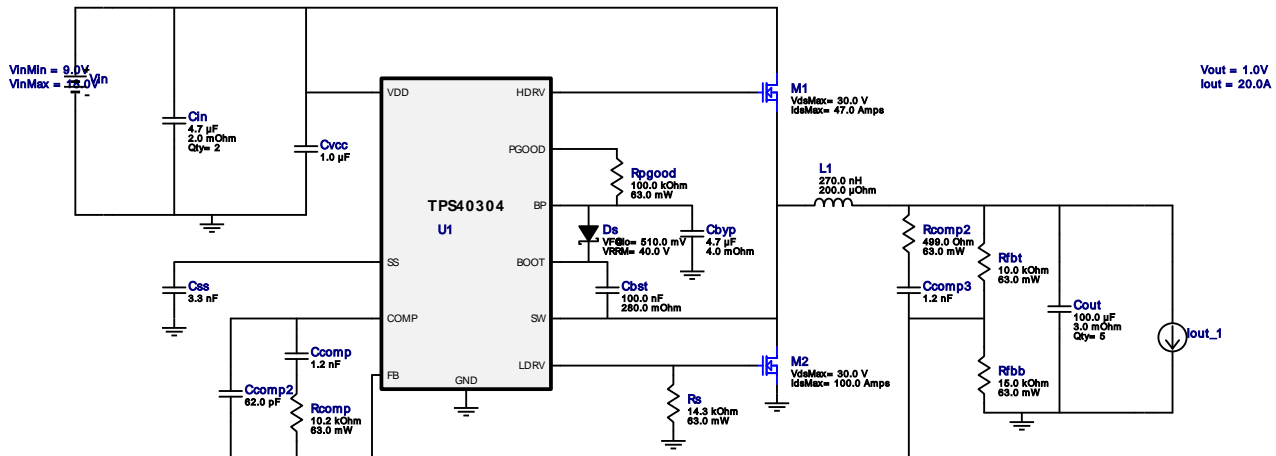










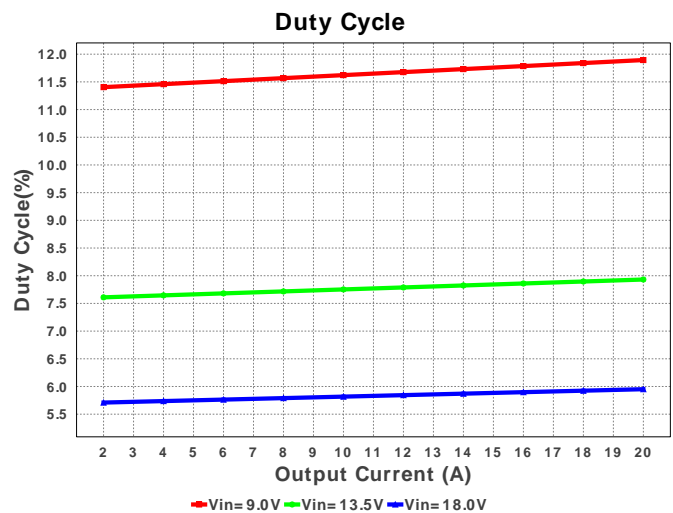
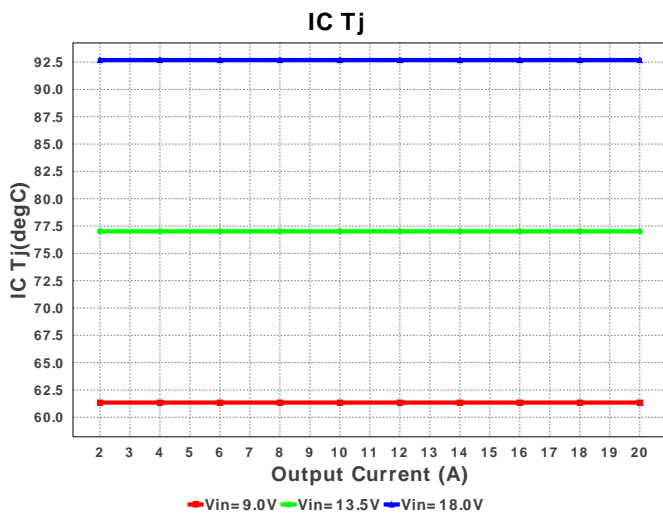
## WEBENCH<sup>®</sup> Design Report

