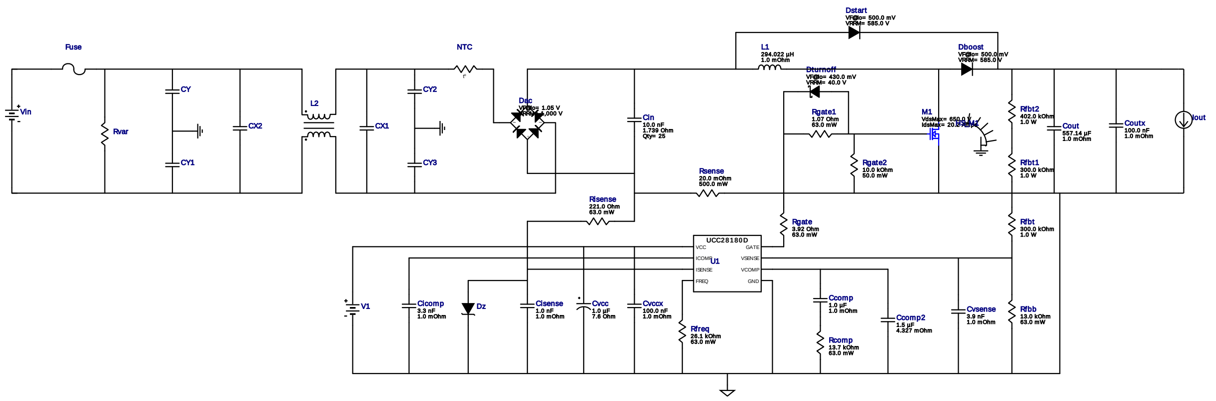
VinMin = 85.0V
VinMax = 265.0V
Vout = 390.0V
Iout = 1.5A

Device = UCC28180DR
Topology = PFC-BOOST
Created = 2020-02-27 02:47:06.972
BOM Cost = NA
BOM Count = 56
Total Pd = 30.58W

WEBENCH ® Design Report

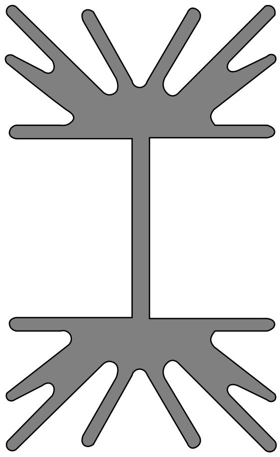
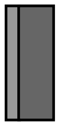
Design : 25 UCC28180DR
UCC28180DR 85V-265V to 390.00V @ 1.5A



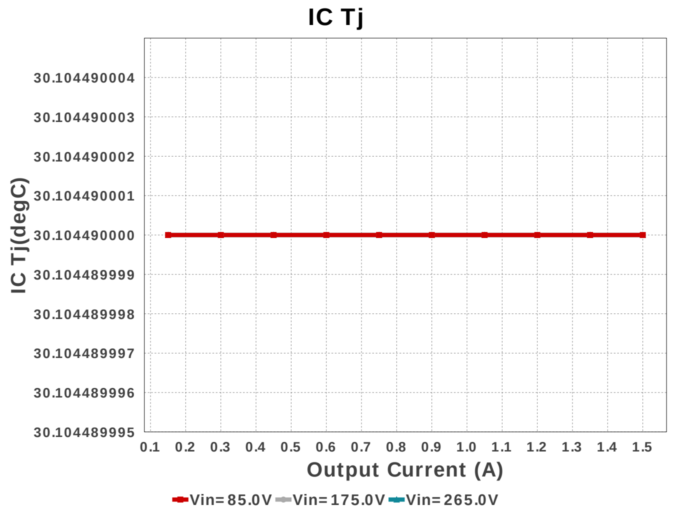
1. Mosfet gate resistances are a starting point and need to be modified according to Mosfet selected. Protection circuit is designed for standard input conditions and should be redesigned for unconventional input conditions.

