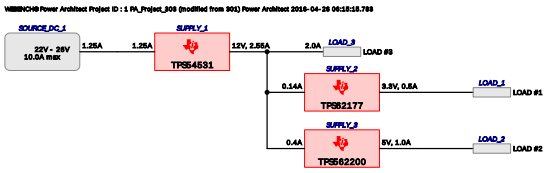
WEBENCH® Power Architect



Project Report

Project : 1218779/1 : PA_Project_303 (modified from 301)
Created : 2016-04-26 06:15:15.783
Optimize project optFactor=3

Project Summary

1.	Total System Efficiency	92.735 %
2.	Total System BOM Count	25.0
3.	Total System Footprint	570.0 mm2
4.	Total System BOM Cost	$3.57
5.	Total System Power Dissipation	2.401 W

--> Launch WEBENCH Power Architect.

Sequencer Flag Table

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

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	TPS54531	Switcher : Step Down Converter with Eco-Mode	12 V	2.549 A	94.4%	383	$1.82	7	14
2.	SUPPLY_2	TPS62177	Switcher : Fixed 3.3Vout, High Light-Load Efficiency Buck Converter	3.3 V	0.5 A	86.3%	74	$0.86	5	4
3.	SUPPLY_3	TPS562200	Switcher : 17V, 2A,6-pin, Low Iq Synchronous buck converter with Advanced Eco-mode	5 V	1.0 A	93.6%	113	$0.89	6	9

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #3	12 V	2 A	VoutRipple=10%
2.	LOAD #1	3.3 V	0.5 A	VoutRipple=10%
3.	LOAD #2	5 V	1 A	VoutRipple=10%

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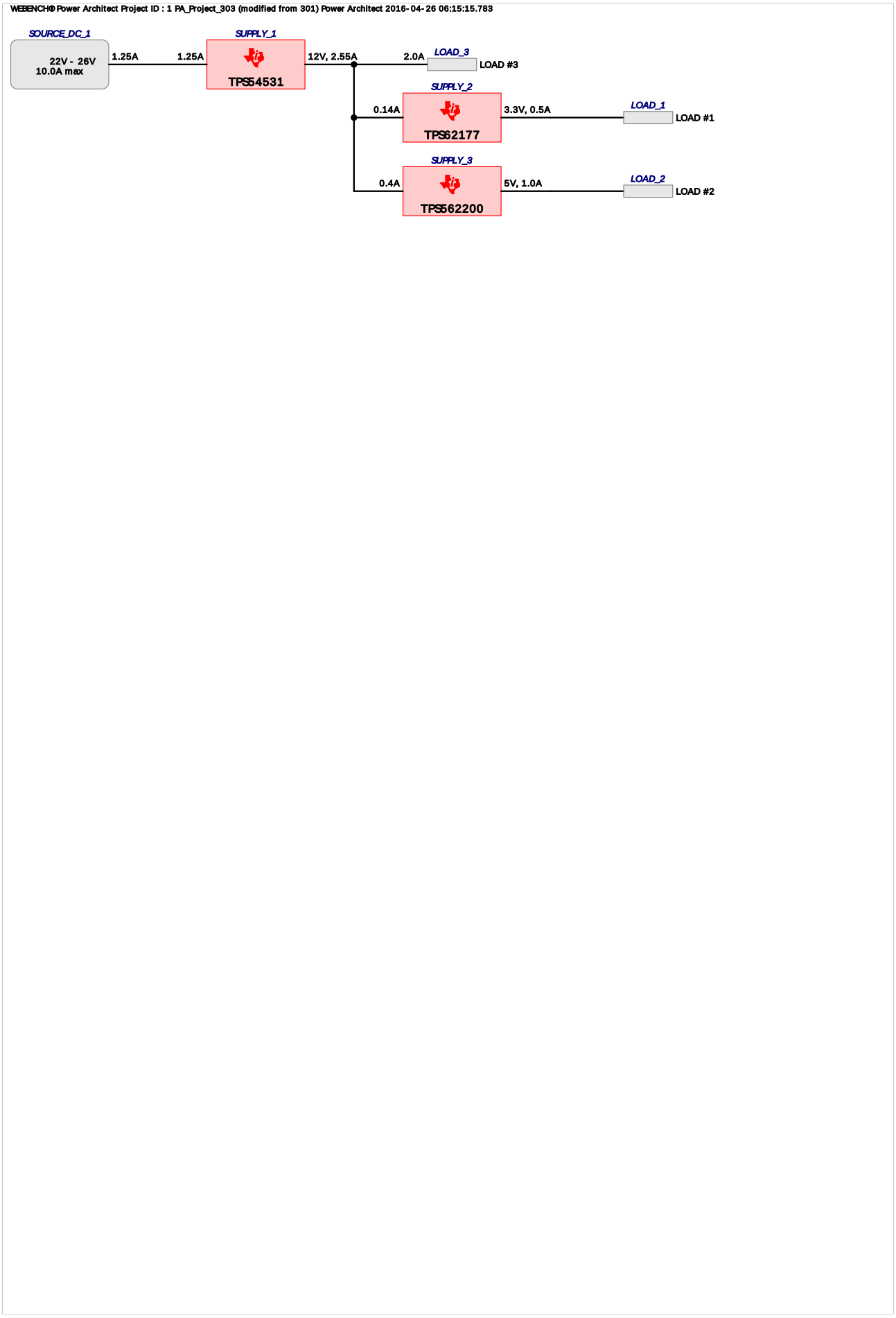
Project Diagram



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
AVX	08053C104KAT2A	0805	1	$0.01	7
Diodes Inc.	B240A-13-F	SMA	1	$0.09	37
Yageo America	CC0805KRX7R9BB472	0805	1	$0.01	7
Samsung Electro-Mechanics	CL21C131JBANNNC	0805	1	$0.01	7
Vishay-Dale	CRCW0402100KFKED	0402	1	$0.01	3
Vishay-Dale	CRCW040210K0FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040210K2FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040211K3FKED	0402	1	$0.01	3
Vishay-Dale	CRCW040256K2FKED	0402	1	$0.01	3
Vishay-Dale	CRCW0402732RFKED	0402	1	$0.01	3
MuRata	GRM033R61A822KA01D	0201	1	$0.01	2
MuRata	GRM155R61A104KA01D	0402	1	$0.01	3
MuRata	GRM188R61C225KE15D	0603	1	$0.02	5
MuRata	GRM21BR60J226ME39L	0805	1	$0.04	7
MuRata	GRM31CR61A226KE19L	1206_190	1	$0.07	11
MuRata	GRM32ER61E226KE15L	1210	2	$0.16	29
MuRata	GRM32ER71H475KA88L	1210	2	$0.19	15
Bourns	SDR0503-100ML	SDR0503	1	$0.19	48
Bourns	SRN6045-4R7Y	SRN6045	1	$0.16	64
Bourns	SRR1208-150ML	SRR1208	1	$0.37	216
Texas Instruments	TPS54531DDAR	DDA0008E	1	$0.75	57
Texas Instruments	TPS562200DDCR	DDC0006A	1	$0.47	10
Texas Instruments	TPS62177DQCR	R-PWSON-N10	1	$0.60	12
Total			25	$3.57	554.6803

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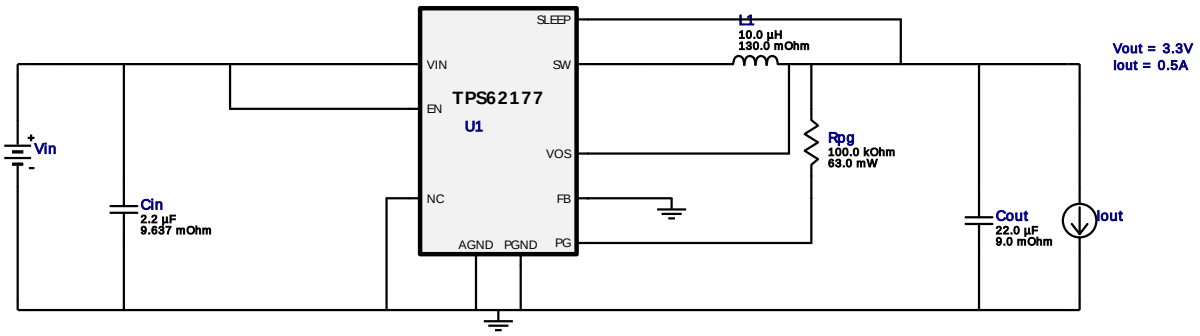
WEBENCH® Design Report

Vout = 3.3V
Iout = 0.5A

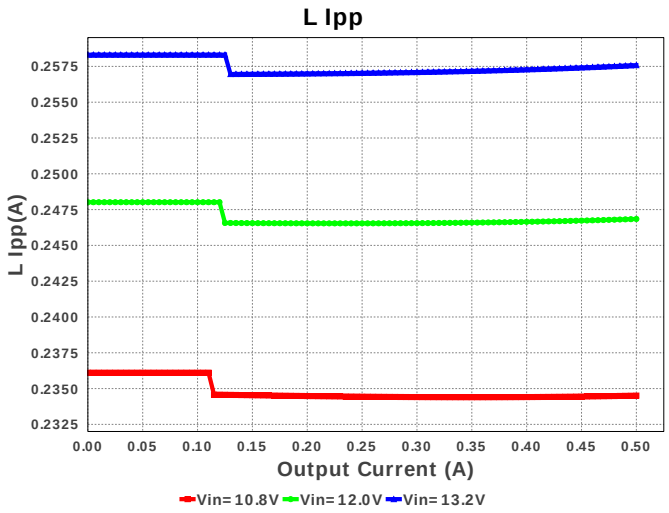
Device = TPS62177DQCR
Topology = Buck
Created = 4/26/16 6:15:13 AM
BOM Cost = $0.86
BOM Count = 5
Total Pd = 0.26W

