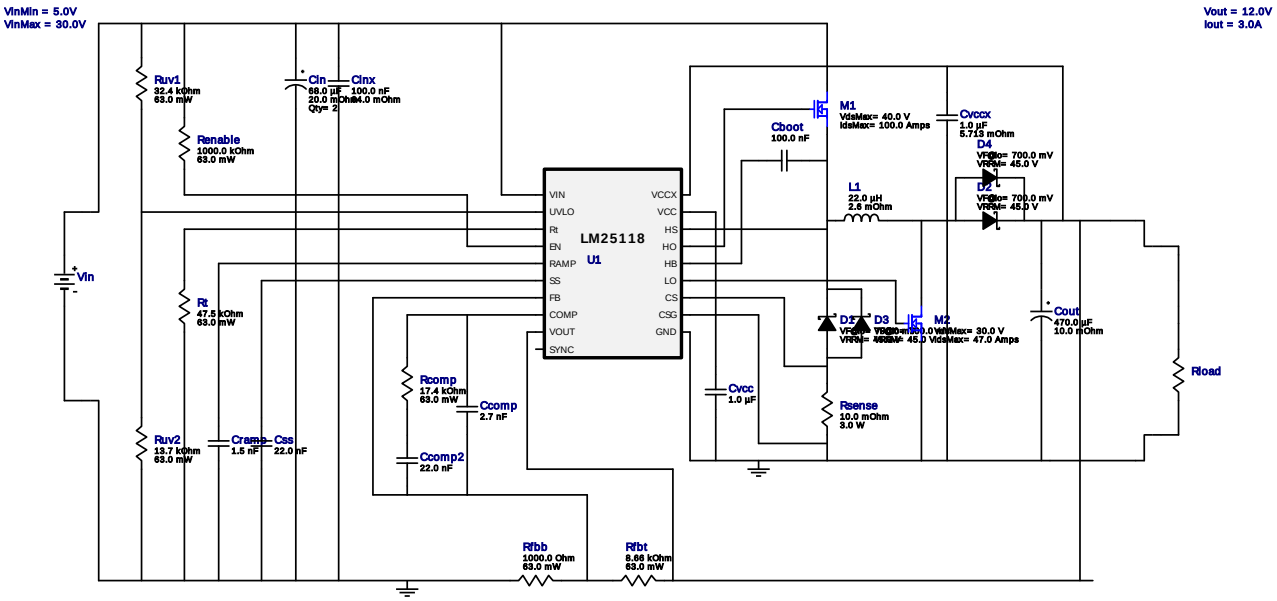
# WEBENCH® Design Report

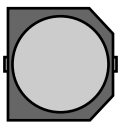
VinMin = 5.0V
VinMax = 30.0V
Vout = 12.0V
Iout = 3.0A

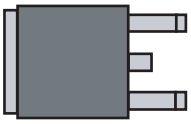
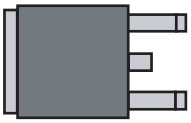
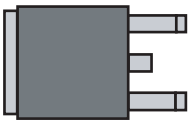
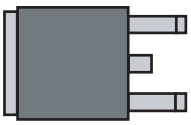
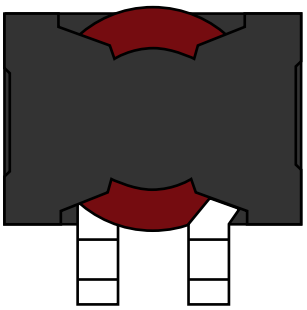
Device = LM25118MH/NOPB
Topology = Buck_Boost
Created = 12/8/14 2:18:39 AM
BOM Cost = $11.67
Footprint = 2,208.0 mm$^2$
BOM Count = 27
Total Pd = 3.81W

Design : 1542746/388 LM25118MH/NOPB
LM25118MH/NOPB 5.0V-30.0V to 12.00V @ 3.0A

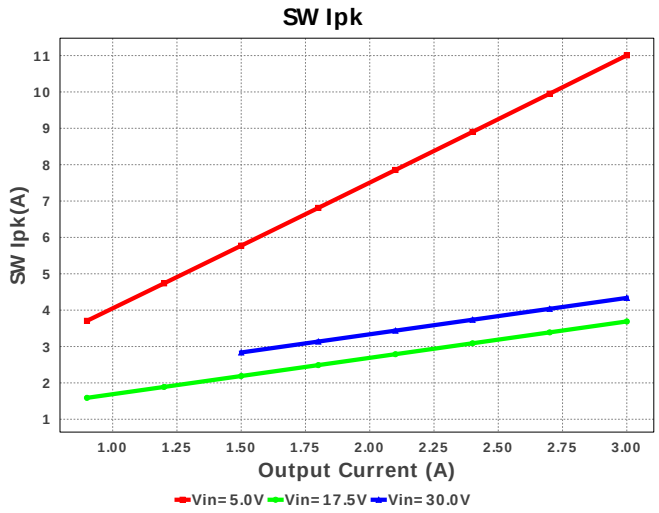


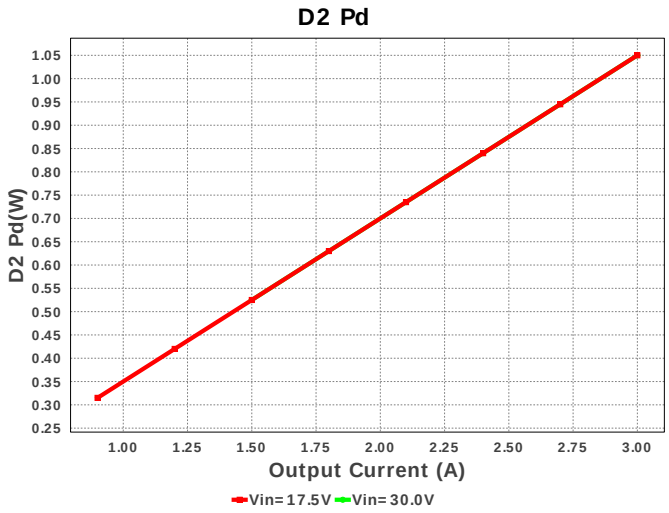

## Electrical BOM

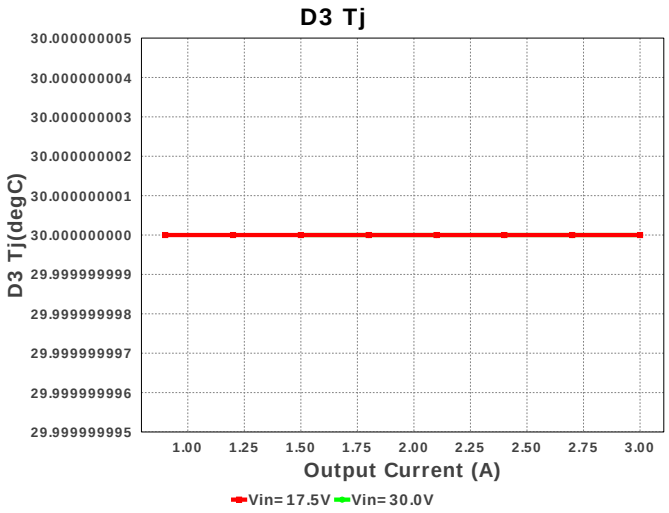
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cboot | MuRata | GRM21BR71E104KA01L<br>Series= X7R | Cap= 100.0 nF<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 2. | Ccomp | Yageo America | CC0805KRX7R9BB272<br>Series= X7R | Cap= 2.7 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 3. | Ccomp2 | Yageo America | CC0805KRX7R9BB223<br>Series= X7R | Cap= 22.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 4. | Cin | Panasonic | 50SVPF68M<br>Series= 1273 | Cap= 68.0 uF<br>ESR= 20.0 mOhm<br>VDC= 50.0 V<br>IRMS= 4.3 A | 2 | $0.92 | CAPSMT_62_F12 151 mm$^2$ |
| 5. | 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 | $0.01 | 0805 7 mm$^2$ |
| 6. | Cout | Panasonic | 16SVPE470M<br>Series= 259 | Cap= 470.0 uF<br>ESR= 10.0 mOhm<br>VDC= 16.0 V<br>IRMS= 6.1 A | 1 | $0.88 |  <br>CAPSMT_62_JC0 156 mm$^2$ |
| 7. | Cramp | Yageo America | CC0805KRX7R9BB152<br>Series= X7R | Cap= 1.5 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 8. | Css | Yageo America | CC0805KRX7R9BB223<br>Series= X7R | Cap= 22.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |

