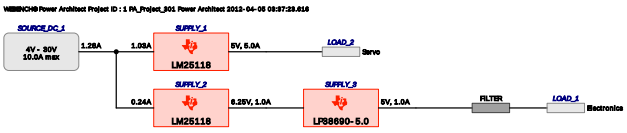



# WEBENCH® Power Architect

## Project Report

Project : 682565/1 : PA_Project_301
Created : 2012-04-05 03:37:23.616
Optimize project optFactor=3

Project Summary

| | | |
|---|---|---|
| 1. | Total System Efficiency | 77.014 % |
| 2. | Total System BOM Count | 61.0 |
| 3. | Total System Footprint | 2.401 kmm2 |
| 4. | Total System BOM Cost | $17.52 |
| 5. | Total System Power Dissipation | 8.954 W |

--> Launch WEBENCH Power Architect.

### Power Supplies

| # | Name | NSID | Description | Vout | Iout | Efficiency | Foot-print | Cost | Design | Page |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | SUPPLY_1 | LM25118 | Switcher : Wide Range BuckBoost controller | 5 V | 5.0 A | 80.6% | 1538 | $11.91 | 4 | 4 |
| 2. | SUPPLY_2 | LM25118 | Switcher : Wide Range BuckBoost controller | 6.25 V | 1.0 A | 85.9% | 786 | $4.92 | 6 | 10 |
| 3. | SUPPLY_3 | LP38690-5.0 | LDO : Very low quiescent current | 5 V | 1.0 A | 72.5% | 142 | $0.76 | 5 | 8 |

### Power Loads

| # | Name | VLoad | ILoad | Description |
|---|---|---|---|---|
| 1. | Servo | 5 V | 5 A | VoutRipple=10% |
| 2. | Electronics | 5 V | 1 A | Filter required |

## Project Diagram

## Electrical Procurement BOM

| Manufacturer | Part Number | Description | Quantity | Budgetary Price | Footprint ($mm^2$) |
|---|---|---|---|---|---|
| Vishay-Semiconductor | 12CWQ03FNPBF | DPAK | 2 | $0.76 | 203 |
| Vishay-Semiconductor | 12CWQ04FNPBF | DPAK | 2 | $0.76 | 203 |
| Nippon Chemi-Con | APXA6R3ARA681MJC0G | CAPSMT_62_JC0 | 3 | $0.71 | 156 |
| Nippon Chemi-Con | APXE100ARA151MF80G | CAPSMT_62_F80 | 1 | $0.51 | 74 |
| Diodes Inc. | B220A-13-F | SMA | 2 | $0.09 | 75 |
| Diodes Inc. | B240A-13-F | SMA | 2 | $0.09 | 75 |
| Infineon Technologies | BSZ050N03MS G | PG-TSDSON-8 | 1 | $0.33 | 29 |
| Infineon Technologies | BSZ165N04NS G | PG-TSDSON-8 | 1 | $0.30 | 29 |
| Kemet | C0805C104K5RACTU | 0805 | 2 | $0.01 | 26 |
| TDK | C1005X5R0J105M | 0402 | 1 | $0.01 | 8 |
| TDK | C1608X5R1A105K | 0603 | 1 | $0.01 | 10 |
| TDK | C2012Y5V1C105Z/0.85 | 0805 | 2 | $0.01 | 26 |
| TDK | C5750X7R1H106M | 2220 | 6 | $0.68 | 120 |
| Yageo America | CC0805JRNP09BN121 | 0805 | 1 | $0.01 | 13 |
| Yageo America | CC0805KRX7R9BB152 | 0805 | 1 | $0.01 | 13 |
| Yageo America | CC0805KRX7R9BB221 | 0805 | 1 | $0.01 | 13 |
| Yageo America | CC0805KRX7R9BB223 | 0805 | 2 | $0.01 | 26 |
| Yageo America | CC0805KRX7R9BB331 | 0805 | 1 | $0.01 | 13 |
| Yageo America | CC0805KRX7R9BB472 | 0805 | 1 | $0.01 | 13 |
| Yageo America | CC0805KRX7R9BB561 | 0805 | 1 | $0.01 | 13 |
| Vishay-Dale | CRCW040218K7FKED | 0402 | 3 | $0.01 | 22 |
| Vishay-Dale | CRCW04021K00FKED | 0402 | 2 | $0.01 | 15 |
| Vishay-Dale | CRCW04021M00FKED | 0402 | 2 | $0.01 | 15 |
| Vishay-Dale | CRCW040232K4FKED | 0402 | 2 | $0.01 | 15 |
| Vishay-Dale | CRCW04023K09FKED | 0402 | 1 | $0.01 | 8 |
| Vishay-Dale | CRCW040241K2FKED | 0402 | 1 | $0.01 | 8 |
| Vishay-Dale | CRCW040246K4FKED | 0402 | 1 | $0.01 | 8 |
| Vishay-Dale | CRCW040247K5FKED | 0402 | 1 | $0.01 | 8 |
| Vishay-Dale | CRCW04024K12FKED | 0402 | 1 | $0.01 | 8 |
| Texas Instruments | CSD16301Q2 | TRANS_NexFET_Q2 | 1 | $0.22 | 16 |
| Stackpole Electronics Inc | CSR1206FK75L0 | 1206 | 1 | $0.10 | 19 |
| Stackpole Electronics Inc | CSRN2512FK15L0 | 2512 | 1 | $0.19 | 43 |
| Nippon Chemi-Con | EMVY160ADA470MF55G | CAPSMT_62_F55 | 1 | $0.09 | 77 |
| Fairchild Semiconductor | FDMC8462 | TRANS_Fairchild_PQFN08B | 1 | $0.76 | 28 |
| MuRata | GRM155R61A105KE15D | 0402 | 2 | $0.01 | 15 |
| MuRata | GRM21BR71E104KA01L | 0805 | 2 | $0.01 | 26 |
| Texas Instruments | LM25118MHE | MXA20A | 2 | $2.19 | 143 |
| Texas Instruments | LP38690SD-5.0 | SDE06A | 1 | $0.55 | 25 |
| TDK | NLCV32T-R15M-PFR | NLCV32 | 1 | $0.10 | 22 |
| Bourns | SRR1208-150ML | SRR1208 | 1 | $0.41 | 216 |
| Coilcraft | XAL1010-822MEB | XAL1010 | 1 | $1.08 | 160 |
| **Total** | | | **61** | **$17.59** | **2,033** |