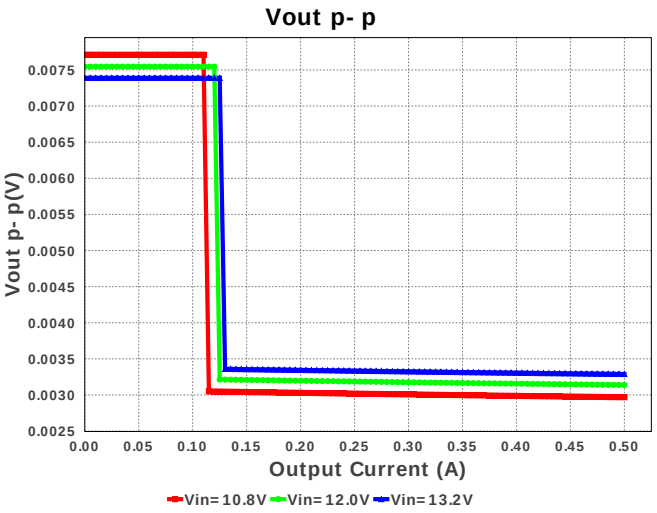
Design : 1218779/5 TPS62177DQCR
TPS62177DQCR 10.8V-13.2V to 3.30V @ 0.5A



Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM188R61C225KE15D Series= X5R	Cap= 2.2 uF ESR= 9.637 mOhm VDC= 16.0 V IRMS= 1.20373 A	1	$0.02	0603 5 mm²
2.	Cout	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	1	$0.04	0805 7 mm²
3.	L1	Bourns	SDR0503-100ML	L= 10.0 µH DCR= 130.0 mOhm	1	$0.19	SDR0503 48 mm²
4.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
5.	U1	Texas Instruments	TPS62177DQCR	Switcher	1	$0.60	R-PWSON-N10 12 mm²





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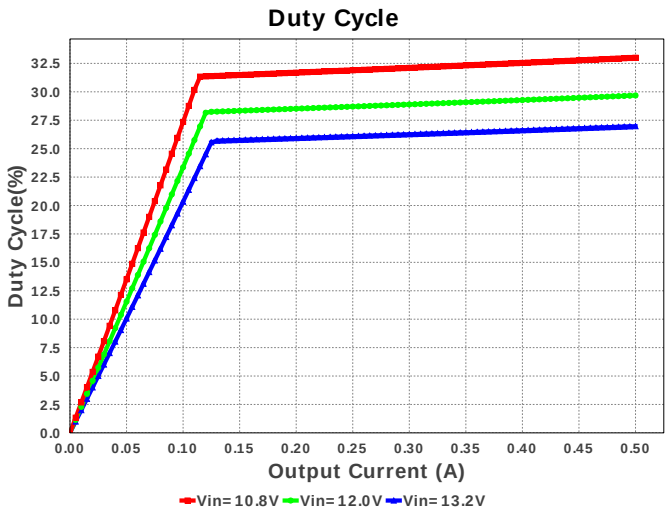

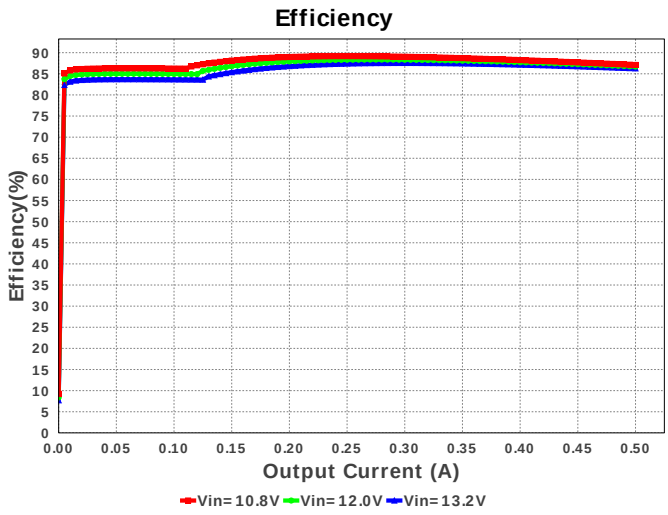

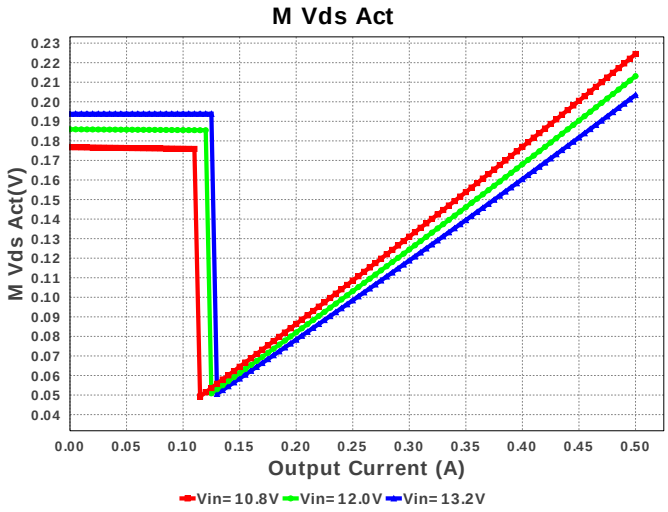

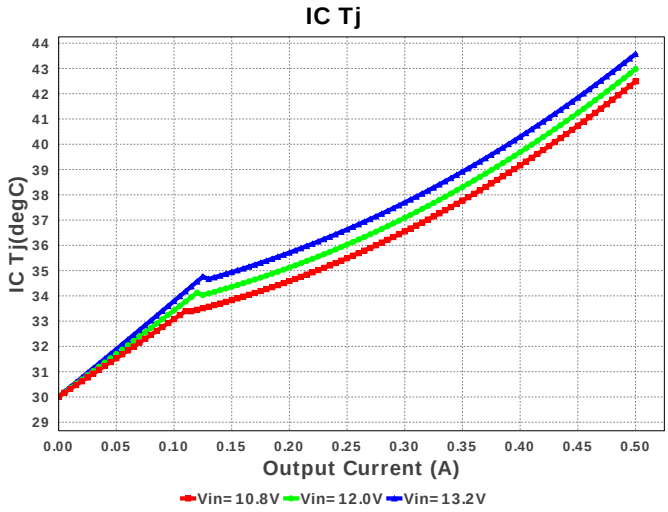

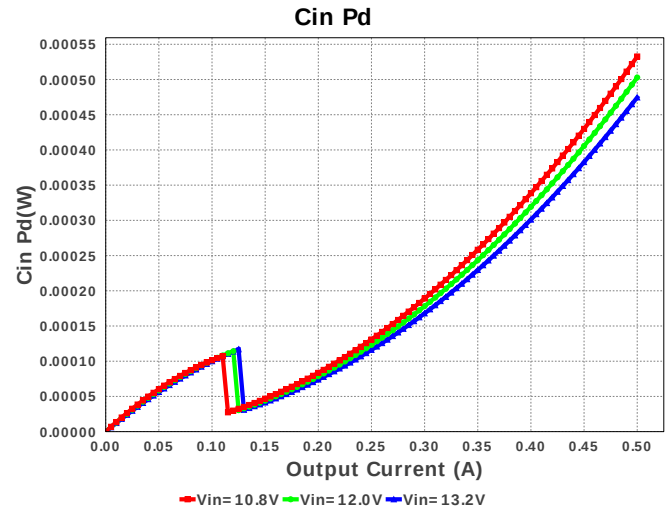

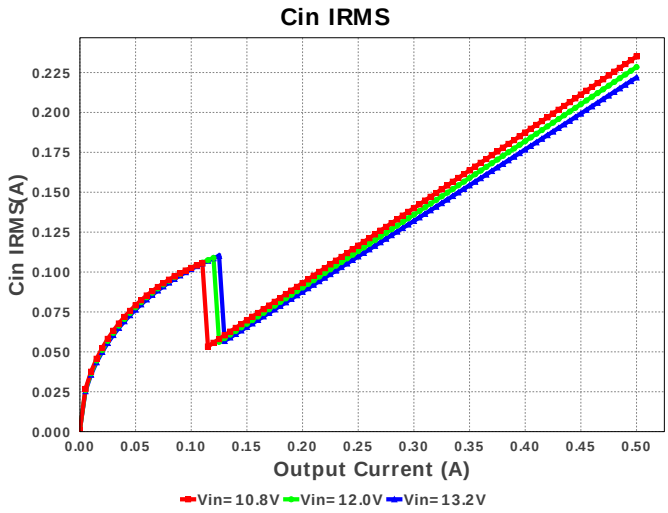

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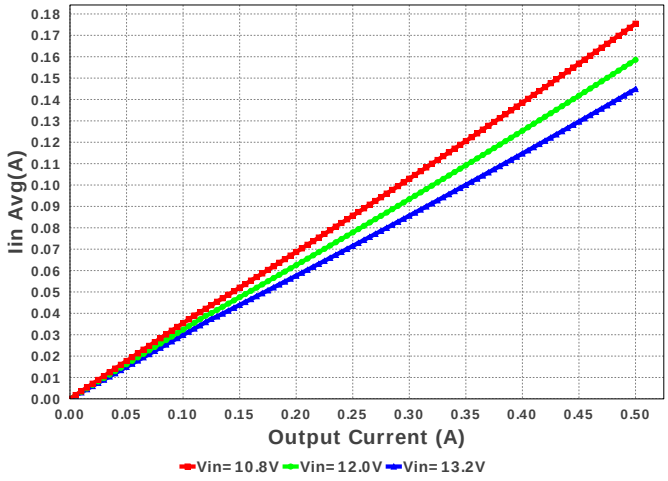
Iin Avg



