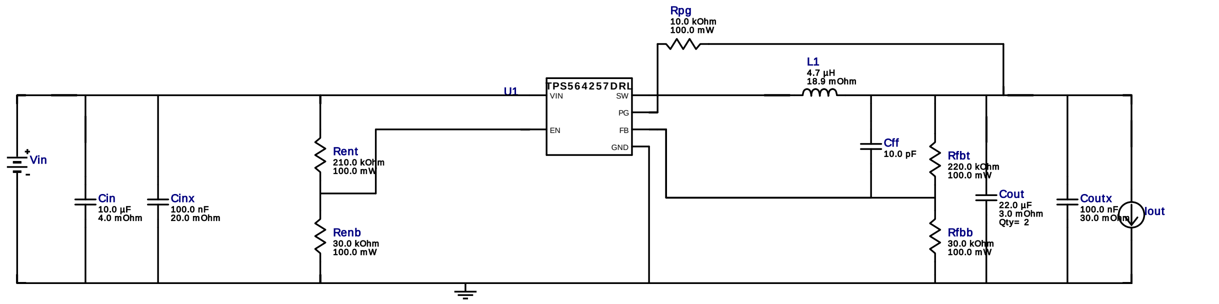
TEXAS INSTRUMENTS

WEBENCH® Design Report

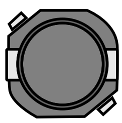
VinMin = 10.0V
VinMax = 14.0V
Vout = 5.0V
Iout = 3.0A

Device = TPS564257DRLR
Topology = Buck
Created = 2025-05-11 18:59:32.469
BOM Cost = $0.94
BOM Count = 13
Total Pd = 0.83W

Design : 5 TPS564257DRLR
TPS564257DRLR 10V-14V to 5.00V @ 3A

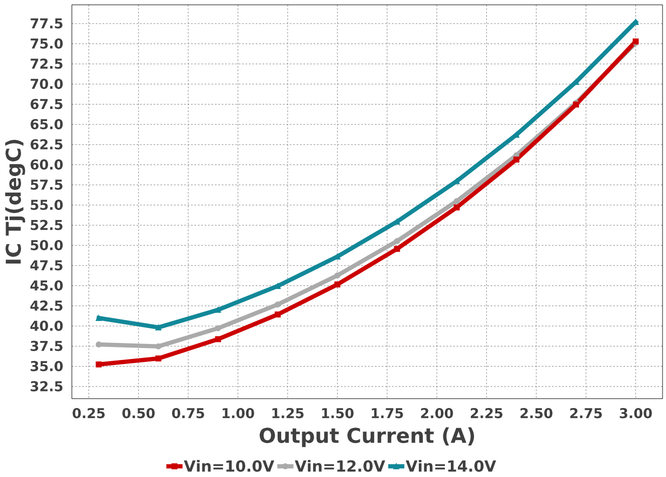


Electrical BOM

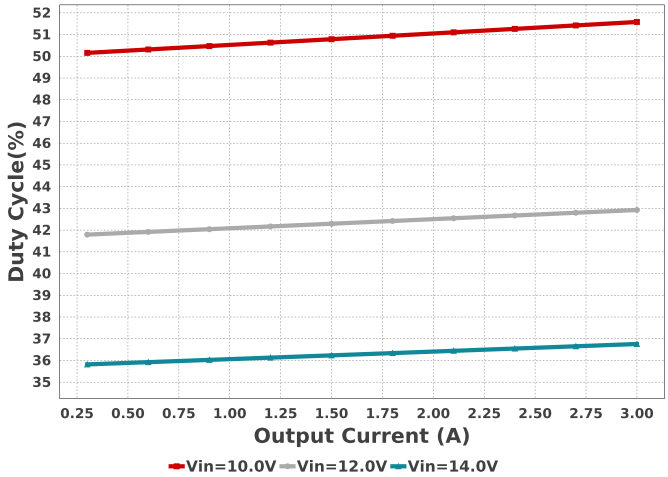
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cff	MuRata	GRM1555C1H100GA01D Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cin	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	1	$0.04	0805 7 mm^2
Cinx	MuRata	GRM188R71H104KA93D Series= X7R	Cap= 100.0 nF ESR= 20.0 mOhm VDC= 50.0 V IRMS= 3.8 A	1	$0.02	0603 5 mm^2
Cout	MuRata	GRM21BR61A226ME44L Series= X5R	Cap= 22.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 3.84 A	2	$0.09	0805 7 mm^2
Coutx	MuRata	GRM188R71E104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 1.51 A	1	$0.01	0603 5 mm^2
L1	TDK	CLF10040T-4R7N	L= 4.7 µH 18.9 mOhm	1	$0.49	 CLF10040 148 mm^2
Renb	Yageo	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rent	Vishay-Dale	CRCW0603210KFKEA Series= CRCW..e3	Res= 210.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbb	Yageo	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbt	Yageo	RC0603FR-07220KL Series= ?	Res= 220.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rpg	Vishay-Dale	CRCW060310K0FKEA Series= CRCW..e3	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	TPS564257DRLR	Switcher	1	$0.14	DRL0006A 7 mm^2

