

# WEBENCH® Power Architect

## Project Report

Project : 4354344/11 : PA\_Project\_304 (modified from 301)

Created : 2016-07-13 01:43:46.087

Optimize project optFactor=3

### Project Summary

|                                   |           |
|-----------------------------------|-----------|
| 1. Total System Efficiency        | 81.629 %  |
| 2. Total System BOM Count         | 8.0       |
| 3. Total System Footprint         | 121.0 mm2 |
| 4. Total System BOM Cost          | \$1.68    |
| 5. Total System Power Dissipation | 371.3 mW  |

--> Launch WEBENCH Power Architect.

## My Comments

No comments

## Sequencer Flag Table

| Supply   | Sequencer Flag | Load   | Load Name |
|----------|----------------|--------|-----------|
| SUPPLY_1 | 0              | LOAD_1 | LOAD #1   |

## Power Supplies

| #  | Name     | NSID      | Description                                        | Vout  | Iout  | Efficiency | Foot-print | Cost   | Design | Page |
|----|----------|-----------|----------------------------------------------------|-------|-------|------------|------------|--------|--------|------|
| 1. | SUPPLY_1 | LMR16006X | Switcher : SIMPLE SWITCHER Wide Vin Buck Regulator | 3.3 V | 0.5 A | 81.6%      | 121        | \$1.68 | 50     | 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 : 11\_PA\_Project\_304 (modified from 301) Power Architect 2016-07-13 01:43:46.087



## Electrical Procurement BOM

| Manufacturer      | Part Number         | Description | Quantity | Budgetary Price | Footprint<br>(mm <sup>2</sup> ) |
|-------------------|---------------------|-------------|----------|-----------------|---------------------------------|
| Kemet             | C0805C104K5RACTU    | 0805        | 1        | \$0.01          | 7                               |
| TDK               | C3225X7R2A225K230AB | 1210_250    | 1        | \$0.19          | 15                              |
| Vishay-Dale       | CRCW04028K45FKED    | 0402        | 1        | \$0.01          | 3                               |
| Panasonic         | ERJ-6ENF2802V       | 0805        | 1        | \$0.01          | 7                               |
| MuRata            | GRM21BR60J226ME39L  | 0805        | 1        | \$0.04          | 7                               |
| Texas Instruments | LMR16006XDDCR       | DDC0006A    | 1        | \$1.20          | 10                              |
| NXP Semiconductor | PMEG6010CEH,115     | SOD-123F    | 1        | \$0.04          | 12                              |
| Bourns            | SDR0604-330KL       | SDR0604     | 1        | \$0.18          | 61                              |
| <b>Total</b>      |                     |             | 8        | \$1.68          | 126                             |

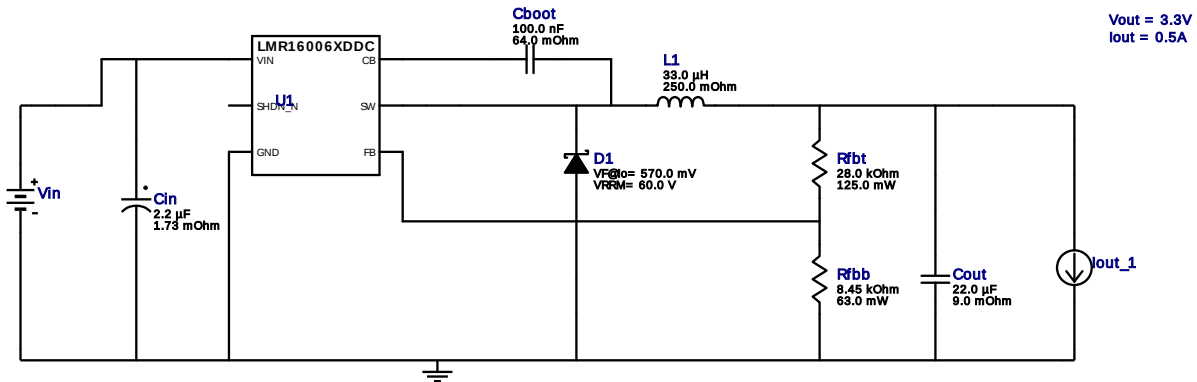


Vout = 3.3V  
Iout = 0.5A

Device = LMR16006XDDCR  
Topology = Buck  
Created = 7/13/16 1:43:45 AM  
BOM Cost = \$1.68  
BOM Count = 8  
Total Pd = 0.37W

