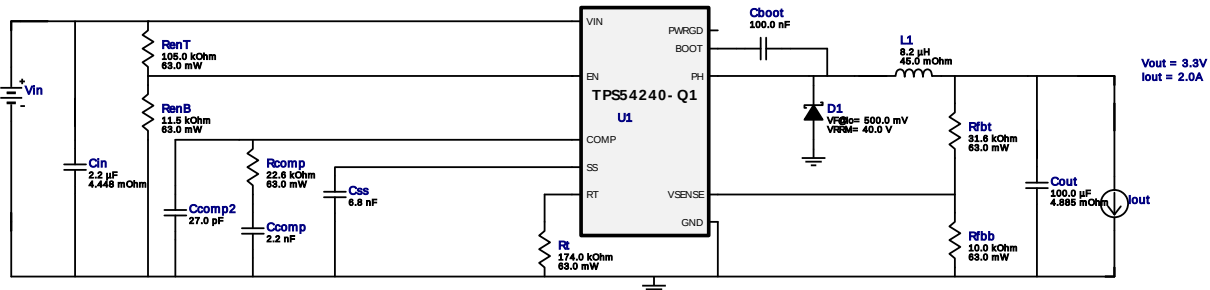


## WEBENCH® Design Report

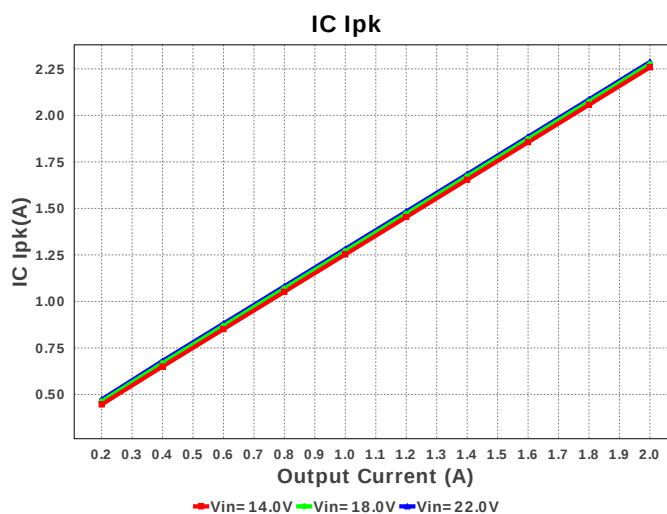
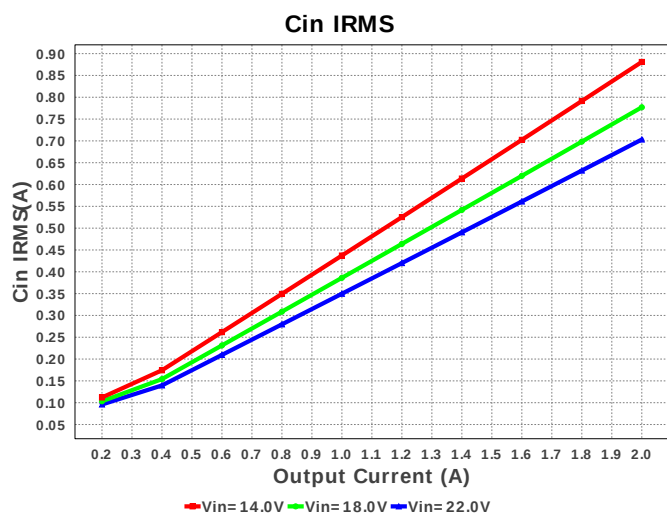
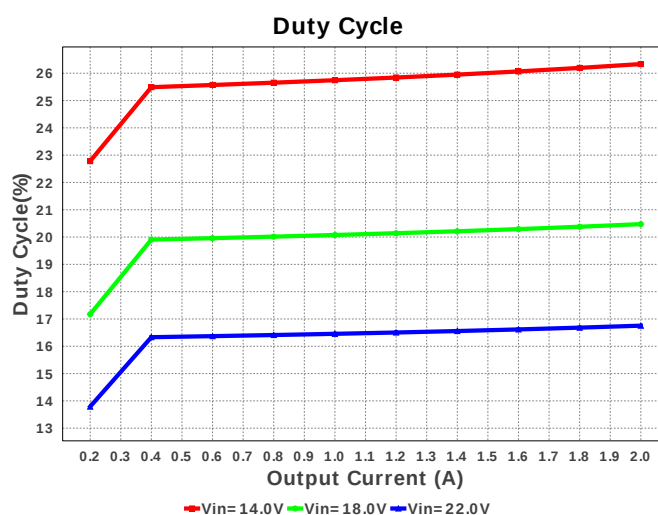
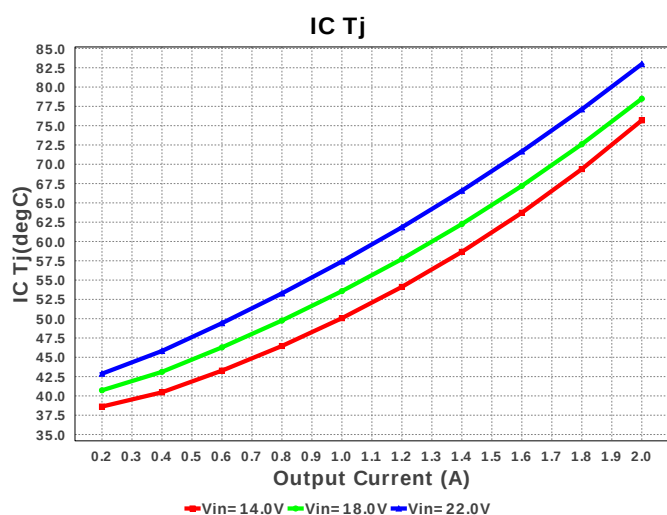
Design : 4737567/79 TPS54240QDGQRQ1  
TPS54240QDGQRQ1 14.0V-22.0V to 3.30V @ 2.0A


