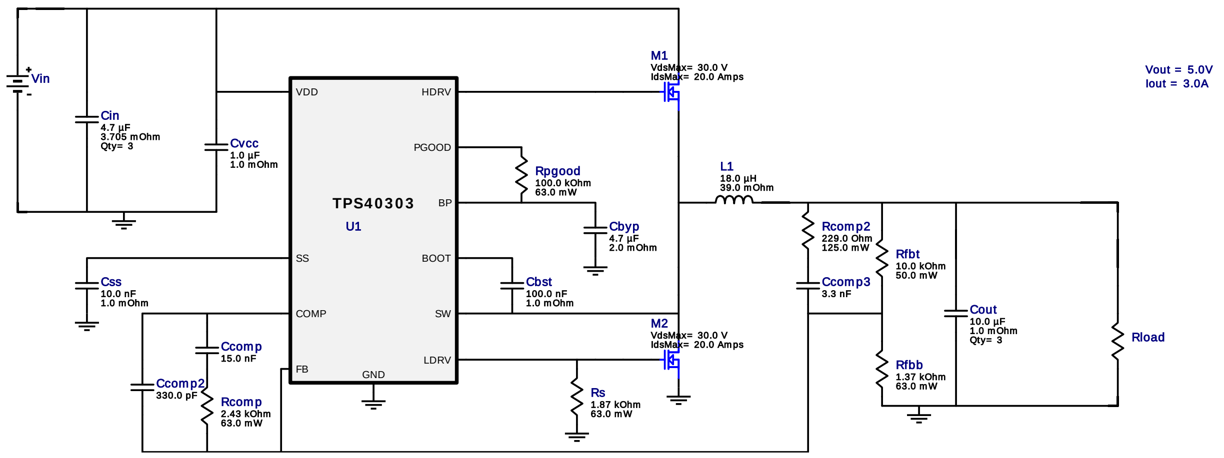
VinMin = 10.0V
VinMax = 14.0V
Vout = 5.0V
Iout = 3.0A

Device = TPS40303DRCR
Topology = Buck
Created = 2021-09-02 08:51:09.807
BOM Cost = NA
BOM Count = 23
Total Pd = 0.64W

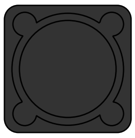
WEBENCH ® Design Report

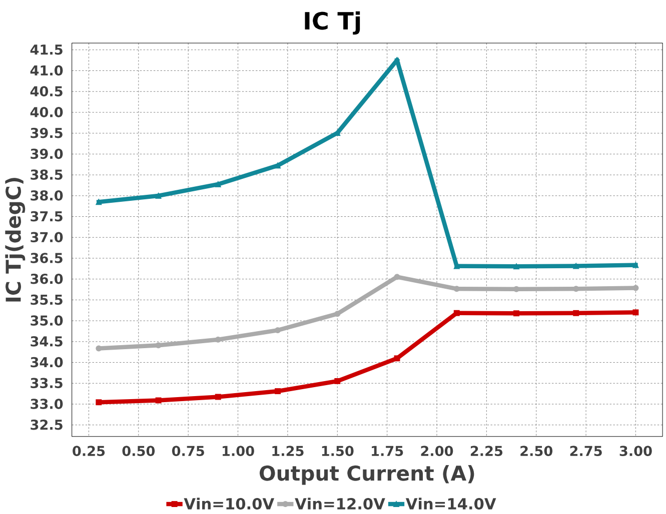
Design : 46 TPS40303DRCR
TPS40303DRCR 10V-14V to 5.00V @ 2A

