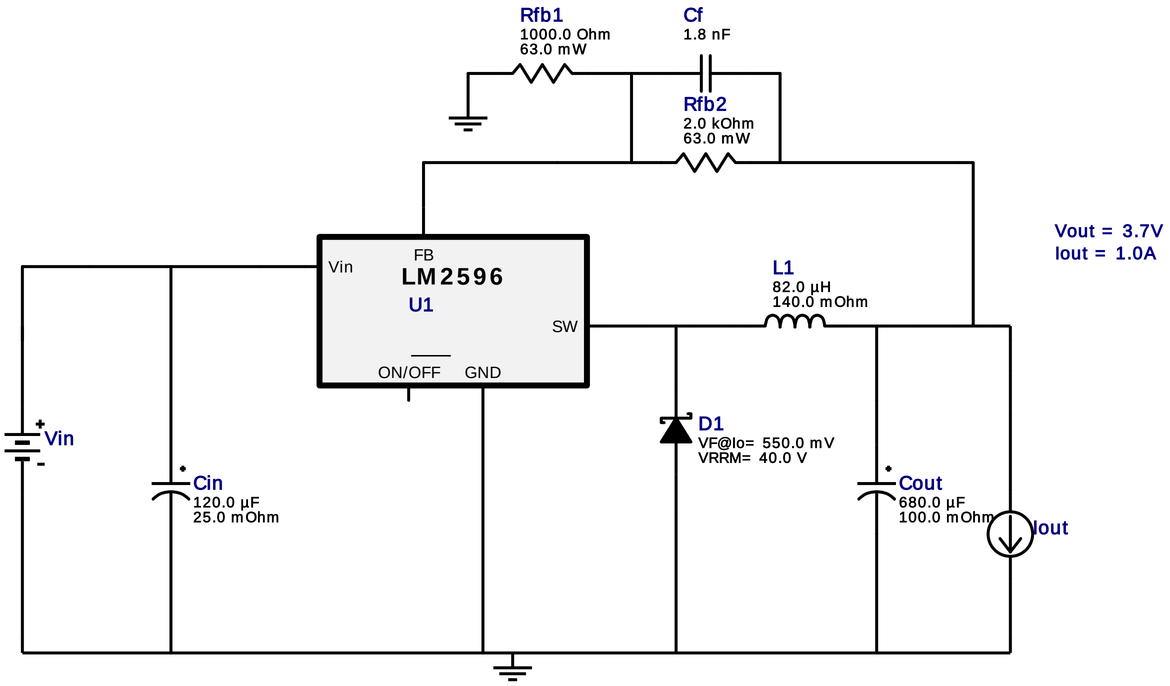
VinMin = 11.0V
VinMax = 13.0V
Vout = 3.7V
Iout = 1.0A

Device = LM2596T-ADJ/NOPB
Topology = Buck
Created = 2022-01-06 10:18:01.374
BOM Cost = $5.74
BOM Count = 8
Total Pd = 0.99W

