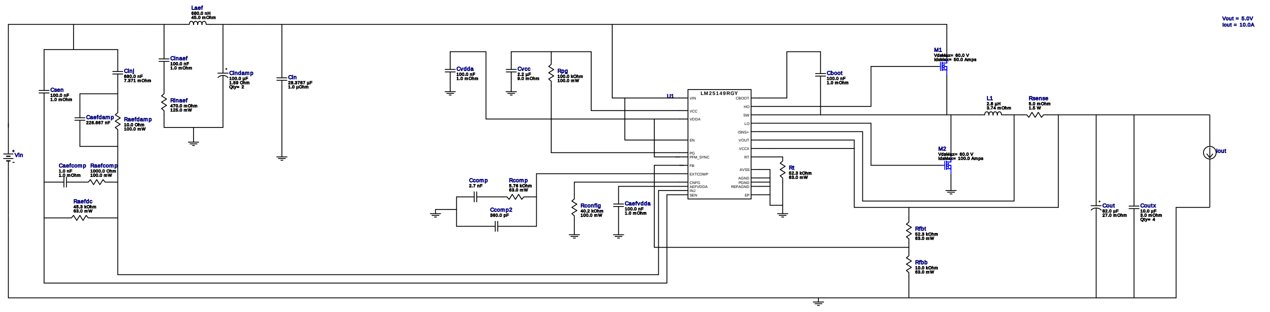
TEXAS INSTRUMENTS

WEBENCH® Design Report

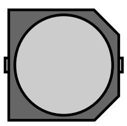
VinMin = 9.0V
VinMax = 36.0V
Vout = 5.0V
Iout = 10.0A

Device = LM25149RGYR
Topology = Buck
Created = 2025-10-23 05:52:39.495
BOM Cost = NA
BOM Count = 35
Total Pd = 3.2W

Design : 9 LM25149RGYR
LM25149RGYR 9V-36V to 5.00V @ 10A

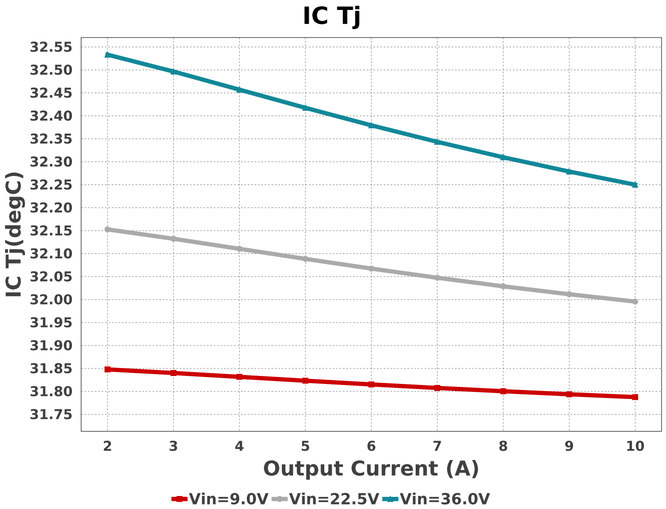


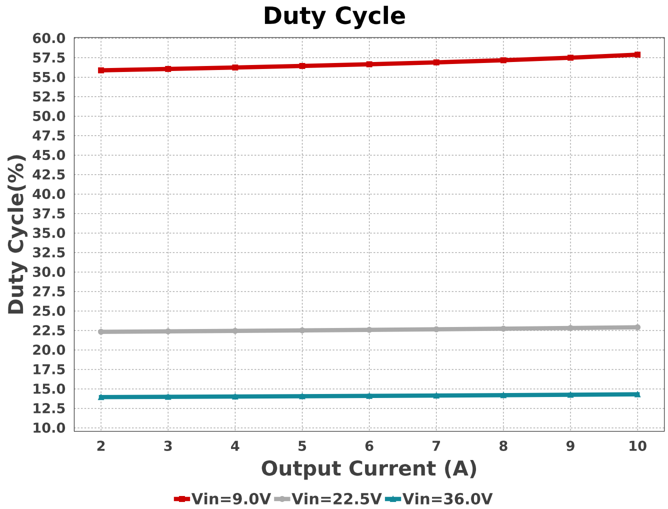
Electrical BOM

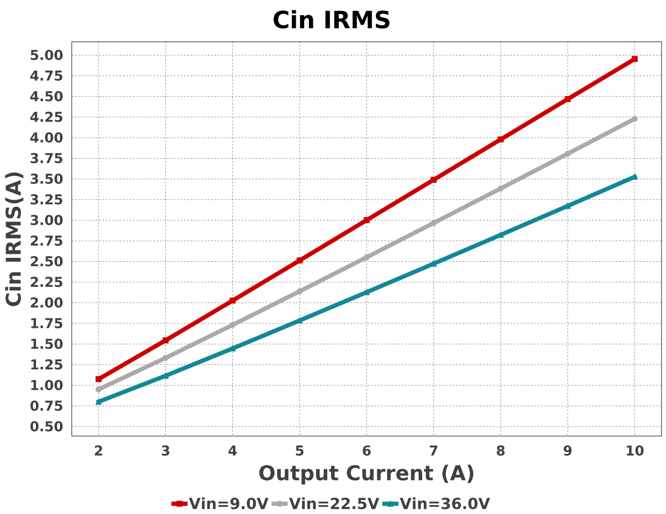
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Caefcomp	MuRata	GRM155R72A102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Caefdamp	CUSTOM	CUSTOM Series= ?	Cap= 226.667 nF VDC= 72.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm²
Caefvdda	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
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
Ccomp	MuRata	GRM1885C1H272JA01J Series= C0G/NP0	Cap= 2.7 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0603 5 mm²
Ccomp2	MuRata	GRM1555C1H361GA01D Series= C0G/NP0	Cap= 360.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0402 3 mm²
Cin	CUSTOM	CUSTOM Series= ?	Cap= 28.3767 uF ESR= 1.0 uOhm VDC= 54.0 V IRMS= 7.0762 A	1	NA	CUSTOM 0 mm²
Cinaef	MuRata	GRM188R72A104KA35D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 3.85 A	1	$0.04	0603 5 mm²
Cindamp	Chemi-Con	EMVE630ADA101MJA0G Series= MVE	Cap= 100.0 uF ESR= 1.59 Ohm VDC= 63.0 V IRMS= 310.0 mA	2	$0.40	 CAPSMT_62_JA0 151 mm²
Cinj	TDK	C3216X5R2A684K160AA Series= X5R	Cap= 680.0 nF ESR= 7.371 mOhm VDC= 100.0 V IRMS= 2.67843 A	1	$0.12	1206_180 11 mm²

