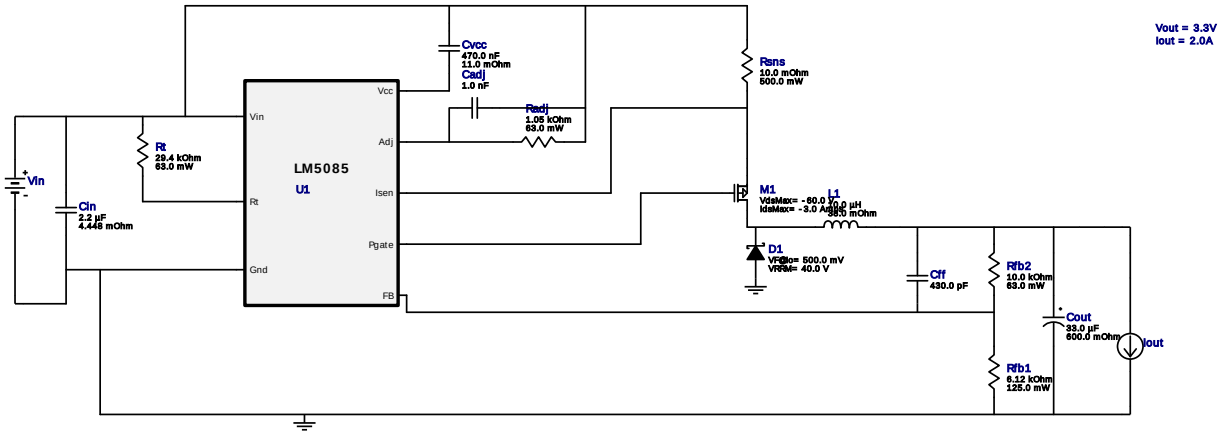
# WEBENCH® Design Report

VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

Device = LM5085MY/NOPB
Topology = Buck
Created = 9/19/16 10:55:50 PM
BOM Cost = $1.83
BOM Count = 14
Total Pd = 1.26W

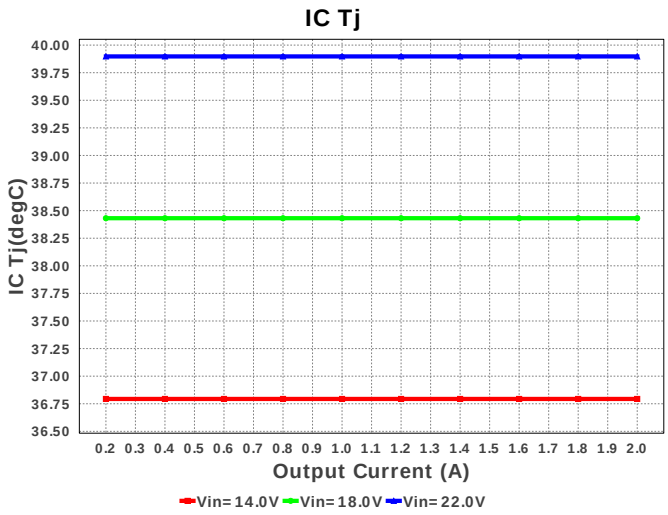
Design : 4796941/3 LM5085MY/NOPB
LM5085MY/NOPB 14.0V-22.0V to 3.30V @ 2.0A

