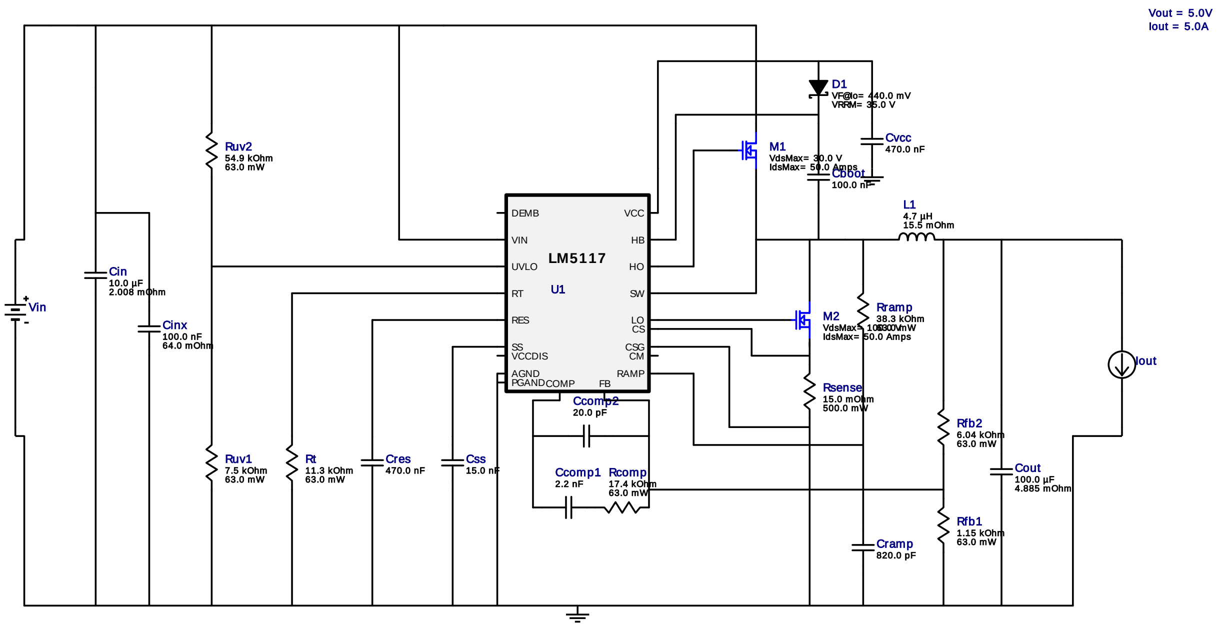
VinMin = 12.0V
VinMax = 24.0V
Vout = 5.0V
Iout = 5.0A

Device = LM5117PMHX/NOPB
Topology = Buck
Created = 7/17/16 9:07:03 AM
BOM Cost = $4.31
BOM Count = 23
Total Pd = 2.52W

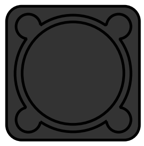
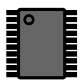
WEBENCH ® Design Report

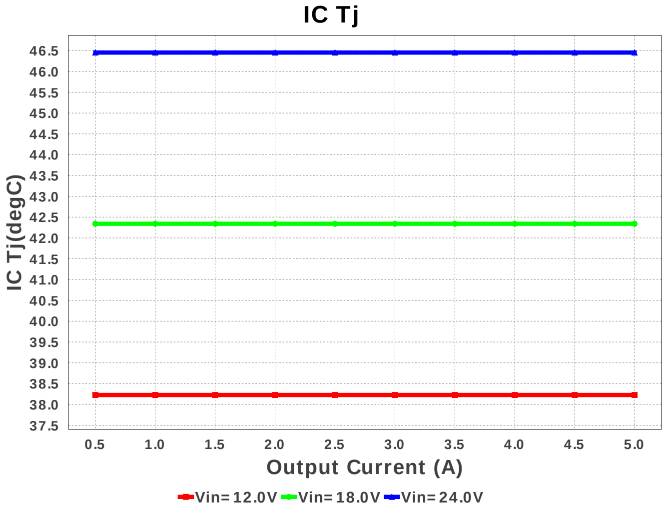
Design : 4466246/74 LM5117PMHX/NOPB
LM5117PMHX/NOPB 12.0V-24.0V to 5.00V @ 5.0A

