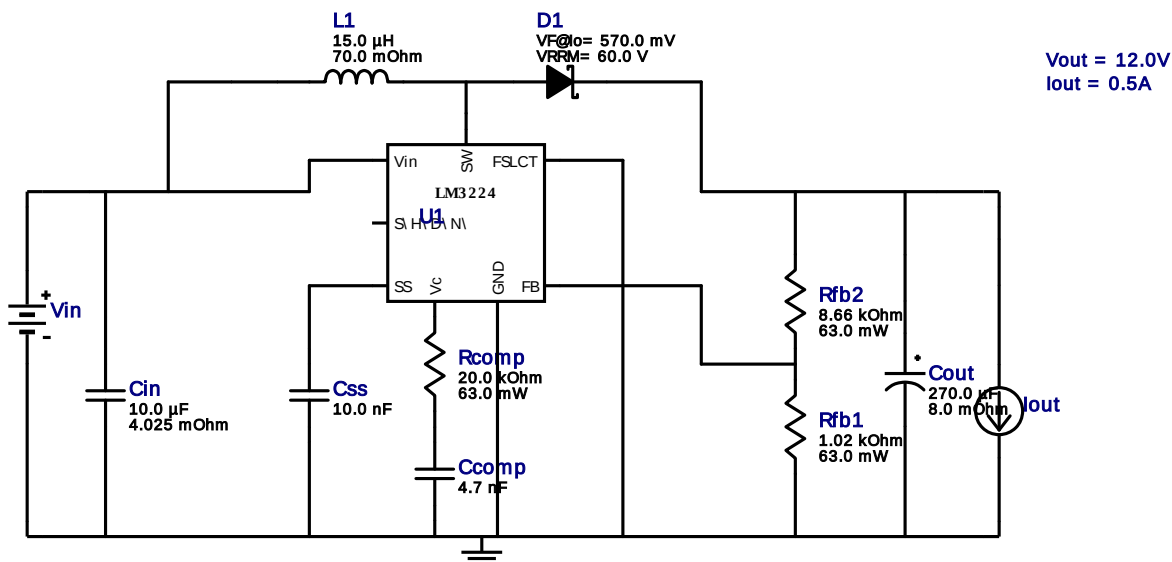


## WEBENCH® Design Report

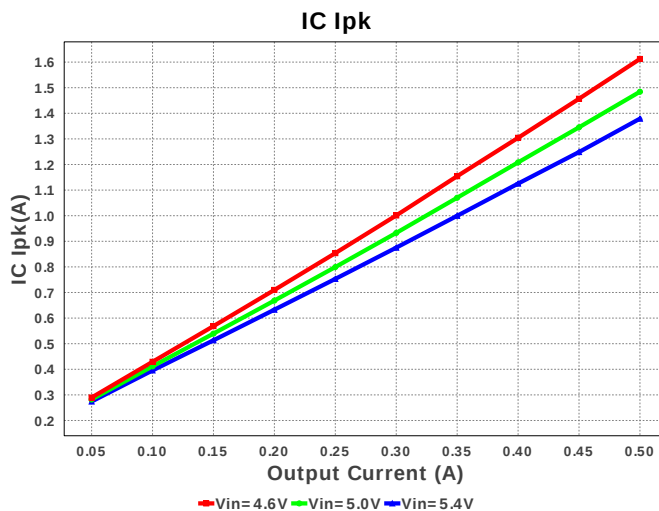
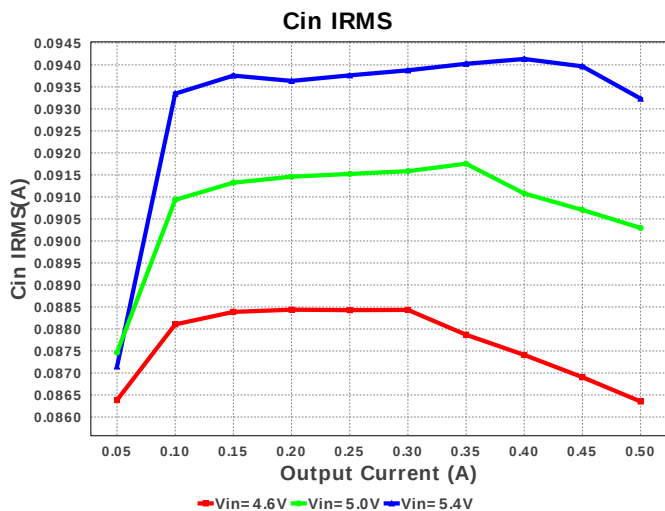
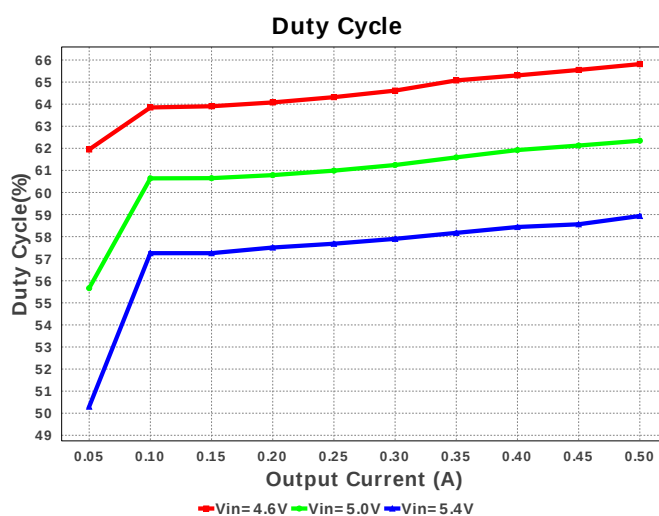
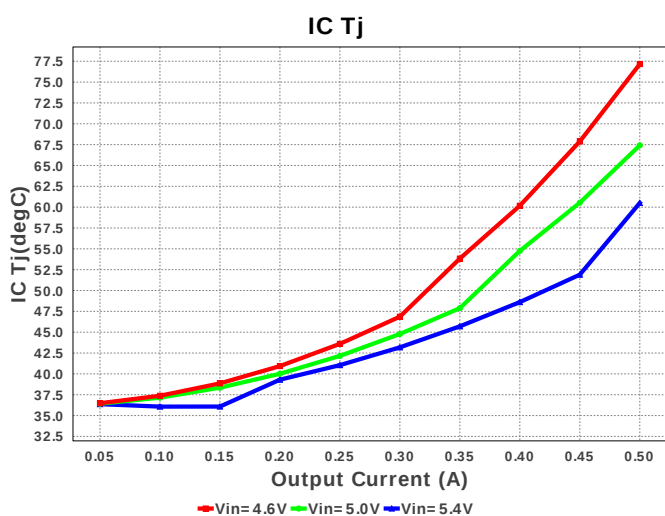
Design : 3496425/9 LM3224MM-ADJ/NOPB  
LM3224MM-ADJ/NOPB 4.6V-5.4V to 12.00V @ 0.5A

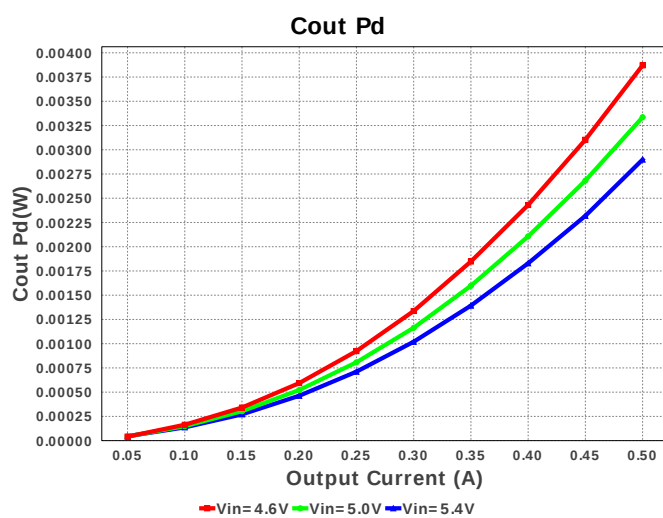
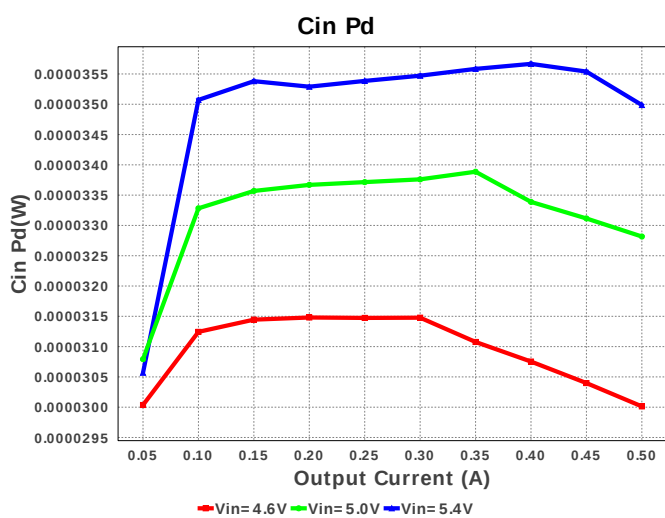
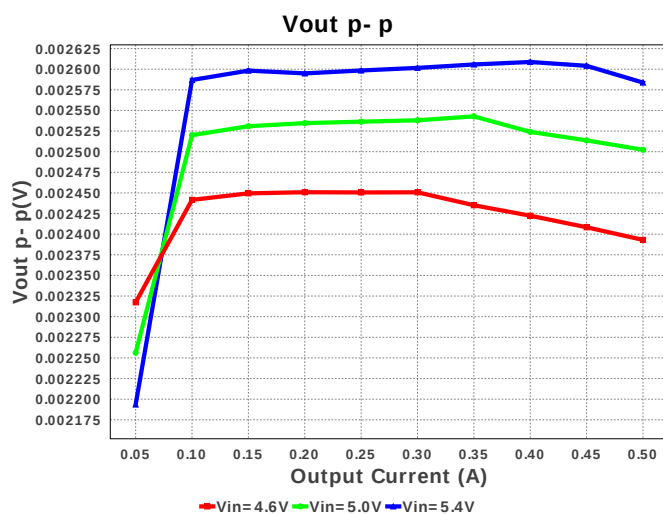
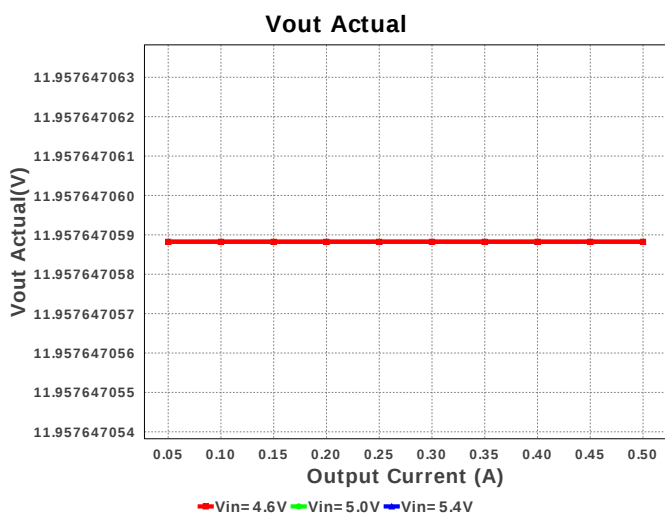
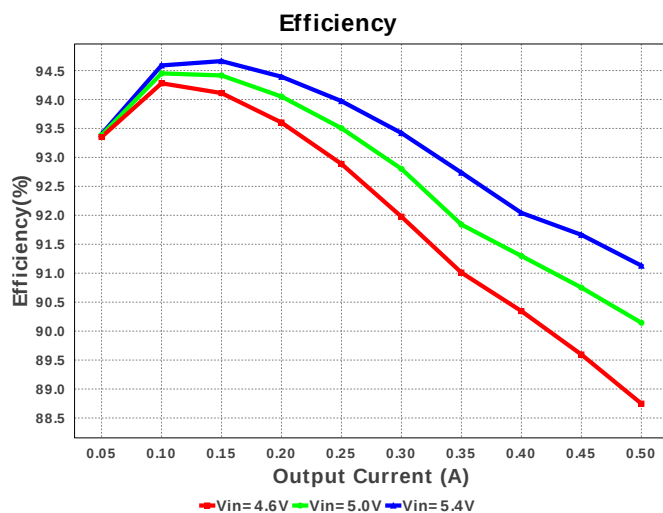
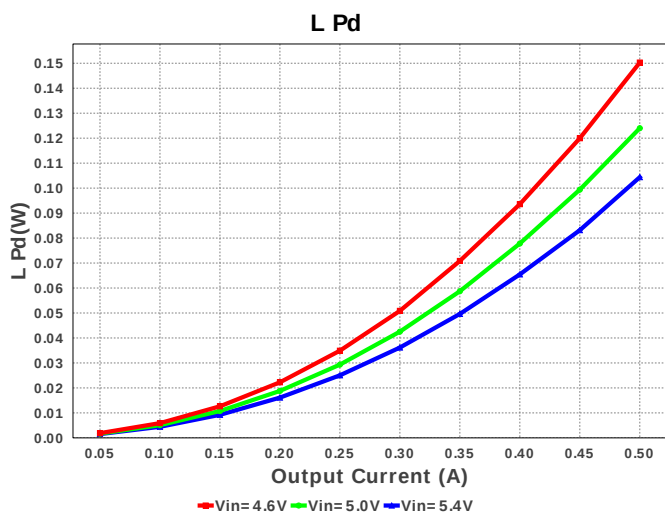


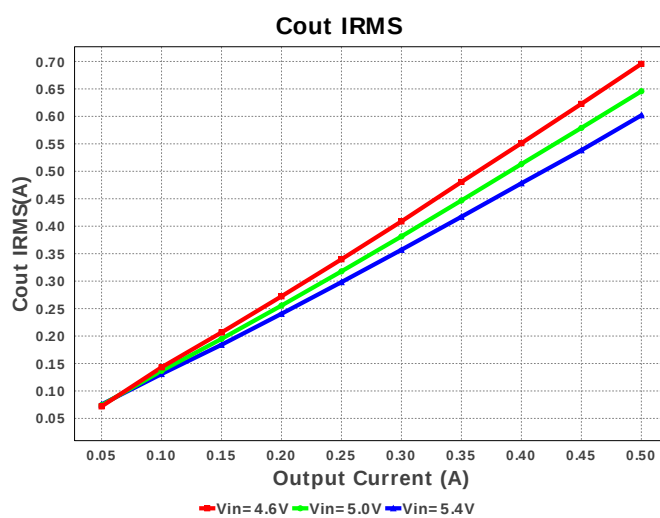
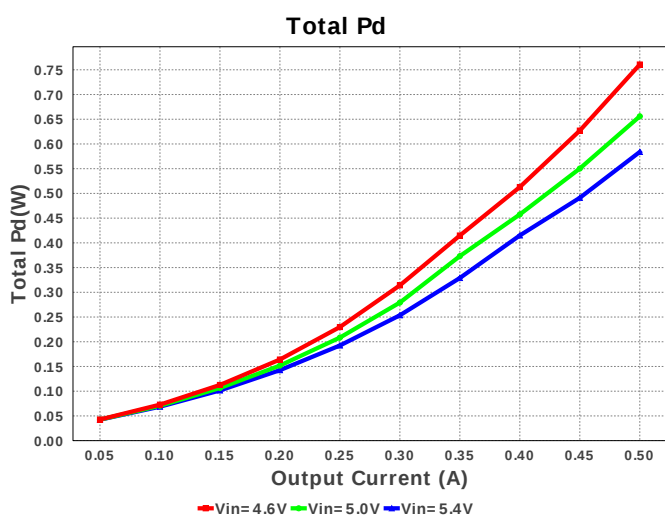
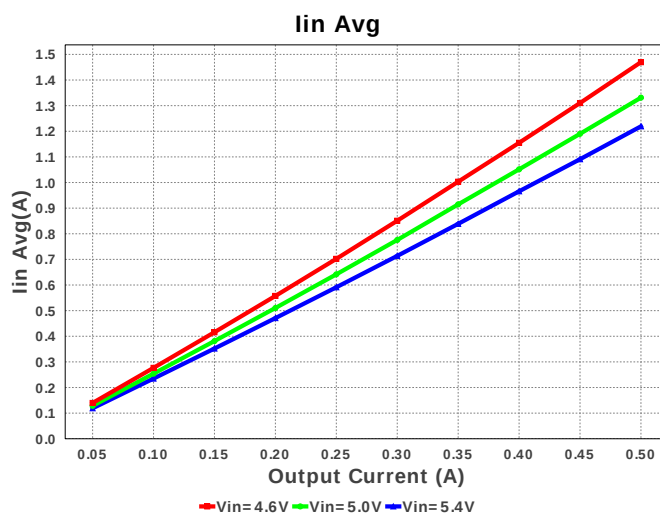
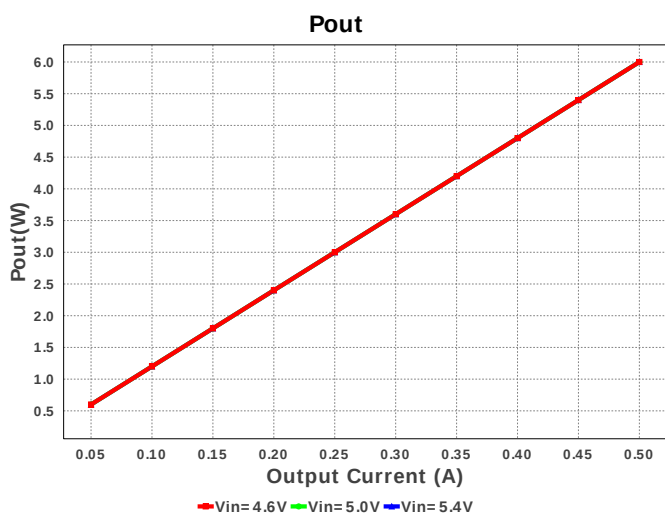
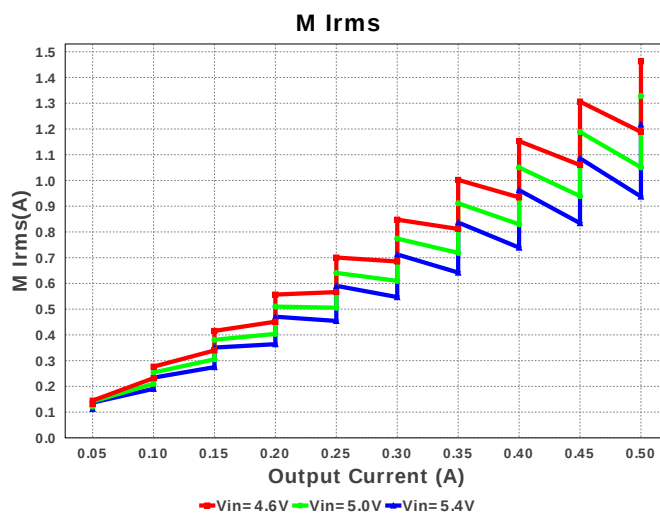
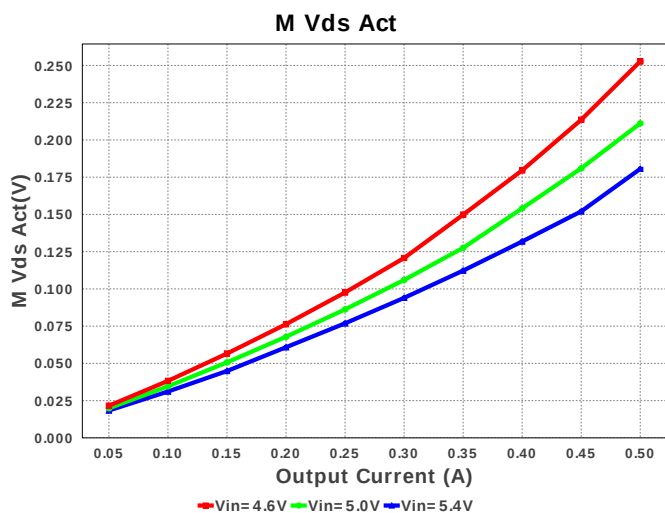
## Electrical BOM

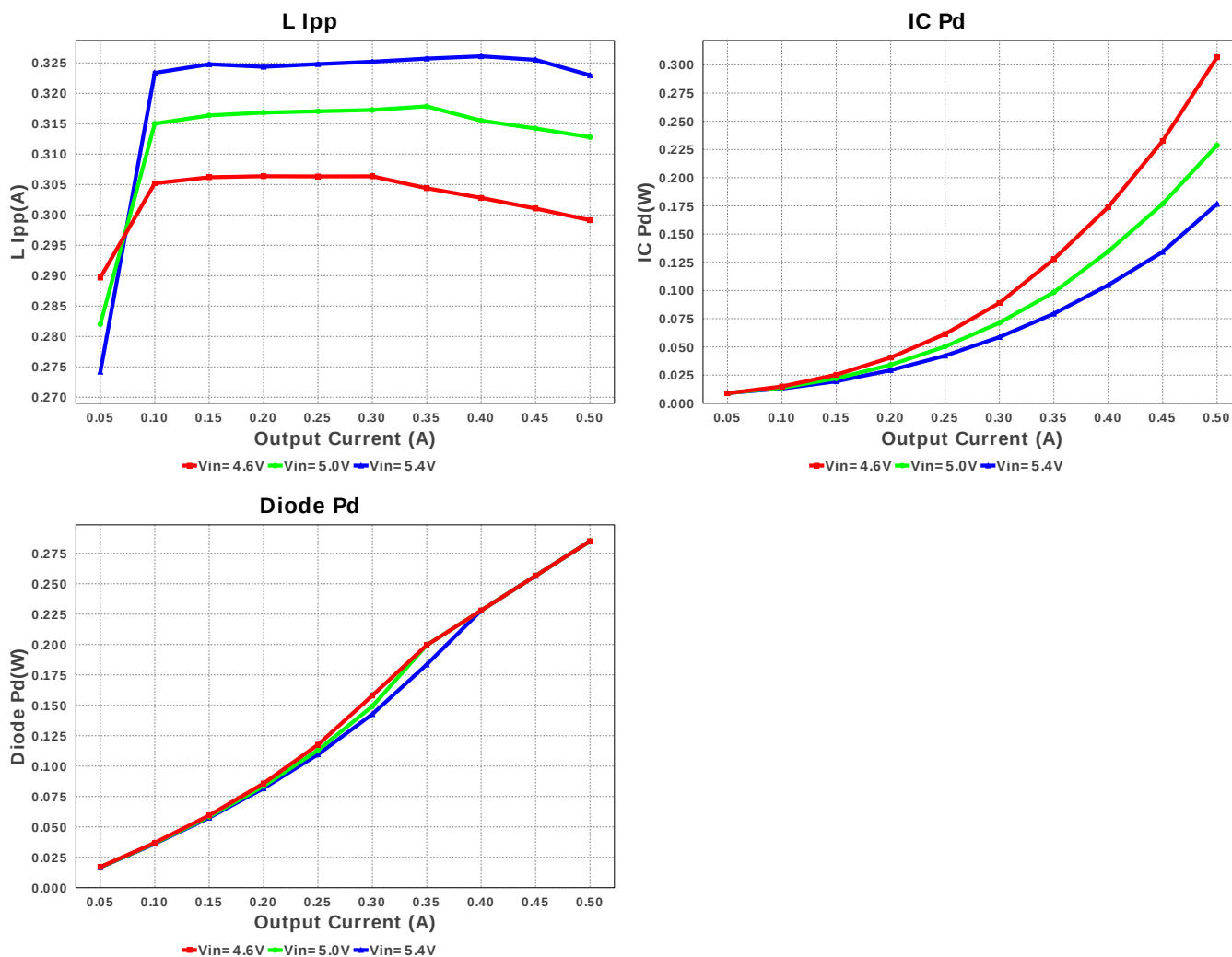
| #  | Name  | Manufacturer      | Part Number                          | Properties                                                      | Qty | Price  | Footprint                                                                                                     |
