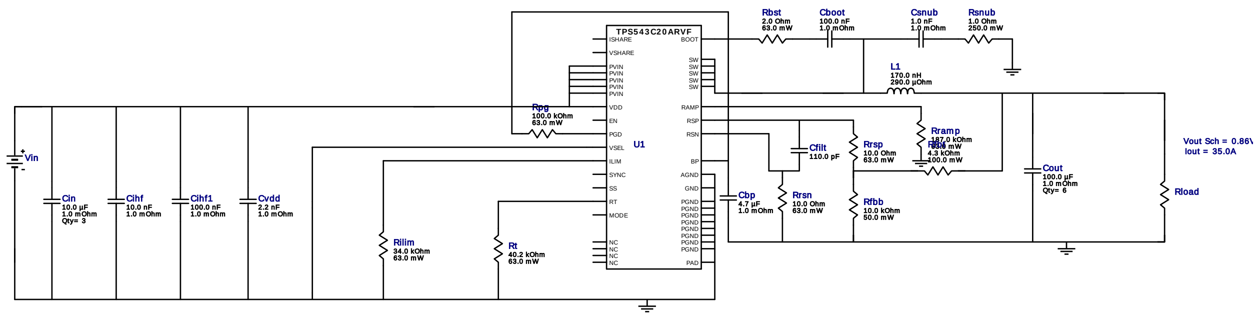
VinMin = 11.0V	Device = TPS543C20ARVFR
VinMax = 13.0V	Topology = Buck
Vout = 0.86V	Created = 2022-04-21 01:29:48.204
Vout Sch = 0.86V	BOM Cost = NA
Iout = 35.0A	BOM Count = 30
	Total Pd = 4.97W