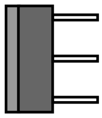
WEBENCH ® Design Report

Design : 532 LM2596T-ADJ/NOPB
LM2596T-ADJ/NOPB 11V-13V to 3.30V @ 2.5A

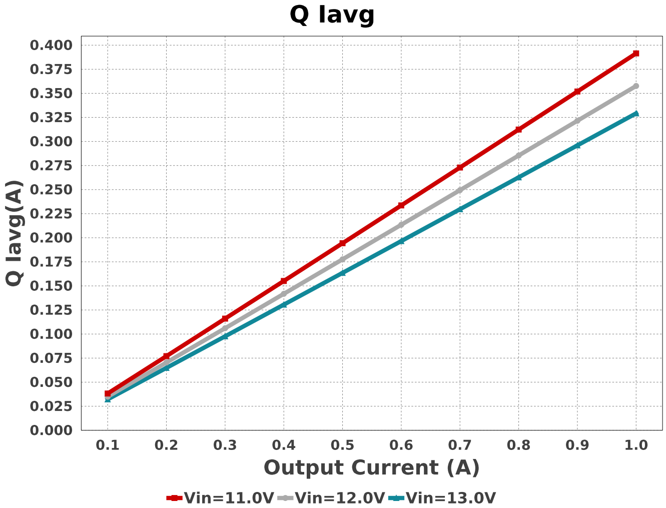


Electrical BOM

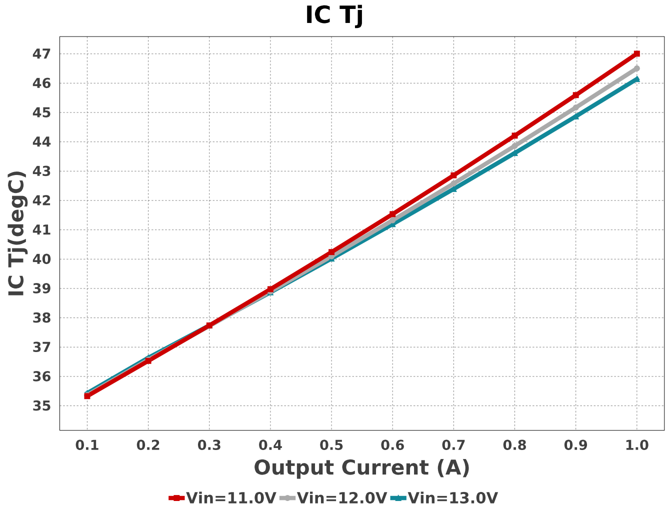
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cf	TDK	C2012C0G1H182K060AA Series= C0G/NP0	Cap= 1.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm^2
Cin	Panasonic	20SVPF120M Series= SVPF	Cap= 120.0 uF ESR= 25.0 mOhm VDC= 20.0 V IRMS= 3.2 A	1	$0.44	CAPSMT_62_F61 74 mm^2
Cout	Chemi-Con	EMVH350GDA681MMH0S Series= MVH	Cap= 680.0 uF ESR= 100.0 mOhm VDC= 35.0 V IRMS= 1.2 A	1	$2.60	CAPSMT_62_MH0 441 mm^2
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.04	SOD-123F 12 mm^2
L1	Bourns	SDR1307-820KL	L= 82.0 µH 140.0 mOhm	1	$0.42	SDR1307 226 mm^2
Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfb2	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LM2596T-ADJ/NOPB	Switcher	1	$2.18	 TA05F 127 mm²

