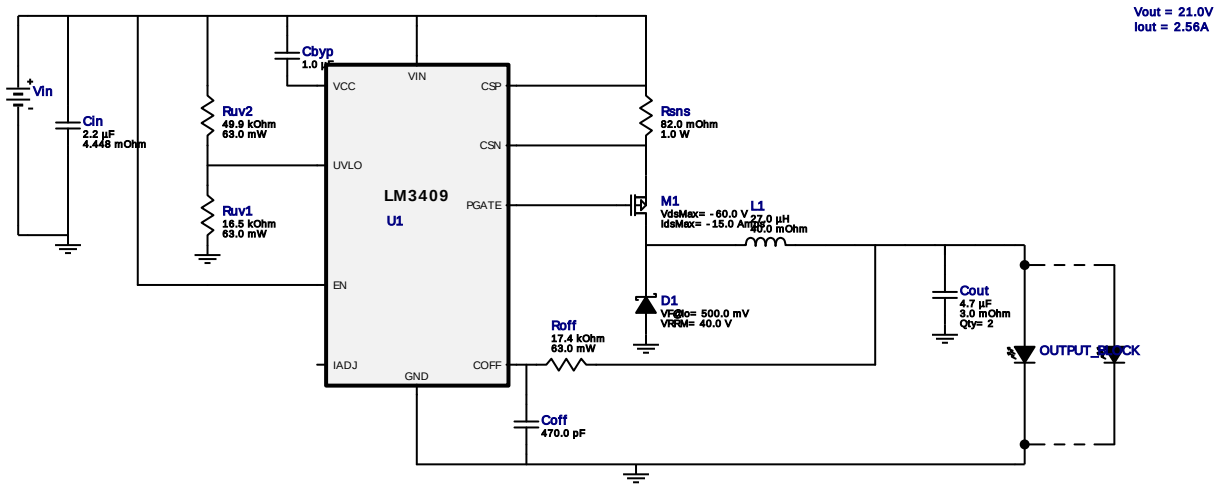
WEBENCH® Design Report

VinMin = 24.0V
VinMax = 32.0V
Vout = 21.0V
Iout = 2.56A

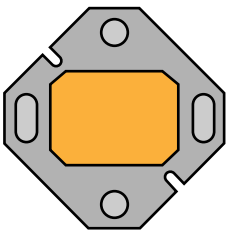
Device = LM3409MY/NOPB
Topology = Buck
Created = 7/19/16 6:48:02 AM
BOM Cost = $123.11
BOM Count = 21
Total Pd = 2.87W

Design : 1194016/2120 LM3409MY/NOPB
LM3409MY/NOPB 24.0V-32.0V to 21.00V @ 2.56A

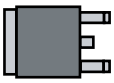


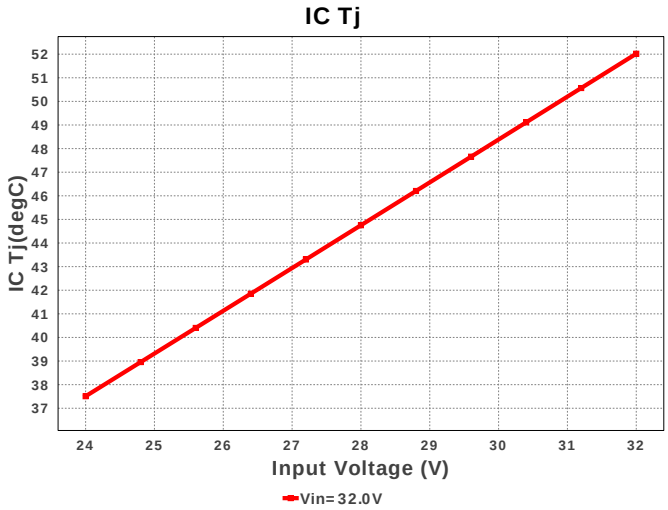
1. Bypass Capacitor Connection : WEBENCH schematic configured for the selected PFET's total gate charge (Qg). If the Qg value is > 30 nC, the Bypass Capacitor(Cbyp or CF) is connected from the VCC pin to CSN pin instead of the typically connected from VCC to Vin when Qg < 30nC.