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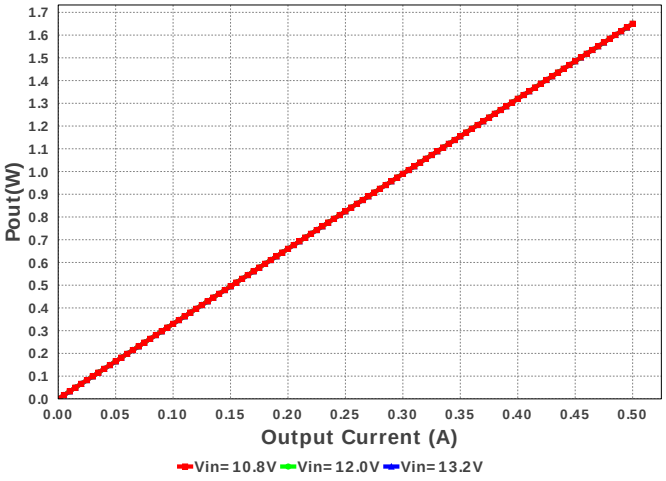
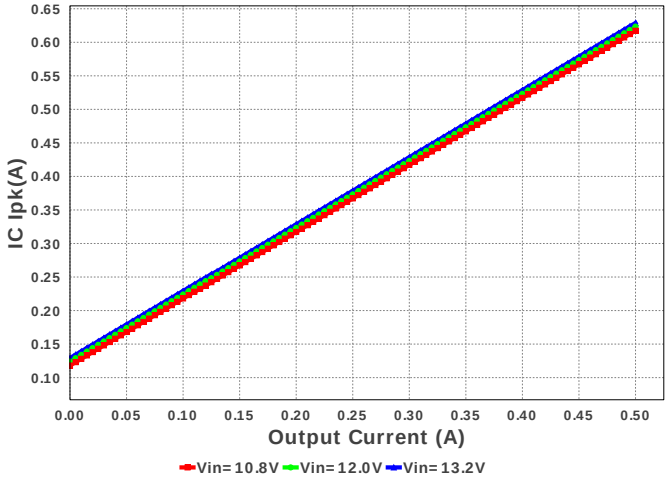
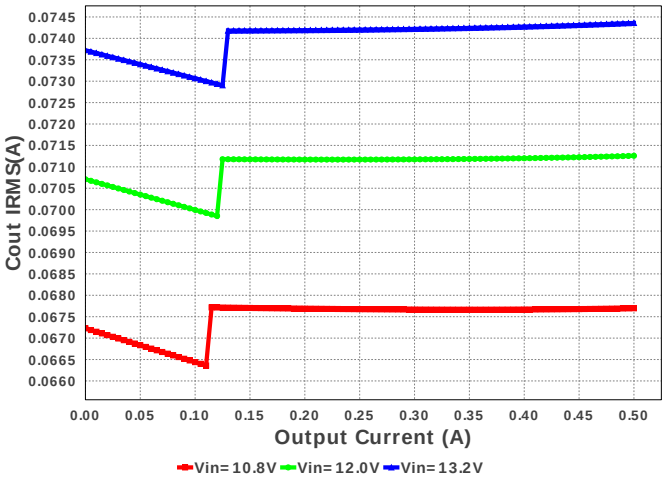


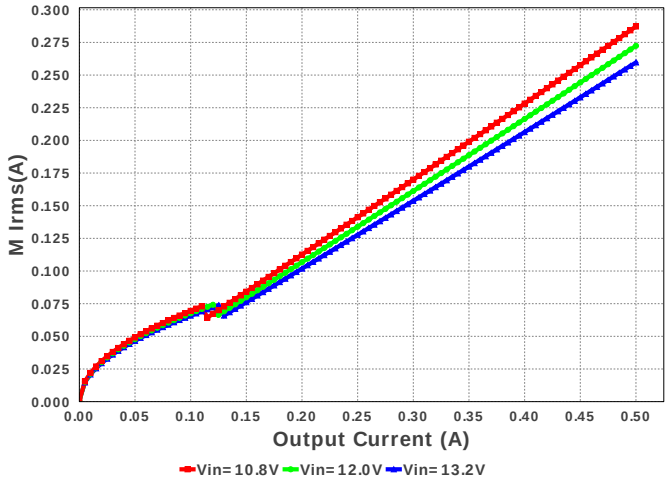
IC Ipk



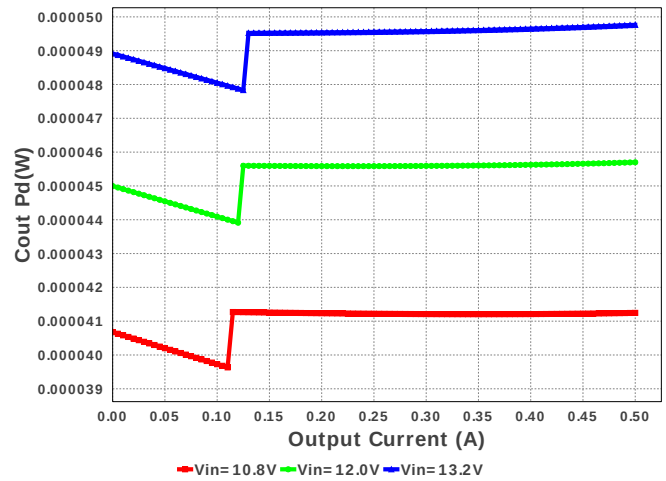
Cout IRMS



M Irms



Cout Pd



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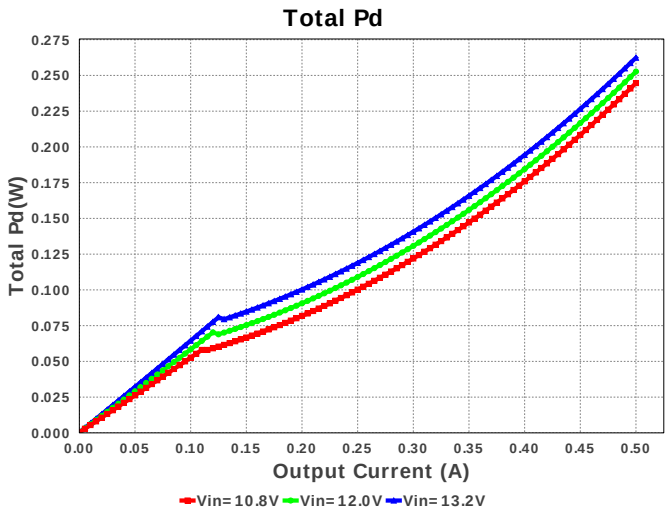

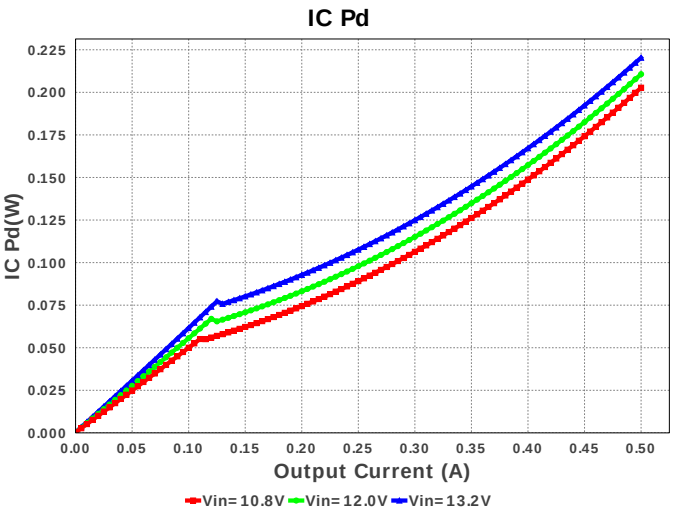

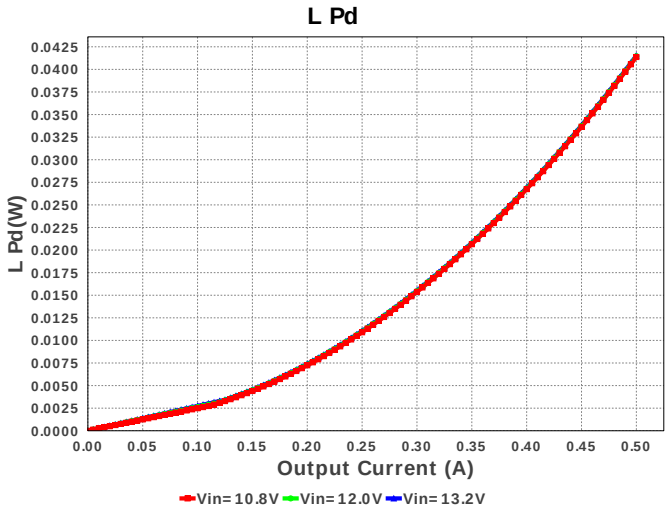

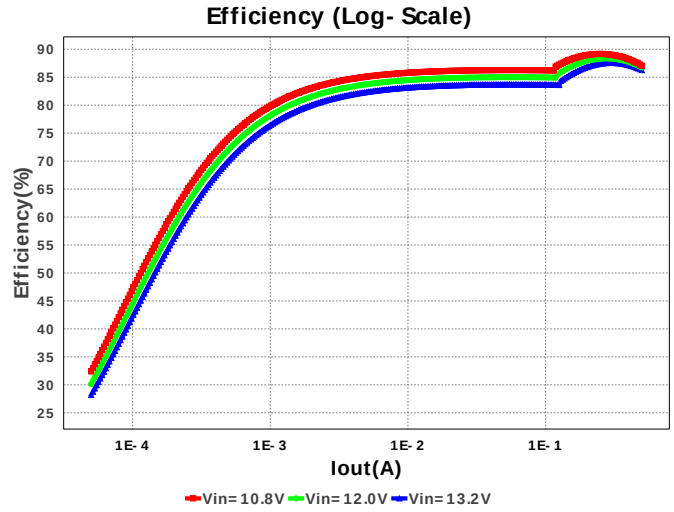

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	221.911 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	74.359 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	628.794 mA	Current	Peak switch current in IC
4.	Iin Avg	144.88 mA	Current	Average input current
5.	L Ipp	257.59 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	259.68 mA	Current	Q Iavg
7.	BOM Count	5	General	Total Design BOM count
8.	FootPrint	74.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	1.037 MHz	General	Switching frequency
10.	IC Tolerance	24.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	203.433 mV	General	Voltage drop across the MosFET
12.	Pout	1.65 W	General	Total output power
13.	Total BOM	$0.86	General	Total BOM Cost
14.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	26.974 %	Op_point	Duty cycle
16.	Efficiency	86.28 %	Op_point	Steady state efficiency
17.	IC Tj	43.573 degC	Op_point	IC junction temperature
18.	ICThetaJA	61.6 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	500.0 mA	Op_point	Iout operating point
20.	VIN_OP	13.2 V	Op_point	Vin operating point
21.	Vout p-p	3.29 mV	Op_point	Peak-to-peak output ripple voltage
22.	Cin Pd	474.57 µW	Power	Input capacitor power dissipation
23.	Cout Pd	49.764 µW	Power	Output capacitor power dissipation
24.	IC Pd	220.341 mW	Power	IC power dissipation
25.	L Pd	41.524 mW	Power	Inductor power dissipation
26.	Total Pd	262.383 mW	Power	Total Power Dissipation
27.	Vout Tolerance	727.273 m%		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

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#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	13.2	Maximum input voltage
3.	VinMin	10.8	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS62177	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS62177** Product Folder : http://www.ti.com/product/TPS62177 : contains the data sheet and other resources.

