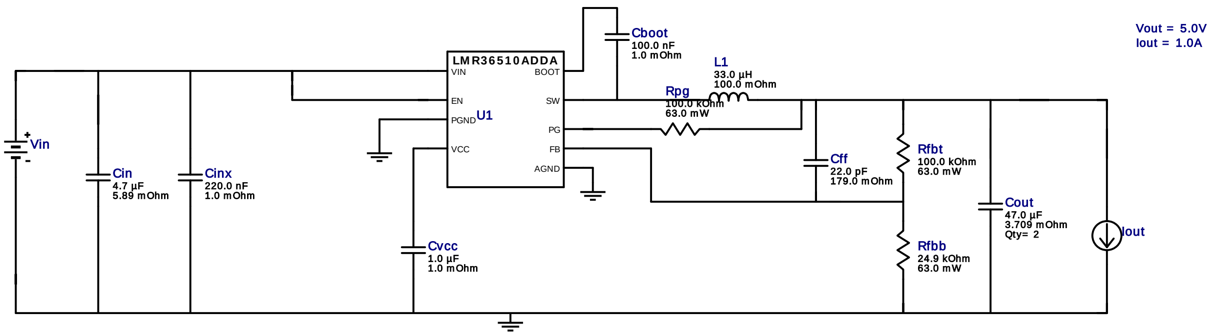
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 8.0V
VinMax = 40.0V
Vout = 5.0V
Iout = 1.0A

Device = LMR36510ADDAR
Topology = Buck
Created = 2025-09-02 05:40:32.404
BOM Cost = $2.44
BOM Count = 12
Total Pd = 0.69W

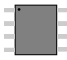
Design : 50 LMR36510ADDAR
LMR36510ADDAR 8V-40V to 5.00V @ 1A

