

# WEBENCH® Power Architect

## Project Report

Project : 1165565/6 : PA\_Project\_326 (modified from 302)

Created : 2016-07-13 01:07:10.160

### Project Summary

|                                   |                       |
|-----------------------------------|-----------------------|
| 1. Total System Efficiency        | 78.183 %              |
| 2. Total System BOM Count         | 10.0                  |
| 3. Total System Footprint         | 245.0 mm <sup>2</sup> |
| 4. Total System BOM Cost          | \$2.50                |
| 5. Total System Power Dissipation | 460.4 mW              |

--> Launch WEBENCH Power Architect.

## Sequencer Flag Table

| Supply       | Sequencer Flag | Load   | Load Name |
|--------------|----------------|--------|-----------|
| PMU_1 (Ch 1) | NaN            | LOAD_1 | LOAD #1   |
| SUPPLY_1     | NA             |        |           |

## Power Supplies

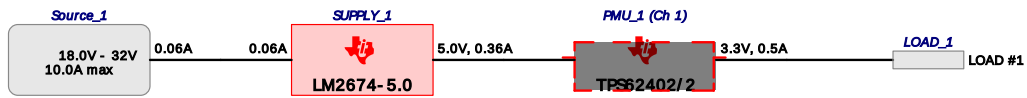
| #  | Name         | NSID       | Description                                                | Vout  | Iout    | Efficiency | Foot-print | Cost   | Design | Page |
|----|--------------|------------|------------------------------------------------------------|-------|---------|------------|------------|--------|--------|------|
| 1. | SUPPLY_1     | LM2674-5.0 | Switcher : Third Generation SIMPLE SWITCHER                | 5.0 V | 0.356 A | 83.9%      | 237        | \$1.65 | 19     | 9    |
| 2. | PMU_1 (Ch 1) | TPS62402/2 | Buck : 2.25-MHz 400-mA and 600-mA Dual Step-Down Converter | 3.3 V | 0.5 A   | 92.6%      | 34         | \$0.00 | 18     | 4    |

## Power Loads

| #  | Name    | VLoad | ILoad | Description    |
|----|---------|-------|-------|----------------|
| 1. | LOAD #1 | 3.3 V | 0.5 A | VoutRipple=10% |

## Project Diagram

WEBENCH® Power Architect Project ID : 6 PA\_Project\_326 (modified from 302) Power Architect 2016-07-13 01:07:10.160



## Electrical Procurement BOM

| Manufacturer      | Part Number        | Description | Quantity | Budgetary Price        | Footprint<br>(mm <sup>2</sup> ) |
|-------------------|--------------------|-------------|----------|------------------------|---------------------------------|
| Kemet             | C0805C104K5RACTU   | 0805        | 1        | \$0.01                 | 7                               |
| MuRata            | GRM188R60J106ME47D | 0603        | 1        | \$0.02                 | 5                               |
| MuRata            | GRM216R71H103KA01D | 0805        | 1        | \$0.01                 | 7                               |
| MuRata            | GRM21BR71H105KA12L | 0805        | 1        | \$0.05                 | 7                               |
| MuRata            | GRM31CR61A226KE19L | 1206_190    | 1        | \$0.07                 | 11                              |
| Texas Instruments | LM2674MX-5.0/NOPB  | M08A        | 1        | \$1.20                 | 55                              |
| TDK               | NLCV32T-4R7M-PFR   | NLCV32      | 1        | \$0.10                 | 13                              |
| NXP Semiconductor | PMEG6010CEH,115    | SOD-123F    | 1        | \$0.04                 | 12                              |
| Texas Instruments | TPS62402DRCR       | DRC0010J    | 1        | \$0.78                 | 16                              |
| TDK               | VLP8040T-221M      | VLP8040     | 1        | \$0.22                 | 113                             |
| Total             |                    |             | 10       | \$2450.609999999999999 |                                 |

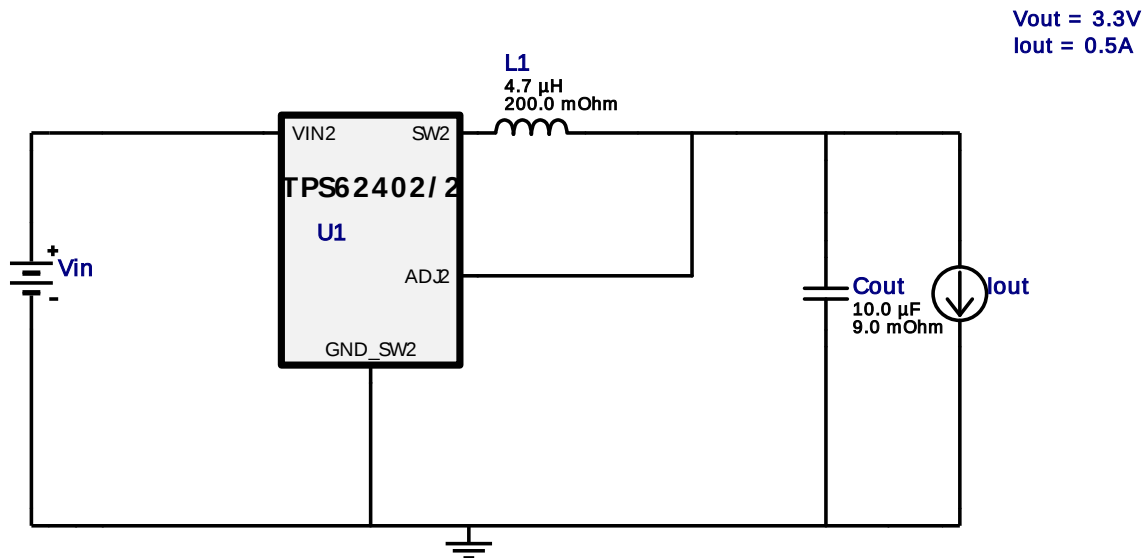


Vout = 3.3V  
Iout = 0.5A

Device = TPS62402DRCR  
Topology = Buck  
Created = 7/13/16 1:07:09 AM  
BOM Cost = \$0.90  
BOM Count = 3  
Total Pd = 0.14W

