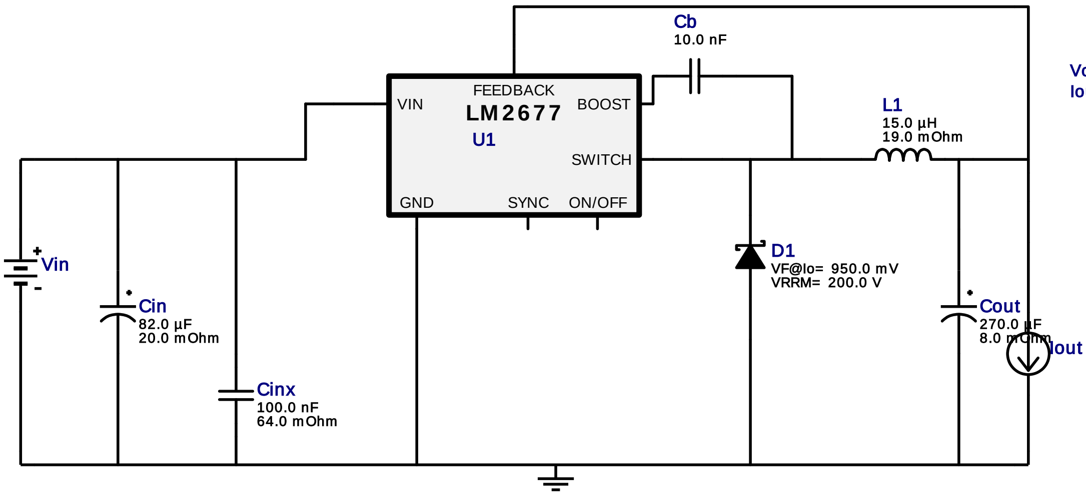
VinMin = 18.0V
VinMax = 26.0V
Vout = 5.0V
Iout = 4.0A

Device = LM2677SX-5.0/NOPB
Topology = Buck
Created = 2022-12-12 16:49:55.899
BOM Cost = $5.68
BOM Count = 7
Total Pd = 4.2W

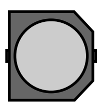
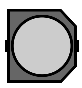
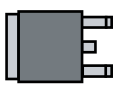
WEBENCH ® Design Report

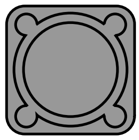
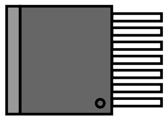
Design : 14 LM2677SX-5.0/NOPB
LM2677SX-5.0/NOPB 18V-26V to 5.00V @ 4A

