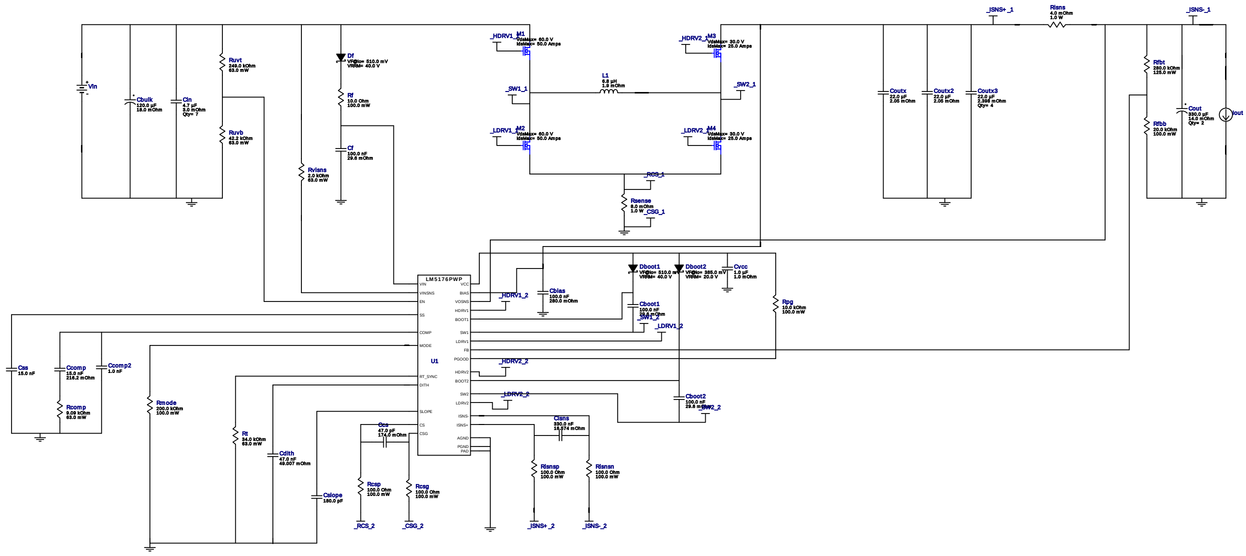
# WEBENCH ® Design Report

VinMin = 9.0V
VinMax = 24.0V
Vout = 12.0V
Iout = 6.0A

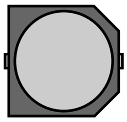
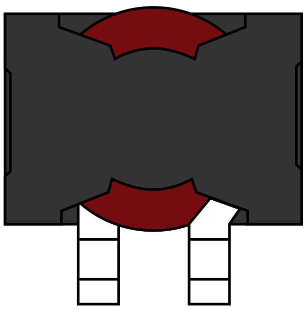
Device = LM5176PWPR
Topology = Buck_Boost
Created = 2025-02-03 08:31:19.887
BOM Cost = $13.31
BOM Count = 53
Total Pd = 1.45W

Design : 61 LM5176PWPR
LM5176PWPR 9V-24V to 12.00V @ 6A



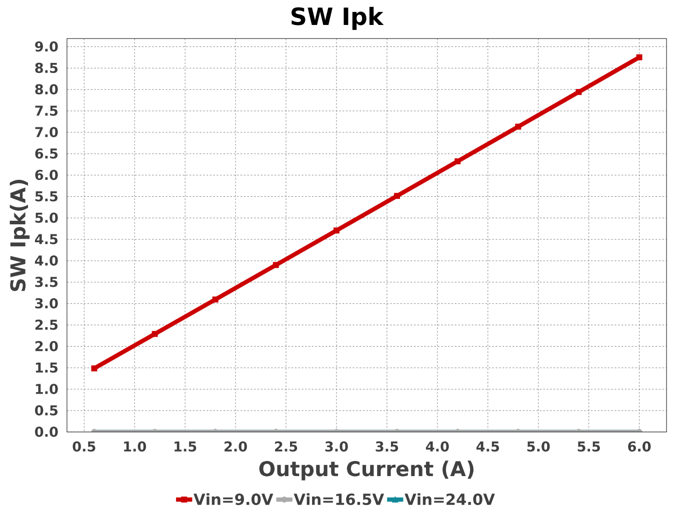
## Electrical BOM

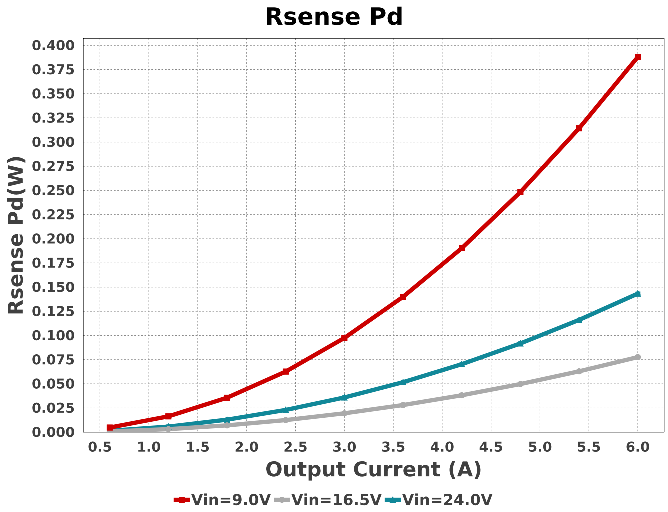
| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|
| Cbias | AVX | 08053C104KAT2A<br>Series= X7R | Cap= 100.0 nF<br>ESR= 280.0 mOhm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| Cboot1 | TDK | CGA3E2X7R1H104K080AA<br>Series= X7R | Cap= 100.0 nF<br>ESR= 29.6 mOhm<br>VDC= 50.0 V<br>IRMS= 971.99 mA | 1 | $0.01 | 0603 5 mm$^2$ |
| Cboot2 | TDK | CGA3E2X7R1H104K080AA<br>Series= X7R | Cap= 100.0 nF<br>ESR= 29.6 mOhm<br>VDC= 50.0 V<br>IRMS= 971.99 mA | 1 | $0.01 | 0603 5 mm$^2$ |
| Cbulk | Panasonic | 35SVPF120M<br>Series= SVPF | Cap= 120.0 uF<br>ESR= 18.0 mOhm<br>VDC= 35.0 V<br>IRMS= 4.4 A | 1 | $1.33 | CAPSMT_62_F12 151 mm$^2$ |
| Ccomp | TDK | CGA2B3X7R1H153K050BB<br>Series= X7R | Cap= 15.0 nF<br>ESR= 216.2 mOhm<br>VDC= 50.0 V<br>IRMS= 379.39 mA | 1 | $0.01 | 0402 3 mm$^2$ |
| Ccomp2 | Kemet | C0402C102K5GACTU<br>Series= C0G/NP0 | Cap= 1.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.07 | 0402 3 mm$^2$ |
| Ccs | AVX | 06035A470JAT2A<br>Series= C0G/NP0 | Cap= 47.0 pF<br>ESR= 174.0 mOhm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0603 5 mm$^2$ |
| Cdith | TDK | CGA3E2X7R1H473K080AA<br>Series= X7R | Cap= 47.0 nF<br>ESR= 49.007 mOhm<br>VDC= 50.0 V<br>IRMS= 767.53 mA | 1 | $0.01 | 0603 5 mm$^2$ |