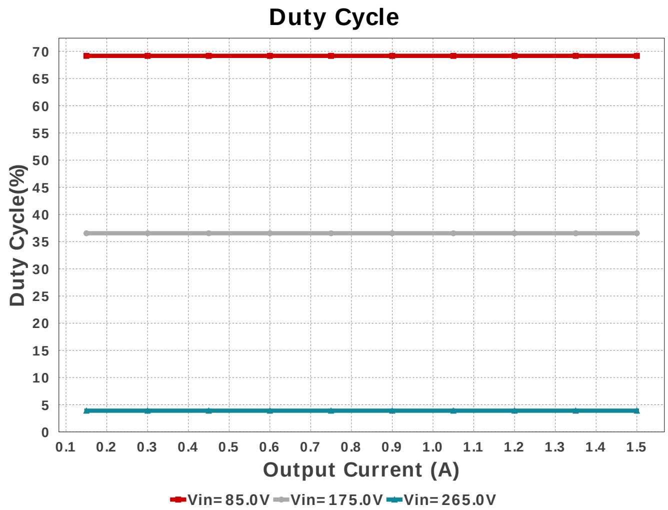
Electrical BOM

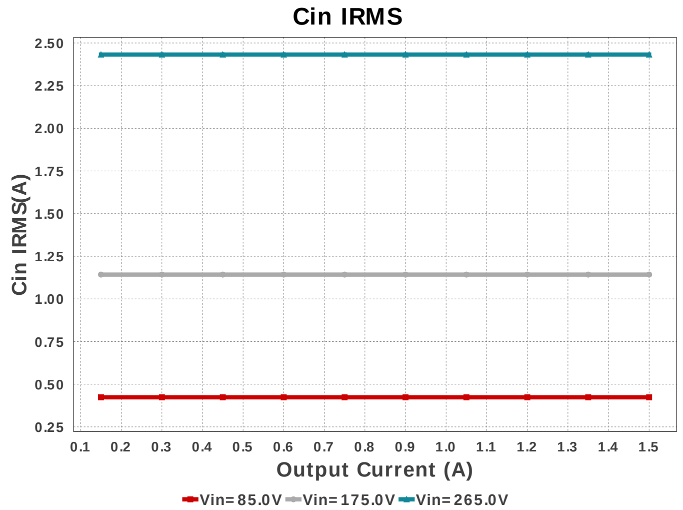
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Ccomp	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Ccomp2	TDK	C1608X7R1A155K080AC Series= X7R	Cap= 1.5 uF ESR= 4.327 mOhm VDC= 10.0 V IRMS= 2.50174 A	1	$0.05	0603 5 mm^2
Cicomp	MuRata	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	25	$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= 557.14 uF ESR= 1.0 mOhm VDC= 585.0 V IRMS= 6.369 A	1	NA	CUSTOM 0 mm^2
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

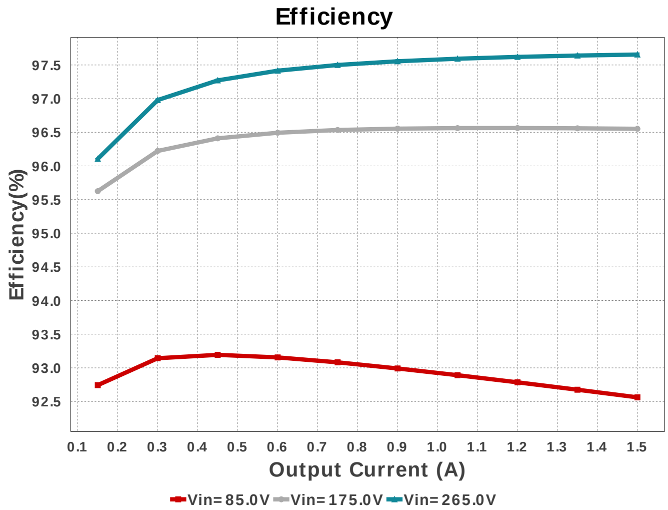
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cvsense	MuRata	GRM033R71A392KA01D Series= X7R	Cap= 3.9 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
Dac	Diodes Inc.	GBJ2510-F	VF@Io= 1.05 V VRRM= 1,000.0 V	1	$1.09	GBJ 211 mm²
Dboost	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 585.0 V	1	NA	CUSTOM 0 mm²
Dstart	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 585.0 V	1	NA	CUSTOM 0 mm²
Dturnoff	Bourns	CD214A-B240LLF	VF@Io= 430.0 mV VRRM= 40.0 V	1	$0.13	 SMA 37 mm²
Dz	Vishay-Semiconductor	TZMC1V0-M-18	Zener	1	$0.05	MiniMELF 11 mm²
HS_M1	Aavid	529802B02500G	Heatsink	1	$0.91	 529802 1203 mm²
L1	CUSTOM	CUSTOM	L= 294.022 µH 1.0 mOhm	1	NA	CUSTOM 0 mm²
M1	Infineon Technologies	IPP60R190P6	VdsMax= 650.0 V IdsMax= 20.2 Amps	1	$1.30	 TO-220AB 79 mm²
NTC	GE Sensing	CL-101 Series= CL	Thermistor	1	$2.30	CL-101 194 mm²
Rcomp	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW040213K0FKED Series= CRCW..e3	Res= 13.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW2512300KJNEG Series= CRCW..e3	Res= 300.0 kOhm Power= 1.0 W Tolerance= 5.0%	1	$0.04	 2512 43 mm²
Rfbt1	Vishay-Dale	CRCW2512300KJNEG Series= CRCW..e3	Res= 300.0 kOhm Power= 1.0 W Tolerance= 5.0%	1	$0.04	 2512 43 mm²
Rfbt2	Vishay-Dale	CRCW2512402KFKEG Series= CRCW..e3	Res= 402.0 kOhm Power= 1.0 W Tolerance= 1.0%	1	$0.05	 2512 43 mm²
Rfreq	Vishay-Dale	CRCW040226K1FKED Series= CRCW..e3	Res= 26.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

