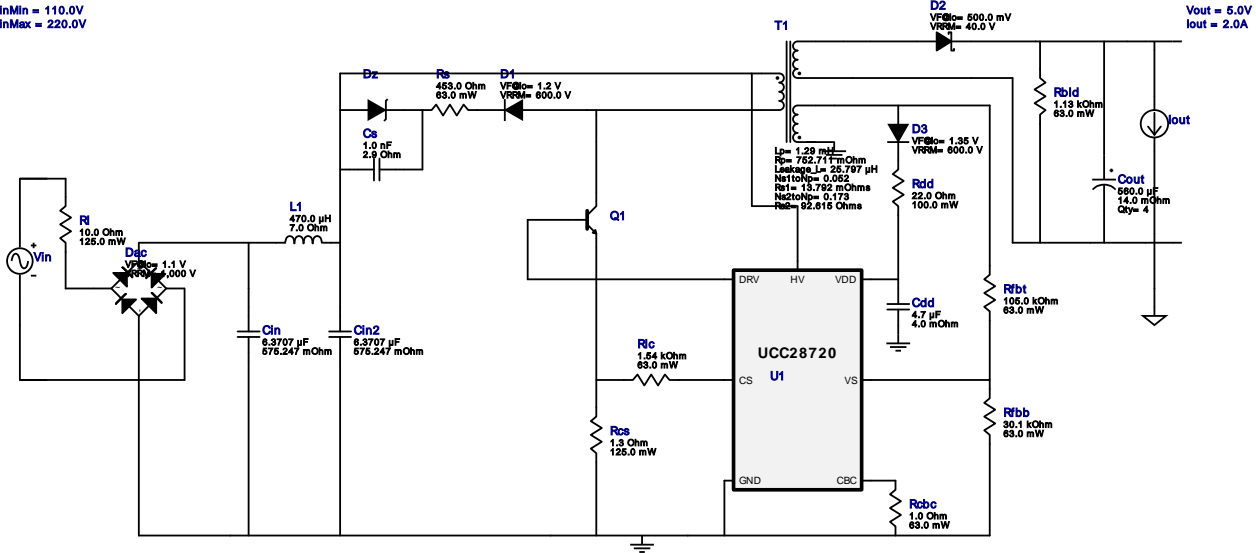


WEBENCH[®] Design Report

Design : 4417704/23 UCC28720DR
 UCC28720DR 110.0V-220.0V to 5.37V @ 2.0A












VinMin = 110.0V
 VinMax = 220.0V

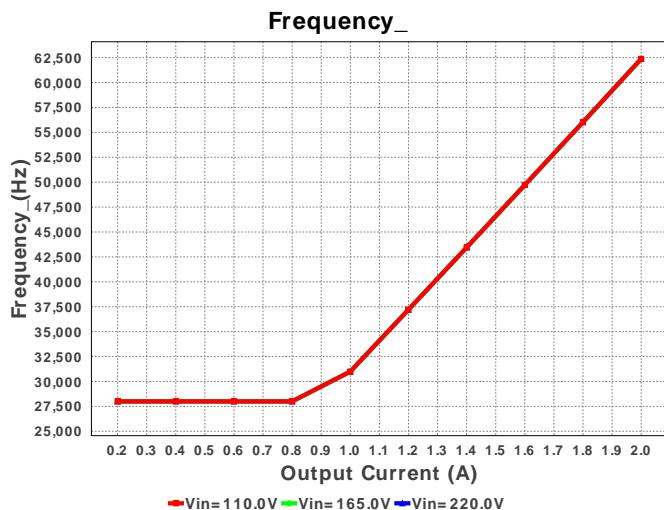
