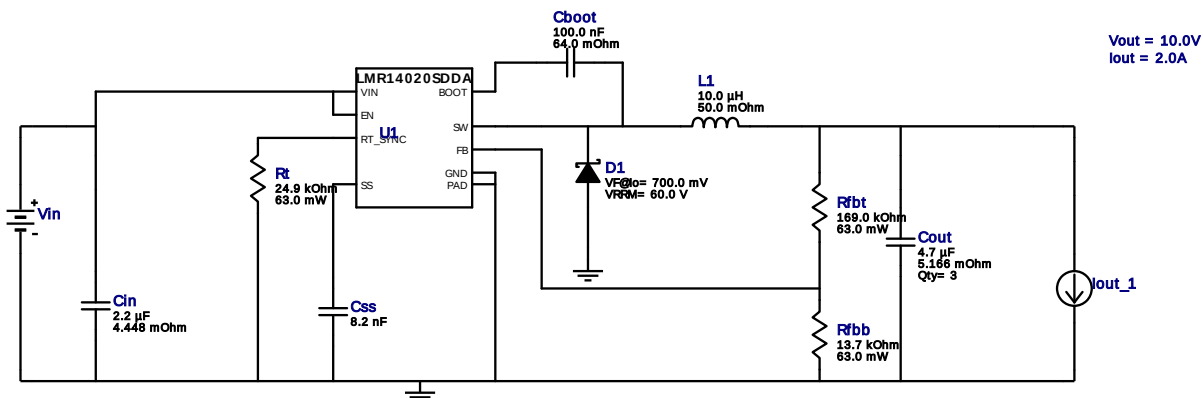


## WEBENCH® Design Report

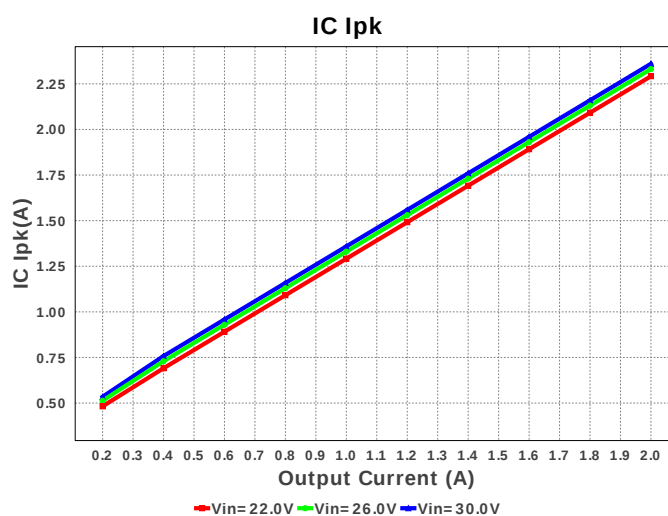
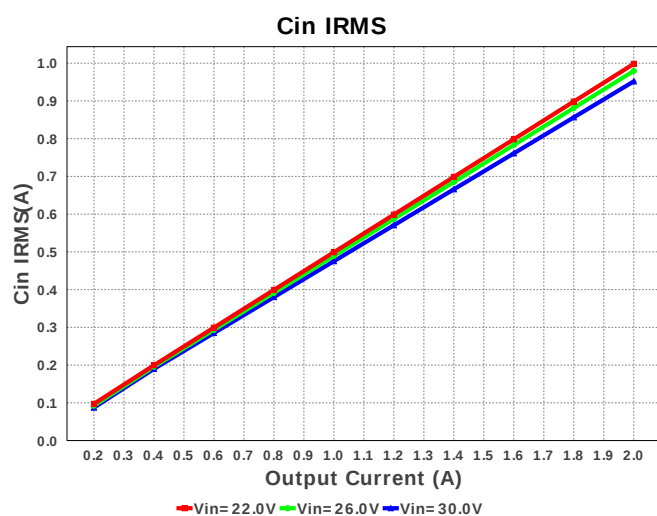
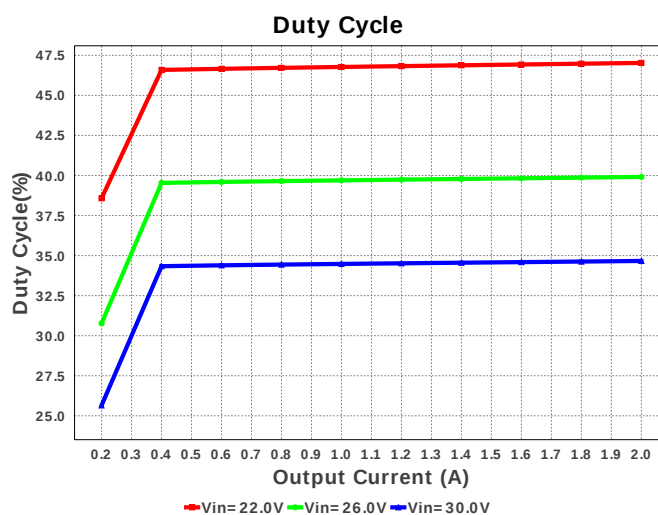
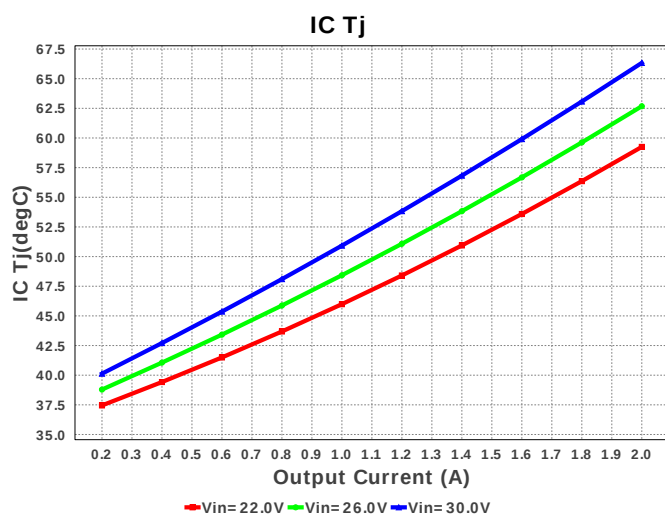
Design : 4352199/46 LMR14020SDDAR  
LMR14020SDDAR 22.0V-30.0V to 10.00V @ 2.000164203612479A

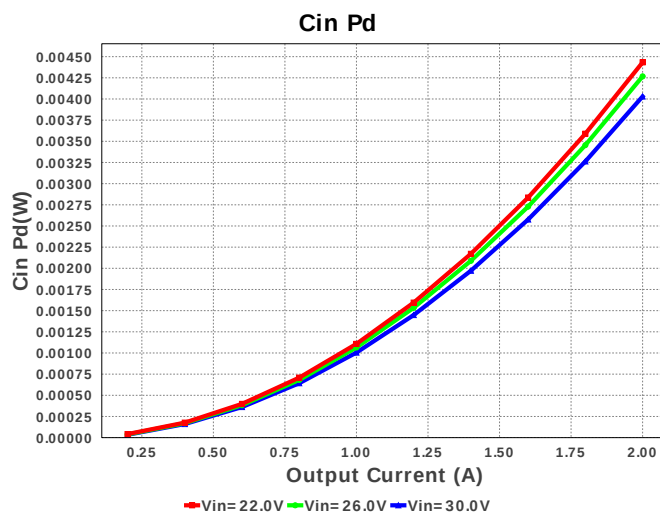
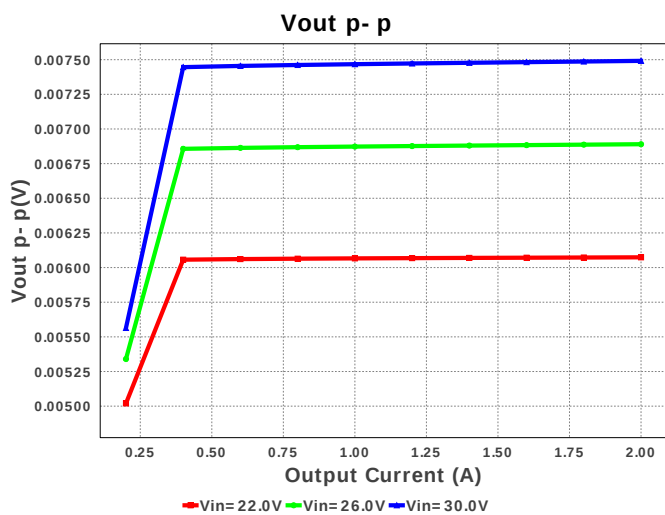
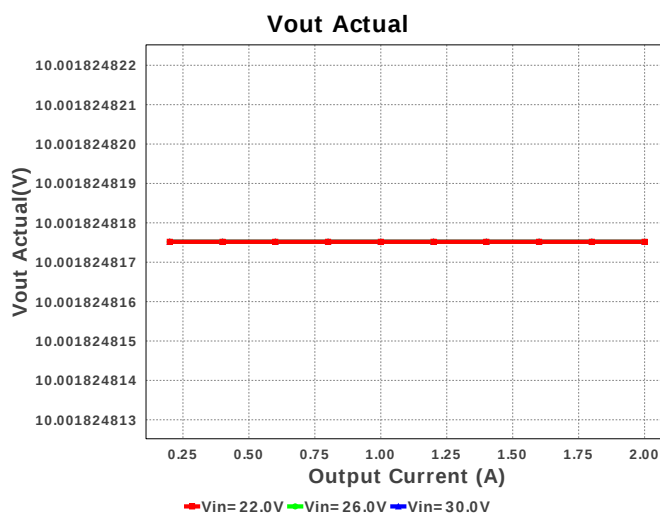
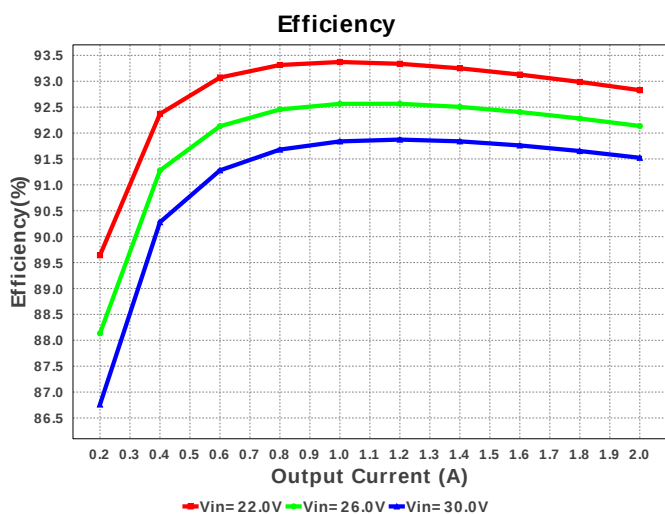
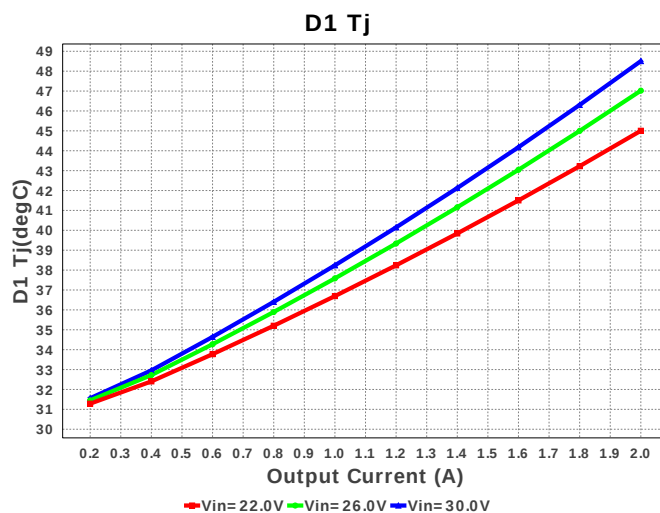
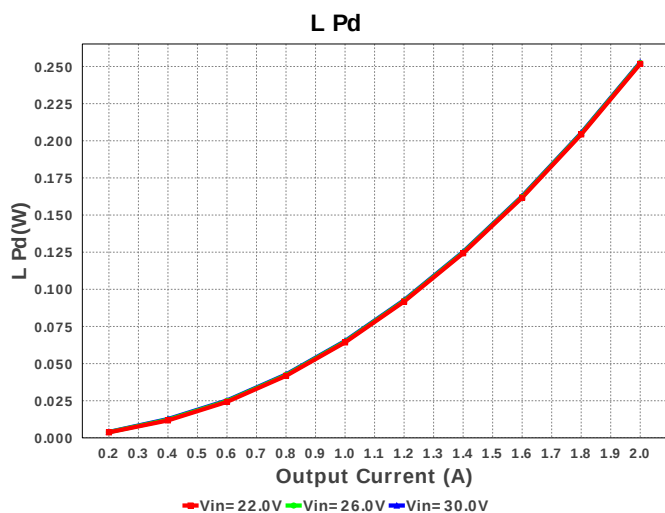


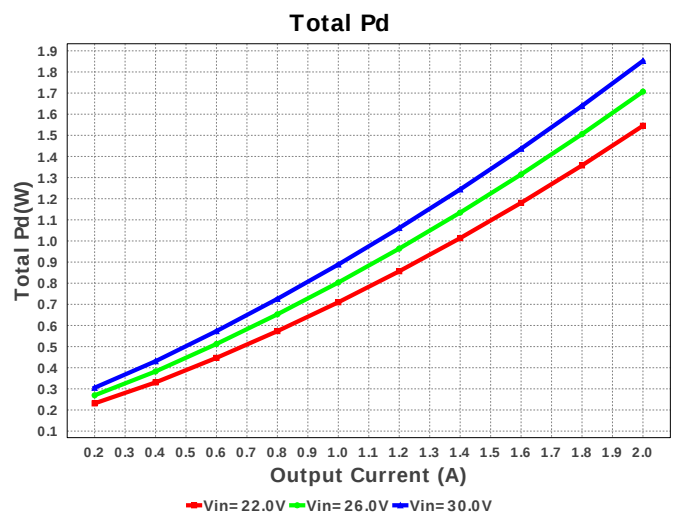
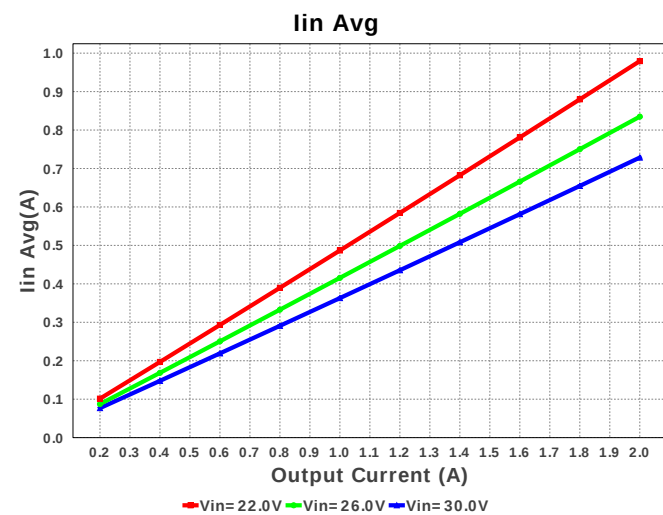
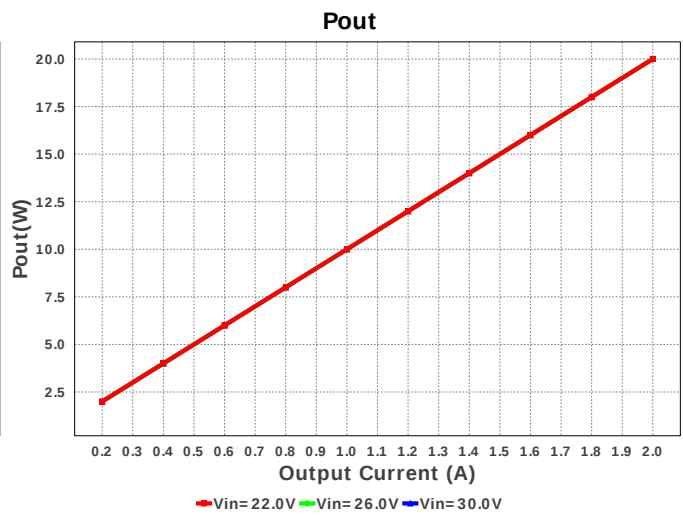
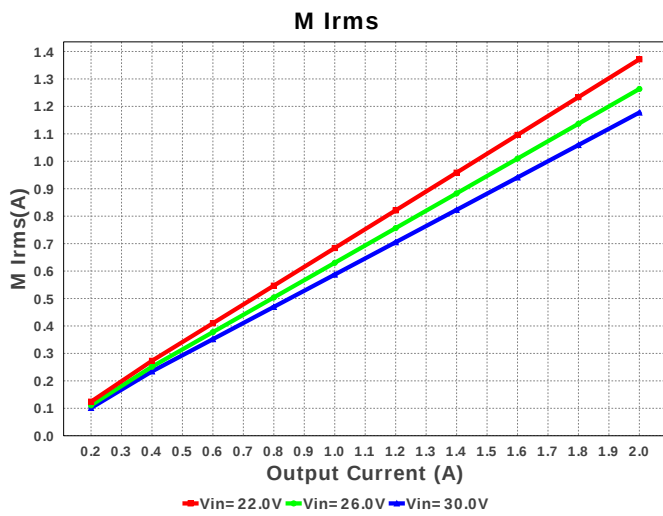
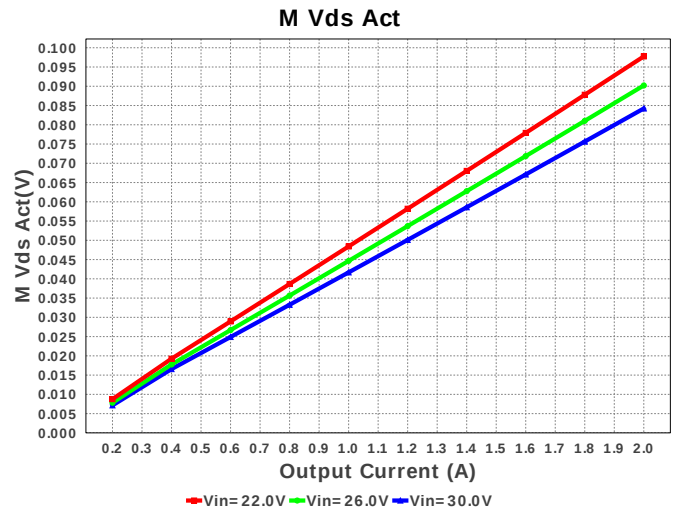
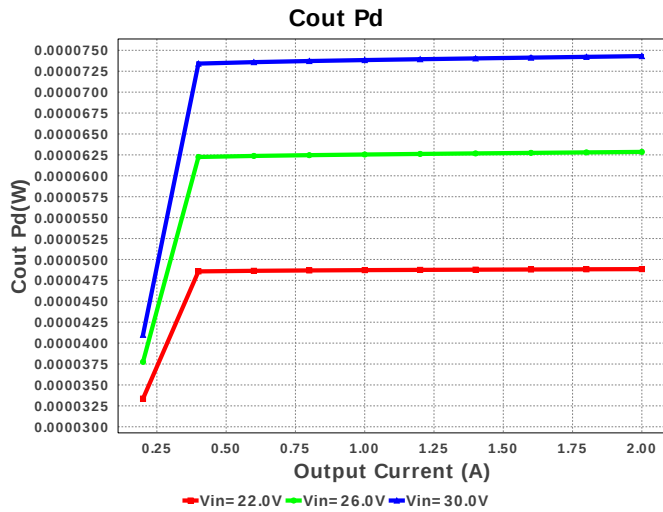
## Electrical BOM

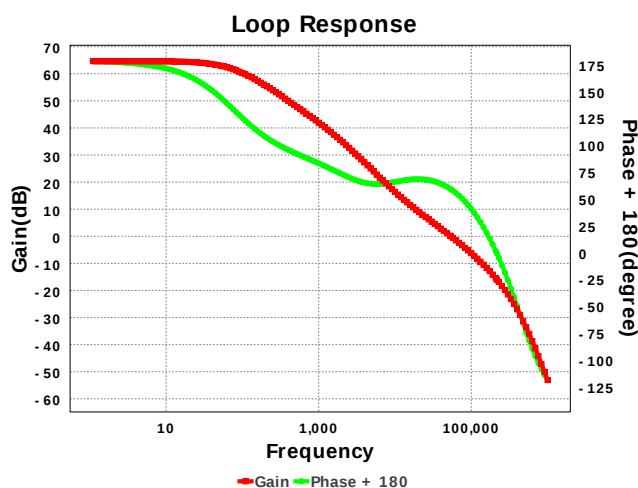
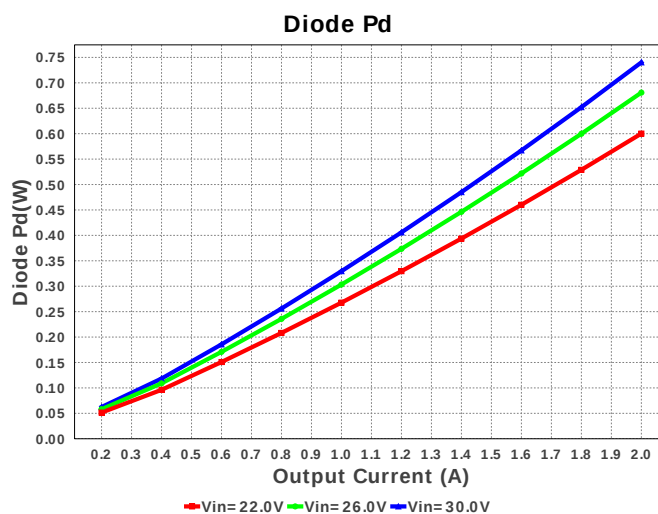
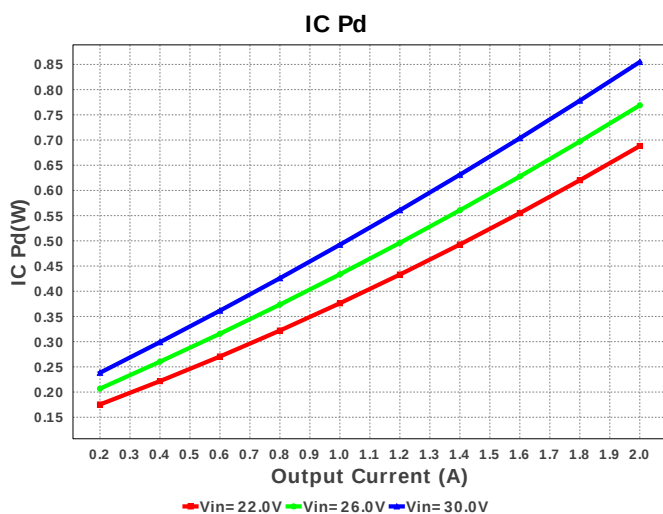
