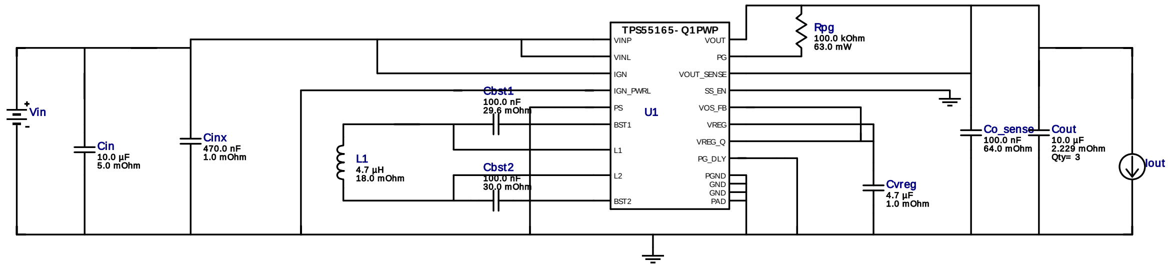
VinMin = 10.0V
VinMax = 15.0V
Vout = 12.0V
Iout = 1.0A

Device = TPS55165QPWPRQ1
Topology = Buck_Boost
Created = 2021-04-06 21:30:27.647
BOM Cost = $2.81
BOM Count = 12
Total Pd = 0.82W

WEBENCH ® Design Report

Design : 2 TPS55165QPWPRQ1
TPS55165QPWPRQ1 10V-15V to 12.00V @ 1A

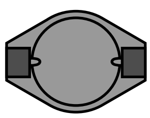


Design Alerts

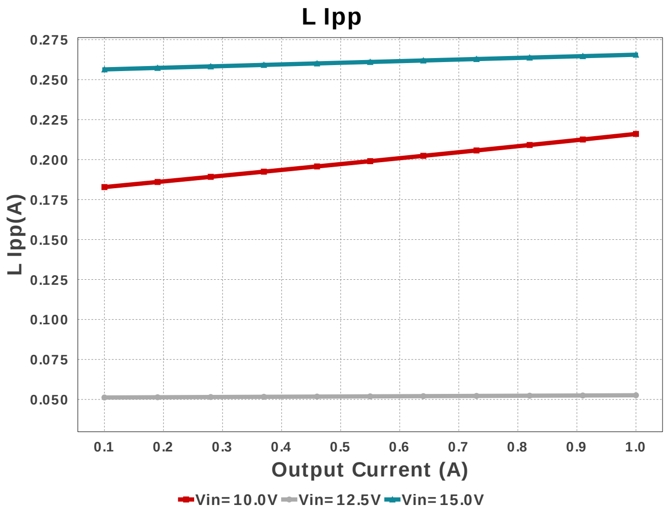
Component Selection Information

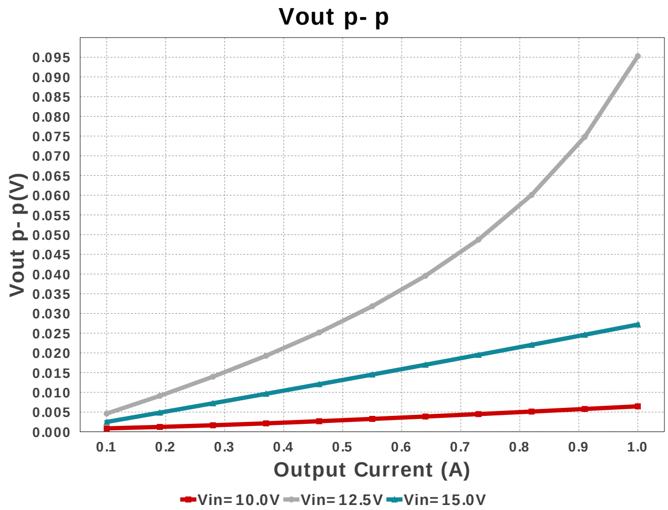
The TPS55165-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. Please note that for the device TPS55165-Q1 to start up the minimum input voltage has to be 5.3V.