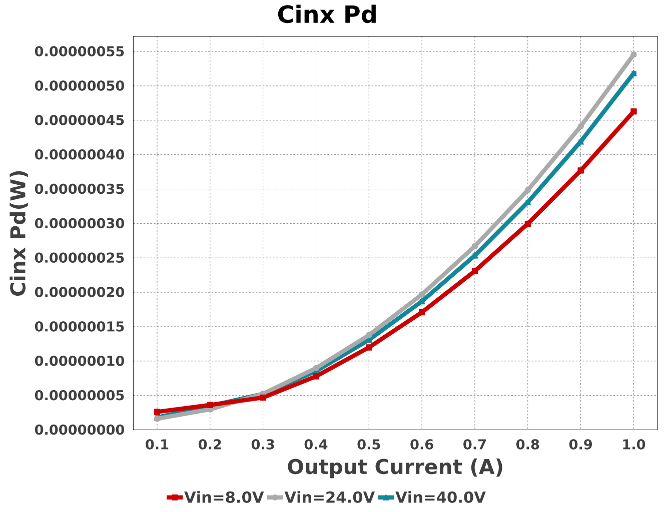


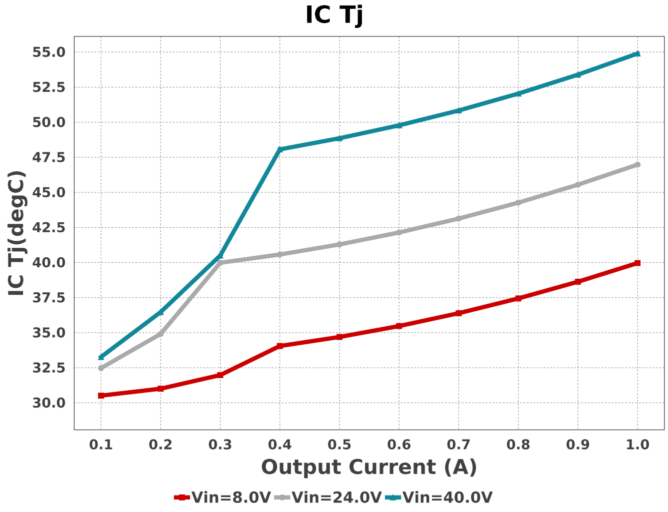
Electrical BOM

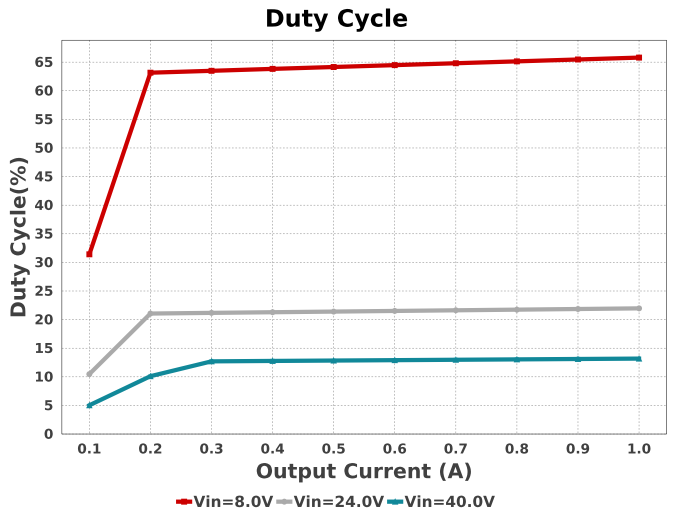
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cff	Kemet	C0805C220J5GACTU Series= C0G/NP0	Cap= 22.0 pF ESR= 179.0 mOhm VDC= 50.0 V IRMS= 464.0 mA	1	$0.01	0805 7 mm²
Cin	TDK	C3225X7S2A475M200AB Series= X7S	Cap= 4.7 uF ESR= 5.89 mOhm VDC= 100.0 V IRMS= 6.7739 A	1	$0.45	1210 15 mm²
Cinx	MuRata	GRM21AR72A224KAC5L Series= X7R	Cap= 220.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.08	0805 7 mm²
Cout	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	2	$0.21	1206_190 11 mm²
Cvcc	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
L1	Bourns	SDR1105-330KL	L= 33.0 µH 100.0 mOhm	1	$0.49	SDR1105 157 mm²
Rfbb	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 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

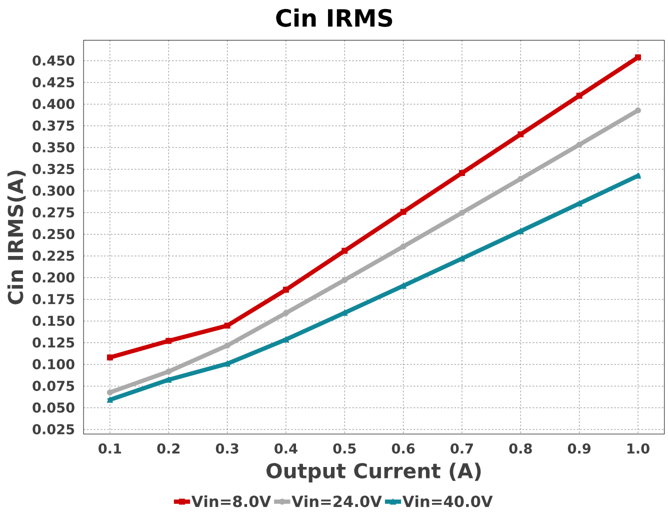
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LMR36510ADDAR	Switcher	1	$0.94	DDA0008J 55 mm^2

