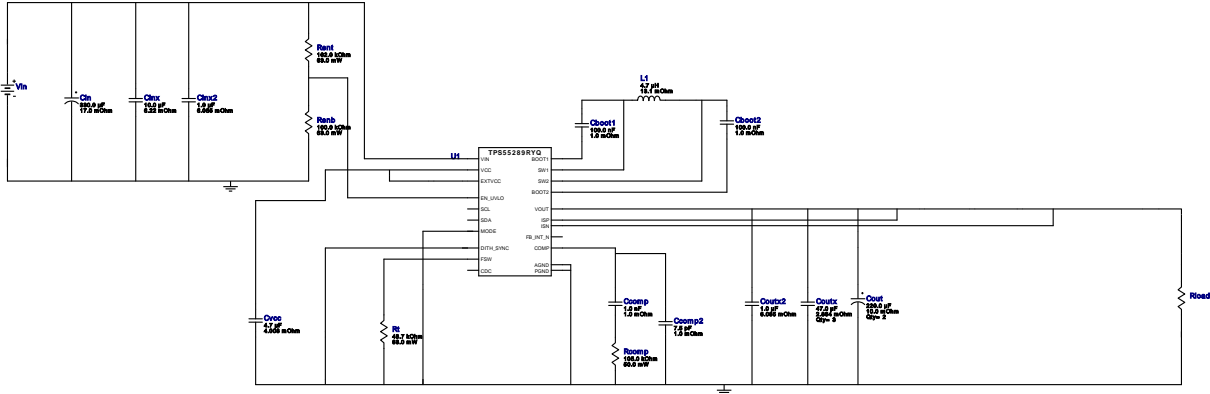


## WEBENCH® Design Report

Design : 14 TPS55289RYQR  
TPS55289RYQR 3.3V-4.2V to 3.30V @ 5A

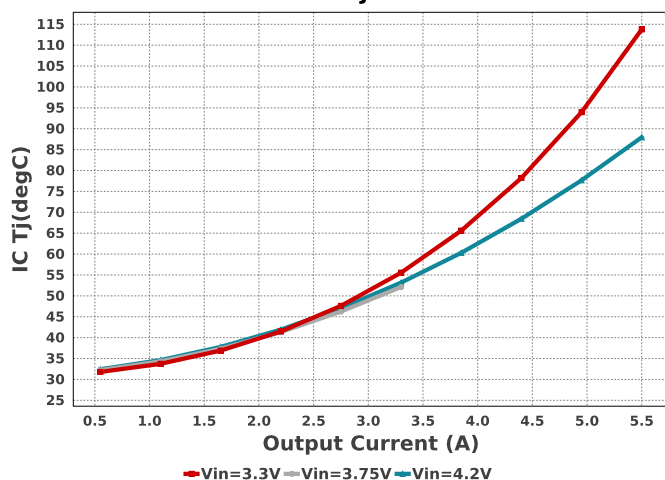


## Electrical BOM

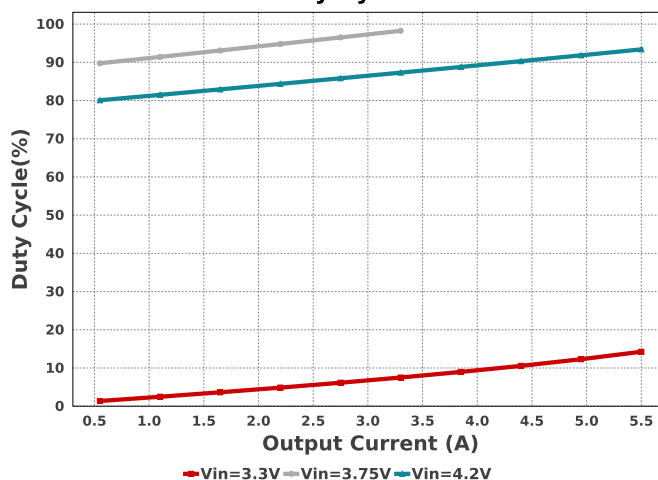
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm <sup>2</sup>
Cboot2	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm <sup>2</sup>
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 <sup>2</sup>
Ccomp2	MuRata	GRM1555C1H7R5CA01D Series= C0G/NP0	Cap= 7.5 pF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
Cin	Panasonic	6SVPC330M Series= SVPC	Cap= 330.0 uF ESR= 17.0 mOhm VDC= 6.3 V IRMS= 3.39 A	1	\$0.47	SM_RADIAL_6.3AMM 80 mm <sup>2</sup>
Cinx	Taiyo Yuden	MSASL32NSB5106KTNA01 Series= X5R	Cap= 10.0 uF ESR= 6.22 mOhm VDC= 10.0 V IRMS= 3.19741 A	1	\$0.12	1210 15 mm <sup>2</sup>
Cinx2	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 <sup>2</sup>
Cout	Chemi-Con	APXF6R3ARA221MF61G Series= PXF	Cap= 220.0 uF ESR= 10.0 mOhm VDC= 6.3 V IRMS= 3.9 A	2	\$0.26	CAPSMT_62_F61 74 mm <sup>2</sup>
Coutx	MuRata	GRM32ER71A476KE15L Series= X7R	Cap= 47.0 uF ESR= 2.864 mOhm VDC= 10.0 V IRMS= 4.8625 A	3	\$0.35	1210_280 15 mm <sup>2</sup>

