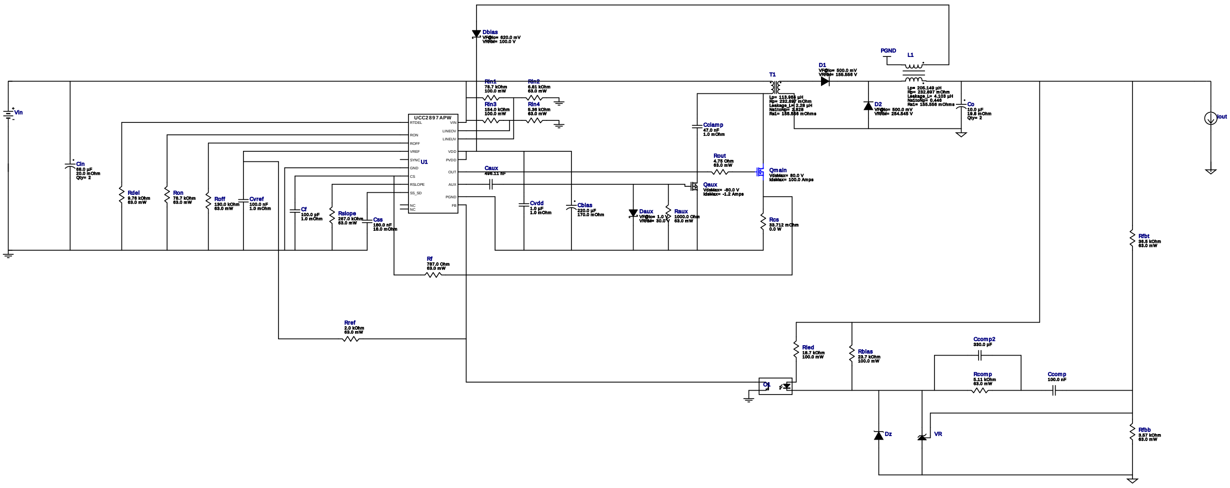
VinMin = 18.0V
VinMax = 36.0V
Vout = 28.0V
Iout = 3.6A

Device = UCC2897APW
Topology = Active Clamp Forward
Created = 2021-10-14 06:23:36.703
BOM Cost = NA
BOM Count = 43
Total Pd = 10.55W

WEBENCH ® Design Report

Design : 48 UCC2897APW
UCC2897APW 18V-36V to 28.00V @ 3.6A

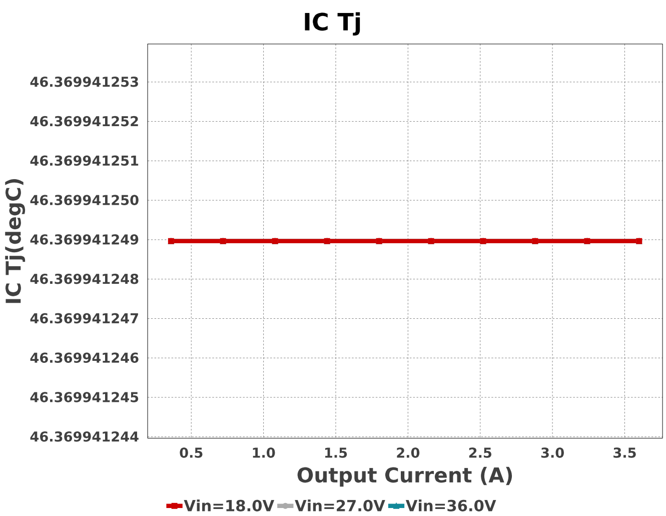


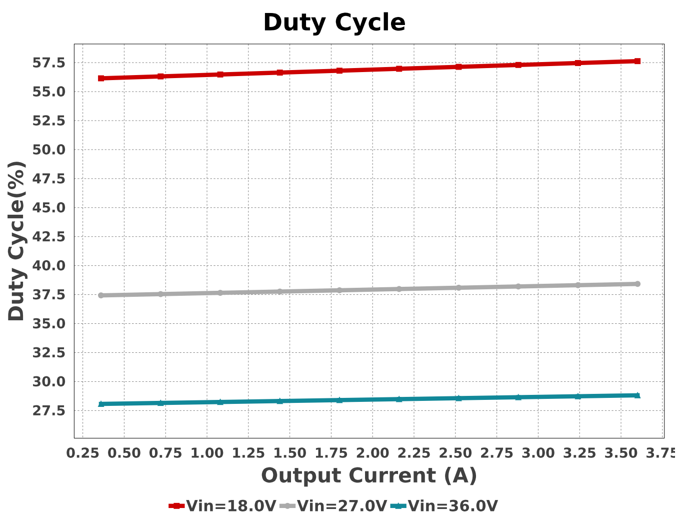
Electrical BOM

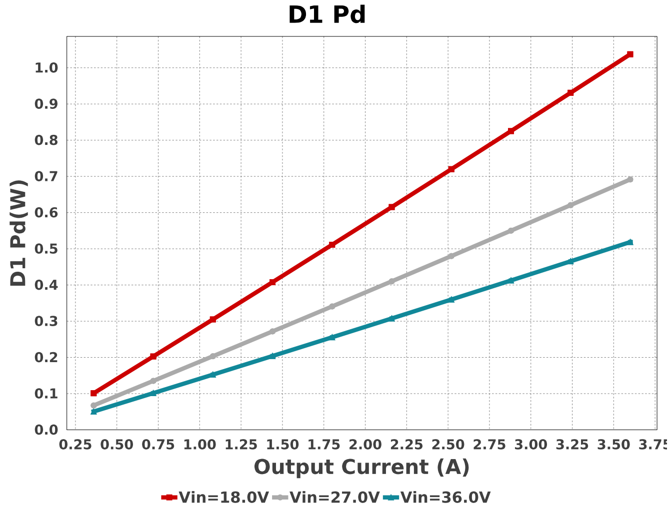
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Caux	CUSTOM	CUSTOM Series= ?	Cap= 496.11 nF VDC= 25.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm²
Cbias	Nichicon	UUD1E221MNL1GS Series= uD	Cap= 220.0 uF ESR= 170.0 mOhm VDC= 25.0 V IRMS= 450.0 mA	1	$0.17	SM_RADIAL_8MM 113 mm²
Cclamp	MuRata	GRM21BR72A473KA01L Series= X7R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
Ccomp	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C331JBANNNC Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cf	MuRata	GRM033R71E101KA01D Series= X7R	Cap= 100.0 pF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
Cin	Panasonic	50SVPF68M Series= SVPF	Cap= 68.0 uF ESR= 20.0 mOhm VDC= 50.0 V IRMS= 4.3 A	2	$0.95	CAPSMT_62_F12 151 mm²
Co	Rubycon	200RX3010M8X16 Series= ?	Cap= 10.0 uF ESR= 19.8 mOhm VDC= 200.0 V IRMS= 200.0 mA	2	$0.18	RX30_800x1600 100 mm²