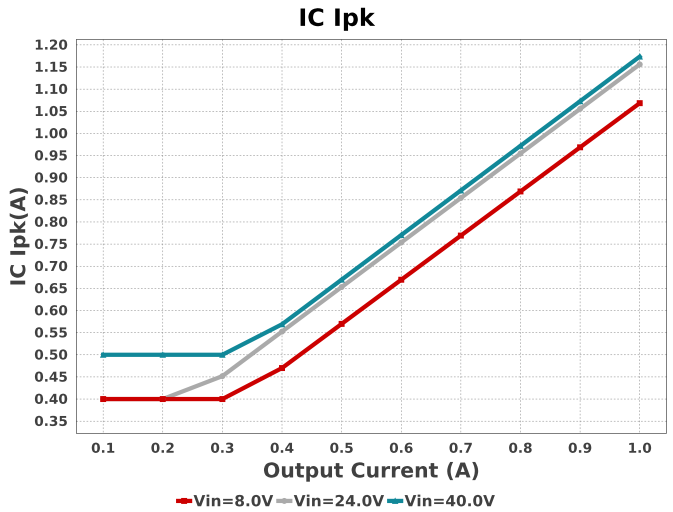


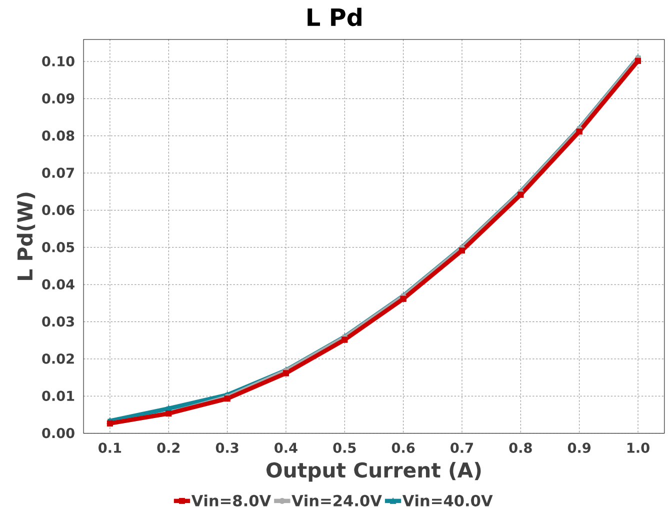




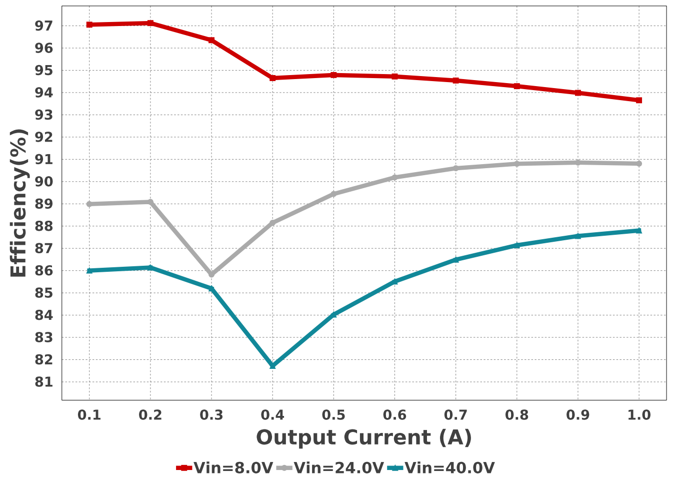




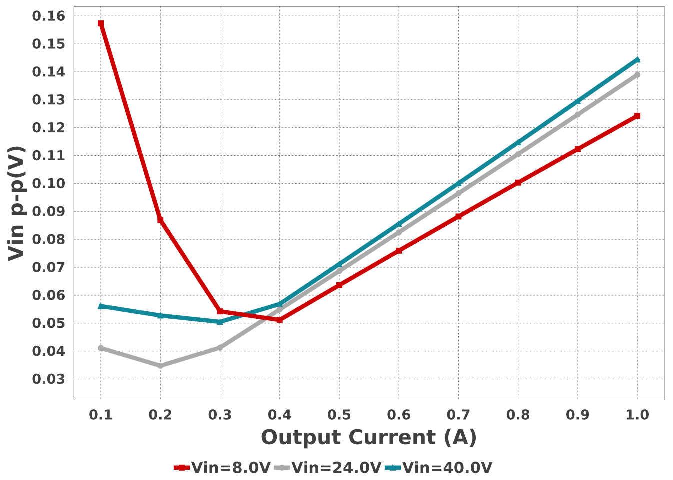




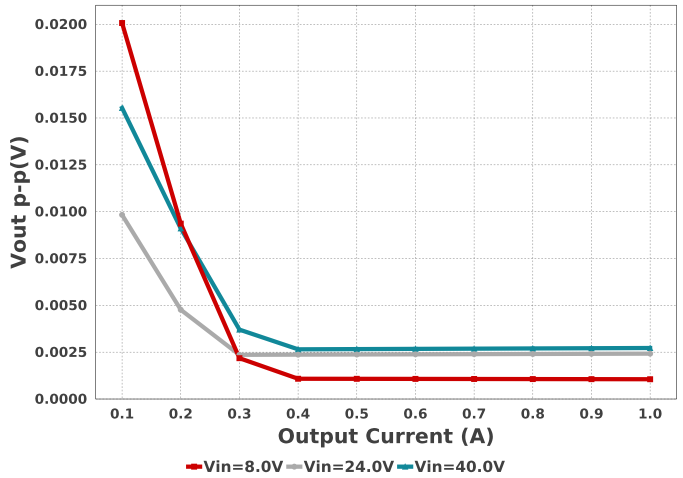
Efficiency



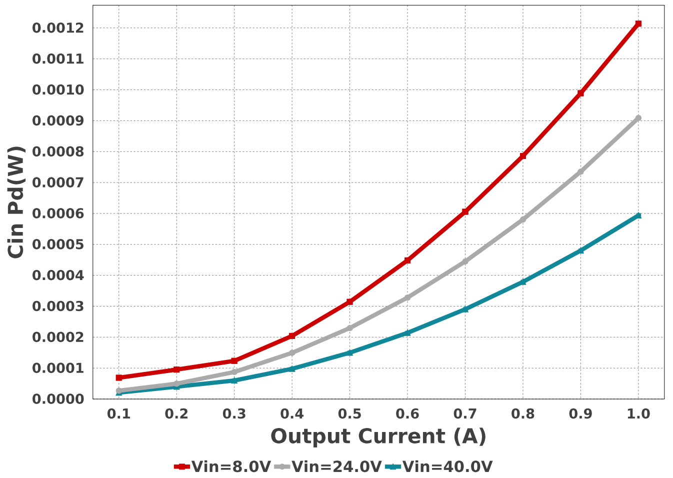
Vin p-p



