

LTC4217

2A Integrated Hot Swap Controller

DESCRIPTION

Demonstration circuit 1051A includes two separate circuits for performance evaluation of the LTC®4217 2A integrated Hot Swap™ controller. This integrated circuit includes a power MOSFET to save board area and to minimize external component count. The standard version of the controller (LTC4217) is intended to operate with 2.9V to 26.5V rails, while the LTC4217-12 has internal adjustment for 12V applications.

The circuit of DC1051A located on the upper board area is assembled with the LTC4217 configured for operation with a 24V rail. The lower circuit includes the LTC4217-12. Current limit features of both circuits are identical, with 5% accuracy and a distinctive foldback property.

The LTC4217 features a ground-referred current monitor. The current monitor sources a current that is proportional

to the sense voltage and it may be converted to a voltage signal with an appropriate resistor.

The current limit may be reduced by placing an external resistor between GND and the ISET pin.

The DC1051A schematic allows the LTC4217 to operate in turn-on and turn-off modes as well as in the steady-state mode with different loads, and in the fault mode.

The LTC4217 features an overtemperature protection circuit, and protects the load from overvoltage and undervoltage conditions.

Design files for this circuit board are available at <http://www.linear.com/demo>

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PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------|---------------------------------|---|-------|-------|-------|---------------|
| 24V Circuit | | | | | | |
| V_{DD} | Input Supply Range | Typical Value | 19.9 | 24 | 26.3 | V |
| $V_{DD(UVL)}$ | Input Supply Undervoltage Range | V_{DD} Rising | 19.12 | 19.9 | 20.30 | V |
| $V_{DD(OVH)}$ | Input Supply Overvoltage Range | V_{DD} Rising | 25.32 | 26.3 | 27.38 | V |
| t_{TIMER} | Timer Period | | 0.9 | 1.235 | 1.76 | ms |
| I_{LIM} | Current Limit Value | $V_{FB} = 1.235\text{V}$ (V_{OUT} in the Range 20.3V to 21.2V) | 1.9 | 2 | 2.1 | A |
| | | $V_{FB} = 0\text{V}$ to 0.15V (V_{OUT} in the Range 0V to 2.5V) | 0.35 | 0.5 | 0.7 | A |
| C_{MAX24} | Maximal Load Capacitance | For Successful Power-Up | | 900 | | μF |
| C_{MIN24} | Minimal Load Capacitance | For Unsuccessful Power-Up | | 3500 | | μF |
| 12V Circuit | | | | | | |
| V_{DD} | Input Supply Range | Typical Value | 9.88 | 12 | 15.05 | V |
| $V_{DD(UVL)}$ | Input Supply Undervoltage Range | V_{DD} Rising | 9.6 | 9.88 | 10.2 | V |
| $V_{DD(OVH)}$ | Input Supply Overvoltage Range | V_{DD} Rising | 14.7 | 15.05 | 15.4 | V |
| t_{TIMER} | Timer Period | V_{TIMER} Rising | 0.9 | 1.235 | 1.76 | ms |
| I_{LIM} | Current Limit Value | $V_{FB} = 1.235\text{V}$ (V_{OUT} in the Range 10.15V to 10.6V) | 1.9 | 2 | 2.1 | A |
| | | $V_{FB} = 0\text{V}$ to 0.15V (V_{OUT} in the Range 0V to 1.15V) | 0.35 | 0.5 | 0.7 | A |
| C_{MAX12} | Maximal Load Capacitance | For Successful Power-Up | | 1000 | | μF |
| C_{MIN12} | Minimal Load Capacitance | For Unsuccessful Power-Up | | 4000 | | μF |

OPERATING PRINCIPLES

The LTC4217 is suited for low voltage applications such as hot board insertion and removal. The LTC4217 has a rich set of features to support Hot Swap applications including:

- Integrated power MOSFET for a compact Hot Swap solution
- 2% accurate undervoltage and overvoltage protection
- Adjustable 5% accurate current limit

- Adjustable inrush current control
- Load current monitoring
- Adjustable current limit timer before power is turned off
- Power good signaling

QUICK START PROCEDURE

Demonstration circuit 1051 is easy to set up to evaluate the performance of the LTC4217. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below.

