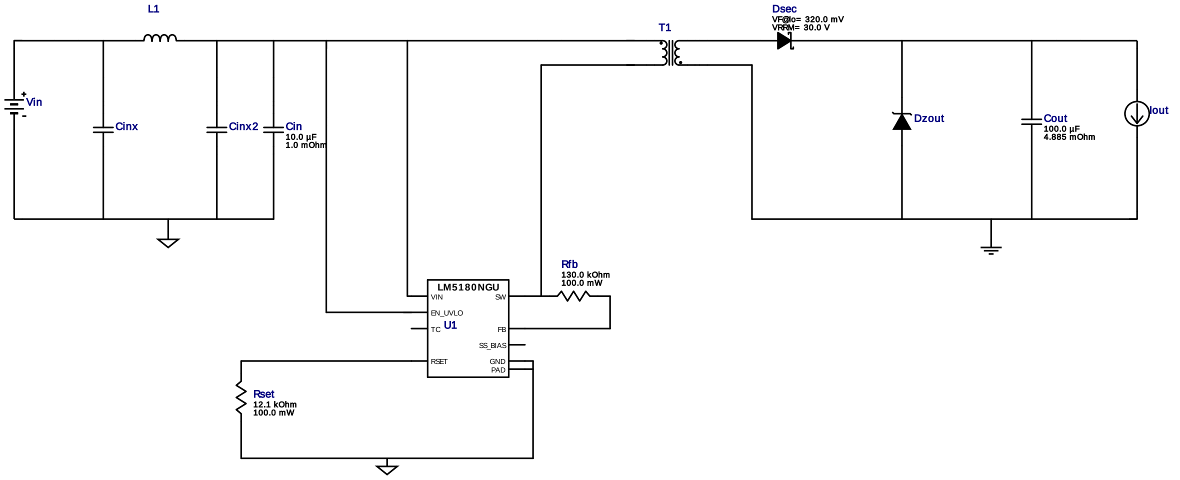
VinMin = 5.0V
VinMax = 5.0V
Vout = 5.0V
Iout = 0.45A

Device = LM5180NGUR
Topology = Flyback
Created = 2019-08-29 02:24:36.418
BOM Cost = $4.65
BOM Count = 8
Total Pd =

WEBENCH ® Design Report

Design : 709 LM5180NGUR
LM5180NGUR 5V-5V to 5.00V @ 0.45A



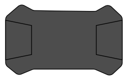
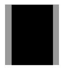
Design Alerts

