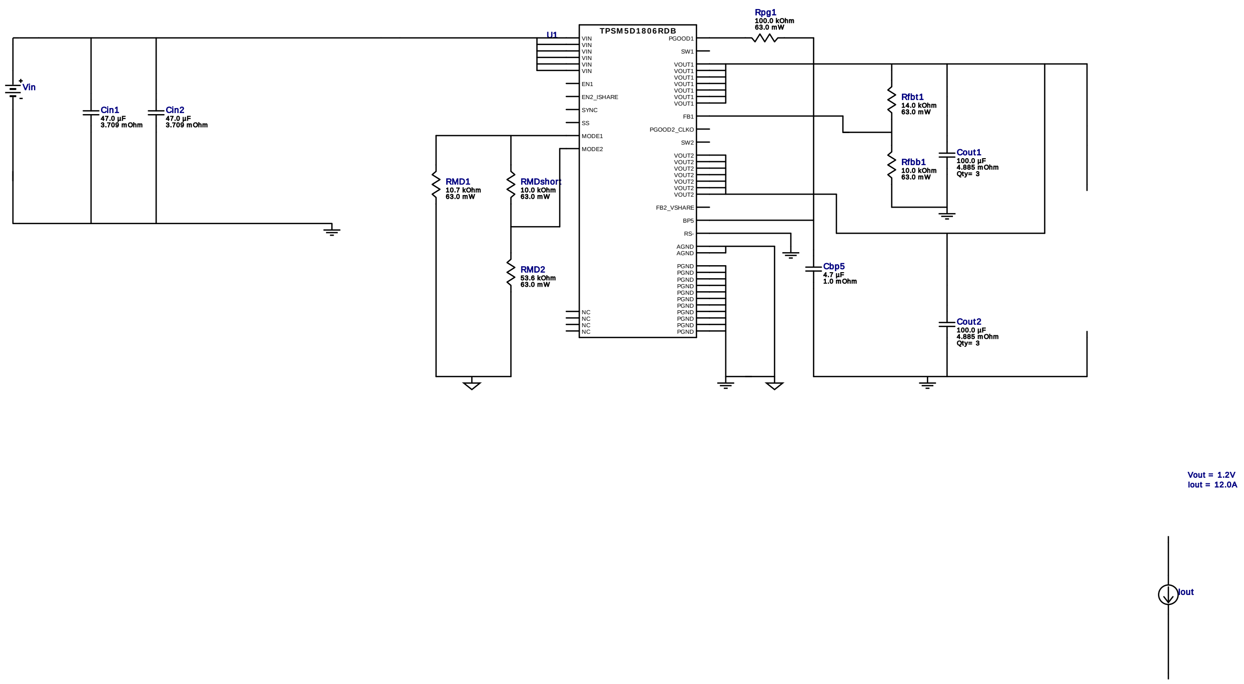
VinMin = 5.0V	Device = TPSM5D1806RDBR
VinMax = 5.0V	Topology = Buck
Vout = 1.2V	Created = 2023-09-06 18:54:54.662
Iout = 12.0A	BOM Cost = $17.18
	BOM Count = 16
	Total Pd = 3.0W

WEBENCH ® Design Report

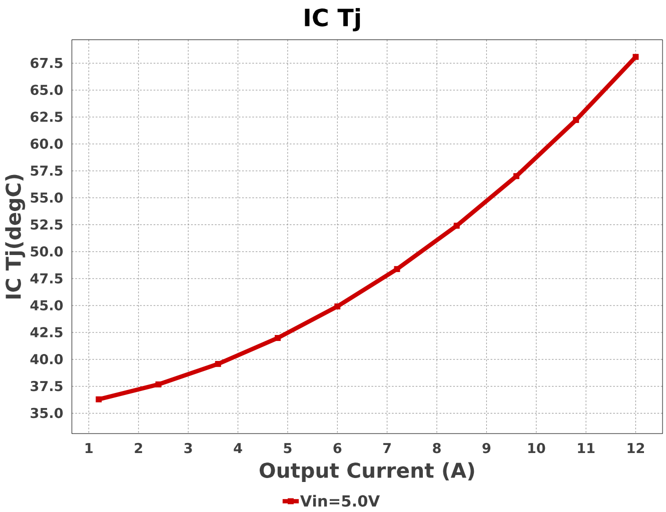
Design : 8 TPSM5D1806RDBR
TPSM5D1806RDBR 5V-5V to 1.20V @ 12A

