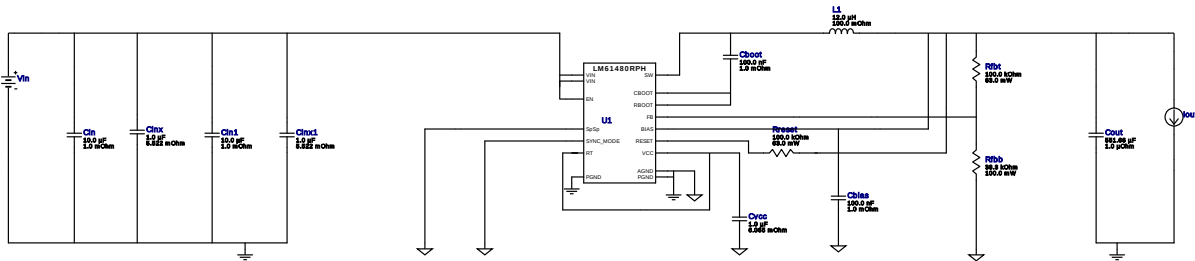


WEBENCH® Design Report

Design : 10 LM61480RPHR
LM61480RPHR 9V-36V to 3.60V @ 1A



Design Alerts

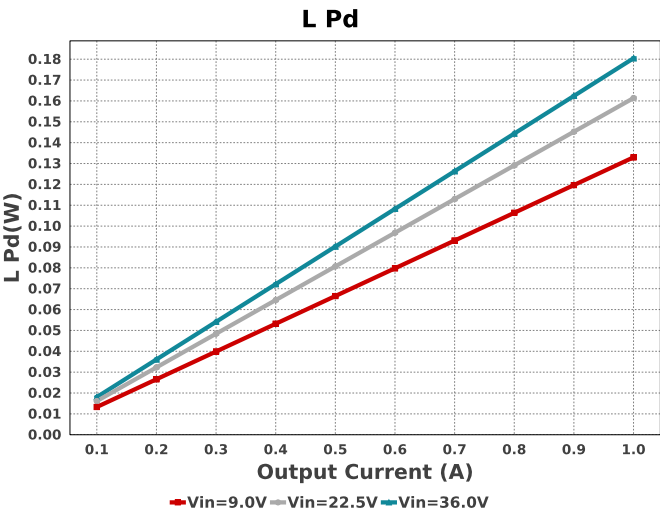
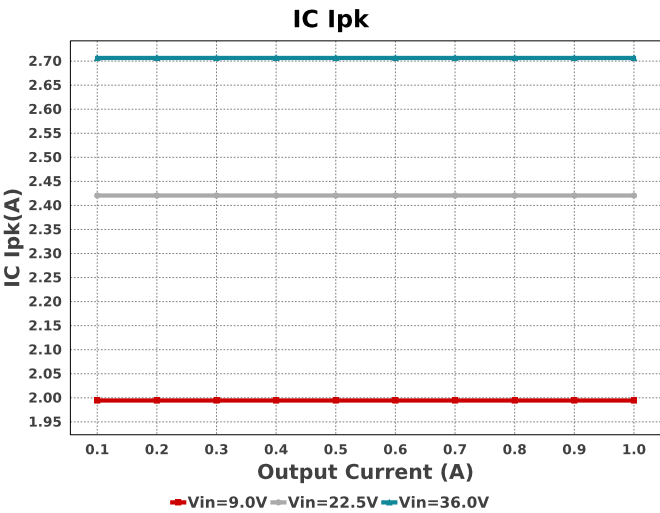
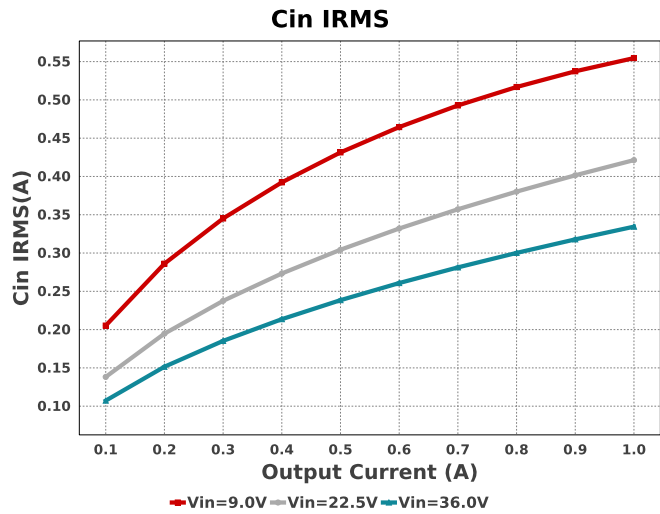
