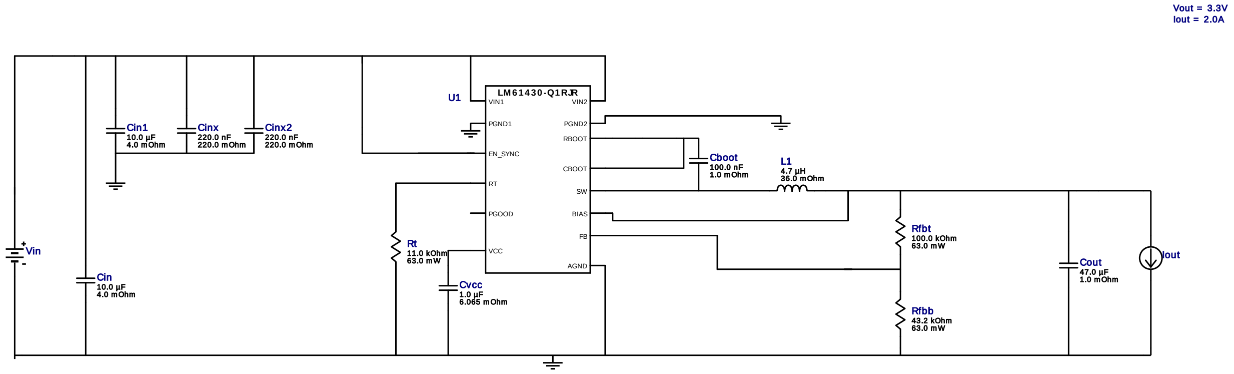
VinMin = 6.0V
VinMax = 16.0V
Vout = 3.3V
Iout = 2.0A

Device = LM61430AASQRJRRQ1
Topology = Buck
Created = 2023-04-27 00:05:42.872
BOM Cost = $2.66
BOM Count = 12
Total Pd = 0.49W

WEBENCH ® Design Report

Design : 3 LM61430AASQRJRRQ1
LM61430AASQRJRRQ1 6V-16V to 3.30V @ 2A



Design Alerts

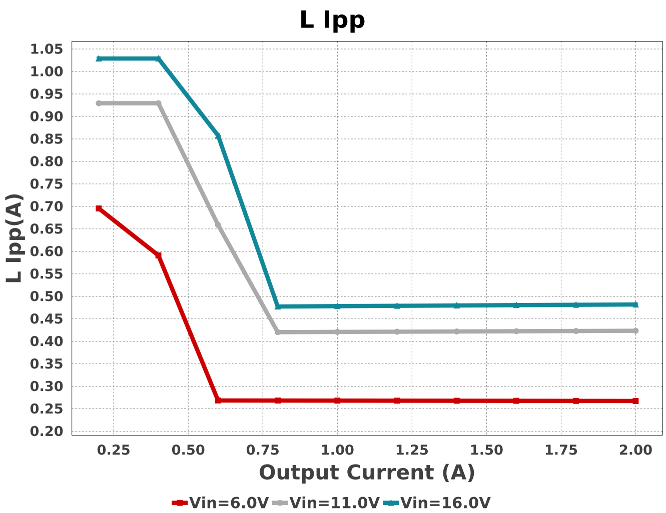
Component Selection Information

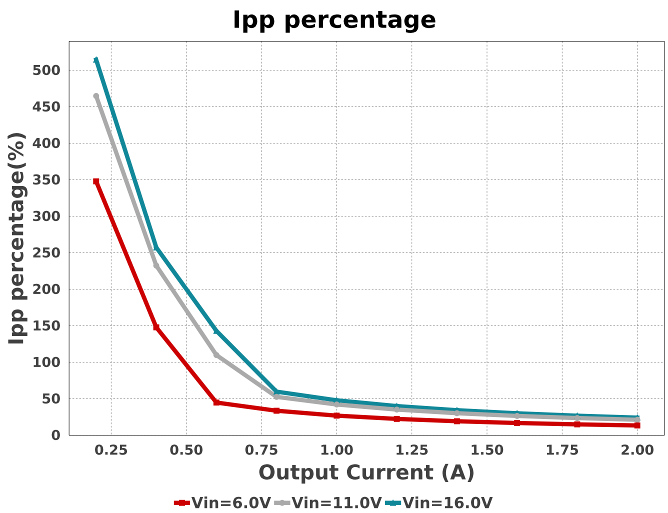
The LM61430AAS-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