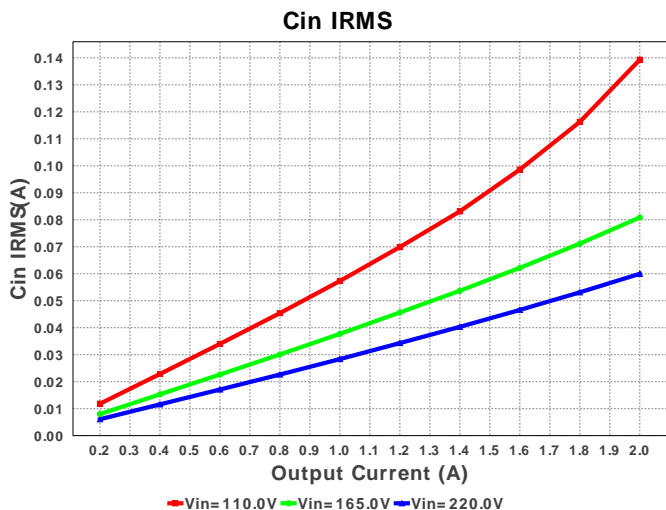
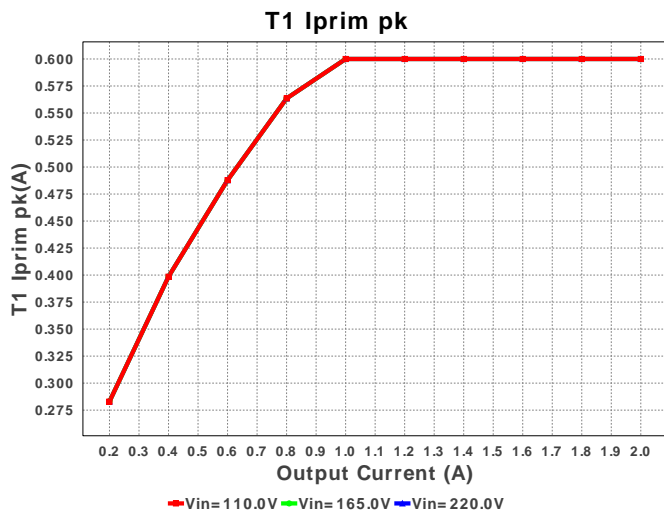
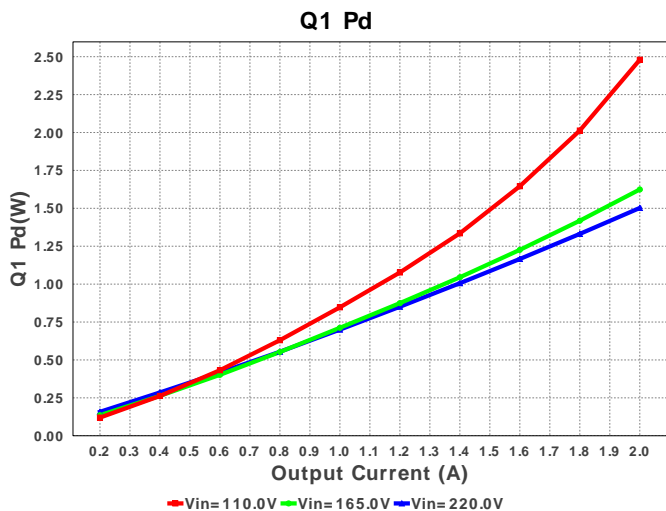
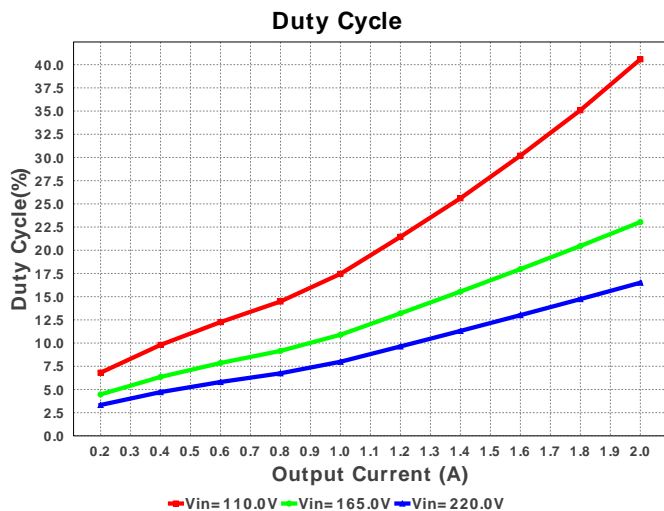
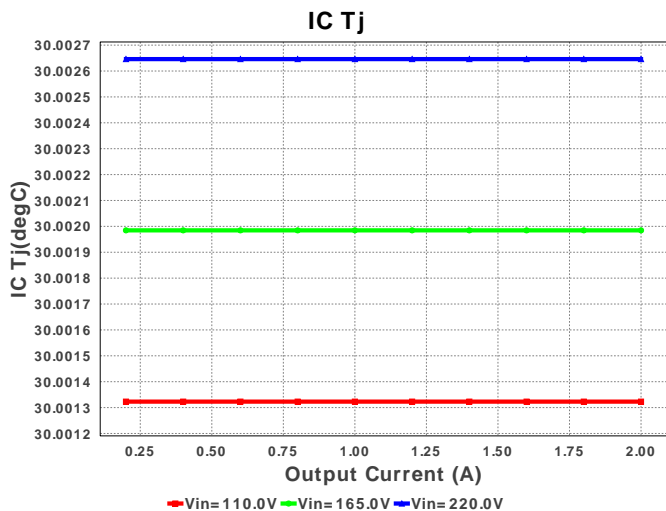