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 <sup>2</sup>
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 mm <sup>2</sup>
L1	Coilcraft	XAL6060-472MEB	L= 4.7 uH 13.1 mOhm	1	\$0.82	XAL6060 72 mm <sup>2</sup>
Rcomp	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	0201 2 mm <sup>2</sup>
Renb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
Rent	Yageo	AC0402FR-07162KL Series= ?	Res= 162.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
Rt	Vishay-Dale	CRCW040248K7FKED Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
U1	Texas Instruments	TPS55289RYQR	Switcher	1	\$2.70	RYQ0021A 35 mm <sup>2</sup>

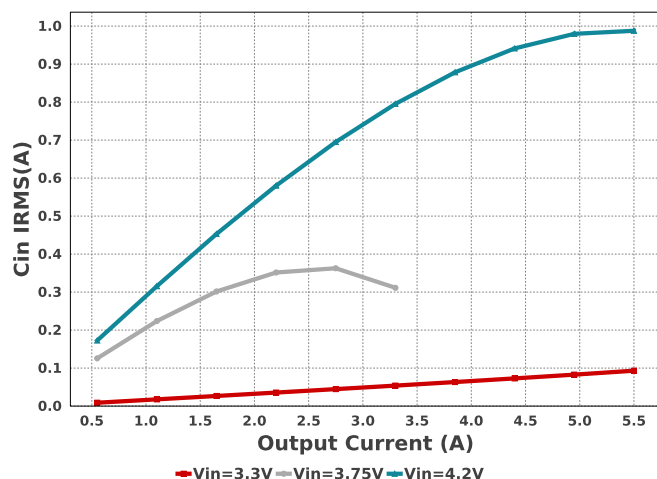
IC Tj



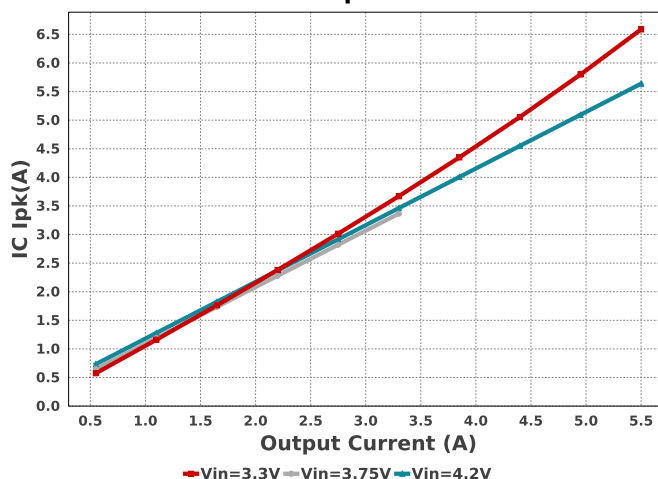
Duty Cycle

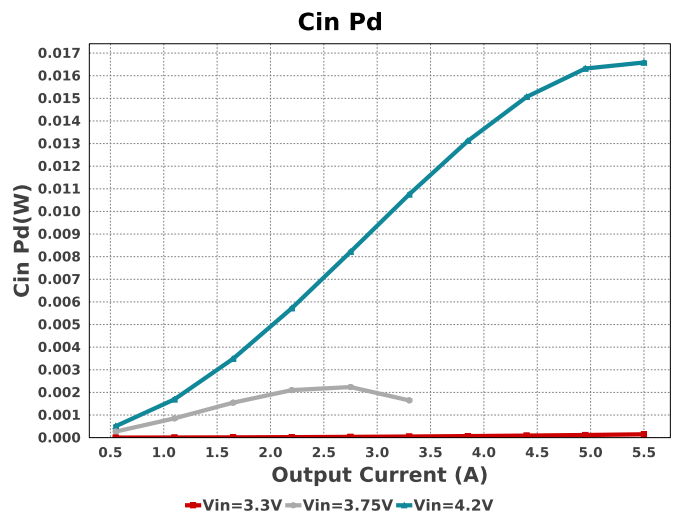
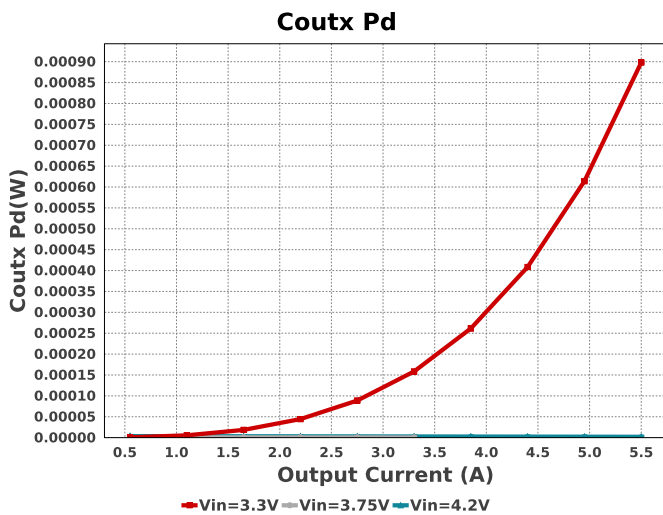
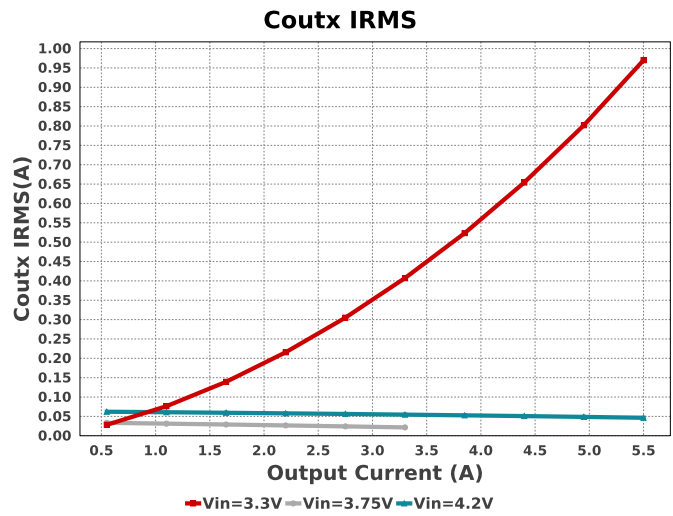
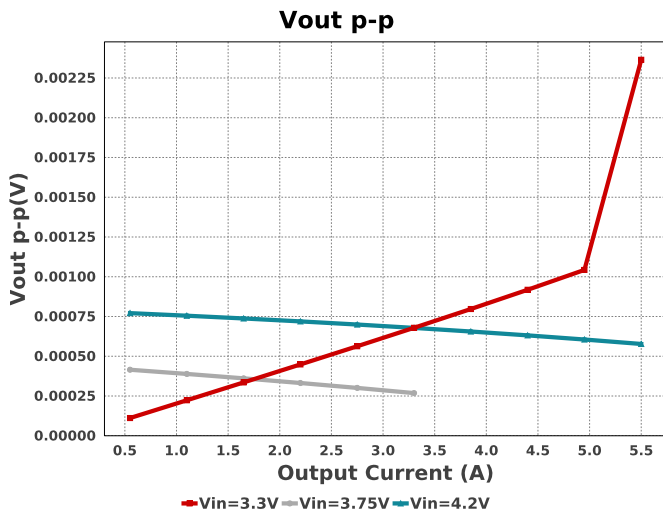
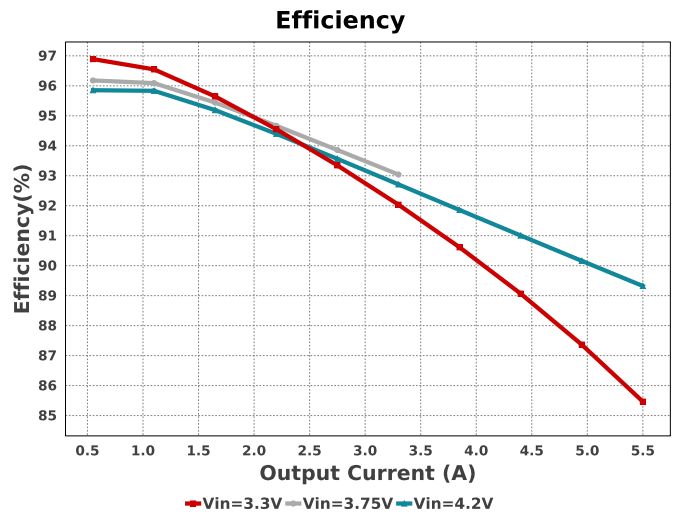
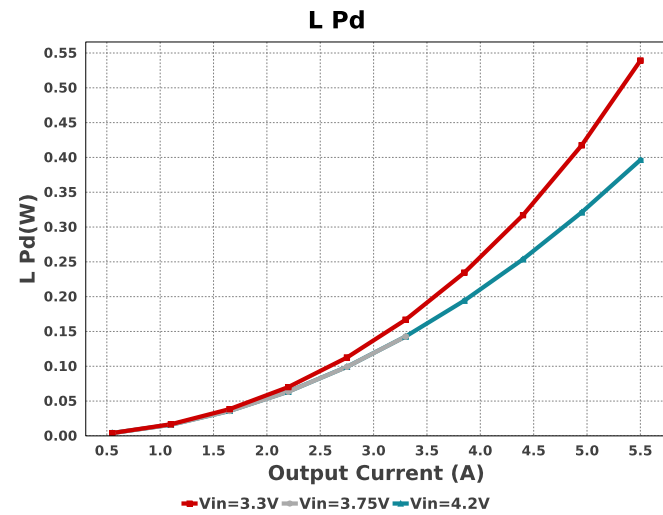


