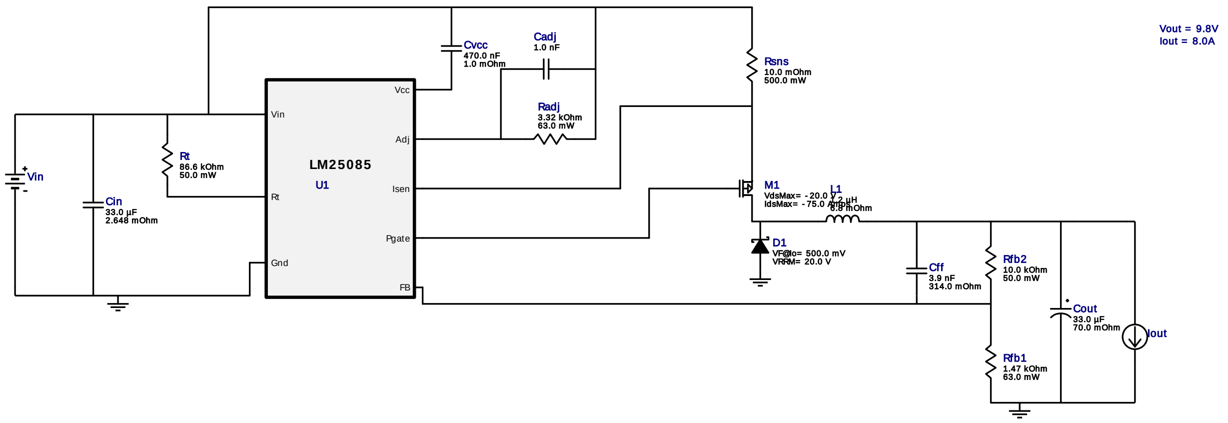
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 10.1V
VinMax = 12.6V
Vout = 9.8V
Iout = 8.0A

Device = LM25085MY/NOPB
Topology = Buck
Created = 2019-12-16 22:57:37.350
BOM Cost = $2.94
BOM Count = 14
Total Pd = 3.22W

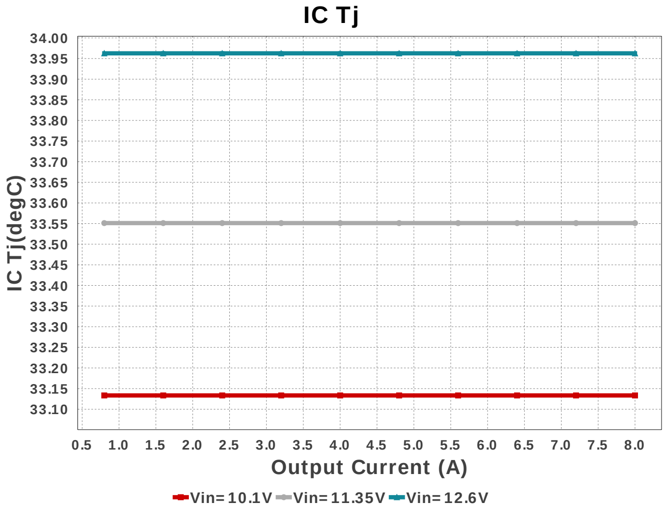
Design : 6 LM25085MY/NOPB
LM25085MY/NOPB 10.1V-12.6V to 10.00V @ 8A

