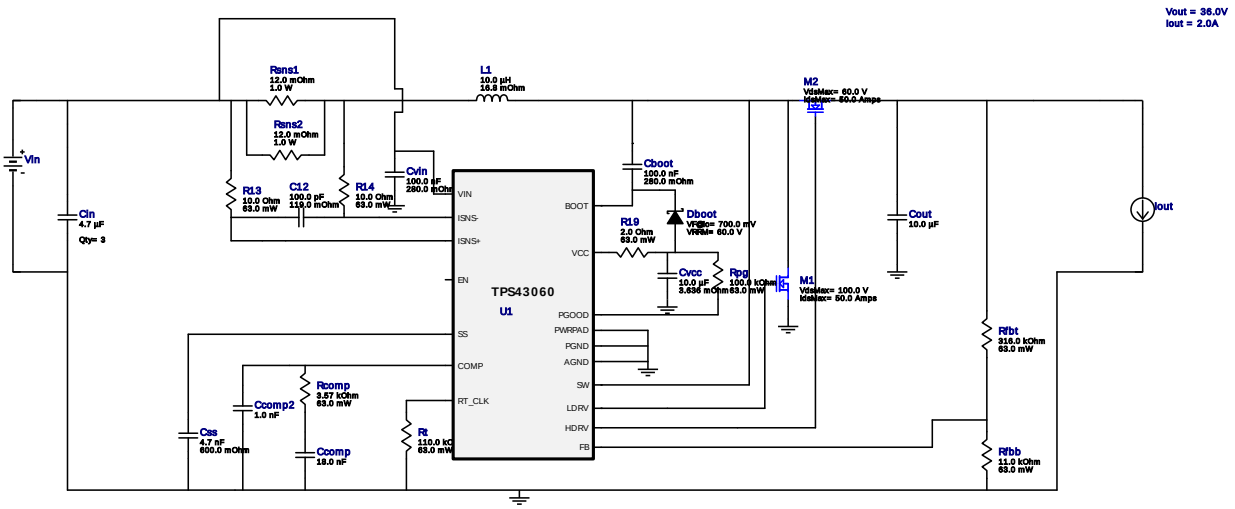
# WEBENCH® Design Report

VinMin = 12.0V
VinMax = 14.0V
Vout = 36.0V
Iout = 2.0A

Device = TPS43060RTER
Topology = Boost
Created = 7/19/16 4:14:34 AM
BOM Cost = $4.25
BOM Count = 26
Total Pd = 4.38W

Design : 4077713/22 TPS43060RTER
TPS43060RTER 12.0V-14.0V to 36.00V @ 2.0A




1. The pulse skip mode in the device has not been modeled. Efficiency and operational parameters of the model in pulse skip mode is not valid.

## Electrical BOM

| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | C12 | AVX | 06035A101JAT2A<br>Series= C0G/NP0 | Cap= 100.0 pF<br>ESR= 119.0 mOhm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0603 5 mm$^2$ |
| 2. | Cboot | 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 | $0.01 | 0805 7 mm$^2$ |
| 3. | Ccomp | Yageo America | CC0805KRX7R9BB183<br>Series= X7R | Cap= 18.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 4. | Ccomp2 | Samsung Electro-Mechanics | CL21C102JBCNFNC<br>Series= C0G/NP0 | Cap= 1.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 5. | Cin | TDK | C3216X6S1E475K<br>Series= X6S | Cap= 4.7 uF<br>VDC= 25.0 V<br>IRMS= 0.0 A | 3 | $0.03 | 1206 11 mm$^2$ |
| 6. | Cout | MuRata | GRM32ER71J106KA12L<br>Series= X7R | Cap= 10.0 uF<br>VDC= 63.0 V<br>IRMS= 0.0 A | 1 | $0.27 | 1210_280 15 mm$^2$ |
| 7. | Css | MuRata | GRM188R71E472KA01D<br>Series= X7R | Cap= 4.7 nF<br>ESR= 600.0 mOhm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0603 5 mm$^2$ |
| 8. | Cvcc | MuRata | GRM188R61C106MA73D<br>Series= X5R | Cap= 10.0 uF<br>ESR= 3.636 mOhm<br>VDC= 16.0 V<br>IRMS= 2.8889 A | 1 | $0.07 | 0603 5 mm$^2$ |
| 9. | Cvin | 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 | $0.01 | 0805 7 mm$^2$ |

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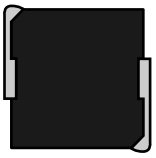
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 10. | Dboot | Diodes Inc. | B260A-13-F | VF@Io= 700.0 mV<br>VRRM= 60.0 V | 1 | $0.09 |  <br>SMA 37 mm$^2$ |
| 11. | L1 | Bourns | SRP1270-100M | L= 10.0 µH<br>DCR= 16.8 mOhm | 1 | $0.60 |  <br>SRP1270 246 mm$^2$ |
| 12. | M1 | Texas Instruments | CSD19537Q3 | VdsMax= 100.0 V<br>IdsMax= 50.0 Amps | 1 | $0.75 |  <br>TRANS_NexFET_Q3 18 mm$^2$ |
| 13. | M2 | Texas Instruments | CSD18537NQ5A | VdsMax= 60.0 V<br>IdsMax= 50.0 Amps | 1 | $0.46 |  <br>TRANS_NexFET_Q5A 55 mm$^2$ |
| 14. | R13 | Vishay-Dale | CRCW040210R0FKED<br>Series= CRCW..e3 | Res= 10.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 15. | R14 | Vishay-Dale | CRCW040210R0FKED<br>Series= CRCW..e3 | Res= 10.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 16. | R19 | Vishay-Dale | CRCW04022R00FKED<br>Series= CRCW..e3 | Res= 2.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 17. | Rcomp | Vishay-Dale | CRCW04023K57FKED<br>Series= CRCW..e3 | Res= 3.57 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 18. | Rfbb | Vishay-Dale | CRCW040211K0FKED<br>Series= CRCW..e3 | Res= 11.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 19. | Rfbt | Vishay-Dale | CRCW0402316KFKED<br>Series= CRCW..e3 | Res= 316.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 20. | Rpg | Vishay-Dale | CRCW0402100KFKED<br>Series= CRCW..e3 | Res= 100.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 21. | Rsns1 | Susumu Co Ltd | PRL1632-R012-F-T1<br>Series= PRL1632 | Res= 12.0 mOhm<br>Power= 1.0 W<br>Tolerance= 1.0% | 1 | $0.19 |  <br>0612 11 mm$^2$ |
| 22. | Rsns2 | Susumu Co Ltd | PRL1632-R012-F-T1<br>Series= PRL1632 | Res= 12.0 mOhm<br>Power= 1.0 W<br>Tolerance= 1.0% | 1 | $0.19 |  <br>0612 11 mm$^2$ |
| 23. | Rt | Vishay-Dale | CRCW0402110KFKED<br>Series= CRCW..e3 | Res= 110.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm$^2$ |
| 24. | U1 | Texas Instruments | TPS43060RTER | Switcher | 1 | $1.40 |  <br>S-PVQFN-N16 17 mm$^2$ |

