

WEBENCH® Power Architect

Project Report

Project : 1194016/431 : PA_Project_304 (modified from 301)

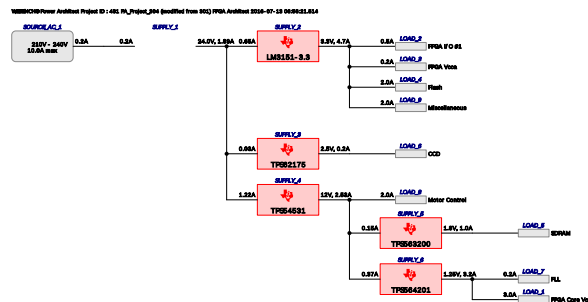
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Optimize project optFactor=3

Project Summary

1. Total System Efficiency	85.757 %
2. Total System BOM Count	80.0
3. Total System Footprint	2.67 kmm2
4. Total System BOM Cost	\$0.00
5. Total System Power Dissipation	7.608 W

--> Launch WEBENCH Power Architect.



Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_2	0	LOAD_2	FPGA I/O #1
SUPPLY_2	0	LOAD_3	FPGA Vcca
SUPPLY_2	0	LOAD_4	Flash
SUPPLY_2	0	LOAD_9	Miscellaneous
SUPPLY_3	0	LOAD_6	CCD
SUPPLY_4	0	LOAD_8	Motor Control
SUPPLY_5	0	LOAD_5	SDRAM
SUPPLY_6	0	LOAD_7	PLL
SUPPLY_6	0	LOAD_1	FPGA Core Vccint
SUPPLY_1	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	1.888 A	93.9%	1403	\$0.00	2088	33
2.	SUPPLY_2	LM3151-3.3	Switcher : SIMPLE SWITCHER(r) Controller	3.3 V	4.7 A	91.1%	513	\$2.91	2083	5
3.	SUPPLY_3	TPS62175	Switcher : High Light-Load Efficiency Buck Converter	2.5 V	0.2 A	73.2%	88	\$0.91	2084	12
4.	SUPPLY_4	TPS54531	Switcher : Step Down Converter with Eco-Mode	12 V	2.528 A	94.4%	383	\$1.82	2087	27
5.	SUPPLY_5	TPS563200	Switcher : 17V, 3A,6-pin, Low Iq Synchronous buck converter with Advanced Eco-mode	1.8 V	1.0 A	88.7%	149	\$1.06	2085	17
6.	SUPPLY_6	TPS564201	Switcher : 17V, 4A,6-pin, Low Iq Synchronous buck converter	1.25 V	3.2 A	81%	134	\$1.46	2086	22

Power Loads

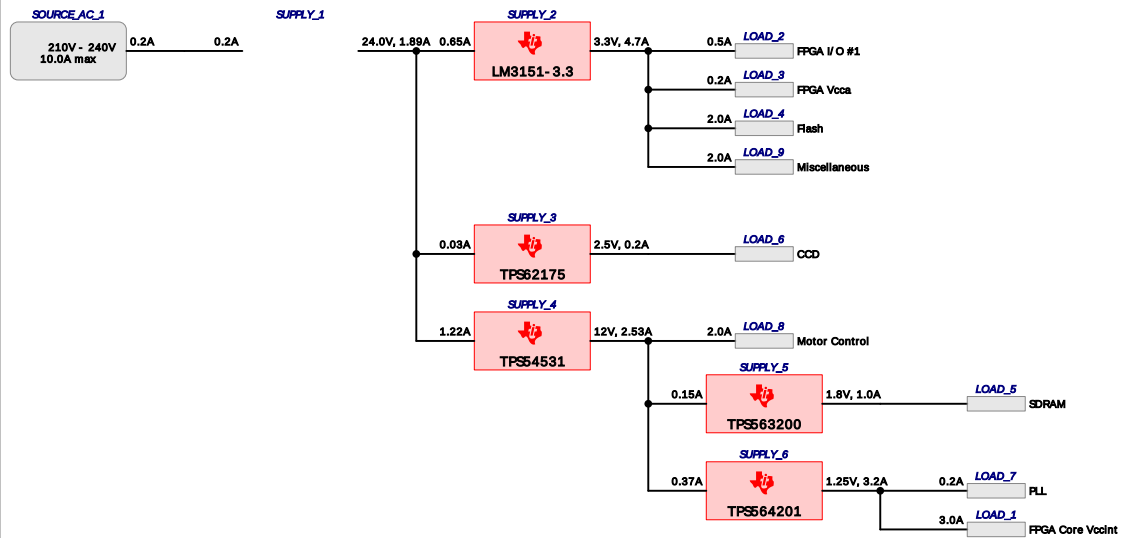
#	Name	VLoad	ILoad	Description
1.	FPGA I/O #1	3.3 V	0.5 A	VoutRipple=10%
2.	FPGA Vcca	3.3 V	0.2 A	VoutRipple=10%
3.	Flash	3.3 V	2 A	VoutRipple=10%
4.	Miscellaneous	3.3 V	2 A	VoutRipple=10%
5.	CCD	2.5 V	0.2 A	VoutRipple=10%
6.	Motor Control	12 V	2 A	VoutRipple=10%
7.	SDRAM	1.8 V	1 A	VoutRipple=10%
8.	PLL	1.25 V	0.2 A	VoutRipple=10%
9.	FPGA Core Vccint	1.25 V	3 A	VoutRipple=10%

FPGAs, Processors

#	Manufacturer	Part Number	Name	Series	Description
1.	Altera	10M08DA	FPGA_1	Max10	FPGA Altera Max10 10M08DA

Project Diagram

WEBENCH® Power Architect Project ID : 431 PA_Project_304 (modified from 301) FPGA Architect 2016-07-13 06:56:21.514



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
AVX	08053C104KAT2A	0805	2	\$0.01	14
Panasonic	20SVPF390M	CAPSMT_62_E12	1	\$0.63	106
Panasonic	6SVPE220MW	CAPSMT_62_E61	1	\$0.20	53
Würth Elektronik	750313417	WE-DD-L	1	\$0.00	210
Diodes Inc.	B240A-13-F	SMA	1	\$0.09	37
Infineon Technologies	BSC097N06NS	PG-	1	\$0.32	55
		TDSON-8			
Infineon Technologies	BSC100N06LS3 G	PG-	1	\$0.26	55
		TDSON-8			
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	2	\$0.01	14
TDK	C3216X5R1E476M160AC	1206	1	\$0.35	11
TDK	C3216X6S0G476M	1206	1	\$0.13	11
TDK	C3225X7S3D222K	1210	1	\$0.22	15
Yageo America	CC0805KRX7R9BB153	0805	1	\$0.01	7
Yageo America	CC0805KRX7R9BB472	0805	1	\$0.01	7
Samsung Electro-Mechanics	CL21C121JB61PNC	0805	1	\$0.01	7
Samsung Electro-Mechanics	CL21C620JBANNNC	0805	1	\$0.01	7
TDK	CLF7045T-1R5N	CLF7045	1	\$0.42	86
Vishay-Dale	CRCW0402100KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040210K0FKED	0402	3	\$0.01	9
Vishay-Dale	CRCW040210K2FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW040211K3FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040213K7FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040220K5FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04022M00FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402383KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402499RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04024K53FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04026K49FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402732RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040288K7FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0805100RFKEA	0805	1	\$0.01	7
Vishay-Semiconductor	DF10SA	DF-S	1	\$0.24	99
Taiyo Yuden	EMK212B7225KG-T	0805	1	\$0.03	7
Taiyo Yuden	EMK212B7474KD-T	0805	1	\$0.02	7
Panasonic	ERJ-6ENF1742V	0805	1	\$0.01	7
Panasonic	ERJ-8ENF2322V	1206	1	\$0.01	11
Micro Commercial Components	ES1J-TP	SMA	1	\$0.08	37
Kemet	ESG106M400AH4AA	ESG106	2	\$0.19	144
MuRata	GRM033R61A822KA01D	0201	1	\$0.01	2
MuRata	GRM155R61A104KA01D	0402	1	\$0.01	3
MuRata	GRM155R71E103KA01D	0402	2	\$0.01	6
MuRata	GRM188R72E102KW07D	0603	1	\$0.01	5
MuRata	GRM21BC80G226ME39L	0805	1	\$0.04	7
MuRata	GRM21BR61E475KA12L	0805	1	\$0.02	7
MuRata	GRM31CR61C226ME15L	1206_190	1	\$0.13	11
MuRata	GRM31CR71H225KA88L	1206_190	1	\$0.05	11
MuRata	GRM31CR71H475KA12L	1206	1	\$0.07	11
MuRata	GRM32ER61E226KE15L	1210	3	\$0.16	44
MuRata	GRM32ER71H475KA88L	1210	2	\$0.19	15
Infineon Technologies	IPP65R190CFD	TO-220	1	\$2.34	0
Texas Instruments	LM3151MHX-3.3/NOPB	MXA14A	1	\$1.35	59
Texas Instruments	LM5023MM-2/NOPB	MUA08A	1	\$0.38	24
Rohm	MCR25JZHFLR270	1210	1	\$0.03	15
ON Semiconductor	MURS360T3	SMC	1	\$1.12	83
California Eastern Laboratories	PS2811-1	SSOP-4	1	\$0.38	111
Yageo America	RC0603FR-07820KL	0603	1	\$0.01	5
Bourns	SDR0503-100ML	SDR0503	1	\$0.19	48
Bourns	SRN8040-2R2Y	SRN8040	1	\$0.22	100
Bourns	SRP1250-6R8M	SRP1250	1	\$0.64	253
Bourns	SRR1208-150ML	SRR1208	1	\$0.37	216
Vishay-Semiconductor	SS14-E3/61T	SMA	2	\$0.08	75
STMicroelectronics	STW21N90K5	TO-247	1	\$3.94	123
Texas Instruments	TL431AIDBVR	R-PDSO-G3	1	\$0.07	16
Texas Instruments	TPS54531DDAR	DDA0008E	1	\$0.75	57
Texas Instruments	TPS563200DDCR	DDC0006A	1	\$0.52	10
Texas Instruments	TPS564201DDCR	DDC0006A_N	1	\$0.50	10

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
Texas Instruments	TPS62175DQCR	R- PWSON- N10	1	\$0.60	12
Total			80	\$18.46	2411.0133

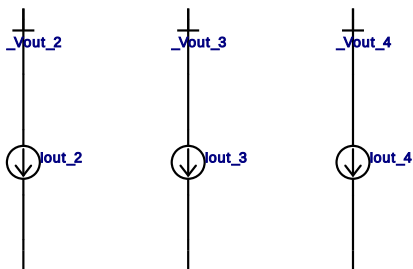
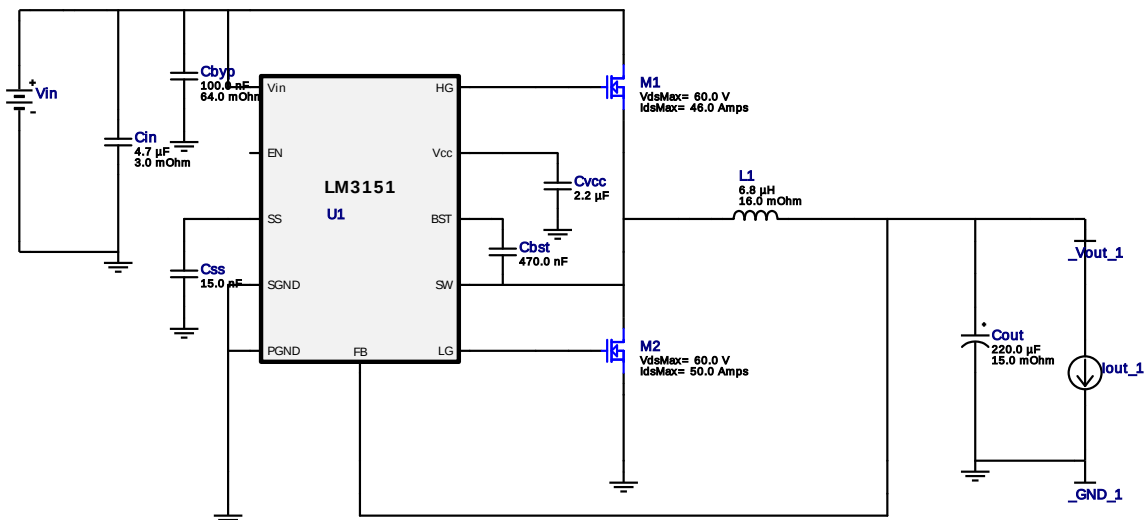


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Iout = 4.7A

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BOM Cost = \$2.91
BOM Count = 10
Total Pd = 1.52W

WEBENCH® Design Report

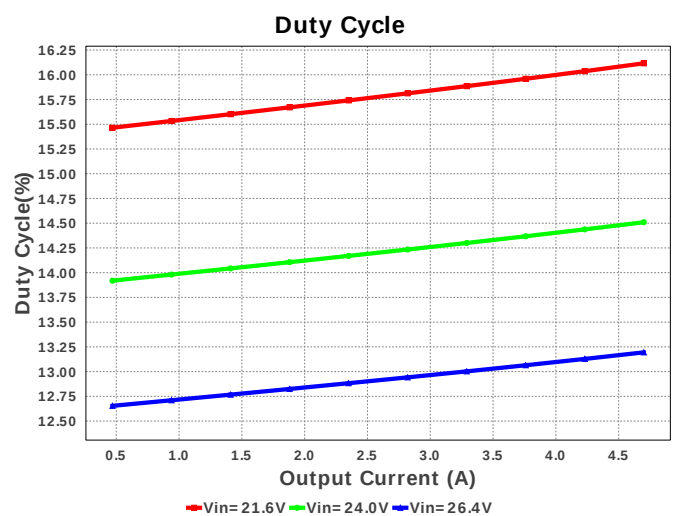
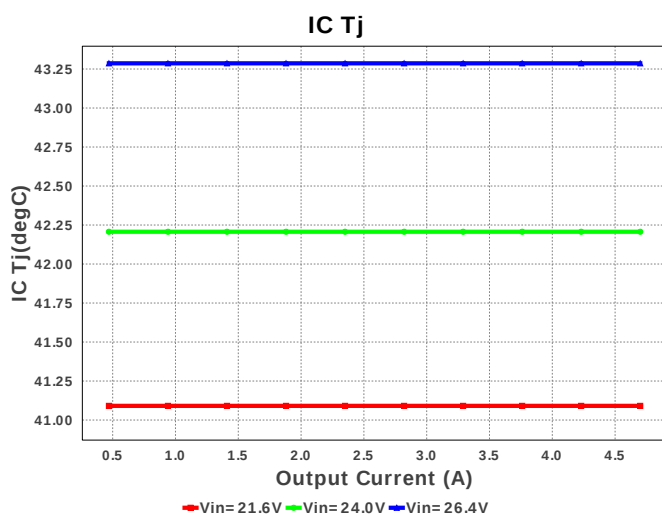
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LM3151MHX-3.3/NOPB 21.6V-26.4V to 3.30V @ 4.7A

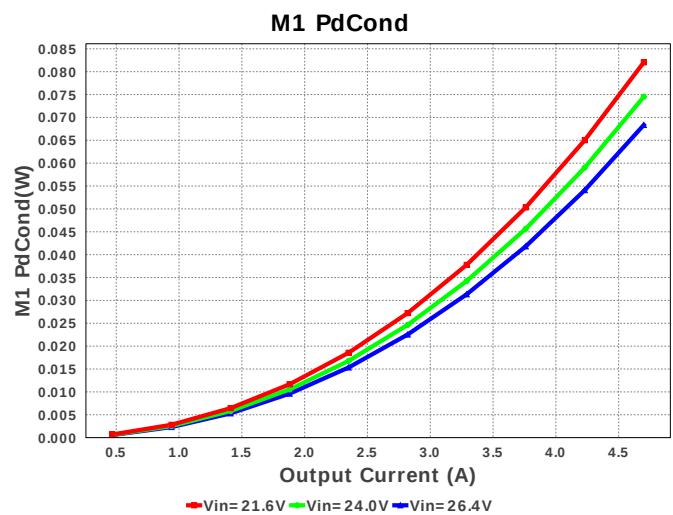
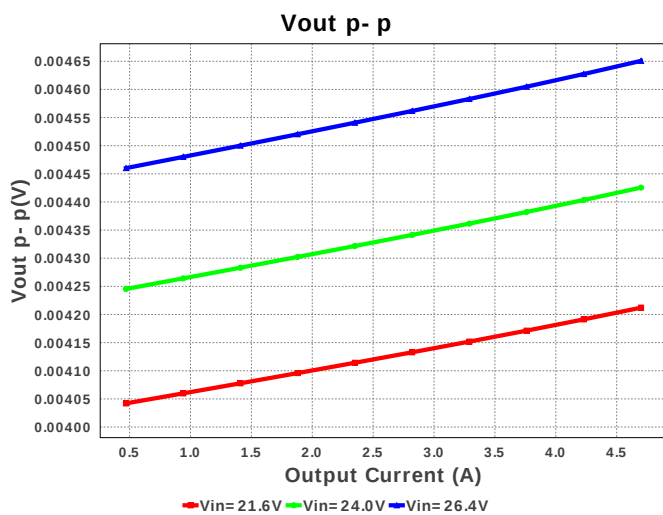
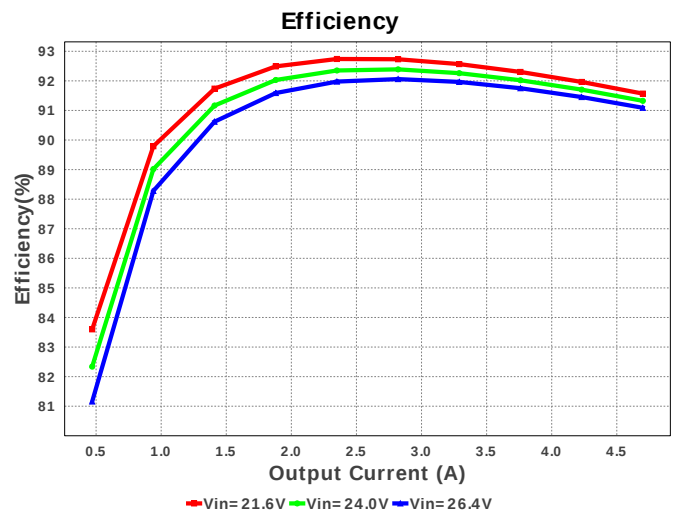
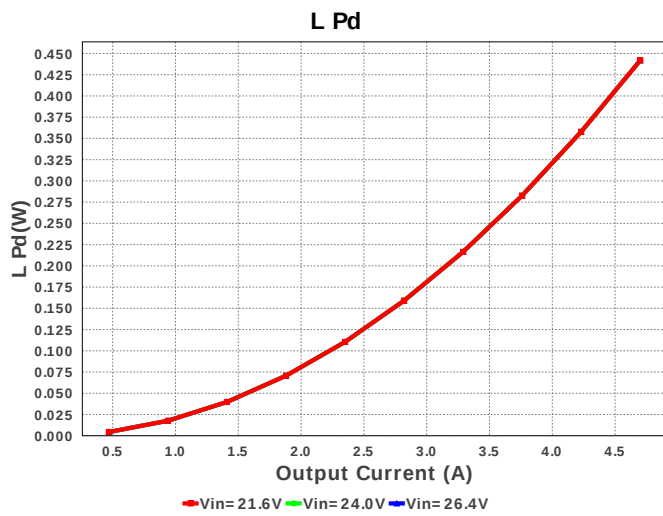
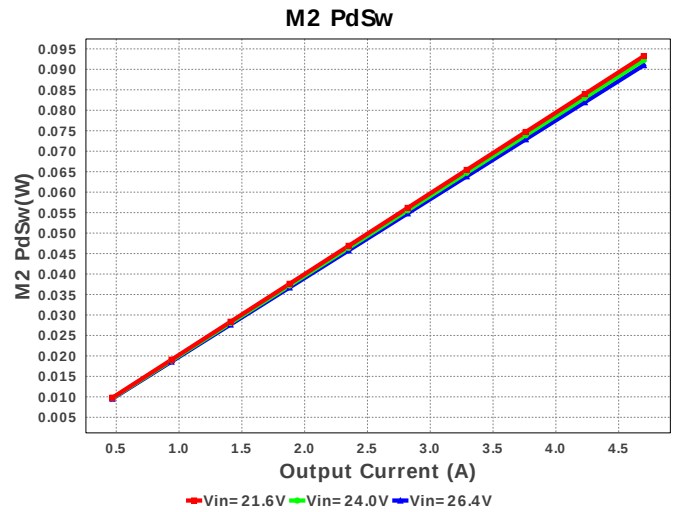
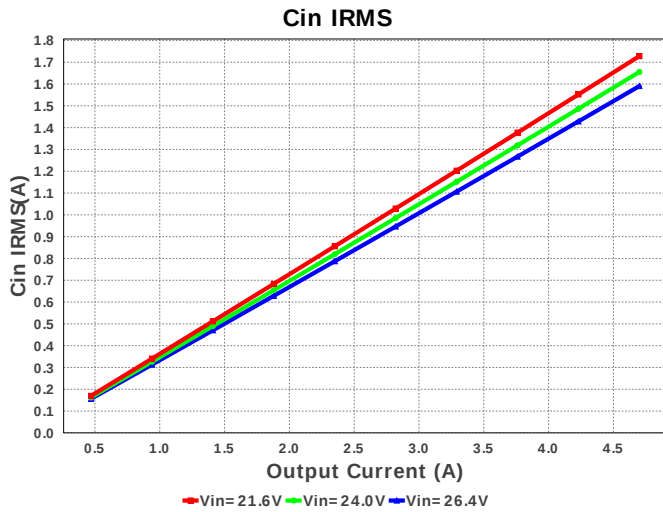


