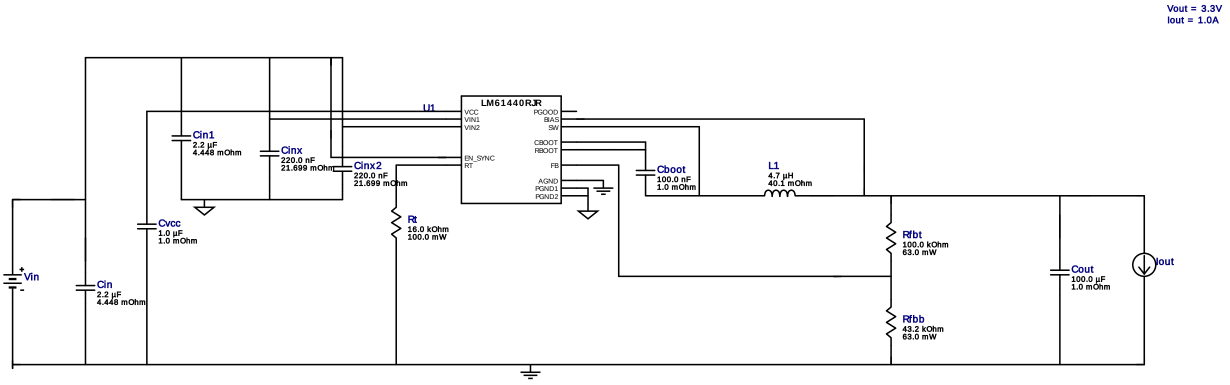
VinMin = 18.0V
VinMax = 32.0V
Vout = 3.3V
Iout = 1.0A

Device = LM61440AANRJRR
Topology = Buck
Created = 2021-01-28 21:14:58.188
BOM Cost = $2.90
BOM Count = 12
Total Pd = 0.75W