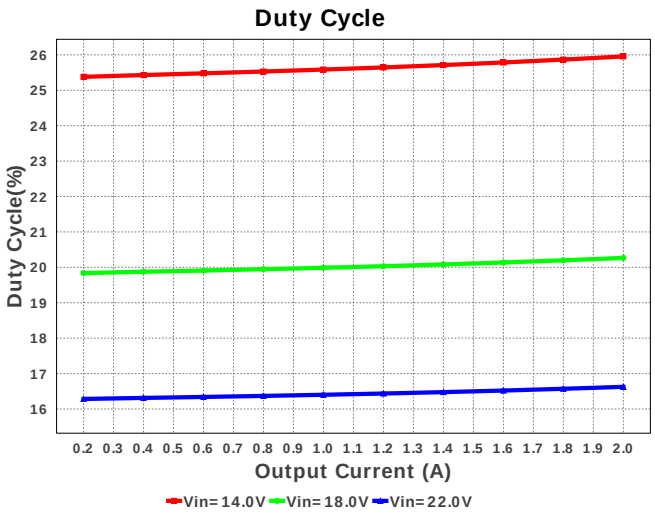


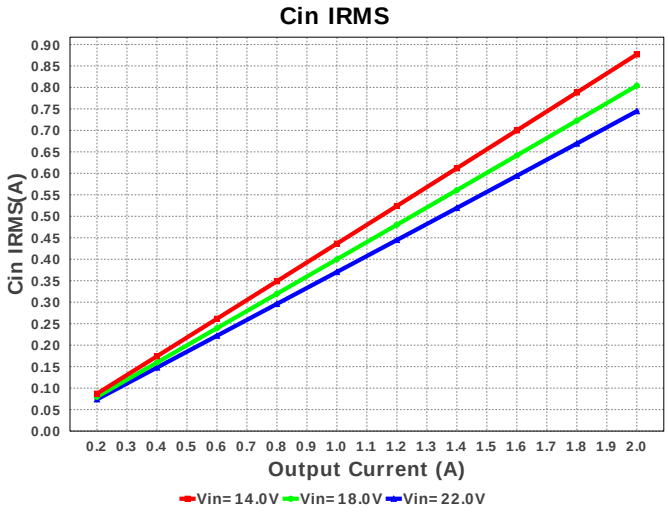

## Electrical BOM

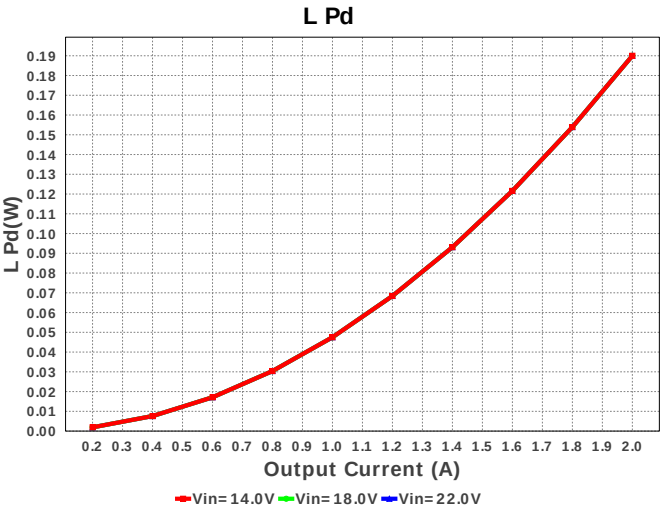
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cadj | Samsung Electro-Mechanics | CL21C102JBCNFNC<br>Series= C0G/NP0 | Cap= 1.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.01 | 0805 7 mm² |
| 2. | Cff | MuRata | GRM1555C1H431GA01D<br>Series= C0G/NP0 | Cap= 430.0 pF<br>VDC= 50.0 V<br>IRMS= 0.0 A | 1 | $0.02 | 0402 3 mm² |
| 3. | 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 mm² |
| 4. | Cout | AVX | TPSA336K006R0600<br>Series= TPS | Cap= 33.0 uF<br>ESR= 600.0 mOhm<br>VDC= 6.3 V<br>IRMS= 318.0 mA | 1 | $0.13 | 3216-18 11 mm² |
| 5. | Cvcc | AVX | 0805YC474KAT2A<br>Series= X7R | Cap= 470.0 nF<br>ESR= 11.0 mOhm<br>VDC= 16.0 V<br>IRMS= 0.0 A | 1 | $0.02 | 0805 7 mm² |
| 6. | D1 | Diodes Inc. | B340A-13-F | VF@Io= 500.0 mV<br>VRRM= 40.0 V | 1 | $0.11 | SMA 37 mm² |
| 7. | L1 | TDK | VLP8040T-100M | L= 10.0 µH<br>DCR= 38.0 mOhm | 1 | $0.22 | VLP8040 113 mm² |
| 8. | M1 | Fairchild Semiconductor | FDC5614P | VdsMax= -60.0 V<br>IdsMax= -3.0 Amps | 1 | $0.23 | SOT-23-6 15 mm² |
| 9. | Radj | Vishay-Dale | CRCW04021K05FKED<br>Series= CRCW..e3 | Res= 1.05 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm² |
| 10. | Rfb1 | Yageo America | RT0805BRD076K12L<br>Series= RT0805 | Res= 6.12 kOhm<br>Power= 125.0 mW<br>Tolerance= 0.1% | 1 | $0.05 | 0805 7 mm² |

