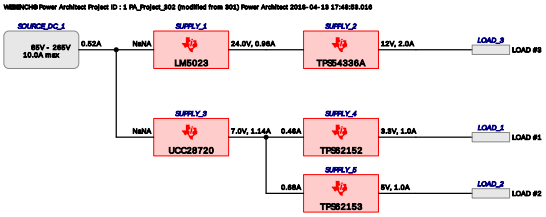
WEBENCH® Power Architect



Project Report

Project : 4079404/1 : PA_Project_302 (modified from 301)
Created : 2016-04-13 17:48:53.016
Optimize project optFactor=3

Project Summary

1.	Total System Efficiency	86.444 %
2.	Total System BOM Count	82.0
3.	Total System Footprint	2.299 kmm2
4.	Total System BOM Cost	$0.00
5.	Total System Power Dissipation	5.065 W

--> Launch WEBENCH Power Architect.

Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_2	0	LOAD_3	LOAD #3
SUPPLY_4	0	LOAD_1	LOAD #1
SUPPLY_5	0	LOAD_2	LOAD #2
SUPPLY_1	NA		
SUPPLY_3	NA		

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LM5023	Switcher : AC-DC QR Current Mode PWM Controller	24.0 V	0.96 A	95.4%	1180	$0.00	26	10
2.	SUPPLY_2	TPS54336A	Switcher : 28V, 3A, Low Iq, Synchronous, monolithic buck converter with Eco-mode	12 V	2.0 A	94.7%	333	$1.95	25	5
3.	SUPPLY_3	UCC28720	Switcher : Flyback Controller with Primary Side Regulation	7.0 V	1.138 A	80.1%	644	$0.00	29	30
4.	SUPPLY_4	TPS62152	Switcher : 3V-17V,3.3Vout,1A,Buck,DCS-Control	3.3 V	1.0 A	93.5%	71	$1.10	27	20
5.	SUPPLY_5	TPS62153	Switcher : 3V-17V,5Vout,1A,Buck,DCS-Control	5 V	1.0 A	95.5%	71	$1.16	28	25

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #3	12 V	2 A	VoutRipple=10%, SoftStart delay=50.0 µSec
2.	LOAD #1	3.3 V	1 A	VoutRipple=10%, SoftStart delay=50.0 µSec
3.	LOAD #2	5 V	1 A	VoutRipple=10%, SoftStart delay=50.0 µSec

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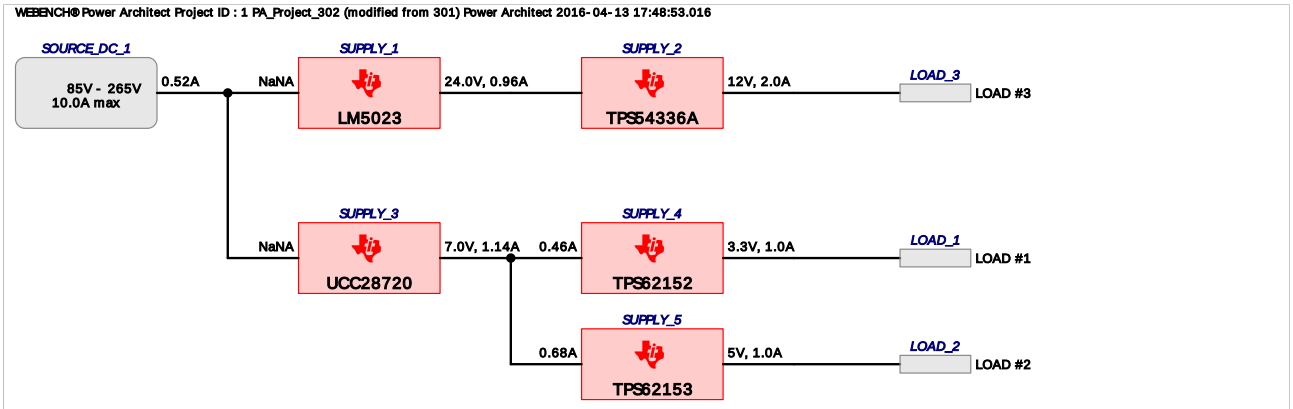
Project Diagram



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
Panasonic	16SVPF1000M	CAPSMT_62_F12	1	$0.74	151
Panasonic	20SVPF390M	CAPSMT_62_E12	1	$0.63	106
Rubycon	400KXW100MEFC16X30	CAPPR750W80D1600H3000	1	$1.65	272
Diodes Inc.	B240A-13-F	SMA	1	$0.09	37
NXP Semiconductor	BZX585-C22,115	SOD-523	1	$0.02	5
Kemet	C0201C101K3GACTU	0201	1	$0.01	2
Kemet	C0805C102K5RACTU	0805	1	$0.01	7
Kemet	C0805C104K5RACTU	0805	3	$0.01	20
TDK	C2012C0G2E102J	0805	1	$0.02	7
TDK	C3216X5R1E476M160AC	1206	1	$0.35	11
TDK	C4532JB3D222K	1812	1	$0.16	23
Bourns	CD1408-FU1400	Diode_1408	1	$0.13	13
Samsung Electro-Mechanics	CL21C111JBANNNC	0805	1	$0.01	7
Samsung Electro-Mechanics	CL21C201JBANNNC	0805	1	$0.01	7
Vishay-Dale	CRCW0402100KFKED	0402	3	$0.01	9
Vishay-Dale	CRCW040210K0FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040210K2FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04021K74FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04021R00FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040220K5FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04022M00FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040231K6FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04023K01FKED	0402	1	$0.01	3
Vishay-Dale	CRCW0402432RFKED	0402	1	$0.01	3
Vishay-Dale	CRCW04024K64FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04024K99FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04025K11FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04027K15FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040288K7FKED	0402	1	$0.01	3
Vishay-Dale	CRCW0805100RFKEA	0805	1	$0.01	7
Vishay-Dale	CRCW08051R30FKEA	0805	1	$0.01	7
CUSTOM	CUSTOM	CUSTOM	4	$0.00	0
Vishay-Semiconductor	DF10SA	DF-S	2	$0.24	198
Taiyo Yuden	EMK212BJ106KG-T	0805	2	$0.05	14
Panasonic	ERJ-6ENF1962V	0805	1	$0.01	7
Panasonic	ERJ-8ENF10R0V	1206	1	$0.01	11
Panasonic	ERJ-8ENF2431V	1206	1	$0.01	11
Micro Commercial Components	ES1J-TP	SMA	2	$0.08	75
MuRata	GRM033C80J123KE01D	0201	1	$0.01	2
MuRata	GRM033R71C101KA01D	0201	2	$0.01	4
MuRata	GRM033R71C151KA01D	0201	1	$0.01	2
MuRata	GRM155R71E103KA01D	0402	2	$0.01	6
MuRata	GRM155R72A472KA01D	0402	1	$0.01	3
MuRata	GRM21BR61E475KA12L	0805	2	$0.03	14
MuRata	GRM31CR61C226ME15L	1206_190	1	$0.13	11
MuRata	GRM32ER7YA106KA12L	1210_280	1	$0.25	15
Taiyo Yuden	JMK212BJ226MG-T	0805	1	$0.06	7
Texas Instruments	LM5023MM-2/NOPB	MUA08A	1	$0.38	24
Taiyo Yuden	LMK212BJ226MG-T	0805	1	$0.12	7
ON Semiconductor	MBR0530T1G	SOD-123	2	$0.06	26
Rohm	MCR25JZHFLR390	1210	1	$0.03	15
ON Semiconductor	MMBZ5270BLT1G	SOT-23	1	$0.03	14
Diodes Inc.	MURS160-13-F	SMB	1	$0.11	44
California Eastern Laboratories	PS2811-1	SSOP-4	1	$0.38	111
Yageo America	RC0603FR-07160KL	0603	1	$0.01	5
Yageo America	RC0603FR-0722RL	0603	1	$0.01	5
Bourns	SDR0403-2R2ML	SDR0403	2	$0.18	55
Bourns	SRR1208-330YL	SRR1208	1	$0.37	216
STMicroelectronics	STB4NK60ZT4	DDPAK	1	$0.53	210
STMicroelectronics	STN2580	SOT-223	1	$0.19	76
STMicroelectronics	STU7NM60N	DPAK	1	$0.00	102
Texas Instruments	TL431AIDBZR	DBZ0003A	1	$0.08	14
Texas Instruments	TPS54336ADDAR	R-PDSO-G8	1	$0.90	57
Texas Instruments	TPS62152RGTR	S-PVQFN-N16	1	$0.79	25
Texas Instruments	TPS62153RGTR	S-PVQFN-N16	1	$0.79	25
Texas Instruments	UCC28720DR	R-PDSO-G7	1	$0.40	55
TDK	VLCF4028T-471MR14-2	VLCF4028	1	$0.36	25

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Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
Total			82	$11.34	2220.323

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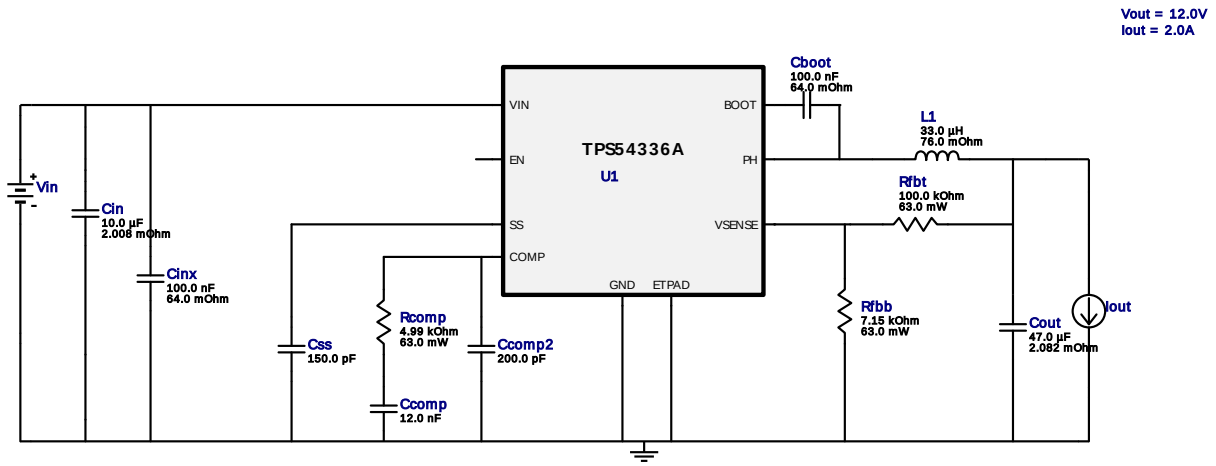
WEBENCH ® Design Report

Vout = 12.0V
Iout = 2.0A

Device = TPS54336ADDAR
Topology = Buck
Created = 4/13/16 5:48:50 PM
BOM Cost = $1.95
BOM Count = 12
Total Pd = 1.35W

Design : 4079404/25 TPS54336ADDAR
TPS54336ADDAR 21.6V-26.4V to 12.00V @ 2.0A



Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
2.	Ccomp	MuRata	GRM033C80J123KE01D Series= X6S	Cap= 12.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
3.	Ccomp2	Samsung Electro-Mechanics	CL21C201JBANNNC Series= C0G/NP0	Cap= 200.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cin	MuRata	GRM32ER7YA106KA12L Series= X7R	Cap= 10.0 uF ESR= 2.008 mOhm VDC= 35.0 V IRMS= 4.6772 A	1	$0.25	1210_280 15 mm²
5.	Cinx	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
6.	Cout	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	1	$0.35	1206 11 mm²
7.	Css	MuRata	GRM033R71C151KA01D Series= X7R	Cap= 150.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
8.	L1	Bourns	SRR1208-330YL	L= 33.0 µH DCR= 76.0 mOhm	1	$0.37	SRR1208 216 mm²
9.	Rcomp	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

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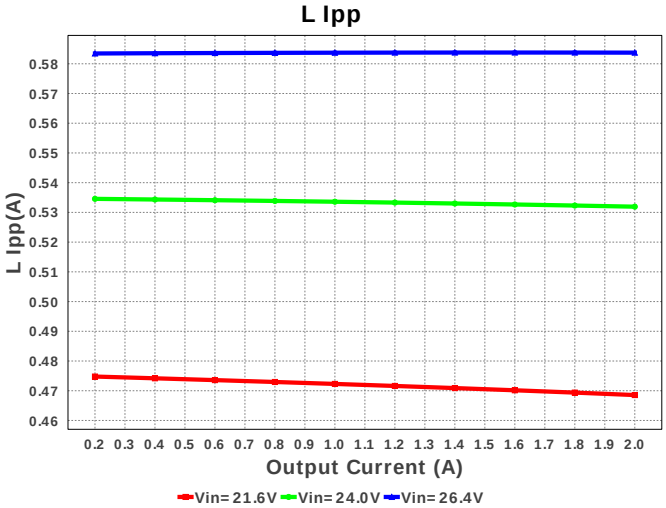
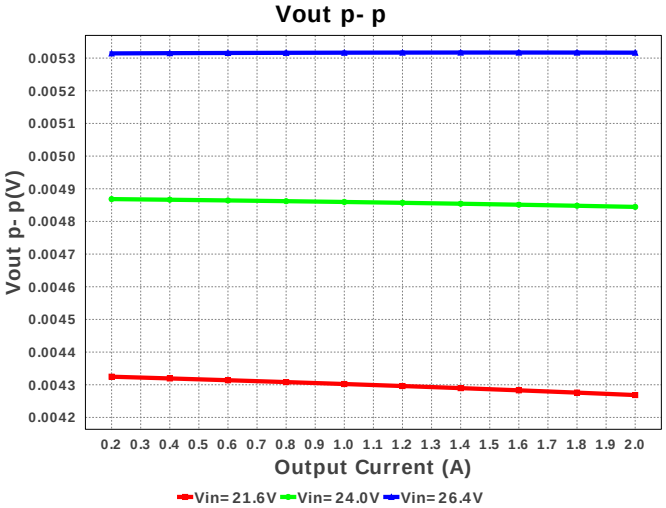
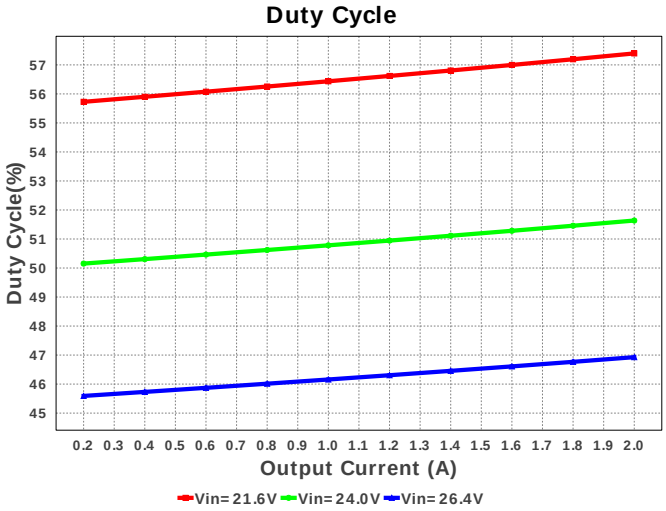
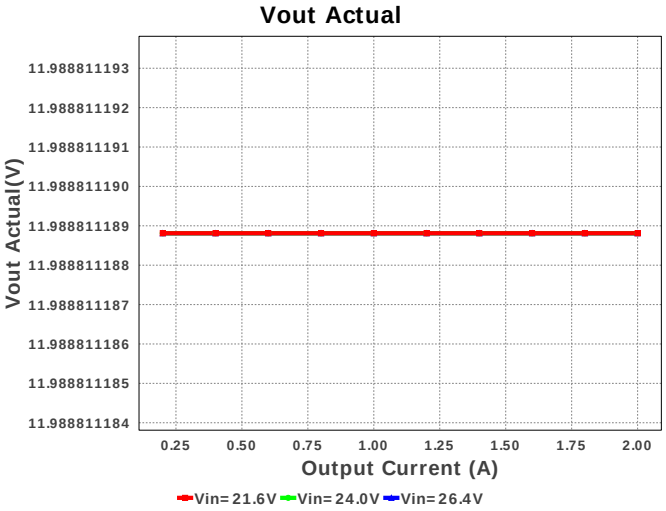
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Rfbb	Vishay-Dale	CRCW04027K15FKED Series= CRCW..e3	Res= 7.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
11.	Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
12.	U1	Texas Instruments	TPS54336ADDAR	Switcher	1	$0.90	

R-PDSO-G8 57 mm²









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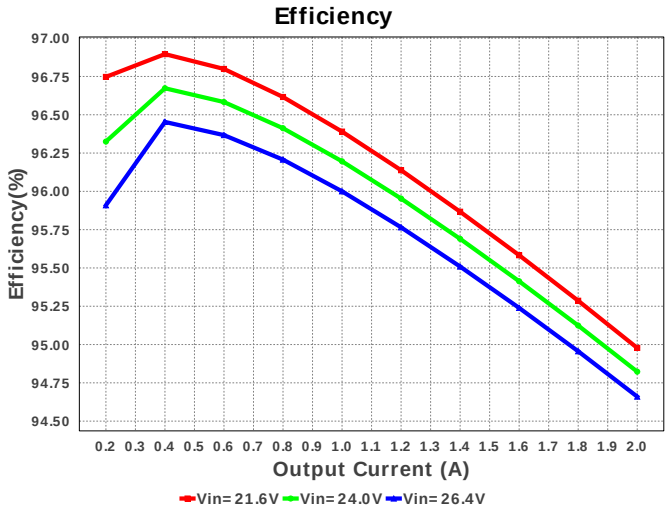

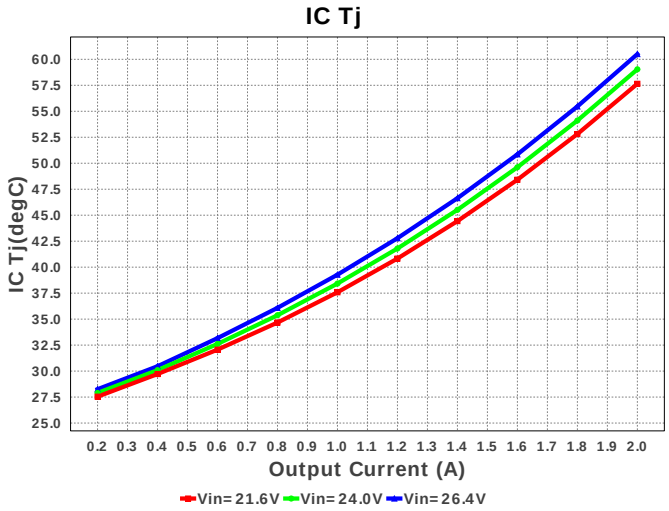

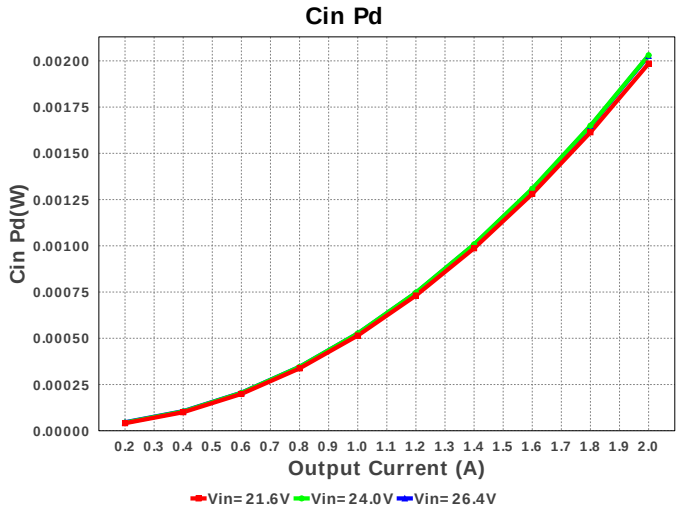

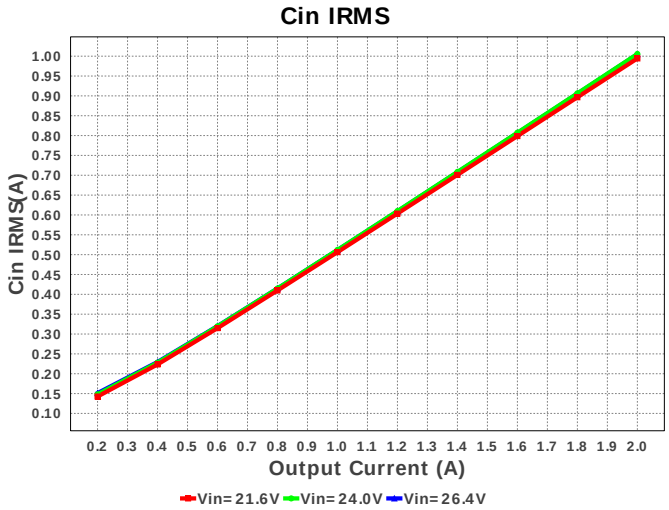

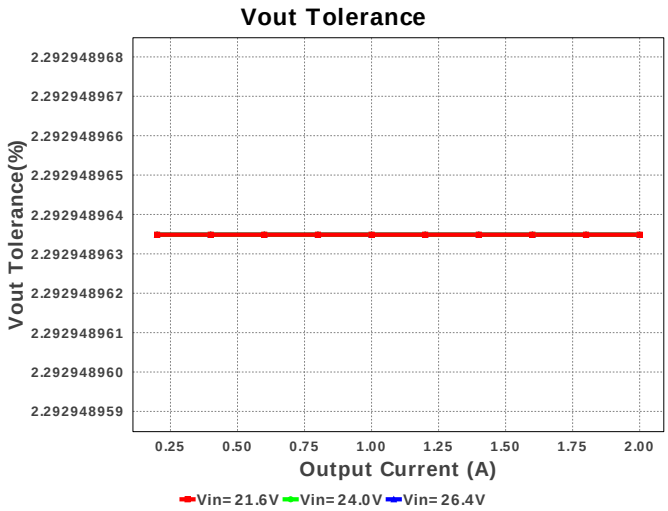

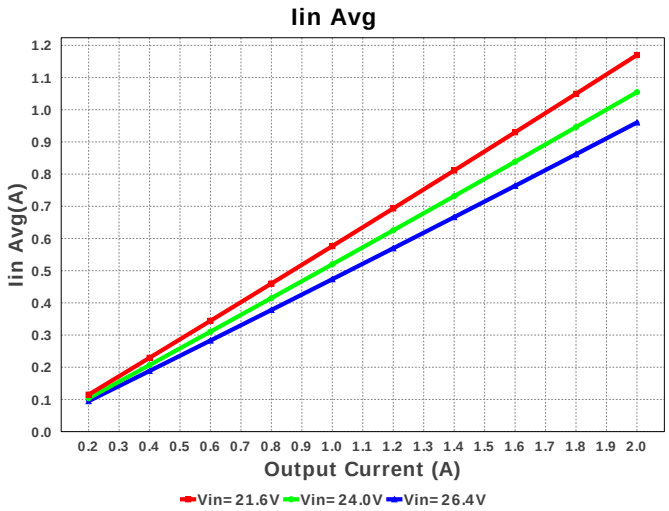

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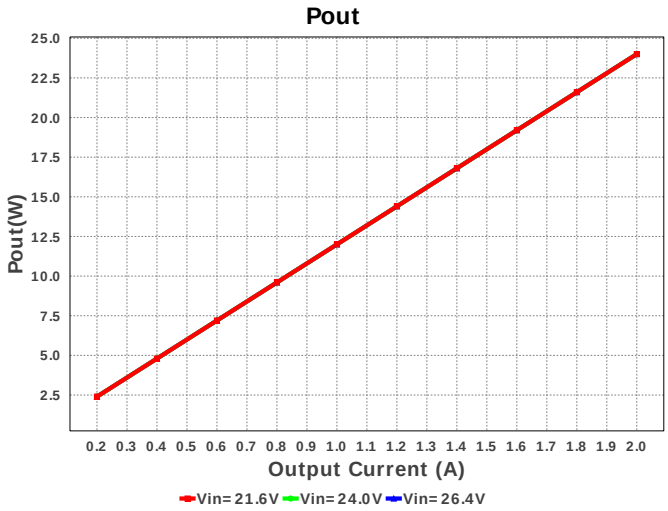

