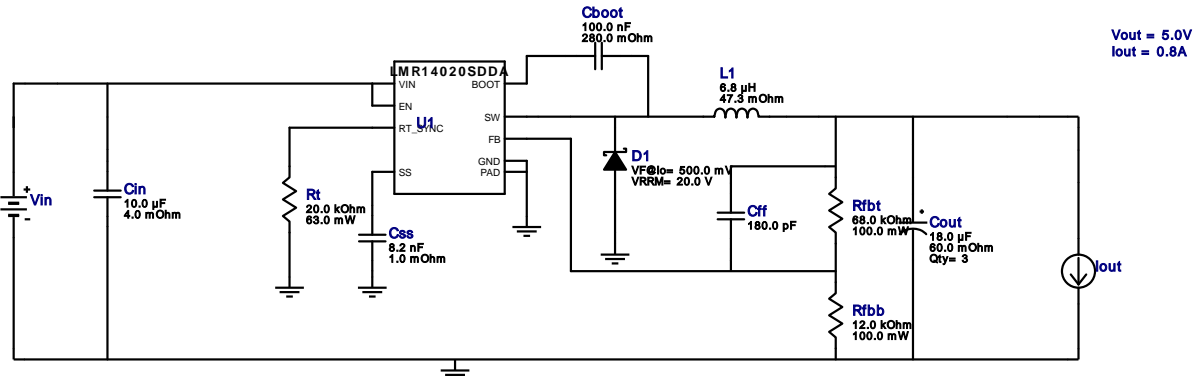


# WEBENCH® Design Report

Design : 26 LMR14020SDDAR  
LMR14020SDDAR 6V-10V to 5.00V @ 0.8A


VinMin = 6.0V  
VinMax = 10.0V  
Vout = 5.0V  
Iout = 0.8A

Device = LMR14020SDDAR  
Topology = Buck  
Created = 2023-04-21 10:09:42.568  
BOM Cost = \$4.27  
BOM Count = 13  
Total Pd = 0.36W