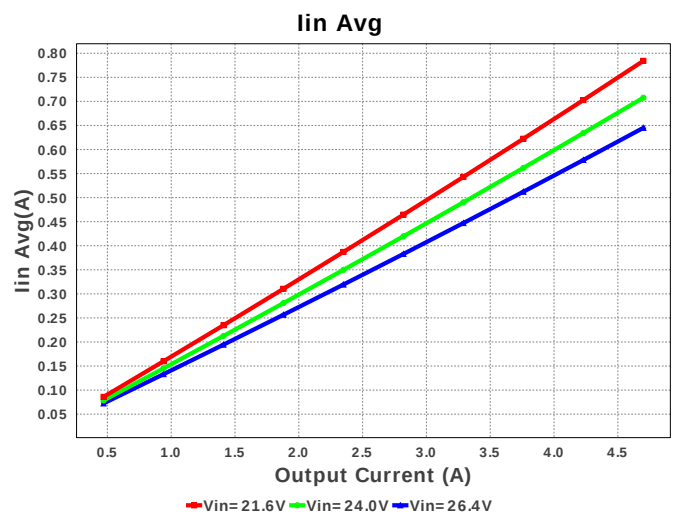
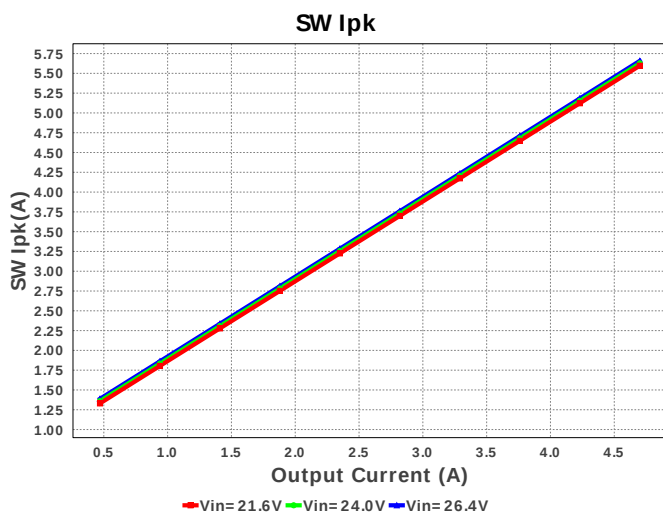
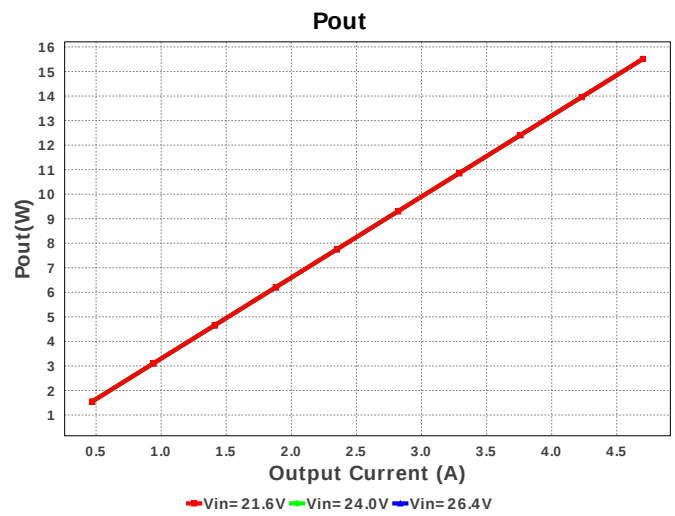
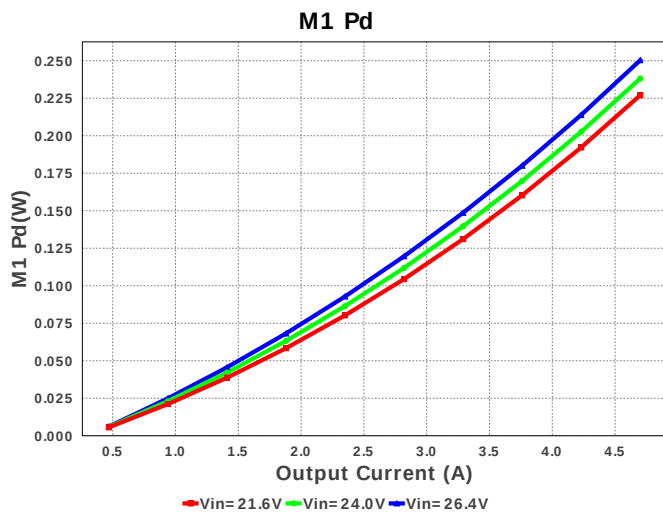
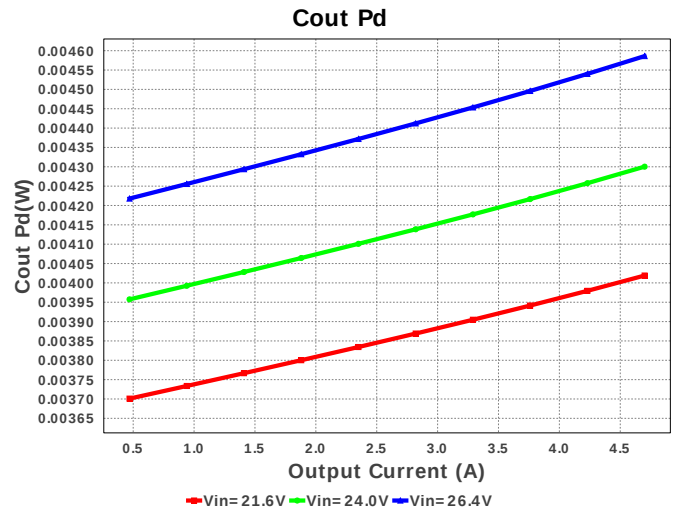
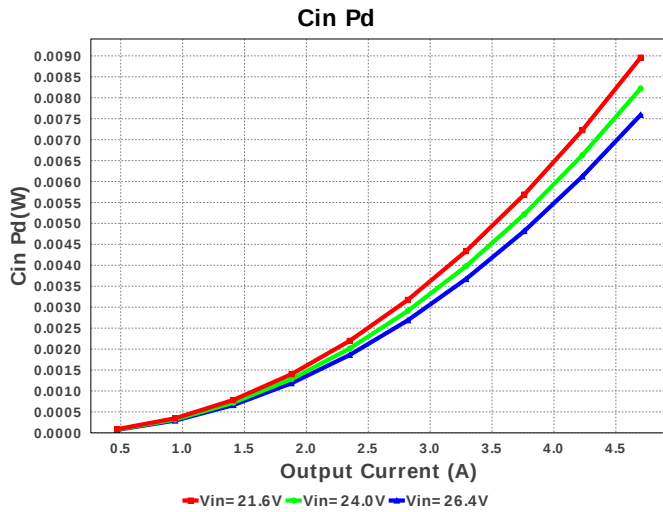
Electrical BOM

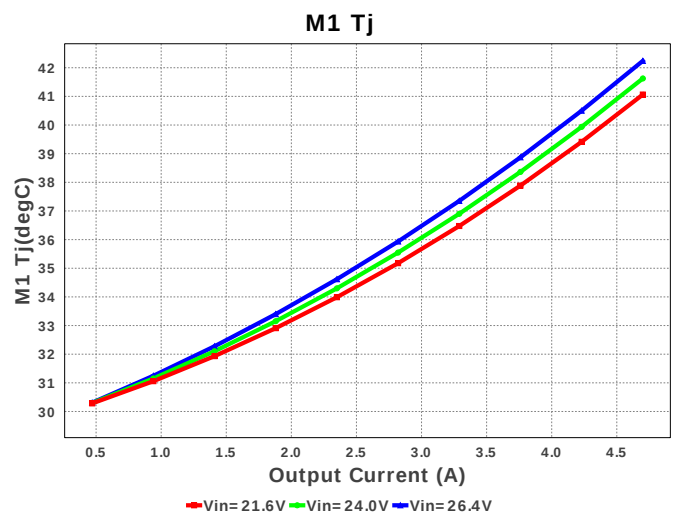
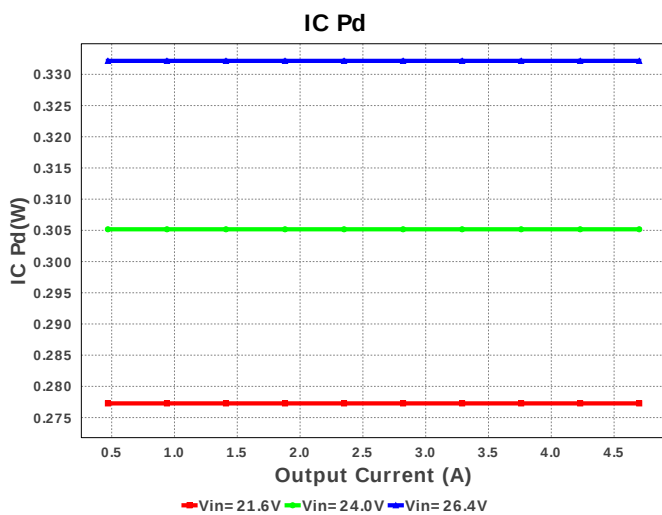
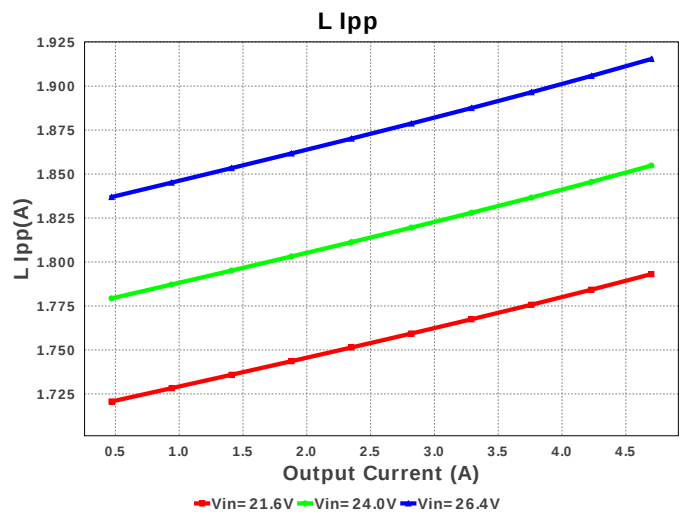
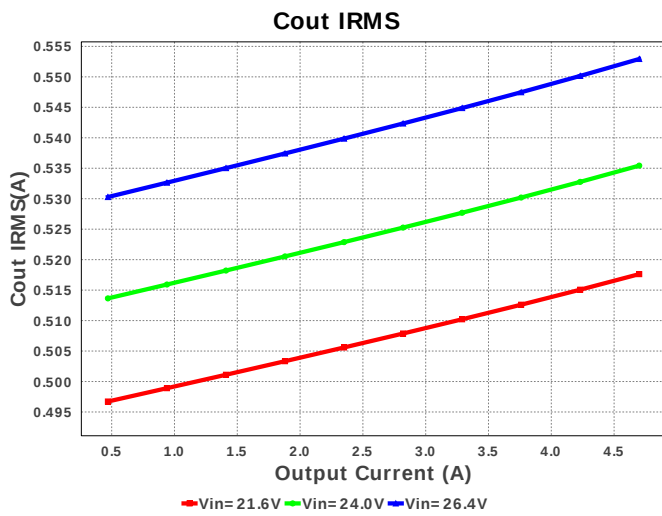
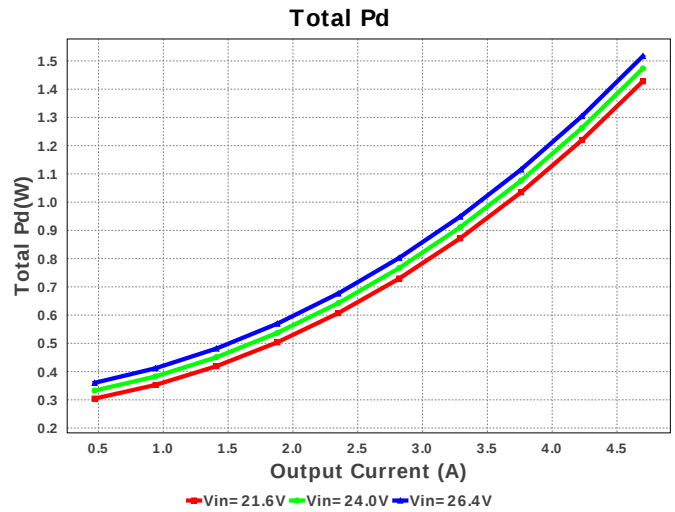
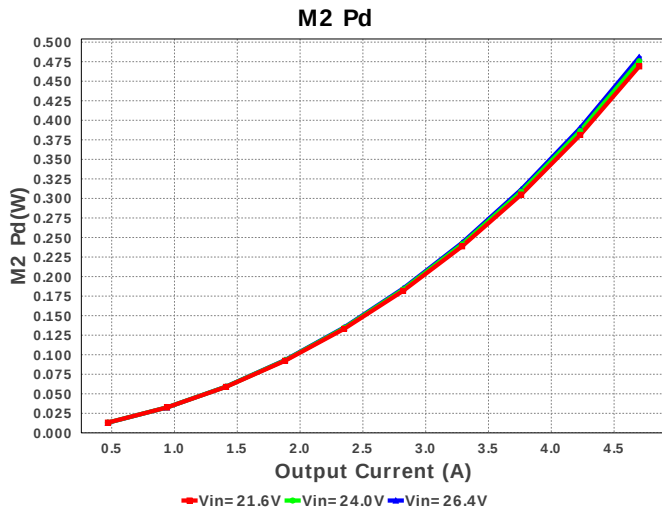
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	Taiyo Yuden	EMK212B7474KD-T Series= X7R	Cap= 470.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.02	 0805 7 mm ²
2.	Cbyo	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	\$0.01	 0805 7 mm ²
3.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	\$0.07	 1206 11 mm ²
4.	Cout	Panasonic	6SVPE220MW Series= SVPE	Cap= 220.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 3.15 A	1	\$0.20	 CAPSMT_62_E61 53 mm ²
5.	Css	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

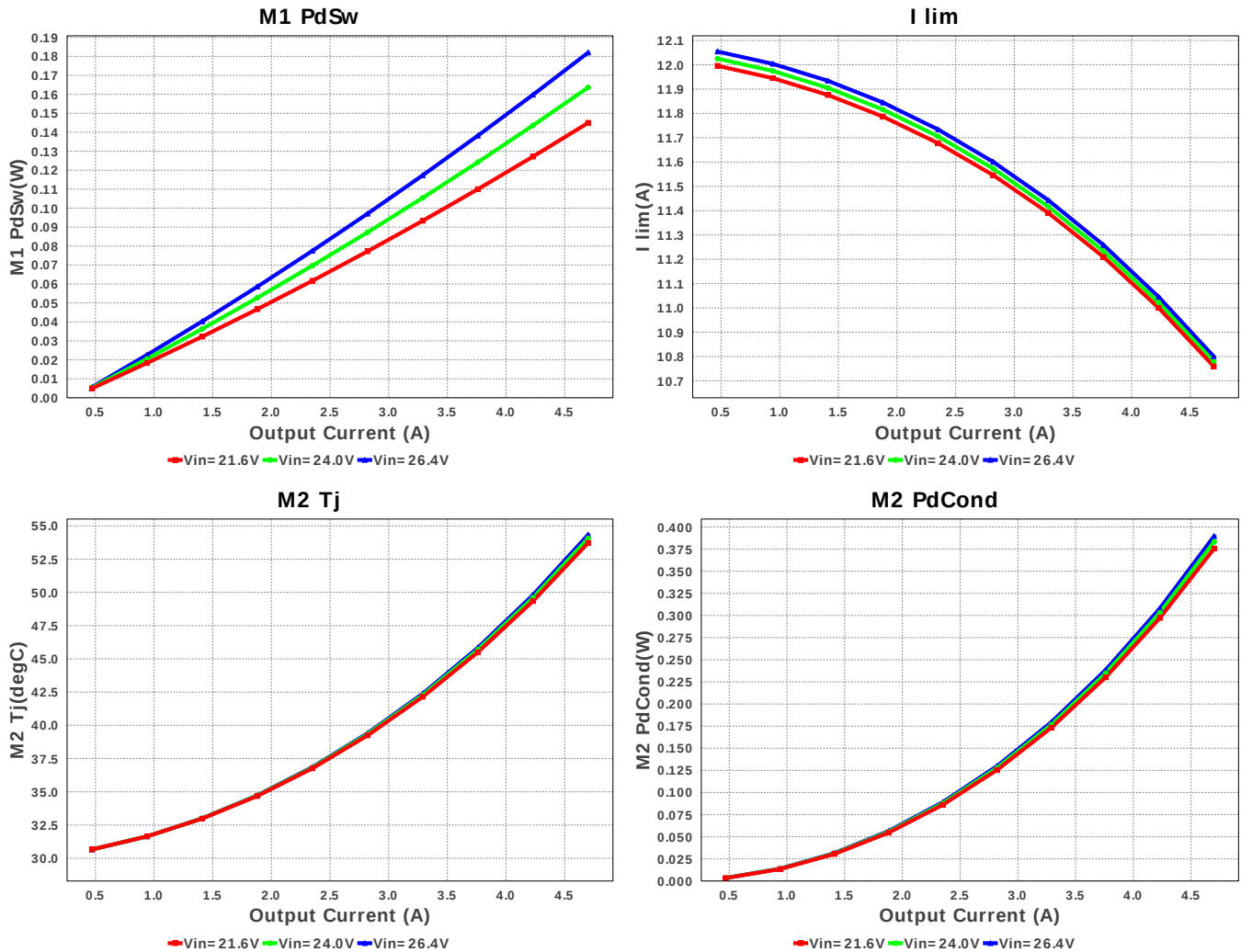
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
6.	Cvcc	Taiyo Yuden	EMK212B7225KG-T Series= X7R	Cap= 2.2 uF VDC= 16.0 V IRMS= 0.0 A	1	\$0.03	 0805 7 mm ²
7.	L1	Bourns	SRP1250-6R8M	L= 6.8 µH DCR= 16.0 mOhm	1	\$0.64	 SRP1250 253 mm ²
8.	M1	Infineon Technologies	BSC097N06NS	VdsMax= 60.0 V IdsMax= 46.0 Amps	1	\$0.32	 PG-TDSON-8 55 mm ²
9.	M2	Infineon Technologies	BSC100N06LS3 G	VdsMax= 60.0 V IdsMax= 50.0 Amps	1	\$0.26	 PG-TDSON-8 55 mm ²
10.	U1	Texas Instruments	LM3151MHX-3.3/NOPB	Switcher	1	\$1.35	 MXA14A 59 mm ²











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.591 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	552.942 mA	Current	Output capacitor RMS ripple current
3.	I lim	10.795 A	Current	Current limit threshold
4.	Iin Avg	645.06 mA	Current	Average input current
5.	L lpp	1.915 A	Current	Peak-to-peak inductor ripple current
6.	SW lpk	5.658 A	Current	Peak switch current
7.	BOM Count	10	General	Total Design BOM count
8.	FootPrint	513.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	234.008 kHz	General	Switching frequency
10.	IC Tolerance	66.0 mV	General	IC Feedback Tolerance
11.	Pout	15.51 W	General	Total output power
12.	Total BOM	\$2.91	General	Total BOM Cost
13.	Duty Cycle	13.195 %	Op_point	Duty cycle
14.	Efficiency	91.077 %	Op_point	Steady state efficiency
15.	IC Tj	51.59 degC	Op_point	IC junction temperature
16.	IOUT_OP	4.7 A	Op_point	Iout operating point
17.	M1 Tj	42.24 degC	Op_point	M1 MOSFET junction temperature
18.	M2 Tj	54.444 degC	Op_point	M2 MOSFET junction temperature
19.	VIN_OP	26.4 V	Op_point	Vin operating point
20.	Vout p-p	4.651 mV	Op_point	Peak-to-peak output ripple voltage
21.	Cin Pd	7.59 mW	Power	Input capacitor power dissipation
22.	Cout Pd	4.586 mW	Power	Output capacitor power dissipation
23.	IC Pd	332.161 mW	Power	IC power dissipation
24.	L Pd	441.8 mW	Power	Inductor power dissipation
25.	M1 Pd	250.544 mW	Power	M1 MOSFET total power dissipation
26.	M1 PdCond	68.543 mW	Power	M1 MOSFET conduction losses
27.	M1 PdSw	182.001 mW	Power	M1 MOSFET switching losses
28.	M2 Pd	482.947 mW	Power	M2 MOSFET total power dissipation
29.	M2 PdCond	389.853 mW	Power	M2 MOSFET conduction losses
30.	M2 PdSw	93.094 mW	Power	M2 MOSFET switching losses
31.	Total Pd	1.52 W	Power	Total Power Dissipation

#	Name	Value	Category	Description
32.	Vout Tolerance	2.0 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	4.7	Maximum Output Current
2.	VinMax	26.4	Maximum input voltage
3.	VinMin	21.6	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	LM3151	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **LM3151** Product Folder : <http://www.ti.com/product/LM3151> : contains the data sheet and other resources.

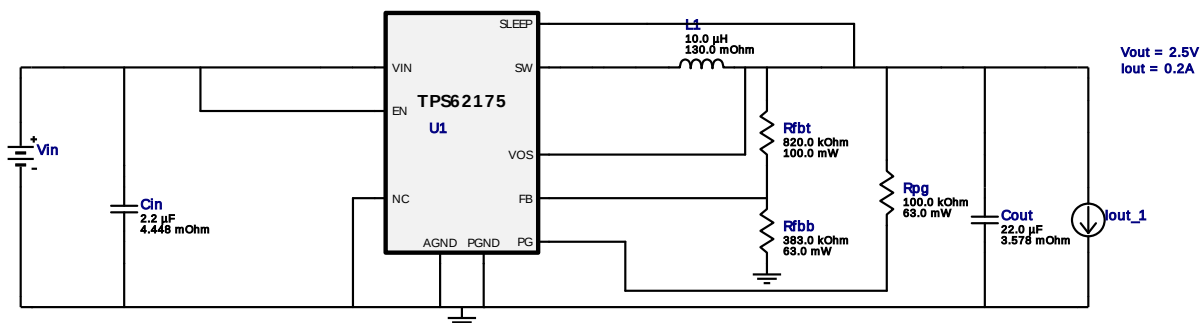


Vout = 2.5V
Iout = 0.2A

Device = TPS62175DQCR
Topology = Buck
Created = 7/13/16 6:56:17 AM
BOM Cost = \$0.91
BOM Count = 7
Total Pd = 0.18W

