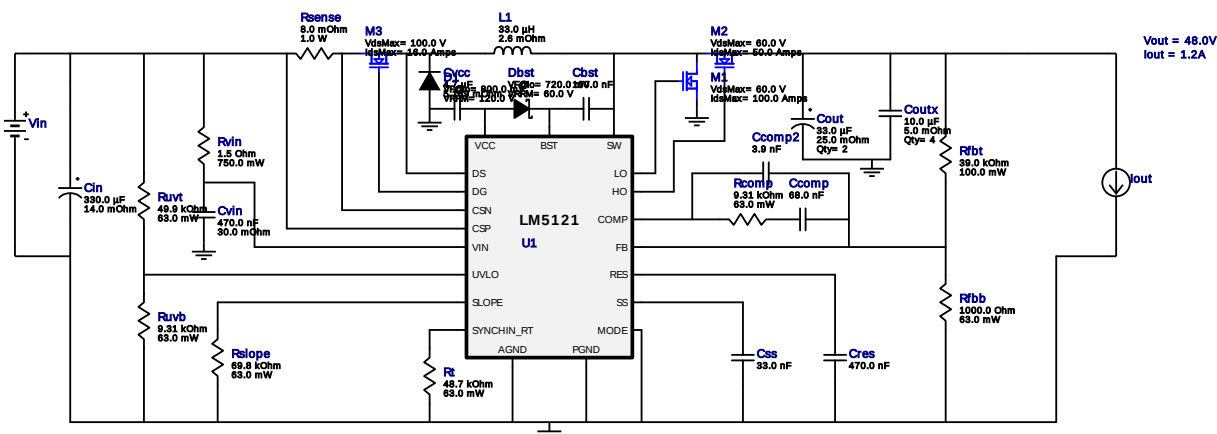


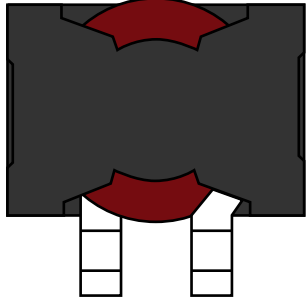
## WEBENCH® Design Report

Design : 1641152/106 LM5121MH/NOPB  
LM5121MH/NOPB 10.0V-14.4V to 48.00V @ 1.2A

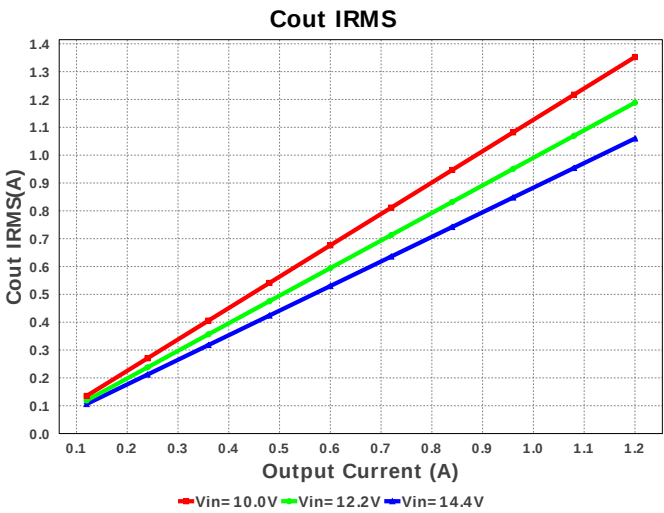
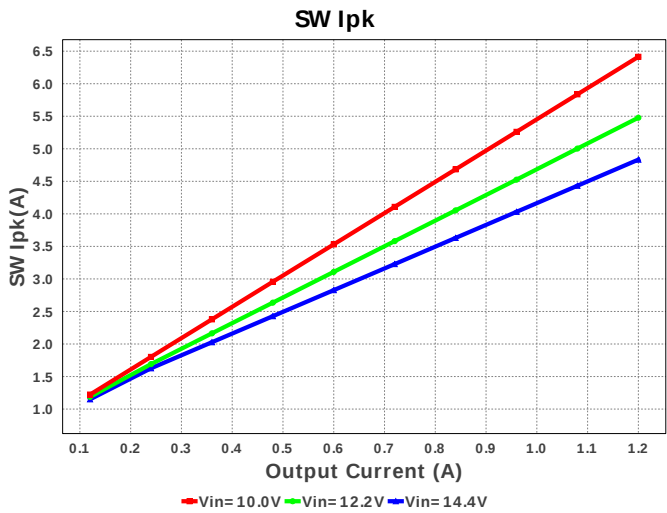
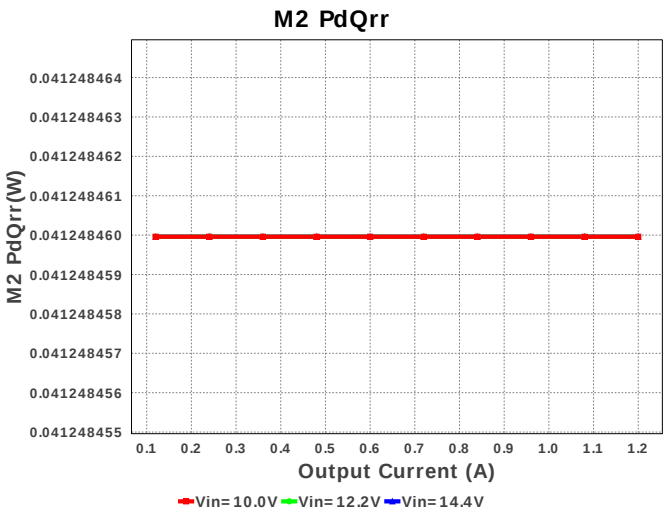
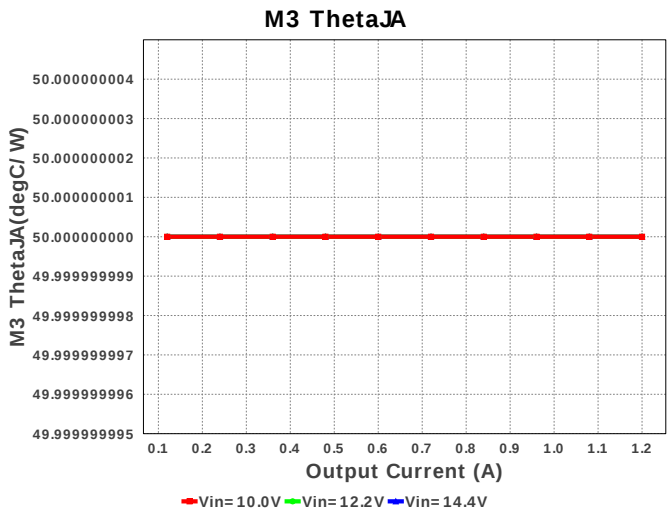


