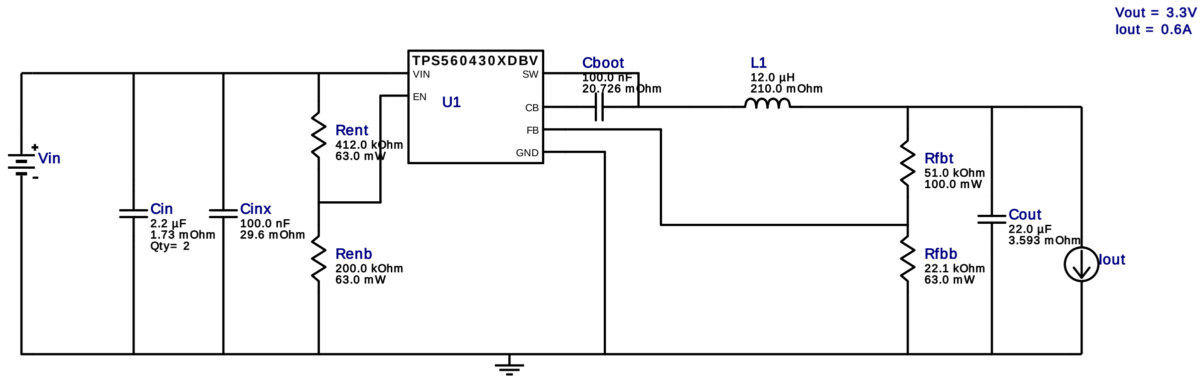
VinMin = 8.0V
VinMax = 36.0V
Vout = 3.3V
Iout = 0.6A

Device = TPS560430XDBVR
Topology = Buck
Created = 2024-12-01 02:06:07.644
BOM Cost = $1.01
BOM Count = 11
Total Pd = 0.57W

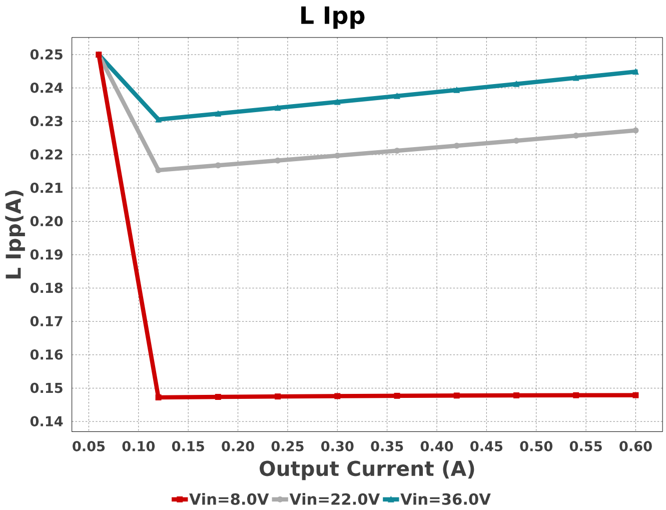
WEBENCH ® Design Report

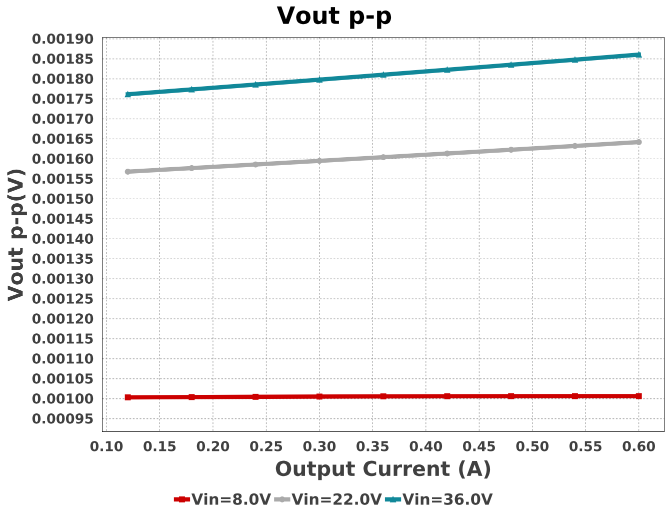
Design : 82 TPS560430XDBVR
TPS560430XDBVR 8V-36V to 3.30V @ 0.6A