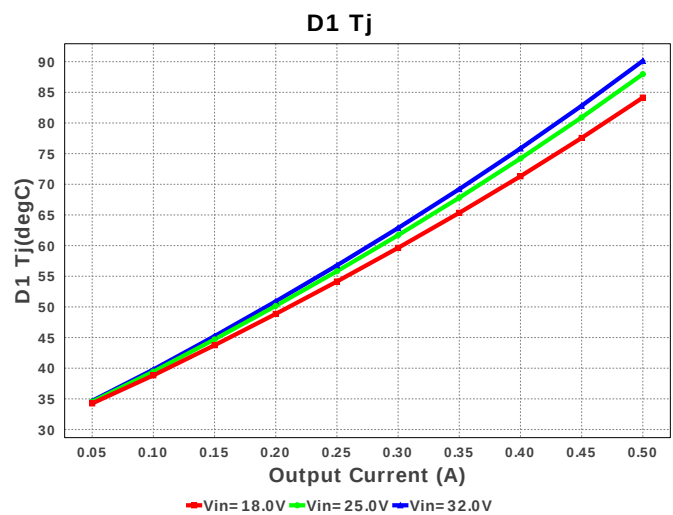
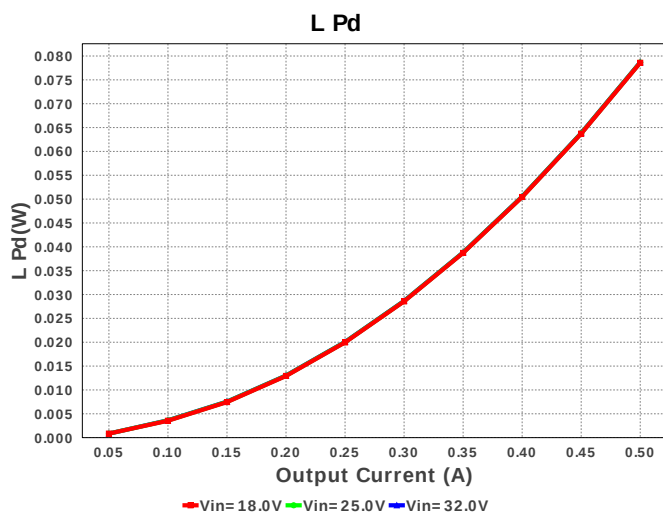
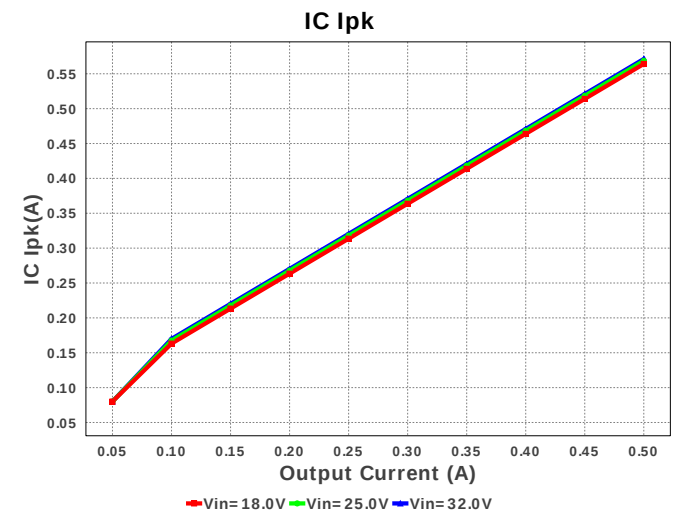
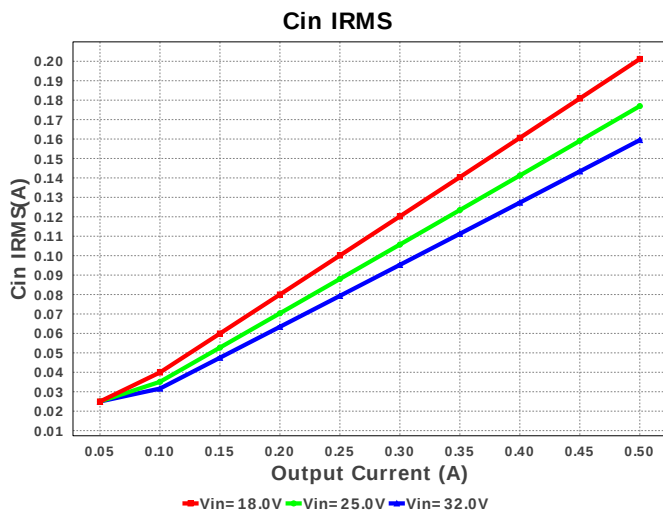
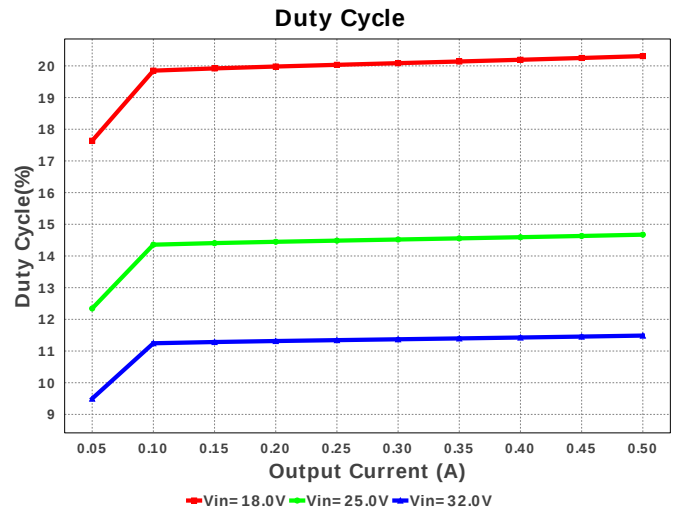
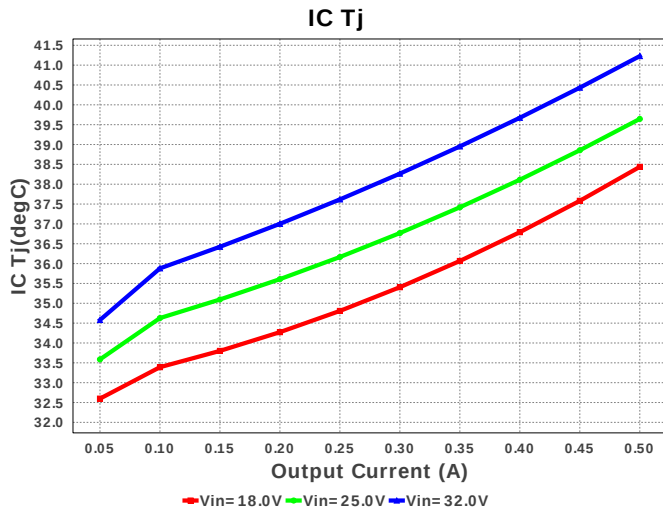
## WEBENCH® Design Report

