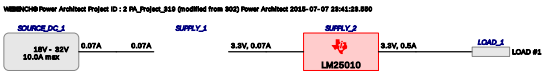


WEBENCH® Power Architect

Project Report

Project : 1836019/2 : PA_Project_319 (modified from 302)
Created : 2015-07-07 23:41:23.550
Optimize project optFactor=3

Project Summary

1.	Total System Efficiency	72.492 %
2.	Total System BOM Count	27.0
3.	Total System Footprint	516.0 mm2
4.	Total System BOM Cost	$4.33
5.	Total System Power Dissipation	626.1 mW

--> Launch WEBENCH Power Architect.

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LM5069-2	Hotswap : Auto Restart	3.3 V	0.07 A	98.5%	292	$2.72	6	10
2.	SUPPLY_2	LM25010	Switcher : 42V 1.0A Step Down Regulator	3.3 V	0.5 A	73.9%	224	$1.61	5	4

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #1	3.3 V	0.5 A	VoutRipple=2%, SoftStart delay=50.0 µSec

Project Diagram

Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
AVX	12061A151JAT2A	1206	1	$0.11	11
Kemet	C0805C102K5RACTU	0805	1	$0.01	7
Kemet	C0805C104K5RACTU	0805	1	$0.01	7
Vishay-Dale	CRCW040228K0FKED	0402	1	$0.01	3
Vishay-Dale	CRCW04025K76FKED	0402	1	$0.01	3
Stackpole Electronics Inc	CSRN2010FKR400	2010	1	$0.11	32
Taiyo Yuden	EMK212B7474KD-T	0805	1	$0.02	7
Chemi-Con	EMVY500ADA470MF80G	CAPSMT_62_F80	1	$0.12	74
Panasonic	ERJ-6ENF1002V	0805	1	$0.01	7
Panasonic	ERJ-6ENF1503V	0805	1	$0.01	7
Panasonic	ERJ-6ENF4122V	0805	1	$0.01	7
Panasonic	ERJ-6ENF6341V	0805	1	$0.01	7
Panasonic	ERJ-6ENF7321V	0805	1	$0.01	7
Panasonic	ERJ-6ENF8252V	0805	1	$0.01	7
MuRata	GRM033R71C221KA01D	0201	1	$0.01	2
MuRata	GRM155R61C223KA01D	0402	1	$0.01	3
MuRata	GRM155R71C224KA12D	0402	1	$0.01	3
MuRata	GRM188R60J475ME19D	0603	1	$0.02	5
MuRata	GRM31CR71H475KA12L	1206	1	$0.07	11
International Rectifier	IRF540NLPBF	TO-262	1	$0.92	85
Texas Instruments	LM25010MH/NOPB	PWP0014A	1	$0.95	59
Texas Instruments	LM5069MM-2/NOPB	MUB10A	1	$1.47	24
Rohm	MCR25JZHFLR100	1210	1	$0.03	15
NXP Semiconductor	PMEG6010CEH,115	SOD-123F	1	$0.11	12
Susumu Co Ltd	RR1220P-183-D	0805	1	$0.01	7
Diodes Inc.	SMBJ70A-13-F	SMB	1	$0.10	44
Bourns	SRN6045-470M	SRN6045	1	$0.16	64
Total			27	$4.33	520

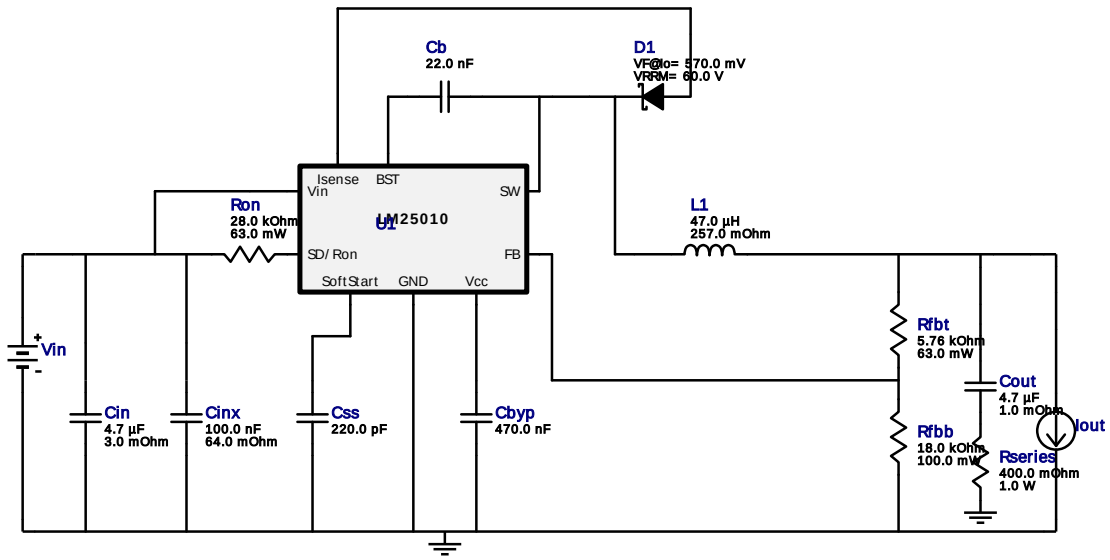
TEXAS INSTRUMENTS

WEBENCH® Design Report

VinMin = 18.0V
VinMax = 32.0V
Vout = 3.3V
Iout = 0.5A

Device = LM25010MH/NOPB
Topology = Buck
Created = 7/7/15 11:41:22 PM
BOM Cost = $1.61
Footprint = 224.0 mm²
BOM Count = 14
Total Pd = 0.58W

