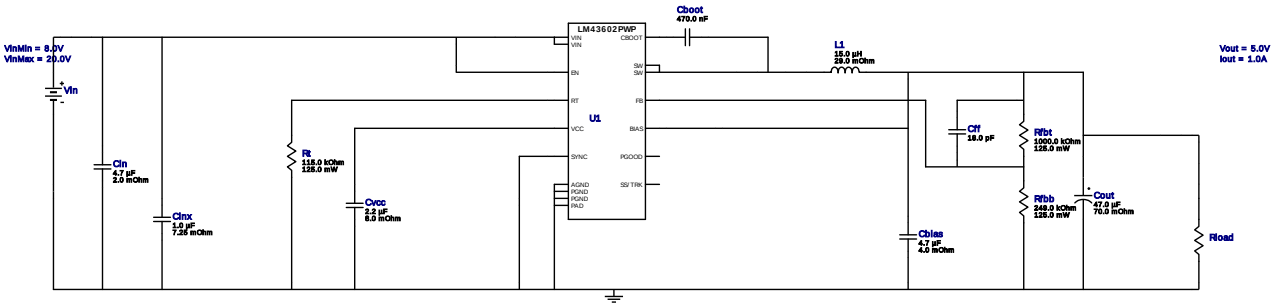
# WEBENCH® Design Report

VinMin = 8.0V
VinMax = 20.0V
Vout = 5.0V
Iout = 1.0A

Device = LM43602PWPR
Topology = Buck
Created = 6/16/15 5:37:28 AM
BOM Cost = $2.87
Footprint = 285.0 mm$^2$
BOM Count = 12
Total Pd = 0.28W

Design : 3931741/2 LM43602PWPR
LM43602PWPR 8.0V-20.0V to 5.00V @ 1.0A



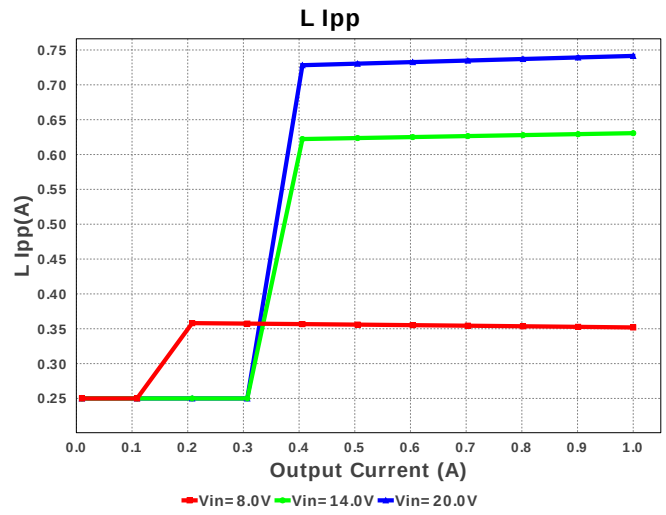

1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.

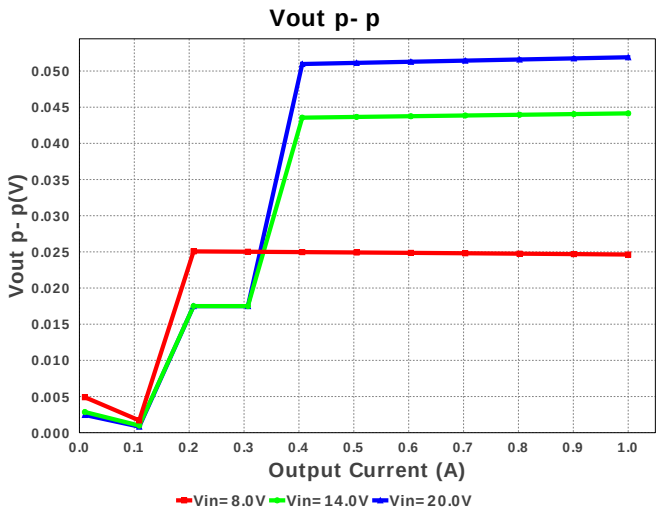
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating at a much lower voltage than the maximum input voltage. Sizing the inductor based on the maximum input voltage may yield an inductance much larger than typically needed, causing a larger footprint for the overall design. At the same time, components such as the input capacitor must be rated based on the maximum input voltage. WEBENCH now supports the use of this additional input voltage specification.