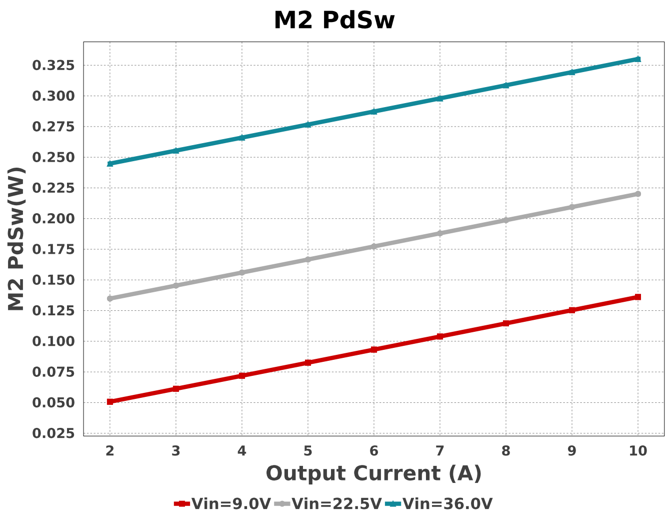
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cout	Panasonic	16SVPF82M Series= SVPF	Cap= 82.0 uF ESR= 27.0 mOhm VDC= 16.0 V IRMS= 3.0 A	1	$0.47	CAPSMT_62_E61 53 mm^2
Coutx	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	4	$0.03	0805 7 mm^2
Csen	MuRata	GRM188R72A104KA35D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 3.85 A	1	$0.04	0603 5 mm^2
Cvcc	MuRata	GRM188R71A225KE15D Series= X7R	Cap= 2.2 uF ESR= 9.0 mOhm VDC= 10.0 V IRMS= 3.3 A	1	$0.02	0603 5 mm^2
Cvdda	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 mm^2
L1	Wurth Elektronik	7443551280	L= 2.8 µH 3.74 mOhm	1	$2.50	WE-HCI_1365 222 mm^2
Laef	TDK	NLCV32T-R68M-PFR	L= 680.0 nH 45.0 mOhm	1	$0.10	NLCV32 13 mm^2
M1	Texas Instruments	CSD18534Q5A	VdsMax= 60.0 V IdsMax= 50.0 Amps	1	$0.34	DQJ0008A 55 mm^2
M2	Texas Instruments	CSD18531Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$0.45	TRANS_NexFET_Q5A 55 mm^2
Raefcomp	Vishay-Dale	CRCW06031K00FKEA Series= CRCW..e3	Res= 1000.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Raefdamp	Vishay-Dale	CRCW060310R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Raefdc	Vishay-Dale	CRCW040245K3FKED Series= CRCW..e3	Res= 45.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rcomp	Vishay-Dale	CRCW04025K76FKED Series= CRCW..e3	Res= 5.76 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rconfig	Vishay-Dale	CRCW060340K2FKEA Series= CRCW..e3	Res= 40.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW040252K3FKED Series= CRCW..e3	Res= 52.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rinaef	Panasonic	ERJ-2BQFR47X Series= ERJ-2B	Res= 470.0 mOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.06	0402 3 mm^2
Rpg	Vishay-Dale	CRCW0603100KFKEA Series= CRCW..e3	Res= 100.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rsense	Stackpole Electronics Inc	CSNL2010FT5L00 Series= ?	Res= 5.0 mOhm Power= 1.5 W Tolerance= 1.0%	1	$0.19	2010 32 mm^2

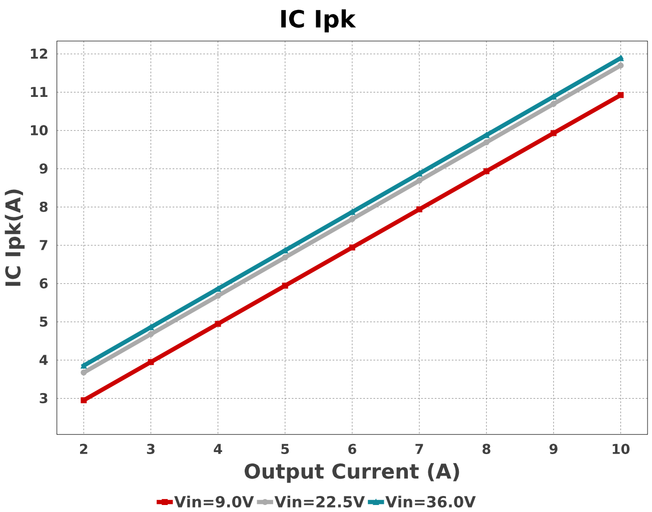
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rt	Vishay-Dale	CRCW040252K3FKED Series= CRCW..e3	Res= 52.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LM25149RGYR	Switcher	1	$1.38	RGY0024E-MFG 48 mm²

