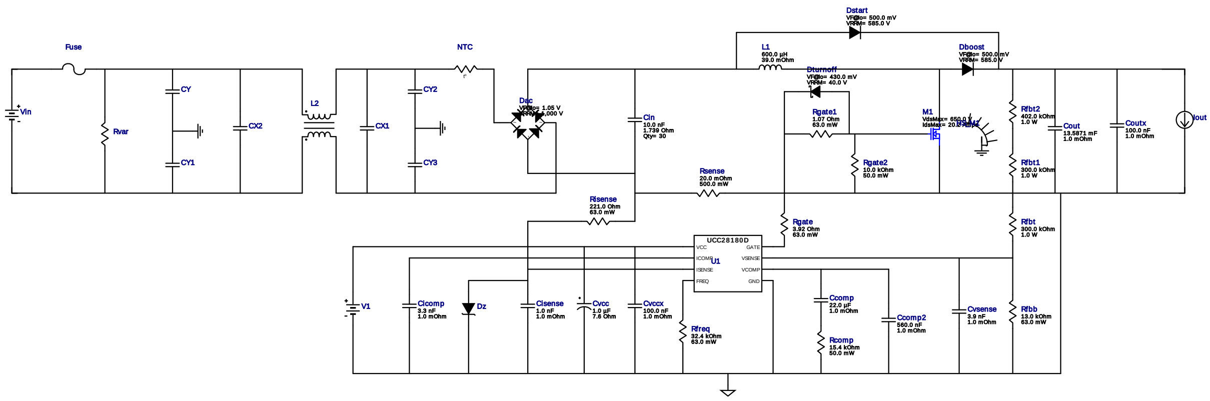
VinMin = 85.0V
VinMax = 265.0V
Vout = 390.0V
Iout = 1.5A

Device = UCC28180DR
Topology = PFC-BOOST
Created = 2020-02-24 08:37:35.594
BOM Cost = NA
BOM Count = 61
Total Pd = 42.83W

WEBENCH ® Design Report

Design : 82 UCC28180DR
UCC28180DR 85V-265V to 390.00V @ 1.5A



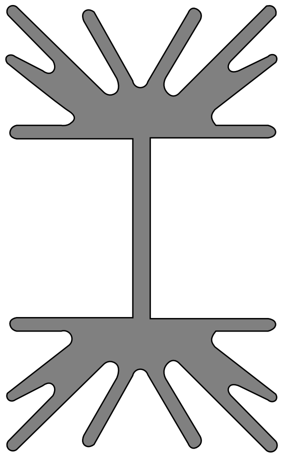
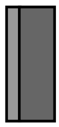
1. Mosfet gate resistances are a starting point and need to be modified according to Mosfet selected. Protection circuit is designed for standard input conditions and should be redesigned for unconventional input conditions.

Design Alerts

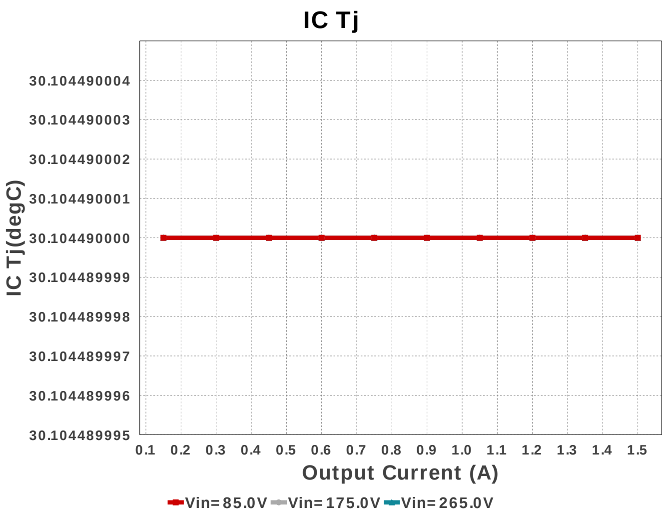
M1 Junction temperature is too high
M1 Tj:179.54 degC Specification: <150.00 degC
Suggested:<150.00 degC
This may lead to a device malfunction or breakdown.
Some possible solutions are below:
Decrease Switching Frequency to decrease MOSFET or Diode switching losses
Decrease ambient temperature
Decrease thermal resistance by adding a heat sink if feasible
Increase the copper area and thickness of the board

