

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.

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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} ≤ 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)}	GATE _n Output Current	V _{ON1} = V _{ON1} =2V, V _{GATEn} =0V	-7	-9.5	-120	uA
I _{GATE(DN)}	GATE _n Output Current	V _{ON1} = V _{ON1} =0.6V, V _{GATEn} =3.3V	75	100	125	uA
I _{GATE(FSTDN)}	GATE _n Output Current	UNLO with V _{GATEn} =3.3V or FAULT latched with V _{GATEn} =3.3V		16		mA
Δ V _{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 $V_{CC1}=5.0V$, $V_{CC2}=3.3V$	8		16	V
		$V_{GATEn}-V_{CC1}$ for $V_{CC1}=12V$, $V_{CC2}=12V$	7		18	V
$V_{ON(OFF)}$	ONn Off Threshold	High to Low, GATEn Turns Off by 100 μ A Pull-Down	0.796	0.821	0.846	V
$\Delta V_{ON(OFFHYST)}$	ONn 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
$V_{FB(UV)}$	FBn Undervoltage Threshold	FBn Falling	0.605	0.617	0.629	V
$V_{FB(OV)}$	FBn Overvoltage Threshold	FBn Rising	0.805	0.822	0.838	V
$I_{FILTER(UP)}$	FILTER Pull-Up Current	During Current Fault Condition	-80	-105	-132	μ A
$I_{FILTER(DN)}$	FILTER Pull-Down Current	During Normal Cycle	1.15	1.8	2.45	μ A
$V_{FILTER(TH)}$	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	μ A
$I_{TMR(UP2)}$	TIMER Pull-Up Current 2	Start-Up cycle	-15	-20	-25	μ A
$I_{TMR(FSTDN)}$	TIMER Pull-Down Current	$V_{TMR}=1.5V$, End of Initial Timing Cycle		9		mA
$V_{TMR(H)}$	TIMER High Threshold	TIMER 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 ONn 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 1 μ s 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.

