

LTC3867EUF

High Efficiency Synchronous Buck Converter

DESCRIPTION

Demonstration circuit 1928A is a single output synchronous buck converter featuring the [LTC®3867EUF](#) in a 24-lead 4mm x 4mm QFN package.

The DC1928A is configured with a sense resistor. Inductor DCR sensing circuit is optional. Using the inductor's DCR as the sense element instead of the onboard sense resistor saves cost, board space while improving efficiency. Using a sense resistor provides more accurate current limit.

The board has a lot of features including an internal 5V linear regulator for bias, output voltage remote-sense, programmable nonlinear control to improve load transient performance, programmable thermal shutdown, an

optional temperature compensated DCR sense circuit, and selectable continuous, pulse-skipping or Burst Mode® operation. Synchronization to an external clock is also possible.

The input voltage range is from 18V to 36V. The LTC3867 data sheet gives a complete description of the part, operation and application information and must be read in conjunction with this demo manual for DC1928A.

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

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PERFORMANCE SUMMARY Specifications are at T_A = 25°C

PARAMETER	CONDITIONS / NOTES	VALUE
Input Voltage Range		18V ~ 36V
Output Voltage, V _{OUT}	V _{IN} = 18V ~ 36V, I _{OUT} = 0A ~ 12A, JP3: CCM	12V ±2% (11.76V ~ 12.24V)
Default Operating Frequency (Typical)		250kHz
External Clock Sync. Frequency Range		200kHz to 780kHz
Typical Full Load Efficiency (See Figure 3)	V _{IN} = 24V, V _{OUT} = 12V, I _{OUT1} = 12A, f _{SW} = 250kHz	97.6%

QUICK START PROCEDURE

Demonstration circuit DC1928A is easy to set up to evaluate the performance of the LTC3867EUF. Please refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions for a typical application:

JP2: On

JP3: CCM

2. With power off, connect the input power supply, load and meters as shown in Figure 1. Preset the load to 0A and V_{IN} supply to 24V.

3. Turn on the power supply at the input.

Note: Make sure that the input voltage does not exceed 36V.

4. Check the output voltage. The output voltage should be between 11.76V and 12.24V.

Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, output voltage ripple, efficiency and other parameters.

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 VIN or VOUT and GND terminals. See Figure 2 for proper scope probe technique.

5. Change JP3 jumper position to select different operation modes. Set jumper to CCM, BURST or P.S. position to set forced continuous conduction, burst or pulse-skipping mode respectively. For synchronizing to an external clock source, set the jumper to BURST position and apply the clock signal to MODE/PLLIN turret.