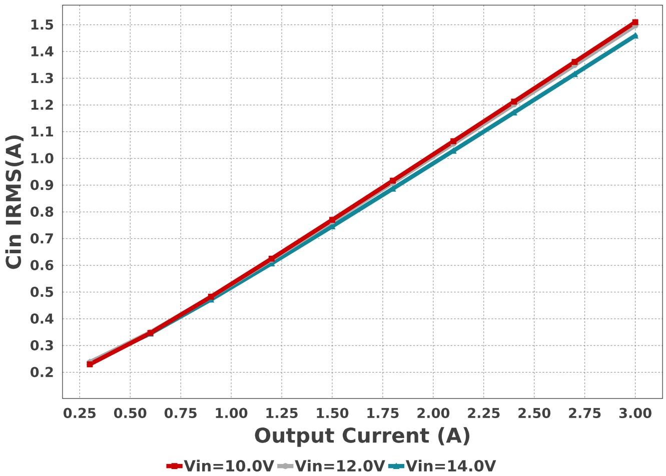
IC Tj



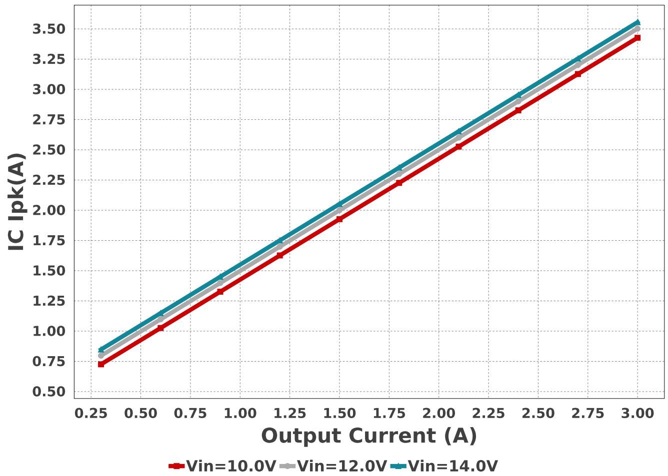
Duty Cycle



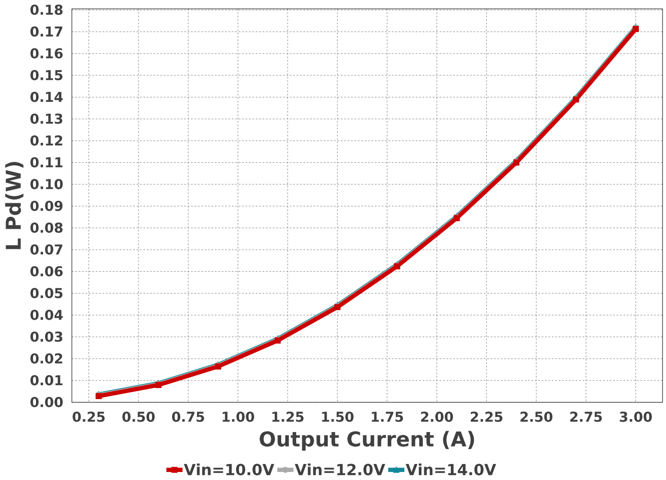
Cin IRMS



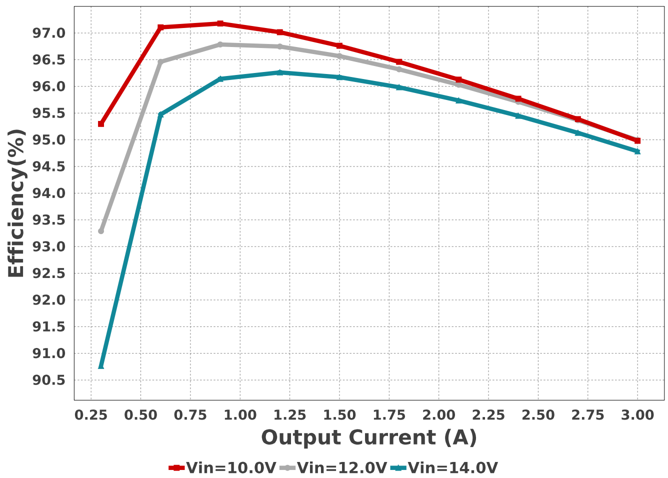
IC Ipk

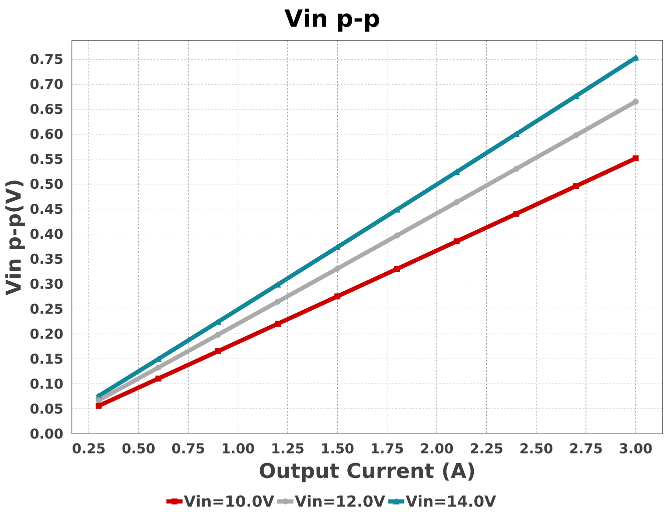


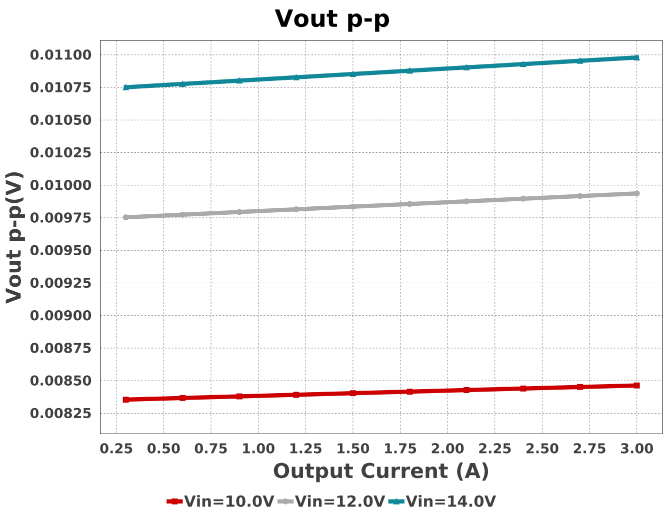
L Pd

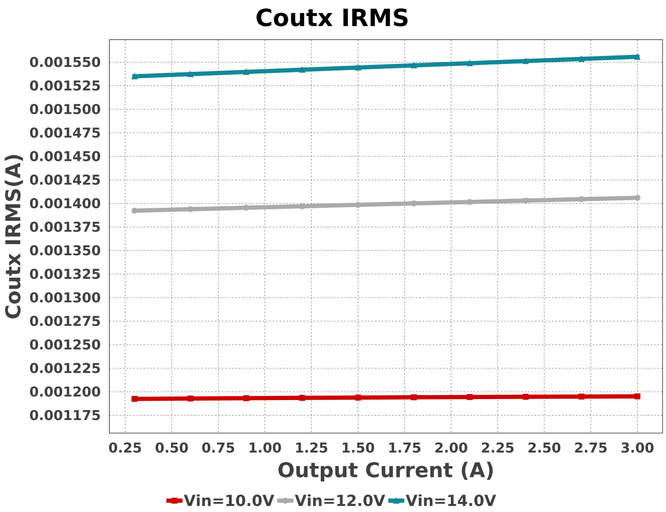


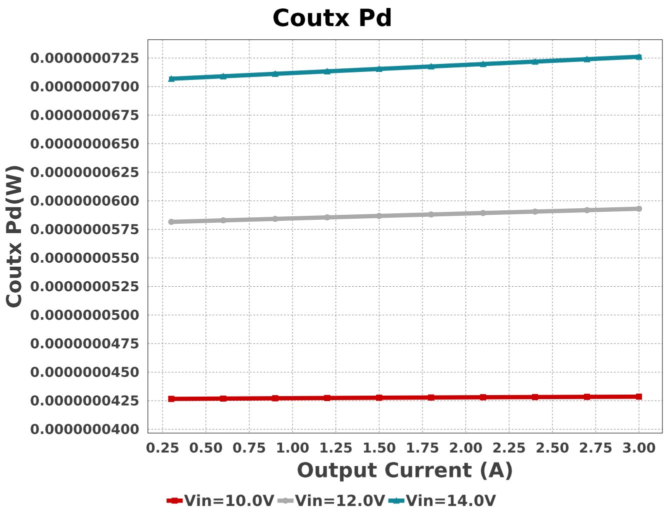
Efficiency

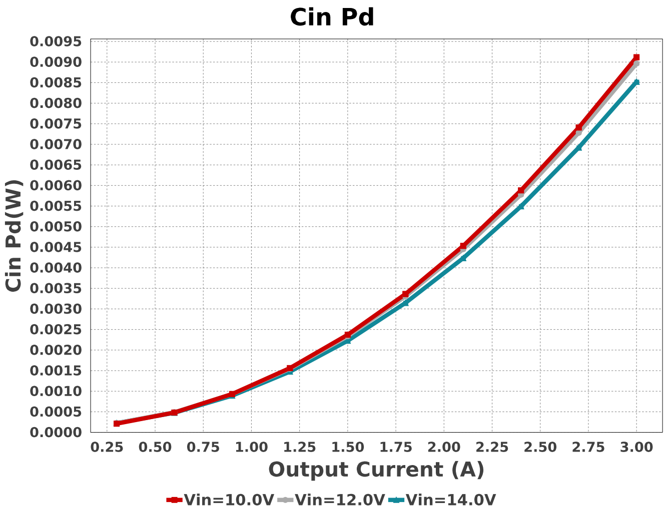


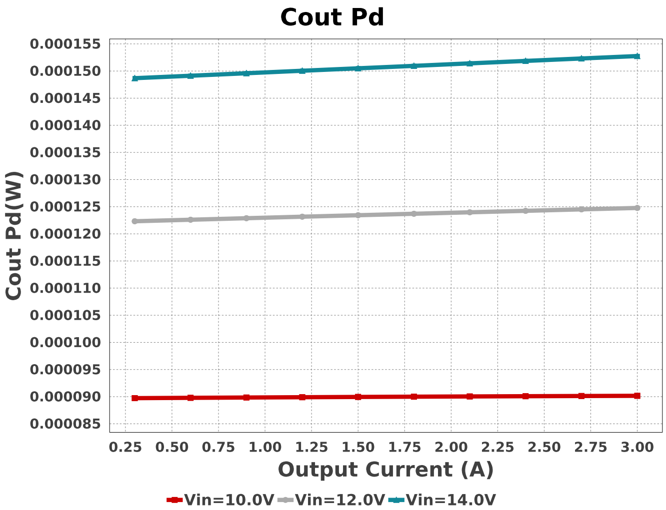

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

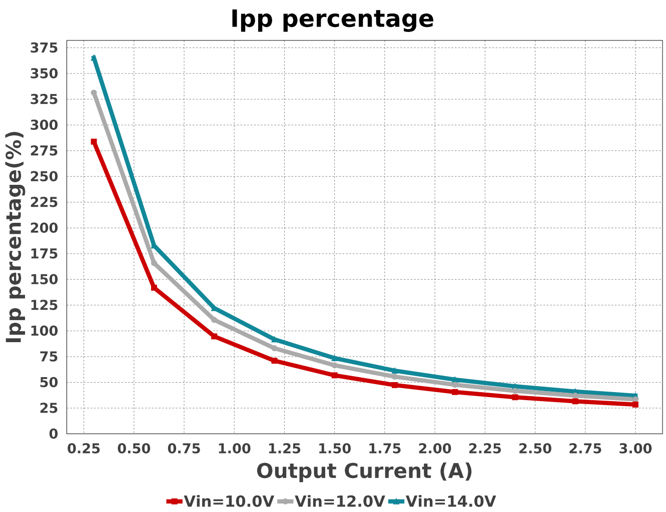

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