|----|-------|-------------------|--------------------------------------|-----------------------------------------------------------------|-----|--------|---------------------------------------------------------------------------------------------------------------|
| 1. | Ccomp | Yageo America     | CC0805KRX7R9BB472<br>Series= X7R     | Cap= 4.7 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                       | 1   | \$0.01 | <br>0805 7 mm²           |
| 2. | Cin   | MuRata            | GRM21BR61A106KE19L<br>Series= X5R    | Cap= 10.0 uF<br>ESR= 4.025 mOhm<br>VDC= 10.0 V<br>IRMS= 2.445 A | 1   | \$0.03 | <br>0805 7 mm²           |
| 3. | Cinx  | MuRata            | GRM155R60J104KA01D<br>Series= X5R    | Cap= 100.0 nF<br>VDC= 6.3 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | <br>0402 3 mm²           |
| 4. | Cout  | Panasonic         | 16SVP6270M<br>Series= ?              | Cap= 270.0 uF<br>ESR= 8.0 mOhm<br>VDC= 16.0 V<br>IRMS= 5.8 A    | 1   | \$0.70 | <br>CAPSMT_62_C10 74 mm² |
| 5. | Css   | MuRata            | GRM216R71H103KA01D<br>Series= X7R    | Cap= 10.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | <br>0805 7 mm²           |
