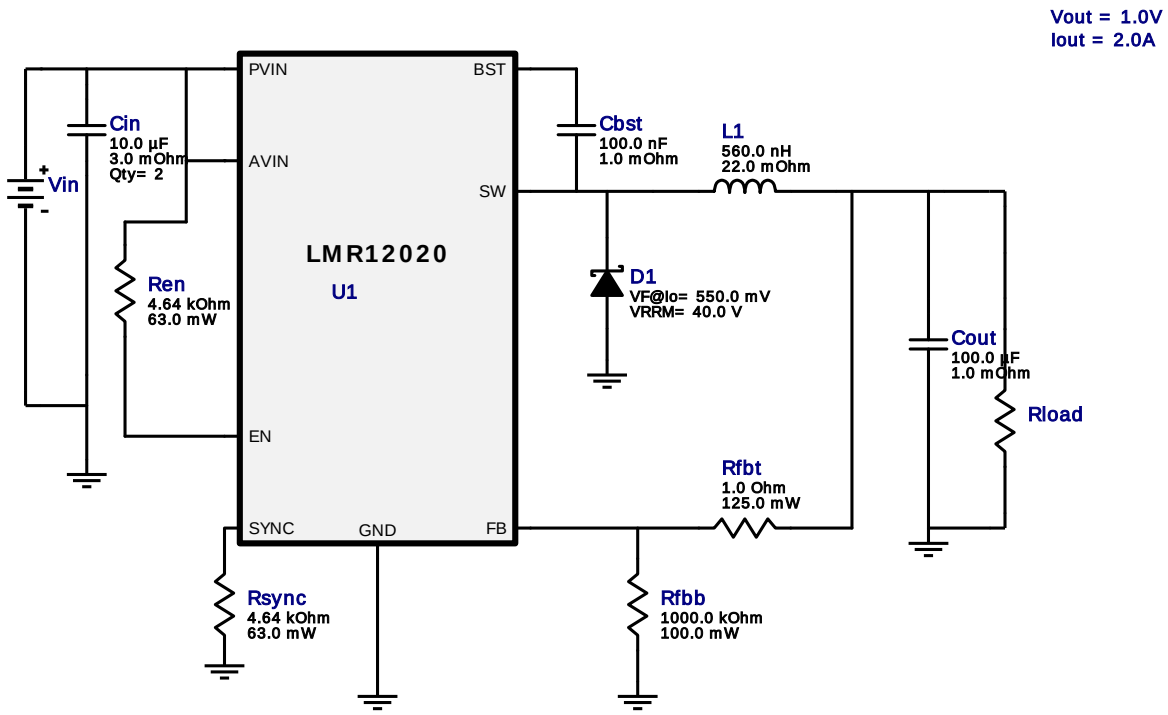
VinMin = 3.3V
VinMax = 3.3V
Vout = 1.0V
Iout = 2.0A

Device = LMR12020XSD/NOPB
Topology = Buck
Created = 2023-02-08 04:31:42.665
BOM Cost = $1.72
BOM Count = 11
Total Pd = 1.15W

WEBENCH® Design Report

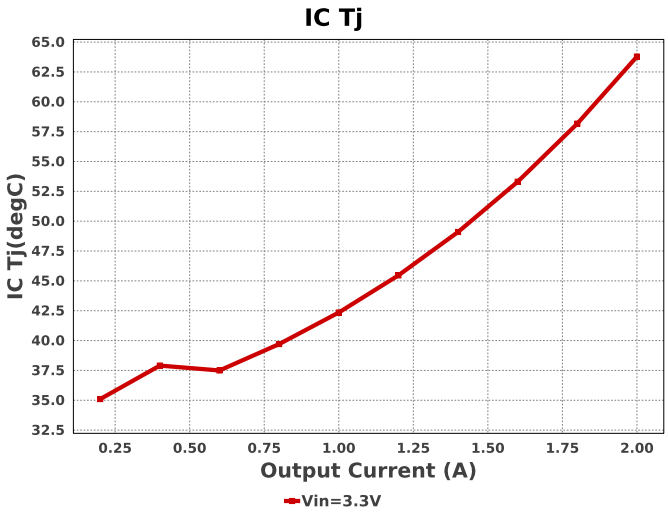
Design : 1 LMR12020XSD/NOPB
LMR12020XSD/NOPB 3.3V-3.3V to 1.00V @ 2A

