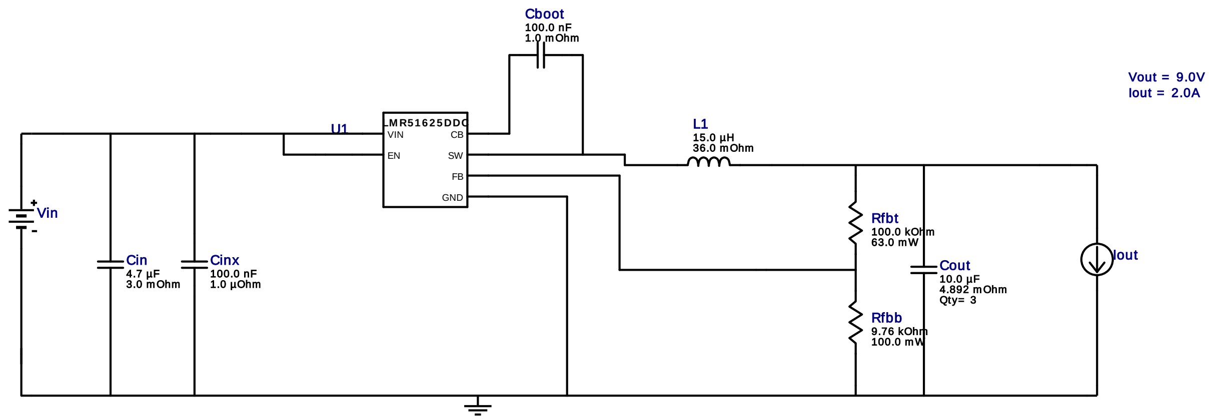
TEXAS INSTRUMENTS

WEBENCH® Design Report

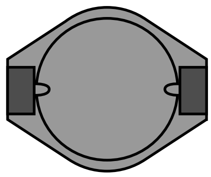
VinMin = 10.0V
VinMax = 24.0V
Vout = 9.0V
Iout = 2.0A

Device = LMR51625DDC
Topology = Buck
Created = 2026-01-04 14:59:54.957
BOM Cost = NA
BOM Count = 10
Total Pd = 0.61W

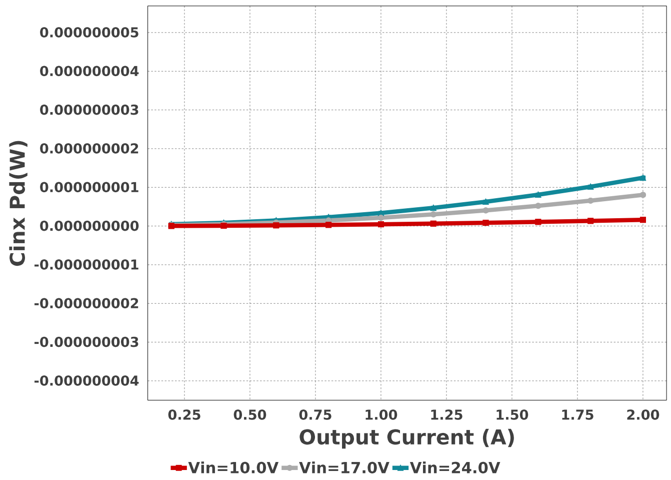
Design : 11 LMR51625DDC
LMR51625DDC 10V-24V to 9.00V @ 2A