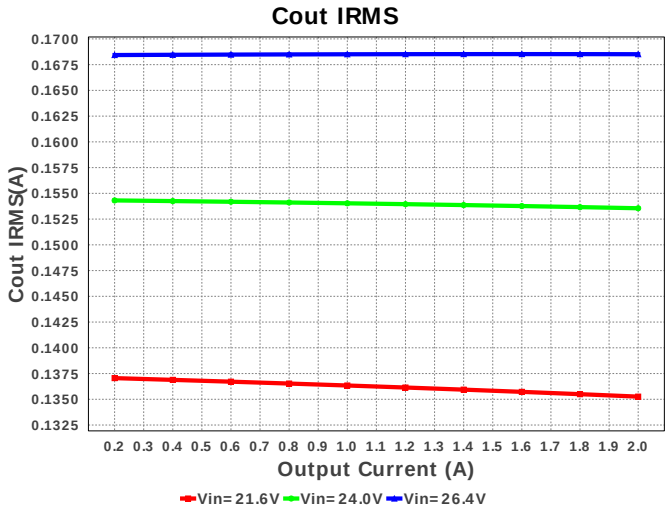

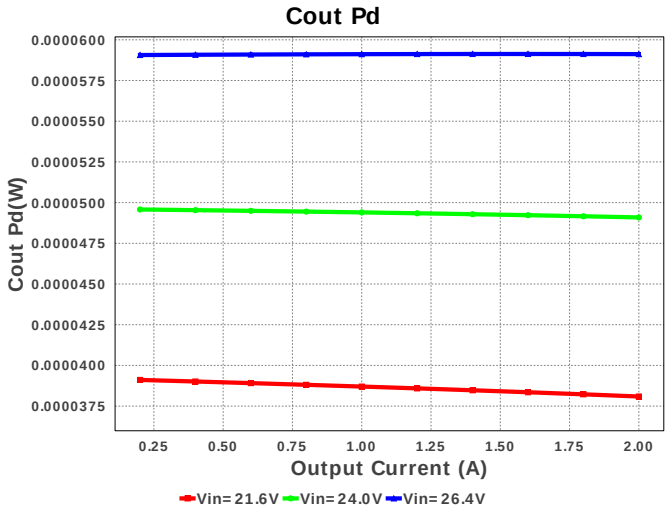

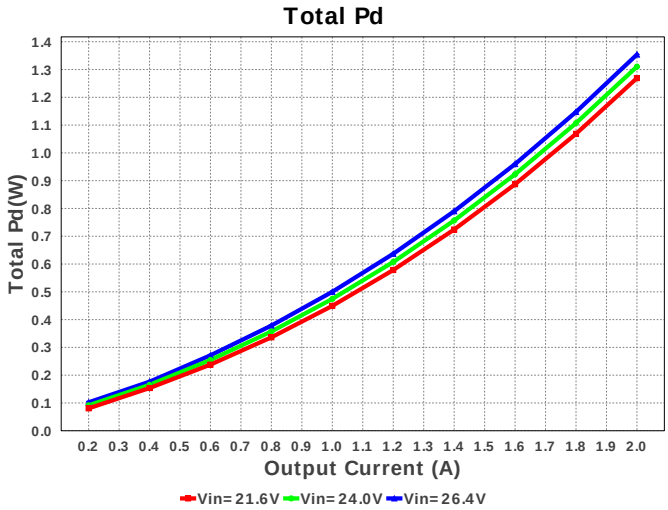

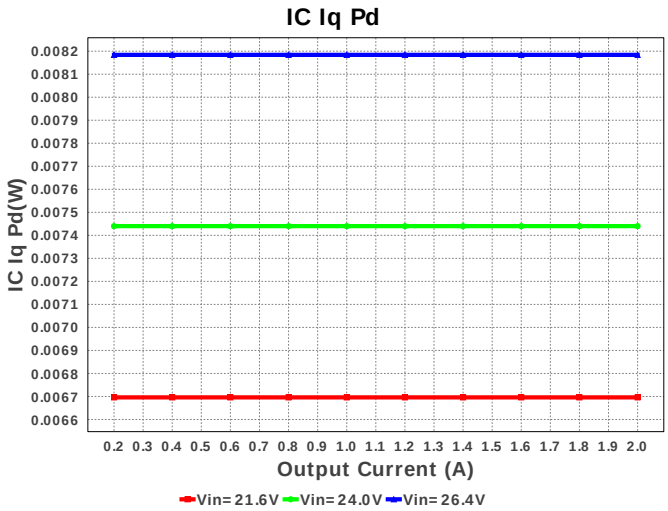

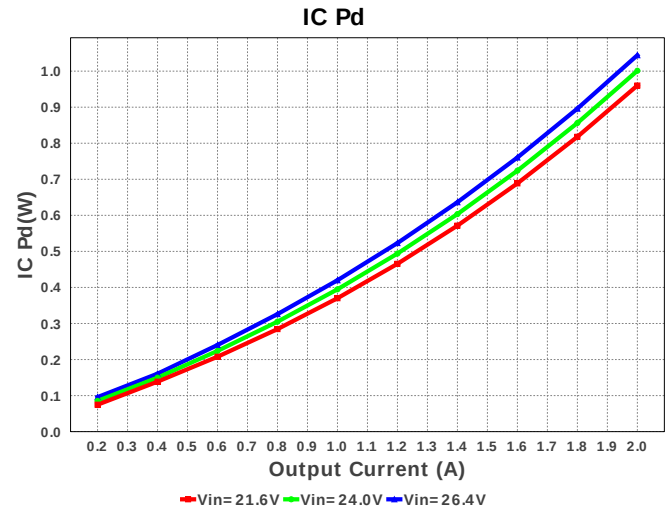

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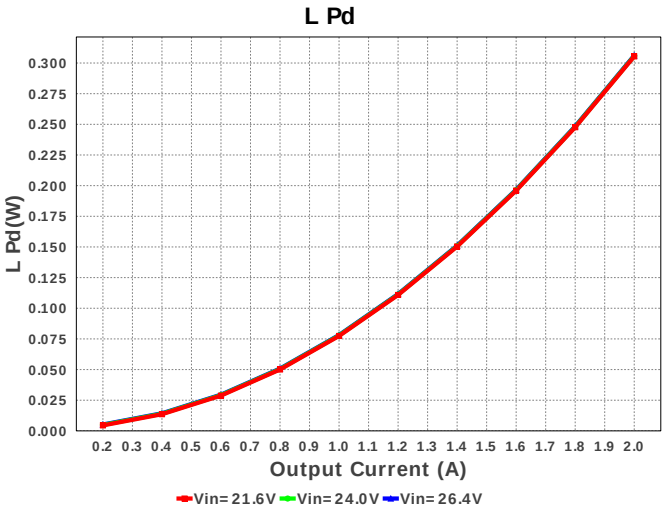
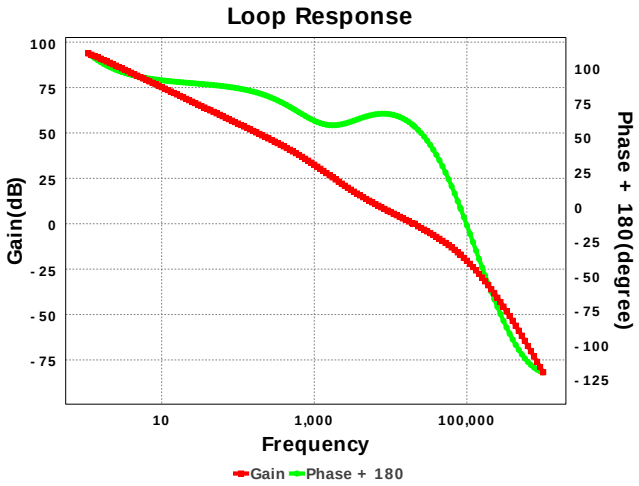




Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.005 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	168.512 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	960.37 mA	Current	Average input current
4.	L Ipp	583.74 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	12	General	Total Design BOM count
6.	FootPrint	333.0 mm^2	General	Total Foot Print Area of BOM components
7.	Frequency	340.0 kHz	General	Switching frequency
8.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
9.	Pout	24.0 W	General	Total output power
10.	Total BOM	$1.95	General	Total BOM Cost
11.	ICThetaJA Effective	34.0 degC/W	Op_Point	Effective IC Junction-to-Ambient Thermal Resistance
12.	Low Freq Gain	93.787 dB	Op_Point	Gain at 10Hz
13.	Vout Actual	11.989 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
14.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
15.	Cross Freq	19.819 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	46.928 %	Op_point	Duty cycle
17.	Efficiency	94.66 %	Op_point	Steady state efficiency
18.	Gain Marg	-16.956 dB	Op_point	Bode Plot Gain Margin
19.	IC Tj	60.502 degC	Op_point	IC junction temperature
20.	IOUT_OP	2.0 A	Op_point	Iout operating point
21.	Phase Marg	59.447 deg	Op_point	Bode Plot Phase Margin
22.	VIN_OP	26.4 V	Op_point	Vin operating point
23.	Vout p-p	5.317 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	2.027 mW	Power	Input capacitor power dissipation
25.	Cout Pd	59.121 µW	Power	Output capacitor power dissipation
26.	IC Iq Pd	8.184 mW	Power	IC Iq Pd
27.	IC Pd	1.044 W	Power	IC power dissipation
28.	L Pd	306.158 mW	Power	Inductor power dissipation
29.	Total Pd	1.354 W	Power	Total Power Dissipation
30.	Vout Tolerance	2.293 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	SoftStart	0.05 ms	Soft Start Time (ms)
3.	VinMax	26.4	Maximum input voltage
4.	VinMin	21.6	Minimum input voltage
5.	Vout	12.0	Output Voltage
6.	base_pn	TPS54336A	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	25.0	Ambient temperature

Design Assistance

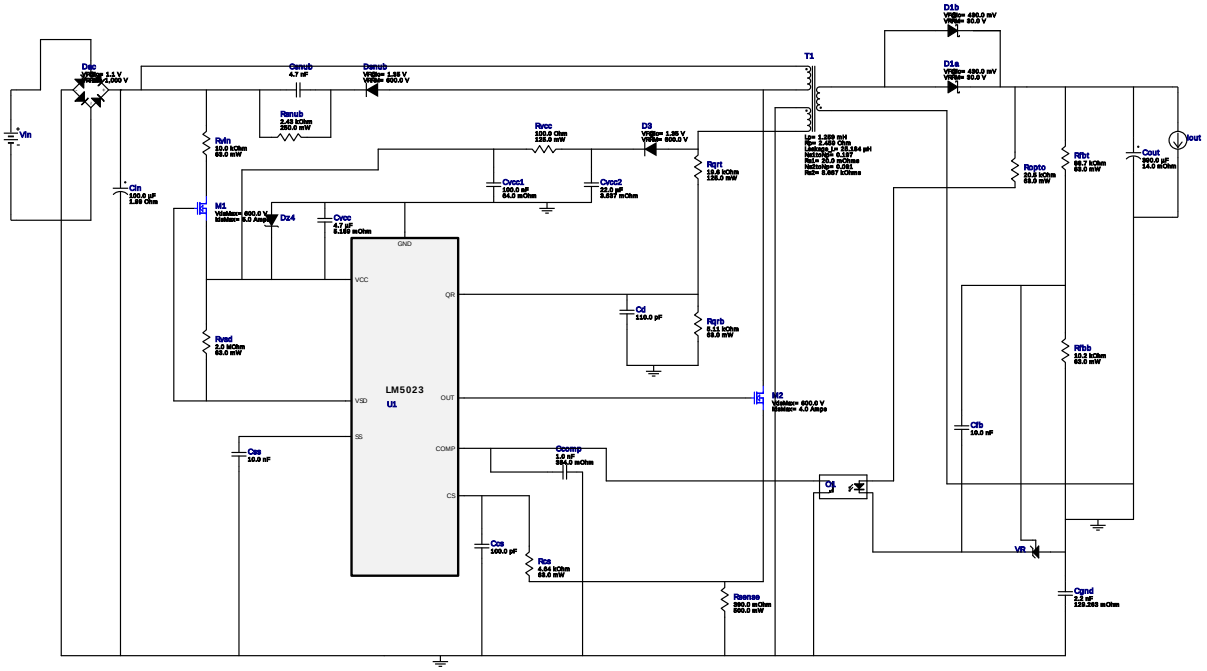
1. TPS54336A Product Folder : http://www.ti.com/product/TPS54336A : contains the data sheet and other resources.

WEBENCH ® Design Report

Vout = 24.0V
Iout = 0.96A

Device = LM5023MM-2/NOPB
Topology = Flyback
Created = 4/13/16 5:48:51 PM
BOM Cost = $0.00
BOM Count = 35
Total Pd = 1.11W

Design : 4079404/26 LM5023MM-2/NOPB
LM5023MM-2/NOPB 85.0V-265.0V to 24.19V @ 0.96037A



1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp	Kemet	C0805C102K5RACTU Series= X7R	Cap= 1.0 nF ESR= 384.0 mOhm VDC= 50.0 V IRMS= 214.0 mA	1	$0.01	0805 7 mm²
2.	Ccs	Kemet	C0201C101K3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
3.	Cd	Samsung Electro-Mechanics	CL21C111JBANNNC Series= C0G/NP0	Cap= 110.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cfb	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
5.	Cgnd	TDK	C4532JB3D222K Series= JB	Cap= 2.2 nF ESR= 129.263 mOhm VDC= 2.0 kV IRMS= 0.0 A	1	$0.16	1812 23 mm²

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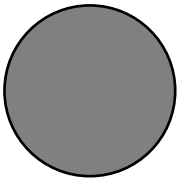
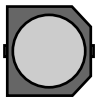
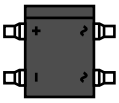
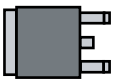
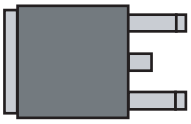
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
6.	Cin	Rubycon	400KXW100MEFC16X30 Series= ?	Cap= 100.0 uF ESR= 1.99 Ohm VDC= 400.0 V IRMS= 580.0 mA	1	$1.65	 CAPPR750W80D1600H3000 272 mm²
7.	Cout	Panasonic	20SVPF390M Series= SVPF	Cap= 390.0 uF ESR= 14.0 mOhm VDC= 20.0 V IRMS= 4.95 A	1	$0.63	 CAPSMT_62_E12 106 mm²
8.	Csnub	MuRata	GRM155R72A472KA01D Series= X7R	Cap= 4.7 nF VDC= 100.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
9.	Css	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
10.	Cvcc	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.03	 0805 7 mm²
11.	Cvcc1	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	 0805 7 mm²
12.	Cvcc2	MuRata	GRM31CR61C226ME15L Series= X5R	Cap= 22.0 uF ESR= 3.637 mOhm VDC= 16.0 V IRMS= 3.4771 A	1	$0.13	 1206_190 11 mm²
13.	D1a	ON Semiconductor	MBR0530T1G	VF@Io= 430.0 mV VRRM= 30.0 V	1	$0.06	 SOD-123 13 mm²
14.	D1b	ON Semiconductor	MBR0530T1G	VF@Io= 430.0 mV VRRM= 30.0 V	1	$0.06	 SOD-123 13 mm²
15.	D3	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	$0.08	 SMA 37 mm²
16.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
17.	Dsnub	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	$0.08	 SMA 37 mm²
18.	Dz4	NXP Semiconductor	BZX585-C22,115	Zener	1	$0.02	 SOD-523 5 mm²
19.	M1	STMicroelectronics	STU7NM60N	VdsMax= 600.0 V IdsMax= 5.0 Amps	1	NA	 DPAK 102 mm²
20.	M2	STMicroelectronics	STB4NK60ZT4	VdsMax= 600.0 V IdsMax= 4.0 Amps	1	$0.53	 DDPAK 210 mm²
21.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.38	 SSOP-4 111 mm²

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#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
22.	Rcs	Vishay-Dale	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
23.	Rfbb	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
24.	Rfbt	Vishay-Dale	CRCW040288K7FKED Series= CRCW..e3	Res= 88.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
25.	Ropto	Vishay-Dale	CRCW040220K5FKED Series= CRCW..e3	Res= 20.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
26.	Rqrb	Vishay-Dale	CRCW04025K11FKED Series= CRCW..e3	Res= 5.11 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
27.	Rqrt	Panasonic	ERJ-6ENF1962V Series= ERJ-6E	Res= 19.6 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
28.	Rsense	Rohm	MCR25JZHFLR390 Series= MCR25	Res= 390.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.03	1210 15 mm²
29.	Rsnub	Panasonic	ERJ-8ENF2431V Series= ERJ-8E	Res= 2.43 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
30.	Rvcc	Vishay-Dale	CRCW0805100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
31.	Rvin	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
32.	Rvsd	Vishay-Dale	CRCW04022M00FKED Series= CRCW..e3	Res= 2.0 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
33.	T1	CUSTOM	CUSTOM	Lp= 1.259 mH Rp= 2.459 Ohm Leakage_L= 25.184 µH Ns1toNp= 0.197 Rs1= 20.0 mOhms Ns2toNp= 0.091 Rs2= 8.687 kOhms	1	NA	CUSTOM 0 mm²
34.	U1	Texas Instruments	LM5023MM-2/NOPB	Switcher	1	$0.38	MUA08A 24 mm²
35.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	$0.08	DBZ0003A 14 mm²

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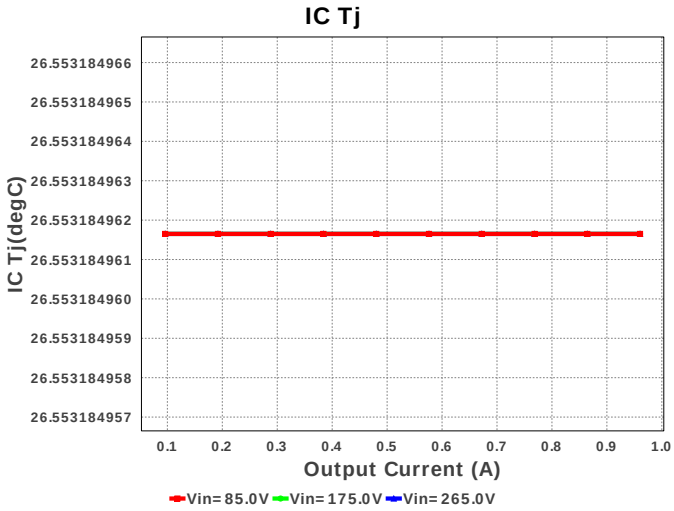

