LTC4421
Dual Channel Prioritized Powerpath Controller

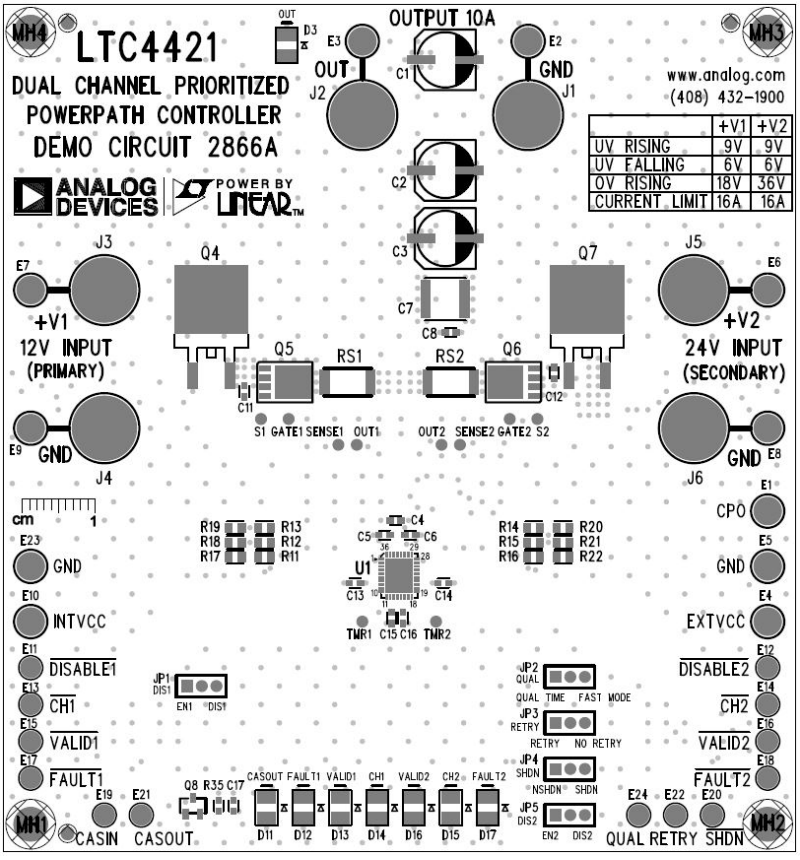
DESCRIPTION

Demonstration circuit 2866A features the LTC®4421 Dual Supply High Power Prioritized Powerpath™ Controller in a 12V/24V, 10A application. The LTC4421 incorporates strong gate drivers to switch large external N-channel MOSFETs and fast switchover circuitry to minimize V_{OUT} droop while preventing reverse and cross conduction currents, making it an ideal solution for high reliability systems, battery back up systems, and servers. DC2866A arbitrates between two input supply rails, selecting the highest priority, valid supply to power the load. By definition, the supply connected to V1 is the higher priority supply, although it can be changed dynamically. External resistive dividers set the undervoltage and overvoltage thresholds that bound the valid voltage window. External sense resistors set the limit on maximum current that can flow to the load. Two or more DC2866As can be cascaded to provide switchover between more than two rails.

Design files for this circuit board are available.

Overview

The LTC4421 controls two sets of external back-to-back N-channel MOSFETs to connect the proper rail to the load. Precision comparators are used to monitor each of the two input rails for both UV and OV conditions. The highest priority supply whose voltage is within its respective OV/UV window for time t_{VALID} set by the QUAL pin is considered valid and connected to the load. A low signal on $\overline{VALID1}$ and $\overline{VALID2}$ pins indicates that the voltage on



DESCRIPTION

V1 and V2 is within their valid voltage range, respectively. A low signal on $\overline{CH1}$ or $\overline{CH2}$ indicates whether V_{OUT} is getting powered by V1 or V2. A low signal on $\overline{FAULT1}$ or $\overline{FAULT2}$ pins indicates if V1 or V2 is in current limit.

The LTC4421 is a low voltage high current power path prioritizer that has a 2.7V to 36V operating range and absolute maximum voltage rating of 60V on V1 and V2 pins. This device has a 25mV current limit voltage threshold.