WEBENCH ® Design Report

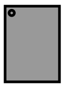
Design : 80 TPS543C20ARVFR

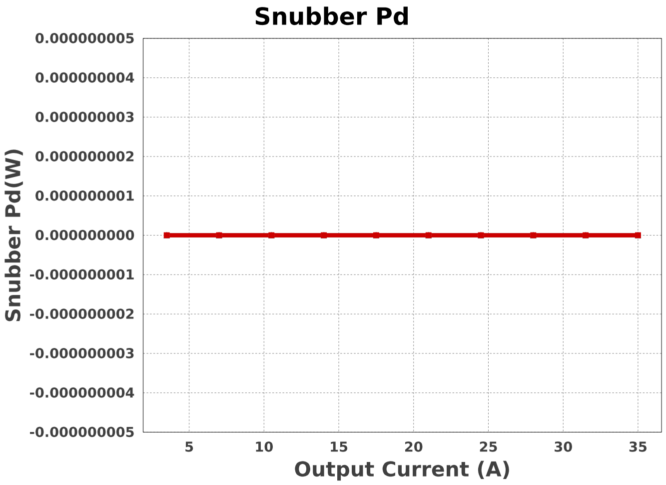
TPS543C20ARVFR 11V-13V to .86V @ 40A

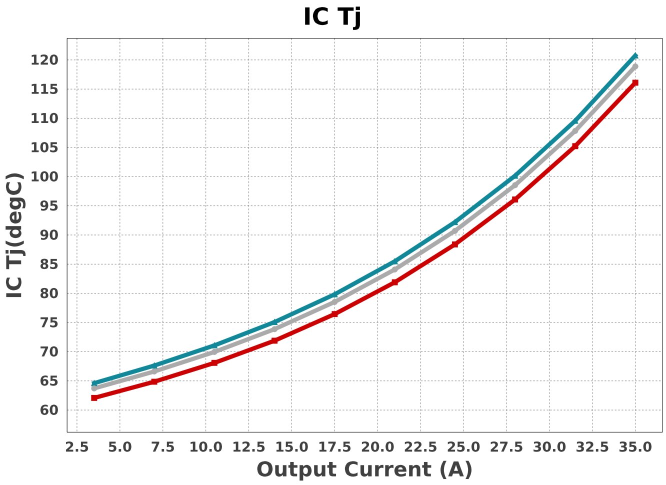


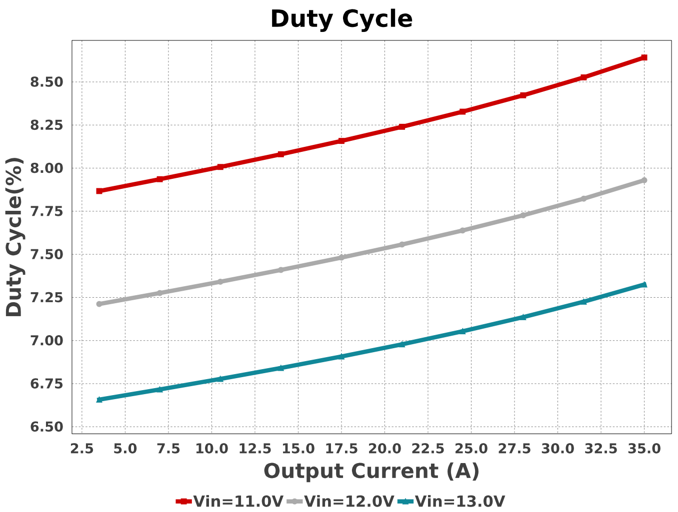
Electrical BOM

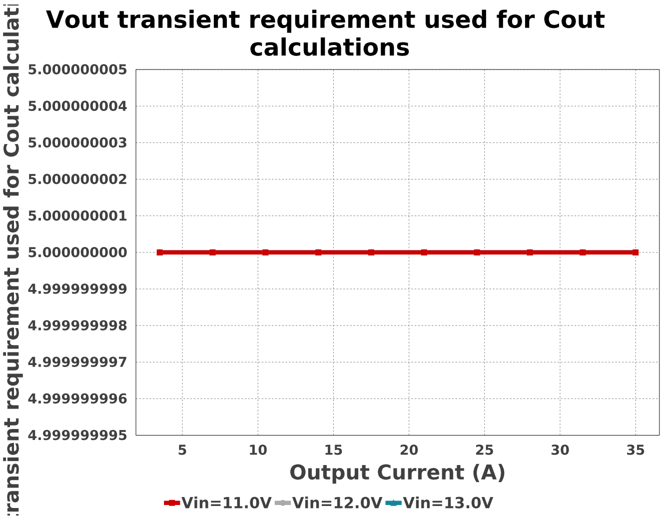
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0603 5 mm^2
Cbp	Taiyo Yuden	EMK212BJ475KG-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm^2
Cfilt	MuRata	GRM0335C1H111JA01D Series= C0G/NP0	Cap= 110.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
Cihf	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cihf1	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cin	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	3	$0.28	1210 15 mm^2
Cinx	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	2	$0.01	0603 5 mm^2
Cout	CUSTOM	CUSTOM Series= X5R	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 4.4118 A	6	NA	1206_190 0 mm^2
Csnub	Kemet	C0603C102K5RACTU Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cvdd	MuRata	GRM155R71E222KA01D Series= X7R	Cap= 2.2 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2

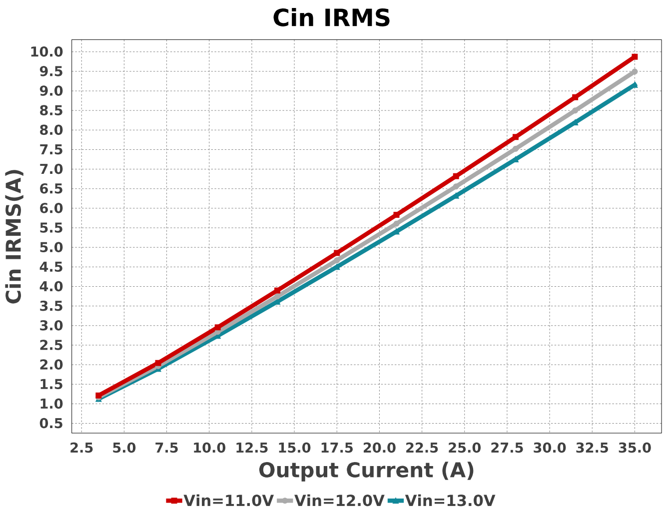
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Coiltronics	FP1007R3-R17-R	L= 170.0 nH 290.0 µOhm	1	$0.87	 IND_FP1007R3 124 mm²
Rbst	Vishay-Dale	CRCW04022R00FKED Series= CRCW..e3	Res= 2.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbt	Yageo	RC0603FR-074K3L Series= ?	Res= 4.3 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rilim	Vishay-Dale	CRCW040234K0FKED Series= CRCW..e3	Res= 34.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rramp	Vishay-Dale	CRCW0402187KFKED Series= CRCW..e3	Res= 187.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rrsn	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rrsp	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rsnub	Vishay-Dale	CRCW12061R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
Rt	Vishay-Dale	CRCW040240K2FKED Series= CRCW..e3	Res= 40.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS543C20ARVFR	Switcher	1	$3.95	 RVF0040A 63 mm²