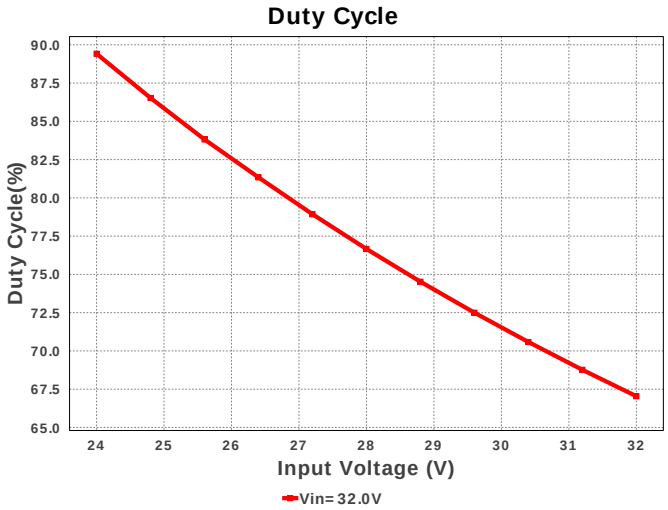
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbyp	Taiyo Yuden	EMK212B7105KG-T Series= X7R	Cap= 1.0 uF VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
2.	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 mm²
3.	Coff	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cout	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	2	$0.07	1206 11 mm²
5.	D1	Diodes Inc.	B240A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.09	SMA 37 mm²
6.	D_LED	SHARP Electronics	GW5BWF15L00	LED	8	$15.15	 gw5b 400 mm²

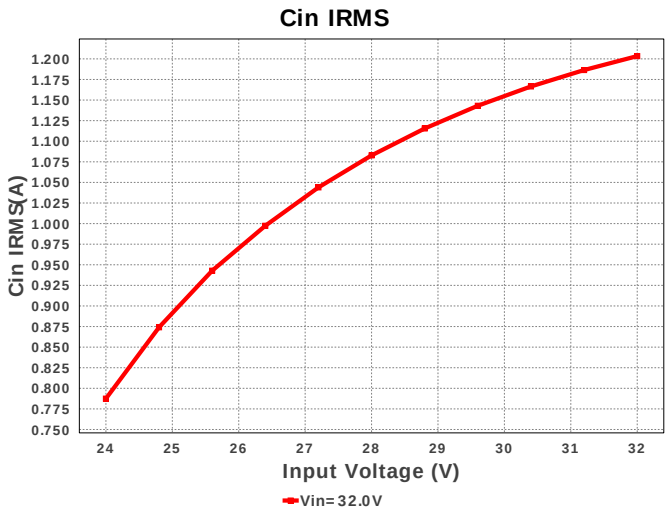
Copyright © 2016, Texas Instruments Incorporated

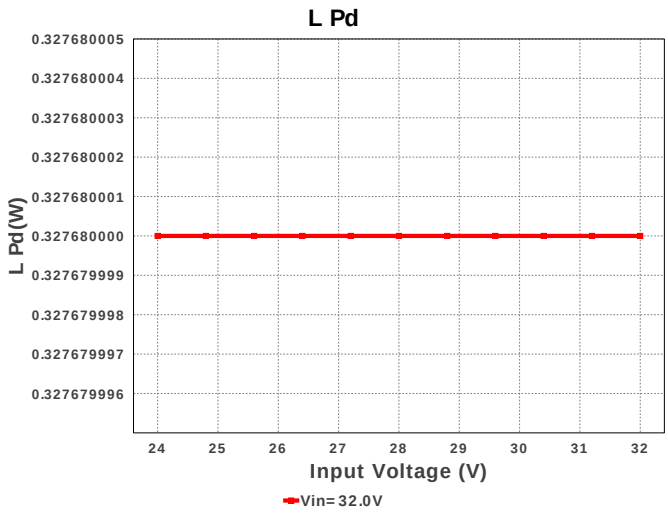
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	L1	Bourns	SRR1210-270M	L= 27.0 µH DCR= 40.0 mOhm	1	$0.44	 SRR1210 196 mm^2
8.	M1	Fairchild Semiconductor	FDD5614P	VdsMax= -60.0 V IdsMax= -15.0 Amps	1	$0.24	 DPAK 102 mm^2
9.	Roff	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
10.	Rsns	Bourns	CRM2010-FZ-R082ELF Series= ?	Res= 82.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.19	 2010 32 mm^2
11.	Ruv1	Vishay-Dale	CRCW040216K5FKED Series= CRCW..e3	Res= 16.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
12.	Ruv2	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
13.	U1	Texas Instruments	LM3409MY/NOPB	Switcher	1	$0.70	 MUC10A 24 mm^2