For the 24V circuit:

1. Place jumpers in the following positions:
JP1 $\overline{\text{FAULT}}$ Signal
JP2 AUX_UV ON
2. With power off, connect the 24V power supply terminals to the 24V_{IN} (E1) and GND (E3) turrets.
3. Turn on the 24V supply and verify the output voltage between the V_{OUT} (E7) and GND (E8) turrets. Two green LEDs, 24V_{IN} (D2) and V_{OUT} (D6), should light up.
4. Check the current limit using an electronic or resistive load. It should be in the range of 1.9A to 2.1A if an overcurrent condition occurs while the output is high (after powering up properly). If the output is shorted initially, the load current will be limited in the range of 0.475A to 0.525A due to the foldback characteristic. Current may be monitored on the IMON test point during this measurement. The IMON signal scale is 1V/A.

An overcurrent condition is indicated by red LED $\overline{\text{FAULT}}$ (D3) and red LED PG (D4).
5. Check the output voltage slew rate with an oscilloscope, without a load connected. It takes 43.6ms to 160ms for the output voltage to power up completely.

6. Use a 900 μ F capacitive load to demonstrate that power up mode completes successfully. Use a current probe to verify that inrush current is limited initially by the foldback characteristic and later by the low output voltage slew rate.
7. Use a 3500 μ F capacitive load to demonstrate that the part not only enters into the current limit state but operates in this state until the timer period expires.

For the 12V circuit:

8. Place jumpers in the following positions:
JP3 $\overline{\text{FAULT}}$ Signal
JP4 AUX_UV ON
9. With power off, connect the 12V power supply terminals to the 12V_{IN} (E9) and GND (E12) turrets.
10. Turn on the 12V supply and verify the output voltage at the V_{OUT} (E15) and GND (E16) turrets. Green LEDs 12V_{IN} (D8) and V_{OUT} (D12) should light.
11. Check the current limit using an electronic or resistive load. It should be in the range of 1.9A to 2.1A. During this measurement verify the current monitor performance. The monitor signal related to the current limit level should be 1.9V to 2.1V.
12. Check the output voltage slew rate with an oscilloscope, without a load connected. It should take from 21ms to 80ms for the output voltage to rise to 12V.

QUICK START PROCEDURE

13. Use a 1000 μ F capacitive load to demonstrate that the part powers up without fault. Use a current probe to observe that inrush current is limited by the low output voltage slew rate.
14. Use a 4000 μ F capacitive load to demonstrate that the part enters the current limit state, and operates in this state until the timer period expires. The $\overline{\text{FAULT}}$ red LED (D9) indicates this state accompanied by the PG red LED (D10), which shows that the output voltage is lower than the power good level.

