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

DESCRIPTION

Demonstration circuit 1354B is a positive high voltage hot swap controller featuring either the LT®1641-1, 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 (V_{OUT}) 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 DC1354B 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.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{CC}	Operating Voltage	LT1641 LT4256	9 10.8		80 80	V V
V_{LKO}	V_{CC} Undervoltage Lockout	LT1641 LT4256	7.5	8.3 9.8	8.8	V V
V_{UNLH}	Undervoltage Threshold	LT1641, ON pin voltage Low to High transition LT4256, UV pin voltage Low to High transition	1.28 3.96	1.313 4	1.345 4.04	V V
V_{FB}	Feedback Voltage Threshold	LT1641, FB Low-to-High Transition, FB High-to-Low Transition LT4256, FB Low-to-High Transition, FB High-to-Low Transition	1.28 1.221 3.95 4.2	1.313 1.233 3.99 4.45	1.345 1.245 4.03 4.65	V V V V
$V_{SENSETRIP}$	SENSE Pin Trip-Voltage(V_{CC}-V_{SENSE})	LT1641, V_{FB} =0V V_{FB} =1V LT4256, V_{FB} =0V V_{FB} ≥2V	8 39 5.5 45	12 47 14 55	17 55 22 65	mV mV mV mV
ΔV_{GATE}	External N-Channel Gate Drive	LT1641, V_{GATE}- V_{CC}, 10.8V ≤V_{CC}≤20V 20 V≤V_{CC} ≤ 80V LT4256, V_{GATE}- V_{CC}, 10.8≤V_{CC}≤ 20V 20 V≤V_{CC} ≤ 80V	4.5 10 4.5 10	 8.8 11.6	18 18 12.5 12.8	V V V V
I_{GATEUP}	GATE Pin Pull-Up Current	LT1641 LT4256	5 16	10 32	20 63	µA µA
I_{GATEDN}	GATE Pin Pull-Down Current	LT1641 LT4256	35 40	70 62	100 80	mA 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 DC1354B, 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 DC1354B as supplied by the factory is assembled with the SUM90N10-8m2p MOSFET in a D2PAK package and 7mΩ current sense resistor (R1).

QUICK START PROCEDURE

Demonstration circuit DC1354B is easy to set up to evaluate the performance of the LT1641-1, LT1641-2, LT4256-1, and LT4256-2. Refer to 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:

   LT1641

   - Low Capacitive Load: 1000uF
   - High Capacitive Load: 8700uF
   - Low Resistive Load: 10Ω, 50W
   - High Resistive Load: 5.5Ω

   LT4256

   - Low Capacitive Load: 250uF
   - High Capacitive Load: 3500uF
   - Low Resistive Load: 11Ω, 50W
   - High Resistive Load: 5.0Ω

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 (V_{OUT} – green and PWRGD - green) 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 for a 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 the 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 (green) 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 V_{OUT} (green) and PWRGD (green) LED will blink indicating an autoretry in the failed power up.

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 is alive after the 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).

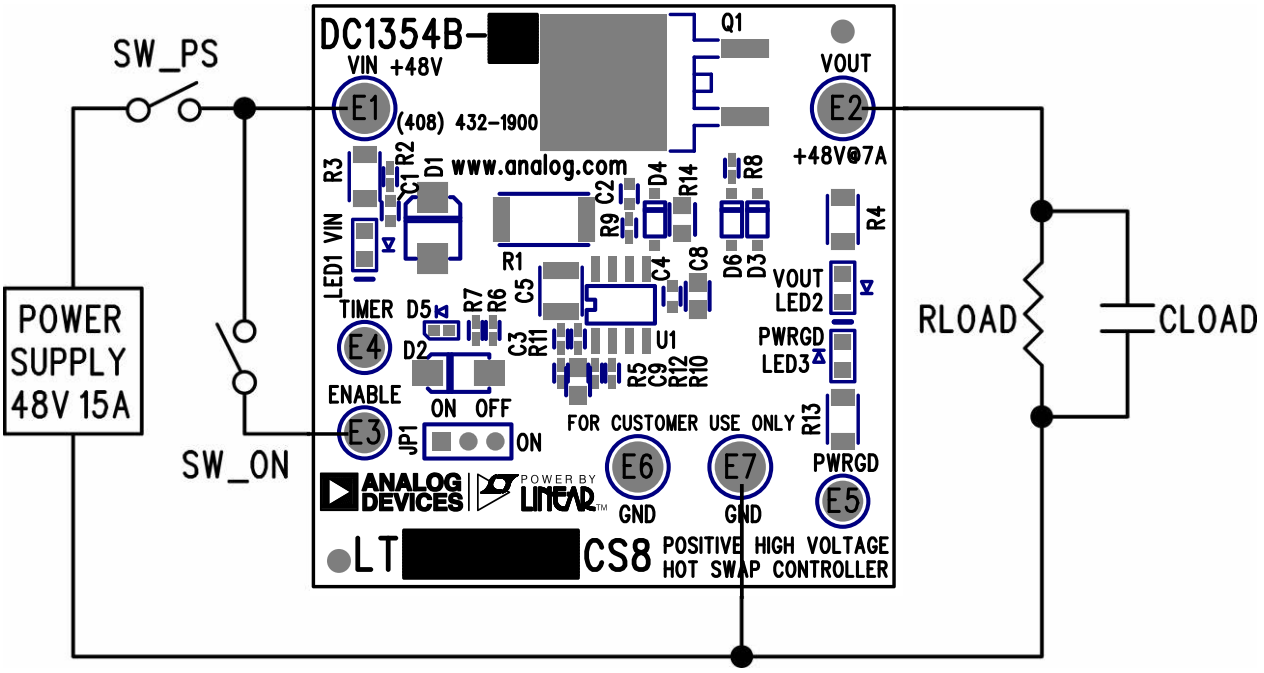

Figure 1. Proper Measurement Equipment Setup

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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