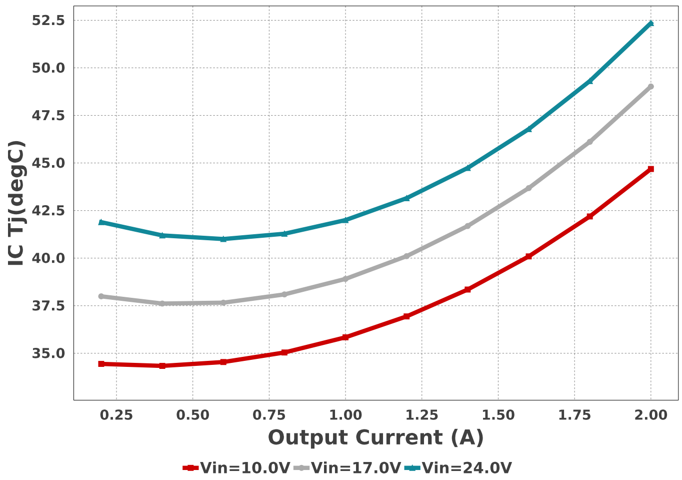
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.10	1206 11 mm²
Cinx	CUSTOM	CUSTOM Series= ?	Cap= 100.0 nF ESR= 1.0 uOhm VDC= 36.0 V IRMS= 36.003 mA	1	NA	CUSTOM 0 mm²
Cout	Taiyo Yuden	MSAST32NSB5106KTNA01 Series= X5R	Cap= 10.0 uF ESR= 4.892 mOhm VDC= 25.0 V IRMS= 3.25158 A	3	$0.12	1210 15 mm²
L1	NIC Components	NPI52W150MTRF	L= 15.0 µH 36.0 mOhm	1	$0.45	 IND_NPI52W 358 mm²
Rfbb	Yageo	RC0603FR-079K76L Series= ?	Res= 9.76 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 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
U1	Texas Instruments	LMR51625DDC	Switcher	1	$0.65	DDC0006A 15 mm²