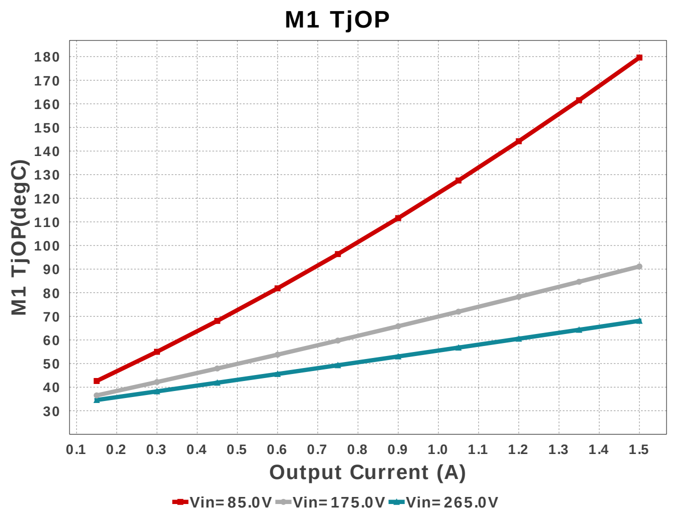
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rgate	Vishay-Dale	CRCW04023R92FKED Series= CRCW..e3	Res= 3.92 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rgate1	Vishay-Dale	CRCW04021R07FKED Series= CRCW..e3	Res= 1.07 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rgate2	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Risense	Vishay-Dale	CRCW0402221RFKED Series= CRCW..e3	Res= 221.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rsense	Stackpole Electronics Inc	CSR1206FK20L0 Series= ?	Res= 20.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm²
Rvar	TDK	S10K275E2		0	$0.15	VAR_S10K275E2 104 mm²
U1	Texas Instruments	UCC28180DR	Switcher	1	$0.45	D0008A 57 mm²