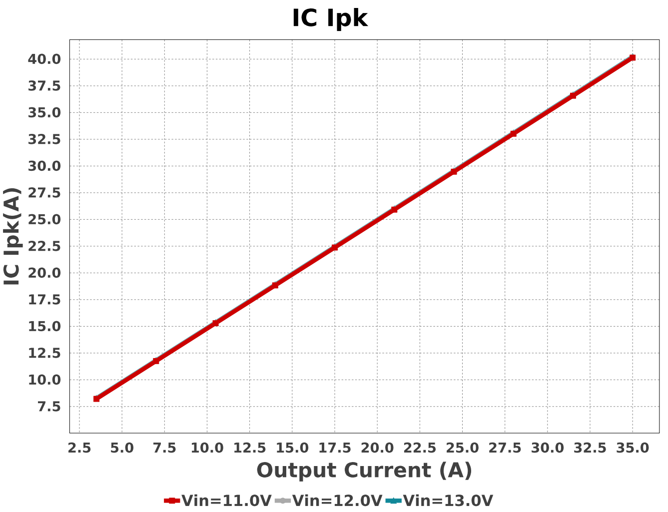


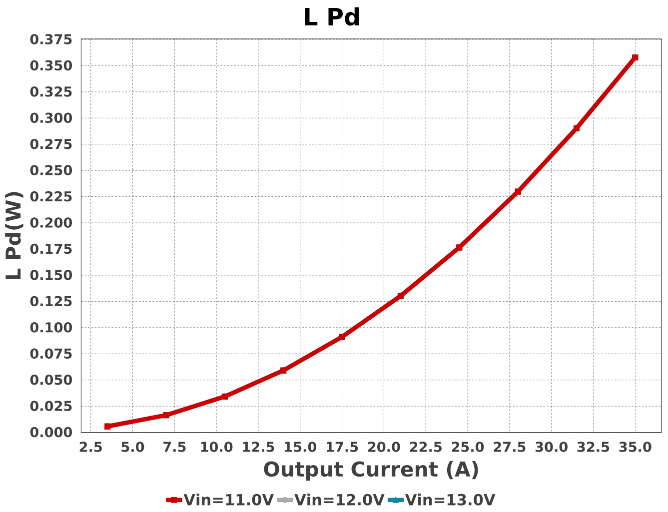


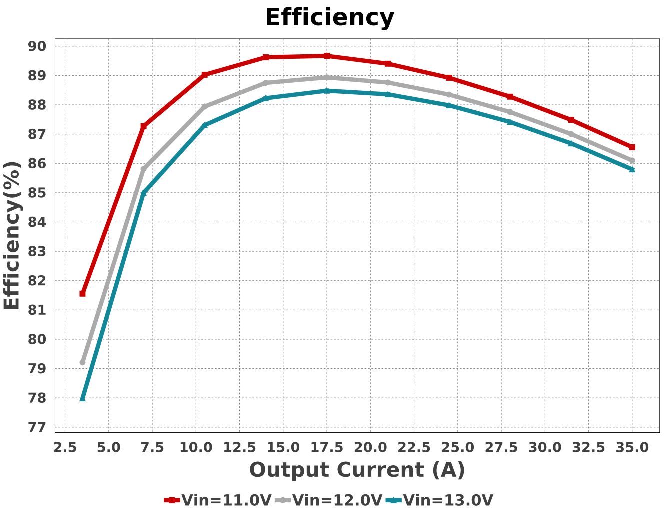

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V


Vout transient requirement used for Cout calculations
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

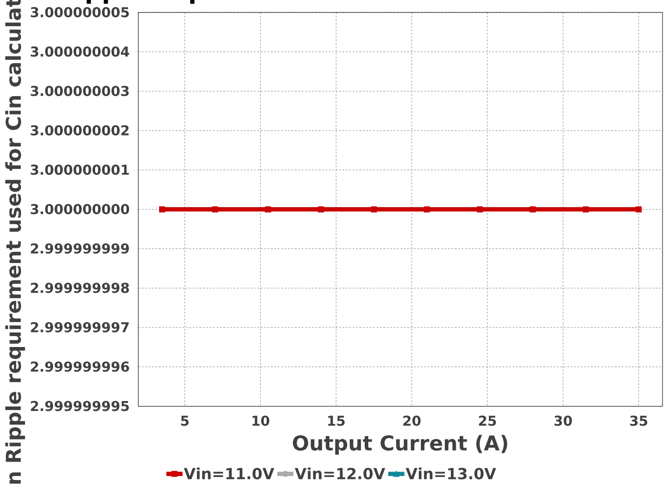

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V


IC Ipk
IC Ipk(A)
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

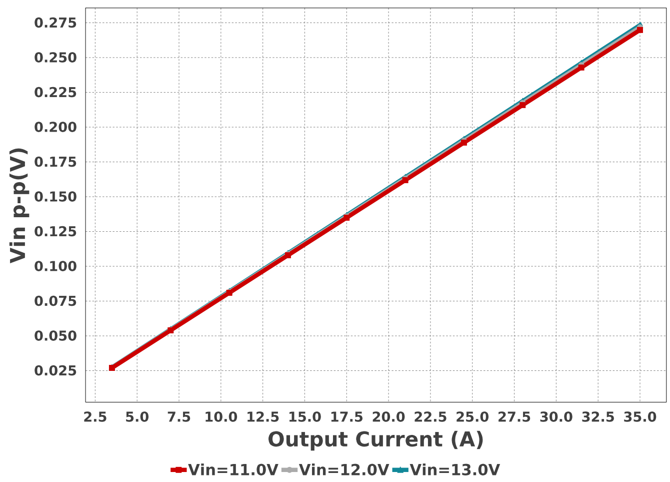

L Pd
L Pd(W)
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V


Efficiency
Efficiency(%)
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

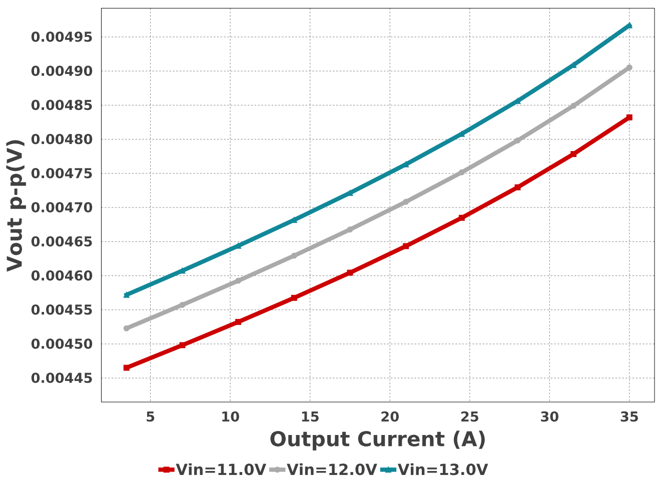
Vin Ripple requirement used for Cin calculations



