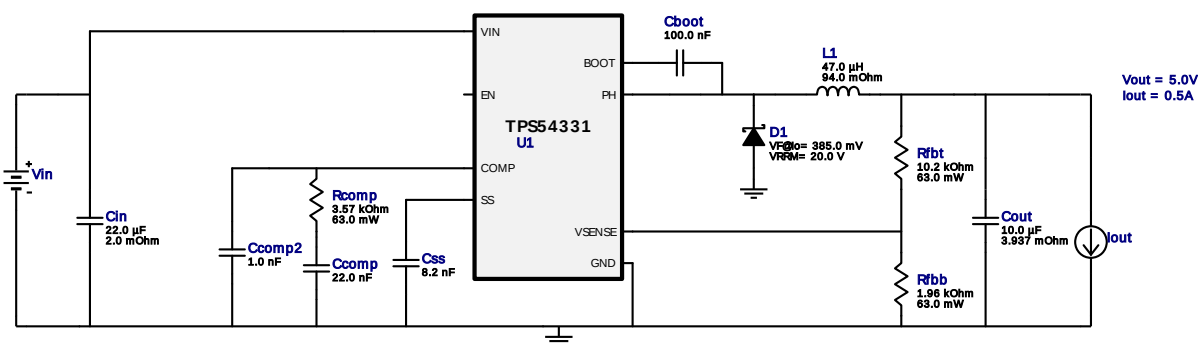


## WEBENCH® Design Report

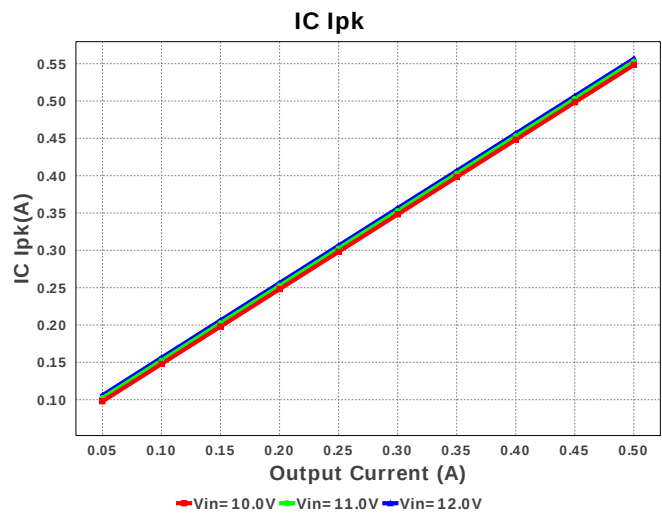
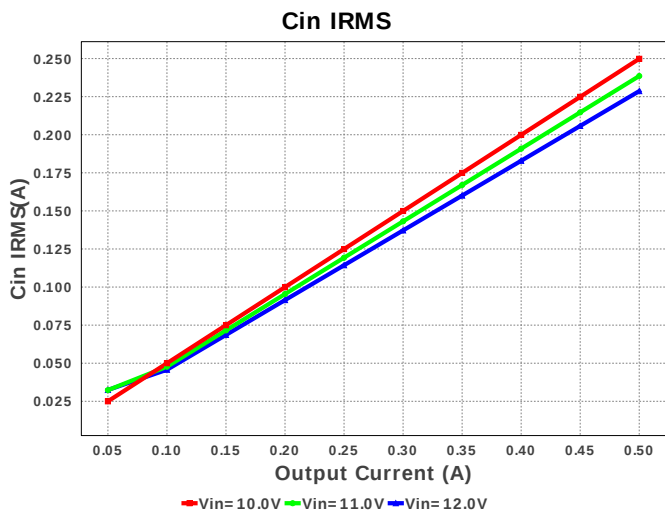
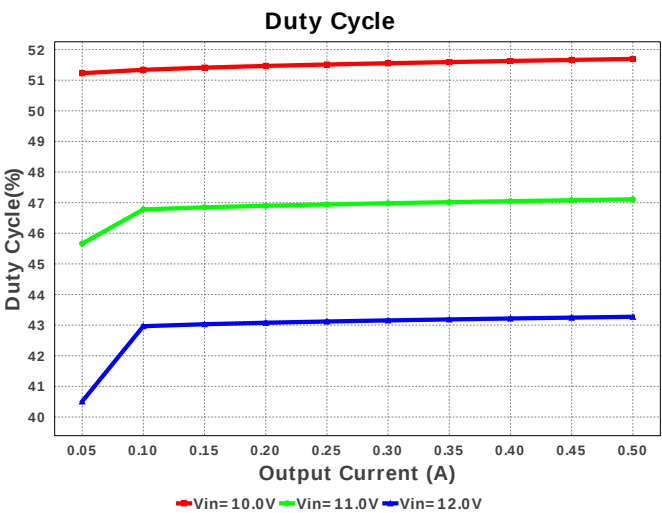
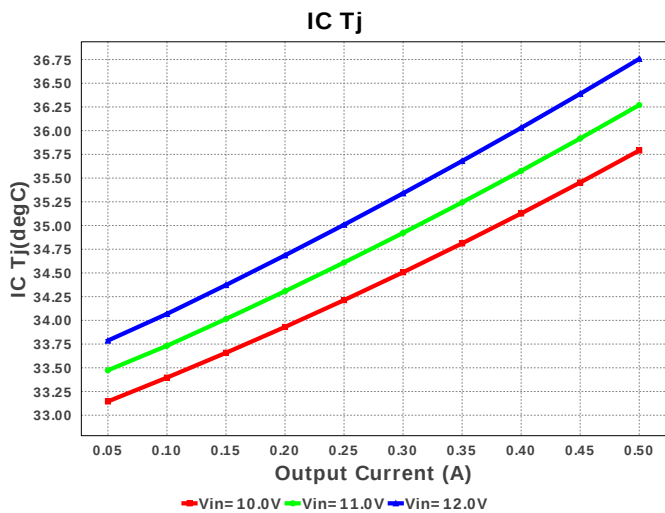
Design : 4742013/230 TPS54331DDAR  
TPS54331DDAR 10.0V-12.0V to 5.00V @ 0.5A

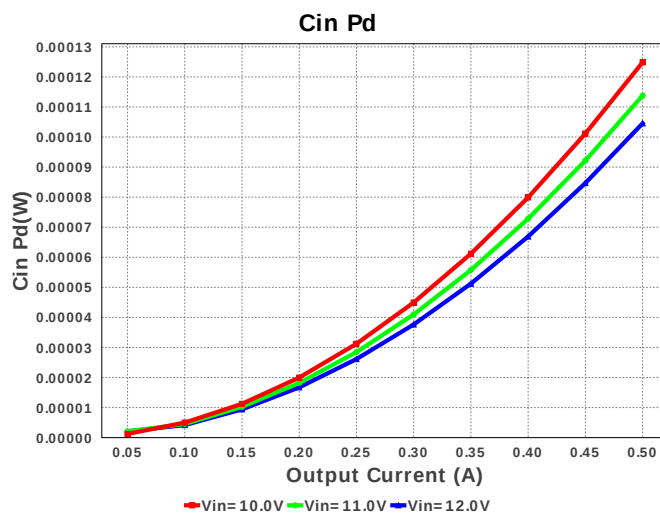
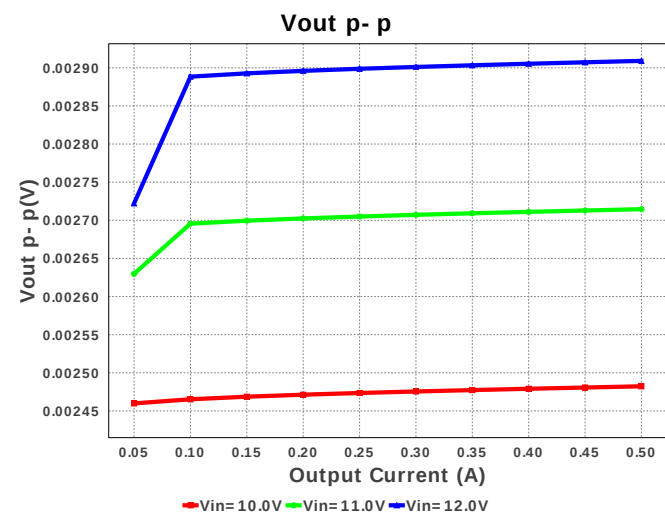
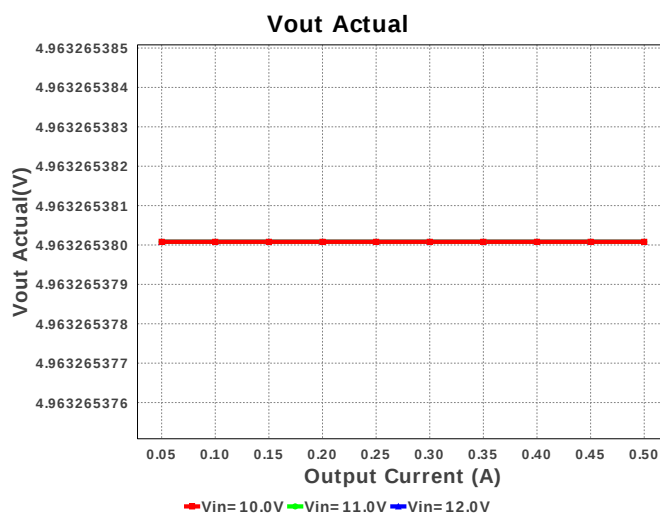
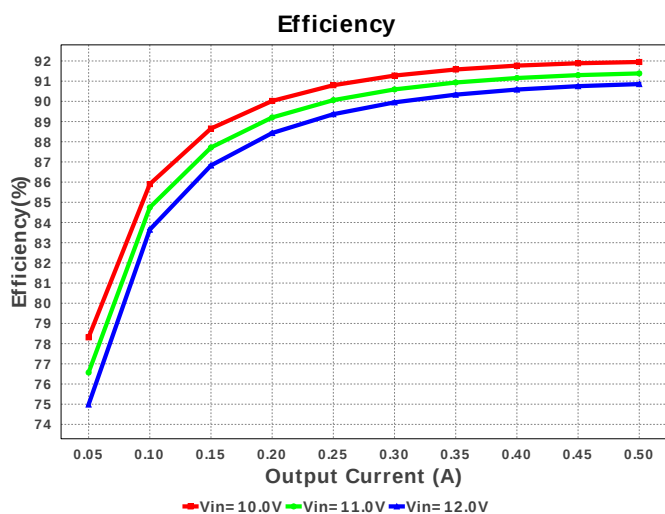
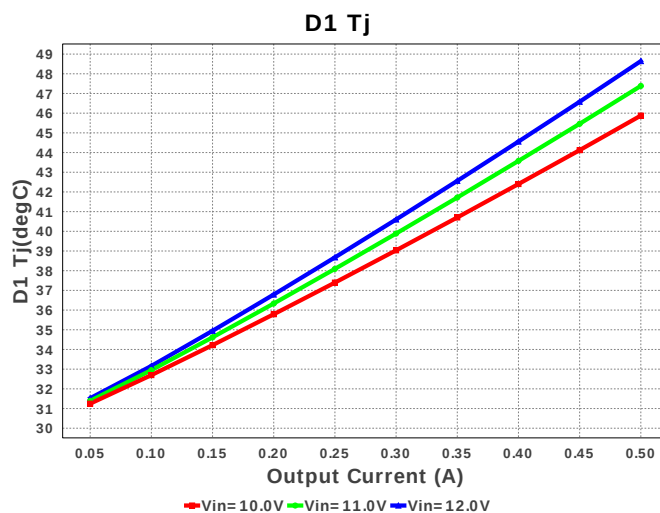
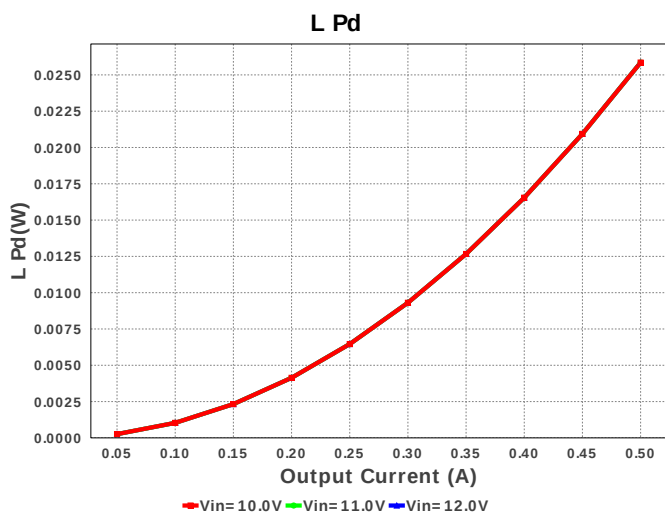


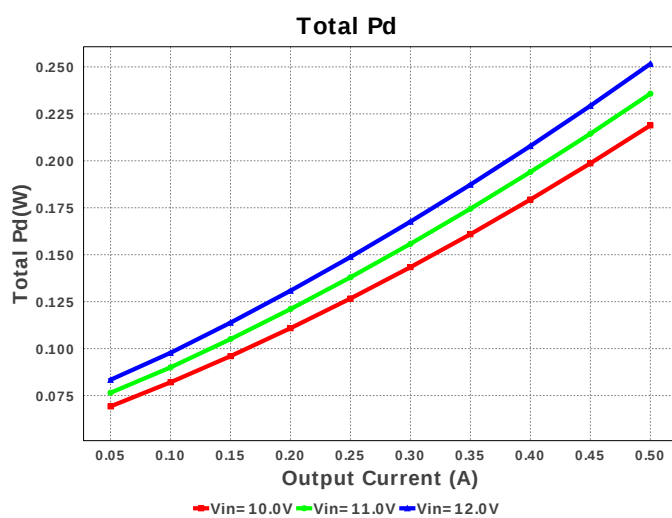
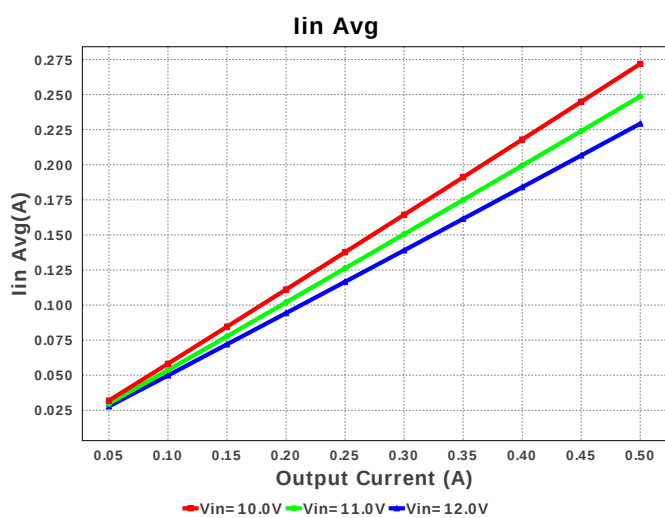
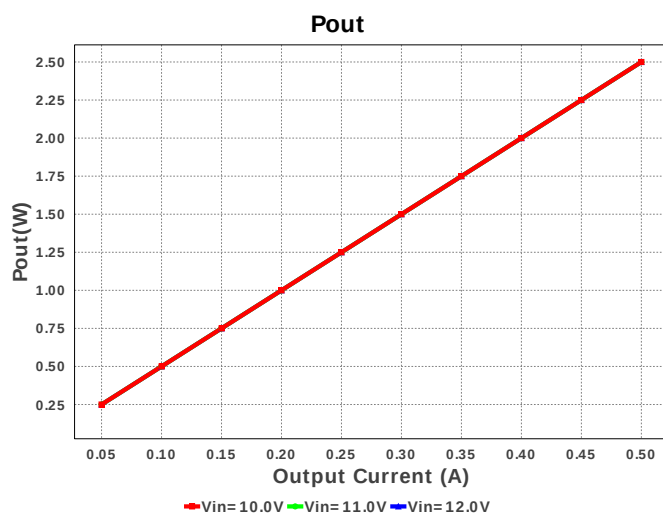
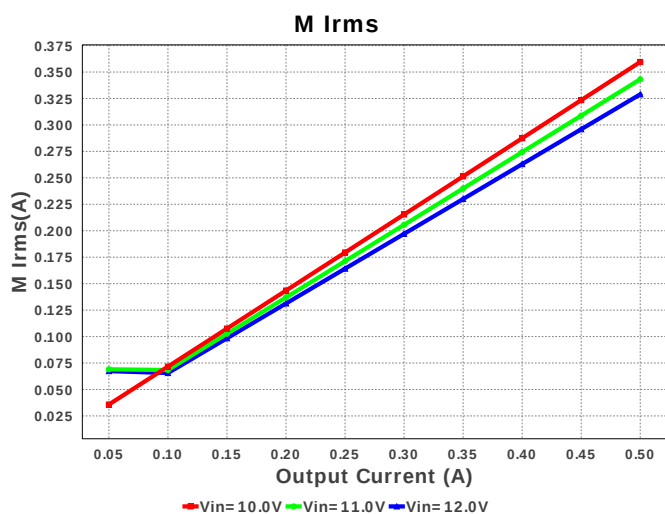
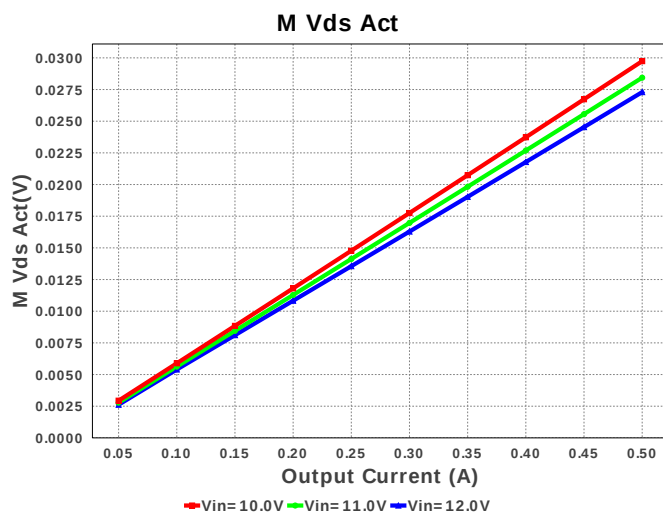
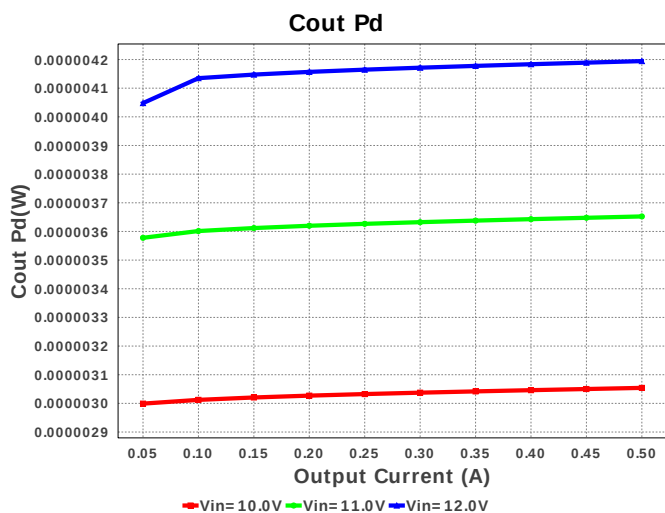
## Electrical BOM

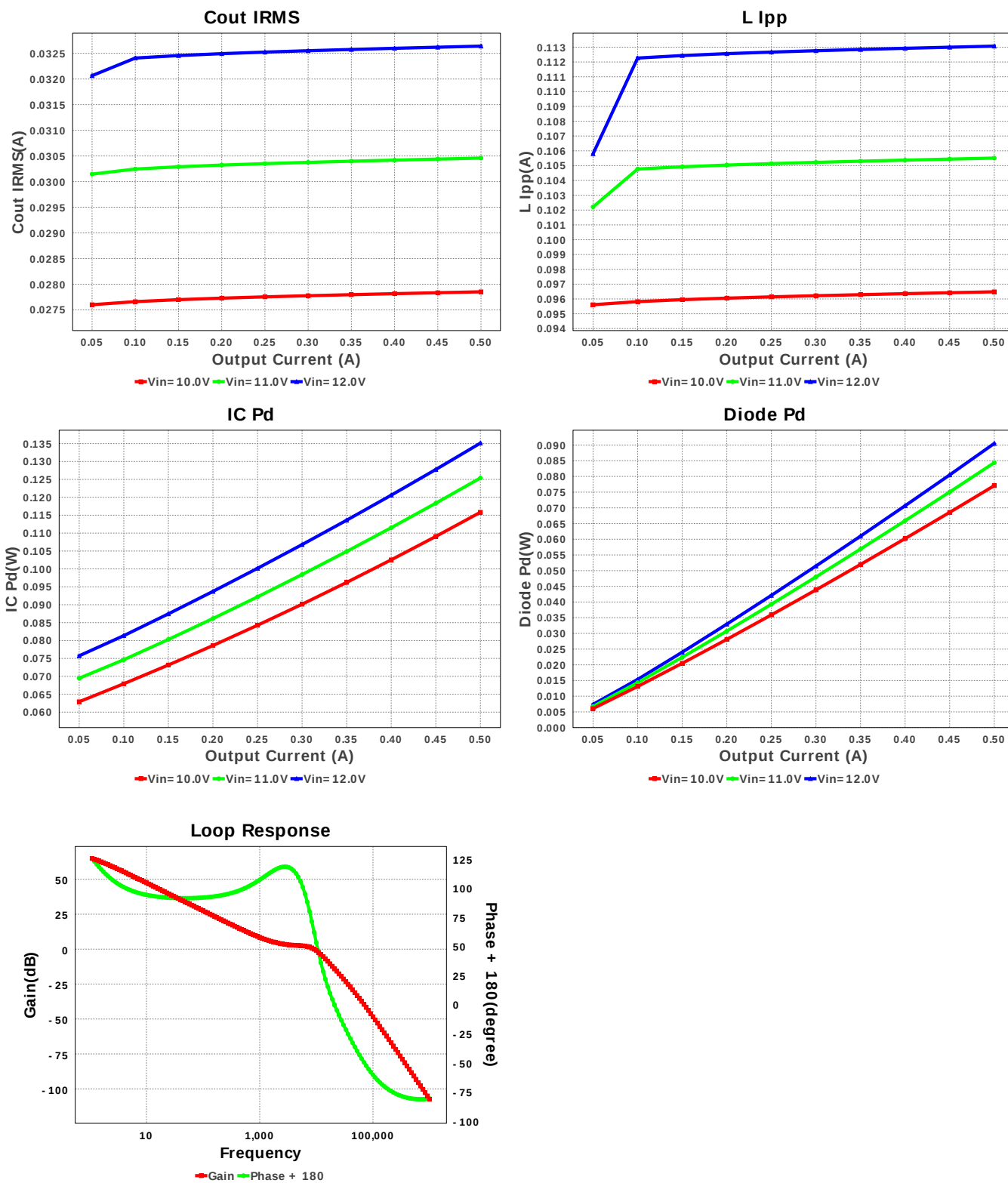
| #   | Name   | Manufacturer              | Part Number                          | Properties                                                       | Qty | Price  | Footprint                   |