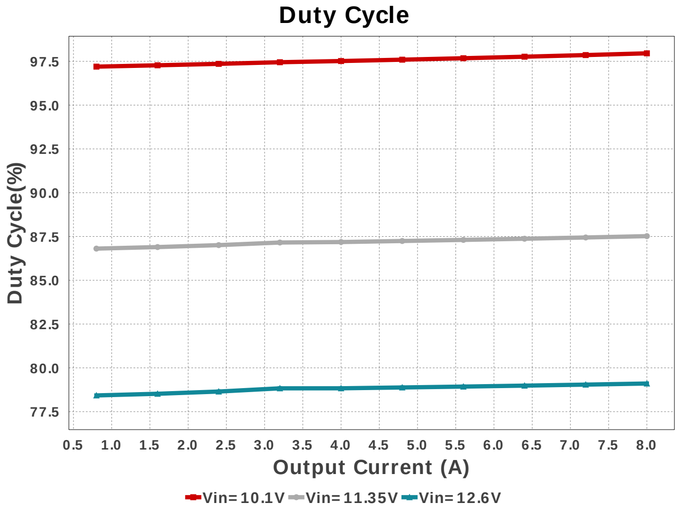


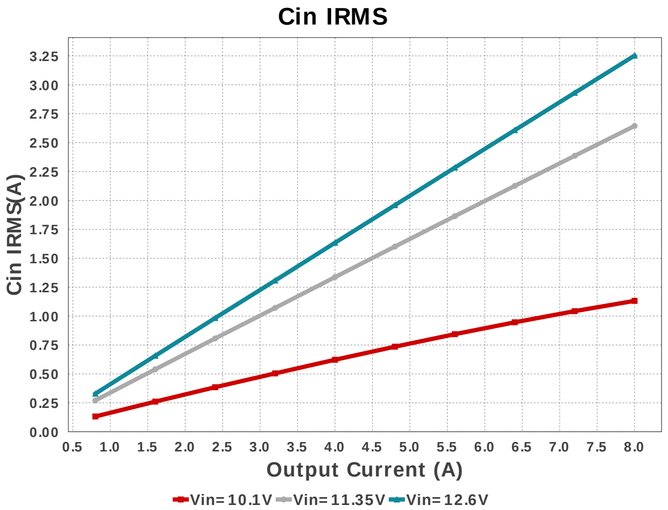
Electrical BOM

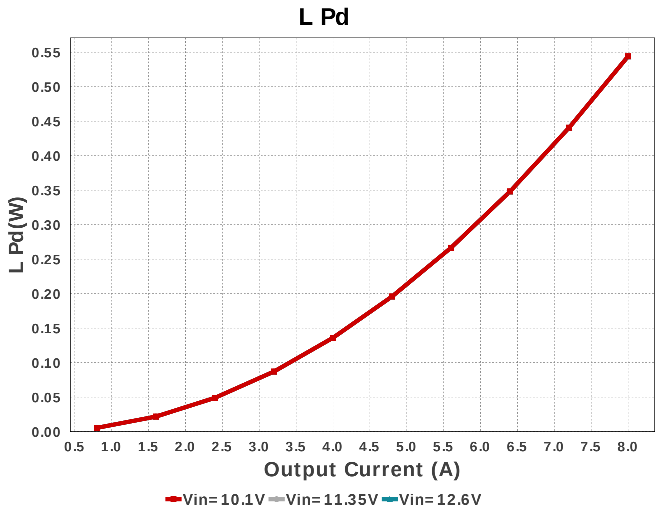
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cadj	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cff	Kemet	C1206C392K5RACTU Series= X7R	Cap= 3.9 nF ESR= 314.0 mOhm VDC= 50.0 V IRMS= 300.0 mA	1	$0.08	1206 11 mm²
Cin	TDK	C3216X5R1E336M160AC Series= X5R	Cap= 33.0 uF ESR= 2.648 mOhm VDC= 25.0 V IRMS= 4.4586 A	1	$0.39	1206_180 11 mm²
Cout	Panasonic	12TPG33M Series= TPG	Cap= 33.0 uF ESR= 70.0 mOhm VDC= 12.5 V IRMS= 1.0 A	1	$0.49	CAPSMT_6_B1G 17 mm²
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 mm²
D1	Diodes Inc.	B320-13-F	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.15	SMC 83 mm²
L1	Coilcraft	XAL6030-122MEB	L= 1.2 µH 6.8 mOhm	1	$0.65	XAL6030 72 mm²
M1	Texas Instruments	CSD25402Q3A	VdsMax= -20.0 V IdsMax= -75.0 Amps	1	$0.29	DNH0008A 18 mm²
Radj	Vishay-Dale	CRCW04023K32FKED Series= CRCW..e3	Res= 3.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfb1	Vishay-Dale	CRCW04021K47FKED Series= CRCW..e3	Res= 1.47 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

