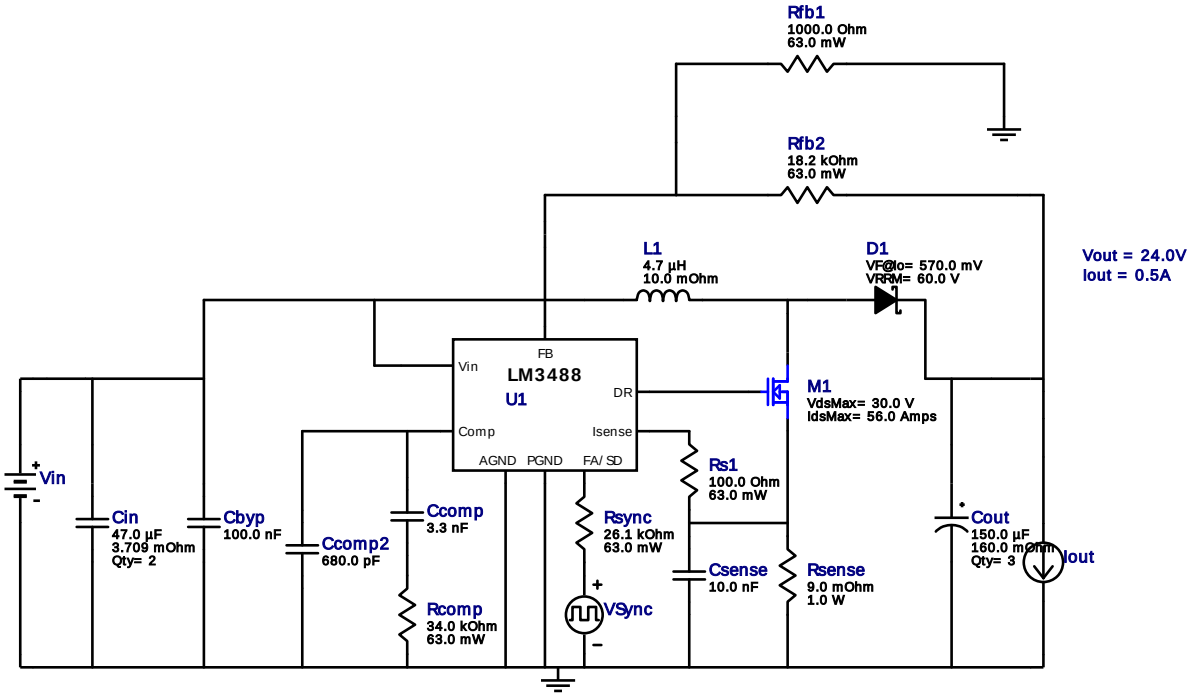
# WEBENCH® Design Report

VinMin = 3.3V
VinMax = 5.0V
Vout = 24.0V
Iout = 0.5A

Device = LM3488MMX/NOPB
Topology = Boost
Created = 8/4/16 12:22:53 AM
BOM Cost = $2.72
BOM Count = 19
Total Pd = 1.48W

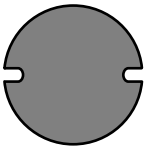
Design : 4738418/9 LM3488MMX/NOPB
LM3488MMX/NOPB 3.3V-5.0V to 24.00V @ 0.5A

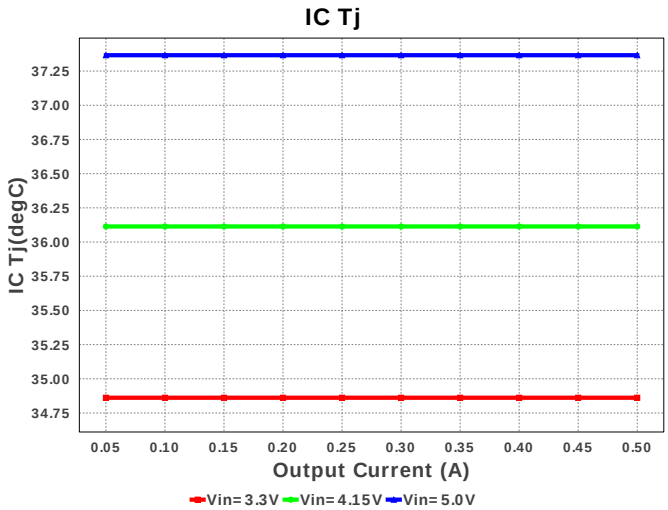


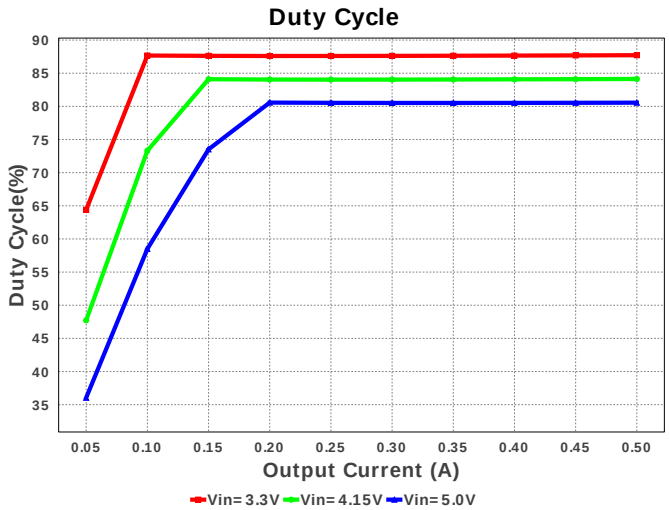

1. With the low turn of voltage of the LM34x8 your power supply may current limit before you reach your working input voltage. If this happens, or to preempt this from happening, you can include a low pass RC filter from input voltage to Vin on the IC. Make sure the rise time on the RC network is slower than your supply's rise time. If you are not using the syncronization feature of the part use the LM3478.