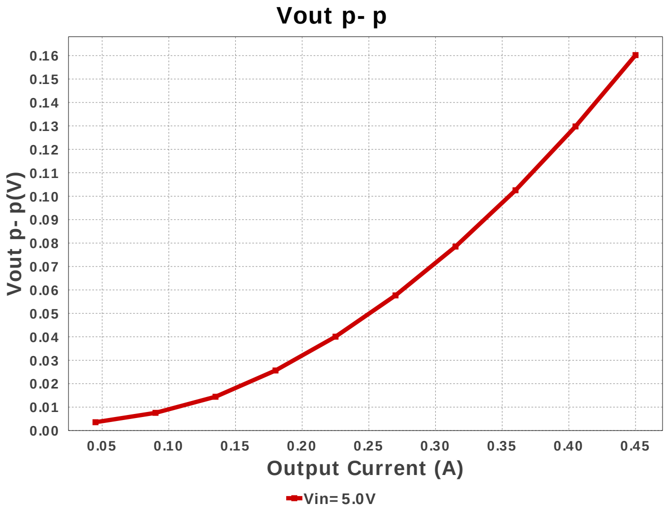
Component Selection Information

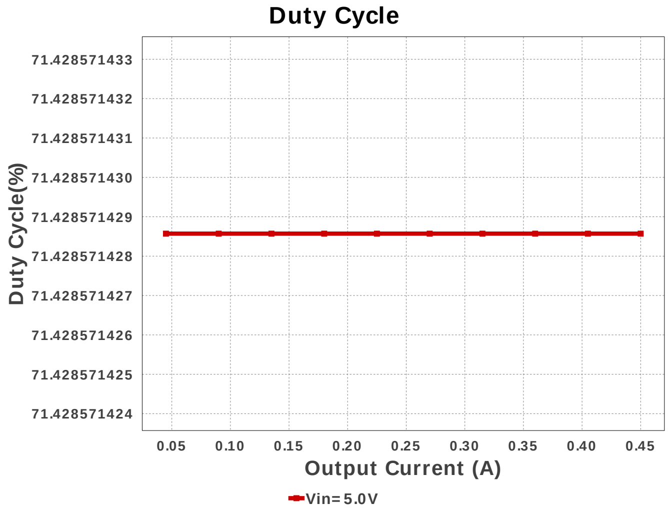
Click on the transformer symbol in the schematic and select "Explore Transformer Core/Bobbin Selection" to design using specific transformer cores and bobbin.

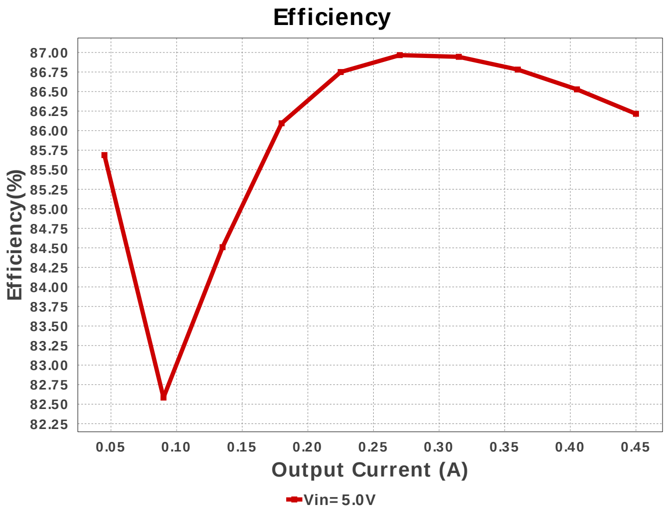
Electrical BOM

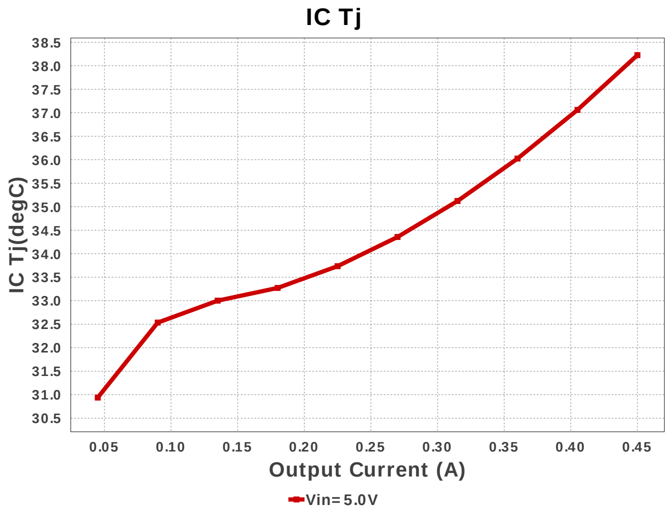
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	TDK	C3216X5R1H106K160AB Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.9 A	1	$0.30	1206_180 11 mm²
Cout	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	1	$0.34	1206_190 11 mm²
Dsec	Toshiba	CMS06	VF@Io= 320.0 mV VRRM= 30.0 V	1	$0.19	M-FLAT 19 mm²
Dzout	ON Semiconductor	1SMB5919BT3G	Zener	1	$0.09	SMB 44 mm²
Rfb	Susumu Co Ltd	RG1608P-134-B-T5 Series= RG1608	Res= 130.0 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	0603 5 mm²
Rset	Susumu Co Ltd	RG1608P-1212-B-T5 Series= RG1608	Res= 12.1 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	0603 5 mm²

