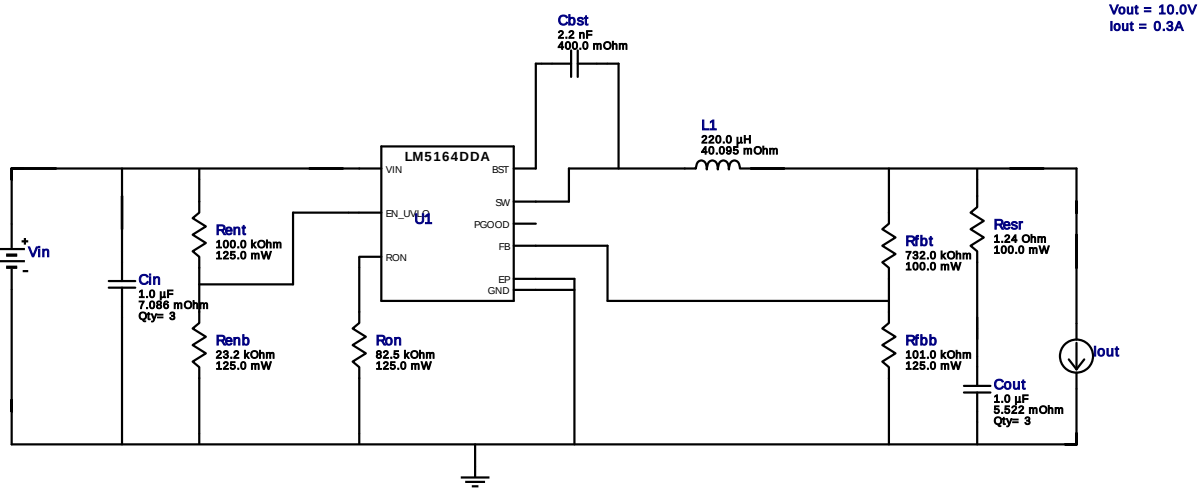


WEBENCH® Design Report

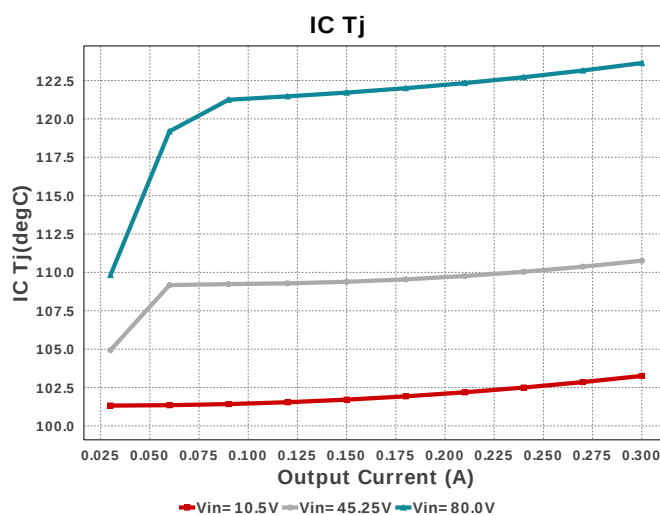
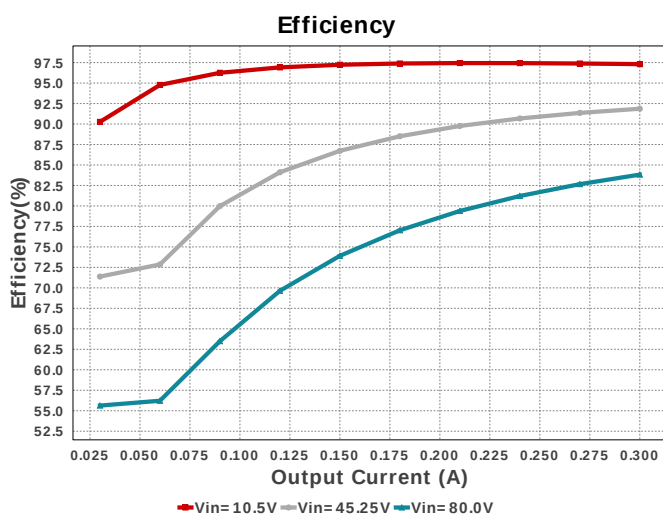
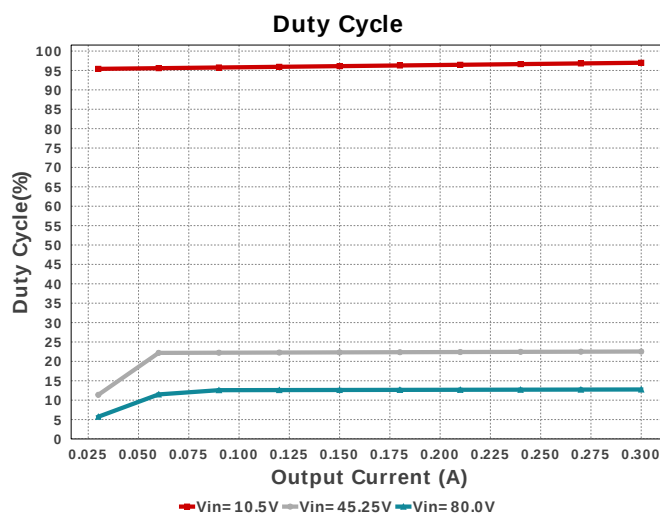
