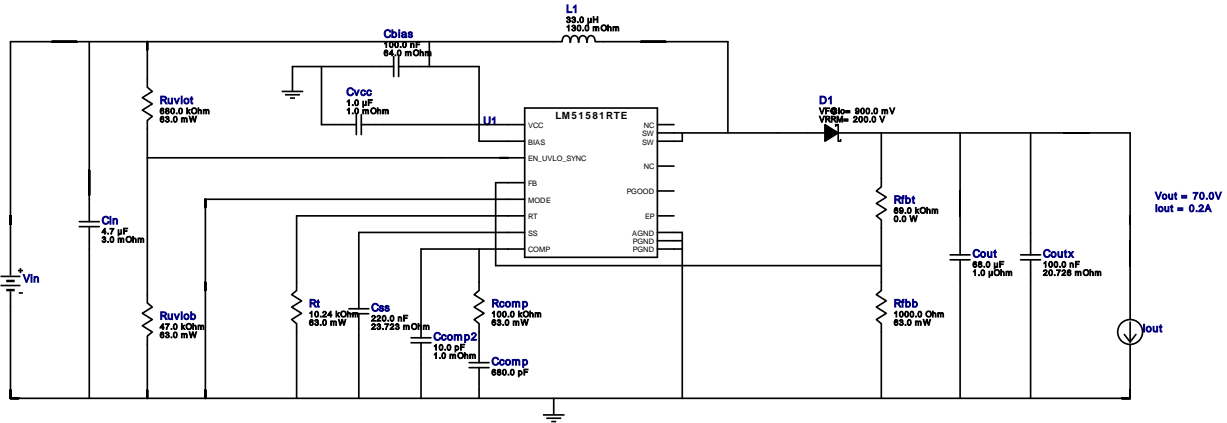








WEBENCH® Design Report

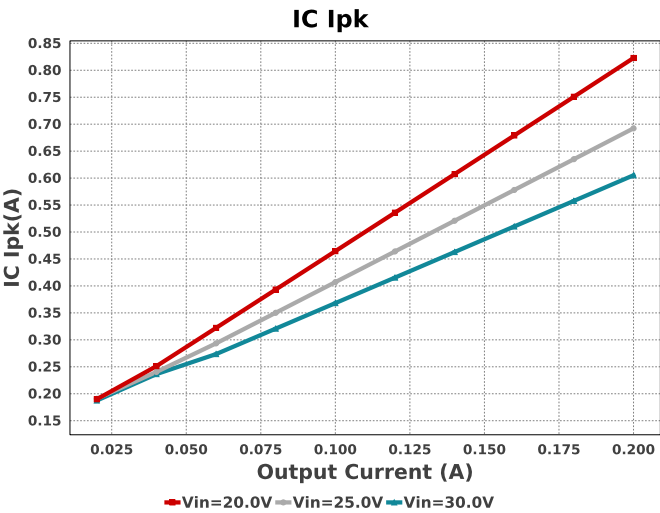
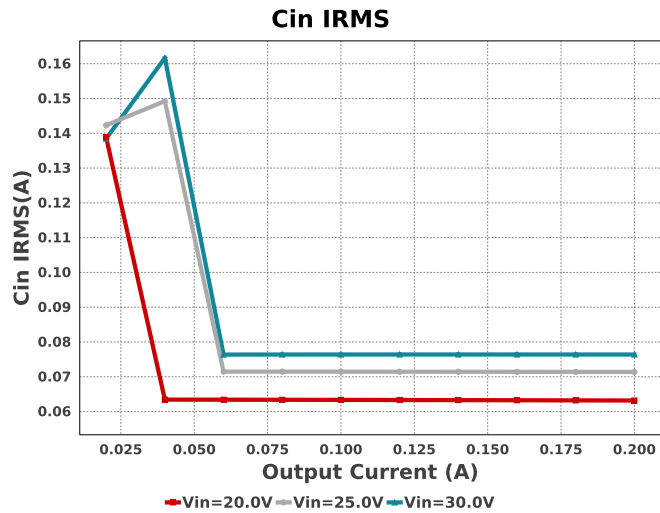
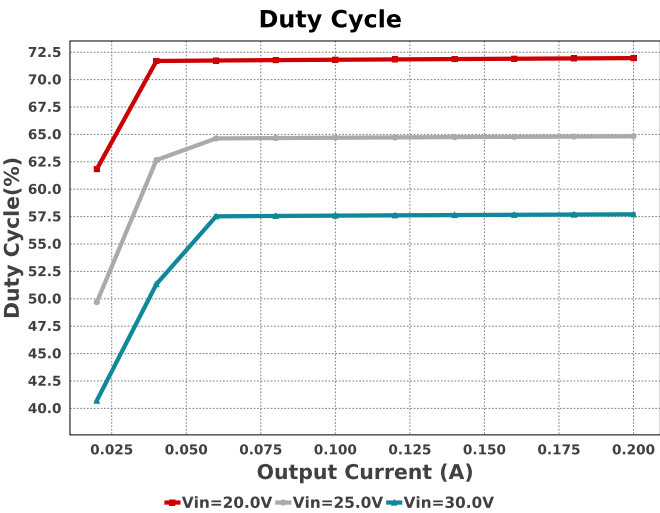
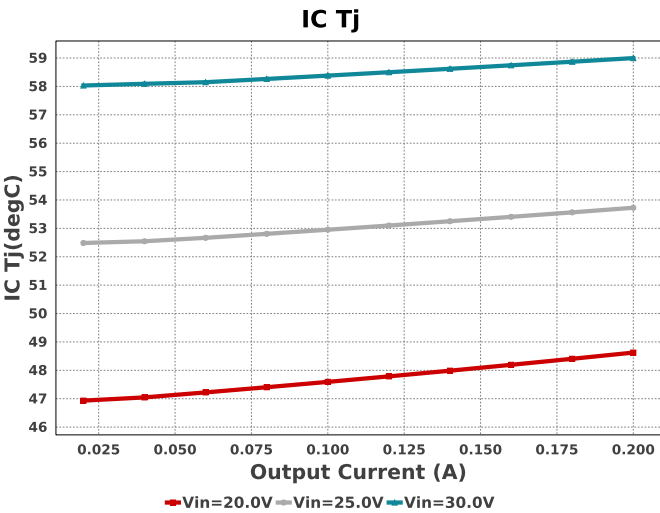
Design : 16 LM51581RTER
LM51581RTER 20V-30V to 70.00V @ 0.2A