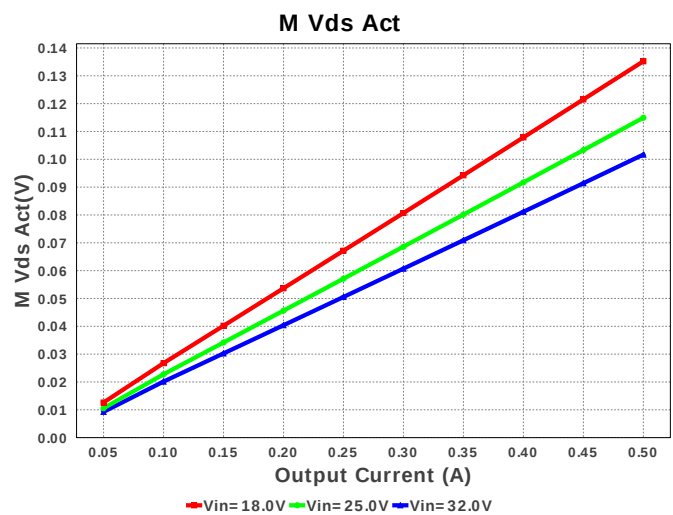
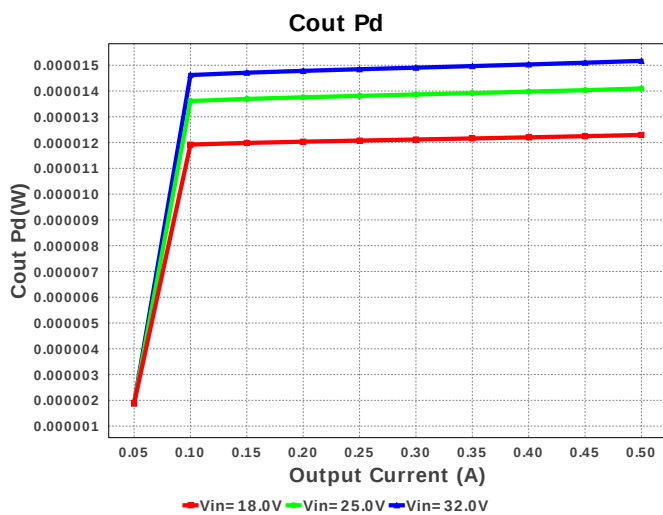
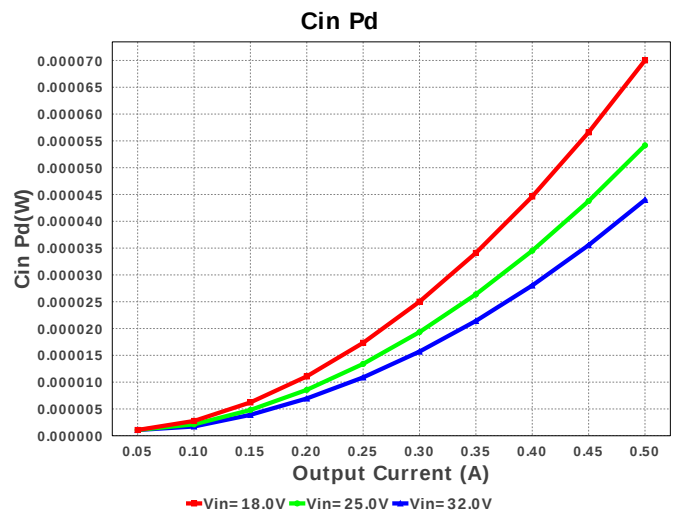
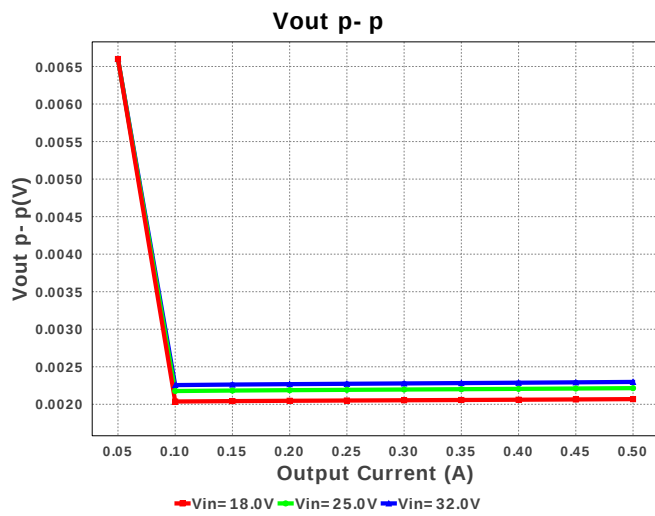