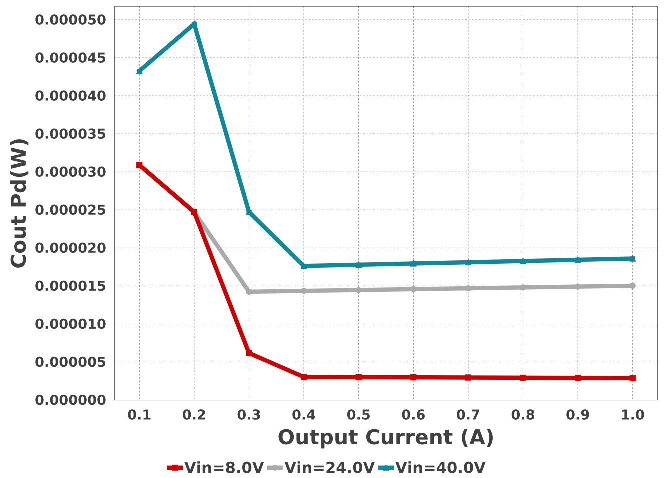
Vout p-p



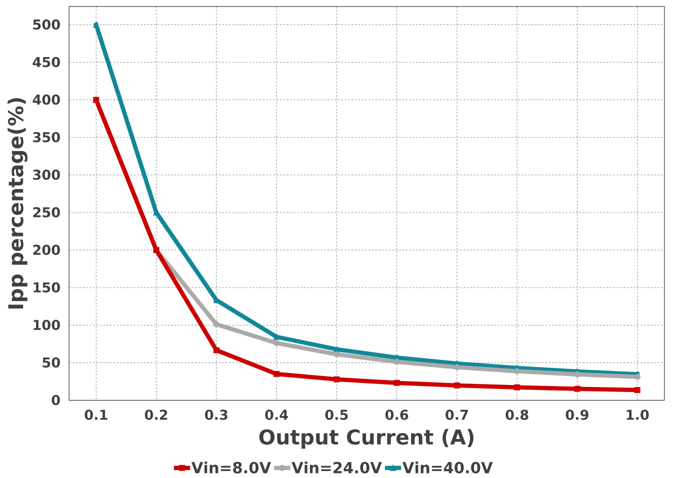
Cin Pd

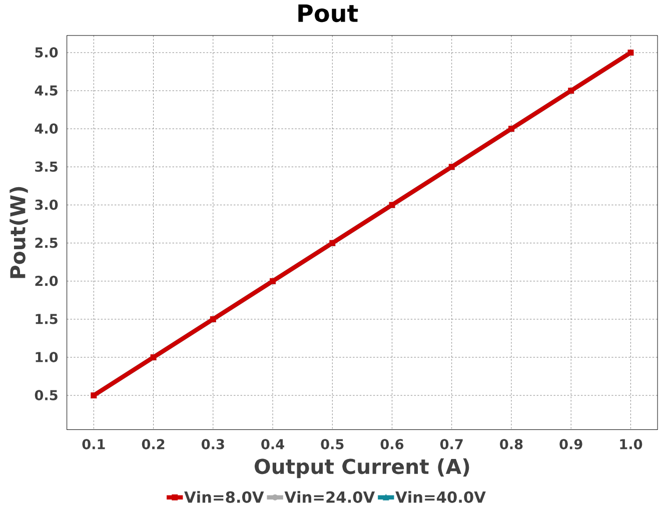


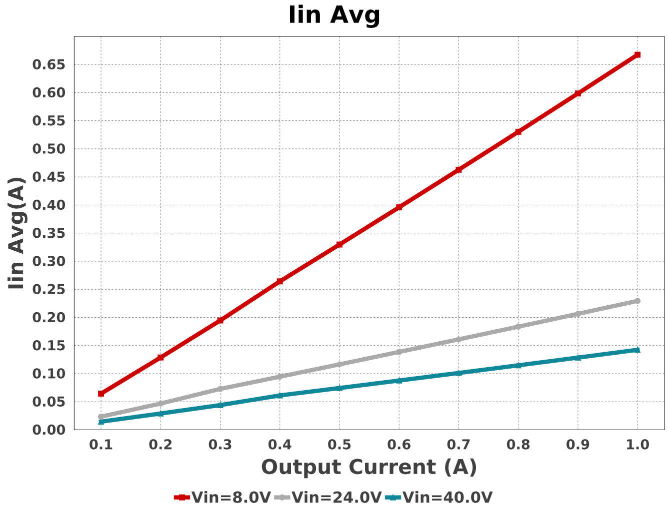
Cout Pd

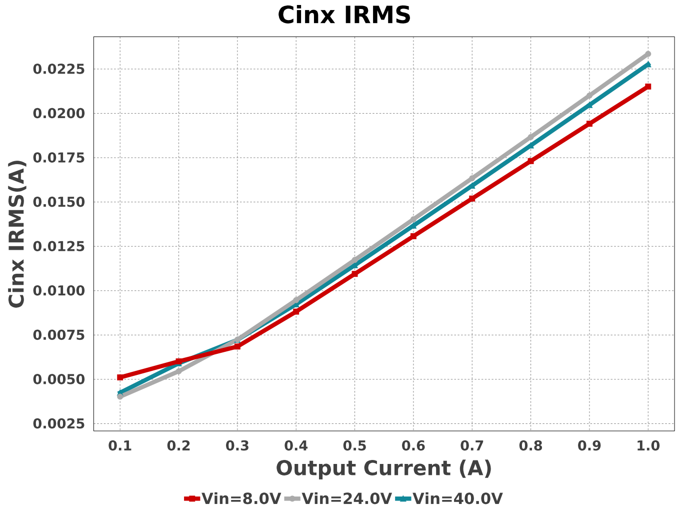


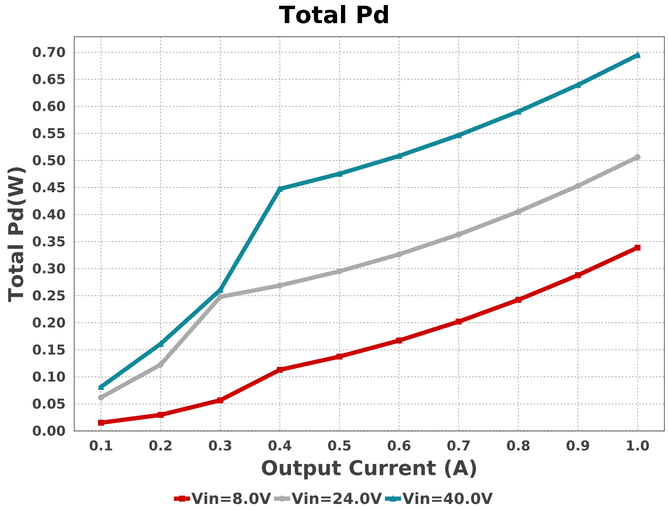
Ipp percentage