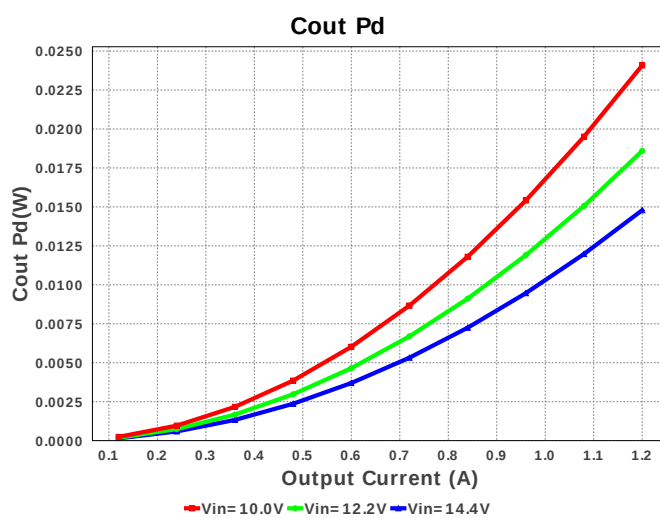
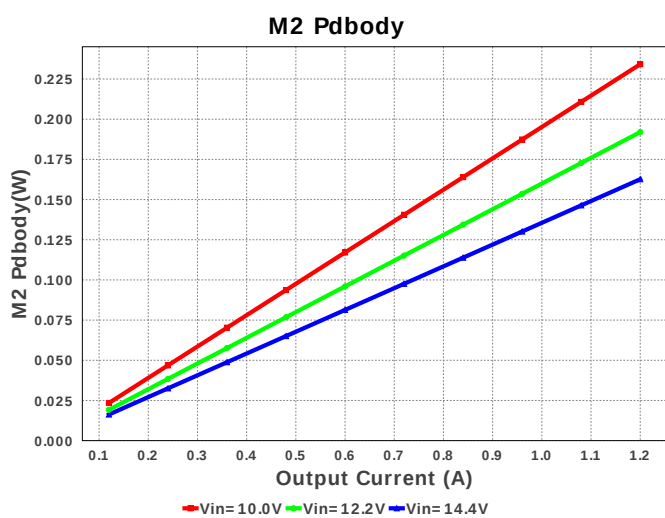
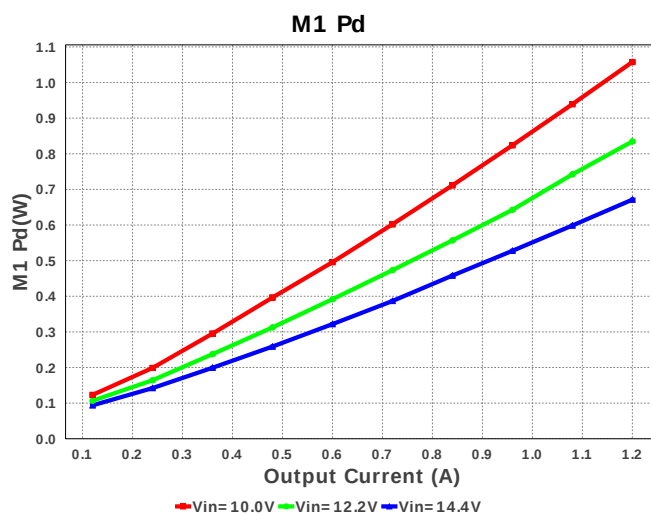
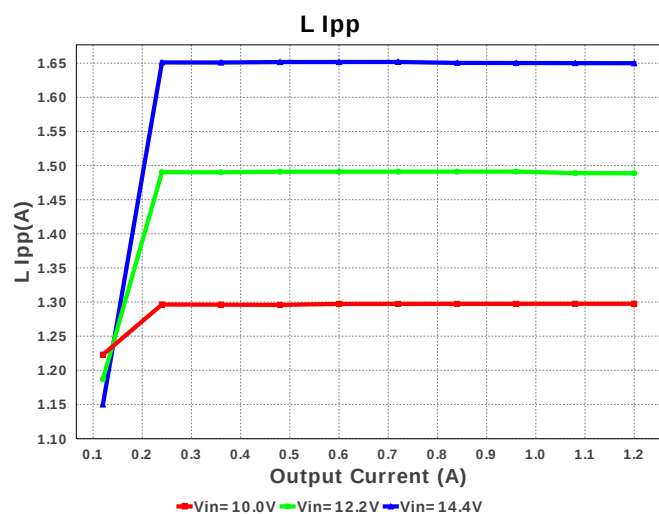
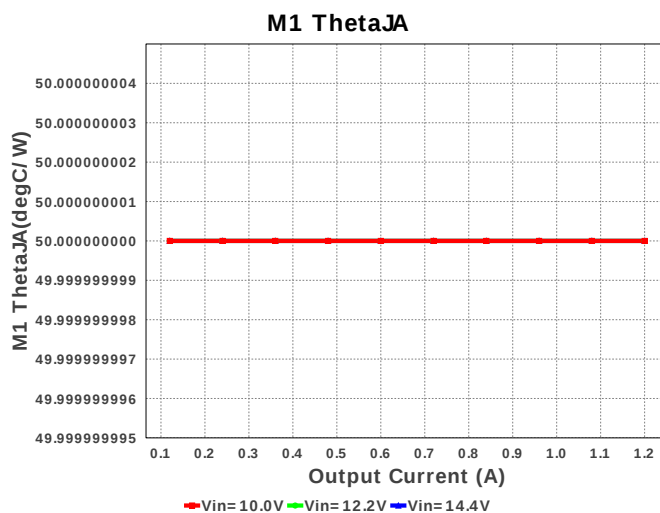
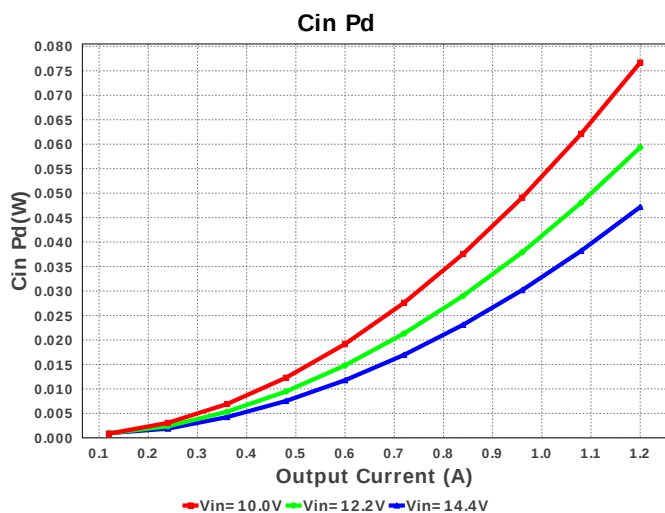
## Electrical BOM