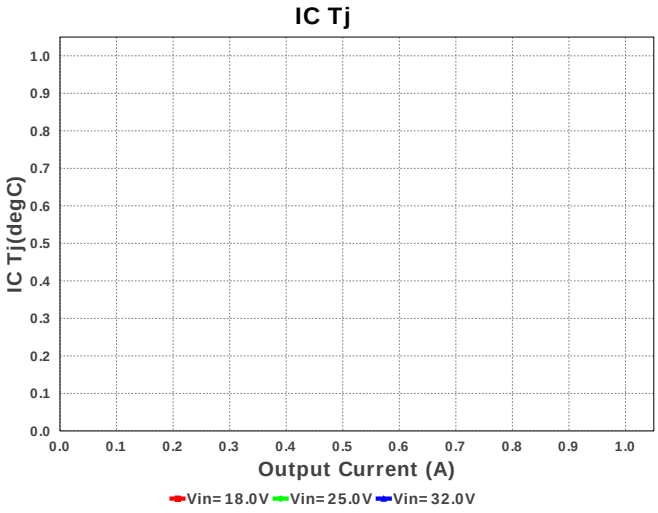
Design : 1836019/5 LM25010MH/NOPB
LM25010MH/NOPB 18.0V-32.0V to 3.30V @ 0.5A