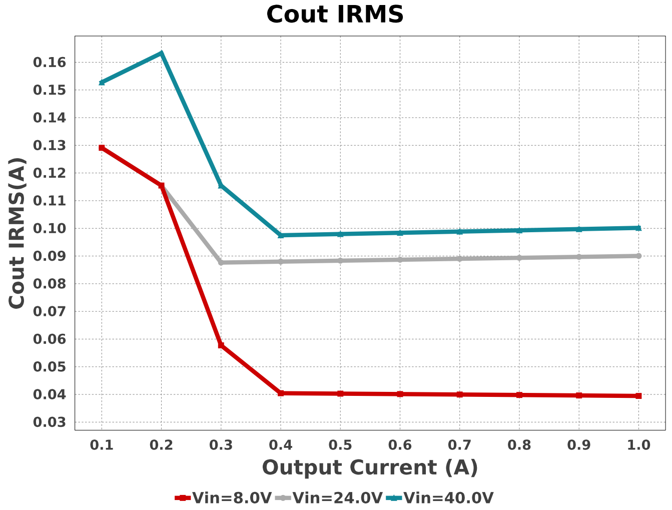


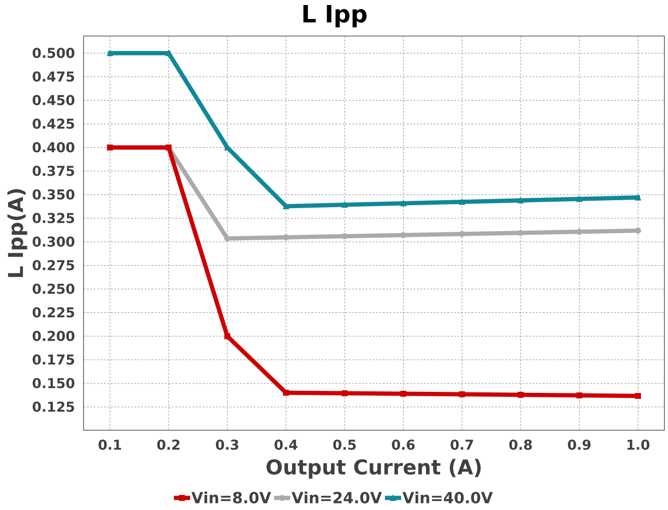

Pout
Pout(W)
Output Current (A)
Vin=8.0V Vin=24.0V Vin=40.0V

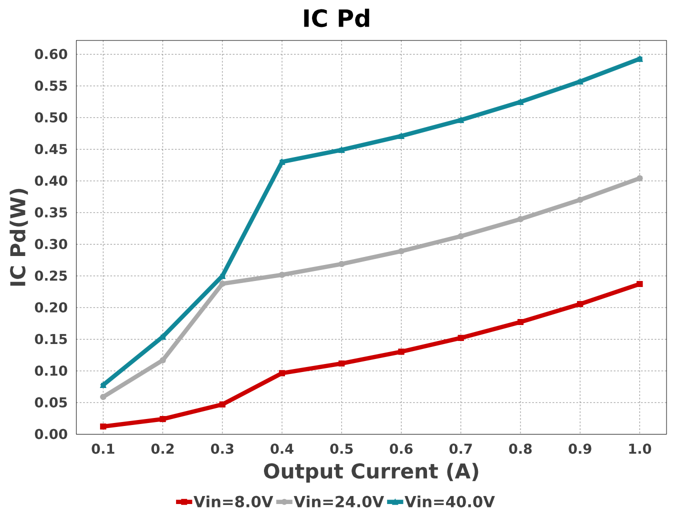

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=8.0V Vin=24.0V Vin=40.0V

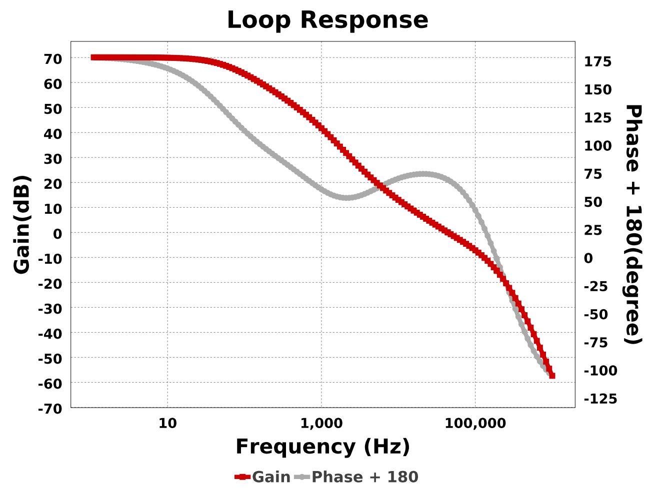

