DESCRIPTION

Demonstration circuit DC694 is an ORed Power Supply Demo Circuit featuring the LT®4351. The demo circuit is intended to allow for 3 diode ORed supplies. Two supplies are ORed with the LT4351 MOSFET Diode-OR Controller while the third uses a Schottky diode for comparison.

The LT4351 circuits on this assembly are set up for use with 12V supplies.

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

Table 1. Performance Summary (T_A = 25°C)

PARAMETER	CONDITION	VALUE
Maximum Input Voltage		19V
Maximum Output Current	Limited by pass elements	Typically 7.5A
Nominal V_{DD1} or V_{DD2} voltage	Generated by on chip boost regulator	(V1 or V2)+10.7V
Overvoltage trip voltage for LT4351 channels		15.1V
Undervoltage trip voltage for LT4351 channels		9.6V
Turn on voltage for LT4351 channels		10.2V
Undervoltage hysteresis for LT4351 channels		0.6V

OPERATING PRINCIPLES

DC694 uses the LT4351 controller (U1 and U2) to create a nearly ideal diode function for two channels. The third channel is a Schottky diode (D5).

The LT4351 creates the ideal diode function by turning on low RDSON N-channel MOSFETs when the input supply is greater than the output. When the input source voltage drops below the output common supply voltage it turns off the MOSFET, thereby matching the function and performance of an ideal diode.

The demo circuit uses dual N-channel MOSFETs in a single package, wired back-to-back (Q3 and Q6). Back-to-back MOSFETs are used to prevent current flow in the MOSFET body diode during an overvoltage condition.

The LT4351 gate driver amplifier monitors the input (V1 or V2) and output (OUT) and controls the MOSFETs. If the input voltage exceeds OUT by 15mV, the LT4351 turns on the MOSFETs allowing current to flow from VIN to OUT.

Additionally the LT4351 can inhibit current flow when the input supply is out of range either high or low. This is done with on chip undervoltage and overvoltage comparators. Resistive dividers (R5/R6, RA1/RB1 and R11/R12, RA2/RB2) in conjunction with the LT4351 UV and OV pins sets appropriate thresholds such that the MOSFETs are off when the UV pin is below 300mV or OV pin is above 300mV.

To help deal with the transients on the supply lines, the UV input has current hysteresis. When the UV voltage drops below the 300mV threshold, a 10μA current is pulled from the pin. Thus the user can set the hysteresis level through appropriate values in the divider. For the demo circuit the resistive dividers set a 9.6V undervoltage and 15.1V overvoltage.

LED's are provided to indicate the states of the controller. The green STATUS LEDs (D1, D6) will light when the MOSFETs are most likely on and passing current ((V1 or V2) > OUT + 15mV and GATE > (V1 or V2) + 0.7V).

The red FAULT LEDs (D2, D7) turn on when the respective channel is out of range because of overvoltage or undervoltage condition.

The FAULT LED can also light when there may be a problem with the MOSFETs such that maximum gate drive is being provided and the drop across the MOSFETs is greater than 0.21V. This can occur if the MOSFETs fail or if the I* RDSON is greater than 0.21V. For the FDS6868A dual MOSFET in the demo circuit the equivalent RDSON at 125C is (2*14mΩ) =28mΩ. Thus if the current is greater than 0.21V/28mΩ = 7.5A the FAULT LED will turn on. Note that the STATUS LED will also be on in this state.

The LEDs take their power from the input however R2 and R8 can be removed and power can be supplied from VCC1 and VCC2. FAULT derives its drive from the greater of input voltage (V1, V2) or OUT. It becomes active when either voltage is greater than 0.9V.

The gate drive consists of a high current, wide bandwidth amplifier. When the amplifier is enabled, it attempts to regulate the GATE voltage such that the voltage across the MOSFETs is approximately 15mV. If the MOSFETs on resistance is so high as to prevent regulation, then GATE goes to compliance and the MOSFETs fully turn on. The inputs to the amplifier are V1 or V2 and OUT.

The LT4351 gate drives derive their power from on-chip boost regulators (L1, D3, C5 and L2, D8, C9). These regulators will generate a VDD voltage approximately 10.7V above VIN.

If an external supply is available to supply VDD it can be connected to VDD1 and VDD2. The on-chip regulators can be disabled by removing L1/D3 and L2/D8.