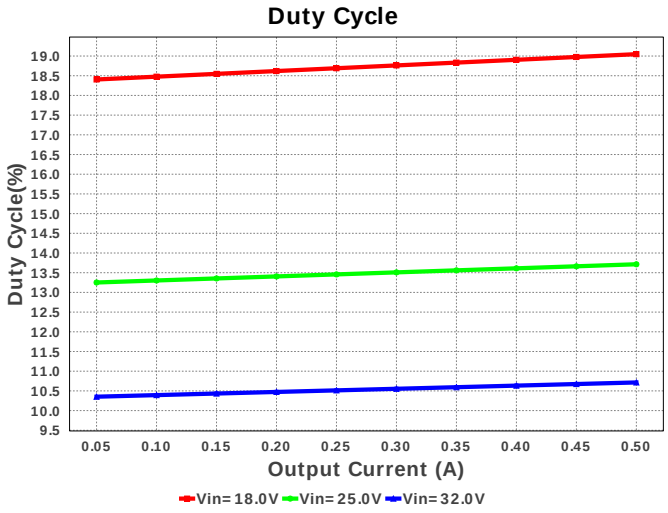


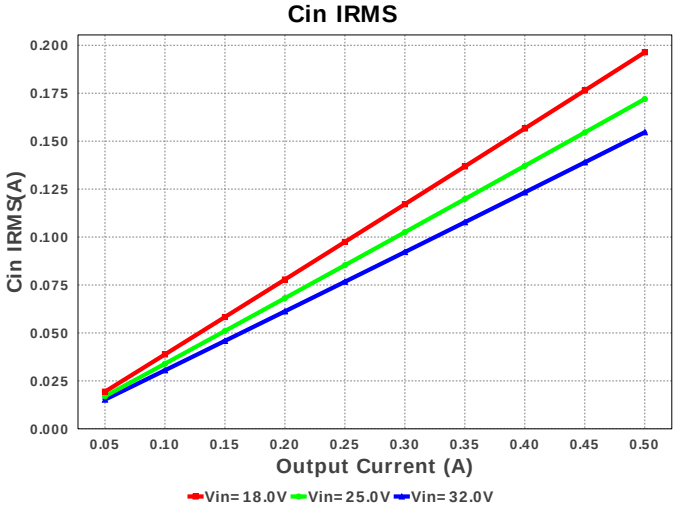
Electrical BOM

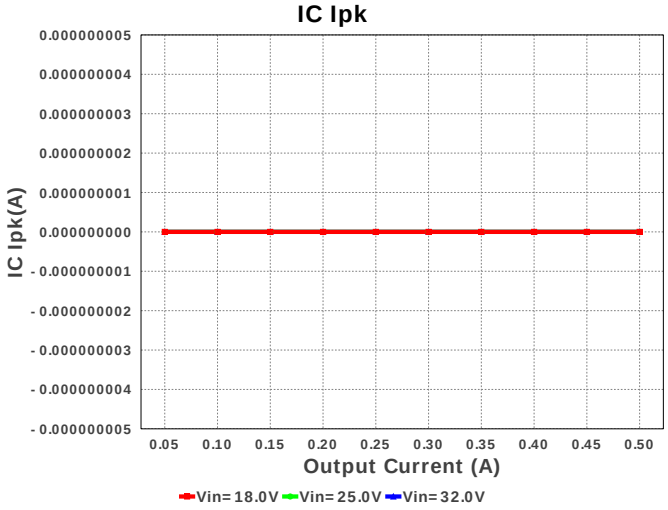
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cb	MuRata	GRM155R61C223KA01D Series= X5R	Cap= 22.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Cbyp	Taiyo Yuden	EMK212B7474KD-T Series= X7R	Cap= 470.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
3.	Cff	AVX	12061A151JAT2A Series= C0G/NP0	Cap= 150.0 pF ESR= 573.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.11	1206 11 mm²
4.	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 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	MuRata	GRM188R60J475ME19D Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.02	0603 5 mm²
7.	Css	MuRata	GRM033R71C221KA01D Series= X7R	Cap= 220.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
8.	D1	NXP Semiconductor	PMEG6010CEH,115	VF@Io= 570.0 mV VRRM= 60.0 V	1	$0.11	SOD-123F 12 mm²

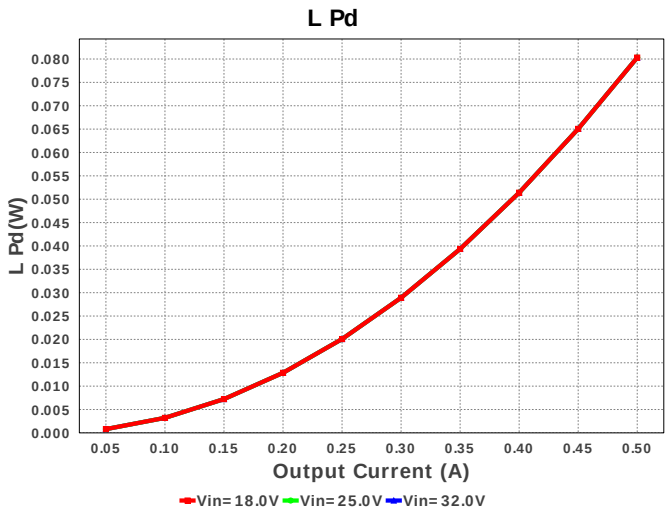
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	L1	Bourns	SRN6045-470M	L= 47.0 µH DCR= 257.0 mOhm	1	$0.16	 SRN6045 64 mm^2
10.	Rfbb	Susumu Co Ltd	RR1220P-183-D Series= 264	Res= 18.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	 0805 7 mm^2
11.	Rfbt	Vishay-Dale	CRCW04025K76FKED Series= CRCW..e3	Res= 5.76 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
12.	Ron	Vishay-Dale	CRCW040228K0FKED Series= CRCW..e3	Res= 28.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
13.	Rseries	Stackpole Electronics Inc	CSRN2010FKR400 Series= ?	Res= 400.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.11	 2010 32 mm^2
14.	U1	Texas Instruments	LM25010MH/NOPB	Switcher	1	$0.95	 PWP0014A 59 mm^2

