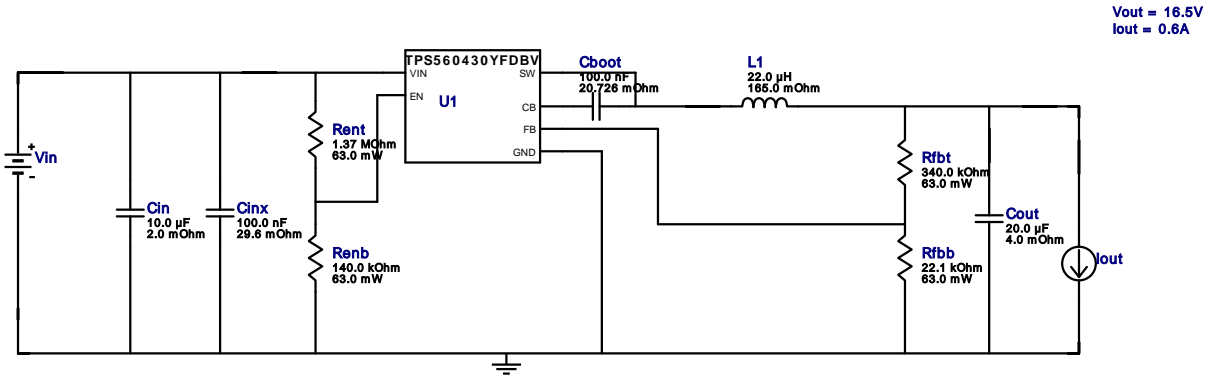


WEBENCH® Design Report

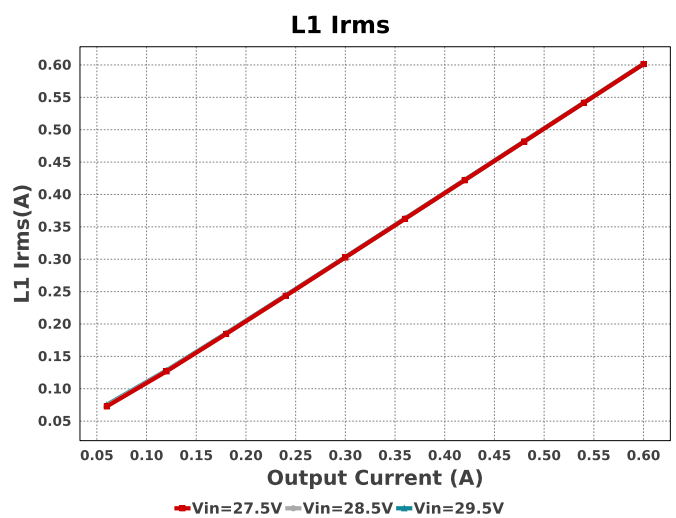
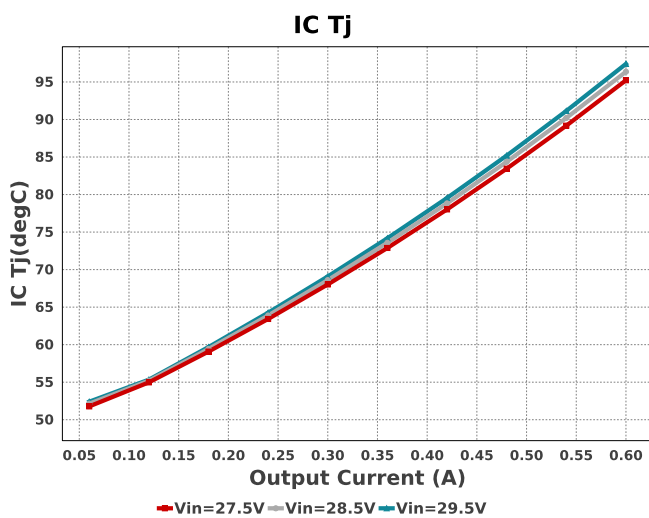
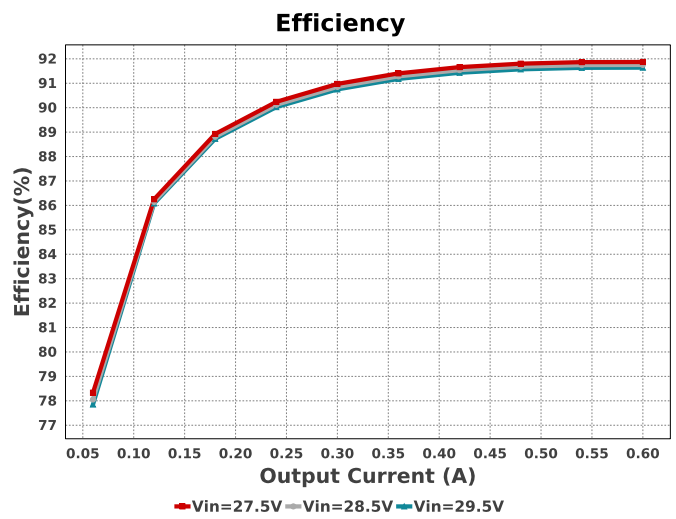