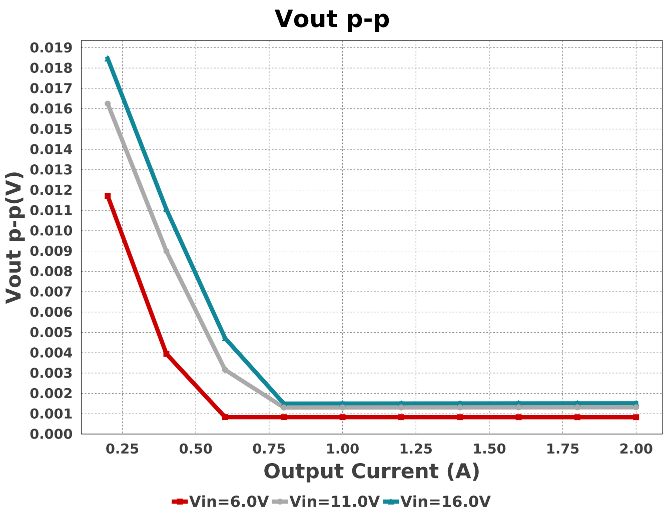
Electrical BOM

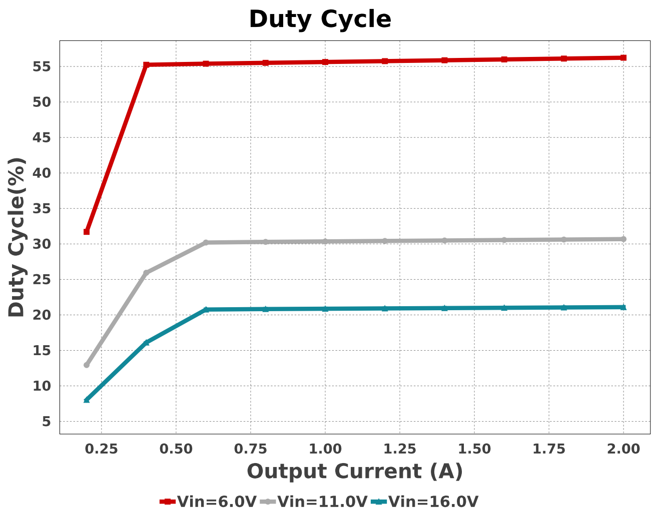
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	1	$0.04	0805 7 mm²
Cin1	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	1	$0.04	0805 7 mm²
Cinx	MuRata	GRM188R71E224KA88D Series= X7R	Cap= 220.0 nF ESR= 220.0 mOhm VDC= 25.0 V IRMS= 2.24 A	1	$0.03	0603 5 mm²
Cinx2	MuRata	GRM188R71E224KA88D Series= X7R	Cap= 220.0 nF ESR= 220.0 mOhm VDC= 25.0 V IRMS= 2.24 A	1	$0.03	0603 5 mm²
Cout	MuRata	GRM32ER60J476ME20L Series= X5R	Cap= 47.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	$0.19	1210_270 15 mm²
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 mm²
L1	Coilcraft	XAL5030-472MEB	L= 4.7 µH 36.0 mOhm	1	$0.63	XAL5030 54 mm²