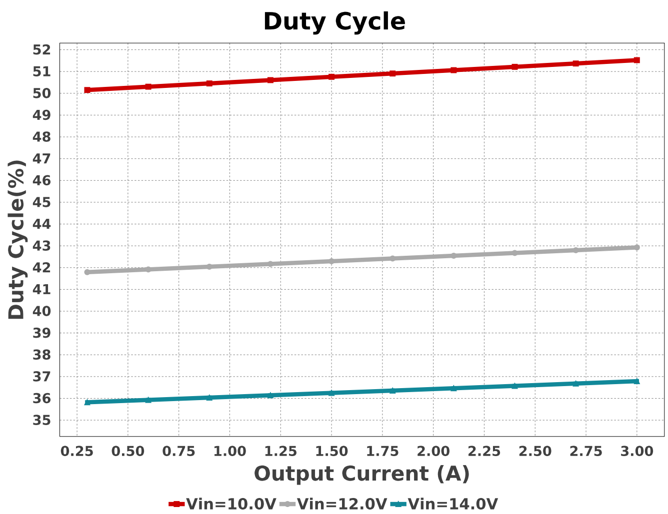


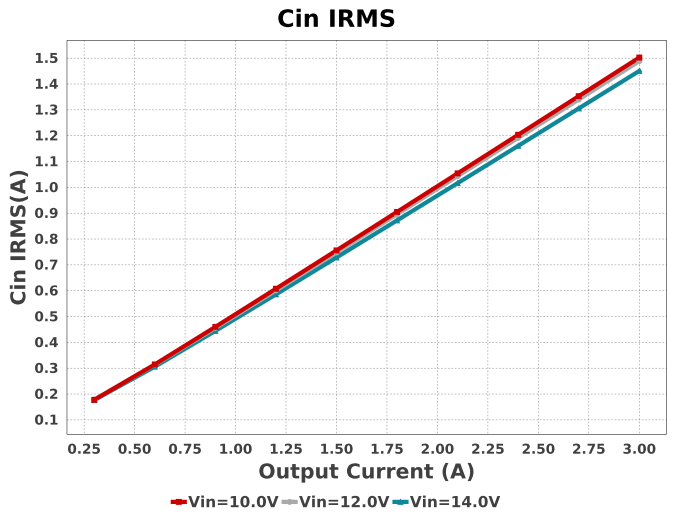
Electrical BOM

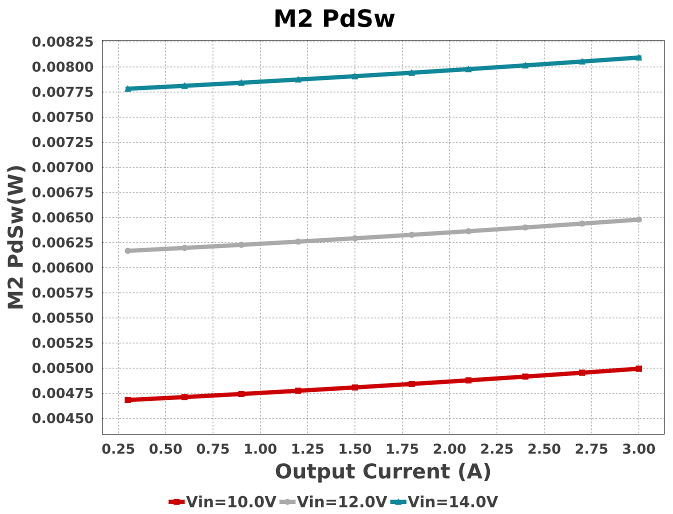
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cbyp	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	1	$0.06	0805 7 mm²
Ccomp	TDK	CGA4F2C0G1H153J085AA Series= C0G/NP0	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C331JBANNNC Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp3	TDK	C2012C0G1H332J060AA Series= C0G/NP0	Cap= 3.3 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Cin	MuRata	GRM31CR71E475KA88L Series= X7R	Cap= 4.7 uF ESR= 3.705 mOhm VDC= 25.0 V IRMS= 2.8649 A	3	$0.08	1206_190 11 mm²
Cout	TDK	C2012X7R1A106M125AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	3	$0.09	0805 7 mm²
Css	MuRata	GRM033R71A103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
Cvcc	Taiyo Yuden	TMK212B7105KG-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²

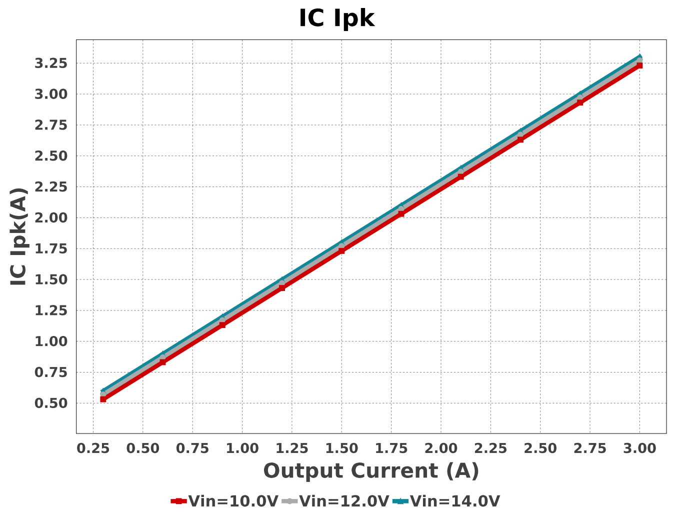
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Wurth Elektronik	744770118	L= 18.0 µH 39.0 mOhm	1	$1.39	 WE-PD_1280 196 mm²
M1	Texas Instruments	CSD17579Q3A	VdsMax= 30.0 V IdsMax= 20.0 Amps	1	$0.15	 DNH0008A 18 mm²
M2	Texas Instruments	CSD17578Q3A	VdsMax= 30.0 V IdsMax= 20.0 Amps	1	$0.17	 DNH0008A 18 mm²
Rcomp	Vishay-Dale	CRCW04022K43FKED Series= CRCW..e3	Res= 2.43 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rcomp2	Yageo	RT0805BRD07229RL Series= RT0805	Res= 229.0 Ohm Power= 125.0 mW Tolerance= 0.1%	1	NA	0805 7 mm²
Rfbb	Vishay-Dale	CRCW04021K37FKED Series= CRCW..e3	Res= 1.37 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rs	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS40303DRCR	Switcher	1	$0.82	 S-PVSON-N10 17 mm²

