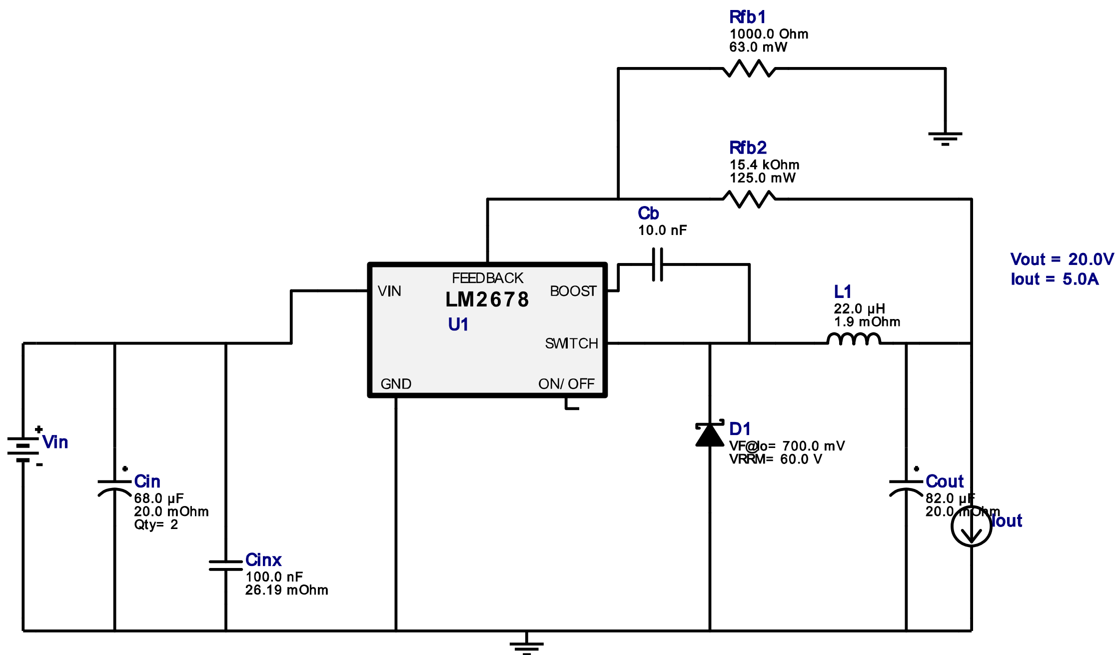
TEXAS INSTRUMENTS

WEBENCH ® Design Report

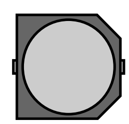
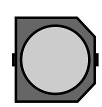
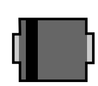
VinMin = 24.0V
VinMax = 30.0V
Vout = 20.0V
Iout = 5.0A

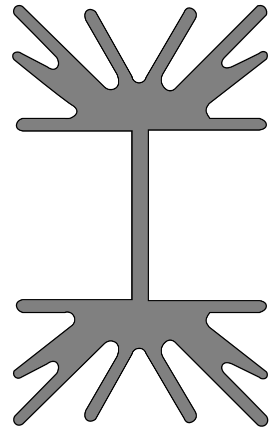
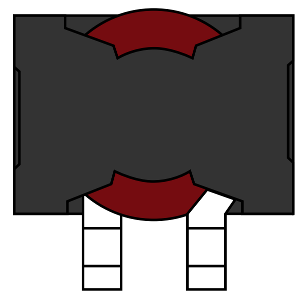
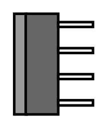
Device = LM2678T-ADJ/NOPB
Topology = Buck
Created = 2018-11-05 08:07:18.488
BOM Cost = $9.34
BOM Count = 11
Total Pd = 4.98W

