

LTC4232 and LTC4232-1: 5A Integrated Hot Swap Controller

DESCRIPTION

Demonstration circuit 1886B features the [LTC4232](#) and the [LTC4232-1](#) 5A integrated Hot Swap™ controllers. The LTC4232 is ideally suited for demanding power distribution control in 2.9V to 15V applications for hot board insertion protection, high side power switching, and electronic circuit breaker functions. The LTC4232 provides a rich set of features to support Hot Swap applications including:

- 2% accurate undervoltage and overvoltage comparators
- Thermal protection
- Adjustable inrush current control
- Adjustable, 10% accurate current limit with programmable cutout time
- Foldback current limiting
- Programmable output voltage ramp rate
- Configurable auto-retry or latchoff on overcurrent faults
- Power good and fault outputs
- Debounce time during supply turn-on

The LTC4232 debounce time is 100ms, while the LTC4232-1 is 16ms. Both are available in a 16-lead 5mm × 3mm DFN package. The LTC4232 is showcased on demonstration circuit 1886B-A. The LTC4232-1 is installed on DC1886B-B. Both demo boards are configured for 12V application. By changing a few passive components, 2.9V to 15V applications can be easily evaluated.

The LTC4232 has limited output voltage slew rate with a typical value of 300V/s, while the LTC4232-1 does not have a special circuit to limit this parameter. The natural (maximum) gate voltage slew rate (S_N) of the LTC4232-1 is defined by the internal MOSFET C_{RSS} (reverse transfer capacitance) value and gate driver current capability. It is 48000V/s as a typical value.

Design files for this circuit board are available at <http://www.linear.com/demo/DC1886B>

LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks and Hot Swap is a trademark of Linear Technology Corporation. All other trademarks are the property of their respective owners.

PERFORMANCE SUMMARY (T_A = 25°C)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V _{DD}	Board Input Supply Range	Min Is UV, Max Is OV	9.2	12	15.1	V
dV _{GATE} /dt	GATE Pin Turn-On Ramp Rate	LTC4232 LTC4232-1 with 10nF GATE Capacitor	0.15 1.7	0.3 2.4	0.55 3.5	V/ms V/ms
R _{ON}	MOSFET + Sense Resistor On-Resistance		15	33	50	mΩ
I _{LIM(TH)}	Current Limit Threshold	V _{FB} = 1.23V, No R _{SET} V _{FB} = 0V V _{FB} = 1.23V, R _{SET} = 20k	5.0 1.2 2.6	5.6 1.5 2.9	6.1 1.8 3.3	A A A
V _{TH}	OV, UV, FB Pin Threshold Voltage	V _{IN} Rising	1.21	1.235	1.26	V
V _{UV(RTH)}	UV Pin Reset Threshold Voltage	V _{UV} Falling	0.55	0.62	0.7	V
V _{FB(HYST)}	FB Pin Power Good Hysteresis		10	20	30	mV
t _{D(AUTO-RETRY)}	Auto-Retry Turn-On Delay (Internal)	LTC4232 LTC4232-1	50 8	100 16	150 24	ms ms
T _{ADJUST}	Timer Period for ADJUSTABLE Option	LTC4232 LTC4232-1	9.5 0.95	12.3 1.23	16.8 1.68	ms ms

JUMPERS AND LEDS

Two demo board jumpers, JP1 and JP2, allow selection of controller operation:

- JP1 TIMER DURATION: Set to FIXED 2ms position for the internal 2ms timer period (FIXED 2ms not recommended for LTC4232-1 during auto-retry) or ADJUSTABLE determined by TIMER capacitor C1 (12ms for LTC4232 and 1.2ms for LTC4232-1). (Default position: ADJUSTABLE)
- JP2 AUTORETRY: Set to ON for auto-retry or OFF for latchoff on overcurrent fault. (Default position: OFF)

When selecting AUTORETRY option for the circuit with a predominantly resistive load, particularly for LTC4232-1, pay special attention to the power MOSFET thermal condition. The initial low current limit (due to the foldback characteristic) can power the load only during a very short time, and the MOSFET will experience the maximum current limit for almost all of the remaining power up period. This may exceed the MOSFET SOA, if allowed to autoretry.