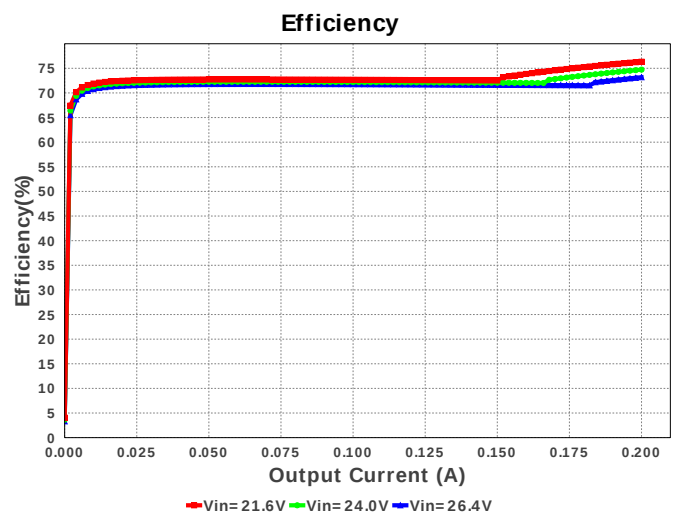
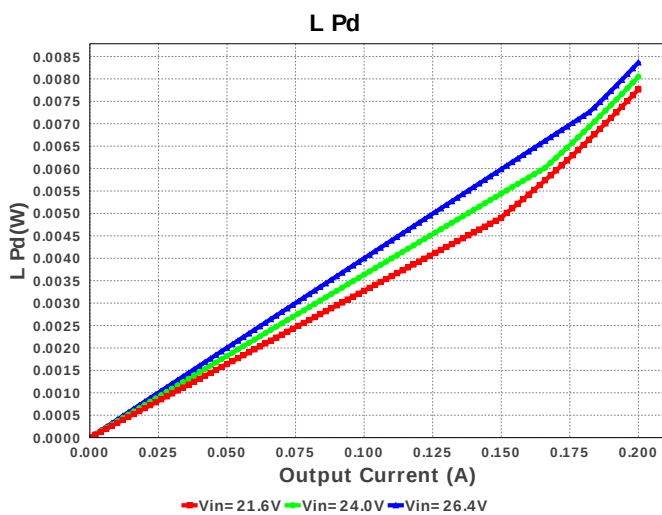
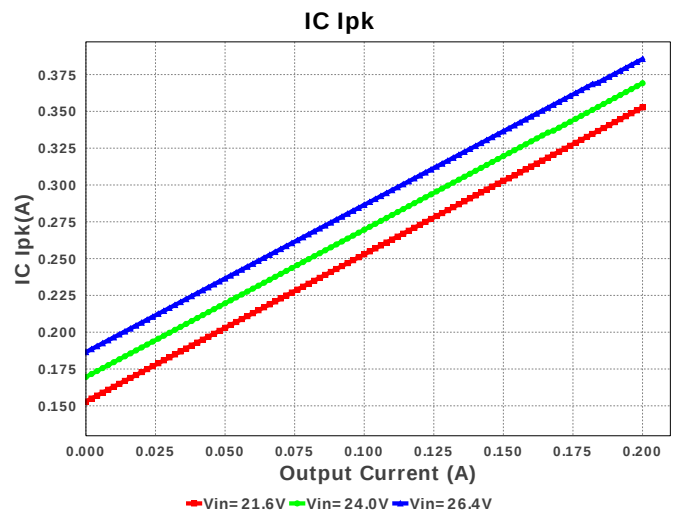
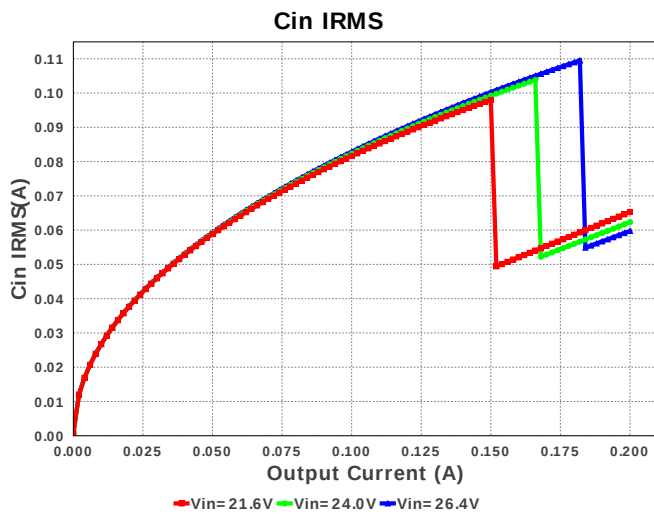
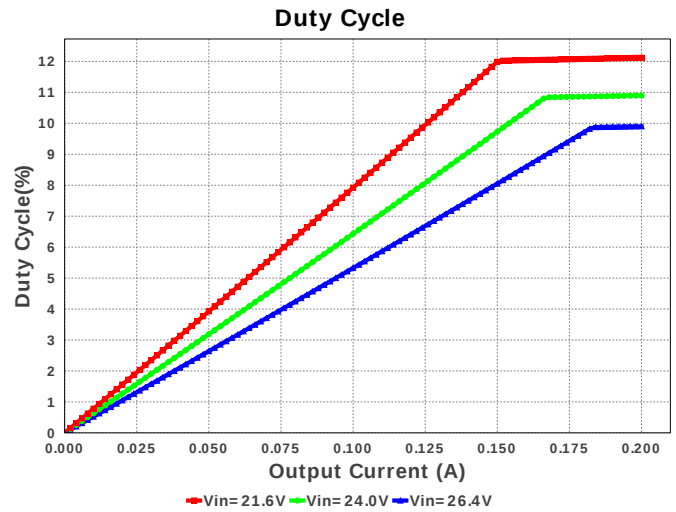
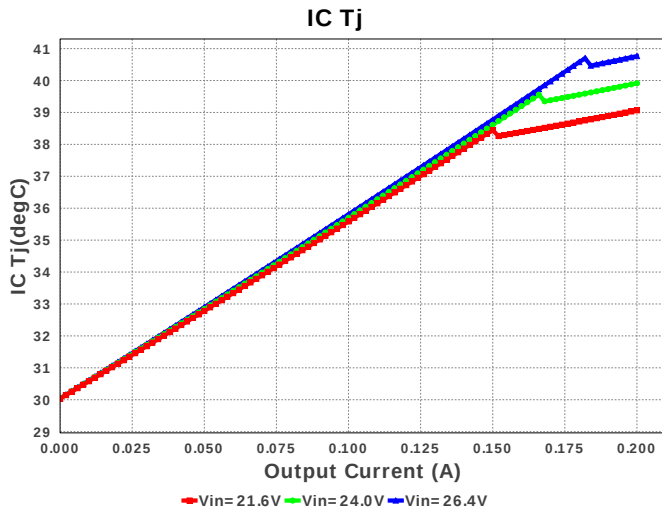
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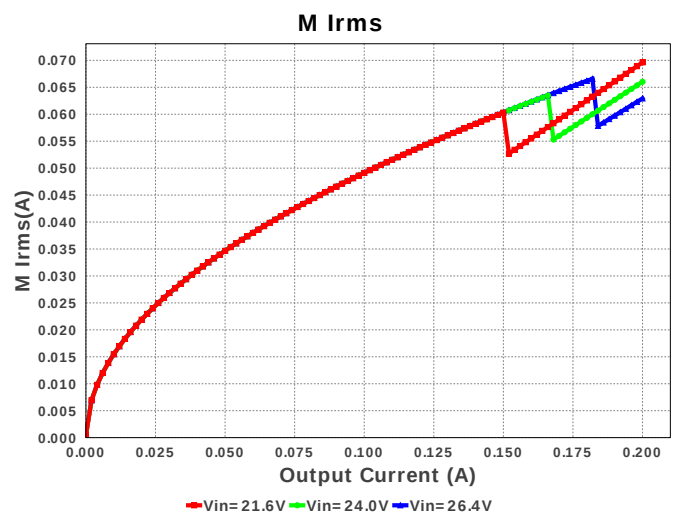
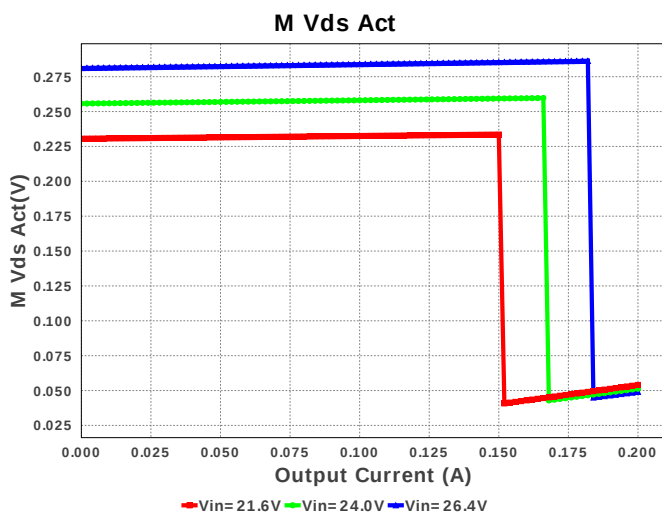
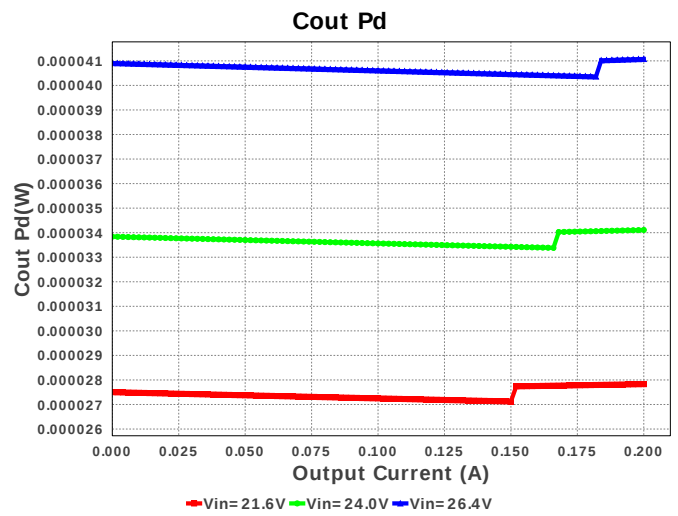
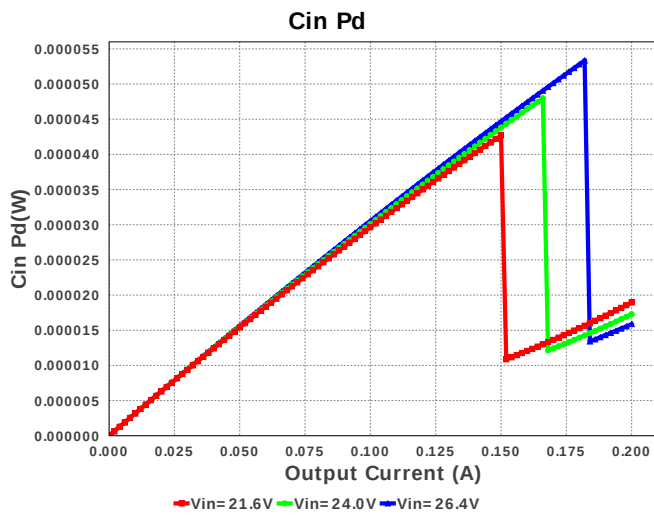
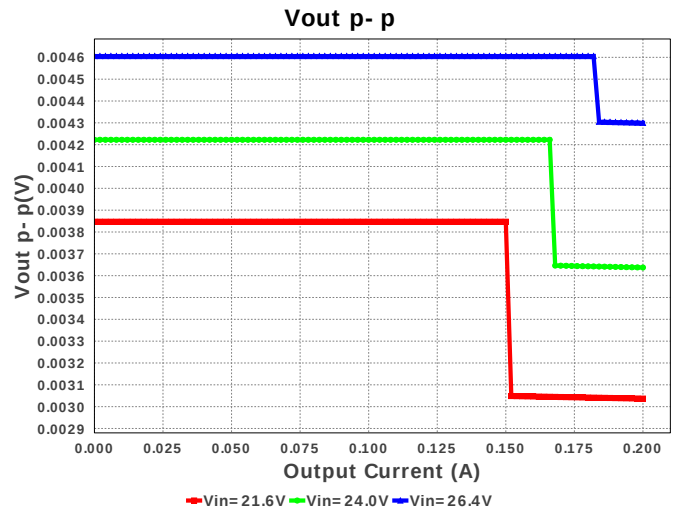
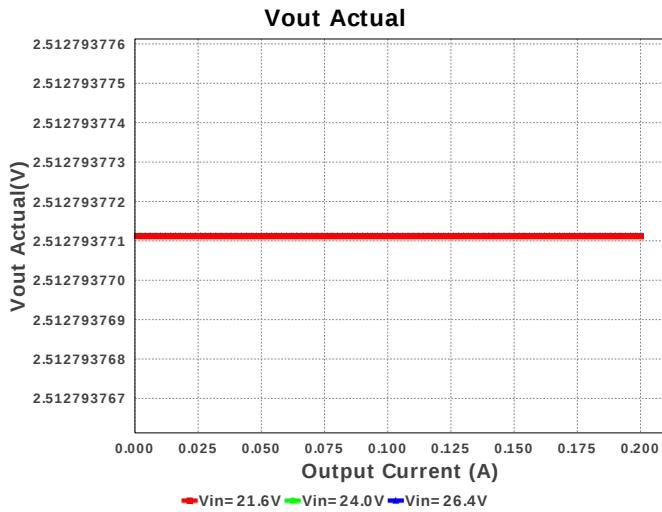
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TPS62175DQCR 21.6V-26.4V to 2.50V @ 0.2A

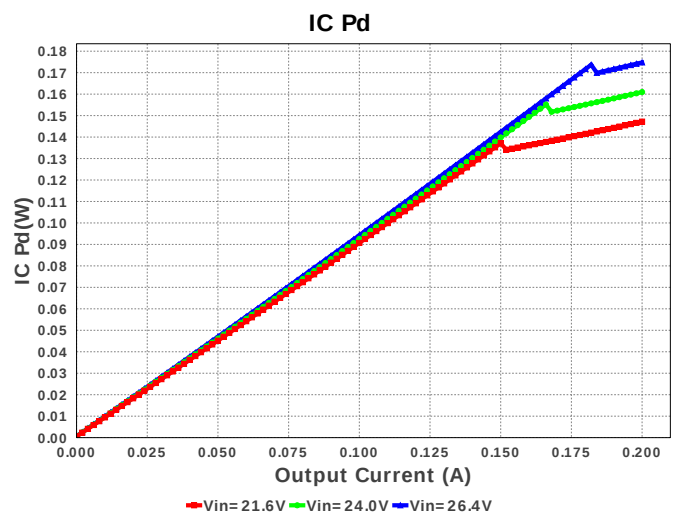
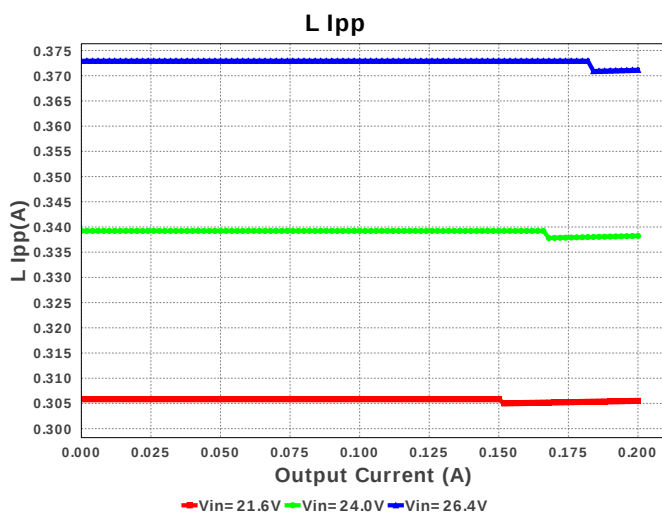
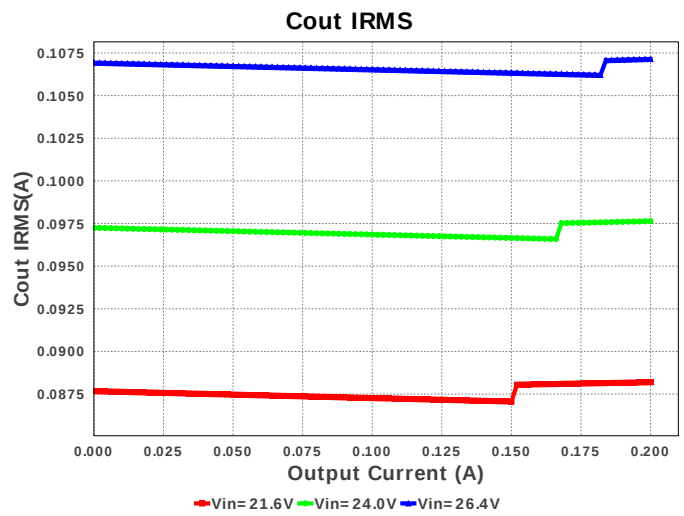
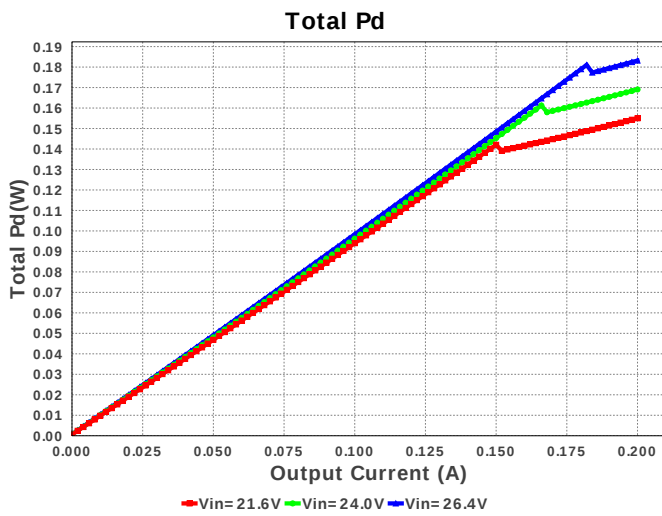
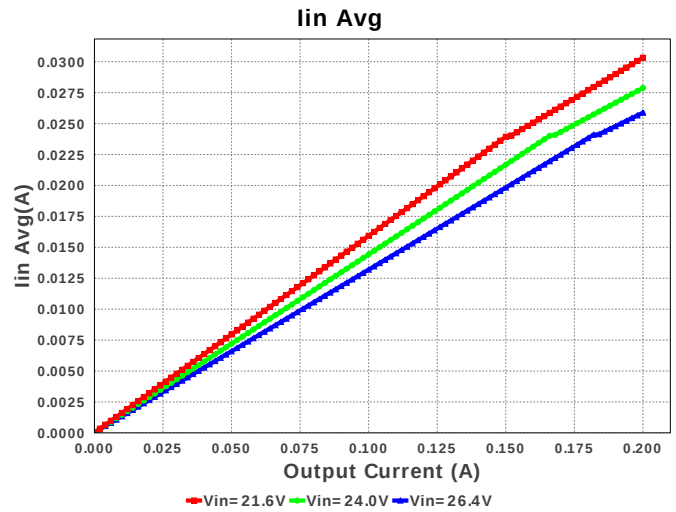
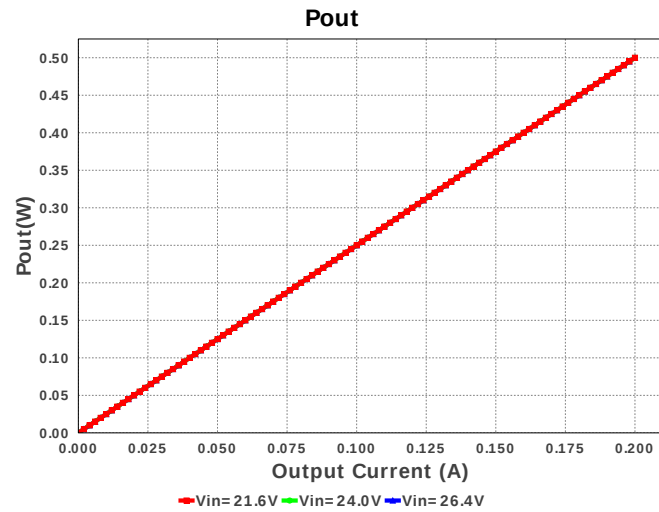


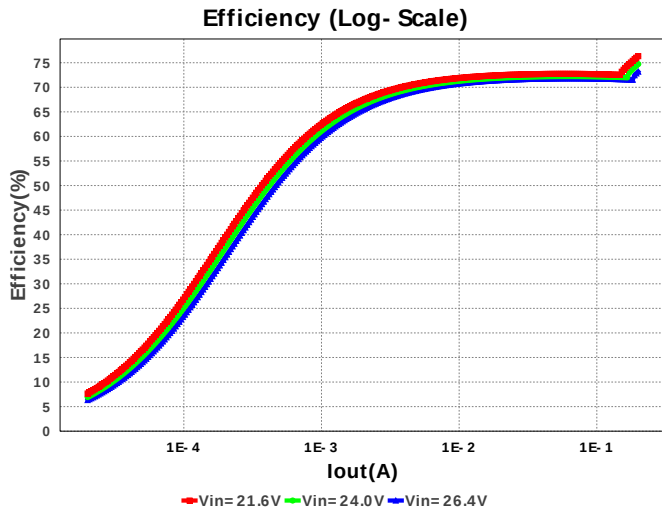
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM31CR71H225KA88L Series= X7R	Cap= 2.2 uF ESR= 4.448 mOhm VDC= 50.0 V IRMS= 2.2252 A	1	\$0.05	 1206_190 11 mm ²
2.	Cout	MuRata	GRM21BC80G226ME39L Series= X6S	Cap= 22.0 uF ESR= 3.578 mOhm VDC= 4.0 V IRMS= 3.29633 A	1	\$0.04	 0805 7 mm ²
3.	L1	Bourns	SDR0503-100ML	L= 10.0 µH DCR= 130.0 mOhm	1	\$0.19	 SDR0503 48 mm ²
4.	Rfbb	Vishay-Dale	CRCW0402383KFKED Series= CRCW..e3	Res= 383.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
5.	Rfbb	Yageo America	RC0603FR-07820KL Series= ?	Res= 820.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
6.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
7.	U1	Texas Instruments	TPS62175DQCR	Switcher	1	\$0.60	 R-PWSON-N10 12 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	59.74 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	107.146 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	385.583 mA	Current	Peak switch current in IC
4.	Iin Avg	25.878 mA	Current	Average input current
5.	L Ipp	371.17 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	62.938 mA	Current	Q Iavg
7.	BOM Count	7	General	Total Design BOM count
8.	FootPrint	88.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	637.67 kHz	General	Switching frequency
10.	IC Tolerance	24.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	48.988 mV	General	Voltage drop across the MosFET
12.	Pout	500.0 mW	General	Total output power
13.	Total BOM	\$0.91	General	Total BOM Cost
14.	Vout Actual	2.513 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Vout OP	2.5 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	9.903 %	Op_point	Duty cycle
17.	Efficiency	73.187 %	Op_point	Steady state efficiency
18.	IC Tj	40.765 degC	Op_point	IC junction temperature
19.	ICThetaJA	61.6 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	200.0 mA	Op_point	Iout operating point
21.	VIN_OP	26.4 V	Op_point	Vin operating point
22.	Vout p-p	4.3 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	15.875 μW	Power	Input capacitor power dissipation
24.	Cout Pd	41.077 μW	Power	Output capacitor power dissipation
25.	IC Pd	174.76 mW	Power	IC power dissipation
26.	L Pd	8.366 mW	Power	Inductor power dissipation
27.	Total Pd	183.181 mW	Power	Total Power Dissipation
28.	Vout Tolerance	4.418 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	200.0 m	Maximum Output Current
2.	VinMax	26.4	Maximum input voltage
3.	VinMin	21.6	Minimum input voltage
4.	Vout	2.5	Output Voltage
5.	base_pn	TPS62175	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS62175** Product Folder : <http://www.ti.com/product/TPS62175> : contains the data sheet and other resources.