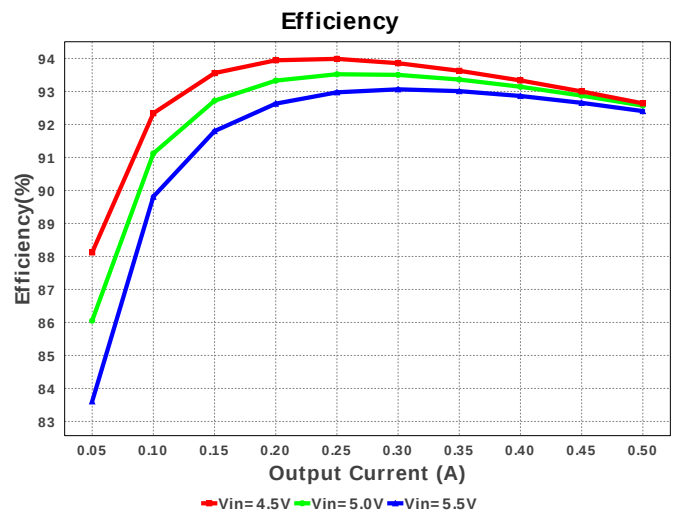
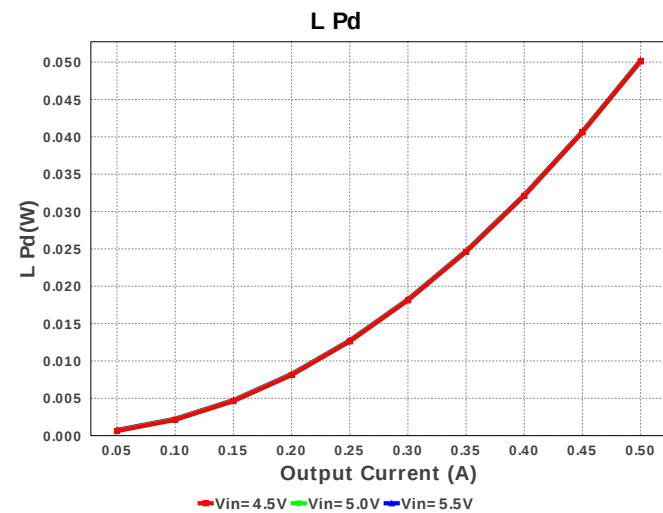
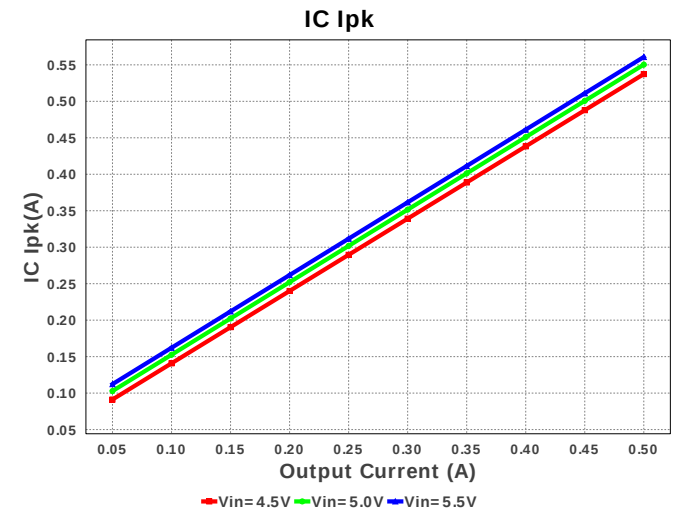
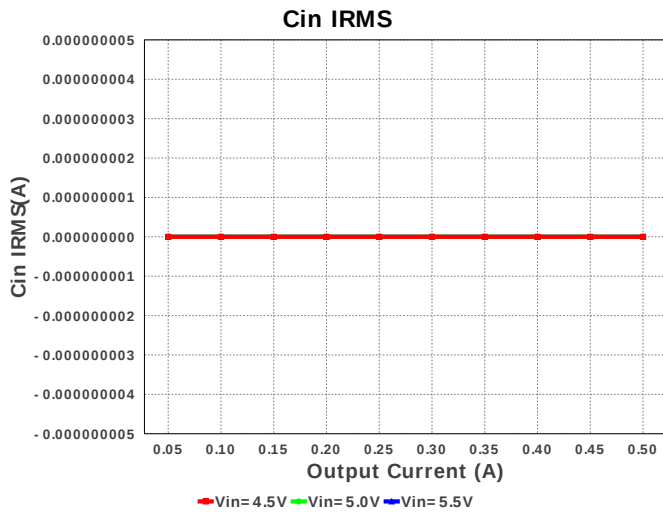
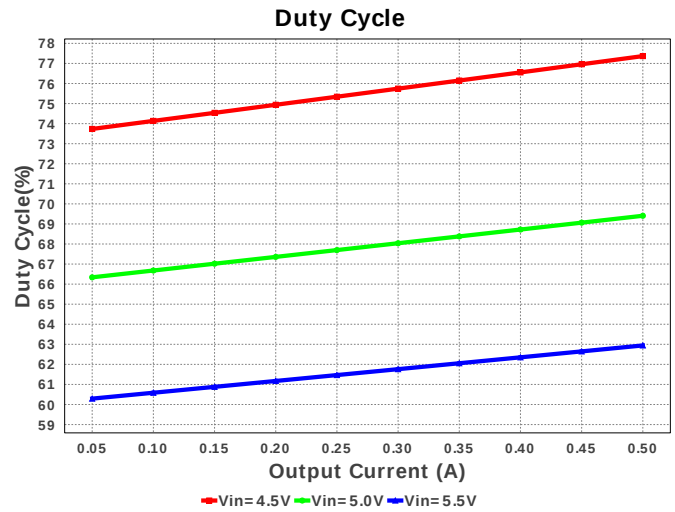
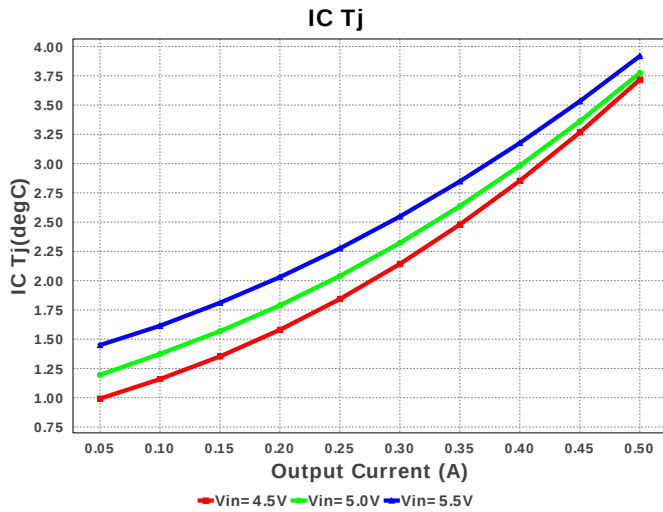
## WEBENCH® Design Report

