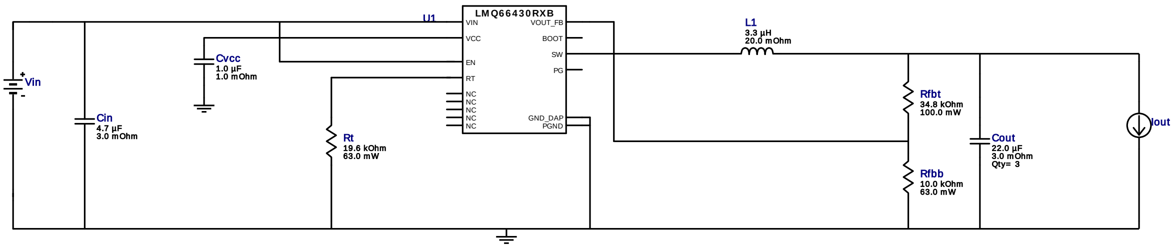
VinMin = 18.0V
VinMax = 22.0V
Vout = 4.48V
Iout = 3.0A

Device = LMQ66430R5RXBR
Topology = Buck
Created = 2023-02-21 01:41:18.103
BOM Cost = $1.92
BOM Count = 10
Total Pd = 1.61W

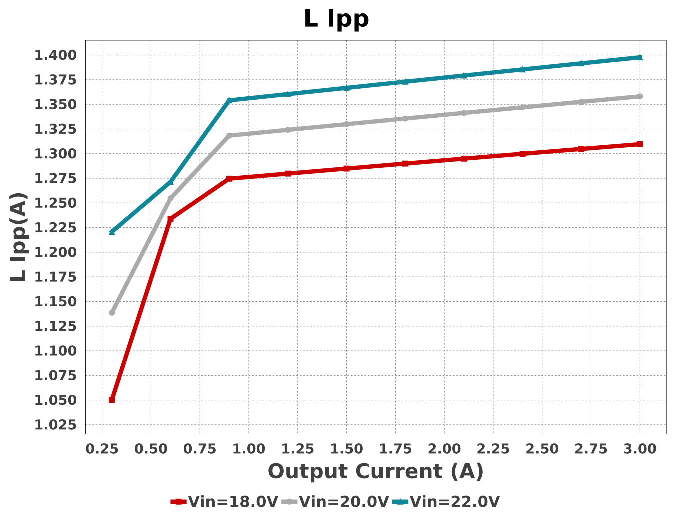
WEBENCH ® Design Report

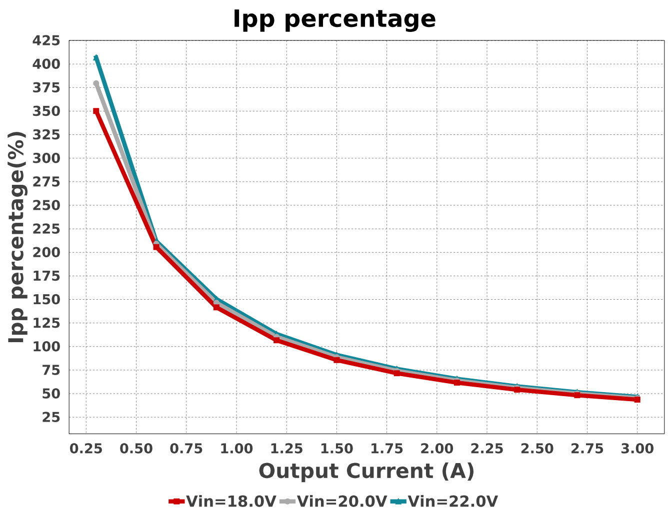
Design : 87 LMQ66430R5RXBR
LMQ66430R5RXBR 18V-22V to 4.48V @ 3A