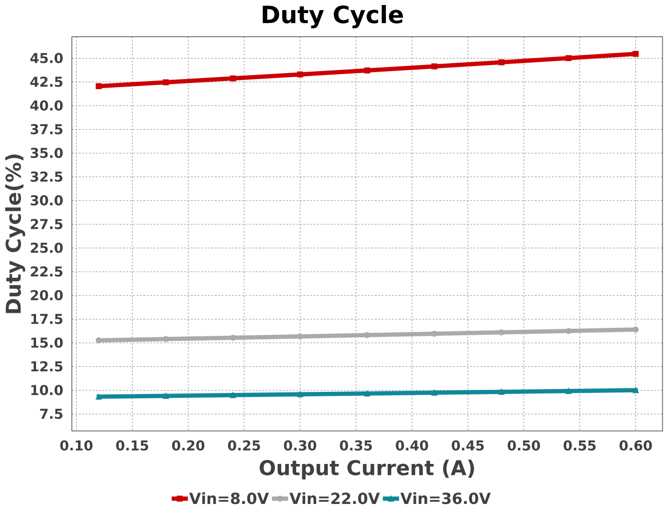


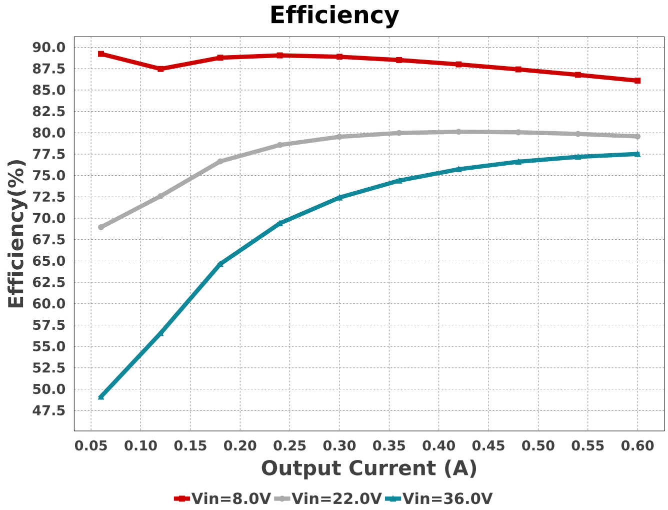
Electrical BOM

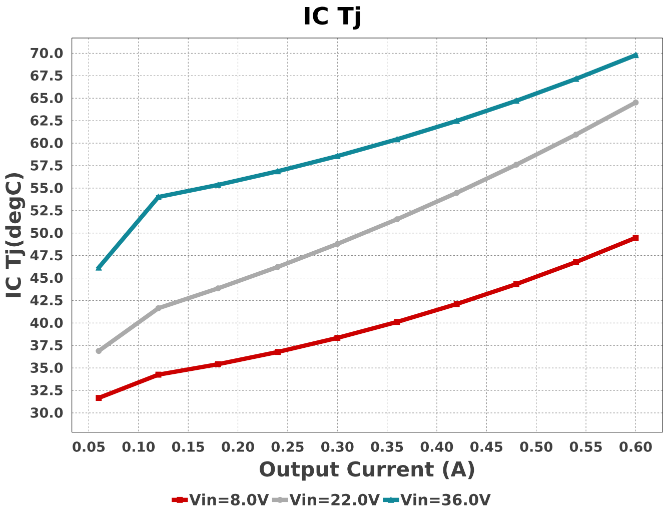
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	TDK	C2012X7R2A104K125AA Series= X7R	Cap= 100.0 nF ESR= 20.726 mOhm VDC= 100.0 V IRMS= 1.456 A	1	$0.03	0805 7 mm²
Cin	TDK	C3225X7R2A225K230AB Series= X7R	Cap= 2.2 uF ESR= 1.73 mOhm VDC= 100.0 V IRMS= 5.5932 A	2	$0.21	1210_250 15 mm²
Cinx	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	$0.01	0603 5 mm²
Cout	MuRata	GRM31CR71A226KE15L Series= X7R	Cap= 22.0 uF ESR= 3.593 mOhm VDC= 10.0 V IRMS= 3.5332 A	1	$0.12	1206_190 11 mm²
L1	NIC Components	NPI43C120MTRF	L= 12.0 µH 210.0 mOhm	1	$0.07	IND_NPI43C 31 mm²
Renb	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rent	Vishay-Dale	CRCW0402412KFKED Series= CRCW..e3	Res= 412.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Yageo	RC0603FR-0751KL Series= ?	Res= 51.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
U1	Texas Instruments	TPS560430XDBVR	Switcher	1	$0.32	DBV0006A 15 mm²

