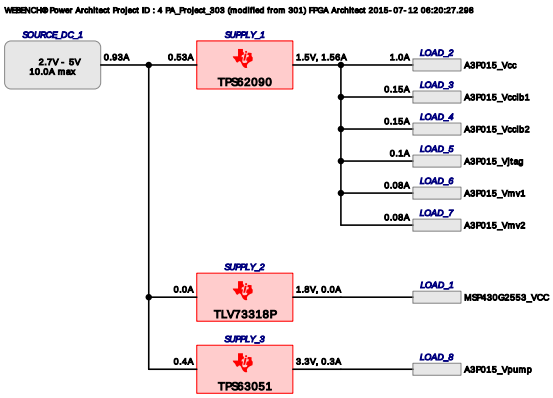
# WEBENCH® Power Architect




## Project Report

Project : 4410947/4 : PA_Project_303 (modified from 301)
Created : 2015-07-12 06:20:27.298
Optimize project optFactor=3

Project Summary

| | | |
|---|---|---|
| 1. | Total System Efficiency | 89.383 % |
| 2. | Total System BOM Count | 19.0 |
| 3. | Total System Footprint | 131.0 mm2 |
| 4. | Total System BOM Cost | $2.96 |
| 5. | Total System Power Dissipation | 395.6 mW |

--> Launch WEBENCH Power Architect.

## Power Supplies

| # | Name | NSID | Description | Vout | Iout | Efficiency | Foot-print | Cost | Design | Page |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | SUPPLY_1 | TPS62090 | Switcher : 3A High Efficiency Step Down Converter with DCS Control | 1.5 V | 1.56 A | 88.5% | 82 | $1.59 | 8 | 9 |
| 2. | SUPPLY_2 | TLV73318P | LDO : TLV733P Capacitor-Free 300-mA Low-Dropout Regulator | 1.8 V | 0.0 A | 33.2% | 10 | $0.19 | 9 | 14 |
| 3. | SUPPLY_3 | TPS63051 | Switcher : 1A Single Inductor Buck Boost with adjustable soft start | 3.3 V | 0.3 A | 91.7% | 39 | $1.18 | 10 | 4 |

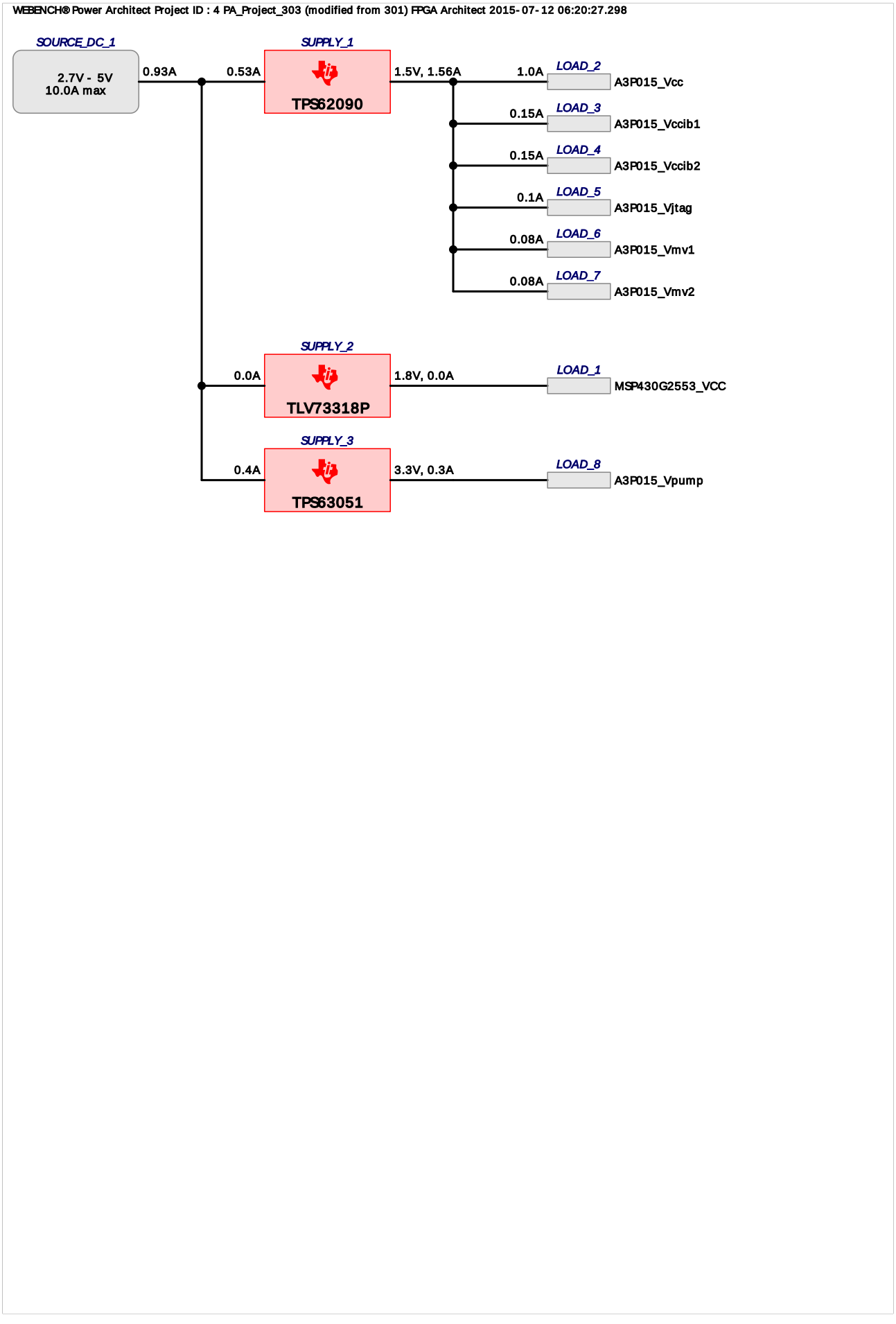
## Power Loads

| # | Name | VLoad | ILoad | Description |
|---|---|---|---|---|
| 1. | A3P015_Vcc | 1.5 V | 1 A | VoutRipple=5%, SoftStart delay=1.0 mSec |
| 2. | A3P015_Vccib1 | 1.5 V | 0.15 A | VoutRipple=5%, SoftStart delay=1.0 mSec |
| 3. | A3P015_Vccib2 | 1.5 V | 0.15 A | VoutRipple=5%, SoftStart delay=1.0 mSec |
| 4. | A3P015_Vjtag | 1.5 V | 0.1 A | VoutRipple=5%, SoftStart delay=1.0 mSec |
| 5. | A3P015_Vmv1 | 1.5 V | 0.08 A | VoutRipple=5%, SoftStart delay=1.0 mSec |
| 6. | A3P015_Vmv2 | 1.5 V | 0.08 A | VoutRipple=5%, SoftStart delay=1.0 mSec |
| 7. | MSP430G2553_VCC | 1.8 V | 0.0004 A | VoutRipple=10% |
| 8. | A3P015_Vpump | 3.3 V | 0.3 A | VoutRipple=9%, Group=Pump, SoftStart delay=1.0 mSec |

## FPGAs, Processors

| # | Manufacturer | Part Number | Name | Series | Description |
|---|---|---|---|---|---|
| 1. | Texas Instruments | MSP430G2553 | FPGA_1 | MSP430G2XX | FPGA Texas Instruments MSP430G2XX MSP430G2553 |
| | http://www.ti.com/lit/ds/symlink/msp430g2153.pdf | | | | |
| 2. | Actel | A3P015 | FPGA_1 | ProASIC3 | FPGA Actel ProASIC3 A3P015 |
| | http://www.actel.com/documents/PA3_DS.pdf | | | | |
| 3. | Actel | A3P015 | FPGA_1 | ProASIC3 | FPGA Actel ProASIC3 A3P015 |
| | http://www.actel.com/documents/PA3_DS.pdf | | | | |

Project Diagram



## Electrical Procurement BOM

| Manufacturer | Part Number | Description | Quantity | Budgetary Price | Footprint ($mm^2$) |
|---|---|---|---|---|---|
| TDK | C1005X5R0J105M | 0402 | 2 | $0.01 | 6 |
| TDK | C1005X7R1E103K | 0402 | 1 | $0.01 | 3 |
| Samsung Electro-Mechanics | CL10A106MQ8NNNC | 0603 | 2 | $0.02 | 9 |
| Vishay-Dale | CRCW0402137KFKED | 0402 | 1 | $0.01 | 3 |
| Vishay-Dale | CRCW0402158KFKED | 0402 | 1 | $0.01 | 3 |
| Vishay-Dale | CRCW0402499KFKED | 0402 | 1 | $0.01 | 3 |
| Vishay-Dale | CRCW0603100KFKEA | 0603 | 1 | $0.01 | 5 |
| MuRata | GRM033R71A682KA01D | 0201 | 1 | $0.01 | 2 |
| MuRata | GRM155R61A222KA01D | 0402 | 1 | $0.01 | 3 |
| MuRata | GRM188R61C106MA73D | 0603 | 1 | $0.06 | 5 |
| MuRata | GRM21BR60J226ME39L | 0805 | 2 | $0.05 | 14 |
| MuRata | LQM2HPN1R5MG0L | 1008 | 1 | $0.12 | 10 |
| Bourns | SRP4020-1R0M | SRP4020 | 1 | $0.49 | 29 |
| Texas Instruments | TLV73318PDQNR | DQN0004A | 1 | $0.17 | 4 |
| Texas Instruments | TPS62090RGTR | S-PVQFN-N16 | 1 | $0.95 | 25 |
| Texas Instruments | TPS63051YFFT | YFF0012AFAF | 1 | $0.94 | 6 |
| **Total** | | | 19 | $2.96 | 130 |

