

WEBENCH® Power Architect

Project Report

Project : 3520048/6 : PA_Project_305 (modified from 301)

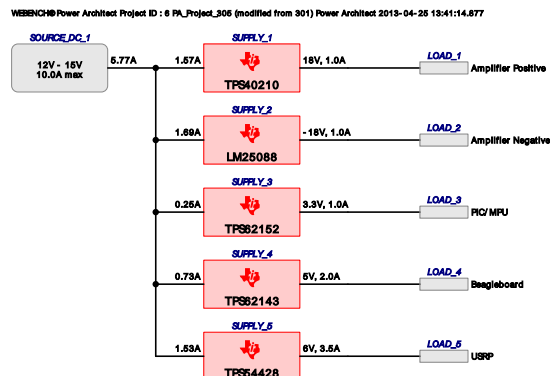
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Optimize project optFactor=3

Project Summary

1. Total System Efficiency	91.621 %
2. Total System BOM Count	69.0
3. Total System Footprint	1.903 kmm2
4. Total System BOM Cost	\$10.24
5. Total System Power Dissipation	6.429 W

--> Launch WEBENCH Power Architect.



Power Supplies

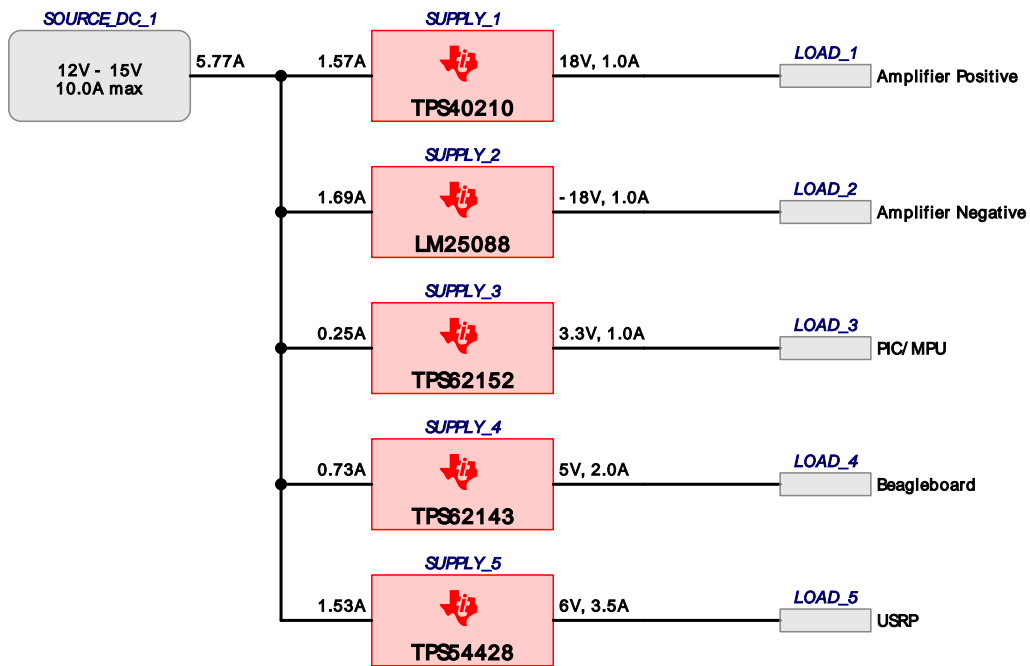
#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	TPS40210	Switcher : Current Mode Boost Controller,10pin DCQ-PowerPAD	18 V	1.0 A	95.8%	646	\$2.14	21	4
2.	SUPPLY_2	LM25088	Switcher : Positive to negative inverting buck boost converter with dither	-18 V	1.0 A	88.5%	664	\$3.26	22	12
3.	SUPPLY_3	TPS62152	Switcher : 3V-17V,3.3Vout,1A,Buck,DCS-Control,pin selectable frequency	3.3 V	1.0 A	87.3%	127	\$1.32	23	21
4.	SUPPLY_4	TPS62143	Switcher : 3V-17V,5Vout,2A,Buck,DCS-Control,pin selectable frequency	5 V	2.0 A	91.5%	152	\$1.52	24	26
5.	SUPPLY_5	TPS54428	Switcher : 4A Synchronous Buck SWIFT Converter with Eco-Mode	6 V	3.5 A	91.8%	314	\$2.00	25	31

Power Loads

#	Name	VLoad	Iload	Description
1.	Amplifier Positive	18 V	1 A	VoutRipple=10%
2.	Amplifier Negative	-18 V	1 A	VoutRipple=10%
3.	PIC/MPU	3.3 V	1 A	VoutRipple=10%
4.	Beagleboard	5 V	2 A	VoutRipple=10%
5.	USRP	6 V	3.5 A	VoutRipple=10%

Project Diagram

WEBENCH® Power Architect Project ID : 6 PA_Project_305 (modified from 301) Power Architect 2013-04-25 13:41:14.877



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
AVX	08053C104KAT2A	0805	2	\$0.01	26
AOS	AON7246	TRANS_AOS_DFN3X3	1	\$0.26	25
Diodes Inc.	B340A-13-F	SMA	1	\$0.11	37
Kemet	C0603C104K3RACTU	0603	1	\$0.01	10
Kemet	C0805C332K5RACTU	0805	2	\$0.01	26
Kemet	C1206C105K3RACTU	1206	1	\$0.04	19
TDK	C1608X5R1C105K	0603	2	\$0.01	20
TDK	C2012X5R0J226M	0805	1	\$0.06	13
TDK	C3216X7R1H105K	1206	1	\$0.04	19
TDK	C5750X7R1E226M	2220	1	\$0.84	60
Yageo America	CC0805DRNP09BN7R0	0805	1	\$0.01	13
Yageo America	CC0805DRNP09BN9R0	0805	1	\$0.01	13
Yageo America	CC0805JRN09BN101	0805	1	\$0.01	13
Yageo America	CC0805JRN09BN151	0805	1	\$0.01	13
Yageo America	CC0805KRX7R9BB152	0805	1	\$0.01	13
Yageo America	CC0805KRX7R9BB821	0805	1	\$0.01	13
Vishay-Dale	CRCW0402100KFKED	0402	2	\$0.01	15
Vishay-Dale	CRCW040210K0FKED	0402	2	\$0.01	15
Vishay-Dale	CRCW040210K2FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW0402154KFKED	0402	1	\$0.01	8
Vishay-Dale	CRCW0402187KFKED	0402	1	\$0.01	8
Vishay-Dale	CRCW04021K00FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW04021K43FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW04021K65FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW040222K1FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW040223K2FKED	0402	2	\$0.01	15
Vishay-Dale	CRCW04022K05FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW040251K1FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW040251R1FKED	0402	1	\$0.01	8
Vishay-Dale	CRCW0402649KFKED	0402	1	\$0.01	8
Texas Instruments	CSD17313Q2	TRANS_NexFET_Q2	1	\$0.17	16
Stackpole Electronics Inc	CSR1206FK20L0	1206	1	\$0.10	19
Panasonic	EEE-FK1V331P	SM_RADIAL_G	1	\$0.28	172
Panasonic	ERJ-L14KF39MU	1210	1	\$0.11	23
Taiyo Yuden	GMK212B7105KG-T	0805	1	\$0.05	13
MuRata	GRM1555C1E301JA01D	0402	1	\$0.01	8
MuRata	GRM155C80J334KE01D	0402	1	\$0.01	8
MuRata	GRM155R61A105KE15D	0402	1	\$0.01	8
MuRata	GRM155R61A154KE19D	0402	1	\$0.01	8
MuRata	GRM155R61A274KE15D	0402	1	\$0.02	8
MuRata	GRM155R71A104KA01D	0402	1	\$0.01	8
MuRata	GRM155R71A393KA01D	0402	1	\$0.01	8
MuRata	GRM155R71E822KA01D	0402	1	\$0.01	8
MuRata	GRM1885C1H750JA01D	0603	1	\$0.01	10
MuRata	GRM21BR61E475MA12L	0805	2	\$0.06	13
MuRata	GRM31CR61E106KA12L	1206	2	\$0.07	37
MuRata	GRM32ER61C476ME15L	1210	1	\$0.22	23
MuRata	GRM32ER61E226KE15L	1210	1	\$0.31	23
Texas Instruments	LM25088MH-1/NOPB	MXA16A	1	\$1.25	59
Taiyo Yuden	LMK212BJ226MG-T	0805	1	\$0.12	13
Susumu Co Ltd	RR1220P-124-D	0805	1	\$0.01	13
Bourns	SDR0403-2R2ML	SDR0403	1	\$0.17	39
Bourns	SDR1307-120ML	SDR1307	1	\$0.34	227
TDK	SLF10165T-4R7N4R73PF	SLF10165	1	\$0.05	146
Bourns	SRN6045-2R2Y	SRN6045	1	\$0.16	64
Bourns	SRR1260-330M	SRR1260	1	\$0.41	210
Vishay-Semiconductor	SS36-E3/57T	SMC	1	\$0.18	83
Texas Instruments	TPS40210DGQR	S-PDSO-G10	1	\$0.80	36
Texas Instruments	TPS54428DDAR	R-PDSO-G8	1	\$1.35	57
Texas Instruments	TPS62143RGTR	S-PVQFN-N16	1	\$1.15	36
Texas Instruments	TPS62152RGTR	S-PVQFN-N16	1	\$1.00	36
Total			69	\$10.25	1,891

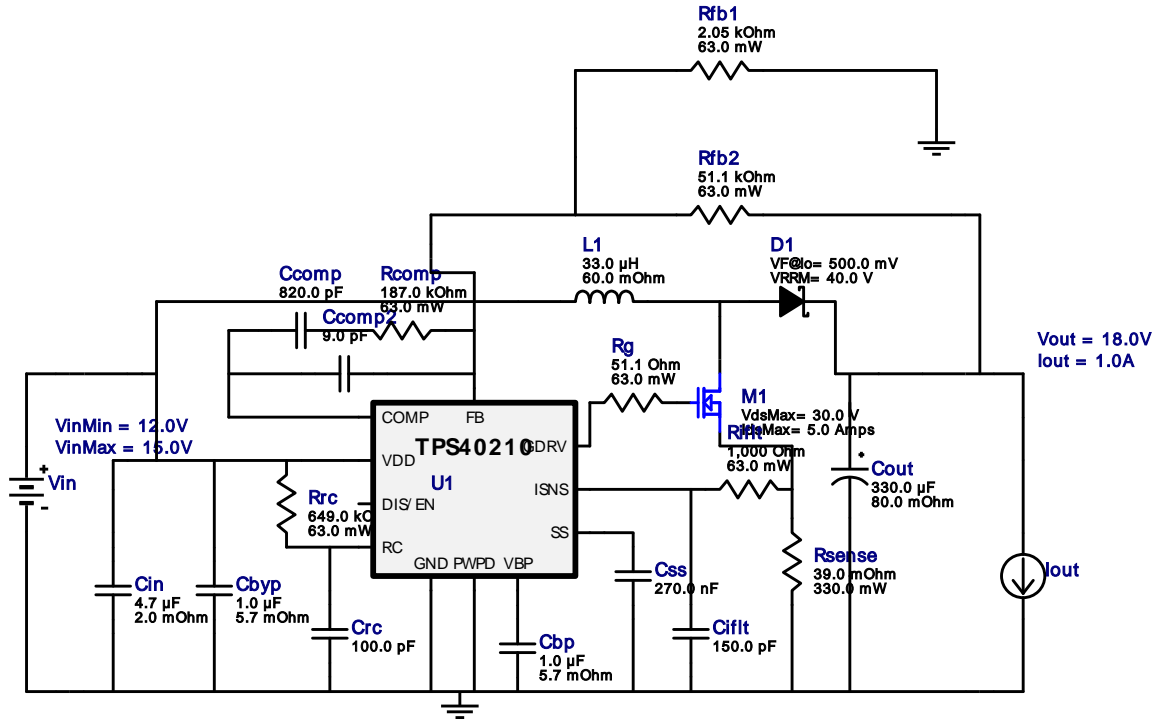


VinMin = 12.0V
 VinMax = 15.0V
 Vout = 18.0V
 Iout = 1.0A

Device = TPS40210DGQR
 Topology = Boost
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 BOM Cost = \$2.14
 Total Pd = 0.8W
 Footprint = 646.0mm2
 BOM Count = 21

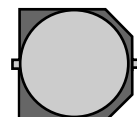
WEBENCH® Design Report

Design : 3520048/21 TPS40210DGQR
 TPS40210DGQR 12.0V-15.0V to 18.0V @ 1.0A



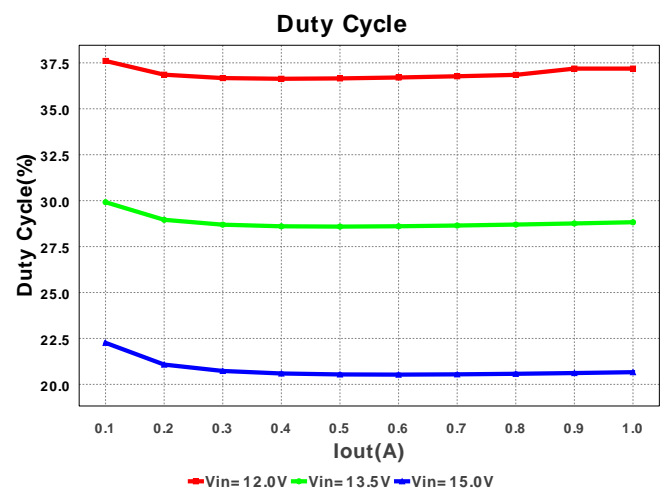
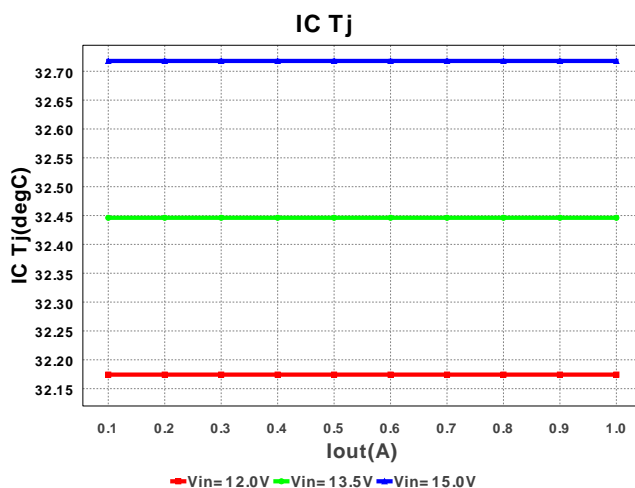
Electrical BOM

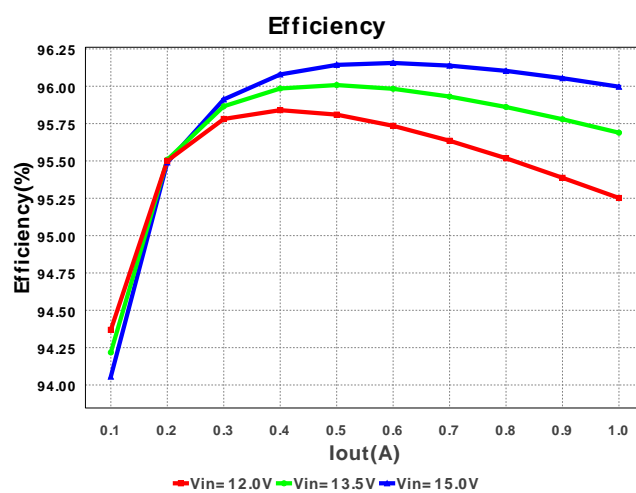
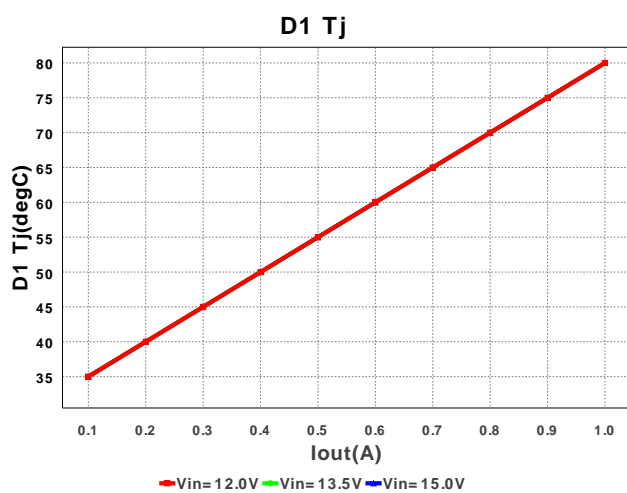
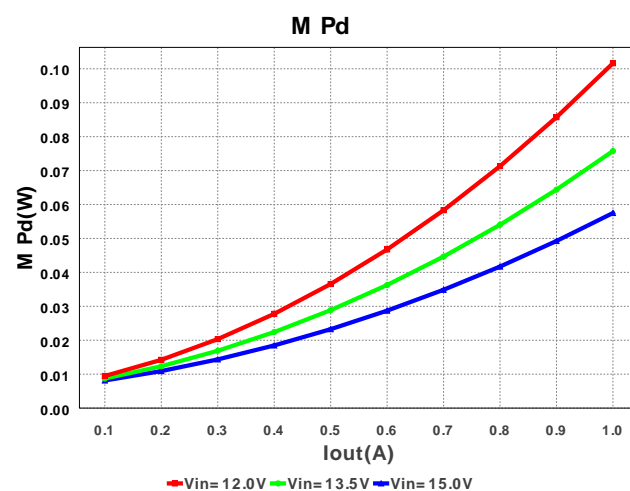
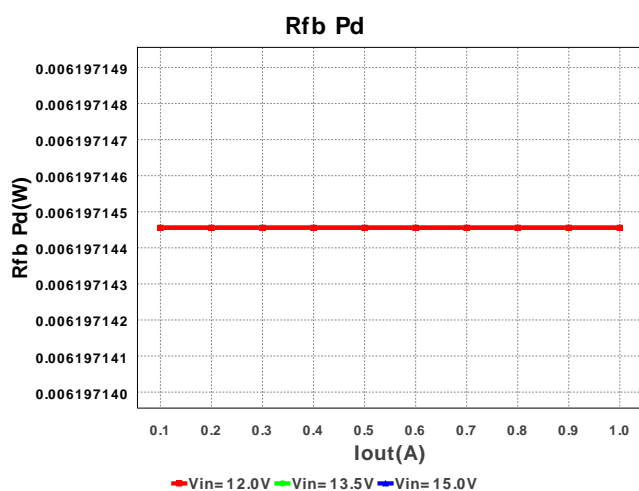
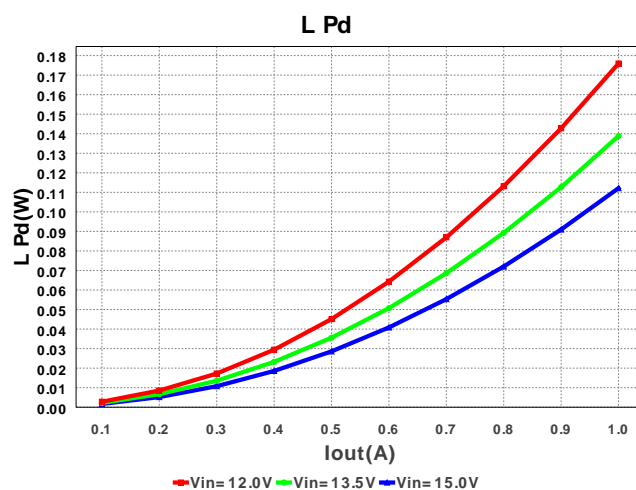
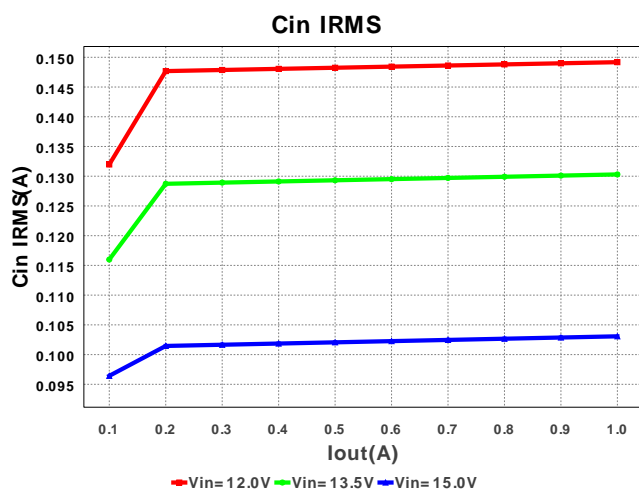
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbp	TDK	C1608X5R1C105K Series= X5R	Cap= 1.0 μ F ESR= 5.7 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 10mm2
2.	Cbyp	TDK	C1608X5R1C105K Series= X5R	Cap= 1.0 μ F ESR= 5.7 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0603 10mm2
3.	Ccomp	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 13mm2
4.	Ccomp2	Yageo America	CC0805DRNP09BN9R0 Series= C0G/NP0	Cap= 9.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 13mm2
5.	Ciflt	Yageo America	CC0805JRNP09BN151 Series= C0G/NP0	Cap= 150.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 13mm2
6.	Cin	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 μ F ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	2	\$0.06	0805 13mm2
7.	Cout	Panasonic	EEE-FK1V331P Series= FK	Cap= 330.0 μ F ESR= 80.0 mOhm VDC= 35.0 V IRMS= 850.0 mA	1	\$0.28	SM_RADIAL_G 172mm2