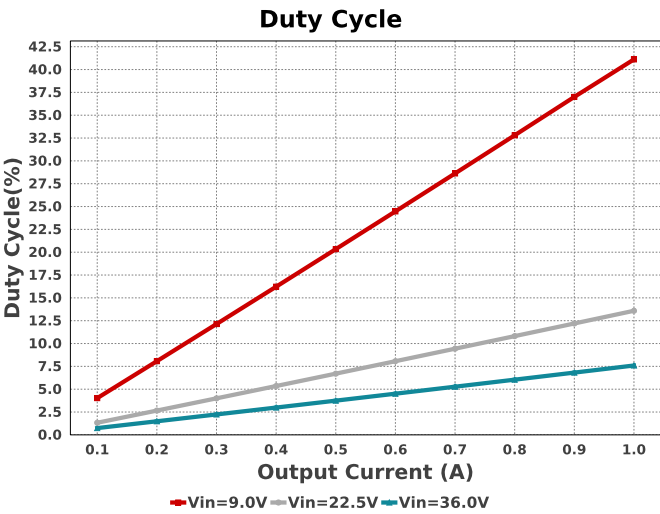
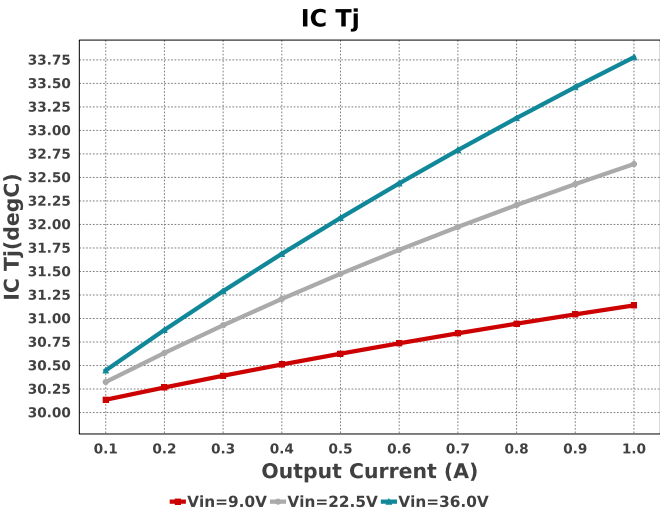
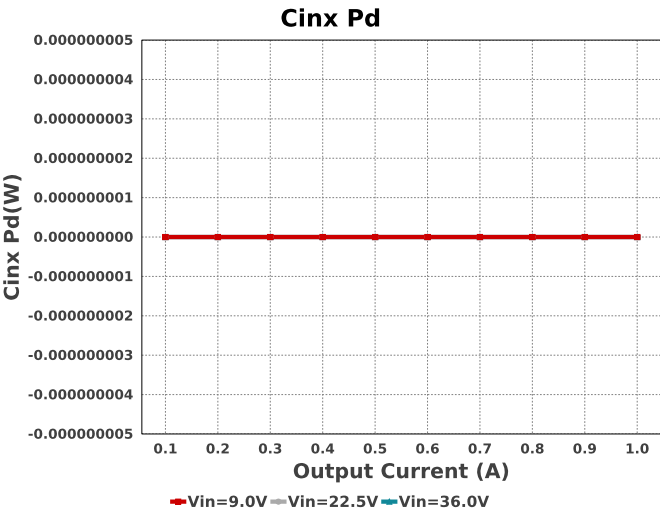
Component Selection Information

This device can work in steady state at Vin = 3V. However, needs a minimum of 3.6V during start up. See datasheet for details.