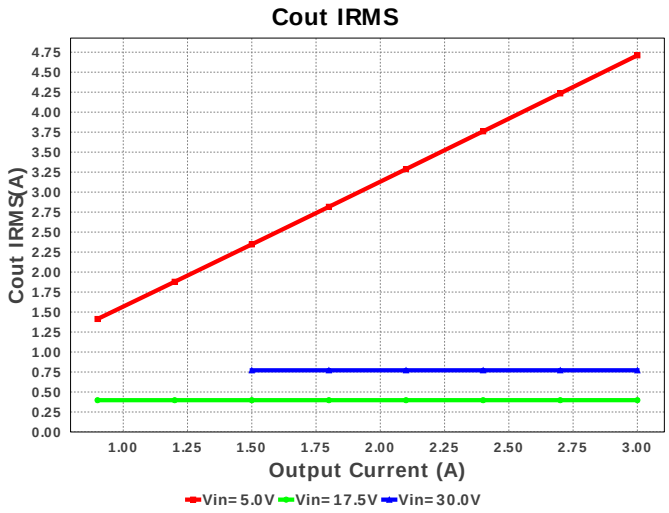
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 9. | Cvcc | MuRata | GRM155R61A105KE15D<br>Series= X5R | Cap= 1.0 uF<br>VDC= 10.0 V<br>IRMS= 0.0 A | 1 | $0.01 | <br>0402 3 mm² |
| 10. | Cvccx | TDK | C1608X5R1C105K<br>Series= 285 | Cap= 1.0 uF<br>ESR= 5.713 mOhm<br>VDC= 16.0 V<br>IRMS= 0.0 A | 1 | $0.01 | <br>0603 5 mm² |
| 11. | D1 | Vishay-Semiconductor | MBRB745PBF | VF@Io= 700.0 mV<br>VRRM= 45.0 V | 1 | $0.69 |  <br>DDPAK 210 mm² |
| 12. | D2 | Vishay-Semiconductor | MBRB745PBF | VF@Io= 700.0 mV<br>VRRM= 45.0 V | 1 | $0.69 |  <br>DDPAK 210 mm² |
| 13. | D3 | Vishay-Semiconductor | MBRB745PBF | VF@Io= 700.0 mV<br>VRRM= 45.0 V | 1 | $0.69 |  <br>DDPAK 210 mm² |
| 14. | D4 | Vishay-Semiconductor | MBRB745PBF | VF@Io= 700.0 mV<br>VRRM= 45.0 V | 1 | $0.69 |  <br>DDPAK 210 mm² |
| 15. | L1 | Coilcraft | SER2918H-223KL | L= 22.0 µH<br>DCR= 2.6 mOhm | 1 | $2.40 |  <br>SER2918H 652 mm² |
| 16. | M1 | Texas Instruments | CSD18503Q5A | VdsMax= 40.0 V<br>IdsMax= 100.0 Amps | 1 | $0.73 |  <br>TRANS_NexFET_Q5A 55 mm² |
| 17. | M2 | Texas Instruments | CSD17308Q3 | VdsMax= 30.0 V<br>IdsMax= 47.0 Amps | 1 | $0.34 |  <br>TRANS_NexFET_Q3 19 mm² |
| 18. | Rcomp | Vishay-Dale | CRCW040217K4FKED<br>Series= CRCW..e3 | Res= 17.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 19. | Renable | Vishay-Dale | CRCW04021M00FKED<br>Series= CRCW..e3 | Res= 1000.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 20. | Rfbb | Vishay-Dale | CRCW04021K00FKED<br>Series= CRCW..e3 | Res= 1000.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 21. | Rfbt | Vishay-Dale | CRCW04028K66FKED<br>Series= CRCW..e3 | Res= 8.66 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |

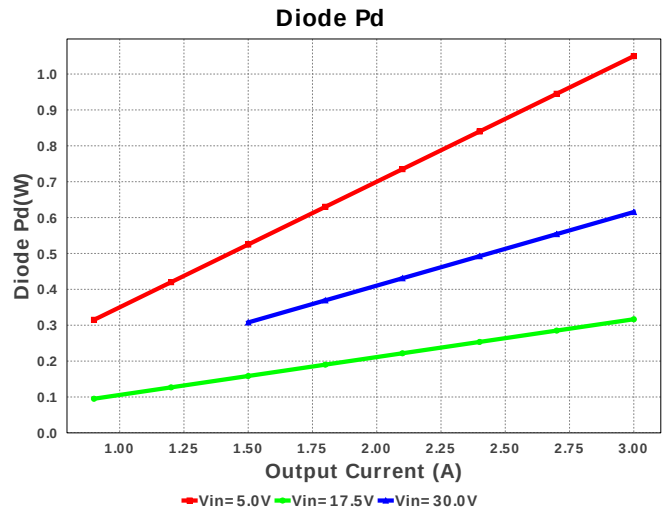
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 22. | Rsense | Bourns | CRA2512-FZ-R010ELF<br>Series= 385 | Res= 10.0 mOhm<br>Power= 3.0 W<br>Tolerance= 1.0% | 1 | $0.17 |  <br>2512 43 mm$^2$ |
| 23. | Rt | Vishay-Dale | CRCW040247K5FKED<br>Series= CRCW..e3 | Res= 47.5 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 24. | Ruv1 | Vishay-Dale | CRCW040232K4FKED<br>Series= CRCW..e3 | Res= 32.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 25. | Ruv2 | Vishay-Dale | CRCW040213K7FKED<br>Series= CRCW..e3 | Res= 13.7 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 26. | U1 | Texas Instruments | LM25118MH/NOPB | Switcher | 1 | $2.40 |  <br>MXA20A 71 mm$^2$ |