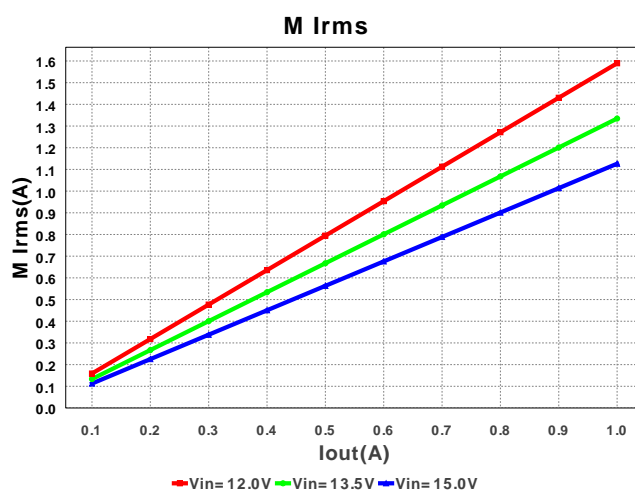
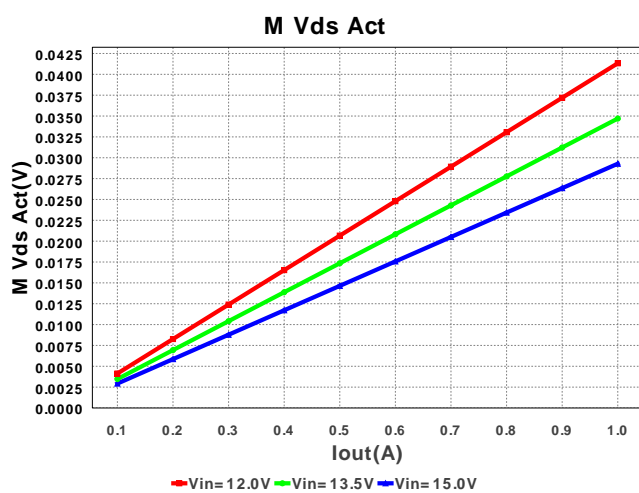
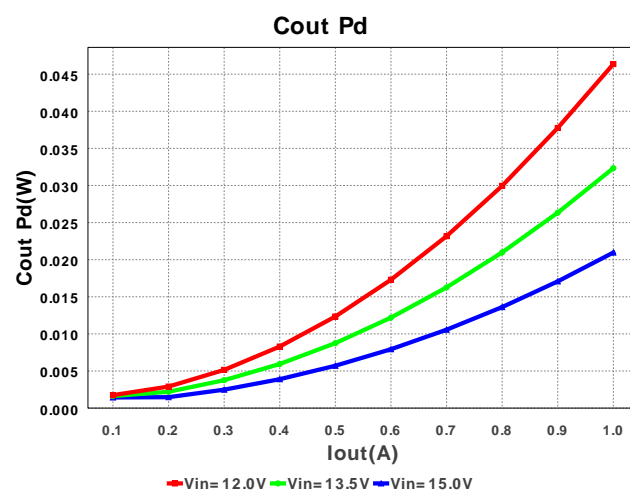
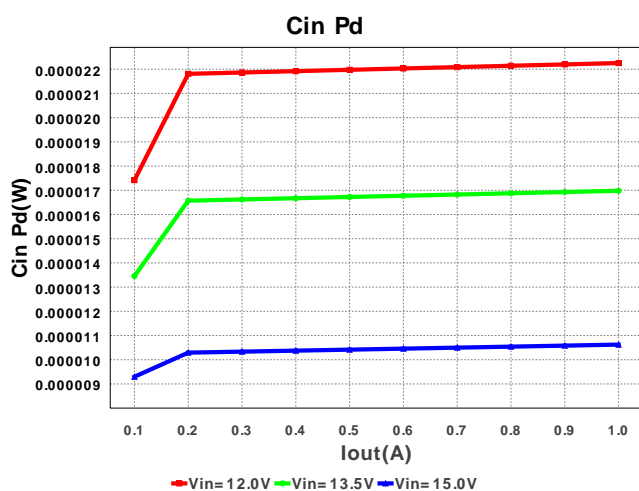
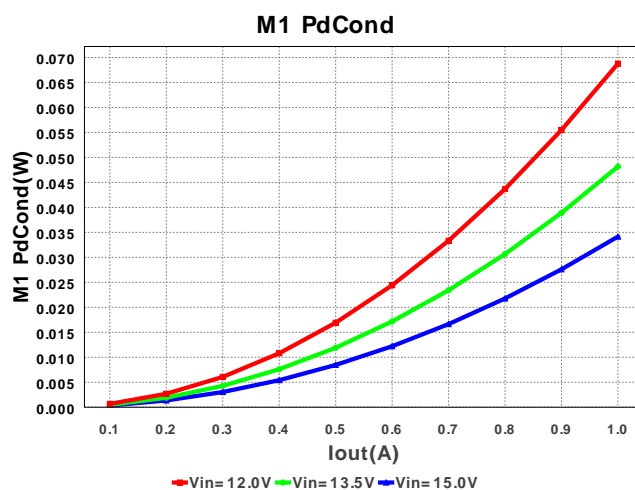
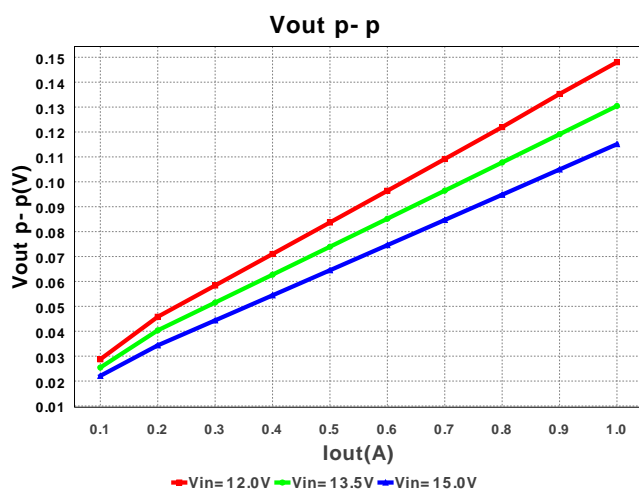


SM_RADIAL_G 172mm2

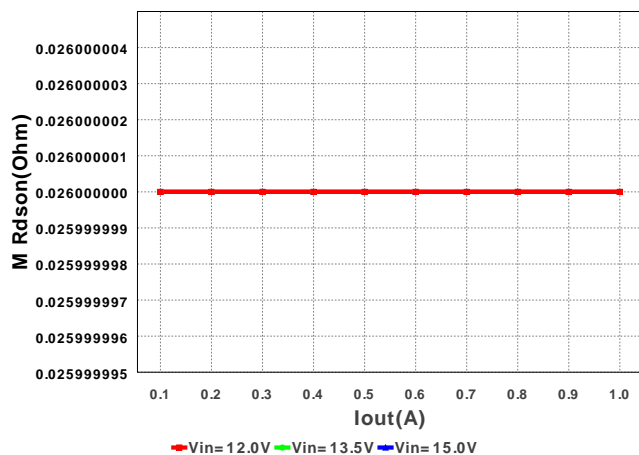
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8.	Crc	Yageo America	CC0805JRNPO9BN101 Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 13mm2
9.	Css	MuRata	GRM155R61A274KE15D Series= X5R	Cap= 270.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.02	 0402 8mm2
10.	D1	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.11	 SMA 37mm2
11.	L1	Bourns	SRR1260-330M	L= 33.0 µH DCR= 60.0 mOhm	1	\$0.41	 SRR1260 210mm2
12.	M1	Texas Instruments	CSD17313Q2	VdsMax= 30.0 V IdsMax= 5.0 Amps	1	\$0.17	 TRANS_NexFET_Q2 16mm2
13.	Rcomp	Vishay-Dale	CRCW0402187KFKED Series= CRCW..e3	Res= 187.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
14.	Rfb1	Vishay-Dale	CRCW04022K05FKED Series= CRCW..e3	Res= 2.05 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
15.	Rfb2	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
16.	Rg	Vishay-Dale	CRCW040251R1FKED Series= CRCW..e3	Res= 51.1 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
17.	Riflt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1,000 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
18.	Rrc	Vishay-Dale	CRCW0402649KFKED Series= CRCW..e3	Res= 649.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
19.	Rsense	Panasonic	ERJ-L14KF39MU Series= 232	Res= 39.0 mOhm Power= 330.0 mW Tolerance= 1.0%	1	\$0.11	 1210 23mm2
20.	U1	Texas Instruments	TPS40210DGQR	Switcher	1	\$0.80	 S-PDSO-G10 36mm2



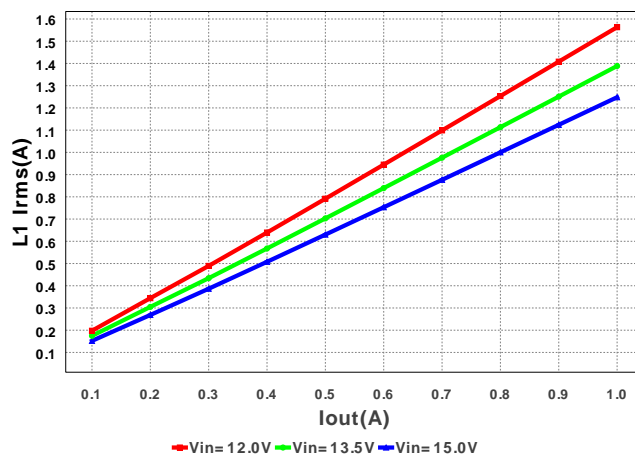




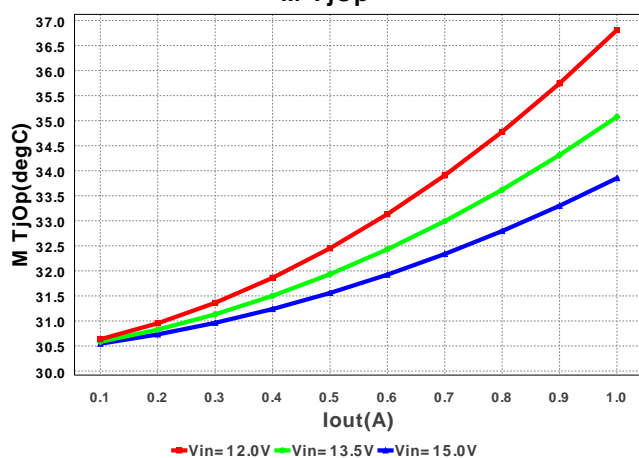
M Rdson



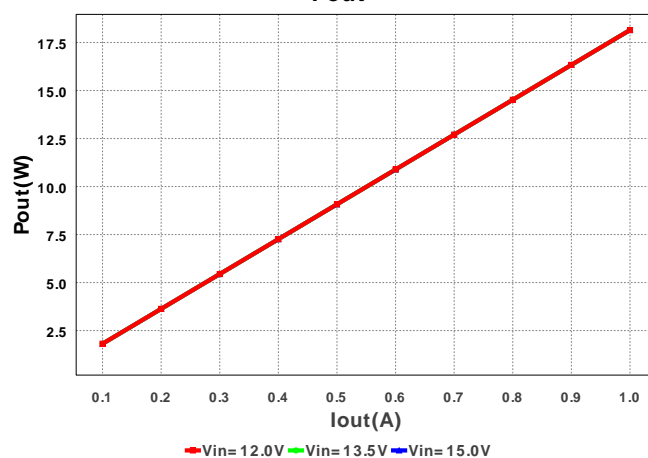
L1 Irms



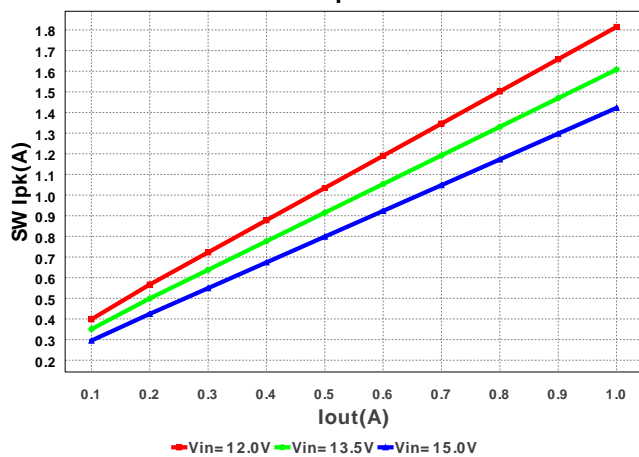
M TjOp



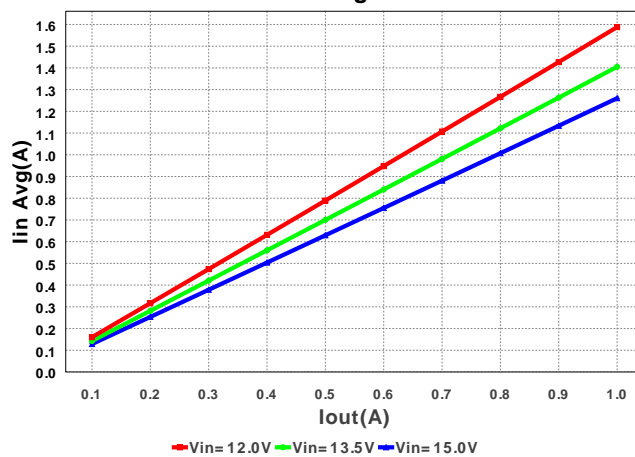
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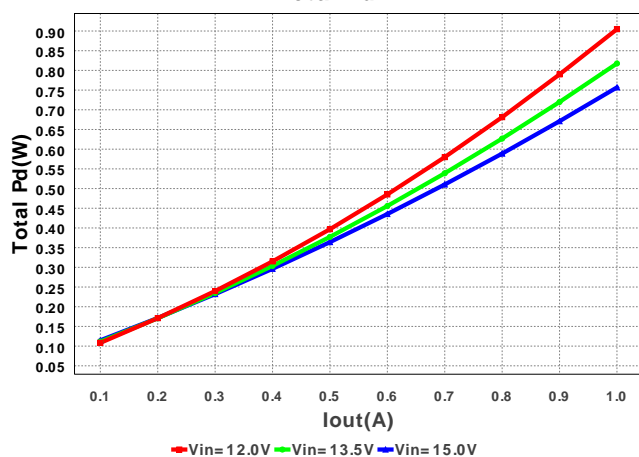
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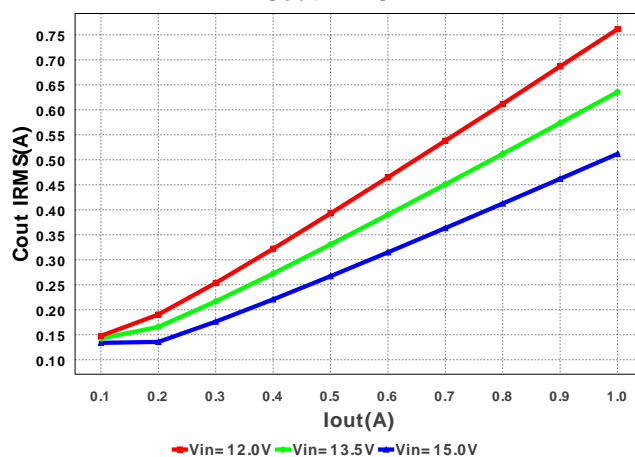
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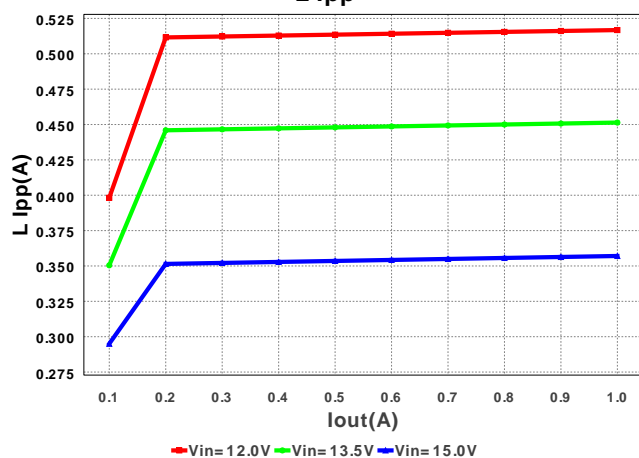
Total Pd



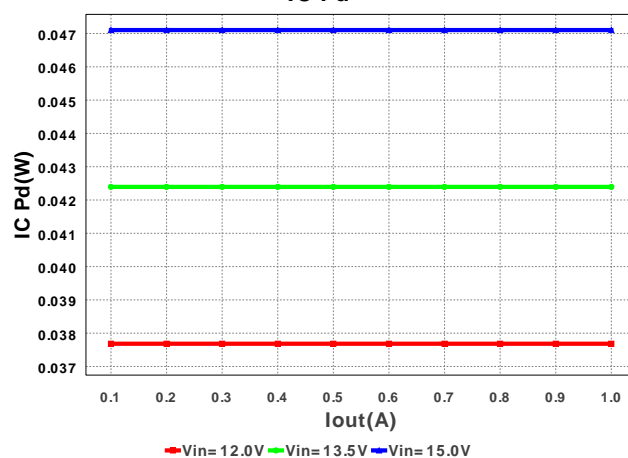
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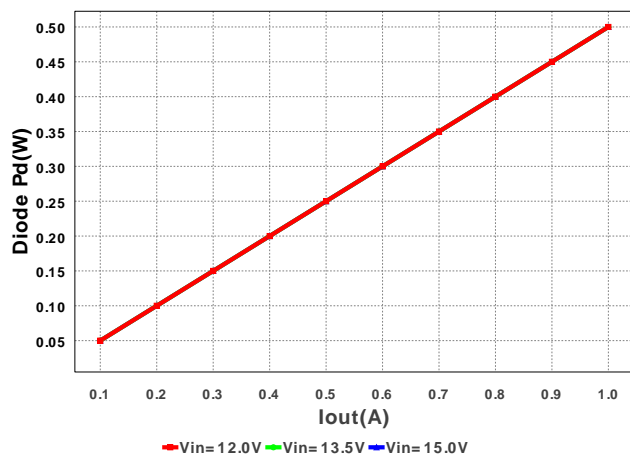
L Ipp



