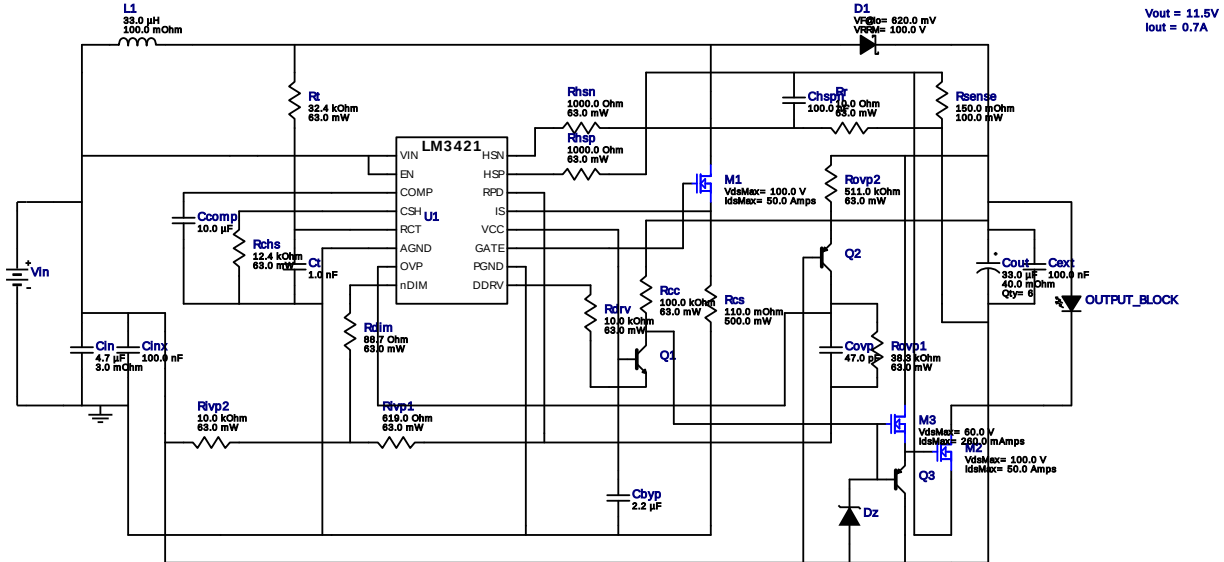


## WEBENCH® Design Report

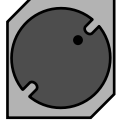
Design : 4331192/25 LM3421MHX/NOPB  
LM3421MHX/NOPB 24.0V-32.0V to 18.86V @ 0.6639684946236559A



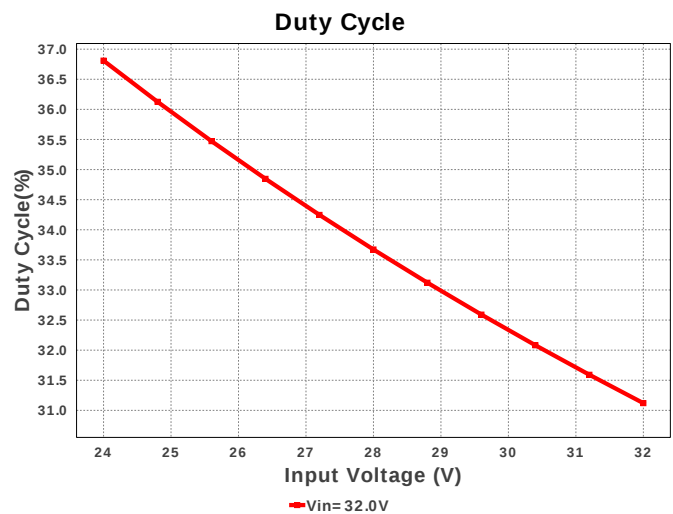
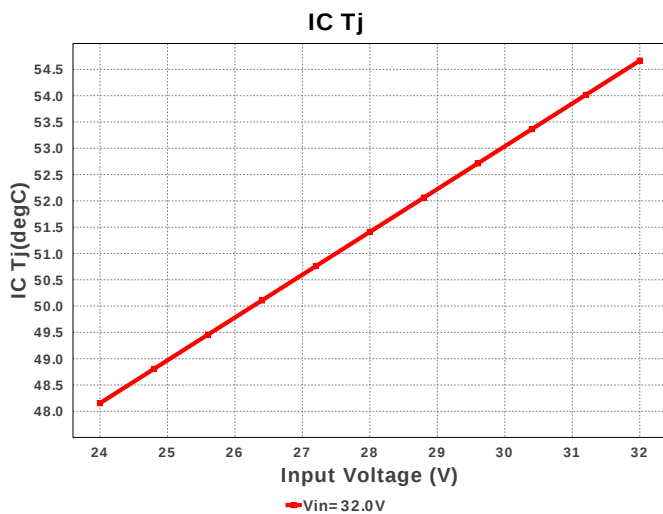
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