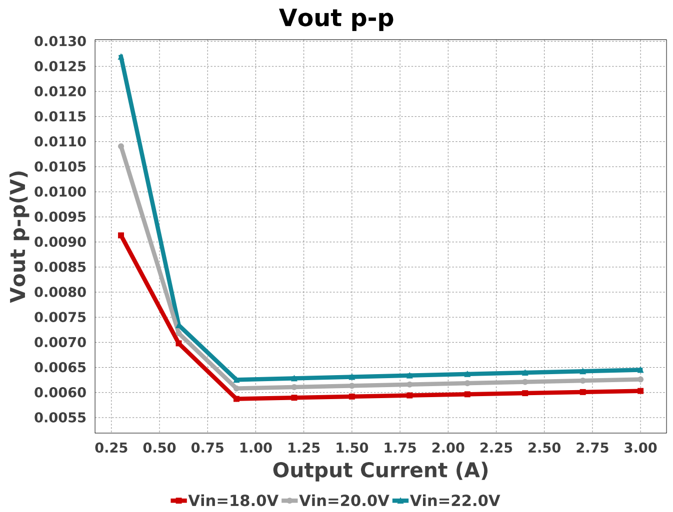


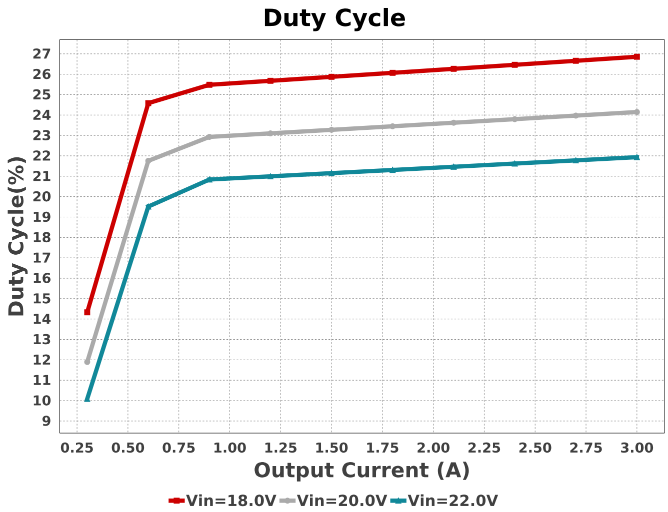
Electrical BOM

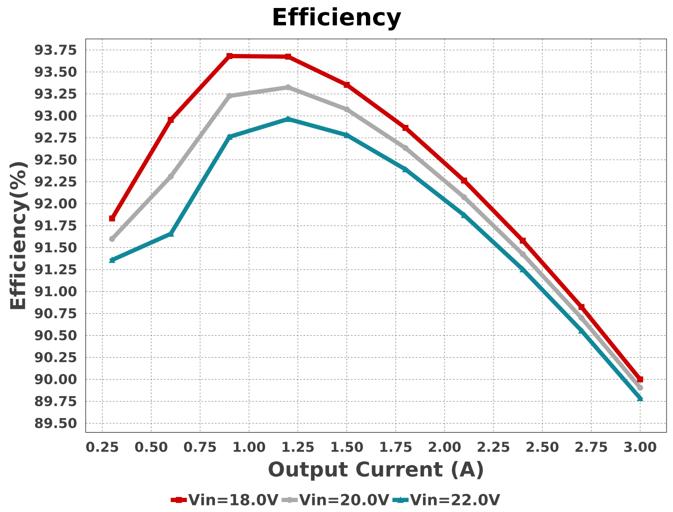
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.10	1206 11 mm^2
Cout	MuRata	GRM21BR61A226ME44L Series= X5R	Cap= 22.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 3.84 A	3	$0.09	0805 7 mm^2
Cvcc	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
L1	TDK	VLP8040T-3R3N	L= 3.3 µH 20.0 mOhm	1	$0.22	VLP8040 113 mm^2
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW060334K8FKEA Series= CRCW..e3	Res= 34.8 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rt	Vishay-Dale	CRCW040219K6FKED Series= CRCW..e3	Res= 19.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LMQ66430R5RXBR	Switcher	1	$1.29	RXB0014A 13 mm^2

