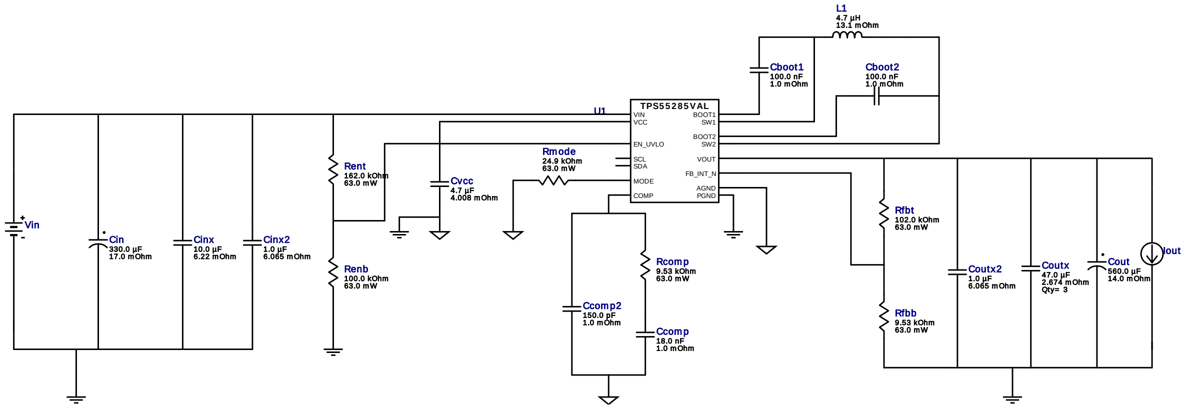
Texas Instruments

VinMin = 3.3V
VinMax = 4.2V
Vout = 3.3V
Iout = 6.2A

Device = TPS55285VALR
Topology = Buck_Boost
Created = 2025-10-12 21:01:58.612
BOM Cost = $5.07
BOM Count = 21
Total Pd = 3.53W

WEBENCH ® Design Report

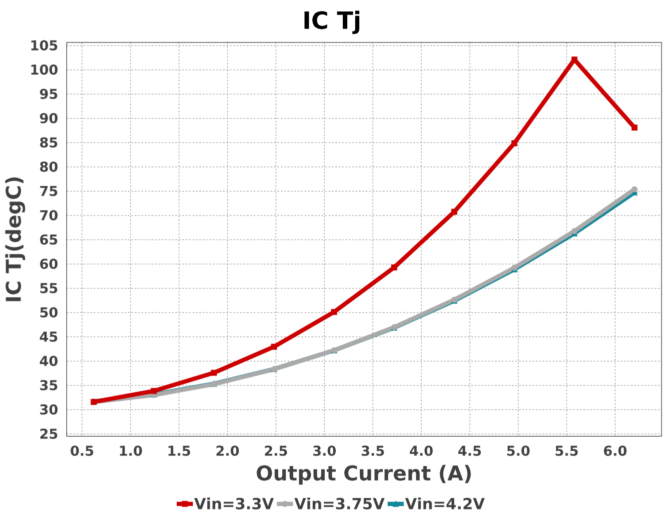
Design : 7 TPS55285VALR
TPS55285VALR 3V-22V to 5.00V @ 3A