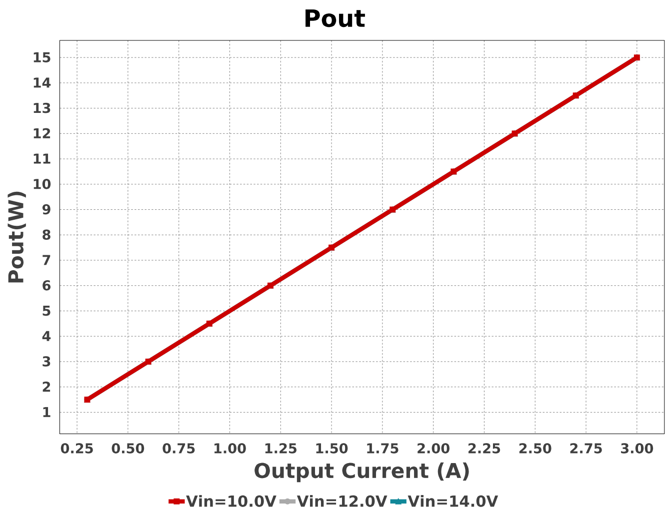

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

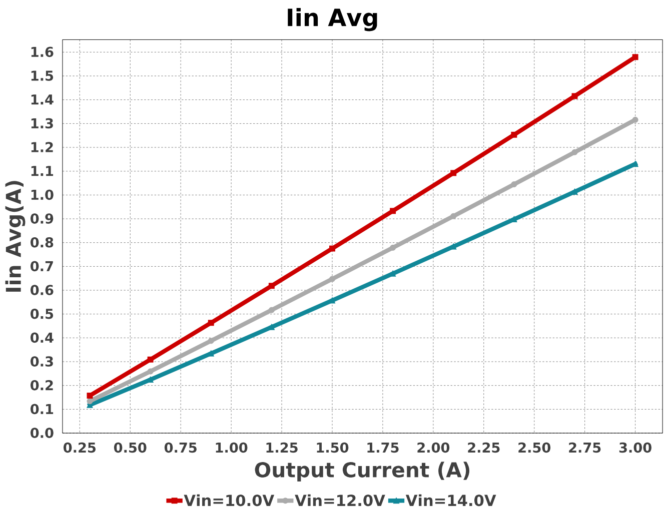

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

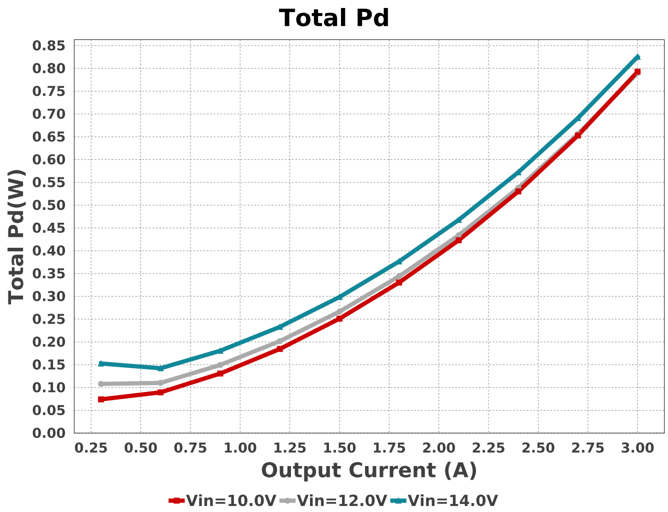

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

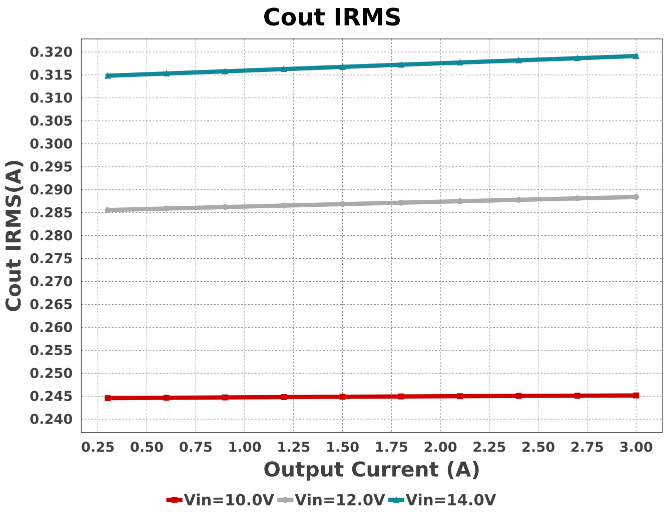

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

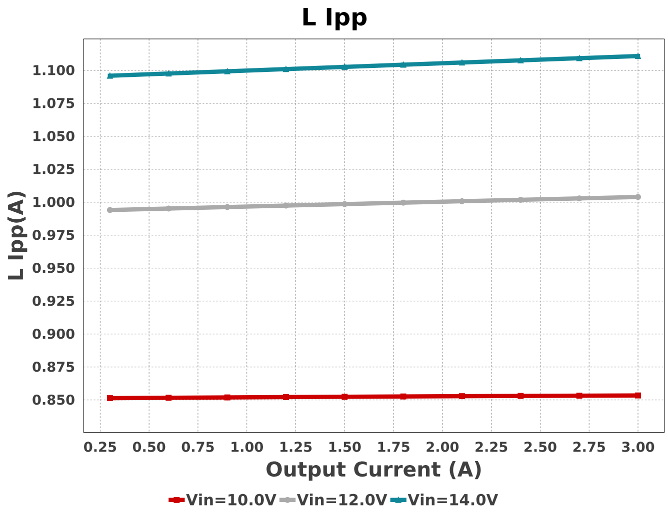

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

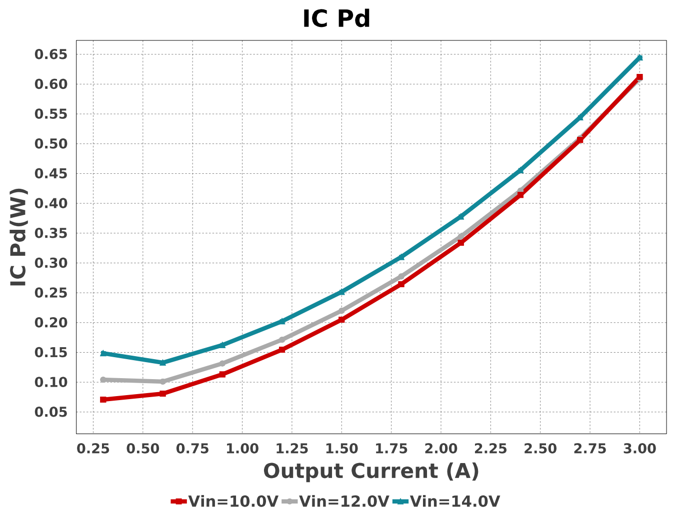

Pout
Pout(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