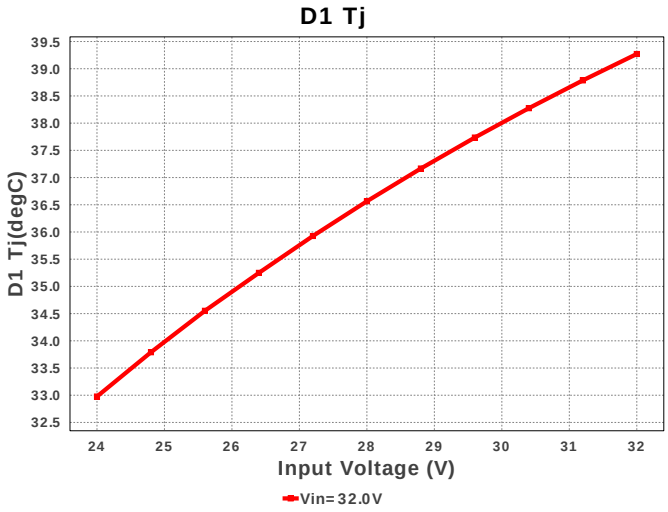


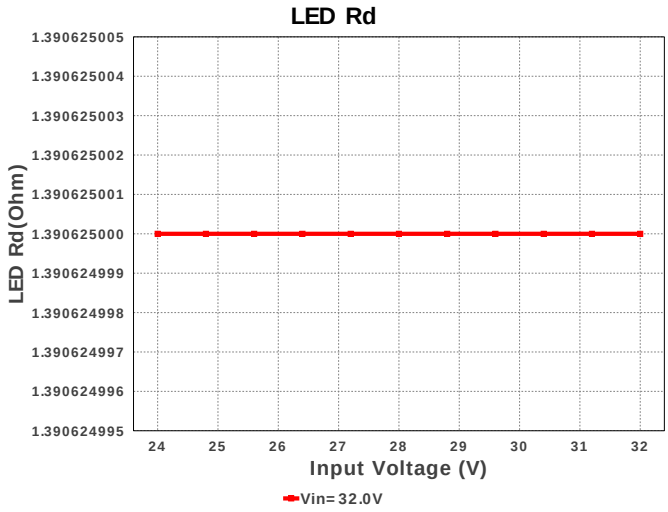


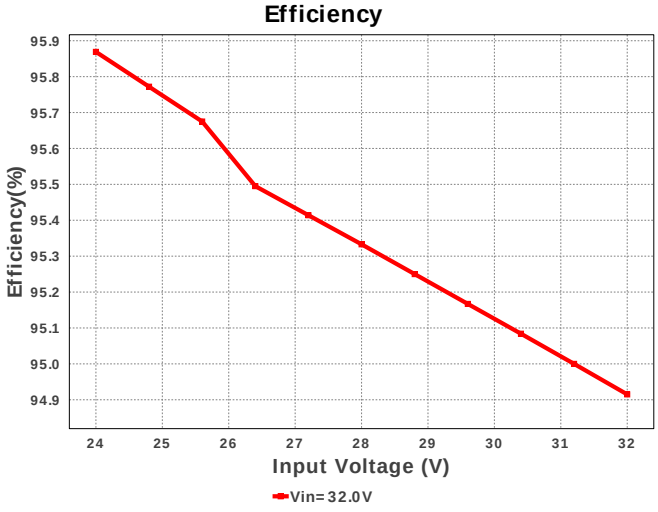
Copyright © 2016, Texas Instruments Incorporated