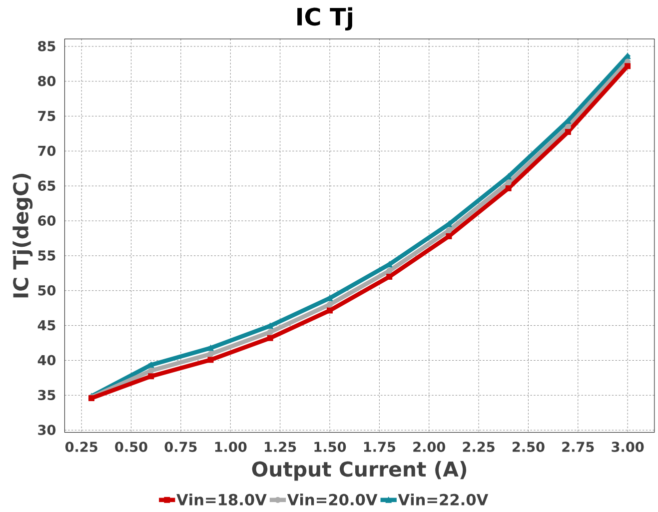

L Ipp
L Ipp(A)
Output Current (A)
Vin=18.0V
Vin=20.0V
Vin=22.0V

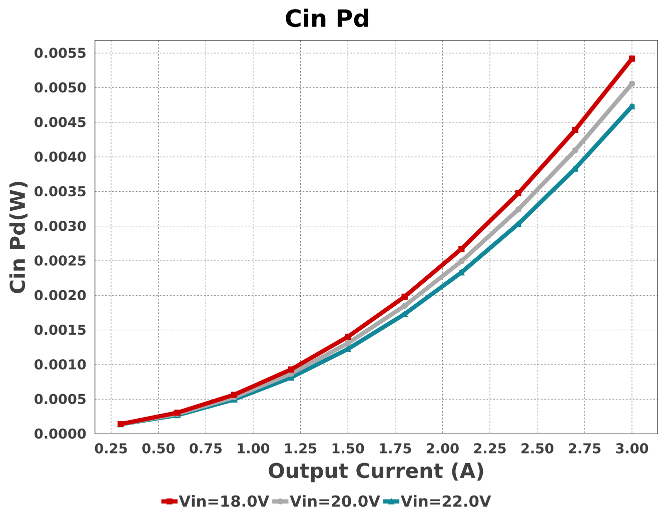

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=18.0V
Vin=20.0V
Vin=22.0V

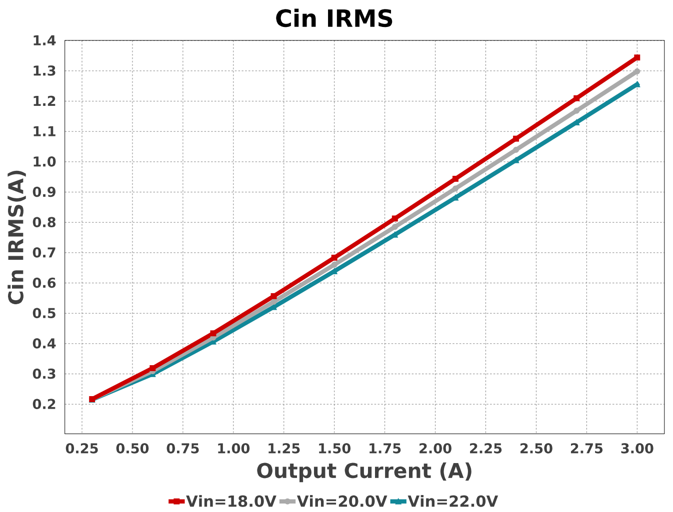

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=18.0V
Vin=20.0V
Vin=22.0V

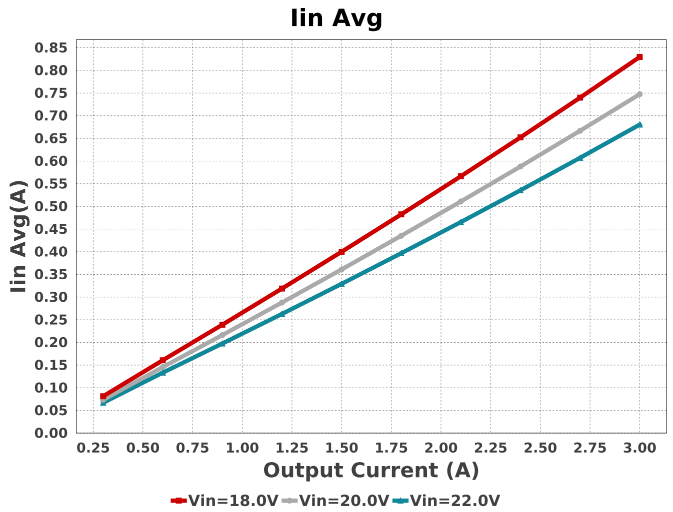

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=18.0V
Vin=20.0V
Vin=22.0V

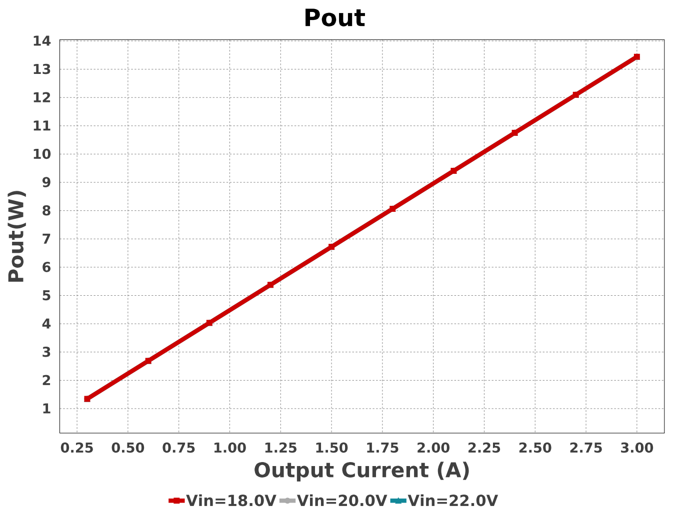

Efficiency
Efficiency(%)
Output Current (A)
Vin=18.0V
Vin=20.0V
Vin=22.0V

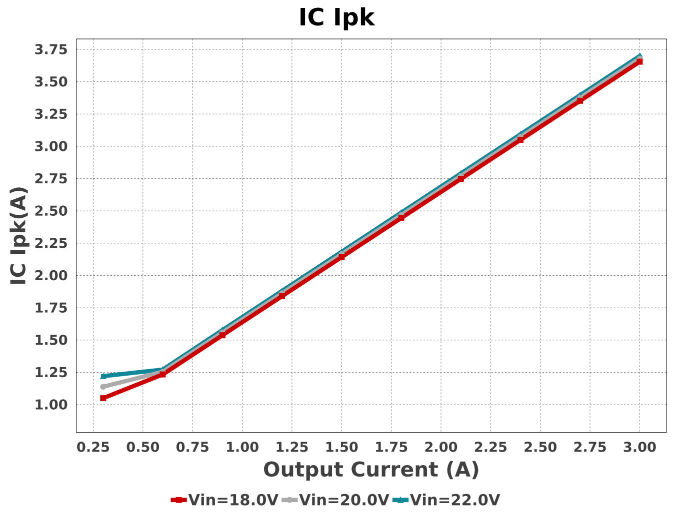

IC Tj
IC Tj(degC)
Output Current (A)
Vin=18.0V
Vin=20.0V
Vin=22.0V

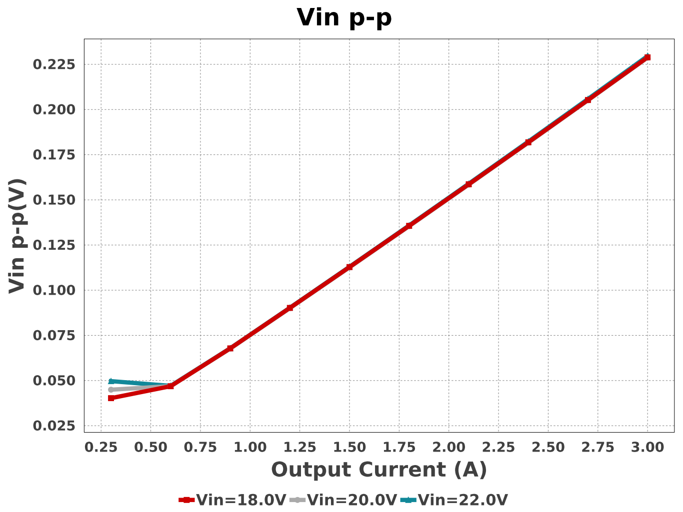

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

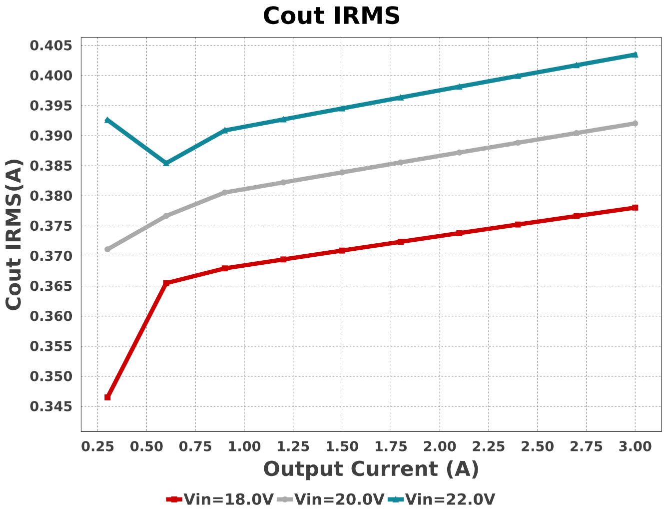

