

WEBENCH® Power Architect

Project Report

Project : 3496425/8 : PA_Project_302 (modified from 301)

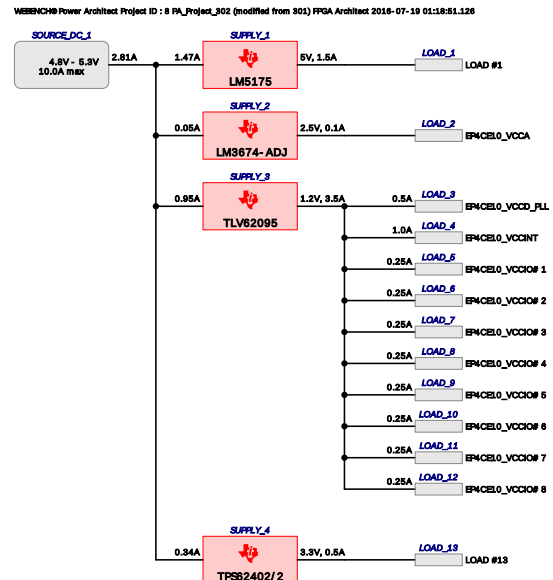
Created : 2016-07-19 01:18:51.126

Optimize project optFactor=3

Project Summary

1. Total System Efficiency	91.47 %
2. Total System BOM Count	59.0
3. Total System Footprint	614.0 mm ²
4. Total System BOM Cost	\$9.33
5. Total System Power Dissipation	1.268 W

--> Launch WEBENCH Power Architect.



Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_1	0	LOAD_1	LOAD #1
SUPPLY_2	0	LOAD_2	EP4CE10_VCCA
SUPPLY_3	0	LOAD_3	EP4CE10_VCCD_PLL
SUPPLY_3	0	LOAD_4	EP4CE10_VCCINT
SUPPLY_3	0	LOAD_5	EP4CE10_VCCIO# 1
SUPPLY_3	0	LOAD_6	EP4CE10_VCCIO# 2
SUPPLY_3	0	LOAD_7	EP4CE10_VCCIO# 3
SUPPLY_3	0	LOAD_8	EP4CE10_VCCIO# 4
SUPPLY_3	0	LOAD_9	EP4CE10_VCCIO# 5
SUPPLY_3	0	LOAD_10	EP4CE10_VCCIO# 6
SUPPLY_3	0	LOAD_11	EP4CE10_VCCIO# 7
SUPPLY_3	0	LOAD_12	EP4CE10_VCCIO# 8
SUPPLY_4	0	LOAD_13	LOAD #13

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LM5175	Switcher : Single Inductor 4-Switch Buck Boost	5 V	1.5 A	96.4%	437	\$6.35	37	5
2.	SUPPLY_2	LM3674-ADJ	Switcher : 2MHz, 600mA Step-Down DC-DC Converter in SOT 23-5	2.5 V	0.1 A	94.5%	51	\$0.48	38	18
3.	SUPPLY_3	TLV62095	Switcher : 4-A High Efficient Step Down Converter with DCS Control	1.2 V	3.5 A	83.4%	92	\$1.60	39	23
4.	SUPPLY_4	TPS62402/2	Switcher : 2.25-MHz 400-mA and 600-mA Dual Step-Down Converter	3.3 V	0.5 A	92.1%	34	\$0.90	40	28

Power Loads

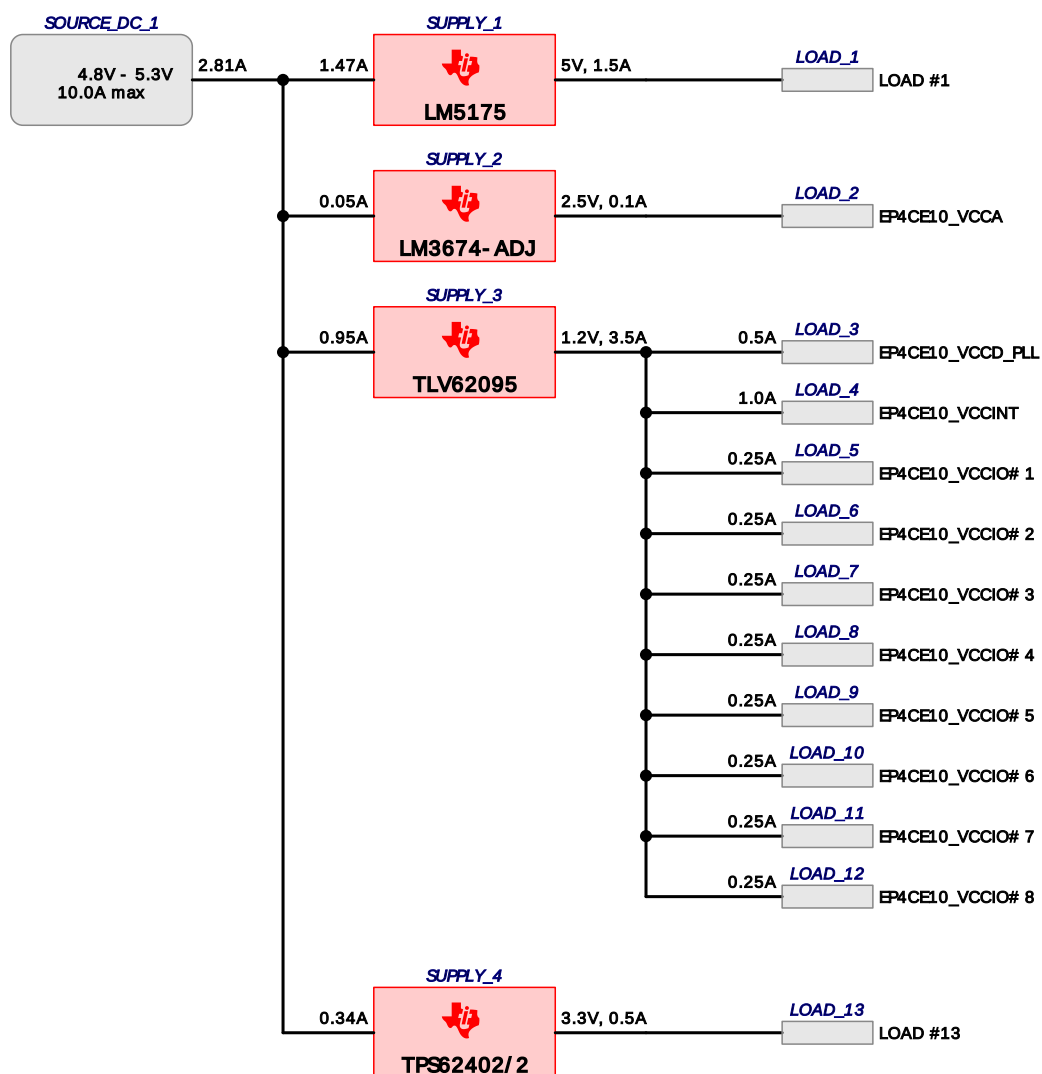
#	Name	VLoad	ILoad	Description
1.	LOAD #1	5 V	1.5 A	VoutRipple=5%, SoftStart delay=50.0 µSec
2.	EP4CE10_VCCA	2.5 V	0.1 A	VoutRipple=6%, SoftStart delay=1.0 mSec
3.	EP4CE10_VCCD_PLL	1.2 V	0.5 A	VoutRipple=6%, SoftStart delay=1.0 mSec
4.	EP4CE10_VCCINT	1.2 V	1 A	VoutRipple=6%, SoftStart delay=1.0 mSec
5.	EP4CE10_VCCIO# 1	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
6.	EP4CE10_VCCIO# 2	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
7.	EP4CE10_VCCIO# 3	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
8.	EP4CE10_VCCIO# 4	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
9.	EP4CE10_VCCIO# 5	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
10.	EP4CE10_VCCIO# 6	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
11.	EP4CE10_VCCIO# 7	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
12.	EP4CE10_VCCIO# 8	1.2 V	0.25 A	VoutRipple=10%, SoftStart delay=1.0 mSec
13.	LOAD #13	3.3 V	0.5 A	VoutRipple=10%

FPGAs, Processors

#	Manufacturer	Part Number	Name	Series	Description
1.	Altera http://www.altera.com/literature/hb/cyclone-iv/cyiv-53001.pdf	EP4CE10	FPGA_1	Cyclone-IV E	FPGA Altera Cyclone-IV E EP4CE10

Project Diagram

WEBENCH® Power Architect Project ID : 8_PA_Project_302 (modified from 301) FPGA Architect 2016-07-19 01:18:51.126



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
AVX	06035A470JAT2A	0603	1	\$0.01	5
Kemet	C0603C104K3RACTU	0603	2	\$0.01	9
Kemet	C0603C470J3GACTU	0603	1	\$0.01	5
Kemet	C0805C100M4GACTU	0805	1	\$0.01	7
Kemet	C0805C224K5RACTU	0805	1	\$0.02	7
TDK	C3225X6S1C226M	1210	3	\$0.13	44
Yageo America	CC0603JRNPO9BN331	0603	1	\$0.01	5
Yageo America	CC0805KRX7R9BB183	0805	1	\$0.01	7
Yageo America	CC0805KRX7R9BB391	0805	1	\$0.01	7
Toshiba	CMS06	M-FLAT	1	\$0.19	19
Vishay-Dale	CRCW0402100KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402249KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04022K21FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402402KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040263K4FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040293K1FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0603100RFKEA	0603	2	\$0.01	9
Vishay-Dale	CRCW0603105KFKEA	0603	1	\$0.01	5
Vishay-Dale	CRCW060310R0FKEA	0603	1	\$0.01	5
Vishay-Dale	CRCW060320K0FKEA	0603	2	\$0.01	9
Vishay-Dale	CRCW0603499KFKEA	0603	1	\$0.01	5
Vishay-Dale	CRCW060380K6FKEA	0603	1	\$0.01	5
Vishay-Dale	CRCW060393K1FKEA	0603	1	\$0.01	5
Texas Instruments	CSD16323Q3	TRANS_NexFET_Q3	3	\$0.44	55
Texas Instruments	CSD16411Q3	TRANS_NexFET_Q3	1	\$0.34	18
Stackpole Electronics Inc	CSR1206FK10L0	1206	1	\$0.11	11
MuRata	GRM033R61A682KA01D	0201	1	\$0.01	2
MuRata	GRM155R71E103KA01D	0402	1	\$0.01	3
MuRata	GRM188R60J106ME47D	0603	2	\$0.02	9
MuRata	GRM188R60J475KE19D	0603	1	\$0.01	5
MuRata	GRM188R61A105KA61D	0603	1	\$0.01	5
MuRata	GRM188R61C105KA93D	0603	1	\$0.01	5
MuRata	GRM219R61A106KE44D	0805	1	\$0.03	7
MuRata	GRM21BC80G226ME39L	0805	2	\$0.04	7
MuRata	GRM21BR60J226ME39L	0805	1	\$0.04	7
MuRata	GRM31CR60J107ME39L	1206_190	1	\$0.14	11
Taiyo Yuden	JMK212BJ226KG-T	0805	1	\$0.13	7
Texas Instruments	LM3674MFX-ADJ/NOPB	MF05A	1	\$0.32	15
Texas Instruments	LM5175PWPR	PWP0028F_N	1	\$3.10	98
ON Semiconductor	MBR0520LT1G	SOD-123	4	\$0.06	52
Coilcraft	ME3220-102MLB	ME3220	1	\$0.23	16
TDK	NLCV32T-2R2M-PFR	NLCV32	1	\$0.10	13
TDK	NLCV32T-4R7M-PFR	NLCV32	1	\$0.10	13
Yageo America	RC0603FR-07160KL	0603	1	\$0.01	5
Texas Instruments	TLV62095RGTR	RGT0016C	1	\$0.74	25
Texas Instruments	TPS62402DRCR	DRC0010J	1	\$0.78	16
Coilcraft	XAL4020-102MEB	XAL4020	1	\$0.60	28
Total			59	\$9687.60280000000001	

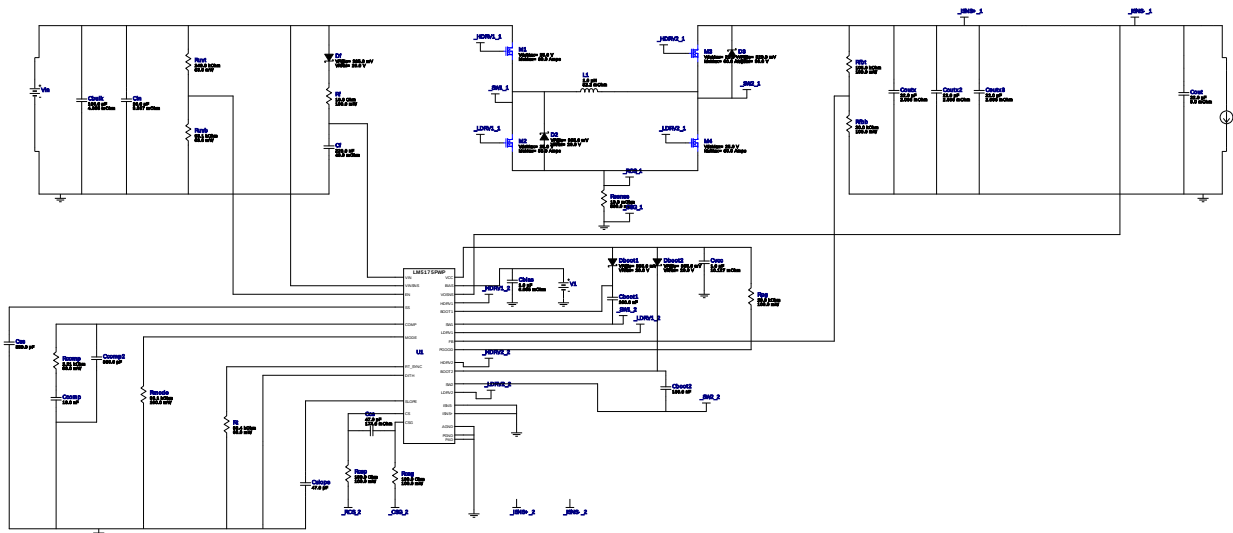


Vout = 5.0V
Iout = 1.5A

Device = LM5175PWPR
Topology = Buck_Boost
Created = 7/19/16 1:18:48 AM
BOM Cost = \$6.35
BOM Count = 39
Total Pd = 0.28W

WEBENCH® Design Report

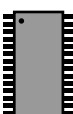
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LM5175PWPR 4.8V-5.3V to 5.00V @ 1.5A

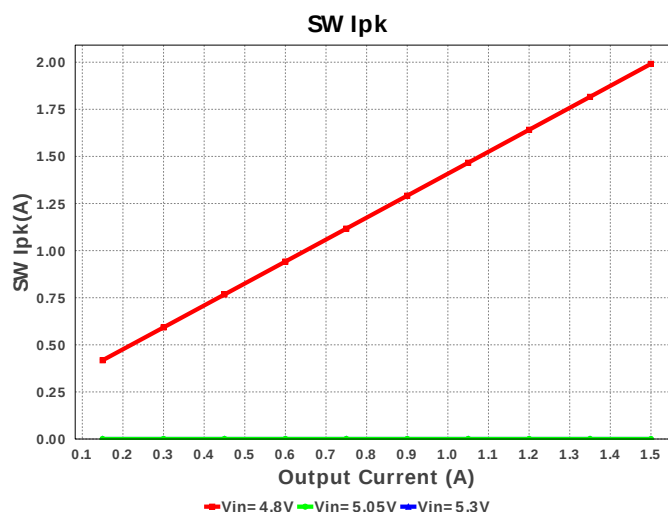
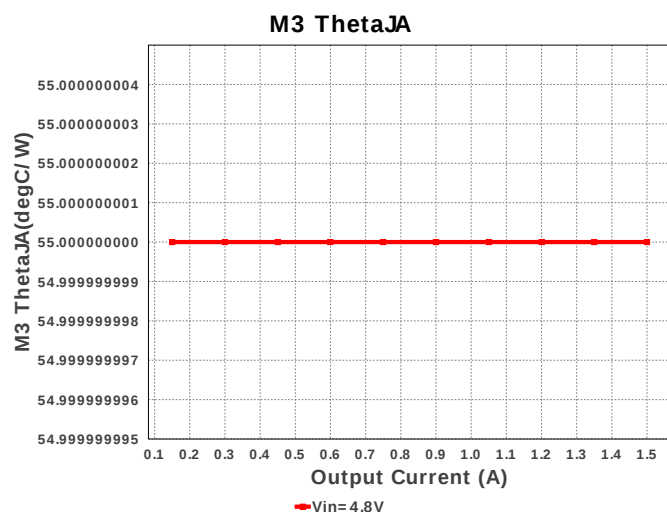


