

## DESCRIPTION

Demonstration circuit 894B-C is a 36V-72Vin, synchronous flyback converter featuring the LT3825. This circuit was designed specifically to attain a high current, low ripple, synchronously rectified flyback to efficiently power 12V loads at up to 5A from a typical telecom input voltage range. This circuit features synchronous rectifier drive outputs, output voltage

regulation without the need of an optocoupler, self-starting architecture and input undervoltage lockout.

**Design files for this circuit board are available. Call the LTC factory.**

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**Table 1. Performance Summary ( $T_A = 25^\circ\text{C}$ )**

| PARAMETER                       | CONDITION                                                                  | VALUE                                |
|---------------------------------|----------------------------------------------------------------------------|--------------------------------------|
| Minimum Input Voltage           |                                                                            | 36V                                  |
| Maximum Input Voltage           |                                                                            | 72V                                  |
| Output Voltage $V_{OUT}$        | $V_{IN} = 36\text{V to } 72\text{V}$ , $I_{OUT} = 0\text{A to } 5\text{A}$ | 12.0V                                |
| Maximum Output Current          |                                                                            | 5A                                   |
| Typical Output Ripple $V_{OUT}$ | $V_{IN} = 48\text{V}$ , $I_{OUT} = 5\text{A}$                              | $< 120\text{mV}_{P-P}$               |
| Output Regulation               | Over All Input Voltages and Output Currents                                | $\pm 1\%$                            |
| Load Transient Response         | Peak Deviation with Load Step of 3.75A to 5A (10A/us)                      | $\pm 250\text{mV}$ ( $< \pm 2.5\%$ ) |
|                                 | Settling Time                                                              | 100us                                |
| Nominal Switching Frequency     |                                                                            | 200kHz                               |
| Efficiency                      | $V_{IN} = 48\text{V}$ , $I_{OUT} = 5\text{A}$                              | 91% Typical                          |

## OPERATING PRINCIPLES

The LT3825 controller exhibits a self-starting capability. When an input voltage is applied, a trickle charge resistor, R8, charges C10 (See Figure 9) to power Vcc. Then, the IC begins a controlled soft-start of the output voltage. As this voltage begins to rise, Vcc power is quickly taken over by T1, D2, and R7. When the soft-start period is over, the LT3825 then regulates output voltage by observing the pulses across the auxiliary winding of T1 during the flyback time. The Primary Gate drive (PG) and Synchronous Gate (SG) drive is then Pulse Width

Modulated (PWM) in order to keep the output voltage constant. The synchronous gate drive signal is transmitted to the secondary via the small signal transformer, T2. The output of T2 then drives a discrete gate drive buffer, R26, Q12, and Q13 in order to achieve fast gate transition times, hence a higher efficiency.

The two-stage input filter, C25, L1, and C30 and output filter, C1, C2, L2, and C29 are the reasons that this flyback has exceptionally low conducted emissions.

## QUICK START PROCEDURE

Demonstration circuit 894B-C is easy to set up to evaluate the performance of the LT3825. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**NOTE:** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output (or input) voltage ripple by touching the probe tip and probe ground directly across the +Vout and –Vout (or +Vin and –Vin) terminals. See Figure 2 for proper scope probe technique.

1. Set an input power supply that is capable of 36V to 72V at a current of at least 2.5A to a voltage of 36V. Then, turn off the supply.
2. With power off, connect the supply to the input terminals +Vin and –Vin.
  - a. Input voltages lower than 36V can keep the converter from turning on due to the under-voltage lockout feature of the LT3825.
  - b. If efficiency measurements are desired, an ammeter capable of measuring 2.5A<sub>dc</sub> can be put in series with the input supply in order to measure the DC894B-C's input current.
  - c. A voltmeter with a capability of measuring at least 72V can be placed across the input terminals in order to get an accurate input voltage measurement.
3. Turn on the power at the input.

**NOTE:** Make sure that the input voltage never exceeds 72V.
4. Check for the proper output voltage of 12V
5. Turn off the power at the input.
6. Once the proper output voltages are established, connect a variable load capable of sinking 5A at 12V to the output terminals +Vout and –Vout. Set the current for 0A.
  - a. If efficiency measurements are desired, an ammeter or a resistor current shunt that is capable of handling at least 5A<sub>dc</sub> can be put in series with the output load in order to measure the DC894B-C's output current.
  - b. A voltmeter with a capability of measuring at least 12V can be placed across the output terminals in order to get an accurate output voltage measurement.
7. Turn on the power at the input.

