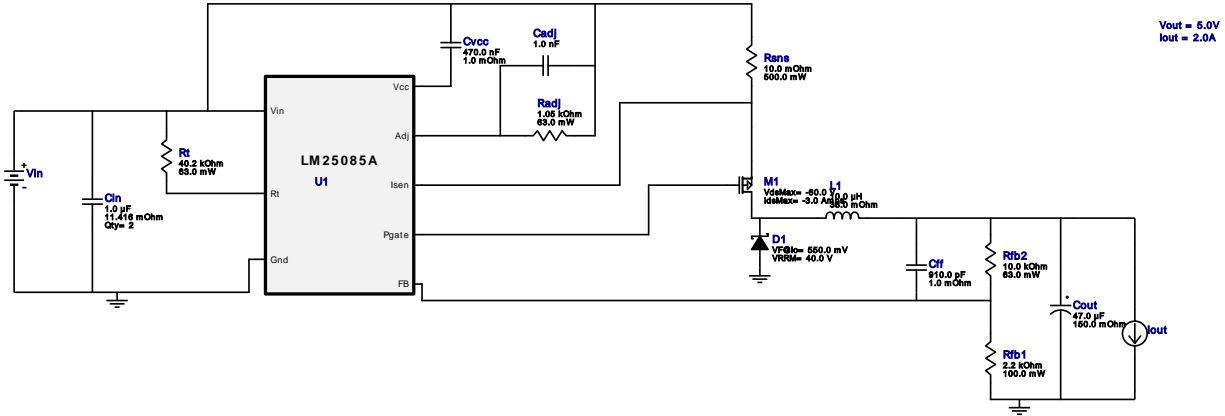


# WEBENCH® Design Report

Design : 24 LM25085AMY/NOPB  
LM25085AMY/NOPB 17V-20V to 5.00V @ 2A

VinMin = 17.0V  
VinMax = 20.0V  
Vout = 5.0V  
Iout = 2.0A

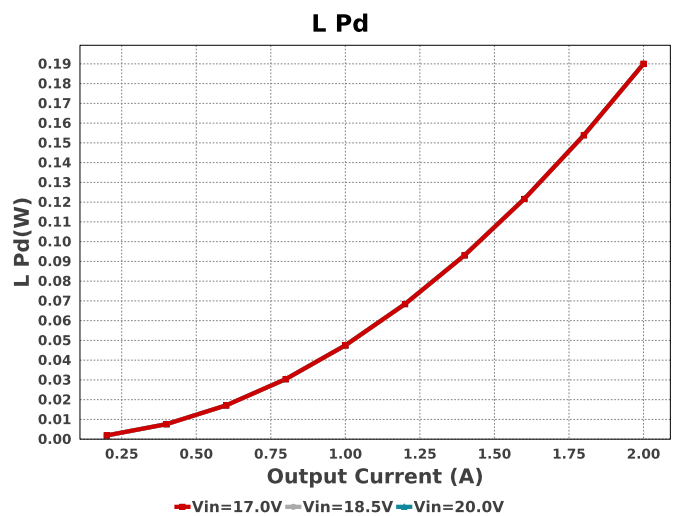
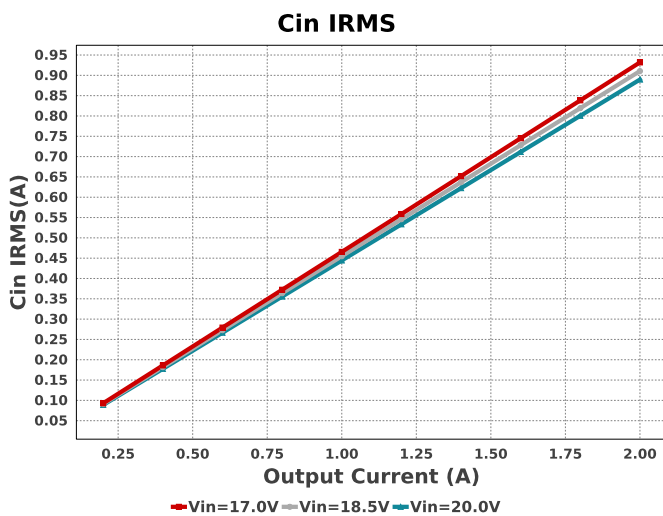
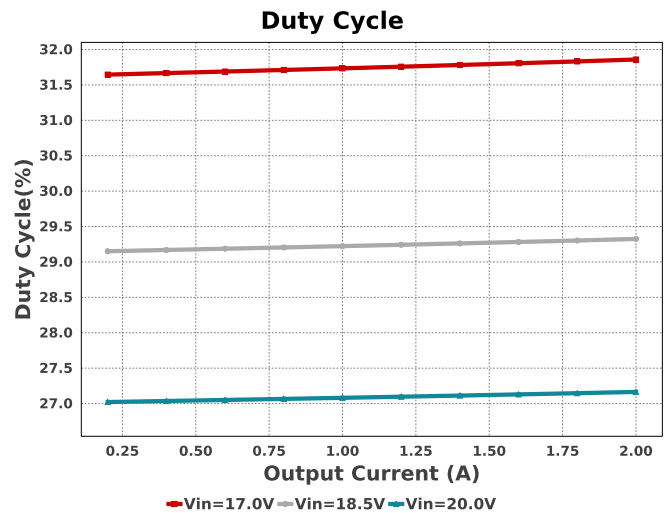
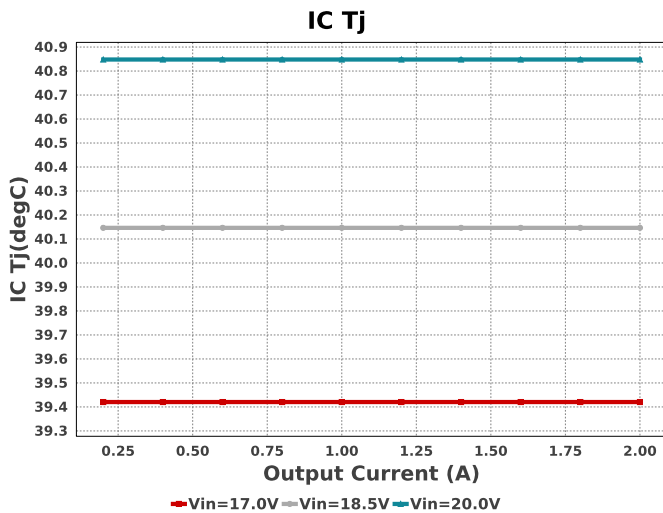
Device = LM25085AMY/NOPB  
Topology = Buck  
Created = 2023-03-22 05:54:32.317  
BOM Cost = \$2.19  
BOM Count = 15  
Total Pd = 1.46W