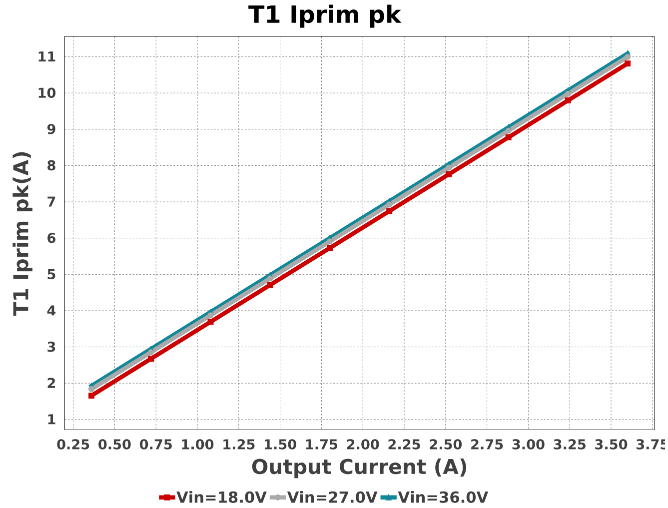
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Css	AVX	08053C184KAT2A Series= X7R	Cap= 180.0 nF ESR= 18.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm^2
Cvdd	Taiyo Yuden	TMK212B7105KG-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Cvref	Yageo	CC0805KRX7R8BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
D1	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 155.556 V	1	NA	CUSTOM 0 mm^2
D2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 254.545 V	1	NA	CUSTOM 0 mm^2
Daux	SMC Diode Solutions	BAT54WSTR	VF@Io= 1.0 V VRRM= 30.0 V	1	$0.02	SOD-323 9 mm^2
Dbias	Vishay-Semiconductor	SS2PH10-M3	VF@Io= 620.0 mV VRRM= 100.0 V	1	$0.15	DO-220AA 14 mm^2
Dz	ON Semiconductor	BZX84C36LT1G	Zener	1	$0.02	SOT-23 14 mm^2
L1	CUSTOM	CUSTOM	Lp= 205.149 µH Rp= 232.897 mOhm Leakage_L= 4.103 µH Ns1toNp= 446.429 m Rs1= 155.556 mOhms	1	NA	CUSTOM 0 mm^2
O1	Fairchild Semiconductor	FOD817A	Optocoupler	1	$0.11	DIP-4 71 mm^2
Qaux	Vishay-Siliconix	SI2337DS-T1-E3	VdsMax= -80.0 V IdsMax= -1.2 Amps	1	$0.41	SOT-23 14 mm^2
Qmain	Texas Instruments	CSD19502Q5B	VdsMax= 80.0 V IdsMax= 100.0 Amps	1	$0.90	DQK0006C 9 mm^2
Raux	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rbias	Vishay-Dale	CRCW060323K7FKEA Series= CRCW..e3	Res= 23.7 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rcomp	Vishay-Dale	CRCW04025K11FKED Series= CRCW..e3	Res= 5.11 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rcs	CUSTOM	CUSTOM Series= ?	Res= 33.712 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rdel	Vishay-Dale	CRCW04029K76FKED Series= CRCW..e3	Res= 9.76 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rf	Vishay-Dale	CRCW0402787RFKED Series= CRCW..e3	Res= 787.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW04023K57FKED Series= CRCW..e3	Res= 3.57 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	AC0402FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

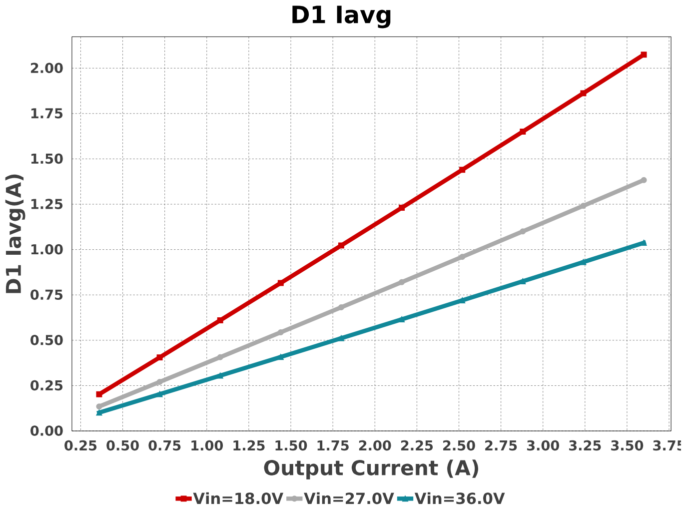
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rin1	Vishay-Dale	CRCW060378K7FKEA Series= CRCW..e3	Res= 78.7 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rin2	Vishay-Dale	CRCW04026K81FKED Series= CRCW..e3	Res= 6.81 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rin3	Vishay-Dale	CRCW0603154KFKEA Series= CRCW..e3	Res= 154.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rin4	Vishay-Dale	CRCW04025K36FKED Series= CRCW..e3	Res= 5.36 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rled	Vishay-Dale	CRCW060318K7FKEA Series= CRCW..e3	Res= 18.7 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Roff	Vishay-Dale	CRCW0402130KFKED Series= CRCW..e3	Res= 130.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ron	Vishay-Dale	CRCW040278K7FKED Series= CRCW..e3	Res= 78.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rout	Vishay-Dale	CRCW04024R75FKED Series= CRCW..e3	Res= 4.75 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rref	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rslope	Vishay-Dale	CRCW0402267KFKED Series= CRCW..e3	Res= 267.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
T1	CUSTOM	CUSTOM	Lp= 113.984 µH Rp= 232.897 mOhm Leakage_L= 2.28 µH Ns1toNp= 2.828 Rs1= 155.556 mOhms	1	NA	CUSTOM 0 mm^2
U1	Texas Instruments	UCC2897APW	Switcher	1	$1.11	PW0020A 74 mm^2
VR	Texas Instruments	TL431IDBVR	Voltage References	1	$0.07	R-PDSO-G3 16 mm^2