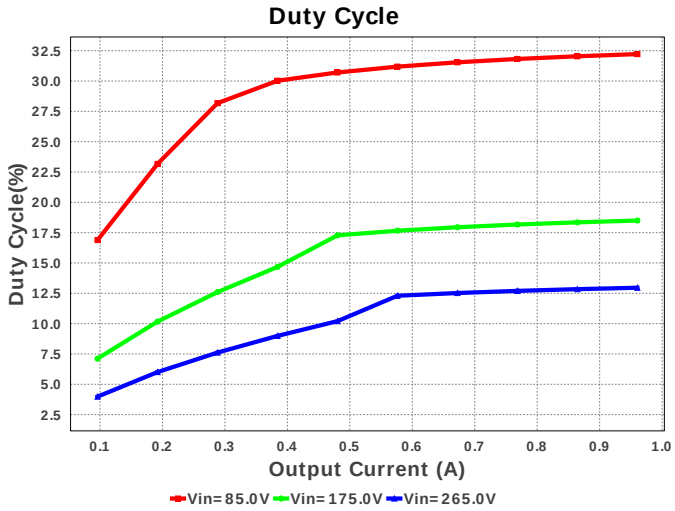

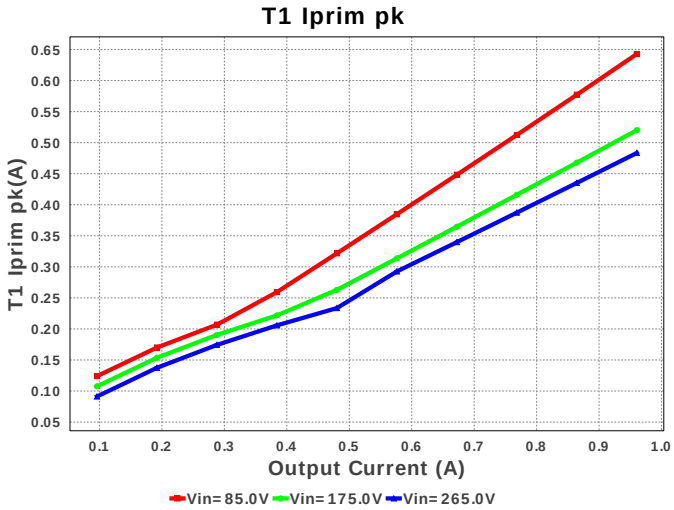

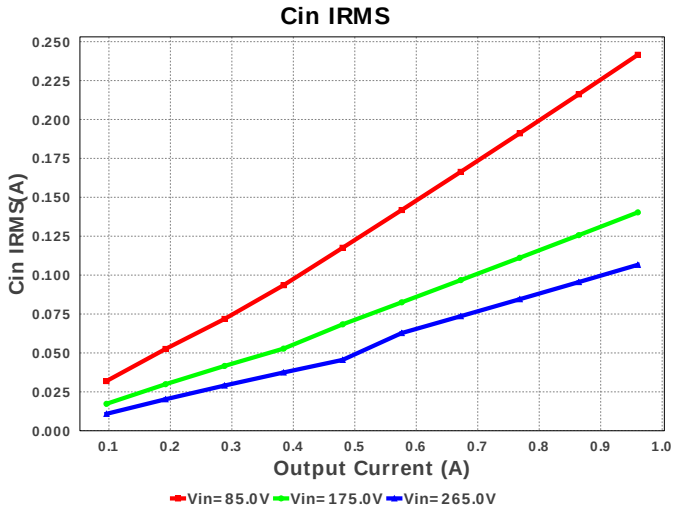

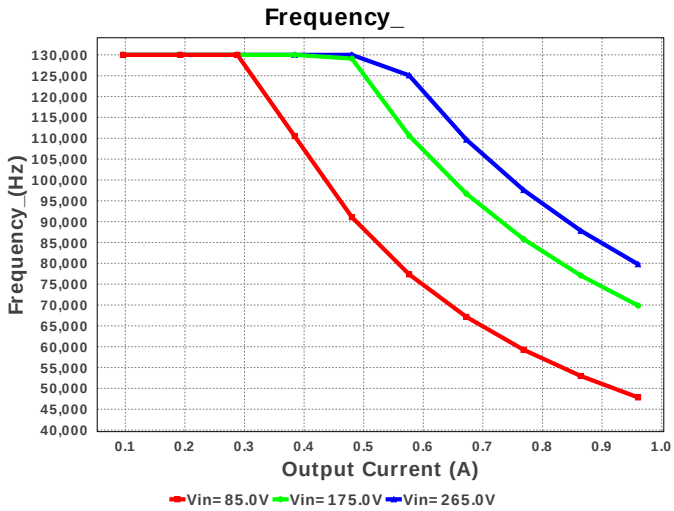

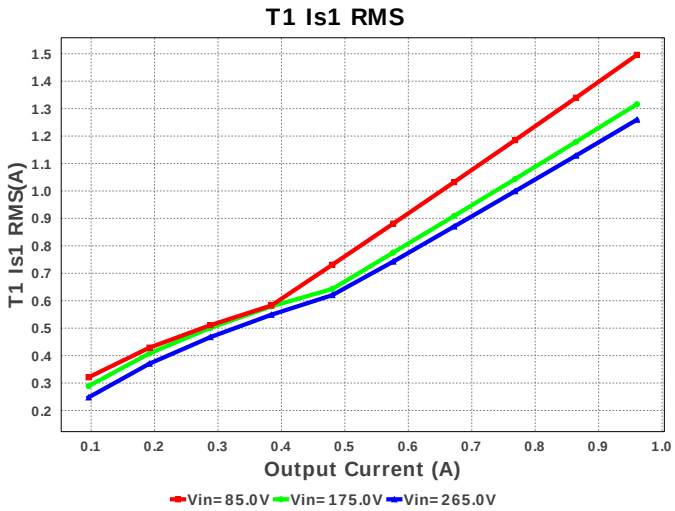

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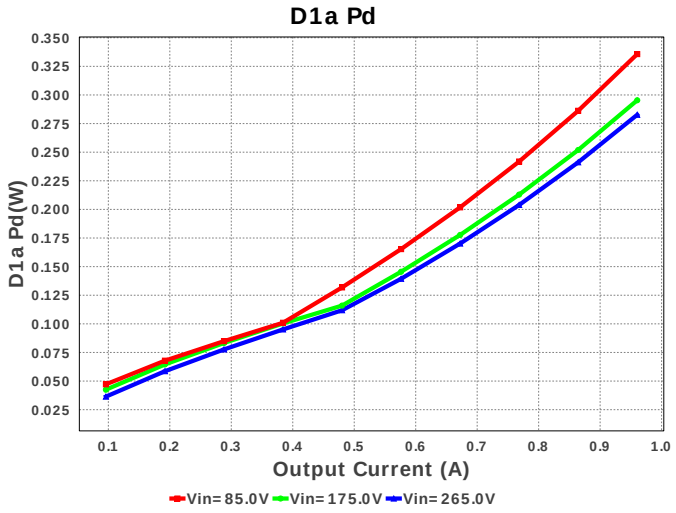
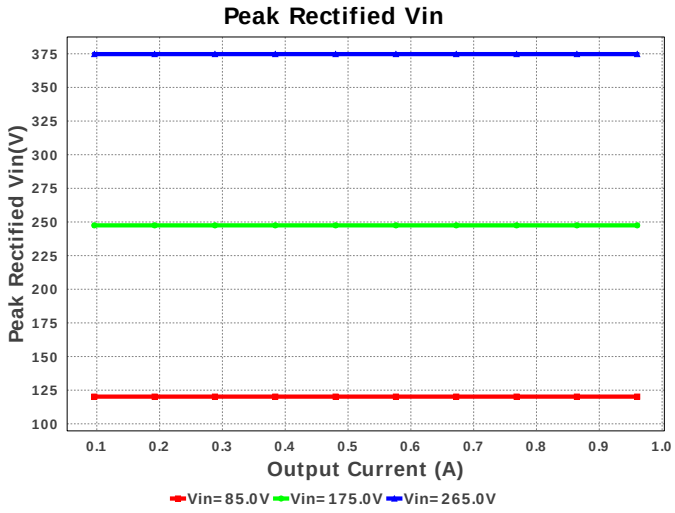
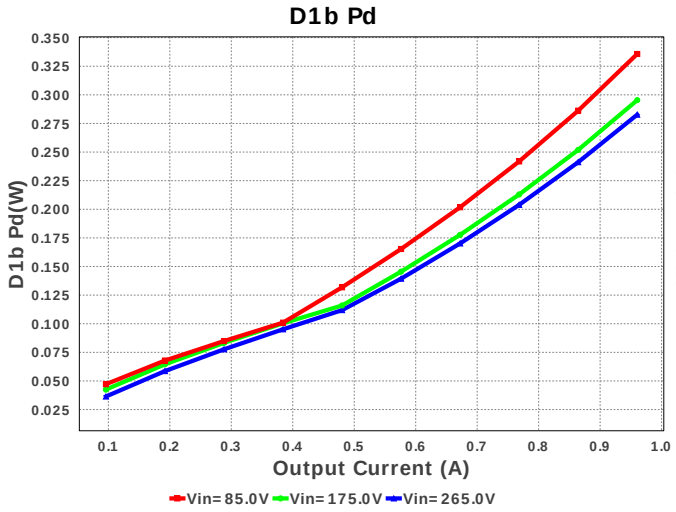
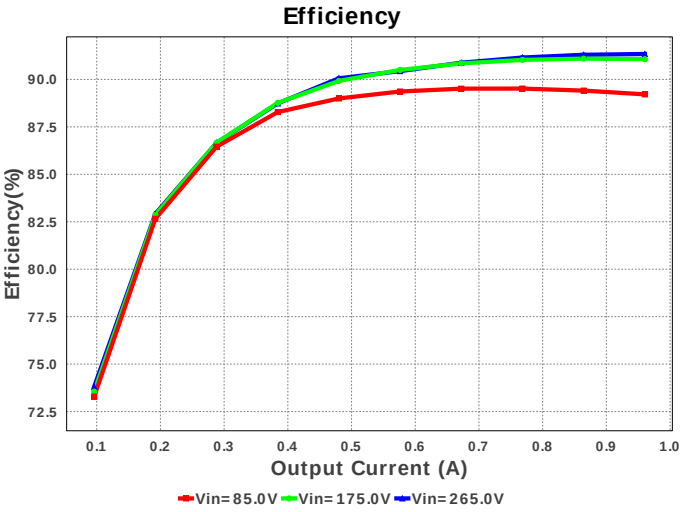
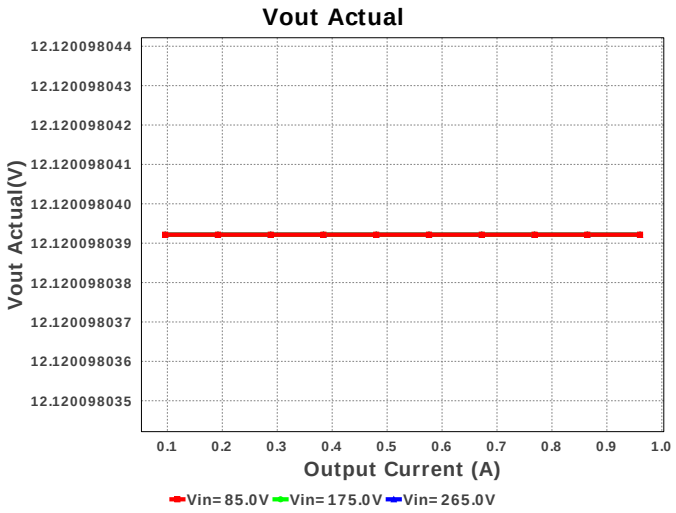
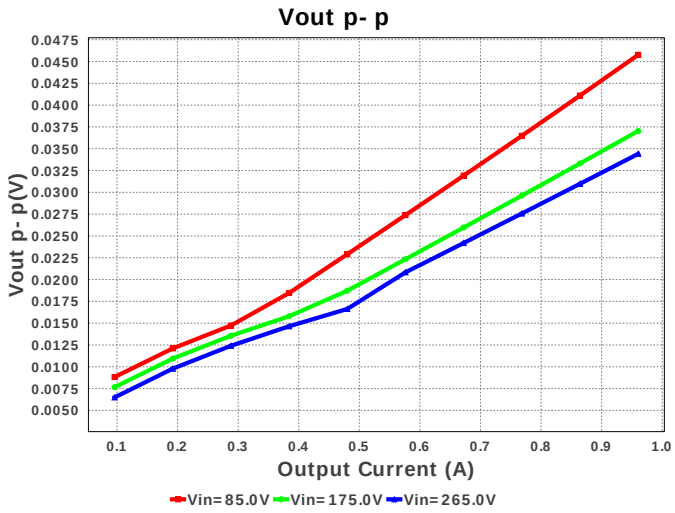

D1a Pd
D1a Pd(W)
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

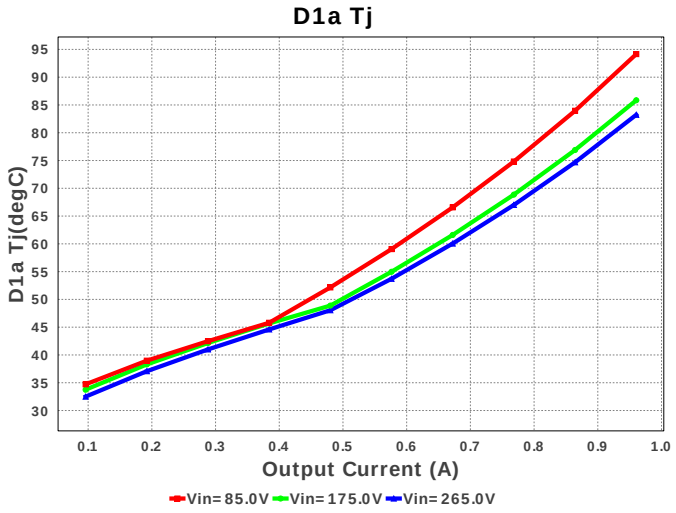

Peak Rectified Vin
Peak Rectified Vin(V)
375
350
325
300
275
250
225
200
175
150
125
100
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

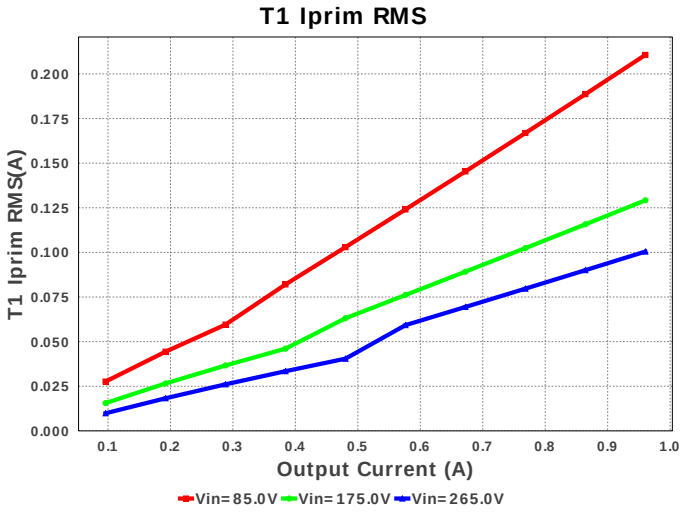

D1b Pd
D1b Pd(W)
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

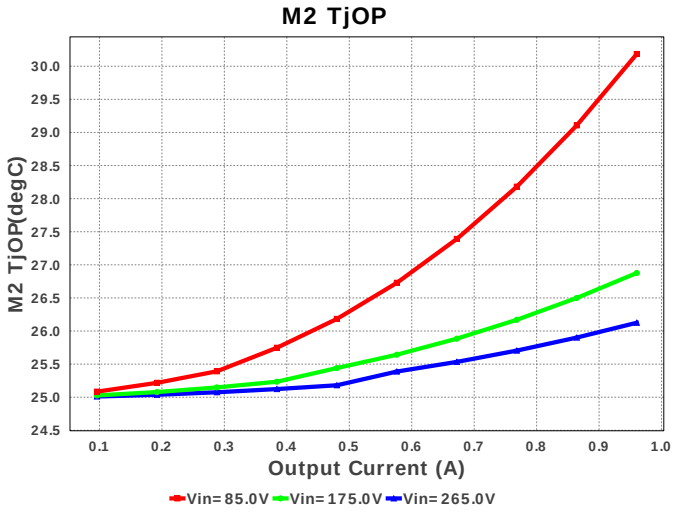

Efficiency
Efficiency(%)
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

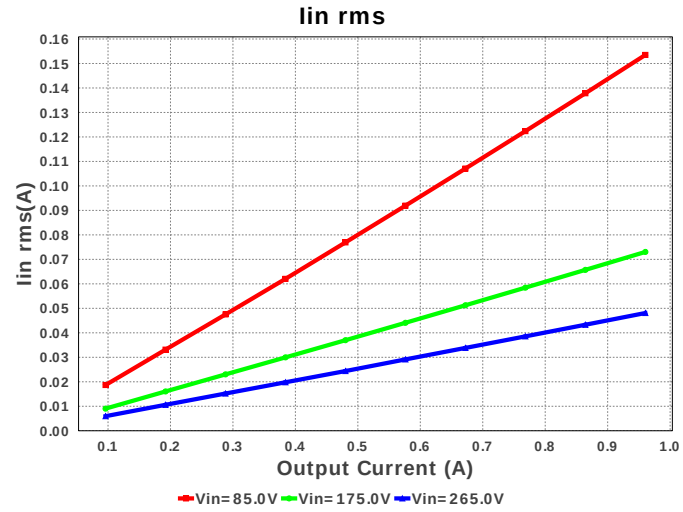

Vout Actual
Vout Actual(V)
12.120098044
12.120098043
12.120098042
12.120098041
12.120098040
12.120098039
12.120098038
12.120098037
12.120098036
12.120098035
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

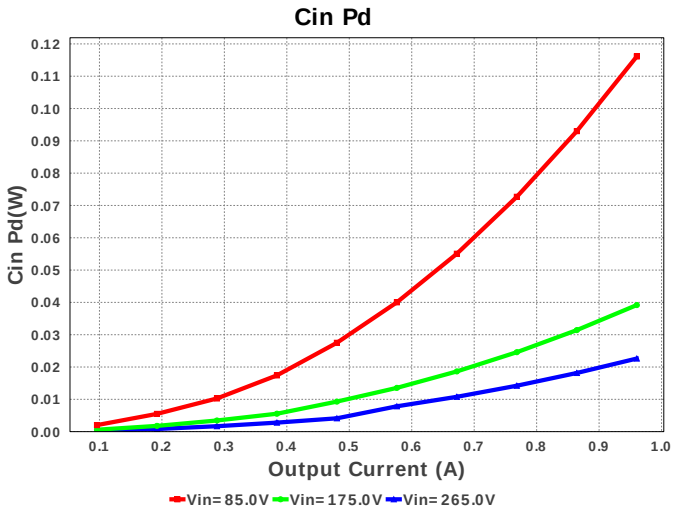

Vout p- p
Vout p- p(V)
0.0475
0.0450
0.0425
0.0400
0.0375
0.0350
0.0325
0.0300
0.0275
0.0250
0.0225
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

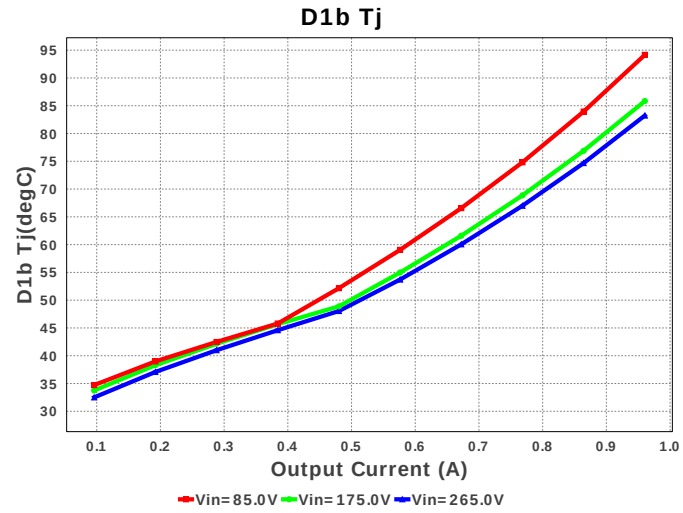

D1a Tj
D1a Tj(degC)
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=85.0V
Vin=175.0V
Vin=265.0V

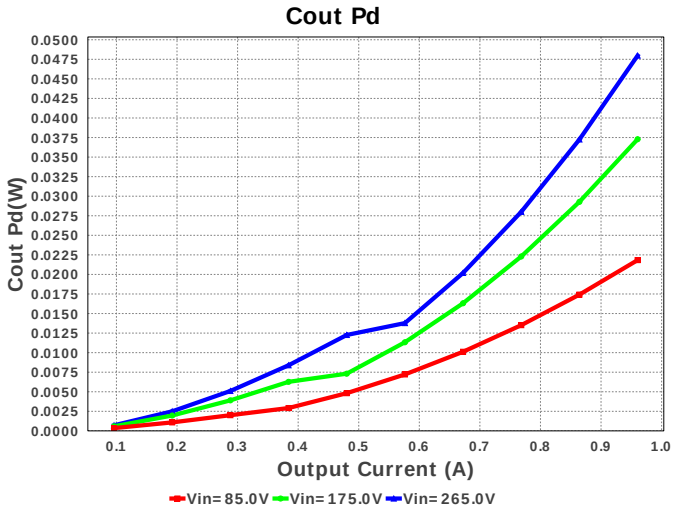

T1 Iprim RMS
T1 Iprim RMS(A)
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=85.0V
Vin=175.0V
Vin=265.0V

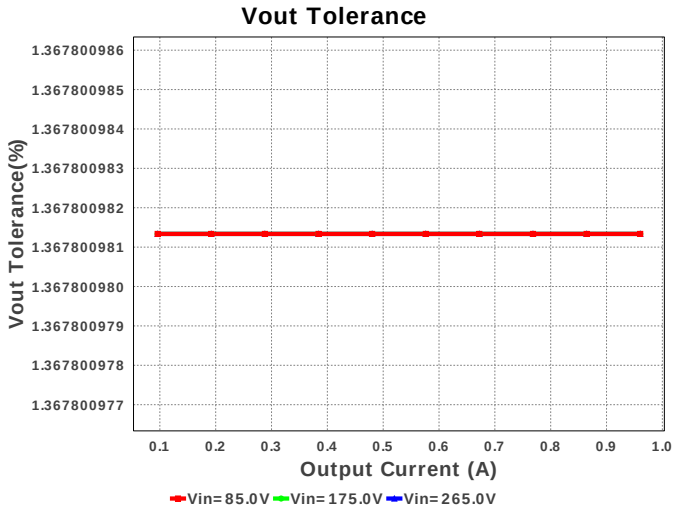

M2 TjOP
M2 TjOP(degC)
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
24.5
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=85.0V
Vin=175.0V
Vin=265.0V

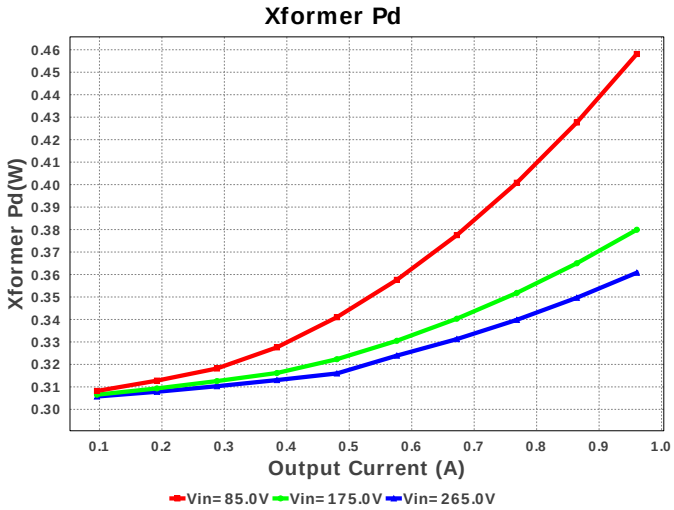

Iin rms
Iin rms(A)
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=85.0V
Vin=175.0V
Vin=265.0V

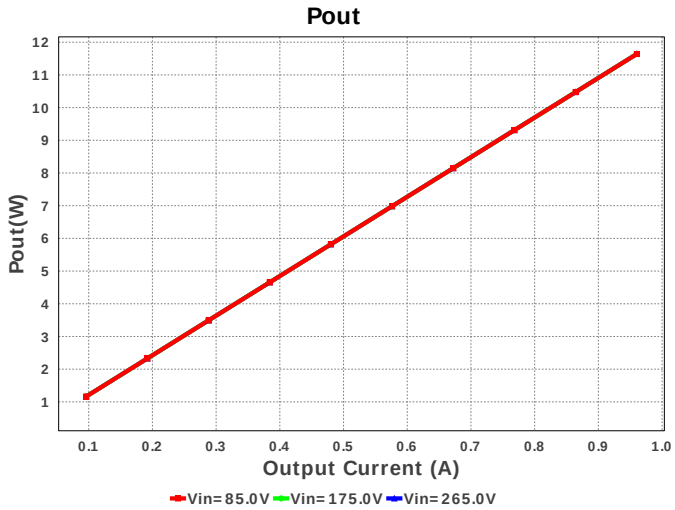

Cin Pd
Cin Pd(W)
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=85.0V
Vin=175.0V
Vin=265.0V

