![Texas Instruments]

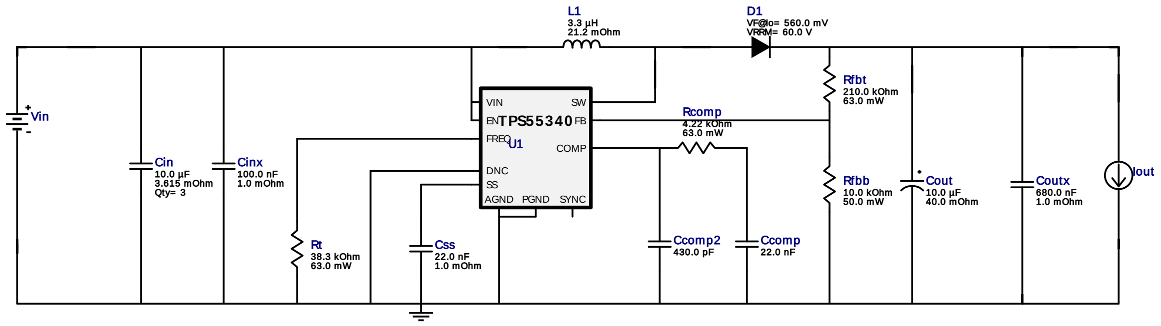
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 4.5V
VinMax = 5.5V
Vout = 27.0V
Iout = 0.6A

Device = TPS55340RTER
Topology = Boost
Created = 2019-06-26 14:33:37.133
BOM Cost = $3.72
BOM Count = 16
Total Pd = 0.45W

Design : 15 TPS55340RTER
TPS55340RTER 4.5V-5.5V to 27.00V @ 0.6A

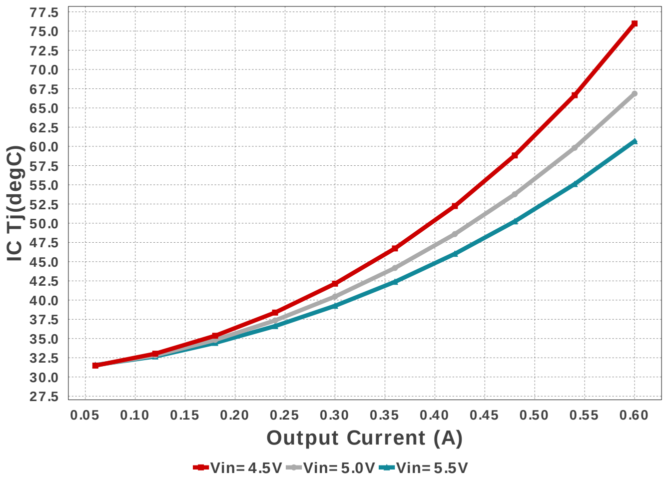


Electrical BOM

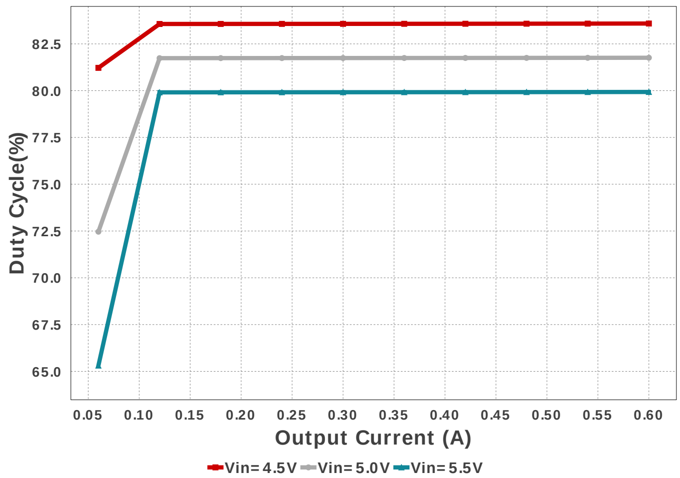
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Ccomp	MuRata	GCM21B5C1H223JA16L Series= C0G/NP0	Cap= 22.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.12	0805 7 mm²
Ccomp2	MuRata	GRM1555C1H431GA01D Series= C0G/NP0	Cap= 430.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0402 3 mm²
Cin	MuRata	GRM31CR61C106KA88L Series= X5R	Cap= 10.0 uF ESR= 3.615 mOhm VDC= 16.0 V IRMS= 3.8281 A	3	$0.08	1206_190 11 mm²
Cinx	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 mm²
Cout	Panasonic	50SVPF10M Series= SVPF	Cap= 10.0 uF ESR= 40.0 mOhm VDC= 50.0 V IRMS= 2.5 A	1	$0.41	CAPSMT_62_F61 74 mm²
Coutx	MuRata	GRM31MR72A684KA35L Series= X7R	Cap= 680.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.20	1206 11 mm²
Css	MuRata	GRM033R60J223KE01D Series= X5R	Cap= 22.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
D1	Diodes Inc.	PDS760-13	VF@Io= 560.0 mV VRRM= 60.0 V	1	$0.63	PowerDI5 50 mm²
L1	Coilcraft	XAL5030-332MEB	L= 3.3 µH 21.2 mOhm	1	$0.63	XAL5030 54 mm²
Rcomp	Vishay-Dale	CRCW04024K22FKED Series= CRCW..e3	Res= 4.22 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Vishay-Dale	CRCW0402210KFKED Series= CRCW..e3	Res= 210.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rt	Vishay-Dale	CRCW040238K3FKED Series= CRCW..e3	Res= 38.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS55340RTER	Switcher	1	$1.40	S-PWQFN-N16 17 mm^2

