TEXAS INSTRUMENTS

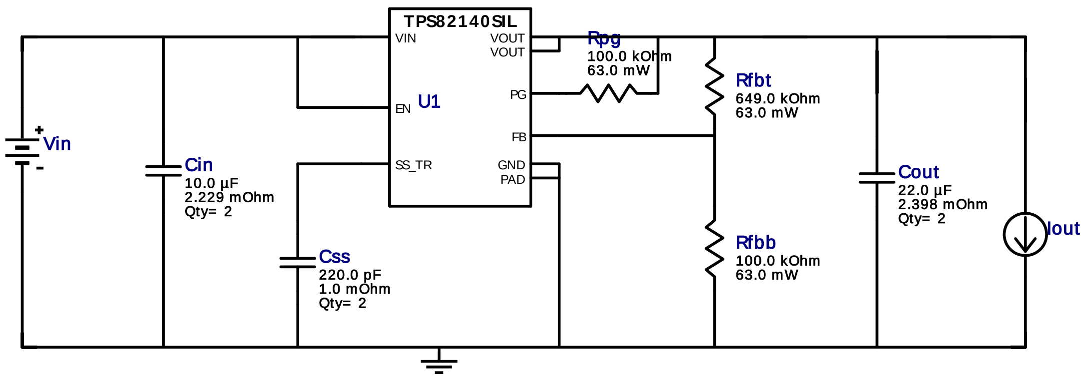
WEBENCH® Design Report

VinMin = 9.0V
VinMax = 15.0V
Vout = 6.0V
Iout = 1.0A

Device = TPS82140SILR
Topology = Buck
Created = 2019-07-24 20:47:48.185
BOM Cost = $2.46
BOM Count = 10
Total Pd = 0.65W

Design : 5 TPS82140SILR
TPS82140SILR 9V-15V to 6.00V @ 1A

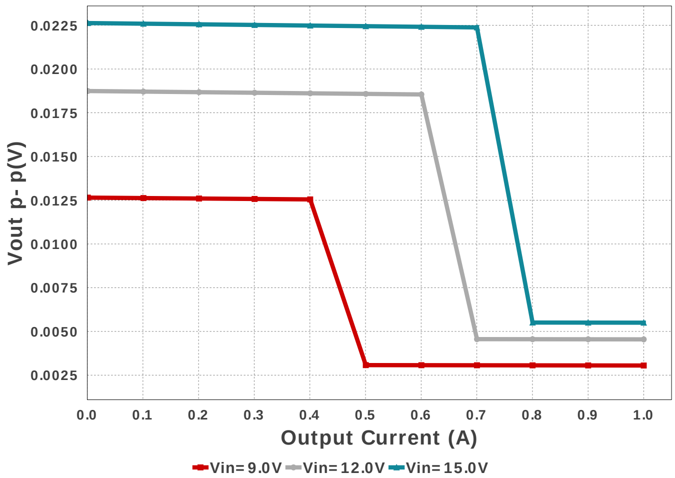
Vout = 6.0V
Iout = 1.0A



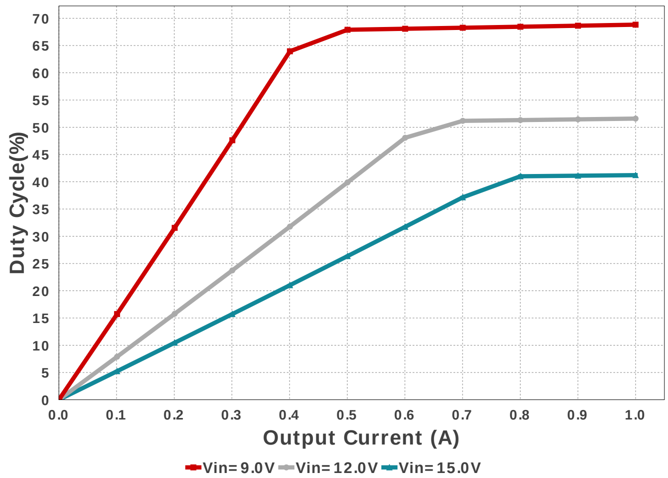
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	TDK	C3216X7R1V106K160AC Series= X7R	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	2	$0.21	1206_180 11 mm²
Cout	TDK	C3216X7S1A226M160AC Series= X7S	Cap= 22.0 uF ESR= 2.398 mOhm VDC= 10.0 V IRMS= 4.6851 A	2	$0.27	1206_180 11 mm²
Css	MuRata	GRM155R71H221KA01D Series= X7R	Cap= 220.0 pF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	2	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW0402649KFKED Series= CRCW..e3	Res= 649.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS82140SILR	Switcher	1	$1.45	SIL0008D_SMD 15 mm²

