# SP7663 : 12V Input, 5 Volts out at 4Amps

**Designed by:** Tim Sullivan

**Part Number:** SP7663

**Application Description:** A SP7663 PowerBlox™ device is used to create a 5volt output from a 12volt source

**Electrical Requirements:**

| | |
|---|---|
| Input Voltage | 12V nominal (9.6V – 22V capable with this design) |
| Output Voltage | 5.0V |
| Output Current | 4 Amps |

**Circuit Description:**

This circuit has been designed to provide 5.0 Volts from a 12Volt nominal input supply. It uses the PowerBlox™ solution SP7663 and 19 parts (not including PCB and I/O pins) and uses approximately 2 square inches of board space. It is possible to maintain this small area usage due to the incorporation of the high and low side FETs and the PWM controller into one package.

The solution uses a Wurth 10x10x4mm, low resistance inductor which is a good balance of size and performance for this solution. Ceramic capacitors were used on the converter input and output and a Type III feedback configuration was implemented to provide excellent transient response.

This example has been selected to illustrate the proper connection of the PowerBlox™ part with an output greater than 3.3Volts. Because of the limitations of the Overcurrent Detection internal comparator (controller schematic shown below), only voltages up to 3.3 volts can use the overcurrent protection feature. See the complete schematic in the report for a detailed schematic diagram.



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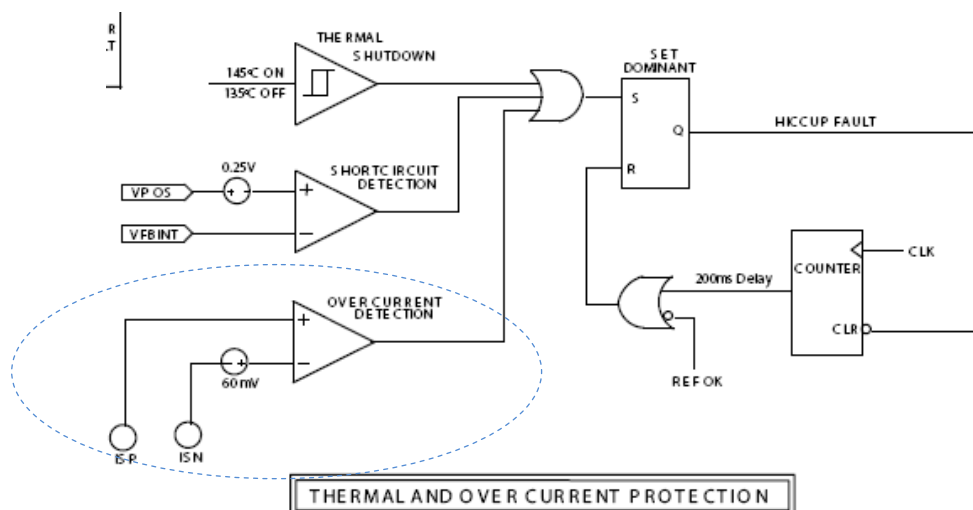
## Simplified Design Solution Schematic
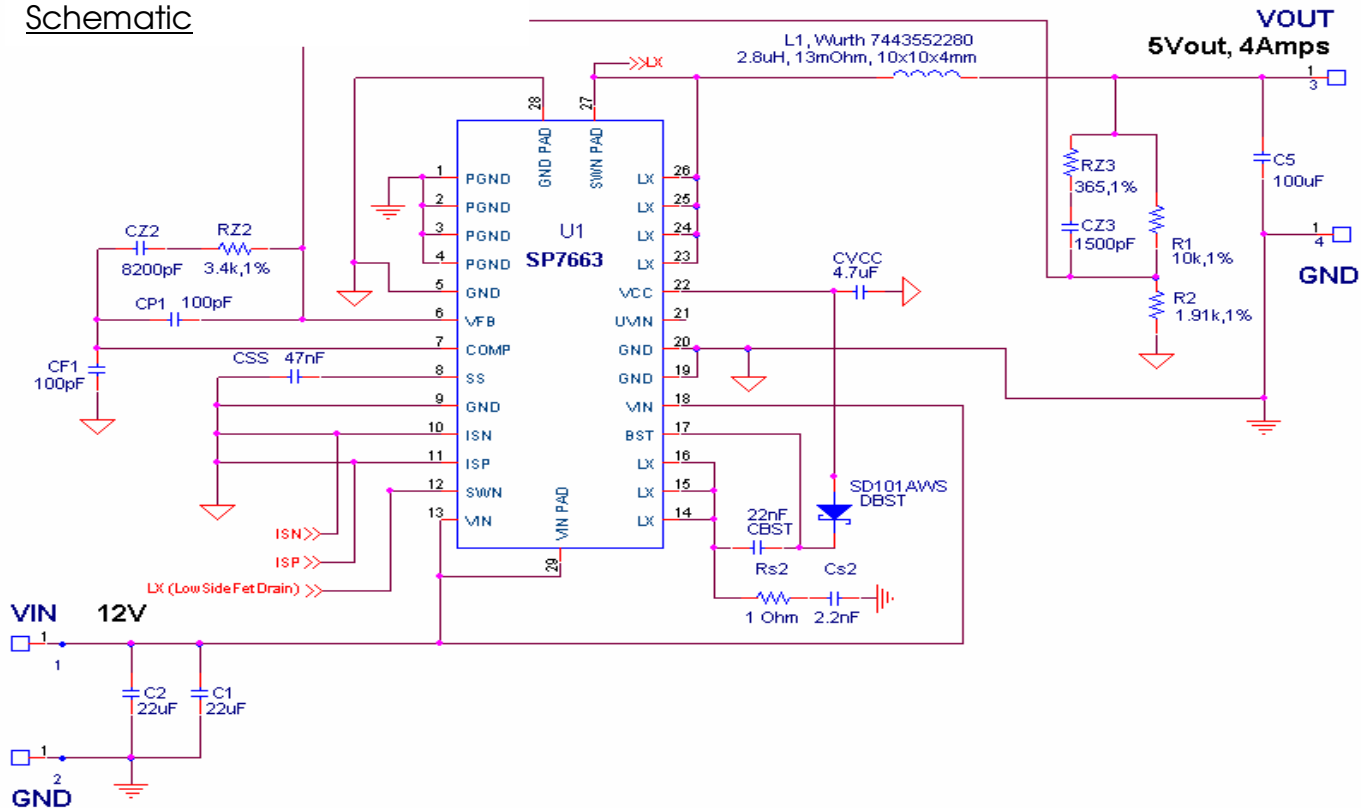