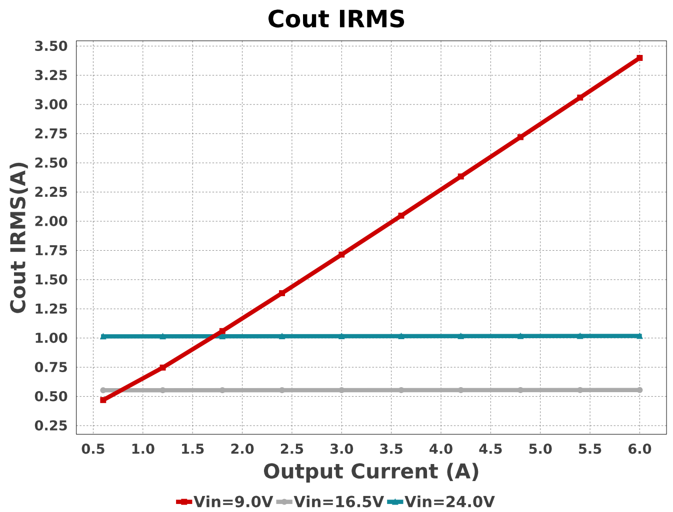
| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|
| Cf | TDK | CGA3E2X7R1H104K080AA<br>Series= X7R | Cap= 100.0 nF<br>ESR= 29.6 mOhm<br>VDC= 50.0 V<br>IRMS= 971.99 mA | 1 | $0.01 | 0603 5 mm² |
| Cin | MuRata | GRM31CR71H475KA12L<br>Series= X7R | Cap= 4.7 uF<br>ESR= 3.0 mOhm<br>VDC= 50.0 V<br>IRMS= 4.98 A | 7 | $0.10 | 1206 11 mm² |
| Cisns | TDK | C1608X5R1H334K080AB<br>Series= X5R | Cap= 330.0 nF<br>ESR= 16.574 mOhm<br>VDC= 50.0 V<br>IRMS= 1.28367 A | 1 | $0.03 | 0603 5 mm² |
| Cout | Panasonic | 25SVPF330M<br>Series= SVPF | Cap= 330.0 uF<br>ESR= 14.0 mOhm<br>VDC= 25.0 V<br>IRMS= 5.0 A | 2 | $1.33 | <br>CAPSMT_62_F12 151 mm² |
| Coutx | TDK | C2012X5R1V226M125AC<br>Series= X5R | Cap= 22.0 uF<br>ESR= 2.05 mOhm<br>VDC= 35.0 V<br>IRMS= 4.5559 A | 1 | $0.31 | 0805 7 mm² |
| Coutx2 | TDK | C2012X5R1V226M125AC<br>Series= X5R | Cap= 22.0 uF<br>ESR= 2.05 mOhm<br>VDC= 35.0 V<br>IRMS= 4.5559 A | 1 | $0.31 | 0805 7 mm² |
| Coutx3 | TDK | C3216X5R1V226M160AC<br>Series= X5R | Cap= 22.0 uF<br>ESR= 2.398 mOhm<br>VDC= 35.0 V<br>IRMS= 4.6851 A | 4 | $0.32 | 1206_180 11 mm² |
| Cslope | Yageo | CC0603JRNPO9BN181<br>Series= C0G/NP0 | Cap= 180.0 pF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0603 5 mm² |
| Css | Kemet | C0603C153J3GACTU<br>Series= C0G/NP0 | Cap= 15.0 nF<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.09 | 0603 5 mm² |
| Cvcc | Taiyo Yuden | EMK107B7105KA-T<br>Series= X7R | Cap= 1.0 uF<br>ESR= 1.0 mOhm<br>VDC= 16.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0603 5 mm² |
| Dboot1 | Comchip Technology | CDBK0540-HF | VF@Io= 510.0 mV<br>VRRM= 40.0 V | 1 | $0.07 | SOD-123F 12 mm² |
| Dboot2 | Comchip Technology | CDBK0520L-HF | VF@Io= 385.0 mV<br>VRRM= 20.0 V | 1 | $0.07 | SOD-123F 12 mm² |
| Df | Comchip Technology | CDBK0540-HF | VF@Io= 510.0 mV<br>VRRM= 40.0 V | 1 | $0.07 | SOD-123F 12 mm² |
| L1 | Coilcraft | SER2915H-682KL | L= 6.8 µH<br>1.9 mOhm | 1 | $1.95 | <br>SER2915H 652 mm² |
| M1 | Texas Instruments | CSD18534Q5A | VdsMax= 60.0 V<br>IdsMax= 50.0 Amps | 1 | $0.28 | DQJ0008A 55 mm² |

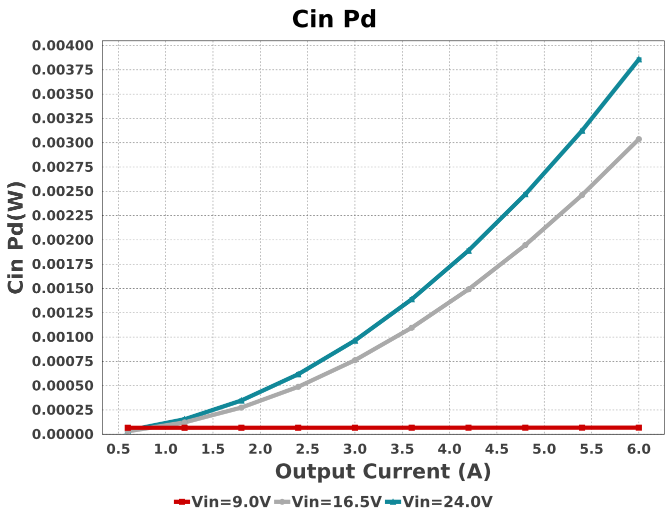
| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|
| M2 | Texas Instruments | CSD18537NQ5A | VdsMax= 60.0 V<br>IdsMax= 50.0 Amps | 1 | $0.24 | TRANS_NexFET_Q5A 55 mm$^2$ |
| M3 | Texas Instruments | CSD17579Q5A | VdsMax= 30.0 V<br>IdsMax= 25.0 Amps | 1 | $0.14 | TRANS_NexFET_Q5A 55 mm$^2$ |
| M4 | Texas Instruments | CSD17579Q5A | VdsMax= 30.0 V<br>IdsMax= 25.0 Amps | 1 | $0.14 | TRANS_NexFET_Q5A 55 mm$^2$ |
| Rcomp | Vishay-Dale | CRCW04029K09FKED<br>Series= CRCW..e3 | Res= 9.09 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| Rcsg | Vishay-Dale | CRCW0603100RFKEA<br>Series= CRCW..e3 | Res= 100.0 Ohm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Rcsp | Vishay-Dale | CRCW0603100RFKEA<br>Series= CRCW..e3 | Res= 100.0 Ohm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Rf | Yageo | RC0603FR-0710RL<br>Series= ? | Res= 10.0 Ohm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Rfbb | Susumu Co Ltd | RG1608P-203-B-T5<br>Series= RG1608 | Res= 20.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 0.1% | 1 | $0.06 | 0603 5 mm$^2$ |
| Rfbt | Susumu Co Ltd | RG2012P-2803-B-T5<br>Series= RG2012 | Res= 280.0 kOhm<br>Power= 125.0 mW<br>Tolerance= 0.1% | 1 | $0.06 | 0805 7 mm$^2$ |
| Risns | Panasonic | ERJ-M1WTF4M0U<br>Series= ERJ | Res= 4.0 mOhm<br>Power= 1.0 W<br>Tolerance= 1.0% | 1 | $0.17 | 2512 43 mm$^2$ |
| Risnsn | Vishay-Dale | CRCW0603100RFKEA<br>Series= CRCW..e3 | Res= 100.0 Ohm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Risnsp | Vishay-Dale | CRCW0603100RFKEA<br>Series= CRCW..e3 | Res= 100.0 Ohm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Rmode | Yageo | RC0603FR-07200KL<br>Series= ? | Res= 200.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Rpg | Yageo | RC0603FR-0710KL<br>Series= ? | Res= 10.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0603 5 mm$^2$ |
| Rsense | Panasonic | ERJ-M1WSF8M0U<br>Series= ERJ | Res= 8.0 mOhm<br>Power= 1.0 W<br>Tolerance= 1.0% | 1 | $0.17 | 2512 43 mm$^2$ |
| Rt | Vishay-Dale | CRCW040234K0FKED<br>Series= CRCW..e3 | Res= 34.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| Ruvb | Vishay-Dale | CRCW040242K2FKED<br>Series= CRCW..e3 | Res= 42.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| Ruvt | Vishay-Dale | CRCW0402249KFKED<br>Series= CRCW..e3 | Res= 249.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| Rvisns | Vishay-Dale | CRCW04022K00FKED<br>Series= CRCW..e3 | Res= 2.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |

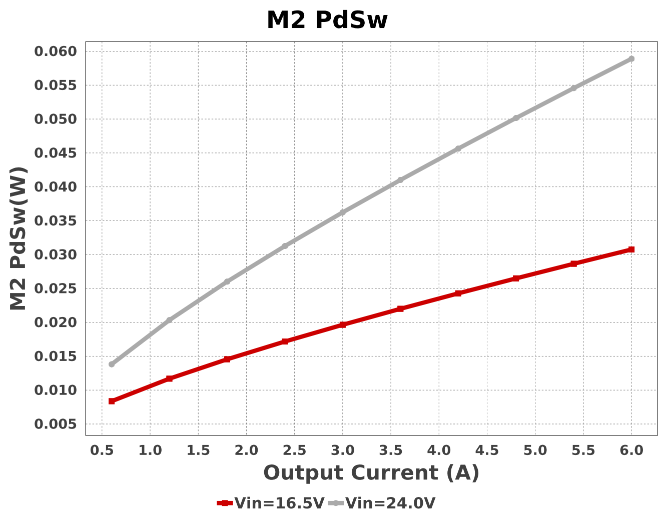
| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|
| U1 | Texas Instruments | LM5176PWPR | Switcher | 1 | $2.90 | PWP0028C_N 98 $mm^2$ |

