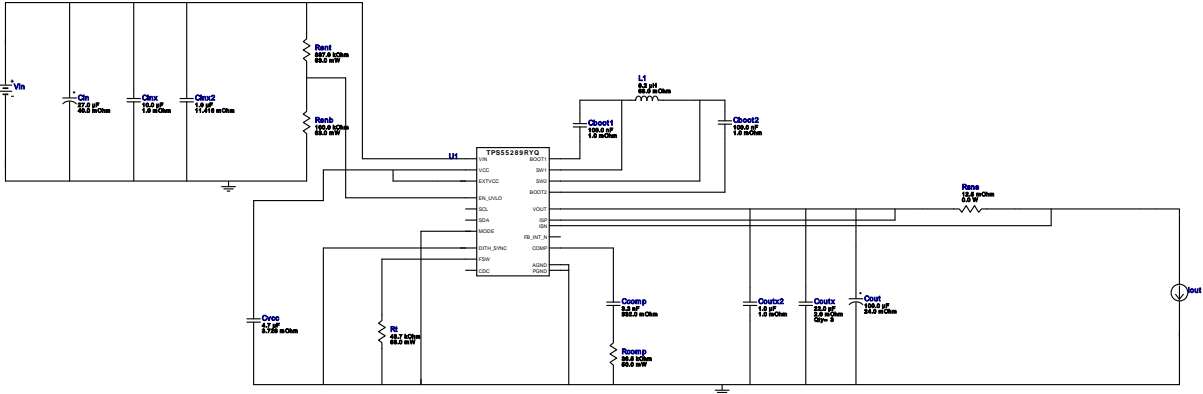


WEBENCH® Design Report

Design : 96 TPS55289RYQR
TPS55289RYQR 5V-20V to 9.00V @ 1A

VinMin = 12.0V
VinMax = 20.0V
Vout = 9.0V
Iout = 4.0A
Device = TPS55289RYQR
Topology = Buck_Boost
Created = 2024-04-18 03:37:02.012
BOM Cost = NA
BOM Count = 19
Total Pd = 2.51W




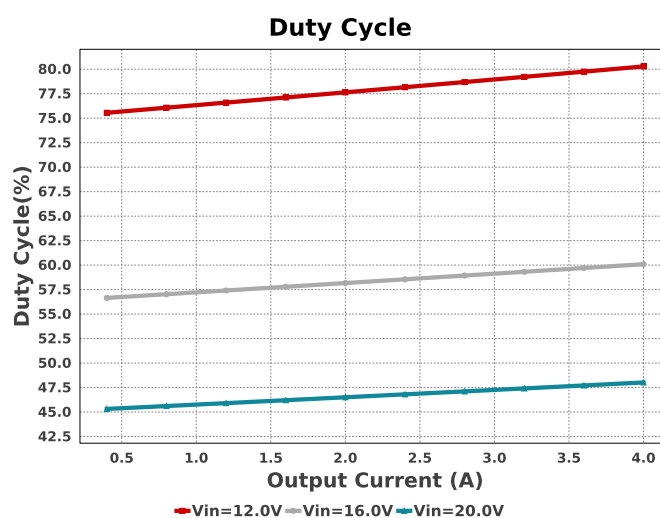
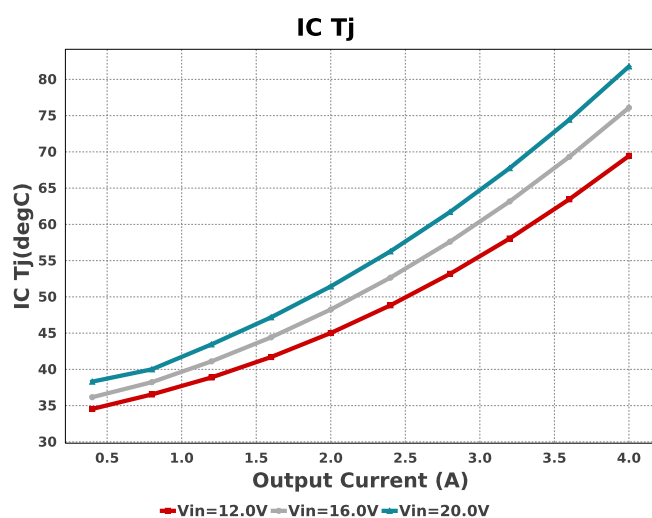
Design Alerts

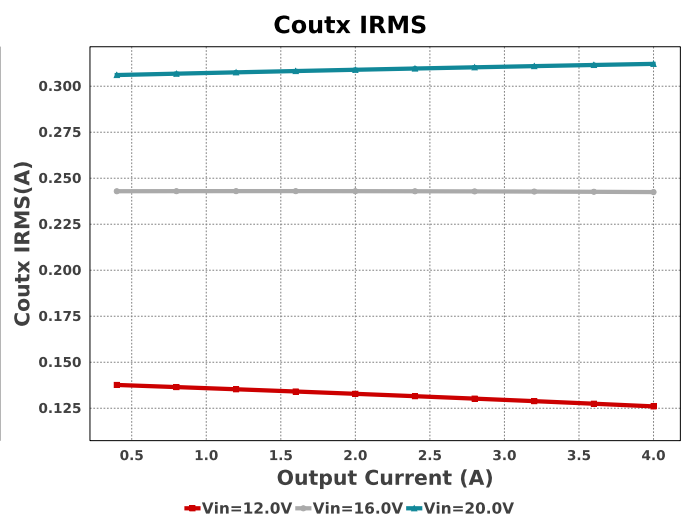
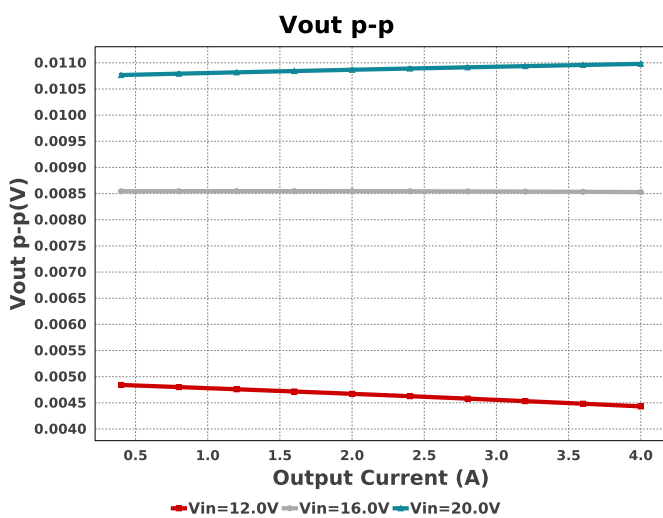
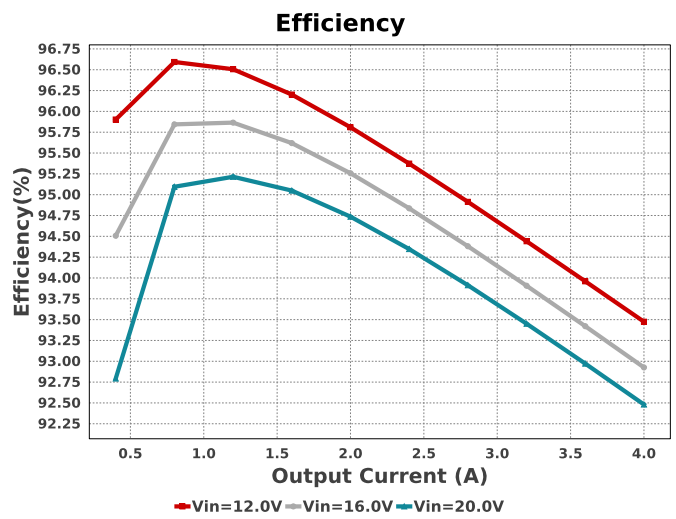
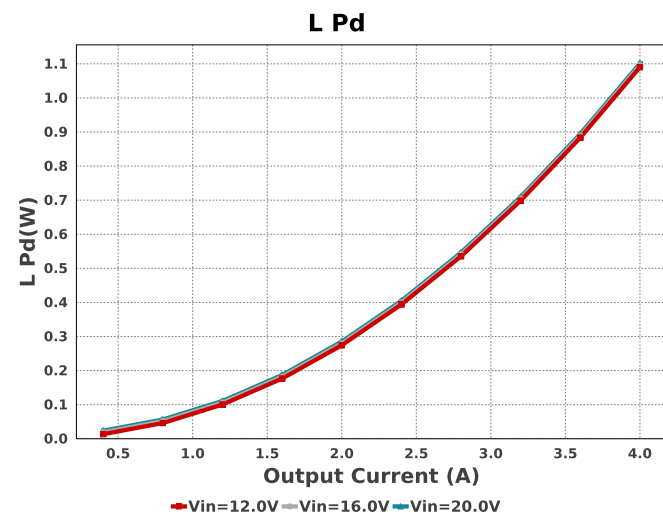
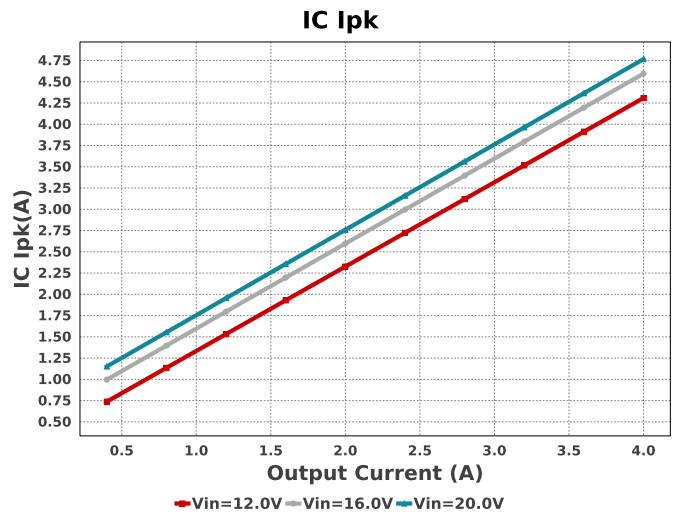
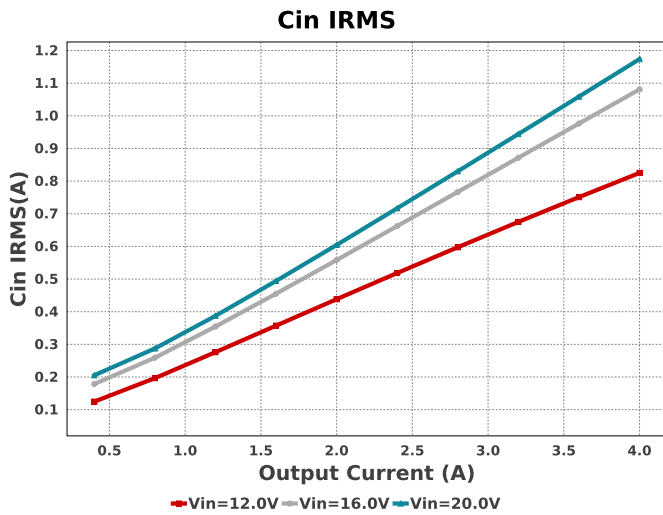
Current Sense Option Information
For Iout greater than 6A, please disable Output Current Sense Option

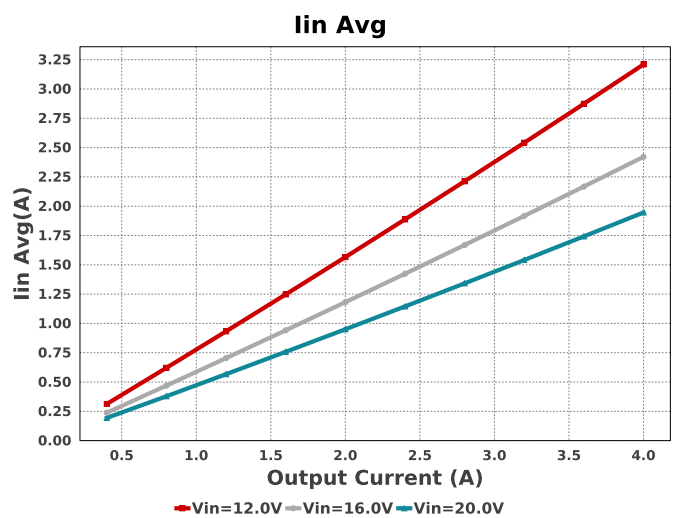
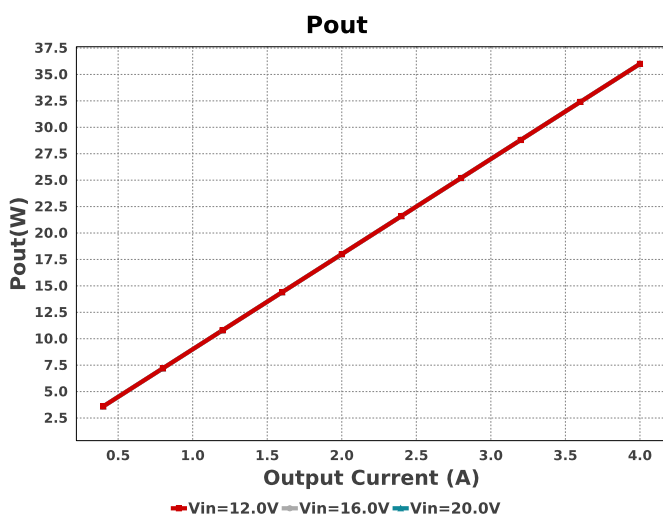
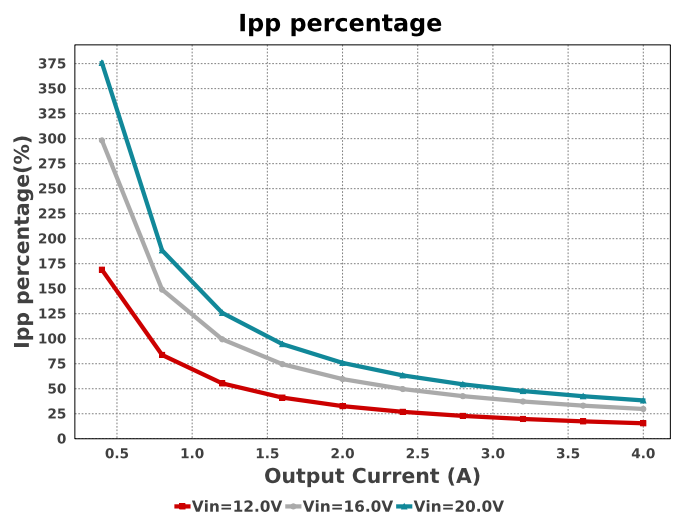
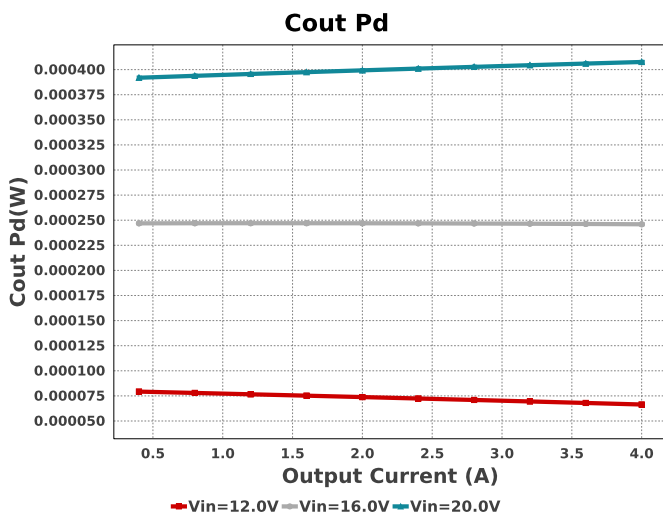