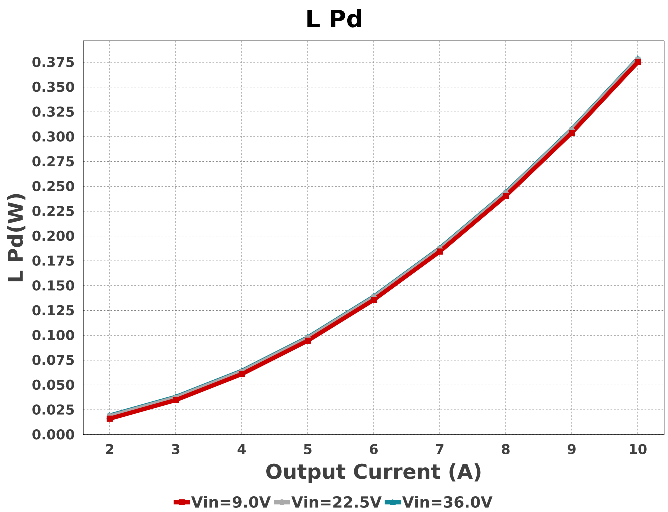


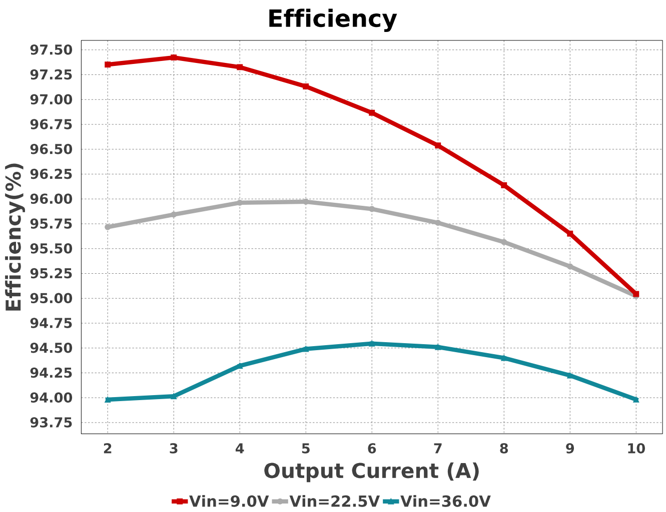


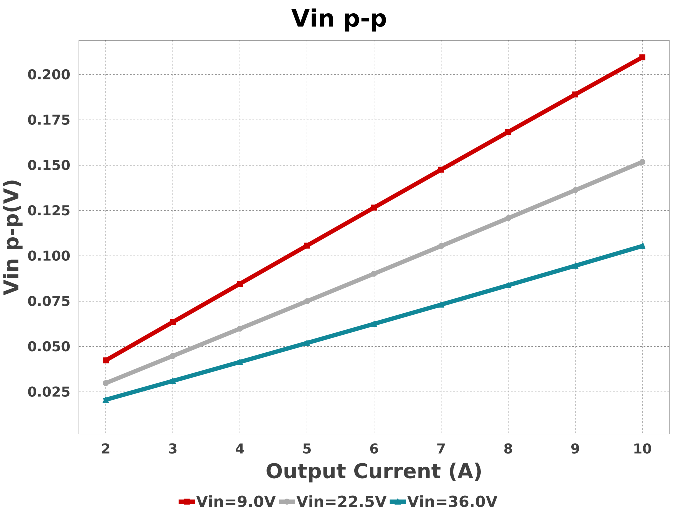


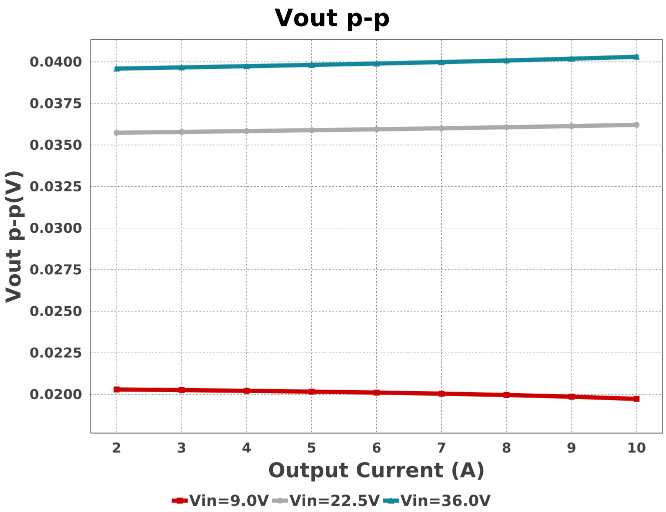


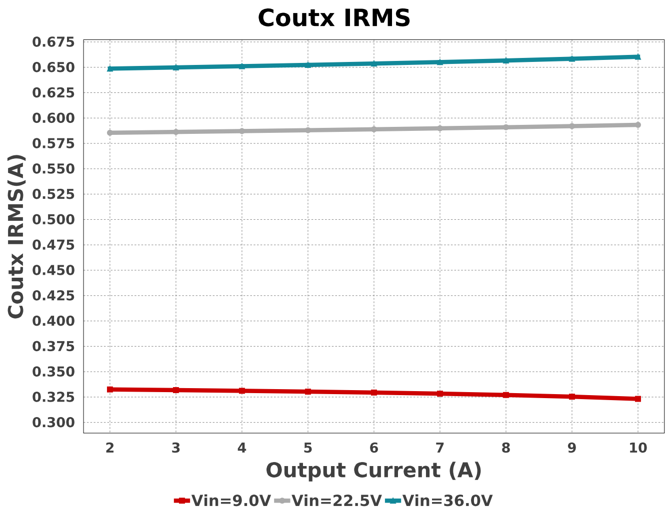


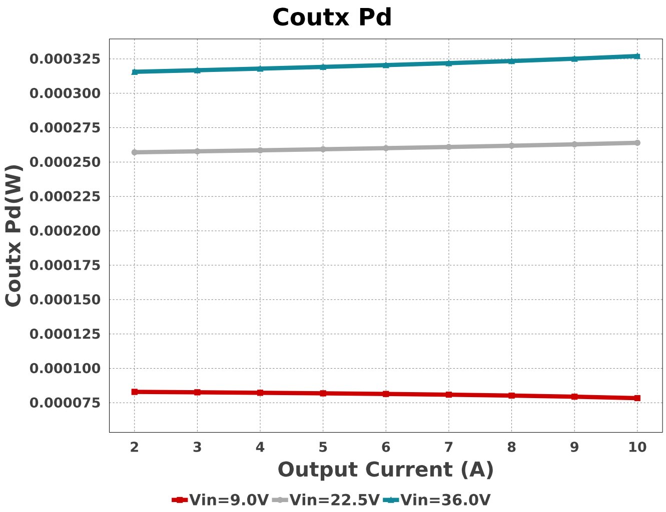


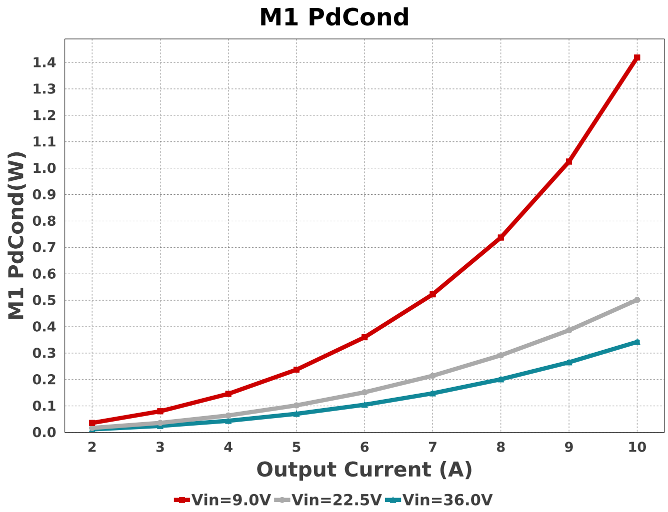

Efficiency
Efficiency(%)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V


Vin p-p
Vin p-p(V)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

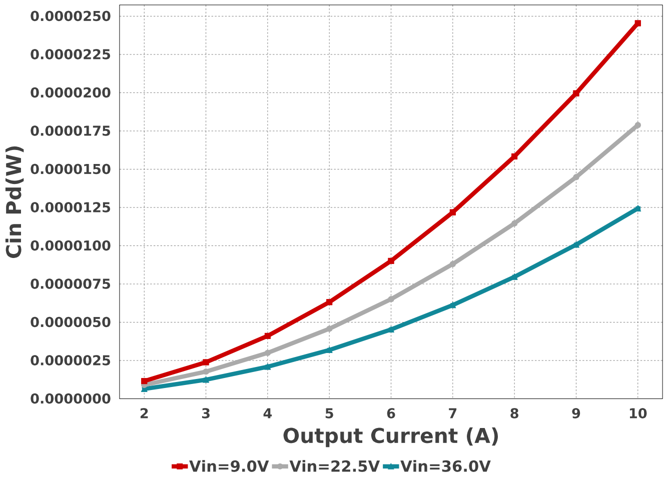

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V


Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

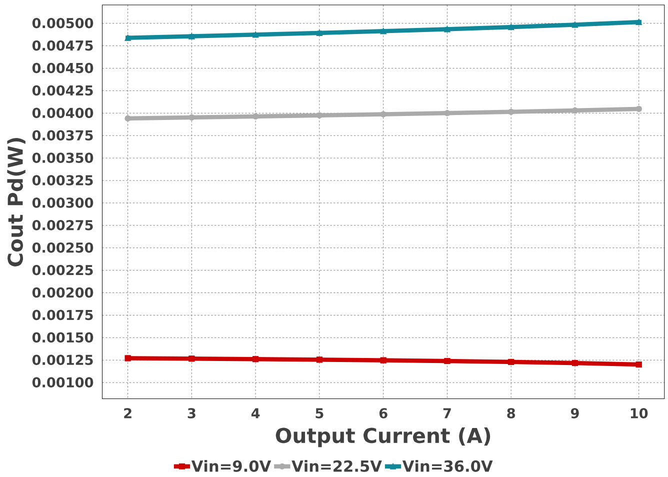

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V


M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

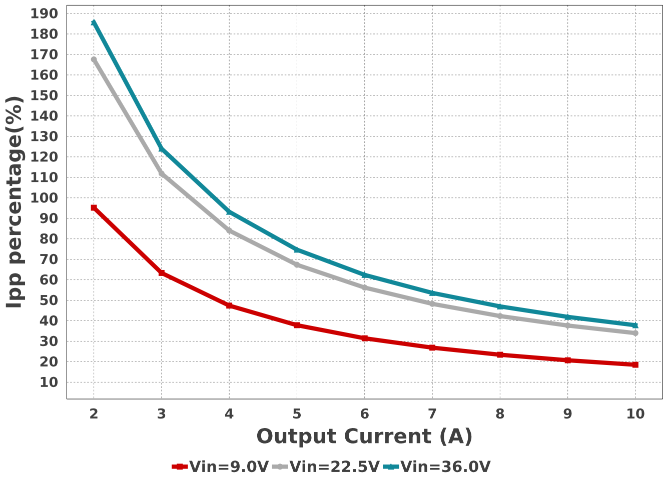
Cin Pd



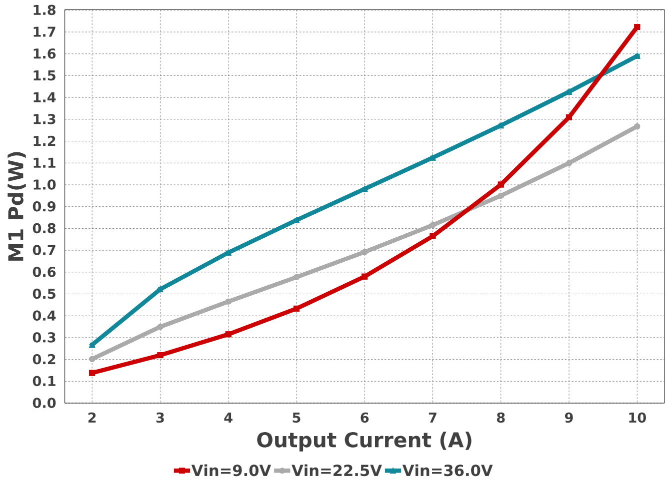
Cout Pd



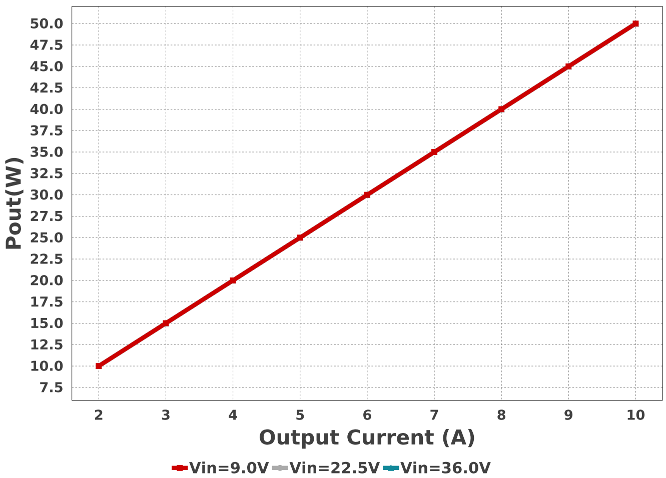
Ipp percentage



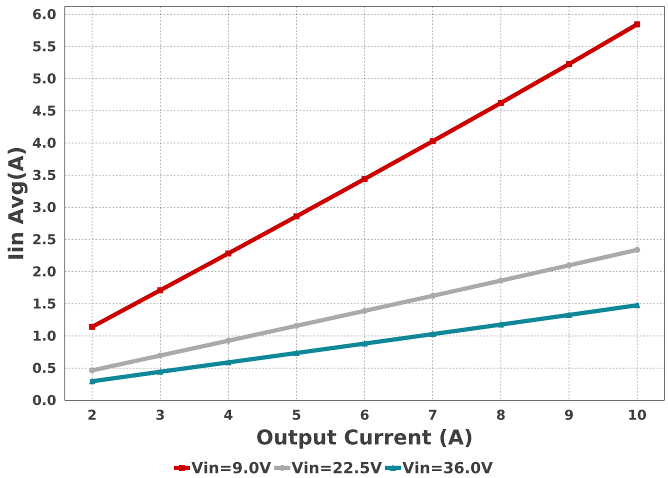
M1 Pd

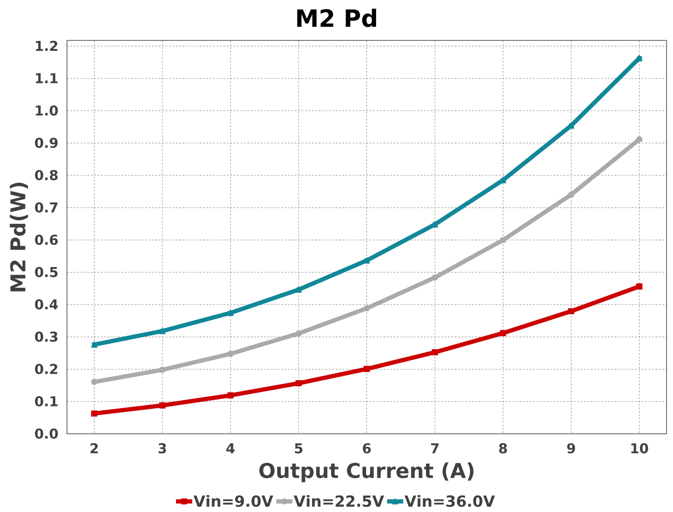