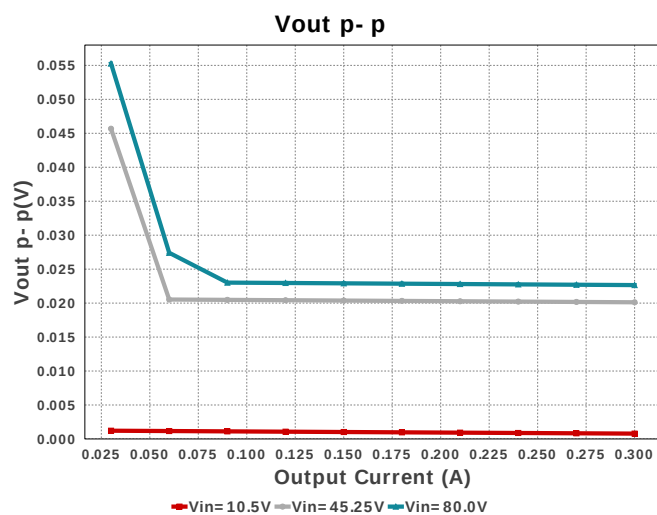
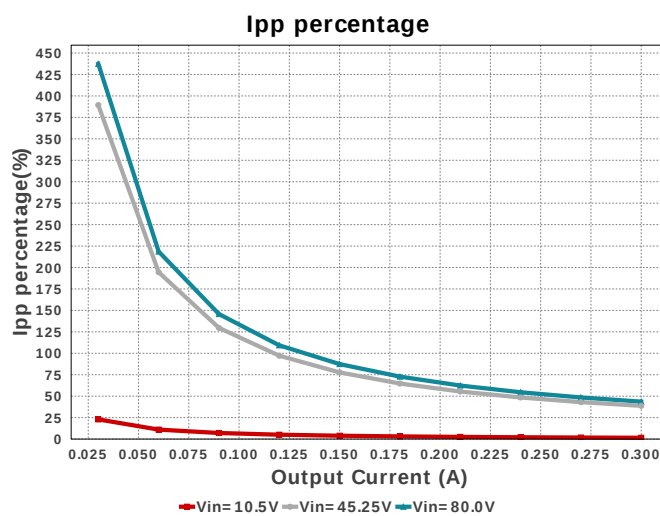
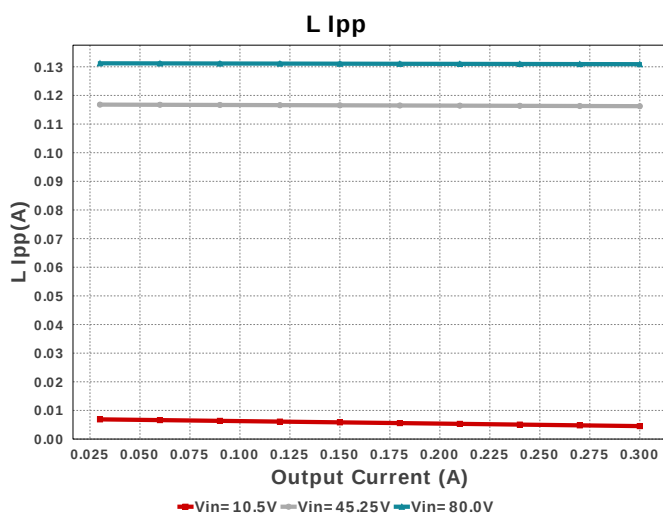
Design : 9 LM5164DDAR
LM5164DDAR 10.5V-80V to 10.00V @ 0.3A