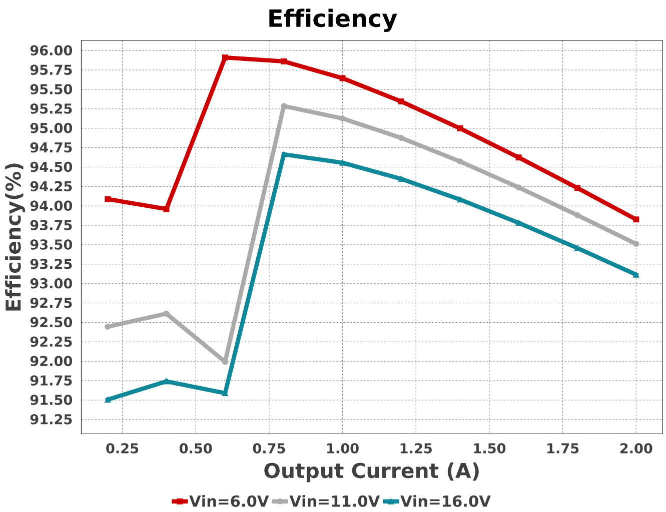
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbb	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rt	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LM61430AASQRJRRQ1	Switcher	1	$1.65	RJR0014A 22 mm^2

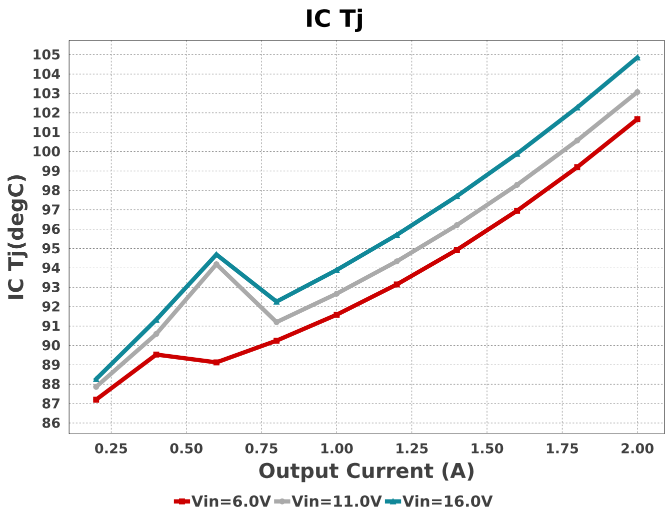


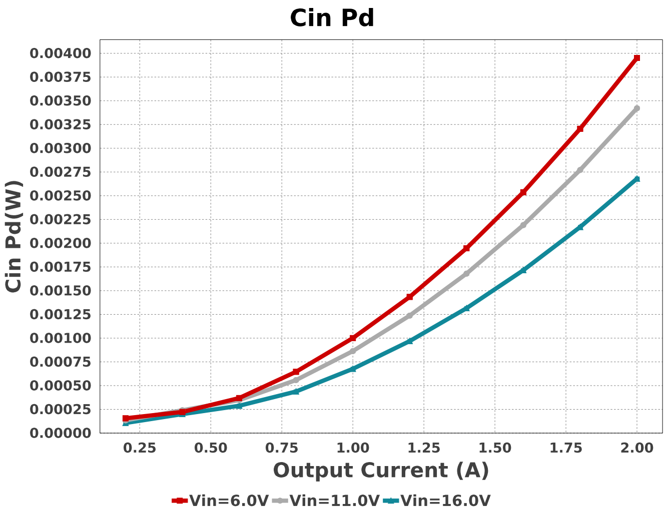