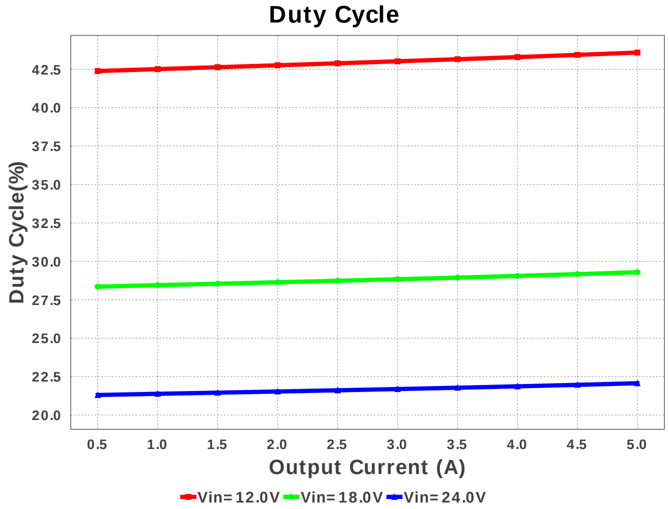


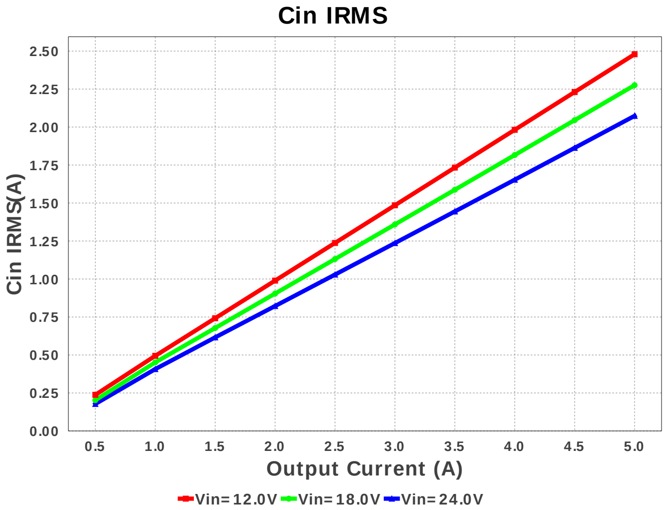
Electrical BOM

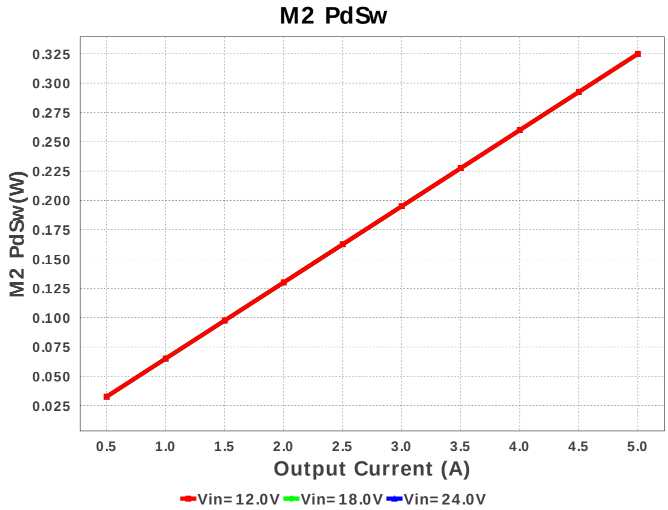
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Ccomp1	Yageo America	CC0805KRX7R9BB222 Series= X7R	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	Ccomp2	Samsung Electro-Mechanics	CL21C200JBANNNC Series= C0G/NP0	Cap= 20.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cin	MuRata	GRM32ER7YA106KA12L Series= X7R	Cap= 10.0 uF ESR= 2.008 mOhm VDC= 35.0 V IRMS= 4.6772 A	1	$0.22	1210_280 15 mm²
5.	Cinx	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
6.	Cout	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	1	$0.14	1206_190 11 mm²
7.	Cramp	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
8.	Cres	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²

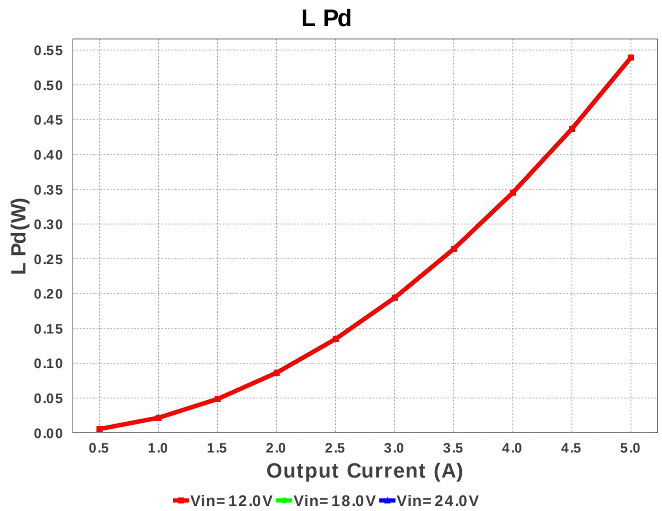
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Css	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
10.	Cvcc	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
11.	D1	Bourns	CD0603-B0130L	VF@Io= 440.0 mV VRRM= 35.0 V	1	$0.09	Diode_0603 5 mm²
12.	L1	Bourns	SRR1280-4R7Y	L= 4.7 µH DCR= 15.5 mOhm	1	$0.41	 SRR1280 210 mm²
13.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 50.0 Amps	1	$0.34	 TRANS_NexFET_Q3 18 mm²
14.	M2	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.75	 TRANS_NexFET_Q3 18 mm²
15.	Rcomp	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
16.	Rfb1	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
17.	Rfb2	Vishay-Dale	CRCW04026K04FKED Series= CRCW..e3	Res= 6.04 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
18.	Rramp	Vishay-Dale	CRCW040238K3FKED Series= CRCW..e3	Res= 38.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
19.	Rsense	Stackpole Electronics Inc	CSR1206FK15L0 Series= ?	Res= 15.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.11	1206 11 mm²
20.	Rt	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
21.	Ruv1	Vishay-Dale	CRCW04027K50FKED Series= CRCW..e3	Res= 7.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
22.	Ruv2	Vishay-Dale	CRCW040254K9FKED Series= CRCW..e3	Res= 54.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
23.	U1	Texas Instruments	LM5117PMHX/NOPB	Switcher	1	$2.10	 PWP0020A 71 mm²

