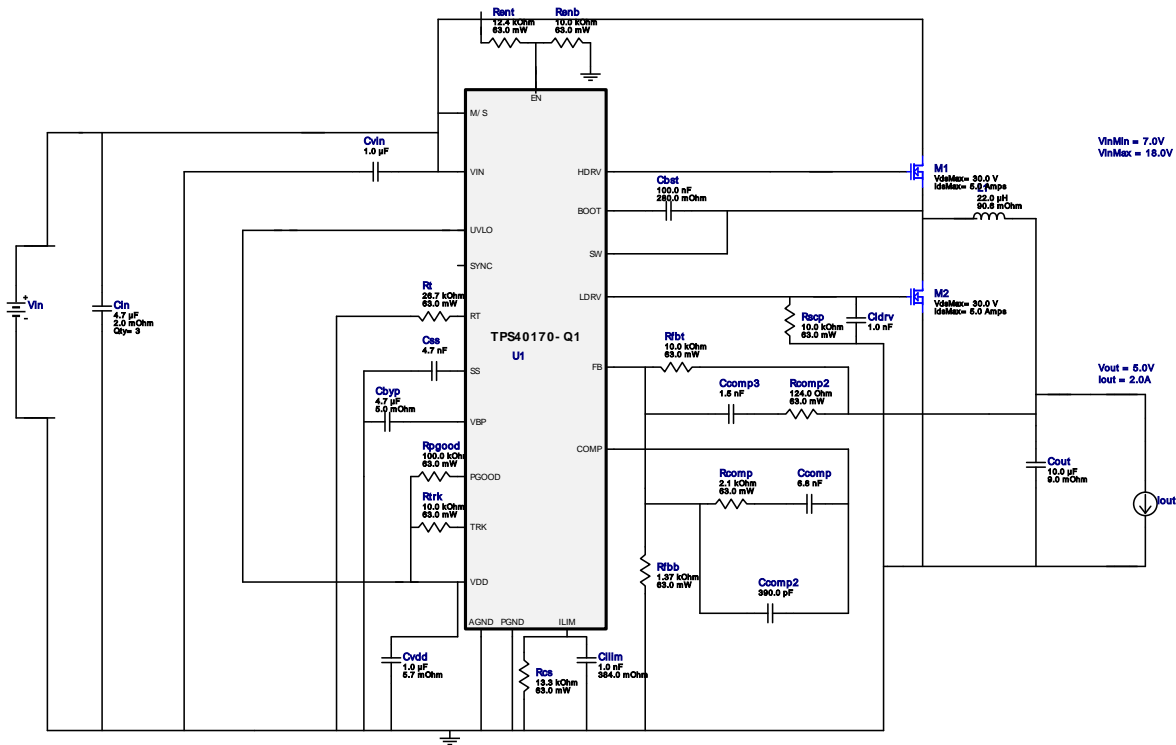






















WEBENCH® Design Report

Design : 3550864/10 TPS40170QRGYRQ1
TPS40170QRGYRQ1 7.0V-18.0V to 5.0V @ 2.0A


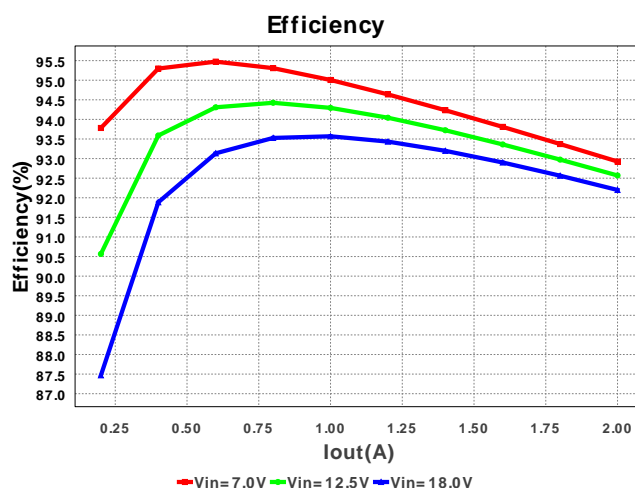
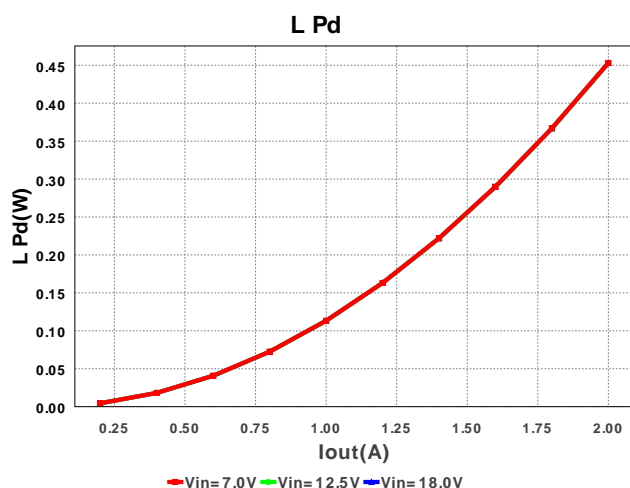