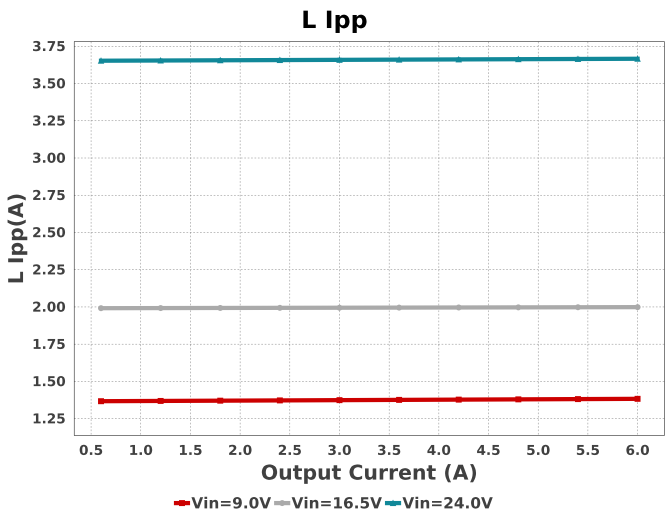


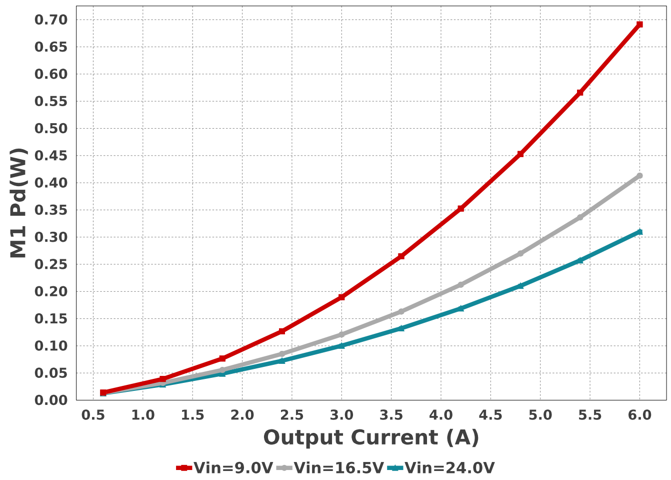



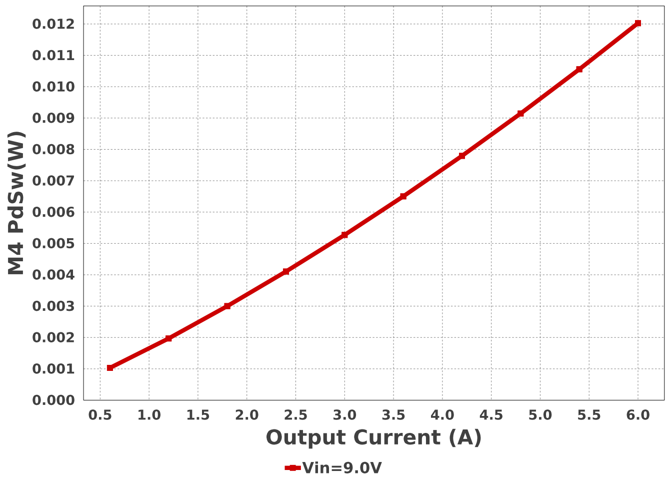



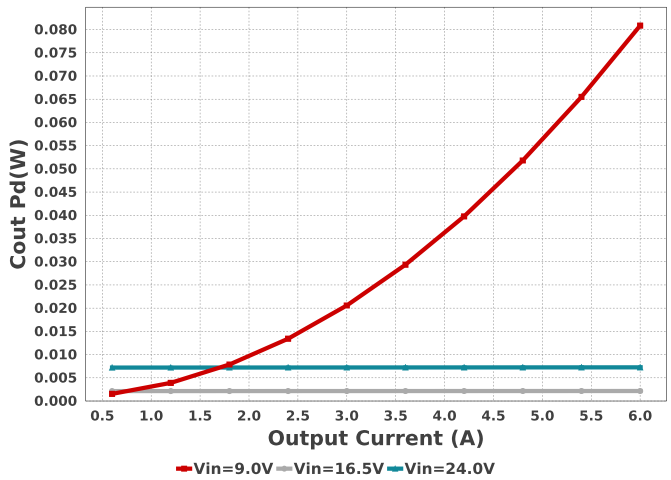
## M1 Pd



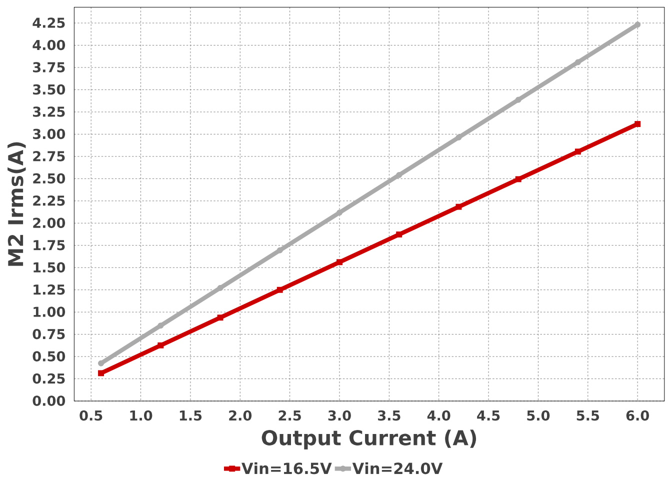

## M4 PdSw



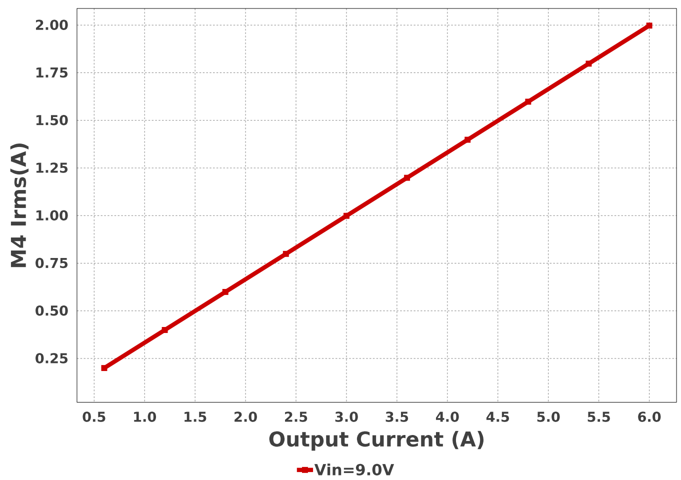

## Cout Pd



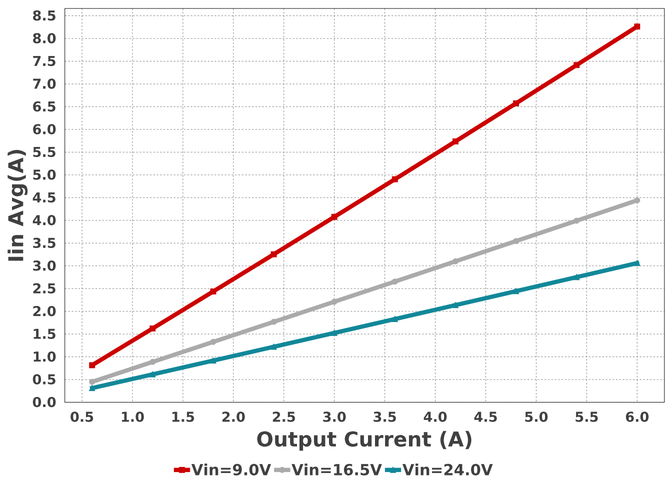

## M2 Irms

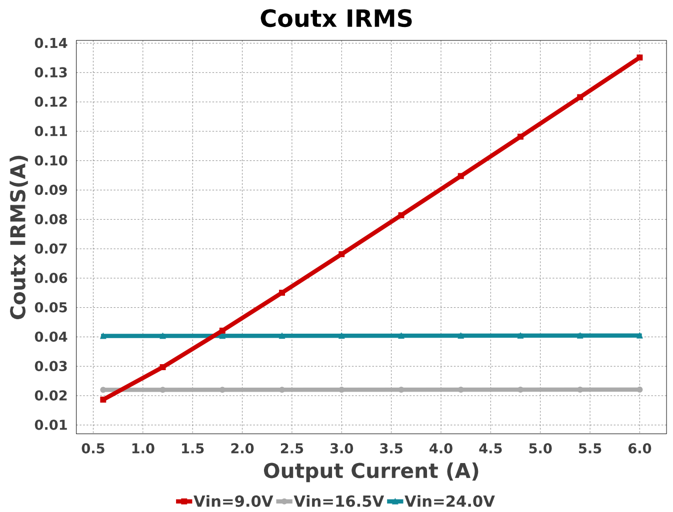


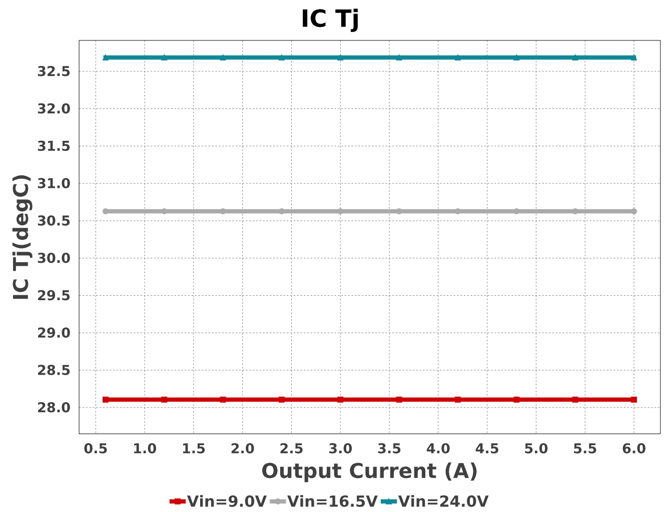

## M4 Irms

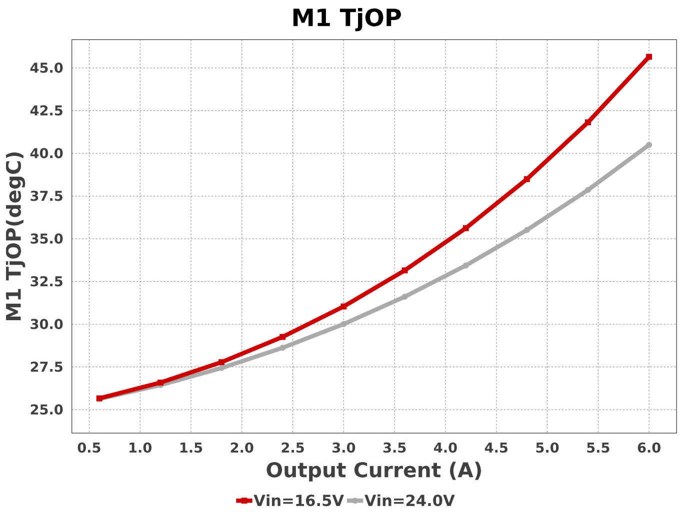


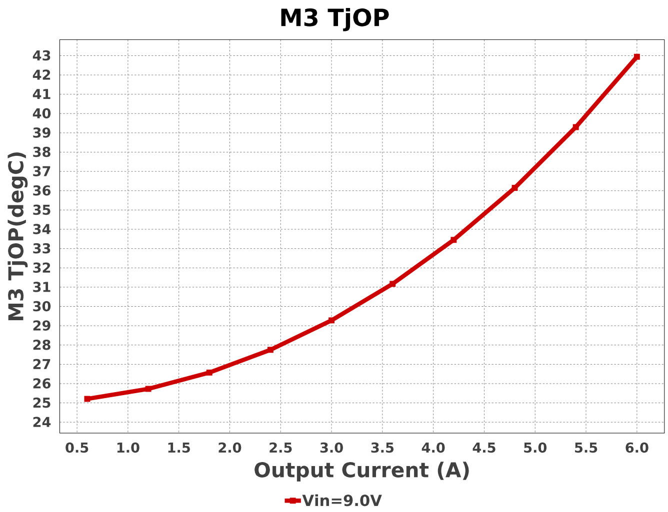

## Iin Avg

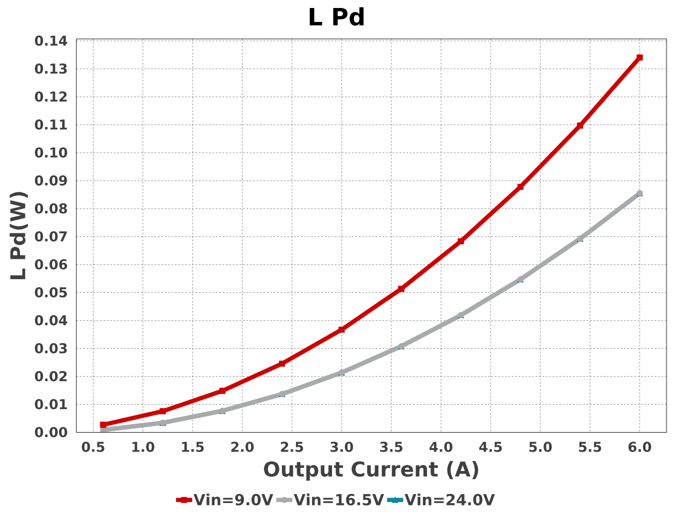


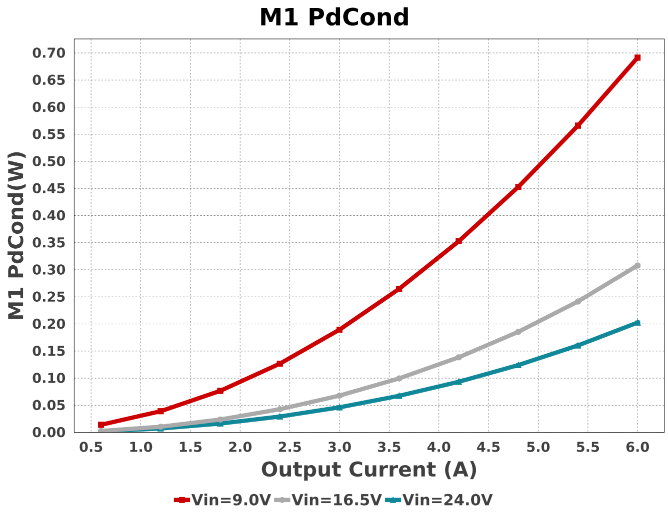

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

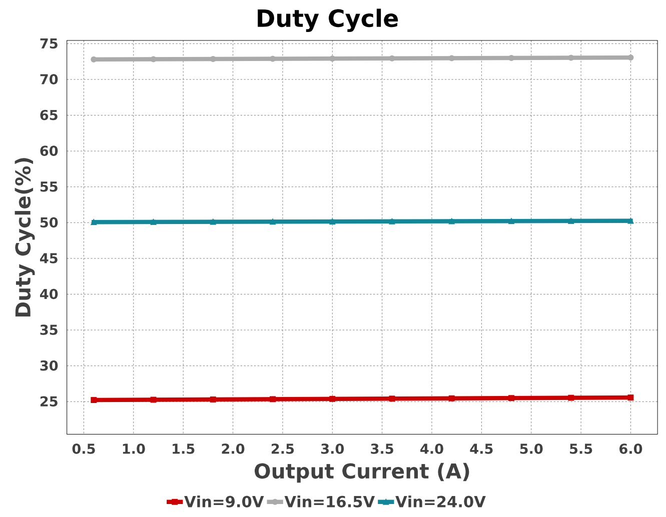

IC Tj
IC Tj(degC)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

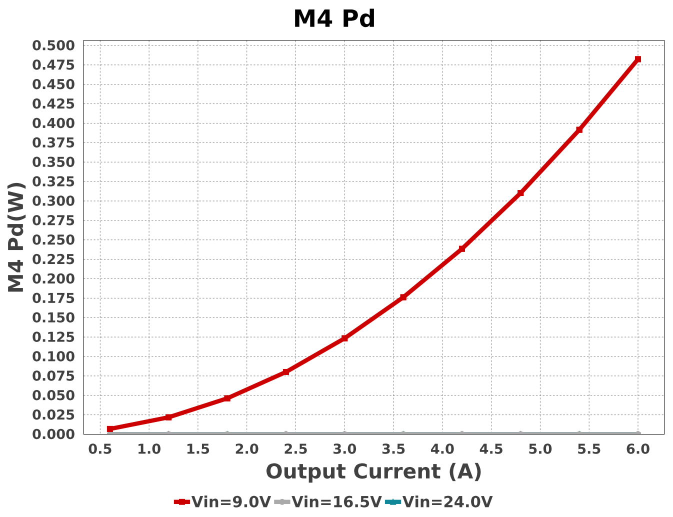

