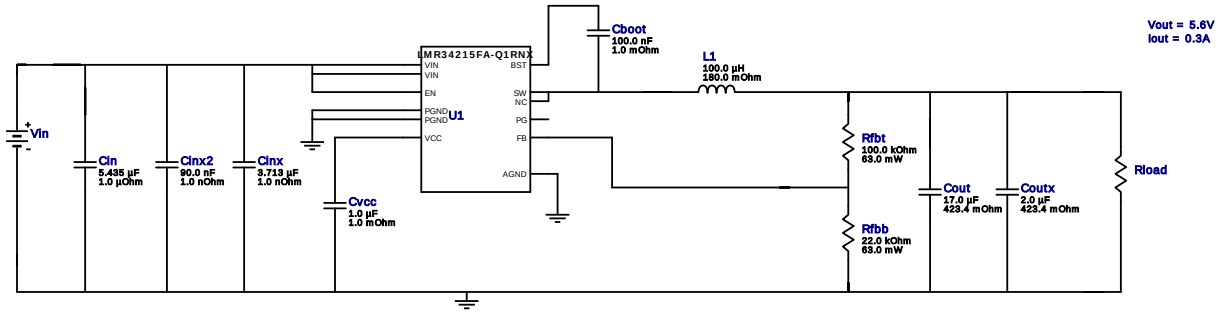
VinMin = 11.76V
VinMax = 12.24V
Vout = 5.6V
Iout = 0.3A

Device = LMR34215FAQRNXRQ1
Topology = Buck
Created = 2024-01-23 04:23:53.682
BOM Cost = NA
BOM Count = 11
Total Pd = 0.11W

WEBENCH® Design Report

Design : 38 LMR34215FAQRNXRQ1
LMR34215FAQRNXRQ1 11.4V-12.6V to 5.00V @ 0.3A



Design Alerts

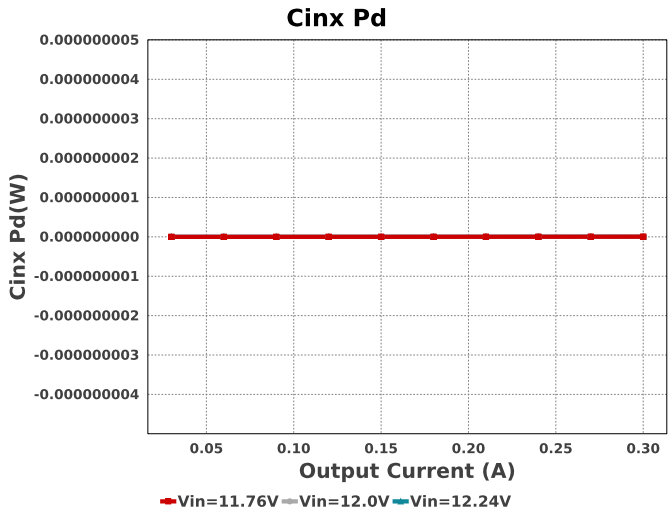
Component Selection Information
The LMR34215FA-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

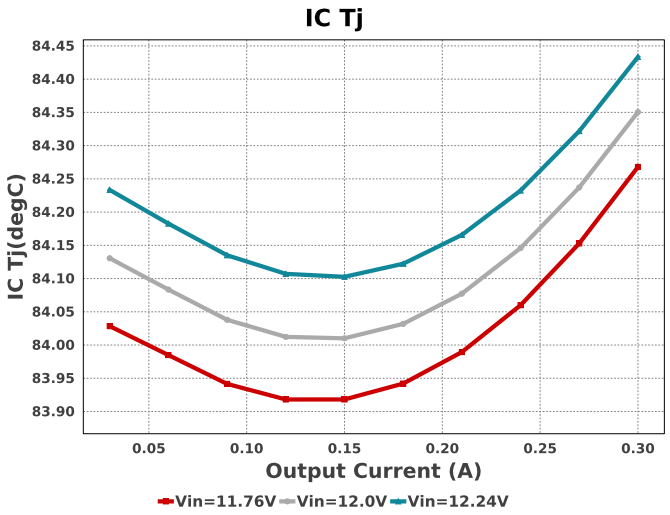
Phase margin is too low
Phase margin: 22.34deg < Specification 35.0deg
This may lead to unstable design. Please click 'APPLY' to auto-recompensate or change your design.