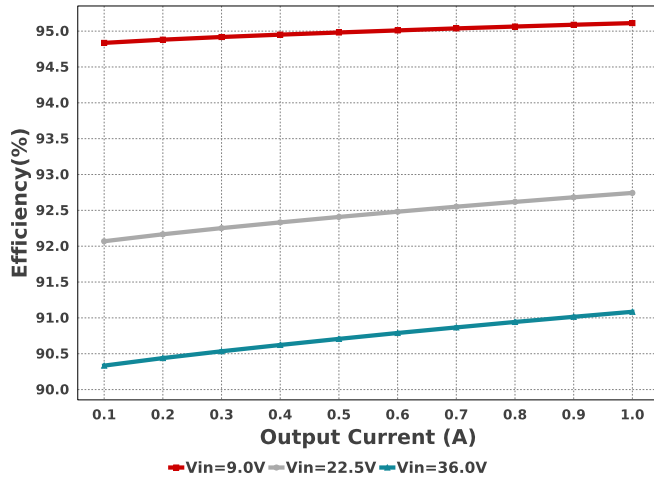
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbias	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Cin	MuRata	GRM32ER71H106KA12L Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 6.0 A	1	\$0.47	1210_270 15 mm ²
Cin1	MuRata	GRM32ER71H106KA12L Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 6.0 A	1	\$0.47	1210_270 15 mm ²
Cinx	TDK	C1608X5R1H105K080AB Series= X5R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 50.0 V IRMS= 2.2162 A	1	\$0.03	0603 5 mm ²
Cinx1	TDK	C1608X5R1H105K080AB Series= X5R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 50.0 V IRMS= 2.2162 A	1	\$0.03	0603 5 mm ²
Cout	CUSTOM	CUSTOM Series= ?	Cap= 551.66 uF ESR= 1.0 uOhm VDC= 5.4 V IRMS= 1.28123 A	1	NA	CUSTOM 0 mm ²
Cvcc	MuRata	GRM188R60J105KA01D Series= X5R	Cap= 1.0 uF ESR= 6.065 mOhm VDC= 6.3 V IRMS= 1.36934 A	1	\$0.01	0603 5 mm ²
L1	NIC Components	NPI54C120MTRF	L= 12.0 uH 100.0 mOhm	1	\$0.09	IND_NPI54C 61 mm ²
Rfbb	Vishay-Dale	CRCW060338K3FKEA Series= CRCW..e3	Res= 38.3 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²

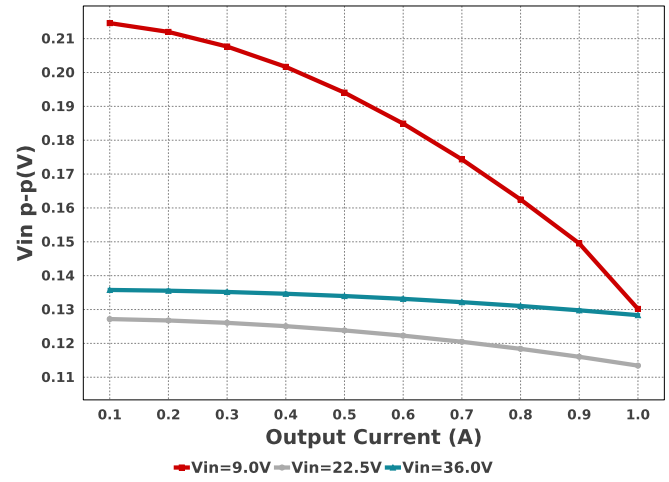
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rreset	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
U1	Texas Instruments	LM61480RPHR	Switcher	1	\$1.81	RPH0016A 25 mm ²