WEBENCH ® Design Report

Design : 6781 LM61440AANRJRR
LM61440AANRJRR 18V-32V to 3.30V @ 1A

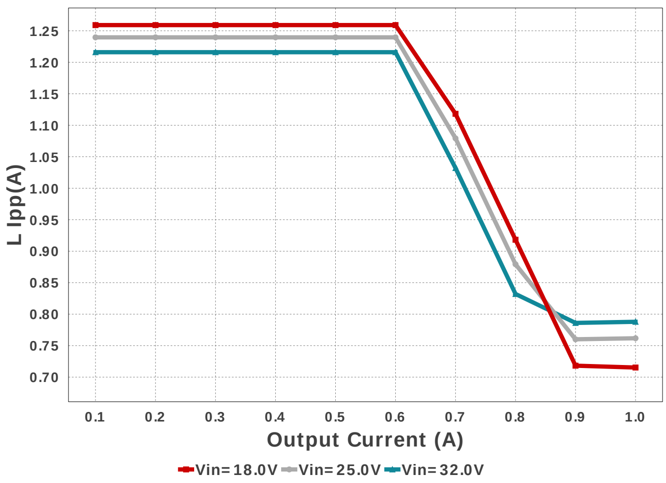


Electrical BOM

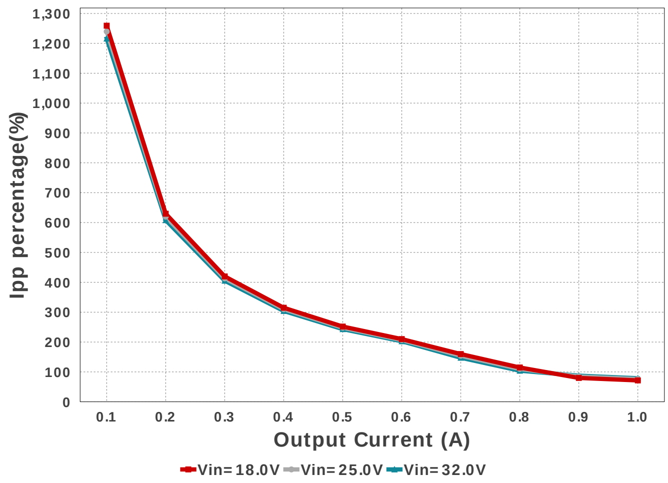
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cin	MuRata	GRM31CR61H225KA88L Series= X5R	Cap= 2.2 uF ESR= 4.448 mOhm VDC= 50.0 V IRMS= 2.2252 A	1	$0.10	1206_190 11 mm^2
Cin1	MuRata	GRM31CR61H225KA88L Series= X5R	Cap= 2.2 uF ESR= 4.448 mOhm VDC= 50.0 V IRMS= 2.2252 A	1	$0.10	1206_190 11 mm^2
Cinx	TDK	CGA3E3X7R1H224K080AB Series= X7R	Cap= 220.0 nF ESR= 21.699 mOhm VDC= 50.0 V IRMS= 1.125 A	1	$0.03	0603 5 mm^2
Cinx2	TDK	CGA3E3X7R1H224K080AB Series= X7R	Cap= 220.0 nF ESR= 21.699 mOhm VDC= 50.0 V IRMS= 1.125 A	1	$0.03	0603 5 mm^2
Cout	MuRata	GRM32ER60J107ME20L Series= X5R	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	$0.52	1210_270 15 mm^2
Cout	MuRata	GRM32ER60J107ME20L Series= X5R	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	$0.52	1210_270 15 mm^2
Cvcc	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
L1	Coilcraft	XAL4030-472MEB	L= 4.7 µH 40.1 mOhm	1	$0.72	XAL4030 25 mm^2
Rfbb	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 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 mm²
Rt	Yageo	RC0603FR-0716KL Series= ?	Res= 16.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
U1	Texas Instruments	LM61440AANRJRR	Switcher	1	$1.35	RJR0014A 22 mm²

