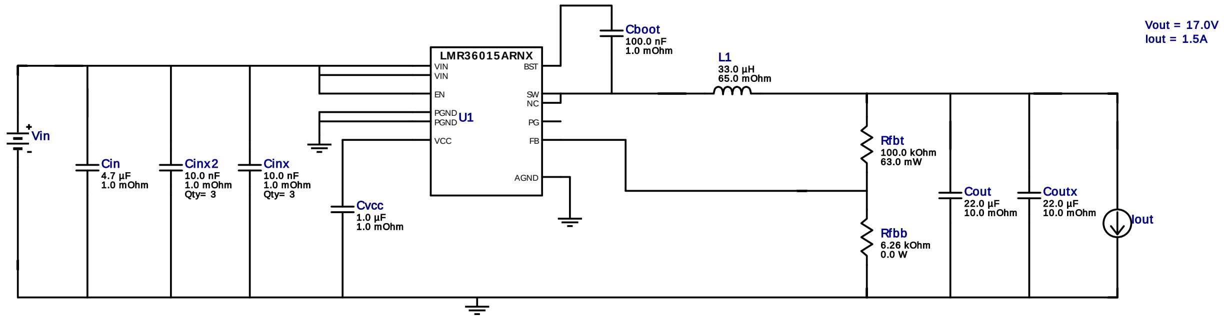
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 40.0V
VinMax = 42.0V
Vout = 17.0V
Iout = 1.5A

Device = LMR36015ARNXR
Topology = Buck
Created = 2021-06-04 13:31:54.200
BOM Cost = NA
BOM Count = 15
Total Pd = 1.29W

Design : 66 LMR36015ARNXR
LMR36015ARNXR 40V-42V to 17.00V @ 1.5A

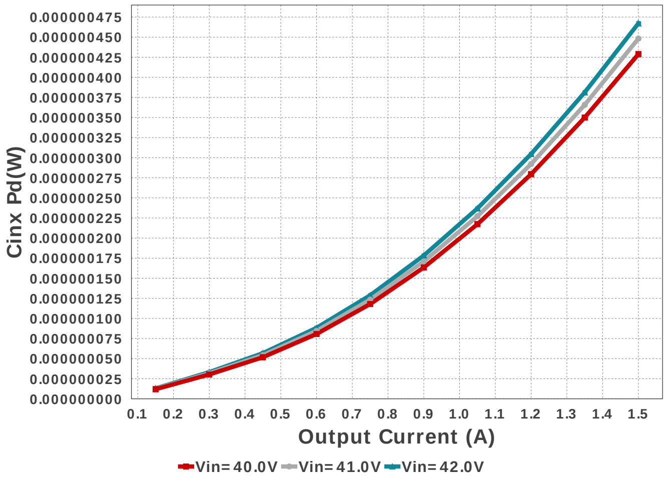


Electrical BOM

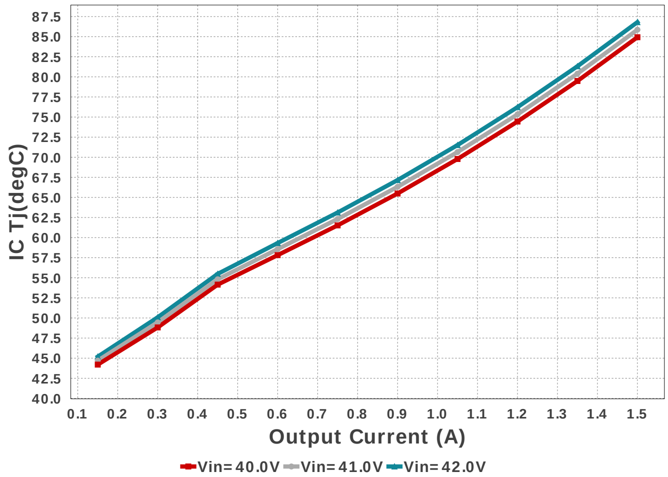
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	TDK	C2012X5R1H475K125AB Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.3 A	1	$0.18	0805 7 mm²
Cinx	MuRata	GRM188R72A103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	3	$0.01	0603 5 mm²
Cinx2	MuRata	GRM188R72A103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	3	$0.01	0603 5 mm²
Cout	TDK	CKG57NX5R1H226M500JH Series= X5R	Cap= 22.0 uF ESR= 10.0 mOhm VDC= 50.0 V IRMS= 4.6 A	1	$1.93	CKG57N 56 mm²
Coutx	TDK	CKG57NX5R1H226M500JH Series= X5R	Cap= 22.0 uF ESR= 10.0 mOhm VDC= 50.0 V IRMS= 4.6 A	1	$1.93	CKG57N 56 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
L1	Bourns	SDR1307-330KL	L= 33.0 µH 65.0 mOhm	1	$0.42	SDR1307 226 mm²
Rfbb	CUSTOM	CUSTOM Series= ?	Res= 6.26 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
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	LMR36015ARNXR	Switcher	1	$0.80	RNX0012B 12 mm²