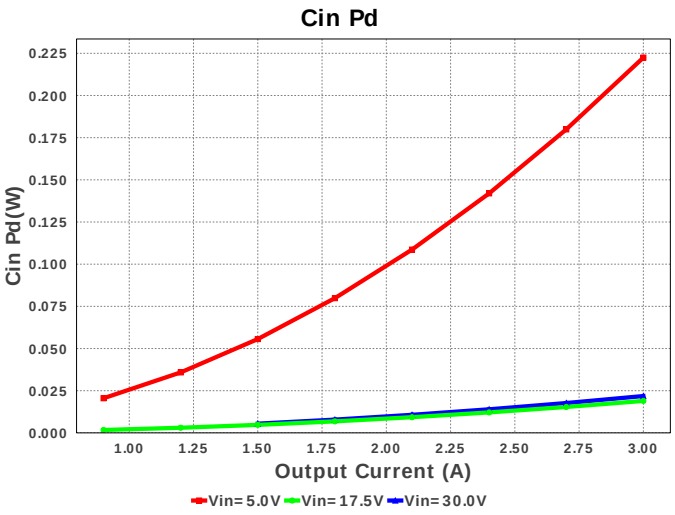


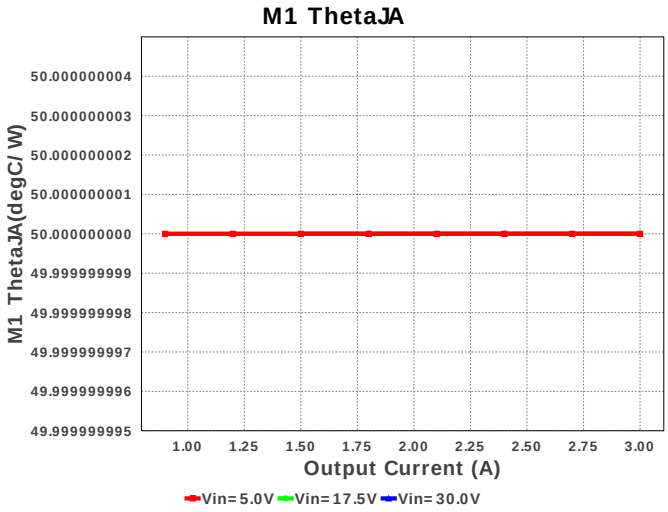



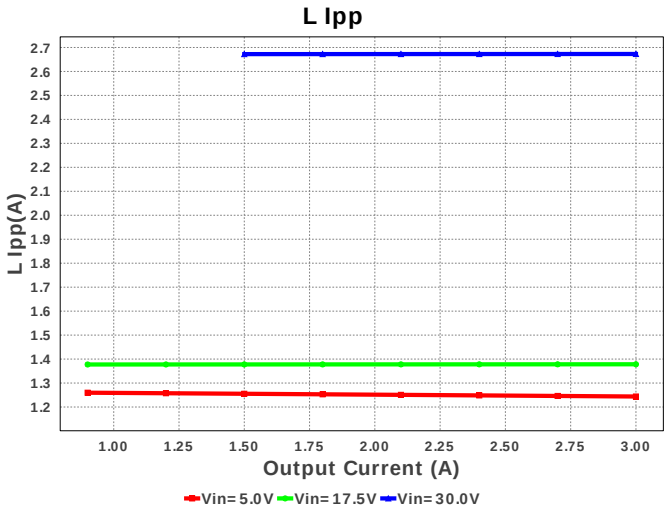



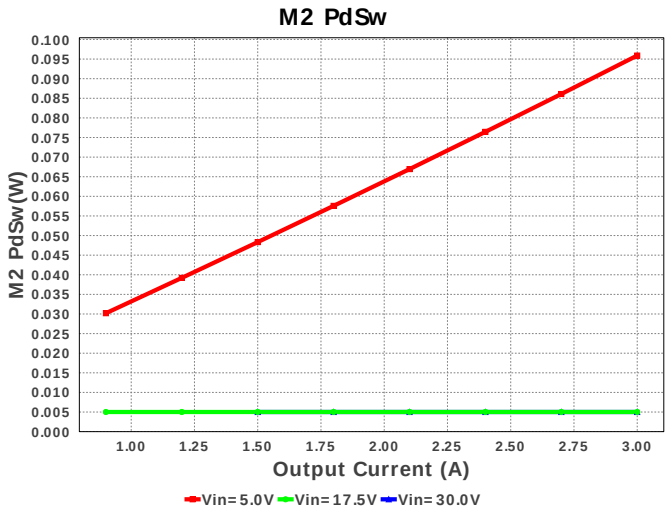



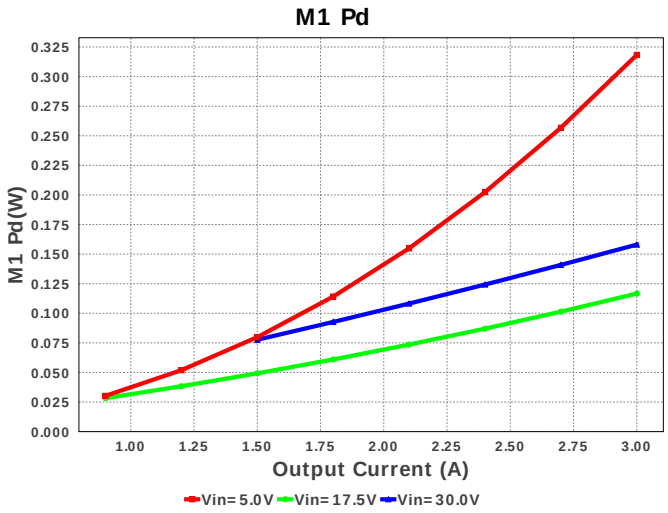


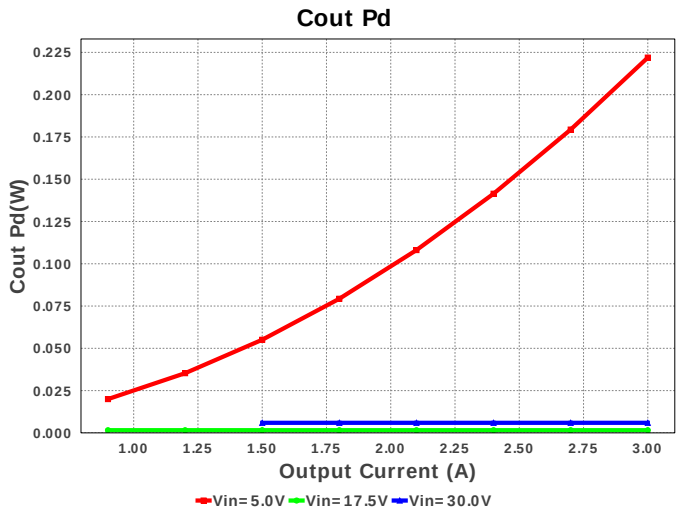



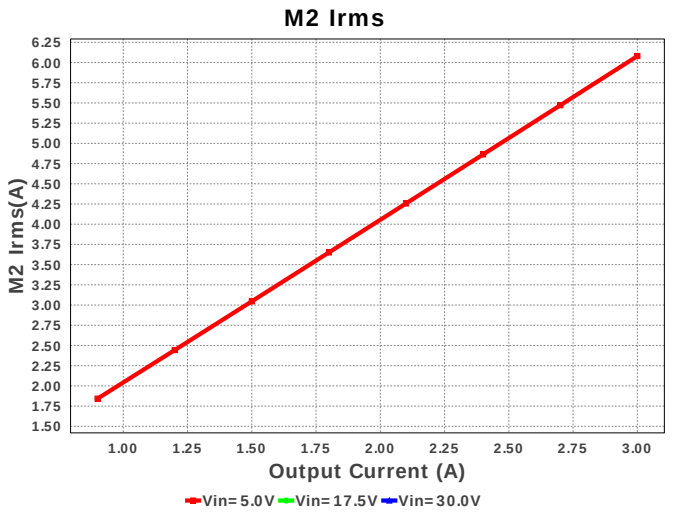



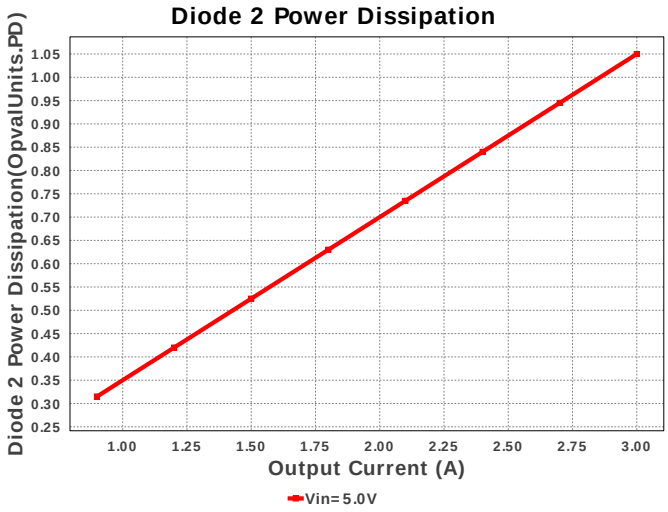



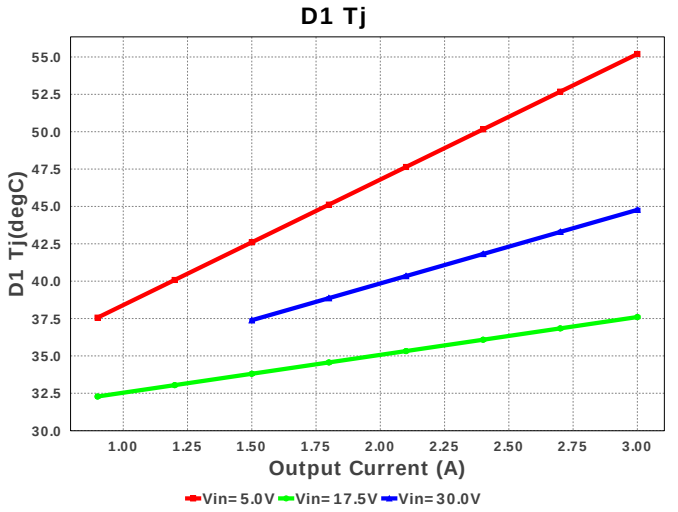



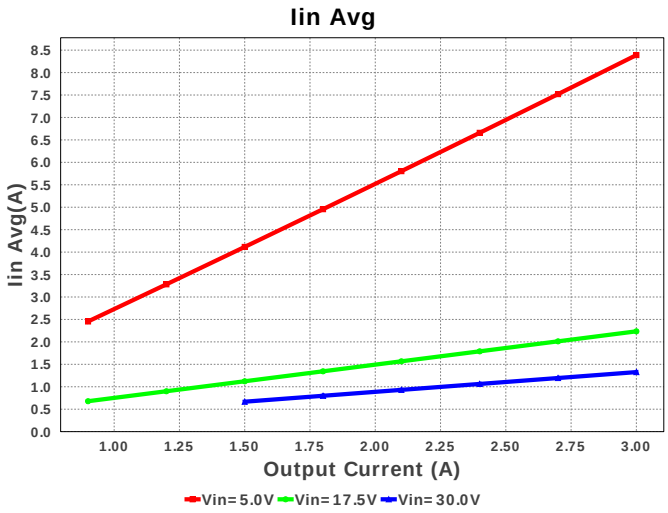



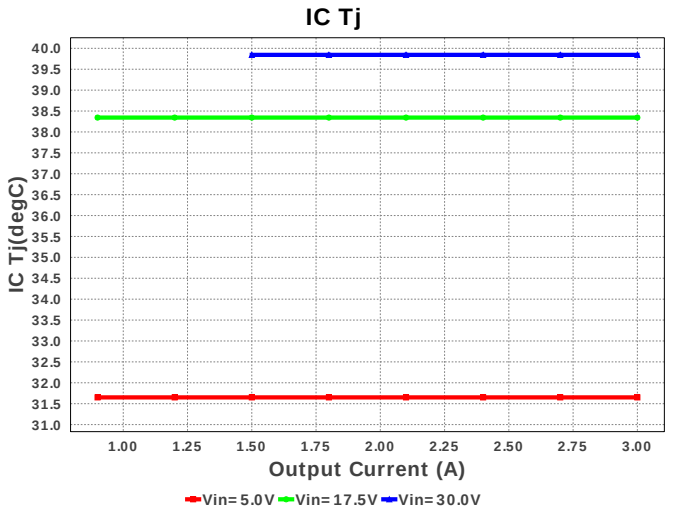


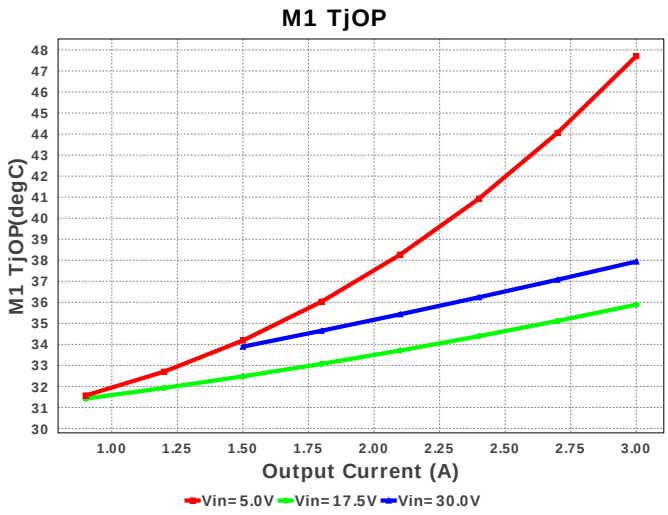



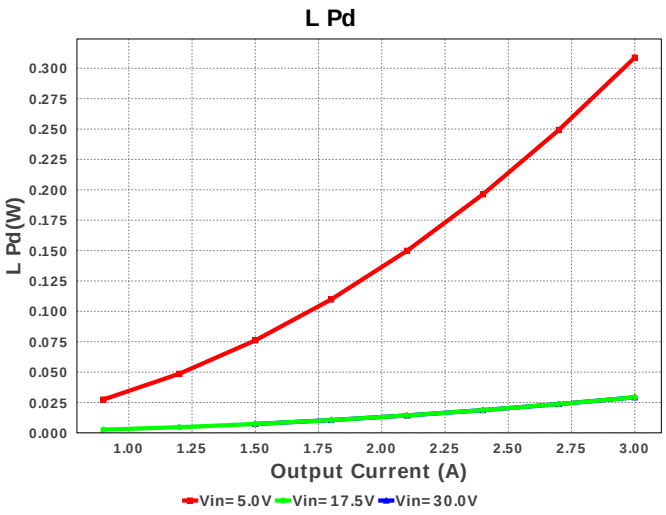



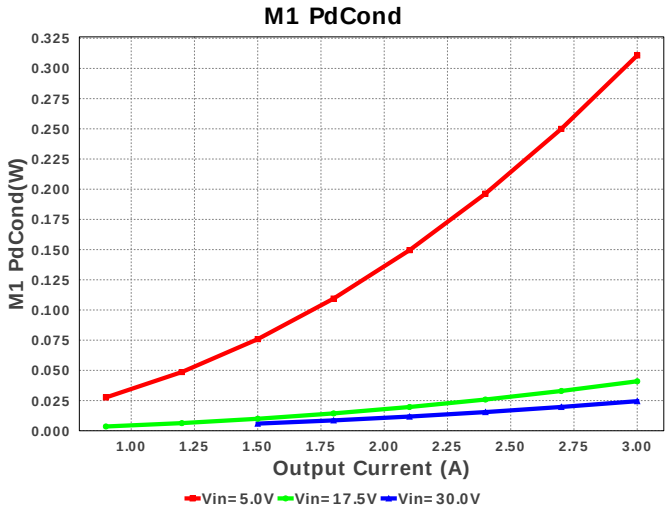



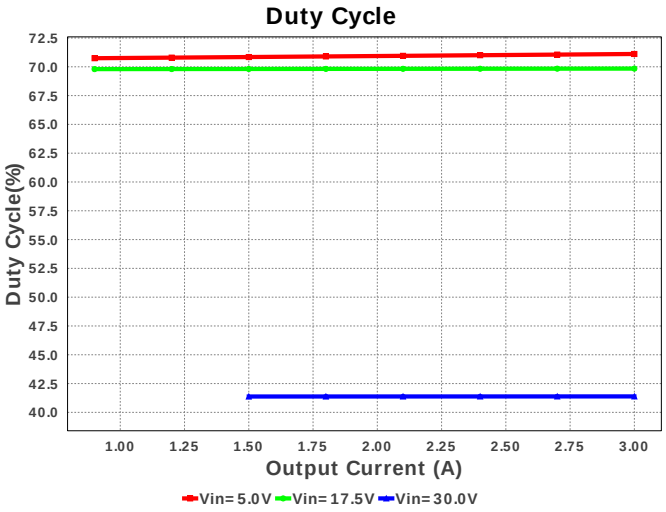



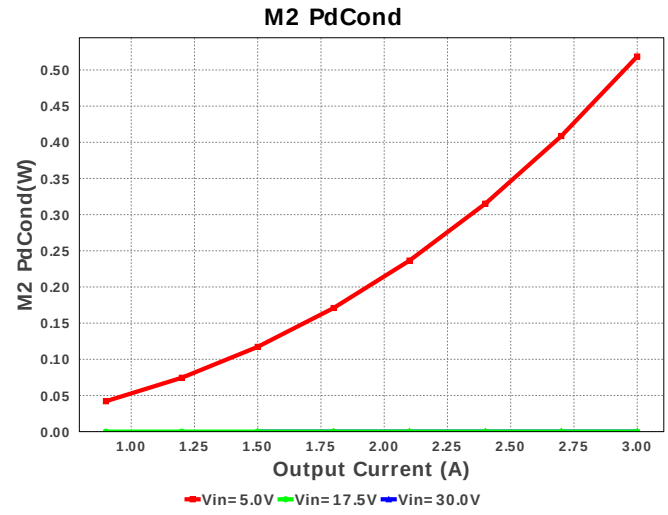



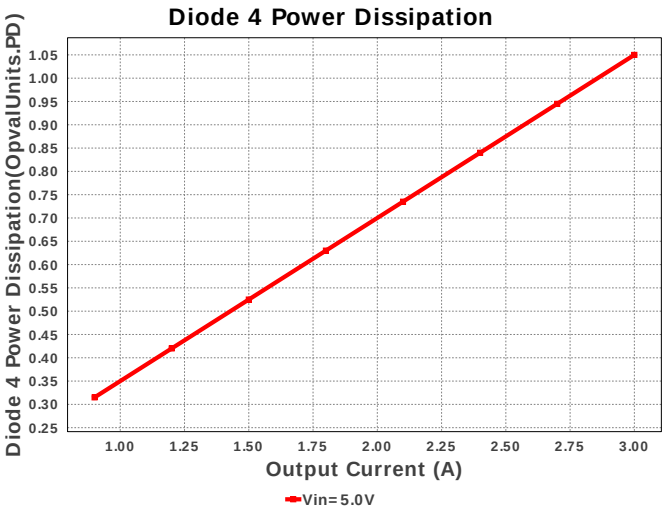


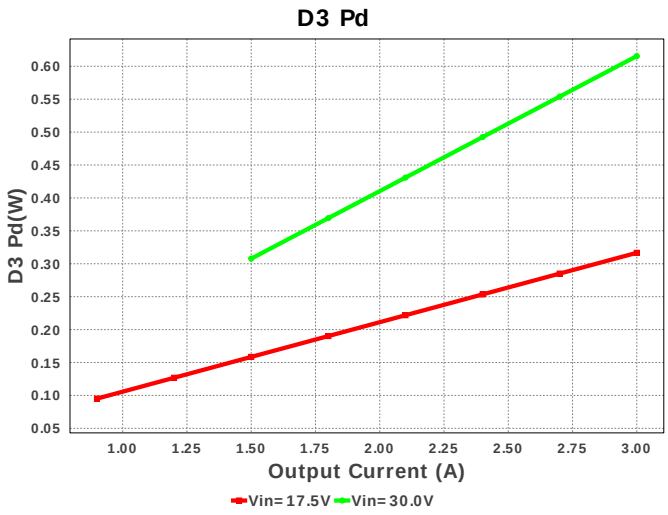



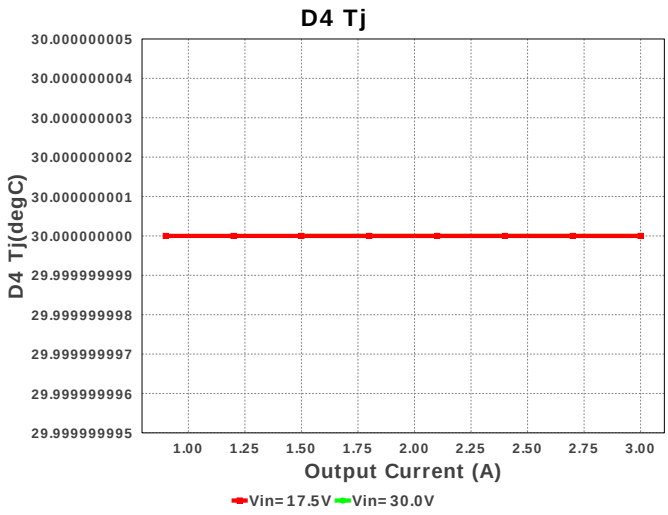



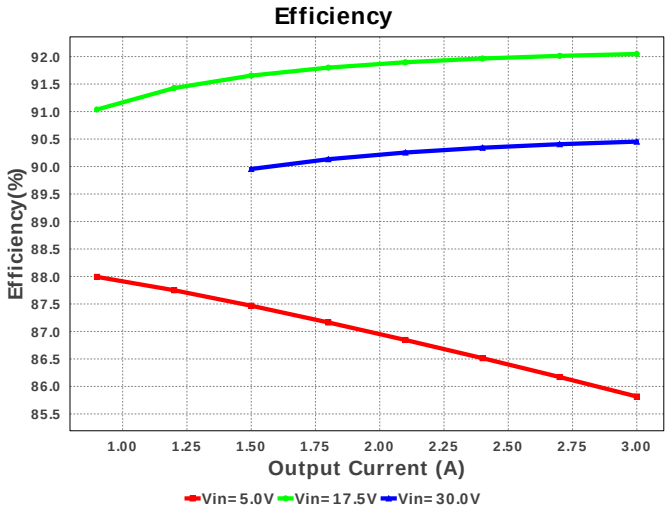



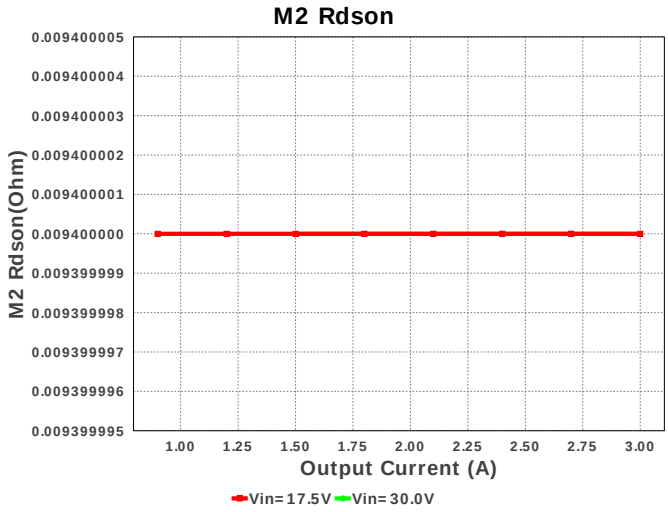



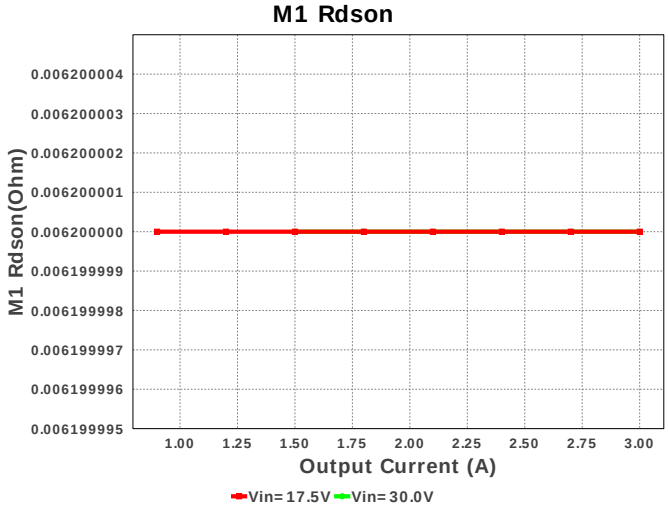



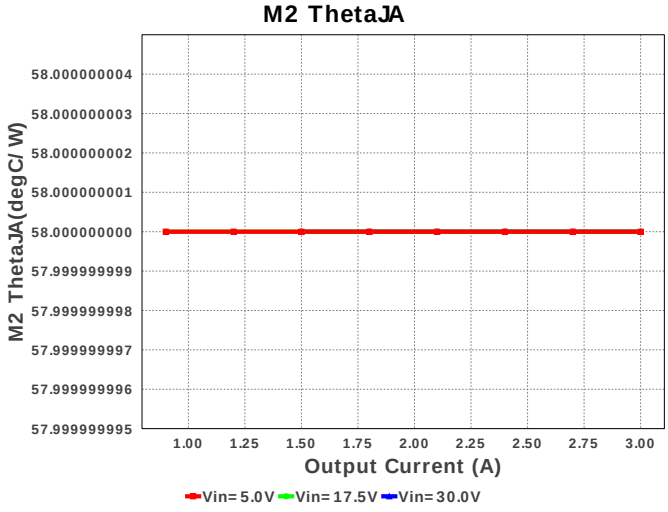


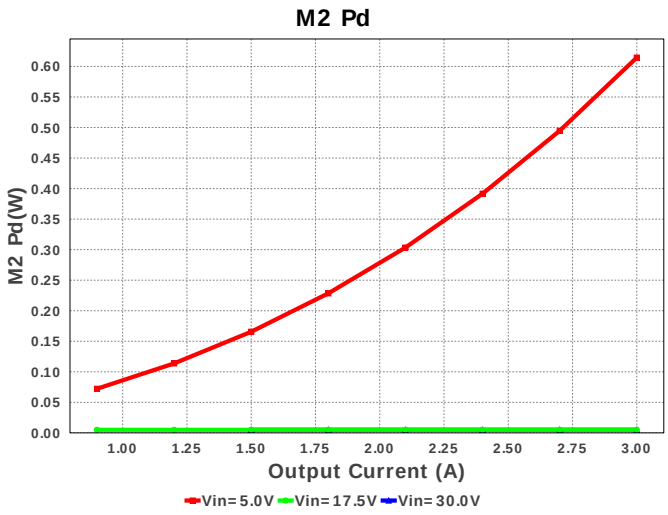



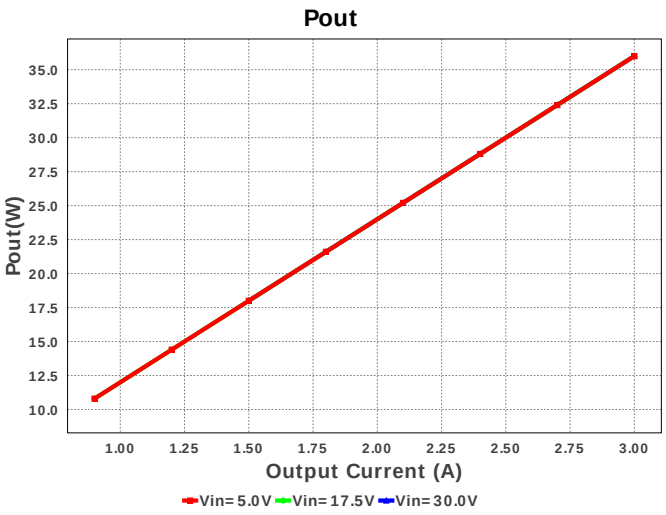