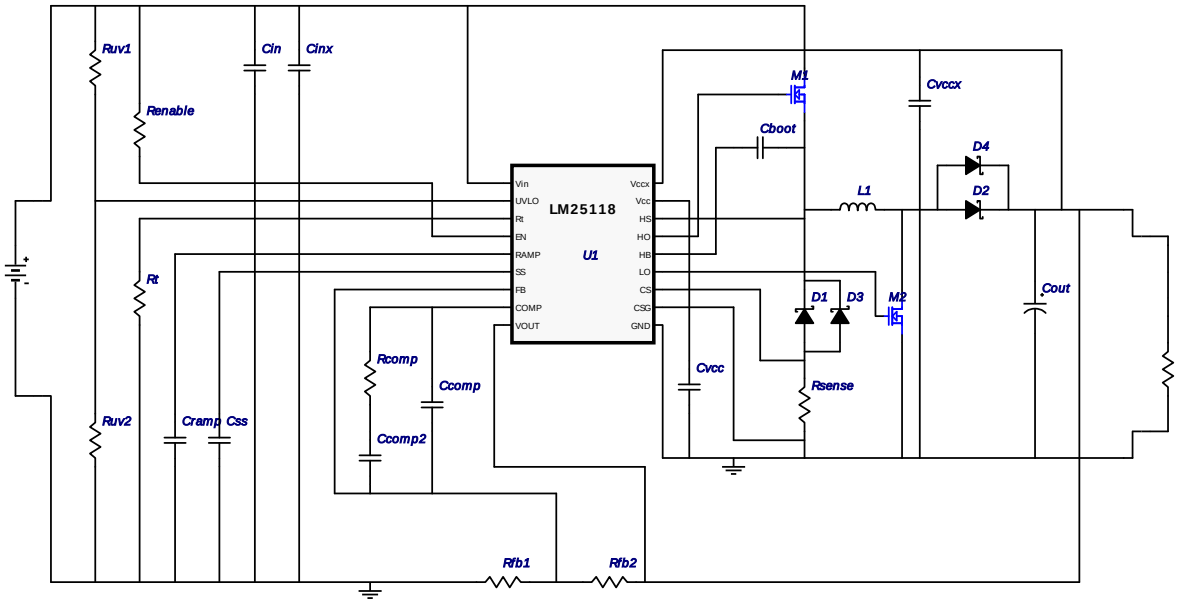
TEXAS INSTRUMENTS

# WEBENCH® Design Report

VinMin = 4.0V
VinMax = 30.0V
Vout = 5.0V
Iout = 5.0A

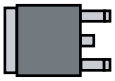
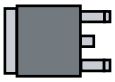
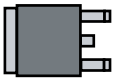
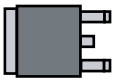
Device = LM25118MHE
Topology = Buck_Boost
Created = 4/5/12 3:37:20 AM
BOM Cost = $11.91
Total Pd = 6.03 W
Footprint = 1,538.0 mm2
BOM Count = 30