Four LEDs indicate the state of the hot swap circuit. Red LEDs, D3 and D5, provide fault status and low output voltage (it is a NOT power good signal). Two green LEDs, D2 and D4, signal the presence of valid input and output voltages.

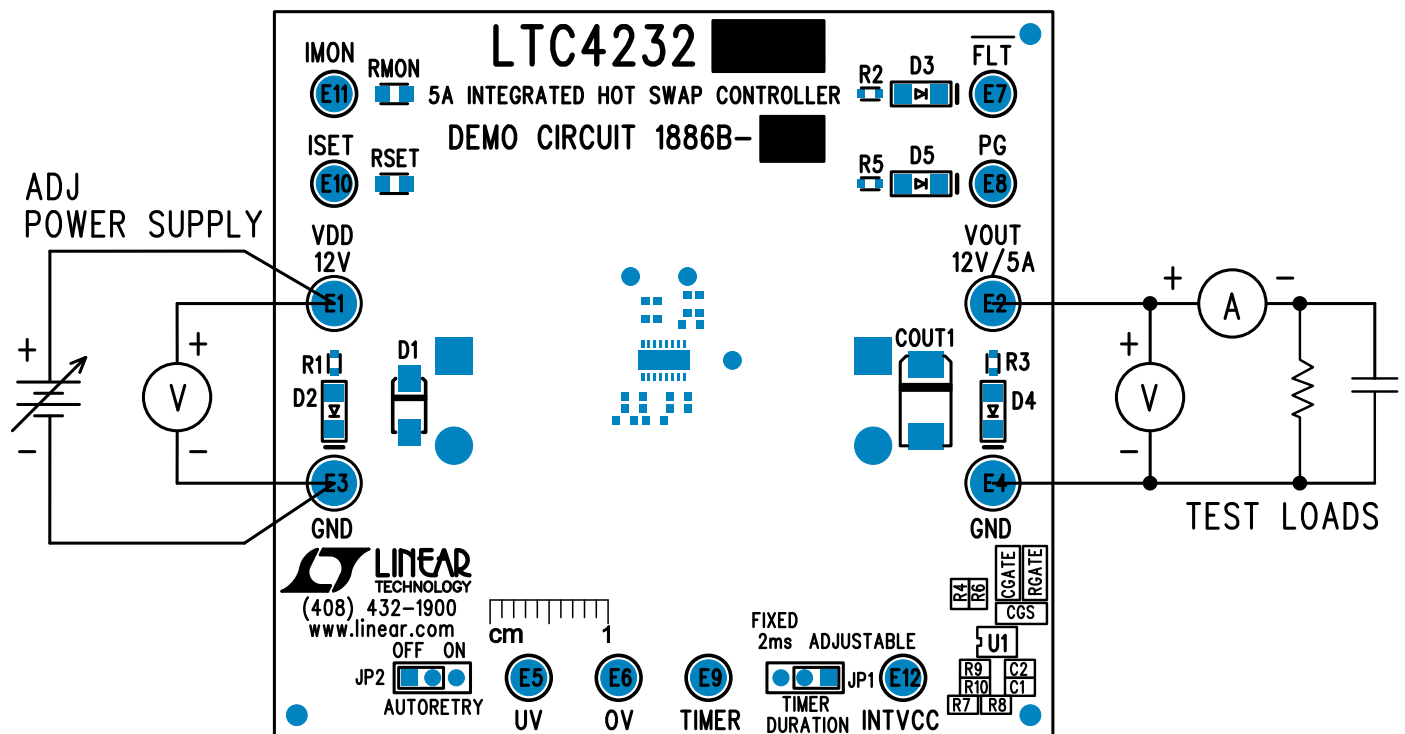


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Demonstration circuit 1886B is easy to set up to evaluate the performance of the LTC4232 or LTC4232-1. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below.