Design : 4058737/11 TPS40304DRCR  
TPS40304DRCR 9.0V-18.0V to 1.00V @ 20.0A


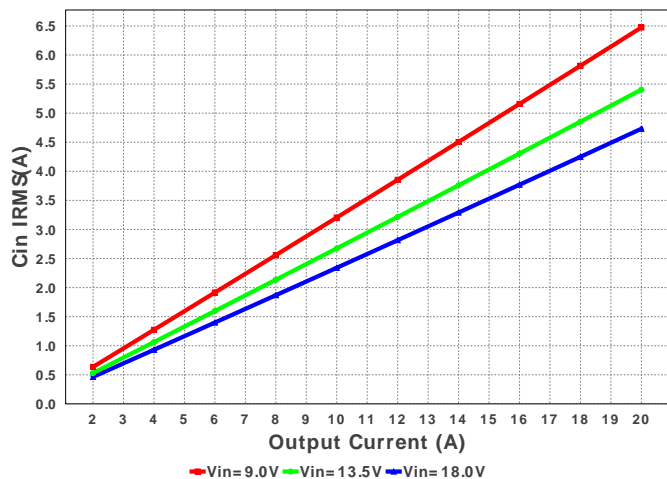
## Electrical BOM

| #   | Name   | Manufacturer     | Part Number                           | Properties   | Qty | Price  | Footprint                  |
|-----|--------|------------------|---------------------------------------|--|-----|--------|----------------------------|
| 1.  | Cbst   | 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 <sup>2</sup>     |
| 2.  | Cbyp   | Kemet            | C0805C475K8PACTU<br>Series= X5R       | Cap= 4.7 uF<br>ESR= 4.0 mOhm<br>VDC= 10.0 V<br>IRMS= 9.89 A    | 1   | \$0.03 | 0805 7 mm <sup>2</sup>     |
| 3.  | Ccomp  | MuRata           | GRM155R71H122KA01D<br>Series= X7R     | Cap= 1.2 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | 0402 3 mm <sup>2</sup>     |
| 4.  | Ccomp2 | MuRata           | GRM1885C2A620JA01D<br>Series= C0G/NP0 | Cap= 62.0 pF<br>VDC= 100.0 V<br>IRMS= 0.0 A                    | 1   | \$0.01 | 0603 5 mm <sup>2</sup>     |
| 5.  | Ccomp3 | MuRata           | GRM155R71H122KA01D<br>Series= X7R     | Cap= 1.2 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | 0402 3 mm <sup>2</sup>     |
| 6.  | Cin    | MuRata           | GRM21BR61E475MA12L<br>Series= X5R     | Cap= 4.7 uF<br>ESR= 2.0 mOhm<br>VDC= 25.0 V<br>IRMS= 7.29 A    | 2   | \$0.06 | 0805 7 mm <sup>2</sup>     |
| 7.  | Cout   | MuRata           | GRM31CR60J107ME39L<br>Series= X5R     | Cap= 100.0 uF<br>ESR= 3.0 mOhm<br>VDC= 6.3 V<br>IRMS= 0.0 A    | 5   | \$0.20 | 1206 11 mm <sup>2</sup>    |
| 8.  | Css    | MuRata           | GRM033R71C332KA88D<br>Series= X7R     | Cap= 3.3 nF<br>VDC= 16.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | 0201 2 mm <sup>2</sup>     |
| 9.  | Cvcc   | MuRata           | GRM188R61E105KA12D<br>Series= X5R     | Cap= 1.0 uF<br>VDC= 25.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | 0603 5 mm <sup>2</sup>     |
| 10. | Ds     | ON Semiconductor | MBR0540T1G                            | VF@Io= 510.0 mV<br>VRRM= 40.0 V                                | 1   | \$0.06 | SOD-123 13 mm <sup>2</sup> |

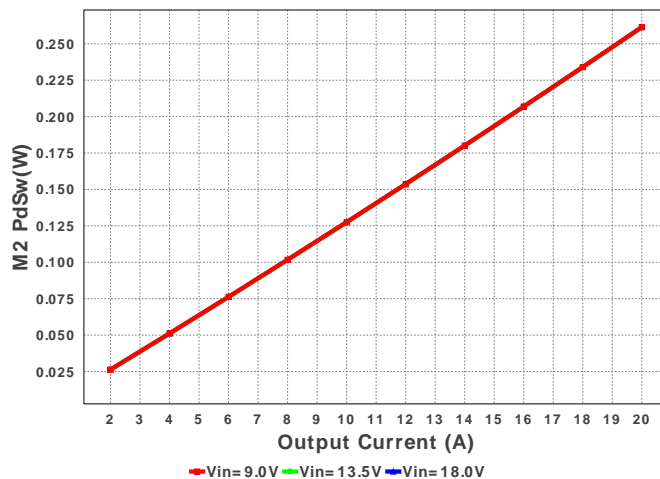
| #          | Name | Manufacturer          | Part Number                          | Properties   | Qty | Price  | Footprint   |
|------------|------|-----------------------|--------------------------------------|--|-----|--------|---|
| 11. L1     |      | Coilcraft             | SLC1175-271MEB                       | L= 270.0 nH<br>DCR= 200.0 $\mu$ Ohm                  | 1   | \$0.48 | <br>SLC1175 125 mm <sup>2</sup>        |
| 12. M1     |      | Texas Instruments     | CSD17308Q3                           | VdsMax= 30.0 V<br>IdsMax= 47.0 Amps                  | 1   | \$0.34 | <br>TRANS_NexFET_Q3 19 mm <sup>2</sup> |
| 13. M2     |      | Infineon Technologies | BSC020N03MS G                        | VdsMax= 30.0 V<br>IdsMax= 100.0 Amps                 | 1   | \$0.55 | <br>PG-TDSON-8 55 mm <sup>2</sup>      |
| 14. Rcomp  |      | Vishay-Dale           | CRCW040210K2FKED<br>Series= CRCW..e3 | Res= 10.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>             |
| 15. Rcomp2 |      | Vishay-Dale           | CRCW0402499RFKED<br>Series= CRCW..e3 | Res= 499.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>             |
| 16. Rfbb   |      | Vishay-Dale           | CRCW040215K0FKED<br>Series= CRCW..e3 | Res= 15.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>             |
| 17. Rfbt   |      | Vishay-Dale           | CRCW040210K0FKED<br>Series= CRCW..e3 | Res= 10.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>             |
| 18. Rpgood |      | 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 <sup>2</sup>             |
| 19. Rs     |      | Vishay-Dale           | CRCW040214K3FKED<br>Series= CRCW..e3 | Res= 14.3 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>            |
| 20. U1     |      | Texas Instruments     | TPS40304DRCR                         | Switcher   | 1   | \$0.95 | <br>S-PVSON-N10 17 mm <sup>2</sup>   |



