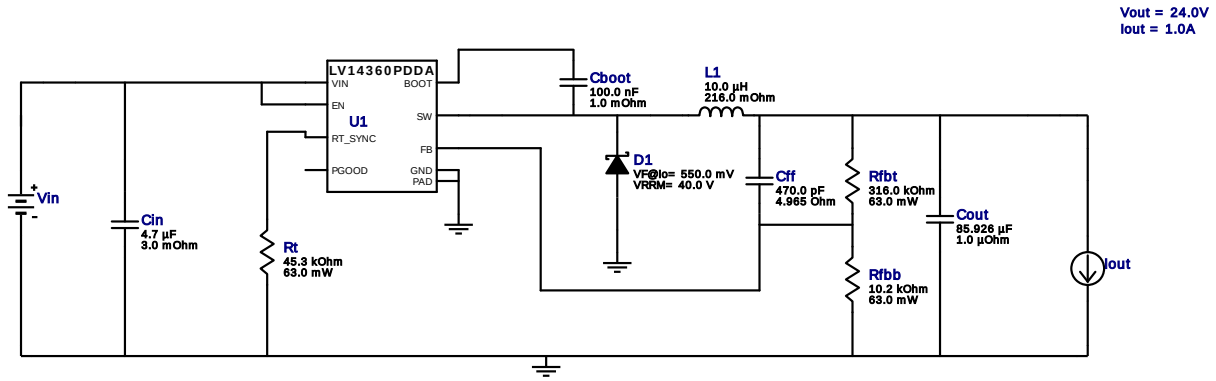
WEBENCH® Design Report

VinMin = 25.0V
VinMax = 27.0V
Vout = 24.0V
Iout = 1.0A

Device = LV14360PDDAR
Topology = Buck
Created = 2024-07-08 21:02:18.476
BOM Cost = NA
BOM Count = 10
Total Pd = 0.85W

Design : 37 LV14360PDDAR
LV14360PDDAR 25V-27V to 23.99V @ 1A



Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cff	TDK	CGA2B2X7R1H471K050BA Series= X7R	Cap= 470.0 pF ESR= 4.9649 Ohm VDC= 50.0 V IRMS= 228.41 mA	1	$0.01	0402 3 mm²
Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.10	1206 11 mm²
Cout	CUSTOM	CUSTOM Series= ?	Cap= 85.926 uF ESR= 1.0 uOhm VDC= 34.2857 V IRMS= 156.49 mA	1	NA	CUSTOM 0 mm²
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.03	SOD-123F 12 mm²
L1	Wurth Elektronik	74405042100	L= 10.0 µH 216.0 mOhm	1	$0.42	WE-LQSH_4020 24 mm²
Rfbb	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW0402316KFKED Series= CRCW..e3	Res= 316.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rt	Vishay-Dale	CRCW040245K3FKED Series= CRCW..e3	Res= 45.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LV14360PDDAR	Switcher	1	$1.10	DDA0008E_N 55 mm²

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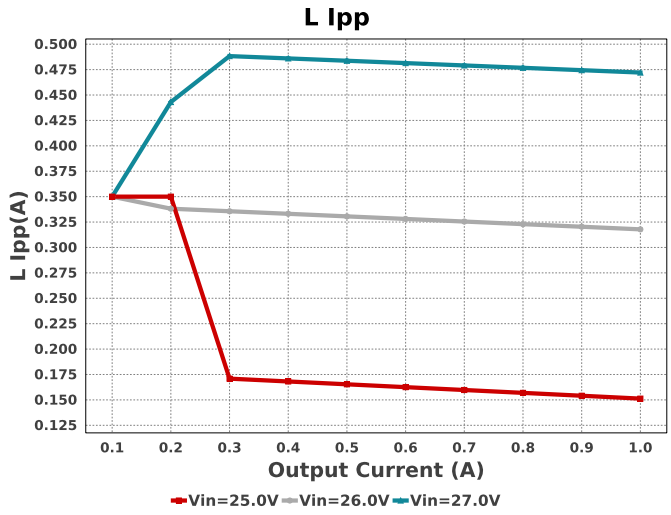