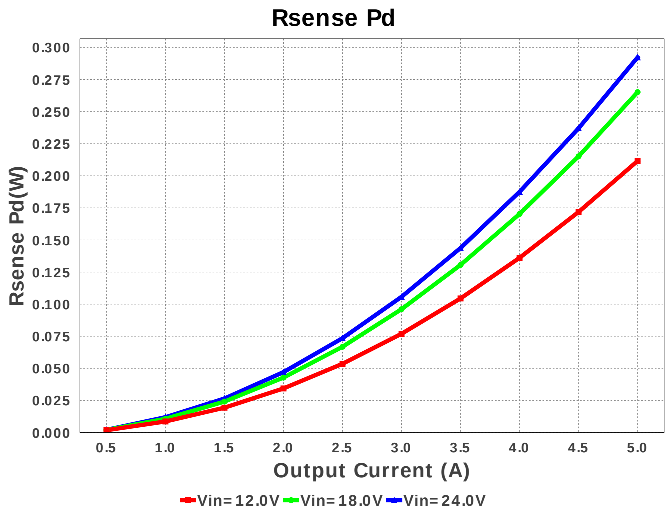

IC Tj
IC Tj(degC)
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V


Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V

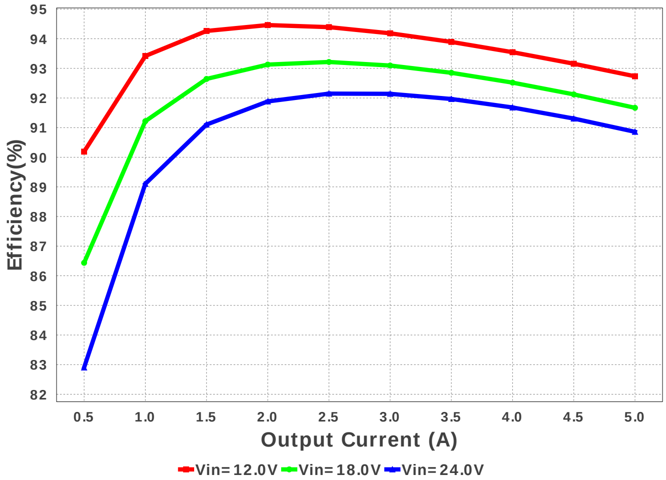

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V


M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V

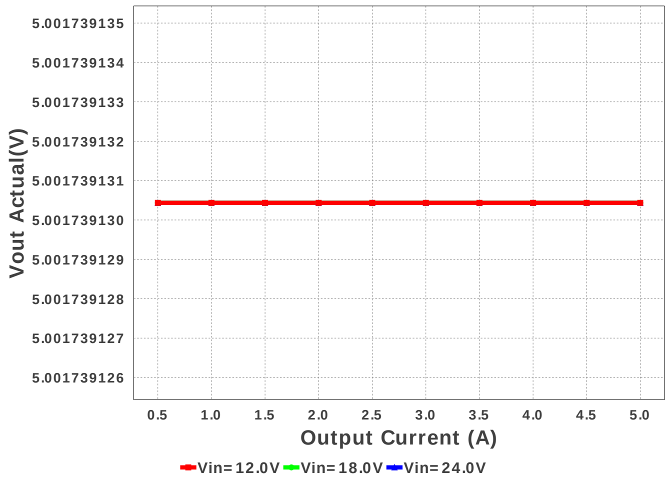

L Pd
L Pd(W)
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V


Rsense Pd
Rsense Pd(W)
