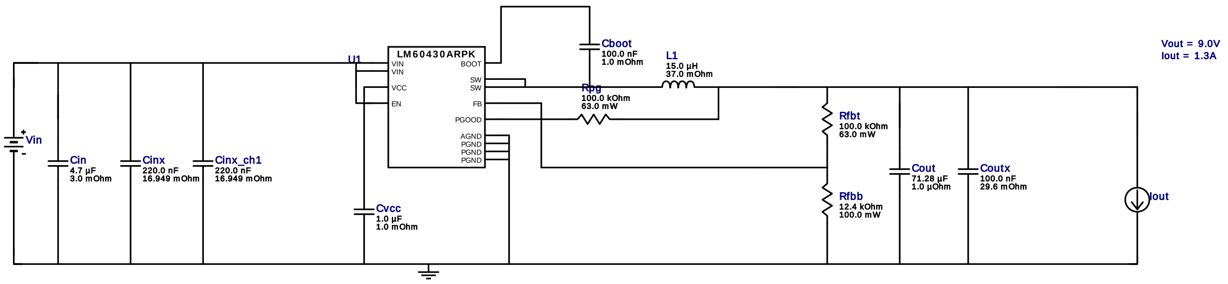
VinMin = 20.0V
VinMax = 30.0V
Vout = 9.0V
Iout = 1.3A

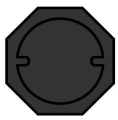
Device = LM60430ARPKR
Topology = Buck
Created = 2023-02-27 02:50:58.912
BOM Cost = NA
BOM Count = 12
Total Pd = 0.29W

WEBENCH ® Design Report

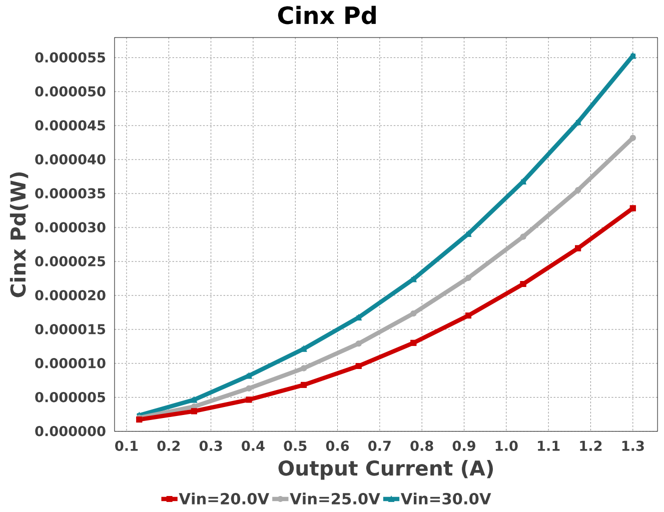
Design : 24 LM60430ARPKR
LM60430ARPKR 20V-30V to 9.00V @ 1.3A