|-----|--------|---------------------------|--------------------------------------|------------------------------------------------------------------|-----|--------|-----------------------------|
| 1.  | Cboot  | MuRata                    | GRM155R61A104KA01D<br>Series= X5R    | Cap= 100.0 nF<br>VDC= 10.0 V<br>IRMS= 0.0 A                      | 1   | \$0.01 | 0402 3 mm <sup>2</sup>      |
| 2.  | Ccomp  | Yageo America             | CC0805KRX7R9BB223<br>Series= X7R     | Cap= 22.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                       | 1   | \$0.01 | 0805 7 mm <sup>2</sup>      |
| 3.  | Ccomp2 | Samsung Electro-Mechanics | CL21C102JBCNFNC<br>Series= C0G/NP0   | Cap= 1.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                        | 1   | \$0.01 | 0805 7 mm <sup>2</sup>      |
| 4.  | Cin    | MuRata                    | GRM32ER61E226KE15L<br>Series= X5R    | Cap= 22.0 uF<br>ESR= 2.0 mOhm<br>VDC= 25.0 V<br>IRMS= 3.67 A     | 1   | \$0.16 | 1210 15 mm <sup>2</sup>     |
| 5.  | Cout   | MuRata                    | GRM219R61A106KE44D<br>Series= X5R    | Cap= 10.0 uF<br>ESR= 3.937 mOhm<br>VDC= 10.0 V<br>IRMS= 2.7713 A | 1   | \$0.03 | 0805 7 mm <sup>2</sup>      |
