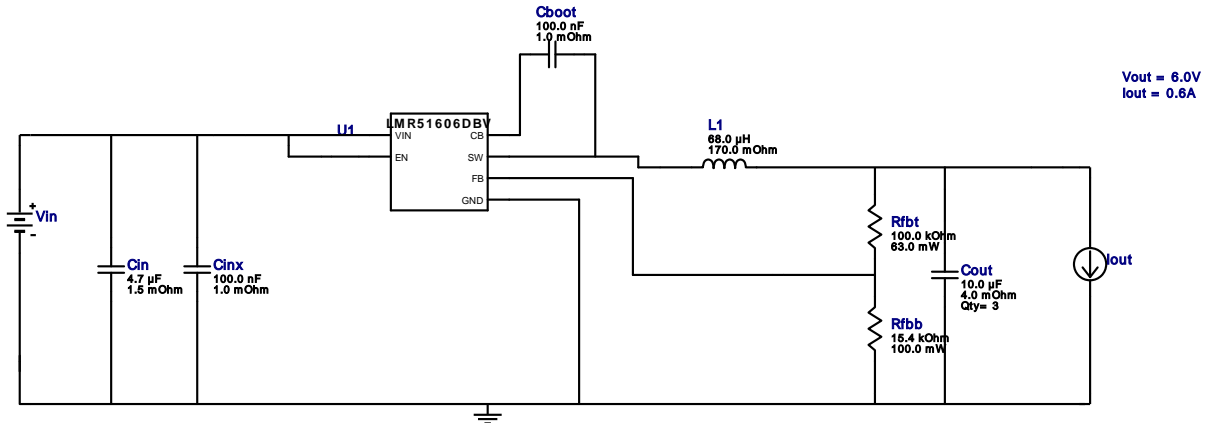




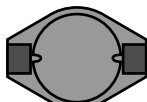





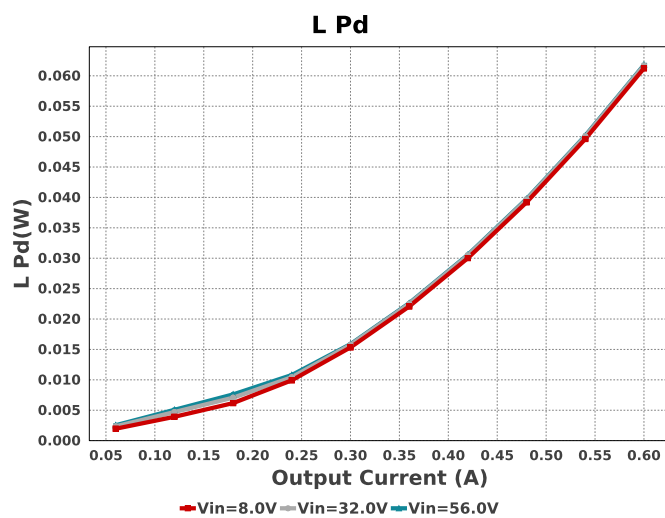
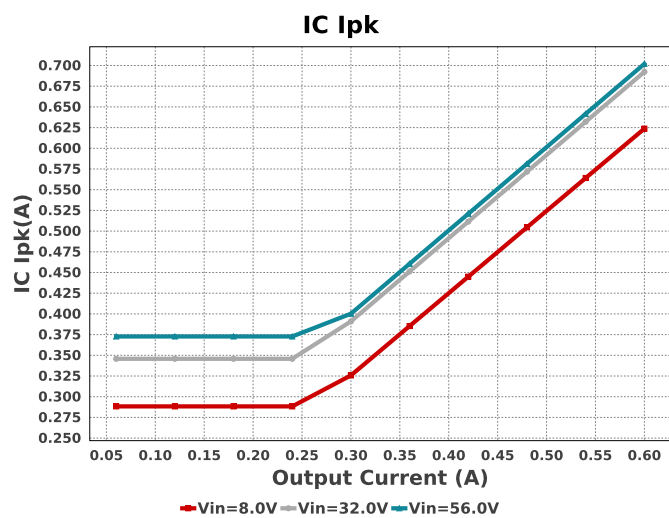