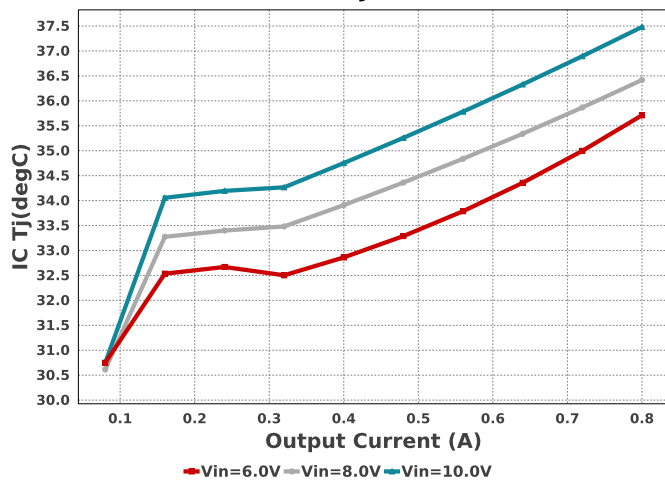


## Electrical BOM

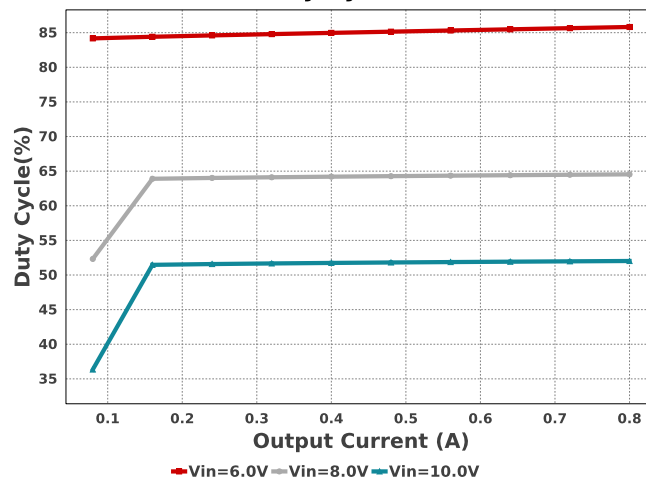
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
Cff	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
Cin	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	1	\$0.04	0805 7 mm <sup>2</sup>
Cout	Panasonic	35SVPD18M Series= SVPD	Cap= 18.0 uF ESR= 60.0 mOhm VDC= 35.0 V IRMS= 1.8 A	3	\$0.97	SM_RADIAL_10AMM 160 mm <sup>2</sup>
Css	MuRata	GRM155R71C822KA01D Series= X7R	Cap= 8.2 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
D1	Diodes Inc.	B220-13-F	VF@Io= 500.0 mV VRRM= 20.0 V	1	\$0.09	SMB 44 mm <sup>2</sup>
L1	Bourns	SRN6045-6R8Y	L= 6.8 uH 47.3 mOhm	1	\$0.25	SRN6045 64 mm <sup>2</sup>
Rfbb	Yageo	RC0603FR-0712KL Series= ?	Res= 12.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm <sup>2</sup>
Rfht	Yageo	RC0603FR-0768KL Series= ?	Res= 68.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm <sup>2</sup>
Rt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LMR14020SDDAR	Switcher	1	\$0.92	 DDA0008E_N 55 mm <sup>2</sup>