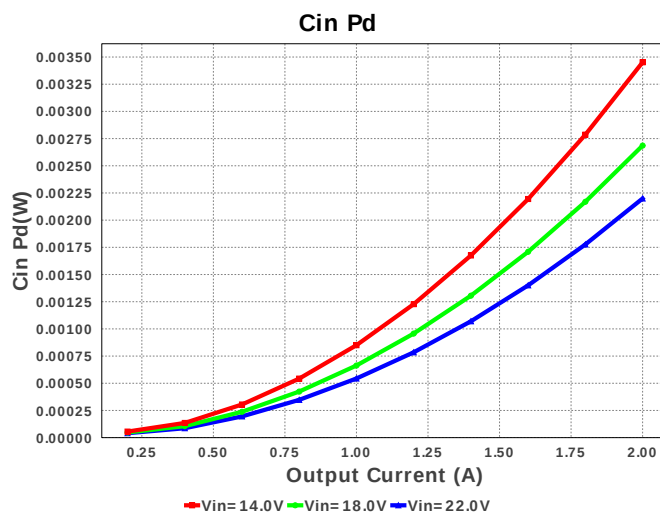
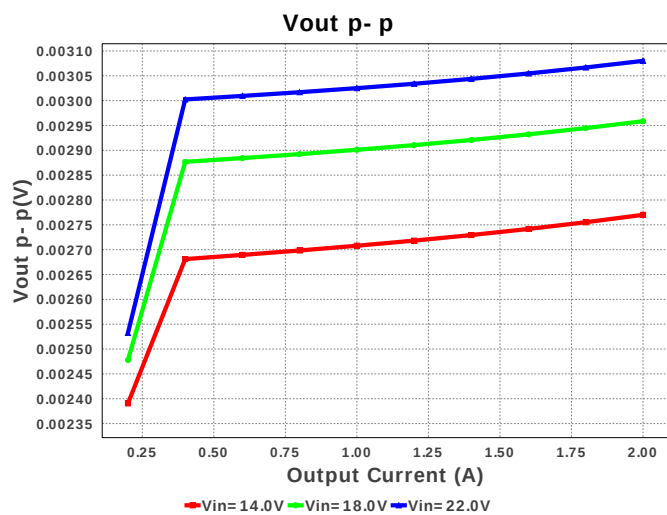
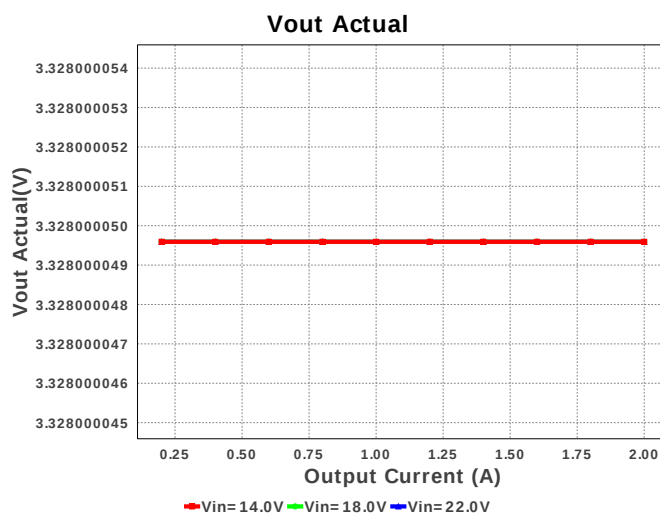
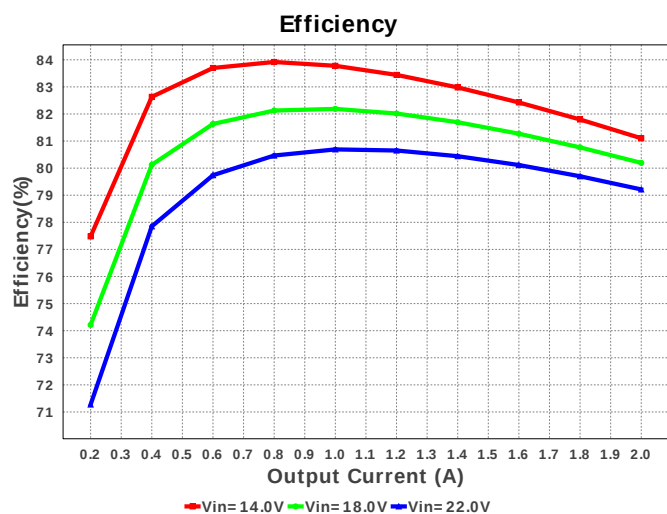