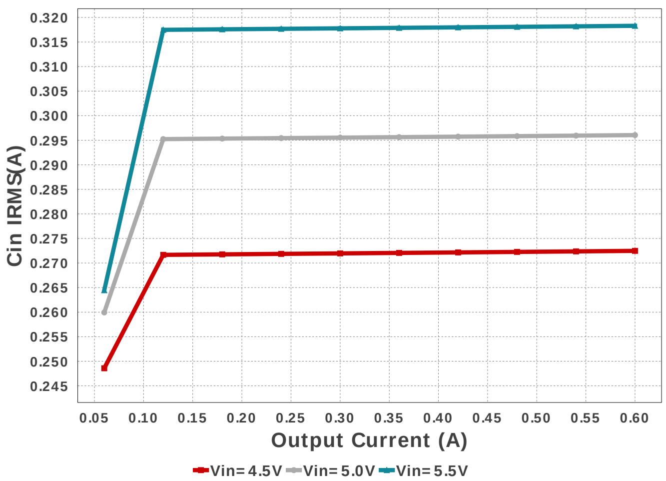
IC Tj



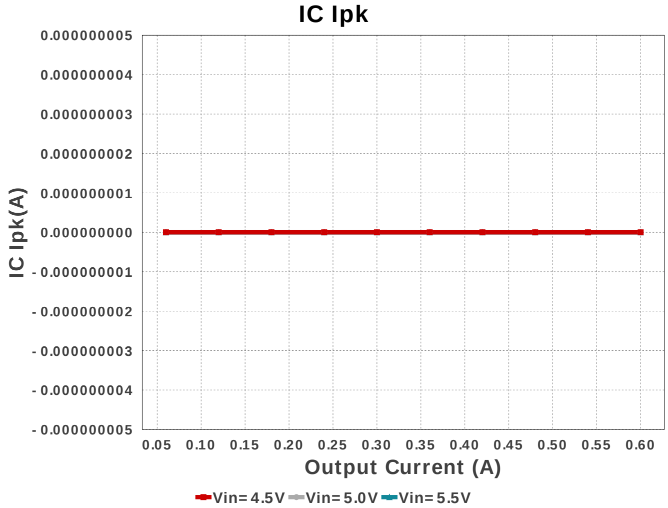
Duty Cycle



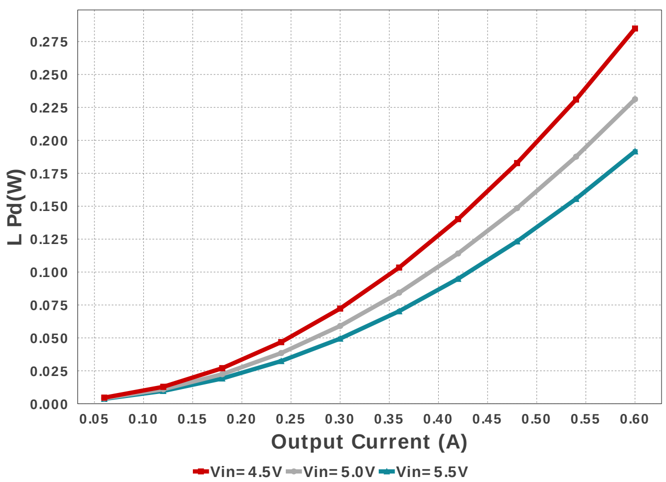
Cin IRMS



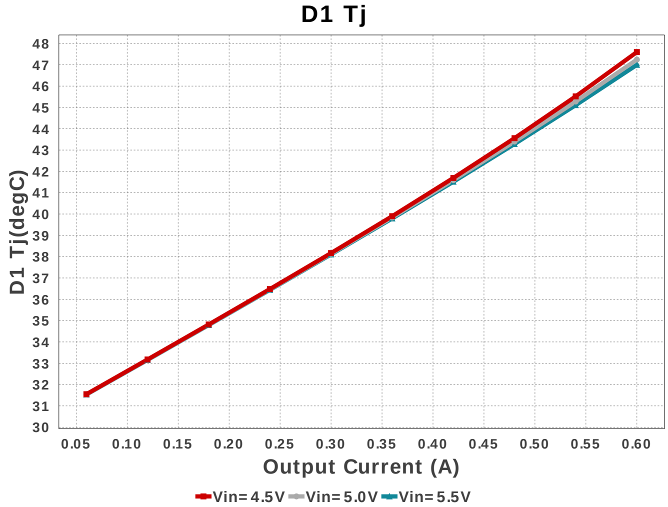
IC Ipk



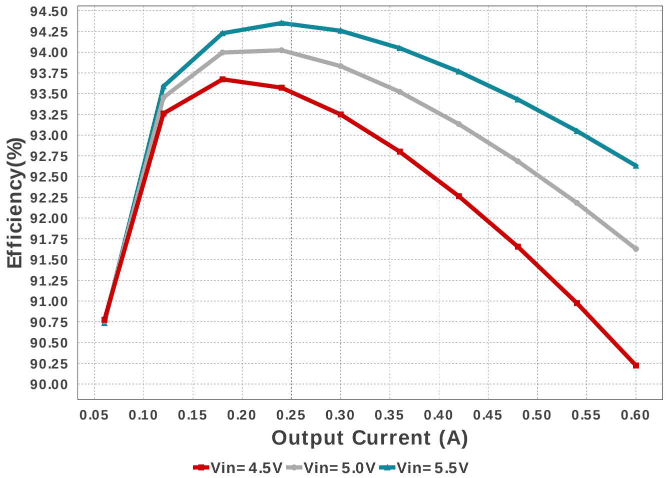
L Pd



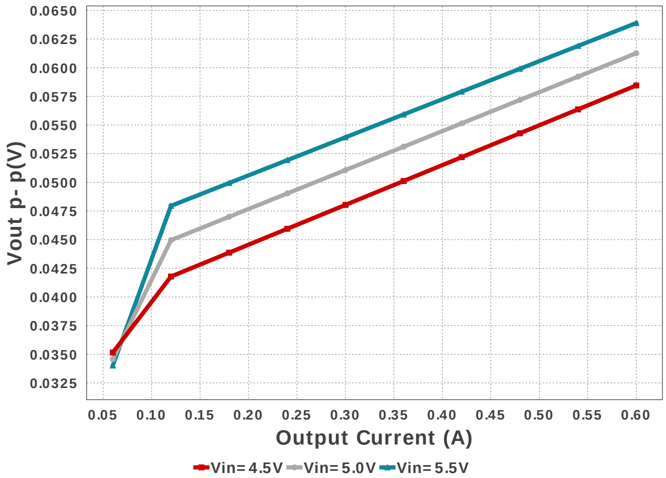
D1 Tj



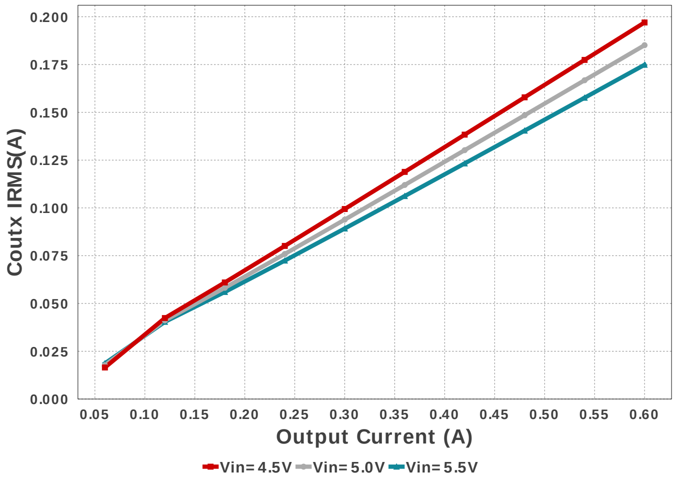
Efficiency



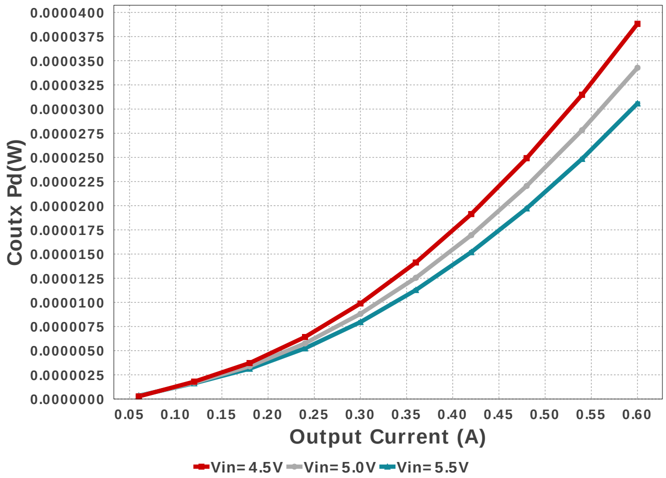
Vout p- p



