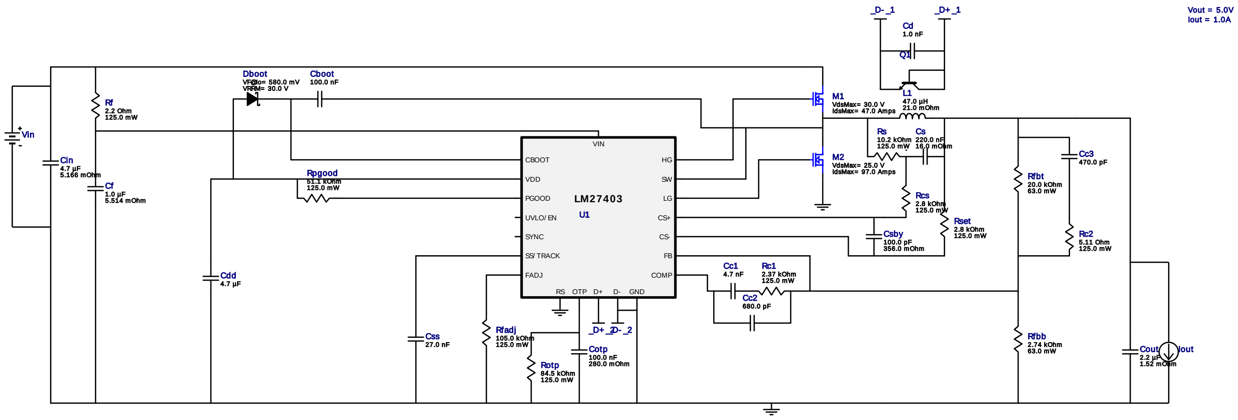
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 6.0V
VinMax = 12.0V
Vout = 5.0V
Iout = 1.0A

Device = LM27403SQ/NOPB
Topology = Buck
Created = 3/10/16 4:50:19 PM
BOM Cost = $3.22
BOM Count = 30
Total Pd = 0.08W

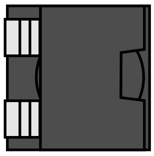
Design : 4116161/7 LM27403SQ/NOPB
LM27403SQ/NOPB 6.0V-12.0V to 5.00V @ 1.0A



