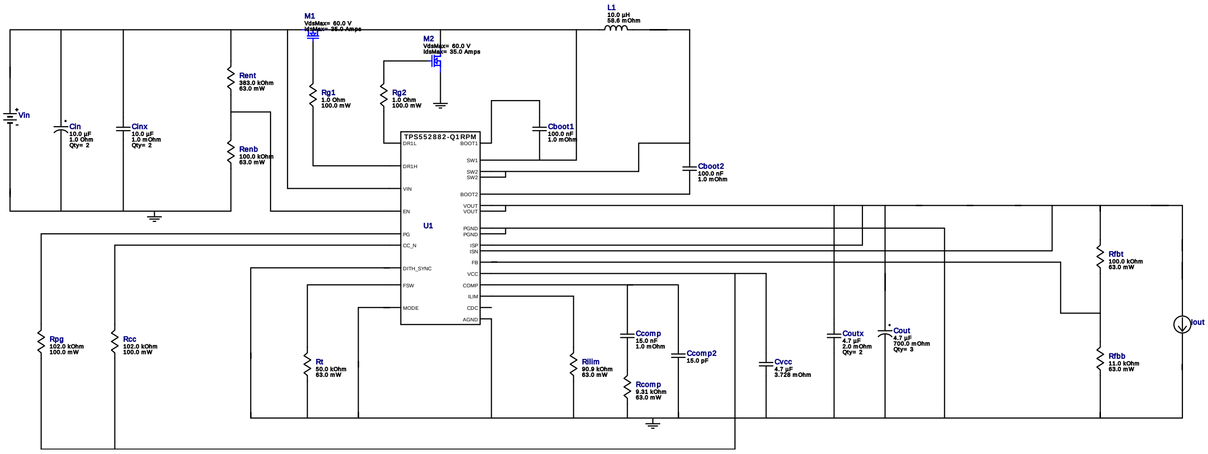
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 6.0V
VinMax = 36.0V
Vout = 12.0V
Iout = 0.5A

Device = TPS552882QRPMRQ1
Topology = Buck_Boost
Created = 2025-04-16 18:20:07.170
BOM Cost = $11.62
BOM Count = 31
Total Pd = 0.36W

Design : 15 TPS552882QRPMRQ1
TPS552882QRPMRQ1 6V-36V to 12.00V @ 3A



Design Alerts

Component Selection Information

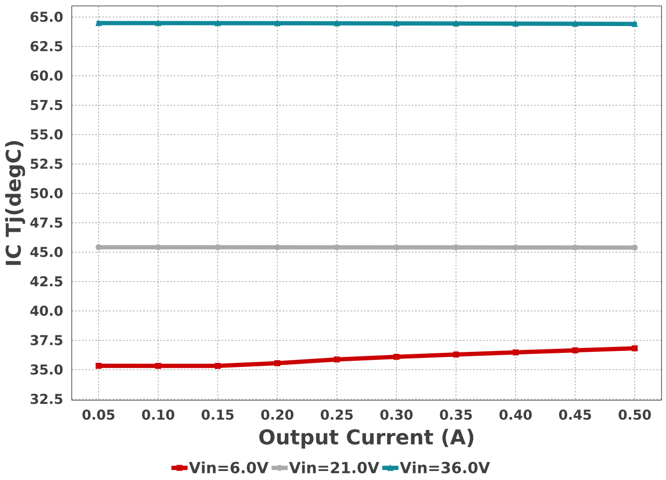
The TPS552882-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

Electrical BOM

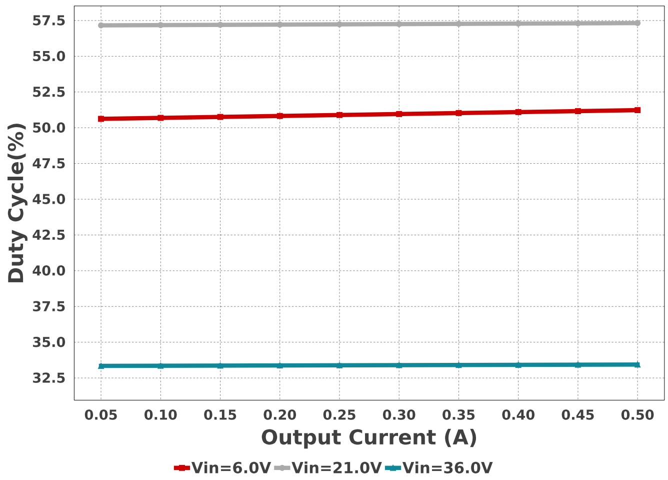
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cboot2	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Ccomp	MuRata	GRM155R71C153KA01D Series= X7R	Cap= 15.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp2	Kemet	C0402C150J4GACTU Series= C0G/NP0	Cap= 15.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	Vishay-Sprague	293D106X9063E2TE3 Series= 293D	Cap= 10.0 uF ESR= 1.0 Ohm VDC= 63.0 V IRMS= 580.0 mA	2	$3.39	3216-18 11 mm²
Cinx	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	2	$0.27	1210 15 mm²
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 mm²
Cout	AVX	TPSB475K035R0700 Series= TPS	Cap= 4.7 uF ESR= 700.0 mOhm VDC= 35.0 V IRMS= 314.0 mA	3	$0.24	3528-21 17 mm²