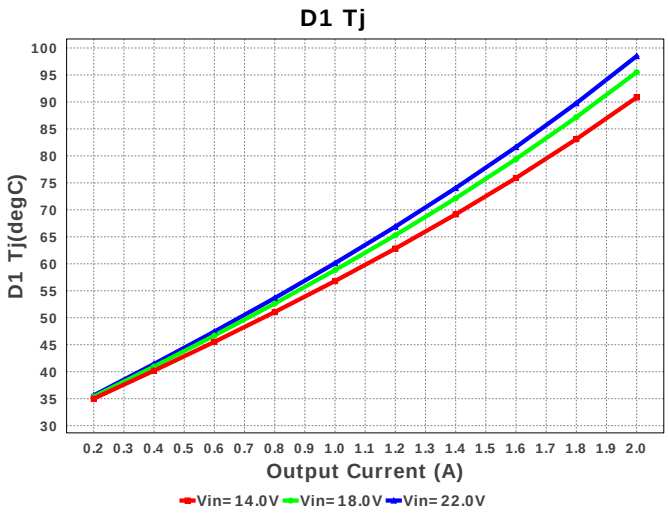
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|---|---|---|---|---|---|---|---|
| 11. | Rfb2 | Vishay-Dale | CRCW040210K0FKED<br>Series= CRCW..e3 | Res= 10.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| 12. | Rsns | Stackpole Electronics Inc | CSR1206FK10L0<br>Series= ? | Res= 10.0 mOhm<br>Power= 500.0 mW<br>Tolerance= 1.0% | 1 | $0.11 | 1206 11 mm$^2$ |
| 13. | Rt | Vishay-Dale | CRCW040229K4FKED<br>Series= CRCW..e3 | Res= 29.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1 | $0.01 | 0402 3 mm$^2$ |
| 14. | U1 | Texas Instruments | LM5085MY/NOPB | Switcher | 1 | $0.85 | MUY08A 24 mm$^2$ |