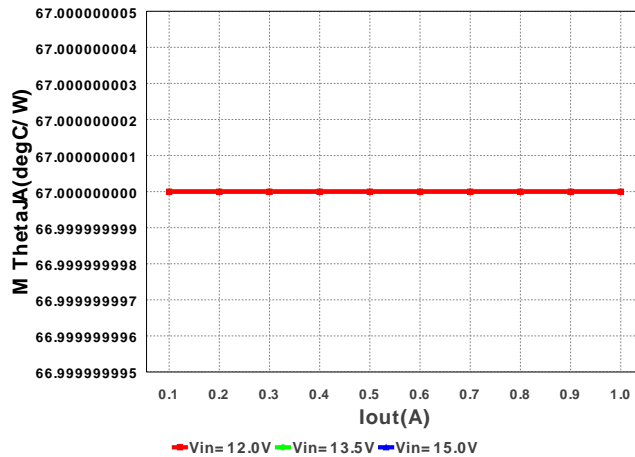
IC Pd

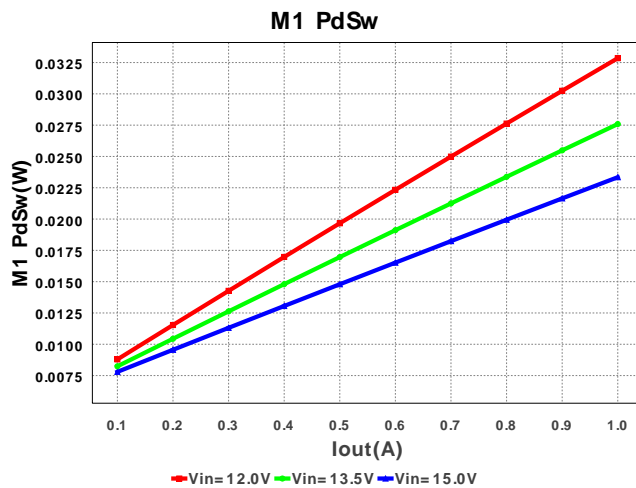


Diode Pd



M ThetaJA





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	147.23 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	750.004 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	1.566 A	Current	Average input current
4.	L Ipp	510.021 mA	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	1.549 A	Current	Inductor ripple current
6.	M Irms	1.568 A	Current	MOSFET RMS ripple current
7.	SW Ipk	1.797 A	Current	Peak switch current
8.	BOM Count	21	General	Total Design BOM count
9.	FootPrint	646.0 mm2	General	Total Foot Print Area of BOM components
10.	Frequency	254.072 kHz	General	Switching frequency
11.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
12.	M Rdson	26.0 mOhm	General	Drain-Source On-resistance
13.	M Vds Act	40.756 mV	General	M Vds
14.	Mode	CCM	General	Conduction Mode
15.	Pout	18.0 W	General	Total output power
16.	Total BOM	\$2.14	General	Total BOM Cost
17.	D1 Tj	80.0 degC	Op_Point	D1 junction temperature
18.	Vout OP	18.0 V	Op_Point	Operational Output Voltage
19.	Cross Freq	6.07 kHz	Op_point	Bode plot crossover frequency
20.	Cross Freq	6.07 kHz	Op_point	Bode plot crossover frequency
21.	Duty Cycle	36.161 %	Op_point	Duty cycle
22.	Efficiency	95.765 %	Op_point	Steady state efficiency
23.	IC Tj	32.174 degC	Op_point	IC junction temperature
24.	ICThetaJA	57.7 degC/W	Op_point	IC junction-to-ambient thermal resistance
25.	IOUT_OP	1.0 A	Op_point	Iout operating point
26.	M ThetaJA	67.0 degC/W	Op_point	MOSFET junction-to-ambient thermal resistance
27.	M TjOp	36.601 degC	Op_point	MOSFET junction temperature
28.	Phase Marg	97.243 deg	Op_point	Bode Plot Phase Margin
29.	Phase Marg	97.243 deg	Op_point	Bode Plot Phase Margin
30.	VIN_OP	12.0 V	Op_point	Vin operating point
31.	Vout p-p	145.717 mV	Op_point	Peak-to-peak output ripple voltage
32.	Cin Pd	21.677 μW	Power	Input capacitor power dissipation
33.	Cout Pd	45.0 mW	Power	Output capacitor power dissipation
34.	Diode Pd	500.0 mW	Power	Diode power dissipation
35.	IC Pd	37.669 mW	Power	IC power dissipation
36.	L Pd	172.686 mW	Power	Inductor power dissipation
37.	M Pd	98.521 mW	Power	MOSFET power dissipation
38.	M1 PdCond	66.85 mW	Power	M1 MOSFET conduction losses
39.	M1 PdSw	31.671 mW	Power	M1 MOSFET switching losses
40.	Rfb Pd	6.096 mW	Power	Rfb Power Dissipation
41.	Total Pd	795.994 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	1.0 A	Maximum Output Current
2.	Iout1	1.0 Amps	Output Current #1
3.	VinMax	15.0 V	Maximum input voltage
4.	VinMin	12.0 V	Minimum input voltage
5.	Vout	18.0 V	Output Voltage
6.	Vout1	18.0 Volt	Output Voltage #1
7.	base_pn	TPS40210	National Based Product Number

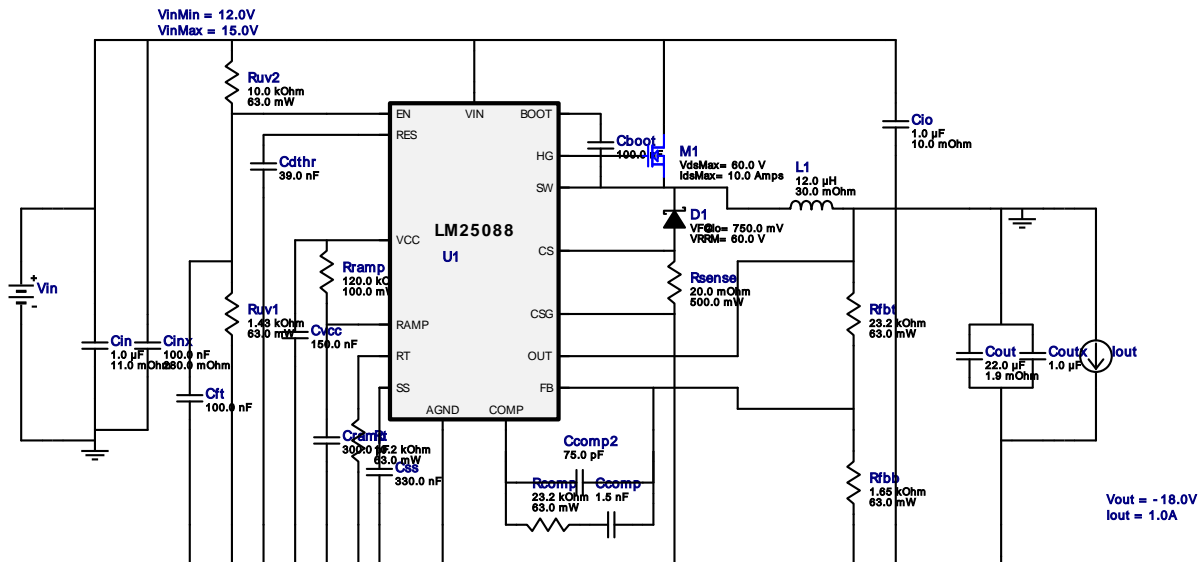
#	Name	Value	Description
8.	source	DC	Input Source Type
9.	Ta	30.0 degC	Ambient temperature

Design Assistance

1. **TPS40210** Product Folder : <http://www.ti.com/product/tps40210> : contains the data sheet and other resources.

Device = LM25088MH-1/NOPB
Topology = Inverting_Buck_Boost
Created = 4/25/13 1:40:16 PM
BOM Cost = \$3.26
Total Pd = 2.34W
Footprint = 664.0mm2
BOM Count = 25

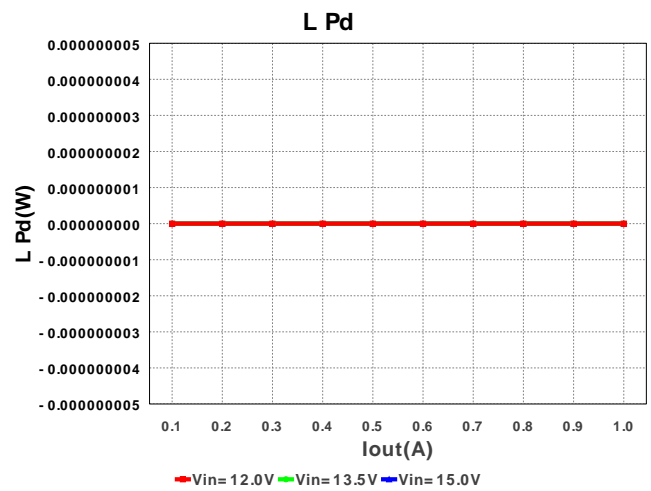
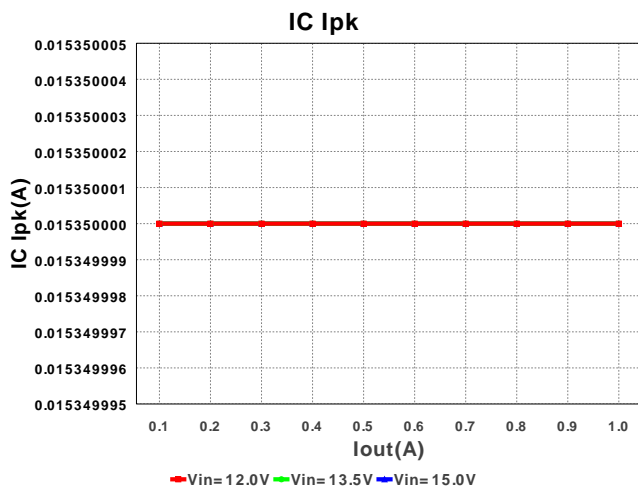
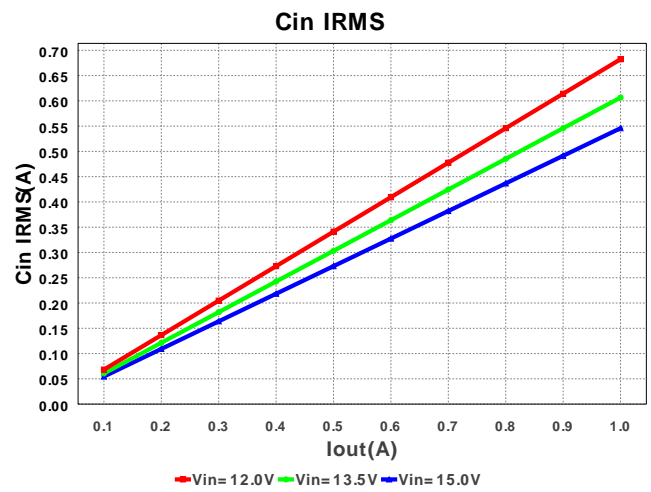
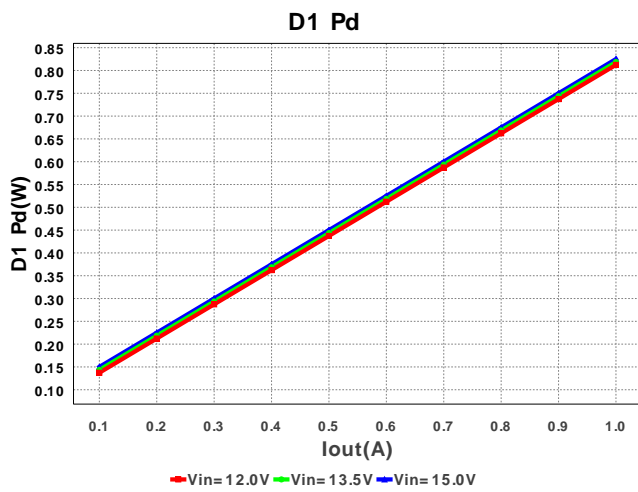
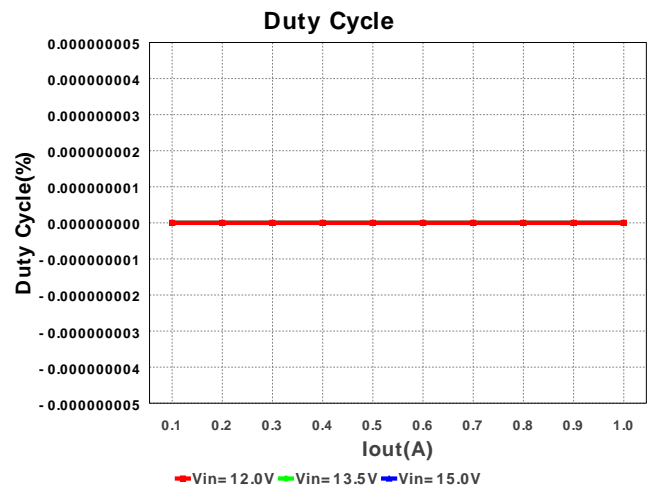
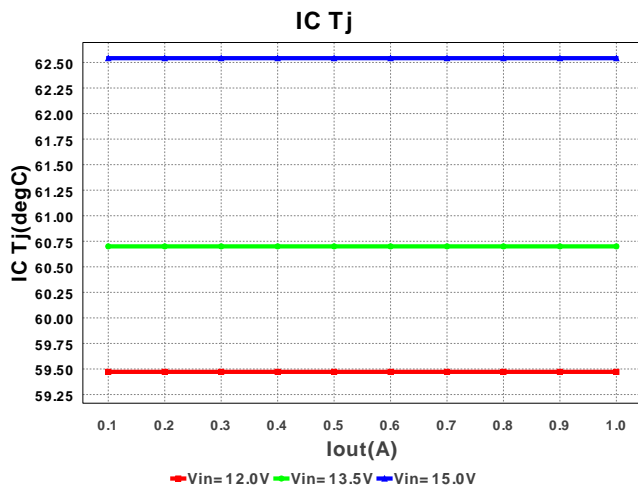
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LM25088MH-1/NOPB 12.0V-15.0V to -18.0V @ 1.0A

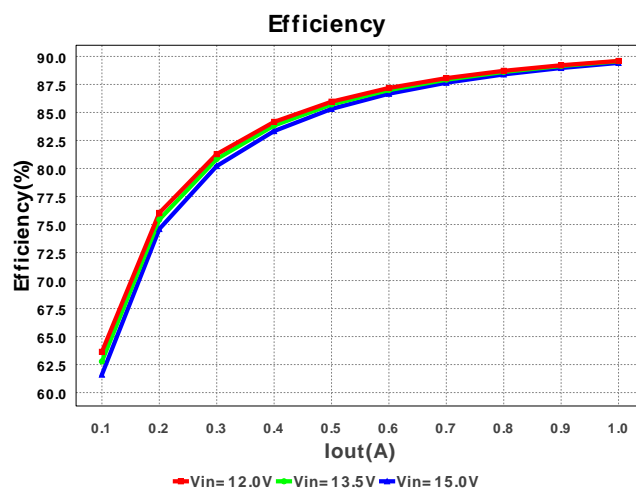
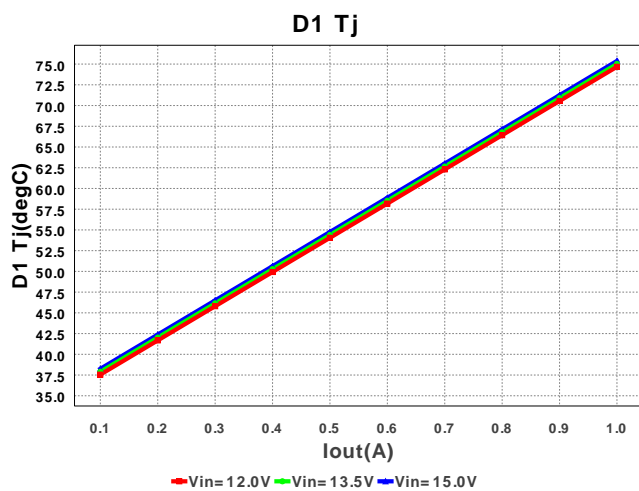
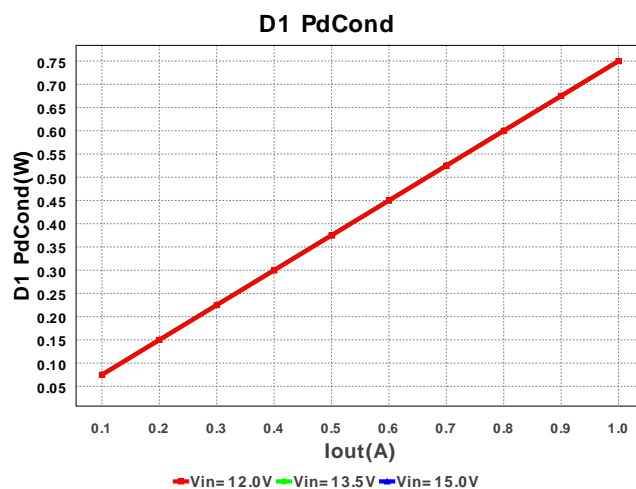
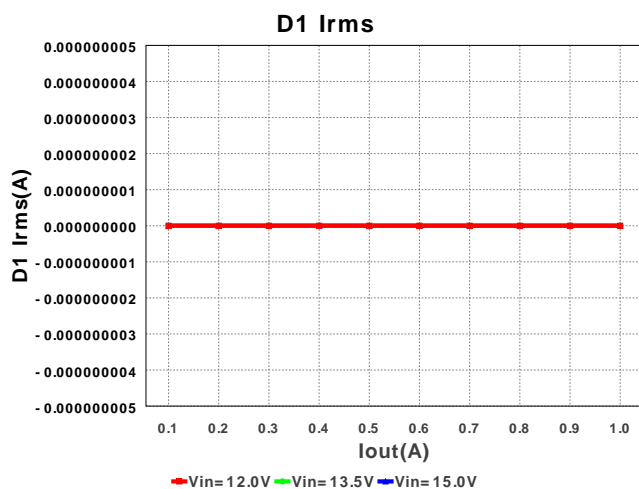
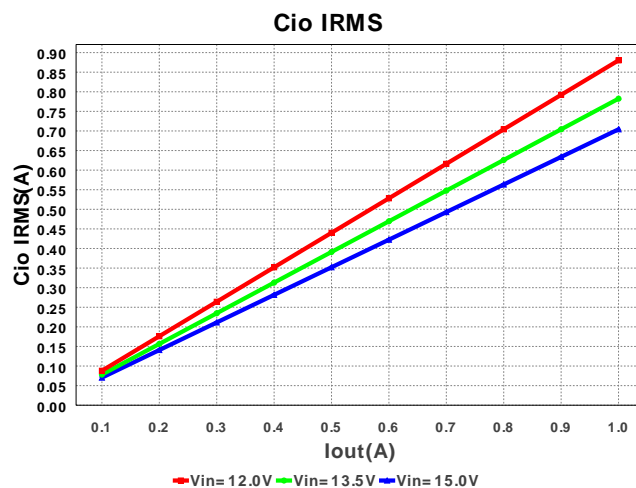
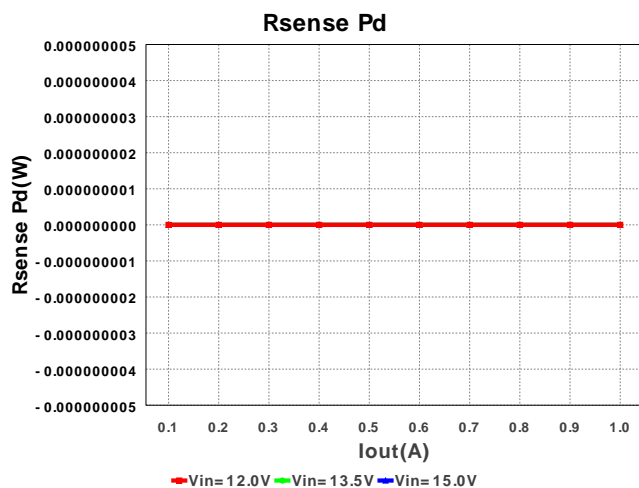