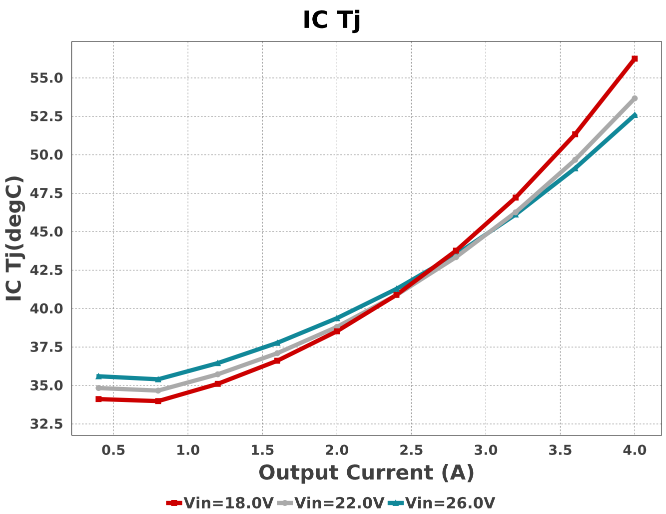


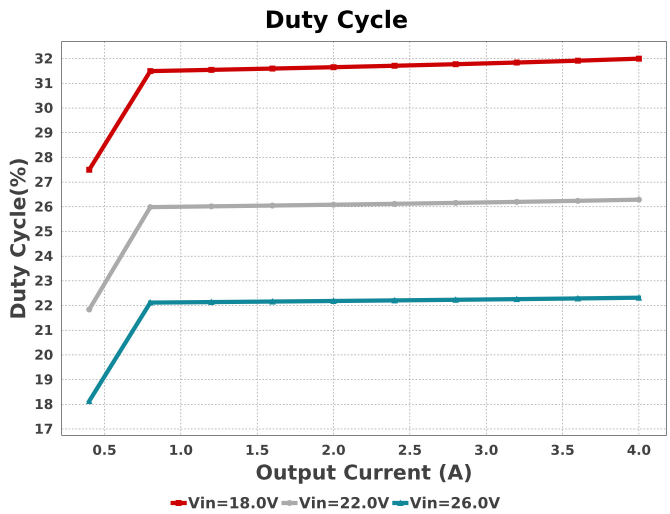
1. The small series "trace inductance", particularly from the Switch Output pin, can create a high frequency (10's of MHz) ringing signal at the switch output. If problematic, this ringing can be reduced or eliminated by the use of a series RC damper or snubber network from the switch output to ground. Values of 0.01 uF and 10 ohm are good starting values that may need to be varied depending on the magnitude of parasitic factors in a given design. In an actual end application, these components are normally not required if proper care to minimize trace lengths is taken in the PCB design.

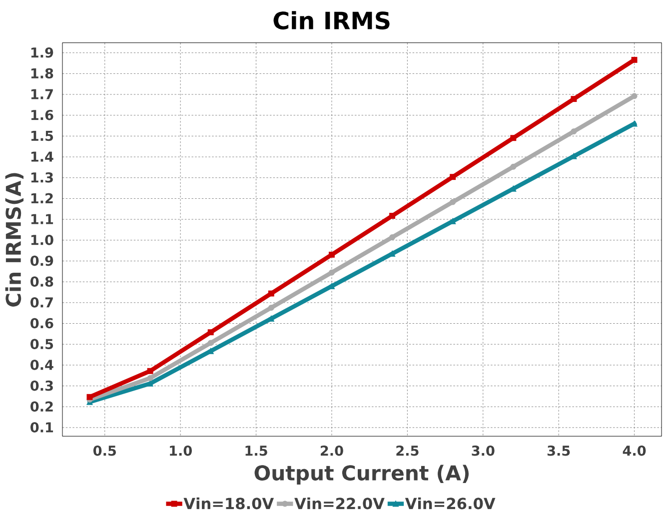
Electrical BOM

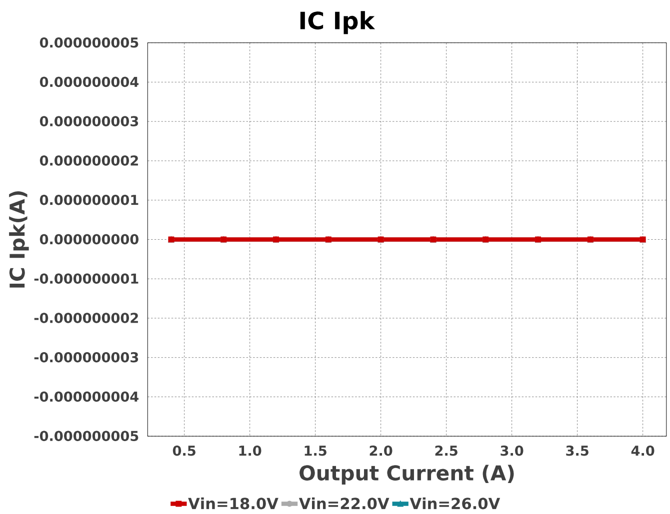
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cb	TDK	CGA4C2C0G1H103J060AA Series= C0G/NP0	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²
Cin	Panasonic	35SVPF82M Series= SVPF	Cap= 82.0 uF ESR= 20.0 mOhm VDC= 35.0 V IRMS= 4.0 A	1	$1.17	 CAPSMT_62_E12 106 mm²
Cinx	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
Cout	Panasonic	16SVPG270M Series= SVPG	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.97	 CAPSMT_62_C10 74 mm²
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	 DPAK 102 mm²

