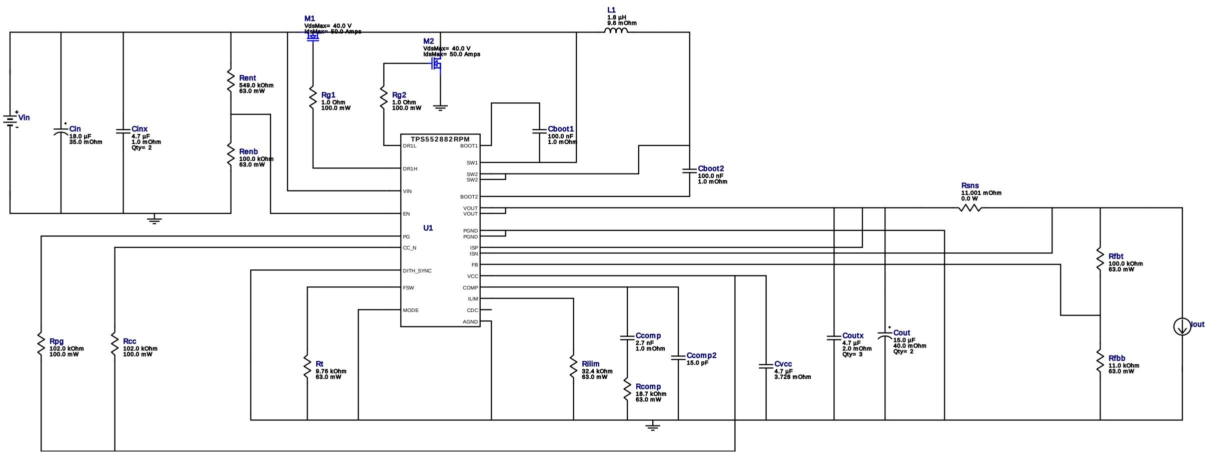
VinMin = 8.0V VinMax = 32.0V Vout = 12.0V Iout = 4.0A	Device = TPS552882RPMR Topology = Buck_Boost Created = 2024-03-31 04:03:09.807 BOM Cost = NA BOM Count = 31 Total Pd = 4.28W

WEBENCH ® Design Report

Design : 38 TPS552882RPMR
TPS552882RPMR 8V-32V to 12.00V @ 4A

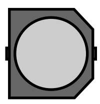


Design Alerts

Current Sense Option Information

For Iout greater than 6A, please disable Output Current Sense Option

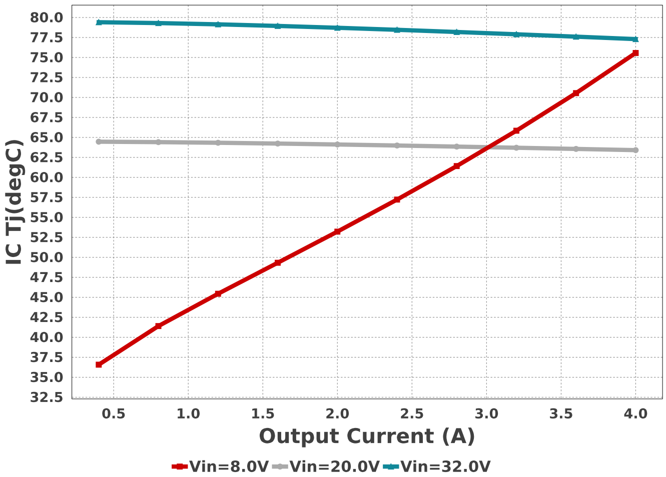
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cboot2	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Ccomp	MuRata	GRM155R71H272KA01D Series= X7R	Cap= 2.7 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	Kemet	C0402C150J4GACTU Series= C0G/NP0	Cap= 15.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cin	Panasonic	50SVPF18M Series= SVPF	Cap= 18.0 uF ESR= 35.0 mOhm VDC= 50.0 V IRMS= 2.7 A	1	$0.70	 CAPSMT_62_E7 106 mm^2
Cinx	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 6.0 A	2	$0.16	1210 15 mm^2
Cinx2	TDK	C1608X5R1H105K080AB Series= X5R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 50.0 V IRMS= 2.2162 A	1	$0.03	0603 5 mm^2
Cout	Panasonic	EEFCX1E150R Series= CX	Cap= 15.0 uF ESR= 40.0 mOhm VDC= 25.0 V IRMS= 3.2 A	2	$0.68	 7343-20 59 mm^2