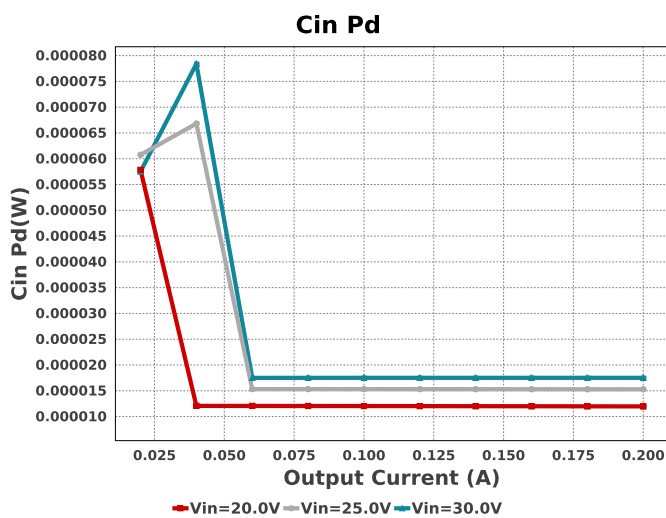
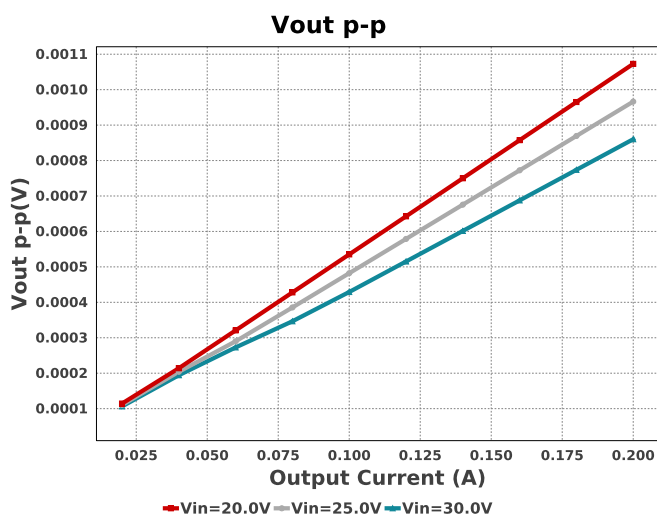
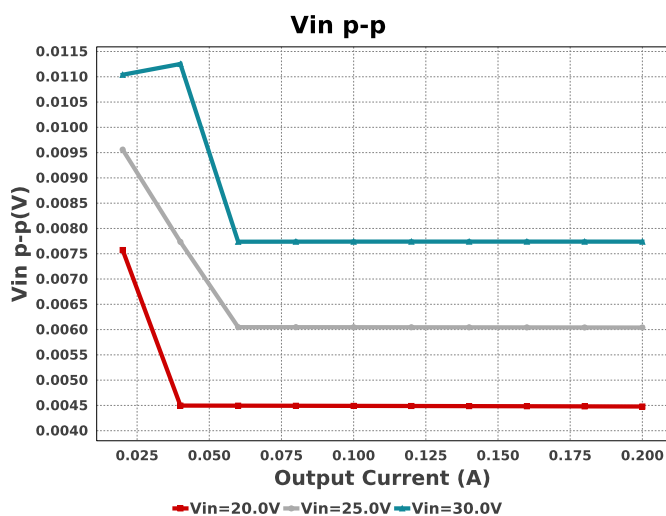
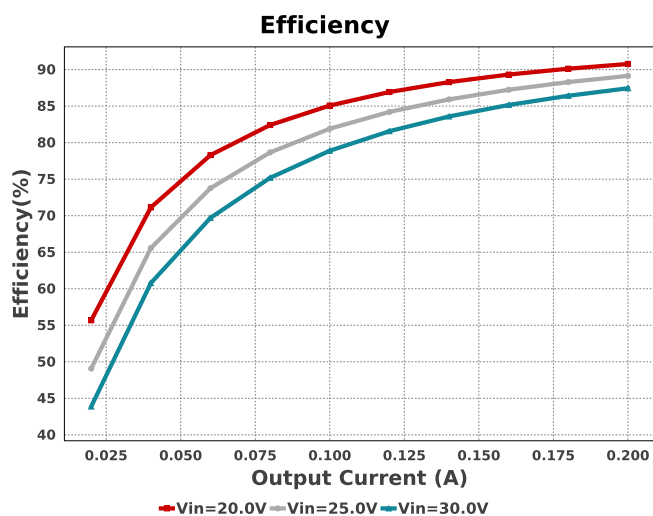
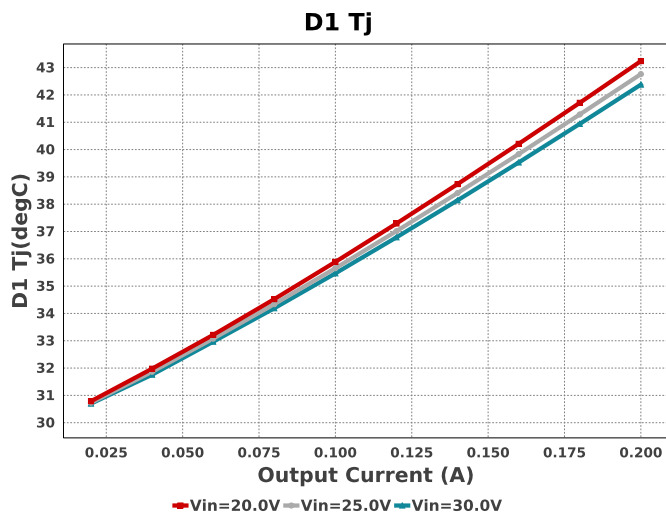
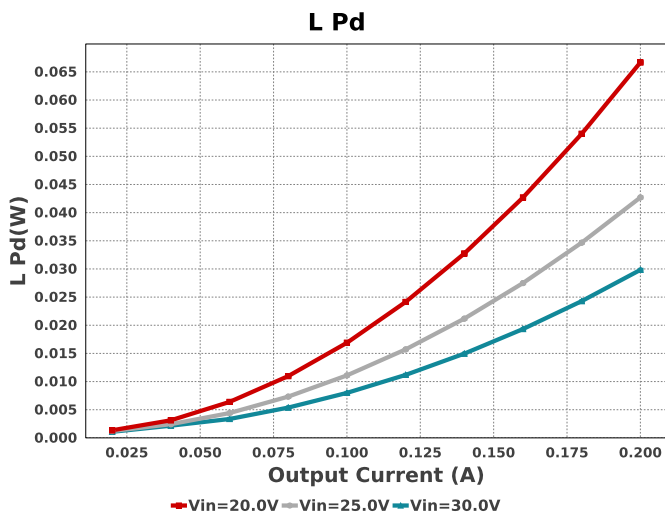