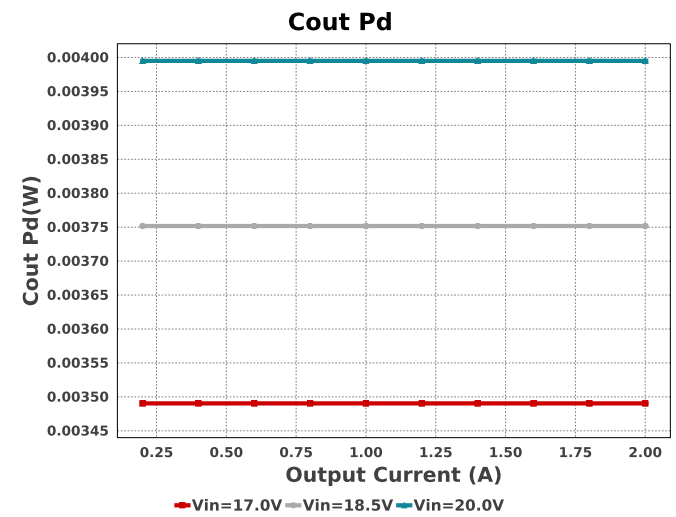
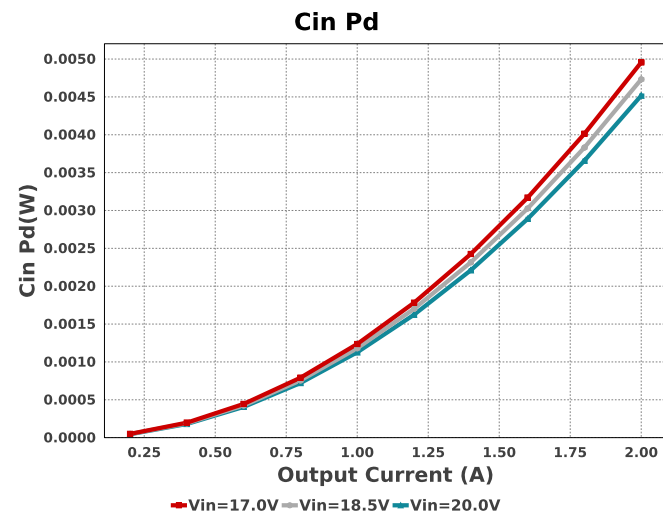
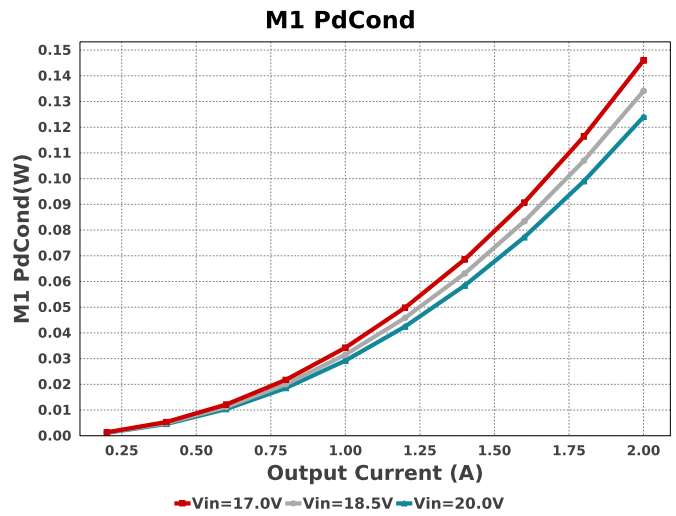
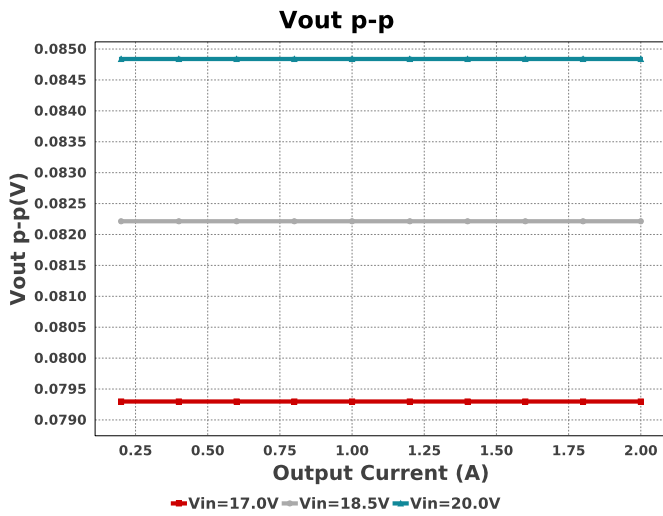
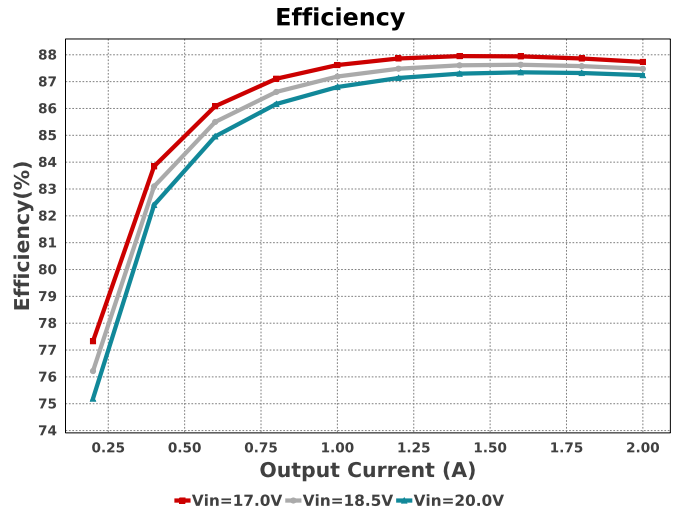
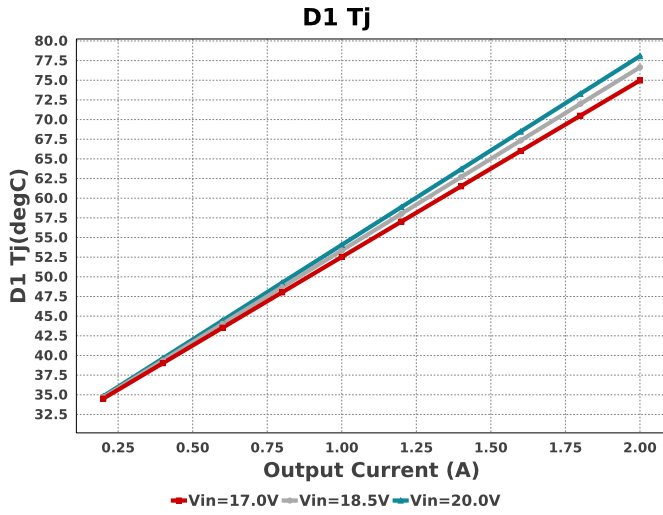