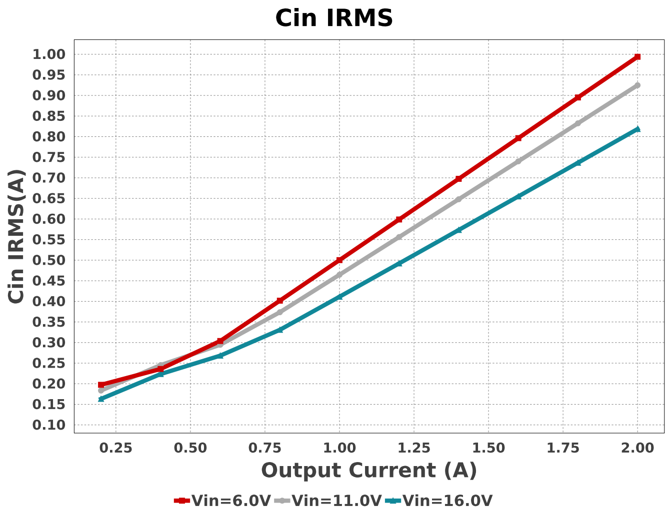


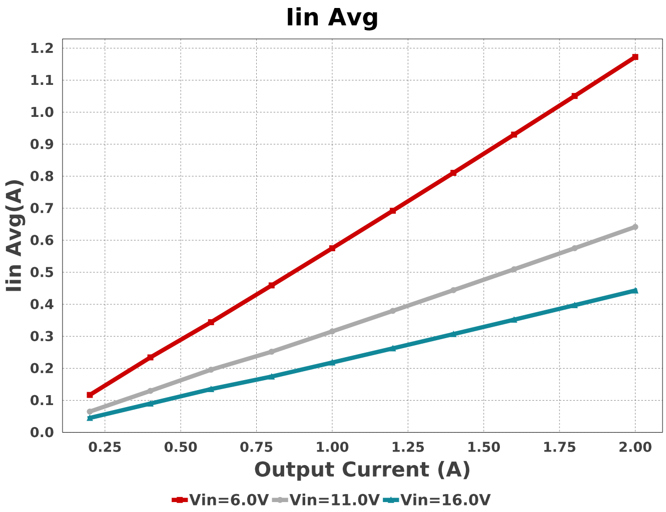


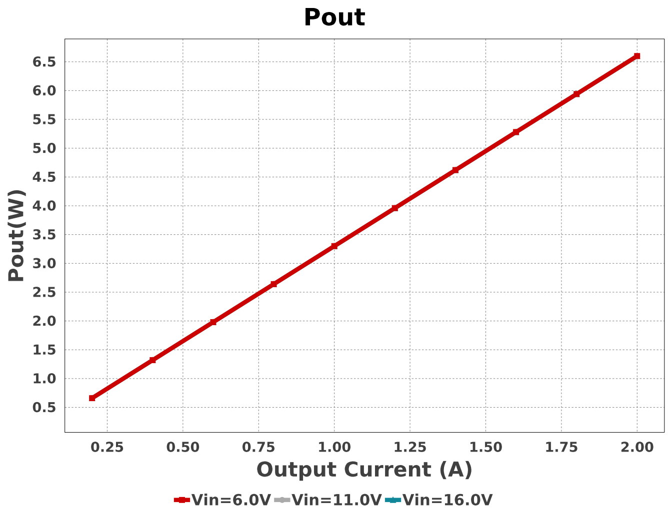

Efficiency
Efficiency(%)
96.00
95.75
95.50
95.25
95.00
94.75
94.50
94.25
94.00
93.75
93.50
93.25
93.00
92.75
92.50
92.25
92.00
91.75
91.50
91.25
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=6.0V Vin=11.0V Vin=16.0V