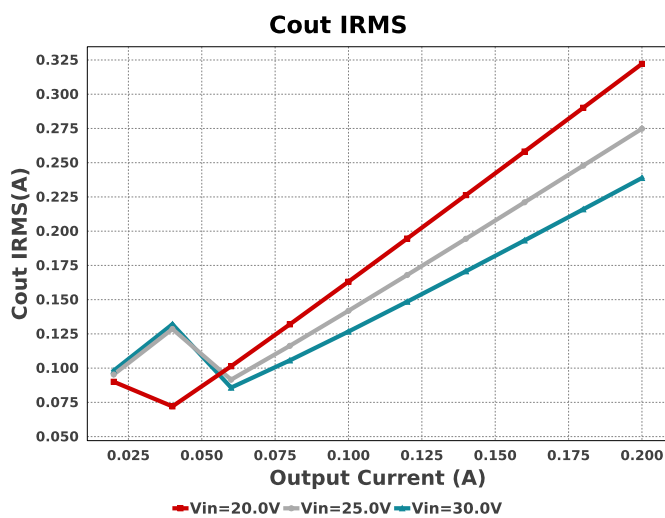
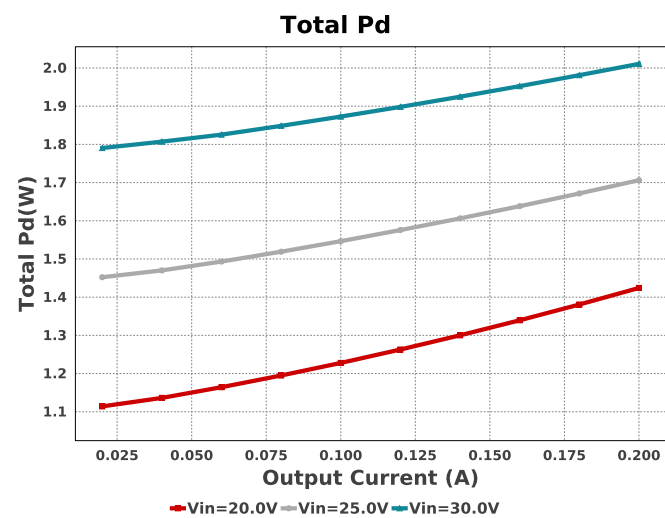
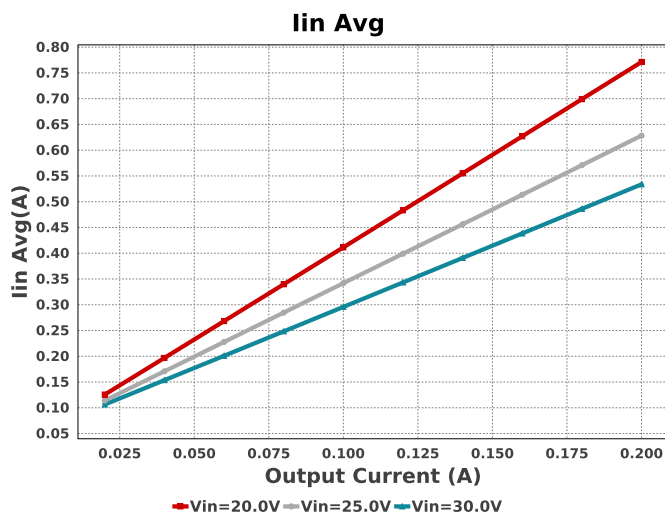
