LTC4221 Dual Hot Swap Controller/Power Sequencer w/ Dual Speed, Dual Level Fault Protection

DESCRIPTION

Demonstration circuit DC1355 is a dual hot swap circuit featuring the LTC4221 Dual Hot Swap Controller / Power Sequencer with Dual Speed, Dual Level Fault Protection

DC1355 facilitates evaluation of the LTC4221 performance characteristics including supply ramp-up transients, steady state operation, and overcurrent fault conditions. On board LEDs indicate input supply presence, output state, and power good conditions.

The first LTC4221 channel controls a rail from 2.7V to 13.5V and the second one from 1V to 13.5V with condition that $V_{CC2} \leq V_{CC1}$.

DC1355 is assembled to operate with a +12V rail with 6A maximum current and a +3.3V rail with 3.0A maximum current.

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

PERFORMANCE SUMMARY

Specifications are at TA = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{CC1}	Supply Voltage Channel 1		2.7		13.5	V
V_{CC2}	Supply Voltage Channel 2	$V_{CC2} \leq V_{CC1}$	1.0		13.5	V
$V_{CC1(UVL)}$	Undervoltage Lockout for Channel 1	V_{CC1} Rising	2.1	2.5	2.675	V
$V_{CC2(UVL)}$	Undervoltage Lockout for Channel 2	V_{CC2} Rising	0.65	0.8	0.975	V
$V_{SENSE(FC)}$	SENSE*n* Threshold Voltage	Channel*n* Fast Comparator Threshold	85	100	115	mV
$V_{SENSE(SC)}$	SENSE*n* Threshold Voltage	Channel*n* Slow Comparator Threshold	20.5	25	29.5	mV
$V_{SENSE(ACL)}$	SENSE*n* Voltage at Active Current Limit	V_{FBn}=0V V_{FBn}=0.65V	4 20.5	9 25	16 29.5	mV mV
$I_{GATE(UP)}$	GATEn Output Current	V_{ON1}= V_{ON1}=2V, V_{GATEn}=0V	-7	-9.5	-120	uA
$I_{GATE(DN)}$	GATEn Output Current	V_{ON1}= V_{ON1}=0.6V, V_{GATEn}=3.3V	75	100	125	uA
$I_{GATE(FSTDN)}$	GATEn Output Current	UNLO with V_{GATEn}=3.3V or FAULT latched with V_{GATEn}=3.3V		16		mA
ΔV_{GATE}	External N-Channel Gate Drive	V_{GATEn}-V_{CC1} for V_{CC1}=2.7V, V_{CC2}=1V V_{GATEn}-V_{CC1} for V_{CC1}=3.3V, V_{CC2}=2.5V	4.5 5		13 16	V V

PERFORMANCE SUMMARY **Specifications are at TA = 25°C**

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
		V_{GATEn}-V_{CC1} for V_{CC1}=5.0V, V_{CC2}=3.3V V_{GATEn}-V_{CC1} for V_{CC1}=12V, V_{CC2}=12V	8 7		16 18	V V
$V_{ON(OFF)}$	ON*n* Off Threshold	High to Low , GATE*n* Turns Off by 100uA Pull-Down	0.796	0.821	0.846	V
$\Delta V_{ON(OFFHYST)}$	ON*n* Off Threshold Hysteresis			30		mV
$V_{ON(RESET)}$	ON1 Reset Threshold	V_{ON1} Falling	0.375	0.4	0.425	V
$\Delta V_{ON(RESETHYST)}$	ON1 Reset Threshold Hysteresis			25		mV
$V_{FB(UV)}$	FB*n* Undervoltage Threshold	FB*n* Falling	0.605	0.617	0.629	V
$V_{FB(OV)}$	FB*n* Overvoltage Threshold	FB*n* Rising	0.805	0.822	0.838	V
$I_{FILTER\ (UP)}$	FILTER Pull-Up Current	During Current Fault Condition	-80	-105	-132	µA
$I_{FILTER\ (DN)}$	FILTER Pull-Down Current	During Normal Cycle	1.15	1.8	2.45	µA
$V_{FILTER(TH)}$	FILTER Threshold	Latched Off Threshold, FILTER Rising	1.18	1.24	1.30	V
$\Delta V_{FILTER(HYST)}$	FILTER Threshold Hysteresis			105		mV
$I_{TMR(UP1)}$	TIMER Pull-Up Current 1	Initial Timing Cycle	-1.2	1.9	-2.6	µA
$I_{TMR(UP2)}$	TIMER Pull-Up Current 2	Start-Up cycle	-15	-20	-25	µA
$I_{TMR(FSTDN)}$	TIMER Pull-Down Current	V_{TMR} =1.5V, End of Initial Timing Cycle		9		mA
$V_{TMR(H)}$	TIMER High Threshold	TMER Rising	1.172	1.234	1.27	V
$V_{TMR(L)}$	TIMER Low Threshold	TIMER Falling	0.1	0.4	0.5	V