**NOTE:** If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
8. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other desired parameters.

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 894B-C

## 36V-72VIN, SYNCHRONOUS FLYBACK

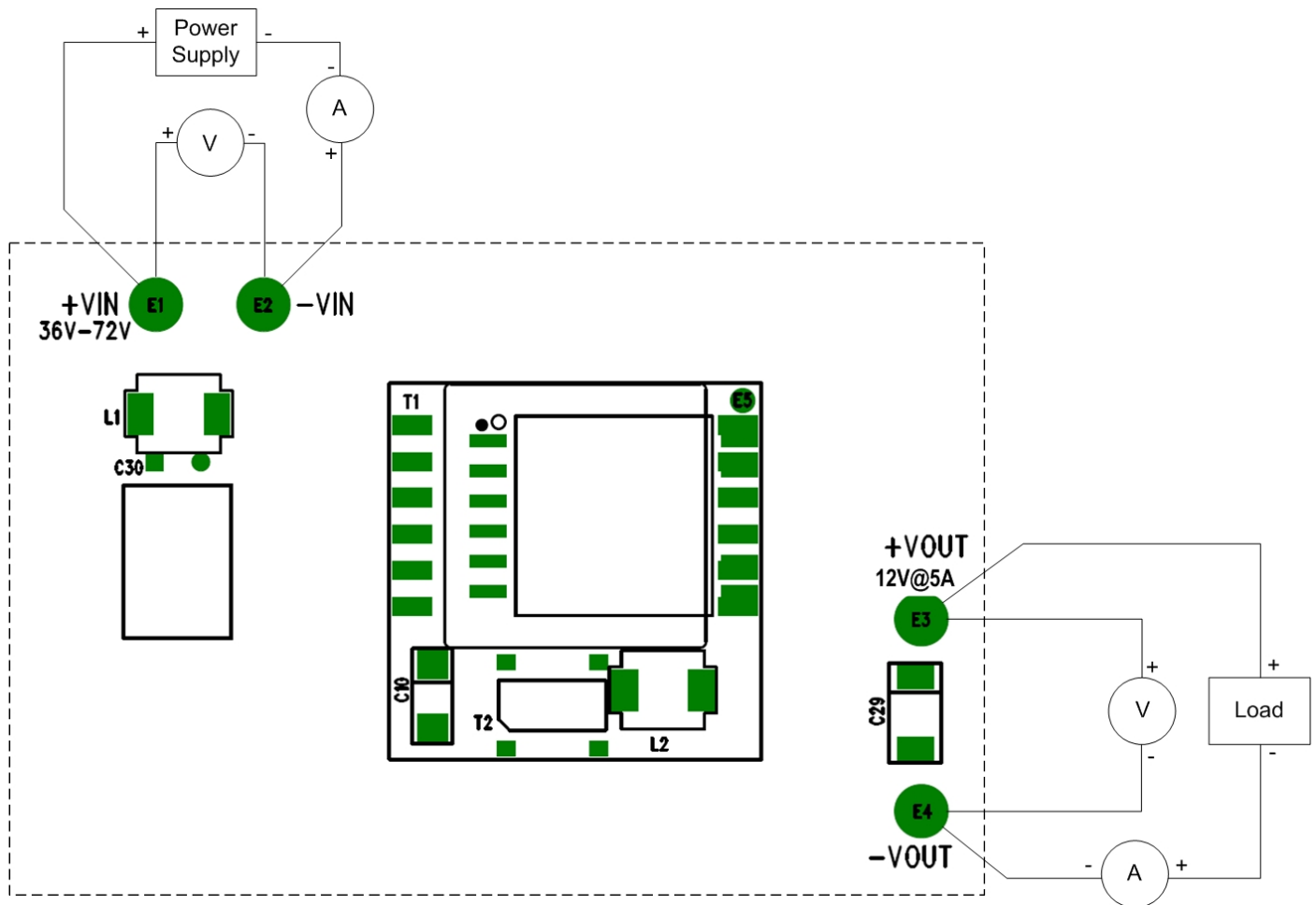


Figure 1. Proper Measurement Equipment Setup

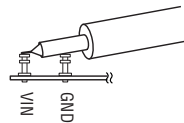


Figure 2. Measuring Input or Output Ripple

## MEASURED DATA

Figures 3 through 8 are measured data for a typical DC894B-C. Figures 9 through 11 are schematics and bill of materials.

