

DESCRIPTION

Demonstration circuit 830 is an isolated input to high current output ¼ Brick footprint converter featuring the LT®1952 switching controller. The DC830 converts isolated 36V to 75V input to 3.3V output and provides over 40A of output current. The converter operates at 300kHz with efficiency greater than 92%. The DC830 can easily be modified to generate output voltages in the range from 0.6V to 28V. The output currents are limited by total output power of up to 200W.

Demonstration circuit 830 can generate output currents as high as 55A. The output voltage can also be changed to any value between 0.6V and 28V by changing the MOSFETs, power transformer, output inductor and output capacitors. Please consult LTC factory for details.

The DC830 circuit features soft-start which prevents output voltage overshoot on startup or when recovering from an overload condition.

The DC830 has a precise over-current protection circuit that allows for continuous operation under short circuit conditions. The low power dissipation under short circuit conditions insures high reliability even during short circuits.

The LT1952 can be synchronized to an external clock of up to 400kHz. Please refer to the LT1952 data sheet for design details and applications information.

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

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Table 1. Performance Summary

PARAMETER	CONDITION	VALUE
Minimum Input Voltage		36V
Maximum Input Voltage		75V
V_{OUT}	$V_{IN} = 36V \text{ to } 72V, I_{OUT} = 0A \text{ to } 40A$	3.3V $\pm 3\%$
Typical Output Ripple V_{OUT}	$V_{IN} = 36V \text{ to } 72V, I_{OUT} = 0A \text{ to } 40A$	50mV _{P-P}
Nominal Switching Frequency		300kHz

QUICK START PROCEDURE

Demonstration circuit 830 is easy to set up to evaluate the performance of the LT1952. 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 input or output voltage ripple by touching the probe tip directly across the Vin or Vout and GND terminals. See Figure 2. for proper scope probe technique.

1. With power off, connect the input power supply to Vin and GND. Make sure that the input power supply has sufficient current rating at minimum input voltage for the required output load.

2. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 75V.

3. Check for the proper output voltage.
 $V_{out} = 3.3V.$

If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

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- 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 parameters.
- The DC830 is equipped with an output capacitor CSYS (470uF) that approximates typical system rail capacitance. If system board already has capacitance of similar value CSYS can be removed.