Design : 682565/4 LM25118MHE
LM25118MHE 4.0V-30.0V to 5.0V @ 5.0A




## Electrical BOM

| # | Name | Manufacturer | Part Number | Quantity | Price | Properties | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cboot | MuRata | GRM21BR71E104KA01L<br>Series= X7R | 1 | $0.01 | Cap= 100.0 nF<br>ESR= 0.0 Ohm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 2. | Ccomp | Yageo America | CC0805KRX7R9BB561<br>Series= X7R | 1 | $0.01 | Cap= 560.0 pF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 3. | Ccomp2 | Yageo America | CC0805KRX7R9BB472<br>Series= X7R | 1 | $0.01 | Cap= 4.7 nF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 4. | Cin | TDK | C5750X7R1H106M<br>Series= X7R | 3 | $0.68 | Cap= 10.0 µF<br>ESR= 3.0 mOhm<br>VDC= 50.0 V<br>IRMS= 5.5 A | 2220 60mm2 |
| 5. | Cinx | Kemet | C0805C104K5RACTU<br>Series= X7R | 1 | $0.01 | Cap= 100.0 nF<br>ESR= 64.0 mOhm<br>VDC= 50.0 V<br>IRMS= 1.64 A | 0805 13mm2 |
| 6. | Cout | Nippon Chemi-Con | APXA6R3ARA681MJC0G<br>Series= PXA | 3 | $0.71 | Cap= 680.0 µF<br>ESR= 10.0 mOhm<br>VDC= 6.3 V<br>IRMS= 5.5 A | CAPSMT_62_JC0 156mm2 |
| 7. | Cramp | Yageo America | CC0805KRX7R9BB331<br>Series= X7R | 1 | $0.01 | Cap= 330.0 pF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 0805 13mm2 |

| # | Name | Manufacturer | Part Number | Quantity | Price | Properties | Footprint |
|---|---|---|---|---|---|---|---|
| 8. | Css | Yageo America | CC0805KRX7R9BB223<br>Series= X7R | 1 | $0.01 | Cap= 22.0 nF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A |  <br>0805 13mm2 |
| 9. | Cvcc | MuRata | GRM155R61A105KE15D<br>Series= X5R | 1 | $0.01 | Cap= 1.0 µF<br>ESR= 0.0 Ohm<br>VDC= 10.0 V<br>IRMS= 0.0 A | <br>0402 8mm2 |
| 10. | Cvccx | TDK | C2012Y5V1C105Z/0.85<br>Series= Y5V | 1 | $0.01 | Cap= 1.0 µF<br>ESR= 9.0 mOhm<br>VDC= 16.0 V<br>IRMS= 0.0 A |  <br>0805 13mm2 |
| 11. | D1 | Vishay-Semiconductor | 12CWQ04FNPBF | 1 | $0.76 | VF@Io= 680.0 mV<br>VRRM= 40.0 V |  <br>DPAK 102mm2 |
| 12. | D2 | Vishay-Semiconductor | 12CWQ03FNPBF | 1 | $0.76 | VF@Io= 550.0 mV<br>VRRM= 30.0 V |  <br>DPAK 102mm2 |
| 13. | D3 | Vishay-Semiconductor | 12CWQ04FNPBF | 1 | $0.76 | VF@Io= 680.0 mV<br>VRRM= 40.0 V |  <br>DPAK 102mm2 |
| 14. | D4 | Vishay-Semiconductor | 12CWQ03FNPBF | 1 | $0.76 | VF@Io= 550.0 mV<br>VRRM= 30.0 V |  <br>DPAK 102mm2 |
| 15. | L1 | Coilcraft | XAL1010-822MEB | 1 | $1.08 | L= 8.2 µH<br>DCR= 10.0 mOhm |  <br>XAL1010 160mm2 |
| 16. | M1 | Fairchild Semiconductor | FDMC8462 | 1 | $0.76 | VdsMax= 40.0 V<br>IdsMax= 20.0 Amps |  <br>TRANS_Fairchild_PQFN08B<br>28mm2 |
| 17. | M2 | Infineon Technologies | BSZ050N03MS G | 1 | $0.33 | VdsMax= 30.0 V<br>IdsMax= 40.0 Amps |  <br>PG-TSDSON-8 29mm2 |
| 18. | Rcomp | Vishay-Dale | CRCW040241K2FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 41.2 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 19. | Renable | Vishay-Dale | CRCW04021M00FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 1000.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 20. | Rfb1 | Vishay-Dale | CRCW04021K00FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 1,000 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 21. | Rfb2 | Vishay-Dale | CRCW04023K09FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 3.09 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 22. | Rsense | Stackpole Electronics Inc | CSRN2512FK15L0<br>Series= ? | 1 | $0.19 | Res= 15.0 mOhm<br>Power= 2.0 W<br>Tolerance= 1.0% |  <br>2512 43mm2 |
| 23. | Rt | Vishay-Dale | CRCW040246K4FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 46.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 24. | Ruv1 | Vishay-Dale | CRCW040232K4FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 32.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |

| # | Name | Manufacturer | Part Number | Quantity | Price | Properties | Footprint |
|---|---|---|---|---|---|---|---|
| 25. | Ruv2 | Vishay-Dale | CRCW040218K7FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 18.7 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 0402 8mm2 |
| 26. | U1 | Texas Instruments | LM25118MHE | 1 | $2.19 | Switcher |  <br>MXA20A 71mm2 |

## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 1.942 A | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 1.245 A | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 1.034 A | Current | Average input current |
| 4. | L Ipp | 4.311 A | Current | Peak-to-peak inductor ripple current |
| 5. | L1 Irms | 5.153 A | Current | Inductor ripple current |
| 6. | M1 Irms | 2.152 A | Current | MOSFET RMS ripple current |
| 7. | SW Ipk | 7.156 A | Current | Peak switch current |
| 8. | BOM Count | 30.0 | General | Total Design BOM count |
| 9. | FootPrint | 1.538 k mm2 | General | Total Foot Print Area of BOM components |
| 10. | Frequency | 131.0 k Hz | General | Switching frequency |
| 11. | IC Tolerance | 18.0 m V | General | IC Feedback Tolerance |
| 12. | M1 Rdson | 8.0 m Ohm | General | Drain-Source On-resistance |
| 13. | M1 ThetaJA | 53.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 14. | Mode | CCM | General | Conduction Mode |
| 15. | Pout | 25.0 W | General | Total output power |
| 16. | Total BOM | $11.91 | General | Total BOM Cost |
| 17. | D1 Tj | 52.161 degC | Op_Point | D1 junction temperature |
| 18. | Vout OP | 5.0 V | Op_Point | Operational Output Voltage |
| 19. | Cross Freq | 5.3 k Hz | Op_point | Bode plot crossover frequency |
| 20. | Duty Cycle | 18.524 % | Op_point | Duty cycle |
| 21. | Efficiency | 80.559 % | Op_point | Steady state efficiency |
| 22. | IC Tj | 31.442 degC | Op_point | IC junction temperature |
| 23. | ICThetaJA | 40.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 24. | IOUT_OP | 5.0 A | Op_point | Iout operating point |
| 25. | M1 TjOP | 34.929 degC | Op_point | MOSFET junction temperature |
| 26. | Operating Topology | Buck | Op_point | The current operating topology of the device |
| 27. | Phase Marg | 54.064 deg | Op_point | Bode Plot Phase Margin |
| 28. | VIN_OP | 30.0 V | Op_point | Vin operating point |
| 29. | Vout p-p | 14.511 m V | Op_point | Peak-to-peak output ripple voltage |
| 30. | Cin Pd | 3.773 m W | Power | Input capacitor power dissipation |
| 31. | Cout Pd | 5.163 m W | Power | Output capacitor power dissipation |
| 32. | Diode Pd | 1.385 W | Power | Diode power dissipation |
| 33. | IC Pd | 36.043 m W | Power | IC power dissipation |
| 34. | L Pd | 312.5 m W | Power | Inductor power dissipation |
| 35. | M1 Pd | 93.207 m W | Power | MOSFET power dissipation |
| 36. | M1 PdCond | 37.288 m W | Power | M1 MOSFET conduction losses |
| 37. | M1 PdSw | 55.919 m W | Power | M1 MOSFET switching losses |
| 38. | Total Pd | 6.033 W | Power | Total Power Dissipation |
| 39. | Diode 1 Power Dissipation | 1.385 OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 40. | Diode 2 Power Dissipation | 1.375 OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 41. | Diode 3 Power Dissipation | 1.385 OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 42. | Diode 4 Power Dissipation | 1.375 OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 43. | Input Load Capacitance | 30.1 µ F | Unknown | Input load capacitance seen by upstream circuit |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 5.0 A | Maximum Output Current |
| 2. | Iout1 | 5.0 Amps | Output Current #1 |
| 3. | VinMax | 30.0 V | Maximum input voltage |
| 4. | VinMin | 4.0 V | Minimum input voltage |
| 5. | Vout | 5.0 V | Output Voltage |
| 6. | Vout1 | 5.0 Volt | Output Voltage #1 |
| 7. | base_pn | LM25118 | National Based Product Number |
| 8. | Ta | 30.0 degC | Ambient temperature |

## Design Assistance

1. The LM5118 is a wide range buck-boost controller which is operable in an ultra wide input range of 3 to 75V. A buck-boost regulator can maintain regulation for input voltages either higher or lower than the output voltage. The challenge is that buck-boost power converters are not as efficient as buck regulators. The LM5118 has been designed as a dual mode controller whereby the power converter acts as a buck regulator while the input voltage is above the output. As the input voltage approaches the output voltage, a gradual transition to the buck-boost mode occurs. This gradual transition between modes eliminates disturbances at the output during transitions.