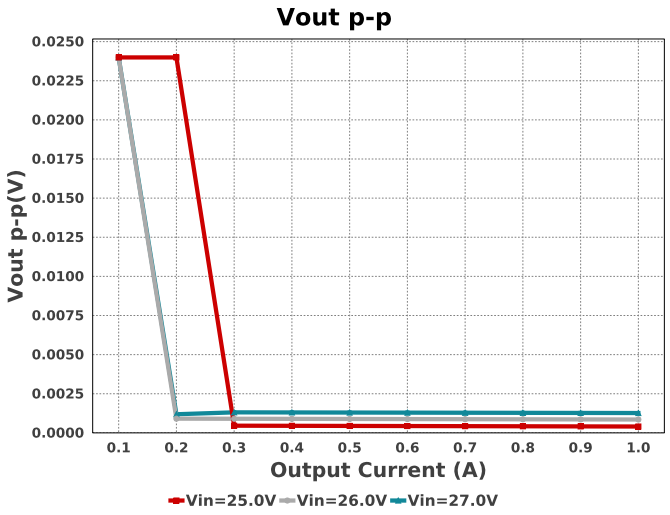

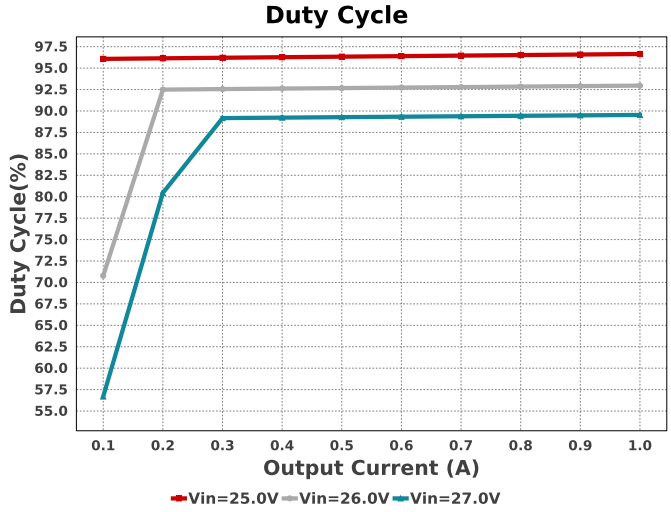

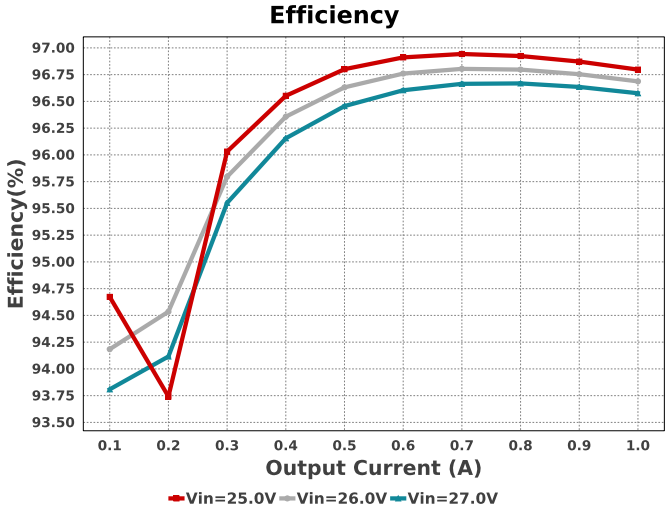

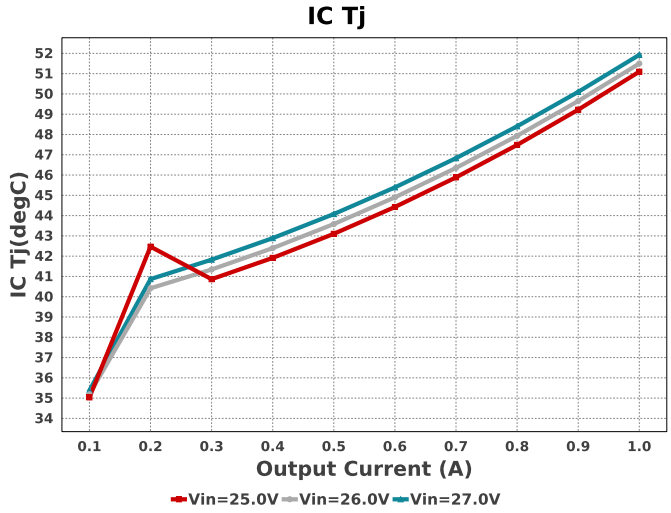

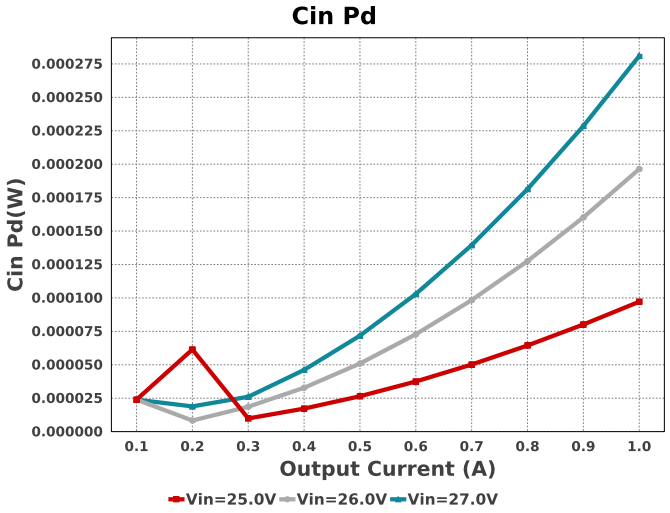

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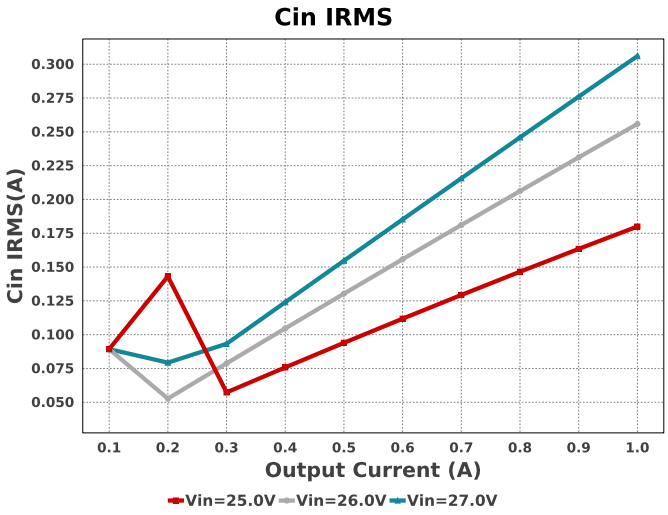