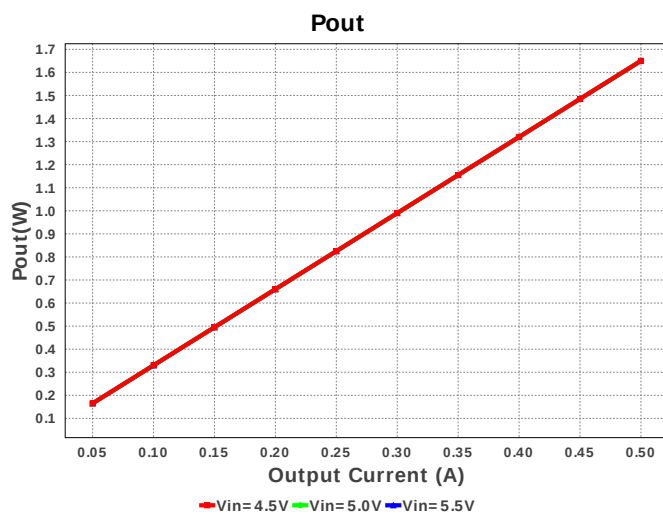
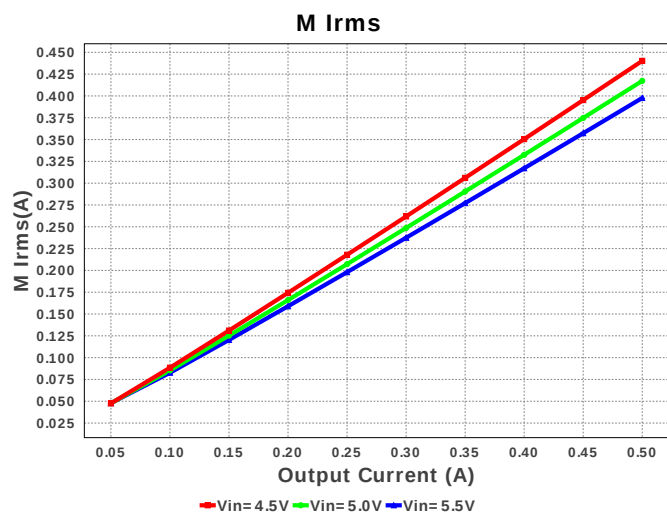
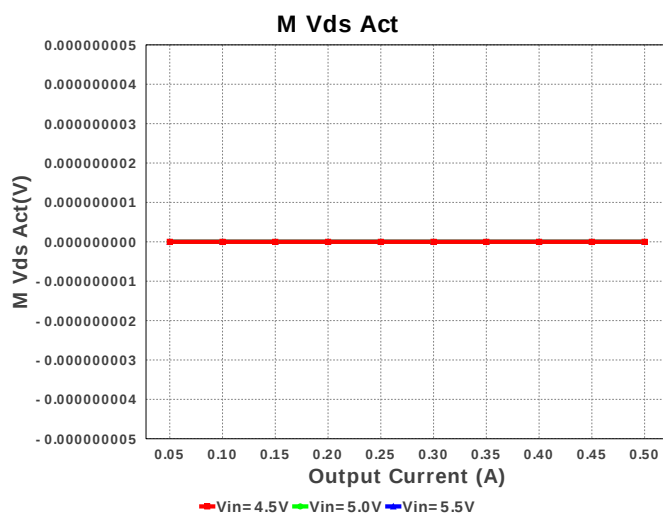
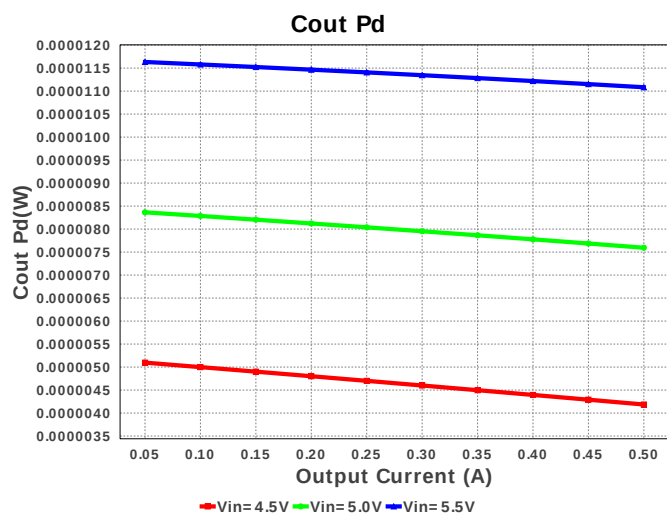
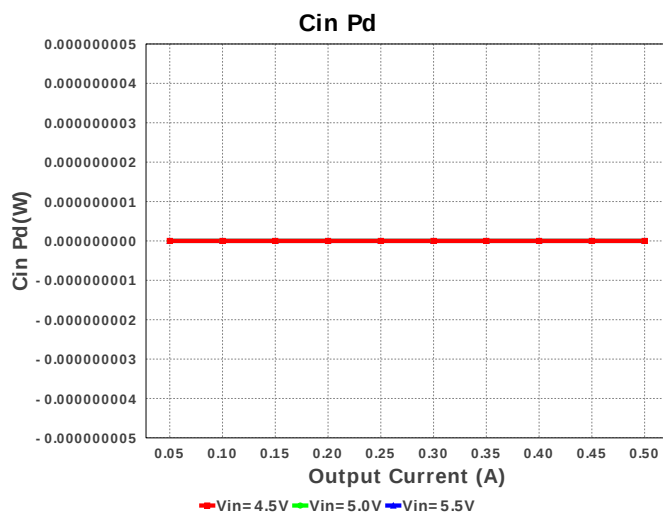
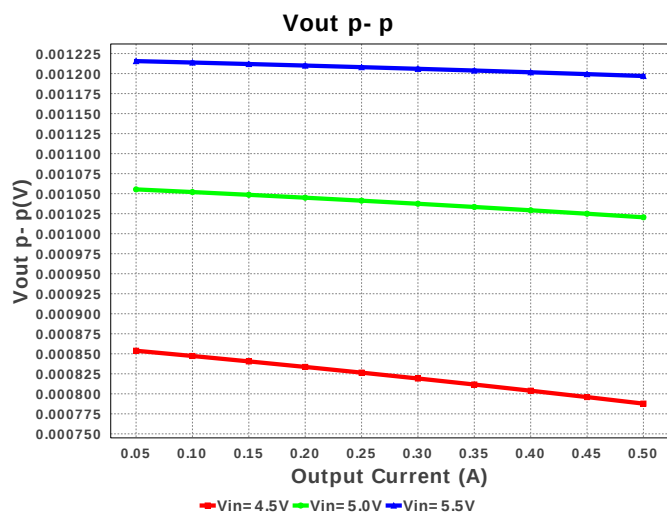
Design : 1165565/18 TPS62402DRCR  
TPS62402DRCR 4.5V-5.5V to 3.30V @ 0.5A