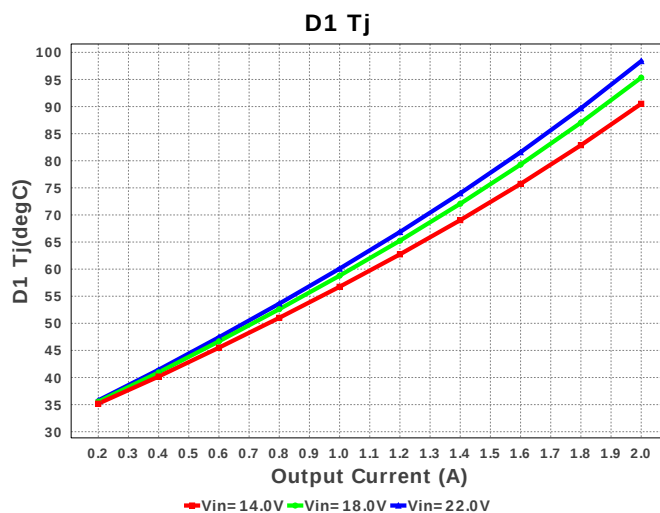
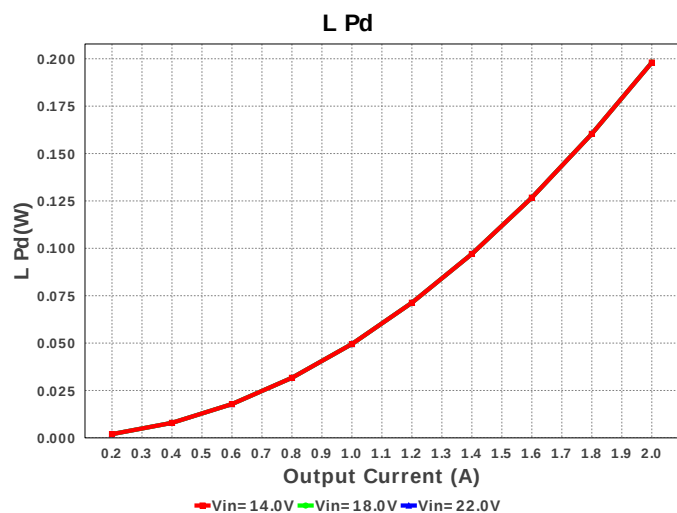
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. View WEBENCH(R) Disclaimer.