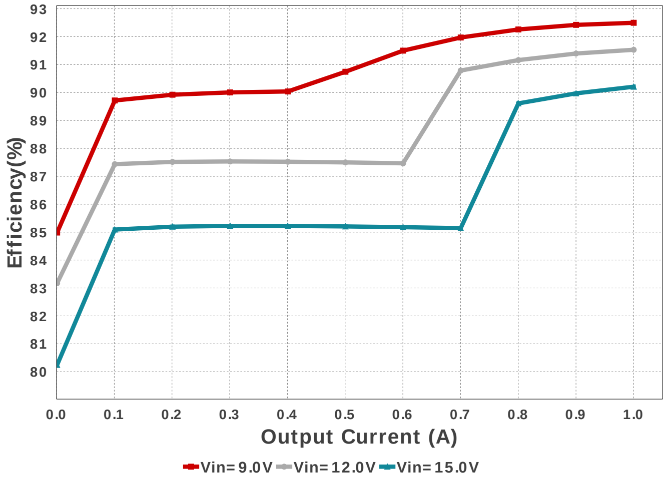
Vout p- p



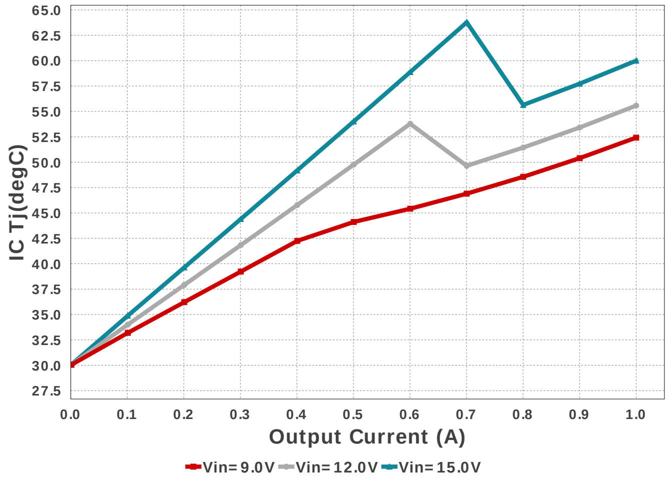
Duty Cycle



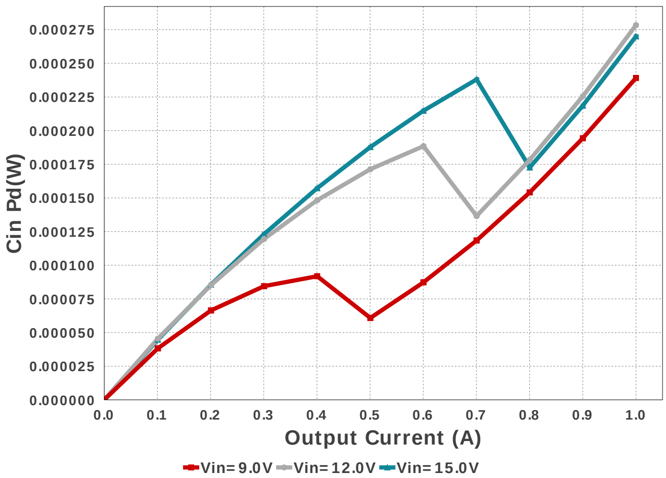
Efficiency



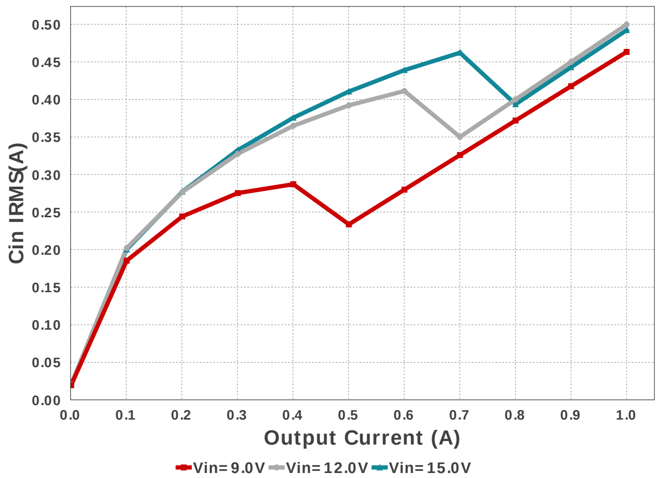
IC Tj

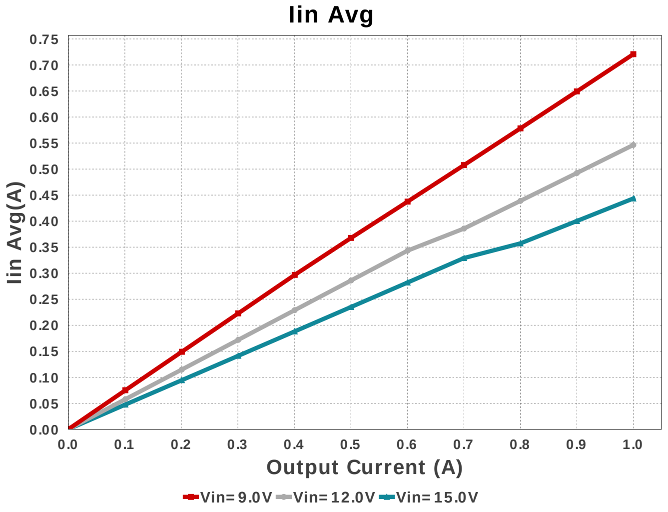


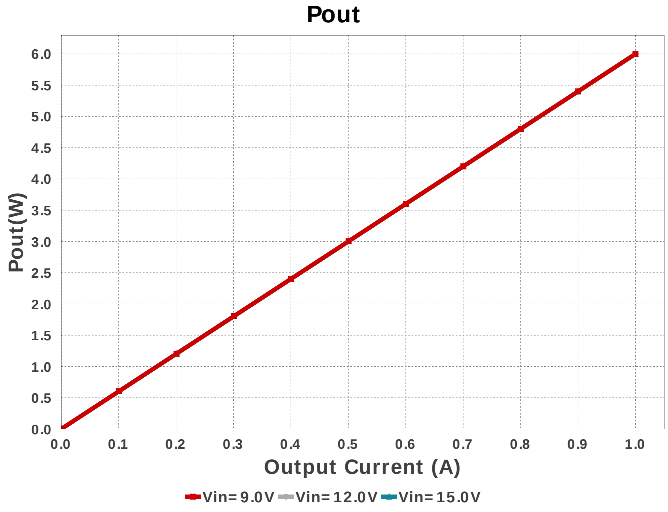
Cin Pd

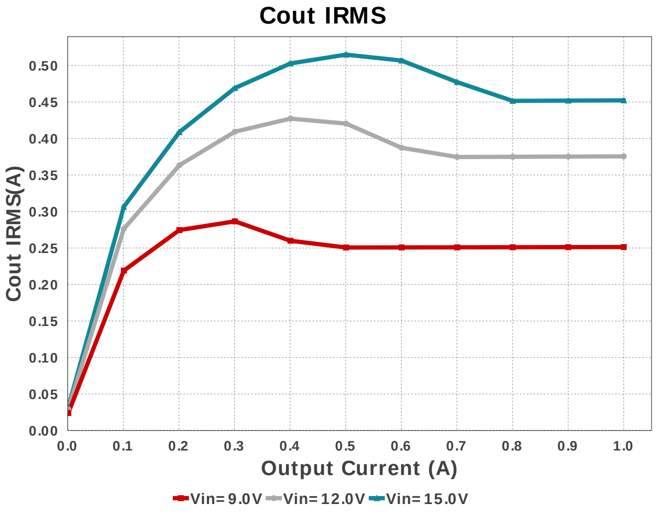


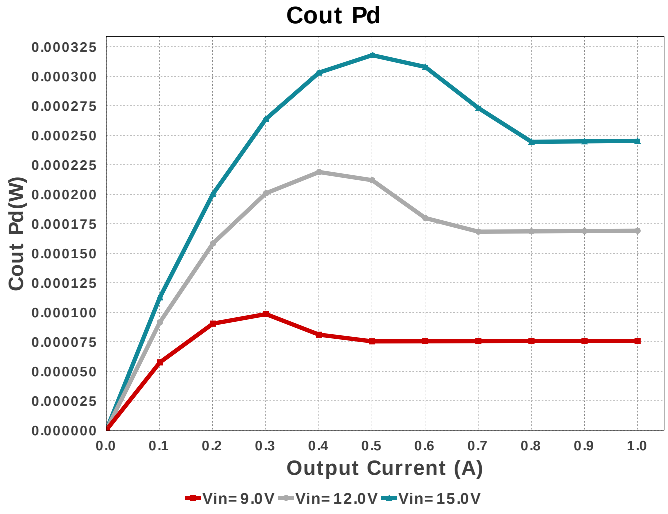
Cin IRMS

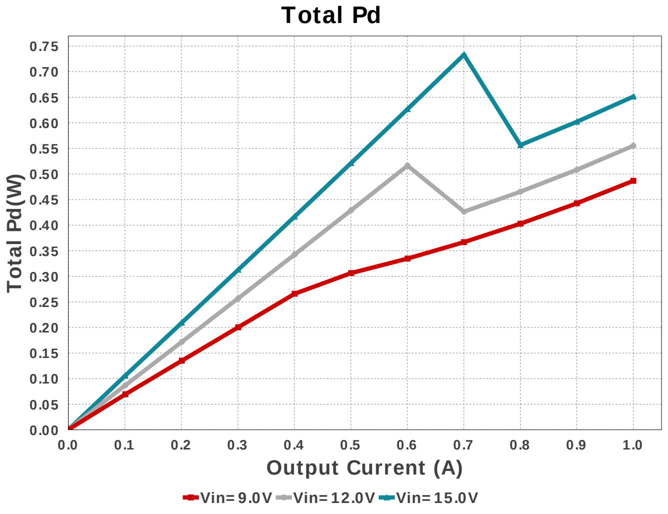


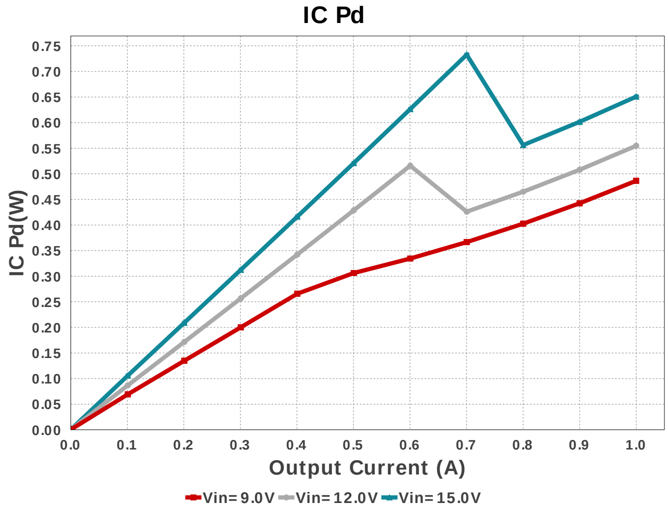

Iin Avg
Iin Avg(A)
Output Current (A)
Vin= 9.0V
Vin= 12.0V
Vin= 15.0V

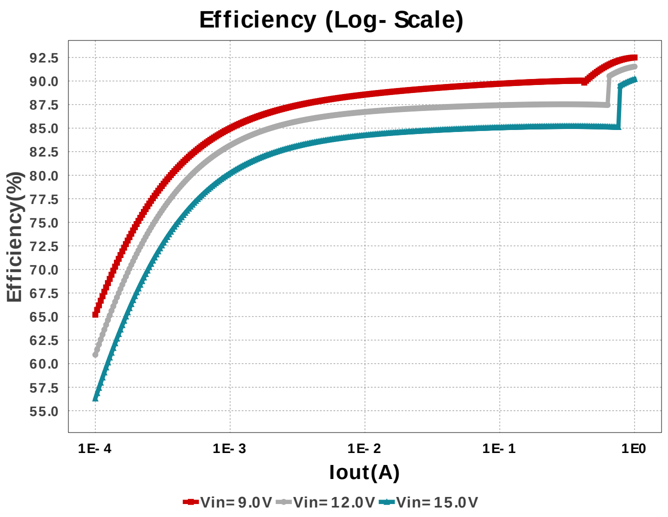

Pout
Pout(W)
Output Current (A)
Vin= 9.0V
Vin= 12.0V