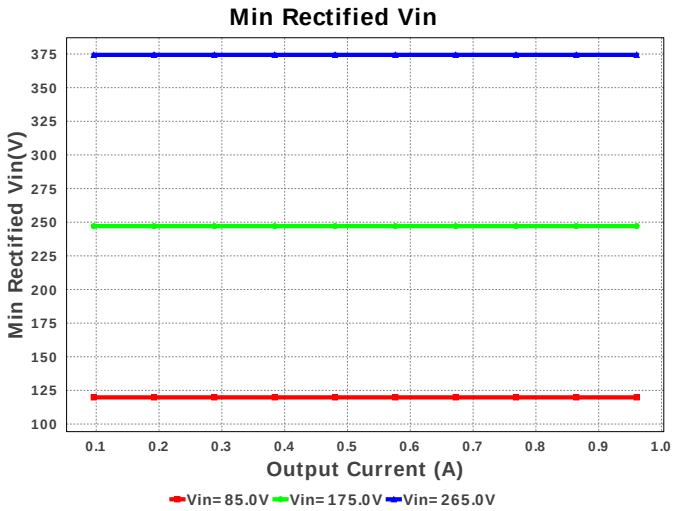

D1b Tj
D1b Tj(degC)
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=85.0V
Vin=175.0V
Vin=265.0V

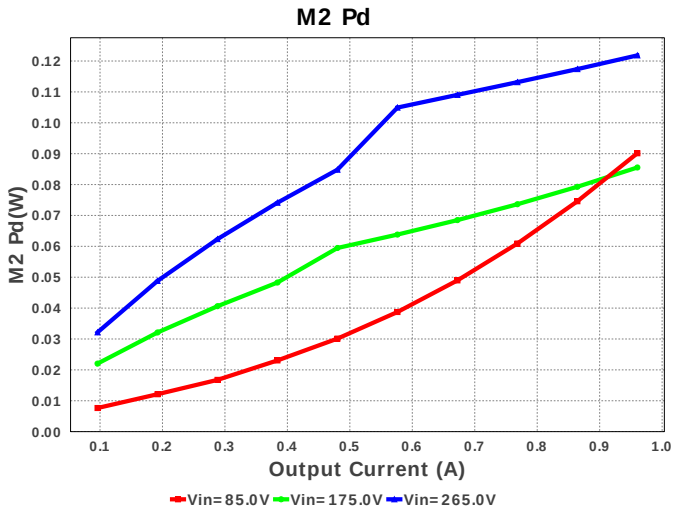












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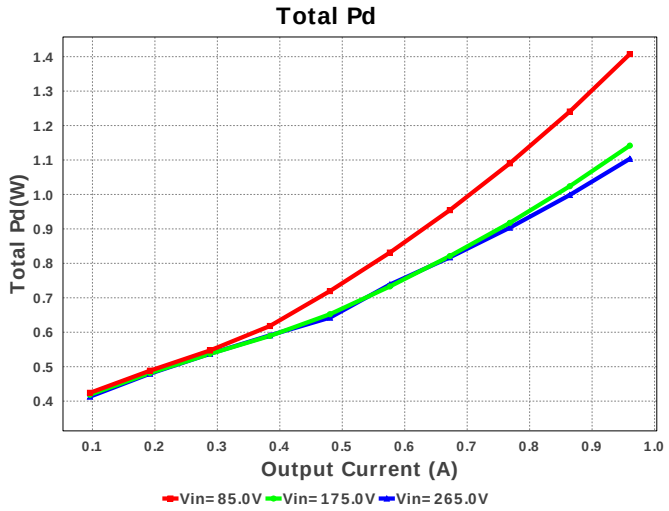
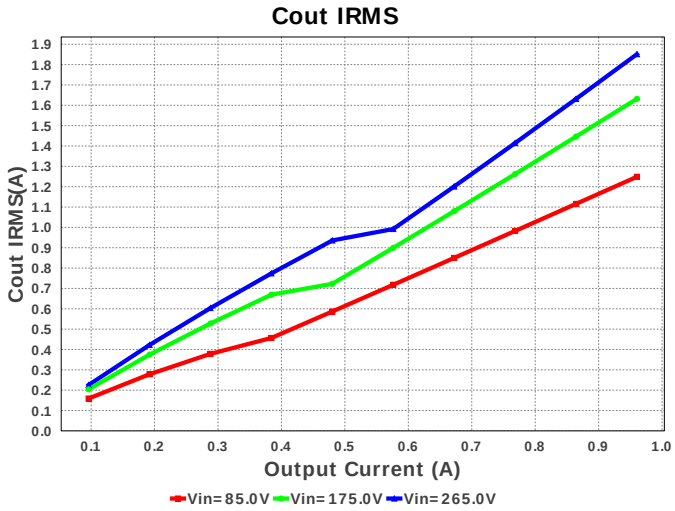
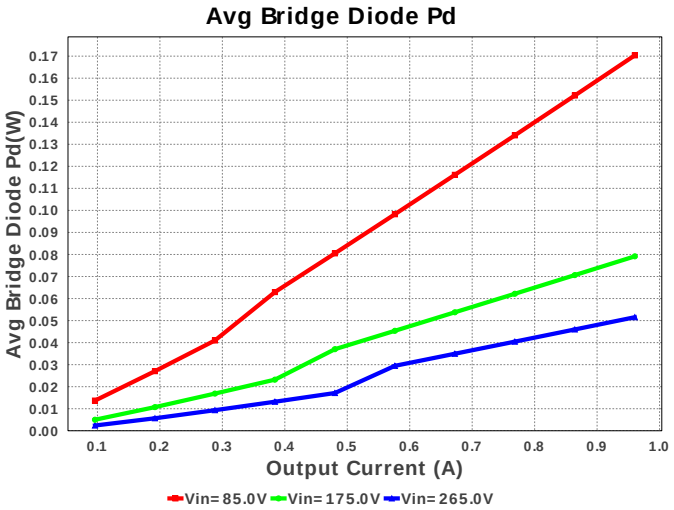
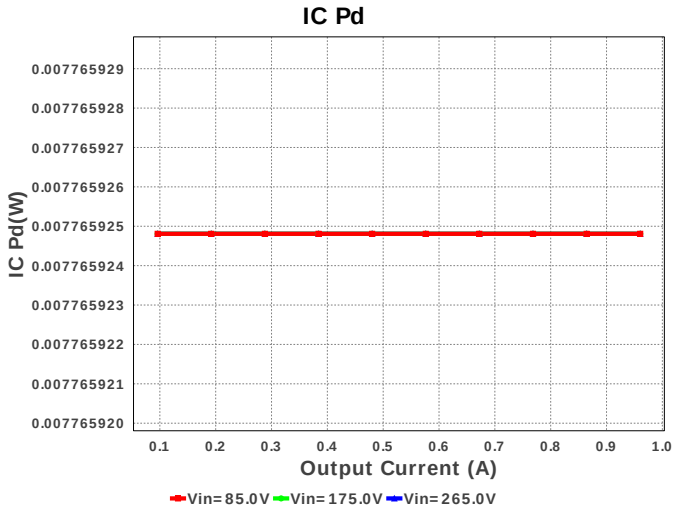
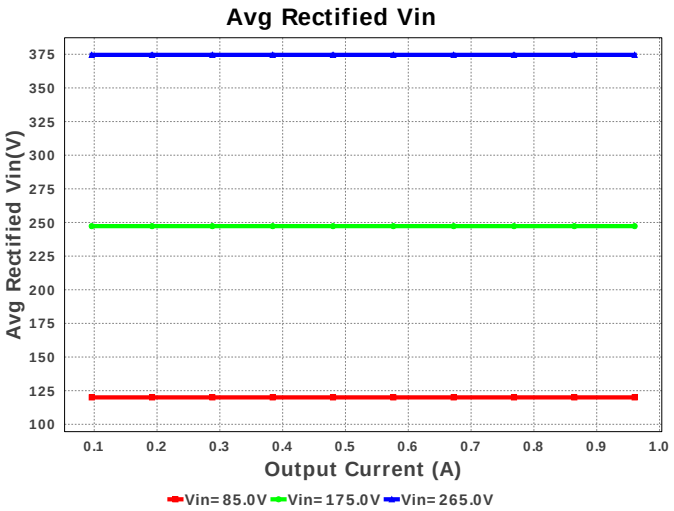
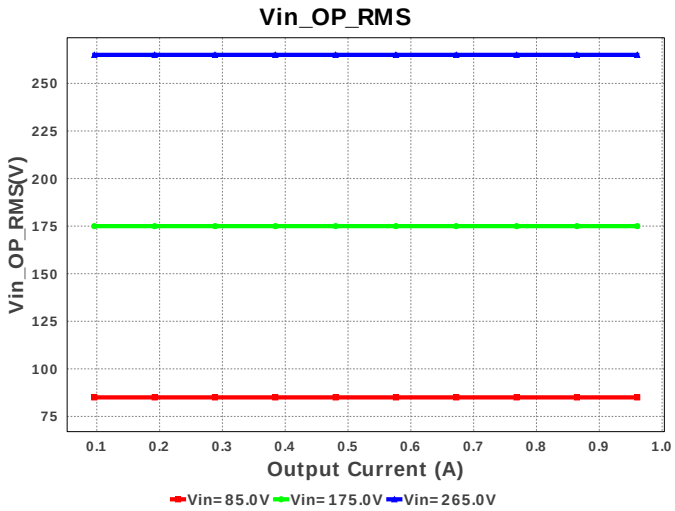

Total Pd
Total Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

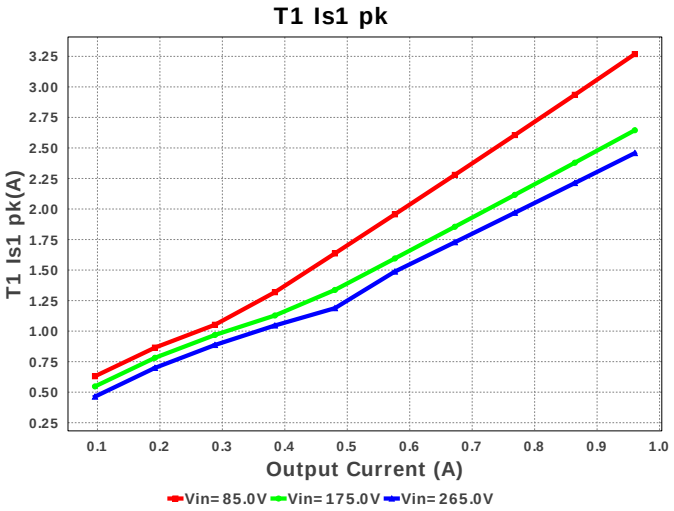

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Avg Bridge Diode Pd
Avg Bridge Diode Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Avg Rectified Vin
Avg Rectified Vin(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Vin_OP_RMS
Vin_OP_RMS(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	154.461 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	1.311 A	Current	Output capacitor RMS ripple current
3.	Iin rms	91.865 mA	Current	RMS Input Current
4.	T1 Iprim RMS	139.875 mA	Current	Transformer Primary RMS Current
5.	T1 Iprim pk	517.727 mA	Current	Transformer Primary Peak Current
6.	T1 Is1 RMS	1.014 A	Current	Transformer Secondary1 RMS Current
7.	T1 Is1 pk	2.633 A	Current	Transformer Secondary1 Peak Current
8.	Avg Rectified Vin	374.563 V	General	Average Rectified Voltage for the AC Line Period
9.	BOM Count	35	General	Total Design BOM count
10.	FootPrint	1.18 k mm^2	General	Total Foot Print Area of BOM components
11.	Pout	23.233 W	General	Total output power
12.	Total BOM	$0.0	General	Total BOM Cost
13.	D1a Tj	71.856 degC	Op_Point	D1 junction temperature
14.	D1b Tj	71.856 degC	Op_Point	D1 junction temperature
15.	Vout Actual	24.192 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	24.192 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	21.898 %	Op_point	Duty cycle
18.	Efficiency	95.436 %	Op_point	Steady state efficiency
19.	Frequency_	125.864 kHz	Op_point	Switching frequency
20.	IC Tj	28.229 degC	Op_point	IC junction temperature
21.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	960.37 mA	Op_point	Iout operating point
23.	M2 TjOP	27.209 degC	Op_point	M2 MOSFET junction temperature
24.	Min Rectified Vin	374.363 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	374.763 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	265.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	36.856 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	79.539 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	47.478 mW	Power	Input capacitor power dissipation
30.	Cout Pd	24.075 mW	Power	Output capacitor power dissipation
31.	D1a Pd	227.458 mW	Power	Diode1 power dissipation
32.	D1b Pd	227.458 mW	Power	Diode1 power dissipation
33.	IC Pd	16.144 mW	Power	IC power dissipation
34.	M2 Pd	162.709 mW	Power	M2 MOSFET total power dissipation
35.	Total Pd	1.111 W	Power	Total Power Dissipation
36.	Xformer Pd	406.321 mW	Power	Transformer power dissipation
37.	Vout Tolerance	1.275 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	960.37 m	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	85.0	Minimum input voltage
4.	Vout	24.0	Output Voltage
5.	base_pn	LM5023	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	25.0	Ambient temperature

Design Assistance

1. The feedback resistors will set the output voltage of the circuit. The values chosen may need to be fined tuned based on the final Transformer turns ratios and the voltage across the output diode at close to zero current. Please see the datasheet for further design guidance. http://www.ti.com/lit/ds/symlink/lm5023.pdf

2. LM5023 Product Folder : http://www.ti.com/product/LM5023 : contains the data sheet and other resources.

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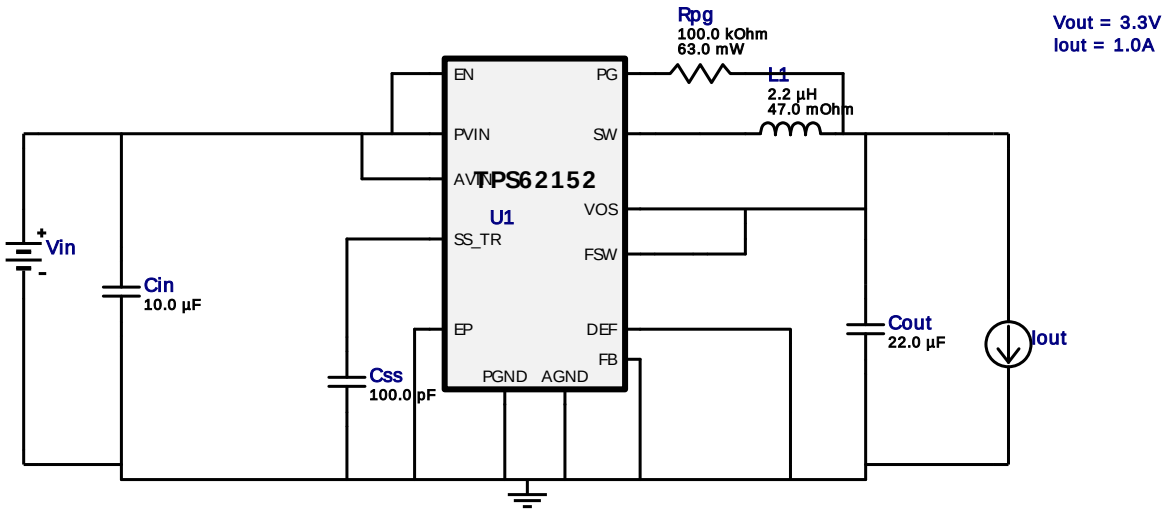
Vout = 3.3V
Iout = 1.0A

Device = TPS62152RGTR
Topology = Buck
Created = 4/13/16 5:48:51 PM
BOM Cost = $1.10
BOM Count = 6
Total Pd = 0.23W

Design : 4079404/27 TPS62152RGTR
TPS62152RGTR 6.3V-7.7V to 3.30V @ 1.0A



Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	Taiyo Yuden	EMK212BJ106KG-T Series= X5R	Cap= 10.0 uF VDC= 16.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
2.	Cout	Taiyo Yuden	JMK212BJ226MG-T Series= X5R	Cap= 22.0 uF VDC= 6.3 V IRMS= 0.0 A	1	$0.06	0805 7 mm²
3.	Css	MuRata	GRM033R71C101KA01D Series= X7R	Cap= 100.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
4.	L1	Bourns	SDR0403-2R2ML	L= 2.2 µH DCR= 47.0 mOhm	1	$0.18	SDR0403 28 mm²
5.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
6.	U1	Texas Instruments	TPS62152RGTR	Switcher	1	$0.79	S-PVQFN-N16 25 mm²

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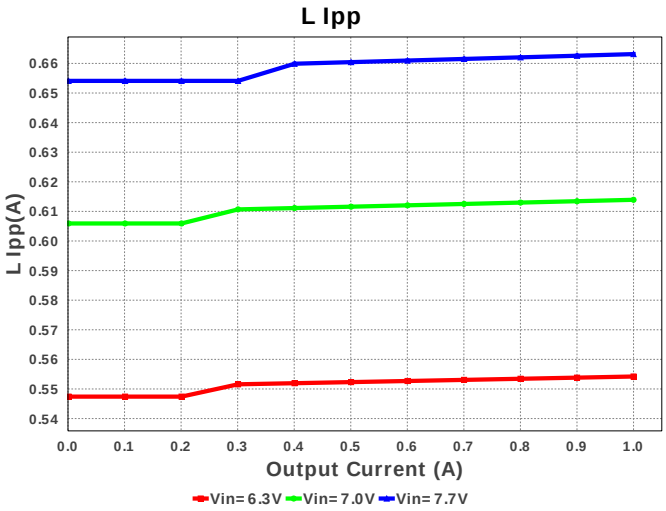
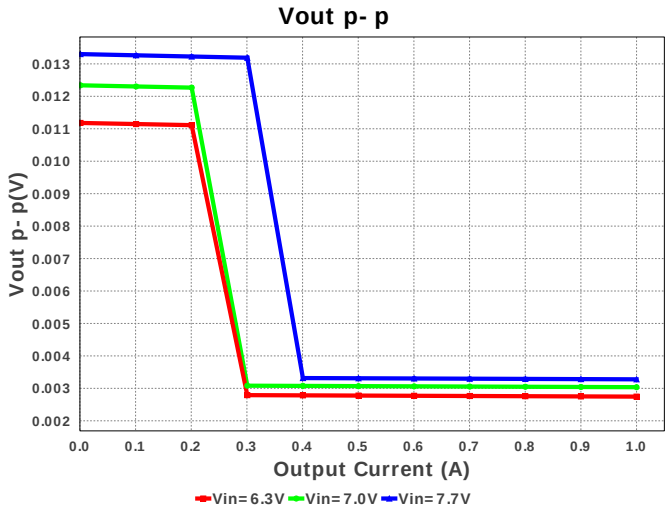
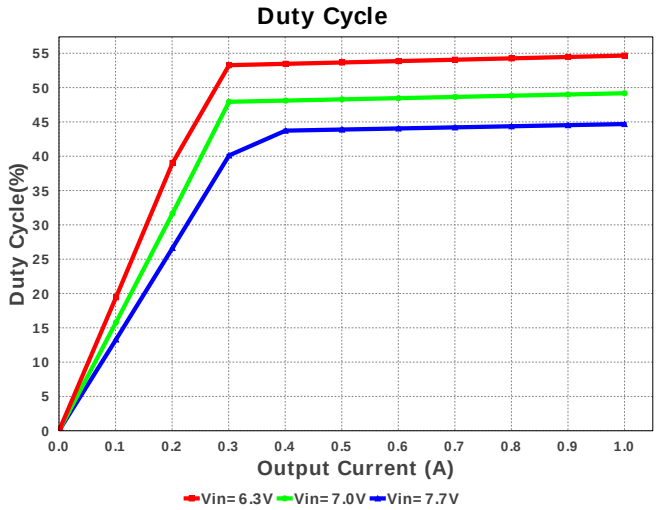
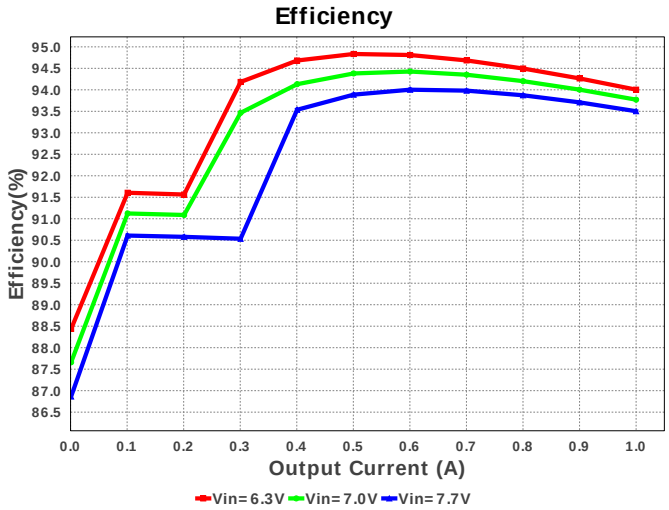
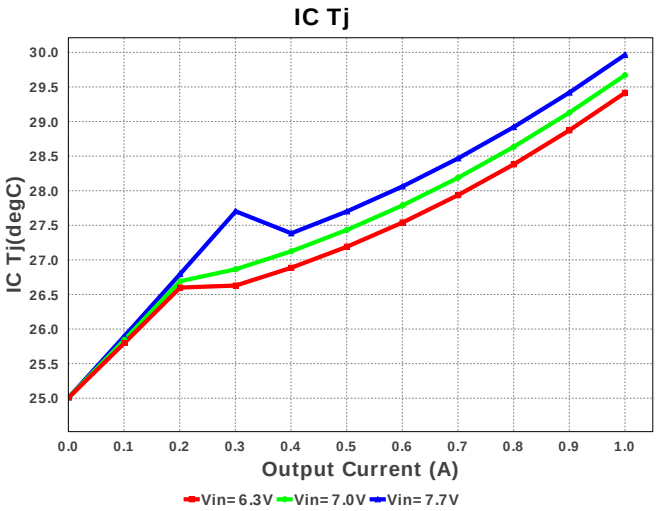
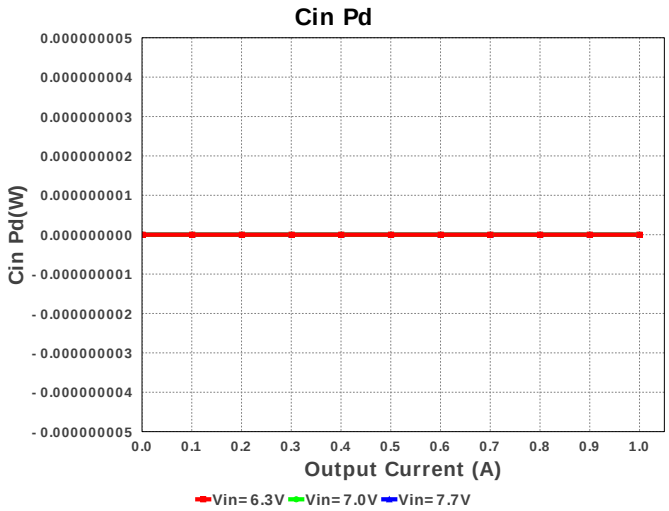