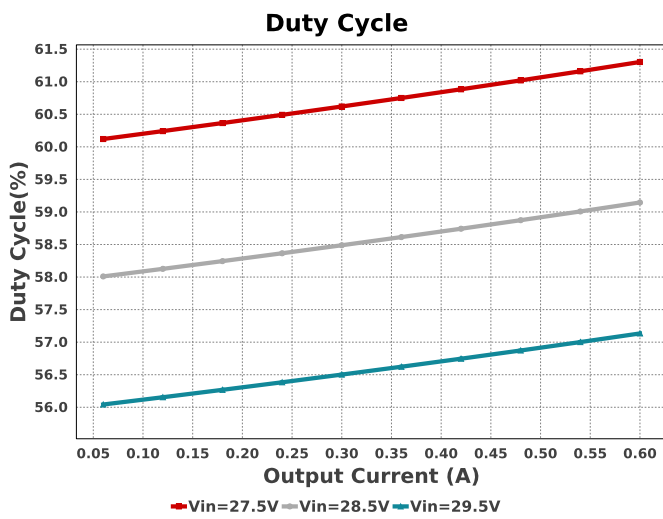
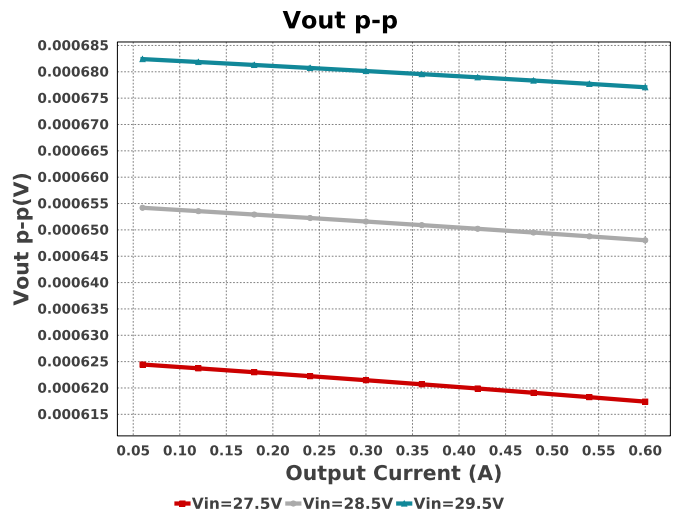
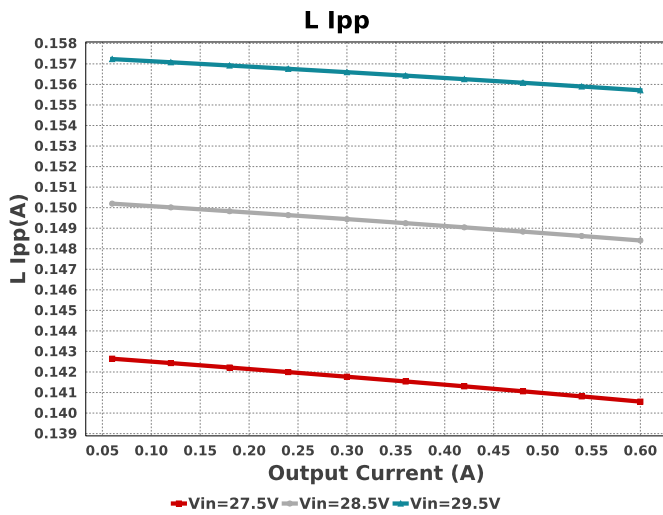
Design : 148 TPS560430YFDBVR
TPS560430YFDBVR 27.5V-29.5V to 16.50V @ 0.6A