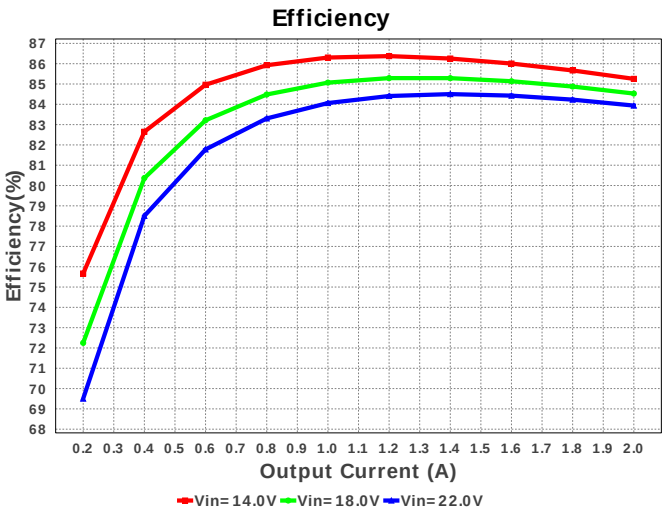


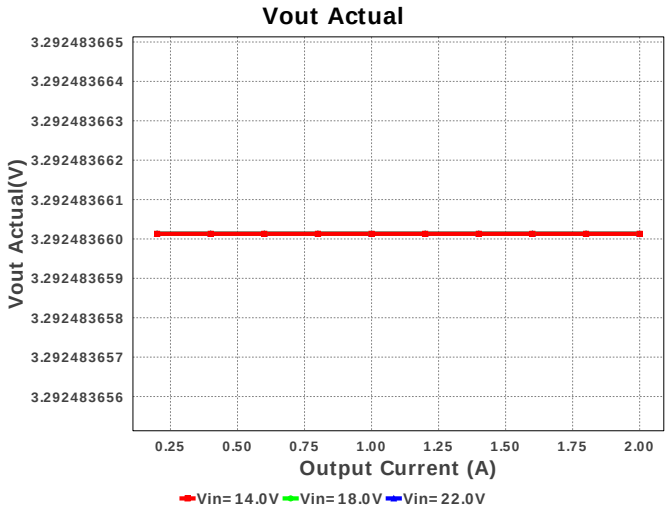



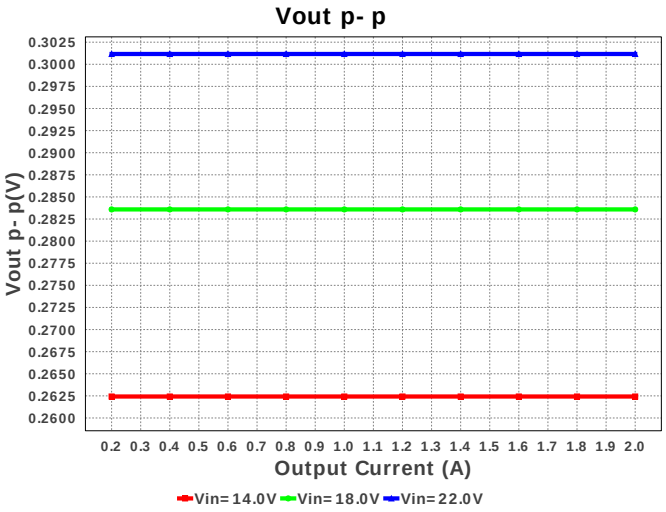



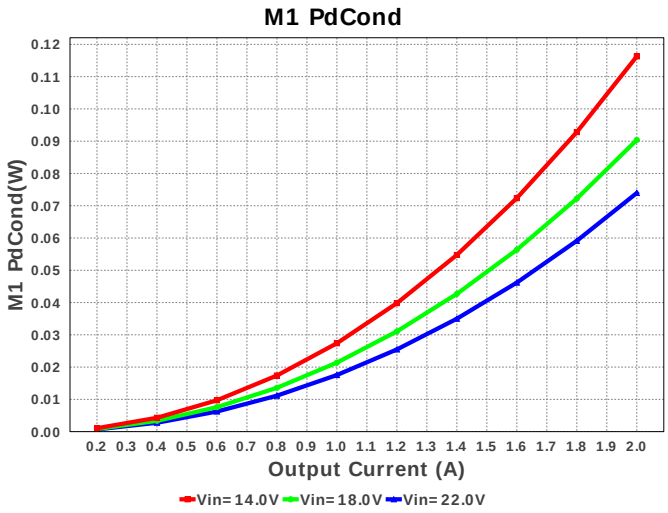



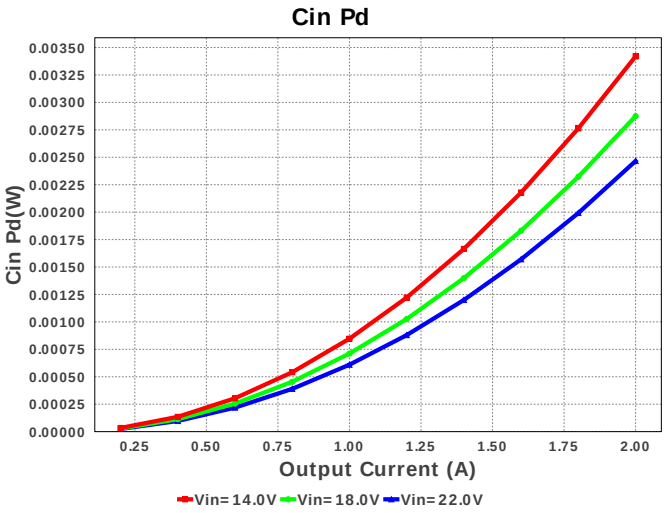


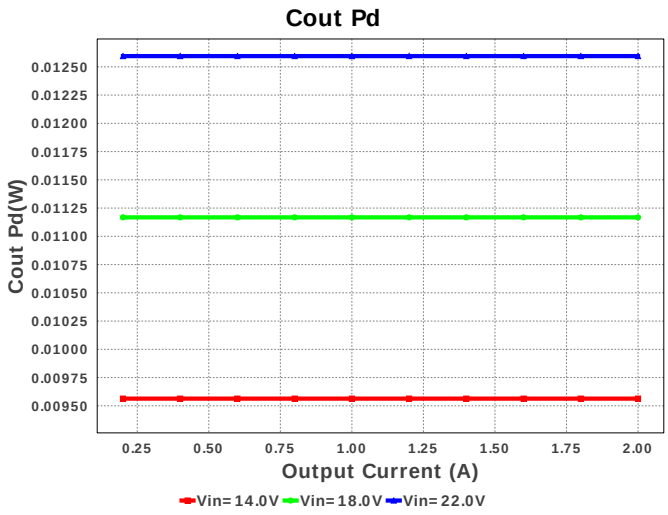



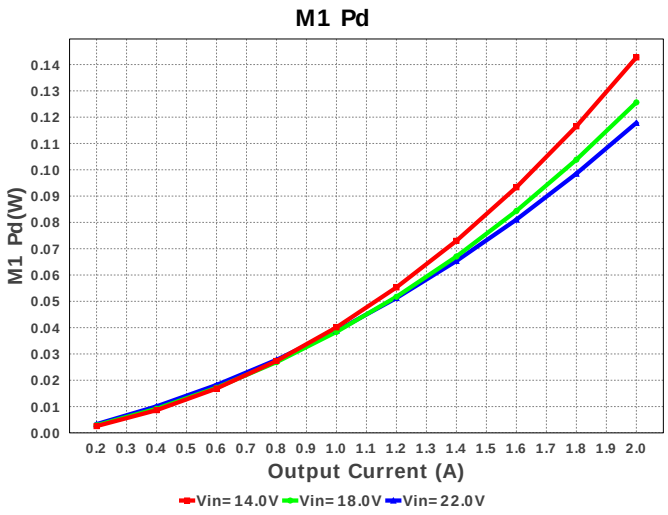



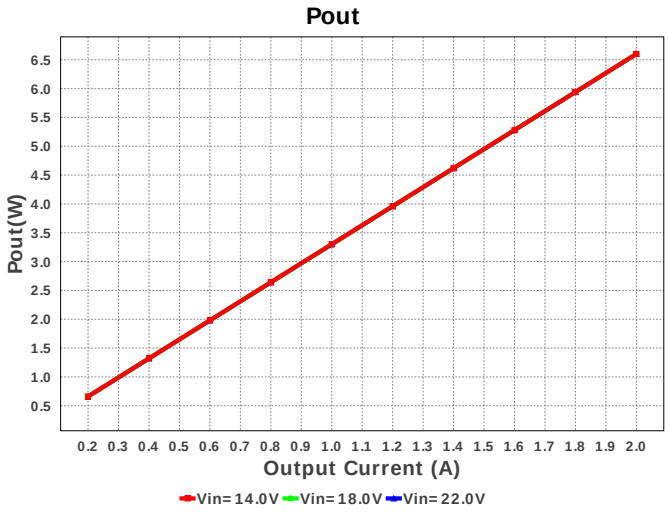



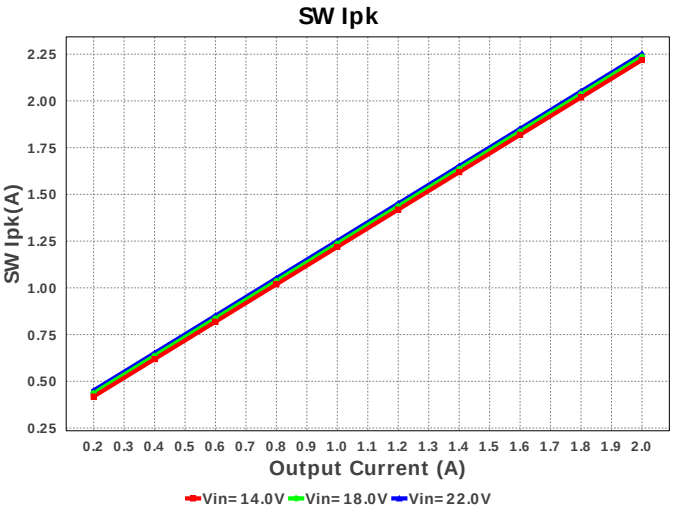



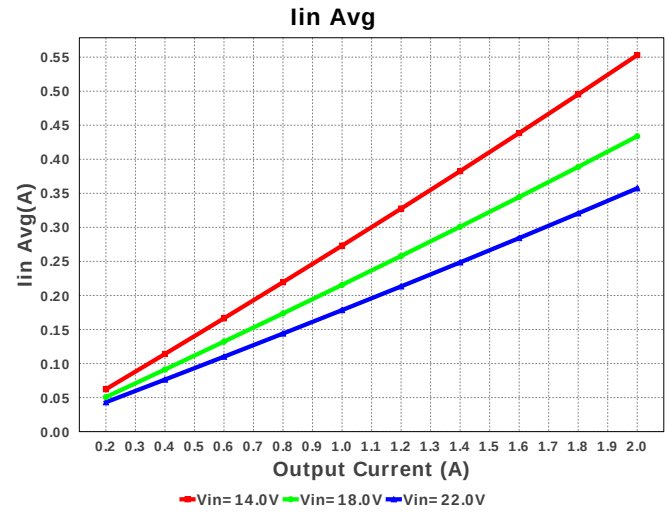



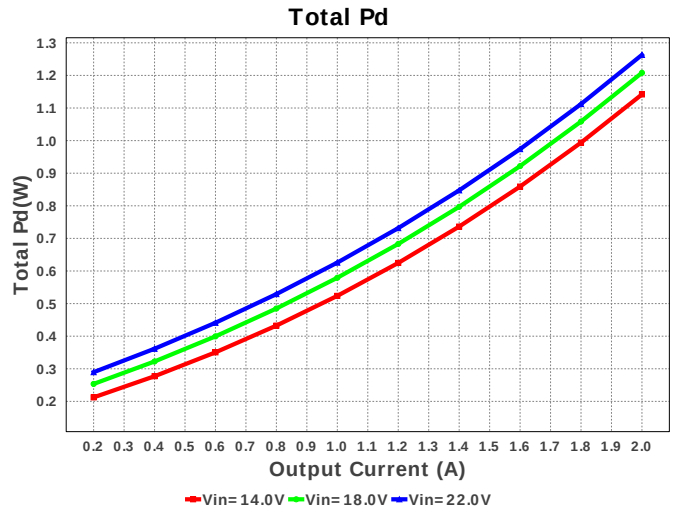


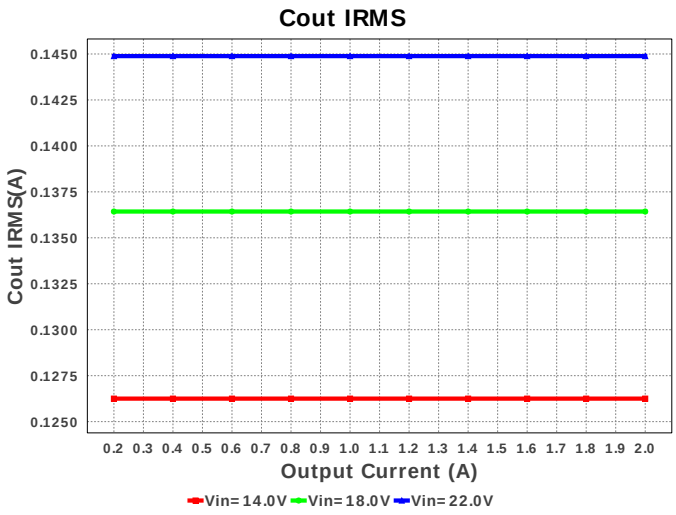



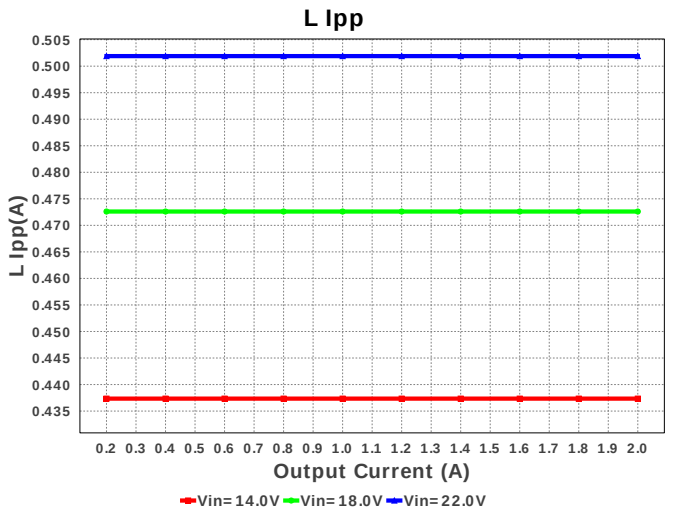



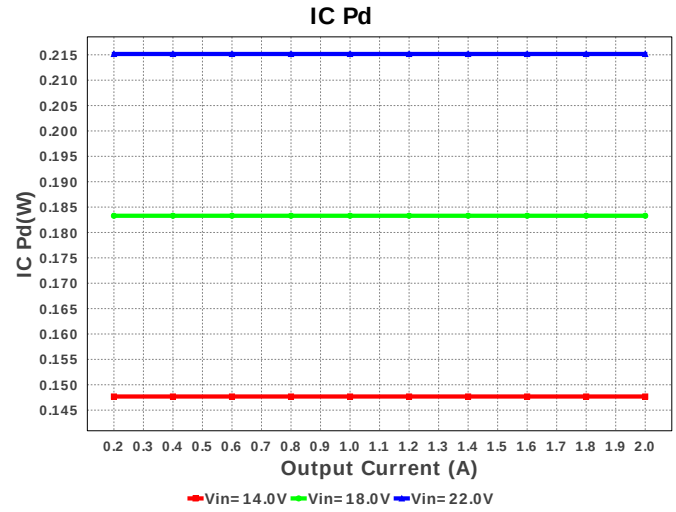



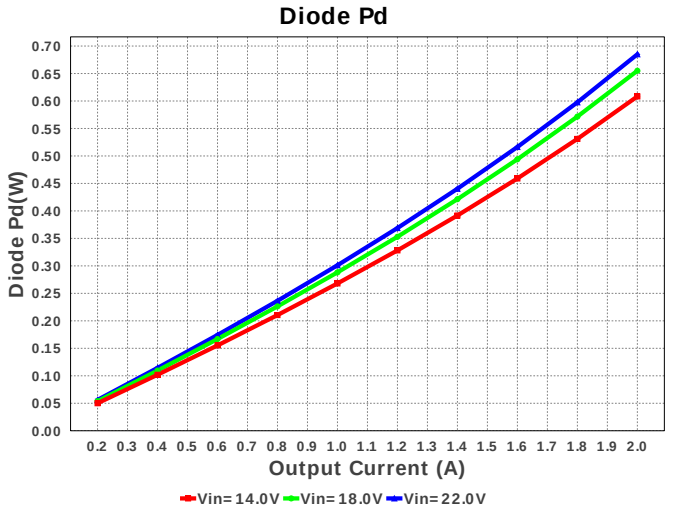



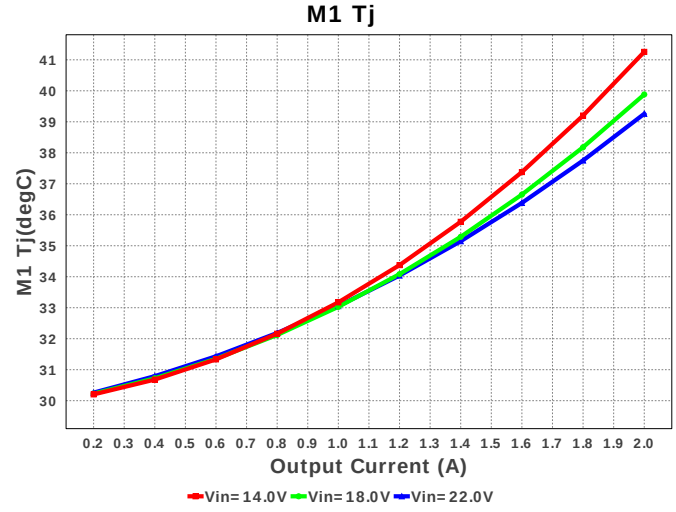