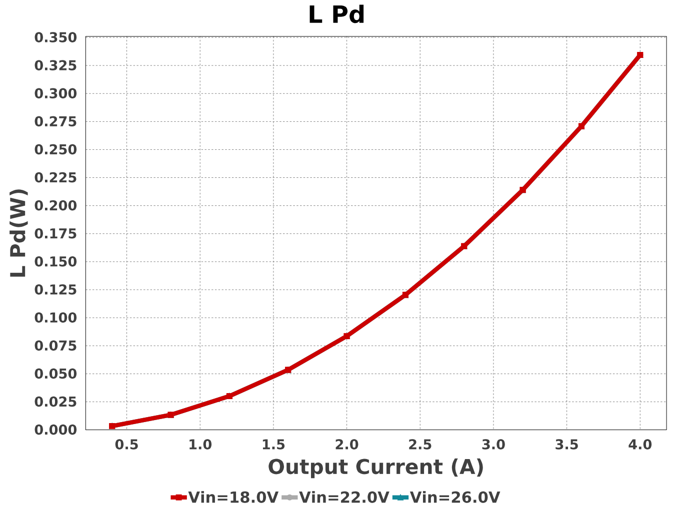
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Coilcraft	MSS1210-153MEB	L= 15.0 µH 19.0 mOhm	1	$0.81	 MSS1210 204 mm^2
U1	Texas Instruments	LM2677SX-5.0/NOPB	Switcher	1	$2.48	 TS7B 199 mm^2