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V

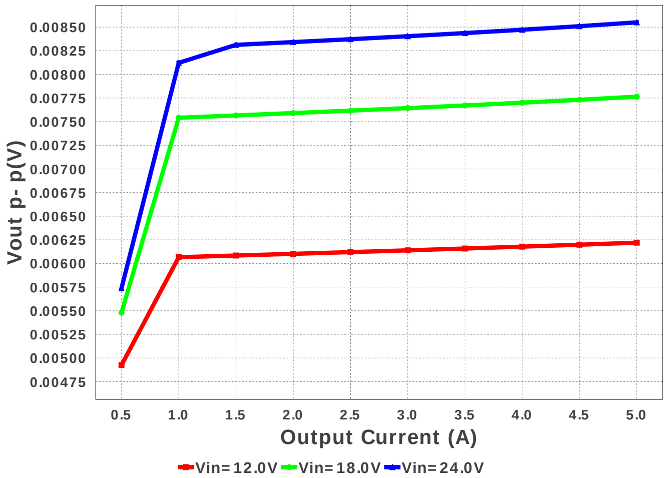
Efficiency



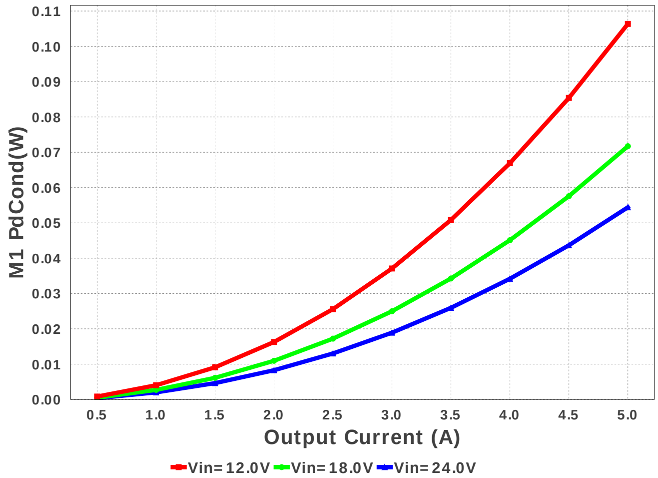
Vout Actual



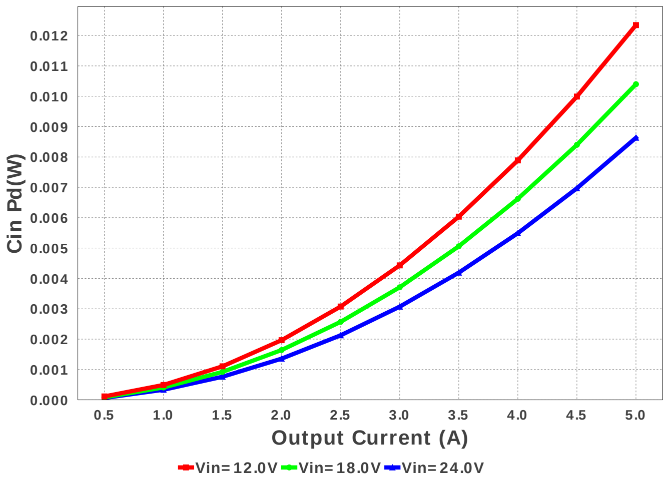
Vout p- p



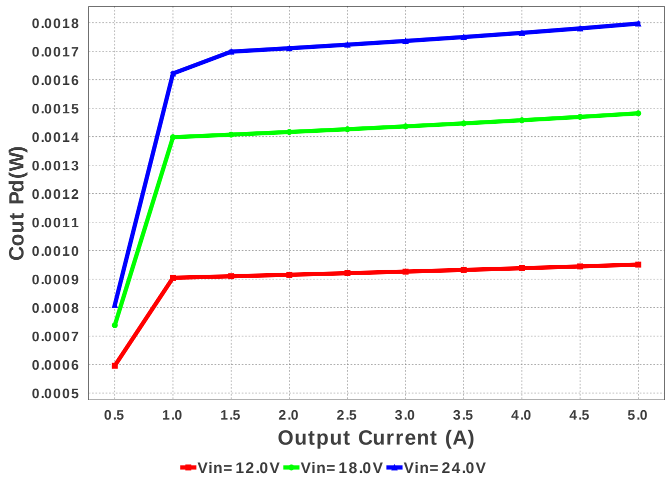
M1 PdCond

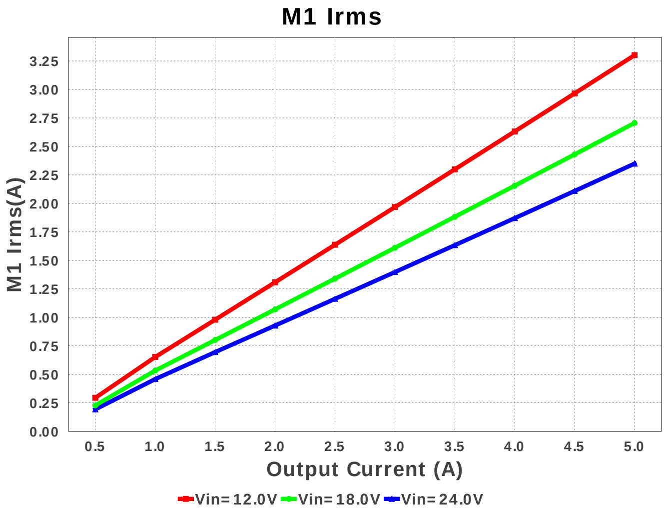


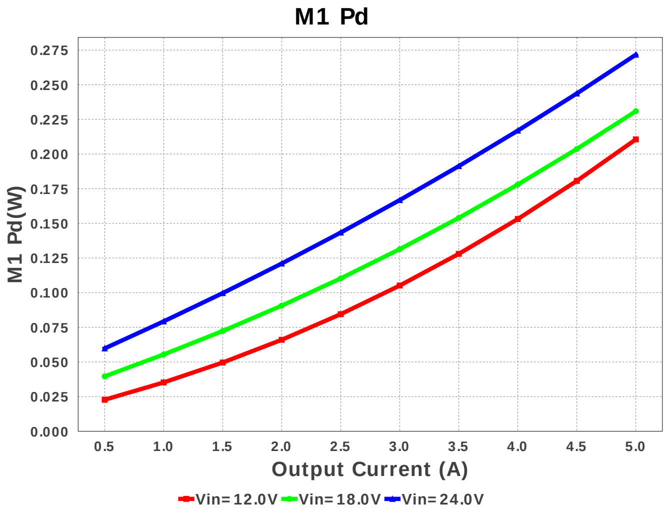
Cin Pd

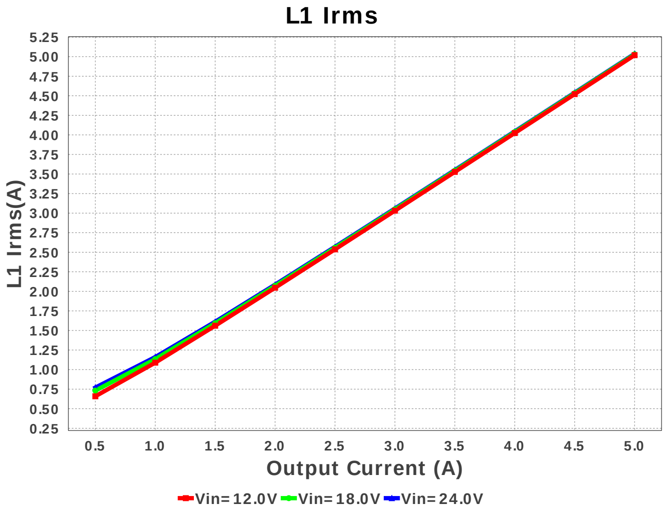


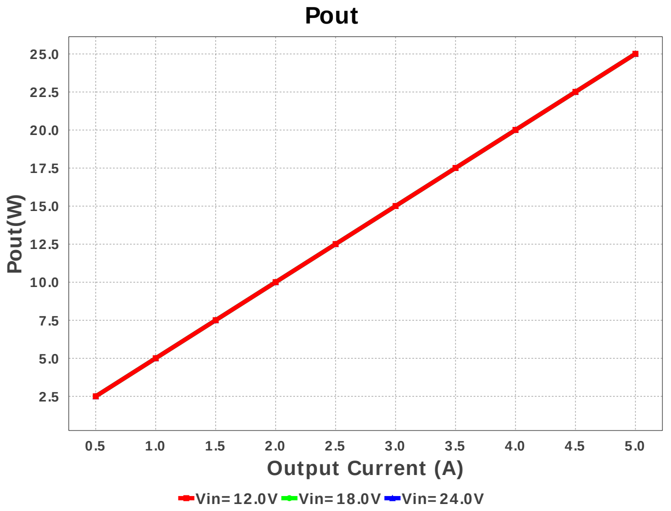
Cout Pd