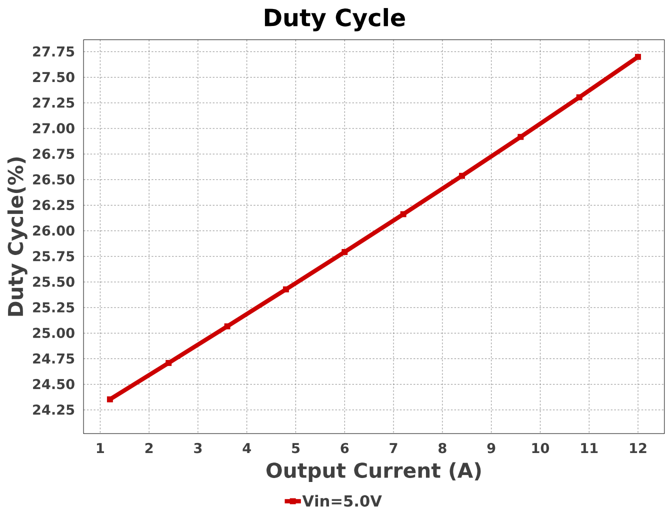


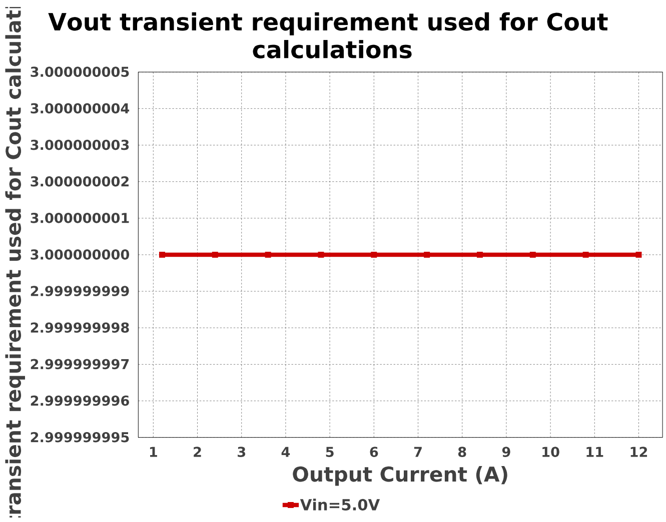
Electrical BOM

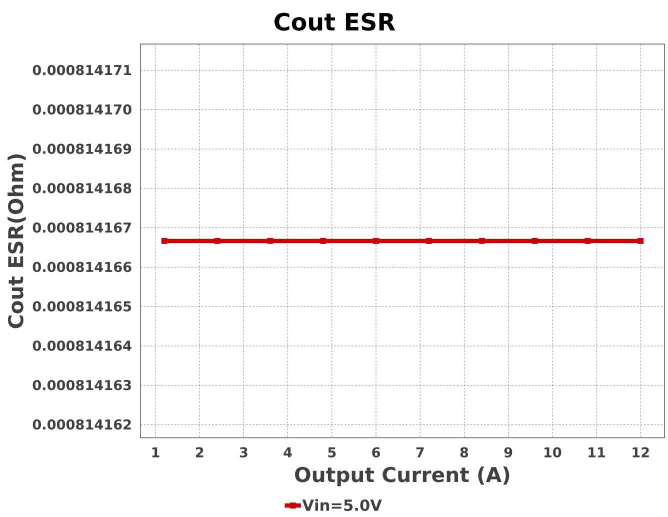
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbp5	MuRata	GRM155R61A475MEAAD Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.02	0402_065 3 mm²
Cin1	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	1	$0.21	1206_190 11 mm²
Cin2	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	1	$0.21	1206_190 11 mm²
Cout1	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	3	$0.78	1206_190 11 mm²
Cout2	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	3	$0.78	1206_190 11 mm²
RMD1	Vishay-Dale	CRCW040210K7FKED Series= CRCW..e3	Res= 10.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
RMD2	Vishay-Dale	CRCW040253K6FKED Series= CRCW..e3	Res= 53.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
RMDshort	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb1	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt1	Vishay-Dale	CRCW040214K0FKED Series= CRCW..e3	Res= 14.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpg1	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPSM5D1806RDBR	Switcher	1	$12.00	RPB0025A 35 mm^2