| 6. | D1    | NXP Semiconductor | PMEG6010CEH,115                      | VF@Io= 570.0 mV<br>VRRM= 60.0 V                                 | 1   | \$0.04 | <br>SOD-123F 12 mm²      |
| 7. | L1    | Bourns            | SRN8040-150M                         | L= 15.0 µH<br>DCR= 70.0 mOhm                                    | 1   | \$0.22 | <br>SRN8040 100 mm²      |
| 8. | Rcomp | Vishay-Dale       | CRCW040220K0FKED<br>Series= CRCW..e3 | Res= 20.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%             | 1   | \$0.01 | <br>0402 3 mm²           |
| 9. | Rfb1  | Vishay-Dale       | CRCW04021K02FKED<br>Series= CRCW..e3 | Res= 1.02 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%             | 1   | \$0.01 | <br>0402 3 mm²           |

| #   | Name | Manufacturer      | Part Number                          | Properties                                          | Qty | Price  | Footprint                                                                                         |
|-----|------|-------------------|--------------------------------------|-----------------------------------------------------|-----|--------|---------------------------------------------------------------------------------------------------|
| 10. | Rfb2 | Vishay-Dale       | CRCW04028K66FKED<br>Series= CRCW..e3 | Res= 8.66 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1   | \$0.01 |  0402 3 mm²    |
| 11. | U1   | Texas Instruments | LM3224MM-ADJ/NOPB                    | Switcher                                            | 1   | \$1.05 |  MUA08A 24 mm² |









## Operating Values

| #   | Name           | Value                 | Category | Description                                                                                |
|-----|----------------|-----------------------|----------|--------------------------------------------------------------------------------------------|
| 1.  | Cin IRMS       | 86.018 mA             | Current  | Input capacitor RMS ripple current                                                         |
| 2.  | Cout IRMS      | 691.261 mA            | Current  | Output capacitor RMS ripple current                                                        |
| 3.  | IC Ipk         | 1.6 A                 | Current  | Peak switch current in IC                                                                  |