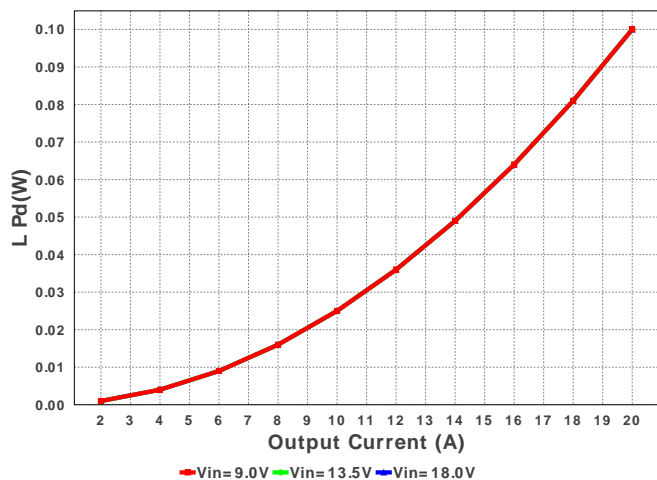
Cin IRMS



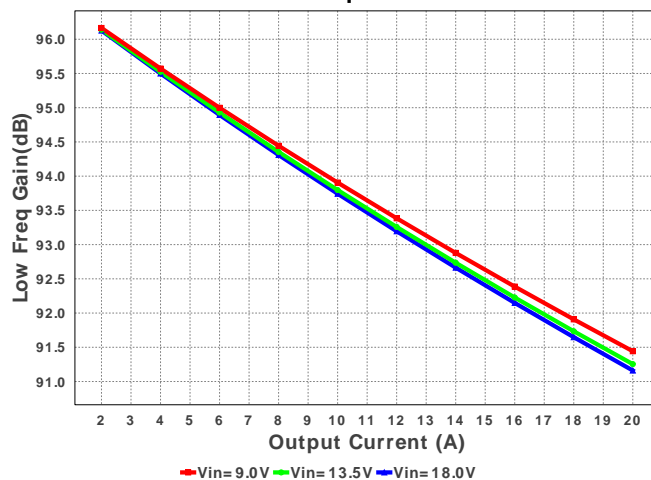
M2 PdSw



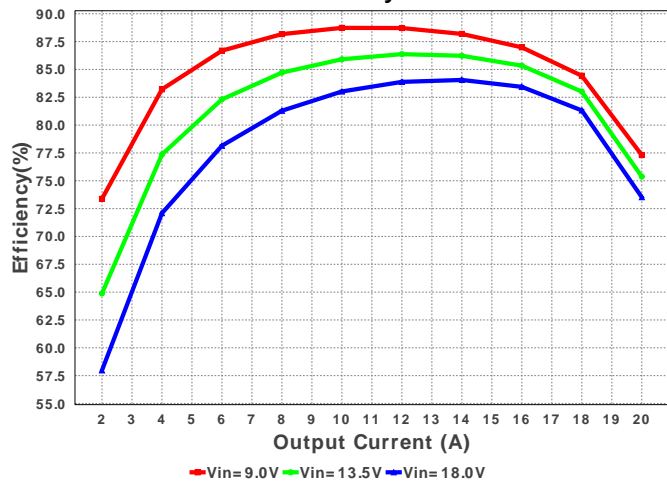
L Pd



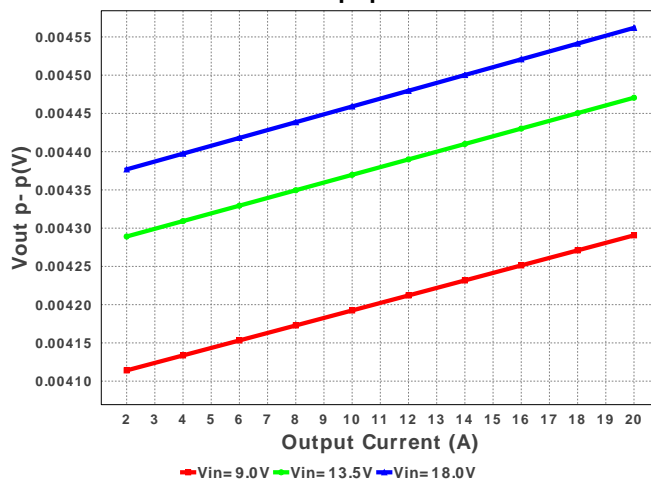