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	2	$0.06	0805 7 mm^2
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 mm^2
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 mm^2
L1	Bourns	SRN6045-100M	L= 10.0 µH 58.6 mOhm	1	$0.25	SRN6045 64 mm^2
M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.21	DNH0008A 18 mm^2
M2	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.21	DNH0008A 18 mm^2
Rcc	Vishay-Dale	CRCW0603102KFKEA Series= CRCW..e3	Res= 102.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rcomp	Vishay-Dale	CRCW04029K31FKED Series= CRCW..e3	Res= 9.31 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Renb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rent	Vishay-Dale	CRCW0402383KFKED Series= CRCW..e3	Res= 383.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rg1	Vishay-Dale	CRCW06031R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rg2	Vishay-Dale	CRCW06031R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rilim	Vishay-Dale	CRCW040290K9FKED Series= CRCW..e3	Res= 90.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpg	Vishay-Dale	CRCW0603102KFKEA Series= CRCW..e3	Res= 102.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rt	Vishay-Dale	CRCW040250K0FKED Series= 0402	Res= 50.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS552882QRPMRQ1	Switcher	1	$2.50	RPM0026A-MFG 22 mm^2

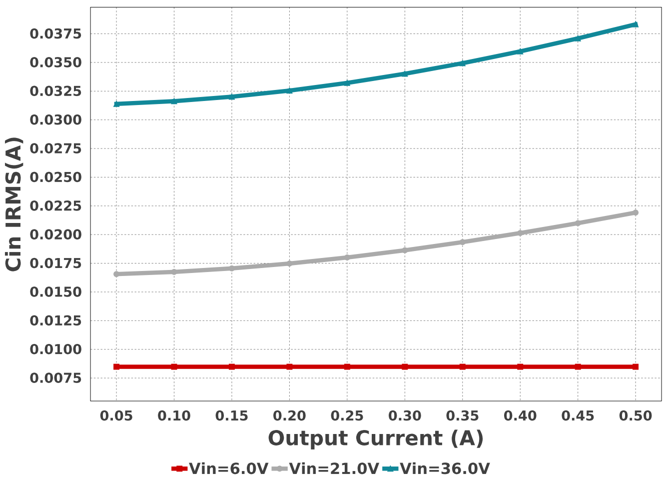
IC Tj



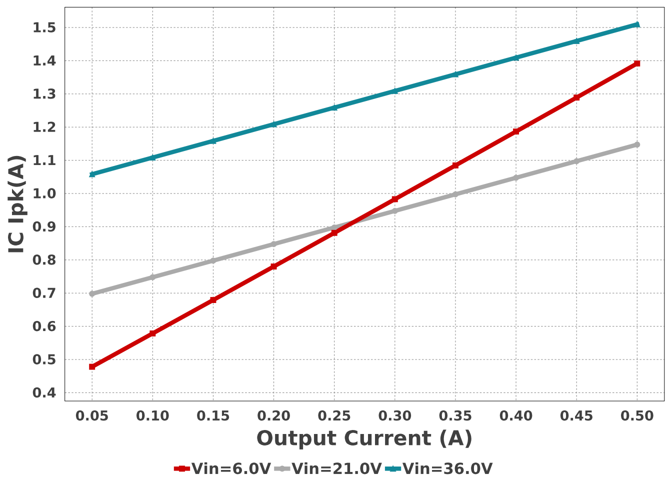
Duty Cycle



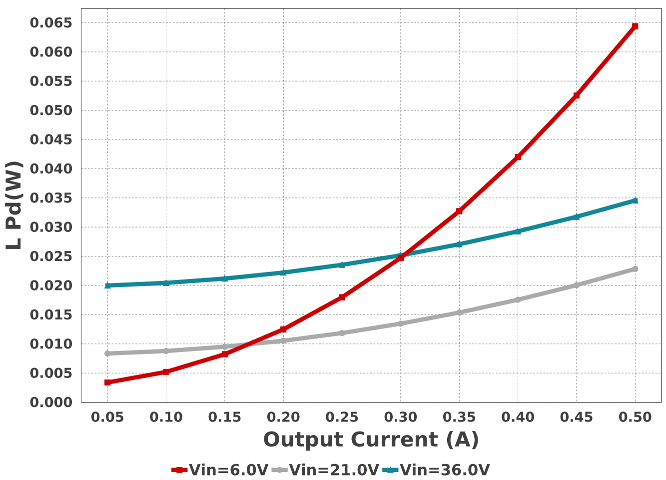
Cin IRMS



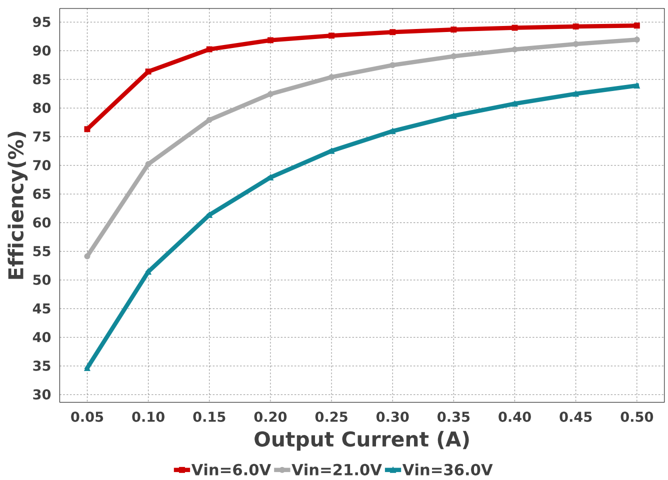
IC Ipk

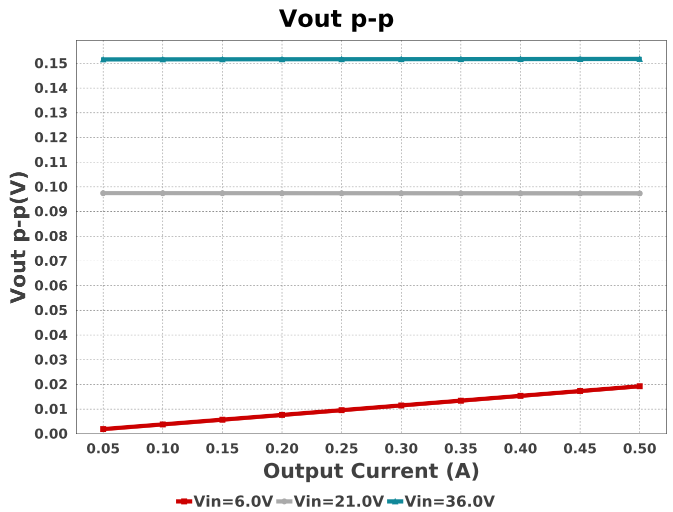


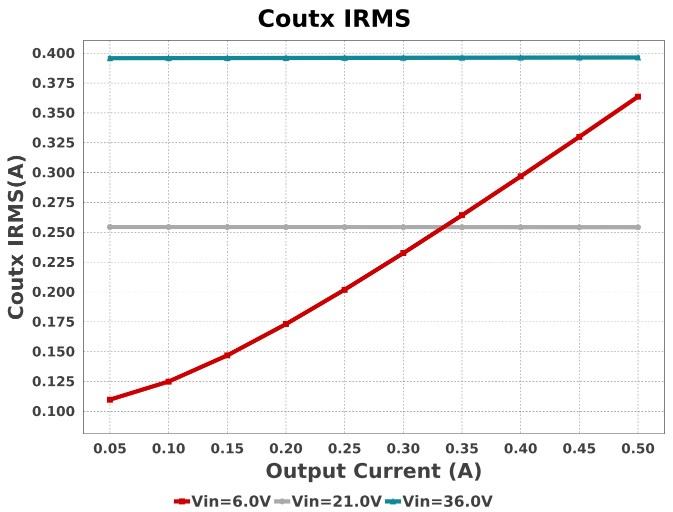
L Pd

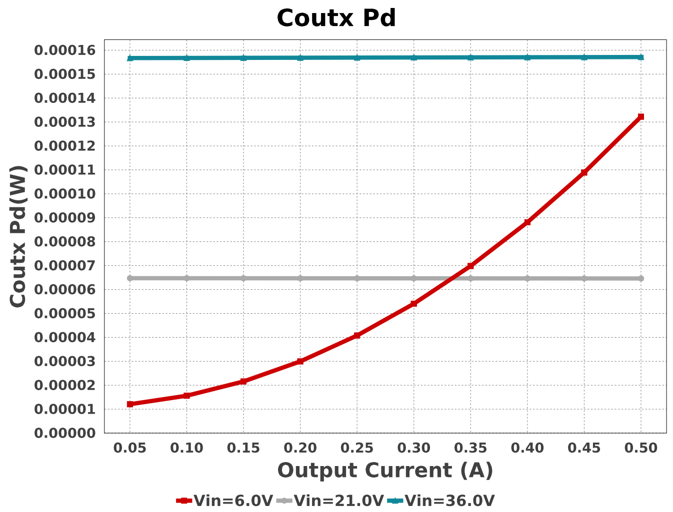


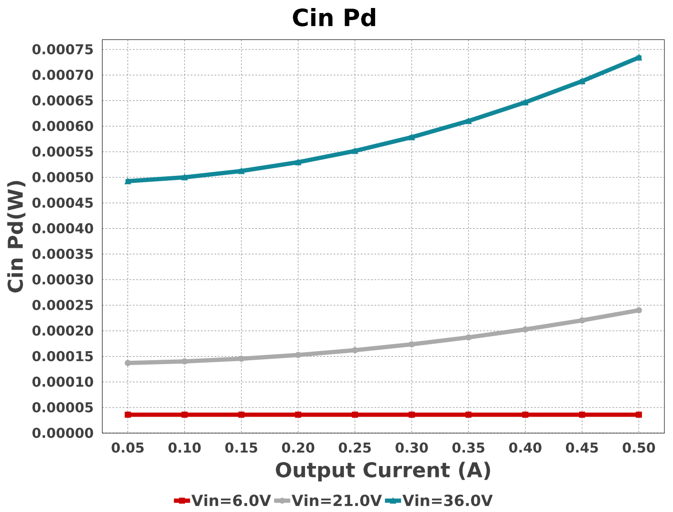
Efficiency

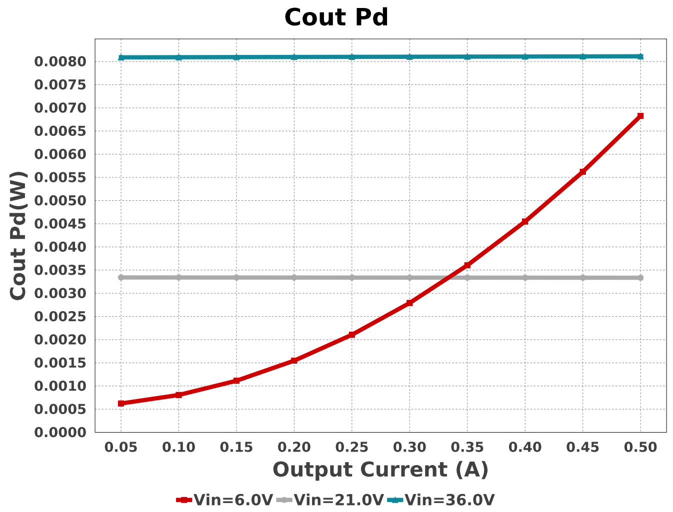


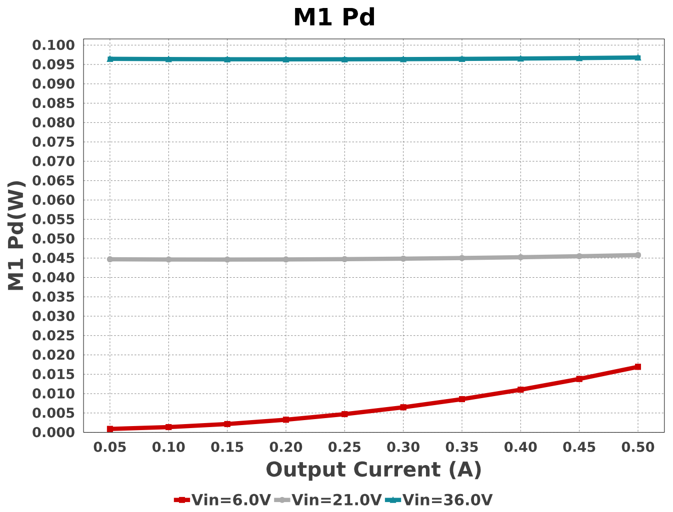

