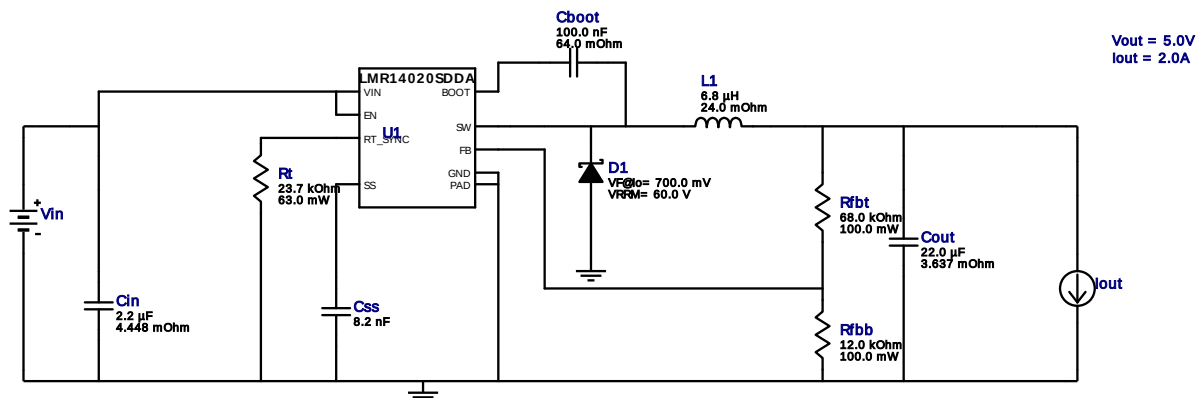


## WEBENCH® Design Report

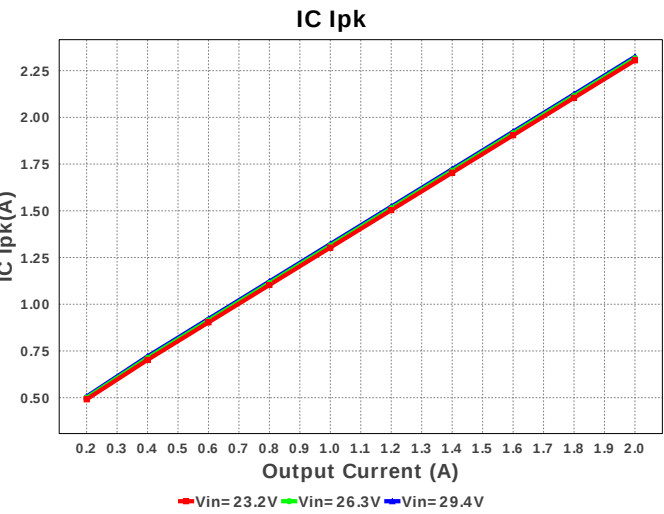
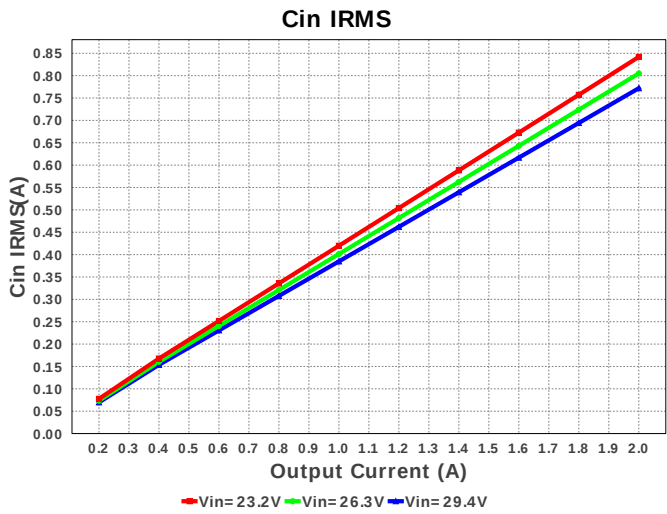
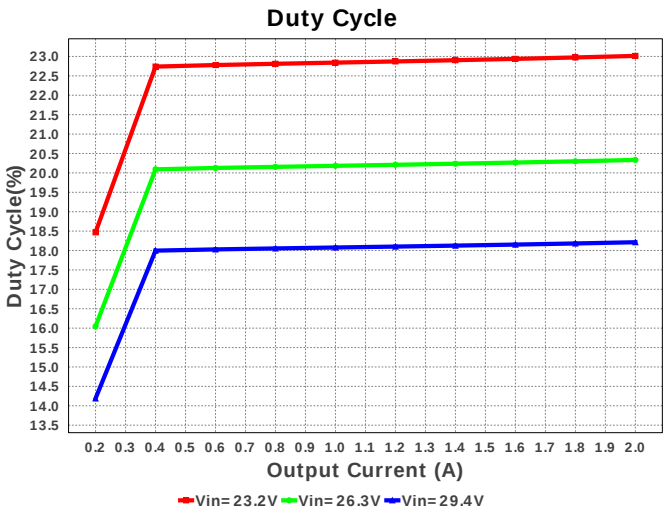
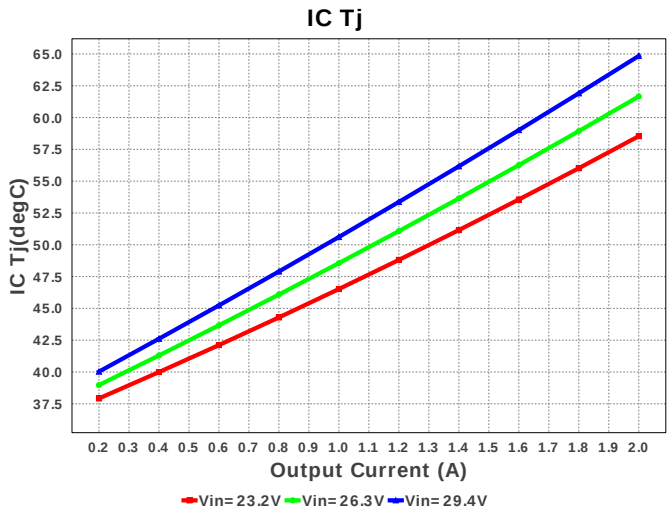
Design : 4738396/3 LMR14020SDDAR  
LMR14020SDDAR 23.2V-29.4V to 5.00V @ 2.0001874999999996A

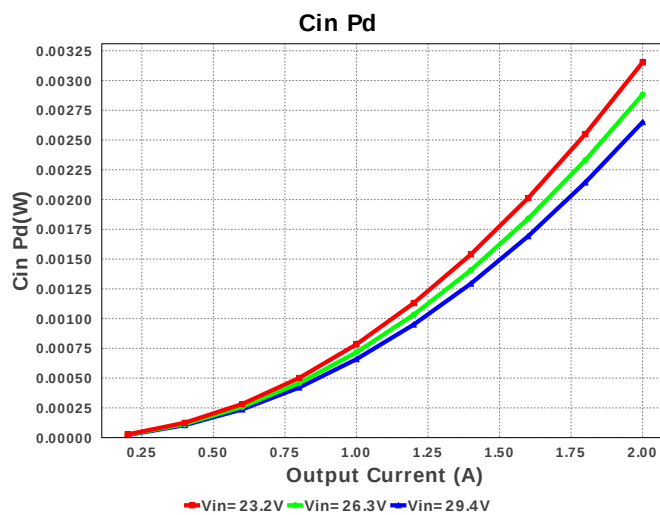
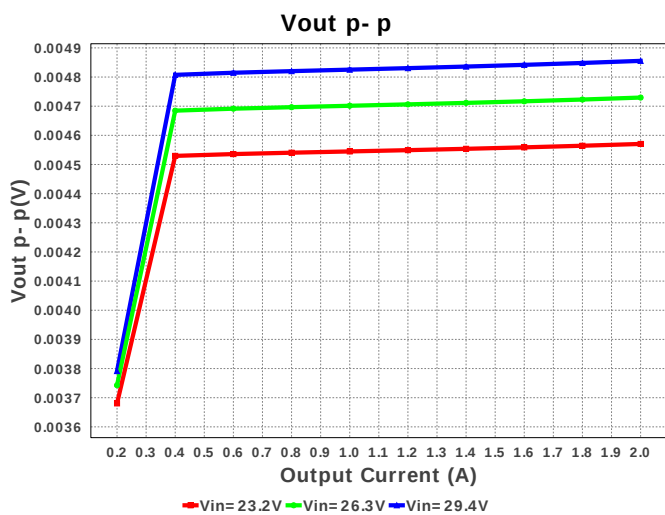
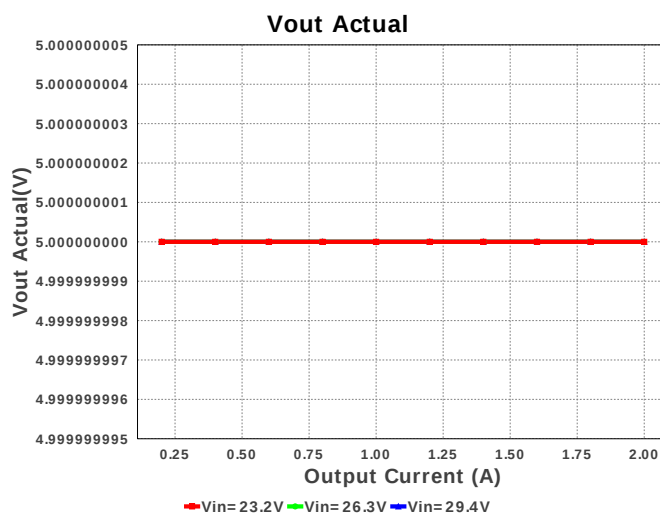
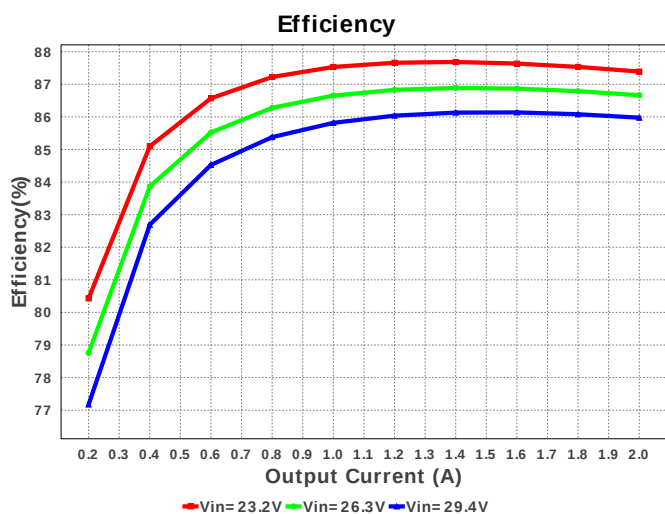
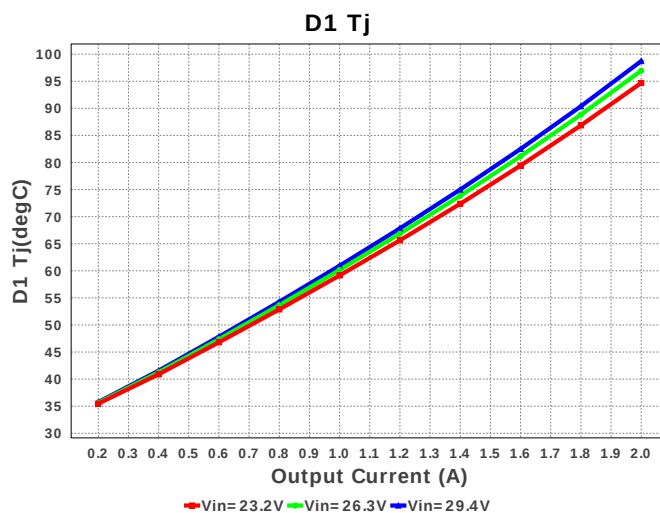
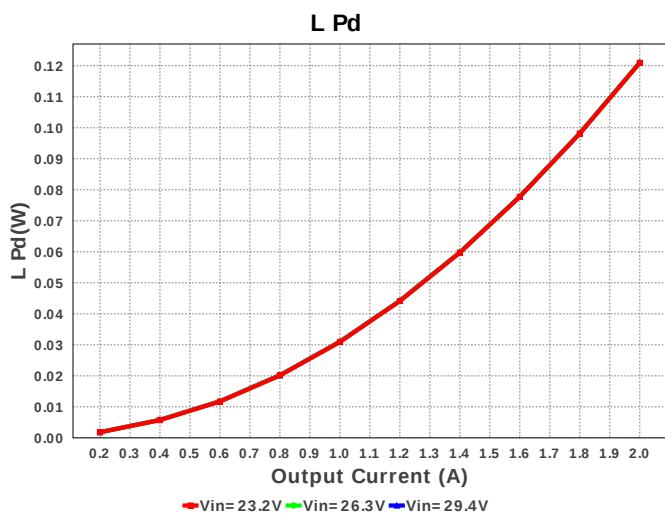


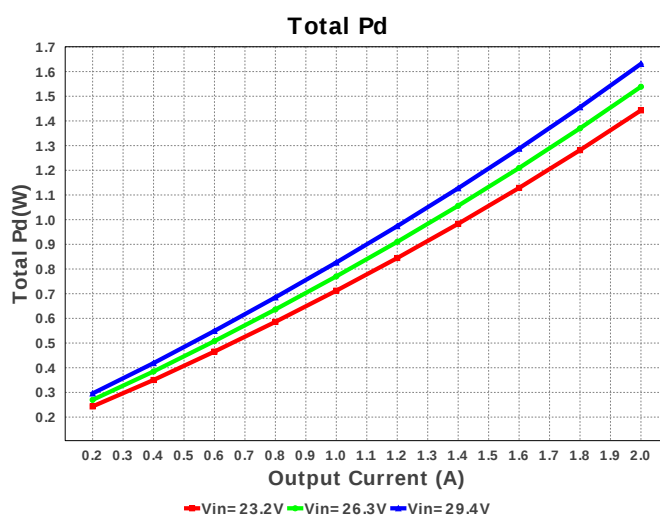
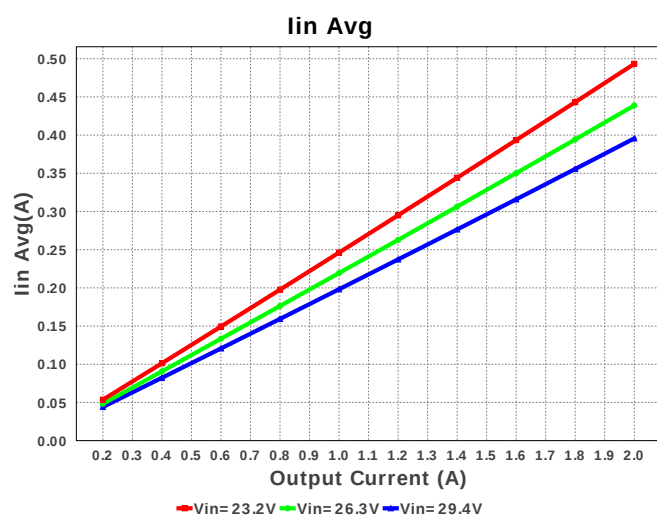
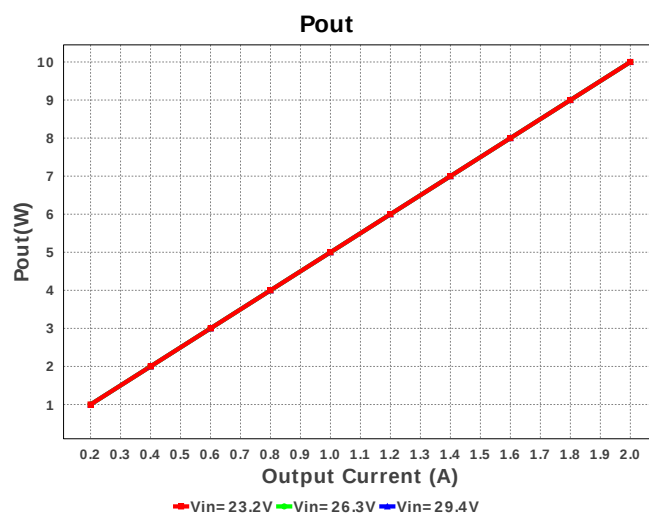
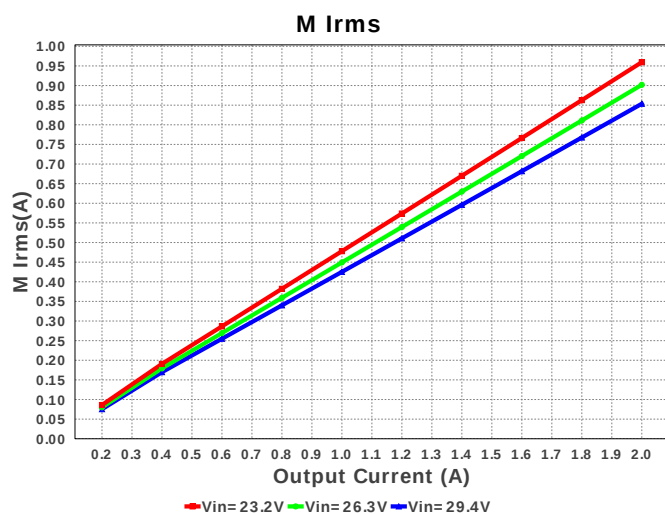
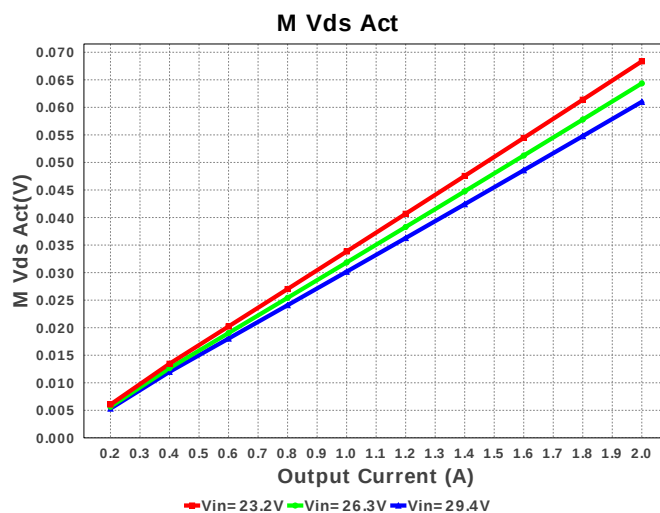
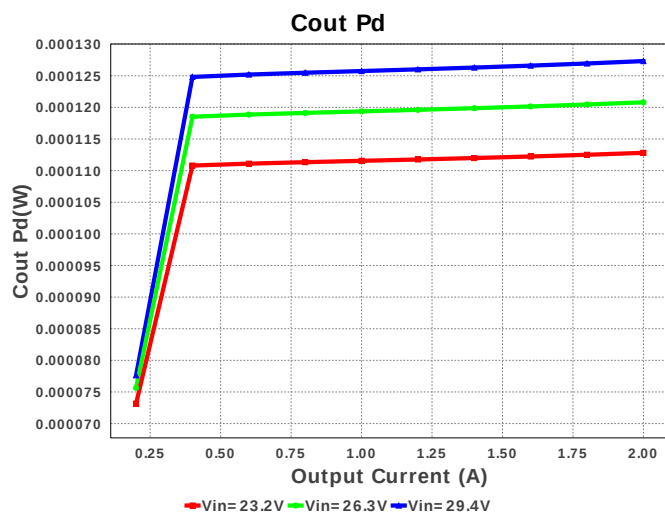
## Electrical BOM

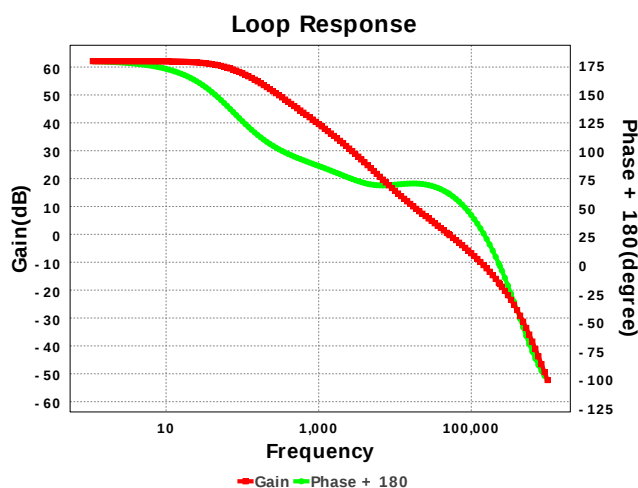
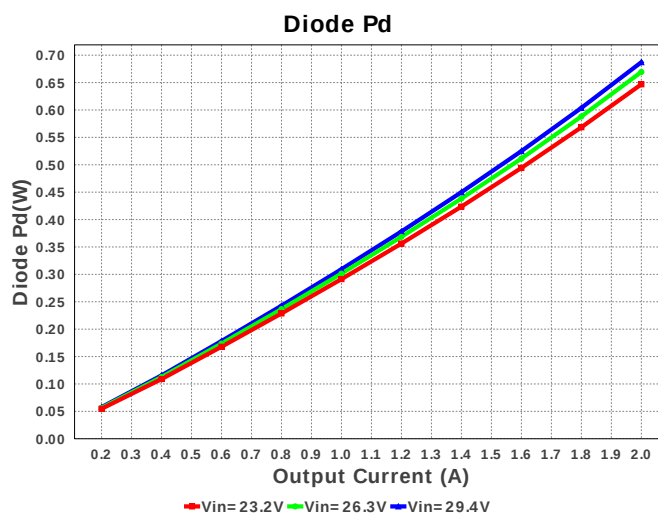
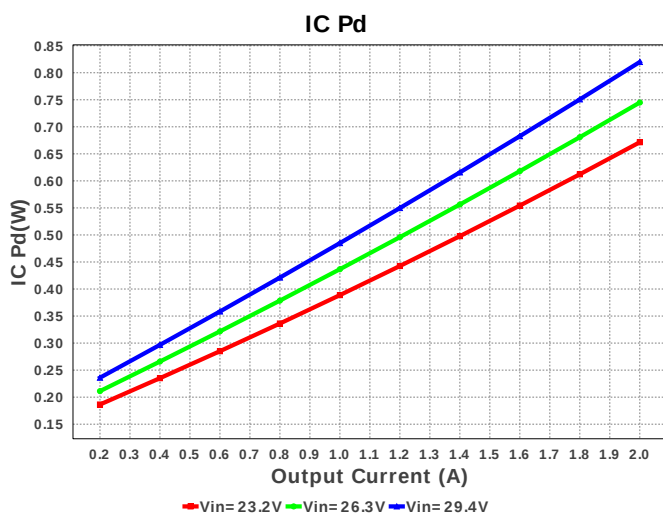
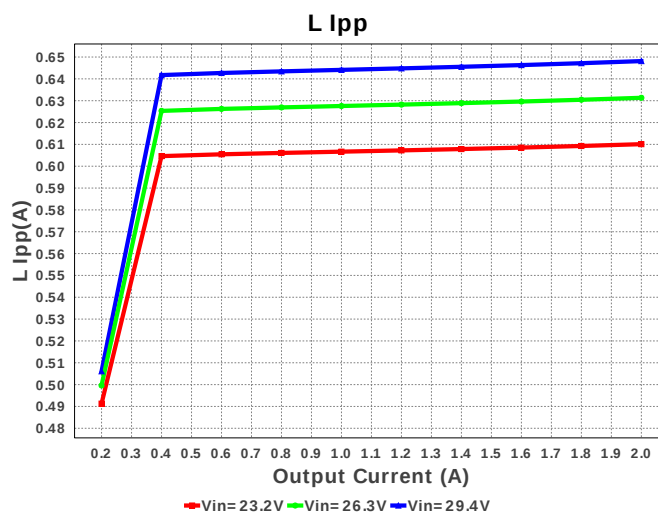
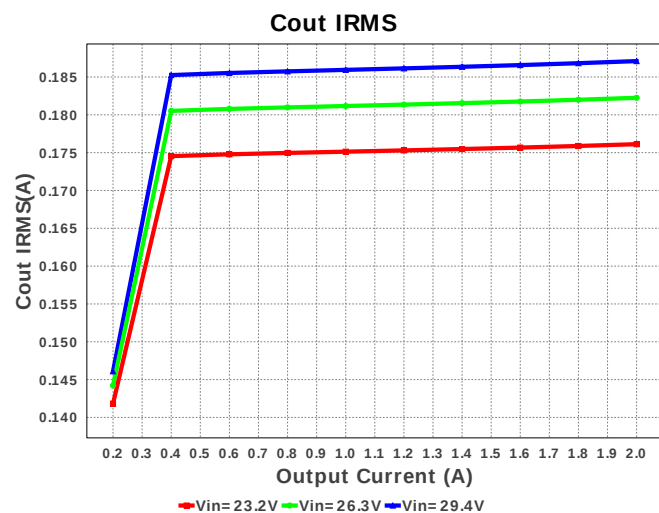