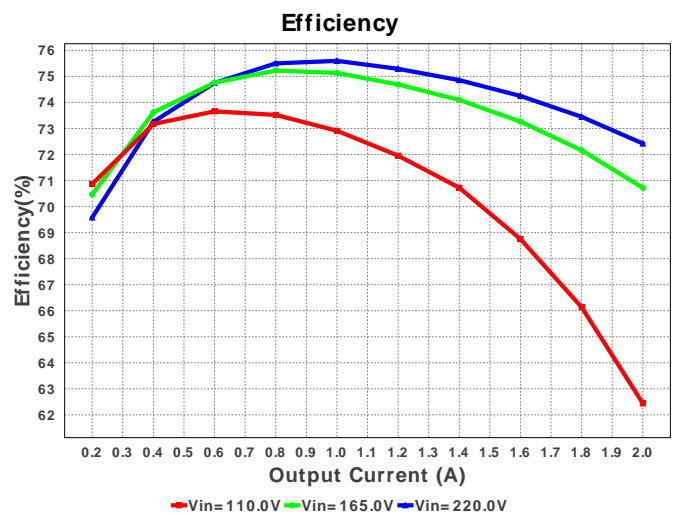
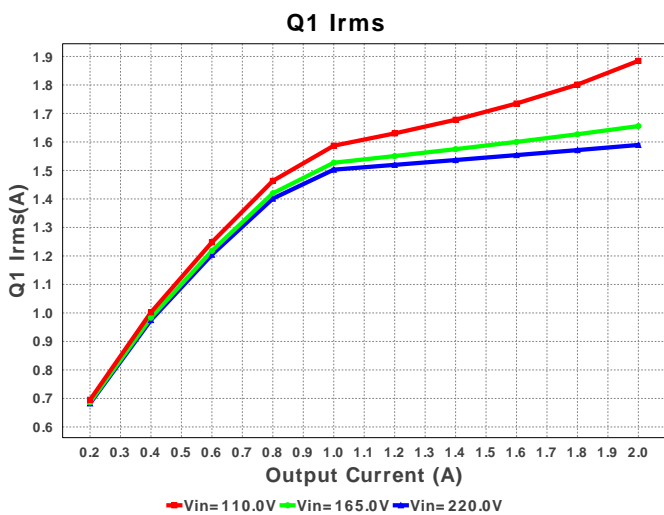
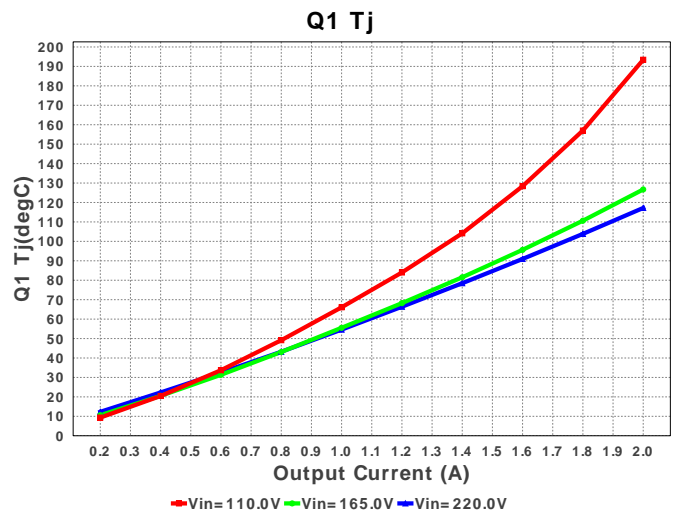
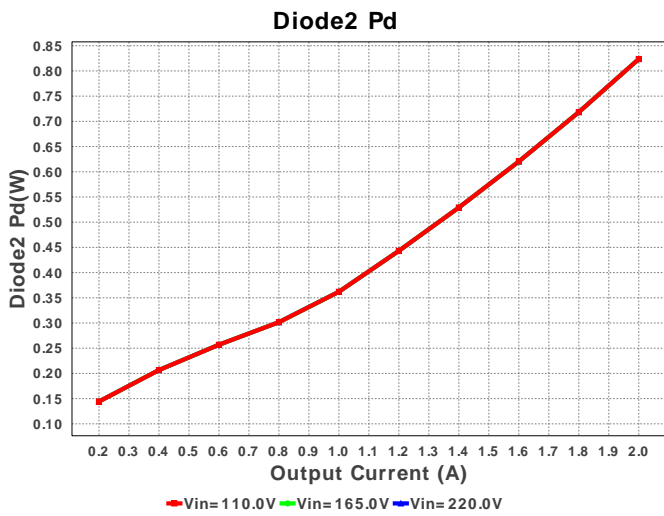
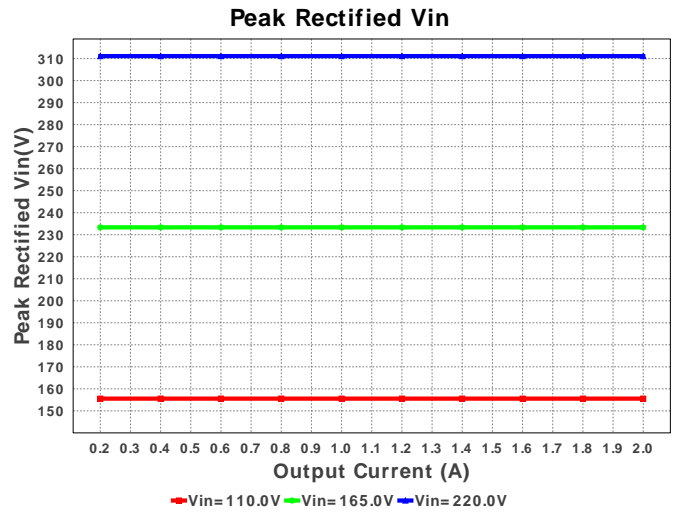
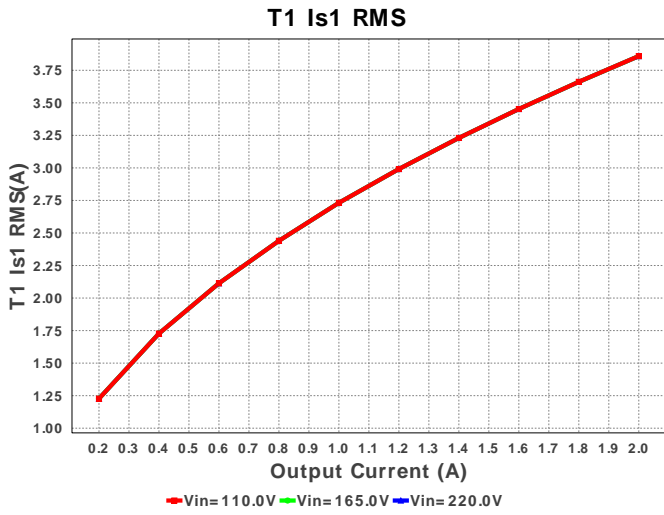
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