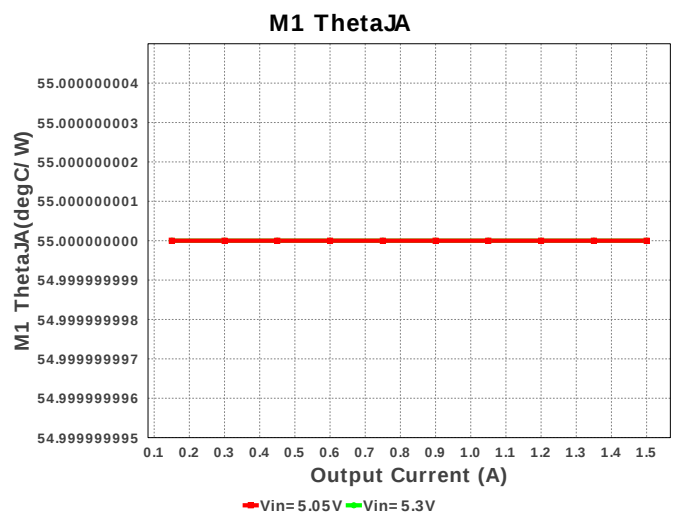
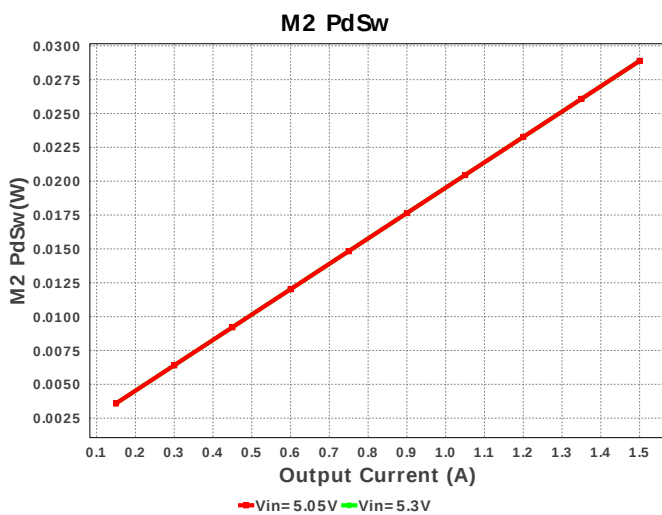
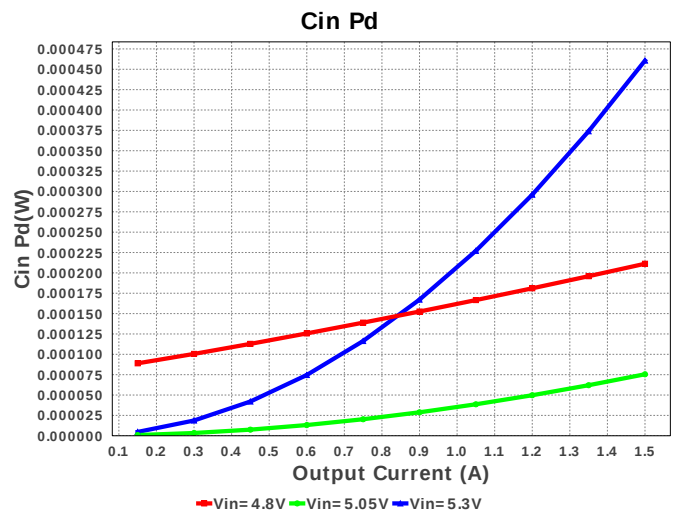
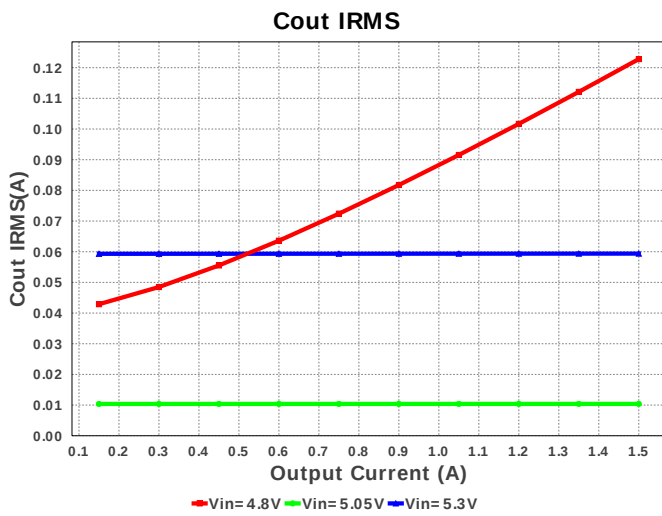
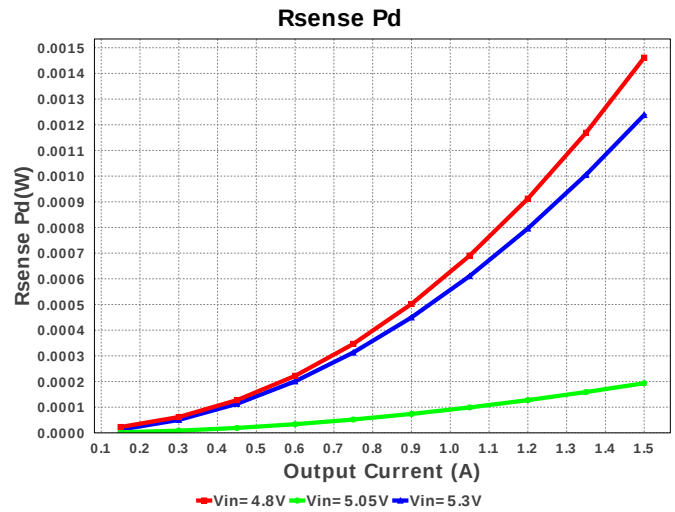
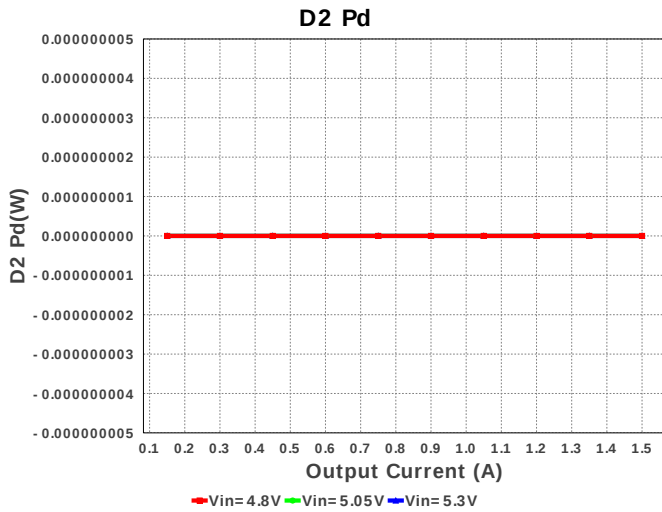
Electrical BOM

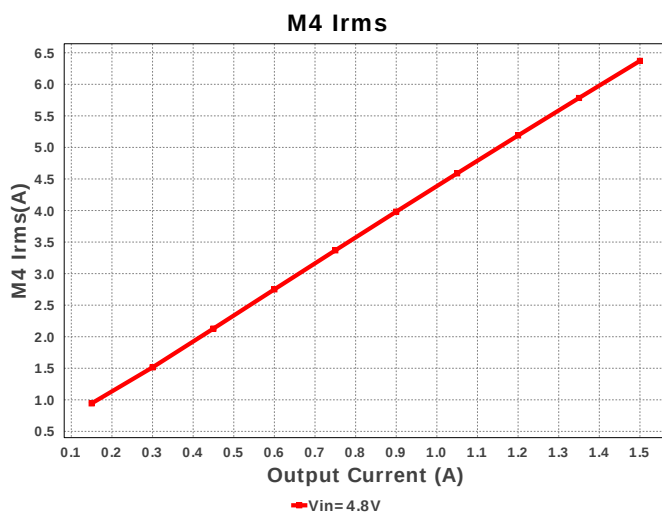
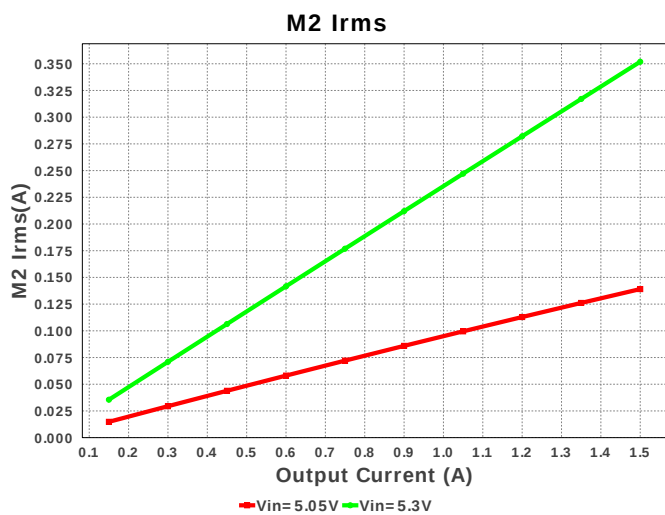
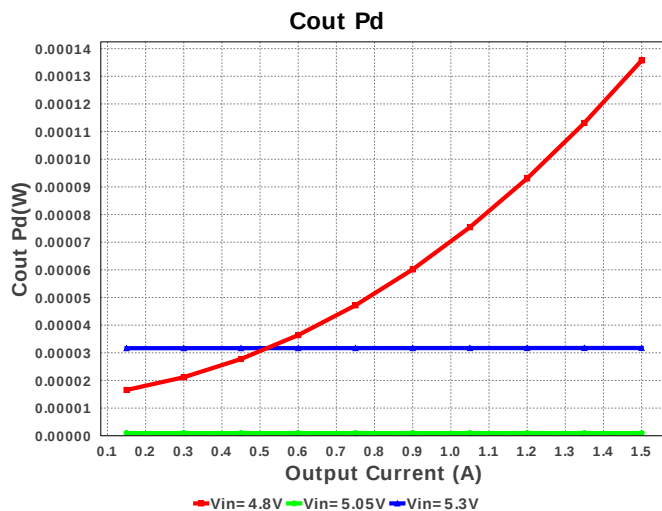
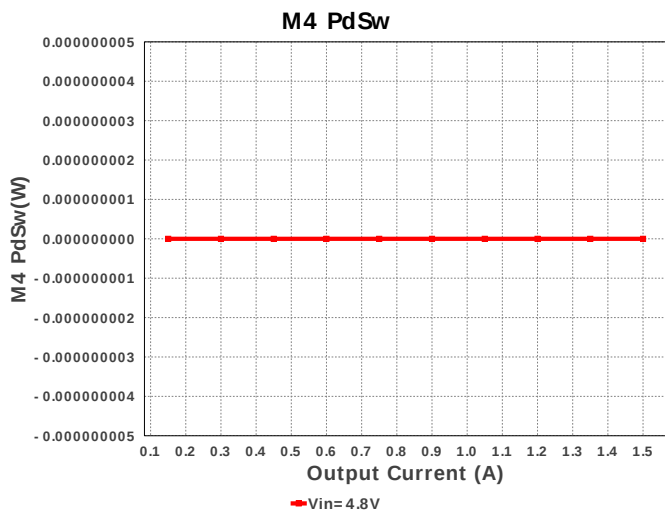
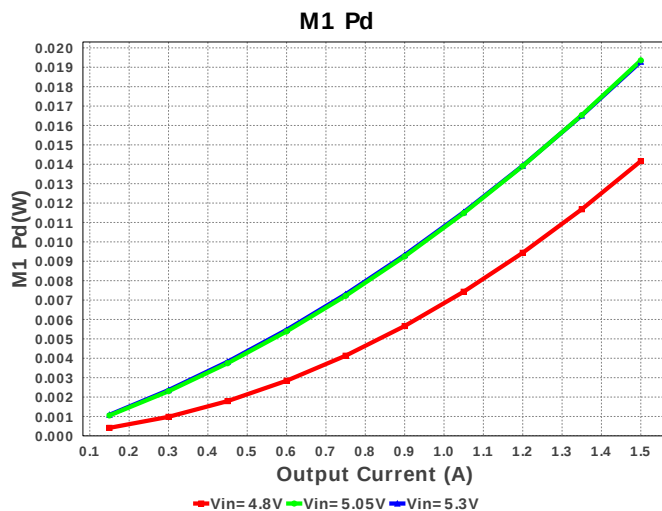
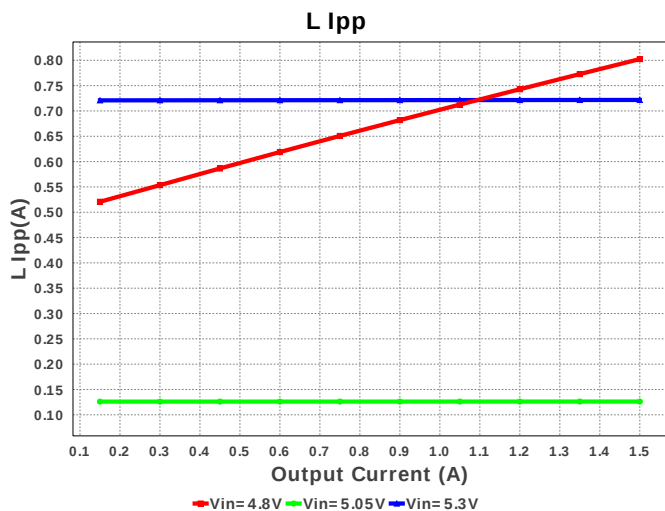
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	MuRata	GRM188R61A105KA61D Series= X5R	Cap= 1.0 uF ESR= 6.065 mOhm VDC= 10.0 V IRMS= 1.30675 A	1	\$0.01	0603 5 mm ²
2.	Cboot1	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
3.	Cboot2	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
4.	Cbulk	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 mm ²
5.	Ccomp	Yageo America	CC0805KRX7R9BB183 Series= X7R	Cap= 18.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
6.	Ccomp2	Yageo America	CC0805KRX7R9BB391 Series= X7R	Cap= 390.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
7.	Ccs	AVX	06035A470JAT2A Series= C0G/NP0	Cap= 47.0 pF ESR= 174.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
8.	Cf	Kemet	C0805C224K5RACTU Series= X7R	Cap= 220.0 nF ESR= 46.0 mOhm VDC= 50.0 V IRMS= 2.65 A	1	\$0.02	0805 7 mm ²
9.	Cin	MuRata	GRM219R61A106KE44D Series= X5R	Cap= 10.0 uF ESR= 3.937 mOhm VDC= 10.0 V IRMS= 2.7713 A	1	\$0.03	0805 7 mm ²

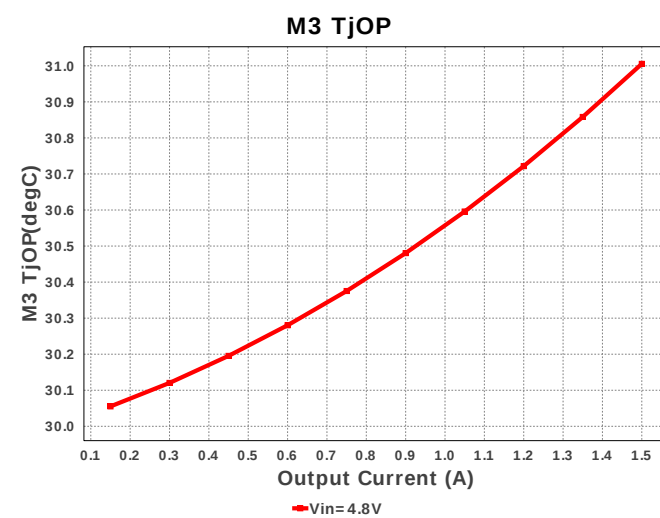
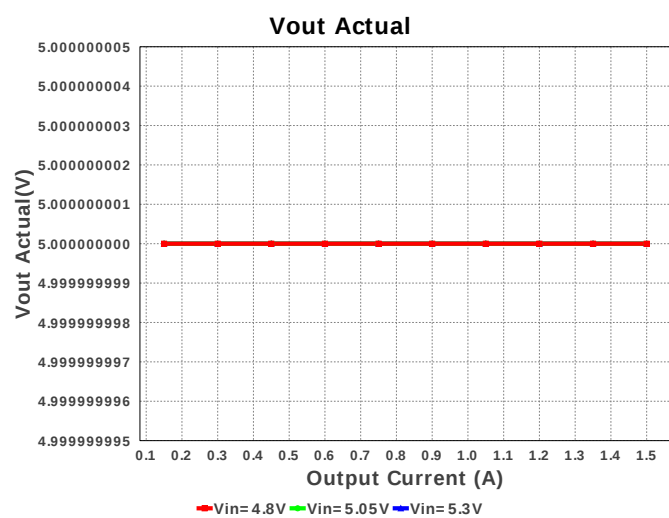
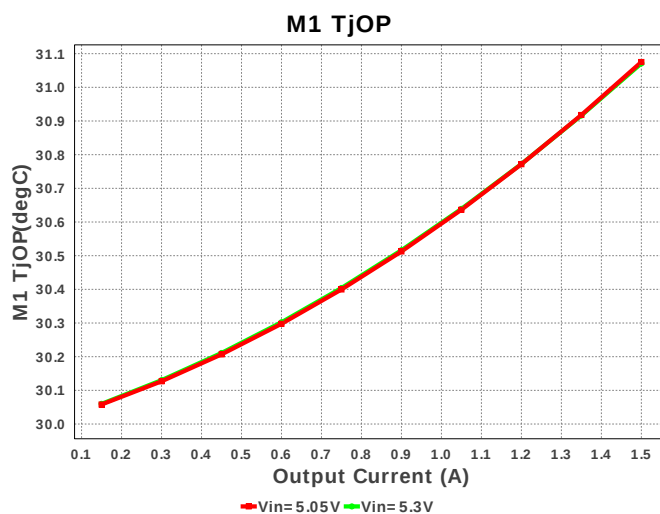
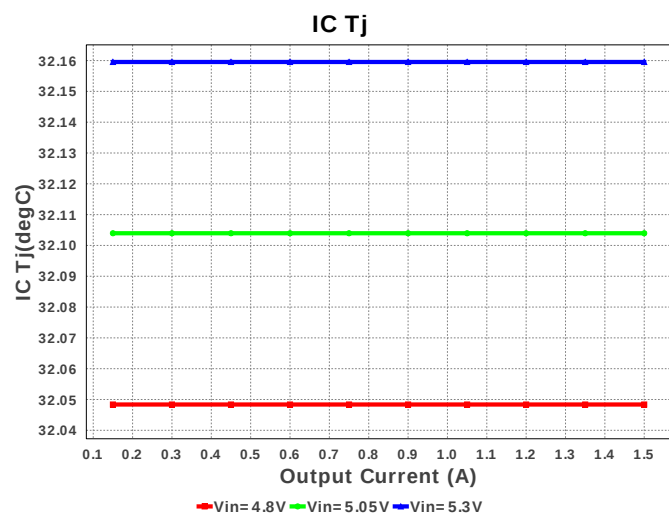
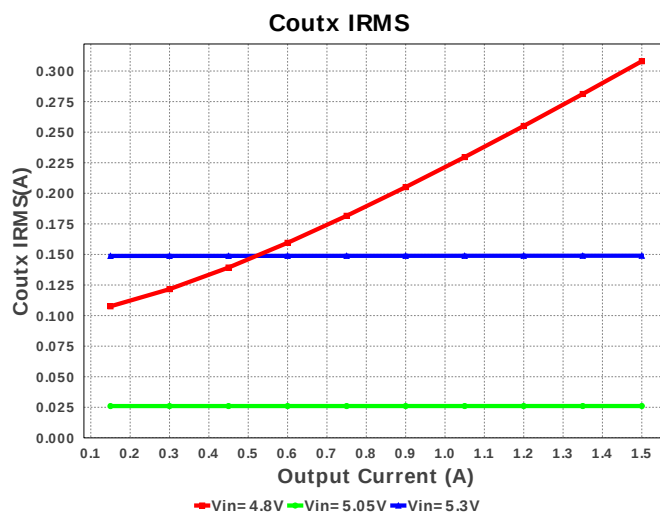
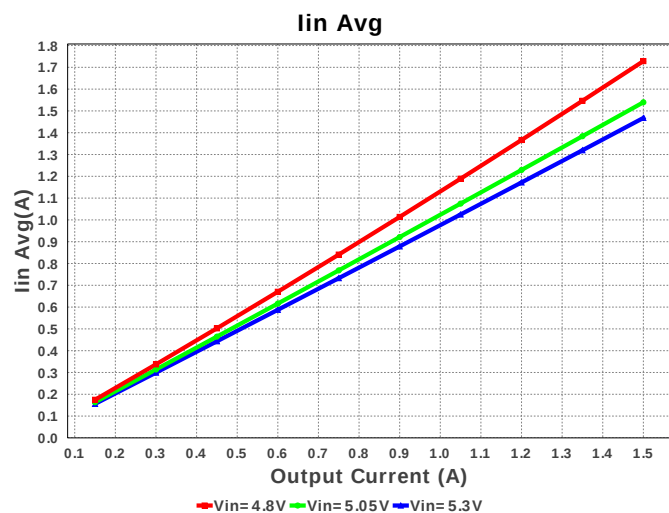
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10.	Cout	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	1	\$0.04	 0805 7 mm ²
11.	Coutx	TDK	C3225X6S1C226M Series= X6S	Cap= 22.0 uF ESR= 2.096 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.13	 1210 15 mm ²
12.	Coutx2	TDK	C3225X6S1C226M Series= X6S	Cap= 22.0 uF ESR= 2.096 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.13	 1210 15 mm ²
13.	Coutx3	TDK	C3225X6S1C226M Series= X6S	Cap= 22.0 uF ESR= 2.096 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.13	 1210 15 mm ²
14.	Cslope	Kemet	C0603C470J3GACTU Series= C0G/NP0	Cap= 47.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
15.	Css	Yageo America	CC0603JRNPO9BN331 Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
16.	Cvcc	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	 0603 5 mm ²
17.	D2	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	\$0.06	 SOD-123 13 mm ²
18.	D3	Toshiba	CMS06	VF@Io= 320.0 mV VRRM= 30.0 V	1	\$0.19	 M-FLAT 19 mm ²
19.	Dboot1	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	\$0.06	 SOD-123 13 mm ²
20.	Dboot2	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	\$0.06	 SOD-123 13 mm ²
21.	Df	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	\$0.06	 SOD-123 13 mm ²
22.	L1	Coilcraft	ME3220-102MLB	L= 1.0 uH DCR= 52.2 mOhm	1	\$0.23	 ME3220 16 mm ²
23.	M1	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.44	 TRANS_NexFET_Q3 18 mm ²
24.	M2	Texas Instruments	CSD16411Q3	VdsMax= 25.0 V IdsMax= 56.0 Amps	1	\$0.34	 TRANS_NexFET_Q3 18 mm ²
25.	M3	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.44	 TRANS_NexFET_Q3 18 mm ²
26.	M4	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.44	 TRANS_NexFET_Q3 18 mm ²
27.	Rcomp	Vishay-Dale	CRCW04022K21FKED Series= CRCW..e3	Res= 2.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
28.	Rcsg	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
29.	Rcsp	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
30.	Rf	Vishay-Dale	CRCW060310R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
31.	Rfbb	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
32.	Rfbt	Vishay-Dale	CRCW0603105KFKEA Series= CRCW..e3	Res= 105.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
33.	Rmode	Vishay-Dale	CRCW060393K1FKEA Series= CRCW..e3	Res= 93.1 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
34.	Rpg	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
35.	Rsense	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	\$0.11	 1206 11 mm ²
36.	Rt	Vishay-Dale	CRCW040263K4FKED Series= CRCW..e3	Res= 63.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	Ruvb	Vishay-Dale	CRCW040293K1FKED Series= CRCW..e3	Res= 93.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
38.	Ruvt	Vishay-Dale	CRCW0402249KFKED Series= CRCW..e3	Res= 249.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	U1	Texas Instruments	LM5175PWPR	Switcher	1	\$3.10	 PWP0028F_N 98 mm ²