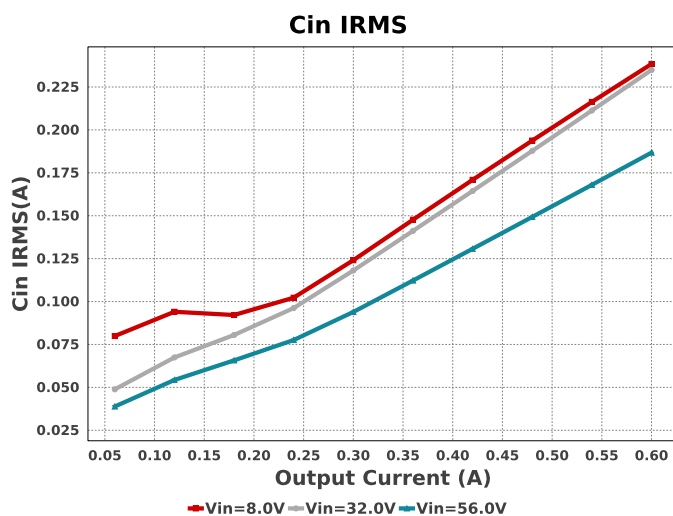
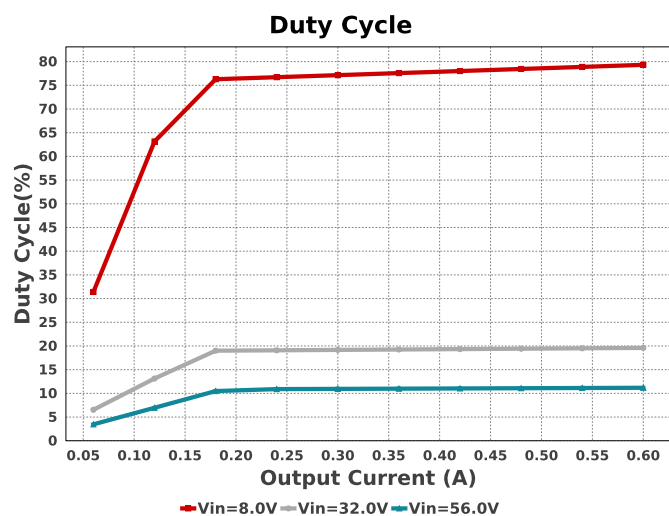
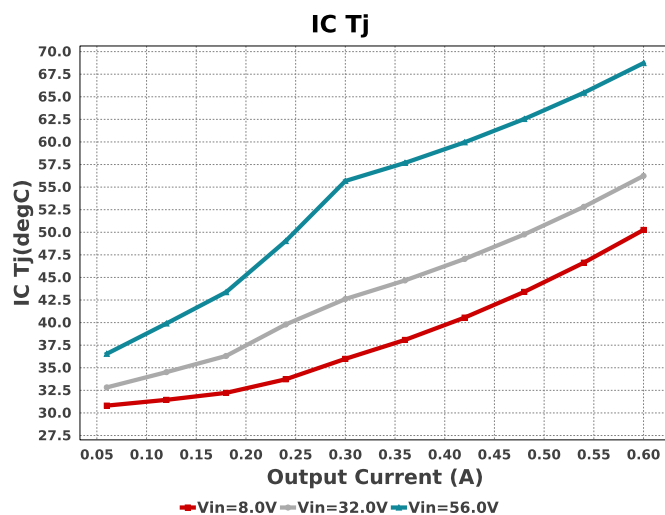
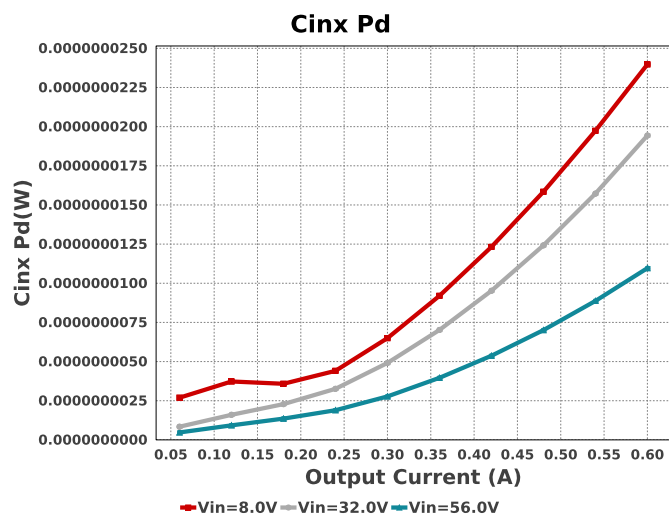
WEBENCH® Design Report