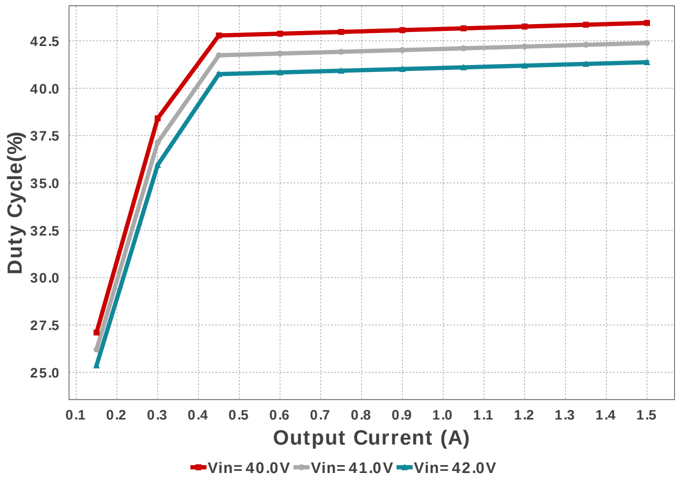
Cinx Pd



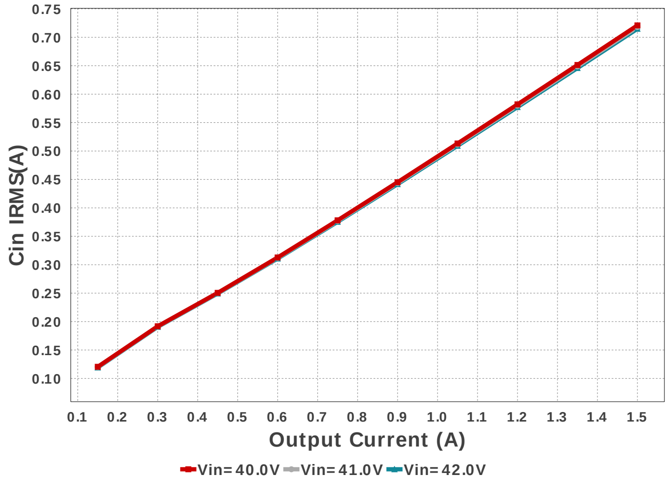
IC Tj



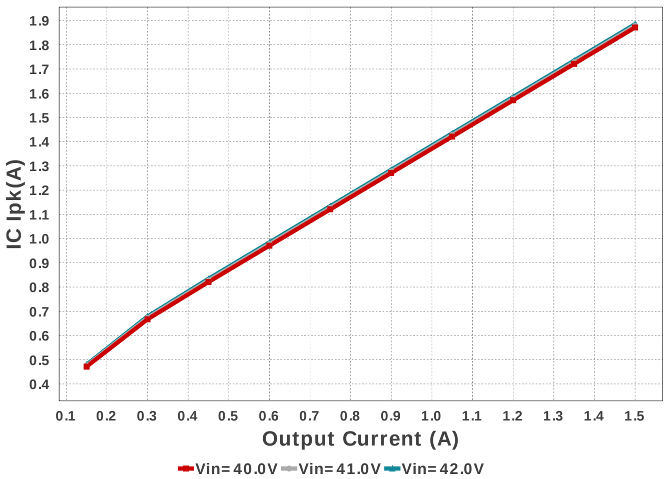
Duty Cycle



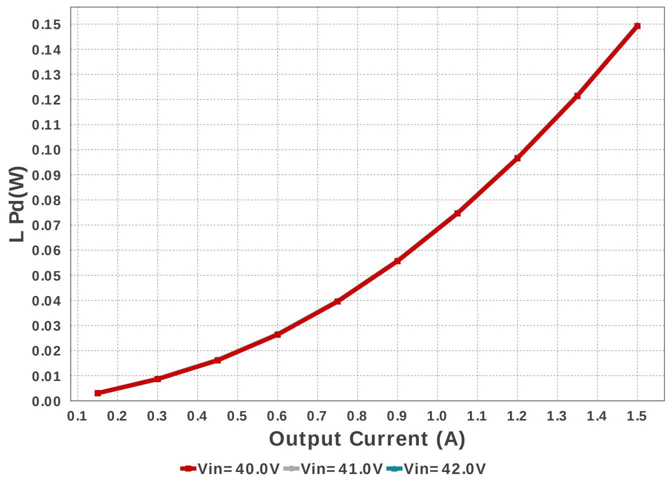
Cin IRMS



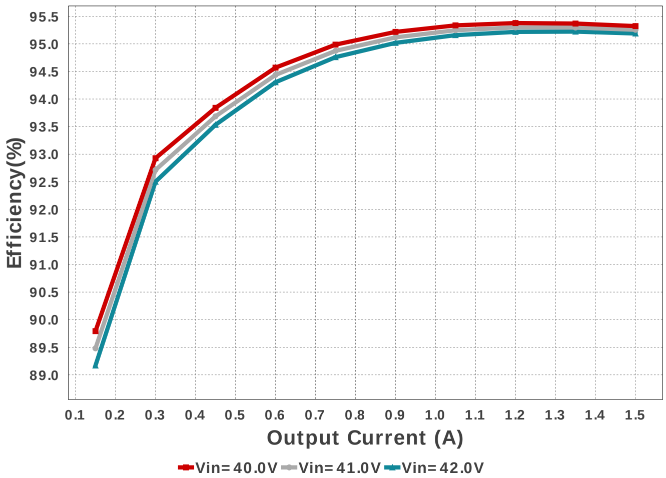
IC Ipk