L Ipp
L Ipp(A)
0.66
0.65
0.64
0.63
0.62
0.61
0.60
0.59
0.58
0.57
0.56
0.55
0.54
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

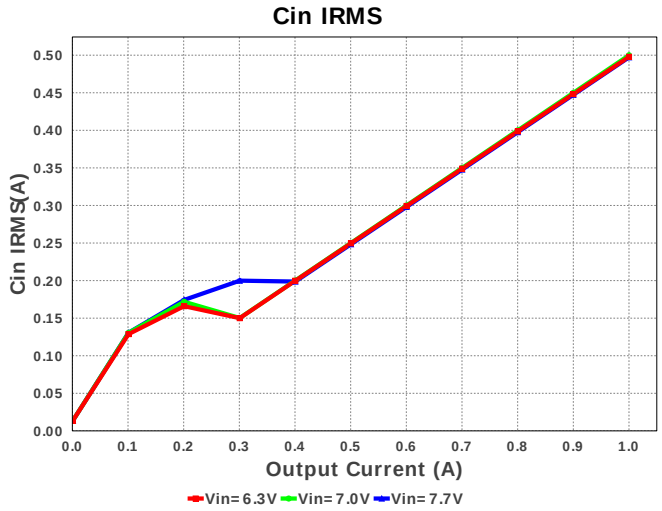

Vout p- p
Vout p- p(V)
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

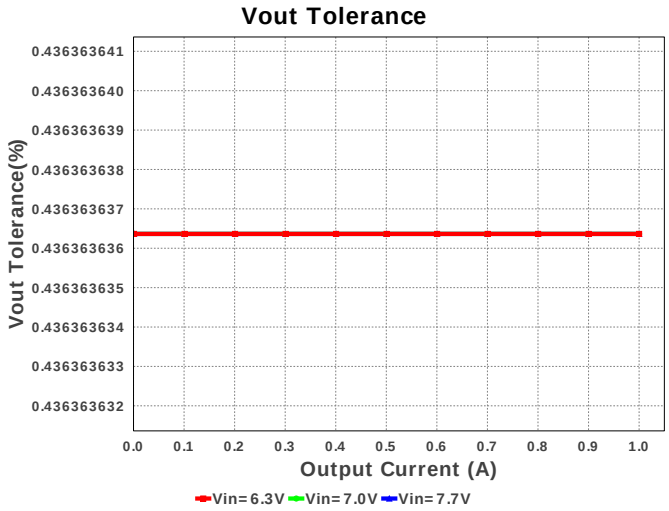

Duty Cycle
Duty Cycle(%)
55
50
45
40
35
30
25
20
15
10
5
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

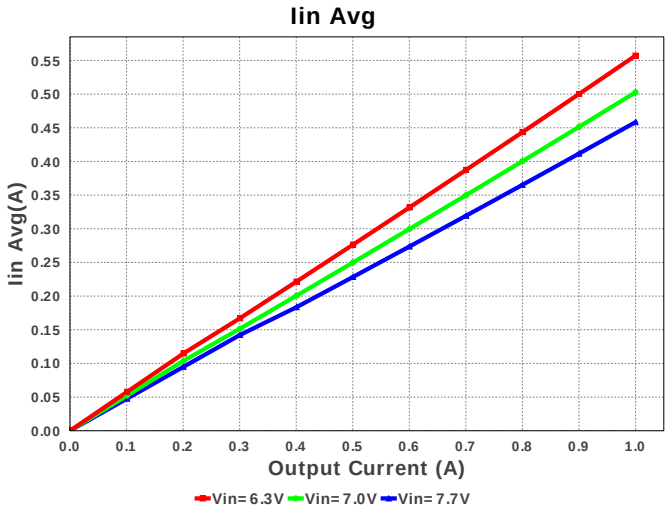

Efficiency
Efficiency(%)
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
88.5
88.0
87.5
87.0
86.5
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

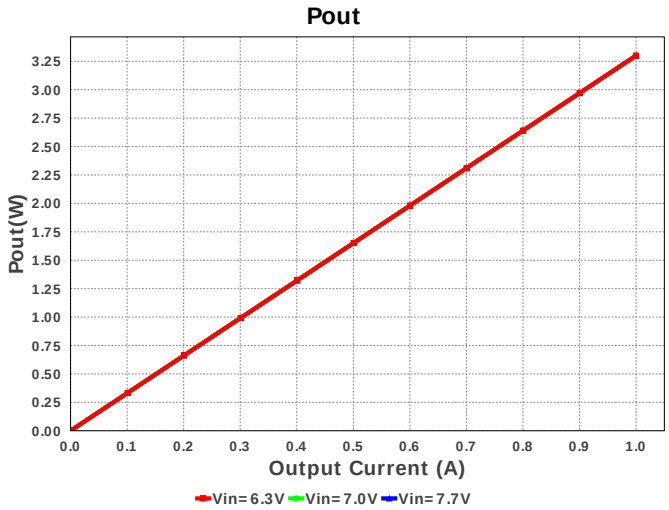

IC Tj
IC Tj(degC)
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

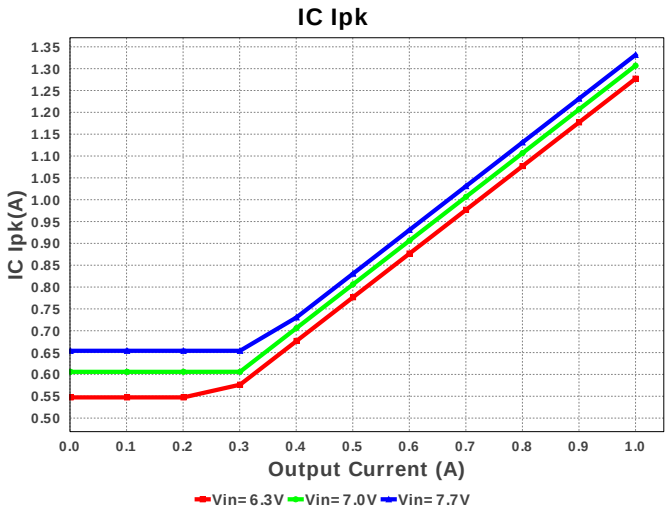

Cin Pd
Cin Pd(W)
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
- 0.000000001
- 0.000000002
- 0.000000003
- 0.000000004
- 0.000000005
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

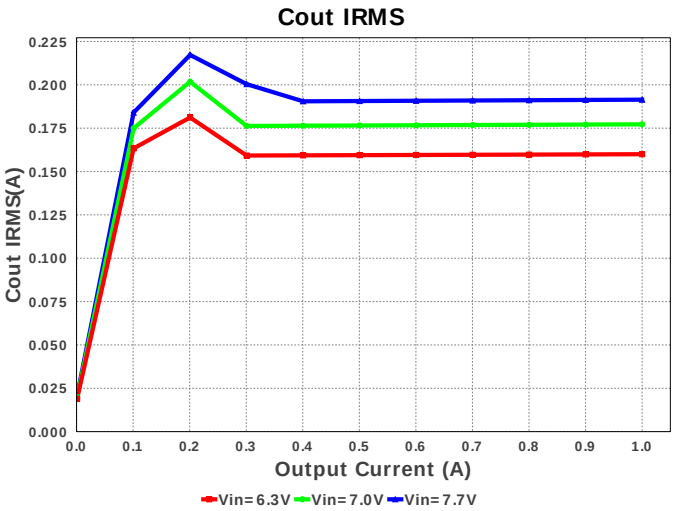

Cin IRMS
Cin IRMS(A)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=6.3V
Vin=7.0V
Vin=7.7V

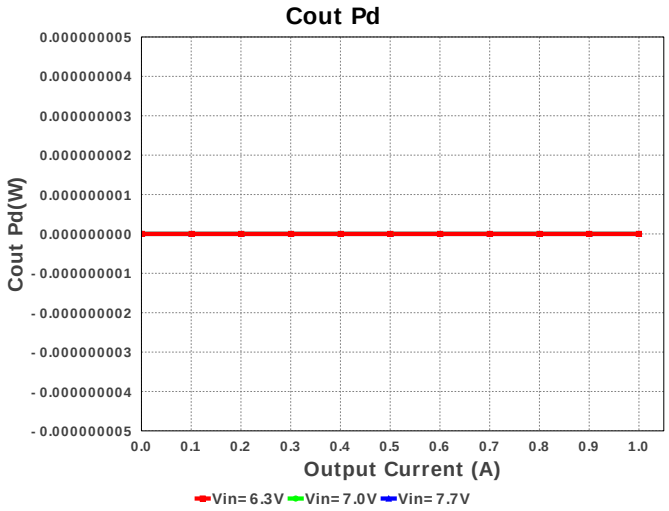

Vout Tolerance
Vout Tolerance(%)
0.436363632
0.436363633
0.436363634
0.436363635
0.436363636
0.436363637
0.436363638
0.436363639
0.436363640
0.436363641
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=6.3V
Vin=7.0V
Vin=7.7V

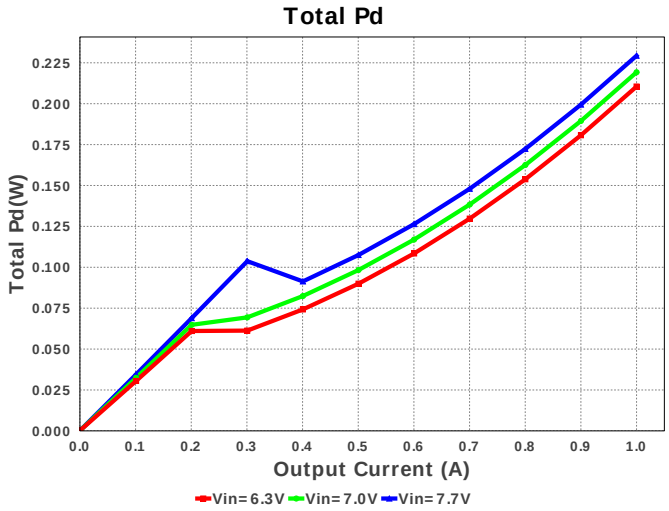

Iin Avg
Iin Avg(A)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=6.3V
Vin=7.0V
Vin=7.7V

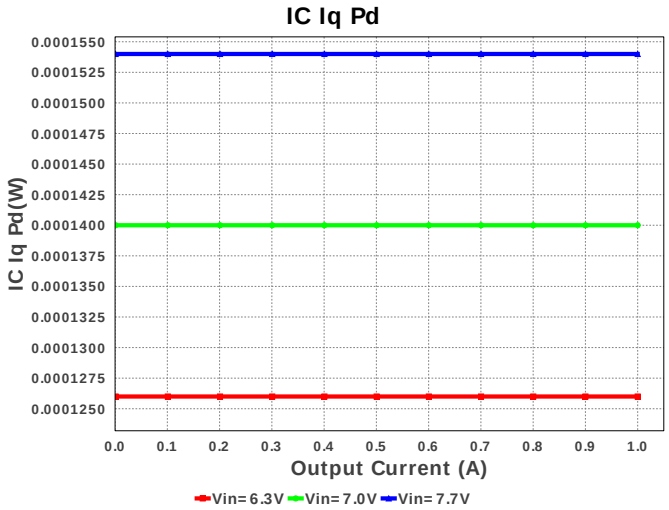

Pout
Pout(W)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
3.25
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=6.3V
Vin=7.0V
Vin=7.7V

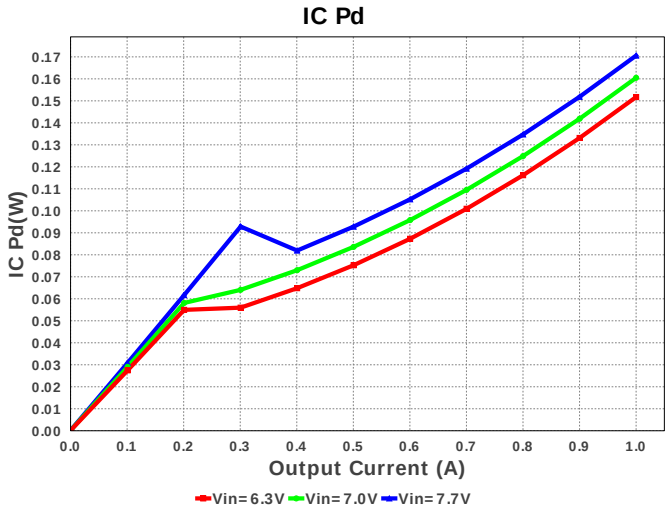

IC Ipk
IC Ipk(A)
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
1.05
1.10
1.15
1.20
1.25
1.30
1.35
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=6.3V
Vin=7.0V
Vin=7.7V

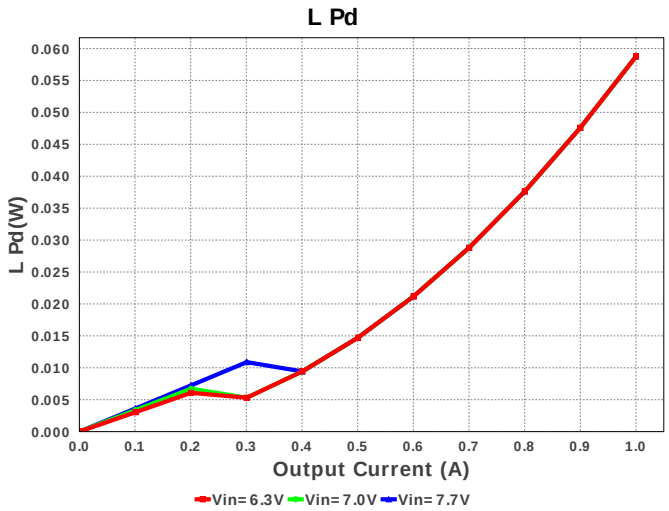

Cout IRMS
Cout IRMS(A)
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
0.225
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Output Current (A)
Vin=6.3V
Vin=7.0V
Vin=7.7V

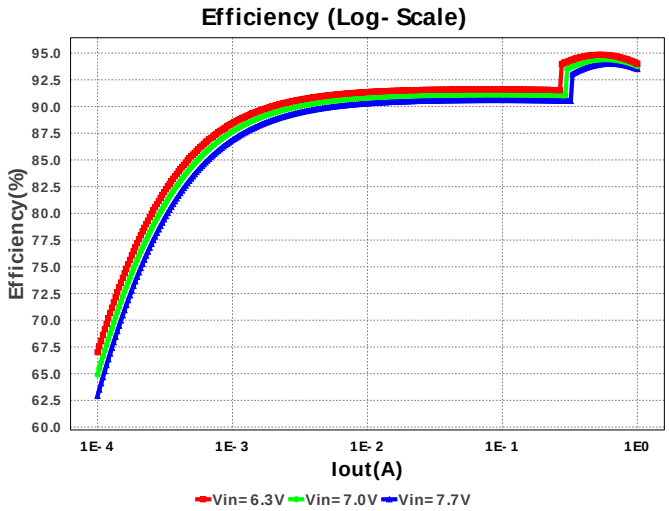












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	497.169 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	191.435 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.332 A	Current	Peak switch current in IC
4.	Iin Avg	458.36 mA	Current	Average input current
5.	L Ipp	663.15 mA	Current	Peak-to-peak inductor ripple current
6.	BOM Count	6	General	Total Design BOM count
7.	FootPrint	71.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	1.348 MHz	General	Switching frequency
9.	Pout	3.3 W	General	Total output power
10.	Total BOM	$1.1	General	Total BOM Cost
11.	Vout OP	3.3 V	Op_Point	Operational Output Voltage

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#	Name	Value	Category	Description
12.	Duty Cycle	44.687 %	Op_point	Duty cycle
13.	Efficiency	93.502 %	Op_point	Steady state efficiency
14.	IC Tj	29.964 degC	Op_point	IC junction temperature
15.	ICThetaJA	29.1 degC/W	Op_point	IC junction-to-ambient thermal resistance
16.	IOUT_OP	1.0 A	Op_point	Iout operating point
17.	VIN_OP	7.7 V	Op_point	Vin operating point
18.	Vout p-p	3.278 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
20.	Cout Pd	0.0 W	Power	Output capacitor power dissipation
21.	IC Iq Pd	154.0 µW	Power	IC Iq Pd
22.	IC Pd	170.587 mW	Power	IC power dissipation
23.	L Pd	58.75 mW	Power	Inductor power dissipation
24.	Total Pd	229.339 mW	Power	Total Power Dissipation
25.	Vout Tolerance	436.364 m%		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	SoftStart	0.05 ms	Soft Start Time (ms)
3.	VinMax	7.7	Maximum input voltage
4.	VinMin	6.3	Minimum input voltage
5.	Vout	3.3	Output Voltage
6.	base_pn	TPS62152	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	25.0	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 voltageSelectable 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

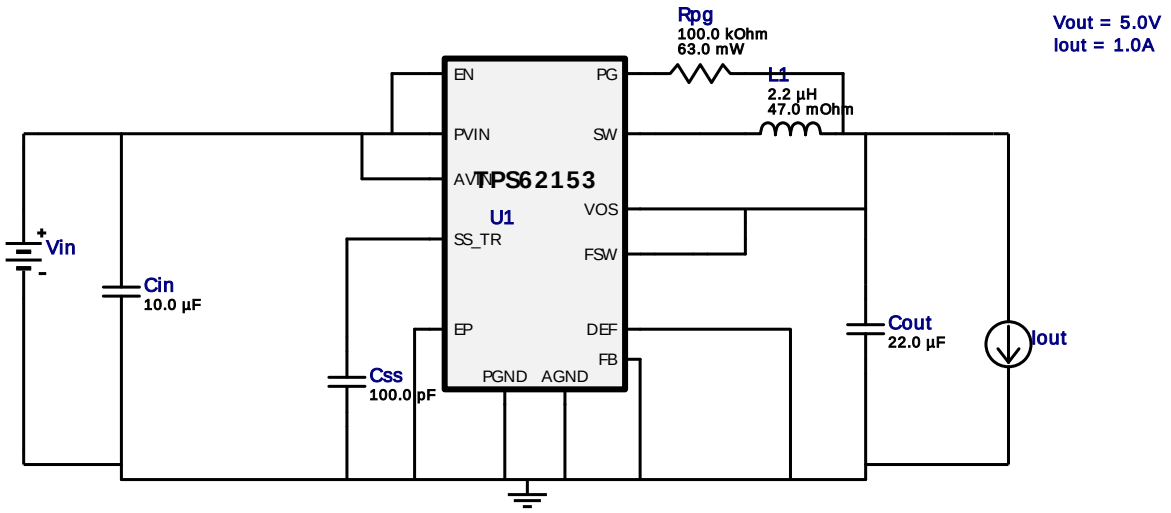
2. TPS62152 Product Folder : http://www.ti.com/product/TPS62152 : contains the data sheet and other resources.

