LTC4231 Micropower Hot Swap Controller

DESCRIPTION

Demonstration circuit 2161A showcases the LTC®4231 Micropower Hot Swap™ Controller in a 12V, 3A application. Included on the board are input overvoltage and reverse voltage protection, input voltage dividers for UV and OV detection, an output voltage LED, jumpers to disable UV/OV, manual and remote enable control, and quiescent current measurement. There are turrets provided to monitor input voltage, output voltage, output status, quiescent current, several ground connections, timer pin, and control the ON pin. Input, output and return voltages are provided on banana jacks. The DC2161A-A version is used to demonstrate the LTC4231-1 which remains off after a current fault, while the DC2161A-B demonstrates the LTC4231-2 which automatically reapplies power after a cool-down period.

Design files for this circuit board are available at http://www.linear.com/demo/DC2161A

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PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

Table 1

PARAMETER	CONDITIONS	VALUE
Input Supply Voltage Range	Limited by Transient Surge Protector	–24V to +24V
Nominal Operating Voltage		12V
Overvoltage Lockout	Nominal	14.4V
Undervoltage Lockout (Voltage Falling)	Nominal	9.6V
Undervoltage Lockout (Voltage Rising)	Nominal	10.8V
Output Current Limit		3A
Maximum Load Capacitance		600µF
Timer Expiration Period		2ms

Table 2. Power Input and Output Connections

NOMENCLATURE	CONNECTOR	DESCRIPTION
VIN 12V	J1	12V Input
GND	J2	12V Input Return
VOUT 12V, 3A	J3	12V Output
GND	J4	12V Output Return

Table 3. Test Points

NOMENCLATURE	TURRET	DESCRIPTION
VIN 12V	E1	12V Input Monitor
GND	E2, E4, E6, E8	Ground
VOUT 12V, 3A	E3	12V Output Monitor
STATUS	E5	Status, Open Drain when Output Enabled
GND	E6	Ground
IQ	E7	Quiescent Current Monitor. Use Microammeter at This Point When JP2 Selects MEASURE IQ.
ON	E9	Enable LTC4231 Output. Enables Output or Selects External Control of Output
TIMER	E10	TIMER Pin

JUMPERS

DC2161A contains 3 jumpers. A description of each jumper follows.

JP1, UV/OV. This jumper selects whether or not undervoltage or overvoltage lockout is enabled. When the jumper is in the disable position, a UV or OV condition will not block operation of the Hot Swap Controller. The default is ENABLE.

JP2, IQ. The LTC4231 is a low power device, meaning it draws very little current to perform its function. Any board leakage on the GATE pin caused by board contamination or a defective MOSFET will cause this current to increase. JP2, when in the MEASURE IQ position, facilitates measurement of the quiescent current of the LTC4231 exclusive of the current of other components on the board, such as LED D2, output coupling capacitor C3, TVS diode D1, capacitor C1, voltage divider R6, R7, R8 and R9, or any leakage on the board. This current is measured via a microammeter connected between turret E7 and GND. If the MEASURE IQ position is selected, verify a microammeter is connected to prevent damage to the board via leakage between V_{IN} and the gate of the MOSFETs. The default position for JP2 is NORMAL.

JP3, ENABLE. This jumper either enables or disables the output or provides external control of the output. This is provided by the ON pin of the LTC4231. When in the ON position, the 12V V_{OUT} is enabled. When in the OFF position, the 12V V_{OUT} is disabled. When in the EXT position, the ON pin is connected via a 100kΩ resistor from turret E9 to the ON pin of the LTC4231. A logic 1 on this pin will enable the 12V V_{OUT}. The default position for JP3 is ON.

OPERATING PRINCIPLES

The LTC4231 is a Micropower Hot Swap Controller that has a 2.7V to 36V operating range and a –40V to 40V absolute maximum voltage for the IN pin. This demo circuit is populated for +12V operation, but it can easily be readjusted for any voltage between 2.7V and 36V by replacing R6, R7, R8, and R9 in the UVL, UVH, and OV divider string. These values should be selected using guidelines suggested in the LTC4231 data sheet to minimize current drain. The DC2161A is populated with a Si7960DP dual MOSFET with one section used as a pass MOSFET and the other section used for reverse voltage protection. It also has a 15mΩ sense resistor. This combination provides an output current of 3A. Pads are provided on the PCB for external MOSFET and sense resistor connections for other voltages and currents.