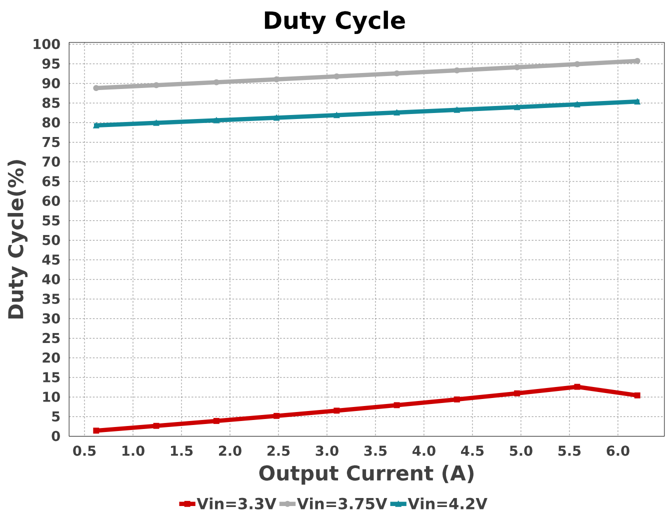


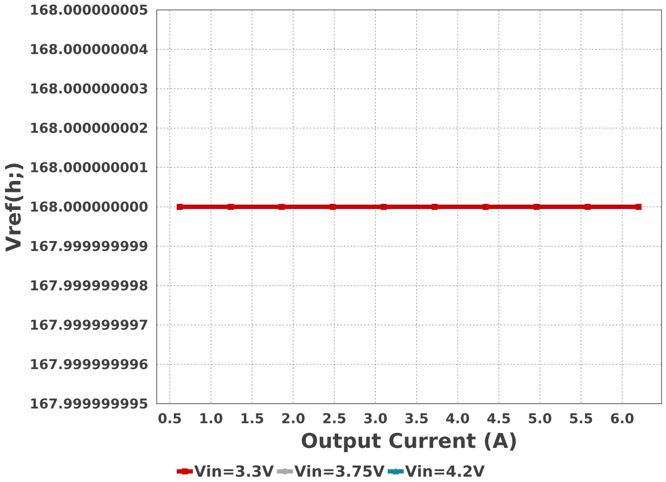
Electrical BOM

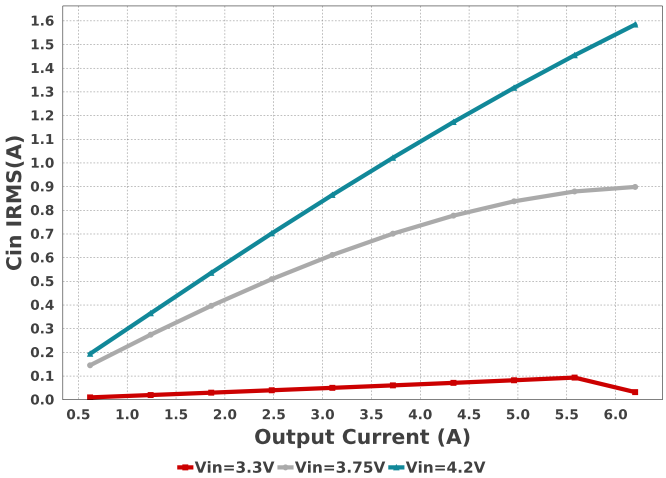
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cboot2	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp	MuRata	GRM155R71C183KA01D Series= X7R	Cap= 18.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	MuRata	GRM1555C1H151JA01D Series= C0G/NP0	Cap= 150.0 pF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
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^2
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^2
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^2
Cout	Panasonic	16SVPF560M Series= SVPF	Cap= 560.0 uF ESR= 14.0 mOhm VDC= 16.0 V IRMS= 4.95 A	1	$1.08	CAPSMT_62_E12 106 mm^2
Coutx	Taiyo Yuden	MSASL21GBB5476MTNA01 Series= X5R	Cap= 47.0 uF ESR= 2.674 mOhm VDC= 10.0 V IRMS= 3.1668 A	3	$0.26	0805 7 mm^2