M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=16.5V
Vin=24.0V

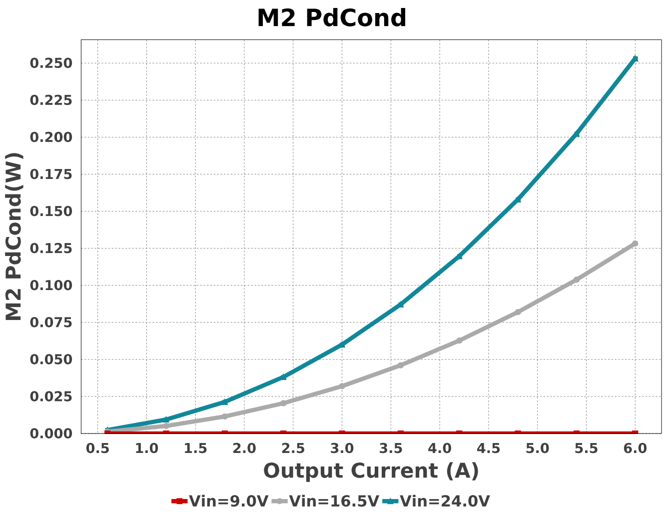

M3 TjOP
M3 TjOP(degC)
Output Current (A)
Vin=9.0V

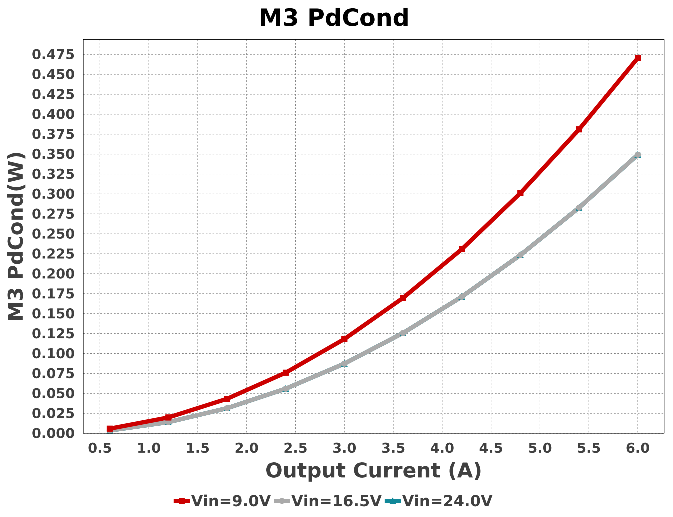

L Pd
L Pd(W)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

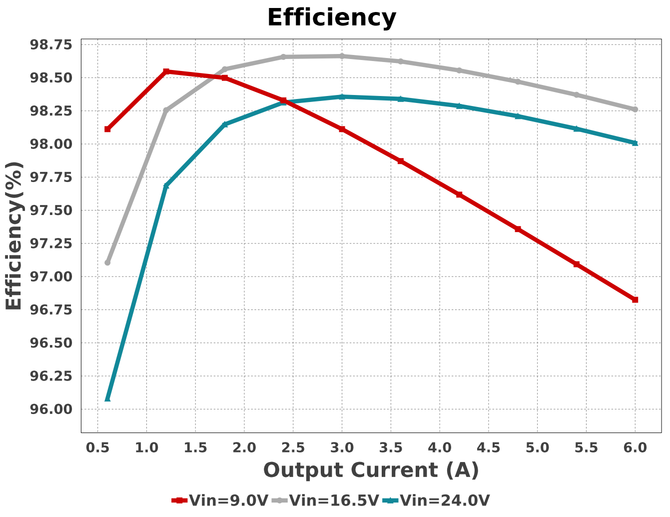

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

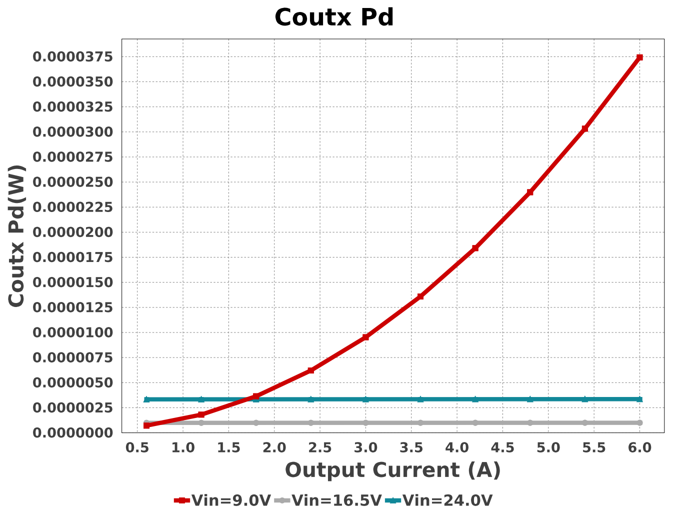

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

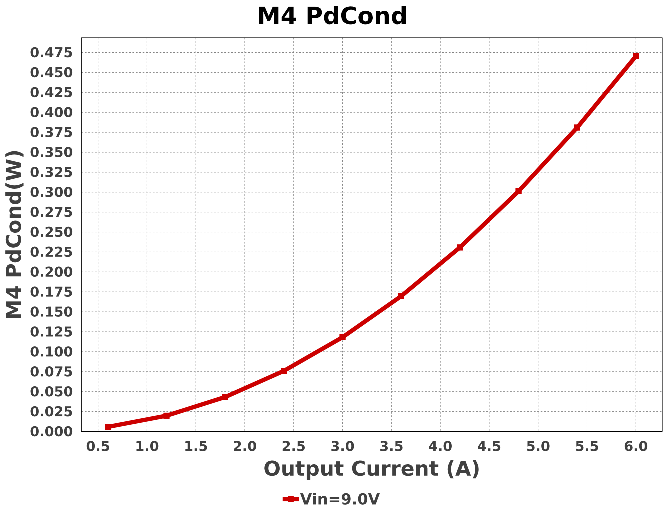

M4 Pd
M4 Pd(W)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

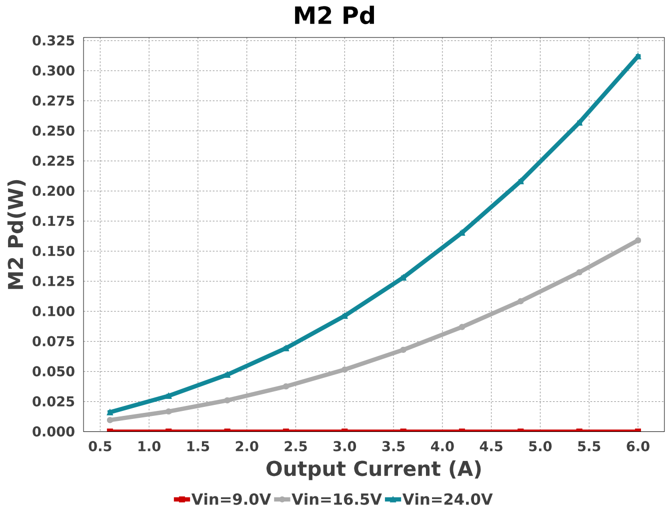

M2 PdCond
M2 PdCond(W)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

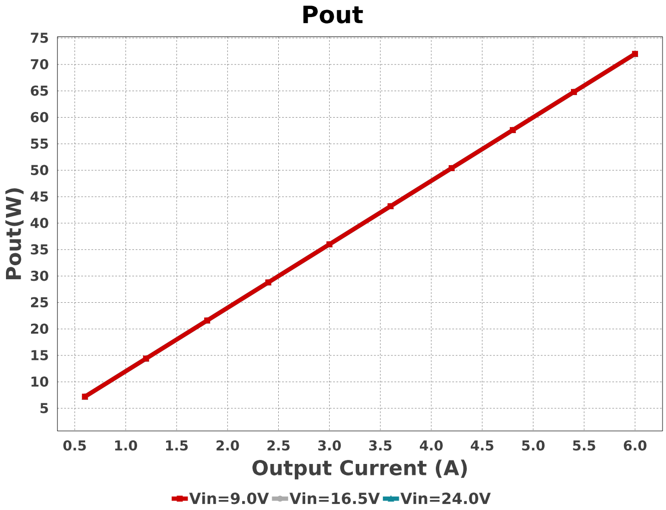

M3 PdCond
M3 PdCond(W)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