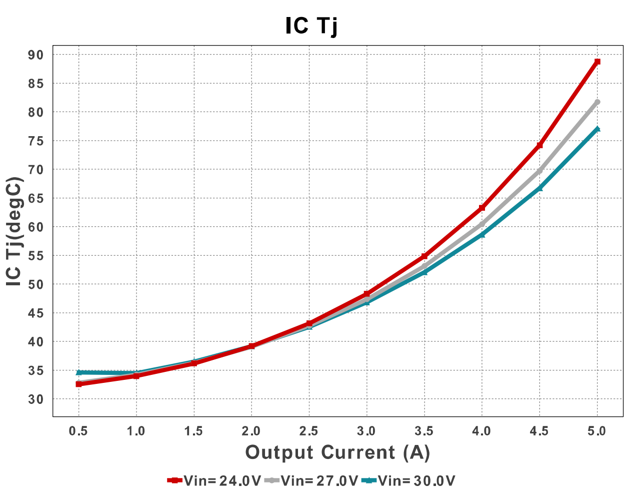
Design : 825 LM2678T-ADJ/NOPB
LM2678T-ADJ/NOPB 24V-30V to 20.00V @ 5A

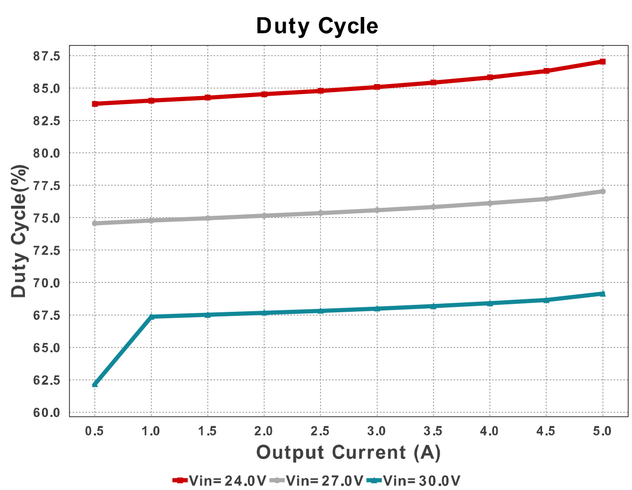


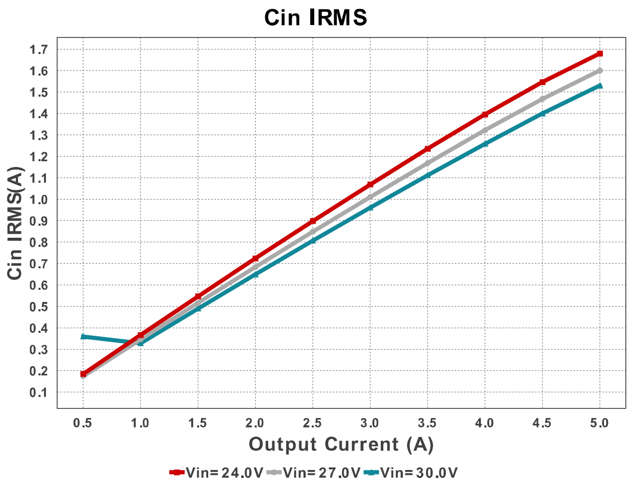
Electrical BOM

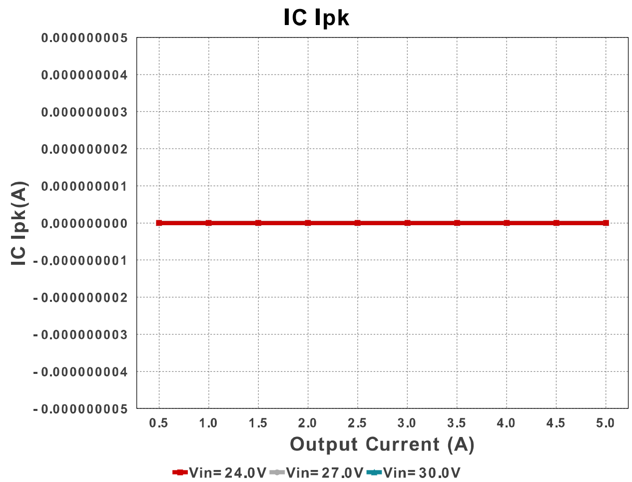
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cb	TDK	CGA4C2C0G1H103J060AA Series= C0G/NP0	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
Cin	Panasonic	50SVPF68M Series= SVPF	Cap= 68.0 uF ESR= 20.0 mOhm VDC= 50.0 V IRMS= 4.3 A	2	$1.00	 CAPSMT_62_F12 151 mm²
Cinx	TDK	C2012X7R1H104K085AA Series= X7R	Cap= 100.0 nF ESR= 26.19 mOhm VDC= 50.0 V IRMS= 1.29514 A	1	$0.02	0805 7 mm²
Cout	Panasonic	35SVPF82M Series= SVPF	Cap= 82.0 uF ESR= 20.0 mOhm VDC= 35.0 V IRMS= 4.0 A	1	$0.66	 CAPSMT_62_E12 106 mm²
D1	Diodes Inc.	B560C-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	$0.19	 SMC 83 mm²