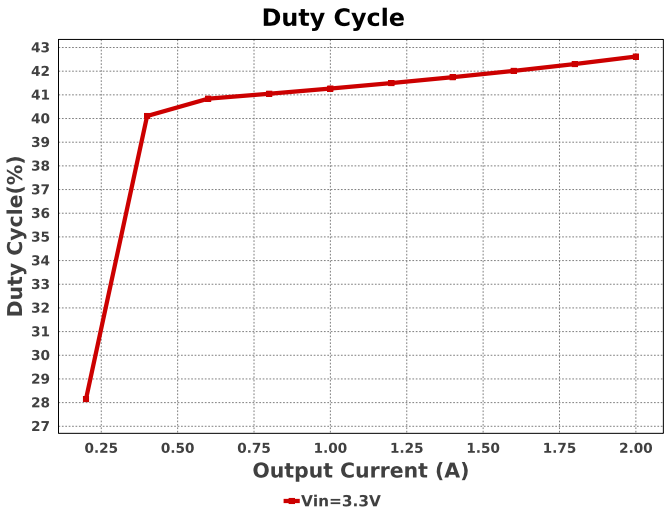


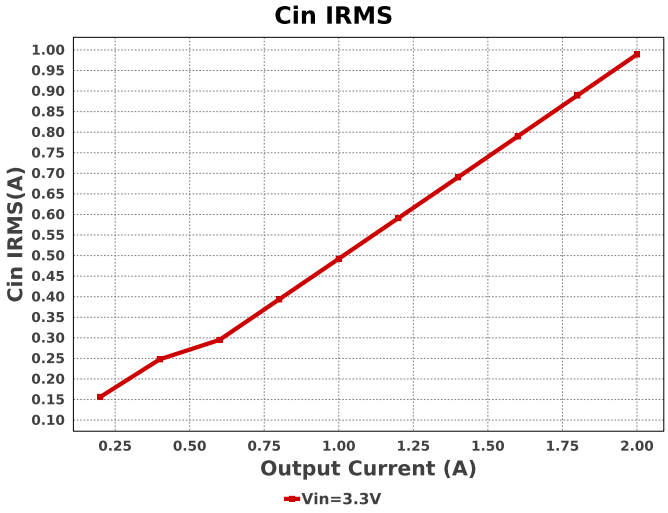
Electrical BOM

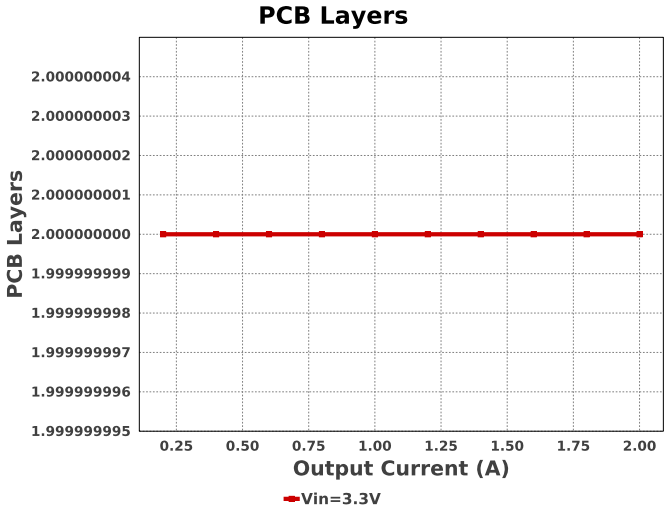
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	2	$0.03	0805 7 mm²
Cout	MuRata	GRM32EC80J107ME20L Series= X6S	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	$0.17	1210_270 15 mm²
D1	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.09	SOD-123F 12 mm²
L1	Vishay-Dale	IFSC1515AHERR56M01	L= 560.0 nH 22.0 mOhm	1	$0.20	ELL6RH 67 mm²
Ren	Vishay-Dale	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Yageo	RC0603FR-071ML Series= ?	Res= 1000.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²