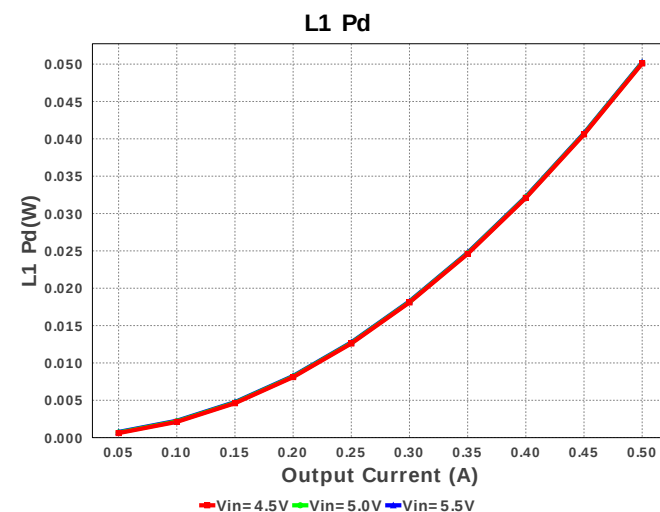
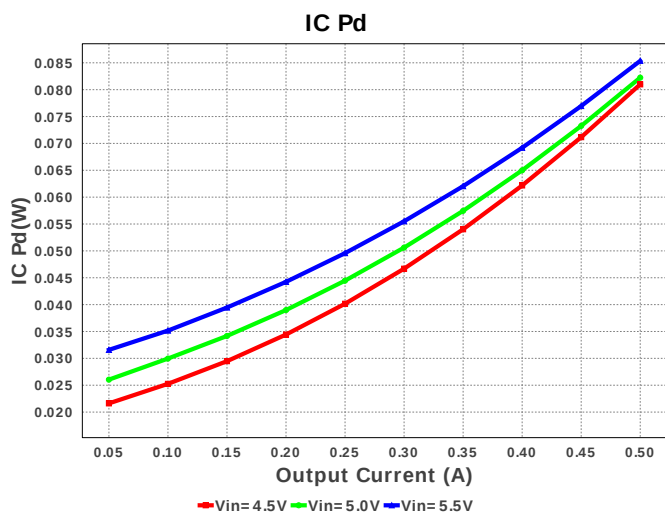
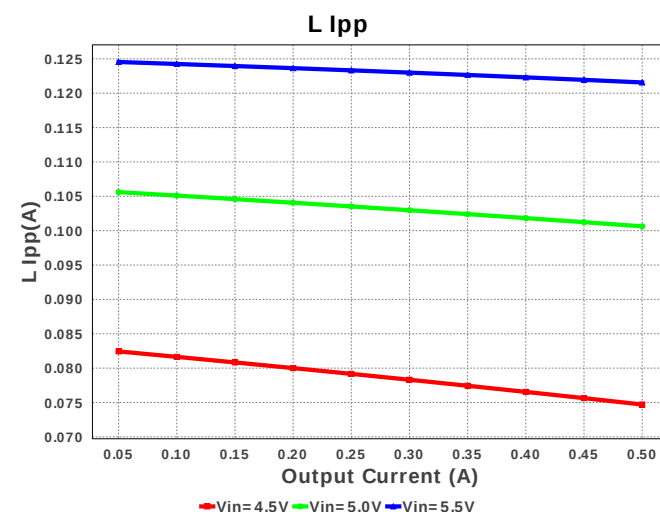
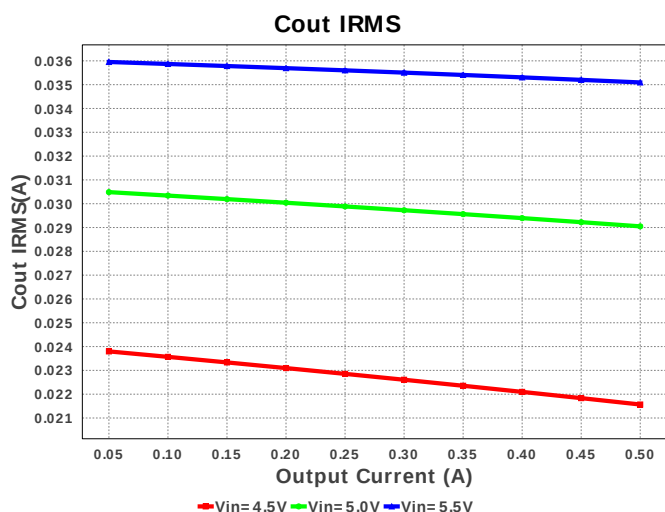
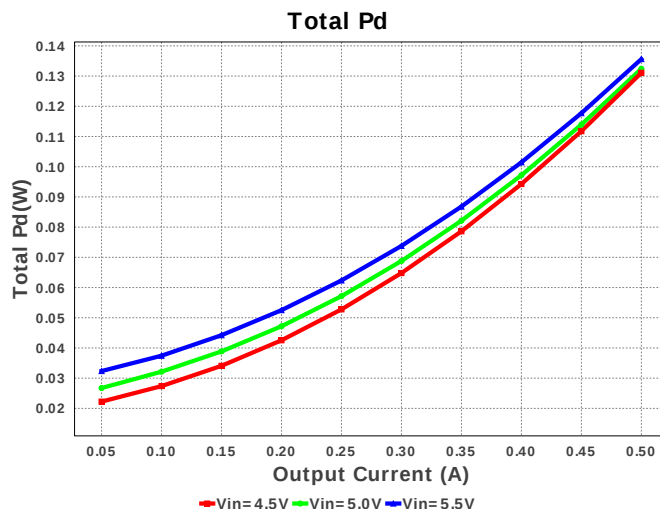
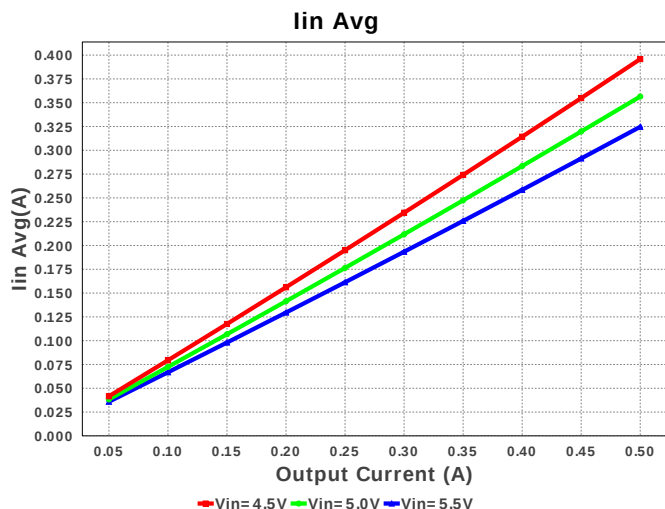


### Electrical BOM

| #  | Name | Manufacturer      | Part Number                       | Properties                                                  | Qty | Price  | Footprint                   |
|----|------|-------------------|-----------------------------------|-------------------------------------------------------------|-----|--------|-----------------------------|
| 1. | Cout | MuRata            | GRM188R60J106ME47D<br>Series= X5R | Cap= 10.0 uF<br>ESR= 9.0 mOhm<br>VDC= 6.3 V<br>IRMS= 2.74 A | 1   | \$0.02 | 0603 5 mm <sup>2</sup>      |
| 2. | L1   | TDK               | NLCV32T-4R7M-PFR                  | L= 4.7 µH<br>DCR= 200.0 mOhm                                | 1   | \$0.10 | NLCV32 13 mm <sup>2</sup>   |
| 3. | U1   | Texas Instruments | TPS62402DRCR                      | Switcher                                                    | 1   | \$0.78 | DRC0010J 16 mm <sup>2</sup> |







## Operating Values

| #   | Name         | Value                | Category | Description                             |
|-----|--------------|----------------------|----------|-----------------------------------------|
| 1.  | Cin IRMS     | 0.0 A                | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS    | 35.093 mA            | Current  | Output capacitor RMS ripple current     |
| 3.  | IC Ipk       | 560.783 mA           | Current  | Peak switch current in IC               |
| 4.  | Iin Avg      | 324.66 mA            | Current  | Average input current                   |
| 5.  | L Ipp        | 121.57 mA            | Current  | Peak-to-peak inductor ripple current    |
| 6.  | M Irms       | 397.66 mA            | Current  | MOSFET RMS current                      |
| 7.  | BOM Count    | 3                    | General  | Total Design BOM count                  |
| 8.  | FootPrint    | 34.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |
| 9.  | Frequency    | 2.25 MHz             | General  | Switching frequency                     |
| 10. | IC Tolerance | 10.0 mV              | General  | IC Feedback Tolerance                   |
| 11. | M Vds Act    | 0.0 V                | General  | Voltage drop across the MosFET          |

| #   | Name           | Value          | Category | Description                                                                                |
|-----|----------------|----------------|----------|--------------------------------------------------------------------------------------------|
| 12. | Pout           | 1.65 W         | General  | Total output power                                                                         |
| 13. | Total BOM      | \$0.9          | General  | Total BOM Cost                                                                             |
| 14. | Vout OP        | 3.3 V          | Op_Point | Operational Output Voltage                                                                 |
| 15. | Duty Cycle     | 62.943 %       | Op_point | Duty cycle                                                                                 |
| 16. | Efficiency     | 92.405 %       | Op_point | Steady state efficiency                                                                    |
| 17. | IC Tj          | 3.918 degC     | Op_point | IC junction temperature                                                                    |
| 18. | ICThetaJA      | 45.9 degC/W    | Op_point | IC junction-to-ambient thermal resistance                                                  |
| 19. | IOUT_OP        | 500.0 mA       | Op_point | Iout operating point                                                                       |
| 20. | VIN_OP         | 5.5 V          | Op_point | Vin operating point                                                                        |
| 21. | Vout p-p       | 1.197 mV       | Op_point | Peak-to-peak output ripple voltage                                                         |
| 22. | Cin Pd         | 0.0 W          | Power    | Input capacitor power dissipation                                                          |
| 23. | Cout Pd        | 11.084 $\mu$ W | Power    | Output capacitor power dissipation                                                         |
| 24. | IC Pd          | 85.36 mW       | Power    | IC power dissipation                                                                       |
| 25. | L Pd           | 50.246 mW      | Power    | Inductor power dissipation                                                                 |
| 26. | L1 Pd          | 50.246 mW      | Power    | Power Dissipation in the Inductor                                                          |
| 27. | Total Pd       | 135.619 mW     | Power    | Total Power Dissipation                                                                    |
| 28. | Vout Tolerance | 303.03 m%      |          | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