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin=8.0V Vin=24.0V Vin=40.0V

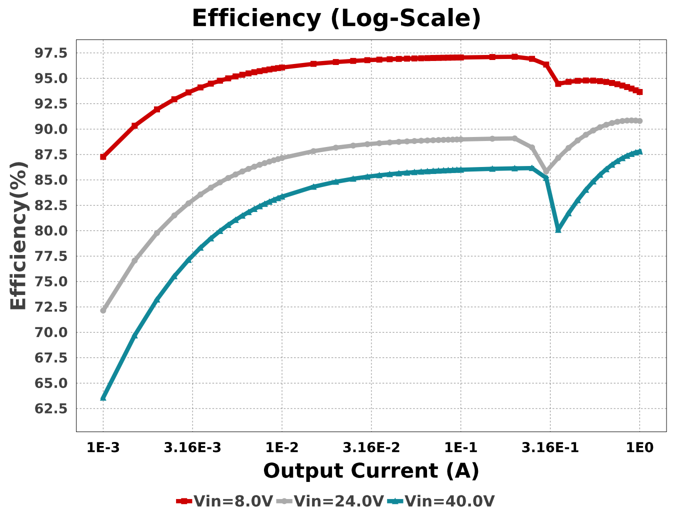

Total Pd
Total Pd(W)
Output Current (A)
Vin=8.0V Vin=24.0V Vin=40.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=8.0V Vin=24.0V Vin=40.0V


