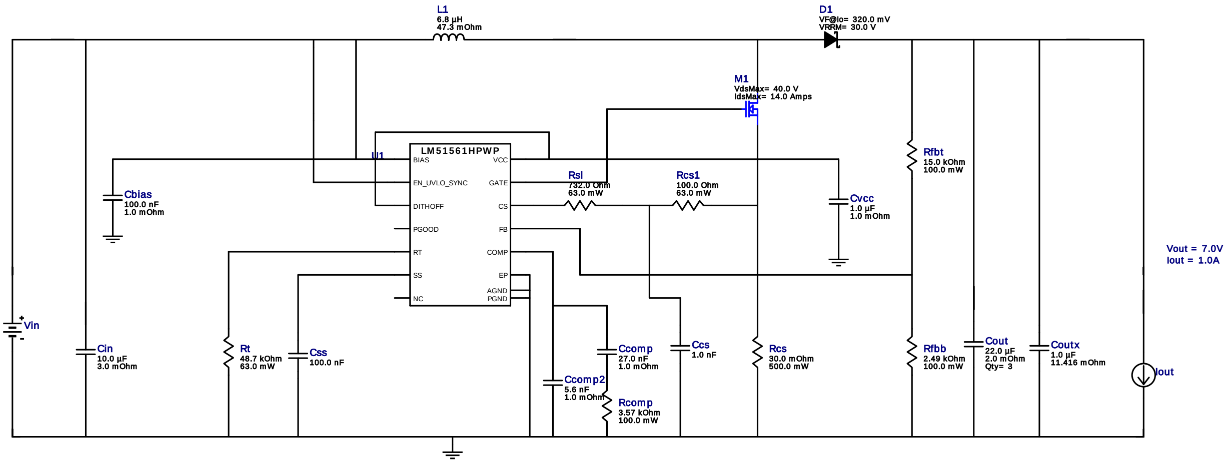
VinMin = 3.5V
VinMax = 4.2V
Vout = 7.0V
Iout = 1.0A

Device = LM51561HPWPR
Topology = Boost
Created = 2024-04-02 12:11:39.716
BOM Cost = $3.03
BOM Count = 22
Total Pd = 0.69W

WEBENCH ® Design Report

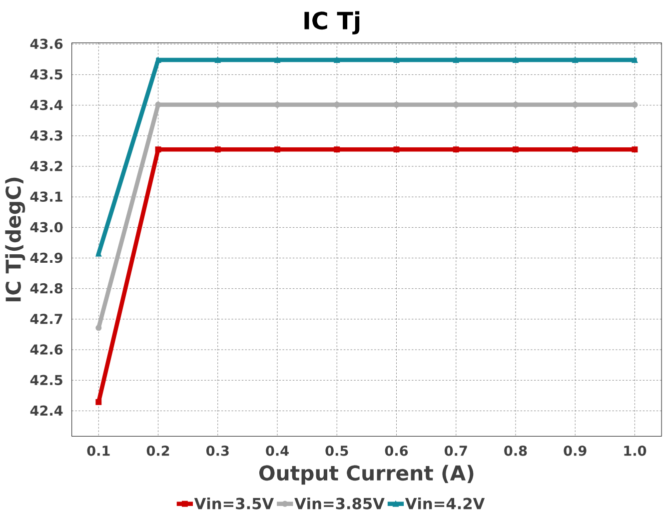
Design : 1 LM51561HPWPR
LM51561HPWPR Boost Converter

