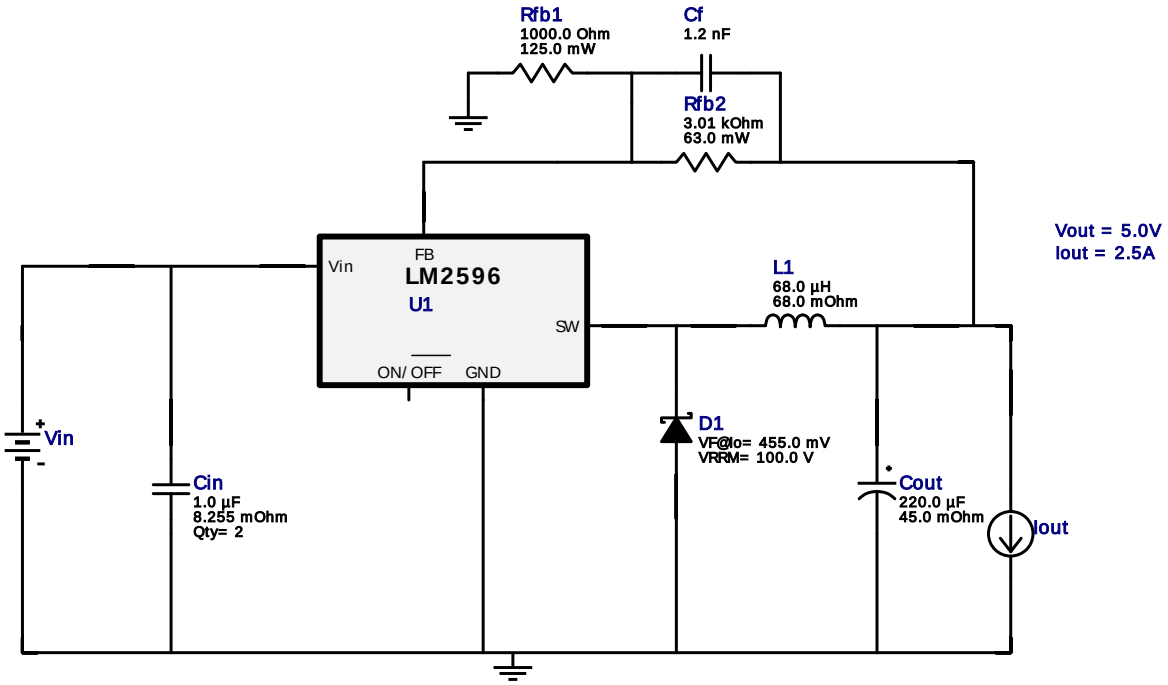
WEBENCH® Design Report

VinMin = 35.0V
VinMax = 40.0V
Vout = 5.0V
Iout = 2.5A

Device = LM2596SX-ADJ/NOPB
Topology = Buck
Created = 2019-02-27 03:44:51.463
BOM Cost = $5.39
BOM Count = 9
Total Pd = 2.85W

Design : 11 LM2596SX-ADJ/NOPB
LM2596SX-ADJ/NOPB 35V-40V to 5.00V @ 2.5A



Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cf	Samsung Electro-Mechanics	CL10C122JB8NNNC Series= C0G/NP0	Cap= 1.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cin	TDK	C2012X7S2A105K125AB Series= X7S	Cap= 1.0 uF ESR= 8.255 mOhm VDC= 100.0 V IRMS= 2.27442 A	2	$0.14	0805 7 mm²
Cout	Kemet	T495D227K010ATE045 Series= T495	Cap= 220.0 uF ESR= 45.0 mOhm VDC= 10.0 V IRMS= 1.643 A	1	$1.08	7343-31 59 mm²
D1	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.39	DDPAK 210 mm²
L1	Coilcraft	MSS1210-683MEB	L= 68.0 µH 68.0 mOhm	1	$0.81	MSS1210 204 mm²
Rfb1	Panasonic	ERJ-6ENF1001V Series= ERJ-6E	Res= 1000.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