L Ipp
L Ipp(A)
Output Current (A)
Vin=8.0V Vin=24.0V Vin=40.0V







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	12		Total Design BOM count
2.	Total BOM	$2.436		Total BOM Cost
3.	Cin IRMS	317.502 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	593.75 µW	Capacitor	Input capacitor power dissipation
5.	Cinx IRMS	22.768 mA	Capacitor	Bulk capacitor RMS ripple current
6.	Cinx Pd	518.38 nW	Capacitor	Bulk capacitor power dissipation
7.	Cout IRMS	100.17 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	18.608 µW	Capacitor	Output capacitor power dissipation
9.	IC Ipk	1.173 A	IC	Peak switch current in IC
10.	IC Pd	592.8 mW	IC	IC power dissipation
11.	IC Tj	54.898 degC	IC	IC junction temperature
12.	IC Tolerance	15.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA Effective	42.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
14.	Iin Avg	142.37 mA	IC	Average input current
15.	Ipp percentage	34.7 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
16.	L Ipp	347.0 mA	Inductor	Peak-to-peak inductor ripple current
17.	L Pd	101.0 mW	Inductor	Inductor power dissipation
18.	Cin Pd	593.75 µW	Power	Input capacitor power dissipation
19.	Cinx Pd	518.38 nW	Power	Bulk capacitor power dissipation
20.	Cout Pd	18.608 µW	Power	Output capacitor power dissipation
21.	IC Pd	592.8 mW	Power	IC power dissipation
22.	L Pd	101.0 mW	Power	Inductor power dissipation
23.	Total Pd	694.652 mW	Power	Total Power Dissipation
24.	Cross Freq	43.957 kHz	System Information	Bode plot crossover frequency
25.	Duty Cycle	13.184 %	System Information	Duty cycle
26.	Efficiency	87.802 %	System Information	Steady state efficiency
27.	FootPrint	279.0 mm^2	System Information	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
28.	Frequency	400.0 kHz	System Information	Switching frequency
29.	Gain Marg	-15.259 dB	System Information	Bode Plot Gain Margin
30.	Iout	1.0 A	System Information	Iout operating point
31.	Low Freq Gain	70.083 dB	System Information	Gain at 1Hz
32.	Mode	CCM	System Information	Conduction Mode
33.	Phase Marg	69.794 deg	System Information	Bode Plot Phase Margin
34.	Pout	5.0 W	System Information	Total output power
35.	Vin	40.0 V	System Information	Vin operating point
36.	Vin p-p	144.379 mV	System Information	Peak-to-peak input voltage
37.	Vout	5.0 V	System Information	Operational Output Voltage
38.	Vout Actual	5.016 V	System Information	Vout Actual calculated based on selected voltage divider resistors
39.	Vout Tolerance	3.142 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout p-p	2.723 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	40.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LMR36510A	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

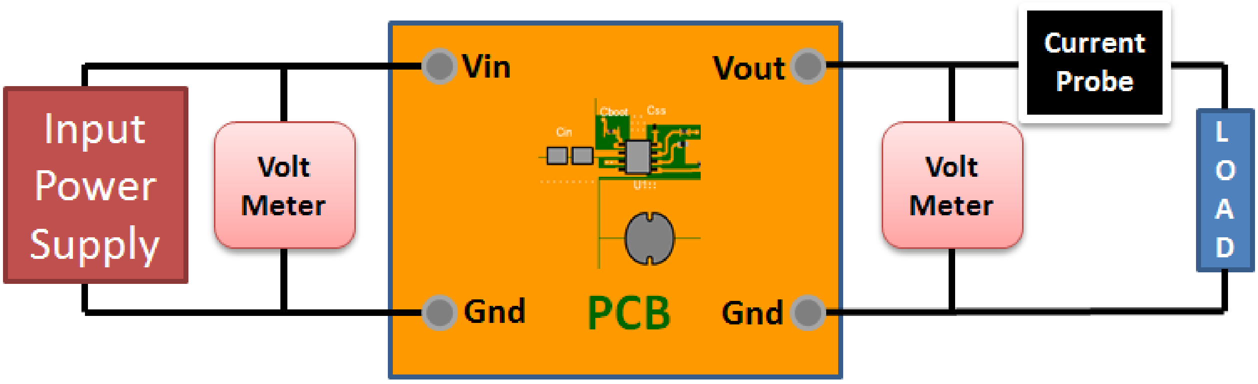
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 8.0V 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.