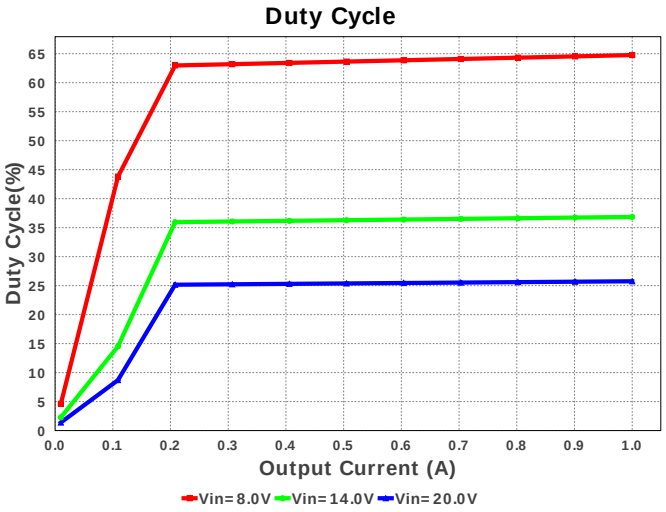
## Electrical BOM

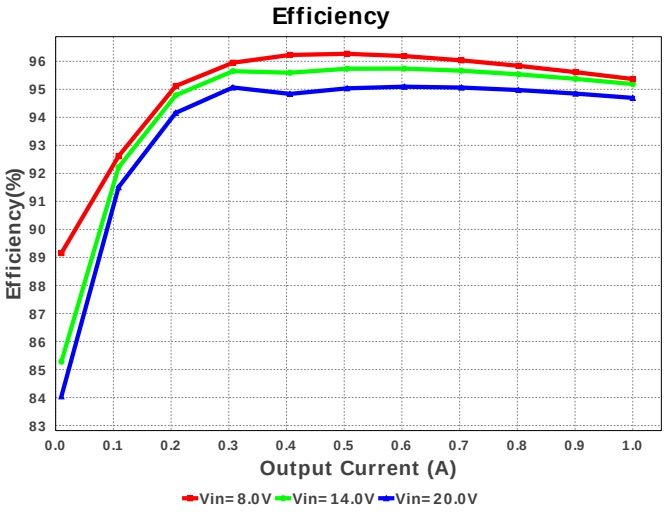
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cbias | Kemet | C0805C475K8PACTU<br>Series= X5R | Cap= 4.7 uF<br>ESR= 4.0 mOhm<br>VDC= 10.0 V<br>IRMS= 9.89 A | 1 | $0.03 | 0805 7 mm$^2$ |
| 2. | Cboot | MuRata | GRM155C80J474KE19D<br>Series= 379 | Cap= 470.0 nF<br>VDC= 6.3 V<br>IRMS= 0.0 A | 1 | $0.01 | 0402 3 mm$^2$ |
| 3. | Cff | Kemet | C0805C180M3GACTU<br>Series= C0G/NP0 | Cap= 18.0 pF<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm$^2$ |
| 4. | Cin | MuRata | GRM32ER71H475KA88L<br>Series= X7R | Cap= 4.7 uF<br>ESR= 2.0 mOhm<br>VDC= 50.0 V<br>IRMS= 5.35 A | 1 | $0.29 | 1210 15 mm$^2$ |
| 5. | Cinx | TDK | C2012X5R1E105K<br>Series= X5R | Cap= 1.0 uF<br>ESR= 7.25 mOhm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 1 | $0.03 | 0805 7 mm$^2$ |
| 6. | Cout | Panasonic | 10TPB47M<br>Series= 1356 | Cap= 47.0 uF<br>ESR= 70.0 mOhm<br>VDC= 10.0 V<br>IRMS= 1.1 A | 1 | $0.36 | 3528-20 17 mm$^2$ |
| 7. | Cvcc | Kemet | C0805C225K8RACTU<br>Series= X7R | Cap= 2.2 uF<br>ESR= 8.0 mOhm<br>VDC= 10.0 V<br>IRMS= 15.55 A | 1 | $0.03 | 0805 7 mm$^2$ |
| 8. | L1 | Bourns | SRU1048-150Y | L= 15.0 µH<br>DCR= 29.0 mOhm | 1 | $0.33 | SRU1048 144 mm$^2$ |

| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 9. | Rfbb | Panasonic | ERJ-6ENF2493V<br>Series= 225 | Res= 249.0 kOhm<br>Power= 125.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0805 7 mm² |
| 10. | Rfbt | Panasonic | ERJ-6ENF1004V<br>Series= 225 | Res= 1000.0 kOhm<br>Power= 125.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0805 7 mm² |
| 11. | Rt | Panasonic | ERJ-6ENF1153V<br>Series= 225 | Res= 115.0 kOhm<br>Power= 125.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0805 7 mm² |
| 12. | U1 | Texas Instruments | LM43602PWPR | Switcher | 1 | $1.75 | PWP0016F 59 mm² |

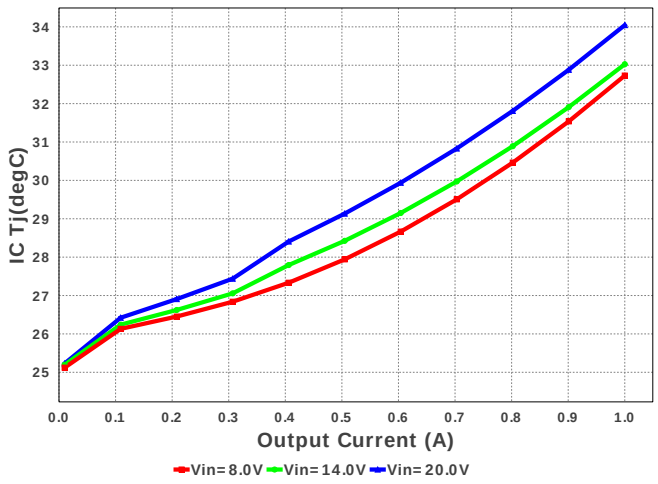


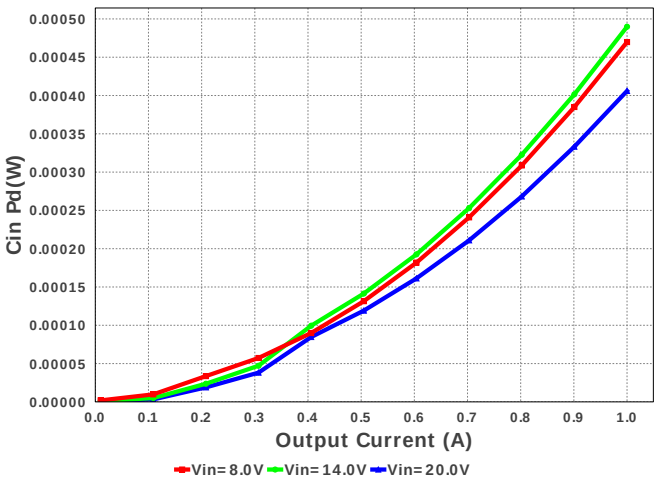



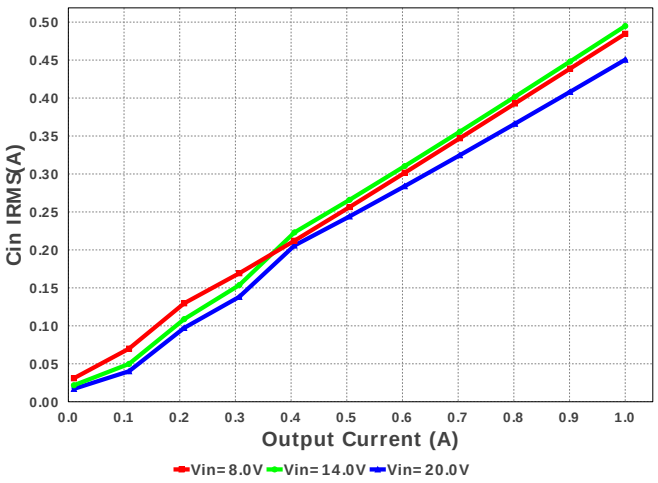