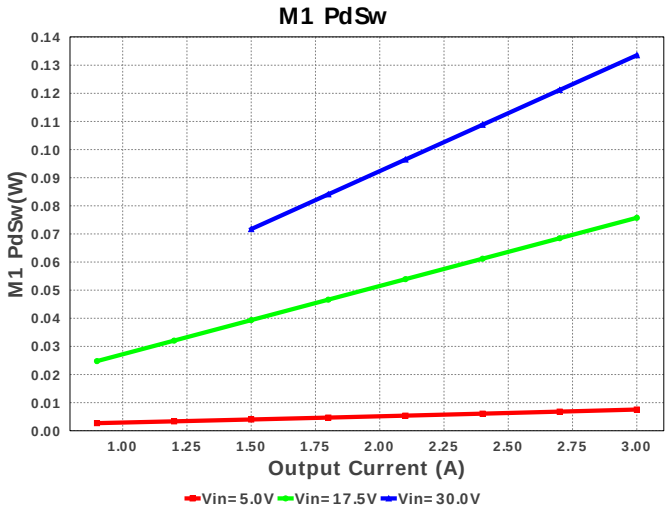



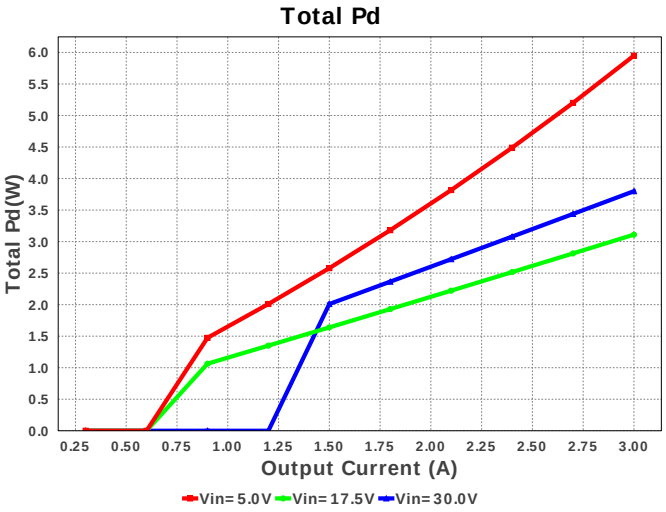



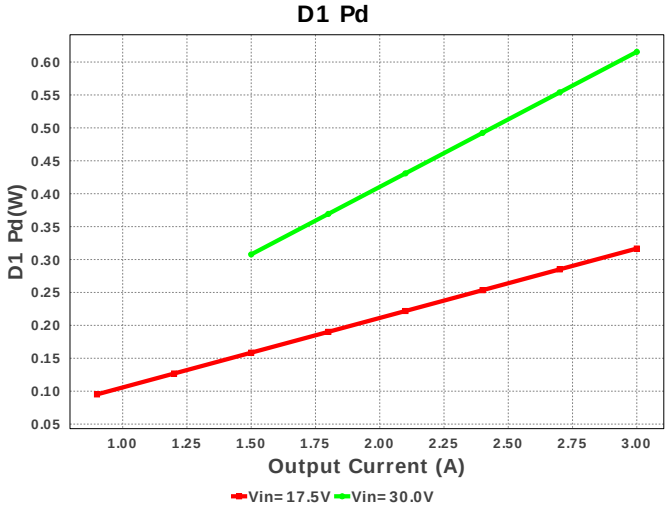



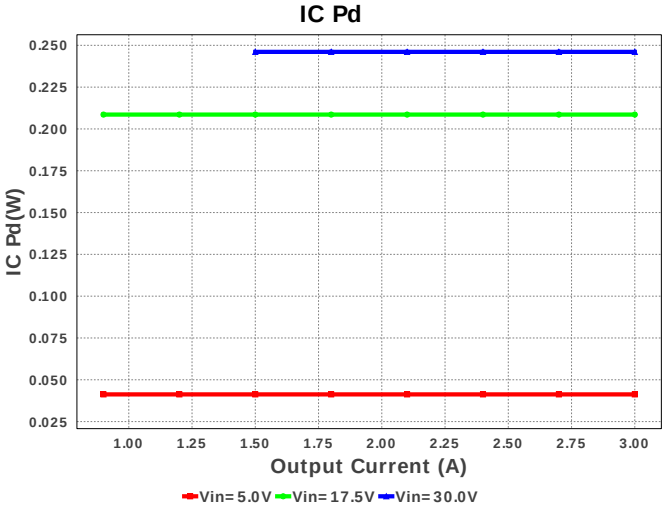


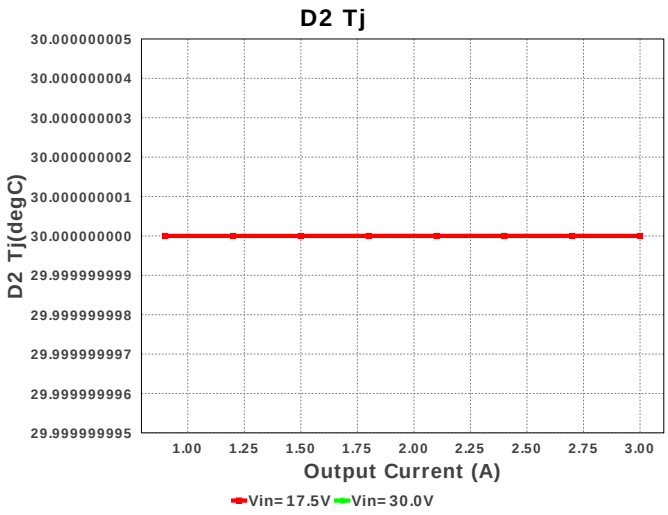



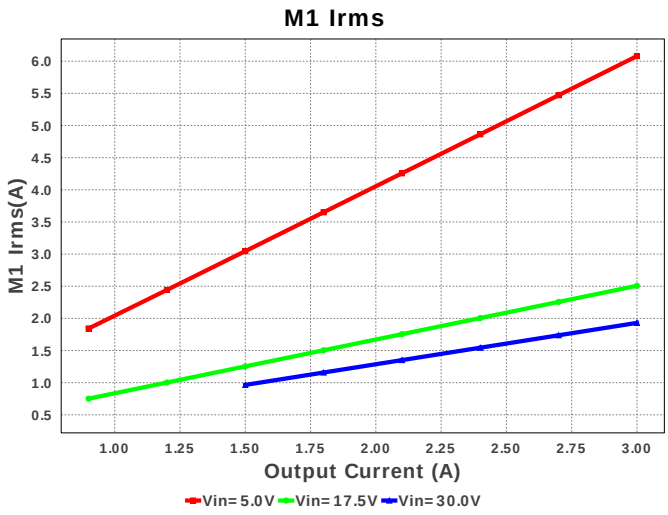



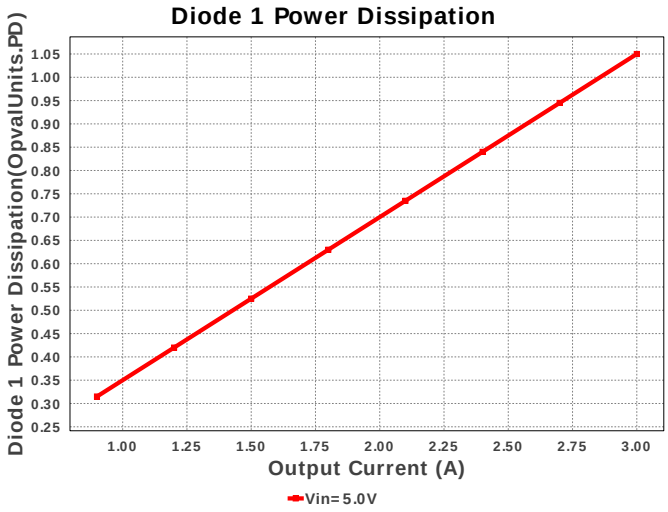



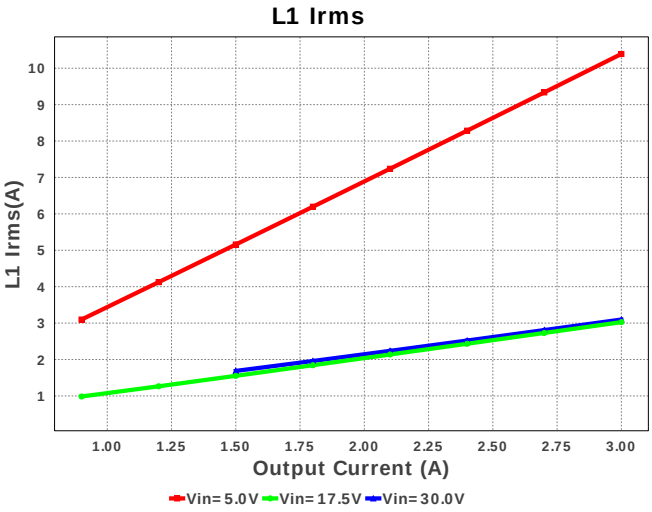



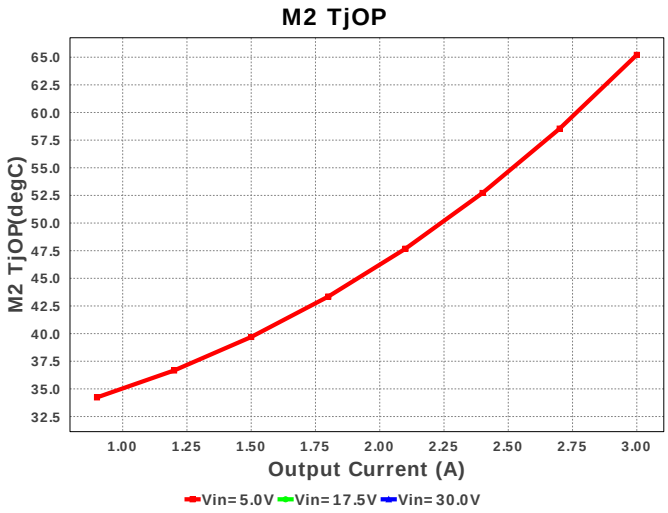



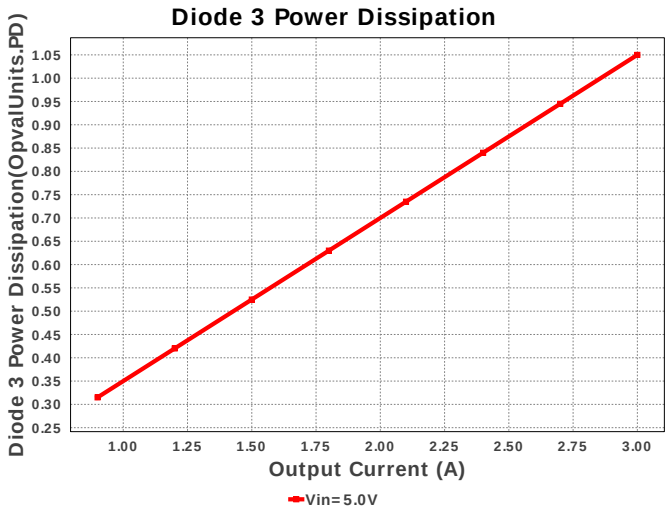


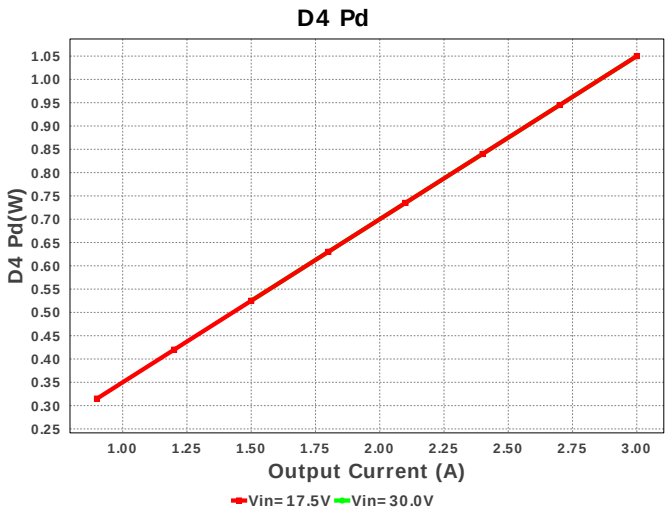



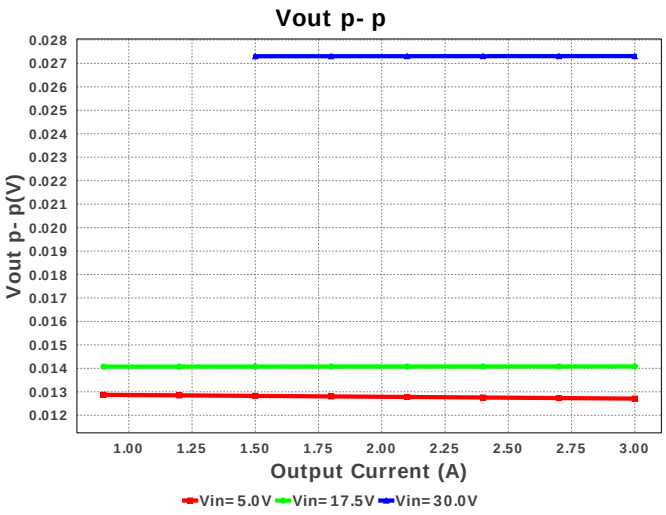



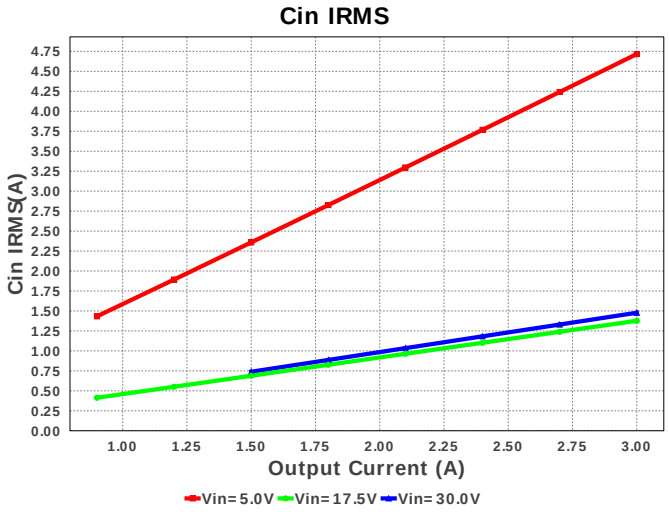



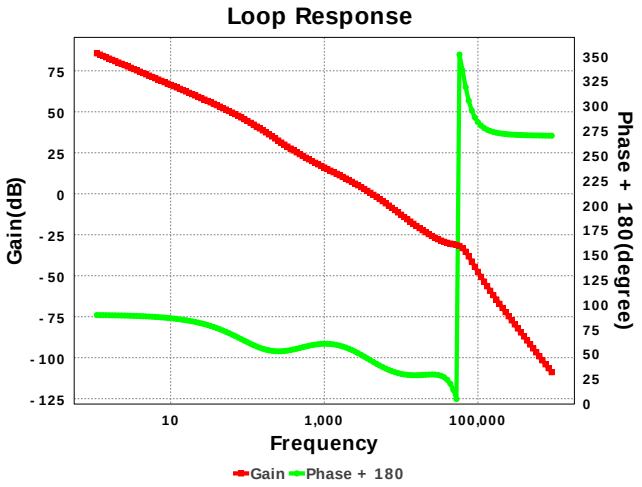






## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 1.478 A | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 771.752 mA | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 1.327 A | Current | Average input current |
| 4. | L Ipp | 2.673 A | Current | Peak-to-peak inductor ripple current |
| 5. | L1 Irms | 3.098 A | Current | Inductor ripple current |
| 6. | M1 Irms | 1.93 A | Current | MOSFET RMS ripple current |