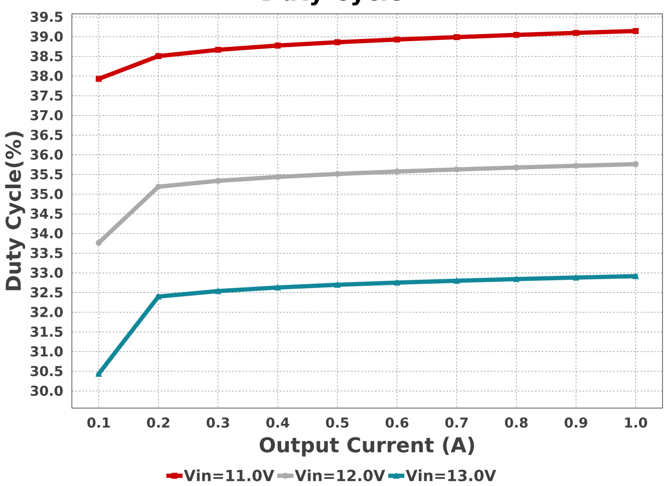
Q Iavg



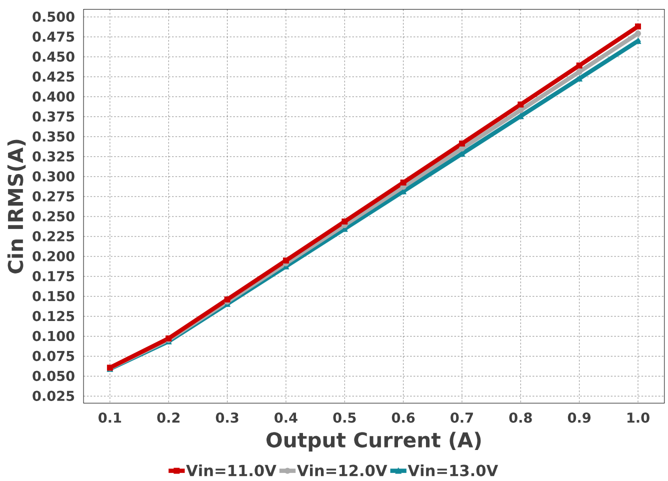
IC Tj



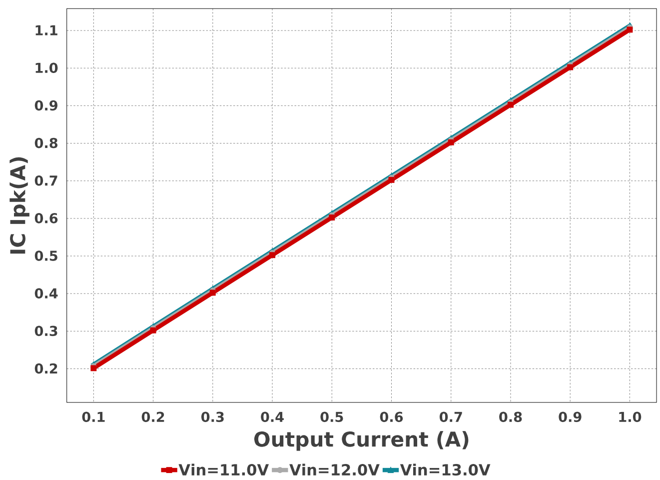
Duty Cycle



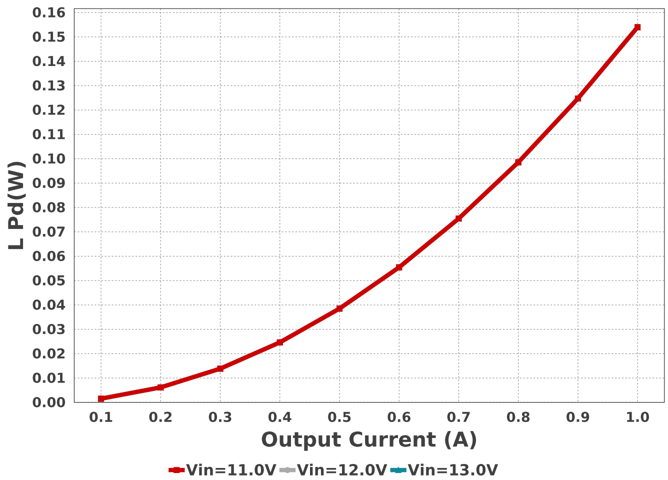
Cin IRMS

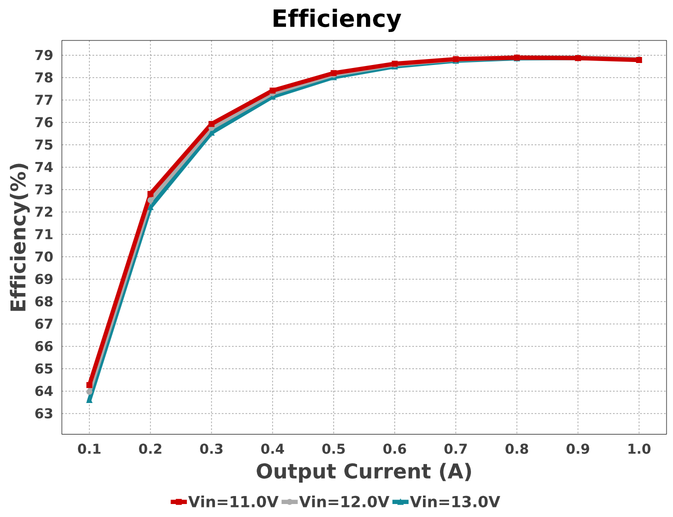


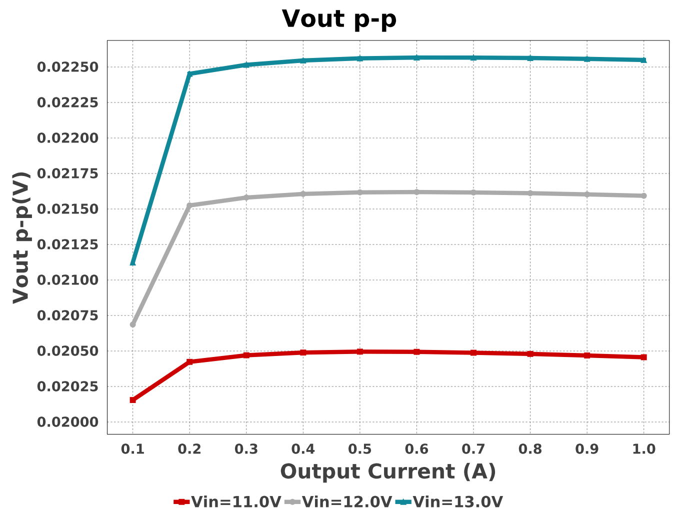
IC Ipk

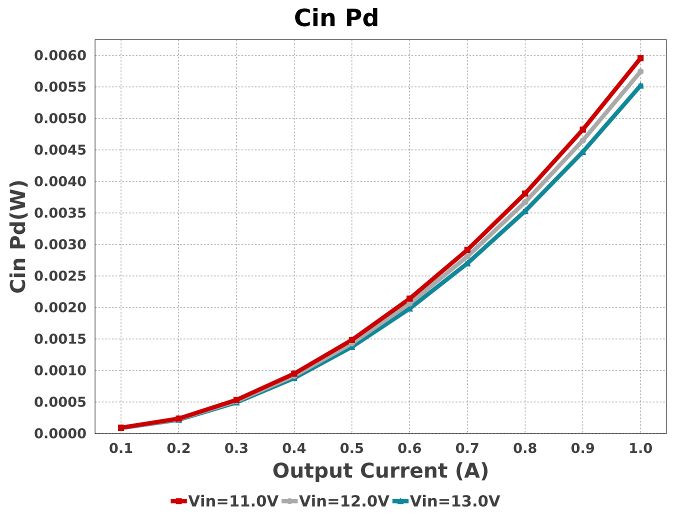


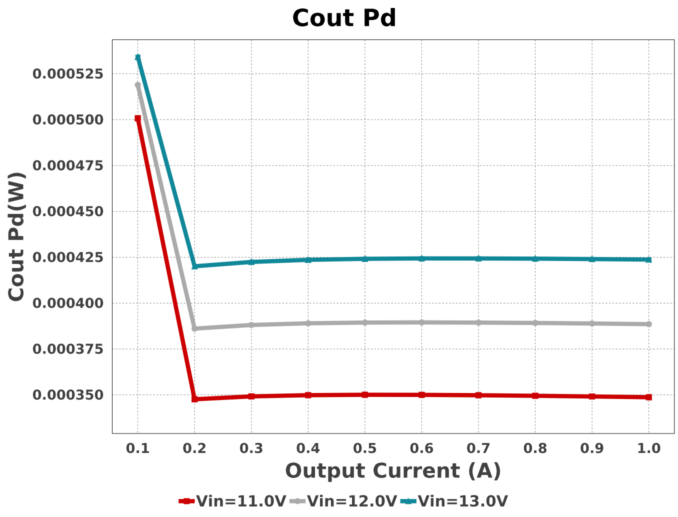
L Pd

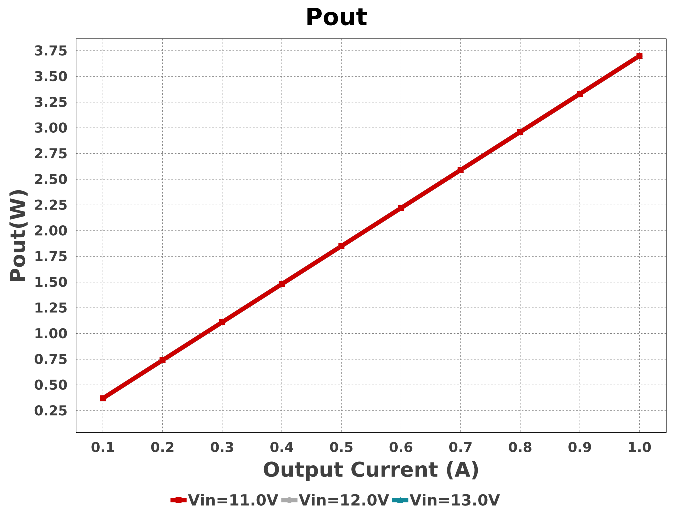