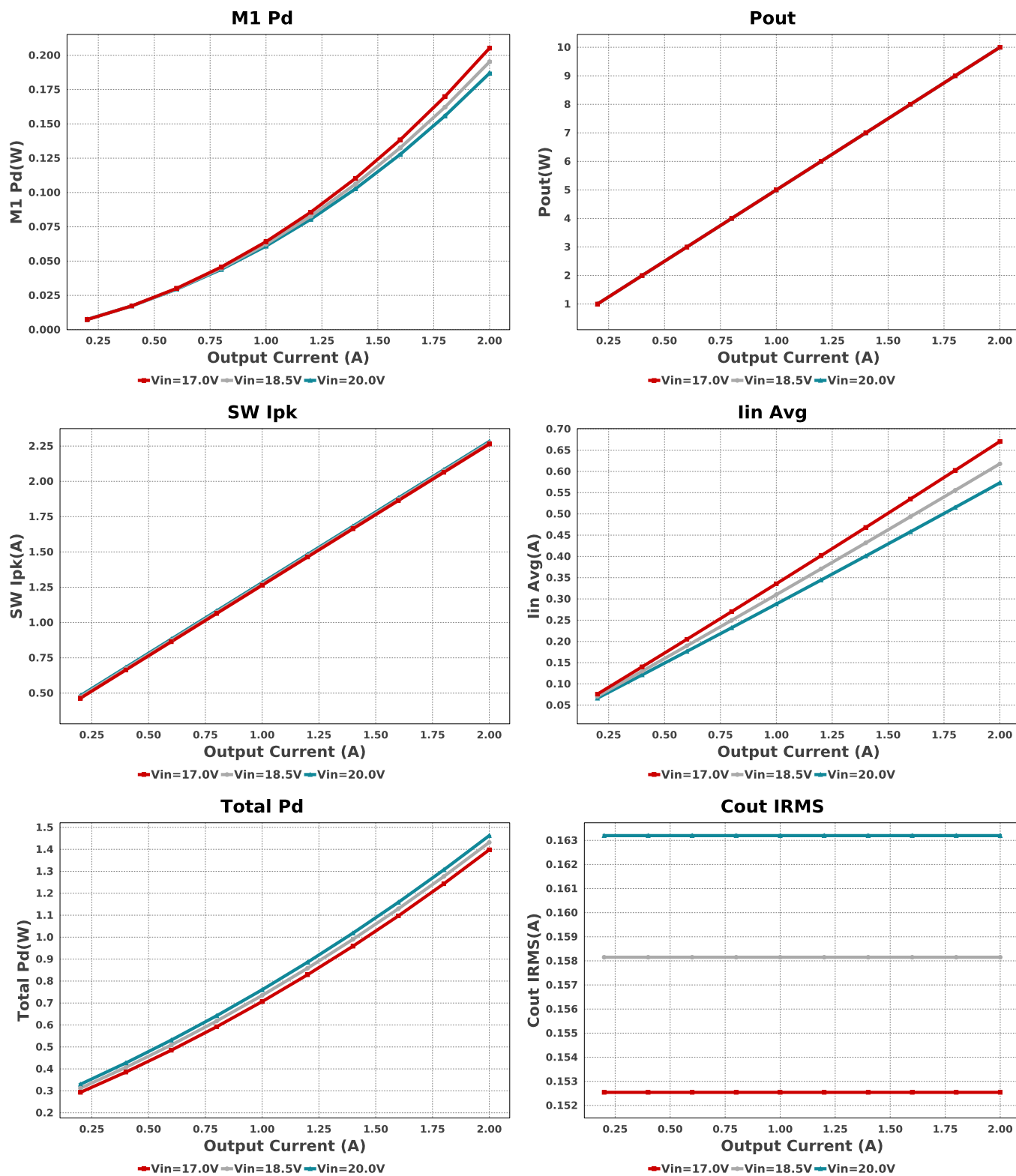
## Electrical BOM

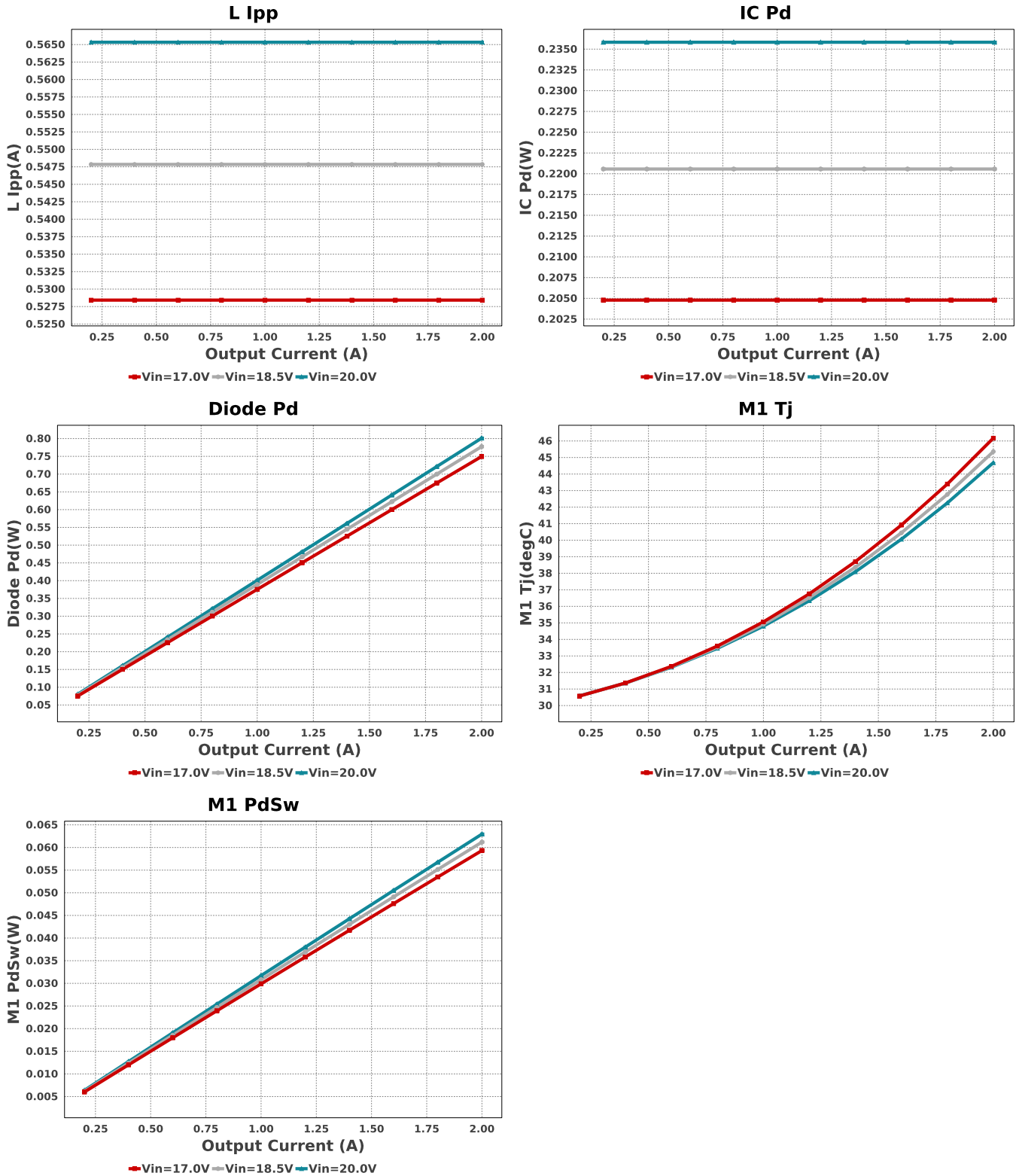
| Name | Manufacturer              | Part Number                          | Properties  | Qty | Price  | Footprint                      |
|------|---------------------------|--------------------------------------|---|-----|--------|--------------------------------|
| Cadj | Samsung Electro-Mechanics | CL21C102JBCNNNC<br>Series= C0G/NP0   | Cap= 1.0 nF<br>VDC= 50.0 V<br>IRMS= 0.0 A                       | 1   | \$0.01 | 0805 7 mm <sup>2</sup>         |
| Cff  | Kemet                     | C0603C911J5GACTU<br>Series= C0G/NP0  | Cap= 910.0 pF<br>ESR= 1.0 mOhm<br>VDC= 50.0 V<br>IRMS= 0.0 A    | 1   | \$0.08 | 0603 5 mm <sup>2</sup>         |
| Cin  | TDK                       | C1005X5R1V105K050BC<br>Series= X5R   | Cap= 1.0 uF<br>ESR= 11.416 mOhm<br>VDC= 35.0 V<br>IRMS= 1.483 A | 2   | \$0.03 | 0402 3 mm <sup>2</sup>         |
| Cout | Panasonic                 | 6TPU47MSI<br>Series= TPU             | Cap= 47.0 uF<br>ESR= 150.0 mOhm<br>VDC= 6.3 V<br>IRMS= 510.0 mA | 1   | \$0.44 | CAPSMT_6_S09 7 mm <sup>2</sup> |