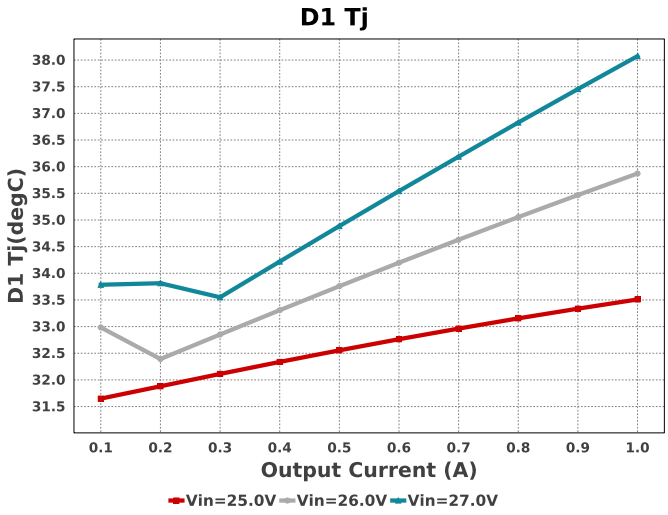

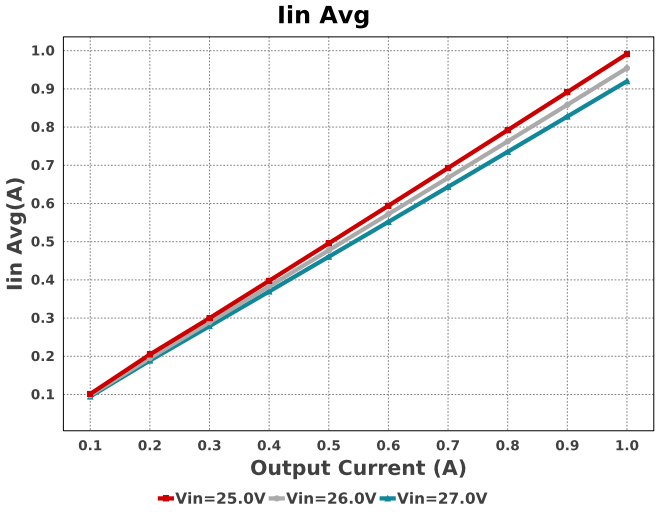

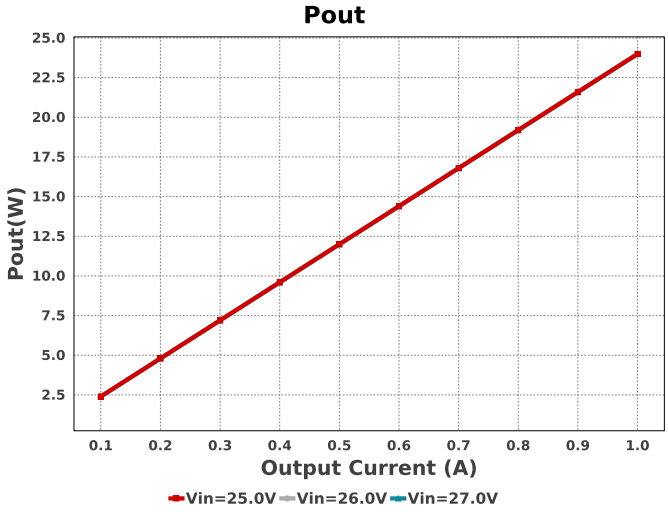

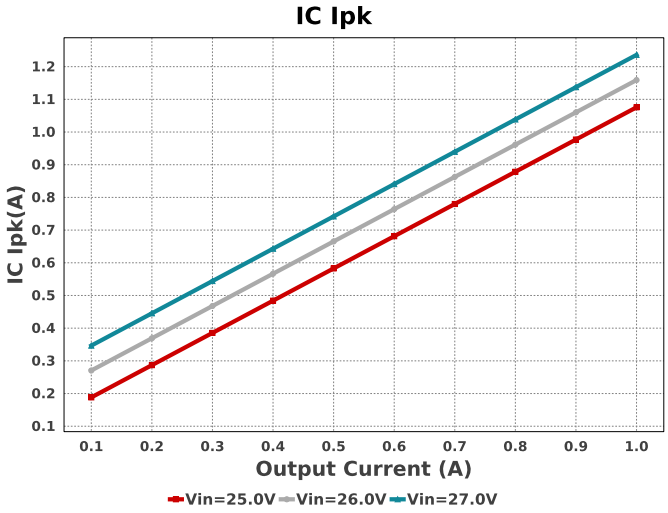

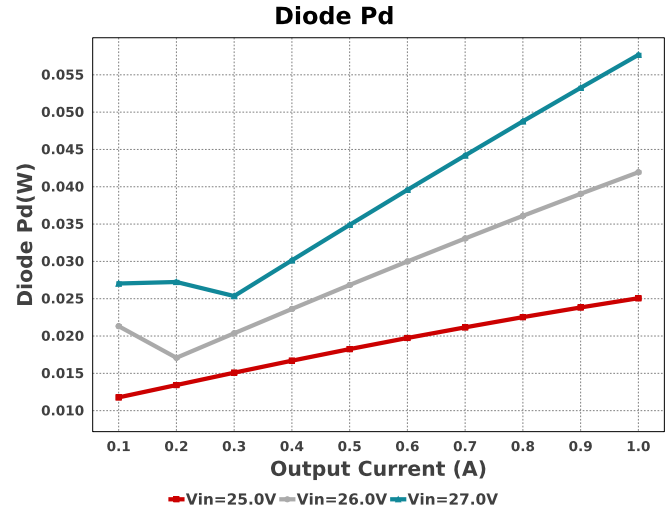

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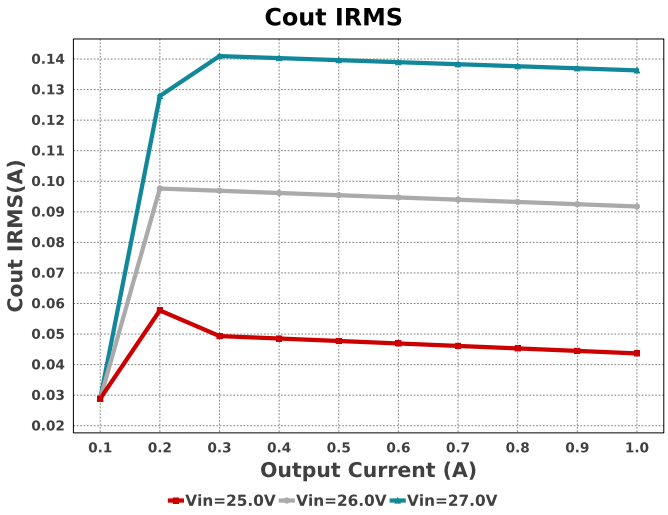