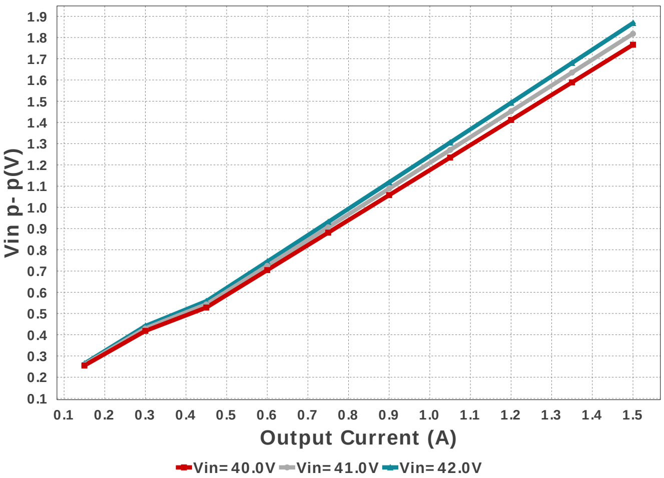
L Pd



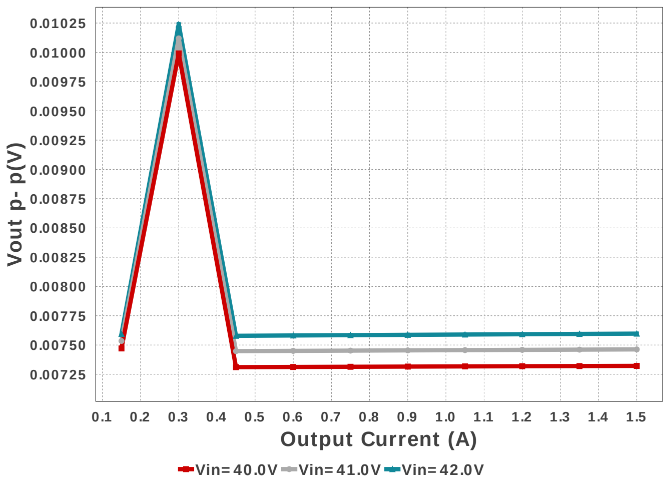
Efficiency



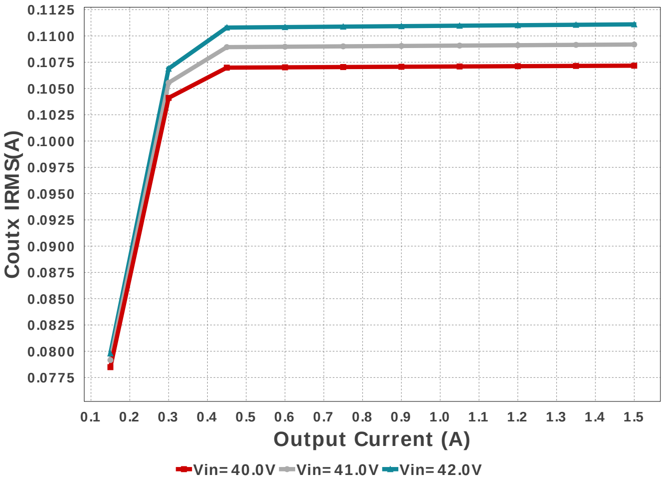
Vin p- p



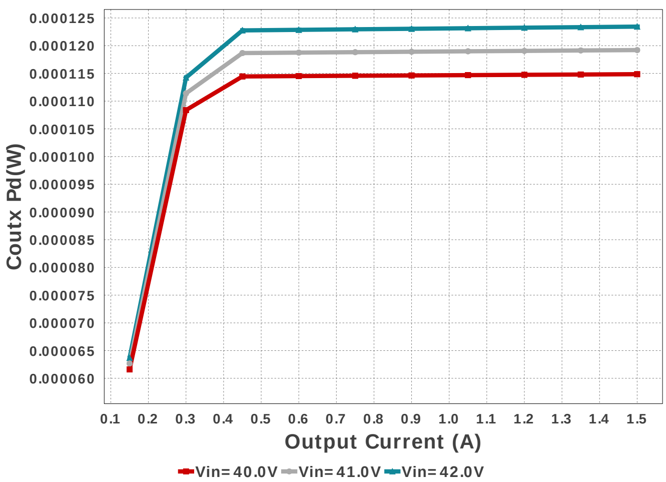
Vout p- p



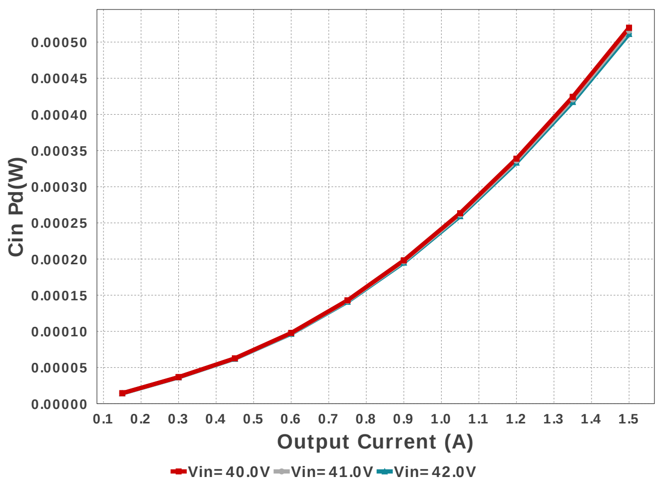
Coutx IRMS