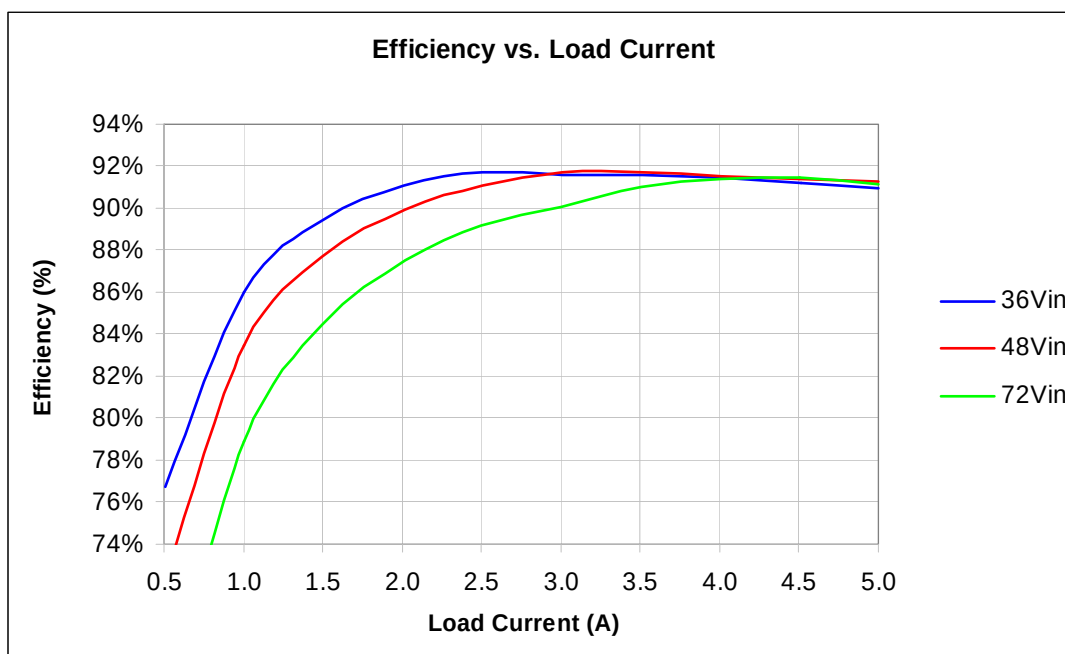


Figure 3. Efficiency

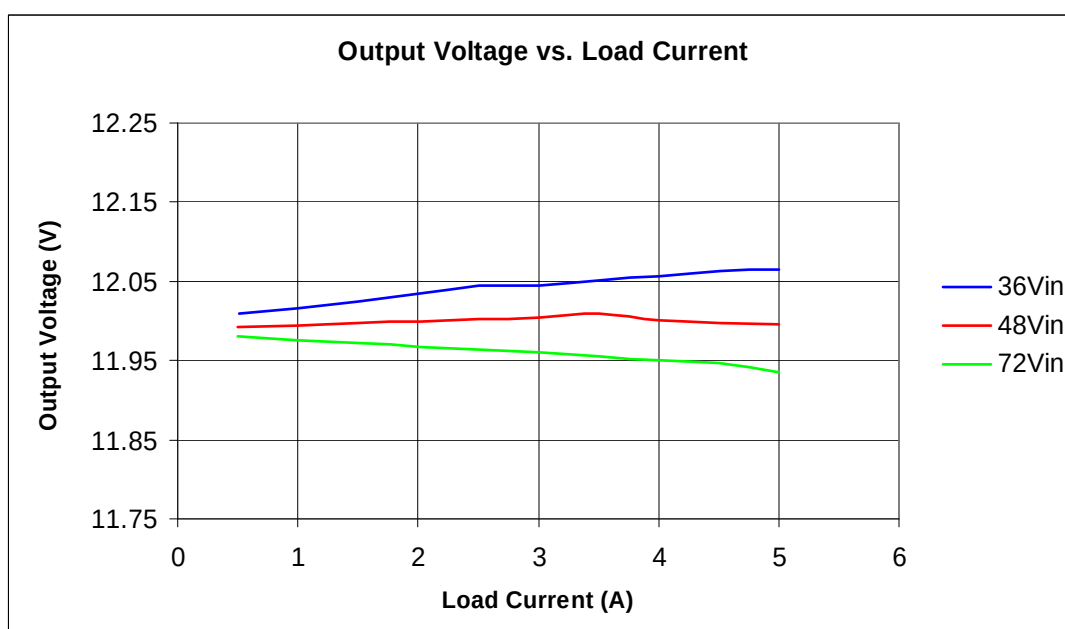


Figure 4. Regulation

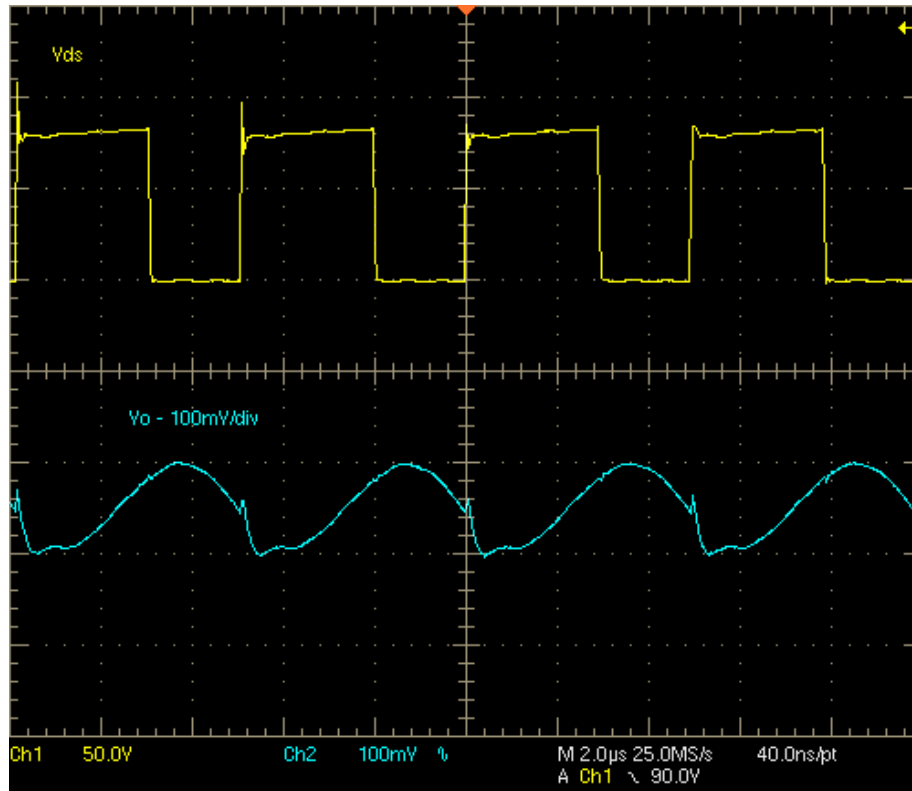


Figure 5. Output Voltage Ripple (48Vin 5A)