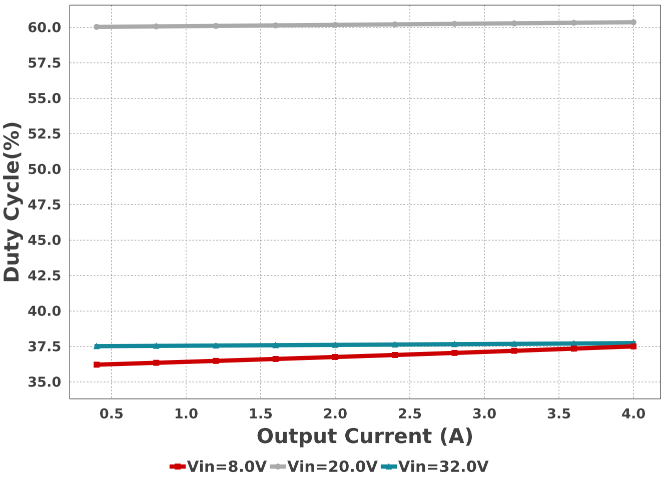
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	3	$0.06	0805 7 mm²
Coutx2	TDK	C1005X5R1V105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.416 mOhm VDC= 35.0 V IRMS= 1.483 A	1	$0.03	0402 3 mm²
Cvcc	TDK	C1608X6S1C475K080AC Series= X6S	Cap= 4.7 uF ESR= 3.728 mOhm VDC= 16.0 V IRMS= 2.69359 A	1	$0.08	0603 5 mm²
L1	Coilcraft	XAL6030-182MEB	L= 1.8 µH 9.6 mOhm	1	$0.65	XAL6030 72 mm²
M1	Texas Instruments	CSD18514Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.22	TRANS_NexFET_Q5A 55 mm²
M2	Texas Instruments	CSD18514Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.22	TRANS_NexFET_Q5A 55 mm²
Rcc	Vishay-Dale	CRCW0603102KFKEA Series= CRCW..e3	Res= 102.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rcomp	Yageo	AC0402FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Renb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rent	Vishay-Dale	CRCW0402549KFKED Series= CRCW..e3	Res= 549.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 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
Rg1	Vishay-Dale	CRCW06031R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rg2	Vishay-Dale	CRCW06031R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rilim	Vishay-Dale	CRCW040232K4FKED Series= CRCW..e3	Res= 32.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0603102KFKEA Series= CRCW..e3	Res= 102.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rsns	CUSTOM	CUSTOM Series= ?	Res= 11.001 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
Rt	Vishay-Dale	CRCW04029K76FKED Series= CRCW..e3	Res= 9.76 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	TPS552882RPMR	Switcher	1	$2.52	RPM0026A-MFG 22 mm^2