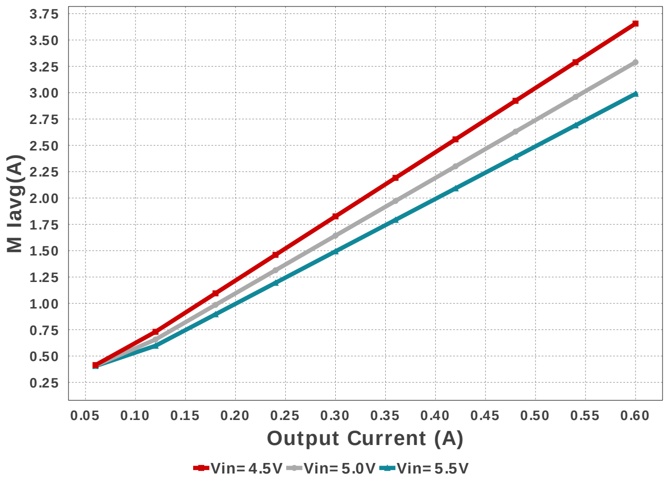
Coutx IRMS



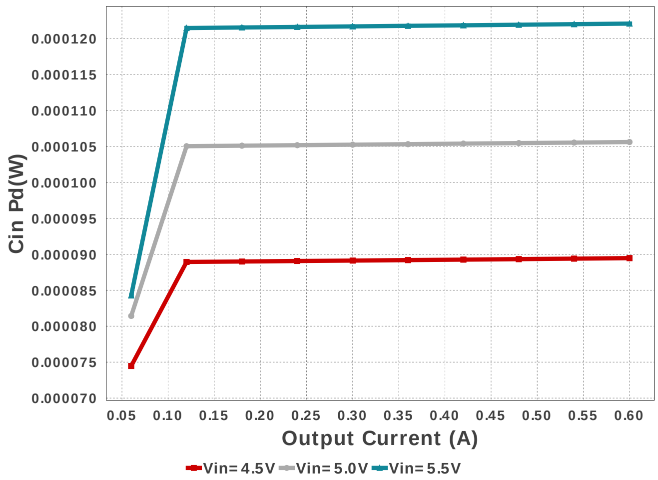
Coutx Pd

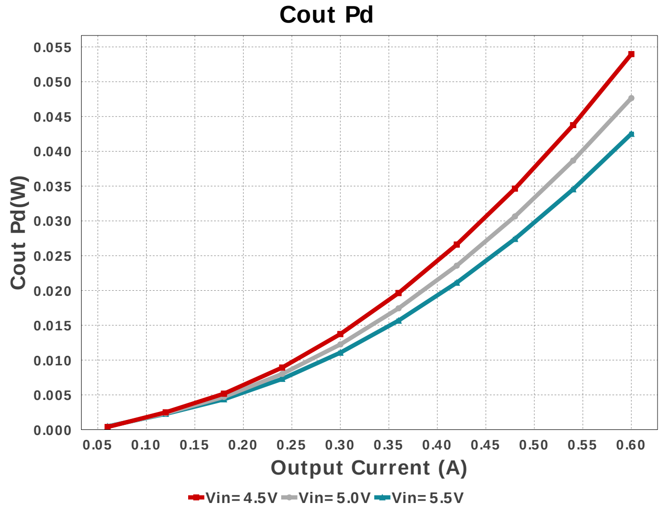


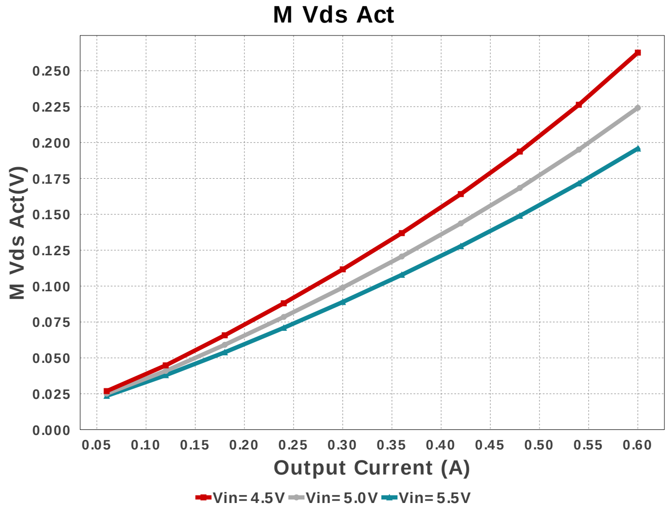
M Iavg

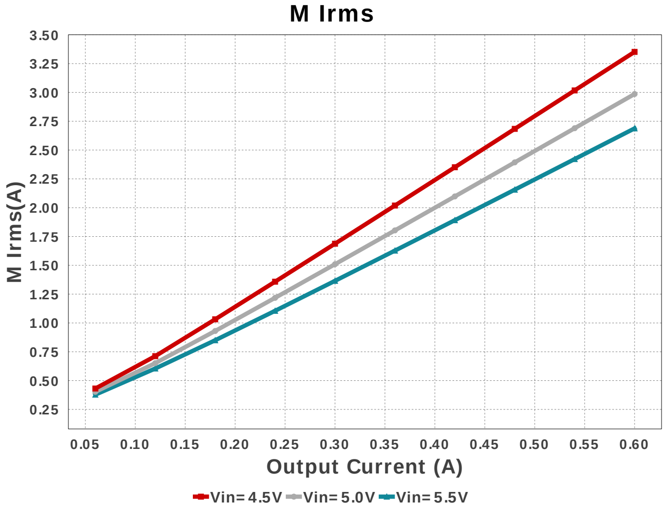


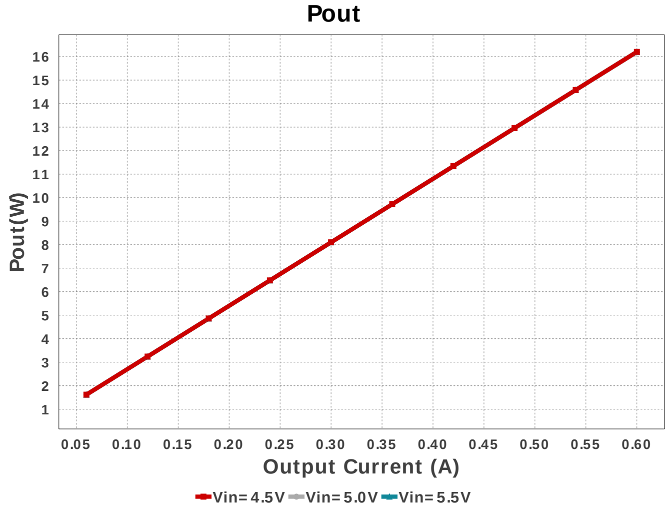
Cin Pd

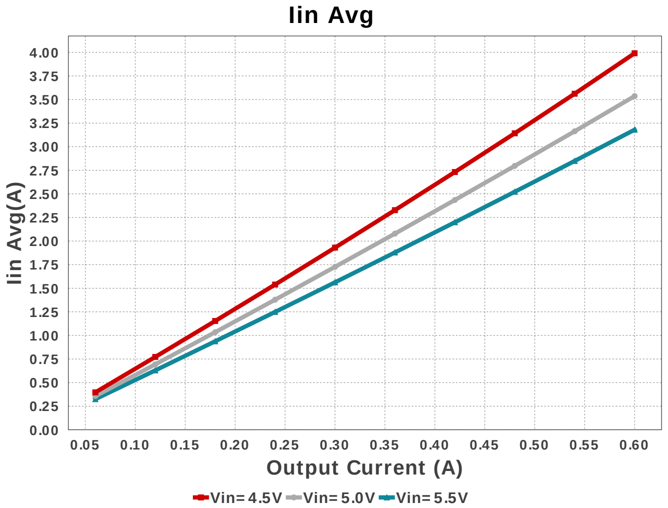


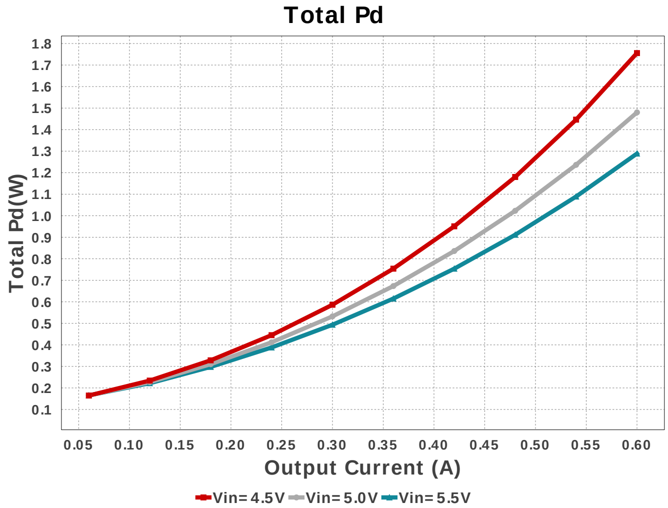

Cout Pd
Cout Pd(W)
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