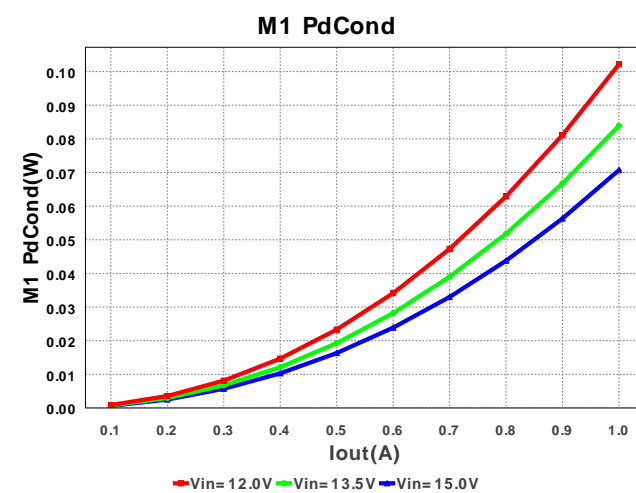
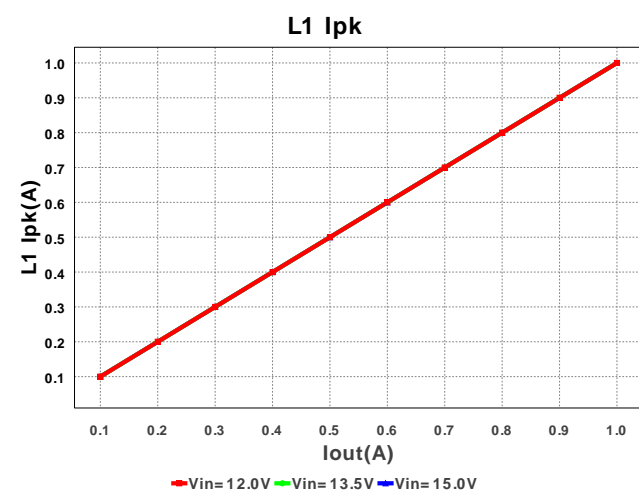
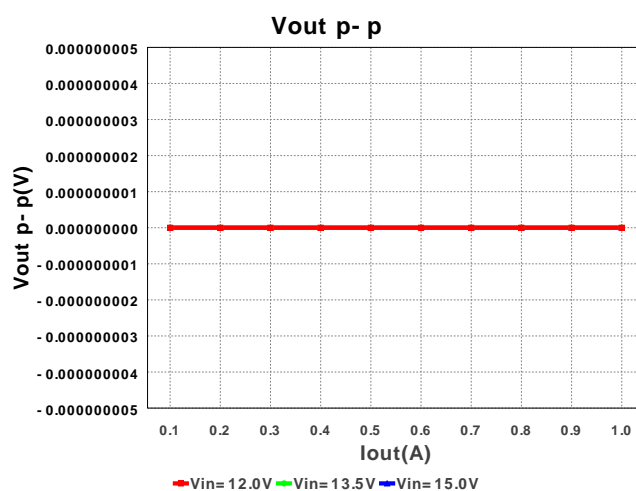
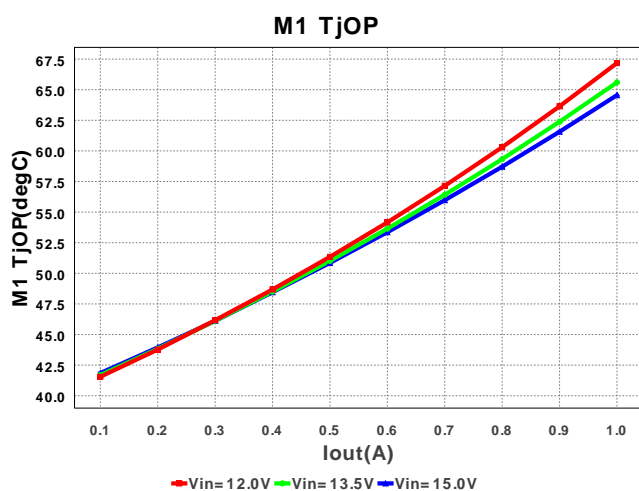
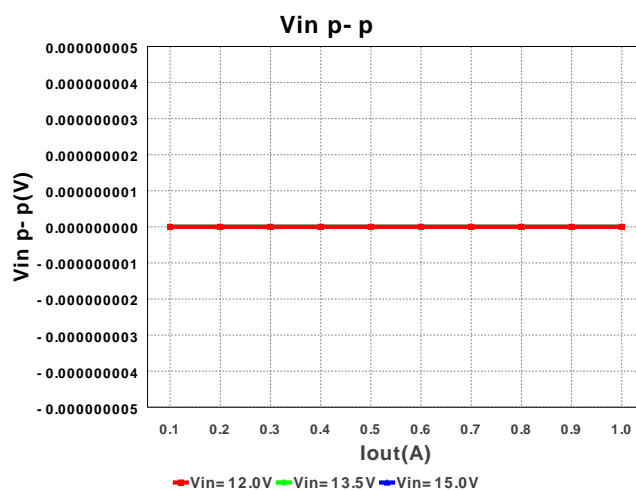
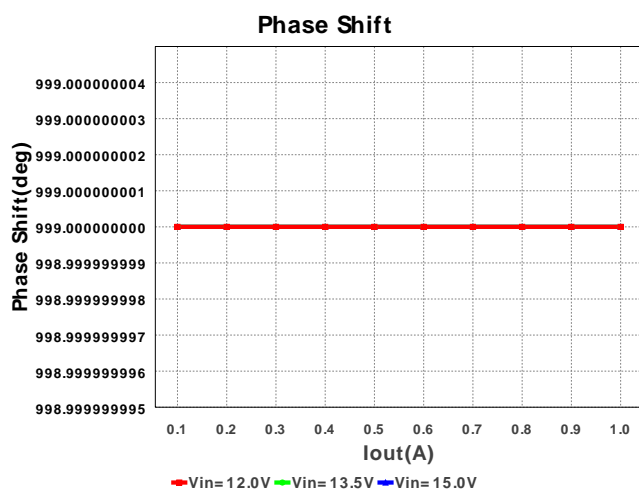
Electrical BOM

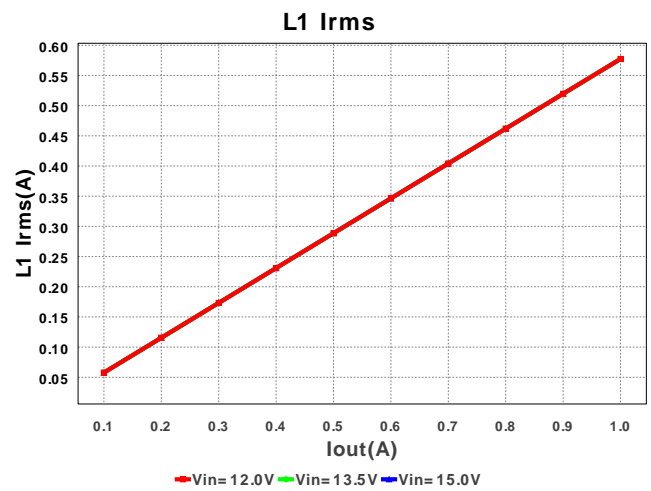
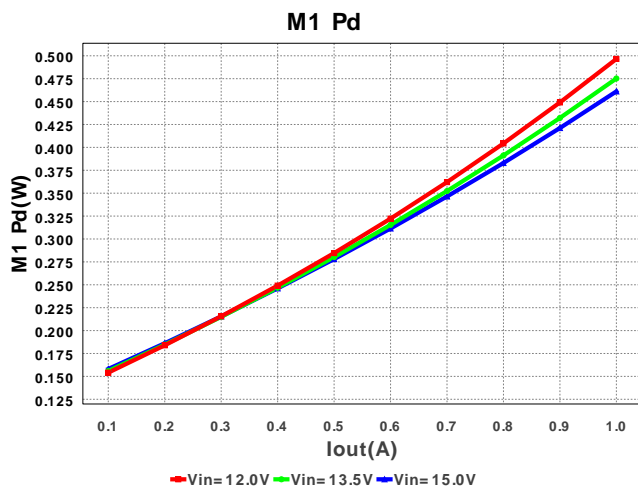
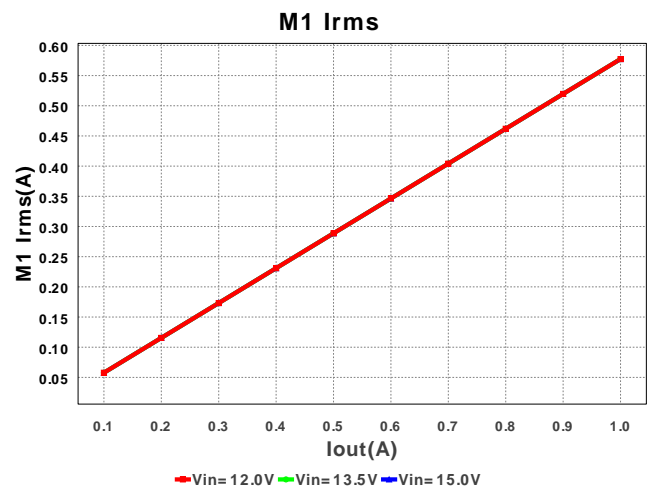
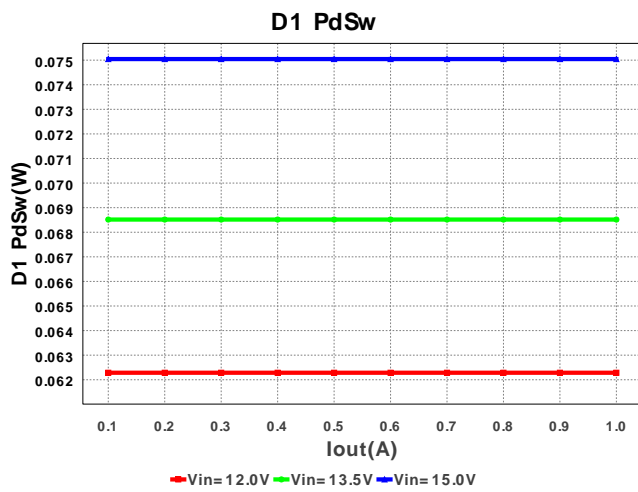
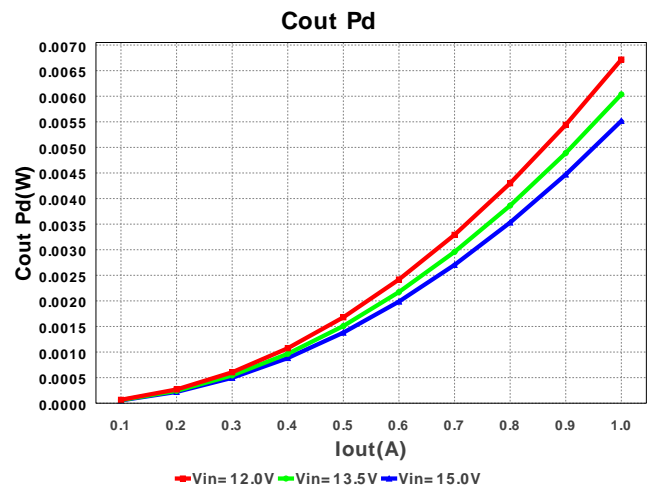
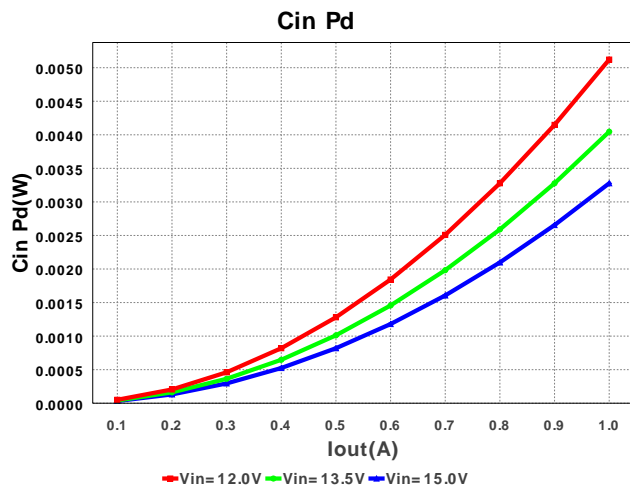
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1.	Cboot	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 10mm2
2.	Ccomp	Yageo America	CC0805KRX7R9BB152 Series= X7R	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 13mm2
3.	Ccomp2	MuRata	GRM1885C1H750JA01D Series= C0G/NP0	Cap= 75.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 10mm2
4.	Cdthr	MuRata	GRM155R71A393KA01D Series= X7R	Cap= 39.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
5.	Cft	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
6.	Cin	Kemet	C1206C105K3RACTU Series= X7R	Cap= 1.0 µF ESR= 11.0 mOhm VDC= 25.0 V IRMS= 3.55 A	1	\$0.04	 1206 19mm2
7.	Cinx	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 13mm2
8.	Cio	TDK	C3216X7R1H105K Series= X7R	Cap= 1.0 µF ESR= 10.0 mOhm VDC= 50.0 V IRMS= 3.2 A	1	\$0.04	 1206 19mm2
9.	Cout	TDK	C5750X7R1E226M Series= X7R	Cap= 22.0 µF ESR= 1.9 mOhm VDC= 25.0 V IRMS= 3.6 A	1	\$0.84	 2220 60mm2

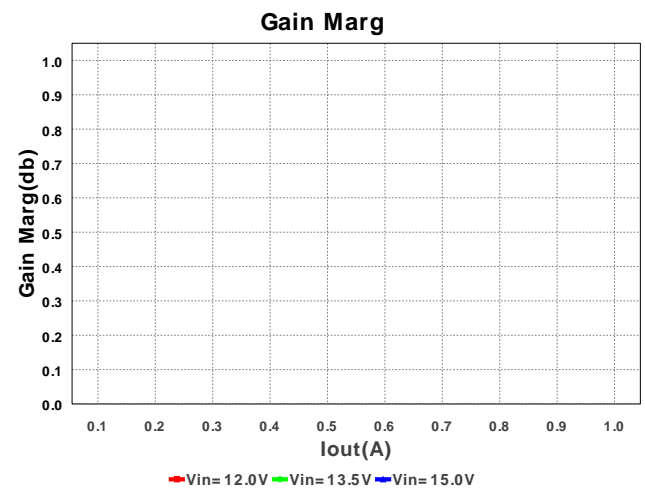
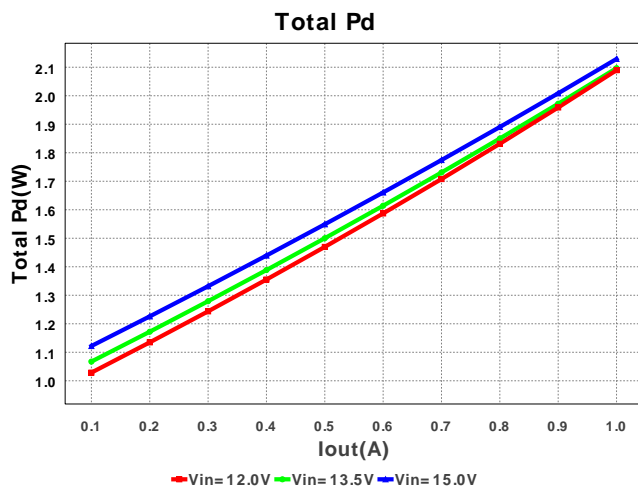
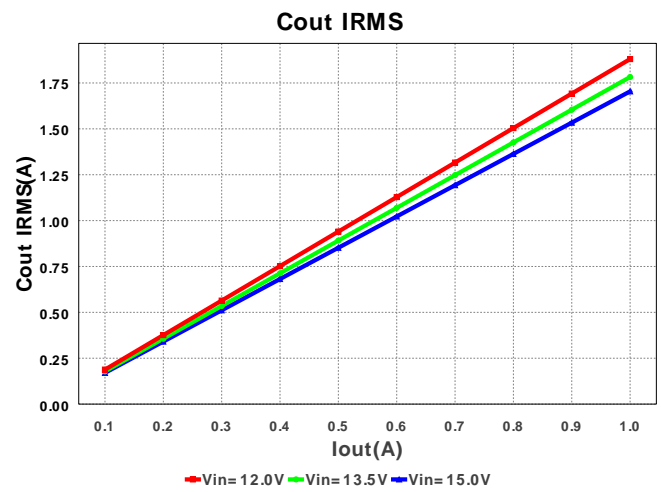
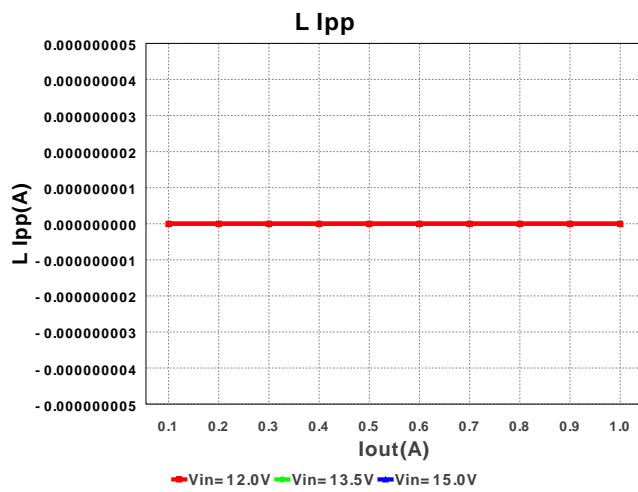
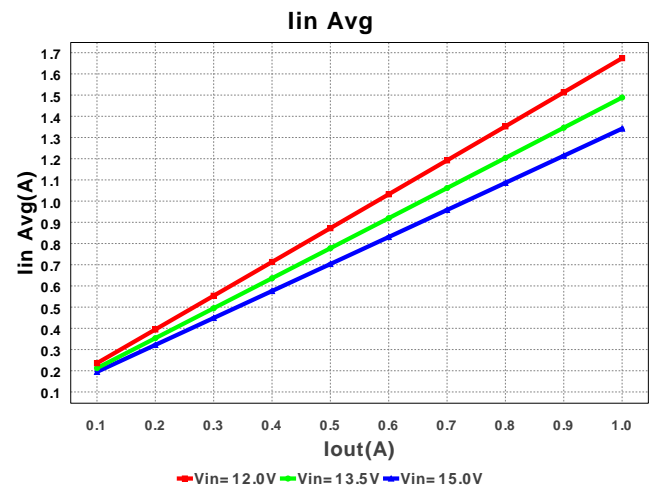
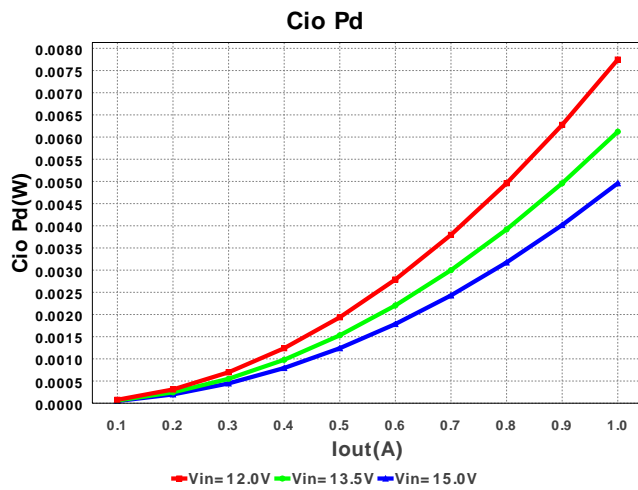
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10.	Coutx	Taiyo Yuden	GMK212B7105KG-T Series= X7R	Cap= 1.0 μ F VDC= 35.0 V IRMS= 0.0 A	1	\$0.05	 0805 13mm2
11.	Cramp	MuRata	GRM1555C1E301JA01D Series= C0G/NP0	Cap= 300.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
12.	Css	MuRata	GRM155C80J334KE01D Series= 379	Cap= 330.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
13.	Cvcc	MuRata	GRM155R61A154KE19D Series= X5R	Cap= 150.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
14.	D1	Vishay-Semiconductor	SS36-E3/57T	VF@Io= 750.0 mV VRRM= 60.0 V	1	\$0.18	 SMC 83mm2
15.	L1	Bourns	SDR1307-120ML	L= 12.0 μ H DCR= 30.0 mOhm	1	\$0.34	 SDR1307 227mm2
16.	M1	AOS	AON7246	VdsMax= 60.0 V IdsMax= 10.0 Amps	1	\$0.26	 TRANS_AOS_DFN3X3 25mm2
17.	Rcomp	Vishay-Dale	CRCW040223K2FKED Series= CRCW..e3	Res= 23.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
18.	Rfbb	Vishay-Dale	CRCW04021K65FKED Series= CRCW..e3	Res= 1.65 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
19.	Rfbt	Vishay-Dale	CRCW040223K2FKED Series= CRCW..e3	Res= 23.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
20.	Rramp	Susumu Co Ltd	RR1220P-124-D Series= 264	Res= 120.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	\$0.01	 0805 13mm2
21.	Rsense	Stackpole Electronics Inc	CSR1206FK20L0 Series= ?	Res= 20.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	\$0.10	 1206 19mm2
22.	Rt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
23.	Ruv1	Vishay-Dale	CRCW04021K43FKED Series= CRCW..e3	Res= 1.43 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
24.	Ruv2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
25.	U1	Texas Instruments	LM25088MH-1/NOPB	Switcher	1	\$1.25	 MXA16A 59mm2