Note in the simplified version the components that are not used in the >3.3Vout design. Where 0Ω resistors were used, connections have been placed. By shorting ISN and ISP to ground the overcurrent circuitry in the controller is disabled. The converter will still have the short circuit protection feature. Note also the removal of R6, R7, C8, and R12. When a nominal 12Volts input is used, UVIN components are not required as the internal UVLO level is set to 9.6 volts.
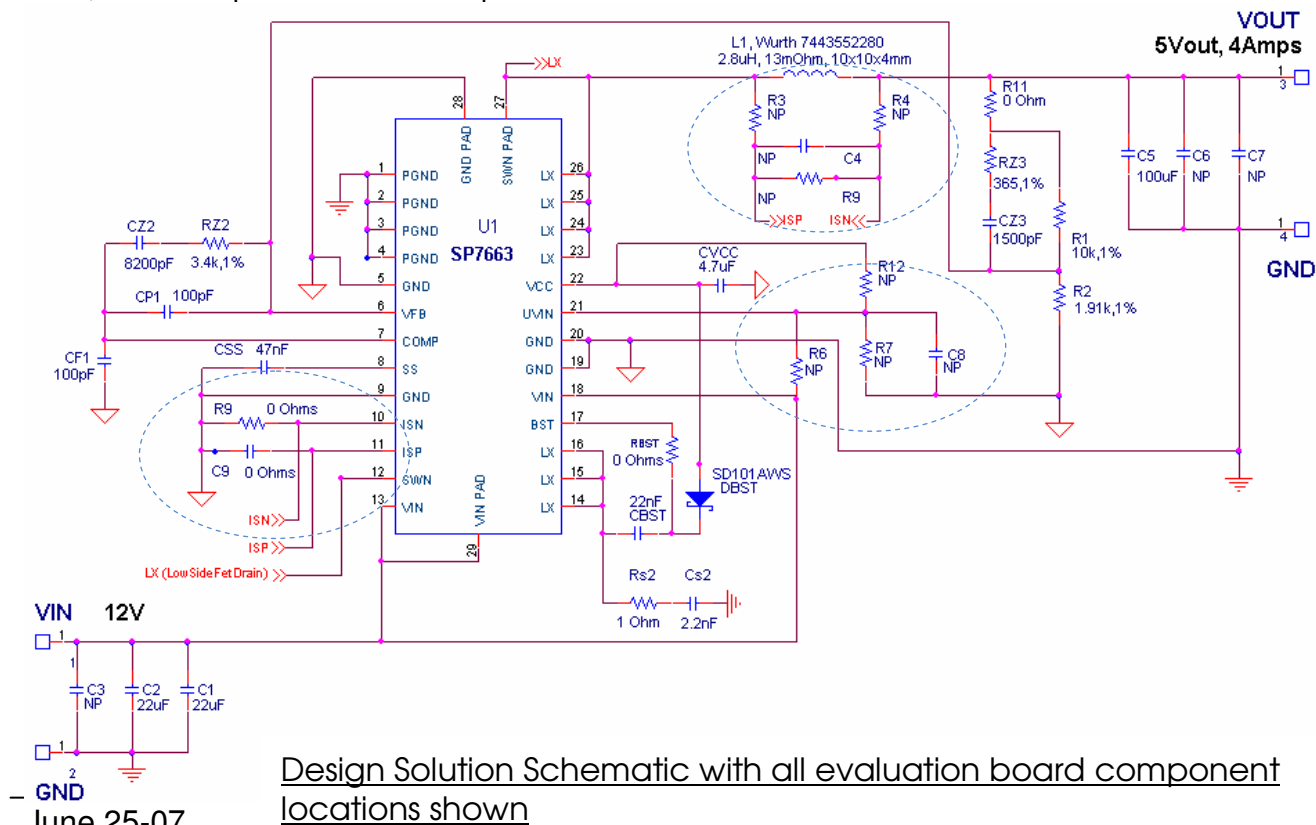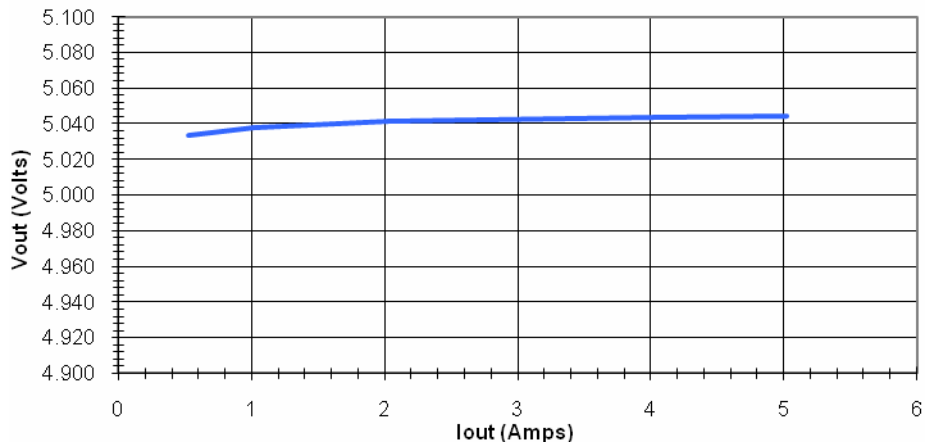