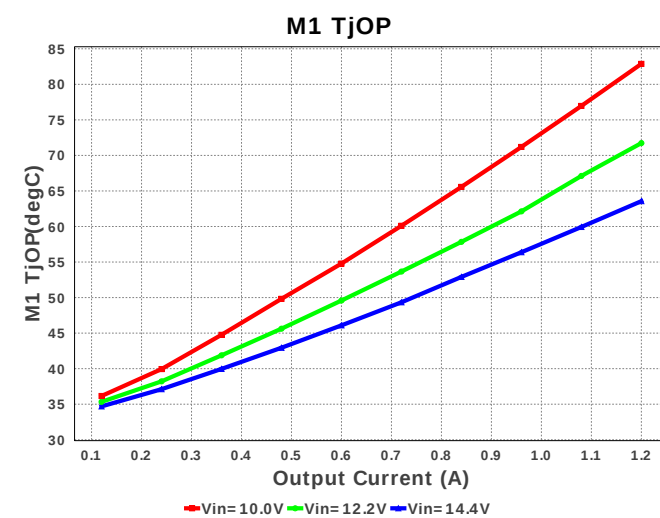
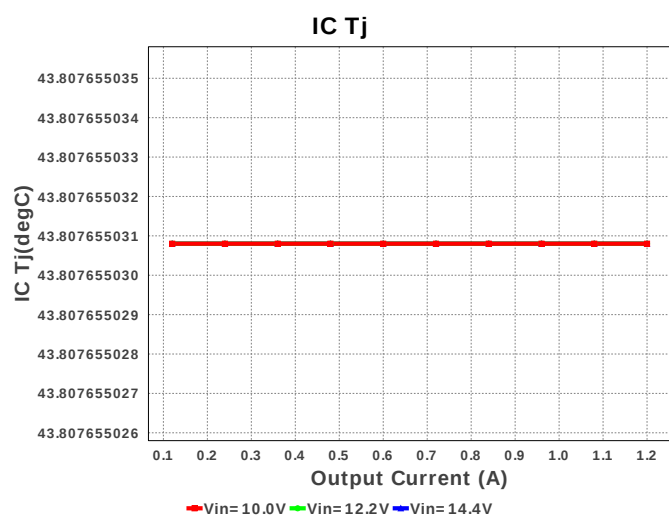
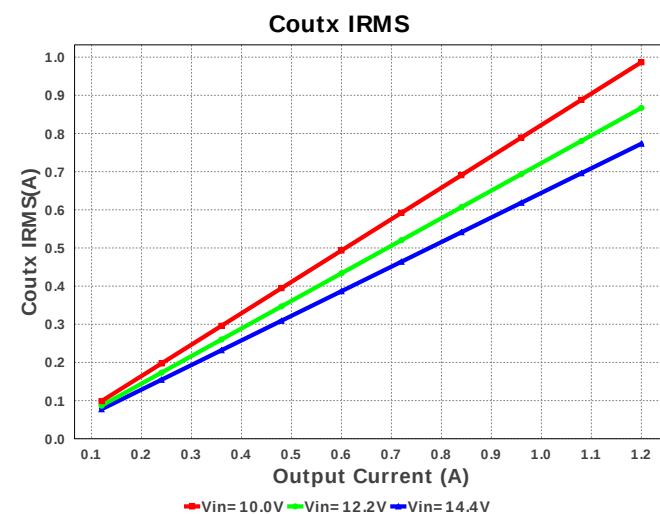
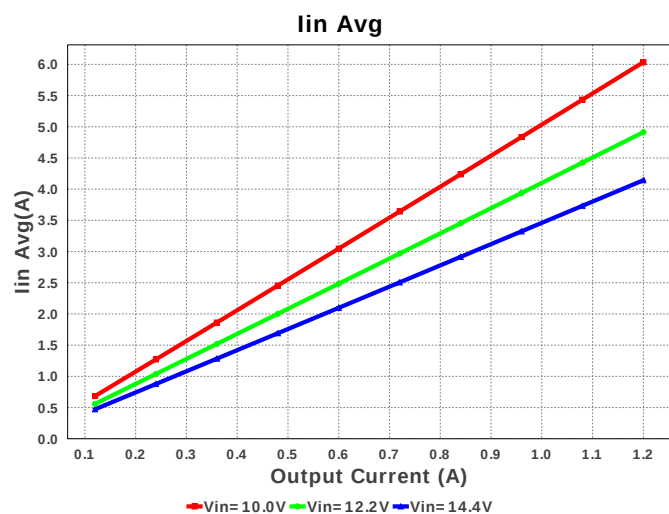
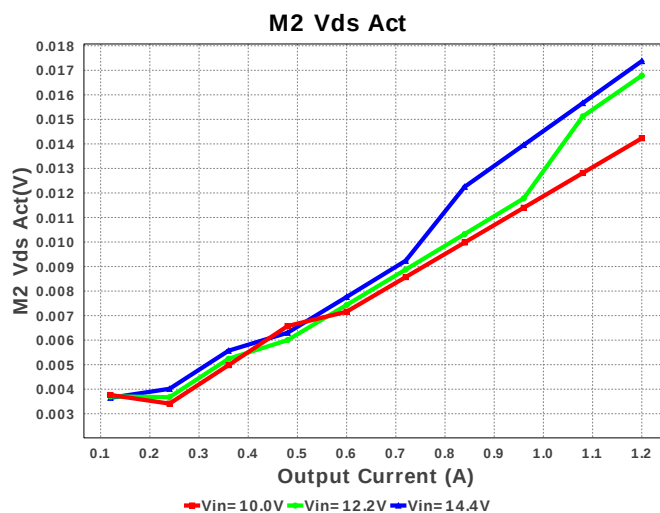
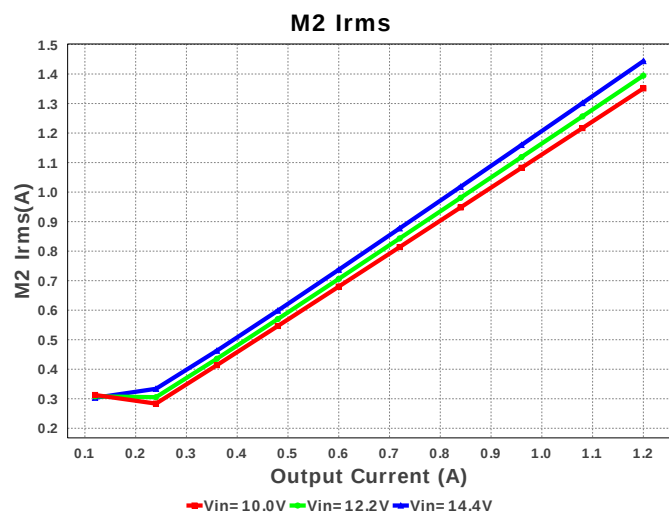
| #  | Name   | Manufacturer  | Part Number                        | Properties                                                       | Qty | Price  | Footprint                         |
|----|--------|---------------|------------------------------------|------------------------------------------------------------------|-----|--------|-----------------------------------|
| 1. | Cbst   | CUSTOM        | CUSTOM<br>Series= ?                | Cap= 100.0 nF<br>VDC= 57.6 V<br>IRMS= 0.0 A                      | 1   | NA     | CUSTOM 0 mm <sup>2</sup>          |
| 2. | Ccomp  | MuRata        | GRM155R61A683KA01D<br>Series= X5R  | Cap= 68.0 nF<br>VDC= 10.0 V<br>IRMS= 0.0 A                       | 1   | \$0.01 | 0402 3 mm <sup>2</sup>            |
| 3. | Ccomp2 | Yageo America | CC0805KRX7R9BB392<br>Series= X7R   | Cap= 3.9 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                        | 1   | \$0.01 | 0805 7 mm <sup>2</sup>            |
| 4. | Cin    | Panasonic     | 25SVPF330M<br>Series= ?            | Cap= 330.0 uF<br>ESR= 14.0 mOhm<br>VDC= 25.0 V<br>IRMS= 5.0 A    | 1   | \$0.70 | CAPSMT_62_F12 151 mm <sup>2</sup> |
| 5. | Cout   | Panasonic     | 63SXV33M<br>Series= ?              | Cap= 33.0 uF<br>ESR= 25.0 mOhm<br>VDC= 63.0 V<br>IRMS= 2.95 A    | 2   | \$1.25 | CAPSMT_62_E12 106 mm <sup>2</sup> |
| 6. | Coutx  | TDK           | C5750X7S2A106M230KB<br>Series= X7S | Cap= 10.0 uF<br>ESR= 5.0 mOhm<br>VDC= 100.0 V<br>IRMS= 6.45 A    | 4   | NA     | 2220 54 mm <sup>2</sup>           |
| 7. | Cres   | Taiyo Yuden   | TMK212BJ474KD-T<br>Series= X5R     | Cap= 470.0 nF<br>VDC= 20.0 V<br>IRMS= 0.0 A                      | 1   | \$0.02 | 0805 7 mm <sup>2</sup>            |
| 8. | Css    | MuRata        | GRM155R71E333KA88D<br>Series= X7R  | Cap= 33.0 nF<br>VDC= 25.0 V<br>IRMS= 0.0 A                       | 1   | \$0.01 | 0402 3 mm <sup>2</sup>            |
| 9. | Cvcc   | MuRata        | GRM21BR61E475KA12L<br>Series= X5R  | Cap= 4.7 uF<br>ESR= 5.189 mOhm<br>VDC= 25.0 V<br>IRMS= 2.03531 A | 1   | \$0.02 | 0805 7 mm <sup>2</sup>            |