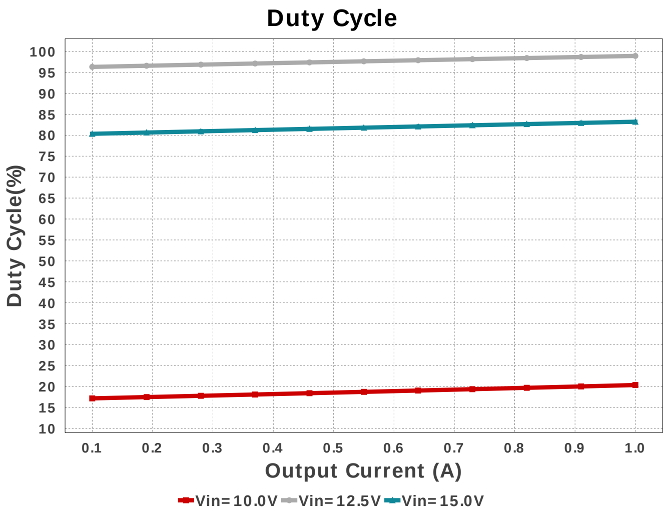
Electrical BOM

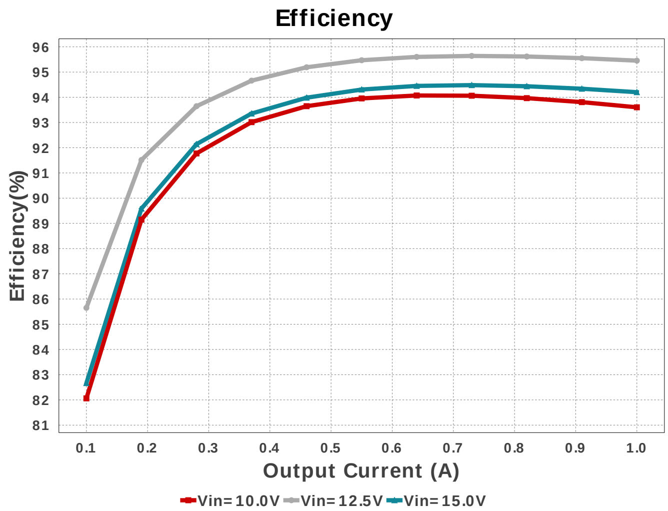
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst1	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	$0.01	0603 5 mm²
Cbst2	MuRata	GRM188R61E104KA01D Series= X5R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cin	Samsung Electro-Mechanics	CL32B106KBJNNWE Series= X7R	Cap= 10.0 uF ESR= 5.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.17	1210_270 15 mm²
Cinx	MuRata	GRM21BR71H474KA88L Series= X7R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.08	0805 7 mm²
Co_sense	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
Cout	TDK	C3216X6S1V106K160AC Series= X6S	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	3	$0.18	1206_180 11 mm²
Cvreg	Taiyo Yuden	LMK212BJ475KD-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
L1	NIC Components	NPI31W4R7MTRF	L= 4.7 µH 18.0 mOhm	1	$0.23	 IND_NPI31W 172 mm²

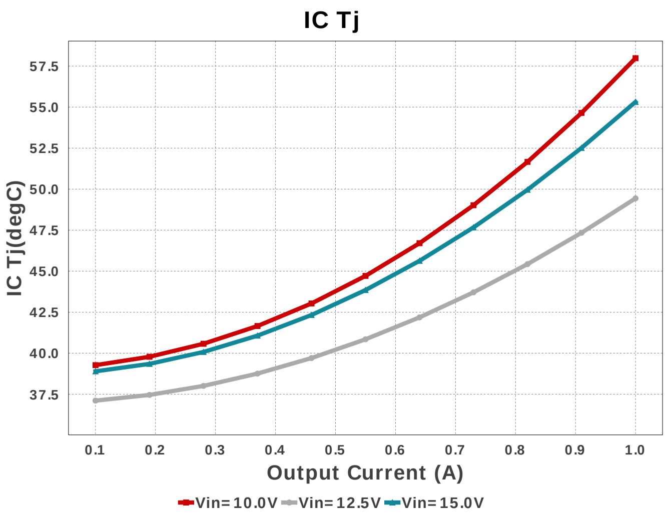
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS55165QPWPRQ1	Switcher	1	$1.72	PWP0020P_N 71 mm^2