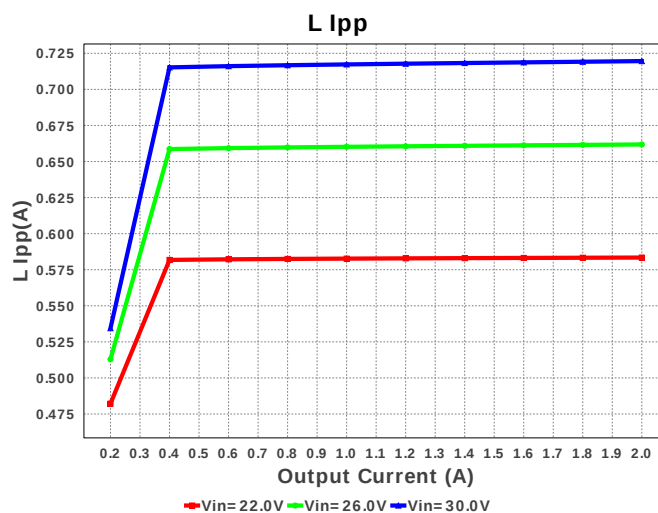
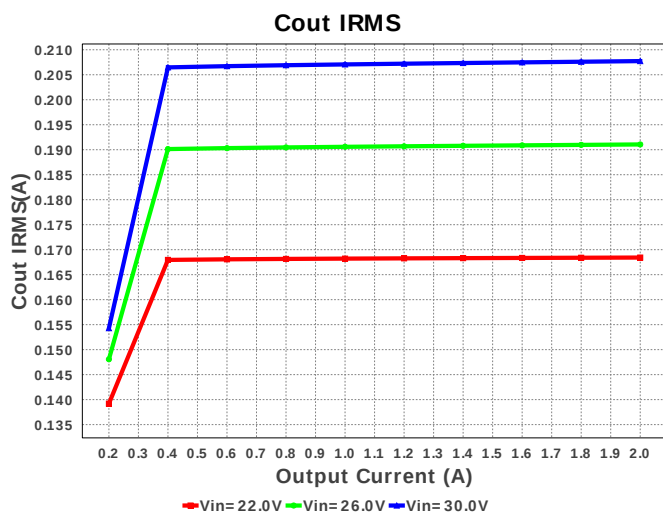
| #  | Name  | Manufacturer | Part Number                          | Properties                                                       | Qty | Price  | Footprint                                                                                                            |
|----|-------|--------------|--------------------------------------|------------------------------------------------------------------|-----|--------|----------------------------------------------------------------------------------------------------------------------|
| 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 | <br>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 | <br>1206_190 11 mm <sup>2</sup> |
| 3. | Cout  | MuRata       | GRM21BC81E475KA12L<br>Series= X6S    | Cap= 4.7 uF<br>ESR= 5.166 mOhm<br>VDC= 25.0 V<br>IRMS= 2.03531 A | 3   | \$0.02 | <br>0805 7 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 | <br>0402 3 mm <sup>2</sup>      |