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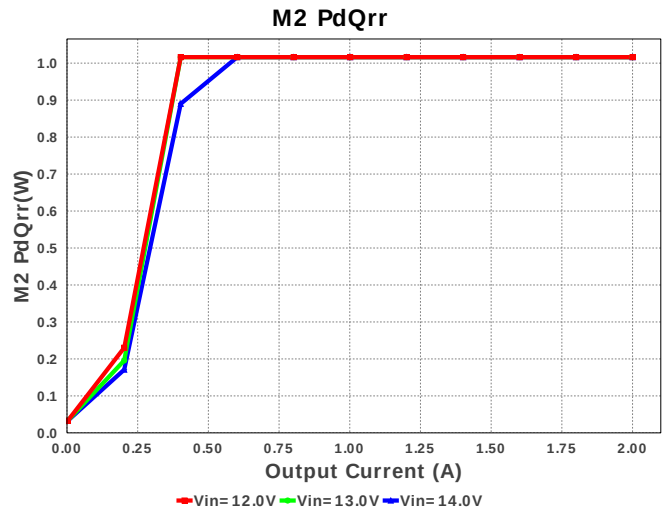


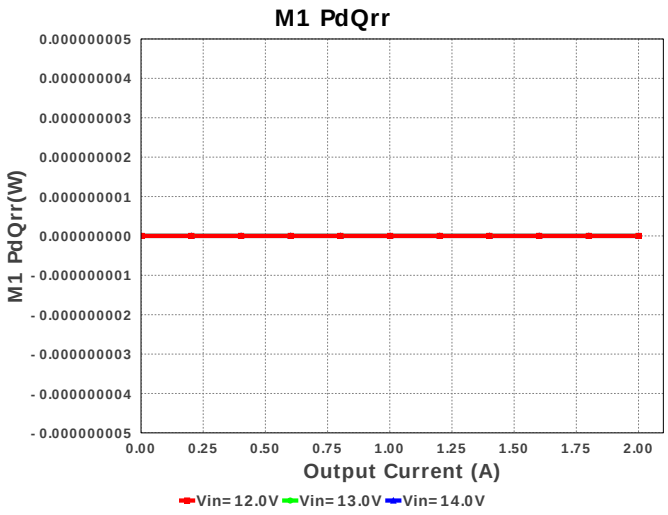


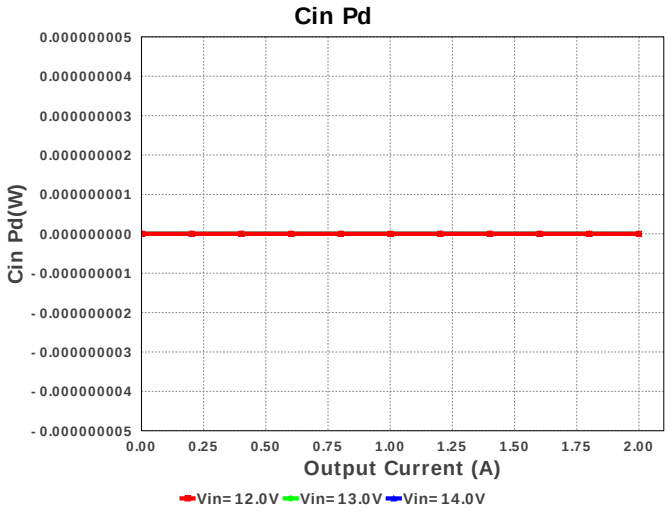


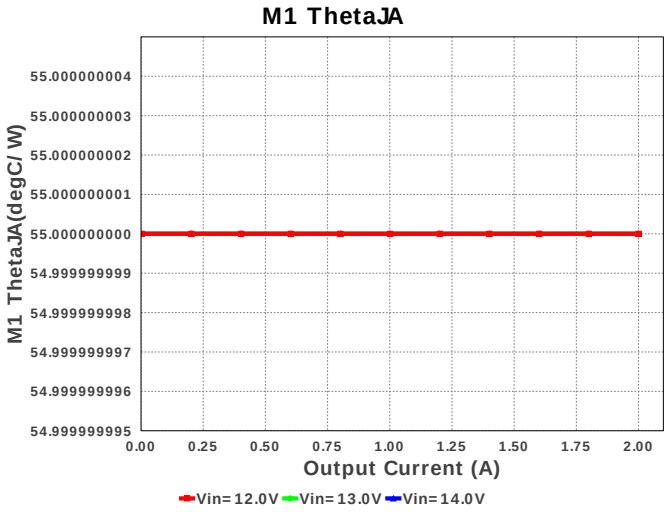


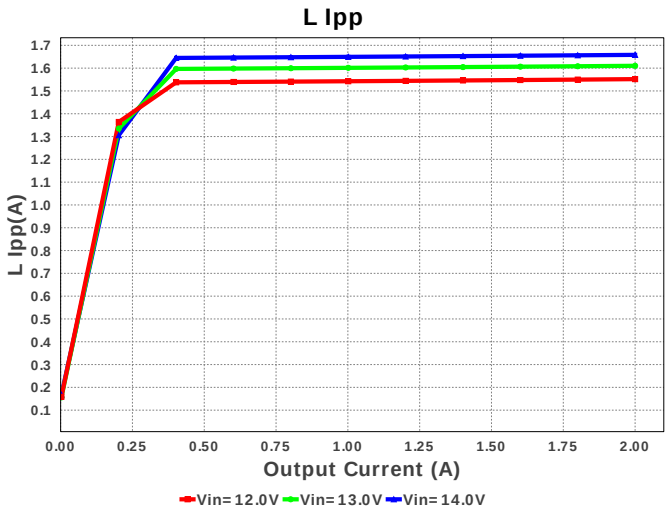


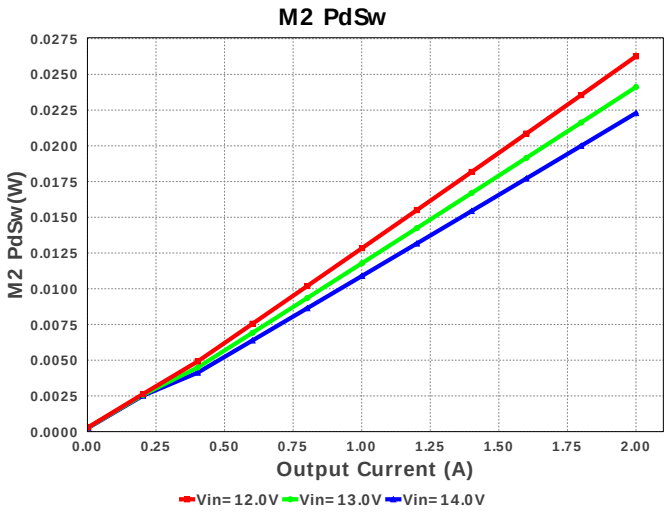


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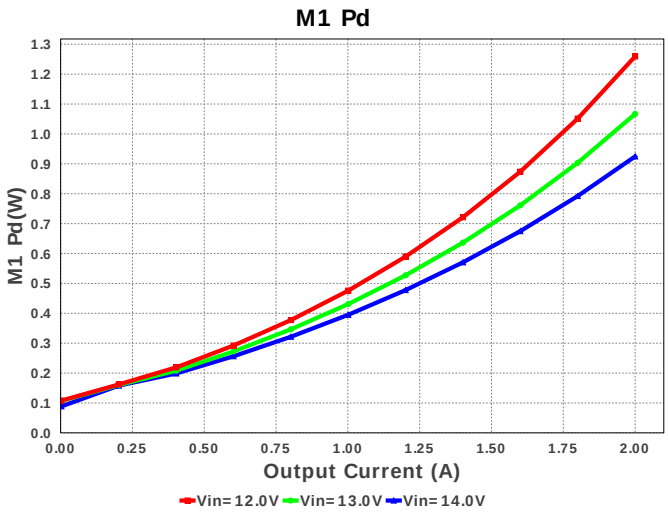