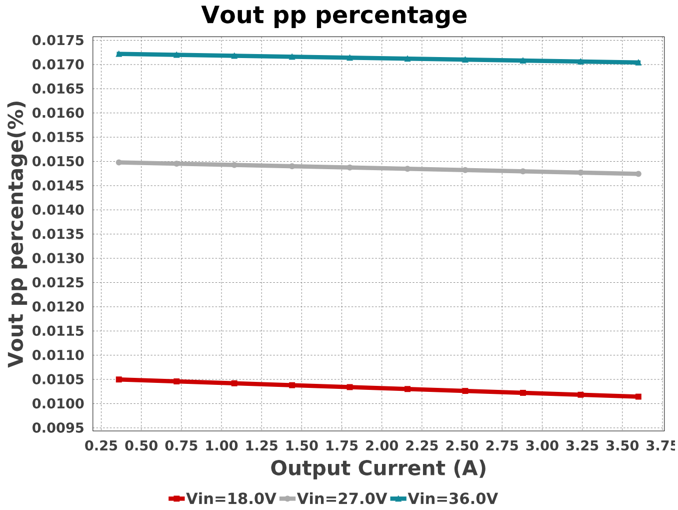


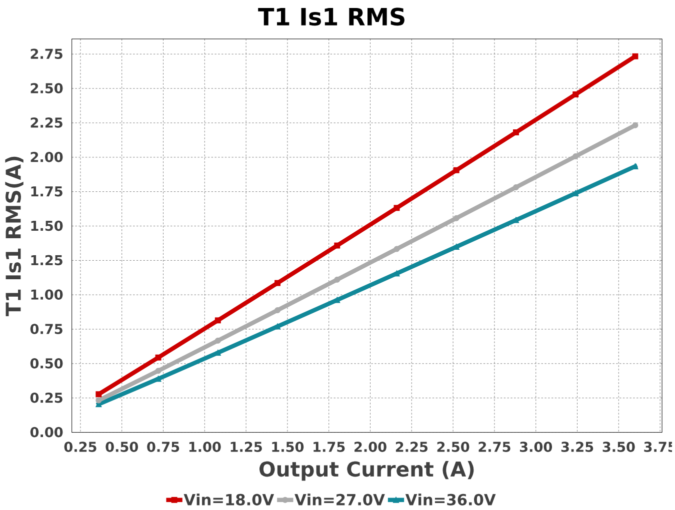


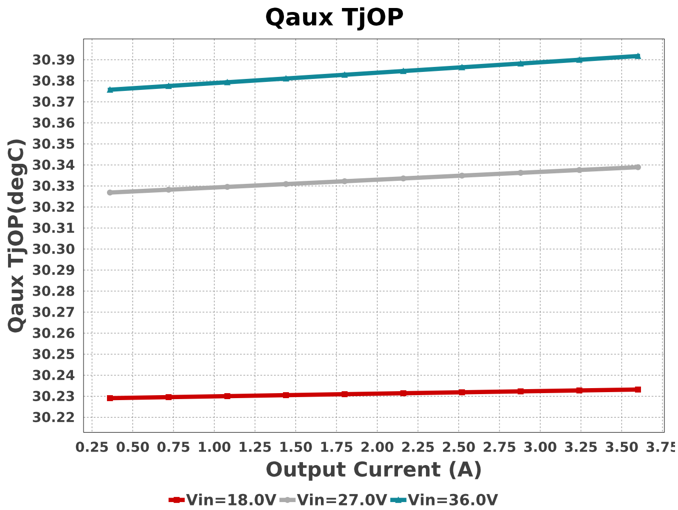

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

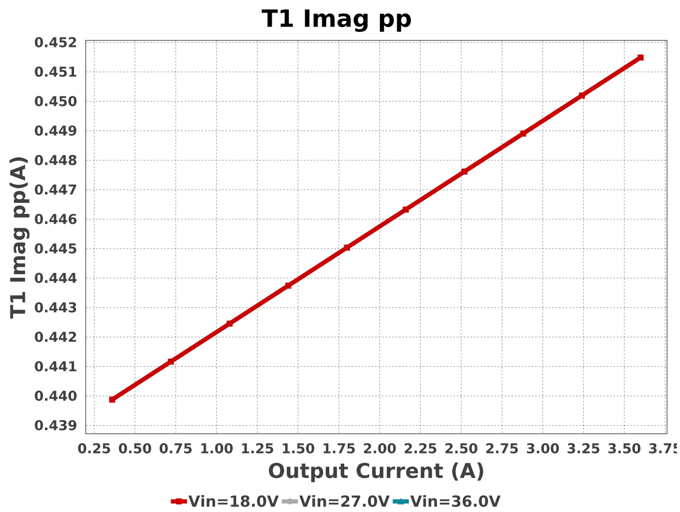

T1 Iprim pk
T1 Iprim pk(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

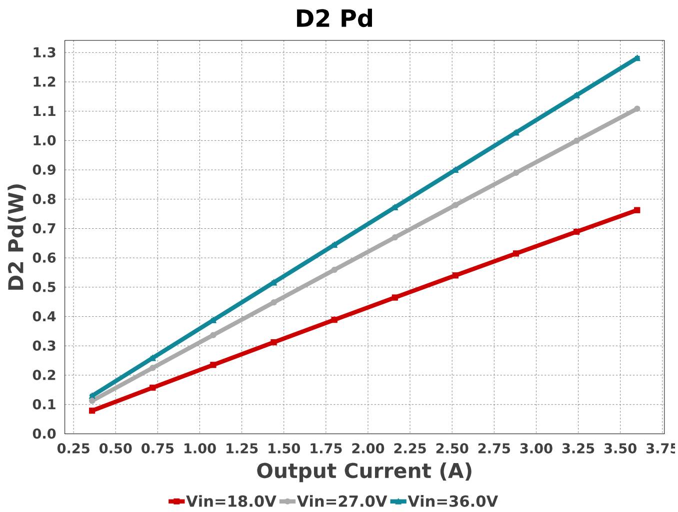

D1 Iavg
D1 Iavg(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

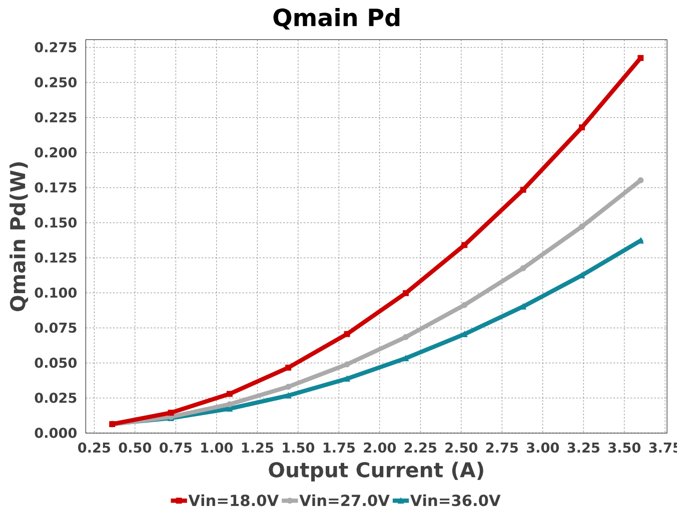

Vout pp percentage
Vout pp percentage(%)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