## Design Solution Schematic with all evaluation board component locations shown

## Efficiency and Load Regulation

**7663 Efficiency**
**12Vin - 5Vout - 4Amp**
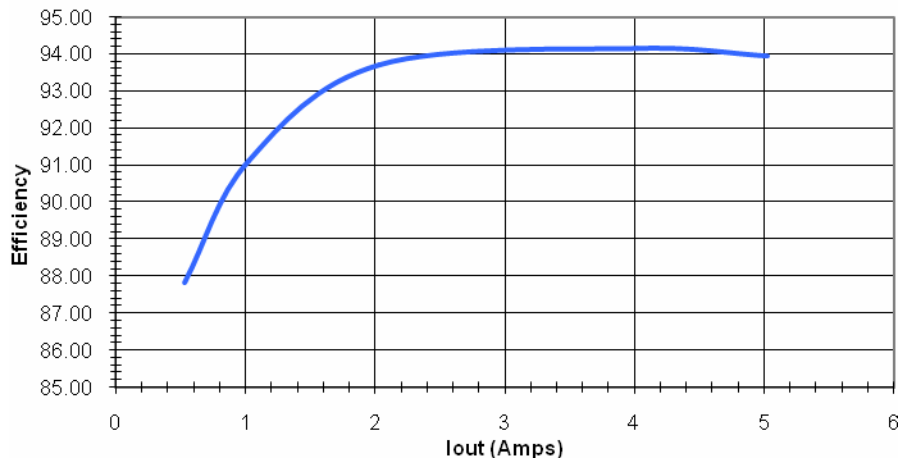


**7663 Load Regulation**
**12Vin - 5Vout - 4Amp**



## Performance Measurements

| V<sub>IN</sub> | I<sub>IN</sub>(A) | V<sub>OUT</sub> | I<sub>OUT</sub>(A) | | Efficiency | P<sub>OUT</sub> (W) | P<sub>DISS</sub>(W) | P<sub>DISS</sub> PB(W) | Output Ripple |
|------|------|-------|------|---|-----------|----------|----------|------------|---------------|
| 12.01 | 2.25 | 5.044 | 5.02 | | 93.94 | 25.32 | 1.63 | 1.56 | 29mV |
| 12.02 | 1.79 | 5.043 | 4.02 | | 94.14 | 20.27 | 1.26 | 1.21 | 29mV |
| 12.04 | 0.91 | 5.041 | 2.03 | | 93.71 | 10.23 | 0.69 | 0.67 | 27mV |
| 12.05 | 0.47 | 5.038 | 1.02 | | 91.12 | 5.14 | 0.50 | 0.50 | 26mV |
| 12.06 | 0.25 | 5.034 | 0.53 | | 87.81 | 2.67 | 0.37 | 0.37 | 25mV |