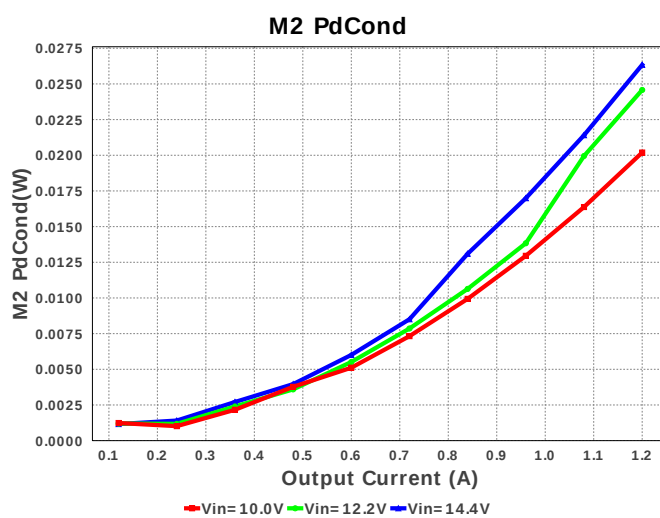
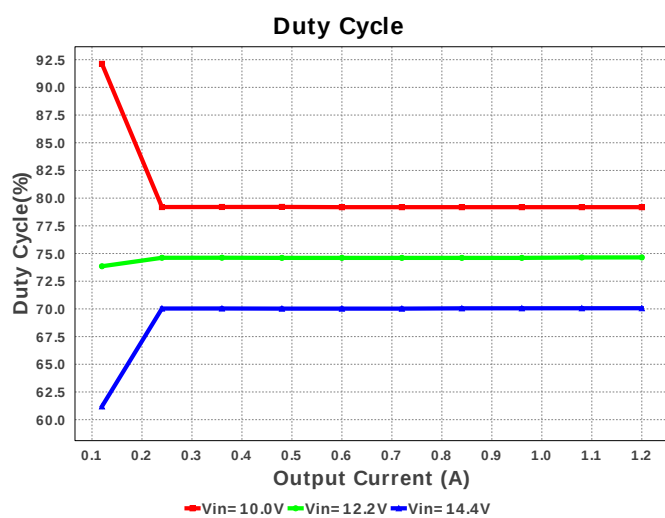
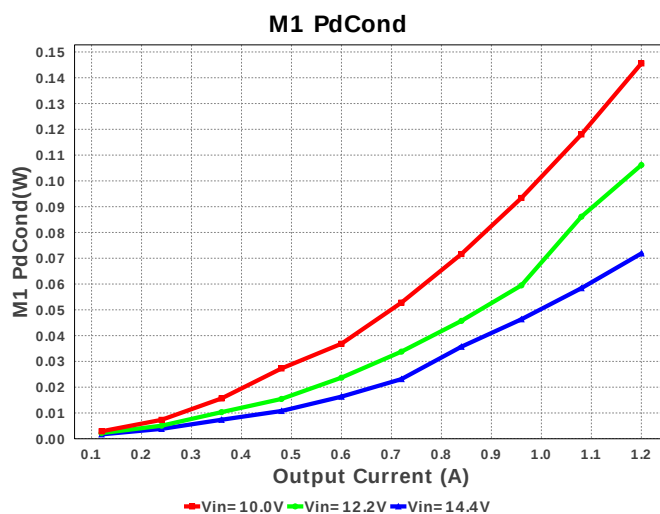
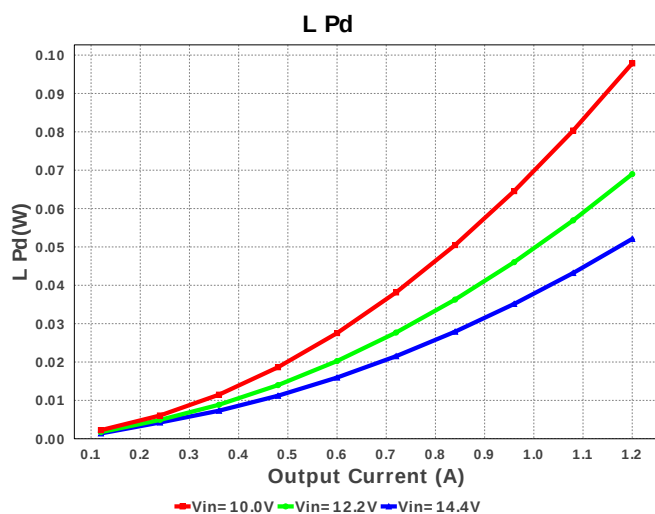
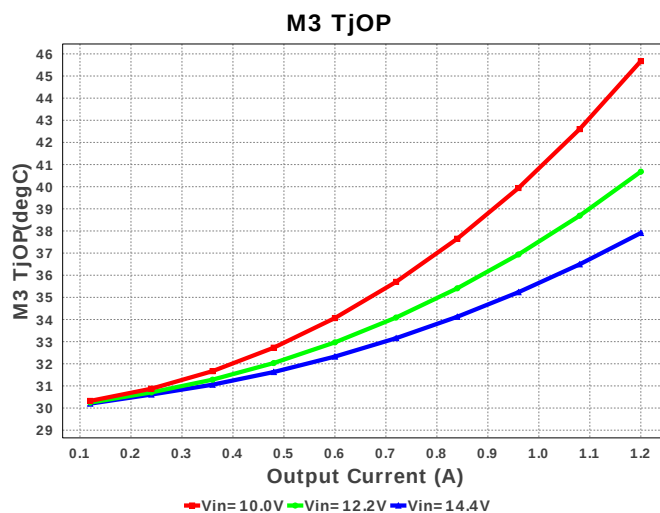
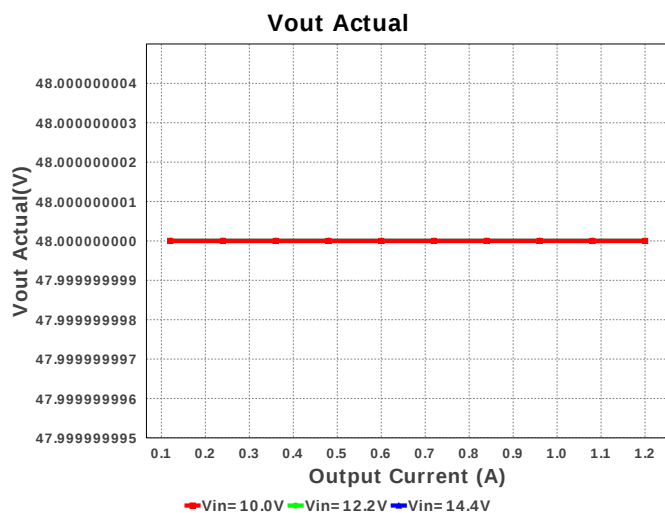
| #   | Name   | Manufacturer              | Part Number                          | Properties                                                    | Qty | Price  | Footprint                                                                                                     |
|-----|--------|---------------------------|--------------------------------------|---------------------------------------------------------------|-----|--------|---------------------------------------------------------------------------------------------------------------|
| 10. | Cvin   | MuRata                    | GRM188R71E474KA12D<br>Series= X7R    | Cap= 470.0 nF<br>ESR= 30.0 mOhm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1   | \$0.02 |  0603 5 mm²                |
| 11. | D1     | Vishay-Semiconductor      | V12P12-M3/86A                        | VF@Io= 800.0 mV<br>VRRM= 120.0 V                              | 1   | \$0.40 |  TO-277A 56 mm²            |
| 12. | Dbst   | ON Semiconductor          | SS16T3G                              | VF@Io= 720.0 mV<br>VRRM= 60.0 V                               | 1   | \$0.08 |  SMA 37 mm²                |
| 13. | L1     | Coilcraft                 | SER2918H-333KL                       | L= 33.0 µH<br>DCR= 2.6 mOhm                                   | 1   | \$2.65 |  SER2918H 652 mm²          |
| 14. | M1     | Texas Instruments         | CSD18563Q5A                          | VdsMax= 60.0 V<br>IdsMax= 100.0 Amps                          | 1   | \$0.68 |  TRANS_NexFET_Q5A 55 mm²   |
| 15. | M2     | Texas Instruments         | CSD18537NQ5A                         | VdsMax= 60.0 V<br>IdsMax= 50.0 Amps                           | 1   | \$0.46 |  TRANS_NexFET_Q5A 55 mm²  |
| 16. | M3     | Texas Instruments         | CSD19531Q5A                          | VdsMax= 100.0 V<br>IdsMax= 16.0 Amps                          | 1   | \$1.01 |  TRANS_NexFET_Q5A 55 mm² |
| 17. | Rcomp  | Vishay-Dale               | CRCW04029K31FKED<br>Series= CRCW..e3 | Res= 9.31 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%           | 1   | \$0.01 |  0402 3 mm²              |
| 18. | Rfbb   | Vishay-Dale               | CRCW04021K00FKED<br>Series= CRCW..e3 | Res= 1000.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%          | 1   | \$0.01 |  0402 3 mm²              |
| 19. | Rfbt   | Yageo America             | RC0603FR-0739KL<br>Series= ?         | Res= 39.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0%          | 1   | \$0.01 |  0603 5 mm²              |
| 20. | Rsense | Susumu Co Ltd             | PRL1632-R008-F-T1<br>Series= PRL1632 | Res= 8.0 mOhm<br>Power= 1.0 W<br>Tolerance= 1.0%              | 1   | \$0.19 |  0612 11 mm²             |
| 21. | Rslope | Vishay-Dale               | CRCW040269K8FKED<br>Series= CRCW..e3 | Res= 69.8 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%           | 1   | \$0.01 |  0402 3 mm²              |
| 22. | Rt     | Vishay-Dale               | CRCW040248K7FKED<br>Series= CRCW..e3 | Res= 48.7 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%           | 1   | \$0.01 |  0402 3 mm²              |
| 23. | Ruvb   | Vishay-Dale               | CRCW04029K31FKED<br>Series= CRCW..e3 | Res= 9.31 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%           | 1   | \$0.01 |  0402 3 mm²              |
| 24. | Rvvt   | Vishay-Dale               | CRCW040249K9FKED<br>Series= CRCW..e3 | Res= 49.9 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%           | 1   | \$0.01 |  0402 3 mm²              |
| 25. | Rvin   | Stackpole Electronics Inc | RMCF2010FT1R50<br>Series= ?          | Res= 1.5 Ohm<br>Power= 750.0 mW<br>Tolerance= 1.0%            | 1   | \$0.03 |  2010 32 mm²             |