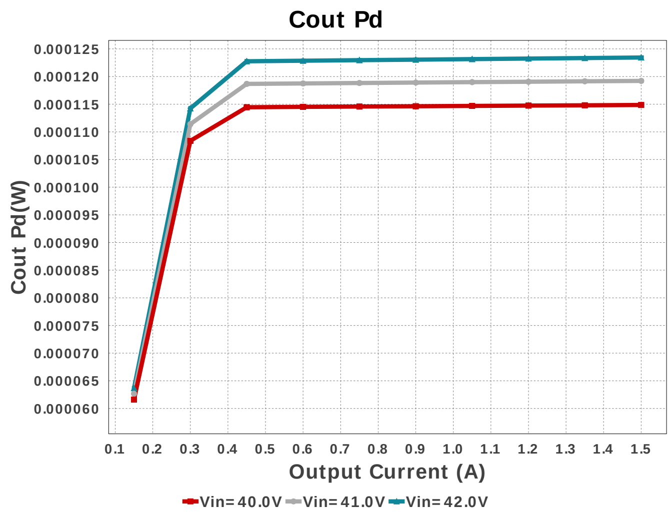


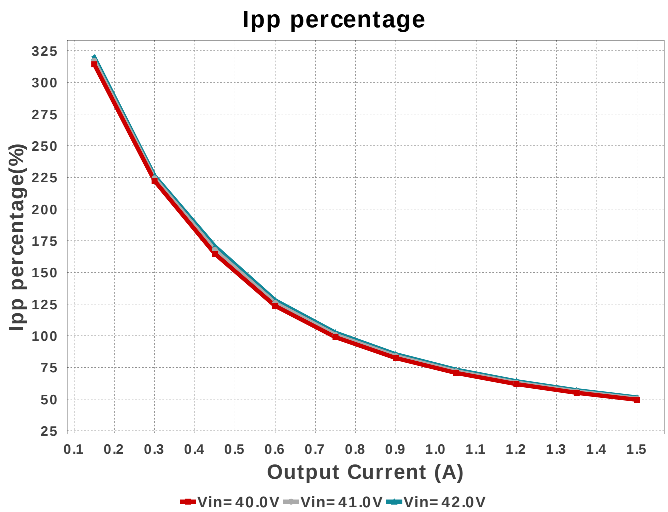
Coutx Pd

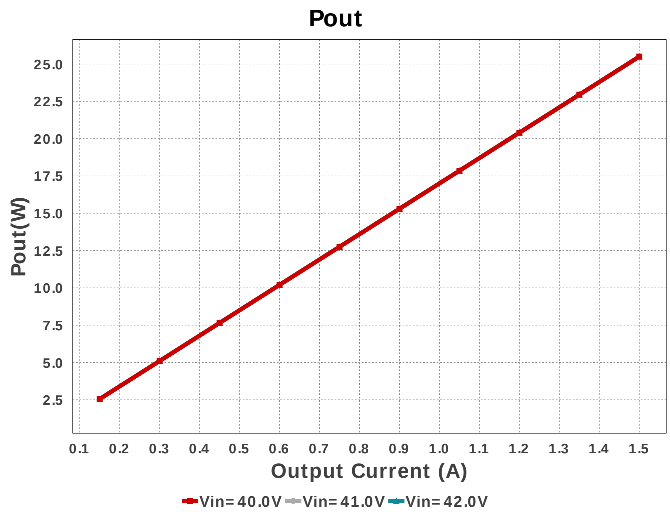


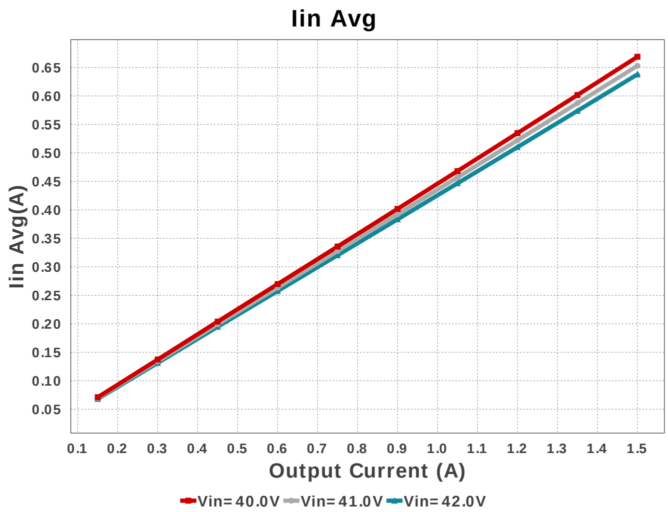
Cin Pd

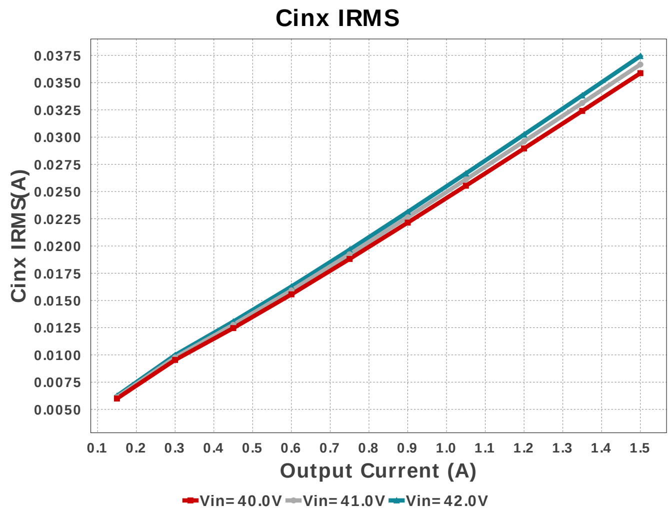


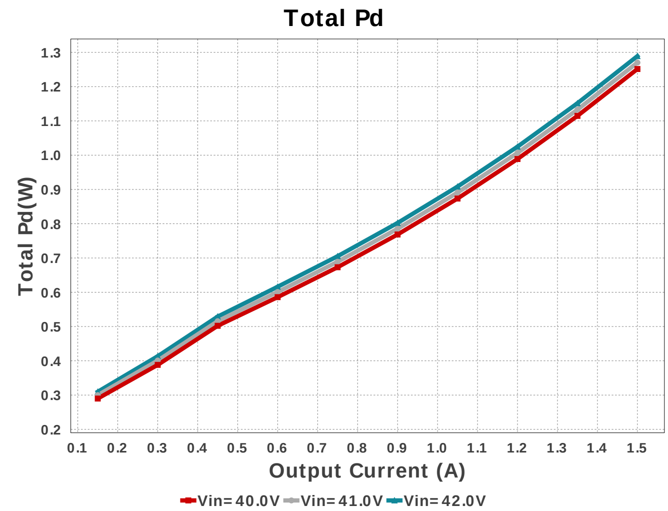