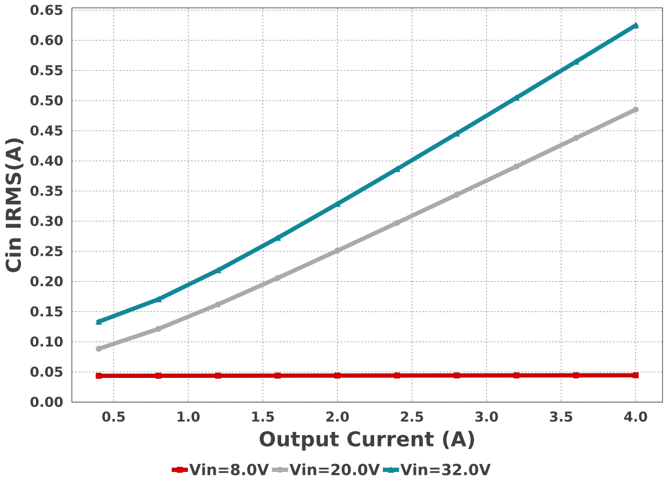
IC Tj



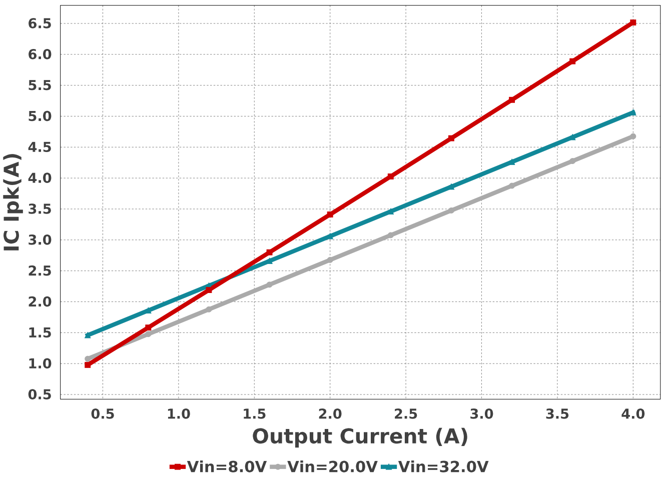
Duty Cycle



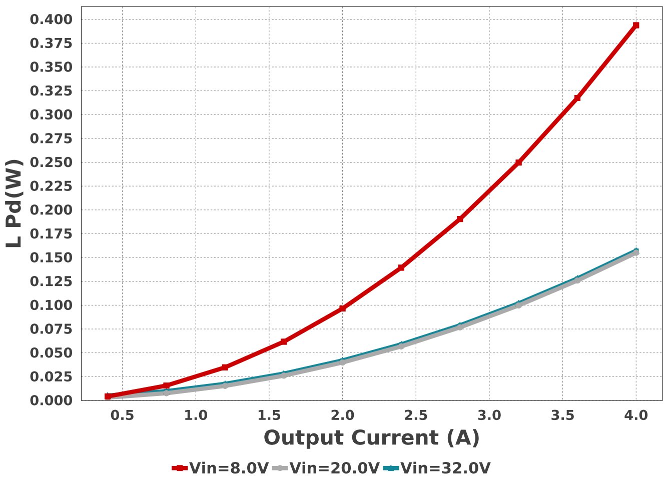
Cin IRMS



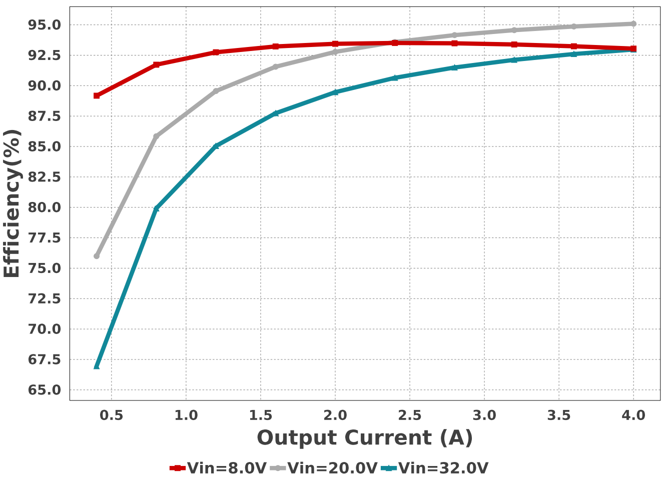
IC Ipk

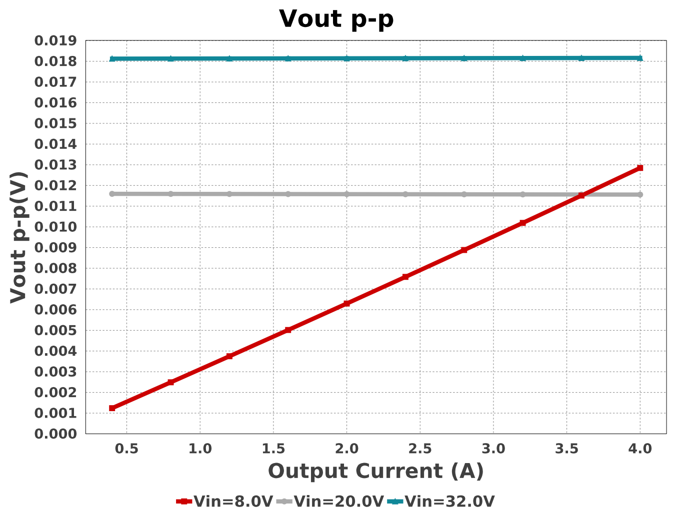


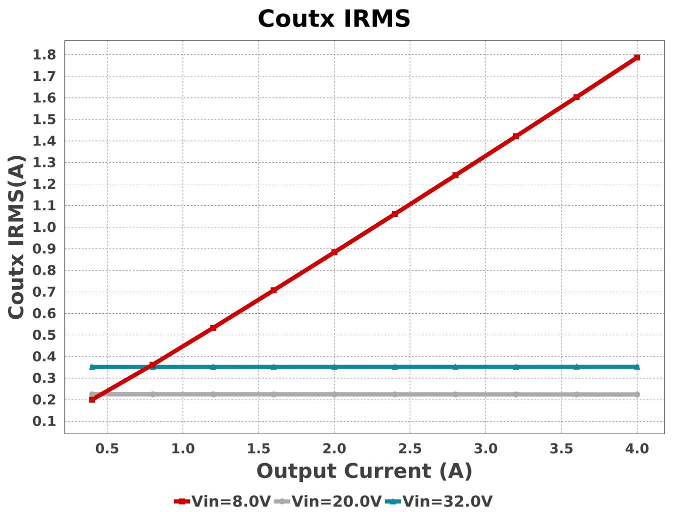
L Pd

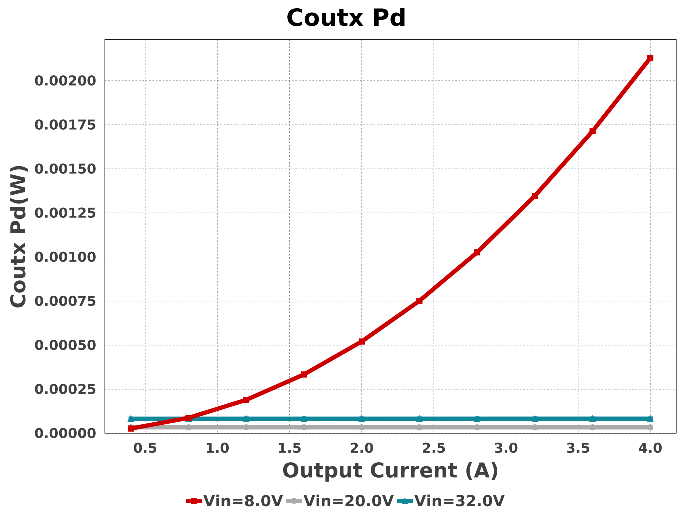


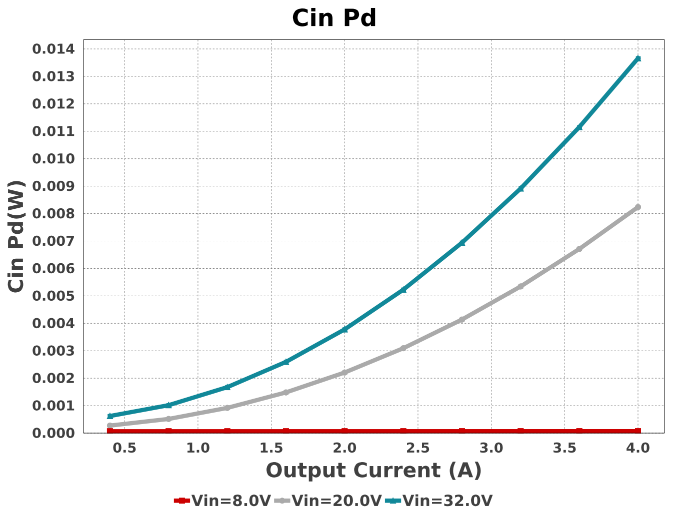
Efficiency

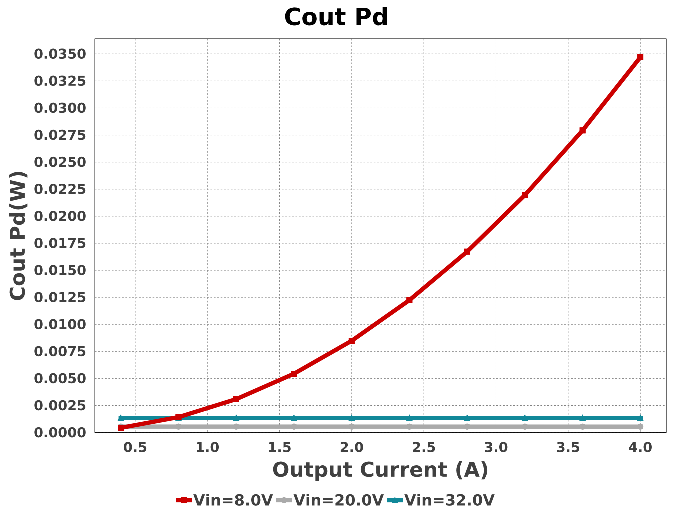


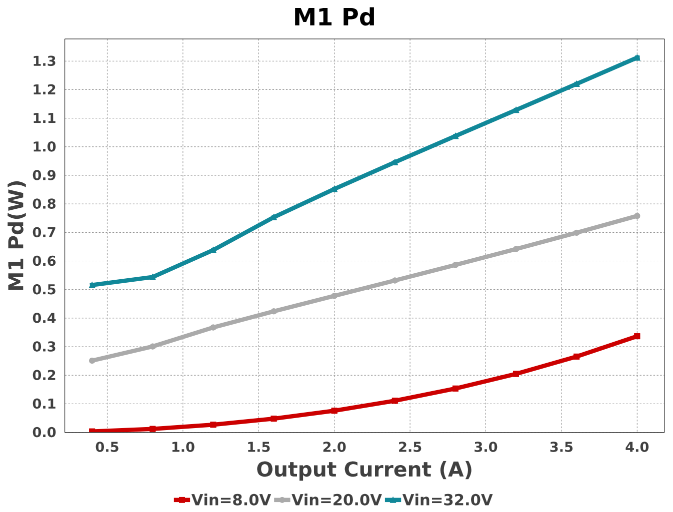