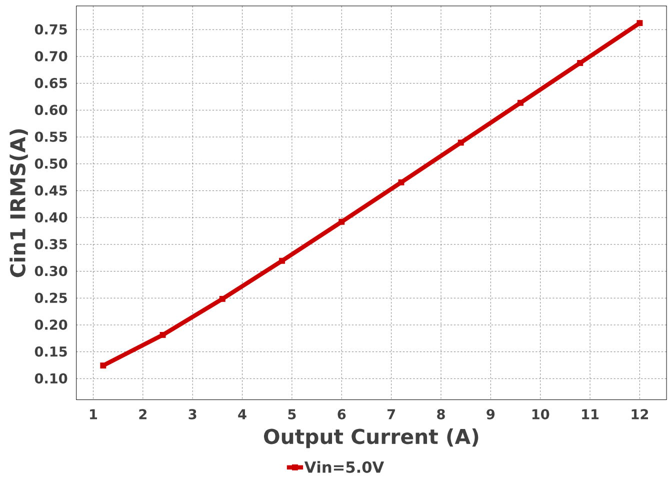




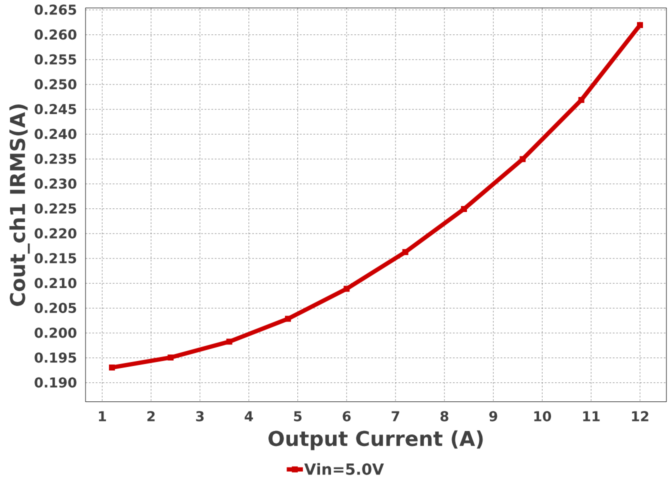




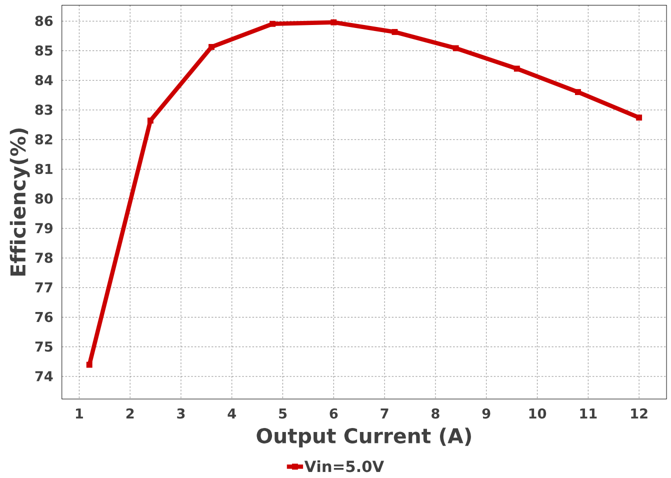
Cin1 IRMS



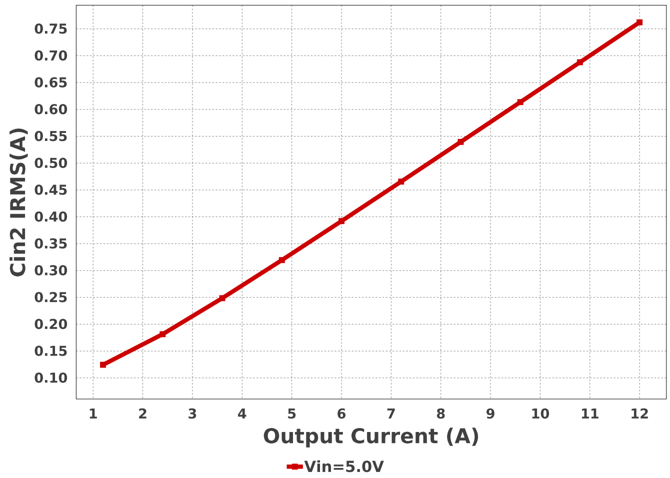
Cout_ch1 IRMS



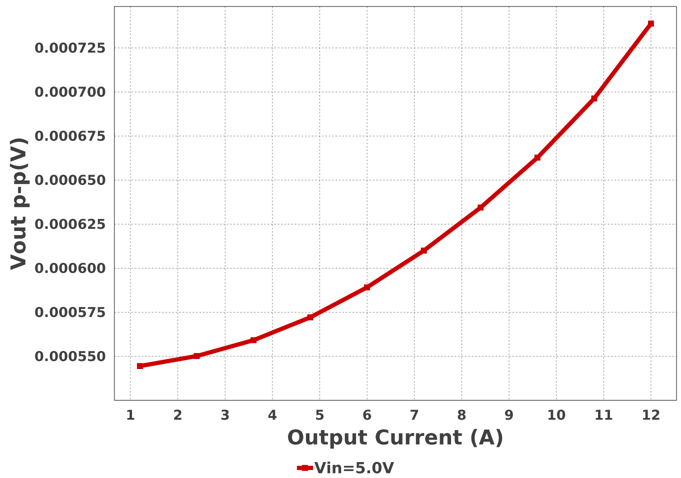
Efficiency