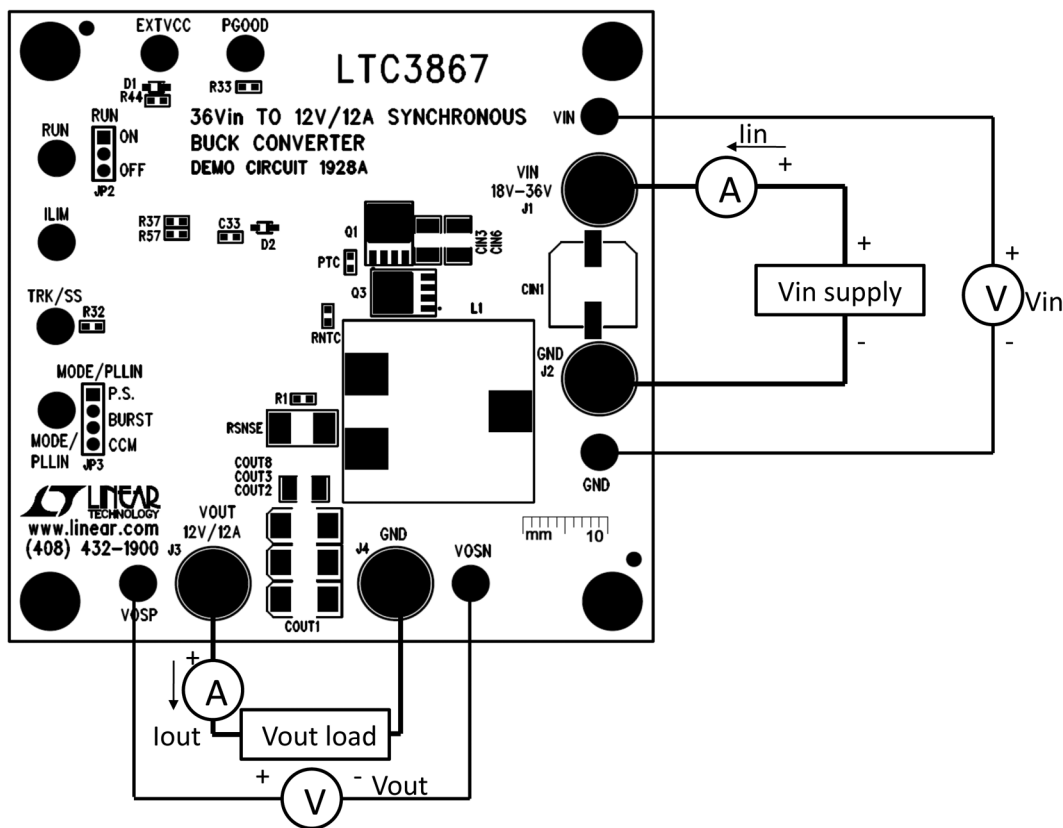


Figure 1. Test Setup of DC1928A

QUICK START PROCEDURE

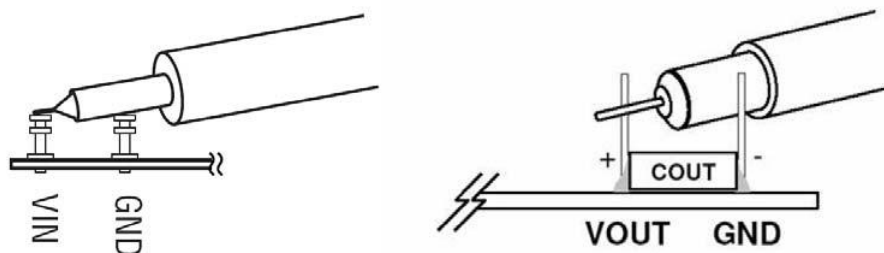


Figure 2. Measuring Input or Output Ripple Across Terminals or Directly Across Bulk Capacitor

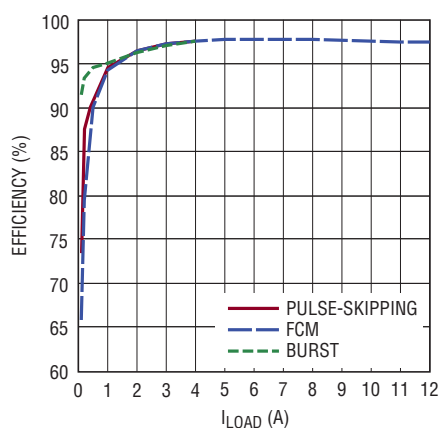


Figure 3. Measured Efficiency

RAIL TRACKING

Demonstration circuit 1928A is configured for an onboard soft-start circuit. The soft-start ramp rate can be adjusted by changing the value of C24. Demonstration circuit 1928A

can also be modified to track an external reference. Refer to Table 1 for tracking options and to the data sheet for more details.