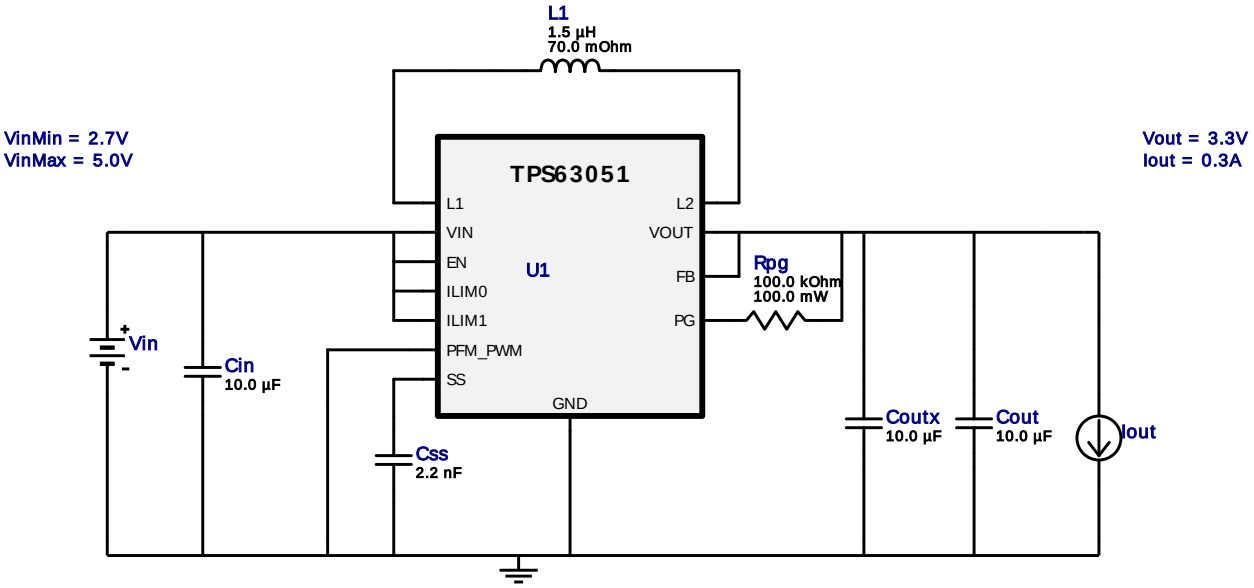
TEXAS INSTRUMENTS

# WEBENCH® Design Report

VinMin = 2.7V
VinMax = 5.0V
Vout = 3.3V
Iout = 0.3A

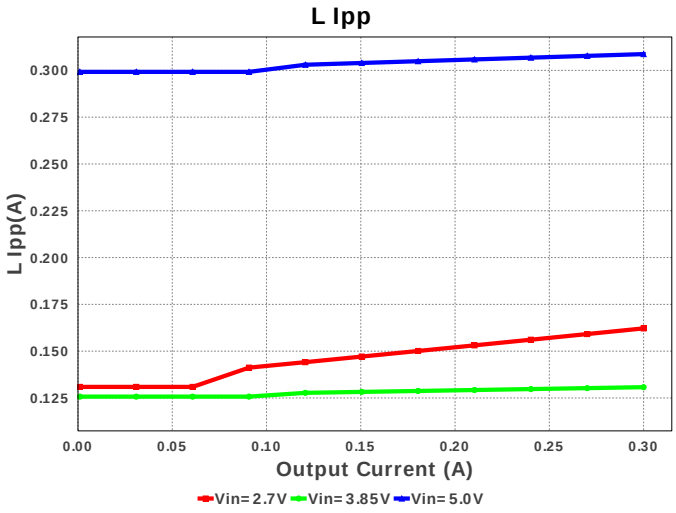
Device = TPS63051YFFT
Topology = Buck_Boost
Created = 7/12/15 6:20:26 AM
BOM Cost = $1.18
Footprint = 39.0 mm²
BOM Count = 7
Total Pd = 0.09W

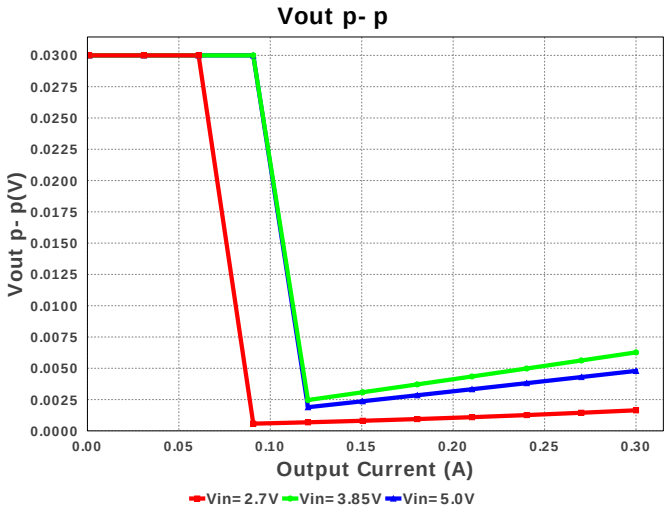
Design : 4410947/10 TPS63051YFFT
TPS63051YFFT 2.7V-5.0V to 3.30V @ 0.3A

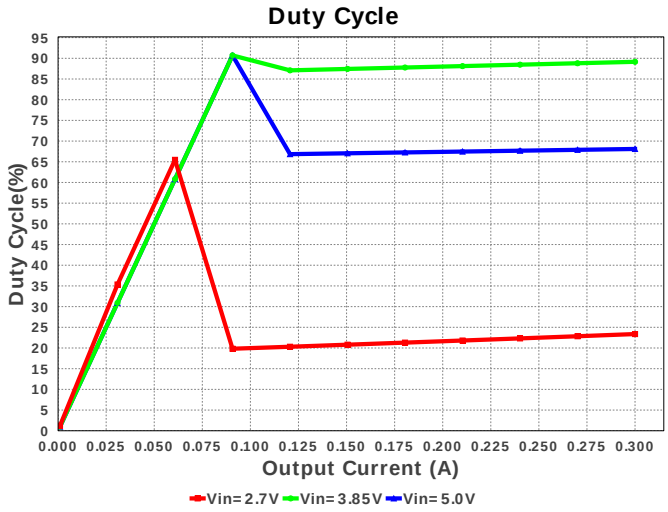


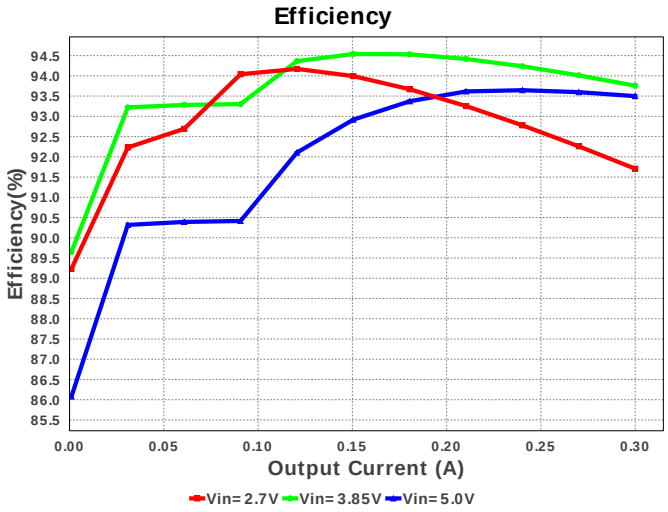

## Electrical BOM

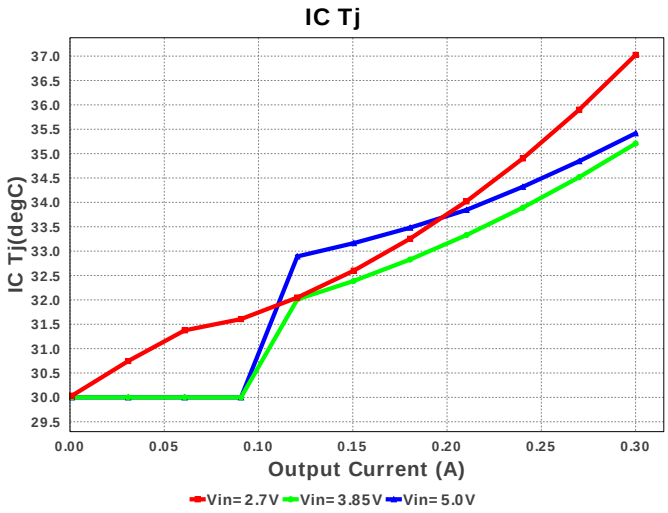
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cin | MuRata | GRM188R61C106MA73D<br>Series= X5R | Cap= 10.0 uF<br>VDC= 16.0 V<br>IRMS= 0.0 A | 1 | $0.06 | 0603 5 mm² |
| 2. | Cout | Samsung Electro-Mechanics | CL10A106MQ8NNNC<br>Series= X5R | Cap= 10.0 uF<br>VDC= 6.3 V<br>IRMS= 0.0 A | 1 | $0.02 | 0603 5 mm² |
| 3. | Coutx | Samsung Electro-Mechanics | CL10A106MQ8NNNC<br>Series= X5R | Cap= 10.0 uF<br>VDC= 6.3 V<br>IRMS= 0.0 A | 1 | $0.02 | 0603 5 mm² |
| 4. | Css | MuRata | GRM155R61A222KA01D<br>Series= X5R | Cap= 2.2 nF<br>VDC= 10.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0402 3 mm² |
| 5. | L1 | MuRata | LQM2HPN1R5MG0L | L= 1.5 µH<br>DCR= 70.0 mOhm | 1 | $0.12 | 1008 10 mm² |
| 6. | Rpg | Vishay-Dale | CRCW0603100KFKEA<br>Series= CRCW..e3 | Res= 100.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm² |
| 7. | U1 | Texas Instruments | TPS63051YFFT | Switcher | 1 | $0.94 | YFF0012AFAF 6 mm² |