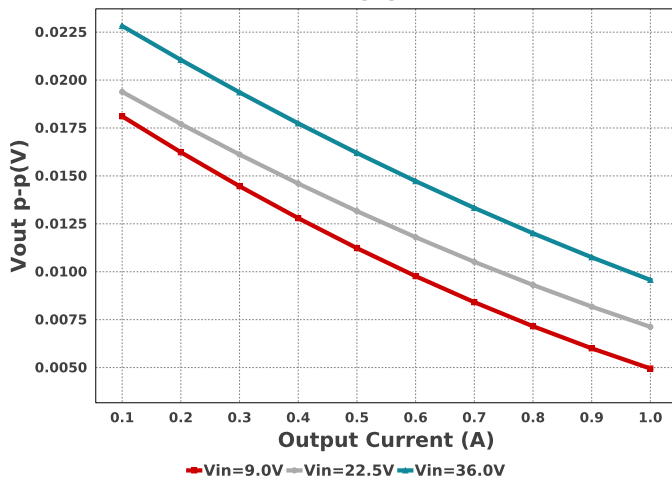
Efficiency



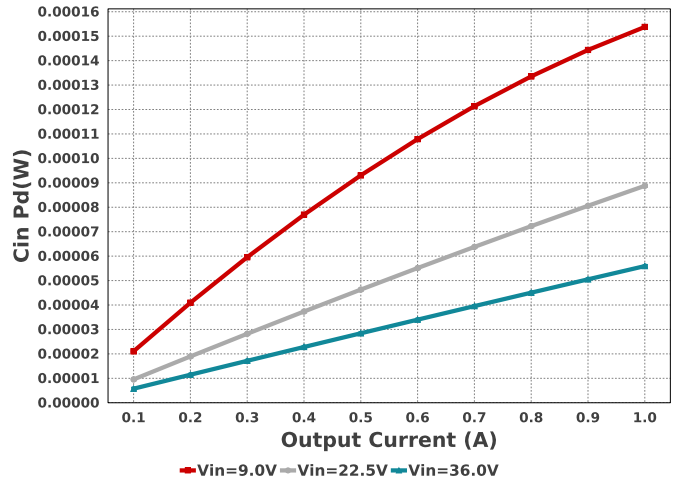
Vin p-p



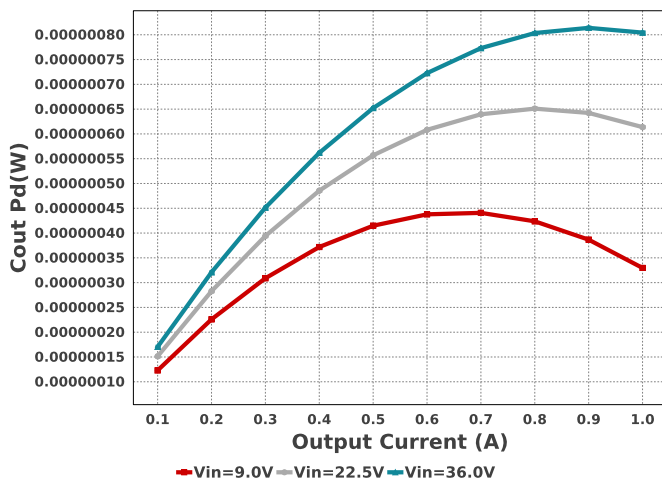
