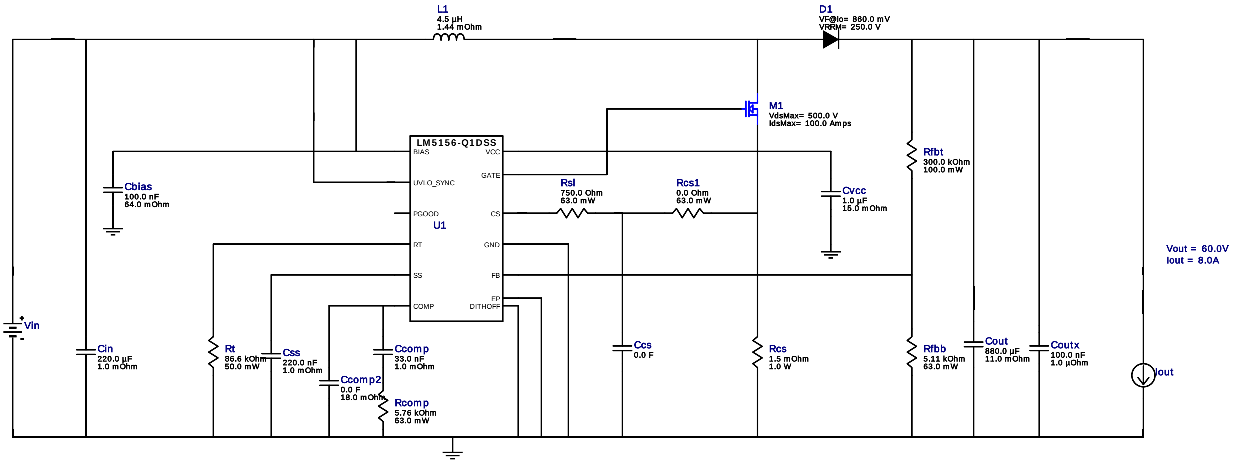
VinMin = 14.0V
VinMax = 16.0V
Vout = 60.0V
Iout = 8.0A

Device = LM5156QDSSRQ1
Topology = Boost
Created = 2021-11-10 12:55:54.542
BOM Cost = NA
BOM Count = 20
Total Pd =

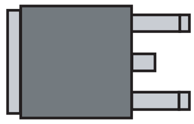
WEBENCH ® Design Report

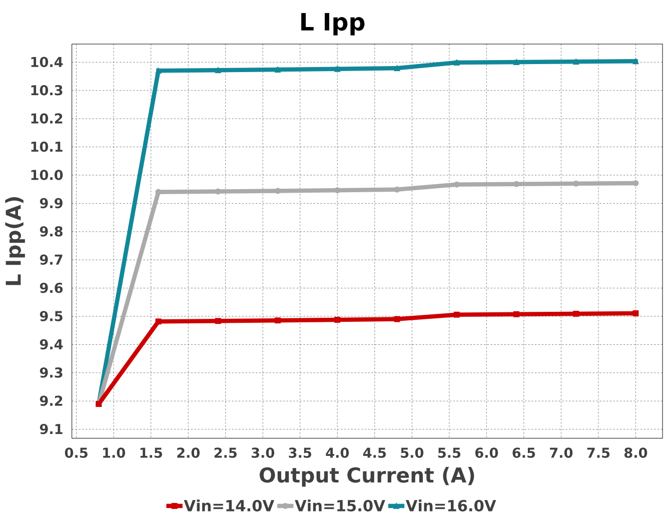
Design : 1 LM5156QDSSRQ1
LM5156QDSSRQ1 14V-16V to 60.00V @ 8A