Low Freq Gain



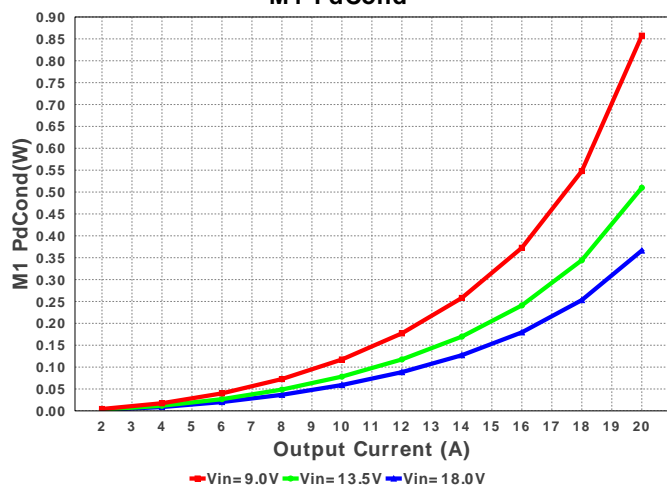
Efficiency



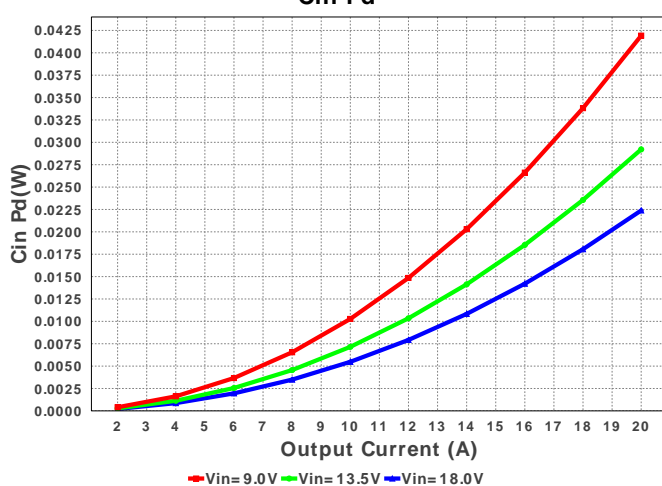
Vout p-p



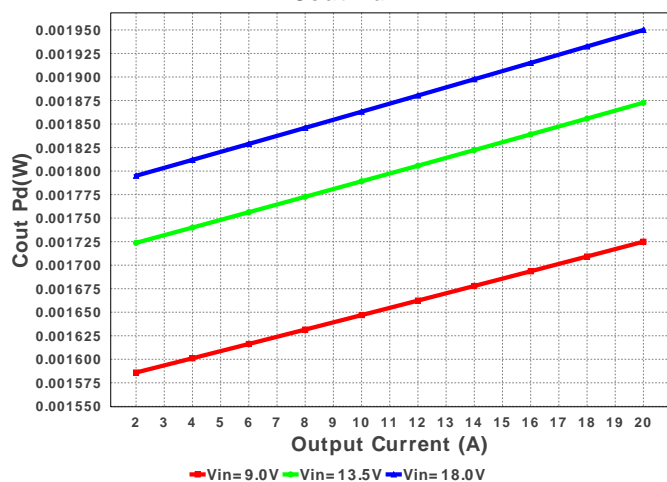
M1 PdCond