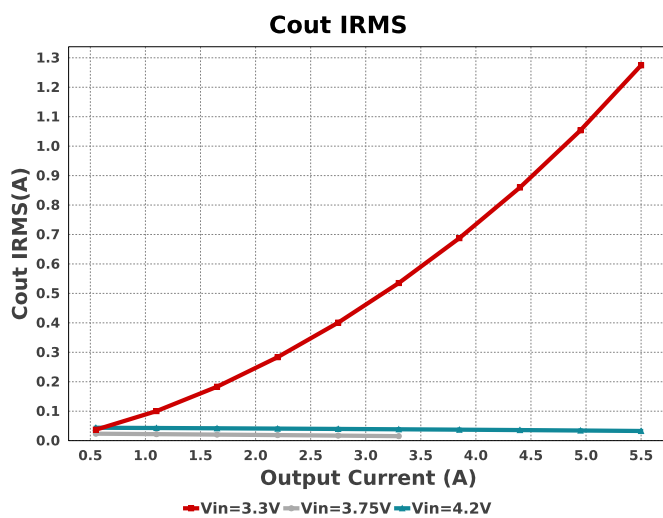
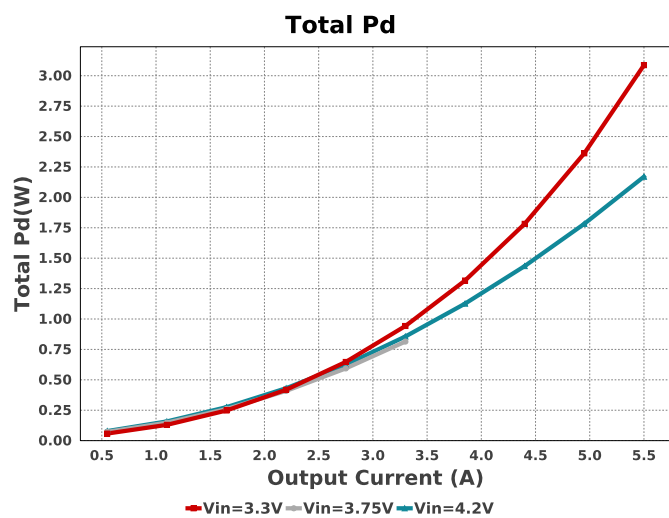
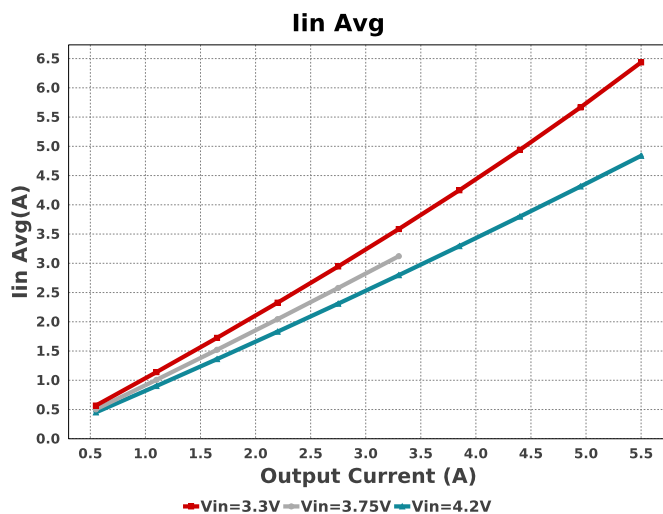