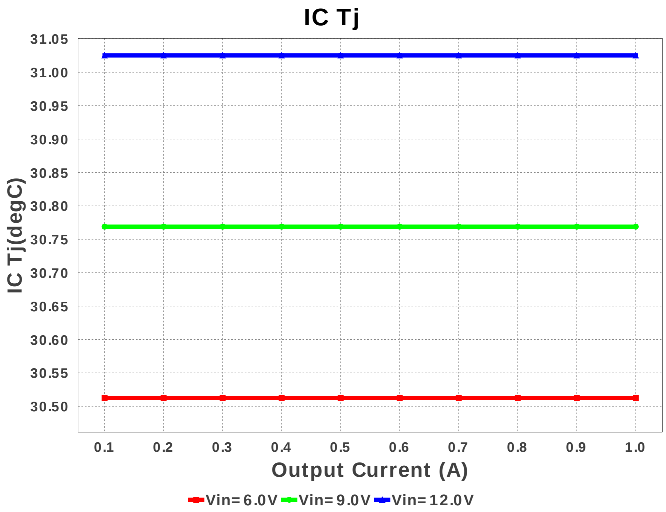
My Comments

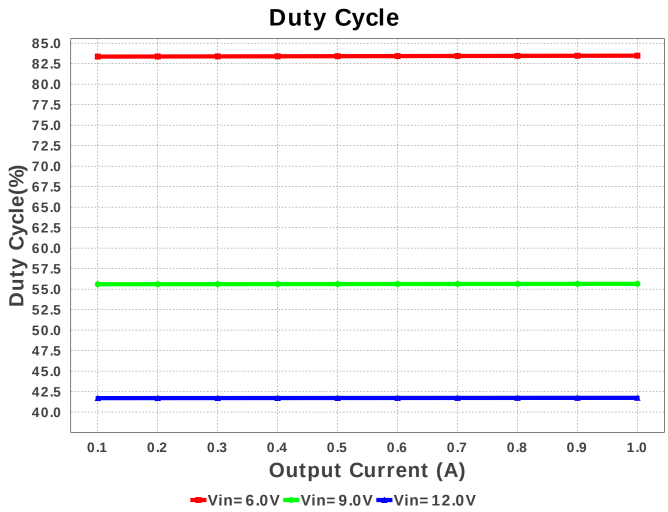
Electrical BOM

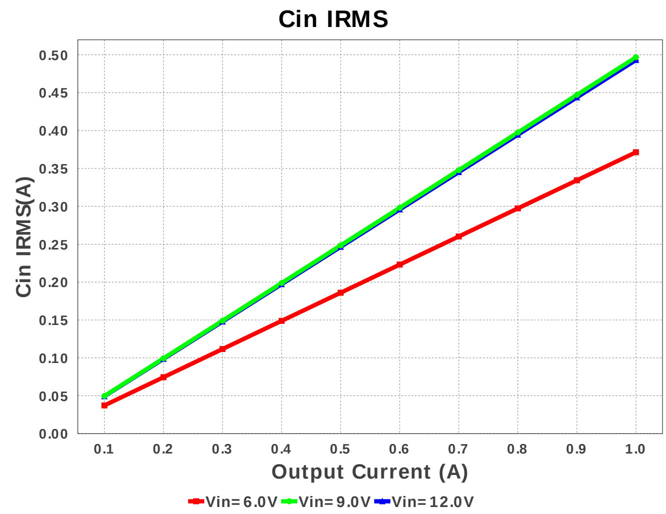
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Cc1	Yageo America	CC0805KRX7R9BB472 Series= X7R	Cap= 4.7 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
3.	Cc2	Yageo America	CC0805KRX7R9BB681 Series= X7R	Cap= 680.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Cc3	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
5.	Cd	MuRata	GRM155R61A102KA01D Series= X5R	Cap= 1.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
6.	Cdd	Taiyo Yuden	LMK212BJ475KD-T Series= X5R	Cap= 4.7 uF VDC= 10.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm^2
7.	Cf	MuRata	GRM21BR71E105KA99L Series= X7R	Cap= 1.0 uF ESR= 5.514 mOhm VDC= 25.0 V IRMS= 1.47583 A	1	$0.03	0805 7 mm^2
8.	Cin	MuRata	GRM21BR61C475KA88L Series= X5R	Cap= 4.7 uF ESR= 5.166 mOhm VDC= 16.0 V IRMS= 1.8541 A	1	$0.03	0805 7 mm^2
9.	Cotp	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
10.	Cout	Taiyo Yuden	JMK105BJ225MV-F Series= X5R	Cap= 2.2 uF ESR= 1.52 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.03	0402 3 mm^2

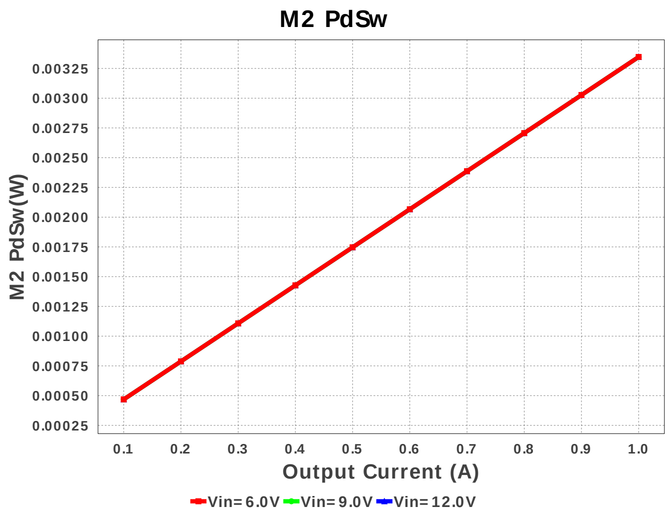
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Cs	AVX	0805YC224KAT2A Series= X7R	Cap= 220.0 nF ESR= 16.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm^2
12.	Csby	AVX	08055A101JAT2A Series= C0G/NP0	Cap= 100.0 pF ESR= 356.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
13.	Css	MuRata	GRM155R61C273KA01D Series= X5R	Cap= 27.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
14.	Dboot	Diodes Inc.	SBR0230T5-7-F	VF@Io= 580.0 mV VRRM= 30.0 V	1	$0.10	SOD-523 5 mm^2
15.	L1	Coilcraft	SER1390-473MLB	L= 47.0 µH DCR= 21.0 mOhm	1	$0.95	 SER1390 240 mm^2
16.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 47.0 Amps	1	$0.34	TRANS_NexFET_Q3 18 mm^2
17.	M2	Texas Instruments	CSD16322Q5C	VdsMax= 25.0 V IdsMax= 97.0 Amps	1	$0.50	TRANS_NexFET_Q5C 56 mm^2
18.	Q1	Diodes Inc.	MMBT3904T	Bipolar Transistor	1	$0.04	SOT-523 7 mm^2
19.	Rc1	Panasonic	ERJ-6ENF2371V Series= ERJ-6E	Res= 2.37 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
20.	Rc2	Vishay-Dale	CRCW08055R11FKEA Series= CRCW..e3	Res= 5.11 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
21.	Rcs	Panasonic	ERJ-6ENF2801V Series= ERJ-6E	Res= 2.8 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
22.	Rf	Yageo America	RC0805FR-072R2L Series= ?	Res= 2.2 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
23.	Rfadj	Panasonic	ERJ-6ENF1053V Series= ERJ-6E	Res= 105.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
24.	Rfbb	Vishay-Dale	CRCW04022K74FKED Series= CRCW..e3	Res= 2.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
25.	Rfbt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
26.	Rotp	Panasonic	ERJ-6ENF8452V Series= ERJ-6E	Res= 84.5 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
27.	Rpgood	Panasonic	ERJ-6ENF5112V Series= ERJ-6E	Res= 51.1 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
28.	Rs	Panasonic	ERJ-6ENF1022V Series= ERJ-6E	Res= 10.2 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2