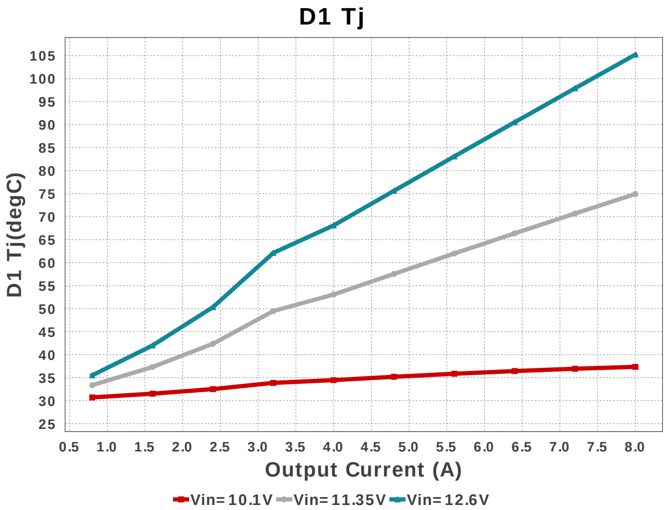
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfb2	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rsns	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.12	1206 11 mm^2
Rt	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	LM25085MY/NOPB	Switcher	1	$0.70	MUY08A 24 mm^2