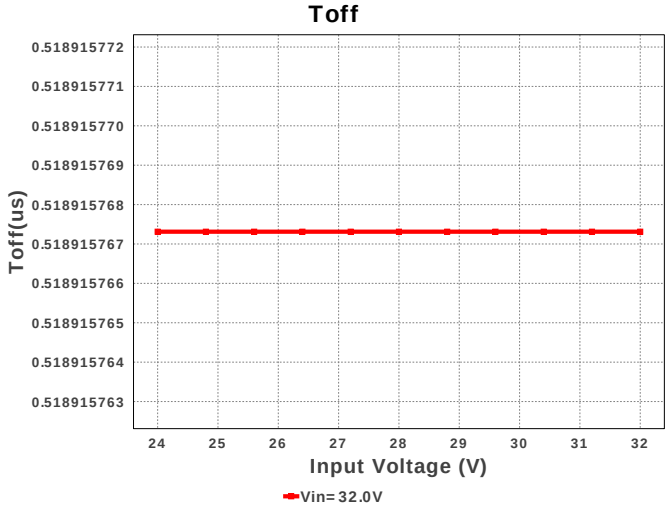




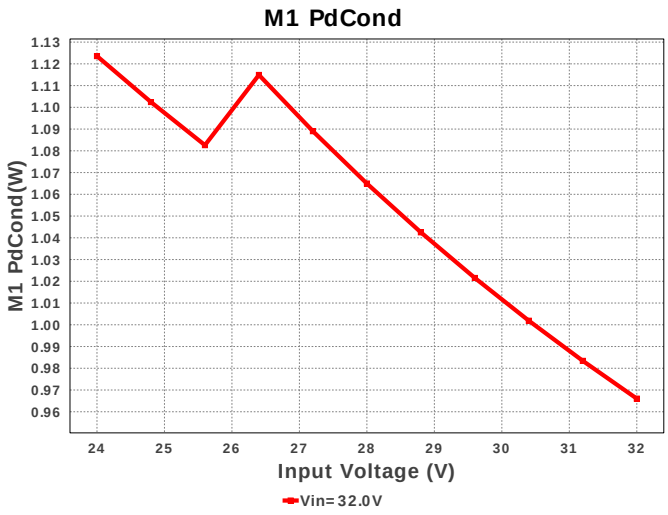


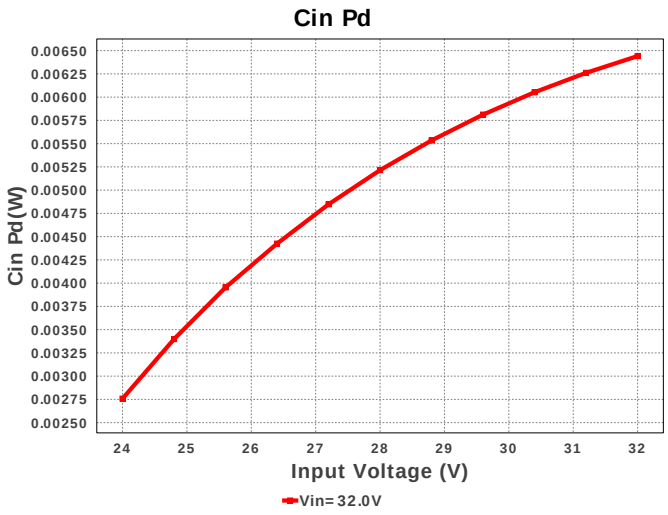


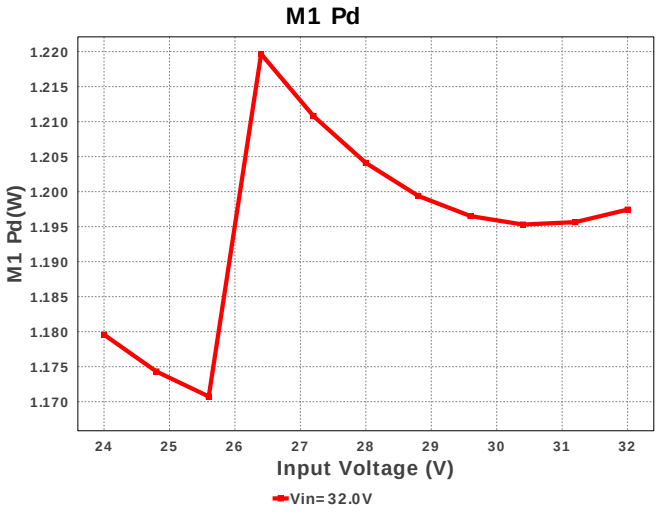