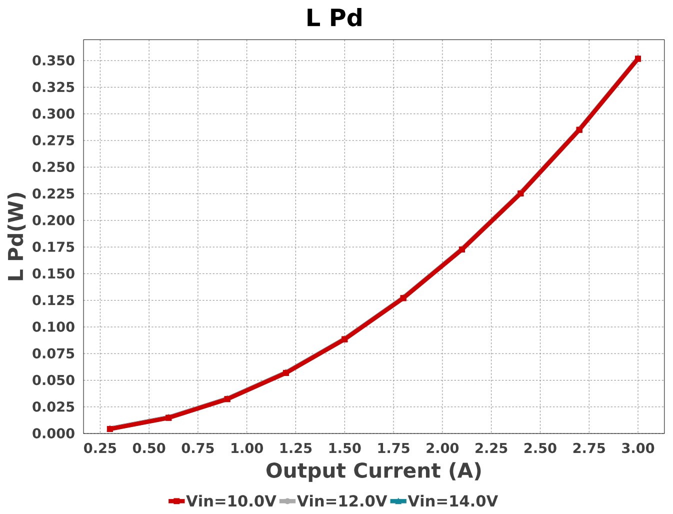


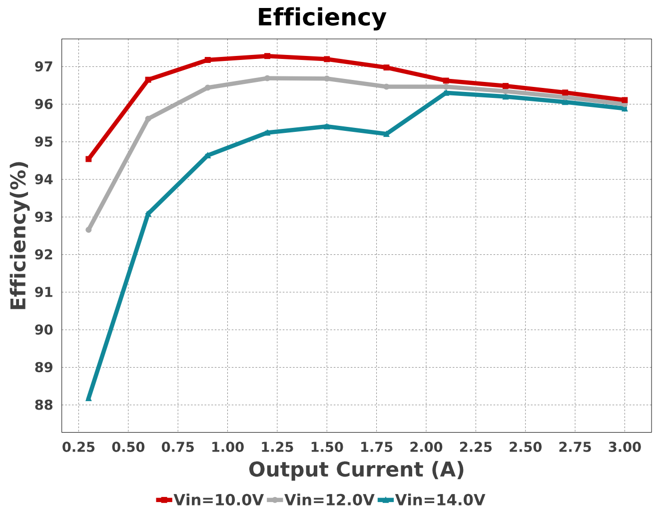


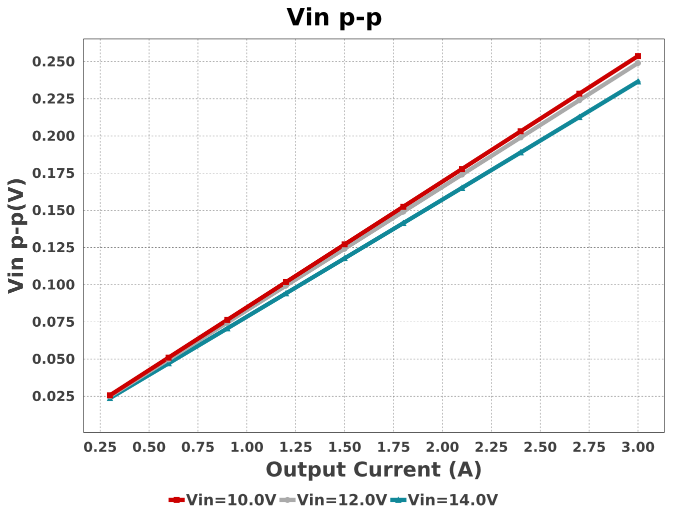

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

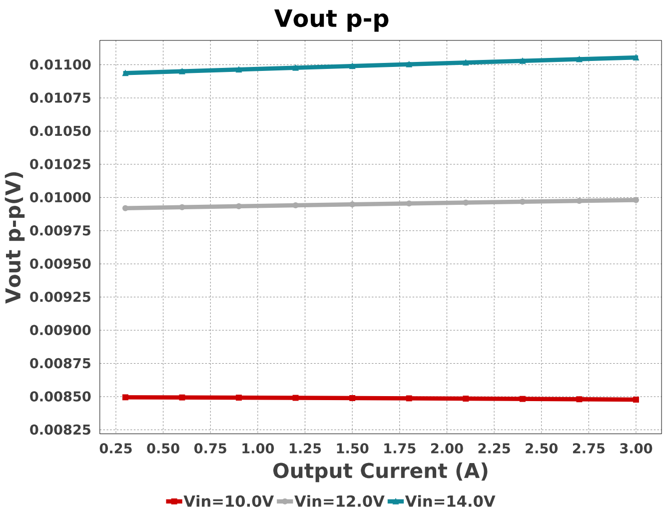

M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

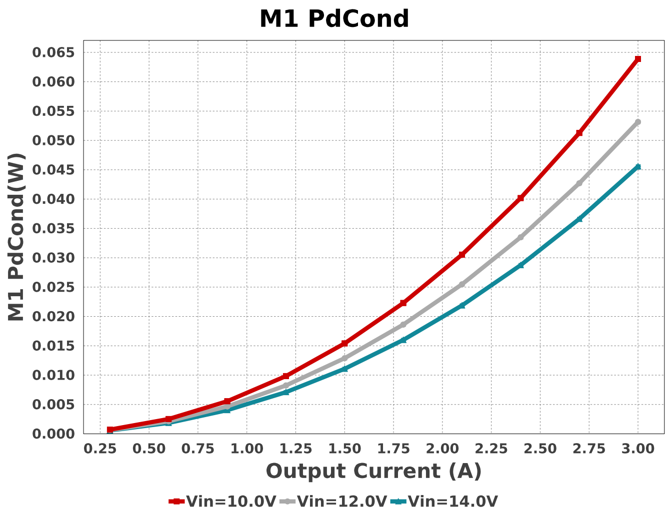

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

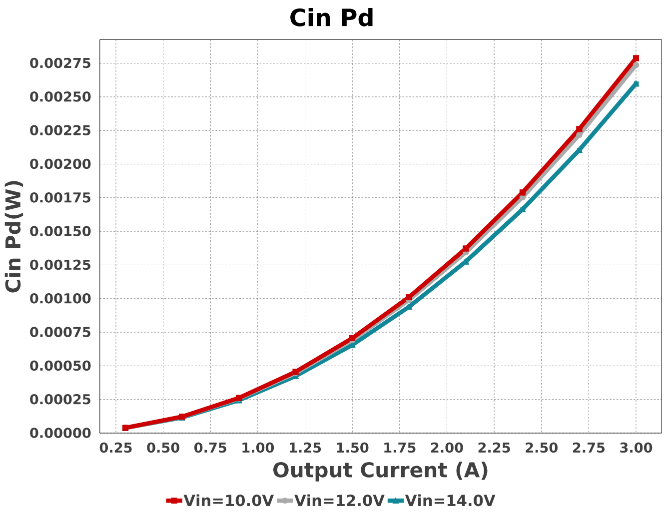

L Pd
L Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

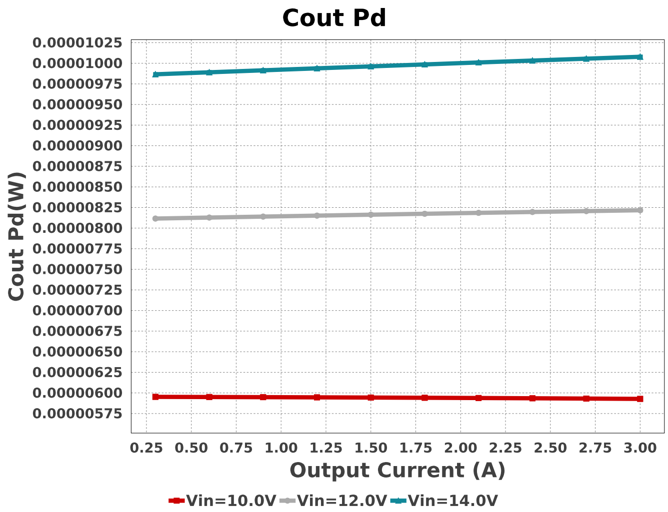

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

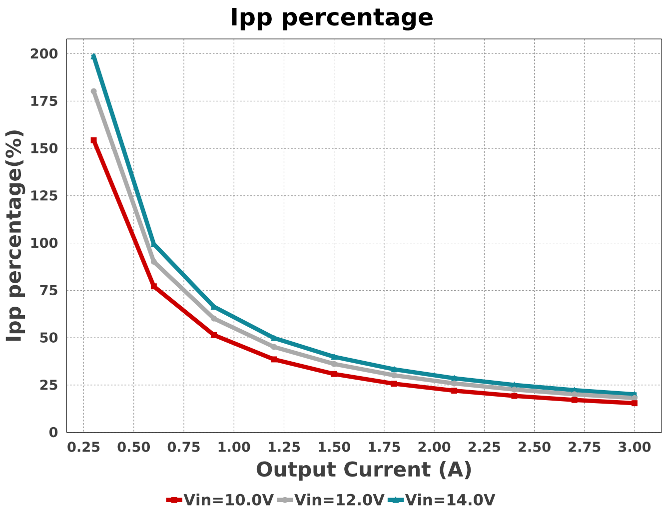

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