| #  | Name  | Manufacturer  | Part Number                           | Properties                                                        | Qty | Price  | Footprint                   |
|----|-------|---------------|---------------------------------------|-------------------------------------------------------------------|-----|--------|-----------------------------|
| 1. | Cboot | Kemet         | C0805C104K5RACTU<br>Series= X7R       | Cap= 100.0 nF<br>ESR= 64.0 mOhm<br>VDC= 50.0 V<br>IRMS= 1.64 A    | 1   | \$0.01 | 0805 7 mm <sup>2</sup>      |
| 2. | 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 | 1206_190 11 mm <sup>2</sup> |
| 3. | Cout  | MuRata        | GRM31CR61A226KE19L<br>Series= X5R     | Cap= 22.0 uF<br>ESR= 3.637 mOhm<br>VDC= 10.0 V<br>IRMS= 3.56456 A | 1   | \$0.07 | 1206_190 11 mm <sup>2</sup> |
| 4. | Css   | MuRata        | GRM155R71C822KA01D<br>Series= X7R     | Cap= 8.2 nF<br>VDC= 16.0 V<br>IRMS= 0.0 A                         | 1   | \$0.01 | 0402 3 mm <sup>2</sup>      |
| 5. | D1    | Diodes Inc.   | B360A-13-F                            | VF@Io= 700.0 mV<br>VRRM= 60.0 V                                   | 1   | \$0.12 | SMA 37 mm <sup>2</sup>      |
| 6. | L1    | TDK           | VLP8040T-6R8M                         | L= 6.8 uH<br>DCR= 24.0 mOhm                                       | 1   | \$0.22 | VLP8040 113 mm <sup>2</sup> |
| 7. | Rfbb  | Yageo America | RC0603FR-0712KL<br>Series= ?          | Res= 12.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | 0603 5 mm <sup>2</sup>      |
| 8. | Rfbb  | Yageo America | RC0603FR-0768KL<br>Series= ?          | Res= 68.0 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | 0603 5 mm <sup>2</sup>      |
| 9. | Rt    | Vishay-Dale   | CRCW040223K7FKED<br>Series= CRCW...e3 | Res= 23.7 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                                                                                                |
|--------|------|-------------------|---------------|------------|-----|--------|----------------------------------------------------------------------------------------------------------|