QUICK START PROCEDURE

Demonstration circuit 694 is easy to set up to evaluate the performance of the LT4351. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supplies to V1, V2 and V3 and the respective GND's.
2. Set the output load to approximately 1A (12Ω at 12V)
3. Turn on the V1 power and ramp up the voltage to 5V. The red FAULT LED should be on and green STATUS LED off.
4. The boost regulator will start going at V_{IN} =0.9V. The boost voltage will increase with increasing V1. Check that the boost regulator is working by measuring the voltage on V_{DD1}. With V1=5V, V_{DD1} should be approximately 15.7V
5. Continue to turn up the V1 supply. At approximately 10V the red FAULT LED will go out and the green STATUS LED will turn ON. Turn up the supply to 12V
6. Monitor the OUT voltage. The load ammeter should read 1A. The output voltage should be approximately 12V-1A*(2*10mΩ) =11.98V. When the load current is reduced below 0.75A the OUT voltage should hold at approximately 11.985. Turn the load current back up to 1A.
7. Check that the boost regulator is working by measuring the voltage on V_{DD1}. It should be approximately 22.7V
8. Turn down the V1 supply until the red FAULT LED turns on. This is the undervoltage trip point (approximately 9.6V).
9. Turn up the V1 supply. At approximately 10V the red FAULT LED will go out and the green STATUS

LED will turn ON. Turn up the supply till the red FAULT LED turns on. This is the overvoltage trip point (approximately 15V)

10. Turn down the V1 supply and repeat steps 3 to 10 using the V2 supply. V_{DD2} is the boost regulator output for the second channel.

11. The third channel is a simple Schottky diode. With V1 and V2 off, turn on V3 supply. Ramp up V3. OUT should follow at approximately 0.3V below V3.

12. Turn off V3. Turn on V1 and set to 12V. The green STATUS LED on channel 1 should be ON. Turn on V2 and raise the voltage. Initially the red FAULT LED on channel 2 turns on and will stay on until V2 reaches 10V. At 10V that LED turns off. The green STATUS LED on channel 2 will turn on when V2 reaches the V1 voltage. As you increase the V2 voltage the green STATUS LED on channel 1 will go out.

13. You can adjust V1 and V2 and load current to see how the ORing function behaves. Current sharing between channels will depend on the input voltages and the on resistances of the MOSFET pass elements.

14. If desired the V3 supply can be turned on and used for comparing the ORing between the LT4351 circuit and a Schottky diode. Note that the Schottky forward drop is higher than the MOSFETs forward drop so V3 will have to be set 0.3V or more higher than V1 and V2.

15. Optionally Q3 and/or Q6 can be removed and individual SO8 MOSFETs can be used on the backside of the board (Q1/Q2, Q4/Q5). This will allow the user to use MOSFETs with lower RDS_{ON} for higher current evaluation.

NOTE: The demo circuit has modest input and output capacitance (10uF ceramic). Depending on your application more capacitance may be required. When the current is abruptly turned off, inductance on the input feed lines may ring above the maximum voltage ratings for the MOSFETs. Keeping the inductance low and/or adding larger input capacitance with appropriate ESR can help reduce this. Alternately, a zener or voltage clamp can be added