| 4.  | Iin Avg        | 1.457 A               | Current  | Average input current                                                                      |
| 5.  | L Ipp          | 297.98 mA             | Current  | Peak-to-peak inductor ripple current                                                       |
| 6.  | M Irms         | 1.176 A               | Current  | MOSFET RMS current                                                                         |
| 7.  | BOM Count      | 11                    | General  | Total Design BOM count                                                                     |
| 8.  | FootPrint      | 242.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components                                                    |
| 9.  | Frequency      | 615.0 kHz             | General  | Switching frequency                                                                        |
| 10. | IC Tolerance   | 31.5 mV               | General  | IC Feedback Tolerance                                                                      |
| 11. | M Vds Act      | 249.012 mV            | General  |                                                                                            |
| 12. | Pout           | 6.0 W                 | General  | Total output power                                                                         |
| 13. | Total BOM      | \$2.1                 | General  | Total BOM Cost                                                                             |
| 14. | Vout Actual    | 11.958 V              | Op_Point | Vout Actual calculated based on selected voltage divider resistors                         |
| 15. | Cross Freq     | 447.659 Hz            | Op_point | Bode plot crossover frequency                                                              |
| 16. | Duty Cycle     | 65.531 %              | Op_point | Duty cycle                                                                                 |
| 17. | Efficiency     | 89.52 %               | Op_point | Steady state efficiency                                                                    |
| 18. | IC Tj          | 76.405 degC           | Op_point | IC junction temperature                                                                    |
