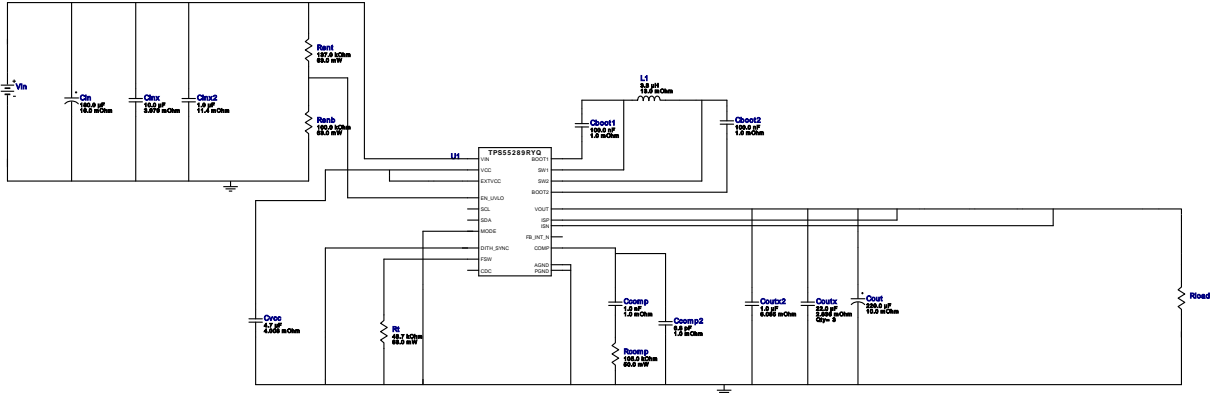


WEBENCH® Design Report

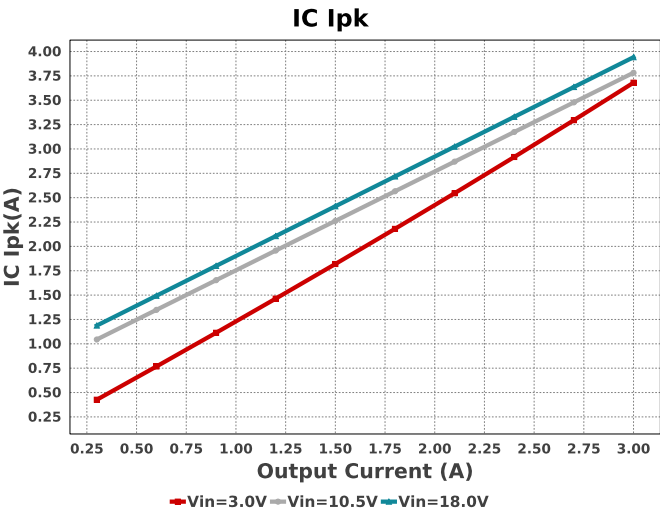
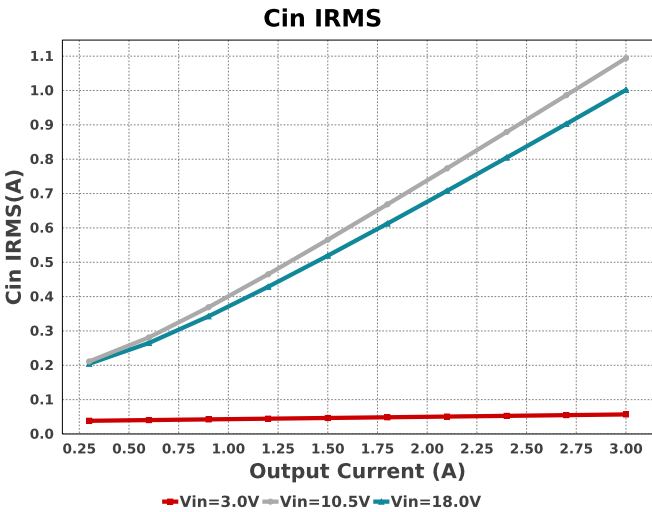
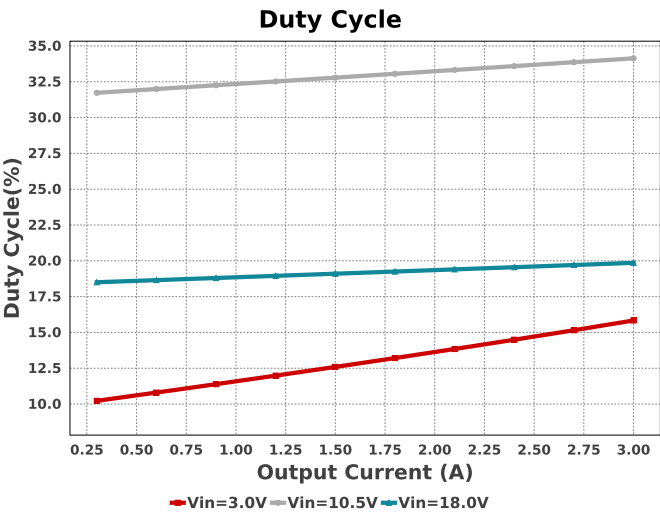
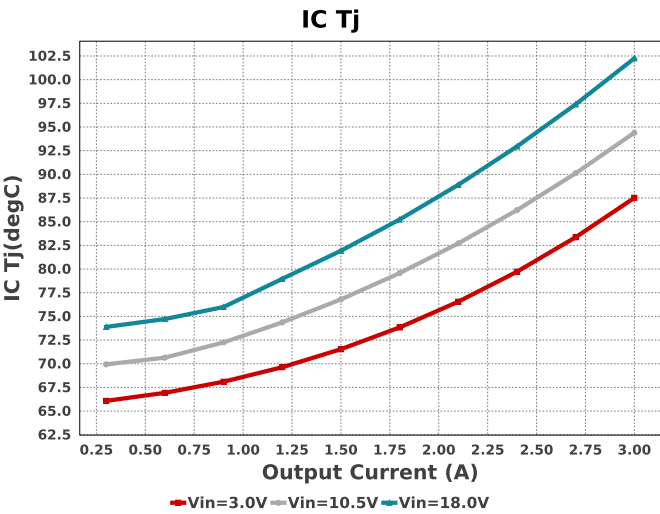
Design : 2 TPS55289RYQR
TPS55289RYQR 3V-18V to 3.30V @ 3A

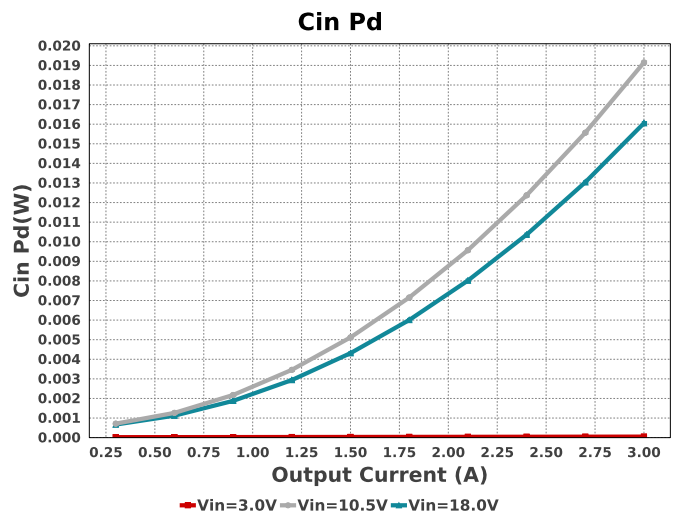
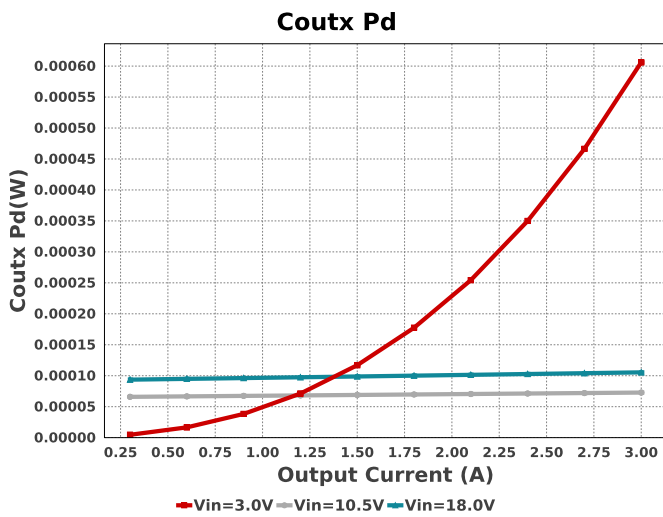
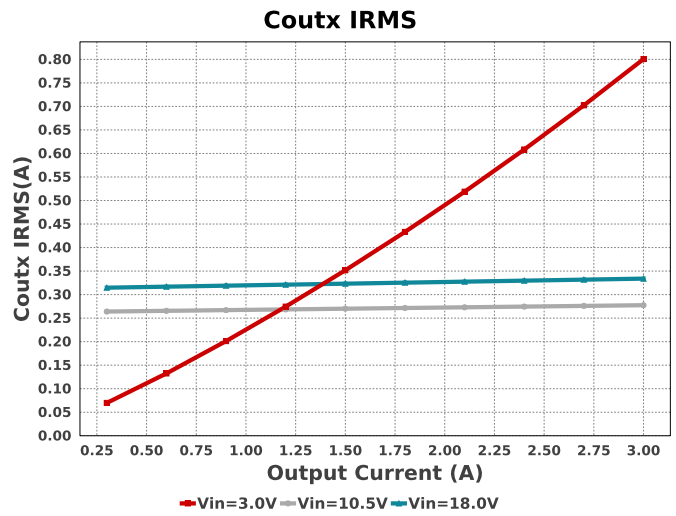
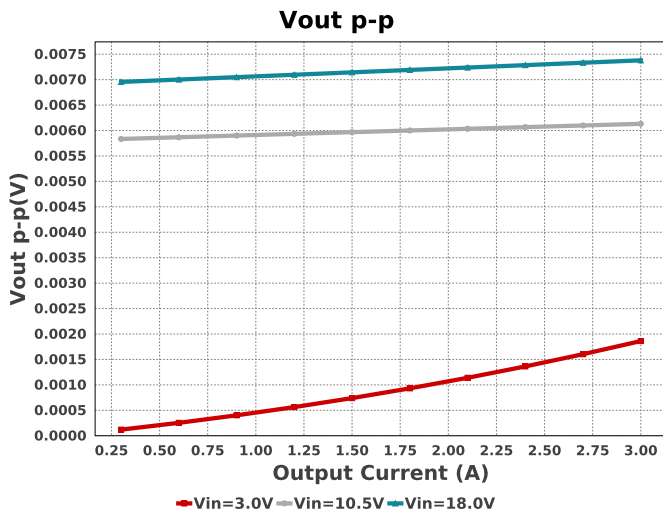
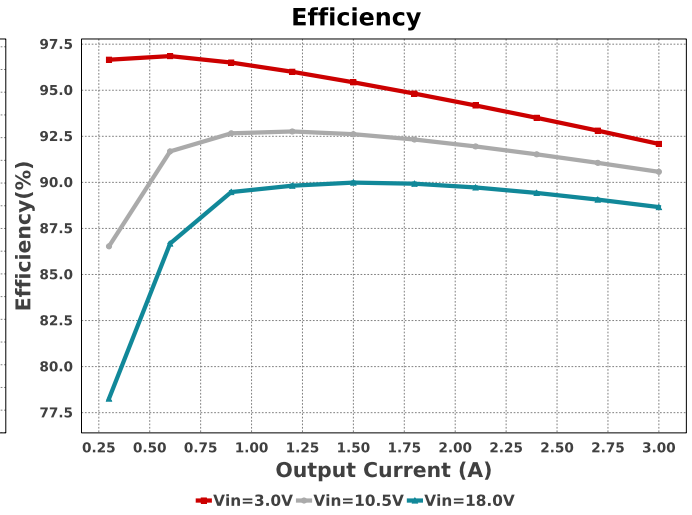
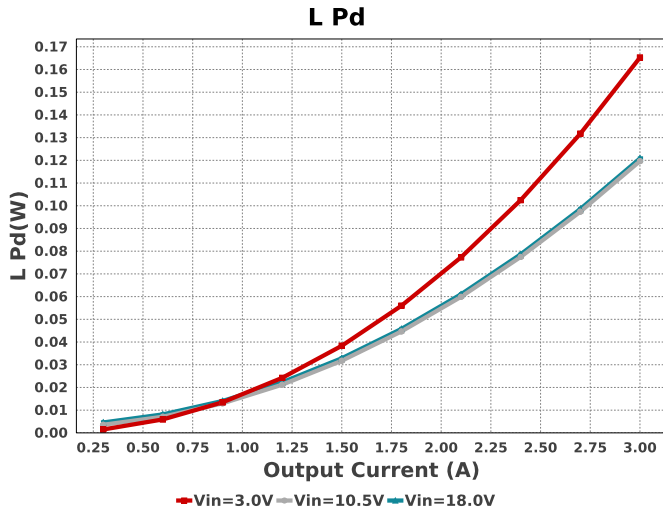


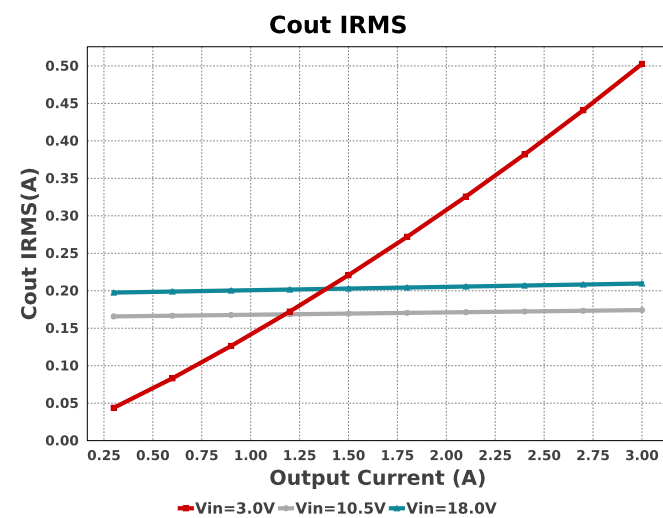
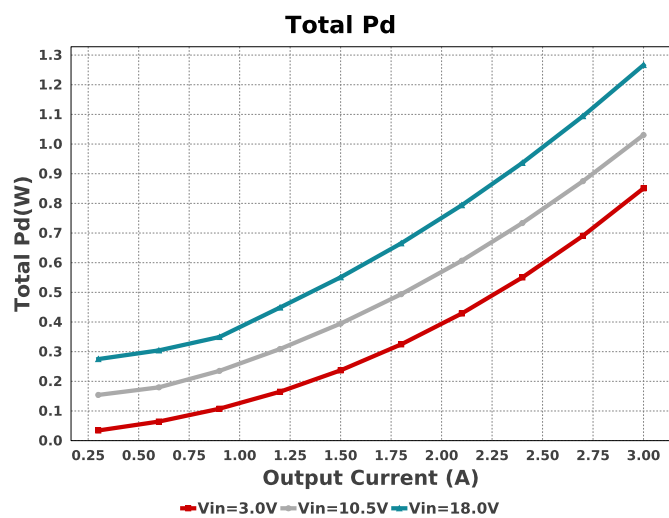
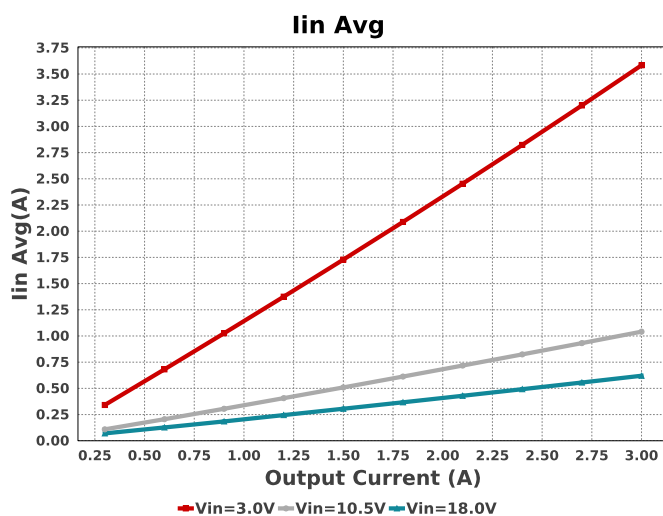
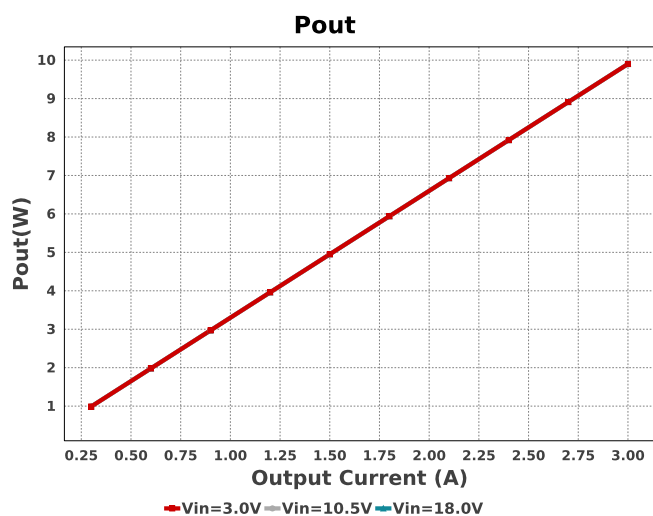
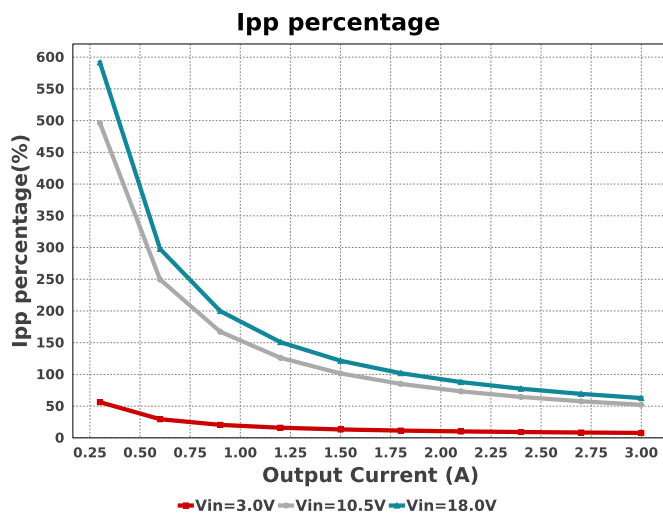