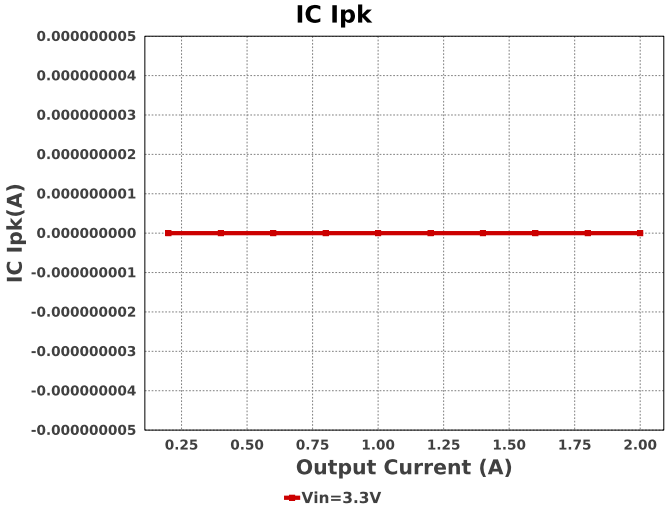
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Vishay-Dale	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Rsync	Vishay-Dale	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LMR12020XSD/NOPB	Switcher	1	$1.15	SDA10A 16 mm^2