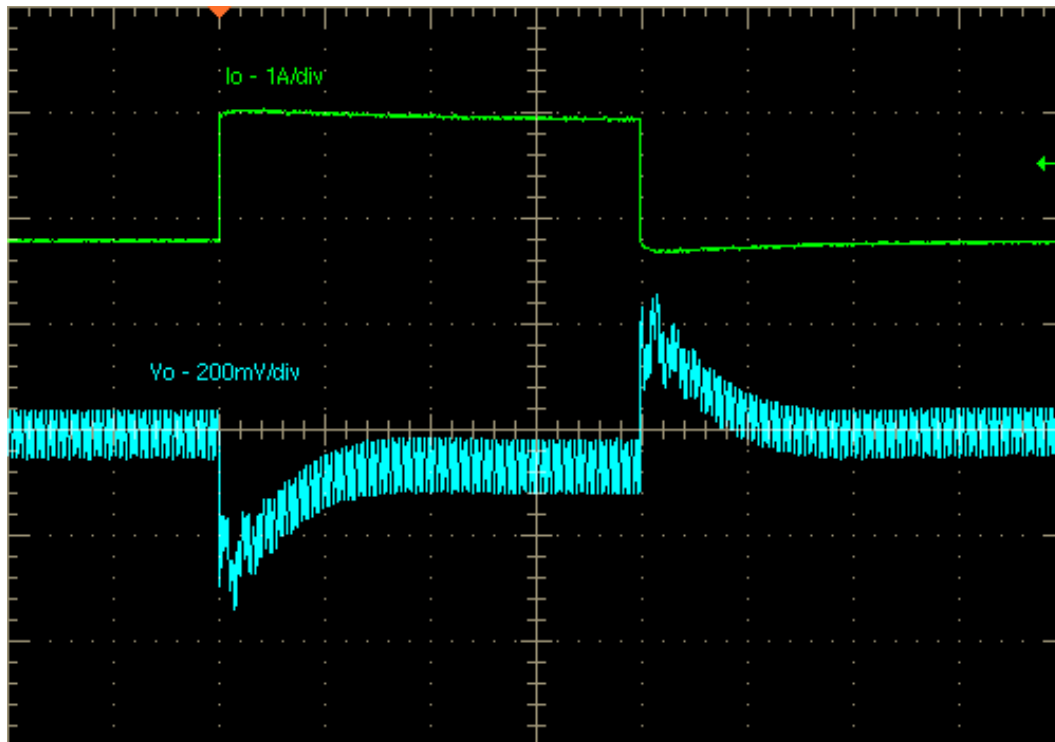


Figure 6. Load Transient Response (10A/us)

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 894B-C

## 36V-72VIN, SYNCHRONOUS FLYBACK



Figure 7. Temp Data (48Vin, 5A, 100LFM airflow – front)



Figure 8. Temp Data (48Vin, 8A, 100LFM airflow – back)

