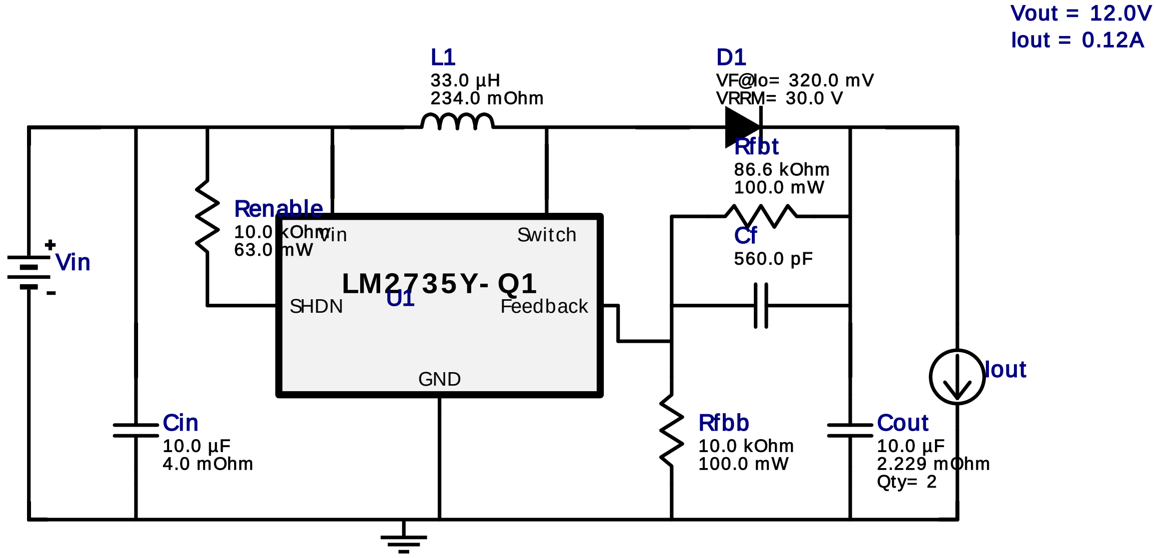
![Texas Instruments]

WEBENCH® Design Report

VinMin = 3.3V
VinMax = 3.7V
Vout = 12.0V
Iout = 0.12A

Device = LM2735YQMF/NOPB
Topology = Boost
Created = 2020-10-19 22:12:54.466
BOM Cost = $2.38
BOM Count = 10
Total Pd = 0.14W

Design : 39 LM2735YQMF/NOPB
LM2735YQMF/NOPB 3.3V-3.7V to 12.00V @ 0.12A



1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.View WEBENCH(R) Disclaimer.