| 10. U1 |      | Texas Instruments | LMR14020SDDAR | Switcher   | 1   | \$1.46 | <br>DDA0008E_N 57 mm² |









## Operating Values

| #   | Name         | Value                 | Category | Description                             |
|-----|--------------|-----------------------|----------|-----------------------------------------|
| 1.  | Cin IRMS     | 771.932 mA            | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS    | 187.101 mA            | Current  | Output capacitor RMS ripple current     |
| 3.  | IC Ipk       | 2.324 A               | Current  | Peak switch current in IC               |
| 4.  | Iin Avg      | 395.63 mA             | Current  | Average input current                   |
| 5.  | L Ipp        | 648.14 mA             | Current  | Peak-to-peak inductor ripple current    |
| 6.  | M1 Irms      | 853.567 mA            | Current  | Q lavg                                  |
| 7.  | BOM Count    | 10                    | General  | Total Design BOM count                  |
| 8.  | FootPrint    | 252.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |
| 9.  | Frequency    | 1.006 MHz             | General  | Switching frequency                     |
| 10. | IC Tolerance | 18.0 mV               | General  | IC Feedback Tolerance                   |
| 11. | M Vds Act    | 60.995 mV             | General  | Voltage drop across the MosFET          |

| #   | Name           | Value       | Category | Description                                                                                |
|-----|----------------|-------------|----------|--------------------------------------------------------------------------------------------|
| 12. | Pout           | 10.0 W      | General  | Total output power                                                                         |
| 13. | Total BOM      | \$1.97      | General  | Total BOM Cost                                                                             |
| 14. | D1 Tj          | 98.72 degC  | Op_Point | D1 junction temperature                                                                    |