OPERATING PRINCIPLES

The LTC4221 controls two rails with external N-channel MOSFETs.

Two independent ON*n* comparators allow ramping rails up and down separately or simultaneously.

Each channel has two current limit comparators that provide dual level and dual speed overcurrent circuit breaker protection after the start-up period. If any current sense voltage exceeds 100mV for 1us or 25mV for the timeout delay, then the FAULT latch is set and both GATE pins are pulled low.

The LTC4221 is suited for low voltage applications such as a hot board insertion and removal and has a rich set of features to support hot swap application including:

- Overvoltage protection
- FAULT latch setting and resetting and fault state indication
- Adjustable Inrush Current Control
- Adjustable duration for Current Limit before switch is turned off
- Power-good signaling

QUICK START PROCEDURE

Demonstration circuit 1355 is easy to set up to evaluate the performance of the LTC4221. Refer to Figure 1. for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the initial position:

JP1 (ON2) Off

JP2 (ON1) Off

JP3 (AUTO RETRY) NO

JP4 (FAULT SIGNAL) NO

2. Adjust +12V supply output voltage between 10.6V and 13.0V. Connect +12V power supply to the +12V INPUT and GND turrets and turn it on. Green LED +12V INPUT (D2) should light.

3. Adjust +3.3V supply output voltage between 2.89V and 3.67V. Connect +3.3V power supply to the +3.3V INPUT and GND turrets and turn it on. Green LED +3.3V INPUT (D6) should light.

4. Place jumpers JP1 and JP2 in the ON positions. Two amber LEDs, PWRGD1 and PWRGD2, should light.

5. Connect electronic or resistive loads to the +12V and +3.3V output turrets.

6. Activate both loads with lower than 1A for each rail. Increase load current, use a current probe or meter and verify circuit breaker threshold level. For the +12V circuit it should be between 5A and 7.5A, for the +3.3V circuit, between 2.5A and 3.8A. After an overcurrent fault associated power good LED D3 or D4 will be off. To reset FAULT latch turn +12V supply off and then on.

7. Remove the loads. Turn both +12V and +3.3V rails off by placing JP1 and JP2 in the OFF position. Load the +12V output with a 1500uF capacitor and return jumper headers of the JP1 and JP2 to the ON position. Turn the +3.3V rail on first and then the +12V rail. Both rails should be on.

8. Repeat step 7 with a 6000uF capacitor. In this case only the +3.3V rail comes up, but +12V fails.

9. Place the JP3 (AUTO RETRY) in the YES position. Use a current probe to display the +12V rail current and scope probes to display +12V and +3.3V output voltages. Activate both channels and overload +12V rail. The transient should be similar to that shown in Figure 2.

10. Place JP4 (FAULT SIGNAL) in the YES position and control FAULT pin signal on the FAULT turret. Activate both channels with no load. Slowly increase the +12V supply output (not higher than 16V). Overvoltage protection should disable both channels when the output voltage is in a range from 13.6V to 15.0V and FAULT turret signal drops to low.

11. Activate both channels with no load. Slowly decrease +12V supply output. The PWRGD1 LED goes off when output is in the range of 10.4V to 11.3V.

12. Place JP4 (FAULT SIGNAL) in the YES position and control FAULT pin signal on the FAULT turret. Activate both channels with no load. Slowly increase +3.3V supply output (not higher than 16V). Overvoltage protection should disable both channels, when the output voltage is in the range of 3.7V to 3.9V and FAULT turret signal drops to low.

13. Activate both channels with no load. Slowly decrease +3.3V supply output. The PWRGD2 LED goes off when output is in a range from 2.76V to 3.0V.