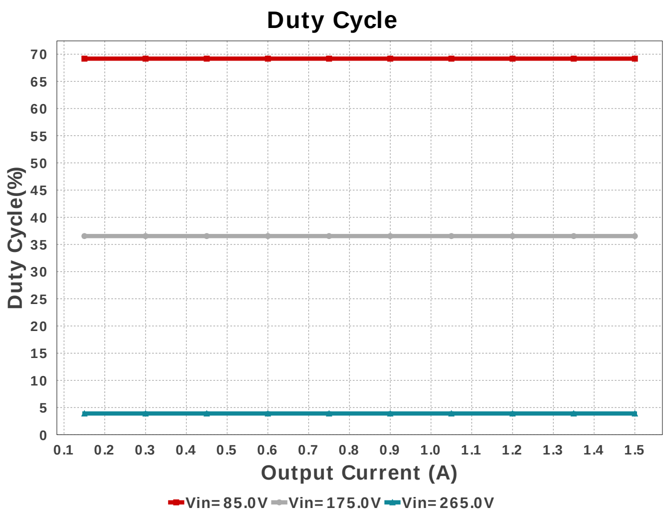
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Ccomp	Taiyo Yuden	LMK212BJ226MG-T Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.10	0805 7 mm^2
Ccomp2	MuRata	GRM155R61A564KE15D Series= X5R	Cap= 560.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 6.0 A	1	$0.03	0402 3 mm^2
Cicomp	MuRata	GRM216R71E332KA01D Series= X7R	Cap= 3.3 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Cin	Kemet	C0805C103K1RACTU Series= X7R	Cap= 10.0 nF ESR= 1.739 Ohm VDC= 500.0 V IRMS= 411.0 mA	30	$0.01	0805 7 mm^2
Cisense	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
Cout	CUSTOM	CUSTOM Series= ?	Cap= 13.5871 mF ESR= 1.0 mOhm VDC= 585.0 V IRMS= 6.369 A	1	NA	CUSTOM 0 mm^2

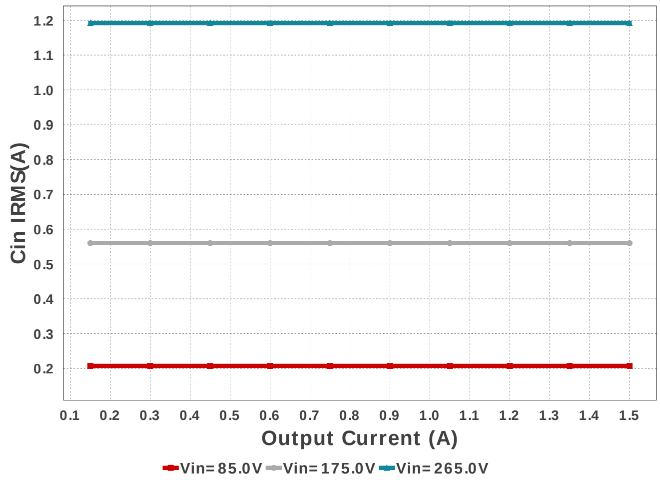
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx	CUSTOM	CUSTOM Series= ?	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 585.0 V IRMS= 6.369 A	1	NA	CUSTOM 0 mm^2
Cvcc	Vishay-Sprague	293D105X9025A2TE3 Series= 293D	Cap= 1.0 uF ESR= 7.6 Ohm VDC= 25.0 V IRMS= 100.0 mA	1	$0.09	3216-18 11 mm^2
Cvccx	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cvsense	MuRata	GRM033R71A392KA01D Series= X7R	Cap= 3.9 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
Dac	Diodes Inc.	GBJ2510-F	VF@Io= 1.05 V VRRM= 1,000.0 V	1	$1.09	GBJ 211 mm^2
Dboost	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 585.0 V	1	NA	CUSTOM 0 mm^2
Dstart	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 585.0 V	1	NA	CUSTOM 0 mm^2
Dturnoff	Bourns	CD214A-B240LLF	VF@Io= 430.0 mV VRRM= 40.0 V	1	$0.13	 SMA 37 mm^2
Dz	Vishay-Semiconductor	TZMC1V0-M-18	Zener	1	$0.05	MiniMELF 11 mm^2
HS_M1	Aavid	529802B02500G	Heatsink	1	$0.91	 529802 1203 mm^2
L1	CUSTOM	CUSTOM	L= 600.0 µH 39.0 mOhm	1	NA	CUSTOM 0 mm^2
M1	Infineon Technologies	IPP60R190P6	VdsMax= 650.0 V IdsMax= 20.2 Amps	1	$1.30	 TO-220AB 79 mm^2
NTC	GE Sensing	CL-101 Series= CL	Thermistor	1	$2.30	CL-101 194 mm^2
Rcomp	Yageo	RC0201FR-0715K4L Series= ?	Res= 15.4 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rfbb	Vishay-Dale	CRCW040213K0FKED Series= CRCW..e3	Res= 13.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW2512300KJNEG Series= CRCW..e3	Res= 300.0 kOhm Power= 1.0 W Tolerance= 5.0%	1	$0.04	 2512 43 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt1	Vishay-Dale	CRCW2512300KJNEG Series= CRCW..e3	Res= 300.0 kOhm Power= 1.0 W Tolerance= 5.0%	1	$0.04	2512 43 mm^2
Rfbt2	Vishay-Dale	CRCW2512402KFKEG Series= CRCW..e3	Res= 402.0 kOhm Power= 1.0 W Tolerance= 1.0%	1	$0.05	2512 43 mm^2
Rfreq	Vishay-Dale	CRCW040232K4FKED Series= CRCW..e3	Res= 32.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rgate	Vishay-Dale	CRCW04023R92FKED Series= CRCW..e3	Res= 3.92 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rgate1	Vishay-Dale	CRCW04021R07FKED Series= CRCW..e3	Res= 1.07 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rgate2	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Risense	Vishay-Dale	CRCW0402221RFKED Series= CRCW..e3	Res= 221.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsense	Stackpole Electronics Inc	CSR1206FK20L0 Series= ?	Res= 20.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm^2
Rvar	TDK	S10K275E2		0	$0.15	VAR_S10K275E2 104 mm^2
U1	Texas Instruments	UCC28180DR	Switcher	1	$0.45	D0008A 57 mm^2