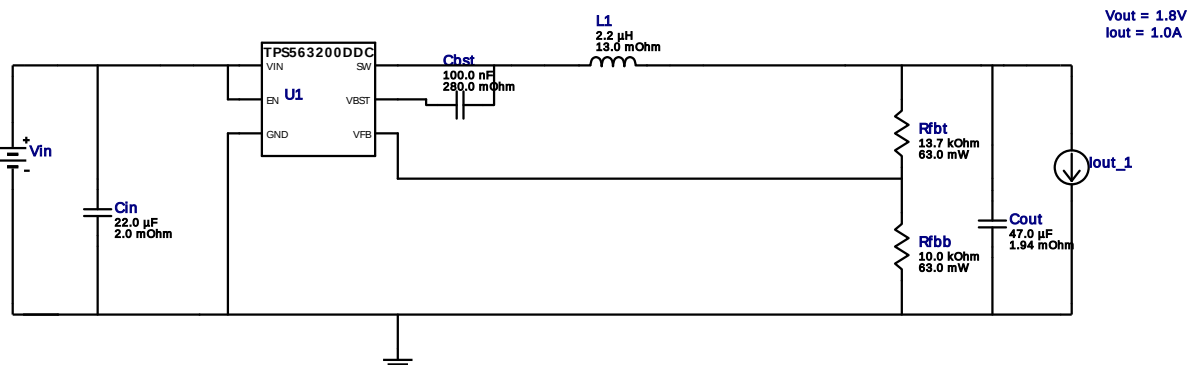


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Iout = 1.0A

Device = TPS563200DDCR
Topology = Buck
Created = 7/13/16 6:56:18 AM
BOM Cost = \$1.06
BOM Count = 7
Total Pd = 0.23W

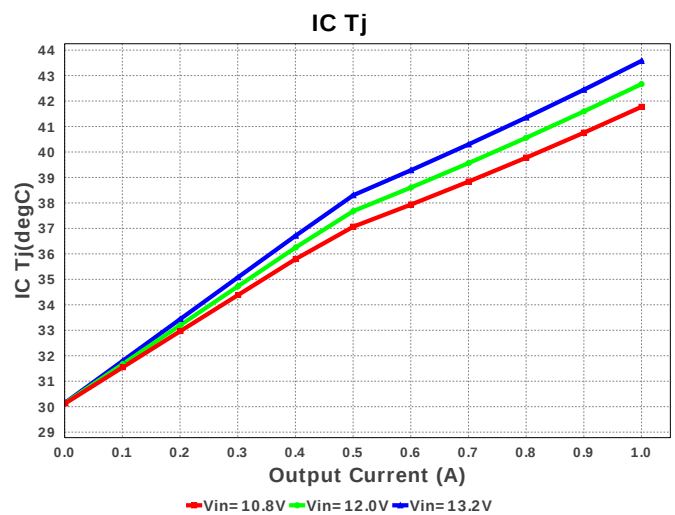
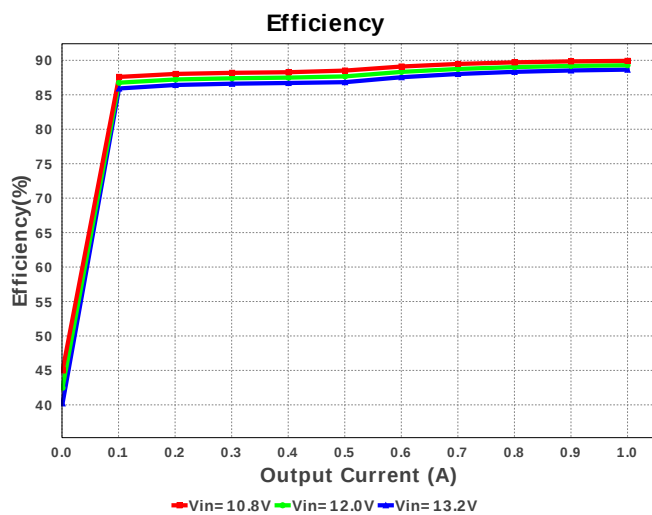
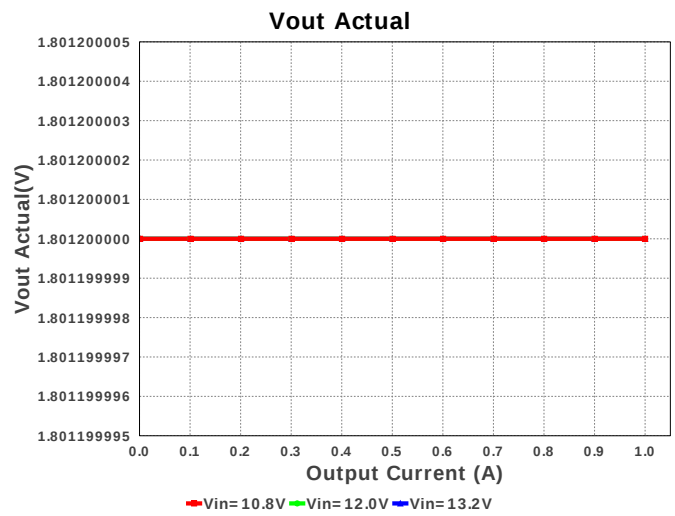
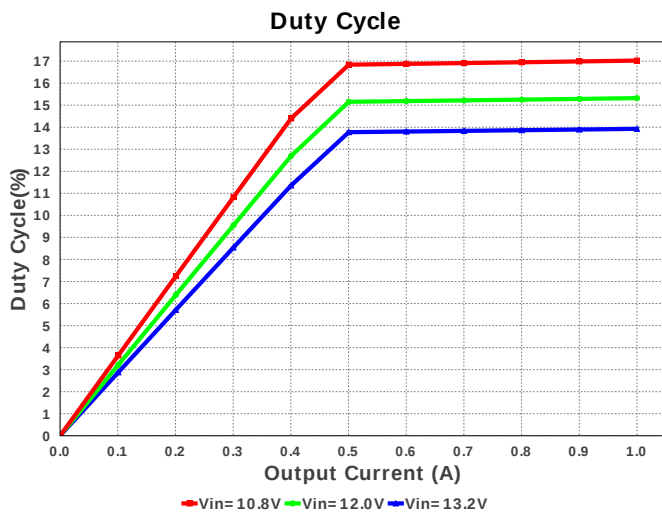
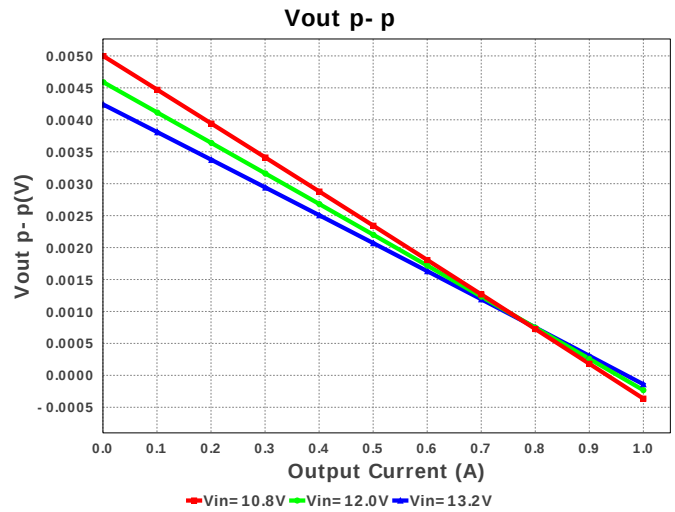
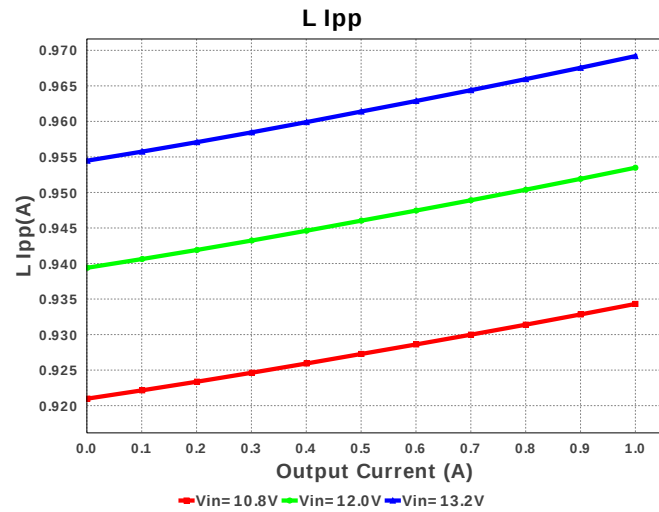
WEBENCH® Design Report

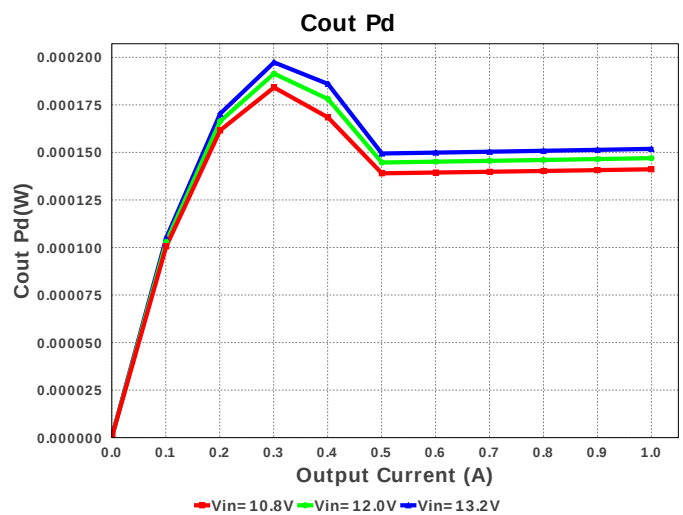
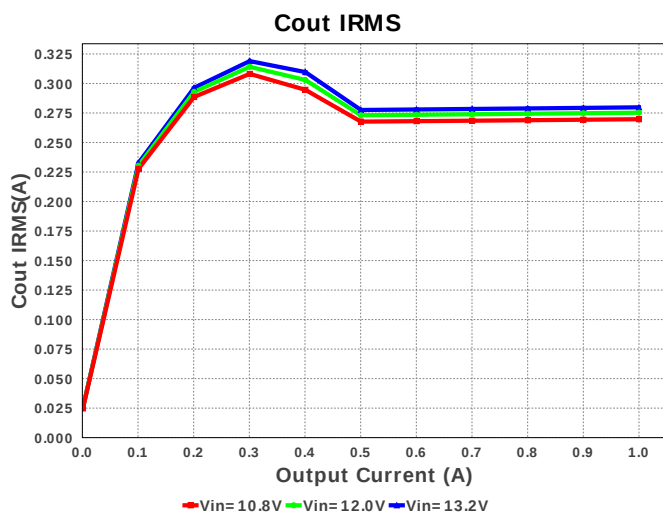
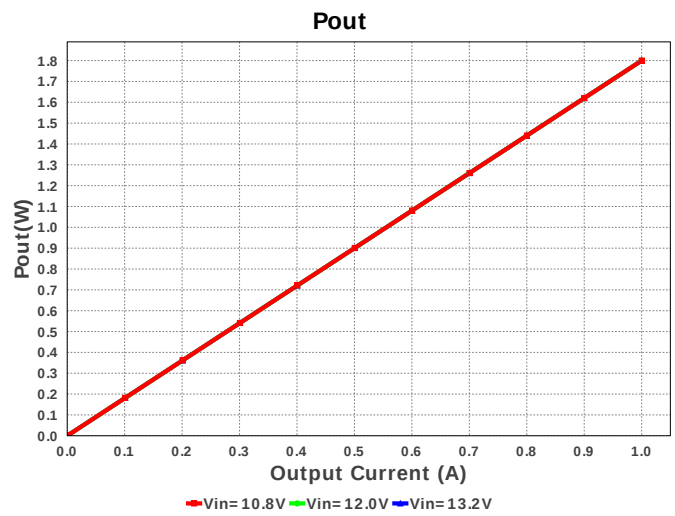
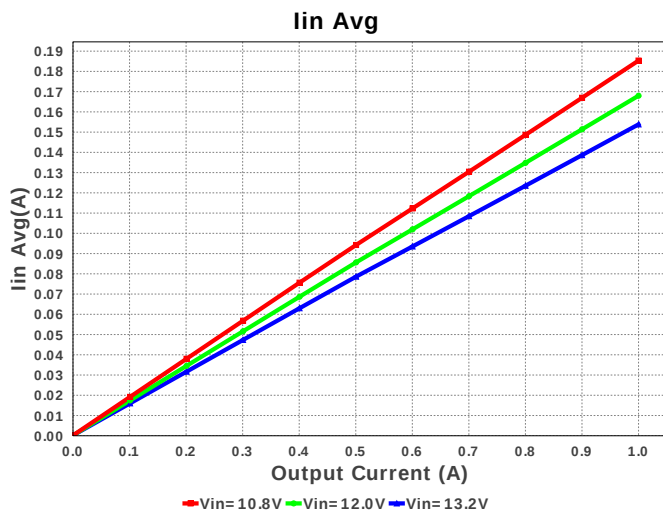
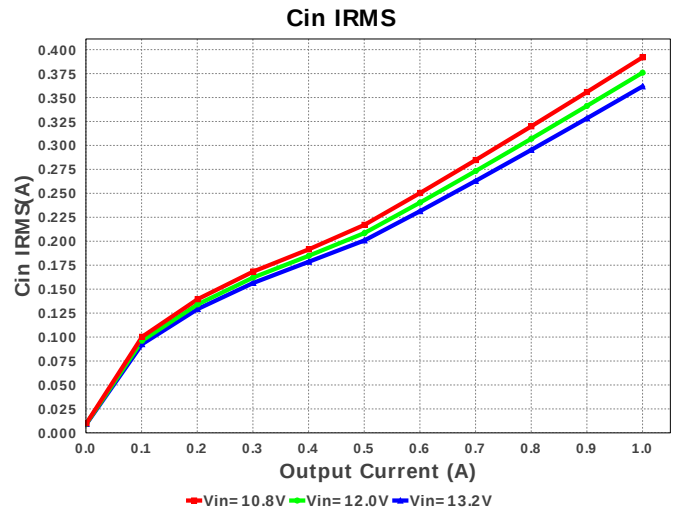
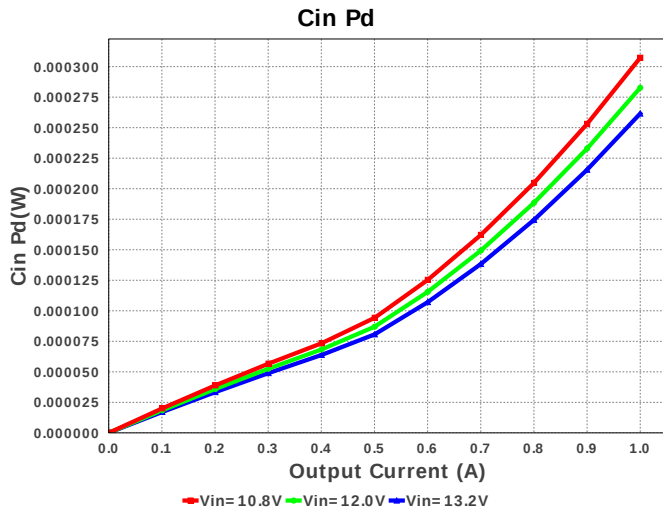
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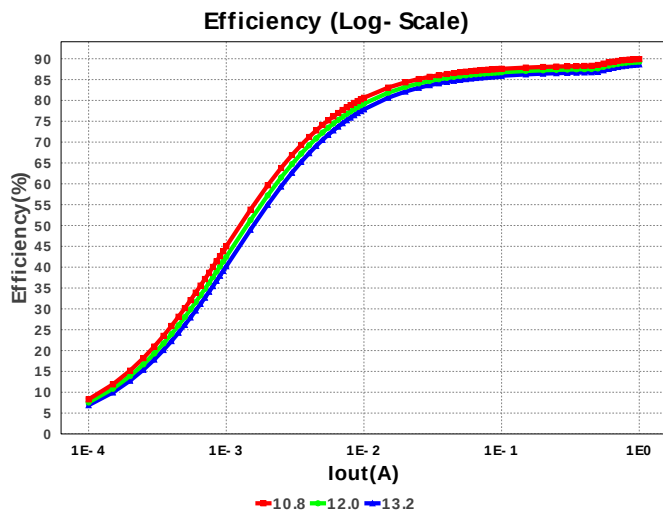
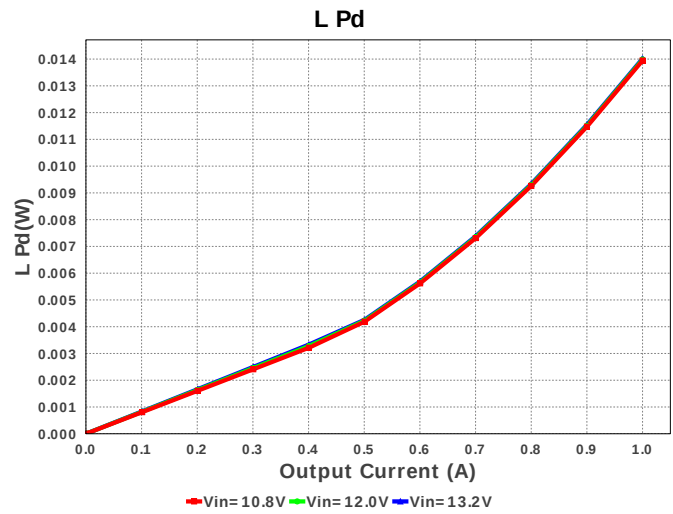
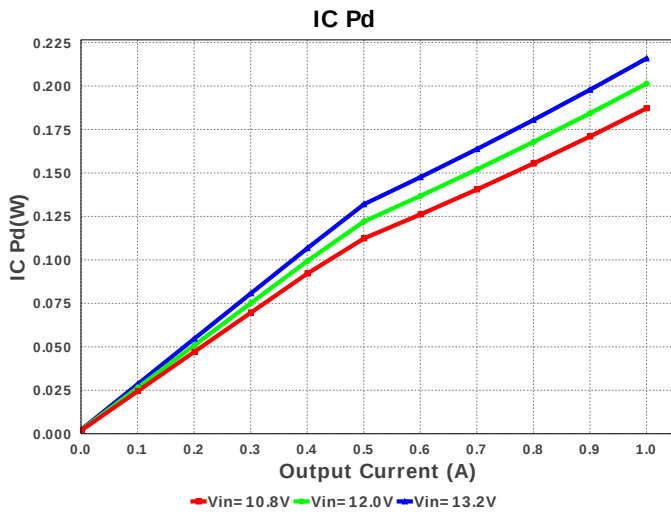
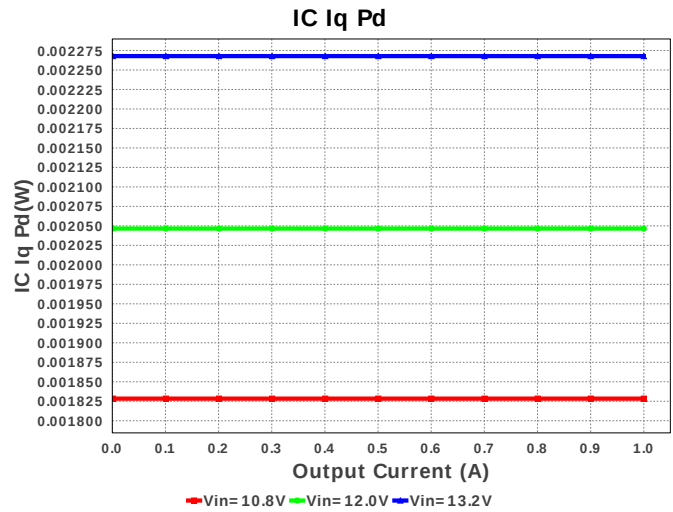
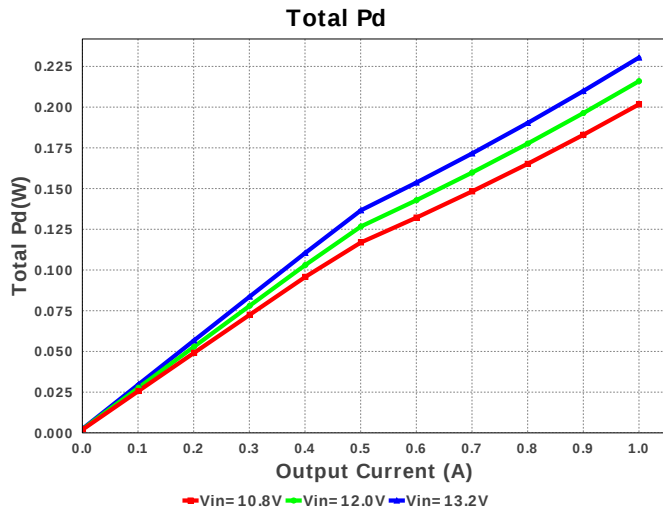


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.16	1210 15 mm ²
3.	Cout	TDK	C3216X6S0G476M Series= X6S	Cap= 47.0 uF ESR= 1.94 mOhm VDC= 4.0 V IRMS= 0.0 A	1	\$0.13	1206 11 mm ²
4.	L1	Bourns	SRN8040-2R2Y	L= 2.2 uH DCR= 13.0 mOhm	1	\$0.22	SRN8040 100 mm ²
5.	Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
6.	Rfbs	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
7.	U1	Texas Instruments	TPS563200DDCR	Switcher	1	\$0.52	DDC0006A 10 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	361.634 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	279.781 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	153.82 mA	Current	Average input current
4.	L Ipp	969.19 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	7	General	Total Design BOM count
6.	FootPrint	149.0 mm ²	General	Total Foot Print Area of BOM components
7.	Frequency	740.754 kHz	General	Switching frequency
8.	Pout	1.8 W	General	Total output power
9.	Total BOM	\$1.06	General	Total BOM Cost
10.	Vout Actual	1.801 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
11.	Vout OP	1.8 V	Op_Point	Operational Output Voltage

#	Name	Value	Category	Description
12.	Duty Cycle	13.927 %	Op_point	Duty cycle
13.	Efficiency	88.651 %	Op_point	Steady state efficiency
14.	IC Tj	43.578 degC	Op_point	IC junction temperature
15.	ICThetaJA	62.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
16.	IOUT_OP	1.0 A	Op_point	Iout operating point
17.	VIN_OP	13.2 V	Op_point	Vin operating point
18.	Vout p-p	4.413 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	261.559 μ W	Power	Input capacitor power dissipation
20.	Cout Pd	151.858 μ W	Power	Output capacitor power dissipation
21.	IC Iq Pd	2.268 mW	Power	IC Iq Pd
22.	IC Pd	215.861 mW	Power	IC power dissipation
23.	L Pd	14.018 mW	Power	Inductor power dissipation
24.	Total Pd	230.433 mW	Power	Total Power Dissipation
25.	Vout Tolerance	2.499 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	13.2	Maximum input voltage
3.	VinMin	10.8	Minimum input voltage
4.	Vout	1.8	Output Voltage
5.	base_pn	TPS563200	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS563200** Product Folder : <http://www.ti.com/product/TPS563200> : contains the data sheet and other resources.