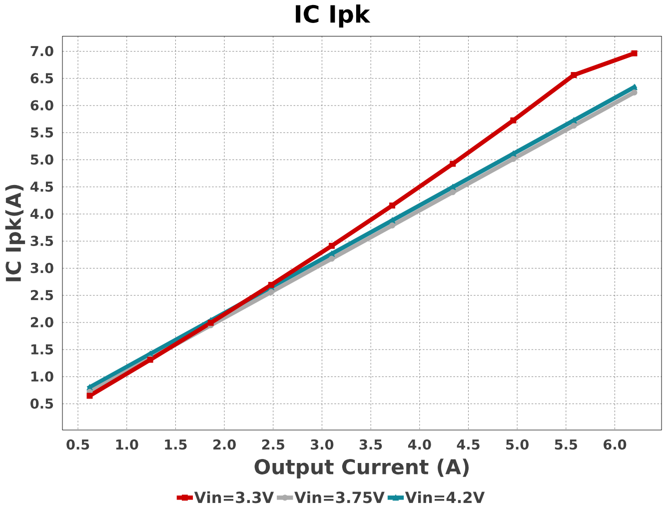
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM188R60J105KA01D Series= X5R	Cap= 1.0 uF ESR= 6.065 mOhm VDC= 6.3 V IRMS= 1.36934 A	1	$0.01	0603 5 mm^2
Cvcc	TDK	C1608X5R1C475K080AC Series= X5R	Cap= 4.7 uF ESR= 4.008 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.06	0603 5 mm^2
L1	Coilcraft	XAL6060-472MEB	L= 4.7 µH 13.1 mOhm	1	$0.82	XAL6060 72 mm^2
Rcomp	Vishay-Dale	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 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	Yageo	AC0402FR-07162KL Series= ?	Res= 162.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW0402102KFKED Series= CRCW..e3	Res= 102.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rmode	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS55285VALR	Switcher	1	$1.61	VAL0015A 16 mm^2

