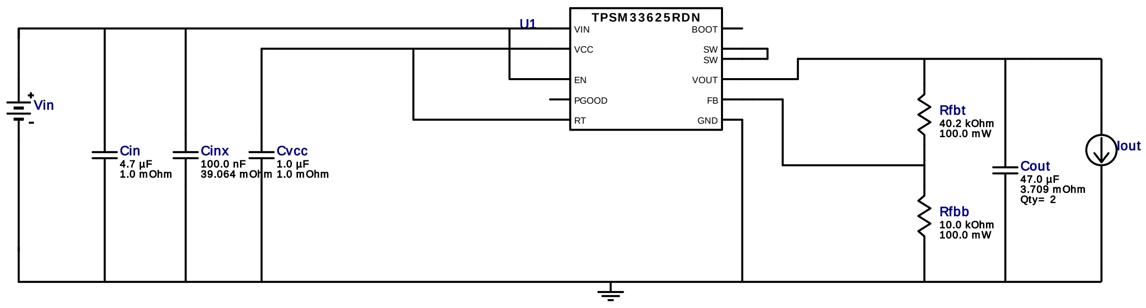
VinMin = 8.0V
VinMax = 35.0V
Vout = 5.0V
Iout = 2.5A

Device = TPSM33625RDNR
Topology = Buck
Created = 2024-07-31 09:00:35.507
BOM Cost = $2.03
BOM Count = 8
Total Pd = 1.6W

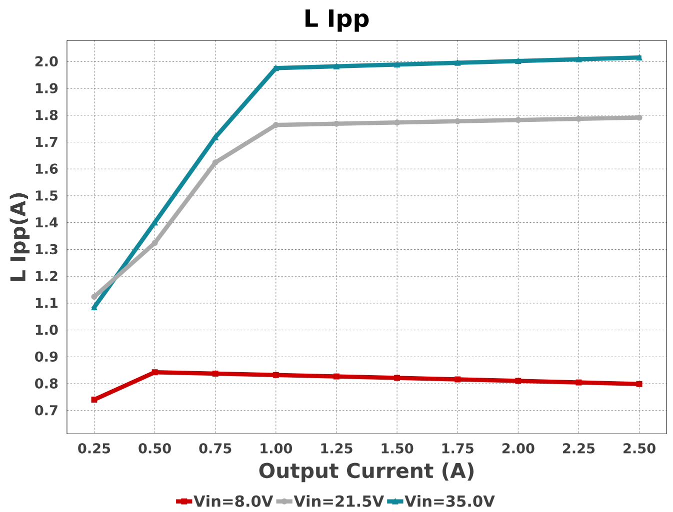
WEBENCH ® Design Report

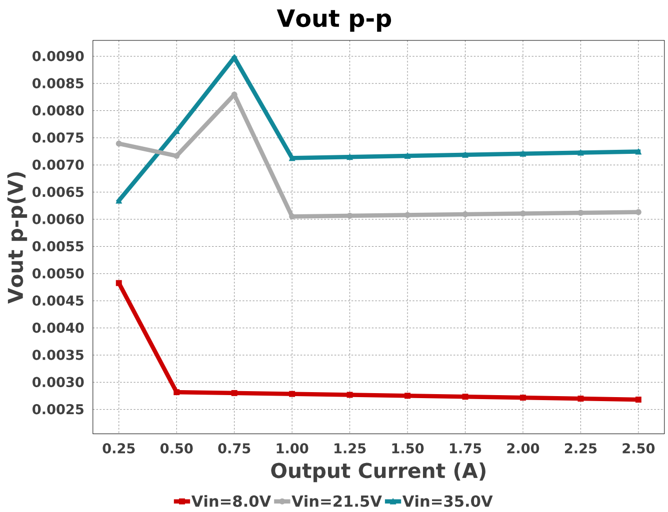
Design : 2 TPSM33625RDNR
TPSM33625RDNR 8V-35V to 5.00V @ 2.5A