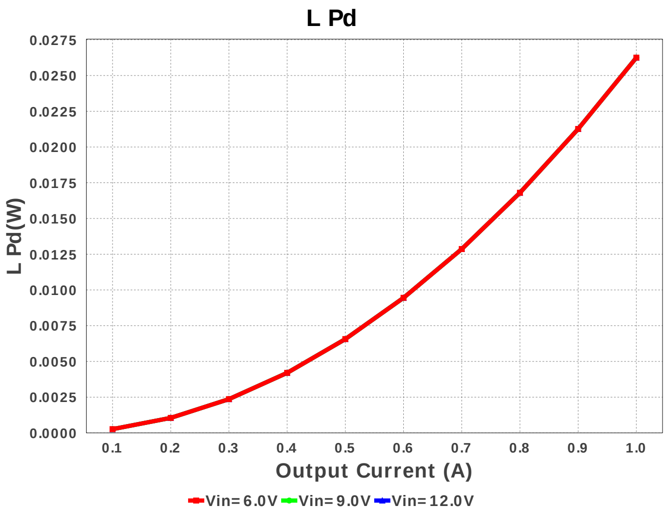
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
29.	Rset	Panasonic	ERJ-6ENF2801V Series= ERJ-6E	Res= 2.8 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
30.	U1	Texas Instruments	LM27403SQ/NOPB	Switcher	1	$0.95	WQFN-24 25 mm^2