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 894B-C

## 36V-72VIN, SYNCHRONOUS FLYBACK

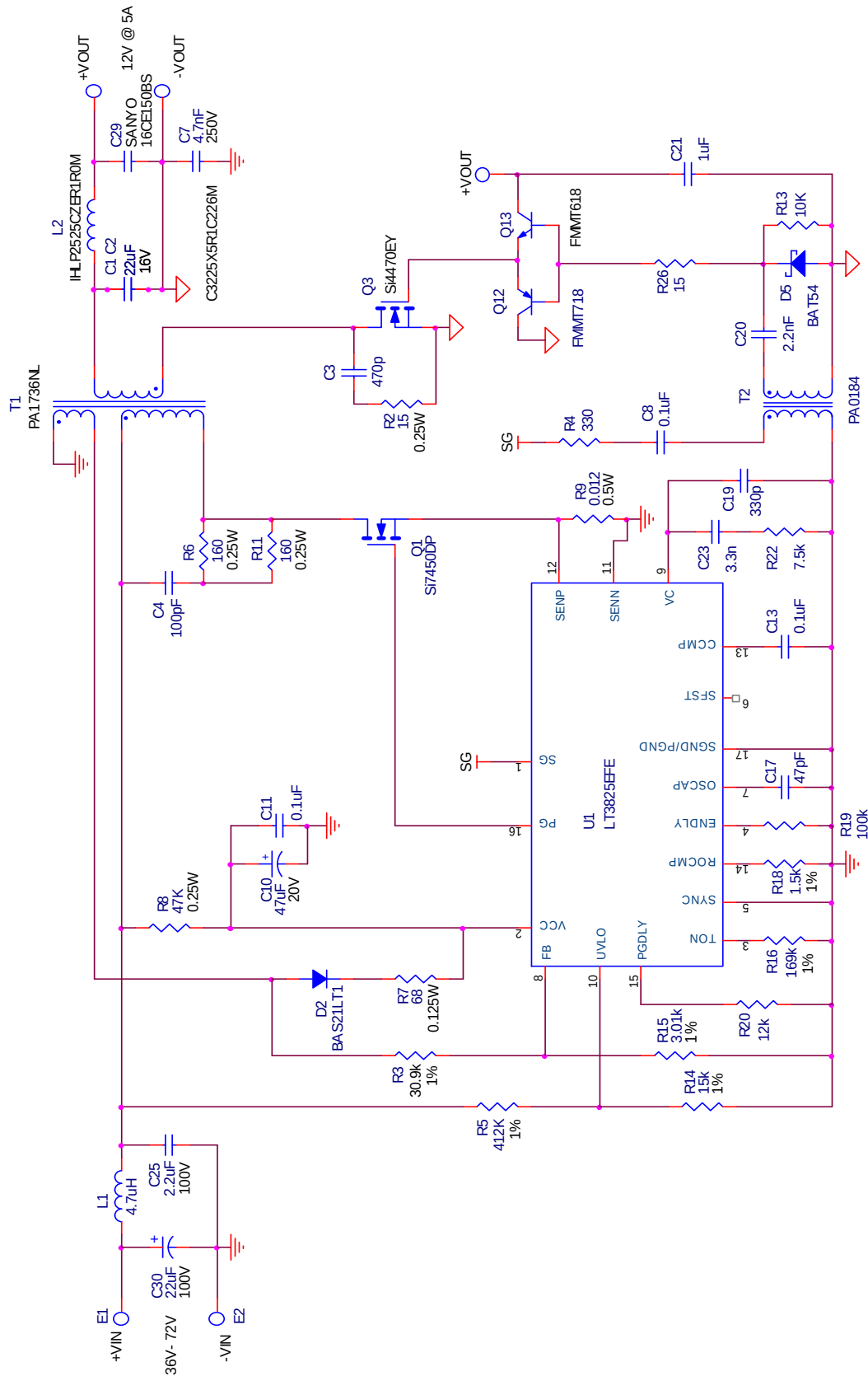


Figure 9. Simplified Schematic



### Figure 10. Full Board Schematic



# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 894B-C

## 36V-72VIN, SYNCHRONOUS FLYBACK

| Item                                           | Qty | Ref-Des    | Description                   | Manufacturer's Part Number |
|------------------------------------------------|-----|------------|-------------------------------|----------------------------|
| <b>REQUIRED CIRCUIT COMPONENTS<sup>1</sup></b> |     |            |                               |                            |
| 1                                              | 2   | C1,C2      | CAP, 1210 22uF 20% 16V X5R    | TDK C3225X5R1C226M         |
| 2                                              | 1   | C3         | CAP, 1206 470pF 5% 100V COG   | AVX 12061A471JAT           |
| 3                                              | 1   | C4         | CAP, 1206 100pF 10% 630V COG  | TDK C3216COG2J101K         |
| 4                                              | 1   | C7         | CAP, 4.7nF 10% 250V X7R       | MURATA GA343DR7GD472KW01L  |
| 5                                              | 3   | C8,C11,C13 | CAP, 0603 0.1uF 10% 50V X7R   | TDK C1608X7R1H104K         |
| 6                                              | 1   | C10        | CAP, 6032 47uF 20% 20V TANT   | AVX TAJC476M020R           |
| 7                                              | 0   | C12        | CAP, 0603 470pF 10% 25V NPO   | AVX 06033A471KAT2A OPTION  |
| 8                                              | 1   | C17        | CAP, 0603 47pF 10% 25V NPO    | AVX 06033A470KAT2A         |
| 9                                              | 1   | C19        | CAP, 0603 330pF 5% 50V COG    | AVX 06035A331JAT           |
| 10                                             | 1   | C20        | CAP, 0603 2.2nF 5% 50V X7R    | AVX 06035C222JAT           |
| 11                                             | 1   | C21        | CAP, 1206 1uF 20% 25V X7R     | AVX 12063C105MAT2A         |
| 12                                             | 1   | C23        | CAP, 0603 3.3nF 10% 25V X7R   | AVX 06033C332KAT           |
| 13                                             | 1   | C25        | CAP, 1812 2.2uF 10% 100V X7R  | TDK C4532X7R2A225K         |
| 14                                             | 1   | C29        | CAP, 150uF 20% 16V            | SANYO 16CE150BS            |
| 15                                             | 1   | D2         | DIODE, BAS21-7                | DIODES INC. BAS21-7-F      |
| 16                                             | 1   | D5         | DIODE, SCHOTTKY               | DIODES INC. BAT54-7        |
| 17                                             | 1   | L2         | IND, 1.0uH                    | VISHAY IHLP2525CZER1R0M    |
| 18                                             | 1   | Q1         | XSTR, MOSFET N-CHANNEL        | VISHAY SILICONIX Si7450DP  |
