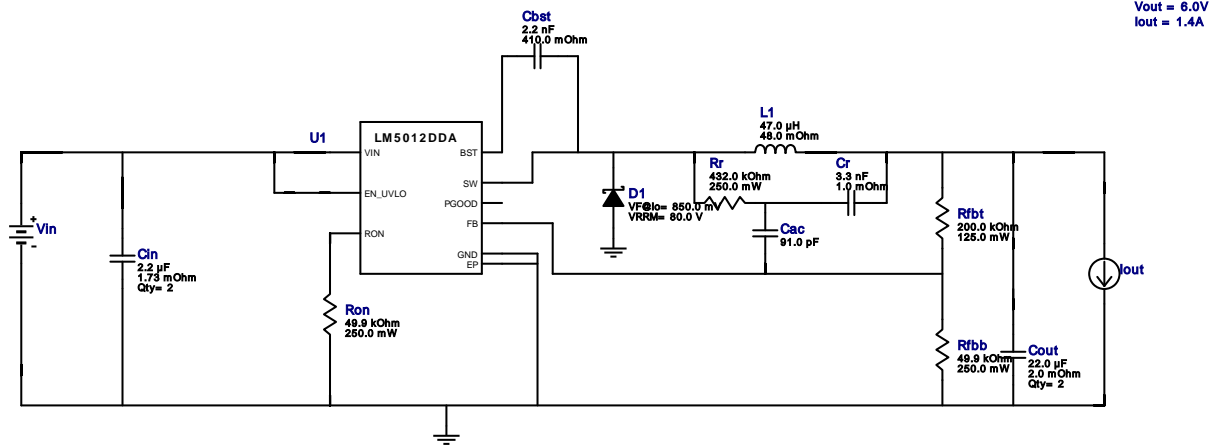




WEBENCH® Design Report

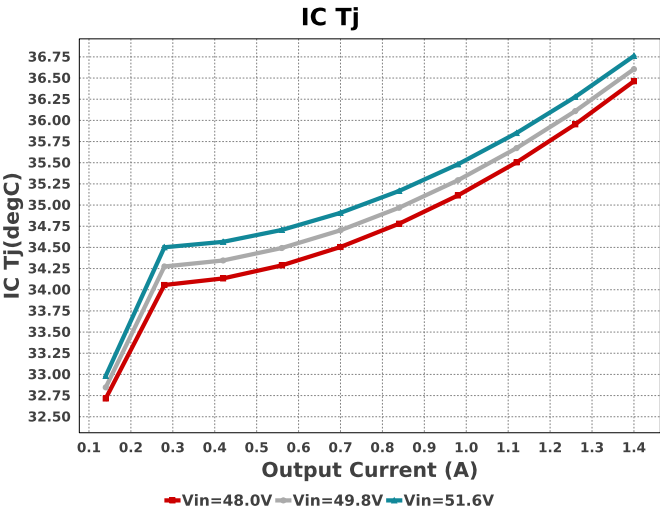
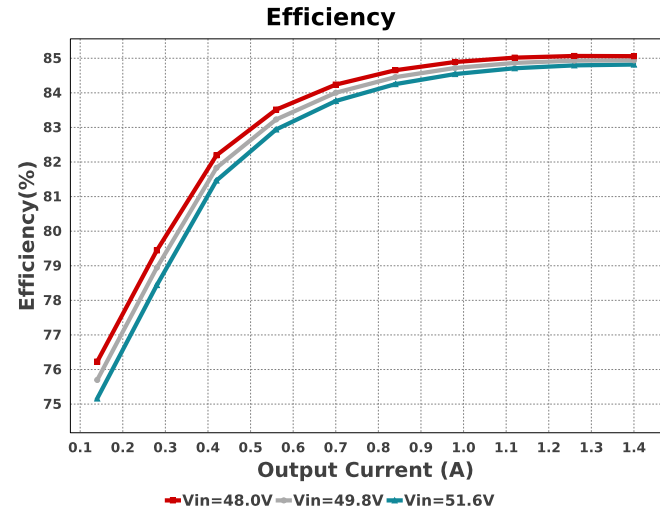
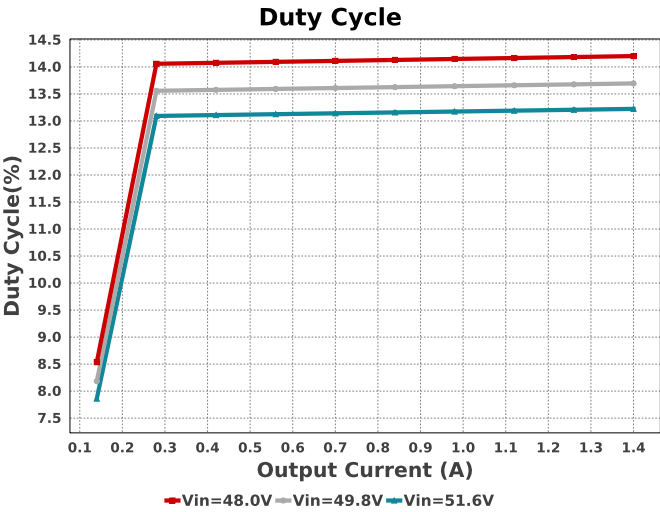
