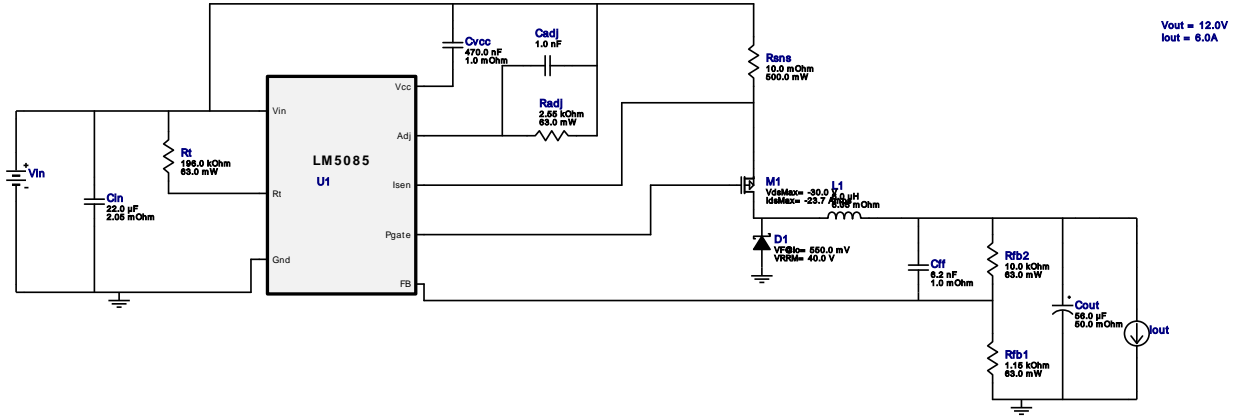


WEBENCH® Design Report

Design : 2 LM5085MY/NOPB
LM5085MY/NOPB 16V-20V to 12.00V @ 6A







VinMin = 16.0V
VinMax = 20.0V
Vout = 12.0V
Iout = 6.0A

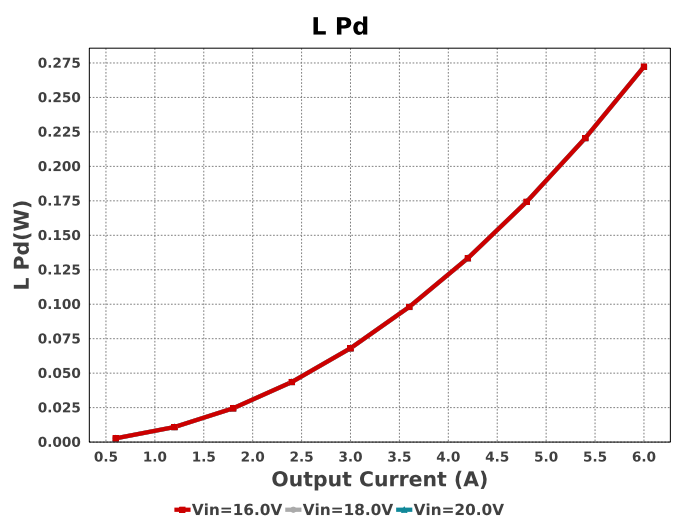
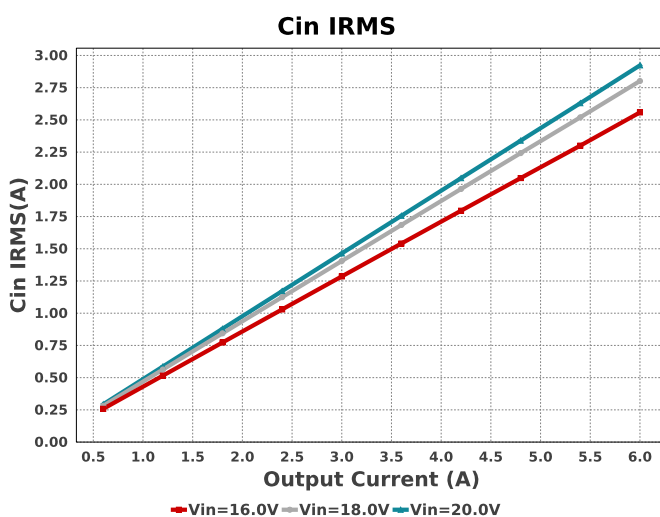
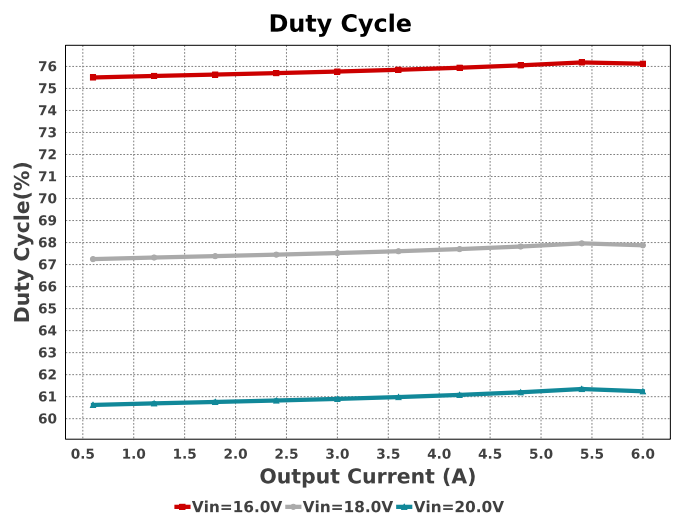
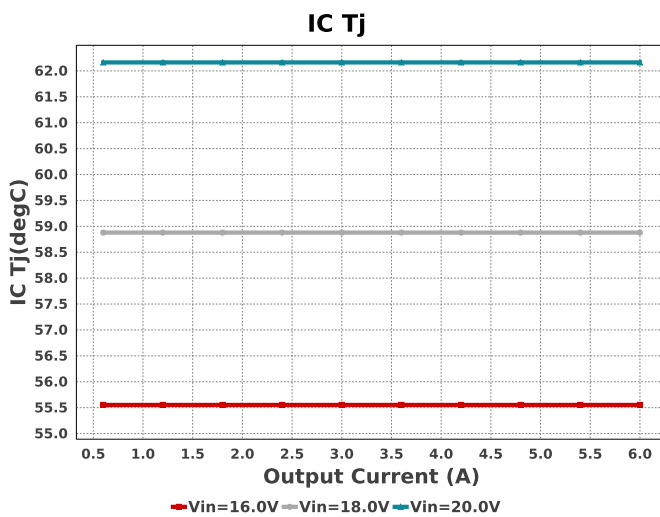
Device = LM5085MY/NOPB
Topology = Buck
Created = 2022-11-11 03:20:31.211
BOM Cost = \$3.60
BOM Count = 14
Total Pd = 4.88W

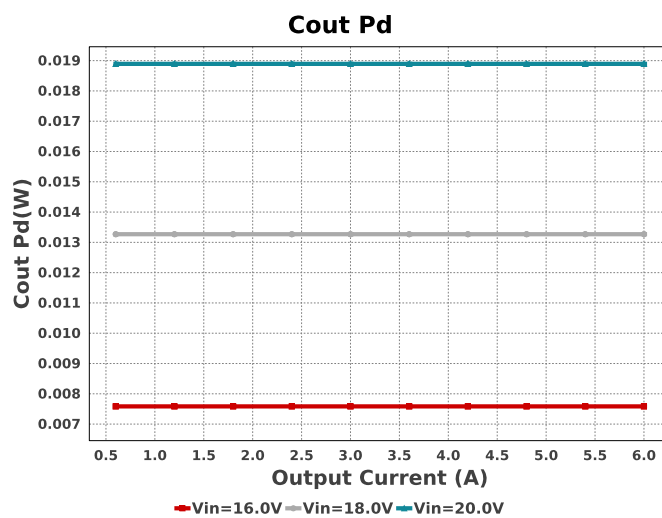
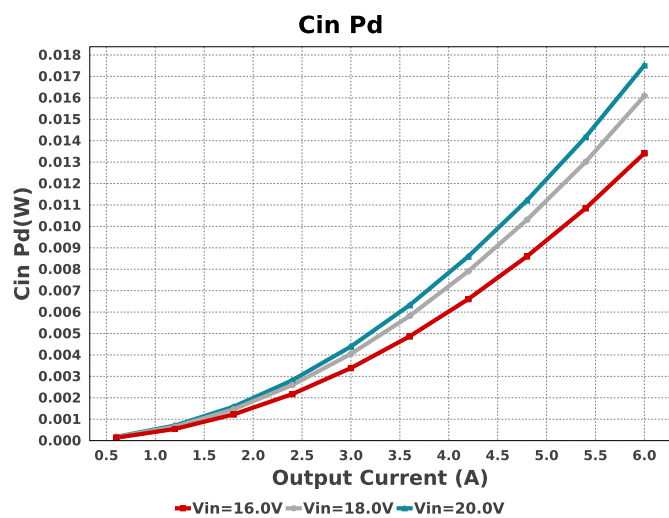
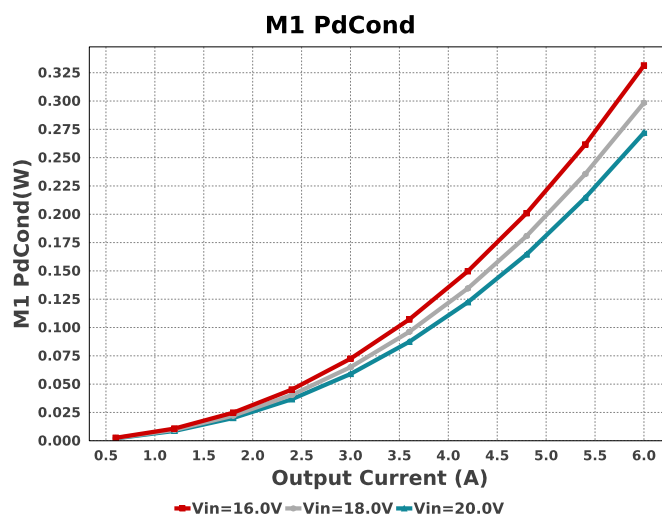
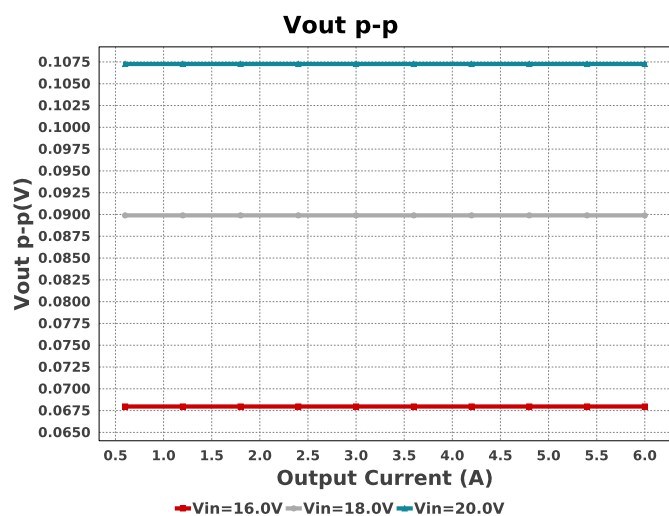
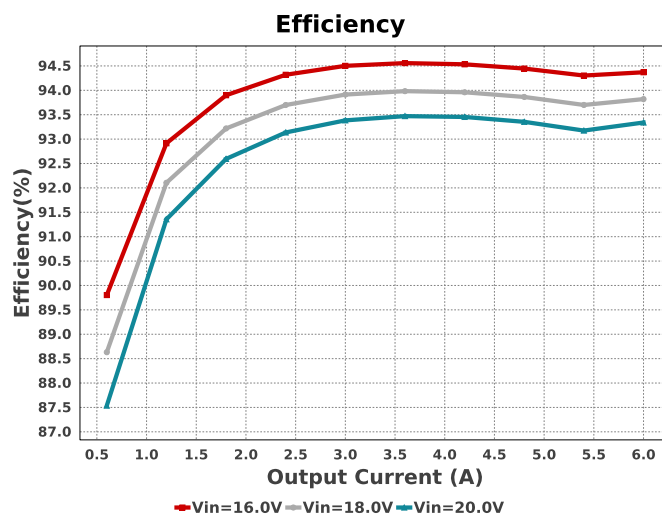
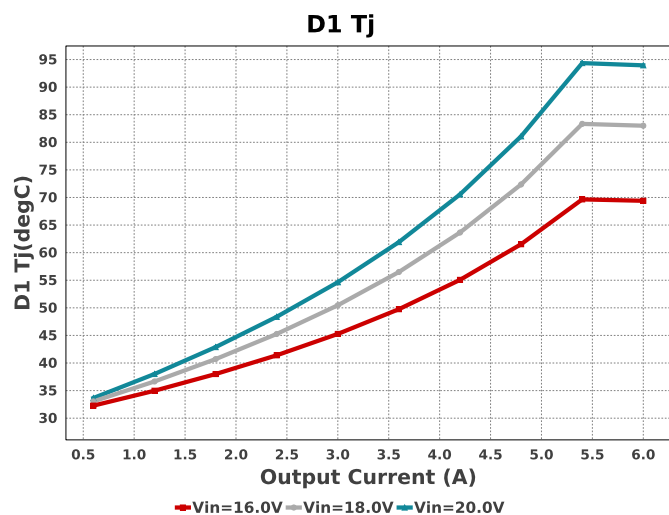