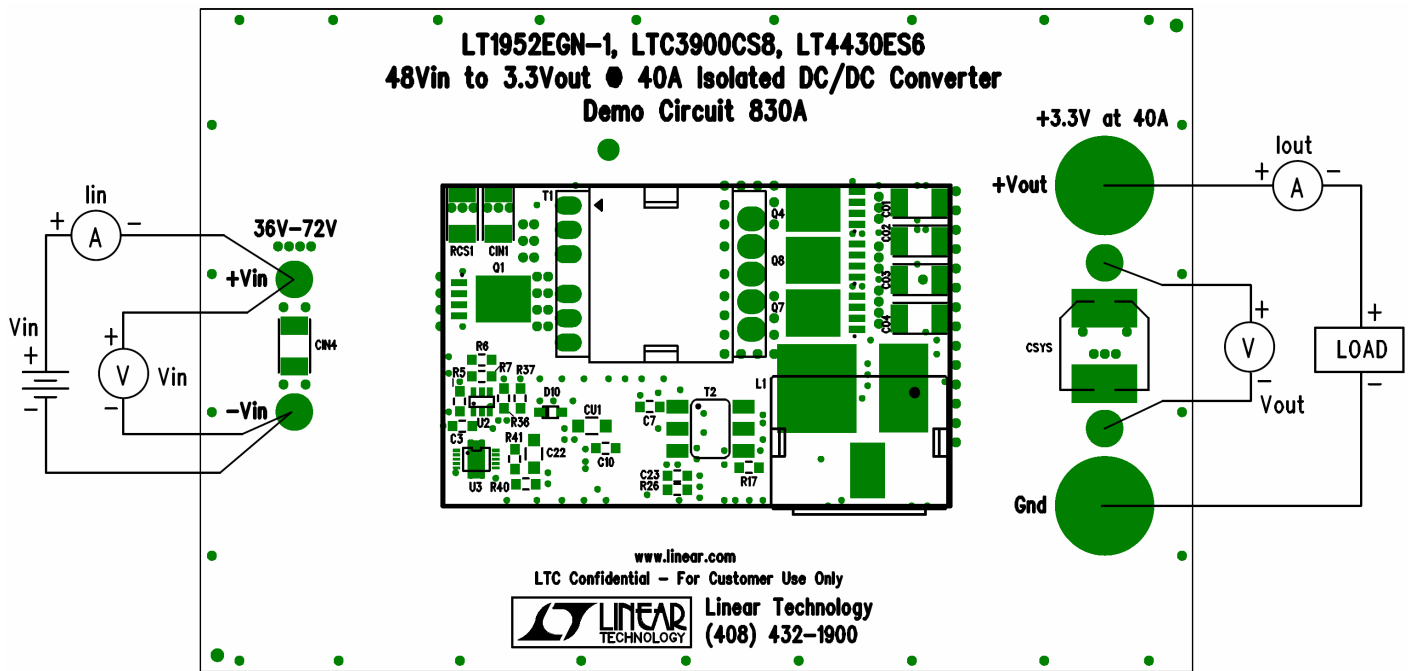


Figure 1. Proper Measurement Equipment Setup

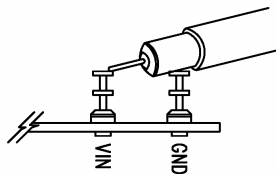


Figure 2. Scope Probe Placement for Measuring Input or Output Ripple

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CHANGING THE OUTPUT VOLTAGE

To set the output voltage lower than 3.3V, change the bottom voltage divider resistor connected to LT4430 FB pin (R38). For example, to get 2.5V output, change R38 resistor value to 26.1k.

To get higher than 5V output voltages a transformer with higher turns ratio will be required. Also, output MOSFETs with higher voltage ratings may be required. Please contact LTC factory for details.

OPTIONAL PRIMARY MOSFET DRIVER LTC4440

The DC830 has an optional LTC4440 MOSFET driver which can be enabled in place of the LTC4441 driver. The LTC4440 has lower output drive capability than the LTC4441 but it may be adequate in some applications. To enable the LTC4440, first disable the LTC4441 by removing resistors R36 and R37. Then install 1 ohm resistors R6 and R7. Measure the efficiency before and after the change to see if swapping drivers made a significant difference.

USING OUTPUT MOSFET BUFFERS

The optional MOSFET buffers Q13 and Q14 can improve the efficiency if MOSFETs with high Q_g are used. By default, the MOSFET buffers are disabled. To test the performance with the buffers perform the following steps.

1. Turn the power off.
2. Change the base-emitter resistors R12 and R25 to 10ohm.
3. Turn the power on.
4. Measure the efficiency.

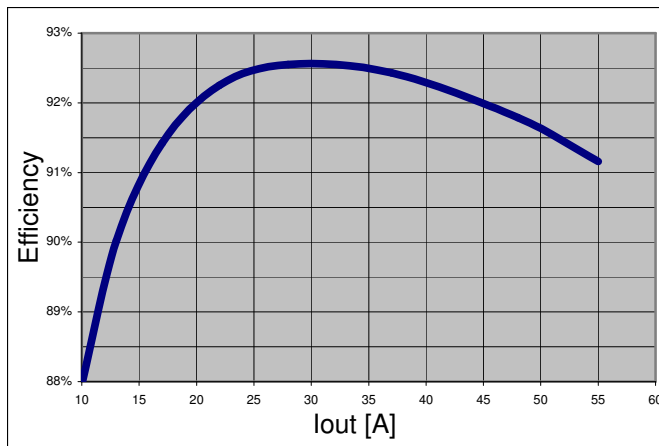


Figure 3. High efficiency of DC830 allows the board to be used in thermally critical applications