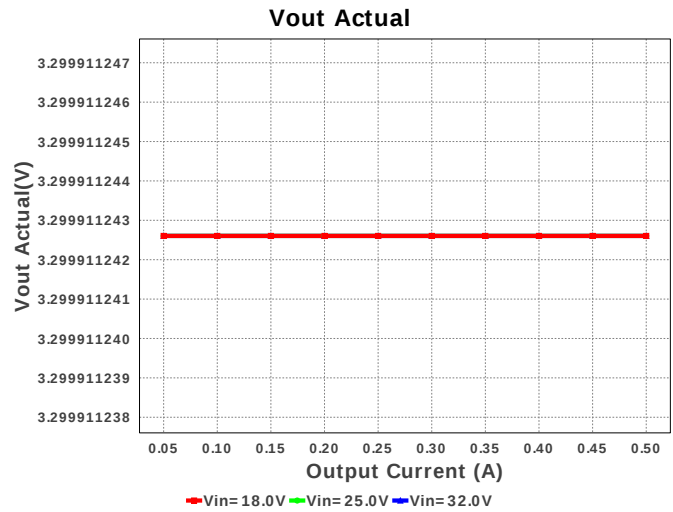
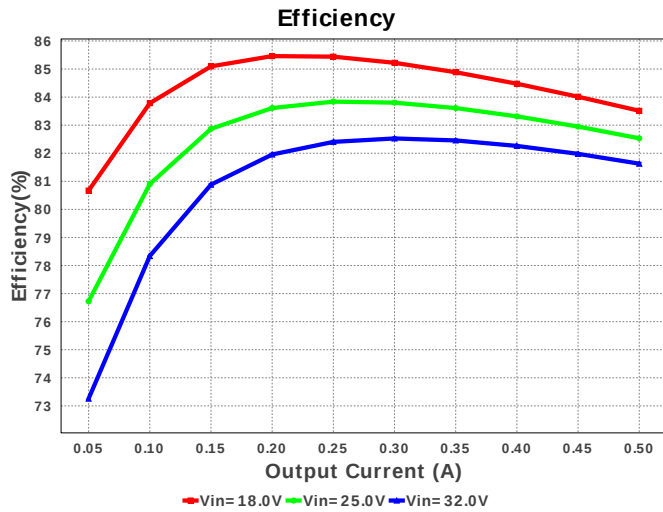
Design : 4354344/50 LMR16006XDDCR  
LMR16006XDDCR 18.0V-32.0V to 3.30V @ 0.5A