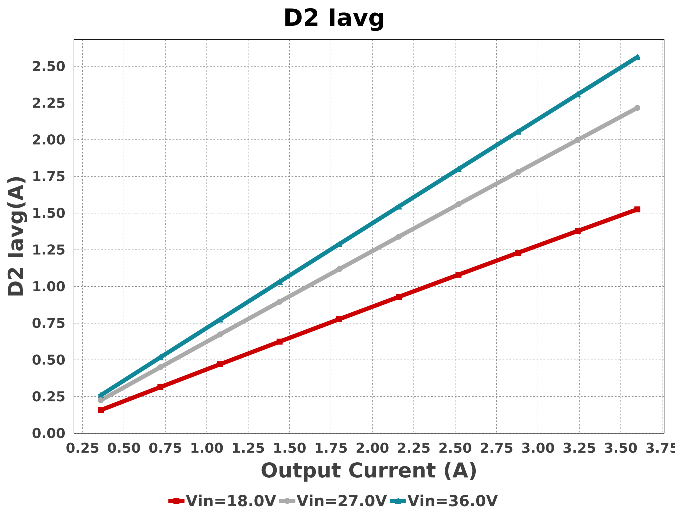

T1 Is1 RMS
T1 Is1 RMS(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

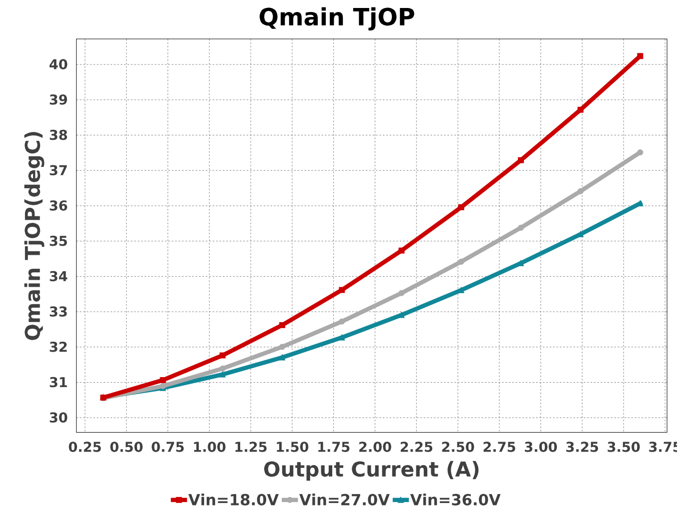

Qaux TjOP
Qaux TjOP(degC)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

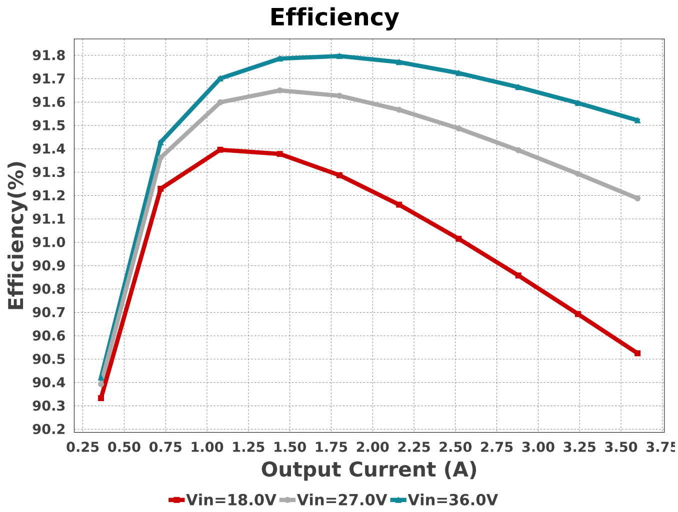

T1 Imag pp
T1 Imag pp(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

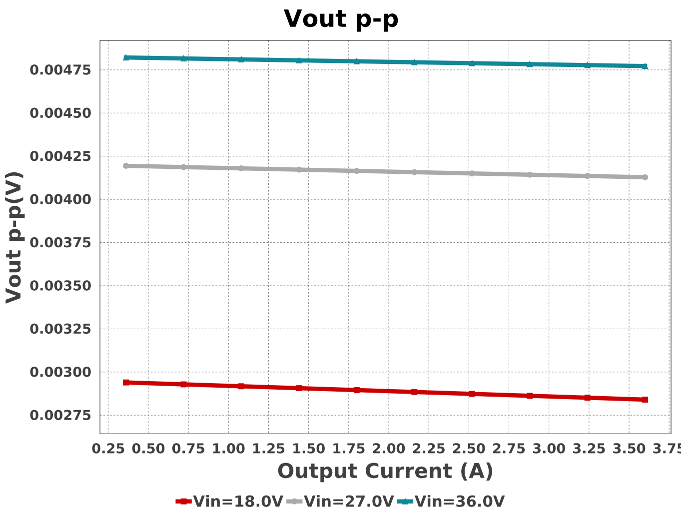

D2 Pd
D2 Pd(W)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

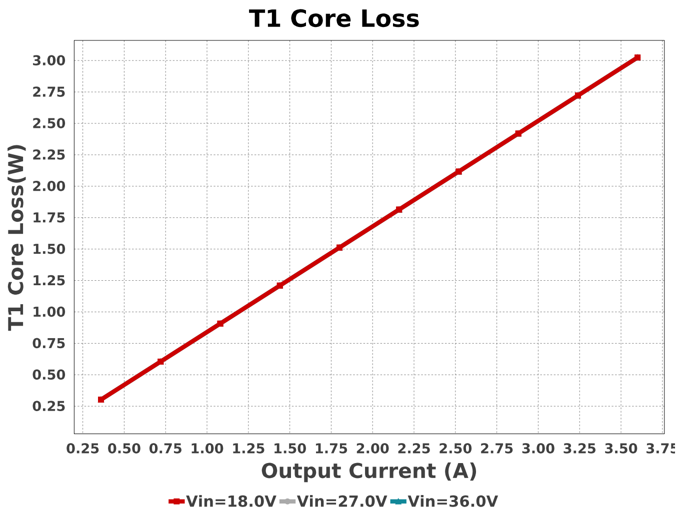

Qmain Pd
Qmain Pd(W)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