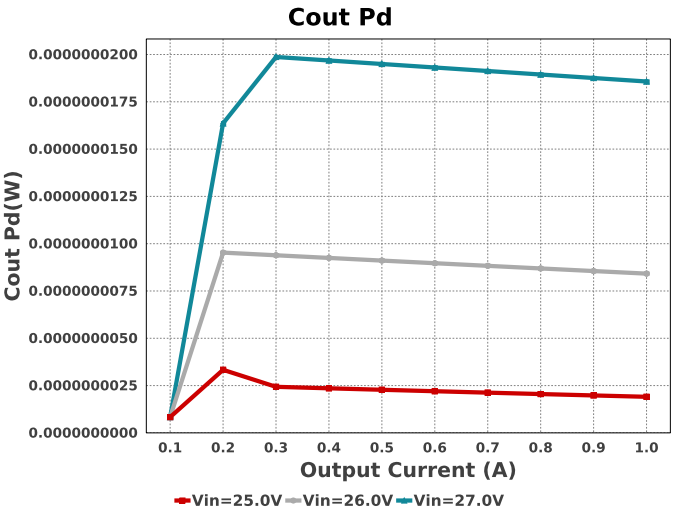

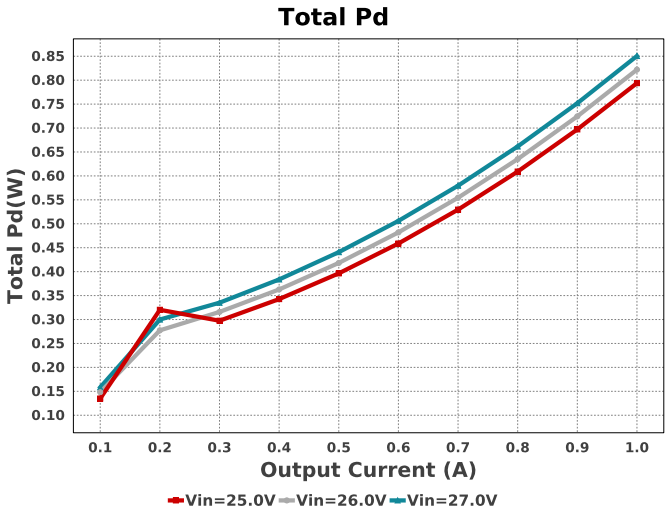

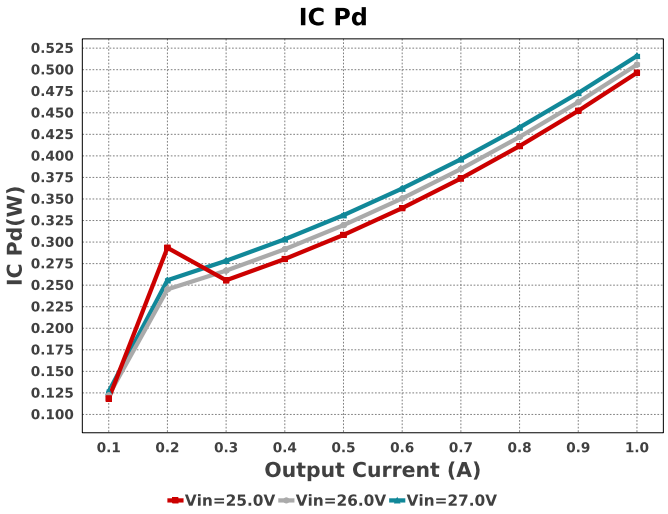

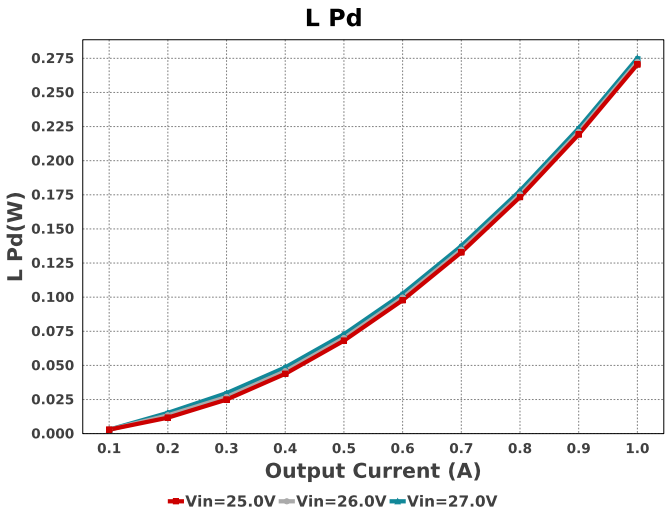

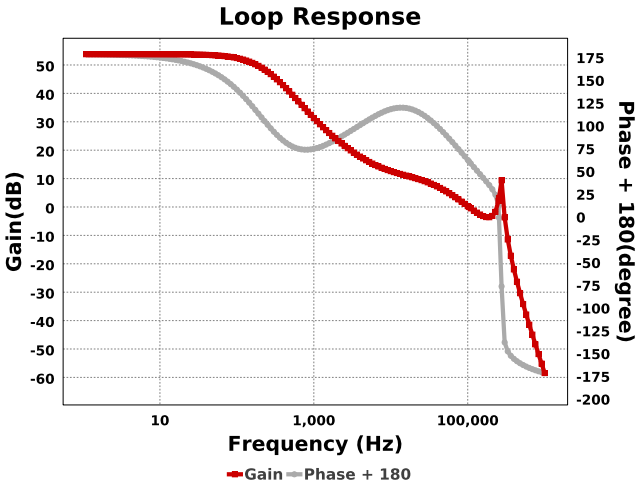

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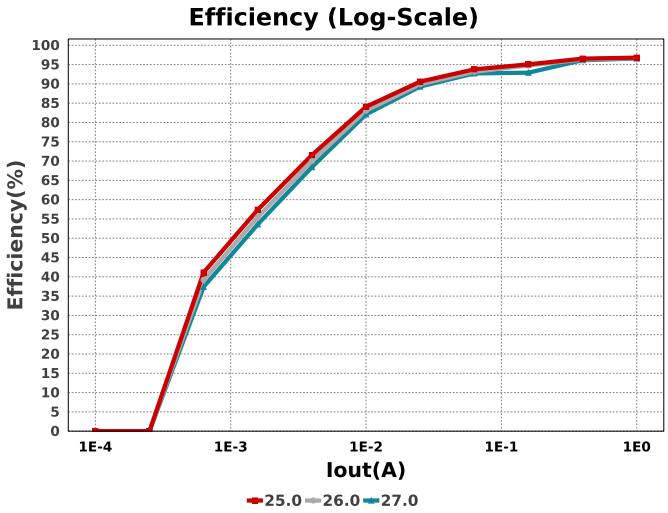

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	306.023 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	280.95 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	136.283 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	18.573 nW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	38.074 degC	Diode	D1 junction temperature
6.	Diode Pd	57.673 mW	Diode	Diode power dissipation
7.	IC Ipk	1.236 A	IC	Peak switch current in IC
8.	IC Pd	515.89 mW	IC	IC power dissipation
9.	IC Tj	51.668 degC	IC	IC junction temperature
10.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	42.0 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	920.02 mA	IC	Average input current
13.	L Ipp	472.1 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	275.01 mW	Inductor	Inductor power dissipation
15.	Cin Pd	280.95 µW	Power	Input capacitor power dissipation
16.	Cout Pd	18.573 nW	Power	Output capacitor power dissipation
17.	Diode Pd	57.673 mW	Power	Diode power dissipation
18.	IC Pd	515.89 mW	Power	IC power dissipation
19.	L Pd	275.01 mW	Power	Inductor power dissipation
20.	Total Pd	850.54 mW	Power	Total Power Dissipation
21.	BOM Count	10	System Information	Total Design BOM count