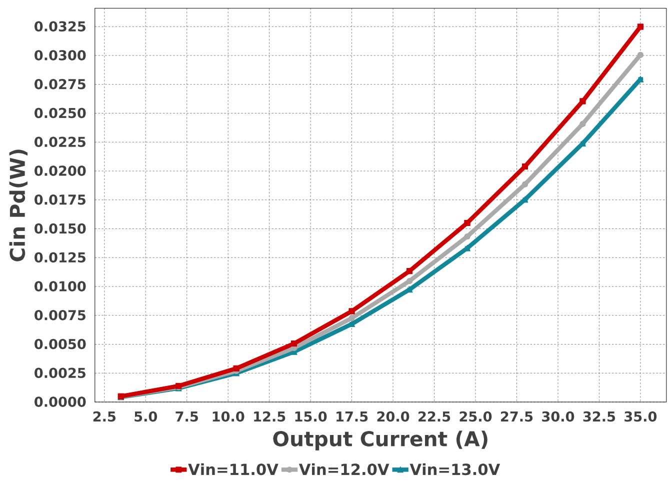
Vin p-p



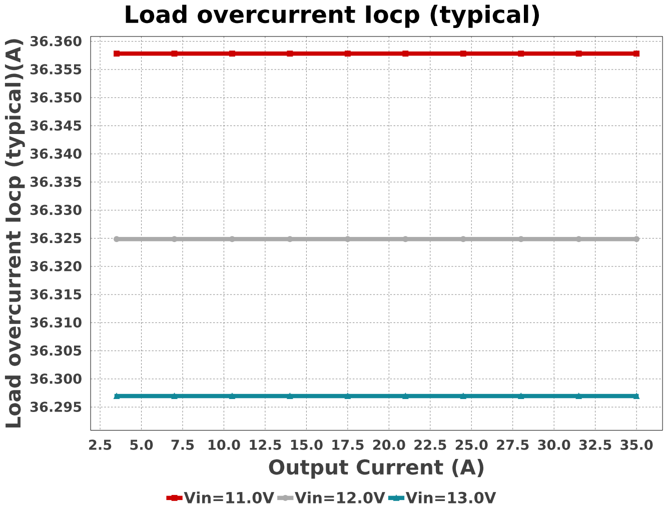
Vout p-p



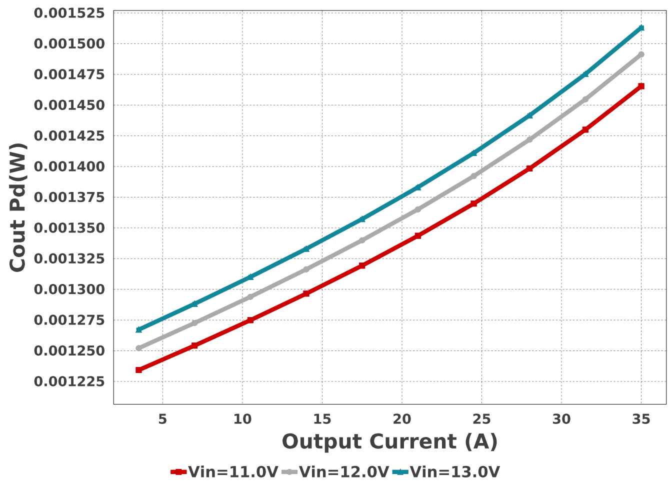
Cin Pd

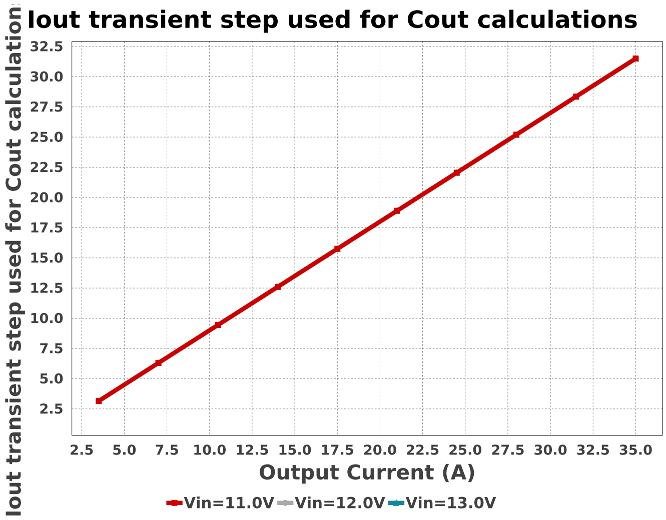


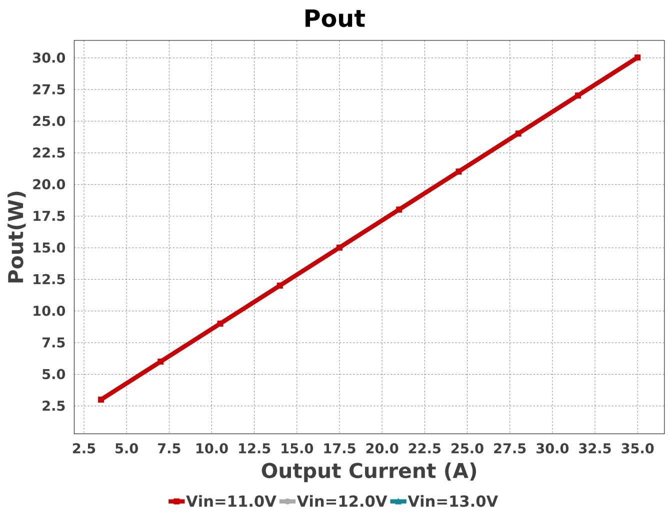
Load overcurrent Iocp (typical)

