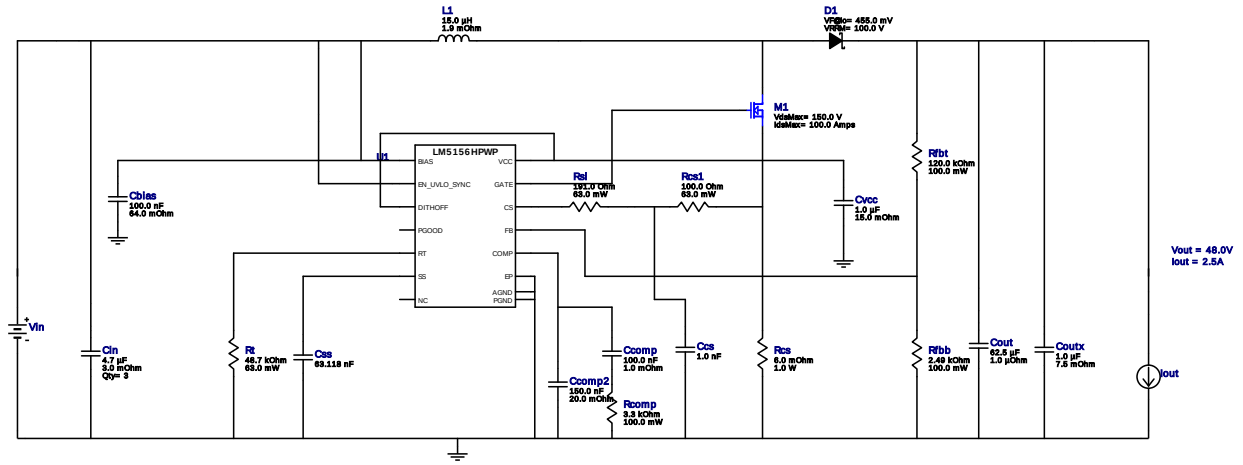
WEBENCH® Design Report

VinMin = 10.0V
VinMax = 30.0V
Vout = 48.0V
Iout = 2.5A

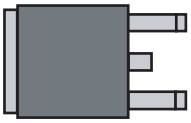
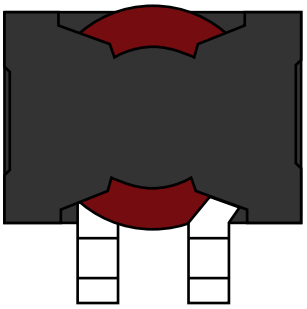
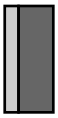
Device = LM5156HPWPR
Topology = Boost
Created = 2021-08-05 23:31:50.128
BOM Cost = NA
BOM Count = 23
Total Pd = 9.31W