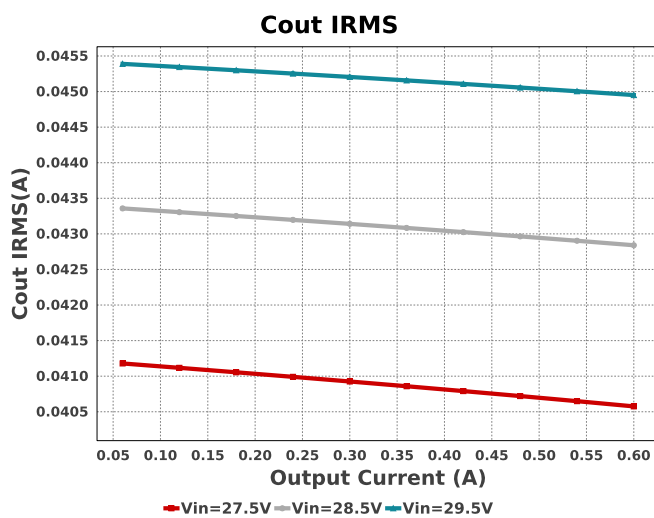
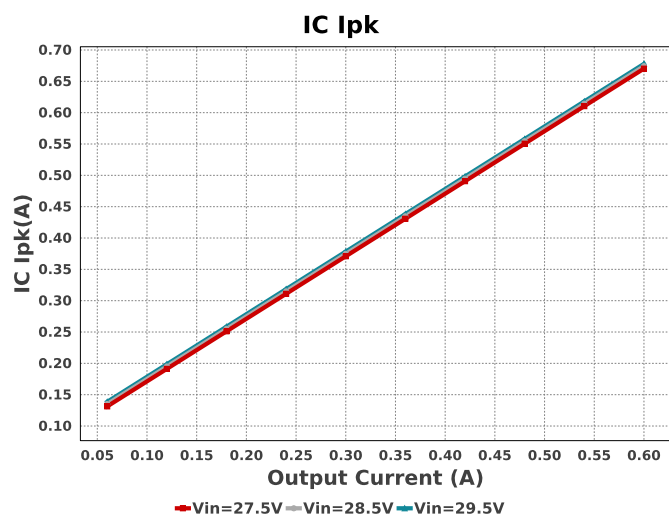
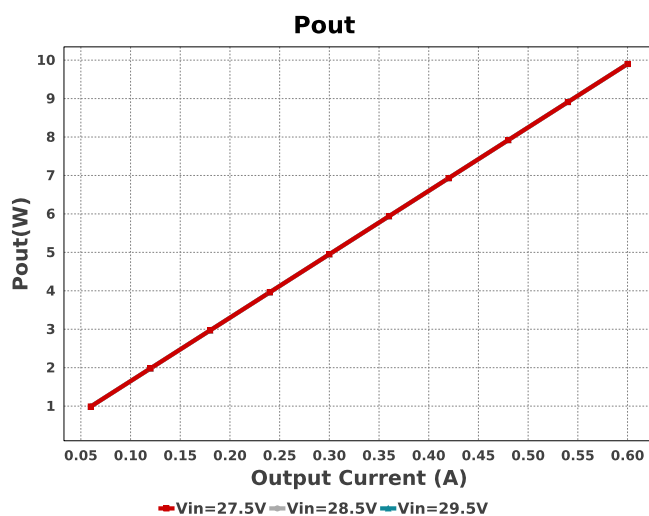
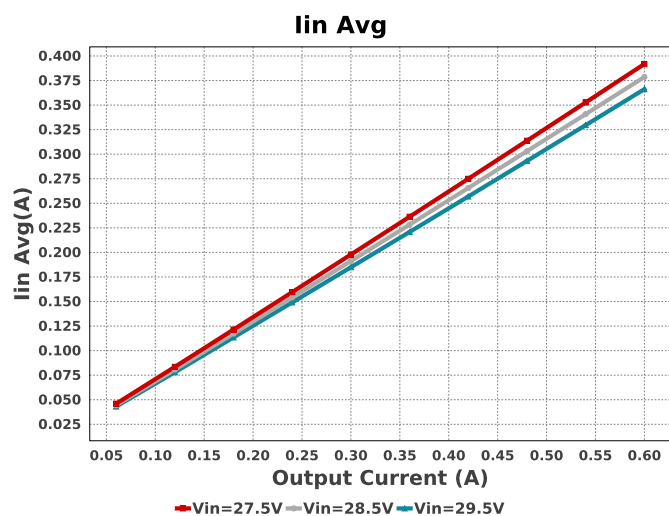
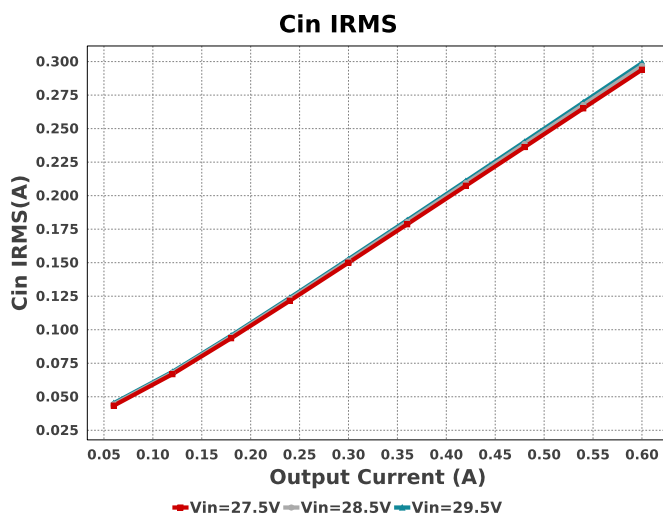
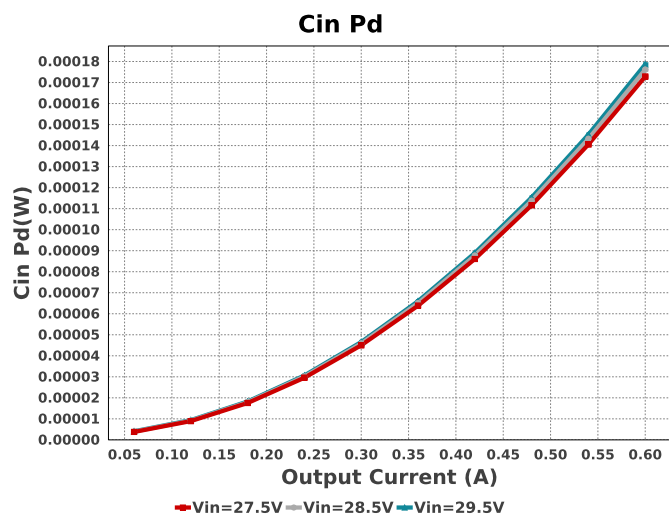
VinMin = 27.5V
VinMax = 29.5V
Vout = 16.5V
Iout = 0.6A
Device = TPS560430YFDBVR
Topology = Buck
Created = 2024-02-20 02:42:45.707
BOM Cost = NA
BOM Count = 10
Total Pd = 0.9W