Design : 3 LMR51606DBVR
LMR51606DBVR 8V-56V to 6.00V @ 0.6A

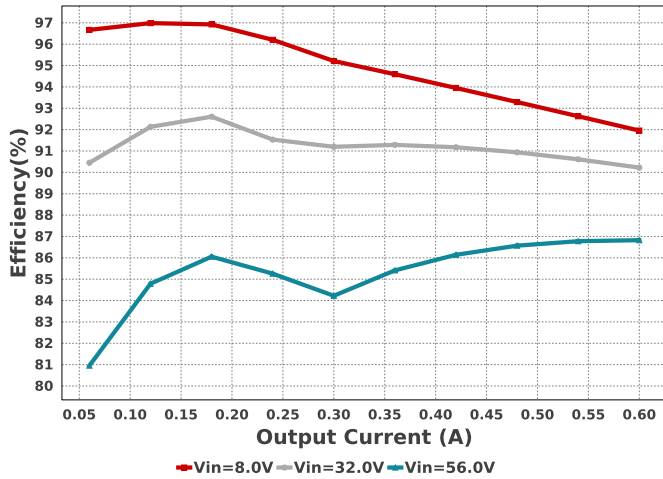


Electrical BOM

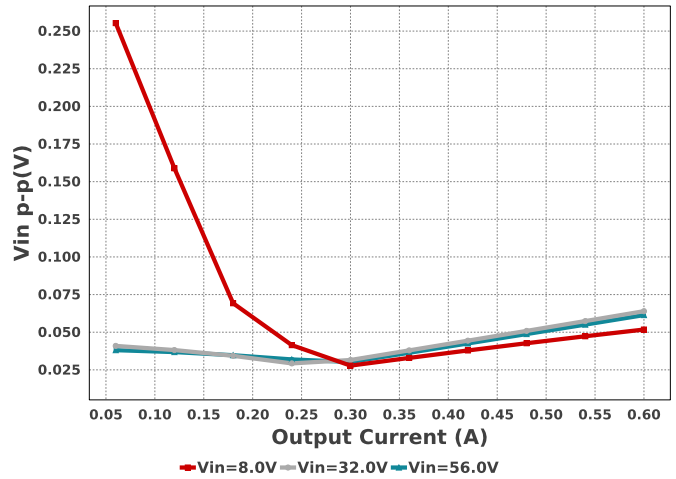
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
Cin	TDK	C5750X7R2A475M230KA Series= X7R	Cap= 4.7 uF ESR= 1.5 mOhm VDC= 100.0 V IRMS= 5.5 A	1	\$0.86	 2220_280 54 mm ²
Cinx	MuRata	GRM188R72A104KA35D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 3.85 A	1	\$0.04	 0603 5 mm ²
Cout	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	3	\$0.04	 0805 7 mm ²
L1	NIC Components	NPI34W680MTRF	L= 68.0 uH 170.0 mOhm	1	\$0.25	 IND_NPI34W 172 mm ²
Rfbb	Vishay-Dale	CRCW060315K4FKEA Series= CRCW..e3	Res= 15.4 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 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
U1	Texas Instruments	LMR51606DBVR	Switcher	1	\$0.40	 DBV0006A 15 mm ²