Vout p-p



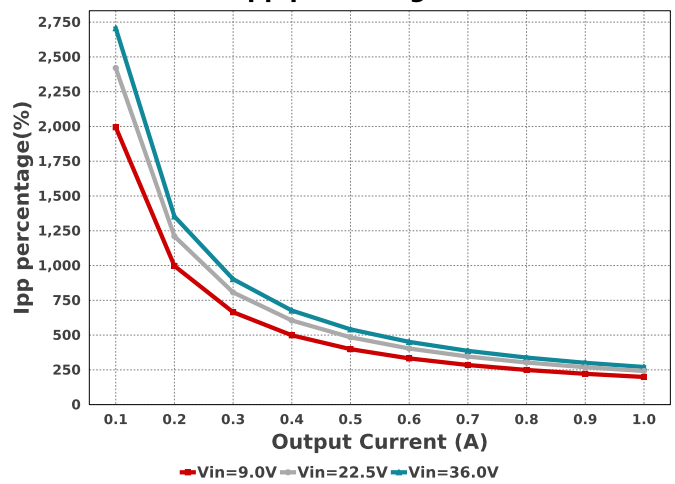
Cin Pd

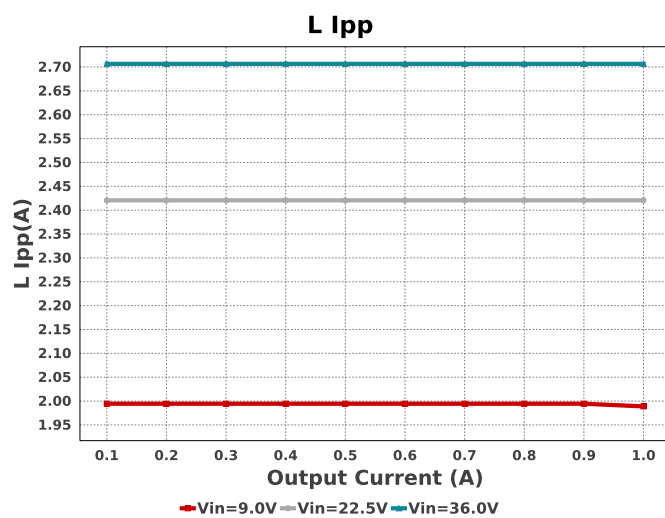
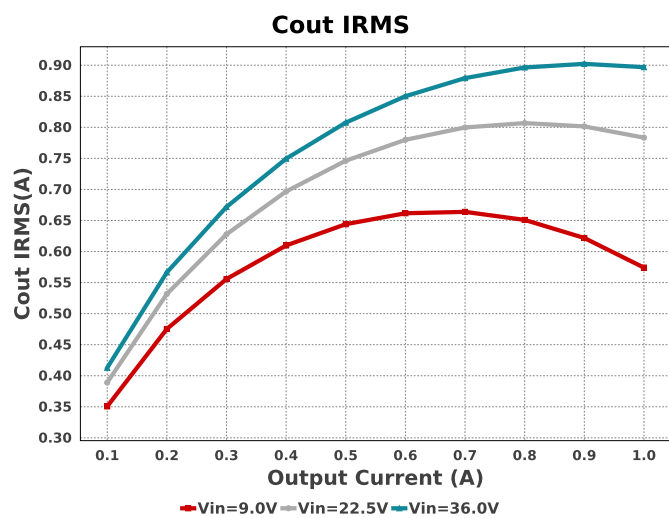