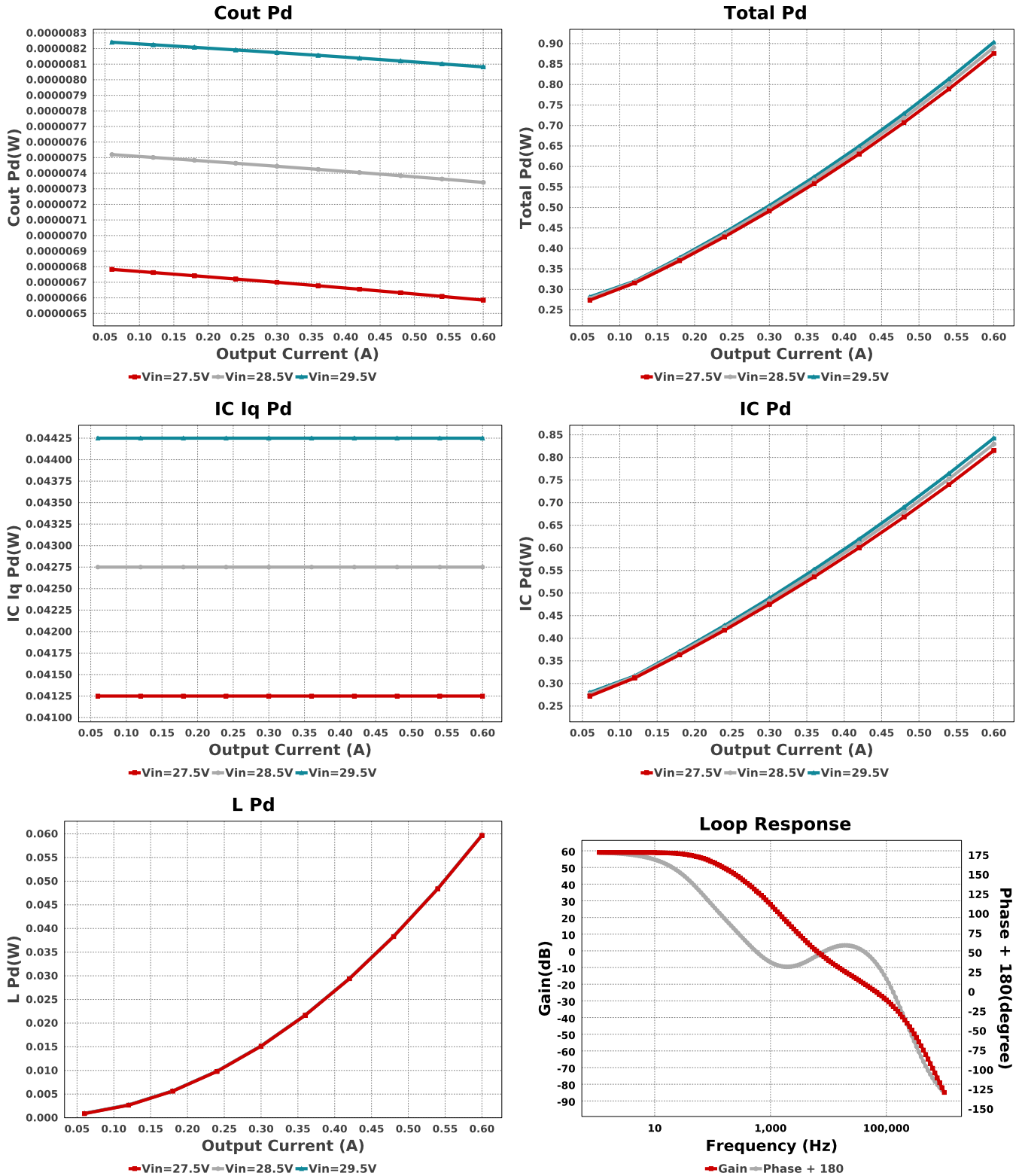


Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	TDK	C2012X7R2A104K125AA Series= X7R	Cap= 100.0 nF ESR= 20.726 mOhm VDC= 100.0 V IRMS= 1.456 A	1	\$0.03	0805 7 mm ²
Cin	CUSTOM	CUSTOM Series= X7R	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	NA	1206 0 mm ²
Cinx	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	\$0.01	0603 5 mm ²
Cout	CUSTOM	CUSTOM Series= X7R	Cap= 20.0 uF ESR= 4.0 mOhm VDC= 50.0 V IRMS= 5.0 A	1	NA	1210 0 mm ²
L1	CUSTOM	CUSTOM	L= 22.0 uH 165.0 mOhm	1	NA	VLP8040 0 mm ²
Renb	Vishay-Dale	CRCW0402140KFKED Series= CRCW..e3	Res= 140.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rent	Vishay-Dale	CRCW04021M37FKED Series= CRCW..e3	Res= 1.37 MOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfbb	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfbt	Vishay-Dale	CRCW0402340KFKED Series= CRCW..e3	Res= 340.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
U1	Texas Instruments	TPS560430YFDBVR	Switcher	1	\$0.32	DBV0006A_N 15 mm ²







