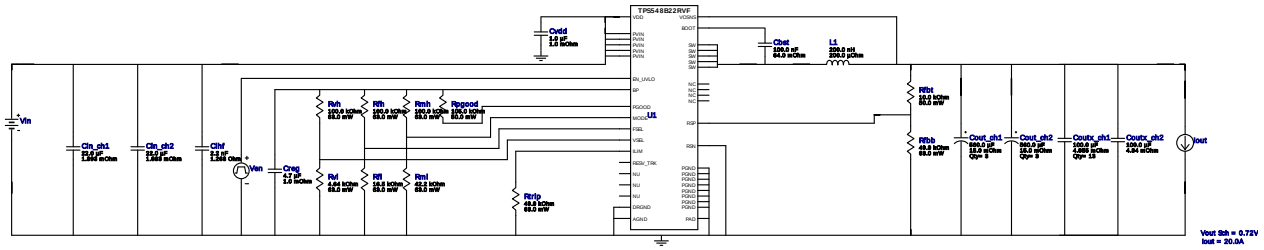
WEBENCH® Design Report

VinMin = 10.0V
VinMax = 14.0V
Vout = 0.72V
Vout Sch = 0.72V
Iout = 20.0A

Device = TPS548B22RVFR
Topology = Buck
Created = 2019-10-24 14:26:06.468
BOM Cost = $14.36
BOM Count = 39
Total Pd = 2.63W

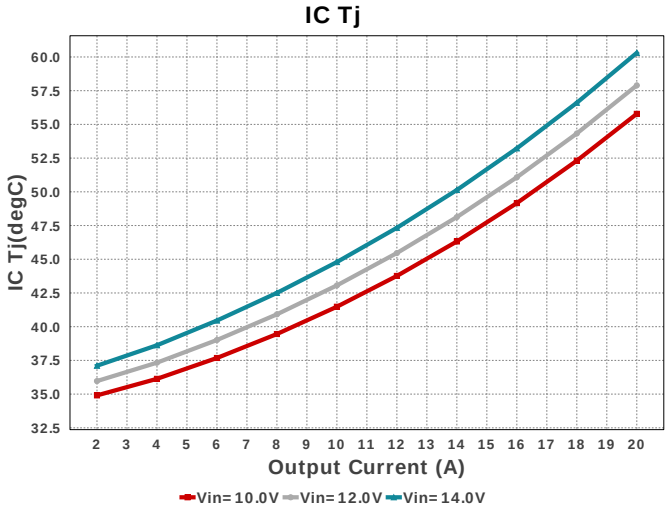
Design : 10752 TPS548B22RVFR
TPS548B22RVFR 10V-14V to .72V @ 20A