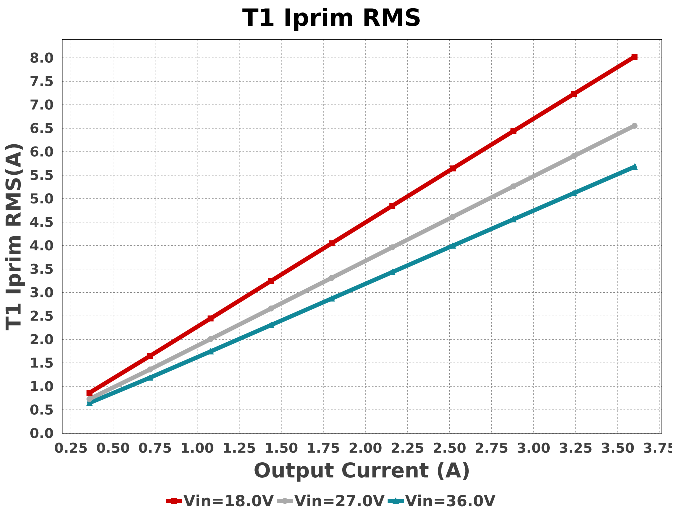

D2 Iavg
D2 Iavg(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

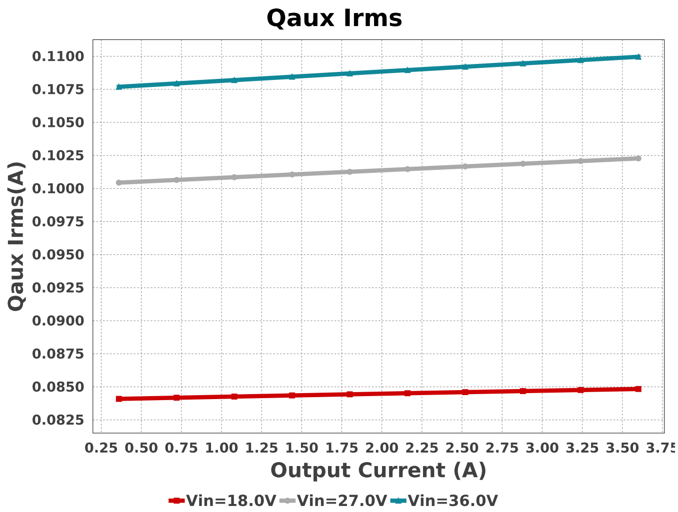

Qmain TjOP
Qmain TjOP(degC)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

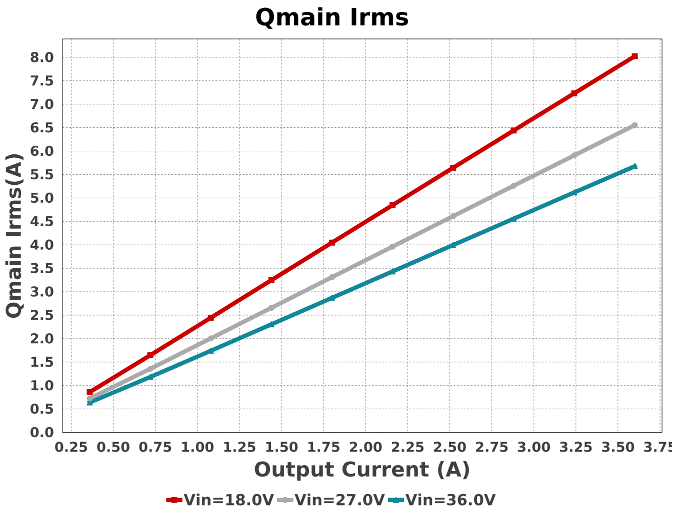

Efficiency
Efficiency(%)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

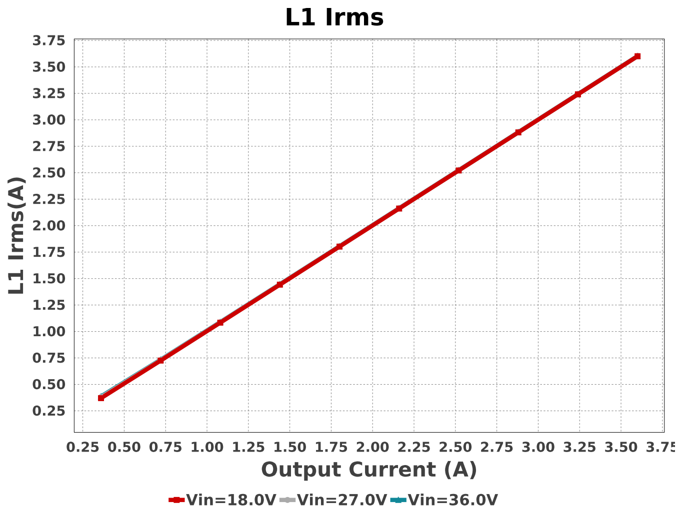

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


T1 Core Loss
T1 Core Loss(W)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