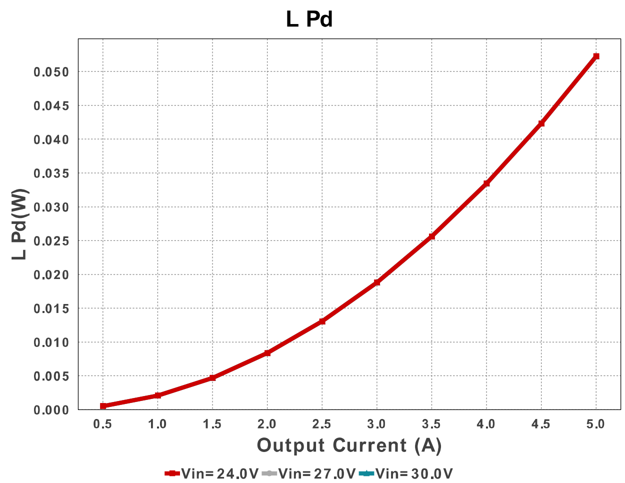
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
HeatSink	Aavid	529802B02500G	Heatsink	1	$2.23	 529802 1203 mm²
L1	Coilcraft	SER2915H-223KL	L= 22.0 µH DCR= 1.9 mOhm	1	$1.95	 SER2915H 652 mm²
Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfb2	Vishay-Dale	CRCW080515K4FKEA Series= CRCW..e3	Res= 15.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
U1	Texas Instruments	LM2678T-ADJ/NOPB	Switcher	1	$2.20	 TA07B 121 mm²