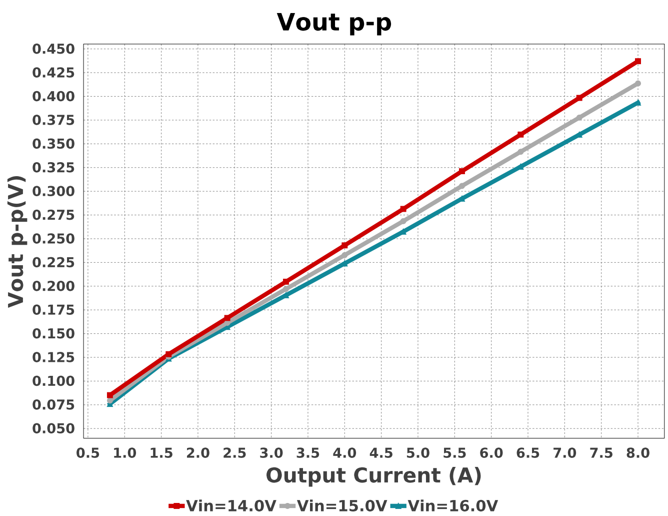


Electrical BOM

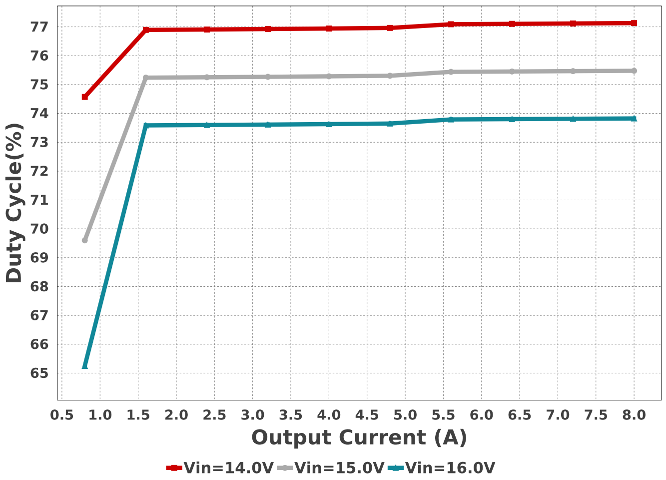
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbias	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Ccomp	MuRata	GRM155R71E333KA88D Series= X7R	Cap= 33.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	CUSTOM	CUSTOM Series= X7R	Cap= 0.0 F ESR= 18.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	NA	0805 0 mm^2
Ccs	CUSTOM	CUSTOM Series= C0G/NP0	Cap= 0.0 F VDC= 50.0 V IRMS= 0.0 A	1	NA	0402 0 mm^2
Cin	CUSTOM	CUSTOM Series= ?	Cap= 220.0 uF ESR= 1.0 mOhm VDC= 24.0 V IRMS= 46.323 A	1	NA	CUSTOM 0 mm^2
Cout	CUSTOM	CUSTOM Series= ?	Cap= 880.0 uF ESR= 11.0 mOhm VDC= 90.0 V IRMS= 36.912 A	1	NA	CUSTOM 0 mm^2
Coutx	CUSTOM	CUSTOM Series= ?	Cap= 100.0 nF ESR= 1.0 uOhm VDC= 120.0 V IRMS= 36.912 A	1	NA	CUSTOM 0 mm^2
Css	MuRata	GRM155R71C224KA12D Series= X7R	Cap= 220.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm^2
Cvcc	Kemet	C0805C105K4RACTU Series= X7R	Cap= 1.0 uF ESR= 15.0 mOhm VDC= 16.0 V IRMS= 8.19 A	1	$0.02	0805 7 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
D1	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	$0.94	 DDPAK 210 mm²
L1	CUSTOM	CUSTOM	L= 4.5 µH 1.44 mOhm	1	NA	CUSTOM 0 mm²
M1	NA	IdealFET	VdsMax= 500.0 V IdsMax= 100.0 Amps	1	NA	NA 0 mm²
M1	NA	IdealFET	VdsMax= 500.0 V IdsMax= 100.0 Amps	1	NA	NA 0 mm²
Rcomp	Vishay-Dale	CRCW04025K76FKED Series= CRCW..e3	Res= 5.76 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rcs	Panasonic	ERJ-M1WTF1M5U Series= ERJ	Res= 1.5 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.17	2512 43 mm²
Rcs1	CUSTOM	CUSTOM Series= CRCW..e3	Res= 0.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm²
Rfbb	Vishay-Dale	CRCW04025K11FKED Series= CRCW..e3	Res= 5.11 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Susumu Co Ltd	RR1220P-304-D Series= RR12	Res= 300.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	0805 7 mm²
Rsl	Vishay-Dale	CRCW0402750RFKED Series= CRCW..e3	Res= 750.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rt	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
U1	Texas Instruments	LM5156QDSSRQ1	Switcher	1	$0.86	DSS0012B 12 mm²