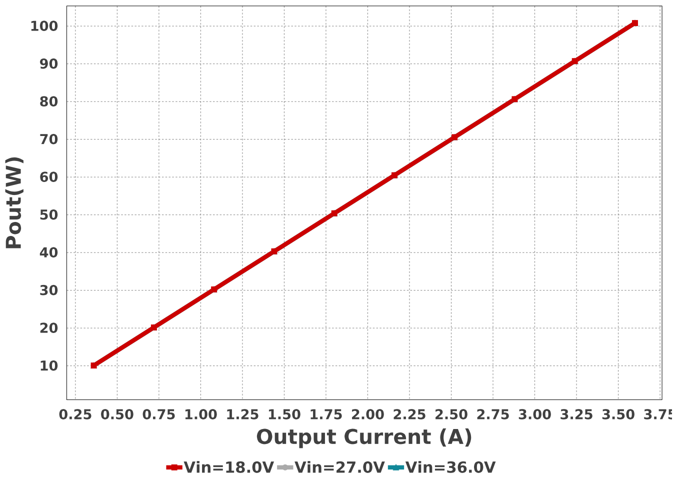

T1 Iprim RMS
T1 Iprim RMS(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


Qaux Irms
Qaux Irms(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

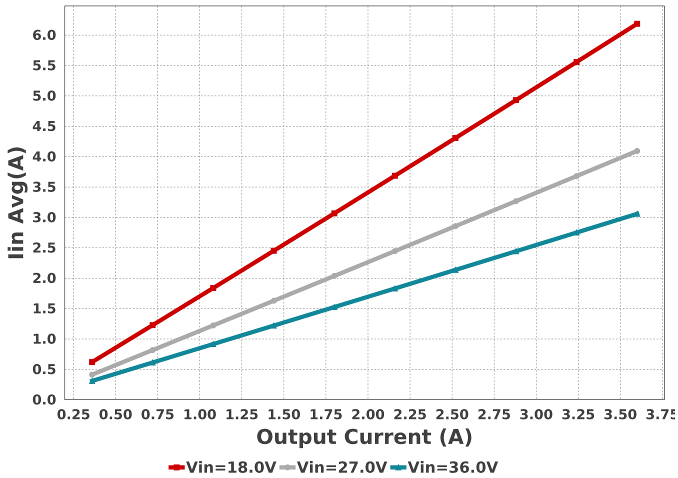

Qmain Irms
Qmain Irms(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


L1 Irms
L1 Irms(A)
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

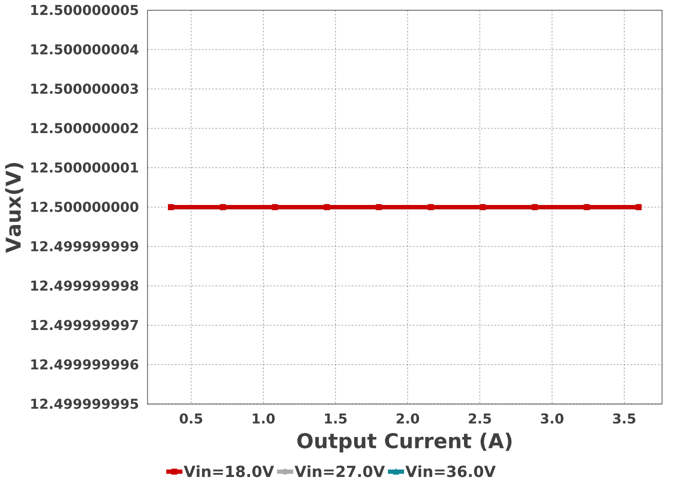
Pout



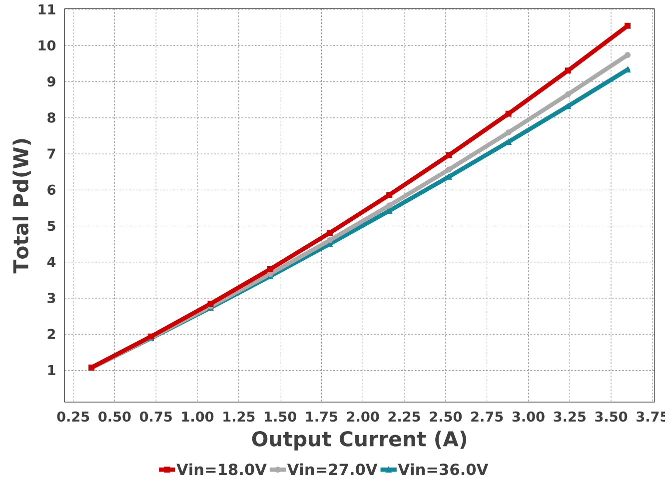
Iin Avg



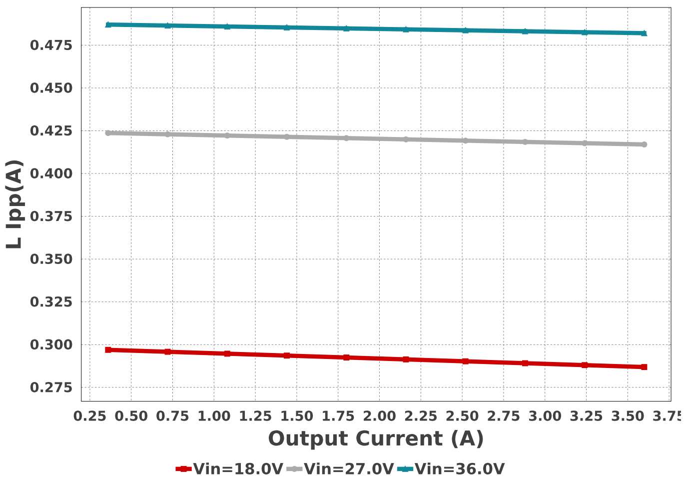
Vaux



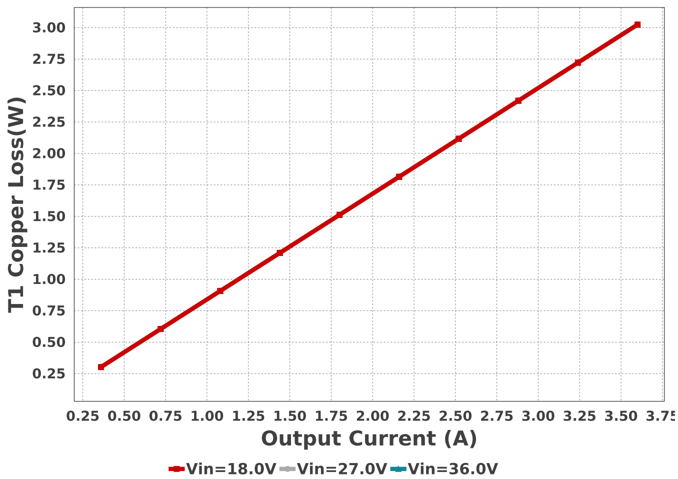
Total Pd

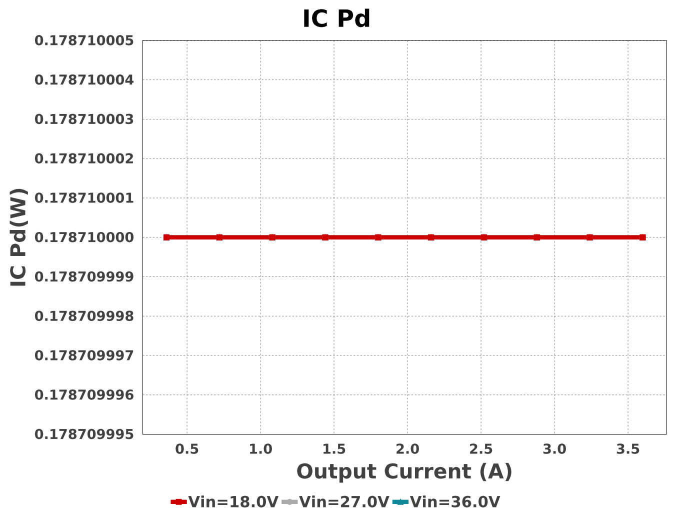


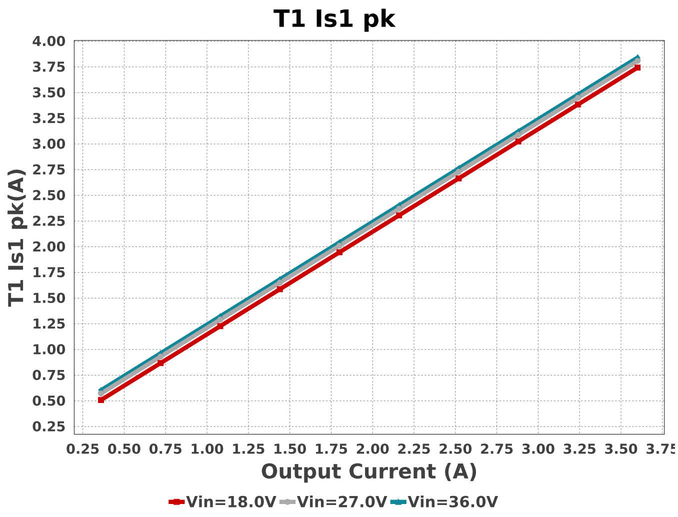
L Ipp

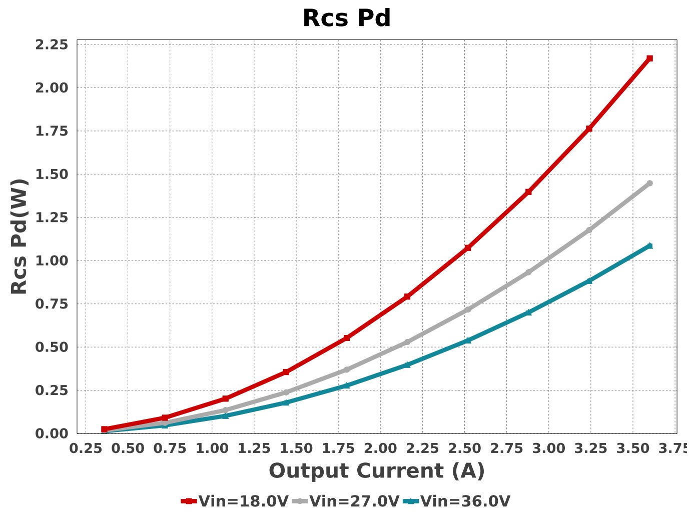