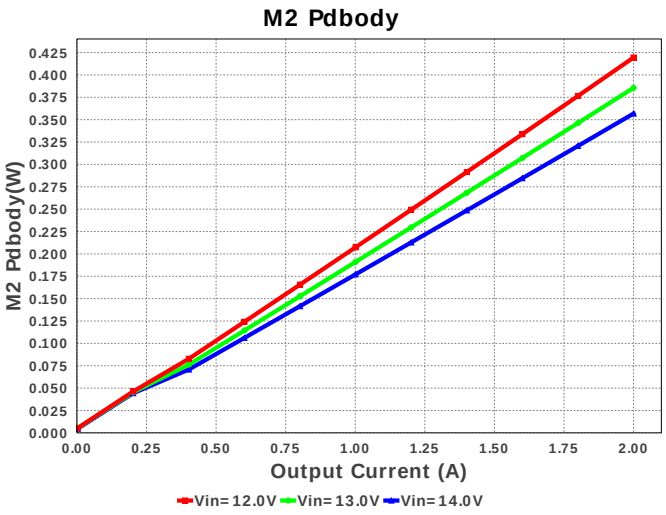


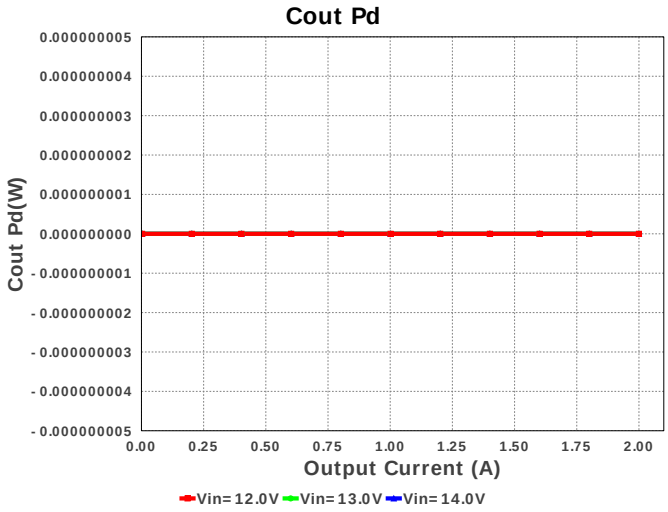


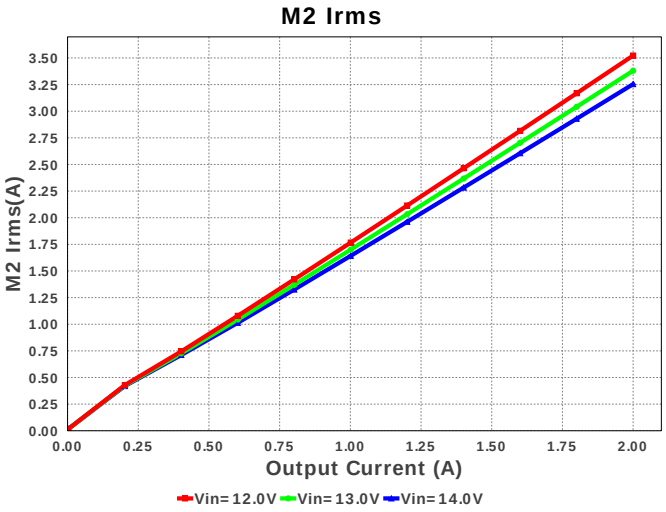


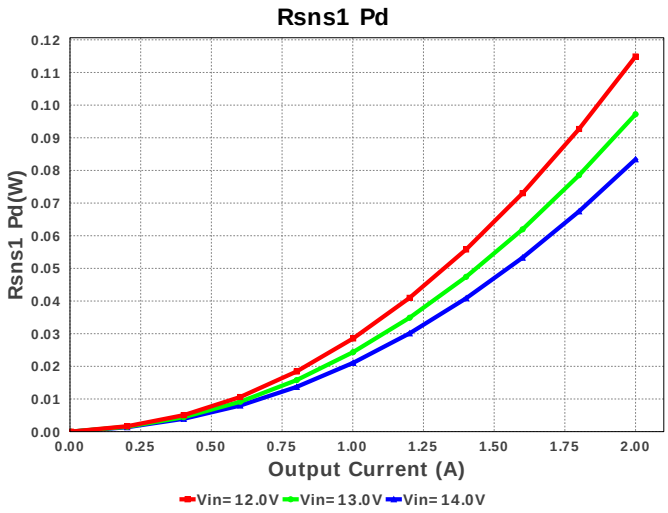


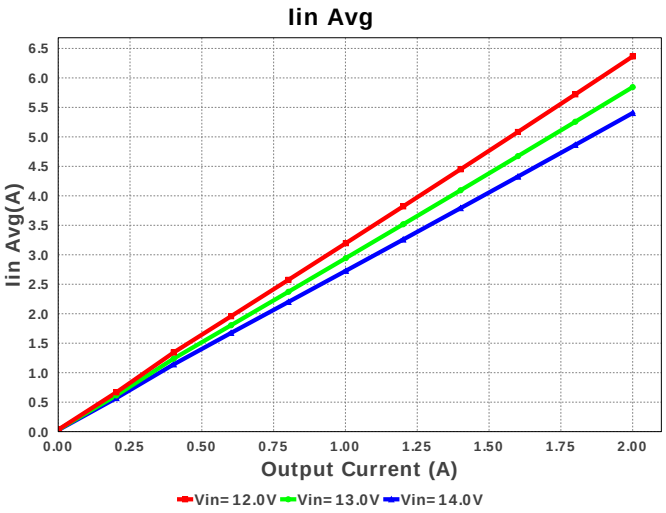


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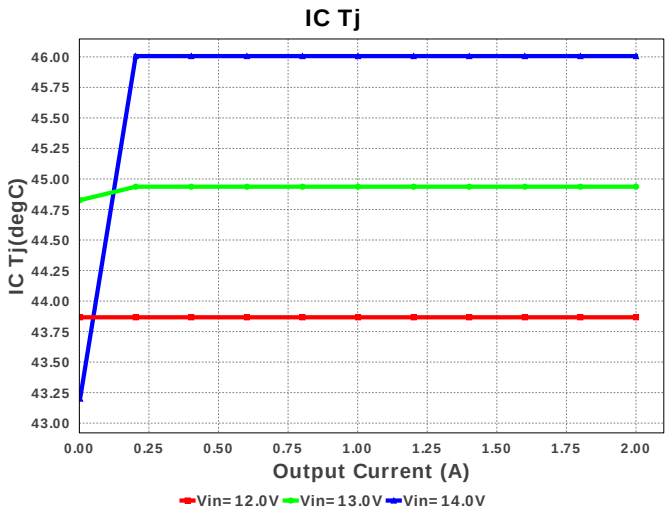