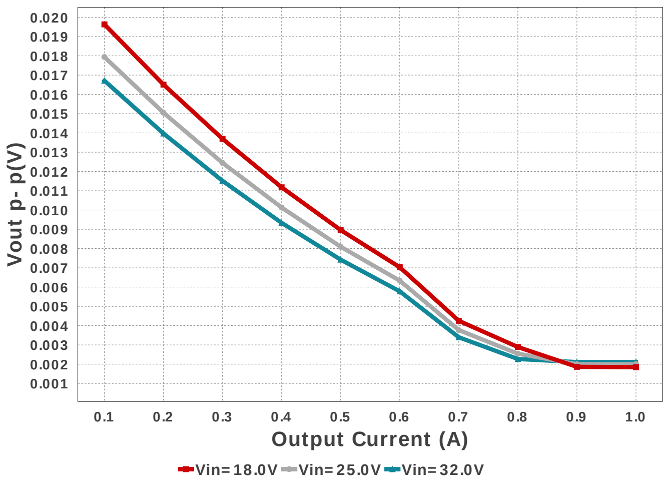
L Ipp



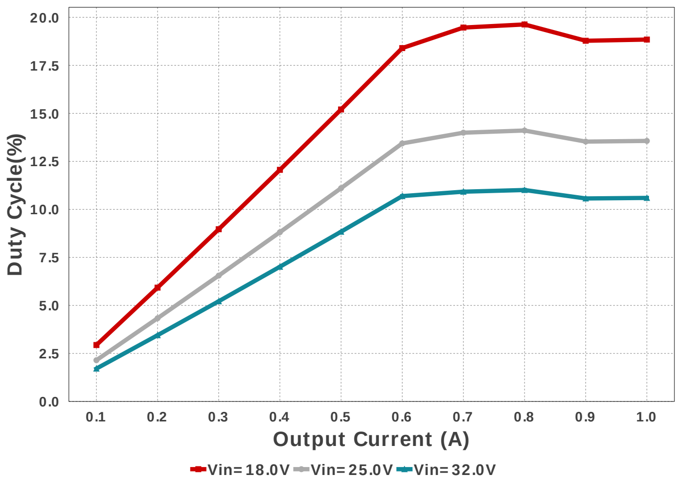
Ipp percentage



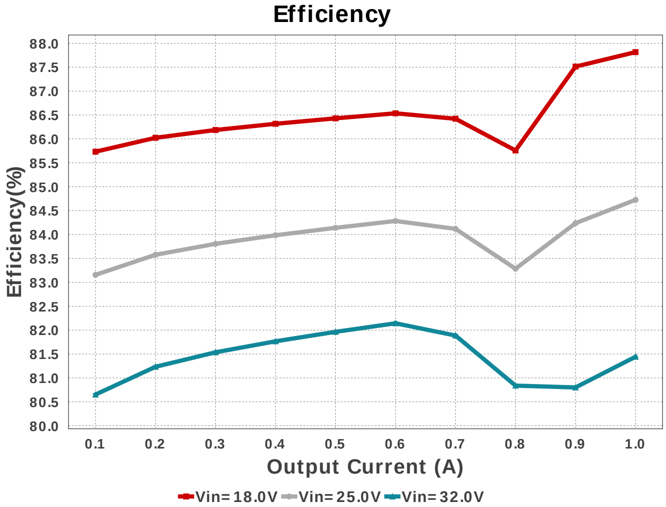
Vout p-p



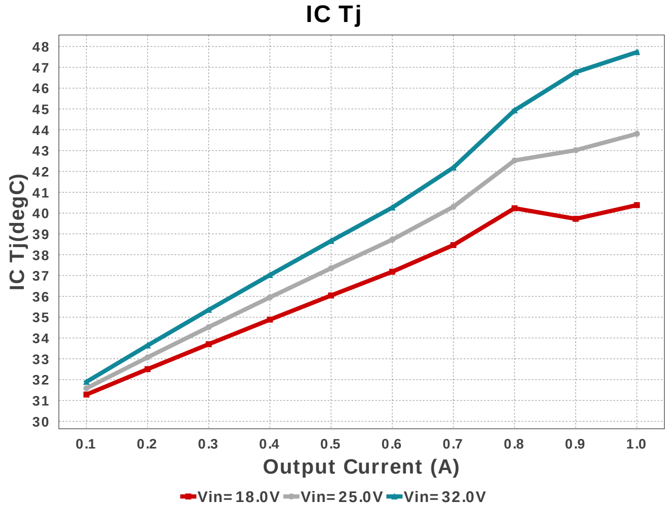
Duty Cycle



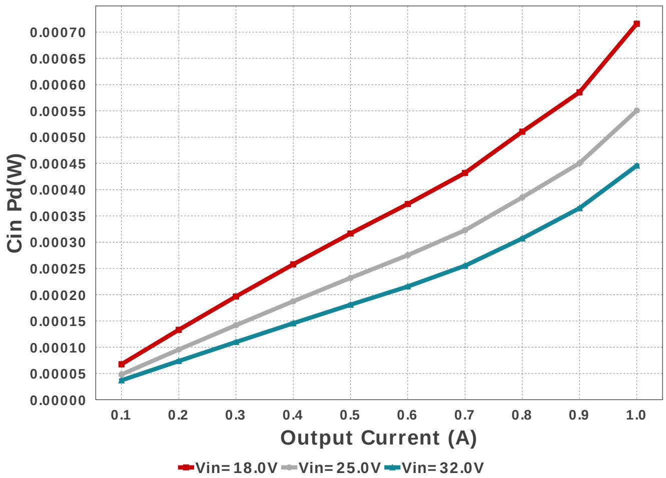
Efficiency



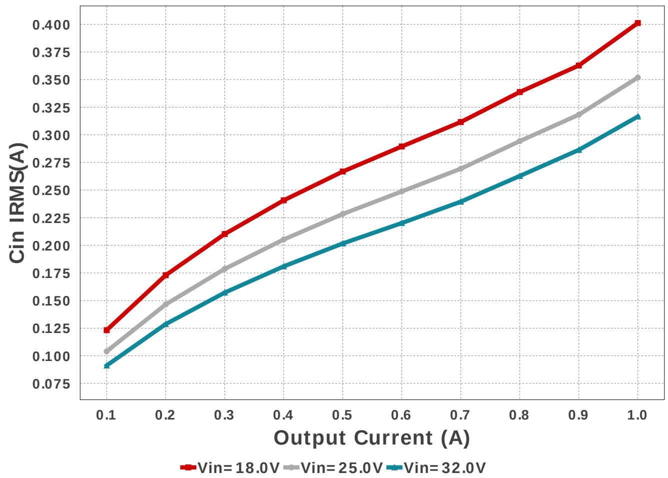
IC Tj



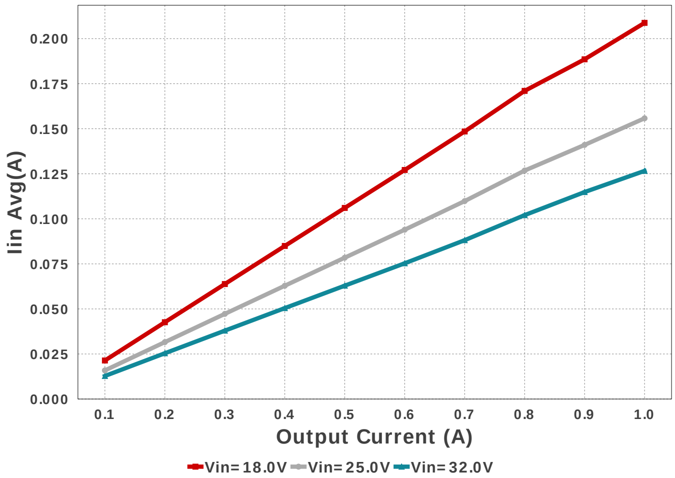
Cin Pd



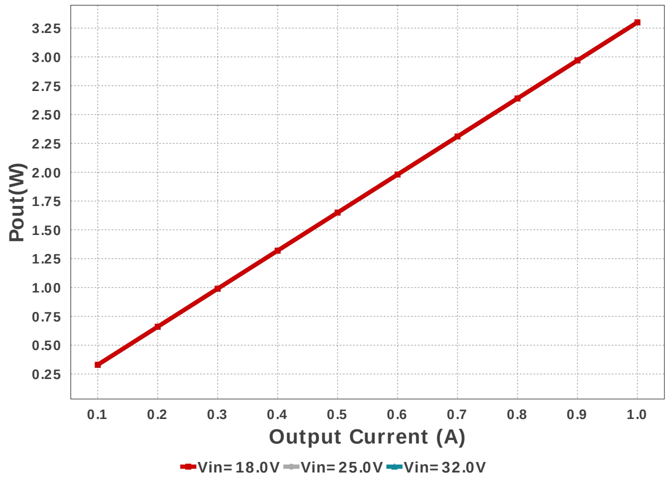
Cin IRMS



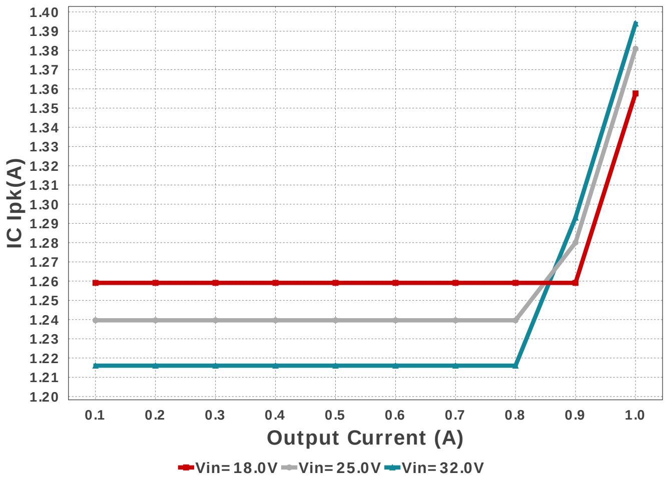
Iin Avg



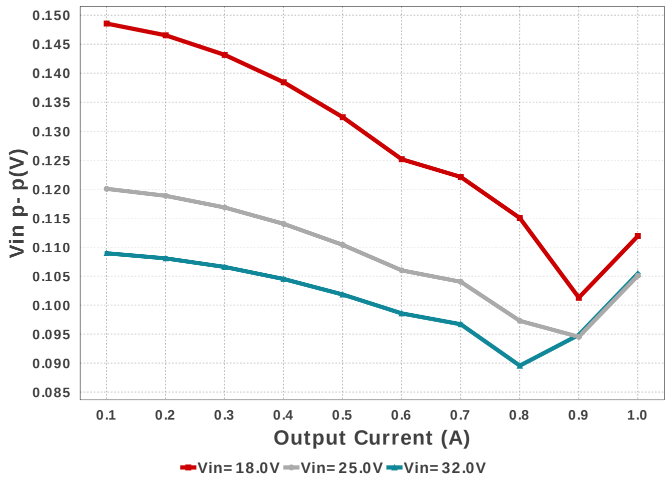
Pout

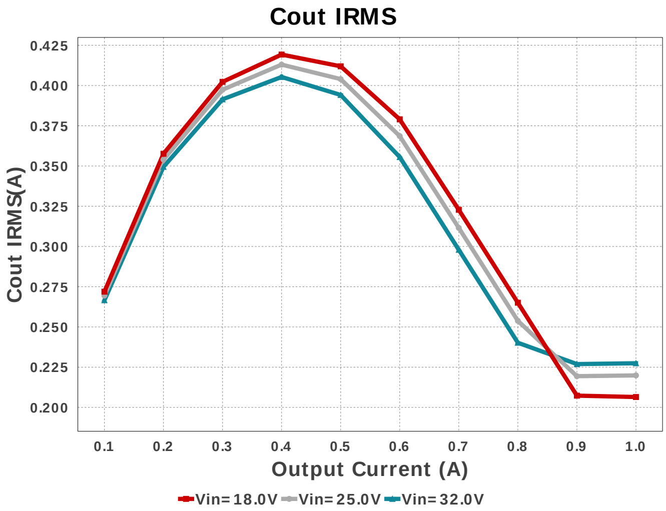


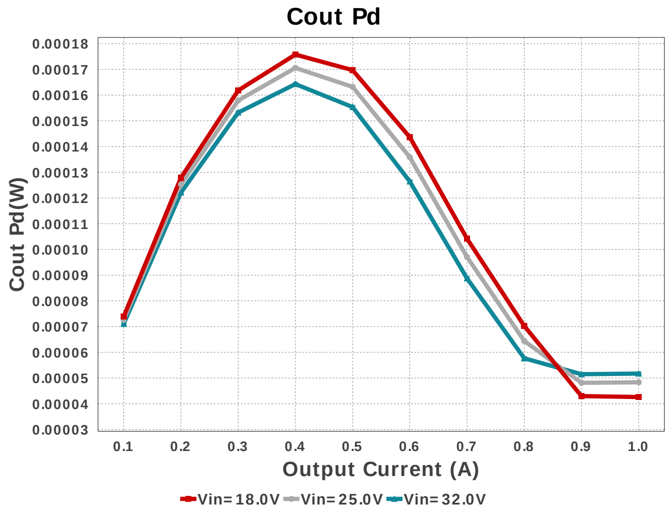
IC Ipk

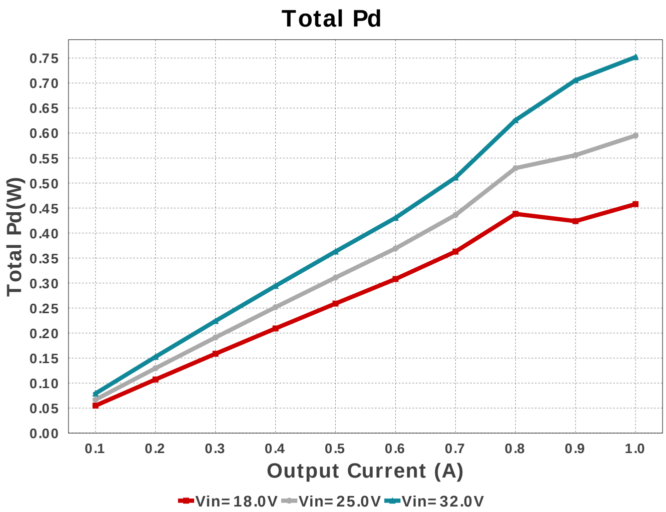


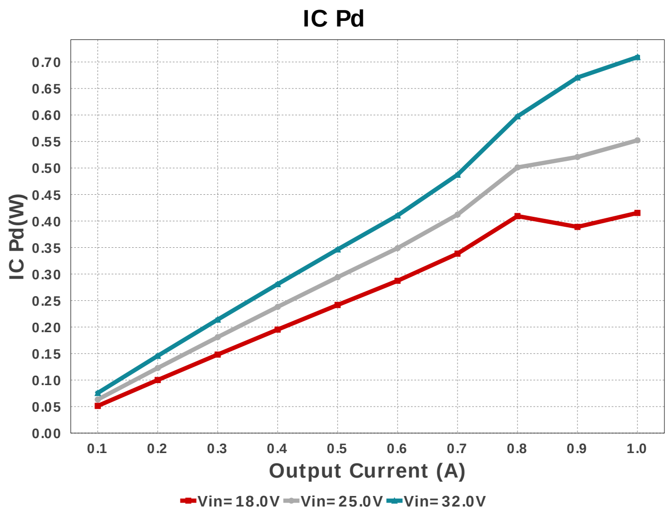
Vin p- p

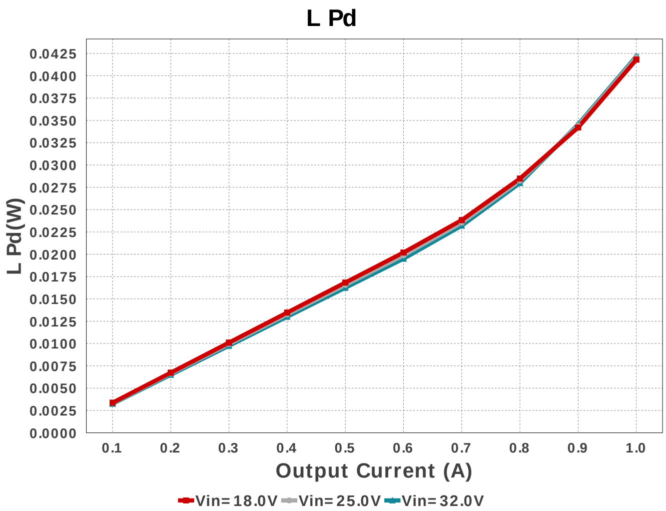


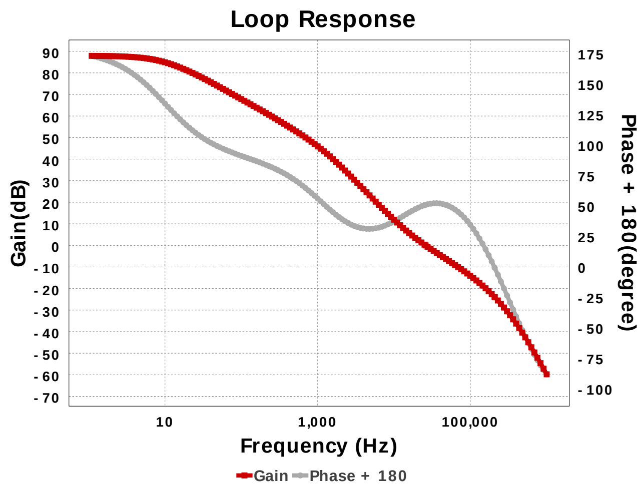

