

## LT1641-1, LT1641-2, LT4256-1, and LT4256-2 Positive High Voltage Hot Swap Controller

### DESCRIPTION

Demonstration circuit 1354 is a Positive High Voltage Hot Swap Controller featuring either the LT1641-1, LT1641-2, LT4256-1, or LT4256-2.

The board facilitates measurement of transient conditions, steady state operation with different loads, and fault conditions. The Controller responds to fault conditions such as input undervoltage(UV), output power good (PWRGD) fault, and overcurrent and response can be verified by the output voltage (VOUT) LED state and PWRGD pin signal.

The LT1641-1 and LT4256-1 latch off, if MOSFET shuts off under overcurrent condition, while LT1641-2 and LT4256-2 automatically restart after time-out delay.

The DC1354 contains one Hot Swap Controller, power MOSFET, current sense resistor, enable circuit, input voltage clamp, gate protection circuit, resistive output voltage divider for feedback signal, and three LEDs to indicate the presence of input and output voltages and power good condition.

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

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### PERFORMANCE SUMMARY

Specifications are at TA = 25°C

| SYMBOL                     | PARAMETER                                                    | CONDITIONS                                                                            | MIN   | TYP   | MAX   | UNITS   |
|----------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------|-------|-------|-------|---------|
| V <sub>CC</sub>            | Operating Voltage                                            | LT1641                                                                                | 9.0   |       | 80    | V       |
|                            |                                                              | LT4256                                                                                | 10.8  |       | 80    | V       |
| V <sub>LKO</sub>           | V <sub>CC</sub> Undervoltage Lockout                         | LT1641                                                                                | 7.5   | 8.3   | 8.8   | V       |
|                            |                                                              | LT4256                                                                                |       | 9.8   |       | V       |
| V <sub>UNLH</sub>          | Undervoltage Threshold                                       | LT1641, ON pin voltage Low to High transition                                         | 1.280 | 1.313 | 1.345 | V       |
|                            |                                                              | LT4256, UV pin voltage Low to High transition                                         | 3.96  | 4     | 4.04  | V       |
| V <sub>FB</sub>            | Feedback Voltage Threshold                                   | LT1641, FB Low-to-High Transition,                                                    | 1.280 | 1.313 | 1.345 | V       |
|                            |                                                              | FB High-to-Low Transition                                                             | 1.221 | 1.233 | 1.245 | V       |
|                            |                                                              | LT4256, FB Low-to-High Transition,                                                    | 3.95  | 3.99  | 4.03  | V       |
|                            |                                                              | FB High-to-Low Transition                                                             | 4.2   | 4.45  | 4.65  | V       |
| V <sub>SENSETRIP</sub>     | SENSE Pin Trip-Voltage(V <sub>CC</sub> -V <sub>SENSE</sub> ) | LT1641, V <sub>FB</sub> = 0V                                                          | 8     | 12    | 17    | mV      |
|                            |                                                              | V <sub>FB</sub> = 1V,                                                                 | 39    | 47    | 55    | mV      |
|                            |                                                              | LT4256, V <sub>FB</sub> = 0V,                                                         | 5.5   | 14    | 22    | mV      |
|                            |                                                              | V <sub>FB</sub> $\geq$ 2V                                                             | 45    | 55    | 65    | mV      |
| $\Delta$ V <sub>GATE</sub> | External N-Channel Gate Drive                                | LT1641, V <sub>GATE</sub> - V <sub>CC</sub> , 10.8V $\leq$ V <sub>CC</sub> $\leq$ 20V | 4.5   |       | 18    | V       |
|                            |                                                              | 20 V $\leq$ V <sub>CC</sub> $\leq$ 80V,                                               | 10    |       | 18    | V       |
|                            |                                                              | LT4256, V <sub>GATE</sub> - V <sub>CC</sub> , 10.8 $\leq$ V <sub>CC</sub> $\leq$ 20V  | 4.5   | 8.8   | 12.5  | V       |
|                            |                                                              | 20 V $\leq$ V <sub>CC</sub> $\leq$ 80V,                                               | 10    | 11.6  | 12.8  | V       |
| I <sub>GATEUP</sub>        | GATE Pin Pull-Up Current                                     | LT1641                                                                                | 5     | 10    | 20    | $\mu$ A |
|                            |                                                              | LT4256                                                                                | 16    | 32    | 63    | $\mu$ A |
| I <sub>GATEDN</sub>        | GATE Pin Pull-Down Current                                   | LT1641                                                                                | 35    | 70    | 100   | mA      |
|                            |                                                              | LT4256                                                                                | 40    | 62    | 80    | mA      |