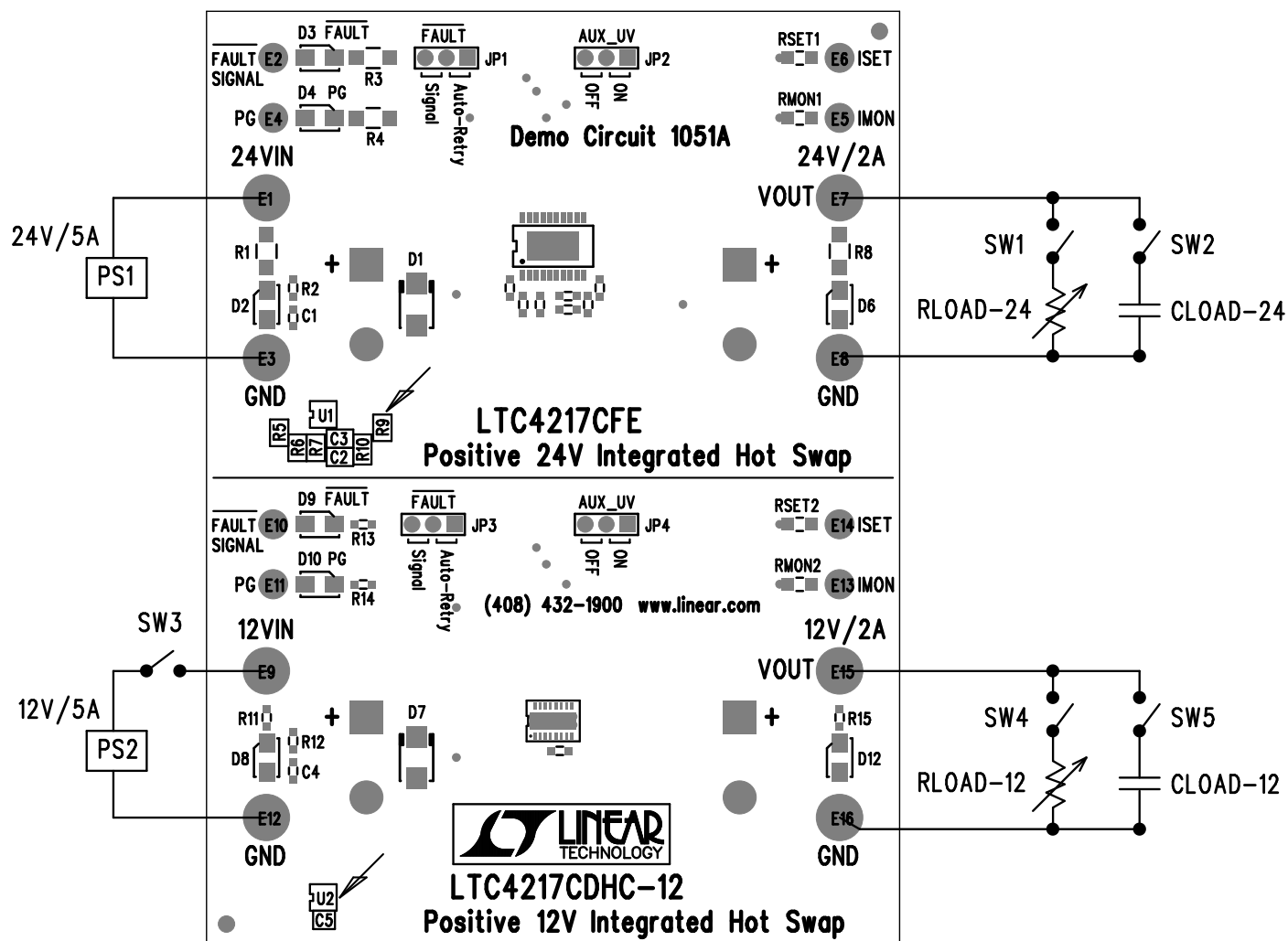


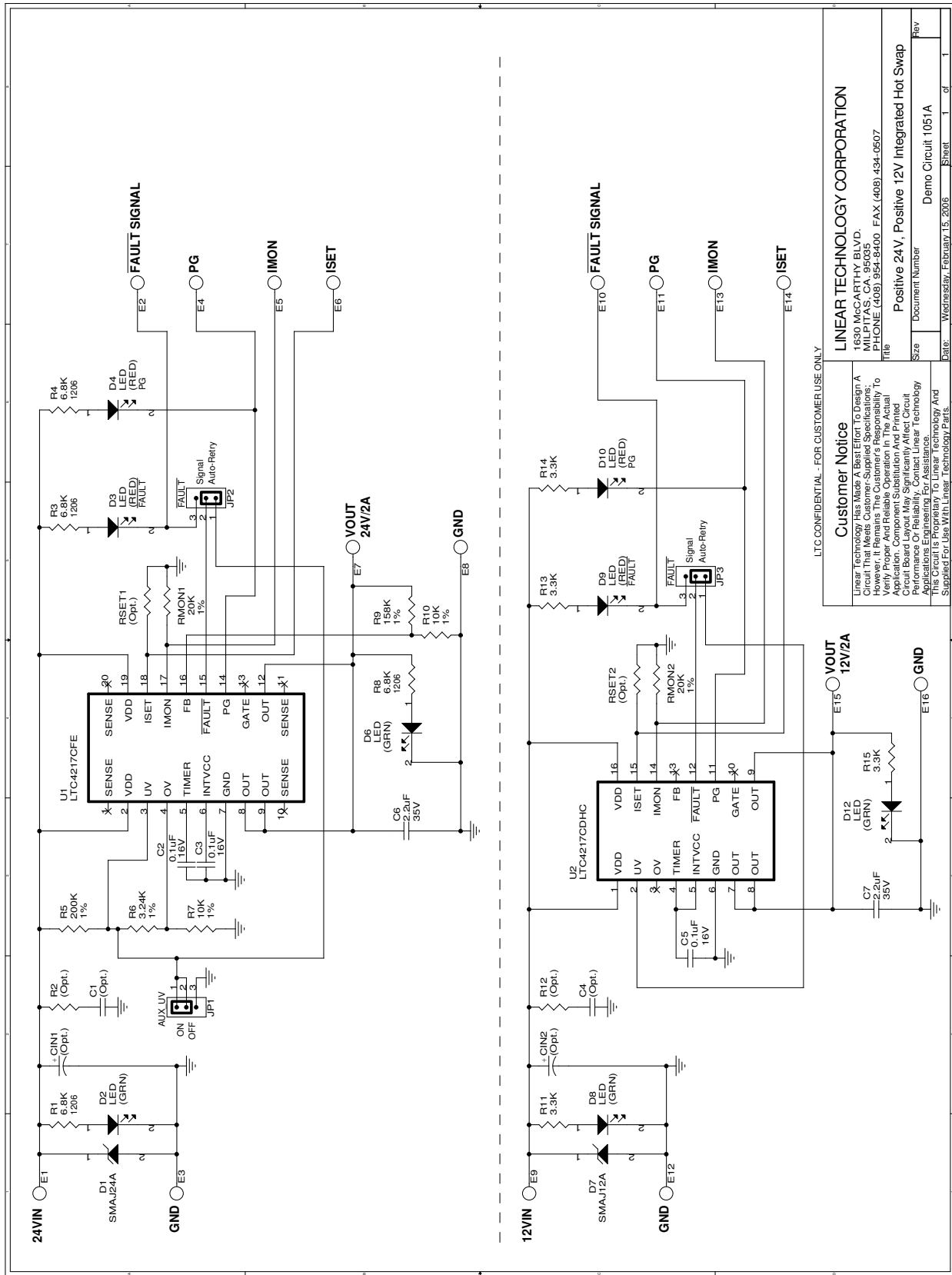
Figure 1. Measurement Equipment Setup

DEMO MANUAL DC1051A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------|-----|------------------------------------|--|--------------------------|
| 1 | 3 | C2, C3, C5 | CAP., CER X7R 0.1µF 16V 0603 | AVX 0603YC104KAT2A |
| 2 | 0 | C1, C4, CIN1, CIN2, COUT1, COUT2 | OPTIONAL | |
| 3 | 8 | E2, E4, E5, E6, E10, E11, E13, E14 | TURRET, TEST PIN, .061" | MILL-MAX 2308-2-00-44 |
| 4 | 8 | E1, E3, E7, E8, E9, E12, E15, E16 | TURRET, TEST PIN, .095" | MILL-MAX 2501-2 |
| 5 | 4 | JP1 - JP4 | JUMPER, 0.079, 3PIN | SAMTEC, TMM-103-02-L-S |
| 6 | 4 | JP1 - JP4 | SHUNT | SAMTEC, 2SN-BK-G |
| 7 | 4 | D3, D4, D9, D10 | LED, SMT RED | PANASONIC, LN1251C |
| 8 | 4 | D2, D6, D8, D12 | LED, SMT GREEN | PANASONIC, LN1351C |
| 9 | 1 | D1 | DIODE, 400W TRANSIENT VOLTAGE SUPPRESSOR | DIODES INC., SMAJ24A |
| 10 | 1 | D7 | DIODE, 400W TRANSIENT VOLTAGE SUPPRESSOR | DIODES INC., SMAJ12A |
| 11 | 1 | R6 | RES., CHIP, 3.24k 1/16W 1% 0603 | VISHAY, CRCW06033K24FKTA |
| 12 | 4 | R11, R13, R14, R15 | RES., CHIP, 3.30k 1/16W 5% 0603 | VISHAY, CRCW06033K30JEA |
| 13 | 4 | R1, R3, R4, R8 | RES., CHIP, 6.80k 1/4W 5% 1206 | VISHAY, CRCW12066K80JNEA |
| 14 | 2 | R7, R10 | RES., CHIP, 10k 1/16W 1% 0603 | VISHAY, CRCW060310K0FEA |