QUICK START PROCEDURE

DC2161A is easy to set up to evaluate the performance of the LTC4231.

Connect a power supply capable of delivering greater than 3.5A of current between 10V and 20V to the V_{IN} jack J1 with its return lead connected to GND J2. Monitor the input voltage at turrets E1 and E2. Place a voltmeter between turrets E3 and E4. Connect an ammeter between J3 and the test loads. Connect the return lead of the test loads to jack J4. The connections are shown schematically in Figure 1.

The active load should be set to provide a resistive load since the LTC4231 may not start into a constant current load. With the resistive load set at 5.4Ω, vary the input voltage from 9V to 17V and from 17V to 9V to check the UV and OV thresholds.

Set the input voltage to 12V, vary the load resistance, and observe output indicator D2. Determine from the ammeter that the output remains on at 3A (4Ω). The output should turn off at approximately 3.2A.

Reduce the load resistance to below 4Ω and observe an auto reset in the DC2161A-B. In the DC2161A-A, power will have to be removed and then applied to the input to reset the LTC4231.

Remove the resistive load from the output and replace it with a 500µF capacitor. Observe the polarity when connecting the capacitor. Upon application of input voltage, LED D2 should illuminate to indicate V_{OUT} is present. This indicates the Hot Swap Controller is capable of starting into a 500µF capacitor.