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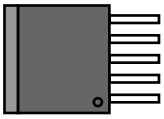
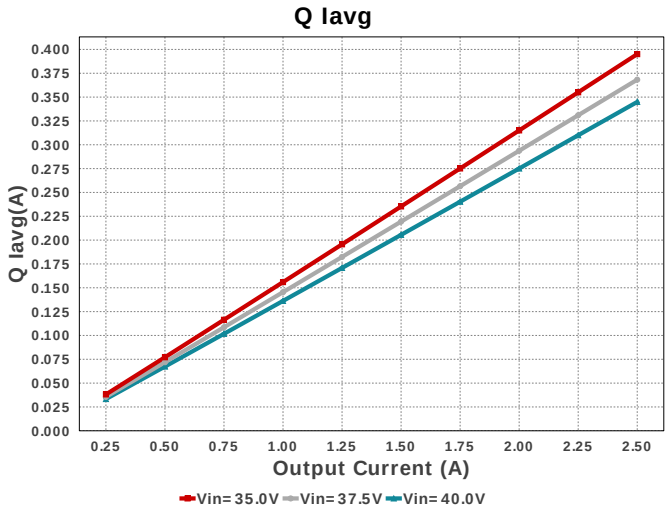
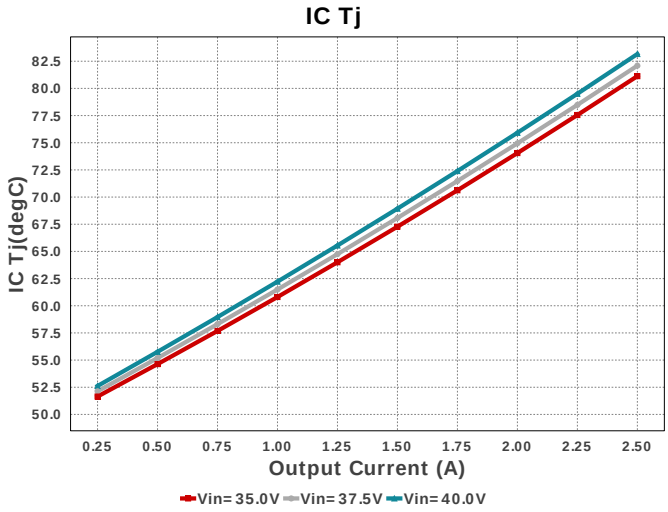
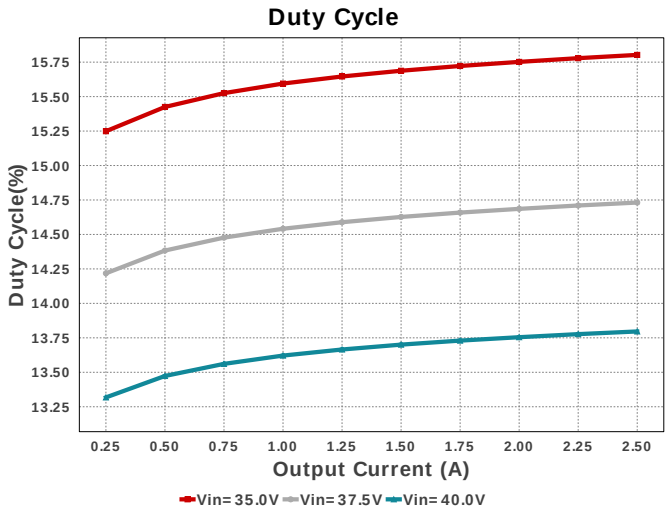
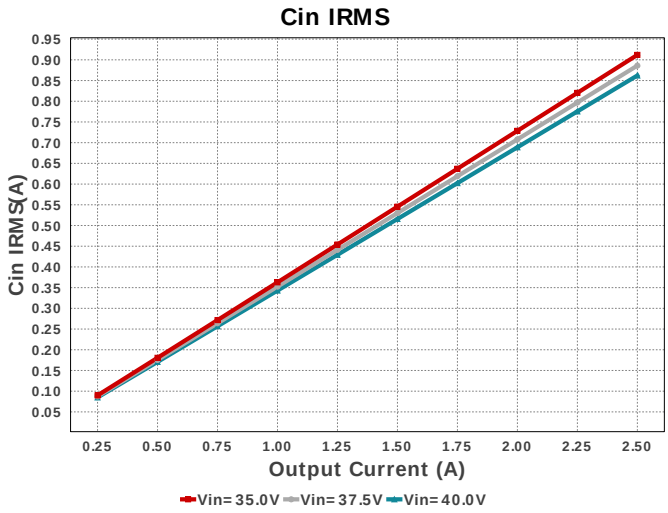
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfb2	Vishay-Dale	CRCW04023K01FKED Series= CRCW..e3	Res= 3.01 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LM2596SX-ADJ/NOPB	Switcher	1	$1.80	TS5B 199 mm^2