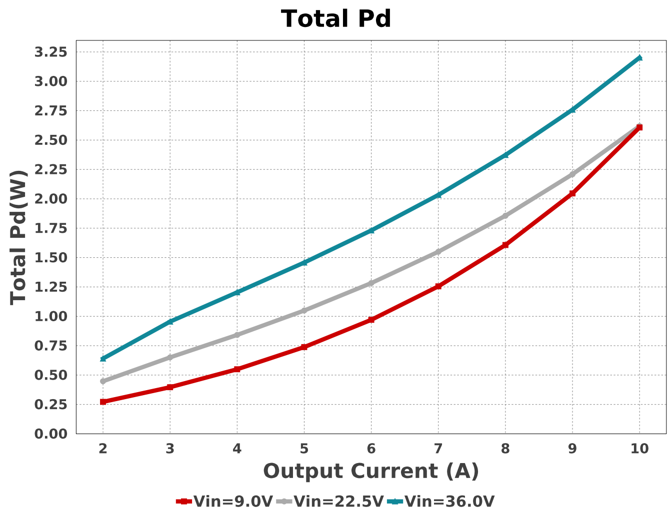
Pout

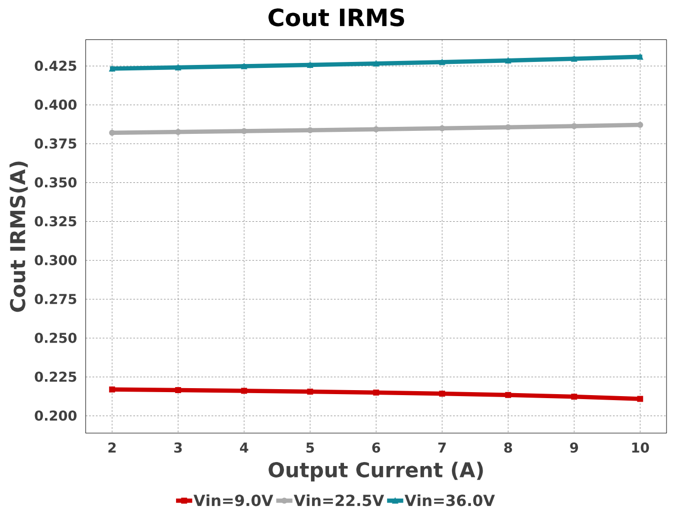


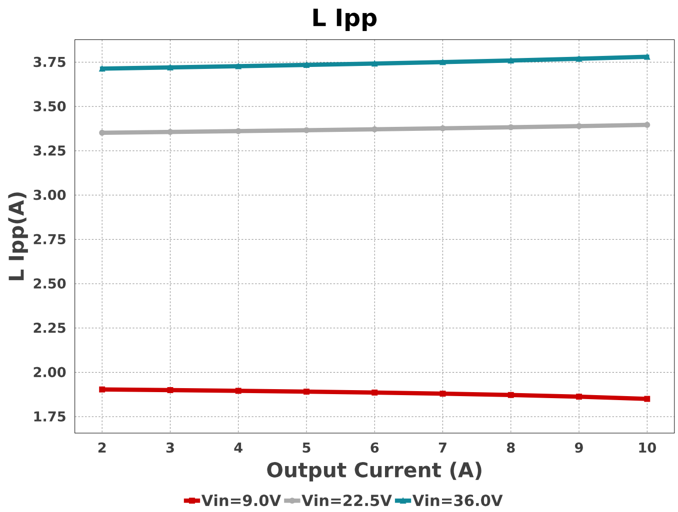
Iin Avg

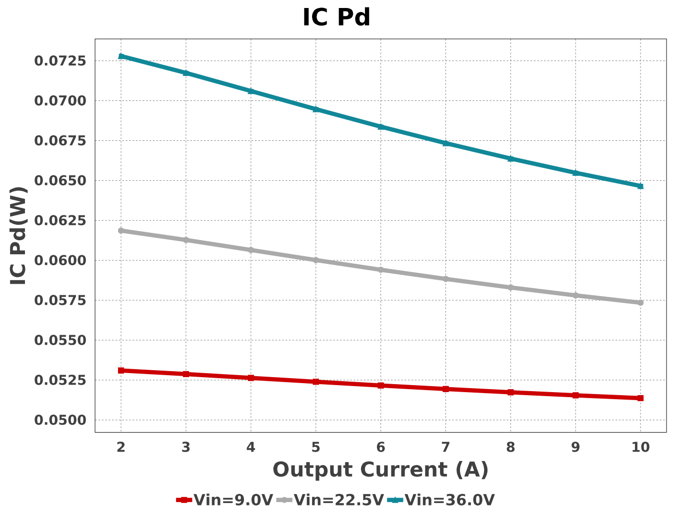


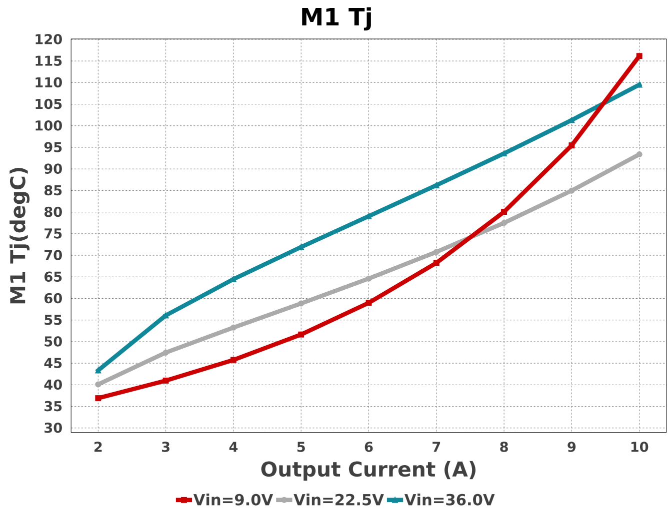

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

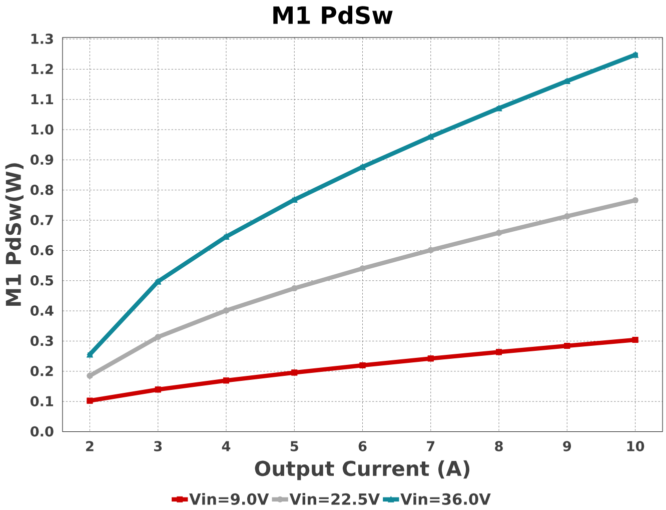

Total Pd
Total Pd(W)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

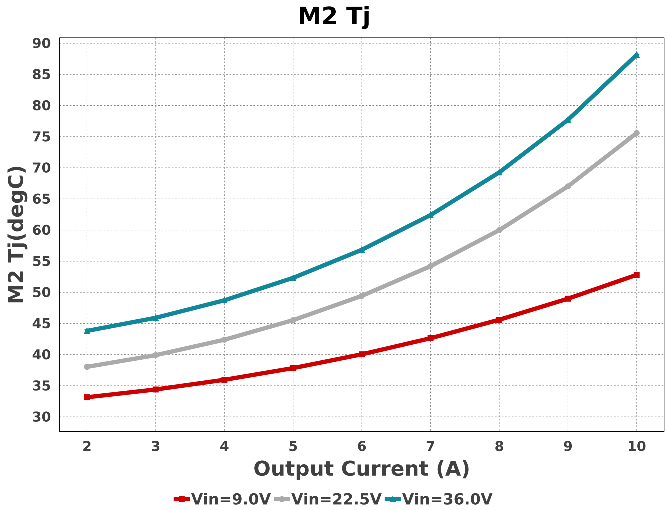

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

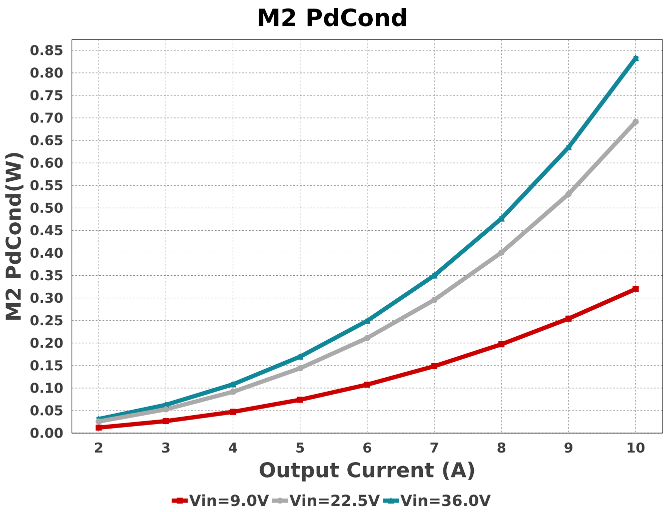

L Ipp
L Ipp(A)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

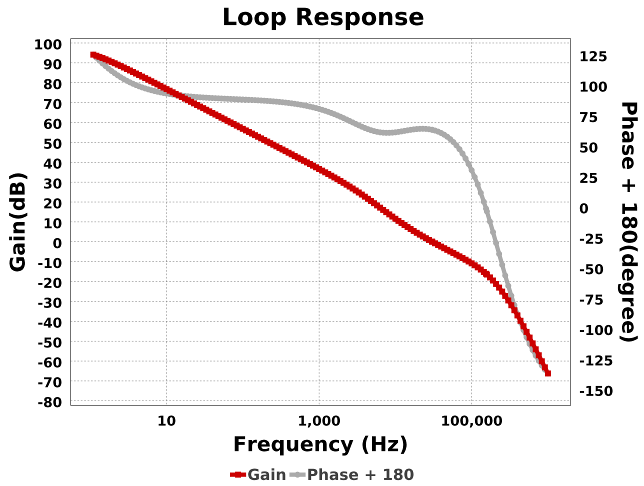

IC Pd
IC Pd(W)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V

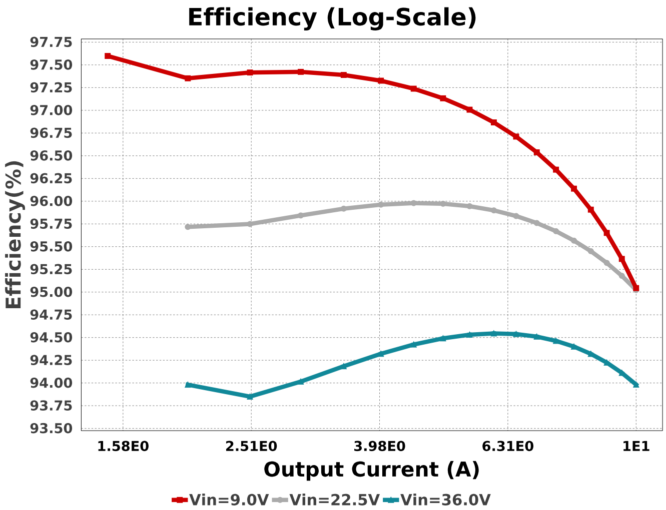

M1 Tj
M1 Tj(degC)
Output Current (A)
Vin=9.0V Vin=22.5V Vin=36.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.527 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	12.437 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	430.938 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	