Vin= 15.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin= 9.0V
Vin= 12.0V
Vin= 15.0V


Cout Pd
Cout Pd(W)
Output Current (A)
Vin= 9.0V
Vin= 12.0V
Vin= 15.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin= 9.0V
Vin= 12.0V
Vin= 15.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin= 9.0V
Vin= 12.0V
Vin= 15.0V



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	10		Total Design BOM count
2.	Total BOM	$2.46		Total BOM Cost
3.	Cin IRMS	492.226 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	270.03 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	452.283 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	245.27 µW	Capacitor	Output capacitor power dissipation
7.	IC Pd	650.76 mW	IC	IC power dissipation
8.	IC Tj	60.0 degC	IC	IC junction temperature
9.	ICThetaJA Effective	46.1 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	443.42 mA	IC	Average input current
11.	Cin Pd	270.03 µW	Power	Input capacitor power dissipation
12.	Cout Pd	245.27 µW	Power	Output capacitor power dissipation
13.	IC Pd	650.76 mW	Power	IC power dissipation
14.	Total Pd	651.295 mW	Power	Total Power Dissipation
15.	Duty Cycle	41.217 %	System Information	Duty cycle
16.	Efficiency	90.208 %	System Information	Steady state efficiency
17.	FootPrint	74.0 mm^2	System Information	Total Foot Print Area of BOM components
18.	Frequency	2.152 MHz	System Information	Switching frequency
19.	Iout	1.0 A	System Information	Iout operating point
20.	Mode	CCM	System Information	Conduction Mode
21.	Pout	6.0 W	System Information	Total output power
22.	Vin	15.0 V	System Information	Vin operating point
23.	Vout	6.0 V	System Information	Operational Output Voltage
24.	Vout Actual	5.992 V	System Information	Vout Actual calculated based on selected voltage divider resistors
25.	Vout Tolerance	3.658 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
26.	Vout p-p	5.5 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	9.0	Minimum input voltage
Vout	6.0	Output Voltage
base_pn	TPS82140	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

