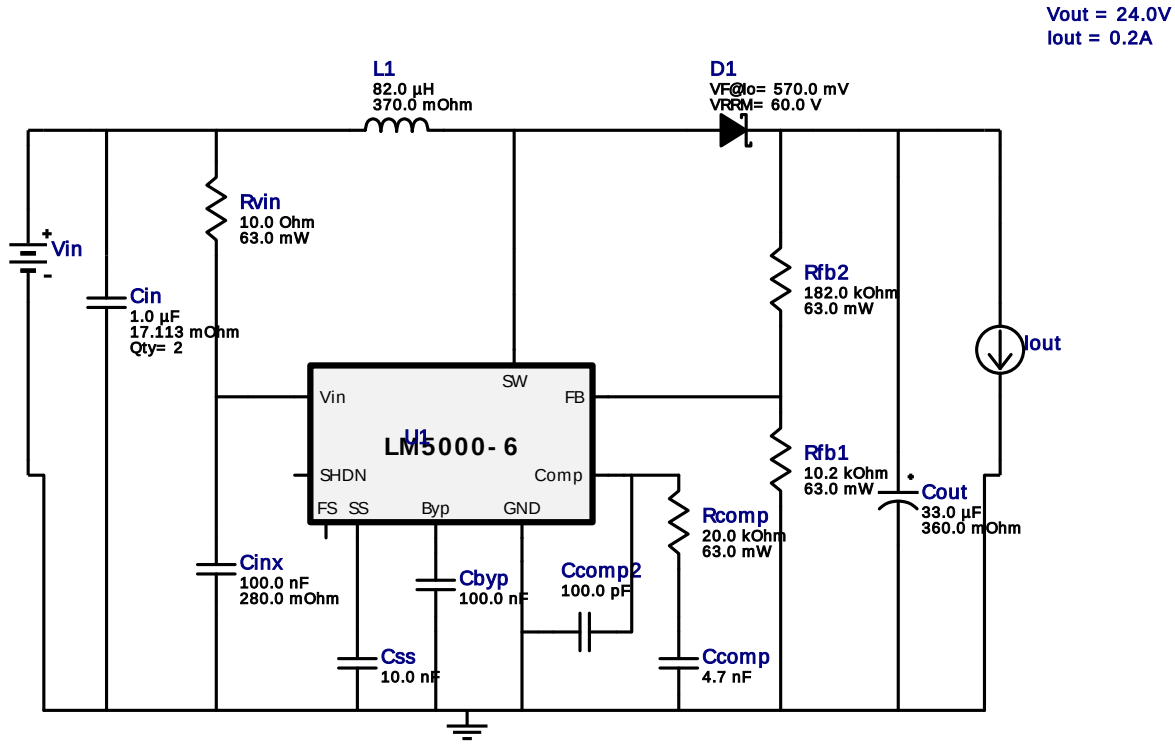
# WEBENCH® Design Report

VinMin = 11.0V
VinMax = 13.0V
Vout = 24.0V
Iout = 0.2A

Device = LM5000SD-3/NOPB
Topology = Boost
Created = 7/15/16 8:34:45 PM
BOM Cost = $2.18
BOM Count = 15
Total Pd = 0.35W

