

LTC4420

18V Dual Input Micropower PowerPath Prioritizer with Backup Supply Monitoring

DESCRIPTION

Demonstration circuit DC2208A uses the **LTC®4420** to provide backup switchover, keeping the output load powered during brownout or power loss conditions. Priority is assigned by supply connection to the V1 and V2 inputs. The power source connected to the V1 input has a higher priority, and it is monitored continuously by adjustable comparator (ADJ) with the proper threshold arranged by an external resistive divider. If the input voltage V1 exceeds 1.55V (1.8V worst case) and the ADJ pin is above 1.097V for at least 64ms after V1 has powered up, and then stays above 1.047V, V1 is considered valid, and the LTC4420 connects V1 to load (OUT pin). If V1 drops below 1.52V, or the ADJ pin voltage is lower than 1.047V, V1 is considered invalid, and LTC4420 switches V2 to load, if the $\overline{V2DIS}$ pin voltage is above 0.9V. If the $\overline{V2DIS}$ pin voltage is below 0.2V, V2 to load connection is activated only if V2UV is >0.387V.

The DC2208A is populated to provide switchover when V1 is below 9.92V $\pm$ 0.32V. The upper limit for V1 is the maximum operating voltage of 18V; recommended V1 voltage is 12V. The resistive divider of the auxiliary comparator CMP1, R1–R2, is adjusted to trigger the comparator when VCM1_TOP turret voltage is in the range 9.82V to 10.69V.

The second rail, V2, is monitoring periodically through the external resistive divider R6, R7 and the V2UV_TEST jumper head in the ON position. The bottom resistor of this divider, R7, is periodically connected to GND through open-drain output GNDSW. V2UV undervoltage range on

the DC2208A is 3.26V to 3.53V. If $\overline{V2DIS}$ is connected to GND, V2UV_TEST is ON, and V2 drops below the undervoltage level, the LTC4420 disconnects OUT from V2.

If the bottom resistor of the divider, R7, is connected to GND, V2 is not monitored for undervoltage condition and the load can be powered by any voltage from 1.8V to 18V.

Recommended V2 voltage is 5V.

The LTC4420's internal overcurrent (0.5A to 1.6A) and thermal protection circuitry allow safe prioritization in critical operation modes. Overtemperature protection terminates prioritizer operation when the junction temperature exceeds 125°C.

Another inherent feature—reverse supply protection—protects the prioritizer input-output and load when negative voltage (up to –15V) is applied to any supply input, V1 or V2.

The LTC4420's break-before-make switching method prevents cross conduction between input channels during switchover; connection to any input occurs only if the input voltage exceeds the output by 50mV. This eliminates reverse current flow from the output into selected input supply.

Design files for this circuit board are available at <http://www.linear.com/demo/DC2208A>

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PERFORMANCE SUMMARY

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V1, V2	V1, V2, Operating Voltage Range		1.8		18	V
R _{ON}	Switch Resistance	V1 = V2 = 5V, I _{OUT} = –100mA	1	2	5	Ω
t _{VALID(V1)}	Input Qualification Time	V1 Rising, ADJ Rising	34	64	94	ms
V _{THA}	ADJ Threshold	ADJ Falling	1.032	1.047	1.062	V
V _{HYSTA}	ADJ Comparator Hysteresis	ADJ Rising	30	50	70	mV
V _{THC}	CMP1, V2UV Threshold	CMP1, V2UV Falling	0.378	0.387	0.396	V

dc2208af

DEMO MANUAL DC2208A

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{HYSTC}	Comparator CMP1, V2UV Hysteresis	CMP1, V2UV Rising	7.5	10	12.5	mV
I_{LIM}	Switch Current Limit	$V_1 = V_2 = 8.4\text{V}$	0.5	1.1	1.6	A
V_{REV}	Reverse Comparator Threshold	$(V_1, V_2) - V_{OUT}$ for PowerPath™ Turn-On	25	50	75	mV
t_{SWITCH}	Break-Before-Make Time	$V_1 = V_2 = 5\text{V}$, $I_{OUT} < 10\text{mA}$	1	2.5	5	μs
$V_1_{SWITCHOVER}$	Demo Board Switchover Voltage		9.6	9.92	10.24	V
V_1_{ALARM}	Demo Board V1 Alarmed Voltage		9.82	10.42	10.69	V
V_{2UV}	Demo Board V2UV Voltage		3.26	3.38	3.53	V
t_{TEST}	Time Between V2UV Monitoring Event	V2TEST	80	132	180	s