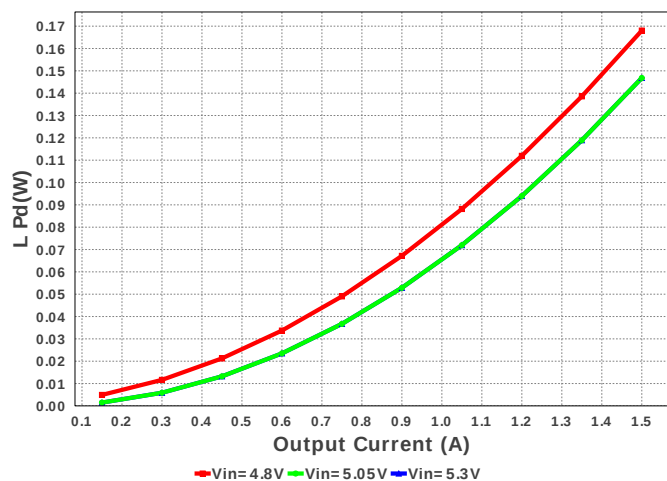




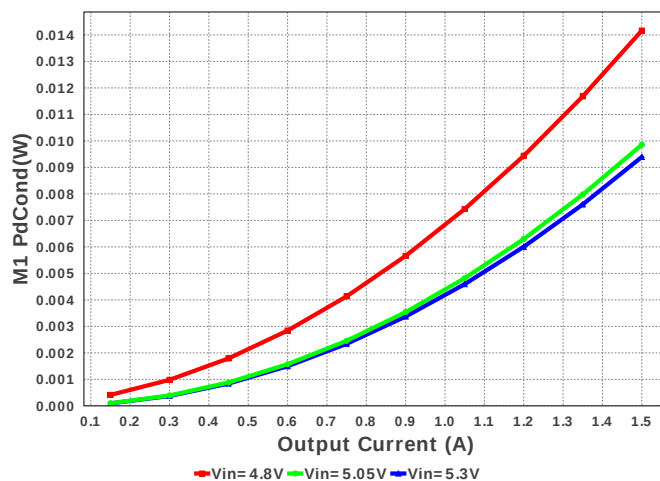




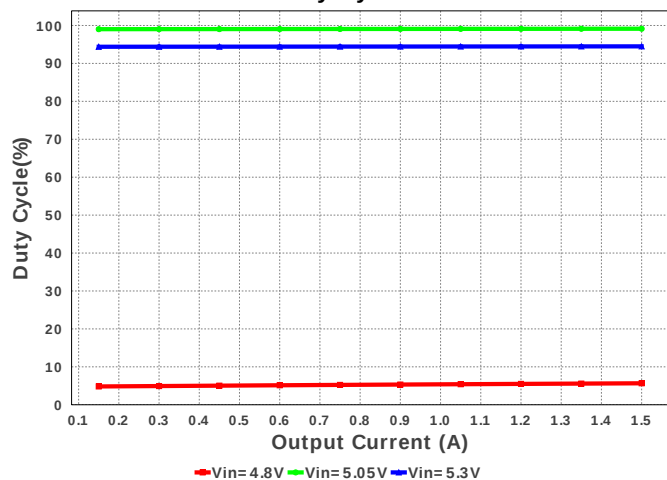
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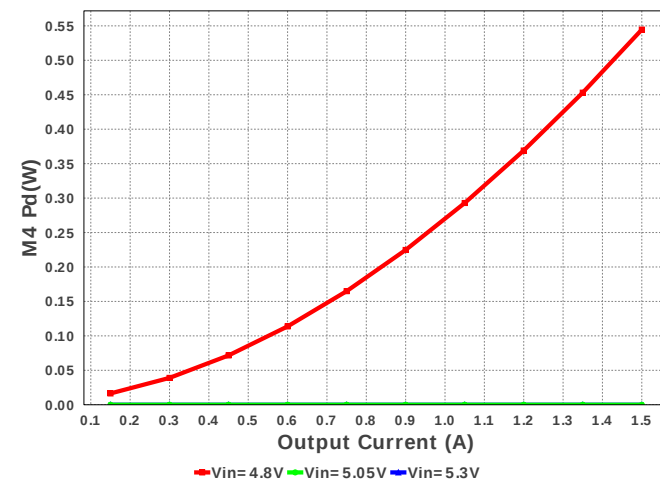
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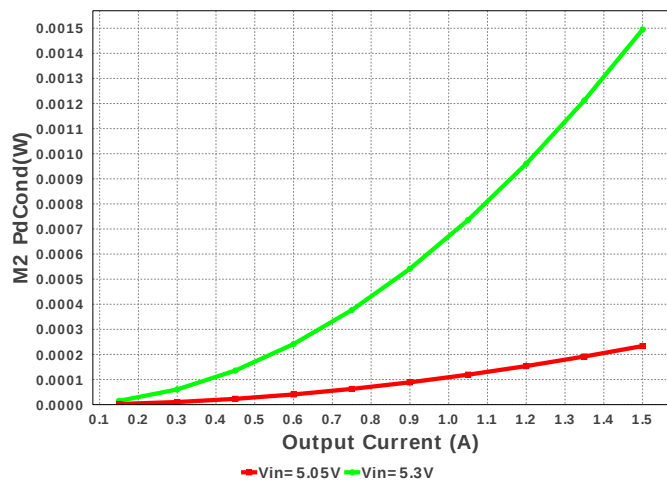
Duty Cycle



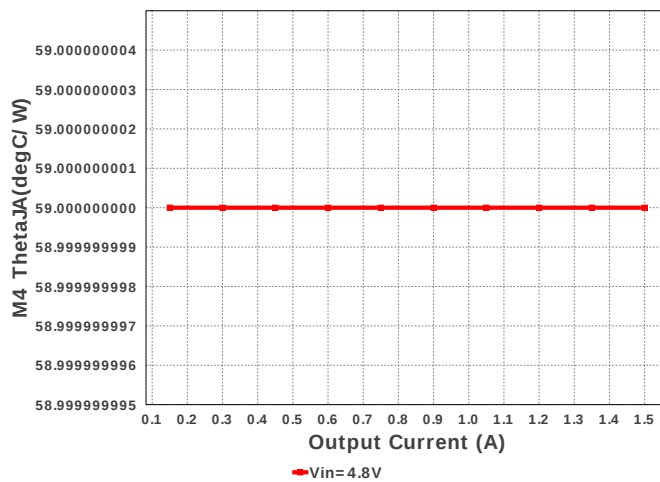
M4 Pd

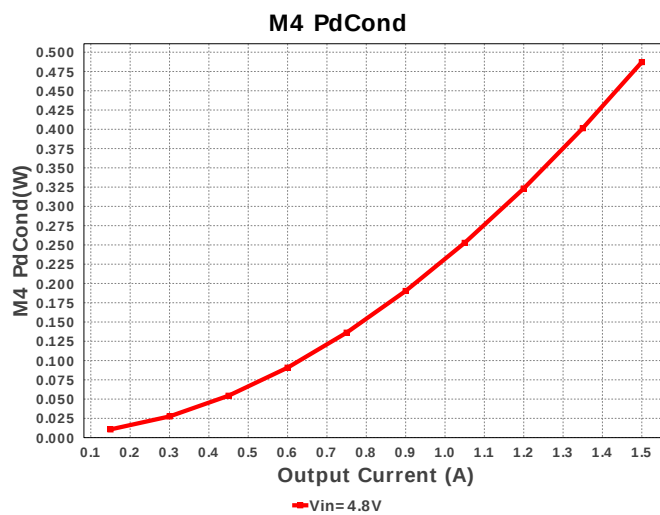
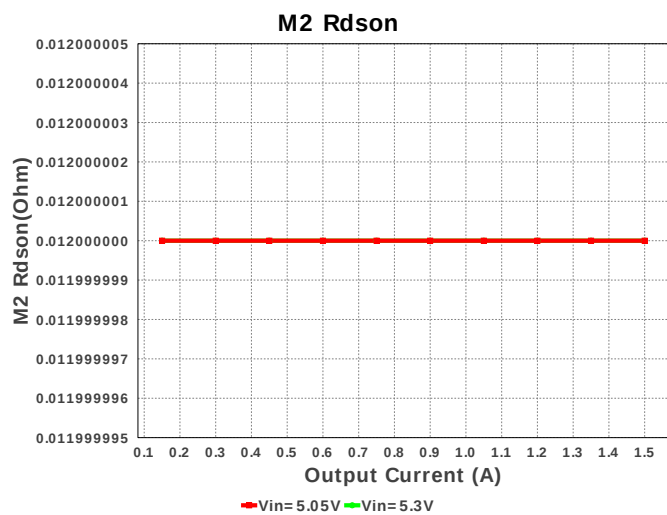
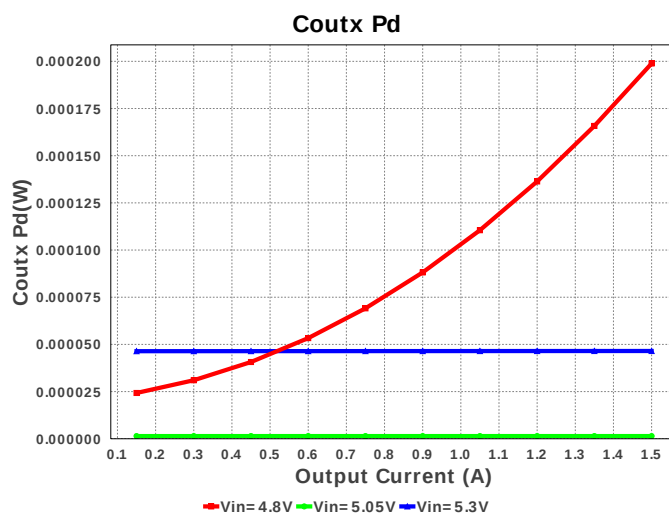
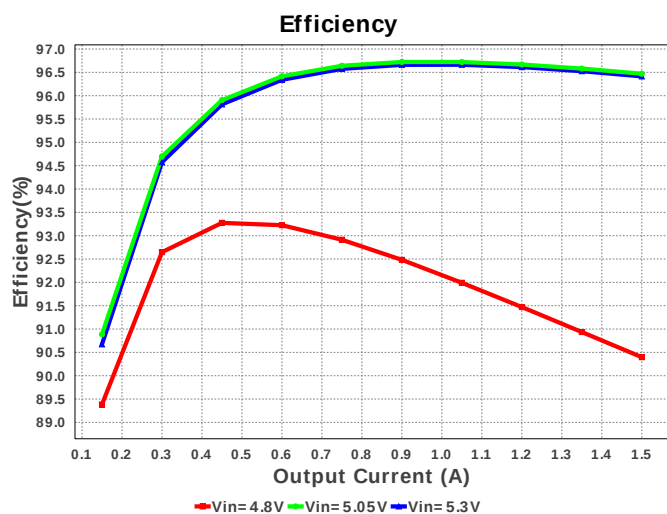
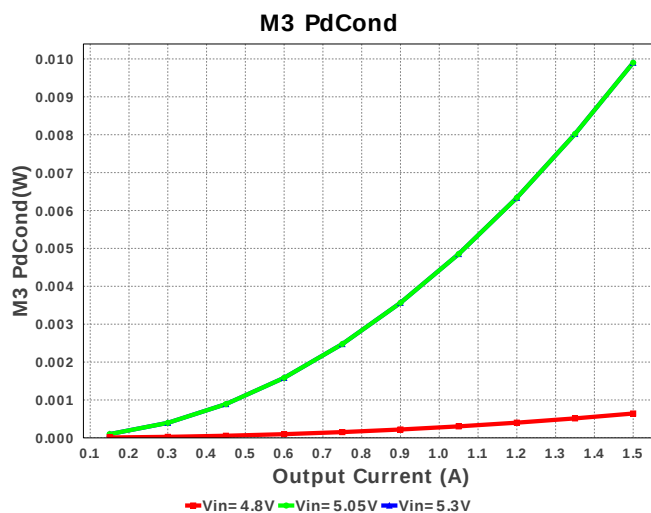
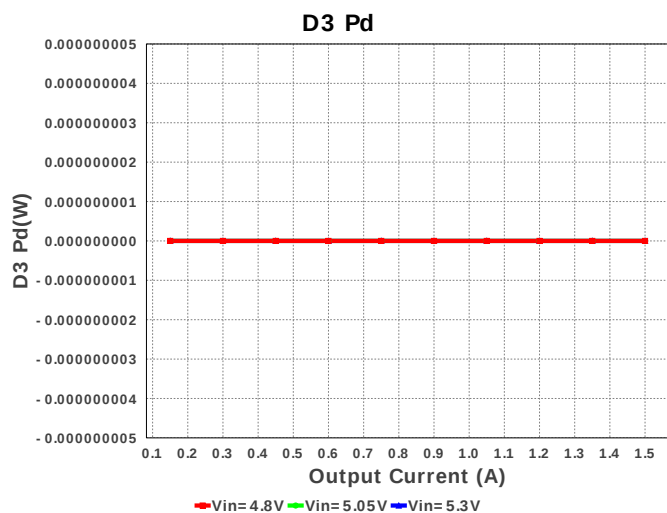