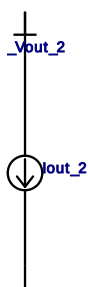
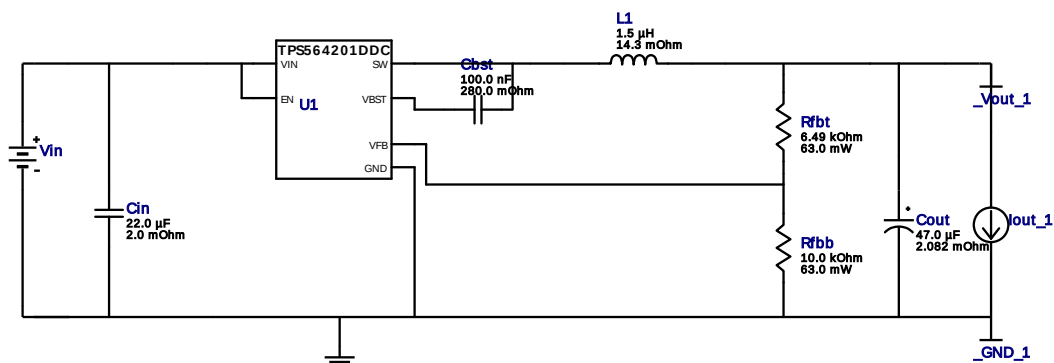


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Iout = 3.2A

Device = TPS564201DDCR
Topology = Buck
Created = 7/13/16 6:56:18 AM
BOM Cost = \$1.46
BOM Count = 7
Total Pd = 0.94W

WEBENCH® Design Report

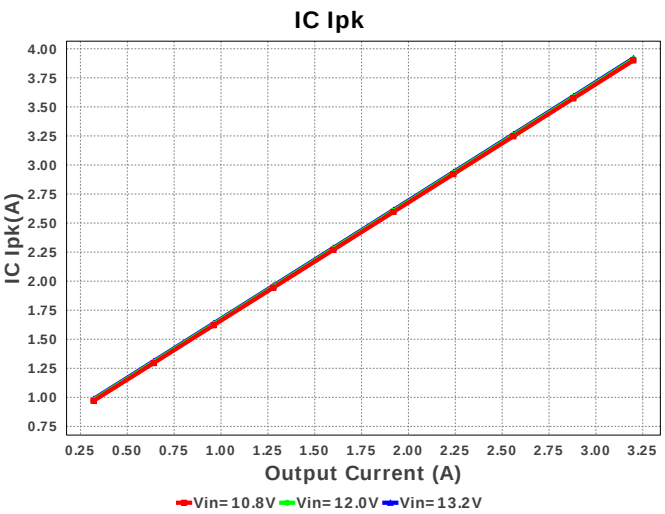
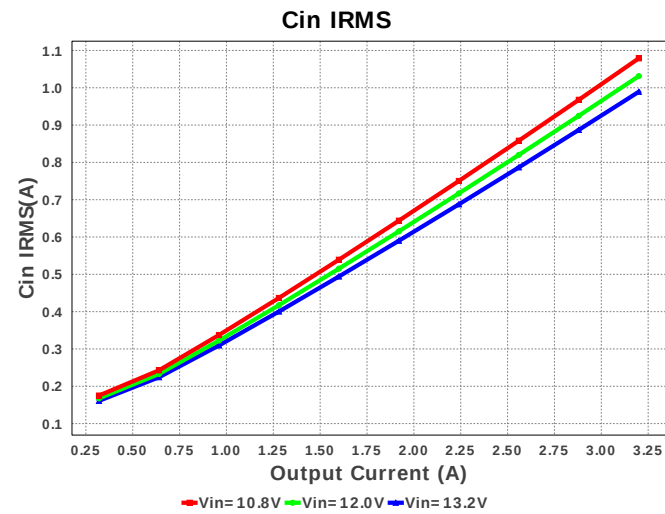
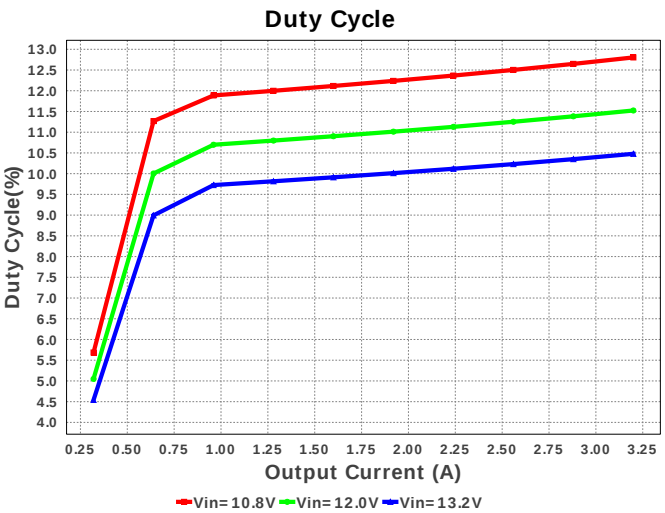
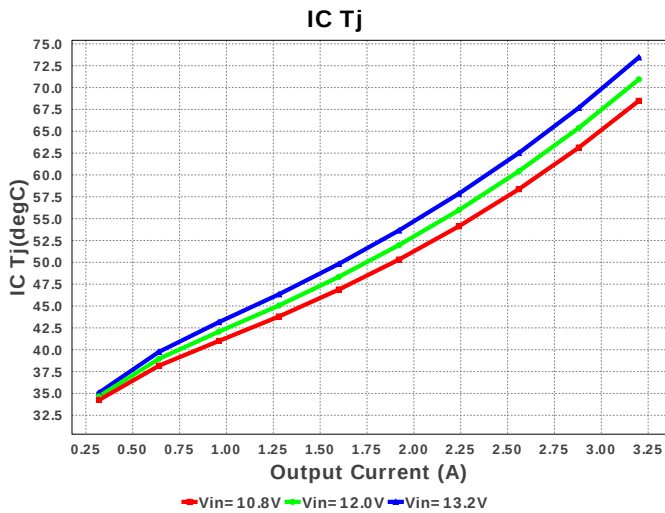
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TPS564201DDCR 10.8V-13.2V to 1.25V @ 3.2A

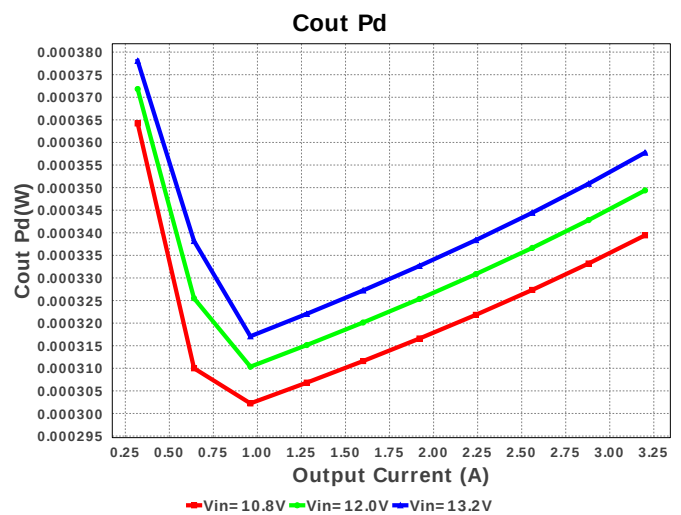
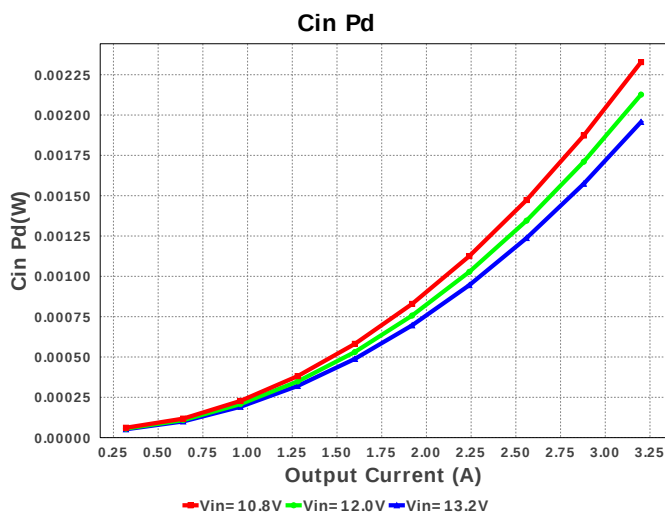
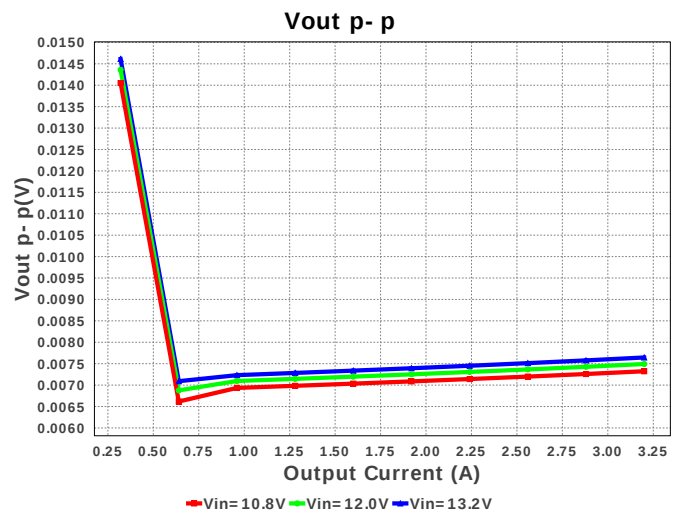
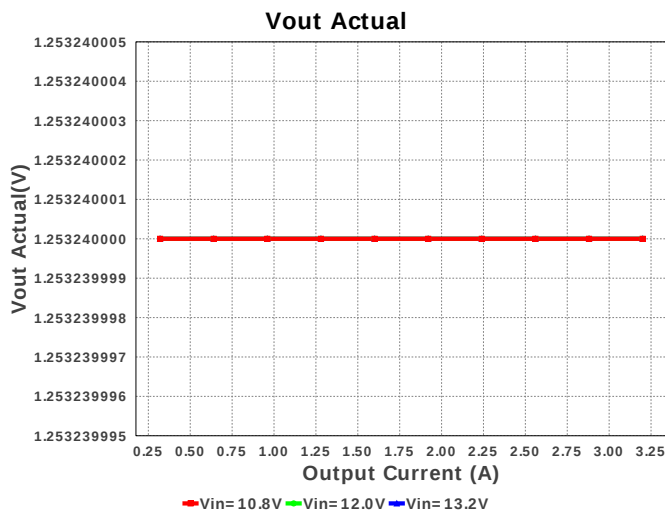
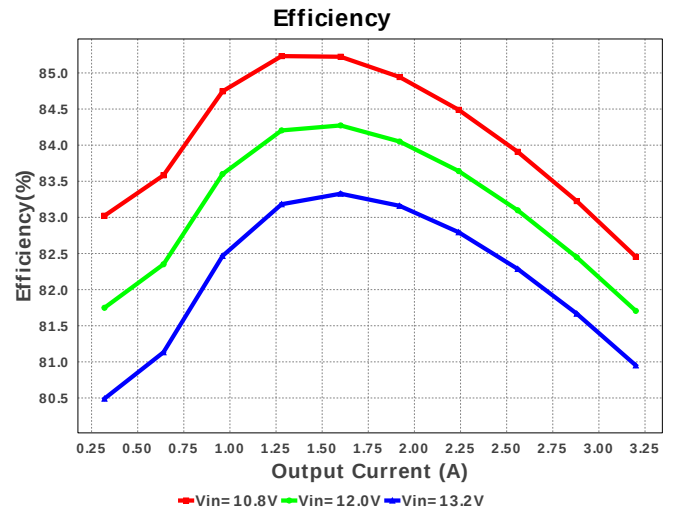
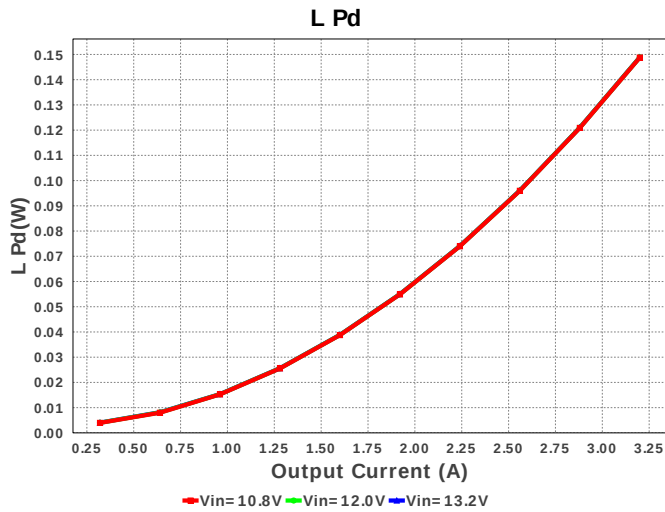


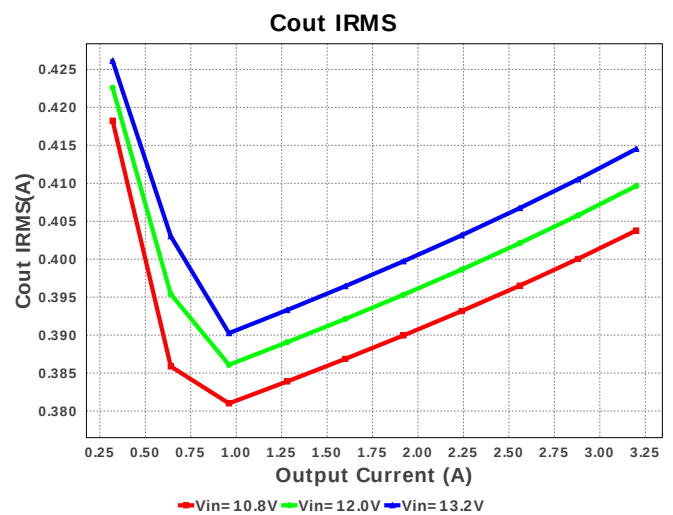
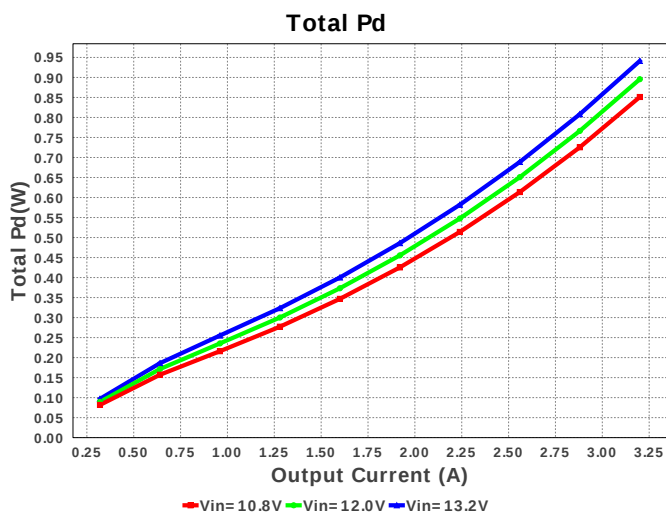
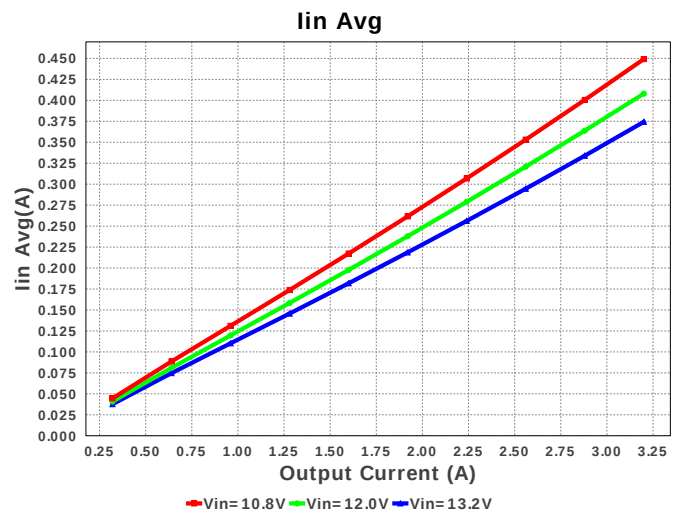
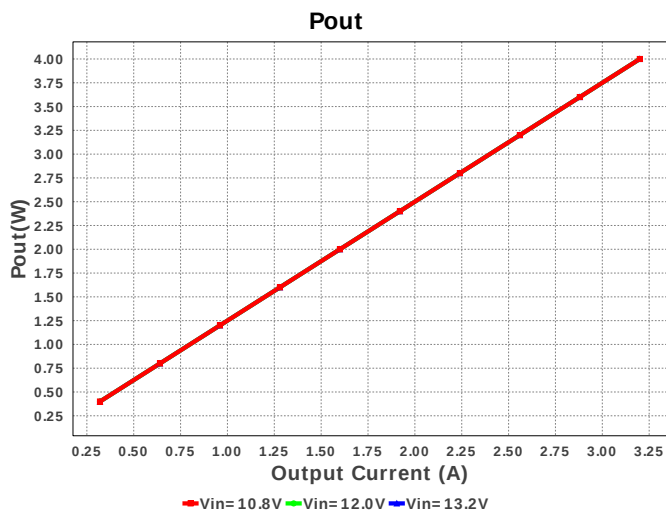
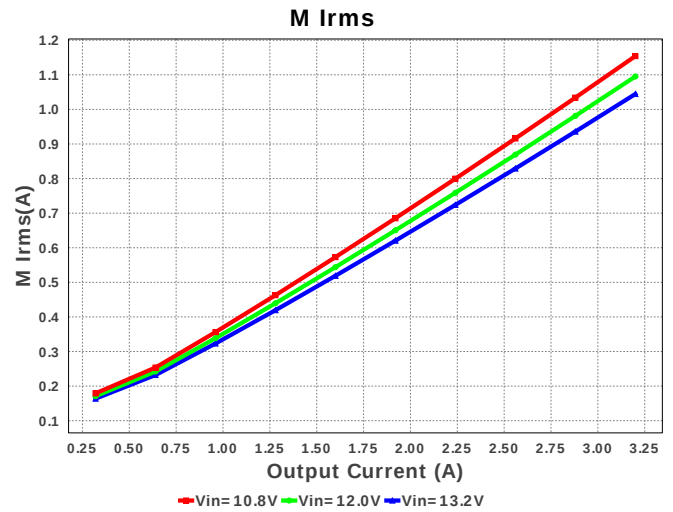
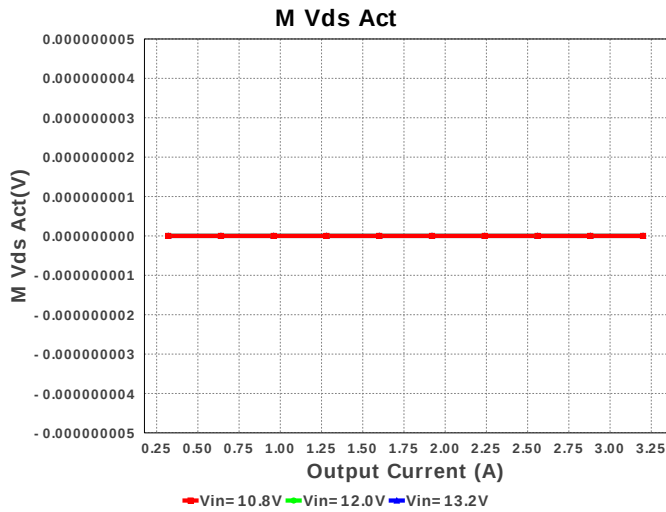
Electrical BOM

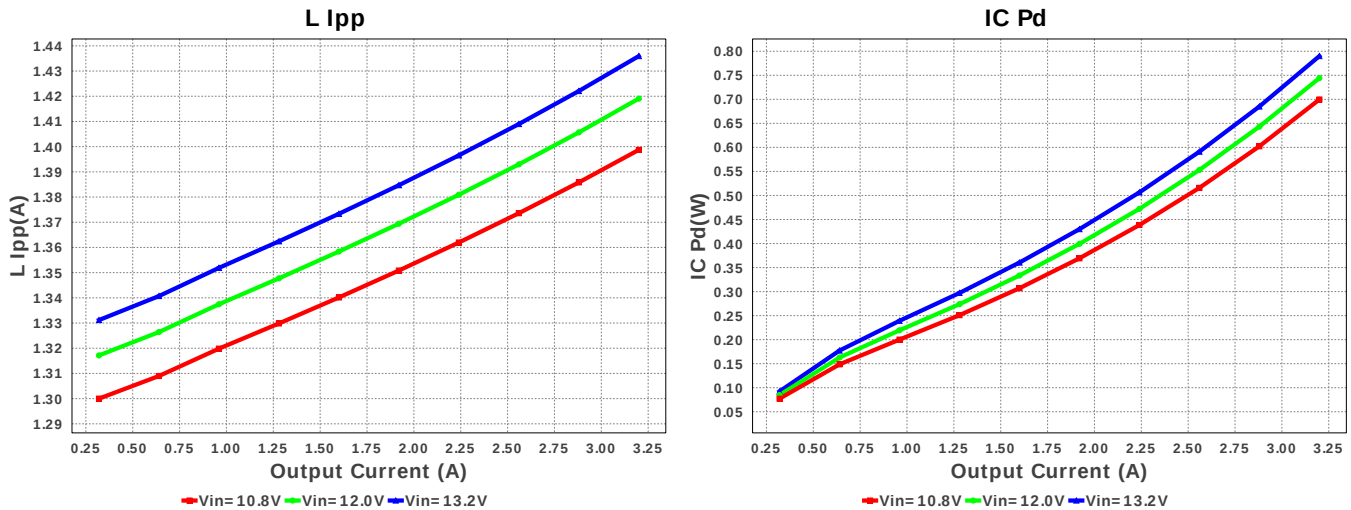
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
2.	Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.16	 1210 15 mm²
3.	Cout	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
4.	L1	TDK	CLF7045T-1R5N	L= 1.5 µH DCR= 14.3 mOhm	1	\$0.42	 CLF7045 86 mm²
5.	Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
6.	Rfbb	Vishay-Dale	CRCW04026K49FKED Series= CRCW..e3	Res= 6.49 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	U1	Texas Instruments	TPS564201DDCR	Switcher	1	\$0.50	 DDC0006A_N 10 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	989.228 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	414.518 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	3.918 A	Current	Peak switch current in IC
4.	Iin Avg	374.34 mA	Current	Average input current
5.	L Ipp	1.436 A	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	1.045 A	Current	Q lavg
7.	BOM Count	7	General	Total Design BOM count
8.	FootPrint	134.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	569.001 kHz	General	Switching frequency
10.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	0.0 V	General	Voltage drop across the MosFET
12.	Pout	4.0 W	General	Total output power
13.	Total BOM	\$1.46	General	Total BOM Cost
14.	Vout Actual	1.253 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Vout OP	1.25 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	10.479 %	Op_point	Duty cycle
17.	Efficiency	80.951 %	Op_point	Steady state efficiency
18.	IC Tj	73.447 degC	Op_point	IC junction temperature
19.	ICThetaJA	55.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	3.2 A	Op_point	Iout operating point
21.	VIN_OP	13.2 V	Op_point	Vin operating point
22.	Vout p-p	7.645 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	1.957 mW	Power	Input capacitor power dissipation
24.	Cout Pd	357.741 μW	Power	Output capacitor power dissipation
25.	IC Pd	789.939 mW	Power	IC power dissipation
26.	L Pd	148.889 mW	Power	Inductor power dissipation
27.	Total Pd	941.266 mW	Power	Total Power Dissipation
28.	Vout Tolerance	2.121 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	3.2	Maximum Output Current
2.	VinMax	13.2	Maximum input voltage
3.	VinMin	10.8	Minimum input voltage
4.	Vout	1.25	Output Voltage
5.	base_pn	TPS564201	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS564201** Product Folder : <http://www.ti.com/product/TPS564201> : contains the data sheet and other resources.