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

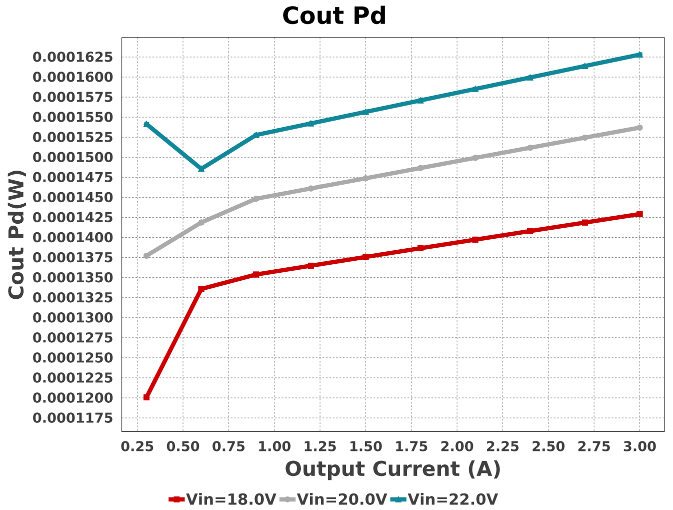

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

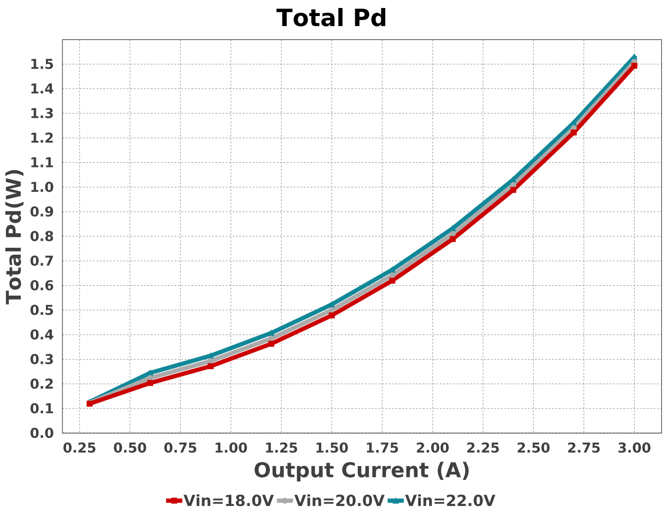

Pout
Pout(W)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

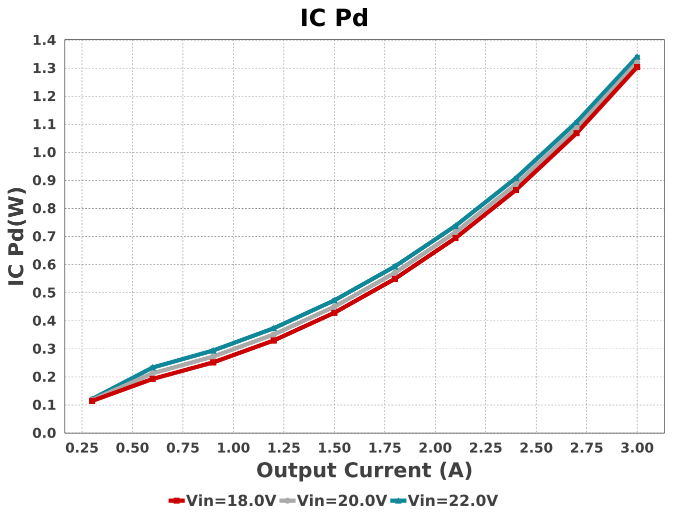

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

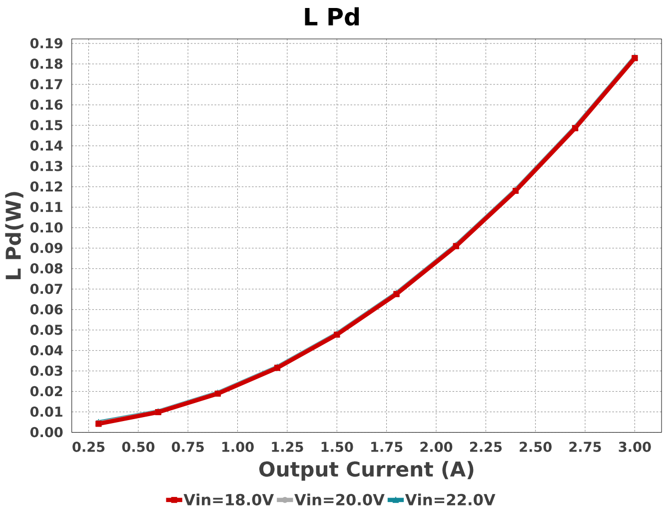

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

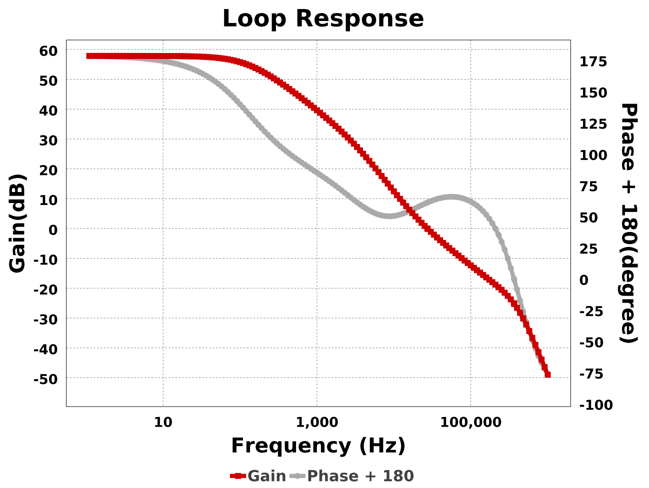

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V

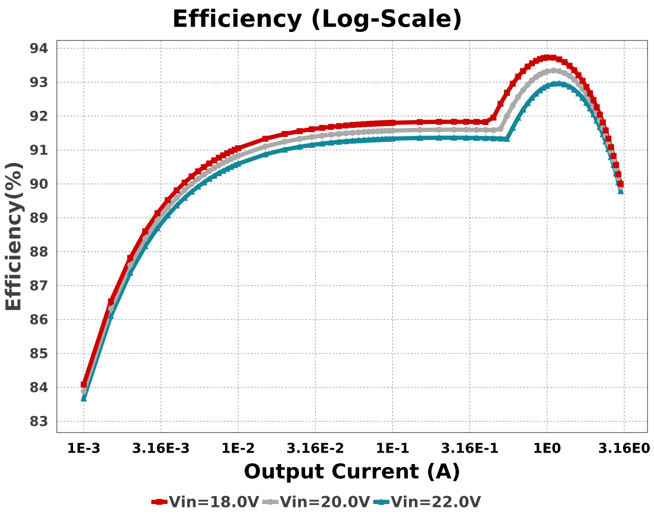

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V


L Pd
L Pd(W)
Output Current (A)
Vin=18.0V Vin=20.0V Vin=22.0V


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