Load Regulation     0.204   %

## Converter Bill of Materials:

| Line No. | Ref. Des. | Qty. | Manufacturer | Layout Size | Component | Vendor Phone # |
|---|---|---|---|---|---|---|
| SP7663 | | | 12Vin 5Vout | | | |
| 1 | PCB | 1 | Sipex | | SP7663EB | 978-667-8700 |
| 2 | U1 | 1 | Sipex | DFN-26 | 7663 Buck Regulator | 978-667-8700 |
| 3 | DBST | 1 | Vishay Semi | SOD-323 | SD101AWS 15mA-30V Schottky | 800-344-4539 |
| 4 | L1 | 1 | Wurth | 10x10mm | 2.8uH, 13mOhm, 7443552280 | 603.361.4457 |
| 5 | C1, C2 | 2 | Murata | 1210 | 22uF Ceramic X5R 25V | 978-779-3111 |
| 6 | C5 | 1 | Murata | 1210 | 100uF Ceramic X5R 6.3V | 978-779-3111 |
| 7 | C4 | 1 | Murata | 0603 | 0.1uF Ceramic X7R 50V | 978-779-3111 |
| 8 | CBST | 1 | Murata | 0603 | 22nF Ceramic X7R 50V | 978-779-3111 |
| 9 | CVCC | 1 | Murata | 0603 | 4.7uF Ceramic X5R 10V | 800-388-2496 |
| 10 | CF1 | 1 | Murata | 0603 | 100pF Ceramic C0G 50V | 978-779-3111 |
| 11 | Cs2 | 1 | Murata | 0603 | 2.2nF Ceramic C0G 50V | 978-779-3111 |
| 12 | CSS1 | 1 | Murata | 0603 | 47nF Ceramic X7R 50V | 978-779-3111 |
| 13 | CP1 | 1 | Murata | 0603 | 100pF Ceramic C0G 50V | 978-779-3111 |