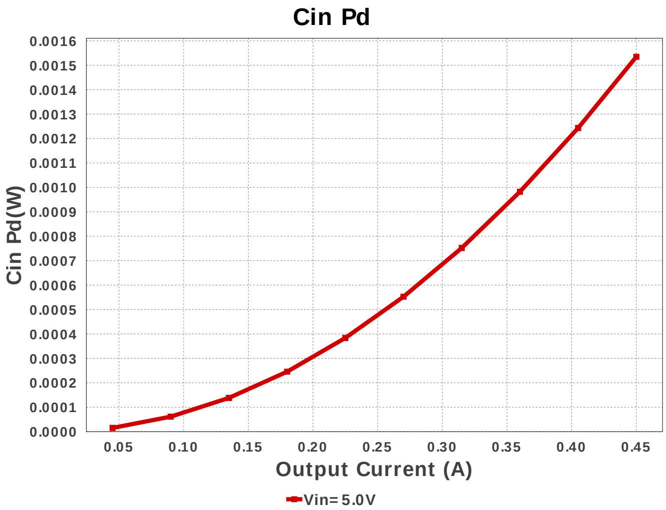
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
T1	Core=TDK , CoilFormer=TDK	Core=B65805J0000R049 , CoilFormer=B65822F1008T001	Lp= 35.0 µH Turns Ratio(Nps)= 10:4 Npri= 10.0 Nsec= 4.0	1	$0.71	 TDK_B65803 146 mm²
U1	Texas Instruments	LM5180NGUR	Switcher	1	$2.90	 0 mm²