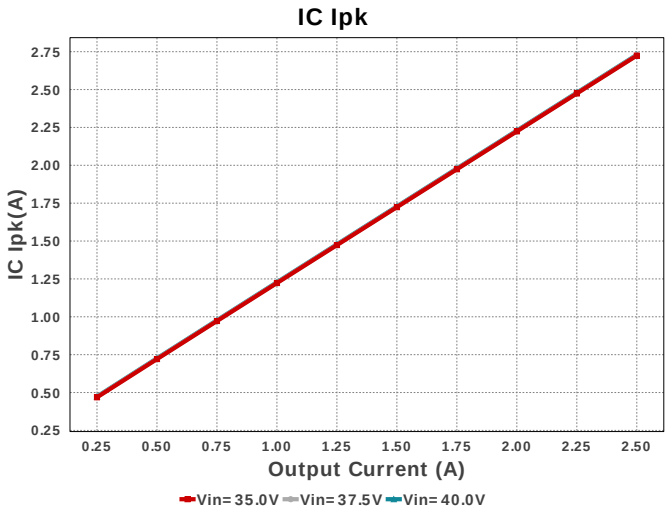


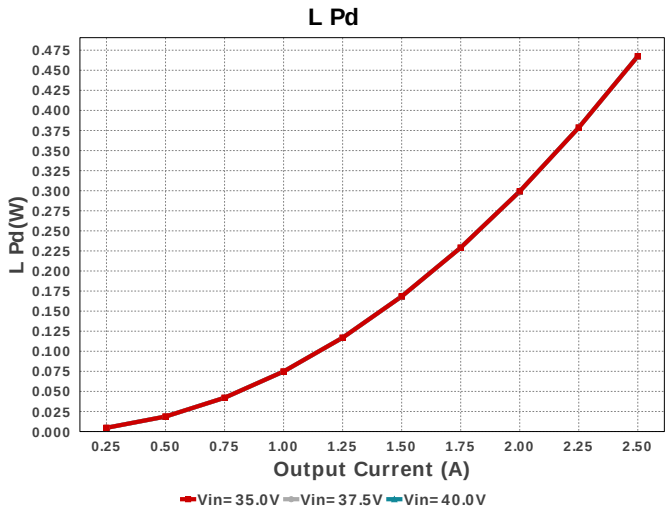












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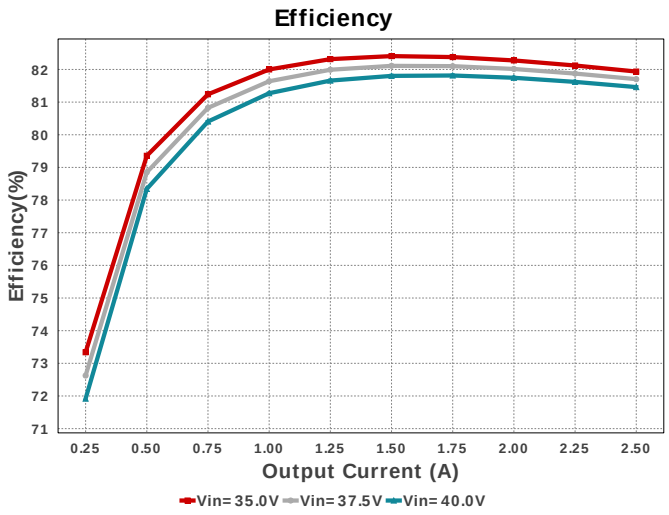