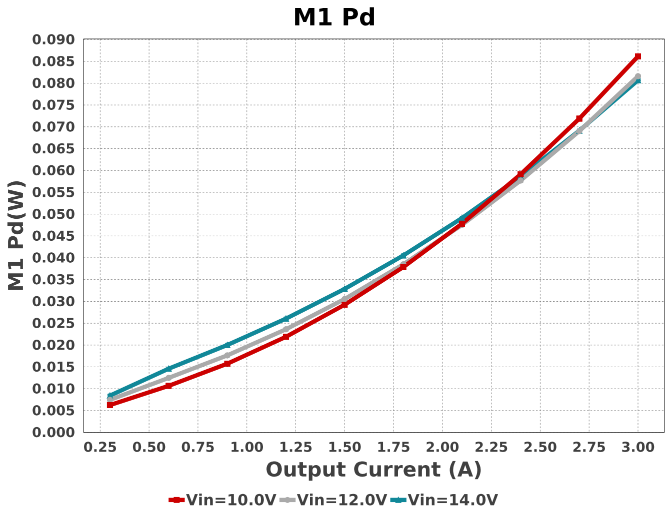

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

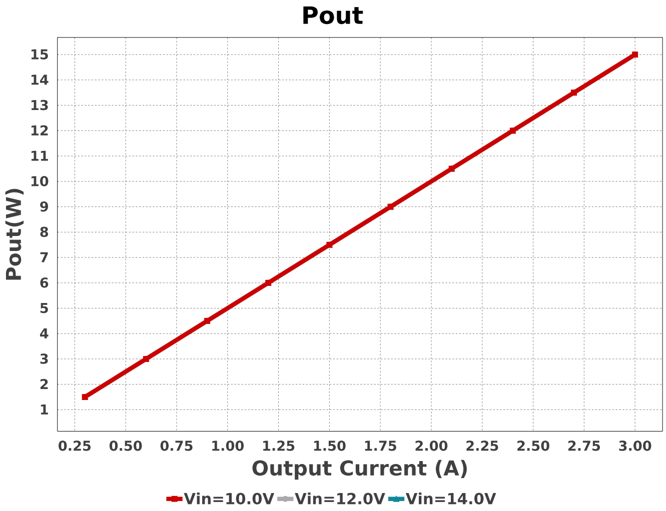

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

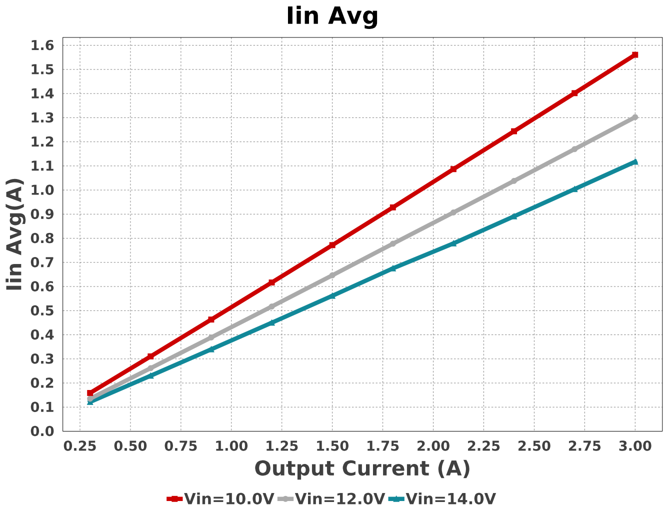

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

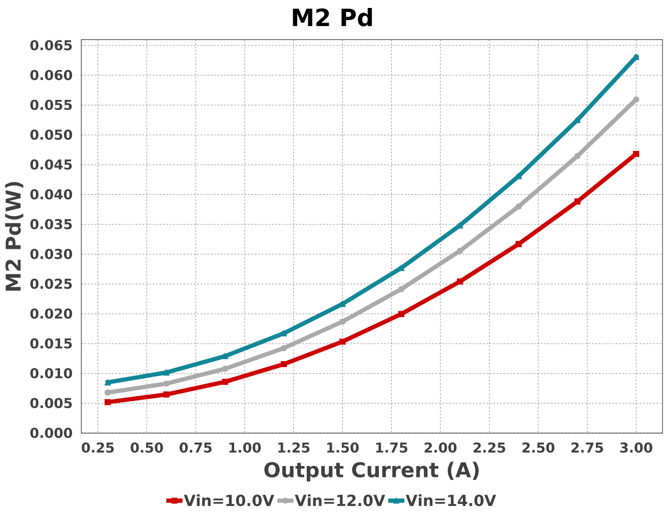

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

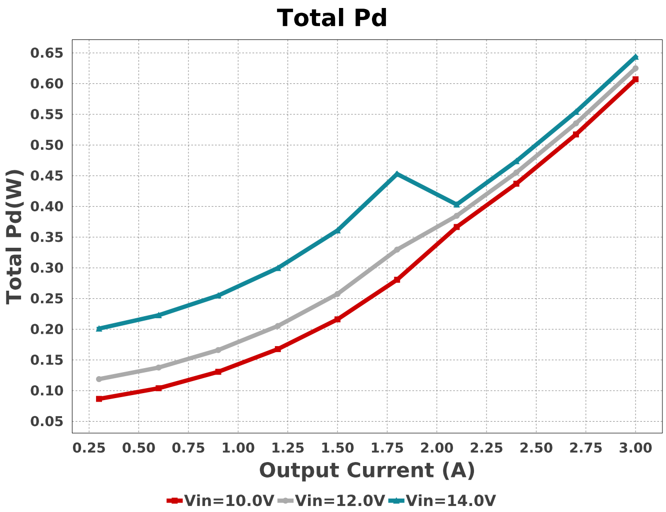

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

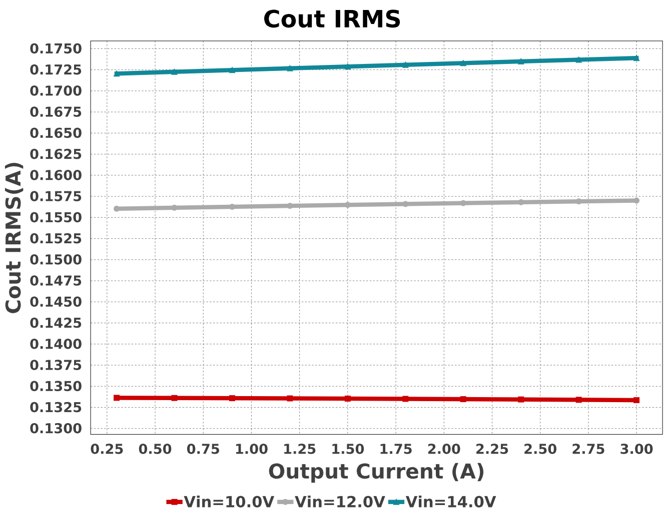

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

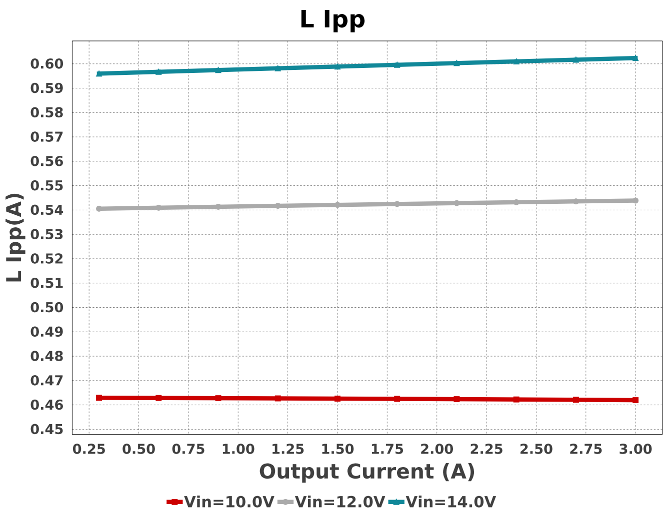

Pout
Pout(W)
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