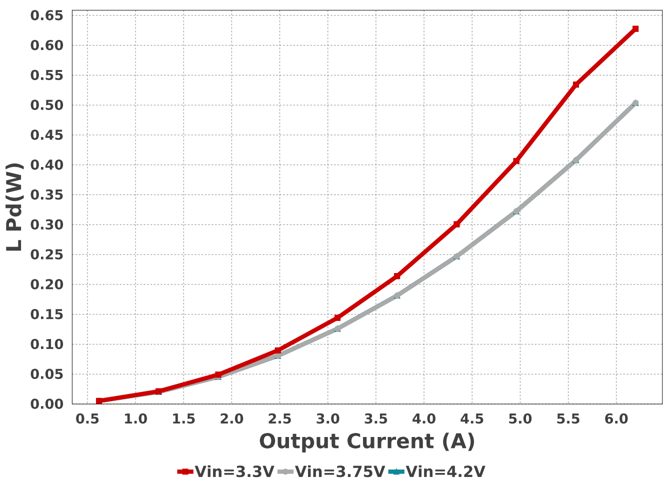


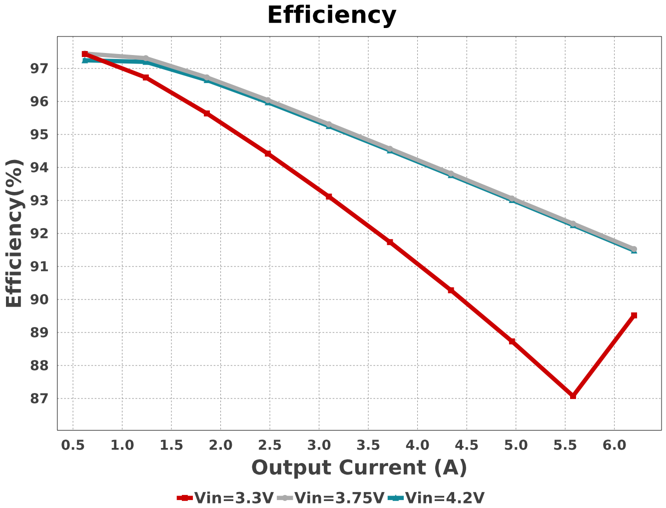


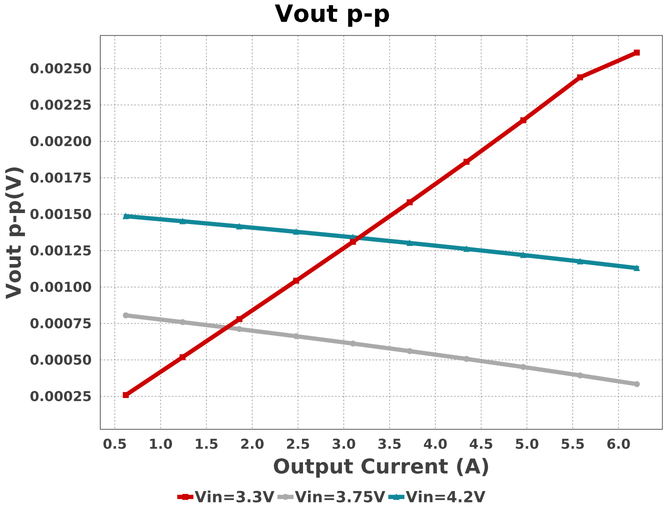

Vref
Vref(h;)
168.000000005
168.000000004
168.000000003
168.000000002
168.000000001
168.000000000
167.999999999
167.999999998
167.999999997
167.999999996
167.999999995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=3.3V Vin=3.75V Vin=4.2V


Cin IRMS
Cin IRMS(A)
1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=3.3V Vin=3.75V Vin=4.2V

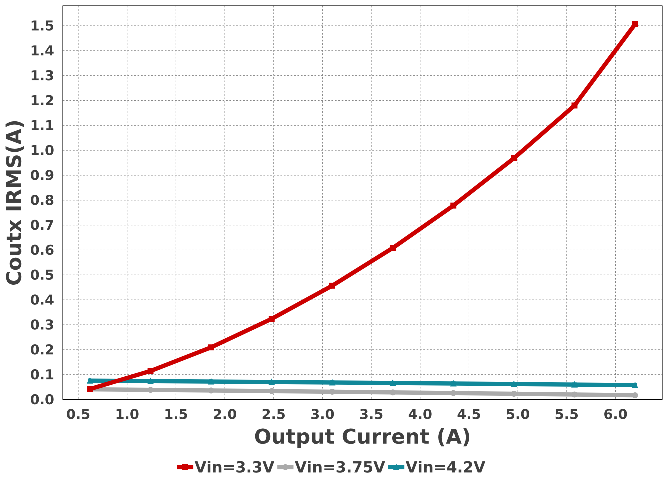

IC Ipk
IC Ipk(A)
7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=3.3V Vin=3.75V Vin=4.2V


L Pd
L Pd(W)
0.65 0.60 0.55 0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=3.3V Vin=3.75V Vin=4.2V

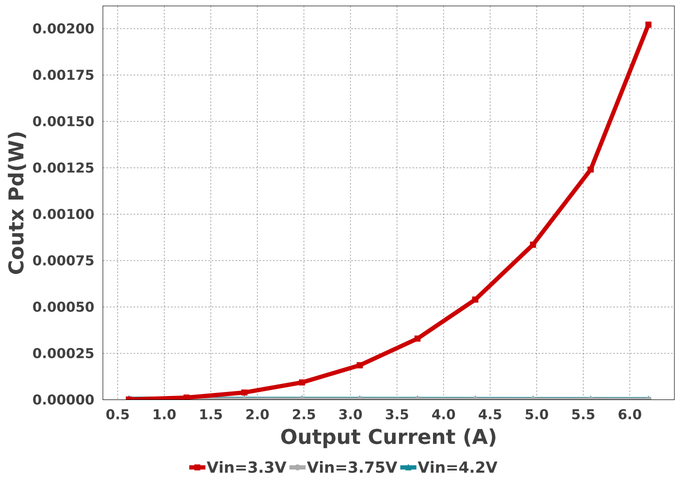

Efficiency
Efficiency(%)
97 96 95 94 93 92 91 90 89 88 87
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=3.3V Vin=3.75V Vin=4.2V