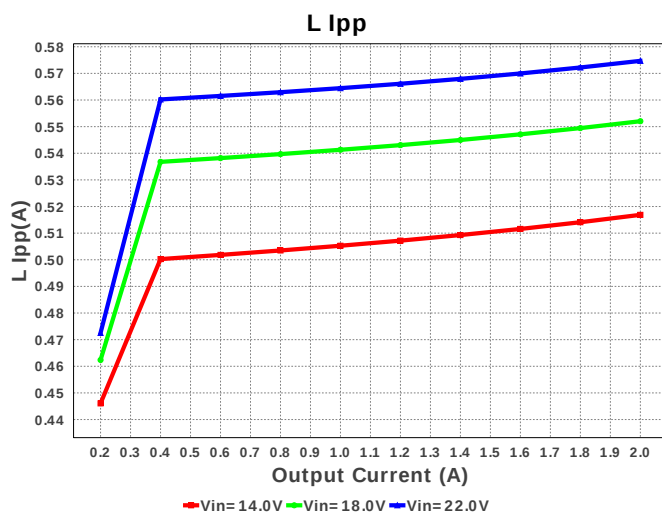
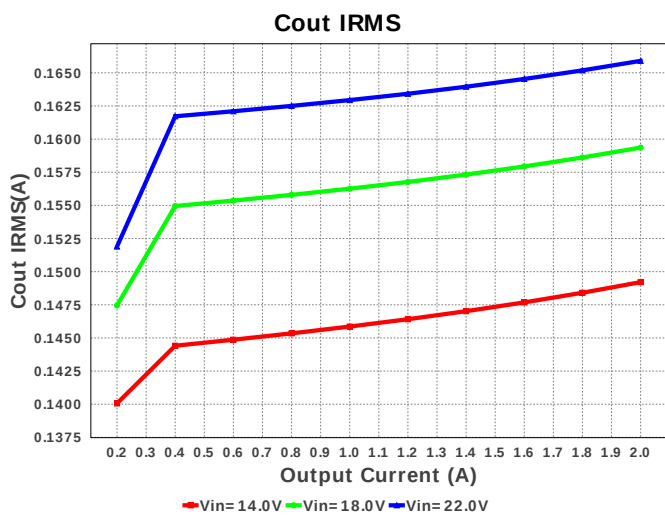
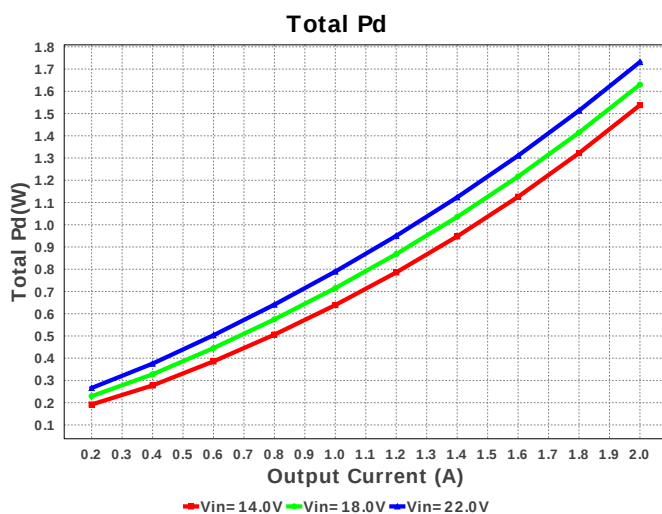