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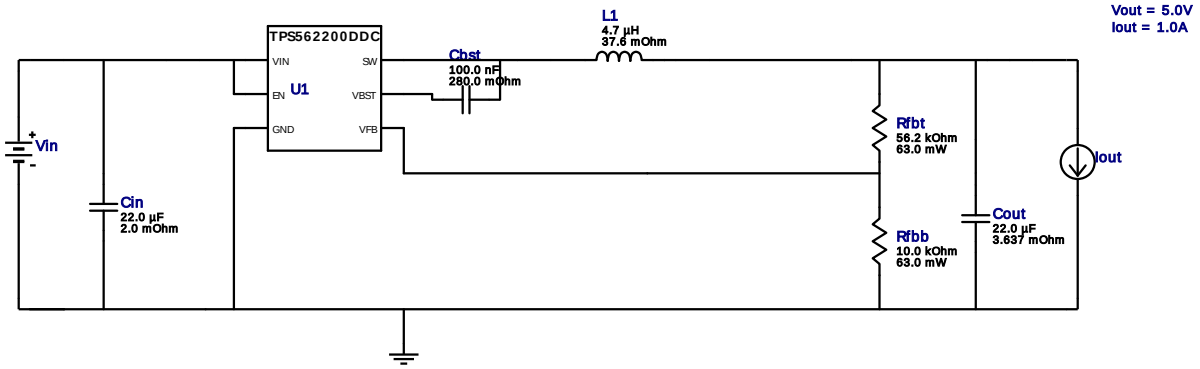
WEBENCH® Design Report

Vout = 5.0V
Iout = 1.0A

Device = TPS562200DDCR
Topology = Buck
Created = 4/26/16 6:15:14 AM
BOM Cost = $0.89
BOM Count = 7
Total Pd = 0.34W

Design : 1218779/6 TPS562200DDCR
TPS562200DDCR 10.8V-13.2V to 5.00V @ 1.0A



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	MuRata	GRM31CR61A226KE19L Series= X5R	Cap= 22.0 uF ESR= 3.637 mOhm VDC= 10.0 V IRMS= 3.56456 A	1	$0.07	1206_190 11 mm²
4.	L1	Bourns	SRN6045-4R7Y	L= 4.7 µH DCR= 37.6 mOhm	1	$0.16	SRN6045 64 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.	Rfbt	Vishay-Dale	CRCW040256K2FKED Series= CRCW..e3	Res= 56.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
7.	U1	Texas Instruments	TPS562200DDCR	Switcher	1	$0.47	DDC0006A 10 mm²

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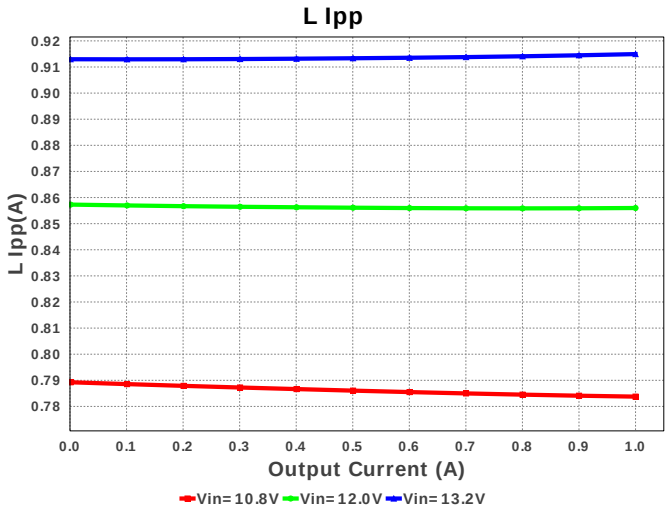

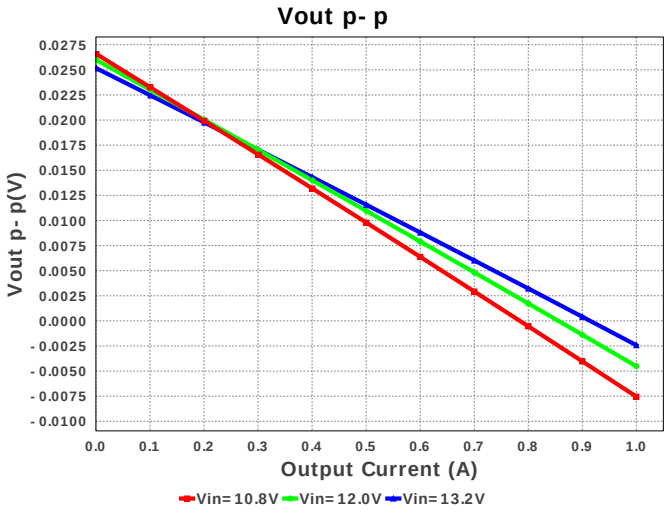

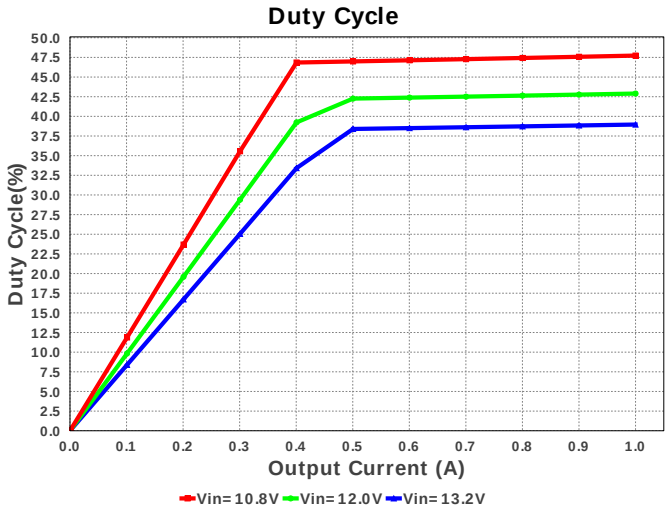

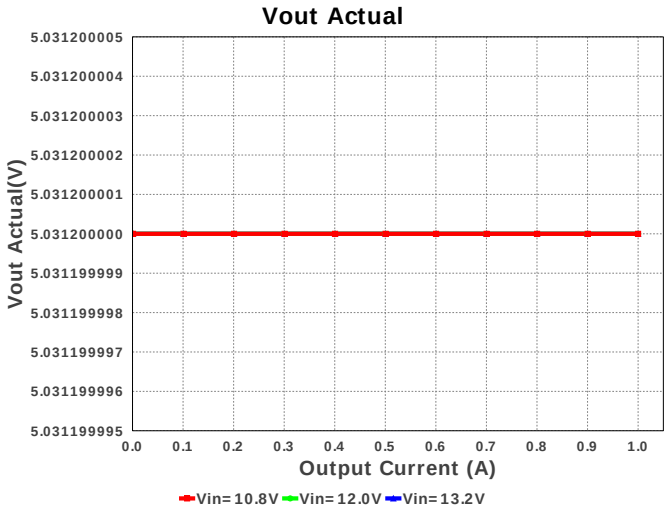

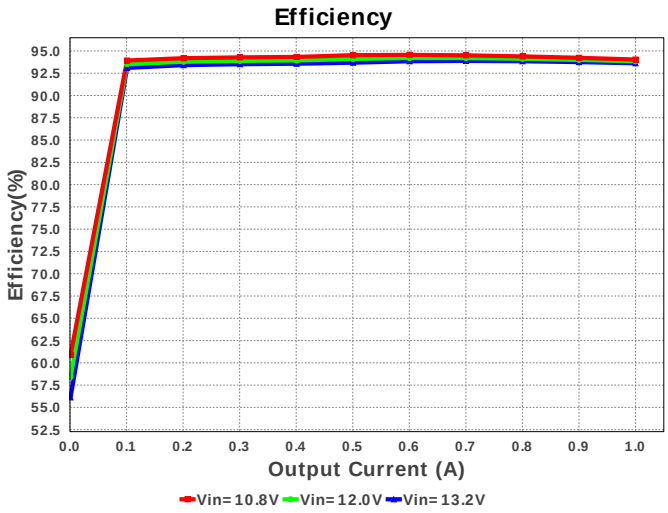

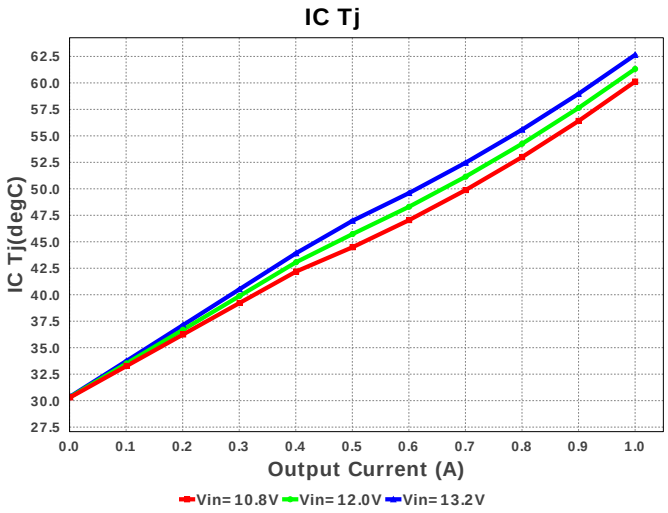

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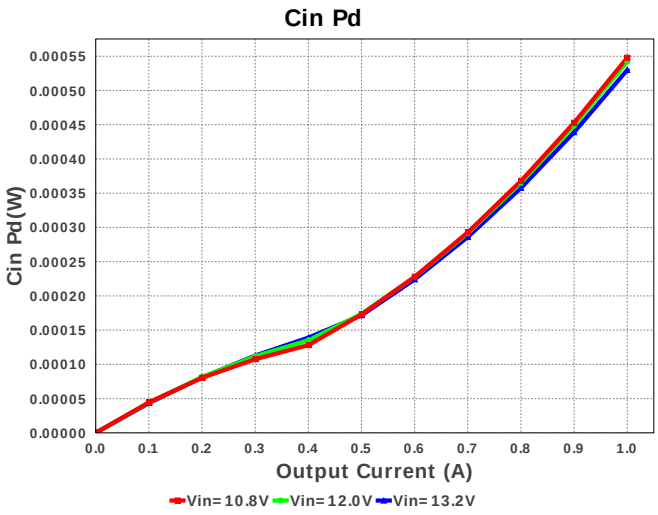

