LTC3110
2A, Bidirectional Buck-Boost DC/DC Regulator and Charger/Balancer

DESCRIPTION

Demonstration circuit 1964A is a 2A, bidirectional buck-boost DC/DC regulator and charger/balancer, featuring the LTC®3110 boost controller. Its wide voltage range both in capacitor/battery charger mode and in system backup mode makes it well suited to a wide variety of applications using supercapacitors and batteries.

The main features of this board include a wide capacitor voltage range from 0.1V to 5.5V, when the controller works as a backup, buck-boost converter. The input voltage range is also wide, 1.8V to 5.25V, when the controller works as a charger. LTC3110 also features automatic switching from charge to backup mode, programmable ±2% accurate charge current, automatic capacitor balancing, Burst Mode® operation, multipurpose comparator, and open-collector outputs to indicate direction of operation and end of charge.

The 1.2MHz constant-frequency operation results in a small and efficient circuit. In backup mode LTC3110 provides high output voltage accuracy over a wide load range with no minimum load requirement.

DC1964A features two modes of operation: automatic and external direction control. In the automatic mode of operation, DC1964 automatically charges the supercapacitor when a system voltage is present and works as a DC/DC converter providing system backup power to the load when system power is removed. In the external direction mode, users have control over charging and discharging the supercapacitor by changing logic on the EXT/DIR terminal.

The DC1964A supports three levels of input current limits—0.5A, 1A, 2A—while charging the supercapacitor.

The DC1964A has a small circuit footprint. It is a high performance and cost effective solution for supercap, battery backup converters and chargers, servers, RAID and RF systems.

DC1964 supports surface-mount supercapacitors as installed C3 and also through-hole packages as optional C5, C8.

Design files for this circuit board are available at http://www.linear.com/demo/DC1964A

PERFORMANCE SUMMARY

PARAMETER	CONDITIONS		UNITS
Minimum Input Supply Voltage		1.8	V
Maximum Input Supply Voltage		5.5	V
System Voltage Range	Backup Mode	1.8 to 5.25	V
Supercapacitor Voltage Range		0.1V to 5.5	V
Typical Switching Frequency		1.2	MHz
Efficiency Typical, DC/DC Mode	Backup Mode	93	%

QUICK START PROCEDURE

Demonstration circuit 1964A is easy to set up to evaluate the performance of the LTC3110 bidirectional regulator. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below. 5V power supply should be rated minimum 2A of output current.

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} or V_{OUT} and GND terminals. See Figure 2 for proper scope probe technique.

To verify the capability of DC1964A for charging supercapacitors, proceed with the following steps:

1. Place jumper MODE (JP4) to FIXED FREQ. position.
2. Place jumper FBCAP (JP5) to 5.0V position. Place jumper PROG (JP3) to 0.5A position. Place switch DIR (SW1) to AUTO position for automatic switch between charge or backup modes of operation.
3. Place jumper FB (JP1) into 3.2V to set 3.2V voltage on the load, when supercapacitor C3 discharges in backup mode.
4. With power off, connect the input power supply to VEXT, GND load to VSYS, GND as shown on Figure 1.
5. Turn the input power source on and slowly increase the input voltage to 4.0V. Set the load to 0.2A. You have to see voltage around 3.6V (diode forward voltage drop lower compared to VEXT) on the VSYS terminal.
6. Place jumper RUN (JP2) in the ON position. Voltage on VCAP terminal should rise above 4.8V. If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

To verify the ability of DC1964 to work in backup mode, proceed with the following:

7. Disconnect input power from VEXT (E2) terminal, because SW1 in AUTO position, supercapacitor C3 starts discharging, however LTC3110 will maintain a voltage of 3.3V on terminal VSYS (E2).
8. Repeat steps 1 to 7 for different charging currents and VSYS voltages. While discharging, increase load current to 2.0A to verify high current capability and good load regulation of LTC3110 controller.
9. You can measure voltage regulation and ripple in backup mode on VSYS (E2) terminals.
10. Make sure that input voltage on VEXT and VSYS terminals does not exceed 5.5V.