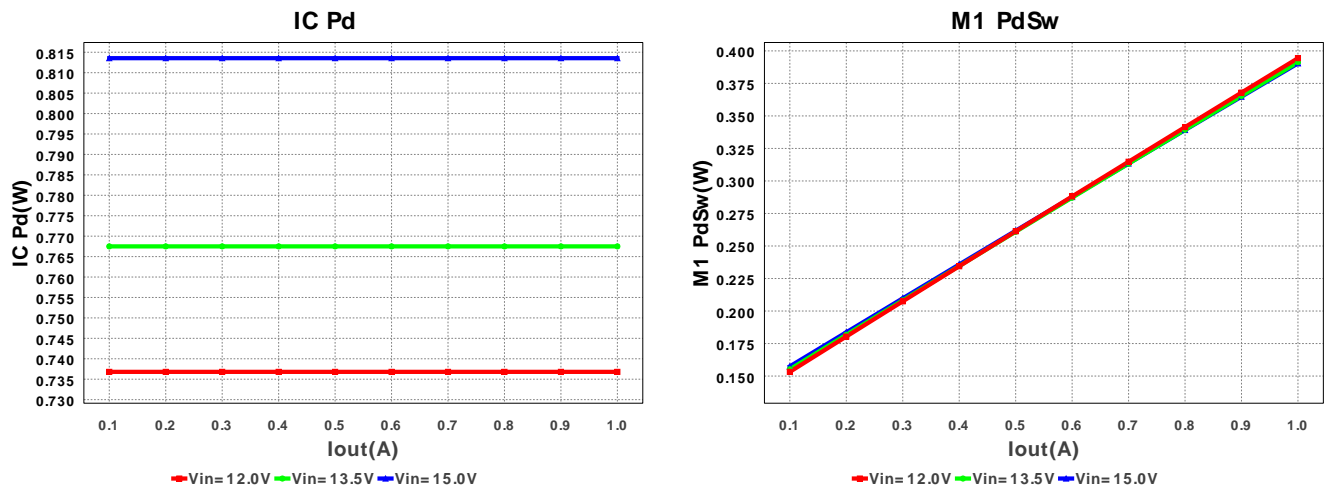












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	638.983 mA	Current	Input capacitor RMS ripple current
2.	Cio IRMS	434.423 mA	Current	Input to output capacitor RMS ripple current
3.	Cout IRMS	1.247 A	Current	Output capacitor RMS ripple current
4.	D1 Irms	1.404 A	Current	D1 Irms
5.	IC Ipk	15.35 mA	Current	Peak switch current in IC
6.	Iin Avg	1.695 A	Current	Average input current
7.	L Ipp	1.098 A	Current	Peak-to-peak output inductor ripple current
8.	L1 Ipk	3.113 A	Current	Inductor peak current
9.	L1 Irms	1.797 A	Current	Inductor ripple current
10.	M1 Irms	1.122 A	Current	M1 MOSFET Irms
11.	BOM Count	25	General	Total Design BOM count
12.	FootPrint	664.0 mm2	General	Total Foot Print Area of BOM components
13.	Frequency	550.0 kHz	General	Switching frequency
14.	IC Tolerance	18.0 mV	General	IC Feedback Tolerance
15.	Mode	DCM	General	Conduction Mode
16.	Total BOM	\$3.26	General	Total BOM Cost
17.	D1 Tj	74.676 degC	Op_Point	D1 junction temperature
18.	Vin p-p	393.732 mV	Op_Point	Peak-to-peak input voltage
19.	Cross Freq	16.447 kHz	Op_point	Bode plot crossover frequency
20.	Duty Cycle	61.0 %	Op_point	Duty cycle
21.	Efficiency	88.5 %	Op_point	Steady state efficiency
22.	Gain Marg	10.447 db	Op_point	Bode Plot Gain Margin
23.	IC Tj	62.542 degC	Op_point	IC junction temperature
24.	IOUT_OP	1.0 A	Op_point	Iout operating point
25.	M1 TjOP	67.176 degC	Op_point	M1 MOSFET junction temperature
26.	Phase Marg	48.5 deg	Op_point	Bode Plot Phase Margin
27.	Phase Shift	45.022 deg	Op_point	Bode Plot Phase Shift
28.	VIN_OP	12.0 V	Op_point	Vin operating point
29.	Vout p-p	64.782 mV	Op_point	Peak-to-peak output ripple voltage
30.	Cin Pd	4.491 mW	Power	Input capacitor power dissipation
31.	Cio Pd	1.887 mW	Power	Input to output capacitor power dissipation
32.	Cout Pd	2.954 mW	Power	Output capacitor power dissipation
33.	D1 Pd	812.285 mW	Power	Diode power dissipation
34.	D1 PdCond	750.0 mW	Power	Diode conduction losses
35.	D1 PdSw	62.285 mW	Power	Diode switching losses
36.	IC Pd	813.55 mW	Power	IC power dissipation
37.	L Pd	190.692 mW	Power	Inductor power dissipation
38.	M1 Pd	496.547 mW	Power	M1 MOSFET total power dissipation
39.	M1 PdCond	102.151 mW	Power	M1 MOSFET conduction losses
40.	M1 PdSw	394.397 mW	Power	M1 MOSFET switching losses
41.	Rsense Pd	44.918 mW	Power	LED Current Rns Power Dissipation
42.	Total Pd	2.339 W	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	1.0 A	Maximum Output Current
2.	Iout1	1.0 Amps	Output Current #1
3.	VinMax	15.0 V	Maximum input voltage
4.	VinMin	12.0 V	Minimum input voltage
5.	Vout	-18.0 V	Output Voltage
6.	Vout1	-18.0 Volt	Output Voltage #1

#	Name	Value	Description
7.	base_pn	LM25088	National Based Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0 degC	Ambient temperature

Design Assistance

1. **LM25088** Product Folder : <http://www.ti.com/product/lm25088> : contains the data sheet and other resources.

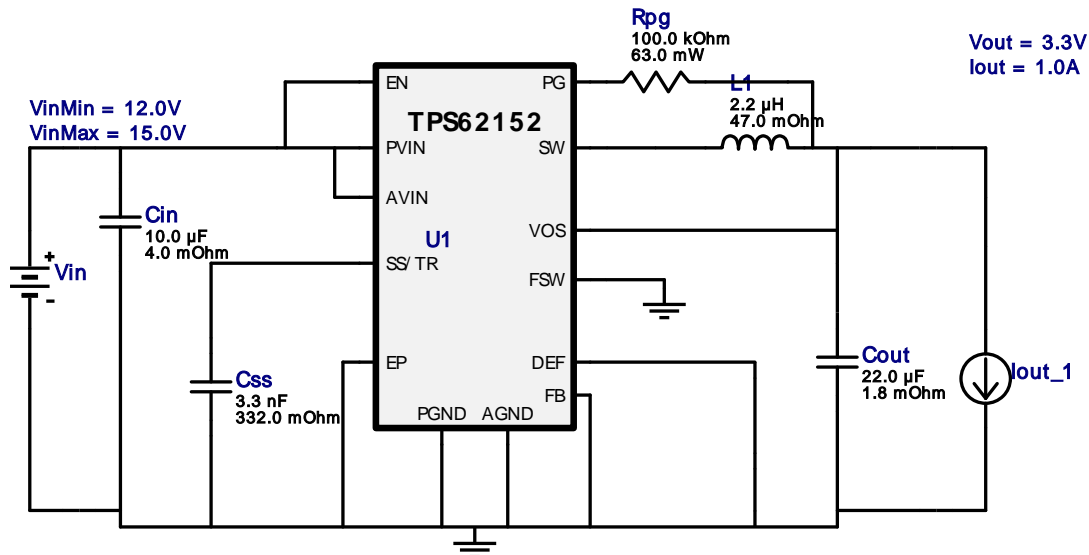


VinMin = 12.0V
 VinMax = 15.0V
 Vout = 3.3V
 Iout = 1.0A

Device = TPS62152RGTR
 Topology = Buck
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 BOM Cost = \$1.32
 Total Pd = 0.48W
 Footprint = 127.0mm2
 BOM Count = 6

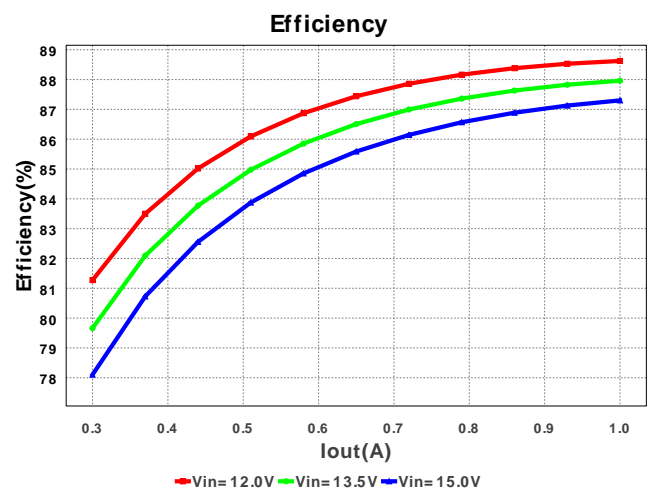
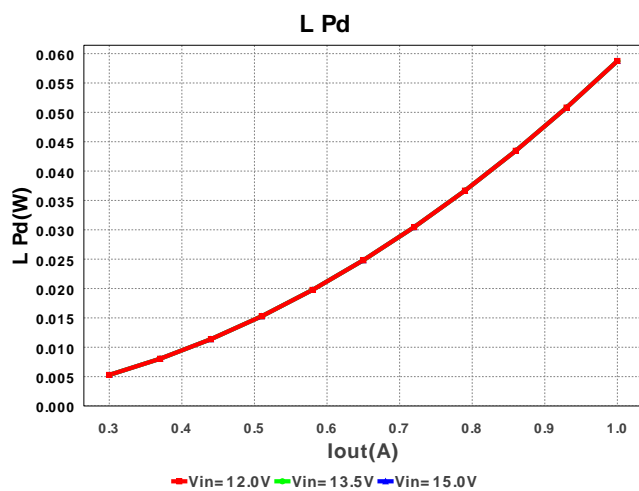
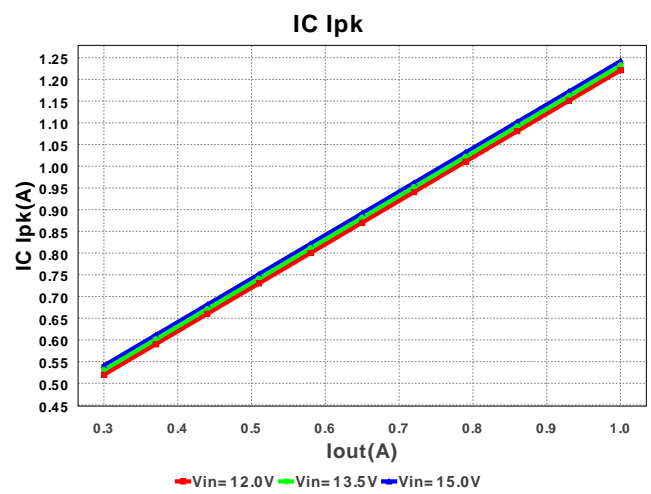
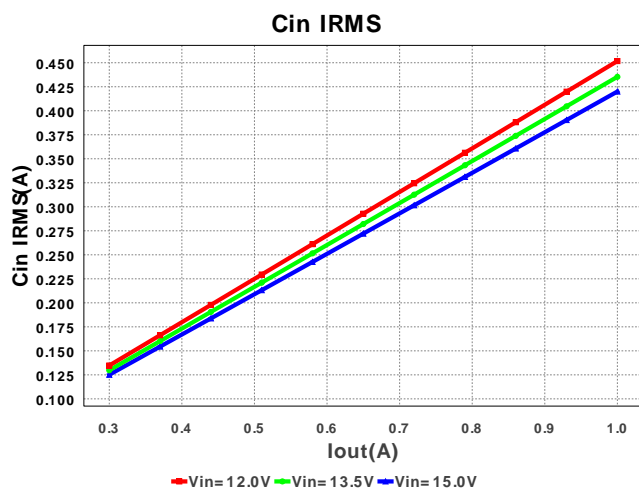
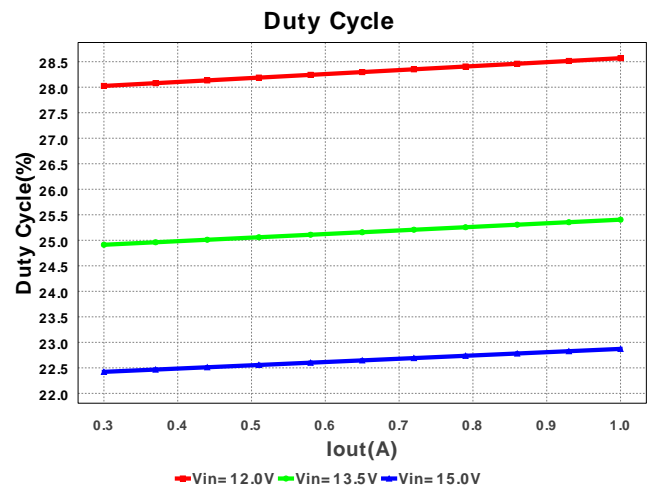
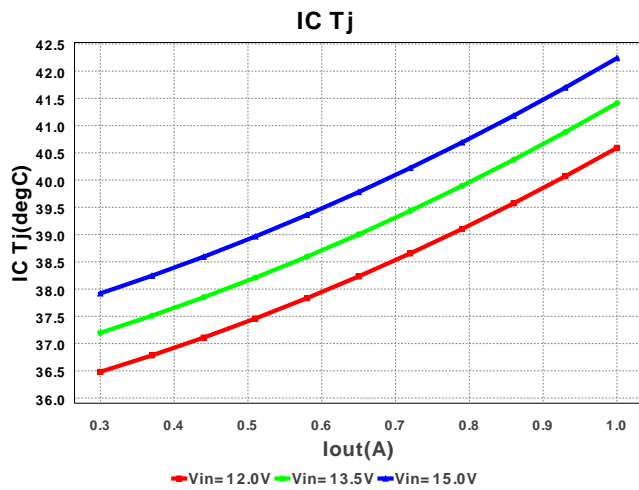
WEBENCH® Design Report