## Electrical BOM

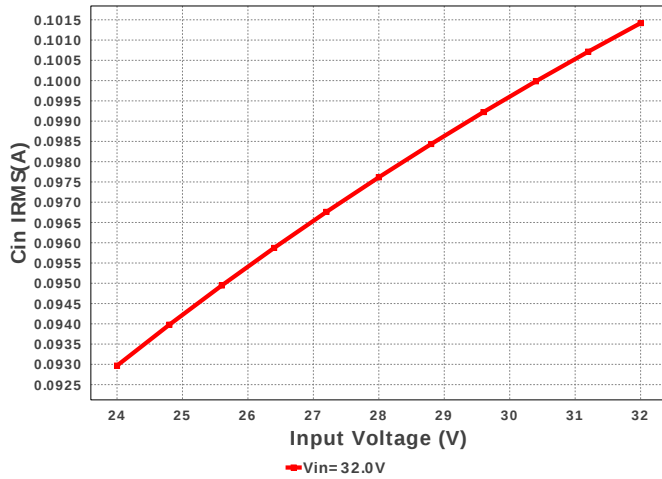
| #  | Name  | Manufacturer              | Part Number                        | Properties                                                   | Qty | Price  | Footprint                         |
|----|-------|---------------------------|------------------------------------|--------------------------------------------------------------|-----|--------|-----------------------------------|
| 1. | Cbyp  | Kemet                     | C0603C225K9PACTU<br>Series= X5R    | Cap= 2.2 uF<br>VDC= 6.3 V<br>IRMS= 0.0 A                     | 1   | \$0.02 | 0603 5 mm <sup>2</sup>            |
| 2. | Ccomp | Taiyo Yuden               | LMK212BJ106KG-T<br>Series= X5R     | Cap= 10.0 uF<br>VDC= 10.0 V<br>IRMS= 0.0 A                   | 1   | \$0.03 | 0805 7 mm <sup>2</sup>            |
| 3. | Cext  | MuRata                    | GRM155R61C104KA88D<br>Series= X5R  | Cap= 100.0 nF<br>VDC= 16.0 V<br>IRMS= 0.0 A                  | 1   | \$0.01 | 0402 3 mm <sup>2</sup>            |
| 4. | Chspn | MuRata                    | GRM21BR71E104KA01L<br>Series= X7R  | Cap= 100.0 nF<br>VDC= 25.0 V<br>IRMS= 0.0 A                  | 1   | \$0.01 | 0805 7 mm <sup>2</sup>            |
| 5. | Cin   | MuRata                    | GRM31CR71H475KA12L<br>Series= X7R  | Cap= 4.7 uF<br>ESR= 3.0 mOhm<br>VDC= 50.0 V<br>IRMS= 4.98 A  | 1   | \$0.07 | 1206 11 mm <sup>2</sup>           |
| 6. | Cinx  | MuRata                    | GRM188R72A104KA35D<br>Series= X7R  | Cap= 100.0 nF<br>VDC= 100.0 V<br>IRMS= 0.0 A                 | 1   | \$0.03 | 0603 5 mm <sup>2</sup>            |
| 7. | Cout  | Panasonic                 | EEHZA1J330P<br>Series= ?           | Cap= 33.0 uF<br>ESR= 40.0 mOhm<br>VDC= 63.0 V<br>IRMS= 1.7 A | 6   | \$0.97 | SM_RADIAL_8MM 113 mm <sup>2</sup> |
| 8. | Covp  | Samsung Electro-Mechanics | CL02C470JO2ANNC<br>Series= C0G/NP0 | Cap= 47.0 pF<br>VDC= 16.0 V<br>IRMS= 0.0 A                   | 1   | \$0.01 | 01005 2 mm <sup>2</sup>           |

| #   | Name  | Manufacturer         | Part Number                          | Properties                                            | Qty | Price  | Footprint                                                                                                              |
|-----|-------|----------------------|--------------------------------------|-------------------------------------------------------|-----|--------|------------------------------------------------------------------------------------------------------------------------|
| 9.  | Ct    | MuRata               | GRM033R71C102KA01D<br>Series= X7R    | Cap= 1.0 nF<br>VDC= 16.0 V<br>IRMS= 0.0 A             | 1   | \$0.01 |  0201 2 mm <sup>2</sup>             |
| 10. | D1    | Vishay-Semiconductor | SS2PH10-M3                           | VF@Io= 620.0 mV<br>VRRM= 100.0 V                      | 1   | \$0.14 | DO-220AA 14 mm <sup>2</sup>                                                                                            |
| 11. | D_LED | Cree                 | XHP50A-00-0000-0D00J40DV             | LED                                                   | 1   | \$5.34 |  xlampxhp 0 mm <sup>2</sup>         |
| 12. | Dz    | ON Semiconductor     | BZX84C10LT1G                         | Zener                                                 | 1   | \$0.02 |  SOT-23 14 mm <sup>2</sup>          |
| 13. | L1    | Bourns               | SDR1105-330KL                        | L= 33.0 µH<br>DCR= 100.0 mOhm                         | 1   | \$0.29 |  SDR1105 157 mm <sup>2</sup>        |
| 14. | M1    | Texas Instruments    | CSD19537Q3                           | VdsMax= 100.0 V<br>IdsMax= 50.0 Amps                  | 1   | \$0.50 |  TRANS_NexFET_Q3 18 mm <sup>2</sup> |
| 15. | M2    | Texas Instruments    | CSD19537Q3                           | VdsMax= 100.0 V<br>IdsMax= 50.0 Amps                  | 1   | \$0.50 |  TRANS_NexFET_Q3 18 mm <sup>2</sup> |
| 16. | M3    | ON Semiconductor     | 2N7002ET1G                           | VdsMax= 60.0 V<br>IdsMax= 260.0 mAmps                 | 1   | \$0.02 |  SOT-23 14 mm <sup>2</sup>          |
| 17. | Q1    | Diodes Inc.          | MMBT3904-7-F                         | Bipolar Transistor                                    | 1   | \$0.02 |  SOT-23 14 mm <sup>2</sup>        |
| 18. | Q2    | Diodes Inc.          | MMBT3906-7-F                         | Bipolar Transistor                                    | 1   | \$0.02 |  SOT-23 14 mm <sup>2</sup>        |
| 19. | Q3    | Diodes Inc.          | MMBT3906-7-F                         | Bipolar Transistor                                    | 1   | \$0.02 |  SOT-23 14 mm <sup>2</sup>        |
| 20. | Rcc   | Vishay-Dale          | CRCW0402100KFKED<br>Series= CRCW..e3 | Res= 100.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 |  0402 3 mm <sup>2</sup>           |
| 21. | Rchs  | Vishay-Dale          | CRCW040212K4FKED<br>Series= CRCW..e3 | Res= 12.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%   | 1   | \$0.01 |  0402 3 mm <sup>2</sup>           |
| 22. | Rcs   | Rohm                 | MCR25JZHFLR110<br>Series= MCR25      | Res= 110.0 mOhm<br>Power= 500.0 mW<br>Tolerance= 1.0% | 1   | \$0.03 |  1210 15 mm <sup>2</sup>          |
| 23. | Rdim  | Vishay-Dale          | CRCW040288R7FKED<br>Series= CRCW..e3 | Res= 88.7 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%    | 1   | \$0.01 |  0402 3 mm <sup>2</sup>           |
| 24. | Rdrv  | 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 <sup>2</sup>           |
| 25. | Rhsn  | Vishay-Dale          | CRCW04021K00FKED<br>Series= CRCW..e3 | Res= 1000.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 |  0402 3 mm <sup>2</sup>           |
| 26. | Rhsp  | Vishay-Dale          | CRCW04021K00FKED<br>Series= CRCW..e3 | Res= 1000.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 |  0402 3 mm <sup>2</sup>           |
| 27. | Rivp1 | Vishay-Dale          | CRCW0402619RFKED<br>Series= CRCW..e3 | Res= 619.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%   | 1   | \$0.01 |  0402 3 mm <sup>2</sup>           |