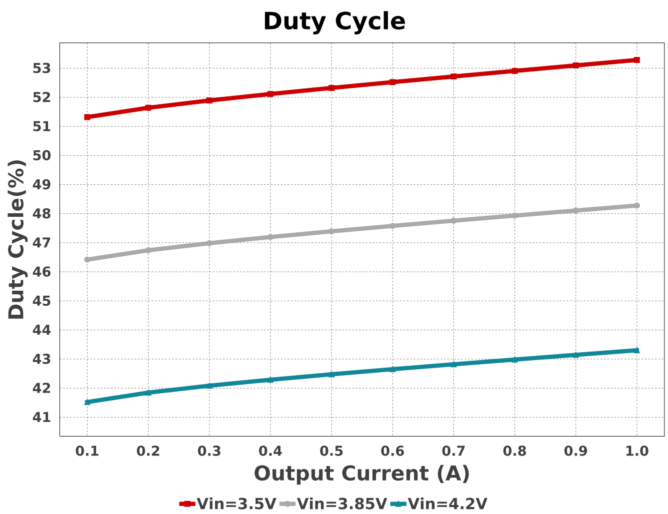


Electrical BOM

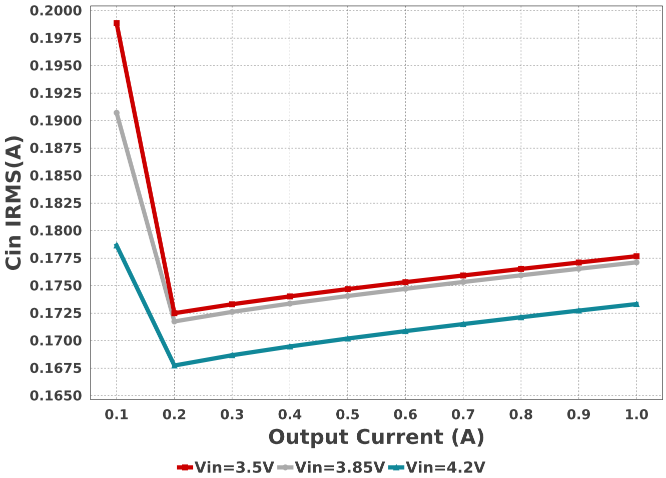
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbias	MuRata	GRM155R70J104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp	MuRata	GRM155R71E273KA88D Series= X7R	Cap= 27.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	MuRata	GRM155R71E562KA01D Series= X7R	Cap= 5.6 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccs	Samsung Electro-Mechanics	CL21C102JBCNNNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	1	$0.03	0805 7 mm^2
Cout	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	3	$0.23	1210 15 mm^2
Coutx	TDK	C1005X6S1C105K050BC Series= X6S	Cap= 1.0 uF ESR= 11.416 mOhm VDC= 16.0 V IRMS= 1.483 A	1	$0.02	0402 3 mm^2
Css	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm^2
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 mm^2
D1	Toshiba	CMS06	VF@Io= 320.0 mV VRRM= 30.0 V	1	$0.20	M-FLAT 19 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Bourns	SRN6045-6R8Y	L= 6.8 µH 47.3 mOhm	1	$0.25	SRN6045 64 mm²
M1	Fairchild Semiconductor	FDD8647L	VdsMax= 40.0 V IdsMax= 14.0 Amps	1	$0.70	DPAK 102 mm²
Rcomp	Susumu Co Ltd	RG1608P-3571-B-T5 Series= RG1608	Res= 3.57 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	0603 5 mm²
Rcs	Stackpole Electronics Inc	CSR1206FK30L0 Series= ?	Res= 30.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm²
Rcs1	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Susumu Co Ltd	RG1608P-2491-B-T5 Series= RG1608	Res= 2.49 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	0603 5 mm²
Rfbt	Susumu Co Ltd	RG1608P-153-B-T5 Series= RG1608	Res= 15.0 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.04	0603 5 mm²
Rsl	Vishay-Dale	CRCW0402732RFKED Series= CRCW..e3	Res= 732.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rt	Vishay-Dale	CRCW040248K7FKED Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LM51561HPWPR	Switcher	1	$0.73	PWP0014H 59 mm²