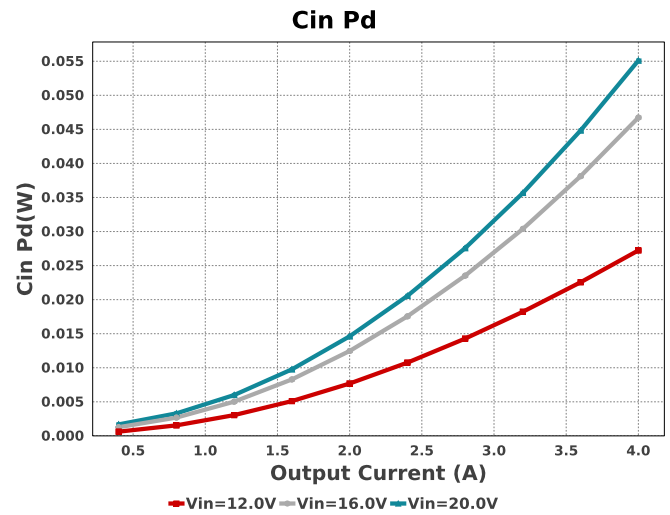
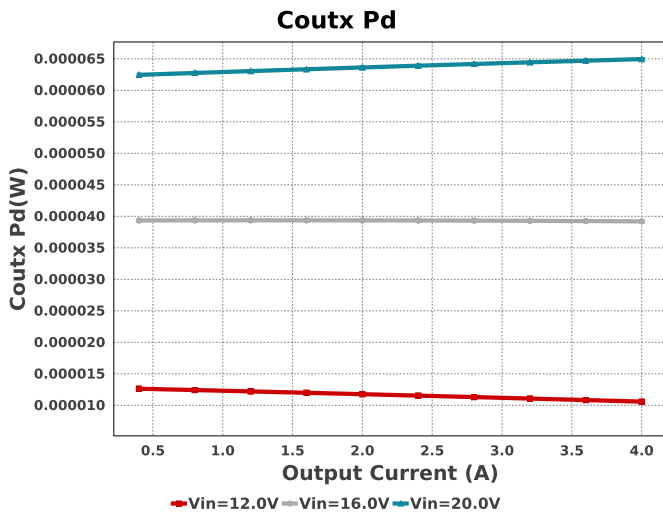
Electrical BOM

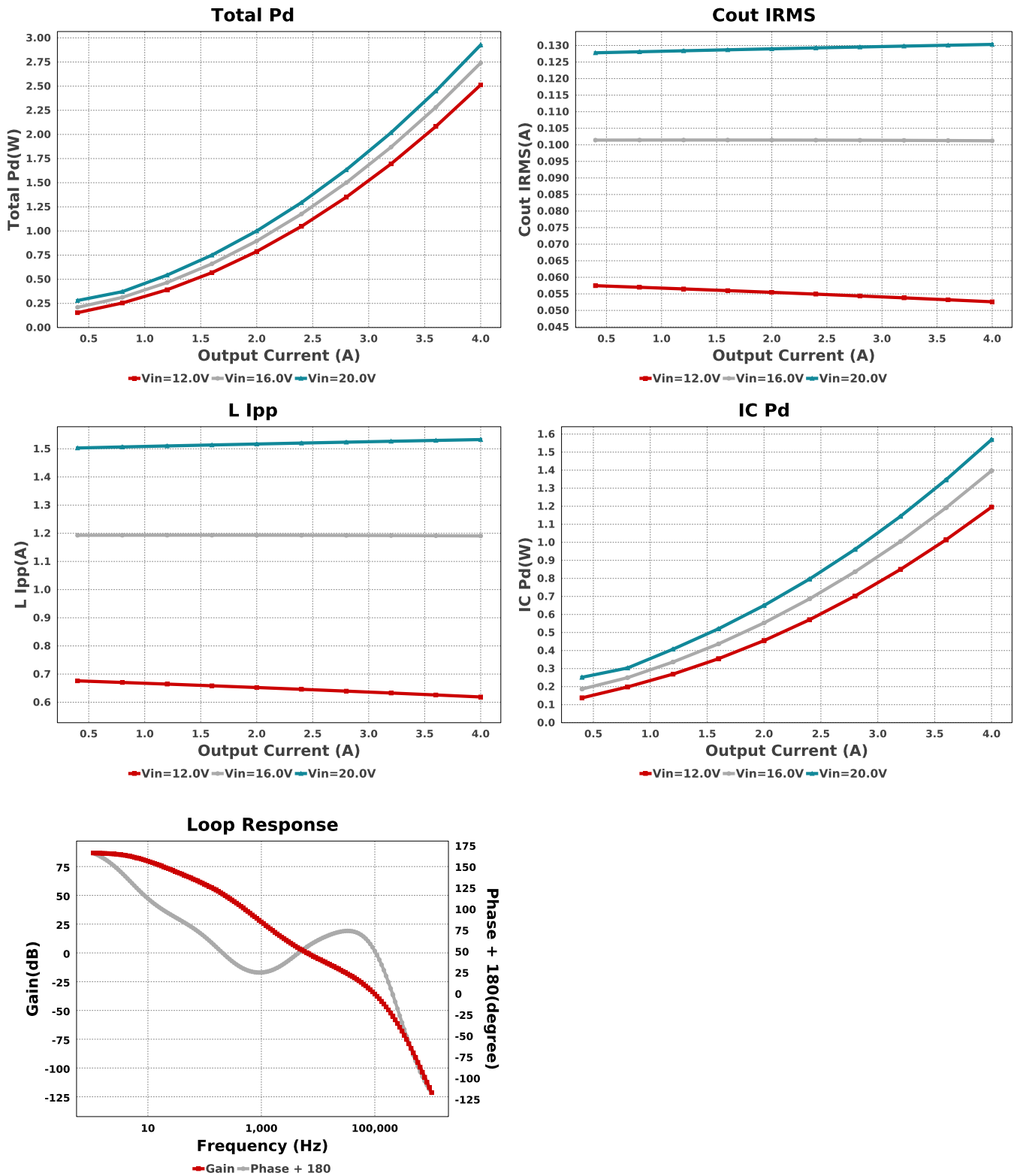
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot1	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
Cboot2	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
Ccomp	Kemet	C0805C332K5RACTU Series= X7R	Cap= 3.3 nF ESR= 332.0 mOhm VDC= 50.0 V IRMS= 319.0 mA	1	\$0.01	0805 7 mm ²
Cin	Panasonic	25SVPF27MX Series= SVPF	Cap= 27.0 uF ESR= 40.0 mOhm VDC= 25.0 V IRMS= 2.45 A	1	\$0.47	CAPSMT_62_E61 53 mm ²
Cinx	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	1	\$0.27	1210 15 mm ²
Cinx2	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
Cout	Panasonic	16SVPC100M Series= SVPC	Cap= 100.0 uF ESR= 24.0 mOhm VDC= 16.0 V IRMS= 2.49 A	1	\$0.47	SM_RADIAL_6.3AMM 80 mm ²