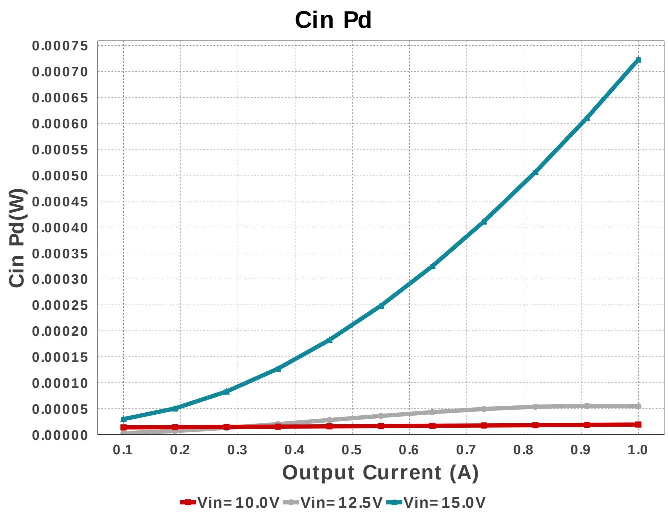


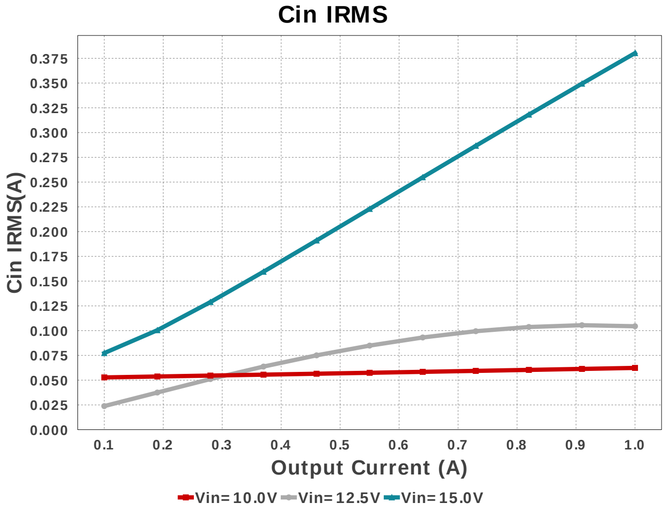


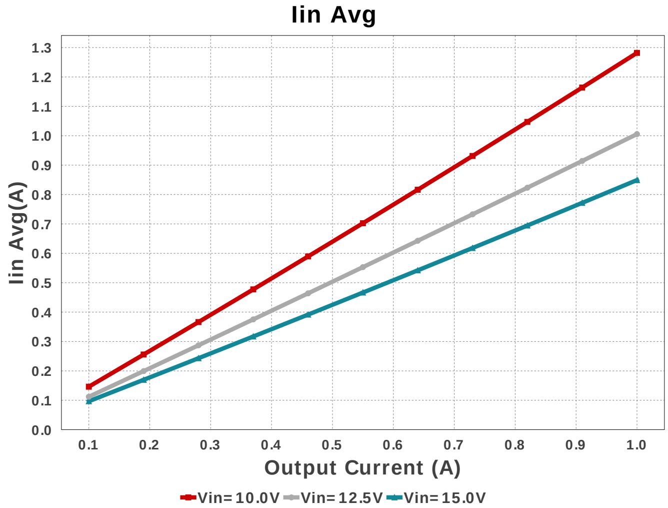


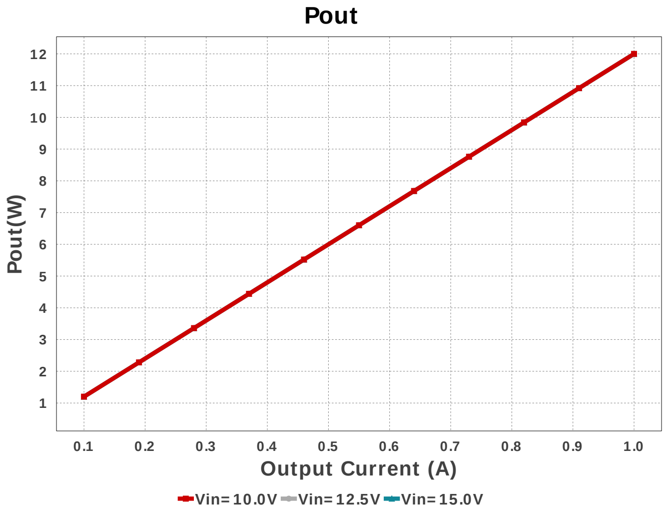


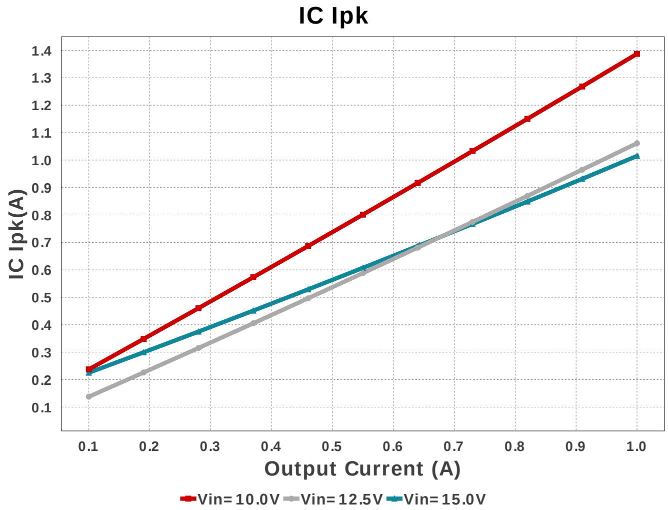


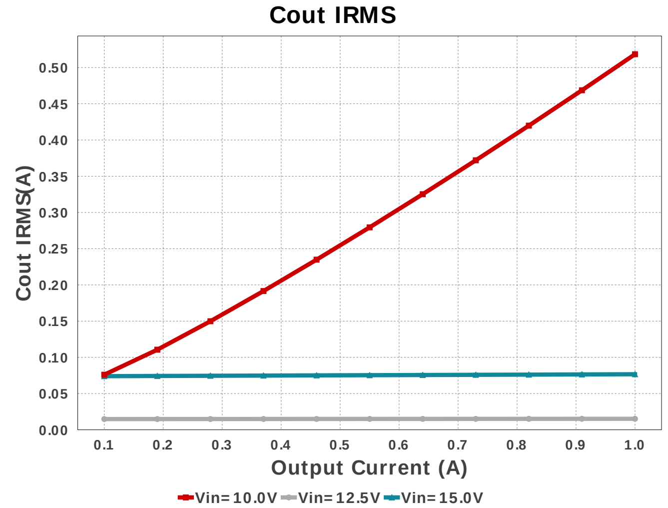


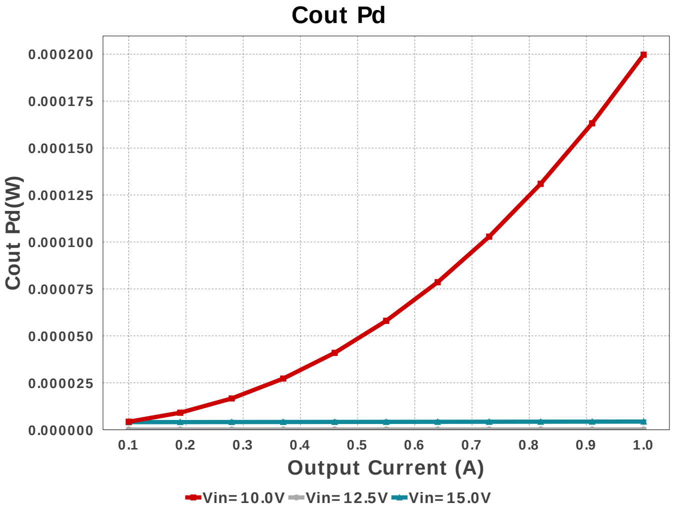

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=10.0V Vin=12.5V Vin=15.0V

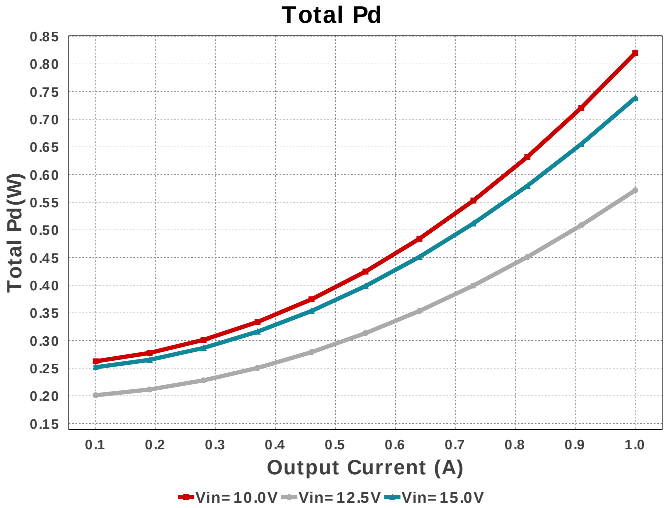

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.0V Vin=12.5V Vin=15.0V

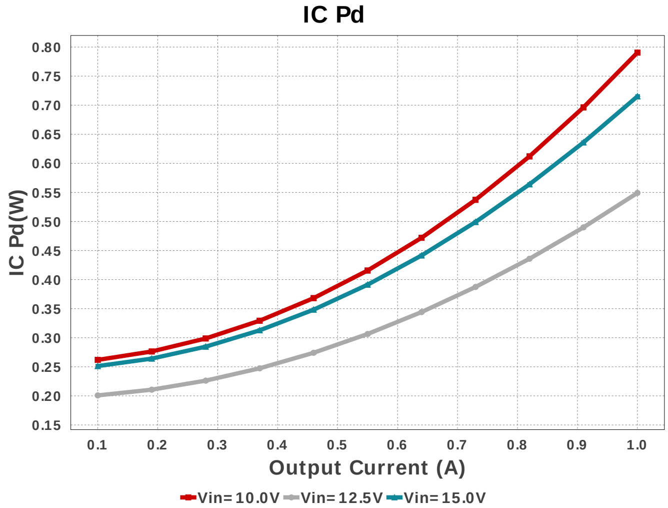

Pout
Pout(W)
Output Current (A)
Vin=10.0V Vin=12.5V Vin=15.0V

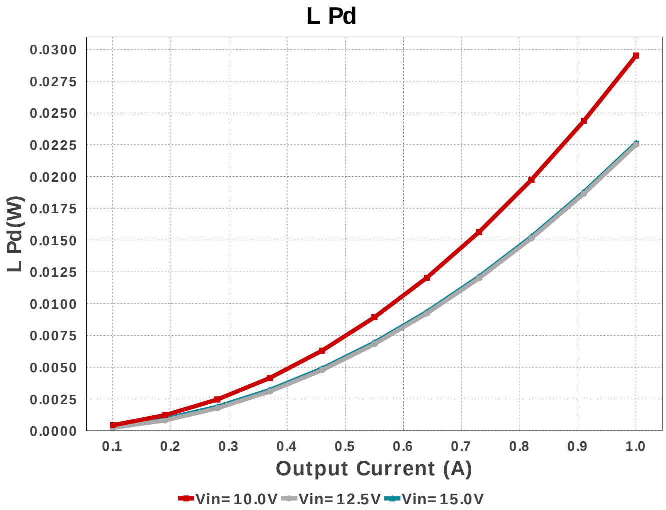