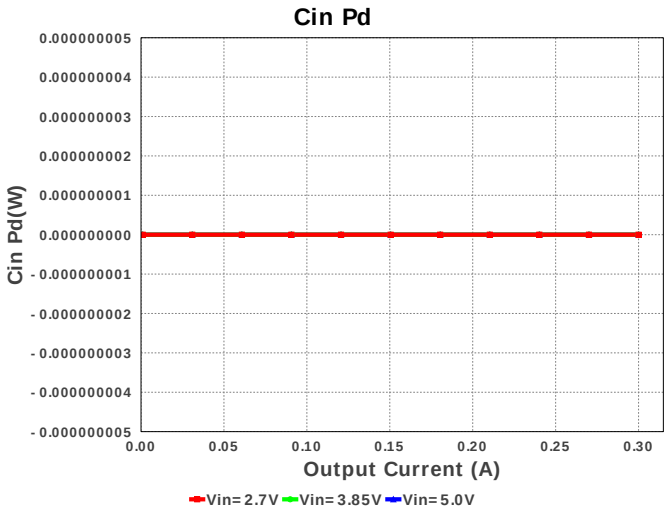


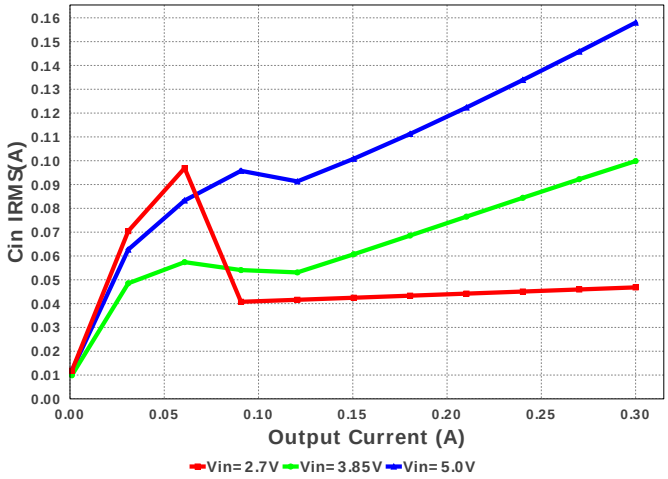



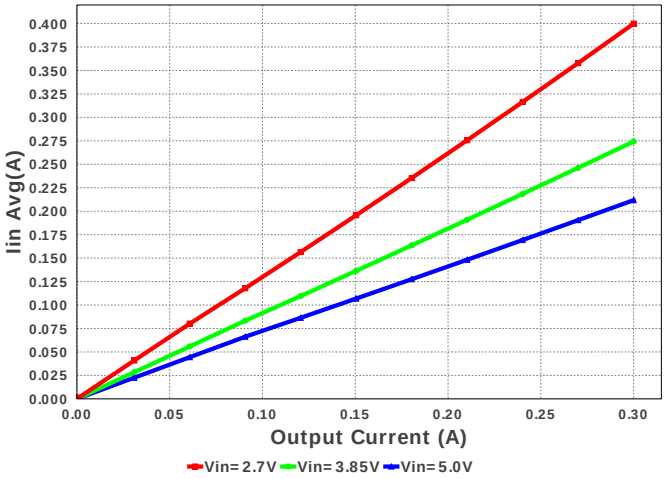



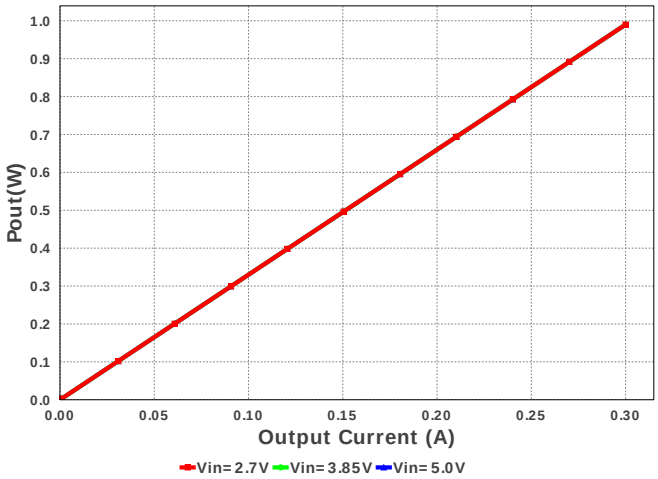
## Cin IRMS



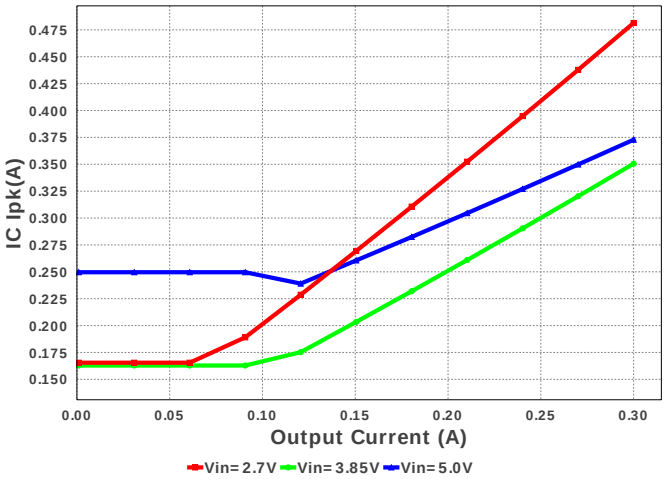

## Iin Avg



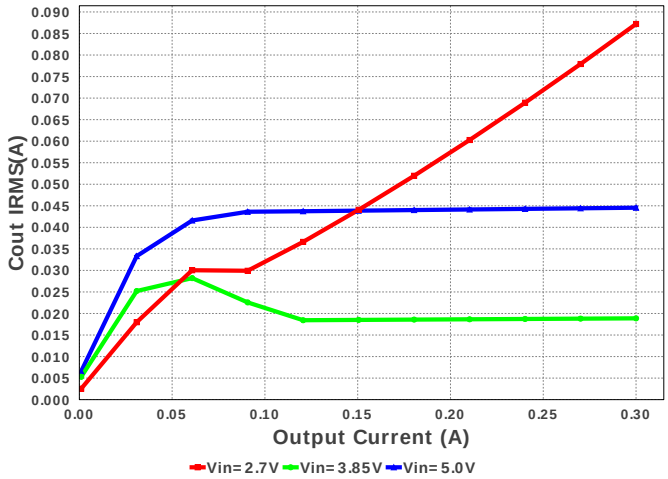

## Pout



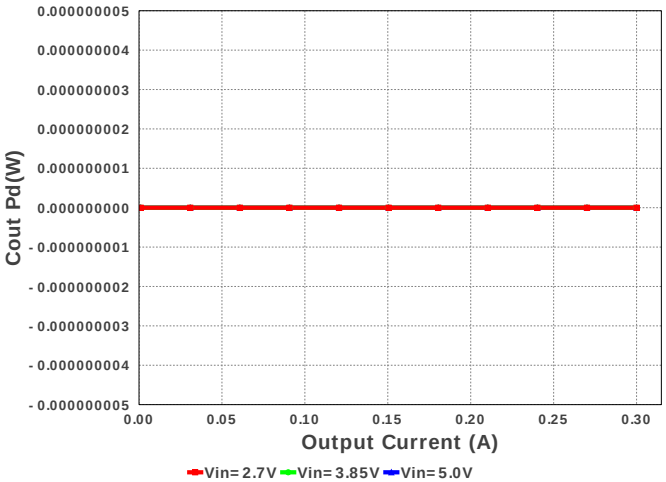

## IC Ipk

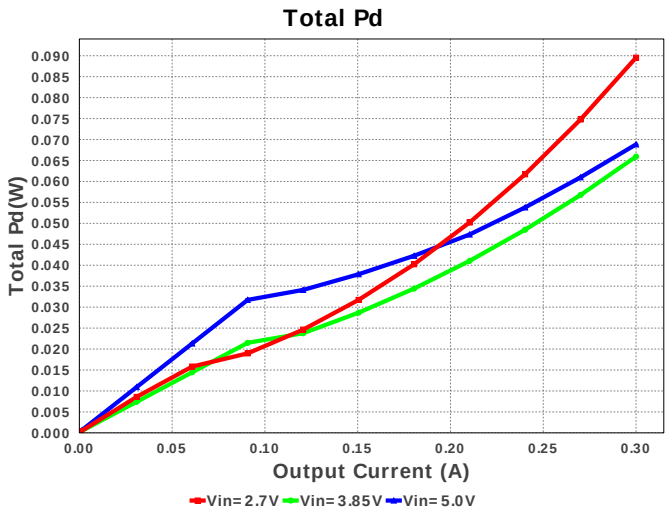


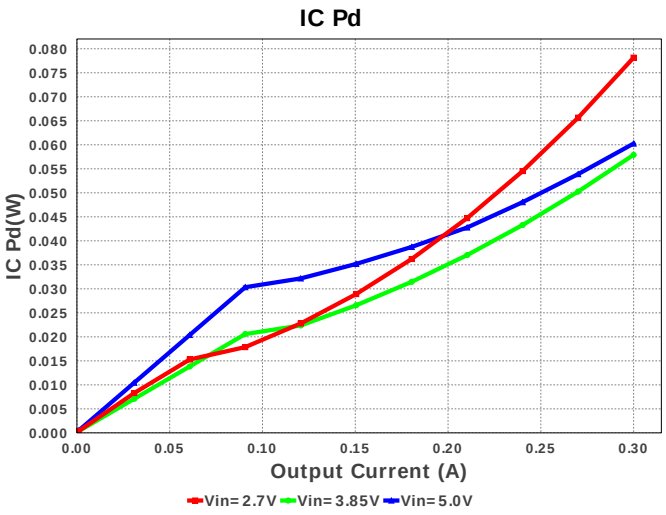

## Cout IRMS

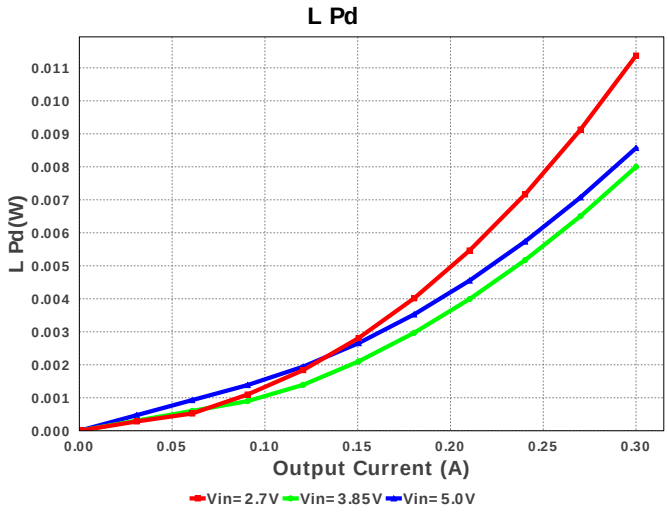



## Cout Pd






## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 46.816 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 87.207 mA | Current | Output capacitor RMS ripple current |
| 3. | IC Ipk | 481.398 mA | Current | Peak switch current in IC |
| 4. | Iin Avg | 399.83 mA | Current | Average input current |
| 5. | L Ipp | 162.18 mA | Current | Peak-to-peak inductor ripple current |
| 6. | BOM Count | 7 | General | Total Design BOM count |
| 7. | FootPrint | 39.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 8. | Frequency | 2.5 MHz | General | Switching frequency |
| 9. | Pout | 990.0 mW | General | Total output power |
| 10. | Total BOM | $1.18 | General | Total BOM Cost |
| 11. | Duty Cycle | 23.368 % | Op_point | Duty cycle |
| 12. | Efficiency | 91.706 % | Op_point | Steady state efficiency |
| 13. | IC Tj | 37.026 degC | Op_point | IC junction temperature |
| 14. | ICThetaJA | 89.9 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 15. | IOUT_OP | 300.0 mA | Op_point | Iout operating point |