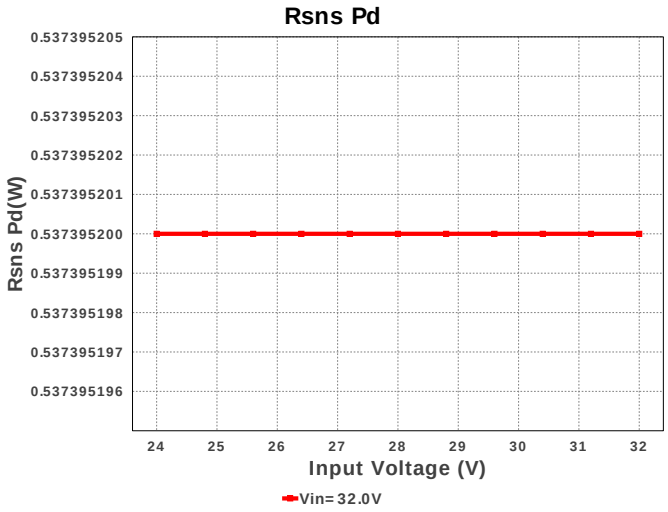


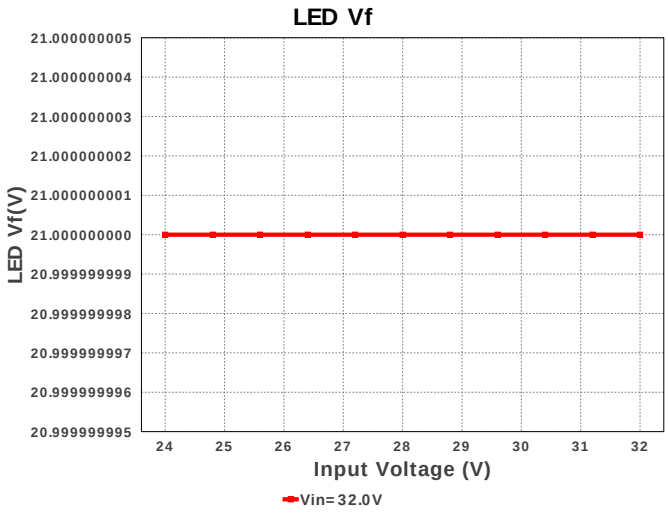
Copyright © 2016, Texas Instruments Incorporated