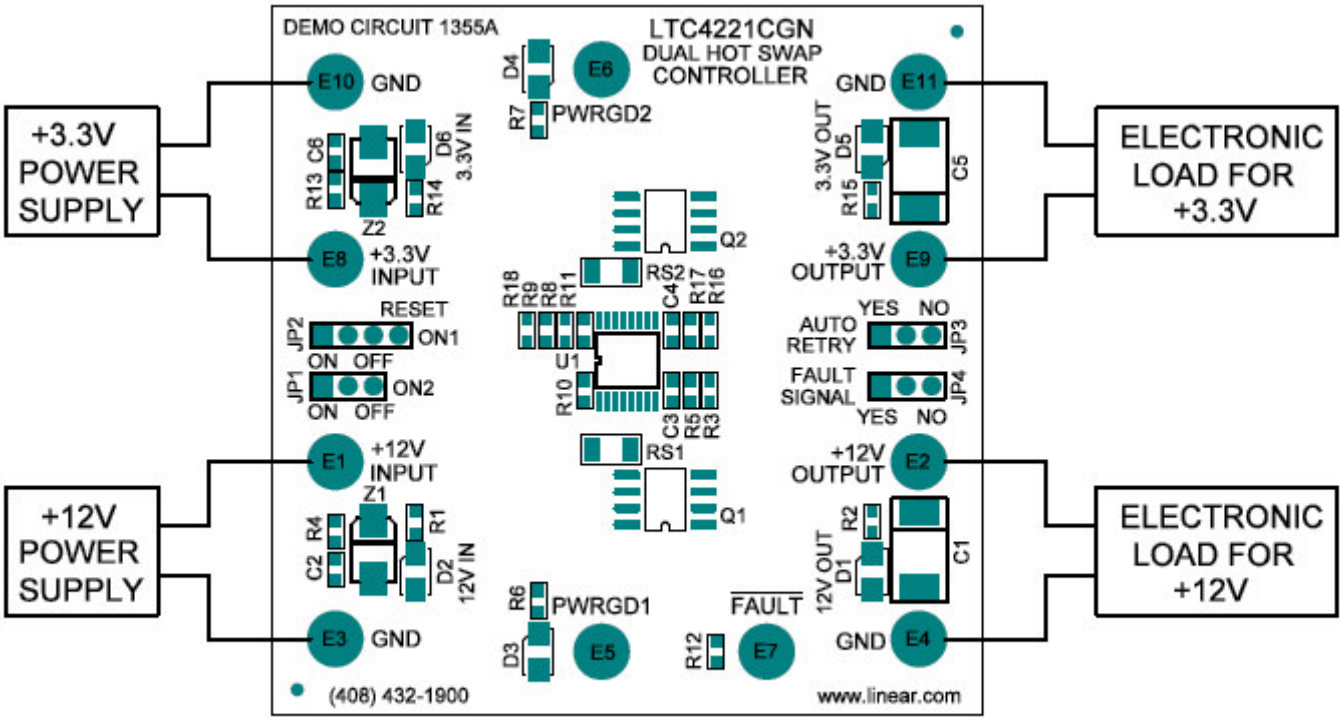
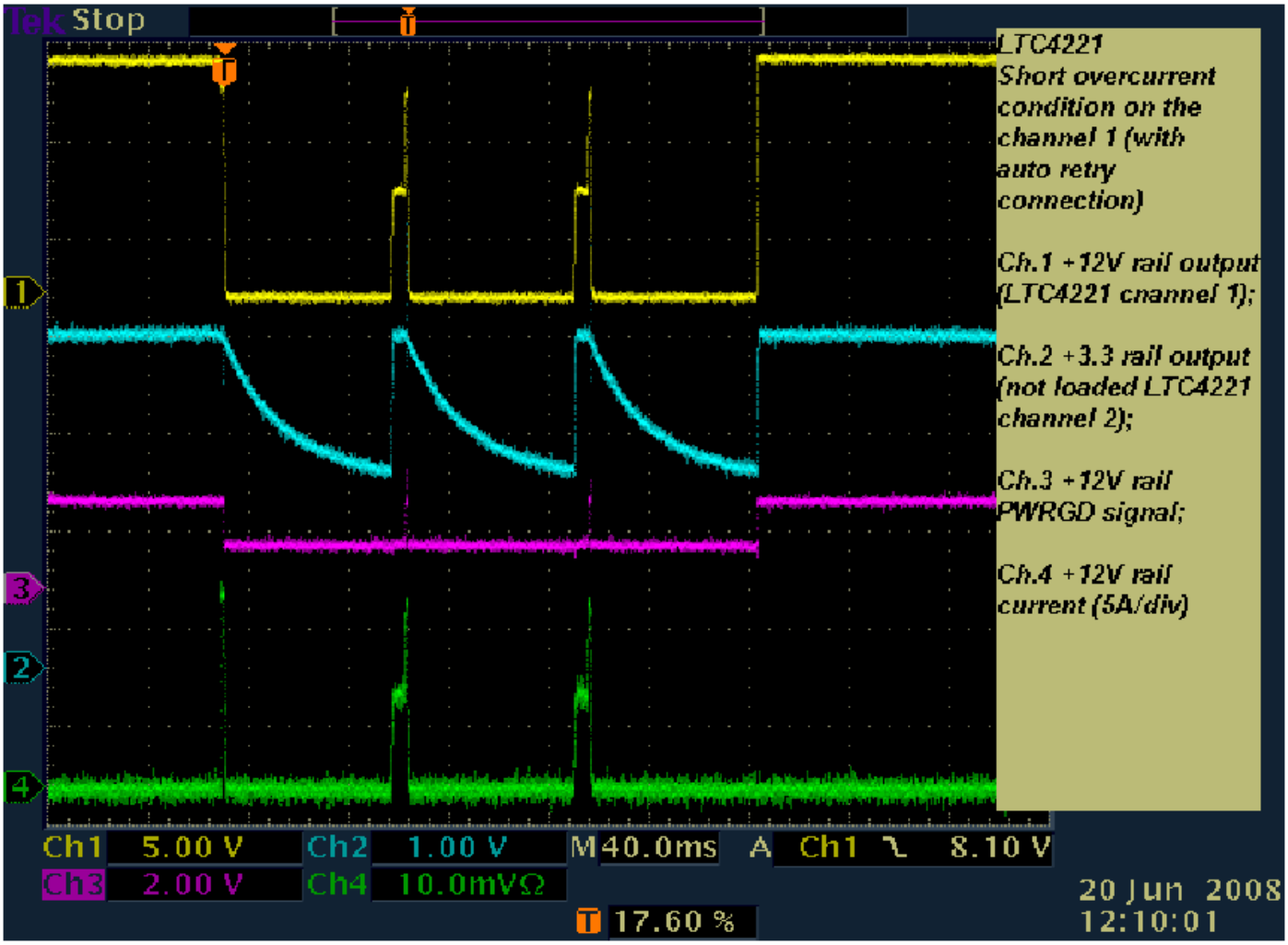