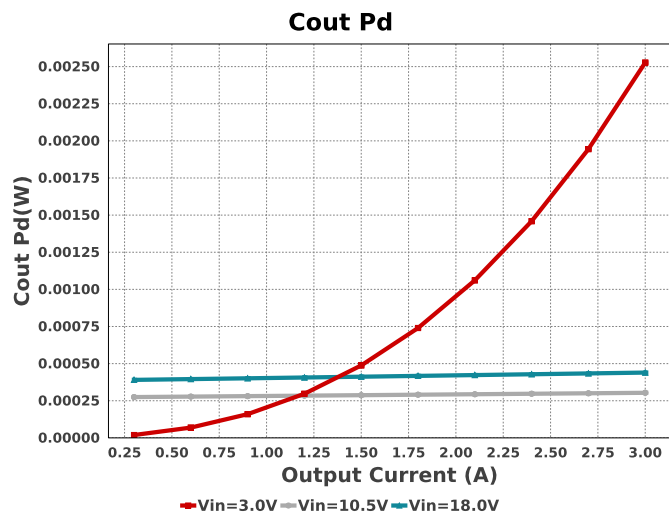
Electrical BOM

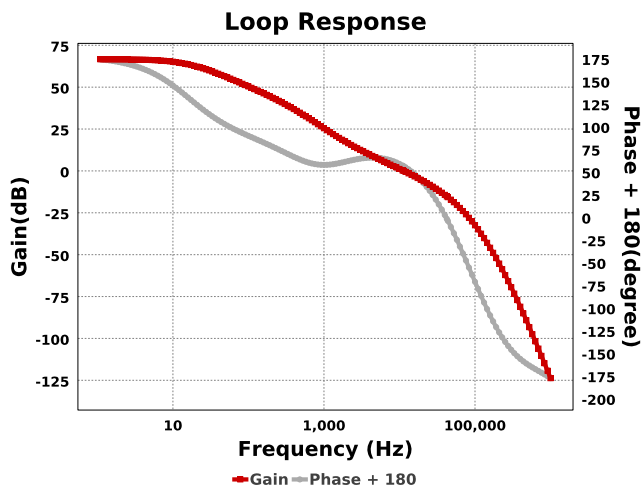
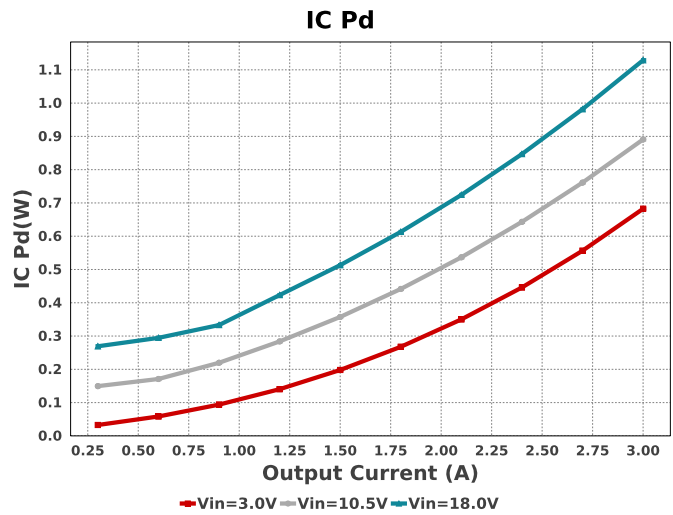
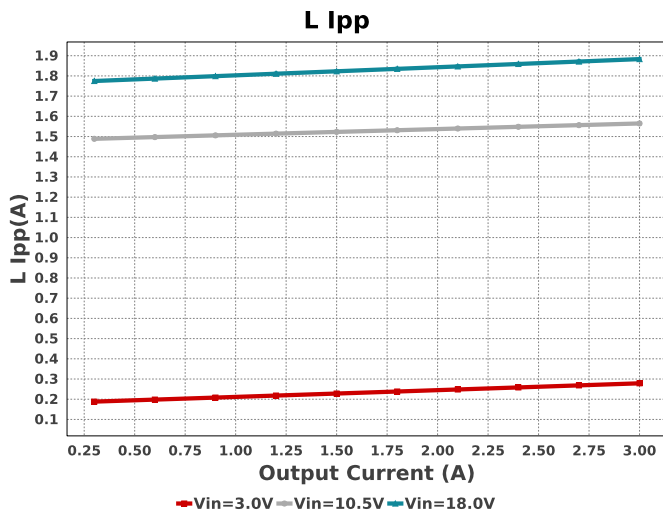
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
Cboot2	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
Ccomp	Yageo	CC0805KRX7R9BB102 Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
Ccomp2	MuRata	GRM1555C1E6R8CA01D Series= C0G/NP0	Cap= 6.8 pF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Cin	Panasonic	25SVPF180M Series= SVPF	Cap= 180.0 uF ESR= 16.0 mOhm VDC= 25.0 V IRMS= 4.65 A	1	\$1.17	CAPSMT_62_E12 106 mm ²
Cinx	Taiyo Yuden	MSASU32MSB5106KPNA01 Series= X5R	Cap= 10.0 uF ESR= 3.979 mOhm VDC= 50.0 V IRMS= 3.4821 A	1	\$0.16	1210 15 mm ²