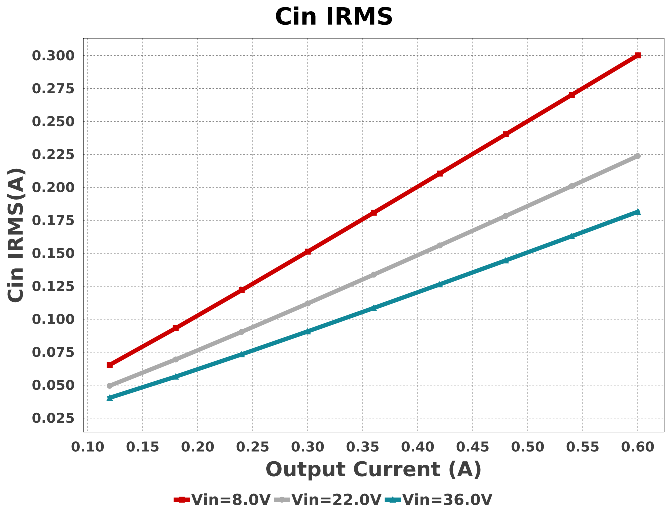

L Ipp
L Ipp(A)
Output Current (A)
Vin=8.0V
Vin=22.0V
Vin=36.0V

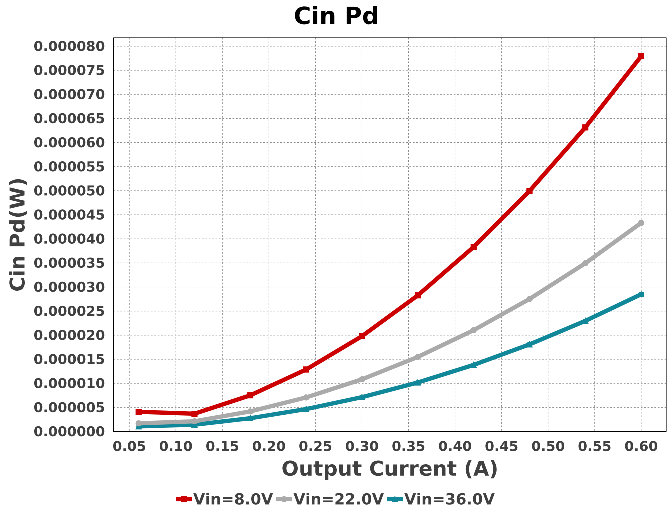

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=8.0V
Vin=22.0V
Vin=36.0V

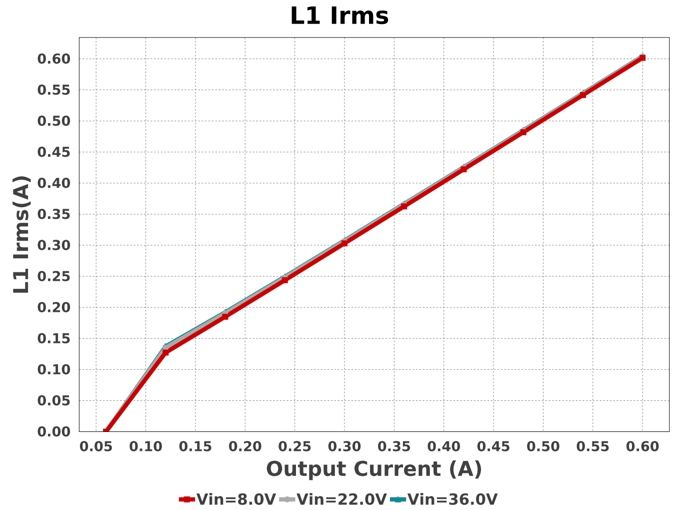

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=8.0V
Vin=22.0V
Vin=36.0V

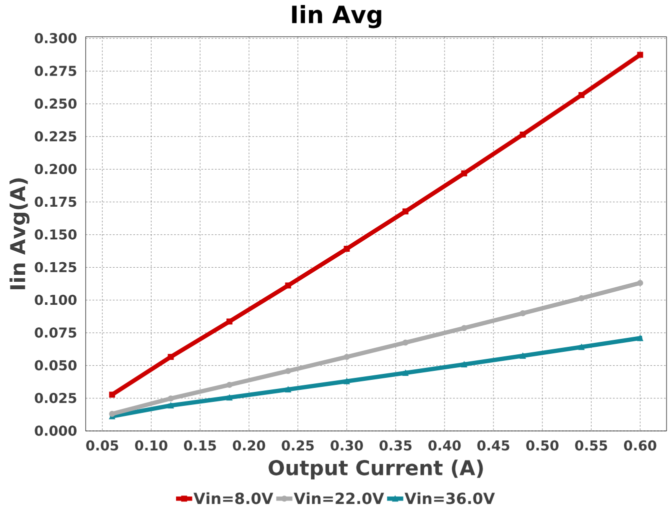

Efficiency
Efficiency(%)
Output Current (A)
Vin=8.0V
Vin=22.0V
Vin=36.0V

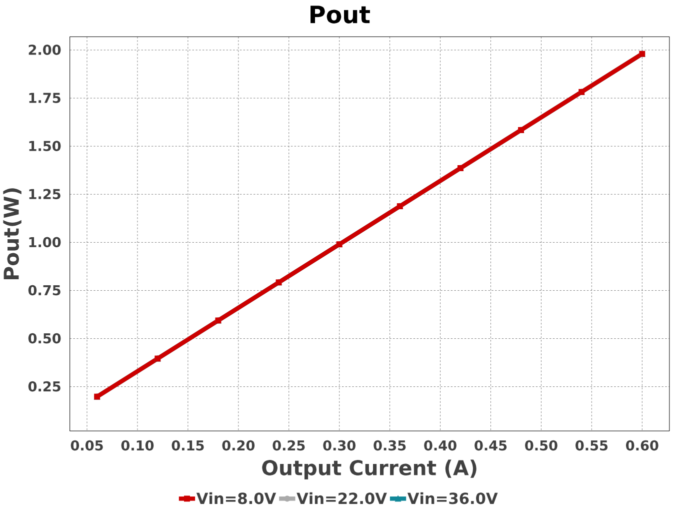