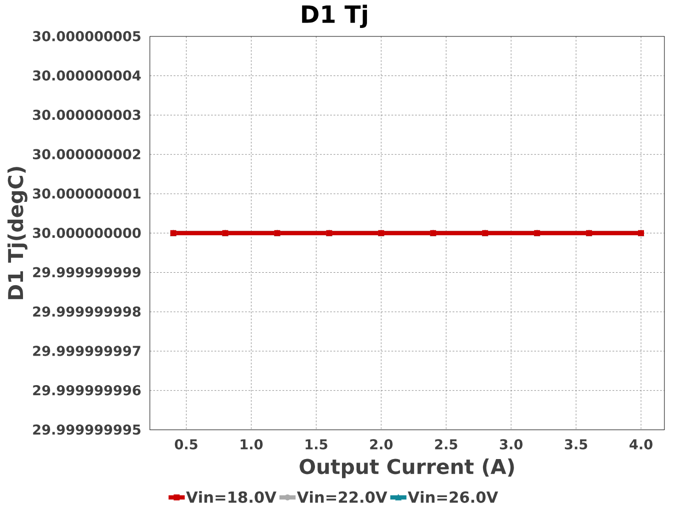


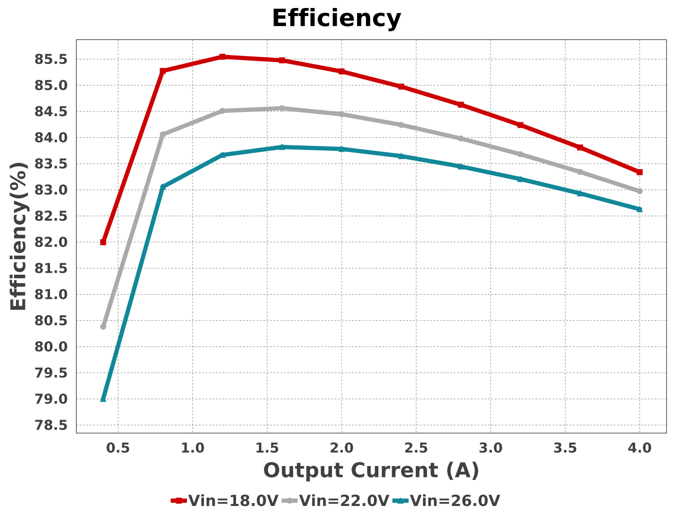


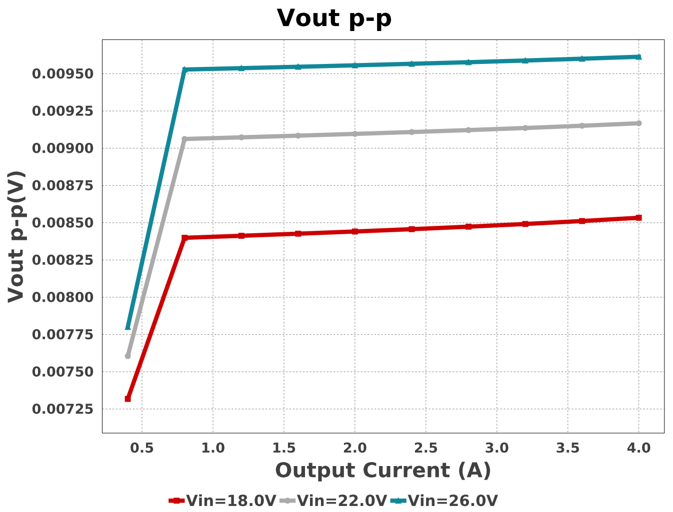


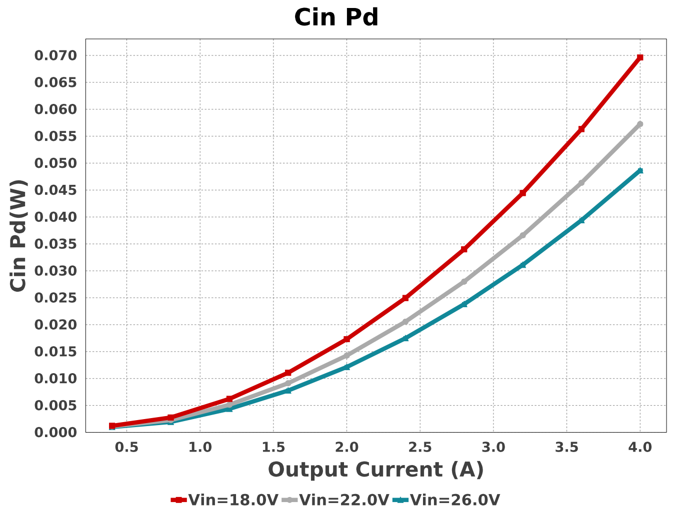


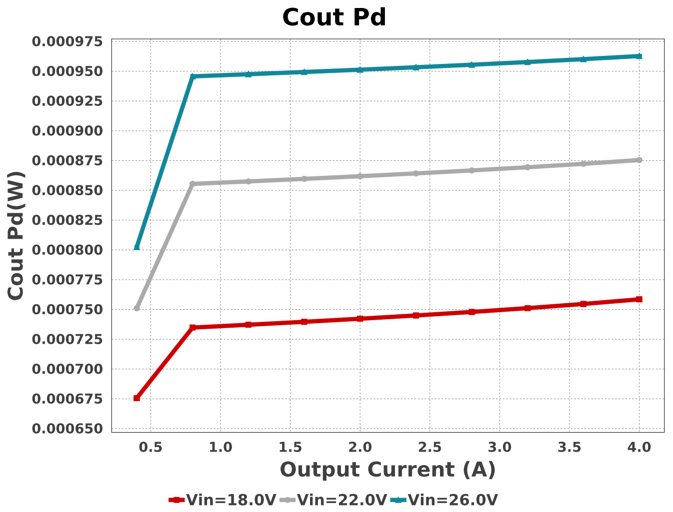

L Pd
L Pd(W)
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=22.0V Vin=26.0V