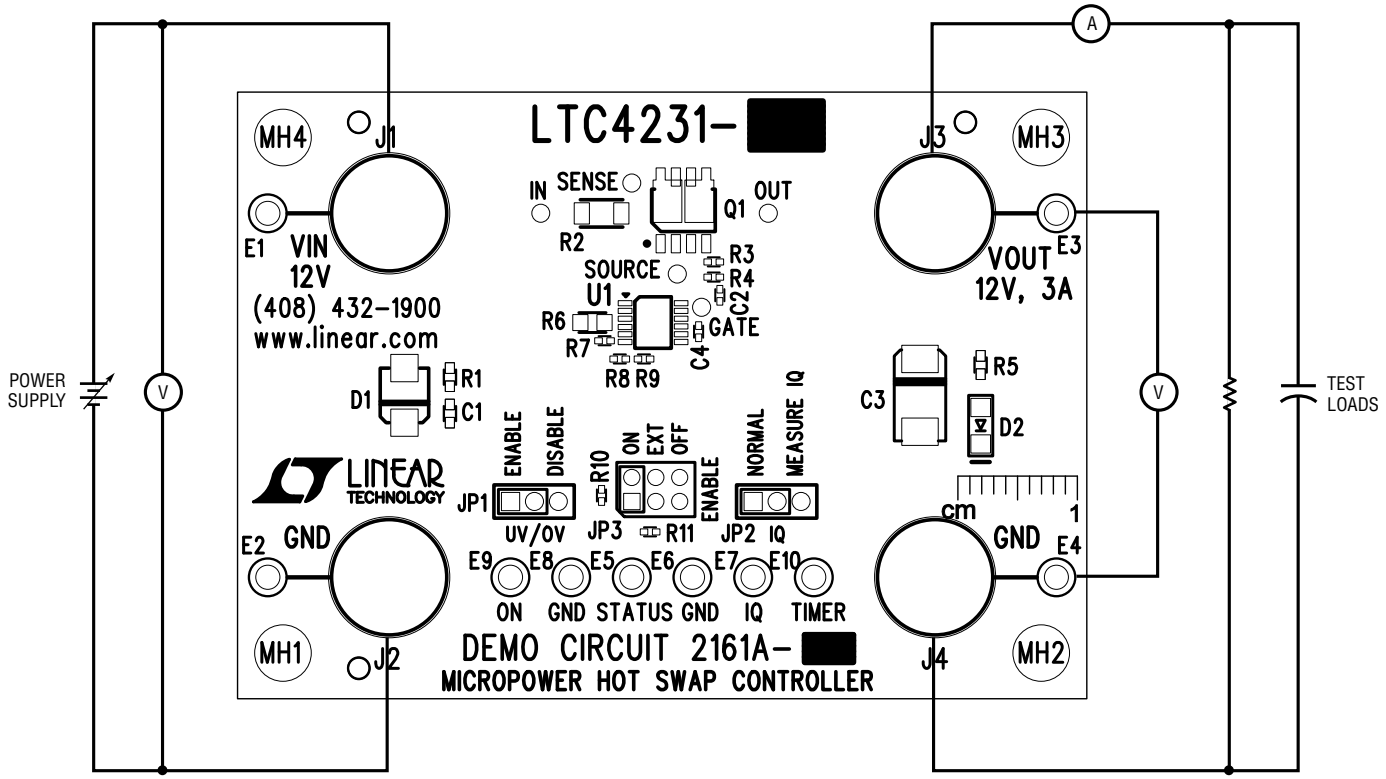
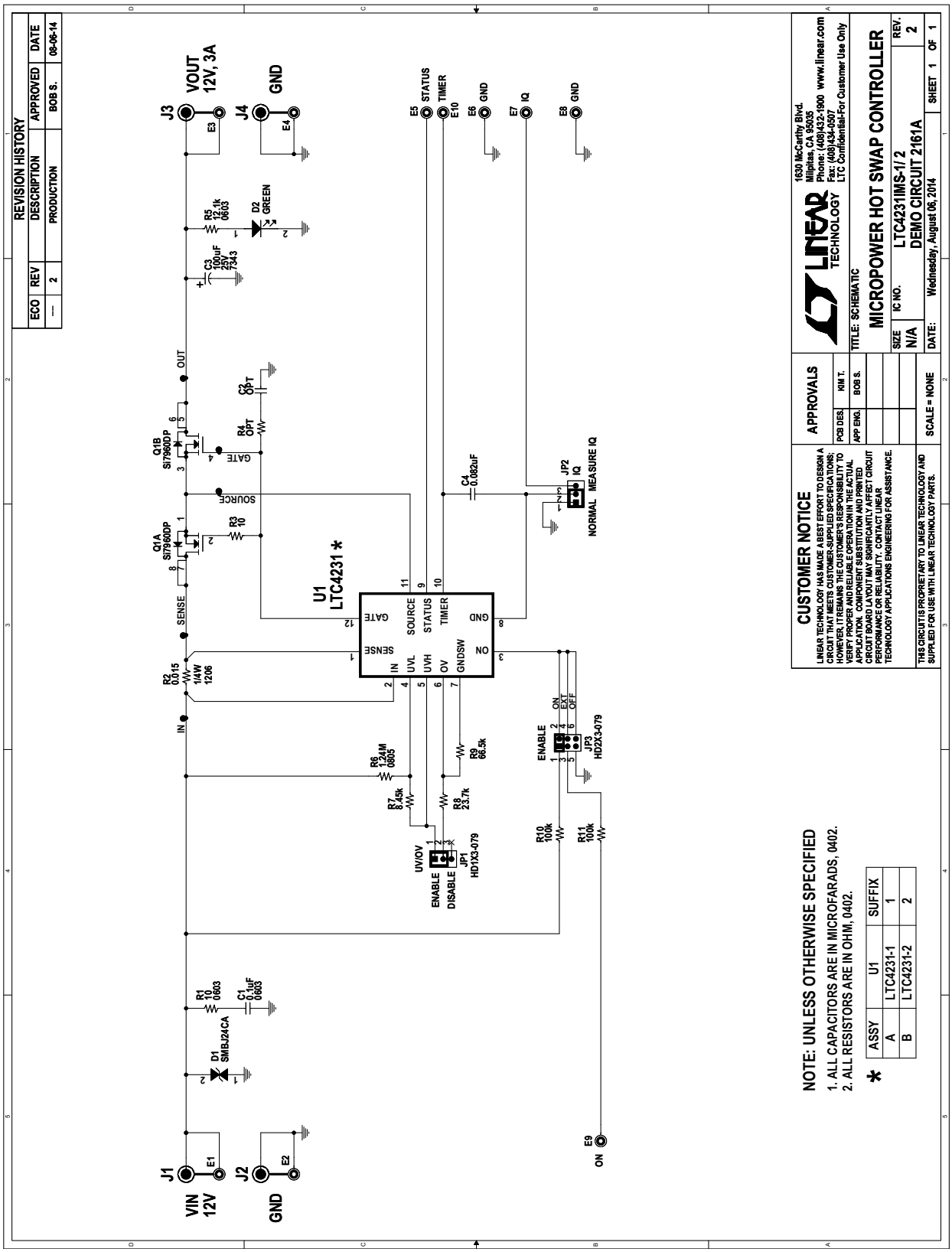