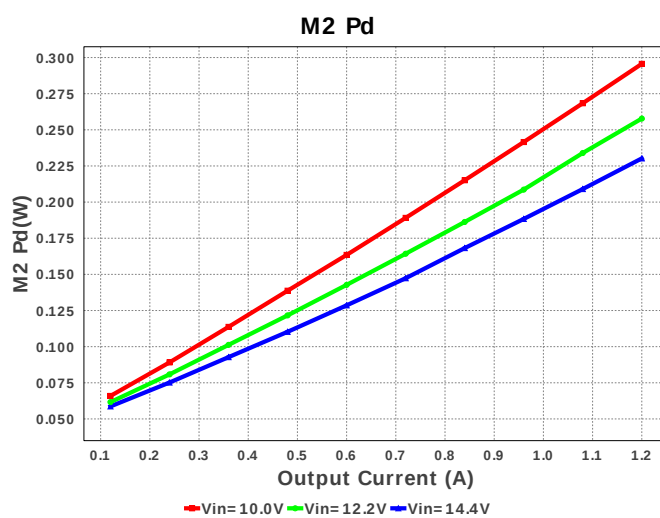
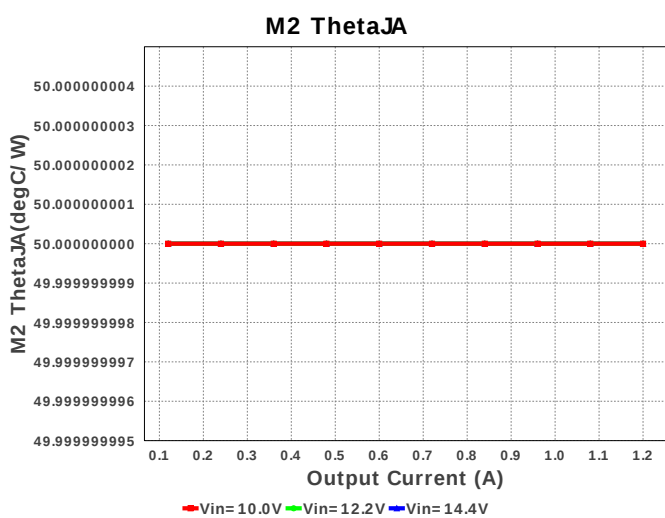
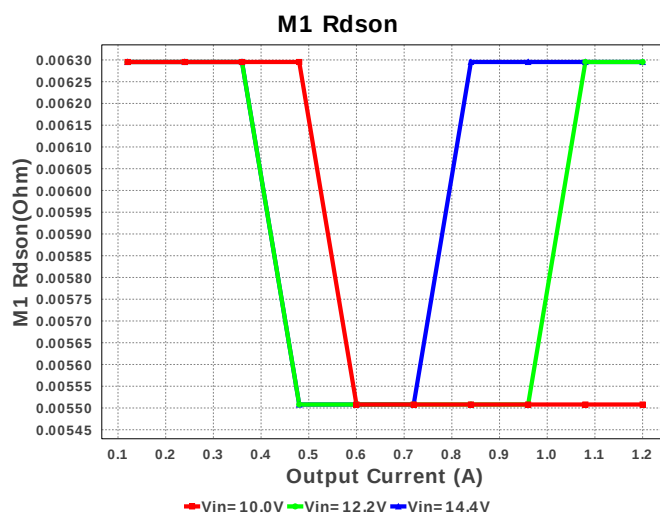
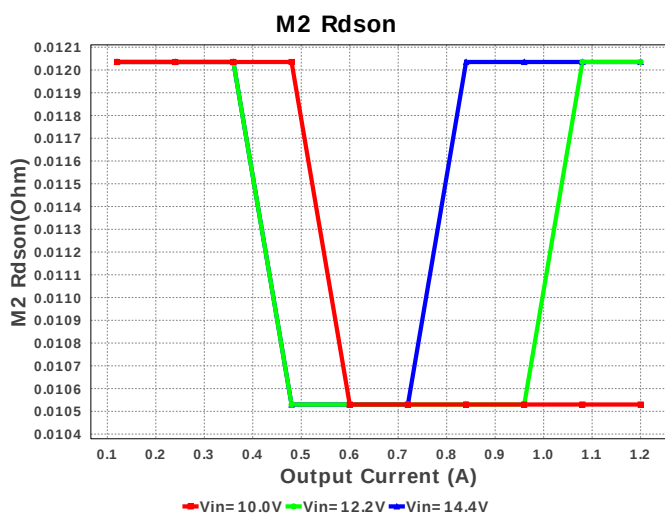
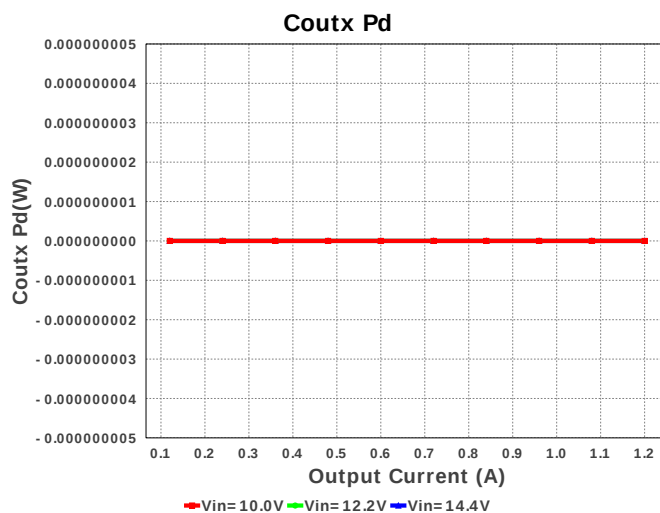
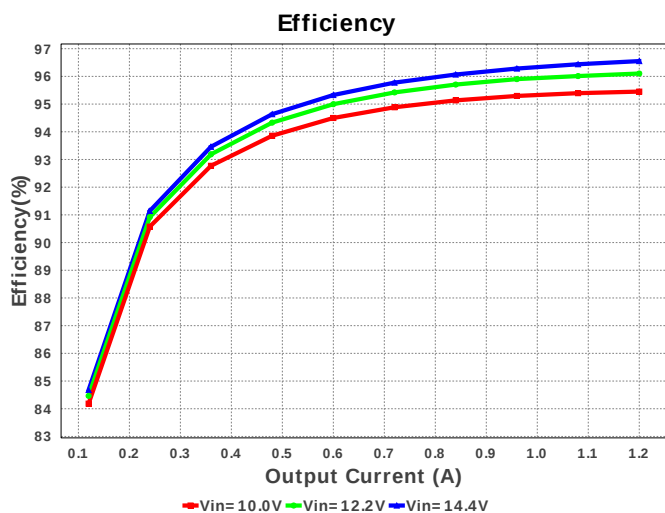
| #   | Name | Manufacturer      | Part Number   | Properties | Qty | Price  | Footprint                                                                                            |
|-----|------|-------------------|---------------|------------|-----|--------|------------------------------------------------------------------------------------------------------|
| 26. | U1   | Texas Instruments | LM5121MH/NOPB | Switcher   | 1   | \$2.46 | <br>MXA20A 71 mm² |