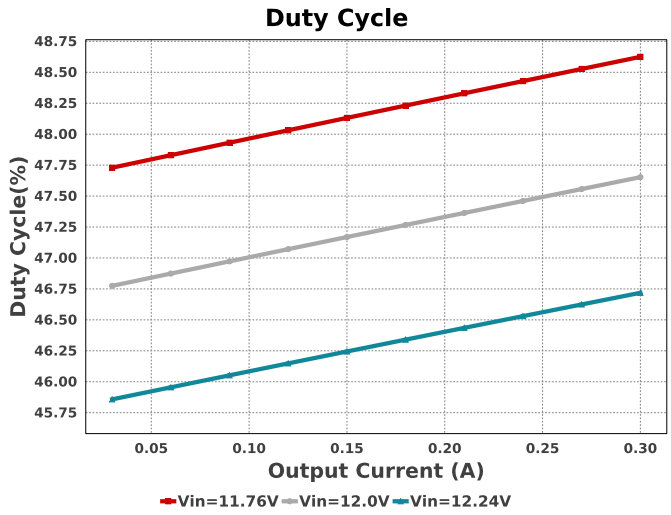
Electrical BOM

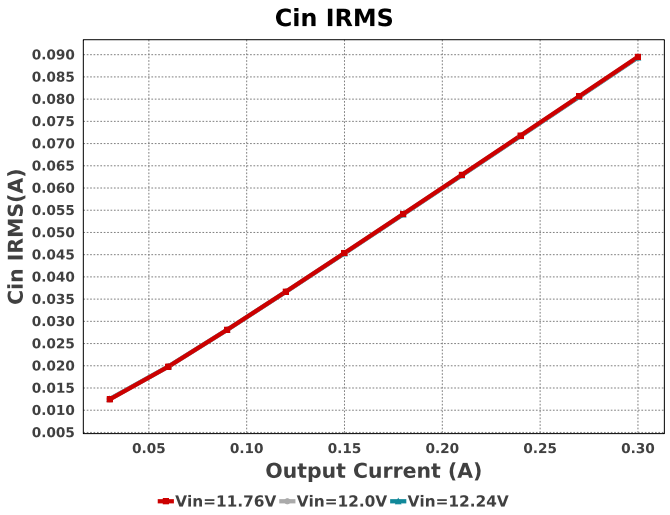
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	CUSTOM	CUSTOM Series= X5R	Cap= 5.435 uF ESR= 1.0 uOhm VDC= 25.0 V IRMS= 7.29 A	1	NA	0805 0 mm²
Cinx	CUSTOM	CUSTOM Series= X7R	Cap= 3.713 uF ESR= 1.0 nOhm VDC= 25.0 V IRMS= 0.0 A	1	NA	0402 0 mm²
Cinx2	CUSTOM	CUSTOM Series= X7R	Cap= 90.0 nF ESR= 1.0 nOhm VDC= 25.0 V IRMS= 0.0 A	1	NA	0402 0 mm²
Cout	CUSTOM	CUSTOM Series= X5R	Cap= 17.0 uF ESR= 423.4 mOhm VDC= 25.0 V IRMS= 3.67 A	1	NA	1210 0 mm²
Coutx	CUSTOM	CUSTOM Series= X5R	Cap= 2.0 uF ESR= 423.4 mOhm VDC= 25.0 V IRMS= 3.67 A	1	NA	1210 0 mm²
Cvcc	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²

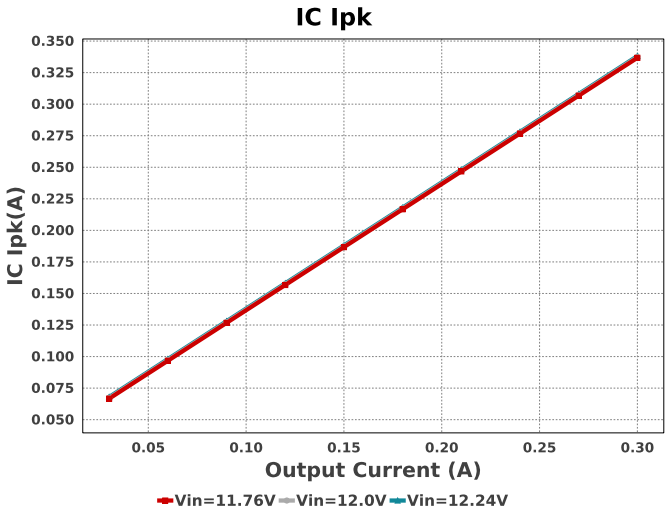
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	CUSTOM	CUSTOM	L= 100.0 µH 180.0 mOhm	1	NA	 VLP8040 0 mm²
Rfbb	CUSTOM	CUSTOM Series= CRCW..e3	Res= 22.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	 0402 0 mm²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
U1	Texas Instruments	LMR34215FAQRNXRQ1	Switcher	1	$0.94	 RNX0012B 12 mm²