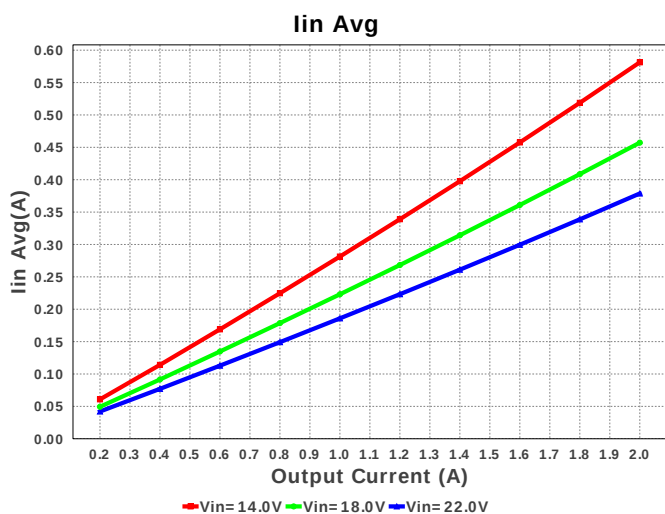
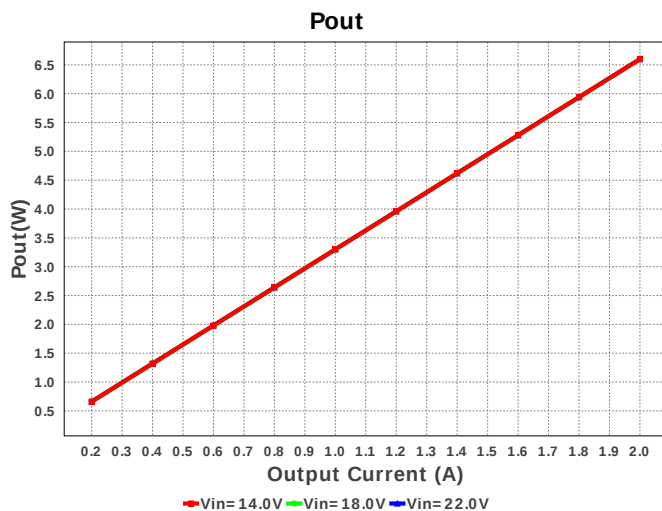
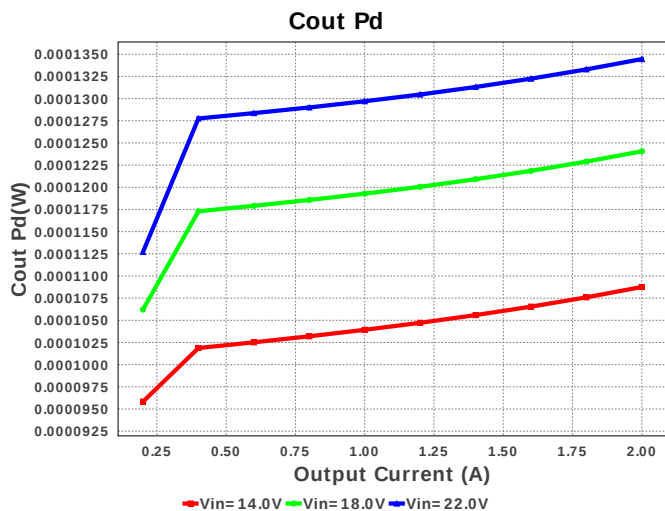
## Electrical BOM