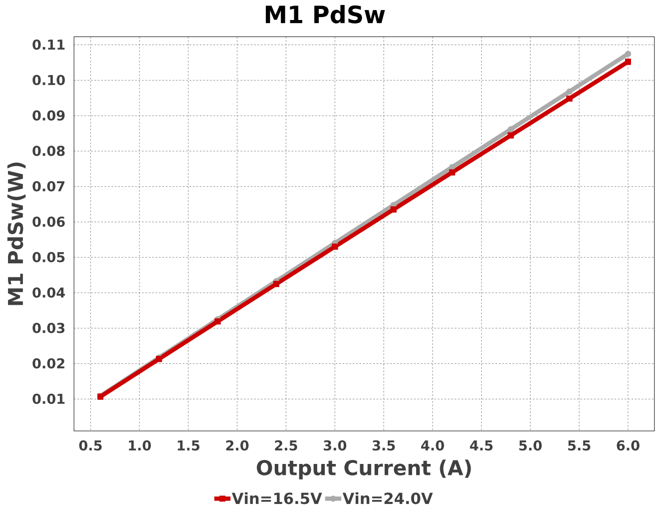

Efficiency
Efficiency(%)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

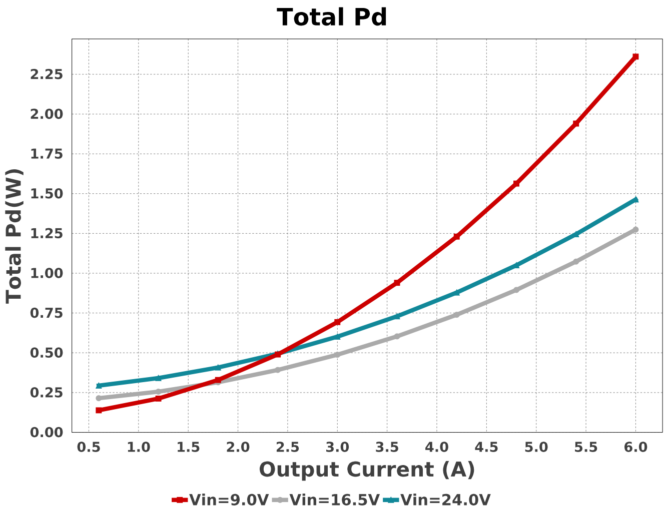

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

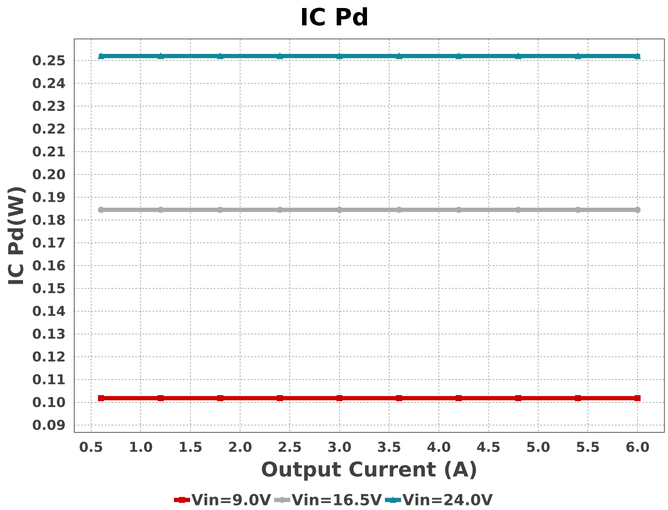

M4 PdCond
M4 PdCond(W)
0.475 0.450 0.425 0.400 0.375 0.350 0.325 0.300 0.275 0.250 0.225 0.200 0.175 0.150 0.125 0.100 0.075 0.050 0.025 0.000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V

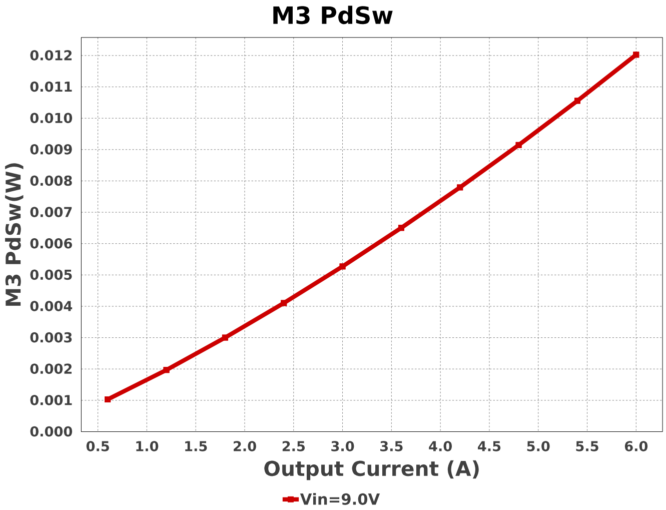

M2 Pd
M2 Pd(W)
0.325 0.300 0.275 0.250 0.225 0.200 0.175 0.150 0.125 0.100 0.075 0.050 0.025 0.000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V Vin=16.5V Vin=24.0V

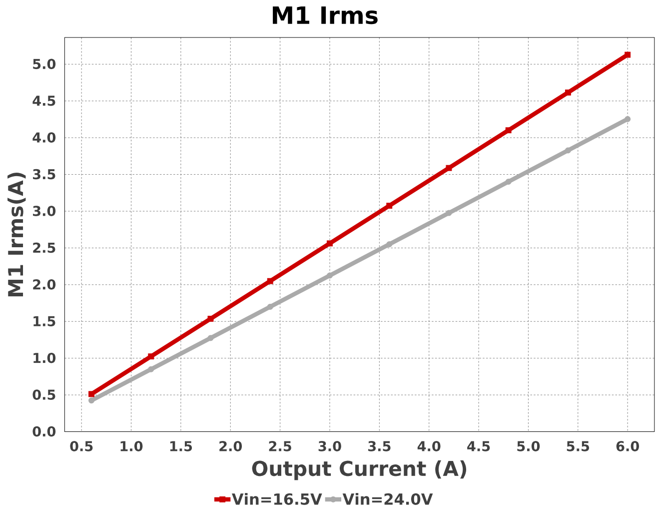

Pout
Pout(W)
75 70 65 60 55 50 45 40 35 30 25 20 15 10 5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V Vin=16.5V Vin=24.0V