| 7. | M2 Irms | 10.286 A | Current | MOSFET RMS ripple current |
| 8. | SW Ipk | 4.337 A | Current | Peak switch current |
| 9. | BOM Count | 27 | General | Total Design BOM count |
| 10. | FootPrint | 2.208 k $mm^2$ | General | Total Foot Print Area of BOM components |
| 11. | Frequency | 126.683 kHz | General | Switching frequency |
| 12. | IC Tolerance | 18.0 mV | General | IC Feedback Tolerance |
| 13. | M1 Rdson | 6.2 mOhm | General | Drain-Source On-resistance |
| 14. | M1 ThetaJA | 50.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 15. | M2 Rdson | 9.4 mOhm | General | Drain-Source On-resistance |
| 16. | M2 ThetaJA | 58.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 17. | Pout | 36.0 W | General | Total output power |
| 18. | Total BOM | $11.67 | General | Total BOM Cost |
| 19. | D1 Tj | 44.769 degC | Op_Point | D1 junction temperature |
| 20. | D1 Tj | 44.769 degC | Op_Point | D1 junction temperature |
| 21. | D2 Tj | 55.2 degC | Op_Point | D1 junction temperature |
| 22. | D3 Tj | 44.769 degC | Op_Point | D1 junction temperature |
| 23. | D4 Tj | 55.2 degC | Op_Point | D1 junction temperature |
| 24. | Vout OP | 12.0 V | Op_Point | Operational Output Voltage |
| 25. | Cross Freq | 4.159 kHz | Op_point | Bode plot crossover frequency |
| 26. | Duty Cycle | 41.394 % | Op_point | Duty cycle |
| 27. | Efficiency | 90.425 % | Op_point | Steady state efficiency |
| 28. | IC Tj | 39.843 degC | Op_point | IC junction temperature |
| 29. | ICThetaJA | 40.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 30. | IOUT_OP | 3.0 A | Op_point | Iout operating point |
| 31. | M1 TjOP | 37.94 degC | Op_point | MOSFET junction temperature |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 32. | M2 TjOP | 102.67 degC | Op_point | MOSFET junction temperature |
| 33. | Phase Marg | 43.281 deg | Op_point | Bode Plot Phase Margin |
| 34. | VIN_OP | 30.0 V | Op_point | Vin operating point |
| 35. | Vout p-p | 27.317 mV | Op_point | Peak-to-peak output ripple voltage |
| 36. | Cin Pd | 21.833 mW | Power | Input capacitor power dissipation |
| 37. | Cout Pd | 5.956 mW | Power | Output capacitor power dissipation |