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=10.0V Vin=12.5V Vin=15.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=10.0V Vin=12.5V Vin=15.0V


Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.0V Vin=12.5V Vin=15.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	62.366 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	19.448 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	518.432 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	199.7 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	1.387 A	IC	Peak switch current in IC
6.	IC Pd	790.44 mW	IC	IC power dissipation
7.	IC Tj	57.981 degC	IC	IC junction temperature
8.	ICThetaJA	35.4 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	1.282 A	IC	Average input current
10.	L Ipp	216.044 mA	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	29.511 mW	Inductor	Inductor power dissipation
12.	Cin Pd	19.448 µW	Power	Input capacitor power dissipation
13.	Cout Pd	199.7 µW	Power	Output capacitor power dissipation
14.	IC Pd	790.44 mW	Power	IC power dissipation
15.	L Pd	29.511 mW	Power	Inductor power dissipation
16.	Total Pd	820.095 mW	Power	Total Power Dissipation
17.	BOM Count	12	System Information	Total Design BOM count
18.	Duty Cycle	20.374 %	System Information	Duty cycle
19.	Efficiency	93.603 %	System Information	Steady state efficiency
20.	FootPrint	324.0 mm^2	System Information	Total Foot Print Area of BOM components
21.	Frequency	2.0 MHz	System Information	Switching frequency
22.	Iout	1.0 A	System Information	Iout operating point
23.	Mode	BOOST PWM CCM	System Information	PWM/PFM Mode
24.	Pout	12.0 W	System Information	Total output power

#	Name	Value	Category	Description
25.	Total BOM	$2.808	System Information	Total BOM Cost
26.	Vin	10.0 V	System Information	Vin operating point
27.	Vout p-p	6.453 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	15.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS55165-Q1	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

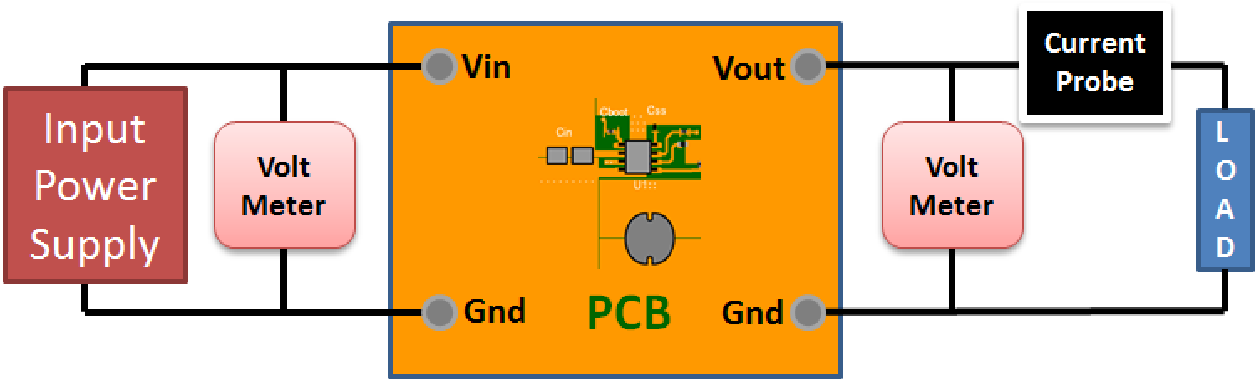
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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