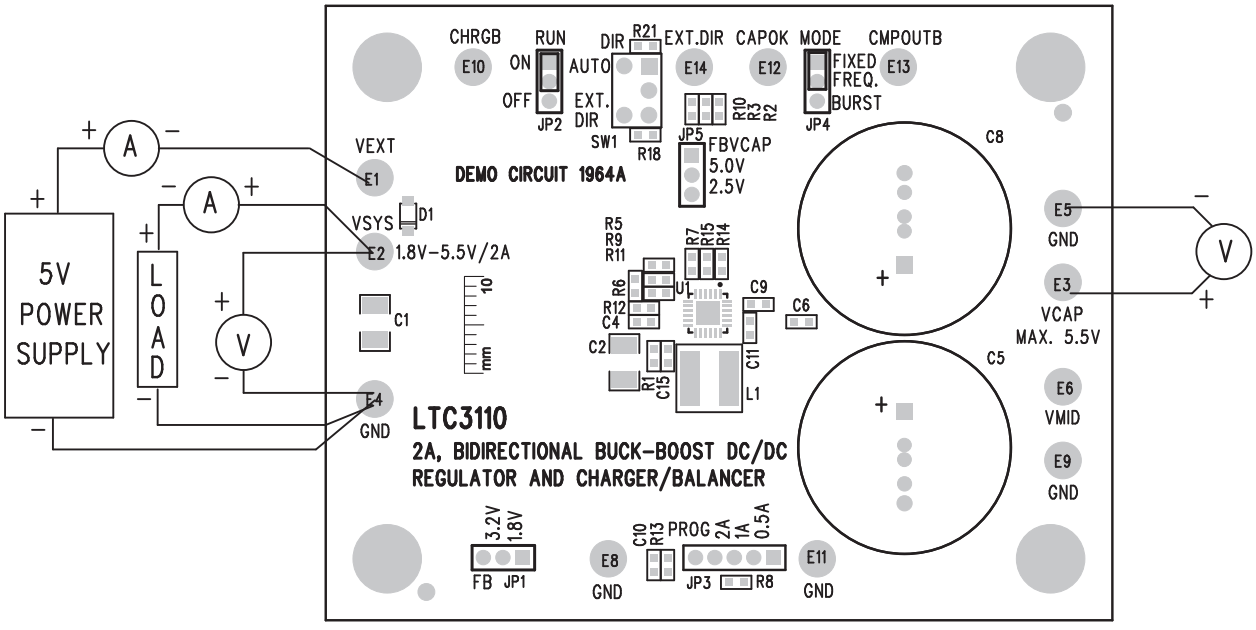


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

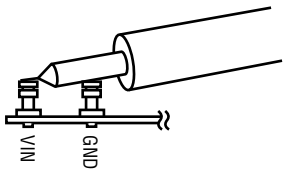


Figure 2. Measuring Input or Output Ripple

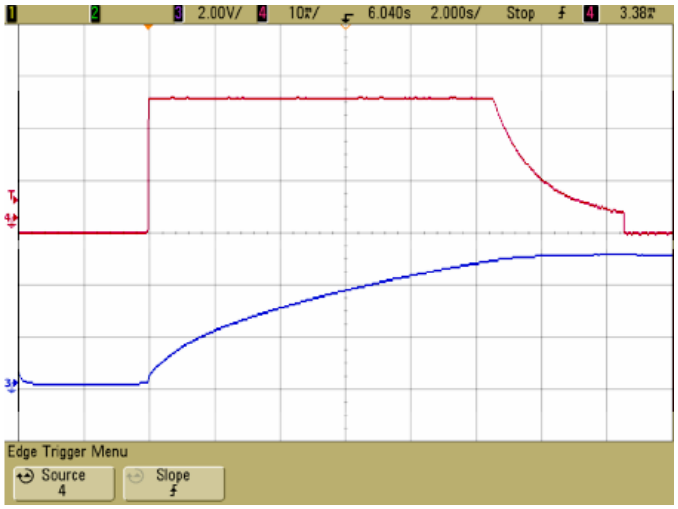


Figure 3. Charging Mode, VSYS 2.5V, Input Current Set to 0.5A, Ch 4 (Red) Input Current, 200mA/DIV, Ch3 (Blue) VCAP Voltage

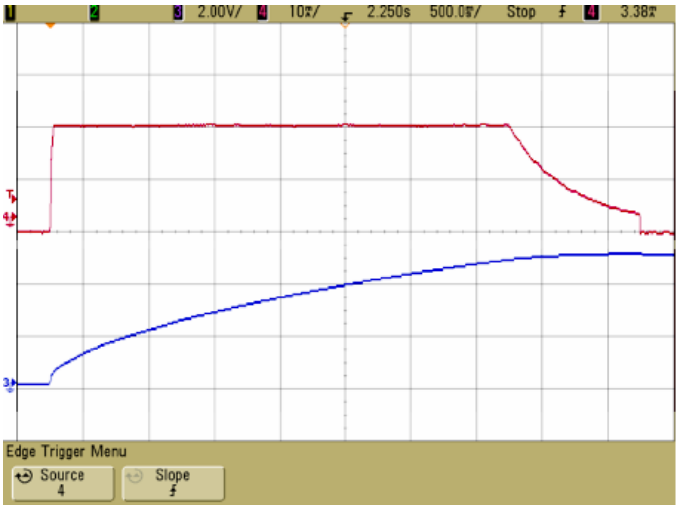


Figure 4. Charging Mode, VSYS 2.5V, Input Current Set to 2.0, Ch 4 (Red) Input Current, 1.0A/DIV, Ch3 (Blue) VCAP Voltage