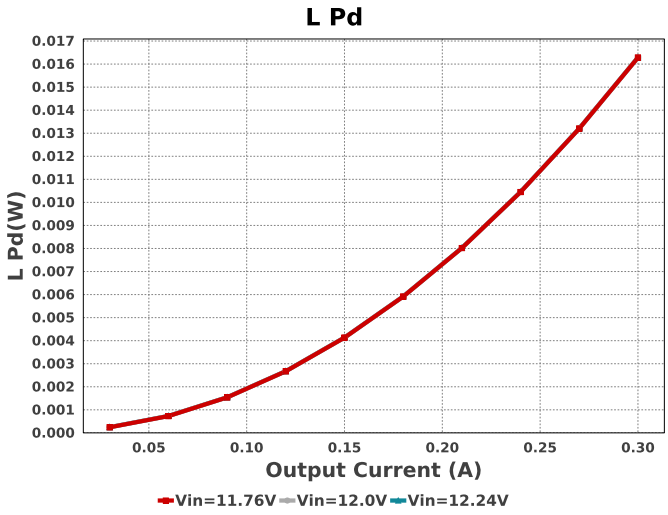


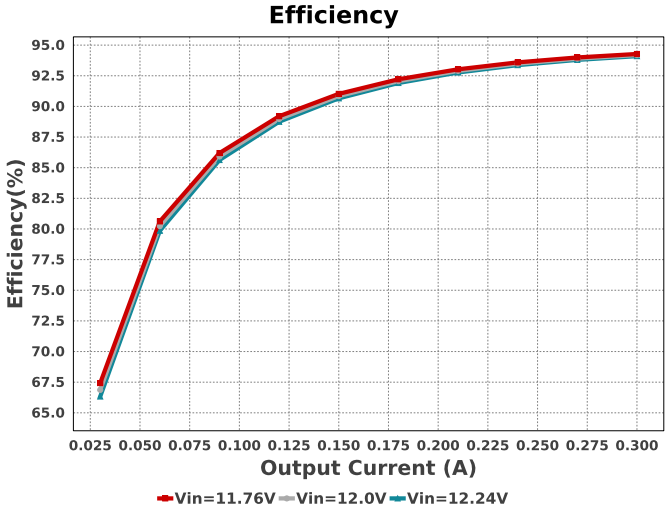


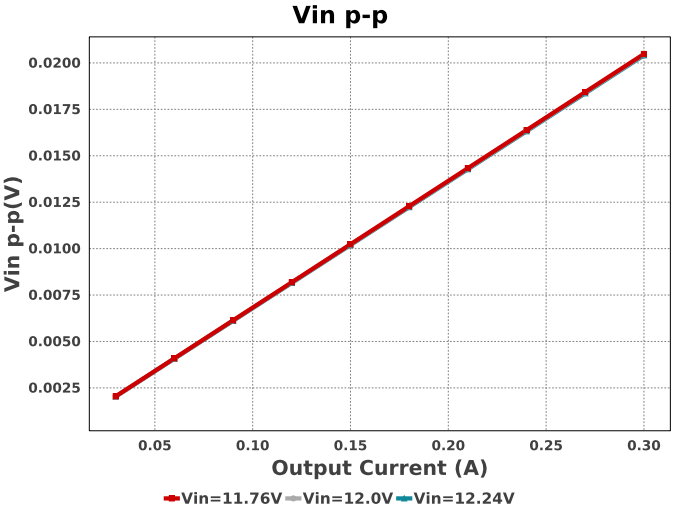


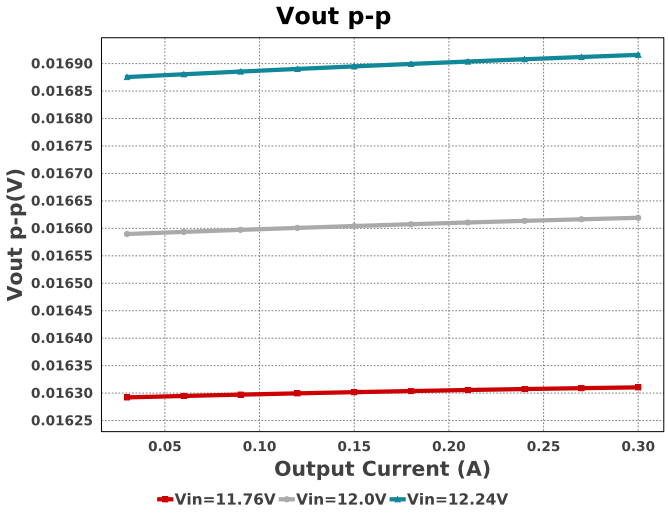


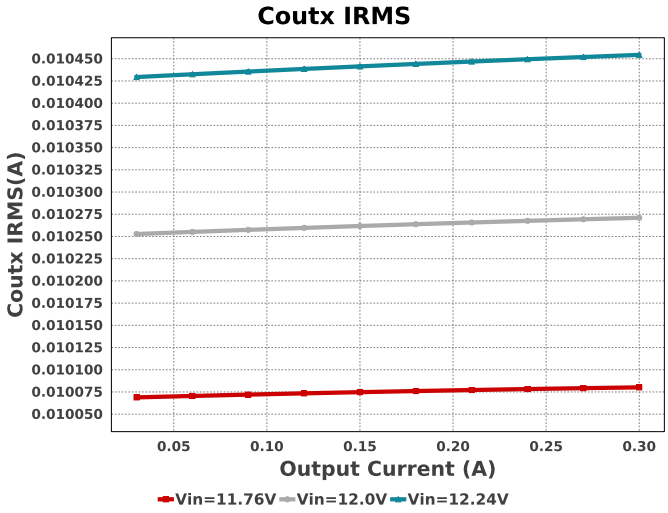




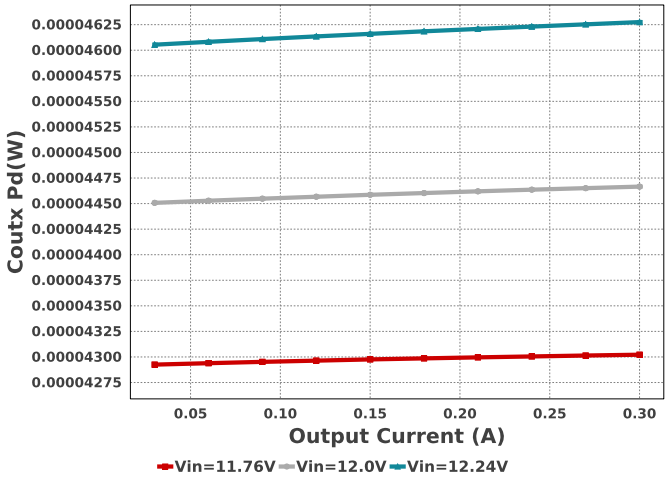




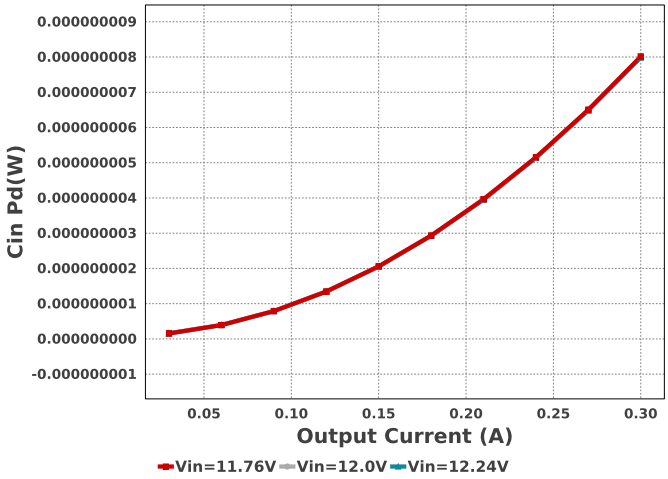




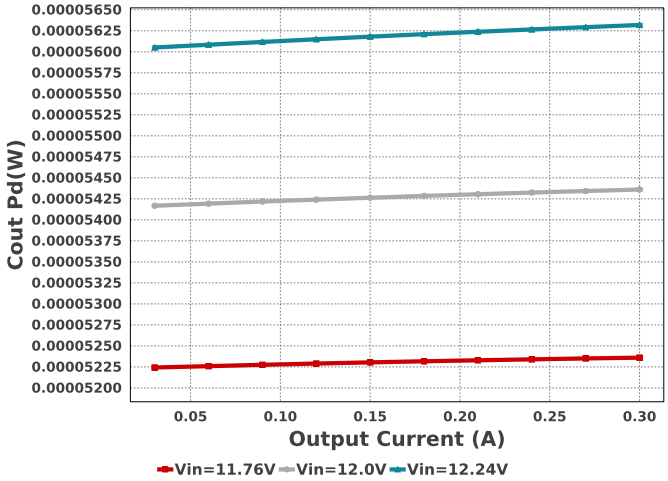
Coutx Pd



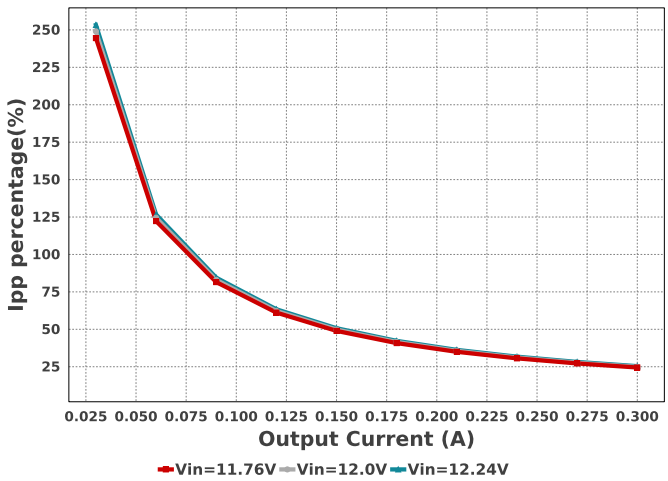
Cin Pd



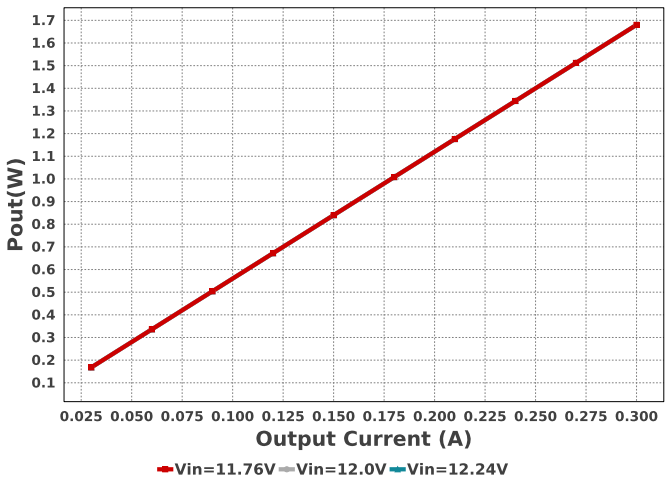
Cout Pd



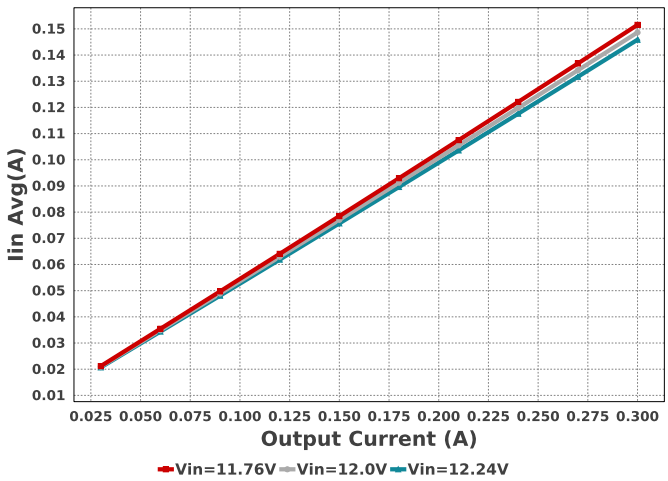
Ipp percentage

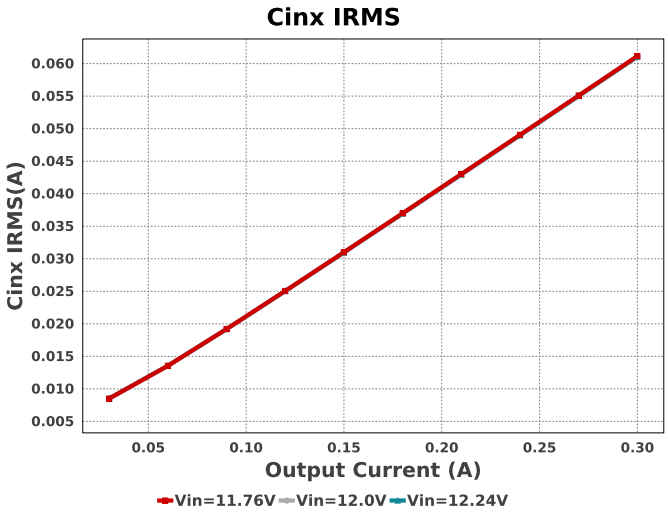


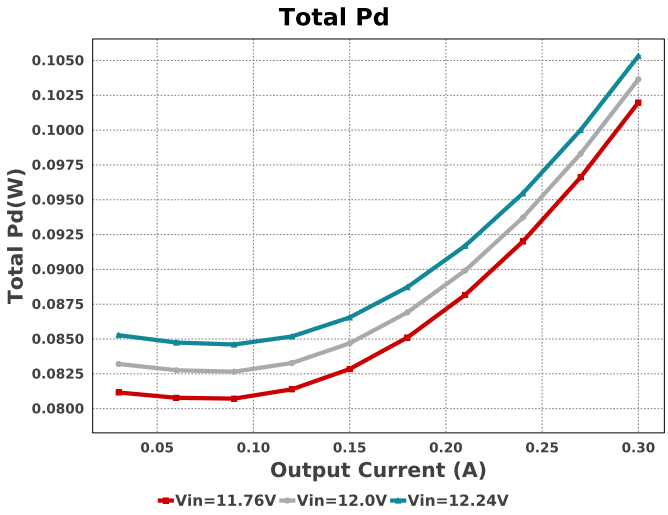
Pout