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

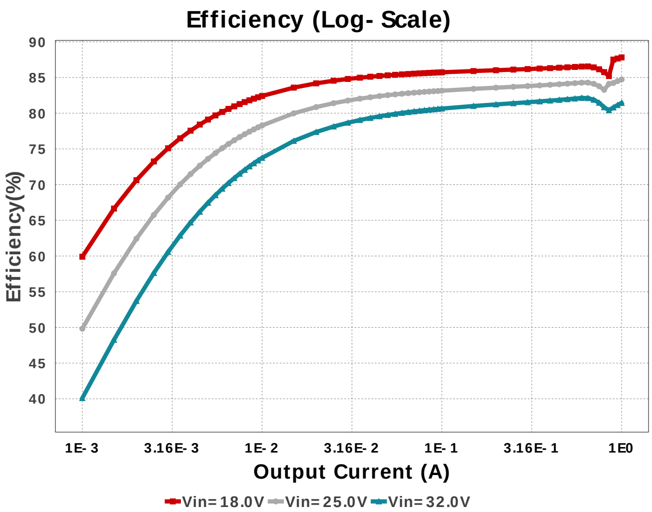

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


L Pd
L Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


Loop Response
Gain(dB)
Phase + 180(degree)
Frequency (Hz)
Gain Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	12		Total Design BOM count
2.	Total BOM	$2.9		Total BOM Cost
3.	Cin IRMS	316.571 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	445.77 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	227.442 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	51.73 µW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	1.394 A	IC	Peak switch current in IC
8.	IC Pd	709.18 mW	IC	IC power dissipation
9.	IC Tj	47.729 degC	IC	IC junction temperature