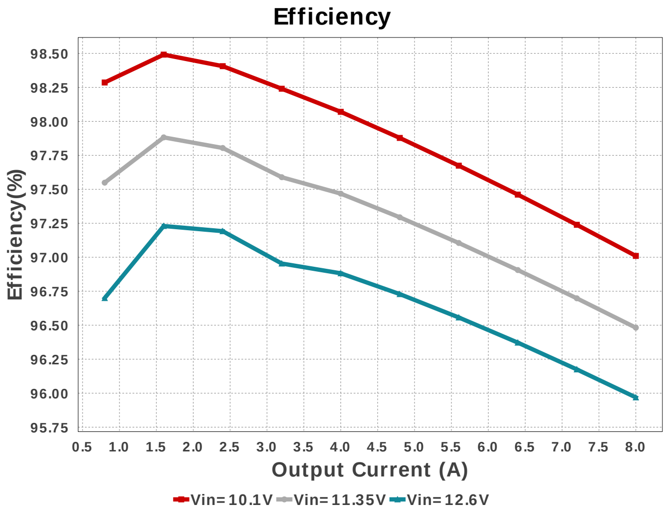


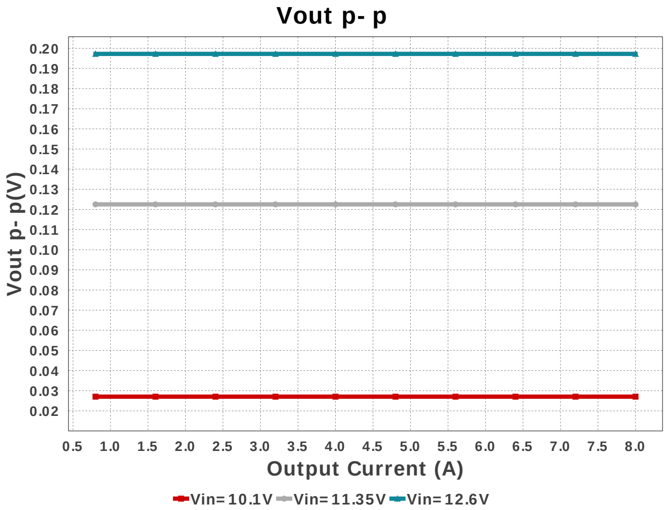


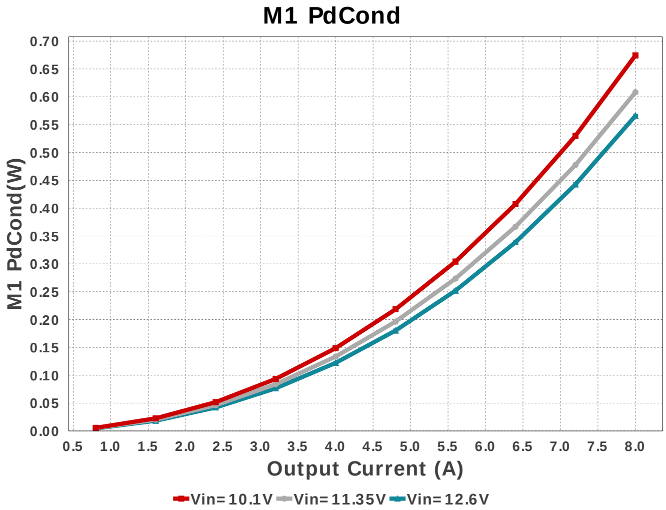


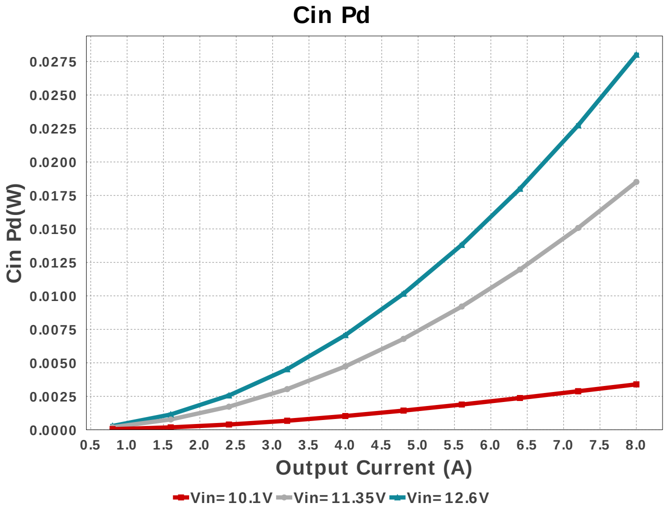


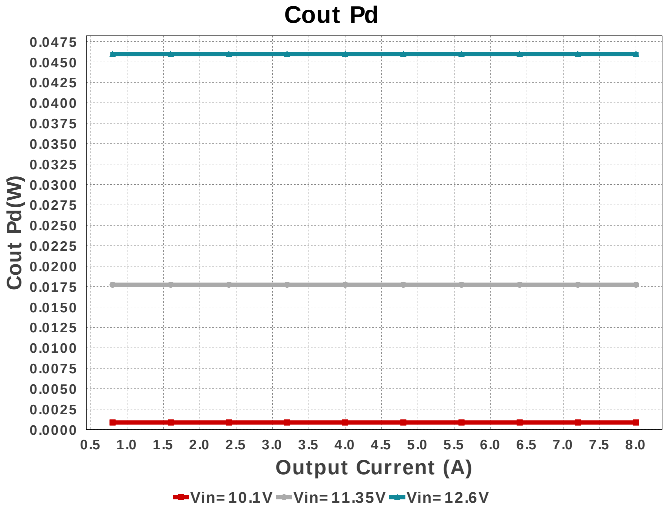

D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

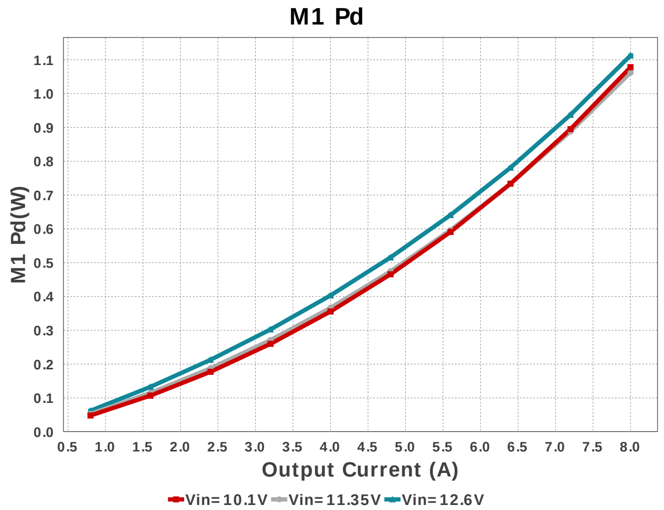

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

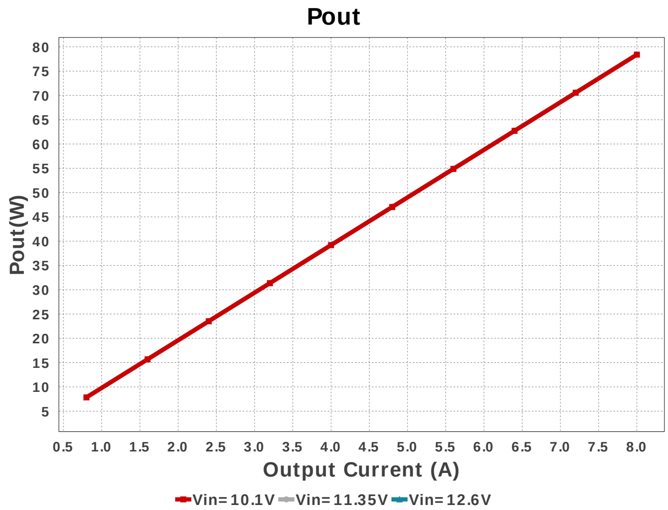

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

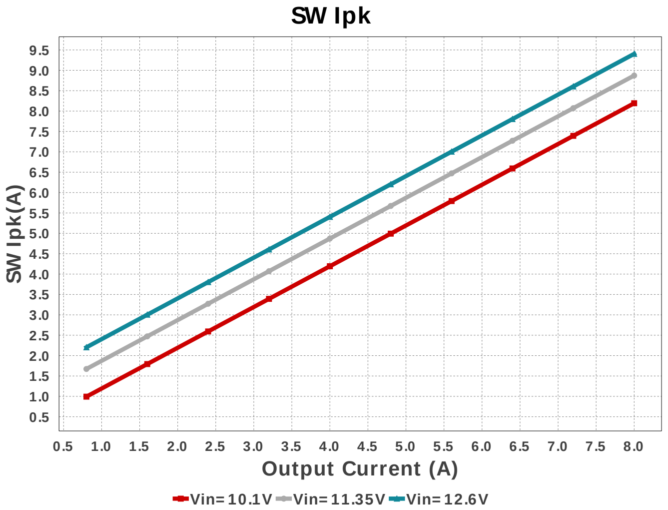