Design : 34 LM5156HPWPR
LM5156HPWPR 10V-30V to 48.00V @ 2.5A

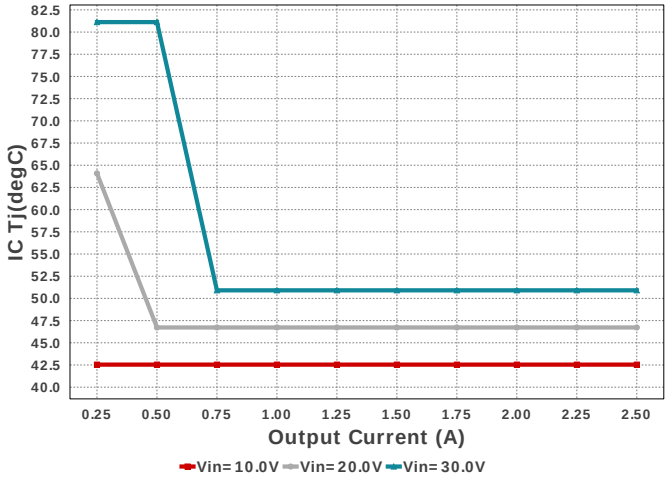


Electrical BOM

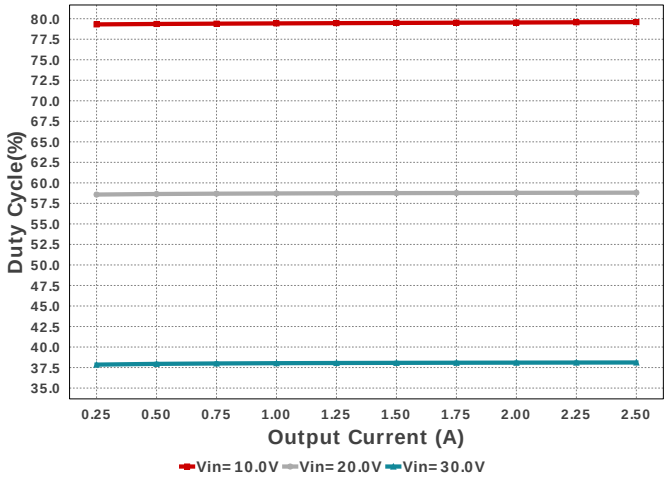
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbias	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Ccomp	Yageo	CC0805KRX7R8BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Ccomp2	MuRata	GRM188R71E154KA01D Series= X7R	Cap= 150.0 nF ESR= 20.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0603 5 mm^2
Ccs	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	3	$0.22	1206 11 mm^2
Cout	CUSTOM	CUSTOM Series= ?	Cap= 62.5 uF ESR= 1.0 uOhm VDC= 72.0 V IRMS= 10.28 A	1	NA	CUSTOM 0 mm^2
Coutx	TDK	C3216X7R2A105M160AA Series= X7R	Cap= 1.0 uF ESR= 7.5 mOhm VDC= 100.0 V IRMS= 5.9235 A	1	$0.12	1206 11 mm^2
Css	CUSTOM	CUSTOM Series= ?	Cap= 63.118 nF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 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	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.33	 DDPAK 210 mm^2
L1	Coilcraft	SER2915H-153KL	L= 15.0 µH 1.9 mOhm	1	$1.95	 SER2915H 652 mm^2
M1	Infineon Technologies	IPP075N15N3GXKSA1	VdsMax= 150.0 V IdsMax= 100.0 Amps	1	$2.88	 TO-220-3 127 mm^2
Rcomp	Susumu Co Ltd	RG1608P-332-B-T5 Series= RG1608	Res= 3.3 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.04	 0603 5 mm^2
Rcs	Susumu Co Ltd	PRL1632-R006-F-T1 Series= PRL1632	Res= 6.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	 0612 11 mm^2
Rcs1	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rfbb	Susumu Co Ltd	RG1608P-2491-B-T5 Series= RG1608	Res= 2.49 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	 0603 5 mm^2
Rfbt	Susumu Co Ltd	RG1608P-124-B-T5 Series= RG1608	Res= 120.0 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	 0603 5 mm^2
Rsl	Vishay-Dale	CRCW0402191RFKED Series= CRCW..e3	Res= 191.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rt	Vishay-Dale	CRCW040248K7FKED Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
U1	Texas Instruments	LM5156HPWPR	Switcher	1	$0.73	PWP0014H 59 mm^2