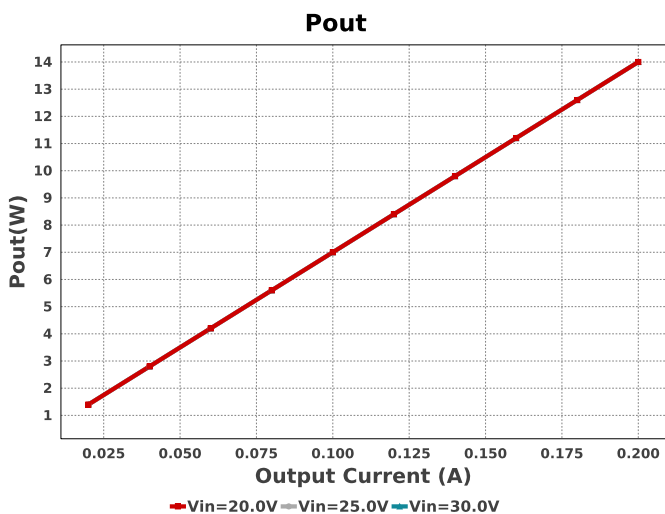
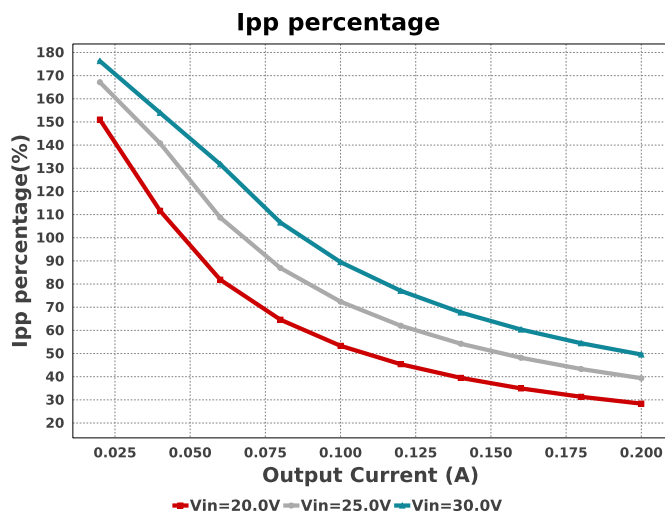
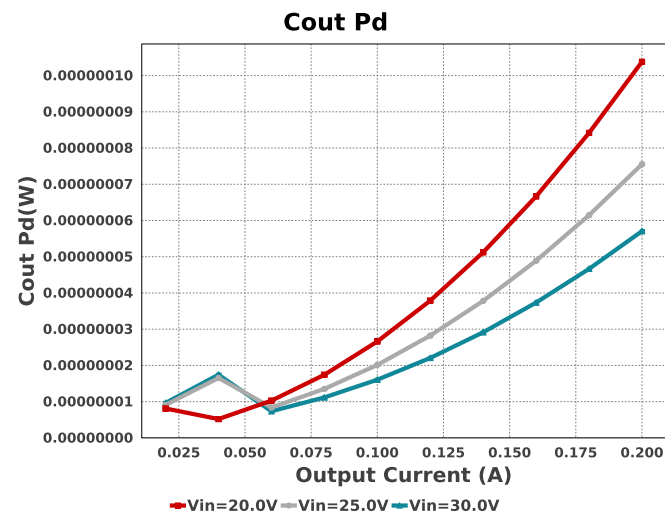
Electrical BOM