10.	IC Tolerance	12.5 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	25.0 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	126.62 mA	IC	Average input current
13.	Ipp percentage	78.788 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	787.883 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	42.174 mW	Inductor	Inductor power dissipation
16.	Cin Pd	445.77 µW	Power	Input capacitor power dissipation
17.	Cout Pd	51.73 µW	Power	Output capacitor power dissipation
18.	IC Pd	709.18 mW	Power	IC power dissipation
19.	L Pd	42.174 mW	Power	Inductor power dissipation
20.	Total Pd	751.9 mW	Power	Total Power Dissipation
21.	Cross Freq	25.944 kHz	System Information	Bode plot crossover frequency
22.	Duty Cycle	10.596 %	System Information	Duty cycle
23.	Efficiency	81.443 %	System Information	Steady state efficiency
24.	FootPrint	112.0 mm^2	System Information	Total Foot Print Area of BOM components
25.	Frequency	818.527 kHz	System Information	Switching frequency
26.	Gain Marg	-23.95 dB	System Information	Bode Plot Gain Margin
27.	Iout	1.0 A	System Information	Iout operating point
28.	Low Freq Gain	87.881 dB	System Information	Gain at 1Hz
29.	Mode	CCM	System Information	Conduction Mode
30.	Phase Marg	51.468 deg	System Information	Bode Plot Phase Margin
31.	Pout	3.3 W	System Information	Total output power
32.	Vin	32.0 V	System Information	Vin operating point
33.	Vin p-p	105.434 mV	System Information	Peak-to-peak input voltage
34.	Vout	3.3 V	System Information	Operational Output Voltage