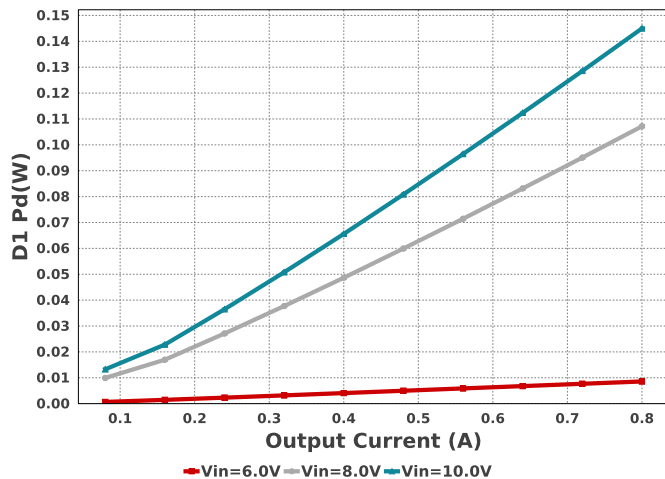
IC Tj



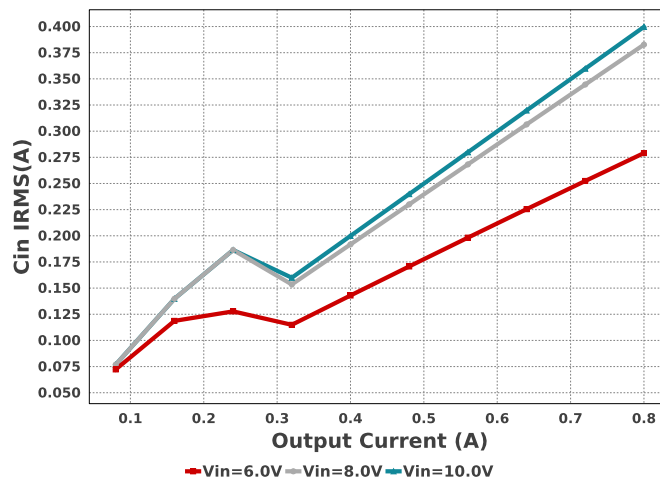
Duty Cycle



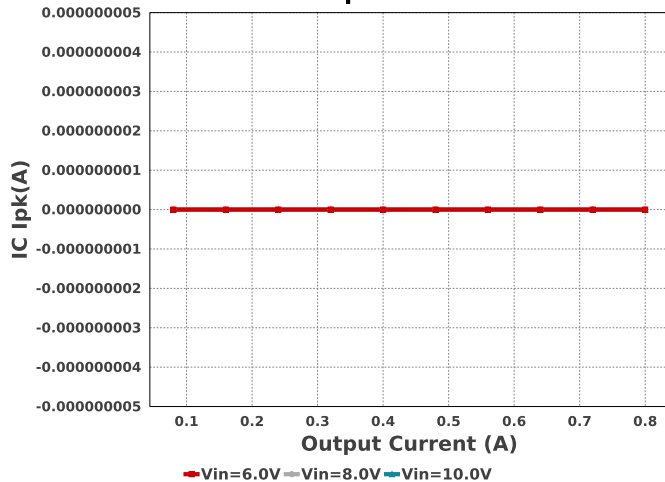
D1 Pd



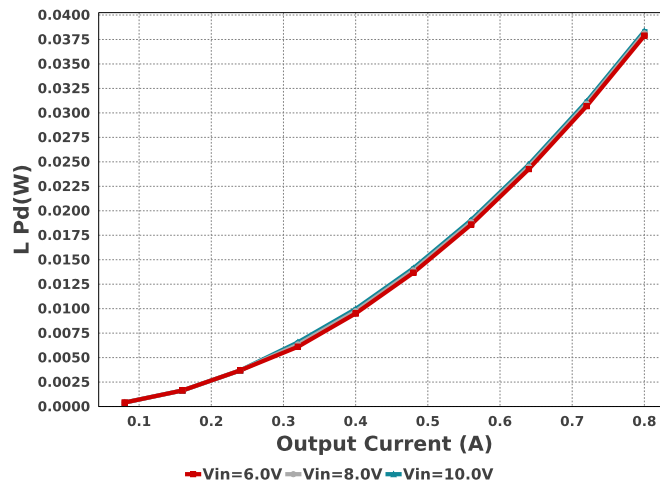
Cin IRMS

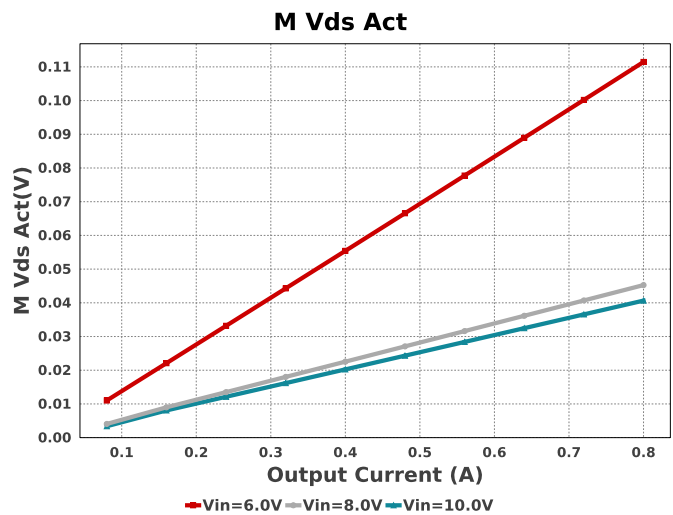