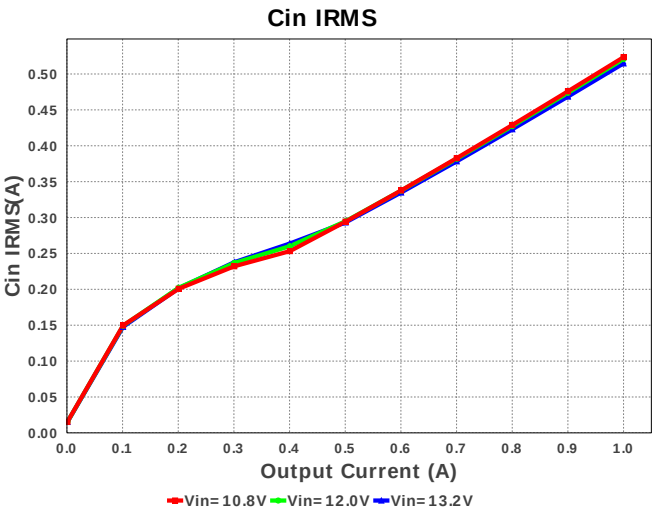

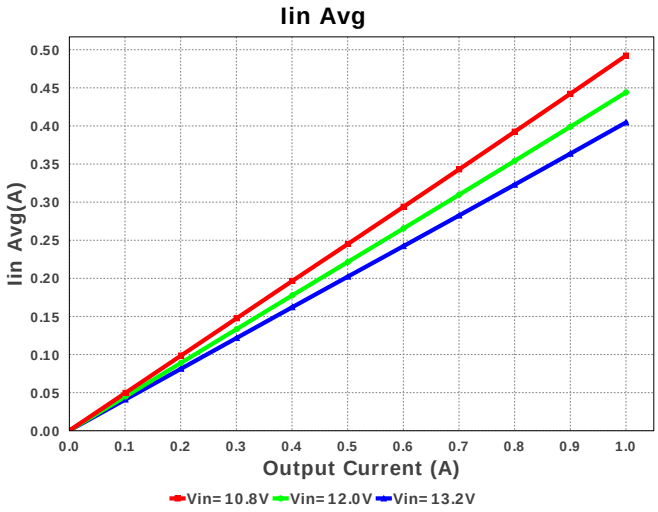

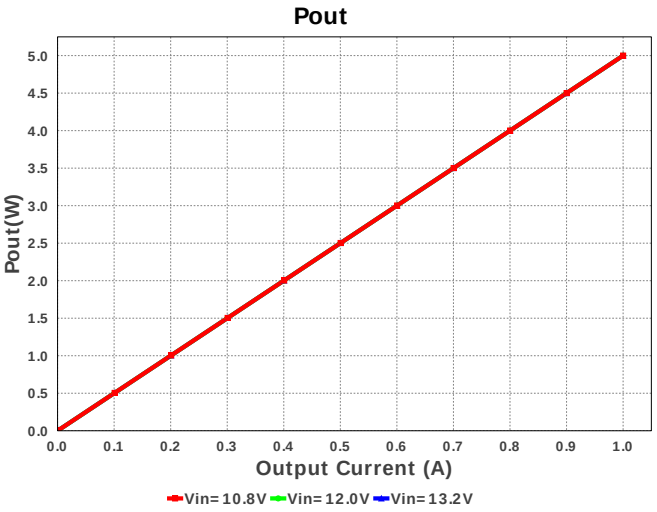

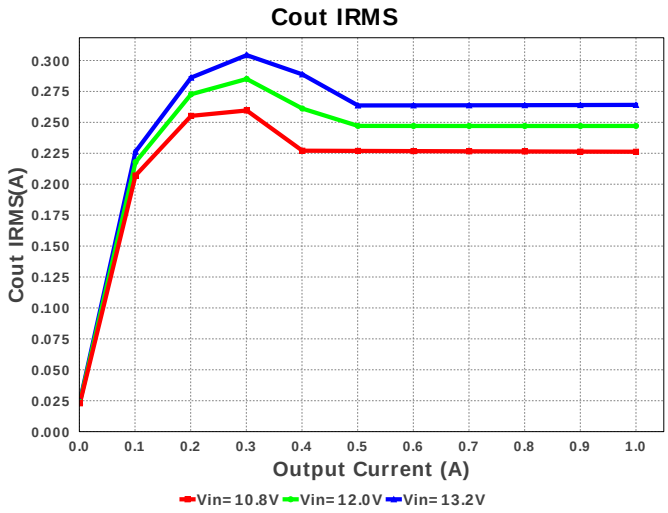

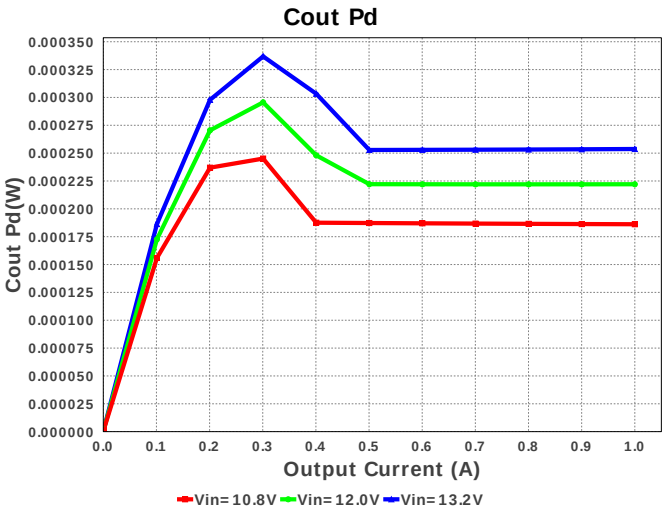

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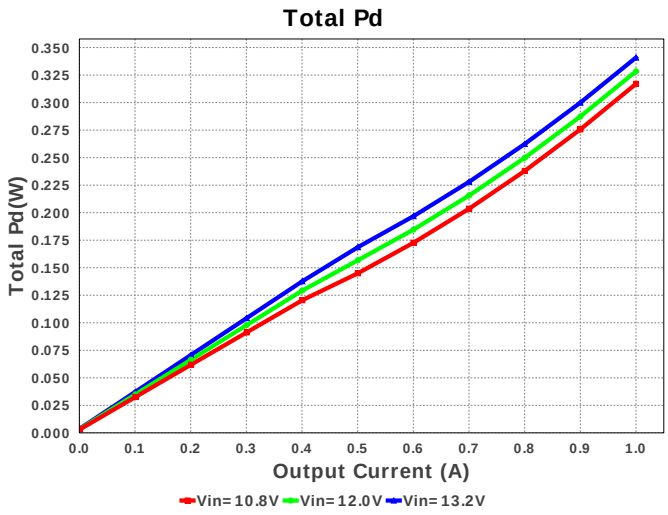