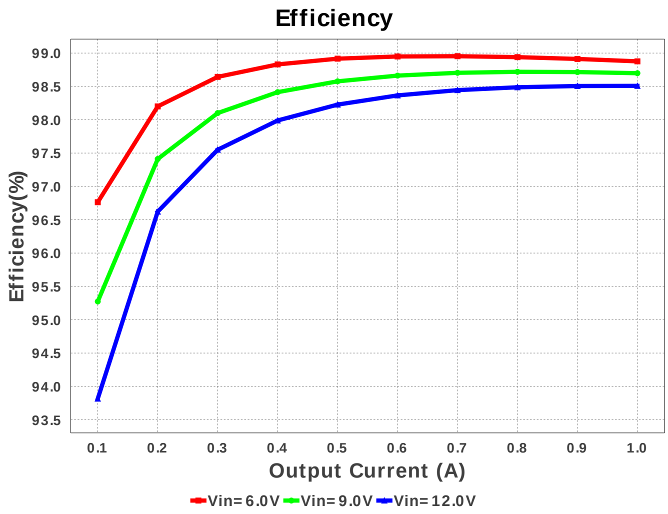


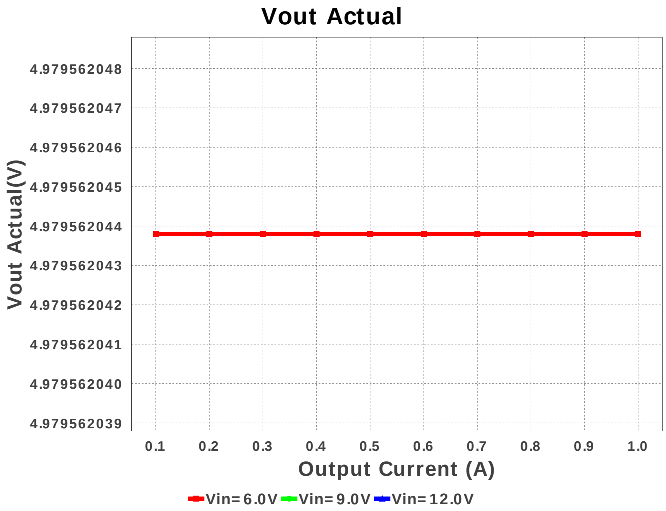


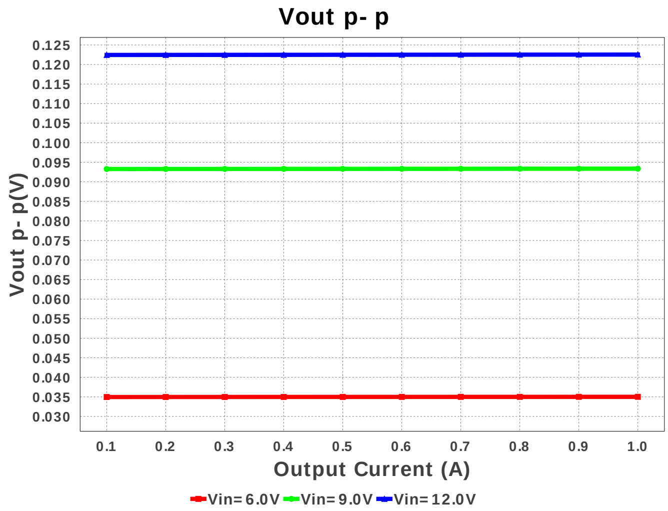


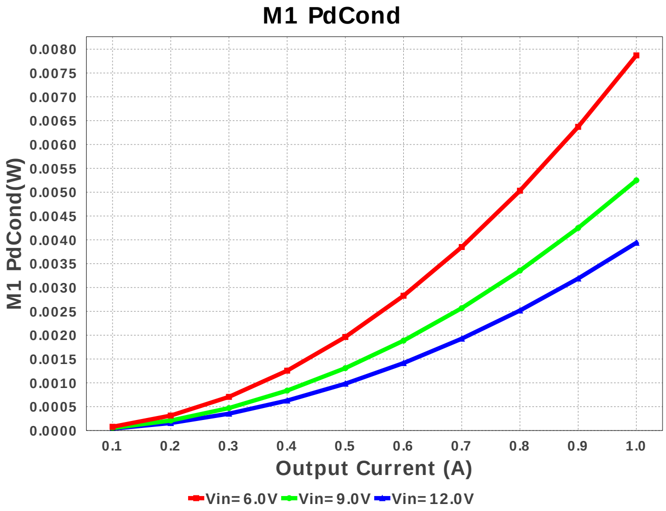


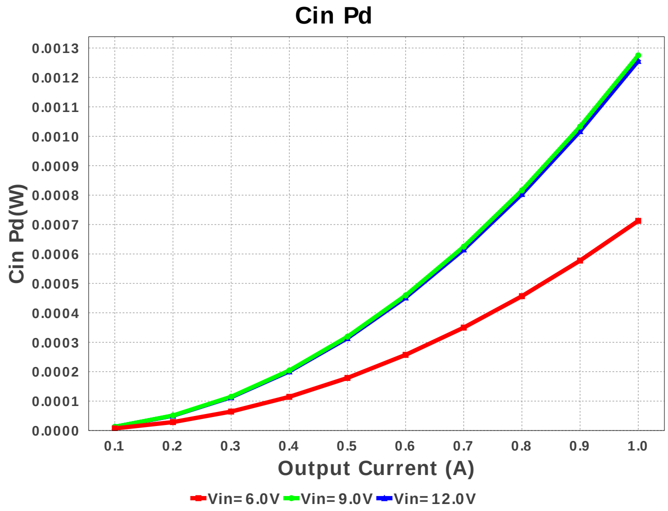


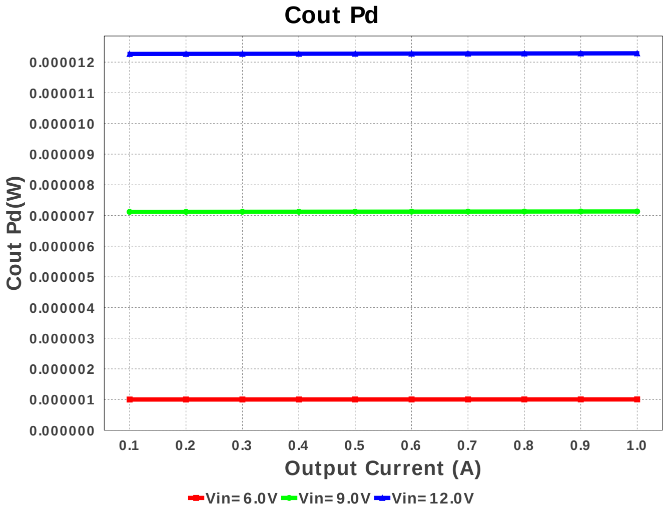


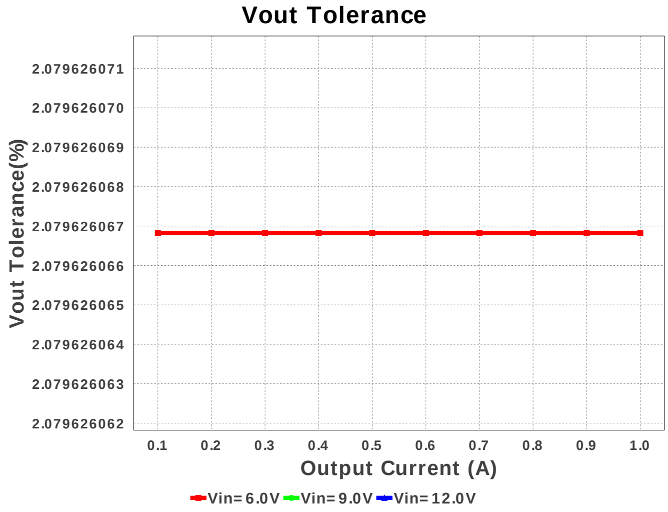