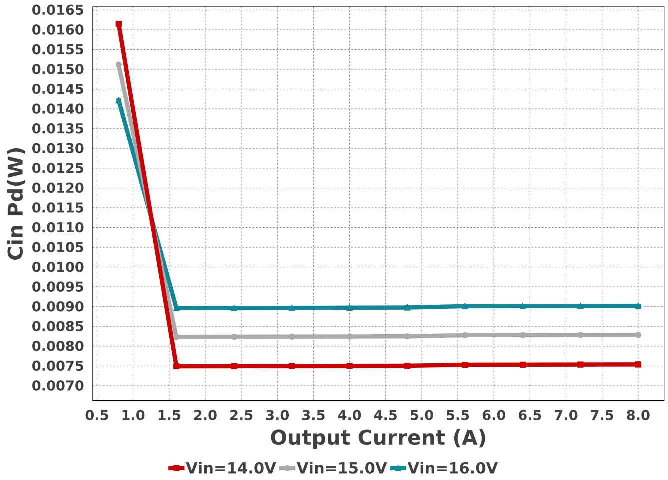




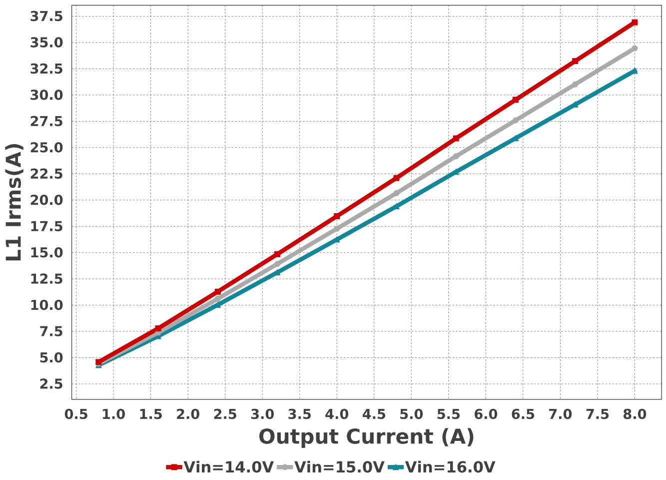
Duty Cycle



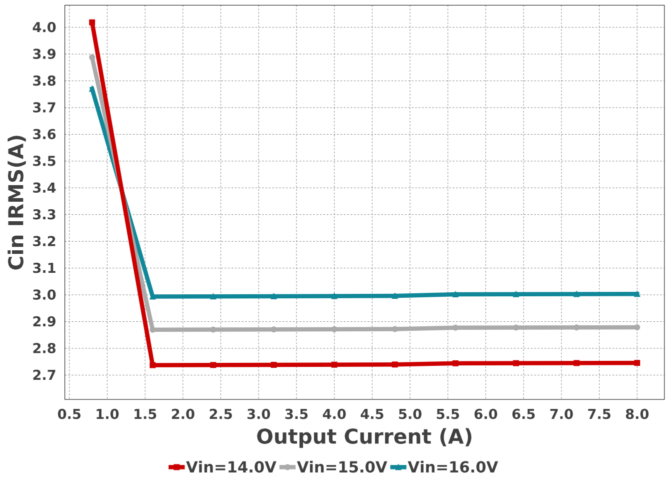
Cin Pd



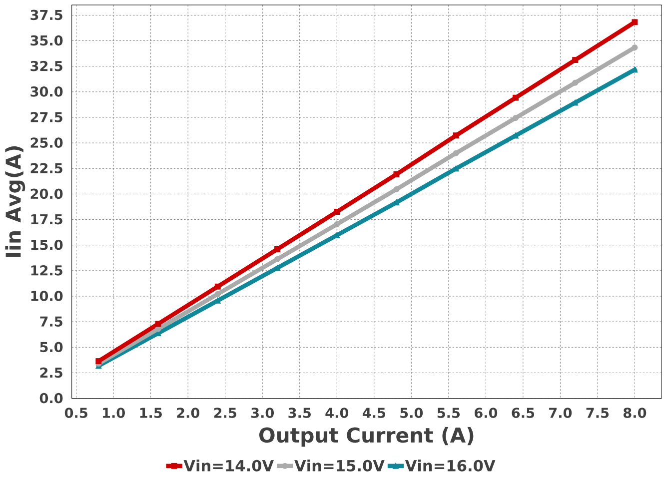
L1 Irms



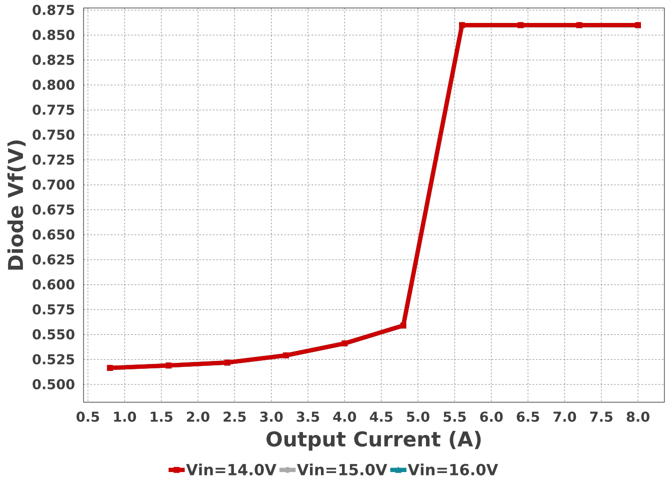
Cin IRMS

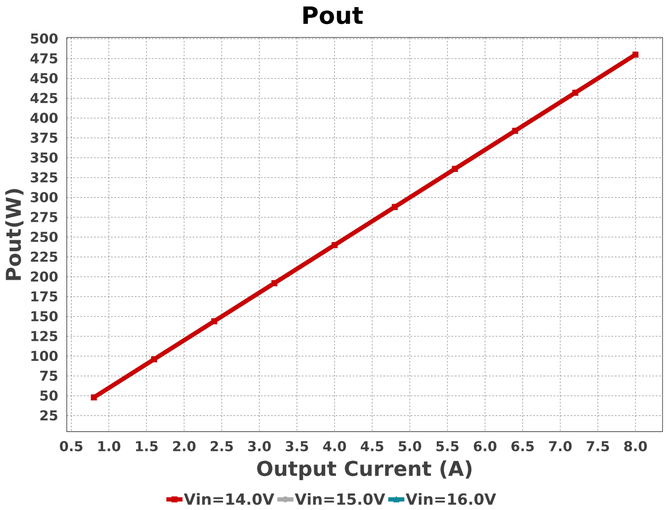


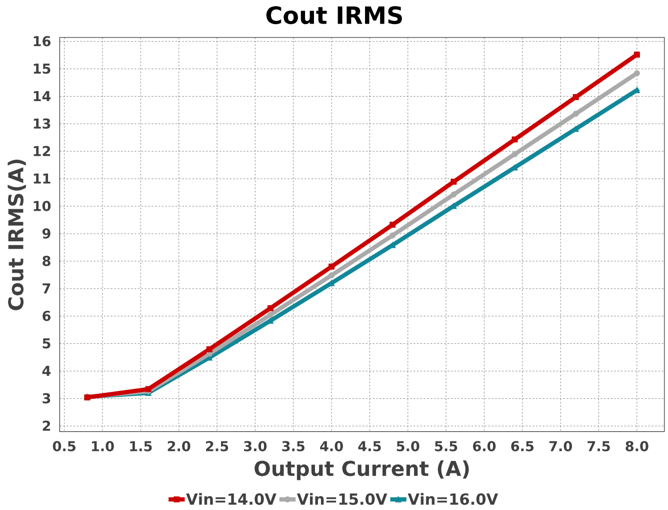
Iin Avg

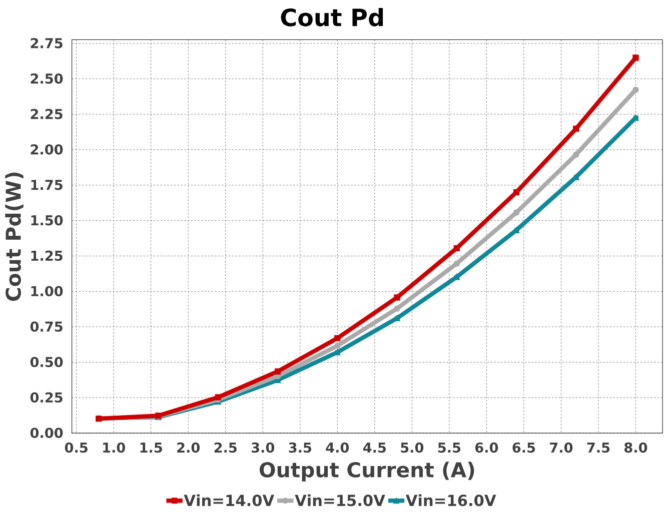