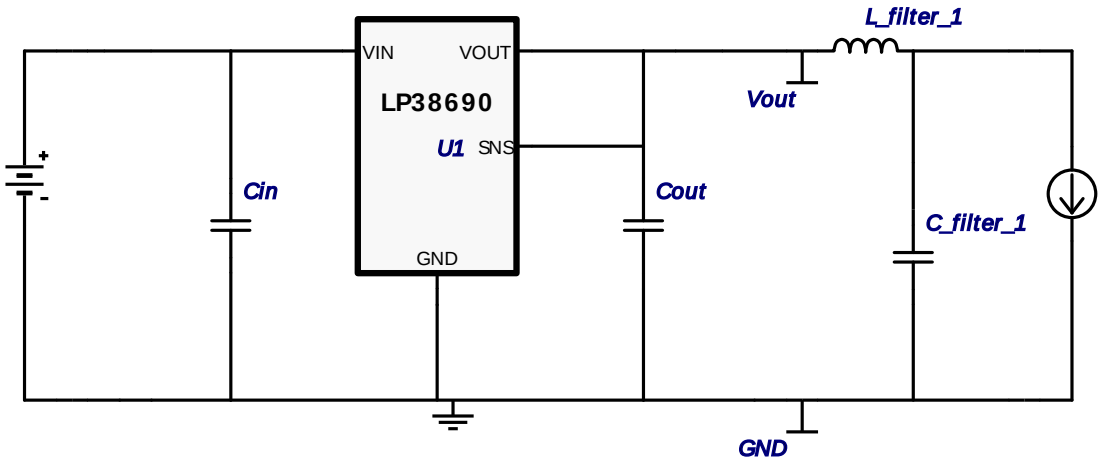
2. **LM25118** Product Folder : http://www.national.com/pf/LM/LM25118.html : contains the data sheet and other resources.

# WEBENCH® Design Report

VinMin = 5.62V
VinMax = 6.88V
Vout = 5.0V
Iout = 1.0A

Device = LP38690SD-5.0
Topology = LDO
Created = 4/5/12 3:37:21 AM
BOM Cost = $0.69
Total Pd = 1.9 W
Footprint = 77.0 mm2
BOM Count = 5

Design : 682565/5 LP38690SD-5.0
LP38690SD-5.0 5.625V-6.875V to 5.0V @ 1.0A




## Electrical BOM

| # | Name | Manufacturer | Part Number | Quantity | Price | Properties | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | C_filter_1 | TDK | C2012Y5V1A106Z<br>Series= Y5V | 1 | $0.02 | Cap= 10.0 µF<br>ESR= 4.8 mOhm<br>VDC= 10.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 2. | Cin | TDK | C1608X5R1A105K<br>Series= X5R | 1 | $0.01 | Cap= 1.0 µF<br>ESR= 5.7 mOhm<br>VDC= 10.0 V<br>IRMS= 0.0 A | 0603 10mm2 |
| 3. | Cout | TDK | C1005X5R0J105M<br>Series= X5R | 1 | $0.01 | Cap= 1.0 µF<br>ESR= 7.9 mOhm<br>VDC= 6.3 V<br>IRMS= 0.0 A | 0402 8mm2 |
| 4. | L_filter_1 | TDK | NLCV32T-R10M-PFR | 1 | $0.10 | L= 100.0 nH<br>DCR= 20.0 mOhm | NLCV32 22mm2 |
| 5. | U1 | Texas Instruments | LP38690SD-5.0 | 1 | $0.55 | Switcher | SDE06A 25mm2 |

## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | IC Iground | 55.0 µ A | Current | IC ground current |
| 2. | Iin Avg | 1.0 A | Current | Average input current |
| 3. | filter_1 attenuation Factor | 500.0 m | Filter | Attenuation factor |
| 4. | filter_1 target Vpp | 0.0 V | Filter | Target voltage ripple through filter filter_1 |
| 5. | BOM Count | 5.0 | General | Total Design BOM count |
| 6. | FootPrint | 77.0 mm2 | General | Total Foot Print Area of BOM components |
| 7. | IC Tolerance | 250.0 m V | General | IC Feedback Tolerance |
| 8. | Pout | 5.0 W | General | Total output power |
| 9. | Total BOM | $0.69 | General | Total BOM Cost |
| 10. | Vin p-p | 24.75 m V | Op_Point | Input Source ripple voltage |
| 11. | filter_1 cut-off freq | 159.155 k Hz | Op_Point | Filter cut off frequency filter_1 |
| 12. | filter_1 voltage drop | 20.0 m V | Op_Point | Voltage drop through filter filter_1 |
| 13. | Efficiency | 72.512 % | Op_point | Steady state efficiency |
| 14. | IC Tj | 121.894 degC | Op_point | IC junction temperature |
| 15. | ICThetaJA | 49.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 16. | IOUT_OP | 1.0 A | Op_point | Iout operating point |
| 17. | Input Ripple Frequency | 300.0 k Hz | Op_point | Input Source Ripple Frequency for PSRR Calculation |
| 18. | PSRR est. | -5.177 dB | Op_point | Power Supply Rejection Ratio estimated |
| 19. | VIN_OP | 6.875 V | Op_point | Vin operating point |
| 20. | Vout p-p | 13.637 m V | Op_point | Peak-to-peak output ripple voltage |
| 21. | IC Pd | 1.875 W | Power | IC power dissipation |
| 22. | Total Pd | 1.895 W | Power | Total Power Dissipation |
| 23. | filter_1_Pd | 20.0 m W | Power | Filter Power Loss filter_1 |
| 24. | Input Load Capacitance | 1.0 µ F | Unknown | Input load capacitance seen by upstream circuit |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 1.0 A | Maximum Output Current |
| 2. | Iout1 | 1.0 Amps | Output Current #1 |
| 3. | VinMax | 6.875 V | Maximum input voltage |
| 4. | VinMin | 5.625 V | Minimum input voltage |
| 5. | Vout | 5.0 V | Output Voltage |
| 6. | Vout1 | 5.0 Volt | Output Voltage #1 |
| 7. | base_pn | LP38690 | National Based Product Number |
| 8. | Ta | 30.0 degC | Ambient temperature |