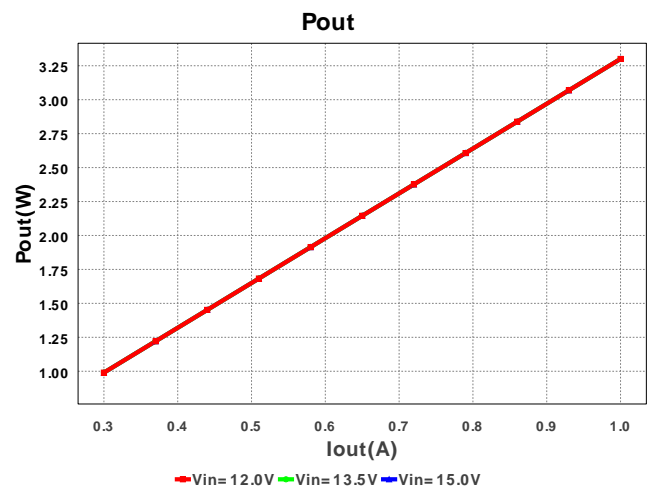
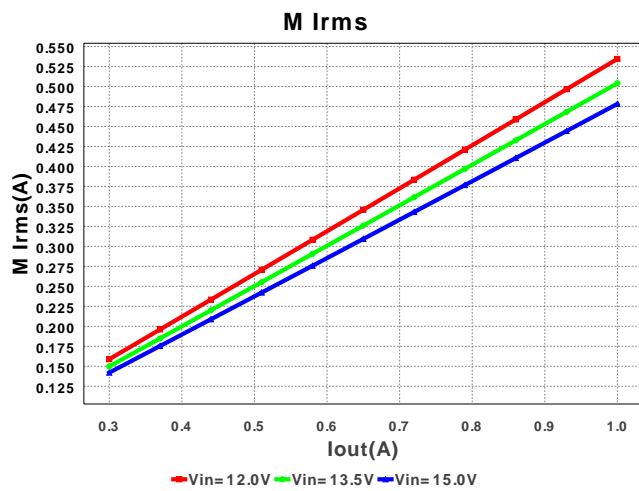
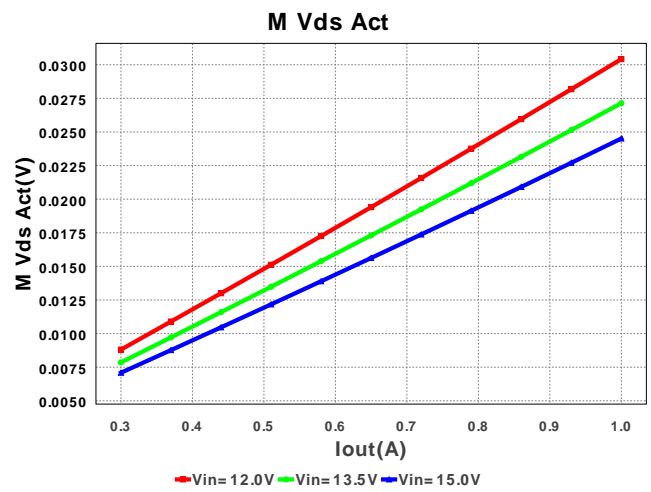
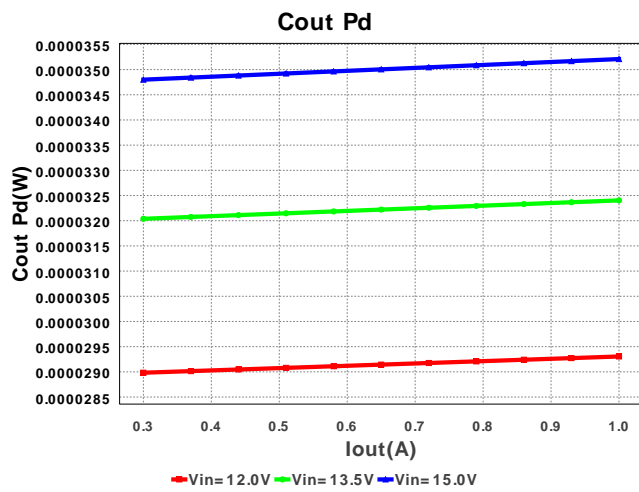
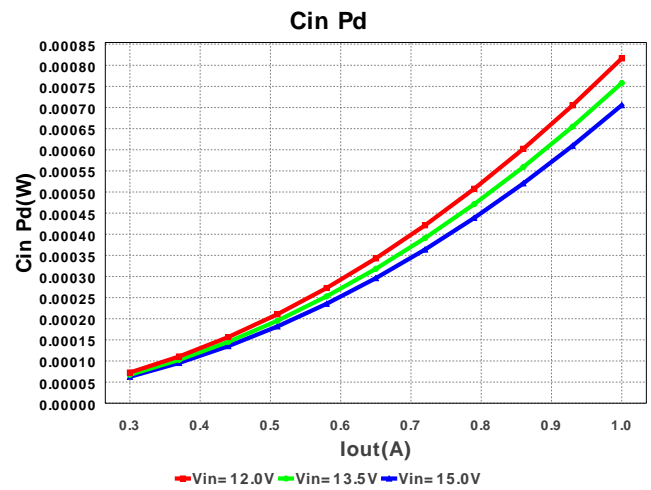
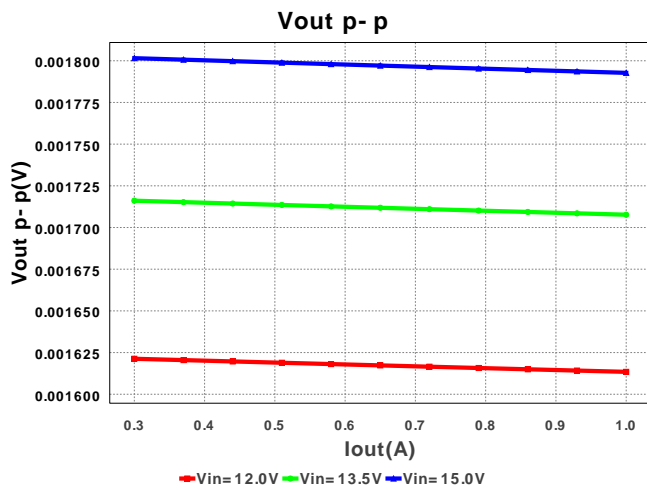
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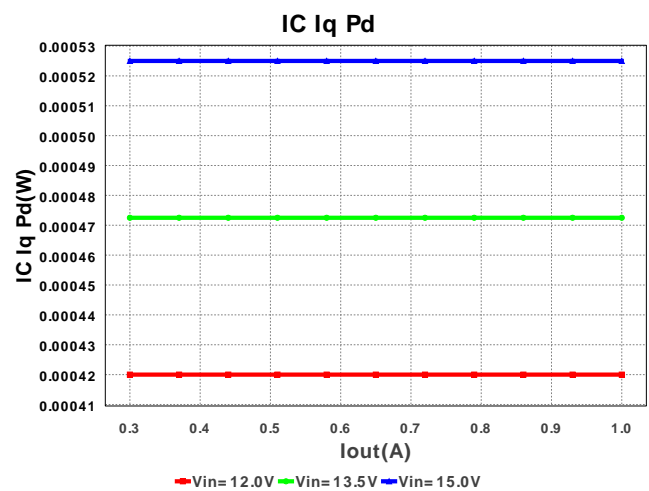
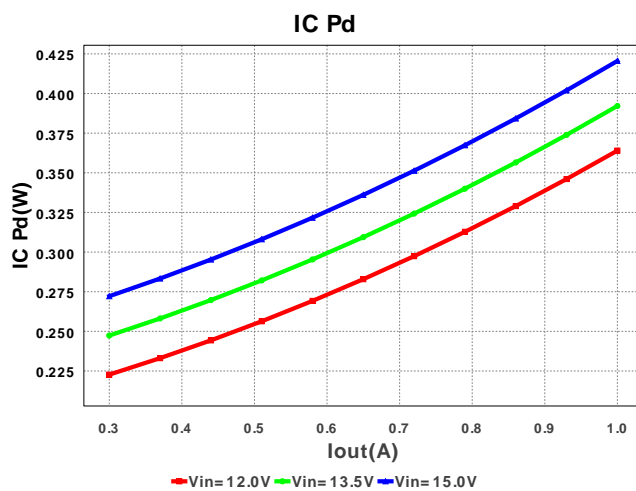
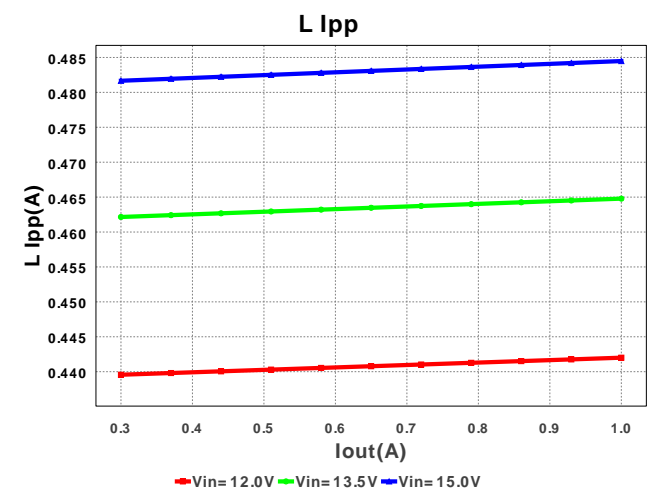
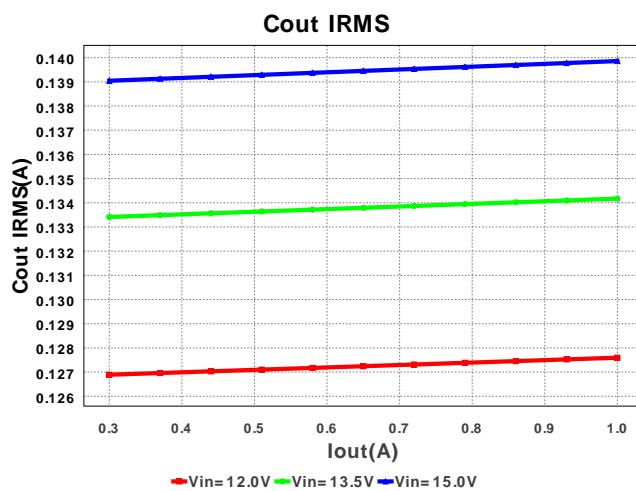
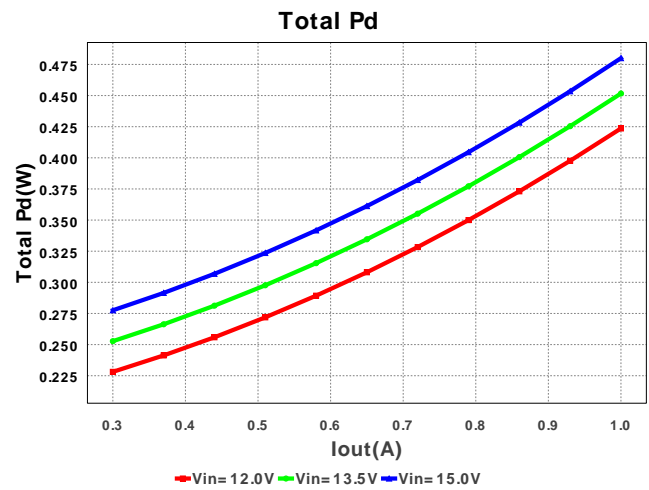
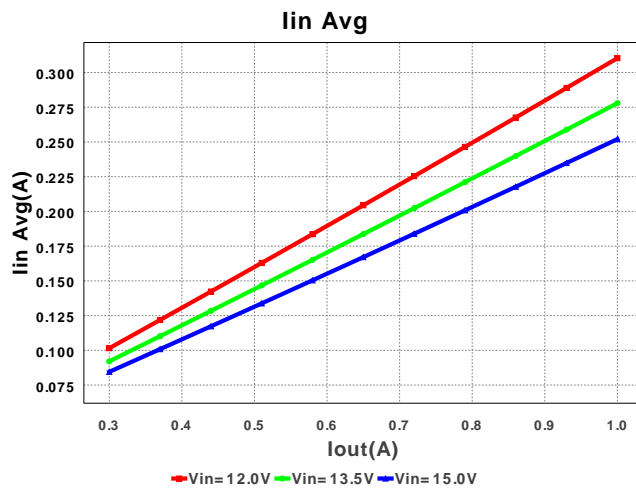


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 µF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.07	1206 19mm2
2.	Cout	TDK	C2012X5R0J226M Series= X5R	Cap= 22.0 µF ESR= 1.8 mOhm VDC= 6.3 V IRMS= 0.0 A	1	\$0.06	0805 13mm2
3.	Css	Kemet	C0805C332K5RACTU Series= X7R	Cap= 3.3 nF ESR= 332.0 mOhm VDC= 50.0 V IRMS= 319.0 mA	1	\$0.01	0805 13mm2
4.	L1	Bourns	SDR0403-2R2ML	L= 2.2 µH DCR= 47.0 mOhm	1	\$0.17	SDR0403 39mm2
5.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 8mm2
6.	U1	Texas Instruments	TPS62152RGTR	Switcher	1	\$1.00	S-PVQFN-N16 36mm2







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	420.007 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	139.859 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.242 A	Current	Peak switch current in IC
4.	Iin Avg	252.0 mA	Current	Average input current
5.	L Ipp	484.485 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	478.244 mA	Current	Q lavg
7.	BOM Count	6	General	Total Design BOM count
8.	FootPrint	127.0 mm2	General	Total Foot Print Area of BOM components
9.	Frequency	2.511 MHz	General	Switching frequency
10.	IC Tolerance	59.4 mV	General	IC Feedback Tolerance
11.	M Vds Act	24.512 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	3.3 W	General	Total output power
14.	Total BOM	\$1.32	General	Total BOM Cost
15.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	22.872 %	Op_point	Duty cycle
17.	Efficiency	87.301 %	Op_point	Steady state efficiency
18.	IC Tj	42.238 degC	Op_point	IC junction temperature
19.	ICThetaJA	29.1 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	1.0 A	Op_point	Iout operating point
21.	VIN_OP	15.0 V	Op_point	Vin operating point
22.	Vout p-p	1.793 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	705.623 μ W	Power	Input capacitor power dissipation
24.	Cout Pd	35.209 μ W	Power	Output capacitor power dissipation
25.	IC Pd	420.539 mW	Power	IC power dissipation
26.	L Pd	58.75 mW	Power	Inductor power dissipation
27.	Total Pd	480.022 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	1.0 A	Maximum Output Current
2.	Iout1	1.0 Amps	Output Current #1
3.	VinMax	15.0 V	Maximum input voltage
4.	VinMin	12.0 V	Minimum input voltage
5.	Vout	3.3 V	Output Voltage
6.	Vout1	3.3 Volt	Output Voltage #1
7.	base_pn	TPS62152	National Based Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0 degC	Ambient temperature

Design Assistance

1. Feature Highlights: DCS-Control(TM) Architecture with upto 1A output current, 3V to 17V Input Voltage Range, 3.3V Fixed Output voltage>Selectable operating frequency, Optional Softstart Capacitor for slow startup, Tracking,Pin selectable output voltage (nominal, +5%) Seamless Power Save Mode for Light Load Efficiency, Power Good Output, 100% Duty Cycle mode, Short Circuit Protection, Thermal Shutdown

2. **TPS62152** Product Folder : <http://www.ti.com/product/tps62152> : contains the data sheet and other resources.

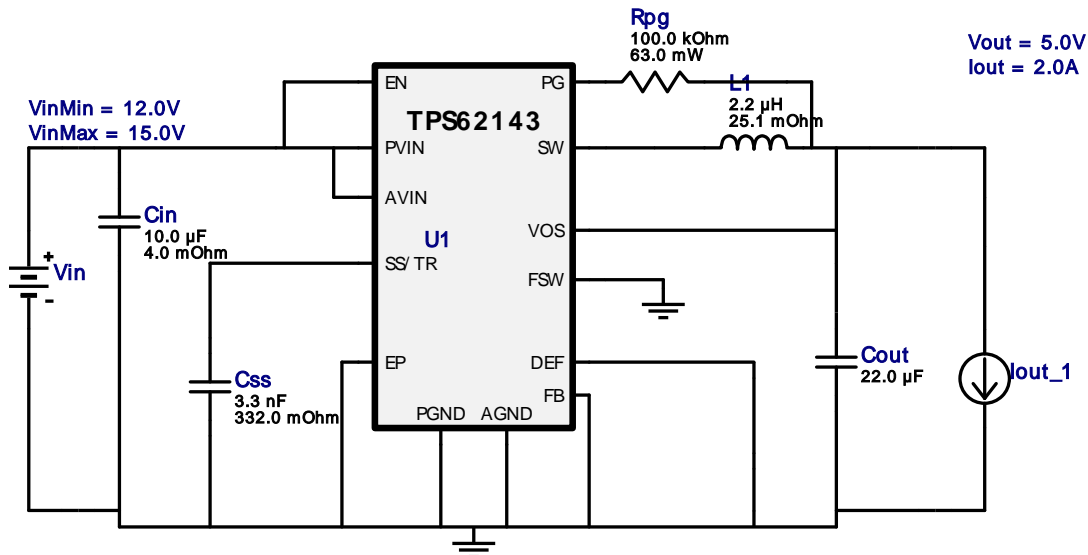


VinMin = 12.0V
 VinMax = 15.0V
 Vout = 5.0V
 Iout = 2.0A

Device = TPS62143RGTR
 Topology = Buck
 Created = 4/25/13 1:40:35 PM
 BOM Cost = \$1.52
 Total Pd = 0.93W
 Footprint = 152.0mm²
 BOM Count = 6