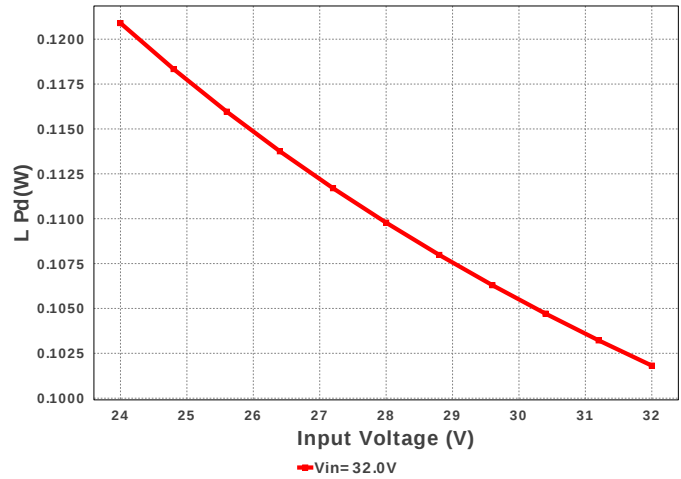
| #   | Name   | Manufacturer      | Part Number                          | Properties                                            | Qty | Price  | Footprint                                                                                                     |
|-----|--------|-------------------|--------------------------------------|-------------------------------------------------------|-----|--------|---------------------------------------------------------------------------------------------------------------|
| 28. | Rvp2   | 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 <sup>2</sup>    |
| 29. | Rovp1  | Vishay-Dale       | CRCW040238K3FKED<br>Series= CRCW..e3 | Res= 38.3 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%   | 1   | \$0.01 |  0402 3 mm <sup>2</sup>    |
| 30. | Rovp2  | Vishay-Dale       | CRCW0402511KFKED<br>Series= CRCW..e3 | Res= 511.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 |  0402 3 mm <sup>2</sup>    |
| 31. | Rr     | Vishay-Dale       | CRCW040210R0FKED<br>Series= CRCW..e3 | Res= 10.0 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0%    | 1   | \$0.01 |  0402 3 mm <sup>2</sup>    |
| 32. | Rsense | Panasonic         | ERJ-3RSFR15V<br>Series= ERJ-3R       | Res= 150.0 mOhm<br>Power= 100.0 mW<br>Tolerance= 1.0% | 1   | \$0.03 |  0603 5 mm <sup>2</sup>    |
| 33. | Rt     | Vishay-Dale       | CRCW040232K4FKED<br>Series= CRCW..e3 | Res= 32.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%   | 1   | \$0.01 |  0402 3 mm <sup>2</sup>    |
| 34. | U1     | Texas Instruments | LM3421MHX/NOPB                       | Switcher                                              | 1   | \$1.15 |  MXA16A 59 mm <sup>2</sup> |