Vout Actual
Vout Actual(V)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

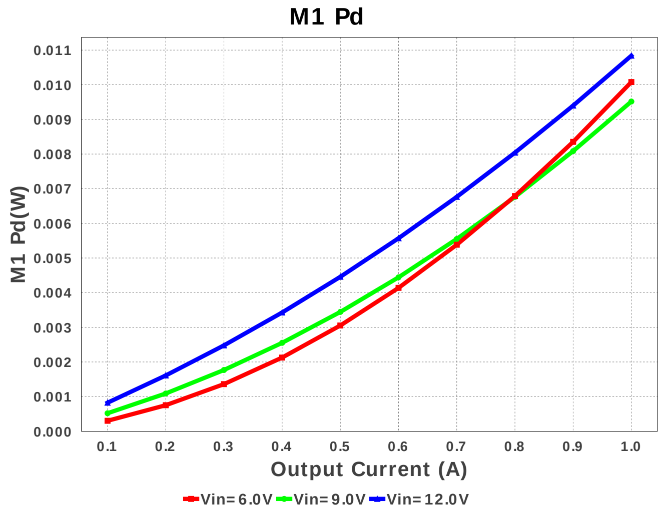

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

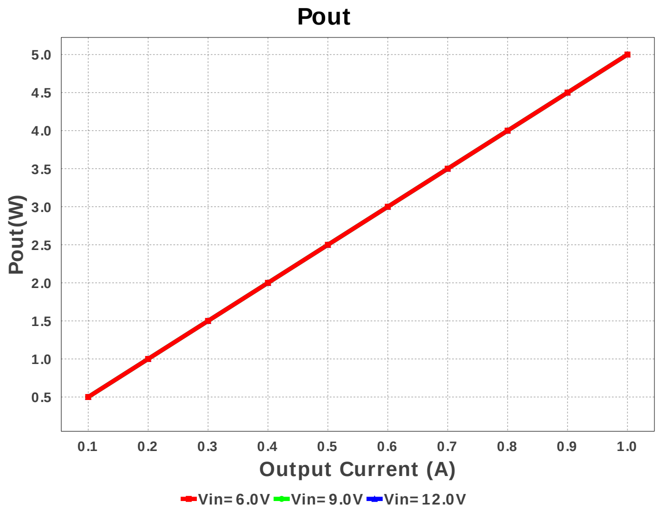

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

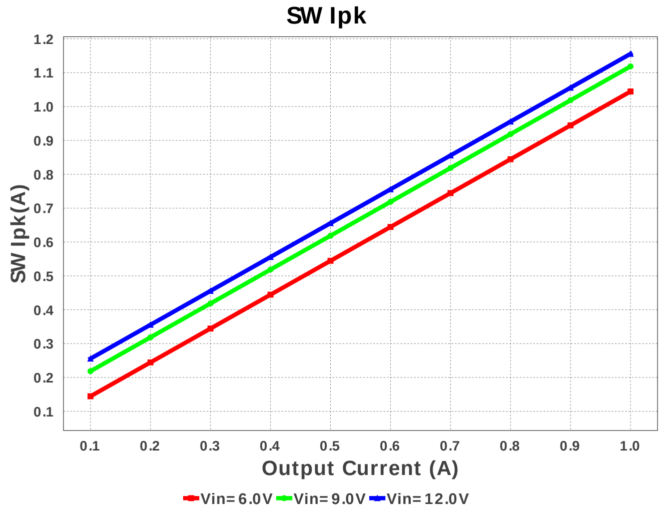