L Ipp
L Ipp(A)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	13		Total Design BOM count
2.	Total BOM	$0.94		Total BOM Cost
3.	Cin IRMS	1.459 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	8.52 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	319.121 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	152.76 µW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	1.556 mA	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	72.612 nW	Capacitor	Output capacitor_x power loss
9.	IC Ipk	3.555 A	IC	Peak switch current in IC
10.	IC Pd	644.63 mW	IC	IC power dissipation
11.	IC Tj	77.703 degC	IC	IC junction temperature
12.	IC Tolerance	6.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA Effective	74.0 degC/W	IC	IC junction-to-ambient thermal resistance with TI EVM
14.	Iin Avg	1.13 A	IC	Average input current
15.	Ipp percentage	37.029 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
16.	L Ipp	1.111 A	Inductor	Peak-to-peak inductor ripple current
17.	L Pd	172.04 mW	Inductor	Inductor power dissipation
18.	Cin Pd	8.52 mW	Power	Input capacitor power dissipation
19.	Cout Pd	152.76 µW	Power	Output capacitor power dissipation
20.	Coutx Pd	72.612 nW	Power	Output capacitor_x power loss
21.	IC Pd	644.63 mW	Power	IC power dissipation
22.	L Pd	172.04 mW	Power	Inductor power dissipation
23.	Total Pd	825.463 mW	Power	Total Power Dissipation
24.	Duty Cycle	36.758 %	System Information	Duty cycle
25.	Efficiency	94.784 %	System Information	Steady state efficiency
26.	FootPrint	210.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	619.766 kHz	System Information	Switching frequency
28.	Iout	3.0 A	System Information	Iout operating point
29.	Mode	CCM	System Information	Conduction Mode
30.	Pout	15.0 W	System Information	Total output power
31.	Vin	14.0 V	System Information	Vin operating point