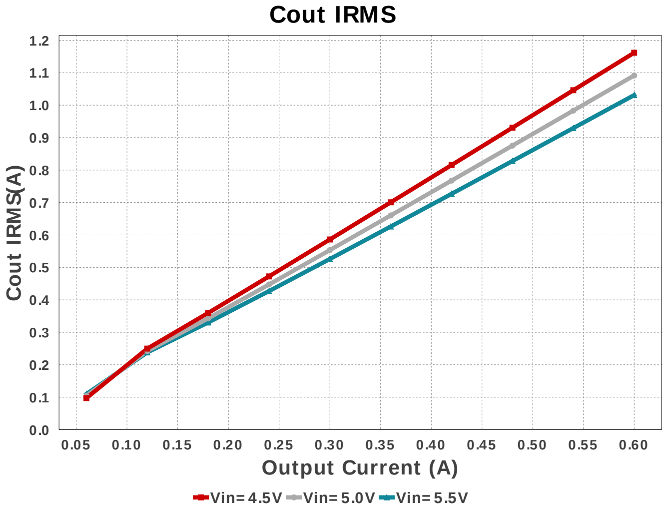

M Vds Act
M Vds Act(V)
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

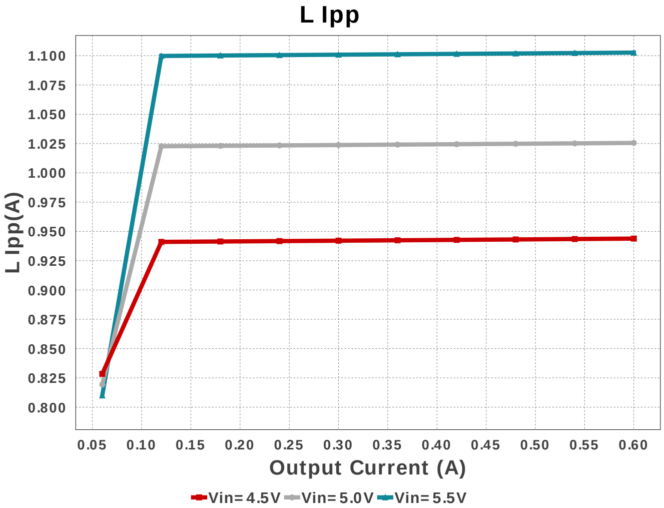

M Irms
M Irms(A)
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

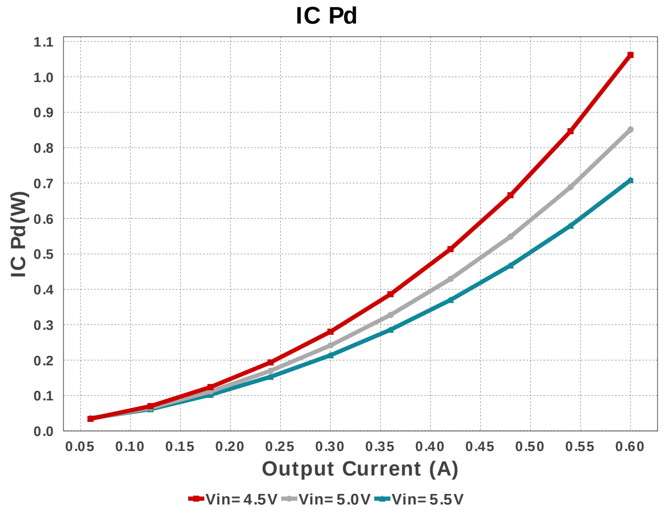

Pout
Pout(W)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

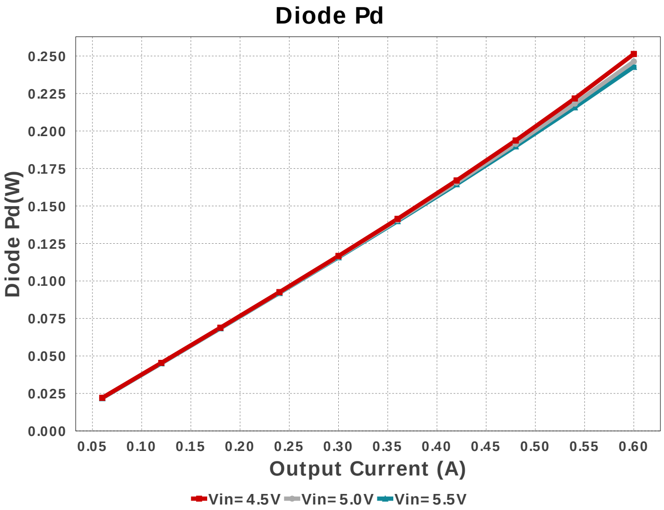

Iin Avg