## Design Inputs

| #  | Name    | Value      | Description                        |
|----|---------|------------|------------------------------------|
| 1. | Iout    | 500.0 m    | Maximum Output Current             |
| 2. | VinMax  | 5.5        | Maximum input voltage              |
| 3. | VinMin  | 4.5        | Minimum input voltage              |
| 4. | Vout    | 3.3        | Output Voltage                     |
| 5. | base_pn | TPS62402/2 | Texas Instruments Base Part Number |
| 6. | source  | DC         | Input Source Type                  |
| 7. | ta      | 0.0        | Ambient temperature                |

## Design Assistance

1. TPS62402/2 Product Folder : <http://www.ti.com/product/tps62402> : contains the data sheet and other resources.

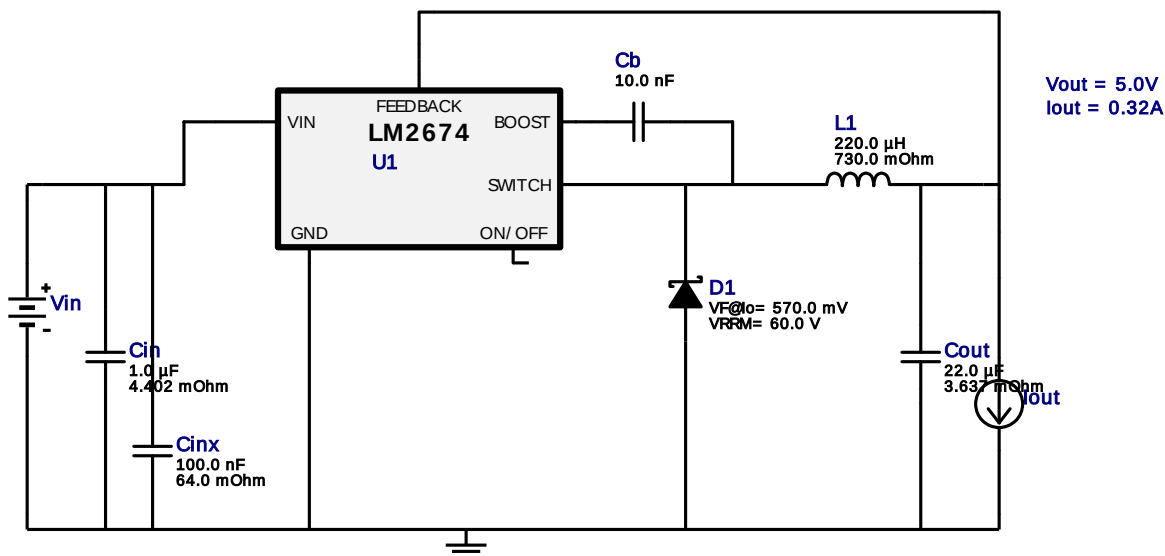


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Iout = 0.32A

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Topology = Buck  
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BOM Cost = \$1.60  
BOM Count = 7  
Total Pd = 0.32W

## WEBENCH® Design Report

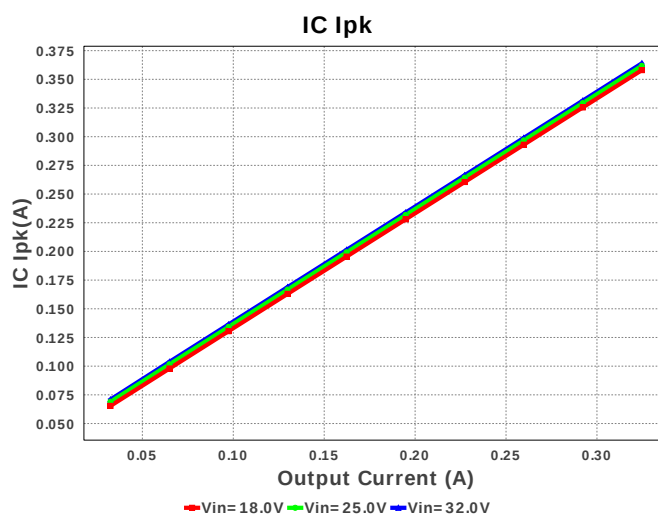
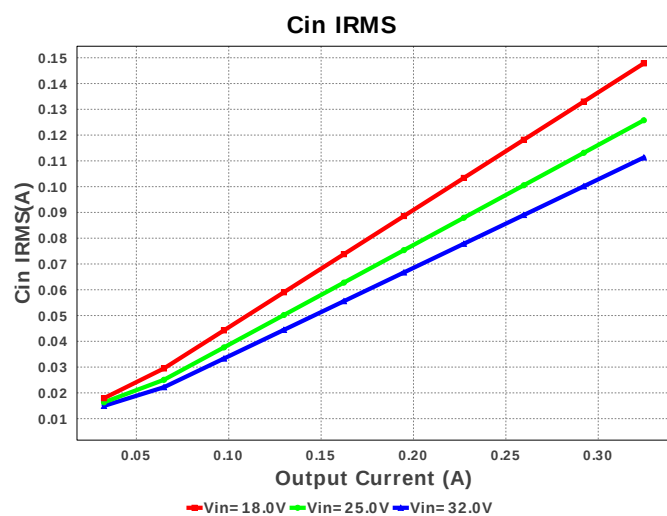
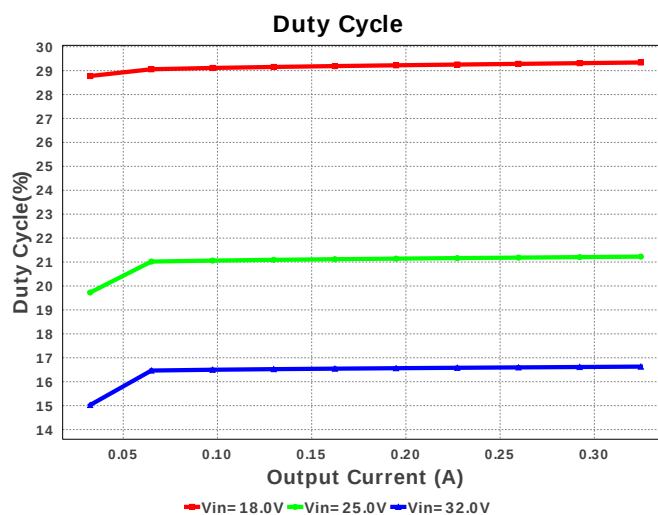
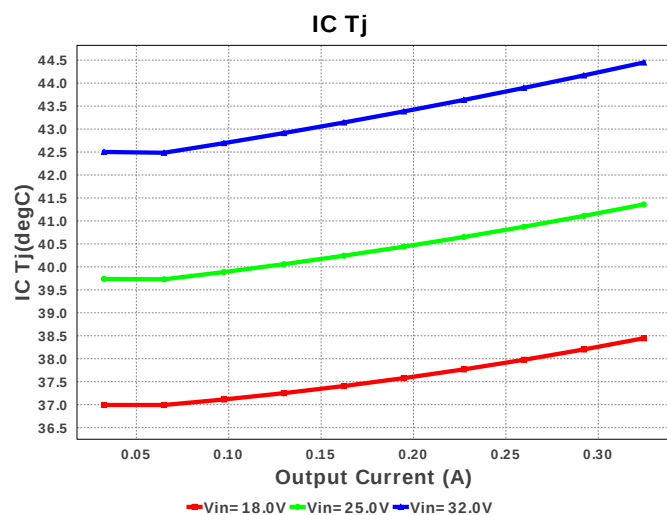
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LM2674MX-5.0/NOPB 18.0V-32.0V to 5.00V @ 0.32466A