Coutx	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	3	\$0.23	1210 15 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 5 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	Vishay-Dale	IHLP2525CZER8R2M01	L= 8.2 uH 68.0 mOhm	1	\$0.61	 IHLP-2525CZ 75 mm ²
Rcomp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	0201 2 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	CRCW0402887KFKED Series= CRCW..e3	Res= 887.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rsns	CUSTOM	CUSTOM Series= ?	Res= 12.5 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²
Rt	Vishay-Dale	CRCW040248K7FKED Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
U1	Texas Instruments	TPS55289RYQR	Switcher	1	\$3.35	RYQ0021A 35 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	825.052 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	27.228 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	52.608 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	66.422 μ W	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	126.008 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	10.585 μ W	Capacitor	Output capacitor_x power loss
7.	IC Ipk	4.309 A	IC	Peak switch current in IC
8.	IC Pd	1.195 W	IC	IC power dissipation
9.	IC Tj	69.438 degC	IC	IC junction temperature
10.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA Effective	33.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	3.209 A	IC	Average input current
13.	Ipp percentage	15.469 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	618.74 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	1.09 W	Inductor	Inductor power dissipation
16.	Cin Pd	27.228 mW	Power	Input capacitor power dissipation
17.	Cout Pd	66.422 μ W	Power	Output capacitor power dissipation
18.	Coutx Pd	10.585 μ W	Power	Output capacitor_x power loss
19.	IC Pd	1.195 W	Power	IC power dissipation
20.	L Pd	1.09 W	Power	Inductor power dissipation