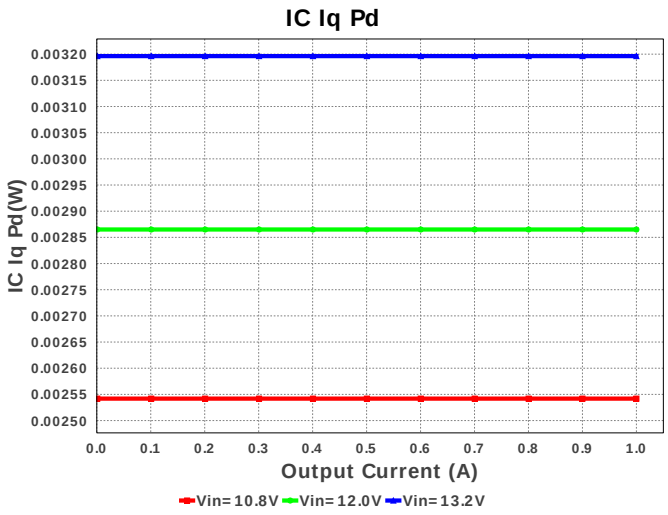

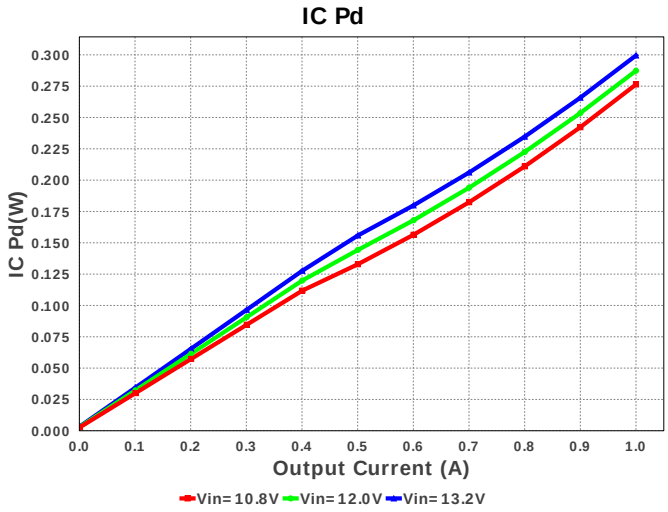

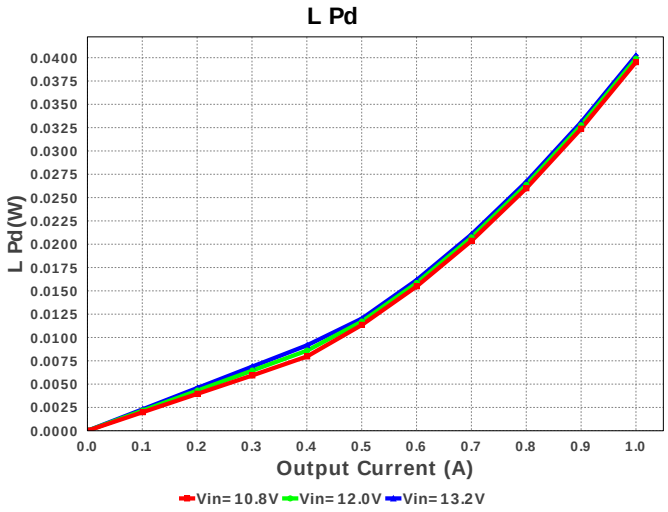

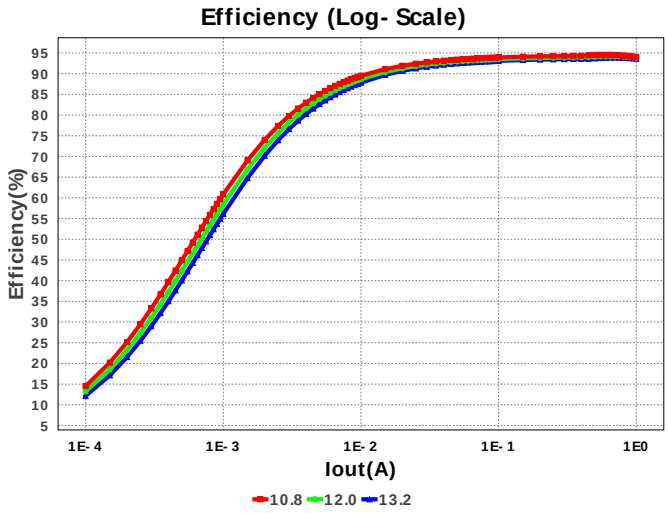

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	514.765 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	264.119 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	404.61 mA	Current	Average input current
4.	L Ipp	914.94 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	7	General	Total Design BOM count
6.	FootPrint	113.0 mm^2	General	Total Foot Print Area of BOM components
7.	Frequency	721.588 kHz	General	Switching frequency
8.	Pout	5.0 W	General	Total output power
9.	Total BOM	$0.89	General	Total BOM Cost
10.	Vout Actual	5.031 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
11.	Vout OP	5.0 V	Op_Point	Operational Output Voltage

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#	Name	Value	Category	Description
12.	Duty Cycle	38.958 %	Op_point	Duty cycle
13.	Efficiency	93.617 %	Op_point	Steady state efficiency
14.	IC Tj	62.647 degC	Op_point	IC junction temperature
15.	ICThetaJA	109.0 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	8.701 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	529.966 µW	Power	Input capacitor power dissipation
20.	Cout Pd	253.714 µW	Power	Output capacitor power dissipation
21.	IC Iq Pd	3.196 mW	Power	IC Iq Pd
22.	IC Pd	299.517 mW	Power	IC power dissipation
23.	L Pd	40.223 mW	Power	Inductor power dissipation
24.	Total Pd	340.907 mW	Power	Total Power Dissipation
25.	Vout Tolerance	3.053 %		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	5.0	Output Voltage
5.	base_pn	TPS562200	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS562200** Product Folder : http://www.ti.com/product/TPS562200 : contains the data sheet and other resources.

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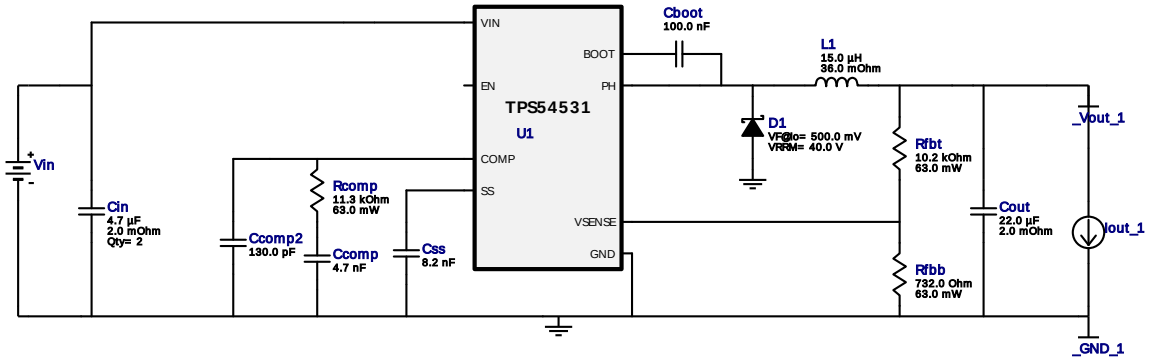
TEXAS INSTRUMENTS

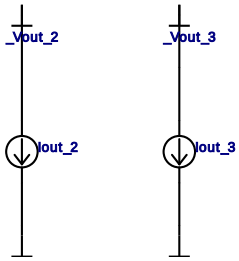
WEBENCH® Design Report

Vout = 12.0V
Iout = 2.55A

Device = TPS54531DDAR
Topology = Buck
Created = 4/26/16 6:15:14 AM
BOM Cost = $1.82
BOM Count = 13
Total Pd = 1.8W

Design : 1218779/7 TPS54531DDAR
TPS54531DDAR 22.0V-26.0V to 12.00V @ 2.54949A





Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Ccomp	Yageo America	CC0805KRX7R9BB472 Series= X7R	Cap= 4.7 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	Ccomp2	Samsung Electro-Mechanics	CL21C131JBANNNC Series= C0G/NP0	Cap= 130.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
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 mm²
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 mm²
6.	Css	MuRata	GRM033R61A822KA01D Series= X5R	Cap= 8.2 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
7.	D1	Diodes Inc.	B240A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.09	SMA 37 mm²

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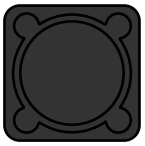
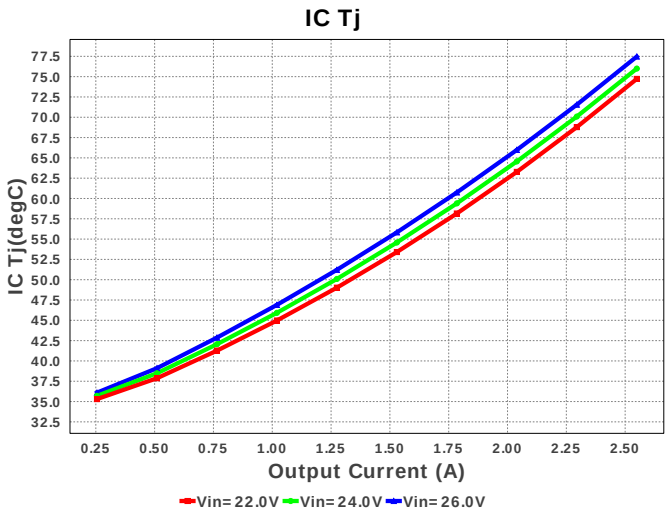
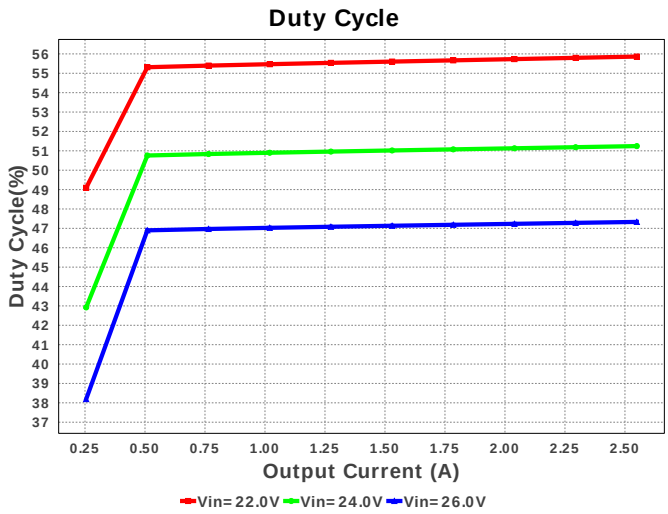
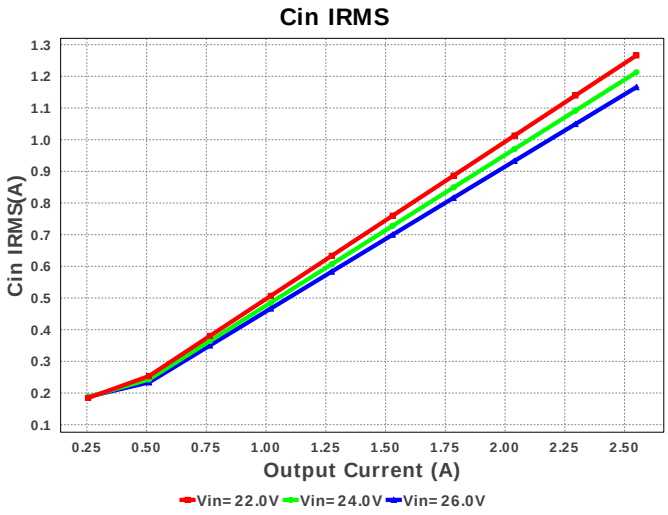
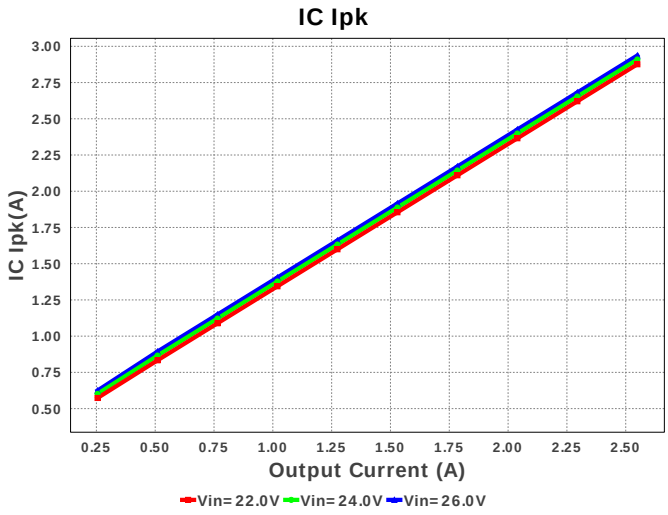
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	L1	Bourns	SRR1208-150ML	L= 15.0 µH DCR= 36.0 mOhm	1	$0.37	 SRR1208 216 mm²
9.	Rcomp	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
10.	Rfbb	Vishay-Dale	CRCW0402732RFKED Series= CRCW..e3	Res= 732.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
11.	Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
12.	U1	Texas Instruments	TPS54531DDAR	Switcher	1	$0.75	 DDA0008E 57 mm²