WEBENCH ® Design Report

Vout = 5.0V
Iout = 1.0A

Device = TPS62153RGTR
Topology = Buck
Created = 4/13/16 5:48:51 PM
BOM Cost = $1.16
BOM Count = 6
Total Pd = 0.23W

Design : 4079404/28 TPS62153RGTR
TPS62153RGTR 6.3V-7.7V to 5.00V @ 1.0A



Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	Taiyo Yuden	EMK212BJ106KG-T Series= X5R	Cap= 10.0 uF VDC= 16.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
2.	Cout	Taiyo Yuden	LMK212BJ226MG-T Series= X5R	Cap= 22.0 uF VDC= 10.0 V IRMS= 0.0 A	1	$0.12	0805 7 mm²
3.	Css	MuRata	GRM033R71C101KA01D Series= X7R	Cap= 100.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
4.	L1	Bourns	SDR0403-2R2ML	L= 2.2 µH DCR= 47.0 mOhm	1	$0.18	SDR0403 28 mm²
5.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
6.	U1	Texas Instruments	TPS62153RGTR	Switcher	1	$0.79	S-PVQFN-N16 25 mm²

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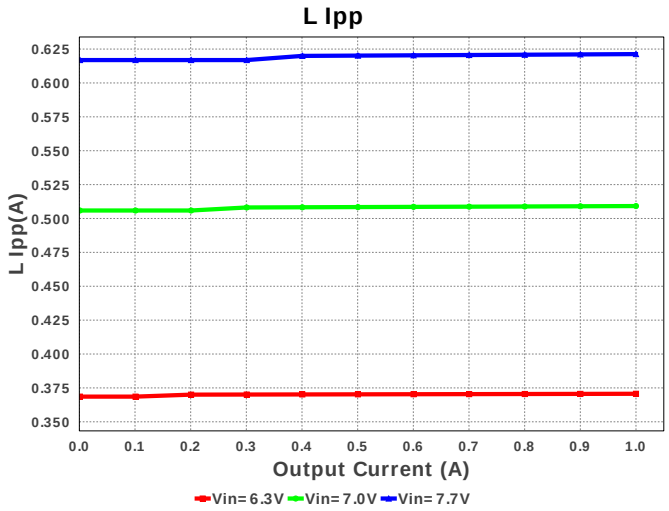
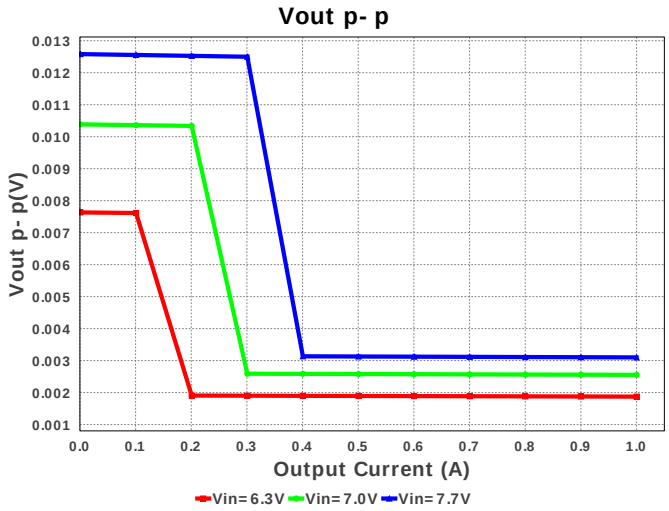
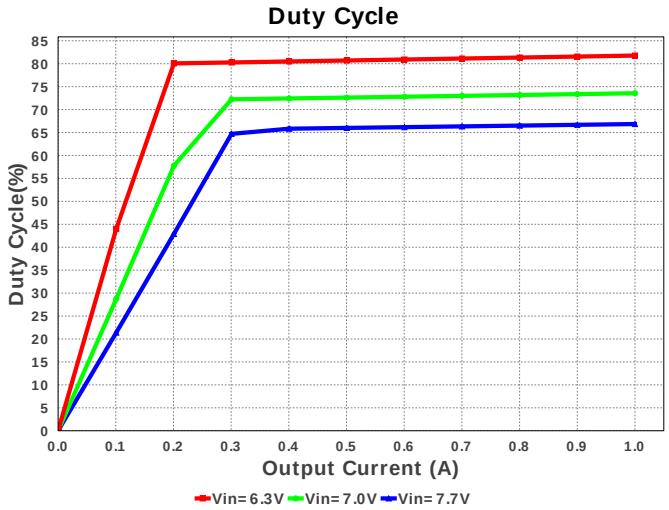
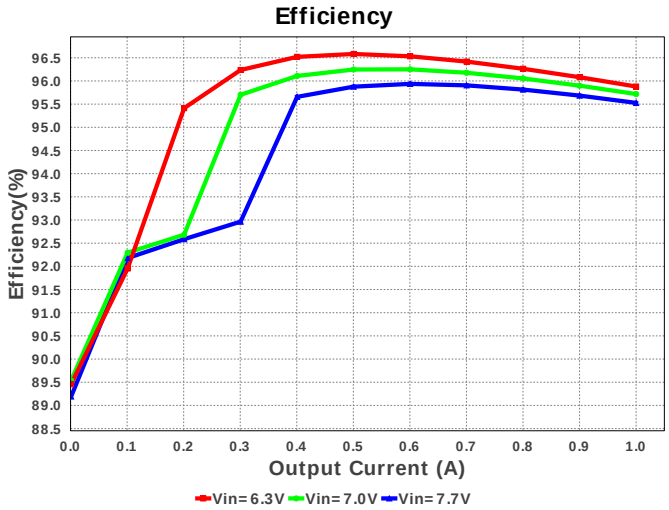
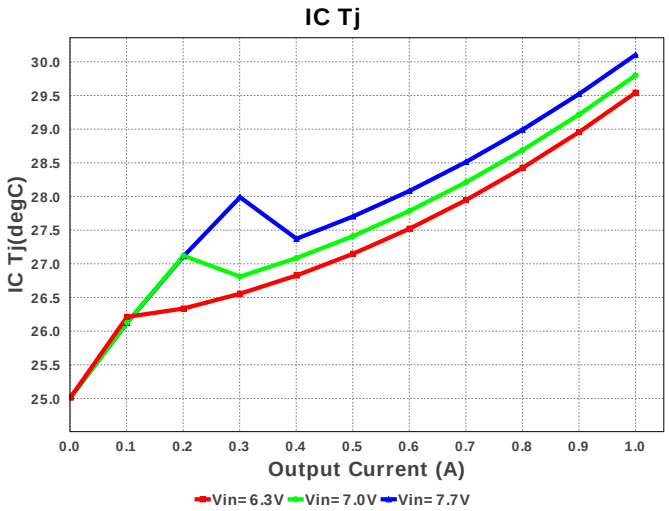
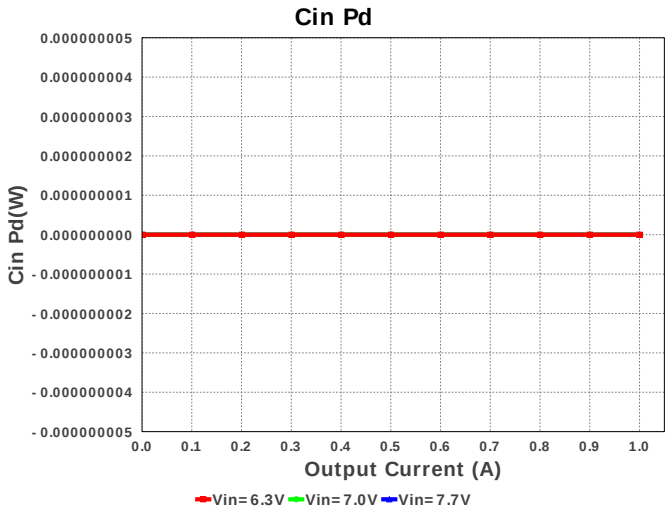

L Ipp
L Ipp(A)
0.625
0.600
0.575
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

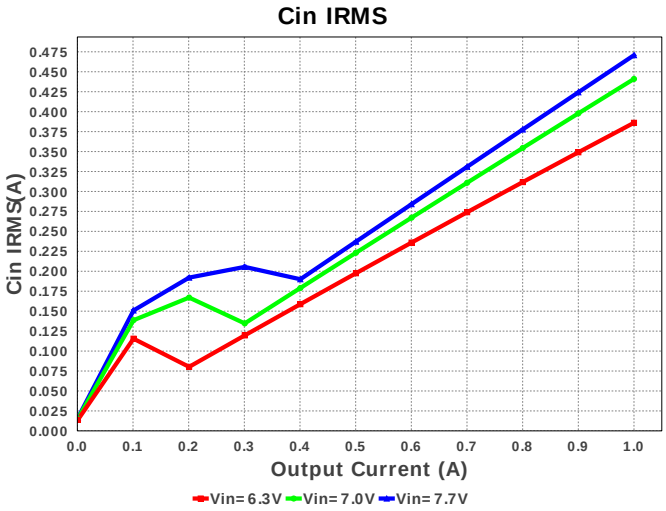

Vout p-p
Vout p-p(V)
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

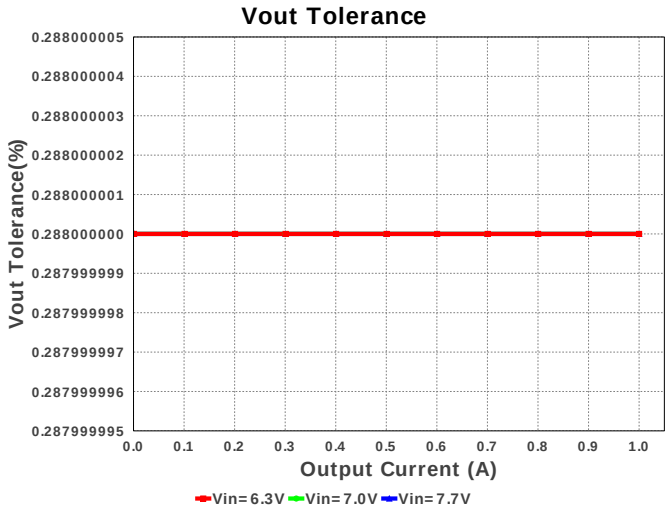

Duty Cycle
Duty Cycle(%)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

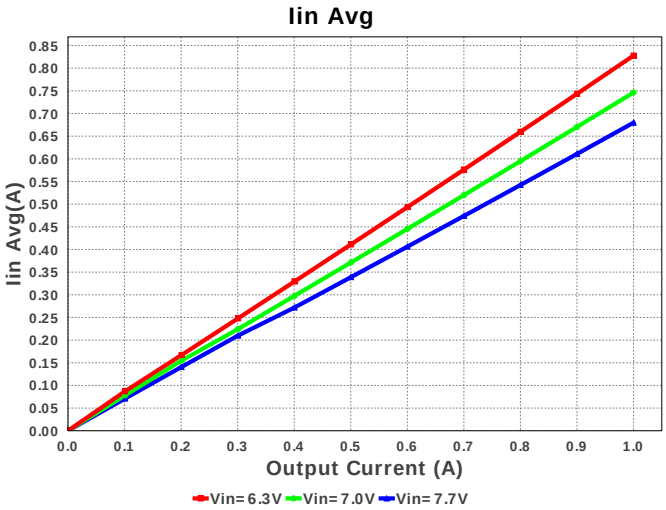

Efficiency
Efficiency(%)
96.5
96.0
95.5
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
88.5
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

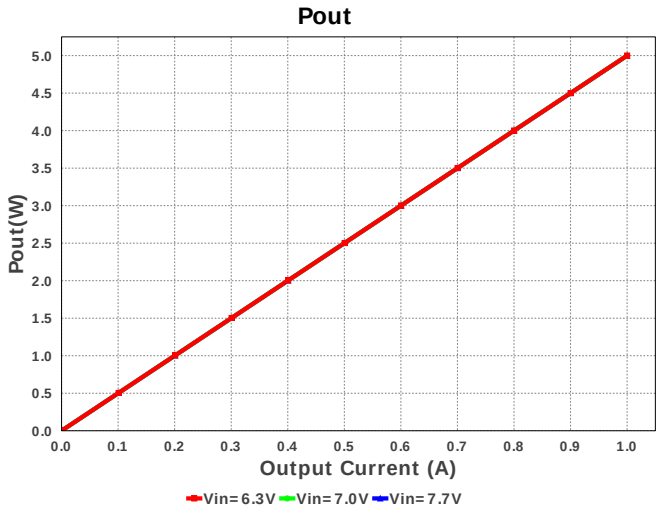

IC Tj
IC Tj(degC)
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

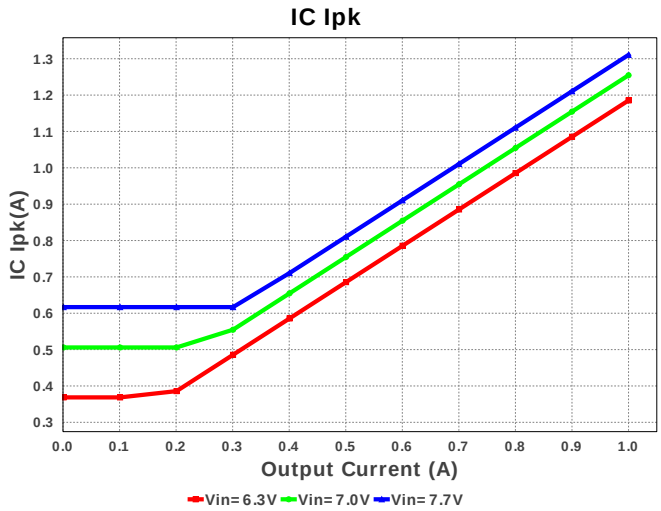

Cin Pd
Cin Pd(W)
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

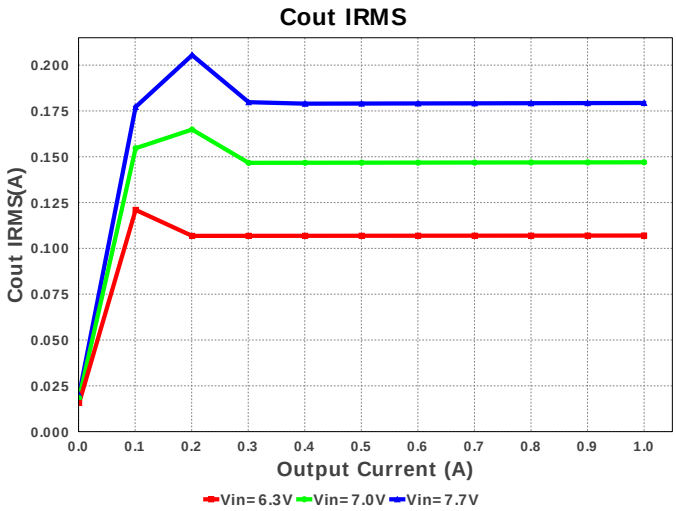

Cin IRMS
Cin IRMS(A)
0.000 0.025 0.050 0.075 0.100 0.125 0.150 0.175 0.200 0.225 0.250 0.275 0.300 0.325 0.350 0.375 0.400 0.425 0.450 0.475
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

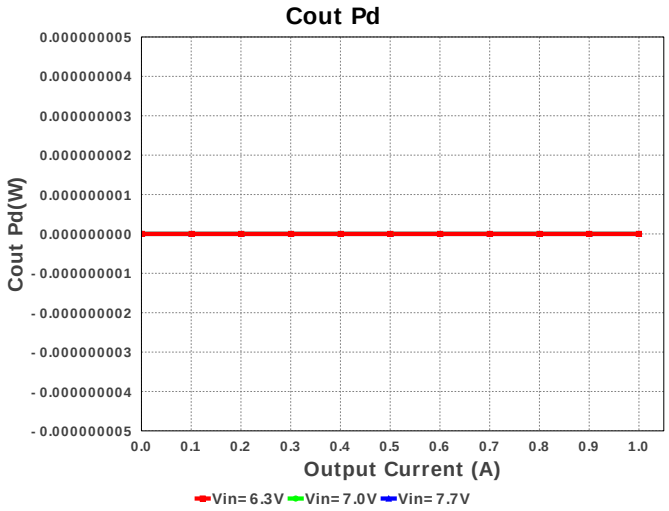

Vout Tolerance
Vout Tolerance(%)
0.287999995 0.287999996 0.287999997 0.287999998 0.287999999 0.288000000 0.288000001 0.288000002 0.288000003 0.288000004 0.288000005
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

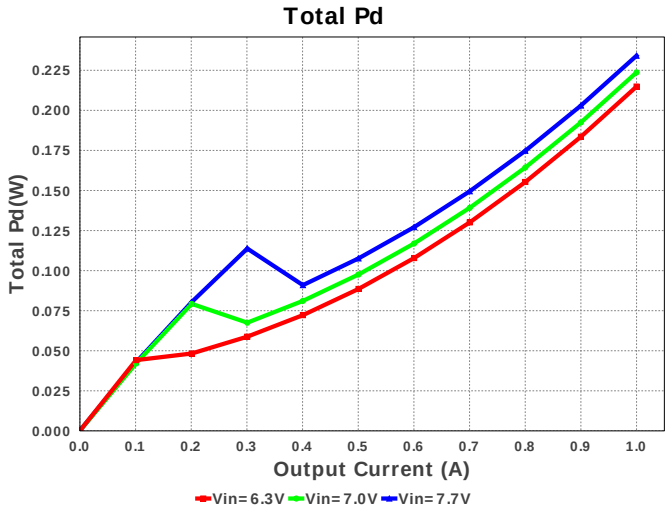

Iin Avg
Iin Avg(A)
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

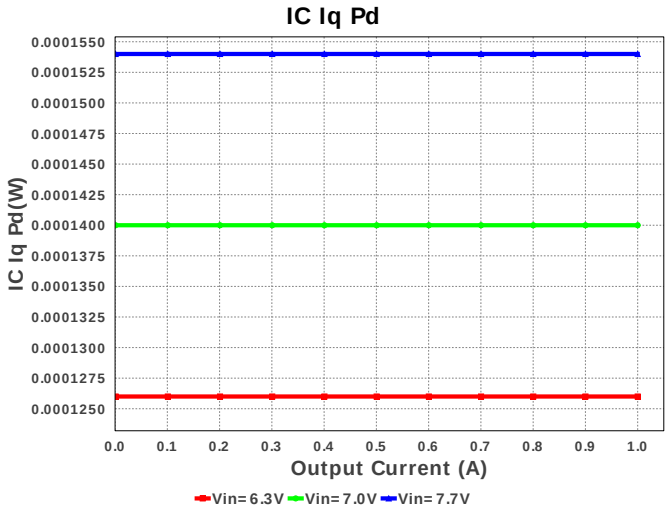

Pout
Pout(W)
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

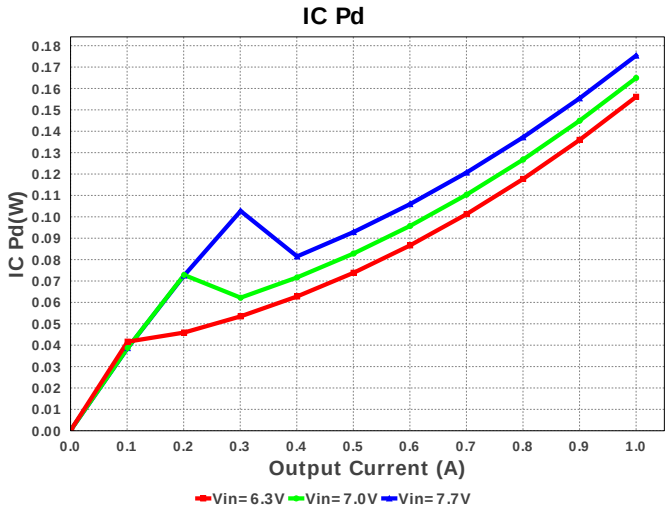

IC Ipk
IC Ipk(A)
0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

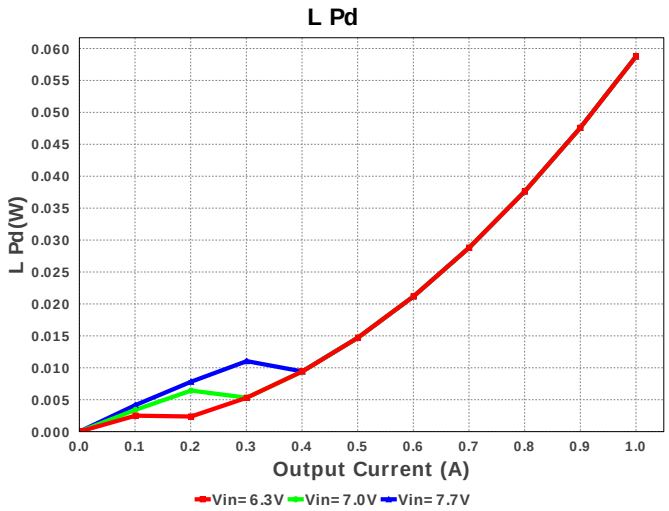

Cout IRMS
Cout IRMS(A)
0.000 0.025 0.050 0.075 0.100 0.125 0.150 0.175 0.200
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=6.3V Vin=7.0V Vin=7.7V

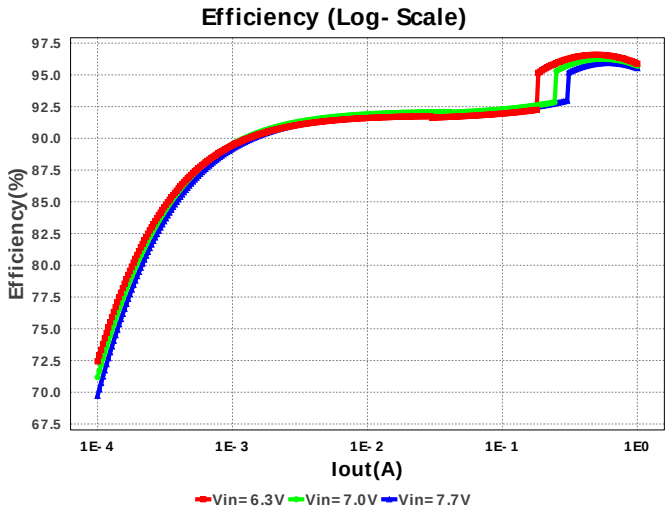












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	470.746 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	179.349 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.311 A	Current	Peak switch current in IC
4.	Iin Avg	679.76 mA	Current	Average input current
5.	L Ipp	621.28 mA	Current	Peak-to-peak inductor ripple current
6.	BOM Count	6	General	Total Design BOM count
7.	FootPrint	71.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	1.321 MHz	General	Switching frequency
9.	Pout	5.0 W	General	Total output power
10.	Total BOM	$1.16	General	Total BOM Cost
11.	Vout OP	5.0 V	Op_Point	Operational Output Voltage

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#	Name	Value	Category	Description
12.	Duty Cycle	66.852 %	Op_point	Duty cycle
13.	Efficiency	95.527 %	Op_point	Steady state efficiency
14.	IC Tj	30.104 degC	Op_point	IC junction temperature
15.	ICThetaJA	29.1 degC/W	Op_point	IC junction-to-ambient thermal resistance
16.	IOUT_OP	1.0 A	Op_point	Iout operating point
17.	VIN_OP	7.7 V	Op_point	Vin operating point
18.	Vout p-p	3.099 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
20.	Cout Pd	0.0 W	Power	Output capacitor power dissipation
21.	IC Iq Pd	154.0 µW	Power	IC Iq Pd
22.	IC Pd	175.382 mW	Power	IC power dissipation
23.	L Pd	58.75 mW	Power	Inductor power dissipation
24.	Total Pd	234.124 mW	Power	Total Power Dissipation
25.	Vout Tolerance	288.0 m%		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	SoftStart	0.05 ms	Soft Start Time (ms)
3.	VinMax	7.7	Maximum input voltage
4.	VinMin	6.3	Minimum input voltage
5.	Vout	5.0	Output Voltage
6.	base_pn	TPS62153	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	25.0	Ambient temperature

Design Assistance

1. Feature Highlights: DCS-Control(TM) Architecture with upto 1A output current, 3V to 17V Input Voltage Range, 5.0V Fixed Output voltageSelectable 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

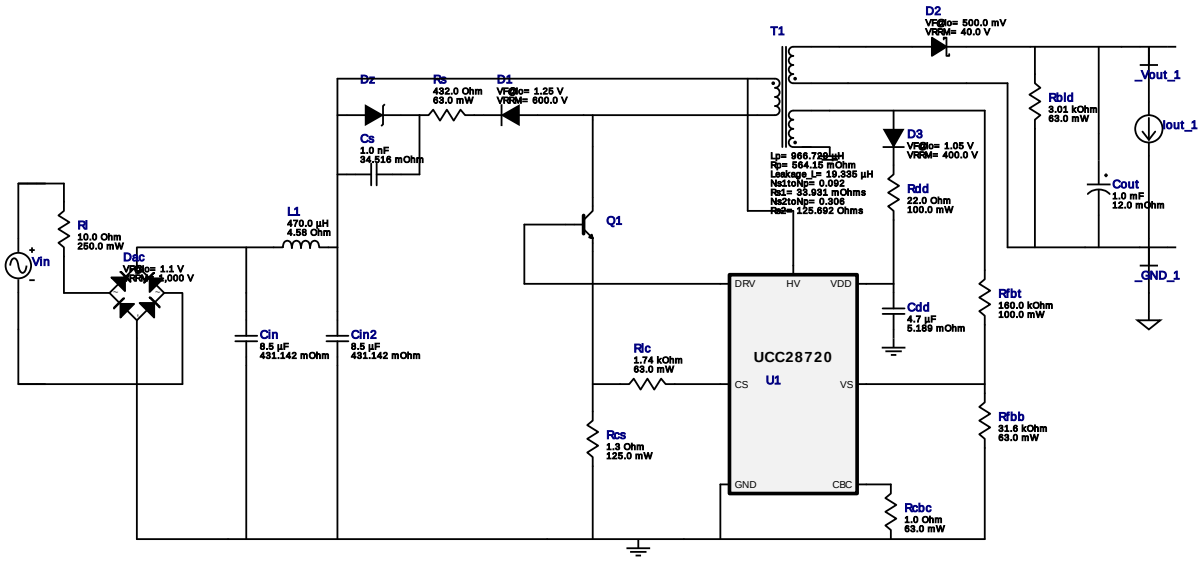
2. TPS62153 Product Folder : http://www.ti.com/product/TPS62153 : contains the data sheet and other resources.

