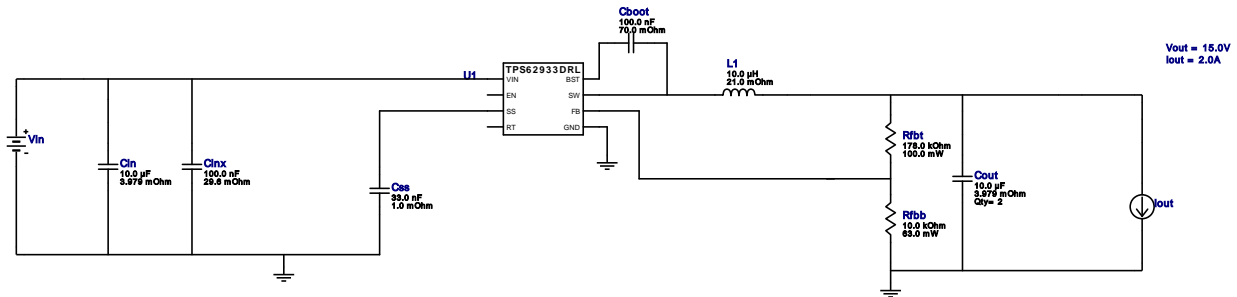


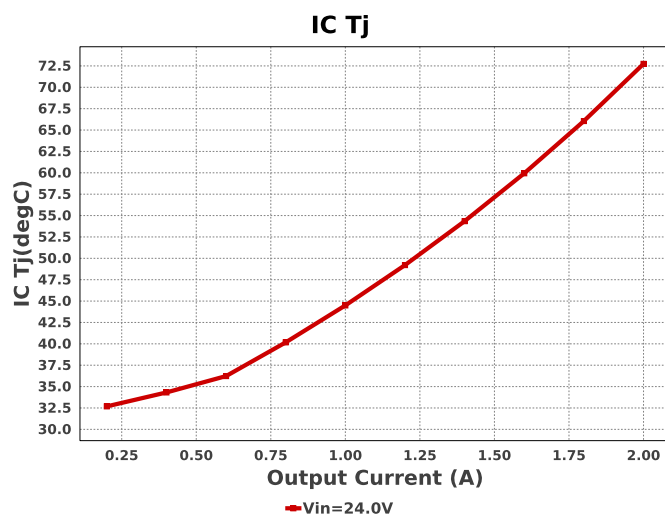
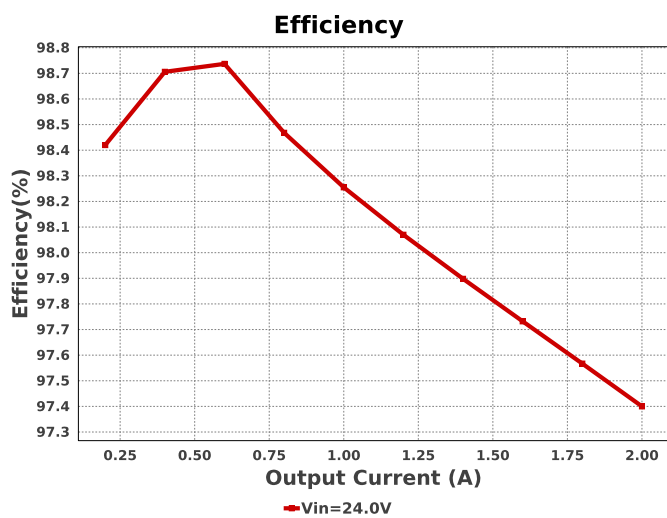
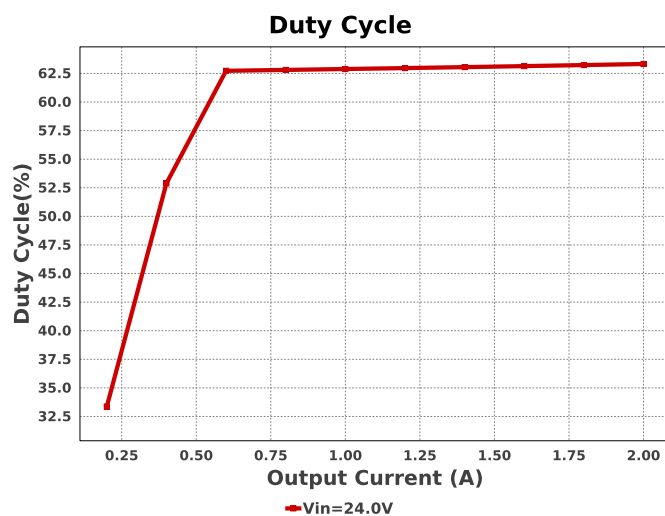
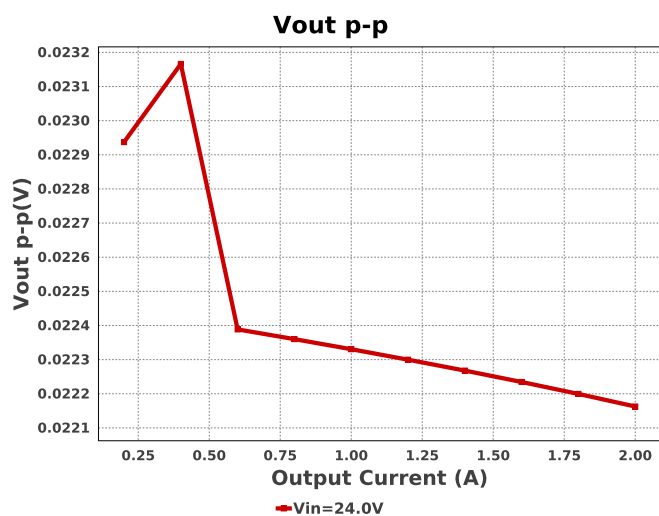
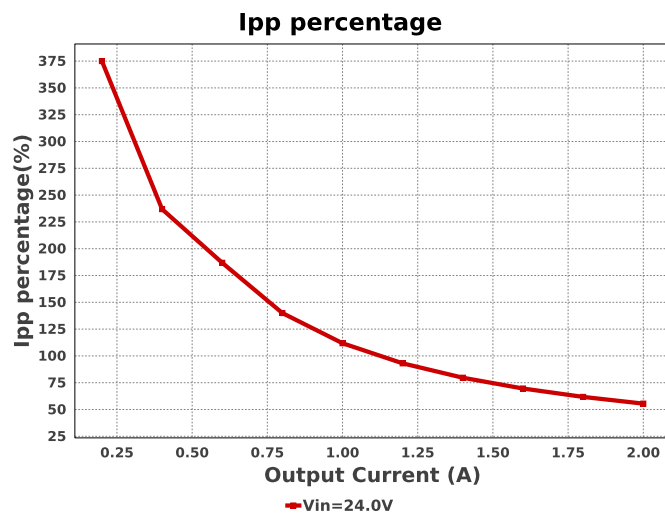
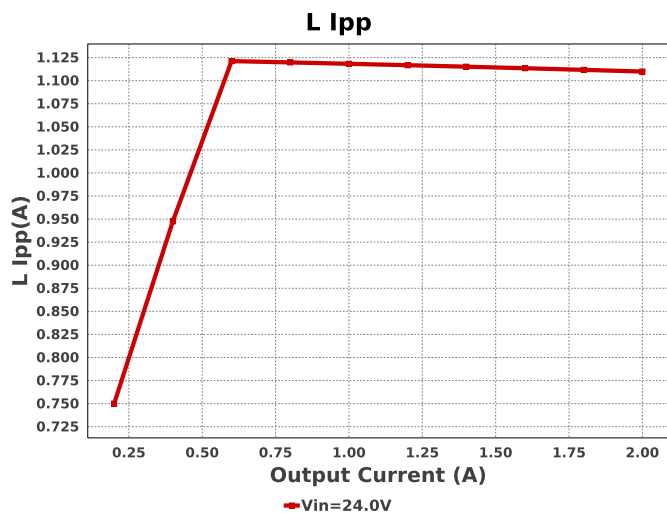
WEBENCH® Design Report

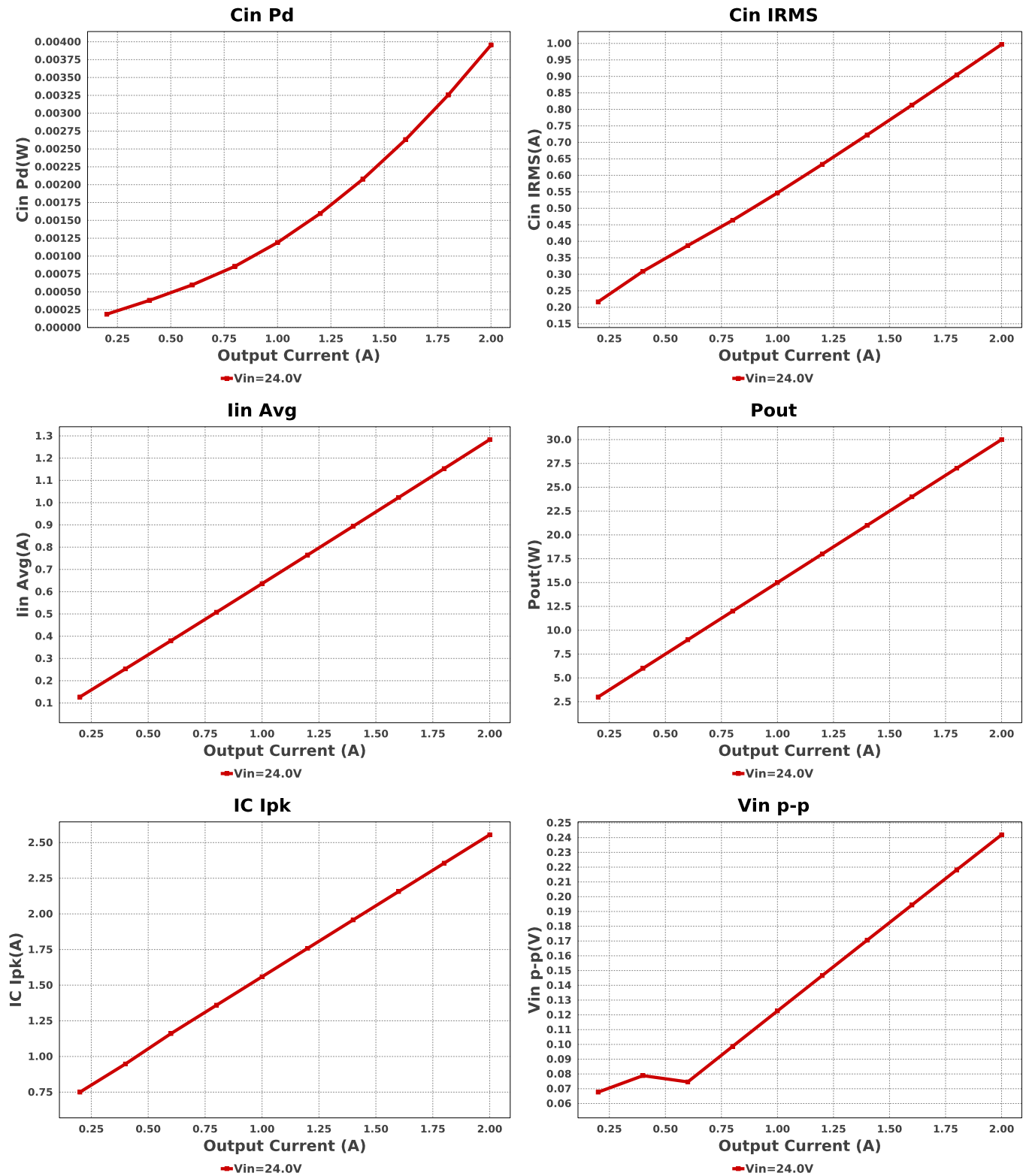
Design : 2 TPS62933DRLR
TPS62933DRLR 24V-24V to 15.00V @ 2A

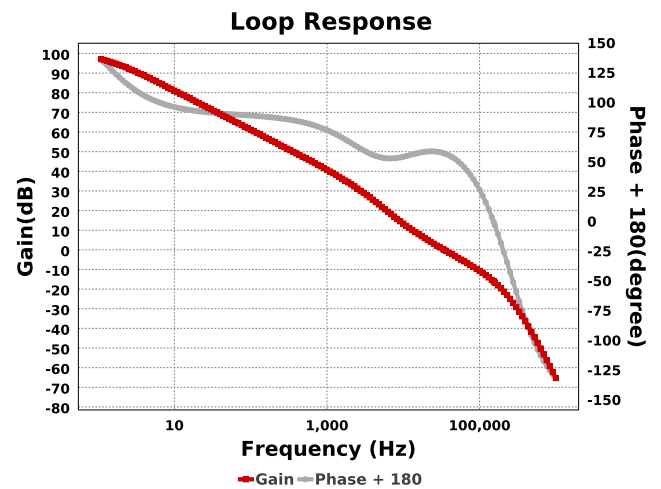
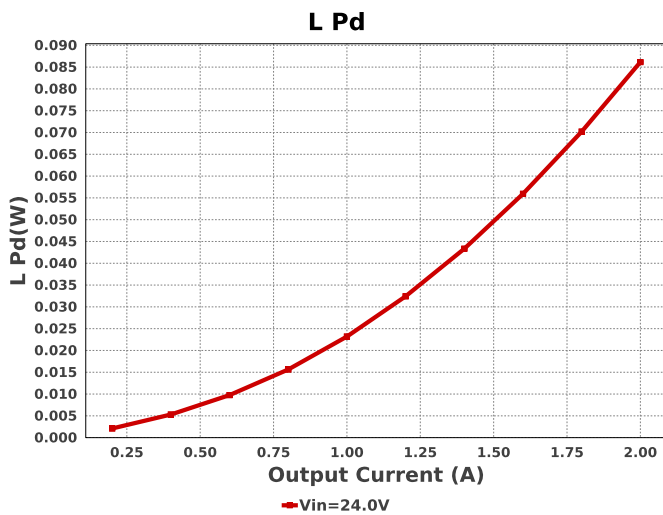
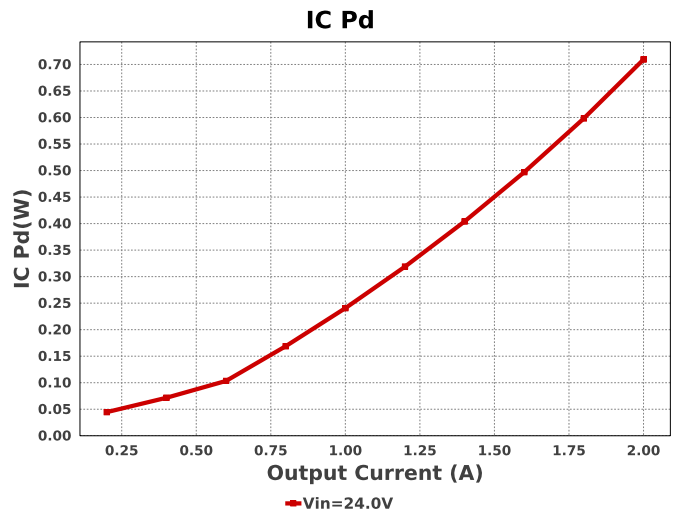
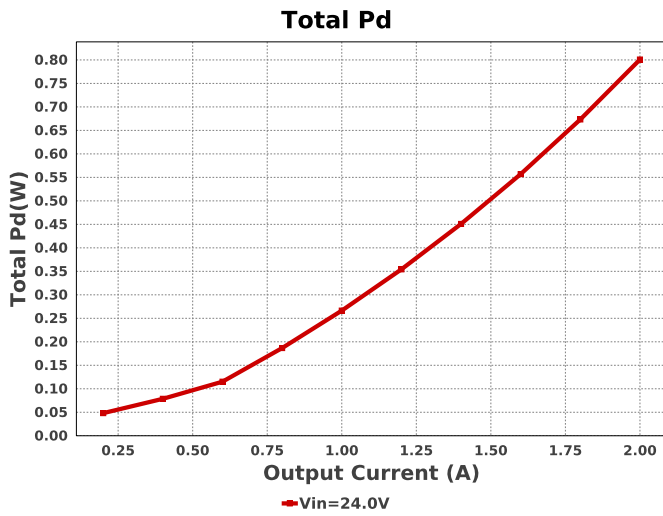
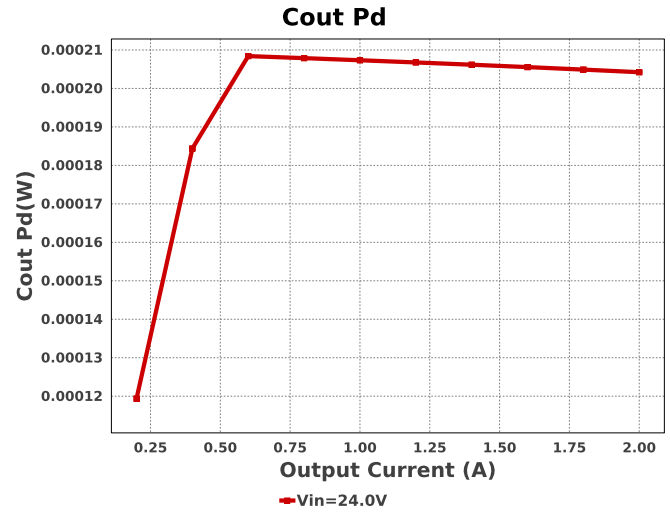
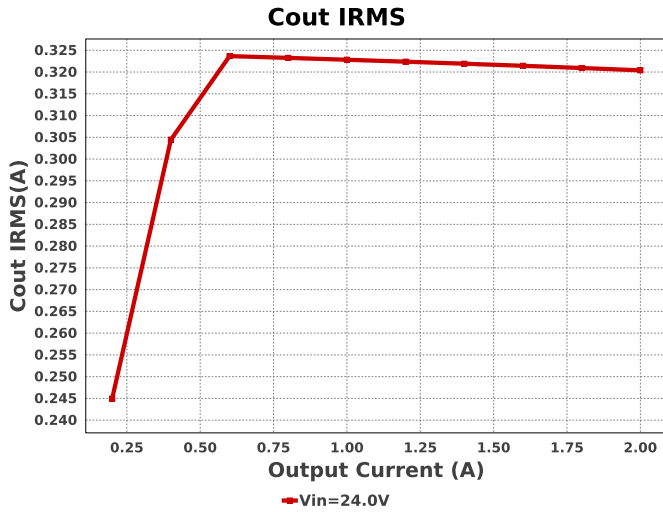


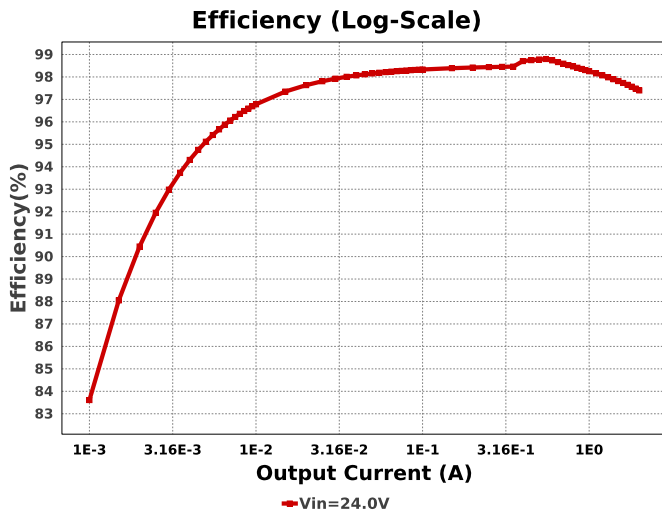
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	TDK	C0603X5R1A104K030BC Series= X5R	Cap= 100.0 nF ESR= 70.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm²