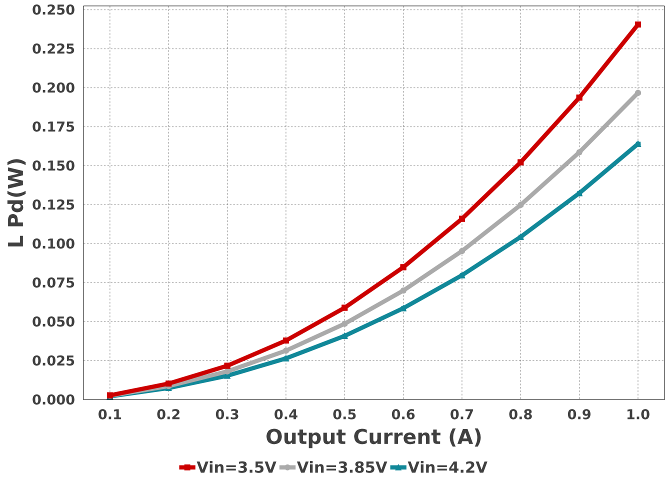




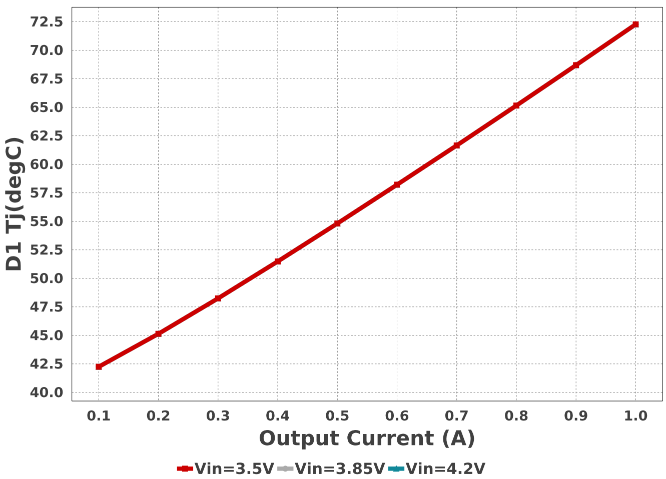
Cin IRMS



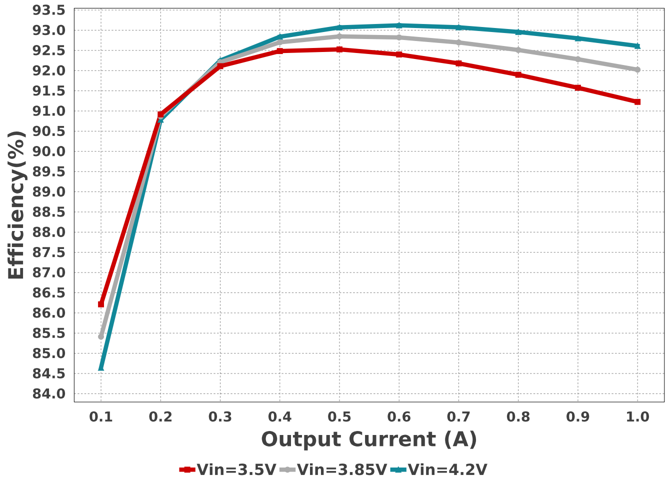
L Pd



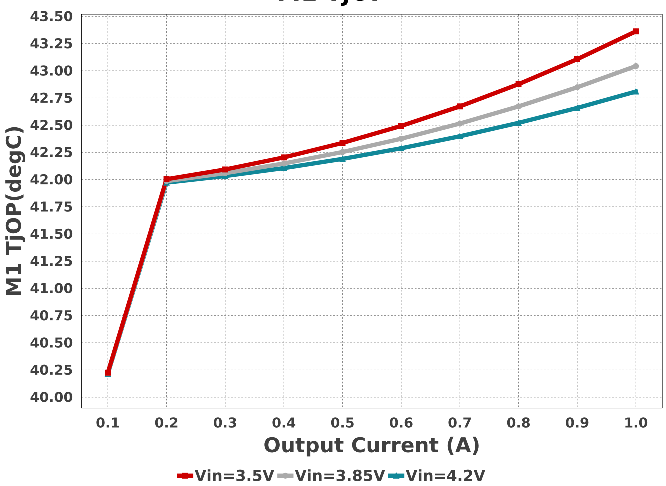
D1 Tj



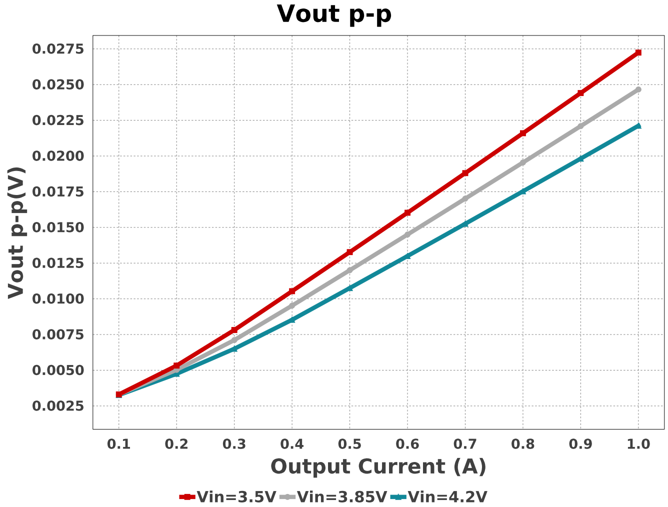
Efficiency

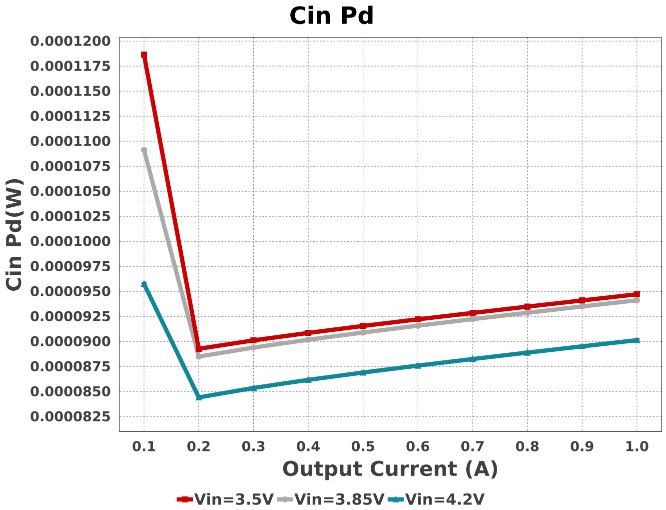


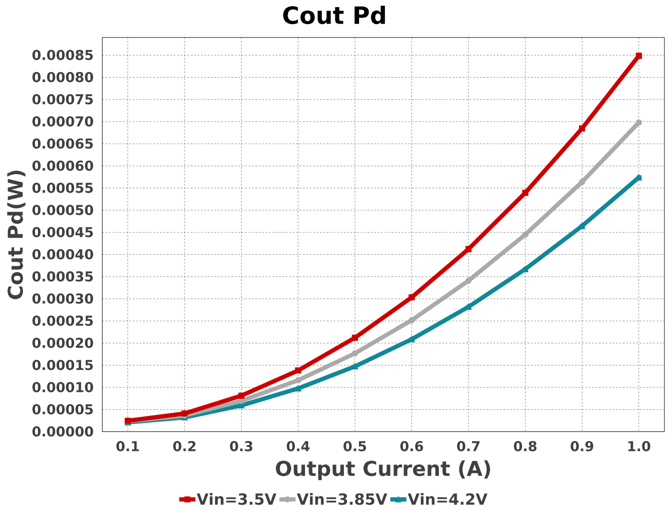
M1 TjOP

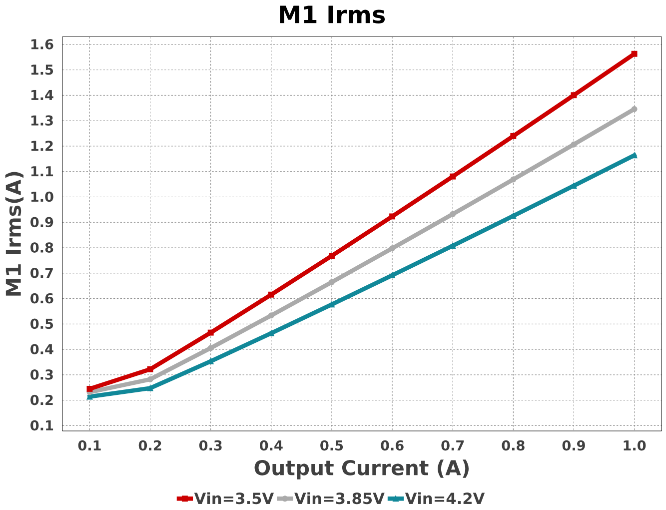


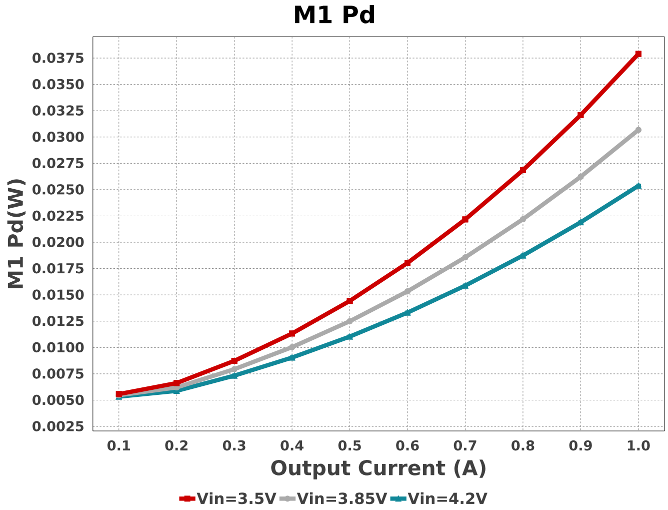
Vout p-p

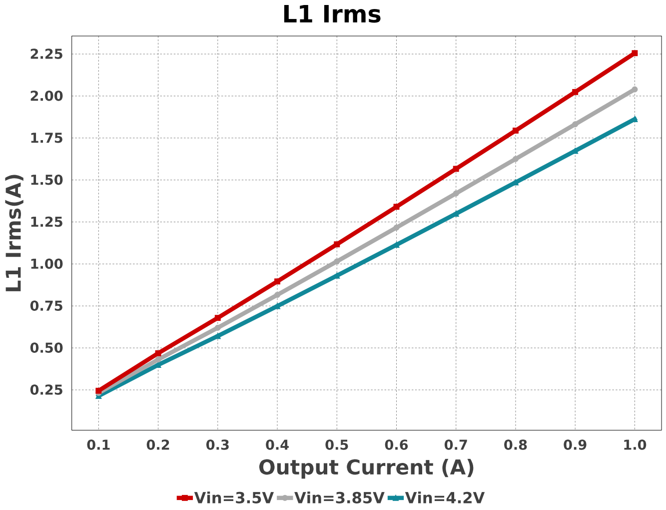


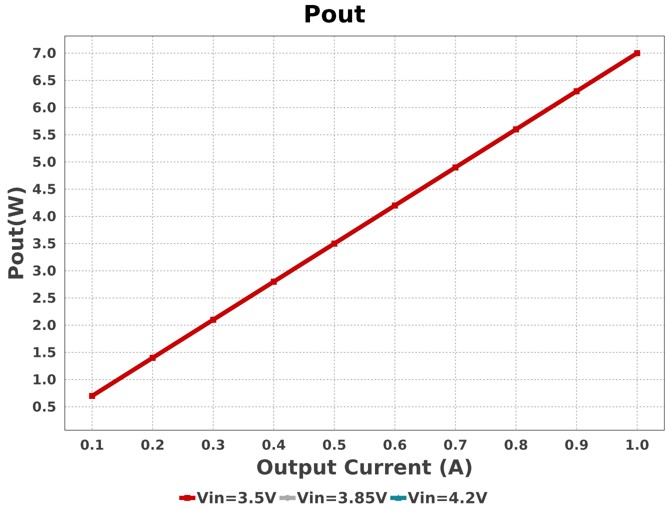

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

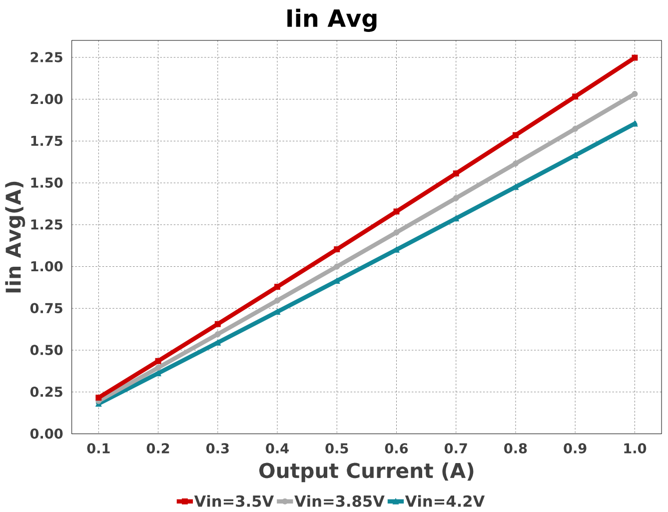

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

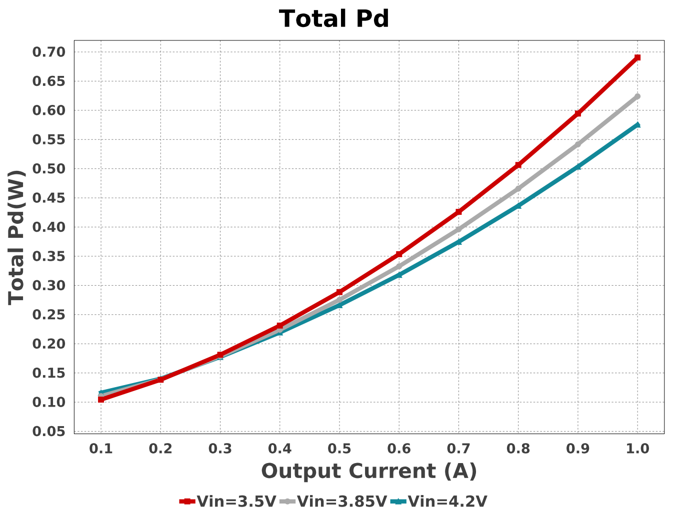