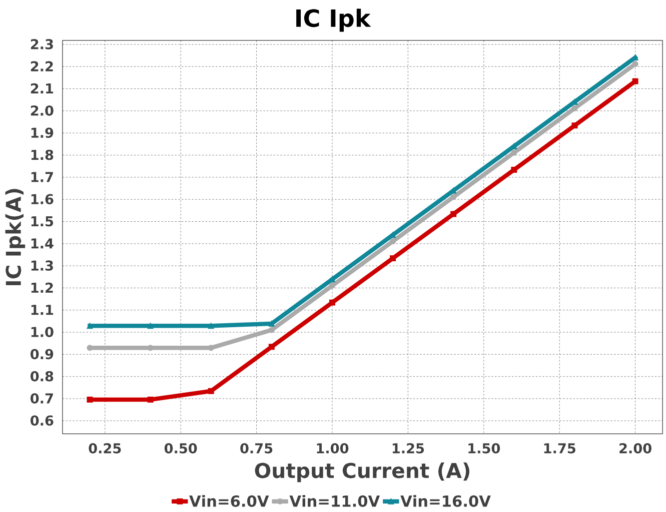

IC Tj
IC Tj(degC)
105
104
103
102
101
100
99
98
97
96
95
94
93
92
91
90
89
88
87
86
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=6.0V Vin=11.0V Vin=16.0V

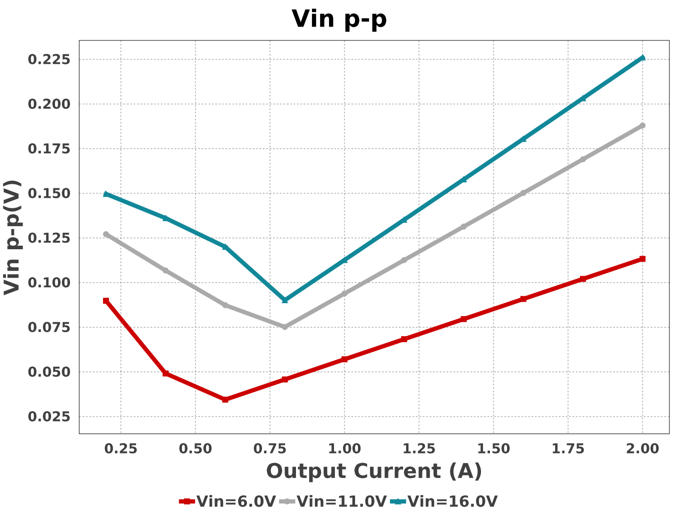

Cin Pd
Cin Pd(W)
0.00400
0.00375
0.00350
0.00325
0.00300
0.00275
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=6.0V Vin=11.0V Vin=16.0V

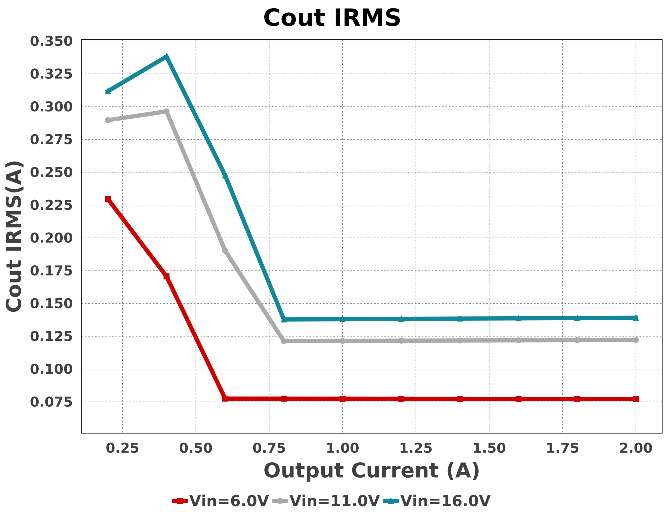

Cin IRMS
Cin IRMS(A)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=6.0V Vin=11.0V Vin=16.0V