## Design Assistance

1. **LP38690** Product Folder : http://www.national.com/pf/LP/LP38690.html : contains the data sheet and other resources.

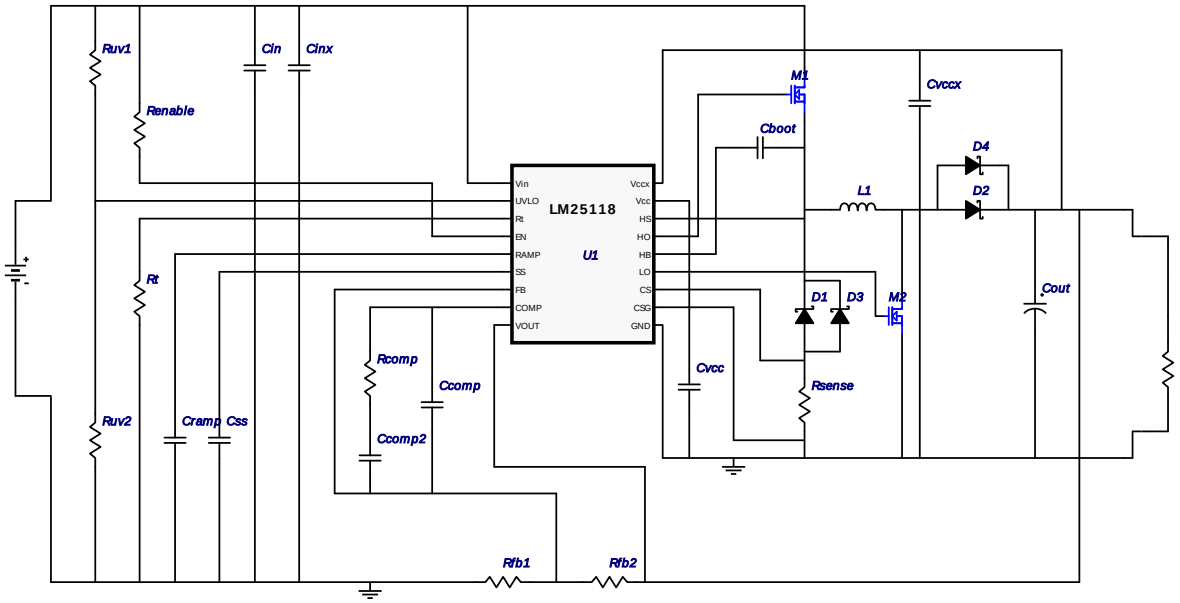
TEXAS INSTRUMENTS

# WEBENCH® Design Report

VinMin = 4.0V
VinMax = 30.0V
Vout = 6.25V
Iout = 1.0A

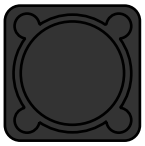
Device = LM25118MHE
Topology = Buck_Boost
Created = 4/5/12 3:37:22 AM
BOM Cost = $4.92
Total Pd = 1.03 W
Footprint = 786.0 mm2
BOM Count = 26