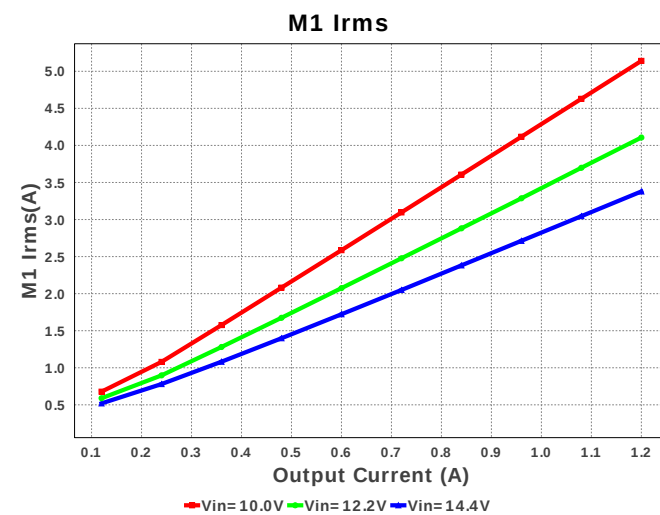
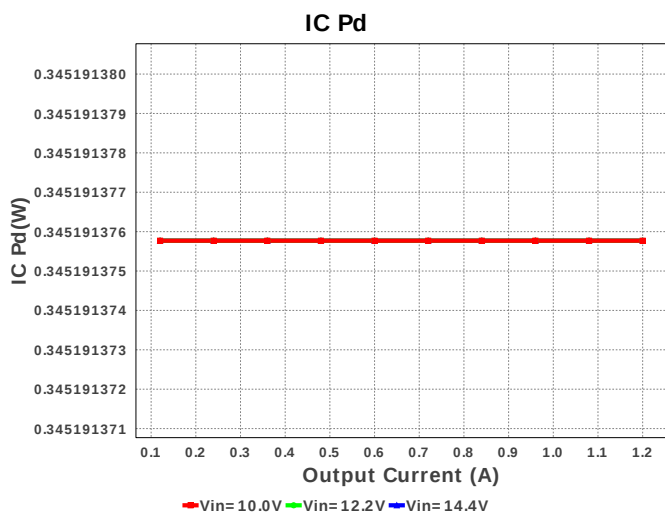
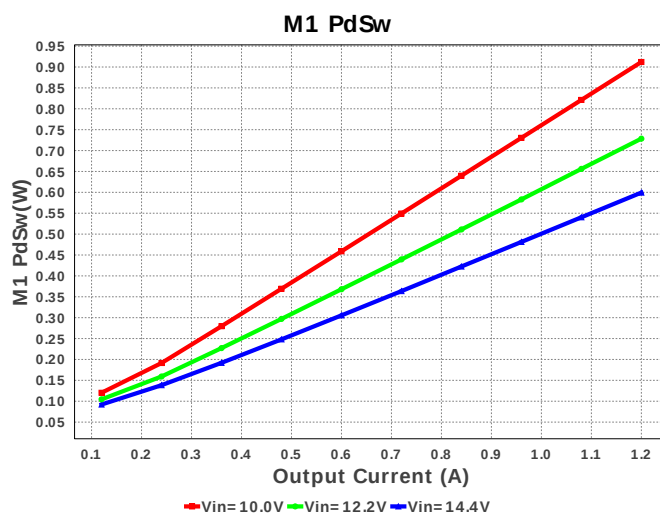
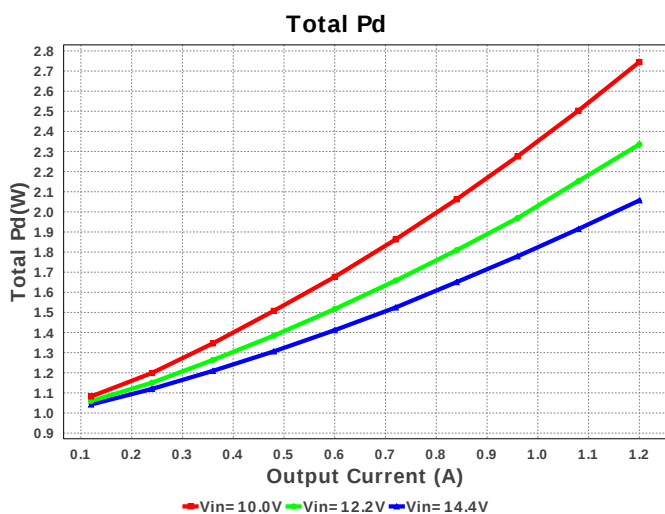
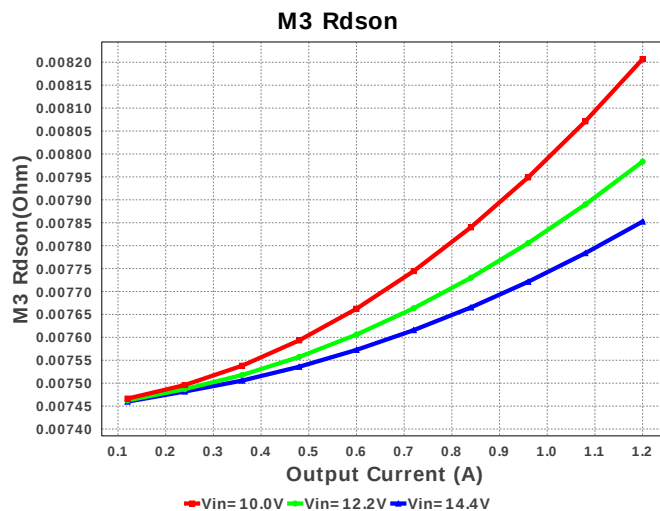
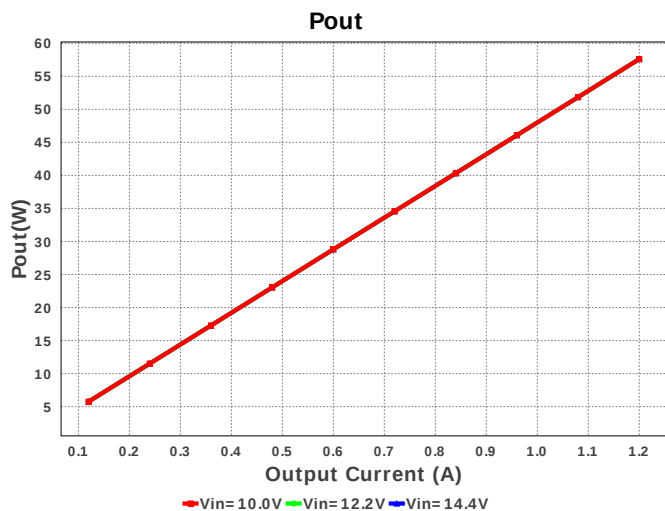