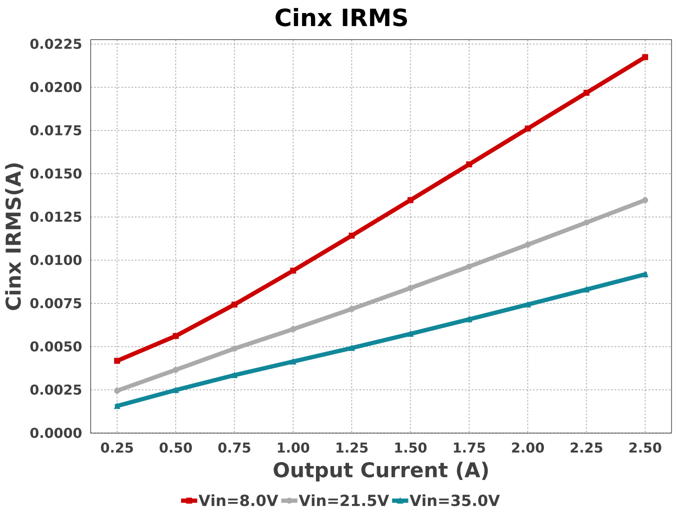


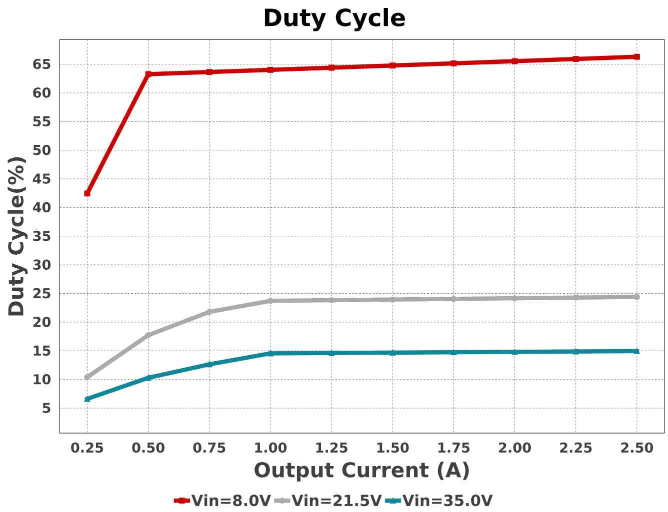
Electrical BOM

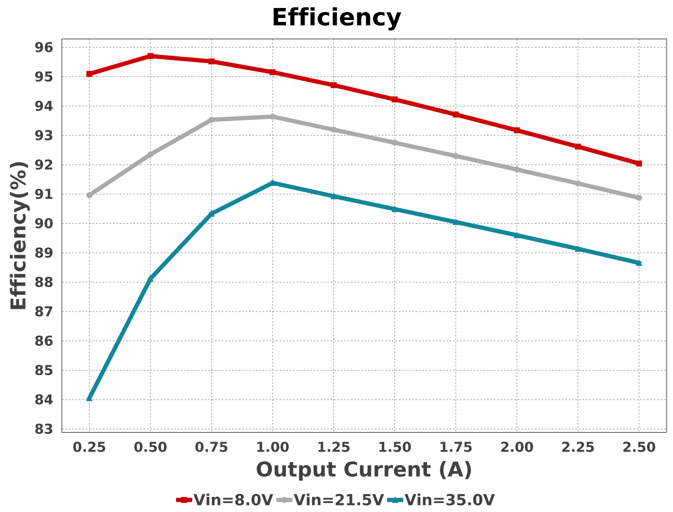
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 6.0 A	1	$0.16	1210 15 mm^2
Cinx	TDK	CGA2B3X7R1H104K050BB Series= X7R	Cap= 100.0 nF ESR= 39.064 mOhm VDC= 50.0 V IRMS= 814.67 mA	1	$0.02	0402 3 mm^2
Cout	MuRata	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 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
Rfbb	Yageo	RC0603FR-0710KL Series= ?	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbt	Vishay-Dale	CRCW060340K2FKEA Series= CRCW..e3	Res= 40.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
U1	Texas Instruments	TPSM33625RDNR	Switcher	1	$1.40	RPE0009A 9 mm^2