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

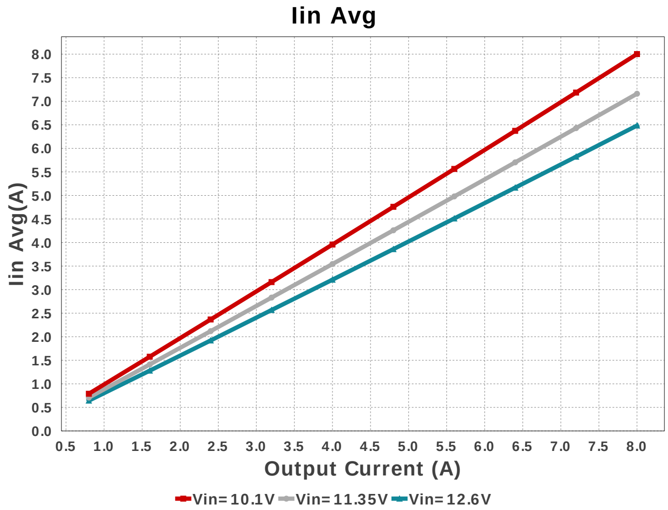

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

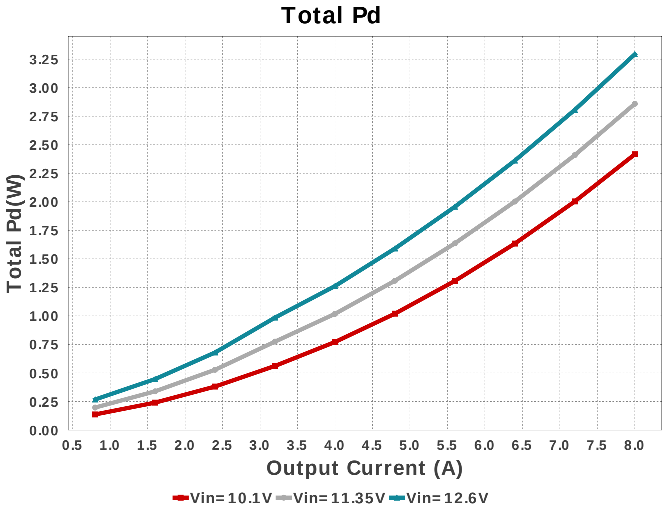

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

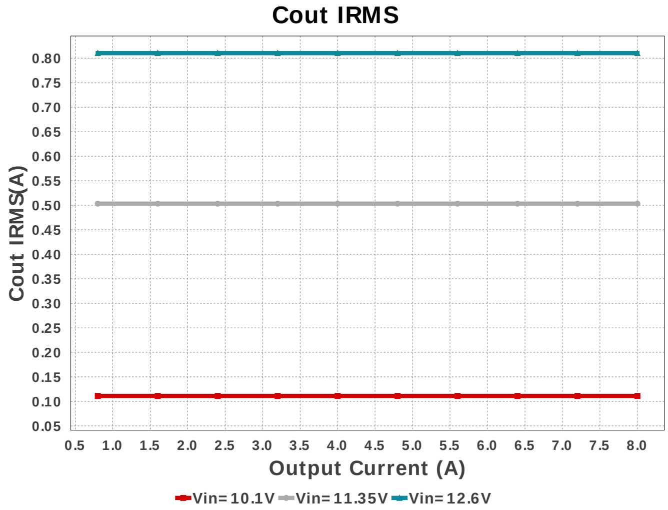

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

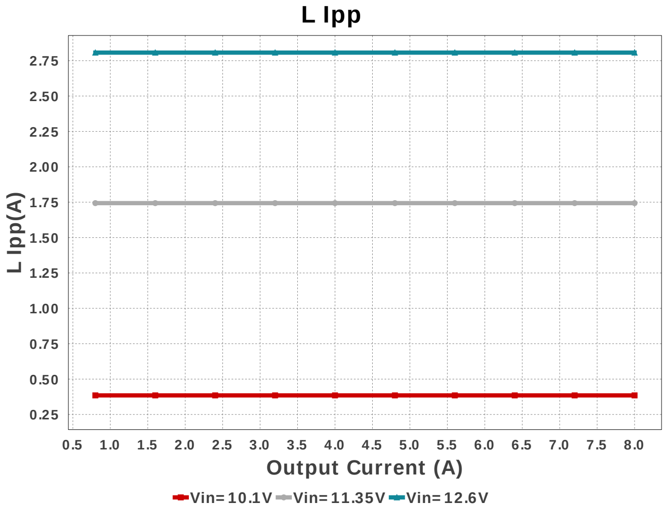

Pout
Pout(W)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