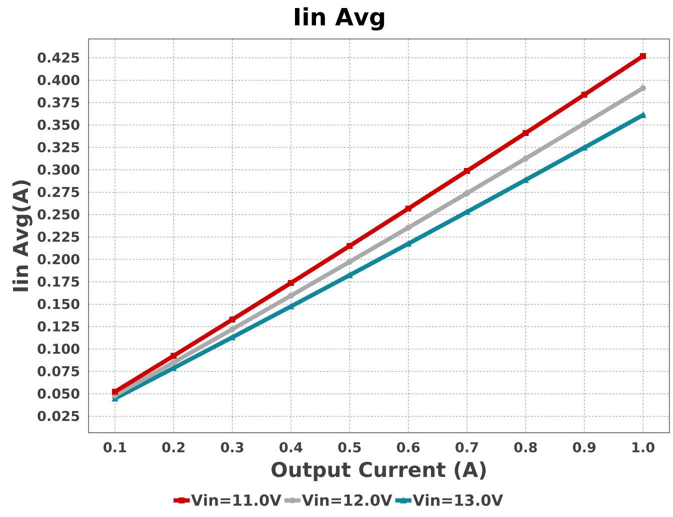

Efficiency
Efficiency(%)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V


Vout p-p
Vout p-p(V)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

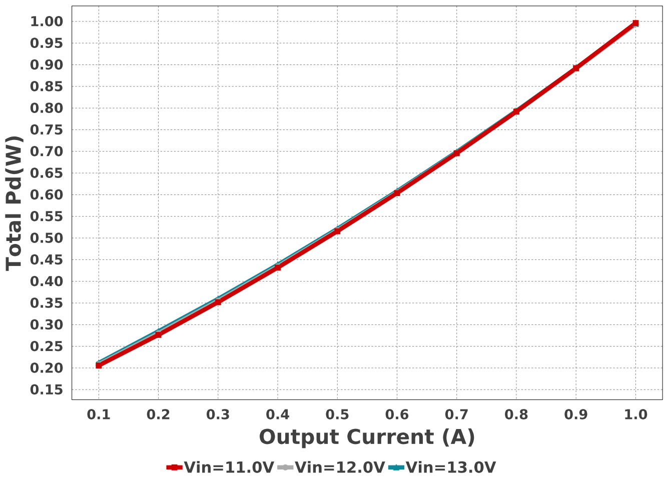

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V


Cout Pd
Cout Pd(W)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

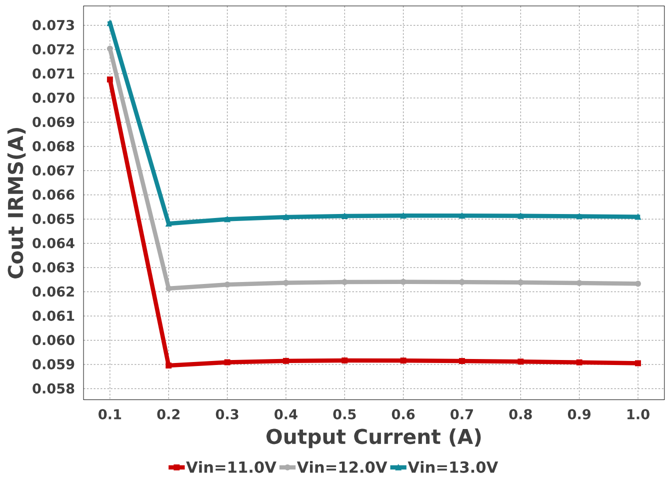

Pout
Pout(W)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