| 16. | VIN_OP | 2.7 V | Op_point | Vin operating point |
| 17. | Vout p-p | 1.644 mV | Op_point | Peak-to-peak output ripple voltage |
| 18. | Cin Pd | 0.0 W | Power | Input capacitor power dissipation |
| 19. | Cout Pd | 0.0 W | Power | Output capacitor power dissipation |
| 20. | IC Pd | 78.15 mW | Power | IC power dissipation |
| 21. | L Pd | 11.371 mW | Power | Inductor power dissipation |
| 22. | Total Pd | 89.537 mW | Power | Total Power Dissipation |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 300.0 m | Maximum Output Current |
| 2. | Iout1 | 300.0 m | Output Current #1 |
| 3. | SoftStart | 1.0 ms | Soft Start Time (ms) |
| 4. | VinMax | 5.0 | Maximum input voltage |
| 5. | VinMin | 2.7 | Minimum input voltage |

| # | Name | Value | Description |
|---|---|---|---|
| 6. | Vout | 3.3 | Output Voltage |
| 7. | Vout1 | 3.3 | Output Voltage #1 |
| 8. | base_pn | TPS63051 | Base Product Number |
| 9. | source | DC | Input Source Type |
| 10. | Ta | 30.0 | Ambient temperature |

## Design Assistance

1. **TPS63051** Product Folder : http://www.ti.com/product/TPS63051 : contains the data sheet and other resources.

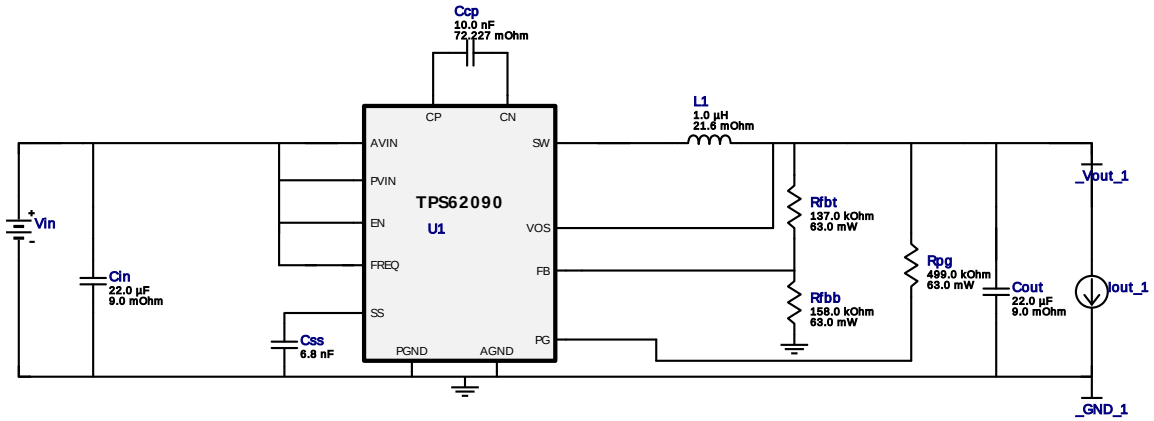
TEXAS INSTRUMENTS

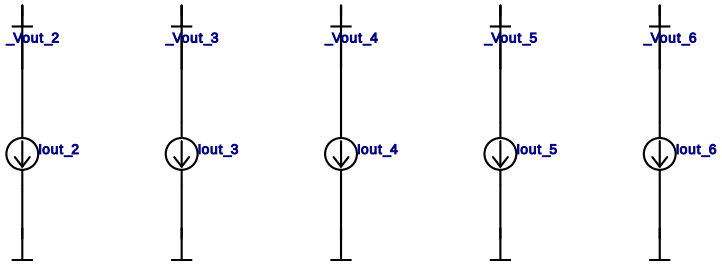
# WEBENCH® Design Report

VinMin = 2.7V
VinMax = 5.0V
Vout = 1.5V
Iout = 1.56A

Device = TPS62090RGTR
Topology = Buck
Created = 7/12/15 6:20:23 AM
BOM Cost = $1.59
Footprint = 82.0 mm²
BOM Count = 9
Total Pd = 0.3W