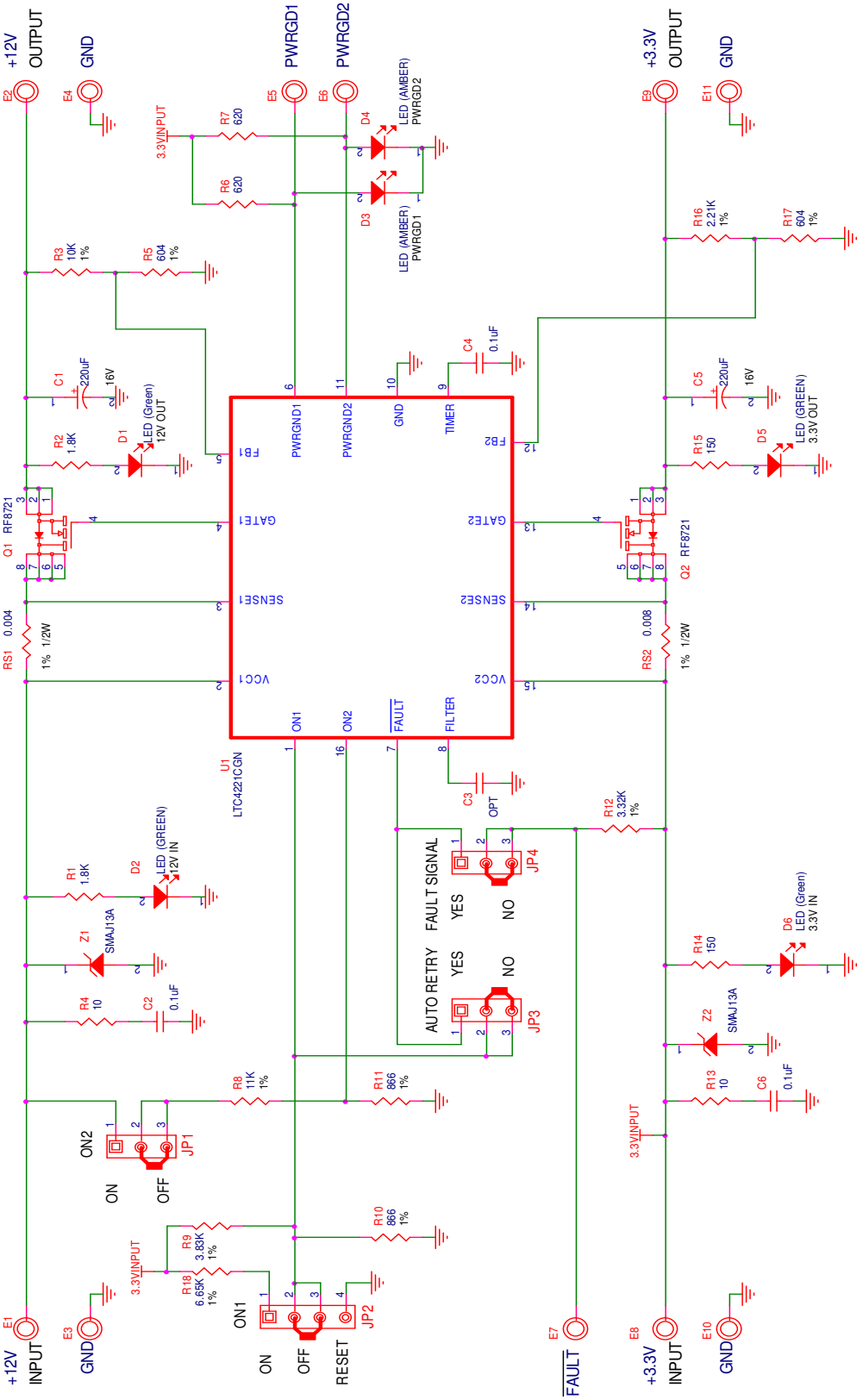