| 5. | D1    | Diodes Inc.  | B260A-13-F                           | VF@Io= 700.0 mV<br>VRRM= 60.0 V                                  | 1   | \$0.09 | <br>SMA 37 mm <sup>2</sup>      |
| 6. | L1    | Bourns       | SRN8040-100M                         | L= 10.0 uH<br>DCR= 50.0 mOhm                                     | 1   | \$0.22 | <br>SRN8040 100 mm <sup>2</sup> |
| 7. | Rfbb  | Vishay-Dale  | CRCW040213K7FKED<br>Series= CRCW..e3 | Res= 13.7 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%              | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>      |
| 8. | Rfbb  | Vishay-Dale  | CRCW0402169KFKED<br>Series= CRCW..e3 | Res= 169.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%             | 1   | \$0.01 | <br>0402 3 mm <sup>2</sup>      |
| 9. | Rt    | Vishay-Dale  | CRCW040224K9FKED<br>Series= CRCW..e3 | Res= 24.9 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                                                                                                            |
|-----|------|-------------------|---------------|------------|-----|--------|----------------------------------------------------------------------------------------------------------------------|
| 10. | U1   | Texas Instruments | LMR14020SDDAR | Switcher   | 1   | \$1.46 | <br>DDA0008E_N 57 mm <sup>2</sup> |









## Operating Values

| #   | Name         | Value                 | Category | Description                             |
|-----|--------------|-----------------------|----------|-----------------------------------------|
| 1.  | Cin IRMS     | 951.828 mA            | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS    | 207.731 mA            | Current  | Output capacitor RMS ripple current     |
| 3.  | IC Ipk       | 2.36 A                | Current  | Peak switch current in IC               |