| 15. | Vout Actual    | 5.0 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     | 50.834 kHz  | Op_point | Bode plot crossover frequency                                                              |
| 18. | Duty Cycle     | 18.213 %    | Op_point | Duty cycle                                                                                 |
| 19. | Efficiency     | 85.976 %    | Op_point | Steady state efficiency                                                                    |
| 20. | IC Tj          | 64.436 degC | Op_point | IC junction temperature                                                                    |
| 21. | ICThetaJA      | 42.0 degC/W | Op_point | IC junction-to-ambient thermal resistance                                                  |
| 22. | IOUT_OP        | 2.0 A       | Op_point | Iout operating point                                                                       |
| 23. | Phase Marg     | 63.248 deg  | Op_point | Bode Plot Phase Margin                                                                     |
| 24. | VIN_OP         | 29.4 V      | Op_point | Vin operating point                                                                        |
| 25. | Vout p-p       | 4.855 mV    | Op_point | Peak-to-peak output ripple voltage                                                         |
| 26. | Cin Pd         | 2.65 mW     | Power    | Input capacitor power dissipation                                                          |
| 27. | Cout Pd        | 127.319 µW  | Power    | Output capacitor power dissipation                                                         |
| 28. | Diode Pd       | 687.205 mW  | Power    | Diode power dissipation                                                                    |
| 29. | IC Pd          | 819.898 mW  | Power    | IC power dissipation                                                                       |
| 30. | L Pd           | 121.058 mW  | Power    | Inductor power dissipation                                                                 |
| 31. | Total Pd       | 1.631 W     | Power    | Total Power Dissipation                                                                    |
| 32. | Vout Tolerance | 4.158 %     |          | 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  | 29.4      | Maximum input voltage  |
| 3. | VinMin  | 23.2      | Minimum input voltage  |
| 4. | Vout    | 5.0       | Output Voltage         |
| 5. | base_pn | LMR14020S | Base Product Number    |
| 6. | source  | DC        | Input Source Type      |
| 7. | Ta      | 30.0      | Ambient temperature    |

## Design Assistance

1. **LMR14020S** Product Folder : <http://www.ti.com/product/LMR14020> : contains the data sheet and other resources.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

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

Use of Texas Instruments' WEBENCH simulation tools is subject to [Texas Instruments' Site Terms and Conditions of Use](#). Prototype boards based on WEBENCH created designs are provided AS IS without warranty of any kind for evaluation and testing purposes and are subject to the terms of the [Evaluation License Agreement](#).