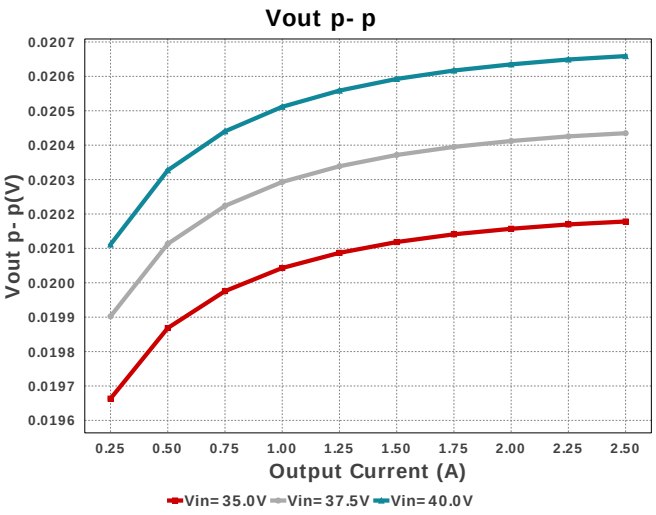

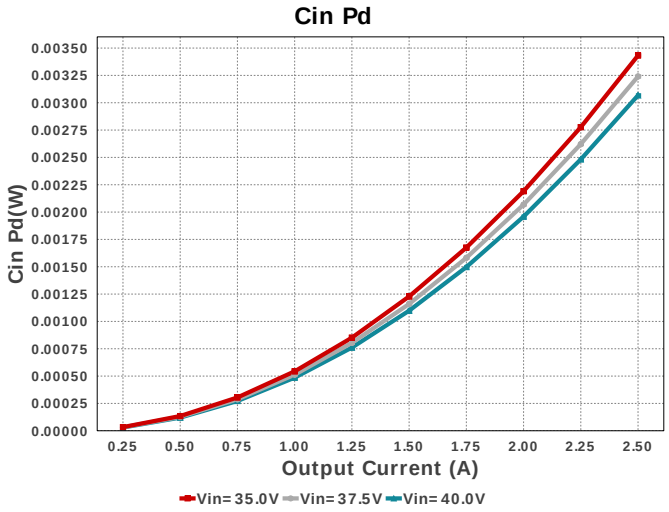

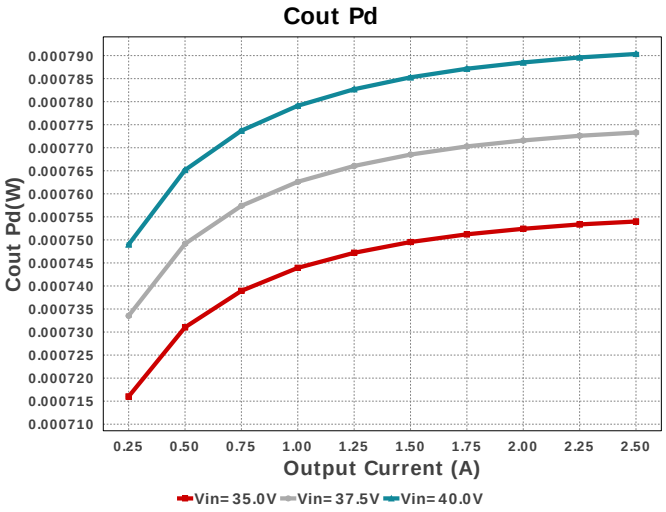

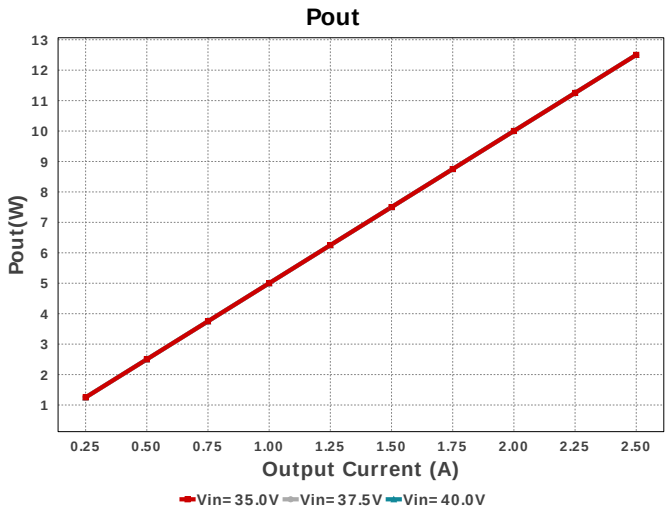