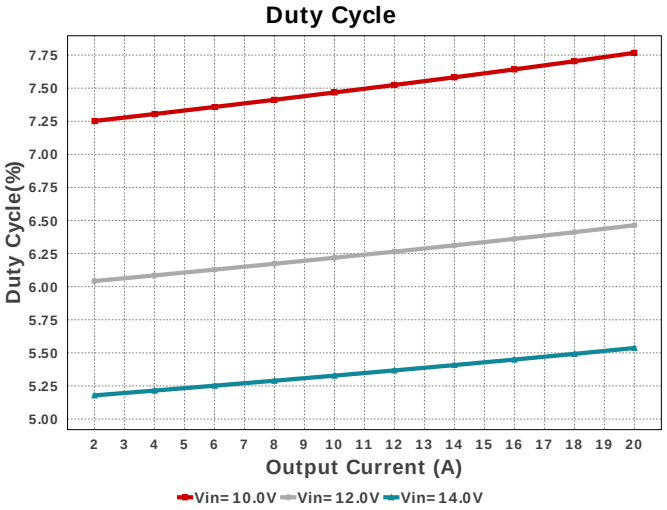


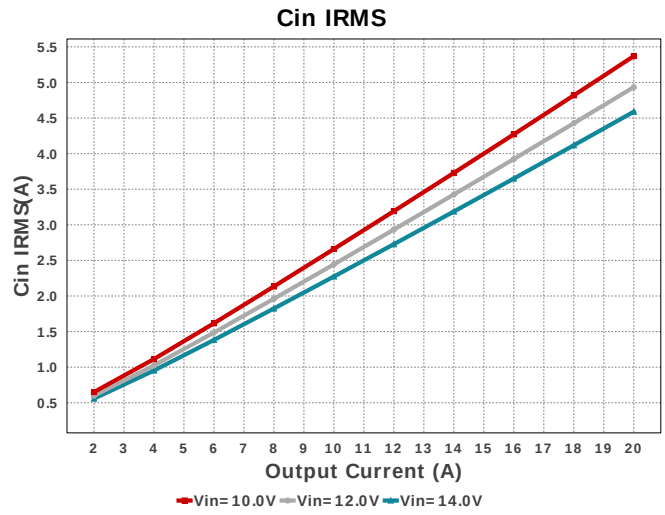
Electrical BOM

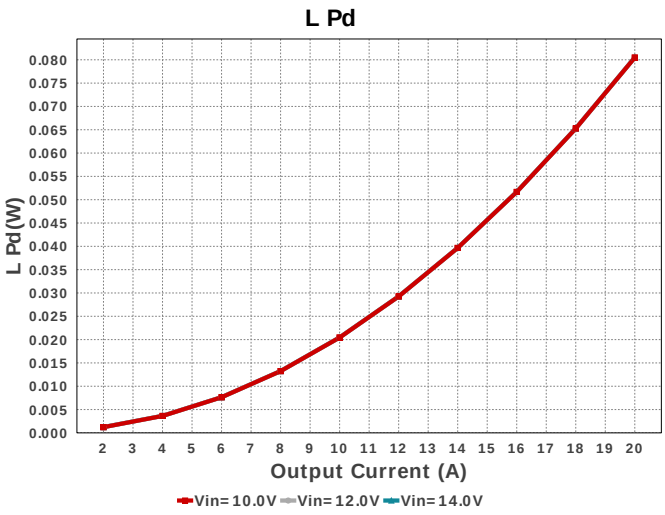
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
Cihf	TDK	CGA1A2X7R1E222K030BA Series= X7R	Cap= 2.2 nF ESR= 1.26834 Ohm VDC= 25.0 V IRMS= 201.468 mA	1	$0.01	0201_033 2 mm²
Cin_ch1	TDK	CGA9P2X7R1E226M250KA Series= X7R	Cap= 22.0 uF ESR= 1.893 mOhm VDC= 25.0 V IRMS= 6.635 A	1	$0.92	2220_280 54 mm²
Cin_ch2	TDK	CGA9P2X7R1E226M250KA Series= X7R	Cap= 22.0 uF ESR= 1.893 mOhm VDC= 25.0 V IRMS= 6.635 A	1	$0.92	2220_280 54 mm²
Cout_ch1	Panasonic	EEFCX0D561R Series= CX	Cap= 560.0 uF ESR= 15.0 mOhm VDC= 2.0 V IRMS= 5.1 A	3	$0.62	7343-20 59 mm²
Cout_ch2	Panasonic	EEFCX0D561R Series= CX	Cap= 560.0 uF ESR= 15.0 mOhm VDC= 2.0 V IRMS= 5.1 A	3	$0.62	7343-20 59 mm²
Coutx_ch1	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	13	$0.34	1206_190 11 mm²
Coutx_ch2	MuRata	GRM31CR60G107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.84 mOhm VDC= 4.0 V IRMS= 4.3381 A	1	$0.34	1206_190 11 mm²
Cref	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Creg	Taiyo Yuden	TMK212BJ475KG-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²