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.256 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	4.73 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	403.484 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	162.8 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	3.699 A	IC	Peak switch current in IC
6.	IC Pd	1.419 W	IC	IC power dissipation
7.	IC Tj	86.763 degC	IC	IC junction temperature
8.	IC Tolerance	12.5 mV	IC	IC Feedback Tolerance
9.	ICThetaJA Effective	40.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	683.99 mA	IC	Average input current
11.	Ipp percentage	46.59 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	1.398 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	183.26 mW	Inductor	Inductor power dissipation
14.	Cin Pd	4.73 mW	Power	Input capacitor power dissipation
15.	Cout Pd	162.8 µW	Power	Output capacitor power dissipation
16.	IC Pd	1.419 W	Power	IC power dissipation
17.	L Pd	183.26 mW	Power	Inductor power dissipation
18.	Total Pd	1.608 W	Power	Total Power Dissipation
19.	BOM Count	10	System Information	Total Design BOM count
20.	Cross Freq	27.221 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	21.935 %	System Information	Duty cycle
22.	Efficiency	89.316 %	System Information	Steady state efficiency
23.	FootPrint	173.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	810.37 kHz	System Information	Switching frequency
25.	Gain Marg	-25.285 dB	System Information	Bode Plot Gain Margin
26.	Iout	3.0 A	System Information	Iout operating point
27.	Low Freq Gain	57.836 dB	System Information	Gain at 1Hz
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	62.112 deg	System Information	Bode Plot Phase Margin
30.	Pout	13.44 W	System Information	Total output power
31.	Total BOM	$1.92	System Information	Total BOM Cost
32.	Vin	22.0 V	System Information	Vin operating point