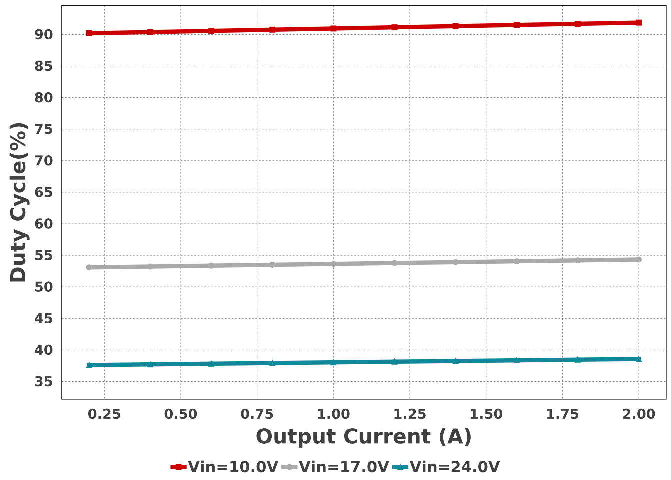
Cinx Pd



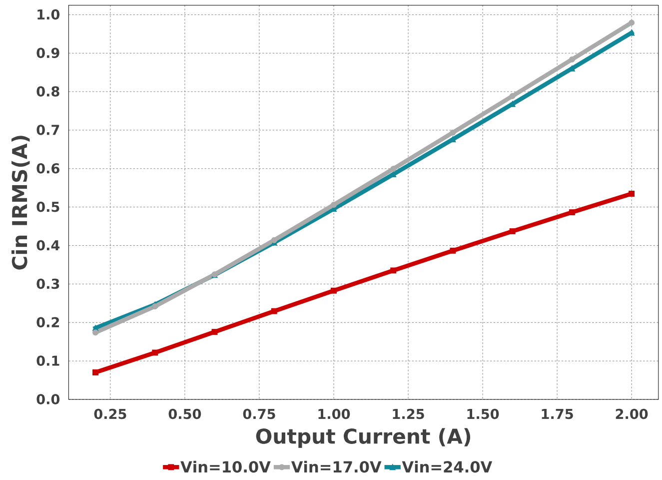
IC Tj



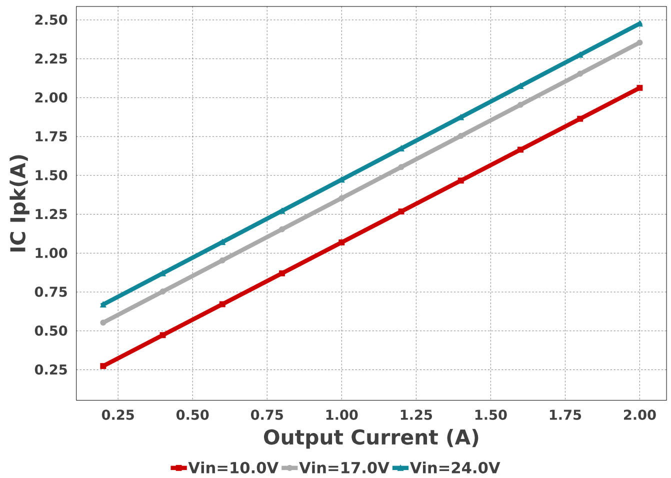
Duty Cycle



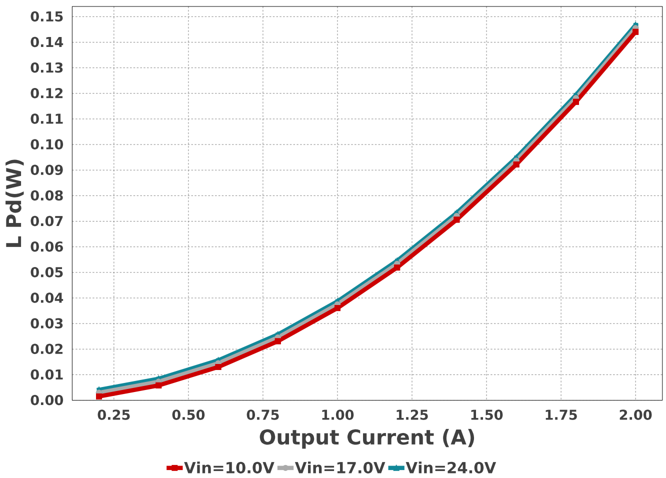
Cin IRMS

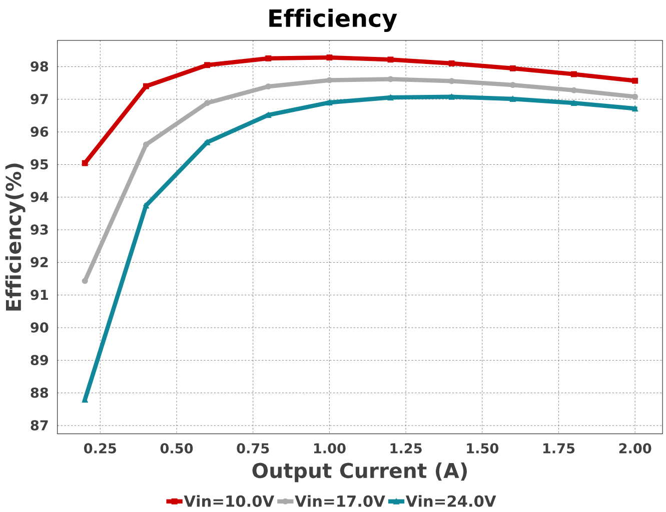


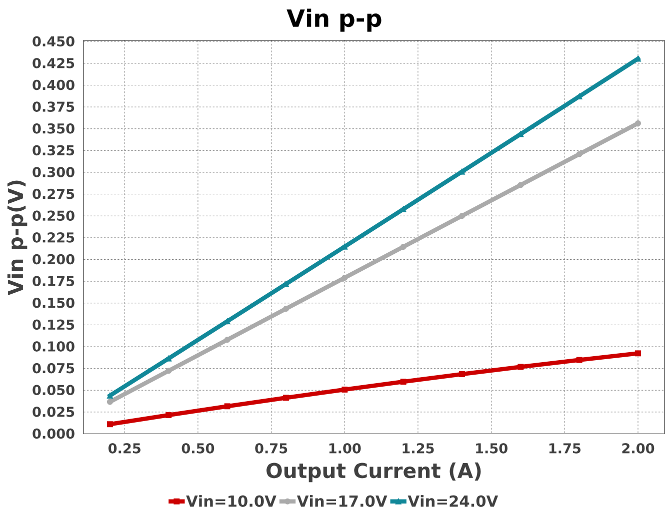
IC Ipk

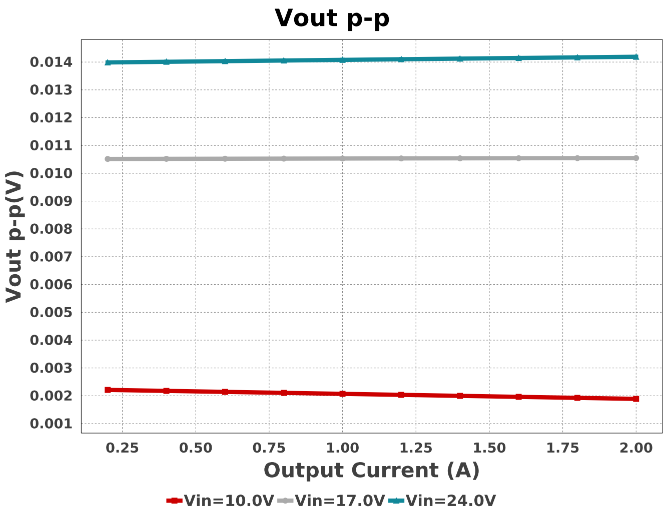


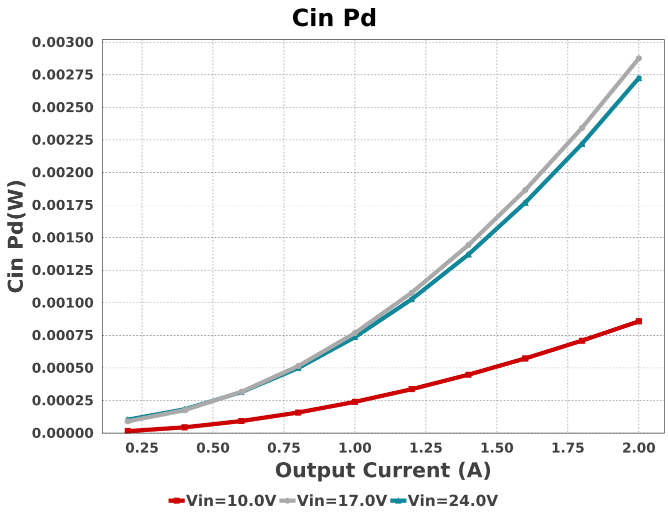
L Pd

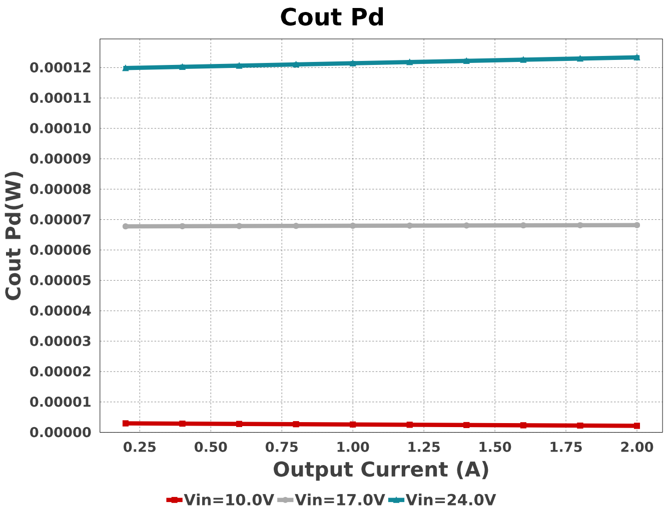


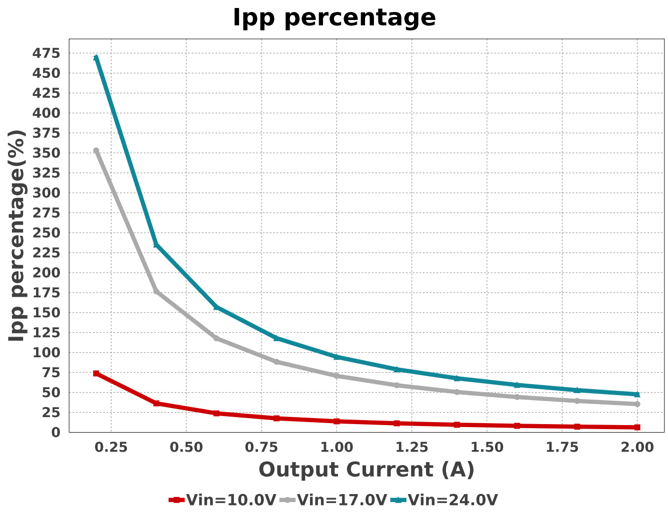

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.0V Vin=17.0V Vin=24.0V


Vin p-p
Vin p-p(V)
Output Current (A)
Vin=10.0V Vin=17.0V Vin=24.0V

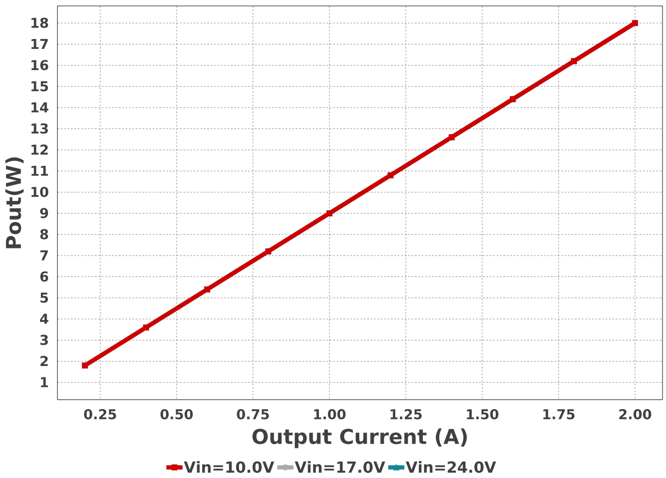

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.0V Vin=17.0V Vin=24.0V


Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V Vin=17.0V Vin=24.0V