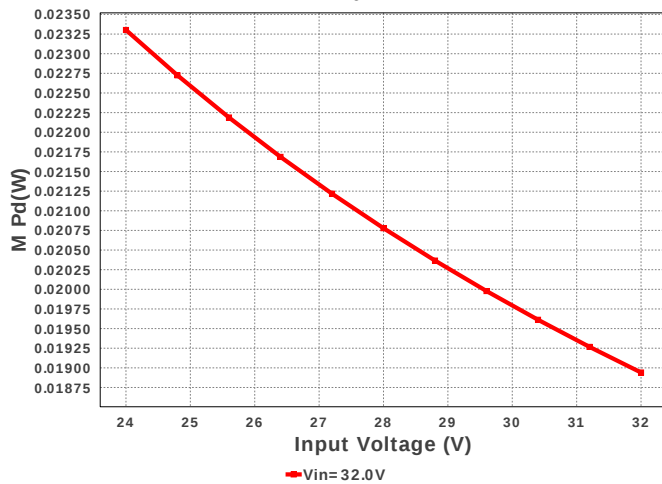
Cin IRMS



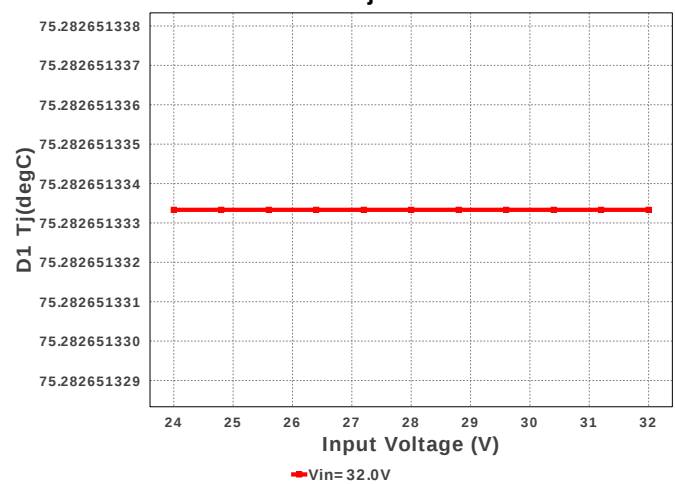
L Pd



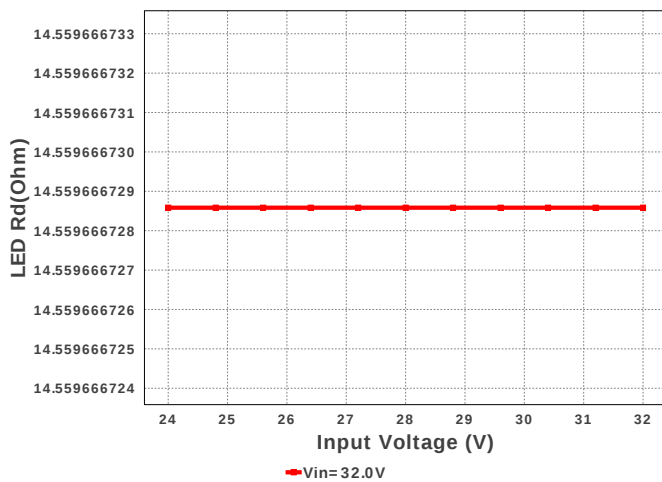
M Pd



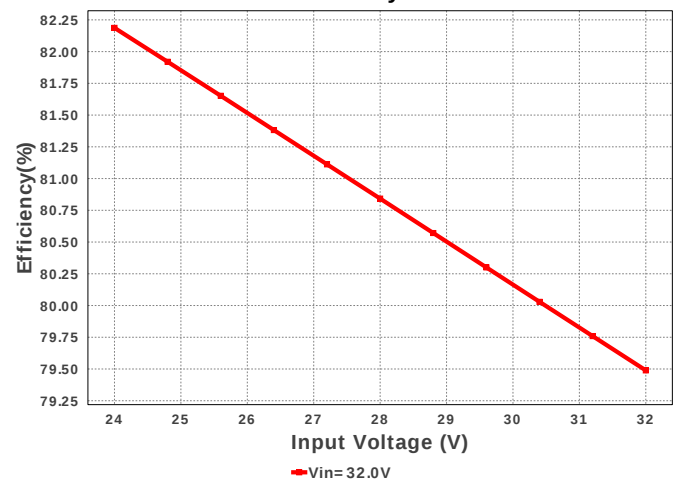
D1 Tj

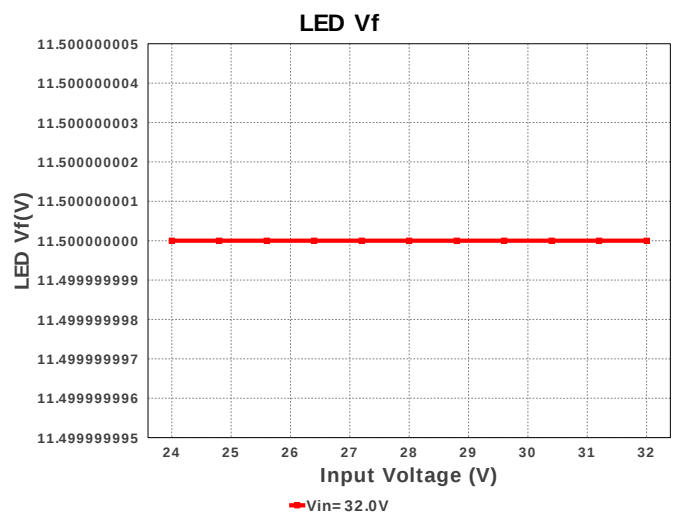
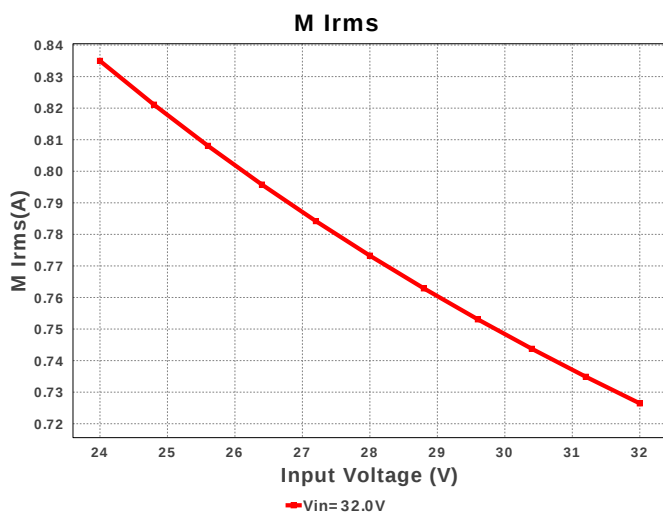
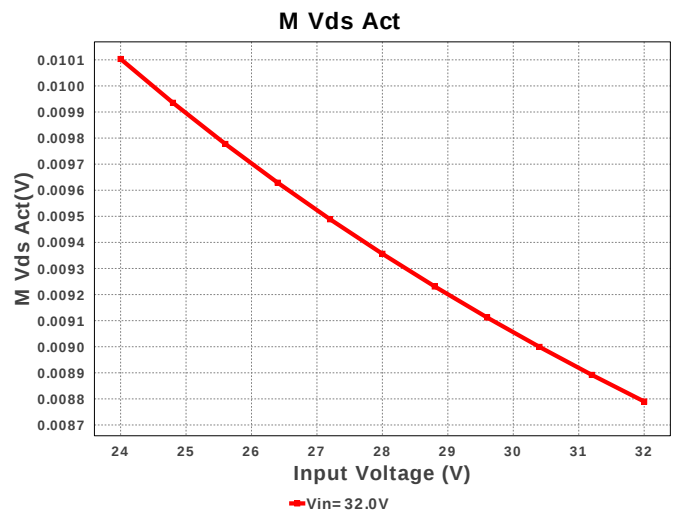
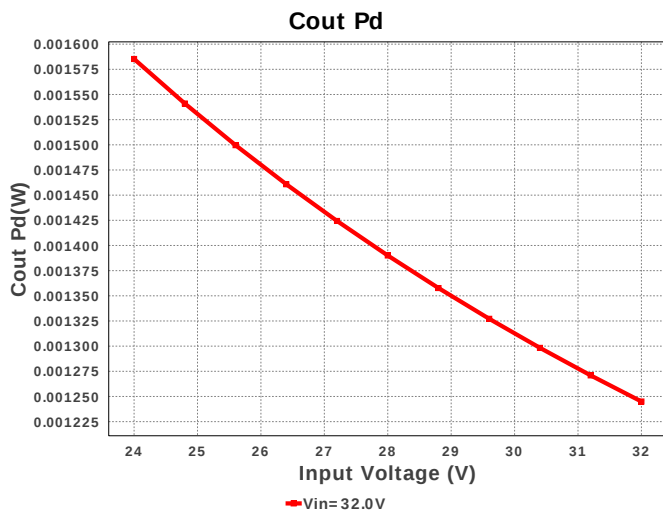
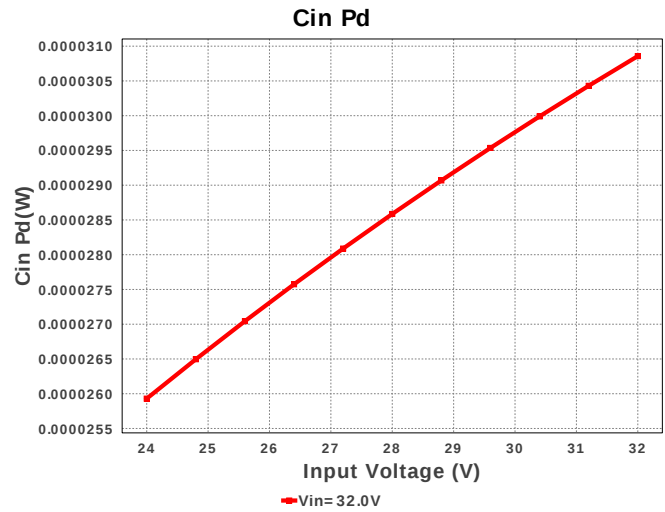
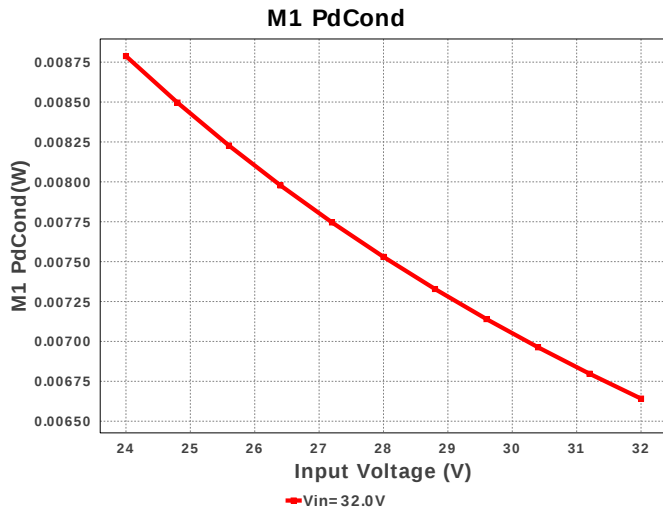