| 19. | ICThetaJA      | 151.0 degC/W          | Op_point | IC junction-to-ambient thermal resistance                                                  |
| 20. | IOUT_OP        | 500.0 mA              | Op_point | Iout operating point                                                                       |
| 21. | Phase Marg     | 22.209 deg            | Op_point | Bode Plot Phase Margin                                                                     |
| 22. | VIN_OP         | 4.6 V                 | Op_point | Vin operating point                                                                        |
| 23. | Vout p-p       | 2.384 mV              | Op_point | Peak-to-peak output ripple voltage                                                         |
| 24. | Cin Pd         | 29.782 μW             | Power    | Input capacitor power dissipation                                                          |
| 25. | Cout Pd        | 3.823 mW              | Power    | Output capacitor power dissipation                                                         |
| 26. | Diode Pd       | 236.638 mW            | Power    | Diode power dissipation                                                                    |
| 27. | IC Pd          | 299.226 mW            | Power    | IC power dissipation                                                                       |
| 28. | L Pd           | 147.811 mW            | Power    | Inductor power dissipation                                                                 |
| 29. | Total Pd       | 702.391 mW            | Power    | Total Power Dissipation                                                                    |
| 30. | Vout Tolerance | 4.353 %               |          | 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  | 5.4     | Maximum input voltage              |
| 3. | VinMin  | 4.6     | Minimum input voltage              |
| 4. | Vout    | 12.0    | Output Voltage                     |
| 5. | base_pn | LM3224  | Texas Instruments Base Part Number |
| 6. | source  | DC      | Input Source Type                  |
| 7. | ta      | 35.0    | Ambient temperature                |

## Design Assistance

1. LM3224 Product Folder : <http://www.ti.com/product/LM3224> : contains the data sheet and other resources.

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