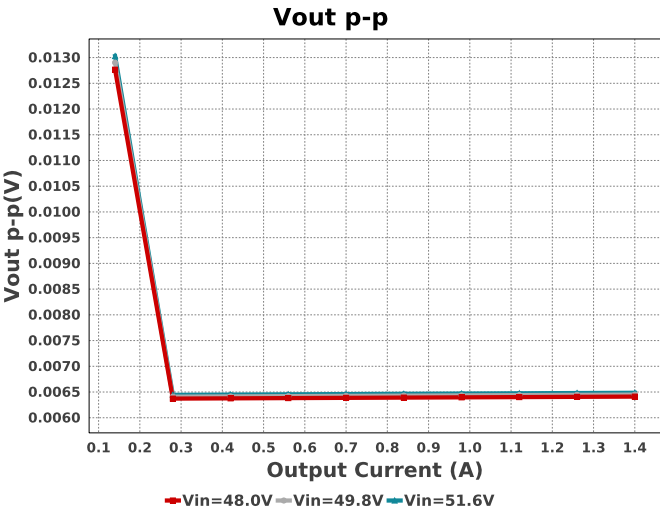
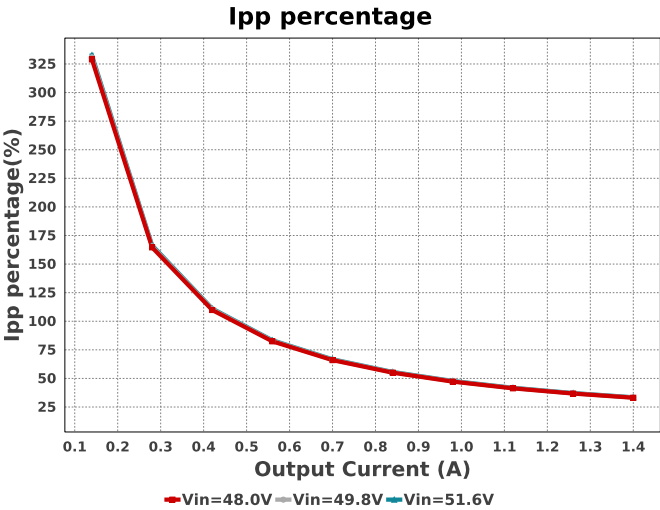
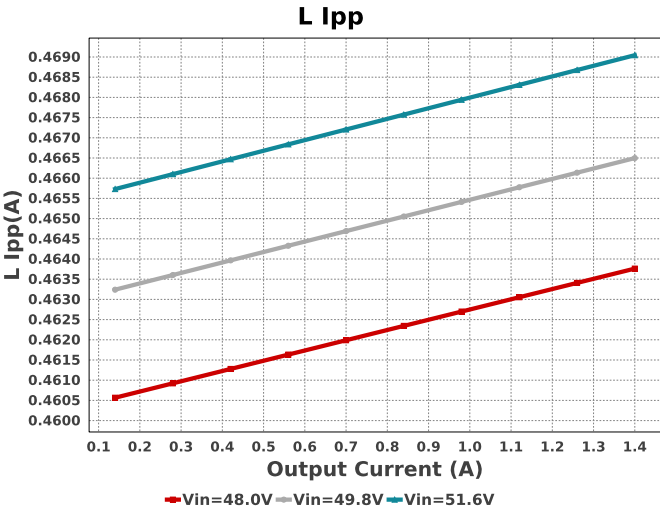
Design : 7 LM5012DDAR
LM5012DDAR **FINAL** 48V-51.6V to 6.00V @ 1.4A