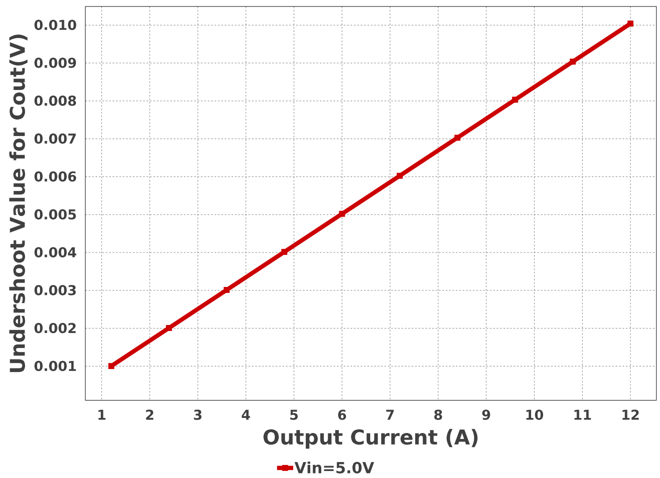
Cin2 IRMS

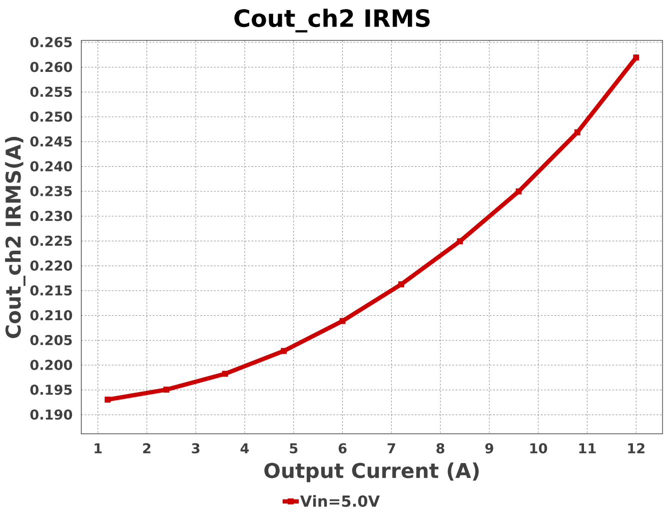


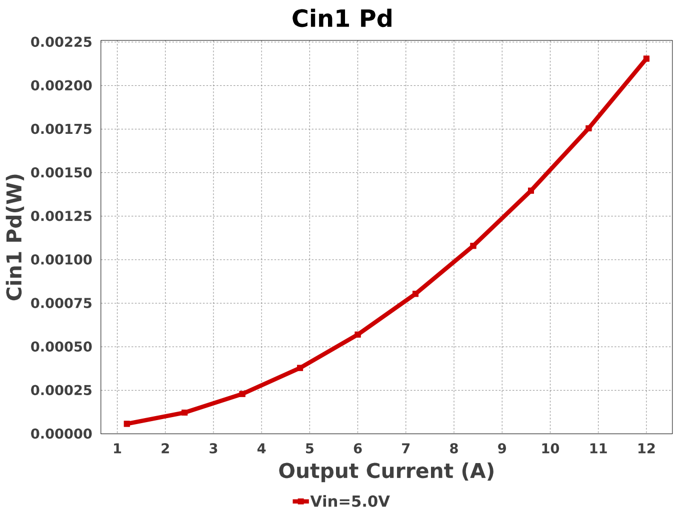
Vout p-p

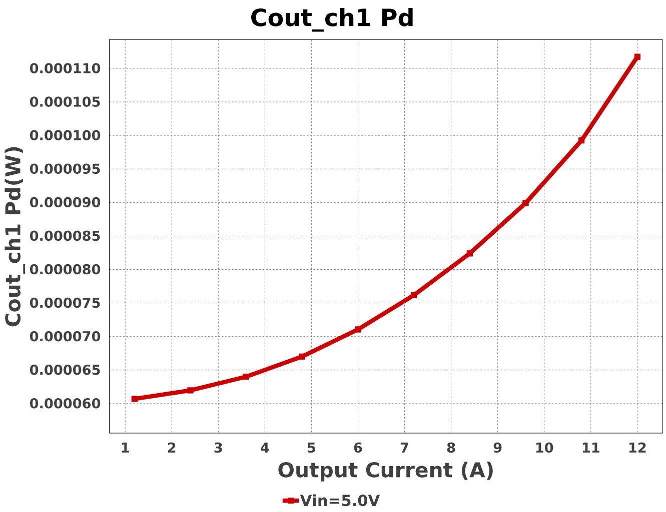


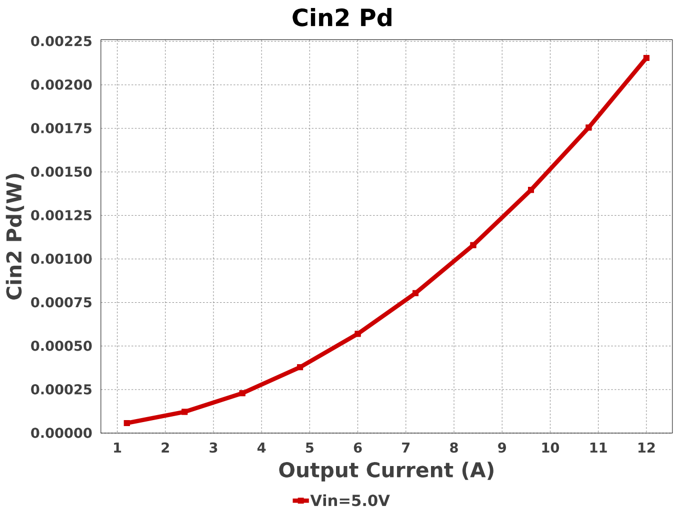
Undershoot Value for Cout

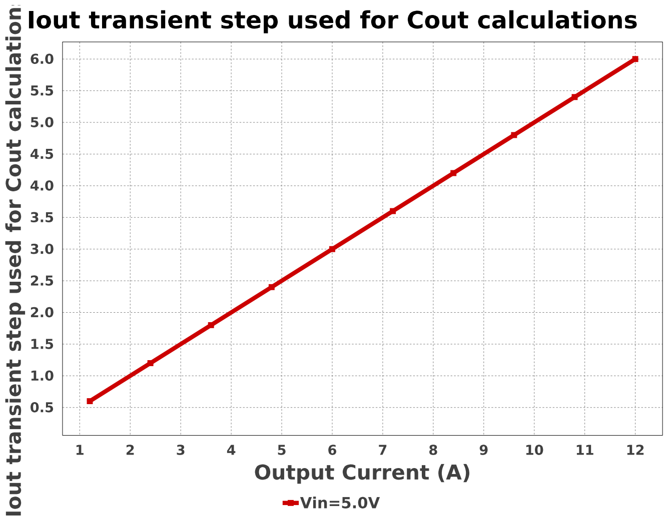