| 15 | 2 | RMON1, RMON2 | RES., CHIP, 20k 1/16W 5% 0805 | VISHAY, CRCW080520K0JEA |
| 16 | 1 | R9 | RES., CHIP, 158k 1/16W 1% 0603 | VISHAY, CRCW0603158KFEA |
| 17 | 1 | R5 | RES., CHIP, 200k 1/16W 1% 0603 | VISHAY, CRCW06032003F |
| 18 | 0 | RSET1, RSET2, R2, R12 | OPTIONAL | OPT |
| 19 | 1 | U1 | IC., HOT SWAP CONTROLLER | LINEAR, LTC4217CFE |
| 20 | 1 | U2 | IC., HOT SWAP CONTROLLER | LINEAR, LTC4217CDHC-12 |

SCHEMATIC DIAGRAM



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Customer Notice

Linear Technology has made a best effort to design a circuit that meets the customer's specifications; however, it remains the customer's responsibility to verify the circuit's performance in their application. Component substitution and printed circuit board layout may significantly affect circuit performance or reliability. Contact Linear Technology Applications Engineering for assistance. Linear Technology is not responsible for any damage or loss of data or equipment caused by the use of Linear Technology parts.

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Title: Positive 24V, Positive 12V Integrated Hot Swap

| | | |
|-------|------------------------------|--------------|
| Size | Document Number | Rev |
| | Demo Circuit 1051A | |
| Date: | Wednesday, February 15, 2006 | Sheet 1 of 1 |

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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