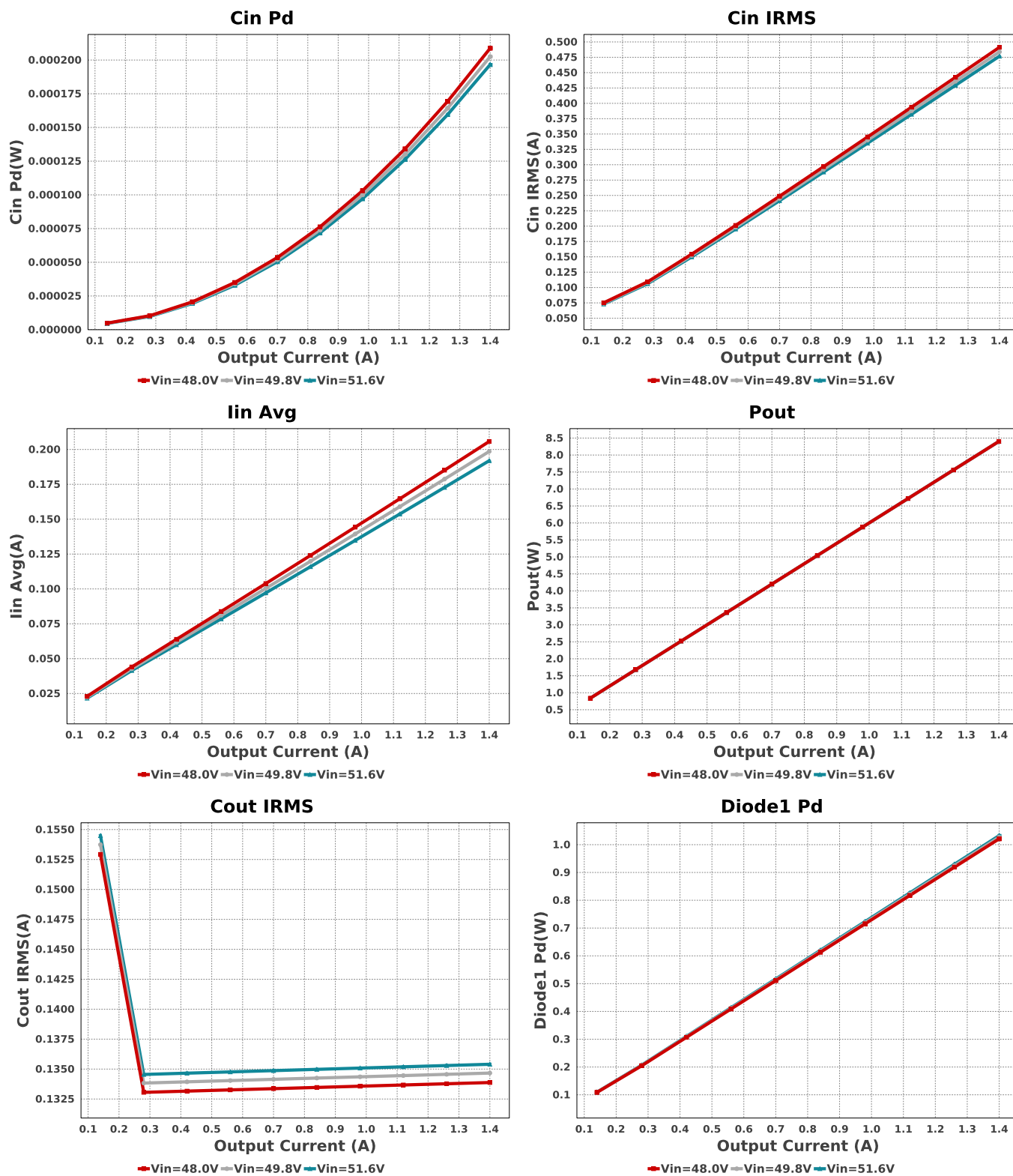


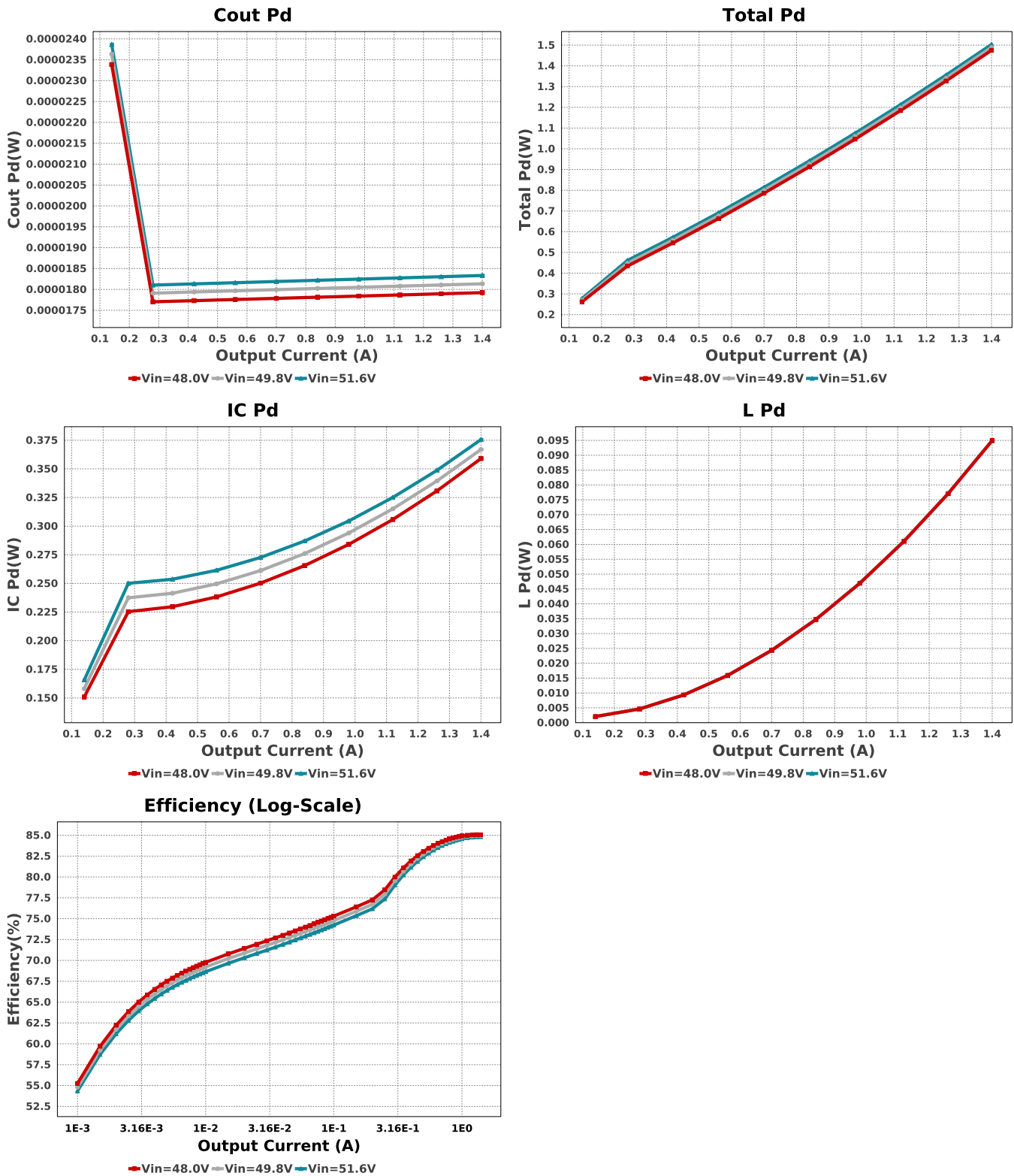
Electrical BOM

| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|------|---------------------------|--------------------------------------|---|-----|--------|---|
| Cac | Samsung Electro-Mechanics | CL21C910JBANNNC Series= C0G/NP0 | Cap= 91.0 pF VDC= 50.0 V IRMS= 0.0 A | 1 | \$0.10 |  0805 7 mm ² |
| Cbst | Kemet | C1206C222K5RACTU Series= X7R | Cap= 2.2 nF ESR= 410.0 mOhm VDC= 50.0 V IRMS= 199.0 mA | 1 | \$0.02 |  1206 11 mm ² |
| Cin | TDK | C3225X7R2A225K230AB Series= X7R | Cap= 2.2 uF ESR= 1.73 mOhm VDC= 100.0 V IRMS= 5.5932 A | 2 | \$0.21 |  1210_250 15 mm ² |
| Cout | MuRata | GRM32ER61E226KE15L Series= X5R | Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A | 2 | \$0.23 |  1210 15 mm ² |
| Cr | Yageo | CC1206KRX7R9BB332 Series= X7R | Cap= 3.3 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A | 1 | \$0.04 |  1206 11 mm ² |