| Cvcc | Taiyo Yuden               | TMK212BJ474KD-T<br>Series= X5R       | Cap= 470.0 nF<br>ESR= 1.0 mOhm<br>VDC= 20.0 V<br>IRMS= 0.0 A    | 1   | \$0.02 | 0805 7 mm <sup>2</sup>         |
| D1   | Fairchild Semiconductor   | SS24FL                               | VF@Io= 550.0 mV<br>VRRM= 40.0 V                                 | 1   | \$0.09 | SOD-123F 12 mm <sup>2</sup>    |
| L1   | TDK                       | VLP8040T-100M                        | L= 10.0 uH<br>38.0 mOhm   | 1   | \$0.22 | VLP8040 113 mm <sup>2</sup>    |
| M1   | Fairchild Semiconductor   | FDC5614P                             | VdsMax= -60.0 V<br>IdsMax= -3.0 Amps                            | 1   | \$0.25 | SOT-23-6 15 mm <sup>2</sup>    |
| 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 mm <sup>2</sup>         |
| Rfb1 | Yageo                     | RC0603FR-072K2L<br>Series= ?         | Res= 2.2 kOhm<br>Power= 100.0 mW<br>Tolerance= 1.0%             | 1   | \$0.01 | 0603 5 mm <sup>2</sup>         |