IC Tj
IC Tj(degC)
Output Current (A)
Vin=8.0V
Vin=22.0V
Vin=36.0V

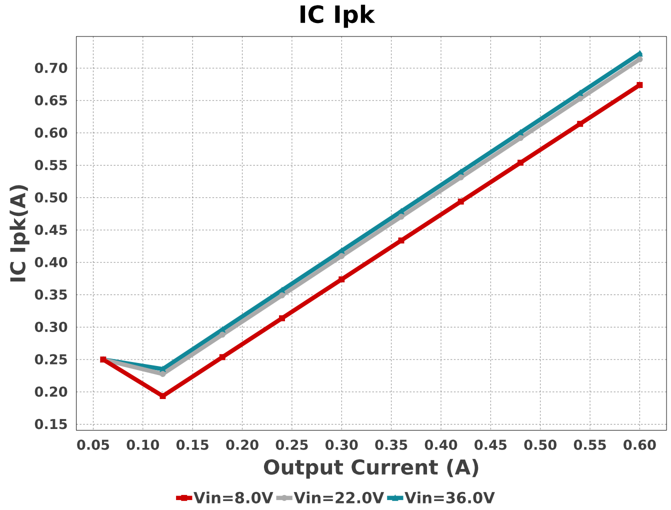

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=8.0V
Vin=22.0V
Vin=36.0V

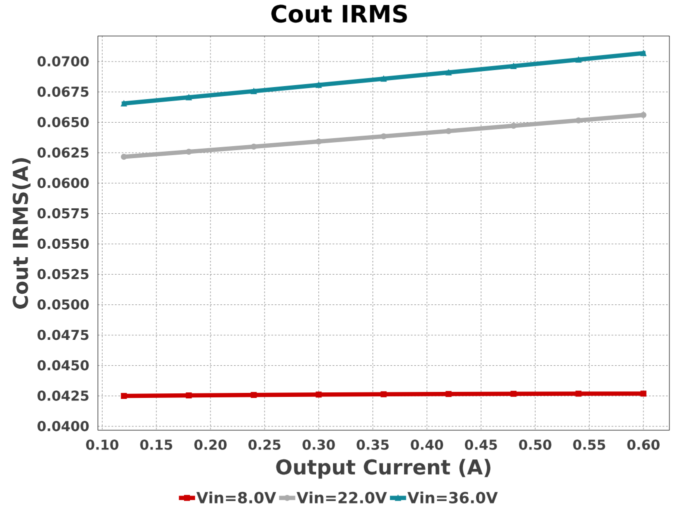

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

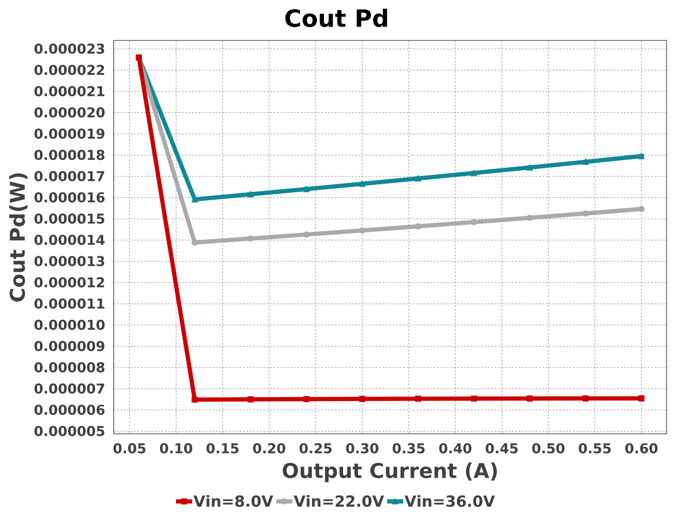

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

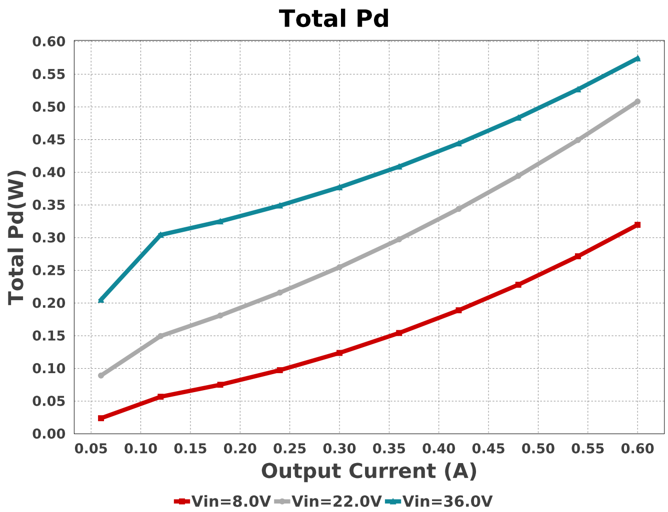

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