| 19                                             | 1   | Q3         | XSTR, MOSFET N-CHANNEL        | VISHAY SILICONIX Si4470EY  |
| 20                                             | 1   | Q12        | XSTR, PNP                     | ZETEX FMMT718TA            |
| 21                                             | 1   | Q13        | XSTR, NPN                     | ZETEX FMMT618TA            |
| 22                                             | 1   | R2         | RES, 1206 15 OHMS 5% 1/4W     | AAC CR18-150JM             |
| 23                                             | 1   | R3         | RES, 0603 30.9k OHMS 1% 1/10W | AAC CR16-1R50FM            |
| 24                                             | 1   | R4         | RES, 0603 330 OHMS 5% 1/10W   | AAC CR16-331JM             |
| 25                                             | 1   | R5         | RES, 0603 412K OHMS 1% 1/8W   | AAC CR16-4123FM            |
| 26                                             | 2   | R6,R11     | RES, 1206 160 OHMS 5% 1/4W    | AAC CR18-161JM             |
| 27                                             | 1   | R7         | RES, 0805 68 OHMS 5% 1/8W     | AAC CR10-680JM             |
| 28                                             | 1   | R8         | RES, 1206 47K OHMS 5% 1/4W    | AAC CR18-473JM             |
| 29                                             | 1   | R9         | RES, 1206 0.012 OHMS 1% 0.5W  | IRC LRC-LRF1206-01-R012-F  |
| 30                                             | 1   | R13        | RES, 0603 10K OHMS 5% 1/10W   | AAC CR16-103JM             |
| 31                                             | 1   | R14        | RES, 0603 15K OHMS 1% 1/10W   | AAC CR16-1502FM            |
| 32                                             | 1   | R15        | RES, 0603 3.01K OHMS 1% 1/10W | AAC CR16-3011FM            |
| 33                                             | 1   | R16        | RES, 0603 169K OHMS 1% 1/10W  | AAC CR16-1693FM            |
| 34                                             | 1   | R18        | RES, 0603 1.5K OHMS 1% 1/10W  | AAC CR16-1501FM            |
| 35                                             | 1   | R19        | RES, 0603 100K OHMS 5% 1/10W  | AAC CR16-104JM             |
| 36                                             | 1   | R20        | RES, 0603 12K OHMS 5% 1/10W   | AAC CR16-123JM             |
| 37                                             | 1   | R22        | RES, 0603 7.5K OHMS 5% 1/10W  | AAC CR16-752JM             |
| 38                                             | 1   | R26        | RES, 0603 15 OHMS 5% 1/10W    | AAC CR16-150JM             |
| 39                                             | 1   | T1         | XFMR, PA1736NL                | PULSE PA1736NL             |
| 40                                             | 1   | T2         | XFMR, 1.4mH MIN, 50KHz        | PULSE PA0184               |
| 41                                             | 1   | U1         | IC, LT3825EFE                 | LINEAR TECH LT3825EFE      |