Vout p-p
Vout p-p(V)
0.00250 0.00225 0.00200 0.00175 0.00150 0.00125 0.00100 0.00075 0.00050 0.00025
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=3.3V Vin=3.75V Vin=4.2V

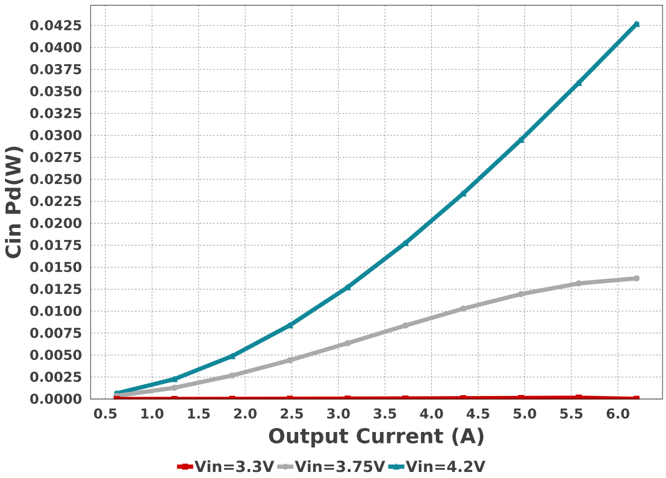
Coutx IRMS



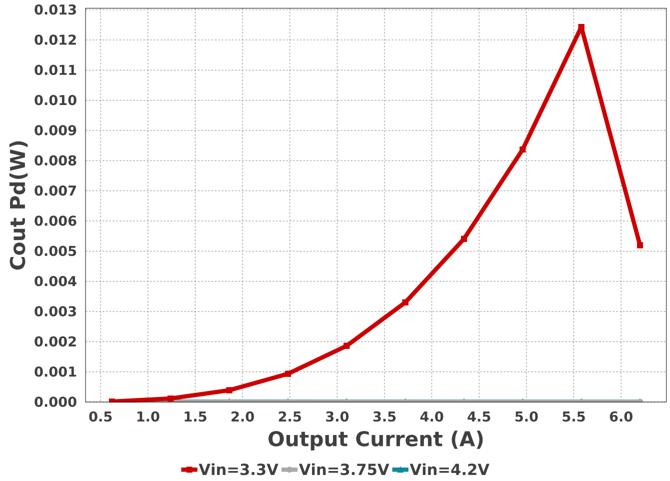
Coutx Pd



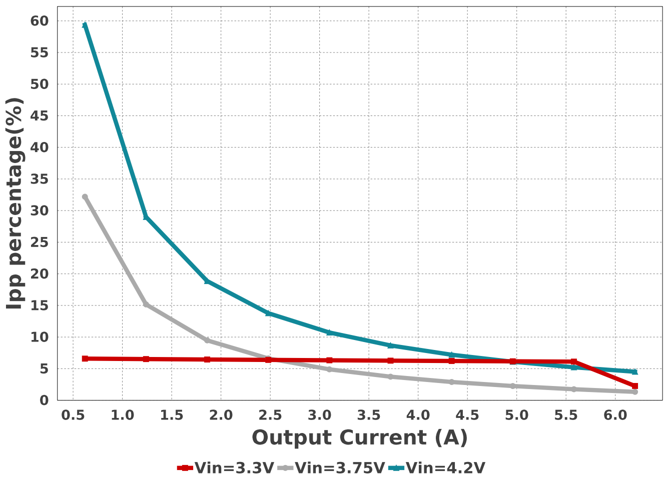
Cin Pd



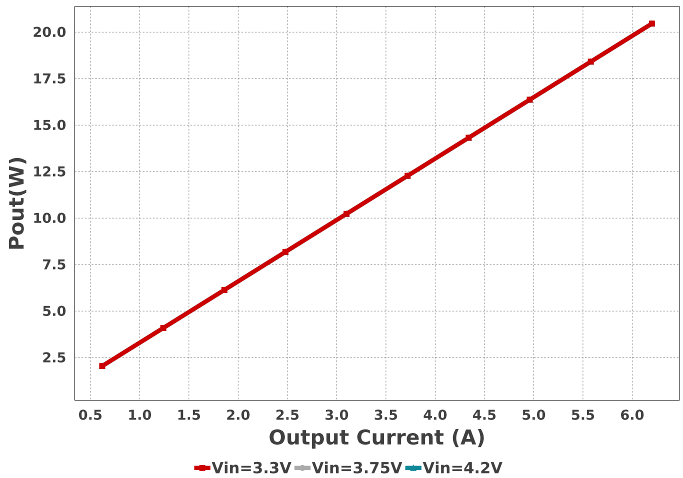
Cout Pd

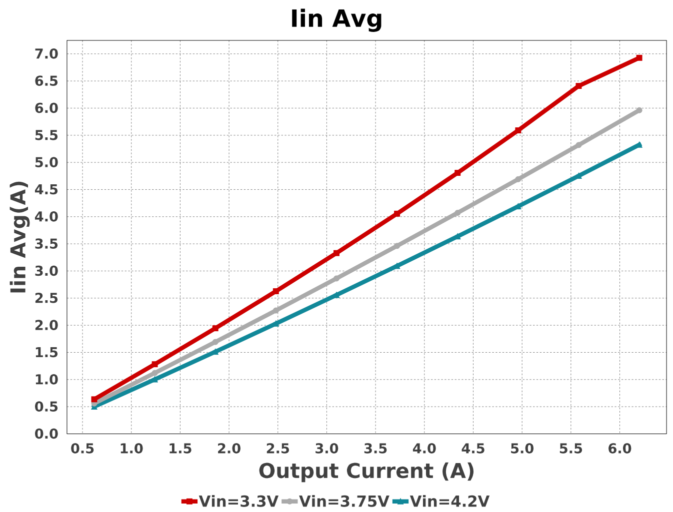