| Name | Manufacturer              | Part Number                          | Properties   | Qty | Price  | Footprint                 |
|------|---------------------------|--------------------------------------|--|-----|--------|---------------------------|
| 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 <sup>2</sup>    |
| 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 <sup>2</sup>   |
| Rt   | Vishay-Dale               | CRCW040240K2FKED<br>Series= CRCW..e3 | Res= 40.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0%  | 1   | \$0.01 | 0402 3 mm <sup>2</sup>    |
| U1   | Texas Instruments         | LM25085AMY/NOPB                      | Switcher   | 1   | \$0.87 | MUY08A 24 mm <sup>2</sup> |









## Operating Values

| #   | Name         | Value       | Category  | Description                               |
|-----|--------------|-------------|-----------|---|
| 1.  | Cin IRMS     | 889.622 mA  | Capacitor | Input capacitor RMS ripple current        |
| 2.  | Cin Pd       | 4.518 mW    | Capacitor | Input capacitor power dissipation         |
| 3.  | Cout IRMS    | 163.198 mA  | Capacitor | Output capacitor RMS ripple current       |
| 4.  | Cout Pd      | 3.995 mW    | Capacitor | Output capacitor power dissipation        |
| 5.  | D1 Tj        | 78.071 degC | Diode     | D1 junction temperature                   |
| 6.  | Diode Pd     | 801.18 mW   | Diode     | Diode power dissipation                   |
| 7.  | IC Pd        | 235.83 mW   | IC        | IC power dissipation                      |
| 8.  | IC Tj        | 40.848 degC | IC        | IC junction temperature                   |
| 9.  | IC Tolerance | 18.0 mV     | IC        | IC Feedback Tolerance                     |
| 10. | ICThetaJA    | 46.0 degC/W | IC        | IC junction-to-ambient thermal resistance |
| 11. | Iin Avg      | 572.95 mA   | IC        | Average input current                     |