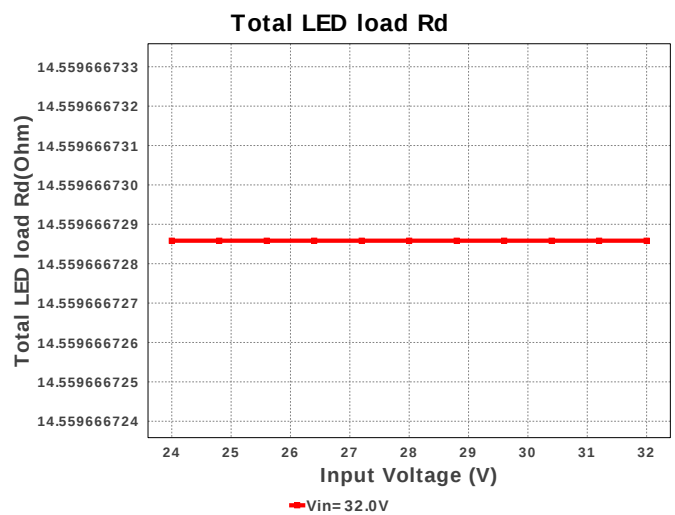
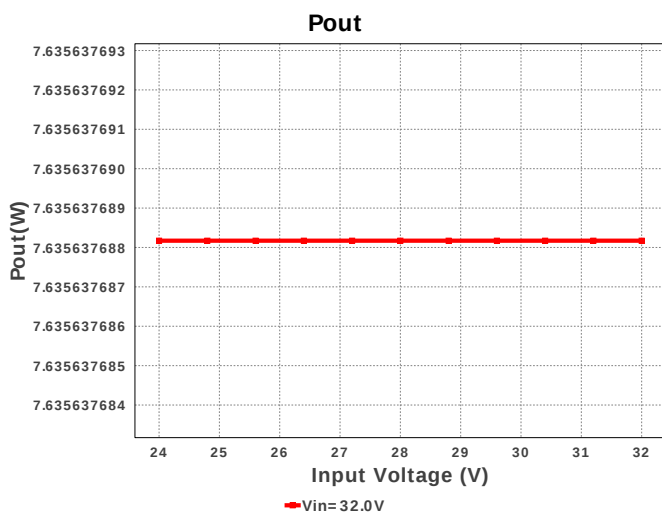
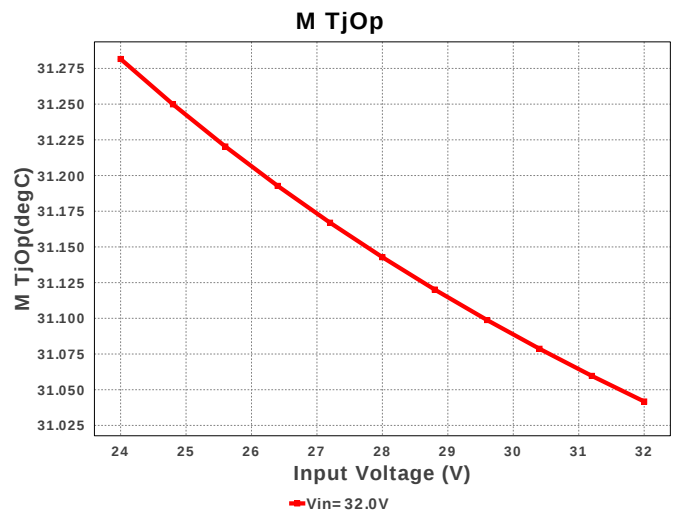
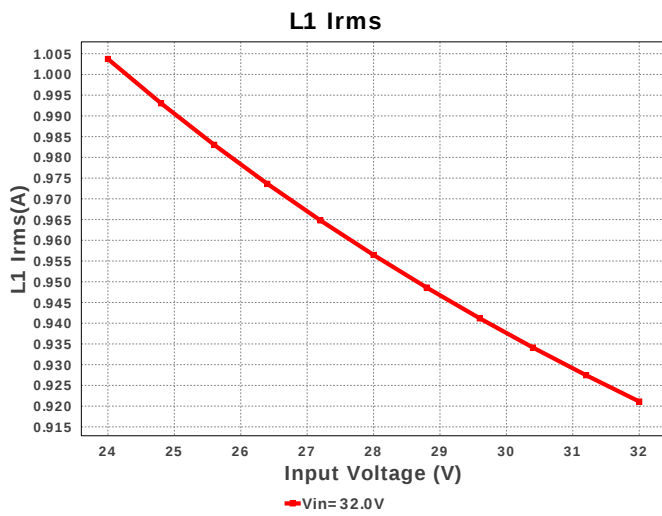
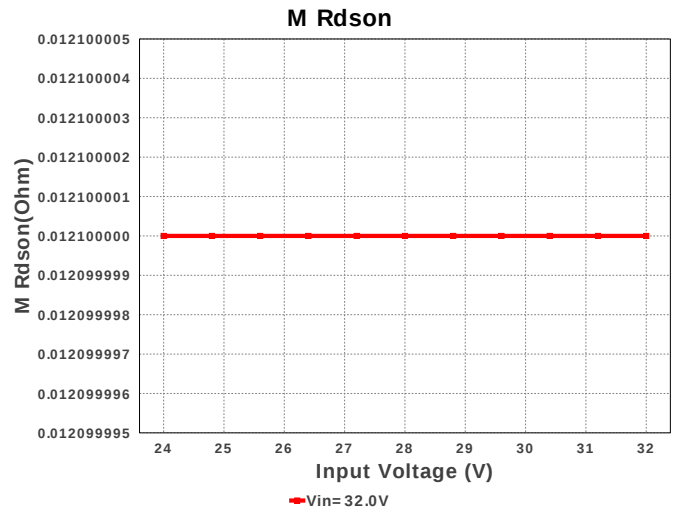
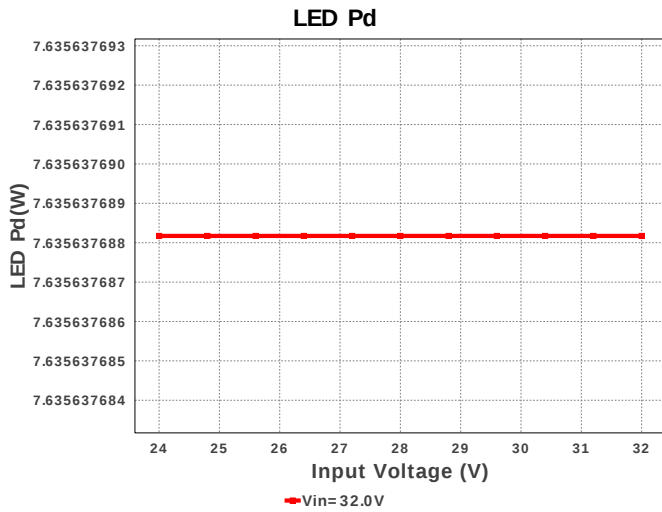
LED Rd