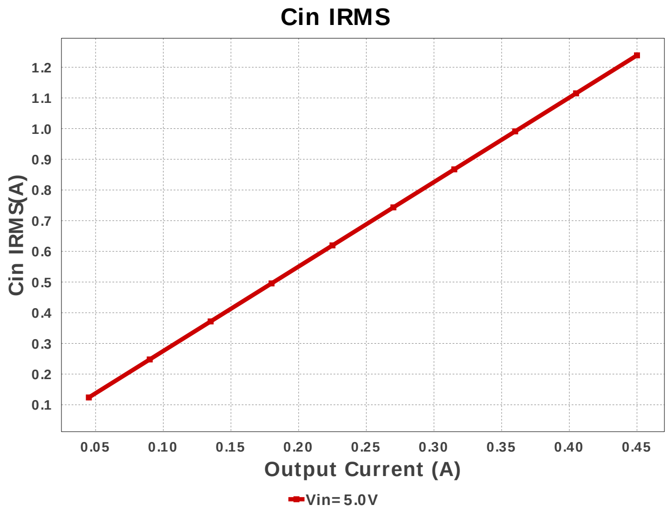


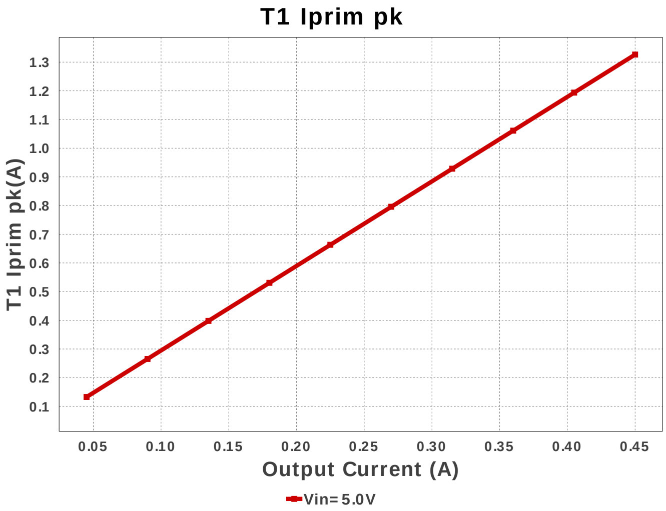


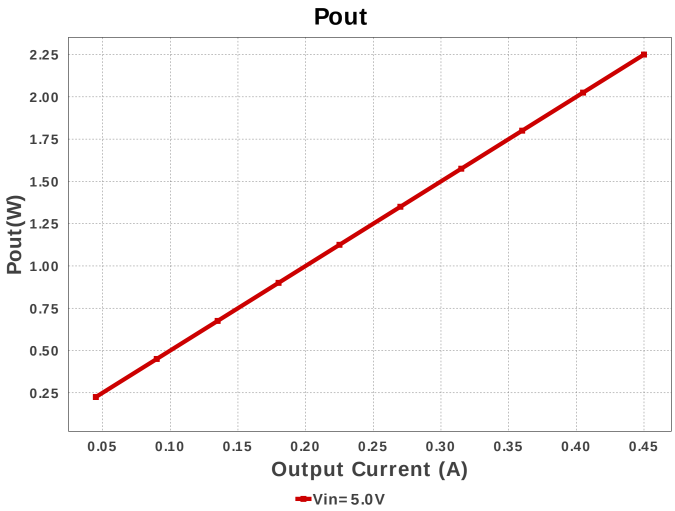


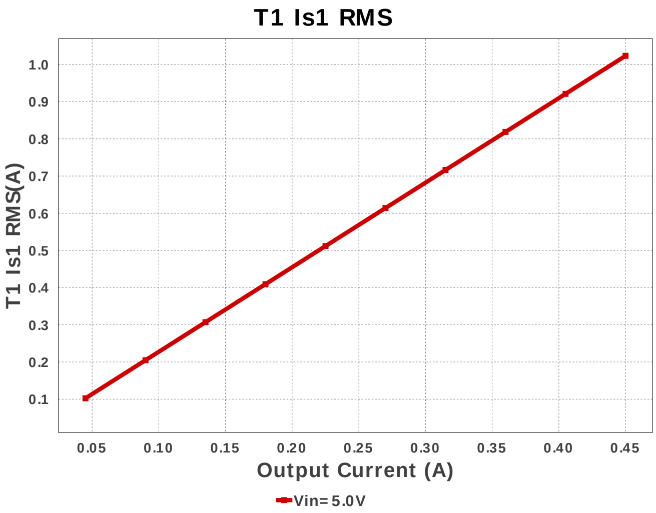


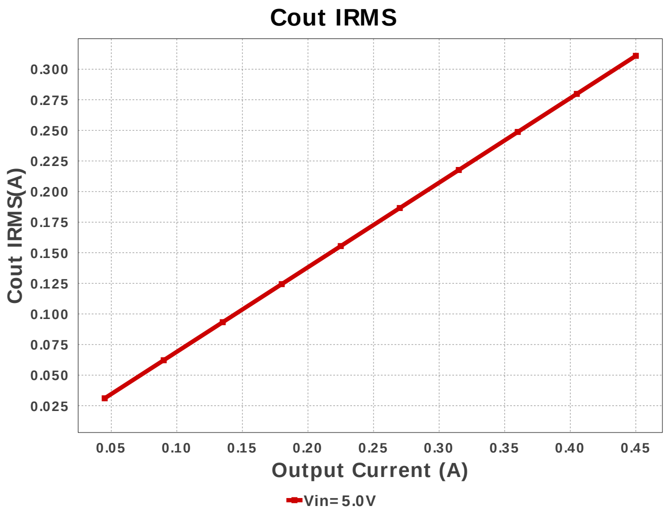


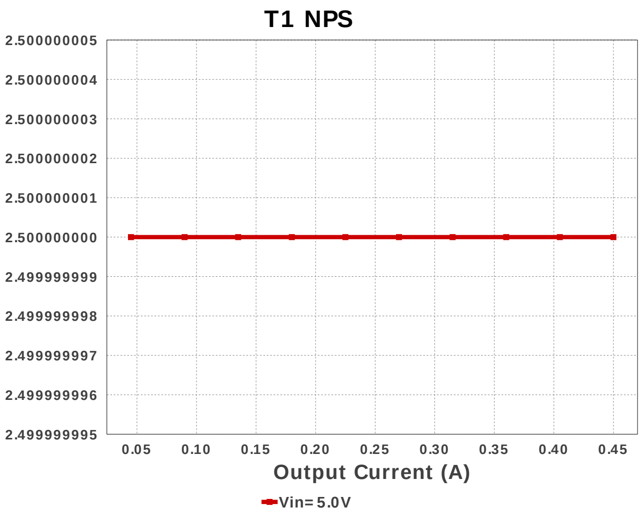


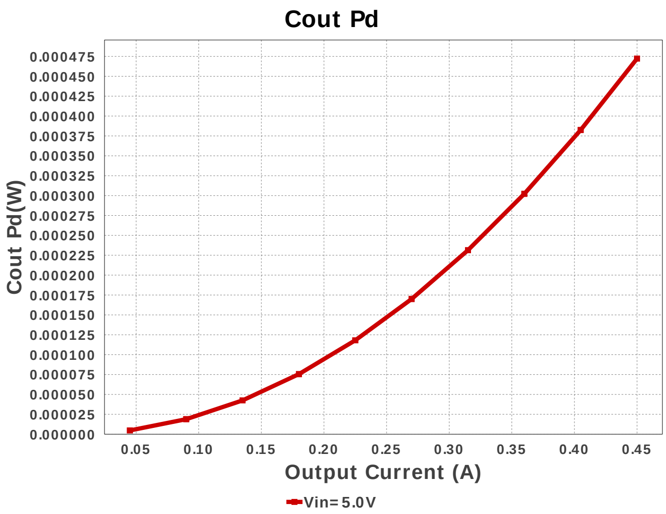

T1 Iprim pk
T1 Iprim pk(A)