| #   | Name           | Value                 | Category    | Description  |
|-----|----------------|-----------------------|-------------|--|
| 12. | L Ipp          | 565.33 mA             | Inductor    | Peak-to-peak inductor ripple current   |
| 13. | L Pd           | 190.0 mW              | Inductor    | Inductor power dissipation   |
| 14. | M1 Pd          | 183.58 mW             | Mosfet      | M1 MOSFET total power dissipation  |
| 15. | M1 PdCond      | 124.45 mW             | Mosfet      | M1 MOSFET conduction losses  |
| 16. | M1 PdSw        | 59.128 mW             | Mosfet      | M1 MOSFET switching losses   |
| 17. | M1 Tj          | 44.373 degC           | Mosfet      | M1 MOSFET junction temperature   |
| 18. | Cin Pd         | 4.518 mW              | Power       | Input capacitor power dissipation  |
| 19. | Cout Pd        | 3.995 mW              | Power       | Output capacitor power dissipation   |
| 20. | Diode Pd       | 801.18 mW             | Power       | Diode power dissipation  |
| 21. | IC Pd          | 235.83 mW             | Power       | IC power dissipation   |
| 22. | L Pd           | 190.0 mW              | Power       | Inductor power dissipation   |
| 23. | M1 Pd          | 183.58 mW             | Power       | M1 MOSFET total power dissipation  |
| 24. | M1 PdCond      | 124.45 mW             | Power       | M1 MOSFET conduction losses  |
| 25. | M1 PdSw        | 59.128 mW             | Power       | M1 MOSFET switching losses   |
| 26. | Total Pd       | 1.459 W               | Power       | Total Power Dissipation  |
| 27. | BOM Count      | 15                    | System      | Total Design BOM count   |
|     |                |                       | Information |  |
| 28. | Duty Cycle     | 27.165 %              | System      | Duty cycle   |
|     |                |                       | Information |  |
| 29. | Efficiency     | 87.267 %              | System      | Steady state efficiency  |
|     |                |                       | Information |  |
| 30. | FootPrint      | 219.0 mm <sup>2</sup> | System      | Total Foot Print Area of BOM components  |
|     |                |                       | Information |  |
| 31. | Frequency      | 585.631 kHz           | System      | Switching frequency  |
|     |                |                       | Information |  |
| 32. | Iout           | 2.0 A                 | System      | Iout operating point   |
|     |                |                       | Information |  |
| 33. | Mode           | CCM                   | System      | Conduction Mode  |
|     |                |                       | Information |  |
| 34. | Pout           | 10.0 W                | System      | Total output power   |
|     |                |                       | Information |  |
| 35. | SW Ipk         | 2.283 A               | System      | Peak switch current  |
|     |                |                       | Information |  |
| 36. | Total BOM      | \$2.19                | System      | Total BOM Cost   |
|     |                |                       | Information |  |
| 37. | Vin            | 20.0 V                | System      | Vin operating point  |
|     |                |                       | Information |  |
| 38. | Vout           | 5.0 V                 | System      | Operational Output Voltage   |
|     |                |                       | Information |  |
| 39. | Vout Actual    | 4.991 V               | System      | Vout Actual calculated based on selected voltage divider resistors                         |
|     |                |                       | Information |  |
| 40. | Vout Tolerance | 3.689 %               | System      | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |
|     |                |                       | Information |  |
| 41. | Vout p-p       | 84.839 mV             | System      | Peak-to-peak output ripple voltage   |
|     |                |                       | Information |  |

## Design Inputs

| Name    | Value    | Description            |
|---------|----------|------------------------|
| Iout    | 2.0      | Maximum Output Current |
| VinMax  | 20.0     | Maximum input voltage  |
| VinMin  | 17.0     | Minimum input voltage  |
| VinTyp  | 18.0     | Typical input voltage  |
| Vout    | 5.0      | Output Voltage         |
| base_pn | LM25085A | Base Product Number    |
| source  | DC       | Input Source Type      |
| Ta      | 30.0     | Ambient temperature    |

## 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

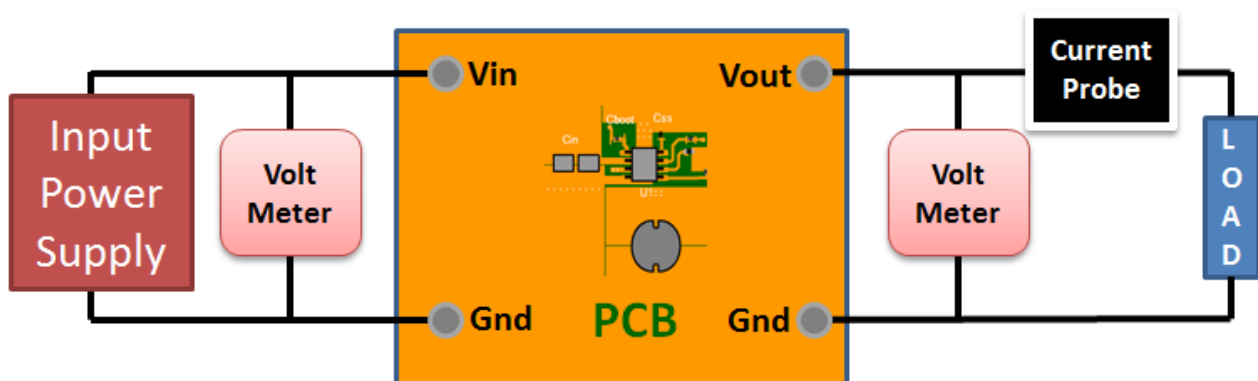
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town 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 17.0V 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 lout 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.

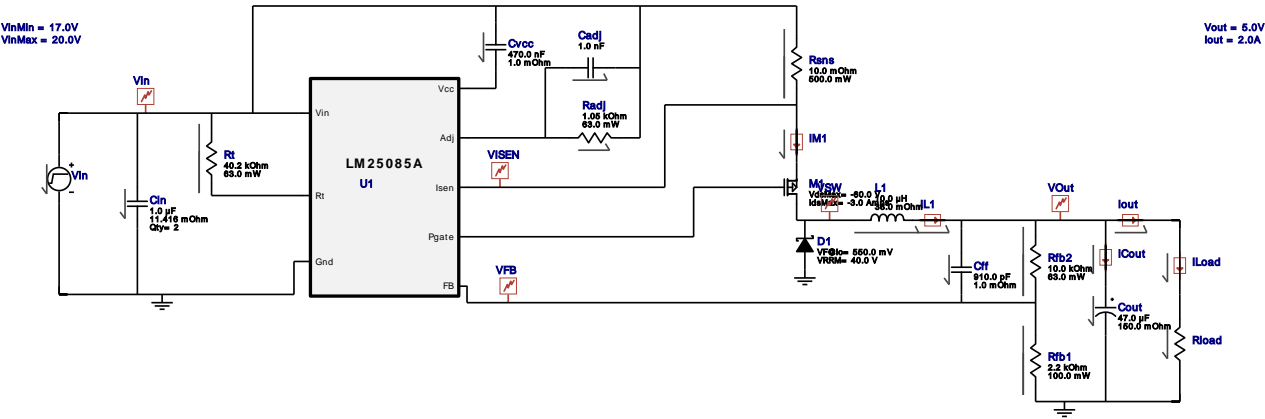
### Load Testing

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.