Iin Avg(A)
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

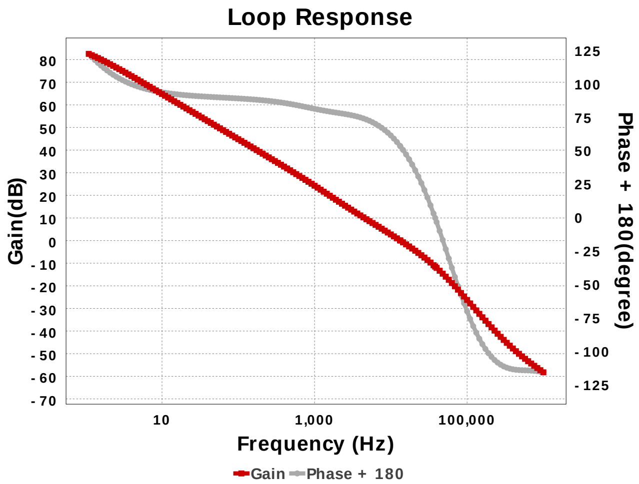

Total Pd
Total Pd(W)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V











Operating Values

#	Name	Value	Category	Description
1.	BOM Count	16		Total Design BOM count
2.	Total BOM	$3.72		Total BOM Cost
3.	Cin IRMS	295.465 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	105.2 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	482.578 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	9.315 mW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	81.858 mA	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	6.701 µW	Capacitor	Output capacitor_x power loss
9.	D1 Tj	37.013 degC	Diode	D1 junction temperature
10.	Diode Pd	100.19 mW	Diode	Diode power dissipation
11.	IC Ipk	0.0 A	IC	Peak switch current in IC