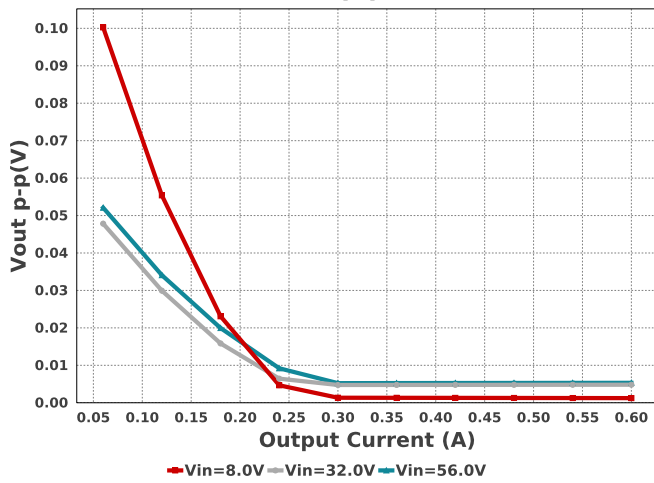
Efficiency



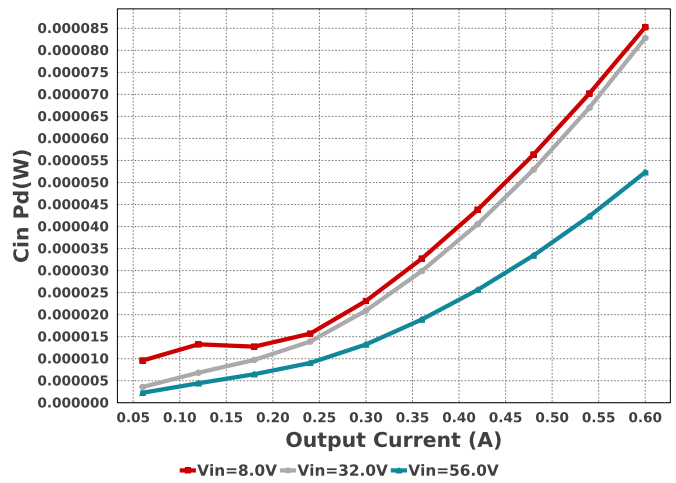
Vin p-p



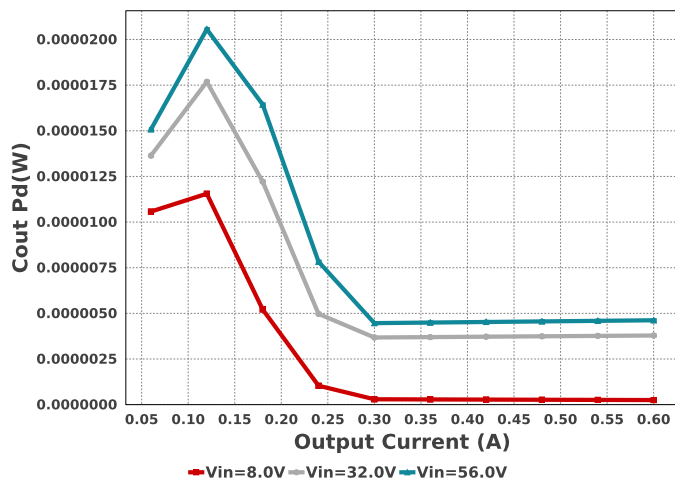
Vout p-p



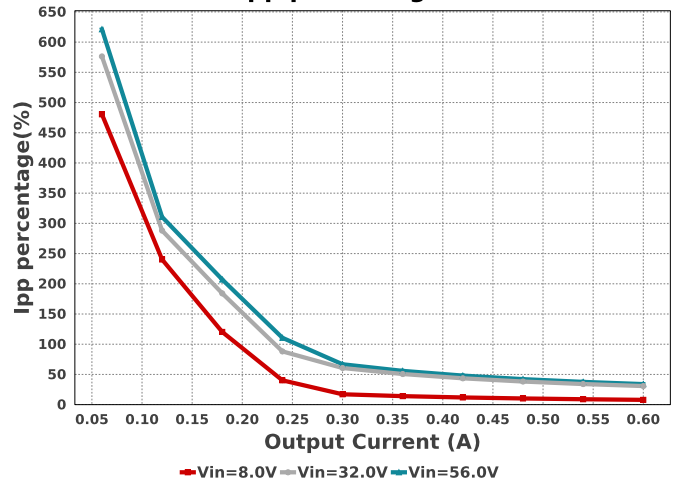
Cin Pd