Cin	Taiyo Yuden	MSASU32MSB5106KPNA01 Series= X5R	Cap= 10.0 uF ESR= 3.979 mOhm VDC= 50.0 V IRMS= 3.4821 A	1	\$0.16	 1210 15 mm²
Cinx	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	\$0.01	 0603 5 mm²
Cout	Taiyo Yuden	MSASU32MSB5106KPNA01 Series= X5R	Cap= 10.0 uF ESR= 3.979 mOhm VDC= 50.0 V IRMS= 3.4821 A	2	\$0.16	 1210 15 mm²
Css	MuRata	GRM155R71A333KA01D Series= X7R	Cap= 33.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
L1	Bourns	SRR1208-100ML	L= 10.0 uH 21.0 mOhm	1	\$0.56	 SRR1208 216 mm²
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
Rfbs	Yageo	RC0603FR-07178KL Series= ?	Res= 178.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
U1	Texas Instruments	TPS62933DRLR	Switcher	1	\$0.44	DRL0008A-MFG 9 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	996.98 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	3.955 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	320.391 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	204.22 μ W	Capacitor	Output capacitor power dissipation
5.	IC Ipk	2.555 A	IC	Peak switch current in IC
6.	IC Pd	709.37 mW	IC	IC power dissipation
7.	IC Tj	72.739 degC	IC	IC junction temperature
8.	IC Tolerance	16.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA Effective	60.25 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	1.283 A	IC	Average input current
11.	Ipp percentage	55.493 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	1.11 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	86.156 mW	Inductor	Inductor power dissipation
14.	Cin Pd	3.955 mW	Power	Input capacitor power dissipation
15.	Cout Pd	204.22 μ W	Power	Output capacitor power dissipation
16.	IC Pd	709.37 mW	Power	IC power dissipation
17.	L Pd	86.156 mW	Power	Inductor power dissipation
18.	Total Pd	800.842 mW	Power	Total Power Dissipation