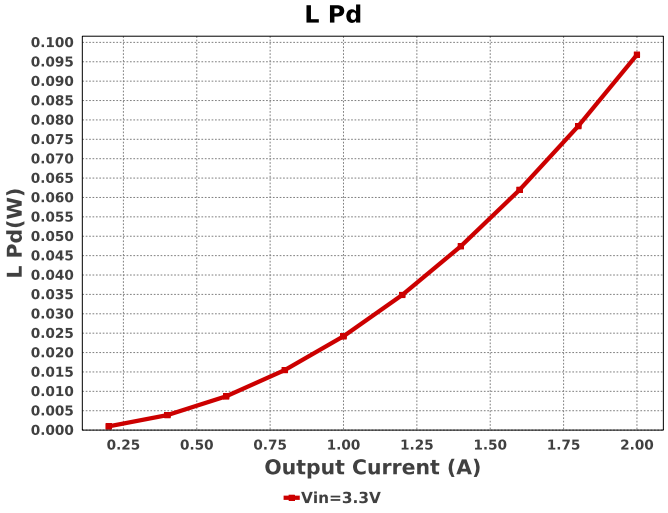


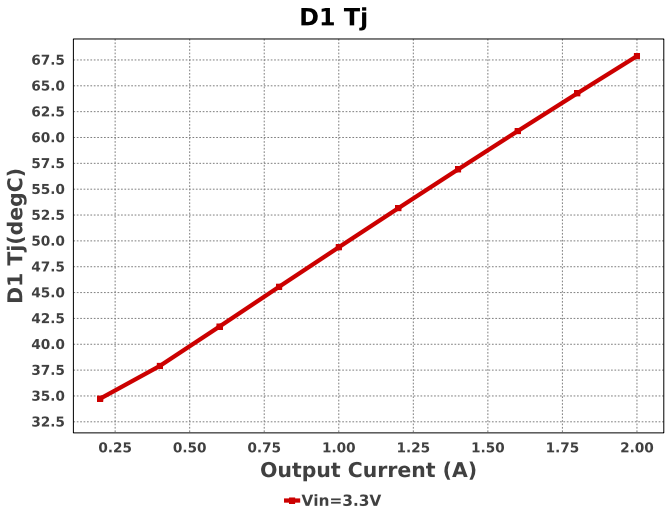


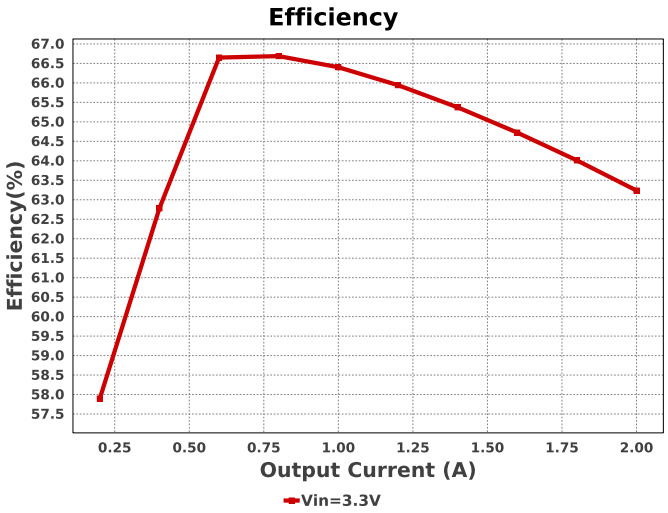


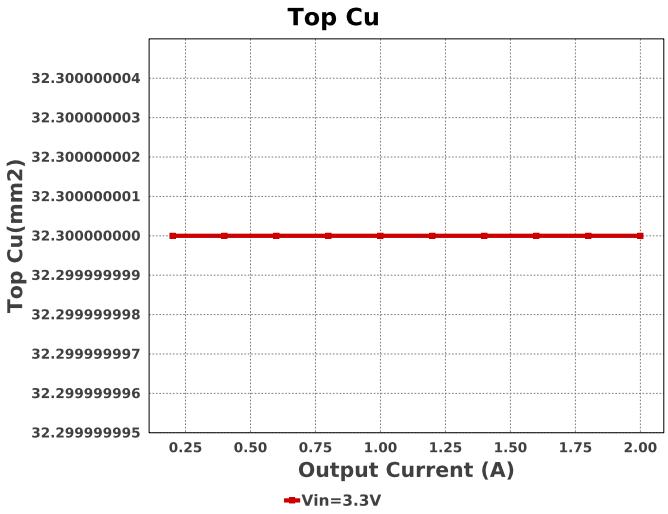


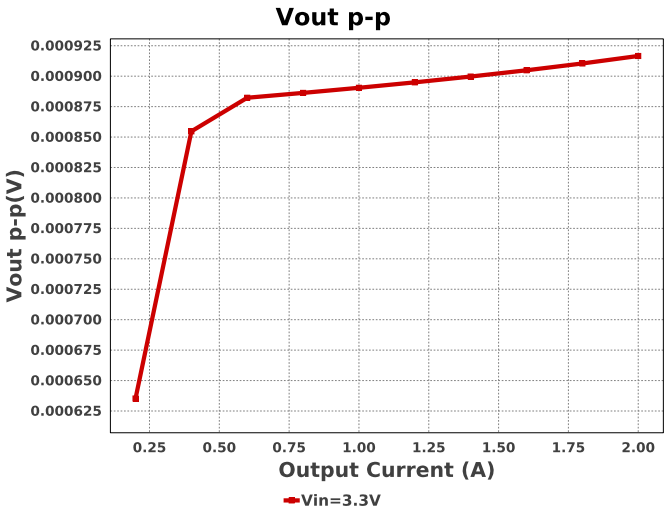


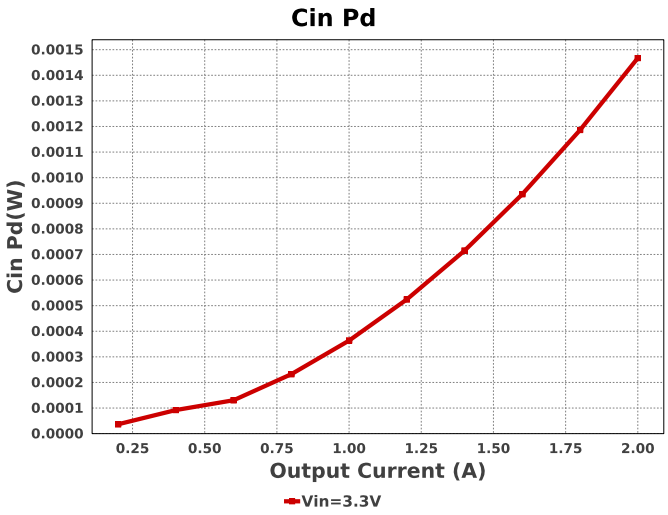


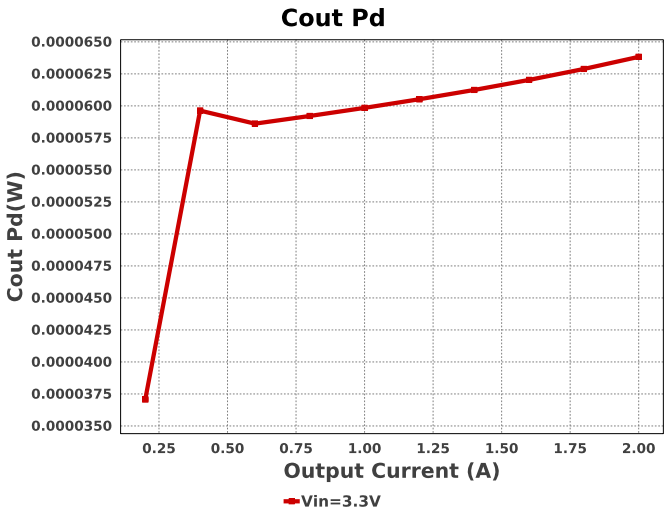


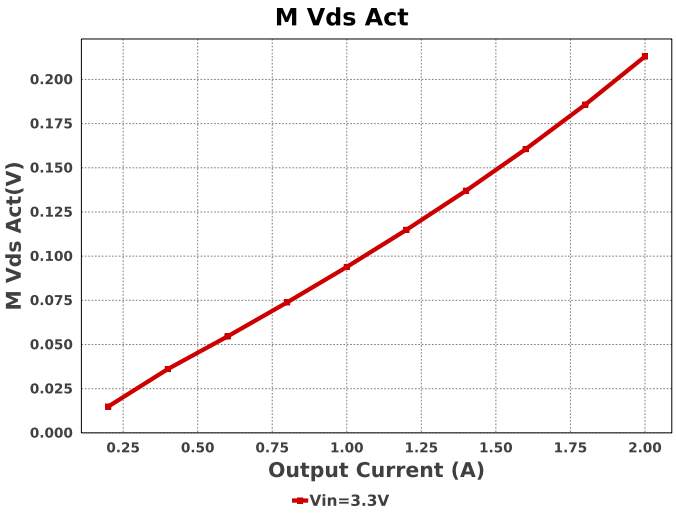


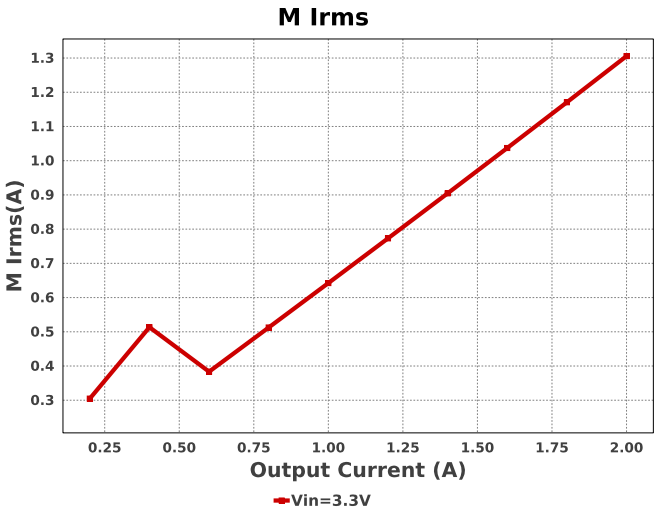