Design Alerts

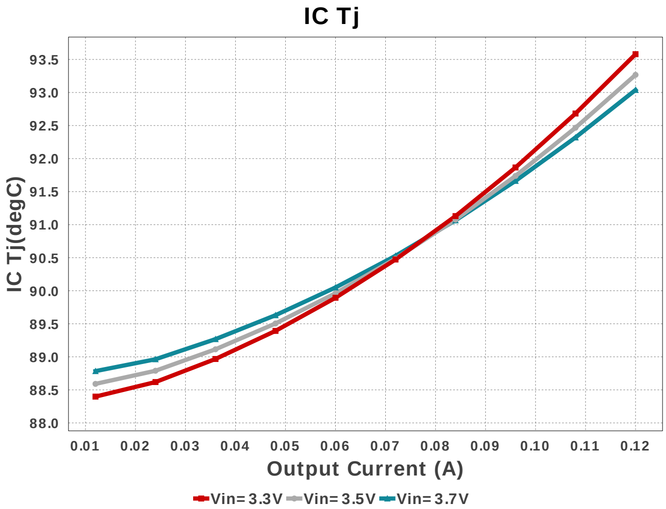
Component Selection Information

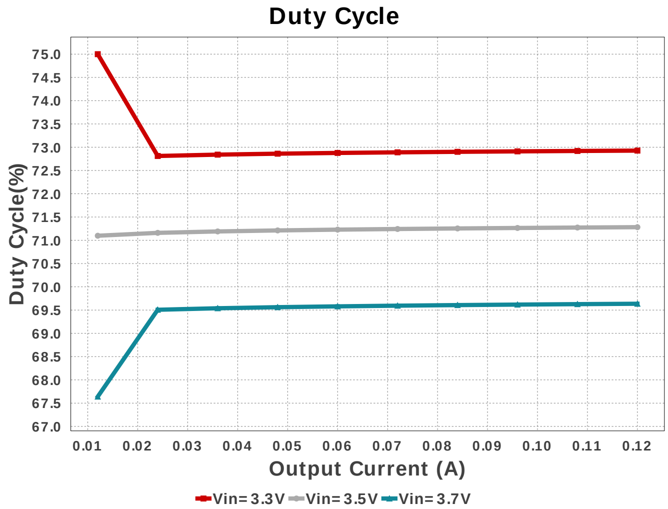
The LM2735Y-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

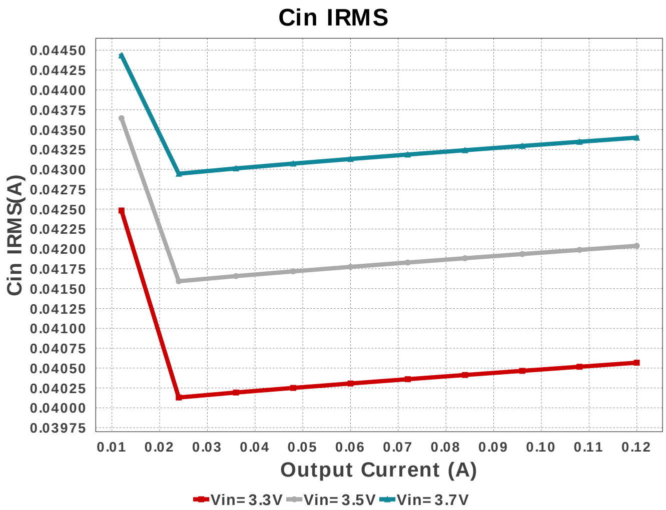
Electrical BOM

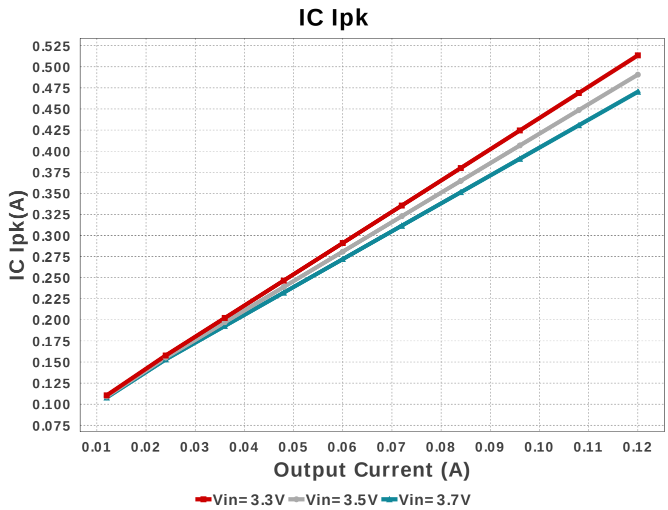
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cf	MuRata	GRM1555C1H561JA01J Series= C0G/NP0	Cap= 560.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	MuRata	GRM31CR71E106KA12L Series= X7R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 6.0 A	1	$0.22	1206_180 11 mm²
Cout	TDK	C3216X7R1V106K160AC Series= X7R	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	2	$0.19	1206_180 11 mm²
D1	Toshiba	CMS06	VF@Io= 320.0 mV VRRM= 30.0 V	1	$0.19	M-FLAT 19 mm²
L1	Coilcraft	LPS6225-333MRB	L= 33.0 µH 234.0 mOhm	1	$0.61	LPS6225 64 mm²
Renable	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Susumu Co Ltd	RG1608P-103-B-T5 Series= RG1608	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.04	0603 5 mm²