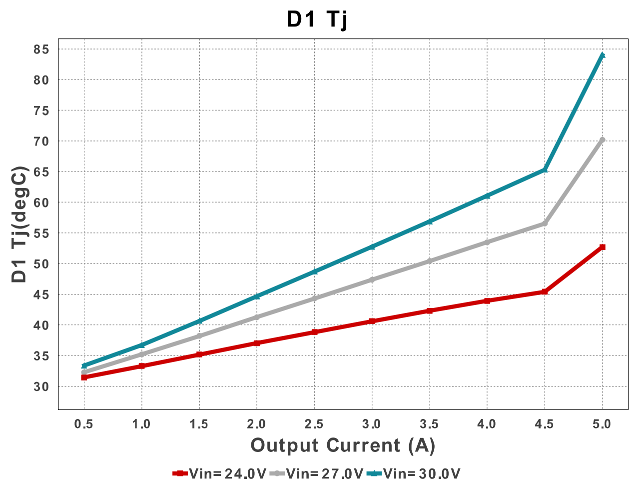


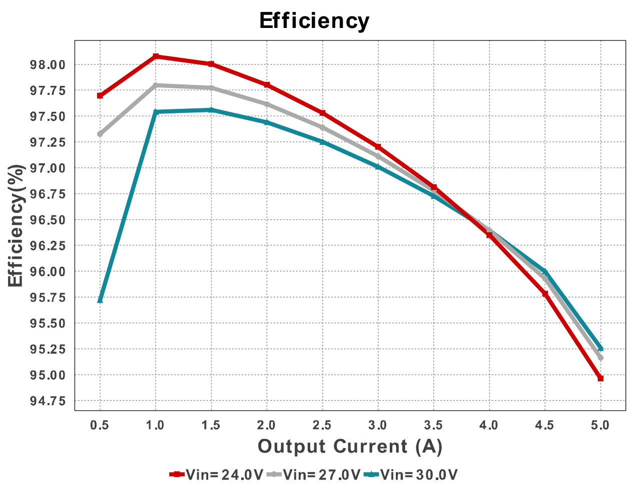


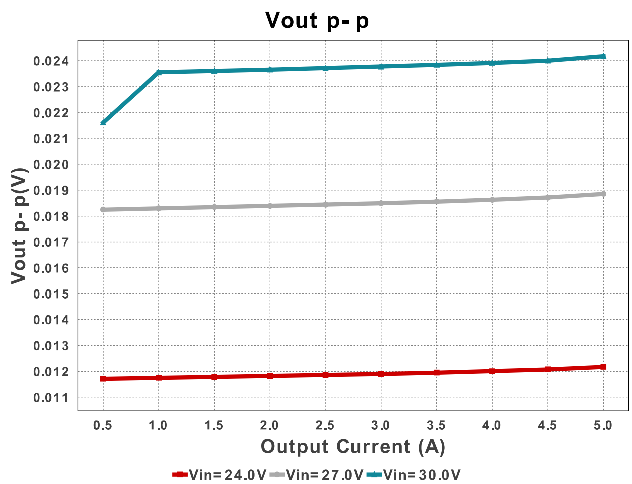

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=24.0V Vin=27.0V Vin=30.0V


IC Ipk
IC Ipk(A)
Output Current (A)
Vin=24.0V Vin=27.0V Vin=30.0V

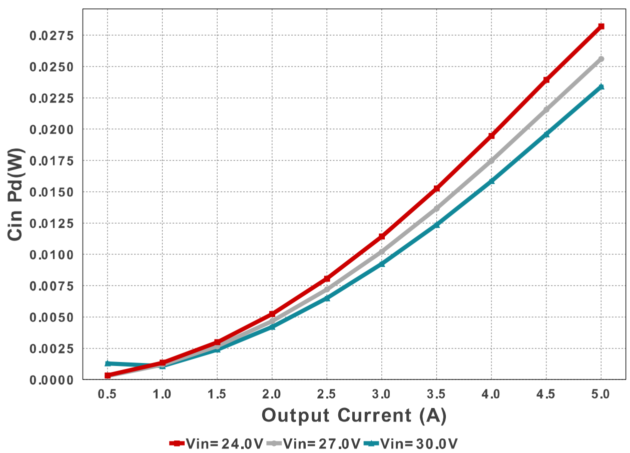

L Pd
L Pd(W)
Output Current (A)
Vin=24.0V Vin=27.0V Vin=30.0V


D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=24.0V Vin=27.0V Vin=30.0V

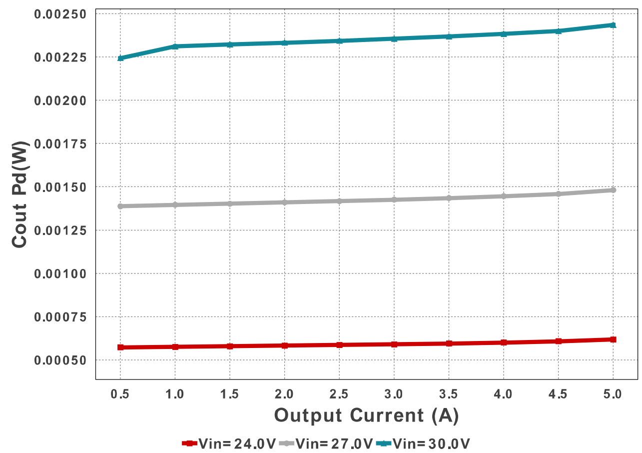

Efficiency
Efficiency(%)
Output Current (A)
Vin=24.0V Vin=27.0V Vin=30.0V