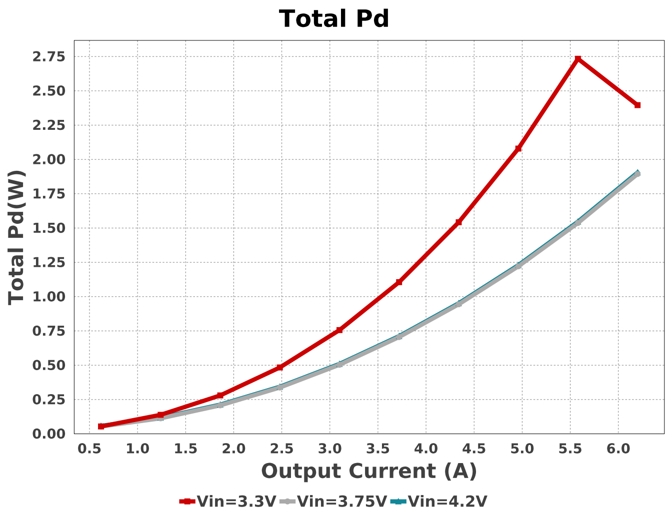
Ipp percentage

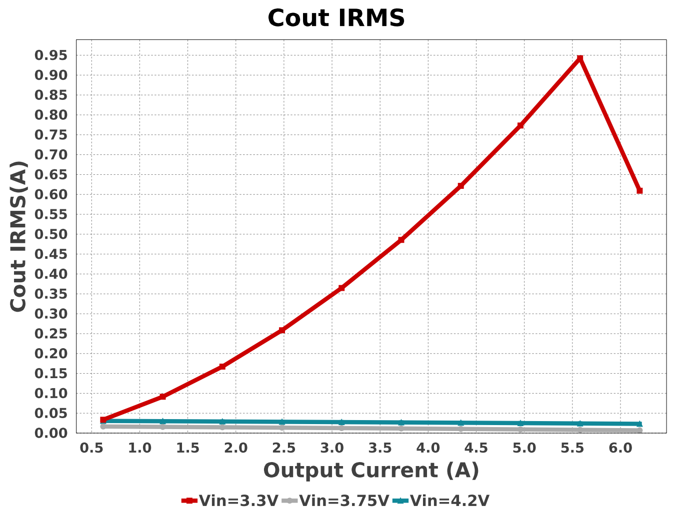


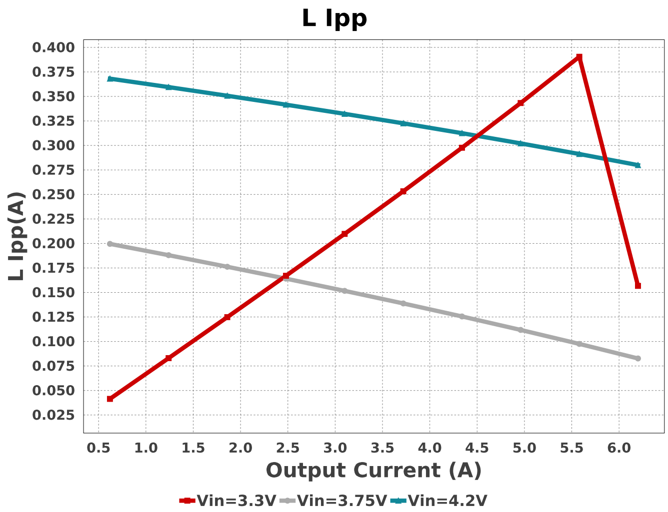
Pout

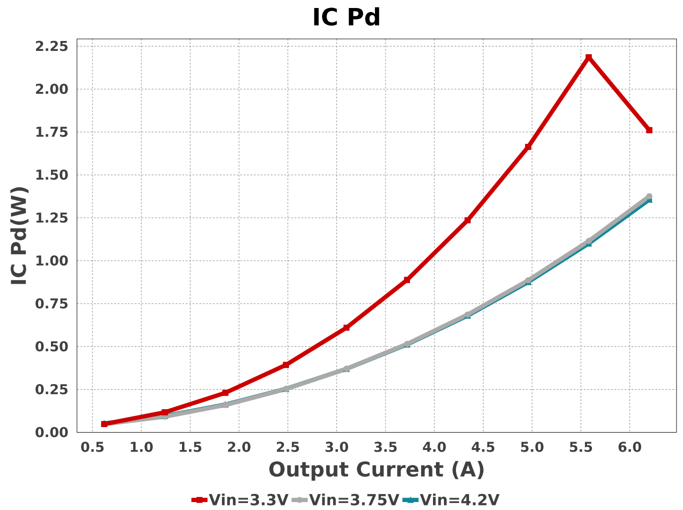


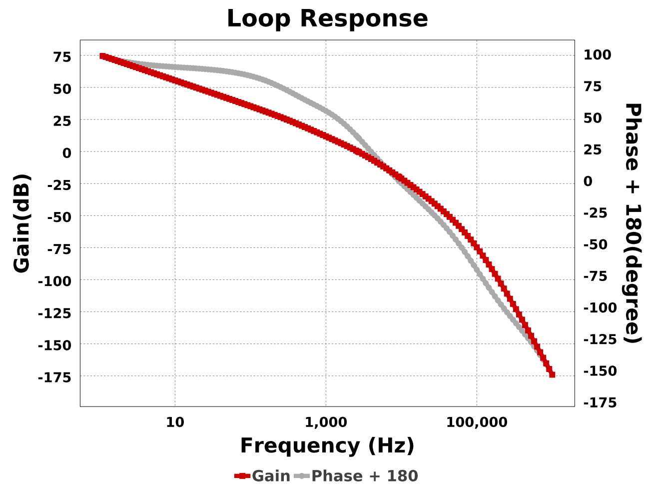












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	105.398 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	188.85 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.131 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	17.904 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	1.416 A	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	1.787 mW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	7.444 A	IC	Peak switch current in IC
8.	IC Pd	2.822 W	IC	IC power dissipation
9.	IC Tj	123.126 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