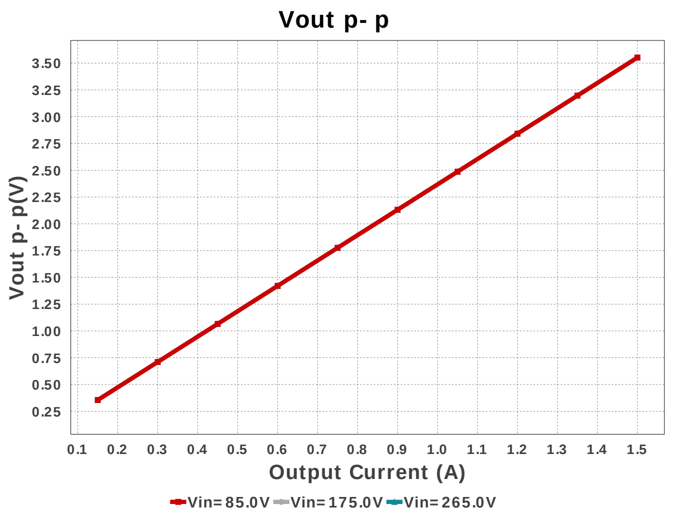


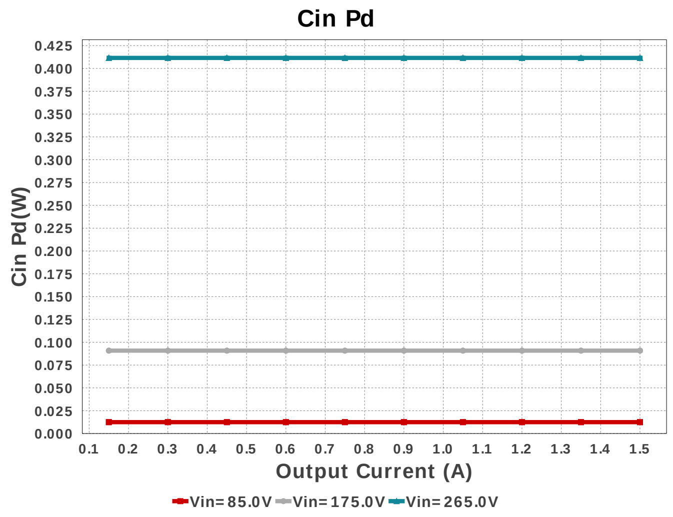


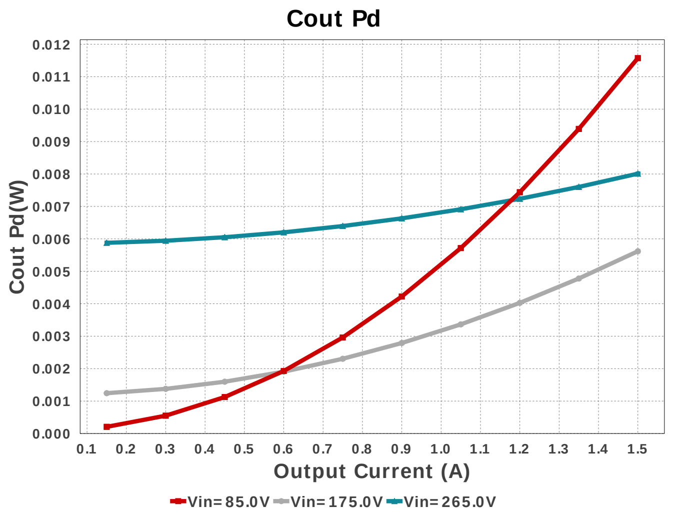


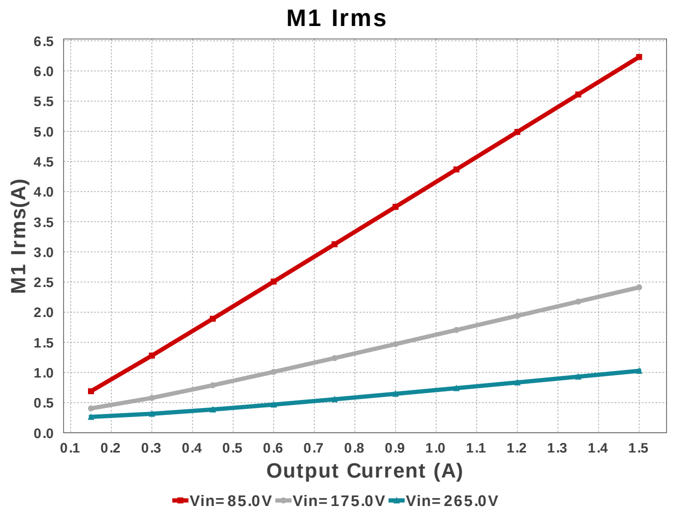


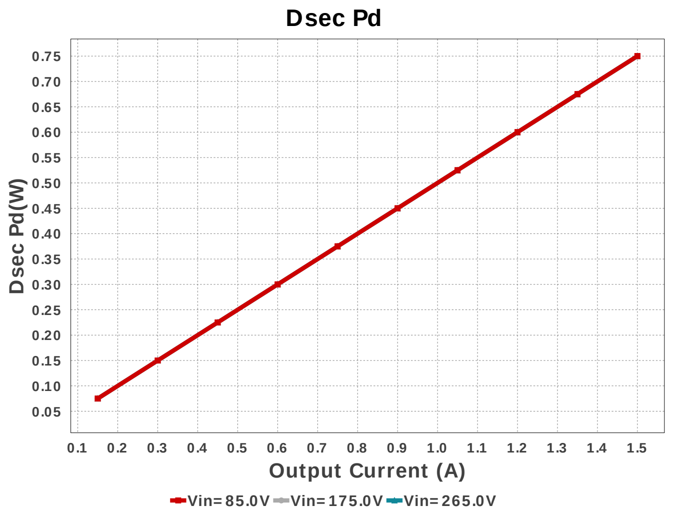

M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

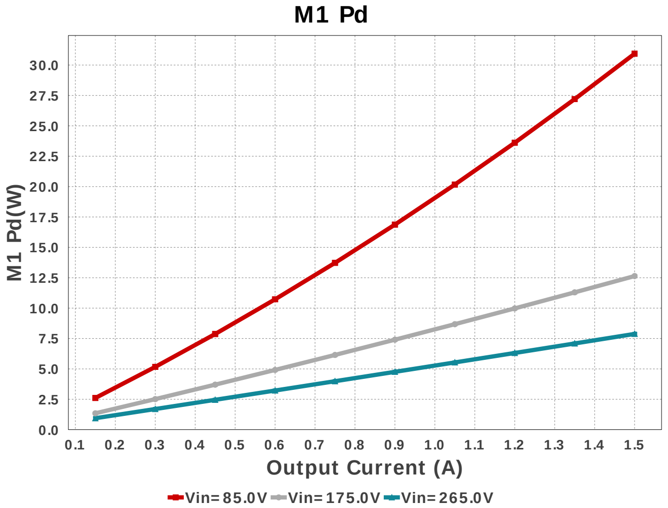

Vout p- p
Vout p- p(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

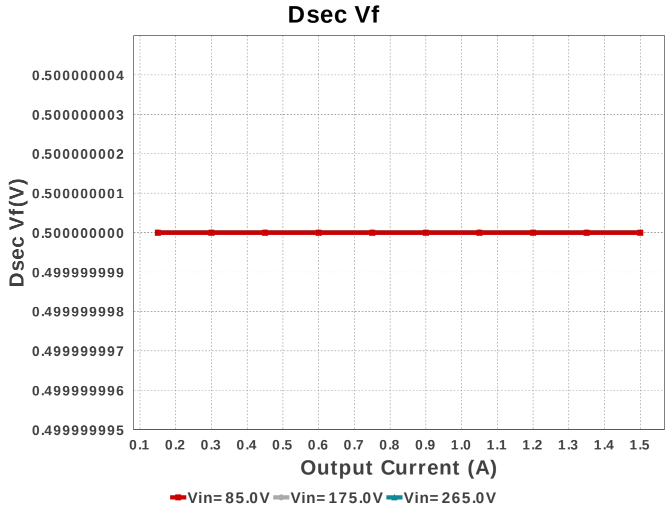

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

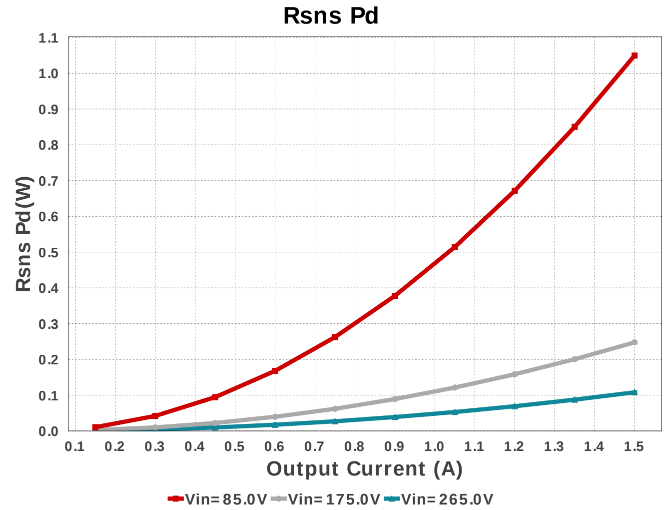

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

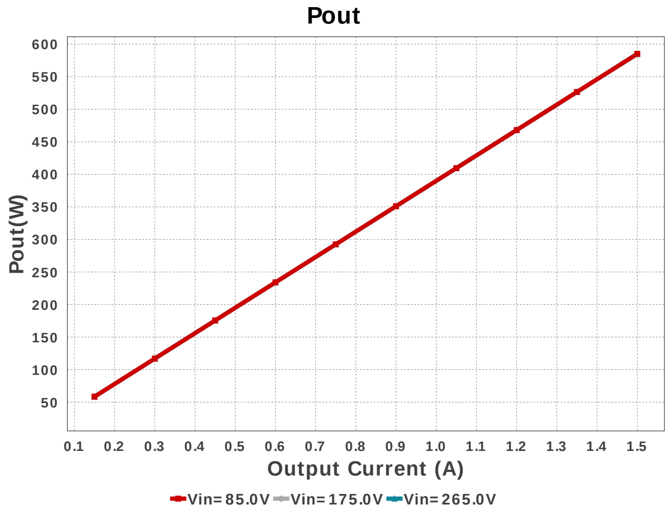

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

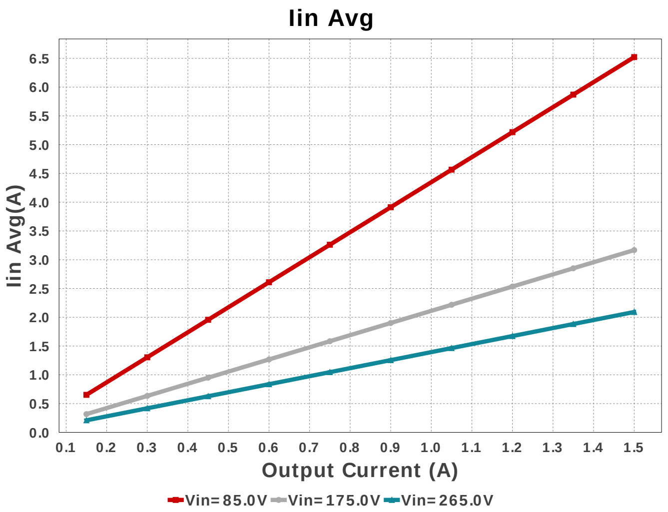

Dsec Pd
Dsec Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