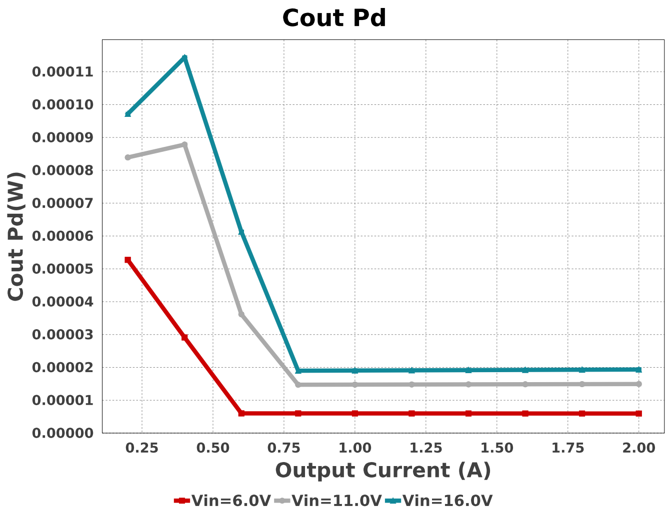

Iin Avg
Iin Avg(A)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=6.0V Vin=11.0V Vin=16.0V

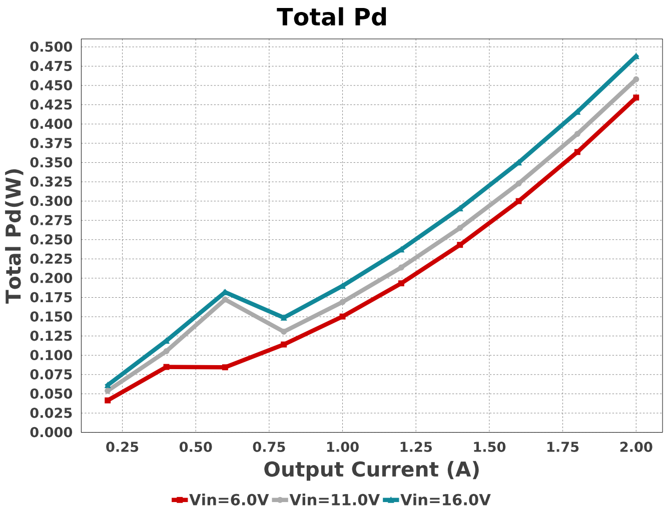

Pout
Pout(W)
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=6.0V Vin=11.0V Vin=16.0V

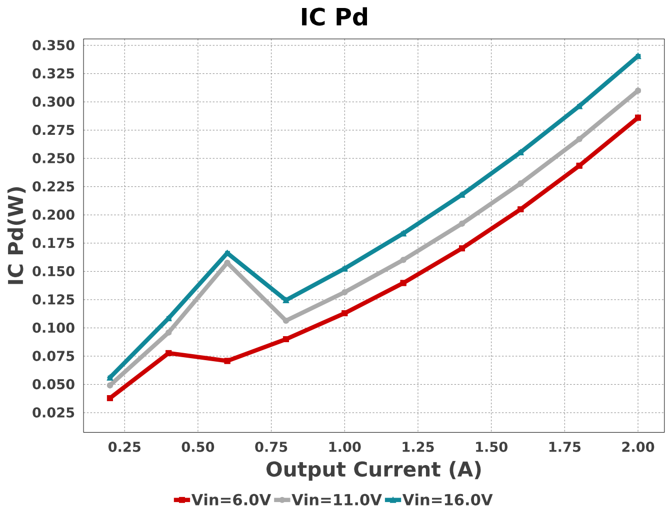

IC Ipk
IC Ipk(A)
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Output Current (A)
Vin=6.0V
Vin=11.0V
Vin=16.0V