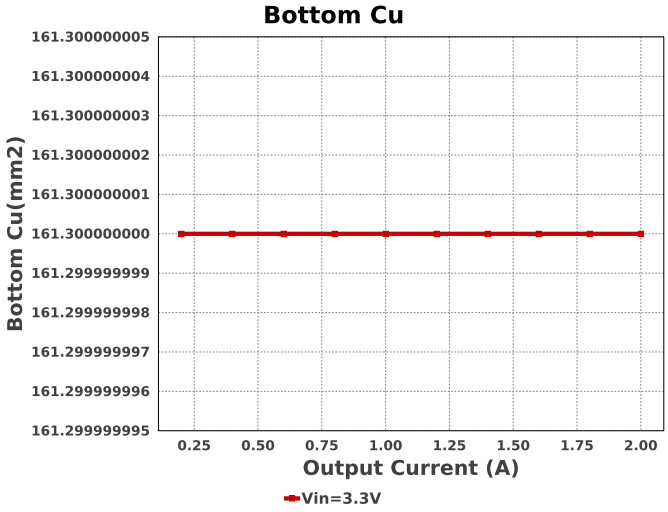


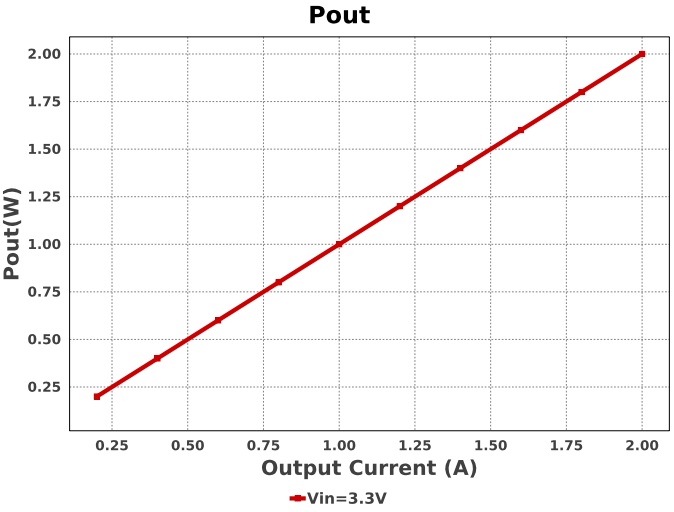


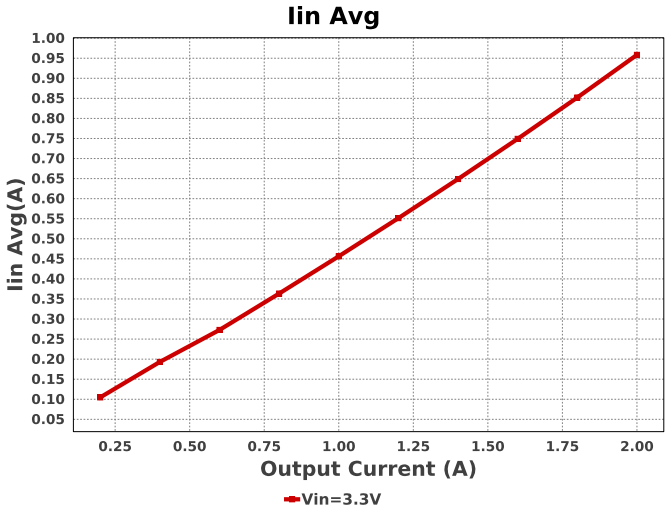


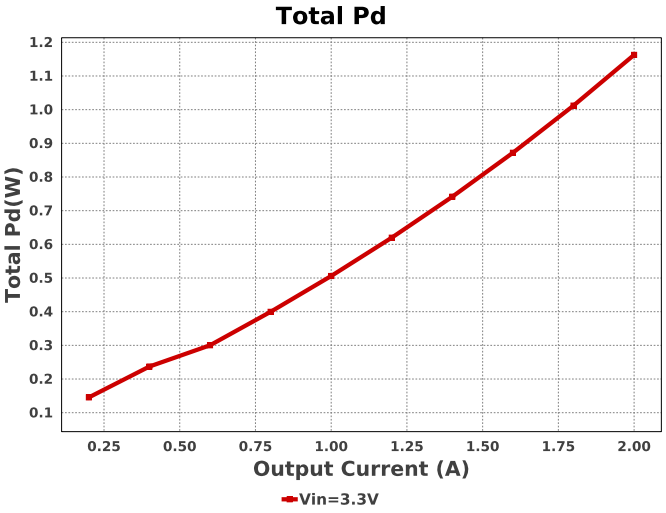


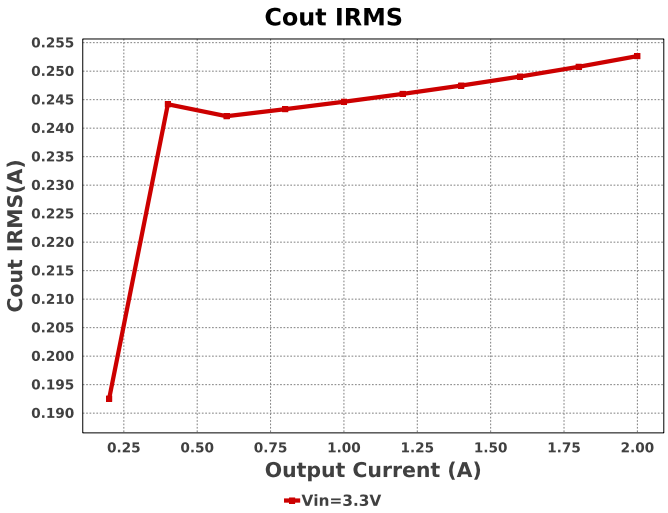


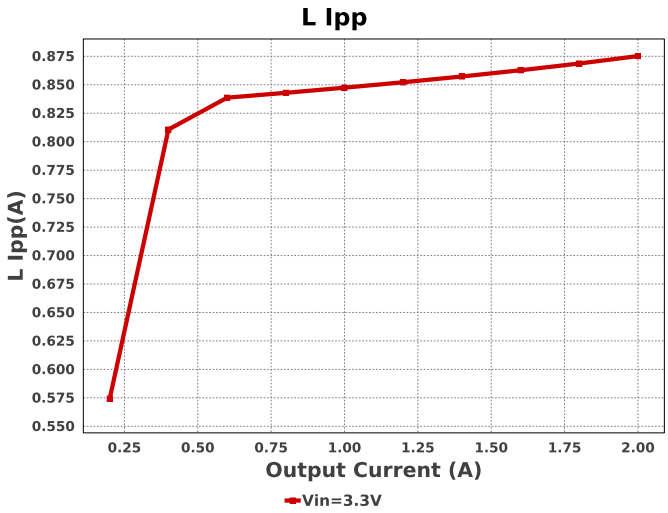


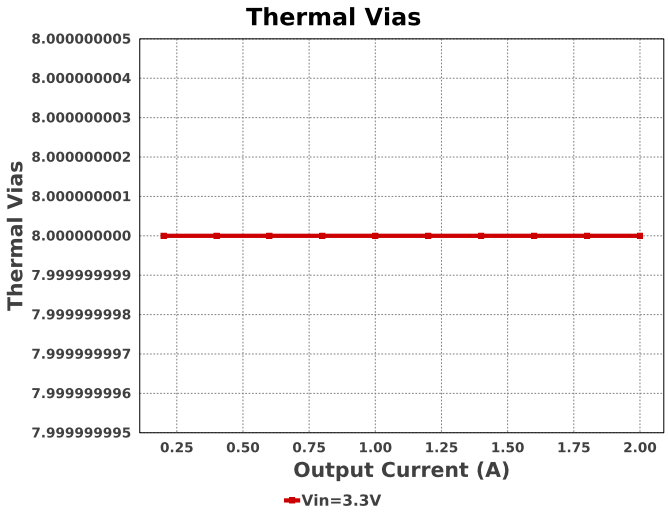


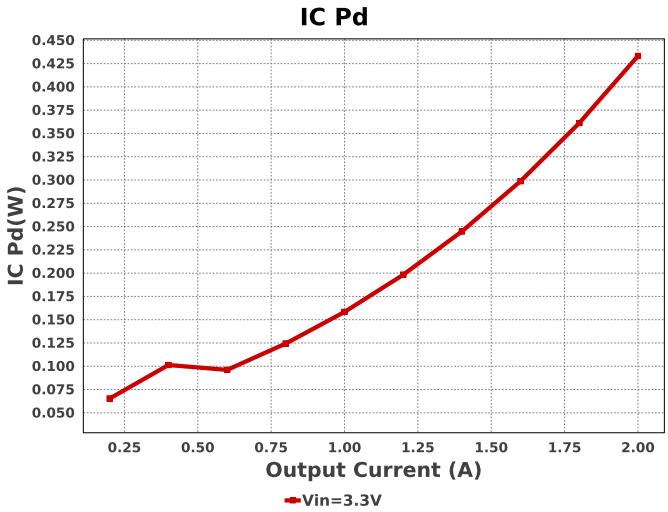


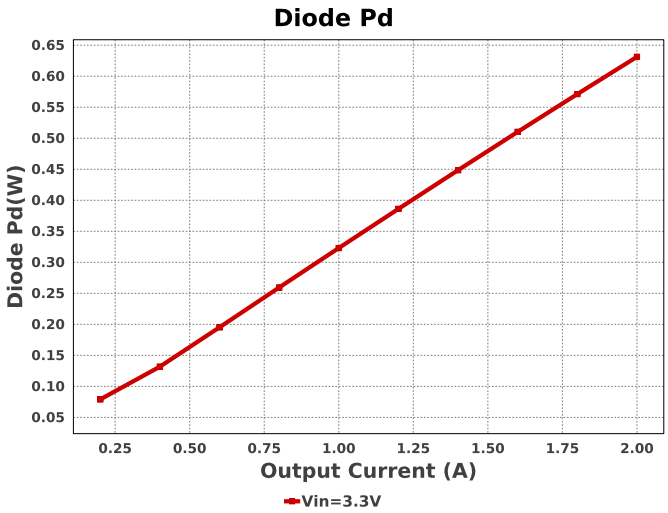












Operating Values

#	Name	Value	Category	Description
1.	Bottom Cu	161.3 mm^2	Board_Layout	Recommended minimum area of bottom layer copper connected to DAP
2.	PCB Layers	2.0	Board_Layout	Recommended number of PCB layers for the necessary IC Thermal Resistance
3.	Thermal Vias	8.0	Board_Layout	Recommended number of 10 mil thermal vias under the IC
4.	Top Cu	32.3 mm^2	Board_Layout	Recommended minimum area of top layer copper connected to DAP
5.	Cin IRMS	988.594 mA	Capacitor	Input capacitor RMS ripple current
6.	Cin Pd	1.466 mW	Capacitor	Input capacitor power dissipation
7.	Cout IRMS	251.767 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	63.387 µW	Capacitor	Output capacitor power dissipation
9.	D1 Tj	67.97 degC	Diode	D1 junction temperature