OUTPUT LOAD STEP RESPONSE

The load step response of DC830 is very fast even though a relatively small amount of output capacitance is present (300uF ceramic and 470uF electrolytic). This is due to the fast error amplifier of the LT4430, the optimal amount of current slope compensation of the LT1952, fast opto coupler and fast error amplifier of LT1952. If higher load steps need to be handled more output capacitance can be added in order to keep the voltage transients at desired levels. The load step transients are shown in Figure 4.

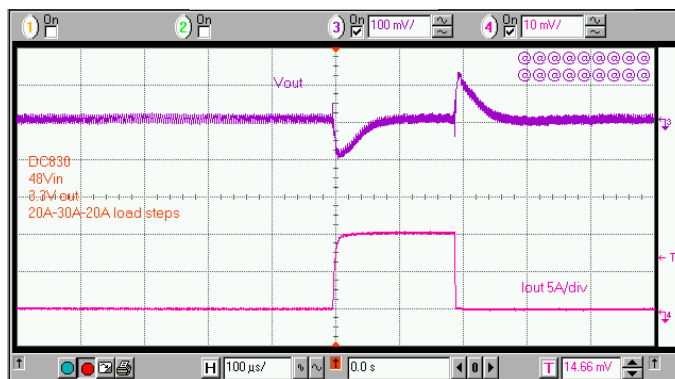


Figure 4. Fast transient response of DC830 is superior to many competing power modules without the additional output capacitors

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SOFT START FUNCTION

DC830 features the LT4430 opto coupler driver that has a soft start function which produces the monotonic startup ramp shown in Figure 5. The rise time of the output voltage is controlled by capacitor C19 which is connected to the OC (overshoot control) pin of the LT4430.

48V, the output voltage and input current can be monitored. The input current should not exceed 100mA without the output load. If one of the MOSFETs is damaged, the input current will exceed 100mA.

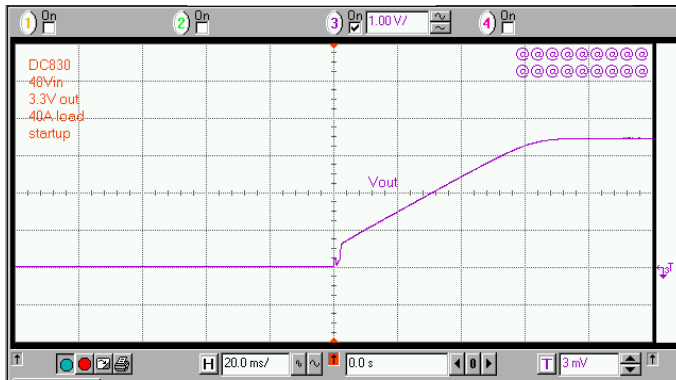


Figure 5. The LT4430 opto coupler driver produces monotonic output voltage rise at startup without output voltage overshoot.

DEBUGGING AND TESTING

The DC830 can easily be tested and debugged by powering the bias circuit separately from the main power circuit. To place DC830 into debug mode remove resistor R1 and connect a 48V, 100mA power source to the +Vb node (right side of R1). By doing this, the primary PWM controller LT1952 can be activated without the main primary power being applied to +Vin.