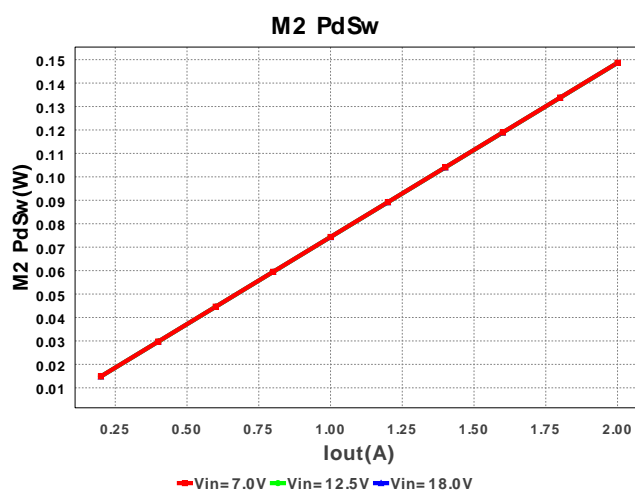
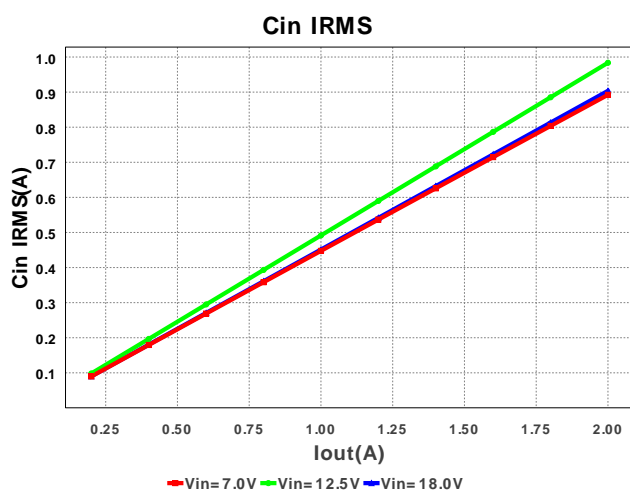
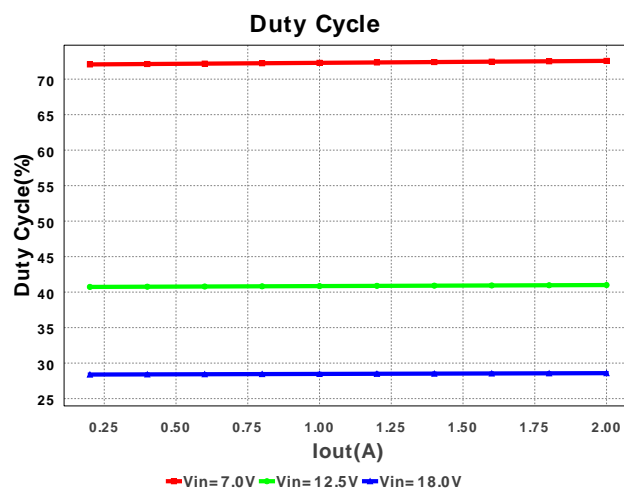
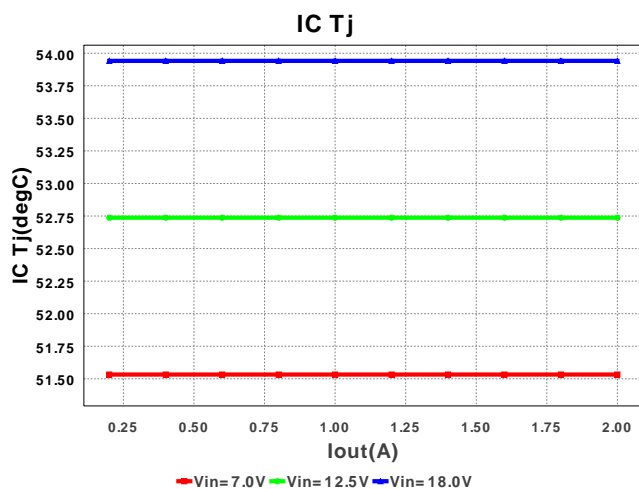
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. View WEBENCH(R) Disclaimer.