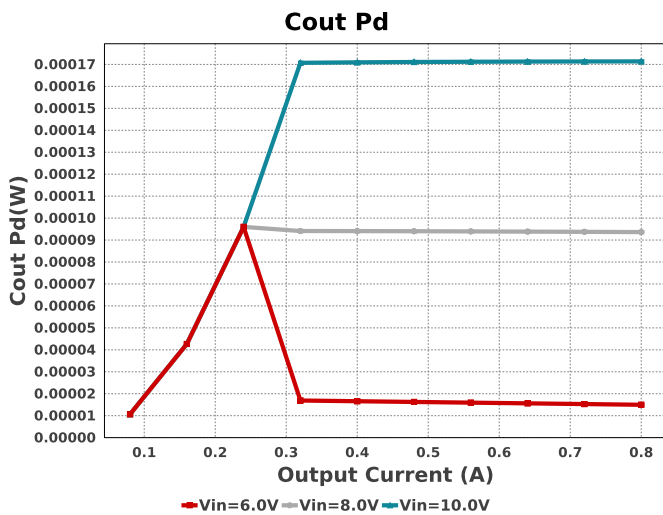
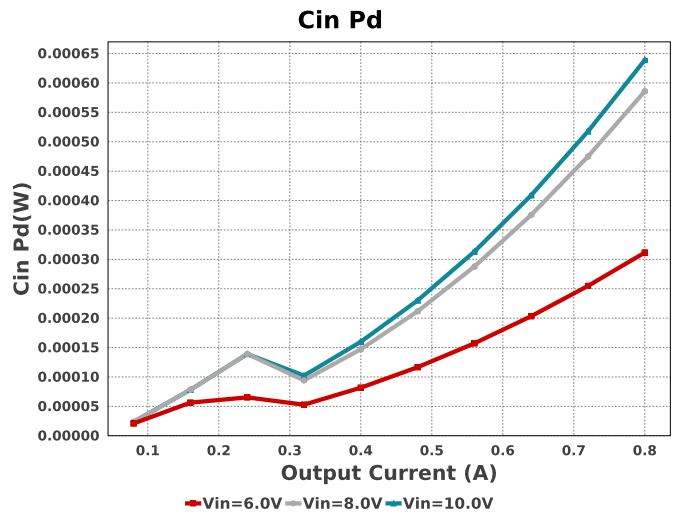
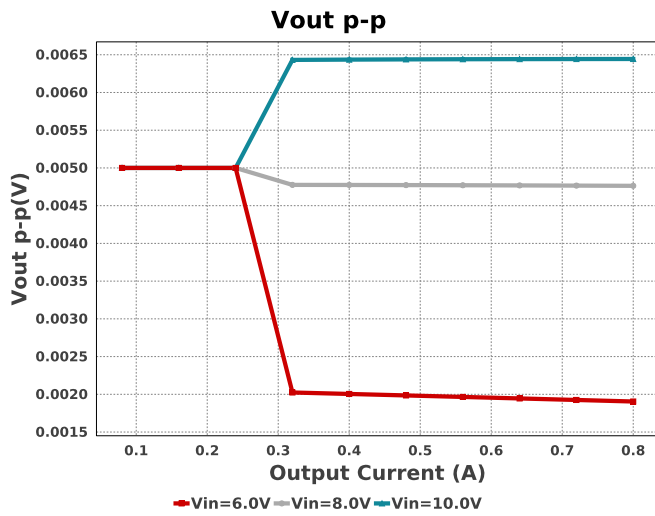
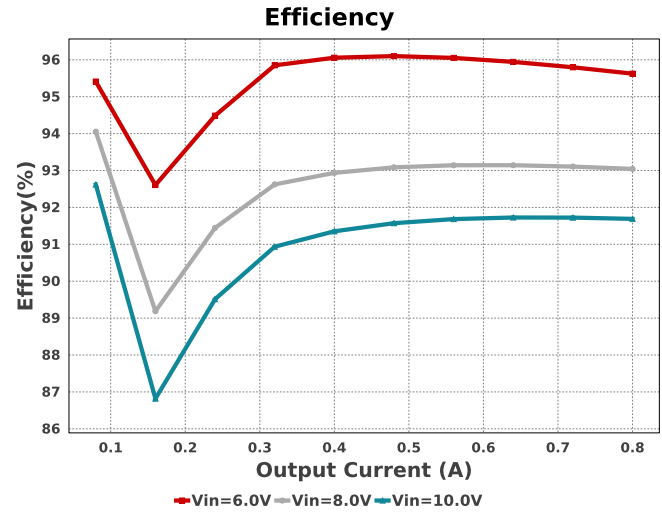
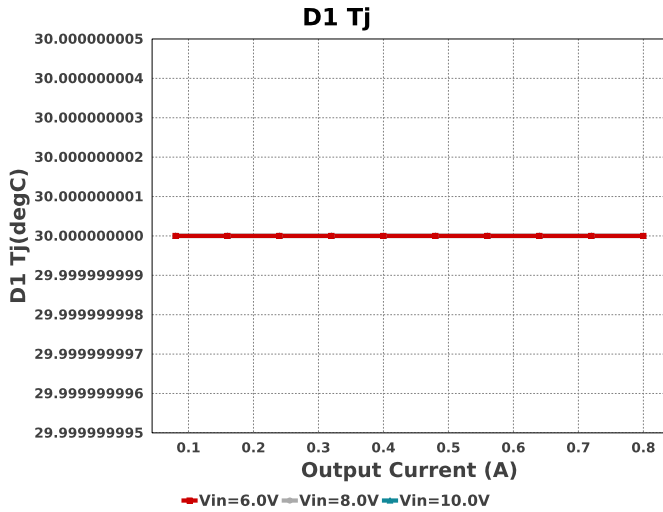