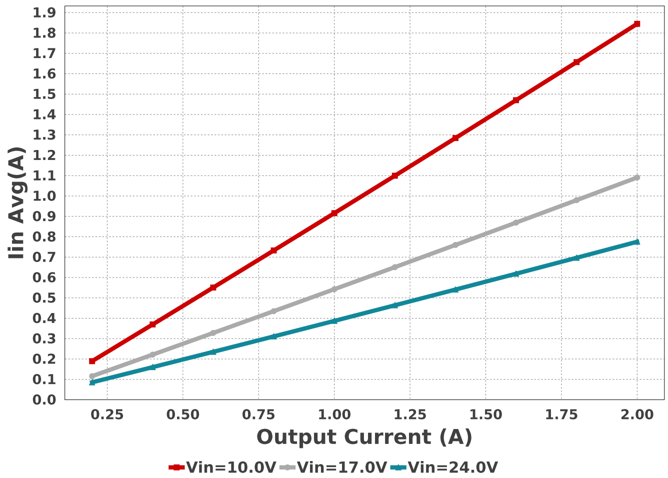

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.0V Vin=17.0V Vin=24.0V


Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=10.0V Vin=17.0V Vin=24.0V

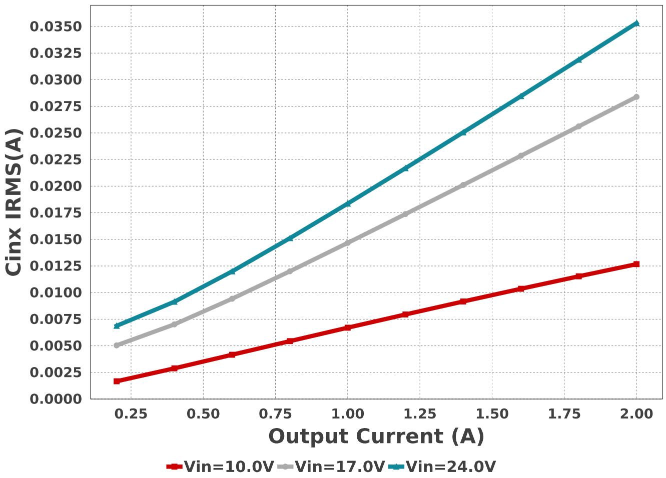
Pout



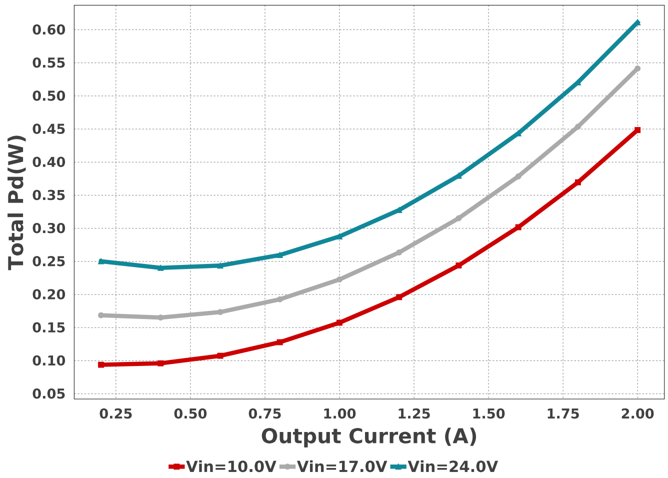
Iin Avg



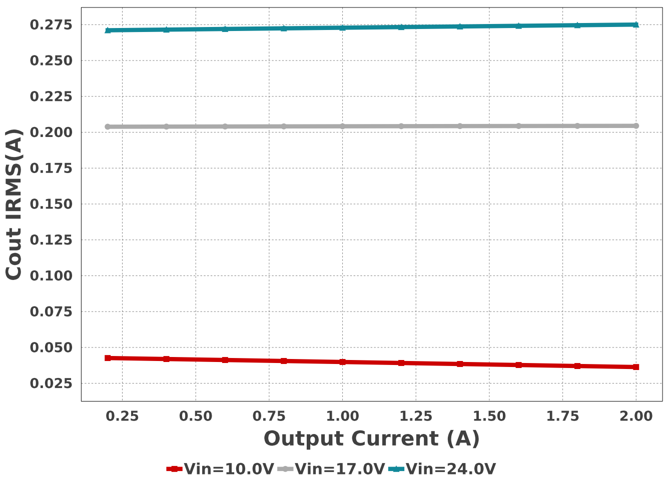
Cinx IRMS



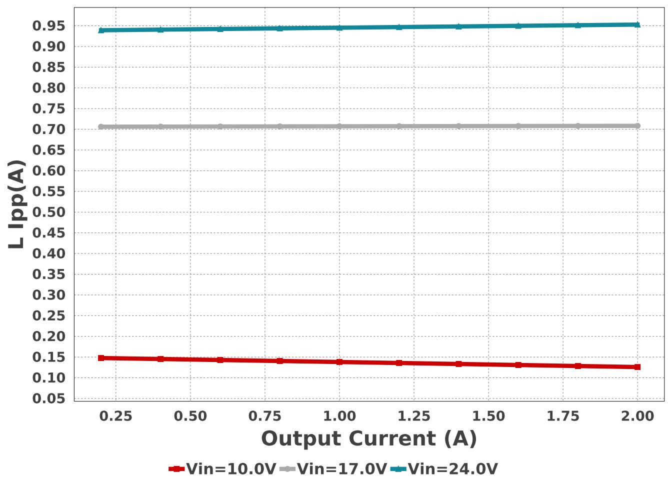
Total Pd

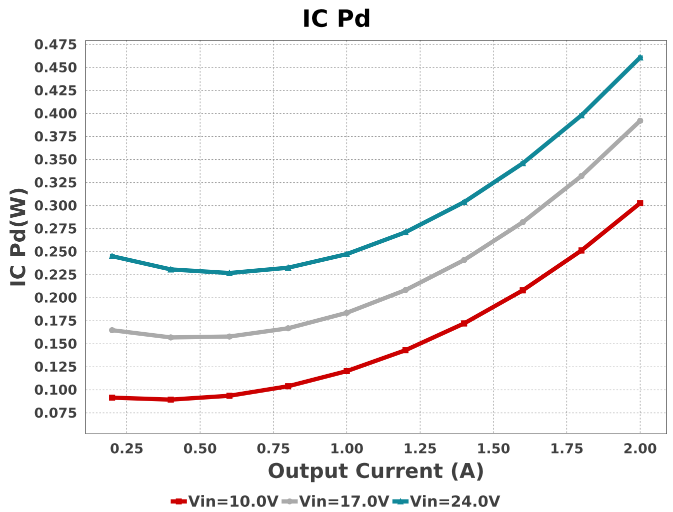


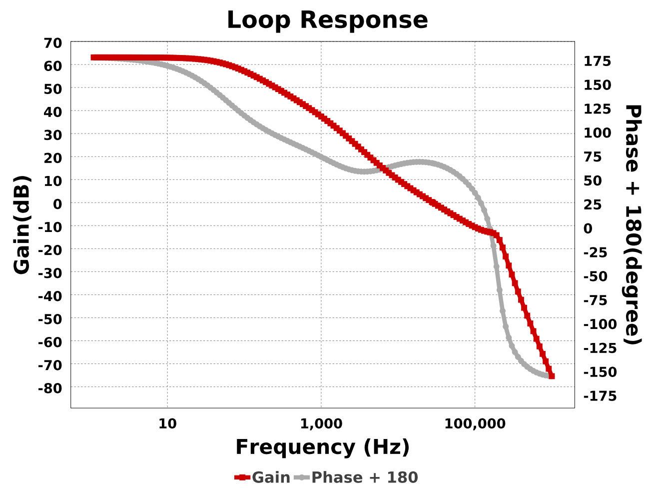
Cout IRMS



L Ipp







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	953.073 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	2.725 mW	Capacitor	Input capacitor power dissipation
3.	Cinx IRMS	35.317 mA	Capacitor	Bulk capacitor RMS ripple current
4.	Cinx Pd	1.247 nW	Capacitor	Bulk capacitor power dissipation