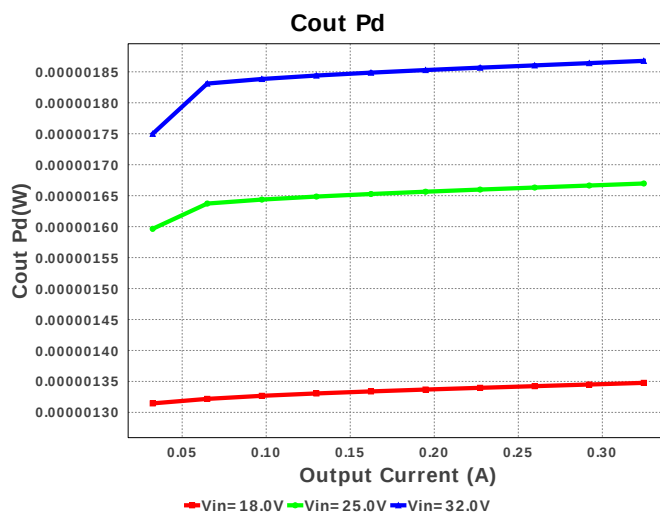
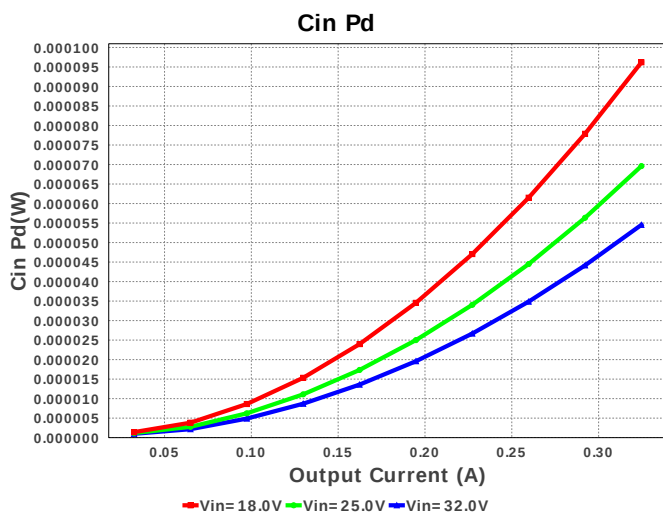
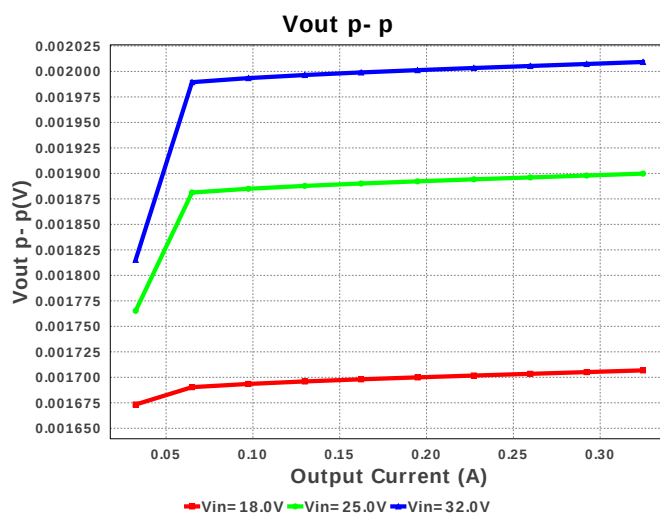
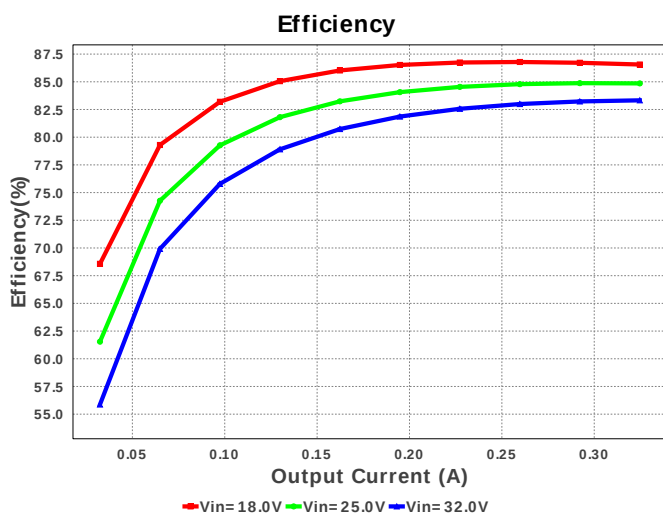
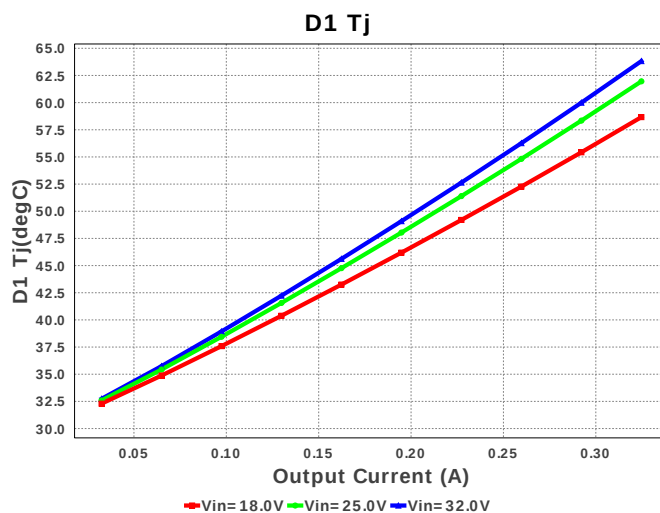
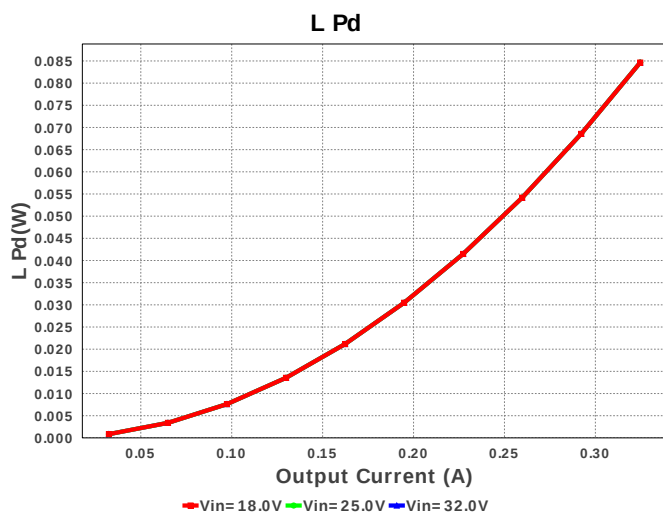