| 6.  | Css    | MuRata                    | GRM033R61A822KA01D<br>Series= X5R    | Cap= 8.2 nF<br>VDC= 10.0 V<br>IRMS= 0.0 A                        | 1   | \$0.01 | 0201 2 mm <sup>2</sup>      |
| 7.  | D1     | ON Semiconductor          | MBR0520LT1G                          | VF@Io= 385.0 mV<br>VRRM= 20.0 V                                  | 1   | \$0.06 | SOD-123 13 mm <sup>2</sup>  |
| 8.  | L1     | Bourns                    | SRU1048-470Y                         | L= 47.0 uH<br>DCR= 94.0 mOhm                                     | 1   | \$0.33 | SRU1048 144 mm <sup>2</sup> |
| 9.  | Rcomp  | Vishay-Dale               | CRCW04023K57FKED<br>Series= CRCW..e3 | Res= 3.57 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | 0402 3 mm <sup>2</sup>      |
| 10. | Rfbb   | Vishay-Dale               | CRCW04021K96FKED<br>Series= CRCW..e3 | Res= 1.96 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | 0402 3 mm <sup>2</sup>      |
| 11. | Rfht   | Vishay-Dale               | CRCW040210K2FKED<br>Series= CRCW..e3 | Res= 10.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | 0402 3 mm <sup>2</sup>      |