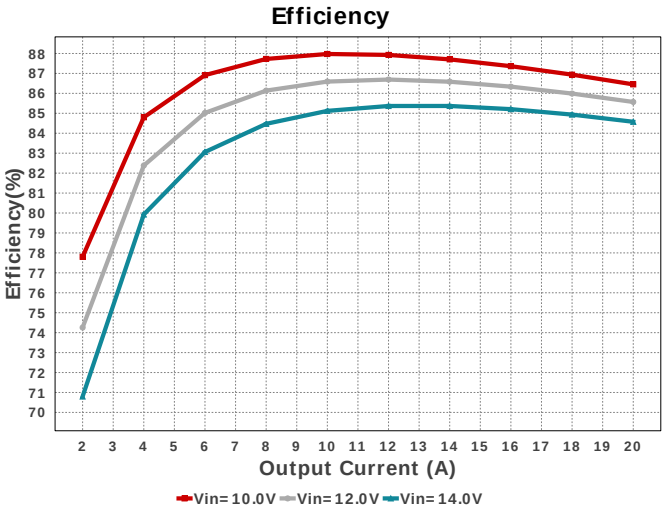
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cvdd	Taiyo Yuden	TMK212B7105KG-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
L1	Coilcraft	SLC1175-201MEB	L= 200.0 nH 200.0 µOhm	1	$0.48	SLC1175 125 mm²
Rfbb	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 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
Rfh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfl	Vishay-Dale	CRCW040216K5FKED Series= CRCW..e3	Res= 16.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rmh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rml	Vishay-Dale	CRCW040242K2FKED Series= CRCW..e3	Res= 42.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpgood	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rtrip	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rvh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rvl	Vishay-Dale	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS548B22RVFR	Switcher	1	$3.35	RVF0040A 63 mm²