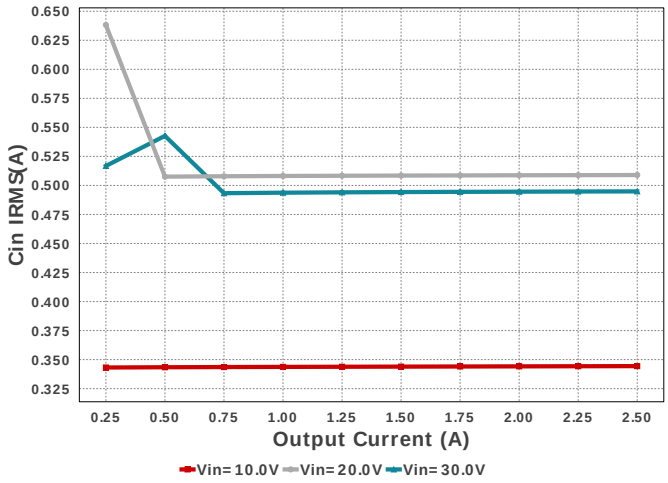
IC Tj



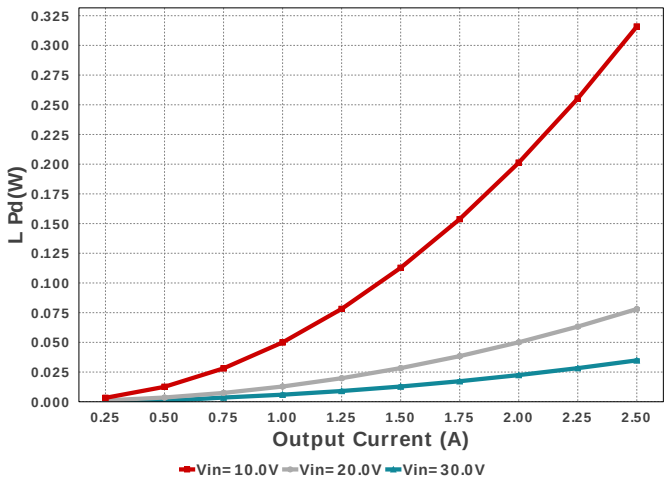
Duty Cycle



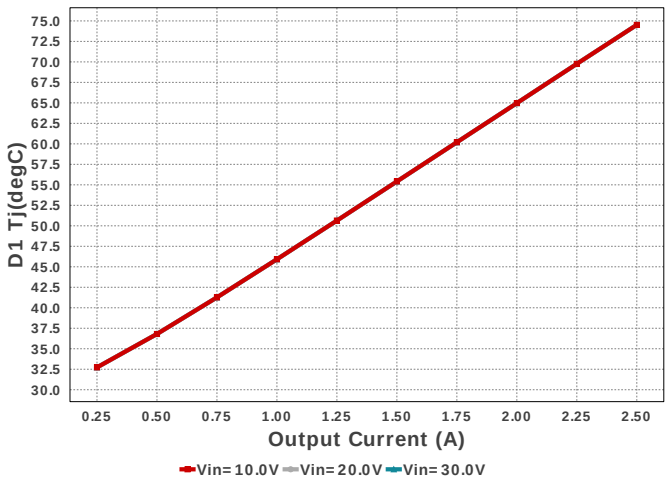
Cin IRMS



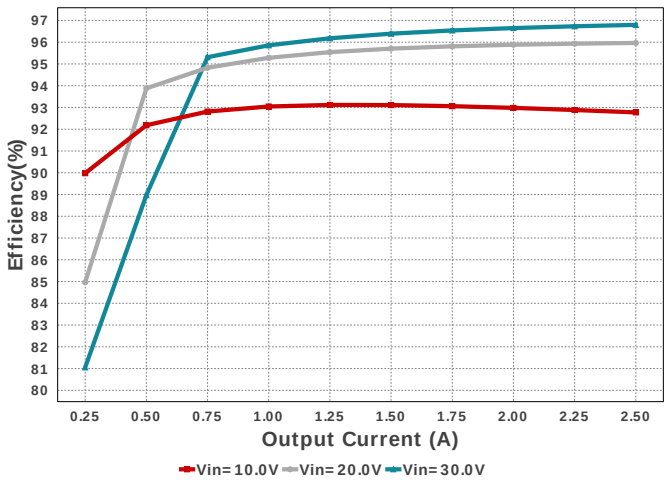
L Pd

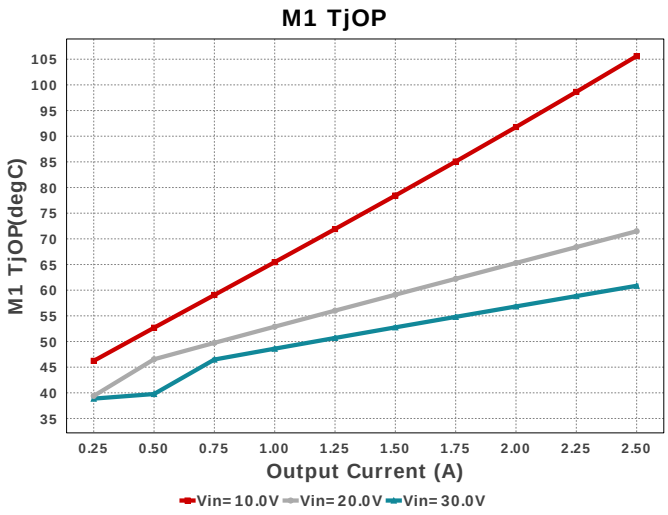


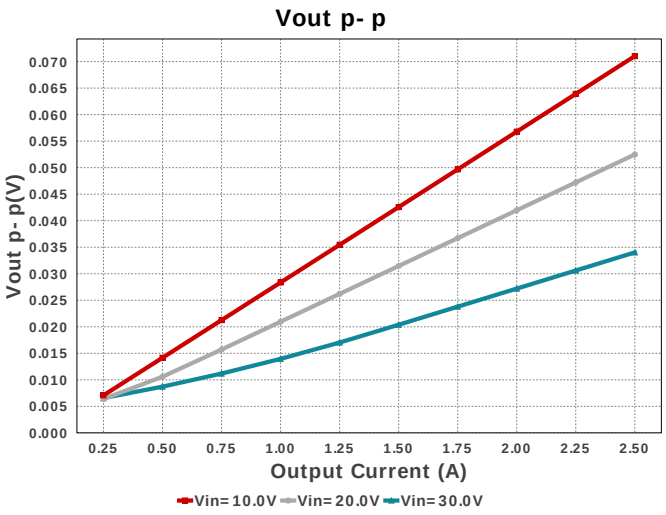
D1 Tj

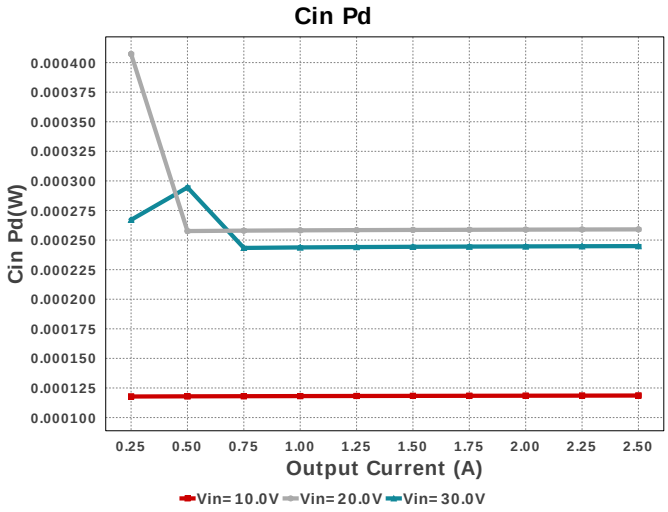


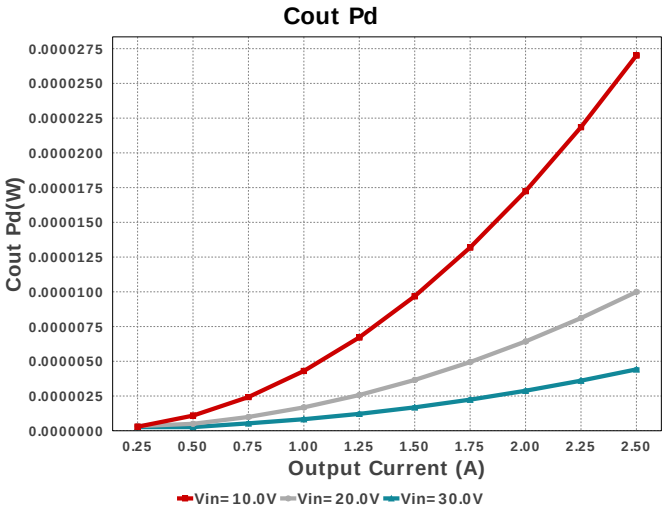
Efficiency

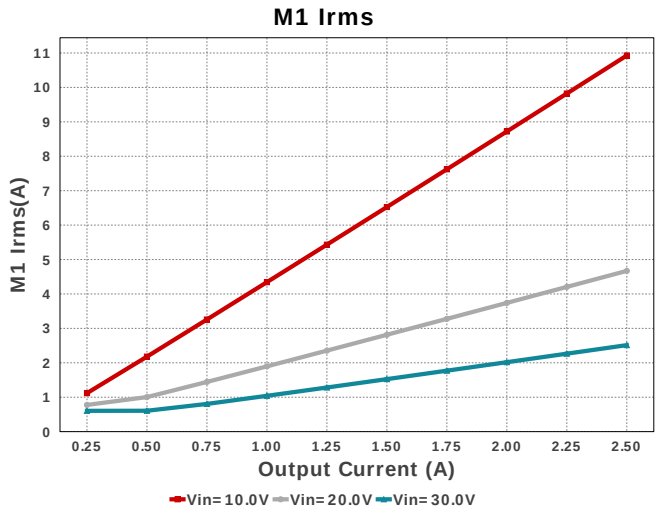


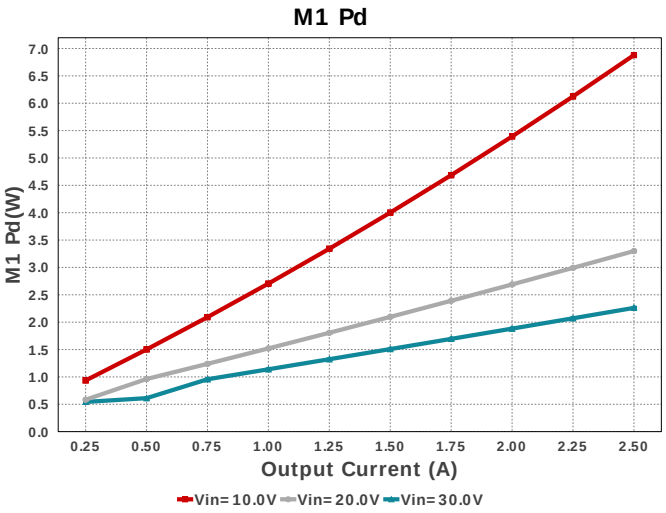


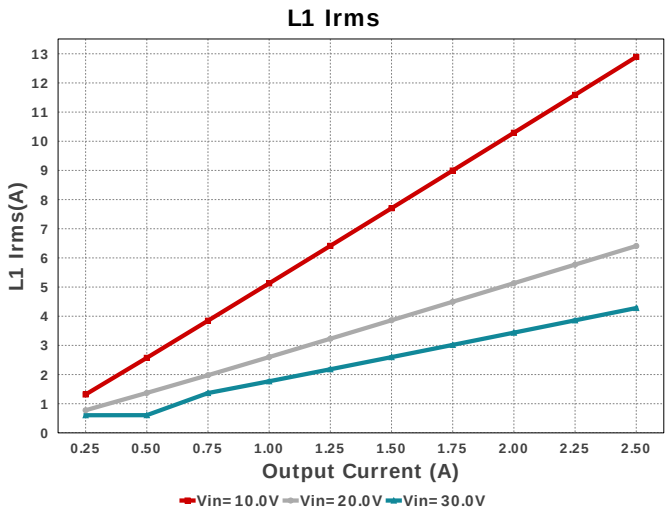


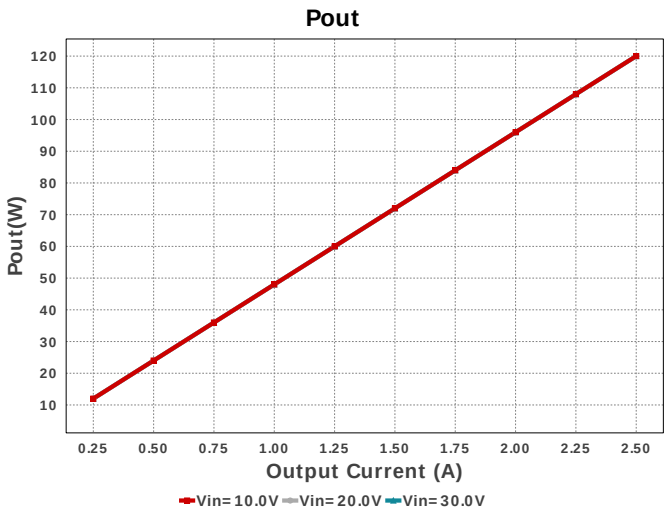


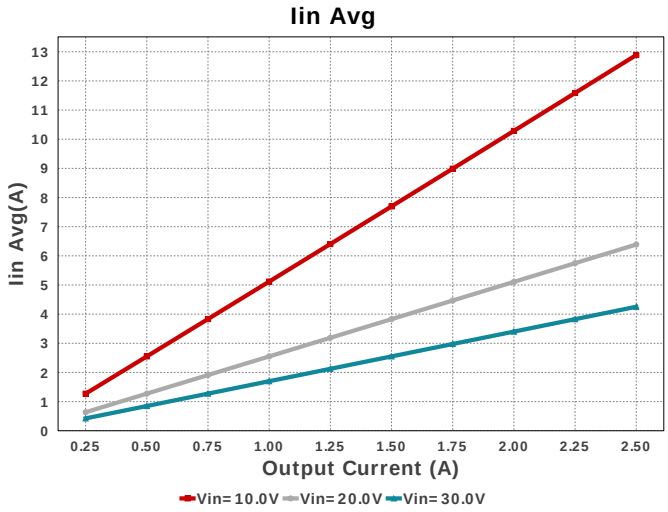