M2 PdCond

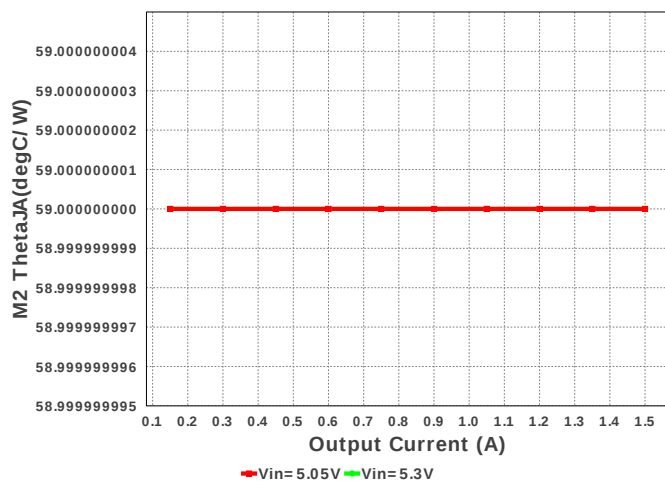


M4 ThetaJA

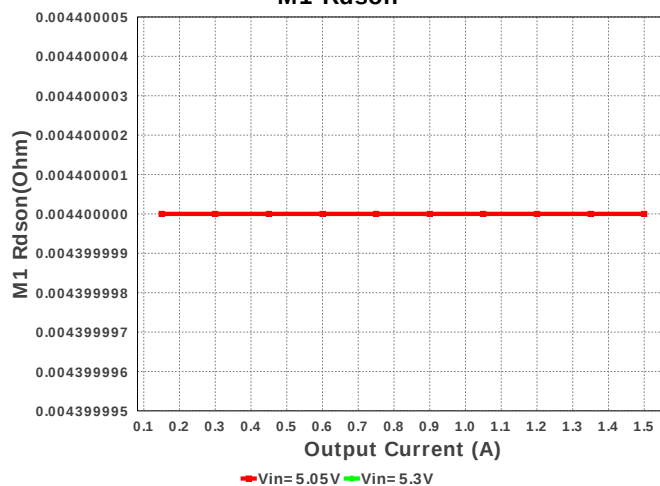




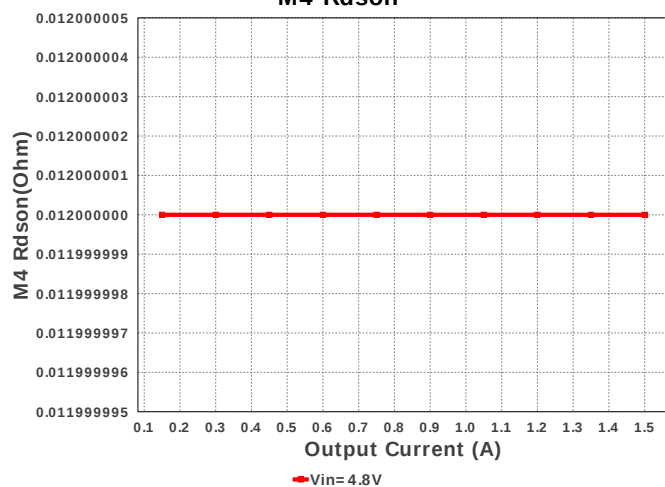
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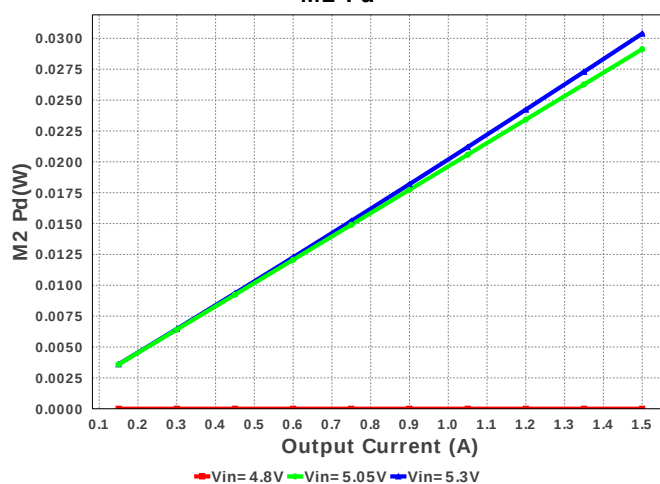
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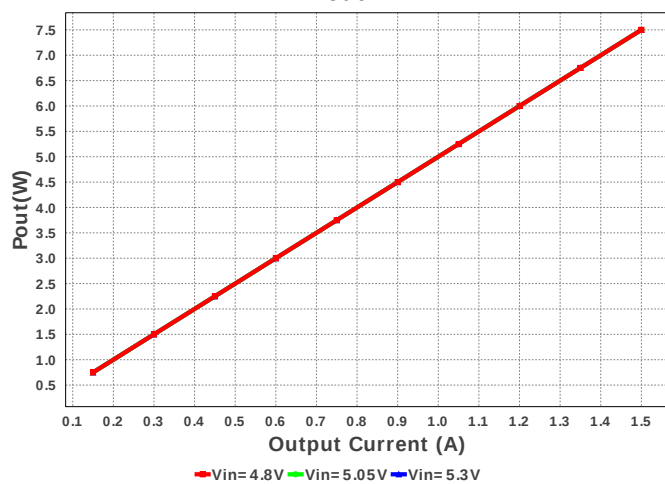
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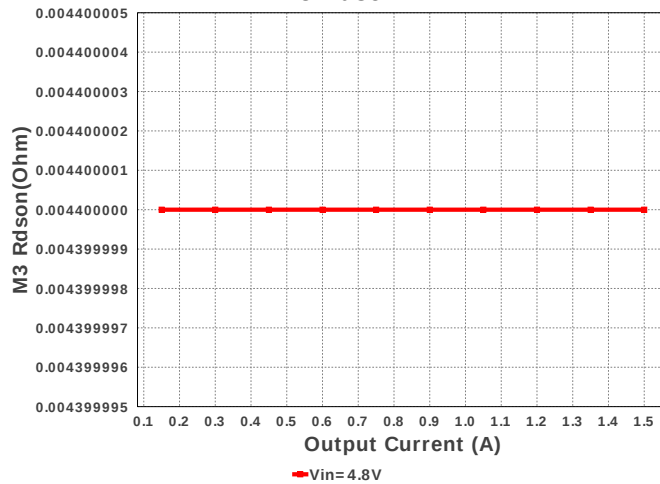
M2 Pd



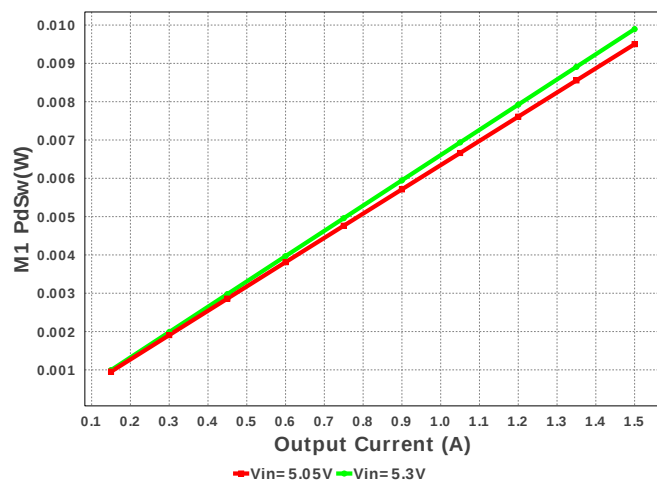
Pout



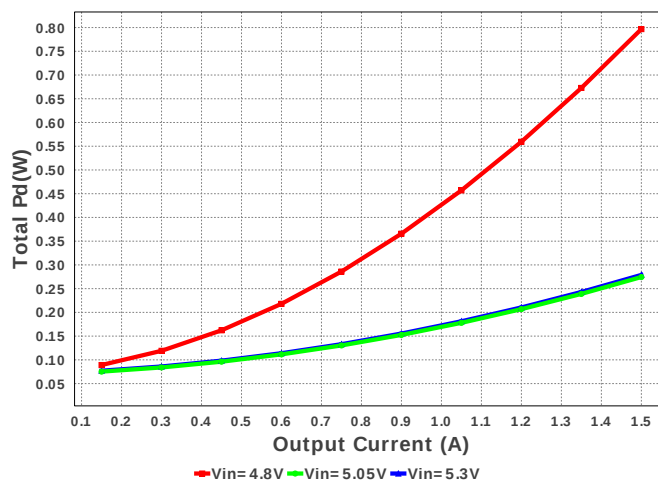
M3 Rdson



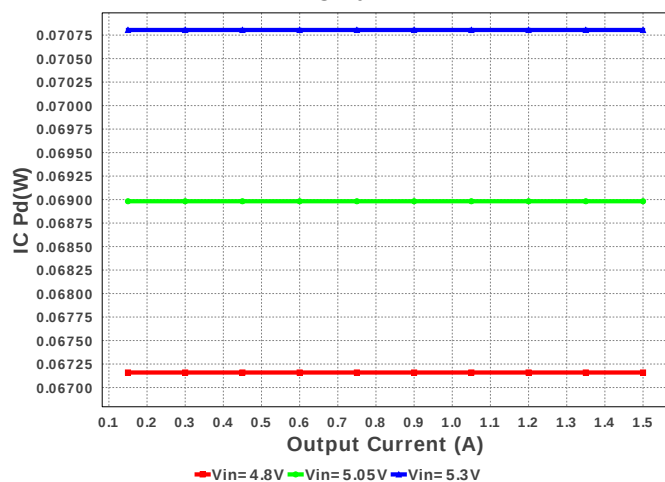
M1 PdSw



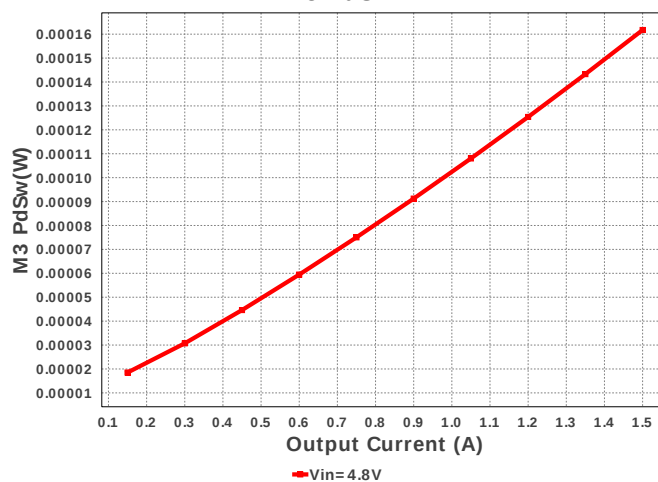
Total Pd



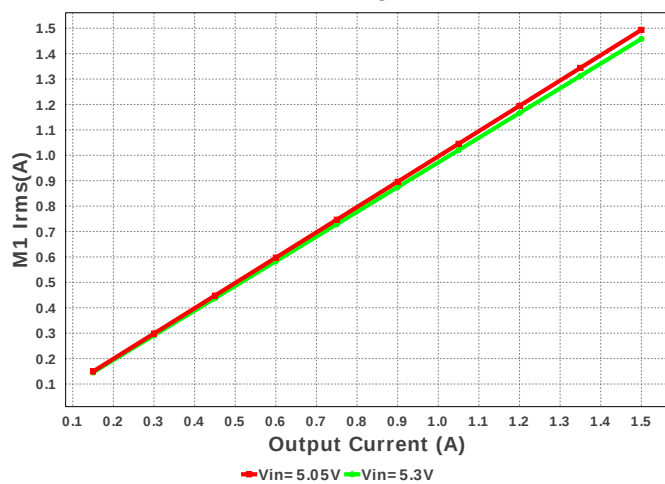
IC Pd



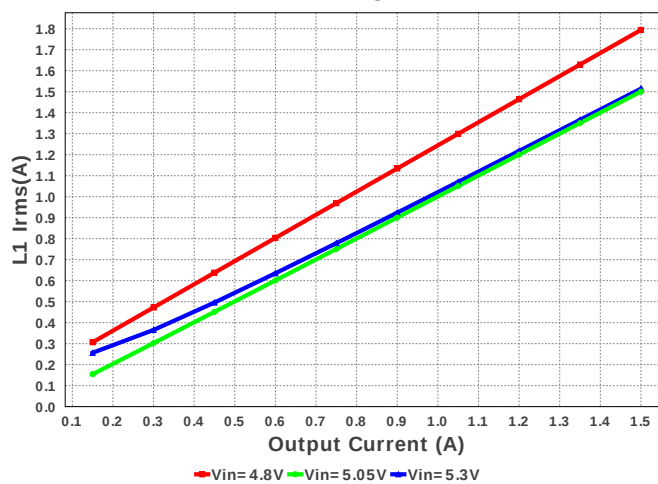
M3 PdSw



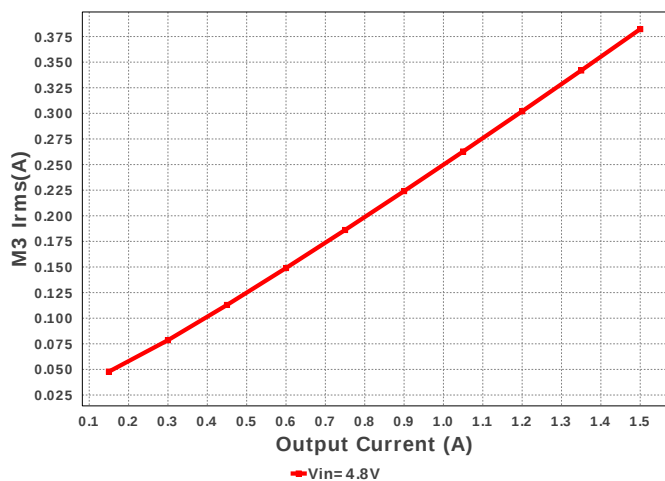
M1 Irms(A)



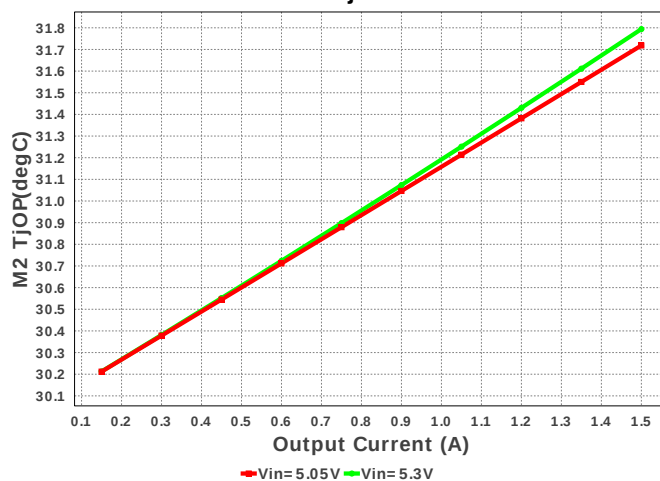
L1 Irms



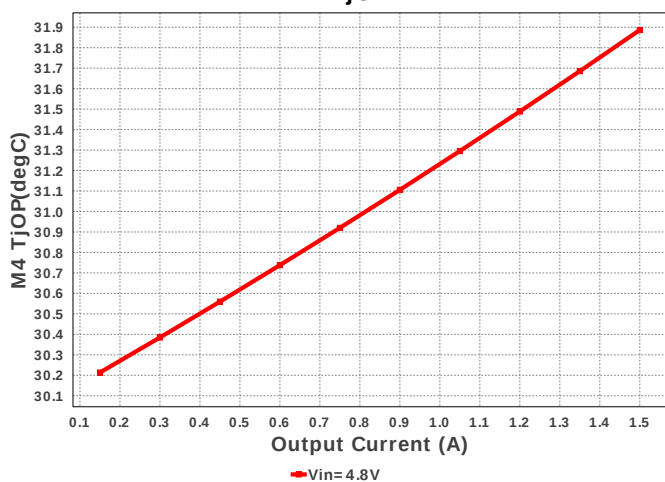
M3 Irms



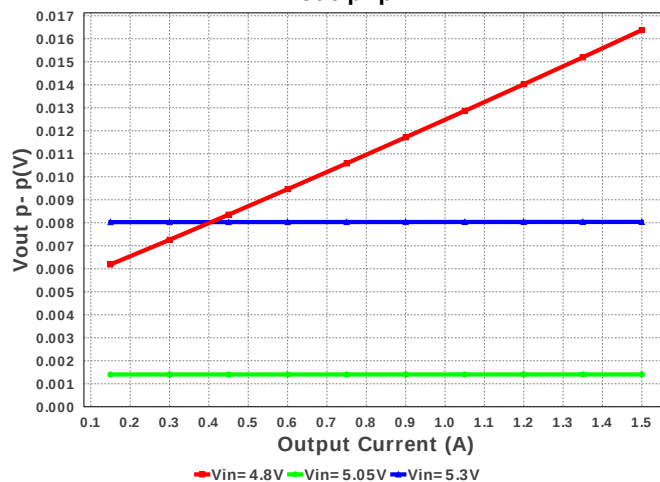
M2 TjOP



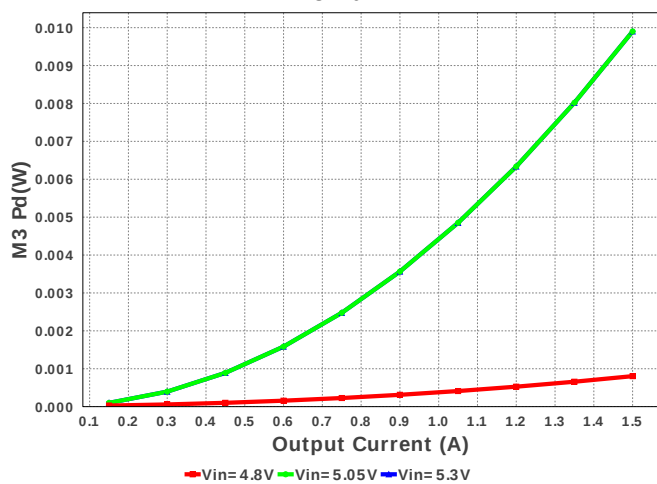
M4 TjOP



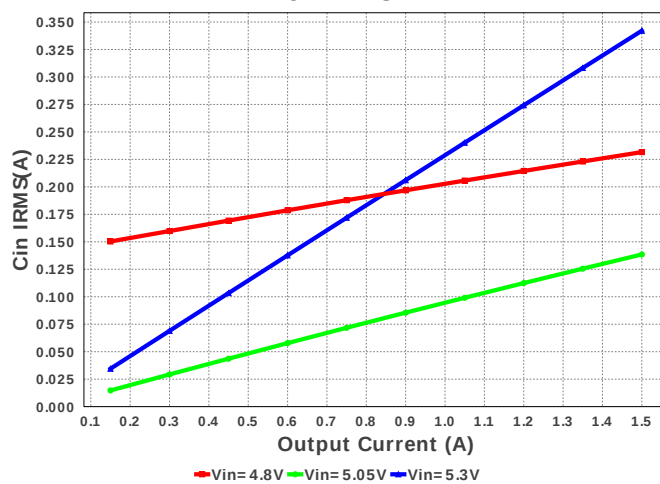
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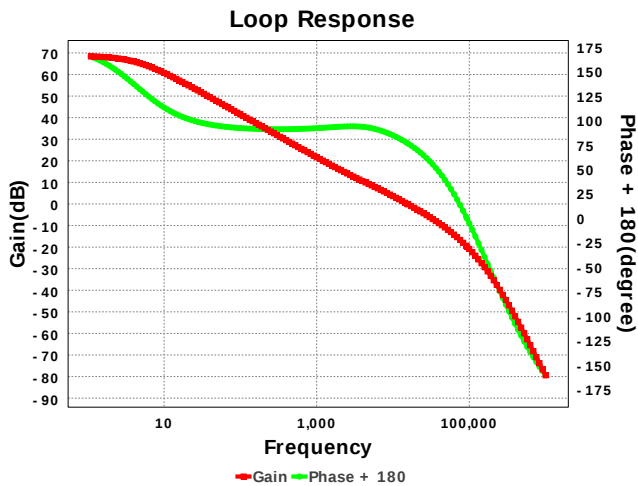