## IC Tj



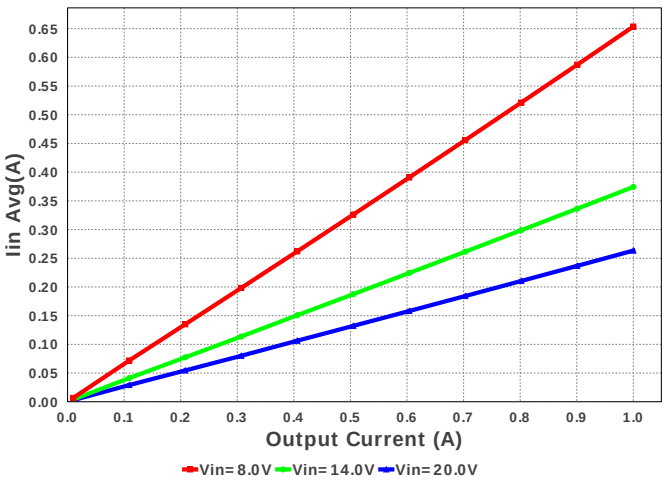

## Cin Pd



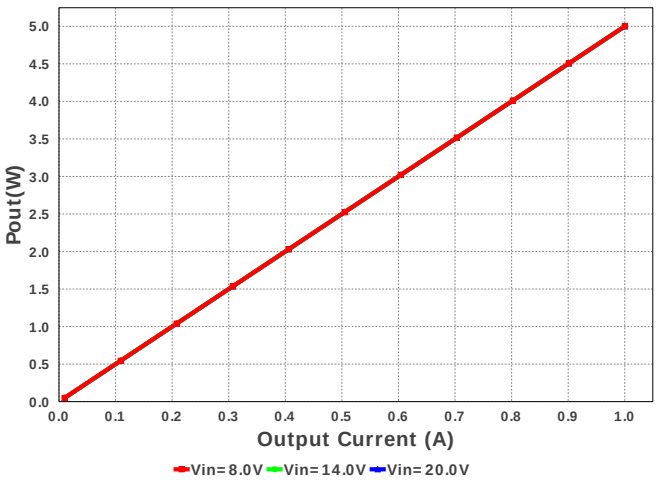

## Cin IRMS



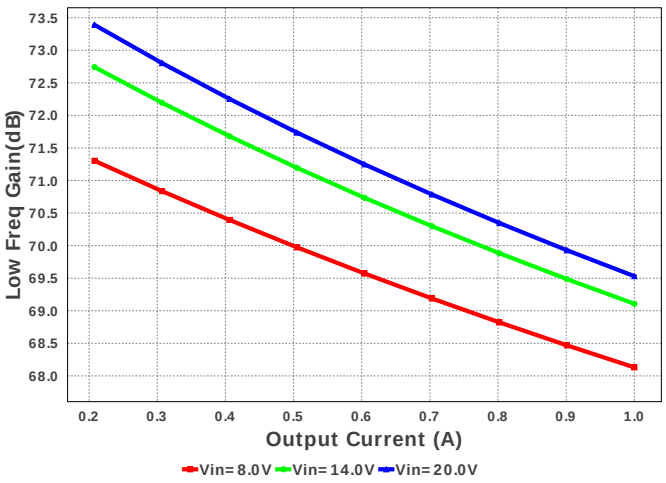

## Iin Avg

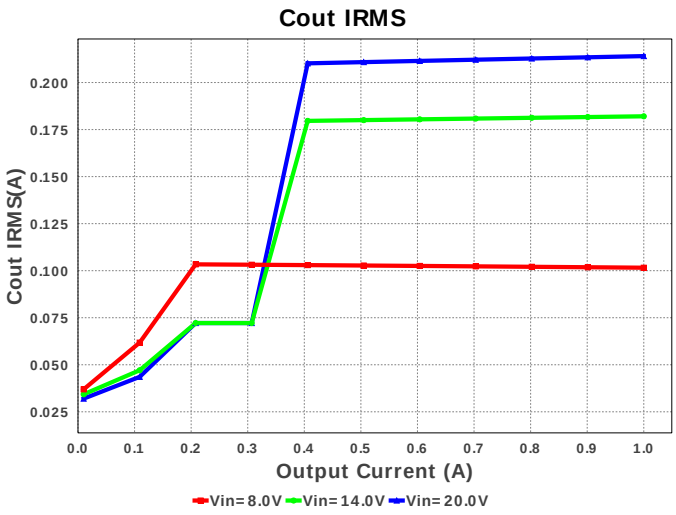


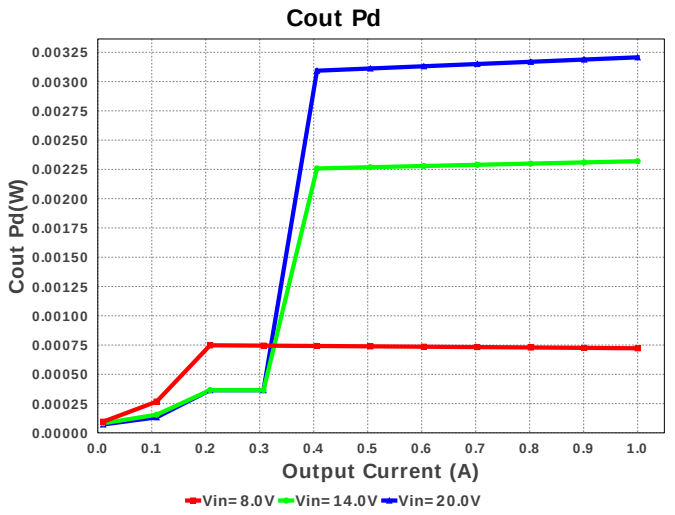

## Pout

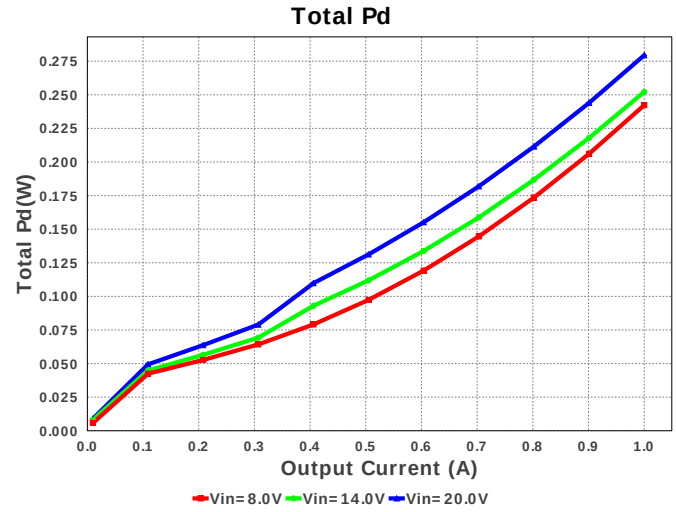


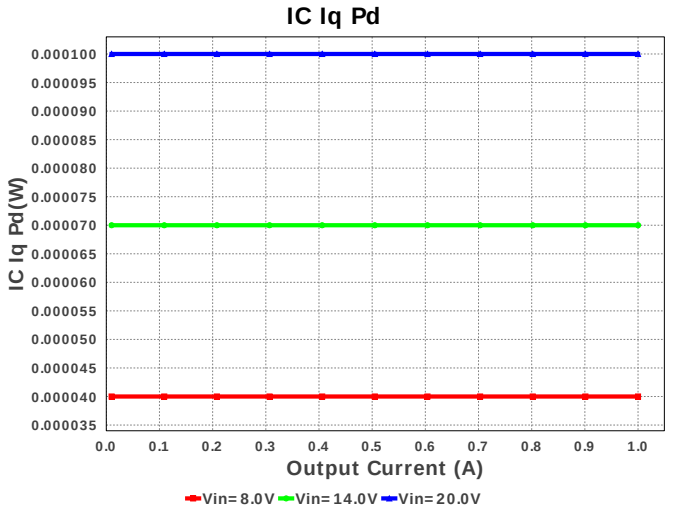

## Low Freq Gain

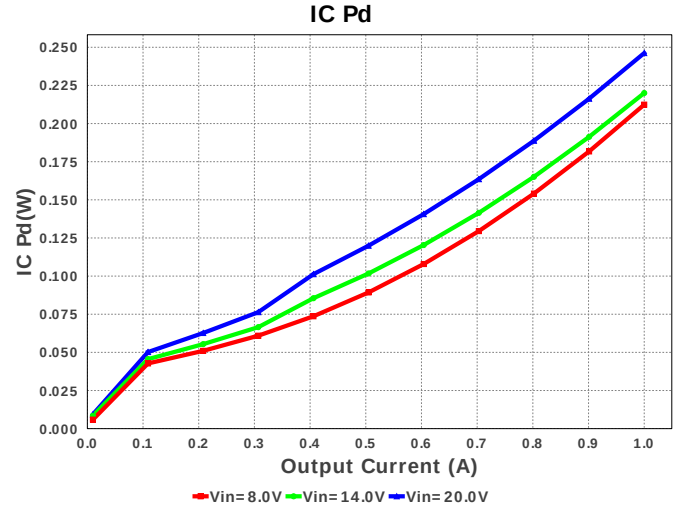


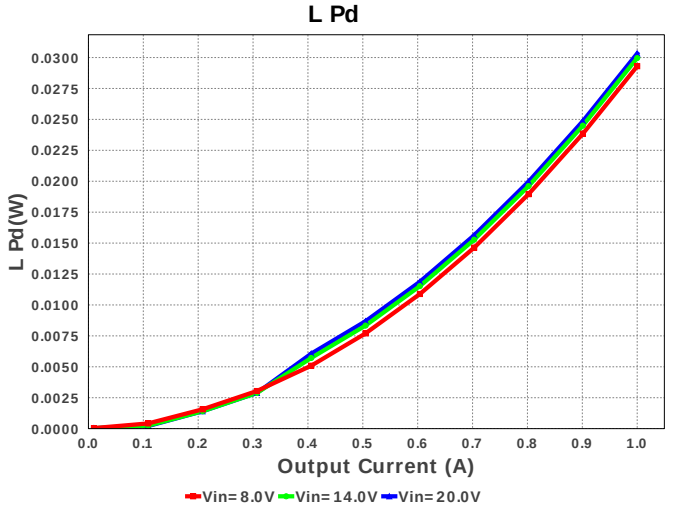


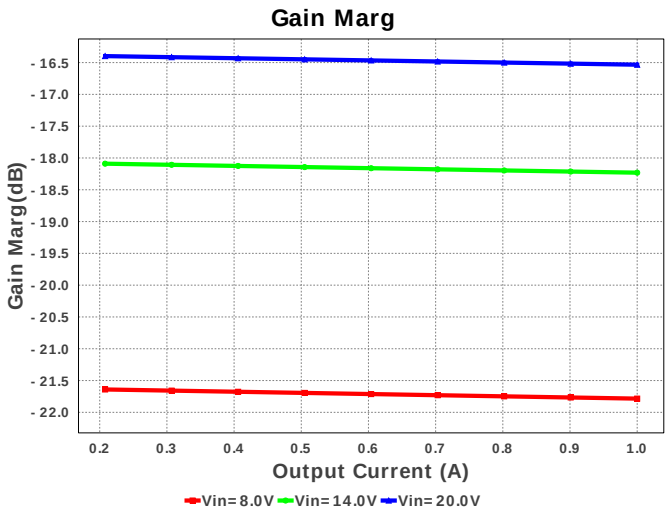



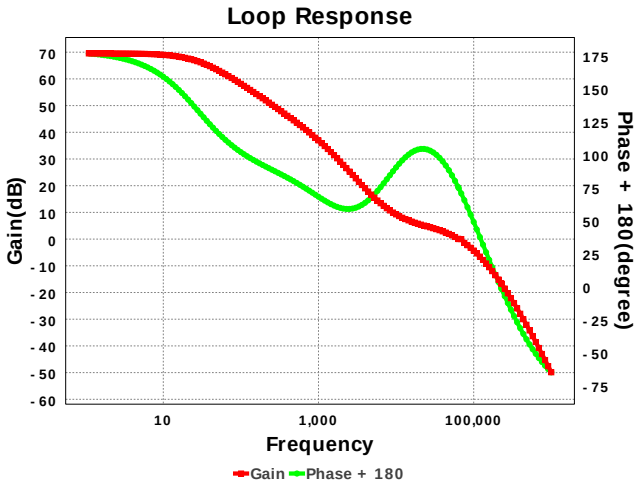



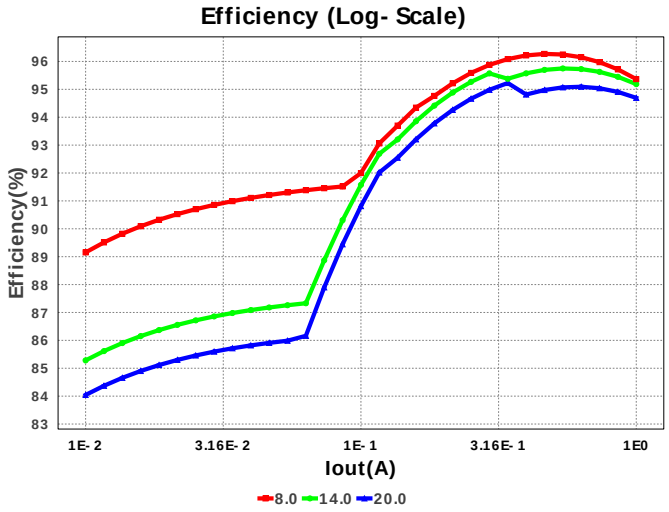






## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 450.374 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 212.669 mA | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 263.35 mA | Current | Average input current |