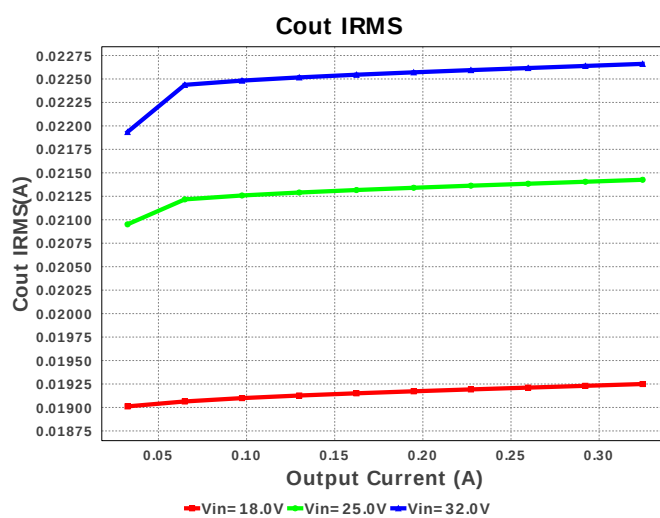
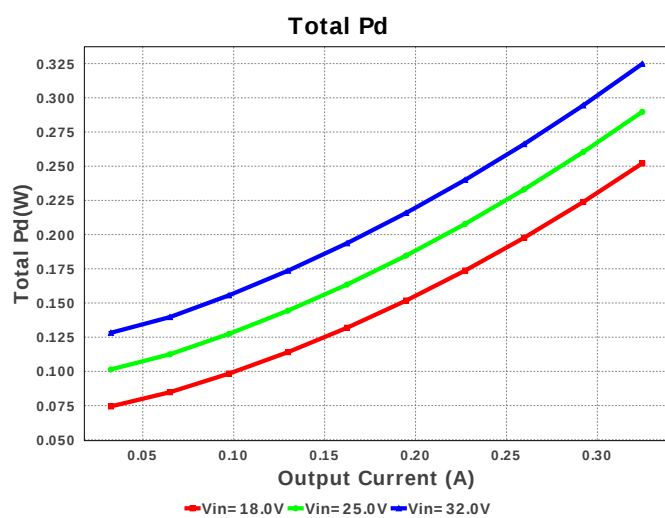
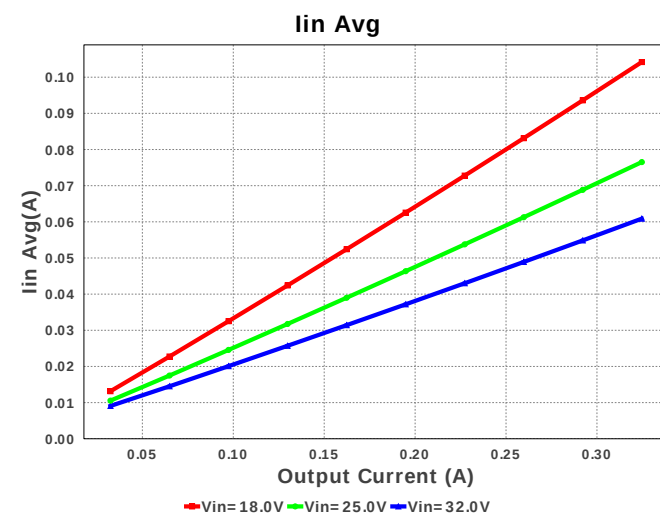
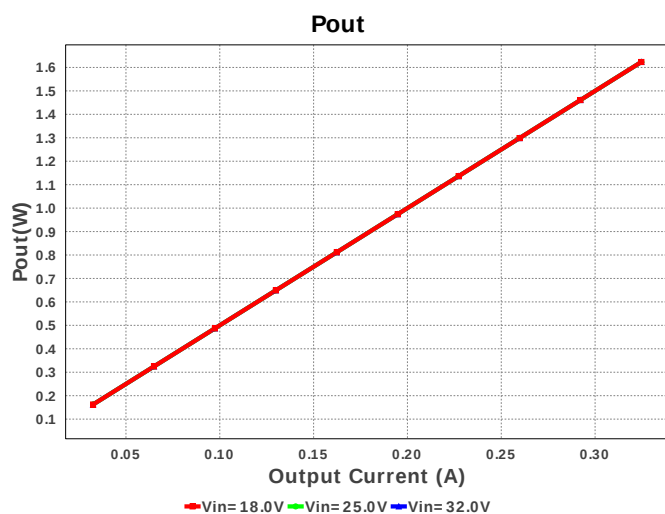
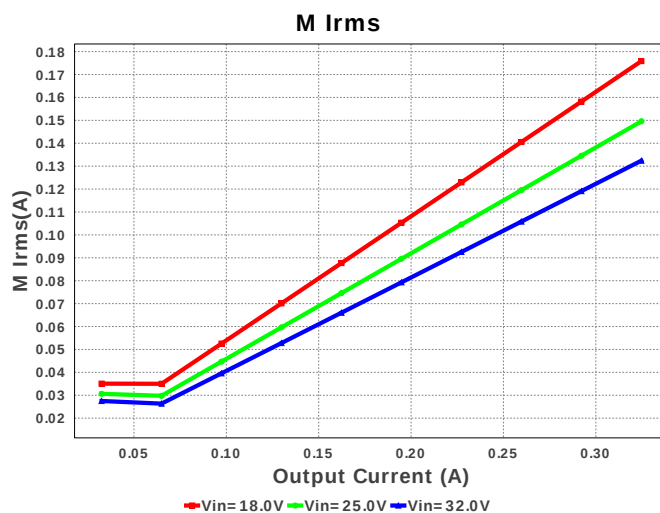
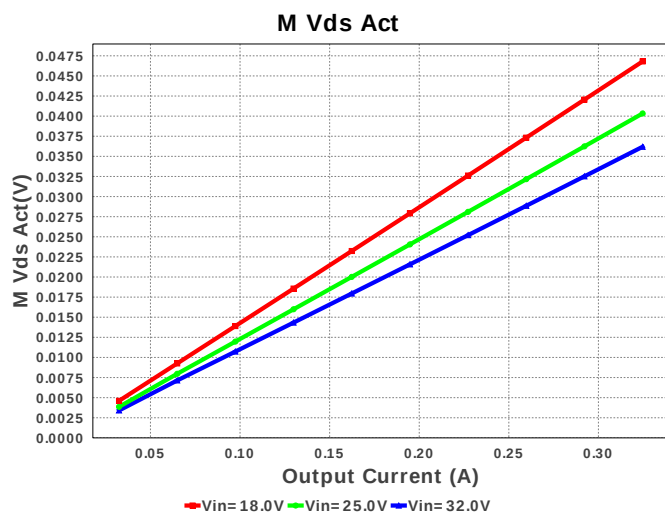
## Electrical BOM