Figure 1. Proper Equipment Measurement Set-Up

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	1	C1	CAP., X7R, 0.1µF 25V, 10%, 0603	MURATA, GRM188R71E104KA01D
2	0	C2	CAP., 0402	OPT
3	1	C3	CAP., TANT, 100µF 25V, 20%, 7343	AVX, TAJE107M025RNJ
4	1	C4	CAP., X7R, 0.082µF 16V, 10%, 0402	MURATA, GRM155R71C823KA88D
5	1	D1	DIODE, SUPPRESSORS,600W, SMB-DIODE	FAIRCHILD SEMI., SMBJ24CA
6	1	D2	LED, GREEN, LED-ROHM-SML-010	ROHM, SML-010FTT86
7	10	E1-E10	TURRET, TESTPOINT 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
8	2	JP1, JP2	HEADER, 2mm SINGLE 3POS	SULLINS, NRPN031PAEN-RC
9	1	JP3	HEADER, 2mm DOUBLE 3POS	SAMTEC, TMM-103-02-L-D
10	4	J1, J2, J3, J4	JACK, BANANA	KEYSTONE, 575-4
11	1	Q1	MOSFET, DUAL-CH, 60V, SO8-POWERPAK	VISHAY SILICONIX, Si7960DP-T1-GE3
12	1	R1	RES., CHIP, 10, 1/16W, 1%, 0603	VISHAY, CRCW060310R0FKEA
13	1	R2	RES., SENSE, 0.015, 1/4W, 1%, 1206	VISHAY, WSL1206R0150FEA
14	1	R3	RES., CHIP, 10, 1/16W, 1%, 0402	VISHAY, CRCW040210R0FKED
15	0	R4	RES., 0402	OPT
16	1	R5	RES., CHIP, 3.32kΩ, 1/16W, 1%, 0603	VISHAY, CRCW06033K32FKEA
17	1	R6	RES., CHIP, 1.24MΩ, 1/8W, 1%, 0805	VISHAY, CRCW08051M24FKEA
18	1	R7	RES., CHIP, 12.4kΩ, 1/16W, 1%, 0402	VISHAY, CRCW040212K4FKED
19	1	R8	RES., CHIP, 24.9kΩ, 1/16W, 1%, 0402	VISHAY, CRCW040224K9FKED
20	1	R9	RES., CHIP, 75kΩ, 1/16W, 1%, 0402	VISHAY, CRCW040275K0FKED
21	2	R10, R11	RES., CHIP, 100kΩ, 1/16W, 5%, 0402	VISHAY, CRCW0402100KJNED
22	3	SHUNTS AS SHOWN ON ASSY DWG	SHUNT, 2mm CTRS.	SAMTEC, 2SN-BK-G
23	4	MH1-MH4	STAND-OFF, NYLON 0.25"	KEYSTONE, 8831 (SNAP ON)
DC2161A-A Additional Demo Board Circuit Components				
1	1		DC2161A-GENERAL BOM	
2	1	U1	I.C., MICROPOWER HOT SWAP CONTROLLER, MS12	LINEAR TECH., LTC4231IMS-1
DC2161A-B Additional Demo Board Circuit Components				
1	1		DC2161A-GENERAL BOM	
2	1	U1	I.C., MICROPOWER HOT SWAP CONTROLLER, MS12	LINEAR TECH., LTC4231IMS-2

SCHEMATIC DIAGRAM



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Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

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Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417
(408) 432-1900 • FAX: (408) 434-0507 • www.linear.com

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Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литера Н,
помещение 100-Н Офис 331