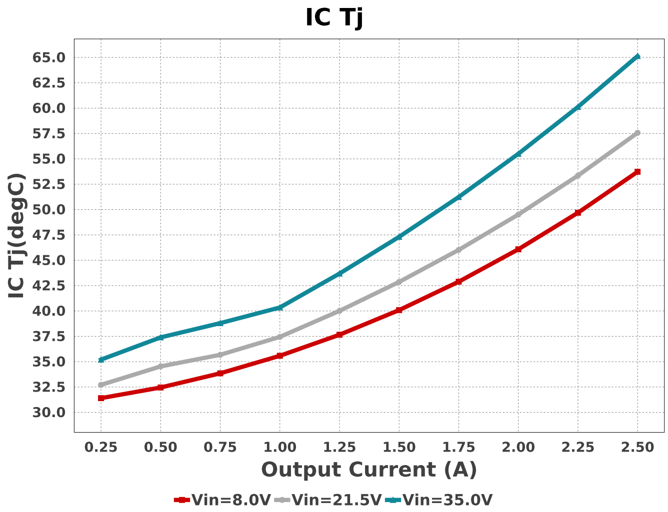

L Ipp
L Ipp(A)
Output Current (A)
Vin=8.0V
Vin=21.5V
Vin=35.0V


Vout p-p
Vout p-p(V)
Output Current (A)
Vin=8.0V
Vin=21.5V
Vin=35.0V

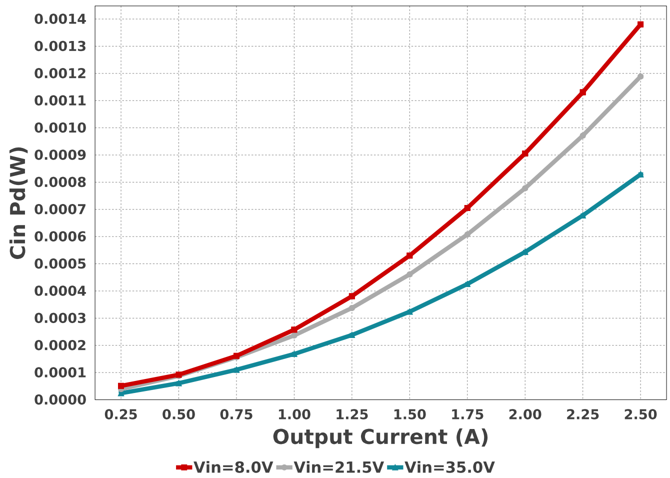

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin=8.0V
Vin=21.5V
Vin=35.0V


Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=8.0V