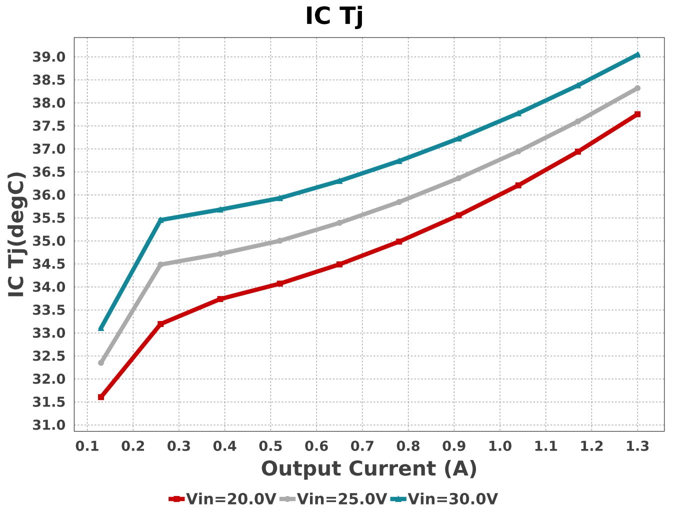


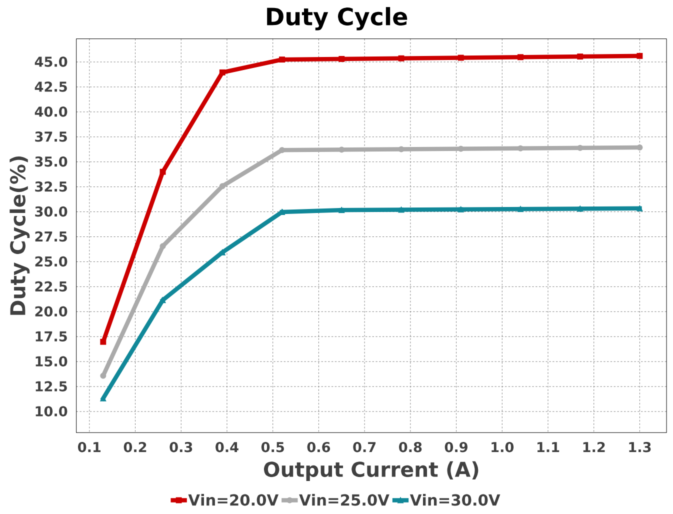
Electrical BOM

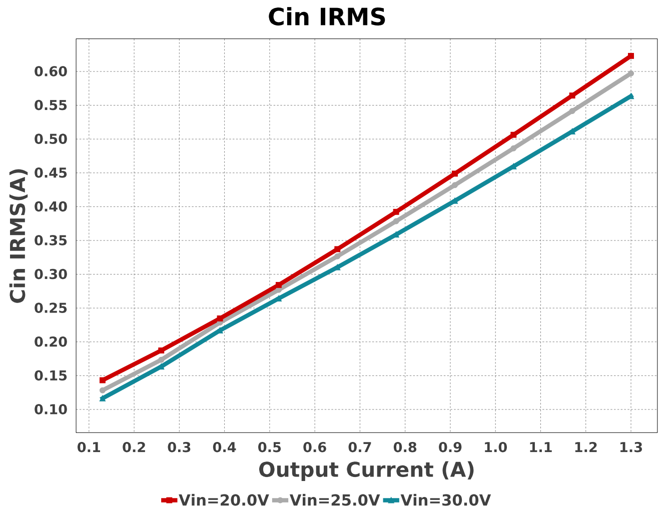
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.10	1206 11 mm²
Cinx	TDK	C2012X7R1H224K125AA Series= X7R	Cap= 220.0 nF ESR= 16.949 mOhm VDC= 50.0 V IRMS= 1.5961 A	1	$0.03	0805 7 mm²
Cinx_ch1	TDK	C2012X7R1H224K125AA Series= X7R	Cap= 220.0 nF ESR= 16.949 mOhm VDC= 50.0 V IRMS= 1.5961 A	1	$0.03	0805 7 mm²
Cout	CUSTOM	CUSTOM Series= ?	Cap= 71.28 uF ESR= 1.0 uOhm VDC= 12.8571 V IRMS= 433.01 mA	1	NA	CUSTOM 0 mm²
Coutx	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	$0.01	0603 5 mm²
Cvcc	Kemet	C0603C105K8PACTU Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
L1	Bourns	SRU1038-150Y	L= 15.0 µH 37.0 mOhm	1	$0.49	 SRU1038 144 mm²
Rfbb	Yageo	RC0603FR-0712K4L Series= ?	Res= 12.4 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

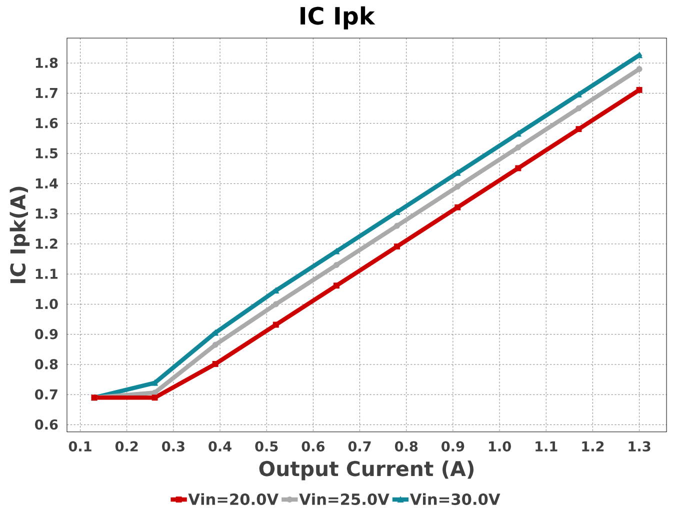
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LM60430ARPKR	Switcher	1	$0.84	RPK0013A 12 mm^2