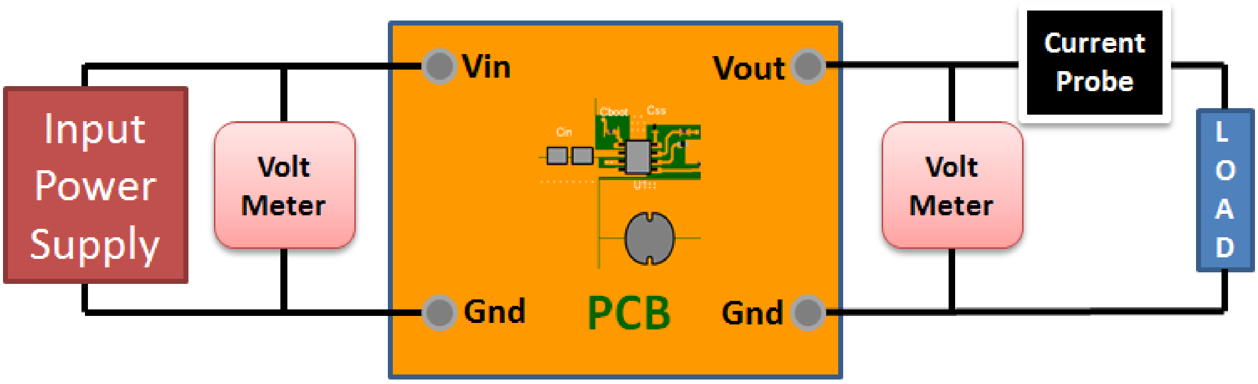
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 9.0V 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.