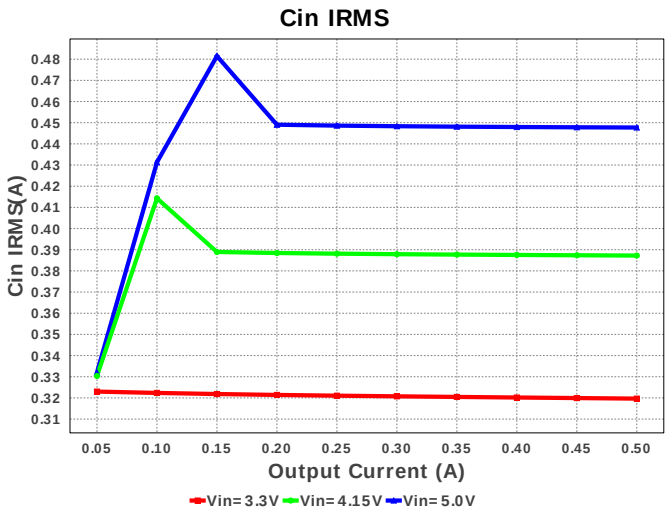
## Electrical BOM

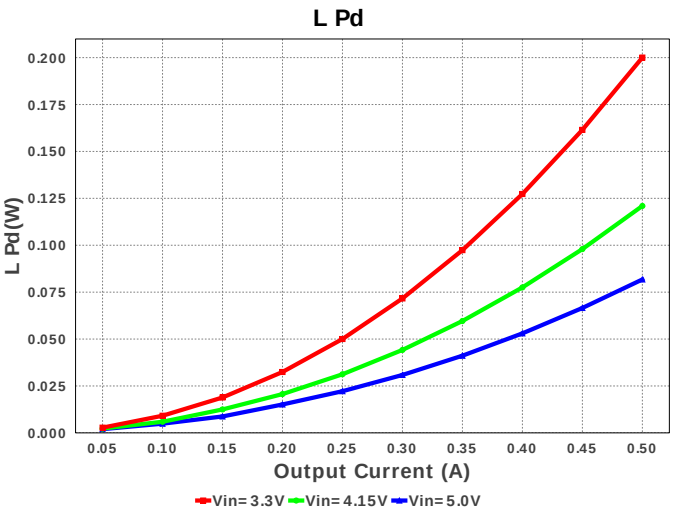
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cbyp | MuRata | GRM155R60J104KA01D<br>Series= X5R | Cap= 100.0 nF<br>VDC= 6.3 V<br>IRMS= 0.0 A | 1 | $0.01 | 0402 3 mm² |
| 2. | Ccomp | MuRata | GRM216R71E332KA01D<br>Series= X7R | Cap= 3.3 nF<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 3. | Ccomp2 | Yageo America | CC0805KRX7R9BB681<br>Series= X7R | Cap= 680.0 pF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 4. | Cin | MuRata | GRM31CR61A476KE15L<br>Series= X5R | Cap= 47.0 uF<br>ESR= 3.709 mOhm<br>VDC= 10.0 V<br>IRMS= 4.2862 A | 2 | $0.15 | 1206_190 11 mm² |
| 5. | Cout | Panasonic | EEE-FK1V151P<br>Series= FK | Cap= 150.0 uF<br>ESR= 160.0 mOhm<br>VDC= 35.0 V<br>IRMS= 600.0 mA | 3 | $0.21 | SM_RADIAL_F 124 mm² |
| 6. | Csense | 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 |
| 7. | D1 | NXP Semiconductor | PMEG6010CEH,115 | VF@Io= 570.0 mV<br>VRRM= 60.0 V | 1 | $0.04 | SOD-123F 12 mm² |

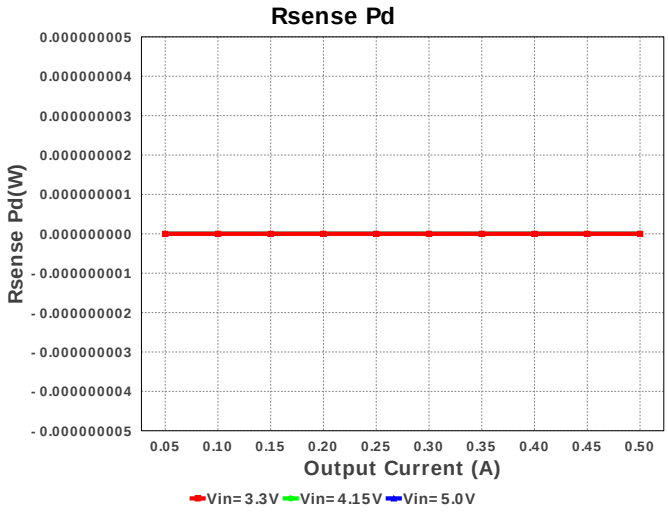
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 8. | L1 | Bourns | SDR1307-4R7ML | L= 4.7 µH<br>DCR= 10.0 mOhm | 1 | $0.35 |  <br>SDR1307 227 mm² |
| 9. | M1 | Texas Instruments | CSD17304Q3 | VdsMax= 30.0 V<br>IdsMax= 56.0 Amps | 1 | $0.32 |  <br>TRANS_NexFET_Q3 18 mm² |
| 10. | Rcomp | Vishay-Dale | CRCW040234K0FKED<br>Series= CRCW..e3 | Res= 34.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 11. | Rfb1 | 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 |
| 12. | Rfb2 | Vishay-Dale | CRCW040218K2FKED<br>Series= CRCW..e3 | Res= 18.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 13. | Rs1 | Vishay-Dale | CRCW0402100RFKED<br>Series= CRCW..e3 | Res= 100.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 14. | Rsense | Susumu Co Ltd | PRL1632-R009-F-T1<br>Series= PRL1632 | Res= 9.0 mOhm<br>Power= 1.0 W<br>Tolerance= 1.0% | 1 | $0.19 |  <br>0612 11 mm² |
| 15. | Rsync | Vishay-Dale | CRCW040226K1FKED<br>Series= CRCW..e3 | Res= 26.1 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | <br>0402 3 mm² |
| 16. | U1 | Texas Instruments | LM3488MMX/NOPB | Switcher | 1 | $0.80 |  <br>MUA08A 24 mm² |