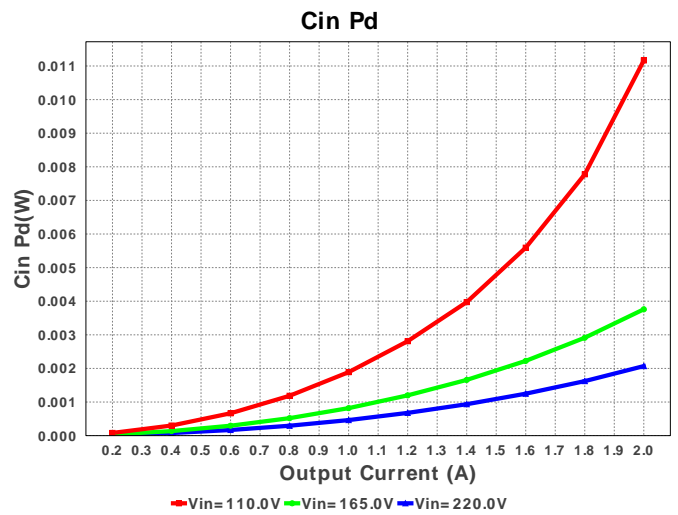
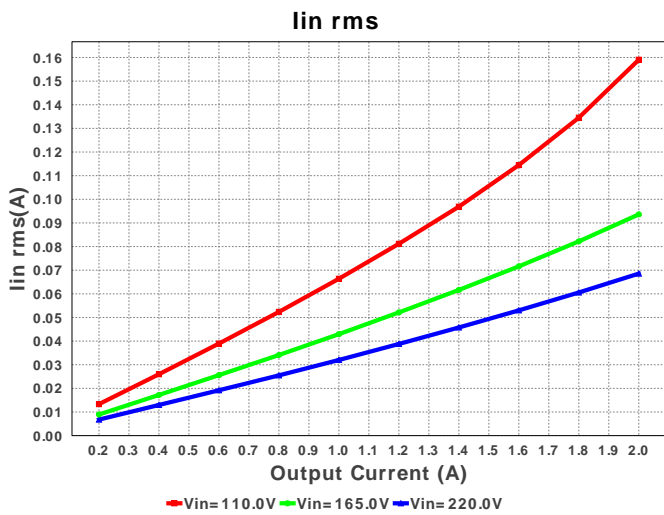
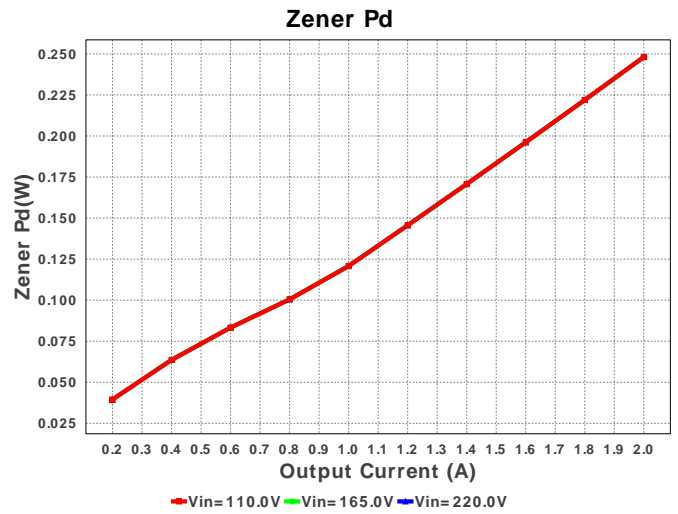
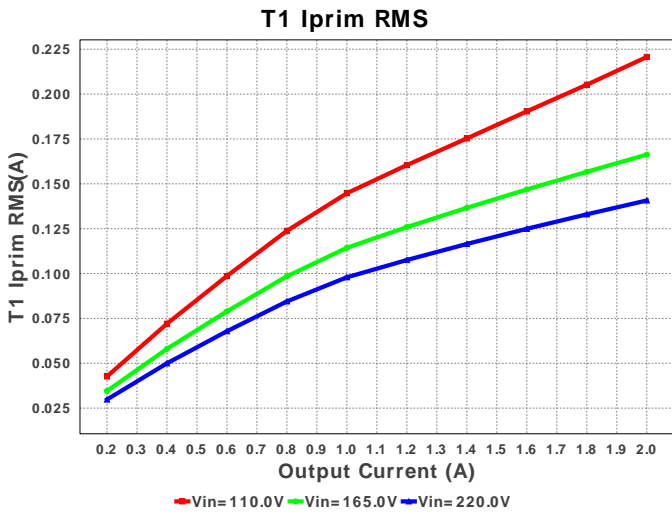
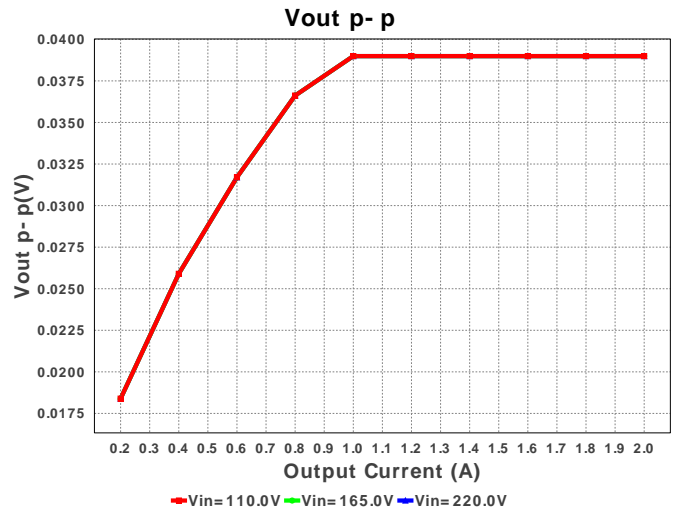
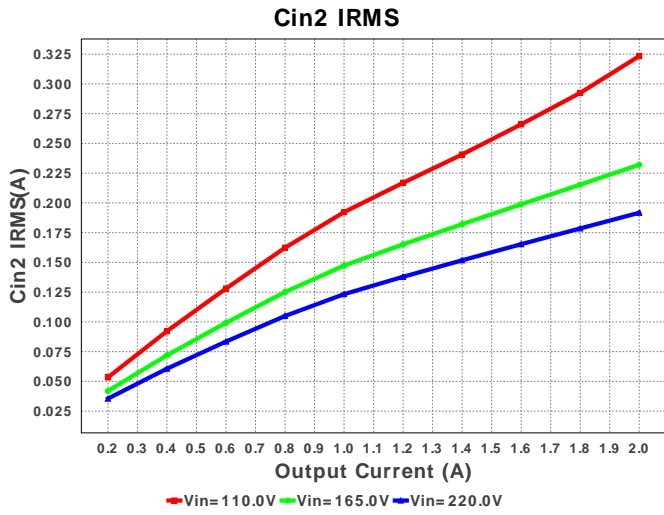
Electrical BOM