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=8.0V
Vin=20.0V
Vin=32.0V

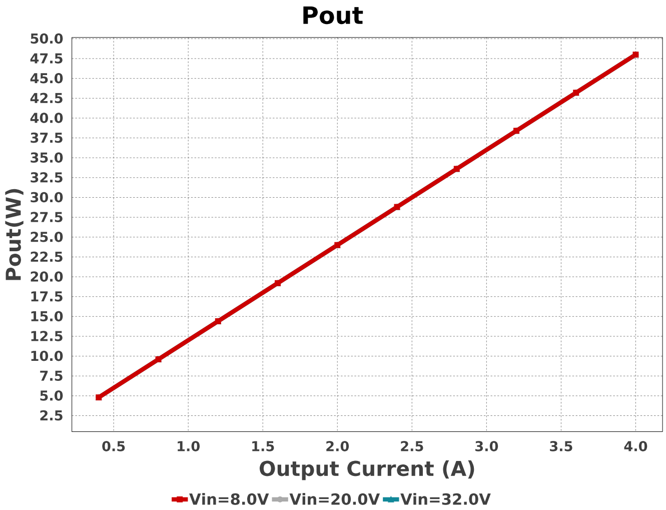

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=8.0V
Vin=20.0V
Vin=32.0V

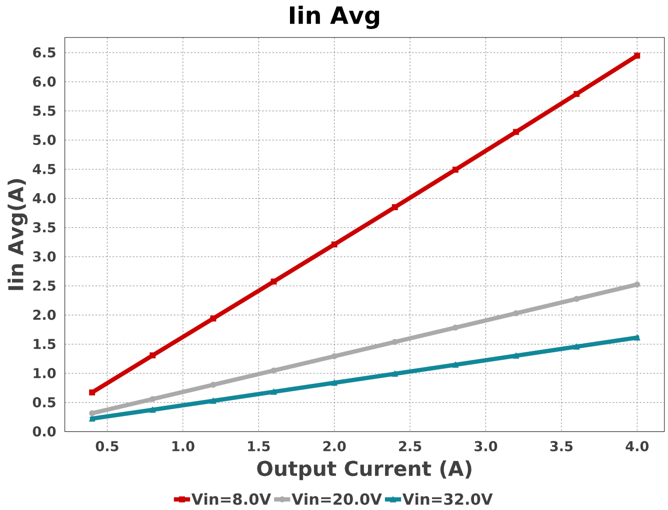

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=8.0V
Vin=20.0V
Vin=32.0V

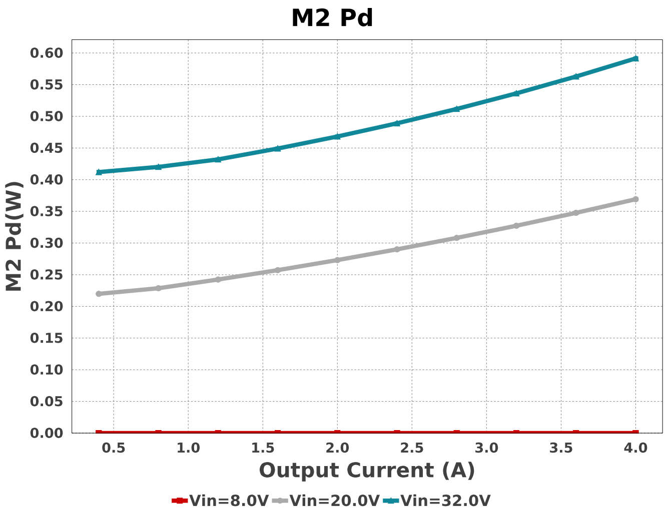

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=8.0V
Vin=20.0V
Vin=32.0V

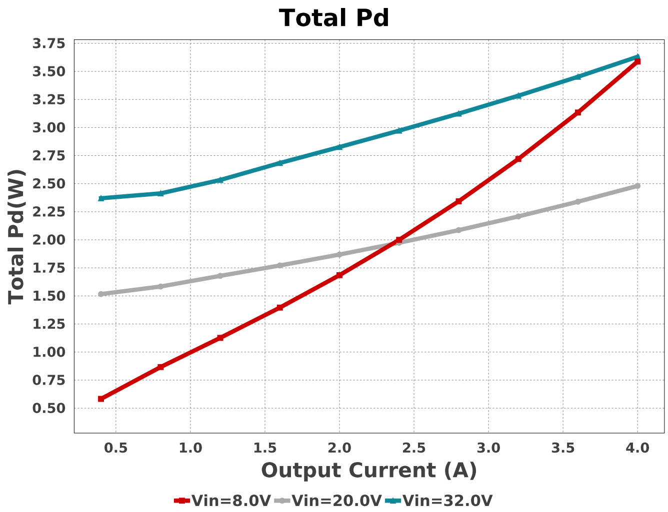

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=8.0V