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

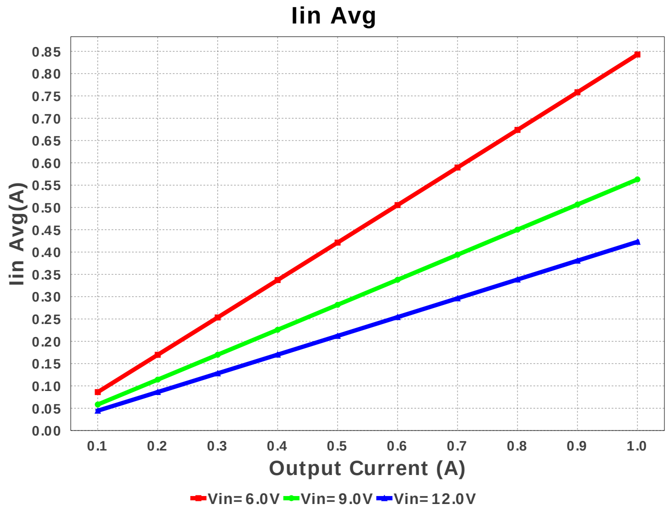

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

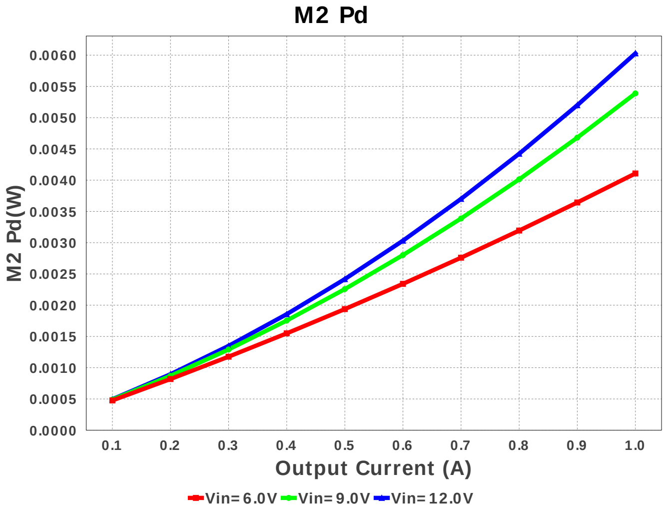

Vout Tolerance
Vout Tolerance(%)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