22.	Cross Freq	103.835 kHz	System Information	Bode plot crossover frequency
23.	Duty Cycle	89.541 %	System Information	Duty cycle
24.	Efficiency	96.576 %	System Information	Steady state efficiency
25.	FootPrint	156.0 mm^2	System Information	Total Foot Print Area of BOM components
26.	Frequency	541.105 kHz	System Information	Switching frequency
27.	Gain Marg	3.187 dB	System Information	Bode Plot Gain Margin
28.	Iout	1.0 A	System Information	Iout operating point
29.	Low Freq Gain	53.793 dB	System Information	Gain at 1Hz
30.	Mode	CCM	System Information	Conduction Mode
31.	Phase Marg	61.875 deg	System Information	Bode Plot Phase Margin
32.	Pout	23.99 W	System Information	Total output power
33.	Total BOM	NA	System Information	Total BOM Cost
34.	Vin	27.0 V	System Information	Vin operating point
35.	Vout	23.99 V	System Information	Operational Output Voltage
36.	Vout Actual	23.985 V	System Information	Vout Actual calculated based on selected voltage divider resistors

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#	Name	Value	Category	Description
37.	Vout Tolerance	4.404 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
38.	Vout p-p	1.269 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	27.0	Maximum input voltage
VinMin	25.0	Minimum input voltage
Vout	24.0	Output Voltage
base_pn	LV14360P	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

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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