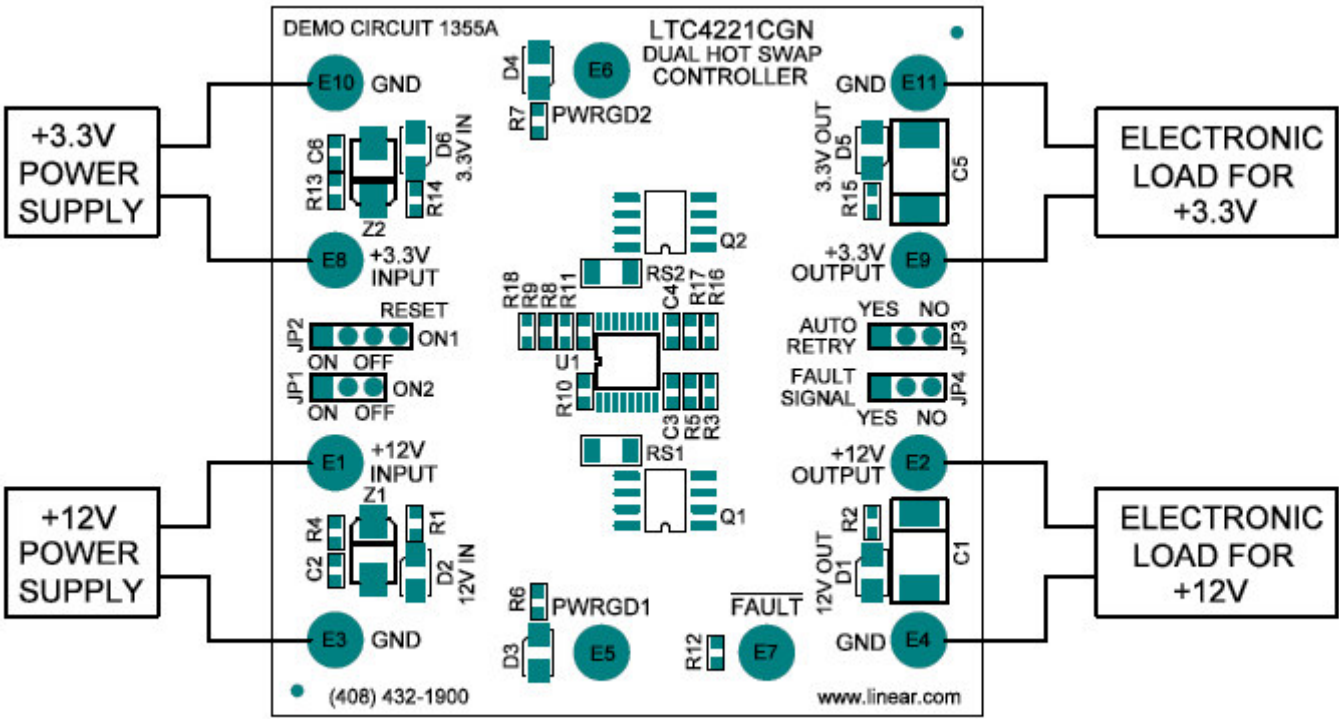
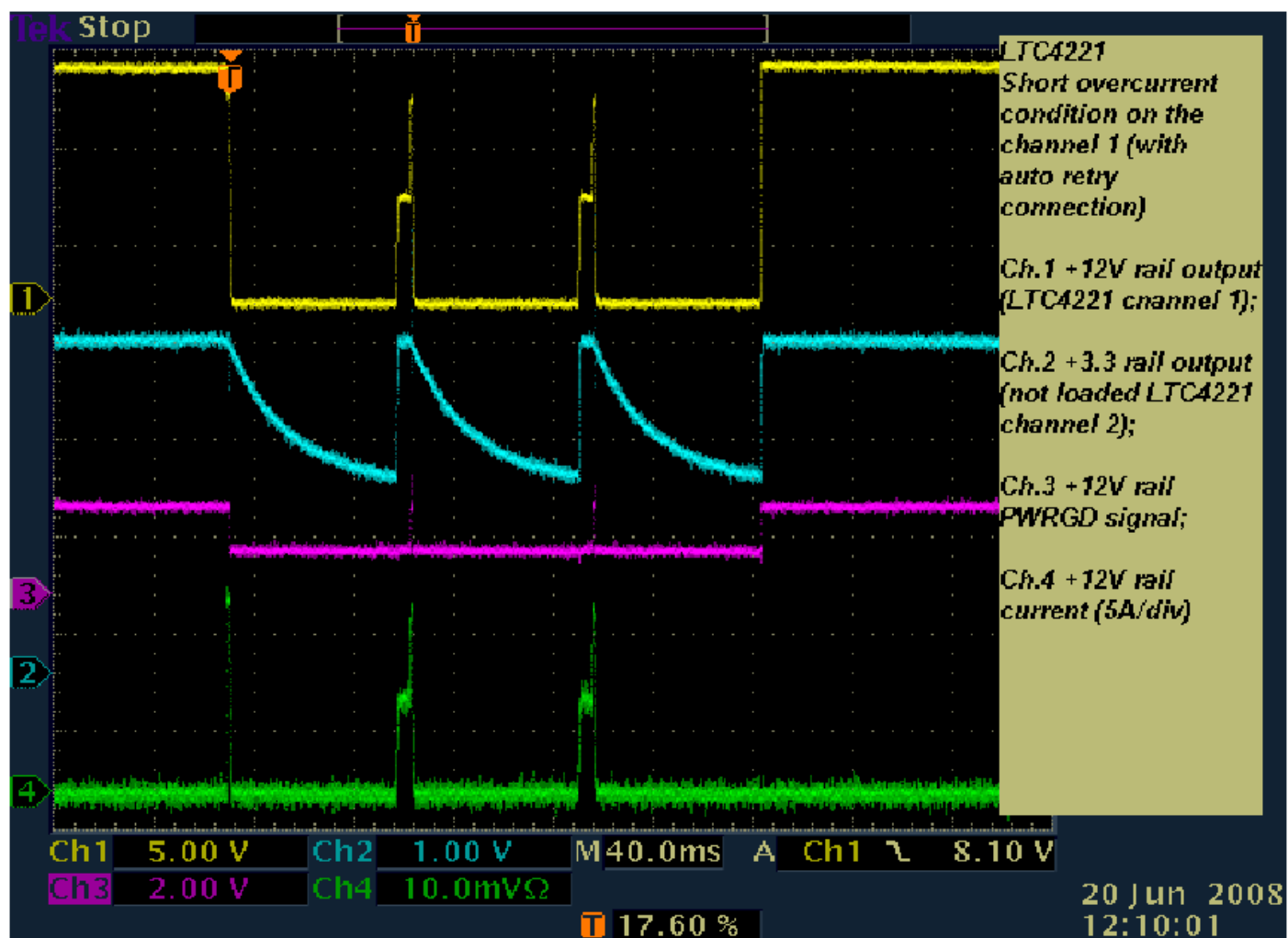


Figure 1.

Figure 2.





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