Vin=21.5V
Vin=35.0V

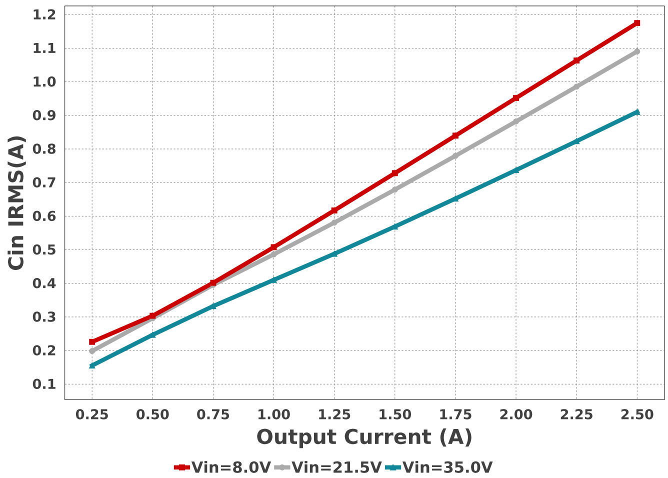

Efficiency
Efficiency(%)
Output Current (A)
Vin=8.0V
Vin=21.5V
Vin=35.0V


IC Tj
IC Tj(degC)
Output Current (A)
Vin=8.0V
Vin=21.5V
Vin=35.0V

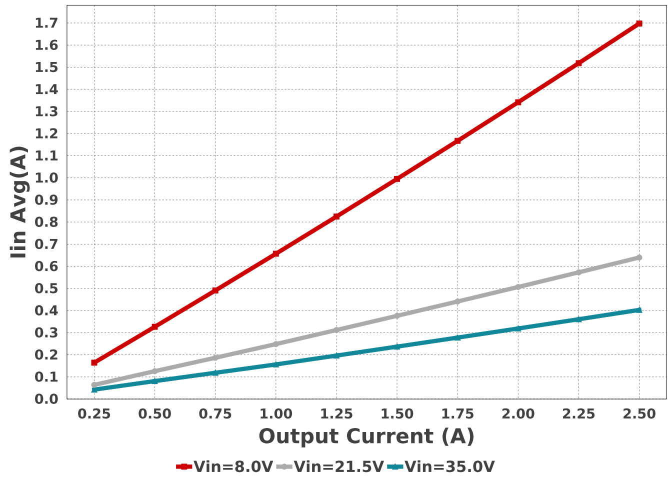
Cin Pd



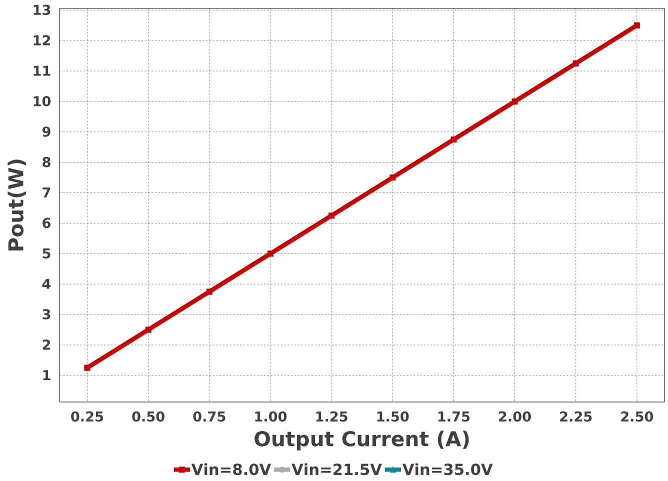
Cin IRMS



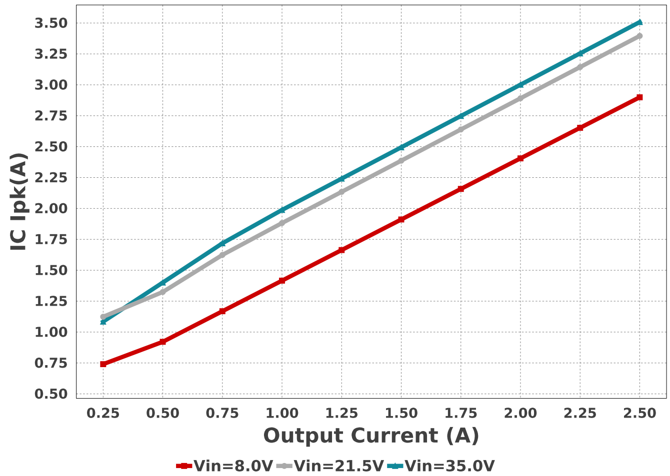
Iin Avg