Vin=20.0V
Vin=32.0V

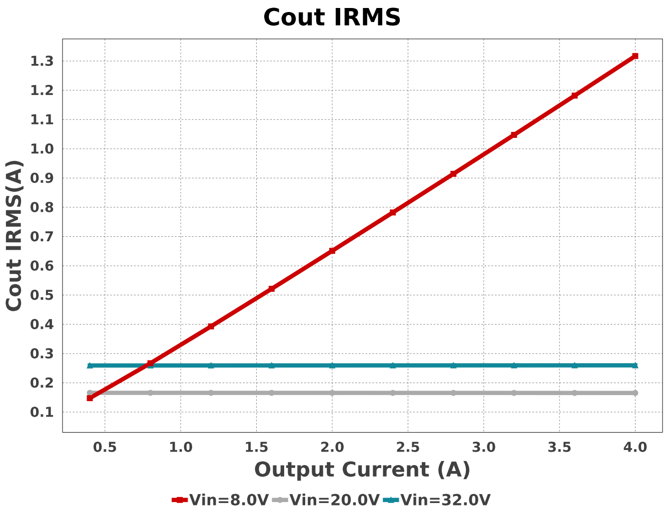

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=8.0V
Vin=20.0V
Vin=32.0V

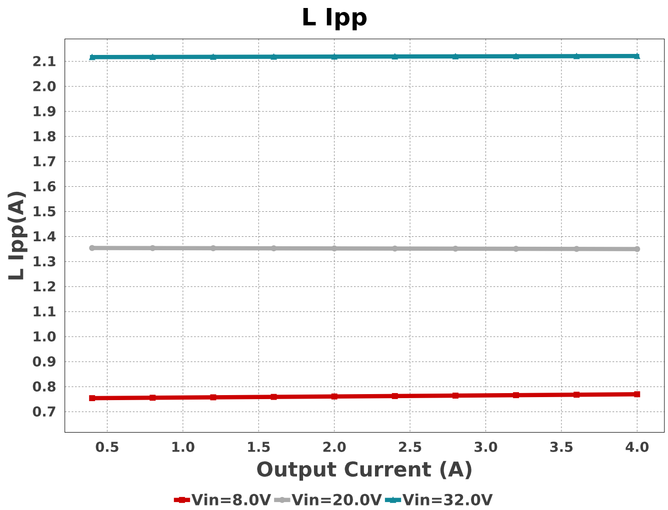

Pout
Pout(W)
Output Current (A)
Vin=8.0V Vin=20.0V Vin=32.0V

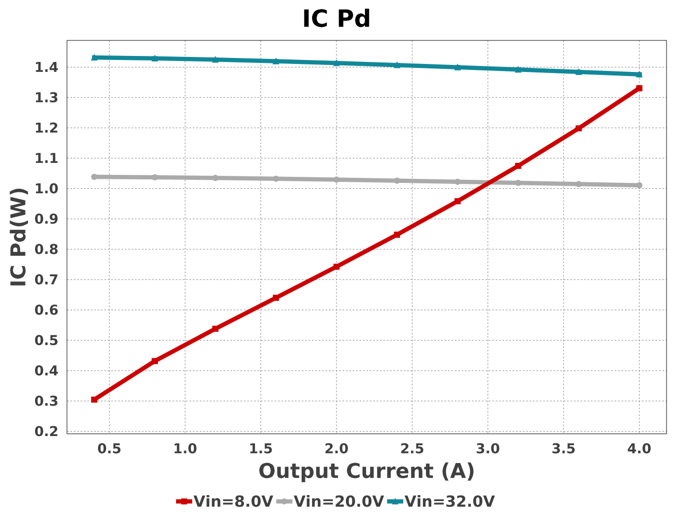

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=8.0V Vin=20.0V Vin=32.0V

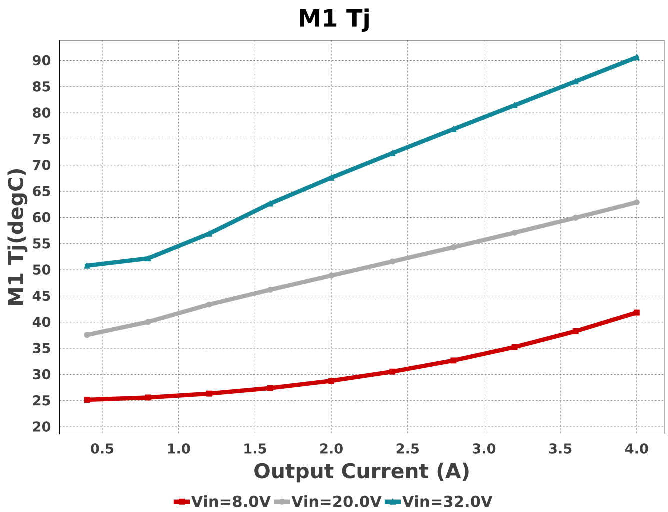

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=8.0V Vin=20.0V Vin=32.0V