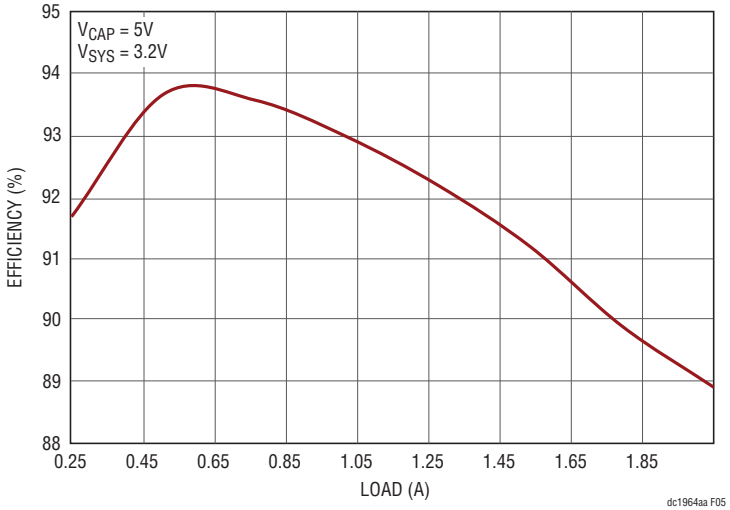
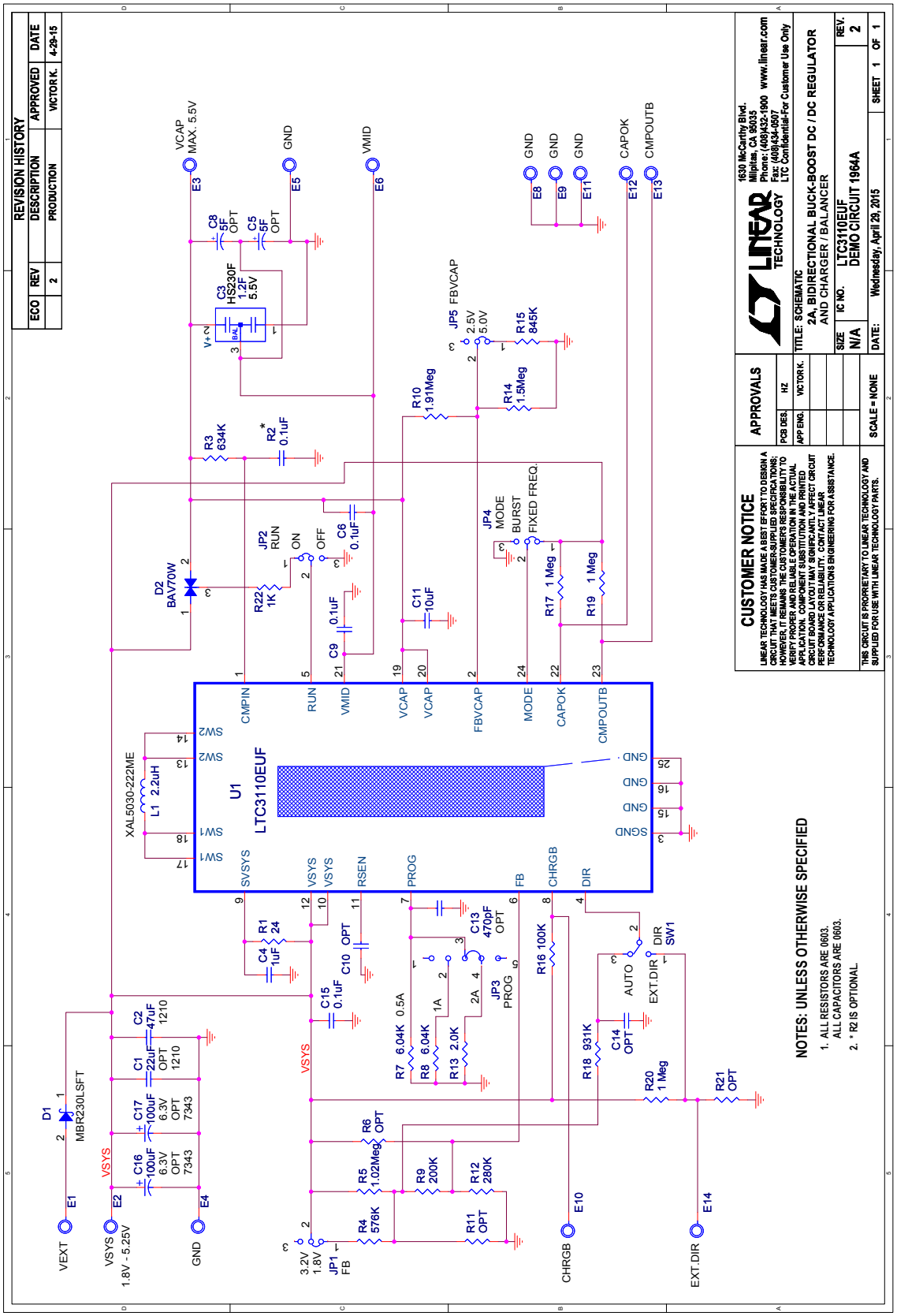