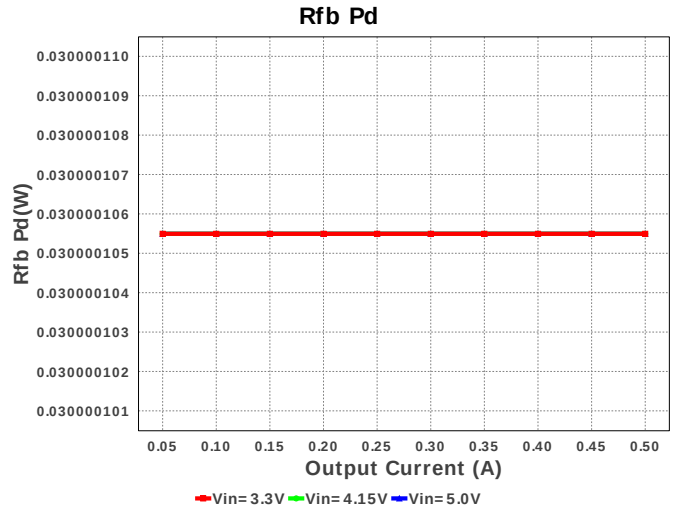


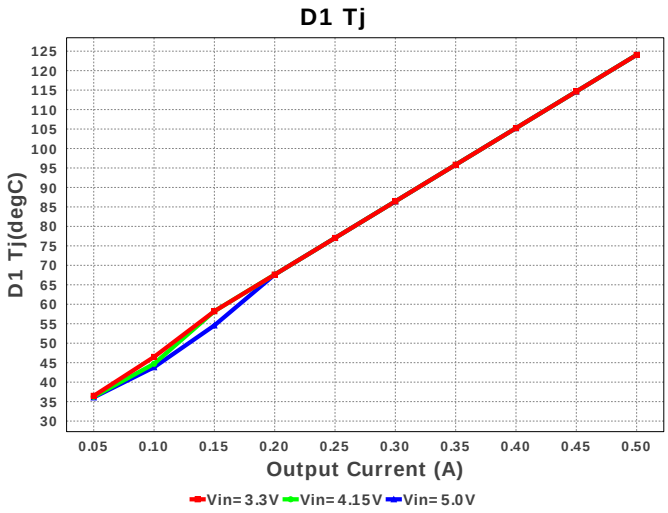



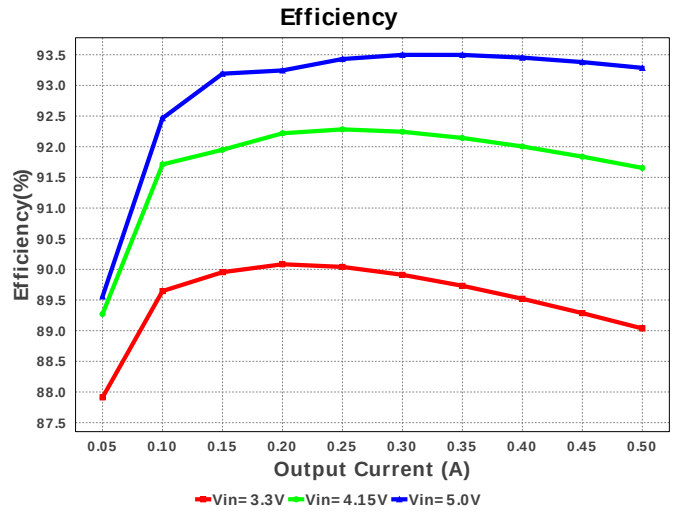


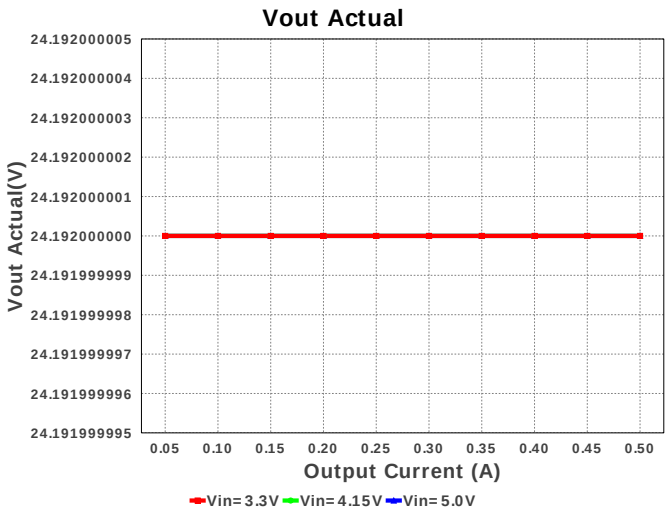



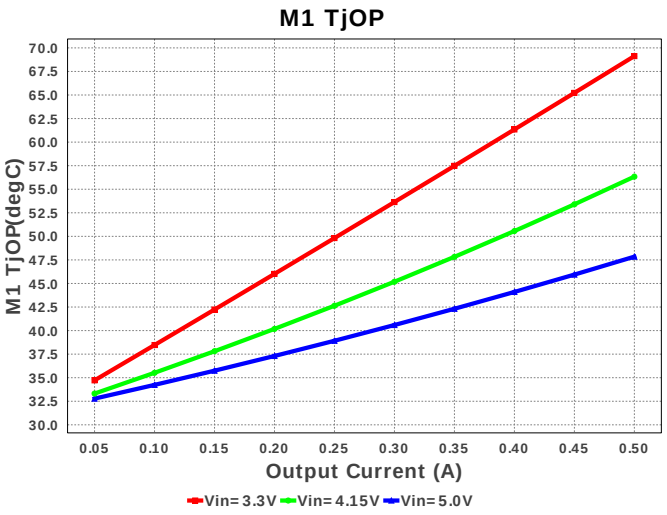



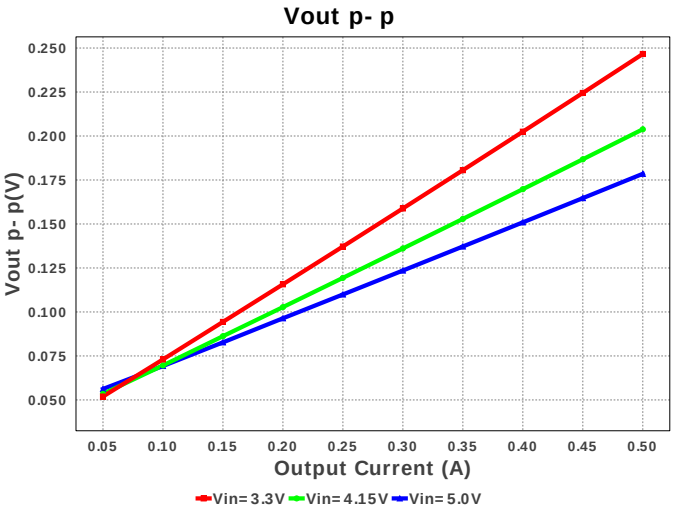



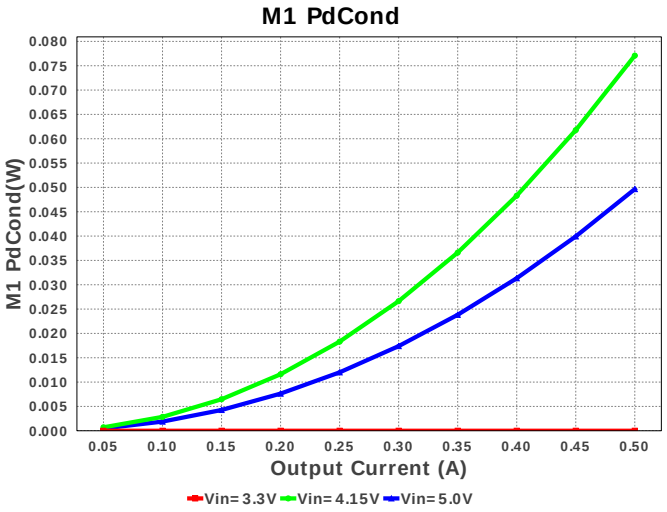



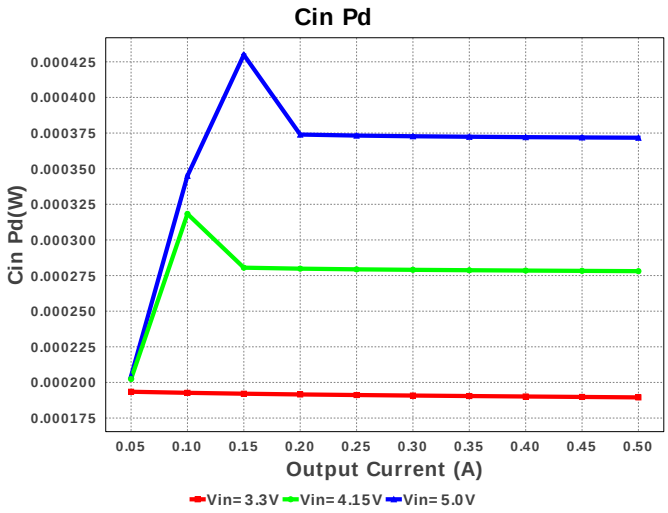



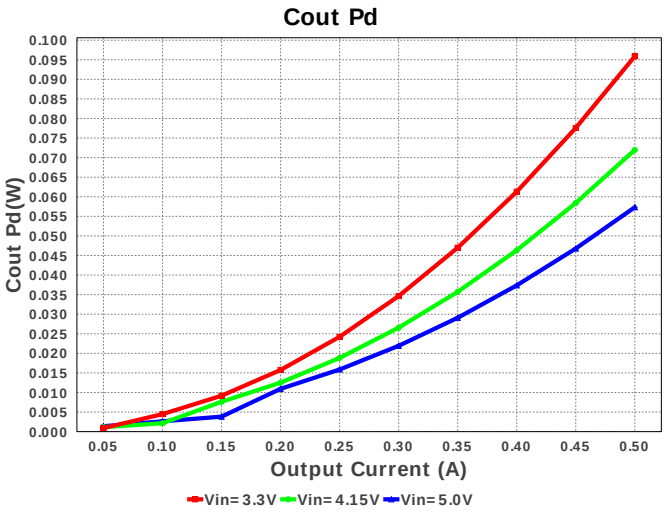


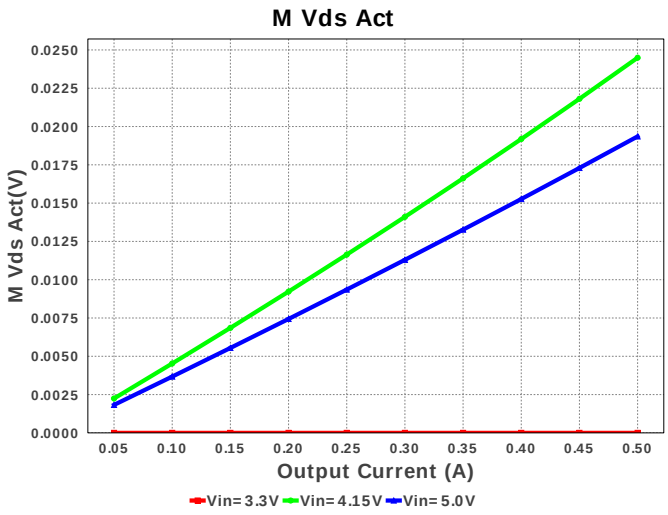



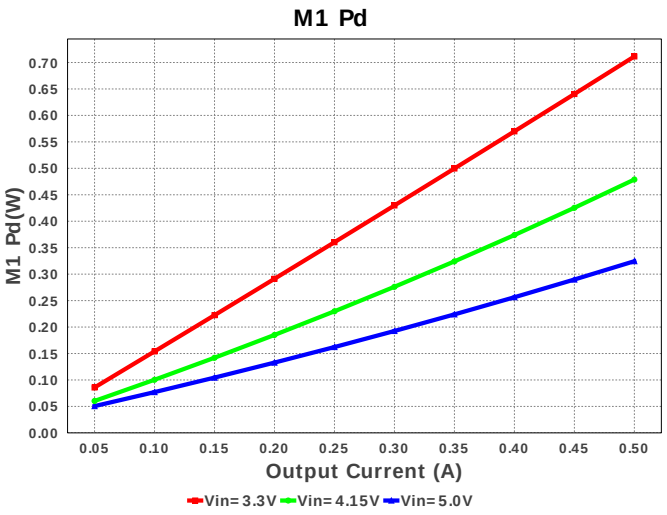



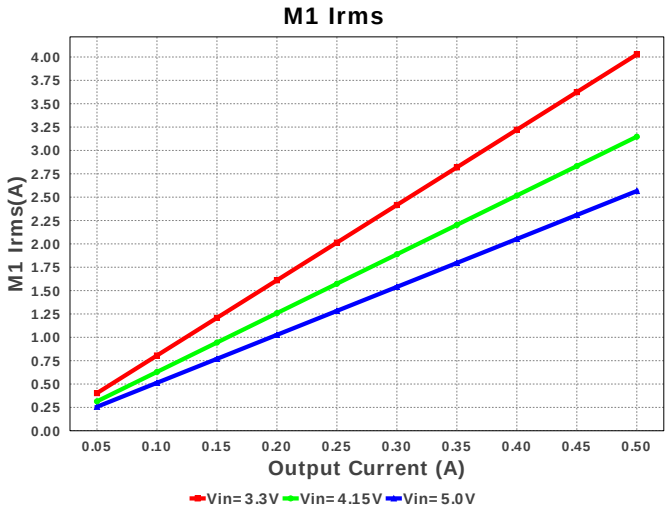



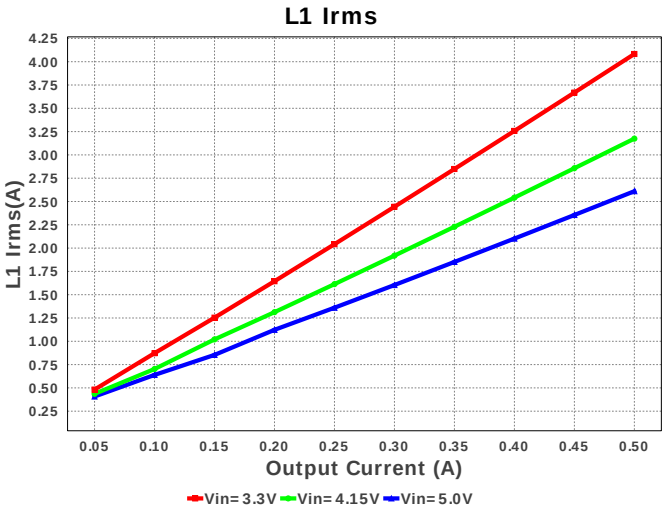



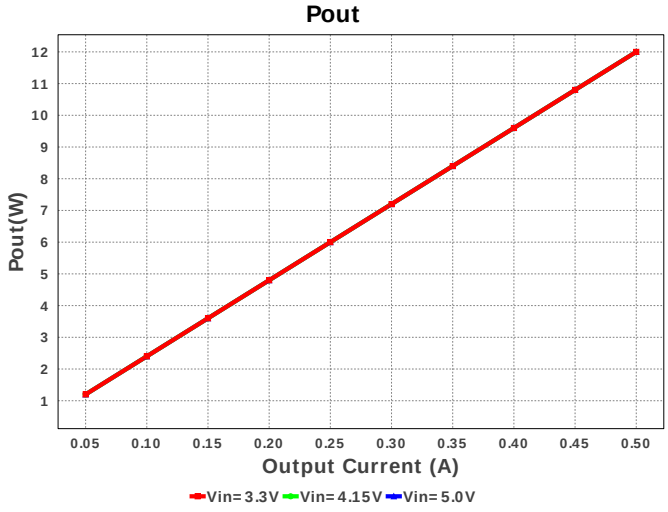



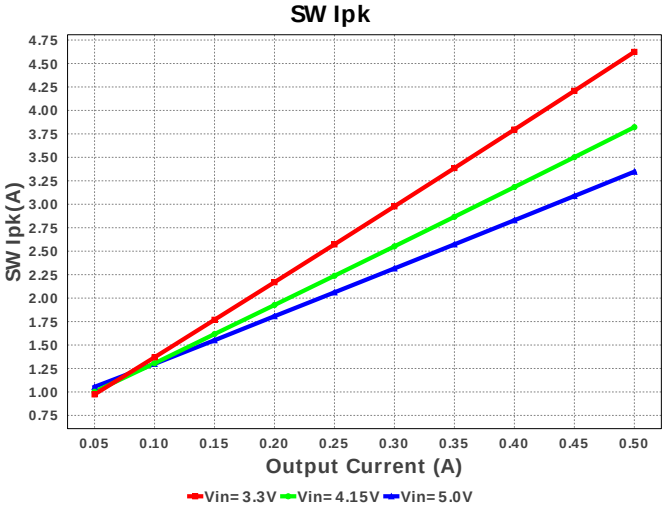


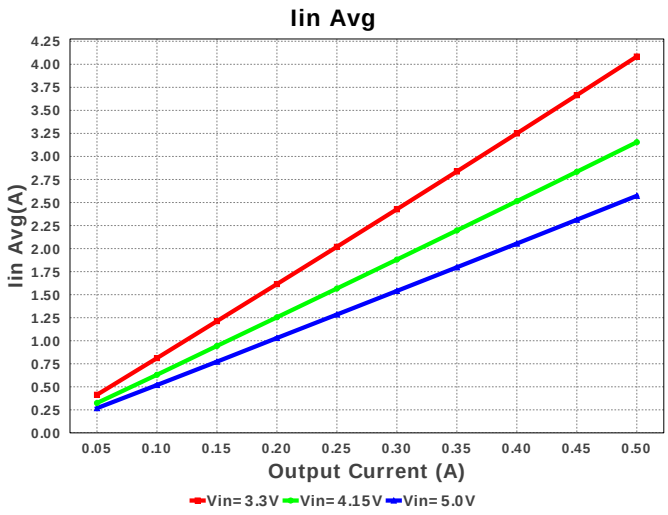



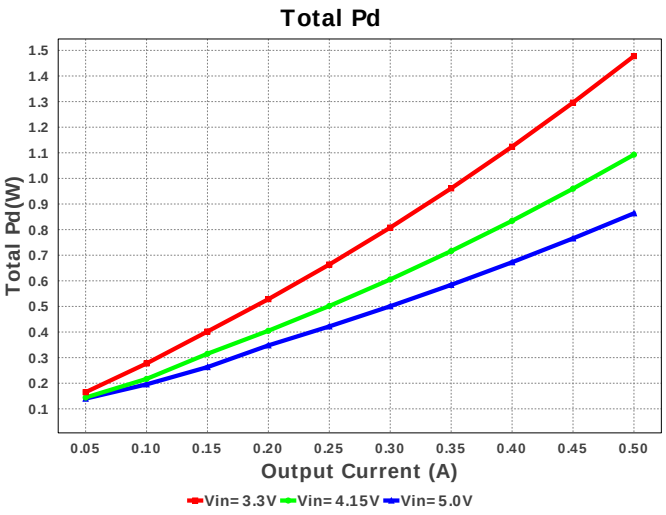