M3 Pd



Cin IRMS





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	342.255 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	38.874 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	97.511 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	1.468 A	Current	Average input current
5.	L Ipp	472.45 mA	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	1.506 A	Current	Inductor ripple current
7.	M1 Irms	1.458 A	Current	MOSFET RMS ripple current
8.	M2 Irms	352.092 mA	Current	MOSFET RMS ripple current
9.	SW Ipk	0.0 A	Current	Peak switch current
10.	BOM Count	39	General	Total Design BOM count
11.	FootPrint	437.0 mm ²	General	Total Foot Print Area of BOM components
12.	Frequency	392.804 kHz	General	Switching frequency
13.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
14.	M1 Rdson	4.4 mOhm	General	Drain-Source On-resistance
15.	M1 ThetaJA	55.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
16.	M2 Rdson	12.0 mOhm	General	Drain-Source On-resistance
17.	M2 ThetaJA	59.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
18.	Pout	7.5 W	General	Total output power
19.	Total BOM	\$6.35	General	Total BOM Cost
20.	Low Freq Gain	68.372 dB	Op_Point	Gain at 10Hz
21.	Vout Actual	5.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
22.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
23.	Cross Freq	15.478 kHz	Op_point	Bode plot crossover frequency
24.	Duty Cycle	94.49 %	Op_point	Duty cycle
25.	Efficiency	96.414 %	Op_point	Steady state efficiency
26.	Gain Marg	-19.812 dB	Op_point	Bode Plot Gain Margin
27.	IC Tj	32.16 degC	Op_point	IC junction temperature
28.	ICThetaJA	30.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
29.	IOUT_OP	1.5 A	Op_point	Iout operating point
30.	M1 TjOP	31.071 degC	Op_point	MOSFET junction temperature
31.	M2 TjOP	31.794 degC	Op_point	MOSFET junction temperature
32.	Phase Marg	77.316 deg	Op_point	Bode Plot Phase Margin
33.	VIN_OP	5.3 V	Op_point	Vin operating point
34.	Vout p-p	5.261 mV	Op_point	Peak-to-peak output ripple voltage
35.	Cin Pd	461.175 µW	Power	Input capacitor power dissipation
36.	Cout Pd	13.601 µW	Power	Output capacitor power dissipation
37.	Coutx Pd	19.93 µW	Power	Output capacitor_x power loss
38.	D2 Pd	0.0 W	Power	Diode power dissipation
39.	D3 Pd	0.0 W	Power	Diode power dissipation
40.	IC Pd	70.805 mW	Power	IC power dissipation
41.	L Pd	146.812 mW	Power	Inductor power dissipation
42.	M1 Pd	19.29 mW	Power	MOSFET power dissipation
43.	M1 PdCond	9.395 mW	Power	M1 MOSFET conduction losses
44.	M1 PdSw	9.895 mW	Power	M1 MOSFET switching losses
45.	M2 Pd	30.385 mW	Power	MOSFET power dissipation
46.	M2 PdCond	1.498 mW	Power	M2 MOSFET conduction losses
47.	M2 PdSw	28.888 mW	Power	M2 MOSFET switching losses
48.	M3 Pd	9.9 mW	Power	M3 MOSFET total power dissipation
49.	M3 PdCond	9.9 mW	Power	M3 MOSFET conduction losses
50.	M4 Pd	0.0 W	Power	M4 MOSFET total power dissipation
51.	Rsense Pd	1.24 mW	Power	Rsense Power Dissipation
52.	Total Pd	278.948 mW	Power	Total Power Dissipation

#	Name	Value	Category	Description
53.	Vout Tolerance	1.697 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.5	Maximum Output Current
2.	SoftStart	0.05 ms	Soft Start Time (ms)
3.	VinMax	5.3	Maximum input voltage
4.	VinMin	4.8	Minimum input voltage
5.	Vout	5.0	Output Voltage
6.	base_pn	LM5175	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. Tip: Snubbers and/or gate resistors may be required to limit the SW1,2 node switching spikes below the IC and FET abs max ratings.
2. Tip: Slope Capacitor: smaller slope capacitors provide better transition region behavior.
3. LM5175 Product Folder : <http://www.ti.com/product/LM5175> : contains the data sheet and other resources.

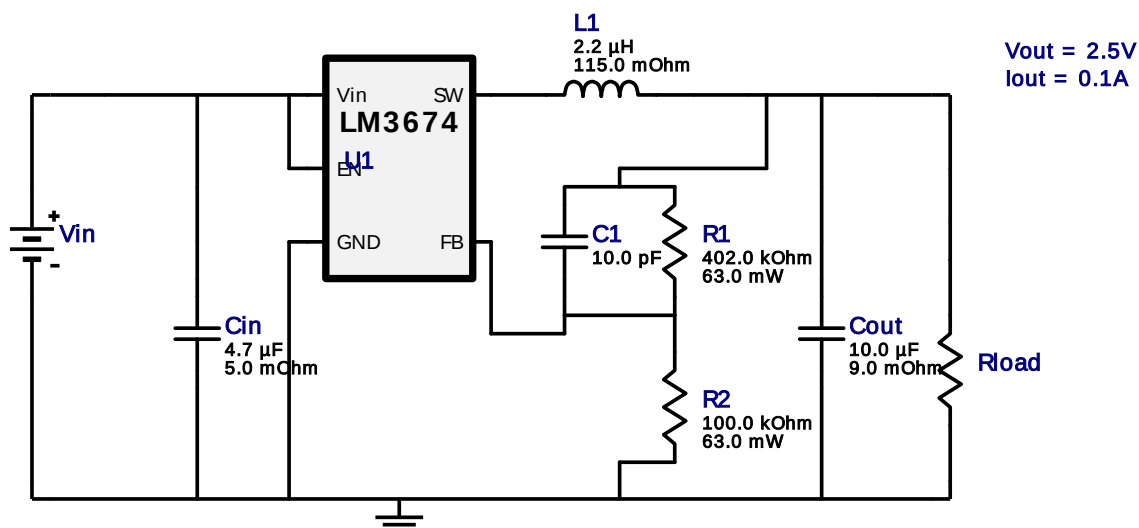


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Iout = 0.1A

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Topology = Buck
Created = 7/19/16 1:18:49 AM
BOM Cost = \$0.48
BOM Count = 7
Total Pd = 0.01W

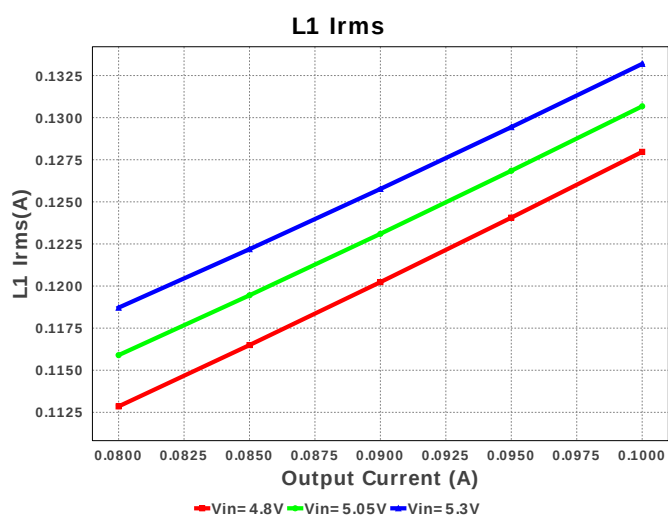
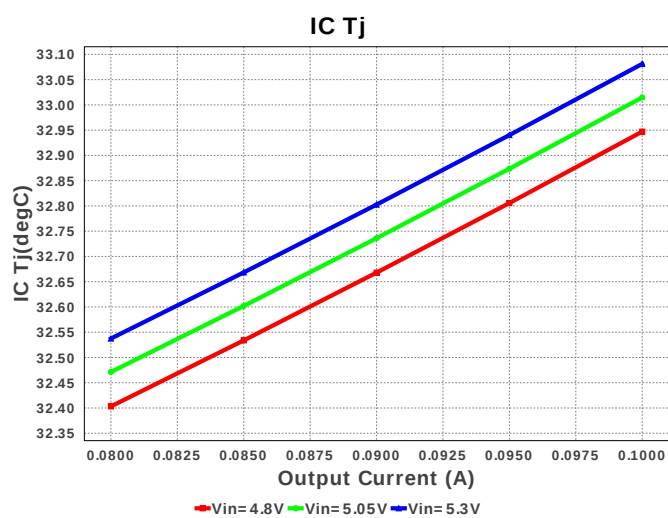
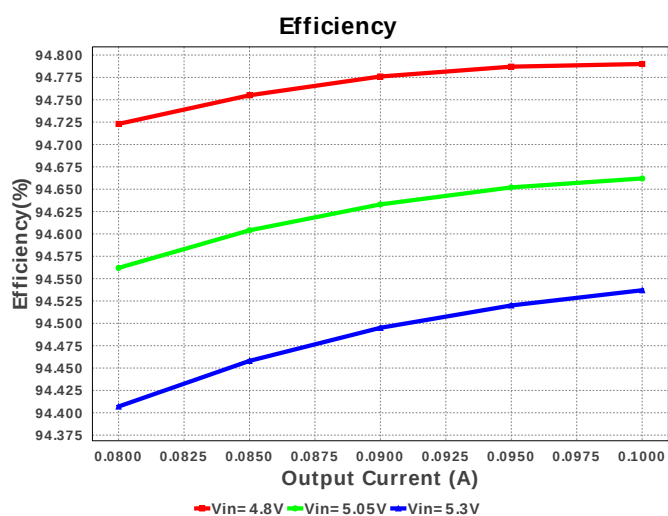
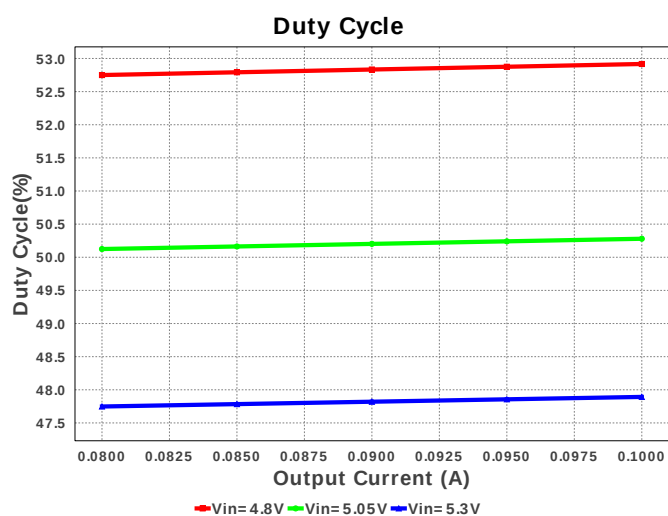
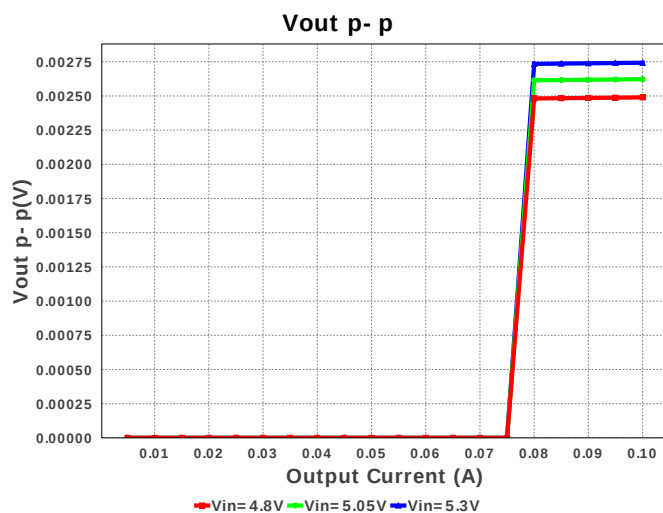
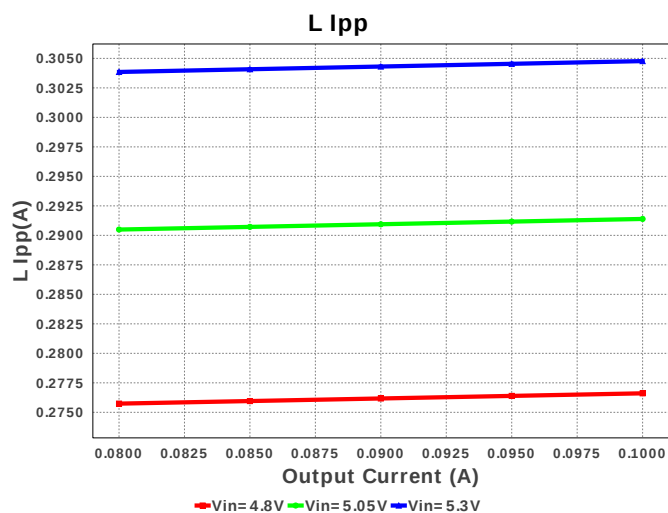
WEBENCH® Design Report

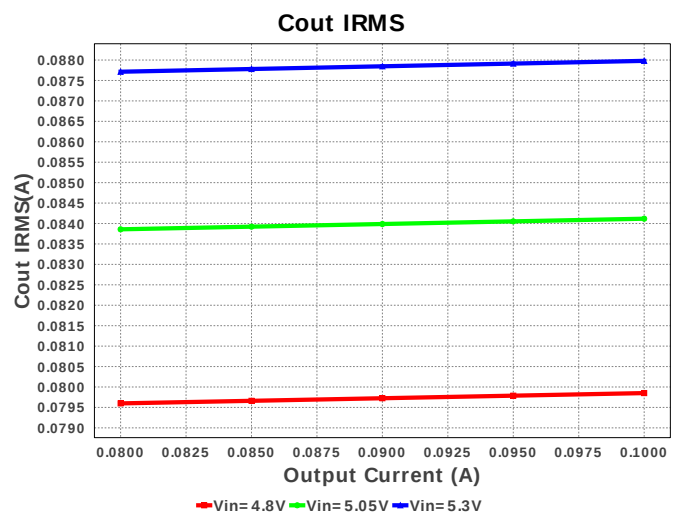
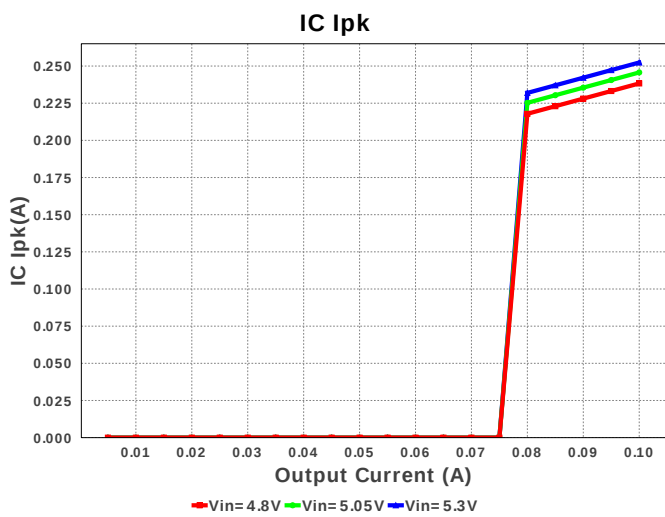
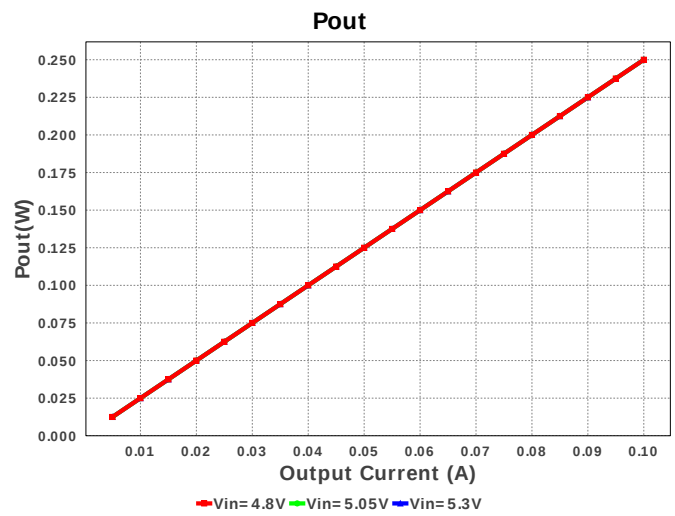
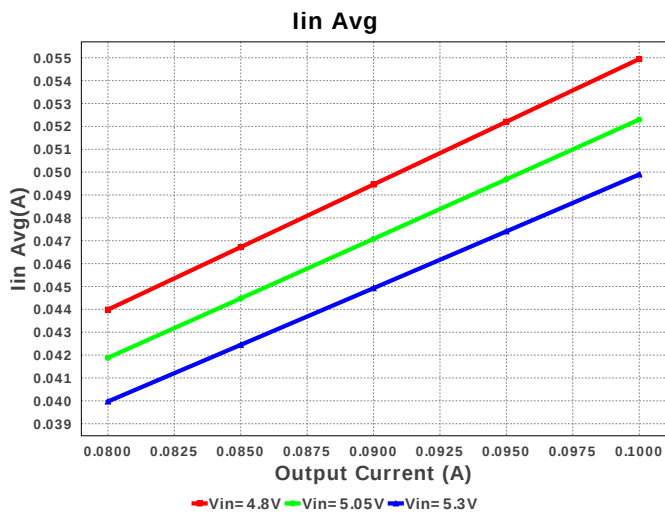
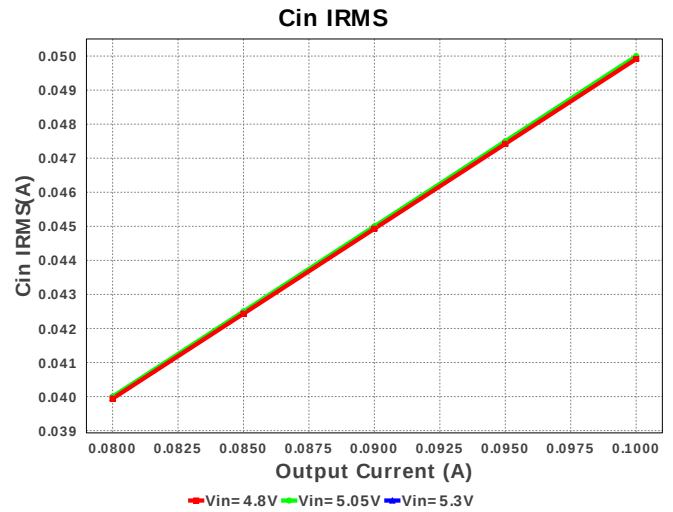
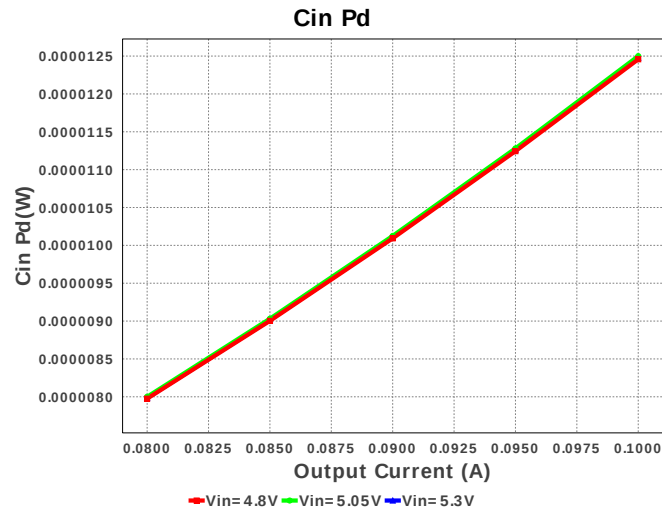
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LM3674MFX-ADJ/NOPB 4.8V-5.3V to 2.50V @ 0.1A