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=40.0V
Vin=41.0V
Vin=42.0V


Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=40.0V
Vin=41.0V
Vin=42.0V

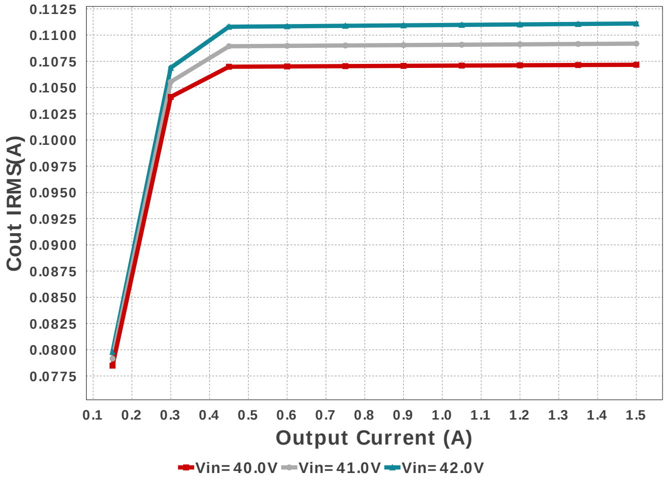

Pout
Pout(W)
Output Current (A)
Vin=40.0V
Vin=41.0V