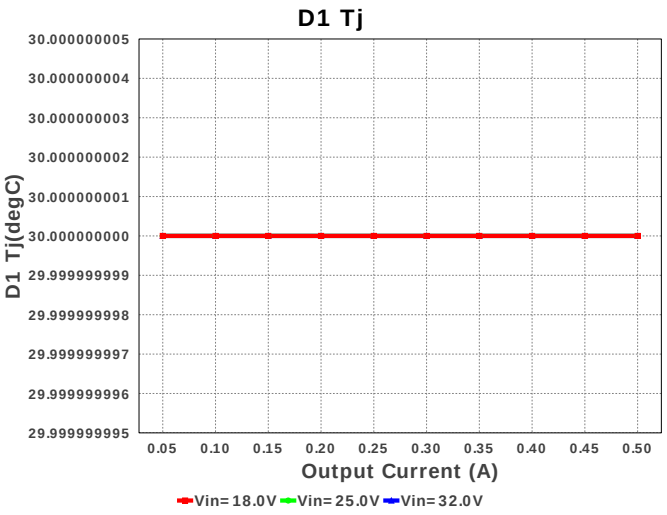


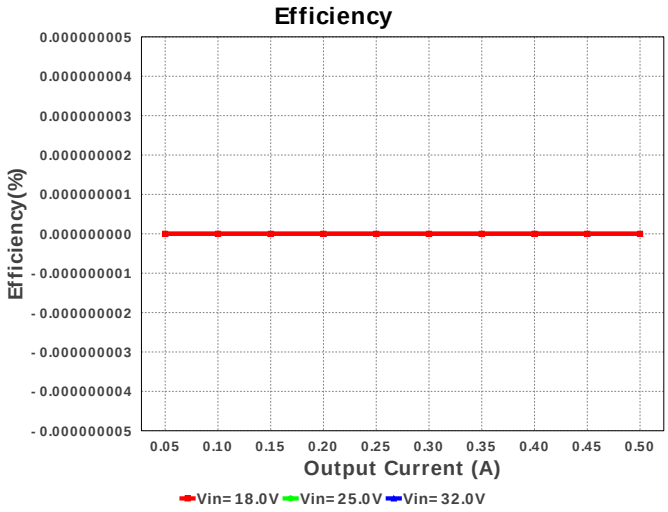


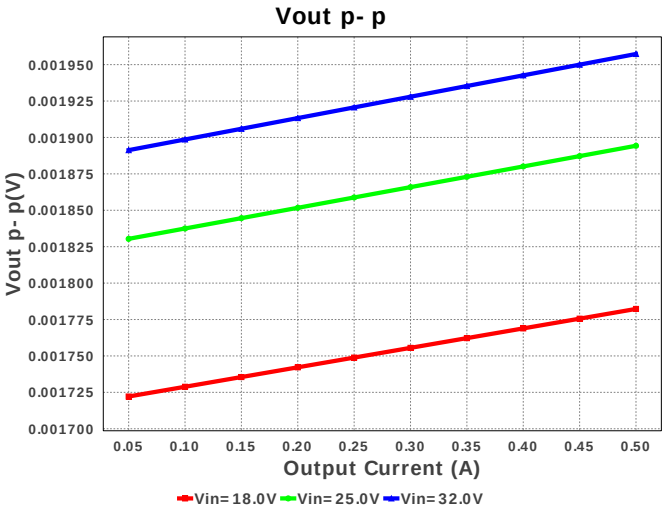


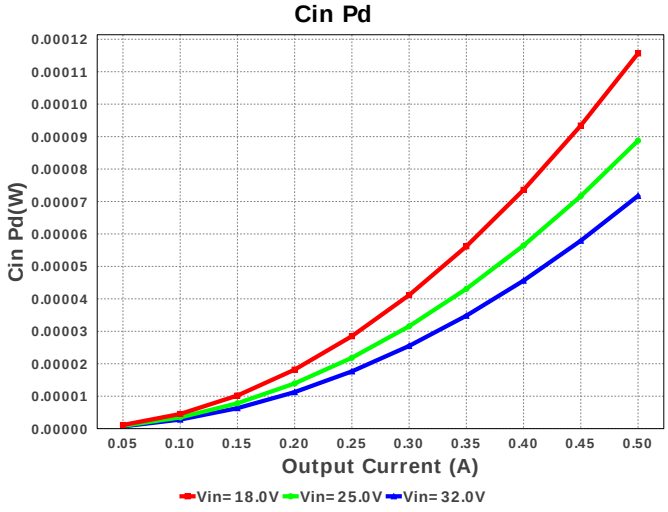


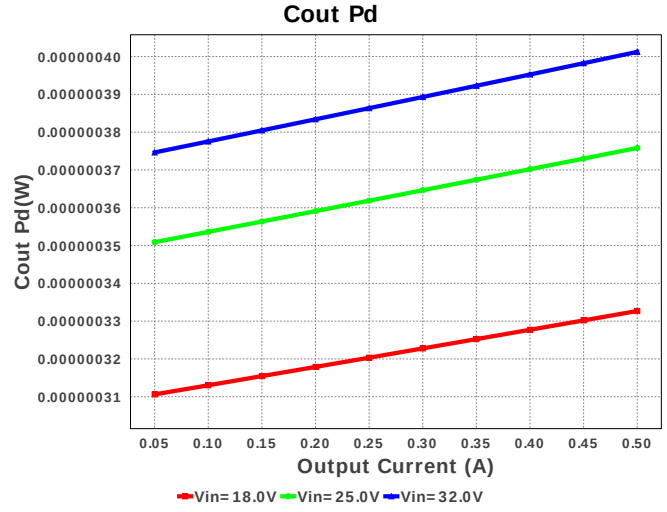


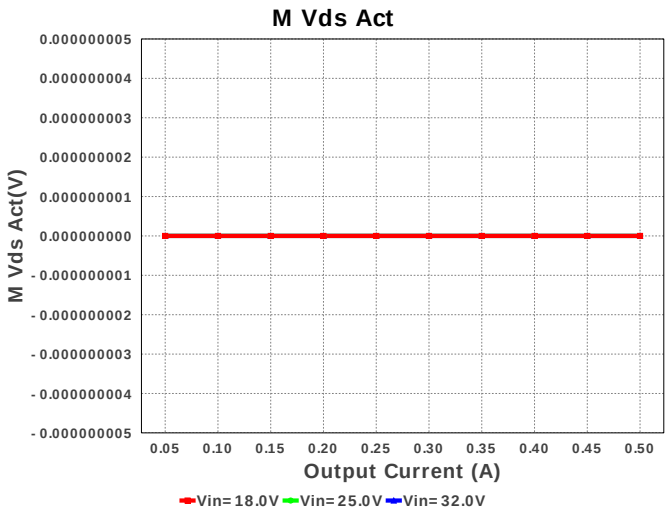


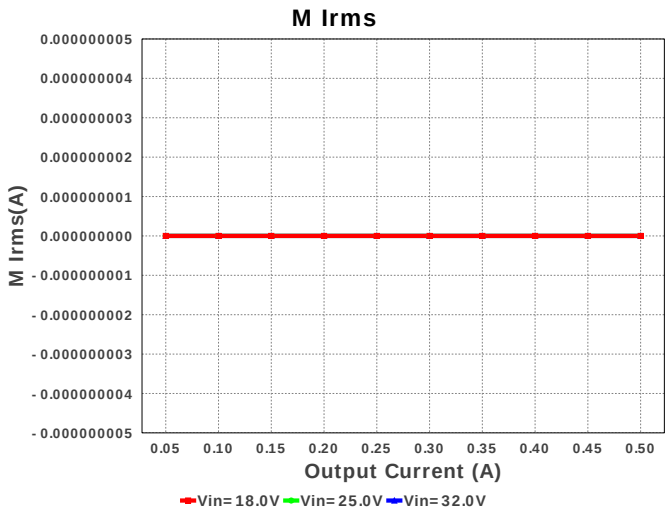


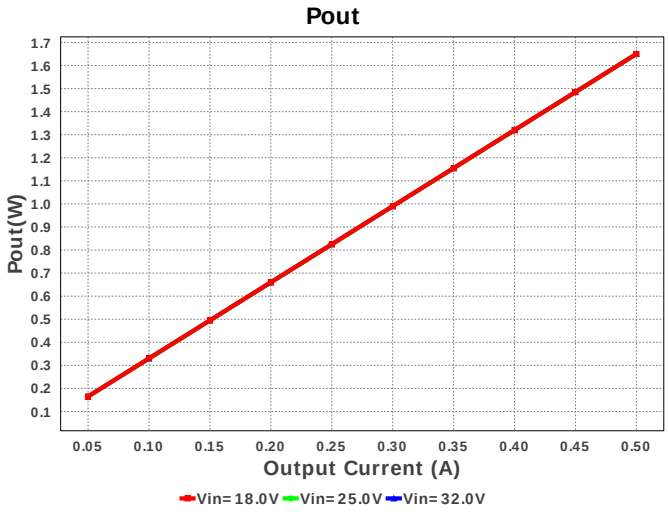


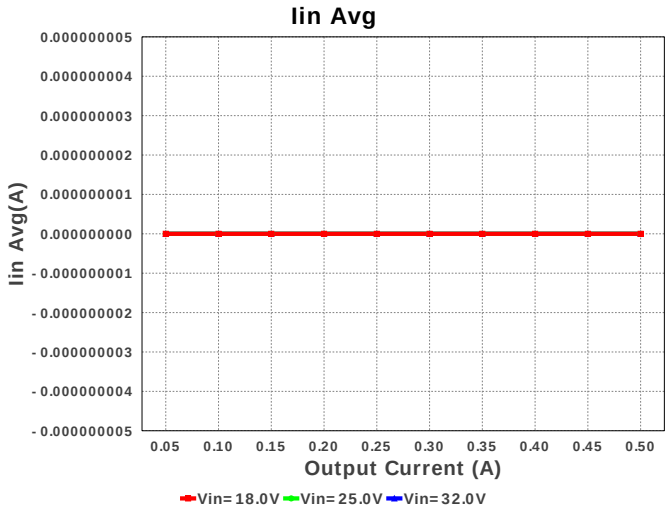


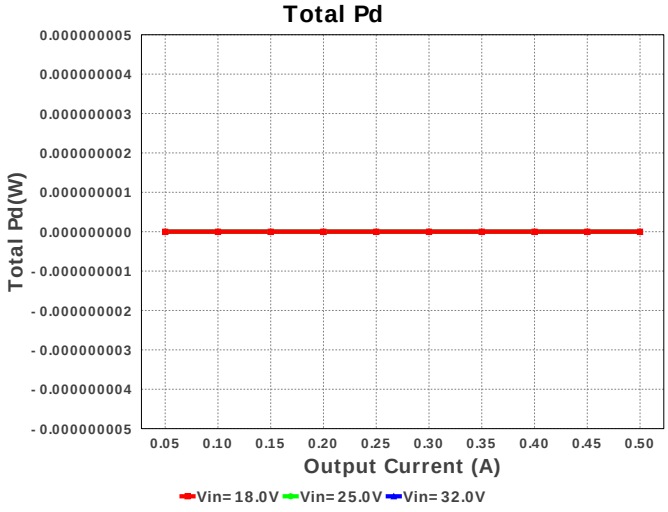


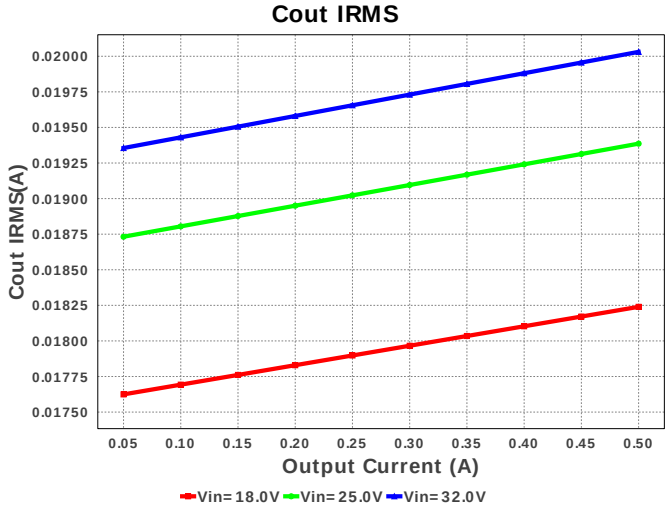


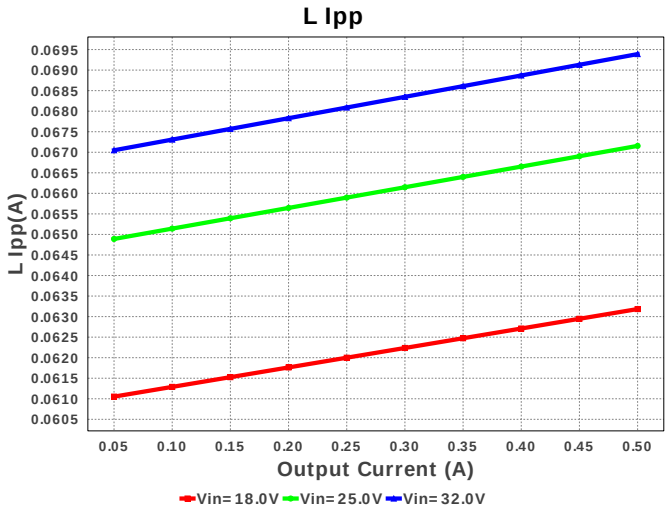


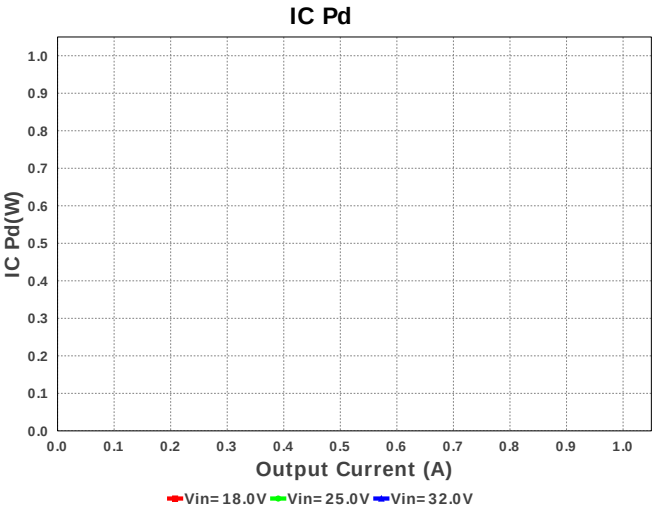


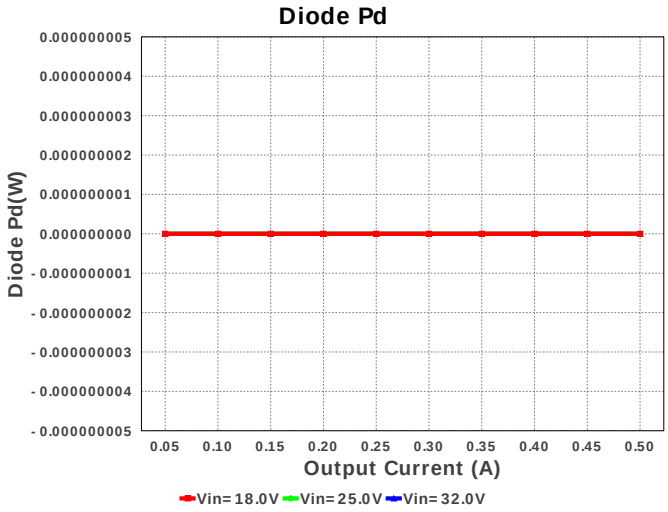












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	151.379 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	21.509 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	537.255 mA	Current	Peak switch current in IC