## OPERATING PRINCIPLES

The LT1641-1, LT1641-2, LT4256-1, and LT4256-2 are Positive High Voltage Hot Swap Controllers that have absolute maximum supply voltage ( $V_{CC}$ ) 100V and operating range (9-80) V for LT1641 and (10.8-80) V for LT4256. In the DC1354A any controller operates on the +48V rail. Each board can easily be readjusted for any

rated voltage by replacing the enable circuit (R5, R11), input voltage clamp (D1), gate protection circuit (R8, R14, D3, D6), and resistive output voltage divider (R10, R12). The DC1354A as supplied by the factory is assembled with the SUM90N10-8m2p MOSFET in a D2PAK package and 7m $\Omega$  current sense resistor (R1).

## QUICK START PROCEDURE

Demonstration circuit DC1354 is easy to set up to evaluate the performance of the LT1641-1, LT1641-2, LT4256-1, and LT4256-2. Refer Figure 1 for proper measurement equipment setup and follow the procedure below.

The board test is performed in several steps by measuring some transient parameters and verifying successful or failed power up actions under defined conditions. In all test steps turn on switch SW\_PS to connect demo board to the +48V power supply, turn on switch SW\_PS to activate controller (connecting the ENABLE pin to the VIN +48V) and turn +48V off for resetting controller after fault.

1. It should be noted that loading parameters such as Low Capacitive Load, High Capacitive Load, Low Resistive Load, and High Resistive are different for LT4256 and for LT1641. These parameters are shown below separately for each controller:

### LTC1641

- Low Capacitive load 1000uF,
- High Capacitive load 8700uF,
- Low Resistive load 10  $\Omega$ , 50W ,
- High Resistive load 5.5  $\Omega$  .

### LTC4256

- Low Capacitive load 250uF,
- High Capacitive load 3500uF,
- Low Resistive load 11  $\Omega$ , 50W ,

- High Resistive load 5.0  $\Omega$  .

2. Place a scope probe to the VOUT turret, turn on controller, and measure a power-up time with no load. For LT4256 this time must be in the range (13.7 - 54) ms, and for LT1641- (43 - 173) ms.
3. Connect Low Capacitive Load to the output of hot swap circuitry (VOUT +48V turret). Turn on controller. This power up should be successful and two LEDs (VOUT – green - and PWRGD - orange) must light.

**NOTE.** The following tests verify loaded Controller performance. The transients with Low Load should be successfully completed, while transients with High Load should fail. The LT1641-1 and LT4256-1 in the overcurrent fault condition are latched off, while the LT1641-2 and LT4256-2 provide retry. To avoid power MOSFET damage in the LT1641-2 and LT4256-2 High Load tests keep switch SW\_ON in the on position very short time.

4. Connect High Capacitive Load to the output of hot swap circuitry (VOUT +48V turret). Turn on controller. This power up should be unsuccessful, and two LEDs remaining off will confirm this.

For LT4256-1 and LT1641-1 the failed power-up is indicated by the VOUT (green) and PWRGD (orange) LED lights remaining off. Disconnect the ENABLE turret from the VIN +48V turret for short time and connect them again. The controller should be latched off in the shut off mode,

For LT4256-2 and LT1641-2 make short time connection of the ENABLE turret and VIN +48V. The VOUT (green) and PWRGD (orange) LED will blink indicating an autoretry in the failed power up.