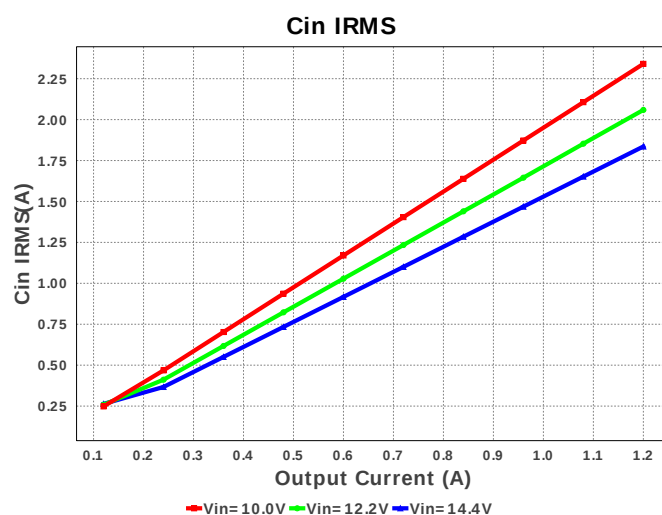
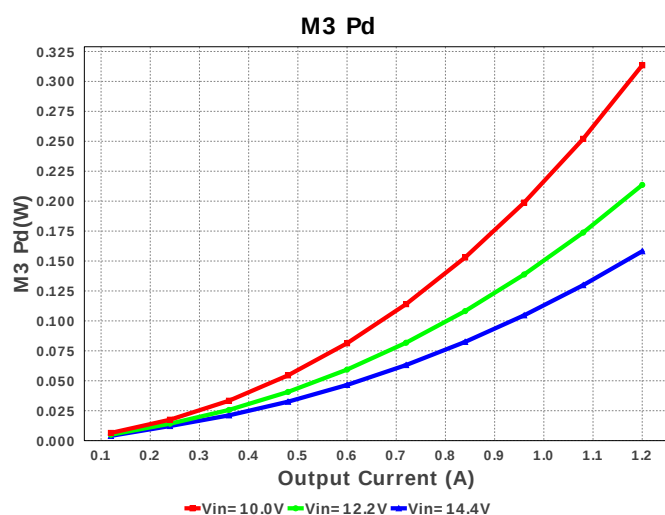
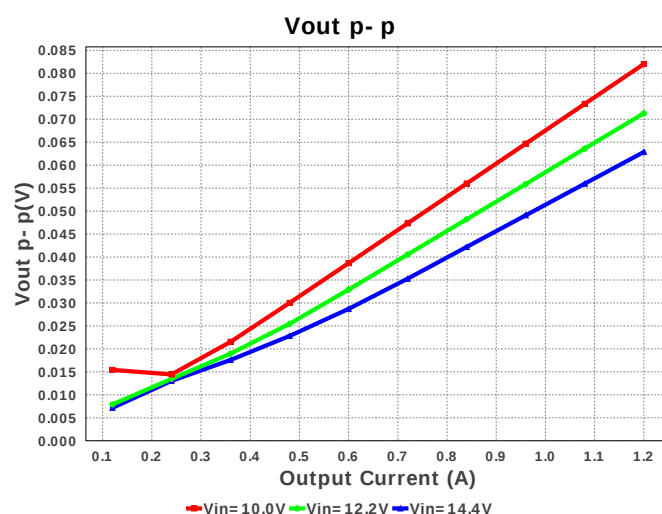
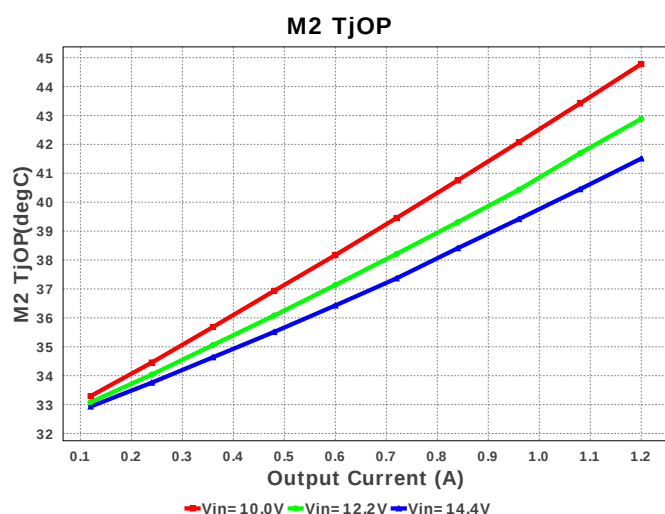
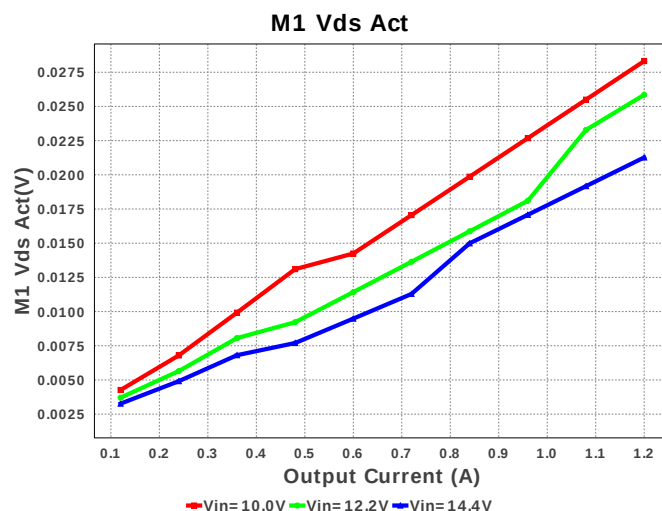
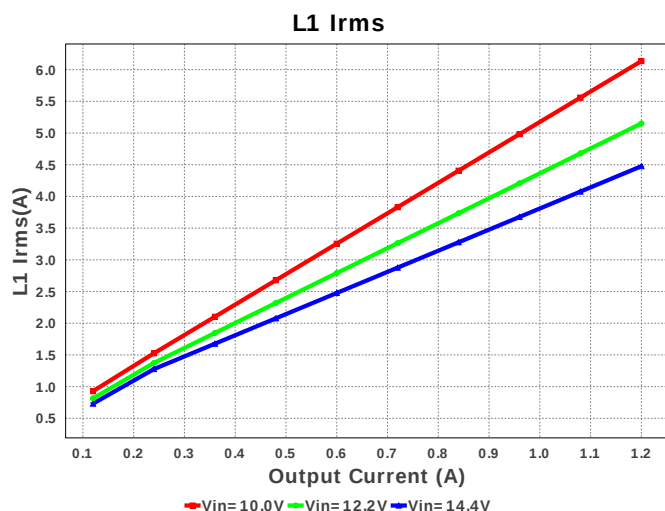