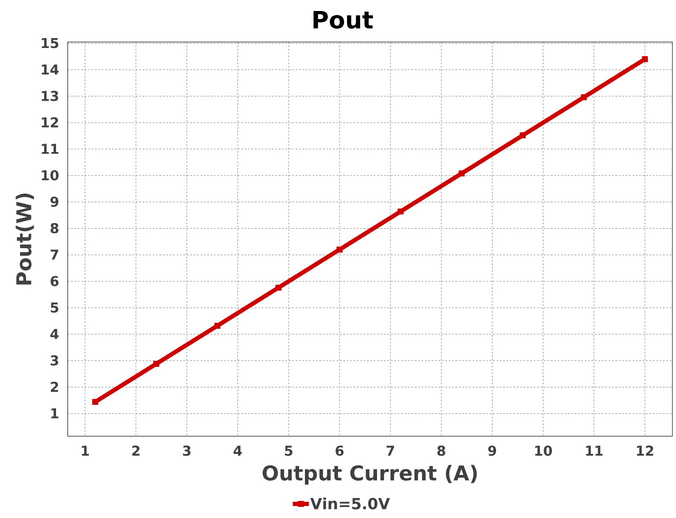

Cout_ch2 IRMS
Cout_ch2 IRMS(A)
Output Current (A)
Vin=5.0V

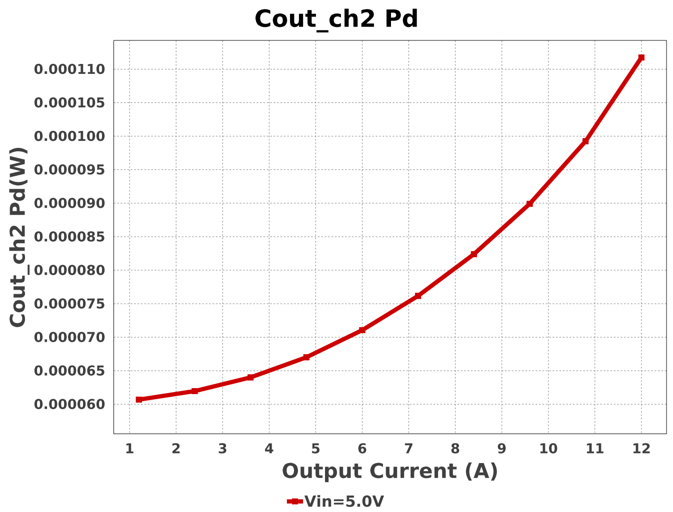

Cin1 Pd
Cin1 Pd(W)
Output Current (A)
Vin=5.0V

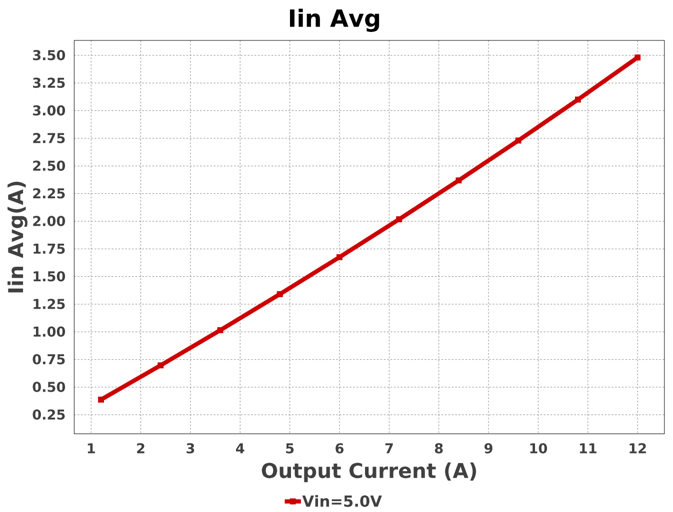

Cout_ch1 Pd
Cout_ch1 Pd(W)