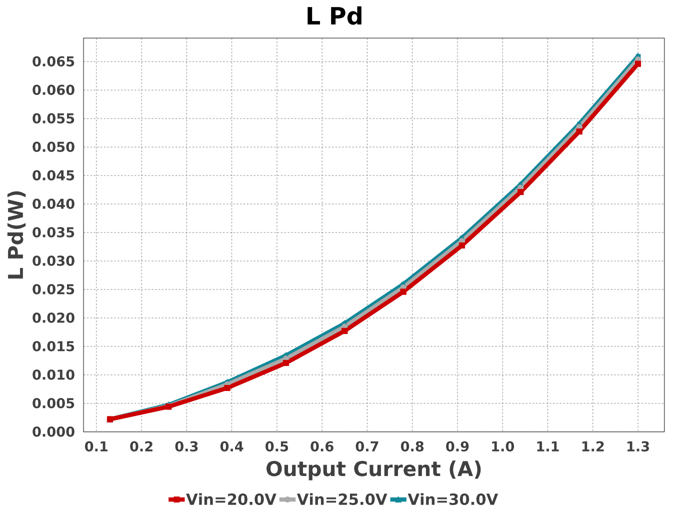


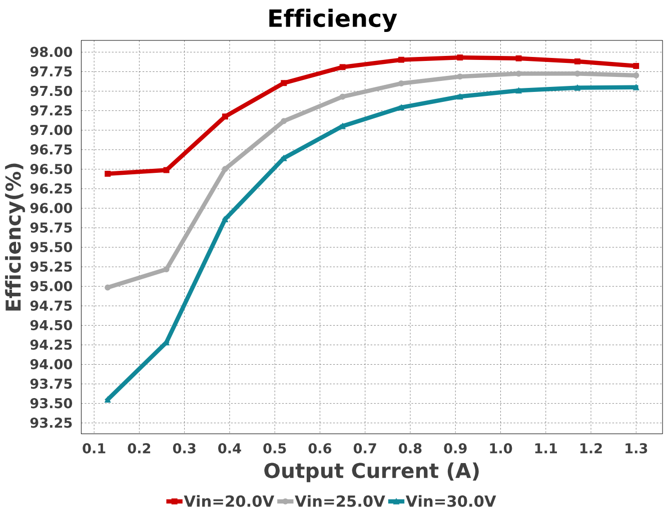


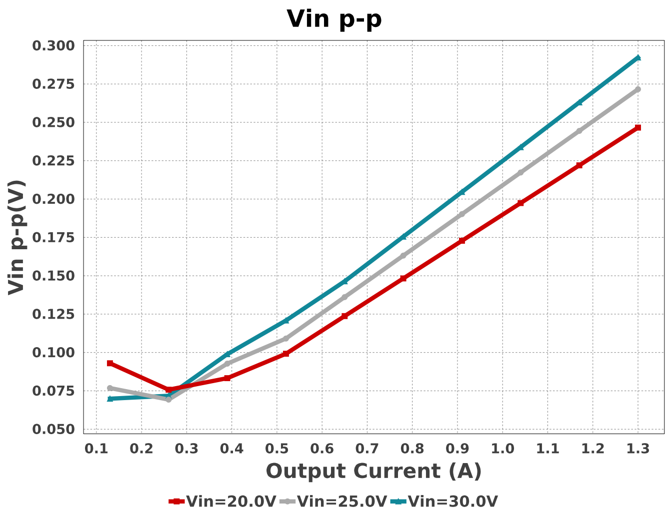


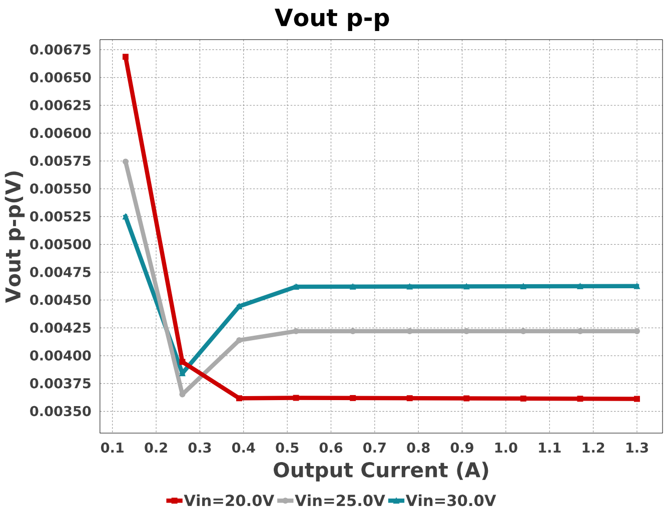


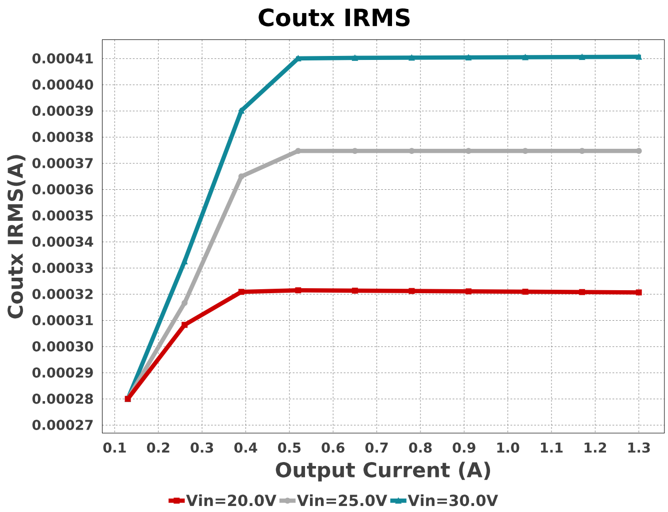


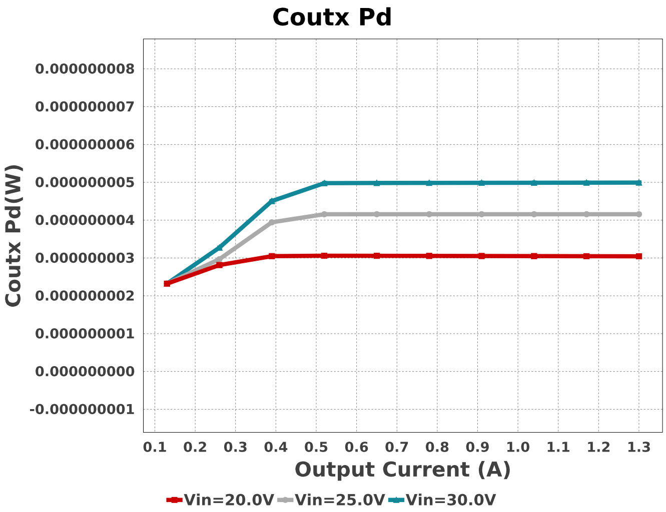


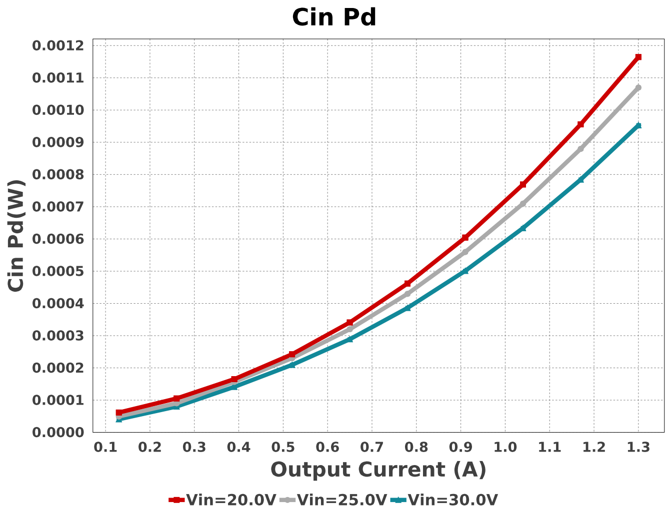

Efficiency
Efficiency(%)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

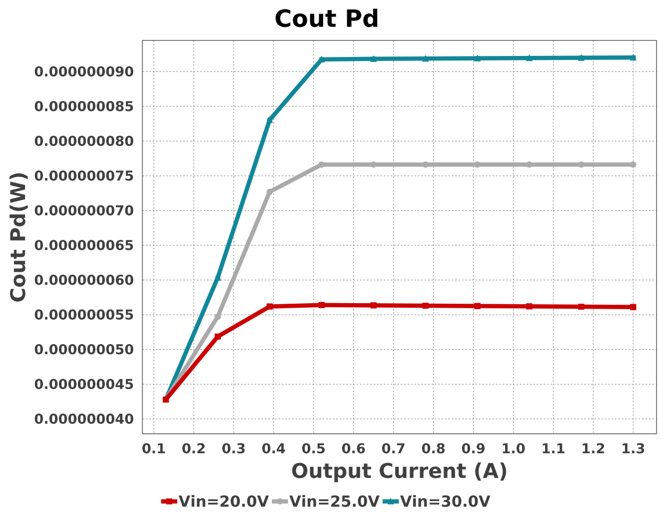