DC2866A is designed to operate from inputs 12V and 24V applied to V1 and V2 respectively. V1 is the highest priority supply and V2 is the lower priority supply. A sense resistor of 1.5mOhm in each power path channel sets the power path current limit to 16A.

LEDs are included to provide visual information about the operating status. LEDs are powered from the higher of V1 or V2.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX
V1 Valid Operating Voltage		9V	12V	18V
V2 Valid Operating Voltage		9V	24V	36V
V1, V2 Absolute Maximum Voltage				40V
V1, V2 Output Current				10A
Input Voltage Qualification Time	JP2 at QUAL TIME		8ms	
	JP2 at FAST MODE		3.5µs	

Voltage and Current Capability

The voltage capability of DC2866A is clearly stated on the top side silk screen and on the schematic. The demo circuit is populated for 12V/10A operation on V1 power supply power path and 24V/10A operation on V2 power supply power path. Operating voltage range of channel 1 and channel 2 is clearly stated on the top side silk screen. Operating voltage range for any channel can be easily changed by changing the R11-R13, R17-R19 resistors for the power supply connected to V1 and R14-R16, R20-R22 resistors for the power supply connected to V2. Current limit of V1 input and V2 input can be adjusted by changing the RS1 and RS2 resistors respectively.

Overcurrent

LTC4421 monitors the channel current using the voltage difference between SENSE and OUT pin. The current limit amplifier and gate driver work together to limit the current in the load by regulating the voltage of the external MOSFET in an active control loop. The SENSE to OUT voltage is regulated to 25mV.

DC2866A is populated for a maximum load current of 10A. If the load current in any channel exceeds 16A, the current sense amplifier regulates the gate drive to keep the current at 16A. It also starts the current limit fault timer which is set by a capacitor on TMR pin. DC2866A is populated for a current limit fault timer of 8ms on channel 1 and 1.8ms on channel 2. When a channel is in current limit, its FAULT LED turns on indicating that the channel is in current limit. If a channel stays in current limit longer than the current limit fault timer, LTC4421 disconnects that channel. If jumper JP3 is installed at RETRY position, LTC4421 will go through a cool down period which is 1024 times longer than the time out period. It will then attempt to reconnect the channel up to 6 additional times after the fault event.

PERFORMANCE SUMMARY

Shutdown

LTC4421 has one common control pin: $\overline{\text{SHDN}}$. Pulling this pin below 1V turns off all the external back-to-back N-channel MOSFETs. When $\overline{\text{SHDN}}$ is pulled low, the quiescent current of the device drops to 6µA. When this pin is driven above 1V, the highest priority valid and enabled channel is connected to the load. All these actions reset the QUAL timer.

EXTERNAL CONNECTIONS

V1 (1 Turret, 1 Banana Jack): 12V Primary Supply Input; This supply is the higher priority supply. Do not exceed 40V.

V2 (1 Turret, 1 Banana Jack): 24V Secondary Supply Input; This supply is the lower priority supply. Do not exceed 40V.

OUT (1 Turret, 1 Banana Jack): Output voltage connection of the LTC4421 circuit. Valid higher priority supply voltage will show up here. A maximum of 10A current can be drawn from here.

GND (5 Turrets, 3 Banana Jacks): These connections are made directly to ground plane.

INTVCC (1 Turret): Internal Low Voltage Supply Decoupling Output. An LTC4421 internal LDO generates a 4V rail to power the pull ups on various pins.

$\overline{\text{DISABLE1}}$, $\overline{\text{CH1}}$, $\overline{\text{VALID1}}$, $\overline{\text{FAULT1}}$, $\overline{\text{FAULT2}}$, $\overline{\text{VALID2}}$, $\overline{\text{CH2}}$, $\overline{\text{DISABLE2}}$, $\overline{\text{SHDN}}$, $\overline{\text{QUAL}}$, $\overline{\text{RETRY}}$ (1 Turret each): Pulled up with 100kOhm to INTVCC.

CASIN (1 Turret): Digital Input for Cascading. Connect to the CASOUT turret of another high priority DC2866A when cascading.

CASOUT (1 Turret): Digital Output for Cascading. Connect to the CASIN turret of another low priority DC2866A when cascading.