Design : 4410947/8 TPS62090RGTR
TPS62090RGTR 2.7V-5.0V to 1.50V @ 1.56A

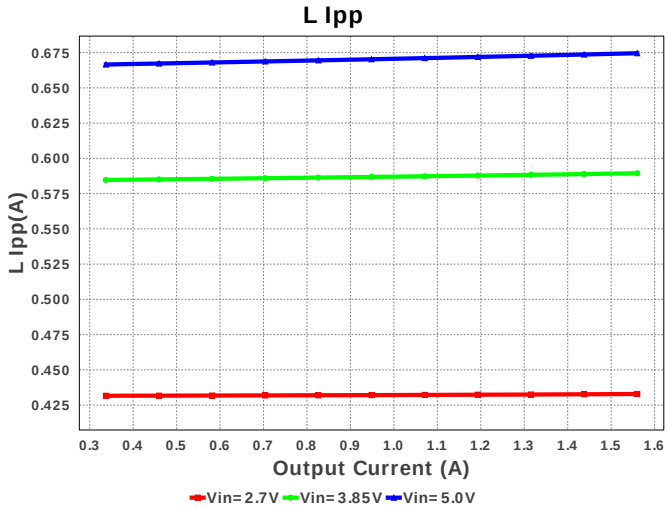


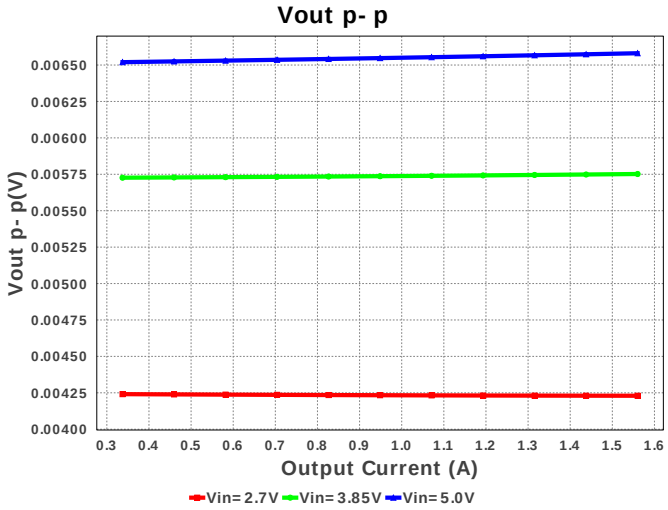



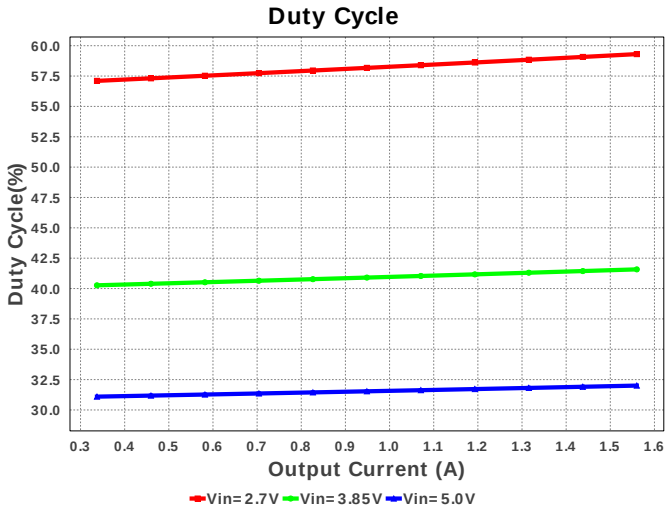

## Electrical BOM

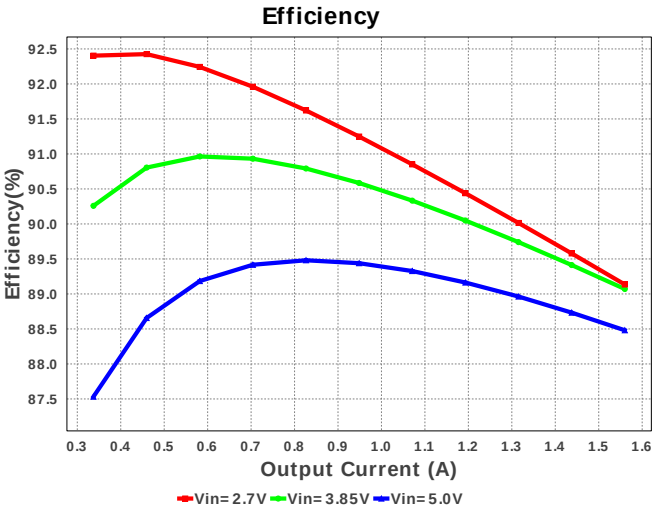
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Ccp | TDK | C1005X7R1E103K<br>Series= X7R | Cap= 10.0 nF<br>ESR= 72.227 mOhm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0402 3 mm² |
| 2. | Cin | MuRata | GRM21BR60J226ME39L<br>Series= X5R | Cap= 22.0 uF<br>ESR= 9.0 mOhm<br>VDC= 6.3 V<br>IRMS= 3.5 A | 1 | $0.05 | 0805 7 mm² |
| 3. | Cout | MuRata | GRM21BR60J226ME39L<br>Series= X5R | Cap= 22.0 uF<br>ESR= 9.0 mOhm<br>VDC= 6.3 V<br>IRMS= 3.5 A | 1 | $0.05 | 0805 7 mm² |
| 4. | Css | MuRata | GRM033R71A682KA01D<br>Series= X7R | Cap= 6.8 nF<br>VDC= 10.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0201 2 mm² |
| 5. | L1 | Bourns | SRP4020-1R0M | L= 1.0 µH<br>DCR= 21.6 mOhm | 1 | $0.49 | SRP4020 29 mm² |
| 6. | Rfbb | Vishay-Dale | CRCW0402158KFKED<br>Series= CRCW..e3 | Res= 158.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm² |

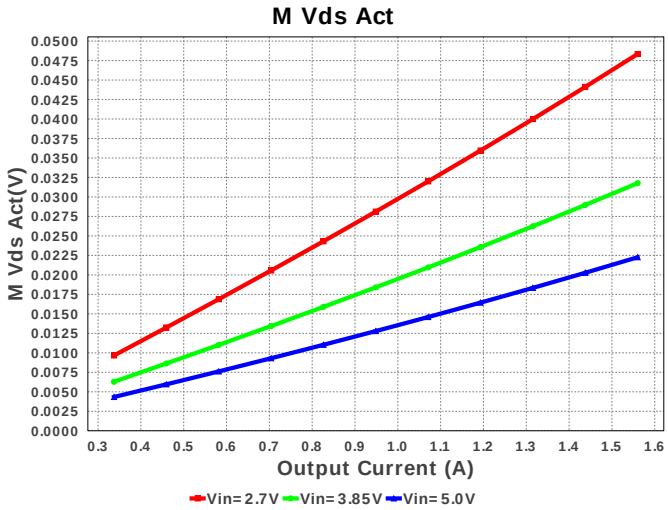
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 7. | Rfbt | Vishay-Dale | CRCW0402137KFKED<br>Series= CRCW..e3 | Res= 137.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| 8. | Rpg | Vishay-Dale | CRCW0402499KFKED<br>Series= CRCW..e3 | Res= 499.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| 9. | U1 | Texas Instruments | TPS62090RGTR | Switcher | 1 | $0.95 | S-PVQFN-N16 25 mm$^2$ |