Vin=42.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=40.0V
Vin=41.0V
Vin=42.0V

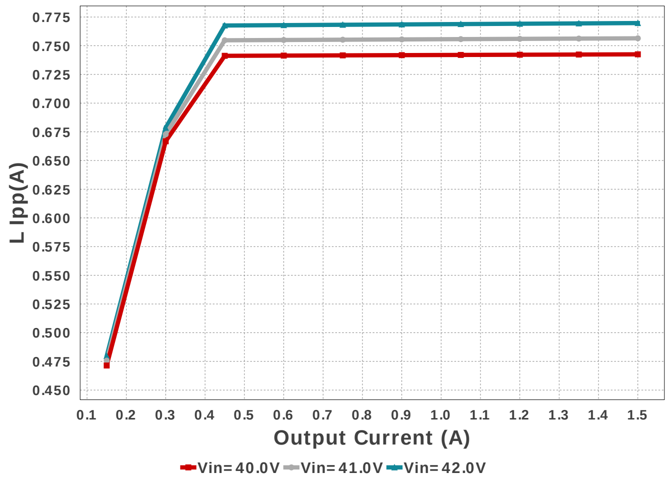

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin=40.0V
Vin=41.0V
Vin=42.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=40.0V
Vin=41.0V
Vin=42.0V