35.	Vout Actual	3.315 V	System Information	Vout Actual calculated based on selected voltage divider resistors

#	Name	Value	Category	Description
36.	Vout Tolerance	2.678 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	2.114 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	32.0	Maximum input voltage
VinMin	18.0	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	LM61440	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	800.0 k	Customer Selected Frequency

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

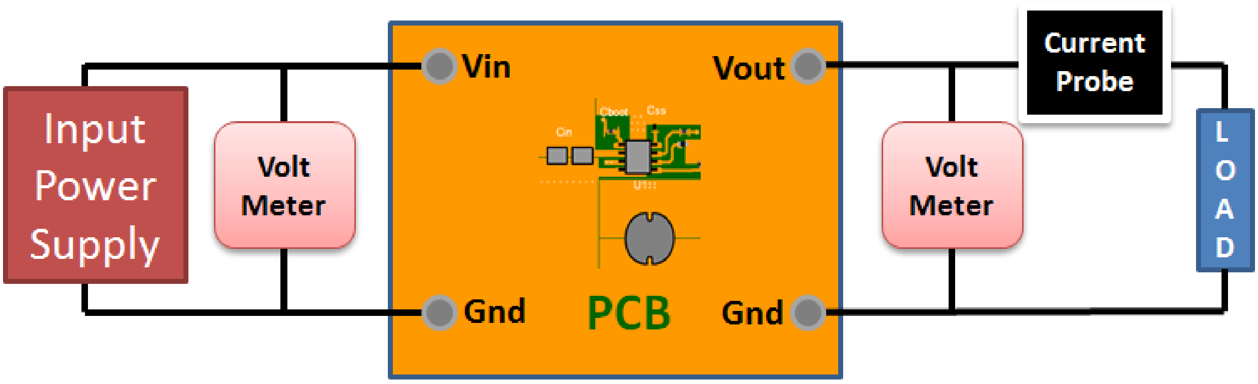
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 : AE3011FD2EE8F4EB[v1]

2. **LM61440** Product Folder : http://www.ti.com/product/LM61440 : contains the data sheet and other resources.

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