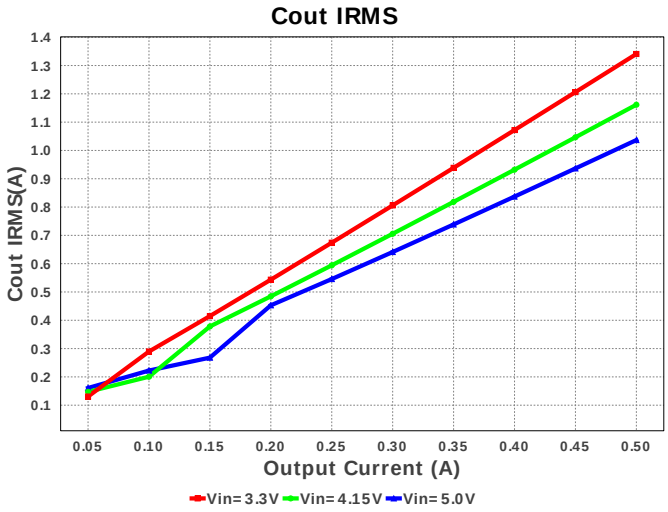



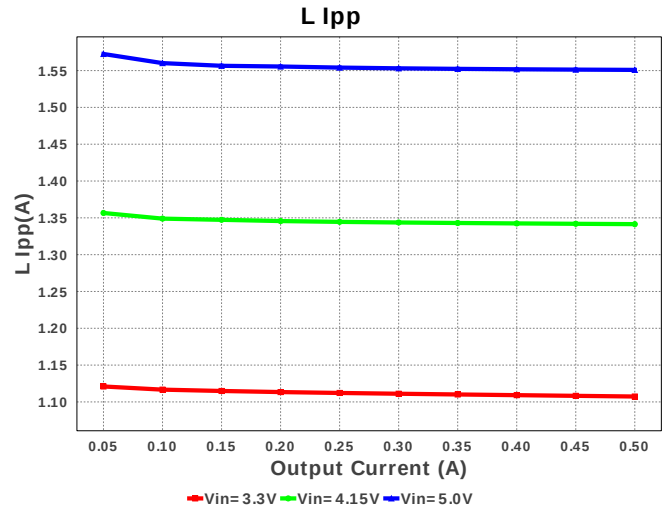



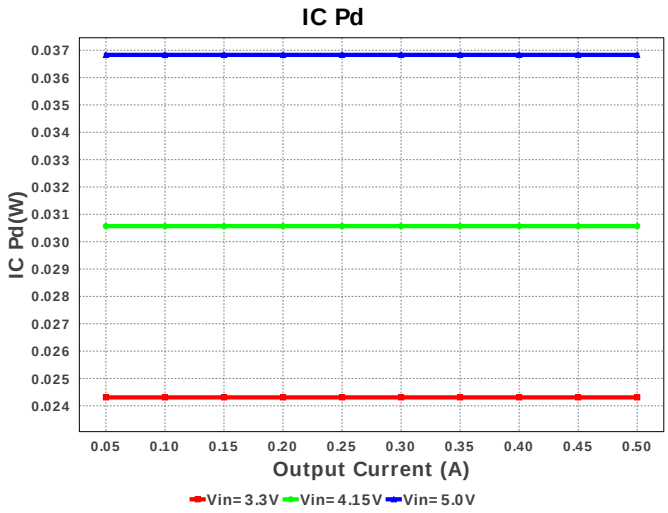



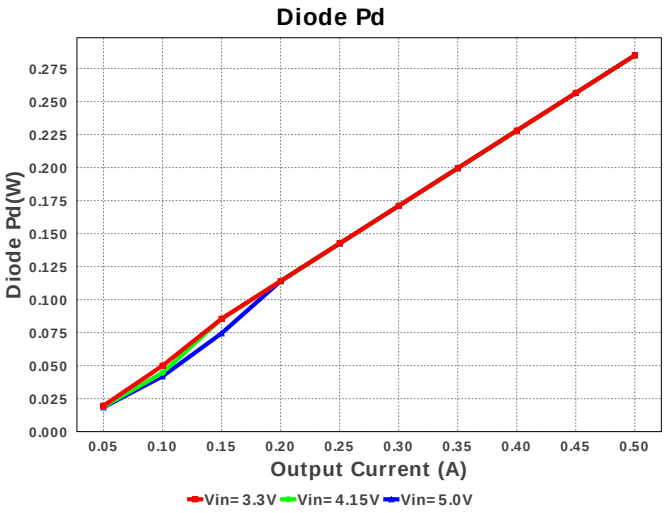


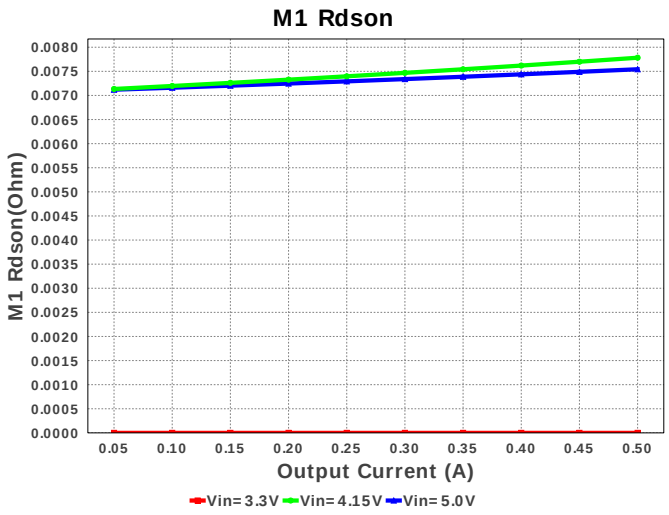



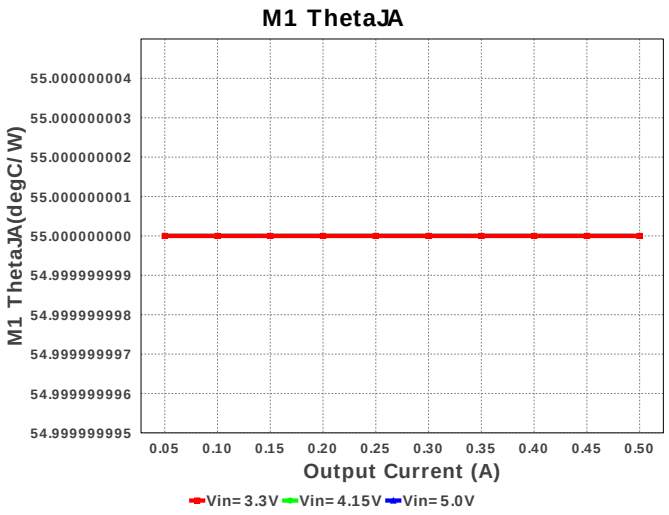



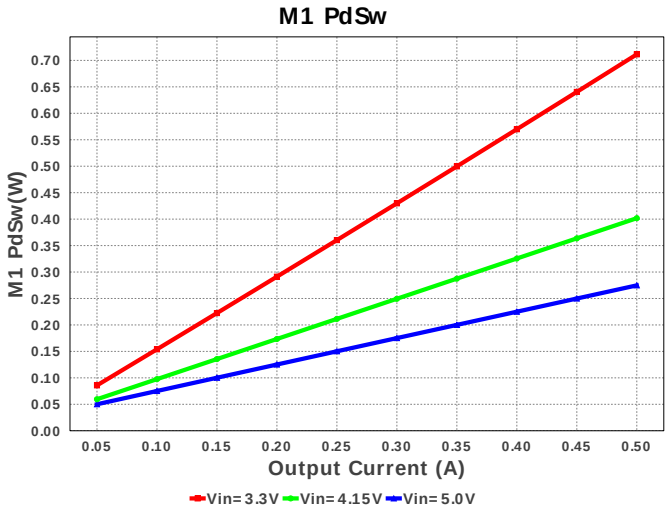



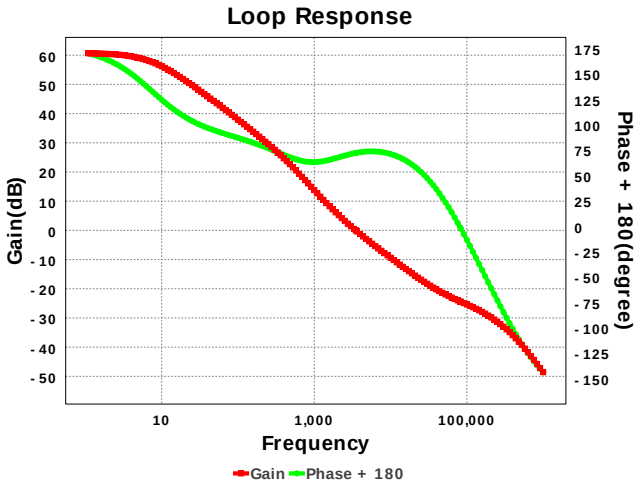






## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 319.664 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 1.341 A | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 4.084 A | Current | Average input current |
| 4. | L Ipp | 1.107 A | Current | Peak-to-peak inductor ripple current |
| 5. | L1 Irms | 4.083 A | Current | Inductor ripple current |
| 6. | M1 Irms | 4.027 A | Current | M1 MOSFET Irms |