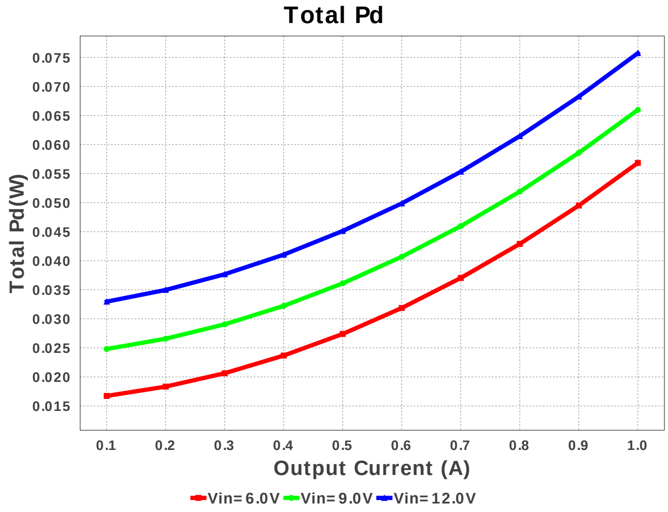

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V


Pout
Pout(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

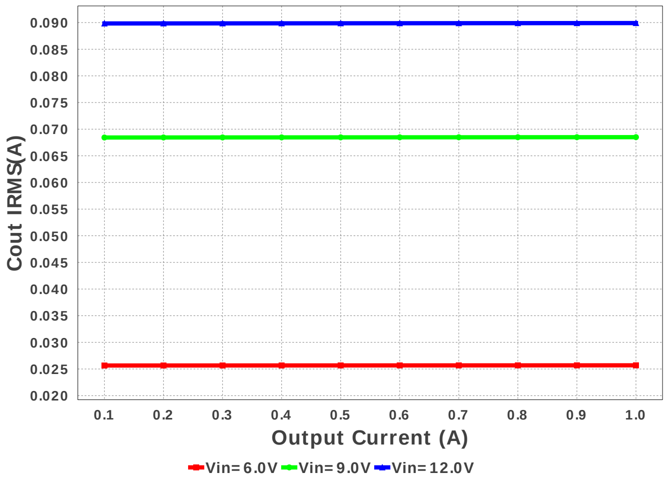

SW Ipk
SW Ipk(A)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

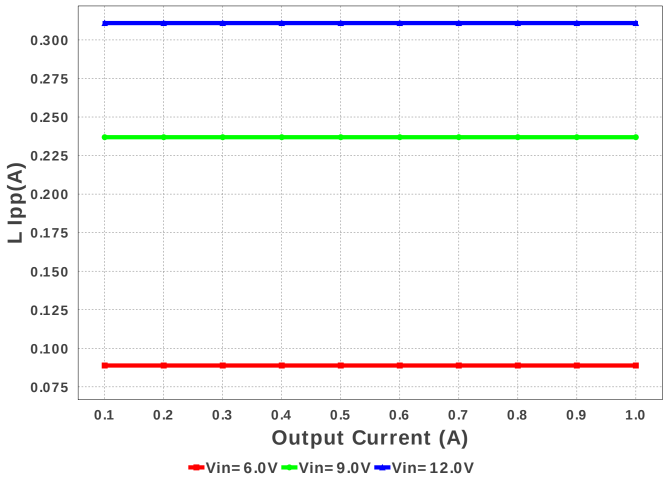

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=6.0V Vin=9.0V Vin=12.0V

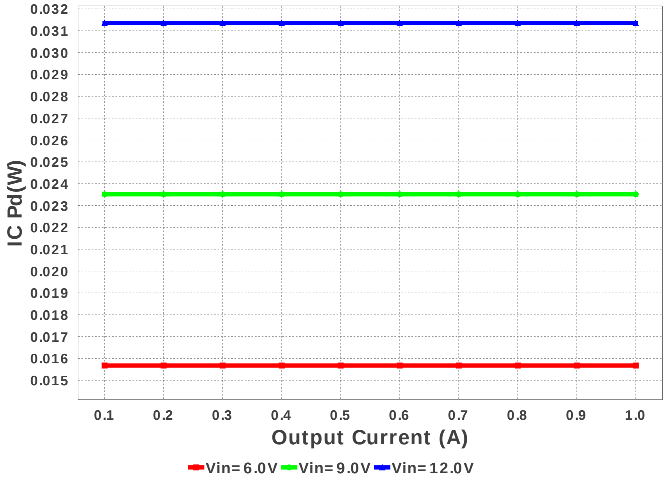
Cout IRMS



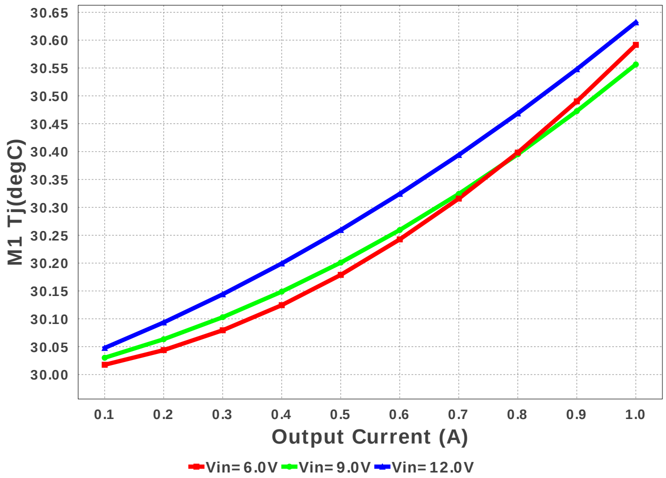
L Ipp



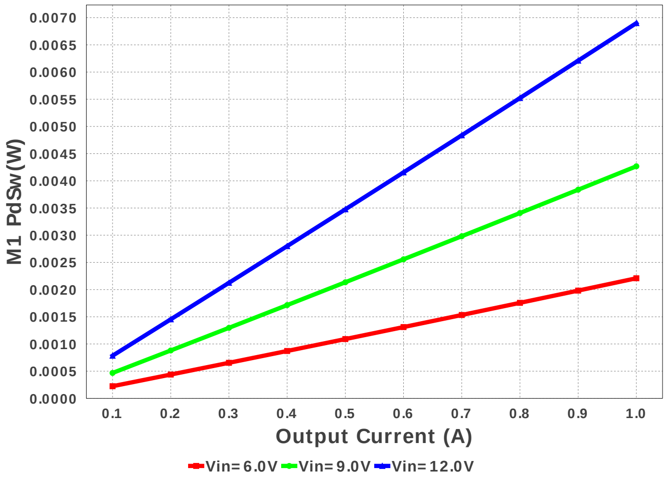
IC Pd



M1 Tj



M1 PdSw



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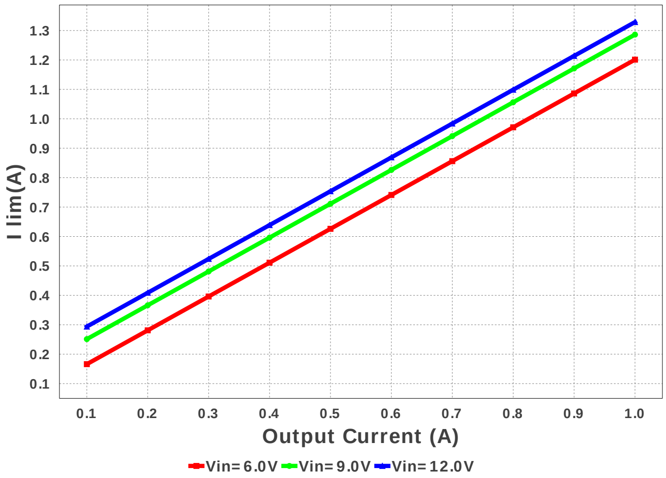