Output Current (A)
Vin=5.0V

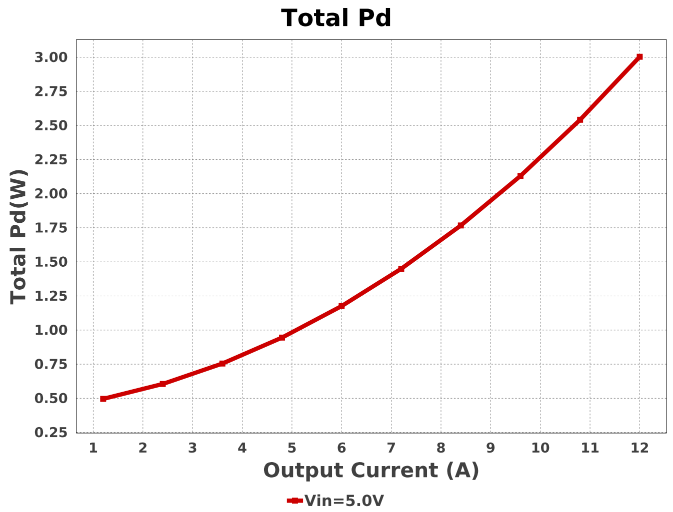

Cin2 Pd
Cin2 Pd(W)
Output Current (A)
Vin=5.0V

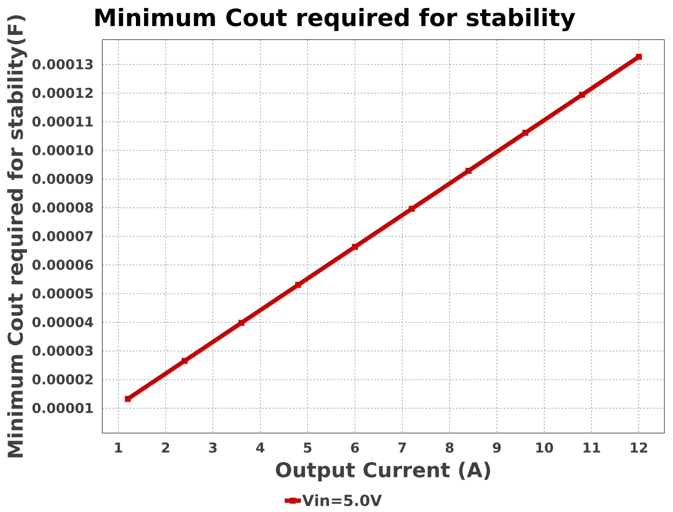

Iout transient step used for Cout calculations
Iout transient step used for Cout calculation
Output Current (A)
Vin=5.0V