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

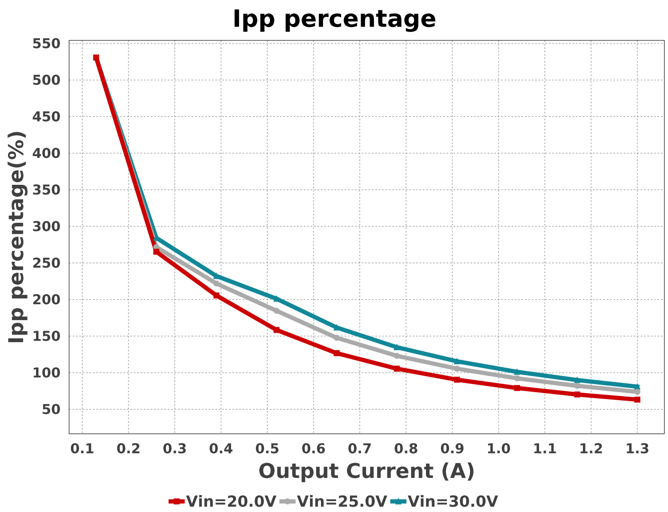

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

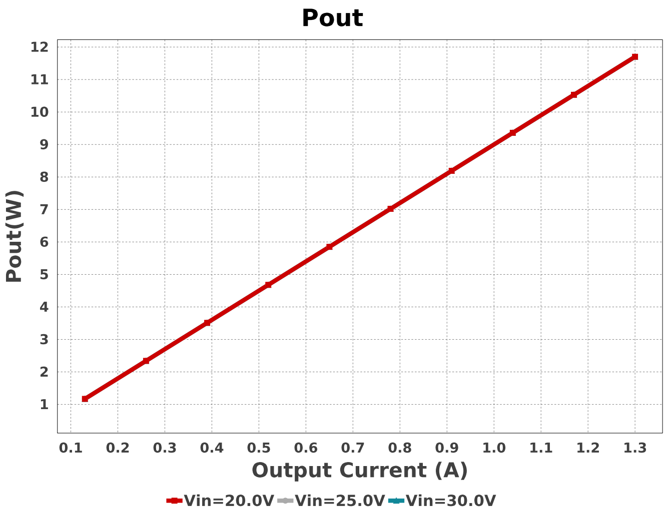

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

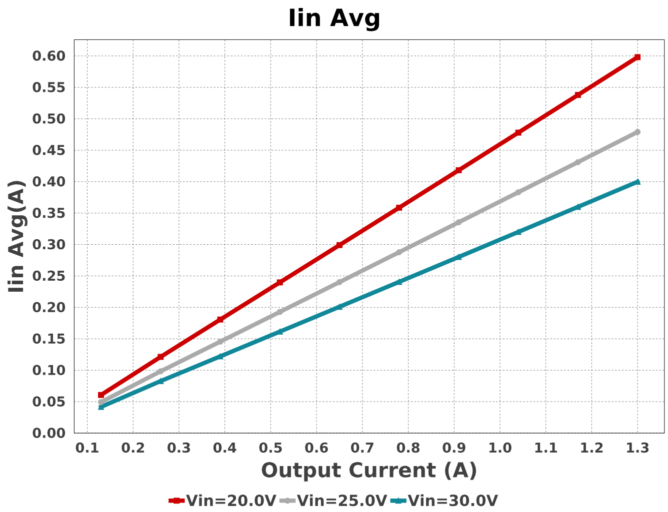

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

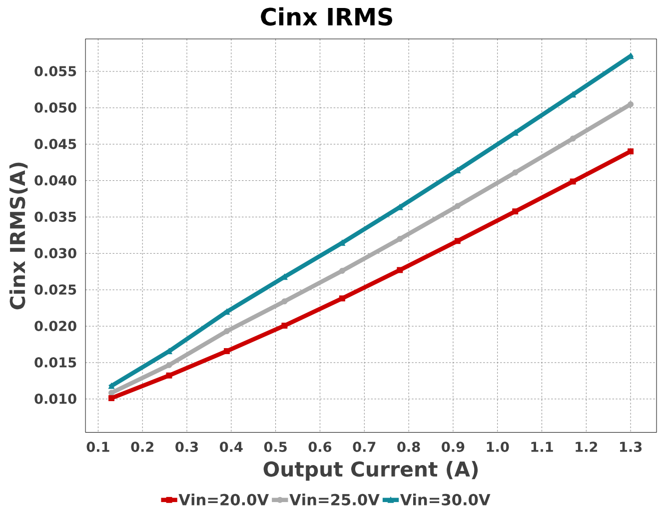

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