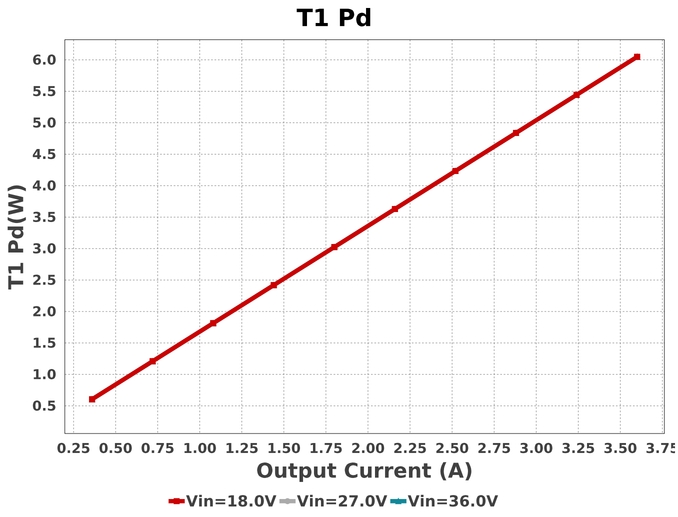
T1 Copper Loss

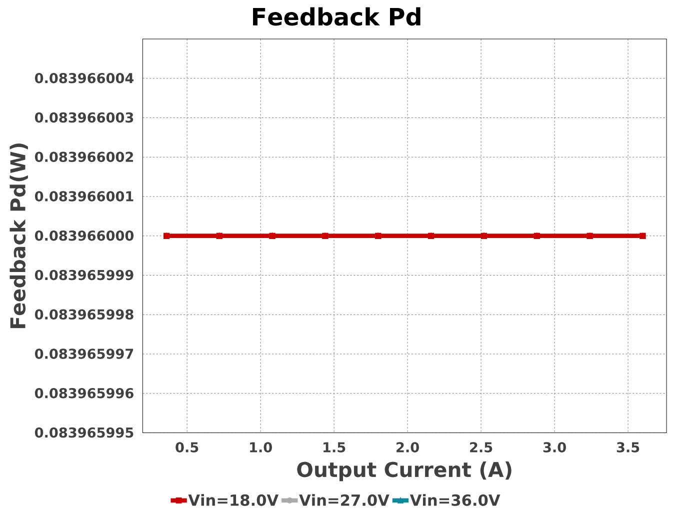


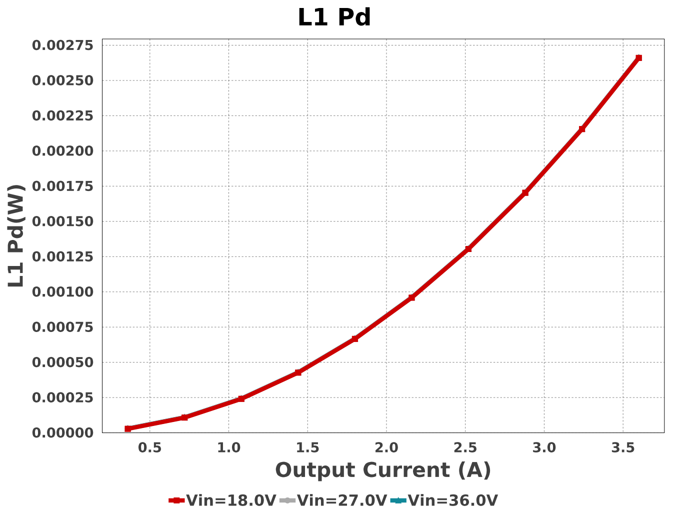

IC Pd
IC Pd(W)
0.178710005
0.178710004
0.178710003
0.178710002
0.178710001
0.178710000
0.178709999
0.178709998
0.178709997
0.178709996
0.178709995
0.5 1.0 1.5 2.0 2.5 3.0 3.5
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V

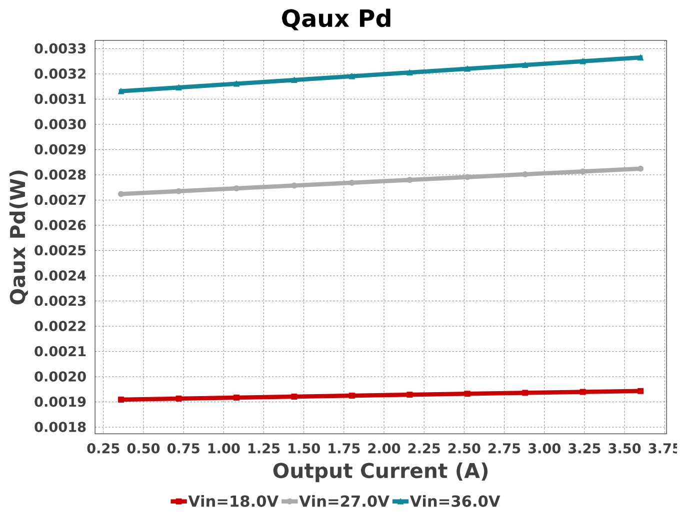

T1 Is1 pk
T1 Is1 pk(A)
4.00 3.75 3.50 3.25 3.00 2.75 2.50 2.25 2.00 1.75 1.50 1.25 1.00 0.75 0.50 0.25
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


Rcs Pd
Rcs Pd(W)
2.25 2.00 1.75 1.50 1.25 1.00 0.75 0.50 0.25 0.00
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