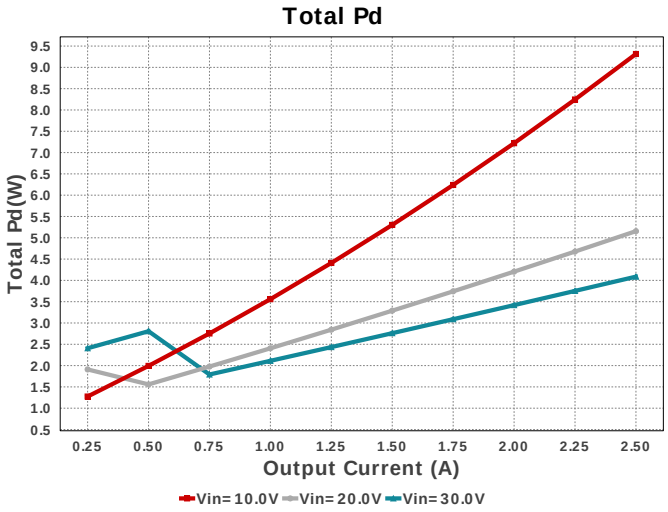


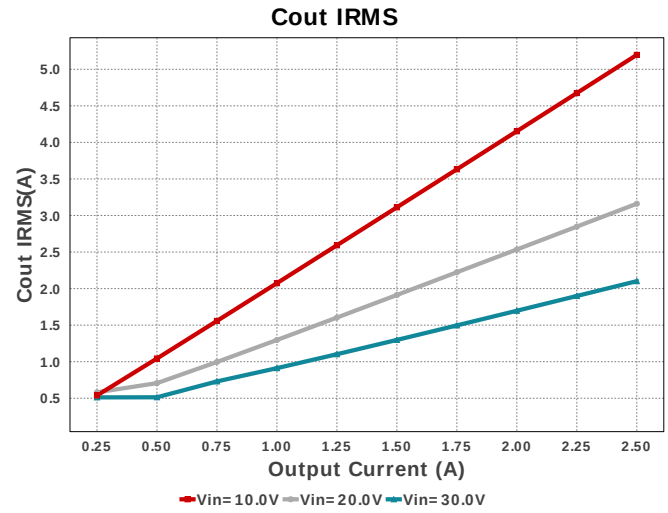


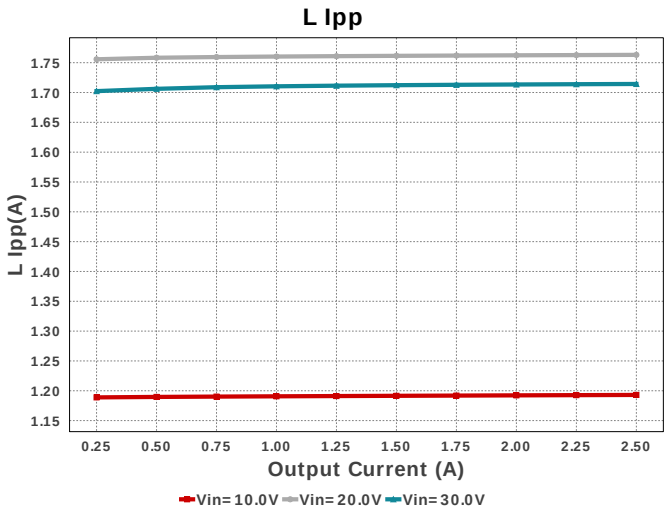


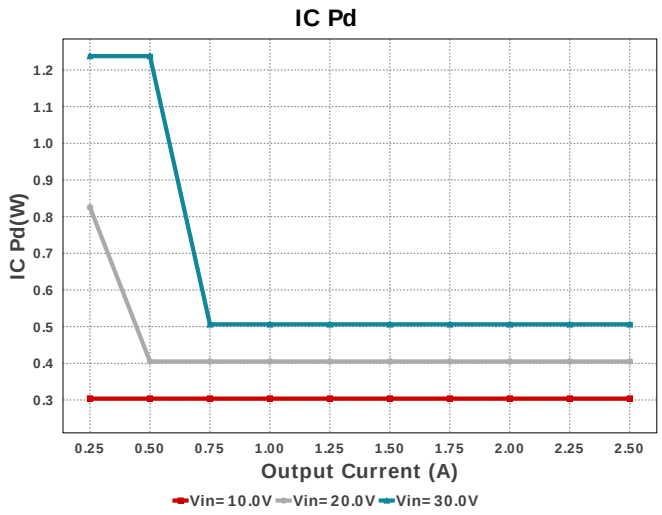


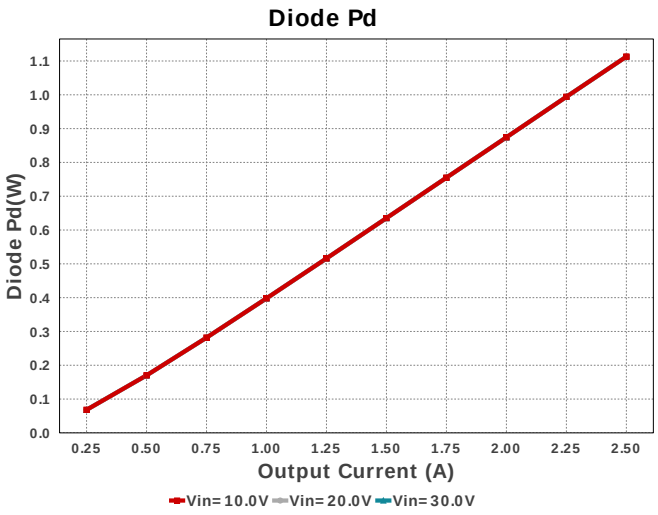


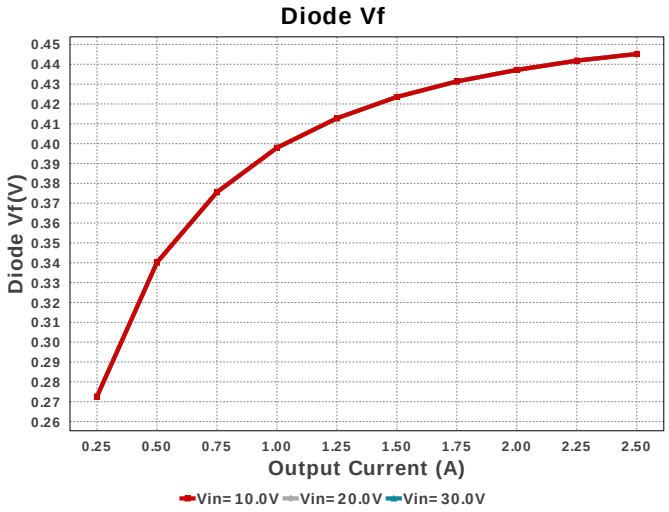


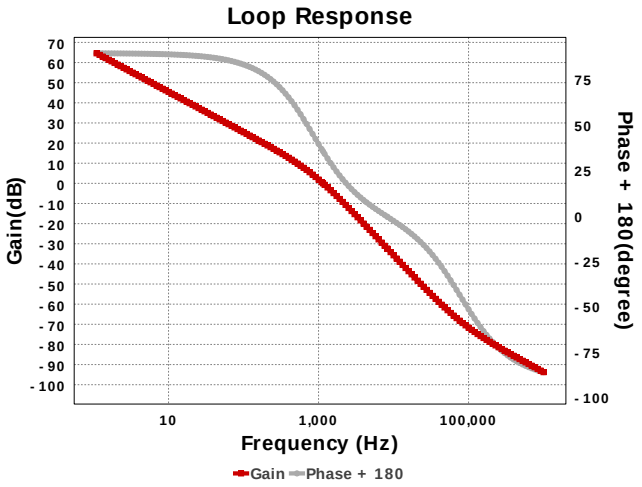












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	344.392 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	118.61 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	5.197 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	27.012 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	74.518 degC	Diode	D1 junction temperature