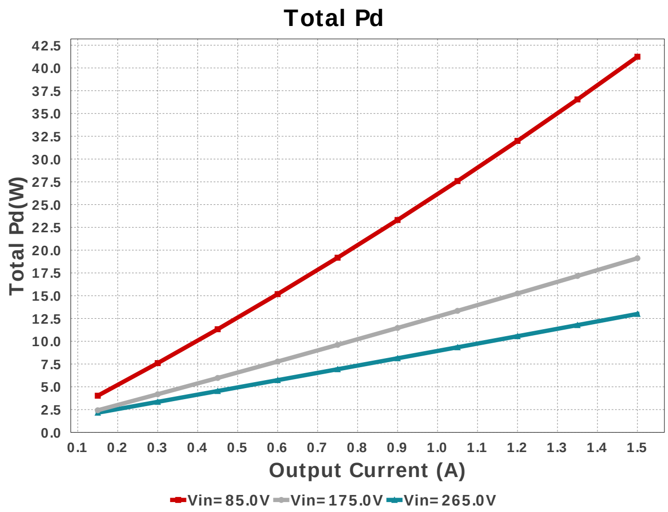

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

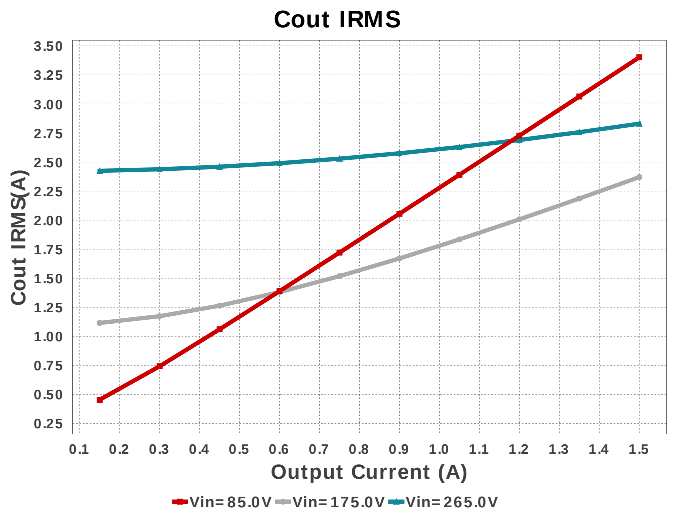

Dsec Vf
Dsec Vf(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

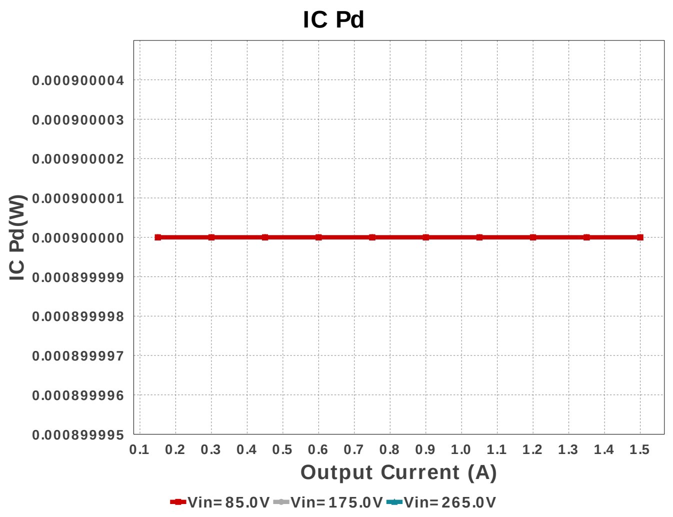

Rsns Pd
Rsns Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

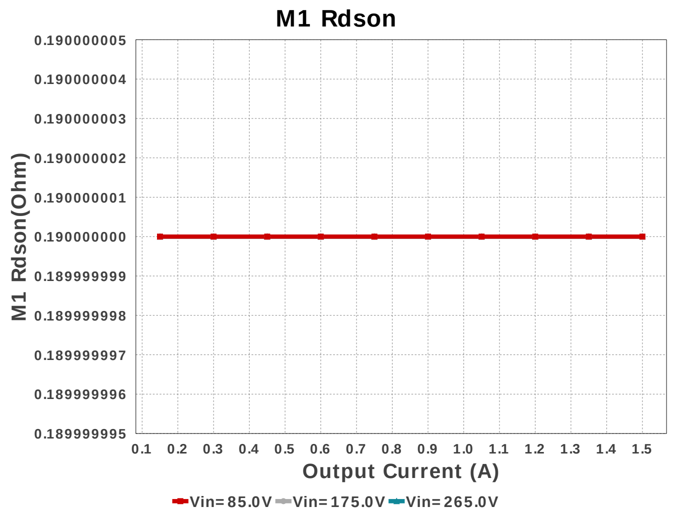

Pout
Pout(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

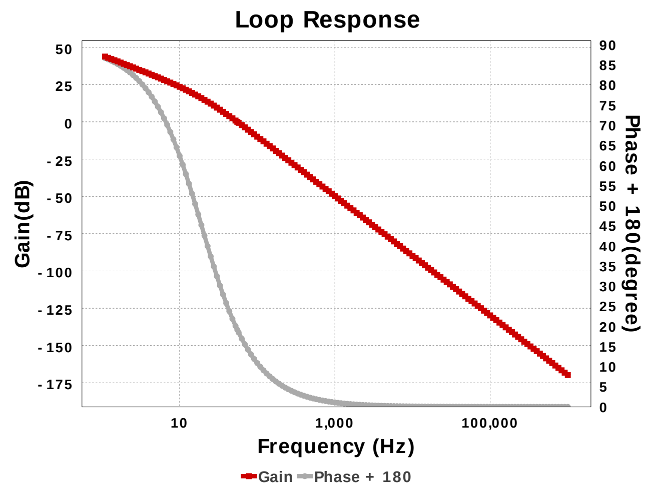

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


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









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	941.353 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	61.64 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	