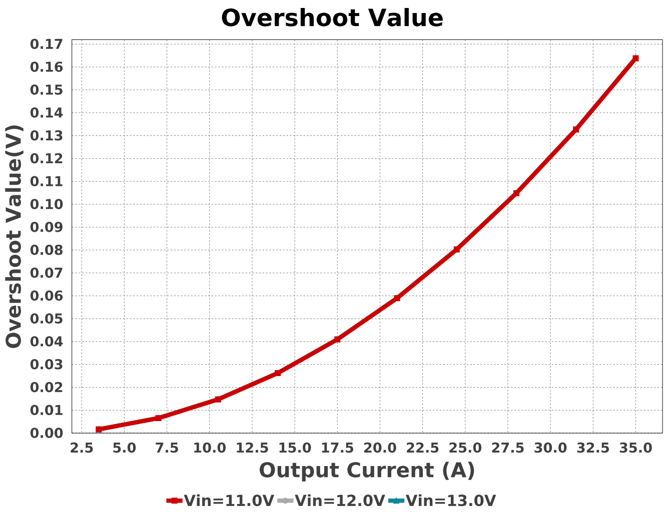


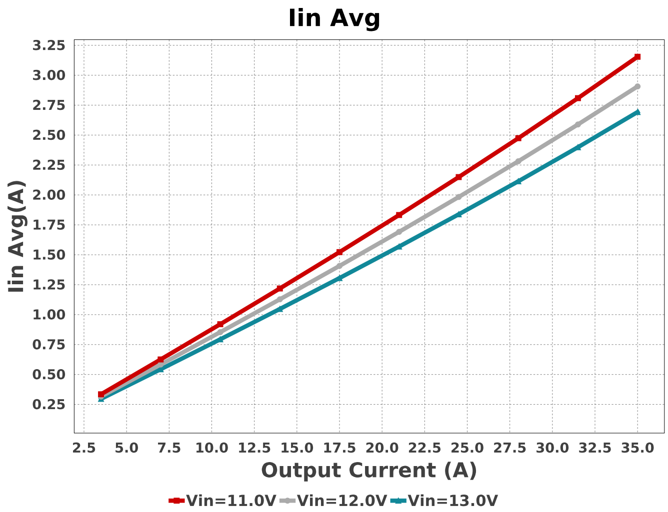
Cout Pd

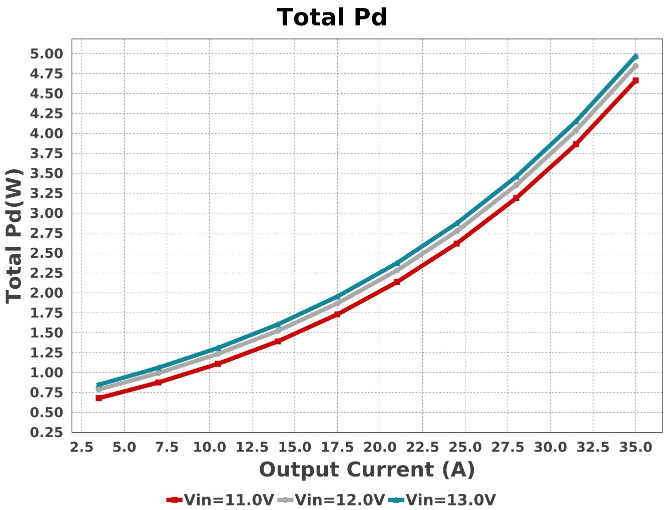


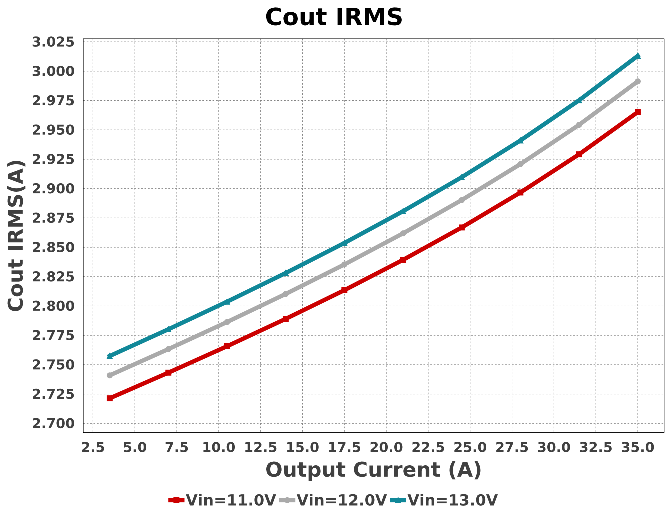

Iout transient step used for Cout calculations
Iout transient step used for Cout calculation
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