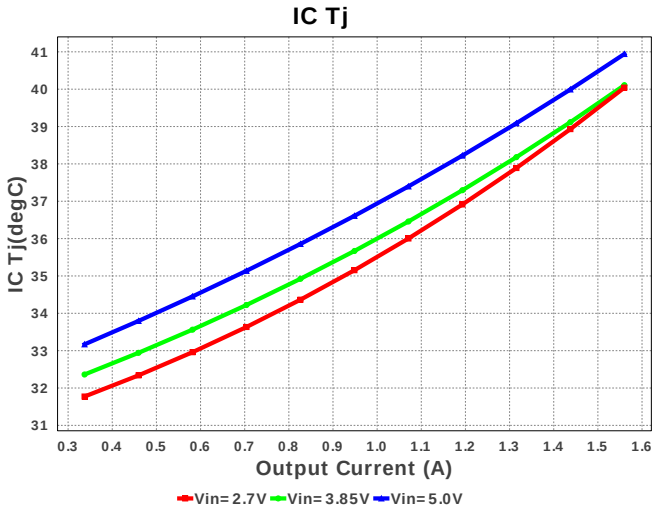


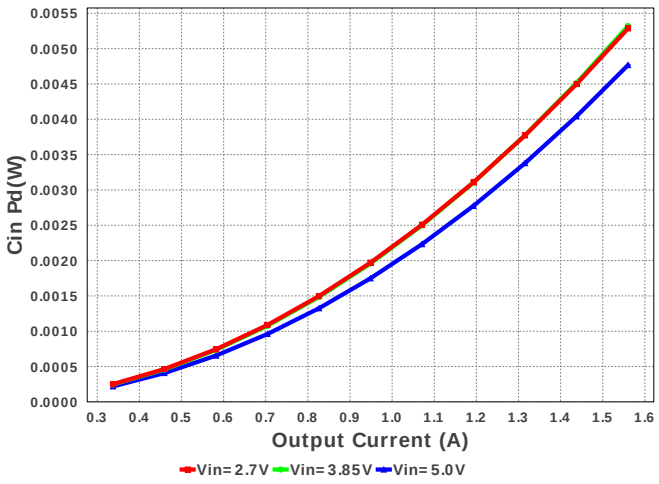



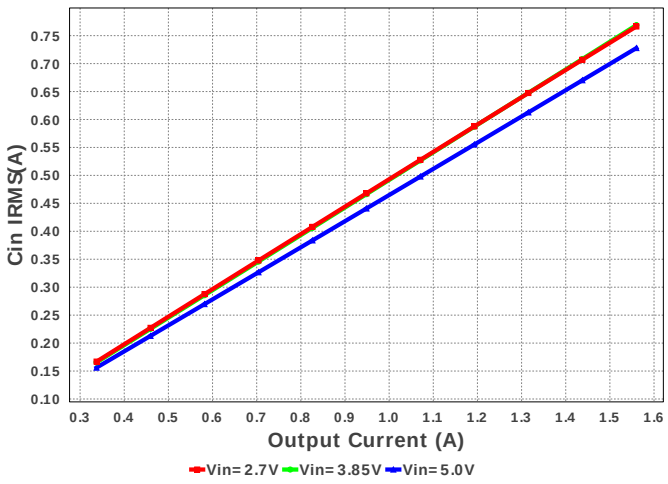



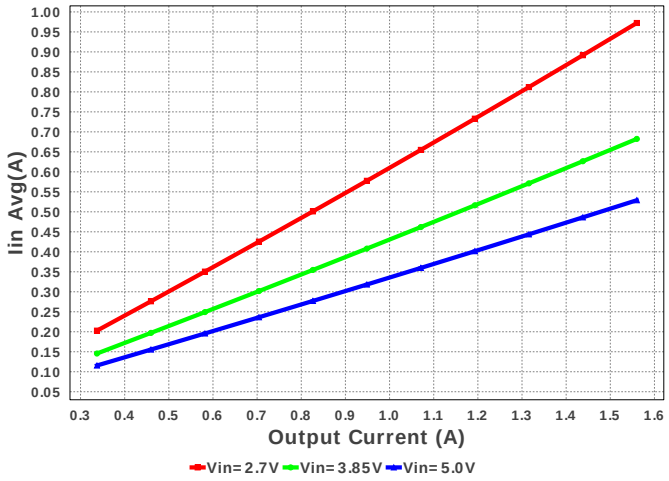
## Cin Pd



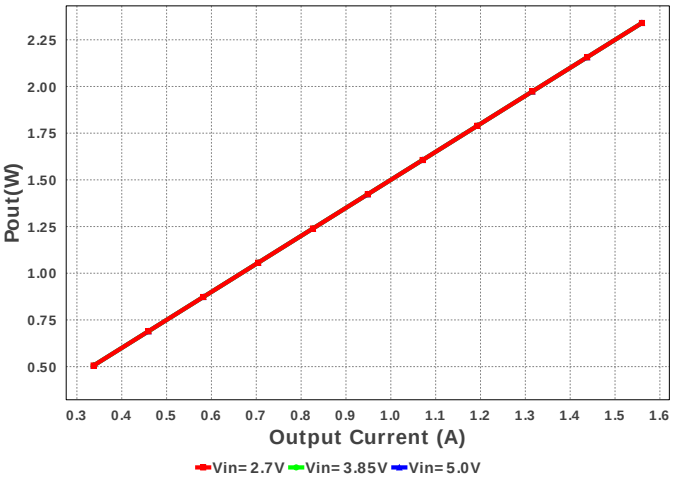

## Cin IRMS



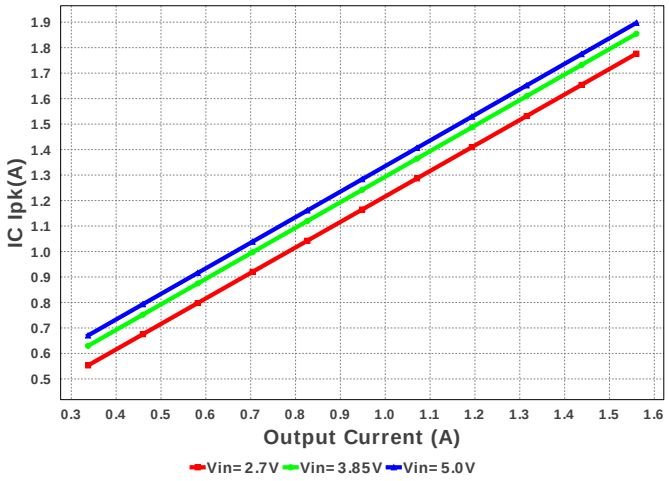

## Iin Avg



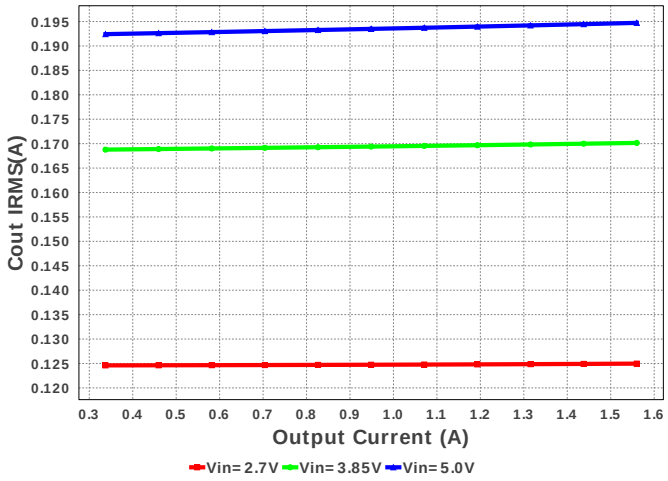

## Pout

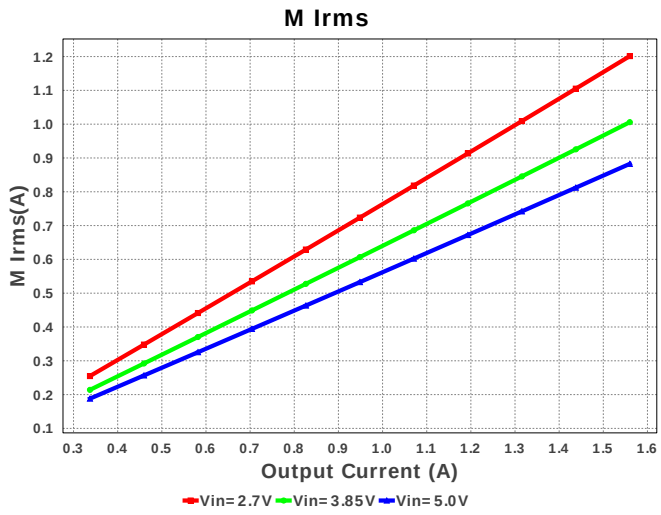


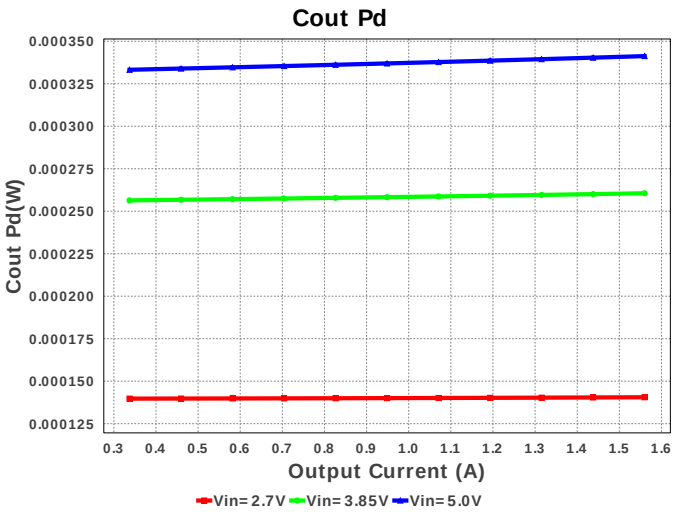

## IC Ipk

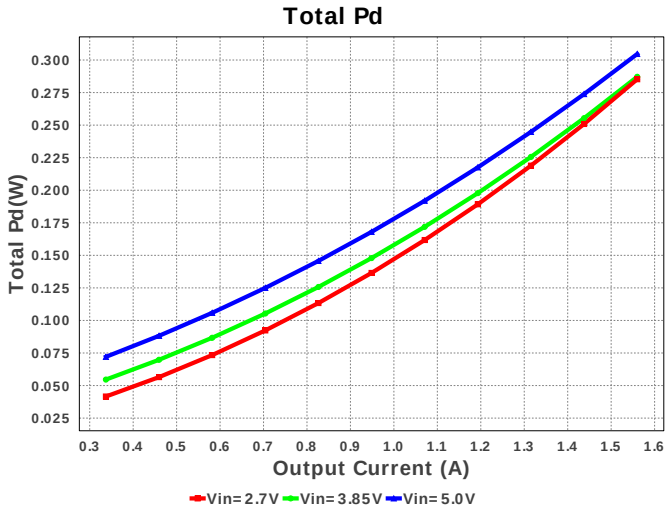


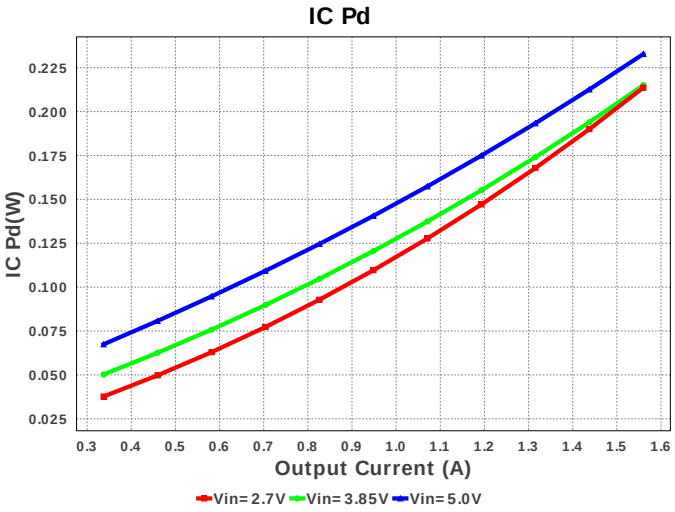

## Cout IRMS

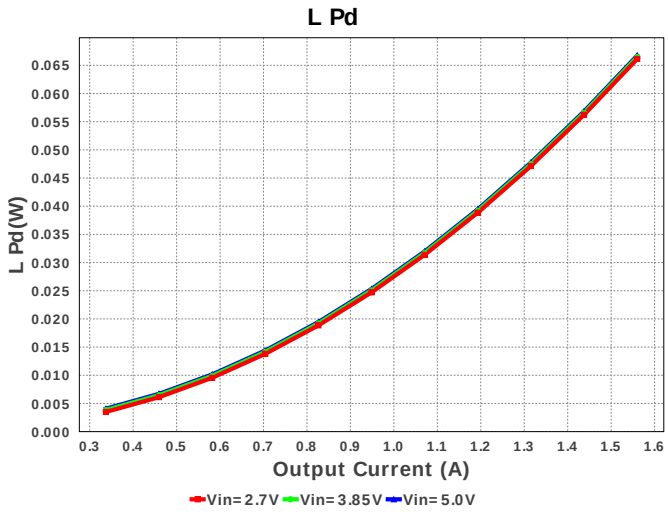





## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 727.744 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 194.725 mA | Current | Output capacitor RMS ripple current |
| 3. | IC Ipk | 1.897 A | Current | Peak switch current in IC |
| 4. | Iin Avg | 528.93 mA | Current | Average input current |
| 5. | L Ipp | 674.55 mA | Current | Peak-to-peak inductor ripple current |
| 6. | M1 Irms | 882.563 mA | Current | Q Iavg |
| 7. | BOM Count | 9 | General | Total Design BOM count |
| 8. | FootPrint | 82.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 9. | Frequency | 1.661 MHz | General | Switching frequency |
| 10. | IC Tolerance | 16.0 mV | General | IC Feedback Tolerance |
| 11. | M Vds Act | 22.262 mV | General | Voltage drop across the MosFET |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 12. | Pout | 2.34 W | General | Total output power |
| 13. | Total BOM | $1.59 | General | Total BOM Cost |
| 14. | Vout OP | 1.5 V | Op_Point | Operational Output Voltage |
| 15. | Duty Cycle | 32.007 % | Op_point | Duty cycle |
| 16. | Efficiency | 88.481 % | Op_point | Steady state efficiency |
| 17. | IC Tj | 40.942 degC | Op_point | IC junction temperature |
| 18. | ICThetaJA | 47.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 19. | IOUT_OP | 1.56 A | Op_point | Iout operating point |
| 20. | VIN_OP | 5.0 V | Op_point | Vin operating point |
| 21. | Vout p-p | 6.581 mV | Op_point | Peak-to-peak output ripple voltage |
| 22. | Cin Pd | 4.766 mW | Power | Input capacitor power dissipation |
| 23. | Cout Pd | 341.262 µW | Power | Output capacitor power dissipation |
| 24. | IC Pd | 232.808 mW | Power | IC power dissipation |
| 25. | L Pd | 66.731 mW | Power | Inductor power dissipation |
| 26. | Total Pd | 304.637 mW | Power | Total Power Dissipation |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 1.56 | Maximum Output Current |
| 2. | Iout1 | 1.56 | Output Current #1 |
| 3. | SoftStart | 1.0 ms | Soft Start Time (ms) |
| 4. | VinMax | 5.0 | Maximum input voltage |
| 5. | VinMin | 2.7 | Minimum input voltage |
| 6. | Vout | 1.5 | Output Voltage |
| 7. | Vout1 | 1.5 | Output Voltage #1 |
| 8. | base_pn | TPS62090 | Base Product Number |
| 9. | source | DC | Input Source Type |
| 10. | Ta | 30.0 | Ambient temperature |