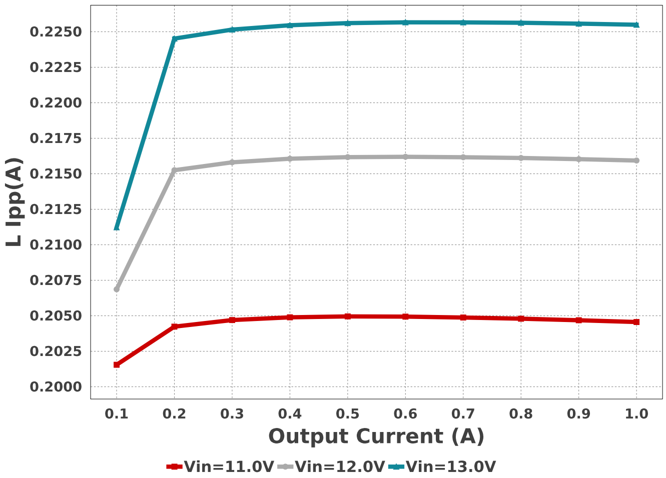
Total Pd



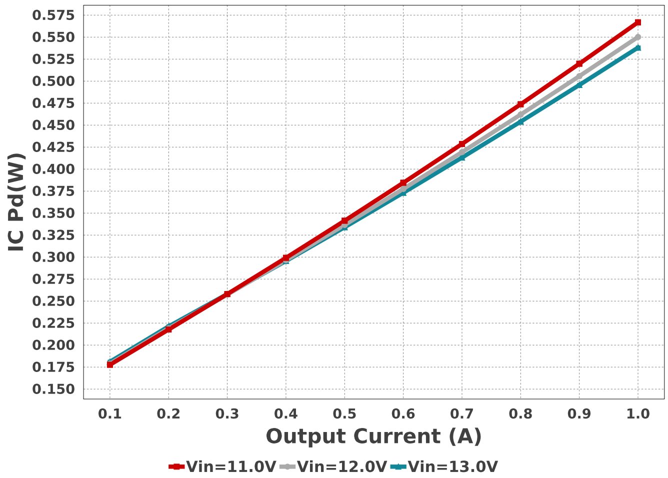
Cout IRMS



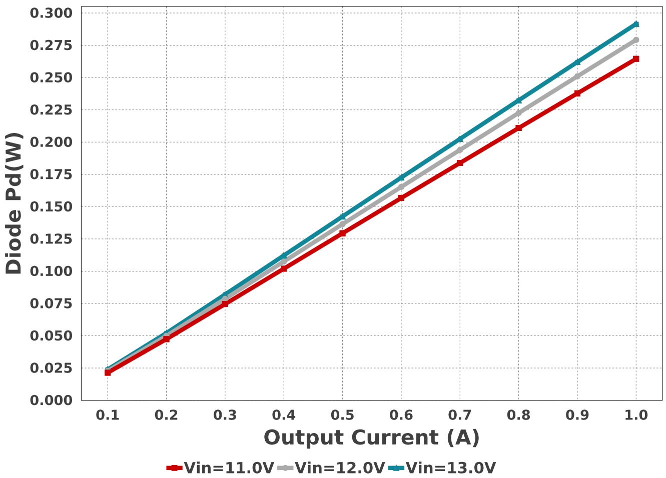
L Ipp



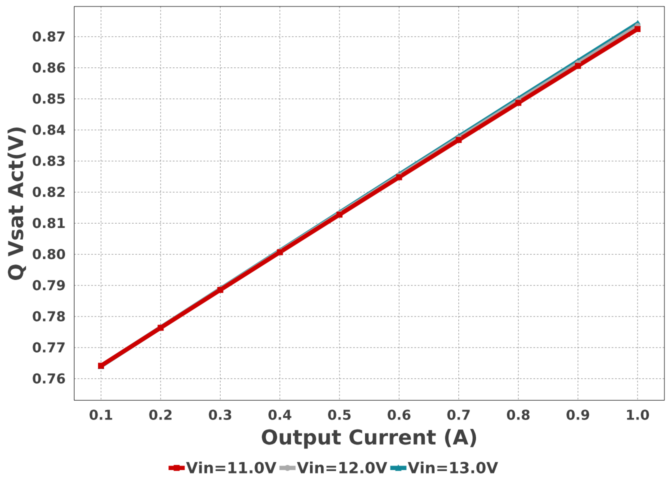
IC Pd



Diode Pd



Q Vsat Act



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	469.915 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	5.52 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	65.095 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	423.73 µW	Capacitor	Output capacitor power dissipation
5.	Diode Pd	291.55 mW	Diode	Diode power dissipation
6.	IC Ipk	1.113 A	IC	Peak switch current in IC
7.	IC Pd	538.06 mW	IC	IC power dissipation
8.	IC Tj	46.142 degC	IC	IC junction temperature
9.	IC Tolerance	0.0 V	IC	IC Feedback Tolerance
10.	ICThetaJA	30.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	361.09 mA	IC	Average input current