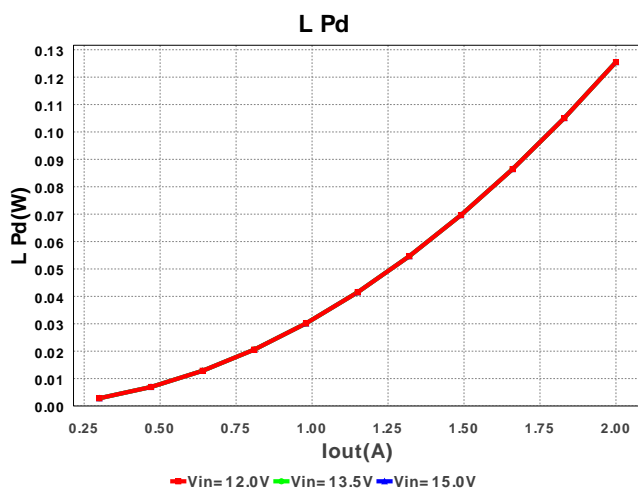
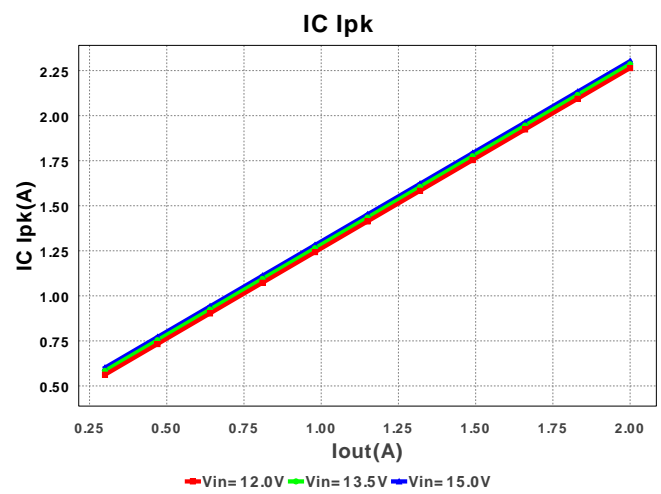
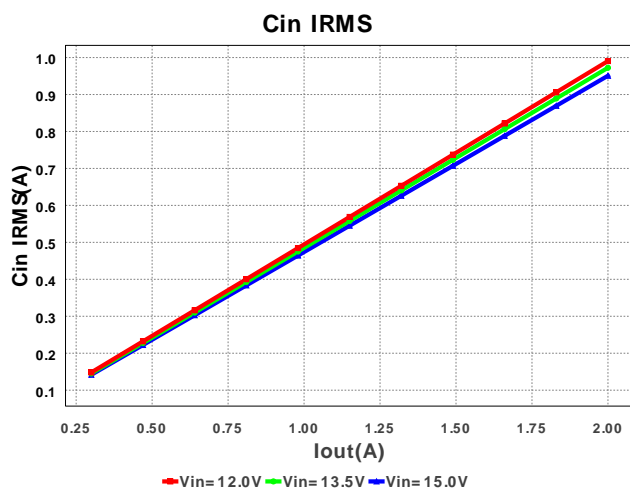
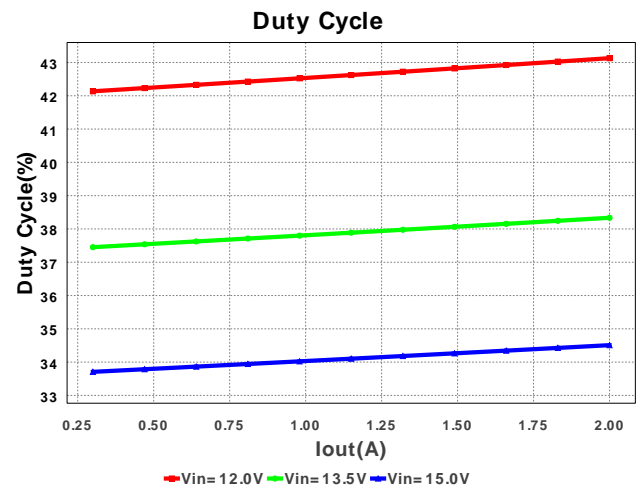
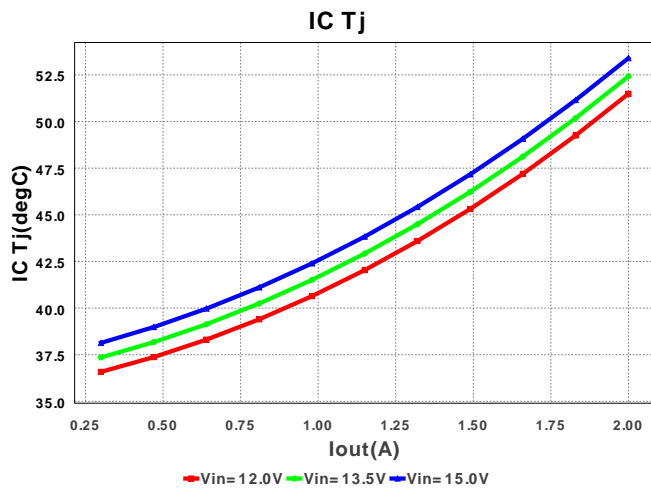
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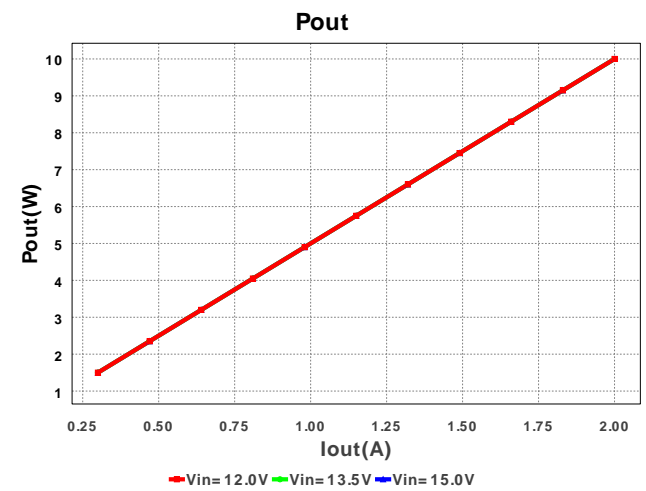
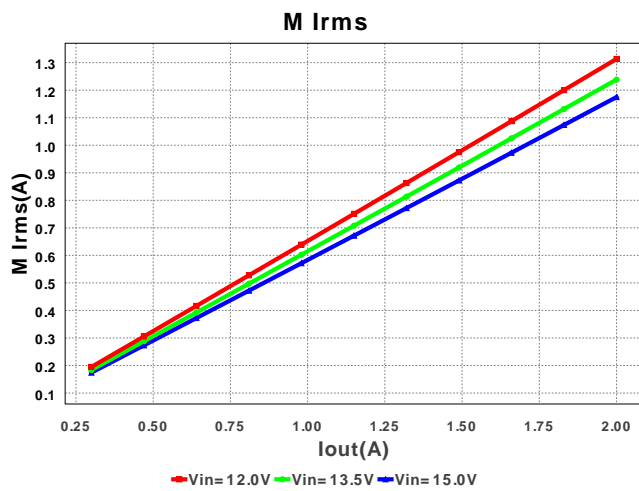
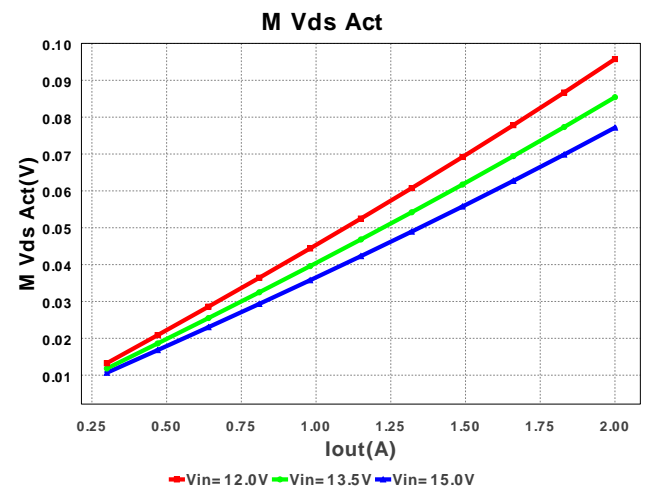
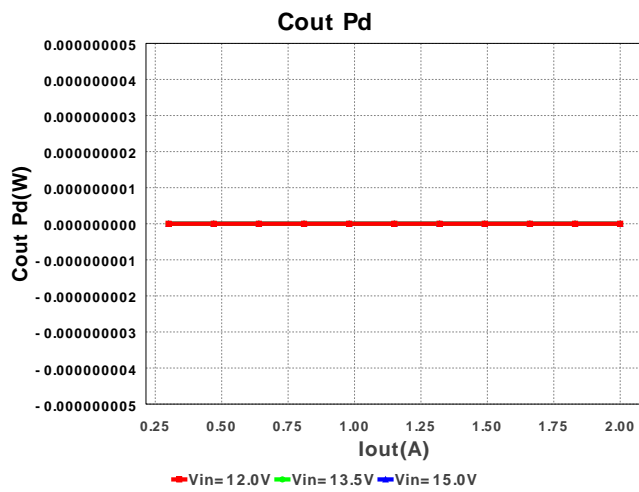
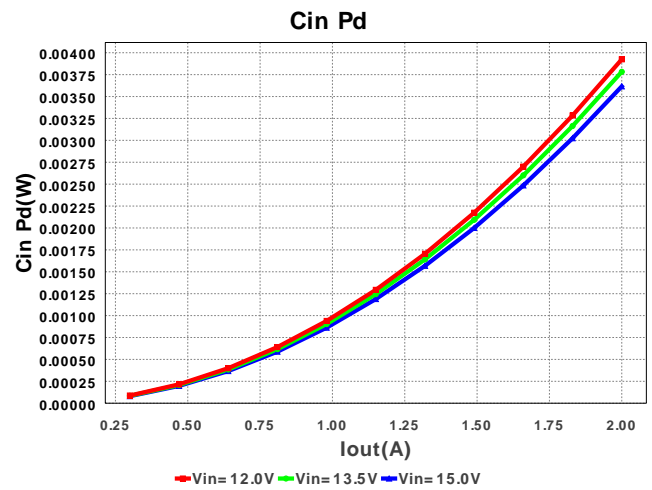
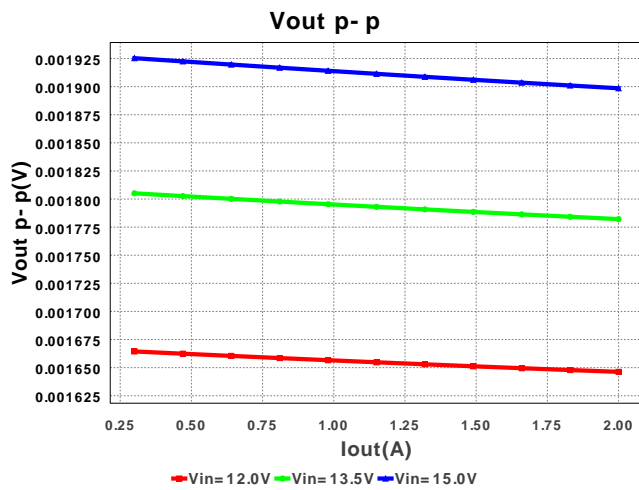
Design : 3520048/24 TPS62143RGTR
 TPS62143RGTR 12.0V-15.0V to 5.0V @ 2.0A

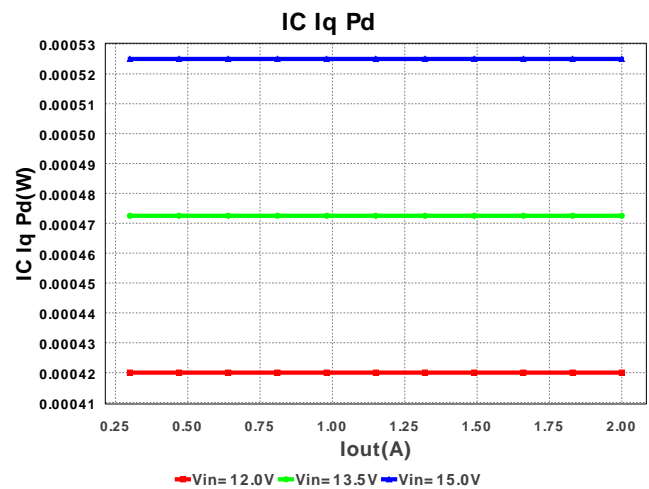
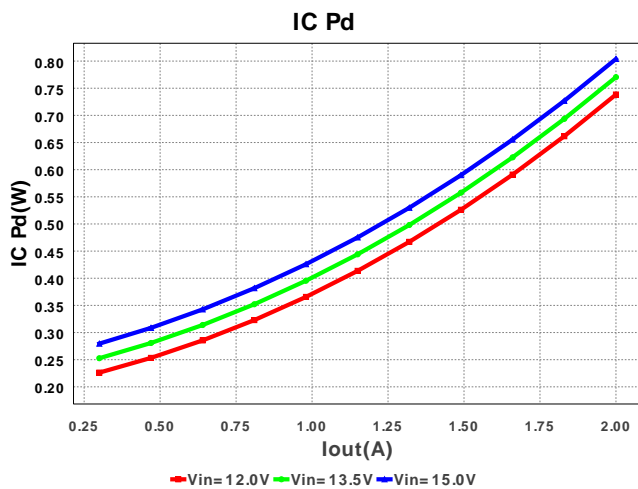
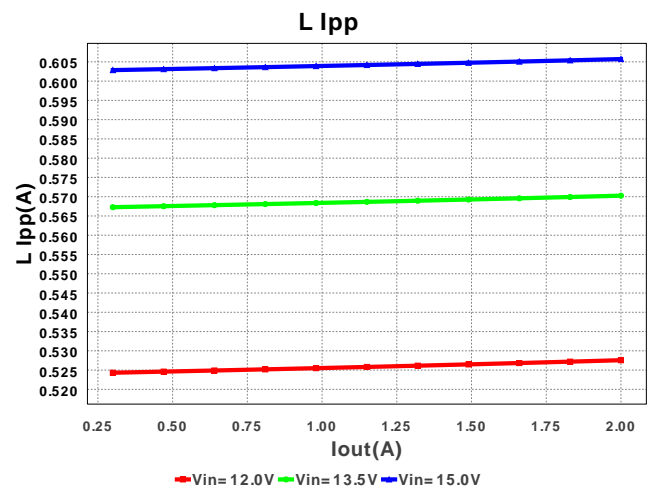
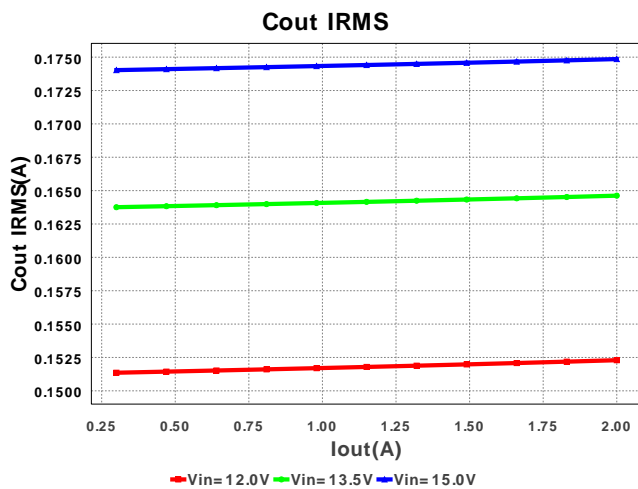
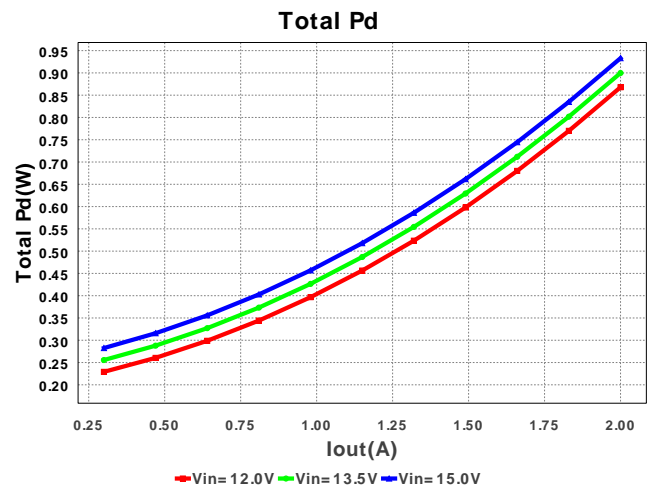
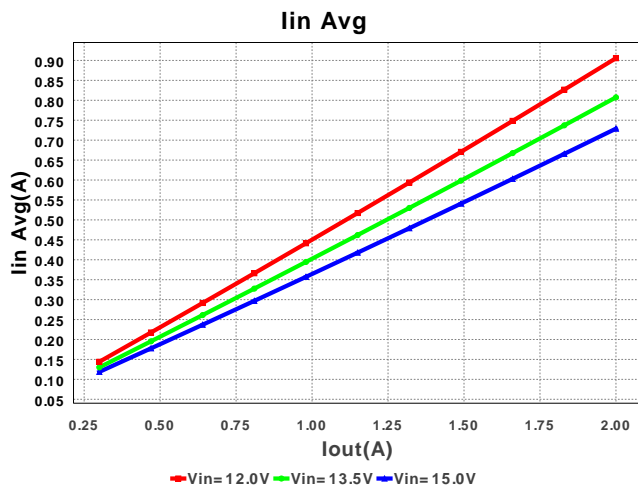


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 µF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.07	 1206 19mm ²
2.	Cout	Taiyo Yuden	LMK212BJ226MG-T Series= X5R	Cap= 22.0 µF VDC= 10.0 V IRMS= 0.0 A	1	\$0.12	 0805 13mm ²
3.	Css	Kemet	C0805C332K5RACTU Series= X7R	Cap= 3.3 nF ESR= 332.0 mOhm VDC= 50.0 V IRMS= 319.0 mA	1	\$0.01	 0805 13mm ²
4.	L1	Bourns	SRN6045-2R2Y	L= 2.2 µH DCR= 25.1 mOhm	1	\$0.16	 SRN6045 64mm ²
5.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm ²
6.	U1	Texas Instruments	TPS62143RGTR	Switcher	1	\$1.15	 S-PVQFN-N16 36mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	950.796 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	174.856 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	2.303 A	Current	Peak switch current in IC
4.	Iin Avg	728.87 mA	Current	Average input current
5.	L Ipp	605.721 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	1.175 A	Current	Q lavg
7.	BOM Count	6	General	Total Design BOM count
8.	FootPrint	152.0 mm2	General	Total Foot Print Area of BOM components
9.	Frequency	2.59 MHz	General	Switching frequency
10.	IC Tolerance	90.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	77.171 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	10.0 W	General	Total output power
14.	Total BOM	\$1.52	General	Total BOM Cost
15.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	34.509 %	Op_point	Duty cycle
17.	Efficiency	91.466 %	Op_point	Steady state efficiency
18.	IC Tj	53.395 degC	Op_point	IC junction temperature
19.	ICThetaJA	29.1 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	2.0 A	Op_point	Iout operating point
21.	VIN_OP	15.0 V	Op_point	Vin operating point
22.	Vout p-p	1.899 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	3.616 mW	Power	Input capacitor power dissipation
24.	Cout Pd	0.0 W	Power	Output capacitor power dissipation
25.	IC Pd	803.942 mW	Power	IC power dissipation
26.	L Pd	125.5 mW	Power	Inductor power dissipation
27.	Total Pd	933.026 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	2.0 A	Maximum Output Current
2.	Iout1	2.0 Amps	Output Current #1
3.	VinMax	15.0 V	Maximum input voltage
4.	VinMin	12.0 V	Minimum input voltage
5.	Vout	5.0 V	Output Voltage
6.	Vout1	5.0 Volt	Output Voltage #1
7.	base_pn	TPS62143	National Based Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0 degC	Ambient temperature

Design Assistance

1. Feature Highlights: DCS-Control(TM) Architecture with upto 2A output current, 3V to 17V Input Voltage Range, 5.0V Fixed Output voltage>Selectable operating frequency, Optional Softstart Capacitor for slow startup, Tracking,Pin selectable output voltage (nominal, +5%) Seamless Power Save Mode for Light Load Efficiency, Power Good Output, 100% Duty Cycle mode, Short Circuit Protection, Thermal Shutdown

2. **TPS62143** Product Folder : <http://www.ti.com/product/tps62143> : contains the data sheet and other resources.

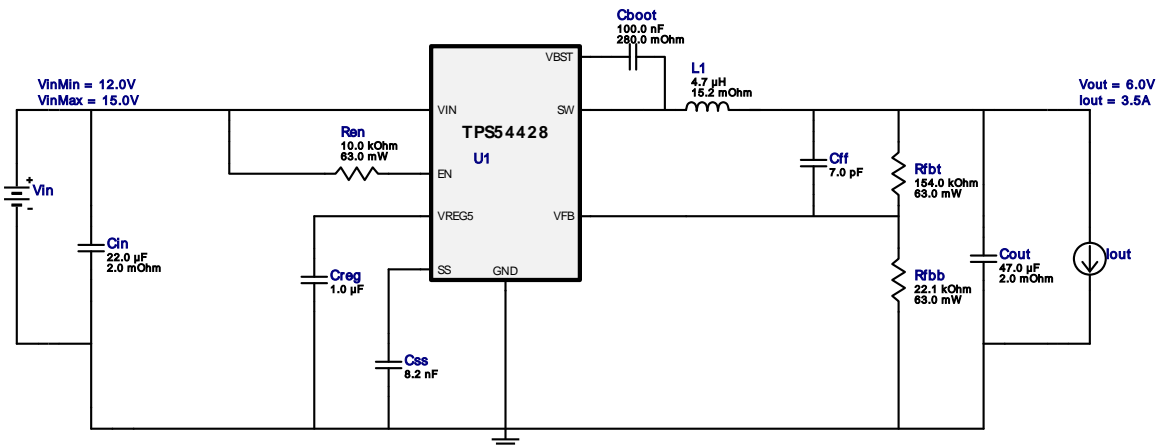


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Design : 3520048/25 TPS54428DDAR
TPS54428DDAR 12.0V-15.0V to 6.0V @ 3.5A

VinMin = 12.0V
VinMax = 15.0V
Vout = 6.0V
Iout = 3.5A

Device = TPS54428DDAR
Topology = Buck
Created = 4/25/13 1:40:36 PM
BOM Cost = \$2.00
Total Pd = 1.88W
Footprint = 314.0mm2
BOM Count = 11