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Output Current (A)
Vin= 5.0V

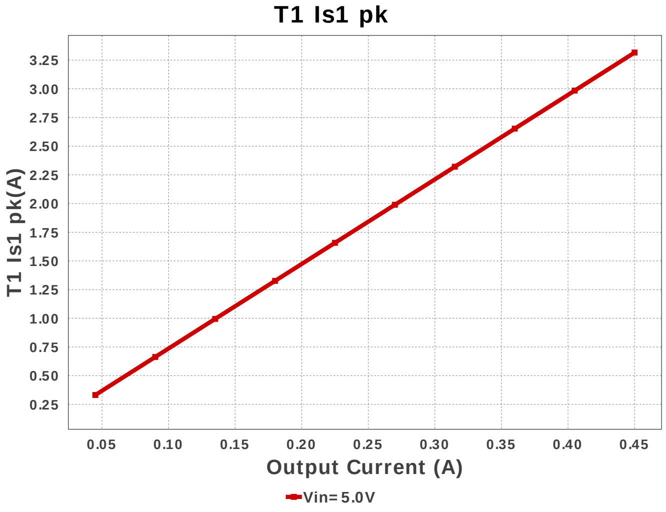

Pout
Pout(W)
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Output Current (A)
Vin= 5.0V

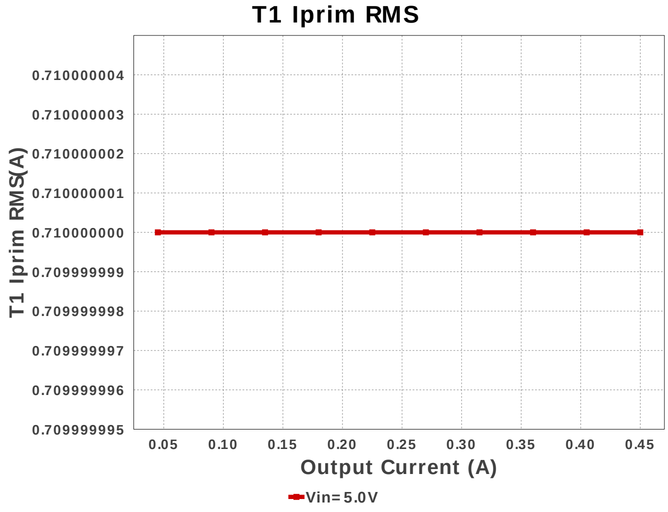

T1 Is1 RMS
T1 Is1 RMS(A)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Output Current (A)
Vin= 5.0V