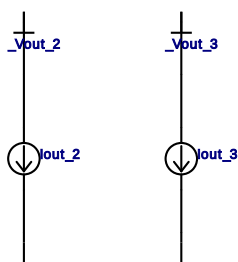
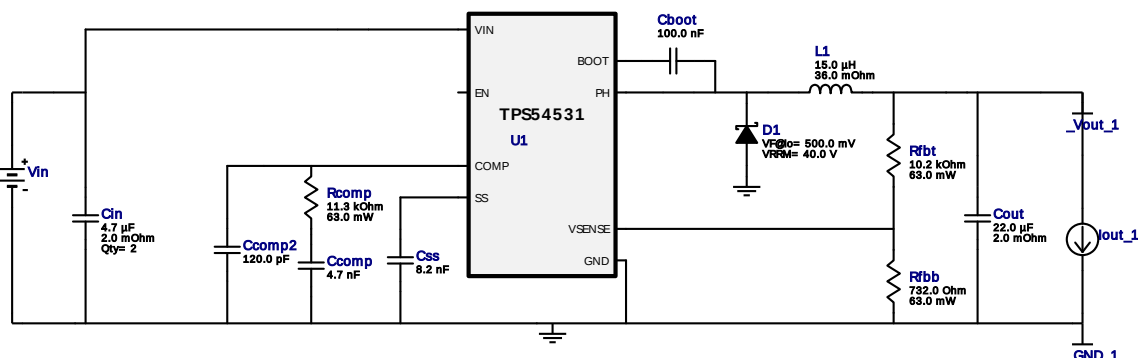


Vout = 12.0V
Iout = 2.53A

Device = TPS54531DDAR
Topology = Buck
Created = 7/13/16 6:56:19 AM
BOM Cost = \$1.82
BOM Count = 13
Total Pd = 1.79W

WEBENCH® Design Report

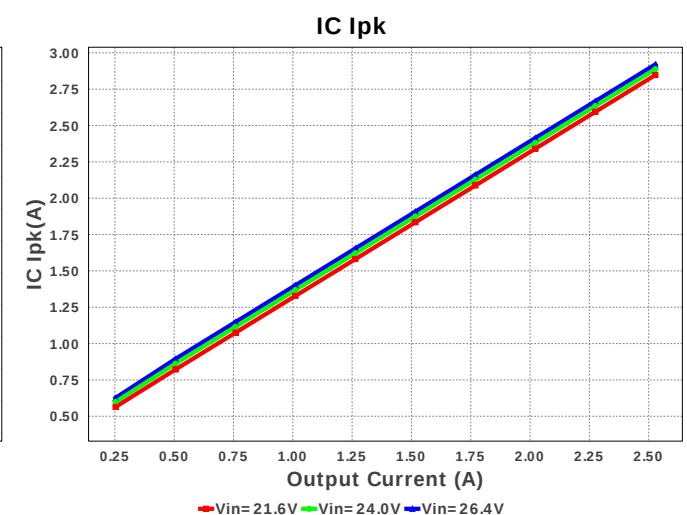
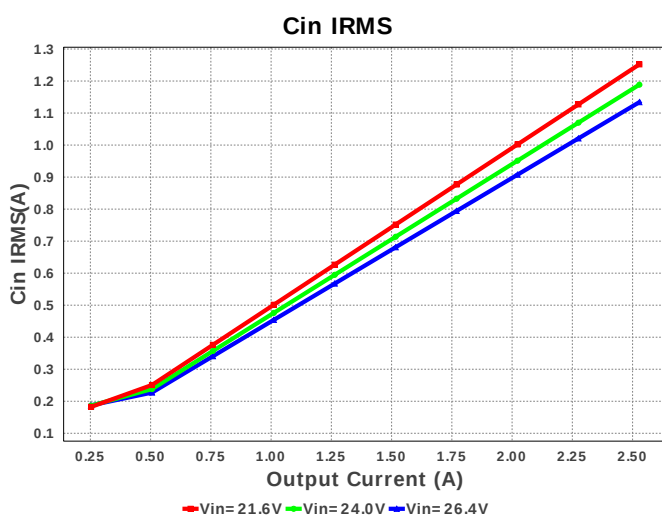
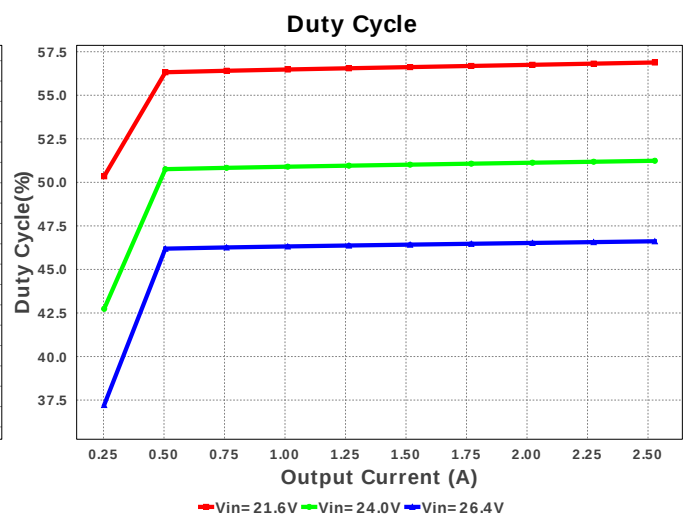
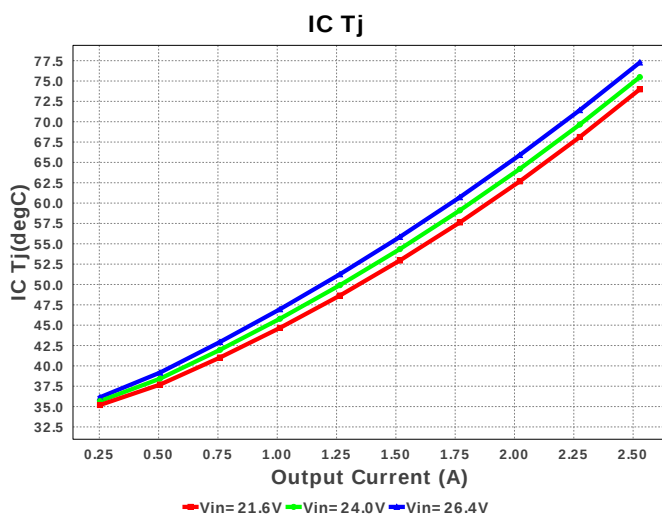
Design : 1194016/2087 TPS54531DDAR
TPS54531DDAR 21.6V-26.4V to 12.00V @ 2.52816A



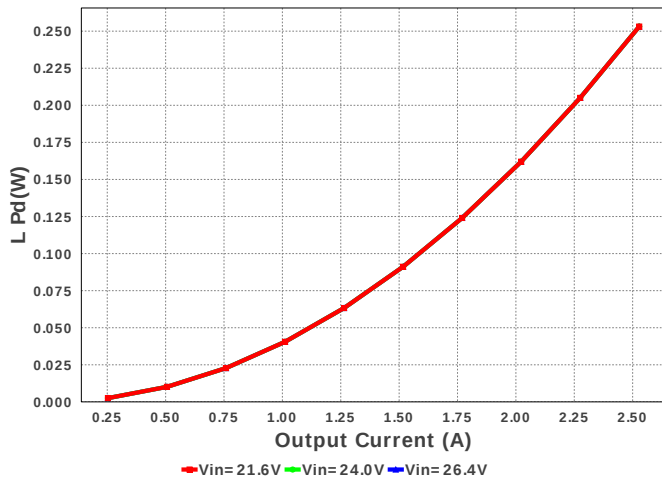
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Ccomp	Yageo America	CC0805KRX7R9BB472 Series= X7R	Cap= 4.7 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
3.	Ccomp2	Samsung Electro-Mechanics	CL21C121JB61PNC Series= C0G/NP0	Cap= 120.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
4.	Cin	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 5.35 A	2	\$0.19	1210 15 mm ²
5.	Cout	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.16	1210 15 mm ²
6.	Css	MuRata	GRM033R61A822KA01D Series= X5R	Cap= 8.2 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
7.	D1	Diodes Inc.	B240A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.09	SMA 37 mm ²

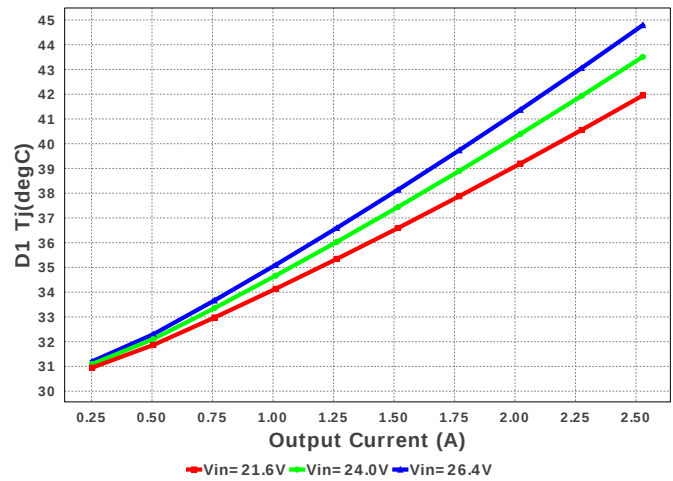
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	L1	Bourns	SRR1208-150ML	L= 15.0 μ H DCR= 36.0 mOhm	1	\$0.37	 SRR1208 216 mm ²
9.	Rcomp	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
10.	Rfbb	Vishay-Dale	CRCW0402732RFKED Series= CRCW..e3	Res= 732.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
11.	Rfbb	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
12.	U1	Texas Instruments	TPS54531DDAR	Switcher	1	\$0.75	 DDA0008E 57 mm ²



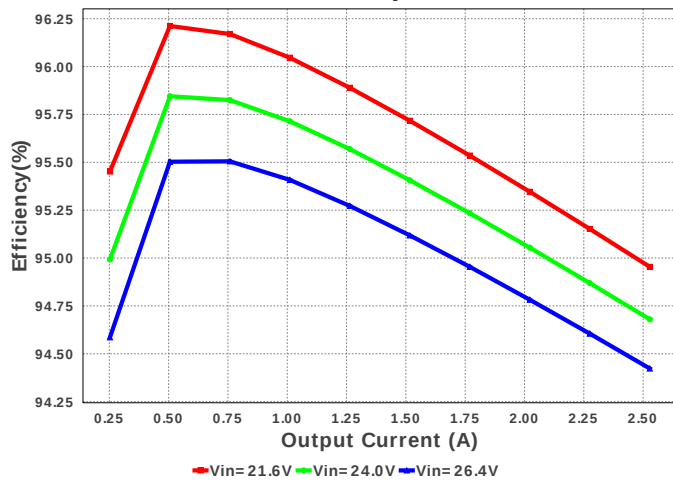
L Pd



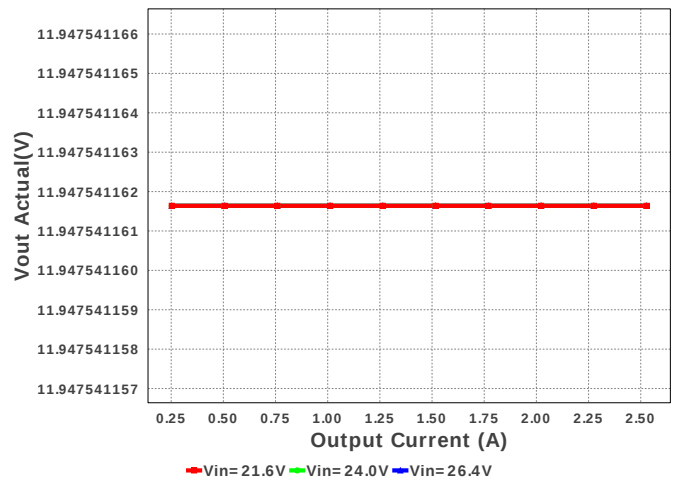
D1 Tj



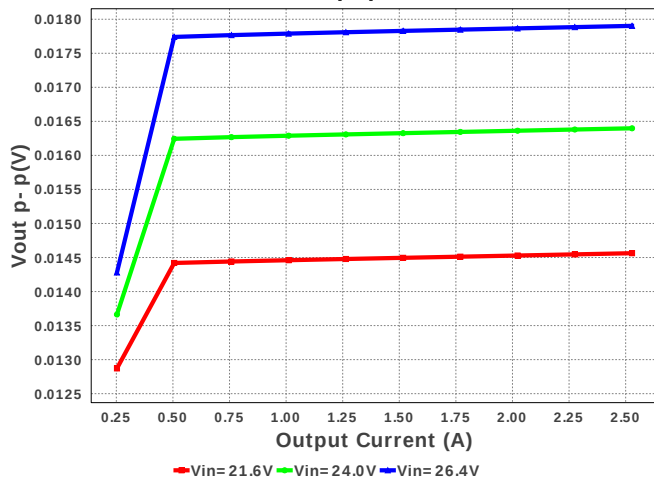
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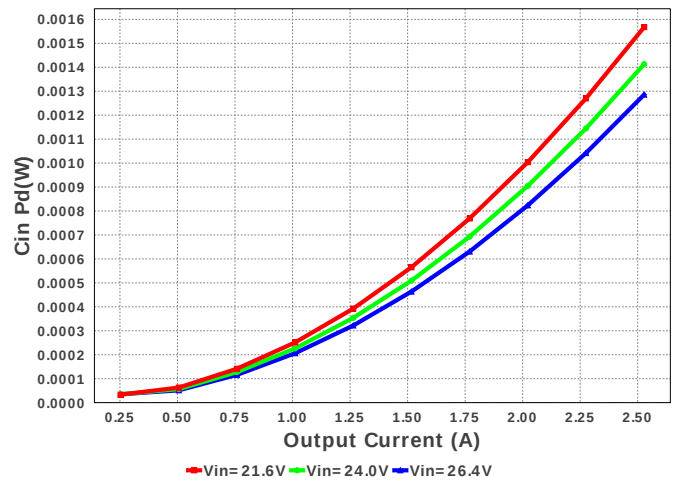
Vout Actual

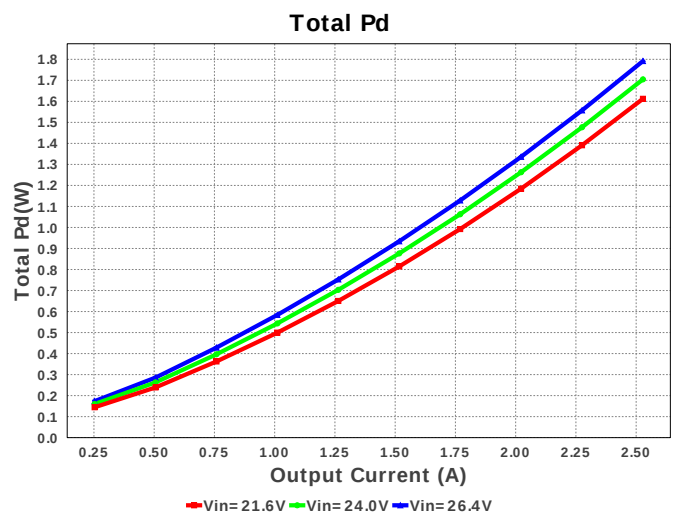
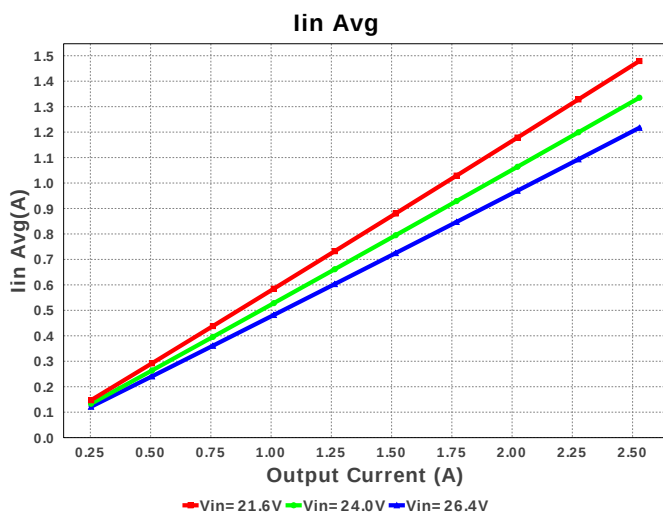
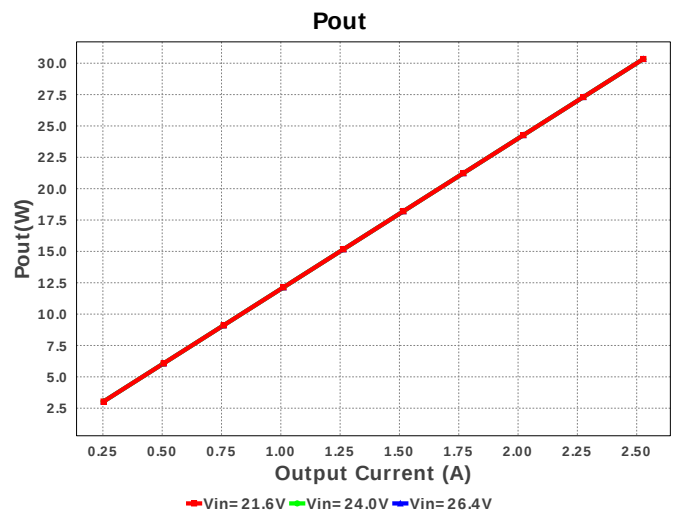
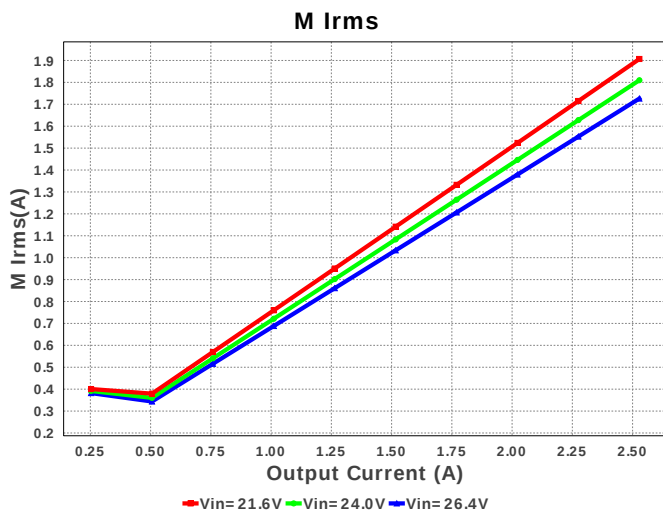
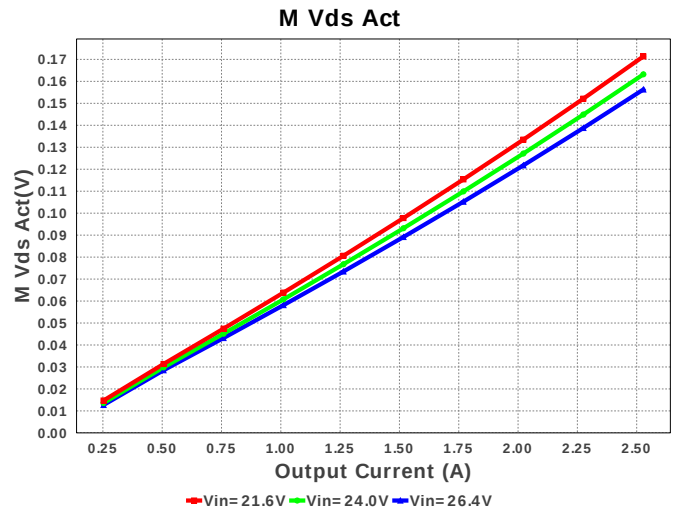
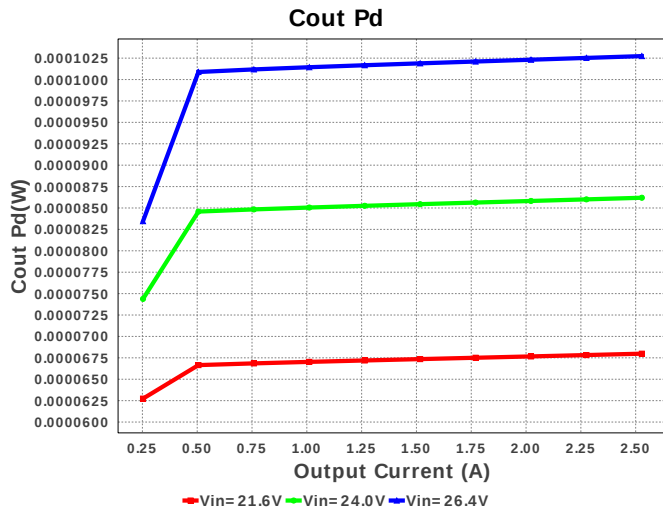


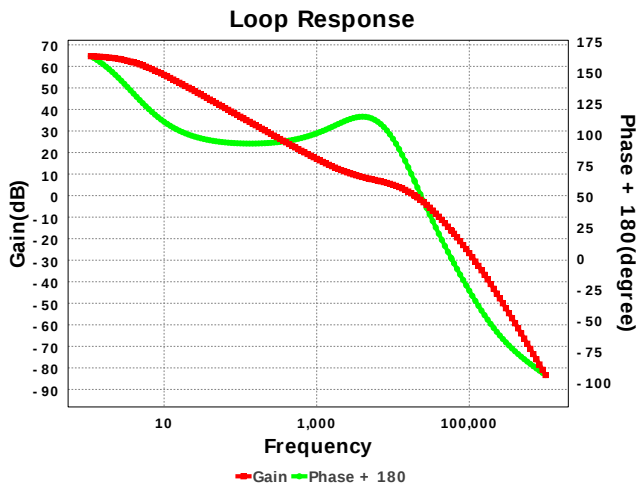
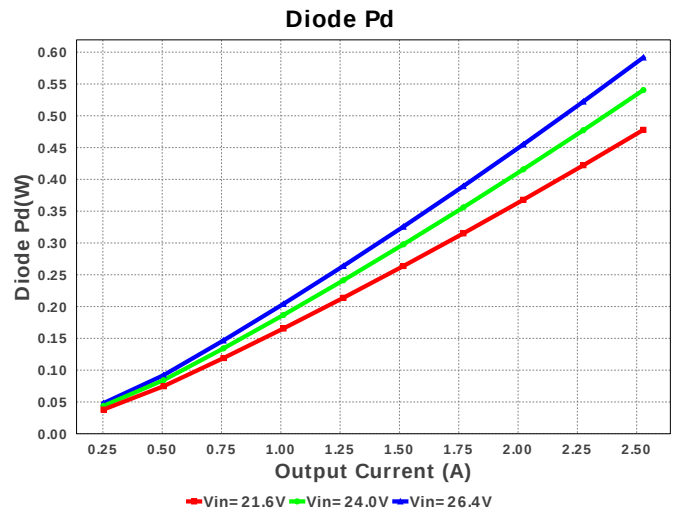
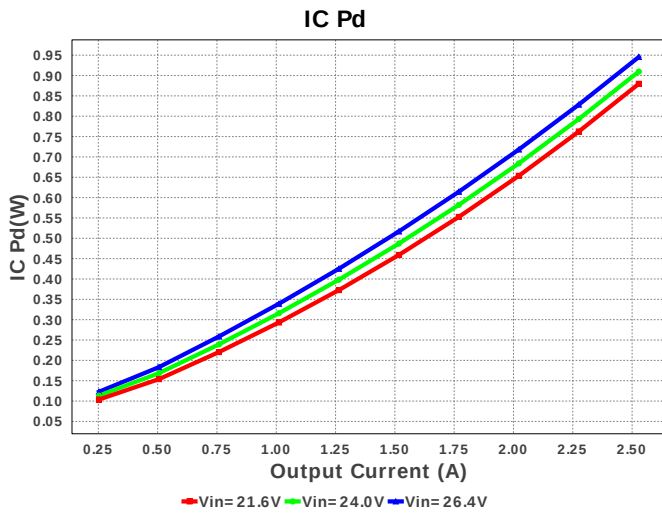
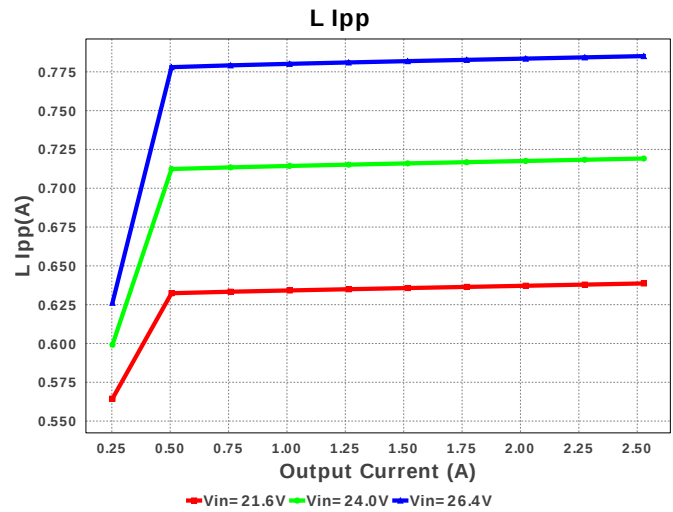
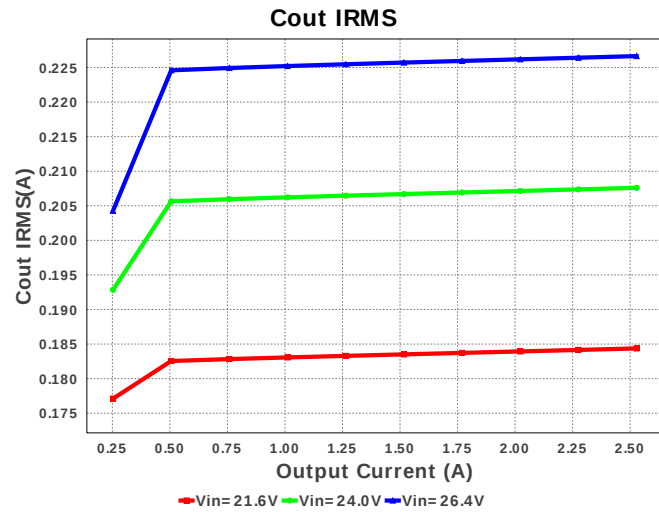
Vout p-p