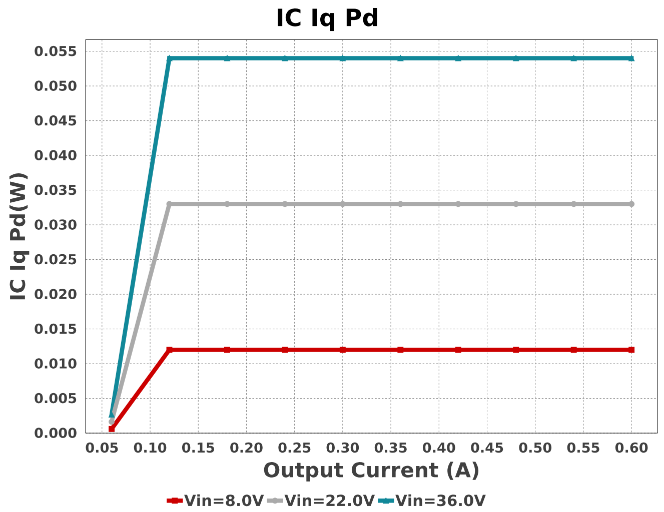

Pout
Pout(W)
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

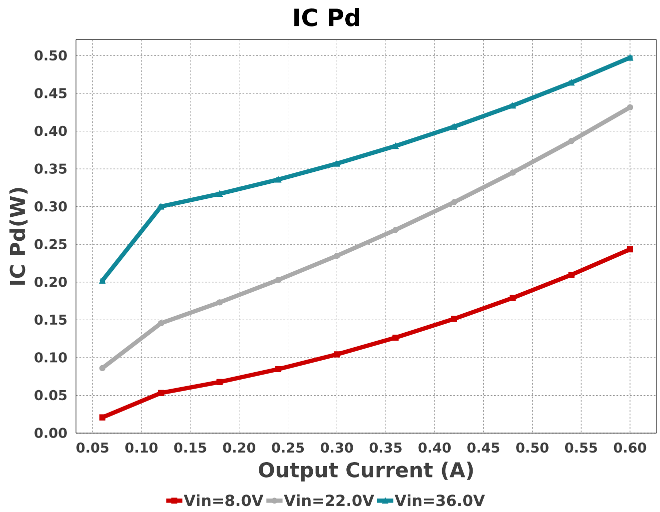

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

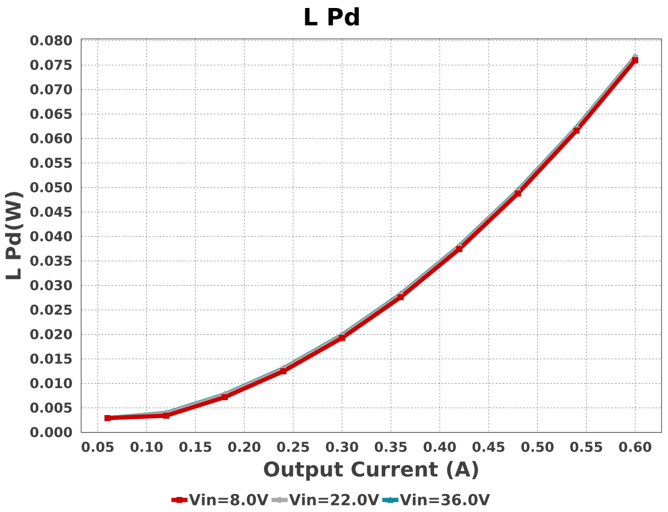

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

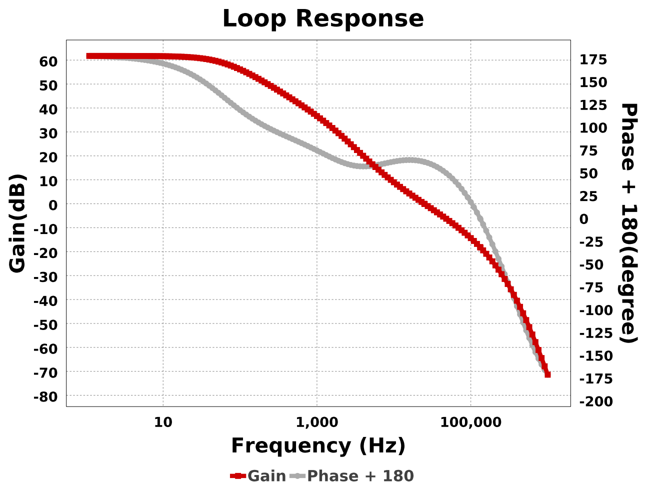

Cout Pd
Cout Pd(W)
0.000023
0.000022
0.000021
0.000020
0.000019
0.000018
0.000017
0.000016
0.000015
0.000014
0.000013
0.000012