| #   | Name | Manufacturer      | Part Number  | Properties | Qty | Price  | Footprint                                                                                                          |
|-----|------|-------------------|--------------|------------|-----|--------|--------------------------------------------------------------------------------------------------------------------|
| 12. | U1   | Texas Instruments | TPS54331DDAR | Switcher   | 1   | \$0.65 | <br>DDA0008H 57 mm <sup>2</sup> |









## Operating Values

| #   | Name      | Value                 | Category | Description                             |
|-----|-----------|-----------------------|----------|-----------------------------------------|
| 1.  | Cin IRMS  | 228.629 mA            | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS | 32.641 mA             | Current  | Output capacitor RMS ripple current     |
| 3.  | IC Ipk    | 556.535 mA            | Current  | Peak switch current in IC               |
| 4.  | Iin Avg   | 229.3 mA              | Current  | Average input current                   |
| 5.  | L Ipp     | 113.07 mA             | Current  | Peak-to-peak inductor ripple current    |
| 6.  | M1 Irms   | 328.913 mA            | Current  | Q lavg                                  |
| 7.  | BOM Count | 12                    | General  | Total Design BOM count                  |
| 8.  | FootPrint | 264.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |
| 9.  | Frequency | 570.0 kHz             | General  | Switching frequency                     |
| 10. | M Vds Act | 27.295 mV             | General  | Voltage drop across the MosFET          |
| 11. | Pout      | 2.5 W                 | General  | Total output power                      |

| #   | Name           | Value       | Category | Description                                                                                |
|-----|----------------|-------------|----------|--------------------------------------------------------------------------------------------|
| 12. | Total BOM      | \$1.3       | General  | Total BOM Cost                                                                             |