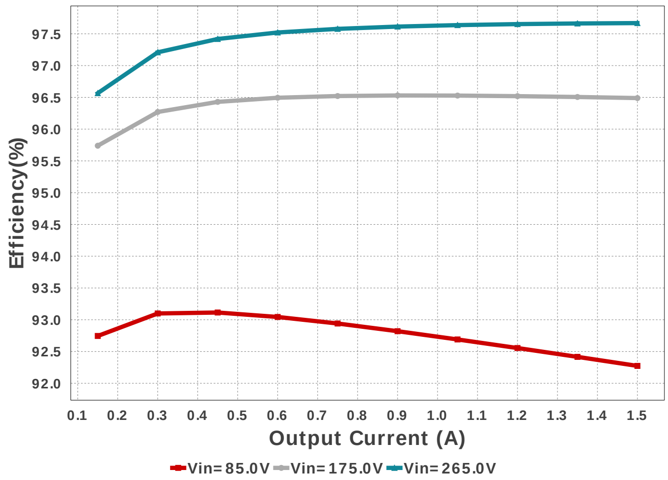




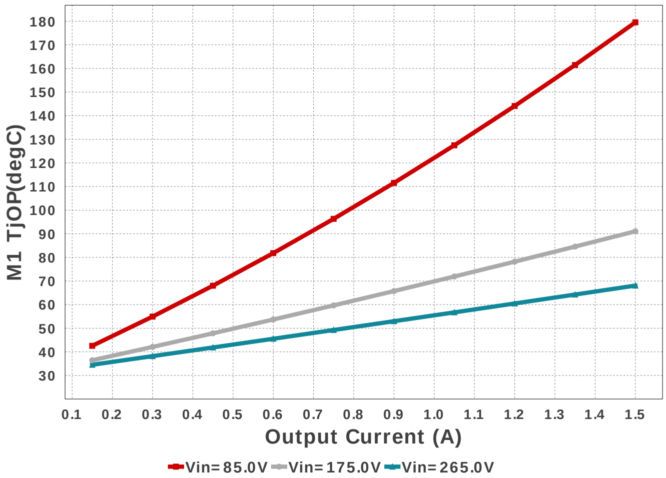
Cin IRMS



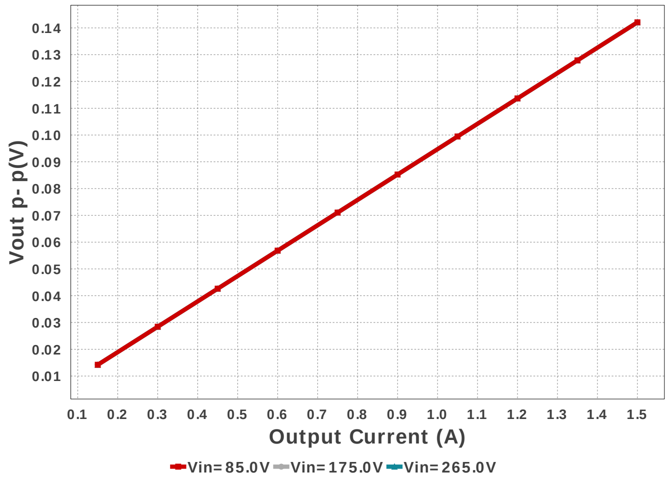
Efficiency



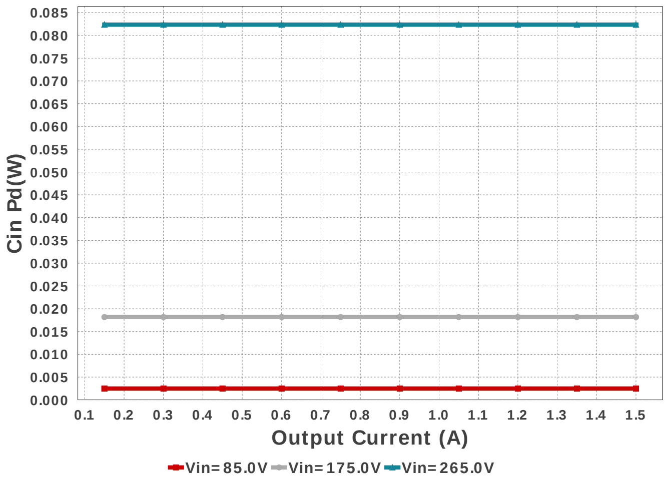
M1 TjOP



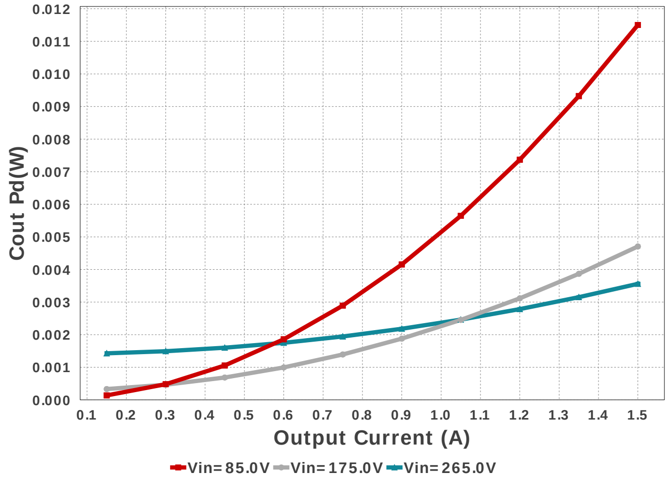
Vout p- p

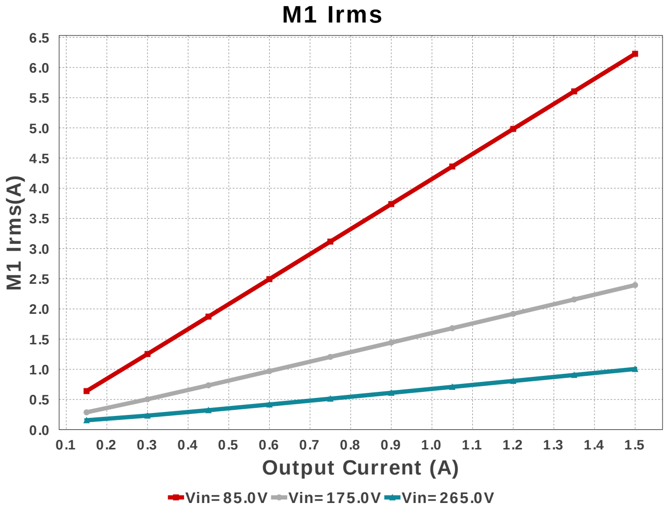


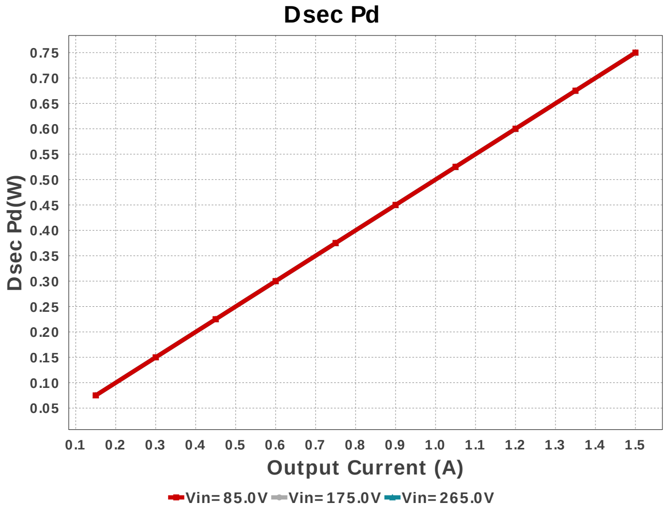
Cin Pd