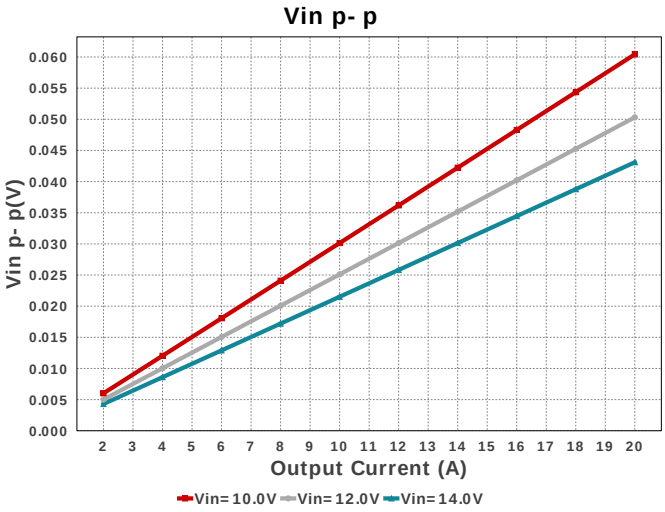


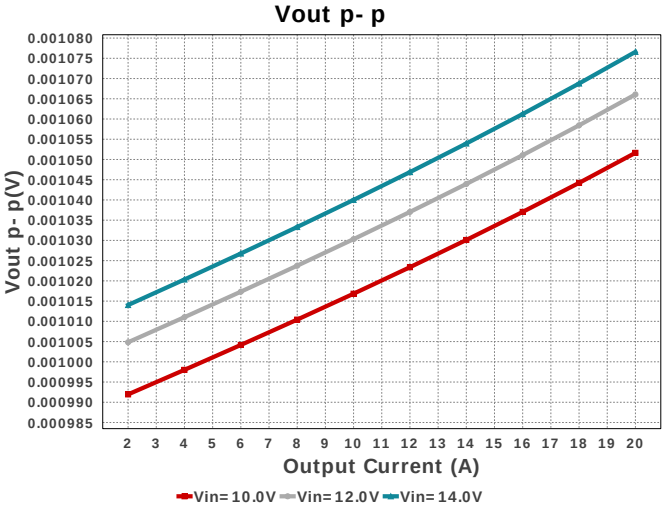


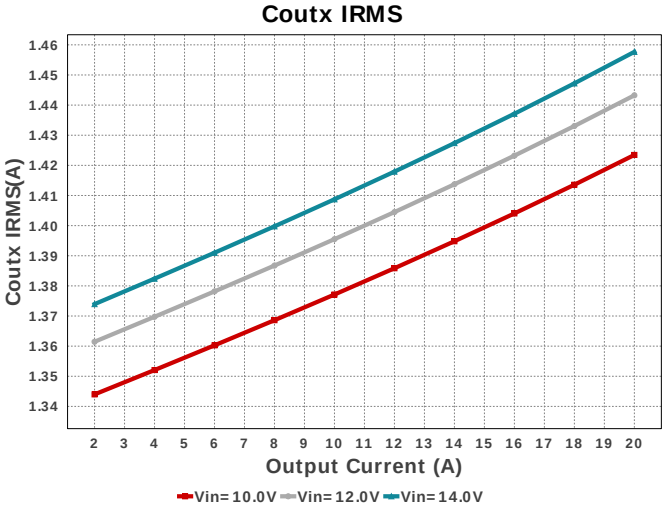


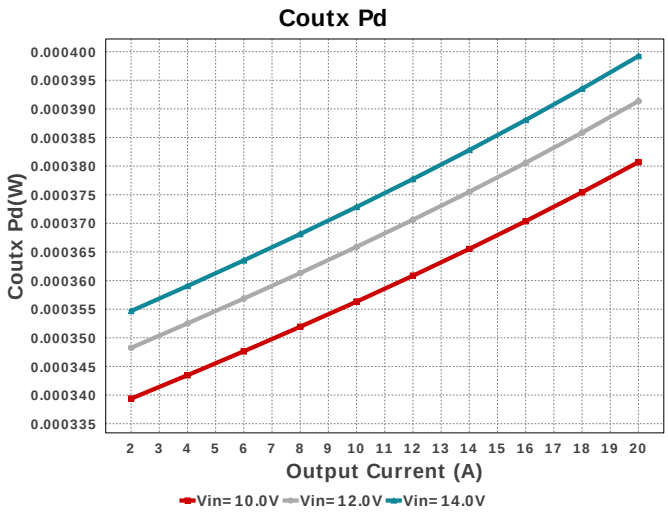


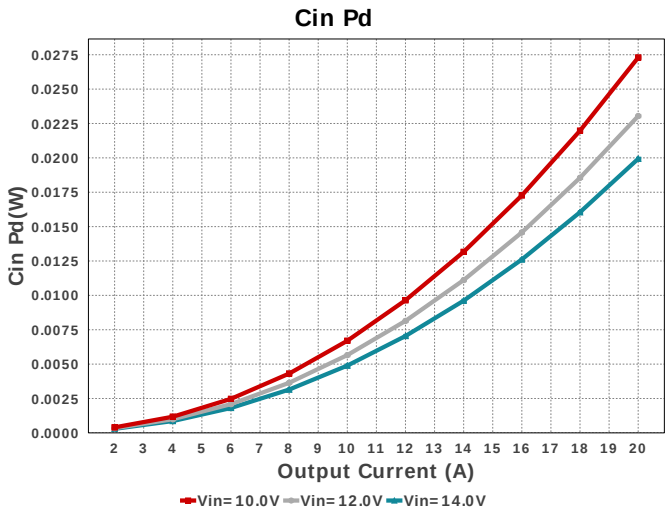


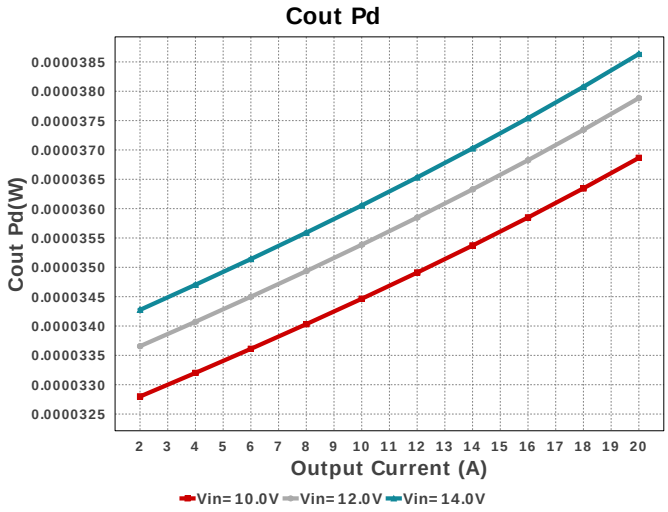


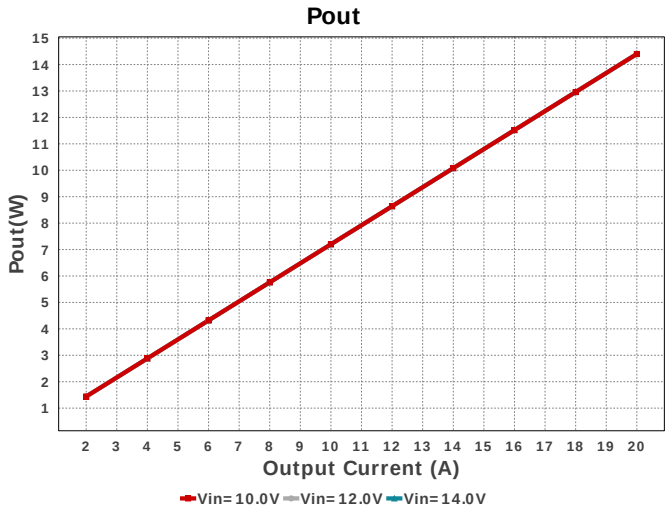


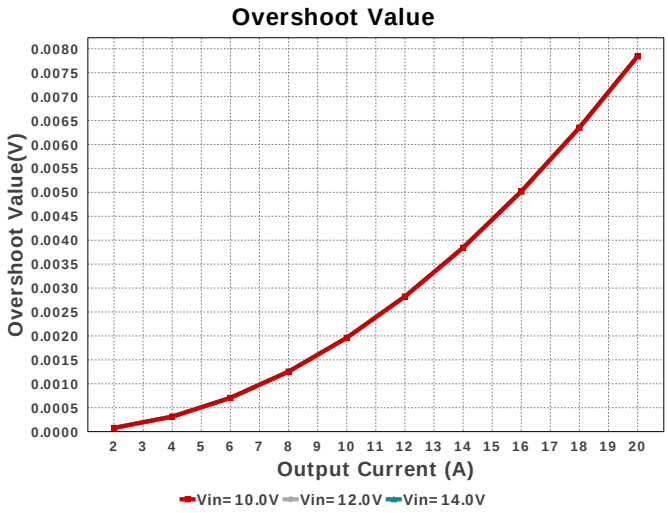


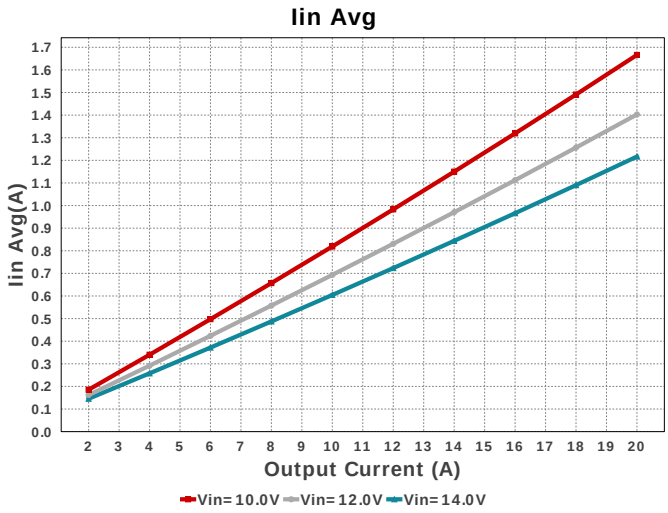


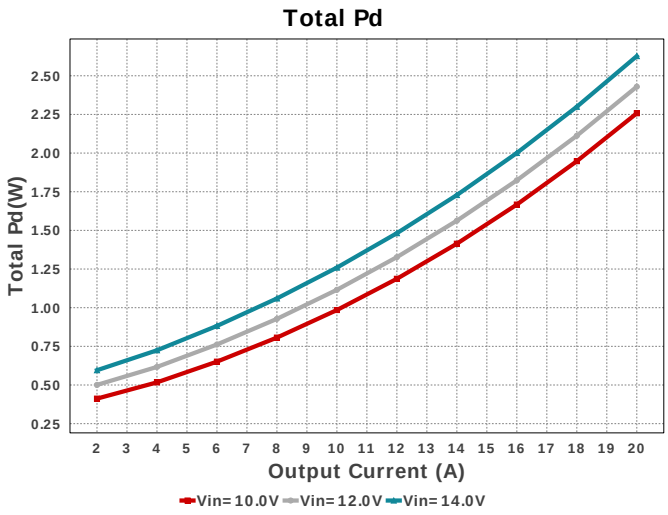


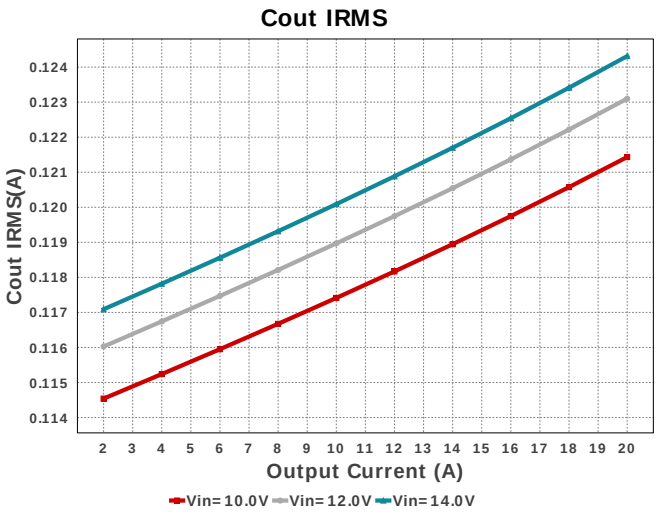


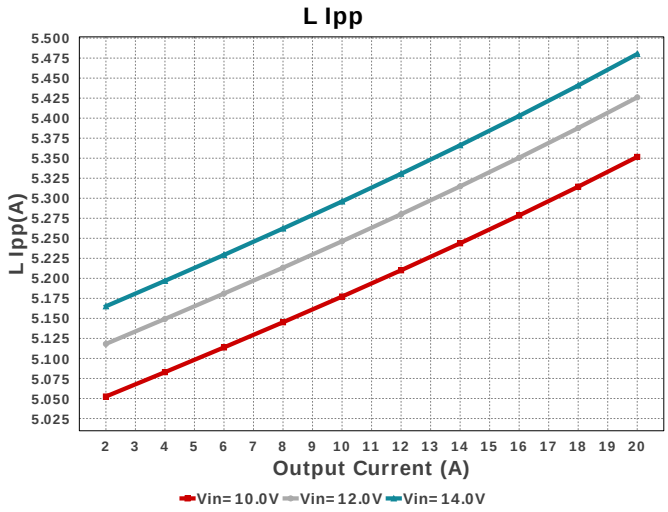


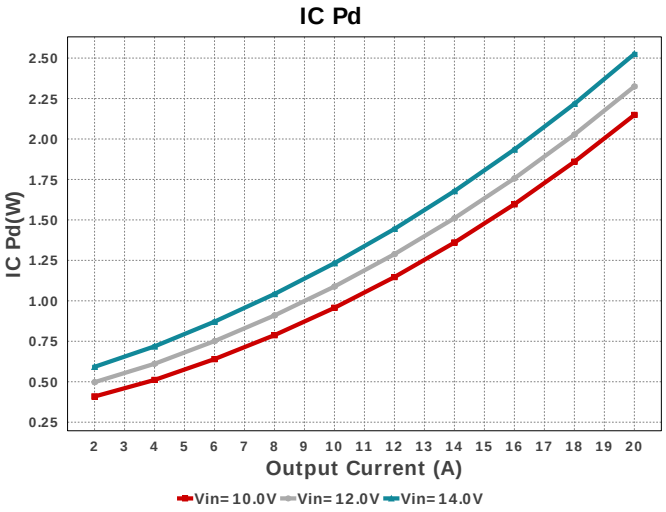


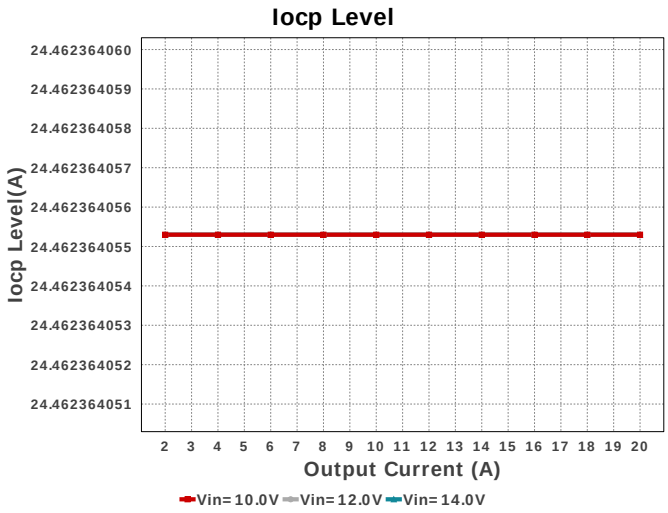


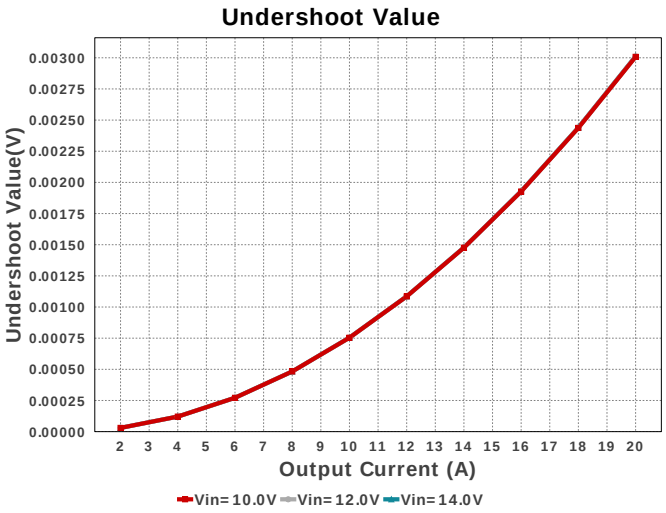












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	39		Total Design BOM count