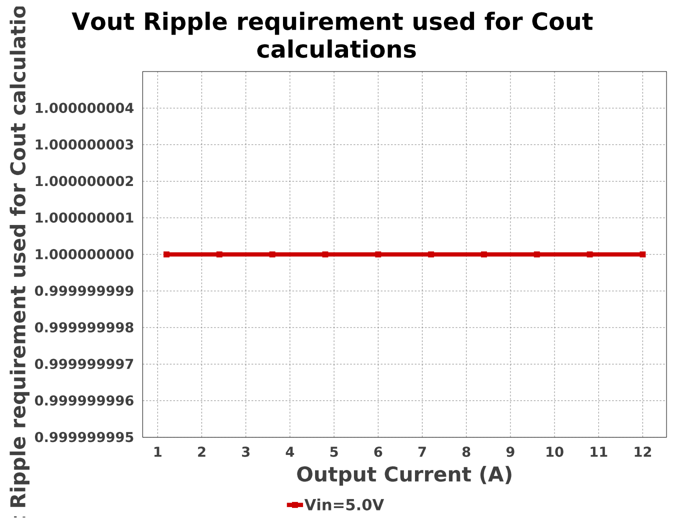

Pout
Pout(W)
Output Current (A)
Vin=5.0V

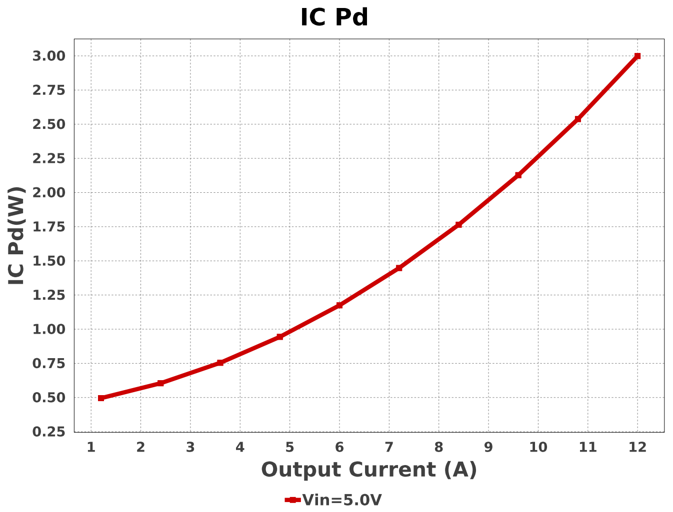

Cout_ch2 Pd
Cout_ch2 Pd(W)
Output Current (A)
Vin=5.0V

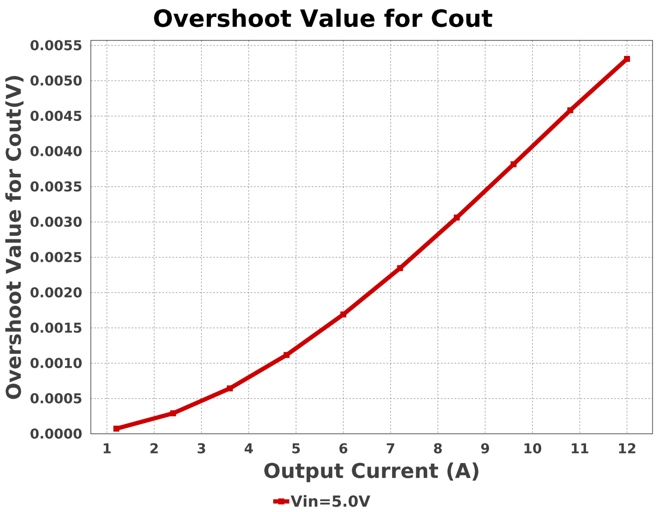

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=5.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=5.0V


Minimum Cout required for stability
Minimum Cout required for stability(F)
Output Current (A)
Vin=5.0V


Vout Ripple requirement used for Cout calculations
Ripple requirement used for Cout calculatio
Output Current (A)
Vin=5.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=5.0V