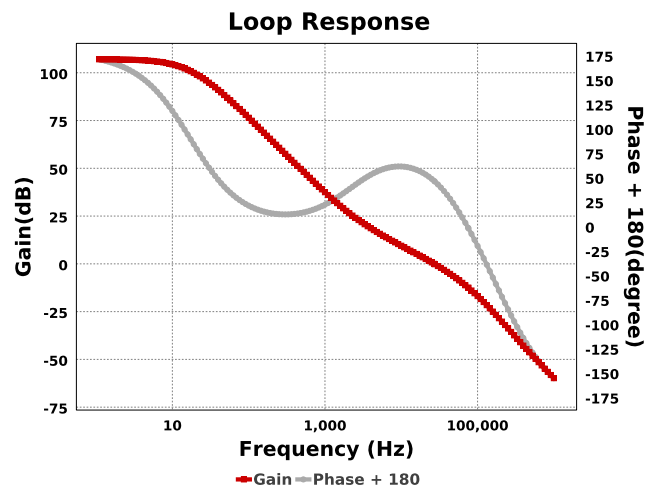
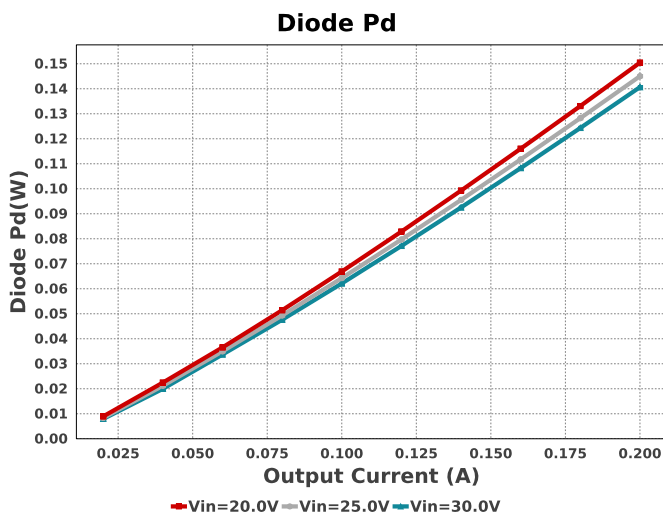
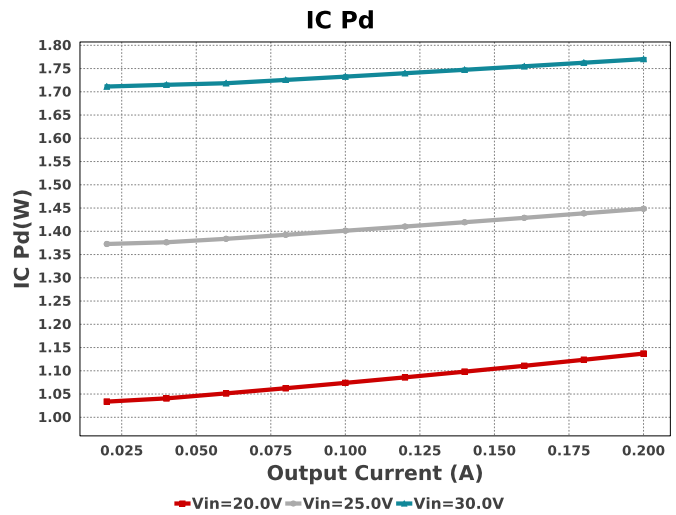
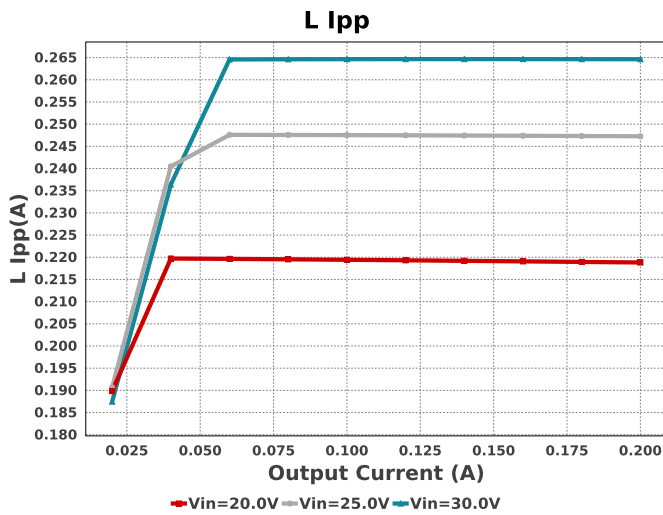
| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|--------|---------------------------|------------------------------------|---|-----|--------|--------------------------|
| Cbias | Kemet | C0805C104M5RACTU Series= X7R | Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A | 1 | \$0.01 | 0805 7 mm ² |
| Ccomp | Samsung Electro-Mechanics | CL05C681JB5NNNC Series= C0G/NP0 | Cap= 680.0 pF VDC= 50.0 V IRMS= 0.0 A | 1 | \$0.01 | 0402 3 mm ² |
| Ccomp2 | CUSTOM | CUSTOM Series= ? | Cap= 10.0 pF ESR= 1.0 mOhm VDC= 140.0 V IRMS= 200.0 mA | 1 | NA | CUSTOM 0 mm ² |
| Cin | MuRata | GRM31CR71H475KA12L Series= X7R | Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A | 1 | \$0.10 | 1206 11 mm ² |
| Cout | CUSTOM | CUSTOM Series= X7S | Cap= 68.0 uF ESR= 1.0 uOhm VDC= 100.0 V IRMS= 6.7739 A | 1 | NA | 1210 0 mm ² |
| Coutx | TDK | C2012X7R2A104K125AA Series= X7R | Cap= 100.0 nF ESR= 20.726 mOhm VDC= 100.0 V IRMS= 1.456 A | 1 | \$0.03 | 0805 7 mm ² |
| Css | CUSTOM | CUSTOM Series= X5R | Cap= 220.0 nF ESR= 23.723 mOhm VDC= 50.0 V IRMS= 1.35424 A | 1 | NA | 0805 0 mm ² |
| Cvcc | Taiyo Yuden | EMK107B7105KA-T Series= X7R | Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A | 1 | \$0.01 | 0603 5 mm ² |
| D1 | SMC Diode Solutions | SK220ATR | VF@Io= 900.0 mV VRRM= 200.0 V | 1 | \$0.06 | SMA 37 mm ² |

| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|--------|-------------------|--------------------------------------|--|-----|--------|--|
| L1 | NIC Components | NPI75C330MTRF | L= 33.0 µH 130.0 mOhm | 1 | \$0.14 |  IND_NPI75C 94 mm² |
| Rcomp | Vishay-Dale | CRCW0402100KFKED Series= CRCW..e3 | Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0402 3 mm² |
| Rfbb | CUSTOM | CUSTOM Series= CRCW..e3 | Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0% | 1 | NA |  0402 0 mm² |
| Rfbt | CUSTOM | CUSTOM Series= ? | Res= 69.0 kOhm Power= 0.0 W Tolerance= 0.0% | 1 | NA | CUSTOM 0 mm² |
| Rt | CUSTOM | CUSTOM Series= CRCW..e3 | Res= 10.24 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | NA |  0402 0 mm² |
| Ruvlob | CUSTOM | CUSTOM Series= CRCW..e3 | Res= 47.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | NA |  0402 0 mm² |
| Ruvlot | CUSTOM | CUSTOM Series= CRCW..e3 | Res= 680.0 kOhm Power= 63.0 mW Tolerance= 1.0% | 1 | NA |  0402 0 mm² |
| U1 | Texas Instruments | LM51581RTER | Switcher | 1 | \$1.60 | RTE0016K-IPC_A 16 mm² |