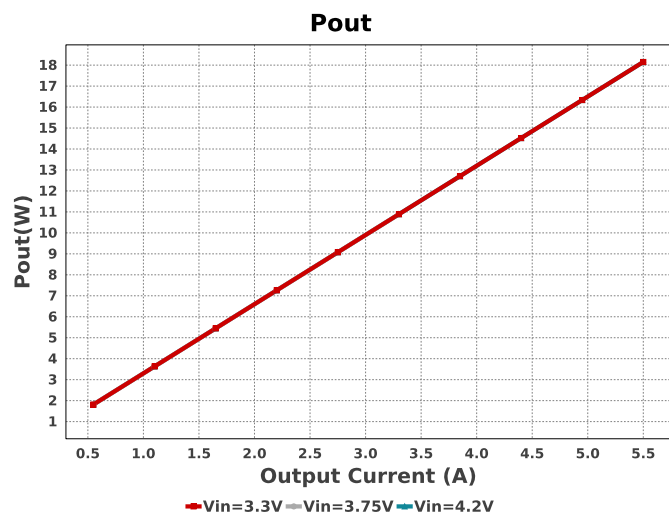
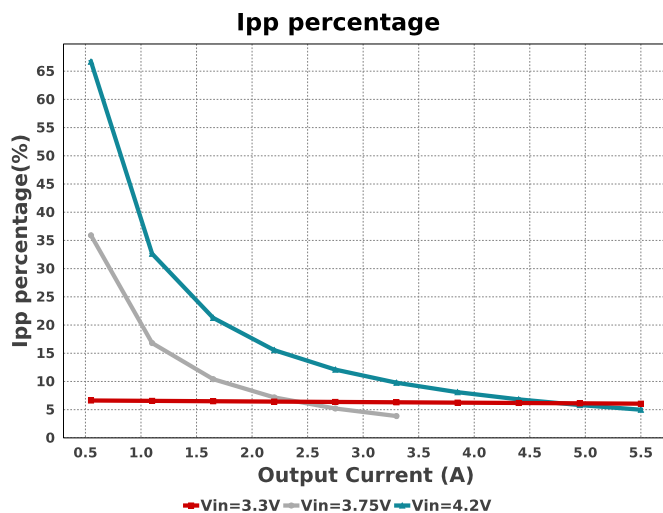
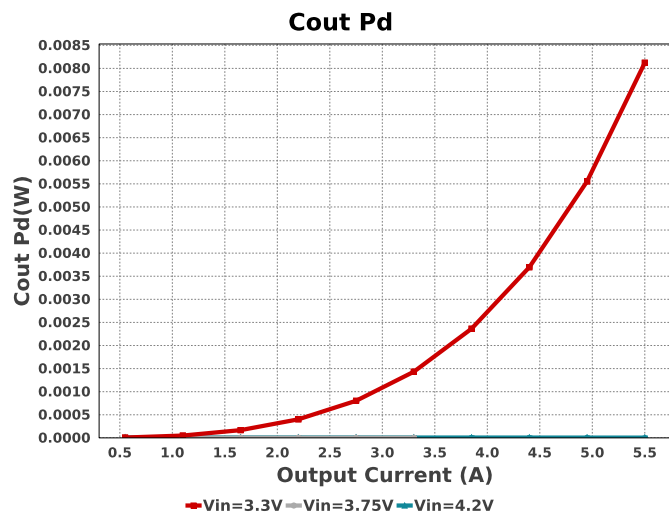
Cin IRMS