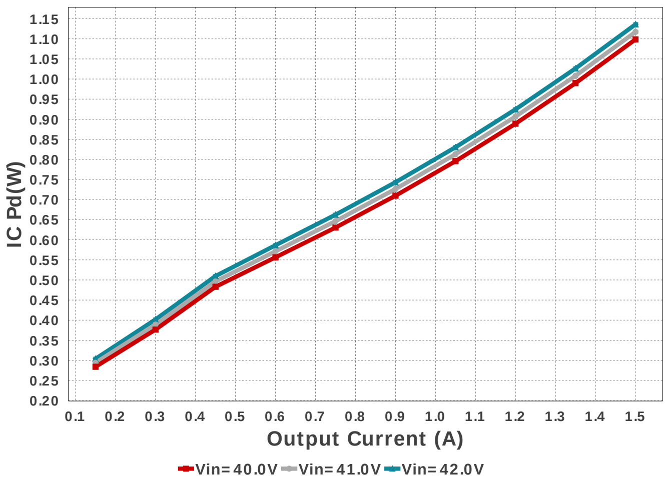
Cout IRMS



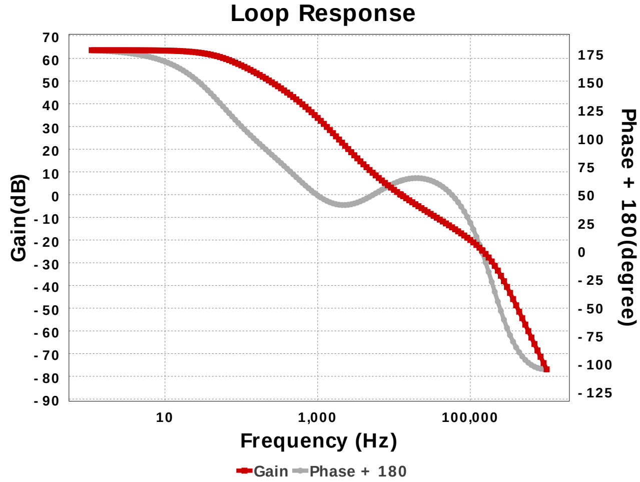
L Ipp



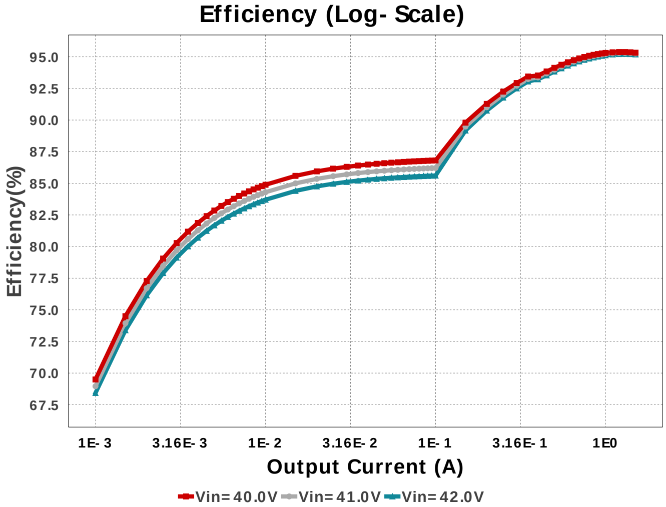
IC Pd



Loop Response



Efficiency (Log- Scale)



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	715.011 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	511.24 µW	Capacitor	Input capacitor power dissipation
3.	Cinx IRMS	37.437 mA	Capacitor	Bulk capacitor RMS ripple current
4.	Cinx Pd	467.19 nW	Capacitor	Bulk capacitor power dissipation
5.	Cout IRMS	111.102 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	123.44 µW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	111.102 mA	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	123.44 µW	Capacitor	Output capacitor_x power loss
9.	IC Ipk	1.885 A	IC	Peak switch current in IC
10.	IC Pd	1.136 W	IC	IC power dissipation
11.	IC Tj	86.807 degC	IC	IC junction temperature