OVERVIEW

The DC2208A is intended to provide a particular prioritizer implementation.

The board includes the LTC4420, 18V dual input micro-power PowerPath prioritizer with backup supply monitoring (U1), LDO regulator with 2.5V output voltage (U2, LT1763) for powering LEDs and logic, dual inverter buffer (U3), three LEDs (D7–D9) for visual information, two jumpers (JP1, JP2) for selecting a power source for LDO and three jumpers (JP4–JP6) for setting monitoring parameters, push button (SW1) for enabling freshness seal mode, a few turrets for connecting the board to power sources, load and measuring instruments. Auxiliary components—LDO and logic—are placed on the bottom side.

The DC2208A design allows adjusting the operating voltage of each channel to any voltage within the full operating range.

Provision is made for increasing the hysteresis of the auxiliary comparator (marked in data sheet as CP1) by placing optional resistor R17.

Turrets

V1 (E1): 12V supply input; the voltage should not exceed +18V, and should not be lower than –15V.

V2 (E8): 5V supply input; the voltage should not exceed +18V, and should not be lower than –15V.

ADJ (E3): Adjustable comparator noninverting input for setting switchover threshold level.

VCMP1_TOP (E2): Input for voltage monitored by first auxiliary comparator CMP1.

V2UV (E7): Undervoltage comparator noninverting input.

VCMP2_TOP (E6): Noninverting input of the comparator V2UV for V2 undervoltage monitoring.

CMP1 (E4): Auxiliary comparator CMP1 noninverting input.

GND (E5 and E11): Common ground.

OUT (E9): Terminal for load connection (up to 0.5A).

LDO_EXT (E14): Positive terminal for external auxiliary 3.5V to 20V power supply.

V2P5V (E10): LDO output voltage terminal (2.5V).

GNDSW (E12): Pulsed GND Output.

Jumpers

LDO (JP1): ON/OFF switch for powering LDO.

LDO_POWER (JP2): Power supply selection for LDO.

V2UV_TEST (JP6): Selection of Monitoring Mode for V2.

V2DIS (JP4): V2 channel enable or disable.

V2TEST (JP5): Enable or disable V2 test.

LEDs

D7: Indicates LDO output voltage.

D8: Indicates first auxiliary comparator output stage (CMPOUT1 pin).

D9: Indicates that V2 is above undervoltage threshold in the monitoring mode.

QUICK START PROCEDURE

Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place JP1 in position ON and JP2 in position LDO_EXTER. Turn off all external switches SW1–SW4. Connect turrets ADJ and GND with external wire.
2. Adjust V1 supply output to 12.0V, V2 to 5V, and auxiliary power supply to 10V. Use 30Ω resistive load.
3. Turn all external switches SW1–SW4 on.
4. Place scope probes at the ADJ and OUT turrets. Disconnect the turrets ADJ and GND and measure the time between events when the ADJ pin voltage reaches 1.097V and when the output voltage starts to rise. The qualification time should be in the range 34ms to 94ms.
5. Turning SW1 off or decreasing V1 to 9V initiates switchover from V1 to V2. Turning SW1 back to on or increasing V1 above 10.5V initiates switchover from V2 to V1 with a qualification time delay.
6. Turn all external switches SW1–SW4 off again and connect turrets ADJ and GND with external wire. Use 5Ω resistive load. Place current probe to measure load current.
7. Turn all external switches SW1–SW4 on. Disconnect the turrets ADJ and GND and observe overcurrent transients with cooling period and thermal protection.
8. Disconnect V1 from the board (turn SW1 off) and verify that:
 - V2 is disconnected from load if V2 is lower than 3.5V in the V2UV_TEST mode (JP6 in ON position) and $\overline{V2DIS}$ is low (JP4 in ON position);
 - V2 is not disconnected from load if V2 is lower than 3.5V in the V2UV_TEST mode (JP6 in ON position) and $\overline{V2DIS}$ is high (JP4 in OFF position).