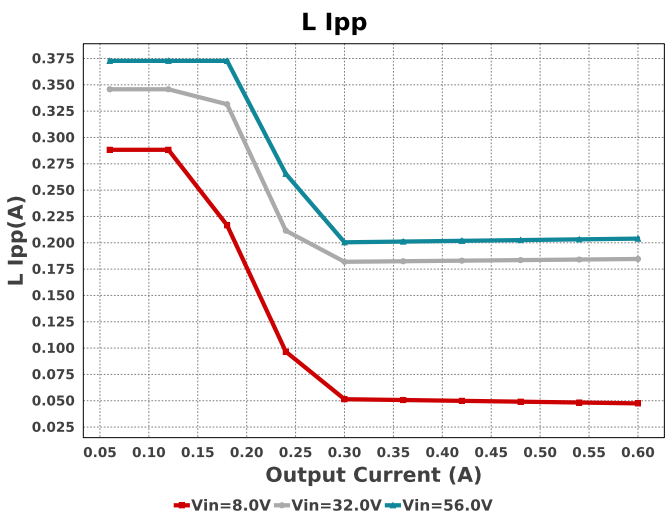
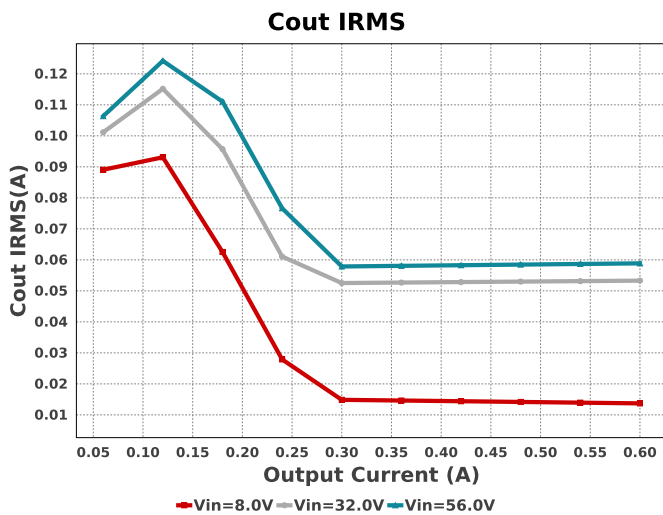
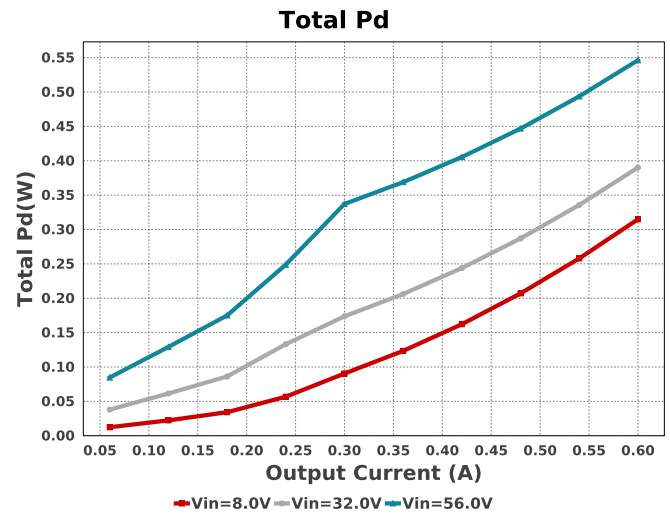
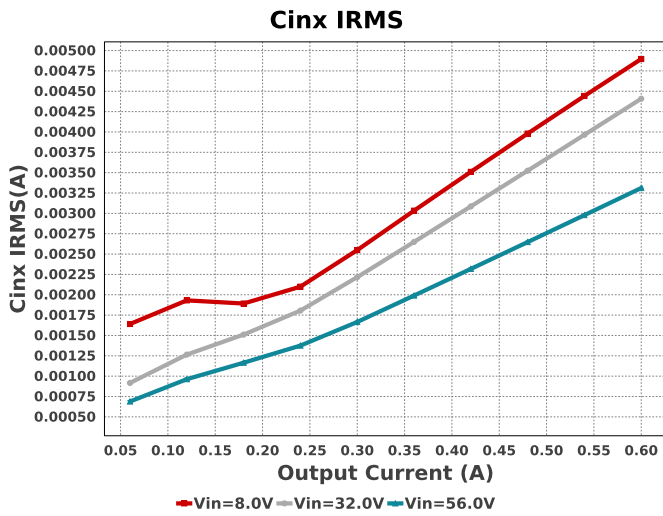
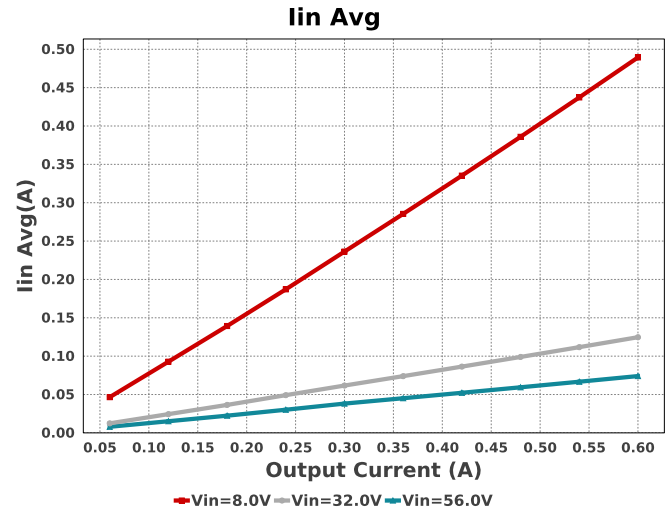
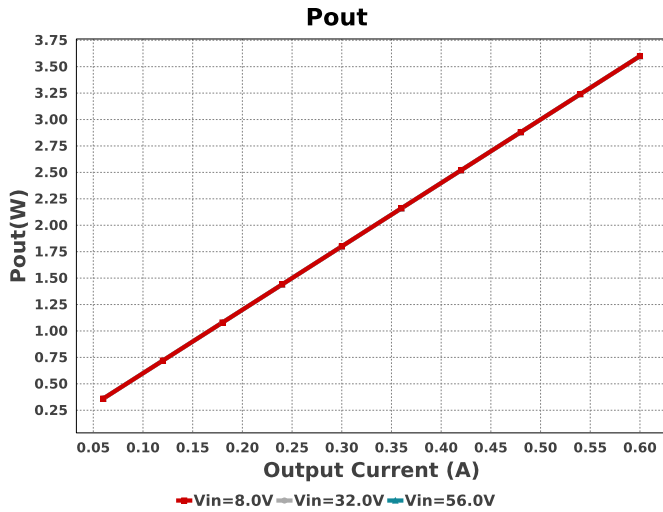