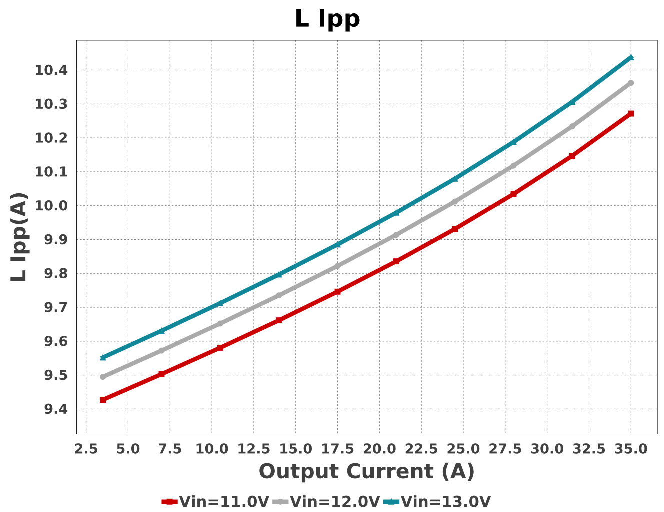

Pout
Pout(W)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

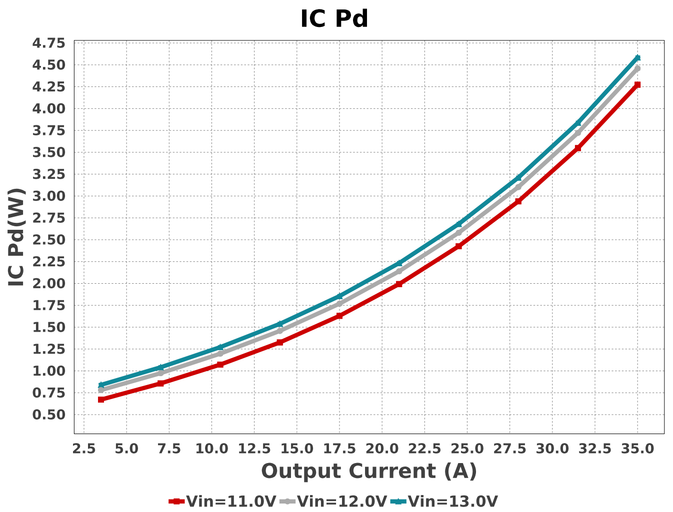

Overshoot Value
Overshoot Value(V)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