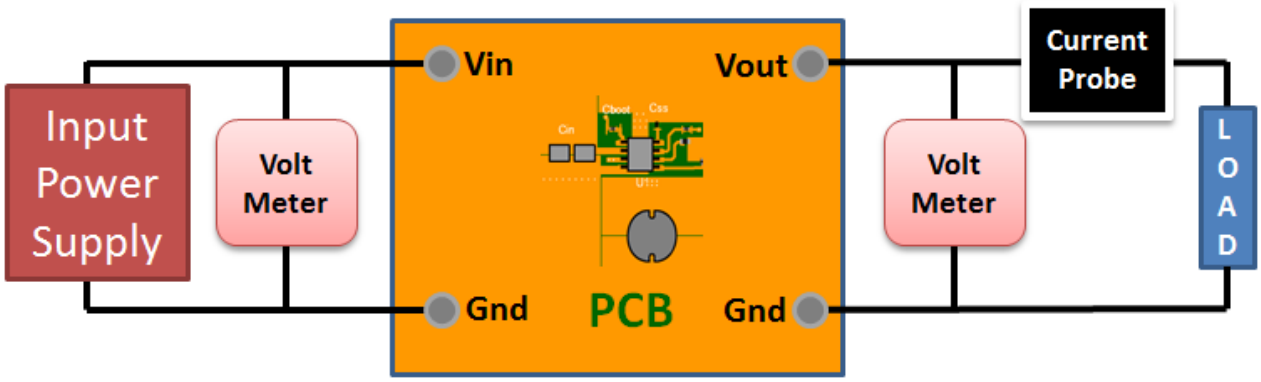
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 25.0V 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.

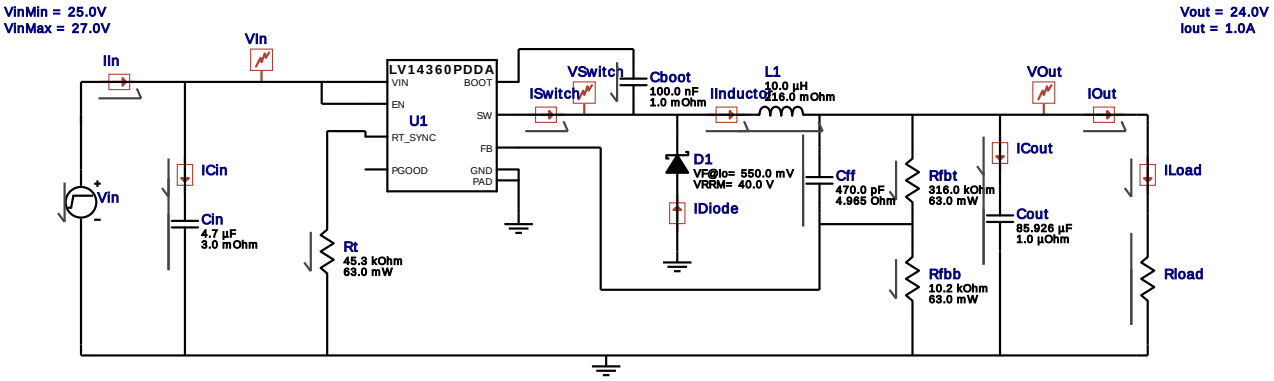


WEBENCH® Electrical Simulation Report

Design Id = 37

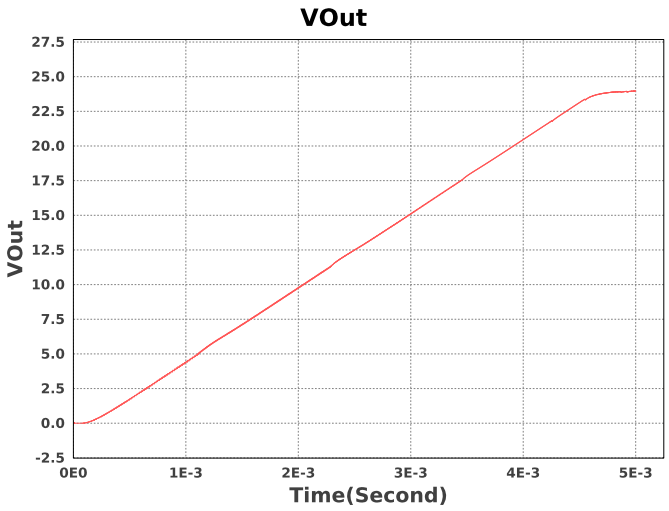
sim_id = 1

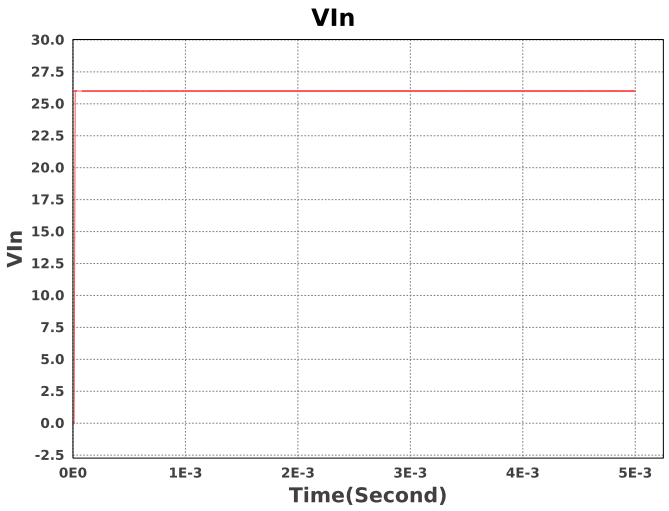
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load resisitance	24.0 ohm