Design : 4742013/37 LM5000SD-3/NOPB
LM5000SD-3/NOPB 11.0V-13.0V to 24.00V @ 0.2A

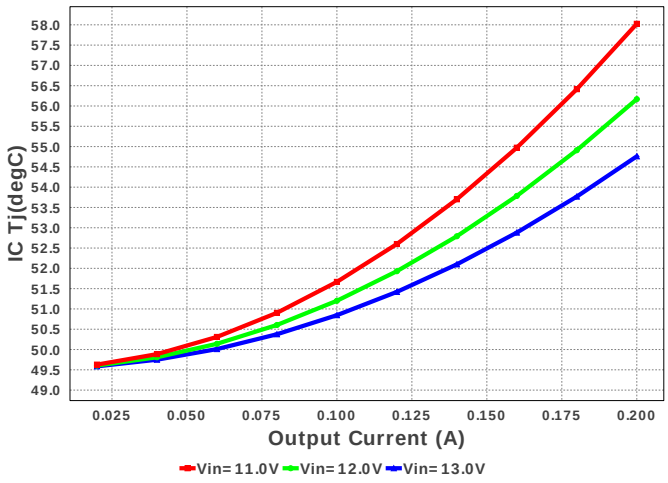



## Electrical BOM

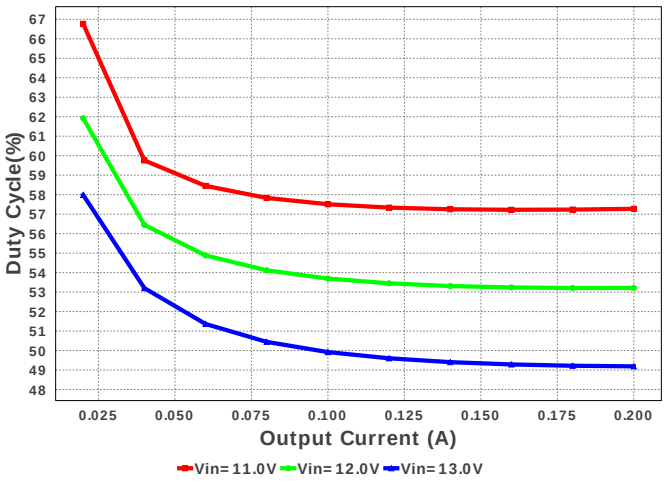
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cbyp | MuRata | GRM21BR71E104KA01L<br>Series= X7R | Cap= 100.0 nF<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 2. | Ccomp | Yageo America | CC0805KRX7R9BB472<br>Series= X7R | Cap= 4.7 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 3. | Ccomp2 | MuRata | GRM033R71C101KA01D<br>Series= X7R | Cap= 100.0 pF<br>VDC= 16.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0201 2 mm² |
| 4. | Cin | MuRata | GRM188R61E105KA12D<br>Series= X5R | Cap= 1.0 uF<br>ESR= 17.113 mOhm<br>VDC= 25.0 V<br>IRMS= 979.39 mA | 2 | $0.01 | 0603 5 mm² |
| 5. | Cinx | AVX | 08053C104KAT2A<br>Series= X7R | Cap= 100.0 nF<br>ESR= 280.0 mOhm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 6. | Cout | Panasonic | EEE-FK1V330P<br>Series= FK | Cap= 33.0 uF<br>ESR= 360.0 mOhm<br>VDC= 35.0 V<br>IRMS= 240.0 mA | 1 | $0.12 | SM_RADIAL_D 84 mm² |
| 7. | Css | MuRata | GRM216R71H103KA01D<br>Series= X7R | Cap= 10.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 8. | D1 | NXP Semiconductor | PMEG6010CEH,115 | VF@Io= 570.0 mV<br>VRRM= 60.0 V | 1 | $0.04 | SOD-123F 12 mm² |

| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 9. | L1 | NIC Components | NPI75C820KTRF | L= 82.0 µH<br>DCR= 370.0 mOhm | 1 | $0.11 |  <br>IND_NPI75C 94 mm² |
| 10. | 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 |
| 11. | Rfb1 | Vishay-Dale | CRCW040210K2FKED<br>Series= CRCW..e3 | Res= 10.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 12. | Rfb2 | Vishay-Dale | CRCW0402182KFKED<br>Series= CRCW..e3 | Res= 182.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 13. | Rvin | Vishay-Dale | CRCW040210R0FKED<br>Series= CRCW..e3 | Res= 10.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 14. | U1 | Texas Instruments | LM5000SD-3/NOPB | Switcher | 1 | $1.80 |  <br>SDA16A 58 mm² |