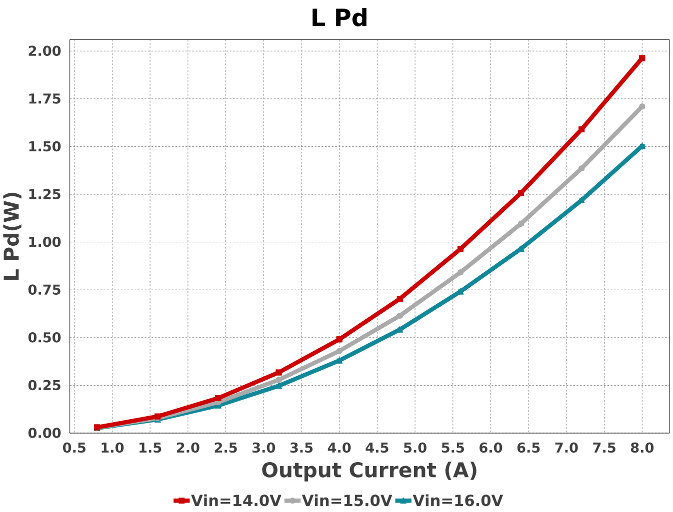
Diode Vf

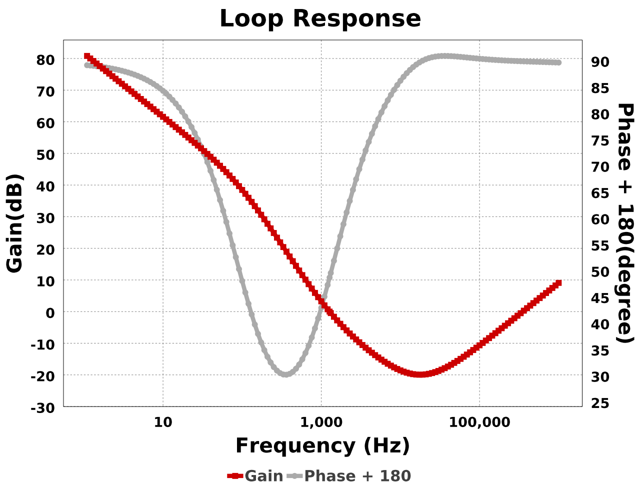












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	20		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	2.745 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	7.538 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	15.519 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	2.649 W	Capacitor	Output capacitor power dissipation
7.	Diode Vf	860.0 mV	Diode	Forward voltage drop of diode D1
8.	ICThetaJA	41.3 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	36.817 A	IC	Average input current
10.	L Ipp	9.511 A	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	1.963 W	Inductor	Inductor power dissipation