| <b>ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS<sup>2</sup></b> |   |     |                                    |                            |
|-------------------------------------------------------------|---|-----|------------------------------------|----------------------------|
| 42                                                          | 0 | C5  | CAP, 1210 OPTION                   | OPTION                     |
| 43                                                          | 0 | C6  | CAP, 1210 47uF 20% 6.3V X5R OPTION | TDK C3225X5R0J476MT OPTION |
| 44                                                          | 0 | C18 | CAP, 0603 10nF 10% 25V X7R OPTION  | AVX 06033C103KAT OPTION    |
| 45                                                          | 1 | C30 | CAP, 22uF 100V                     | SUN ELECTRIC 100ME22AX     |

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 894B-C

## 36V-72VIN, SYNCHRONOUS FLYBACK

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|    |   |     |                               |                                   |
|----|---|-----|-------------------------------|-----------------------------------|
| 46 | 0 | D7  | DIODE, OPTION                 | OPTION                            |
| 47 | 1 | L1  | IND, 4.7uH                    | VISHAY IHPL2525CZER4R7M01         |
| 48 | 0 | Q4  | XSTR, MOSFET N-CHANNEL OPTION | VISHAY SILICONIX Si7336ADP OPTION |
| 49 | 1 | R1  | RES, 0603 0 OHM JUMPER        | VISHAY CRCW06030000ZRT6           |
| 50 | 0 | R10 | RES, OPTION                   | OPTION                            |
| 51 | 0 | R27 | RES, OPTION                   | OPTION                            |
| 52 | 1 | R28 | RES, 0603 0 OHM JUMPER        | VISHAY CRCW06030000ZRT6           |

**Notes:**

1. Required Circuit Components are those parts that are required to implement the circuit function
2. Additional Demo Board Circuit Components are those parts that provide added functionality for the demo board but are or may not be required in the actual circuit.

**Figure 11. Bill of Materials**