| 4.  | Iin Avg      | 728.43 mA             | Current  | Average input current                   |
| 5.  | L Ipp        | 719.6 mA              | Current  | Peak-to-peak inductor ripple current    |
| 6.  | M1 Irms      | 1.178 A               | Current  | Q lavg                                  |
| 7.  | BOM Count    | 12                    | General  | Total Design BOM count                  |
| 8.  | FootPrint    | 245.0 mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |
| 9.  | Frequency    | 959.376 kHz           | General  | Switching frequency                     |
| 10. | IC Tolerance | 18.0 mV               | General  | IC Feedback Tolerance                   |
| 11. | M Vds Act    | 84.211 mV             | General  | Voltage drop across the MosFET          |

| #   | Name           | Value       | Category | Description                                                                                |
|-----|----------------|-------------|----------|--------------------------------------------------------------------------------------------|
| 12. | Pout           | 20.0 W      | General  | Total output power                                                                         |
| 13. | Total BOM      | \$1.93      | General  | Total BOM Cost                                                                             |
| 14. | D1 Tj          | 48.506 degC | Op_Point | D1 junction temperature                                                                    |
| 15. | Vout Actual    | 10.002 V    | Op_Point | Vout Actual calculated based on selected voltage divider resistors                         |
| 16. | Vout OP        | 10.0 V      | Op_Point | Operational Output Voltage                                                                 |
| 17. | Cross Freq     | 53.962 kHz  | Op_point | Bode plot crossover frequency                                                              |