2.	Total BOM	$14.36		Total BOM Cost
3.	Cin IRMS	4.589 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	19.932 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	124.314 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	38.635 µW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	1.458 A	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	399.22 µW	Capacitor	Output capacitor_x power loss
9.	IC Pd	2.525 W	IC	IC power dissipation
10.	IC Tj	60.304 degC	IC	IC junction temperature
11.	ICThetaJA Effective	12.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	1.217 A	IC	Average input current
13.	L Ipp	5.48 A	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	80.501 mW	Inductor	Inductor power dissipation
15.	Cin Pd	19.932 mW	Power	Input capacitor power dissipation
16.	Cout Pd	38.635 µW	Power	Output capacitor power dissipation
17.	Coutx Pd	399.22 µW	Power	Output capacitor_x power loss
18.	IC Pd	2.525 W	Power	IC power dissipation
19.	L Pd	80.501 mW	Power	Inductor power dissipation
20.	Total Pd	2.627 W	Power	Total Power Dissipation
21.	Duty Cycle	5.537 %	System Information	Duty cycle
22.	Efficiency	84.575 %	System Information	Steady state efficiency
23.	FootPrint	858.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	662.829 kHz	System Information	Switching frequency
25.	Iocp Level	24.462 A	System Information	Over current protection threshold