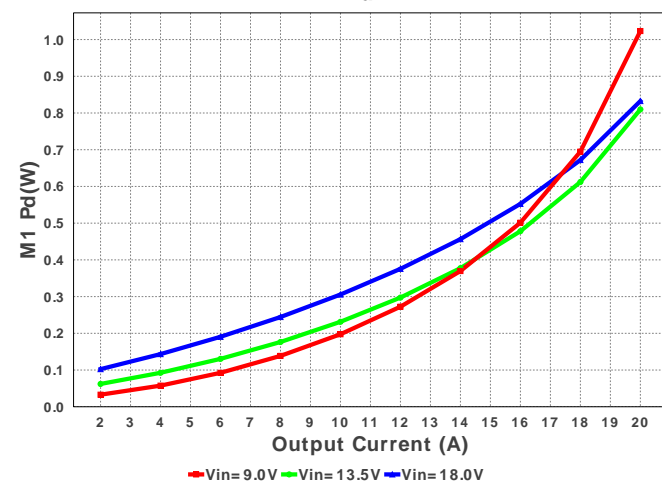
Cin Pd



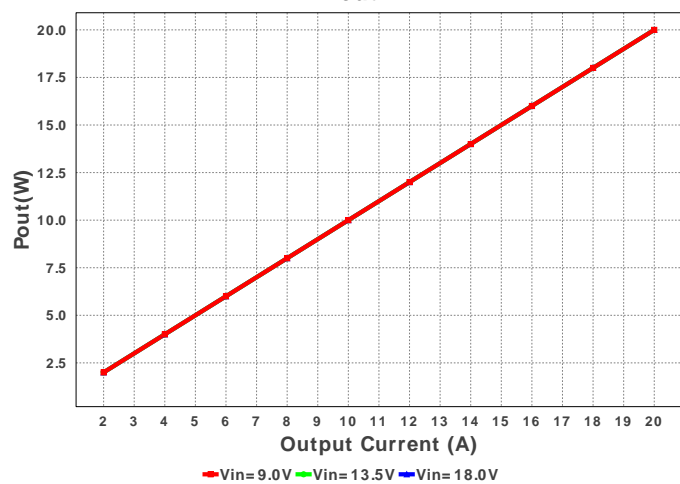
Cout Pd



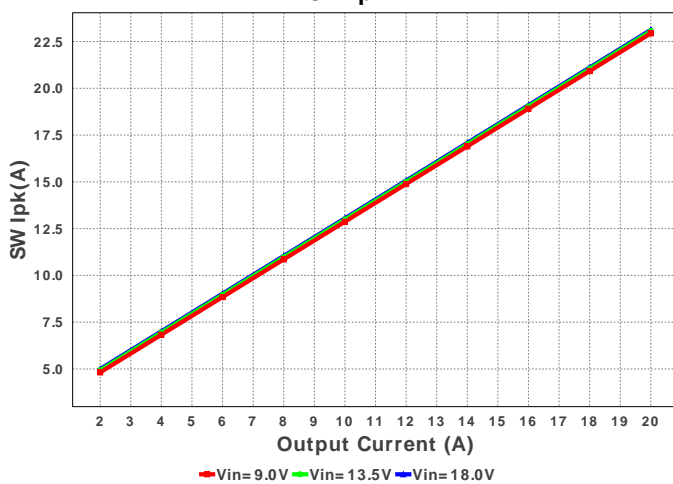
M1 Pd

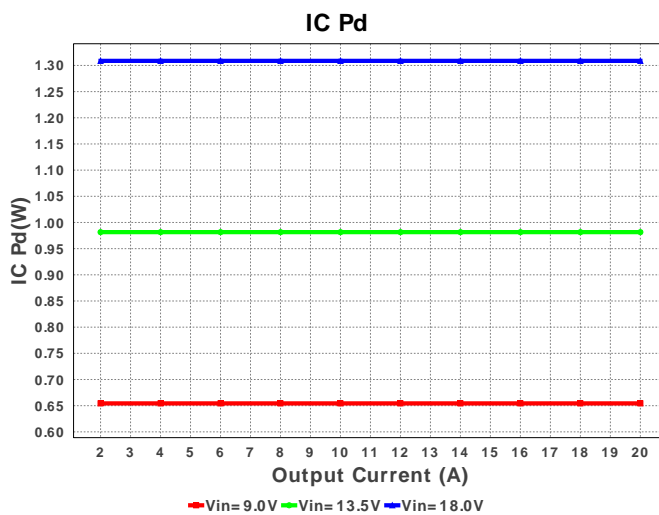