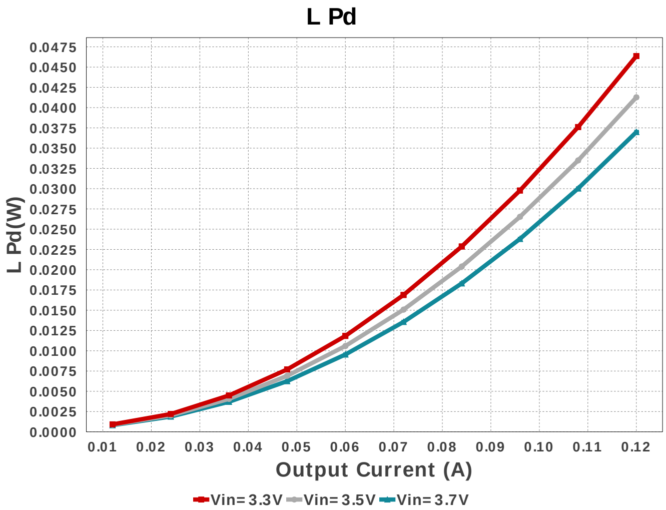
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Susumu Co Ltd	RG1608P-8662-B-T5 Series= RG1608	Res= 86.6 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	0603 5 mm^2
U1	Texas Instruments	LM2735YQMF/NOPB	Switcher	1	$0.86	MF05A 15 mm^2