21.	Total Pd	2.513 W	Power	Total Power Dissipation
22.	BOM Count	19	System	Total Design BOM count
23.	Cross Freq	32.866 kHz	System	Bode plot crossover frequency
24.	Duty Cycle	80.284 %	System	Duty cycle
25.	Efficiency	93.475 %	System	Steady state efficiency
26.	FootPrint	347.0 mm ²	System	Total Foot Print Area of BOM components
27.	Frequency	402.82 kHz	System	Switching frequency
28.	Gain Marg	-49.764 dB	System	Bode Plot Gain Margin
29.	Iout	4.0 A	System	Iout operating point
30.	Low Freq Gain	86.747 dB	System	Gain at 1Hz
31.	Mode	CCM	System	Conduction Mode
32.	Phase Marg	63.207 deg	System	Bode Plot Phase Margin
33.	Pout	36.0 W	System	Total output power
34.	Total BOM	NA	System	Total BOM Cost
35.	Vin	12.0 V	System	Vin operating point
36.	Vout	9.0 V	System	Operational Output Voltage
37.	Vout Tolerance	133.33 m%	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
38.	Vout p-p	4.432 mV	System	Peak-to-peak output ripple voltage
39.	Vref	4.6 kh;	System	Register VREF

Design Inputs

Name	Value	Description
Iout	4.0	Maximum Output Current
VinMax	20.0	Maximum input voltage
VinMin	12.0	Minimum input voltage
Vout	9.0	Output Voltage
base_pn	TPS55289	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	403.0 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 C_{in} and C_{out} , 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 down 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 12.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} 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 V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} 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 : 7E00AF9B0638DEC2[v1]
2. **TPS55289** Product Folder : <https://www.ti.com/product/TPS55289> : contains the data sheet and other resources.

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