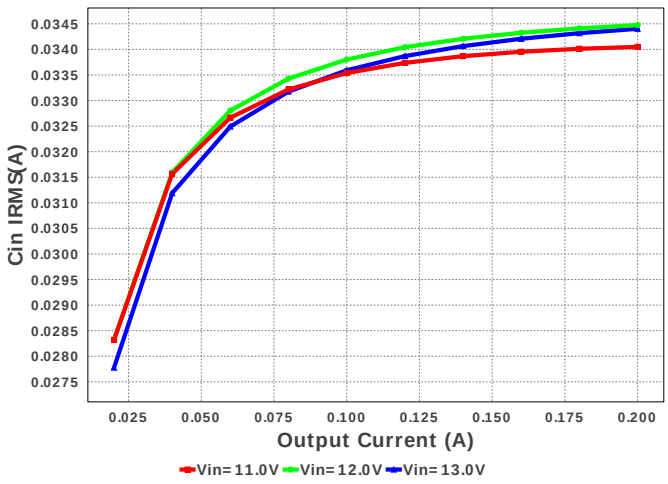
**IC Tj**



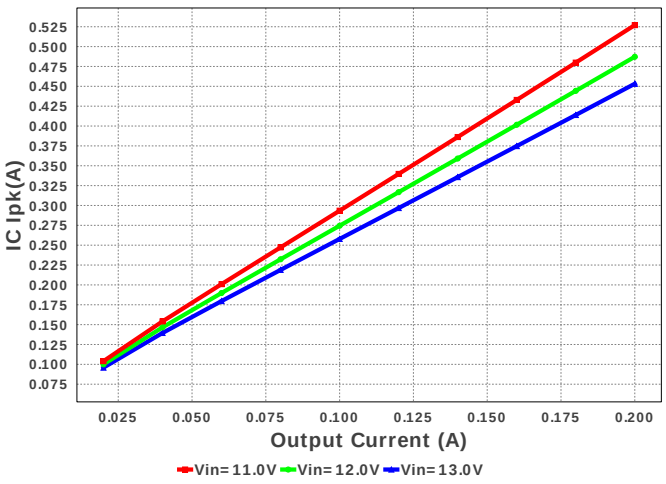

**Duty Cycle**



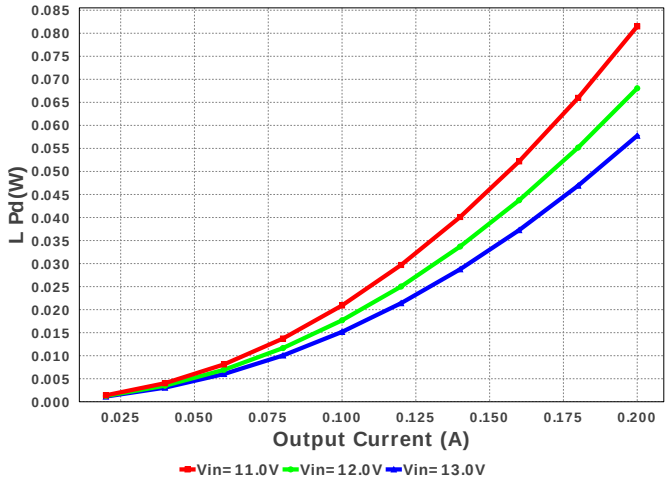
## Cin IRMS



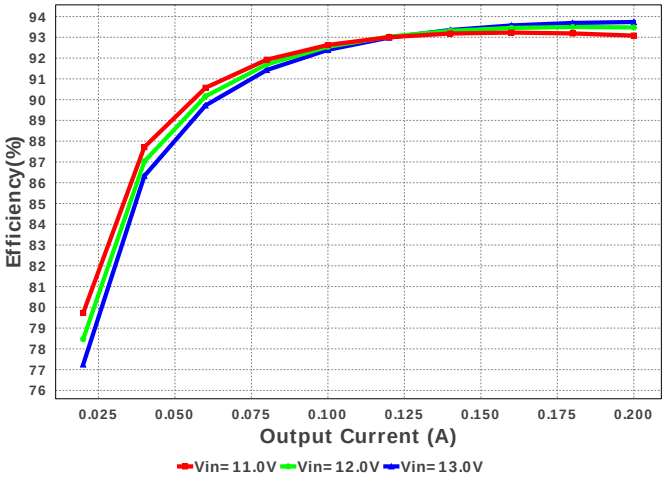

## IC Ipk



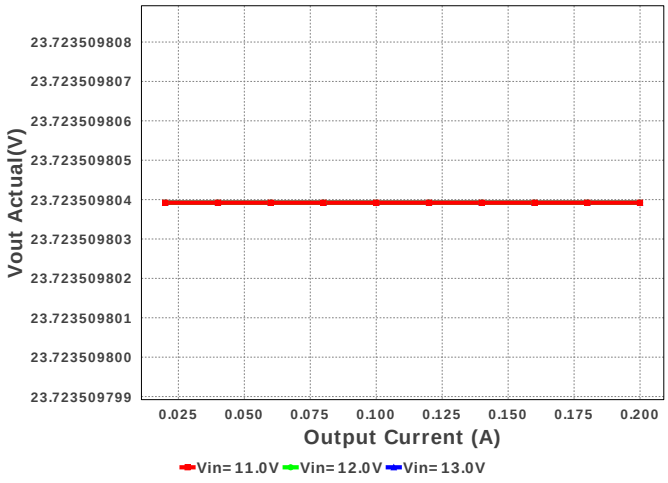

## L Pd



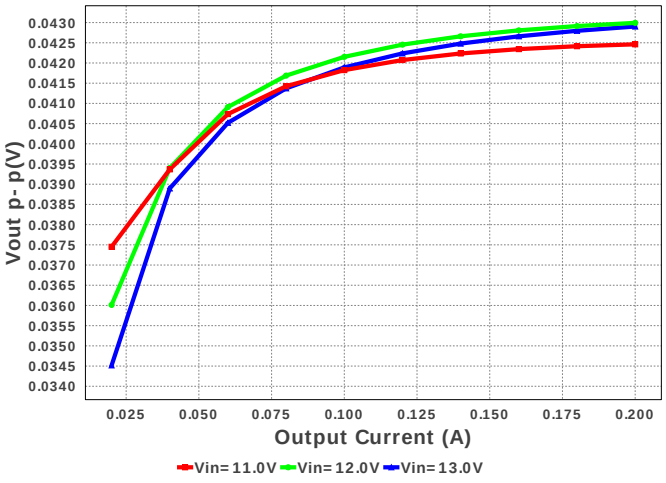

## Efficiency



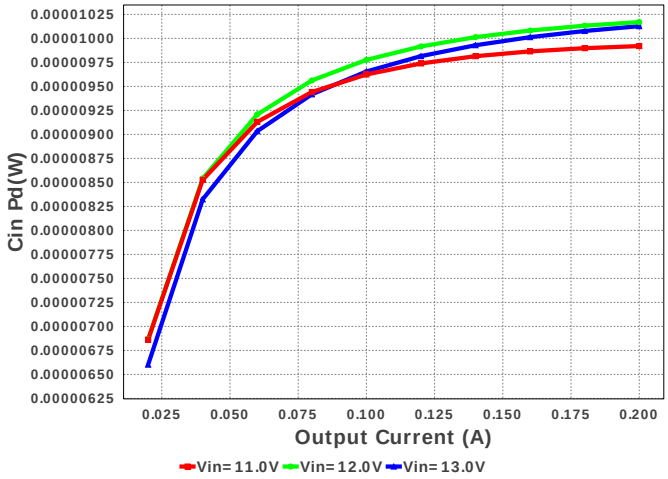

## Vout Actual



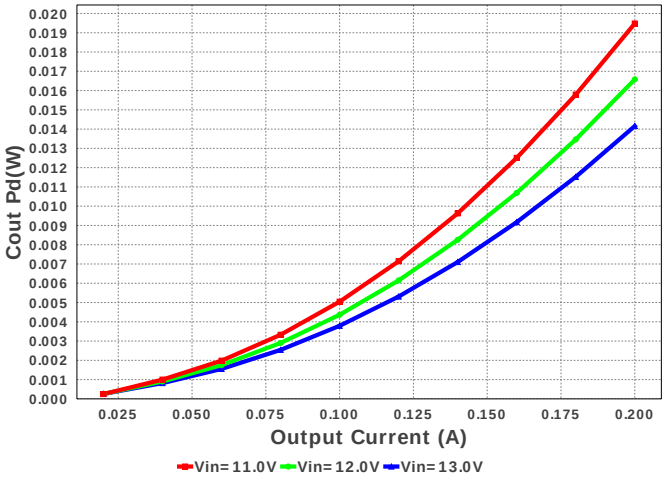

## Vout p- p



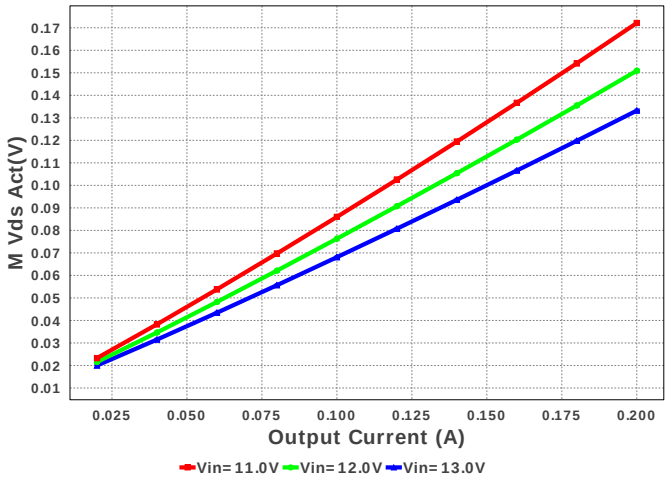
## Cin Pd



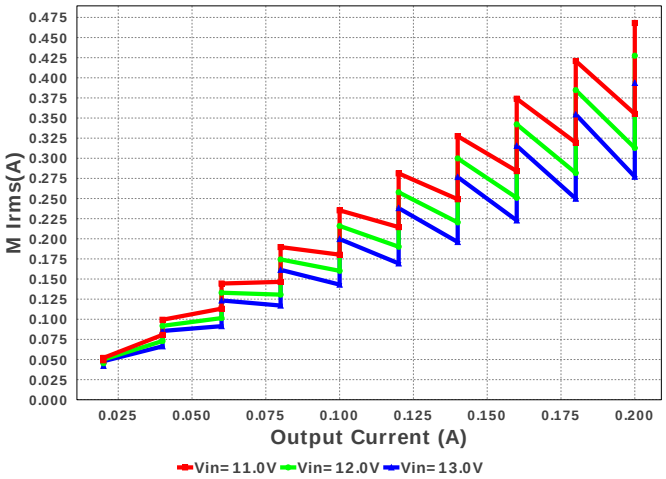

## Cout Pd



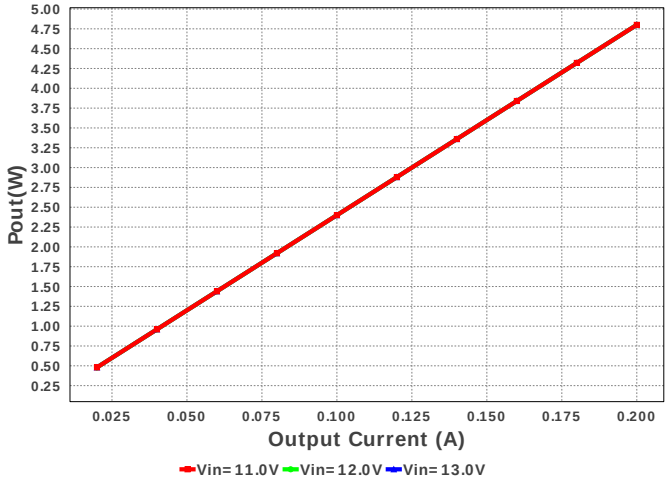

## M Vds Act



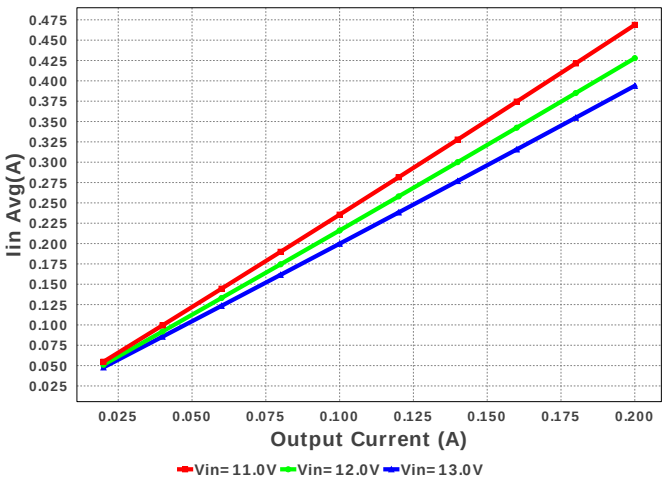

## M Irms

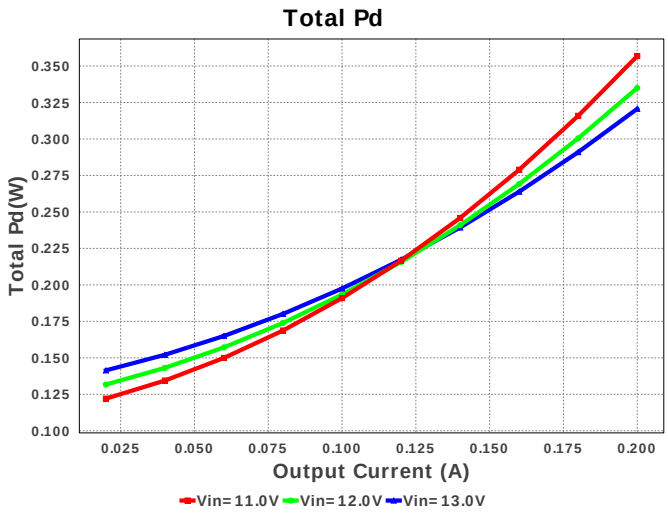