26.	Iout	20.0 A	System Information	Iout operating point
27.	Mode	CCM	System Information	Conduction Mode
28.	Overshoot Value	7.842 mV	System Information	Theoretical Overshoot Value
29.	Pout	14.4 W	System Information	Total output power
30.	Undershoot Value	3.012 mV	System Information	Theoretical Undershoot Value
31.	Vin	14.0 V	System Information	Vin operating point
32.	Vin p-p	43.105 mV	System Information	Peak-to-peak input voltage
33.	Vout	720.0 mV	System Information	Operational Output Voltage
34.	Vout Actual	719.76 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	1.09 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	1.077 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

	Name	Value	Description
	Iout	20.0	Maximum Output Current
	VinMax	14.0	Maximum input voltage
	VinMin	10.0	Minimum input voltage
	Vout	720.0 m	Output Voltage
	base_pn	TPS548B22	Base Product Number
	source	DC	Input Source Type
	Ta	30.0	Ambient temperature
1.	Vout Sch	720.0 m	Output voltage selected

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

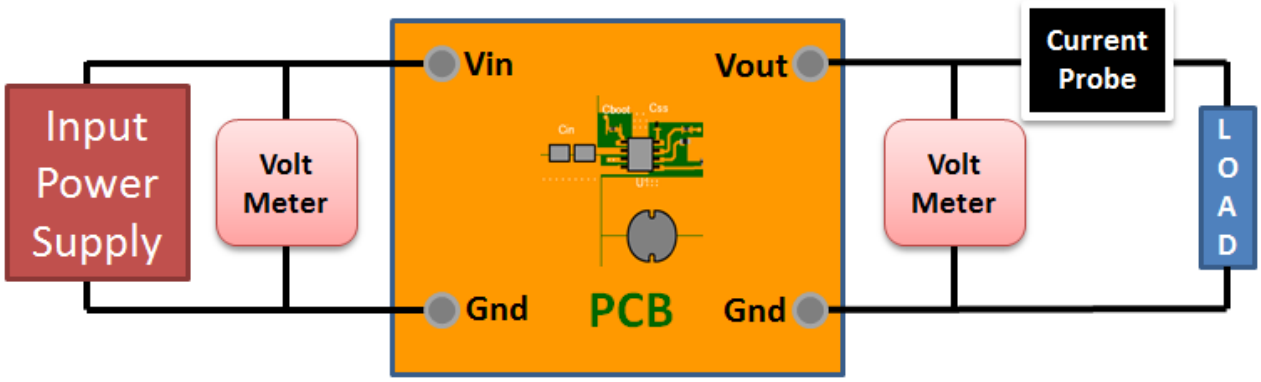
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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



Design Assistance

1. Master key : CF0BBCA199189651[v1]
2. **TPS548B22** Product Folder : http://www.ti.com/product/TPS548B22 : contains the data sheet and other resources.