#	Name	Value	Category	Description
12.	Iin Avg	7.27 A	IC	Average input current
13.	Ipp percentage	6.069 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	439.62 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	687.64 mW	Inductor	Inductor power dissipation
16.	Cin Pd	188.85 µW	Power	Input capacitor power dissipation
17.	Cout Pd	17.904 mW	Power	Output capacitor power dissipation
18.	Coutx Pd	1.787 mW	Power	Output capacitor_x power loss
19.	IC Pd	2.822 W	Power	IC power dissipation
20.	L Pd	687.64 mW	Power	Inductor power dissipation
21.	Total Pd	3.53 W	Power	Total Power Dissipation
22.	BOM Count	21	System Information	Total Design BOM count
23.	Cross Freq	3.678 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	14.412 %	System Information	Duty cycle
25.	Efficiency	85.287 %	System Information	Steady state efficiency
26.	FootPrint	352.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	200.0 kHz	System Information	Switching frequency
28.	Gain Marg	-17.568 dB	System Information	Bode Plot Gain Margin
29.	Iout	6.2 A	System Information	Iout operating point
30.	Low Freq Gain	68.572 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	76.824 deg	System Information	Bode Plot Phase Margin
33.	Pout	20.46 W	System Information	Total output power
34.	Total BOM	$5.07	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 Actual	3.3 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	6.182 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	5.583 mV	System Information	Peak-to-peak output ripple voltage
40.	Vref	168.0 h;	System Information	Register VREF

Design Inputs

Name	Value	Description
Iout	6.2	Maximum Output Current
VinMax	4.2	Maximum input voltage
VinMin	3.3	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS55285	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

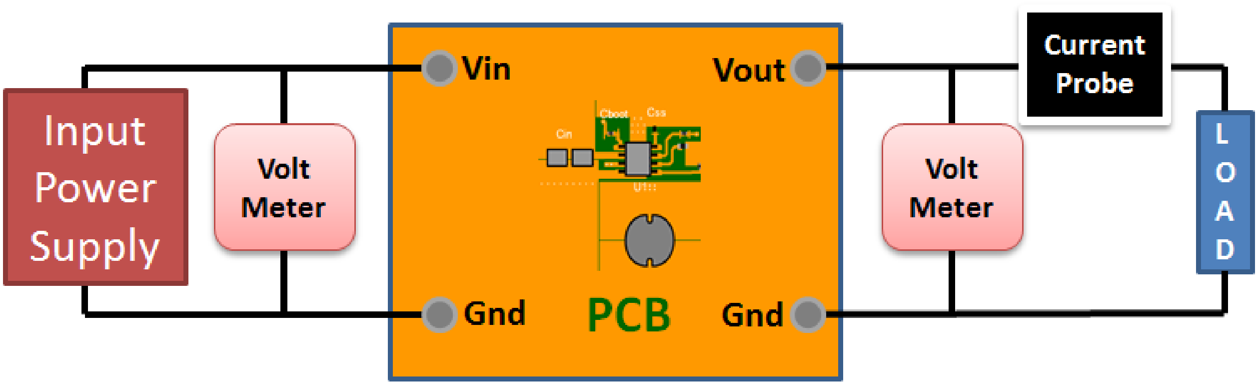
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.3V 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 : BA40E17A3BF621DF0B943C71FF12AB91[v1]

2. **TPS55285** Product Folder : https://www.ti.com/product/TPS55285 : contains the data sheet and other resources.

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