Operating Values

#	Name	Value	Category	Description
1.	Cin1 ESR	3.709 mOhm	Capacitor	Cin Capacitor ESR
2.	Cin1 IRMS	762.178 mA	Capacitor	Input Capacitor Cin1 RMS Ripple Current
3.	Cin1 Pd	2.155 mW	Capacitor	Input capacitor power dissipation
4.	Cin2 ESR	3.709 mOhm	Capacitor	Cin Capacitor ESR
5.	Cin2 IRMS	762.178 mA	Capacitor	Input Capacitor Cin2 RMS Ripple Current
6.	Cin2 Pd	2.155 mW	Capacitor	Input capacitor power dissipation
7.	Cout ESR	814.167 µOhm	Capacitor	Cout Capacitor ESR
8.	Cout_ch1 IRMS	261.954 mA	Capacitor	Output Channel 1 Capacitor RMS ripple current
9.	Cout_ch1 Pd	111.74 µW	Capacitor	Ouput channel 1 capacitor power dissipation
10.	Cout_ch2 IRMS	261.954 mA	Capacitor	Output Channel 2 Capacitor RMS ripple current
11.	Cout_ch2 Pd	111.74 µW	Capacitor	Ouput channel 2 capacitor power dissipation
12.	IC Pd	2.999 W	IC	IC power dissipation
13.	IC Tj	68.084 degC	IC	IC junction temperature
14.	IC Tolerance	5.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA Effective	12.7 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
16.	Iin Avg	3.481 A	IC	Average input current
17.	Cin1 Pd	2.155 mW	Power	Input capacitor power dissipation
18.	Cin2 Pd	2.155 mW	Power	Input capacitor power dissipation
19.	Cout_ch1 Pd	111.74 µW	Power	Ouput channel 1 capacitor power dissipation
20.	Cout_ch2 Pd	111.74 µW	Power	Ouput channel 2 capacitor power dissipation
21.	IC Pd	2.999 W	Power	IC power dissipation
22.	Total Pd	3.003 W	Power	Total Power Dissipation
23.	BOM Count	16	System Information	Total Design BOM count
24.	Duty Cycle	27.699 %	System Information	Duty cycle
25.	Efficiency	82.743 %	System Information	Steady state efficiency
26.	FootPrint	143.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	2.0 MHz	System Information	Switching frequency
28.	Iout	12.0 A	System Information	Iout operating point
29.	Iout transient step used for Cout calculations	6.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
30.	Minimum Cout required for stability	419.079 µF	System Information	Minimum Cout required for stability
31.	Mode	CCM	System Information	Conduction Mode
32.	Overshoot Value for Cout	5.31 mV	System Information	Theoretical Vout Overshoot Value
33.	Pout	14.4 W	System Information	Total output power
34.	Total BOM	$17.18	System Information	Total BOM Cost
35.	Undershoot Value for Cout	10.041 mV	System Information	Theoretical Vout Undershoot Value
36.	Vin	5.0 V	System Information	Vin operating point

#	Name	Value	Category	Description
37.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
38.	Vout p-p	738.803 µV	System Information	Peak-to-peak output ripple voltage
39.	Vout transient requirement used for Cout calculations	3.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	12.0	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	1.2	Output Voltage
base_pn	TPSM5D1806	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

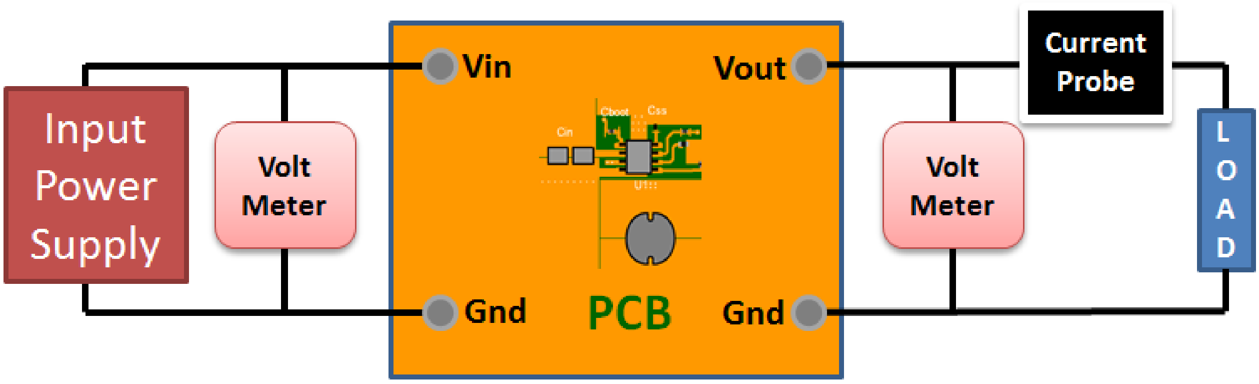
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 5.0V 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. Master key : 99CBB26647818962F696164E0239B07C[v1]

2. **TPSM5D1806** Product Folder : http://www.ti.com/product/TPSM5D1806 : contains the data sheet and other resources.