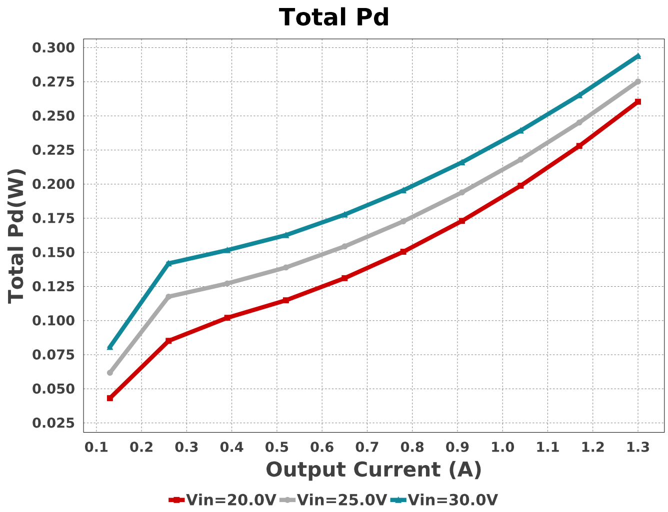

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V


Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

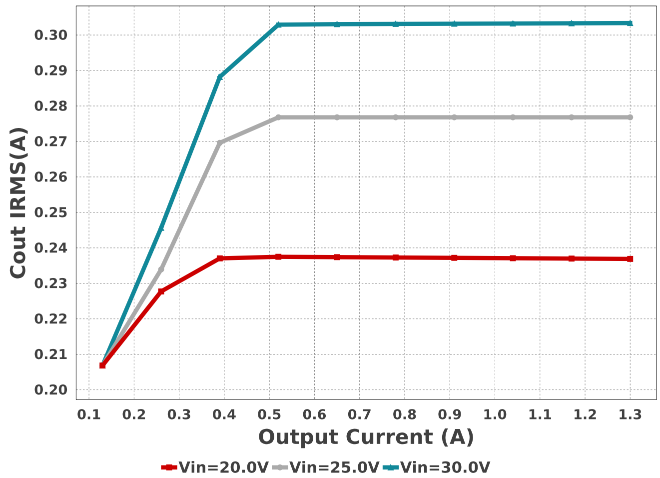

Pout
Pout(W)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

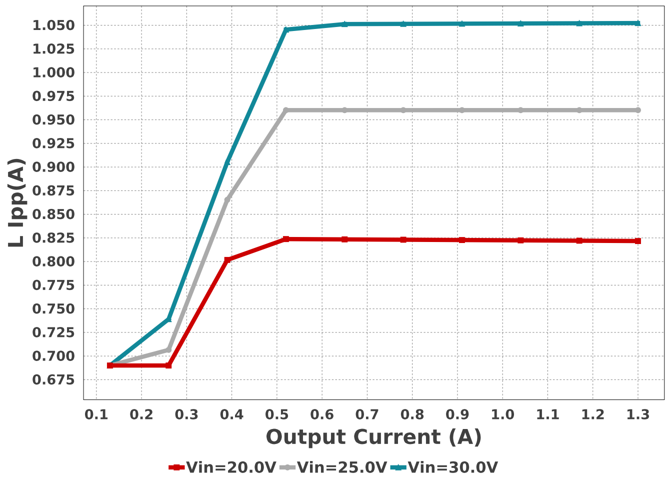

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=20.0V Vin=25.0V Vin=30.0V

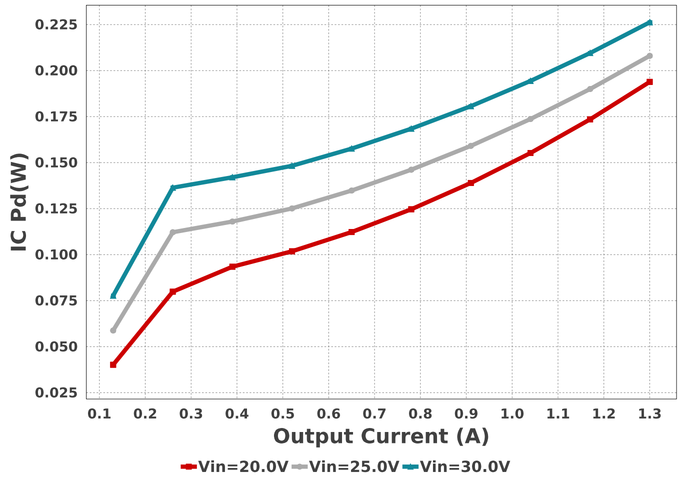