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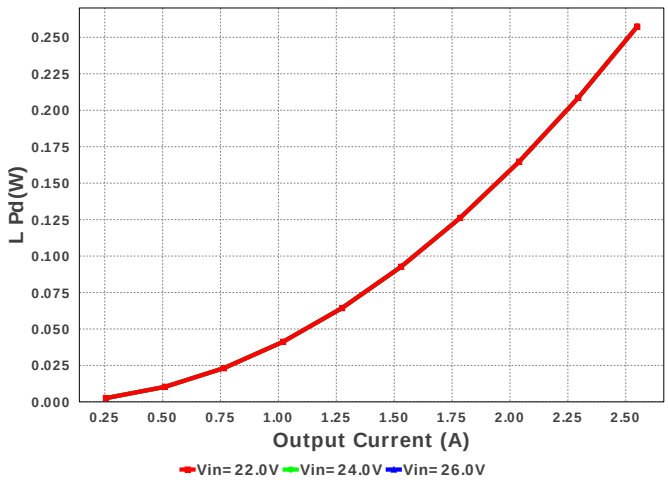
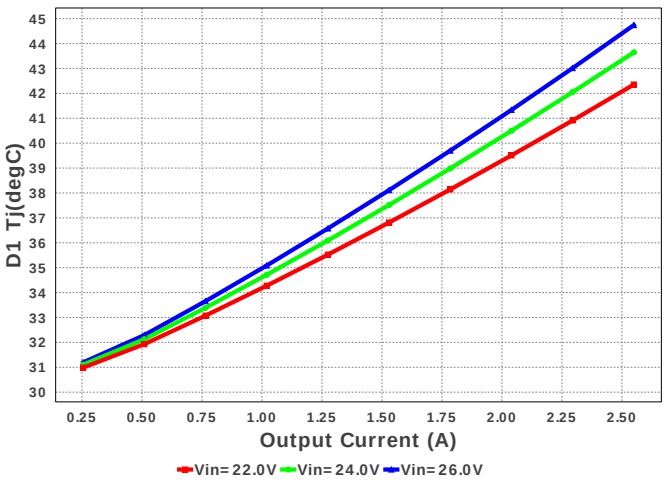
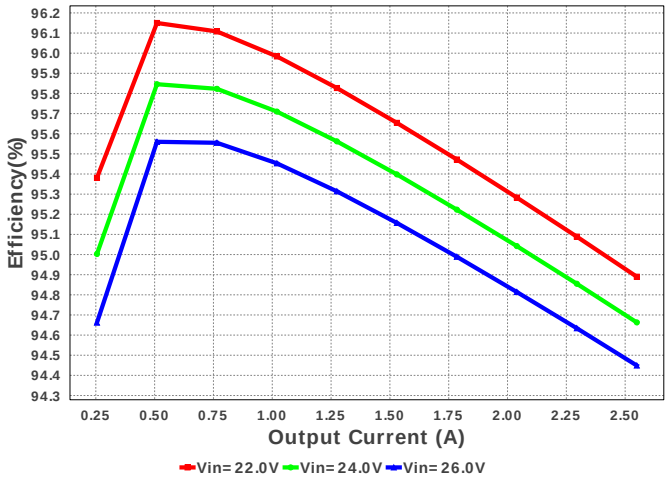
L Pd



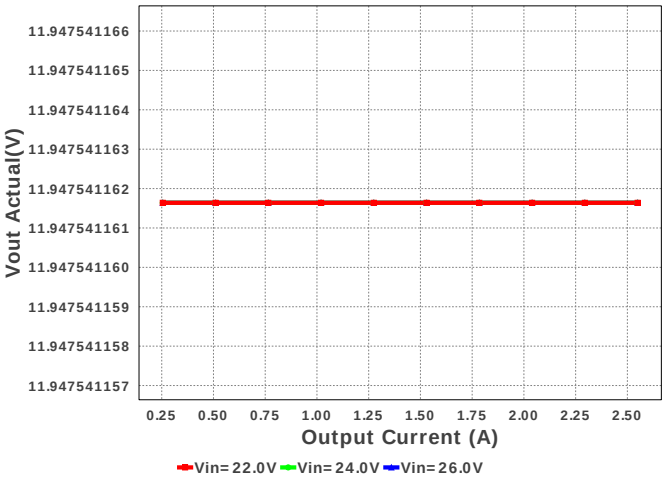
D1 Tj



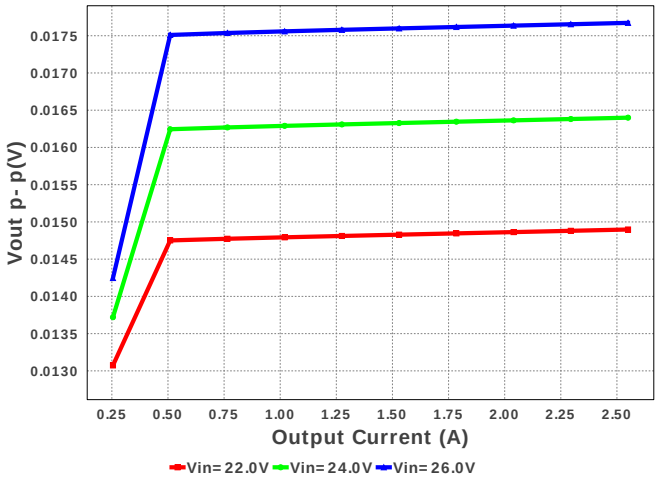
Efficiency



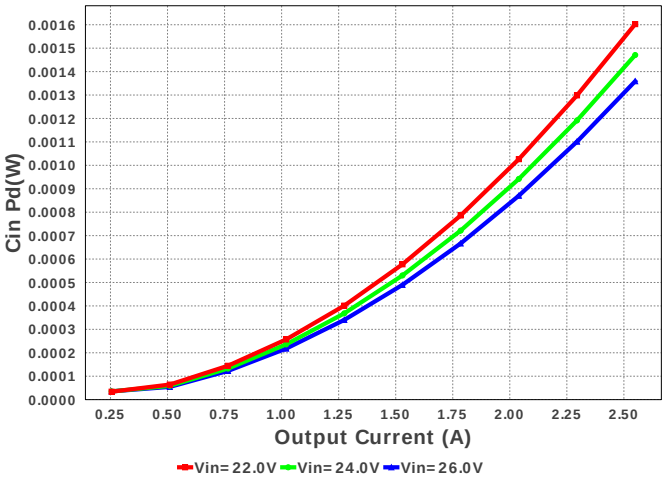
Vout Actual



Vout p- p



Cin Pd



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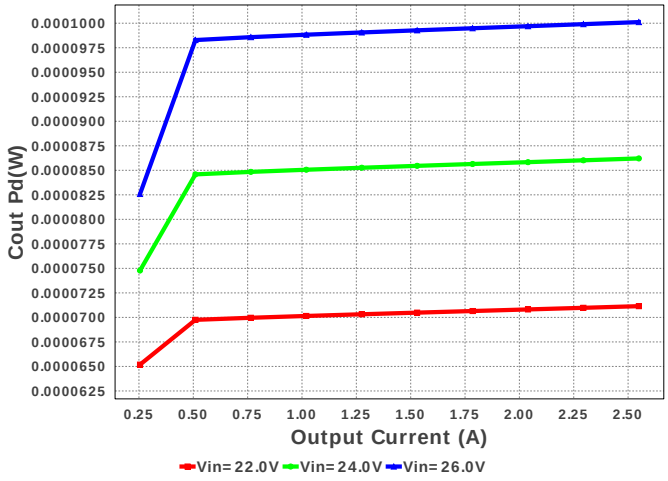
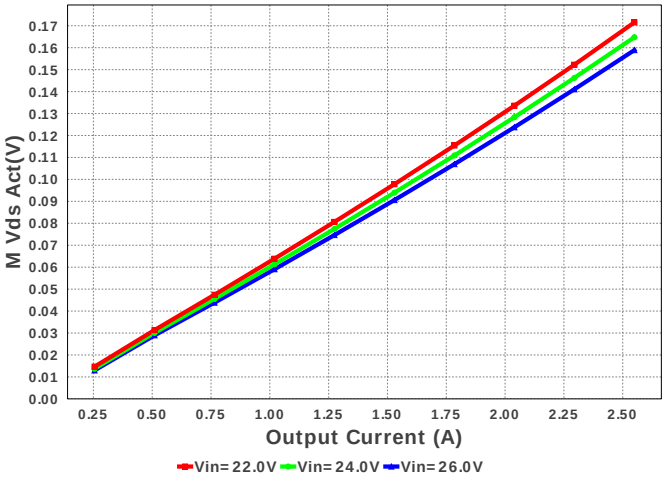
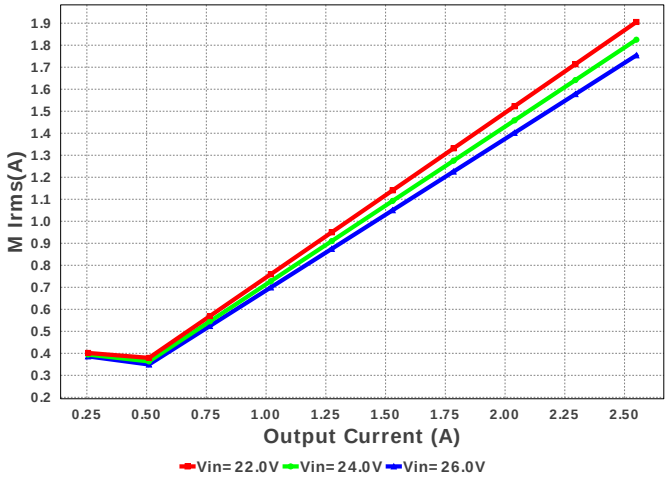
Cout Pd