| 13. | D1 Tj          | 48.644 degC | Op_Point | D1 junction temperature                                                                    |
| 14. | Low Freq Gain  | 64.847 dB   | Op_Point | Gain at 10Hz                                                                               |
| 15. | Vout Actual    | 4.963 V     | Op_Point | Vout Actual calculated based on selected voltage divider resistors                         |
| 16. | Vout OP        | 5.0 V       | Op_Point | Operational Output Voltage                                                                 |
| 17. | Cross Freq     | 9.154 kHz   | Op_point | Bode plot crossover frequency                                                              |
| 18. | Duty Cycle     | 43.274 %    | Op_point | Duty cycle                                                                                 |
| 19. | Efficiency     | 90.856 %    | Op_point | Steady state efficiency                                                                    |
| 20. | Gain Marg      | -14.098 dB  | Op_point | Bode Plot Gain Margin                                                                      |
| 21. | IC Tj          | 36.756 degC | Op_point | IC junction temperature                                                                    |
| 22. | ICThetaJA      | 50.0 degC/W | Op_point | IC junction-to-ambient thermal resistance                                                  |
| 23. | IOUT_OP        | 500.0 mA    | Op_point | Iout operating point                                                                       |
| 24. | Phase Marg     | 62.331 deg  | Op_point | Bode Plot Phase Margin                                                                     |
| 25. | VIN_OP         | 12.0 V      | Op_point | Vin operating point                                                                        |
| 26. | Vout p-p       | 2.909 mV    | Op_point | Peak-to-peak output ripple voltage                                                         |
| 27. | Cin Pd         | 104.543 μW  | Power    | Input capacitor power dissipation                                                          |
| 28. | Cout Pd        | 4.194 μW    | Power    | Output capacitor power dissipation                                                         |
| 29. | Diode Pd       | 90.506 mW   | Power    | Diode power dissipation                                                                    |
| 30. | IC Pd          | 135.128 mW  | Power    | IC power dissipation                                                                       |
| 31. | L Pd           | 25.85 mW    | Power    | Inductor power dissipation                                                                 |
| 32. | Total Pd       | 251.606 mW  | Power    | Total Power Dissipation                                                                    |
| 33. | Vout Tolerance | 5.254 %     |          | 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  | 12.0     | Maximum input voltage  |
| 3. | VinMin  | 10.0     | Minimum input voltage  |
| 4. | Vout    | 5.0      | Output Voltage         |
| 5. | base_pn | TPS54331 | Base Product Number    |
| 6. | source  | DC       | Input Source Type      |
| 7. | Ta      | 30.0     | Ambient temperature    |

## Design Assistance

1. **TPS54331** Product Folder : <http://www.ti.com/product/TPS54331> : contains the data sheet and other resources.

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