33.	Vin p-p	229.596 mV	System Information	Peak-to-peak input voltage
34.	Vout	4.48 V	System Information	Operational Output Voltage

#	Name	Value	Category	Description
35.	Vout Actual	4.48 V	System Information	Vout Actual calculated based on selected voltage divider resistors
36.	Vout Tolerance	2.839 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	6.451 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	22.0	Maximum input voltage
VinMin	18.0	Minimum input voltage
Vout	4.48	Output Voltage
base_pn	LMQ66430R5RXBR	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

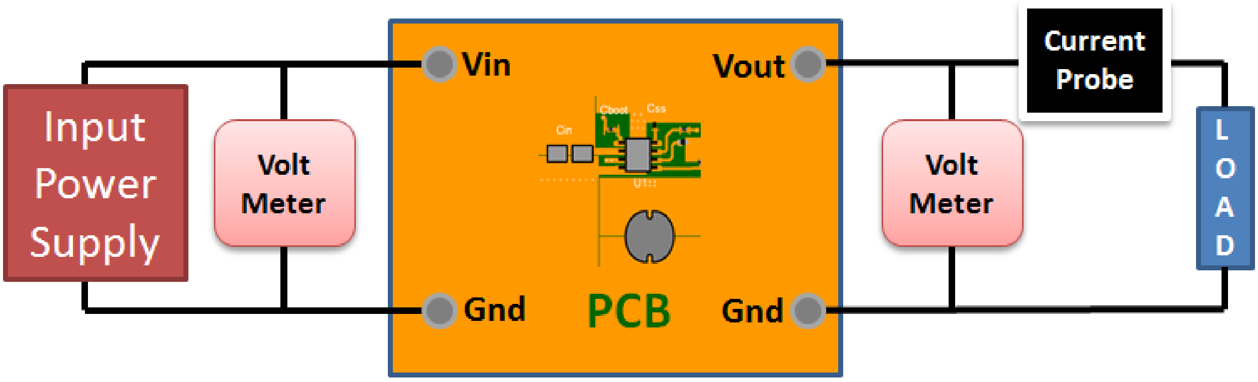
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 : FA18F53613775EC5[v1]

2. **LMQ66430R5RXBR** Product Folder : http://www.ti.com/product/LMQ66430 : contains the data sheet and other resources.

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