Operating Values

| # | Name | Value | Category | Description |
|-----|---------------------|-----------------------|--------------------|---|
| 1. | BOM Count | 17 | | Total Design BOM count |
| 2. | Total BOM | NA | | Total BOM Cost |
| 3. | Cin IRMS | 63.168 mA | Capacitor | Input capacitor RMS ripple current |
| 4. | Cin Pd | 11.971 μ W | Capacitor | Input capacitor power dissipation |
| 5. | Cout IRMS | 322.165 mA | Capacitor | Output capacitor RMS ripple current |
| 6. | Cout Pd | 103.79 nW | Capacitor | Output capacitor power dissipation |
| 7. | D1 Tj | 43.238 degC | Diode | D1 junction temperature |
| 8. | Diode Pd | 150.44 mW | Diode | Diode power dissipation |
| 9. | IC Ipk | 822.767 mA | IC | Peak switch current in IC |
| 10. | IC Pd | 1.137 W | IC | IC power dissipation |
| 11. | IC Tj | 48.624 degC | IC | IC junction temperature |
| 12. | IC Tolerance | 10.0 mV | IC | IC Feedback Tolerance |
| 13. | ICThetaJA Effective | 16.38 degC/W | IC | Effective IC Junction-to-Ambient Thermal Resistance |
| 14. | Iin Avg | 771.21 mA | IC | Average input current |
| 15. | Ipp percentage | 28.374 % | Inductor | Inductor ripple current percentage (with respect to average inductor current) |
| 16. | L Ipp | 218.821 mA | Inductor | Peak-to-peak inductor ripple current |
| 17. | L Pd | 66.673 mW | Inductor | Inductor power dissipation |
| 18. | Cin Pd | 11.971 μ W | Power | Input capacitor power dissipation |
| 19. | Cout Pd | 103.79 nW | Power | Output capacitor power dissipation |
| 20. | Diode Pd | 150.44 mW | Power | Diode power dissipation |
| 21. | IC Pd | 1.137 W | Power | IC power dissipation |
| 22. | L Pd | 66.673 mW | Power | Inductor power dissipation |
| 23. | Total Pd | 1.424 W | Power | Total Power Dissipation |
| 24. | Cross Freq | 19.045 kHz | System | Bode plot crossover frequency |
| 25. | Duty Cycle | 71.964 % | System Information | Duty cycle |
| 26. | Efficiency | 90.767 % | System Information | Steady state efficiency |
| 27. | FootPrint | 226.0 mm ² | System Information | Total Foot Print Area of BOM components |

| # | Name | Value | Category | Description |
|-----|----------------|------------|--------------------|--|
| 28. | Frequency | 1.974 MHz | System Information | Switching frequency |
| 29. | Gain Marg | -12.4 dB | System Information | Bode Plot Gain Margin |
| 30. | Iout | 200.0 mA | System Information | Iout operating point |
| 31. | Low Freq Gain | 103.504 dB | System Information | Gain at 1Hz |
| 32. | Mode | CCM | System Information | Conduction Mode |
| 33. | Phase Marg | 52.586 deg | System Information | Bode Plot Phase Margin |
| 34. | Pout | 14.0 W | System Information | Total output power |
| 35. | Vin | 20.0 V | System Information | Vin operating point |
| 36. | Vin p-p | 4.479 mV | System Information | Input Source ripple voltage |
| 37. | Vout | 70.0 V | System Information | Operational Output Voltage |
| 38. | Vout Actual | 70.0 V | System Information | Vout Actual calculated based on selected voltage divider resistors |
| 39. | Vout Tolerance | 2.006 % | System Information | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |
| 40. | Vout p-p | 1.073 mV | System Information | Peak-to-peak output ripple voltage |

Design Inputs

| Name | Value | Description |
|-----------|---------|-----------------------------|
| Iout | 200.0 m | Maximum Output Current |
| SoftStart | 10.0 ms | Soft Start Time (ms) |
| VinMax | 30.0 | Maximum input voltage |
| VinMin | 20.0 | Minimum input voltage |
| Vout | 70.0 | Output Voltage |
| base_pn | LM51581 | Base Product Number |
| source | DC | Input Source Type |
| Ta | 30.0 | Ambient temperature |
| UserFsw | 2.017 M | Customer Selected Frequency |

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of C_{in} and C_{out} , and the inductance and DC resistance of $L1$ before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 20.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