Cin Pd







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.134 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	226.647 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	2.921 A	Current	Peak switch current in IC
4.	Iin Avg	1.217 A	Current	Average input current
5.	L Ipp	785.13 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	1.726 A	Current	Q lavg
7.	BOM Count	13	General	Total Design BOM count
8.	FootPrint	383.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	570.0 kHz	General	Switching frequency
10.	M Vds Act	156.295 mV	General	Voltage drop across the MosFET
11.	Pout	30.338 W	General	Total output power

#	Name	Value	Category	Description
12.	Total BOM	\$1.82	General	Total BOM Cost
13.	D1 Tj	44.792 degC	Op_Point	D1 junction temperature
14.	Low Freq Gain	64.723 dB	Op_Point	Gain at 10Hz
15.	Vout Actual	11.948 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
17.	Cross Freq	19.292 kHz	Op_point	Bode plot crossover frequency
18.	Duty Cycle	46.617 %	Op_point	Duty cycle
19.	Efficiency	94.423 %	Op_point	Steady state efficiency
20.	Gain Marg	-16.404 dB	Op_point	Bode Plot Gain Margin
21.	IC Tj	77.278 degC	Op_point	IC junction temperature
22.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
23.	IOUT_OP	2.528 A	Op_point	Iout operating point
24.	Phase Marg	62.551 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	26.4 V	Op_point	Vin operating point
26.	Vout p-p	17.903 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	1.286 mW	Power	Input capacitor power dissipation
28.	Cout Pd	102.738 µW	Power	Output capacitor power dissipation
29.	Diode Pd	591.697 mW	Power	Diode power dissipation
30.	IC Pd	945.558 mW	Power	IC power dissipation
31.	L Pd	253.107 mW	Power	Inductor power dissipation
32.	Total Pd	1.792 W	Power	Total Power Dissipation
33.	Vout Tolerance	5.451 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.528	Maximum Output Current
2.	VinMax	26.4	Maximum input voltage
3.	VinMin	21.6	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	TPS54531	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS54531** Product Folder : <http://www.ti.com/product/TPS54531> : contains the data sheet and other resources.

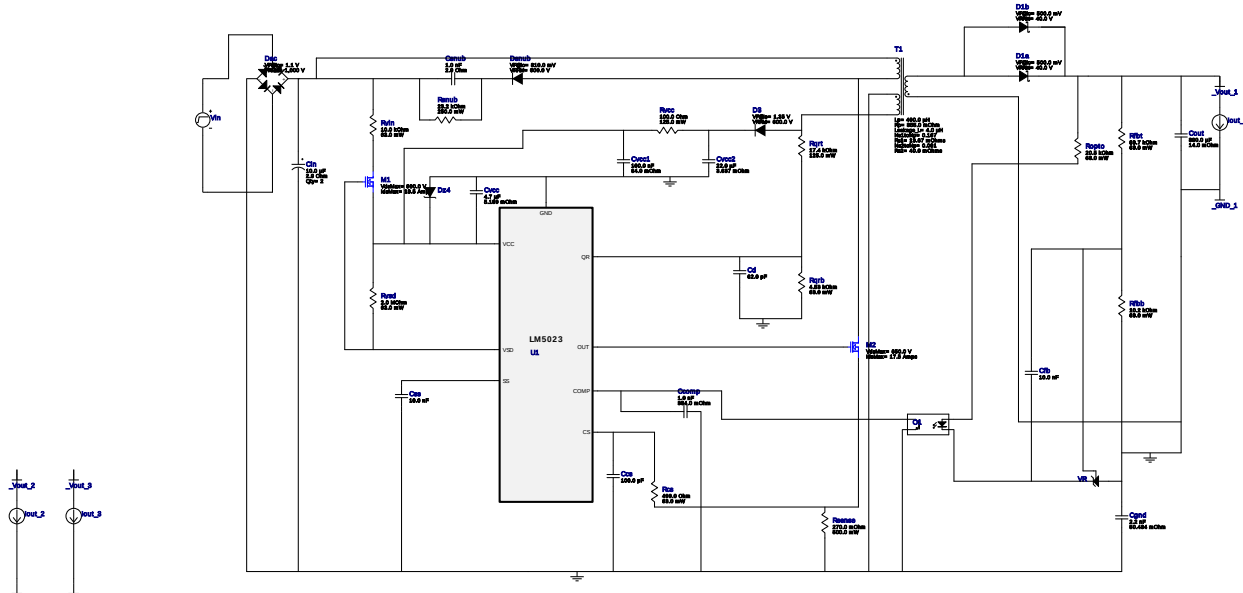


Vout = 24.0V
Iout = 1.89A

Device = LM5023MM-2/NOPB
Topology = Flyback
Created = 7/13/16 6:56:19 AM
BOM Cost = \$0.00
BOM Count = 36
Total Pd = 2.94W

WEBENCH® Design Report

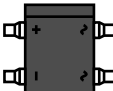
Design : 1194016/2088 LM5023MM-2/NOPB
LM5023MM-2/NOPB 210.0V-240.0V to 24.19V @ 1.88794A

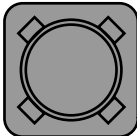


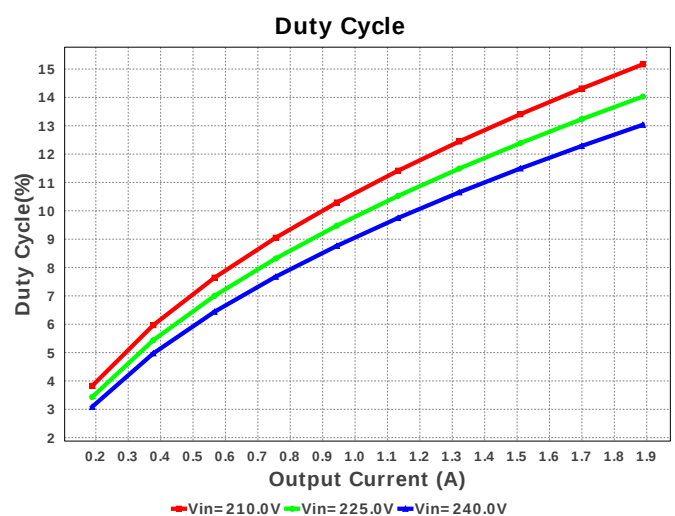
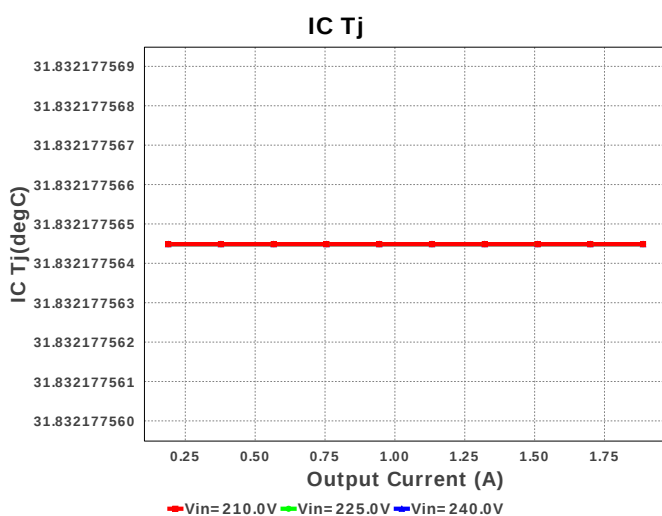
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

Electrical BOM

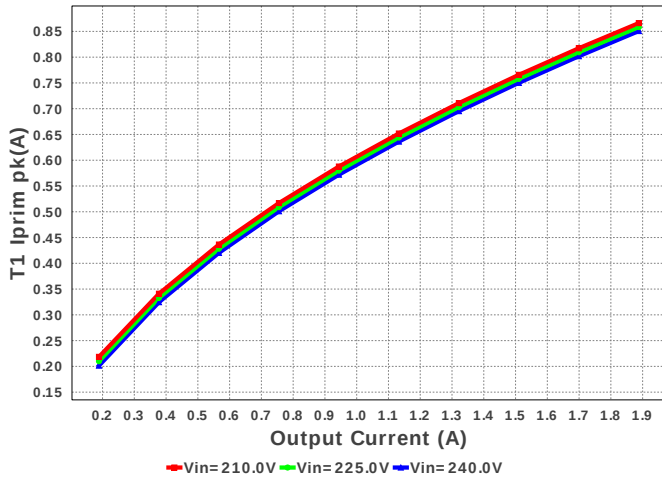
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp	Kemet	C0805C102K5RACTU Series= X7R	Cap= 1.0 nF ESR= 384.0 mOhm VDC= 50.0 V IRMS= 214.0 mA	1	\$0.01	0805 7 mm ²
2.	Ccs	Kemet	C0201C101K3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
3.	Cd	Samsung Electro-Mechanics	CL21C620JBANNNC Series= C0G/NP0	Cap= 62.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
4.	Cfb	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
5.	Cgnd	TDK	C3225X7S3D222K Series= X7S	Cap= 2.2 nF ESR= 50.484 mOhm VDC= 2.0 kV IRMS= 0.0 A	1	\$0.22	1210 15 mm ²
6.	Cin	Kemet	ESG106M400AH4AA Series= 2334	Cap= 10.0 uF ESR= 2.9 Ohm VDC= 400.0 V IRMS= 100.0 mA	2	\$0.19	ESG106 144 mm ²
7.	Cout	Panasonic	20SPVF390M Series= ?	Cap= 390.0 uF ESR= 14.0 mOhm VDC= 20.0 V IRMS= 4.95 A	1	\$0.63	CAPSMT_62_E12 106 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Csnub	MuRata	GRM188R72E102KW07D Series= X7R	Cap= 1.0 nF ESR= 2.9 Ohm VDC= 250.0 V IRMS= 90.0 mA	1	\$0.01	 0603 5 mm ²
9.	Css	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
10.	Cvcc	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	\$0.02	 0805 7 mm ²
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 mm ²
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 mm ²
13.	D1a	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.08	 SMA 37 mm ²
14.	D1b	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.08	 SMA 37 mm ²
15.	D3	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	\$0.08	 SMA 37 mm ²
16.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	\$0.24	 DF-S 99 mm ²
17.	Dsnub	ON Semiconductor	MURS360T3	VF@Io= 810.0 mV VRRM= 600.0 V	1	\$1.12	 SMC 83 mm ²
18.	Dz4	NXP Semiconductor	BZX585-C22,115	Zener	1	\$0.02	 SOD-523 5 mm ²
19.	M1	STMicroelectronics	STW21N90K5	VdsMax= 900.0 V IdsMax= 18.5 Amps	1	\$3.94	 TO-247 123 mm ²
20.	M2	Infineon Technologies	IPP65R190CFD	VdsMax= 650.0 V IdsMax= 17.5 Amps	1	\$2.34	TO-220 0 mm ²
21.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	\$0.38	 SSOP-4 111 mm ²
22.	Rcs	Vishay-Dale	CRCW0402499RFKED Series= CRCW..e3	Res= 499.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
23.	Rfbb	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
24.	Rfbb	Vishay-Dale	CRCW040288K7FKED Series= CRCW..e3	Res= 88.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
25.	Ropto	Vishay-Dale	CRCW040220K5FKED Series= CRCW..e3	Res= 20.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
26.	Rqrb	Vishay-Dale	CRCW04024K53FKED Series= CRCW..e3	Res= 4.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

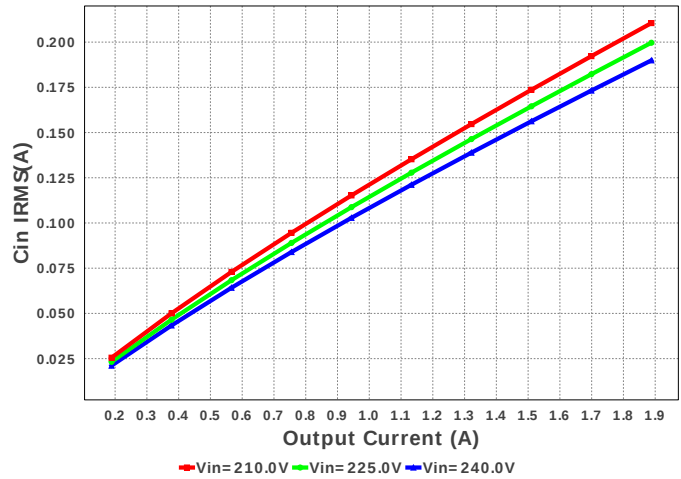
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27.	Rqrt	Panasonic	ERJ-6ENF1742V Series= ERJ-6E	Res= 17.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
28.	Rsense	Rohm	MCR25JZHFLR270 Series= MCR25	Res= 270.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	\$0.03	 1210 15 mm²
29.	Rsnuh	Panasonic	ERJ-8ENF2322V Series= ERJ-8E	Res= 23.2 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.	Rvsn	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	Würth Elektronik	750313417	Lp= 400.0 µH Rp= 355.0 mOhm Leakage_L= 4.0 µH Ns1toNp= 0.167 Rs1= 13.67 mOhms Ns2toNp= 0.091 Rs2= 40.0 mOhms	1	NA	 WE-DD-L 210 mm²
34.	U1	Texas Instruments	LM5023MM-2/NOPB	Switcher	1	\$0.38	 MUA08A 24 mm²
35.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm²