5.014 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	660.374 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	327.07 µW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	11.89 A	IC	Peak switch current in IC
8.	IC Pd	64.659 mW	IC	IC power dissipation
9.	IC Tj	32.25 degC	IC	IC junction temperature
10.	IC Tolerance	8.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA Effective	34.8 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	1.478 A	IC	Average input current
13.	Ipp percentage	37.804 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	3.78 A	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	378.45 mW	Inductor	Inductor power dissipation
16.	M1 Pd	1.59 W	Mosfet	M1 MOSFET total power dissipation
17.	M1 PdCond	342.31 mW	Mosfet	M1 MOSFET conduction losses
18.	M1 PdSw	1.248 W	Mosfet	M1 MOSFET switching losses
19.	M1 Tj	109.51 degC	Mosfet	M1 MOSFET junction temperature
20.	M2 Pd	1.163 W	Mosfet	M2 MOSFET total power dissipation
21.	M2 PdCond	832.74 mW	Mosfet	M2 MOSFET conduction losses
22.	M2 PdSw	330.1 mW	Mosfet	M2 MOSFET switching losses
23.	M2 Tj	88.142 degC	Mosfet	M2 MOSFET junction temperature
24.	Cin Pd	12.437 µW	Power	Input capacitor power dissipation
25.	Cout Pd	5.014 mW	Power	Output capacitor power dissipation
26.	Coutx Pd	327.07 µW	Power	Output capacitor_x power loss
27.	IC Pd	64.659 mW	Power	IC power dissipation
28.	L Pd	378.45 mW	Power	Inductor power dissipation
29.	M1 Pd	1.59 W	Power	M1 MOSFET total power dissipation
30.	M1 PdCond	342.31 mW	Power	M1 MOSFET conduction losses
31.	M1 PdSw	1.248 W	Power	M1 MOSFET switching losses
32.	M2 Pd	1.163 W	Power	M2 MOSFET total power dissipation
33.	M2 PdCond	832.74 mW	Power	M2 MOSFET conduction losses
34.	M2 PdSw	330.1 mW	Power	M2 MOSFET switching losses
35.	Total Pd	3.202 W	Power	Total Power Dissipation
36.	BOM Count	35	System Information	Total Design BOM count
37.	Cross Freq	30.478 kHz	System Information	Bode plot crossover frequency
38.	Duty Cycle	14.315 %	System Information	Duty cycle