#	Name	Value	Category	Description
12.	IC Tolerance	20.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA Effective	50.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
14.	Iin Avg	637.84 mA	IC	Average input current
15.	Ipp percentage	51.316 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
16.	L Ipp	769.738 mA	Inductor	Peak-to-peak inductor ripple current
17.	L Pd	149.46 mW	Inductor	Inductor power dissipation
18.	Cin Pd	511.24 µW	Power	Input capacitor power dissipation
19.	Cinx Pd	467.19 nW	Power	Bulk capacitor power dissipation
20.	Cout Pd	123.44 µW	Power	Output capacitor power dissipation
21.	Coutx Pd	123.44 µW	Power	Output capacitor_x power loss
22.	IC Pd	1.136 W	Power	IC power dissipation
23.	L Pd	149.46 mW	Power	Inductor power dissipation
24.	Total Pd	1.289 W	Power	Total Power Dissipation
25.	BOM Count	15	System Information	Total Design BOM count
26.	Cross Freq	12.315 kHz	System Information	Bode plot crossover frequency
27.	Duty Cycle	41.372 %	System Information	Duty cycle
28.	Efficiency	95.188 %	System Information	Steady state efficiency
29.	FootPrint	401.0 mm^2	System Information	Total Foot Print Area of BOM components
30.	Frequency	400.0 kHz	System Information	Switching frequency
31.	Gain Marg	-24.426 dB	System Information	Bode Plot Gain Margin
32.	Iout	1.5 A	System Information	Iout operating point
33.	Low Freq Gain	63.601 dB	System Information	Gain at 1Hz
34.	Mode	CCM	System Information	Conduction Mode
35.	Phase Marg	62.945 deg	System Information	Bode Plot Phase Margin
36.	Pout	25.5 W	System Information	Total output power
37.	Total BOM	NA	System Information	Total BOM Cost
38.	Vin	42.0 V	System Information	Vin operating point
39.	Vin p-p	1.868 V	System Information	Peak-to-peak input voltage
40.	Vout	17.0 V	System Information	Operational Output Voltage
41.	Vout Actual	16.974 V	System Information	Vout Actual calculated based on selected voltage divider resistors
42.	Vout Tolerance	2.96 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
43.	Vout p-p	7.597 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.5	Maximum Output Current
VinMax	42.0	Maximum input voltage
VinMin	40.0	Minimum input voltage
Vout	17.0	Output Voltage
base_pn	LMR36015A	Base Product Number
source	DC	Input Source Type
Ta	30.0	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

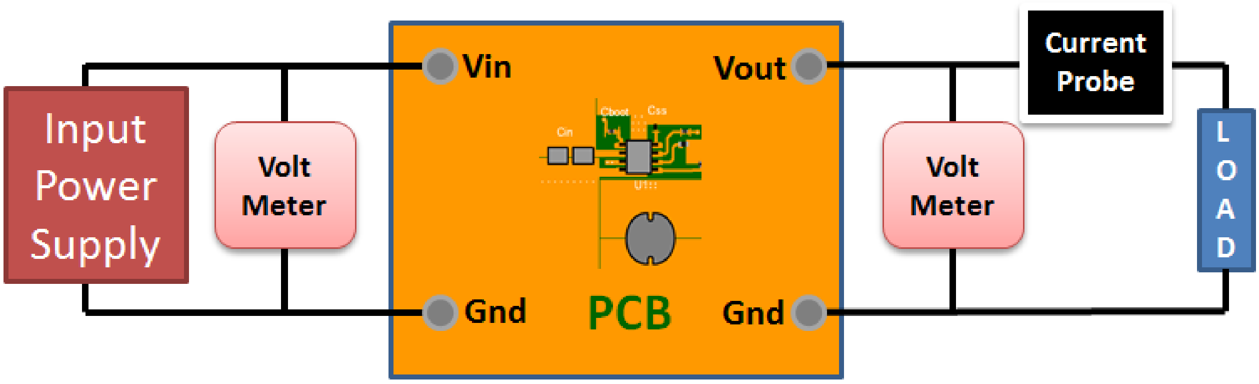
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 40.0V 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

1. Master key : 8575EB877C0BBED7[v1]

2. **LMR36015A** Product Folder : http://www.ti.com/product/LMR36015 : contains the data sheet and other resources.