| 14 | CZ2 | 1 | Murata | 0603 | 8200pF Ceramic C0G 50V | 978-779-3111 |
| 15 | CZ3 | 1 | Murata | 0603 | 1500pF Ceramic C0G 50V | 978-779-3111 |
| 16 | R1 | 1 | Panasonic | 0603 | 10K Ohm Thick Film Res 1% | 800-344-4539 |
| 17 | R2 | 1 | Panasonic | 0603 | 1.91K Ohm Thick Film Res 1% | 800-344-4539 |
| 18 | R11 | 1 | Panasonic | 0603 | 0 Ohm Thick Film Res 1% | 800-344-4539 |
| 19 | RBST | 1 | Panasonic | 0603 | 0 Ohm Thick Film Res 1% | 800-344-4539 |
| 20 | Rs2 | 1 | Panasonic | 0603 | 1 Ohm Thick Film Res 1% | 800-344-4539 |
| 21 | RZ2 | 1 | Panasonic | 0603 | 3.4K Ohm Thick Film Res 1% | 800-344-4539 |
| 22 | RZ3 | 1 | Panasonic | 0603 | 365 Ohm Thick Film Res 1% | 800-344-4539 |
| 23 | VIN, VOUT, GND, GND | 4 | Vector Electronic | .042 Dia | Test Point Post | 800-344-4539 |
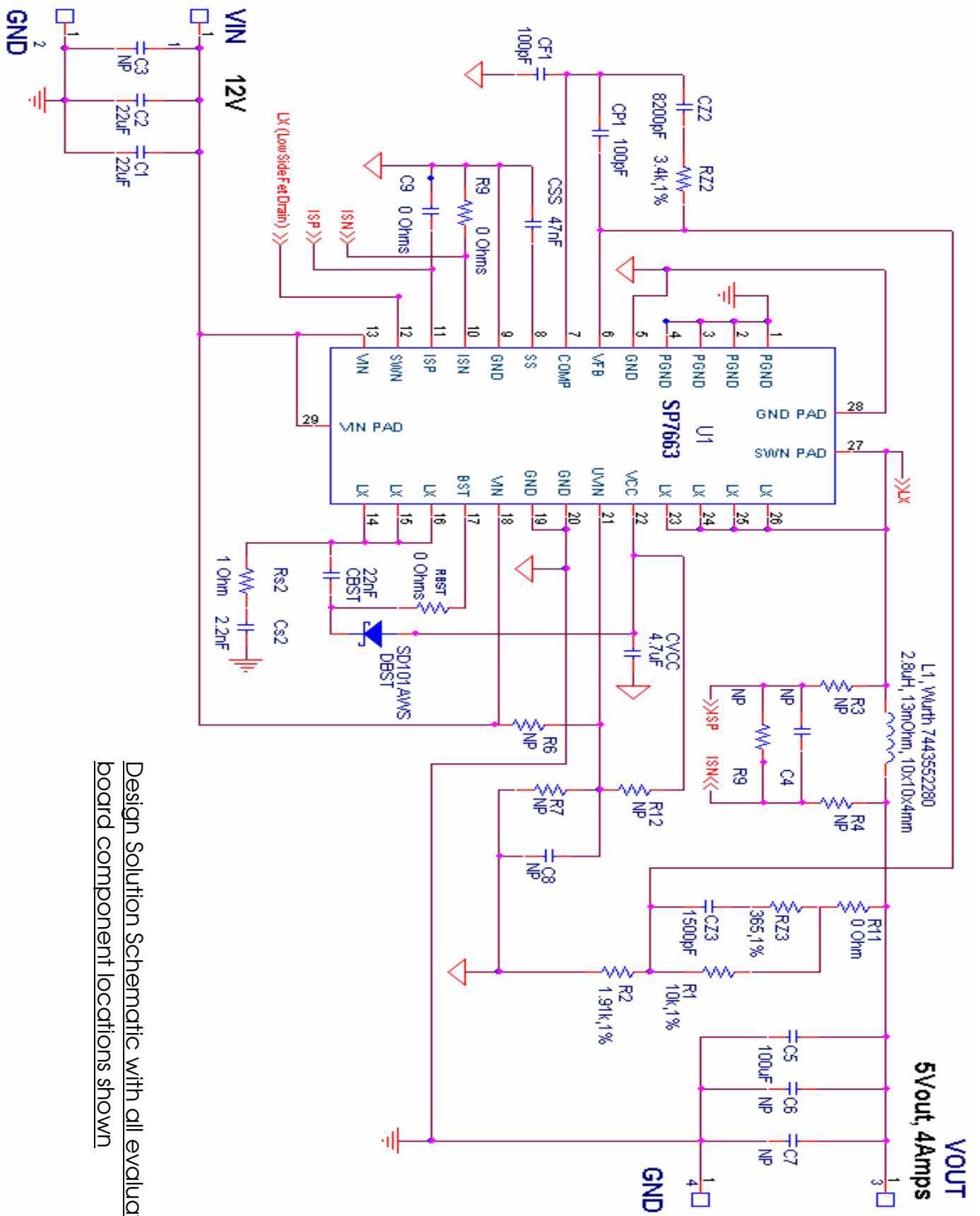
Design Solution Schematic with all evaluation
board component locations shown

For further assistance:

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Live Technical Chat: http://www.geolink-group.com/sipex/
Sipex Application Notes: http://www.sipex.com/applicationNotes.aspx

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