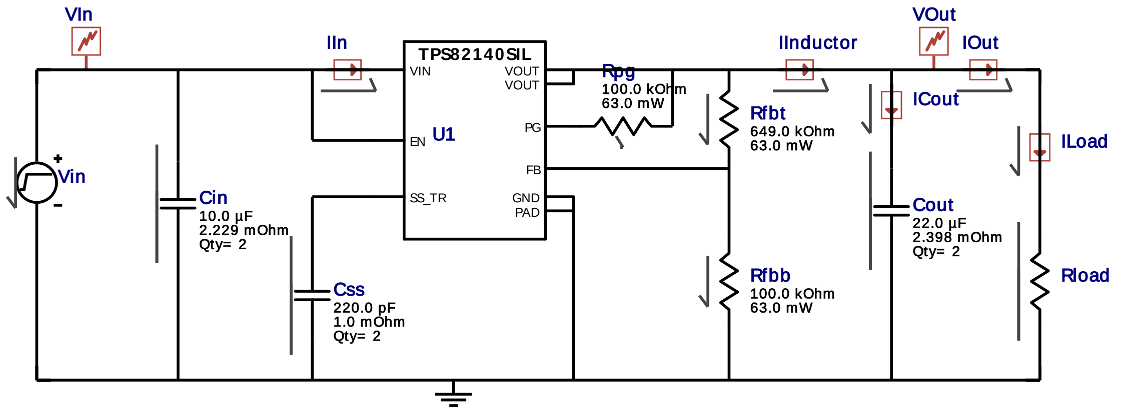


WEBENCH® Electrical Simulation Report

Design Id = 5

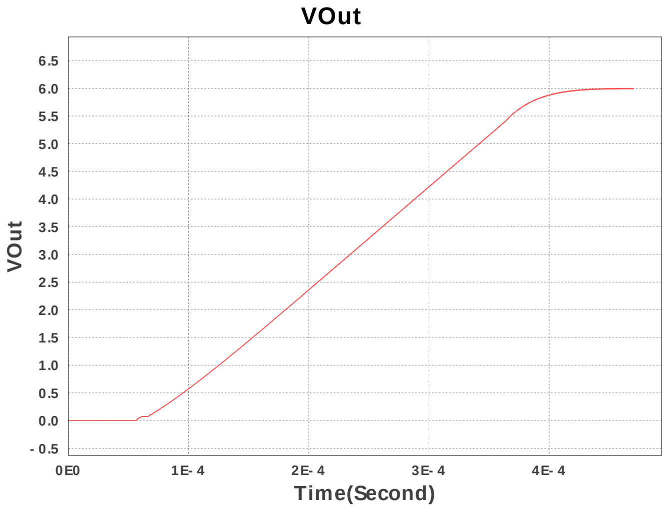
sim_id = 1

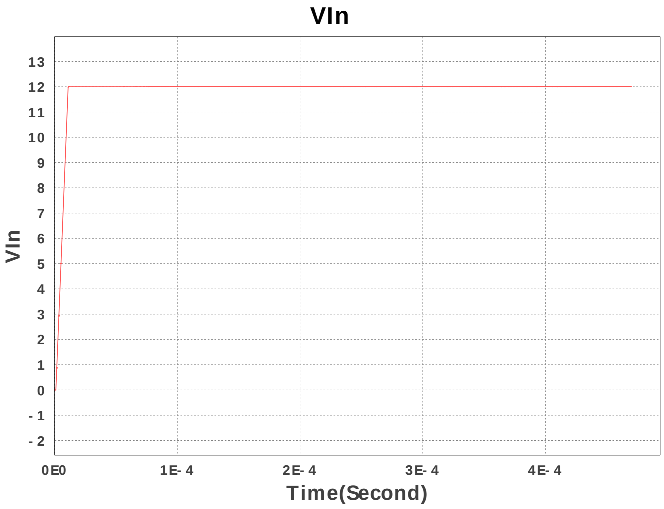
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	11.55 ohm

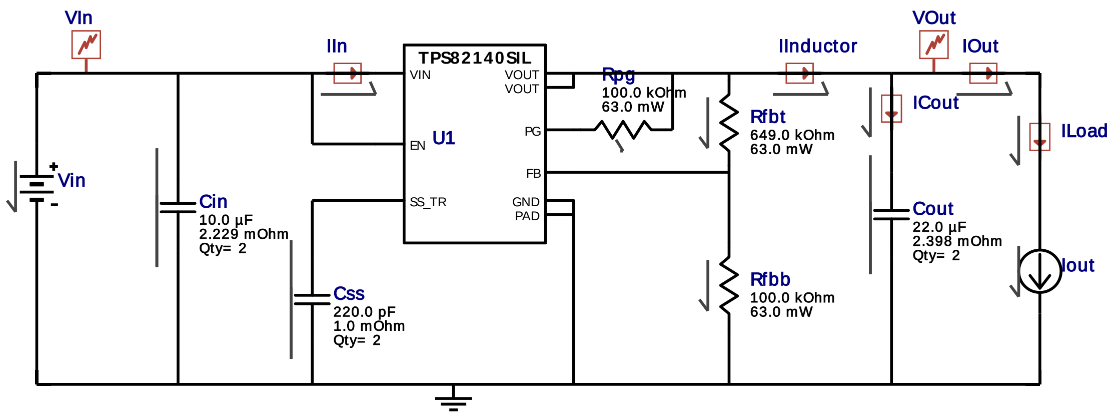




Design Id = 5

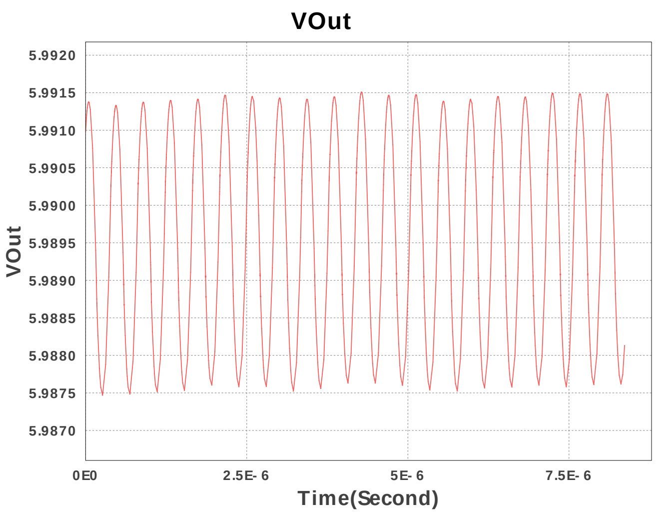
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