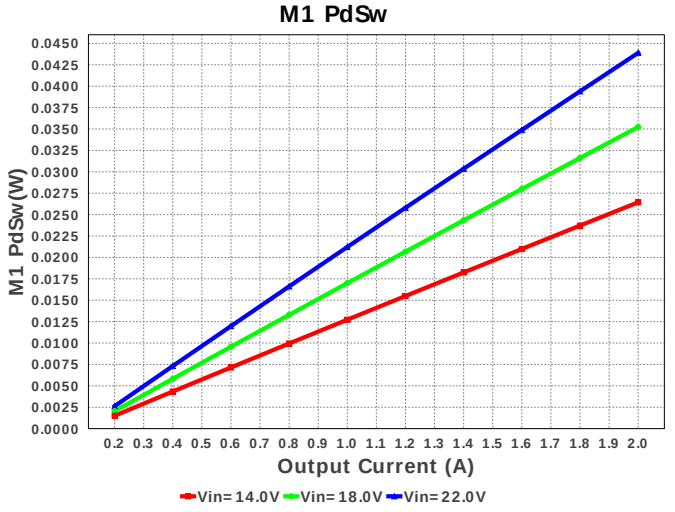



## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 744.614 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 144.885 mA | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 357.41 mA | Current | Average input current |
| 4. | L Ipp | 501.9 mA | Current | Peak-to-peak inductor ripple current |
| 5. | SW Ipk | 2.251 A | Current | Peak switch current |
| 6. | BOM Count | 14 | General | Total Design BOM count |
| 7. | FootPrint | 254.0 $mm^2$ | General | Total Foot Print Area of BOM components |
| 8. | Frequency | 471.114 kHz | General | Switching frequency |
| 9. | IC Tolerance | 25.0 mV | General | IC Feedback Tolerance |
| 10. | Mode | CCM | General | Conduction Mode |