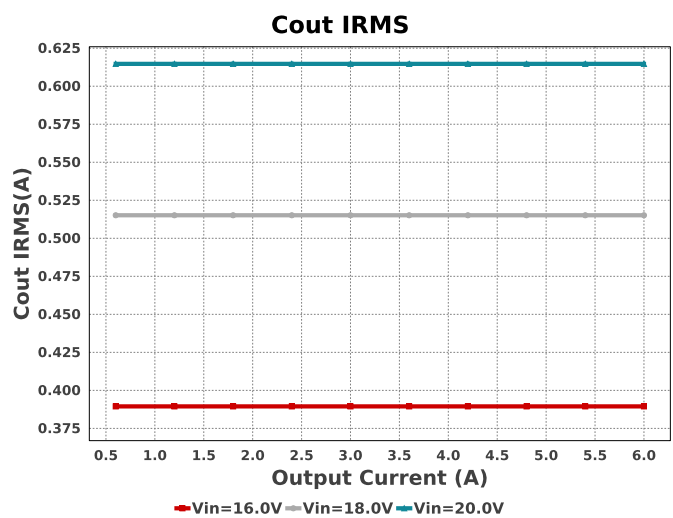
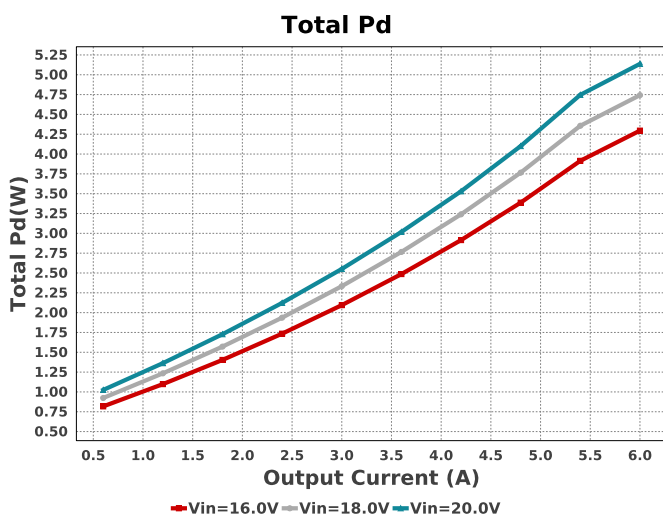
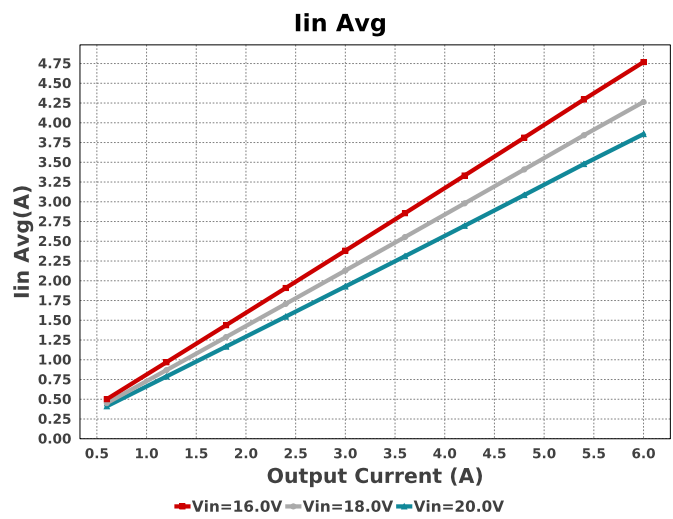
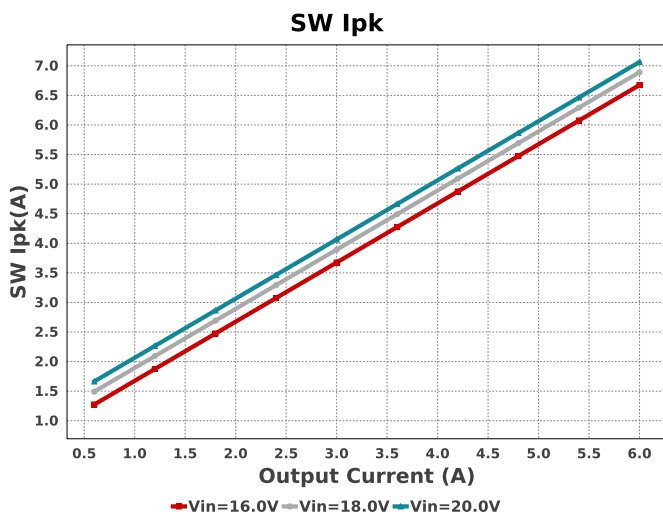
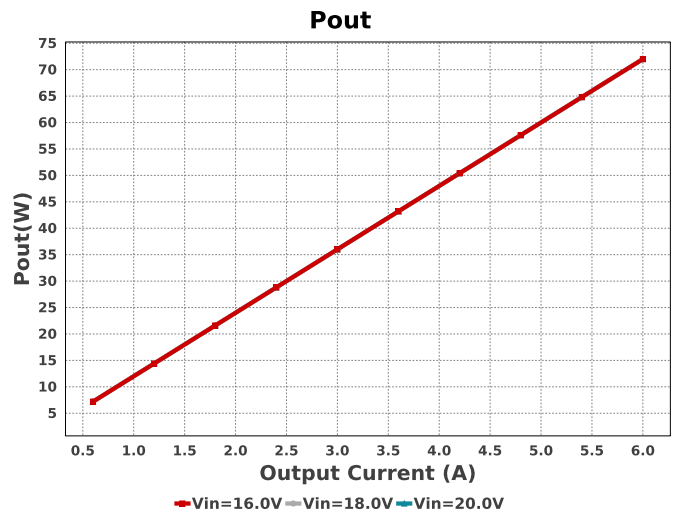
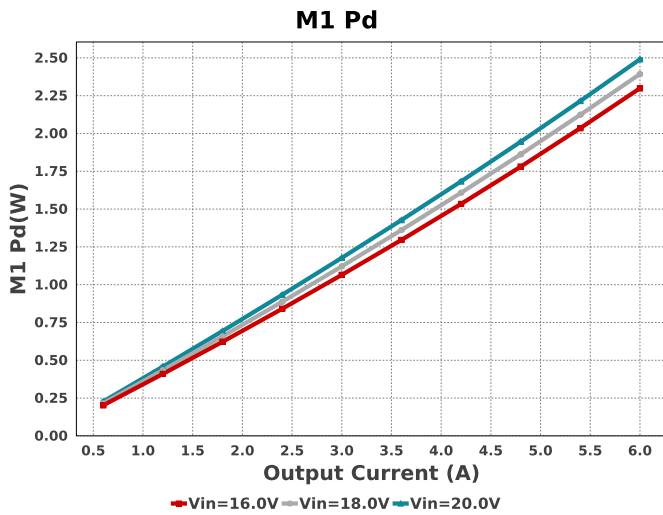
Electrical BOM

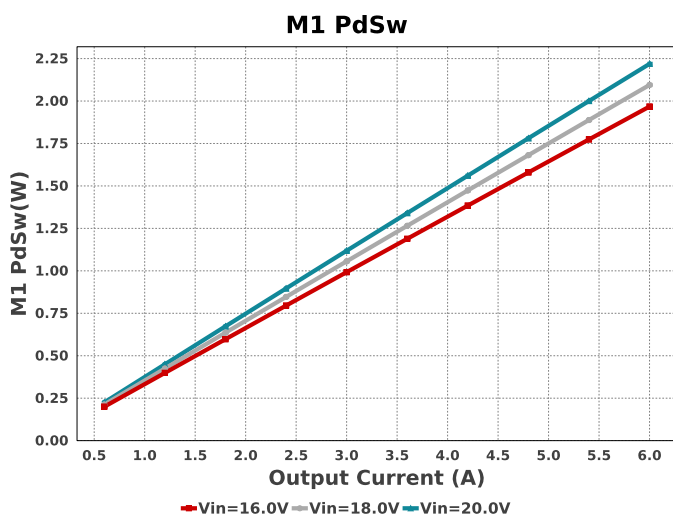
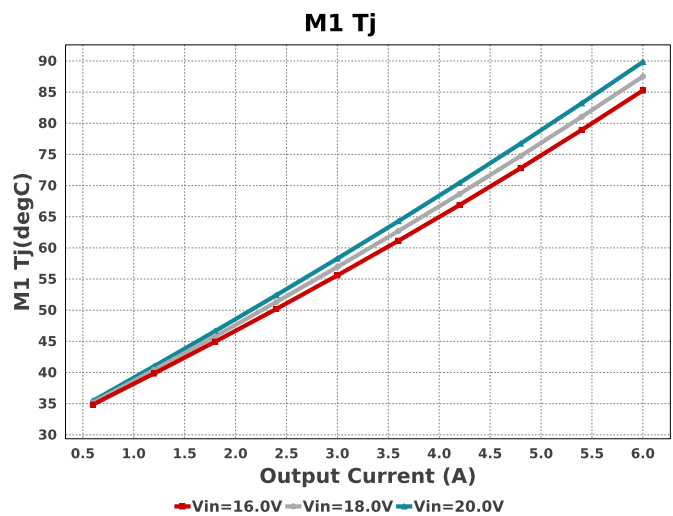
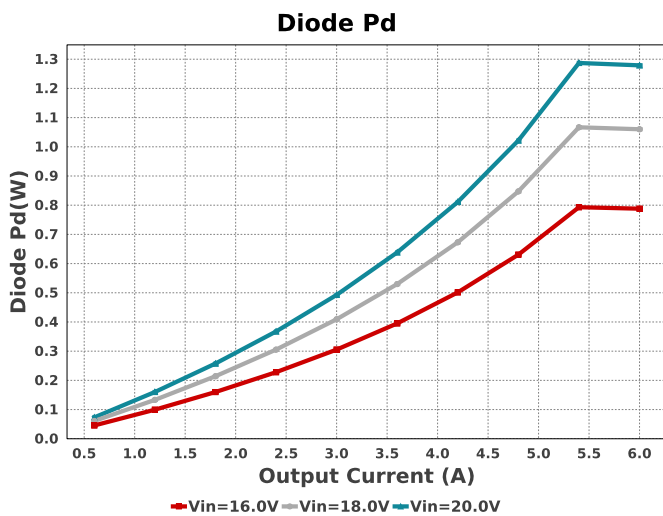
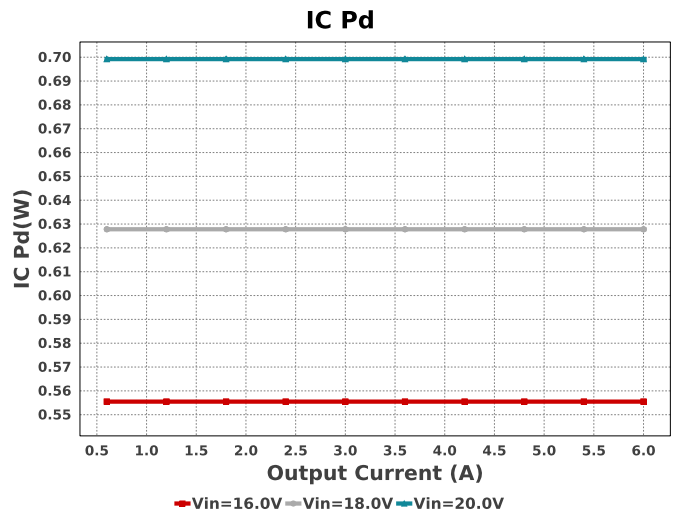
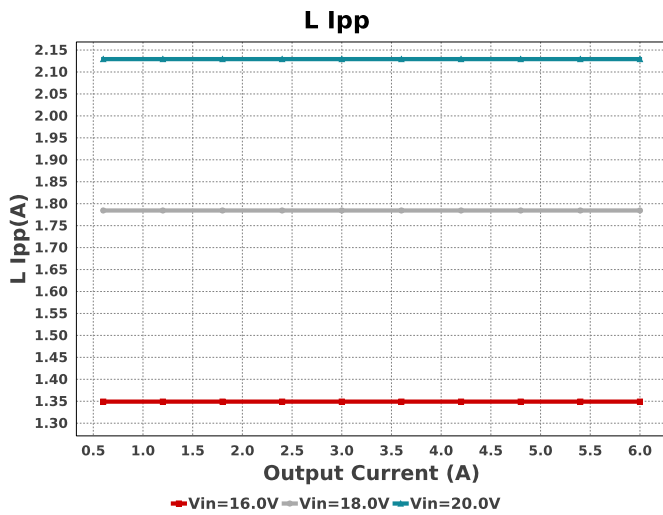
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cadj	Samsung Electro-Mechanics	CL21C102JBCNNNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
Cff	MuRata	GRM2195C1H622JA01D Series= C0G/NP0	Cap= 6.2 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.06	 0805 7 mm ²