| D1 | Comchip Technology | CDBC580-G | VF@Io= 850.0 mV VRRM= 80.0 V | 1 | \$0.26 |  SMC 83 mm ² |
| L1 | Coilcraft | MSS1210-473MEB | L= 47.0 uH 48.0 mOhm | 1 | \$0.81 |  MSS1210 204 mm ² |
| Rfbb | Vishay-Dale | CRCW120649K9FKEA Series= CRCW..e3 | Res= 49.9 kOhm Power= 250.0 mW Tolerance= 1.0% | 1 | \$0.01 |  1206 11 mm ² |
| Rfbt | Vishay-Dale | CRCW0805200KFKEA Series= CRCW..e3 | Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0% | 1 | \$0.01 |  0805 7 mm ² |

| Name | Manufacturer | Part Number | Properties | Qty | Price | Footprint |
|------|-------------------|--------------------------------------|---|-----|--------|---|
| Ron | Vishay-Dale | CRCW120649K9FKEA Series= CRCW..e3 | Res= 49.9 kOhm Power= 250.0 mW Tolerance= 1.0% | 1 | \$0.01 |  1206 11 mm² |
| Rr | Yageo | RC1206FR-07432KL Series= ? | Res= 432.0 kOhm Power= 250.0 mW Tolerance= 1.0% | 1 | \$0.01 |  1206 11 mm² |
| U1 | Texas Instruments | LM5012DDAR | Switcher | 1 | \$1.08 | DDA0008E-MFG 55 mm² |







Operating Values

| # | Name | Value | Category | Description |
|-----|--------------|----------------|-----------|---|
| 1. | BOM Count | 14 | | Total Design BOM count |
| 2. | Total BOM | \$3.23 | | Total BOM Cost |
| 3. | Cin IRMS | 476.79 mA | Capacitor | Input capacitor RMS ripple current |
| 4. | Cin Pd | 196.64 μ W | Capacitor | Input capacitor power dissipation |
| 5. | Cout IRMS | 135.401 mA | Capacitor | Output capacitor RMS ripple current |
| 6. | Cout Pd | 18.334 μ W | Capacitor | Output capacitor power dissipation |
| 7. | Diode1 Pd | 1.033 W | Diode | Diode1 power dissipation |
| 8. | IC Pd | 375.59 mW | IC | IC power dissipation |
| 9. | IC Tj | 36.761 degC | IC | IC junction temperature |
| 10. | IC Tolerance | 19.0 mV | IC | IC Feedback Tolerance |
| 11. | ICThetaJA | 18.0 degC/W | IC | IC junction-to-ambient thermal resistance |