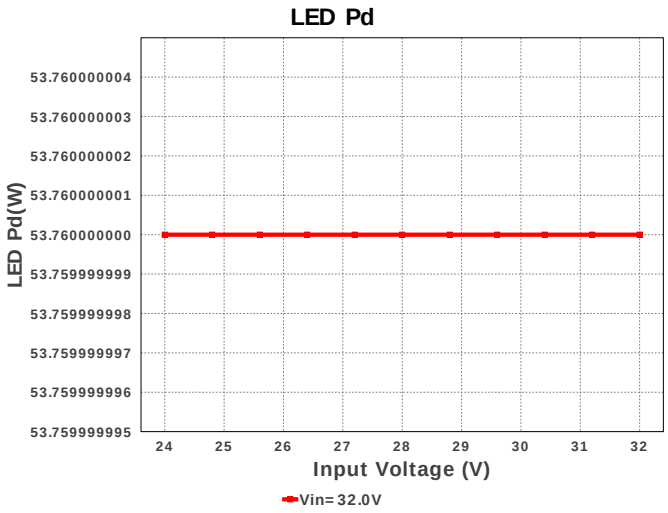




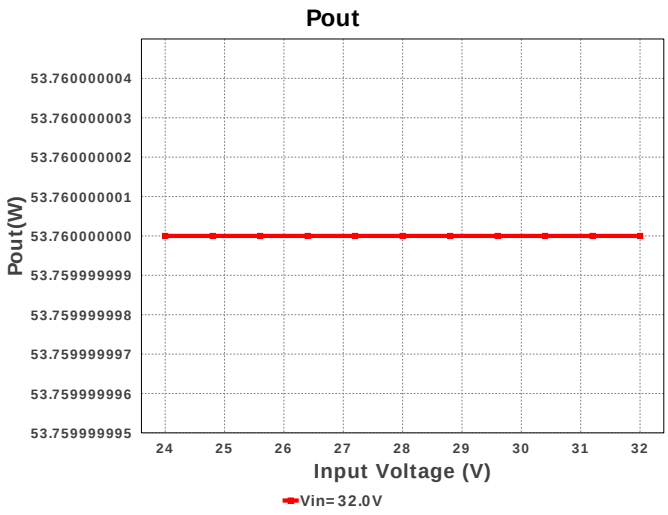


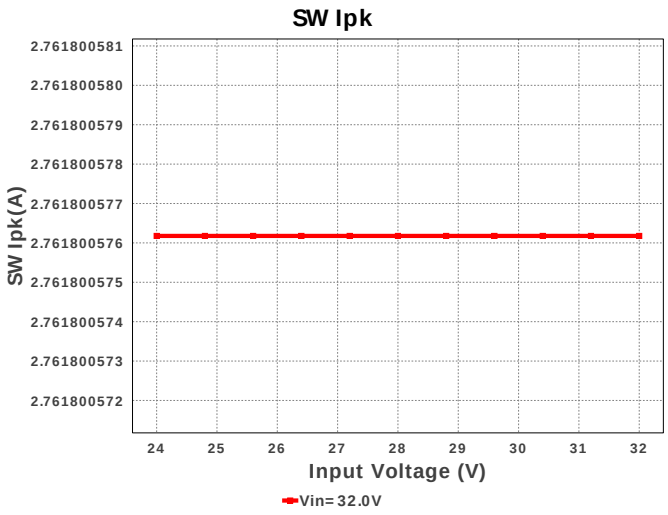


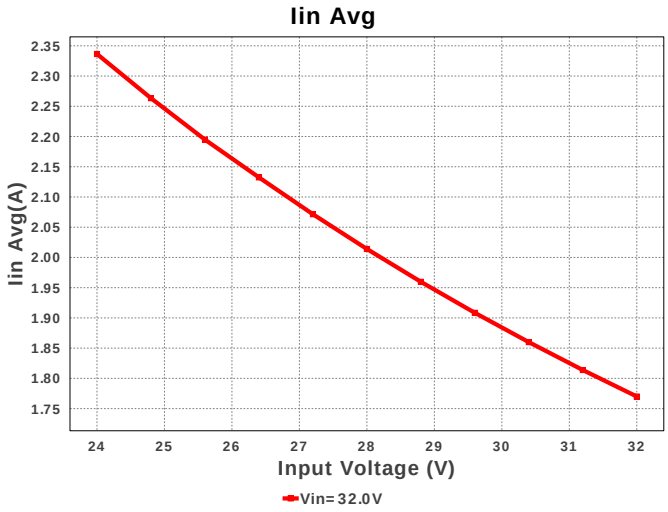


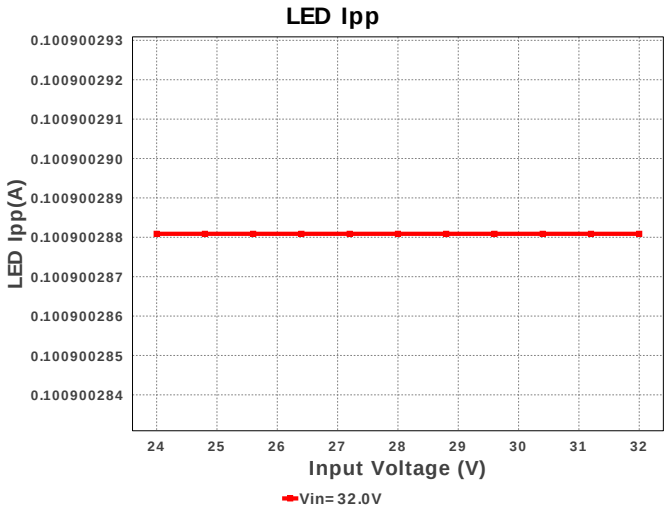


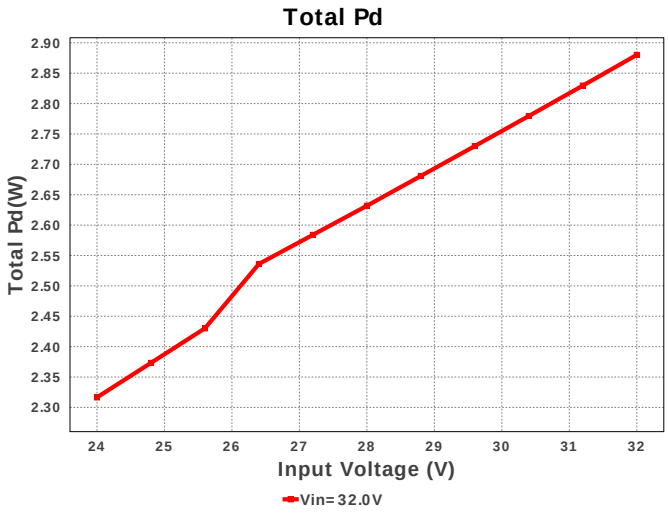
Copyright © 2016, Texas Instruments Incorporated