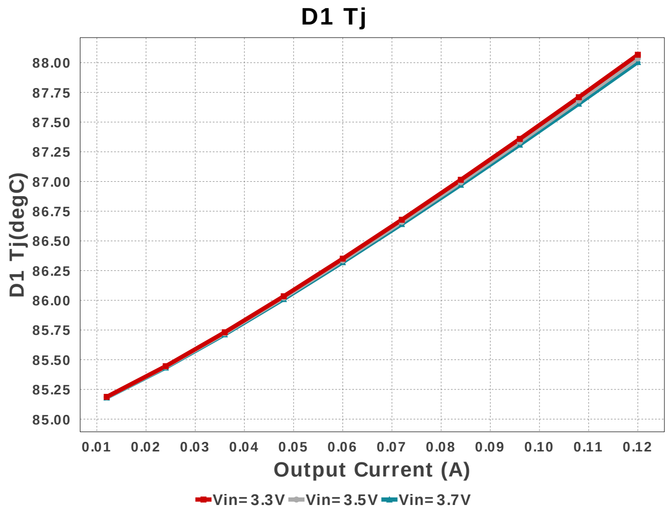


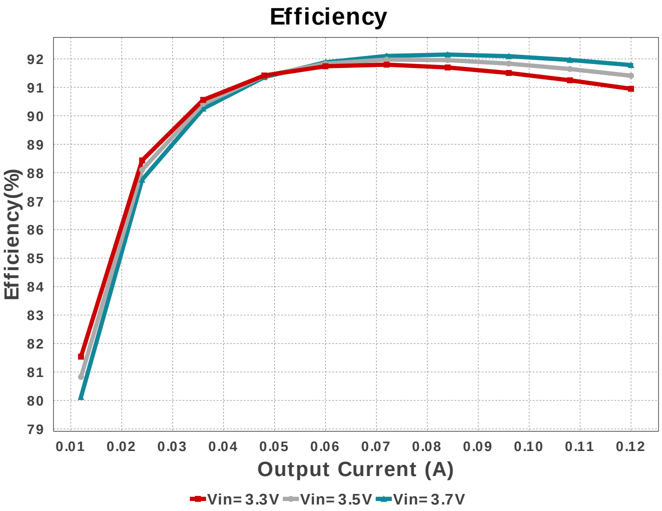


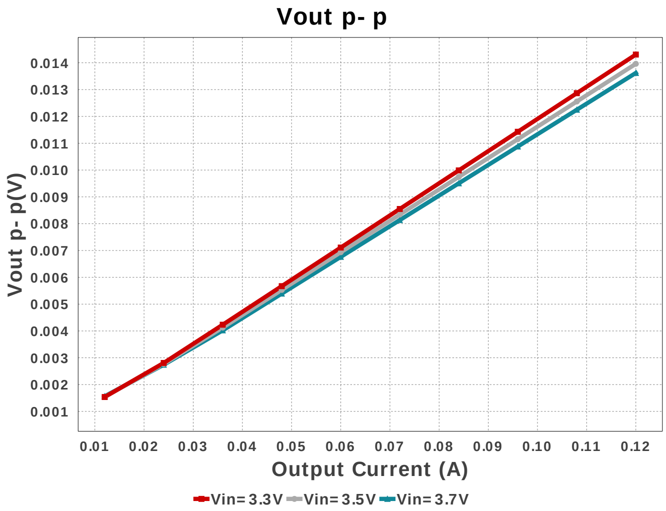


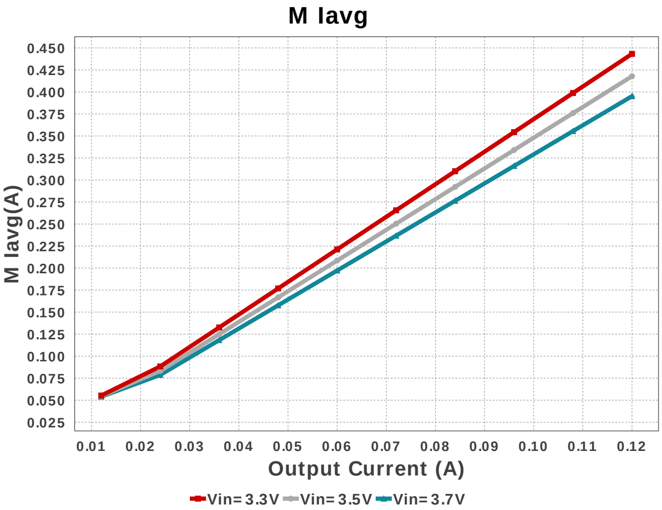


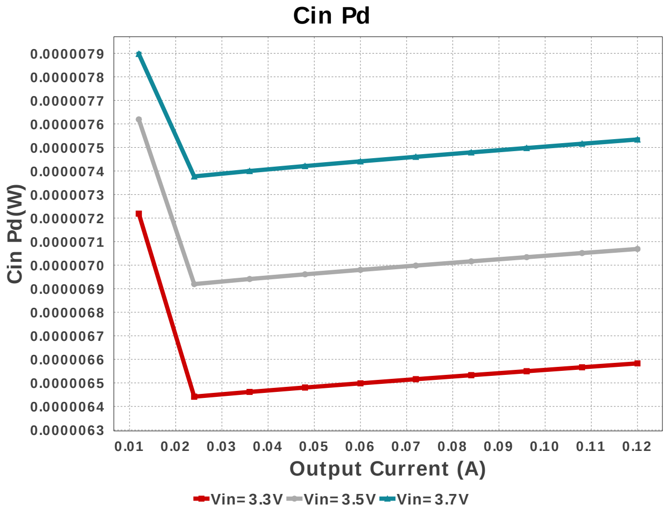


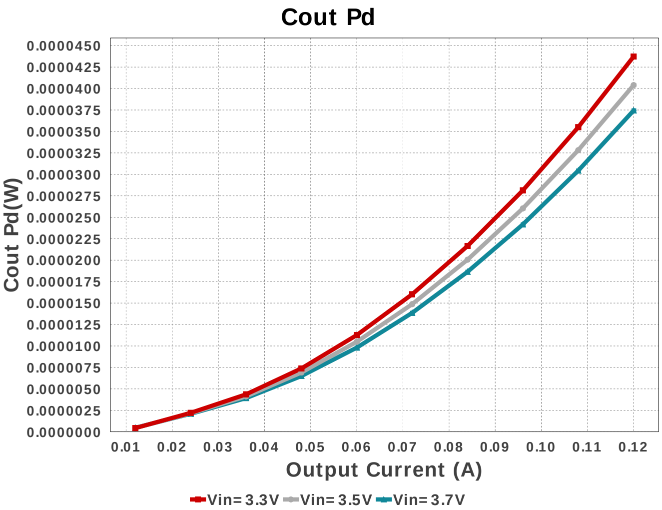


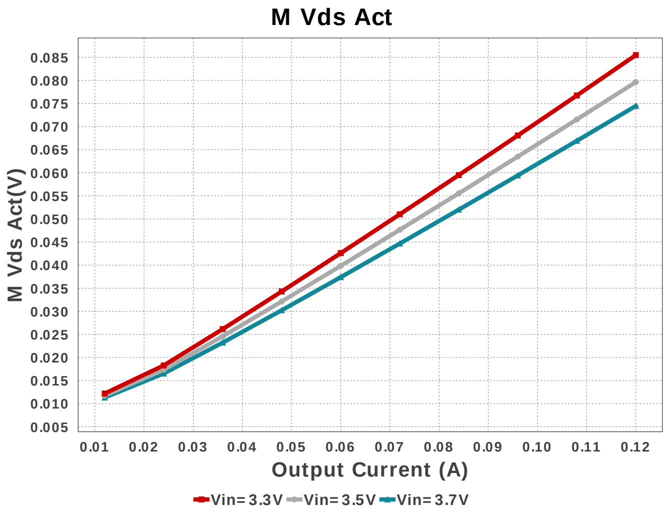

Efficiency
Efficiency(%)
Output Current (A)
Vin= 3.3V Vin= 3.5V Vin= 3.7V