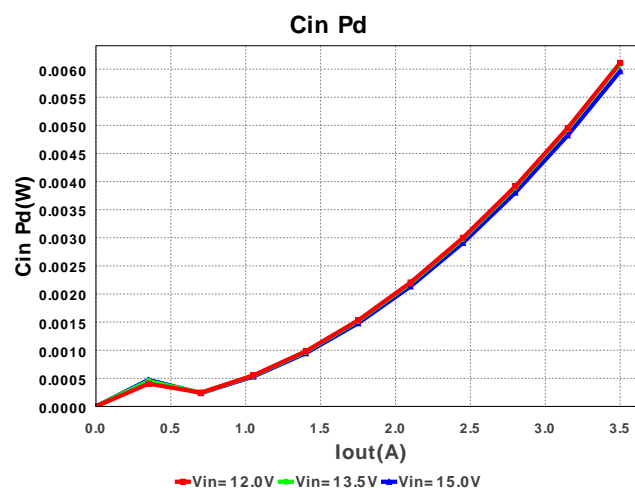
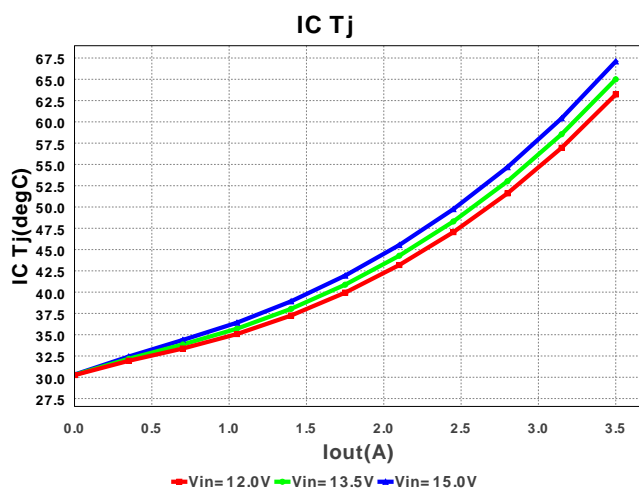
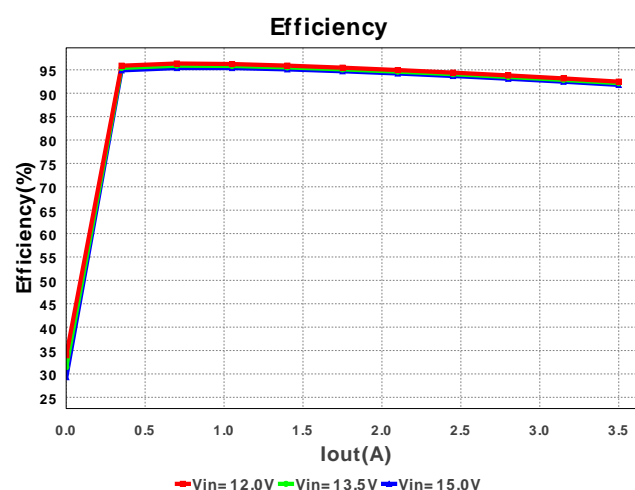
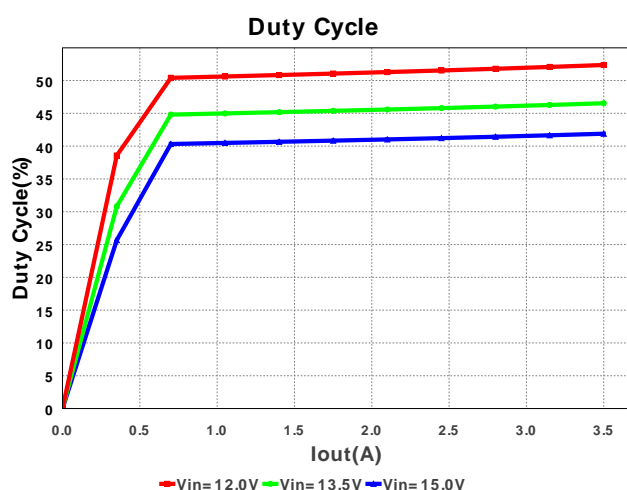
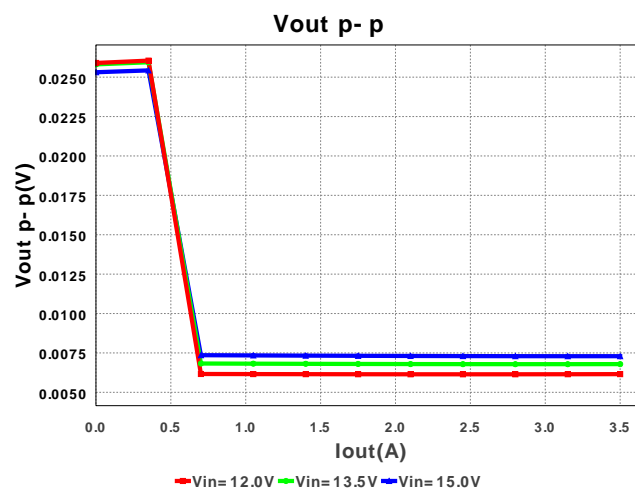
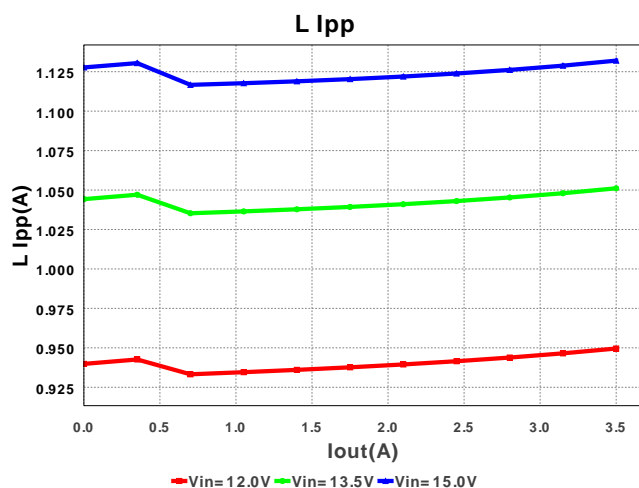
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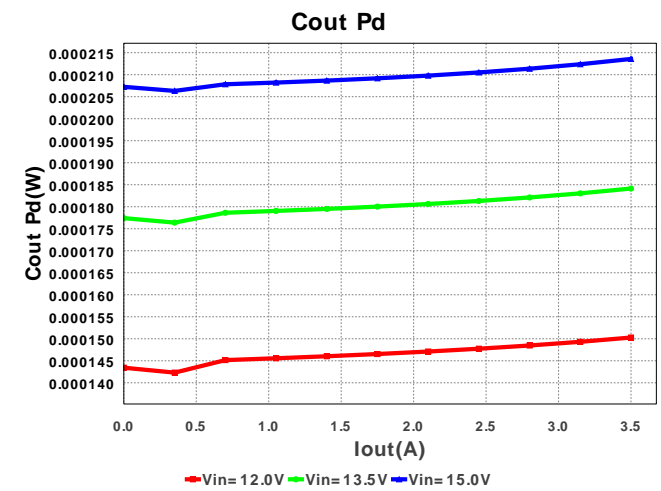
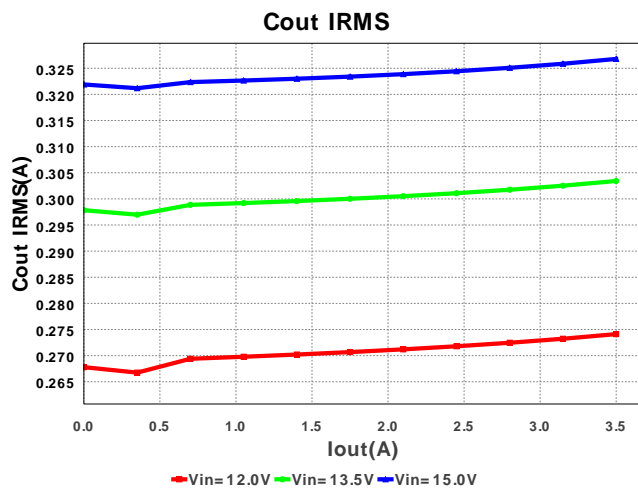
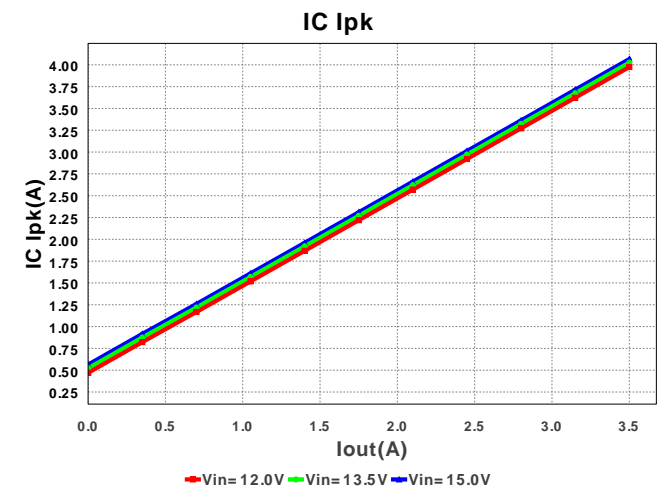
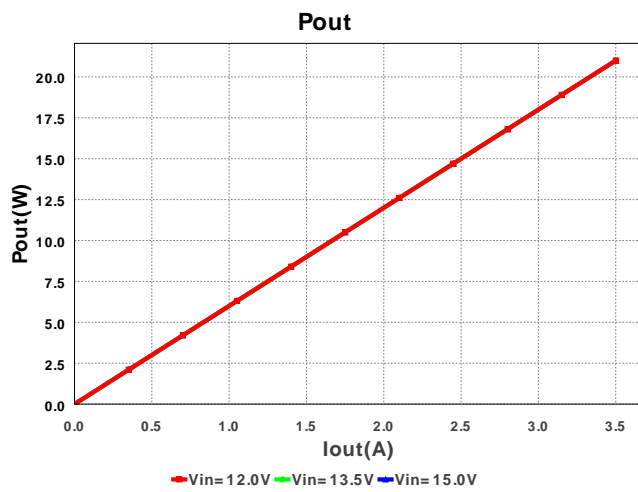
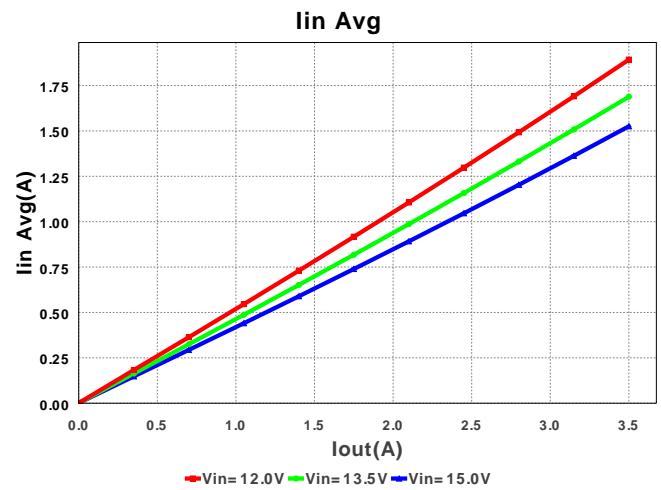
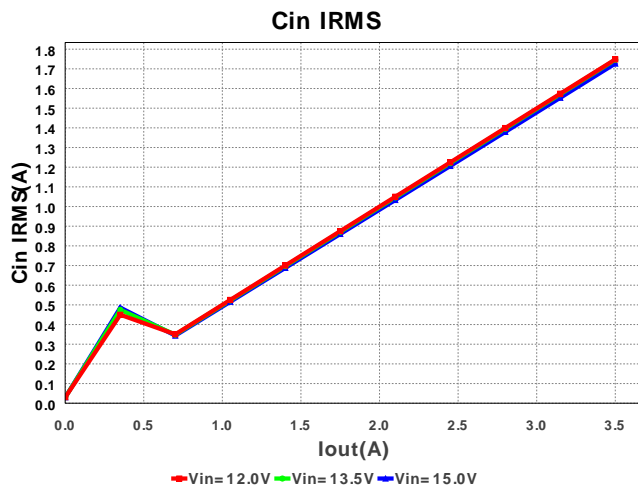
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 13mm2
2.	Cff	Yageo America	CC0805DRNP09BN7R0 Series= C0G/NP0	Cap= 7.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 13mm2
3.	Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 µF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.31	 1210 23mm2
4.	Cout	MuRata	GRM32ER61C476ME15L Series= X5R	Cap= 47.0 µF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.22	 1210 23mm2
5.	Creg	MuRata	GRM155R61A105KE15D Series= X5R	Cap= 1.0 µF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
6.	Css	MuRata	GRM155R71E822KA01D Series= X7R	Cap= 8.2 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0402 8mm2
7.	L1	TDK	SLF10165T-4R7N4R73PF	L= 4.7 µH DCR= 15.2 mOhm	1	\$0.05	 SLF10165 146mm2
8.	Ren	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
9.	Rfbb	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2
10.	Rf1	Vishay-Dale	CRCW0402154KFKED Series= CRCW..e3	Res= 154.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 8mm2

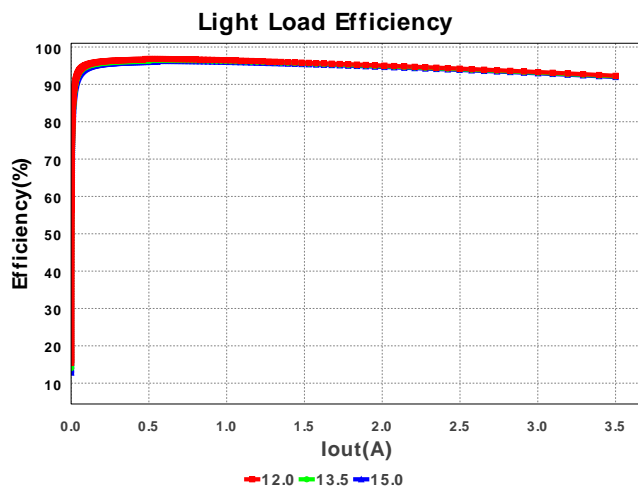
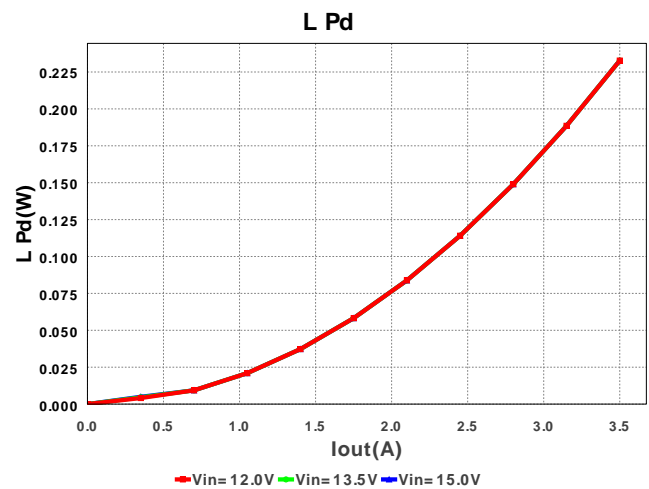
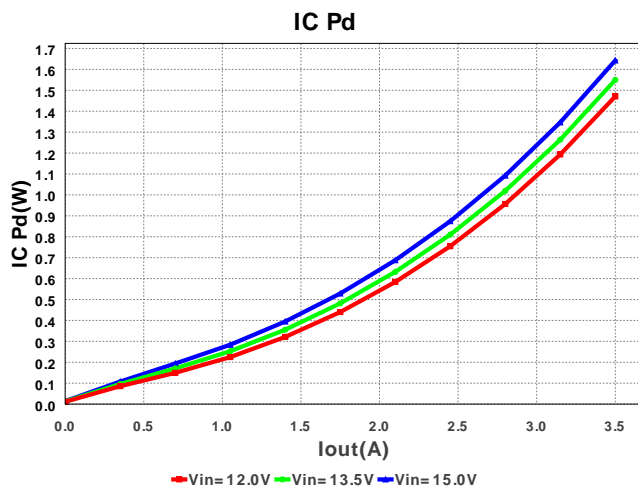
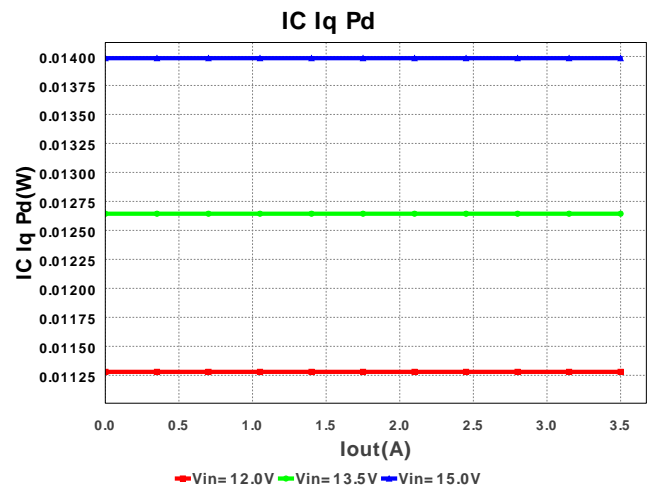
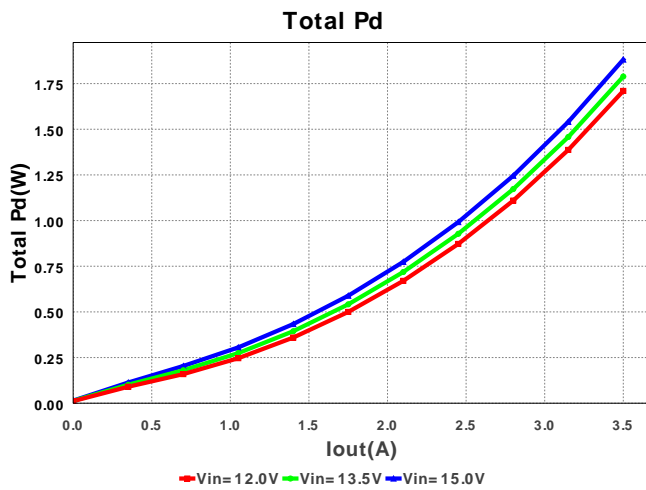
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11. U1		Texas Instruments	TPS54428DDAR	Switcher	1	\$1.35	



R-PDSO-G8 57mm2







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.727 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	326.783 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	4.066 A	Current	Peak switch current in IC
4.	Iin Avg	1.525 A	Current	Average input current
5.	L Ipp	1.132 A	Current	Peak-to-peak inductor ripple current
6.	BOM Count	11	General	Total Design BOM count
7.	FootPrint	314.0 mm2	General	Total Foot Print Area of BOM components
8.	Frequency	708.629 kHz	General	Switching frequency
9.	Mode	CCM	General	Conduction Mode
10.	Pout	21.0 W	General	Total output power
11.	Total BOM	\$2.0	General	Total BOM Cost

#	Name	Value	Category	Description
12.	Vout OP	6.0 V	Op_Point	Operational Output Voltage
13.	Duty Cycle	41.891 %	Op_point	Duty cycle
14.	Efficiency	91.777 %	Op_point	Steady state efficiency
15.	IC Tj	67.102 degC	Op_point	IC junction temperature
16.	ICThetaJA	45.3 degC/W	Op_point	IC junction-to-ambient thermal resistance
17.	IOUT_OP	3.5 A	Op_point	Iout operating point
18.	VIN_OP	15.0 V	Op_point	Vin operating point
19.	Vout p-p	7.293 mV	Op_point	Peak-to-peak output ripple voltage
20.	Cin Pd	5.964 mW	Power	Input capacitor power dissipation
21.	Cout Pd	213.574 μ W	Power	Output capacitor power dissipation
22.	IC Iq Pd	13.985 mW	Power	IC Iq Pd
23.	IC Pd	1.643 W	Power	IC power dissipation
24.	L Pd	232.75 mW	Power	Inductor power dissipation
25.	Total Pd	1.882 W	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	3.5 A	Maximum Output Current
2.	Iout1	3.5 Amps	Output Current #1
3.	VinMax	15.0 V	Maximum input voltage
4.	VinMin	12.0 V	Minimum input voltage
5.	Vout	6.0 V	Output Voltage
6.	Vout1	6.0 Volt	Output Voltage #1
7.	base_pn	TPS54428	National Based Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0 degC	Ambient temperature

Design Assistance

1. **TPS54428** Product Folder : <http://www.ti.com/product/tps54428> : contains the data sheet and other resources.

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