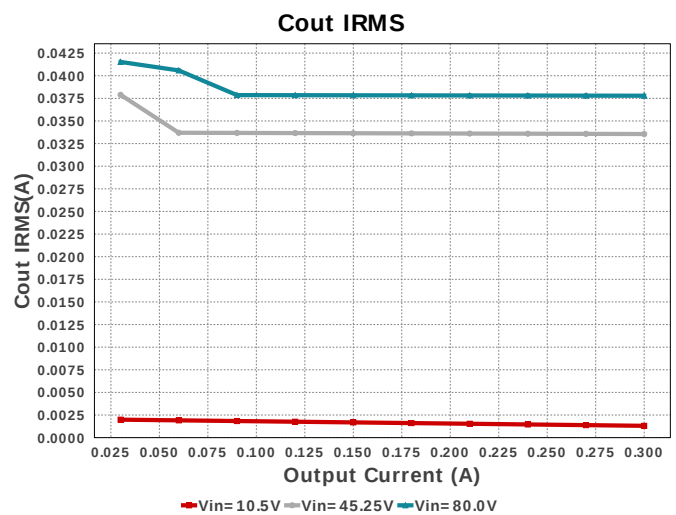
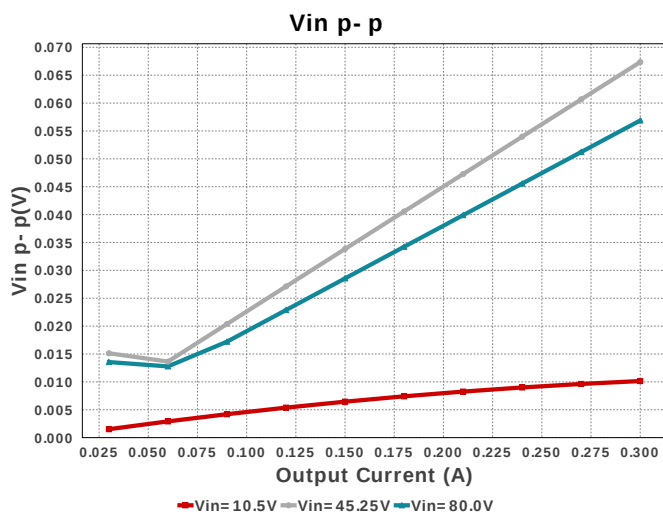
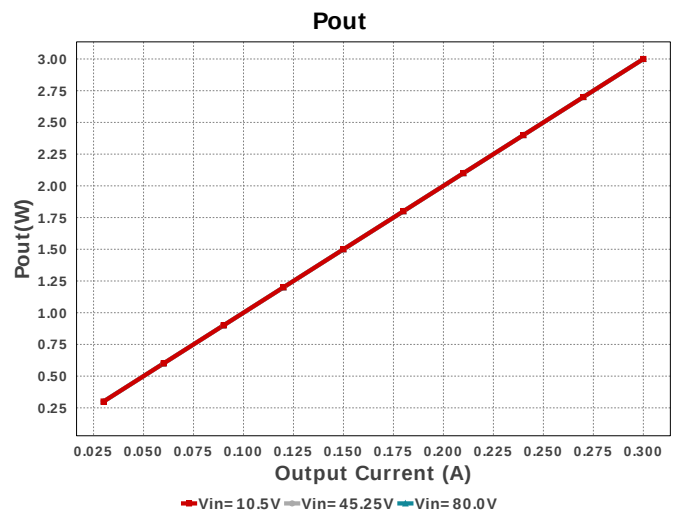
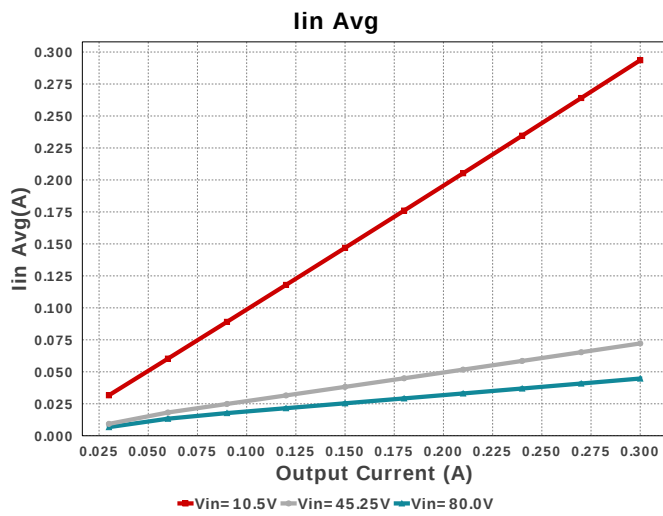
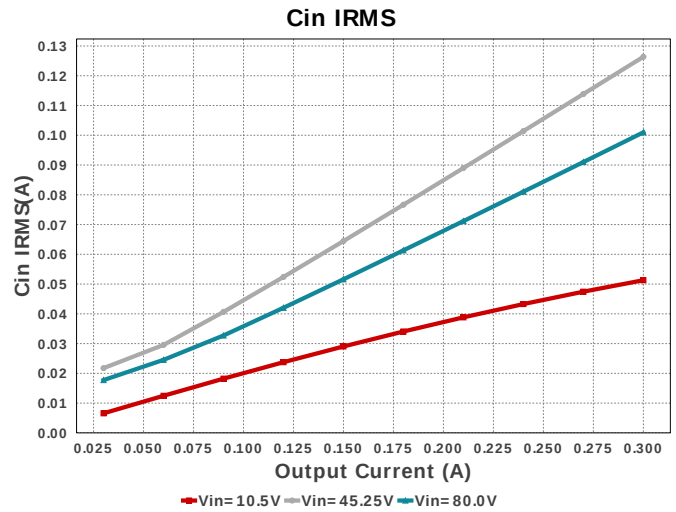
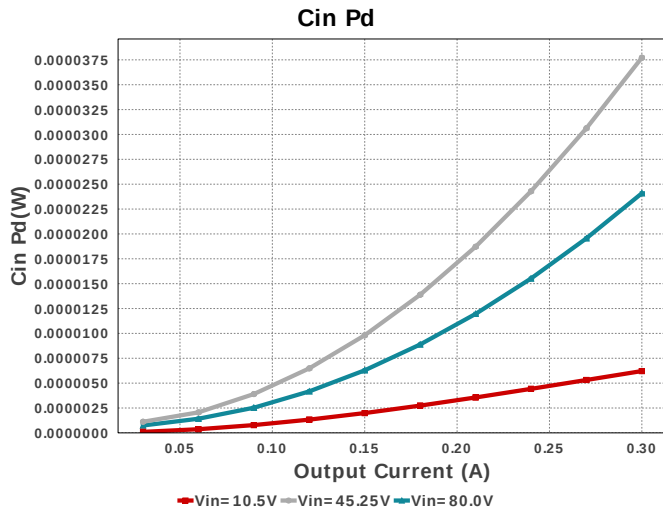