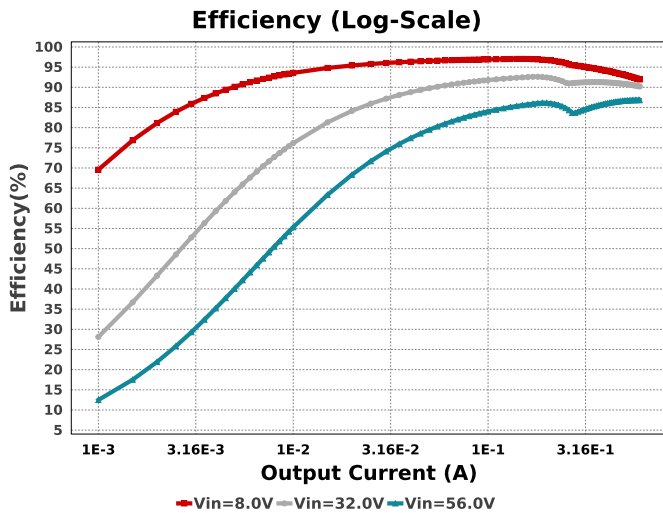
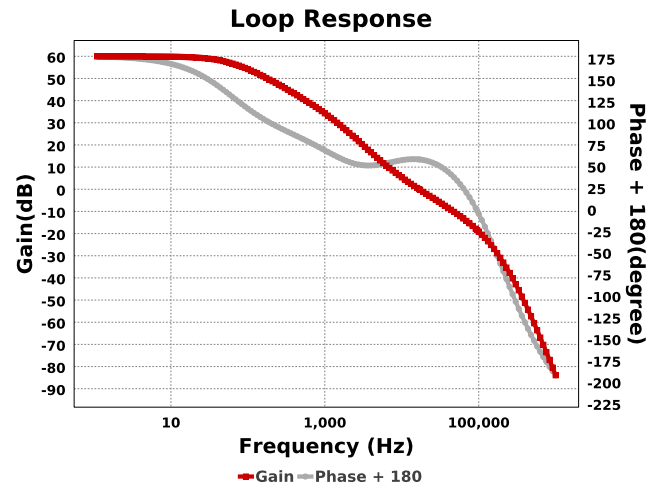
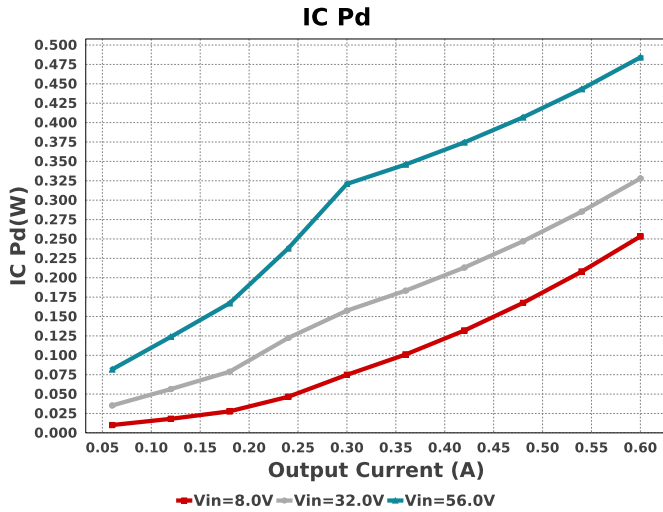
Cout Pd