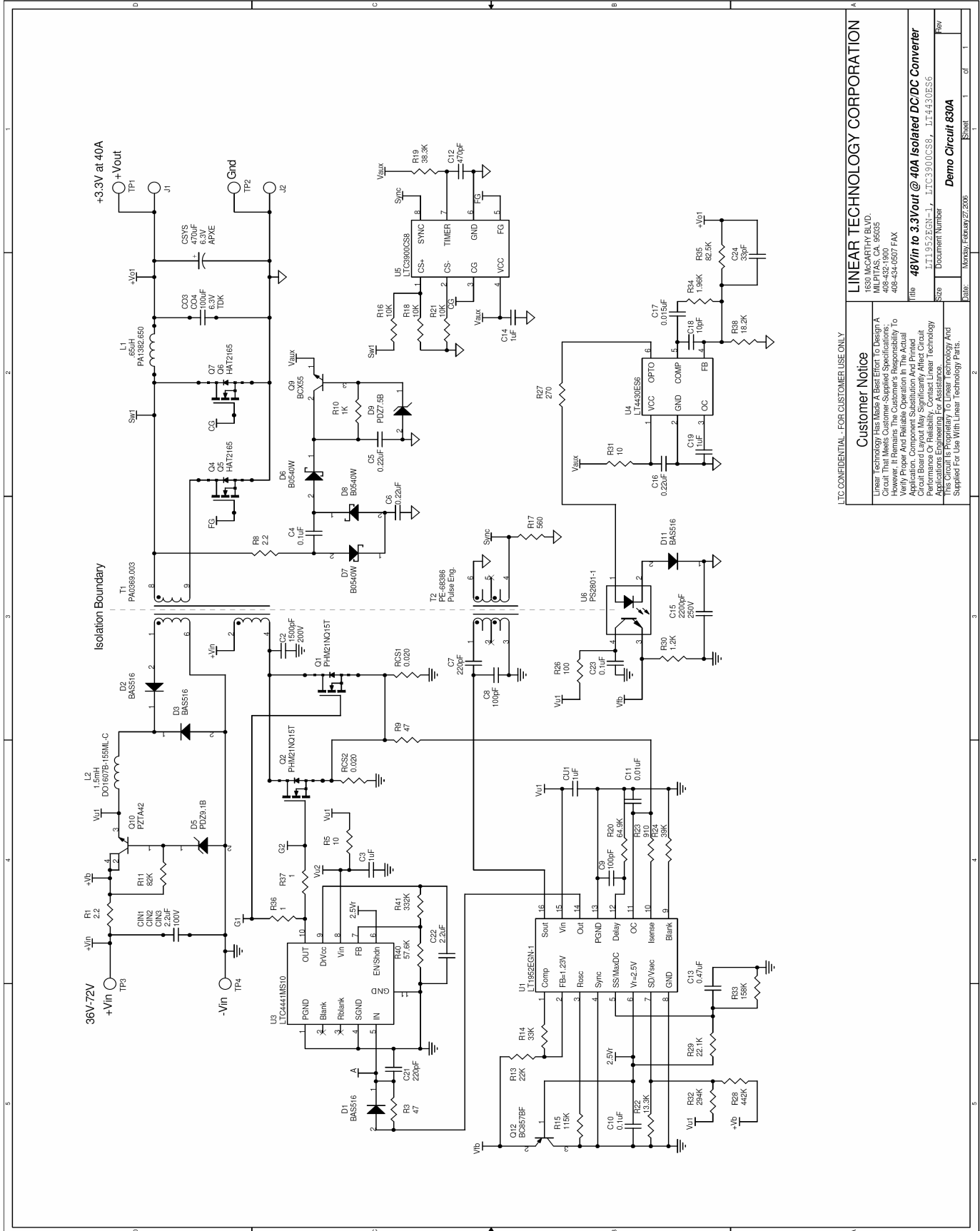
To activate the secondary side MOSFET driver LTC3900 connect a 10V, 100mA power source to the collector of Q9 via a 1A, 50V diode. The 1A diode will prevent current from flowing back to the 10V supply once the converter starts running.

Once the primary and secondary controllers are running the MOSFET gate timing can be checked.