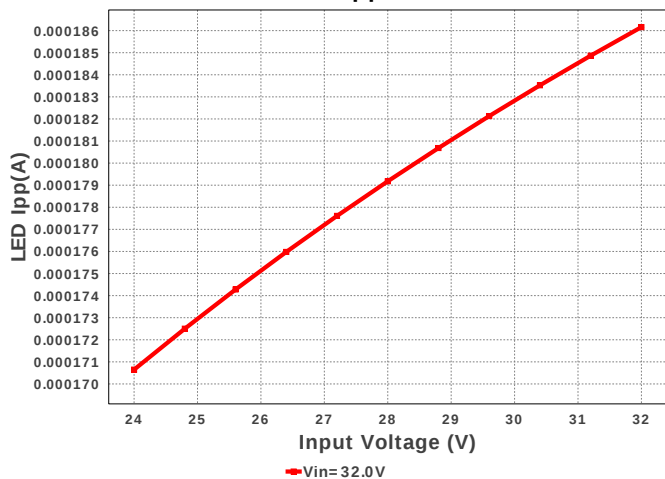
Efficiency



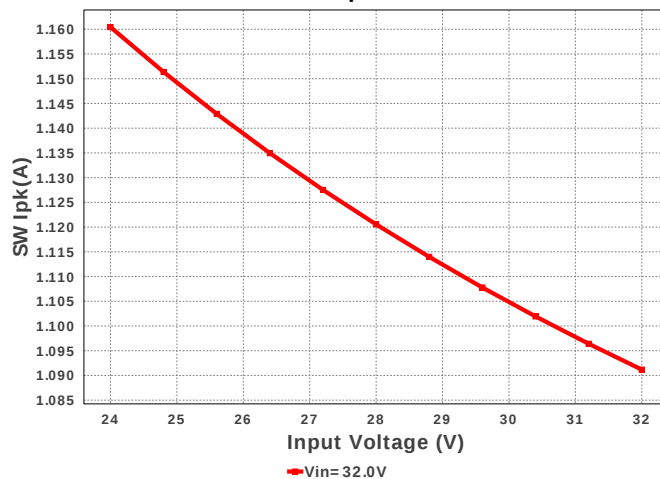




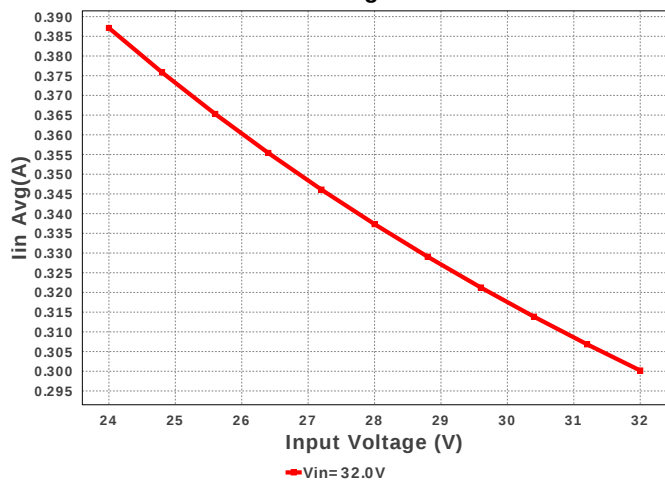
LED Ipp



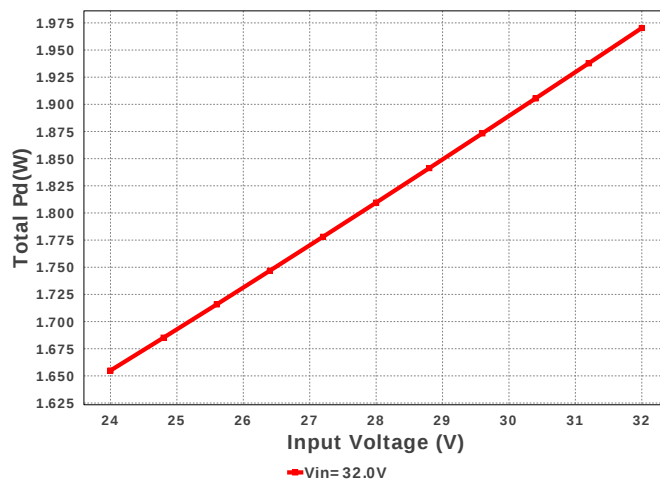
SW Ipk



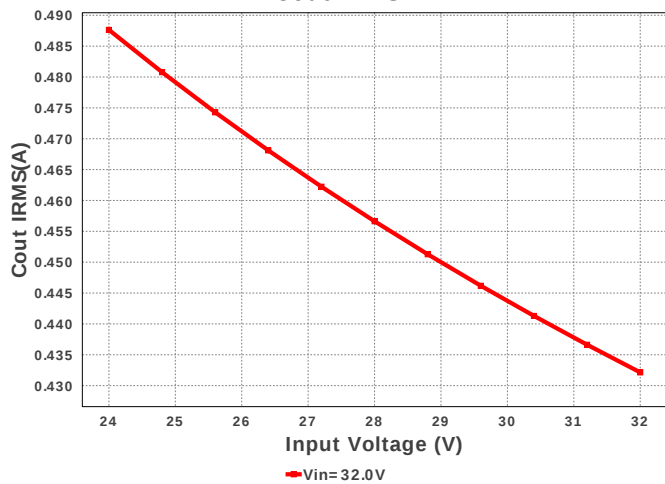
Iin Avg