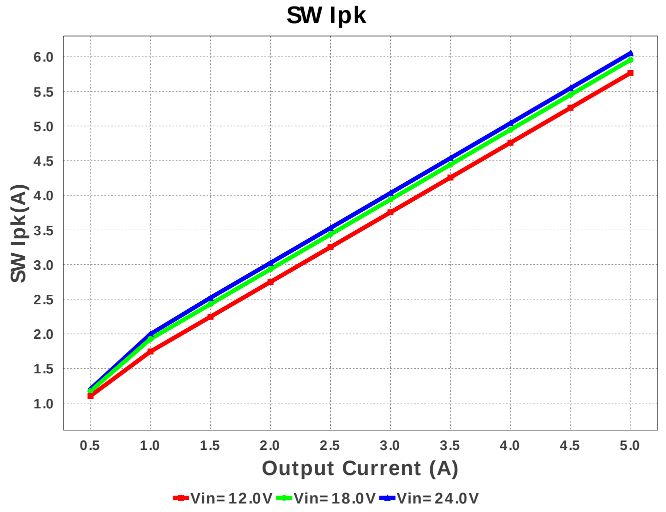


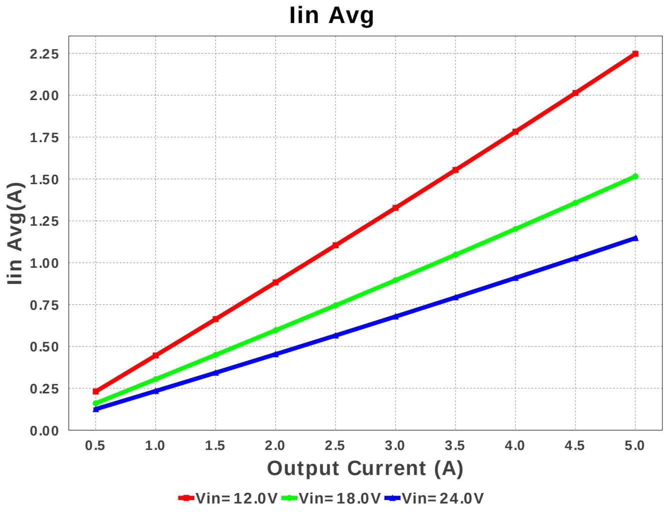

M1 Irms
M1 Irms(A)
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V


M1 Pd
M1 Pd(W)
0.000 0.025 0.050 0.075 0.100 0.125 0.150 0.175 0.200 0.225 0.250 0.275
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V

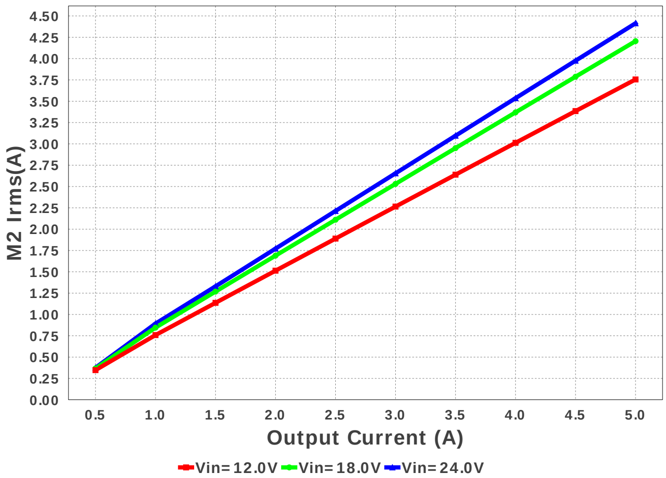

L1 Irms
L1 Irms(A)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 5.25
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V