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

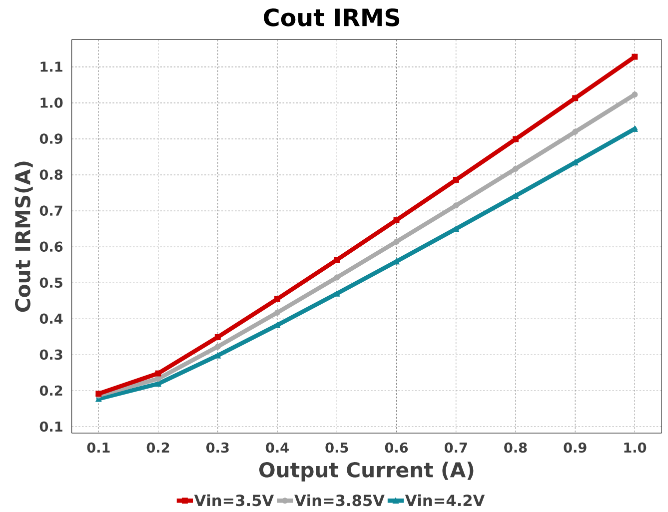

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

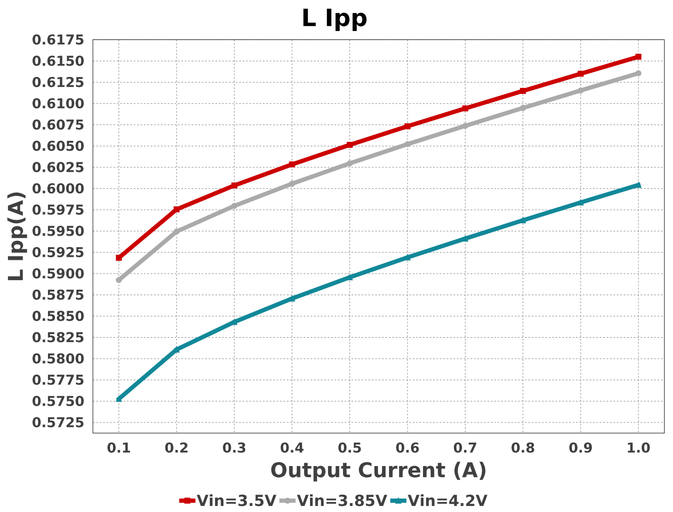

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

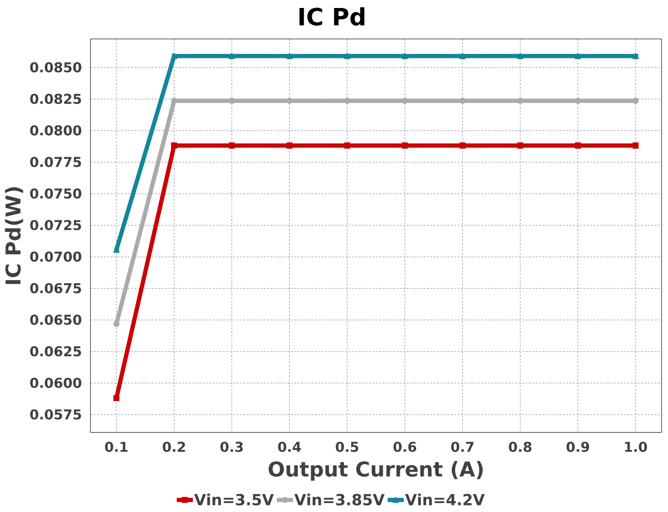

Pout
Pout(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

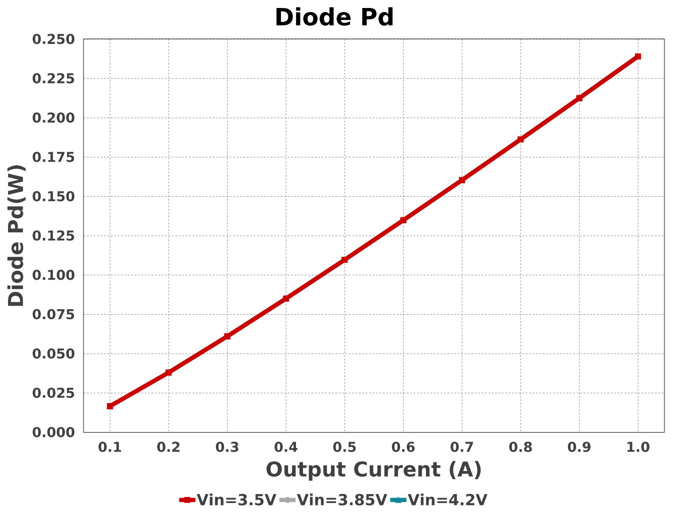

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

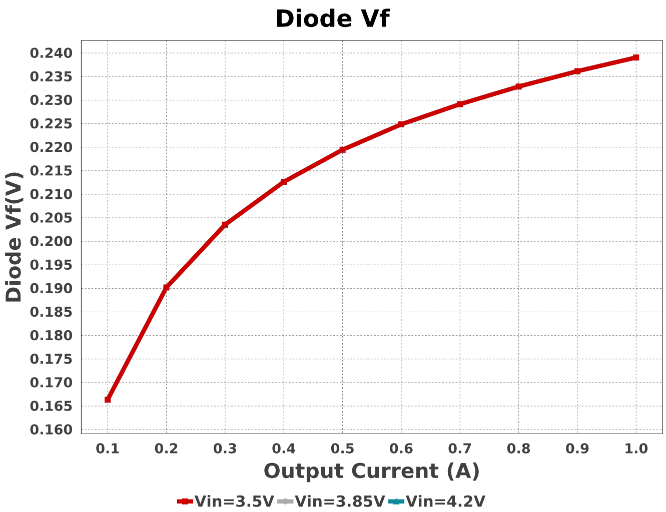

Total Pd
Total Pd(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V

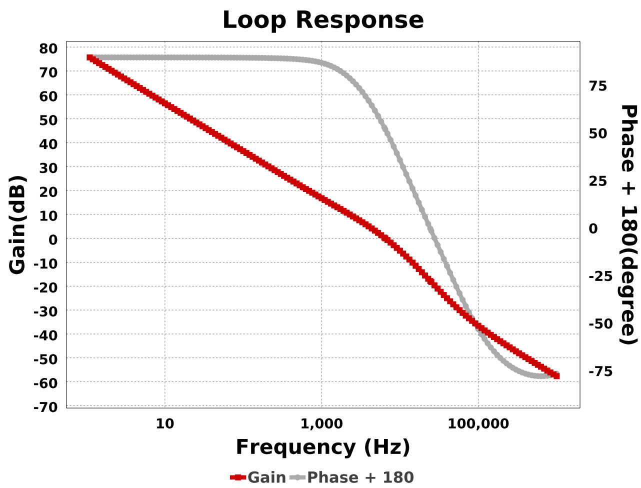

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V


L Ipp
L Ipp(A)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V


IC Pd