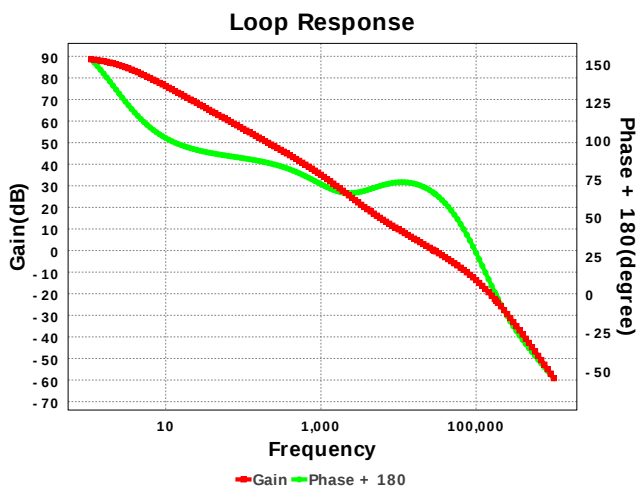
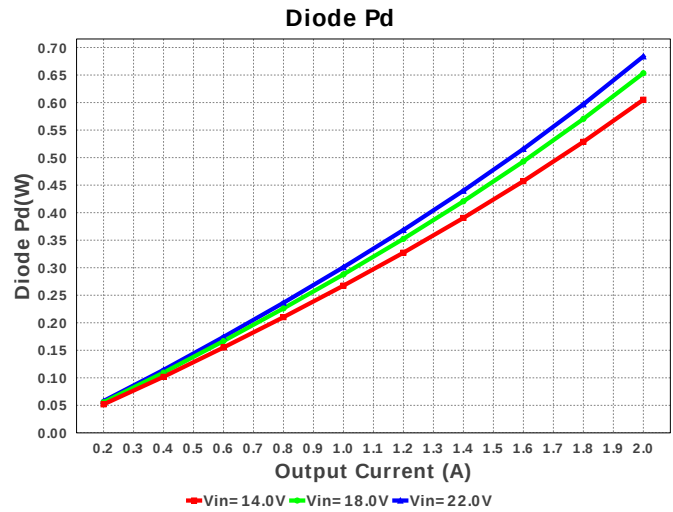
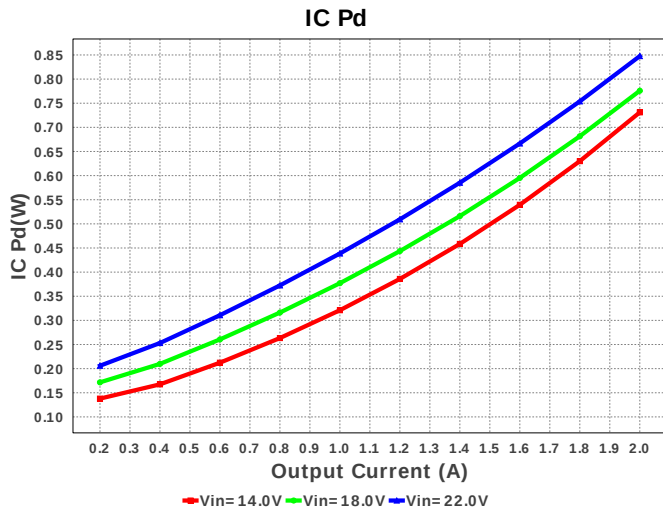
| #   | Name   | Manufacturer  | Part Number                          | Properties                                                       | Qty | Price  | Footprint                                                                                                            |
|-----|--------|---------------|--------------------------------------|------------------------------------------------------------------|-----|--------|----------------------------------------------------------------------------------------------------------------------|
| 1.  | Cboot  | MuRata        | GRM155R61A104KA01D<br>Series= X5R    | Cap= 100.0 nF<br>VDC= 10.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>       |
| 2.  | Ccomp  | Yageo America | CC0805KRX7R9BB222<br>Series= X7R     | Cap= 2.2 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                        | 1   | \$0.01 | <br>0805 7 mm <sup>2</sup>      |
| 3.  | Ccomp2 | Kemet         | C0805C270K5GACTU<br>Series= C0G/NP0  | Cap= 27.0 pF<br>VDC= 50.0 V<br>IRMS= 0.0 A                       | 1   | \$0.01 | <br>0805 7 mm <sup>2</sup>      |
| 4.  | Cin    | MuRata        | GRM31CR71H225KA88L<br>Series= X7R    | Cap= 2.2 uF<br>ESR= 4.448 mOhm<br>VDC= 50.0 V<br>IRMS= 2.2252 A  | 1   | \$0.05 | <br>1206_190 11 mm <sup>2</sup> |