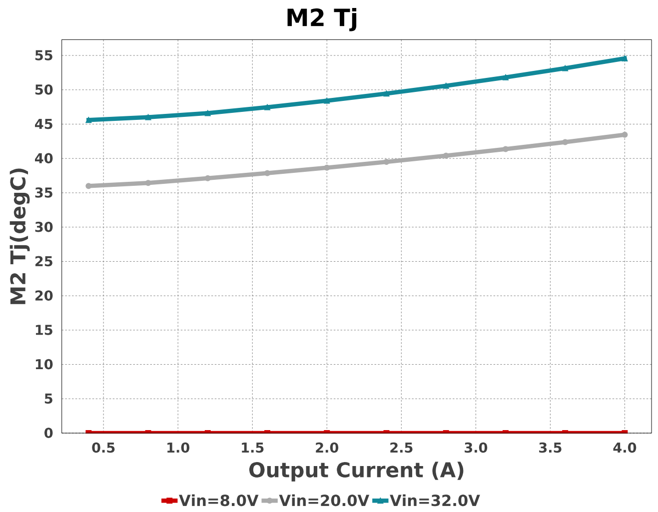

Total Pd
Total Pd(W)
Output Current (A)
Vin=8.0V Vin=20.0V Vin=32.0V

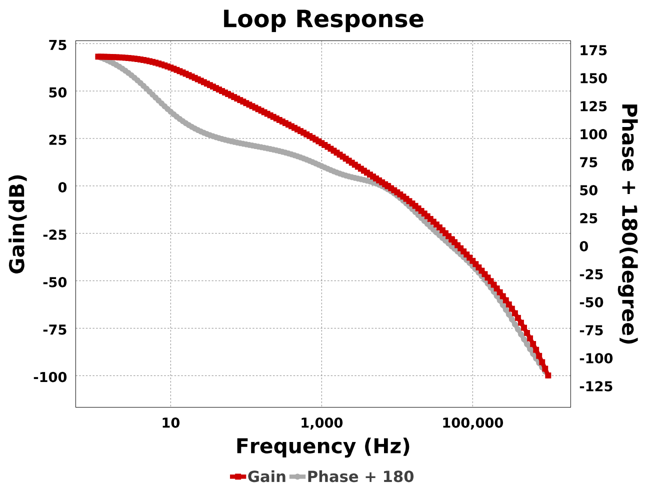

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=8.0V Vin=20.0V Vin=32.0V

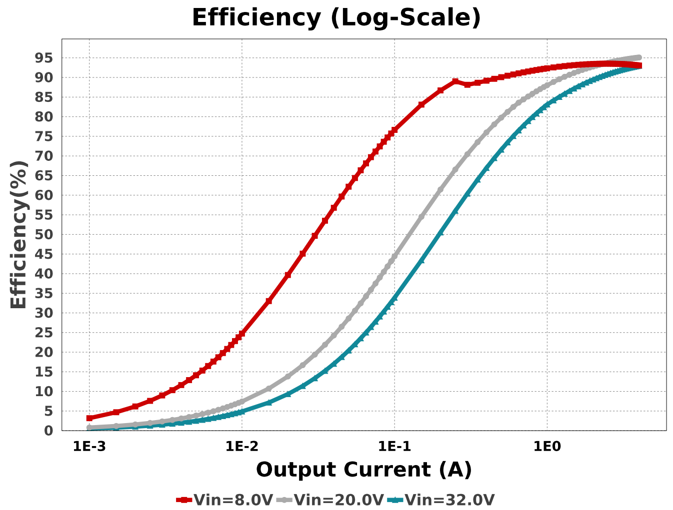

L Ipp
L Ipp(A)
Output Current (A)
Vin=8.0V Vin=20.0V Vin=32.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	44.644 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	69.758 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.503 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	45.19 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	2.04 A	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	2.773 mW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	7.376 A	IC	Peak switch current in IC
8.	IC Pd	1.526 W	IC	IC power dissipation
9.	IC Tj	82.999 degC	IC	IC junction temperature
10.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	38.0 degC/W	IC	IC junction-to-ambient thermal resistance