Cinx2	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
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 mm ²
Coutx	Taiyo Yuden	MCASL32MSB5226MPNA01 Series= X5R	Cap= 22.0 uF ESR= 2.836 mOhm VDC= 10.0 V IRMS= 4.1463 A	3	\$0.21	1210 15 mm ²

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 mm²
Cvcc	TDK	C1608X5R1C475K080AC Series= X5R	Cap= 4.7 uF ESR= 4.008 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.06	 0603 5 mm²
L1	Coiltronics	DR1040-3R8-R	L= 3.8 uH 13.0 mOhm	1	\$0.49	 DR1040 154 mm²
Rcomp	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	 0201 2 mm²
Renb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
Rent	Vishay-Dale	CRCW0402137KFKED Series= CRCW..e3	Res= 137.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
Rt	Vishay-Dale	CRCW040248K7FKED Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
U1	Texas Instruments	TPS55289RYQR	Switcher	1	\$2.70	 RYQ0021A 35 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	59.861 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	57.333 μ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	527.021 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	2.778 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	839.415 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	666.1 μ W	Capacitor	Output capacitor_x power loss
7.	IC Ipk	3.743 A	IC	Peak switch current in IC
8.	IC Pd	847.87 mW	IC	IC power dissipation
9.	IC Tj	92.98 degC	IC	IC junction temperature