39.	Efficiency	93.982 %	System Information	Steady state efficiency
40.	FootPrint	929.0 mm^2	System Information	Total Foot Print Area of BOM components
41.	Frequency	415.541 kHz	System Information	Switching frequency
42.	Gain Marg	-16.094 dB	System Information	Bode Plot Gain Margin
43.	Iout	10.0 A	System Information	Iout operating point
44.	Iout transient step used for Cout calculations	5.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
45.	Low Freq Gain	94.127 dB	System Information	Gain at 1Hz
46.	Mode	CCM	System Information	Conduction Mode
47.	Overshoot Value	67.673 mV	System Information	Theoretical Vout Overshoot Value
48.	Phase Marg	64.708 deg	System Information	Bode Plot Phase Margin
49.	Pout	50.0 W	System Information	Total output power
50.	Total BOM	NA	System Information	Total BOM Cost
51.	Undershoot Value	111.084 mV	System Information	Theoretical Vout Undershoot Value
52.	Vin	36.0 V	System Information	Vin operating point
53.	Vin p-p	104.035 mV	System Information	Peak-to-peak input voltage
54.	Vout	5.0 V	System Information	Operational Output Voltage
55.	Vout Actual	4.984 V	System Information	Vout Actual calculated based on selected voltage divider resistors
56.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
57.	Vout Tolerance	2.713 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
58.	Vout p-p	40.306 mV	System Information	Peak-to-peak output ripple voltage
59.	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	10.0	Maximum Output Current
VinMax	36.0	Maximum input voltage
VinMin	9.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LM25149	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	406.0 k	Customer Selected Frequency

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

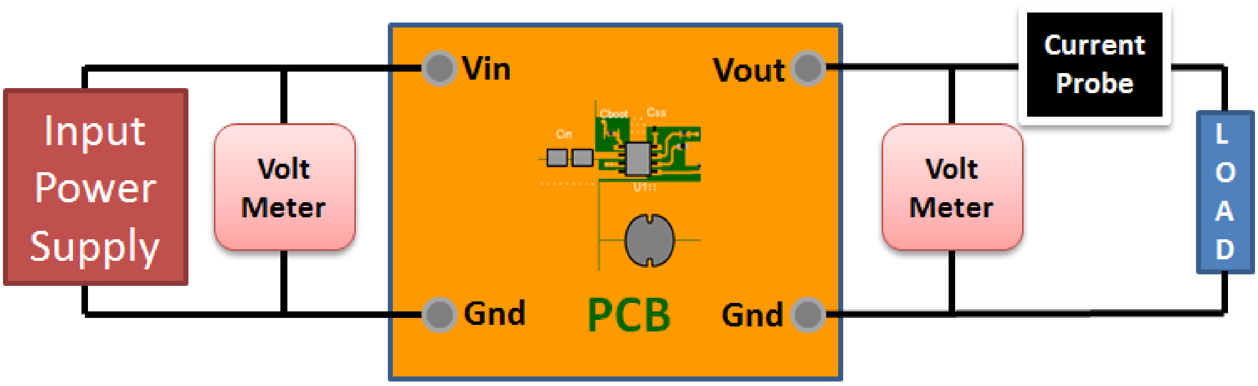
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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



Design Assistance

1. Master key : D2FE52328E1F62D84944AEC27CC07B04[v1]

2. **LM25149** Product Folder : http://www.ti.com/product/LM25149 : contains the data sheet and other resources.