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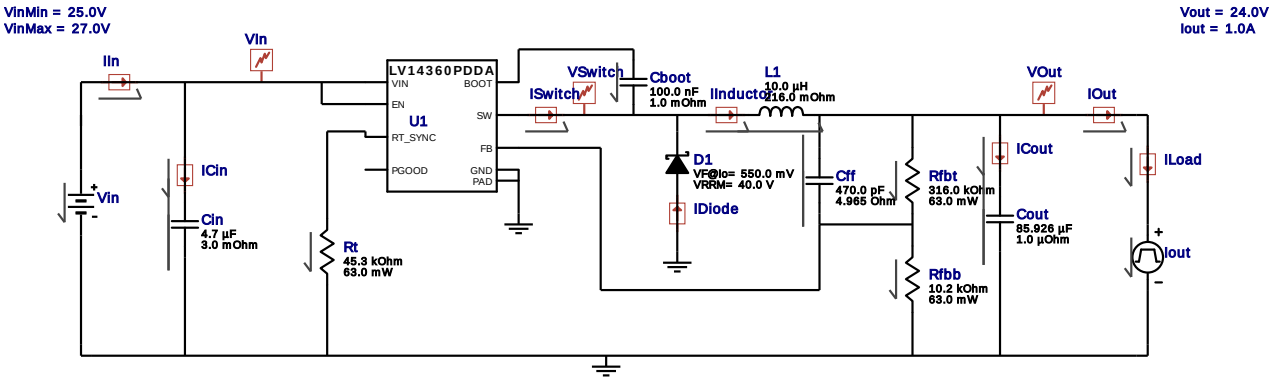
Design Id = 37

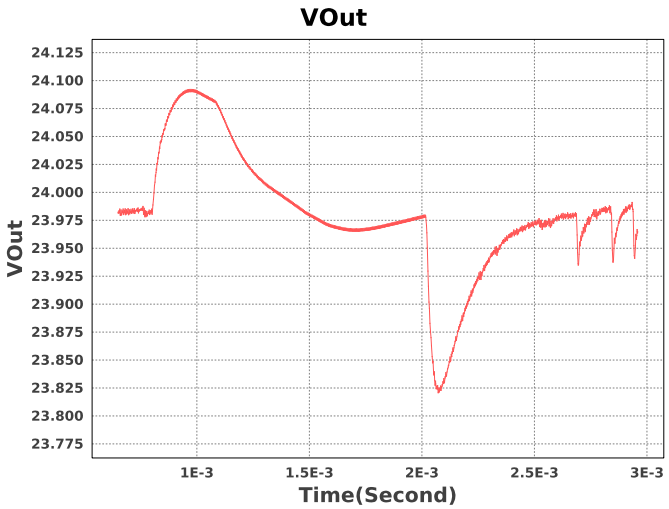
sim_id = 2

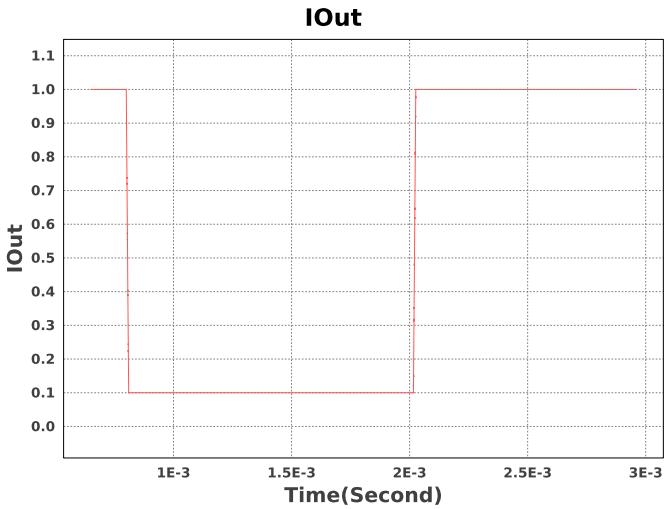
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	no description	5
2.	L1	IC	no description	-1.0
3.	Cout	IC	no description	24.0
4.	ILoad	I	Load current	ILoad1 A
5.	Iout	Signal_type	Signal Type	PULSE
		I1	Initial input current	1.0 A
		I2	Peak Input current	0.1 A
		Td	Initial time delay	800u s
		Tr	Rise time	10u
		Tf	Fall time	10u s
		Pw	Pulse width	0.0012062313676038925 s





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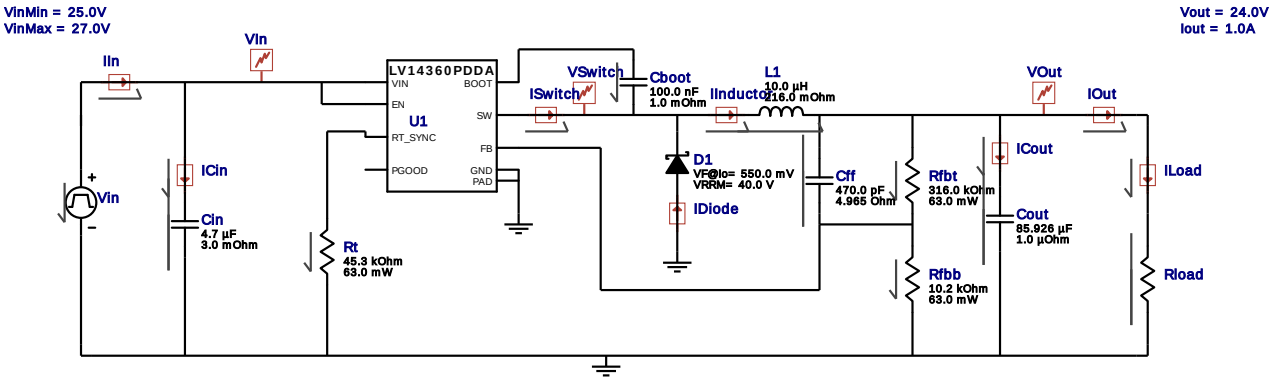
Design Id = 37