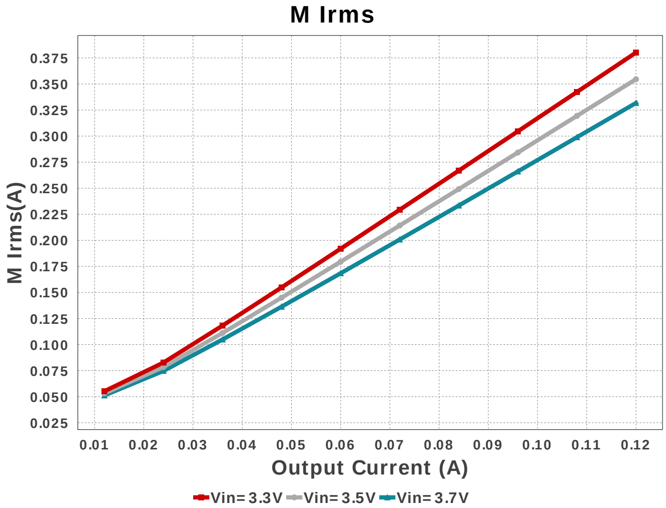

Vout p- p
Vout p- p(V)
Output Current (A)
Vin= 3.3V Vin= 3.5V Vin= 3.7V

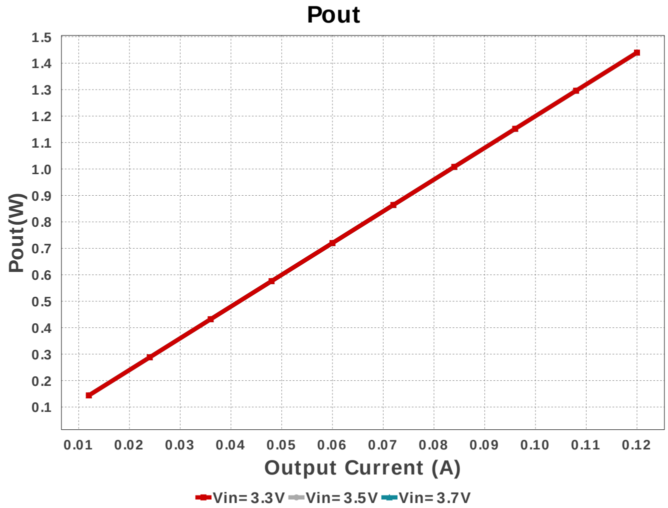

M Iavg
M Iavg(A)
Output Current (A)
Vin= 3.3V Vin= 3.5V Vin= 3.7V

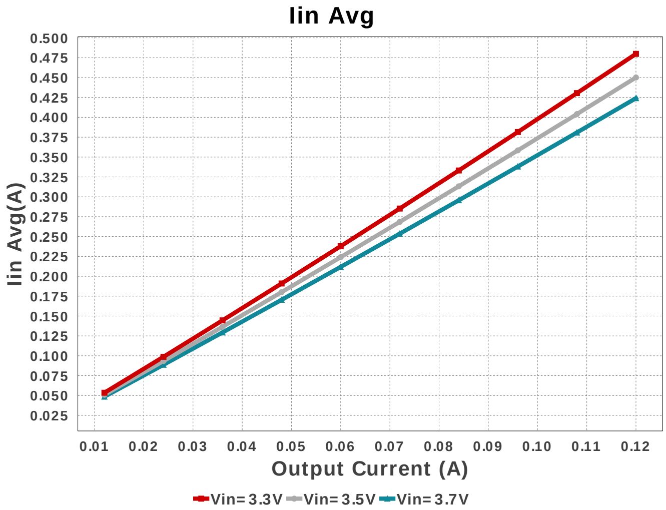

Cin Pd
Cin Pd(W)
Output Current (A)
Vin= 3.3V Vin= 3.5V Vin= 3.7V