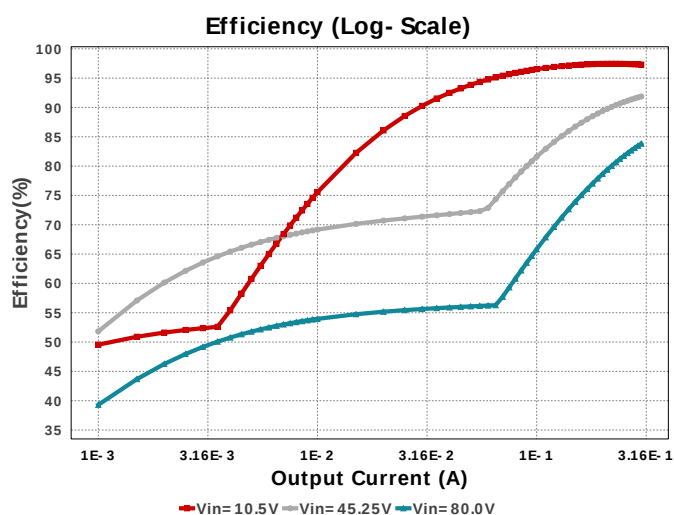
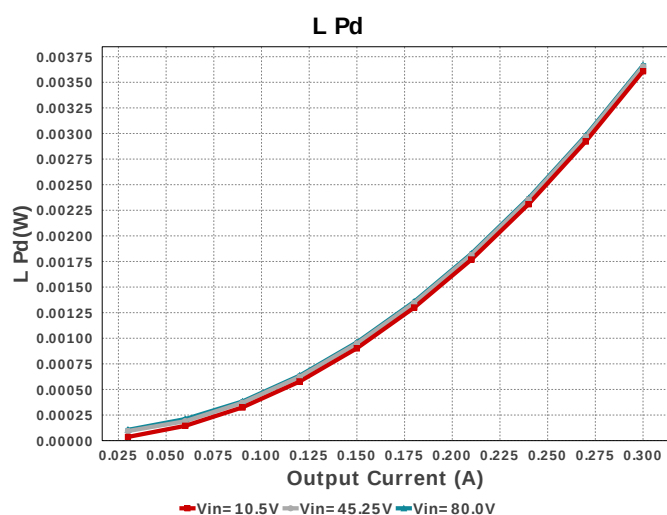
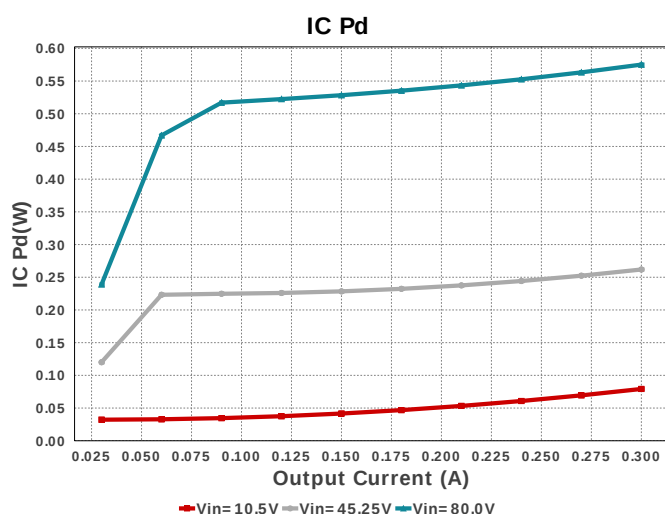
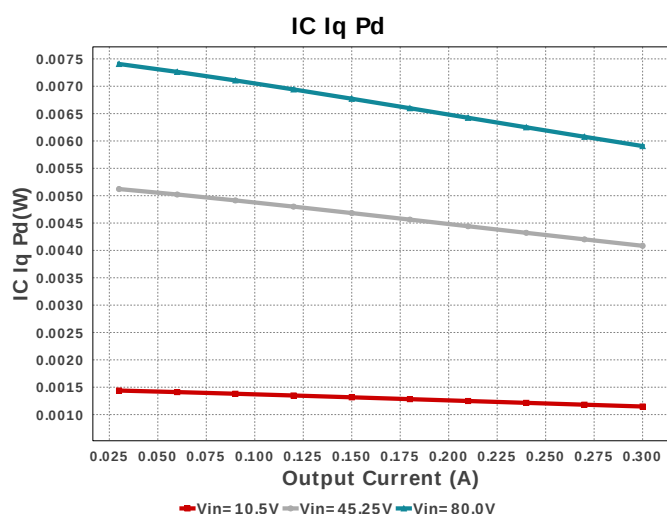
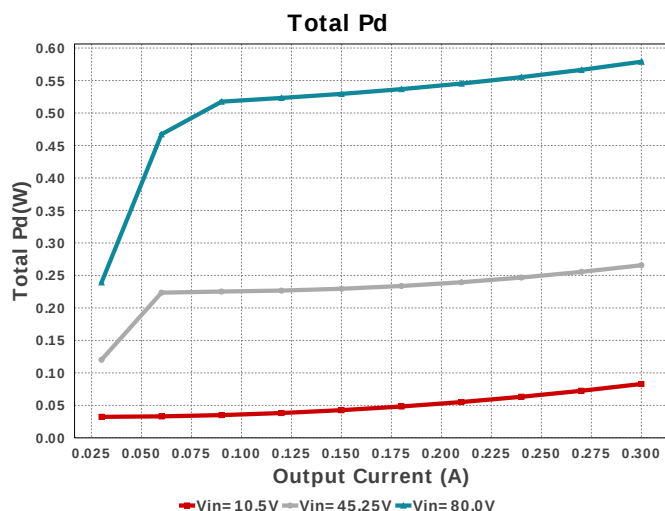
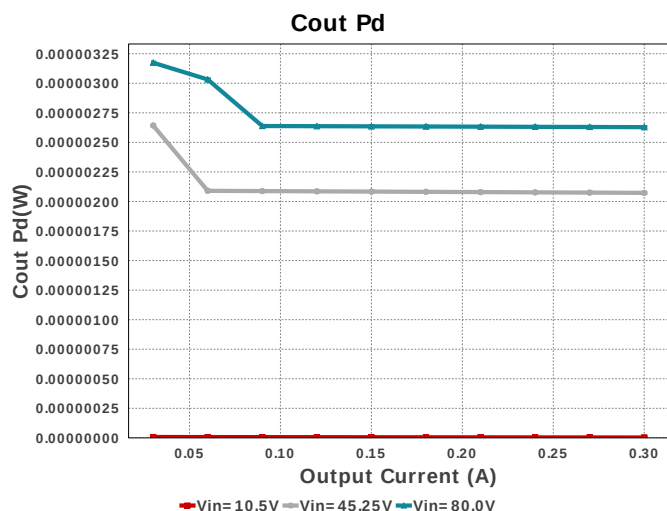
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	Kemet	C0805C222K5RACTU Series= X7R	Cap= 2.2 nF ESR= 400.0 mOhm VDC= 50.0 V IRMS= 251.0 mA	1	\$0.01	0805 7 mm ²
Cin	MuRata	GRM55DR72E105KW01L Series= X7R	Cap= 1.0 uF ESR= 7.086 mOhm VDC= 250.0 V IRMS= 2.0605 A	3	\$0.54	2220_200 54 mm ²
Cout	TDK	C1608X7R1V105K080AC Series= X7R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 35.0 V IRMS= 2.2162 A	3	\$0.05	0603 5 mm ²
L1	Würth Elektronik	74437529203221	L= 220.0 uH 40.095 mOhm	1	\$6.30	WE-HCF Round_2920 0 mm ²
Renb	Panasonic	ERJ-6ENF2322V Series= ERJ-6E	Res= 23.2 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm ²
Rent	Vishay-Dale	CRCW0805100KFKEA Series= CRCW..e3	Res= 100.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm ²
Resr	Vishay-Dale	CRCW06031R24FKEA Series= CRCW..e3	Res= 1.24 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
Rfbb	Yageo	RT0805BRD07101KL Series= RT0805	Res= 101.0 kOhm Power= 125.0 mW Tolerance= 0.1%	1	\$0.06	0805 7 mm ²
Rfbb	Yageo	RC0603FR-07732KL Series= ?	Res= 732.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
Ron	Vishay-Dale	CRCW080582K5FKEA Series= CRCW..e3	Res= 82.5 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LM5164DDAR	Switcher	1	\$1.35	DDA0008E-MFG 55 mm ²