32.	Vin p-p	752.812 mV	System Information	Peak-to-peak input voltage
33.	Vout	5.0 V	System Information	Operational Output Voltage
34.	Vout Actual	5.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	2.796 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	10.98 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	14.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS564257	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

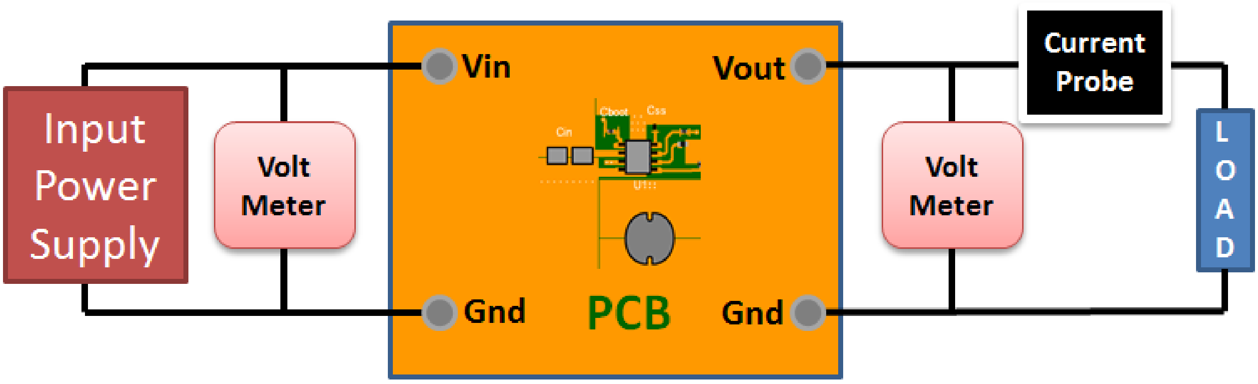
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.0V 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.