#	Name	Value	Category	Description
12.	L Ipp	225.49 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	154.0 mW	Inductor	Inductor power dissipation
14.	Q Iavg	329.178 mA	Mosfet	Q Iavg
15.	Cin Pd	5.52 mW	Power	Input capacitor power dissipation
16.	Cout Pd	423.73 µW	Power	Output capacitor power dissipation
17.	Diode Pd	291.55 mW	Power	Diode power dissipation
18.	IC Pd	538.06 mW	Power	IC power dissipation
19.	L Pd	154.0 mW	Power	Inductor power dissipation
20.	Total Pd	994.131 mW	Power	Total Power Dissipation
21.	BOM Count	8	System Information	Total Design BOM count
22.	Cross Freq	6.31 kHz	System Information	Bode plot crossover frequency
23.	Duty Cycle	32.918 %	System Information	Duty cycle
24.	Efficiency	78.822 %	System Information	Steady state efficiency
25.	FootPrint	893.0 mm^2	System Information	Total Foot Print Area of BOM components
26.	Frequency	150.0 kHz	System Information	Switching frequency
27.	Iout	1.0 A	System Information	Iout operating point
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	73.064 deg	System Information	Bode Plot Phase Margin
30.	Pout	3.7 W	System Information	Total output power
31.	Total BOM	$5.74	System Information	Total BOM Cost
32.	Vin	13.0 V	System Information	Vin operating point
33.	Vout Actual	3.69 V	System Information	Vout Actual calculated based on selected voltage divider resistors
34.	Vout Tolerance	1.347 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
35.	Vout p-p	22.549 mV	System Information	Peak-to-peak output ripple voltage
36.	Q Vsat Act	874.213 mV	Transistor	Q Vsat

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	13.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
Vout	3.7	Output Voltage
base_pn	LM2596	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

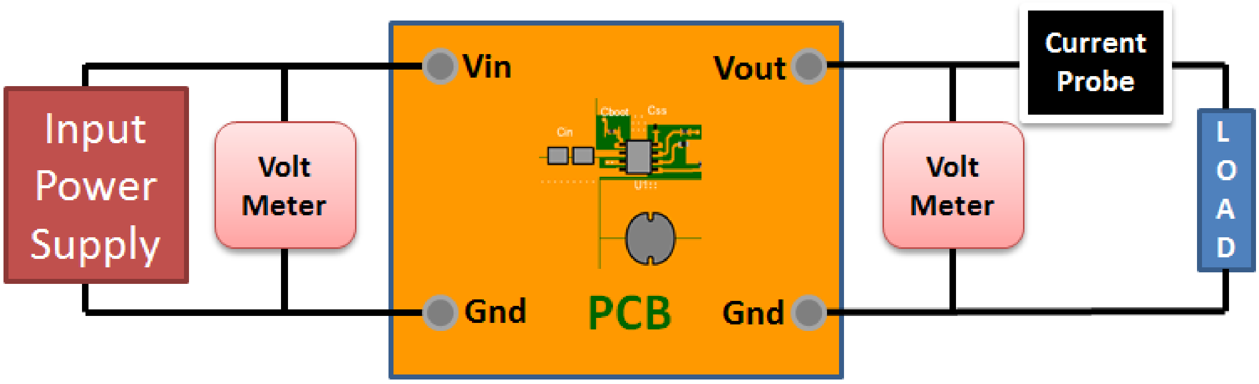
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.0V 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 : 40EE3F1E021441DB[v1]

2. **LM2596** Product Folder : http://www.ti.com/product/LM2596 : contains the data sheet and other resources.