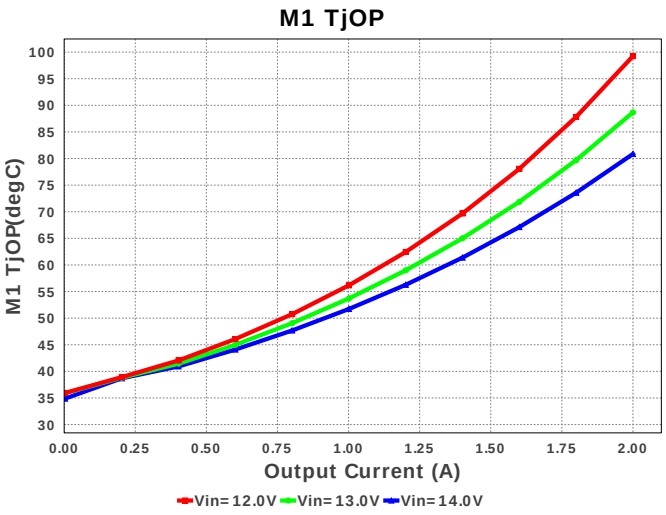


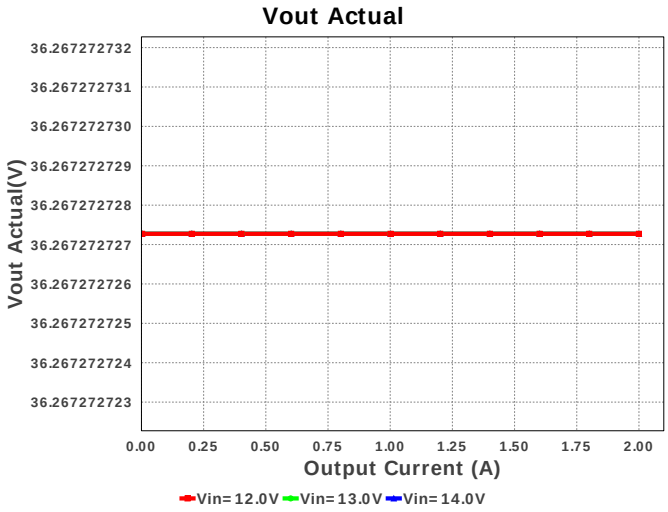


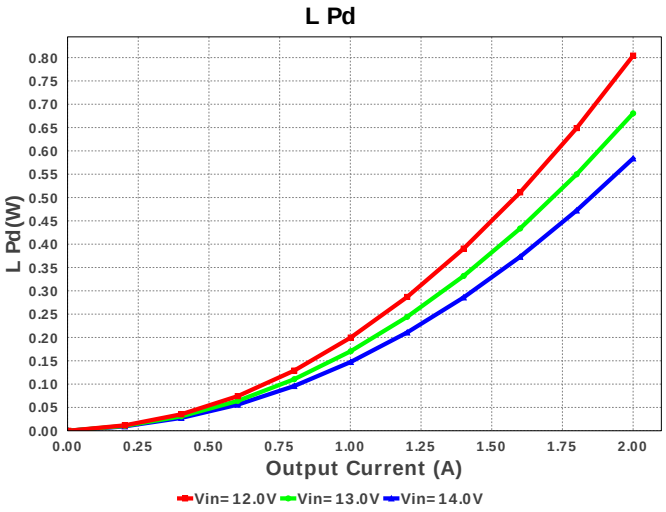


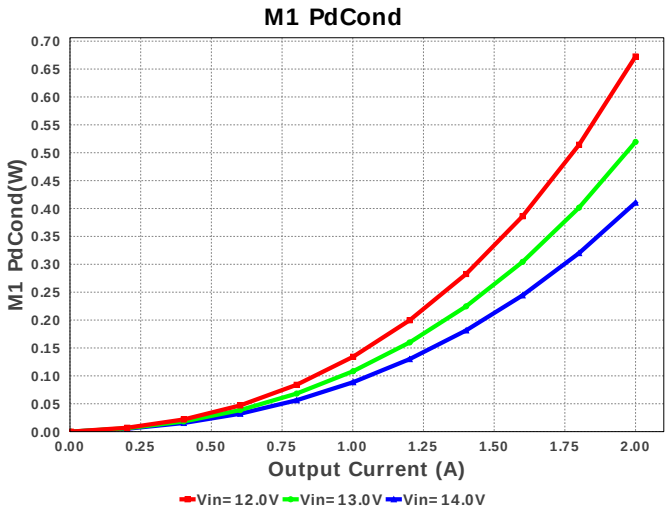


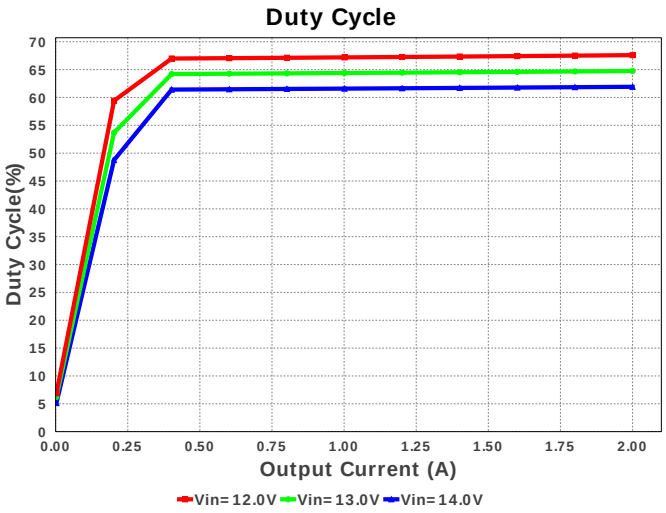


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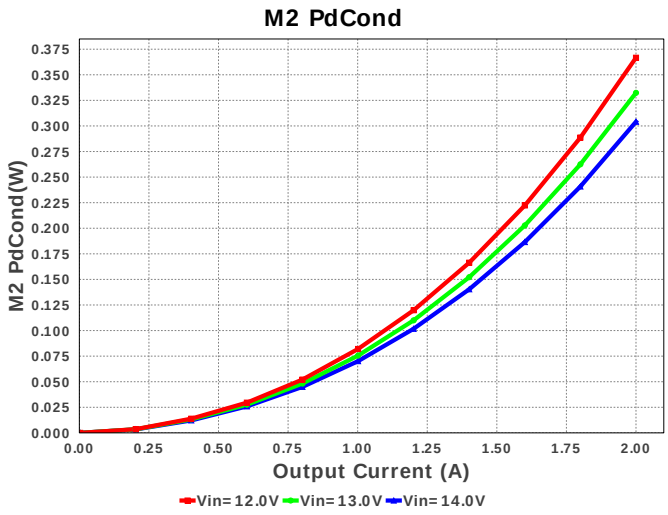