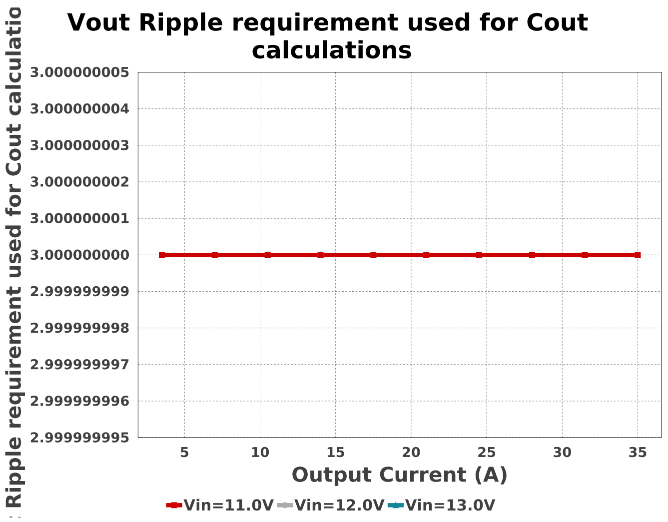

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

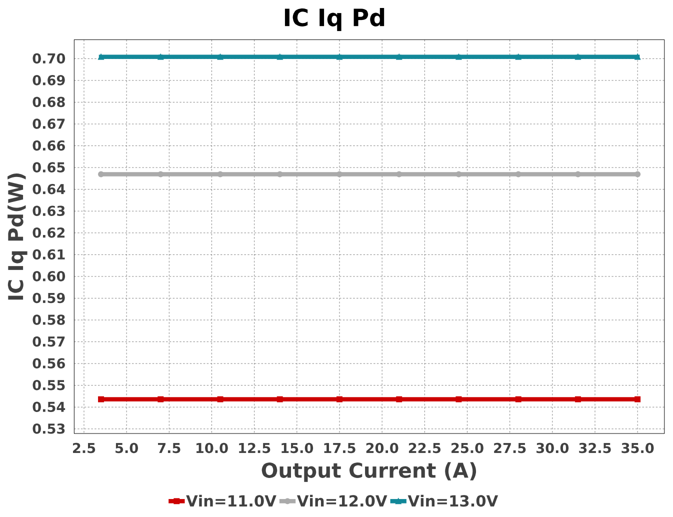

Total Pd
Total Pd(W)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

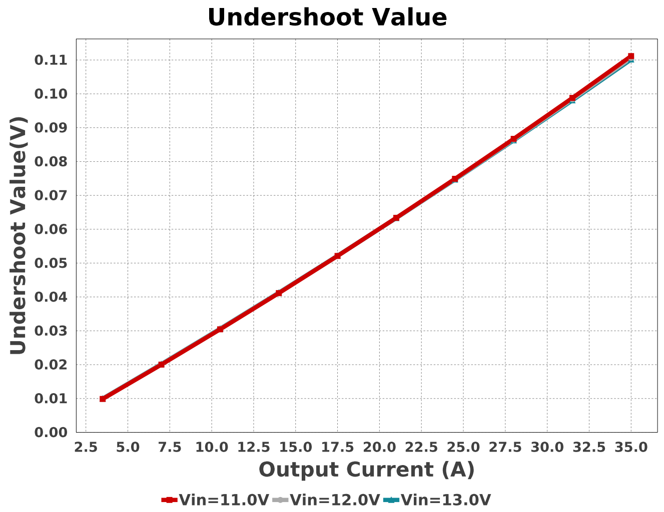

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

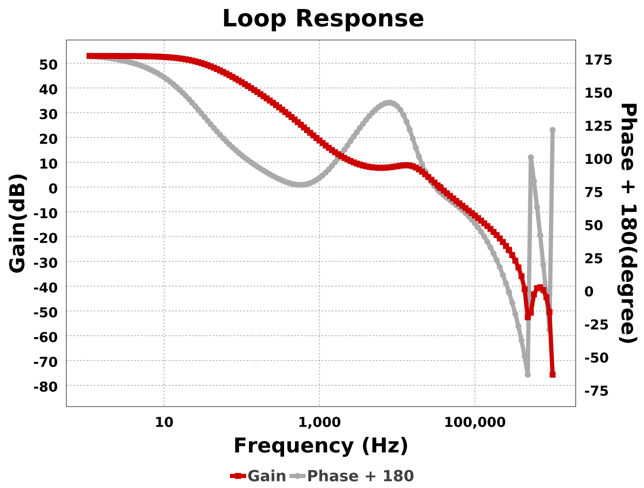












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	30		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	9.156 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	27.941 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	3.013 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	1.513 mW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	40.219 A	IC	Peak switch current in IC
8.	IC Iq Pd	700.836 mW	IC	IC Iq Pd
9.	IC Pd	4.584 W	IC	IC power dissipation
10.	IC Tj	120.758 degC	IC	IC junction temperature
11.	ICThetaJA Effective	15.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	2.692 A	IC	Average input current
13.	L Ipp	10.438 A	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	357.88 mW	Inductor	Inductor power dissipation
15.	Cin Pd	27.941 mW	Power	Input capacitor power dissipation
16.	Cout Pd	1.513 mW	Power	Output capacitor power dissipation
17.	IC Pd	4.584 W	Power	IC power dissipation
18.	L Pd	357.88 mW	Power	Inductor power dissipation
19.	Snubber Pd	0.0 W	Power	Snubber Power Dissipation
20.	Total Pd	4.971 W	Power	Total Power Dissipation
21.	Cross Freq	35.147 kHz	System Information	Bode plot crossover frequency
22.	Duty Cycle	7.325 %	System Information	Duty cycle
23.	Efficiency	85.797 %	System Information	Steady state efficiency
24.	FootPrint	374.0 mm^2	System Information	Total Foot Print Area of BOM components
25.	Frequency	497.512 kHz	System Information	Switching frequency
26.	Gain Marg	-25.297 dB	System Information	Bode Plot Gain Margin
27.	Iout	35.0 A	System Information	Iout operating point
28.	Iout transient step used for Cout calculations	31.5 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
29.	Load overcurrent Iocp (typical)	36.297 A	System Information	Over current protection threshold
30.	Low Freq Gain	52.921 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Overshoot Value	163.833 mV	System Information	Theoretical Vout Overshoot Value
33.	Phase Marg	75.527 deg	System Information	Bode Plot Phase Margin
34.	Pout	30.03 W	System Information	Total output power
35.	Undershoot Value	110.137 mV	System Information	Theoretical Vout Undershoot Value
36.	Vin	13.0 V	System Information	Vin operating point
37.	Vin Ripple requirement used for Cin calculations	3.0 %	System Information	Custom maximum input ripple requirement that was used for Cin selection(% of Minimum Vin).
38.	Vin p-p	273.341 mV	System Information	Peak-to-peak input voltage
39.	Vout	858.0 mV	System Information	Operational Output Voltage
40.	Vout Actual	858.0 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
41.	Vout Ripple requirement used for Cout calculations	3.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
42.	Vout Tolerance	1.614 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
43.	Vout p-p	4.967 mV	System Information	Peak-to-peak output ripple voltage
44.	Vout transient requirement used for Cout calculations	5.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

	Name	Value	Description
	Iout	35.0	Maximum Output Current
	VinMax	13.0	Maximum input voltage
	VinMin	11.0	Minimum input voltage
	Vout	858.0 m	Output Voltage
	base_pn	TPS543C20A	Base Product Number
	source	DC	Input Source Type
	Ta	52.0	Ambient temperature
	UserFsw	500.0 k	Customer Selected Frequency
1.	Vout Sch	860.0 m	Output voltage selected