19.	BOM Count	10	System	Total Design BOM count
20.	Cross Freq	34.44 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	63.326 %	System Information	Duty cycle
22.	Efficiency	97.4 %	System Information	Steady state efficiency
23.	FootPrint	286.0 mm ²	System Information	Total Foot Print Area of BOM components
24.	Frequency	500.0 kHz	System Information	Switching frequency
25.	Gain Marg	-16.12 dB	System Information	Bode Plot Gain Margin
26.	Inductor ripple current requirement used for Inductor selection	40.0 %	System Information	Custom Inductor ripple current (% of average inductor current) requirement used for Inductor selection
27.	Iout	2.0 A	System Information	Iout operating point
28.	Iout transient step used for Cout calculations	1.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
29.	Low Freq Gain	97.078 dB	System Information	Gain at 1Hz
30.	Mode	CCM	System Information	Conduction Mode
31.	Overshoot Value	26.554 mV	System Information	Theoretical Vout Overshoot Value
32.	Phase Marg	57.511 deg	System Information	Bode Plot Phase Margin
33.	Pout	30.0 W	System Information	Total output power
34.	Total BOM	\$1.53	System Information	Total BOM Cost

#	Name	Value	Category	Description
35.	Undershoot Value	104.002 mV	System Information	Theoretical Vout Undershoot Value
36.	Vin	24.0 V	System Information	Vin operating point
37.	Vin p-p	241.937 mV	System Information	Peak-to-peak input voltage
38.	Vout	15.0 V	System Information	Operational Output Voltage
39.	Vout Actual	15.04 V	System Information	Vout Actual calculated based on selected voltage divider resistors
40.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
41.	Vout Tolerance	3.951 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
42.	Vout p-p	22.163 mV	System Information	Peak-to-peak output ripple voltage