## Design Assistance

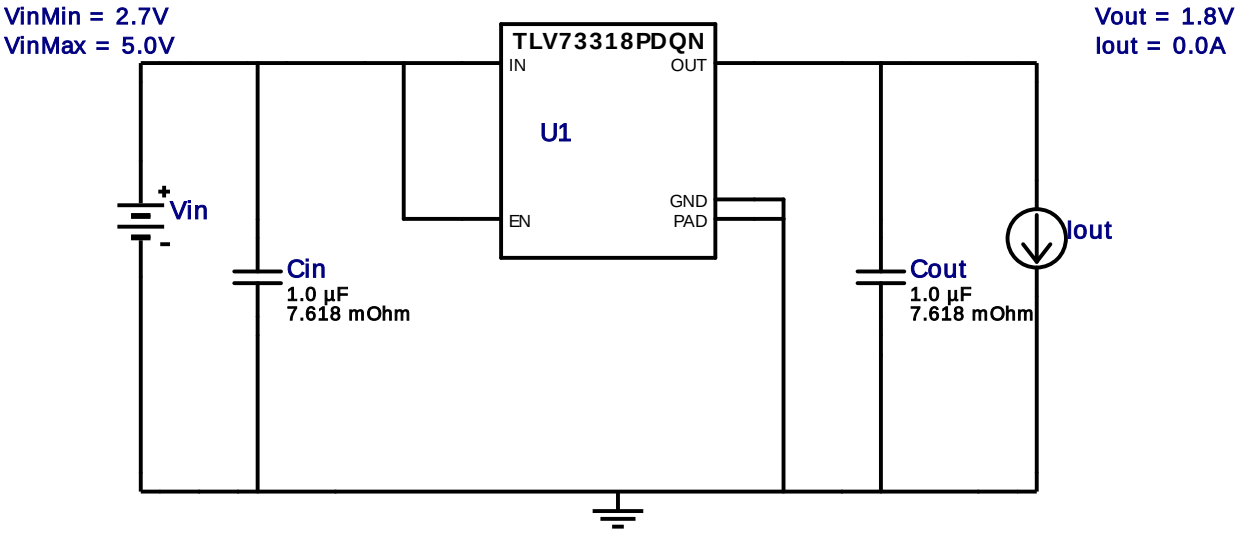
1. **TPS62090** Product Folder : http://www.ti.com/product/TPS62090 : contains the data sheet and other resources.

# WEBENCH® Design Report

VinMin = 2.7V
VinMax = 5.0V
Vout = 1.8V
Iout = 0.0A

Device = TLV73318PDQNR
Topology = LDO
Created = 7/12/15 6:20:24 AM
BOM Cost = $0.19
Footprint = 10.0 mm²
BOM Count = 3
Total Pd = 0.0W

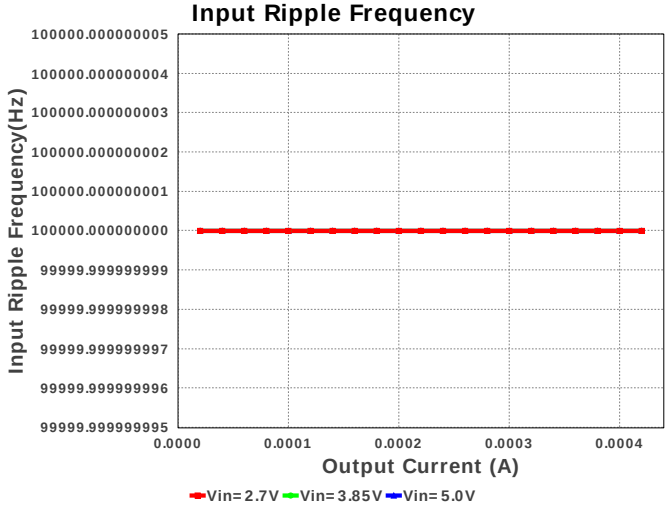
Design : 4410947/9 TLV73318PDQNR
TLV73318PDQNR 2.7V-5.0V to 1.80V @ 4.0E-4A



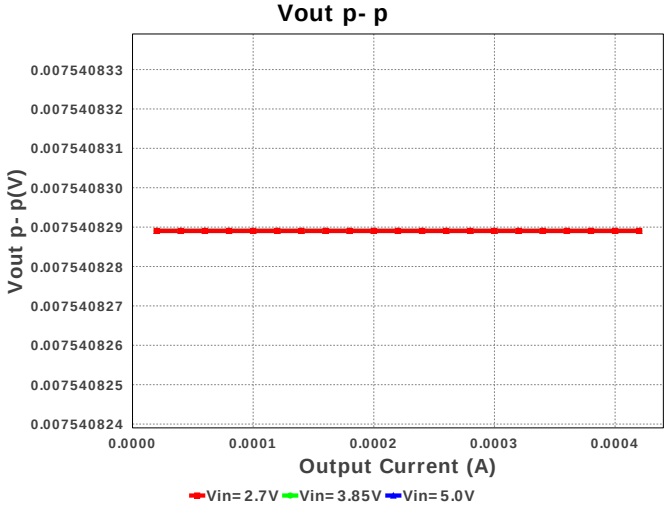

## Electrical BOM

| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cin | TDK | C1005X5R0J105M<br>Series= X5R | Cap= 1.0 uF<br>ESR= 7.618 mOhm<br>VDC= 6.3 V<br>IRMS= 0.0 A | 1 | $0.01 | 0402 3 mm² |
| 2. | Cout | TDK | C1005X5R0J105M<br>Series= X5R | Cap= 1.0 uF<br>ESR= 7.618 mOhm<br>VDC= 6.3 V<br>IRMS= 0.0 A | 1 | $0.01 | 0402 3 mm² |
| 3. | U1 | Texas Instruments | TLV73318PDQNR | Switcher | 1 | $0.17 | DQN0004A 4 mm² |