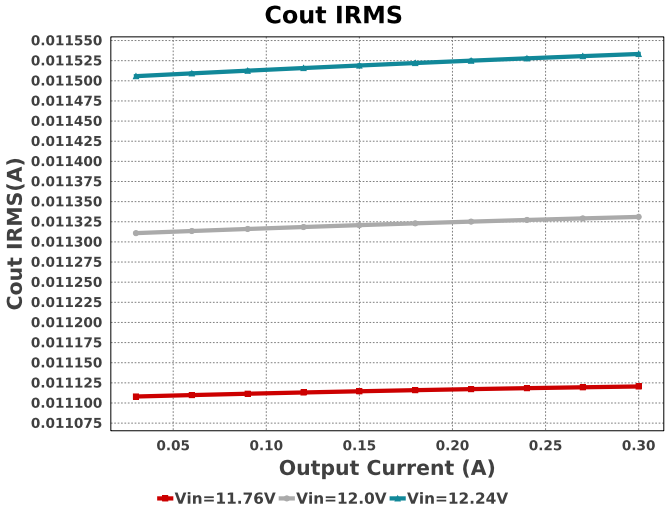


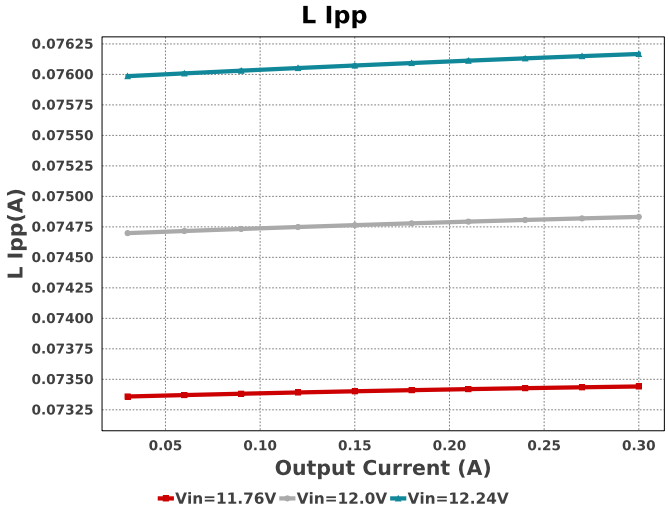
Iin Avg

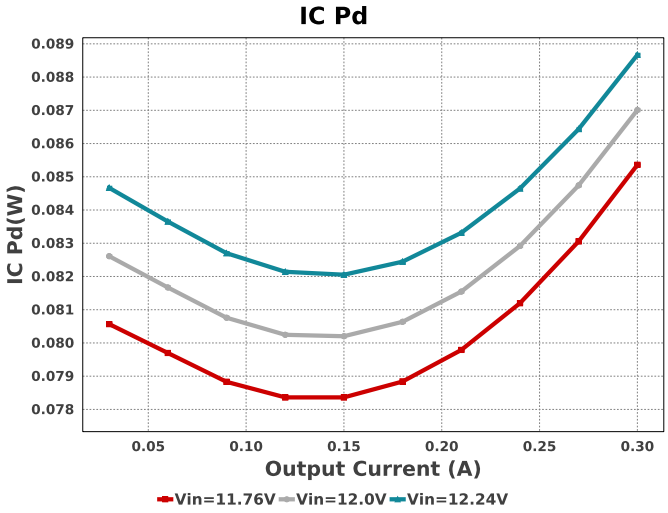


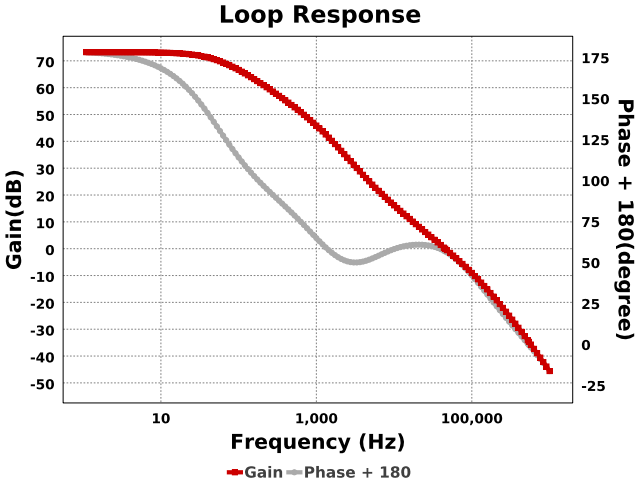

Cinx IRMS
Cinx IRMS(A)
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.05
0.10
0.15
0.20
0.25
0.30
Output Current (A)
Vin=11.76V
Vin=12.0V
Vin=12.24V

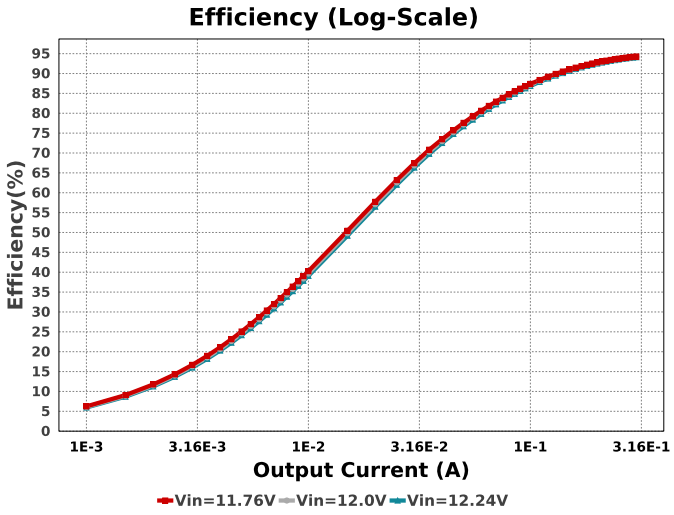

Total Pd
Total Pd(W)
0.1050
0.1025
0.1000
0.0975
0.0950
0.0925
0.0900
0.0875
0.0850
0.0825
0.0800
0.05
0.10
0.15
0.20
0.25
0.30
Output Current (A)
Vin=11.76V
Vin=12.0V
Vin=12.24V


Cout IRMS
Cout IRMS(A)
0.011550
0.011525
0.011500
0.011475
0.011450
0.011425
0.011400
0.011375
0.011350
0.011325
0.011300
0.011275
0.011250
0.011225
0.011200
0.011175
0.011150
0.011125
0.011100
0.011075
0.05
0.10
0.15
0.20
0.25
0.30
Output Current (A)
Vin=11.76V
Vin=12.0V
Vin=12.24V


L Ipp
L Ipp(A)
0.07625
0.07600
0.07575
0.07550
0.07525
0.07500
0.07475
0.07450
0.07425
0.07400
0.07375
0.07350
0.07325
0.05
0.10
0.15
0.20
0.25
0.30
Output Current (A)
Vin=11.76V
Vin=12.0V
Vin=12.24V


IC Pd
IC Pd(W)
0.089
0.088
0.087
0.086
0.085
0.084
0.083
0.082
0.081
0.080
0.079
0.078
0.05
0.10
0.15
0.20
0.25
0.30
Output Current (A)
Vin=11.76V
Vin=12.0V
Vin=12.24V