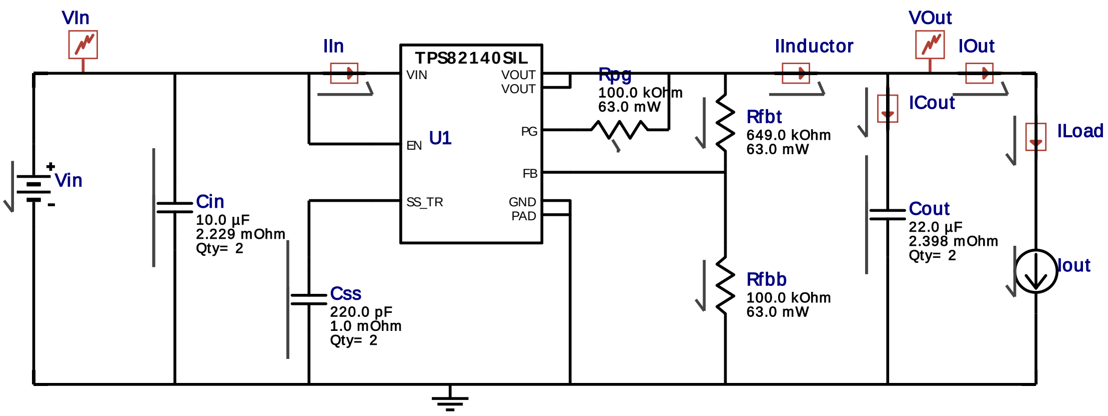
#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	6.0
2.	Iout	I	Load Current	1.0 A



Design Id = 5

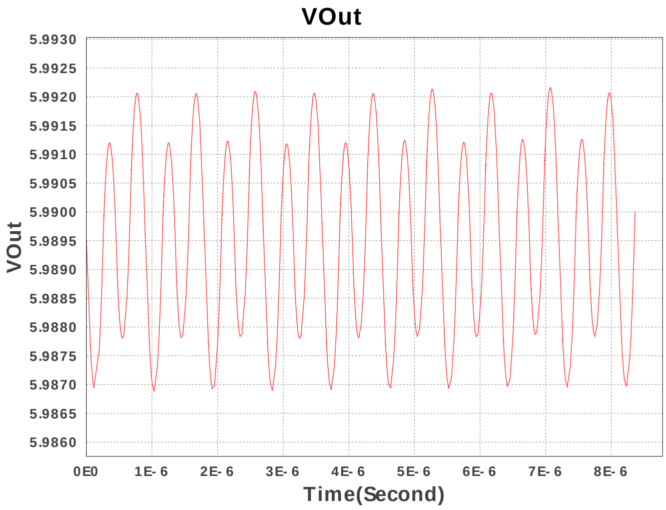
sim_id = 3

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	6.0
2.	Iout	I	Load Current	0.541 A



Design Assistance

1. Feature Highlights: DCS-Control(TM) Architecture with up to 3A output current, Power module with integrated inductor, 3V to 17V Input Voltage Range, Adjustable output voltage from 0.9V to 5V, Optional softstart capacitor for slow startup, Power Save Mode for light load efficiency, 100% duty cycle for lowest dropout, PG=Low when device is in shutdown through EN or Thermal Shutdown

2. Master key : 84F8F281898B6F10[v1]

3. **TPS82140** Product Folder : http://www.ti.com/product/TPS82140 : contains the data sheet and other resources.