#	Name	Value	Category	Description
12.	L1 Irms	36.92 A	Inductor	Inductor ripple current
13.	Cin Pd	7.538 mW	Power	Input capacitor power dissipation
14.	Cout Pd	2.649 W	Power	Output capacitor power dissipation
15.	L Pd	1.963 W	Power	Inductor power dissipation
16.	Cross Freq	1.166 kHz	System Information	Bode plot crossover frequency
17.	Duty Cycle	77.13 %	System Information	Duty cycle
18.	FootPrint	647.0 mm^2	System Information	Total Foot Print Area of BOM components
19.	Frequency	252.298 kHz	System Information	Switching frequency
20.	Iout	8.0 A	System Information	Iout operating point
21.	Mode	CCM	System Information	Conduction Mode
22.	Phase Marg	45.705 deg	System Information	Bode Plot Phase Margin
23.	Pout	480.0 W	System Information	Total output power
24.	Vin	14.0 V	System Information	Vin operating point
25.	Vout Actual	59.708 V	System Information	Vout Actual calculated based on selected voltage divider resistors
26.	Vout Tolerance	4.129 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
27.	Vout p-p	437.095 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	8.0	Maximum Output Current
VinMax	16.0	Maximum input voltage
VinMin	14.0	Minimum input voltage
Vout	60.0	Output Voltage
base_pn	LM5156-Q1	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	250.0 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

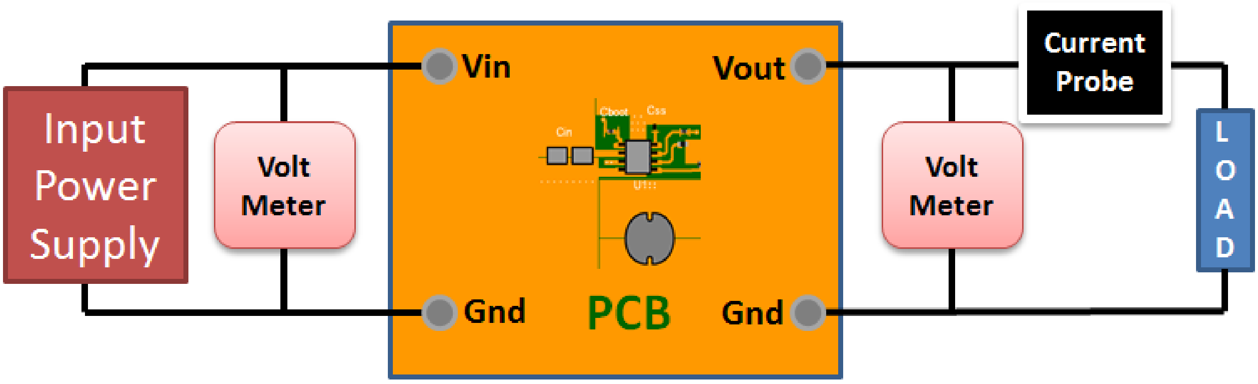
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 14.0V 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.