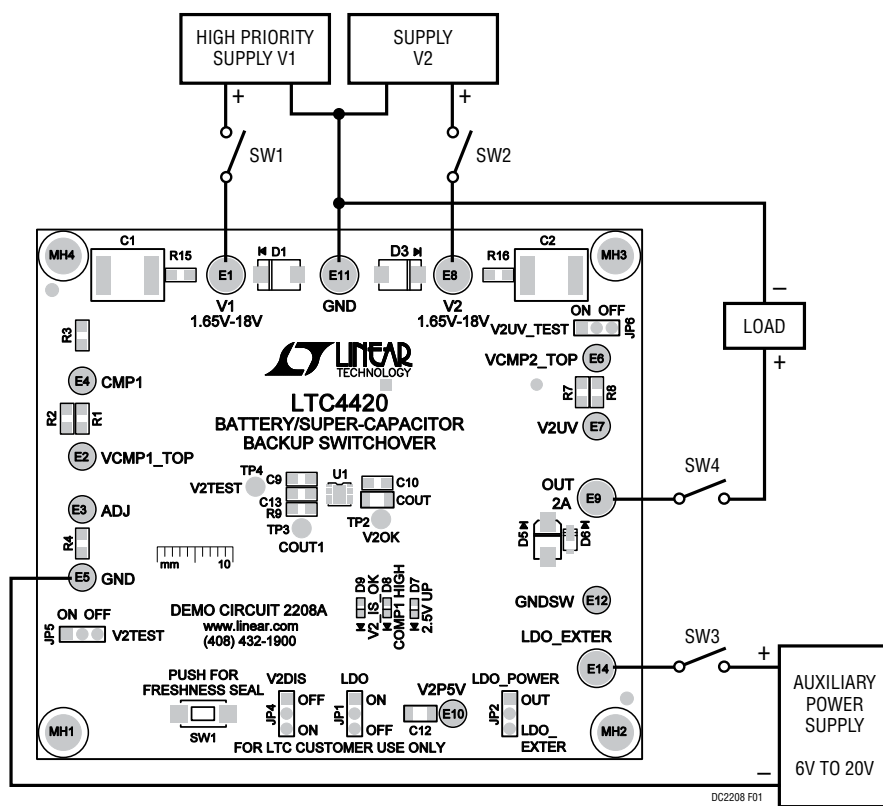


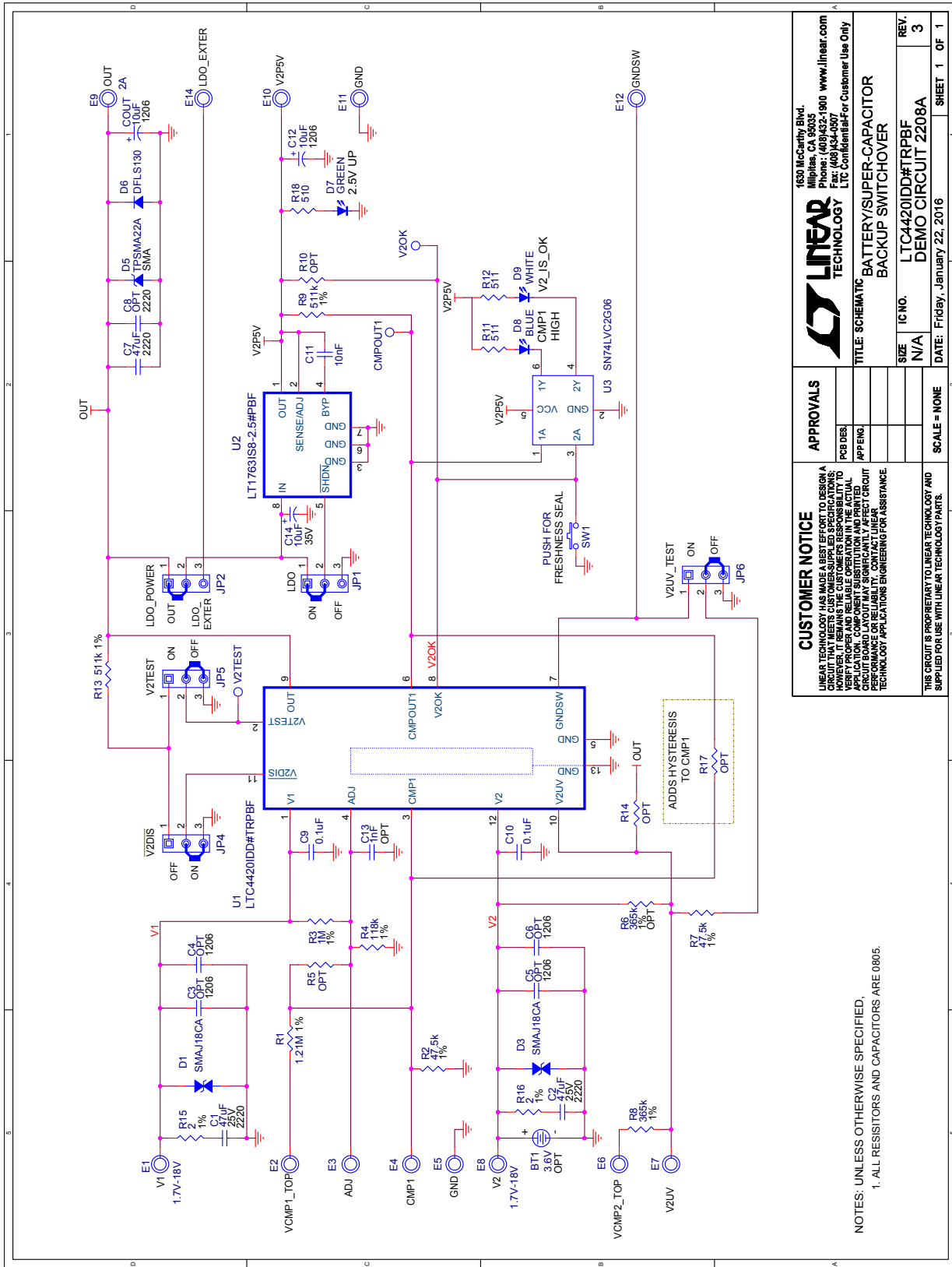
Figure 1. Proper Measurement Equipment Setup