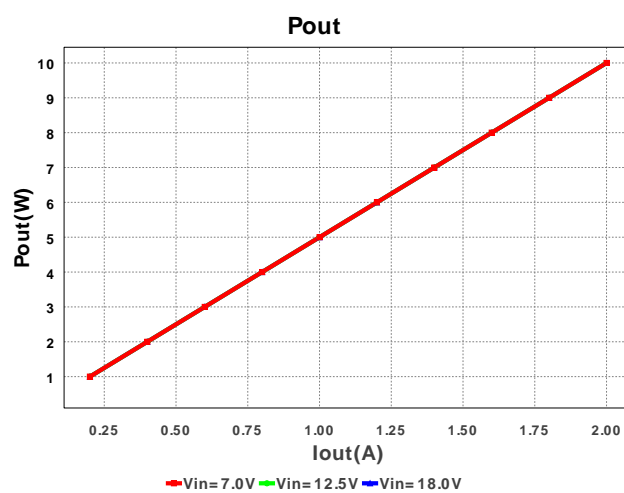
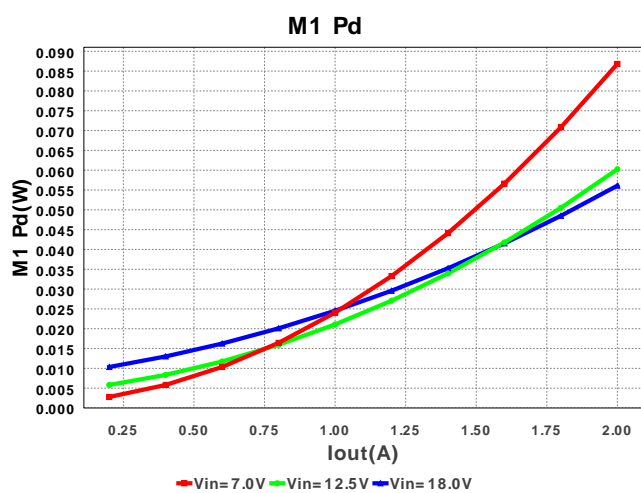
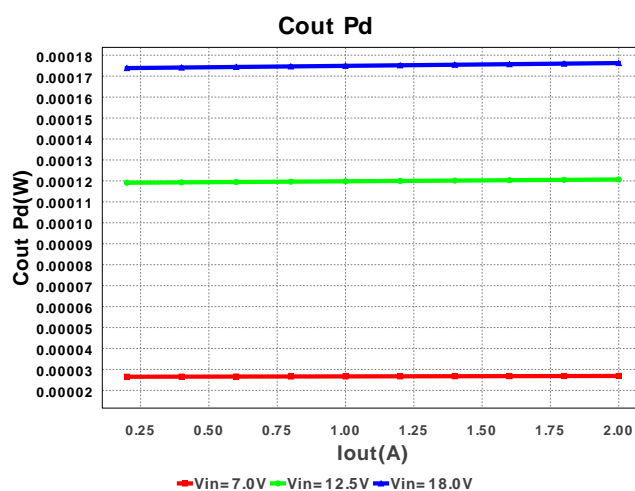
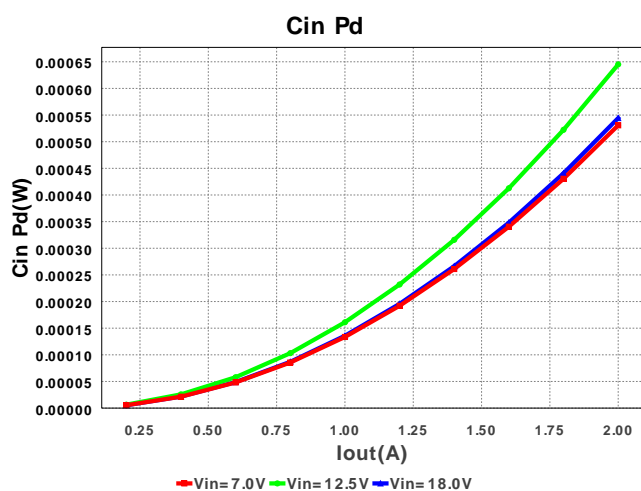
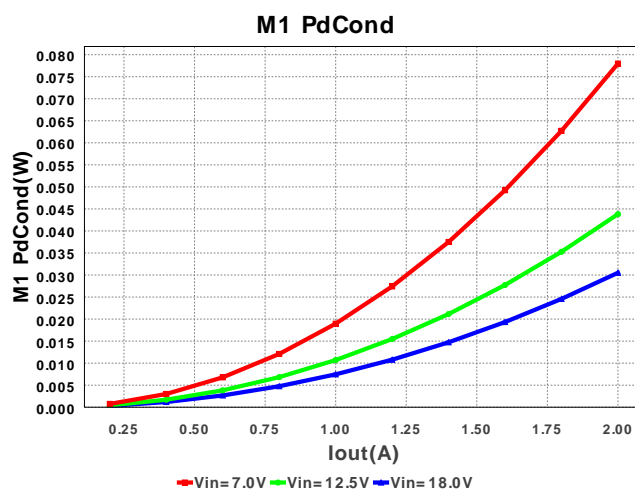
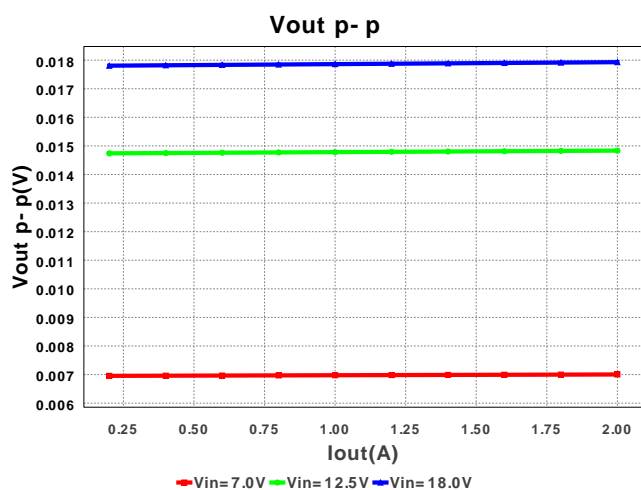
Electrical BOM