Cout IRMS



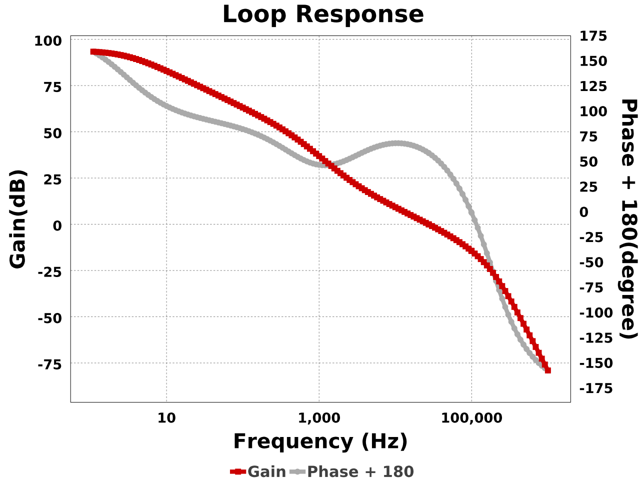
L Ipp



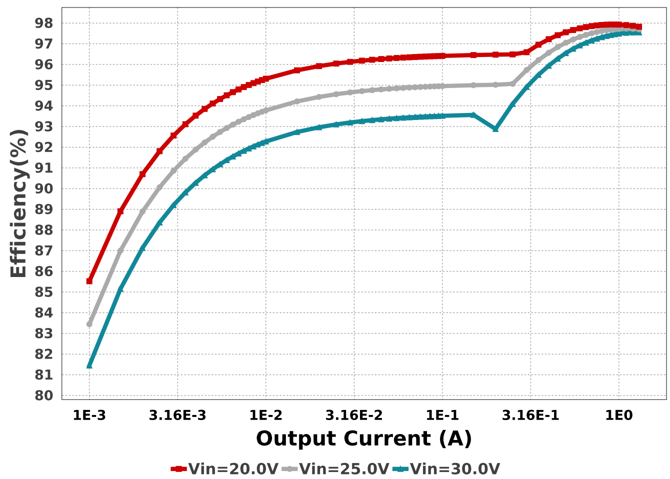
IC Pd



Loop Response



Efficiency (Log-Scale)



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	12		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	563.524 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	952.68 µW	Capacitor	Input capacitor power dissipation
5.	Cinx IRMS	57.11 mA	Capacitor	Bulk capacitor RMS ripple current
6.	Cinx Pd	55.281 µW	Capacitor	Bulk capacitor power dissipation
7.	Cout IRMS	303.372 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	92.035 nW	Capacitor	Output capacitor power dissipation
9.	Coutx IRMS	410.709 µA	Capacitor	Output capacitor_x RMS ripple current
10.	Coutx Pd	4.993 nW	Capacitor	Output capacitor_x power loss
11.	IC Ipk	1.826 A	IC	Peak switch current in IC