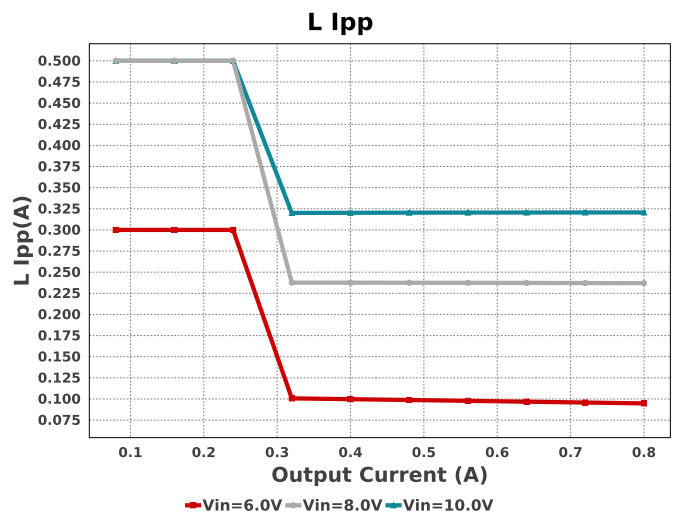
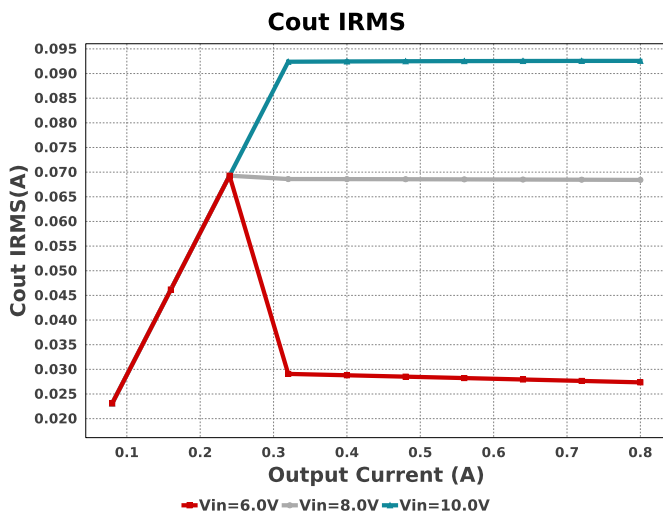
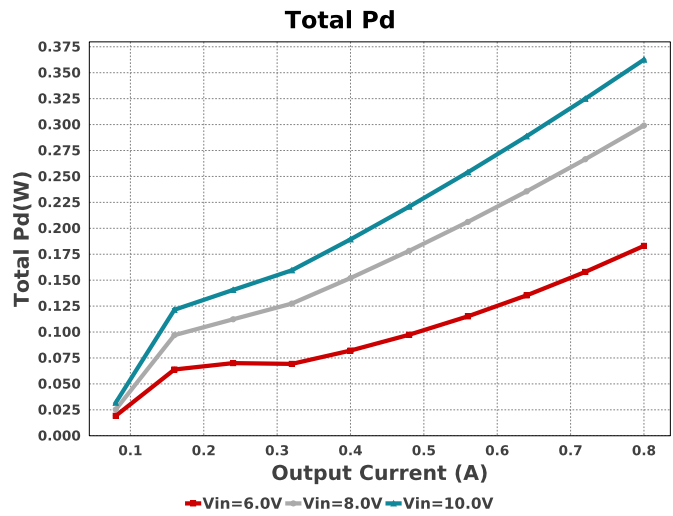
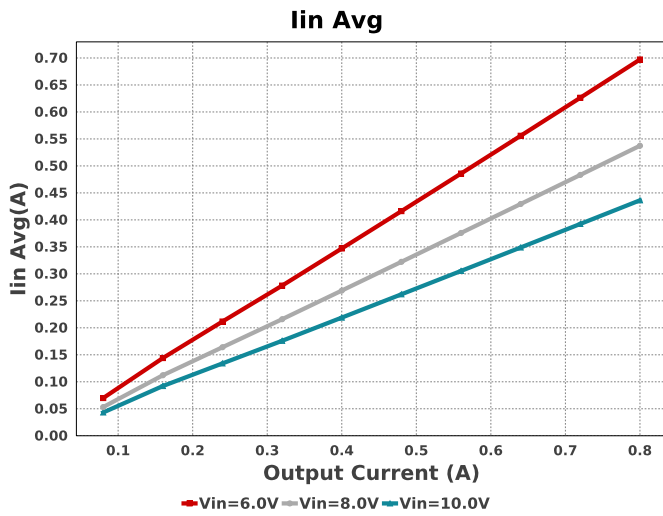
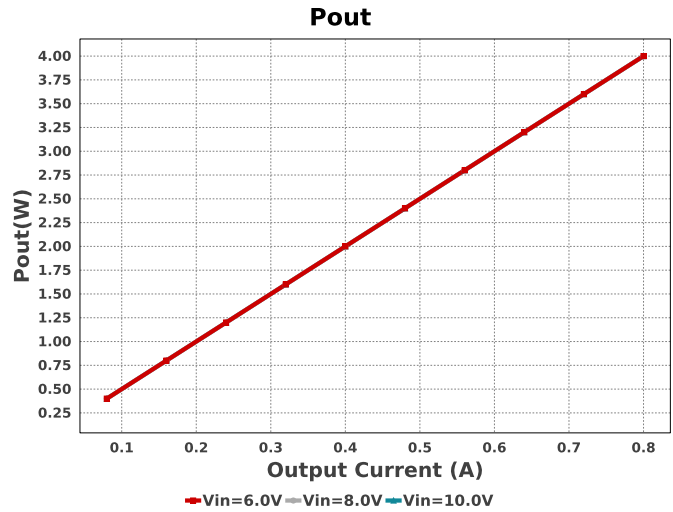
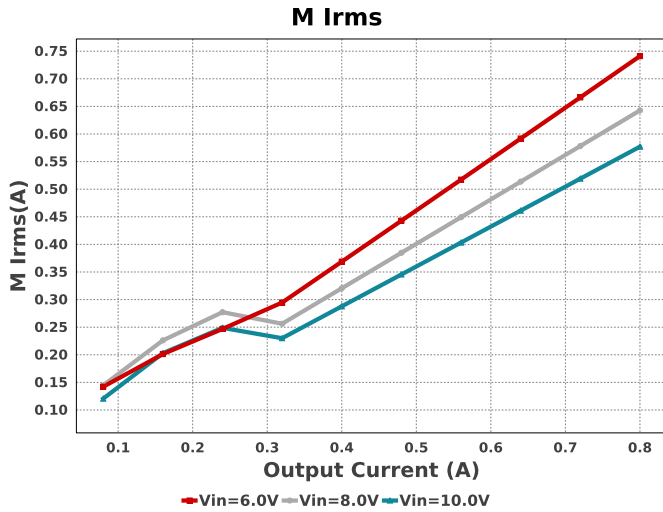
IC Ipk