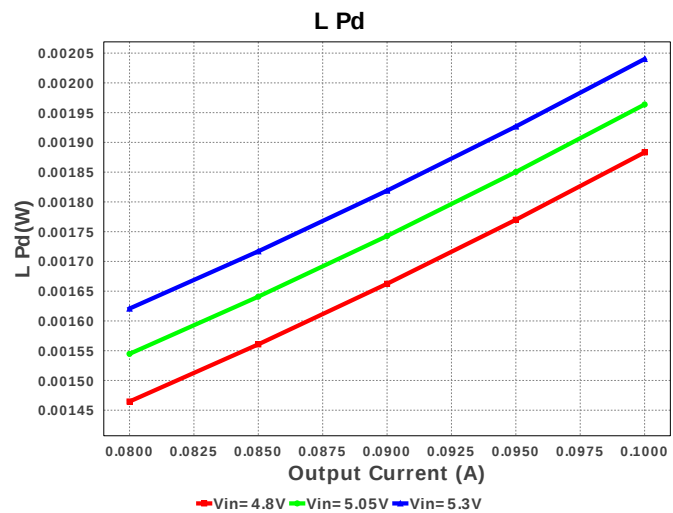
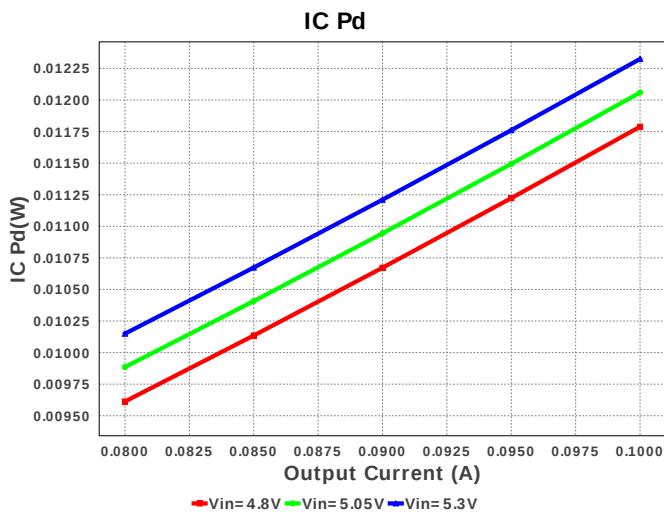
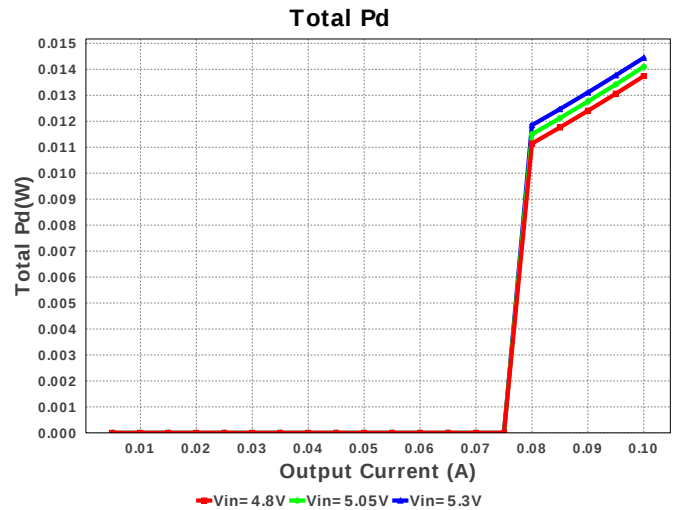
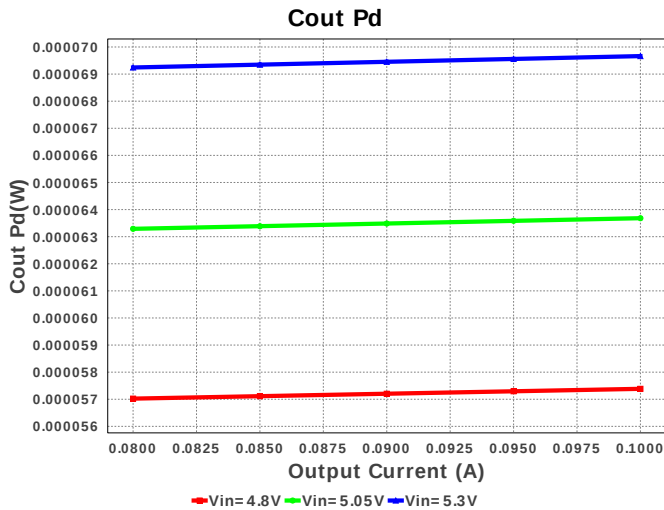


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C1	Kemet	C0805C100M4GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	Cin	MuRata	GRM188R60J475KE19D Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 6.3 V IRMS= 2.0 A	1	\$0.01	0603 5 mm ²
3.	Cout	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	1	\$0.02	0603 5 mm ²
4.	L1	TDK	NLCV32T-2R2M-PFR	L= 2.2 uH DCR= 115.0 mOhm	1	\$0.10	NLCV32 13 mm ²
5.	R1	Vishay-Dale	CRCW0402402KFKED Series= CRCW..e3	Res= 402.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
6.	R2	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
7.	U1	Texas Instruments	LM3674MFX-ADJ/NOPB	Switcher	1	\$0.32	MF05A 15 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	49.956 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	87.98 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	252.385 mA	Current	Peak switch current in IC
4.	Iin Avg	49.896 mA	Current	Average input current
5.	L Ipp	304.77 mA	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	133.193 mA	Current	Inductor ripple current
7.	BOM Count	7	General	Total Design BOM count
8.	FootPrint	51.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	2.0 MHz	General	Switching frequency
10.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
11.	Pout	250.0 mW	General	Total output power
12.	Total BOM	\$0.48	General	Total BOM Cost
13.	Duty Cycle	47.892 %	Op_point	Duty cycle
14.	Efficiency	94.537 %	Op_point	Steady state efficiency
15.	IC Tj	33.081 degC	Op_point	IC junction temperature
16.	ICThetaJA	250.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
17.	IOUT_OP	100.0 mA	Op_point	Iout operating point
18.	VIN_OP	5.3 V	Op_point	Vin operating point
19.	Vout p-p	2.743 mV	Op_point	Peak-to-peak output ripple voltage
20.	Cin Pd	12.478 μW	Power	Input capacitor power dissipation
21.	Cout Pd	69.664 μW	Power	Output capacitor power dissipation
22.	IC Pd	12.325 mW	Power	IC power dissipation
23.	L Pd	2.04 mW	Power	Inductor power dissipation
24.	Total Pd	14.447 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	100.0 m	Maximum Output Current
2.	SoftStart	1.0 ms	Soft Start Time (ms)
3.	VinMax	5.3	Maximum input voltage

#	Name	Value	Description
4.	VinMin	4.8	Minimum input voltage
5.	Vout	2.5	Output Voltage
6.	base_pn	LM3674	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. LM3674 Product Folder : <http://www.ti.com/product/LM3674> : contains the data sheet and other resources.

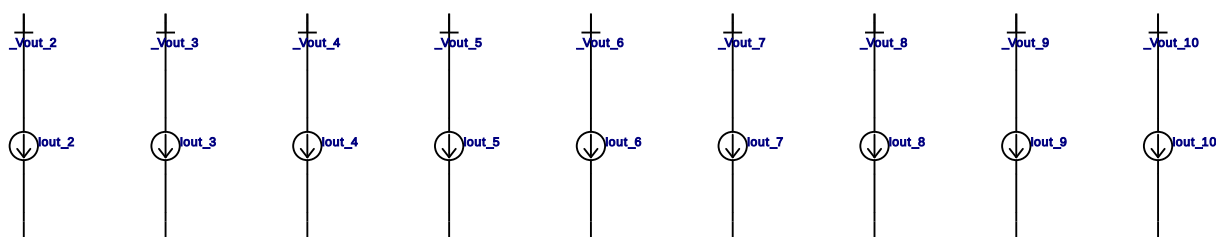
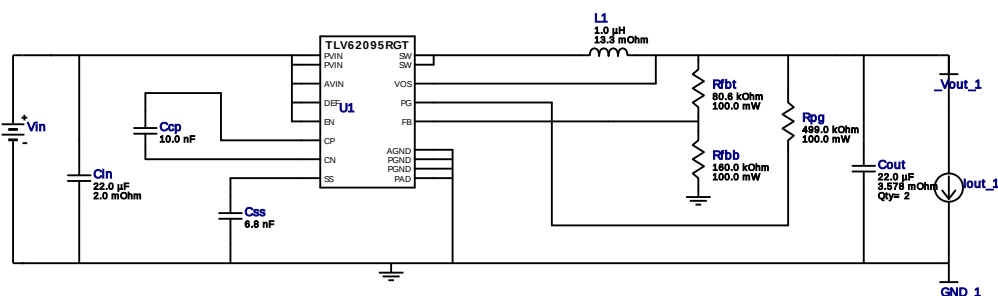


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Iout = 3.5A

Device = TLV62095RGTR
Topology = Buck
Created = 7/19/16 1:18:49 AM
BOM Cost = \$1.60
BOM Count = 10
Total Pd = 0.83W

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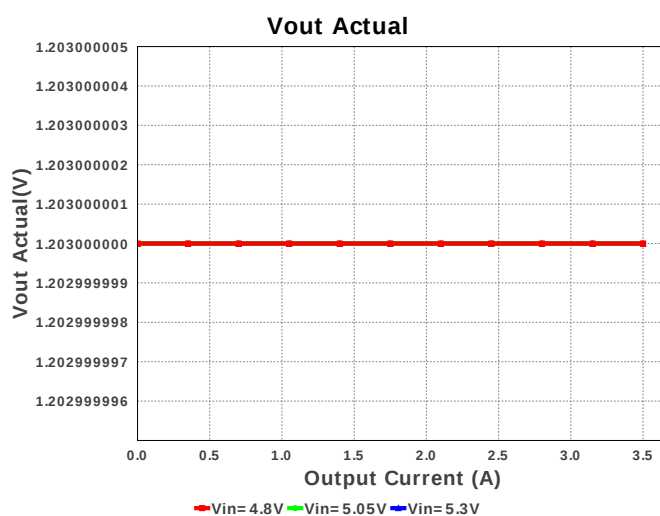
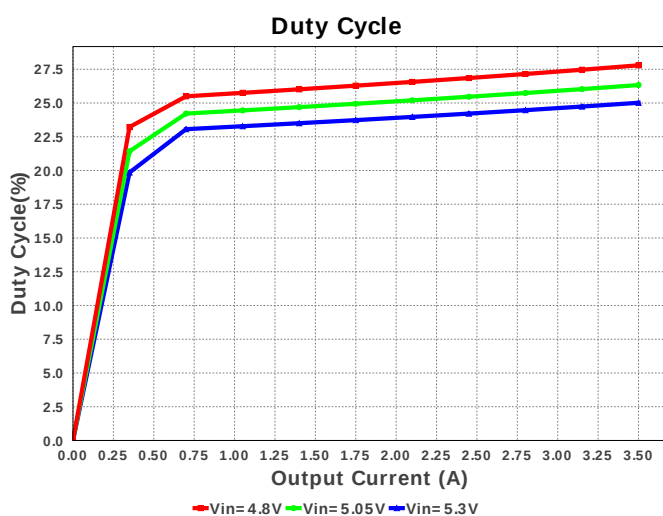
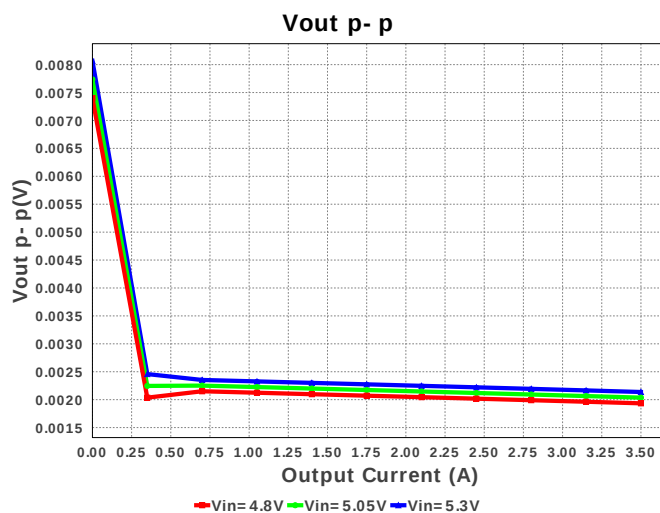
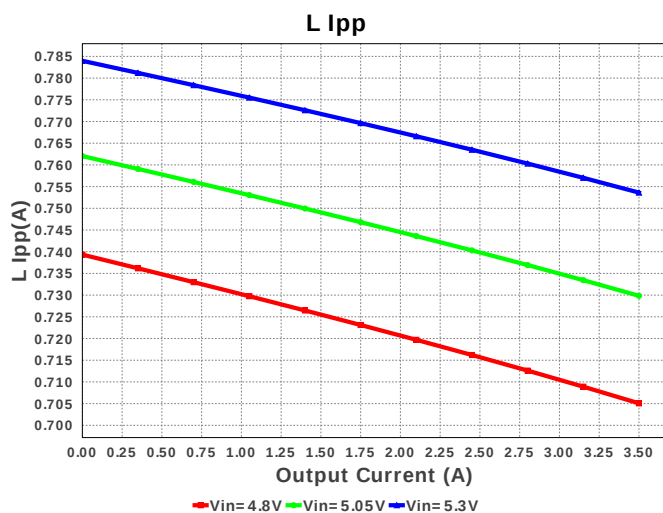
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TLV62095RGTR 4.8V-5.3V to 1.20V @ 3.5A

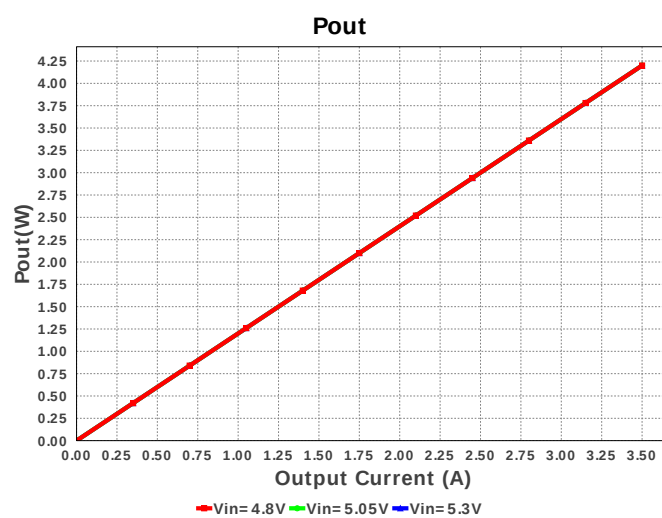
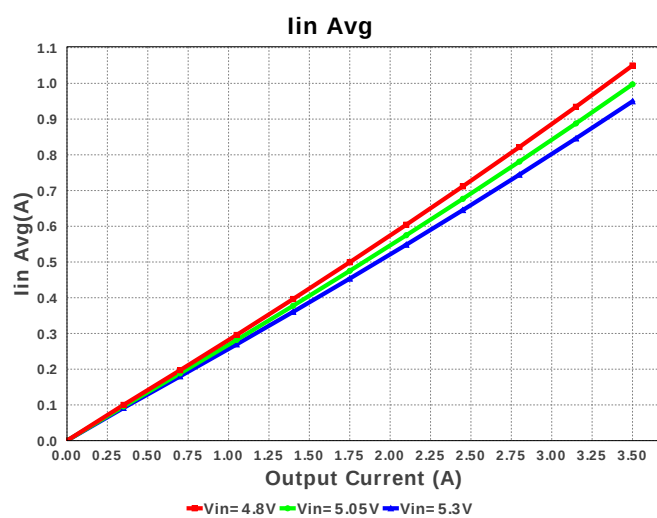
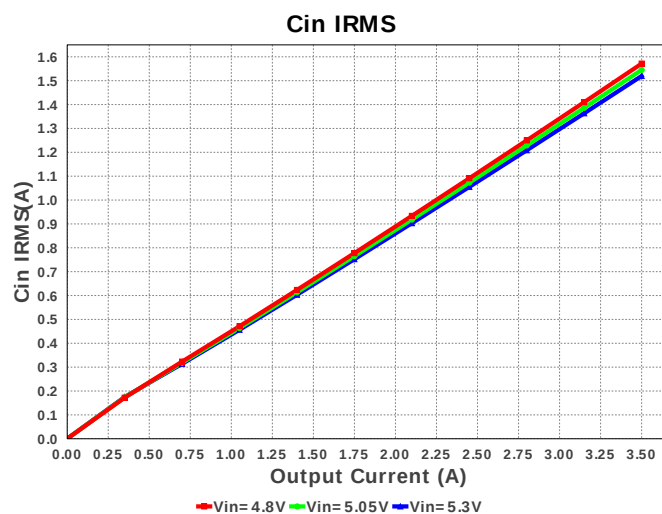
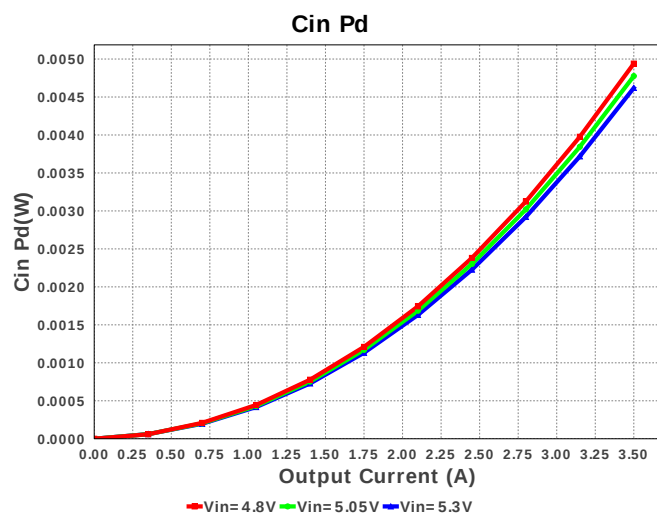
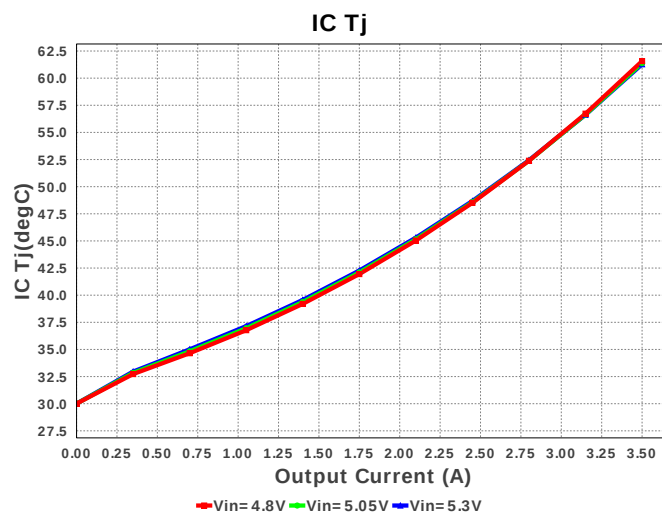
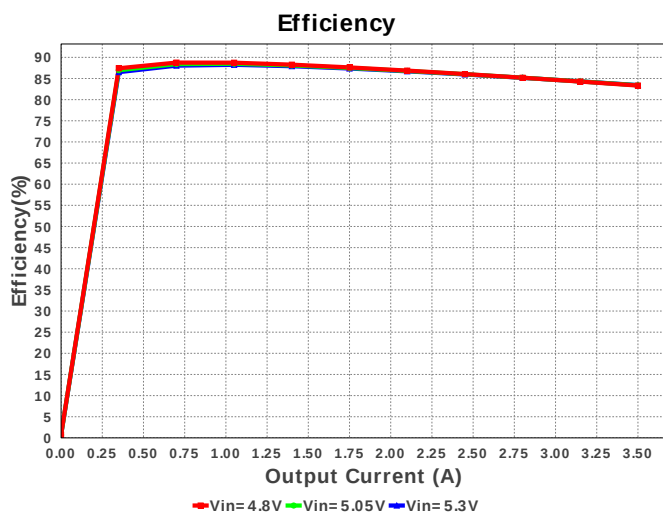