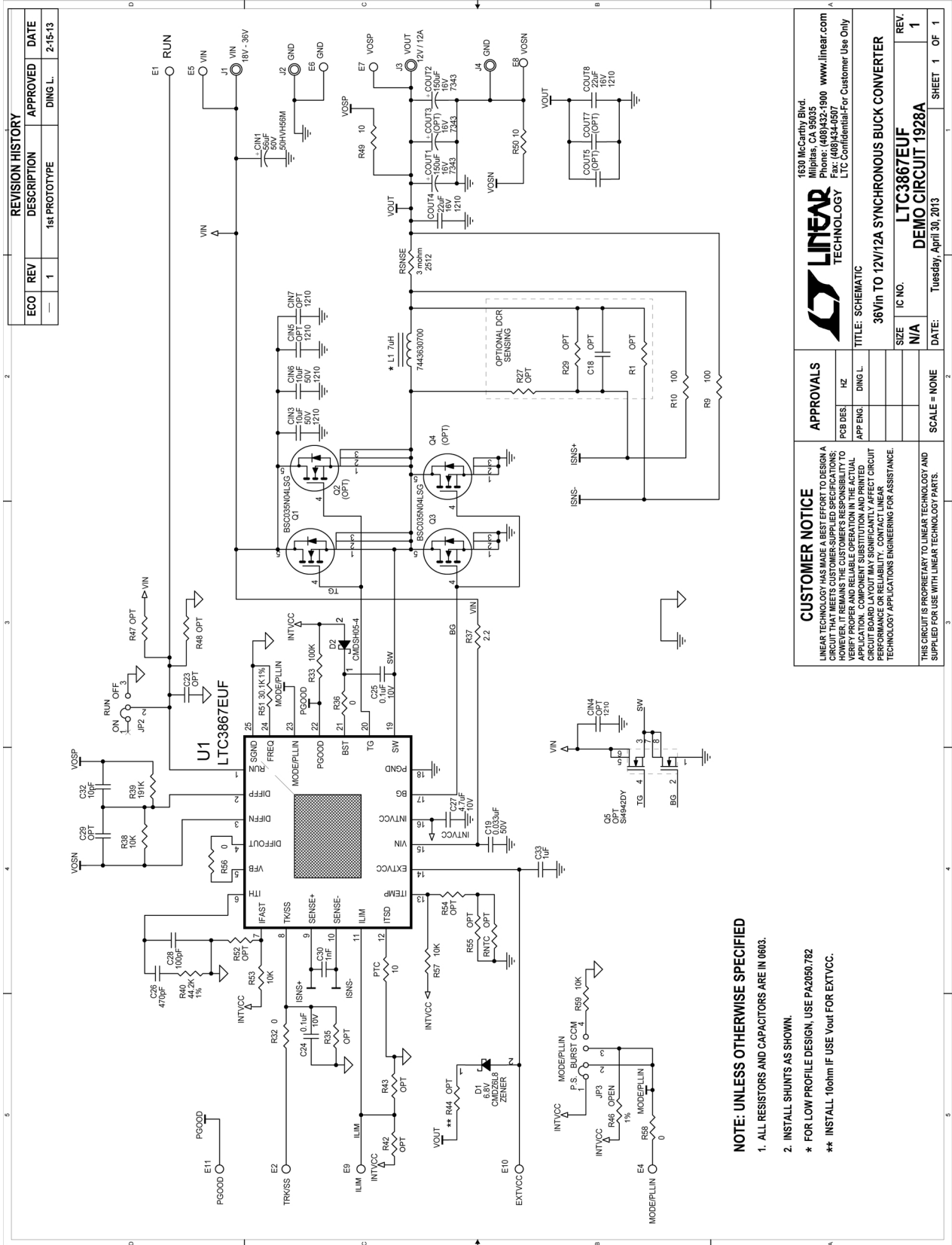
CONFIGURATION	TRK/SS RESISTORS AND CAPACITOR			RAIL TRACKING
	R32	R35	C24	TRK/SS PIN
Soft-Start without Tracking (Default)	0Ω	Open	0.1μF	OPEN
V _{OUT} Equals External Ramp	0Ω	Open	Open	External Reference Applied
V _{OUT} Tracking Scaled External Ramp	Resistor Divider		Open	External Reference Applied