0.000011
0.000010
0.000009
0.000008
0.000007
0.000006
0.000005
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V

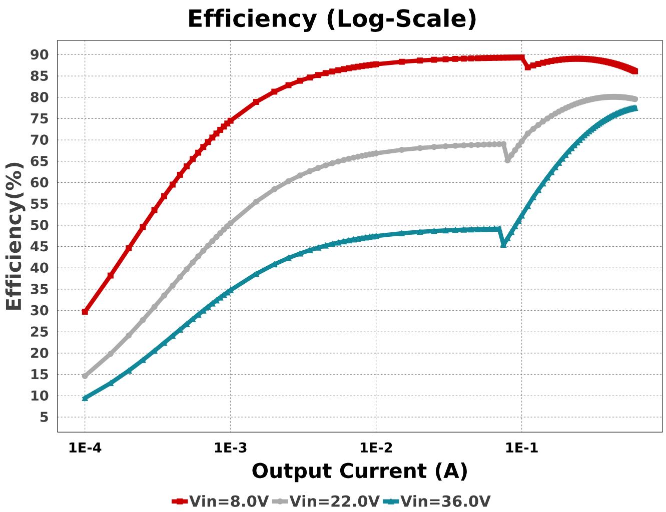

Total Pd
Total Pd(W)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V


IC Iq Pd
IC Iq Pd(W)
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V


IC Pd
IC Pd(W)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V


L Pd
L Pd(W)
0.080
0.075
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=8.0V Vin=22.0V Vin=36.0V