| 4. | L Ipp | 736.71 mA | Current | Peak-to-peak inductor ripple current |
| 5. | BOM Count | 12 | General | Total Design BOM count |
| 6. | FootPrint | 285.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 7. | Frequency | 350.0 kHz | General | Switching frequency |
| 8. | Pout | 5.0 W | General | Total output power |
| 9. | Total BOM | $2.87 | General | Total BOM Cost |
| 10. | Vout OP | 5.0 V | Op_Point | Operational Output Voltage |
| 11. | Cross Freq | 64.131 kHz | Op_point | Bode plot crossover frequency |
| 12. | Duty Cycle | 25.749 % | Op_point | Duty cycle |
| 13. | Efficiency | 94.684 % | Op_point | Steady state efficiency |
| 14. | Gain Marg | -16.61 dB | Op_point | Bode Plot Gain Margin |
| 15. | IC Tj | 34.067 degC | Op_point | IC junction temperature |
| 16. | ICThetaJA | 38.9 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 17. | IOUT_OP | 1.0 A | Op_point | Iout operating point |
| 18. | Phase Marg | 75.826 deg | Op_point | Bode Plot Phase Margin |
| 19. | VIN_OP | 20.0 V | Op_point | Vin operating point |
| 20. | Vout p-p | 51.57 mV | Op_point | Peak-to-peak output ripple voltage |
| 21. | Cin Pd | 405.673 µW | Power | Input capacitor power dissipation |
| 22. | Cout Pd | 3.166 mW | Power | Output capacitor power dissipation |
| 23. | IC Iq Pd | 100.0 µW | Power | IC Iq Pd |
| 24. | IC Pd | 246.846 mW | Power | IC power dissipation |
| 25. | L Pd | 30.312 mW | Power | Inductor power dissipation |
| 26. | Total Pd | 279.994 mW | Power | Total Power Dissipation |
| 27. | Low Freq Gain | 69.549 dB | Unknown | Gain at 10Hz |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 1.0 | Maximum Output Current |
| 2. | Iout1 | 1.0 | Output Current #1 |
| 3. | VinMax | 20.0 | Maximum input voltage |
| 4. | VinMin | 8.0 | Minimum input voltage |
| 5. | Vout | 5.0 | Output Voltage |
| 6. | Vout1 | 5.0 | Output Voltage #1 |
| 7. | base_pn | LM43602 | Base Product Number |
| 8. | source | DC | Input Source Type |
| 9. | Ta | 25.0 | Ambient temperature |

## Design Assistance

1. **LM43602** Product Folder : http://www.ti.com/product/LM43602 : contains the data sheet and other resources.