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	15		Total Design BOM count
2.	Total BOM	\$9.536		Total BOM Cost
3.	Cin IRMS	123.731 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	36.16 μ W	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	34.116 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	2.142 μ W	Capacitor	Output capacitor power dissipation
7.	IC Iq Pd	4.264 mW	IC	IC Iq Pd
8.	IC Pd	280.78 mW	IC	IC power dissipation
9.	IC Tj	111.54 degC	IC	IC junction temperature
10.	ICThetaJA	41.1 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	68.429 mA	IC	Average input current

#	Name	Value	Category	Description
12.	Ipp percentage	39.394 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
13.	L Ipp	118.181 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	3.655 mW	Inductor	Inductor power dissipation
15.	Cin Pd	36.16 μ W	Power	Input capacitor power dissipation
16.	Cout Pd	2.142 μ W	Power	Output capacitor power dissipation
17.	IC Pd	280.78 mW	Power	IC power dissipation
18.	L Pd	3.655 mW	Power	Inductor power dissipation
19.	Total Pd	284.577 mW	Power	Total Power Dissipation
20.	Duty Cycle	21.252 %	System	Duty cycle
21.	Efficiency	91.336 %	System	Steady state efficiency
22.	FootPrint	274.0 mm ²	System	Total Foot Print Area of BOM components
23.	Frequency	309.118 kHz	System	Switching frequency
24.	Iout	300.0 mA	System	Iout operating point
25.	Mode	CCM	System	Conduction Mode
26.	Pout	3.0 W	System	Total output power
27.	Vin	48.0 V	System	Vin operating point
28.	Vin p-p	65.887 mV	System	Peak-to-peak input voltage
29.	Vout	10.0 V	System	Operational Output Voltage
30.	Vout Actual	9.897 V	System	Vout Actual calculated based on selected voltage divider resistors
31.	Vout Tolerance	2.566 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
32.	Vout p-p	20.456 mV	System	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	300.0 m	Maximum Output Current
VinMax	80.0	Maximum input voltage
VinMin	10.5	Minimum input voltage
Vout	10.0	Output Voltage
base_pn	LM5164	Base Product Number
source	DC	Input Source Type
Ta	100.0	Ambient temperature
UserFsw	306.112 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 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

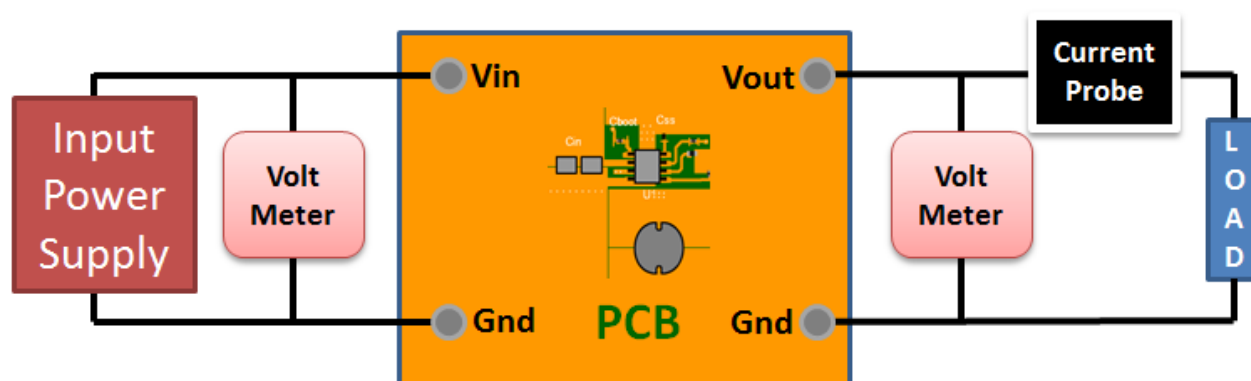
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.5V 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.