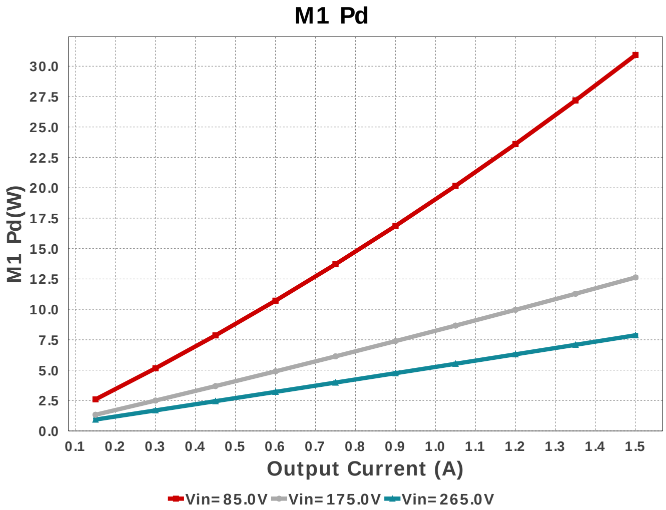


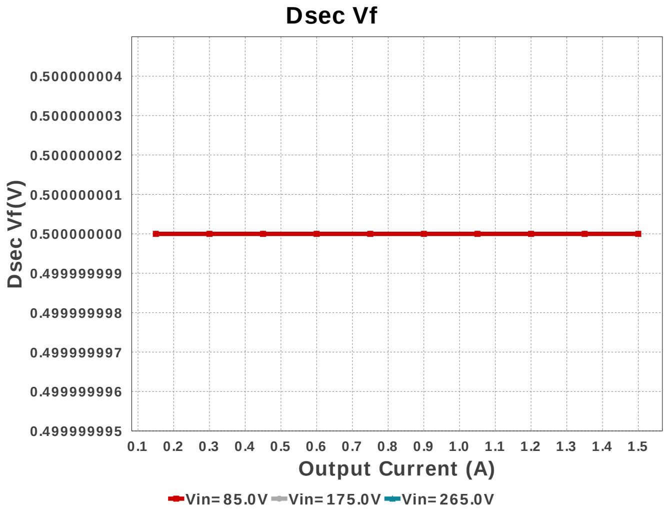
Cout Pd

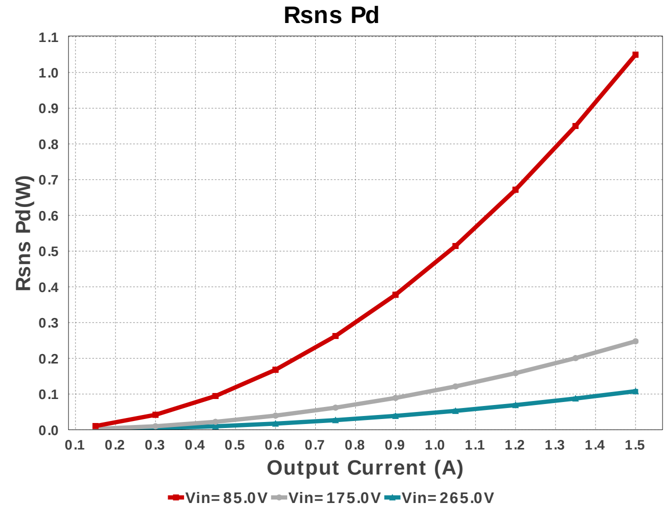


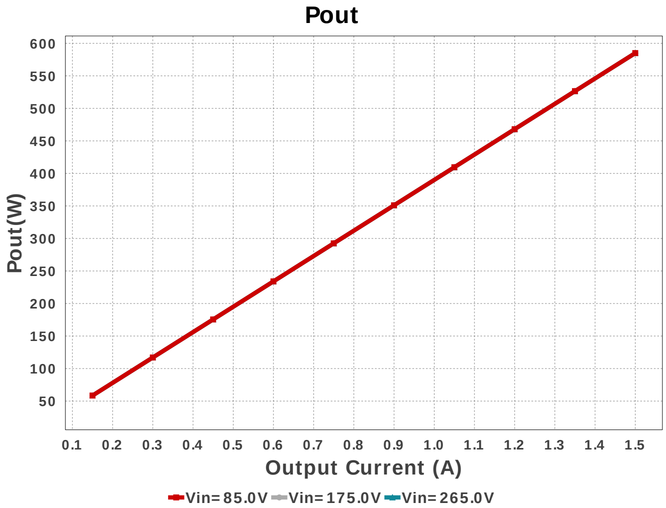

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

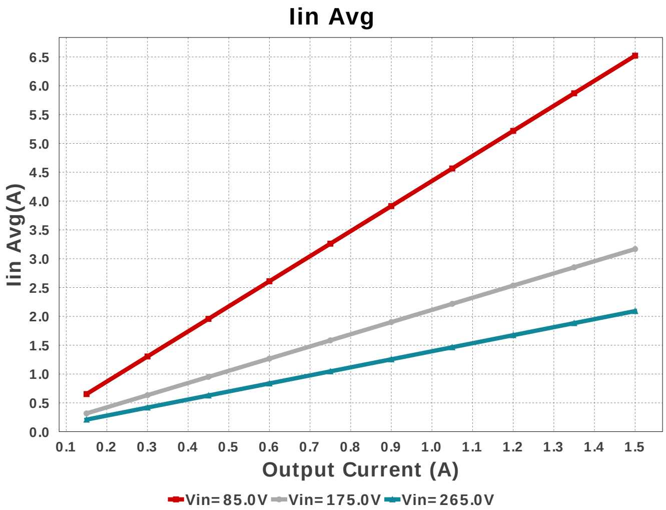

Dsec Pd
Dsec Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

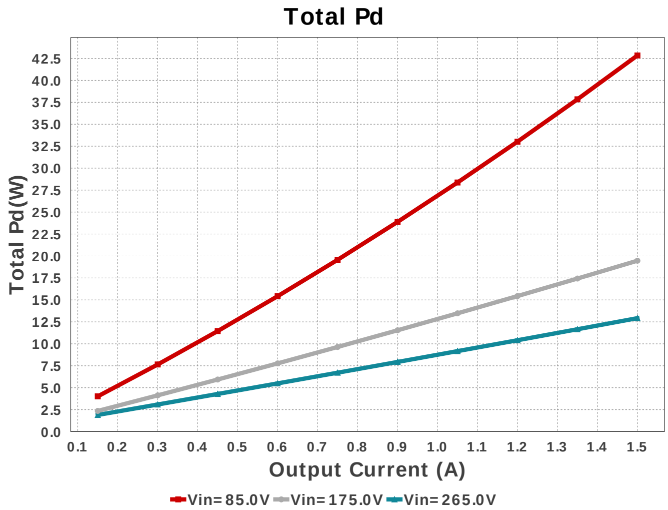