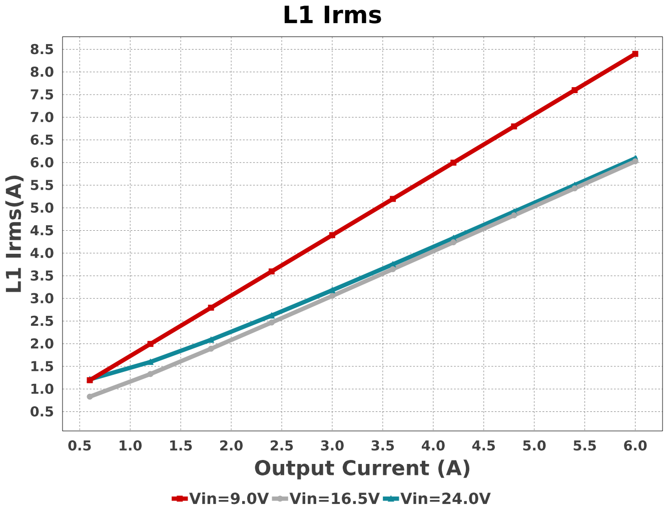

M1 PdSw
M1 PdSw(W)
0.11 0.10 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.02 0.01
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=16.5V Vin=24.0V

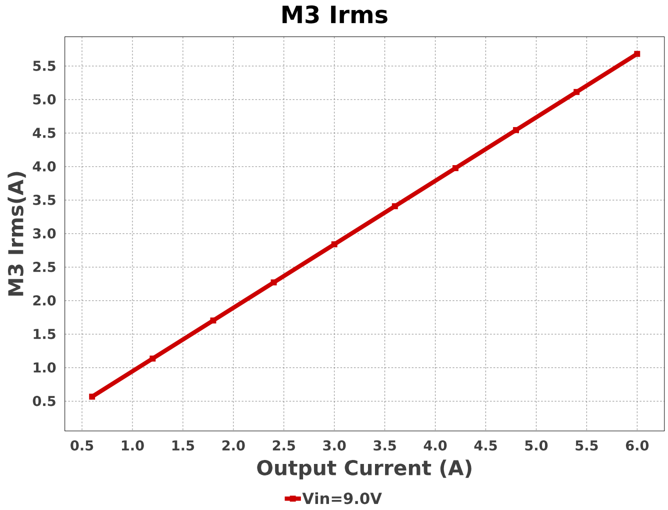

Total Pd
Total Pd(W)
2.25 2.00 1.75 1.50 1.25 1.00 0.75 0.50 0.25 0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V Vin=16.5V Vin=24.0V

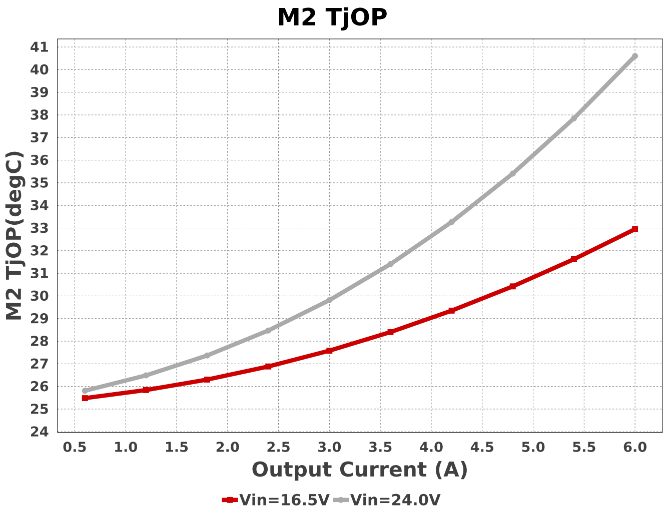

IC Pd
IC Pd(W)
0.25 0.24 0.23 0.22 0.21 0.20 0.19 0.18 0.17 0.16 0.15 0.14 0.13 0.12 0.11 0.10 0.09
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V Vin=16.5V Vin=24.0V

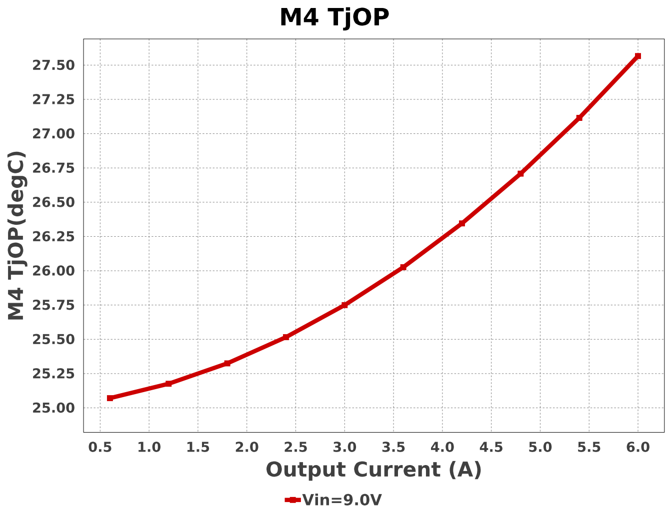

M3 PdSw
M3 PdSw(W)
0.000 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010 0.011 0.012
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V