Vout p-p
Vout p-p(V)
Output Current (A)
Vin=24.0V Vin=27.0V Vin=30.0V

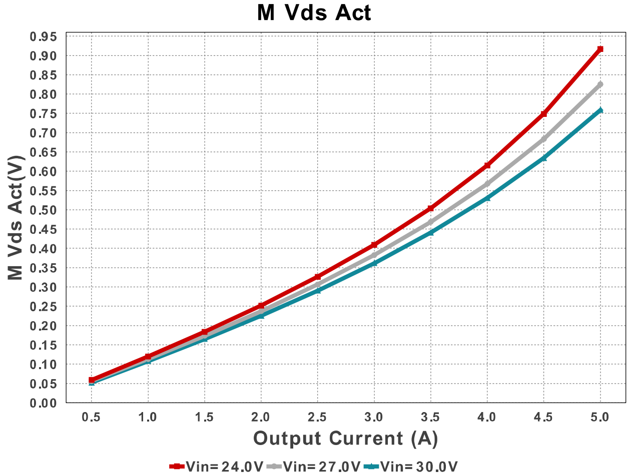
Cin Pd



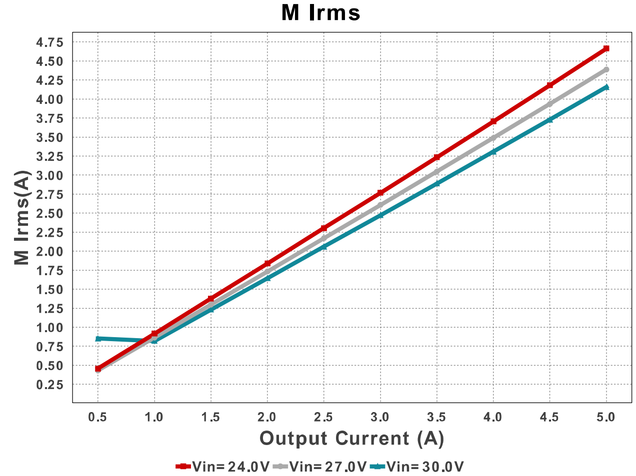
Cout Pd



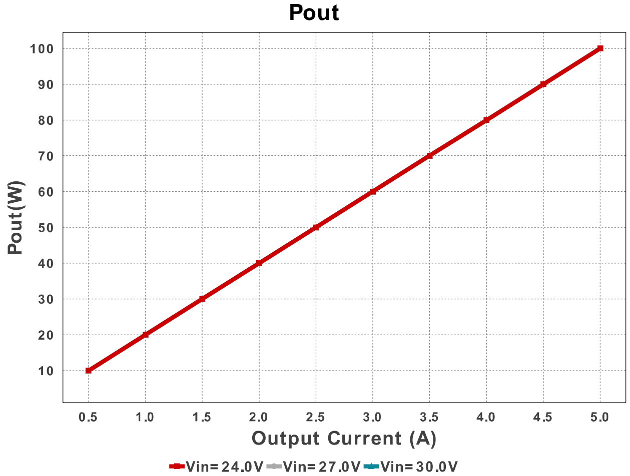
M Vds Act



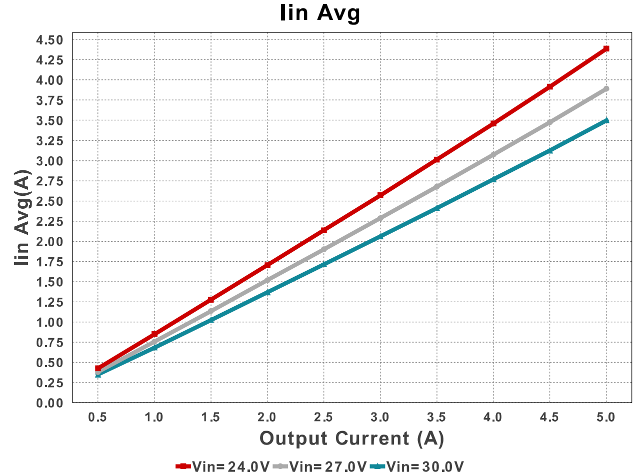
M Irms

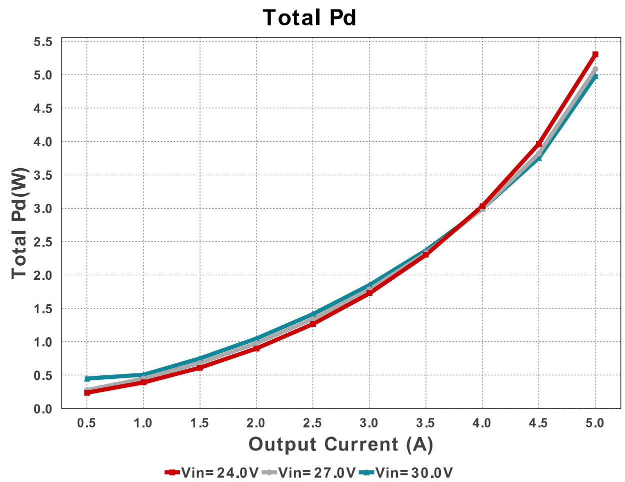


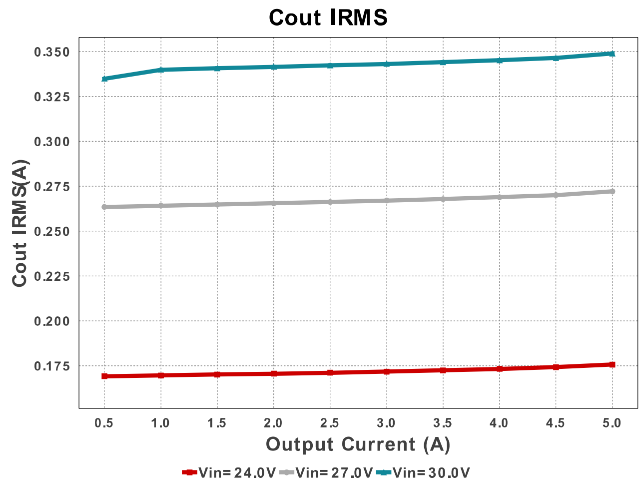
Pout

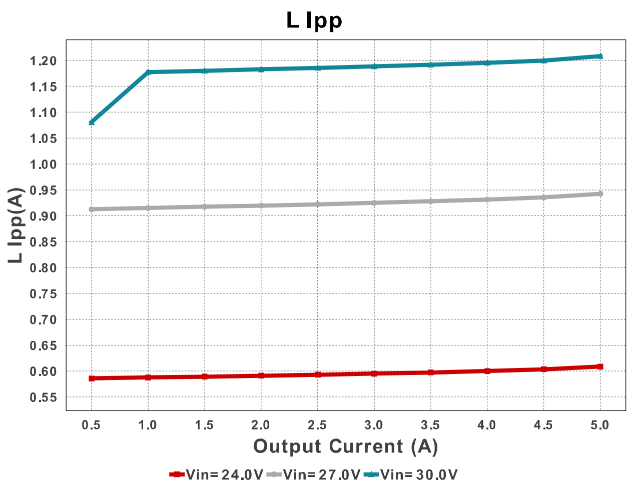


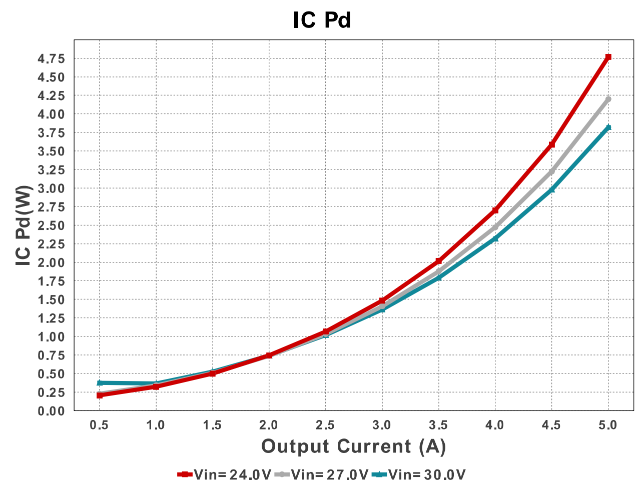
Iin Avg

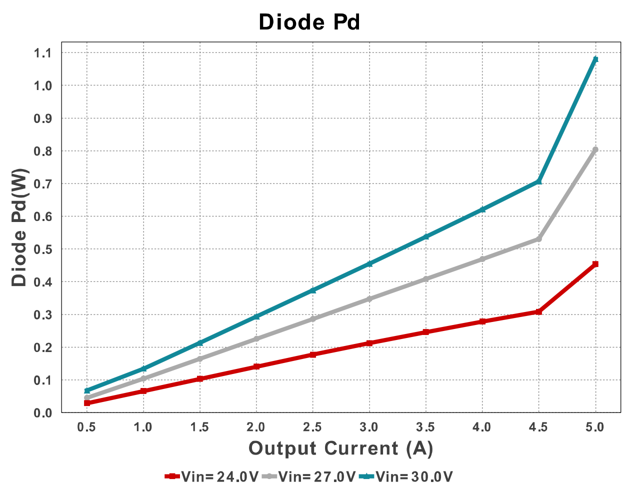












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.53 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	23.4 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	348.909 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	2.435 mW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	84.013 degC	Diode	D1 junction temperature
6.	Diode Pd	1.08 W	Diode	Diode power dissipation
7.	IC Ipk	0.0 A	IC	Peak switch current in IC
8.	IC Pd	3.82 W	IC	IC power dissipation
9.	IC Tj	77.069 degC	IC	IC junction temperature
10.	IC Tolerance	24.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	12.32 degC/W	IC	IC junction-to-ambient thermal resistance