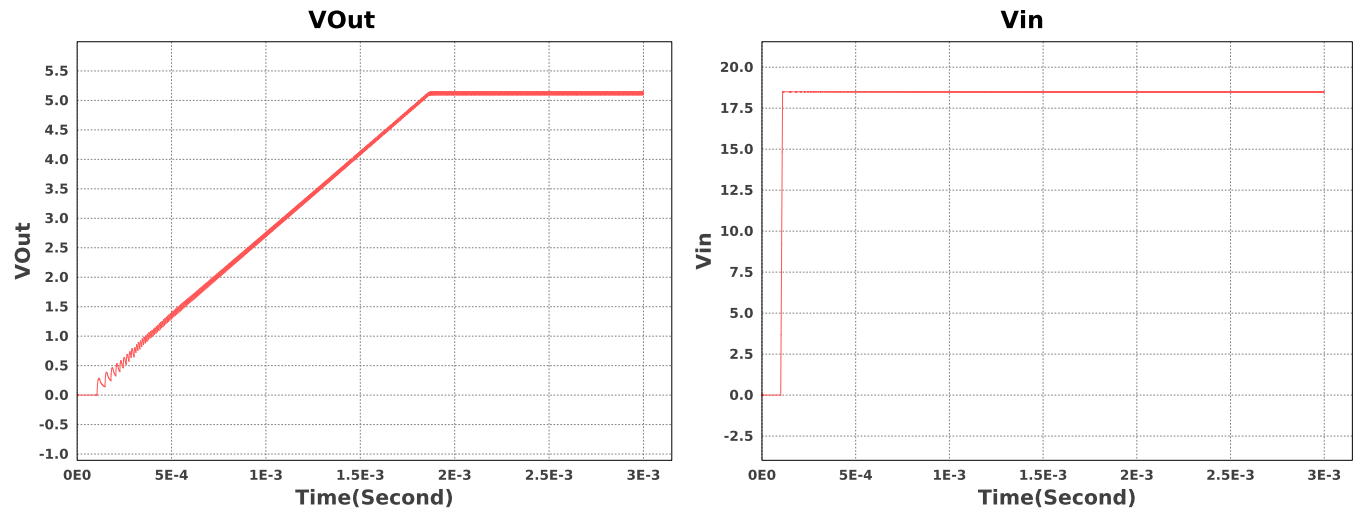
WEBENCH® Electrical Simulation Report

Design Id = 24  
sim\_id = 1  
Simulation Type = Startup



Simulation Parameters

| #  | Name  | Parameter Name | Description     | Values  |
|----|-------|----------------|-----------------|---------|
| 1. | Rload | R              | Load Resistance | 2.5 Ohm |