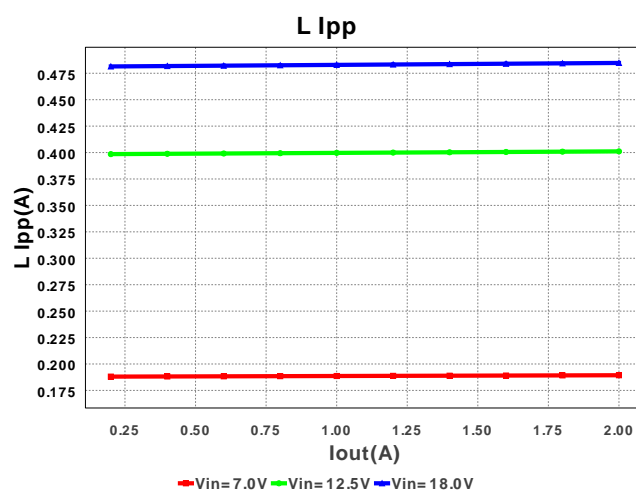
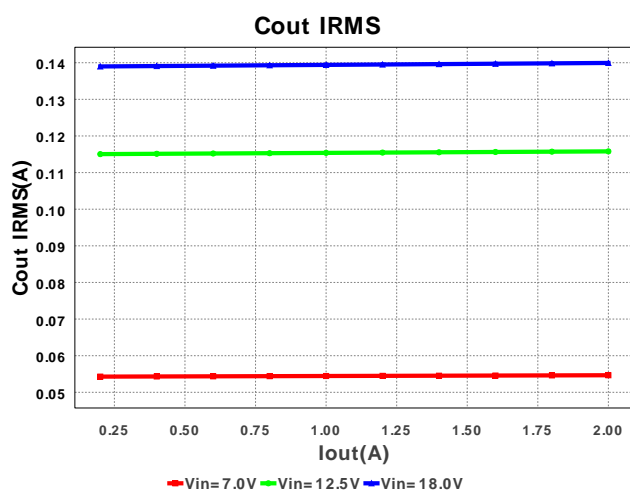
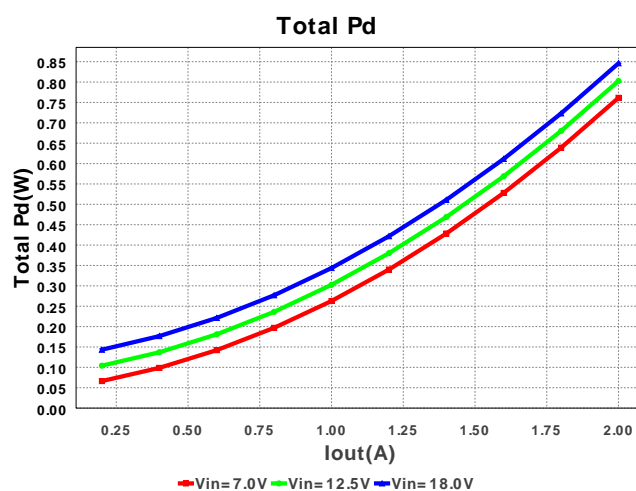
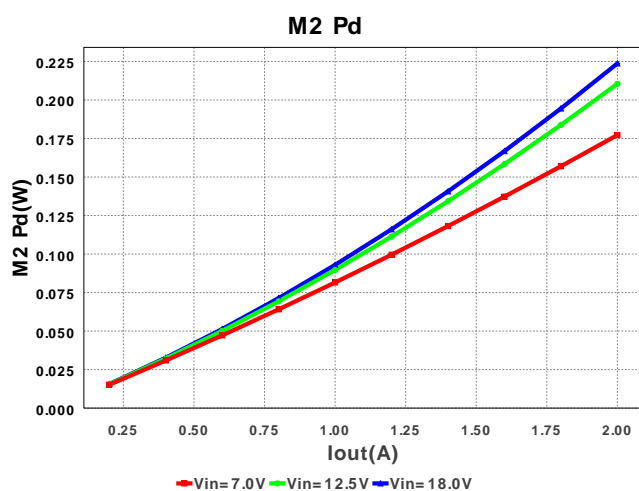
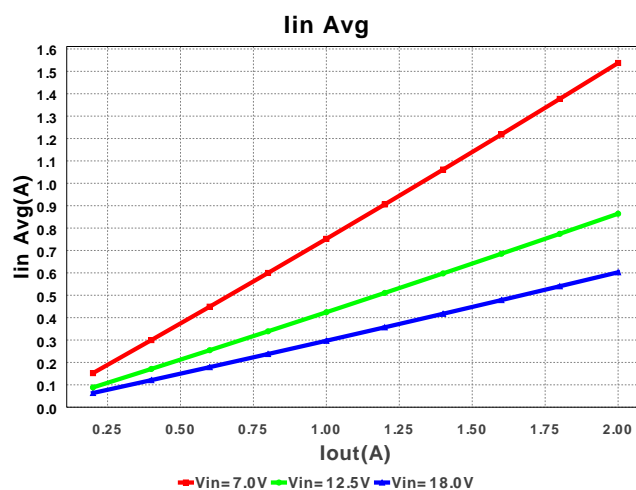
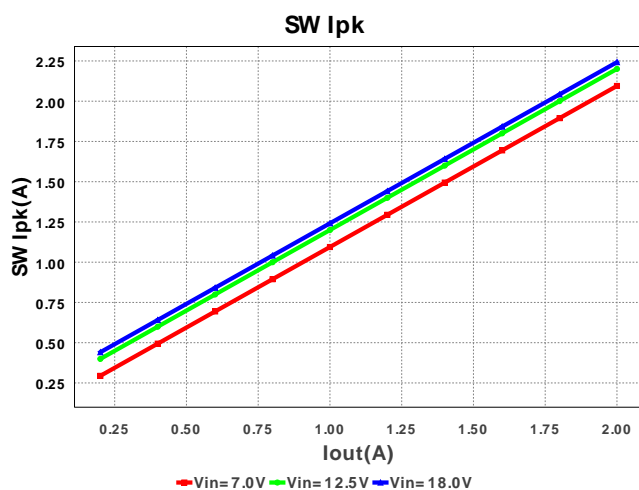
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|----|--------|---------------|-----------------------------------|---|-----|--------|-----------|
| 1. | Cbst | AVX | 08053C104KAT2A Series= X7R | Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A | 1 | \$0.01 | 0805 7mm2 |
| 2. | Cbyp | MuRata | GRM21BR61C475KA88L Series= X5R | Cap= 4.7 µF ESR= 5.0 mOhm VDC= 16.0 V IRMS= 0.0 A | 1 | \$0.04 | 0805 7mm2 |
| 3. | Ccomp | Yageo America | CC0805KRX7R9BB682 Series= X7R | Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A | 1 | \$0.01 | 0805 7mm2 |
| 4. | Ccomp2 | Yageo America | CC0805KRX7R9BB391 Series= X7R | Cap= 390.0 pF VDC= 50.0 V IRMS= 0.0 A | 1 | \$0.01 | 0805 7mm2 |
| 5. | Ccomp3 | Yageo America | CC0805KRX7R9BB152 Series= X7R | Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A | 1 | \$0.01 | 0805 7mm2 |
| 6. | Cilim | Kemet | C0805C102K5RACTU Series= X7R | Cap= 1.0 nF ESR= 384.0 mOhm VDC= 50.0 V IRMS= 214.0 mA | 1 | \$0.01 | 0805 7mm2 |