6.	Diode Pd	1.113 W	Diode	Diode power dissipation
7.	Diode Vf	445.177 mV	Diode	Forward voltage drop of diode D1
8.	IC Pd	303.66 mW	IC	IC power dissipation
9.	IC Tj	42.541 degC	IC	IC junction temperature
10.	ICThetaJA	41.3 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	12.888 A	IC	Average input current
12.	L Ipp	1.193 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	315.84 mW	Inductor	Inductor power dissipation
14.	L1 Irms	12.893 A	Inductor	Inductor ripple current
15.	M1 Irms	10.927 A	Mosfet	Q Iavg
16.	M1 Pd	6.88 W	Mosfet	MOSFET power dissipation
17.	M1 TjOP	105.61 degC	Mosfet	M1 MOSFET junction temperature
18.	Cin Pd	118.61 µW	Power	Input capacitor power dissipation
19.	Cout Pd	27.012 µW	Power	Output capacitor power dissipation
20.	Diode Pd	1.113 W	Power	Diode power dissipation
21.	IC Pd	303.66 mW	Power	IC power dissipation
22.	L Pd	315.84 mW	Power	Inductor power dissipation
23.	M1 Pd	6.88 W	Power	MOSFET power dissipation
24.	Total Pd	9.314 W	Power	Total Power Dissipation
25.	BOM Count	23	System Information	Total Design BOM count
26.	Cross Freq	536.848 Hz	System Information	Bode plot crossover frequency
27.	Duty Cycle	79.587 %	System Information	Duty cycle