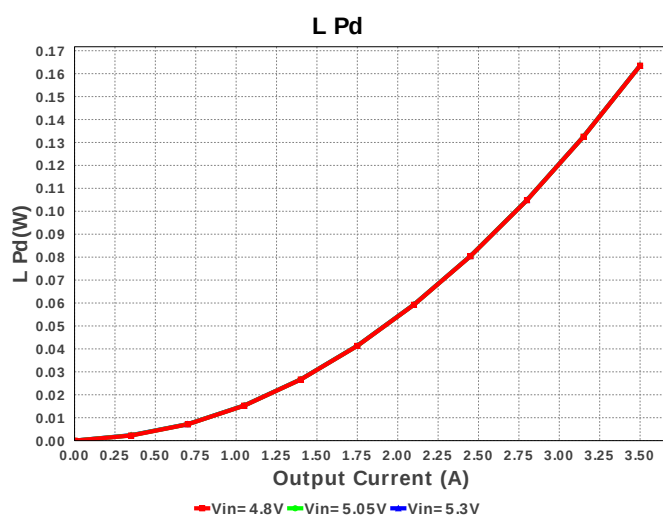
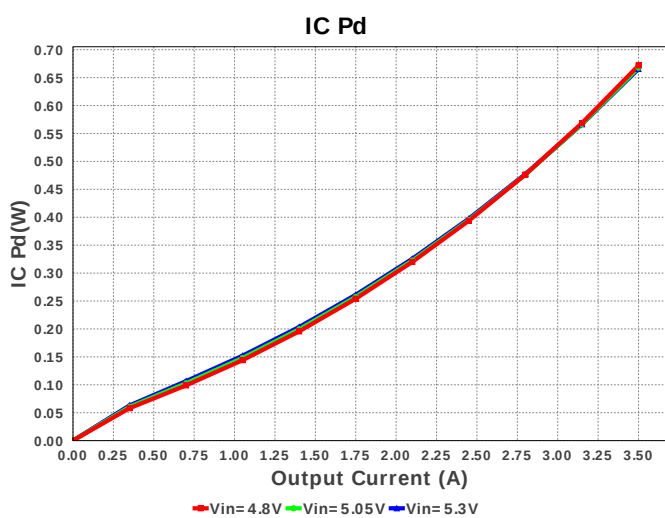
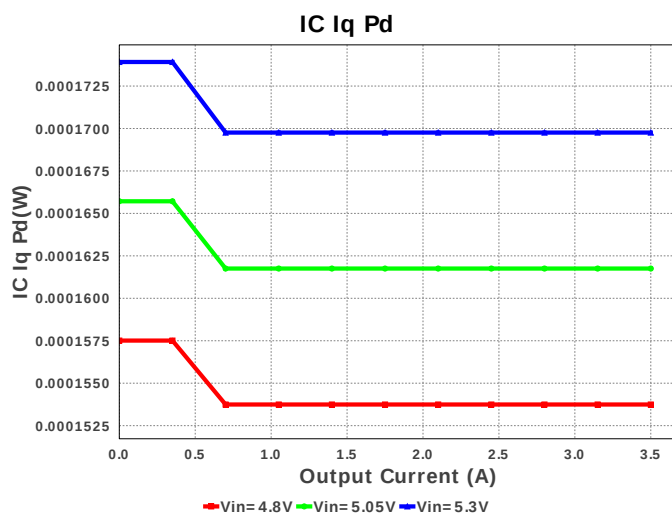
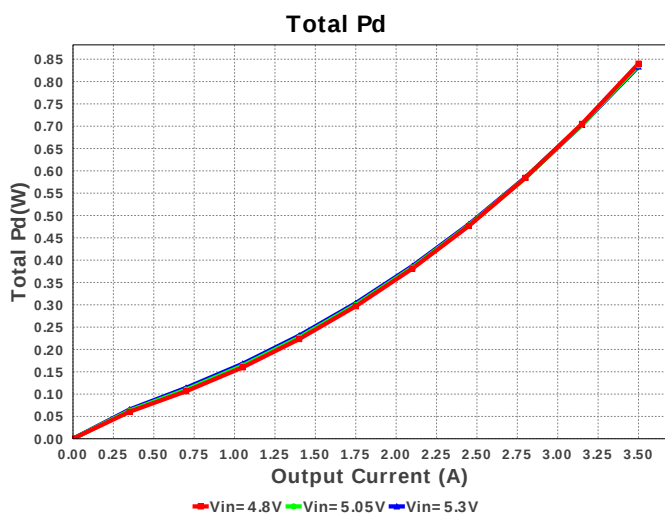
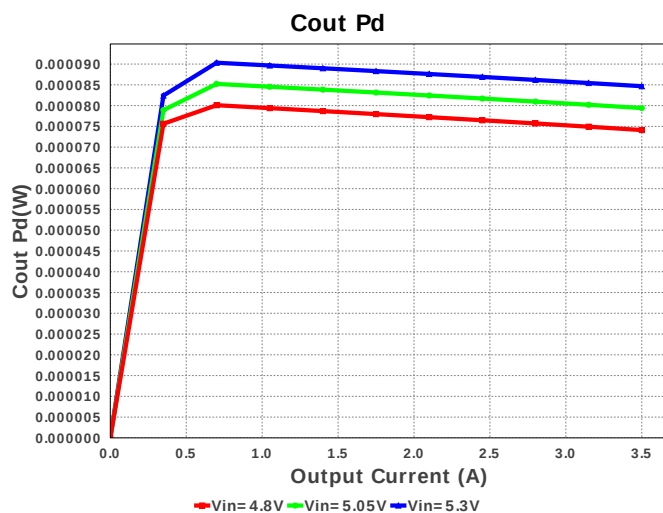
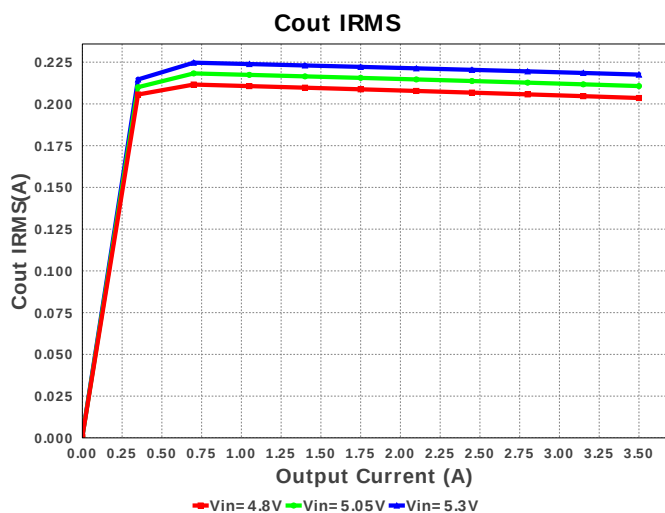
Electrical BOM

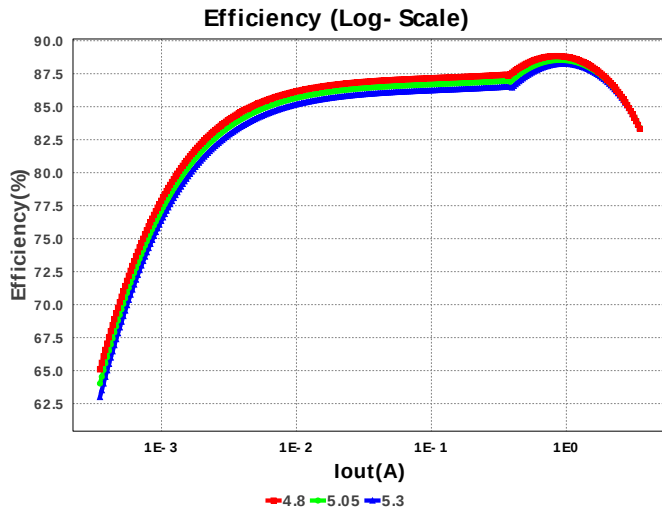
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccp	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Cin	Taiyo Yuden	JMK212BJ226KG-T Series= X5R	Cap= 22.0 µF ESR= 2.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	\$0.13	0805 7 mm ²
3.	Cout	MuRata	GRM21BC80G226ME39L Series= X6S	Cap= 22.0 µF ESR= 3.578 mOhm VDC= 4.0 V IRMS= 3.29633 A	2	\$0.04	0805 7 mm ²
4.	Css	MuRata	GRM033R61A682KA01D Series= X5R	Cap= 6.8 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
5.	L1	Coilcraft	XAL4020-102MEB	L= 1.0 µH DCR= 13.3 mOhm	1	\$0.60	XAL4020 28 mm ²
6.	Rfbb	Yageo America	RC0603FR-07160KL Series= ?	Res= 160.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
7.	Rfbb	Vishay-Dale	CRCW060380K6FKEA Series= CRCW..e3	Res= 80.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
8.	Rpg	Vishay-Dale	CRCW0603499KFKEA Series= CRCW..e3	Res= 499.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	U1	Texas Instruments	TLV62095RGTR	Switcher	1	\$0.74	 RGT0016C 25 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.52 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	217.551 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	949.76 mA	Current	Average input current
4.	L Ipp	753.62 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	10	General	Total Design BOM count
6.	FootPrint	92.0 mm ²	General	Total Foot Print Area of BOM components
7.	Frequency	1.275 MHz	General	Switching frequency
8.	IC Tolerance	20.0 mV	General	IC Feedback Tolerance
9.	Pout	4.2 W	General	Total output power
10.	Total BOM	\$1.6	General	Total BOM Cost
11.	Vout Actual	1.203 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
12.	Vout OP	1.2 V	Op_Point	Operational Output Voltage
13.	Duty Cycle	25.017 %	Op_point	Duty cycle
14.	Efficiency	83.438 %	Op_point	Steady state efficiency
15.	IC Tj	61.276 degC	Op_point	IC junction temperature
16.	ICThetaJA	47.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
17.	IOUT_OP	3.5 A	Op_point	Iout operating point
18.	VIN_OP	5.3 V	Op_point	Vin operating point
19.	Vout p-p	2.137 mV	Op_point	Peak-to-peak output ripple voltage
20.	Cin Pd	4.62 mW	Power	Input capacitor power dissipation
21.	Cout Pd	84.671 μW	Power	Output capacitor power dissipation
22.	IC Iq Pd	169.76 μW	Power	IC Iq Pd
23.	IC Pd	665.443 mW	Power	IC power dissipation
24.	L Pd	163.554 mW	Power	Inductor power dissipation
25.	Total Pd	833.686 mW	Power	Total Power Dissipation
26.	Vout Tolerance	3.194 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	3.5	Maximum Output Current
2.	SoftStart	1.0 ms	Soft Start Time (ms)
3.	VinMax	5.3	Maximum input voltage
4.	VinMin	4.8	Minimum input voltage
5.	Vout	1.2	Output Voltage
6.	base_pn	TLV62095	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. TLV62095 Product Folder : <http://www.ti.com/product/TLV62095> : contains the data sheet and other resources.

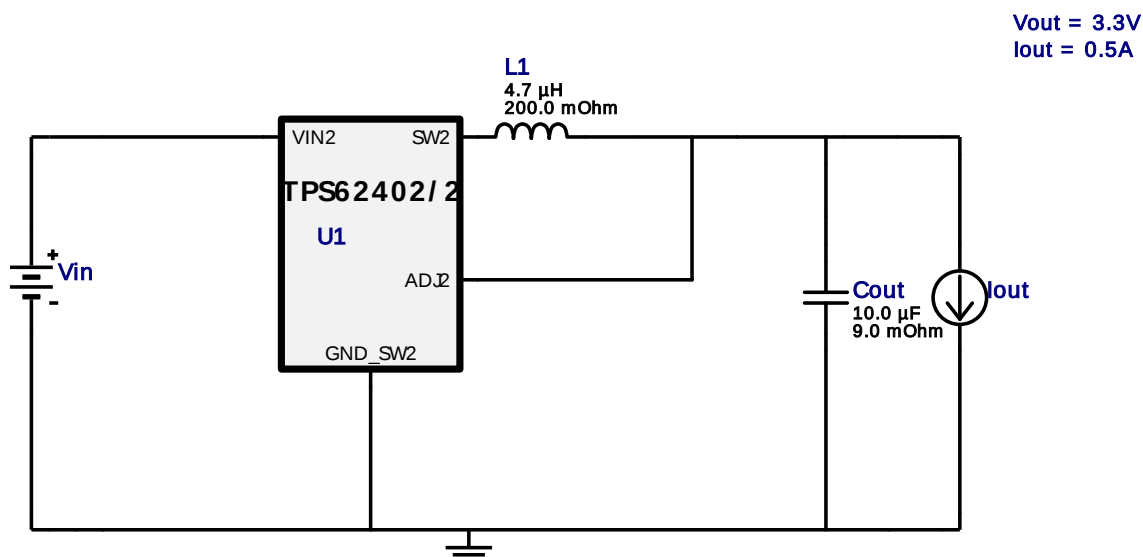


Vout = 3.3V
Iout = 0.5A

Device = TPS62402DRCR
Topology = Buck
Created = 7/19/16 1:18:50 AM
BOM Cost = \$0.90
BOM Count = 3
Total Pd = 0.14W