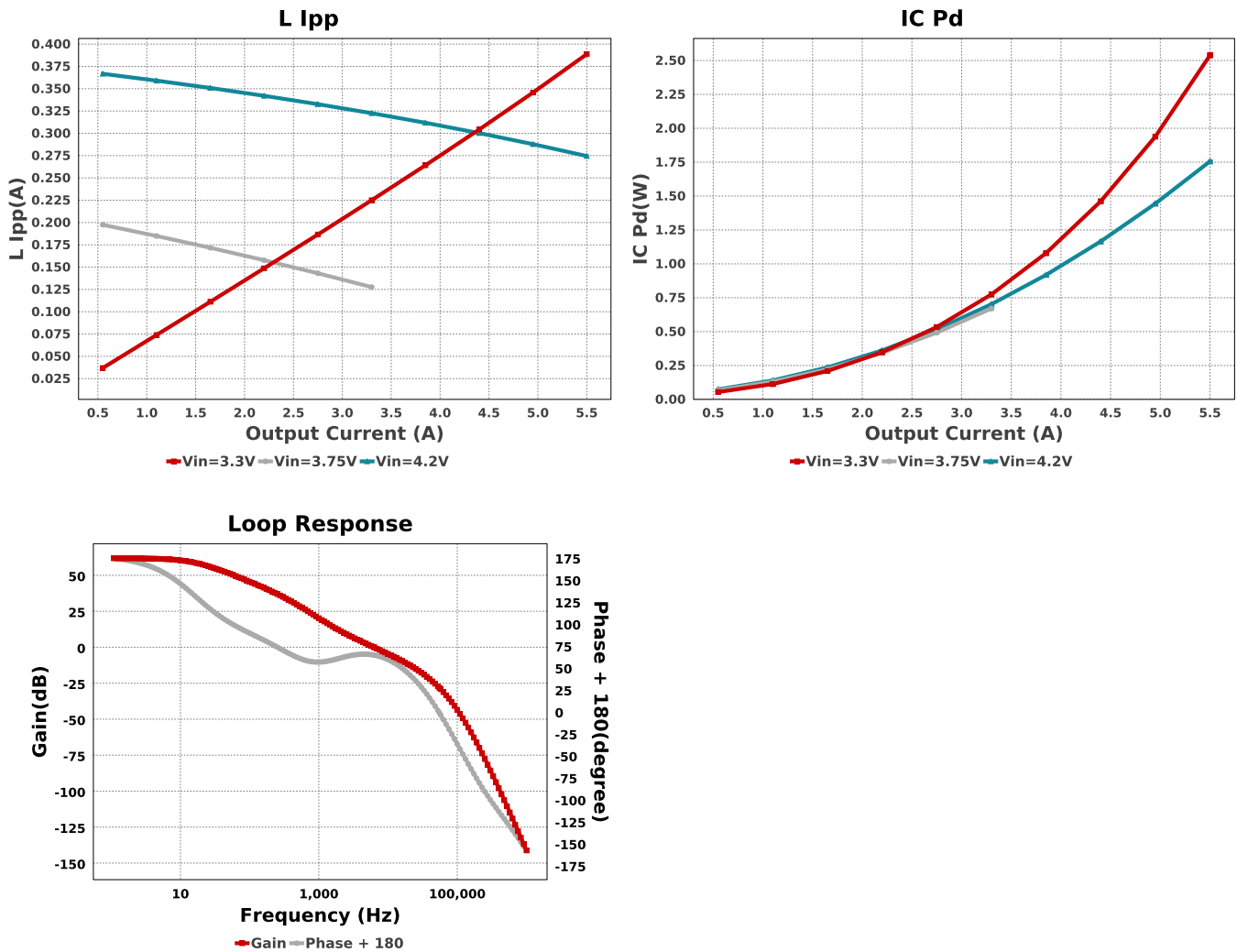


IC Ipk









## Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	38.877 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	25.695 $\mu$ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	895.724 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	4.012 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	1.268 A	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	1.536 mW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	6.405 A	IC	Peak switch current in IC
8.	IC Pd	2.347 W	IC	IC power dissipation
9.	IC Tj	107.45 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	6.373 A	IC	Average input current
13.	Ipp percentage	2.978 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	189.16 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	528.44 mW	Inductor	Inductor power dissipation
16.	Cin Pd	25.695 $\mu$ W	Power	Input capacitor power dissipation
17.	Cout Pd	4.012 mW	Power	Output capacitor power dissipation
18.	Coutx Pd	1.536 mW	Power	Output capacitor_x power loss
19.	IC Pd	2.347 W	Power	IC power dissipation
20.	L Pd	528.44 mW	Power	Inductor power dissipation
21.	Total Pd	2.881 W	Power	Total Power Dissipation
22.	BOM Count	20	System	Total Design BOM count
23.	Cross Freq	6.52 kHz	System	Bode plot crossover frequency
24.	Duty Cycle	13.401 %	System	Duty cycle