| 7. | SW Ipk | 4.624 A | Current | Peak switch current |
| 8. | BOM Count | 19 | General | Total Design BOM count |
| 9. | FootPrint | 722.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 10. | Frequency | 550.0 kHz | General | Switching frequency |
| 11. | IC Tolerance | 15.3 mV | General | IC Feedback Tolerance |
| 12. | M Vds Act | 0.0 V | General | M Vds |
| 13. | M1 Rdson | 0.0 Ohm | General | Drain-Source On-resistance |
| 14. | M1 ThetaJA | 55.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 15. | Pout | 12.0 W | General | Total output power |
| 16. | Total BOM | $2.72 | General | Total BOM Cost |
| 17. | D1 Tj | 124.05 degC | Op_Point | D1 junction temperature |
| 18. | Low Freq Gain | 56.655 dB | Op_Point | Gain at 10Hz |
| 19. | Vout Actual | 24.192 V | Op_Point | Vout Actual calculated based on selected voltage divider resistors |
| 20. | Vout OP | 24.0 V | Op_Point | Operational Output Voltage |
| 21. | Cross Freq | 2.351 kHz | Op_point | Bode plot crossover frequency |
| 22. | Duty Cycle | 87.716 % | Op_point | Duty cycle |
| 23. | Efficiency | 89.036 % | Op_point | Steady state efficiency |
| 24. | Gain Marg | -20.805 dB | Op_point | Bode Plot Gain Margin |
| 25. | IC Tj | 34.862 degC | Op_point | IC junction temperature |
| 26. | ICThetaJA | 200.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 27. | IOUT_OP | 500.0 mA | Op_point | Iout operating point |
| 28. | M1 TjOP | 69.128 degC | Op_point | M1 MOSFET junction temperature |