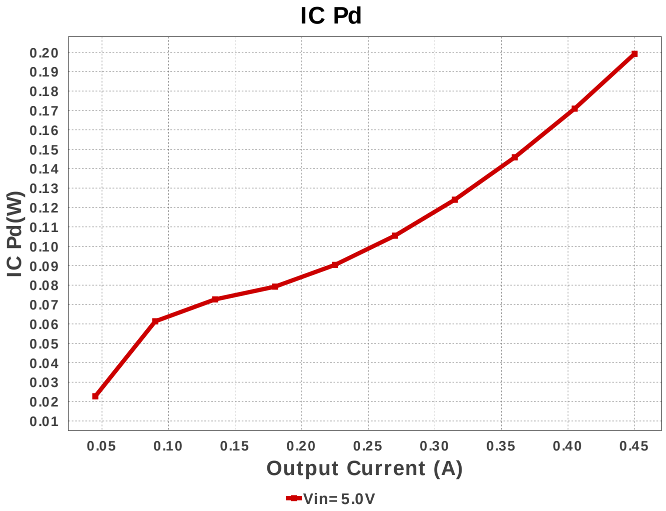

Cout IRMS
Cout IRMS(A)
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Output Current (A)
Vin= 5.0V

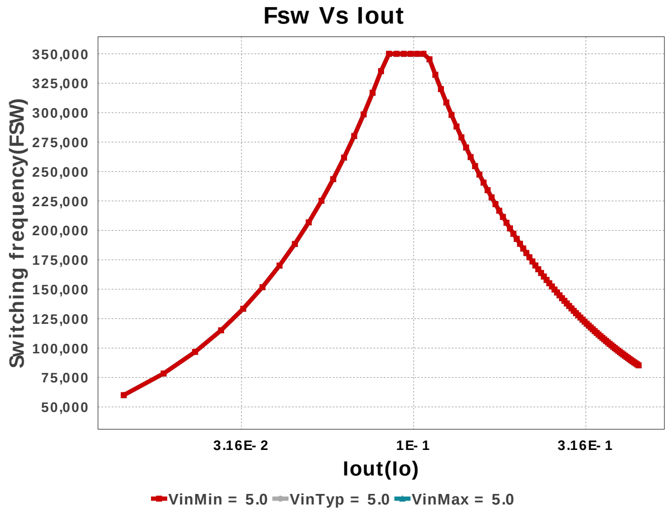

T1 NPS
T1 NPS
2.500000005
2.500000004
2.500000003
2.500000002
2.500000001
2.500000000
2.499999999
2.499999998
2.499999997
2.499999996
2.499999995
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Output Current (A)
Vin= 5.0V


Cout Pd
Cout Pd(W)
0.000475
0.000450
0.000425
0.000400
0.000375
0.000350
0.000325
0.000300
0.000275
0.000250
0.000225
0.000200
0.000175
0.000150
0.000125
0.000100
0.000075
0.000050
0.000025
0.000000
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45
Output Current (A)
Vin= 5.0V









Operating Values

#	Name	Value	Category	Description
1.	T1 NPS	2.5		Transformer primary to secondary turns ratio
2.	Cin IRMS	1.239 A	Capacitor	Input capacitor RMS ripple current
3.	Cin Pd	1.535 mW	Capacitor	Input capacitor power dissipation
4.	Cout IRMS	310.916 mA	Capacitor	Output capacitor RMS ripple current
5.	Cout Pd	472.23 µW	Capacitor	Output capacitor power dissipation
6.	T1 Iprim RMS	709.636 mA	Current	Transformer Primary RMS Current
7.	T1 Iprim pk	1.326 A	Current	Transformer Primary Peak Current
8.	T1 Is1 RMS	1.023 A	Current	Transformer Secondary1 RMS Current
9.	T1 Is1 pk	3.316 A	Current	Transformer Secondary1 Peak Current
10.	IC Pd	198.85 mW	IC	IC power dissipation
11.	IC Tj	38.212 degC	IC	IC junction temperature
12.	ICThetaJA	41.3 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Cin Pd	1.535 mW	Power	Input capacitor power dissipation
14.	Cout Pd	472.23 µW	Power	Output capacitor power dissipation
15.	IC Pd	198.85 mW	Power	IC power dissipation
16.	BOM Count	8	System Information	Total Design BOM count
17.	Duty Cycle	71.429 %	System Information	Duty cycle
18.	Efficiency	80.907 %	System Information	Steady state efficiency
19.	FootPrint	266.0 mm^2	System Information	Total Foot Print Area of BOM components
20.	Frequency	86.41 kHz	System Information	Switching frequency
21.	Iout	450.0 mA	System Information	Iout operating point
22.	Mode	DCM/BCM	System Information	Conduction Mode
23.	Pout	2.25 W	System Information	Total output power