Cin	TDK	C2012X5R1V226M125AC Series= X5R	Cap= 22.0 uF ESR= 2.05 mOhm VDC= 35.0 V IRMS= 4.5559 A	1	\$0.31	 0805 7 mm ²
Cout	Panasonic	EEH2C1E560P Series= ZC	Cap= 56.0 uF ESR= 50.0 mOhm VDC= 25.0 V IRMS= 900.0 mA	1	\$0.29	 SM_RADIAL_6.3AMM 80 mm ²
Cvcc	Taiyo Yuden	TMK212BJ474KD-T Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 20.0 V IRMS= 0.0 A	1	\$0.02	 0805 7 mm ²
D1	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	\$0.19	 SMC 83 mm ²
L1	Coilcraft	SER1360-602KLB	L= 6.0 uH 6.05 mOhm	1	\$0.74	 SER1360 225 mm ²
M1	Vishay-Siliconix	Si7149DP	VdsMax= -30.0 V IdsMax= -23.7 Amps	1	\$0.84	 PowerPAK_SO-8 55 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Radj	Vishay-Dale	CRCW04022K55FKED Series= CRCW..e3	Res= 2.55 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfb1	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfb2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rsns	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	\$0.11	 1206 11 mm ²
Rt	Vishay-Dale	CRCW0402196KFKED Series= CRCW..e3	Res= 196.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
U1	Texas Instruments	LM5085MY/NOPB	Switcher	1	\$0.99	 MUY08A 24 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	2.923 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	17.518 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	614.698 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	18.893 mW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	93.954 degC	Diode	D1 junction temperature