D1 Tj
D1 Tj(degC)
30.000000005
30.000000004
30.000000003
30.000000002
30.000000001
30.000000000
29.999999999
29.999999998
29.999999997
29.999999996
29.999999995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=22.0V Vin=26.0V

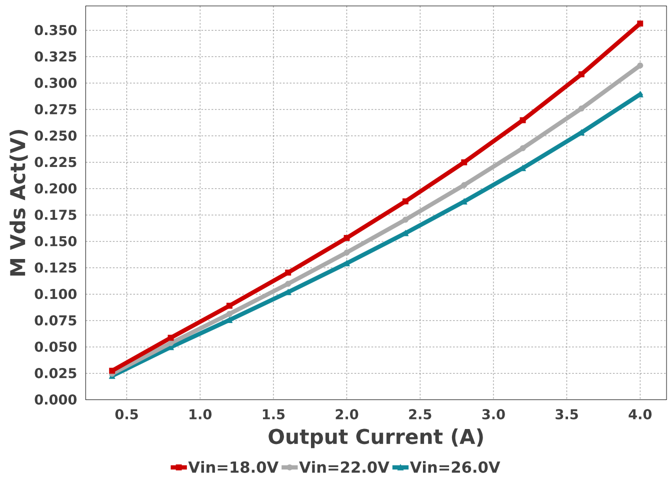

Efficiency
Efficiency(%)
85.5
85.0
84.5
84.0
83.5
83.0
82.5
82.0
81.5
81.0
80.5
80.0
79.5
79.0
78.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=22.0V Vin=26.0V


Vout p-p
Vout p-p(V)
0.00950
0.00925
0.00900
0.00875
0.00850
0.00825
0.00800
0.00775
0.00750
0.00725
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=22.0V Vin=26.0V

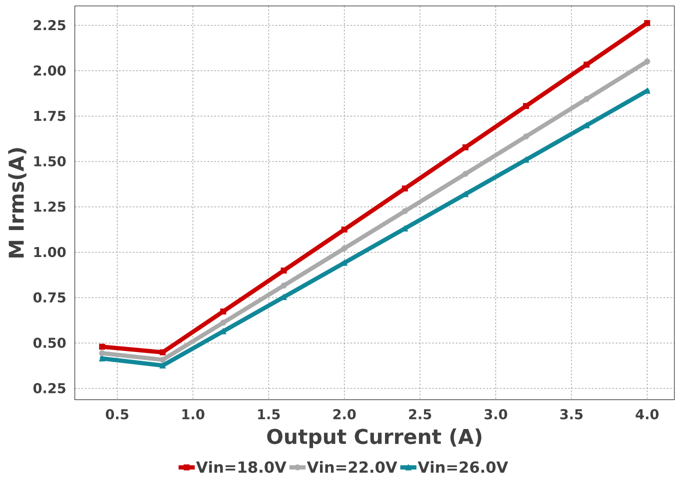

Cin Pd
Cin Pd(W)
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=22.0V Vin=26.0V


Cout Pd
Cout Pd(W)
0.000975
0.000950
0.000925
0.000900
0.000875
0.000850
0.000825
0.000800
0.000775
0.000750
0.000725
0.000700
0.000675
0.000650
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=22.0V Vin=26.0V