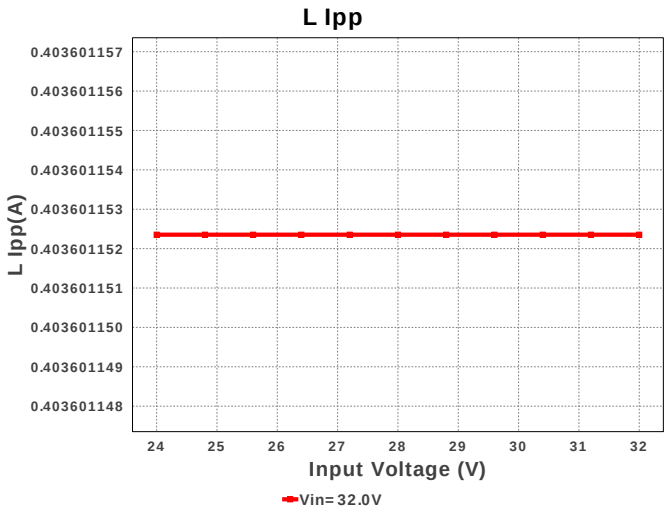




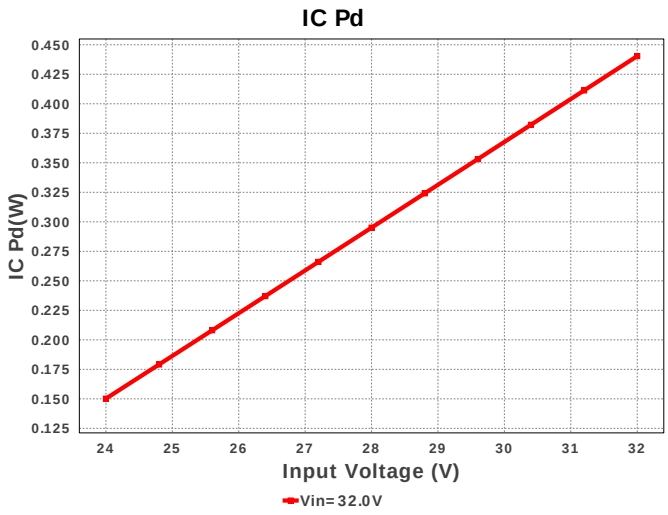


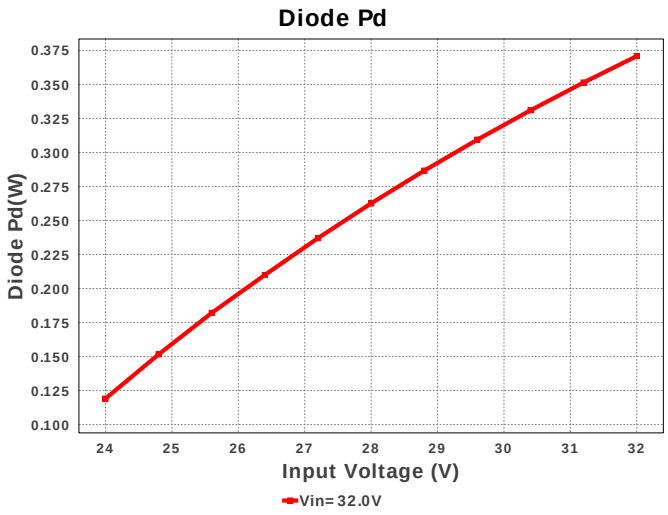


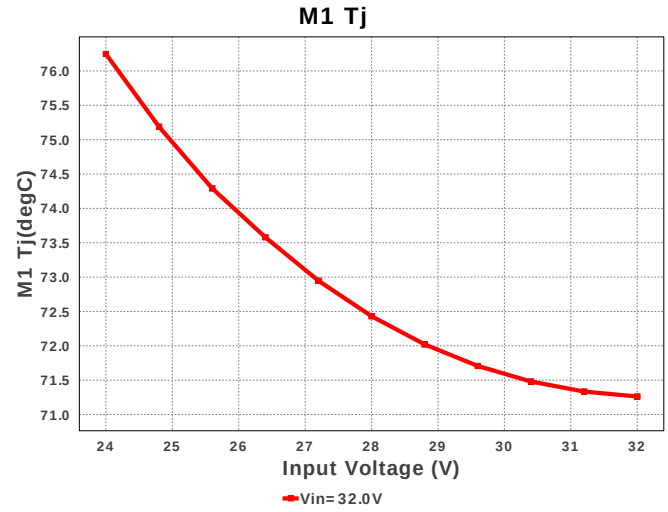


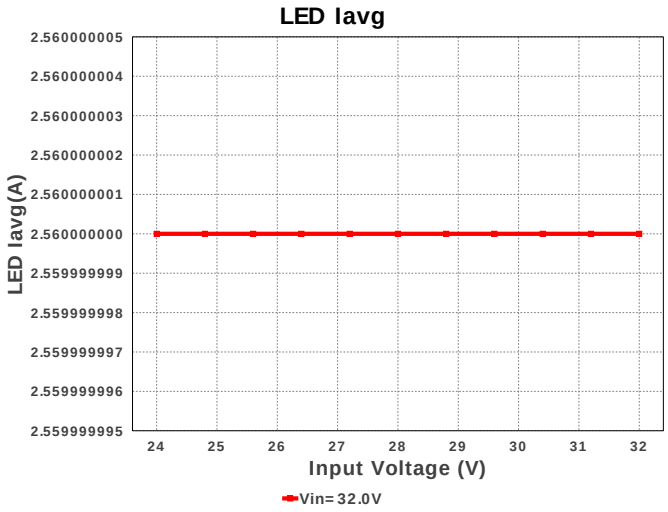


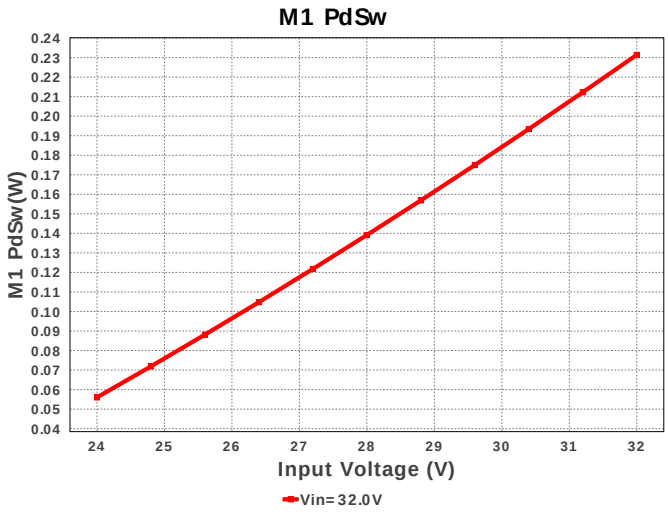
Copyright © 2016, Texas Instruments Incorporated











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.203 A	Current	Input capacitor RMS ripple current
2.	Iin Avg	1.77 A	Current	Average input current
3.	L Ipp	403.6 mA	Current	Peak-to-peak inductor ripple current
4.	LED Iavg	2.56 A	Current	LED Average Current
5.	LED Ipp	10.792 mA	Current	LED Ripple Current
6.	SW Ipk	2.762 A	Current	Peak switch current
7.	BOM Count	21	General	Total Design BOM count
8.	FootPrint	3.645 k mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	644.831 kHz	General	Switching frequency
10.	IC Tolerance	54.0 mV	General	IC Feedback Tolerance
11.	Pout	53.76 W	General	Total output power

Copyright © 2016, Texas Instruments Incorporated

#	Name	Value	Category	Description
12.	Toff	518.916 mus	General	Fixed Off Time
13.	Total BOM	$123.11	General	Total BOM Cost
14.	D1 Tj	39.271 degC	Op_Point	D1 junction temperature
15.	Vout OP	21.0 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	67.04 %	Op_point	Duty cycle
17.	Efficiency	94.929 %	Op_point	Steady state efficiency
18.	IC Tj	51.771 degC	Op_point	IC junction temperature
19.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	2.56 A	Op_point	Iout operating point
21.	LED Rd	1.391 Ohm	Op_point	LED DynamicResistance
22.	LED Vf	21.0 V	Op_point	Total LED Forward Calculated Voltage
23.	M1 Tj	71.104 degC	Op_point	MOSFET junction temperature
24.	M1 Tj	71.104 degC	Op_point	MOSFET junction temperature
25.	VIN_OP	32.0 V	Op_point	Vin operating point
26.	Cin Pd	6.441 mW	Power	Input capacitor power dissipation
27.	Diode Pd	370.843 mW	Power	Diode power dissipation