| 38. | D1 Pd | 615.365 mW | Power | Diode power dissipation |
| 39. | D2 Pd | 1.05 W | Power | Diode power dissipation |
| 40. | D3 Pd | 615.365 mW | Power | Diode power dissipation |
| 41. | D4 Pd | 1.05 W | Power | Diode power dissipation |
| 42. | Diode Pd | 615.365 mW | Power | Diode power dissipation |
| 43. | IC Pd | 246.087 mW | Power | IC power dissipation |
| 44. | L Pd | 29.25 mW | Power | Inductor power dissipation |
| 45. | M1 Pd | 170.38 mW | Power | MOSFET power dissipation |
| 46. | M1 PdCond | 36.836 mW | Power | M1 MOSFET conduction losses |
| 47. | M1 PdSw | 133.544 mW | Power | M1 MOSFET switching losses |
| 48. | M2 Pd | 5.102 mW | Power | MOSFET power dissipation |
| 49. | M2 PdCond | 0.0 W | Power | M2 MOSFET conduction losses |
| 50. | M2 PdSw | 5.102 mW | Power | M2 MOSFET switching losses |
| 51. | Total Pd | 3.812 W | Power | Total Power Dissipation |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 3.0 A | Maximum Output Current |
| 2. | Iout1 | 3.0 Amps | Output Current #1 |
| 3. | VinMax | 30.0 V | Maximum input voltage |
| 4. | VinMin | 5.0 V | Minimum input voltage |
| 5. | Vout | 12.0 V | Output Voltage |
| 6. | Vout1 | 12.0 Volt | Output Voltage #1 |
| 7. | base_pn | LM25118 | Texas Instruments Base Part Number |
| 8. | source | DC | Input Source Type |
| 9. | ta | 30.0 degC | Ambient temperature |

## Design Assistance

1. The LM25118 is a wide range buck-boost controller which is operable in an ultra wide input range of 3 to 75V. A buck-boost regulator can maintain regulation for input voltages either higher or lower than the output voltage. The challenge is that buck-boost power converters are not as efficient as buck regulators. The LM5118 has been designed as a dual mode controller whereby the power converter acts as a buck regulator while the input voltage is above the output. As the input voltage approaches the output voltage, a gradual transition to the buck-boost mode occurs. This gradual transition between modes eliminates disturbances at the output during transitions.

2. LM25118 Product Folder : http://www.ti.com/product/lm25118 : contains the data sheet and other resources.