| # | Name | Value | Category | Description |
|-----|----------------|-----------------------|-----------------------|--|
| 12. | Iin Avg | 191.93 mA | IC | Average input current |
| 13. | Ipp percentage | 33.503 % | Inductor | Inductor ripple current percentage (with respect to average inductor current) |
| 14. | L Ipp | 469.044 mA | Inductor | Peak-to-peak inductor ripple current |
| 15. | L Pd | 94.96 mW | Inductor | Inductor power dissipation |
| 16. | Cin Pd | 196.64 μ W | Power | Input capacitor power dissipation |
| 17. | Cout Pd | 18.334 μ W | Power | Output capacitor power dissipation |
| 18. | Diode1 Pd | 1.033 W | Power | Diode1 power dissipation |
| 19. | IC Pd | 375.59 mW | Power | IC power dissipation |
| 20. | L Pd | 94.96 mW | Power | Inductor power dissipation |
| 21. | Total Pd | 1.504 W | Power | Total Power Dissipation |
| 22. | Duty Cycle | 13.223 % | System Information | Duty cycle |
| 23. | Efficiency | 84.818 % | System Information | Steady state efficiency |
| 24. | FootPrint | 470.0 mm ² | System Information | Total Foot Print Area of BOM components |
| 25. | Frequency | 272.284 kHz | System Information | Switching frequency |
| 26. | Iout | 1.4 A | System Information | Iout operating point |
| 27. | Mode | CCM | System Information | Conduction Mode |
| 28. | Pout | 8.4 W | System Information | Total output power |
| 29. | Vin | 51.6 V | System Information | Vin operating point |
| 30. | Vout | 6.0 V | System Information | Operational Output Voltage |
| 31. | Vout Actual | 6.01 V | System Information | Vout Actual calculated based on selected voltage divider resistors |
| 32. | Vout Tolerance | 3.226 % | System Information | Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable |
| 33. | Vout p-p | 6.485 mV | System Information | Peak-to-peak output ripple voltage |

Design Inputs

| Name | Value | Description |
|---------|--------|------------------------|
| Iout | 1.4 | Maximum Output Current |
| VinMax | 51.6 | Maximum input voltage |
| VinMin | 48.0 | Minimum input voltage |
| Vout | 6.0 | Output Voltage |
| base_pn | LM5012 | 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

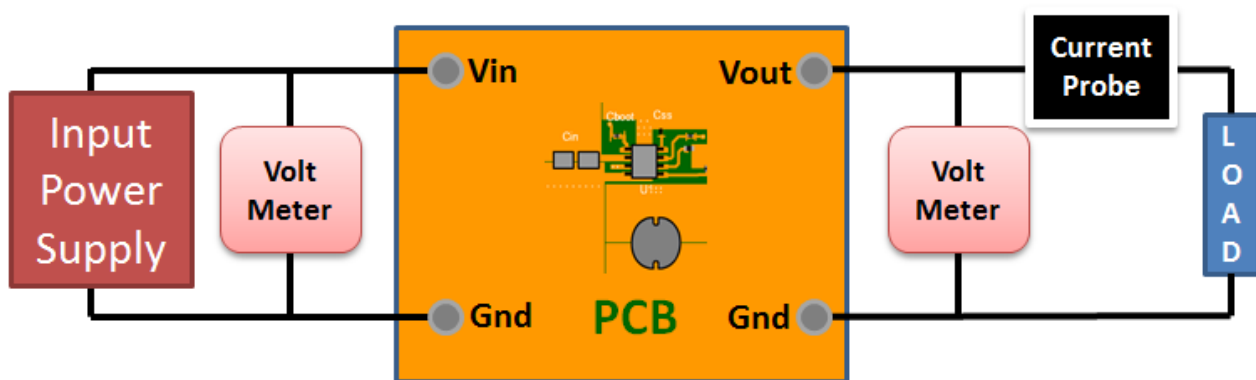
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab 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 48.0V 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.



Design Assistance

1. Master key : 8D46410E296FCE97B33F99C6313555A5[v1]
2. **LM5012** Product Folder : <http://www.ti.com/product/LM5012> : 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 or provided in conjunction with TI products.