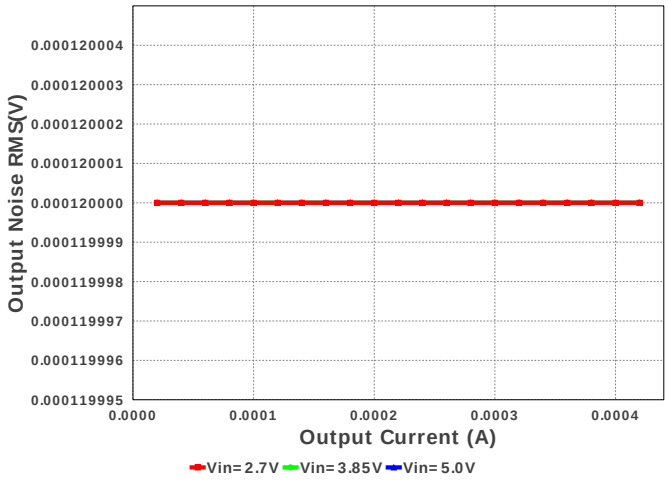
### Input Ripple Frequency



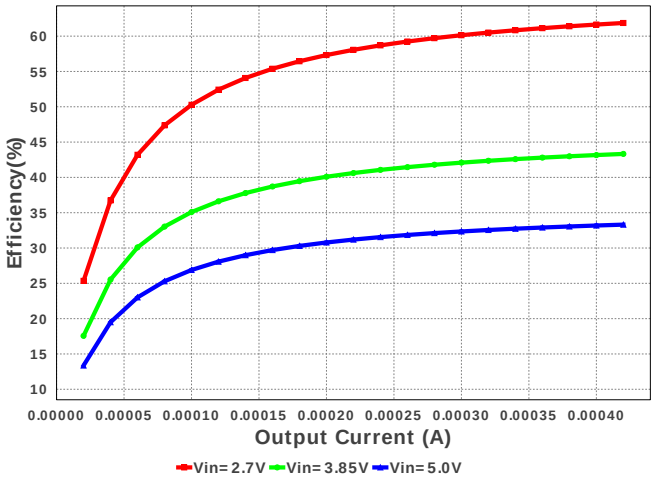

### Vout p- p



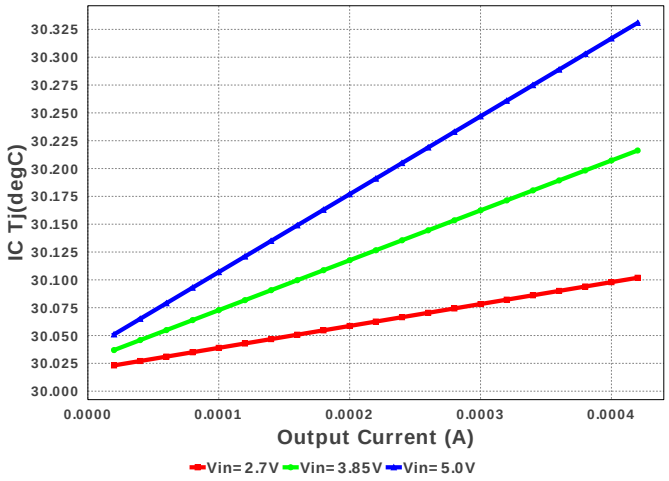

### Output Noise RMS



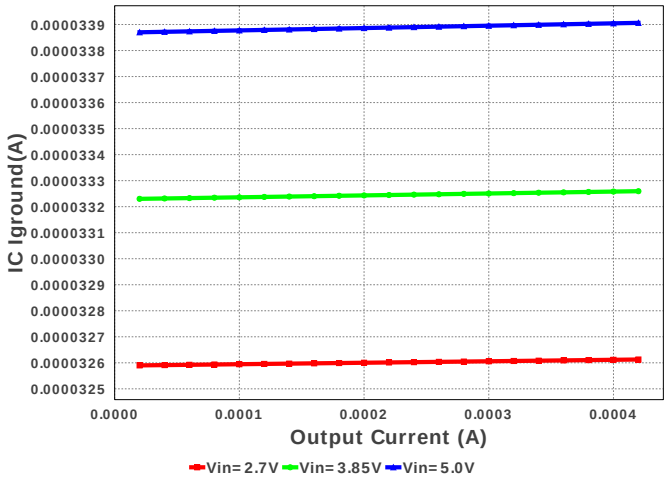

### Efficiency

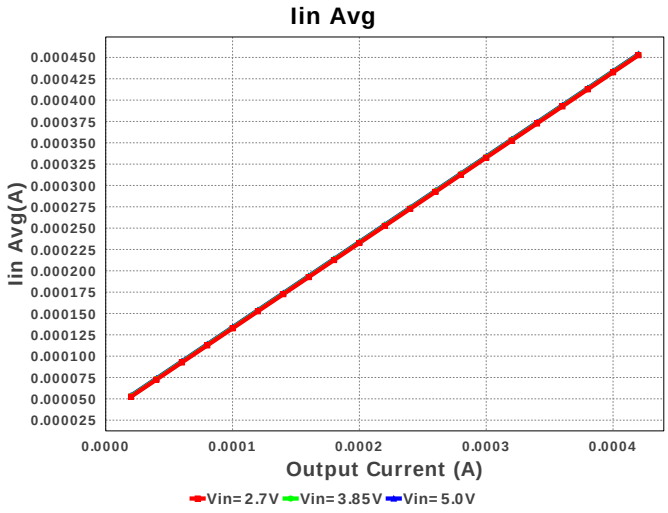


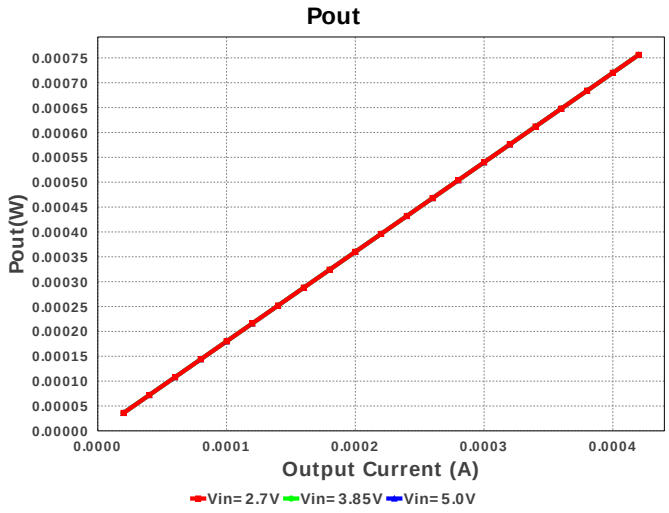

### IC Tj

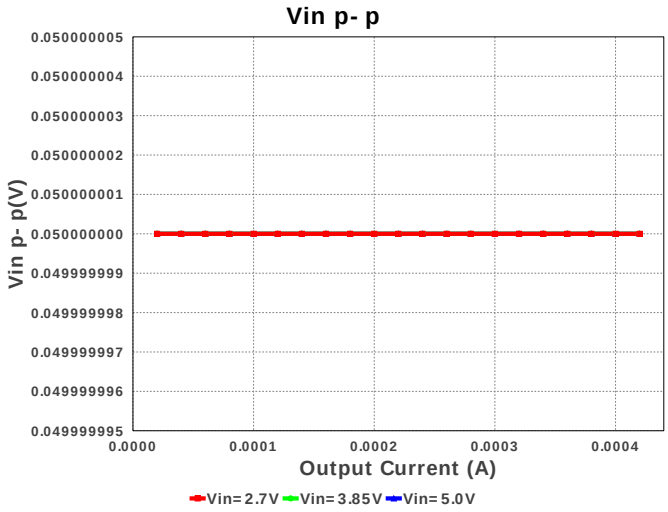


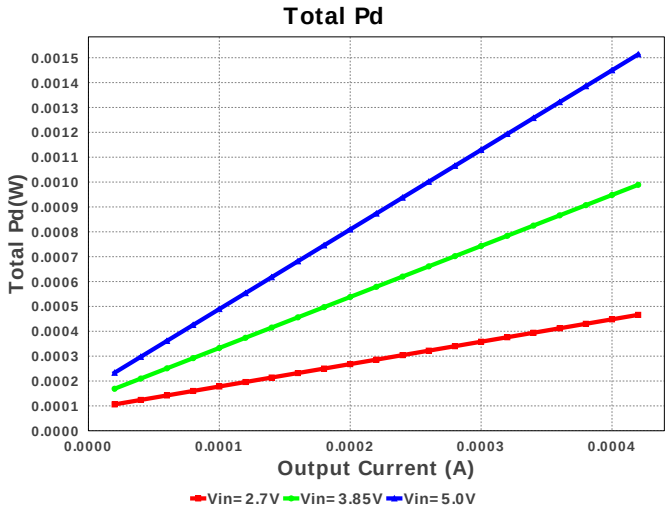

### IC Iground

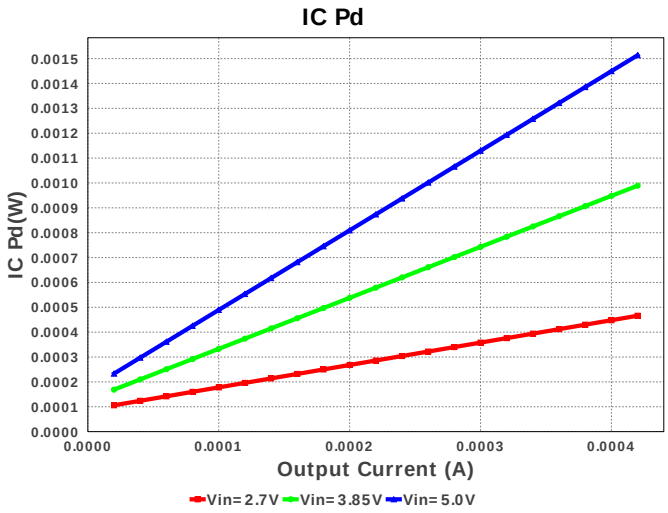


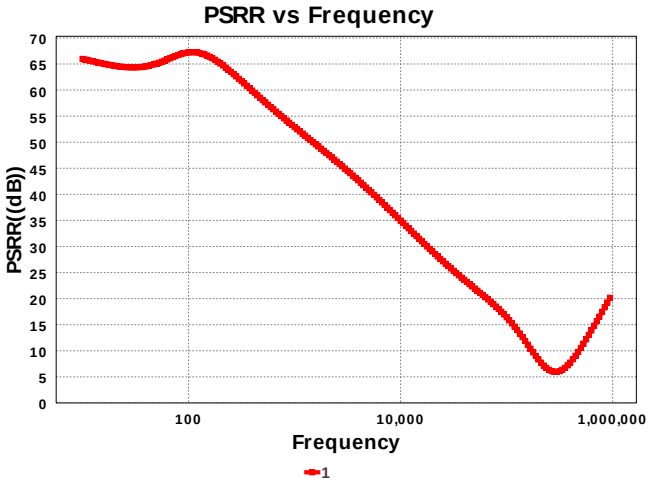



## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | IC Iground | 33.904 µA | Current | IC ground current |
| 2. | Iin Avg | 433.9 µA | Current | Average input current |
| 3. | BOM Count | 3 | General | Total Design BOM count |
| 4. | FootPrint | 10.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 5. | IC Tolerance | 25.2 mV | General | IC Feedback Tolerance |
| 6. | Output Noise RMS | 120.0 µV | General | Noise RMS |
| 7. | Pout | 720.0 µW | General | Total output power |
| 8. | Total BOM | $0.19 | General | Total BOM Cost |
| 9. | Vin p-p | 50.0 mV | Op_Point | Input Source ripple voltage |
| 10. | Vout OP | 1.8 V | Op_Point | Operational Output Voltage |
| 11. | Efficiency | 33.187 % | Op_point | Steady state efficiency |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 12. | IC Tj | 30.317 degC | Op_point | IC junction temperature |
| 13. | ICThetaJA | 218.6 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 14. | IOUT_OP | 400.0 µA | Op_point | Iout operating point |
| 15. | Input Ripple Frequency | 100.0 kHz | Op_point | Input Source Ripple Frequency for PSRR Calculation |
| 16. | PSRR est. | -16.431 dB | Op_point | Power Supply Rejection Ratio estimated |
| 17. | VIN_OP | 5.0 V | Op_point | Vin operating point |
| 18. | Vout p-p | 7.541 mV | Op_point | Peak-to-peak output ripple voltage |
| 19. | IC Pd | 1.45 mW | Power | IC power dissipation |
| 20. | Total Pd | 1.45 mW | Power | Total Power Dissipation |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 400.0 µ | Maximum Output Current |
| 2. | Iout1 | 400.0 µ | Output Current #1 |
| 3. | VinMax | 5.0 | Maximum input voltage |
| 4. | VinMin | 2.7 | Minimum input voltage |
| 5. | Vout | 1.8 | Output Voltage |
| 6. | Vout1 | 1.8 | Output Voltage #1 |
| 7. | base_pn | TLV73318P | Base Product Number |
| 8. | source | DC | Input Source Type |
| 9. | Ta | 30.0 | Ambient temperature |

## Design Assistance

1.

2. **TLV73318P** Product Folder : http://www.ti.com/product/TLV733 : contains the data sheet and other resources.