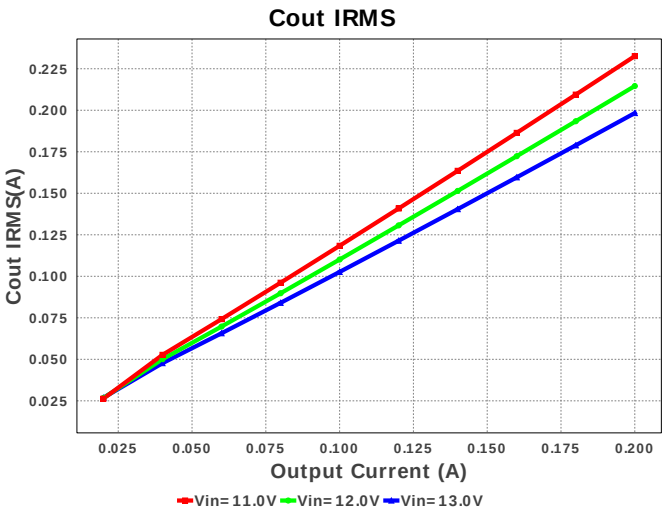

## Pout

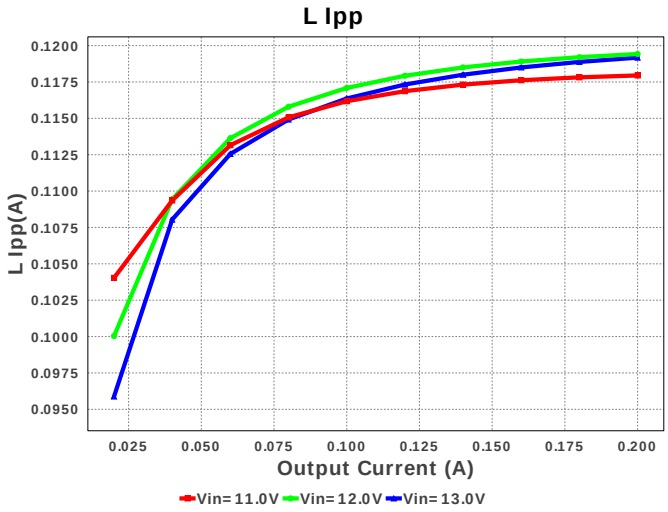


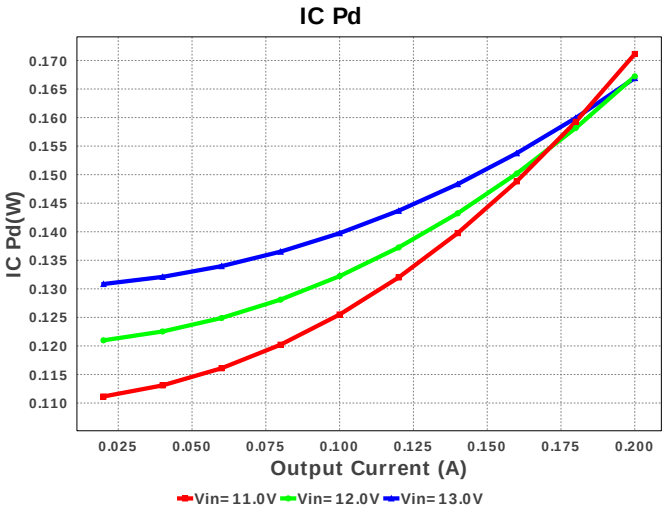

## Iin Avg

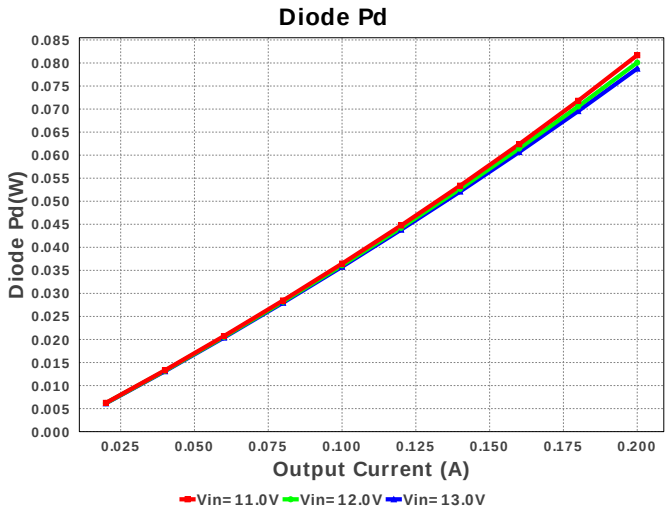





## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 34.007 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 232.343 mA | Current | Output capacitor RMS ripple current |
| 3. | IC Ipk | 526.343 mA | Current | Peak switch current in IC |
| 4. | Iin Avg | 468.12 mA | Current | Average input current |
| 5. | L Ipp | 117.8 mA | Current | Peak-to-peak inductor ripple current |
| 6. | M1 Irms | 354.506 mA | Current | Q Iavg |
| 7. | BOM Count | 15 | General | Total Design BOM count |