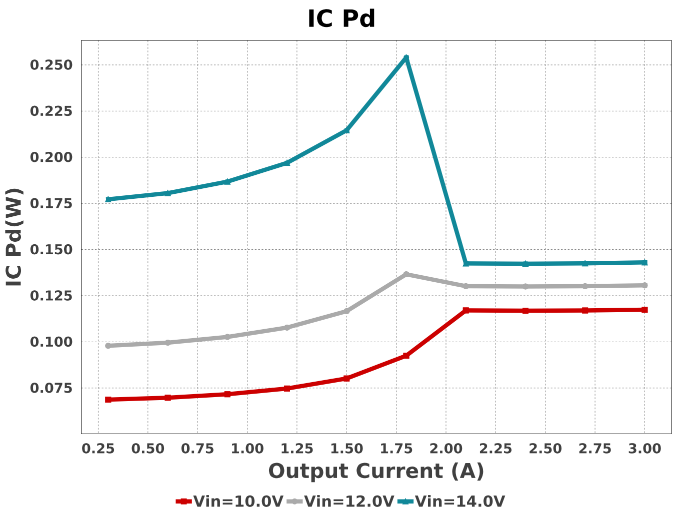

Iin Avg
Iin Avg(A)
1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

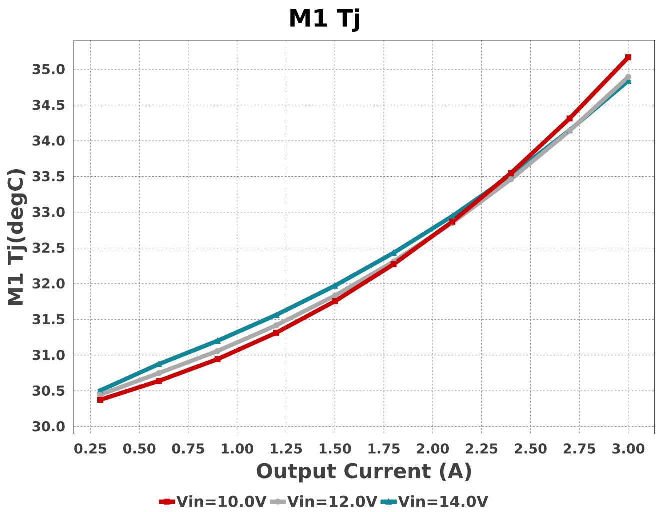

M2 Pd
M2 Pd(W)
0.065 0.060 0.055 0.050 0.045 0.040 0.035 0.030 0.025 0.020 0.015 0.010 0.005 0.000
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

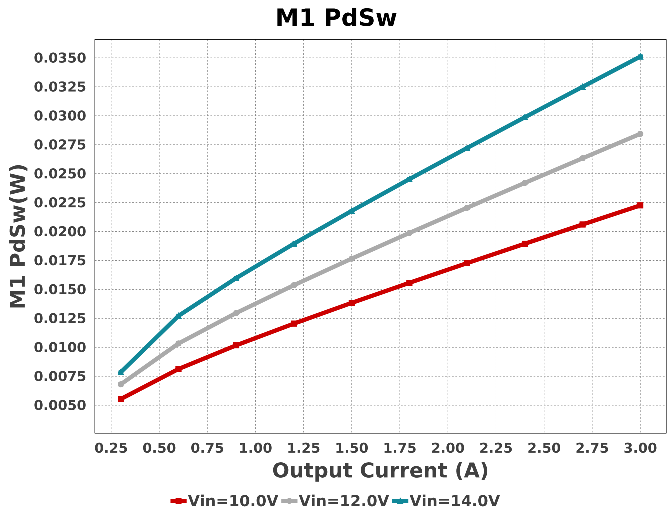

Total Pd
Total Pd(W)
0.65 0.60 0.55 0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

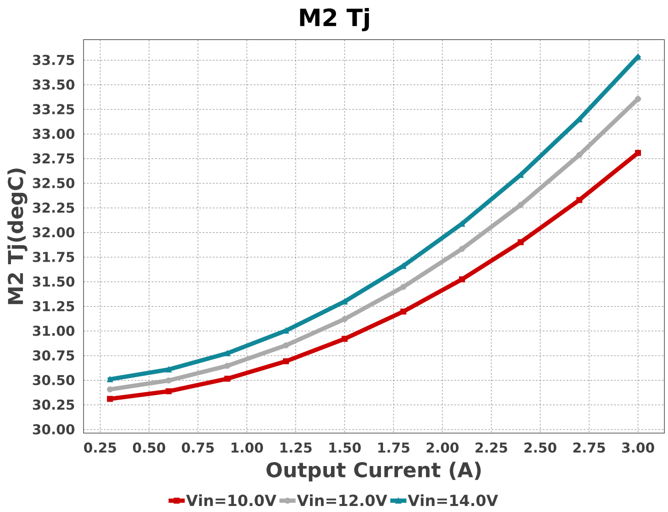

Cout IRMS
Cout IRMS(A)
0.1750 0.1725 0.1700 0.1675 0.1650 0.1625 0.1600 0.1575 0.1550 0.1525 0.1500 0.1475 0.1450 0.1425 0.1400 0.1375 0.1350 0.1325 0.1300
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