6.	Diode Pd	1.279 W	Diode	Diode power dissipation
7.	IC Pd	699.21 mW	IC	IC power dissipation
8.	IC Tj	62.164 degC	IC	IC junction temperature
9.	IC Tolerance	25.0 mV	IC	IC Feedback Tolerance
10.	ICThetaJA	46.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	3.844 A	IC	Average input current

#	Name	Value	Category	Description
12.	L Ipp	2.129 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	272.25 mW	Inductor	Inductor power dissipation
14.	M1 Pd	2.234 W	Mosfet	M1 MOSFET total power dissipation
15.	M1 PdCond	266.58 mW	Mosfet	M1 MOSFET conduction losses
16.	M1 PdSw	1.967 W	Mosfet	M1 MOSFET switching losses
17.	M1 Tj	83.648 degC	Mosfet	M1 MOSFET junction temperature
18.	Cin Pd	17.518 mW	Power	Input capacitor power dissipation
19.	Cout Pd	18.893 mW	Power	Output capacitor power dissipation
20.	Diode Pd	1.279 W	Power	Diode power dissipation
21.	IC Pd	699.21 mW	Power	IC power dissipation
22.	L Pd	272.25 mW	Power	Inductor power dissipation
23.	M1 Pd	2.234 W	Power	M1 MOSFET total power dissipation
24.	M1 PdCond	266.58 mW	Power	M1 MOSFET conduction losses
25.	M1 PdSw	1.967 W	Power	M1 MOSFET switching losses
26.	Total Pd	4.881 W	Power	Total Power Dissipation
27.	BOM Count	14	System	Total Design BOM count
			Information	
28.	Duty Cycle	61.24 %	System	Duty cycle
			Information	
29.	Efficiency	93.651 %	System	Steady state efficiency
			Information	
30.	FootPrint	517.0 mm ²	System	Total Foot Print Area of BOM components
			Information	
31.	Frequency	364.292 kHz	System	Switching frequency