28.	Efficiency	92.773 %	System Information	Steady state efficiency

#	Name	Value	Category	Description
29.	FootPrint	2.401 k mm^2	System Information	Total Foot Print Area of BOM components
30.	Frequency	444.713 kHz	System Information	Switching frequency
31.	Iout	2.5 A	System Information	Iout operating point
32.	Mode	CCM	System Information	Conduction Mode
33.	Phase Marg	55.454 deg	System Information	Bode Plot Phase Margin
34.	Pout	120.0 W	System Information	Total output power
35.	Total BOM	NA	System Information	Total BOM Cost
36.	Vin	10.0 V	System Information	Vin operating point
37.	Vout Actual	49.193 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	1.198 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	71.596 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.5	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	48.0	Output Voltage
base_pn	LM5156H	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

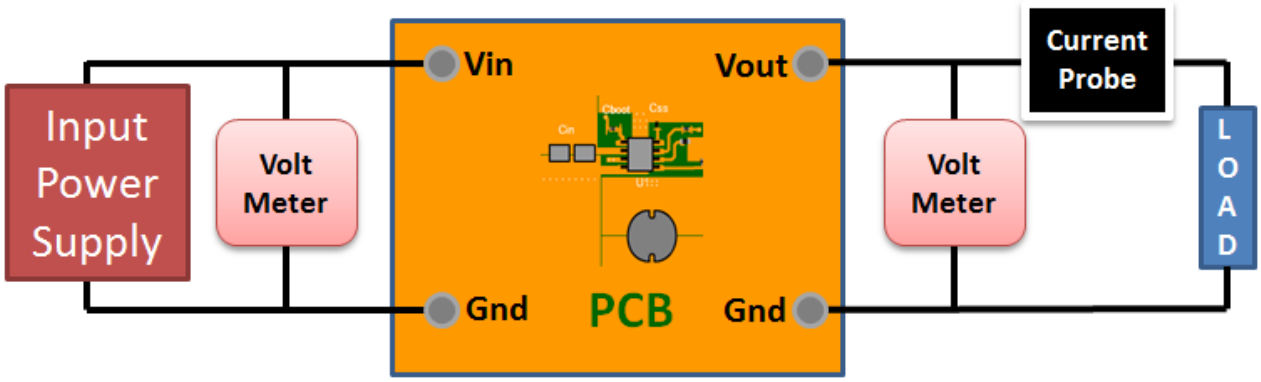
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.0V 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 : 2B4ED45C5E64D05D[v1]
2. **LM5156H** Product Folder : http://www.ti.com/product/LM5156H : contains the data sheet and other resources.