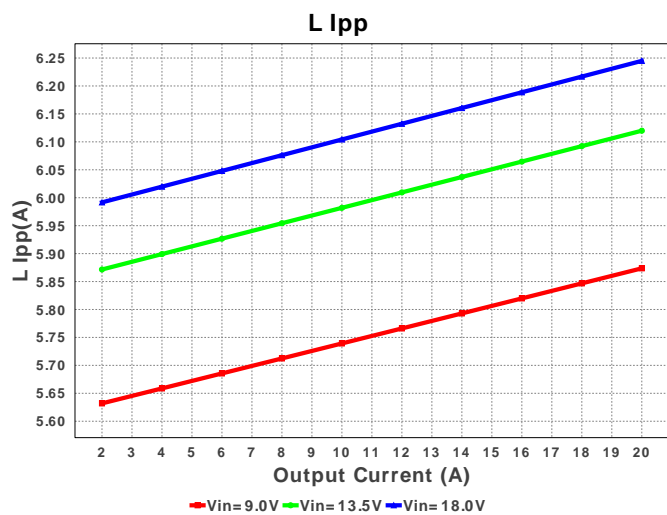
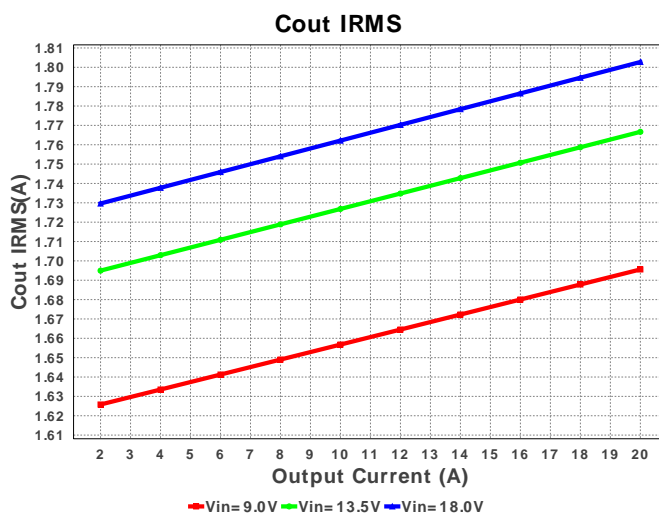
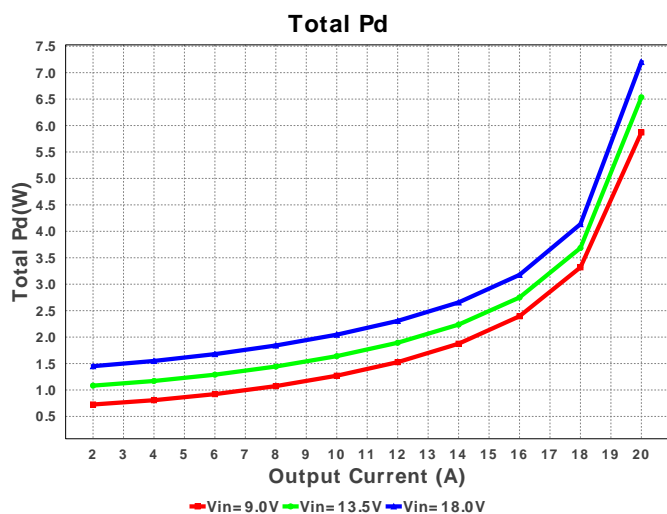
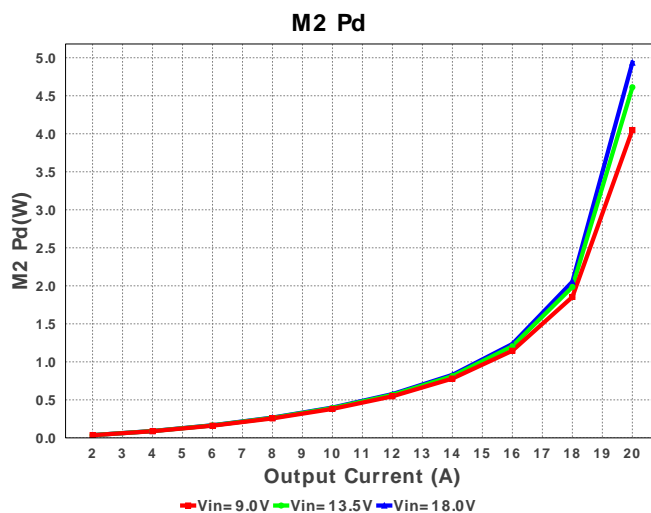
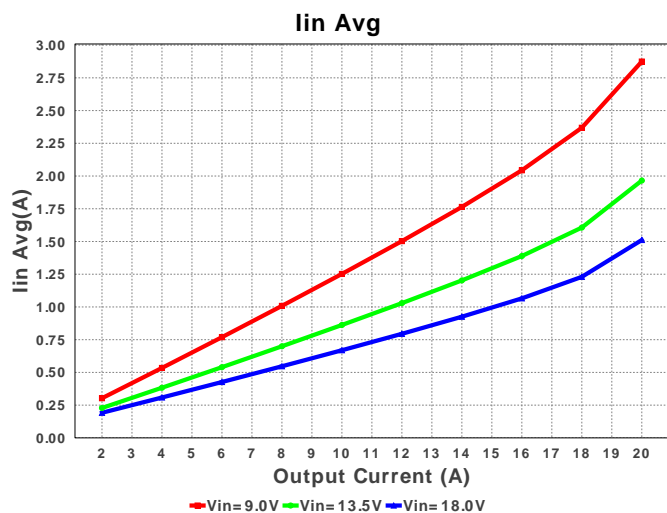