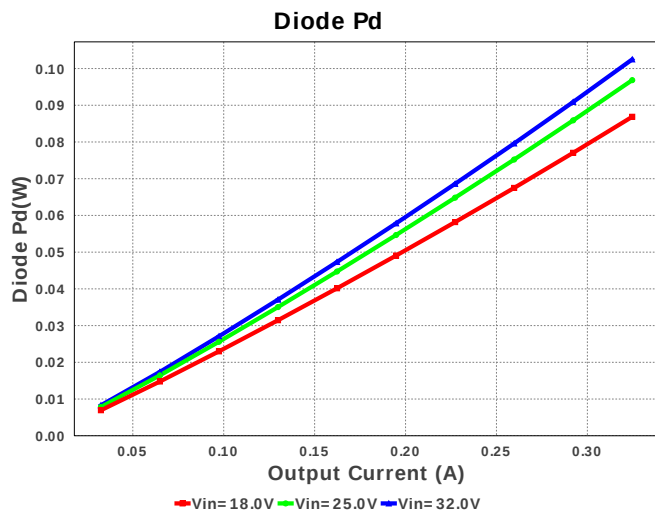
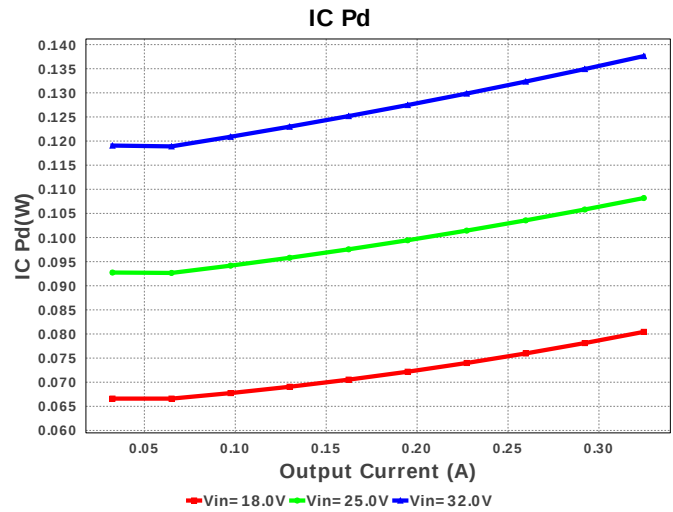
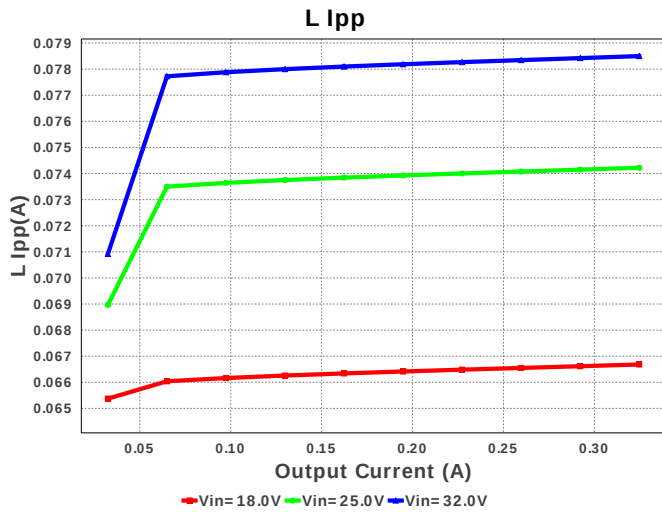
| #  | Name | Manufacturer      | Part Number                       | Properties                                                        | Qty | Price  | Footprint                                                                                                         |
|----|------|-------------------|-----------------------------------|-------------------------------------------------------------------|-----|--------|-------------------------------------------------------------------------------------------------------------------|
| 1. | Cb   | MuRata            | GRM216R71H103KA01D<br>Series= X7R | Cap= 10.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                        | 1   | \$0.01 |  0805 7 mm <sup>2</sup>      |
| 2. | Cin  | MuRata            | GRM21BR71H105KA12L<br>Series= X7R | Cap= 1.0 uF<br>ESR= 4.402 mOhm<br>VDC= 50.0 V<br>IRMS= 1.677 A    | 1   | \$0.05 |  0805 7 mm <sup>2</sup>      |
| 3. | Cinx | Kemet             | C0805C104K5RACTU<br>Series= X7R   | Cap= 100.0 nF<br>ESR= 64.0 mOhm<br>VDC= 50.0 V<br>IRMS= 1.64 A    | 1   | \$0.01 |  0805 7 mm <sup>2</sup>      |
| 4. | Cout | MuRata            | GRM31CR61A226KE19L<br>Series= X5R | Cap= 22.0 uF<br>ESR= 3.637 mOhm<br>VDC= 10.0 V<br>IRMS= 3.56456 A | 1   | \$0.07 |  1206_190 11 mm <sup>2</sup> |
| 5. | D1   | NXP Semiconductor | PMEG6010CEH,115                   | VF@Io= 570.0 mV<br>VRRM= 60.0 V                                   | 1   | \$0.04 |  SOD-123F 12 mm <sup>2</sup> |
| 6. | L1   | TDK               | VLP8040T-221M                     | L= 220.0 µH<br>DCR= 730.0 mOhm                                    | 1   | \$0.22 |  VLP8040 113 mm <sup>2</sup> |

| #  | Name | Manufacturer      | Part Number       | Properties | Qty | Price  | Footprint                                                                                                      |
|----|------|-------------------|-------------------|------------|-----|--------|----------------------------------------------------------------------------------------------------------------|
| 7. | U1   | Texas Instruments | LM2674MX-5.0/NOPB | Switcher   | 1   | \$1.20 | <br>M08A 55 mm <sup>2</sup> |









## Operating Values

| #   | Name         | Value                 | Category | Description                               |
|-----|--------------|-----------------------|----------|-------------------------------------------|
| 1.  | Cin IRMS     | 111.305 mA            | Current  | Input capacitor RMS ripple current        |
| 2.  | Cout IRMS    | 22.661 mA             | Current  | Output capacitor RMS ripple current       |
| 3.  | IC Ipk       | 363.91 mA             | Current  | Peak switch current in IC                 |
| 4.  | Iin Avg      | 60.878 mA             | Current  | Average input current                     |
| 5.  | L Ipp        | 78.5 mA               | Current  | Peak-to-peak inductor ripple current      |
| 6.  | M Irms       | 132.397 mA            | Current  | MOSFET RMS current                        |
| 7.  | BOM Count    | 7                     | General  | Total Design BOM count                    |
| 8.  | FootPrint    | 211.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components   |
| 9.  | Frequency    | 260.0 kHz             | General  | Switching frequency                       |
| 10. | IC Tolerance | 75.0 mV               | General  | IC Feedback Tolerance                     |
| 11. | M Vds Act    | 36.189 mV             | General  | Voltage drop across the MosFET            |
| 12. | Pout         | 1.623 W               | General  | Total output power                        |
| 13. | Total BOM    | \$1.6                 | General  | Total BOM Cost                            |
| 14. | D1 Tj        | 63.821 degC           | Op_Point | D1 junction temperature                   |
| 15. | Vout OP      | 5.0 V                 | Op_Point | Operational Output Voltage                |
| 16. | Cross Freq   | 20.054 kHz            | Op_point | Bode plot crossover frequency             |
| 17. | Duty Cycle   | 16.63 %               | Op_point | Duty cycle                                |
| 18. | Efficiency   | 83.327 %              | Op_point | Steady state efficiency                   |
| 19. | IC Tj        | 44.45 degC            | Op_point | IC junction temperature                   |
| 20. | ICThetaJA    | 105.0 degC/W          | Op_point | IC junction-to-ambient thermal resistance |
| 21. | IOUT_OP      | 324.66 mA             | Op_point | Iout operating point                      |
| 22. | Phase Marg   | 43.482 deg            | Op_point | Bode Plot Phase Margin                    |
| 23. | VIN_OP       | 32.0 V                | Op_point | Vin operating point                       |
| 24. | Vout p-p     | 2.009 mV              | Op_point | Peak-to-peak output ripple voltage        |
| 25. | Cin Pd       | 54.536 $\mu$ W        | Power    | Input capacitor power dissipation         |
| 26. | Cout Pd      | 1.868 $\mu$ W         | Power    | Output capacitor power dissipation        |
| 27. | Diode Pd     | 102.489 mW            | Power    | Diode power dissipation                   |
| 28. | IC Pd        | 137.616 mW            | Power    | IC power dissipation                      |
| 29. | L Pd         | 84.64 mW              | Power    | Inductor power dissipation                |
| 30. | Total Pd     | 324.806 mW            | Power    | Total Power Dissipation                   |

| #   | Name           | Value | Category | Description                                                                                |
|-----|----------------|-------|----------|--------------------------------------------------------------------------------------------|
| 31. | Vout Tolerance | 1.5 % |          | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

## Design Inputs

| #  | Name    | Value    | Description                        |
|----|---------|----------|------------------------------------|
| 1. | Iout    | 324.66 m | Maximum Output Current             |
| 2. | VinMax  | 32.0     | Maximum input voltage              |
| 3. | VinMin  | 18.0     | Minimum input voltage              |
| 4. | Vout    | 5.0      | Output Voltage                     |
| 5. | base_pn | LM2674   | Texas Instruments Base Part Number |
| 6. | source  | DC       | Input Source Type                  |
| 7. | ta      | 30.0     | Ambient temperature                |

## Design Assistance

1. LM2674 Product Folder : <http://www.ti.com/product/LM2674> : 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.

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