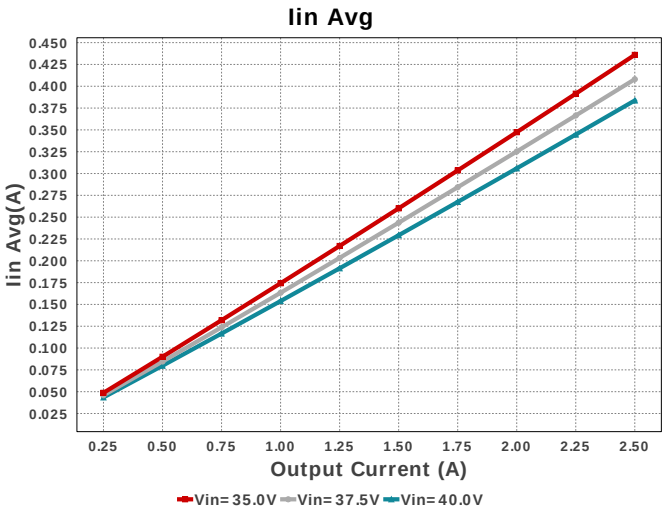

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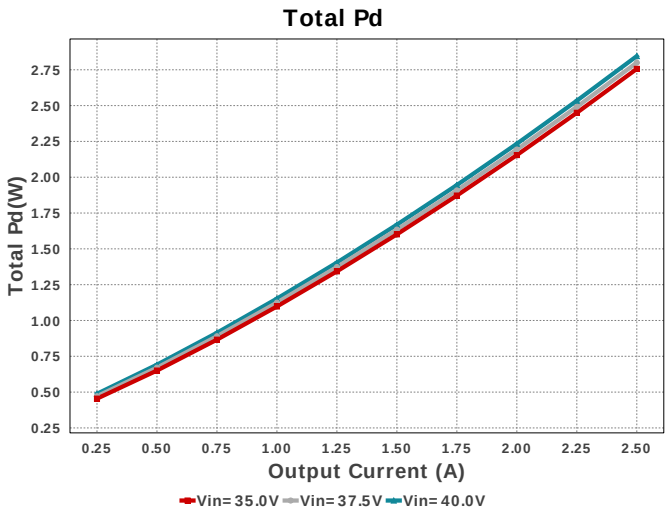