#	Name	Value	Category	Description
12.	Iin Avg	7.352 A	IC	Average input current
13.	L Ipp	772.41 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	512.02 mW	Inductor	Inductor power dissipation
15.	M1 Pd	453.6 mW	Mosfet	M1 MOSFET total power dissipation
16.	M1 Tj	47.68 degC	Mosfet	M1 MOSFET junction temperature
17.	M2 Pd	0.0 W	Mosfet	M2 MOSFET total power dissipation
18.	M2 Tj	0.0 degC	Mosfet	M2 MOSFET junction temperature
19.	Cin Pd	69.758 µW	Power	Input capacitor power dissipation
20.	Cout Pd	45.19 mW	Power	Output capacitor power dissipation
21.	Coutx Pd	2.773 mW	Power	Output capacitor_x power loss
22.	IC Pd	1.526 W	Power	IC power dissipation
23.	L Pd	512.02 mW	Power	Inductor power dissipation
24.	M1 Pd	453.6 mW	Power	M1 MOSFET total power dissipation
25.	M2 Pd	0.0 W	Power	M2 MOSFET total power dissipation
26.	Total Pd	4.278 W	Power	Total Power Dissipation
27.	BOM Count	31	System Information	Total Design BOM count
28.	Cross Freq	12.523 kHz	System Information	Bode plot crossover frequency
29.	Duty Cycle	37.737 %	System Information	Duty cycle
30.	Efficiency	92.726 %	System Information	Steady state efficiency
31.	FootPrint	550.0 mm^2	System Information	Total Foot Print Area of BOM components
32.	Frequency	1.969 MHz	System Information	Switching frequency
33.	Gain Marg	-16.214 dB	System Information	Bode Plot Gain Margin
34.	Iout	4.545 A	System Information	Iout operating point
35.	Low Freq Gain	59.477 dB	System Information	Gain at 1Hz
36.	Mode	CCM	System Information	Conduction Mode
37.	Phase Marg	89.871 deg	System Information	Bode Plot Phase Margin
38.	Pout	54.54 W	System Information	Total output power
39.	Total BOM	NA	System Information	Total BOM Cost
40.	Vin	8.0 V	System Information	Vin operating point
41.	Vout	12.0 V	System Information	Operational Output Voltage
42.	Vout Actual	12.109 V	System Information	Vout Actual calculated based on selected voltage divider resistors
43.	Vout Tolerance	2.838 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
44.	Vout p-p	14.685 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	4.0	Maximum Output Current
VinMax	32.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS552882	Base Product Number
source	DC	Input Source Type
Ta	25.0	Ambient temperature
UserFsw	1.969 M	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

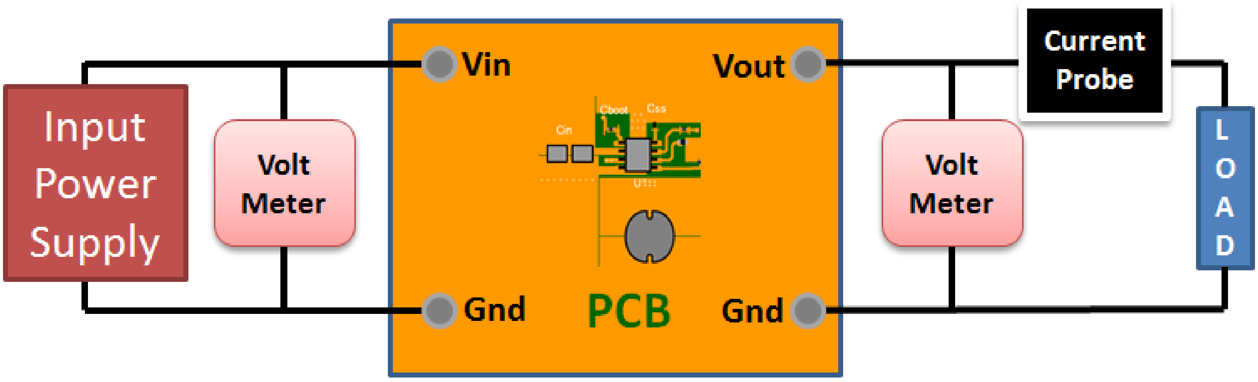
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 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 : B7AF85B75CD429C1E3C03C93AA481501[v1]

2. **TPS552882** Product Folder : http://www.ti.com/product/TPS552882 : contains the data sheet and other resources.