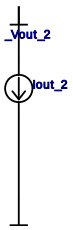
WEBENCH ® Design Report

Vout = 7.0V
Iout = 1.14A

Device = UCC28720DR
Topology = Flyback
Created = 4/13/16 5:48:52 PM
BOM Cost = $0.00
BOM Count = 23
Total Pd = 2.14W

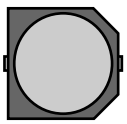
Design : 4079404/29 UCC28720DR
UCC28720DR 85.0V-265.0V to 7.55V @ 1.13812A





1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.03	0805 7 mm²
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 8.5 uF ESR= 431.14 mOhm VDC= 562.14 V IRMS= 419.47 mA	1	NA	CUSTOM 0 mm²
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 8.5 uF ESR= 431.14 mOhm VDC= 562.14 V IRMS= 419.47 mA	1	NA	CUSTOM 0 mm²
4.	Cout	Panasonic	16SVPF1000M Series= SVPF	Cap= 1.0 mF ESR= 12.0 mOhm VDC= 16.0 V IRMS= 5.4 A	1	$0.74	 CAPSMT_62_F12 151 mm²

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#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
5.	Cs	TDK	C2012C0G2E102J Series= C0G/NP0	Cap= 1.0 nF ESR= 34.516 mOhm VDC= 250.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
6.	D1	Diodes Inc.	MURS160-13-F	VF@Io= 1.25 V VRRM= 600.0 V	1	$0.11	SMB 44 mm²
7.	D2	Diodes Inc.	B240A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.09	SMA 37 mm²
8.	D3	Bourns	CD1408-FU1400	VF@Io= 1.05 V VRRM= 400.0 V	1	$0.13	Diode_1408 13 mm²
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	DF-S 99 mm²
10.	Dz	ON Semiconductor	MMBZ5270BLT1G	Zener	1	$0.03	SOT-23 14 mm²
11.	L1	TDK	VLCF4028T-471MR14-2	L= 470.0 µH DCR= 4.58 Ohm	1	$0.36	VLCF4028 25 mm²
12.	Q1	STMicroelectronics	STN2580	Bipolar Transistor	1	$0.19	SOT-223 76 mm²
13.	Rbld	Vishay-Dale	CRCW04023K01FKED Series= CRCW..e3	Res= 3.01 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
14.	Rcbc	Vishay-Dale	CRCW04021R00FKED Series= CRCW..e3	Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
15.	Rcs	Vishay-Dale	CRCW08051R30FKEA Series= CRCW..e3	Res= 1.3 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
16.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
17.	Rfbb	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
18.	Rfbt	Yageo America	RC0603FR-07160KL Series= ?	Res= 160.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
19.	Rl	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
20.	Rlc	Vishay-Dale	CRCW04021K74FKED Series= CRCW..e3	Res= 1.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
21.	Rs	Vishay-Dale	CRCW0402432RFKED Series= CRCW..e3	Res= 432.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
22.	T1	CUSTOM	CUSTOM	Lp= 966.729 µH Rp= 564.15 mOhm Leakage_L= 19.335 µH Ns1toNp= 0.092 Rs1= 33.931 mOhms Ns2toNp= 0.306 Rs2= 125.692 Ohms	1	NA	CUSTOM 0 mm²

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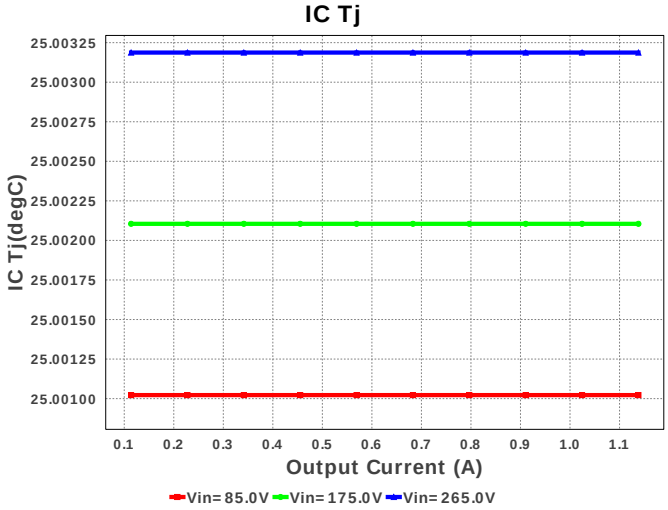
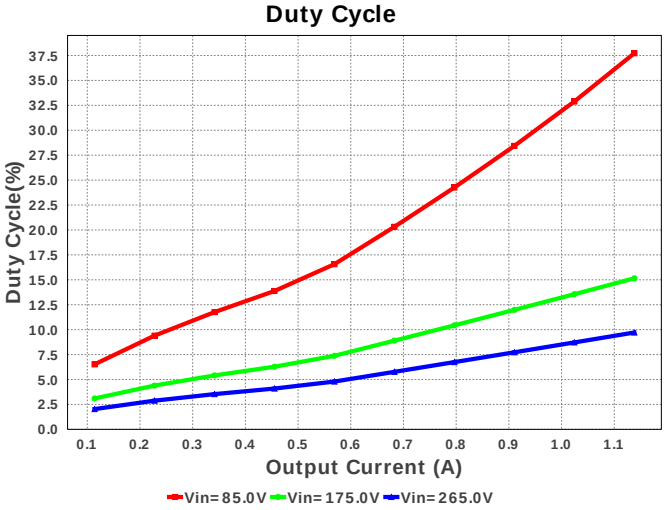
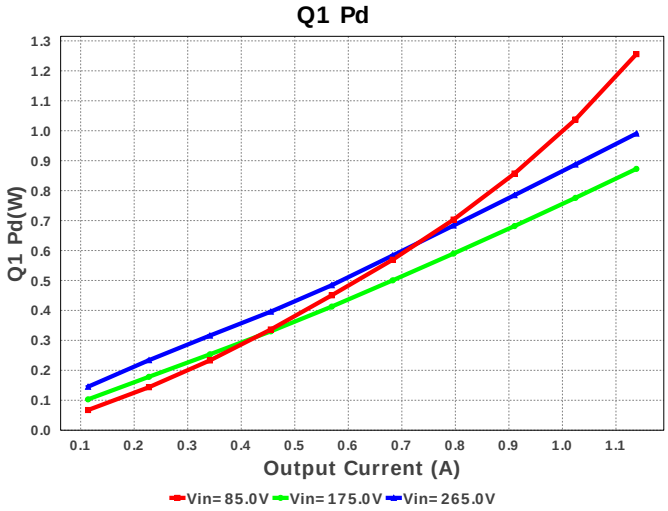
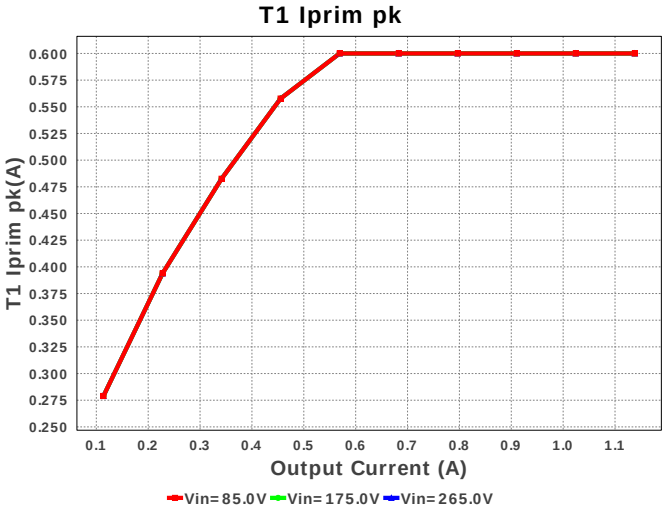
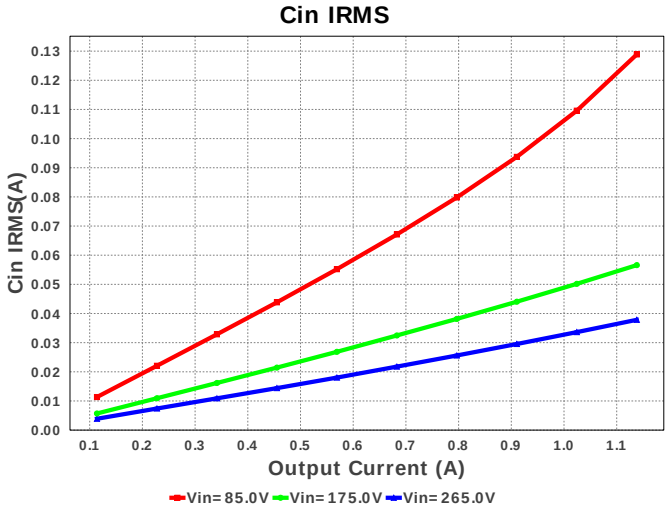
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
23.	U1	Texas Instruments	UCC28720DR	Switcher	1	$0.40	R-PDSO-G7 55 mm²

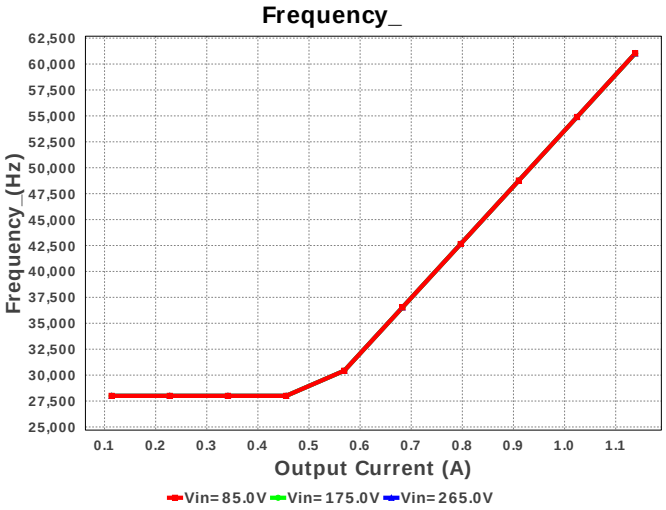












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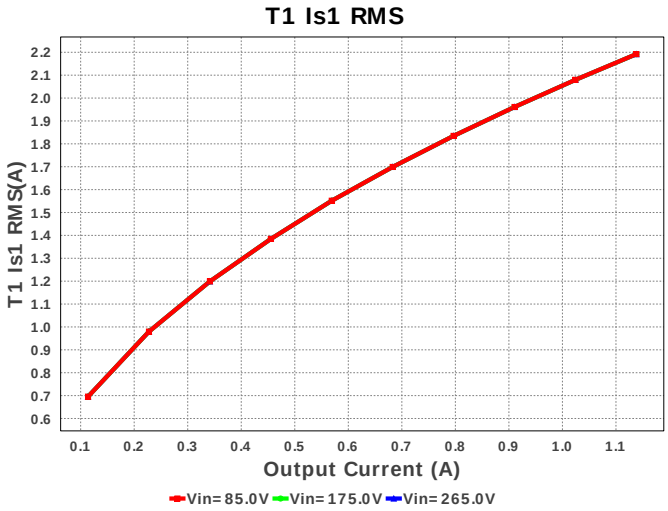

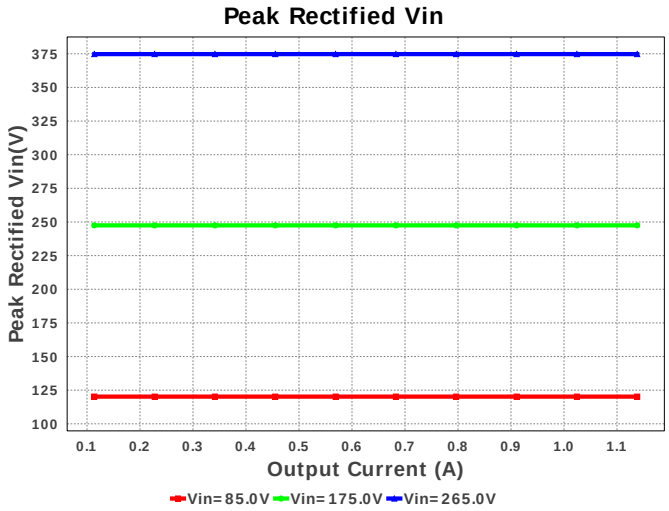

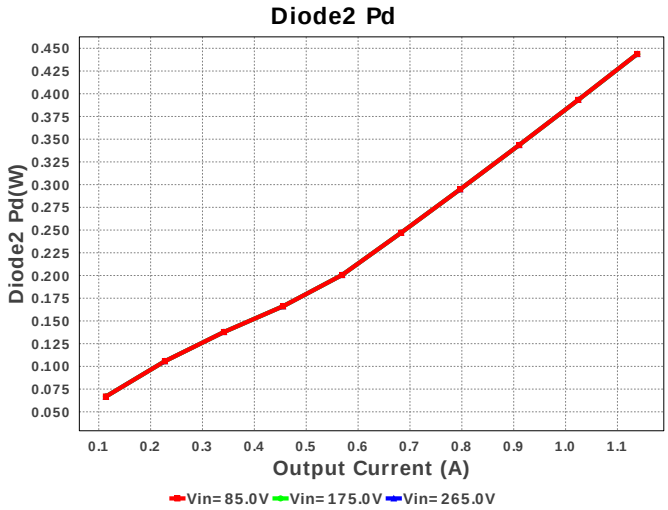

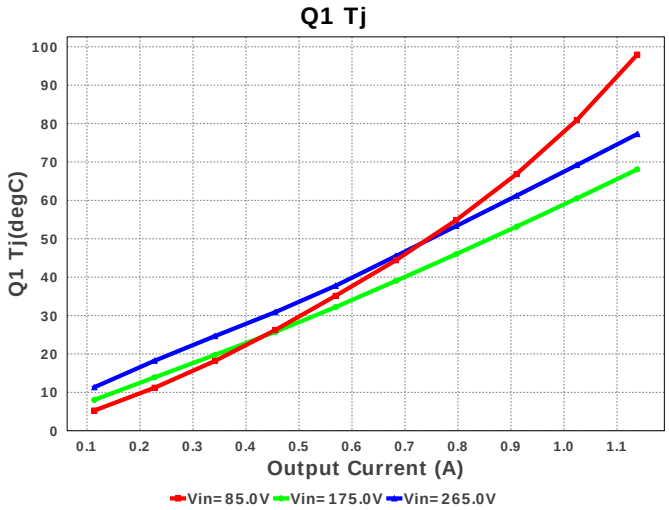

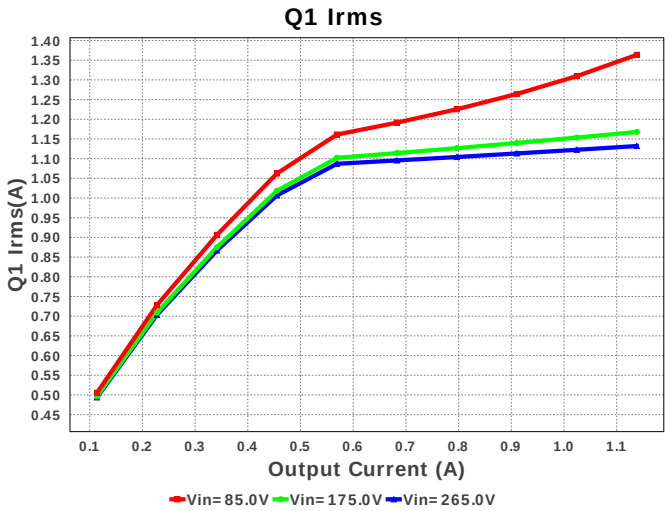

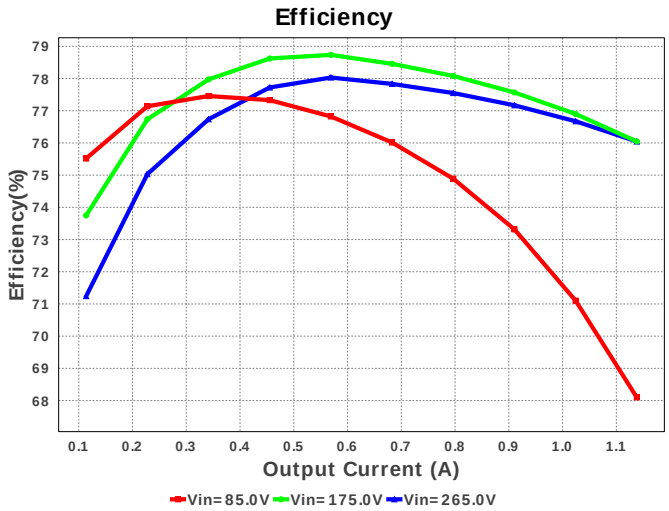

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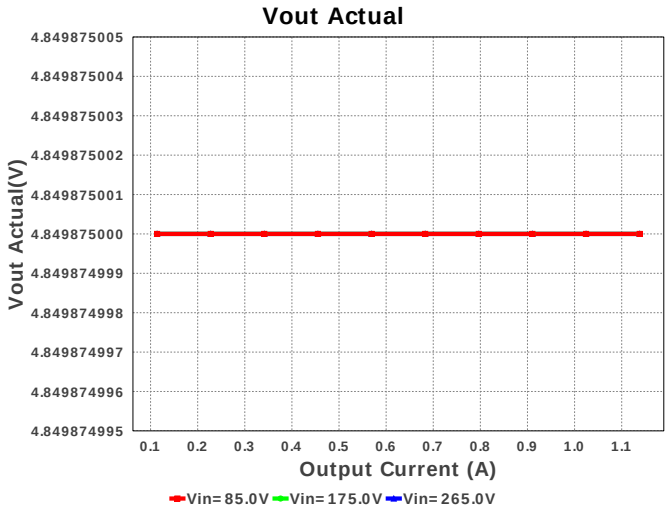