| 18. | Duty Cycle     | 34.664 %    | Op_point | Duty cycle                                                                                 |
| 19. | Efficiency     | 91.523 %    | Op_point | Steady state efficiency                                                                    |
| 20. | IC Tj          | 65.902 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     | 59.907 deg  | Op_point | Bode Plot Phase Margin                                                                     |
| 24. | VIN_OP         | 30.0 V      | Op_point | Vin operating point                                                                        |
| 25. | Vout p-p       | 7.491 mV    | Op_point | Peak-to-peak output ripple voltage                                                         |
| 26. | Cin Pd         | 4.03 mW     | Power    | Input capacitor power dissipation                                                          |
| 27. | Cout Pd        | 74.308 µW   | Power    | Output capacitor power dissipation                                                         |
| 28. | Diode Pd       | 740.25 mW   | Power    | Diode power dissipation                                                                    |
| 29. | IC Pd          | 854.805 mW  | Power    | IC power dissipation                                                                       |
| 30. | L Pd           | 252.711 mW  | Power    | Inductor power dissipation                                                                 |
| 31. | Total Pd       | 1.852 W     | Power    | Total Power Dissipation                                                                    |
| 32. | Vout Tolerance | 4.314 %     |          | 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  | 30.0      | Maximum input voltage  |
| 3. | VinMin  | 22.0      | Minimum input voltage  |
| 4. | Vout    | 10.0      | 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.

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