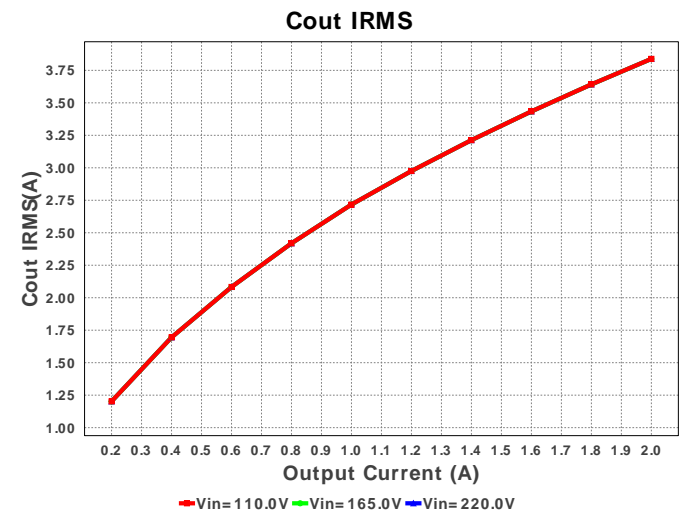
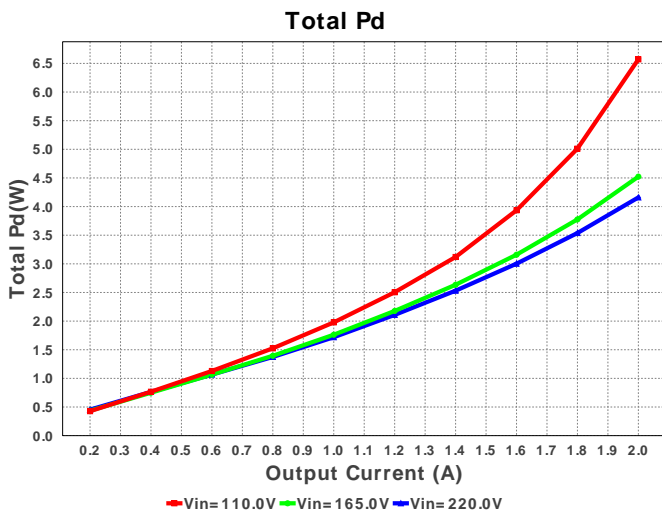
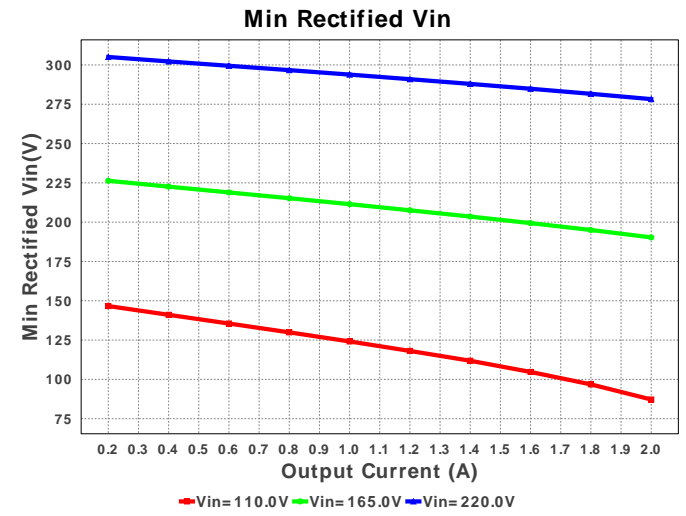
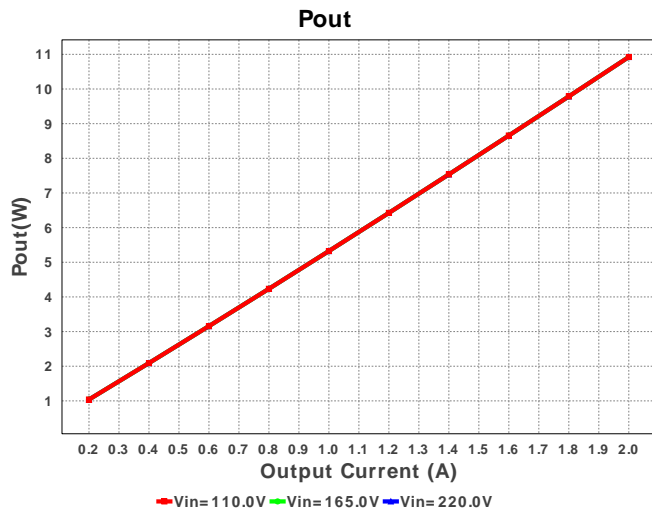
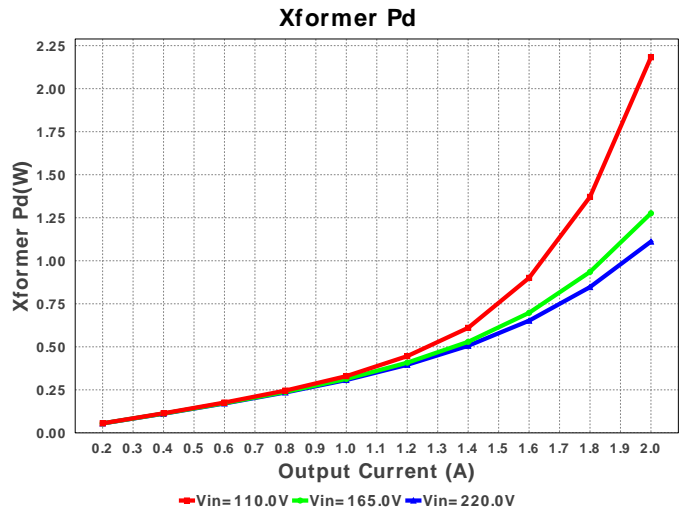
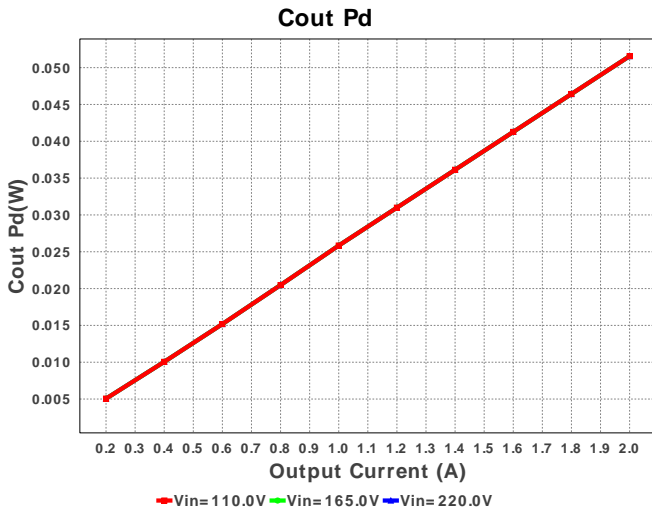
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|----|------|-----------------------------|-----------------------------------|---|-----|--------|-----------------------------------|
| 1. | Cdd | MuRata | GRM21BR61E475KA12L Series= X5R | Cap= 4.7 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 0.0 A | 1 | \$0.03 | 0805 7 mm ² |
| 2. | Cin | CUSTOM | CUSTOM Series= ? | Cap= 6.3707 uF ESR= 575.25 mOhm VDC= 466.69 V IRMS= 406.852 mA | 1 | NA | CUSTOM 0 mm ² |
| 3. | Cin2 | CUSTOM | CUSTOM Series= ? | Cap= 6.3707 uF ESR= 575.25 mOhm VDC= 466.69 V IRMS= 406.852 mA | 1 | NA | CUSTOM 0 mm ² |
| 4. | Cout | Panasonic | 16SVPF560M Series= SVPF | Cap= 560.0 uF ESR= 14.0 mOhm VDC= 16.0 V IRMS= 4.95 A | 4 | \$0.61 | CAPSMT_62_E12 106 mm ² |
| 5. | Cs | MuRata | GRM188R72E102KW07D Series= X7R | Cap= 1.0 nF ESR= 2.9 Ohm VDC= 250.0 V IRMS= 90.0 mA | 1 | \$0.02 | 0603 5 mm ² |
| 6. | D1 | Bourns | CD214B-F3600 | VF@Io= 1.2 V VRRM= 600.0 V | 1 | \$0.14 | SMB 44 mm ² |
| 7. | D2 | Diodes Inc. | B340A-13-F | VF@Io= 500.0 mV VRRM= 40.0 V | 1 | \$0.11 | SMA 37 mm ² |
| 8. | D3 | Micro Commercial Components | ES1J-TP | VF@Io= 1.35 V VRRM= 600.0 V | 1 | \$0.06 | SMA 37 mm ² |