Pout
Pout(W)
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V

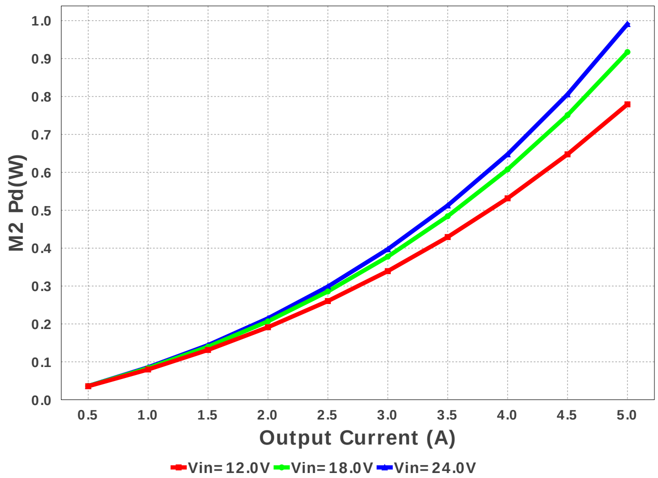

SW Ipk
SW Ipk(A)
1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V


Iin Avg
Iin Avg(A)
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=12.0V Vin=18.0V Vin=24.0V

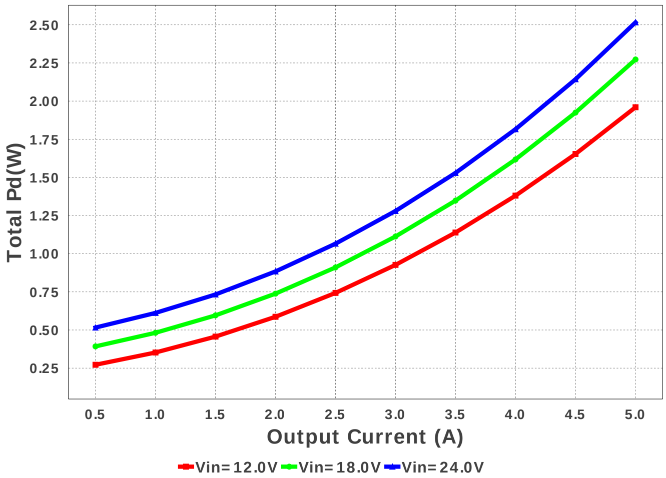
M2 Irms



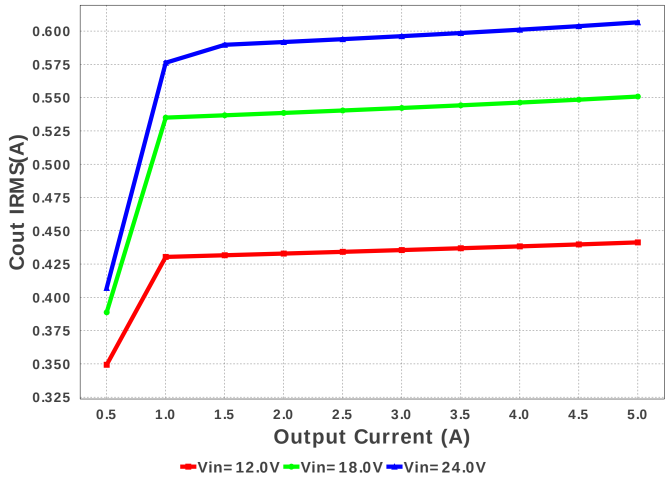
M2 Pd



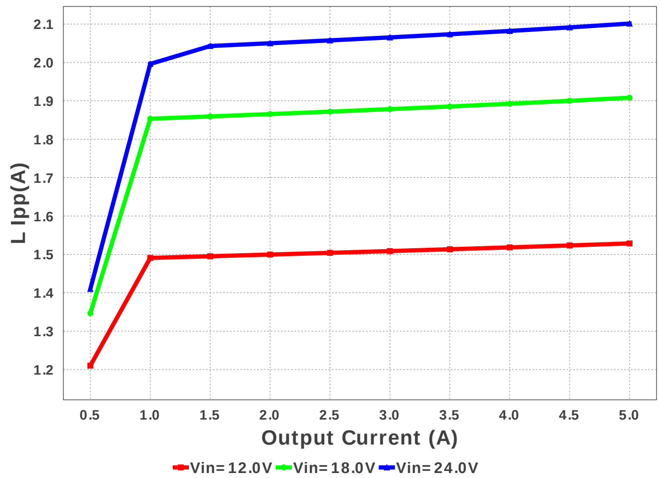
Total Pd



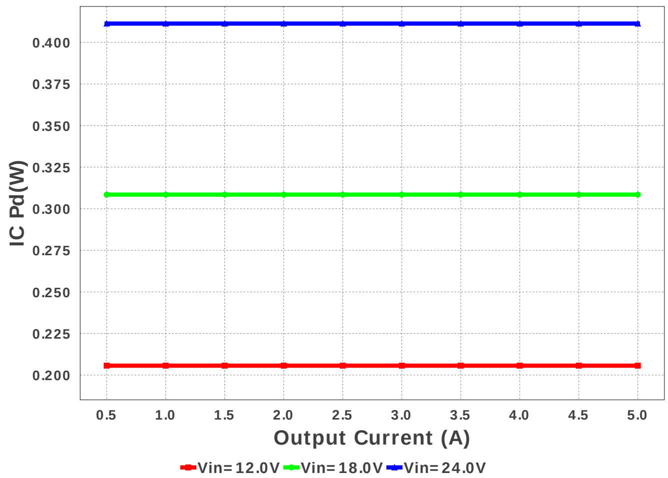
Cout IRMS



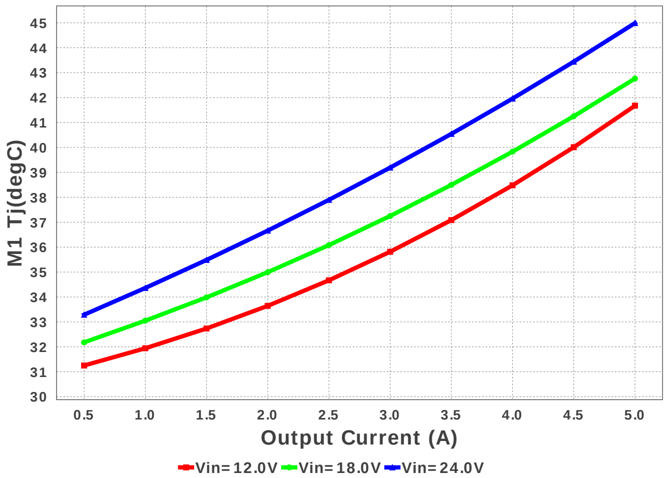
L Ipp



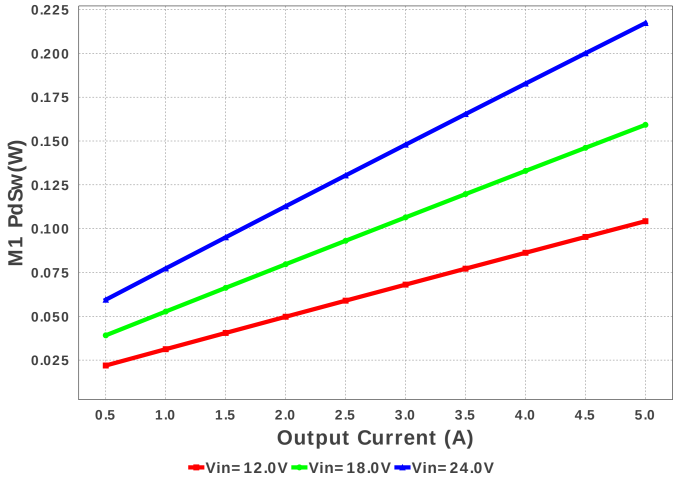
IC Pd



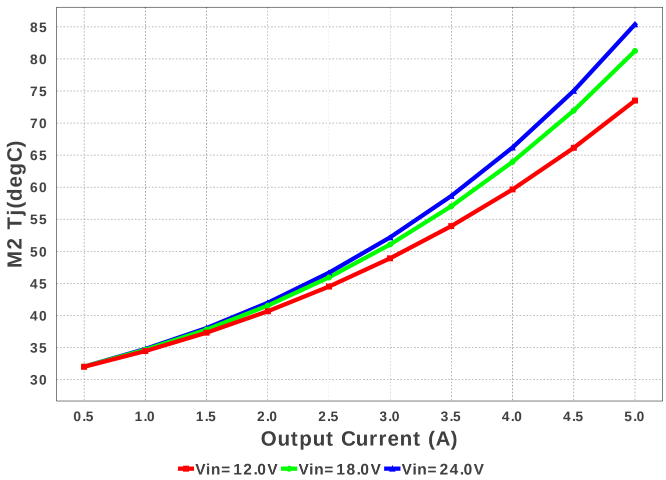
M1 Tj



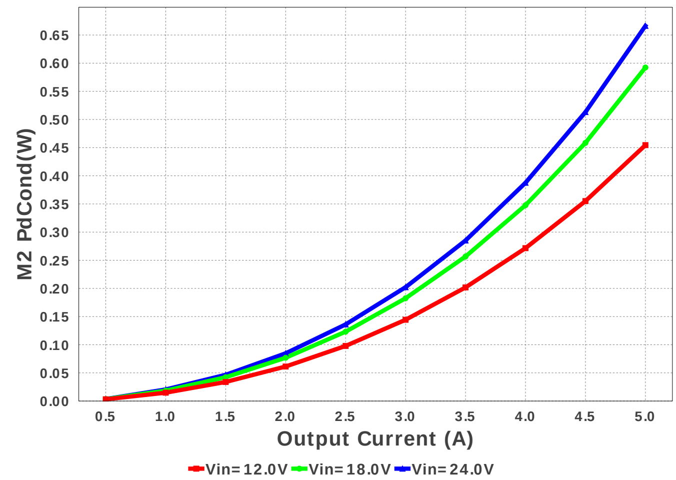
M1 PdSw



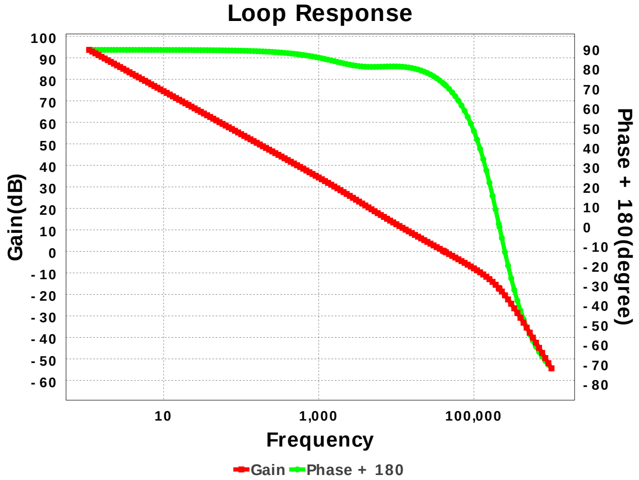
M2 Tj



M2 PdCond



Loop Response



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	2.074 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	606.574 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	1.147 A	Current	Average input current
4.	L Ipp	2.101 A	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	5.036 A	Current	Inductor ripple current
6.	M1 Irms	2.349 A	Current	MOSFET RMS ripple current
7.	M2 Irms	4.414 A	Current	MOSFET RMS ripple current
8.	SW Ipk	6.051 A	Current	Peak switch current
9.	BOM Count	23	General	Total Design BOM count
10.	FootPrint	424.0 mm^2	General	Total Foot Print Area of BOM components
11.	Frequency	424.559 kHz	General	Switching frequency

#	Name	Value	Category	Description
12.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
13.	Pout	25.009 W	General	Total output power