IC Pd(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V


Diode Pd
Diode Pd(W)
Output Current (A)
Vin=3.5V Vin=3.85V Vin=4.2V





Operating Values

#	Name	Value	Category	Description
1.	BOM Count	22		Total Design BOM count
2.	Total BOM	$3.03		Total BOM Cost
3.	Cin IRMS	177.679 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	94.709 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	1.128 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	848.63 µW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	72.272 degC	Diode	D1 junction temperature
8.	Diode Pd	239.05 mW	Diode	Diode power dissipation
9.	Diode Vf	239.053 mV	Diode	Forward voltage drop of diode D1
10.	IC Pd	78.819 mW	IC	IC power dissipation
11.	IC Tj	43.255 degC	IC	IC junction temperature
12.	ICThetaJA	41.3 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	2.248 A	IC	Average input current
14.	L Ipp	615.498 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	240.58 mW	Inductor	Inductor power dissipation
16.	L1 Irms	2.255 A	Inductor	Inductor ripple current
17.	M1 Irms	1.563 A	Mosfet	Q Iavg
18.	M1 Pd	37.898 mW	Mosfet	MOSFET power dissipation
19.	M1 TjOP	43.363 degC	Mosfet	M1 MOSFET junction temperature
20.	Cin Pd	94.709 µW	Power	Input capacitor power dissipation
21.	Cout Pd	848.63 µW	Power	Output capacitor power dissipation
22.	Diode Pd	239.05 mW	Power	Diode power dissipation
23.	IC Pd	78.819 mW	Power	IC power dissipation
24.	L Pd	240.58 mW	Power	Inductor power dissipation