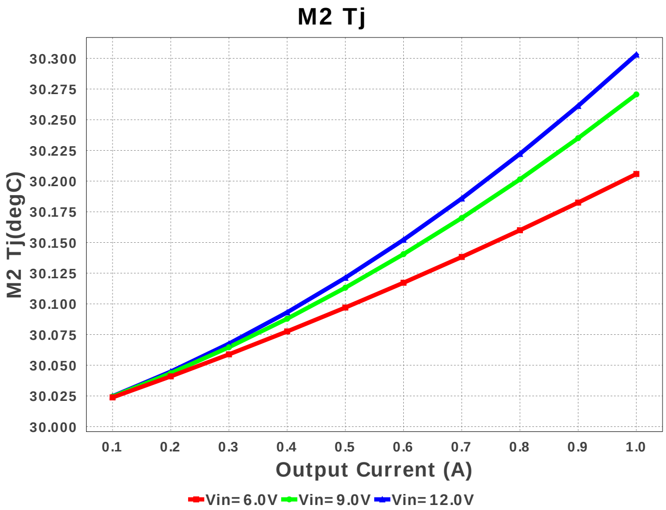

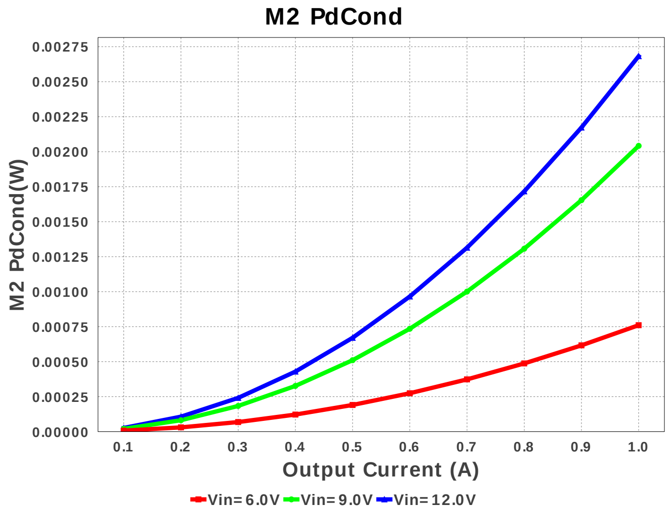

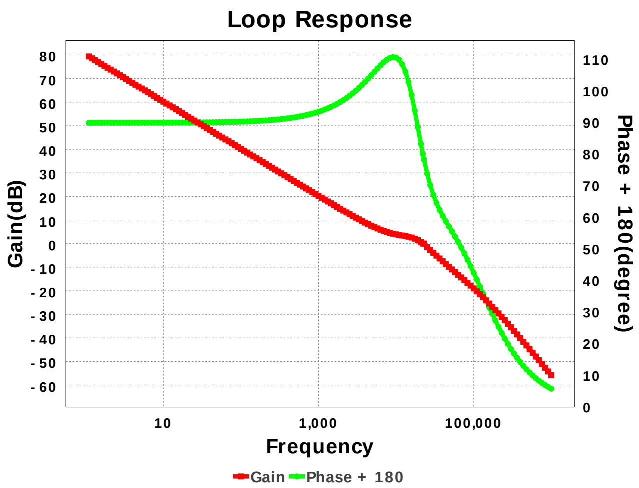

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	493.123 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	89.908 mA	Current	Output capacitor RMS ripple current
3.	I lim	1.329 A	Current	Current limit threshold
4.	Iin Avg	422.98 mA	Current	Average input current
5.	L Ipp	311.45 mA	Current	Peak-to-peak inductor ripple current
6.	SW Ipk	1.156 A	Current	Peak switch current
7.	BOM Count	30	General	Total Design BOM count
8.	FootPrint	491.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	199.581 kHz	General	Switching frequency
10.	IC Tolerance	6.0 mV	General	IC Feedback Tolerance
11.	Pout	5.0 W	General	Total output power
12.	Total BOM	$3.22	General	Total BOM Cost
13.	Low Freq Gain	79.397 dB	Op_Point	Gain at 10Hz
14.	Vout Actual	4.98 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Cross Freq	22.105 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	41.736 %	Op_point	Duty cycle
17.	Efficiency	98.508 %	Op_point	Steady state efficiency
18.	IC Tj	31.025 degC	Op_point	IC junction temperature
19.	IOUT_OP	1.0 A	Op_point	Iout operating point
20.	M1 Tj	30.632 degC	Op_point	M1 MOSFET junction temperature
21.	M2 Tj	30.303 degC	Op_point	M2 MOSFET junction temperature
22.	Phase Marg	80.18 deg	Op_point	Bode Plot Phase Margin
23.	VIN_OP	12.0 V	Op_point	Vin operating point
24.	Vout p-p	122.544 mV	Op_point	Peak-to-peak output ripple voltage
25.	Cin Pd	1.256 mW	Power	Input capacitor power dissipation
26.	Cout Pd	12.287 µW	Power	Output capacitor power dissipation
27.	IC Pd	31.351 mW	Power	IC power dissipation
28.	L Pd	26.25 mW	Power	Inductor power dissipation
29.	M1 Pd	10.839 mW	Power	M1 MOSFET total power dissipation
30.	M1 PdCond	3.939 mW	Power	M1 MOSFET conduction losses
31.	M1 PdSw	6.9 mW	Power	M1 MOSFET switching losses

#	Name	Value	Category	Description
32.	M2 Pd	6.029 mW	Power	M2 MOSFET total power dissipation
33.	M2 PdCond	2.682 mW	Power	M2 MOSFET conduction losses
34.	M2 PdSw	3.347 mW	Power	M2 MOSFET switching losses
35.	Total Pd	75.73 mW	Power	Total Power Dissipation
36.	Vout Tolerance	2.08 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	12.0	Maximum input voltage
3.	VinMin	6.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	LM27403	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. Tip: LM27403 High Current PCB Layout Design Guidance For higher current designs, please take care in designing the PCB layout. Consider good thermal management practices and proper routing of traces. Please see the following for more guidelines. Best Layout Practices for Switching Power Supplies http://sva.ti.com/assets/en/appnotes/national_power_designer114.pdf SIMPLE SWITCHER Layout Guidelines http://www.ti.com/lit/an/snva054c/snva054c.pdf Thermal Design by Insight, not Hindsight http://www.ti.com/lit/an/snva419c/snva419c.pdf

2. General Description: The LM27403 is a synchronous voltage mode buck controller with inductor DCR current sense capability. Sensing the inductor current eliminates the need to add resistive powertrain elements which increases overall efficiency and allows for accurate continuous current limit sensing. A 0.6V +/-1% voltage reference permits high accuracy and low voltage capability at the output. An operating voltage range of 3V to 20V makes the LM27403 suitable for a large variety of input rails. The LM27403 voltage mode control loop incorporates input voltage feed-forward to maintain stability throughout the entire input voltage range. The switching frequency is adjustable from 200 kHz to 1.2 MHz allowing a flexible design space. A power good indicator provides power rail sequencing capability and output fault detection. Programmable external softstart capability limits inrush current and provides monotonic output control at startup. Other features include external tracking of other power supplies, integrated LDO bias supply, and synchronization capability.

3. **LM27403** Product Folder : http://www.ti.com/product/LM27403 : contains the data sheet and other resources.