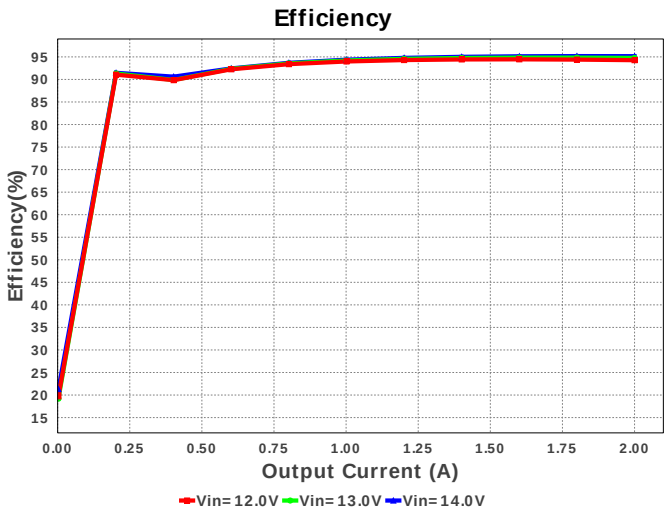


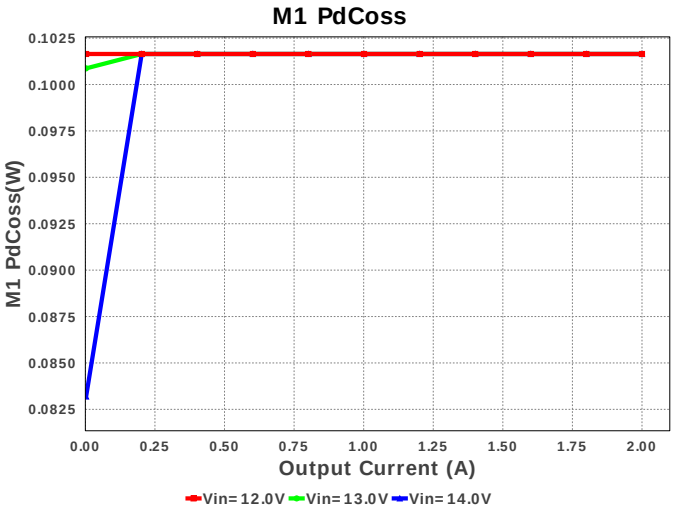


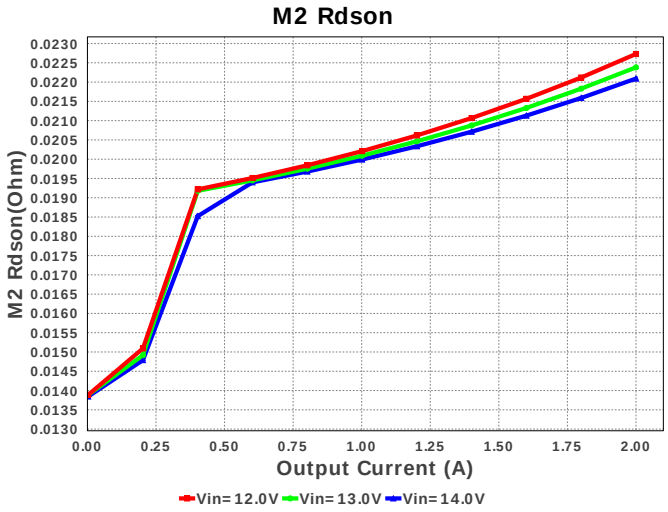


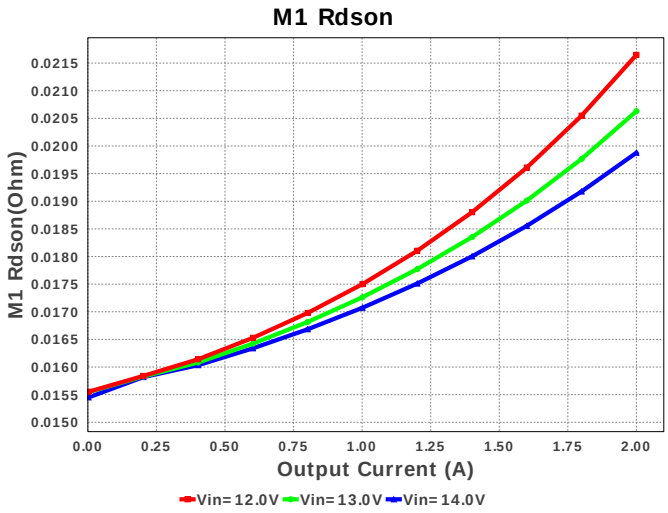


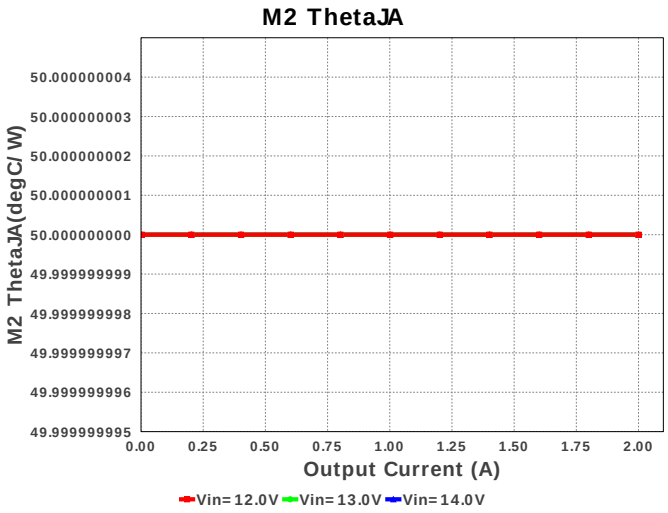


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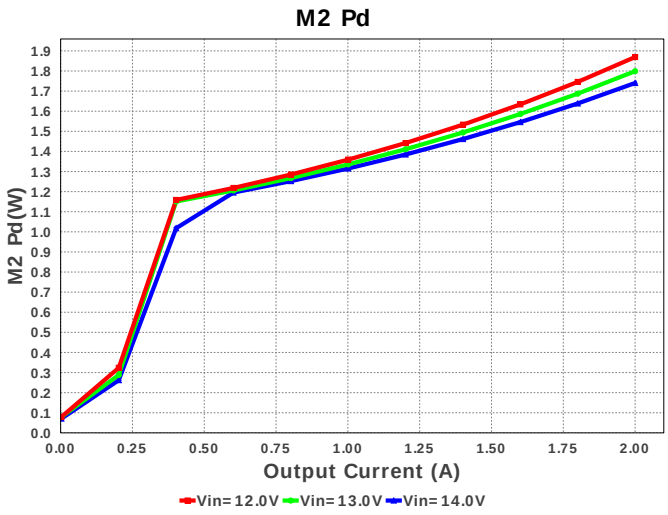