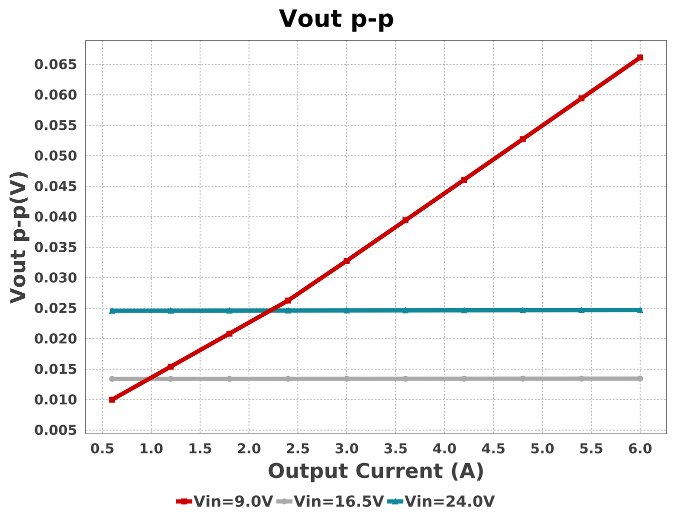

M1 Irms
M1 Irms(A)
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=16.5V
Vin=24.0V

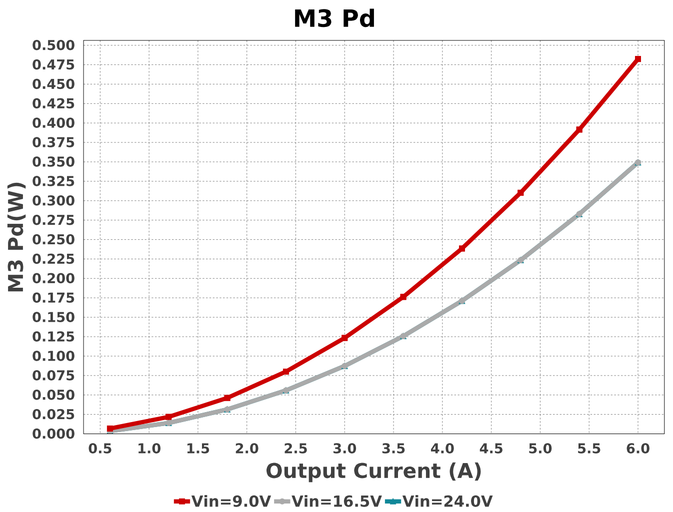

L1 Irms
L1 Irms(A)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V
Vin=16.5V
Vin=24.0V

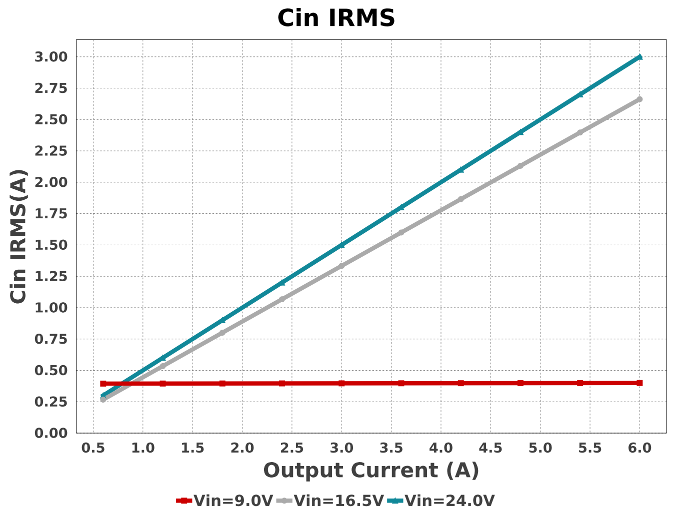

M3 Irms
M3 Irms(A)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V

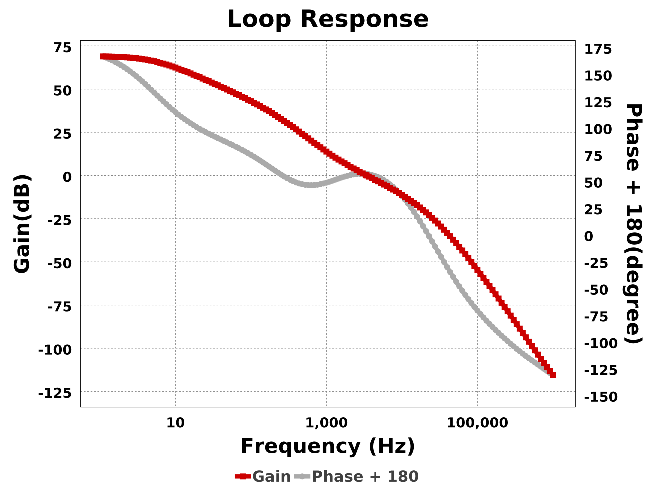

M2 TjOP
M2 TjOP(degC)
24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=16.5V
Vin=24.0V


M4 TjOP
M4 TjOP(degC)
25.00 25.25 25.50 25.75 26.00 26.25 26.50 26.75 27.00 27.25 27.50
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=9.0V




## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | BOM Count | 53 | | Total Design BOM count |
| 2. | Total BOM | $13.314 | | Total BOM Cost |
| 3. | Cin IRMS | 3.0 A | Capacitor | Input capacitor RMS ripple current |
| 4. | Cin Pd | 3.857 mW | Capacitor | Input capacitor power dissipation |
| 5. | Cout IRMS | 1.018 A | Capacitor | Output capacitor RMS ripple current |
| 6. | Cout Pd | 7.253 mW | Capacitor | Output capacitor power dissipation |
| 7. | Coutx IRMS | 40.472 mA | Capacitor | Output capacitor_x RMS ripple current |
| 8. | Coutx Pd | 3.358 µW | Capacitor | Output capacitor_x power loss |
| 9. | IC Pd | 251.97 mW | IC | IC power dissipation |
| 10. | IC Tj | 32.685 degC | IC | IC junction temperature |
| 11. | IC Tolerance | 0.0 V | IC | IC Feedback Tolerance |
| 12. | ICThetaJA | 30.5 degC/W | IC | IC junction-to-ambient thermal resistance |
| 13. | Iin Avg | 3.06 A | IC | Average input current |
| 14. | L Ipp | 3.666 A | Inductor | Peak-to-peak inductor ripple current |
| 15. | L Pd | 85.5 mW | Inductor | Inductor power dissipation |
| 16. | L1 Irms | 6.093 A | Inductor | Inductor ripple current |
| 17. | M1 Irms | 4.254 A | Mosfet | MOSFET RMS ripple current |
| 18. | M1 Pd | 339.5 mW | Mosfet | MOSFET power dissipation |
| 19. | M1 PdCond | 209.15 mW | Mosfet | M1 MOSFET conduction losses |
| 20. | M1 PdSw | 130.35 mW | Mosfet | M1 MOSFET switching losses |
| 21. | M1 Rdson | 9.8 mOhm | Mosfet | Drain-Source On-resistance |
| 22. | M1 ThetaJA | 50.0 degC/W | Mosfet | MOSFET junction-to-ambient thermal resistance |
| 23. | M1 TjOP | 41.975 degC | Mosfet | MOSFET junction temperature |
| 24. | M2 Irms | 4.232 A | Mosfet | MOSFET RMS ripple current |
| 25. | M2 Pd | 269.05 mW | Mosfet | MOSFET power dissipation |
| 26. | M2 PdCond | 242.6 mW | Mosfet | M2 MOSFET conduction losses |
| 27. | M2 PdSw | 26.444 mW | Mosfet | M2 MOSFET switching losses |
| 28. | M2 Rdson | 13.0 mOhm | Mosfet | Drain-Source On-resistance |
| 29. | M2 ThetaJA | 50.0 degC/W | Mosfet | MOSFET junction-to-ambient thermal resistance |
| 30. | M2 TjOP | 38.452 degC | Mosfet | MOSFET junction temperature |
| 31. | M3 Pd | 349.2 mW | Mosfet | M3 MOSFET total power dissipation |
| 32. | M3 PdCond | 349.2 mW | Mosfet | M3 MOSFET conduction losses |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 33. | M4 Pd | 100.0 pW | Mosfet | M4 MOSFET total power dissipation |
| 34. | Cin Pd | 3.857 mW | Power | Input capacitor power dissipation |
| 35. | Cout Pd | 7.253 mW | Power | Output capacitor power dissipation |
| 36. | Coutx Pd | 3.358 µW | Power | Output capacitor_x power loss |
| 37. | IC Pd | 251.97 mW | Power | IC power dissipation |
| 38. | L Pd | 85.5 mW | Power | Inductor power dissipation |
| 39. | M1 Pd | 339.5 mW | Power | MOSFET power dissipation |
| 40. | M1 PdCond | 209.15 mW | Power | M1 MOSFET conduction losses |
| 41. | M1 PdSw | 130.35 mW | Power | M1 MOSFET switching losses |
| 42. | M2 Pd | 269.05 mW | Power | MOSFET power dissipation |
| 43. | M2 PdCond | 242.6 mW | Power | M2 MOSFET conduction losses |
| 44. | M2 PdSw | 26.444 mW | Power | M2 MOSFET switching losses |
| 45. | M3 Pd | 349.2 mW | Power | M3 MOSFET total power dissipation |
| 46. | M3 PdCond | 349.2 mW | Power | M3 MOSFET conduction losses |
| 47. | M4 Pd | 100.0 pW | Power | M4 MOSFET total power dissipation |
| 48. | Rsense Pd | 143.26 mW | Power | LED Current Rsns Power Dissipation |
| 49. | Total Pd | 1.45 W | Power | Total Power Dissipation |
| 50. | Rsense Pd | 143.26 mW | Resistor | LED Current Rsns Power Dissipation |
| 51. | Cross Freq | 3.404 kHz | System Information | Bode plot crossover frequency |
| 52. | Duty Cycle | 50.256 % | System Information | Duty cycle |
| 53. | Efficiency | 98.026 % | System Information | Steady state efficiency |
| 54. | FootPrint | 1.794 k $mm^2$ | System Information | Total Foot Print Area of BOM components |
| 55. | Frequency | 241.896 kHz | System Information | Switching frequency |
| 56. | Gain Marg | -22.933 dB | System Information | Bode Plot Gain Margin |
| 57. | Iout | 6.0 A | System Information | Iout operating point |
| 58. | Low Freq Gain | 68.912 dB | System Information | Gain at 1Hz |
| 59. | Mode | CCM | System Information | Conduction Mode |
| 60. | Operating Topology | Buck | System Information | The current operating topology of the device |
| 61. | Phase Marg | 58.248 deg | System Information | Bode Plot Phase Margin |
| 62. | Pout | 72.0 W | System Information | Total output power |
| 63. | SW Ipk | 0.0 A | System Information | Peak switch current |
| 64. | Vin | 24.0 V | System Information | Vin operating point |
| 65. | Vout | 12.0 V | System Information | Operational Output Voltage |
| 66. | Vout Actual | 12.0 V | System Information | Vout Actual calculated based on selected voltage divider resistors |
| 67. | Vout Tolerance | 186.854 m% | System Information | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |
| 68. | Vout p-p | 24.683 mV | System Information | Peak-to-peak output ripple voltage |