Loop Response
Gain(dB)
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
Phase + 180(degree)
175
150
125
100
75
50
25
0
-25
10
1,000
100,000
Frequency (Hz)
Gain
Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	11		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	89.373 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	7.988 nW	Capacitor	Input capacitor power dissipation
5.	Cinx IRMS	61.056 mA	Capacitor	Bulk capacitor RMS ripple current
6.	Cinx Pd	3.728 pW	Capacitor	Bulk capacitor power dissipation
7.	Cout IRMS	11.533 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	56.319 µW	Capacitor	Output capacitor power dissipation
9.	Coutx IRMS	10.454 mA	Capacitor	Output capacitor_x RMS ripple current
10.	Coutx Pd	46.275 µW	Capacitor	Output capacitor_x power loss
11.	IC Ipk	338.084 mA	IC	Peak switch current in IC
12.	IC Pd	88.668 mW	IC	IC power dissipation
13.	IC Tj	84.433 degC	IC	IC junction temperature
14.	IC Tolerance	20.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA Effective	50.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
16.	Iin Avg	145.86 mA	IC	Average input current
17.	Ipp percentage	25.389 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
18.	L Ipp	76.167 mA	Inductor	Peak-to-peak inductor ripple current
19.	L Pd	16.287 mW	Inductor	Inductor power dissipation
20.	Cin Pd	7.988 nW	Power	Input capacitor power dissipation
21.	Cinx Pd	3.728 pW	Power	Bulk capacitor power dissipation
22.	Cout Pd	56.319 µW	Power	Output capacitor power dissipation
23.	Coutx Pd	46.275 µW	Power	Output capacitor_x power loss
24.	IC Pd	88.668 mW	Power	IC power dissipation
25.	L Pd	16.287 mW	Power	Inductor power dissipation
26.	Total Pd	105.316 mW	Power	Total Power Dissipation
27.	Cross Freq	45.437 kHz	System Information	Bode plot crossover frequency
28.	Duty Cycle	46.718 %	System Information	Duty cycle
29.	Efficiency	94.101 %	System Information	Steady state efficiency
30.	FootPrint	181.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	400.0 kHz	System Information	Switching frequency
32.	Gain Marg	-34.729 dB	System Information	Bode Plot Gain Margin
33.	Iout	300.0 mA	System Information	Iout operating point
34.	Low Freq Gain	73.215 dB	System Information	Gain at 1Hz
35.	Mode	FCCM	System Information	Conduction Mode
36.	Phase Marg	57.222 deg	System Information	Bode Plot Phase Margin
37.	Pout	1.68 W	System Information	Total output power
38.	Vin	12.24 V	System Information	Vin operating point

#	Name	Value	Category	Description
39.	Vin p-p	20.408 mV	System Information	Peak-to-peak input voltage
40.	Vout	5.6 V	System Information	Operational Output Voltage
41.	Vout Actual	5.545 V	System Information	Vout Actual calculated based on selected voltage divider resistors
42.	Vout Tolerance	3.689 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
43.	Vout p-p	16.916 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	300.0 m	Maximum Output Current
VinMax	12.24	Maximum input voltage
VinMin	11.76	Minimum input voltage
Vout	5.6	Output Voltage
base_pn	LMR34215FA-Q1	Base Product Number
source	DC	Input Source Type
Ta	80.0	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

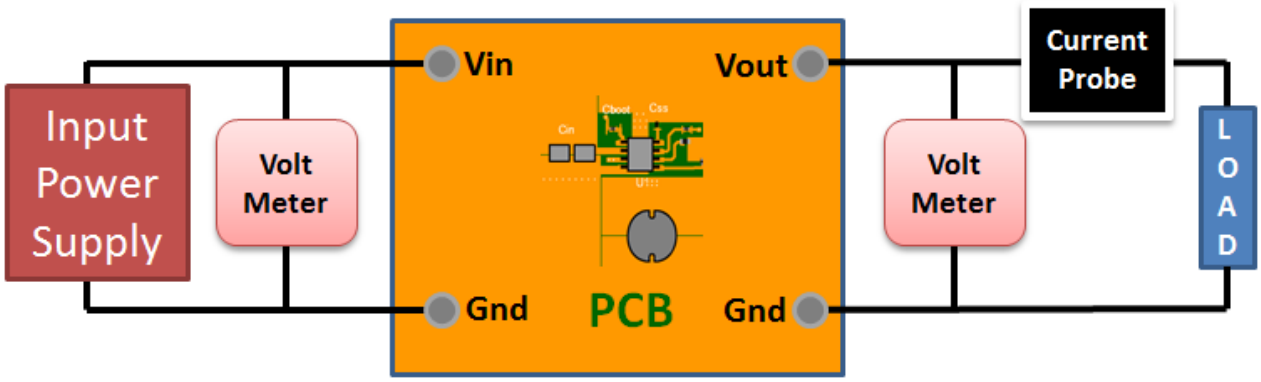
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.76V 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.