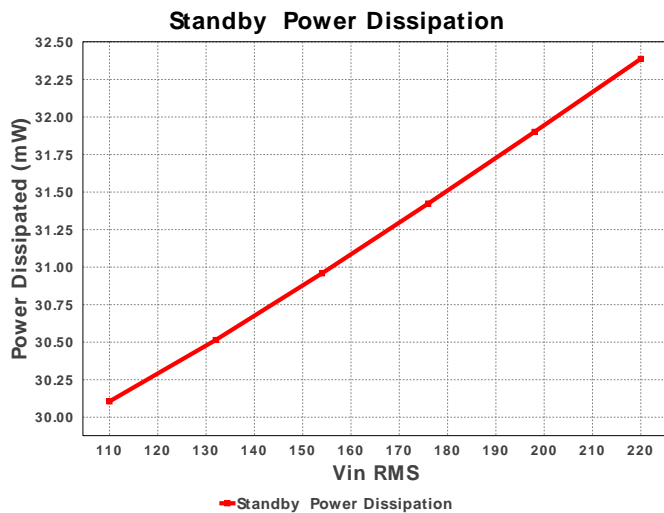
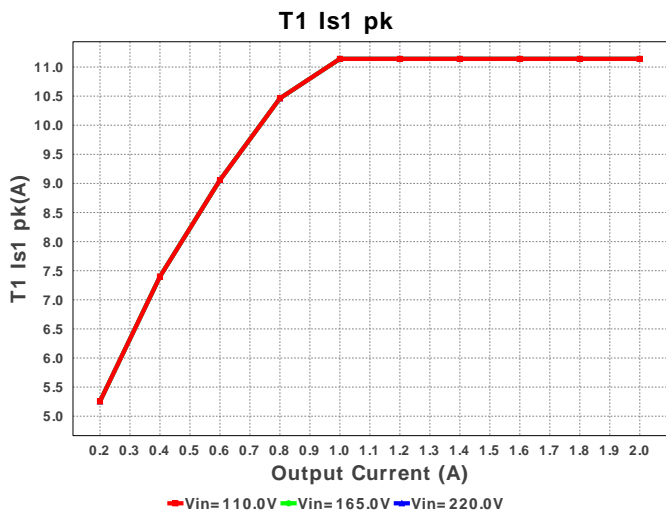
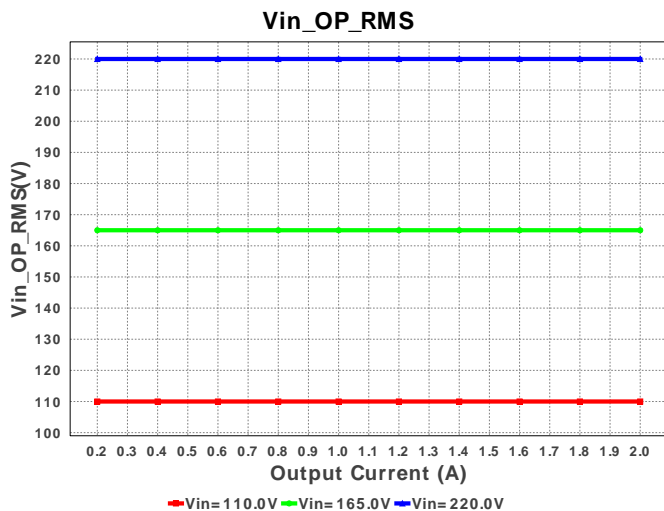
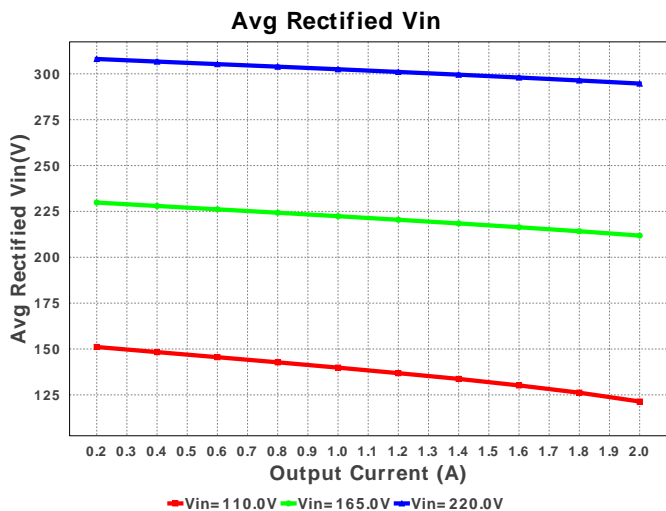
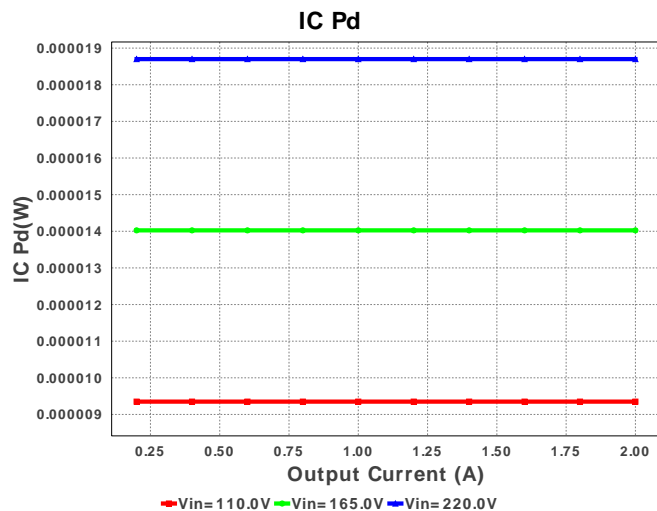
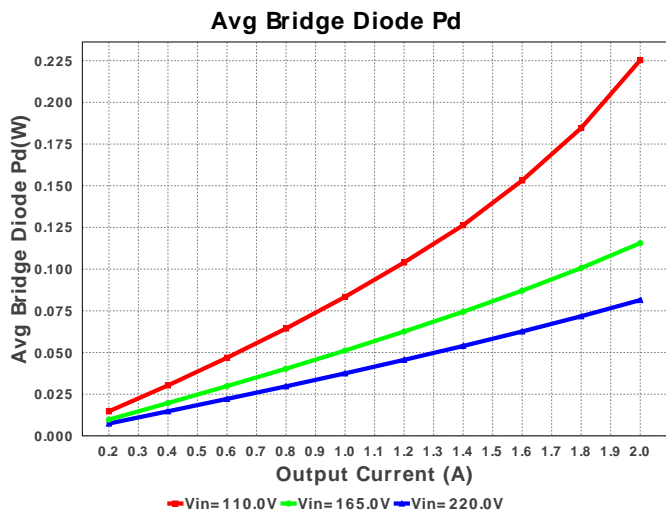
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|-----|------|----------------------|--------------------------------------|--|-----|--------|---|
| 9. | Dac | Vishay-Semiconductor | DF10SA | VF@Io= 1.1 V VRRM= 1,000.0 V | 1 | \$0.24 |  DF-S 99 mm ² |
| 10. | Dz | ON Semiconductor | BZG03C150G | Zener | 1 | \$0.12 |  SMA 37 mm ² |
| 11. | L1 | Bourns | SDR0403-471KL | L= 470.0 µH DCR= 7.0 Ohm | 1 | \$0.18 |  SDR0403 28 mm ² |
| 12. | Q1 | STMicroelectronics | STN2580 | Bipolar Transistor | 1 | \$0.18 |  SOT-223 76 mm ² |
| 13. | Rbld | Vishay-Dale | CRCW04021K13FKED Series= CRCW..e3 | Res= 1.13 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm ² |
| 14. | Rcbc | Vishay-Dale | CRCW04021R00FKED Series= CRCW..e3 | Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm ² |
| 15. | Rcs | Vishay-Dale | CRCW08051R30FKEA Series= CRCW..e3 | Res= 1.3 Ohm Power= 125.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0805 7 mm ² |