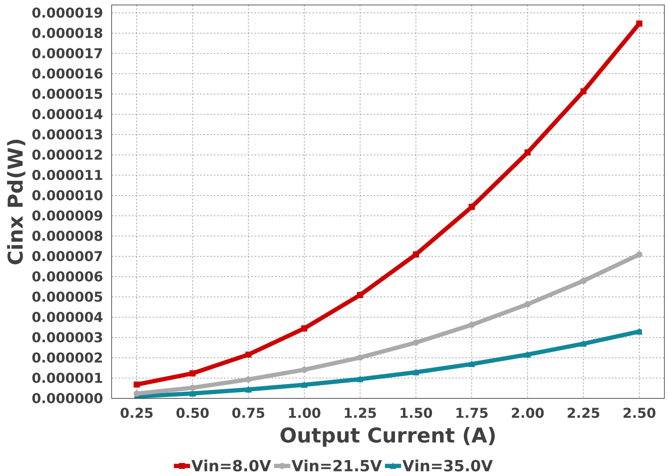
Pout

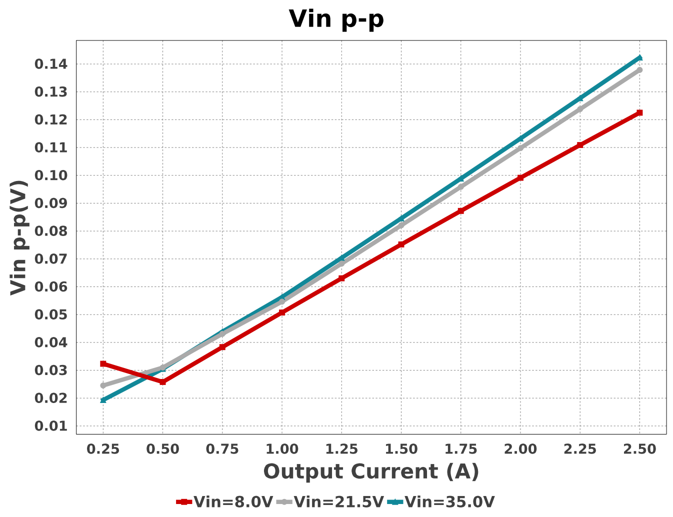


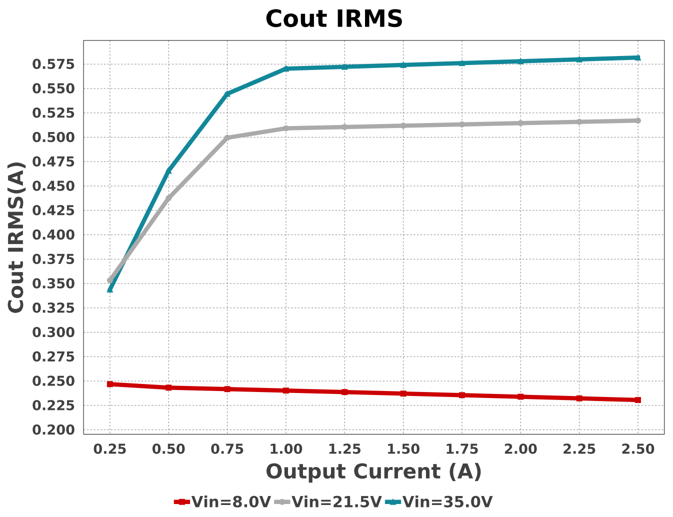
IC Ipk

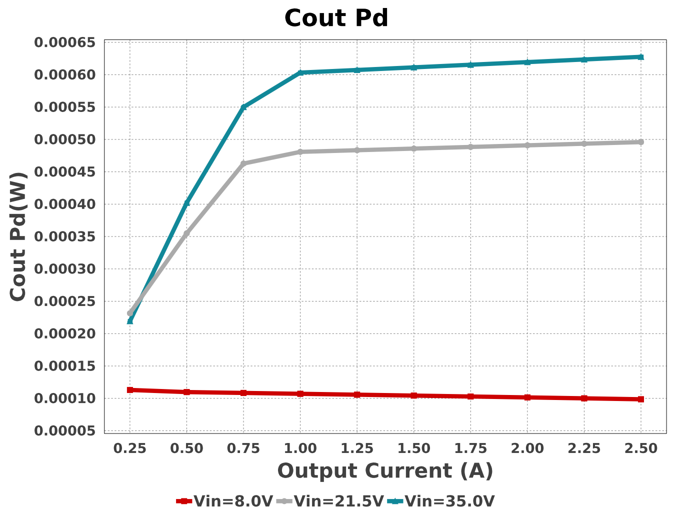


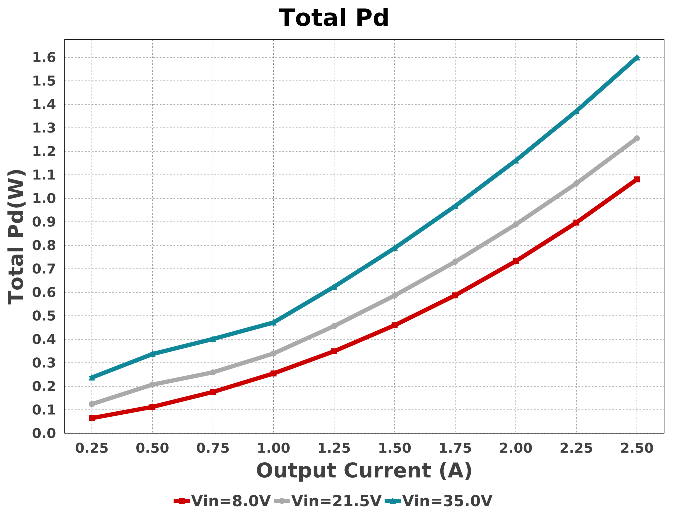
Cinx Pd

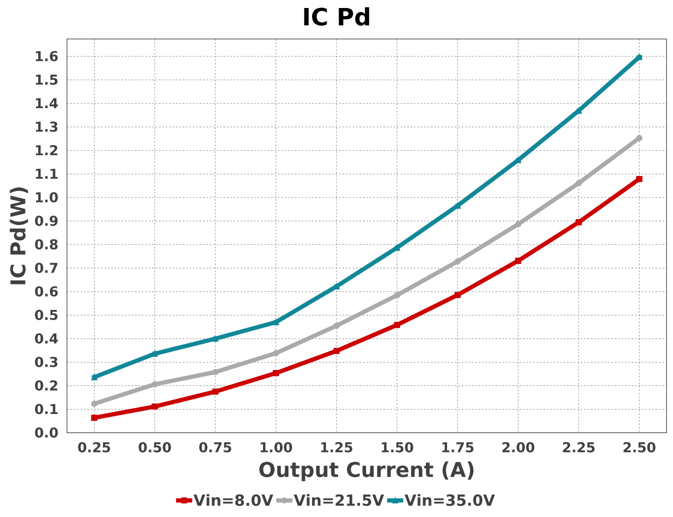


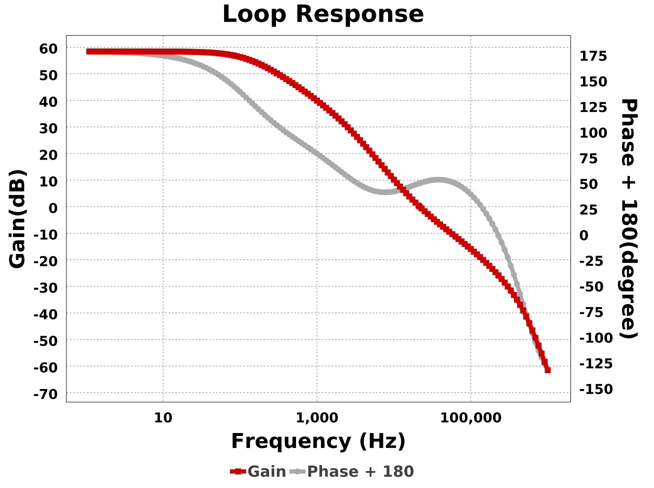

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=8.0V Vin=21.5V Vin=35.0V