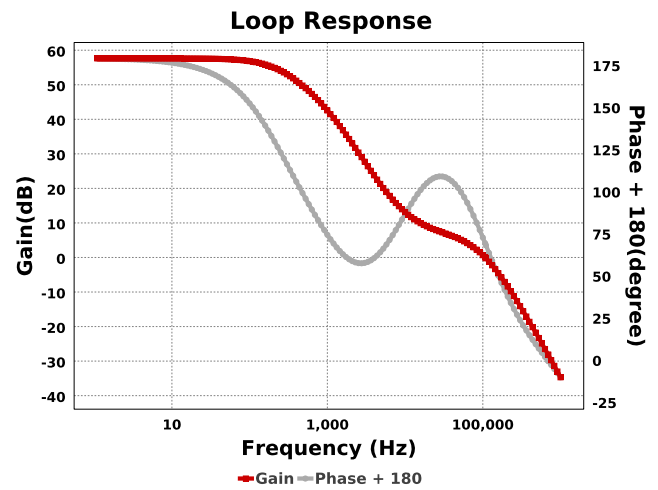
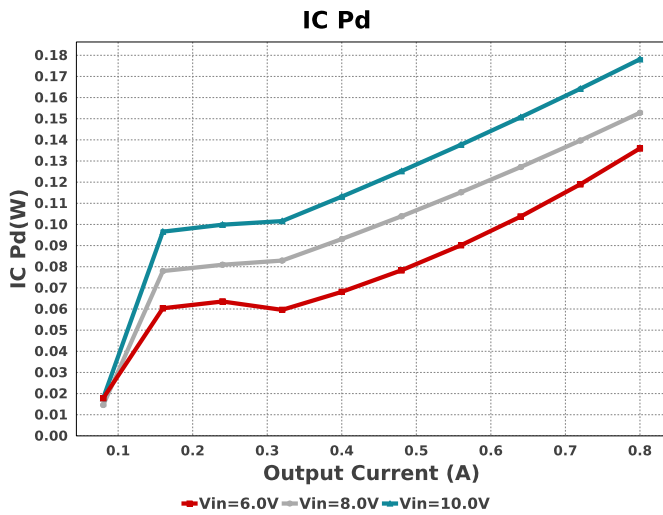