| 16. | Rdd | Susumu Co Ltd | RR1220Q-220-D Series= RR12 | Res= 22.0 Ohm Power= 100.0 mW Tolerance= 0.5% | 1 | \$0.01 |  0805 7 mm ² |
| 17. | Rfbb | Vishay-Dale | CRCW040230K1FKED Series= CRCW..e3 | Res= 30.1 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm ² |
| 18. | Rfbt | Vishay-Dale | CRCW0402105KFKED Series= CRCW..e3 | Res= 105.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm ² |
| 19. | RI | Vishay-Dale | CRCW080510R0FKEA Series= CRCW..e3 | Res= 10.0 Ohm Power= 125.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0805 7 mm ² |
| 20. | Rlc | Vishay-Dale | CRCW04021K54FKED Series= CRCW..e3 | Res= 1.54 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm ² |
| 21. | Rs | Vishay-Dale | CRCW0402453RFKED Series= CRCW..e3 | Res= 453.0 Ohm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm ² |
| 22. | T1 | CUSTOM | CUSTOM | Lp= 1.29 mH Rp= 752.711 mOhm Leakage_L= 25.797 µH Ns1toNp= 0.052 Rs1= 13.792 mOhms Ns2toNp= 0.173 Rs2= 92.615 Ohms | 1 | NA | CUSTOM 0 mm ² |
| 23. | U1 | Texas Instruments | UCC28720DR | Switcher | 1 | \$0.40 |  R-PDSO-G7 55 mm ² |