#	Name	Value	Category	Description
10.	Diode Pd	632.83 mW	Diode	Diode power dissipation
11.	IC Ipk	0.0 A	IC	Peak switch current in IC
12.	IC Pd	416.22 mW	IC	IC power dissipation
13.	IC Tj	52.06 degC	IC	IC junction temperature
14.	IC Tolerance	16.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA	53.0 degC/W	IC	IC junction-to-ambient thermal resistance
16.	Iin Avg	953.75 mA	IC	Average input current
17.	L Ipp	872.15 mA	Inductor	Peak-to-peak inductor ripple current
18.	L Pd	96.8 mW	Inductor	Inductor power dissipation
19.	M Irms	1.303 A	Mosfet	MOSFET RMS ripple current
20.	M Vds Act	200.34 mV	Mosfet	Voltage drop across the MosFET
21.	Cin Pd	1.466 mW	Power	Input capacitor power dissipation
22.	Cout Pd	63.387 µW	Power	Output capacitor power dissipation
23.	Diode Pd	632.83 mW	Power	Diode power dissipation
24.	IC Pd	416.22 mW	Power	IC power dissipation
25.	L Pd	96.8 mW	Power	Inductor power dissipation
26.	Total Pd	1.147 W	Power	Total Power Dissipation
27.	BOM Count	11	System Information	Total Design BOM count
28.	Duty Cycle	42.47 %	System Information	Duty cycle
29.	Efficiency	63.545 %	System Information	Steady state efficiency
30.	FootPrint	145.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	2.0 MHz	System Information	Switching frequency
32.	Iout	2.0 A	System Information	Iout operating point
33.	Mode	CCM	System Information	Conduction Mode
34.	Pout	2.0 W	System Information	Total output power
35.	Total BOM	$1.72	System Information	Total BOM Cost
36.	Vin	3.3 V	System Information	Vin operating point
37.	Vout	1.0 V	System Information	Operational Output Voltage
38.	Vout Act	1.0 V	System Information	Achieved Vout with feedback resistor pair
39.	Vout Actual	1.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
40.	Vout Tolerance	1.6 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
41.	Vout p-p	913.715 µV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	3.3	Maximum input voltage
VinMin	3.3	Minimum input voltage
Vout	1.0	Output Voltage
base_pn	LMR12020	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

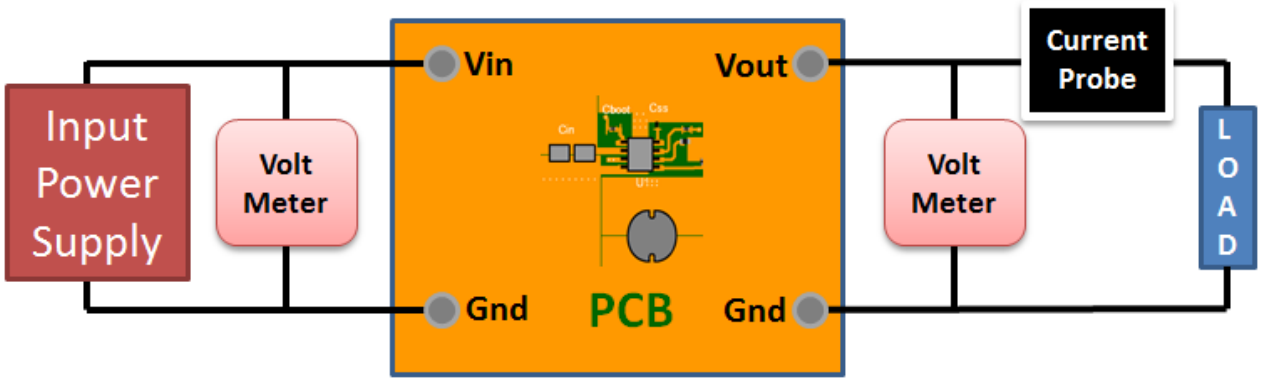
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.3V 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 : 80AD6667D2B13DDF[v1]
2. **LMR12020** Product Folder : http://www.ti.com/product/LMR12020 : contains the data sheet and other resources.