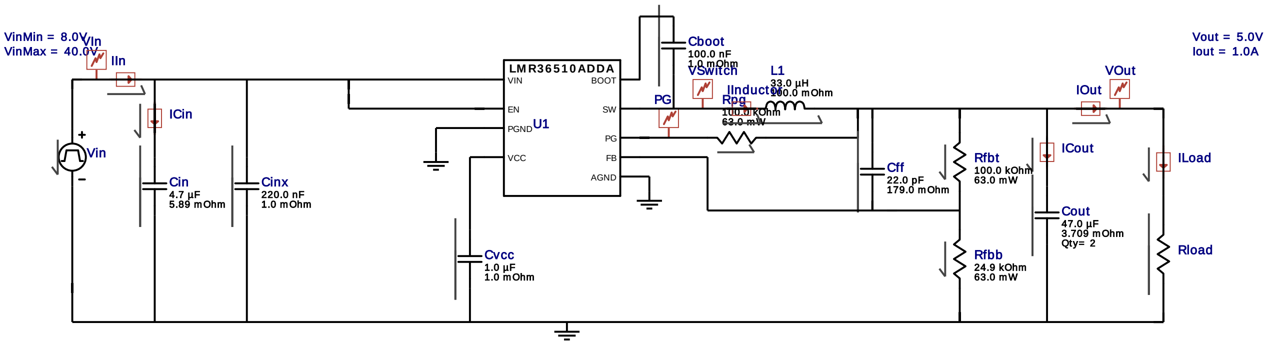


WEBENCH® Electrical Simulation Report

Design Id = 50

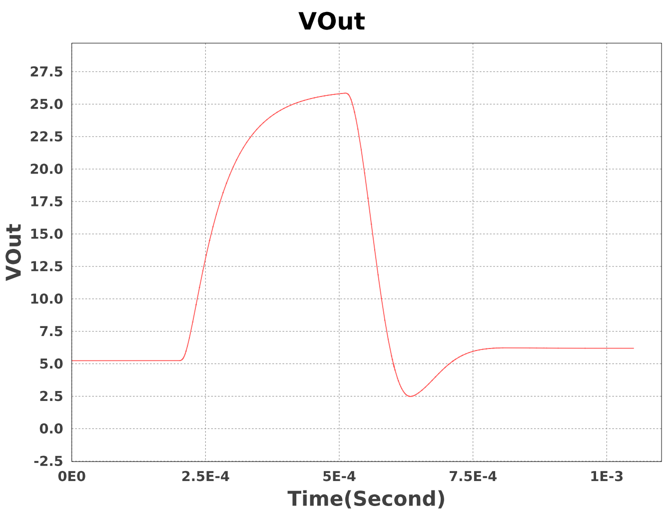
sim_id = 3

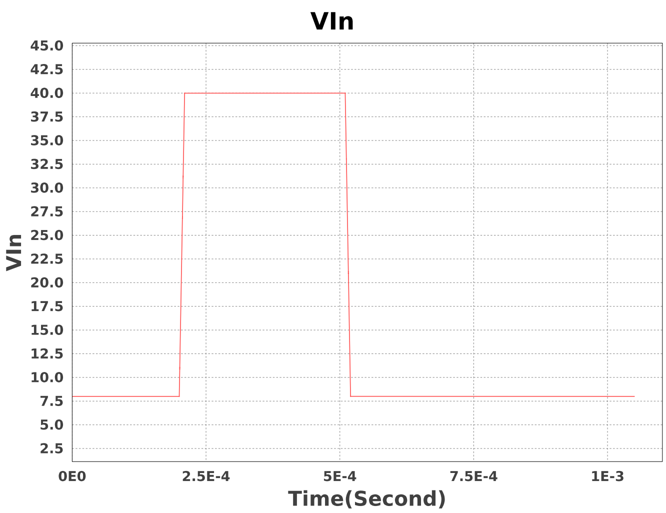
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	1.0 A
2.	Rload	R	load resistance	5.0 ohm





Design Assistance

1. Master key : 5863439BFAEDA59B[v1]

2. **LMR36510A** Product Folder : http://www.ti.com/product/LMR36510 : contains the data sheet and other resources.