14.	Total BOM	$4.31	General	Total BOM Cost
15.	Low Freq Gain	93.71 dB	Op_Point	Gain at 10Hz
16.	Vout Actual	5.002 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
17.	Vout OP	5.002 V	Op_Point	Operational Output Voltage
18.	Cross Freq	41.599 kHz	Op_point	Bode plot crossover frequency
19.	Duty Cycle	22.07 %	Op_point	Duty cycle
20.	Efficiency	90.85 %	Op_point	Steady state efficiency
21.	Gain Marg	-17.395 dB	Op_point	Bode Plot Gain Margin
22.	IC Tj	46.559 degC	Op_point	IC junction temperature
23.	IOUT_OP	5.0 A	Op_point	Iout operating point
24.	M1 Tj	44.99 degC	Op_point	M1 MOSFET junction temperature
25.	M2 Tj	85.402 degC	Op_point	M2 MOSFET junction temperature
26.	Phase Marg	72.534 deg	Op_point	Bode Plot Phase Margin
27.	VIN_OP	24.0 V	Op_point	Vin operating point
28.	Vout p-p	8.552 mV	Op_point	Peak-to-peak output ripple voltage
29.	Cin Pd	8.634 mW	Power	Input capacitor power dissipation
30.	Cout Pd	1.797 mW	Power	Output capacitor power dissipation
31.	IC Pd	413.978 mW	Power	IC power dissipation
32.	L Pd	539.214 mW	Power	Inductor power dissipation
33.	M1 Pd	271.702 mW	Power	M1 MOSFET total power dissipation
34.	M1 PdCond	54.414 mW	Power	M1 MOSFET conduction losses
35.	M1 PdSw	217.288 mW	Power	M1 MOSFET switching losses
36.	M2 Pd	991.144 mW	Power	M2 MOSFET total power dissipation
37.	M2 PdCond	666.241 mW	Power	M2 MOSFET conduction losses
38.	M2 PdSw	324.903 mW	Power	M2 MOSFET switching losses
39.	Rsense Pd	292.239 mW	Power	LED Current Rsns Power Dissipation
40.	Total Pd	2.519 W	Power	Total Power Dissipation
41.	Vout Tolerance	3.223 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	5.0	Maximum Output Current
2.	VinMax	24.0	Maximum input voltage
3.	VinMin	12.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	LM5117	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. Outline The LM5117 is a synchronous buck controller intended for step-down regulator applications from a high voltage or widely varying input supply. The control method is based upon current mode control utilizing an emulated current ramp. Current mode control provides inherent line feed-forward, cycle-by-cycle current limiting and ease of loop compensation. The use of an emulated control ramp reduces noise sensitivity of the pulse-width modulation circuit, allowing reliable control of very small duty cycles necessary in high input voltage applications. External Vcc An output voltage derived bias supply can be applied to the VCC pin to reduce the controller power dissipation at higher input voltage. This can also relax constraints on the driver supply current if your external source can supply more than the LM5117 internal regulator. Please see Datasheet for more information. Diode Emulation A fully synchronous buck regulator implemented with a freewheel MOSFET rather than a diode has the capability to sink current from the output in certain conditions such as light load, over-voltage or pre-bias startup. The LM5117 provides a diode emulation feature that can be enabled to prevent reverse (drain to source) current flow in the low side free-wheel MOSFET.

2. **LM5117** Product Folder : http://www.ti.com/product/LM5117 : contains the data sheet and other resources.