Figure 5. Efficiency vs Load, Backup Mode

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C2	CAP., X5R, 47µF, 6.3V, 10%, 1210	AVX, 12106D476KAT2A
2	1	C3	SUPERCAP, 1.2F, 5.5V, 39mm x 17mm	CAP-XX, HS230F
3	1	C4	CAP., X5R, 1µF, 25V, 10%, 0603	AVX, 06033D105KAT2A
4	1	C11	CAP., X5R, 10µF, 10V, 20%, 0603	AVX, 0603ZD106MAT2A
5	4	C6, C9, C15, R2	CAP., X5R, 0.1µF, 25V, 10%, 0603	AVX, 06033D104KAT2A
6	1	C11	CAP., X5R, 10µF, 10V, 20%, 0603	AVX, 0603ZD106MAT2A
7	1	C13	CAP., X5R, 470pF, 25V, 10%, 0603	AVX, 06033D471KAT2A
8	1	D1	DIODE, SCHOTTKY 2A 30V SOD-123FL	ON SEMI., MBR230LSFT1G
9	1	D2	DIODE, SW DUAL 75V 200MW SC70-3	DIODE, BAV70W-7-F
10	1	L1	POWER INDUCTOR, 2.2uH	COILCRAFT, XAL5030-222MEB
11	1	R1	RES., CHIP, 24, 1%, 0603	VISHAY, CRCW060324R0FKEA
12	1	R3	RES., CHIP, 634k, 1%, 0603	VISHAY, CRCW0603634KFKEA
13	1	R4	RES., CHIP, 576k, 1%, 0603	VISHAY, CRCW0603576KFKEA
14	1	R5	RES., CHIP, 1.02M, 1%, 0603	VISHAY, CRCW06031M02FKEA
15	2	R7, R8	RES., CHIP, 6.04k, 1%, 0603	YAGEO, RC0603FR-076K04L
16	1	R9	RES., CHIP, 200k, 1%, 0603	VISHAY, CRCW0603200KFKEA
17	1	R10	RES., CHIP, 1.91M, 1%, 0603	VISHAY, CRCW06031M91FKEA
18	1	R12	RES., CHIP, 280k, 1%, 0603	VISHAY, CRCW0603280KFKEA
19	1	R13	RES., CHIP, 2k, 1%, 0603	VISHAY, CRCW06032K00FKEA
20	1	R14	RES., CHIP, 1.5M, 1%, 0603	VISHAY, CRCW06031M50FKEA
21	1	R15	RES., CHIP, 845k, 1%, 0603	VISHAY, CRCW0603845KFKEA
22	2	R16, R17	RES., CHIP, 100k, 1%, 0603	VISHAY, CRCW0603100KFKEA
23	1	R18	RES., CHIP, 931k, 1%, 0603	VISHAY, CRCW0603931KFKEA
24	1	R19, R20	RES., CHIP, 1M, 1%, 0603	VISHAY, CRCW06031M00FKEA
25	1	R22	RES., CHIP, 1K, 1%, 0603	VISHAY, CRCW06031K00FKEA
26	1	U1	IC., LTC3110EUF, QFN 4mm × 4mm	LINEAR TECH., LTC3110EUF#PBF
Additional Demo Board Circuit Components				
1		C1, C5, C8, C10, C14, C16, C17		OPT
2		R6, R11, R21		OPT
Hardware: For Demo Board Only				
1	1	JP3	HEADER, 0.079 SINGLE ROW 5 PIN	SULLINS, NRPN051PAEN-RC
2	4	JP1, JP2, JP5, JP6	HEADER, 0.079 SINGLE ROW 3 PIN	SULLINS, NRPN031PAEN-RC
3	5	JP1, JP2, JP3, JP5, JP6	SHUNT	SAMTEC, 2SN-BK-G
4	13	E1-E6, E8-E14	TESTPOINT, TURRET, .095"	MILL-MAX, 2501-2-00-80-00-00-07-0
5	1	SW1	SWITCH, TOGGLE SPDT ULTMINI PC TH LT 5/08/12	C & K, GT11MCBETR

SCHEMATIC DIAGRAM



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