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	10		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	298.868 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	178.64 μ W	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	44.951 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	8.082 μ W	Capacitor	Output capacitor power dissipation
7.	IC Ipk	677.857 mA	IC	Peak switch current in IC
8.	IC Iq Pd	44.25 mW	IC	IC Iq Pd
9.	IC Pd	842.64 mW	IC	IC power dissipation
10.	IC Tj	97.411 degC	IC	IC junction temperature
11.	ICThetaJA Effective	80.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	366.21 mA	IC	Average input current
13.	L Ipp	155.715 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	59.733 mW	Inductor	Inductor power dissipation
15.	L1 Irms	601.681 mA	Inductor	Inductor ripple current
16.	Cin Pd	178.64 μ W	Power	Input capacitor power dissipation
17.	Cout Pd	8.082 μ W	Power	Output capacitor power dissipation
18.	IC Pd	842.64 mW	Power	IC power dissipation
19.	L Pd	59.733 mW	Power	Inductor power dissipation
20.	Total Pd	903.255 mW	Power	Total Power Dissipation
21.	Cross Freq	6.209 kHz	System	Bode plot crossover frequency
			Information	
22.	Duty Cycle	57.134 %	System	Duty cycle
			Information	
23.	Efficiency	91.639 %	System	Steady state efficiency
			Information	
24.	FootPrint	177.0 mm ²	System	Total Foot Print Area of BOM components
			Information	
25.	Frequency	2.1 MHz	System	Switching frequency
			Information	
26.	Gain Marg	-33.301 dB	System	Bode Plot Gain Margin
			Information	
27.	Iout	600.0 mA	System	Iout operating point
			Information	
28.	Low Freq Gain	59.023 dB	System	Gain at 1Hz
			Information	
29.	Mode	CCM	System	PWM/PFM Mode
			Information	
30.	Phase Marg	46.348 deg	System	Bode Plot Phase Margin
			Information	
31.	Pout	9.9 W	System	Total output power
			Information	
32.	Vin	29.5 V	System	Vin operating point
			Information	
33.	Vout Actual	16.385 V	System	Vout Actual calculated based on selected voltage divider resistors
			Information	
34.	Vout Tolerance	1.897 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
			Information	
35.	Vout p-p	677.066 μ V	System	Peak-to-peak output ripple voltage
			Information	

Design Inputs

Name	Value	Description
Iout	600.0 m	Maximum Output Current
VinMax	29.5	Maximum input voltage
VinMin	27.5	Minimum input voltage
VinTyp	28.5	Typical input voltage
Vout	16.5	Output Voltage
base_pn	TPS560430YF	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

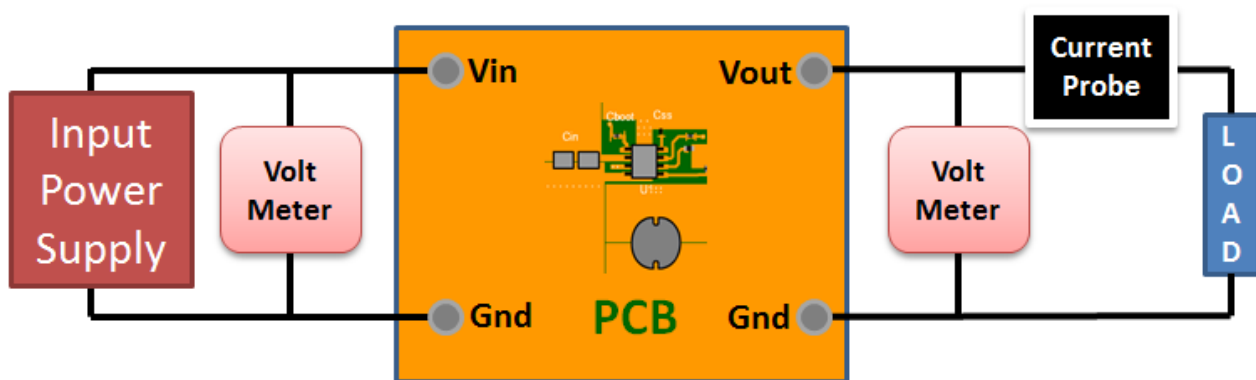
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 27.5V 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.