10.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA Effective	33.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
12.	Iin Avg	3.641 A	IC	Average input current
13.	Ipp percentage	8.097 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	293.16 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	170.49 mW	Inductor	Inductor power dissipation
16.	Cin Pd	57.333 μ W	Power	Input capacitor power dissipation
17.	Cout Pd	2.778 mW	Power	Output capacitor power dissipation
18.	Coutx Pd	666.1 μ W	Power	Output capacitor_x power loss
19.	IC Pd	847.87 mW	Power	IC power dissipation
20.	L Pd	170.49 mW	Power	Inductor power dissipation
21.	Total Pd	1.022 W	Power	Total Power Dissipation
22.	BOM Count	19	System	Total Design BOM count
23.	Cross Freq	10.491 kHz	System	Bode plot crossover frequency
24.	Duty Cycle	17.136 %	System	Duty cycle
25.	Efficiency	90.644 %	System	Steady state efficiency
26.	FootPrint	470.0 mm ²	System	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
27.	Frequency	402.82 kHz	System Information	Switching frequency
28.	Gain Marg	-13.015 dB	System Information	Bode Plot Gain Margin
29.	Iout	3.0 A	System Information	Iout operating point
30.	Low Freq Gain	59.769 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	58.238 deg	System Information	Bode Plot Phase Margin
33.	Pout	9.9 W	System Information	Total output power
34.	Total BOM	\$5.58	System Information	Total BOM Cost
35.	Vin	3.0 V	System Information	Vin operating point
36.	Vout	3.3 V	System Information	Operational Output Voltage