WEBENCH® Electrical Simulation Report

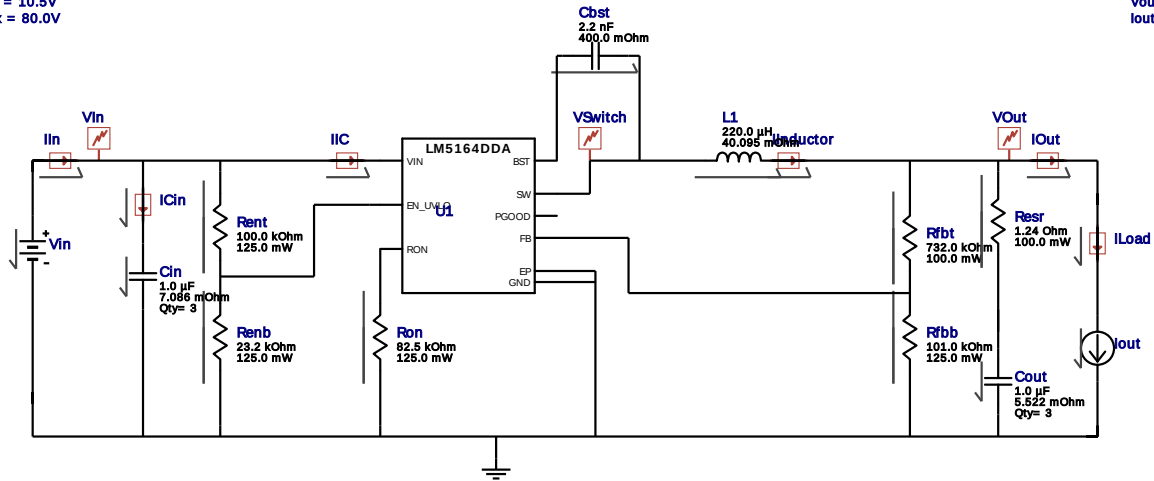
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sim_id = 2

Simulation Type = Steady State

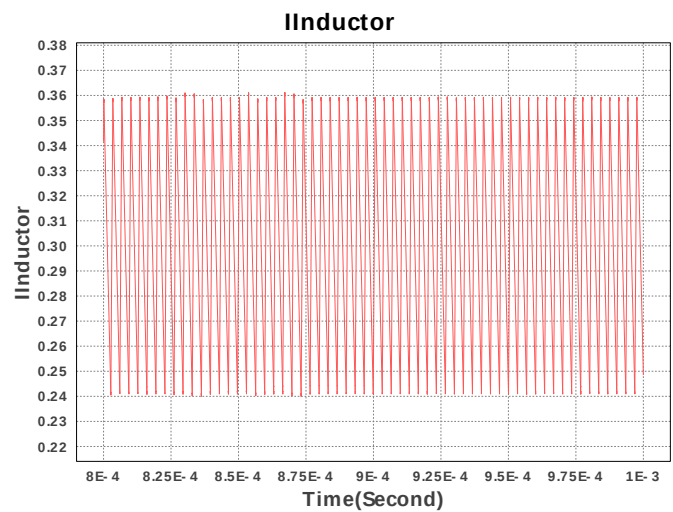
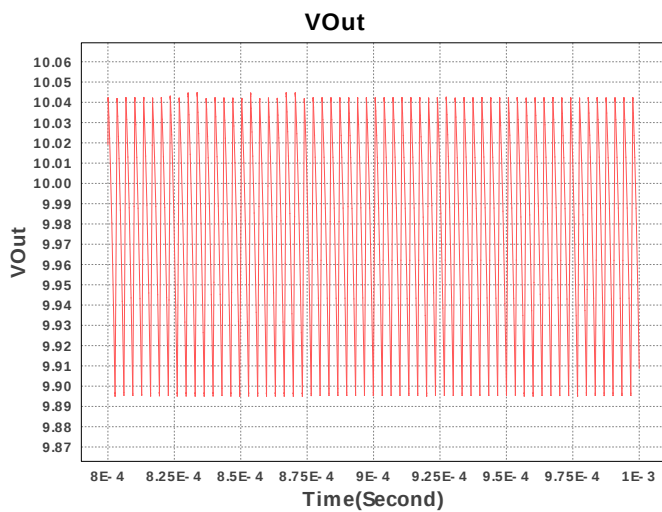
VinMin = 10.5V
VinMax = 80.0V