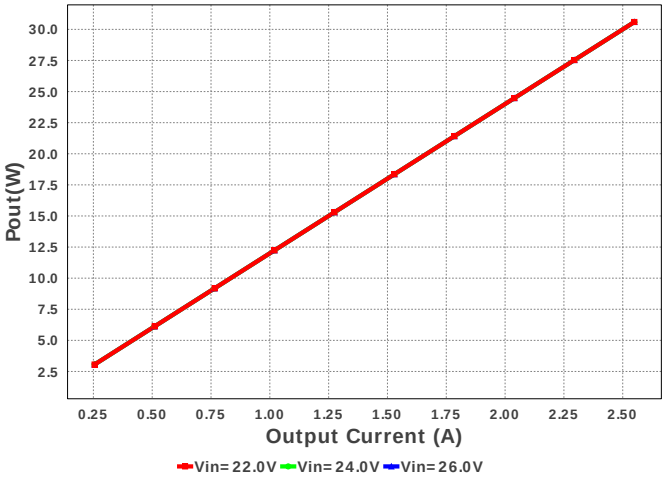
M Vds Act



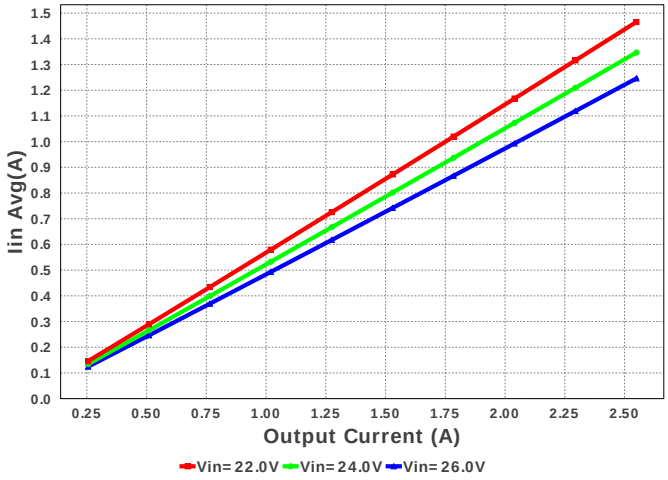
M Irms



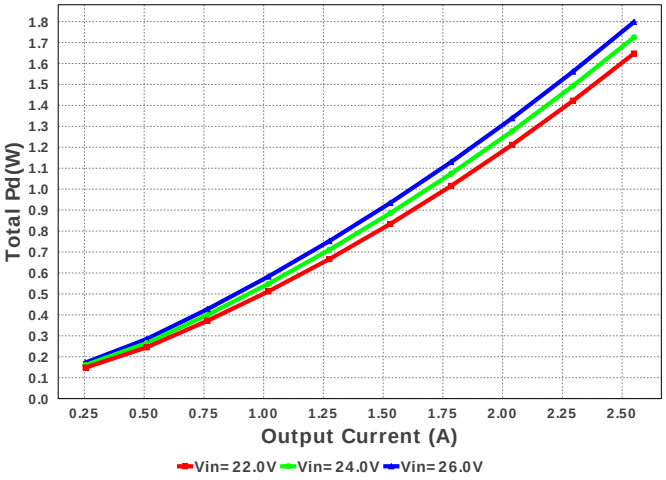
Pout



Iin Avg



Total Pd



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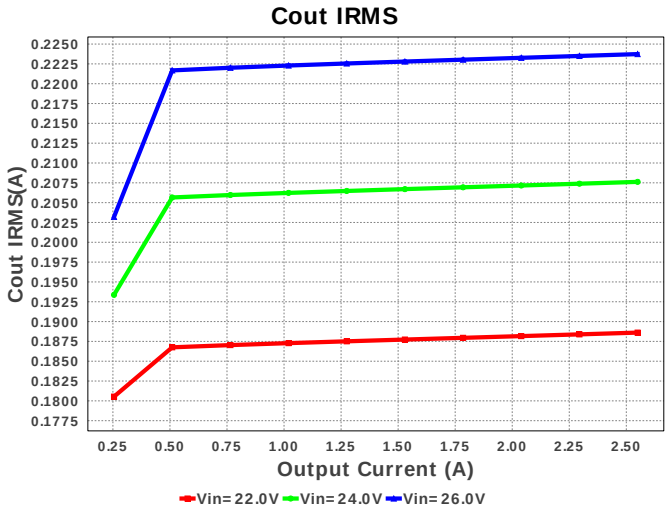

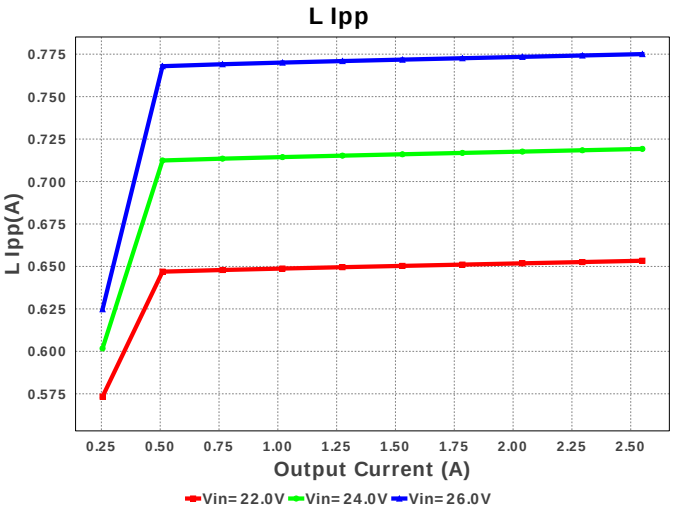

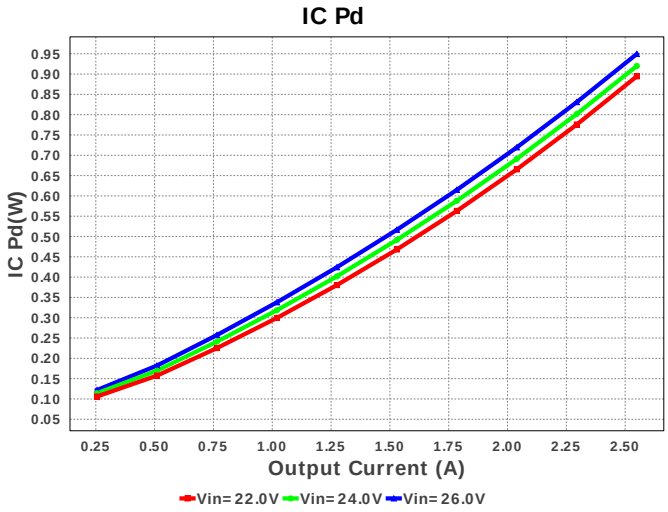

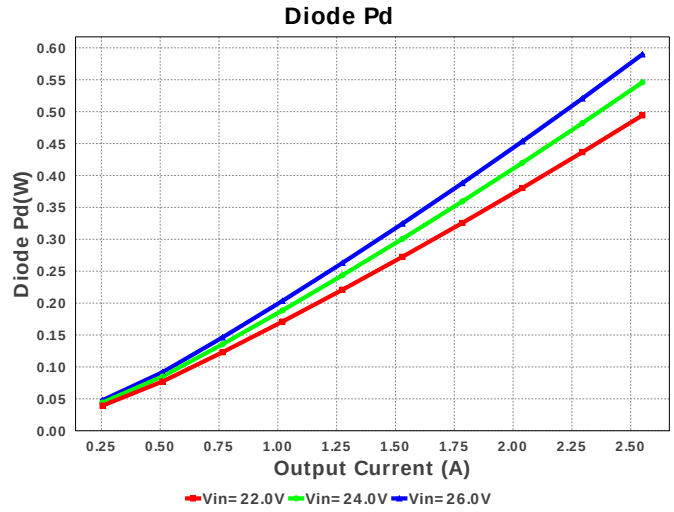

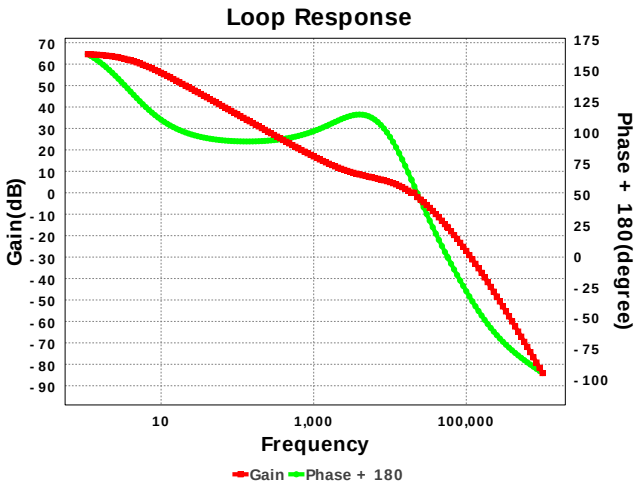

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.166 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	223.734 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	2.937 A	Current	Peak switch current in IC
4.	Iin Avg	1.246 A	Current	Average input current
5.	L Ipp	775.04 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	1.754 A	Current	Q Iavg
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	158.885 mV	General	Voltage drop across the MosFET
11.	Pout	30.594 W	General	Total output power

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#	Name	Value	Category	Description
12.	Total BOM	$1.82	General	Total BOM Cost
13.	D1 Tj	44.742 degC	Op_Point	D1 junction temperature
14.	Low Freq Gain	64.624 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	19.179 kHz	Op_point	Bode plot crossover frequency
18.	Duty Cycle	47.333 %	Op_point	Duty cycle
19.	Efficiency	94.449 %	Op_point	Steady state efficiency
20.	Gain Marg	-15.941 dB	Op_point	Bode Plot Gain Margin
21.	IC Tj	77.472 degC	Op_point	IC junction temperature
22.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
23.	IOUT_OP	2.55 A	Op_point	Iout operating point
24.	Phase Marg	62.059 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	26.0 V	Op_point	Vin operating point
26.	Vout p-p	17.673 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	1.359 mW	Power	Input capacitor power dissipation
28.	Cout Pd	100.114 µW	Power	Output capacitor power dissipation
29.	Diode Pd	589.665 mW	Power	Diode power dissipation
30.	IC Pd	949.433 mW	Power	IC power dissipation
31.	L Pd	257.396 mW	Power	Inductor power dissipation
32.	Total Pd	1.798 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	2.549	Maximum Output Current
2.	VinMax	26.0	Maximum input voltage
3.	VinMin	22.0	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.

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