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

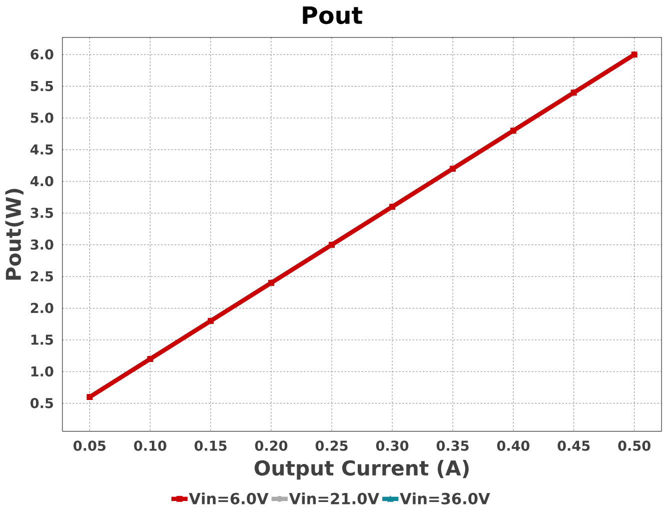

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

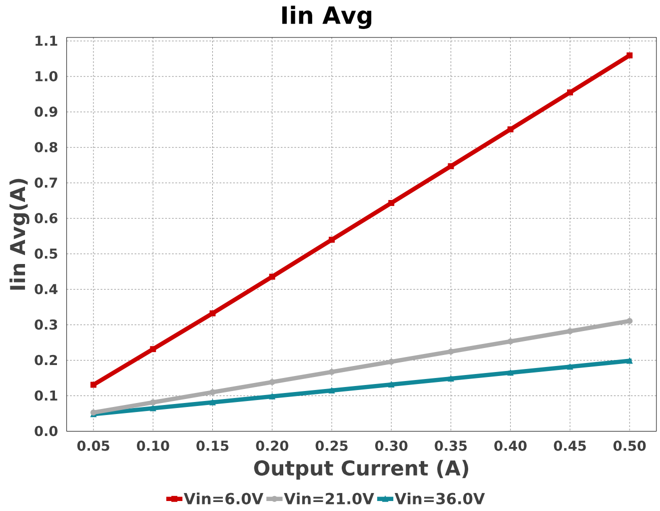

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

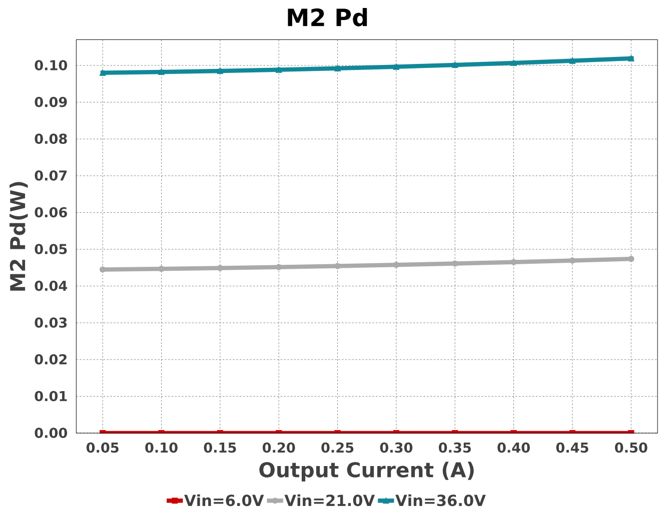

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

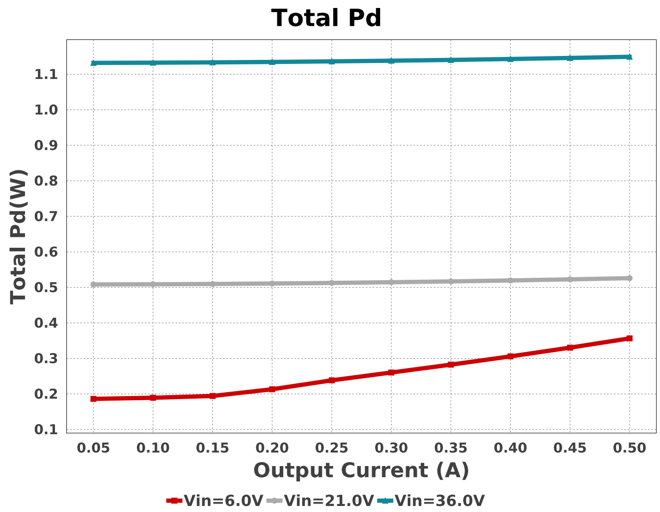

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

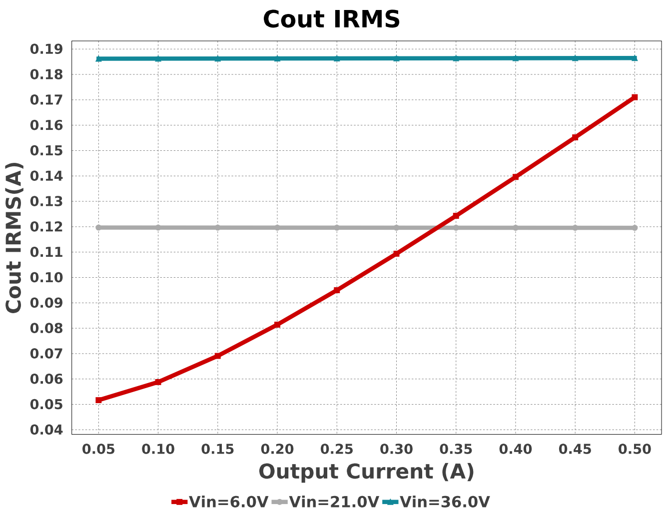

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

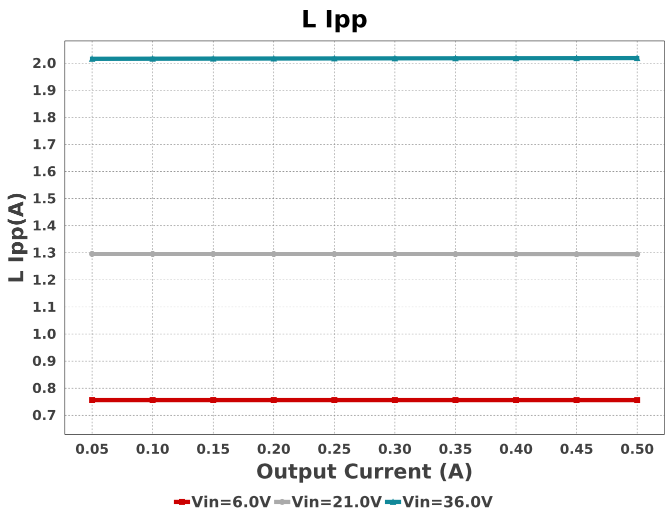

Pout