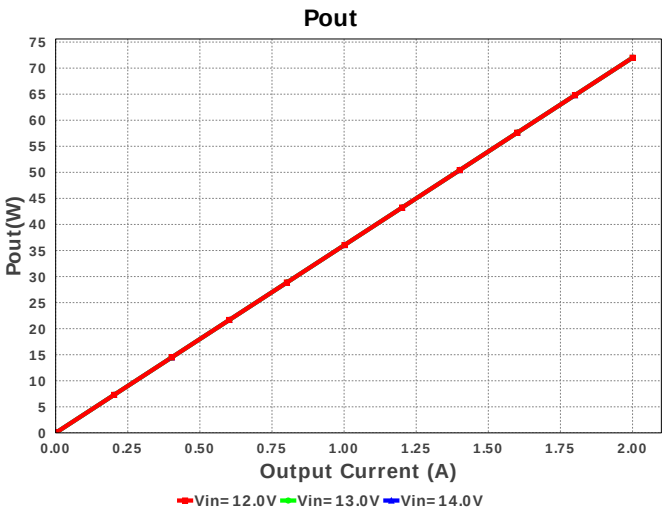


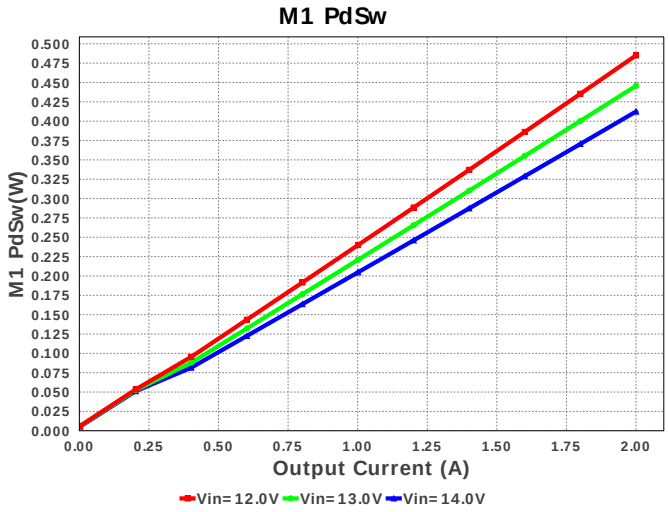


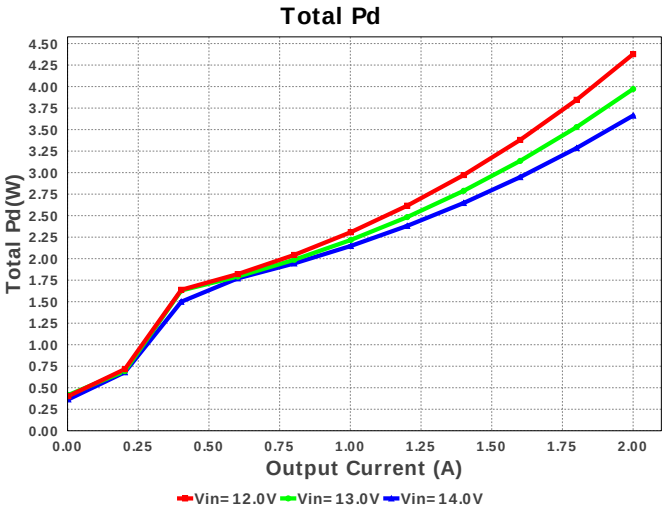


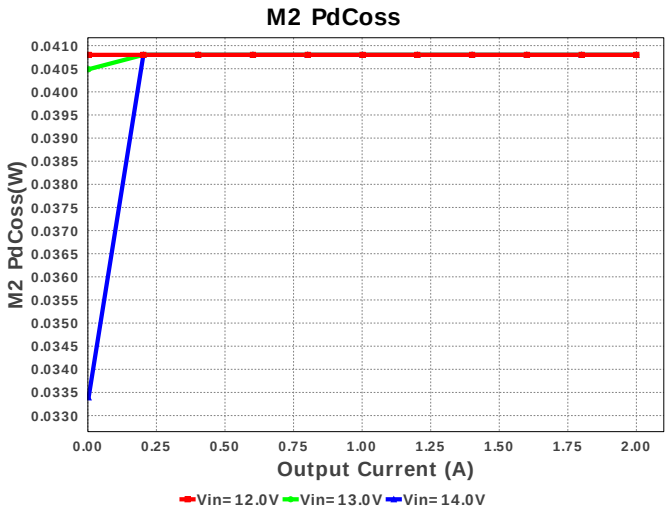


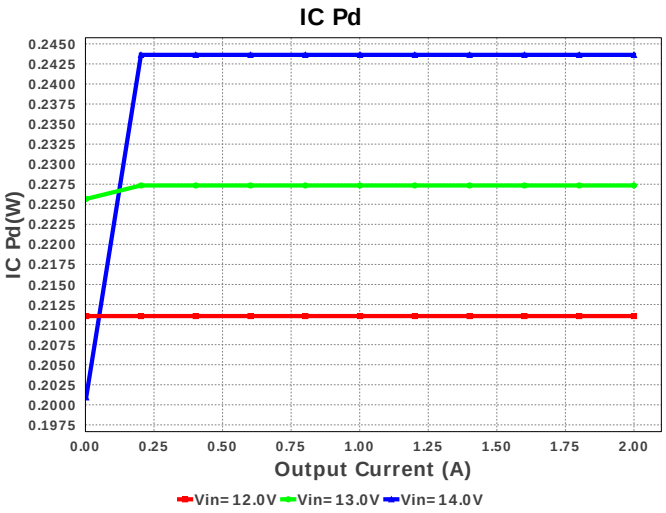


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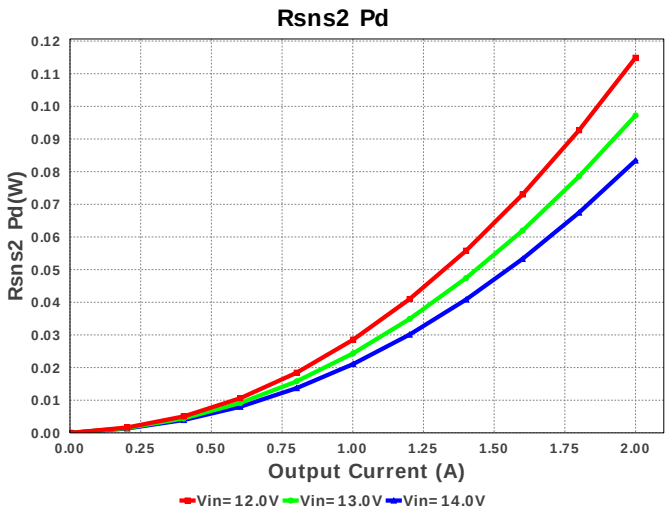