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

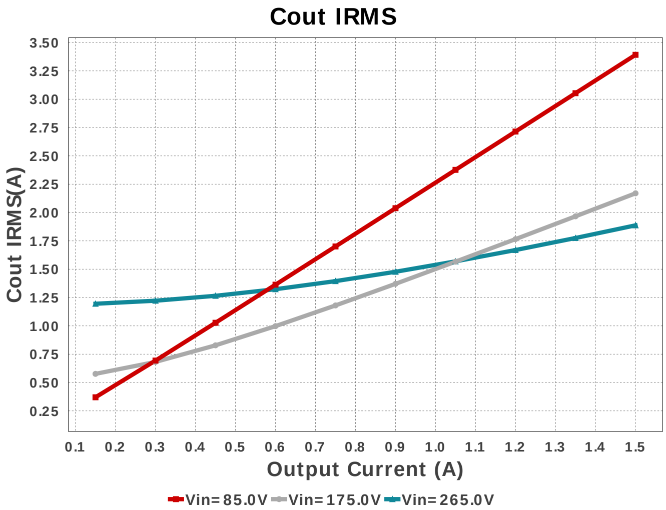

Dsec Vf
Dsec Vf(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

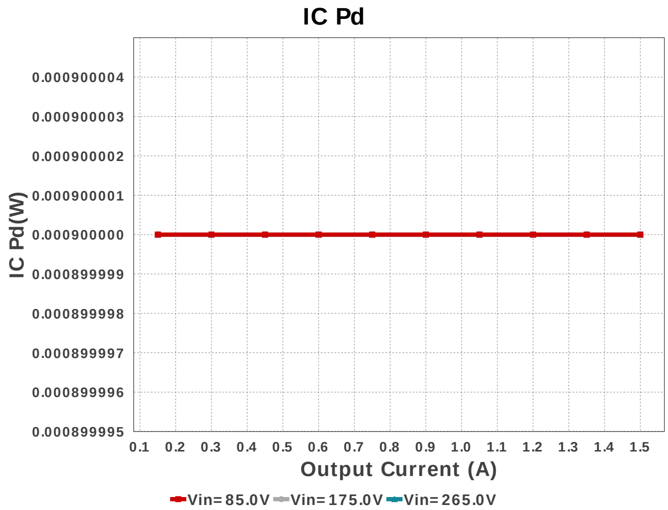

Rsns Pd
Rsns Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

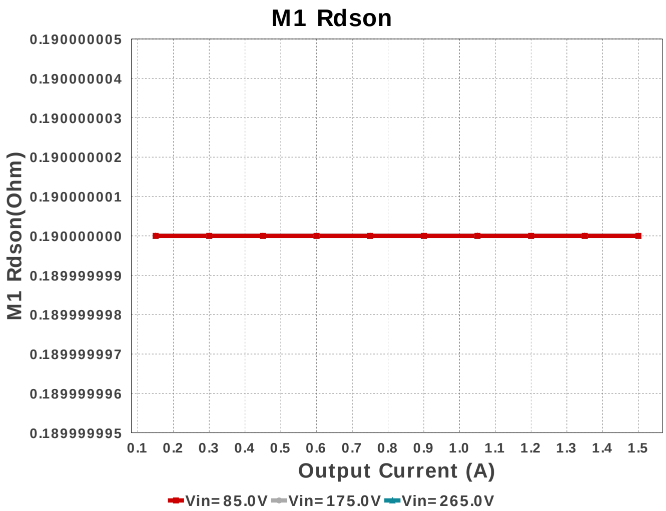

Pout