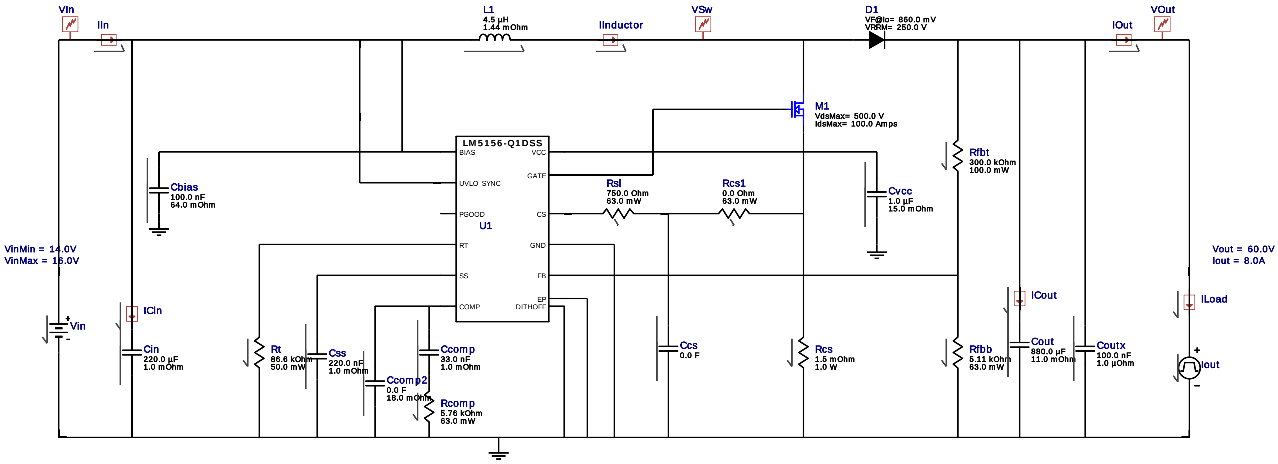


WEBENCH® Electrical Simulation Report

Design Id = 1

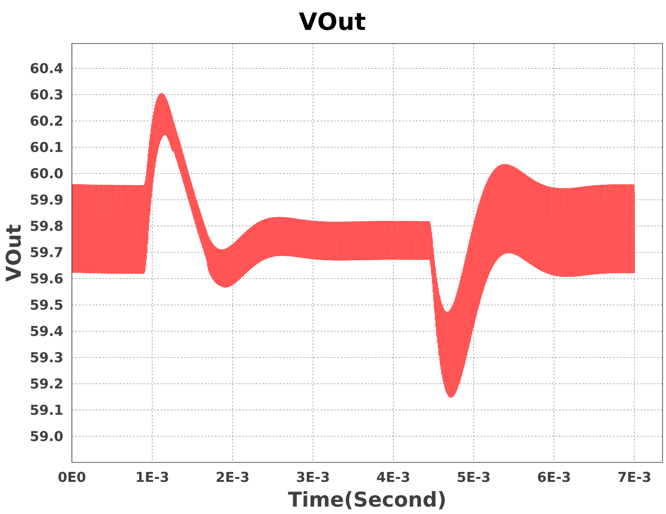
sim_id = 4

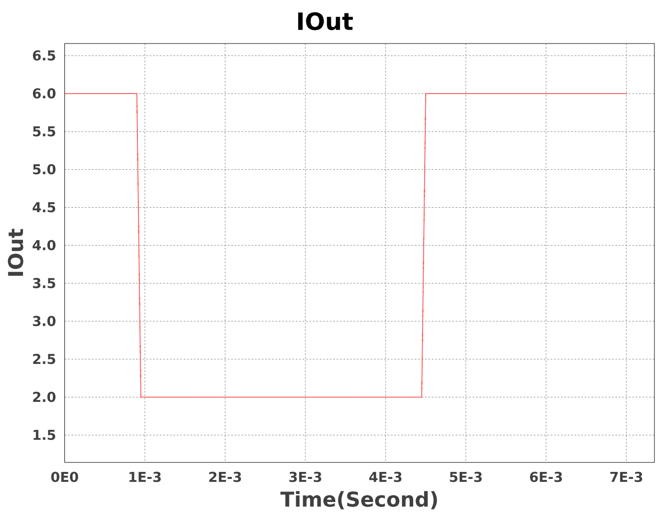
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Css	IC	Initial condition	1
2.	Cvcc	IC	Initial condition	5
3.	Iout	signal_type	Signal Type	PULSE
		I1	Intial current	6.0 A
		I2	Peak Current	2.0 A
		Td	Initial Delay Time	9.0E-4 Sec
		Tr	Rise Time	50u Sec
		Tf	Fall Time	50u Sec
		Pw	Pulse Width	0.0035





Design Assistance

1. Feature Highlights: Output Current up to 10A, up to 60 V Input Voltage Range, Integrated Thermal Protection,Ideal for automotive applications.

2. Master key : BEDEE10F8624C7E0[v1]

3. **LM5156-Q1** Product Folder : http://www.ti.com/product/LM5156%2DQ1 : contains the data sheet and other resources.

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