#	Name	Value	Category	Description
24.	Total BOM	$4.65	System Information	Total BOM Cost
25.	Vin	5.0 V	System Information	Vin operating point
26.	Vout	5.0 V	System Information	Operational Output Voltage
27.	Vout Tolerance	500.0 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
28.	Vout p-p	157.021 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	450.0 m	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LM5180	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

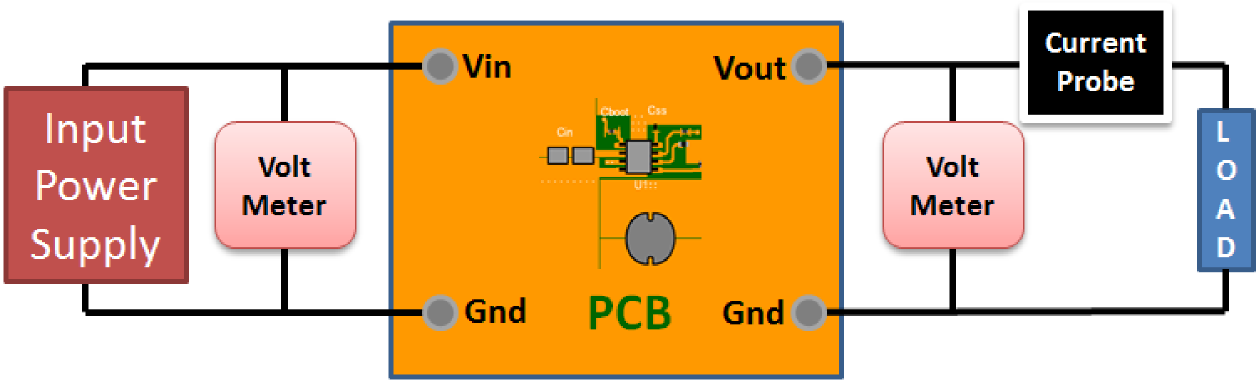
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 5.0V 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.



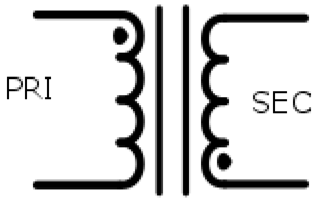
WEBENCH® Transformer Report

#	Name	Value
1.	Core Part Number	B65805J0000R049
2.	Core Manufacturer	TDK
3.	Coil Former Part Number	B65822F1008T001
4.	Coil Former Manufacturer	TDK

Transformer Electrical Diagram

Primary

Turns	10.0
AWG	30.0
Layers	2.0
Strands	3.0
Insulation Type	Heavy Insulated Magnet Wire



Secondary

Turns	4.0
AWG	30.0
Layers	1.0
Strands	2.0
Insulation Type	Triple Insulated

Transformer Construction Diagram

TRANSFORMER WINDING DIAGRAM – COMING SOON

Winding Instruction

Winding	AWG	Turns	Winding Orientation
Primary First 1/2.0	30.0	5	Clockwise
Triple Insulated Secondary	30.0	4.0	Counter Clockwise
Primary Second 1/2.0	30.0	5	Clockwise

Transformer Parameters

#	Name	Value
1.	Lpri	3.5E-5H
2.	Inductance Factor(Al)	350.0nH
3.	Npri	10.0
4.	Nsec	4.0
5.	Core Type	RM5
6.	Core Material	N49
7.	Bmax	0.18T
8.	Switching Frequency	90.28kHz
9.	DMax	0.77
10.	Ipk(Primary)	1.22A
11.	Irms(Primary)	0.71A
12.	Ipk(Secondary)	3.06A
13.	Irms(Secondary)	0.84A

Design Assistance

1. The LM5180 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application

2. Master key : B8DDFD84F2E15CCF[v1]

3. **LM5180** Product Folder : http://www.ti.com/product/LM5180 : contains the data sheet and other resources.