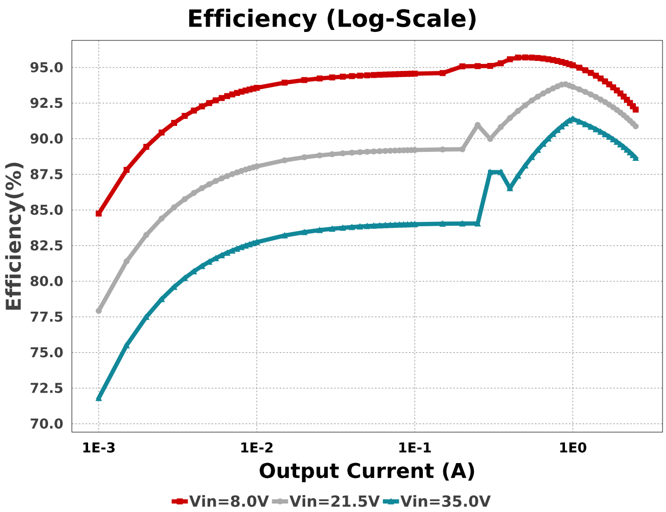

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=8.0V Vin=21.5V Vin=35.0V


Cout Pd
Cout Pd(W)
Output Current (A)
Vin=8.0V Vin=21.5V Vin=35.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=8.0V Vin=21.5V Vin=35.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=8.0V Vin=21.5V Vin=35.0V