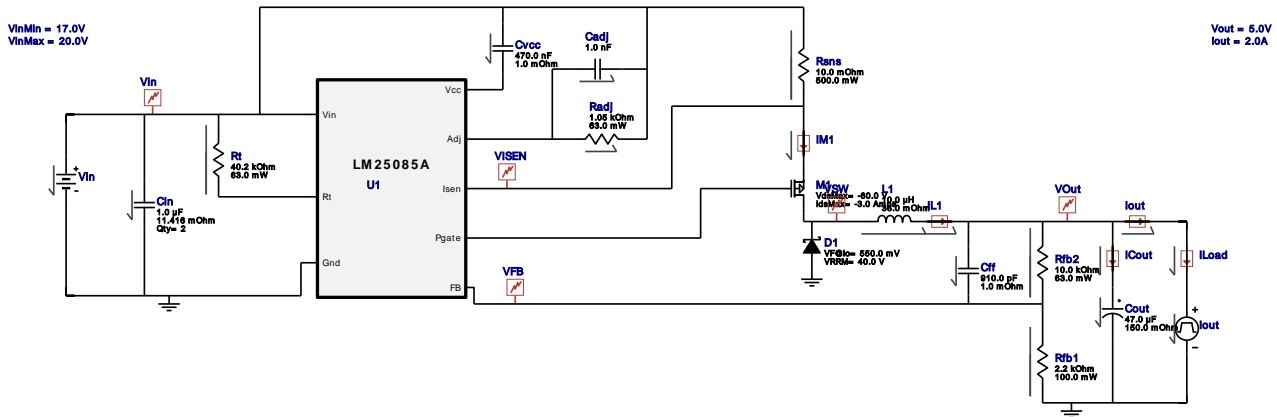




Design Id = 24

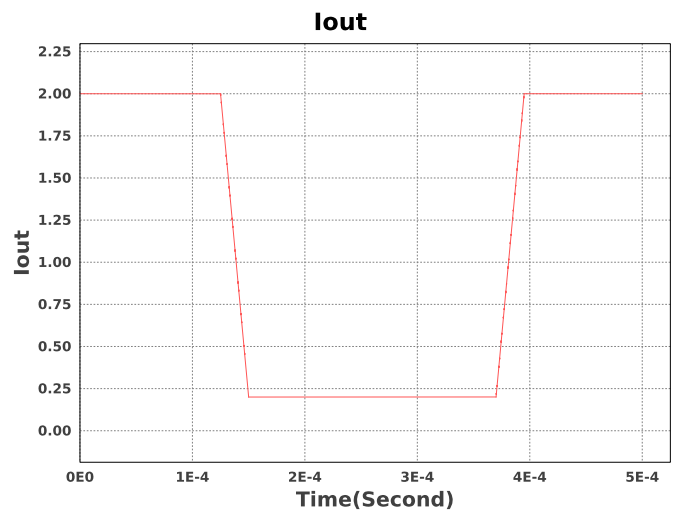
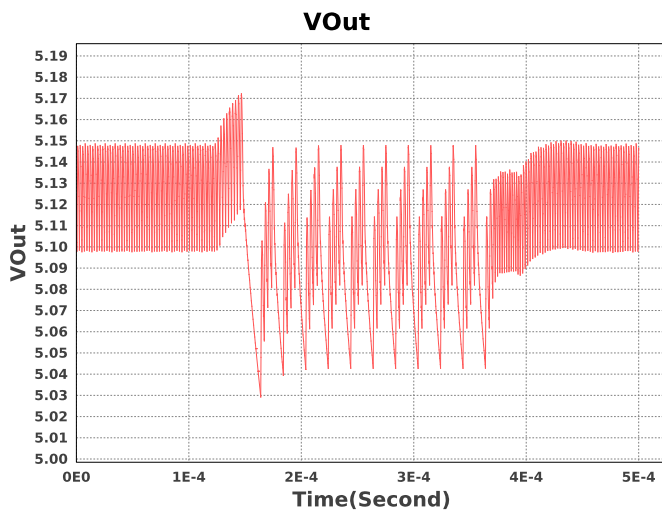
sim\_id = 2

Simulation Type = Load Transient



## Simulation Parameters

| #  | Name | Parameter Name | Description        | Values   |
|----|------|----------------|--------------------|----------|
| 1. | Iout | signal_type    | Signal Type        | PULSE    |
|    |      | I1             | Initial Current    | 2.0 A    |
|    |      | I2             | Peak Current       | 0.2 A    |
|    |      | Td             | Initial Delay Time | 125u Sec |
|    |      | Tr             | Rise Time          | 25u Sec  |
|    |      | Tf             | Fall Time          | 25u Sec  |
|    |      | Pw             | Pulse Width        | 220u Sec |

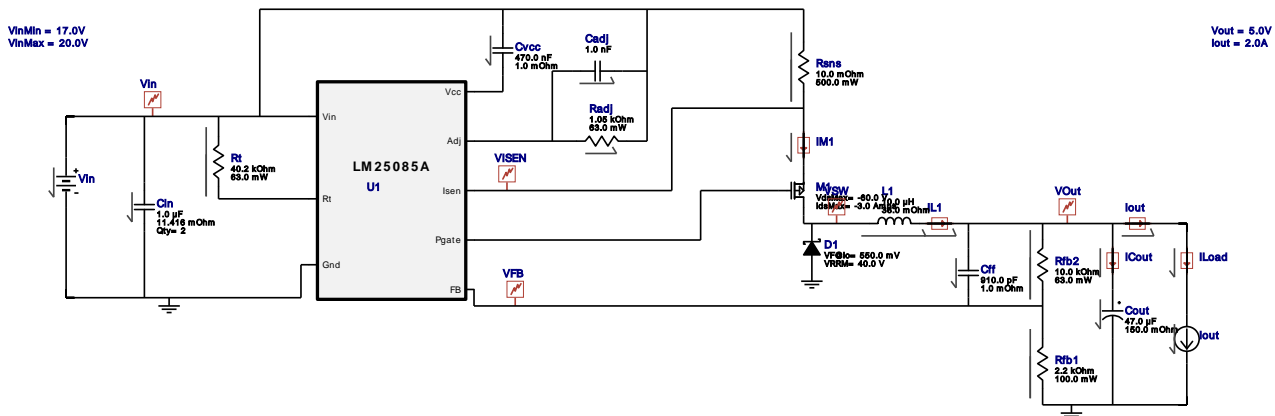




Design Id = 24

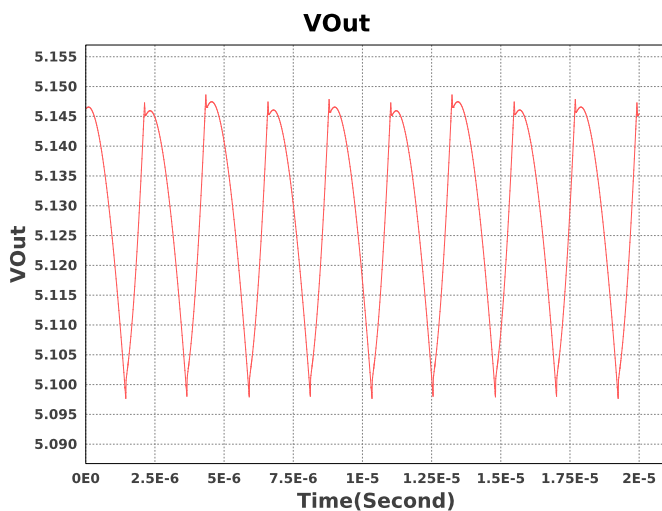
sim\_id = 4

Simulation Type = Steady State



## Simulation Parameters

| #  | Name | Parameter Name | Description  | Values |
|----|------|----------------|--------------|--------|
| 1. | Iout | I              | Load Current | 2.0 A  |



## 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. Master key : B9BB535380F6DCECC9D62E6CF388EC6F[v1]

3. **LM25085A** Product Folder : <http://www.ti.com/product/LM25085A> : 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.