			Information	
32.	Iout	6.0 A	System	Iout operating point
			Information	
33.	Mode	CCM	System	Conduction Mode
			Information	
34.	Pout	72.0 W	System	Total output power
			Information	
35.	SW Ipk	7.065 A	System	Peak switch current
			Information	
36.	Total BOM	\$3.6	System	Total BOM Cost
			Information	
37.	Vin	20.0 V	System	Vin operating point
			Information	
38.	Vout	12.0 V	System	Operational Output Voltage
			Information	
39.	Vout Actual	12.12 V	System	Vout Actual calculated based on selected voltage divider resistors
			Information	
40.	Vout Tolerance	3.848 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
			Information	
41.	Vout p-p	107.265 mV	System	Peak-to-peak output ripple voltage
			Information	

Design Inputs

Name	Value	Description
Iout	6.0	Maximum Output Current
VinMax	20.0	Maximum input voltage
VinMin	16.0	Minimum input voltage
VinTyp	18.0	Typical input voltage
Vout	12.0	Output Voltage
base_pn	LM5085	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

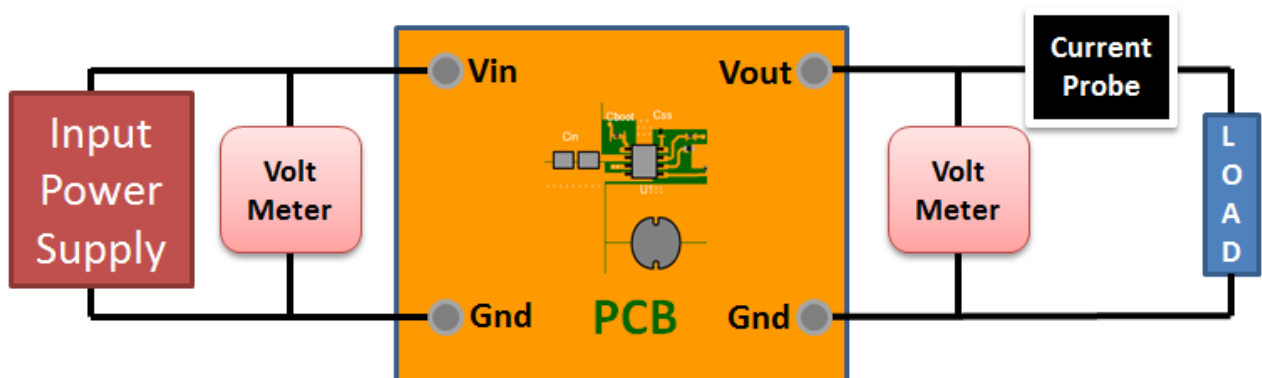
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 16.0V 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. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'optimal solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple.

2. Master key : 554E87F380B10EF862A869D8392B4870[v1]

3. **LM5085 Product Folder** : <http://www.ti.com/product/LM5085> : contains the data sheet and other resources.

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