T1 Pd
T1 Pd(W)
6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


Feedback Pd
Feedback Pd(W)
0.083966004
0.083966003
0.083966002
0.083966001
0.083966000
0.083965999
0.083965998
0.083965997
0.083965996
0.083965995
0.5 1.0 1.5 2.0 2.5 3.0 3.5
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V


L1 Pd
L1 Pd(W)
0.00275 0.00250 0.00225 0.00200 0.00175 0.00150 0.00125 0.00100 0.00075 0.00050 0.00025 0.00000
0.5 1.0 1.5 2.0 2.5 3.0 3.5
Output Current (A)
Vin=18.0V Vin=27.0V Vin=36.0V



Operating Values

#	Name	Value	Category	Description
1.	D1 Iavg	2.075 A	Current	
2.	D2 Iavg	1.525 A	Current	
3.	Qaux Irms	84.838 mA	Current	
4.	Qmain Irms	8.023 A	Current	
5.	D1 Pd	1.037 W	Diode	Output Diode Power Dissipation
6.	D2 Pd	762.68 mW	Diode	D2 diode power dissipation
7.	IC Pd	178.71 mW	IC	IC power dissipation
8.	IC Tj	46.37 degC	IC	IC junction temperature
9.	ICThetaJA	91.6 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	6.186 A	IC	Average input current
11.	L Ipp	286.9 mA	Inductor	Peak-to-peak inductor ripple current
12.	L1 Irms	3.601 A	Inductor	Inductor ripple current
13.	L1 Pd	2.66 mW	Inductor	Power Dissipation in the Inductor
14.	D1 Pd	1.037 W	Power	Output Diode Power Dissipation
15.	D2 Pd	762.68 mW	Power	D2 diode power dissipation
16.	Feedback Pd	83.966 mW	Power	Power Dissipation in Feedback Resistors
17.	IC Pd	178.71 mW	Power	IC power dissipation
18.	L1 Pd	2.66 mW	Power	Power Dissipation in the Inductor
19.	Qaux Pd	1.943 mW	Power	
20.	Qmain Pd	267.49 mW	Power	
21.	Rsns Pd	2.17 W	Power	Power Dissipation in Current Sense Resistors
22.	T1 Copper Loss	3.024 W	Power	Transformer Copper Loss Power Dissipation
23.	T1 Core Loss	3.024 W	Power	Transformer Core Loss Power Dissipation
24.	T1 Pd	6.048 W	Power	Estimated Losses in Transformer
25.	Total Pd	10.551 W	Power	Total Power Dissipation
26.	Feedback Pd	83.966 mW	Resistor	Power Dissipation in Feedback Resistors
27.	Rsns Pd	2.17 W	Resistor	Power Dissipation in Current Sense Resistors
28.	BOM Count	43	System Information	Total Design BOM count
29.	Duty Cycle	57.629 %	System Information	Duty cycle
30.	Efficiency	90.525 %	System Information	Steady state efficiency
31.	FootPrint	1.353 k mm^2	System Information	Total Foot Print Area of BOM components
32.	Frequency	201.569 kHz	System Information	Switching frequency
33.	Iout	3.6 A	System Information	Iout operating point
34.	Mode	CCM	System Information	Conduction Mode
35.	Pout	100.8 W	System Information	Total output power
36.	Qaux TjOP	30.233 degC	System Information	
37.	Qmain TjOP	43.375 degC	System Information	
38.	Total BOM	NA	System Information	Total BOM Cost
39.	Vin	18.0 V	System Information	Vin operating point

#	Name	Value	Category	Description
40.	Vout	28.0 V	System Information	Operational Output Voltage
41.	Vout Actual	28.004 V	System Information	Vout Actual calculated based on selected voltage divider resistors
42.	Vout Tolerance	1.84 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
43.	Vout p-p	2.84 mV	System Information	Peak-to-peak output ripple voltage
44.	Vout pp percentage	10.144 m%	System Information	Output Voltage ripple percentage
45.	T1 Copper Loss	3.024 W	Transformer	Transformer Copper Loss Power Dissipation
46.	T1 Core Loss	3.024 W	Transformer	Transformer Core Loss Power Dissipation
47.	T1 Imag pp	451.489 mA	Transformer	Transformer peak to peak magnetising current
48.	T1 Iprim RMS	8.023 A	Transformer	Transformer Primary RMS Current
49.	T1 Iprim pk	10.813 A	Transformer	Transformer Primary Peak Current
50.	T1 Is1 RMS	2.734 A	Transformer	Transformer Secondary1 RMS Current
51.	T1 Is1 pk	3.743 A	Transformer	Transformer Secondary1 Peak Current
52.	T1 Pd	6.048 W	Transformer	Estimated Losses in Transformer
53.	Vaux	12.5 V	Transformer	Auxiliary Voltage

Design Inputs

Name	Value	Description
Iout	3.6	Maximum Output Current
VinMax	36.0	Maximum input voltage
VinMin	18.0	Minimum input voltage
Vout	28.0	Output Voltage
base_pn	UCC2897A	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	200.0 k	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

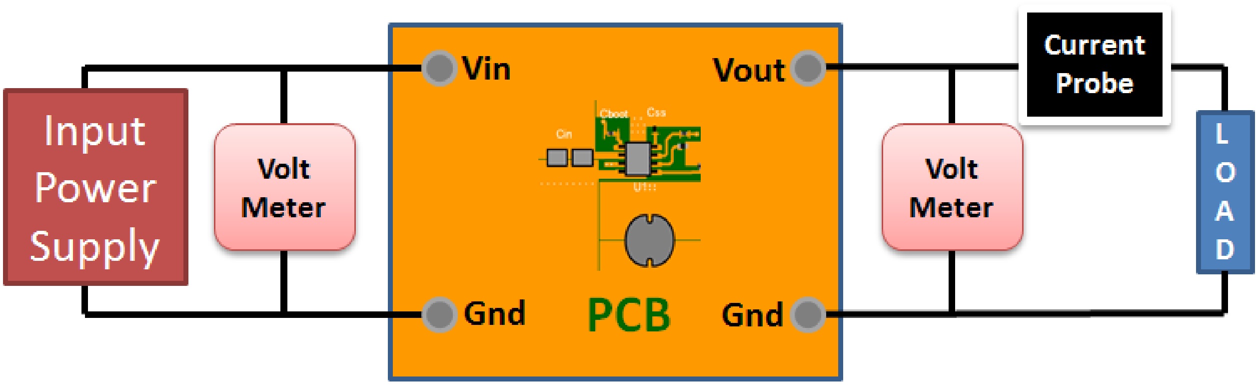
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 18.0V 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 : 19FA529608A3F5C9[v1]

2. **UCC2897A** Product Folder : http://www.ti.com/product/UCC2897A : contains the data sheet and other resources.