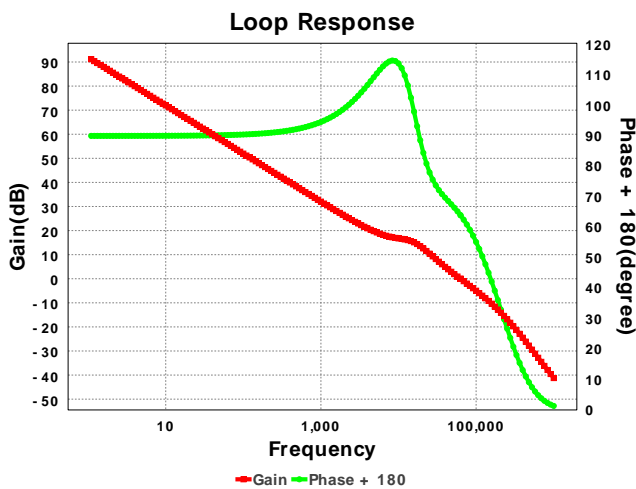
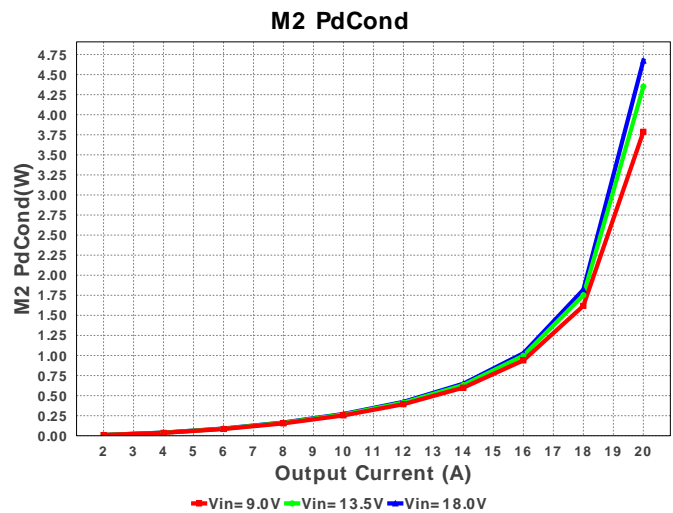
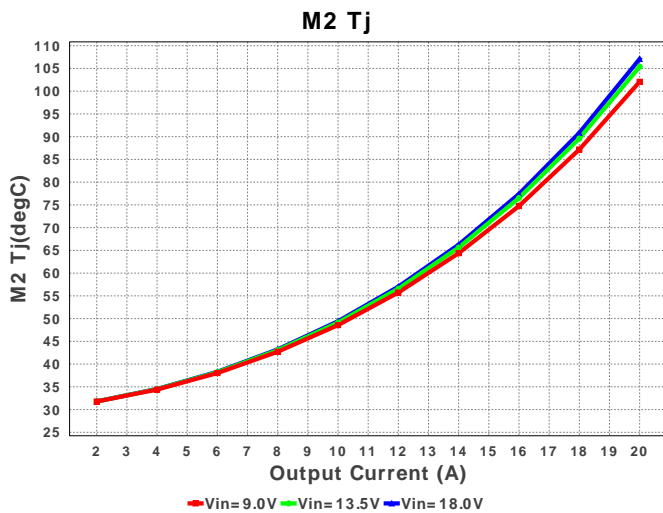
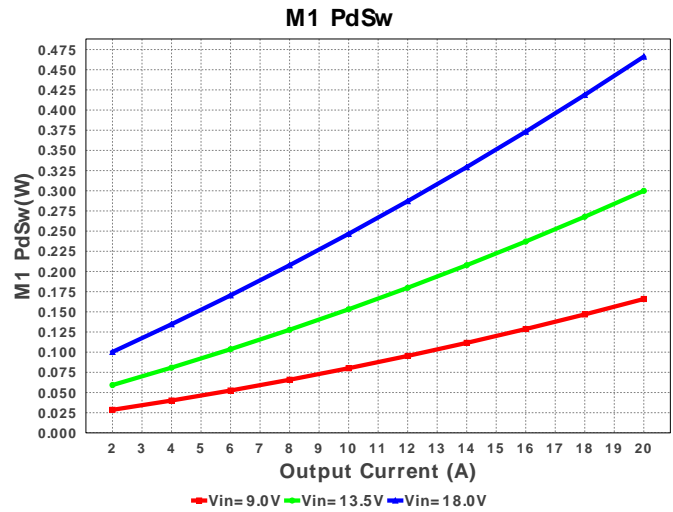
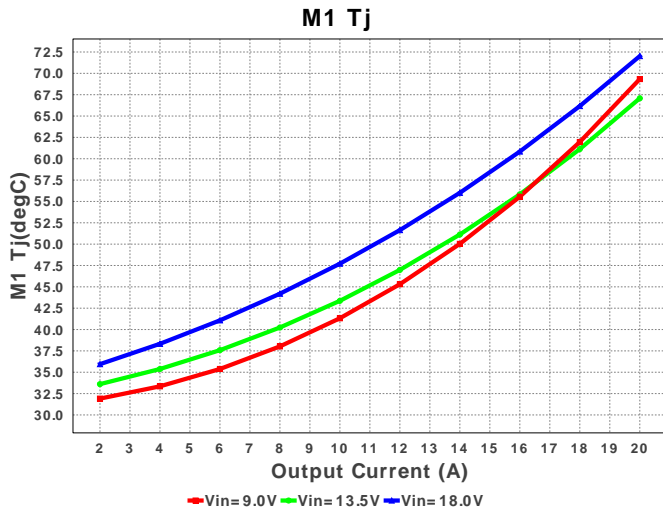
Pout