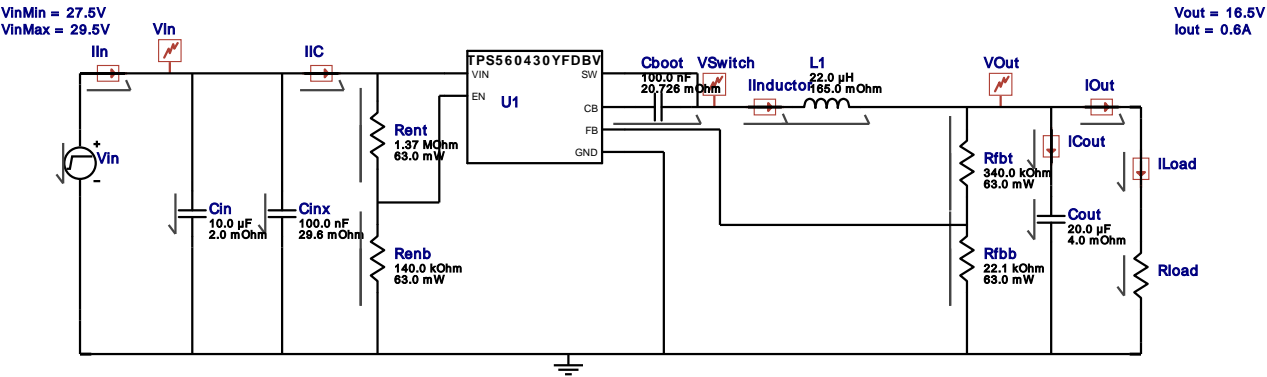
Load Testing

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.



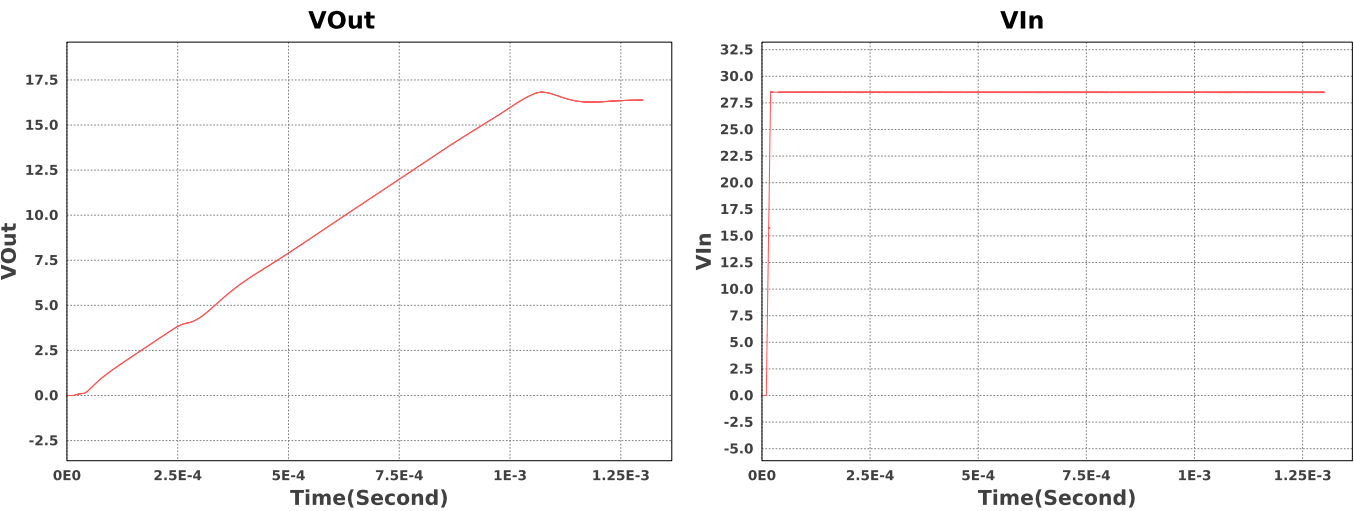
WEBENCH® Electrical Simulation Report

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sim_id = 1
Simulation Type = Startup