EXTVCC (1 Turret): External High Priority Supply Input. Connect a supply greater than 2.45V to power the chip from this turret. If V1 and V2 goes below 2.7V, LTC4421 will be powered by EXTVCC.

CPO (1 Turret): Charge Pump Output. This is the output of the charge pump which is used to provide overdrive to the GATE pins.

JUMPERS

JP1, DIS1: Disables channel 1. When JP1 is installed at DIS1, channel 1 will not be able to power the output load even if it is within the valid voltage window. Keep this jumper installed at EN1 to allow channel 1 to power the output load.

JP2, QUAL: Controls the qualification time for channel validity. When JP2 is installed at QUAL TIME, validation time for a channel is 8ms. When JP2 is installed at FAST MODE, validation time for a channel is 3.5µs.

JP3, RETRY: When JP3 is installed at RETRY, after an overcurrent fault event, LTC4421 attempts to reconnect the input to the output up to 6 additional times, waiting for a cool down period between each reconnection. When JP3 is installed at NO RETRY, after an overcurrent fault event, LTC4421 does not attempt to reconnect the input to the output.

JP4, SHDN: When installed at NSHDN, LTC4421 works normally. When installed at SHDN, LTC4421 goes into a low current shutdown mode and switches off the external MOSFETs.

JP5, DIS2: Disables channel 2. When JP5 is installed at DIS2, channel 2 will not be able to power the output load even if it is within the valid voltage window. Keep this jumper installed at EN2 to allow channel 2 to power the output load.

LEDS

D3, OUT: Indicates that the output is powered.

D11, CASOUT: Indicates that the cascaded lower priority power supplies are not yet enabled to power the load.

D12, FAULT1: Indicates if channel 1 is in an overcurrent event or in a cool down cycle following an overcurrent event.

D13, VALID1: Indicates if channel 1 is within its valid voltage window.

D14, CH1: Indicates that power is being taken from V1.

D15, CH2: Indicates that power is being taken from V2.

D16, VALID2: Indicates if channel 2 is within its valid voltage window.

D17, FAULT2: Indicates if channel 2 is in an overcurrent event or in a cool down cycle following an overcurrent event.

QUICK START PROCEDURE

Demonstration circuit 2866A is easy to set up to evaluate the performance of the LTC4421. Refer to Figure 1 for proper measurement equipment set up and follow the procedure below.

1. Set the jumpers as below to disable LTC4421:

JUMPER	POSITION
JP1	DIS1
JP2	QUAL TIME
JP3	RETRY
JP4	SHDN
JP5	DIS2

2. With all power off, connect input 1 and 2 (+V1 and +V2) power supplies capable of at least 16A each, the load, and meter as shown in Figure 1.

3. Set the system loads to 0A and input supplies to 0V, 0A current limit.

4. Turn on the supplies, setting their current limit above 10A. Adjust the voltage V1 = 12V and V2 = 24V. These voltages can be adjusted to a desired value within the valid window of the supply. Following are the OV/UV levels for the power supplies.

Parameter	V1	V2
Undervoltage	9V	9V
Overvoltage	18V	36V

5. Change the position of the JP4 jumper from SHDN to NSHDN. This will bring LTC4421 out of shutdown. Doing so, $\overline{\text{VALID1}}$, $\overline{\text{VALID2}}$, and CASOUT LEDs will light up.

6. Change the position of JP5 jumper from DIS2 to EN2. Doing so, CH2 LED will light up indicating that the load is being provided by V2.

7. Increase the load current beyond 16A. Once load current crosses 16A, CH2 will hit current limit which will disconnect CH2 from the output and light up $\overline{\text{FAULT2}}$ LED. This demonstrates the current limit feature of LTC4421 for V2 supply

8. Lower the load current below 10A. $\overline{\text{FAULT2}}$ LED will turn off. V2 will reconnect to the output and CH2 LED will turn on

9. Change the position of the JP1 jumper from DIS1 to EN1. This will enable channel 1. Since channel 1 is the highest priority channel, even though V2 is at much higher voltage level than V1, V1 will start to provide the current to the output load. Output voltage will drop from V2 to V1. CH1 LED will light up and CH2 LED will go off. This demonstrates the prioritizer feature of LTC4421.