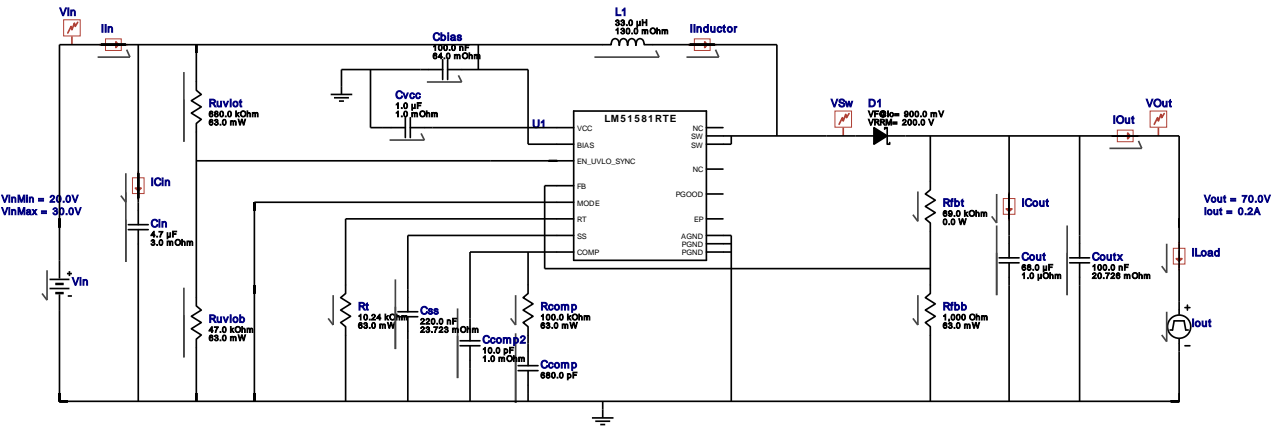
Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



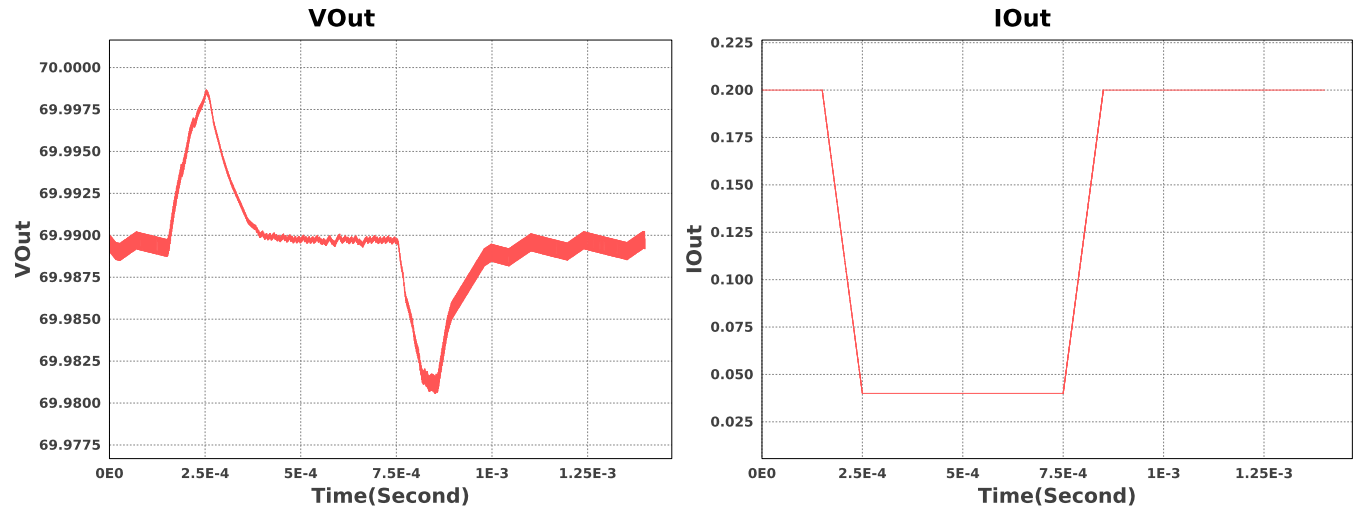
WEBENCH® Electrical Simulation Report

Design Id = 16
sim_id = 4
Simulation Type = Load Transient



Simulation Parameters

| # | Name | Parameter Name | Description | Values |
|----|------|----------------|--------------------|------------------------|
| 1. | Cout | IC | Initial Condition | 70.0 V |
| 2. | Css | IC | Initial Condition | 1 V |
| 3. | Cin | IC | Initial Condition | 25.0 V |
| 4. | Iout | signal_type | Signal Type | PULSE |
| | | I1 | Initial current | 0.2 A |
| | | I2 | Peak Current | 0.040000000000000001 A |
| | | Td | Initial Delay Time | 1.5E-4 Sec |
| | | Tr | Rise Time | 100u s |
| | | Tf | Fall Time | 100u Sec |
| | | Pw | Pulse Width | 5.0E-4 |



Design Assistance

- Master key : 5C7E25139A496A37BD41B9ACC0467E77[v1]
- LM51581 Product Folder : <http://www.ti.com/product/LM51581> : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with TI products.