## LT1641-1, LT1641-2, LT4256-1, AND LT4256-2

5. Load output with Low Resistive Load. Controller should successfully keep this load.
6. Turn controller on. Load output with High Resistive Load. Controller should fail to keep this load.
7. Verify that controller alive after overload test.

**NOTE.** In the designing of the power-up transient with mentioned Controllers special attention should be paid to correspondence between power MOSFET safe operating area and transient parameters (current limit level, duration of the transient, relationship between capacitive load and resistive load and timer period).

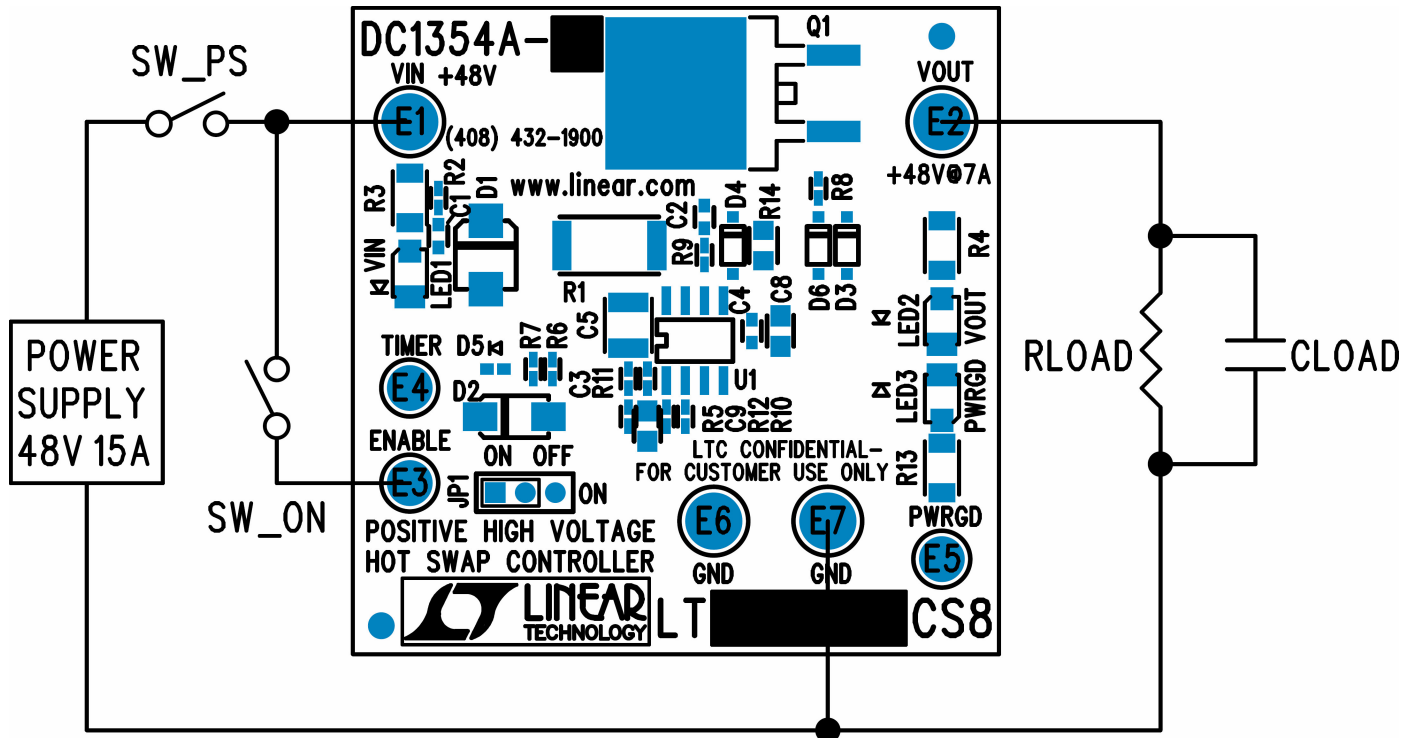


Figure 1. Proper Measurement Equipment Setup



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