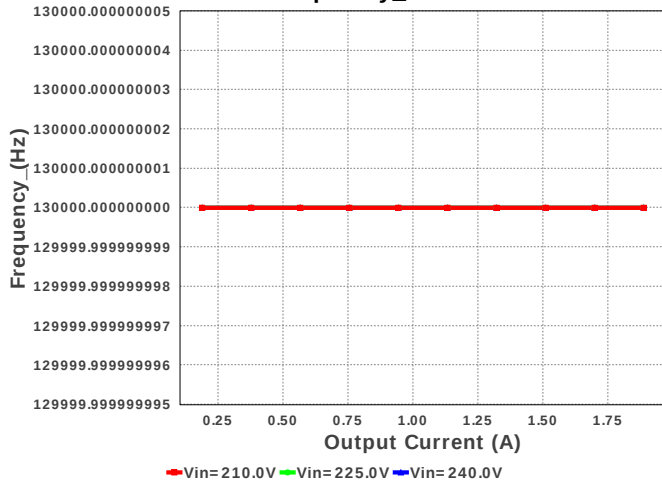
T1 Iprim pk



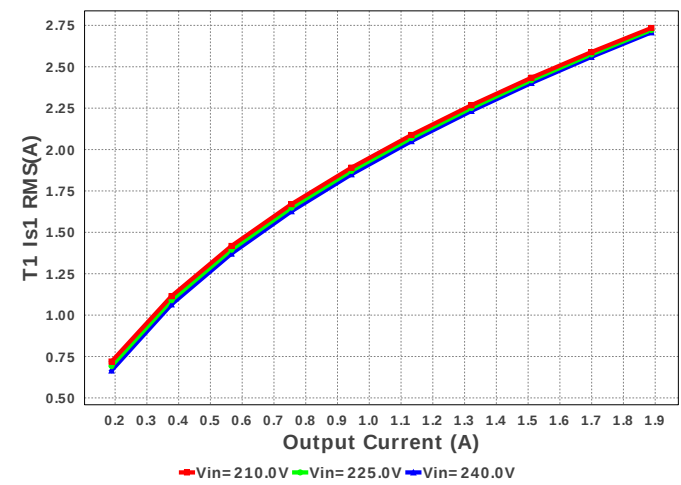
Cin IRMS



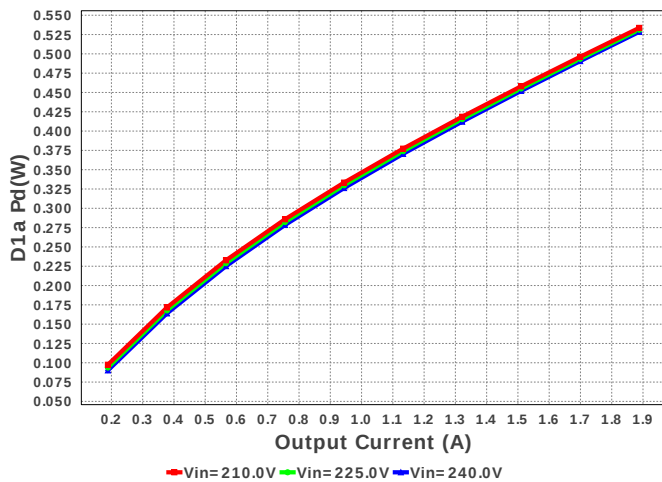
Frequency_



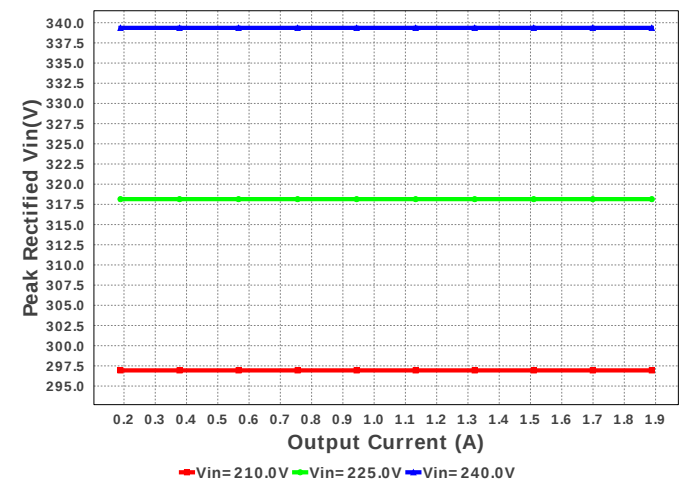
T1 Is1 RMS

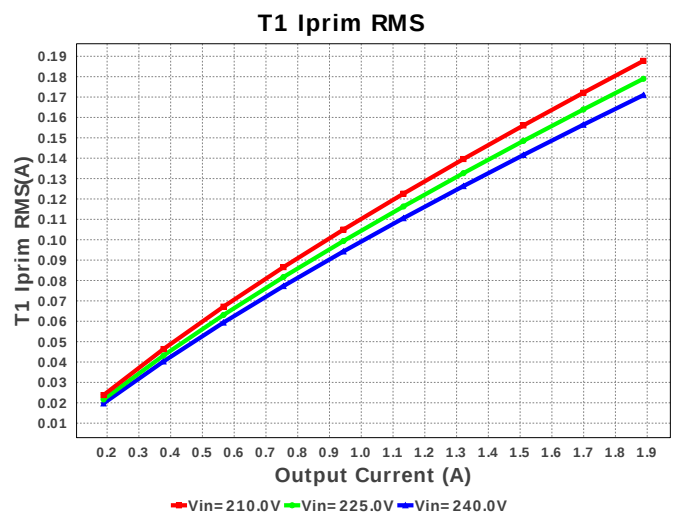
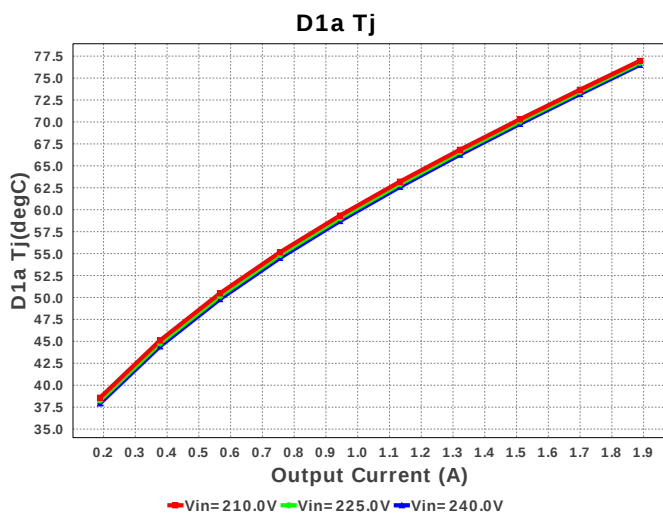
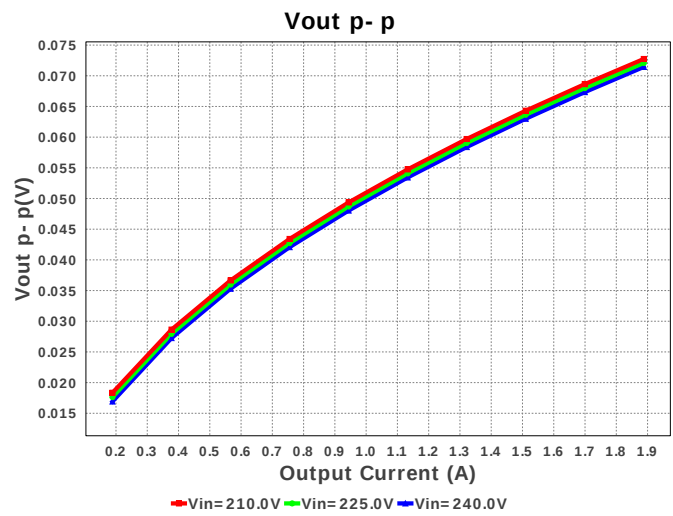
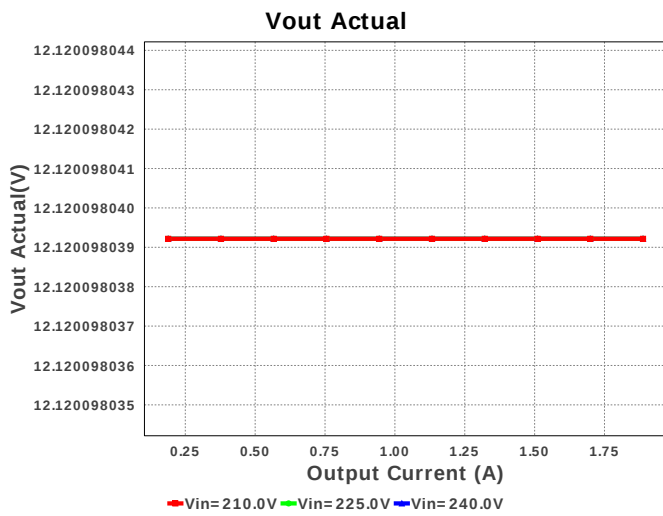
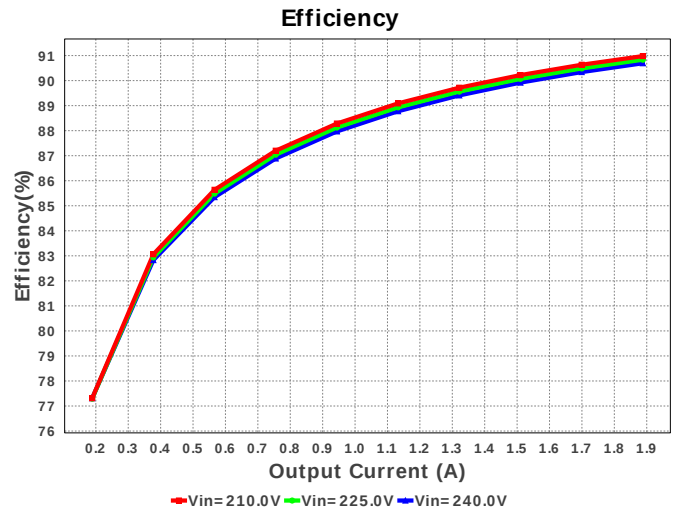
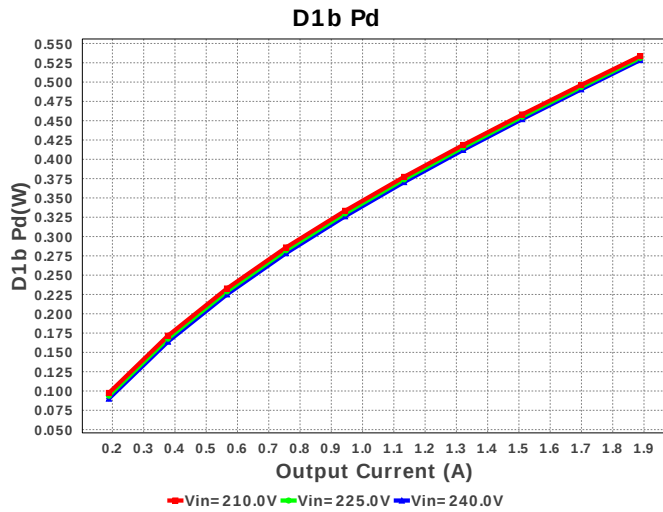


D1a Pd

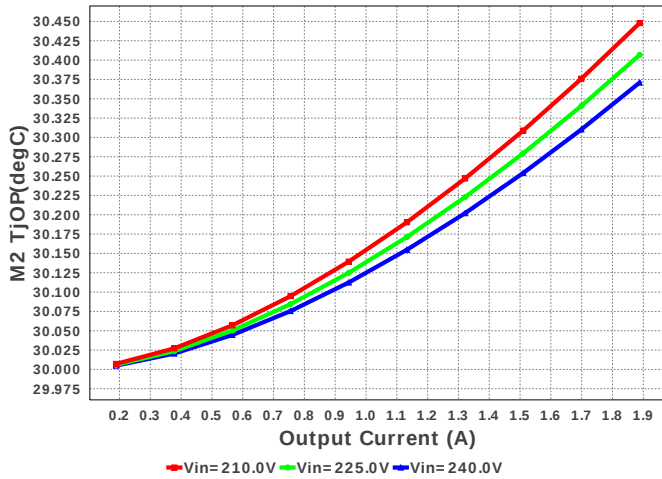


Peak Rectified Vin

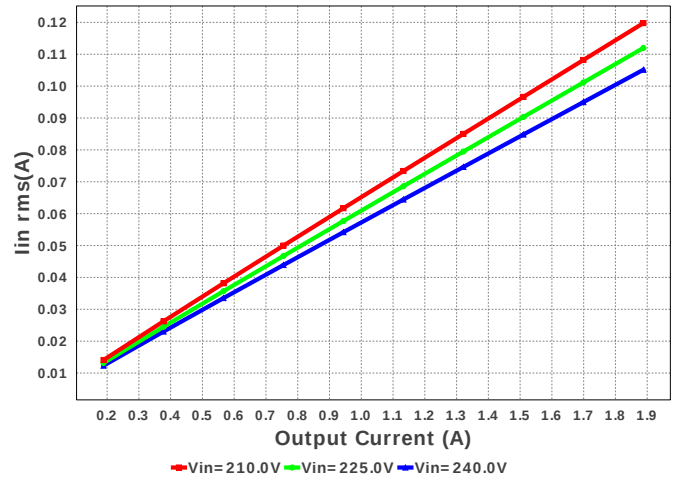




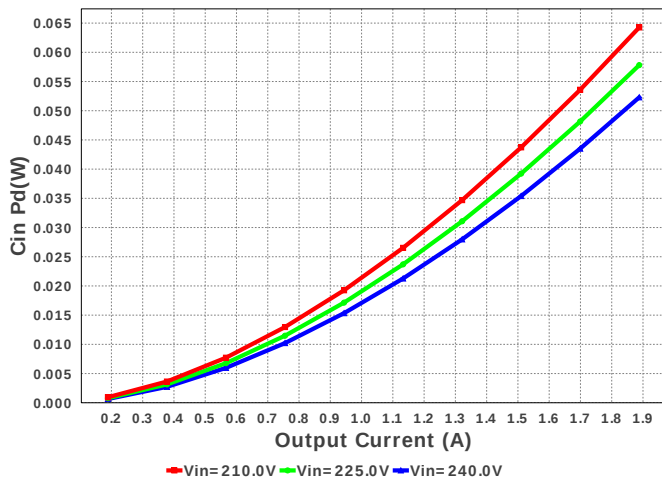
M2 TjOP



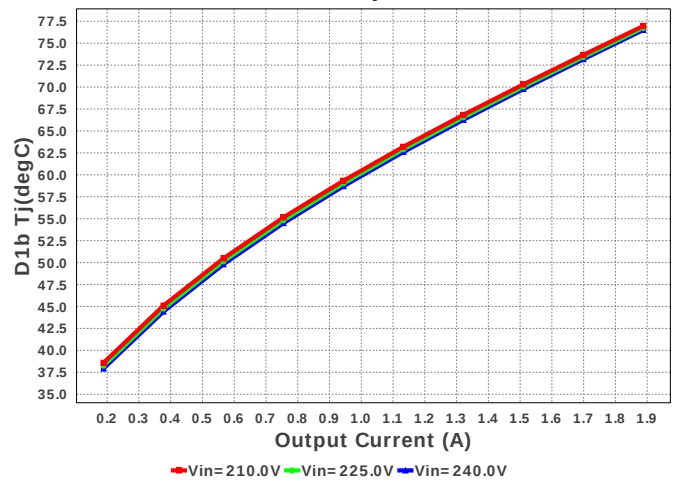
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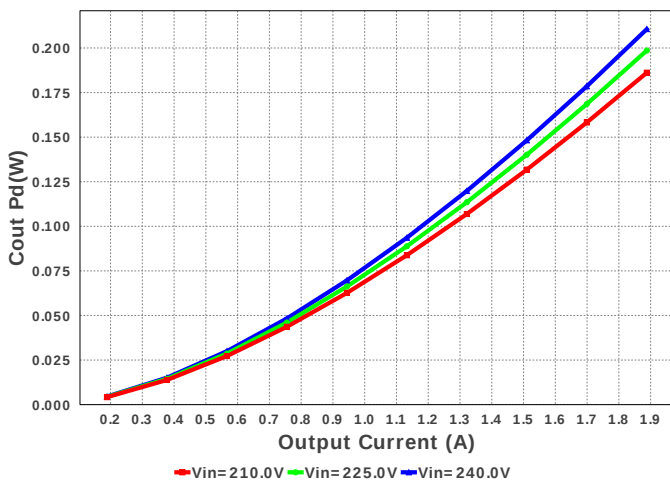
Cin Pd



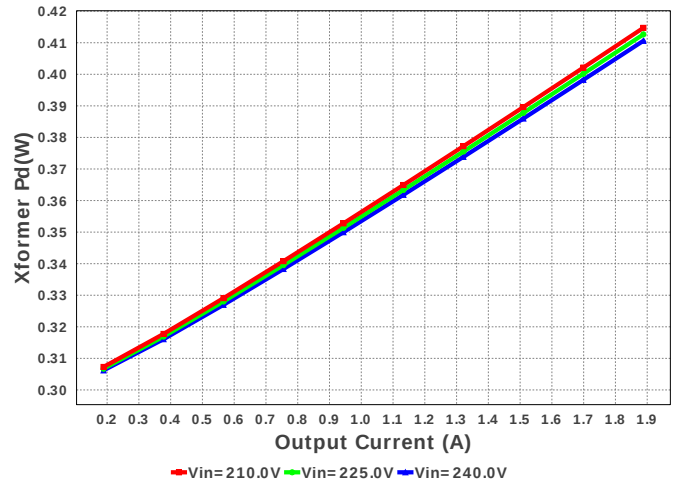
D1b Tj

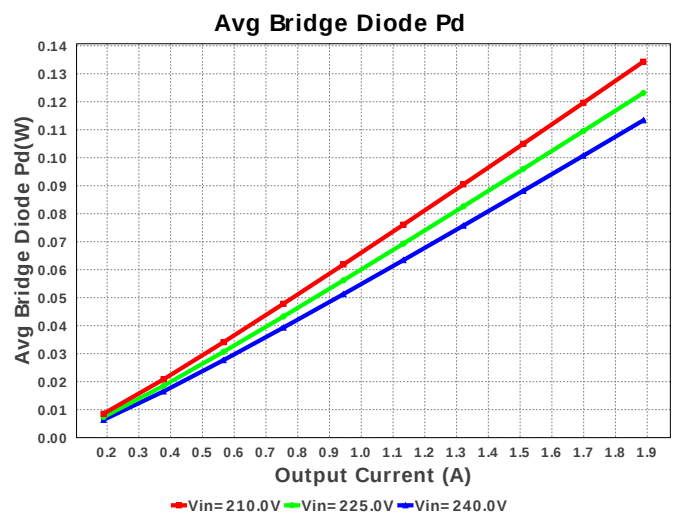
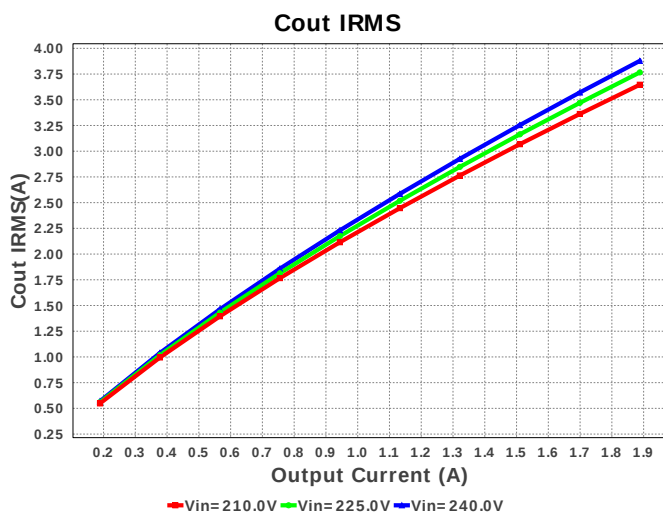
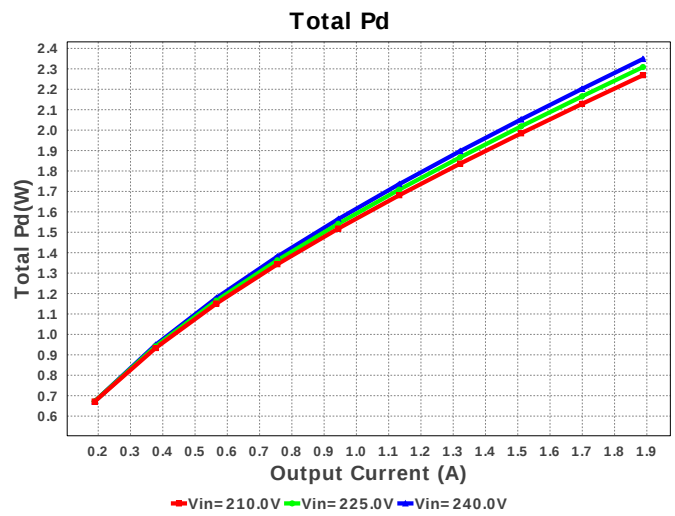
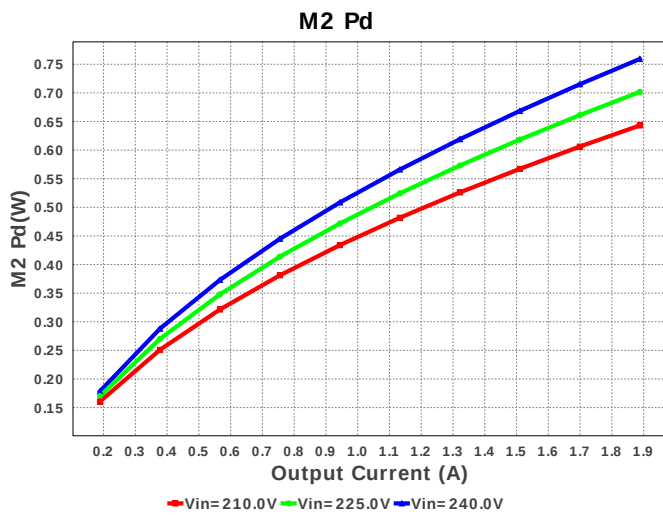
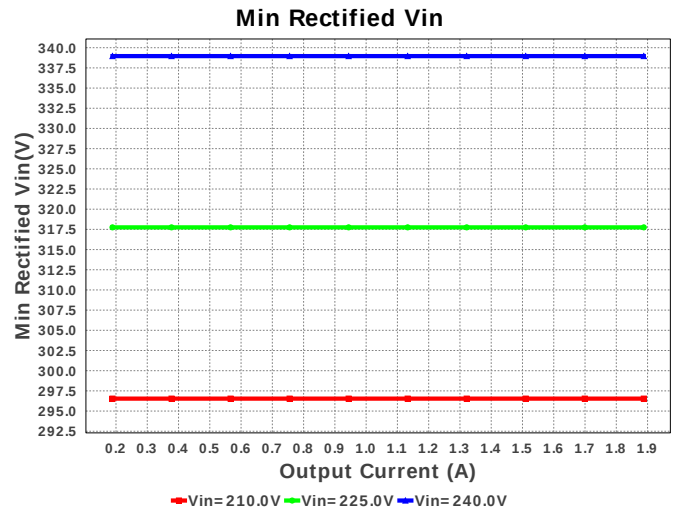
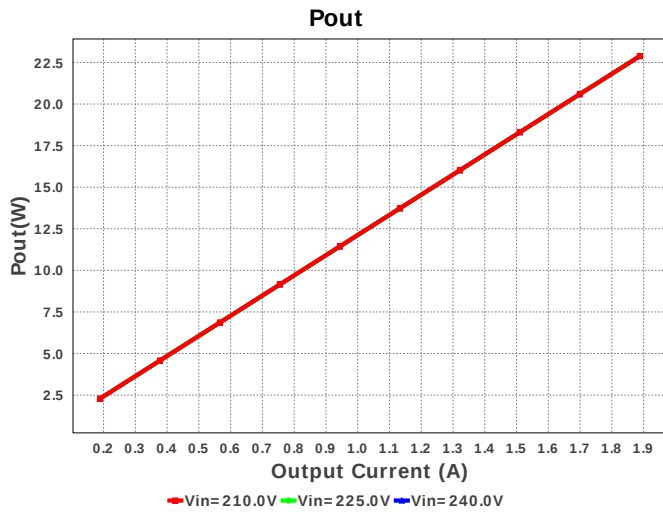


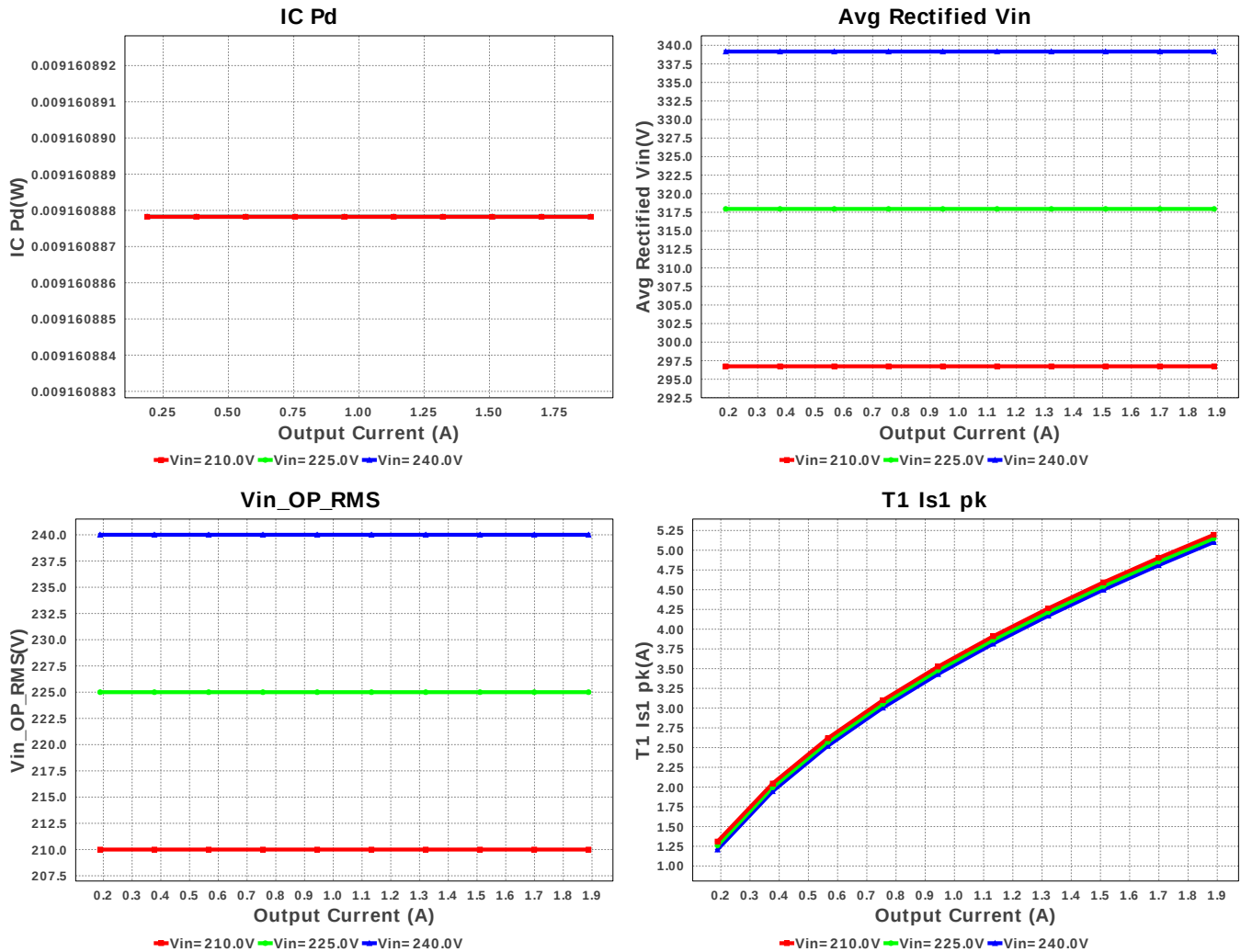
Cout Pd



Xformer Pd







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	365.743 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	3.094 A	Current	Output capacitor RMS ripple current
3.	Iin rms	202.56 mA	Current	RMS Input Current
4.	T1 Iprim RMS	319.222 mA	Current	Transformer Primary RMS Current
5.	T1 Iprim pk	1.234 A	Current	Transformer Primary Peak Current
6.	T1 Is1 RMS	3.838 A	Current	Transformer Secondary1 RMS Current
7.	T1 Is1 pk	7.401 A	Current	Transformer Secondary1 Peak Current
8.	Avg Rectified Vin	339.16 V	General	Average Rectified Voltage for the AC Line Period
9.	BOM Count	36	General	Total Design BOM count
10.	FootPrint	1.403 k mm ²	General	Total Foot Print Area of BOM components
11.	Pout	45.673 W	General	Total output power
12.	Total BOM	\$0.0	General	Total BOM Cost
13.	D1 Tj	95.909 degC	Op_Point	D1 junction temperature
14.	D1 Tj	95.909 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	21.605 %	Op_point	Duty cycle
18.	Efficiency	93.948 %	Op_point	Steady state efficiency
19.	Frequency	130.0 kHz	Op_point	Switching frequency
20.	IC Tj	33.874 degC	Op_point	IC junction temperature
21.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	1.888 A	Op_point	Iout operating point
23.	M2 TjOP	31.309 degC	Op_point	M2 MOSFET junction temperature
24.	Min Rectified Vin	338.96 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	339.36 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	240.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	103.614 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	184.839 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	193.963 mW	Power	Input capacitor power dissipation
30.	Cout Pd	134.061 mW	Power	Output capacitor power dissipation
31.	Diode1 Pd	748.971 mW	Power	Diode1 power dissipation

#	Name	Value	Category	Description
32.	Diode1 Pd	748.971 mW	Power	Diode1 power dissipation
33.	IC Pd	19.369 mW	Power	IC power dissipation
34.	M2 Pd	694.491 mW	Power	M2 MOSFET total power dissipation
35.	Total Pd	2.942 W	Power	Total Power Dissipation
36.	Xformer Pd	537.489 mW	Power	Transformer power dissipation
37.	Vout Tolerance	2.138 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.888	Maximum Output Current
2.	VinMax	240.0	Maximum input voltage
3.	VinMin	210.0	Minimum input voltage
4.	Vout	24.0	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	LM5023	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. The feedback resistors will set the output voltage of the circuit. The values chosen may need to be fine 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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