4.	Iin Avg	69.813 mA	Current	Average input current
5.	L Ipp	74.51 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	169.593 mA	Current	MOSFET RMS current
7.	BOM Count	14	General	Total Design BOM count
8.	FootPrint	224.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	942.857 kHz	General	Switching frequency
10.	IC Tolerance	50.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	152.286 mV	General	Voltage drop across the MosFET
12.	Pout	1.65 W	General	Total output power
13.	Total BOM	$1.61	General	Total BOM Cost
14.	D1 Tj	90.058 degC	Op_Point	D1 junction temperature
15.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	11.505 %	Op_point	Duty cycle
17.	Efficiency	73.858 %	Op_point	Steady state efficiency
18.	IC Tj	43.251 degC	Op_point	IC junction temperature
19.	ICThetaJA	40.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	500.0 mA	Op_point	Iout operating point
21.	VIN_OP	32.0 V	Op_point	Vin operating point
22.	Vout p-p	298.785 µV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	68.747 µW	Power	Input capacitor power dissipation
24.	Cout Pd	462.644 nW	Power	Output capacitor power dissipation
25.	Diode Pd	181.995 mW	Power	Diode power dissipation
26.	IC Pd	331.273 mW	Power	IC power dissipation
27.	L Pd	70.675 mW	Power	Inductor power dissipation
28.	Total Pd	584.016 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	Iout1	500.0 m	Output Current #1
3.	SoftStart	0.05 ms	Soft Start Time (ms)
4.	VinMax	32.0	Maximum input voltage
5.	VinMin	18.0	Minimum input voltage
6.	Vout	3.3	Output Voltage
7.	Vout1	3.3	Output Voltage #1