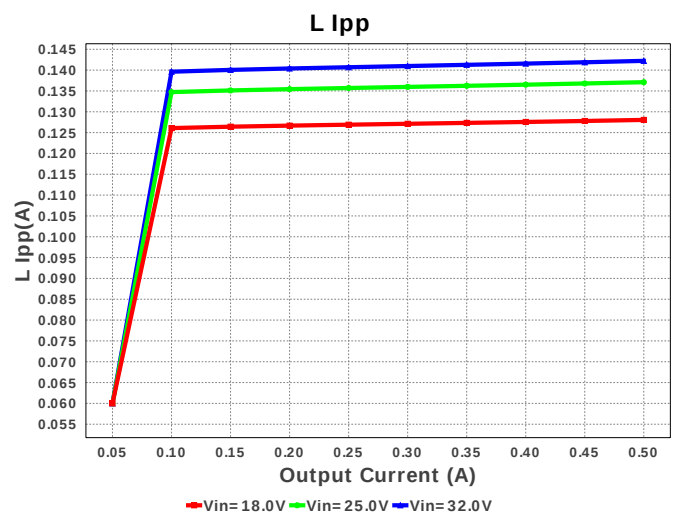
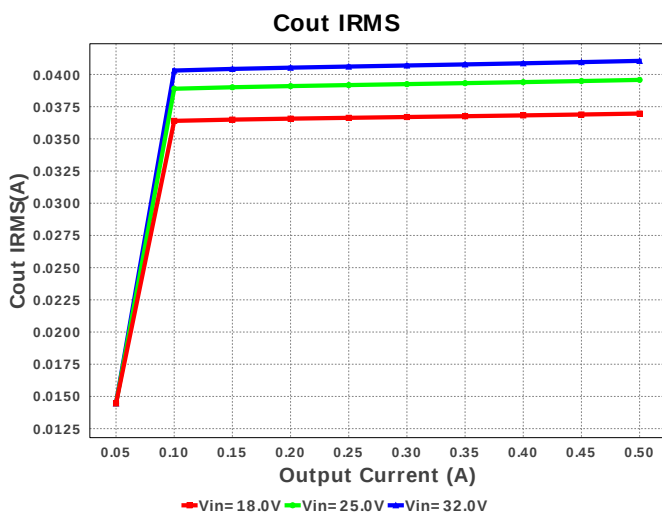
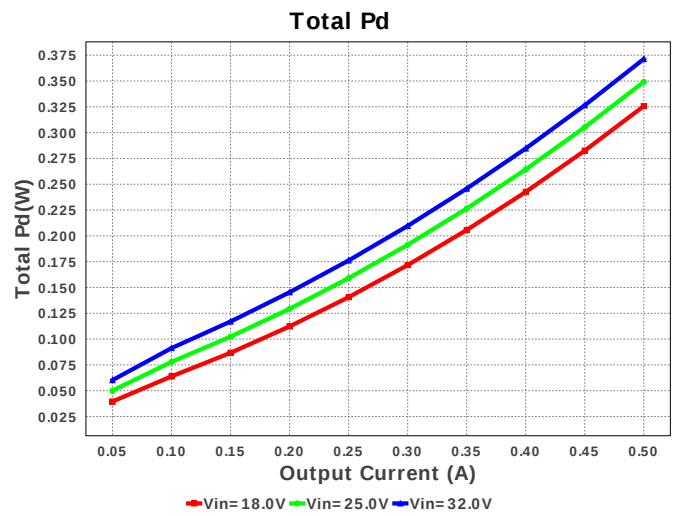
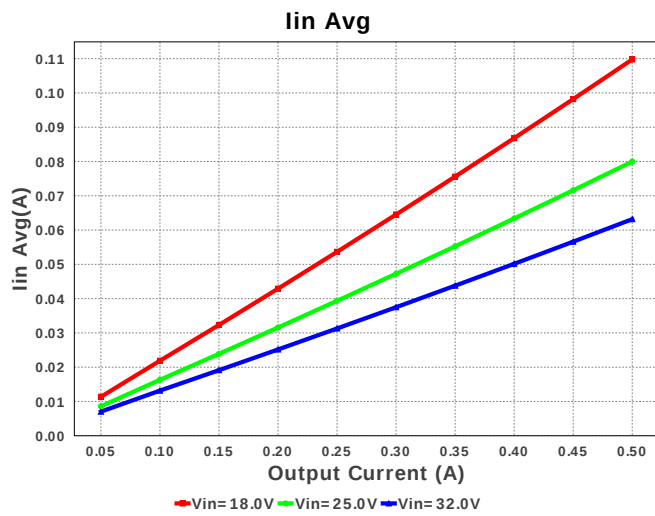
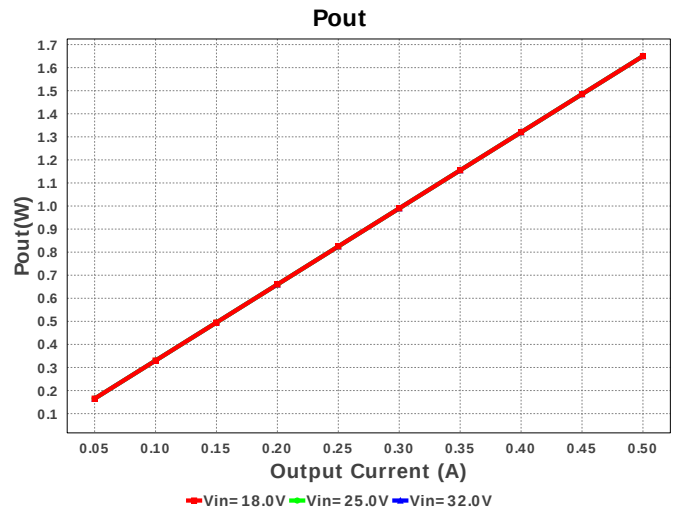
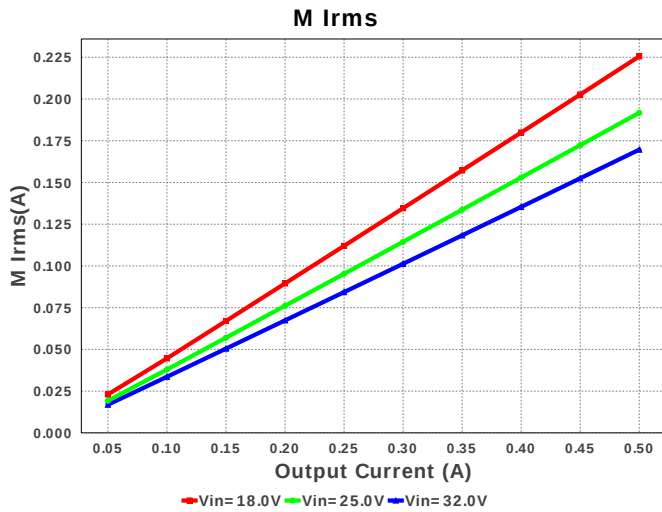