1. Place jumpers in the following positions:

JP1 TIMER DURATION FIXED 2ms

JP2 AUTORETRY OFF

2. With power off, connect 12V power supply terminals to the VDD (E1) and GND (E3) turrets.
3. Turn on the 12V power supply and verify the output voltage between the V_{OUT} (E2) and GND (E4) turrets. Two green LEDs, D2 and D4 should light up.
4. Check the current limit using an electronic or resistive load. It should be in the range of 5A to 6.1A if an overcurrent condition occurs while the output is high (after powering up properly). If the output is shorted initially, the load current will be limited in the range of 1.2A to 1.8A due to the foldback characteristic. Current may be monitored on the IMON turret. The IMON signal scale is 0.4V/A.

An overcurrent condition is indicated by the red LED FLT(D3) and red LED PG (D5).

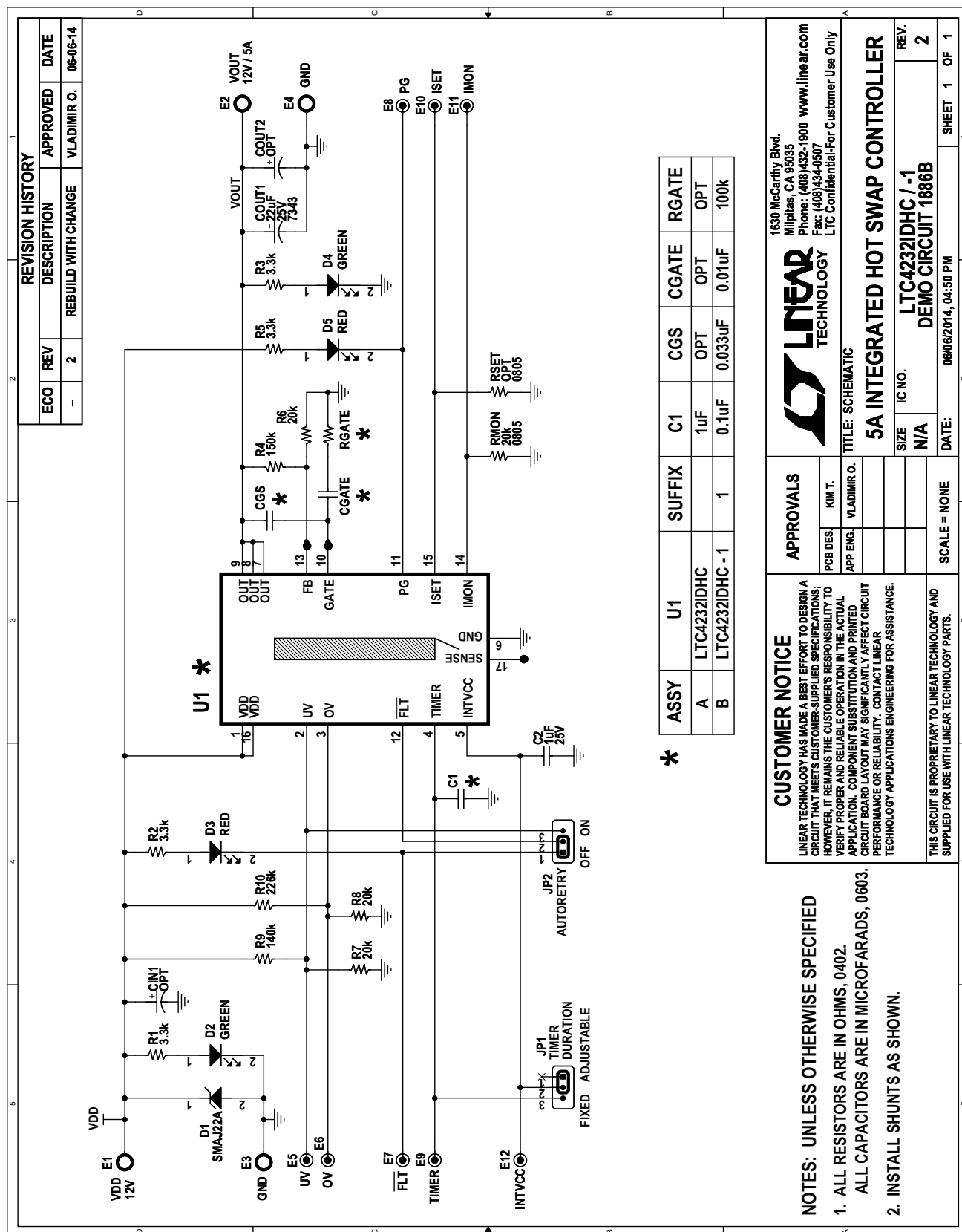
5. Check the output voltage slew rate with an oscilloscope, without a load connected. It should take from 22ms to 80ms for LTC4232, and from 3.0ms to 7.0ms for LTC4232-1.
6. For DC1886B-A (LTC4232) use a 2000μF capacitive load to demonstrate that power up mode completes successfully. Use a current probe to verify that inrush current is limited initially by the foldback characteristic and later by the low output voltage slew rate.
7. For DC1886B-A use a 6000μF capacitive load to demonstrate that the part not only enters into the current limit state but operates in this state until the timer period expires. It is not a successful power up.
8. For DC1886B-B use a 800μF capacitive load to demonstrate a successful power up mode. The controller will operate in current limit almost all of the timer period.
9. For DC1886B-B use a 3000μF capacitive load to demonstrate an unsuccessful power up transient. The operating point does not leave current limit during the whole timer period. It will then time out and turn off.