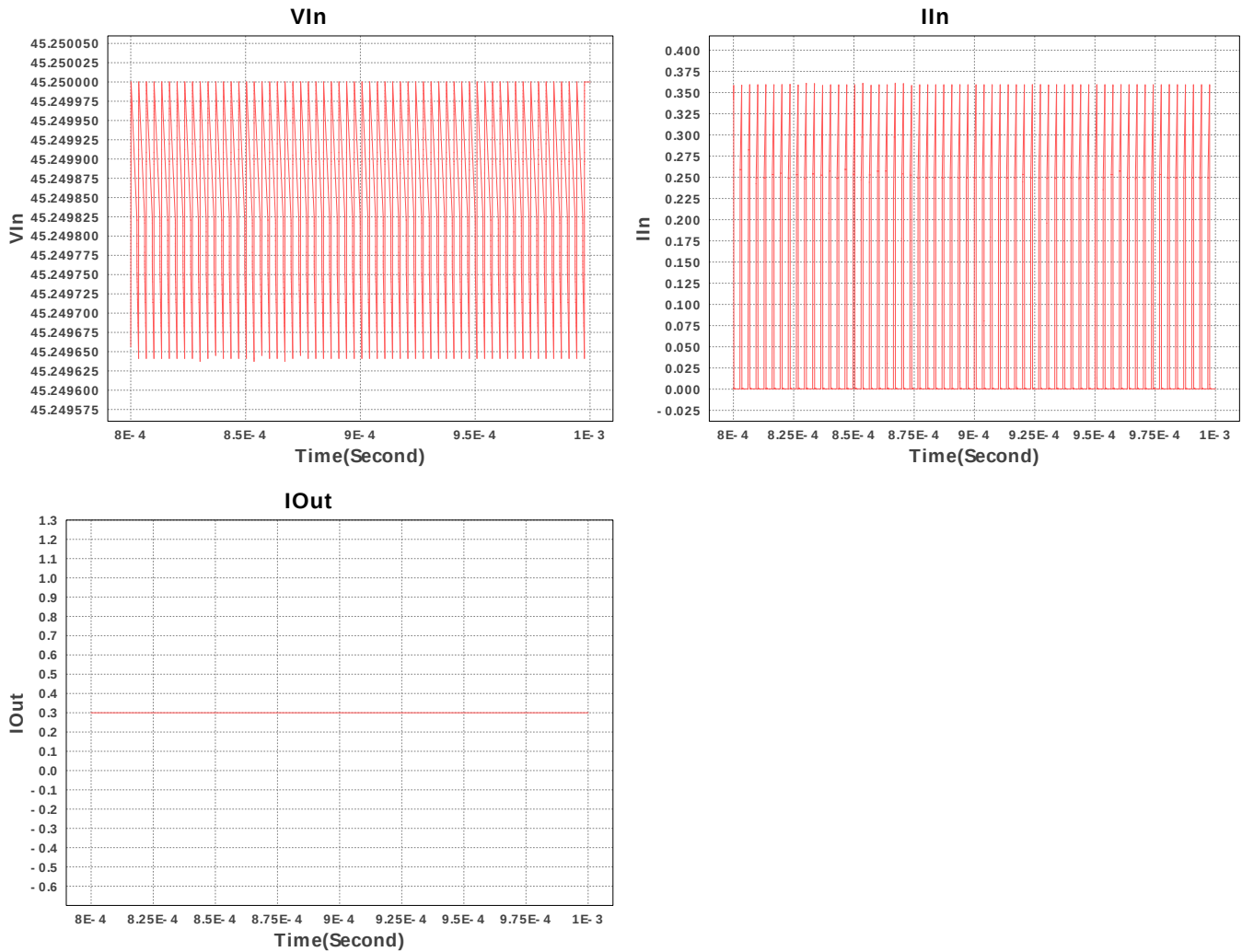
Vout = 10.0V
Iout = 0.3A



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	10.0 V
2.	Cbst	IC	Initial Voltage	5 V
3.	Iout	I	Load current	0.3 A





Design Assistance

1. Master key : 558C956C92E1F8AC[v1]
2. **LM5164** Product Folder : <http://www.ti.com/product/lm5164> : contains the data sheet and other resources.

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