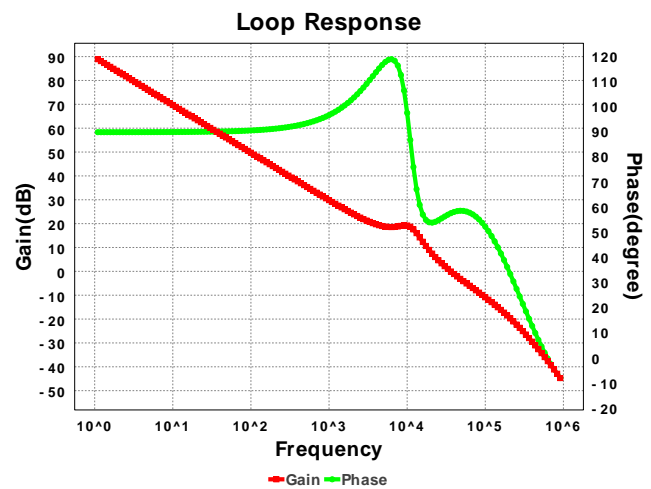
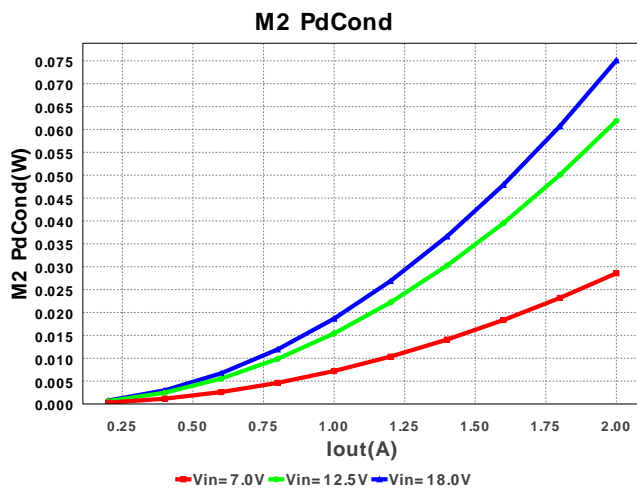
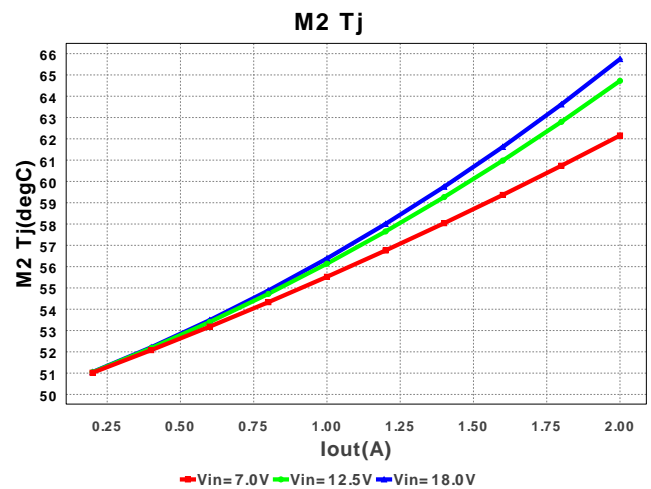
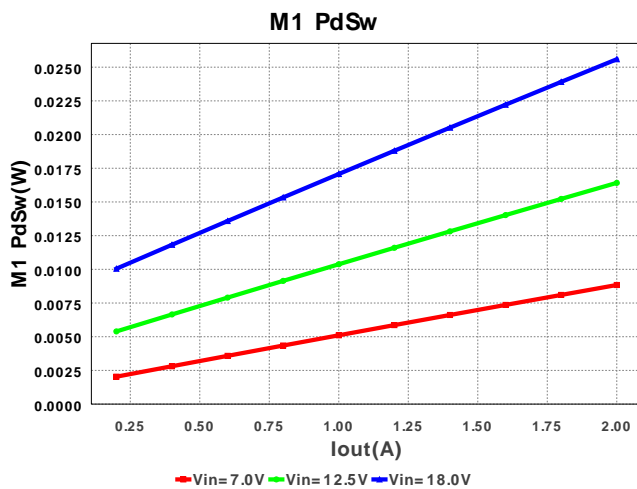
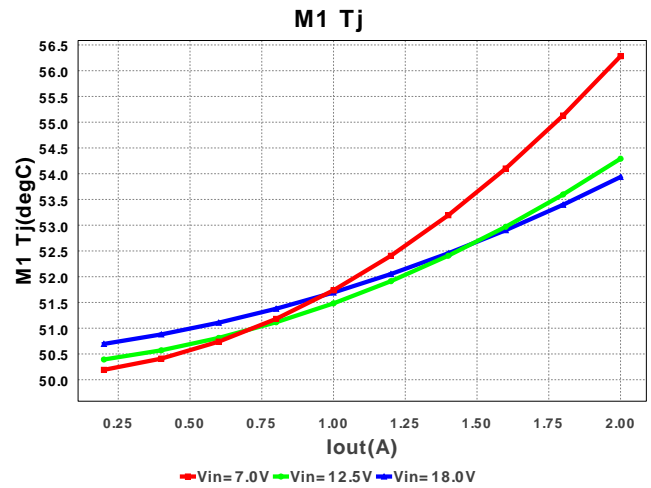
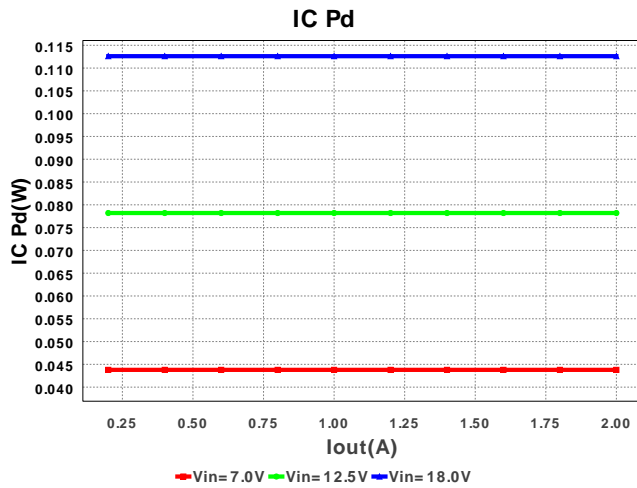
| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|-----|--------|-------------------|--------------------------------------|--|-----|--------|---|
| 7. | Cin | MuRata | GRM21BR61E475MA12L Series= X5R | Cap= 4.7 μ F ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A | 3 | \$0.06 |  0805 7mm2 |
| 8. | Cldrv | MuRata | GRM033R71E102KA01D Series= X7R | Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A | 1 | \$0.01 |  0201 2mm2 |
| 9. | Cout | MuRata | GRM188R60J106ME47D Series= X5R | Cap= 10.0 μ F ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A | 1 | \$0.03 |  0603 5mm2 |
| 10. | Css | MuRata | GRM033R61A472KA01D Series= X5R | Cap= 4.7 nF VDC= 10.0 V IRMS= 0.0 A | 1 | \$0.01 |  0201 2mm2 |
| 11. | Cvdd | TDK | C1608X5R1C105K Series= X5R | Cap= 1.0 μ F ESR= 5.7 mOhm VDC= 16.0 V IRMS= 0.0 A | 1 | \$0.01 |  0603 5mm2 |
| 12. | Cvin | MuRata | GRM188R61E105KA12D Series= X5R | Cap= 1.0 μ F VDC= 25.0 V IRMS= 0.0 A | 1 | \$0.01 |  0603 5mm2 |
| 13. | L1 | Coilcraft | XAL5050-223MEB | L= 22.0 μ H DCR= 90.6 mOhm | 1 | \$0.60 |  XAL5050 54mm2 |
| 14. | M1 | Texas Instruments | CSD17313Q2 | VdsMax= 30.0 V IdsMax= 5.0 Amps | 1 | \$0.17 |  TRANS_NexFET_Q2 9mm2 |