DEMO CIRCUIT 1355A
LTC4221CGN
DUAL HOT SWAP
CONTROLLER
+3.3V
POWER
SUPPLY
+12V
POWER
SUPPLY
ELECTRONIC
LOAD FOR
+3.3V
ELECTRONIC
LOAD FOR
+12V
E10 GND
E8 +3.3V
INPUT
E1 +12V
INPUT
E3 GND
GND E11
+3.3V
OUTPUT E9
+12V
OUTPUT E2
GND E4
E6
E5
E7
PWRGD2
PWRGD1
FAULT
RESET
ON1
ON2
ON OFF
AUTO
RETRY
FAULT
SIGNAL
YES NO
3.3V IN
12V IN
3.3V OUT
12V OUT
Z1
Z2
RS1
RS2
Q1
Q2
U1
(408) 432-1900
www.linear.com

Figure 1.

Figure 2.


Tek Stop
LTC4221
Short overcurrent condition on the channel 1 (with auto retry connection)
Ch.1 +12V rail output (LTC4221 channel 1);
Ch.2 +3.3 rail output (not loaded LTC4221 channel 2);
Ch.3 +12V rail PWRGD signal;
Ch.4 +12V rail current (5A/div)
Ch1 5.00 V
Ch2 1.00 V
M 40.0ms
A Ch1 8.10 V
Ch3 2.00 V
Ch4 10.0mVΩ
17.60 %
20 Jun 2008
12:10:01


+12V INPUT
GND
+12V OUTPUT
GND
PWRGD1
PWRGD2
+3.3V INPUT
GND
+3.3V OUTPUT
GND
FAULT
3.3VINPUT
LED (AMBER) PWRGD1
LED (AMBER) PWRGD2
LED (Green) 12V OUT
LED (GREEN) 12V IN
LED (GREEN) 3.3V OUT
LED (Green) 3.3V IN
RF8721
SMAJ13A
LTC4221CGN
FAULT SIGNAL
AUTO RETRY
ON2
ON1
ON
OFF
RESET
YES
NO
OPT
FB1
PWRGND1
PWRGND2
GND
TIMER
FB2
GATE1
GATE2
SENSE1
SENSE2
VCC1
VCC2
ON1
ON2
FAULT
FILTER

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