## Operating Values

| #   | Name       | Value                   | Category | Description                             |
|-----|------------|-------------------------|----------|-----------------------------------------|
| 1.  | Cin IRMS   | 2.345 A                 | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS  | 1.273 A                 | Current  | Output capacitor RMS ripple current     |
| 3.  | Coutx IRMS | 1.066 A                 | Current  | Output capacitor _x RMS ripple current  |
| 4.  | Iin Avg    | 6.085 A                 | Current  | Average input current                   |
| 5.  | L Ipp      | 1.294 A                 | Current  | Peak-to-peak inductor ripple current    |
| 6.  | L1 Irms    | 6.133 A                 | Current  | Inductor ripple current                 |
| 7.  | M1 Irms    | 5.159 A                 | Current  | MOSFET RMS ripple current               |
| 8.  | M2 Irms    | 1.351 A                 | Current  | MOSFET RMS ripple current               |
| 9.  | SW Ipk     | 6.43 A                  | Current  | Peak switch current                     |
| 10. | BOM Count  | 30                      | General  | Total Design BOM count                  |
| 11. | FootPrint  | 1.662 k mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |

| #   | Name           | Value       | Category | Description                                                                                |
|-----|----------------|-------------|----------|--------------------------------------------------------------------------------------------|
| 12. | Frequency      | 184.805 kHz | General  | Switching frequency                                                                        |
| 13. | IC Tolerance   | 18.0 mV     | General  | IC Feedback Tolerance                                                                      |
| 14. | M1 Rdson       | 5.508 mOhm  | General  | Drain-Source On-resistance                                                                 |
| 15. | M1 ThetaJA     | 50.0 degC/W | General  | MOSFET junction-to-ambient thermal resistance                                              |
| 16. | M2 Rdson       | 10.53 mOhm  | General  | Drain-Source On-resistance                                                                 |
| 17. | M2 ThetaJA     | 50.0 degC/W | General  | MOSFET junction-to-ambient thermal resistance                                              |
| 18. | M2 Vds Act     | 14.224 mV   | General  | M Vds                                                                                      |
| 19. | Pout           | 57.6 W      | General  | Total output power                                                                         |
| 20. | Total BOM      | \$0.0       | General  | Total BOM Cost                                                                             |
| 21. | M3 TjOp        | 53.576 degC | Op_Point | M3 MOSFET junction temperature                                                             |
| 22. | Vout Actual    | 48.0 V      | Op_Point | Vout Actual calculated based on selected voltage divider resistors                         |
| 23. | Vout OP        | 48.0 V      | Op_Point | Operational Output Voltage                                                                 |
| 24. | Duty Cycle     | 79.25 %     | Op_point | Duty cycle                                                                                 |
| 25. | Efficiency     | 94.657 %    | Op_point | Steady state efficiency                                                                    |
| 26. | IC Tj          | 45.922 degC | Op_point | IC junction temperature                                                                    |
| 27. | ICThetaJA      | 40.0 degC/W | Op_point | IC junction-to-ambient thermal resistance                                                  |
| 28. | IOUT_OP        | 1.2 A       | Op_point | Iout operating point                                                                       |
| 29. | M1 TjOP        | 83.092 degC | Op_point | M1 MOSFET junction temperature                                                             |
| 30. | M2 TjOP        | 44.78 degC  | Op_point | MOSFET junction temperature                                                                |
| 31. | VIN_OP         | 10.0 V      | Op_point | Vin operating point                                                                        |
| 32. | Vout p-p       | 77.357 mV   | Op_point | Peak-to-peak output ripple voltage                                                         |
| 33. | Cin Pd         | 76.995 mW   | Power    | Input capacitor power dissipation                                                          |
| 34. | Cout Pd        | 21.672 mW   | Power    | Output capacitor power dissipation                                                         |
| 35. | Coutx Pd       | 0.0 W       | Power    | Output capacitor_x power loss                                                              |
| 36. | IC Pd          | 398.056 mW  | Power    | IC power dissipation                                                                       |
| 37. | L Pd           | 97.808 mW   | Power    | Inductor power dissipation                                                                 |
| 38. | M1 Pd          | 1.062 W     | Power    | MOSFET power dissipation                                                                   |
| 39. | M1 Pd          | 1.062 W     | Power    | MOSFET power dissipation                                                                   |
| 40. | M1 PdCond      | 146.59 mW   | Power    | M1 MOSFET conduction losses                                                                |
| 41. | M1 PdSw        | 915.251 mW  | Power    | M1 MOSFET switching losses                                                                 |
| 42. | M2 Pd          | 295.607 mW  | Power    | MOSFET power dissipation                                                                   |
| 43. | M2 PdCond      | 20.174 mW   | Power    | M2 MOSFET conduction losses                                                                |
| 44. | M2 PdQrr       | 41.248 mW   | Power    | Synchronous Boost High Side Reverse Recovery                                               |
| 45. | M2 Pdbody      | 234.185 mW  | Power    | Power dissipation through lower FET                                                        |
| 46. | M3 Pd          | 471.514 mW  | Power    | M3 MOSFET total power dissipation                                                          |
| 47. | M3 Rdson       | 12.188 mOhm | Power    | Drain-Source On-resistance                                                                 |
| 48. | Total Pd       | 3.251 W     | Power    | Total Power Dissipation                                                                    |
| 49. | M1 Vds Act     | 28.415 mV   |          | M Vds                                                                                      |
| 50. | M3 ThetaJA     | 50.0 degC/W |          | MOSFET junction-to-ambient thermal resistance                                              |
| 51. | Vout Tolerance | 3.499 %     |          | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

## Design Inputs

| #  | Name    | Value  | Description            |
|----|---------|--------|------------------------|
| 1. | Iout    | 1.2    | Maximum Output Current |
| 2. | VinMax  | 14.4   | Maximum input voltage  |
| 3. | VinMin  | 10.0   | Minimum input voltage  |
| 4. | Vout    | 48.0   | Output Voltage         |
| 5. | base_pn | LM5121 | Base Product Number    |
| 6. | source  | DC     | Input Source Type      |
| 7. | Ta      | 30.0   | Ambient temperature    |

## Design Assistance

1. The LM5121 is a wide range boost controller which is operable in an ultra wide input range of 4.5 to 65V. A boost regulator can maintain regulation for input voltages lower than the output voltage.

2. **LM5121 Product Folder** : <http://www.ti.com/product/LM5121> : contains the data sheet and other resources.

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**You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.**

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