| 5.  | Cout   | MuRata        | GRM31CR60J107ME39L<br>Series= X5R    | Cap= 100.0 uF<br>ESR= 4.885 mOhm<br>VDC= 6.3 V<br>IRMS= 4.4118 A | 1   | \$0.14 | <br>1206_190 11 mm <sup>2</sup> |
| 6.  | Css    | Yageo America | CC0805KRX7R9BB682<br>Series= X7R     | Cap= 6.8 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                        | 1   | \$0.01 | <br>0805 7 mm <sup>2</sup>      |
| 7.  | D1     | Diodes Inc.   | B340A-13-F                           | VF@Io= 500.0 mV<br>VRRM= 40.0 V                                  | 1   | \$0.11 | <br>SMA 37 mm <sup>2</sup>      |
| 8.  | L1     | Bourns        | SRN8040-8R2Y                         | L= 8.2 uH<br>DCR= 45.0 mOhm                                      | 1   | \$0.22 | <br>SRN8040 100 mm <sup>2</sup> |
| 9.  | Rcomp  | Vishay-Dale   | CRCW040222K6FKED<br>Series= CRCW..e3 | Res= 22.6 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>      |
| 10. | RenB   | Vishay-Dale   | CRCW040211K5FKED<br>Series= CRCW..e3 | Res= 11.5 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>      |
| 11. | RenT   | Vishay-Dale   | CRCW0402105KFKED<br>Series= CRCW..e3 | Res= 105.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%             | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>      |