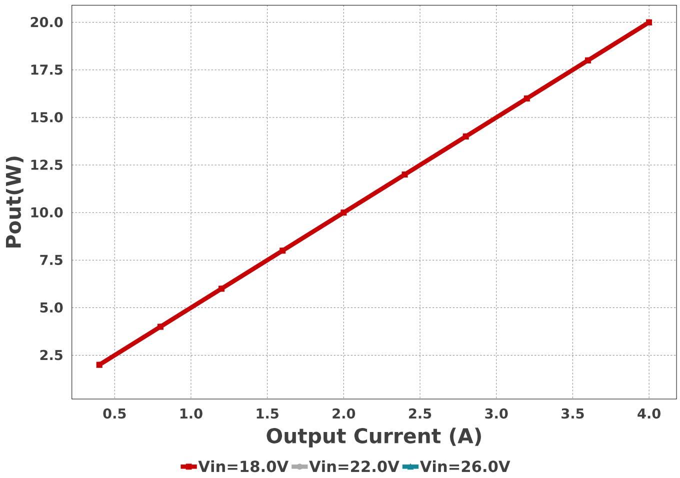
M Vds Act



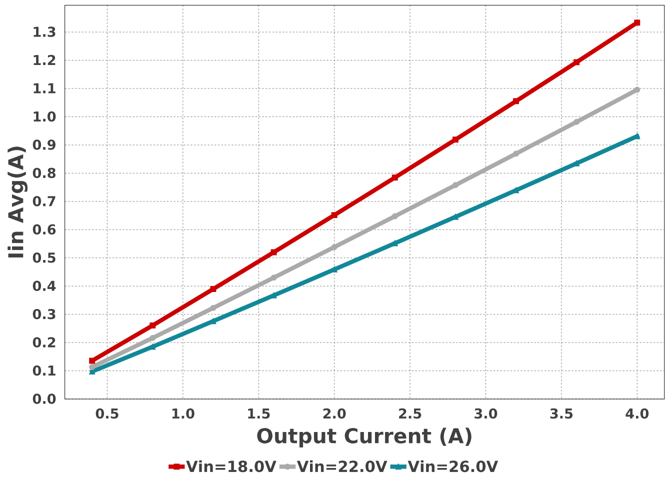
M Irms



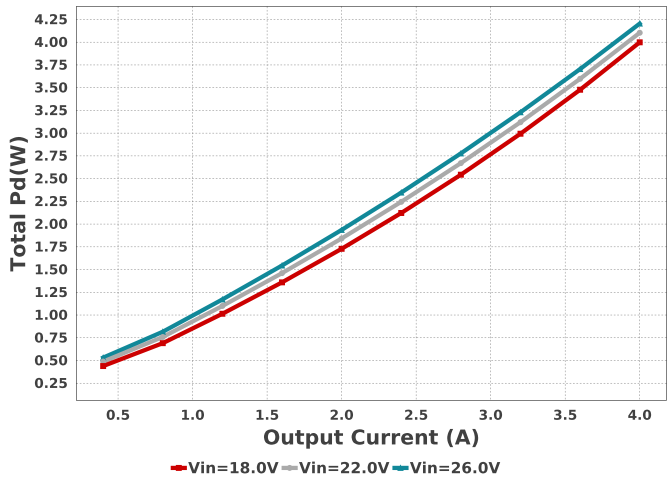
Pout



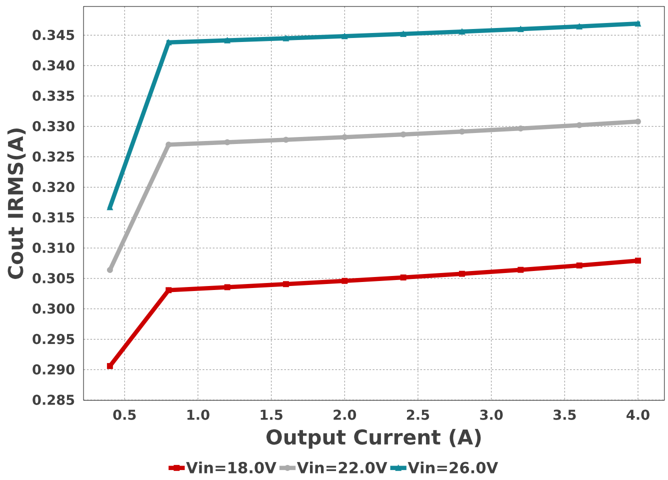
Iin Avg

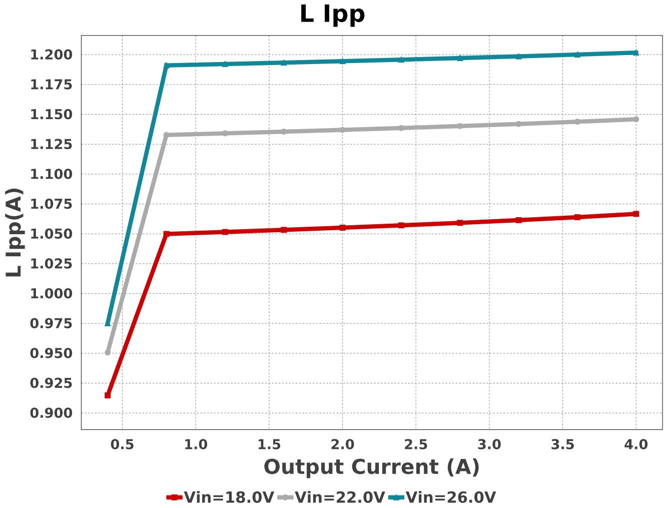


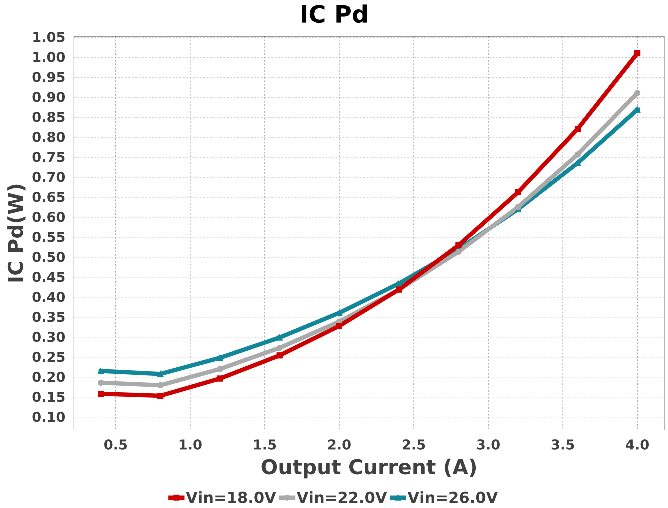
Total Pd

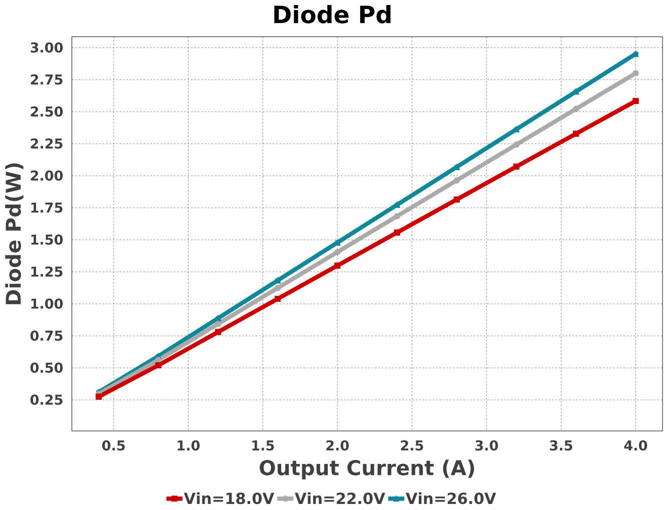


Cout IRMS









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.56 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	48.645 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	346.904 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	962.74 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	30.0 degC	Diode	D1 junction temperature
6.	Diode Pd	2.952 W	Diode	Diode power dissipation
7.	IC Ipk	0.0 A	IC	Peak switch current in IC
8.	IC Pd	868.77 mW	IC	IC power dissipation
9.	IC Tj	52.588 degC	IC	IC junction temperature
10.	IC Tolerance	100.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	26.0 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	930.95 mA	IC	Average input current