| 8. | FootPrint | 299.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 9. | Frequency | 600.0 kHz | General | Switching frequency |
| 10. | IC Tolerance | 26.0 mV | General | IC Feedback Tolerance |
| 11. | M Vds Act | 171.804 mV | General | |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 12. | Pout | 4.8 W | General | Total output power |
| 13. | Total BOM | $2.18 | General | Total BOM Cost |
| 14. | Vout Actual | 23.724 V | Op_Point | Vout Actual calculated based on selected voltage divider resistors |
| 15. | Cross Freq | 1.407 kHz | Op_point | Bode plot crossover frequency |
| 16. | Duty Cycle | 57.214 % | Op_point | Duty cycle |
| 17. | Efficiency | 93.217 % | Op_point | Steady state efficiency |
| 18. | IC Tj | 58.025 degC | Op_point | IC junction temperature |
| 19. | ICThetaJA | 150.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 20. | IOUT_OP | 200.0 mA | Op_point | Iout operating point |
| 21. | Phase Marg | 46.891 deg | Op_point | Bode Plot Phase Margin |
| 22. | VIN_OP | 11.0 V | Op_point | Vin operating point |
| 23. | Vout p-p | 42.409 mV | Op_point | Peak-to-peak output ripple voltage |
| 24. | Cin Pd | 9.895 µW | Power | Input capacitor power dissipation |
| 25. | Cout Pd | 19.434 mW | Power | Output capacitor power dissipation |
| 26. | Diode Pd | 74.652 mW | Power | Diode power dissipation |
| 27. | IC Pd | 170.906 mW | Power | IC power dissipation |
| 28. | L Pd | 81.273 mW | Power | Inductor power dissipation |
| 29. | Total Pd | 349.278 mW | Power | Total Power Dissipation |
| 30. | Vout Tolerance | 4.018 % | | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 200.0 m | Maximum Output Current |
| 2. | VinMax | 13.0 | Maximum input voltage |
| 3. | VinMin | 11.0 | Minimum input voltage |
| 4. | Vout | 24.0 | Output Voltage |
| 5. | base_pn | LM5000-6 | Base Product Number |
| 6. | source | DC | Input Source Type |
| 7. | Ta | 30.0 | Ambient temperature |

## Design Assistance

1. **LM5000-6** Product Folder : http://www.ti.com/product/LM5000 : contains the data sheet and other resources.