Pout(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

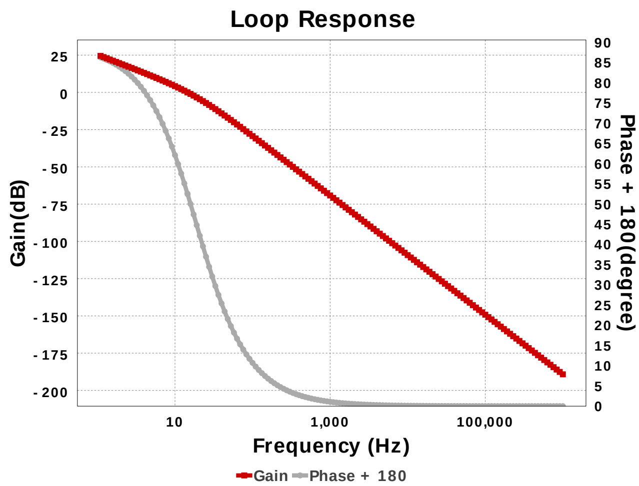












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	61		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	207.37 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	2.493 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	3.391 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	11.502 mW	Capacitor	Output capacitor power dissipation
7.	Dsec Pd	750.0 mW	Diode	Secondary Diode Power Dissipation
8.	Dsec Vf	500.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
9.	IC Pd	900.0 µW	IC	IC power dissipation
10.	IC Tj	30.104 degC	IC	IC junction temperature
11.	ICThetaJA	116.1 degC/W	IC	IC junction-to-ambient thermal resistance