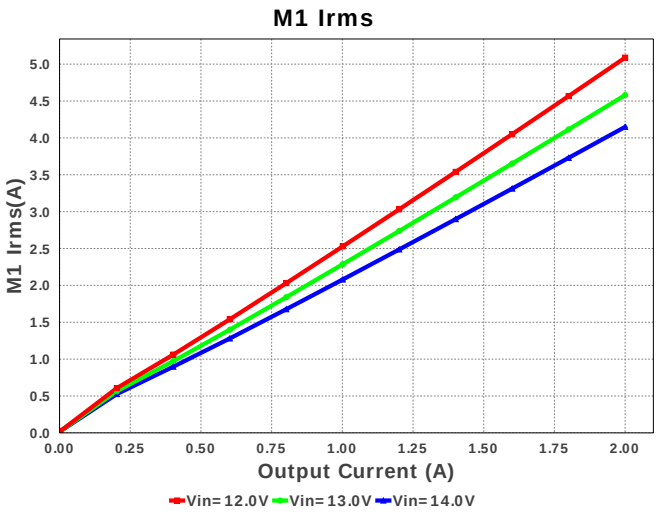


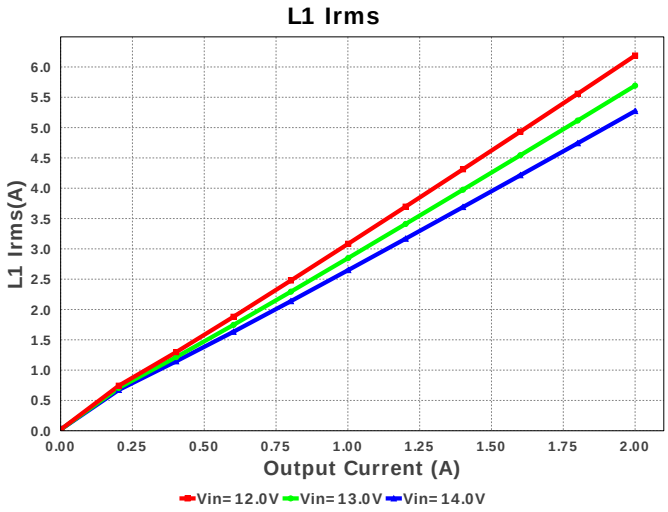


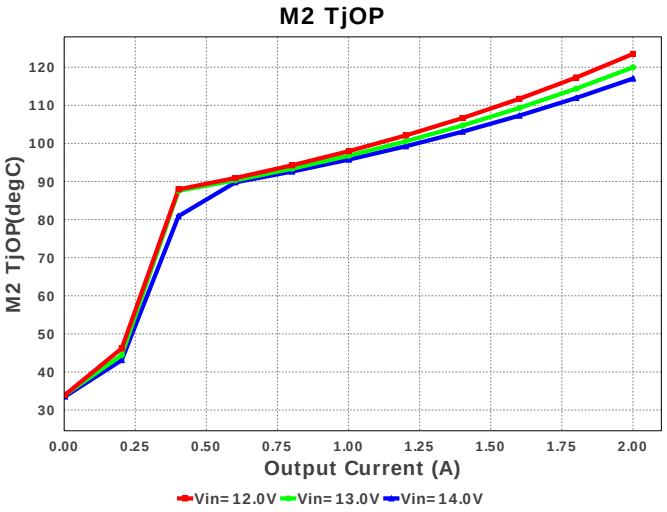


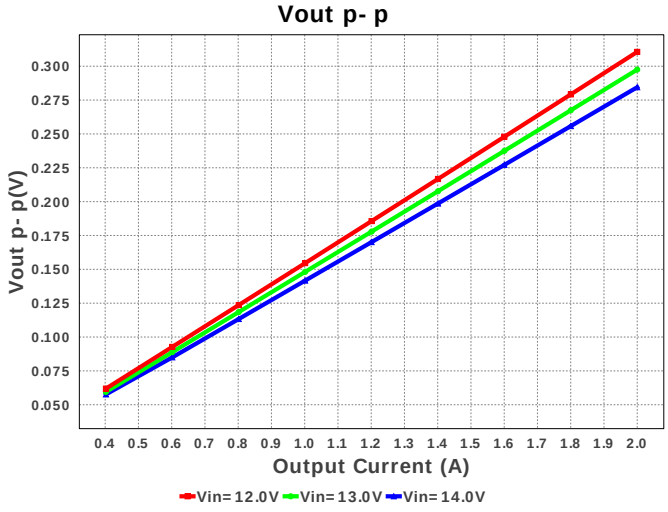


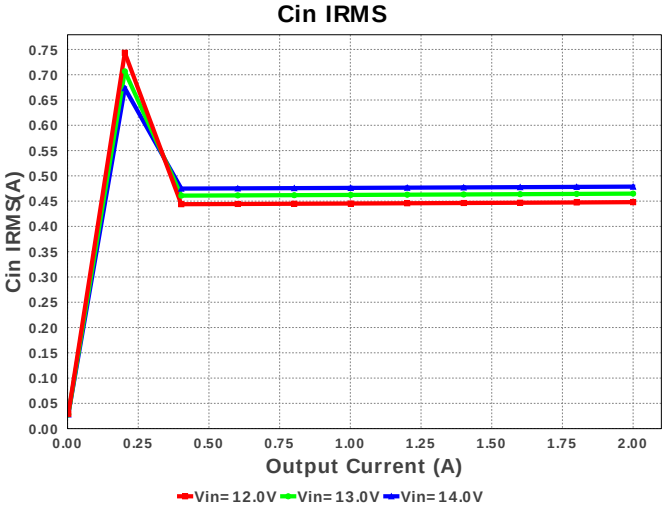


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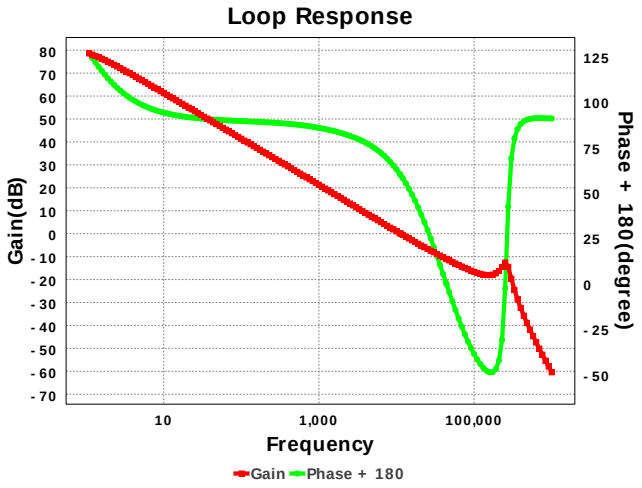


## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 447.965 mA | Current | Input capacitor RMS ripple current |
| 2. | Iin Avg | 6.365 A | Current | Average input current |
| 3. | L Ipp | 1.552 A | Current | Peak-to-peak inductor ripple current |
| 4. | L1 Irms | 6.189 A | Current | Inductor ripple current |
| 5. | M1 Irms | 5.088 A | Current | MOSFET RMS ripple current |
| 6. | M2 Irms | 3.523 A | Current | MOSFET RMS ripple current |
| 7. | BOM Count | 26 | General | Total Design BOM count |
| 8. | FootPrint | 509.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 9. | Frequency | 522.727 kHz | General | Switching frequency |
| 10. | M1 Rdson | 21.649 mOhm | General | Drain-Source On-resistance |
| 11. | M1 ThetaJA | 55.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 12. | M2 Rdson | 22.752 mOhm | General | Drain-Source On-resistance |
| 13. | M2 ThetaJA | 50.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 14. | Pout | 72.0 W | General | Total output power |
| 15. | Total BOM | $4.25 | General | Total BOM Cost |
| 16. | Low Freq Gain | 77.398 dB | Op_Point | Gain at 10Hz |
| 17. | Vout Actual | 36.267 V | Op_Point | Vout Actual calculated based on selected voltage divider resistors |
| 18. | Vout OP | 36.0 V | Op_Point | Operational Output Voltage |
| 19. | Cross Freq | 9.762 kHz | Op_point | Bode plot crossover frequency |
| 20. | Duty Cycle | 67.597 % | Op_point | Duty cycle |
| 21. | Efficiency | 94.263 % | Op_point | Steady state efficiency |
| 22. | Gain Marg | -9.762 dB | Op_point | Bode Plot Gain Margin |
| 23. | IC Tj | 43.867 degC | Op_point | IC junction temperature |
| 24. | ICThetaJA | 65.7 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 25. | IOUT_OP | 2.0 A | Op_point | Iout operating point |
| 26. | M1 TjOP | 99.252 degC | Op_point | M1 MOSFET junction temperature |
| 27. | M2 TjOP | 123.707 degC | Op_point | MOSFET junction temperature |