| 15. | M2 | Texas Instruments | CSD17313Q2 | VdsMax= 30.0 V IdsMax= 5.0 Amps | 1 | \$0.17 |  TRANS_NexFET_Q2 9mm2 |
| 16. | Rcomp | Vishay-Dale | CRCW04022K10FKED Series= CRCW..e3 | Res= 2.1 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 17. | Rcomp2 | Vishay-Dale | CRCW0402124RFKED Series= CRCW..e3 | Res= 124.0 Ohm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 18. | Rcs | Vishay-Dale | CRCW040213K3FKED Series= CRCW..e3 | Res= 13.3 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 19. | Renb | Vishay-Dale | CRCW040210K0FKED Series= CRCW..e3 | Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 20. | Rent | Vishay-Dale | CRCW040212K4FKED Series= CRCW..e3 | Res= 12.4 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 21. | Rfbb | Vishay-Dale | CRCW04021K37FKED Series= CRCW..e3 | Res= 1.37 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 22. | Rfbt | Vishay-Dale | CRCW040210K0FKED Series= CRCW..e3 | Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 23. | Rpgood | Vishay-Dale | CRCW0402100KFKED Series= CRCW..e3 | Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 24. | Rscp | Vishay-Dale | CRCW040210K0FKED Series= CRCW..e3 | Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 25. | Rt | Vishay-Dale | CRCW040226K7FKED Series= CRCW..e3 | Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |
| 26. | Rtrk | Vishay-Dale | CRCW040210K0FKED Series= CRCW..e3 | Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3mm2 |

| # | Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|-----|------|-------------------|-----------------|------------|-----|--------|-------------------|
| 27. | U1 | Texas Instruments | TPS40170QRGYRQ1 | Switcher | 1 | \$2.63 | R-PVQFN-N20 25mm2 |









Operating Values

| # | Name | Value | Category | Description |
|-----|--------------|-------------|----------|---|
| 1. | Cin IRMS | 903.625 mA | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 139.937 mA | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 602.62 mA | Current | Average input current |
| 4. | L Ipp | 484.755 mA | Current | Peak-to-peak inductor ripple current |
| 5. | SW Ipk | 2.242 A | Current | Peak switch current |
| 6. | BOM Count | 29 | General | Total Design BOM count |
| 7. | FootPrint | 209.0 mm2 | General | Total Foot Print Area of BOM components |
| 8. | Frequency | 348.432 kHz | General | Switching frequency |
| 9. | IC Tolerance | 6.0 μ V | General | IC Feedback Tolerance |
| 10. | Pout | 10.0 W | General | Total output power |
| 11. | Total BOM | \$4.02 | General | Total BOM Cost |

| # | Name | Value | Category | Description |
|-----|------------|-----------------|----------|------------------------------------|
| 12. | Cross Freq | 36.117 kHz | Op_point | Bode plot crossover frequency |
| 13. | Duty Cycle | 28.584 % | Op_point | Duty cycle |
| 14. | Efficiency | 92.19 % | Op_point | Steady state efficiency |
| 15. | IC Tj | 53.941 degC | Op_point | IC junction temperature |
| 16. | IOUT_OP | 2.0 A | Op_point | Iout operating point |
| 17. | M1 Tj | 53.937 degC | Op_point | M1 MOSFET junction temperature |
| 18. | M2 Tj | 65.745 degC | Op_point | M2 MOSFET junction temperature |
| 19. | Phase Marg | 57.778 deg | Op_point | Bode Plot Phase Margin |
| 20. | VIN_OP | 18.0 V | Op_point | Vin operating point |
| 21. | Vout p-p | 17.93 mV | Op_point | Peak-to-peak output ripple voltage |
| 22. | Cin Pd | 544.359 μ W | Power | Input capacitor power dissipation |
| 23. | Cout Pd | 176.241 μ W | Power | Output capacitor power dissipation |
| 24. | IC Pd | 112.61 mW | Power | IC power dissipation |
| 25. | L Pd | 453.0 mW | Power | Inductor power dissipation |
| 26. | M1 Pd | 56.385 mW | Power | M1 MOSFET total power dissipation |
| 27. | M1 PdCond | 30.796 mW | Power | M1 MOSFET conduction losses |
| 28. | M1 PdSw | 25.588 mW | Power | M1 MOSFET switching losses |
| 29. | M2 Pd | 224.422 mW | Power | M2 MOSFET total power dissipation |
| 30. | M2 PdCond | 75.801 mW | Power | M2 MOSFET conduction losses |
| 31. | M2 PdSw | 148.621 mW | Power | M2 MOSFET switching losses |
| 32. | Total Pd | 847.163 mW | Power | Total Power Dissipation |

Design Inputs

| # | Name | Value | Description |
|----|---------|-------------|------------------------|
| 1. | Iout | 2.0 A | Maximum Output Current |
| 2. | Iout1 | 2.0 Amps | Output Current #1 |
| 3. | VinMax | 18.0 V | Maximum input voltage |
| 4. | VinMin | 7.0 V | Minimum input voltage |
| 5. | Vout | 5.0 V | Output Voltage |
| 6. | Vout1 | 5.0 Volt | Output Voltage #1 |
| 7. | base_pn | TPS40170-Q1 | Base Product Number |
| 8. | source | DC | Input Source Type |
| 9. | Ta | 50.0 degC | Ambient temperature |

Design Assistance

1. Feature Highlights: Automotive Qualified 4.5V to 60V Wide Input Synchronous PWM Buck Controller
2. The TPS40170-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application
3. **TPS40170-Q1** Product Folder : <http://www.ti.com/product/tps40170-q1> : contains the data sheet and other resources.

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

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