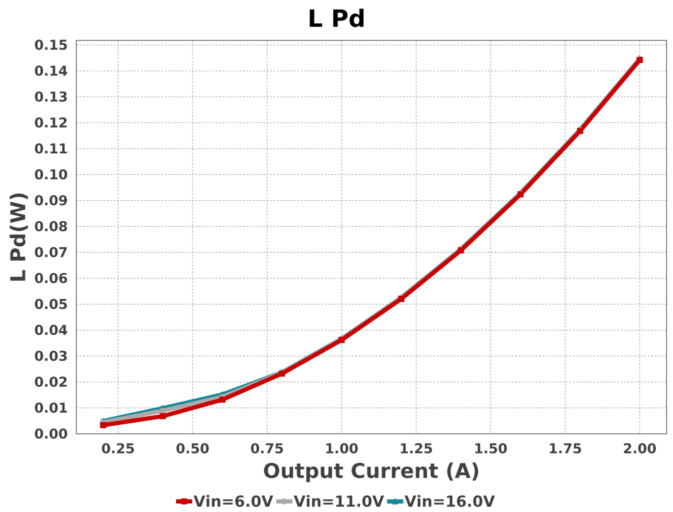

Vin p-p
Vin p-p(V)
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Output Current (A)
Vin=6.0V
Vin=11.0V
Vin=16.0V

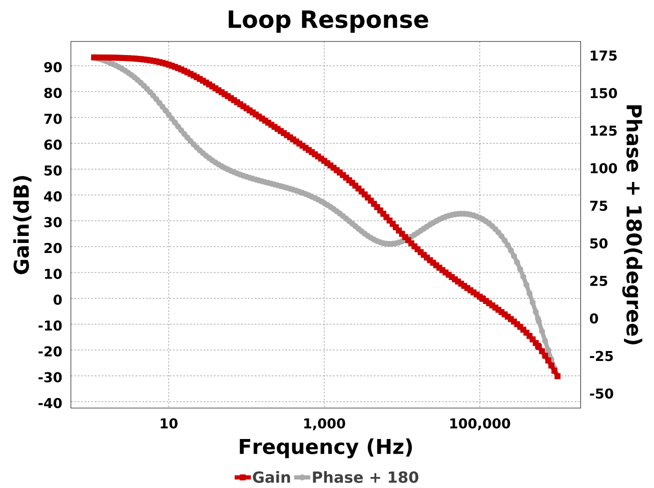

Cout IRMS
Cout IRMS(A)
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Output Current (A)
Vin=6.0V
Vin=11.0V
Vin=16.0V

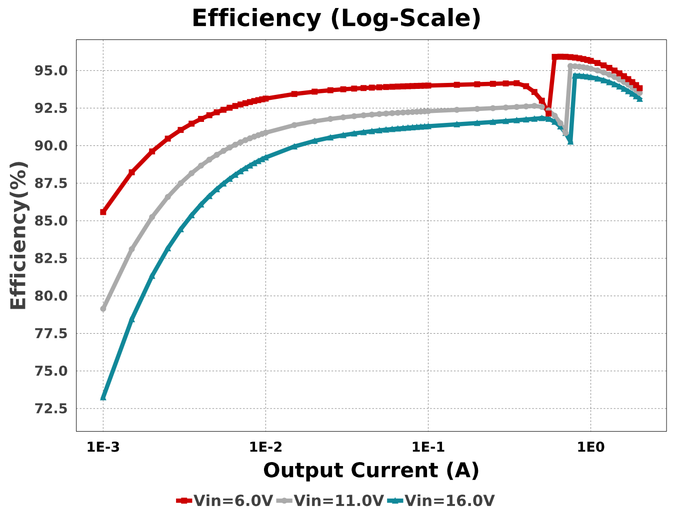

Cout Pd
Cout Pd(W)
0.00011
0.00010
0.00009
0.00008
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Output Current (A)
Vin=6.0V
Vin=11.0V
Vin=16.0V


Total Pd
Total Pd(W)
0.500
0.475
0.450
0.425
0.400
0.375
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
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Output Current (A)
Vin=6.0V
Vin=11.0V
Vin=16.0V