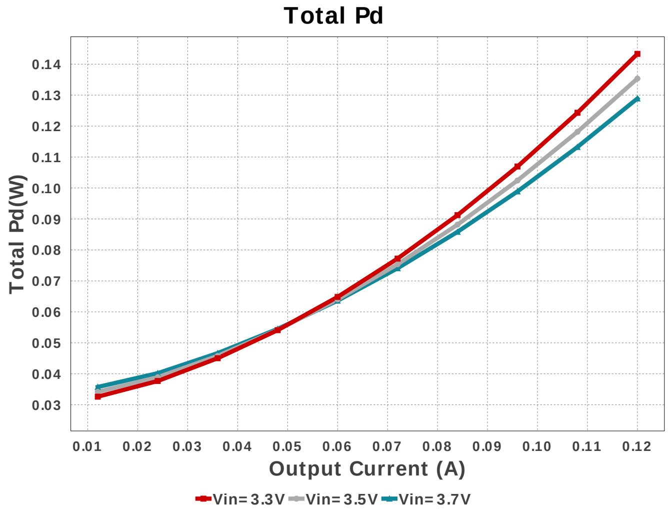

Cout Pd
Cout Pd(W)
Output Current (A)
Vin= 3.3V Vin= 3.5V Vin= 3.7V

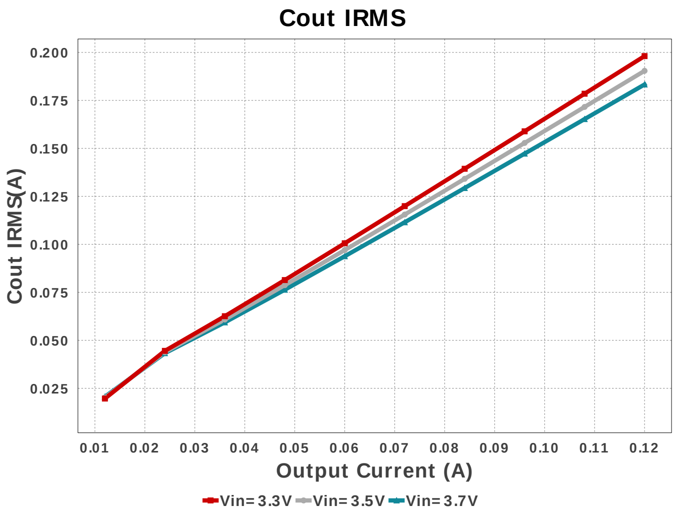

M Vds Act
M Vds Act(V)
Output Current (A)
Vin= 3.3V Vin= 3.5V Vin= 3.7V

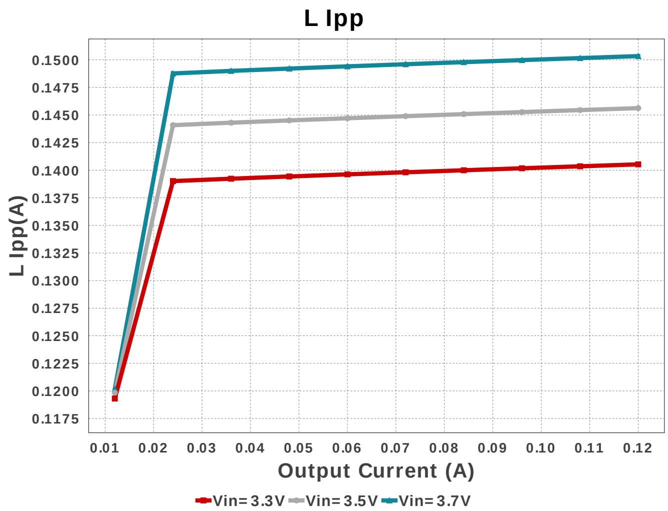

M Irms
M Irms(A)
Output Current (A)
Vin=3.3V
Vin=3.5V
Vin=3.7V

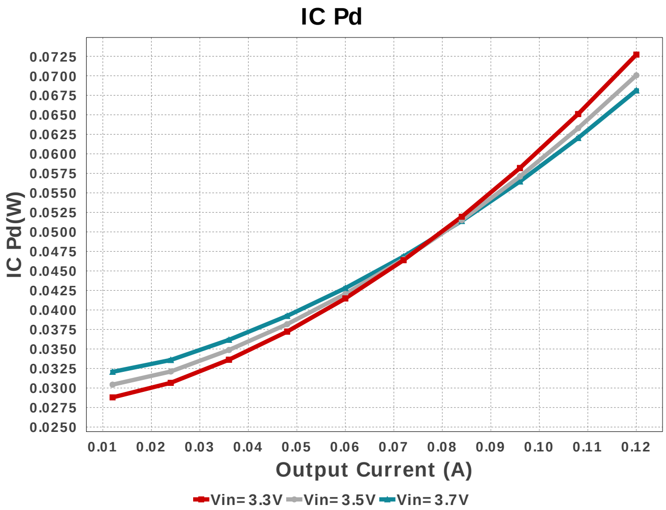

Pout