#	Name	Value	Category	Description
12.	Iin Avg	3.499 A	IC	Average input current
13.	L Ipp	1.209 A	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	52.25 mW	Inductor	Inductor power dissipation
15.	M Irms	4.157 A	Mosfet	MOSFET RMS ripple current
16.	M Vds Act	758.645 mV	Mosfet	Voltage drop across the MosFET
17.	Cin Pd	23.4 mW	Power	Input capacitor power dissipation
18.	Cout Pd	2.435 mW	Power	Output capacitor power dissipation
19.	Diode Pd	1.08 W	Power	Diode power dissipation
20.	IC Pd	3.82 W	Power	IC power dissipation
21.	L Pd	52.25 mW	Power	Inductor power dissipation
22.	Total Pd	4.979 W	Power	Total Power Dissipation
23.	BOM Count	11	System Information	Total Design BOM count
24.	Cross Freq	13.17 kHz	System Information	Bode plot crossover frequency
25.	Duty Cycle	69.135 %	System Information	Duty cycle
26.	Efficiency	95.257 %	System Information	Steady state efficiency
27.	FootPrint	2.491 k mm^2	System Information	Total Foot Print Area of BOM components
28.	Frequency	260.0 kHz	System Information	Switching frequency
29.	Iout	5.0 A	System Information	Iout operating point
30.	Mode	CCM	System Information	Conduction Mode
31.	Phase Marg	49.39 deg	System Information	Bode Plot Phase Margin
32.	Pout	100.0 W	System Information	Total output power
33.	Total BOM	$9.34	System Information	Total BOM Cost
34.	Vin	30.0 V	System Information	Vin operating point
35.	Vout	20.0 V	System Information	Operational Output Voltage
36.	Vout Actual	19.844 V	System Information	Vout Actual calculated based on selected voltage divider resistors
37.	Vout Tolerance	3.918 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
38.	Vout p-p	24.173 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	24.0	Minimum input voltage
Vout	20.0	Output Voltage
base_pn	LM2678	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

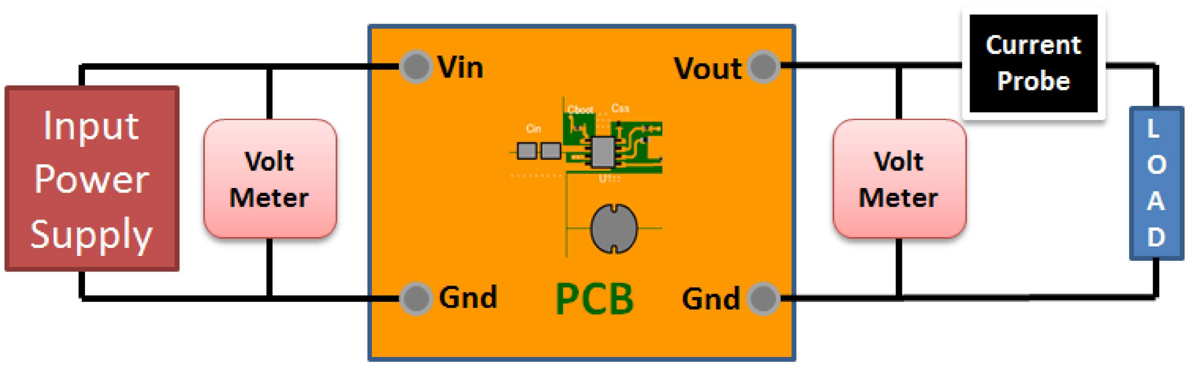
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 24.0V 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 : 2988358CDA4C63C6[v1]

2. **LM2678** Product Folder : http://www.ti.com/product/LM2678 : contains the data sheet and other resources.

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