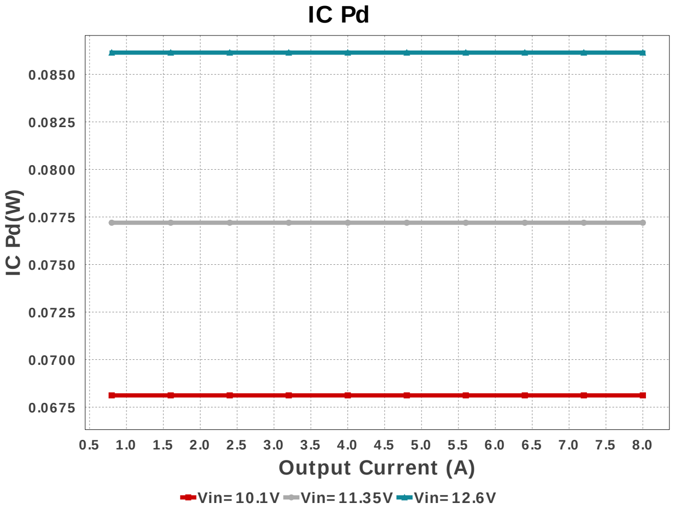

SW Ipk
SW Ipk(A)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

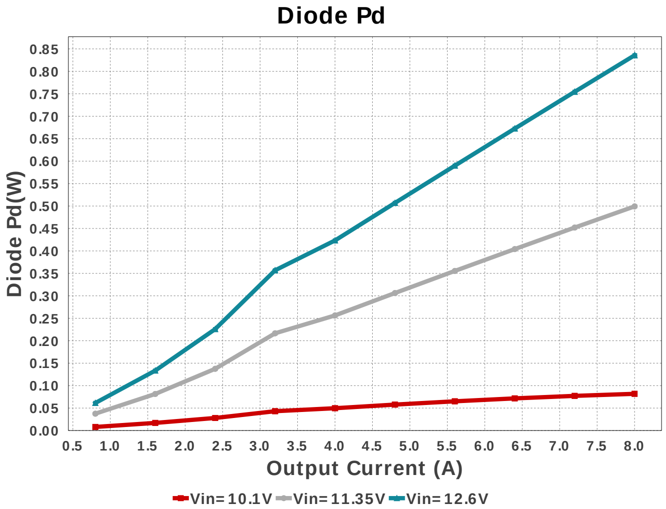

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

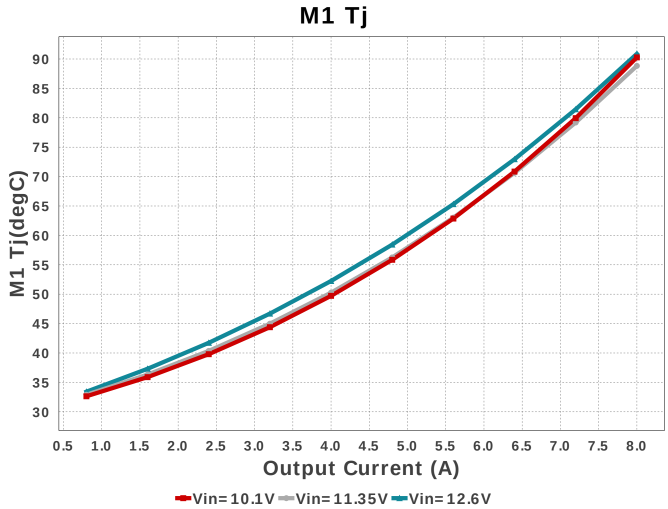

Total Pd
Total Pd(W)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V

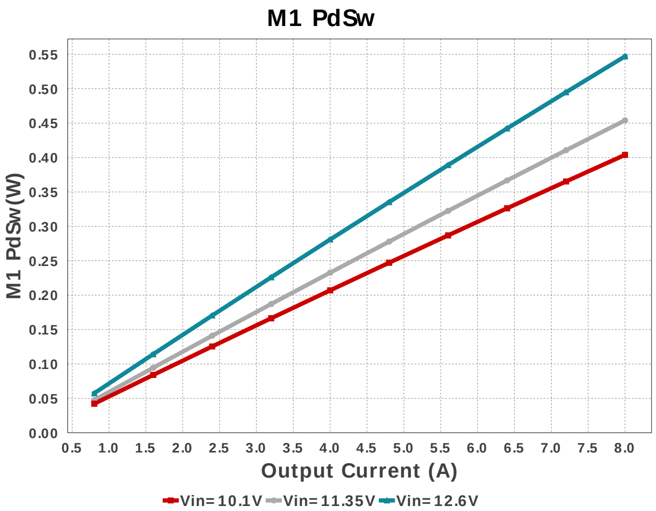

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=10.1V Vin=11.35V Vin=12.6V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.253 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	28.016 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	810.272 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	45.958 mW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	105.24 degC	Diode	D1 junction temperature
6.	Diode Pd	835.97 mW	Diode	Diode power dissipation
7.	IC Pd	86.144 mW	IC	IC power dissipation
8.	IC Tj	33.963 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	6.478 A	IC	Average input current