DEMO MANUAL DC1886B

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	0	CIN1, COUT2	CAP, SANYO\16X25\H	OPT
2	1	COUT1	CAP, TANT, 22 μ F 25V, 20%, 7343	AVX, TPSD226M025R0200
3	1	C2	CAP, X5R, 1 μ F 25V, 0603	AVX, 06033D105KAT2A
4	1	D1	DIODE, 400W TRANSIENT VOLTAGE SUPPRESSOR, SMA-DIODE	DIODES INC., SMAJ22A-13-F
5	2	D2, D4	LED, GREEN, LED-ROHM-SML-010FT	ROHM, SML-010FTT86L
6	2	D3, D5	LED, RED, LED-ROHM-SML-010VT	ROHM, SML-010VTT86L
7	4	E1, E2, E3, E4	TURRET, TEST PIN, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
8	8	E5-E12	TURRET, TEST PIN, 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
9	2	JP1, JP2	JMP, HD1X3, 0.079CC	SULLIN, NRPN031PAEN-RC
10	1	RMON	RES., CHIP, 20k, 1/8W, 5%, 0805	YAGEO, RC0805JR-0720KL
11	0	RSET	RES., CHIP, 0805	OPT
12	4	R1, R2, R3, R5	RES., CHIP, 3.3k, 1/16W, 5%, 0603	YAGEO, RC0603JR-073K3L
13	1	R4	RES., CHIP, 150k, 1/16W, 5%, 0603	YAGEO, RC0603JR-07150KL
14	3	R6, R7, R8	RES., CHIP, 20k, 1/16W, 5%, 0603	YAGEO, RC0603JR-0720KL
15	1	R9	RES., CHIP, 140k, 1/16W, 5%, 0603	YAGEO, RC0603JR-07140KL
16	1	R10	RES., CHIP, 226k, 1/16W, 5%, 0603	YAGEO, RC0603JR-07226KL
17	2		SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G
DC1886B-A Required Circuit Components				
	1		DC1886B-GENERAL BOM	
	1	C1	CAP, X5R, 1 μ F 25V, 0603	AVX, 06033D105KAT2A
	0	CGS, CGATE	CAP, 0603	OPT
	0	RGATE	RES., 0603	OPT
	1	U1	I.C., LTC4232IDHC, DFN16DHC	LINEAR TECH., LTC4232IDHC
DC1886B-B Required Circuit Components				
	1		DC1886B-GENERAL BOM	
	1	C1	CAP, X5R, 0.1 μ F 25V, 0603	AVX, 06033D104KAT2A
	0	CGS	CAP, X7R, 3300pF 100V, 5%, 0603	AVX, 06031C332JAT2A
	1	CGATE	CAP, X7R, 0.01 μ F 100V, 5%, 0603	AVX, 06031C103JAT2A
	1	RGATE	RES., CHIP, 100k, 1/10W, 1% 0603	NIC, NRC06F1003TRF
	1	U1	I.C., LTC4232IDHC-1, DFN16DHC	LINEAR TECH., LTC4232IDHC-1

SCHEMATIC DIAGRAM



DEMO MANUAL DC1886B

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.