25.	M1 Pd	37.898 mW	Power	MOSFET power dissipation
26.	Total Pd	690.478 mW	Power	Total Power Dissipation
27.	Cross Freq	5.588 kHz	System Information	Bode plot crossover frequency
28.	Duty Cycle	53.284 %	System Information	Duty cycle
29.	Efficiency	91.225 %	System Information	Steady state efficiency
30.	FootPrint	359.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	444.713 kHz	System Information	Switching frequency
32.	Iout	1.0 A	System Information	Iout operating point
33.	Mode	CCM	System Information	Conduction Mode
34.	Phase Marg	54.932 deg	System Information	Bode Plot Phase Margin
35.	Pout	7.0 W	System Information	Total output power
36.	Vin	3.5 V	System Information	Vin operating point
37.	Vout Actual	7.024 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	1.173 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	27.241 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	4.2	Maximum input voltage
VinMin	3.5	Minimum input voltage
Vout	7.0	Output Voltage
base_pn	LM51561H	Base Product Number
source	DC	Input Source Type
Ta	40.0	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

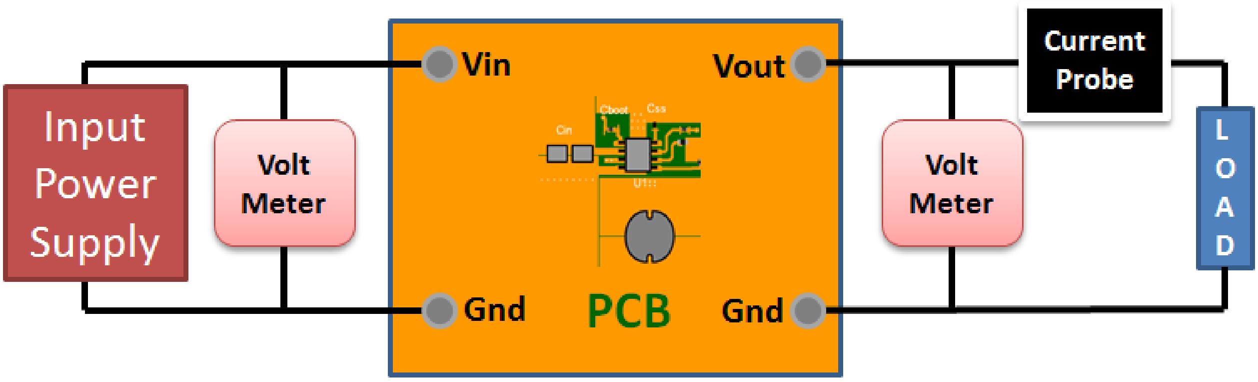
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.5V 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 : D0AD45AA4A7E653181C77A6C597E571A[v1]

2. **LM51561H** Product Folder : http://www.ti.com/product/LM51561H : contains the data sheet and other resources.

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