#	Name	Value	Category	Description
12.	L Ipp	2.807 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	544.0 mW	Inductor	Inductor power dissipation
14.	M1 Pd	1.042 W	Mosfet	M1 MOSFET total power dissipation
15.	M1 PdCond	559.85 mW	Mosfet	M1 MOSFET conduction losses
16.	M1 PdSw	482.07 mW	Mosfet	M1 MOSFET switching losses
17.	M1 Tj	86.943 degC	Mosfet	M1 MOSFET junction temperature
18.	Cin Pd	28.016 mW	Power	Input capacitor power dissipation
19.	Cout Pd	45.958 mW	Power	Output capacitor power dissipation
20.	Diode Pd	835.97 mW	Power	Diode power dissipation
21.	IC Pd	86.144 mW	Power	IC power dissipation
22.	L Pd	544.0 mW	Power	Inductor power dissipation
23.	M1 Pd	1.042 W	Power	M1 MOSFET total power dissipation
24.	M1 PdCond	559.85 mW	Power	M1 MOSFET conduction losses
25.	M1 PdSw	482.07 mW	Power	M1 MOSFET switching losses
26.	Total Pd	3.222 W	Power	Total Power Dissipation
27.	BOM Count	14	System Information	Total Design BOM count
28.	Duty Cycle	79.101 %	System Information	Duty cycle
29.	Efficiency	96.053 %	System Information	Steady state efficiency
30.	FootPrint	267.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	620.761 kHz	System Information	Switching frequency
32.	Iout	8.0 A	System Information	Iout operating point
33.	Mode	CCM	System Information	Conduction Mode
34.	Pout	78.4 W	System Information	Total output power
35.	SW Ipk	9.403 A	System Information	Peak switch current
36.	Total BOM	$2.94	System Information	Total BOM Cost
37.	Vin	12.6 V	System Information	Vin operating point
38.	Vout	9.8 V	System Information	Operational Output Voltage
39.	Vout Actual	9.753 V	System Information	Vout Actual calculated based on selected voltage divider resistors
40.	Vout Tolerance	3.796 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
41.	Vout p-p	197.226 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	8.0	Maximum Output Current
VinMax	12.6	Maximum input voltage
VinMin	10.1	Minimum input voltage
Vout	9.8	Output Voltage
base_pn	LM25085	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

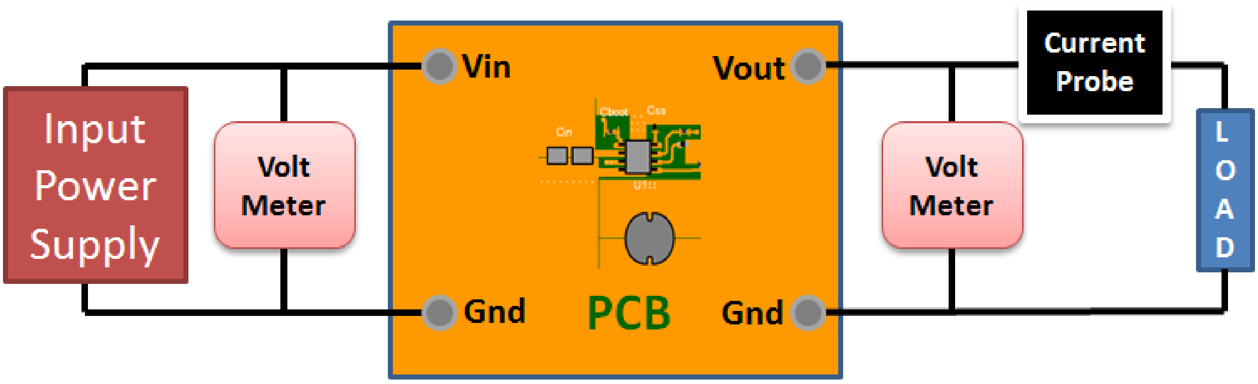
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.1V 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. 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 : 1FF720AF0255931C[v1]

3. **LM25085** Product Folder : http://www.ti.com/product/LM25085 : contains the data sheet and other resources.