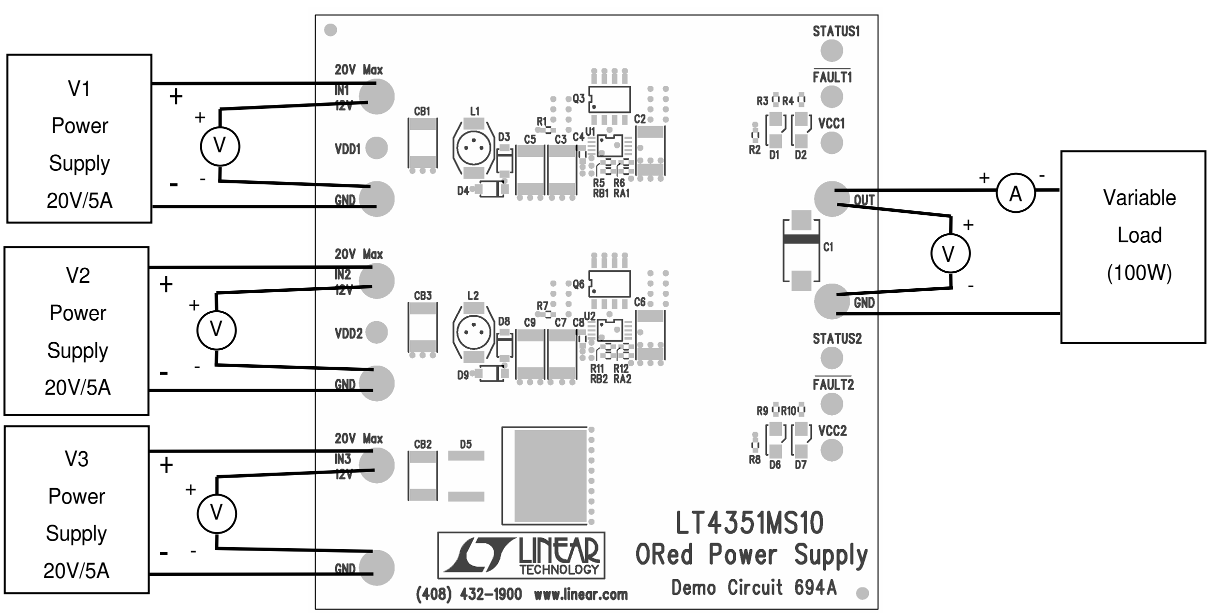
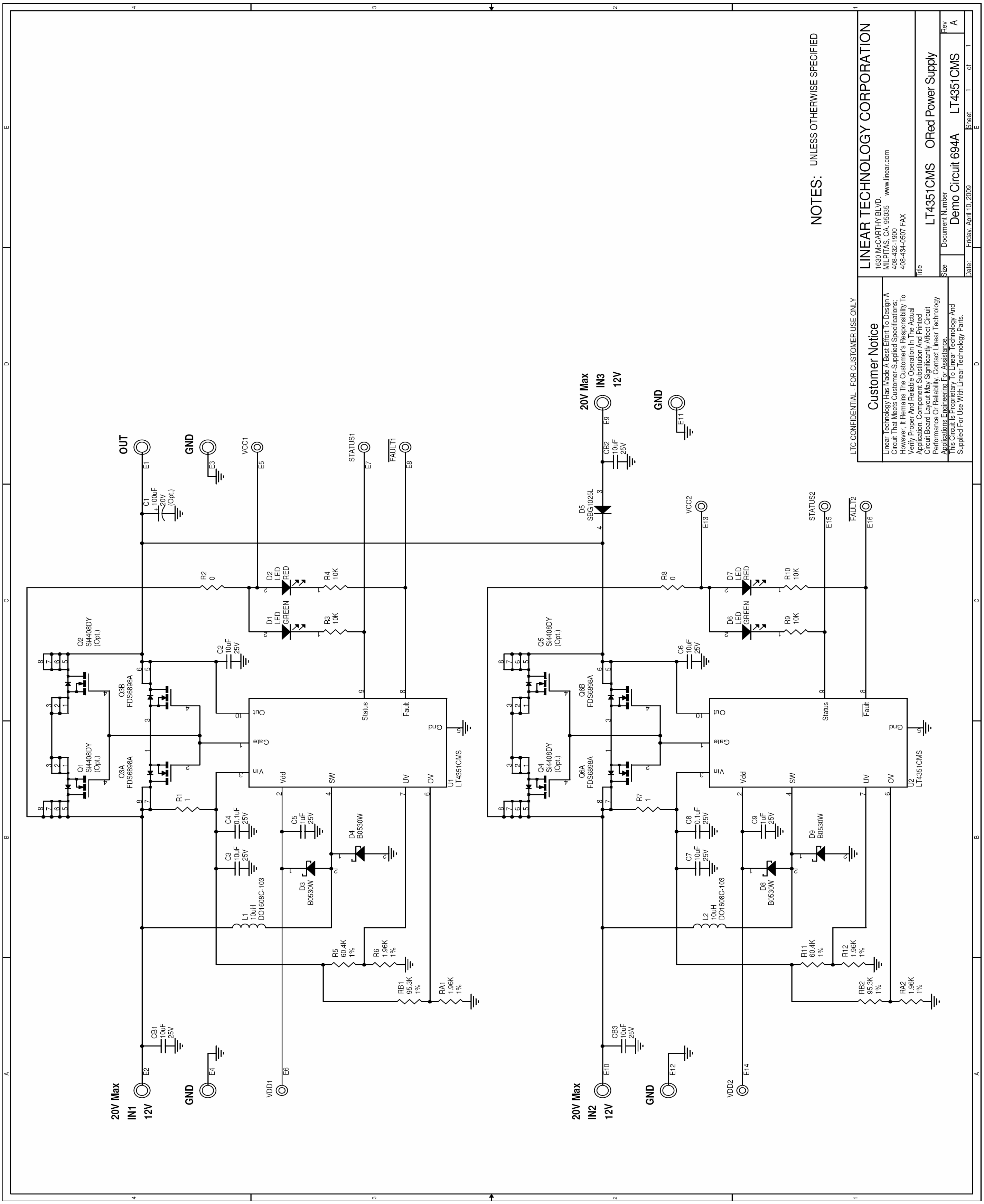


Figure 1. Proper Measurement Equipment Setup



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LT4351CMS ORed Power Supply
Demo Circuit 694A LT4351CMS
Friday, April 10, 2009
OUT
GND
VCC1
STATUS1
FAULT1
20V Max IN1 12V
20V Max IN2 12V
20V Max IN3 12V
VDD1
VDD2
VCC2
STATUS2
FAULT2
U1 LT4351CMS
U2 LT4351CMS