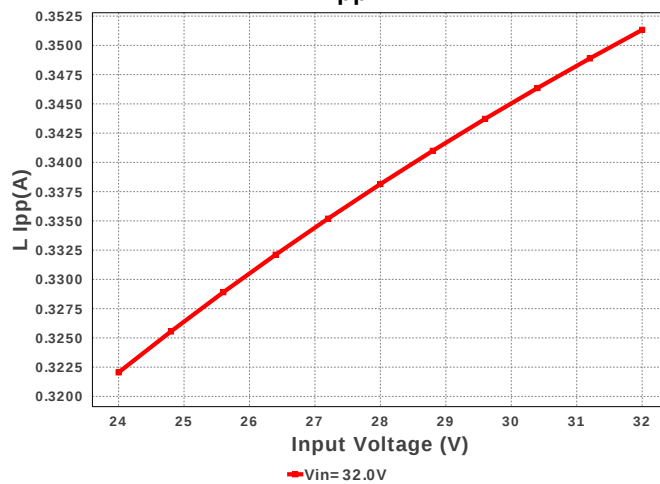
Total Pd

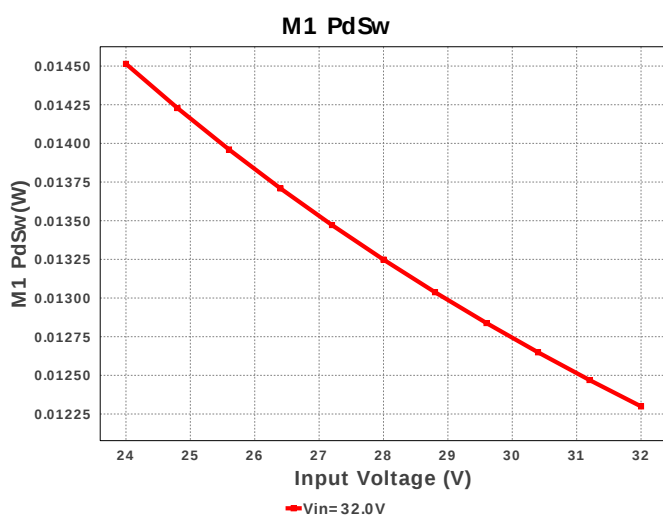
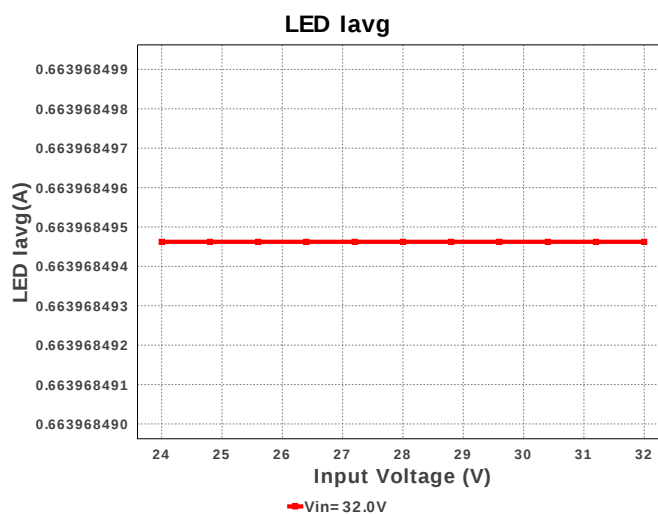
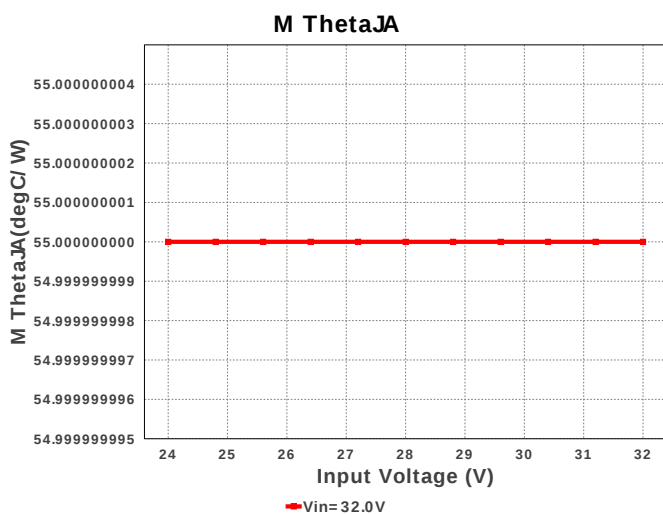
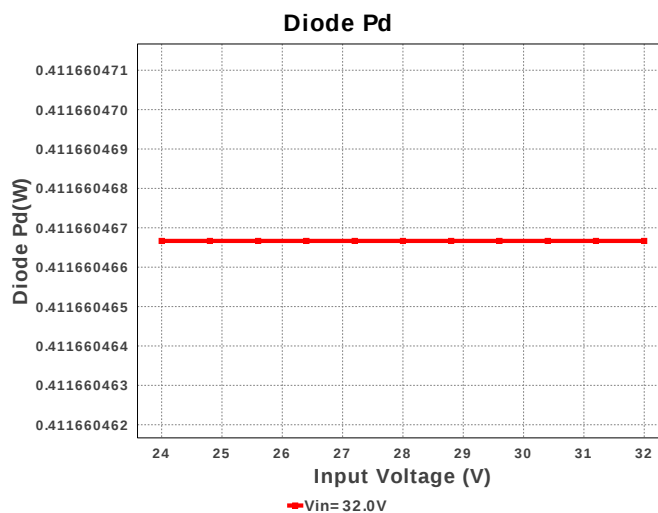
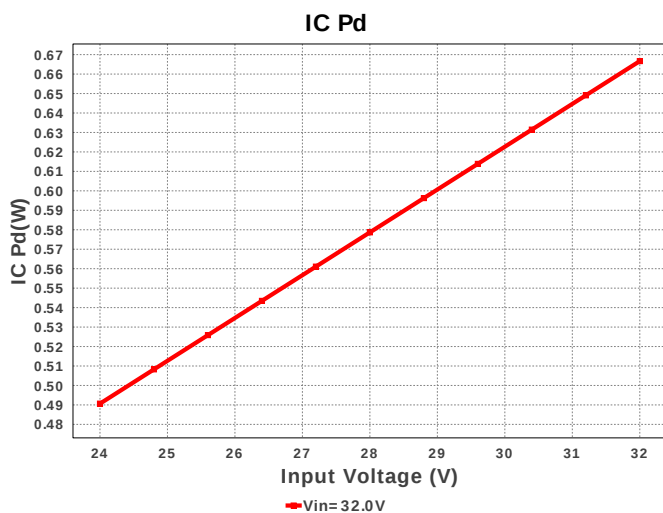