13.	L Ipp	1.202 A	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	334.4 mW	Inductor	Inductor power dissipation
15.	M Irms	1.89 A	Mosfet	MOSFET RMS ripple current
16.	M Vds Act	289.316 mV	Mosfet	Voltage drop across the MosFET
17.	Cin Pd	48.645 mW	Power	Input capacitor power dissipation
18.	Cout Pd	962.74 µW	Power	Output capacitor power dissipation
19.	Diode Pd	2.952 W	Power	Diode power dissipation
20.	IC Pd	868.77 mW	Power	IC power dissipation
21.	L Pd	334.4 mW	Power	Inductor power dissipation
22.	Total Pd	4.205 W	Power	Total Power Dissipation
23.	BOM Count	7	System Information	Total Design BOM count
24.	Cross Freq	20.022 kHz	System Information	Bode plot crossover frequency
25.	Duty Cycle	22.318 %	System Information	Duty cycle
26.	Efficiency	82.629 %	System Information	Steady state efficiency
27.	FootPrint	699.0 mm^2	System Information	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
28.	Frequency	260.0 kHz	System Information	Switching frequency
29.	Iout	4.0 A	System Information	Iout operating point
30.	Mode	CCM	System Information	Conduction Mode
31.	Phase Marg	57.264 deg	System Information	Bode Plot Phase Margin
32.	Pout	20.0 W	System Information	Total output power
33.	Total BOM	$5.68	System Information	Total BOM Cost
34.	Vin	26.0 V	System Information	Vin operating point
35.	Vout	5.0 V	System Information	Operational Output Voltage
36.	Vout Tolerance	2.0 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	9.614 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	4.0	Maximum Output Current
VinMax	26.0	Maximum input voltage
VinMin	18.0	Minimum input voltage
VinTyp	24.0	Typical input voltage
Vout	5.0	Output Voltage
base_pn	LM2677	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

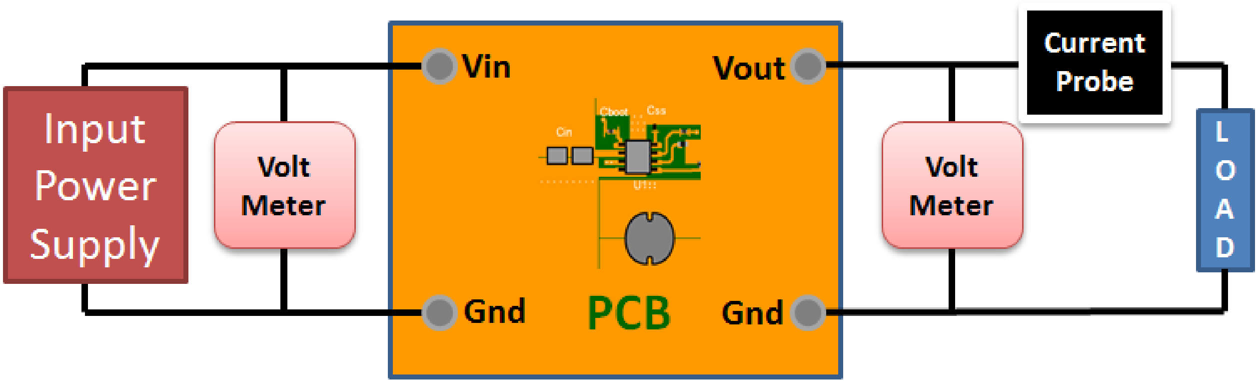
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 18.0V 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 : 732D8BBDAA91D1AD[v1]

2. **LM2677** Product Folder : http://www.ti.com/product/LM2677 : contains the data sheet and other resources.