#	Name	Value	Category	Description
12.	IC Pd	192.18 mW	IC	IC power dissipation
13.	IC Tj	38.321 degC	IC	IC junction temperature
14.	IC Tolerance	9.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA	43.3 degC/W	IC	IC junction-to-ambient thermal resistance
16.	Iin Avg	1.494 A	IC	Average input current
17.	L Ipp	1.024 A	Inductor	Peak-to-peak inductor ripple current
18.	L Pd	44.842 mW	Inductor	Inductor power dissipation
19.	M Iavg	1.424 A	Mosfet	MOSFET Average current
20.	M Irms	1.315 A	Mosfet	MOSFET RMS ripple current
21.	M Vds Act	85.201 mV	Mosfet	Voltage drop across the MosFET
22.	Cin Pd	105.2 µW	Power	Input capacitor power dissipation
23.	Cout Pd	9.315 mW	Power	Output capacitor power dissipation
24.	Coutx Pd	6.701 µW	Power	Output capacitor_x power loss
25.	Diode Pd	100.19 mW	Power	Diode power dissipation
26.	IC Pd	192.18 mW	Power	IC power dissipation
27.	L Pd	44.842 mW	Power	Inductor power dissipation
28.	Total Pd	449.918 mW	Power	Total Power Dissipation
29.	Cross Freq	12.044 kHz	System Information	Bode plot crossover frequency
30.	Duty Cycle	81.742 %	System Information	Duty cycle
31.	Efficiency	93.977 %	System Information	Steady state efficiency
32.	FootPrint	265.0 mm^2	System Information	Total Foot Print Area of BOM components
33.	Frequency	1.212 MHz	System Information	Switching frequency
34.	Gain Marg	-15.096 dB	System Information	Bode Plot Gain Margin
35.	Iout	260.0 mA	System Information	Iout operating point
36.	Low Freq Gain	85.294 dB	System Information	Gain at 1Hz
37.	Mode	CCM	System Information	Conduction Mode
38.	Phase Marg	57.172 deg	System Information	Bode Plot Phase Margin
39.	Pout	7.02 W	System Information	Total output power
40.	Vin	5.0 V	System Information	Vin operating point
41.	Vout	27.0 V	System Information	Operational Output Voltage
42.	Vout Actual	27.038 V	System Information	Vout Actual calculated based on selected voltage divider resistors
43.	Vout Tolerance	2.675 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
44.	Vout p-p	49.711 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	600.0 m	Maximum Output Current
VinMax	5.5	Maximum input voltage
VinMin	4.5	Minimum input voltage
VinTyp	5.0	Typical input voltage
Vout	27.0	Output Voltage
base_pn	TPS55340	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

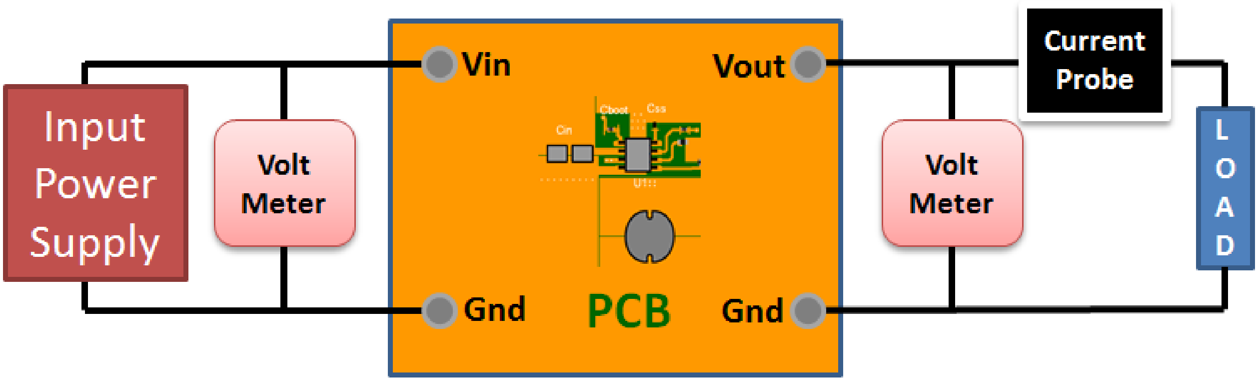
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.5V 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.