Pout(W)
Output Current (A)
Vin=3.3V
Vin=3.5V
Vin=3.7V

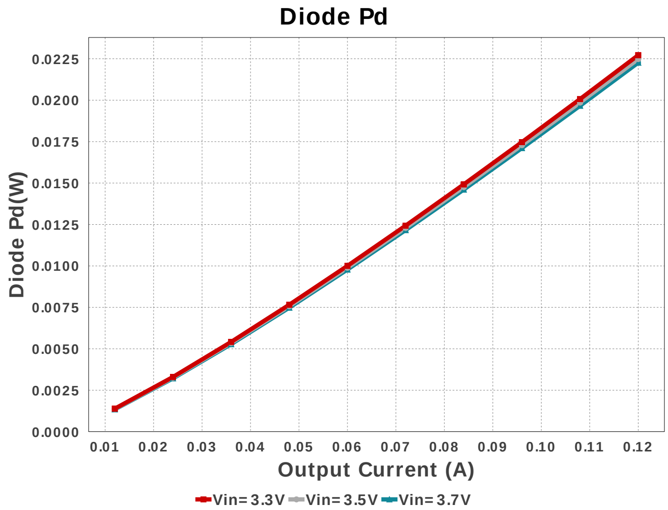

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.3V
Vin=3.5V
Vin=3.7V

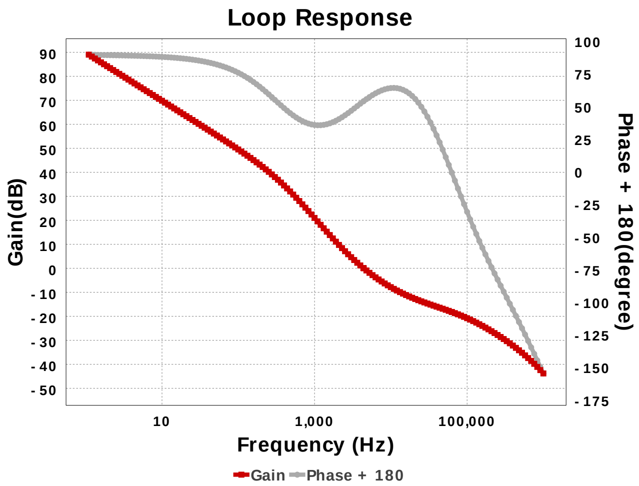

Total Pd
Total Pd(W)
Output Current (A)
Vin=3.3V
Vin=3.5V
Vin=3.7V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=3.3V
Vin=3.5V
Vin=3.7V