| 11. | Pout | 6.6 W | General | Total output power |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 12. | Total BOM | $1.83 | General | Total BOM Cost |
| 13. | D1 Tj | 98.497 degC | Op_Point | D1 junction temperature |
| 14. | Vout Actual | 3.292 V | Op_Point | Vout Actual calculated based on selected voltage divider resistors |
| 15. | Vout OP | 3.3 V | Op_Point | Operational Output Voltage |
| 16. | Duty Cycle | 16.625 % | Op_point | Duty cycle |
| 17. | Efficiency | 83.937 % | Op_point | Steady state efficiency |
| 18. | IC Tj | 39.897 degC | Op_point | IC junction temperature |
| 19. | ICThetaJA | 46.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 20. | IOUT_OP | 2.0 A | Op_point | Iout operating point |
| 21. | M1 Tj | 39.258 degC | Op_point | M1 MOSFET junction temperature |
| 22. | VIN_OP | 22.0 V | Op_point | Vin operating point |
| 23. | Vout p-p | 301.165 mV | Op_point | Peak-to-peak output ripple voltage |
| 24. | Cin Pd | 2.466 mW | Power | Input capacitor power dissipation |
| 25. | Cout Pd | 12.595 mW | Power | Output capacitor power dissipation |
| 26. | Diode Pd | 684.967 mW | Power | Diode power dissipation |
| 27. | IC Pd | 215.161 mW | Power | IC power dissipation |
| 28. | L Pd | 190.0 mW | Power | Inductor power dissipation |
| 29. | M1 Pd | 117.836 mW | Power | M1 MOSFET total power dissipation |
| 30. | M1 PdCond | 73.946 mW | Power | M1 MOSFET conduction losses |
| 31. | M1 PdSw | 43.89 mW | Power | M1 MOSFET switching losses |
| 32. | Total Pd | 1.263 W | Power | Total Power Dissipation |
| 33. | Vout Tolerance | 2.697 % | | 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 | 22.0 | Maximum input voltage |
| 3. | VinMin | 14.0 | Minimum input voltage |
| 4. | Vout | 3.3 | Output Voltage |
| 5. | base_pn | LM5085 | Base Product Number |
| 6. | source | DC | Input Source Type |
| 7. | Ta | 30.0 | Ambient temperature |

## Design Assistance

1. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'optimal solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple

2. **LM5085** Product Folder : http://www.ti.com/product/LM5085 : contains the data sheet and other resources.