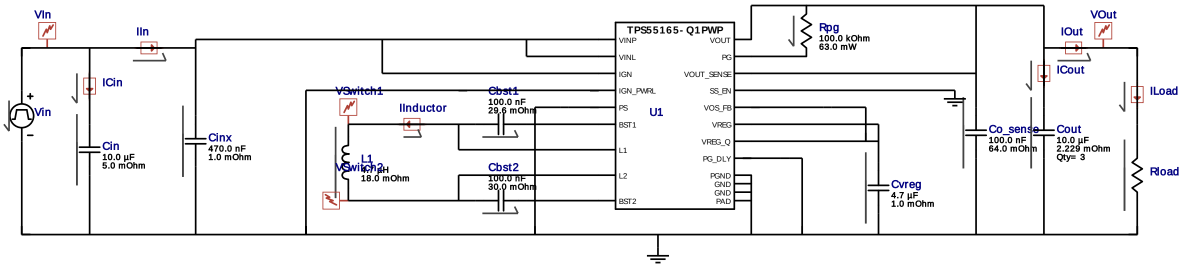


WEBENCH® Electrical Simulation Report

Design Id = 2

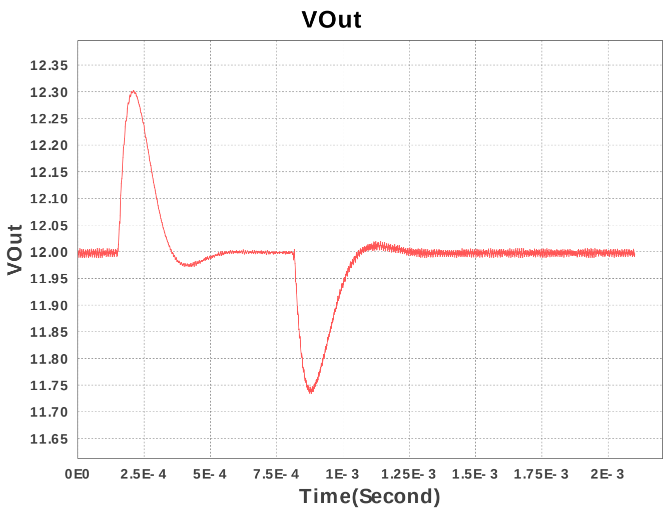
sim_id = 2

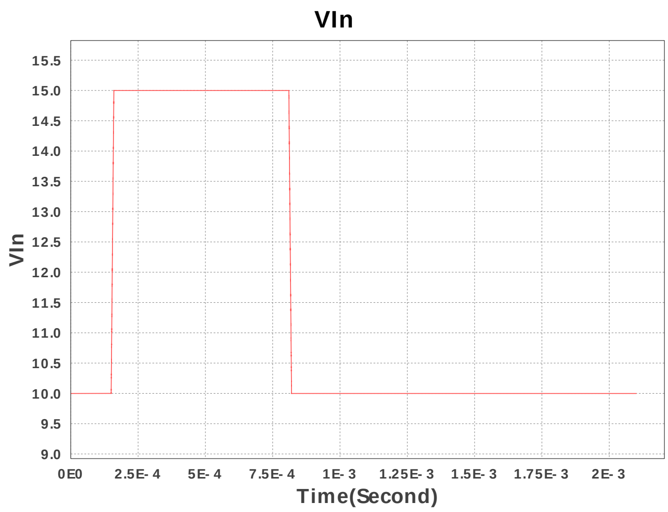
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	12.0 V
2.	L1	IC	Initial Current	1.0 A
3.	Rload	R	Load Resistance	12.0 Ohm





Design Assistance

1. The TPS55165-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

2. Master key : FC210538D0FA6E28[v1]

3. **TPS55165-Q1** Product Folder : http://www.ti.com/product/TPS55165%2DQ1 : contains the data sheet and other resources.

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