Ipp percentage







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	186.765 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	52.322 μ W	Capacitor	Input capacitor power dissipation
3.	Cinx IRMS	3.311 mA	Capacitor	Bulk capacitor RMS ripple current
4.	Cinx Pd	10.965 nW	Capacitor	Bulk capacitor power dissipation
5.	Cout IRMS	58.874 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	4.621 μ W	Capacitor	Output capacitor power dissipation
7.	IC Ipk	701.972 mA	IC	Peak switch current in IC
8.	IC Pd	484.11 mW	IC	IC power dissipation
9.	IC Tj	68.728 degC	IC	IC junction temperature
10.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA Effective	80.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
12.	Iin Avg	74.04 mA	IC	Average input current
13.	Ipp percentage	33.991 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	203.94 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	61.789 mW	Inductor	Inductor power dissipation
16.	Cin Pd	52.322 μ W	Power	Input capacitor power dissipation
17.	Cinx Pd	10.965 nW	Power	Bulk capacitor power dissipation
18.	Cout Pd	4.621 μ W	Power	Output capacitor power dissipation
19.	IC Pd	484.11 mW	Power	IC power dissipation
20.	L Pd	61.789 mW	Power	Inductor power dissipation
21.	Total Pd	546.267 mW	Power	Total Power Dissipation
22.	BOM Count	10	System	Total Design BOM count
23.	Cross Freq	16.892 kHz	System	Bode plot crossover frequency
24.	Duty Cycle	11.178 %	System	Duty cycle
25.	Efficiency	86.825 %	System	Steady state efficiency
26.	FootPrint	277.0 mm ²	System	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
27.	Frequency	400.0 kHz	System Information	Switching frequency
28.	Gain Marg	-18.444 dB	System Information	Bode Plot Gain Margin
29.	Inductor ripple current requirement used for Inductor selection	40.0 %	System Information	Custom Inductor ripple current (% of average inductor current) requirement used for Inductor selection
30.	Iout	600.0 mA	System Information	Iout operating point
31.	Iout transient step used for Cout calculations	300.0 mA	System Information	Custom Transient current step requirement that was used for Cout selection (A).
32.	Low Freq Gain	59.935 dB	System Information	Gain at 1Hz
33.	Mode	CCM	System Information	Conduction Mode
34.	Overshoot Value	42.547 mV	System Information	Theoretical Vout Overshoot Value
35.	Phase Marg	59.608 deg	System Information	Bode Plot Phase Margin
36.	Pout	3.6 W	System Information	Total output power
37.	Total BOM	\$1.7	System Information	Total BOM Cost
38.	Undershoot Value	60.972 mV	System Information	Theoretical Vout Undershoot Value
39.	Vin	56.0 V	System Information	Vin operating point
40.	Vin p-p	61.368 mV	System Information	Peak-to-peak input voltage
41.	Vout	6.0 V	System Information	Operational Output Voltage
42.	Vout Actual	5.995 V	System Information	Vout Actual calculated based on selected voltage divider resistors
43.	Vout Ripple requirement used for Cout calculations	3.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
44.	Vout Tolerance	3.277 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
45.	Vout p-p	5.326 mV	System Information	Peak-to-peak output ripple voltage
46.	Vout transient requirement used for Cout calculations	3.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	600.0 m	Maximum Output Current
VinMax	56.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	6.0	Output Voltage
base_pn	LMR51606	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 8.0V 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. Master key : E03FC439211E3F9A5803B0C08B508BCF[v1]
2. **LMR51606** Product Folder : <http://www.ti.com/product/LMR51606> : contains the data sheet and other resources.

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