#	Name	Value	Category	Description
12.	IC Pd	226.23 mW	IC	IC power dissipation
13.	IC Tj	39.049 degC	IC	IC junction temperature
14.	IC Tolerance	15.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA Effective	40.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
16.	Iin Avg	399.8 mA	IC	Average input current
17.	Ipp percentage	80.949 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
18.	L Ipp	1.052 A	Inductor	Peak-to-peak inductor ripple current
19.	L Pd	65.945 mW	Inductor	Inductor power dissipation
20.	Cin Pd	952.68 µW	Power	Input capacitor power dissipation
21.	Cinx Pd	55.281 µW	Power	Bulk capacitor power dissipation
22.	Cout Pd	92.035 nW	Power	Output capacitor power dissipation
23.	Coutx Pd	4.993 nW	Power	Output capacitor_x power loss
24.	IC Pd	226.23 mW	Power	IC power dissipation
25.	L Pd	65.945 mW	Power	Inductor power dissipation
26.	Total Pd	293.853 mW	Power	Total Power Dissipation
27.	Cross Freq	27.265 kHz	System Information	Bode plot crossover frequency
28.	Duty Cycle	30.341 %	System Information	Duty cycle
29.	Efficiency	97.55 %	System Information	Steady state efficiency
30.	FootPrint	303.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	400.0 kHz	System Information	Switching frequency
32.	Gain Marg	-14.314 dB	System Information	Bode Plot Gain Margin
33.	Iout	1.3 A	System Information	Iout operating point
34.	Low Freq Gain	93.332 dB	System Information	Gain at 1Hz
35.	Mode	CCM	System Information	Conduction Mode
36.	Phase Marg	58.779 deg	System Information	Bode Plot Phase Margin
37.	Pout	11.7 W	System Information	Total output power
38.	Vin	30.0 V	System Information	Vin operating point
39.	Vin p-p	292.257 mV	System Information	Peak-to-peak input voltage
40.	Vout	9.0 V	System Information	Operational Output Voltage
41.	Vout Actual	9.065 V	System Information	Vout Actual calculated based on selected voltage divider resistors
42.	Vout Tolerance	3.324 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
43.	Vout p-p	4.625 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.3	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	20.0	Minimum input voltage
Vout	9.0	Output Voltage
base_pn	LM60430A	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

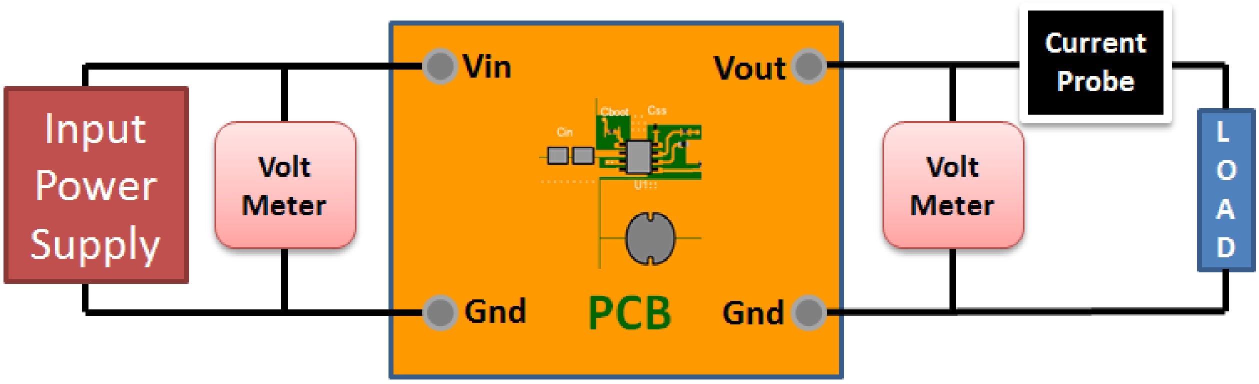
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 20.0V 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 : AF780BC098447727[v1]

2. **LM60430A** Product Folder : http://www.ti.com/product/LM60430 : contains the data sheet and other resources.

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