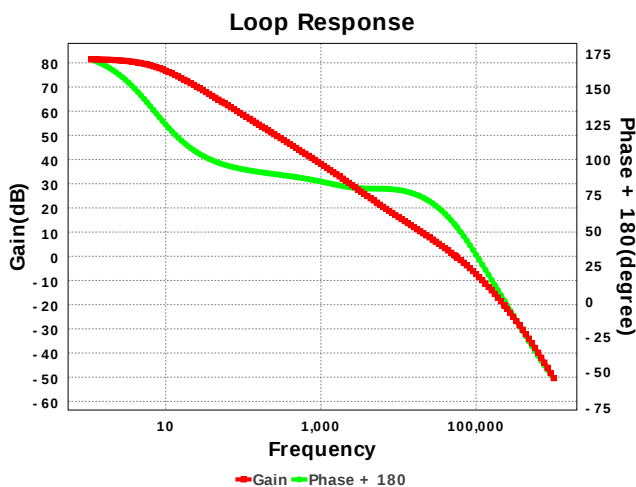
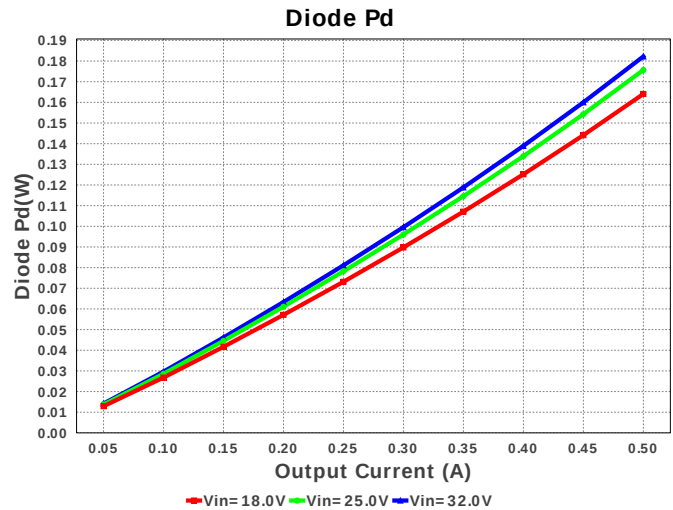
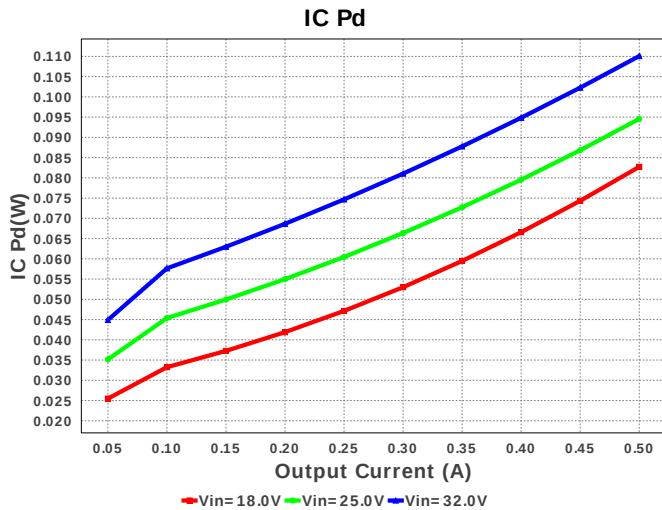
## Electrical BOM