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PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	0	BT1	HOLDER, BATTERY 20mm OPTION	KEYSTONE 1066 OPTION
2	2	C12, COUT	CAP, 1206 10 μ F 20% 25V TANT	AVX F951E106MAAAQ2
3	3	C1, C2, C7	CAP, 2220 47 μ F 20% 25V X5R	TDK CKG57NX5R1E476M500JH
4	0	C3, C4, C5, C6	CAP, 1206 22 μ F 20% 6.3V X5R OPTION	TAIYO YUDEN EMK316BJ226ML-T OPT
5	0	C8	CAP, 2220 OPTION	OPTION
6	2	C9, C10	CAP, 0805 0.1 μ F 10% 25V X5R	AVX 08053D104KAT2A
7	1	C11	CAP, 0805 10nF 10% 16V X7R	AVX 0805YC103KAT2A
8	1	C13	CAP, 0805 1nF 10% 50V X7R	AVX 08055C102KAT
9	1	C14	CAP, 7343 10 μ F 10% 35V TANT	AVX TPSD106K035R0300
10	2	D1, D3	DIODE, 600W TRANSIENT VOLTAGE SUPPRESSOR	DIODES INC. SMAJ18CA
11	1	D5	DIODE, 400W 22V TRANSIENT VOLTAGE SUPPRESSOR	VISHAY TPSMA22A
12	1	D6	DIODE, SCHOTTKY BARRIER RECTIFIER 30V 1.0A	DIODES INC. DFLS130-7
13	1	D7	LED, 0603 GREEN	WURTH ELEKTRONIK 150060GS75000
14	1	D8	LED, 0603 BLUE	WURTH ELEKTRONIK 150060BS75000
15	1	D9	LED, 0603 WHITE	PANASONIC LNJ026X8ARA1
16	5	E1, E8, E9, E11, E14	TURRET	MILL-MAX 2501-2-00-80-00-00-07-0
	8	E2, E3, E4, E5, E6, E7, E10, E12	TURRET	MILL MAX 2308-2-00-80-00-00-07-0
17	4	JP1, JP4, JP5, JP6	HEADER, 2mm, 3-PIN	SULLINS, NRPN031PAEN-RC
18	1	JP2	HEADER, 2mm, 3-PIN	SULLINS, NRPN031PAEN-RC
19	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON	KEYSTONE_8831
20	1	R1	RES, 0805 1.21M Ω 1% 1/8W	VISHAY CRCW08051M21FKEA
21	2	R2, R7	RES, 0805 47.5k Ω 1% 1/8W	VISHAY CRCW080547K5FKEA
22	1	R3	RES, 0805 1M Ω 1% 1/8W	VISHAY CRCW08051M00FKEA
23	1	R4	RES, 0805 118k Ω 1% 1/8W	VISHAY CRCW0805118KFKEA
24	0	R5	RES, 0805 69.8k Ω 1% 1/8W OPTION	VISHAY CRCW080569K8FKEA OPT
25	0	R6	RES, 0805 365k Ω 1% 1/8W OPTION	VISHAY CRCW0805365KFKEA OPT
26	1	R8	RES, 0805 365k Ω 1% 1/8W	VISHAY CRCW0805365KFKEA
27	2	R9, R13	RES, 0805 511k Ω 1% 1/8W	VISHAY CRCW0805511KFKEA
28	0	R10, R14	RES, 0805 511k Ω 1% 1/8W OPTION	VISHAY CRCW0805511KFKEA OPT
29	2	R11, R12	RES, 0805 511 Ω 1% 1/8W	VISHAY CRCW0805511RFKEA
30	2	R15, R16	RES, 0805 2 Ω 1% 1/8W	VISHAY CRCW08052R00FNEA
31	0	R17	RES, 0805 1M Ω 1% 1/8W OPTION	VISHAY CRCW08051M00FKEA OPT
32	1	R18	RES, 0805 510 Ω 5% 1/8W	VISHAY CRCW0805510RJNEA
33	1	SW1	SWITCH, MOMENTARY, PUSH BUTTON	WURTH 434 123 050 816
34	1	U1	IC, LTC4420IDD#TRPBF	LINEAR TECH LTC4420IDD#TRPBF
35	1	U2	IC, 500mA LOW NOISE LDO MICROPOWER REGULATOR	LINEAR TECH LT1763IS8-2.5#PBF
36	1	U3	IC, DUAL INVERTER BUFFER/DRIVER WITH OPEN-DRAIN OUTPUTS	TEXAS INSTRUMENTS SN74LVC2G06DCKR
37	5	XJP1, XJP2, XJP3, XJP4, XJP5		SAMTEC 2SN-BK-G

SCHEMATIC DIAGRAM



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TITLE: SCHEMATIC BATTERY/SUPER-CAPACITOR BACKUP SWITCHOVER		SIZE IC NO. N/A		REV. 3	
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		SCALE = NONE		DATE: Friday, January 22, 2016	
DEMO CIRCUIT 2208A		SHEET 1 OF 1			

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