Design : 682565/6 LM25118MHE
LM25118MHE 4.0V-30.0V to 6.25V @ 1.0A




## Electrical BOM

| # | Name | Manufacturer | Part Number | Quantity | Price | Properties | Footprint |
|---|---|---|---|---|---|---|---|
| 1. | Cboot | MuRata | GRM21BR71E104KA01L<br>Series= X7R | 1 | $0.01 | Cap= 100.0 nF<br>ESR= 0.0 Ohm<br>VDC= 25.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 2. | Ccomp | Yageo America | CC0805KRX7R9BB221<br>Series= X7R | 1 | $0.01 | Cap= 220.0 pF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 3. | Ccomp2 | Yageo America | CC0805KRX7R9BB152<br>Series= X7R | 1 | $0.01 | Cap= 1.5 nF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 0805 13mm2 |
| 4. | Cin | TDK | C5750X7R1H106M<br>Series= X7R | 1 | $0.68 | Cap= 10.0 µF<br>ESR= 3.0 mOhm<br>VDC= 50.0 V<br>IRMS= 5.5 A | 2220 60mm2 |
| 5. | Cinx | Kemet | C0805C104K5RACTU<br>Series= X7R | 1 | $0.01 | Cap= 100.0 nF<br>ESR= 64.0 mOhm<br>VDC= 50.0 V<br>IRMS= 1.64 A | 0805 13mm2 |
| 6. | Cout | Nippon Chemi-Con | APXE100ARA151MF80G<br>Series= PXE | 1 | $0.51 | Cap= 150.0 µF<br>ESR= 21.0 mOhm<br>VDC= 10.0 V<br>IRMS= 2.88 A | CAPSMT_62_F80 74mm2 |
| 7. | Cramp | Yageo America | CC0805JRNP09BN121<br>Series= C0G/NP0 | 1 | $0.01 | Cap= 120.0 pF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A | 0805 13mm2 |

| # | Name | Manufacturer | Part Number | Quantity | Price | Properties | Footprint |
|---|---|---|---|---|---|---|---|
| 8. | Css | Yageo America | CC0805KRX7R9BB223<br>Series= X7R | 1 | $0.01 | Cap= 22.0 nF<br>ESR= 0.0 Ohm<br>VDC= 50.0 V<br>IRMS= 0.0 A |  <br>0805 13mm2 |
| 9. | Cvcc | MuRata | GRM155R61A105KE15D<br>Series= X5R | 1 | $0.01 | Cap= 1.0 µF<br>ESR= 0.0 Ohm<br>VDC= 10.0 V<br>IRMS= 0.0 A | <br>0402 8mm2 |
| 10. | Cvccx | TDK | C2012Y5V1C105Z/0.85<br>Series= Y5V | 1 | $0.01 | Cap= 1.0 µF<br>ESR= 9.0 mOhm<br>VDC= 16.0 V<br>IRMS= 0.0 A |  <br>0805 13mm2 |
| 11. | D1 | Diodes Inc. | B240A-13-F | 1 | $0.09 | VF@Io= 500.0 mV<br>VRRM= 40.0 V |  <br>SMA 37mm2 |
| 12. | D2 | Diodes Inc. | B220A-13-F | 1 | $0.09 | VF@Io= 500.0 mV<br>VRRM= 20.0 V |  <br>SMA 37mm2 |
| 13. | D3 | Diodes Inc. | B240A-13-F | 1 | $0.09 | VF@Io= 500.0 mV<br>VRRM= 40.0 V |  <br>SMA 37mm2 |
| 14. | D4 | Diodes Inc. | B220A-13-F | 1 | $0.09 | VF@Io= 500.0 mV<br>VRRM= 20.0 V |  <br>SMA 37mm2 |
| 15. | L1 | Bourns | SRR1208-150ML | 1 | $0.41 | L= 15.0 µH<br>DCR= 36.0 mOhm |  <br>SRR1208 216mm2 |
| 16. | M1 | Infineon Technologies | BSZ165N04NS G | 1 | $0.30 | VdsMax= 40.0 V<br>IdsMax= 31.0 Amps |  <br>PG-TSDSON-8 29mm2 |
| 17. | M2 | Texas Instruments | CSD16301Q2 | 1 | $0.22 | VdsMax= 25.0 V<br>IdsMax= 5.0 Amps |  <br>TRANS_NexFET_Q2<br>16mm2 |
| 18. | Rcomp | Vishay-Dale | CRCW040247K5FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 47.5 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 19. | Renable | Vishay-Dale | CRCW04021M00FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 1000.0 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 20. | Rfb1 | Vishay-Dale | CRCW04021K00FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 1,000 Ohm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 21. | Rfb2 | Vishay-Dale | CRCW04024K12FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 4.12 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 22. | Rsense | Stackpole Electronics Inc | CSR1206FK75L0<br>Series= ? | 1 | $0.10 | Res= 75.0 mOhm<br>Power= 500.0 mW<br>Tolerance= 1.0% |  <br>1206 19mm2 |
| 23. | Rt | Vishay-Dale | CRCW040218K7FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 18.7 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 24. | Ruv1 | Vishay-Dale | CRCW040232K4FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 32.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 25. | Ruv2 | Vishay-Dale | CRCW040218K7FKED<br>Series= CRCW..e3 | 1 | $0.01 | Res= 18.7 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | <br>0402 8mm2 |
| 26. | U1 | Texas Instruments | LM25118MHE | 1 | $2.19 | Switcher |  <br>MXA20A 71mm2 |