| #  | Name  | Manufacturer      | Part Number                          | Properties                                                      | Qty | Price  | Footprint                   |
|----|-------|-------------------|--------------------------------------|-----------------------------------------------------------------|-----|--------|-----------------------------|
| 1. | Cboot | 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>      |
| 2. | Cin   | TDK               | C3225X7R2A225K230AB<br>Series= X7R   | Cap= 2.2 uF<br>ESR= 1.73 mOhm<br>VDC= 100.0 V<br>IRMS= 5.5932 A | 1   | \$0.19 | 1210_250 15 mm <sup>2</sup> |
| 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   | \$0.04 | 0805 7 mm <sup>2</sup>      |
| 4. | 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> |
| 5. | L1    | Bourns            | SDR0604-330KL                        | L= 33.0 uH<br>DCR= 250.0 mOhm                                   | 1   | \$0.18 | SDR0604 61 mm <sup>2</sup>  |
| 6. | Rfbb  | Vishay-Dale       | CRCW04028K45FKED<br>Series= CRCW..e3 | Res= 8.45 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%             | 1   | \$0.01 | 0402 3 mm <sup>2</sup>      |
| 7. | Rfht  | Panasonic         | ERJ-6ENF2802V<br>Series= ERJ-6E      | Res= 28.0 kOhm<br>Power= 125.0 mW<br>Tolerance= 1.0%            | 1   | \$0.01 | 0805 7 mm <sup>2</sup>      |
| 8. | U1    | Texas Instruments | LMR16006XDDCR                        | Switcher                                                        | 1   | \$1.20 | DDC0006A 10 mm <sup>2</sup> |