SW Ipk







## Operating Values

| #   | Name         | Value                 | Category | Description                             |
|-----|--------------|-----------------------|----------|---|
| 1.  | Cin IRMS     | 4.732 A               | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS    | 1.803 A               | Current  | Output capacitor RMS ripple current     |
| 3.  | Iin Avg      | 1.319 A               | Current  | Average input current                   |
| 4.  | L Ipp        | 6.245 A               | Current  | Peak-to-peak inductor ripple current    |
| 5.  | SW Ipk       | 23.122 A              | Current  | Peak switch current                     |
| 6.  | BOM Count    | 25                    | General  | Total Design BOM count                  |
| 7.  | FootPrint    | 347.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |
| 8.  | Frequency    | 600.0 kHz             | General  | Switching frequency                     |
| 9.  | IC Tolerance | 10.0 mV               | General  | IC Feedback Tolerance                   |
| 10. | Pout         | 20.0 W                | General  | Total output power                      |
| 11. | Total BOM    | \$3.65                | General  | Total BOM Cost                          |

| #   | Name          | Value        | Category | Description                        |
|-----|---------------|--------------|----------|------------------------------------|
| 12. | Cross Freq    | 62.82 kHz    | Op_point | Bode plot crossover frequency      |
| 13. | Duty Cycle    | 5.951 %      | Op_point | Duty cycle                         |
| 14. | Efficiency    | 84.254 %     | Op_point | Steady state efficiency            |
| 15. | IC Tj         | 92.689 degC  | Op_point | IC junction temperature            |
| 16. | IOUT_OP       | 20.0 A       | Op_point | Iout operating point               |
| 17. | M1 Tj         | 72.02 degC   | Op_point | M1 MOSFET junction temperature     |
| 18. | M2 Tj         | 107.078 degC | Op_point | M2 MOSFET junction temperature     |
| 19. | Phase Marg    | 63.979 deg   | Op_point | Bode Plot Phase Margin             |
| 20. | VIN_OP        | 18.0 V       | Op_point | Vin operating point                |
| 21. | Vout p-p      | 4.562 mV     | Op_point | Peak-to-peak output ripple voltage |
| 22. | Cin Pd        | 22.388 mW    | Power    | Input capacitor power dissipation  |
| 23. | Cout Pd       | 1.95 mW      | Power    | Output capacitor power dissipation |
| 24. | IC Pd         | 1.309 W      | Power    | IC power dissipation               |
| 25. | L Pd          | 100.0 mW     | Power    | Inductor power dissipation         |
| 26. | M1 Pd         | 738.021 mW   | Power    | M1 MOSFET total power dissipation  |
| 27. | M1 PdCond     | 271.813 mW   | Power    | M1 MOSFET conduction losses        |
| 28. | M1 PdSw       | 466.208 mW   | Power    | M1 MOSFET switching losses         |
| 29. | M2 Pd         | 1.567 W      | Power    | M2 MOSFET total power dissipation  |
| 30. | M2 PdCond     | 1.305 W      | Power    | M2 MOSFET conduction losses        |
| 31. | M2 PdSw       | 261.426 mW   | Power    | M2 MOSFET switching losses         |
| 32. | Total Pd      | 3.738 W      | Power    | Total Power Dissipation            |
| 33. | Low Freq Gain | 91.161 dB    | Unknown  | Gain at 10Hz                       |

## Design Inputs

| #  | Name    | Value     | Description                        |
|----|---------|-----------|------------------------------------|
| 1. | Iout    | 20.0 A    | Maximum Output Current             |
| 2. | Iout1   | 20.0 Amps | Output Current #1                  |
| 3. | VinMax  | 18.0 V    | Maximum input voltage              |
| 4. | VinMin  | 9.0 V     | Minimum input voltage              |
| 5. | Vout    | 1.0 V     | Output Voltage                     |
| 6. | Vout1   | 1.0 Volt  | Output Voltage #1                  |
| 7. | base_pn | TPS40304  | Texas Instruments Base Part Number |
| 8. | source  | DC        | Input Source Type                  |
| 9. | ta      | 30.0 degC | Ambient temperature                |

## Design Assistance

1. TPS40304 Product Folder : <http://www.ti.com/product/tps40304> : contains the data sheet and other resources.

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