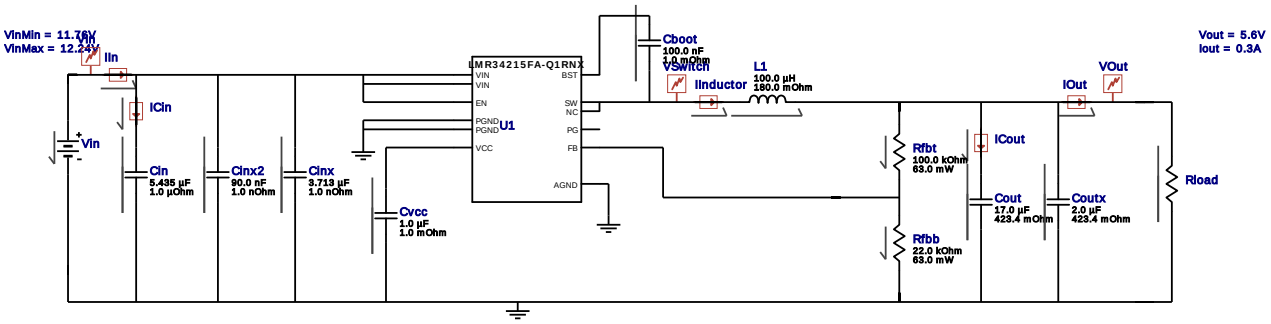


WEBENCH® Electrical Simulation Report

Design Id = 38

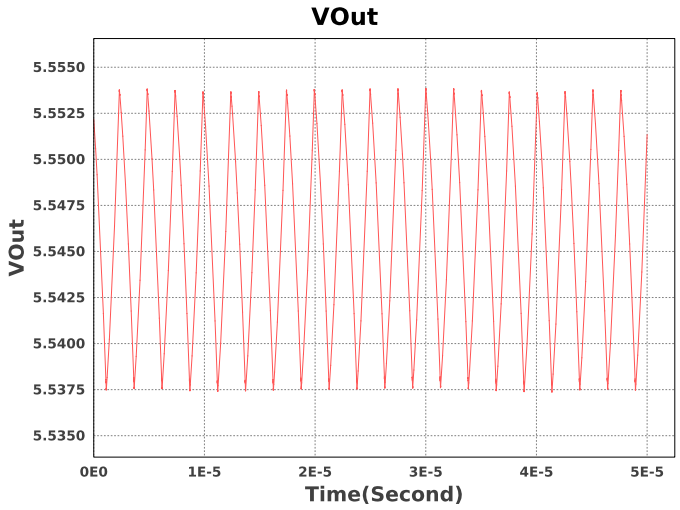
sim_id = 28

Simulation Type = Steady State



Simulation Parameters

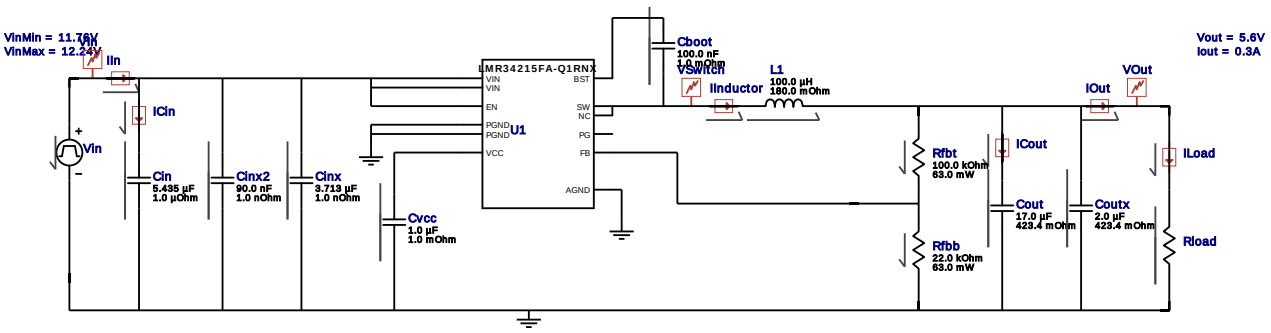
#	Name	Parameter Name	Description	Values
1.	L1	IC	Initia Condition	-0.3 A
2.	Cout	IC	Initial Condition	5.6 V
3.	Rload	R	Load Resistance	18.666666666666668 ohm



Design Id = 38

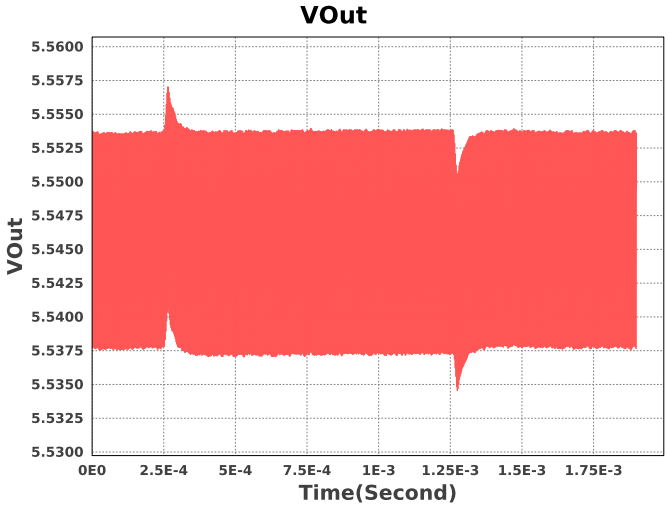
sim_id = 29

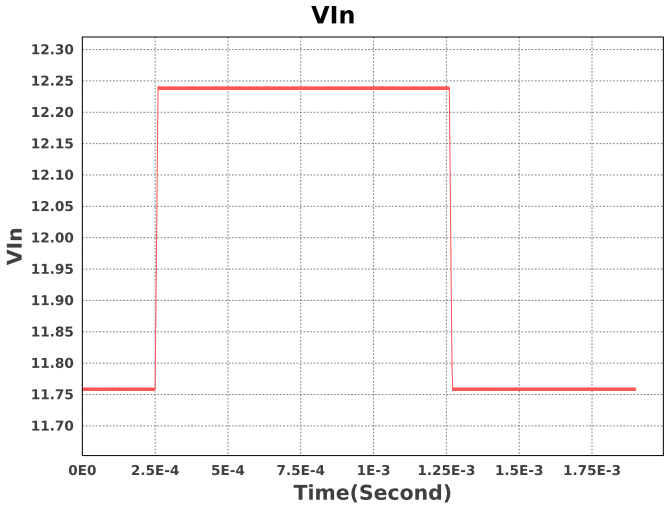
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Condition	-0.3 A
2.	Cout	IC	Initial Condition	Vou1 V
3.	Coutx	IC	Initial condition	5.6 V
4.	Rload	R	Load Resistance	18.666666666666668 Ohm