Cout IRMS



L Ipp





## Operating Values

| #   | Name      | Value                   | Category | Description                             |
|-----|-----------|-------------------------|----------|-----------------------------------------|
| 1.  | Cin IRMS  | 123.903 mA              | Current  | Input capacitor RMS ripple current      |
| 2.  | Cout IRMS | 607.366 mA              | Current  | Output capacitor RMS ripple current     |
| 3.  | Iin Avg   | 599.44 mA               | Current  | Average input current                   |
| 4.  | L Ipp     | 429.21 mA               | Current  | Peak-to-peak inductor ripple current    |
| 5.  | L1 Irms   | 1.209 A                 | Current  | Inductor ripple current                 |
| 6.  | LED Iavg  | 663.968 mA              | Current  | LED Average Current                     |
| 7.  | LED Ipp   | 227.43 $\mu$ A          | Current  | LED Ripple Current                      |
| 8.  | M Irms    | 1.103 A                 | Current  | MOSFET RMS ripple current               |
| 9.  | SW Ipk    | 1.418 A                 | Current  | Peak switch current                     |
| 10. | BOM Count | 39                      | General  | Total Design BOM count                  |
| 11. | FootPrint | 1.113 k mm <sup>2</sup> | General  | Total Foot Print Area of BOM components |

| #   | Name              | Value       | Category | Description                                                                                |
|-----|-------------------|-------------|----------|--------------------------------------------------------------------------------------------|
| 12. | Frequency         | 763.889 kHz | General  | Switching frequency                                                                        |
| 13. | IC Tolerance      | 25.0 mV     | General  | IC Feedback Tolerance                                                                      |
| 14. | M Rdson           | 0.0 Ohm     | General  | Drain-Source On-resistance                                                                 |
| 15. | M Vds Act         | 0.0 V       | General  | M Vds                                                                                      |
| 16. | Mode              | CCM         | General  | Conduction Mode                                                                            |
| 17. | Pout              | 12.524 W    | General  | Total output power                                                                         |
| 18. | Total BOM         | \$14.18     | General  | Total BOM Cost                                                                             |
| 19. | D1 Tj             | 75.283 degC | Op_Point | D1 junction temperature                                                                    |
| 20. | Vout OP           | 18.863 V    | Op_Point | Operational Output Voltage                                                                 |
| 21. | Duty Cycle        | 47.429 %    | Op_point | Duty cycle                                                                                 |
| 22. | Efficiency        | 87.054 %    | Op_point | Steady state efficiency                                                                    |
| 23. | IC Tj             | 50.054 degC | Op_point | IC junction temperature                                                                    |
| 24. | ICThetaJA         | 37.0 degC/W | Op_point | IC junction-to-ambient thermal resistance                                                  |
| 25. | IOUT_OP           | 663.97 mA   | Op_point | Iout operating point                                                                       |
| 26. | LED Rd            | 14.56 Ohm   | Op_point | LED DynamicResistance                                                                      |
| 27. | LED Vf            | 18.863 V    | Op_point | Total LED Forward Calculated Voltage                                                       |
| 28. | M ThetaJA         | 50.0 degC/W | Op_point | MOSFET junction-to-ambient thermal resistance                                              |
| 29. | M TjOp            | 31.973 degC | Op_point | MOSFET junction temperature                                                                |
| 30. | VIN_OP            | 24.0 V      | Op_point | Vin operating point                                                                        |
| 31. | Cin Pd            | 46.056 µW   | Power    | Input capacitor power dissipation                                                          |
| 32. | Cout Pd           | 2.459 mW    | Power    | Output capacitor power dissipation                                                         |
| 33. | Diode Pd          | 411.66 mW   | Power    | Diode power dissipation                                                                    |
| 34. | IC Pd             | 542.0 mW    | Power    | IC power dissipation                                                                       |
| 35. | L Pd              | 175.496 mW  | Power    | Inductor power dissipation                                                                 |
| 36. | LED Pd            | 12.524 W    | Power    | LED Power Dissipation                                                                      |
| 37. | M Pd              | 39.458 mW   | Power    | MOSFET power dissipation                                                                   |
| 38. | M1 PdCond         | 0.0 W       | Power    | M1 MOSFET conduction losses                                                                |
| 39. | M1 PdSw           | 39.458 mW   | Power    | M1 MOSFET switching losses                                                                 |
| 40. | Total Pd          | 1.862 W     | Power    | Total Power Dissipation                                                                    |
| 41. | Total LED load Rd | 14.56 Ohm   |          | Total LED Load DynamicResistance                                                           |
| 42. | Vout Tolerance    | 132.54 m%   |          | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |

## Design Inputs

| #   | Name          | Value                   | Description                 |
|-----|---------------|-------------------------|-----------------------------|
| 1.  | Iout          | 700.0 m                 | Maximum Output Current      |
| 2.  | VinMax        | 32.0                    | Maximum input voltage       |
| 3.  | VinMin        | 24.0                    | Minimum input voltage       |
| 4.  | Vout          | 11.5                    | Output Voltage              |
| 5.  | application   | LED_DRIVER              | LED Application             |
| 6.  | base_pn       | LM3421                  | Base Product Number         |
| 7.  | LED_Architect | N                       | LED Architect Project       |
| 8.  | ledparallel   | 1.0                     | Number of LED in parallel   |
| 9.  | ledpartnumber | XHP50A-00-0000-0D001400 | LED Part number             |
| 10. | ledseries     | 1.0                     | Number of LED in series     |
| 11. | line_fsw      | 60.0                    | AC Line Frequency           |
| 12. | source        | DC                      | Input Source Type           |
| 13. | Ta            | 30.0                    | Ambient temperature         |
| 14. | UserFsw       | 546.358 k               | Customer Selected Frequency |

## Design Assistance

1. **LM3421** Product Folder : <http://www.ti.com/product/LM3421> : 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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