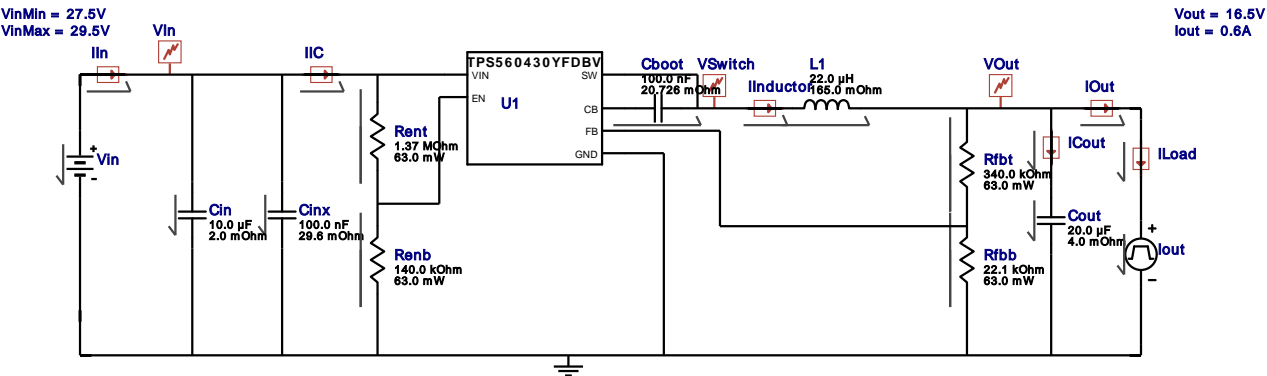


Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	27.5 Ohm

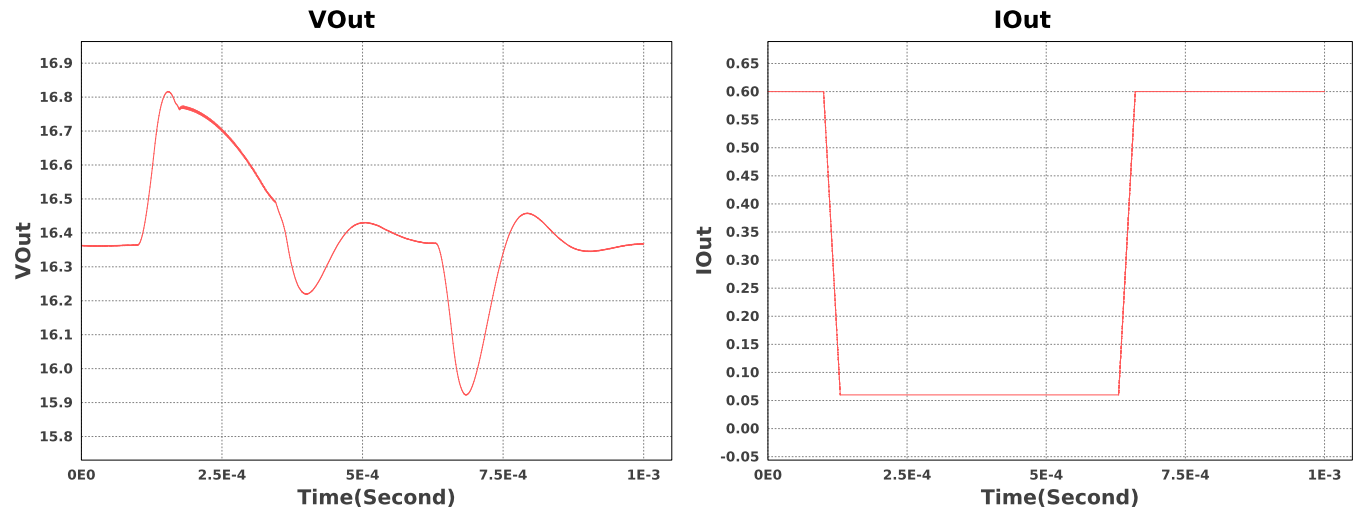


Design Id = 148
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Simulation Type = Load Transient

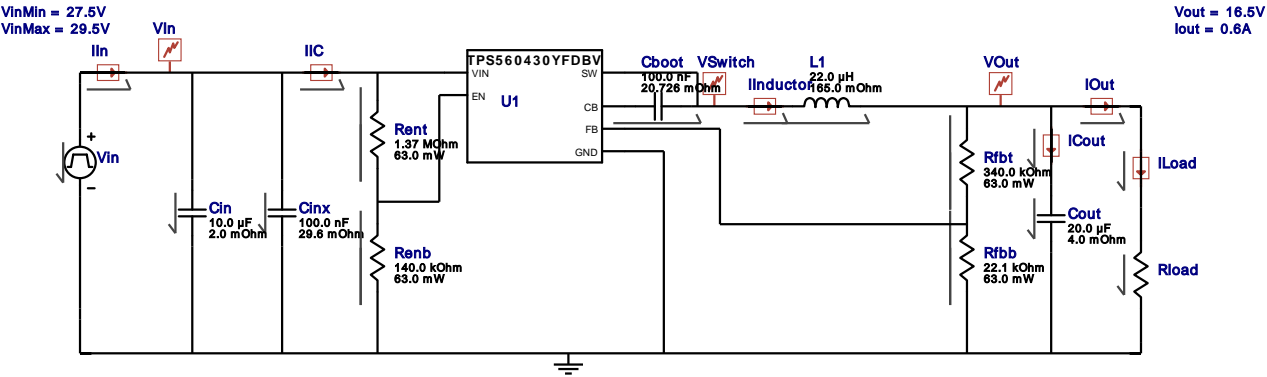


Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	16.5 V
2.	L1	IC	Initial Current	0.6 A
3.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Input Voltage	0.6 A
		I2	Peak Input Voltage	0.06 A
		Td	Initial Time Delay	100u s
		Tr	Rise Time	30u s
		Tf	Fall Time	30u s
		Pw	Pulse Width	500u s