28.	IC Pd	435.423 mW	Power	IC power dissipation
29.	L Pd	327.68 mW	Power	Inductor power dissipation
30.	LED Pd	53.76 W	Power	LED Power Dissipation
31.	M1 Pd	1.194 W	Power	M1 MOSFET total power dissipation
32.	M1 PdCond	965.669 mW	Power	M1 MOSFET conduction losses
33.	M1 PdSw	228.221 mW	Power	M1 MOSFET switching losses
34.	Rsns Pd	537.395 mW	Power	LED Power Dissipation
35.	Total Pd	2.872 W	Power	Total Power Dissipation
36.	Vout Tolerance	257.143 m%		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.56	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	24.0	Minimum input voltage
4.	Vout	21.0	Output Voltage
5.	application	LED_DRIVER	LED Application
6.	base_pn	LM3409	Base Product Number
7.	LED_Architect	N	LED Architect Project
8.	ledparallel	4.0	Number of LED in parallel
9.	ledpartnumber	GW5BWF15L00	LED Part number
10.	ledseries	2.0	Number of LED in series
11.	line_fsw	60.0	AC Line Frequency
12.	source	DC	Input Source Type
13.	Ta	30.0	Ambient temperature

Design Assistance

1. Application Hints Bypass Capacitor Connection WEBENCH schematic configured for the selected PFET's total gate charge (Qg)If the Qg value is > 30 nC, the Bypass Capacitor(Cbyp or CF) is connected from the VCC pin to CSN pin instead of typically connected from VCC to Vin when Qg < 30nC. Please see the datasheet for further design guidance. http://www.ti.com/lit/ds/symlink/LM3409HV.pdf

2. **LM3409** Product Folder : http://www.ti.com/product/LM3409 : contains the data sheet and other resources.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.

Use of Texas Instruments' WEBENCH simulation tools is subject to Texas Instruments' Site Terms and Conditions of Use. Prototype boards based on WEBENCH created designs are provided AS IS without warranty of any kind for evaluation and testing purposes and are subject to the terms of the Evaluation License Agreement.