## Operating Values

| # | Name | Value | Category | Description |
|---|---|---|---|---|
| 1. | Cin IRMS | 415.175 m A | Current | Input capacitor RMS ripple current |
| 2. | Cout IRMS | 337.284 m A | Current | Output capacitor RMS ripple current |
| 3. | Iin Avg | 242.51 m A | Current | Average input current |
| 4. | L Ipp | 1.168 A | Current | Peak-to-peak inductor ripple current |
| 5. | L1 Irms | 1.055 A | Current | Inductor ripple current |
| 6. | M1 Irms | 470.509 m A | Current | MOSFET RMS ripple current |
| 7. | SW Ipk | 1.584 A | Current | Peak switch current |
| 8. | BOM Count | 26.0 | General | Total Design BOM count |
| 9. | FootPrint | 786.0 mm2 | General | Total Foot Print Area of BOM components |
| 10. | Frequency | 300.0 k Hz | General | Switching frequency |
| 11. | IC Tolerance | 18.0 m V | General | IC Feedback Tolerance |
| 12. | M1 Rdson | 18.48 m Ohm | General | Drain-Source On-resistance |
| 13. | M1 ThetaJA | 60.0 degC/W | General | MOSFET junction-to-ambient thermal resistance |
| 14. | Mode | CCM | General | Conduction Mode |
| 15. | Pout | 6.25 W | General | Total output power |
| 16. | Total BOM | $4.92 | General | Total BOM Cost |
| 17. | D1 Tj | 34.866 degC | Op_Point | D1 junction temperature |
| 18. | Vout OP | 6.25 V | Op_Point | Operational Output Voltage |
| 19. | Cross Freq | 12.204 k Hz | Op_point | Bode plot crossover frequency |
| 20. | Duty Cycle | 22.138 % | Op_point | Duty cycle |
| 21. | Efficiency | 85.906 % | Op_point | Steady state efficiency |
| 22. | IC Tj | 32.864 degC | Op_point | IC junction temperature |
| 23. | ICThetaJA | 40.0 degC/W | Op_point | IC junction-to-ambient thermal resistance |
| 24. | IOUT_OP | 1.0 A | Op_point | Iout operating point |
| 25. | M1 TjOP | 30.305 degC | Op_point | MOSFET junction temperature |
| 26. | Operating Topology | Buck | Op_point | The current operating topology of the device |
| 27. | Phase Marg | 53.256 deg | Op_point | Bode Plot Phase Margin |
| 28. | VIN_OP | 30.0 V | Op_point | Vin operating point |
| 29. | Vout p-p | 24.75 m V | Op_point | Peak-to-peak output ripple voltage |
| 30. | Cin Pd | 517.11 µ W | Power | Input capacitor power dissipation |
| 31. | Cout Pd | 2.389 m W | Power | Output capacitor power dissipation |
| 32. | Diode Pd | 194.655 m W | Power | Diode power dissipation |
| 33. | IC Pd | 71.594 m W | Power | IC power dissipation |
| 34. | L Pd | 45.0 m W | Power | Inductor power dissipation |
| 35. | M1 Pd | 5.256 m W | Power | MOSFET power dissipation |
| 36. | M1 PdCond | 4.351 m W | Power | M1 MOSFET conduction losses |
| 37. | M1 PdSw | 904.939 µ W | Power | M1 MOSFET switching losses |
| 38. | Total Pd | 1.025 W | Power | Total Power Dissipation |
| 39. | Diode 1 Power Dissipation | 194.655 m OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 40. | Diode 2 Power Dissipation | 250.0 m OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 41. | Diode 3 Power Dissipation | 194.655 m OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 42. | Diode 4 Power Dissipation | 250.0 m OpvalUnits.PD | Unknown | Power dissipation in the diode |
| 43. | Input Load Capacitance | 10.1 µ F | Unknown | Input load capacitance seen by upstream circuit |

## Design Inputs

| # | Name | Value | Description |
|---|---|---|---|
| 1. | Iout | 1.0 A | Maximum Output Current |
| 2. | Iout1 | 1.0 Amps | Output Current #1 |
| 3. | VinMax | 30.0 V | Maximum input voltage |
| 4. | VinMin | 4.0 V | Minimum input voltage |
| 5. | Vout | 6.25 V | Output Voltage |
| 6. | Vout1 | 6.25 Volt | Output Voltage #1 |
| 7. | base_pn | LM25118 | National Based Product Number |
| 8. | Ta | 30.0 degC | Ambient temperature |

## Design Assistance

1. The LM5118 is a wide range buck-boost controller which is operable in an ultra wide input range of 3 to 75V. A buck-boost regulator can maintain regulation for input voltages either higher or lower than the output voltage. The challenge is that buck-boost power converters are not as efficient as buck regulators. The LM5118 has been designed as a dual mode controller whereby the power converter acts as a buck regulator while the input voltage is above the output. As the input voltage approaches the output voltage, a gradual transition to the buck-boost mode occurs. This gradual transition between modes eliminates disturbances at the output during transitions.

2. **LM25118** Product Folder : http://www.national.com/pf/LM/LM25118.html : contains the data sheet and other resources.