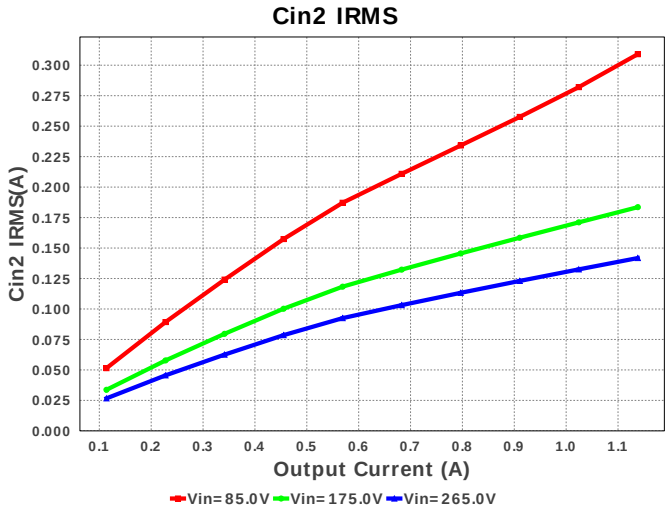

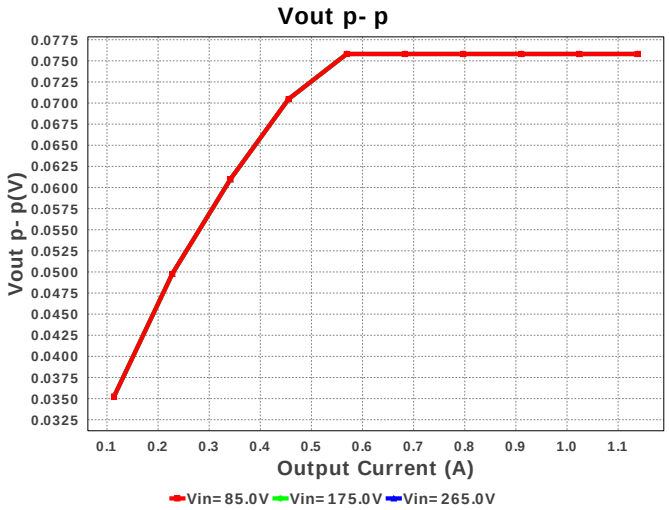

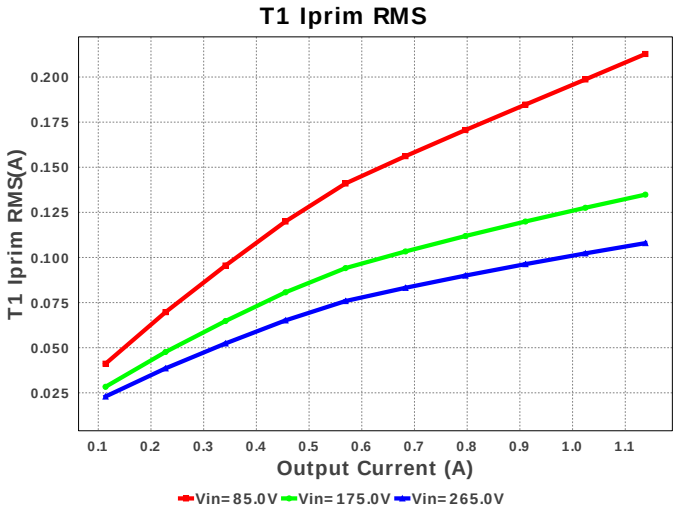

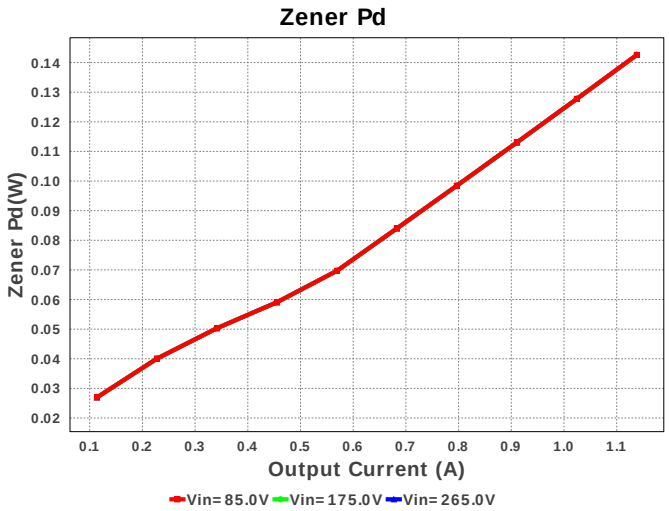

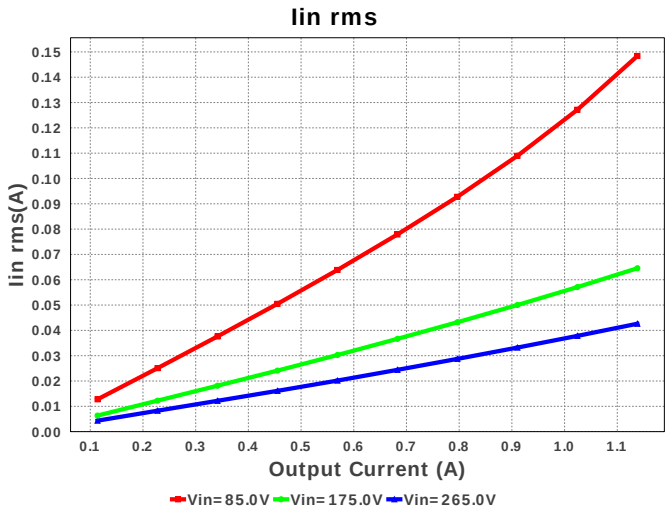

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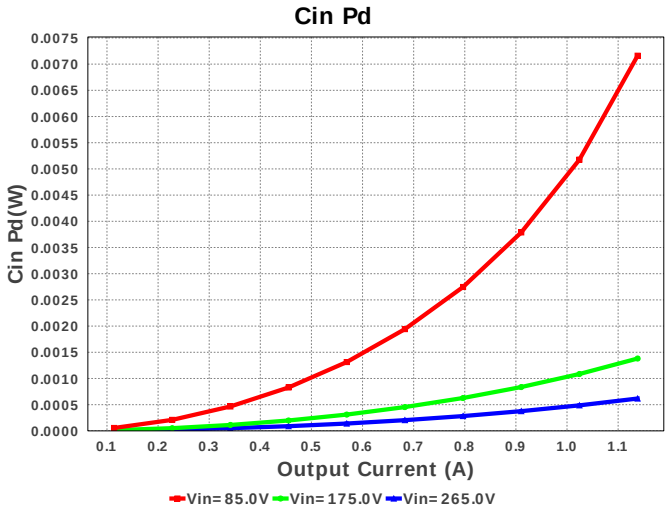
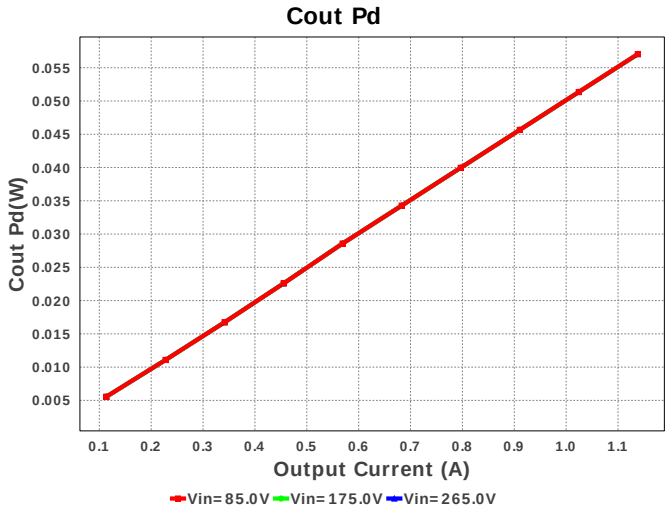
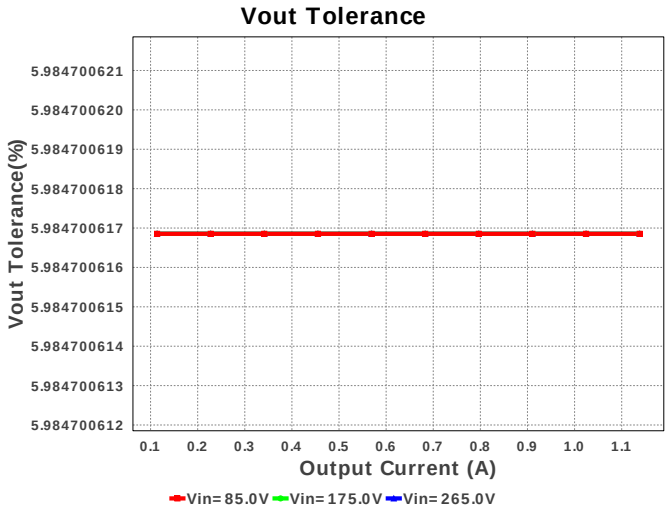
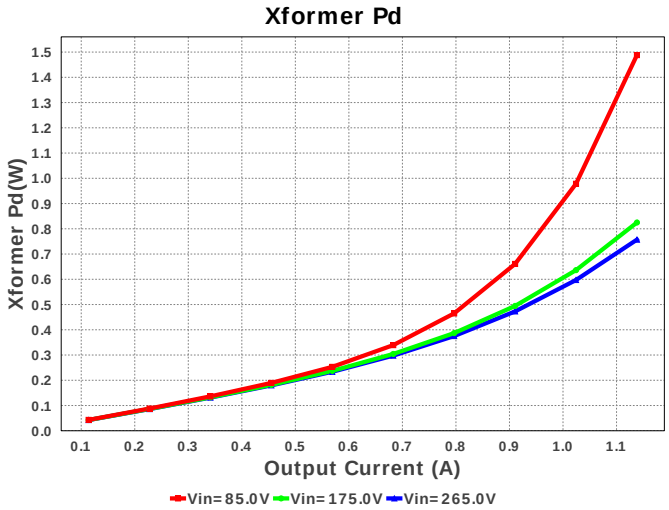
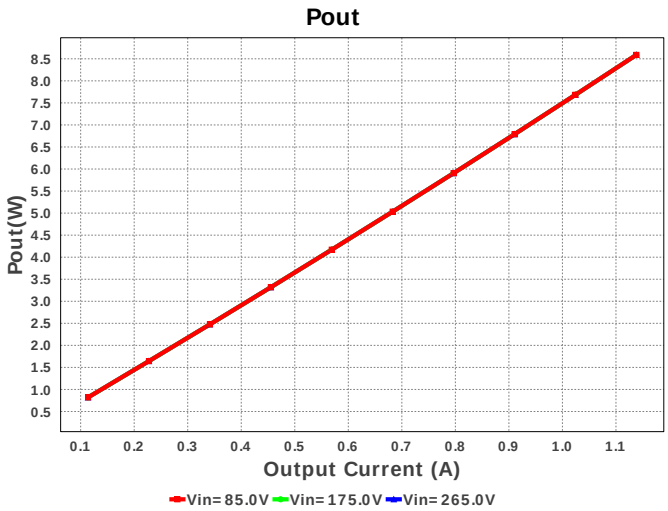
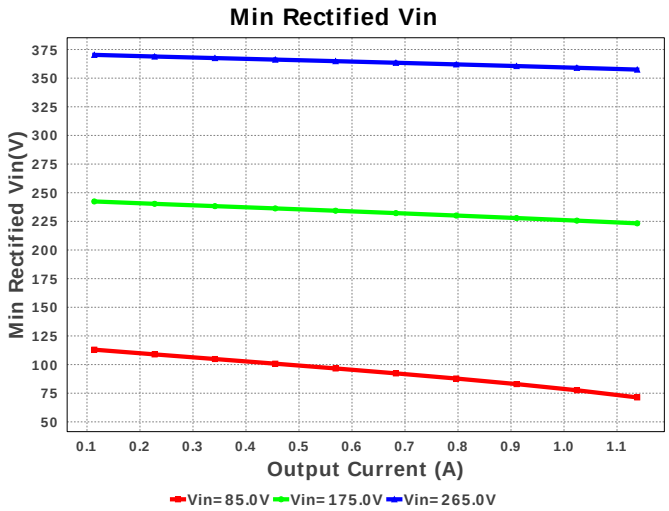

Cin Pd
Cin Pd(W)
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

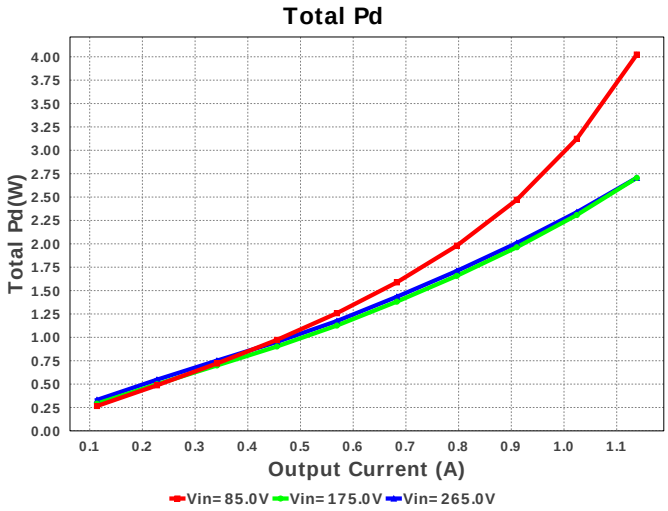

Cout Pd
Cout Pd(W)
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

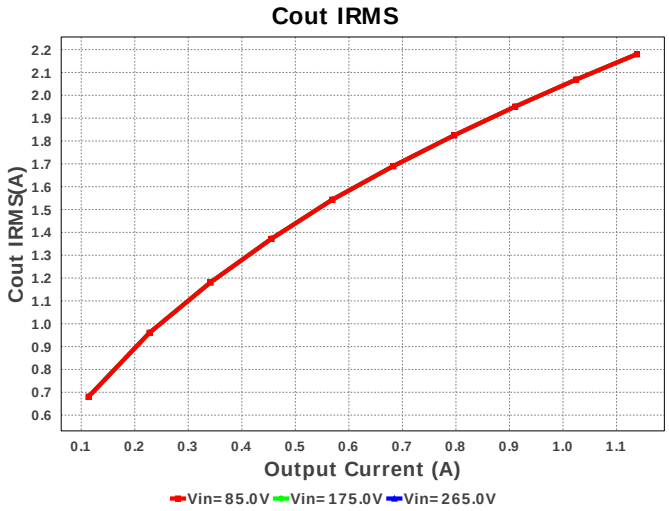

Vout Tolerance
Vout Tolerance(%)
5.984700621
5.984700620
5.984700619
5.984700618
5.984700617
5.984700616
5.984700615
5.984700614
5.984700613
5.984700612
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

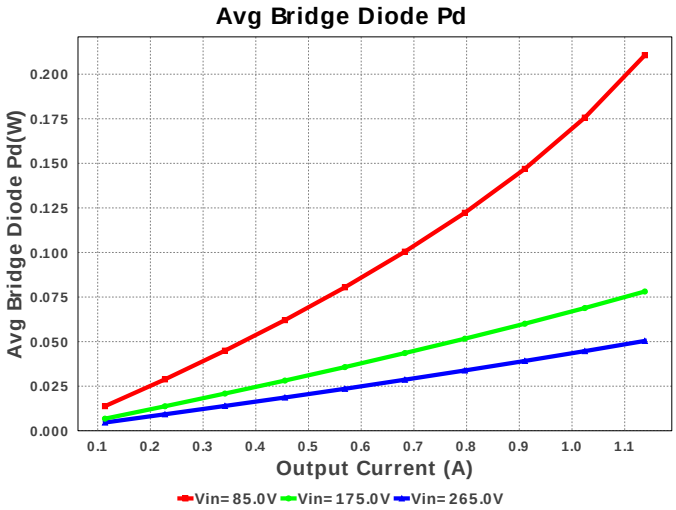

Xformer Pd
Xformer Pd(W)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

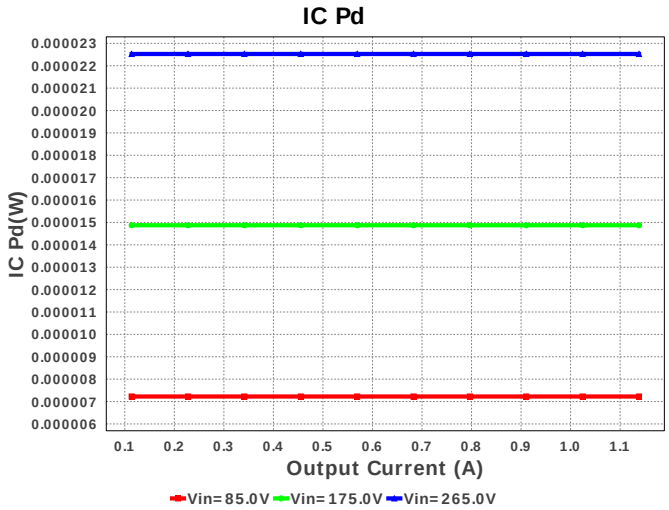

Pout
Pout(W)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

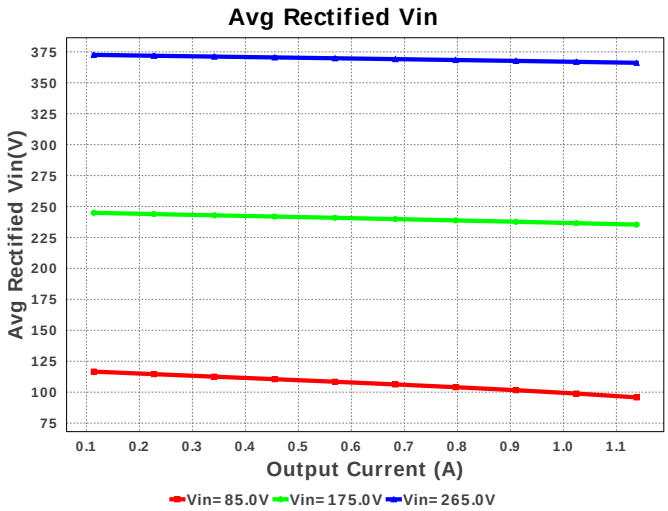

Min Rectified Vin
Min Rectified Vin(V)
375
350
325
300
275
250
225
200
175
150
125
100
75
50
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

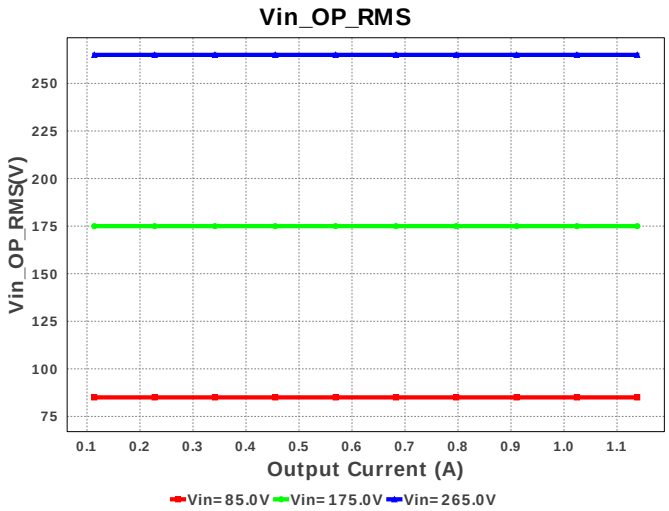

Total Pd
Total Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

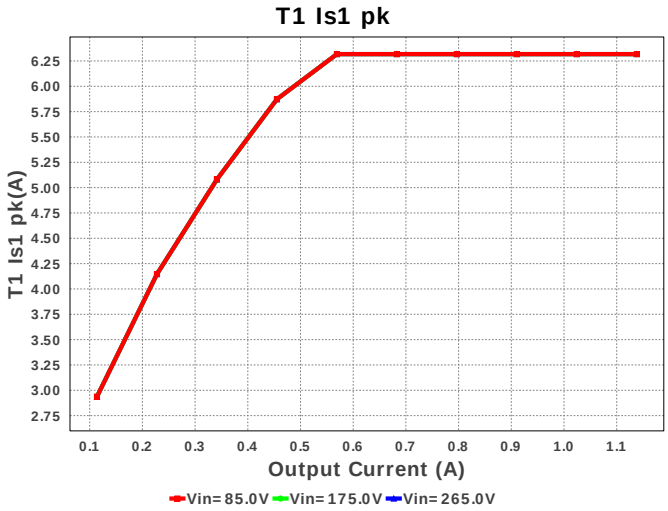

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

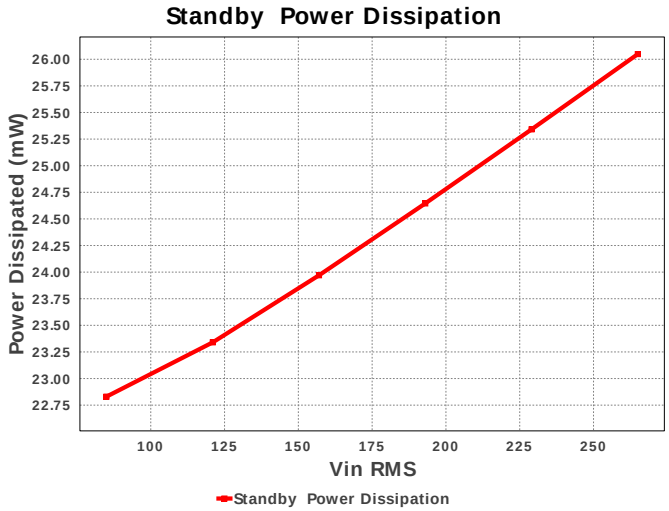

Avg Bridge Diode Pd
Avg Bridge Diode Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

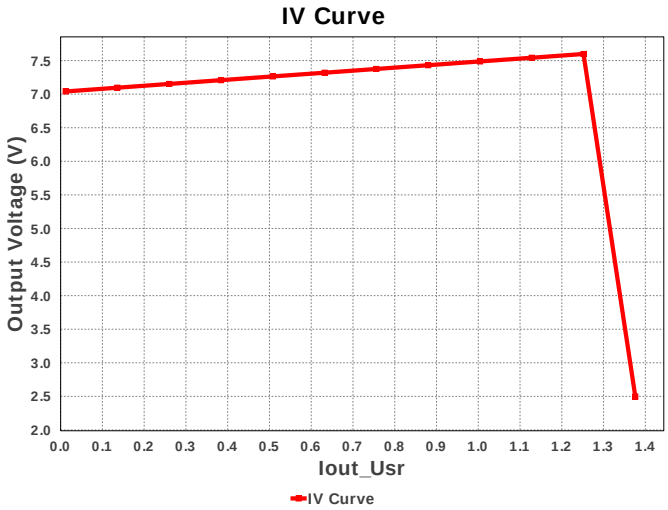

IC Pd
IC Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Avg Rectified Vin
Avg Rectified Vin(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Vin_OP_RMS
Vin_OP_RMS(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	36.057 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	140.484 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	2.18 A	Current	Output capacitor RMS ripple current
4.	Iin rms	40.476 mA	Current	RMS Input Current
5.	Q1 Irms	1.133 A	Current	Q1 RMS current
6.	T1 Iprim RMS	108.494 mA	Current	Transformer Primary RMS Current
7.	T1 Iprim pk	600.0 mA	Current	Transformer Primary Peak Current
8.	T1 Is1 RMS	2.192 A	Current	Transformer Secondary1 RMS Current
9.	T1 Is1 pk	6.318 A	Current	Transformer Secondary1 Peak Current
10.	Avg Rectified Vin	364.294 V	General	Average Rectified Voltage for the AC Line Period
11.	BOM Count	23	General	Total Design BOM count
12.	FootPrint	644.0 mm^2	General	Total Foot Print Area of BOM components
13.	Pout	8.589 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Q1 Tj	54.703 degC	Op_Point	Q1 Junction Temperature
16.	Vout Actual	4.85 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
17.	Vout OP	7.547 V	Op_Point	Operational Output Voltage
18.	Duty Cycle	9.809 %	Op_point	Duty cycle
19.	Efficiency	80.08 %	Op_point	Steady state efficiency
20.	Frequency_	61.016 kHz	Op_point	Switching frequency
21.	IC Tj	25.001 degC	Op_point	IC junction temperature
22.	ICThetaJA	70.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
23.	IOUT_OP	1.138 A	Op_point	Iout operating point
24.	Min Rectified Vin	353.825 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	374.763 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	265.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	75.811 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	42.091 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	560.537 µW	Power	Input capacitor power dissipation
30.	Cout Pd	57.037 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	443.631 mW	Power	Diode2 power dissipation

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#	Name	Value	Category	Description
32.	IC Pd	7.225 µW	Power	IC power dissipation
33.	Q1 Pd	701.321 mW	Power	Q1 Power Dissipation
34.	Total Pd	2.137 W	Power	Total Power Dissipation
35.	Xformer Pd	491.455 mW	Power	Transformer power dissipation
36.	Zener Pd	142.557 mW	Power	Zener power dissipation
37.	Vout Tolerance	5.985 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.138	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	85.0	Minimum input voltage
4.	Vout	7.0	Output Voltage
5.	base_pn	UCC28720	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	25.0	Ambient temperature

Design Assistance

1. Application Hints Rbld Rbld is used to to set a minimum load for the circuit, so that in standby the output voltage does not float up. The value chosen by WEBENCH should be a good starting point but may need to be adjusted to achieve minimum power dissipation at standby as well. Rlc Rlc provides the function of feed-forward line compensation to eliminate change in IPP due to change in di/dt and the propagation delay of the internal comparator and MOSFET turn-off time. For best results the chosen value may need to be adjusted based on board, FET and transformer parasitics. Rcbc Rcbc is used to set the amount of output voltage compensation to offset cable resistance. Connecting this resistor from the CBC pin to GND will program a current that is summed into the VS feedback divider, increasing the regulation voltage as Iout increases. Rfbt & Rfbb The feedback resistors will set the output voltage of the circuit. The values chosen may need to be fined tuned based on the final Transformer turns ratios and the voltage across the output diode at close to zero current. Part Description The UCC28700 family of flyback power supply controllers provides Constant-Voltage (CV) and Constant-Current (CC) output regulation. Primary-Side Regulation (PSR) eliminates the use of an Opto-Coupler. Please see the datasheet for further design guidance. http://www.ti.com/lit/ds/symlink/ucc28720.pdf

2. UCC28720 Product Folder : http://www.ti.com/product/UCC28720 : contains the data sheet and other resources.

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