3.454 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	11.931 mW	Capacitor	Output capacitor power dissipation
5.	Dsec Pd	750.0 mW	Diode	Secondary Diode Power Dissipation
6.	Dsec Vf	500.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
7.	IC Pd	900.0 µW	IC	IC power dissipation
8.	IC Tj	30.104 degC	IC	IC junction temperature
9.	ICThetaJA	116.1 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	6.522 A	IC	Average input current
11.	M1 Irms	6.26 A	Mosfet	Q Iavg
12.	M1 Pd	18.035 W	Mosfet	MOSFET power dissipation
13.	M1 Rdson	190.0 mOhm	Mosfet	Drain-Source On-resistance
14.	M1 TjOP	117.21 degC	Mosfet	M1 MOSFET junction temperature
15.	Cin Pd	61.64 mW	Power	Input capacitor power dissipation
16.	Cout Pd	11.931 mW	Power	Output capacitor power dissipation
17.	Dsec Pd	750.0 mW	Power	Secondary Diode Power Dissipation
18.	IC Pd	900.0 µW	Power	IC power dissipation
19.	M1 Pd	18.035 W	Power	MOSFET power dissipation
20.	Rsns Pd	1.05 W	Power	Current Limit Sense Resistor Power Dissipation
21.	Total Pd	30.583 W	Power	Total Power Dissipation
22.	Rsns Pd	1.05 W	Resistor	Current Limit Sense Resistor Power Dissipation
23.	BOM Count	56	System Information	Total Design BOM count
24.	Cross Freq	27.201 Hz	System Information	Bode plot crossover frequency
25.	Duty Cycle	69.177 %	System Information	Duty cycle
26.	Efficiency	94.483 %	System Information	Steady state efficiency
27.	FootPrint	3.046 k mm^2	System Information	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
28.	Frequency	80.916 kHz	System Information	Switching frequency