## Design Inputs

| Name | Value | Description |
|---|---|---|
| Iout | 6.0 | Maximum Output Current |
| SoftStart | 2.0 ms | Soft Start Time (ms) |
| VinMax | 24.0 | Maximum input voltage |
| VinMin | 9.0 | Minimum input voltage |
| Vout | 12.0 | Output Voltage |
| base_pn | LM5176 | Base Product Number |
| source | DC | Input Source Type |
| Ta | 25.0 | Ambient temperature |
| UserFsw | 247.451 k | Customer Selected Frequency |

# WEBENCH® Assembly

## Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

## Soldering Component to Board

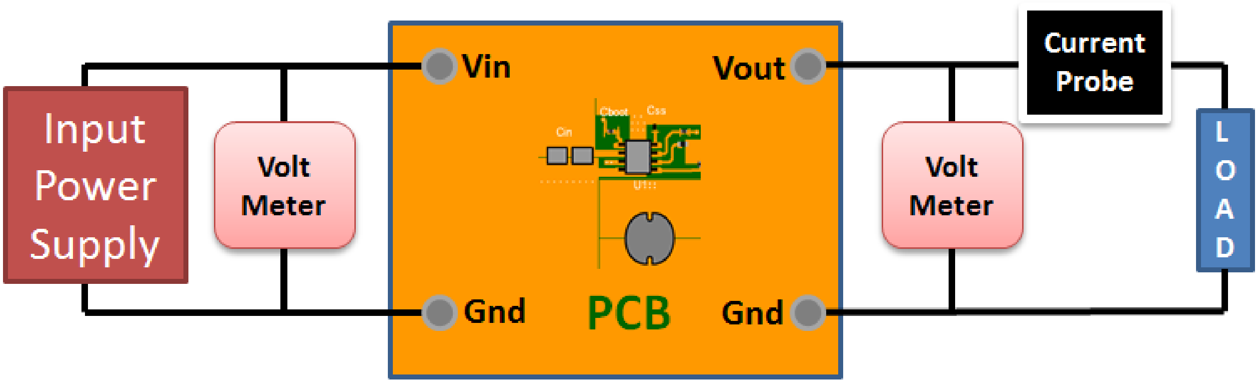
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

## Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 9.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

## Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% ( 7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.

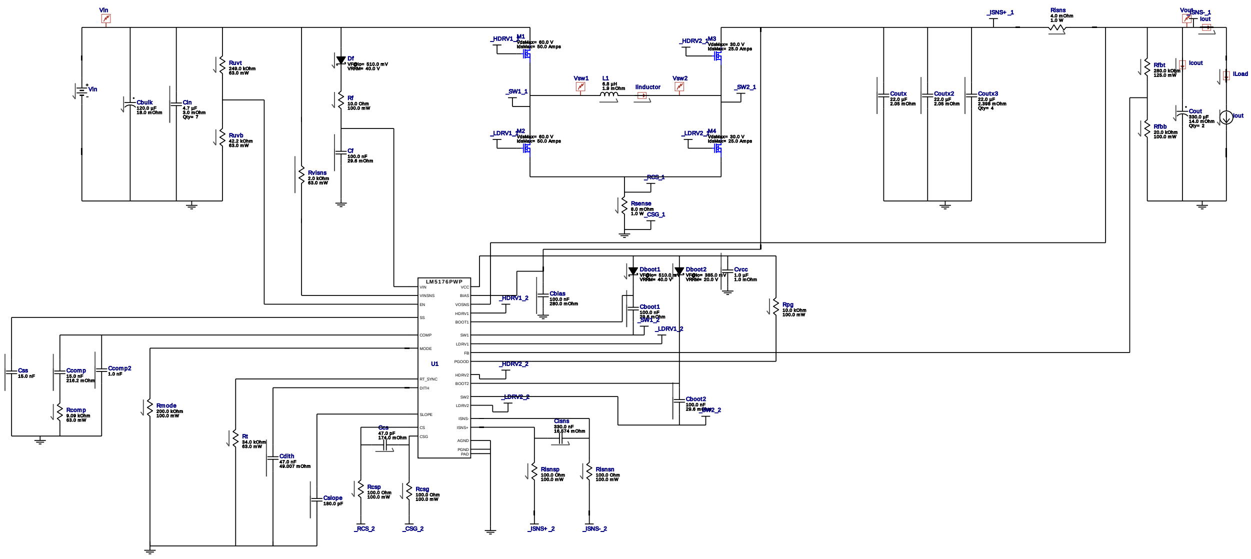


# WEBENCH® Electrical Simulation Report

Design Id = 61

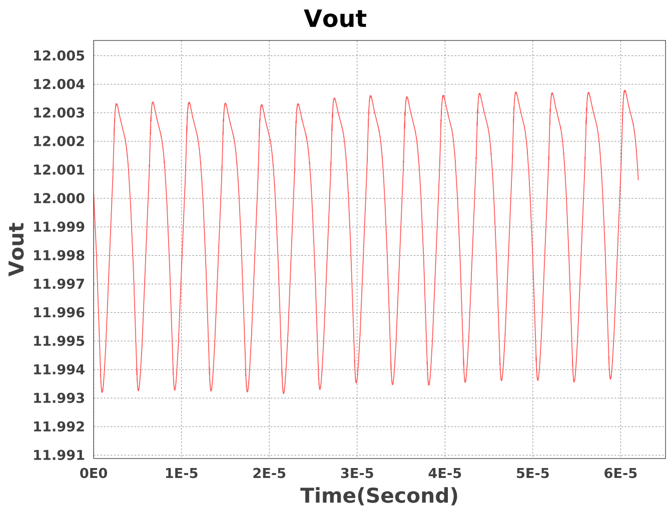
sim_id = 8

Simulation Type = Steady State



## Simulation Parameters

| # | Name | Parameter Name | Description | Values |
|---|---|---|---|---|
| 1. | Ccomp2 | IC | Initial Voltage | 1.8766075435203096 V |
| 2. | L1 | IC | Initial Current | -6.0 A |
| 3. | Cslope | IC | Initial Voltage | 0 V |
| 4. | Cout | IC | Initial Voltage | 12.0 V |
| 5. | Iout | I | Load Current | 0.6 A |




## Design Assistance

1. Tip: Snubbers and/or gate resistors may be required to limit the SW1,2 node switching spikes below the IC and FET abs max ratings.
2. Tip: Slope Capacitor: smaller slope capacitors provide better transition region behavior.
3. Master key : 18D22DF2C2193AE2[v1]
4. **LM5176** Product Folder : http://www.ti.com/product/LM5176 : contains the data sheet and other resources.

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