WEBENCH® Electrical Simulation Report

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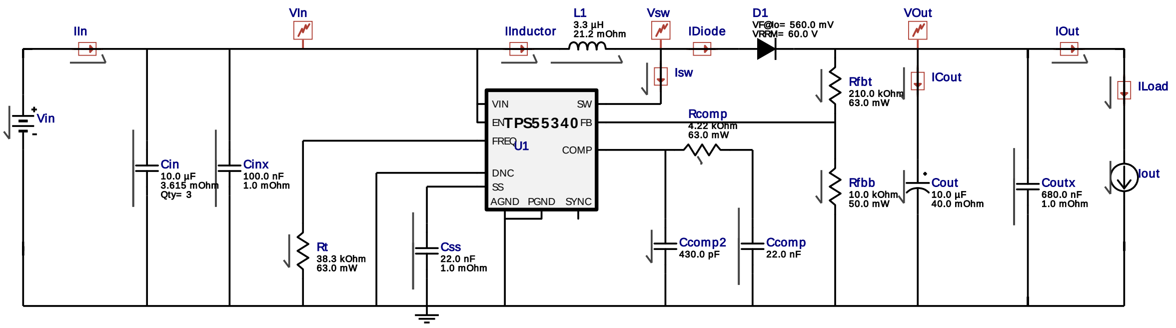
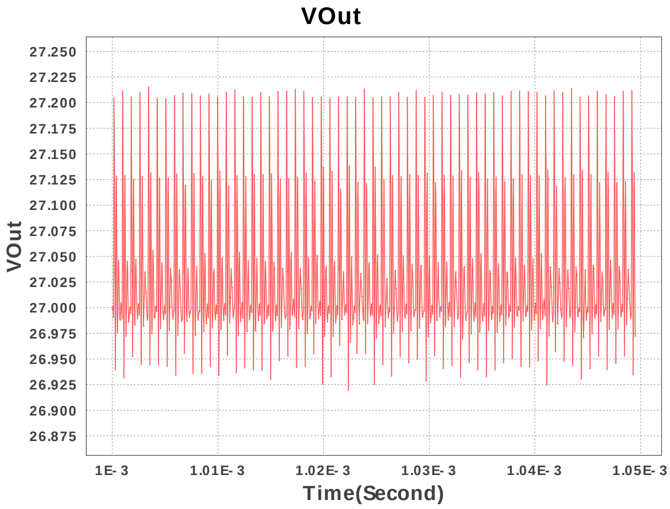
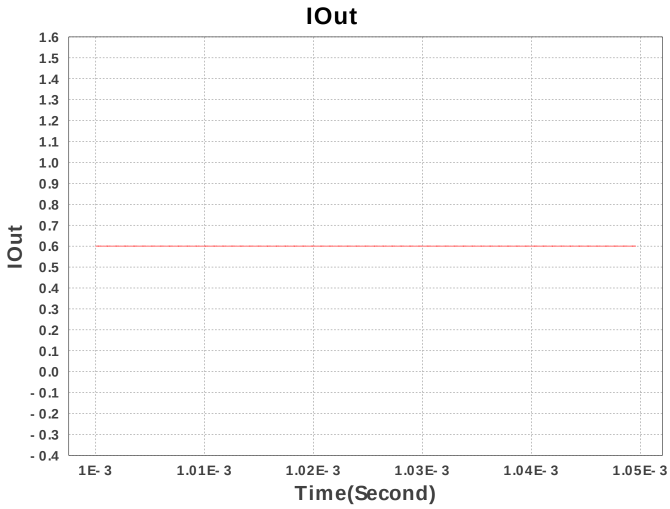
Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	no description	27.0 V
2.	Iout	I	Load Current	0.6 A

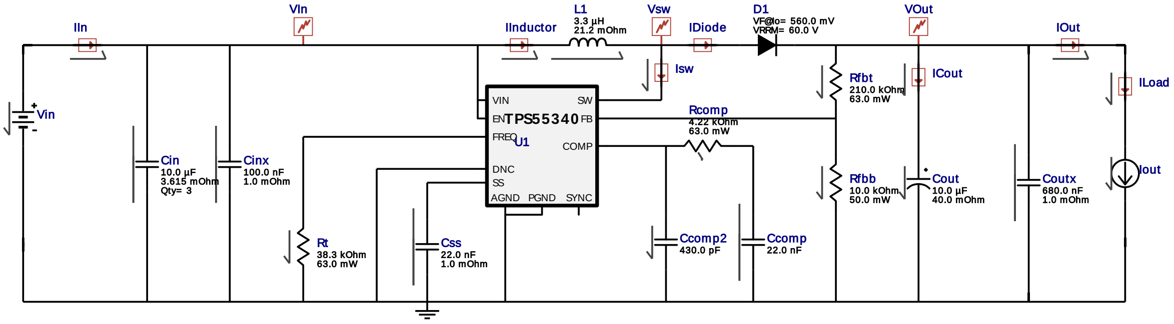




Design Id = 15

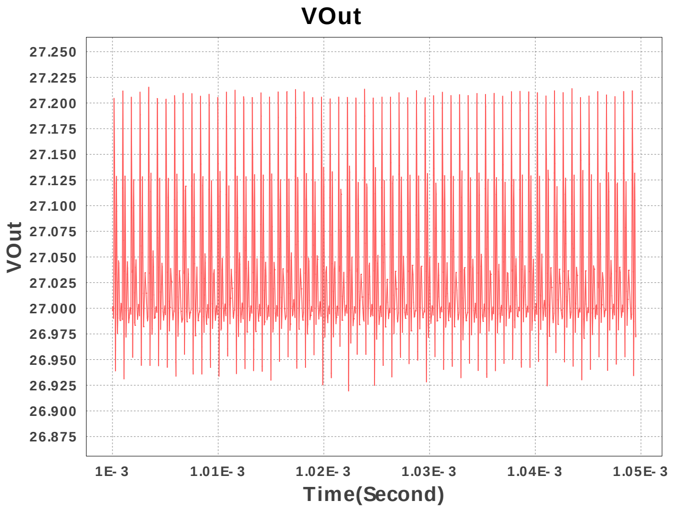
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	no description	27.0 V
2.	Iout	I	Load Current	0.6 A



Design Assistance

1. Master key : E56AD4253327D321[v1]

2. **TPS55340** Product Folder : http://www.ti.com/product/TPS55340 : contains the data sheet and other resources.