Pout(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

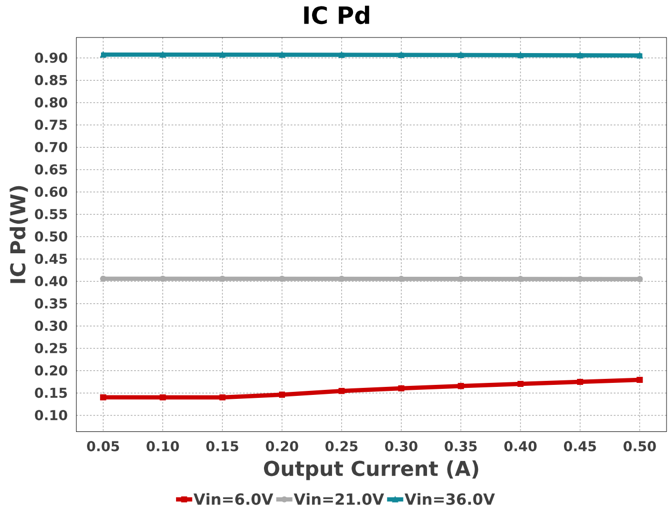

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

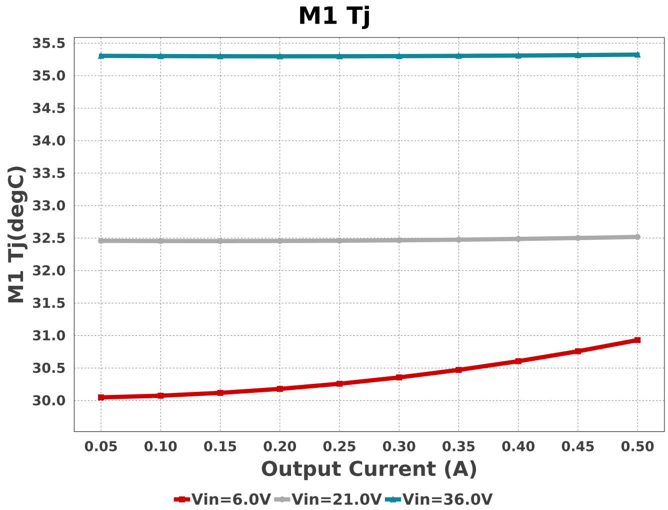

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

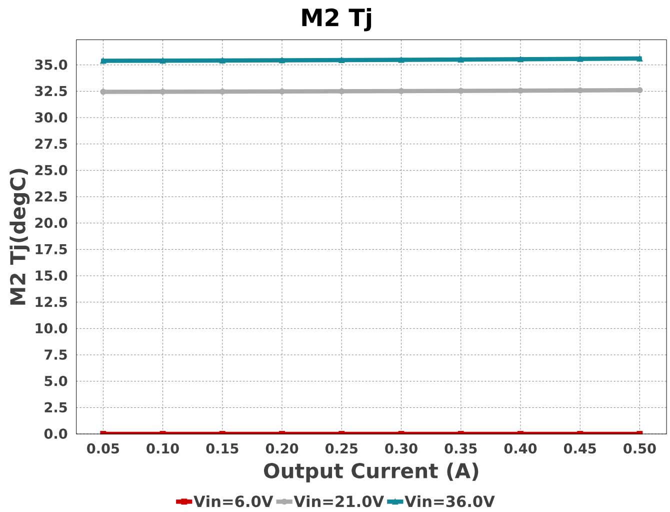

Total Pd
Total Pd(W)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

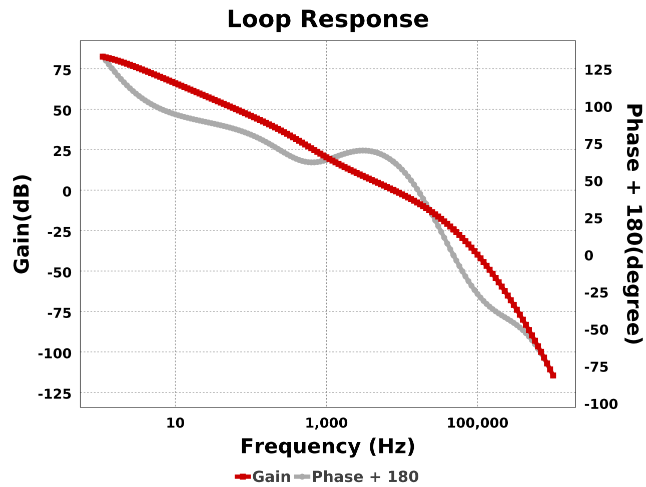

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V

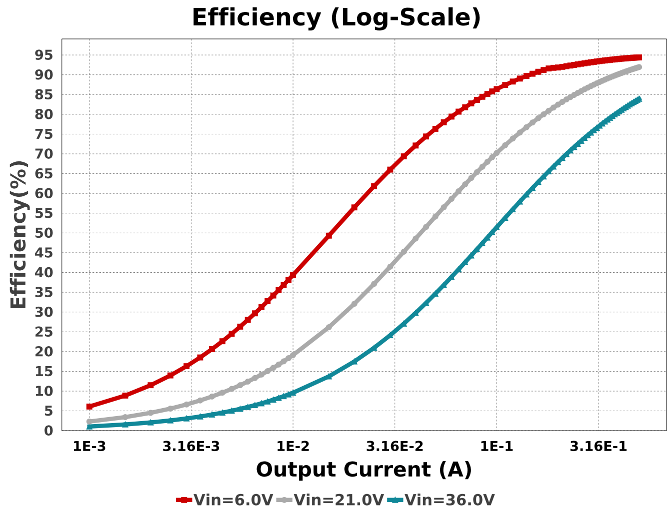

L Ipp
L Ipp(A)
Output Current (A)
Vin=6.0V Vin=21.0V Vin=36.0V











Operating Values

#	Name	Value	Category	Description
1.	BOM Count	31		Total Design BOM count
2.	Total BOM	$11.623		Total BOM Cost
3.	Cin IRMS	8.481 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	35.962 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	171.032 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	6.825 mW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	363.613 mA	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	132.21 µW	Capacitor	Output capacitor_x power loss
9.	IC Ipk	1.392 A	IC	Peak switch current in IC
10.	IC Pd	179.54 mW	IC	IC power dissipation
11.	IC Tj	36.822 degC	IC	IC junction temperature