L Ipp
L Ipp(A)
Output Current (A)
Vin=3.3V
Vin=3.5V
Vin=3.7V







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	10		Total Design BOM count
2.	Total BOM	$2.377		Total BOM Cost
3.	Cin IRMS	40.567 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	6.583 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	198.079 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	43.728 µW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	88.067 degC	Diode	D1 junction temperature
8.	Diode Pd	22.716 mW	Diode	Diode power dissipation
9.	IC Ipk	513.512 mA	IC	Peak switch current in IC
10.	IC Pd	72.711 mW	IC	IC power dissipation
11.	IC Tj	93.58 degC	IC	IC junction temperature
12.	IC Tolerance	25.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA	118.0 degC/W	IC	IC junction-to-ambient thermal resistance
14.	Iin Avg	479.8 mA	IC	Average input current
15.	L Ipp	140.529 mA	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	46.359 mW	Inductor	Inductor power dissipation
17.	M Iavg	443.247 mA	Mosfet	MOSFET Average current
18.	M Irms	380.104 mA	Mosfet	MOSFET RMS ripple current
19.	M Vds Act	85.472 mV	Mosfet	Voltage drop across the MosFET
20.	Cin Pd	6.583 µW	Power	Input capacitor power dissipation
21.	Cout Pd	43.728 µW	Power	Output capacitor power dissipation
22.	Diode Pd	22.716 mW	Power	Diode power dissipation
23.	IC Pd	72.711 mW	Power	IC power dissipation
24.	L Pd	46.359 mW	Power	Inductor power dissipation
25.	Total Pd	143.324 mW	Power	Total Power Dissipation
26.	Cross Freq	4.063 kHz	System Information	Bode plot crossover frequency
27.	Duty Cycle	72.927 %	System Information	Duty cycle
28.	Efficiency	90.948 %	System Information	Steady state efficiency

#	Name	Value	Category	Description
29.	FootPrint	147.0 mm^2	System Information	Total Foot Print Area of BOM components
30.	Frequency	525.0 kHz	System Information	Switching frequency
31.	Gain Marg	-17.318 dB	System Information	Bode Plot Gain Margin
32.	Iout	120.0 mA	System Information	Iout operating point
33.	Low Freq Gain	88.554 dB	System Information	Gain at 1Hz
34.	Mode	CCM	System Information	Conduction Mode
35.	Phase Marg	51.595 deg	System Information	Bode Plot Phase Margin
36.	Pout	1.44 W	System Information	Total output power
37.	Vin	3.3 V	System Information	Vin operating point
38.	Vout	12.0 V	System Information	Operational Output Voltage
39.	Vout Actual	12.123 V	System Information	Vout Actual calculated based on selected voltage divider resistors
40.	Vout Tolerance	2.175 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
41.	Vout p-p	14.307 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	120.0 m	Maximum Output Current
VinMax	3.7	Maximum input voltage
VinMin	3.3	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	LM2735Y-Q1	Base Product Number
source	DC	Input Source Type
Ta	85.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

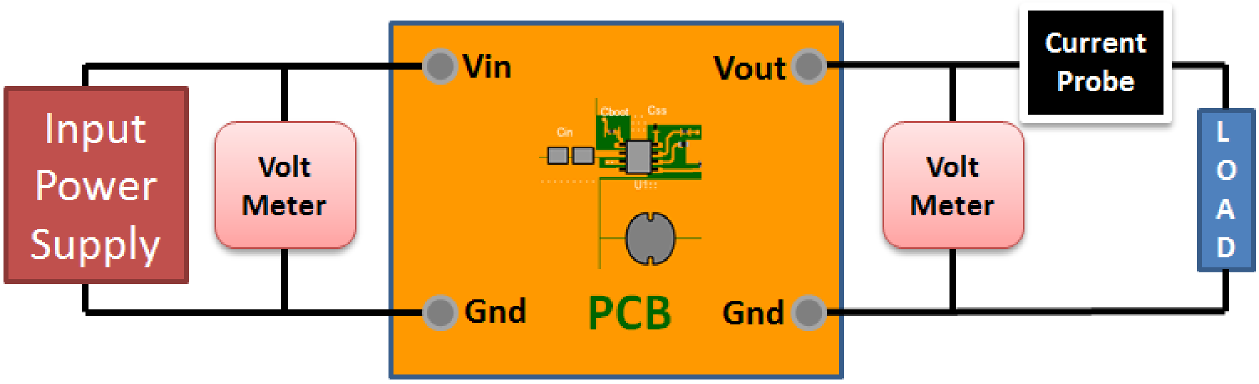
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 3.3V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

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2. Master key : 202DDE02F07E0483[v1]

3. **LM2735Y-Q1** Product Folder : http://www.ti.com/product/lm2735%2DQ1 : contains the data sheet and other resources.