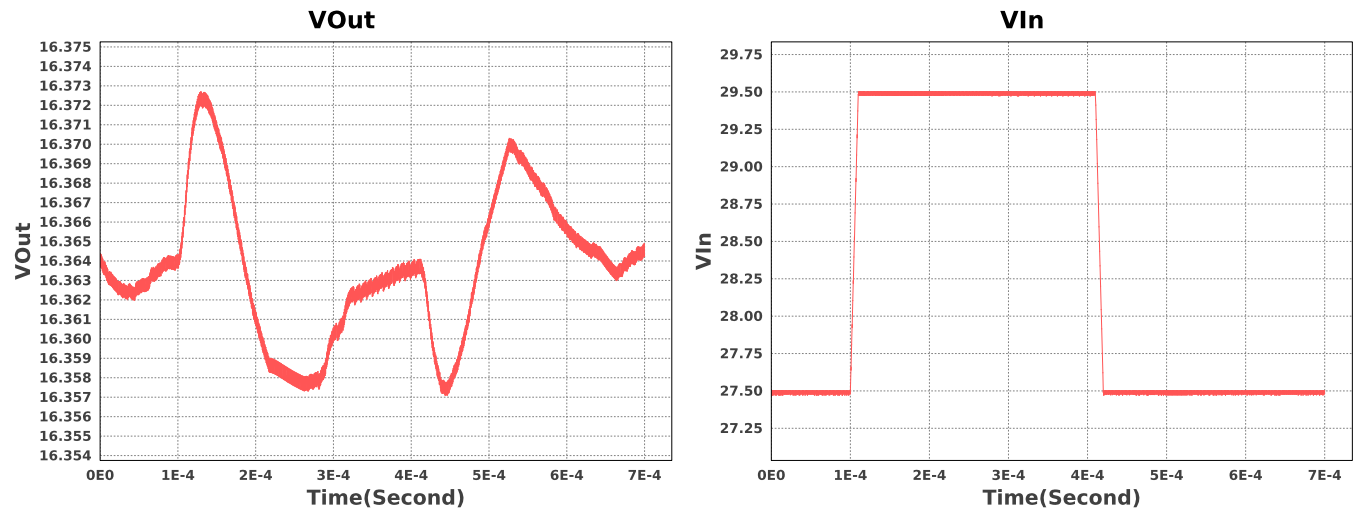


Design Id = 148
sim_id = 3
Simulation Type = Input Transient

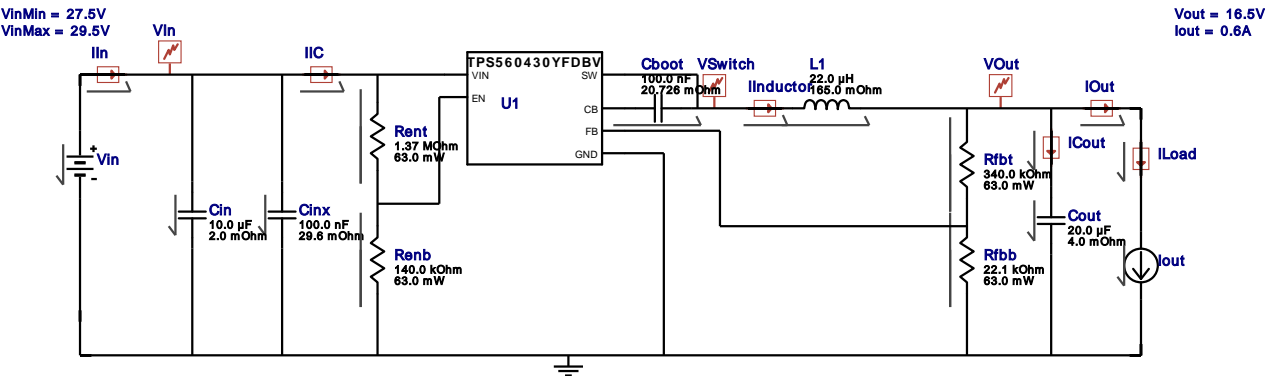


Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	16.5 V
2.	L1	IC	Initial Current	0.6 A
3.	Rload	R	Load Resistance	27.5 Ohm

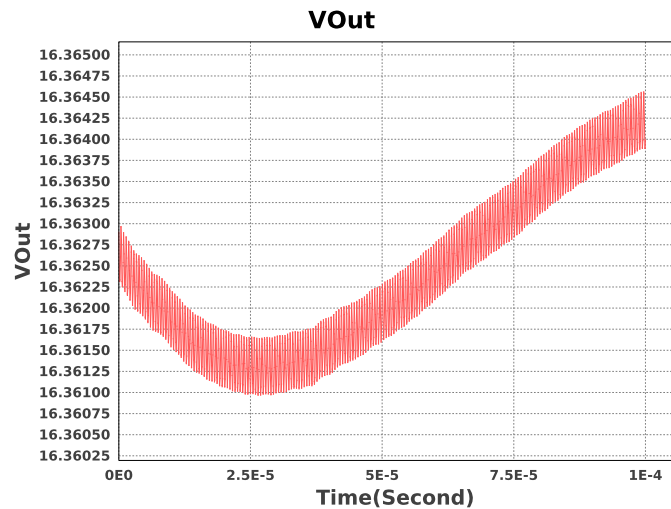


Design Id = 148
sim_id = 4
Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	16.5 V
2.	L1	IC	Initial Current	0.6 A
3.	Iout	I	Load Current	0.6 A



Design Assistance

- Master key : BED2B438EB35597A[v1]
- TPS560430YF Product Folder : <http://www.ti.com/product/TPS560430> : contains the data sheet and other resources.

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