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PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP, ALUM, 56µF 20% 50V	SUN ELECT 50HVH56M
2	2	CIN3, CIN6	CAP, X5R 10µF 20% 50V 1210	TAIYO YUDEN UMK325BJ106MM-T
5	2	COU1, COU2	CAP, POSCAP 150µF 20% 16V 7343	SANYO, 16TQC150MYF
7	2	COU4, COU8	CAP, X5R 22µF 20% 16V 1210	AVX 1210YD226MAT2A
9	1	C32	CAP., X7R 10pF 10% 25V 0603	AVX 06033C100KAT2A
10	1	C33	CAP, X5R 1µF 10% 50V 0603	TDK C1608X5R1E105K
11	1	C19	CAP, X5R 0.033µF 10% 50V 0603	AVX 06035D333KAT2A
12	1	C30	CAP, X7R 1nF 10% 25V 0603	AVX 06033C102KAT
13	2	C24, C25	CAP, X5R 0.1µF 10% 10V 0603	AVX 0603ZD104KAT
14	1	C26	CAP, COG 470pF 5% 50V 0603	MURATA GCM1885C1H471JA16D
15	1	C27	CAP, X5R 4.7µF 10% 10V 0603	AVX 0603ZD475KAT2A
16	1	C28	CAP, COG 100pF 5% 50V 0603	TDK C1608COG1H101JK
17	1	D1	DIODE, 6.8V SOD-323	CENTRAL CMDZ6L8
18	1	D2	DIODE, SOD-323	CENTRAL SEMI CMDSH05-4-LTC
23	1	L1	IND., 7µH	WURTH., 7443630700
24	2	Q1, Q3	XSTR, MOSFET LFPK	INFINEON BSC035N04LSG
28	1	RSNSE	RES, 3mΩ 1% 1W 2512	PANASONIC ERJM1WTF3M0U
29	2	R9, R10	RES, 100Ω 1% 1/10W 0603	NIC NRC06F1000TRF
31	4	R32, R36, R56, R58	RES, 0Ω 1/10W 0603	VISHAY CRCW06030000Z0EA
32	1	R33	RES, 100k 1% 1/10W 0603	NIC NRC06F1003TRF
33	1	R37	RES, 2.2Ω 5% 1/10W 0603	NIC NRC06F2R20TRF
34	1	R39	RES, 191KΩ 1% 0603	VISHAY CRCW060375K0FKEA
35	4	R38, R53, R57, R59	RES, 10k 1% 0603	NIC NRC06F1002TRF
36	1	R40	RES, 44.2k 1% 0603	VISHAY CRCW060344K2FKEA
37	1	R51	RES, 30.1k 1% 0603	NIC NRC06f3012TRF
38	3	R49, R50, PTC	RES, 10Ω 1% 0603	NIC NRC06f10R0TRF
39	1	U1	IC., LTC3867EUF, QFN 4mm x 4mm	LINEAR TECH. LTC3867EUF#PBF
Additional Demo Board Circuit Components				
1	2	COU5, COU7 (OPT)		
2	3	CIN4, CIN5, CIN7,	CAP, X5R 22µF 20% 25V 1210	
3	1	COU3 (OPT)	CAP, POSCAP 7343	
4	3	C18, C23, C29 (OPT)	CAP, 0603	
5	2	Q2, Q4 (OPT)	XSTR, MOSFET LFPK	
6	1	Q5 (OPT)	XSTR, MOSFET, DUAL N-CHANNEL	
7	13	R1, R27, R29, R35, R42, R43, R46-R48, R52, R54, R55, RNTC (OPT)	RES, 0603	
Hardware-For Demo Board Only				
1	8	E1, E2, E4-E11	TURRET, 0.094"	MILL-MAX 2501-2-00-80-00-00-07-0
2	1	JP2	HEADER, 3-PIN	SAMTEC TMM-103-02-L-S
3	1	JP3	HEADER, 4-PIN	SAMTEC TMM-104-02-L-S
4	4	J1-J4	JACK, BANANA	KEYSTONE 575-4
5	2	XJP2, XJP3	SHUNT	SAMTEC 2SN-BK-G
6	4		STANDOFF, SNAP ON	KEYSTONE 8832
7	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 1928A

SCHEMATIC DIAGRAM



REVISION HISTORY			
ECO	REV	DESCRIPTION	DATE
—	1	1st PROTOTYPE	2-15-13

LINEAR TECHNOLOGY

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TITLE: SCHEMATIC
36Vin TO 12V/12A SYNCHRONOUS BUCK CONVERTER

SIZE: IC NO. N/A
REV. 1

DATE: Tuesday, April 30, 2013
SHEET 1 OF 1

APPROVALS

POB DES	HZ
APP ENG	DING L.

SCALE = NONE

CUSTOMER NOTICE

LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY THE PERFORMANCE OF THE CIRCUIT IN THEIR FINAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.

THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

- NOTE: UNLESS OTHERWISE SPECIFIED**
1. ALL RESISTORS AND CAPACITORS ARE IN 0603.
 2. INSTALL SHUNTS AS SHOWN.
- * FOR LOW PROFILE DESIGN, USE PA2050.782
 - ** INSTALL 100mΩ IF USE Vout FOR EXTVCVCC.



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DEMO MANUAL DC1928A

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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.

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