## Operating Values

| #   | Name         | Value                 | Category | Description                                                        |
|-----|--------------|-----------------------|----------|--------------------------------------------------------------------|
| 1.  | Cin IRMS     | 159.466 mA            | Current  | Input capacitor RMS ripple current                                 |
| 2.  | Cout IRMS    | 41.055 mA             | Current  | Output capacitor RMS ripple current                                |
| 3.  | IC IpK       | 571.201 mA            | Current  | Peak switch current in IC                                          |
| 4.  | Iin Avg      | 63.167 mA             | Current  | Average input current                                              |
| 5.  | L Ipp        | 142.22 mA             | Current  | Peak-to-peak inductor ripple current                               |
| 6.  | M1 Irms      | 169.641 mA            | Current  | Q lavg                                                             |
| 7.  | BOM Count    | 8                     | General  | Total Design BOM count                                             |
| 8.  | FootPrint    | 121.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components                            |
| 9.  | Frequency    | 700.0 kHz             | General  | Switching frequency                                                |
| 10. | IC Tolerance | 18.0 mV               | General  | IC Feedback Tolerance                                              |
| 11. | M Vds Act    | 101.699 mV            | General  | Voltage drop across the MosFET                                     |
| 12. | Pout         | 1.65 W                | General  | Total output power                                                 |
| 13. | Total BOM    | \$1.68                | General  | Total BOM Cost                                                     |
| 14. | D1 Tj        | 90.133 degC           | Op_Point | D1 junction temperature                                            |
| 15. | Vout Actual  | 3.3 V                 | Op_Point | Vout Actual calculated based on selected voltage divider resistors |
| 16. | Vout OP      | 3.3 V                 | Op_Point | Operational Output Voltage                                         |
| 17. | Cross Freq   | 54.787 kHz            | Op_point | Bode plot crossover frequency                                      |
| 18. | Duty Cycle   | 11.488 %              | Op_point | Duty cycle                                                         |
| 19. | Efficiency   | 81.629 %              | Op_point | Steady state efficiency                                            |
| 20. | IC Tj        | 41.228 degC           | Op_point | IC junction temperature                                            |
| 21. | ICThetaJA    | 102.0 degC/W          | Op_point | IC junction-to-ambient thermal resistance                          |
| 22. | IOUT_OP      | 500.0 mA              | Op_point | Iout operating point                                               |
| 23. | Phase Marg   | 53.52 deg             | Op_point | Bode Plot Phase Margin                                             |
| 24. | VIN_OP       | 32.0 V                | Op_point | Vin operating point                                                |
| 25. | Vout p-p     | 2.298 mV              | Op_point | Peak-to-peak output ripple voltage                                 |
| 26. | Cin Pd       | 43.993 $\mu$ W        | Power    | Input capacitor power dissipation                                  |
| 27. | Cout Pd      | 15.17 $\mu$ W         | Power    | Output capacitor power dissipation                                 |
| 28. | Diode Pd     | 182.221 mW            | Power    | Diode power dissipation                                            |
| 29. | IC Pd        | 110.075 mW            | Power    | IC power dissipation                                               |
| 30. | L Pd         | 78.68 mW              | Power    | Inductor power dissipation                                         |
| 31. | Total Pd     | 371.341 mW            | Power    | Total Power Dissipation                                            |

| #   | Name           | Value   | Category | Description                                                                                |
|-----|----------------|---------|----------|--------------------------------------------------------------------------------------------|
| 32. | Vout Tolerance | 3.941 % |          | 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  | 32.0      | Maximum input voltage  |
| 3. | VinMin  | 18.0      | Minimum input voltage  |
| 4. | Vout    | 3.3       | Output Voltage         |
| 5. | base_pn | LMR16006X | Base Product Number    |
| 6. | source  | DC        | Input Source Type      |
| 7. | Ta      | 30.0      | Ambient temperature    |

## Design Assistance

1. **LMR16006X** Product Folder : <http://www.ti.com/product/LMR16006> : contains the data sheet and other resources.

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