IC Pd
IC 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
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Output Current (A)
Vin=6.0V
Vin=11.0V
Vin=16.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	818.48 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	2.68 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	139.12 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	19.354 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	2.241 A	IC	Peak switch current in IC
6.	IC Pd	340.56 mW	IC	IC power dissipation
7.	IC Tj	104.854 degC	IC	IC junction temperature
8.	IC Tolerance	10.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA	58.3 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	443.0 mA	IC	Average input current
11.	Ipp percentage	24.096 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	481.92 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	144.7 mW	Inductor	Inductor power dissipation
14.	Cin Pd	2.68 mW	Power	Input capacitor power dissipation
15.	Cout Pd	19.354 µW	Power	Output capacitor power dissipation
16.	IC Pd	340.56 mW	Power	IC power dissipation
17.	L Pd	144.7 mW	Power	Inductor power dissipation
18.	Total Pd	488.009 mW	Power	Total Power Dissipation
19.	BOM Count	12	System Information	Total Design BOM count
20.	Cross Freq	107.38 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	21.096 %	System Information	Duty cycle
22.	Efficiency	93.115 %	System Information	Steady state efficiency
23.	FootPrint	131.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	1.176 MHz	System Information	Switching frequency

#	Name	Value	Category	Description
25.	Gain Marg	-18.377 dB	System Information	Bode Plot Gain Margin
26.	Iout	2.0 A	System Information	Iout operating point
27.	Low Freq Gain	93.238 dB	System Information	Gain at 1Hz
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	66.362 deg	System Information	Bode Plot Phase Margin
30.	Pout	6.6 W	System Information	Total output power
31.	Total BOM	$2.66	System Information	Total BOM Cost
32.	Vin	16.0 V	System Information	Vin operating point
33.	Vin p-p	226.034 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
36.	Vout Tolerance	2.425 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	1.512 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	16.0	Maximum input voltage
VinMin	6.0	Minimum input voltage
VinTyp	12.0	Typical input voltage
Vout	3.3	Output Voltage
base_pn	LM61430AAS-Q1	Base Product Number
source	DC	Input Source Type
Ta	85.0	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

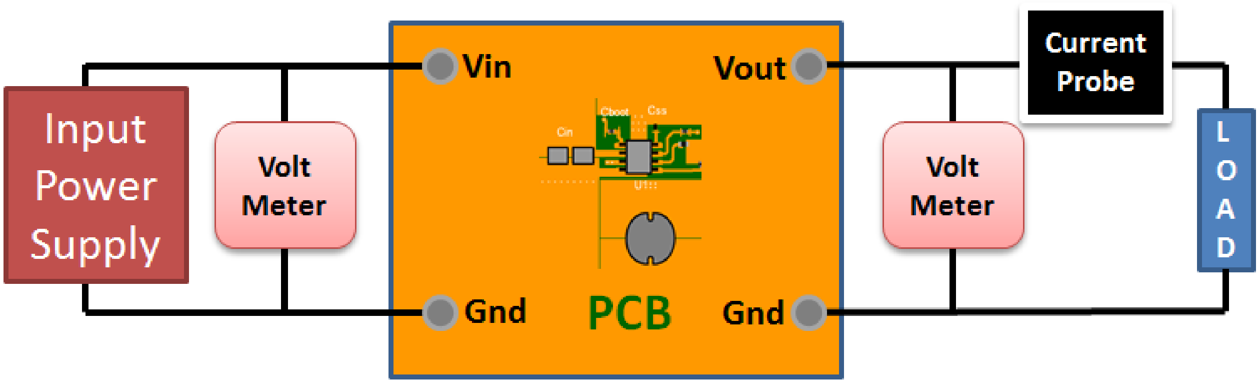
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 6.0V 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. The LM61430AAS-Q1 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 Vin = 3V. However, needs a minimum of 4V 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 : F732D1B6B535D9CA[v1]

3. **LM61430AAS-Q1** Product Folder : https://www.ti.com/product/LM61430%2DQ1 : contains the data sheet and other resources.

Important Notice and Disclaimer