29.	Gain Marg	-192.107 dB	System Information	Bode Plot Gain Margin
30.	Iout	1.5 A	System Information	Iout operating point
31.	Low Freq Gain	32.638 dB	System Information	Gain at 1Hz
32.	Mode	CCM	System Information	Conduction Mode
33.	Phase Marg	35.352 deg	System Information	Bode Plot Phase Margin
34.	Pout	585.0 W	System Information	Total output power
35.	Total BOM	NA	System Information	Total BOM Cost
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	3.57 V	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	80.0 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

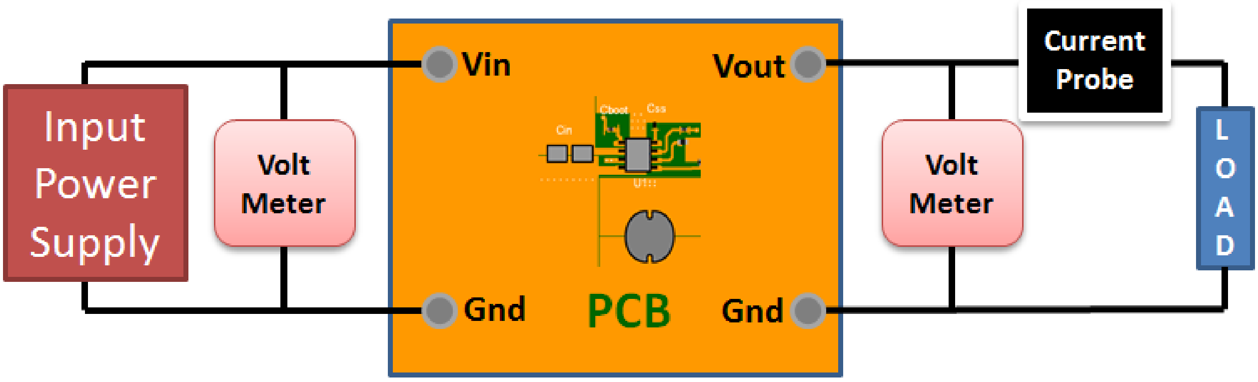
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 : BB689FEF4CAD47BB[v1]

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