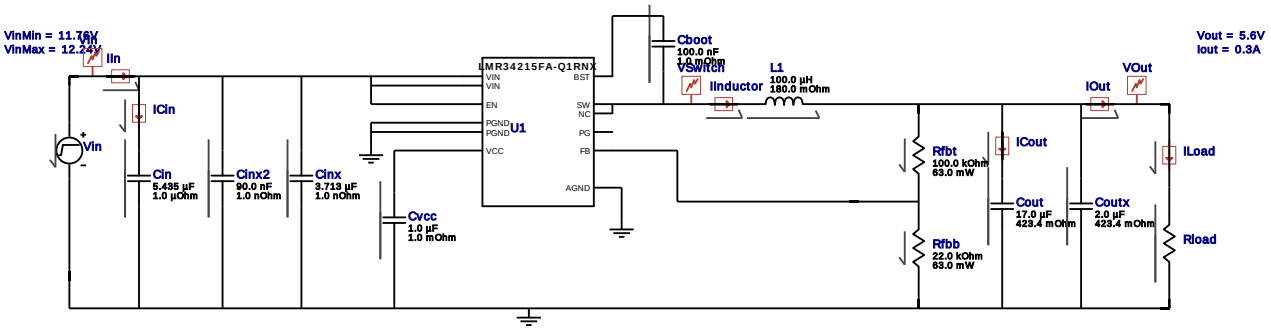




Design Id = 38

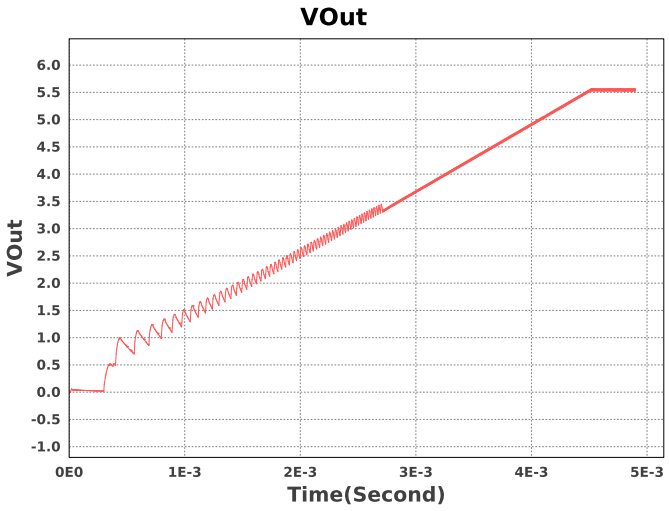
sim_id = 30

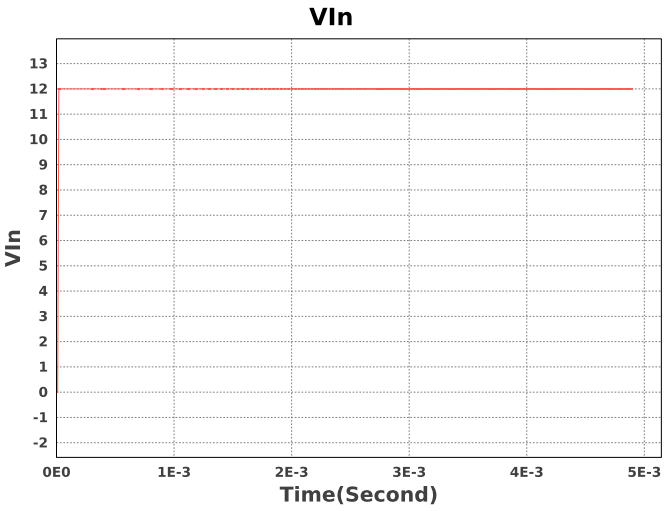
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	18.666666666666668 Ohm

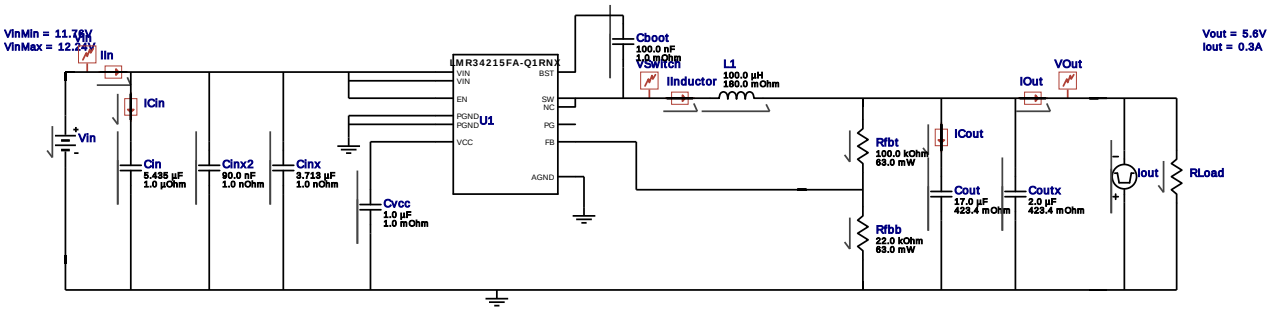




Design Id = 38

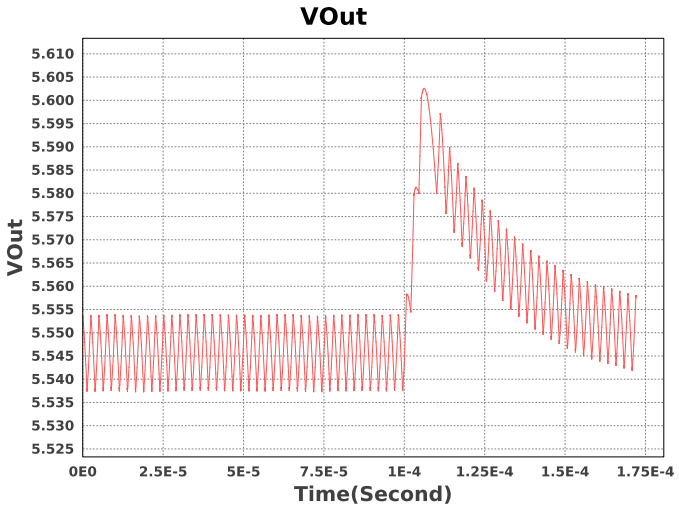
sim_id = 31

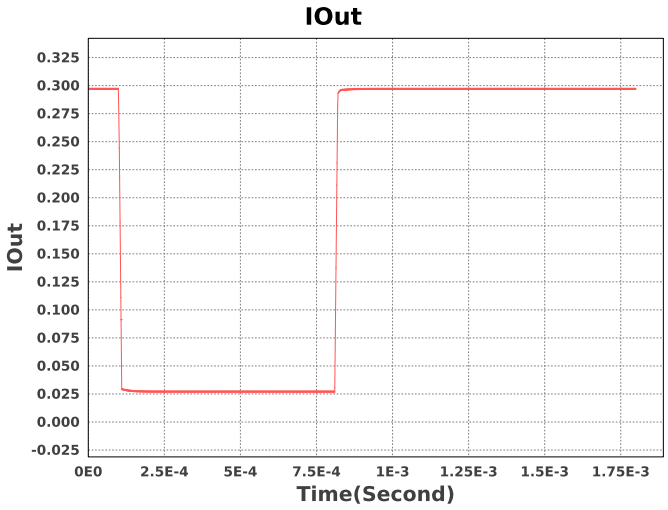
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial condition	-0.3 A
2.	Cout	IC	Initial condition	5.6 V
3.	Iout	signal_type	signal type	PULSE
		I1	Initial Load Current	0 A
		I2	Minimum Load Current	0.27 A
		Td	Initial Time Delay	100u s
		Tf	Fall Time	10u s
		Tr	Rise Time	10u s
		Pw	Pulse Width	700u s
4.	RLoad	R	Load Resistance	18.666666666666668 ohm





Design Assistance

1. The LMR34215FA-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

2. Master key : 86BD50FE7AB87AA6[v1]

3. **LMR34215FA-Q1** Product Folder : http://www.ti.com/product/LMR34215%2DQ1 : contains the data sheet and other resources.