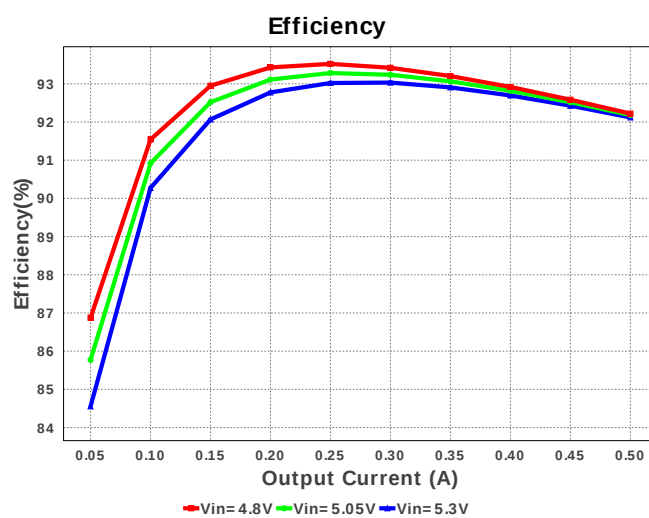
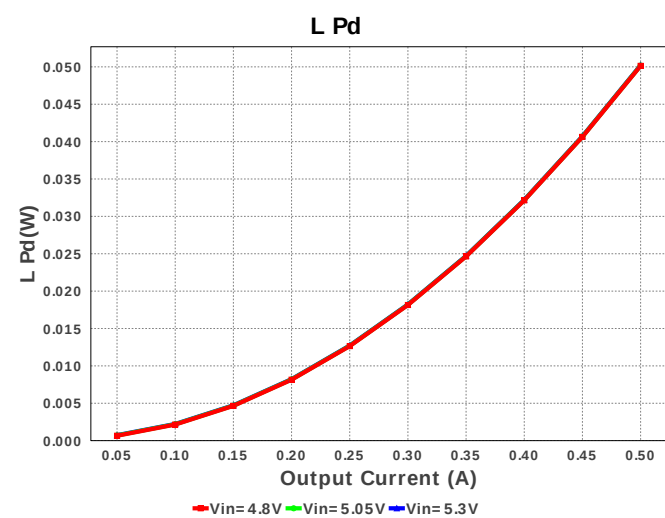
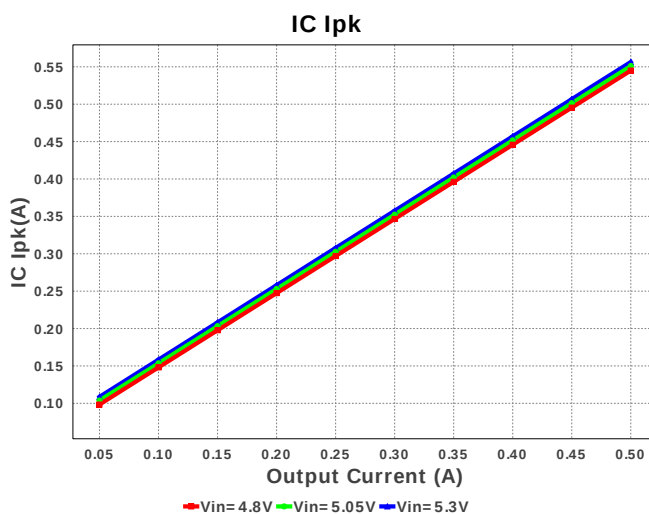
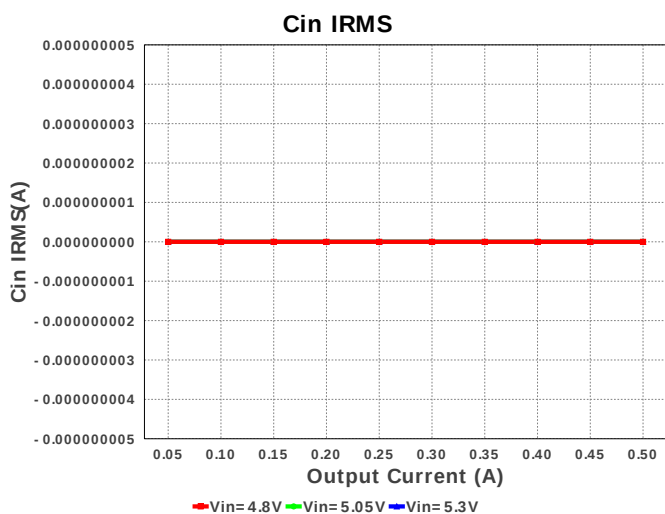
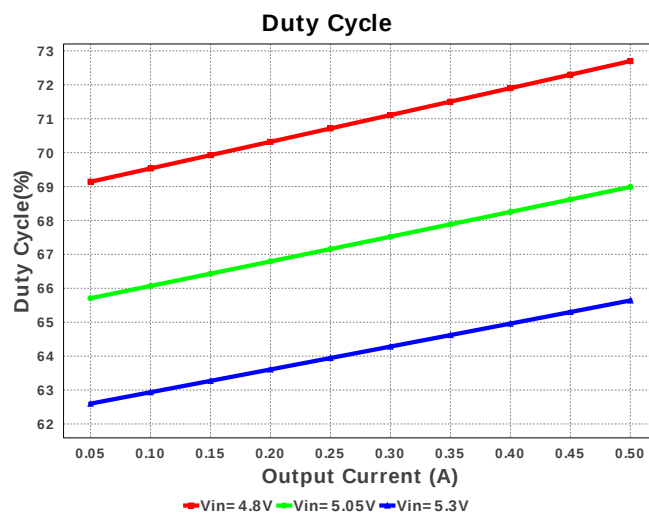
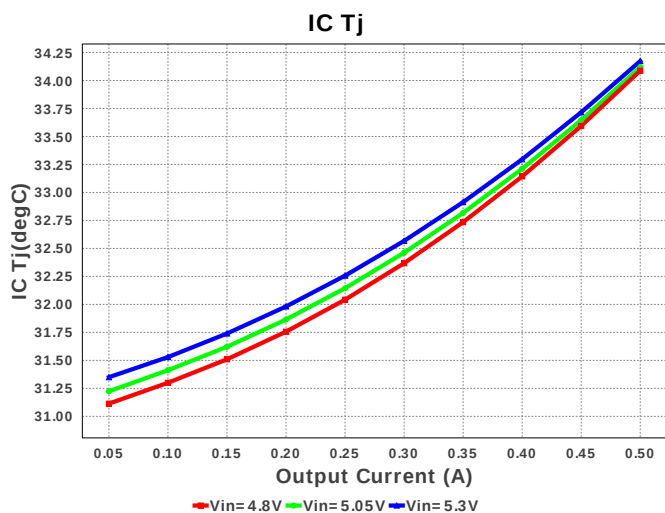
WEBENCH® Design Report

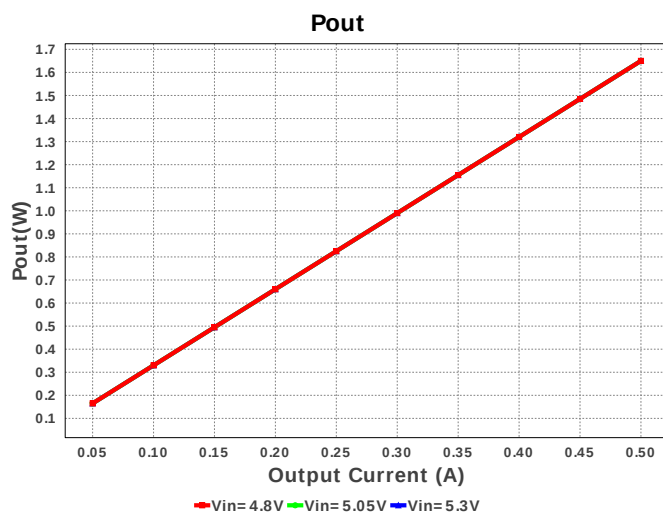
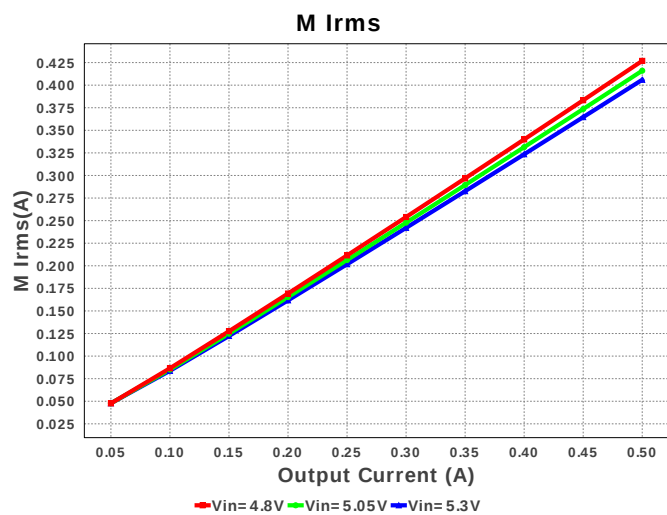
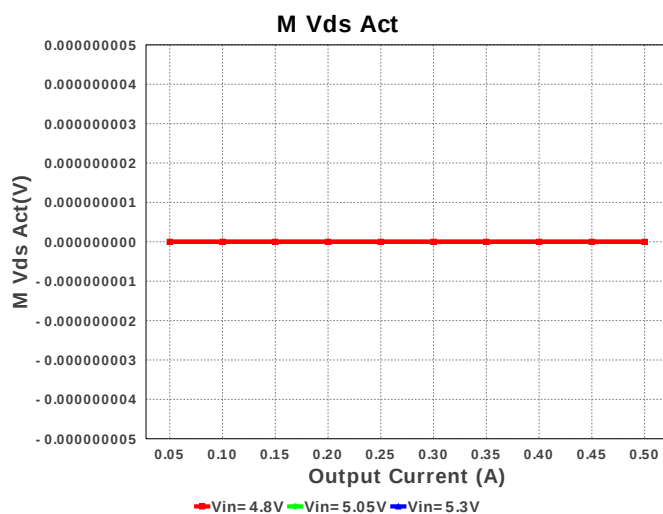
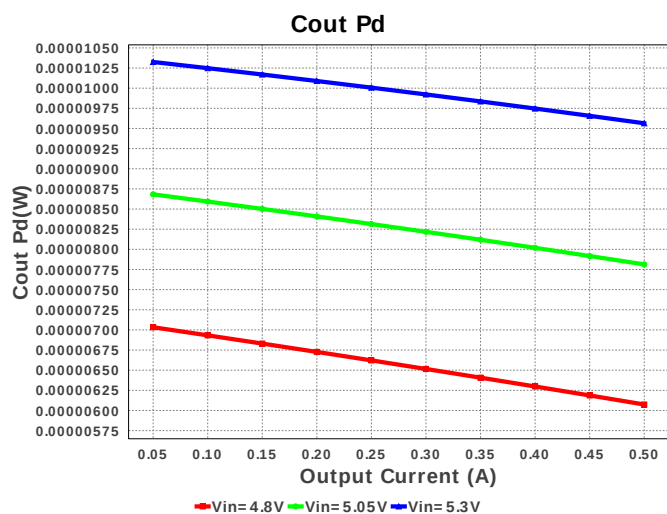
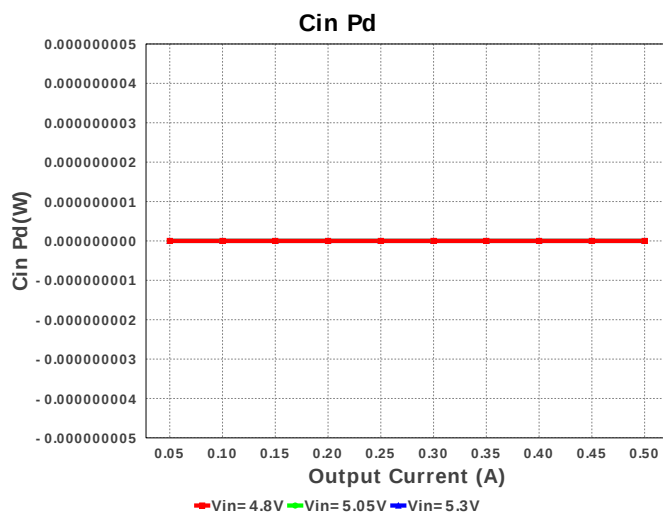
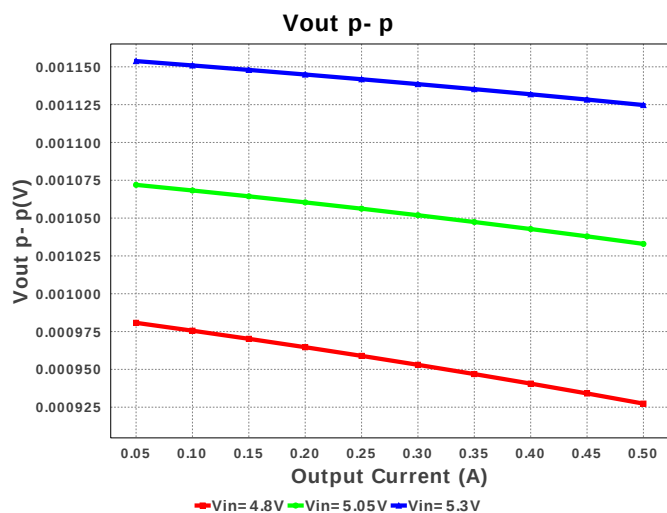
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TPS62402DRCR 4.8V-5.3V to 3.30V @ 0.5A

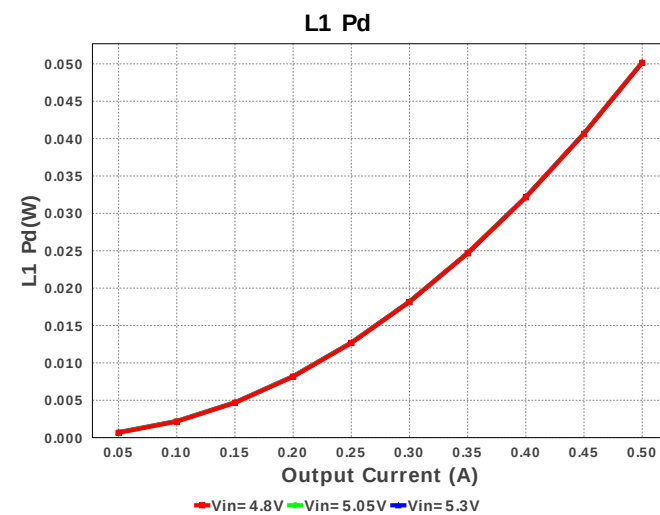
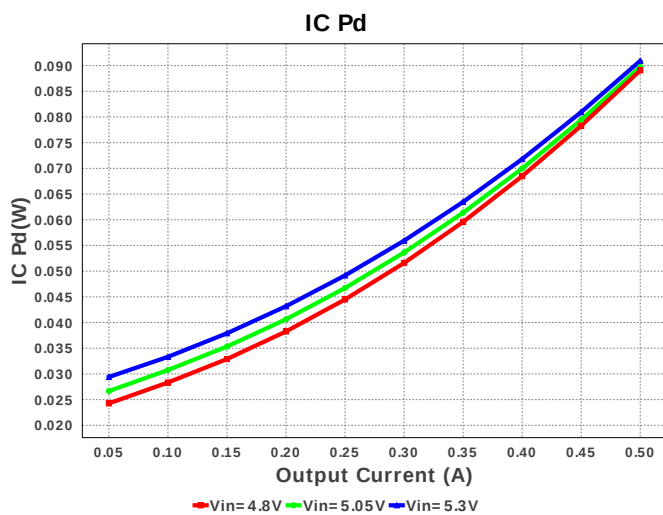
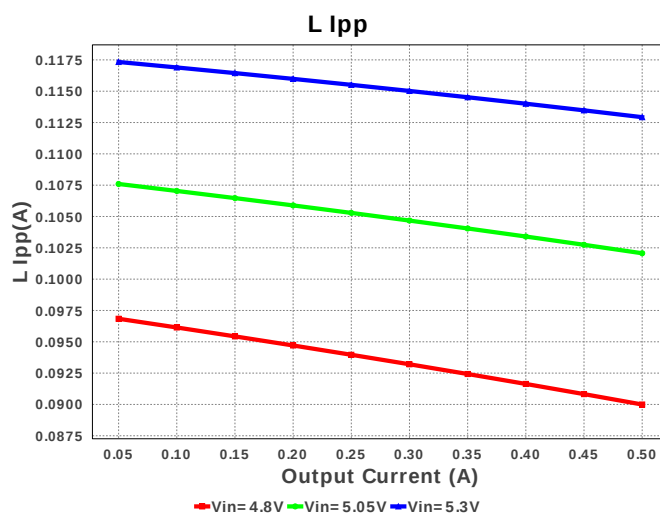
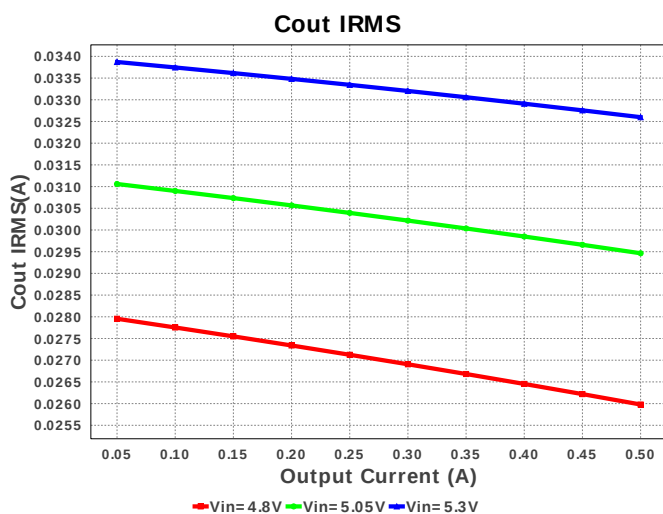
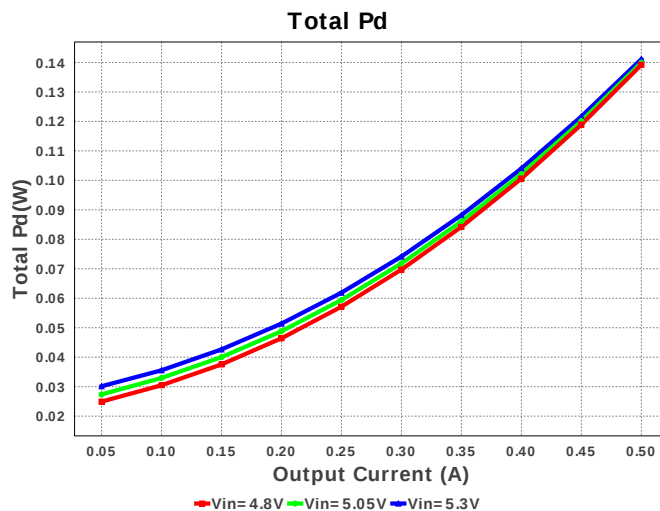
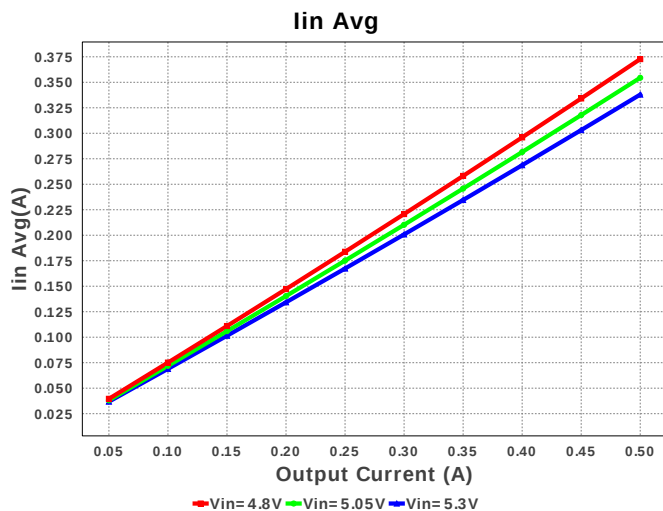


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cout	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	1	\$0.02	0603 5 mm ²
2.	L1	TDK	NLCV32T-4R7M-PFR	L= 4.7 µH DCR= 200.0 mOhm	1	\$0.10	NLCV32 13 mm ²
3.	U1	Texas Instruments	TPS62402DRCR	Switcher	1	\$0.78	DRC0010J 16 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	0.0 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	32.599 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	556.464 mA	Current	Peak switch current in IC
4.	Iin Avg	337.95 mA	Current	Average input current
5.	L Ipp	112.93 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	405.956 mA	Current	MOSFET RMS current
7.	BOM Count	3	General	Total Design BOM count
8.	FootPrint	34.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	2.25 MHz	General	Switching frequency
10.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	0.0 V	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Pout	1.65 W	General	Total output power
13.	Total BOM	\$0.9	General	Total BOM Cost
14.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	65.641 %	Op_point	Duty cycle
16.	Efficiency	92.12 %	Op_point	Steady state efficiency
17.	IC Tj	34.173 degC	Op_point	IC junction temperature
18.	ICThetaJA	45.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	500.0 mA	Op_point	Iout operating point
20.	VIN_OP	5.3 V	Op_point	Vin operating point
21.	Vout p-p	1.125 mV	Op_point	Peak-to-peak output ripple voltage
22.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
23.	Cout Pd	9.564 µW	Power	Output capacitor power dissipation
24.	IC Pd	90.919 mW	Power	IC power dissipation
25.	L Pd	50.213 mW	Power	Inductor power dissipation
26.	L1 Pd	50.213 mW	Power	Power Dissipation in the Inductor
27.	Total Pd	141.141 mW	Power	Total Power Dissipation
28.	Vout Tolerance	303.03 m%		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	5.3	Maximum input voltage
3.	VinMin	4.8	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS62402/2	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. TPS62402/2 Product Folder : <http://www.ti.com/product/tps62402> : contains the data sheet and other resources.

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