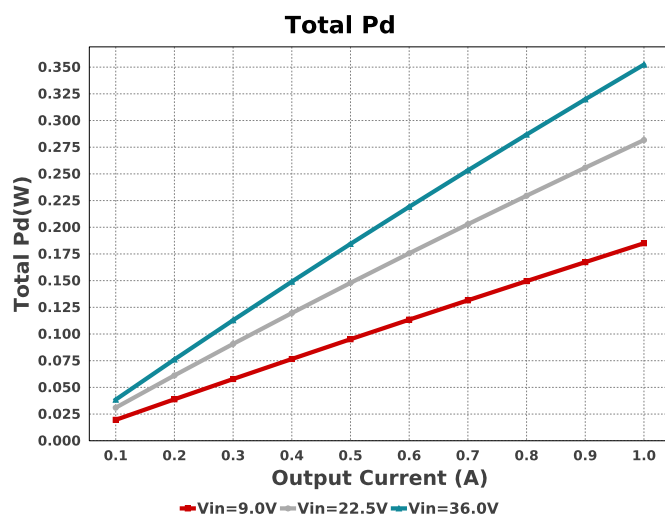
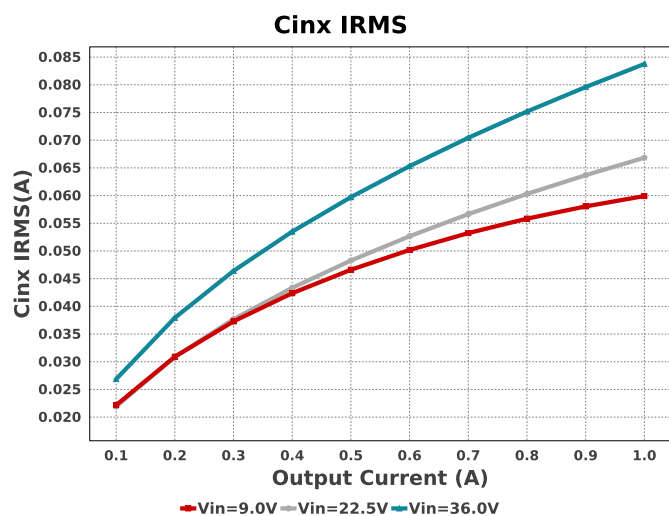
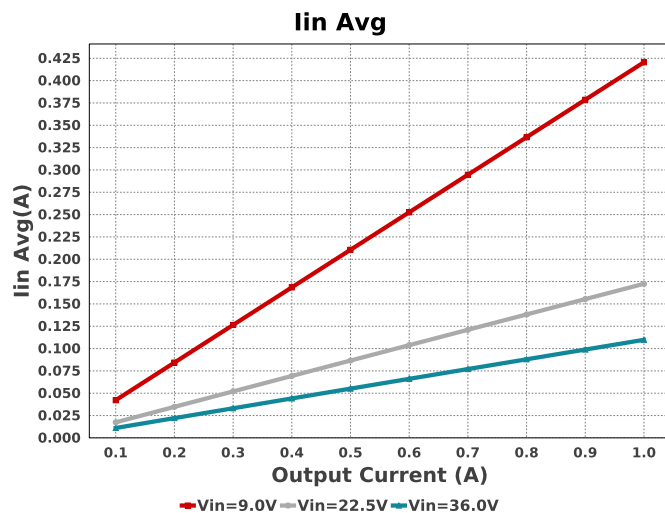
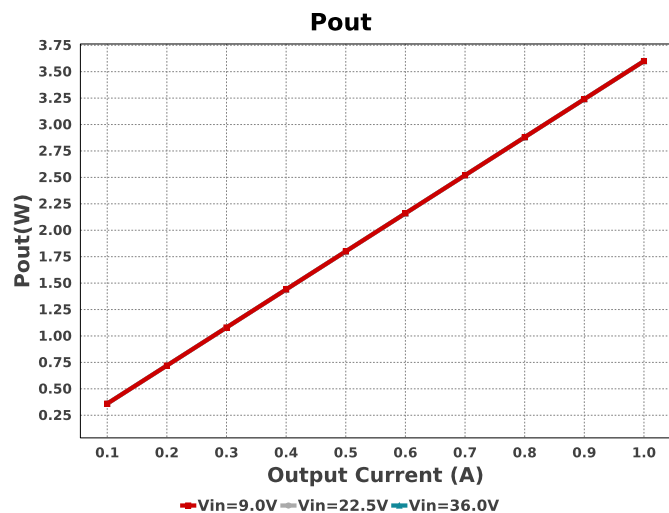