Loop Response
Gain(dB)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Phase + 180(degree)
175
150
125
100
75
50
25
0
-25
-50
-75
-100
-125
-150
-175
-200
10
1,000
100,000
Frequency (Hz)
Gain Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	181.49 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	28.492 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	70.691 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	17.955 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	722.44 mA	IC	Peak switch current in IC
6.	IC Iq Pd	54.0 mW	IC	IC Iq Pd
7.	IC Pd	497.36 mW	IC	IC power dissipation
8.	IC Tj	69.789 degC	IC	IC junction temperature
9.	ICThetaJA Effective	80.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	70.95 mA	IC	Average input current
11.	L Ipp	244.88 mA	Inductor	Peak-to-peak inductor ripple current
12.	L Pd	76.649 mW	Inductor	Inductor power dissipation
13.	L1 Irms	604.15 mA	Inductor	Inductor ripple current
14.	Cin Pd	28.492 µW	Power	Input capacitor power dissipation
15.	Cout Pd	17.955 µW	Power	Output capacitor power dissipation
16.	IC Pd	497.36 mW	Power	IC power dissipation
17.	L Pd	76.649 mW	Power	Inductor power dissipation
18.	Total Pd	574.21 mW	Power	Total Power Dissipation
19.	BOM Count	11	System Information	Total Design BOM count
20.	Cross Freq	24.858 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	10.013 %	System Information	Duty cycle
22.	Efficiency	77.519 %	System Information	Steady state efficiency
23.	FootPrint	111.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	1.1 MHz	System Information	Switching frequency
25.	Gain Marg	-18.275 dB	System Information	Bode Plot Gain Margin
26.	Iout	600.0 mA	System Information	Iout operating point
27.	Low Freq Gain	61.742 dB	System Information	Gain at 1Hz
28.	Mode	CCM	System Information	PWM/PFM Mode
29.	Phase Marg	62.796 deg	System Information	Bode Plot Phase Margin
30.	Pout	1.98 W	System Information	Total output power
31.	Total BOM	$1.01	System Information	Total BOM Cost
32.	Vin	36.0 V	System Information	Vin operating point
33.	Vout Actual	3.308 V	System Information	Vout Actual calculated based on selected voltage divider resistors
34.	Vout Tolerance	1.409 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
35.	Vout p-p	1.861 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	600.0 m	Maximum Output Current
VinMax	36.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS560430X	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

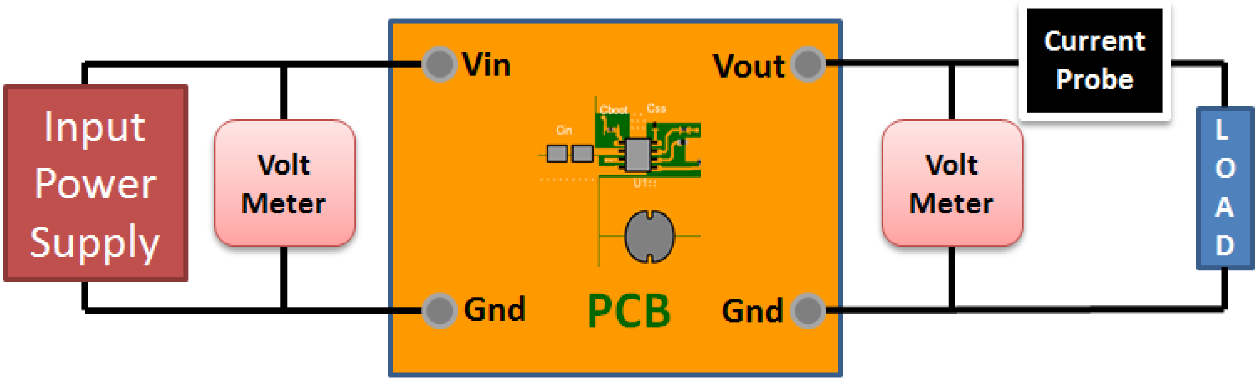
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 : F83D4279EB7FCBF5[v1]

2. **TPS560430X** Product Folder : http://www.ti.com/product/TPS560430 : contains the data sheet and other resources.