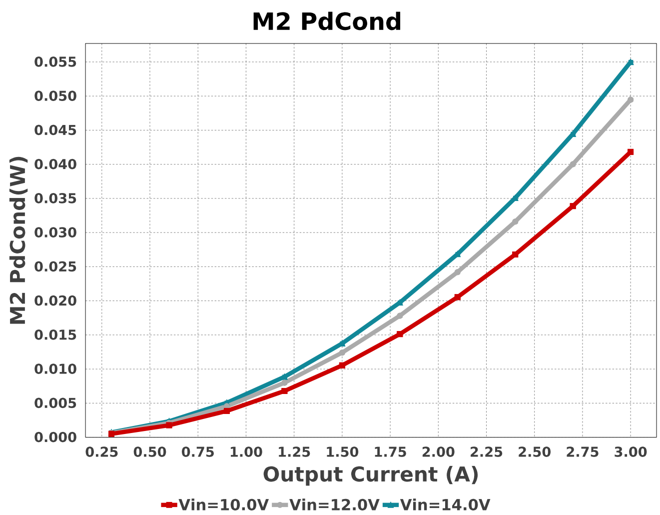

L Ipp
L Ipp(A)
0.60 0.59 0.58 0.57 0.56 0.55 0.54 0.53 0.52 0.51 0.50 0.49 0.48 0.47 0.46 0.45
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

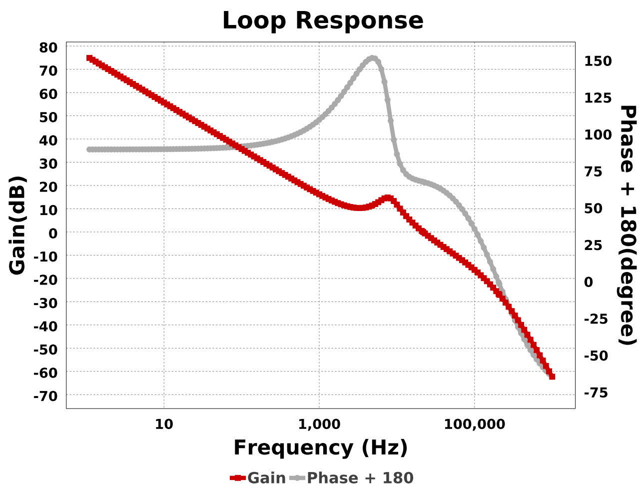












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	23		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	1.451 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	2.598 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	173.889 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	10.079 µW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	3.301 A	IC	Peak switch current in IC
8.	IC Pd	143.05 mW	IC	IC power dissipation
9.	IC Tj	36.337 degC	IC	IC junction temperature
10.	IC Tolerance	6.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	44.3 degC/W	IC	IC junction-to-ambient thermal resistance

#	Name	Value	Category	Description
12.	Iin Avg	1.117 A	IC	Average input current
13.	Ipp percentage	20.079 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	602.369 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	352.18 mW	Inductor	Inductor power dissipation
16.	M1 Pd	80.669 mW	Mosfet	M1 MOSFET total power dissipation
17.	M1 PdCond	45.56 mW	Mosfet	M1 MOSFET conduction losses
18.	M1 PdSw	35.109 mW	Mosfet	M1 MOSFET switching losses
19.	M1 Tj	34.84 degC	Mosfet	M1 MOSFET junction temperature
20.	M2 Pd	63.077 mW	Mosfet	M2 MOSFET total power dissipation
21.	M2 PdCond	54.983 mW	Mosfet	M2 MOSFET conduction losses
22.	M2 PdSw	8.094 mW	Mosfet	M2 MOSFET switching losses
23.	M2 Tj	33.785 degC	Mosfet	M2 MOSFET junction temperature
24.	Cin Pd	2.598 mW	Power	Input capacitor power dissipation
25.	Cout Pd	10.079 µW	Power	Output capacitor power dissipation
26.	IC Pd	143.05 mW	Power	IC power dissipation
27.	L Pd	352.18 mW	Power	Inductor power dissipation
28.	M1 Pd	80.669 mW	Power	M1 MOSFET total power dissipation
29.	M1 PdCond	45.56 mW	Power	M1 MOSFET conduction losses
30.	M1 PdSw	35.109 mW	Power	M1 MOSFET switching losses
31.	M2 Pd	63.077 mW	Power	M2 MOSFET total power dissipation
32.	M2 PdCond	54.983 mW	Power	M2 MOSFET conduction losses
33.	M2 PdSw	8.094 mW	Power	M2 MOSFET switching losses
34.	Total Pd	643.734 mW	Power	Total Power Dissipation
35.	Cross Freq	21.762 kHz	System Information	Bode plot crossover frequency
36.	Duty Cycle	36.789 %	System Information	Duty cycle
37.	Efficiency	95.885 %	System Information	Steady state efficiency
38.	FootPrint	362.0 mm^2	System Information	Total Foot Print Area of BOM components
39.	Frequency	300.0 kHz	System Information	Switching frequency
40.	Gain Marg	-26.651 dB	System Information	Bode Plot Gain Margin
41.	Iout	3.0 A	System Information	Iout operating point
42.	Low Freq Gain	74.888 dB	System Information	Gain at 1Hz
43.	Mode	CCM	System Information	Conduction Mode
44.	Phase Marg	68.045 deg	System Information	Bode Plot Phase Margin
45.	Pout	15.0 W	System Information	Total output power
46.	Vin	14.0 V	System Information	Vin operating point
47.	Vin p-p	236.623 mV	System Information	Peak-to-peak input voltage
48.	Vout	5.0 V	System Information	Operational Output Voltage
49.	Vout Actual	4.98 V	System Information	Vout Actual calculated based on selected voltage divider resistors
50.	Vout Tolerance	2.795 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
51.	Vout p-p	11.054 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	TPS40303	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