37.	Vout Tolerance	363.64 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
38.	Vout p-p	2.015 mV	System Information	Peak-to-peak output ripple voltage
39.	Vref	1.978 kh;	System Information	Register VREF

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	18.0	Maximum input voltage
VinMin	3.0	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS55289	Base Product Number
source	DC	Input Source Type
Ta	65.0	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

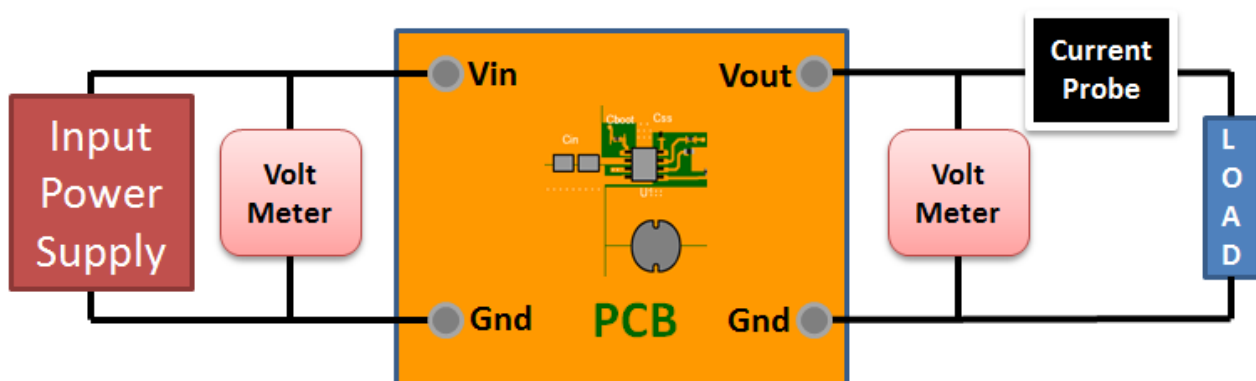
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 : AD9ABD3FB6EB8E71BDFD117B90420B13[v1]
2. **TPS55289** Product Folder : <https://www.ti.com/product/TPS55289> : contains the data sheet and other resources.

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