5.	Cout IRMS	275.052 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	123.37 µW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	2.476 A	IC	Peak switch current in IC
8.	IC Pd	460.88 mW	IC	IC power dissipation
9.	IC Tj	52.353 degC	IC	IC junction temperature
10.	IC Tolerance	80.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA Effective	48.5 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
12.	Iin Avg	775.47 mA	IC	Average input current
13.	Ipp percentage	47.64 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	952.81 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	146.72 mW	Inductor	Inductor power dissipation
16.	Cin Pd	2.725 mW	Power	Input capacitor power dissipation
17.	Cinx Pd	1.247 nW	Power	Bulk capacitor power dissipation
18.	Cout Pd	123.37 µW	Power	Output capacitor power dissipation
19.	IC Pd	460.88 mW	Power	IC power dissipation
20.	L Pd	146.72 mW	Power	Inductor power dissipation
21.	Total Pd	611.194 mW	Power	Total Power Dissipation
22.	BOM Count	10	System Information	Total Design BOM count
23.	Cross Freq	28.427 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	38.569 %	System Information	Duty cycle
25.	Efficiency	96.716 %	System Information	Steady state efficiency
26.	FootPrint	473.0 mm²	System Information	Total Foot Print Area of BOM components
27.	Frequency	400.0 kHz	System Information	Switching frequency
28.	Gain Marg	-12.835 dB	System Information	Bode Plot Gain Margin
29.	Iout	2.0 A	System Information	Iout operating point
30.	Iout transient step used for Cout calculations	1.5 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