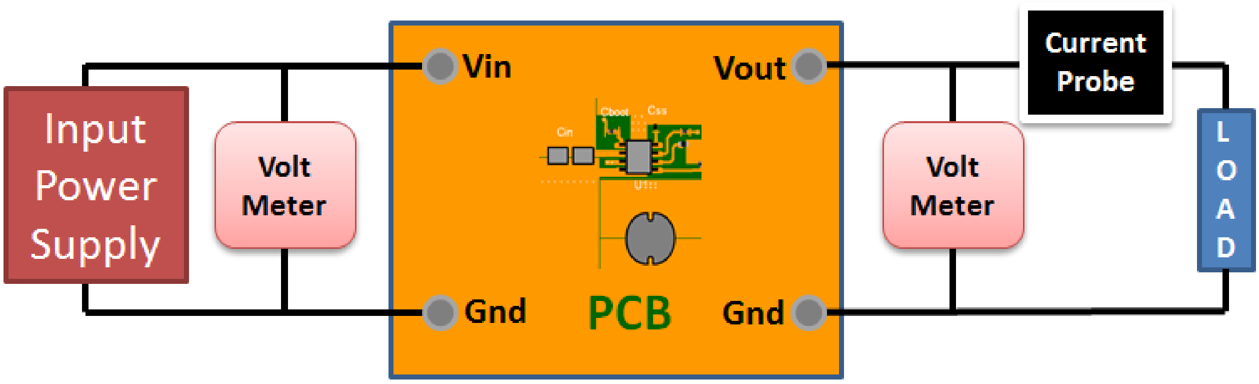
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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