25.	Efficiency	86.301 %	System	Steady state efficiency
26.	FootPrint	437.0 mm <sup>2</sup>	System	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
27.	Frequency	402.82 kHz	System Information	Switching frequency
28.	Gain Marg	-13.078 dB	System Information	Bode Plot Gain Margin
29.	Iout	5.5 A	System Information	Iout operating point
30.	Low Freq Gain	55.796 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	59.121 deg	System Information	Bode Plot Phase Margin
33.	Pout	18.15 W	System Information	Total output power
34.	Total BOM	\$5.84	System Information	Total BOM Cost
35.	Vin	3.3 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	397.728 $\mu$ V	System Information	Peak-to-peak output ripple voltage
39.	Vref	1.978 kh;	System Information	Register VREF

## Design Inputs

Name	Value	Description
Iout	5.5	Maximum Output Current
VinMax	4.2	Maximum input voltage
VinMin	3.3	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS55289	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

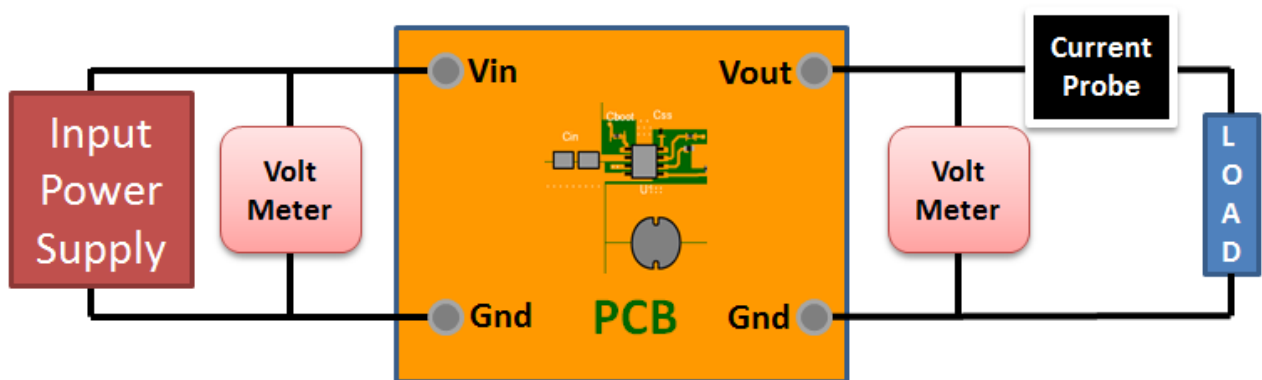
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.3V 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 : BA40E17A3BF621DF0B943C71FF12AB91[v1]
2. **TPS55289** Product Folder : <https://www.ti.com/product/TPS55289> : contains the data sheet and other resources.

#### Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.