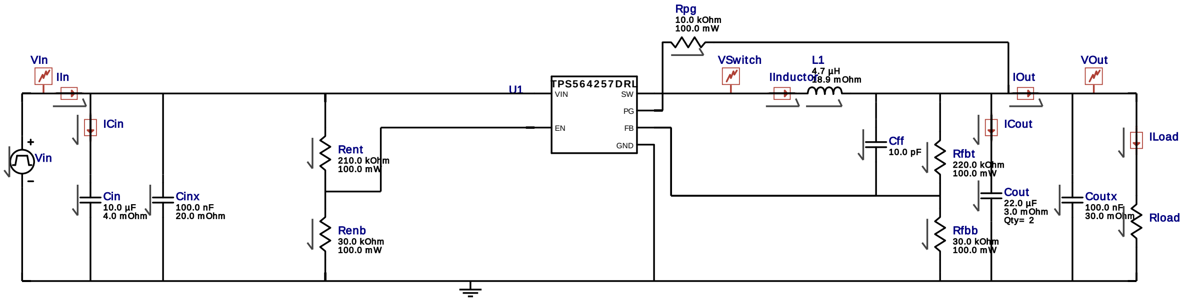


WEBENCH® Electrical Simulation Report

Design Id = 5

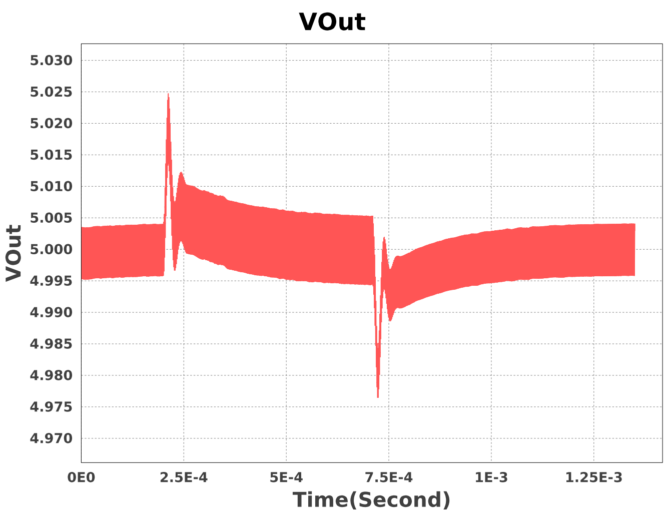
sim_id = 3

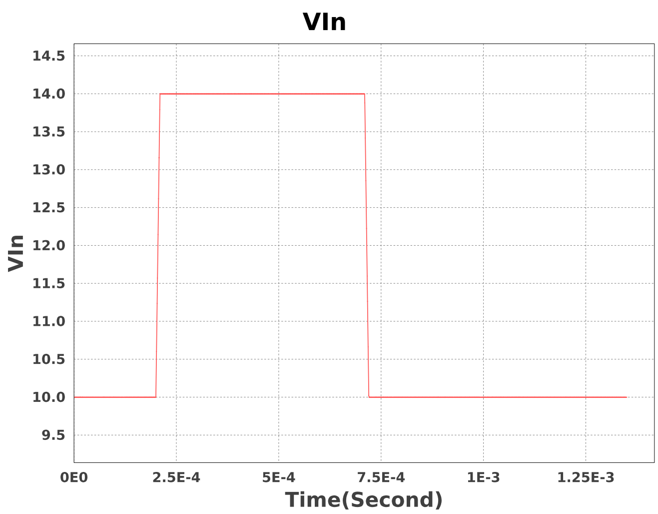
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	3.0 A
2.	Cout	IC	Initial Condition	5.0 V
3.	Rload	R	load resistance	1.6666666666666667 ohm





Design Assistance

1. Master key : 18FBDA0AEA9912E2E0CEDE85DFD76F26[v1]
2. **TPS564257** Product Folder : https://www.ti.com/product/TPS564257 : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.