If the MOSFET gate timing is correct, the main power input can be applied to +Vin. The delay from turn on of FG and G1 should be in the range from -100ns to +100ns. By slowly increasing the +Vin from 0V to

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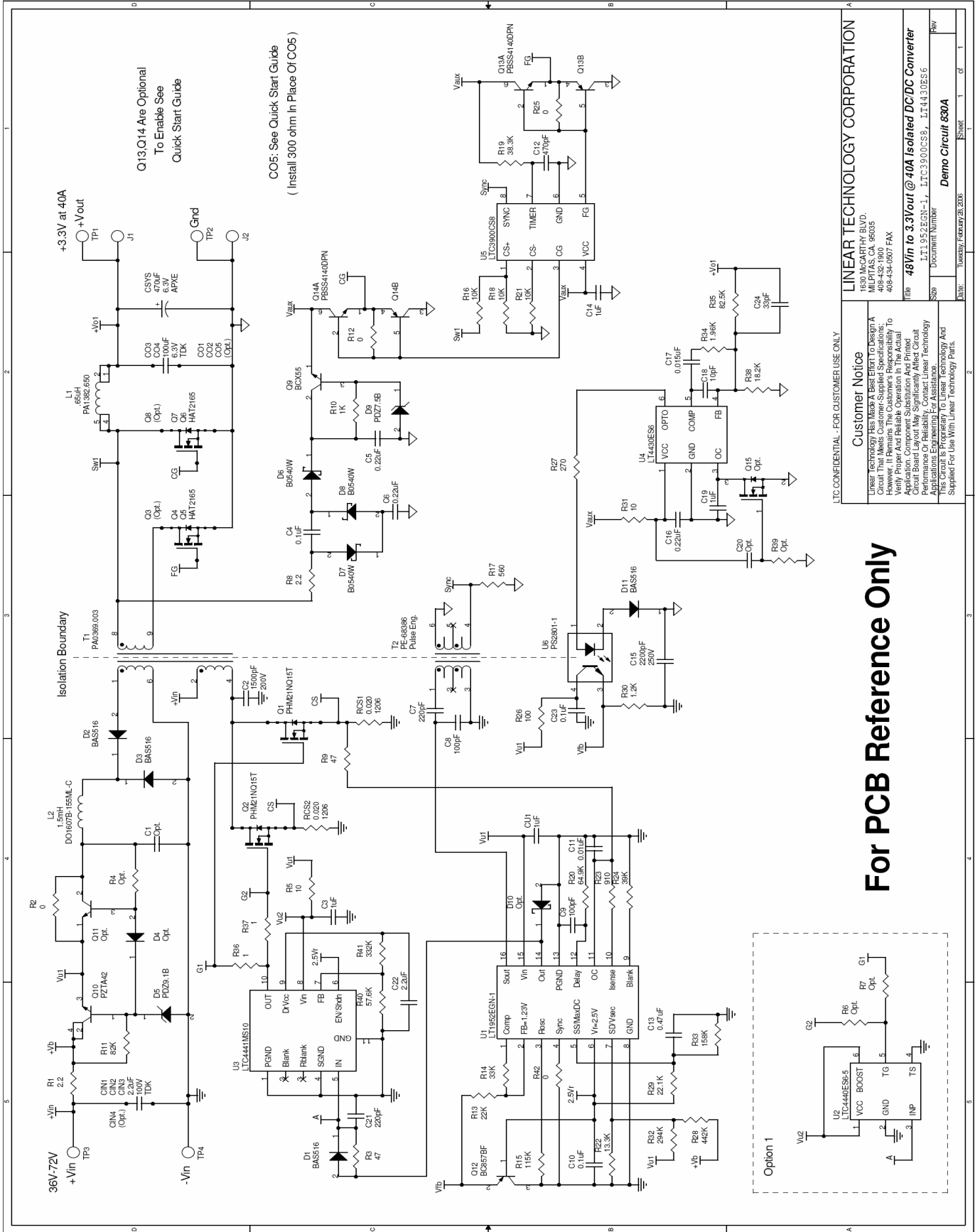


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