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

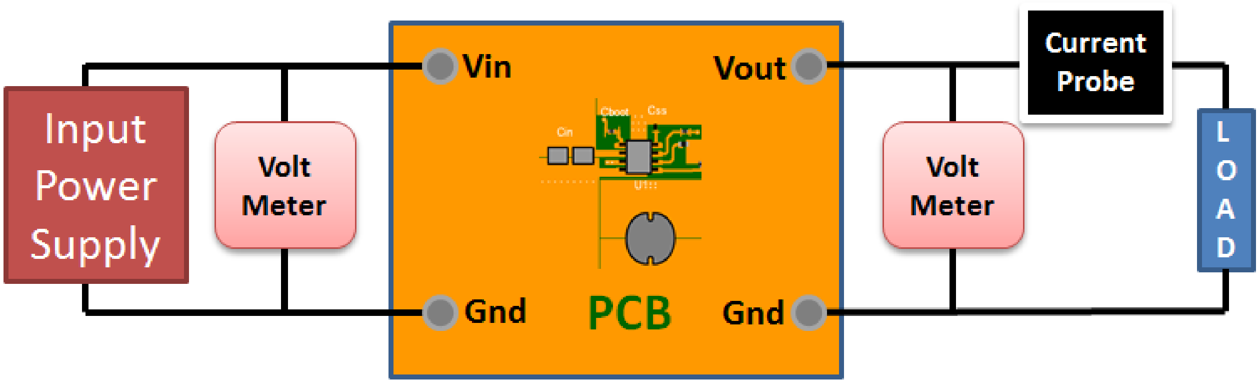
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.0V 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.

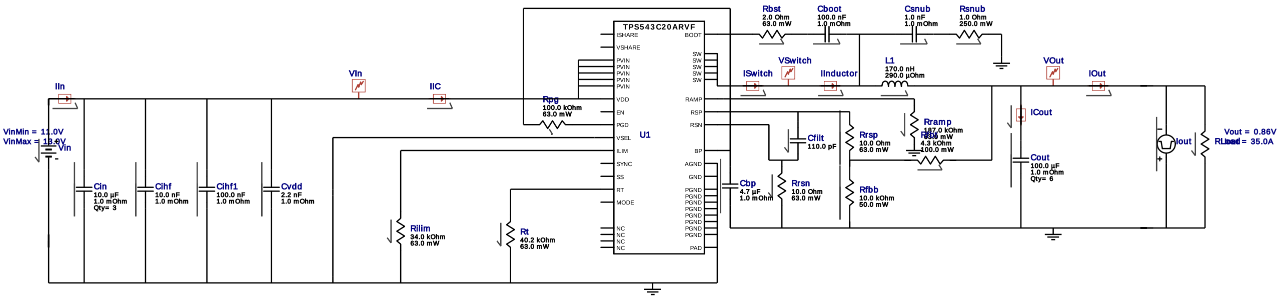


WEBENCH® Electrical Simulation Report

Design Id = 80

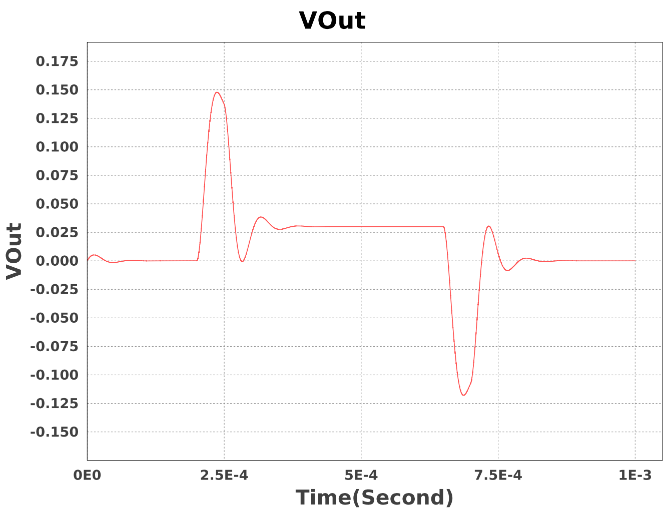
sim_id = 7

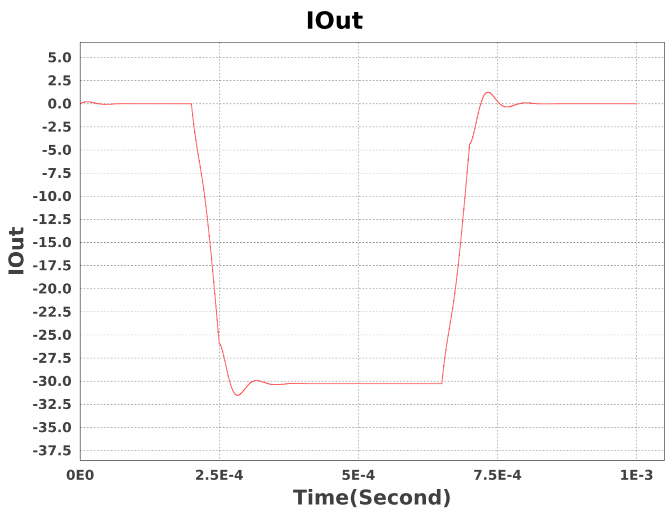
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Condition	35.0 A
2.	Cboot	IC	Initial Condition	3.15 V
3.	Iout	signal_type I1 I2 Td Tr Tf Pw	Signal Type Initial Load Current Peak Input Current Initial Time Delay Rise Time Fall Time Pulse Width	PULSE 0 A 31.5 A 1.9999999999999998E-4 s 50u s 50u s 4.0E-4 s
4.	RLoad	R	Load Resistance	0.024514285714285714 ohm





Design Assistance

1. Master key : 96BEFB9EA58EE8A0[v1]

2. **TPS543C20A** Product Folder : http://www.ti.com/product/TPS543C20A : contains the data sheet and other resources.

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