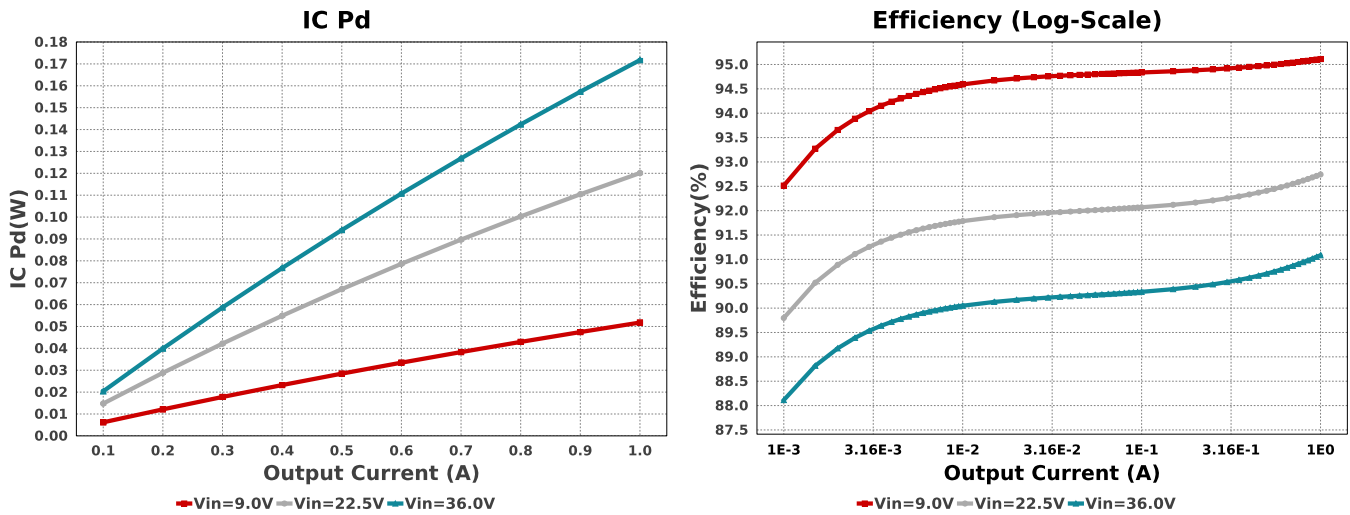
Cout Pd



Ipp percentage







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	334.432 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	55.922 μ W	Capacitor	Input capacitor power dissipation
3.	Cinx IRMS	83.761 mA	Capacitor	Bulk capacitor RMS ripple current
4.	Cinx Pd	0.0 W	Capacitor	Bulk capacitor power dissipation
5.	Cout IRMS	896.863 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	804.36 nW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	2.707 A	IC	Peak switch current in IC
8.	IC Pd	171.75 mW	IC	IC power dissipation
9.	IC Tj	33.779 degC	IC	IC junction temperature
10.	ICThetaJA Effective	22.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
11.	Iin Avg	109.79 mA	IC	Average input current
12.	Ipp percentage	270.654 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
13.	L Ipp	2.706 A	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	180.44 mW	Inductor	Inductor power dissipation
15.	Cin Pd	55.922 μ W	Power	Input capacitor power dissipation
16.	Cinx Pd	0.0 W	Power	Bulk capacitor power dissipation
17.	Cout Pd	804.36 nW	Power	Output capacitor power dissipation
18.	IC Pd	171.75 mW	Power	IC power dissipation
19.	L Pd	180.44 mW	Power	Inductor power dissipation
20.	Total Pd	352.36 mW	Power	Total Power Dissipation
21.	BOM Count	13	System	Total Design BOM count
22.	Duty Cycle	7.595 %	System	Duty cycle
23.	Efficiency	91.085 %	System	Steady state efficiency
24.	FootPrint	186.0 mm ²	System	Total Foot Print Area of BOM components
25.	Frequency	75.53 kHz	System	Switching frequency
26.	Iout	1.0 A	System	Iout operating point
27.	Mode	PFM	System	Conduction Mode
28.	Pout	3.6 W	System	Total output power
29.	Total BOM	NA	System	Total BOM Cost
30.	Vin	36.0 V	System	Vin operating point
31.	Vin p-p	128.336 mV	System	Peak-to-peak input voltage
32.	Vout	3.6 V	System	Operational Output Voltage
33.	Vout Actual	3.611 V	System	Vout Actual calculated based on selected voltage divider resistors
34.	Vout Tolerance	2.475 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
35.	Vout p-p	9.544 mV	System	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	36.0	Maximum input voltage
VinMin	9.0	Minimum input voltage
VinTyp	14.0	Typical input voltage
Vout	3.6	Output Voltage
base_pn	LM61480	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 C_{in} and C_{out} , 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

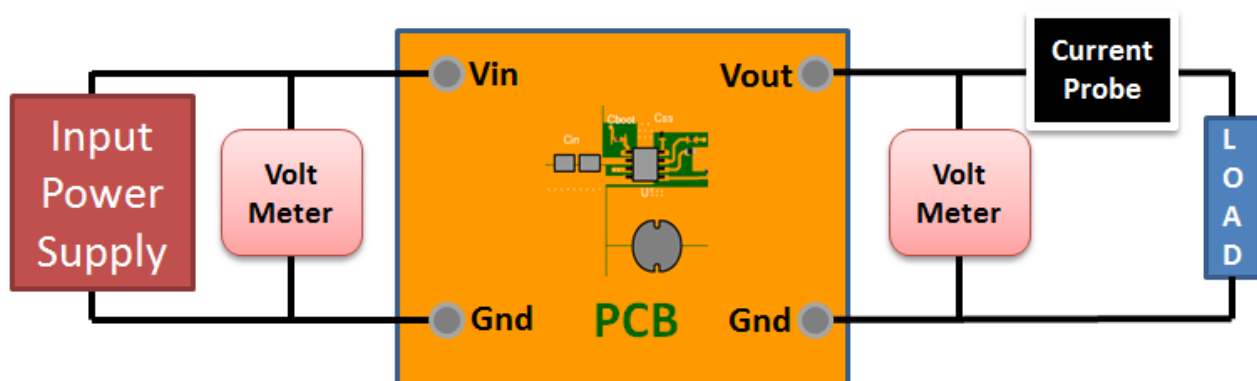
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down 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 9.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} 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 V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} 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. The LM61480 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. This device can work in steady state at $V_{in} = 3V$. However, needs a minimum of 3.6V during start up. See datasheet for details 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 : E8A119AE42F0E3FD181D45ED1F5A0C7F[v1]
3. **LM61480** Product Folder : <http://www.ti.com/product/LM61480> : contains the data sheet and other resources.

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