8.	base_pn	LM25010	Texas Instruments Base Part Number
9.	source	DC	Input Source Type
10.	ta	30.0	Ambient temperature

Design Assistance

1. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'Optimal Solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple.

2. LM25010 Product Folder : http://www.ti.com/product/LM25010 : contains the data sheet and other resources.

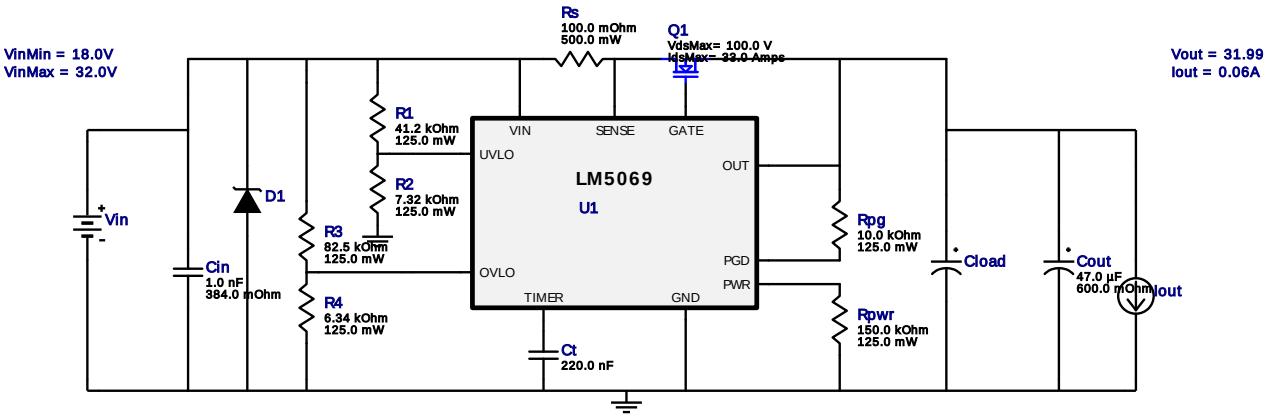
TEXAS INSTRUMENTS

WEBENCH® Design Report

VinMin = 18.0V
VinMax = 32.0V
Vout = 32.0V
Iout = 0.06A

Device = LM5069MM-2/NOPB
Topology = Hotswap
Created = 7/7/15 11:41:23 PM
BOM Cost = $2.72
Footprint = 292.0 mm²
BOM Count = 13
Total Pd = 0.04W

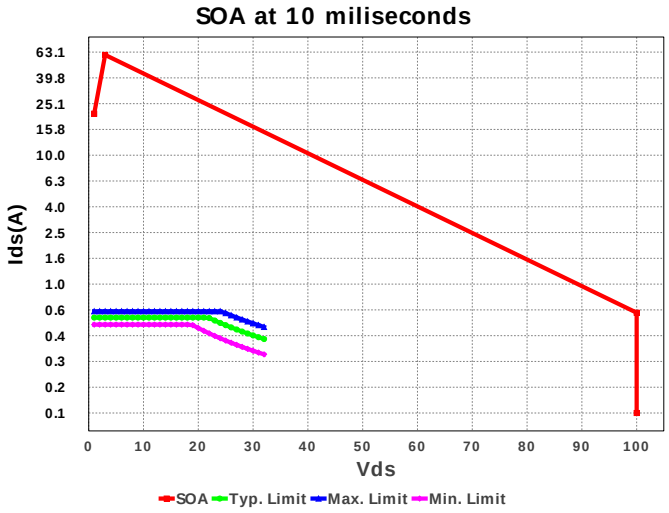
Design : 1836019/6 LM5069MM-2/NOPB
LM5069MM-2/NOPB 18.0V-32.0V to 31.99V @ 0.069813A



Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	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.	Cout	Chemi-Con	EMVY500ADA470MF80G Series= MVY	Cap= 47.0 uF ESR= 600.0 mOhm VDC= 50.0 V IRMS= 170.0 mA	1	$0.12	CAPSMT_62_F80 74 mm²
3.	Ct	MuRata	GRM155R71C224KA12D Series= X7R	Cap= 220.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
4.	D1	Diodes Inc.	SMBJ70A-13-F	Zener	1	$0.10	SMB 44 mm²
5.	Q1	International Rectifier	IRF540NLPBF	VdsMax= 100.0 V IdsMax= 33.0 Amps	1	$0.92	TO-262 85 mm²
6.	R1	Panasonic	ERJ-6ENF4122V Series= 225	Res= 41.2 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
7.	R2	Panasonic	ERJ-6ENF7321V Series= 225	Res= 7.32 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
8.	R3	Panasonic	ERJ-6ENF8252V Series= 225	Res= 82.5 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
9.	R4	Panasonic	ERJ-6ENF6341V Series= 225	Res= 6.34 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
10.	Rpg	Panasonic	ERJ-6ENF1002V Series= 225	Res= 10.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rpwr	Panasonic	ERJ-6ENF1503V Series= 225	Res= 150.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
12.	Rs	Rohm	MCR25JZHFLR100 Series= 298	Res= 100.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.03	1210 15 mm^2
13.	U1	Texas Instruments	LM5069MM-2/NOPB	Switcher	1	$1.47	MUB10A 24 mm^2



Operating Values

#	Name	Value	Category	Description
1.	Iin Avg	69.813 mA	Current	Calculated typical current limit
2.	BOM Count	13	General	Total Design BOM count
3.	FootPrint	292.0 mm^2	General	Total Foot Print Area of BOM components
4.	Pout	2.234 W	General	Total output power
5.	Total BOM	$2.72	General	Total BOM Cost
6.	Vout OP	31.993 V	Op_Point	Operational Output Voltage
7.	Efficiency	98.15 %	Op_point	Steady state efficiency
8.	IOUT_OP	69.813 mA	Op_point	Iout operating point
9.	Ilimit Max Act	615.0 mA	Op_point	Calculated maximum current limit
10.	Ilimit Min Act	485.0 mA	Op_point	Calculated minimum current limit
11.	Ilimit Typ Act	550.0 mA	Op_point	Calculated typical current limit
12.	Lower OVLO	33.299 V	Op_point	Lower OVLO (Overvoltage-Lockout) threshold
13.	Lower UVLO	16.571 V	Op_point	Lower UVLO (Undervoltage-Lockout) threshold
14.	Max FET Plim	14.88 W	Op_point	Resulting Max FET Power Limit
15.	Min FET Plim	9.12 W	Op_point	Resulting Min FET Power Limit
16.	T_insert	159.42 ms	Op_point	Typical Insertion Time
17.	T_start	2.068 s	Op_point	Typical Restart Time
18.	Typical FET Plim	12.0 W	Op_point	Resulting Typical FET Power Limit
19.	Upper OVLO	35.032 V	Op_point	Upper OVLO (Overvoltage-Lockout) threshold
20.	Upper UVLO	17.436 V	Op_point	Upper UVLO (Undervoltage-Lockout) threshold
21.	VIN_OP	32.0 V	Op_point	Vin operating point
22.	IC Pd	42.11 mW	Power	IC power dissipation
23.	M1 Pd	22.803 µW	Power	FET Power Dissipation
24.	Total Pd	42.11 mW	Power	Total Power Dissipation
25.	Fault time	7.553 ms	Unknown	Fault Time

Design Inputs

#	Name	Value	Description
1.	Iout	55.85 m	Maximum Output Current
2.	OVLO	0.0	OVLO nominal
3.	UVLO	0.0	UVLO nominal
4.	VinMax	32.0	Maximum input voltage
5.	VinMin	18.0	Minimum input voltage
6.	base_pn	LM5069	Texas Instruments Base Part Number
7.	currentLimit	69.813 m	Current limit
8.	outputLoadCapacitance	4.8	Output Load capacitance
9.	source	DC	Input Source Type

#	Name	Value	Description
10.	ta	30.0	Ambient temperature

Design Assistance

1. The LM5069 Webench Designer provides the design engineer with a fully functional HotSwap schematic for the positive voltage system.The created design calculates a complete BOM and the total cost of the BOM. Also, the Webench designer offers simulation to emulate the behavior of the device such as Power Sequence, Restart Sequence and Input Transients. To learn more about HotSwap devices and its applications, please refer to the following link: http://www.ti.com/analog/docs/analogtechdoc_hh.tsp?viewType=mostuseful&techDoc=1&rootFamilyId=64&familyId=420&docCategoryId=1&Input3=Go

2. LM5069 Product Folder : http://www.ti.com/product/lm5069 : contains the data sheet and other resources.