| 29. | Phase Marg | 67.054 deg | Op_point | Bode Plot Phase Margin |
| 30. | VIN_OP | 3.3 V | Op_point | Vin operating point |
| 31. | Vout p-p | 246.613 mV | Op_point | Peak-to-peak output ripple voltage |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 32. | Cin Pd | 189.502 µW | Power | Input capacitor power dissipation |
| 33. | Cout Pd | 95.878 mW | Power | Output capacitor power dissipation |
| 34. | Diode Pd | 285.0 mW | Power | Diode power dissipation |
| 35. | IC Pd | 24.308 mW | Power | IC power dissipation |
| 36. | L Pd | 200.035 mW | Power | Inductor power dissipation |
| 37. | M1 Pd | 711.426 mW | Power | M1 MOSFET total power dissipation |
| 38. | M1 PdCond | 0.0 W | Power | M1 MOSFET conduction losses |
| 39. | M1 PdSw | 711.426 mW | Power | M1 MOSFET switching losses |
| 40. | Rfb Pd | 30.0 mW | Power | Rfb Power Dissipation |
| 41. | Rsense Pd | 124.728 mW | Power | LED Current Rsns Power Dissipation |
| 42. | Total Pd | 1.478 W | Power | Total Power Dissipation |
| 43. | Vout Tolerance | 3.152 % | | 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 | 5.0 | Maximum input voltage |
| 3. | VinMin | 3.3 | Minimum input voltage |
| 4. | Vout | 24.0 | Output Voltage |
| 5. | base_pn | LM3488 | Base Product Number |
| 6. | source | DC | Input Source Type |
| 7. | Ta | 30.0 | Ambient temperature |
| 8. | UserFsw | 550.0 k | Customer Selected Frequency |

## Design Assistance

1. **LM3488** Product Folder : http://www.ti.com/product/LM3488 : contains the data sheet and other resources.