#	Name	Value	Category	Description
12.	Iin Avg	6.522 A	IC	Average input current
13.	M1 Irms	6.227 A	Mosfet	Q Iavg
14.	M1 Pd	30.922 W	Mosfet	MOSFET power dissipation
15.	M1 Rdson	190.0 mOhm	Mosfet	Drain-Source On-resistance
16.	M1 TjOP	179.537 degC	Mosfet	M1 MOSFET junction temperature
17.	Cin Pd	2.493 mW	Power	Input capacitor power dissipation
18.	Cout Pd	11.502 mW	Power	Output capacitor power dissipation
19.	Dsec Pd	750.0 mW	Power	Secondary Diode Power Dissipation
20.	IC Pd	900.0 µW	Power	IC power dissipation
21.	M1 Pd	30.922 W	Power	MOSFET power dissipation
22.	Rsns Pd	1.05 W	Power	Current Limit Sense Resistor Power Dissipation
23.	Total Pd	42.828 W	Power	Total Power Dissipation
24.	Rsns Pd	1.05 W	Resistor	Current Limit Sense Resistor Power Dissipation
25.	Cross Freq	8.8 Hz	System Information	Bode plot crossover frequency
26.	Duty Cycle	69.177 %	System Information	Duty cycle
27.	Efficiency	92.274 %	System Information	Steady state efficiency
28.	FootPrint	0.0 mm^2	System Information	Total Foot Print Area of BOM components
29.	Frequency	180.0 kHz	System Information	Switching frequency
30.	Gain Marg	-205.988 dB	System Information	Bode Plot Gain Margin
31.	Iout	1.5 A	System Information	Iout operating point
32.	Low Freq Gain	18.944 dB	System Information	Gain at 1Hz
33.	Mode	CCM	System Information	Conduction Mode
34.	Phase Marg	65.0 deg	System Information	Bode Plot Phase Margin
35.	Pout	585.0 W	System Information	Total output power
36.	Vin	85.0 V	System Information	Vin operating point
37.	Vout	390.0 V	System Information	Operational Output Voltage
38.	Vout Actual	120.385 V	System Information	Vout Actual calculated based on selected voltage divider resistors
39.	Vout Tolerance	5.809 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout p-p	142.084 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.5	Maximum Output Current
VinMax	265.0	Maximum input voltage
VinMin	85.0	Minimum input voltage
Vout	390.0	Output Voltage
acFrequency	60.0	AC Frequency
base_pn	UCC28180	Base Product Number
source	AC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	65.0 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 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

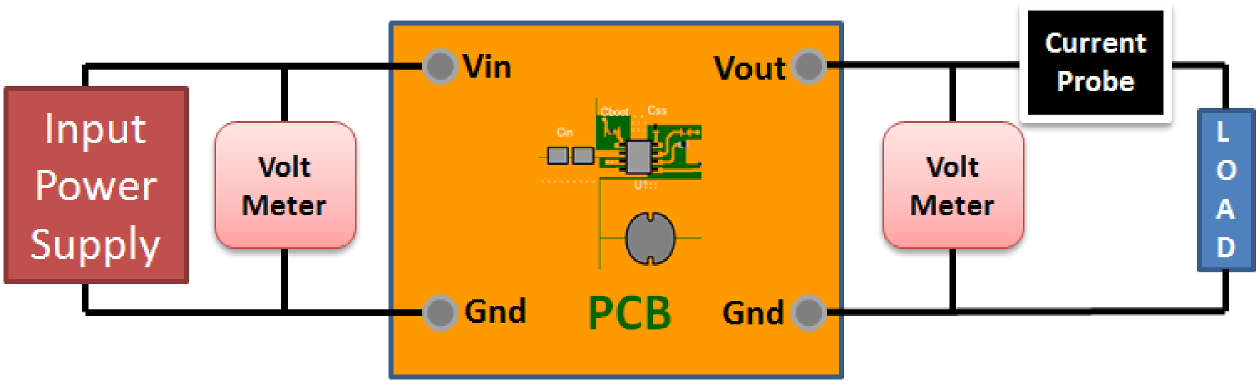
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 85.0V 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. Feature Highlights: Output Current up to 23A, 85 to 265 V Input Voltage Range, Integrated Thermal Protection,Ideal for High power applications.

2. Master key : D17FDA669DEC86C3[v1]

3. **UCC28180** Product Folder : http://www.ti.com/product/UCC28180 : contains the data sheet and other resources.