43.	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	2.0	Maximum Output Current
VinMax	24.0	Maximum input voltage
VinMin	24.0	Minimum input voltage
Vout	15.0	Output Voltage
base_pn	TPS62933	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 C_{in} and C_{out} , 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

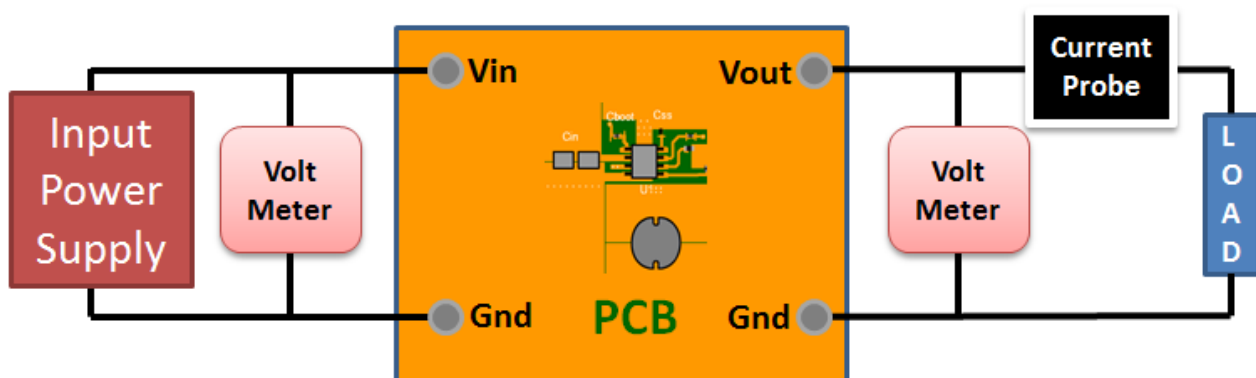
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down 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 24.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} 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 V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} 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 : D9C36EA418C0A5CE9A27A54D0E582552[v1]
2. **TPS62933** Product Folder : <http://www.ti.com/product/TPS62933> : contains the data sheet and other resources.

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