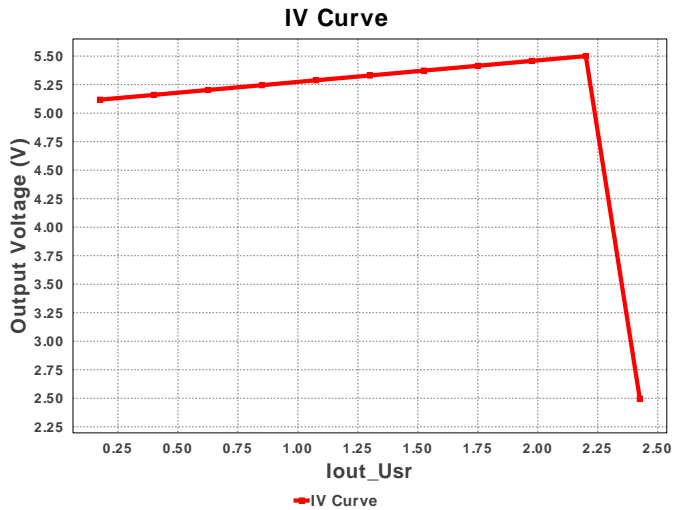












Operating Values

| # | Name | Value | Category | Description |
|-----|---------------------|-----------------------|----------|---|
| 1. | Cin IRMS | 56.876 mA | Current | Input capacitor RMS ripple current |
| 2. | Cin2 IRMS | 190.142 mA | Current | Input Capacitor Cin2 RMS Ripple Current |
| 3. | Cout IRMS | 3.838 A | Current | Output capacitor RMS ripple current |
| 4. | Iin rms | 64.85 mA | Current | RMS Input Current |
| 5. | Q1 Irms | 1.571 A | Current | Q1 RMS current |
| 6. | T1 Iprim RMS | 142.645 mA | Current | Transformer Primary RMS Current |
| 7. | T1 Iprim pk | 600.0 mA | Current | Transformer Primary Peak Current |
| 8. | T1 Is1 RMS | 3.859 A | Current | Transformer Secondary1 RMS Current |
| 9. | T1 Is1 pk | 11.14 A | Current | Transformer Secondary1 Peak Current |
| 10. | Avg Rectified Vin | 291.303 V | General | Average Rectified Voltage for the AC Line Period |
| 11. | BOM Count | 26 | General | Total Design BOM count |
| 12. | FootPrint | 961.0 mm ² | General | Total Foot Print Area of BOM components |
| 13. | Pout | 10.746 W | General | Total output power |
| 14. | Total BOM | \$0.0 | General | Total BOM Cost |
| 15. | Q1 Tj | 85.187 degC | Op_Point | Q1 Junction Temperature |
| 16. | Vout OP | 5.373 V | Op_Point | Operational Output Voltage |
| 17. | Duty Cycle | 16.956 % | Op_point | Duty cycle |
| 18. | Efficiency | 75.32 % | Op_point | Steady state efficiency |
| 19. | Frequency_ | 63.29 kHz | Op_point | Switching frequency |
| 20. | IC Tj | 30.001 degC | Op_point | IC junction temperature |
| 21. | ICThetaJA | 70.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 22. | IOUT_OP | 2.0 A | Op_point | Iout operating point |
| 23. | Min Rectified Vin | 271.482 V | Op_point | Minimum voltage seen at rectified input |
| 24. | Peak Rectified Vin | 311.124 V | Op_point | Peak voltage seen at rectified input |
| 25. | Vin_OP_RMS | 220.0 V | Op_point | AC Input RMS Voltage |
| 26. | Vout p-p | 38.991 mV | Op_point | Peak-to-peak output ripple voltage |
| 27. | Avg Bridge Diode Pd | 69.383 mW | Power | Average Power Dissipation in the Bridge Diode over the AC Line Period |
| 28. | Cin Pd | 1.861 mW | Power | Input capacitor power dissipation |
| 29. | Cout Pd | 51.56 mW | Power | Output capacitor power dissipation |
| 30. | Diode2 Pd | 1.002 W | Power | Diode2 power dissipation |
| 31. | IC Pd | 9.35 µW | Power | IC power dissipation |
| 32. | Q1 Pd | 1.092 W | Power | Q1 Power Dissipation |
| 33. | Total Pd | 3.521 W | Power | Total Power Dissipation |
| 34. | Xformer Pd | 720.39 mW | Power | Transformer power dissipation |
| 35. | Zener Pd | 251.764 mW | Power | Zener power dissipation |

Design Inputs

| # | Name | Value | Description |
|-----|-------------|----------|------------------------------------|
| 1. | Iout | 2.0 | Maximum Output Current |
| 2. | Iout1 | 2.0 | Output Current #1 |
| 3. | VinMax | 220.0 | Maximum input voltage |
| 4. | VinMin | 110.0 | Minimum input voltage |
| 5. | Vout | 5.0 | Output Voltage |
| 6. | Vout1 | 5.0 | Output Voltage #1 |
| 7. | acFrequency | 50.0 | Light Output in Lumen |
| 8. | base_pn | UCC28720 | Texas Instruments Base Part Number |
| 9. | source | AC | Input Source Type |
| 10. | ta | 30.0 | Ambient temperature |

Design Assistance

1. Application Hints Rbld Rbld is used to set a minimum load for the circuit, so that in standby the output voltage does not float up. The value chosen by WEBENCH should be a good starting point but may need to be adjusted to achieve minimum power dissipation at standby as well. Rlc Rlc provides the function of feed-forward line compensation to eliminate change in IPP due to change in di/dt and the propagation delay of the internal comparator and MOSFET turn-off time. For best results the chosen value may need to be adjusted based on board, FET and transformer parasitics. Rcbc Rcbc is used to set the amount of output voltage compensation to offset cable resistance. Connecting this resistor from the CBC pin to GND will program a current that is summed into the VS feedback divider, increasing the regulation voltage as Iout increases. Rfbt & Rfbb The feedback resistors will set the output voltage of the circuit. The values chosen may need to be fine tuned based on the final Transformer turns ratios and the voltage across the output diode at close to zero current. Part Description The UCC28700 family of flyback power supply controllers provides Constant-Voltage (CV) and Constant-Current (CC) output regulation. Primary-Side Regulation (PSR) eliminates the use of an Opto-Coupler. Please see the datasheet for further design guidance. <http://www.ti.com/lit/ds/symlink/ucc28720.pdf>
2. UCC28720 Product Folder : <http://www.ti.com/product/UCC28720> : contains the data sheet and other resources.

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