10. Increase the load current beyond 16A. Once load current crosses 16A, CH1 will hit current limit which will disconnect CH1 from the output and light up $\overline{\text{FAULT1}}$ LED. This demonstrates the current limit feature of LTC4421 for V1 supply.

QUICK START PROCEDURE

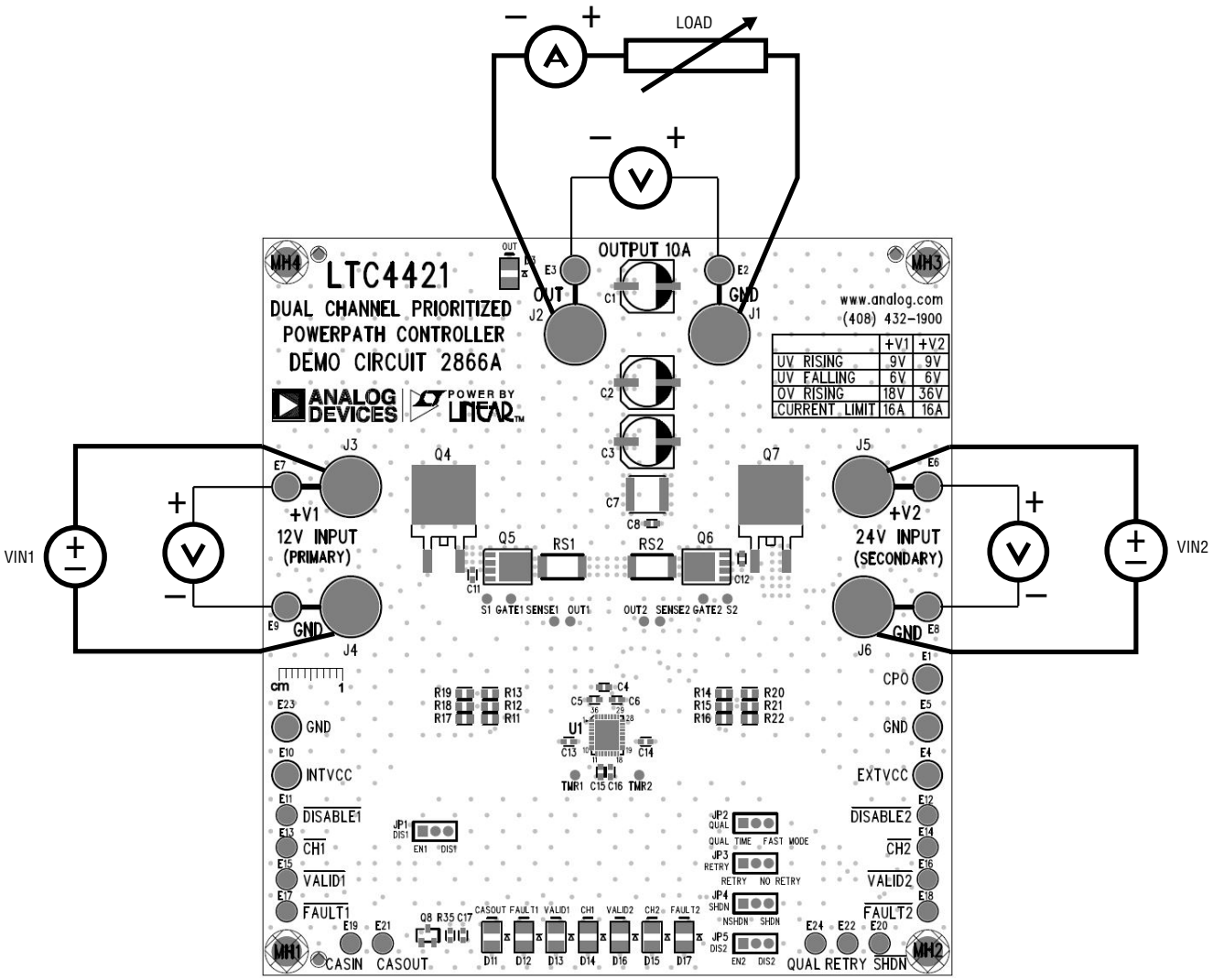


Figure 1. Proper Measurement Equipment Setup

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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