| 28. | Phase Marg | 58.649 deg | Op_point | Bode Plot Phase Margin |
| 29. | VIN_OP | 12.0 V | Op_point | Vin operating point |
| 30. | Vout p-p | 310.6 mV | Op_point | Peak-to-peak output ripple voltage |
| 31. | Cin Pd | 0.0 W | Power | Input capacitor power dissipation |
| 32. | Cout Pd | 0.0 W | Power | Output capacitor power dissipation |
| 33. | IC Pd | 211.064 mW | Power | IC power dissipation |
| 34. | L Pd | 804.255 mW | Power | Inductor power dissipation |
| 35. | M1 Pd | 1.259 W | Power | MOSFET power dissipation |
| 36. | M1 PdCond | 672.519 mW | Power | M1 MOSFET conduction losses |
| 37. | M1 PdCoss | 101.644 mW | Power | M1 MOSFET Coss Losses |
| 38. | M1 PdQrr | 0.0 W | Power | M1 MOSFET switching losses |
| 39. | M1 PdSw | 484.963 mW | Power | M1 MOSFET switching losses |
| 40. | M2 Pd | 1.874 W | Power | MOSFET power dissipation |
| 41. | M2 PdCond | 367.051 mW | Power | M2 MOSFET conduction losses |
| 42. | M2 PdCoss | 40.8 mW | Power | M2 MOSFET Coss Losses |
| 43. | M2 PdQrr | 1.021 W | Power | Synchronous Boost High Side Reverse Recovery |
| 44. | M2 PdSw | 26.264 mW | Power | M2 MOSFET switching losses |
| 45. | M2 Pdbody | 419.435 mW | Power | Power dissipation through lower FET |
| 46. | Rsns1 Pd | 114.894 mW | Power | Rsns1 Power Dissipation |
| 47. | Rsns2 Pd | 114.894 mW | Power | Rsns2 Power Dissipation |
| 48. | Total Pd | 4.382 W | Power | Total Power Dissipation |
| 49. | Vout Tolerance | 4.041 % | | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

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## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 2.0 | Maximum Output Current |
| 2. | VinMax | 14.0 | Maximum input voltage |
| 3. | VinMin | 12.0 | Minimum input voltage |
| 4. | Vout | 36.0 | Output Voltage |
| 5. | base_pn | TPS43060 | Base Product Number |
| 6. | source | DC | Input Source Type |
| 7. | Ta | 30.0 | Ambient temperature |

## Design Assistance

1. Feature Highlights: Low Quiescent Current Boost Controller, Wide Vin Range 4.5V to 38V Vin, 58V Vout, 7.5V Gate Drive optimized for standard MOSFET Thresholds Thermal Shutdown

2. **TPS43060** Product Folder : http://www.ti.com/product/TPS43060 : contains the data sheet and other resources.

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