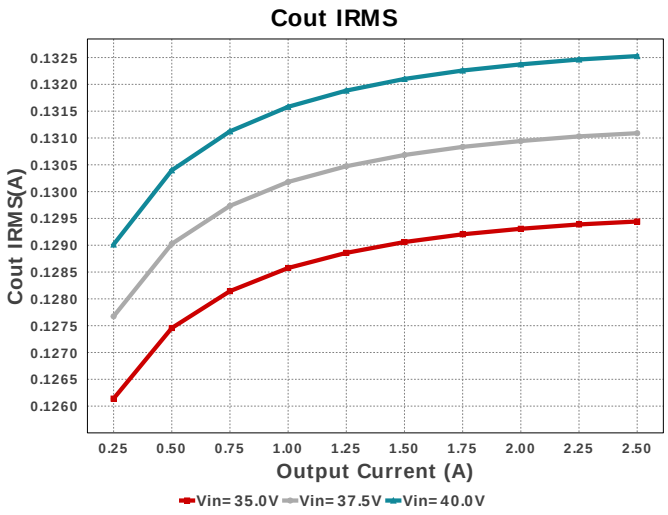

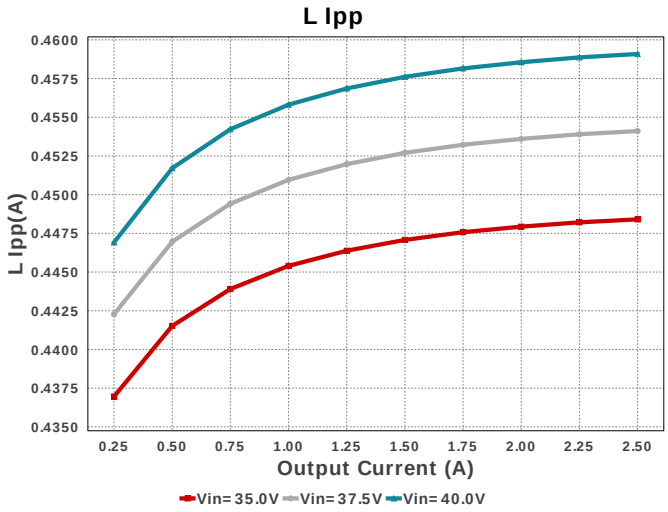

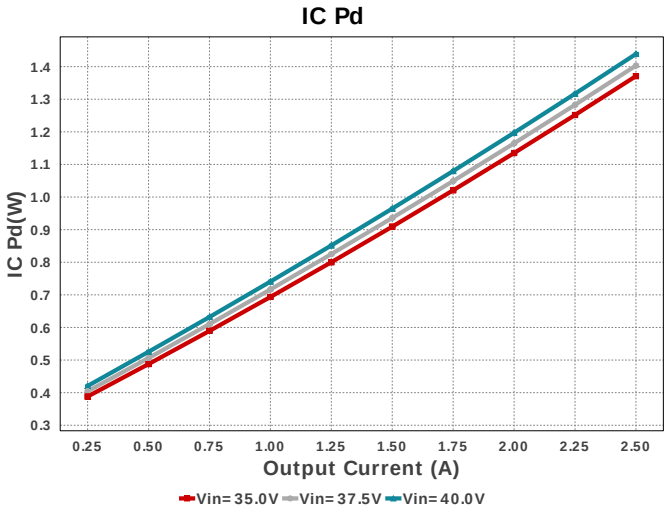

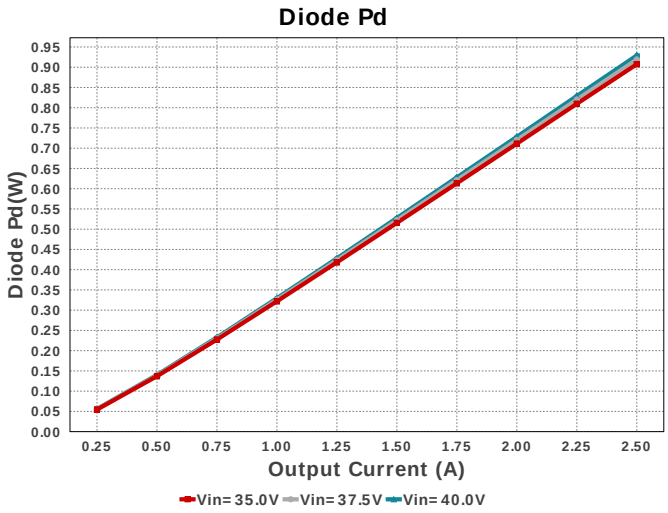

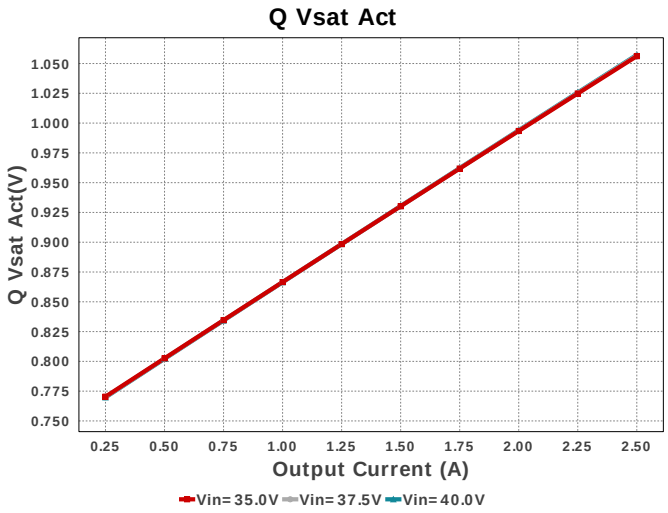

Operating Values

#	Name	Value	Category	Description
1.	BOM Count	9		Total Design BOM count
2.	Total BOM	$5.39		Total BOM Cost
3.	Cin IRMS	862.152 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	3.068 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	132.527 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	790.35 µW	Capacitor	Output capacitor power dissipation
7.	Diode Pd	929.1 mW	Diode	Diode power dissipation
8.	IC Ipk	2.73 A	IC	Peak switch current in IC
9.	IC Pd	1.439 W	IC	IC power dissipation
10.	IC Tj	83.164 degC	IC	IC junction temperature
11.	IC Tolerance	0.0 V	IC	IC Feedback Tolerance