#	Name	Value	Category	Description
12.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA	38.0 degC/W	IC	IC junction-to-ambient thermal resistance
14.	Iin Avg	1.059 A	IC	Average input current
15.	L Ipp	755.92 mA	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	64.386 mW	Inductor	Inductor power dissipation
17.	M1 Pd	16.924 mW	Mosfet	M1 MOSFET total power dissipation
18.	M1 Tj	30.931 degC	Mosfet	M1 MOSFET junction temperature
19.	M2 Pd	0.0 W	Mosfet	M2 MOSFET total power dissipation
20.	M2 Tj	0.0 degC	Mosfet	M2 MOSFET junction temperature
21.	Cin Pd	35.962 µW	Power	Input capacitor power dissipation
22.	Cout Pd	6.825 mW	Power	Output capacitor power dissipation
23.	Coutx Pd	132.21 µW	Power	Output capacitor_x power loss
24.	IC Pd	179.54 mW	Power	IC power dissipation
25.	L Pd	64.386 mW	Power	Inductor power dissipation
26.	M1 Pd	16.924 mW	Power	M1 MOSFET total power dissipation
27.	M2 Pd	0.0 W	Power	M2 MOSFET total power dissipation
28.	Total Pd	356.467 mW	Power	Total Power Dissipation
29.	Cross Freq	4.025 kHz	System Information	Bode plot crossover frequency
30.	Duty Cycle	51.231 %	System Information	Duty cycle
31.	Efficiency	94.392 %	System Information	Steady state efficiency
32.	FootPrint	307.0 mm^2	System Information	Total Foot Print Area of BOM components
33.	Frequency	396.825 kHz	System Information	Switching frequency
34.	Gain Marg	-23.622 dB	System Information	Bode Plot Gain Margin
35.	Iout	500.0 mA	System Information	Iout operating point
36.	Low Freq Gain	70.448 dB	System Information	Gain at 1Hz
37.	Mode	CCM	System Information	Conduction Mode
38.	Phase Marg	72.972 deg	System Information	Bode Plot Phase Margin
39.	Pout	6.0 W	System Information	Total output power
40.	Vin	6.0 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	19.26 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	500.0 m	Maximum Output Current
VinMax	36.0	Maximum input voltage
VinMin	6.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS552882-Q1	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

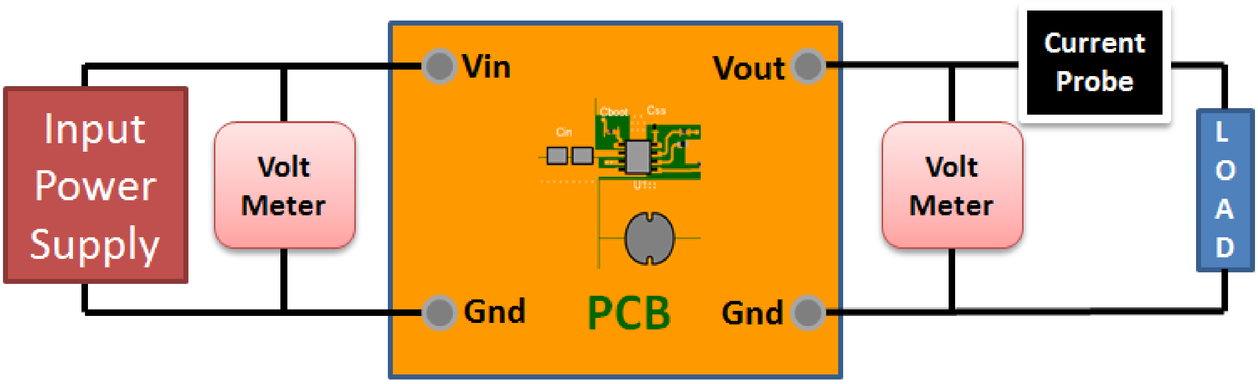
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 6.0V 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 : 8F8315DF577968355B4331E4F31CD614[v1]

2. **TPS552882-Q1** Product Folder : http://www.ti.com/product/TPS552882%2DQ1 : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.