| #   | Name | Manufacturer      | Part Number                          | Properties                                           | Qty | Price  | Footprint                                                                                             |
|-----|------|-------------------|--------------------------------------|------------------------------------------------------|-----|--------|-------------------------------------------------------------------------------------------------------|
| 12. | Rfbb | Vishay-Dale       | CRCW040210K0FKED<br>Series= CRCW..e3 | Res= 10.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 |  0402 3 mm²        |
| 13. | Rfbt | Vishay-Dale       | CRCW040231K6FKED<br>Series= CRCW..e3 | Res= 31.6 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 |  0402 3 mm²        |
| 14. | Rt   | Vishay-Dale       | CRCW0402174KFKED<br>Series= CRCW..e3 | Res= 174.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1   | \$0.01 |  0402 3 mm²        |
| 15. | U1   | Texas Instruments | TPS54240QDGQRQ1                      | Switcher                                             | 1   | \$1.76 |  S-PDSO-G10 24 mm² |









## Operating Values

| #   | Name          | Value                 | Category | Description                                                        |
|-----|---------------|-----------------------|----------|--------------------------------------------------------------------|
| 1.  | Cin IRMS      | 705.323 mA            | Current  | Input capacitor RMS ripple current                                 |
| 2.  | Cout IRMS     | 167.416 mA            | Current  | Output capacitor RMS ripple current                                |
| 3.  | IC Ipk        | 2.0 A                 | Current  | Peak switch current in IC                                          |
| 4.  | Iin Avg       | 381.82 mA             | Current  | Average input current                                              |
| 5.  | L Ipp         | 579.95 mA             | Current  | Peak-to-peak inductor ripple current                               |
| 6.  | BOM Count     | 15                    | General  | Total Design BOM count                                             |
| 7.  | FootPrint     | 224.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components                            |
| 8.  | Frequency     | 664.858 kHz           | General  | Switching frequency                                                |
| 9.  | Pout          | 6.6 W                 | General  | Total output power                                                 |
| 10. | Total BOM     | \$2.38                | General  | Total BOM Cost                                                     |
| 11. | D1 Tj         | 104.993 degC          | Op_Point | D1 junction temperature                                            |
| 12. | Low Freq Gain | 88.544 dB             | Op_Point | Gain at 10Hz                                                       |
| 13. | Vout Actual   | 3.328 V               | Op_Point | Vout Actual calculated based on selected voltage divider resistors |
| 14. | Vout OP       | 3.3 V                 | Op_Point | Operational Output Voltage                                         |
| 15. | Cross Freq    | 28.919 kHz            | Op_point | Bode plot crossover frequency                                      |
| 16. | Duty Cycle    | 16.908 %              | Op_point | Duty cycle                                                         |
| 17. | Efficiency    | 78.572 %              | Op_point | Steady state efficiency                                            |
| 18. | Gain Marg     | -23.145 dB            | Op_point | Bode Plot Gain Margin                                              |
| 19. | IC Tj         | 83.107 degC           | Op_point | IC junction temperature                                            |
| 20. | ICThetaJA     | 62.5 degC/W           | Op_point | IC junction-to-ambient thermal resistance                          |
| 21. | IOUT_OP       | 2.0 A                 | Op_point | Iout operating point                                               |
| 22. | Phase Marg    | 65.743 deg            | Op_point | Bode Plot Phase Margin                                             |
| 23. | VIN_OP        | 22.0 V                | Op_point | Vin operating point                                                |
| 24. | Vout p-p      | 3.108 mV              | Op_point | Peak-to-peak output ripple voltage                                 |
| 25. | Cin Pd        | 2.213 mW              | Power    | Input capacitor power dissipation                                  |
| 26. | Cout Pd       | 136.917 $\mu$ W       | Power    | Output capacitor power dissipation                                 |
| 27. | Diode Pd      | 749.929 mW            | Power    | Diode power dissipation                                            |
| 28. | IC Pd         | 849.713 mW            | Power    | IC power dissipation                                               |
| 29. | L Pd          | 198.0 mW              | Power    | Inductor power dissipation                                         |
| 30. | Total Pd      | 1.8 W                 | Power    | Total Power Dissipation                                            |

| #   | Name           | Value  | Category | Description                                                                                |
|-----|----------------|--------|----------|--------------------------------------------------------------------------------------------|
| 31. | Vout Tolerance | 2.55 % |          | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

## Design Inputs

| #  | Name    | Value       | Description                        |
|----|---------|-------------|------------------------------------|
| 1. | Iout    | 2.0         | Maximum Output Current             |
| 2. | VinMax  | 22.0        | Maximum input voltage              |
| 3. | VinMin  | 14.0        | Minimum input voltage              |
| 4. | Vout    | 3.3         | Output Voltage                     |
| 5. | base_pn | TPS54240-Q1 | Texas Instruments Base Part Number |
| 6. | source  | DC          | Input Source Type                  |
| 7. | ta      | 30.0        | Ambient temperature                |

## Design Assistance

1. The TPS54240-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application

2. TPS54240-Q1 Product Folder : <http://www.ti.com/product/TPS54240%2DQ1> : contains the data sheet and other resources.

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