Loop Response
Gain(dB)
Phase + 180(degree)
Frequency (Hz)
Gain Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	8		Total Design BOM count
2.	Total BOM	$2.03		Total BOM Cost
3.	Cin IRMS	910.271 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	828.59 µW	Capacitor	Input capacitor power dissipation
5.	Cinx IRMS	9.182 mA	Capacitor	Bulk capacitor RMS ripple current
6.	Cinx Pd	3.294 µW	Capacitor	Bulk capacitor power dissipation
7.	Cout IRMS	581.742 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	627.61 µW	Capacitor	Output capacitor power dissipation
9.	IC Ipk	3.508 A	IC	Peak switch current in IC
10.	IC Pd	1.597 W	IC	IC power dissipation
11.	IC Tj	65.14 degC	IC	IC junction temperature
12.	IC Tolerance	12.5 mV	IC	IC Feedback Tolerance
13.	ICThetaJA Effective	22.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
14.	Iin Avg	402.84 mA	IC	Average input current
15.	Cin Pd	828.59 µW	Power	Input capacitor power dissipation
16.	Cinx Pd	3.294 µW	Power	Bulk capacitor power dissipation
17.	Cout Pd	627.61 µW	Power	Output capacitor power dissipation
18.	IC Pd	1.597 W	Power	IC power dissipation
19.	Total Pd	1.599 W	Power	Total Power Dissipation
20.	Cross Freq	21.641 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	14.952 %	System Information	Duty cycle
22.	Efficiency	88.657 %	System Information	Steady state efficiency
23.	FootPrint	63.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	1000.0 kHz	System Information	Switching frequency
25.	Gain Marg	-25.842 dB	System Information	Bode Plot Gain Margin
26.	Iout	2.5 A	System Information	Iout operating point
27.	L Ipp	2.015 A	System Information	Peak-to-peak inductor ripple current
28.	Low Freq Gain	58.419 dB	System Information	Gain at 1Hz
29.	Mode	CCM	System Information	Conduction Mode
30.	Phase Marg	50.957 deg	System Information	Bode Plot Phase Margin
31.	Pout	12.5 W	System Information	Total output power
32.	Vin	35.0 V	System Information	Vin operating point
33.	Vin p-p	142.315 mV	System Information	Peak-to-peak input voltage
34.	Vout	5.0 V	System Information	Operational Output Voltage
35.	Vout Actual	5.02 V	System Information	Vout Actual calculated based on selected voltage divider resistors

#	Name	Value	Category	Description
36.	Vout Tolerance	2.888 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	7.246 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.5	Maximum Output Current
VinMax	35.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPSM33625	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

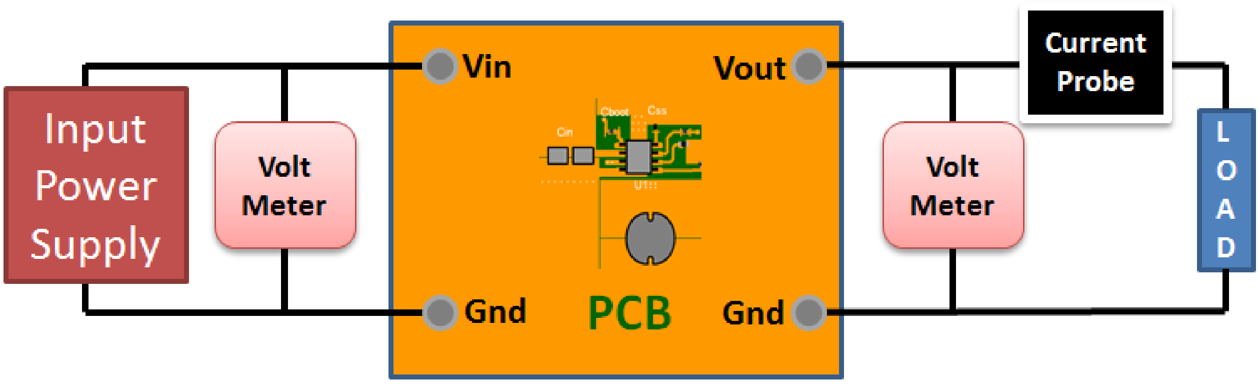
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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



Design Assistance

1. Master key : 2703625DAEF3863DD9FE52FC7C08223E[v1]

2. **TPSM33625** Product Folder : http://www.ti.com/product/TPSM33625 : contains the data sheet and other resources.