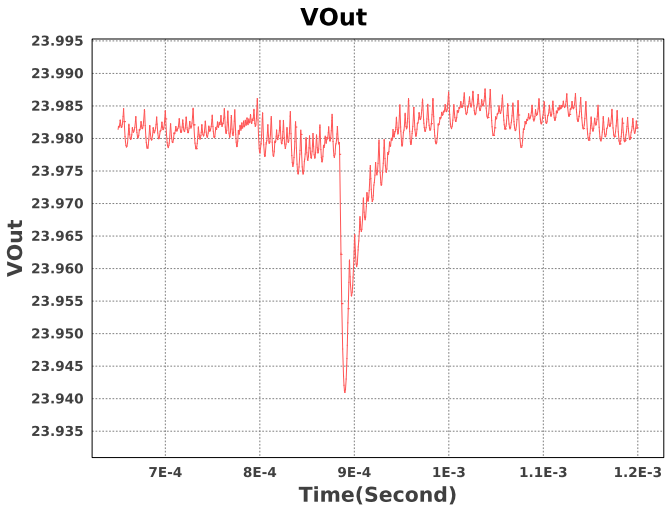
sim_id = 3

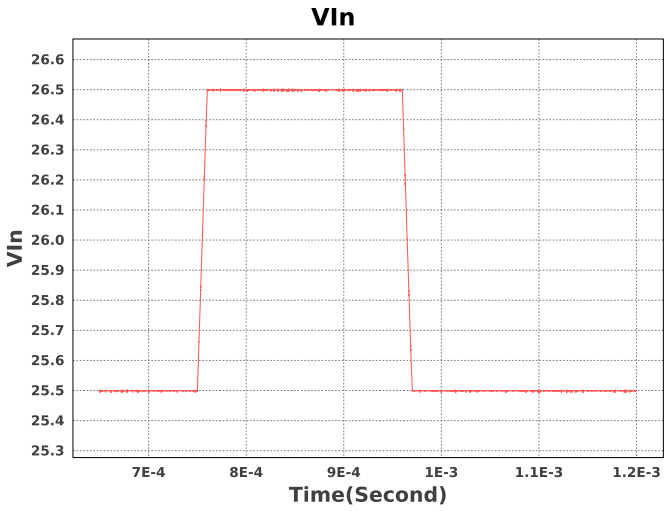
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	no description	5
2.	L1	IC	no description	-1.0
3.	Cout	IC	no description	24.0
4.	Rload	R	Load Resistance	24.0 ohm

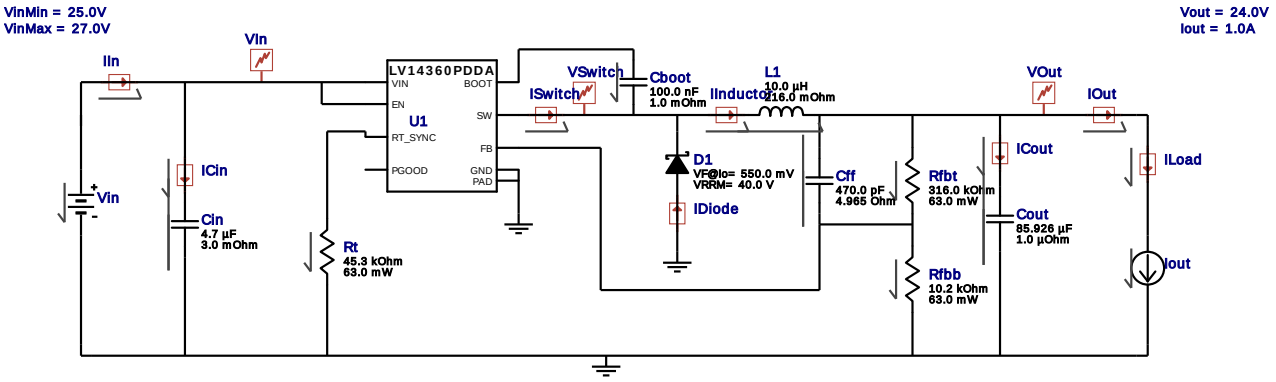




Design Id = 37

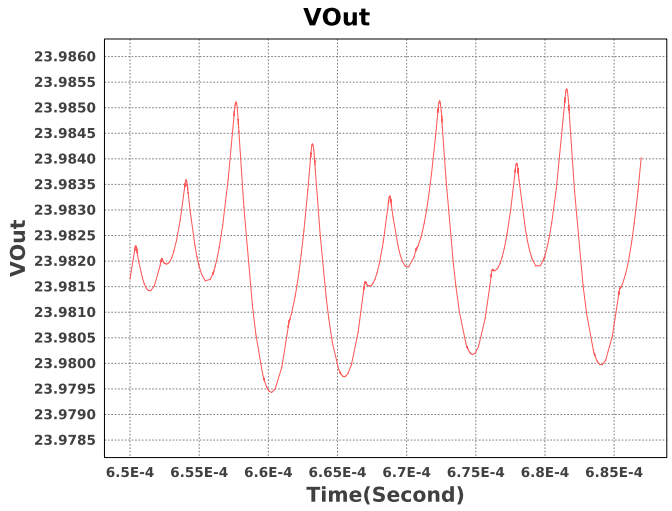
sim_id = 4

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	no description	5
2.	L1	IC	no description	-1.0
3.	Cout	IC	no description	24.0
4.	Iout	I	Load current	1.0 A



Design Assistance

1. Master key : A19BF6113C34B063[v1]
2. **LV14360P** Product Folder : http://www.ti.com/product/LV14360 : contains the data sheet and other resources.

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