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#	Name	Value	Category	Description
12.	ICThetaJA	30.0 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	383.7 mA	IC	Average input current
14.	L Ipp	459.087 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	467.5 mW	Inductor	Inductor power dissipation
16.	Q Iavg	344.906 mA	Mosfet	Q Iavg
17.	Cin Pd	3.068 mW	Power	Input capacitor power dissipation
18.	Cout Pd	790.35 µW	Power	Output capacitor power dissipation
19.	Diode Pd	929.1 mW	Power	Diode power dissipation
20.	IC Pd	1.439 W	Power	IC power dissipation
21.	L Pd	467.5 mW	Power	Inductor power dissipation
22.	Total Pd	2.846 W	Power	Total Power Dissipation
23.	Cross Freq	15.849 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	13.796 %	System Information	Duty cycle
25.	Efficiency	81.46 %	System Information	Steady state efficiency
26.	FootPrint	700.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	150.0 kHz	System Information	Switching frequency
28.	Iout	2.5 A	System Information	Iout operating point
29.	Mode	CCM	System Information	Conduction Mode
30.	Phase Marg	57.827 deg	System Information	Bode Plot Phase Margin
31.	Pout	12.503 W	System Information	Total output power
32.	Vin	40.0 V	System Information	Vin operating point
33.	Vout Actual	4.932 V	System Information	Vout Actual calculated based on selected voltage divider resistors
34.	Vout Tolerance	1.516 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
35.	Vout p-p	20.659 mV	System Information	Peak-to-peak output ripple voltage
36.	Q Vsat Act	1.057 V	Transistor	Q Vsat

Design Inputs

Name	Value	Description
Iout	2.5	Maximum Output Current
VinMax	40.0	Maximum input voltage
VinMin	35.0	Minimum input voltage
Vout	5.001	Output Voltage
base_pn	LM2596	Base Product Number
source	DC	Input Source Type
Ta	40.0	Ambient temperature

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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

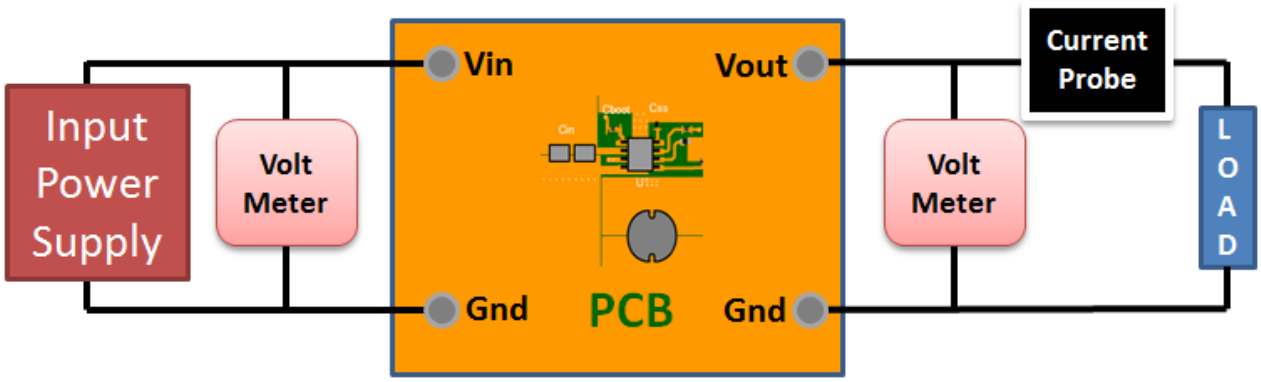
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 35.0V 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 : F94F151332F15CC5[v1]
2. **LM2596** Product Folder : http://www.ti.com/product/LM2596 : contains the data sheet and other resources.

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