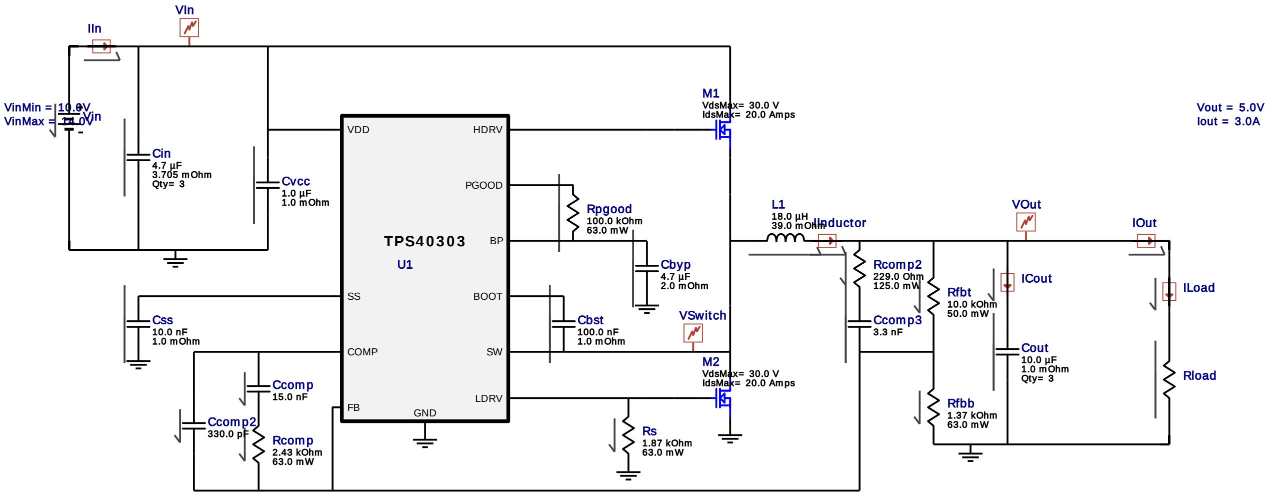


WEBENCH® Electrical Simulation Report

Design Id = 46

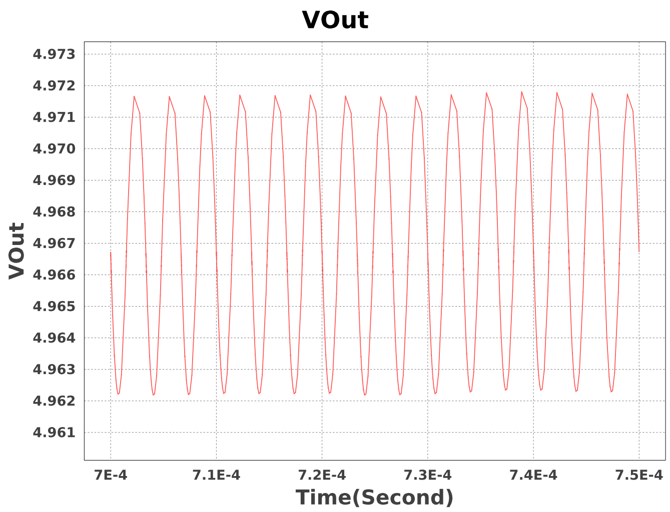
sim_id = 7

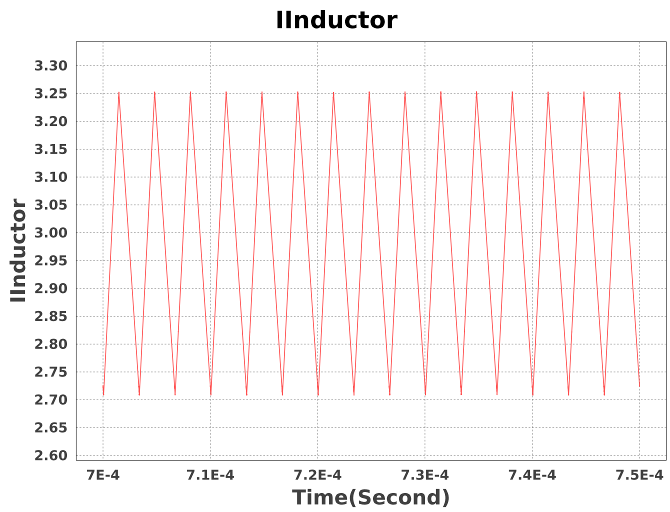
Simulation Type = Steady State

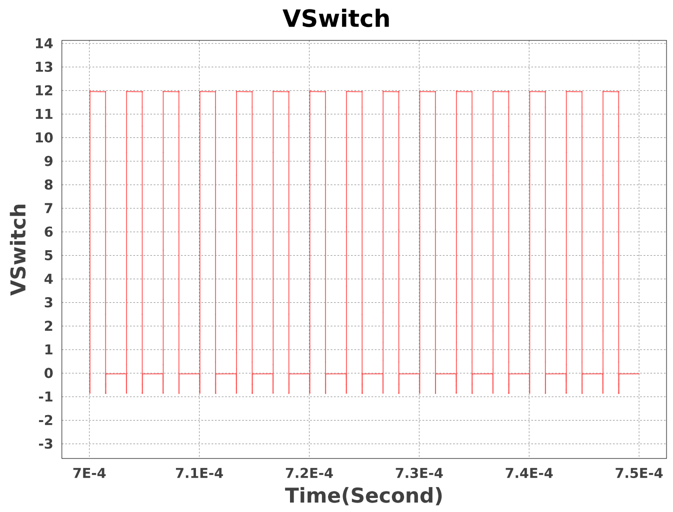


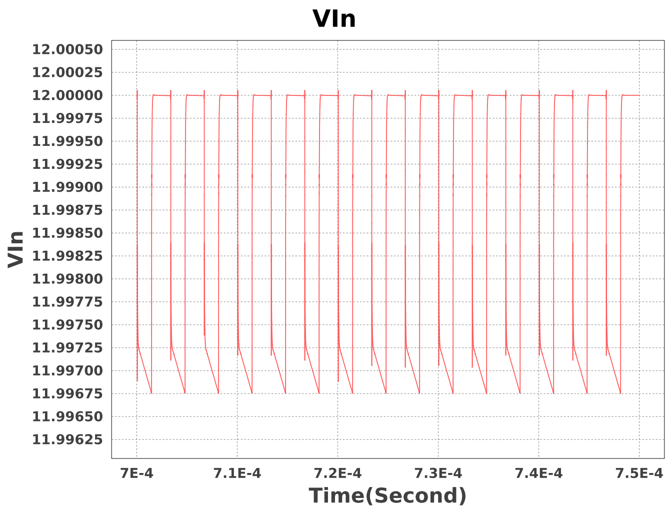
Simulation Parameters

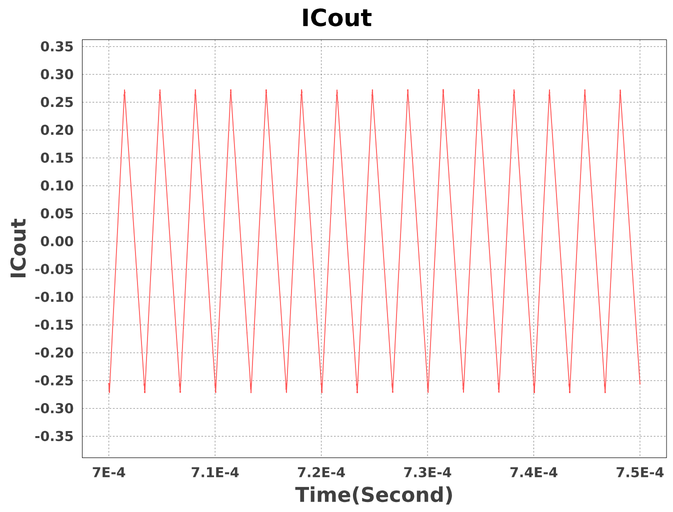
#	Name	Parameter Name	Description	Values
1.	Css	IC	Initial Voltage	1.7 V
2.	Cbst	IC	Initial Voltage	5 V
3.	Rload	R	Load Resistance	1.666667 ohm

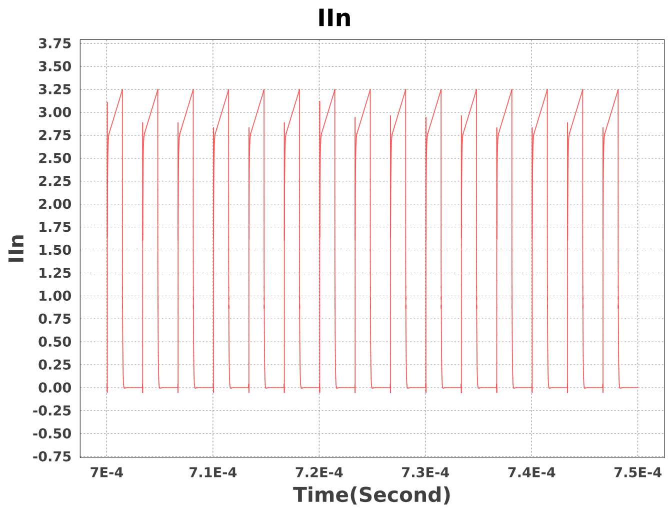


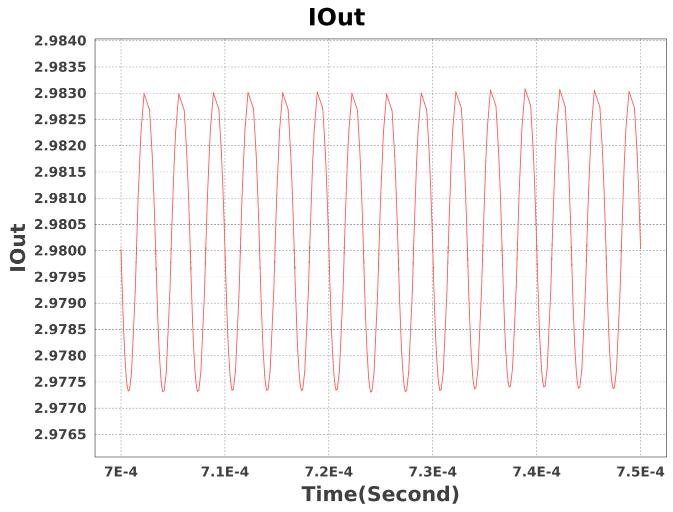


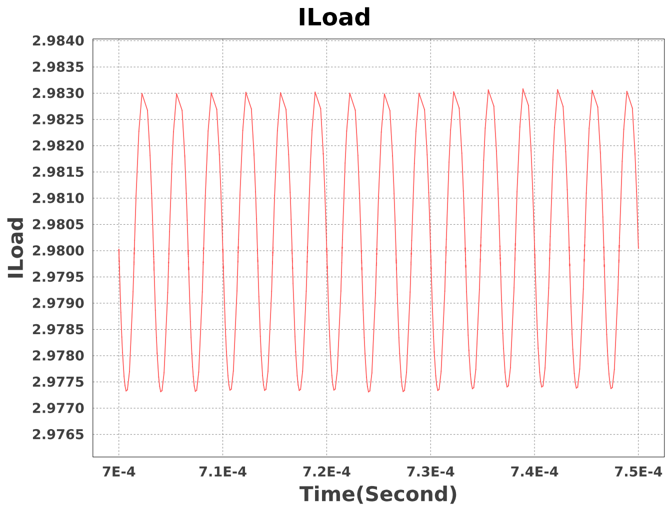












Design Assistance

1. Master key : 325DF75FAF39BAD9[v1]
2. **TPS40303** Product Folder : http://www.ti.com/product/TPS40303 : 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.