31.	Low Freq Gain	63.091 dB	System Information	Gain at 1Hz
32.	Mode	CCM	System Information	Conduction Mode
33.	Overshoot Value	89.07 mV	System Information	Theoretical Vout Overshoot Value
34.	Phase Marg	68.204 deg	System Information	Bode Plot Phase Margin
35.	Pout	18.0 W	System Information	Total output power
36.	Total BOM	NA	System Information	Total BOM Cost

#	Name	Value	Category	Description
37.	Undershoot Value	164.779 mV	System Information	Theoretical Vout Undershoot Value
38.	Vin	24.0 V	System Information	Vin operating point
39.	Vin p-p	430.383 mV	System Information	Peak-to-peak input voltage
40.	Vout	9.0 V	System Information	Operational Output Voltage
41.	Vout Actual	8.997 V	System Information	Vout Actual calculated based on selected voltage divider resistors
42.	Vout Ripple requirement used for Cout calculations	3.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
43.	Vout Tolerance	12.025 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
44.	Vout p-p	14.189 mV	System Information	Peak-to-peak output ripple voltage
45.	Vout transient requirement used for Cout calculations	3.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	24.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	9.0	Output Voltage
base_pn	LMR51625	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

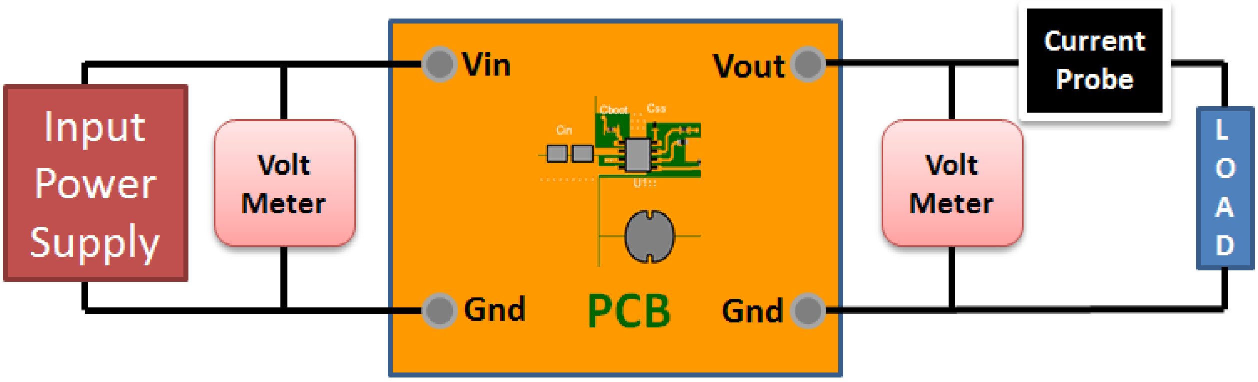
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.0V 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 : 9C194656D625C64D[v1]

2. **LMR51625** Product Folder : https://www.ti.com/product/LMR51625 : contains the data sheet and other resources.

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