L Pd









## Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	399.672 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	638.95 $\mu$ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	92.569 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	171.38 $\mu$ W	Capacitor	Output capacitor power dissipation
5.	D1 Pd	144.98 mW	Diode	Output Diode Power Dissipation
6.	D1 Tj	33.624 degC	Diode	D1 junction temperature
7.	IC Ipk	0.0 A	IC	Peak switch current in IC
8.	IC Pd	178.12 mW	IC	IC power dissipation
9.	IC Tj	37.481 degC	IC	IC junction temperature
10.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	42.0 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	436.26 mA	IC	Average input current
13.	L Ipp	320.67 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	38.347 mW	Inductor	Inductor power dissipation
15.	M Irms	577.02 mA	Mosfet	MOSFET RMS ripple current
16.	M Vds Act	40.658 mV	Mosfet	Voltage drop across the MosFET
17.	Cin Pd	638.95 $\mu$ W	Power	Input capacitor power dissipation
18.	Cout Pd	171.38 $\mu$ W	Power	Output capacitor power dissipation
19.	D1 Pd	144.98 mW	Power	Output Diode Power Dissipation
20.	IC Pd	178.12 mW	Power	IC power dissipation
21.	L Pd	38.347 mW	Power	Inductor power dissipation
22.	Total Pd	362.576 mW	Power	Total Power Dissipation
23.	BOM Count	13	System	Total Design BOM count
24.	Cross Freq	107.099 kHz	System	Bode plot crossover frequency
25.	Duty Cycle	52.024 %	System	Duty cycle
26.	Efficiency	91.689 %	System	Steady state efficiency
27.	FootPrint	679.0 mm <sup>2</sup>	System	Total Foot Print Area of BOM components
28.	Frequency	1.183 MHz	System	Switching frequency
29.	Gain Marg	-28.192 dB	System	Bode Plot Gain Margin
30.	Iout	800.0 mA	System	Iout operating point
31.	Low Freq Gain	57.622 dB	System	Gain at 1Hz
32.	Mode	CCM	System	Conduction Mode
33.	Phase Marg	69.968 deg	System	Bode Plot Phase Margin
34.	Pout	4.0 W	System	Total output power
35.	Total BOM	\$4.27	System	Total BOM Cost
36.	Vin	10.0 V	System	Vin operating point

#	Name	Value	Category	Description
37.	Vout	5.0 V	System Information	Operational Output Voltage
38.	Vout Actual	5.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
39.	Vout Tolerance	4.158 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout p-p	6.444 mV	System Information	Peak-to-peak output ripple voltage

## Design Inputs

Name	Value	Description
Iout	800.0 m	Maximum Output Current
VinMax	10.0	Maximum input voltage
VinMin	6.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LMR14020S	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 6.0V 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 : 2987CECD7190F5F83249B689B90B3C5B[v1]
2. **LMR14020S** Product Folder : <http://www.ti.com/product/LMR14020> : contains the data sheet and other resources.

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