

# Low Quiescent Current, High Voltage Step-Down Converter

## DESCRIPTION

Demonstration circuit 1940A is a low quiescent current, synchronous buck converter featuring the LTC®3891EUDC. This demo board converts a 16V to 60V voltage to a 12V at 15A output.

The main features of this board include an internal LDO for gate drive power from  $V_{IN}$  or  $EXTV_{CC}$ , RUN and PGOOD pins, a mode selector that allows the converter to run in constant current mode (CCM), pulse-skipping or Burst Mode® operation, and selectable current limit. The DC1940A supports an adjustable output voltage, soft-start and tracking. The wide input voltage range of 16V to 60V is suitable for double battery automotive and distributed DC power systems where low quiescent current is important.

The LTC3891 data sheet gives a complete description of this part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1940A.

The 60V avalanche rated MOSFETs, which are used on DC1940A, can be operated at their rated voltage. However, if application derating requirements are stricter, MOSFETs with higher voltage rating can be used.

Please note, MOSFETs with higher voltage ratings may affect the efficiency. If 60V MOSFETs are used, the MOSFET avalanche rating and testing is typically done with 30% over voltage margin (78V for 60V rated MOSFET). Please check with particular MOSFET manufacturer to ensure the avalanche voltage rating.

The DC1940A supports the following MOSFET packages: LPAK, PowerPAK SO-8 and Power 56. The subsequent logic level (SV gate) MOSFETs can be used with DC1940A.

Si7850DP	Vishay
RJK0651DPB	Renesas
HAT2266H	Renesas
BSC100N06LS3 G	Infineon
FDMS86520L	Fairchild

For synchronization to an external clock, **remove jumper JP2** and apply sync signal on terminal SYNC.

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

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## PERFORMANCE SUMMARY (T<sub>A</sub> = 25°C)

PARAMETER	CONDITIONS	VALUE	UNITS
Minimum Input Supply Voltage		16	V
Maximum Input Supply Voltage		60	V
Output Voltage Range	$V_{IN} = 16V$ to $60V$ , $I_{OUT1} = 0A$ to $5A$	$12 \pm 2\%$	V
Typical Switching Frequency		125	kHz
Typical Output Ripple ( $V_{OUT}$ , 12V)	$I_{LOAD} = 15A$	80	mV
Efficiency Typical ( $V_{OUT}$ , 12V)		97	%
Supply Quiescent Current	$V_{IN} = 24V$ ; $V_{OUT} = 12V$ , $I_O = 0A$ , Burst Mode Operation	50.8	$\mu A$
Supply Shutdown Current	$V_{IN} = 24V$	14.7	$\mu A$

## QUICK START PROCEDURE

Demonstration circuit 1940A is easy to set up to evaluate the performance of the LTC3891EUDC. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**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.

1. Place jumper **JP1** in the **ON** position.
2. With power off, connect the input power supply to  $V_{IN}$  and GND.

3. Turn on the power at the input. Check for the proper output voltages:

$$V_{OUT1} = 11.9V \text{ to } 12.4V$$

**NOTE:** If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

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

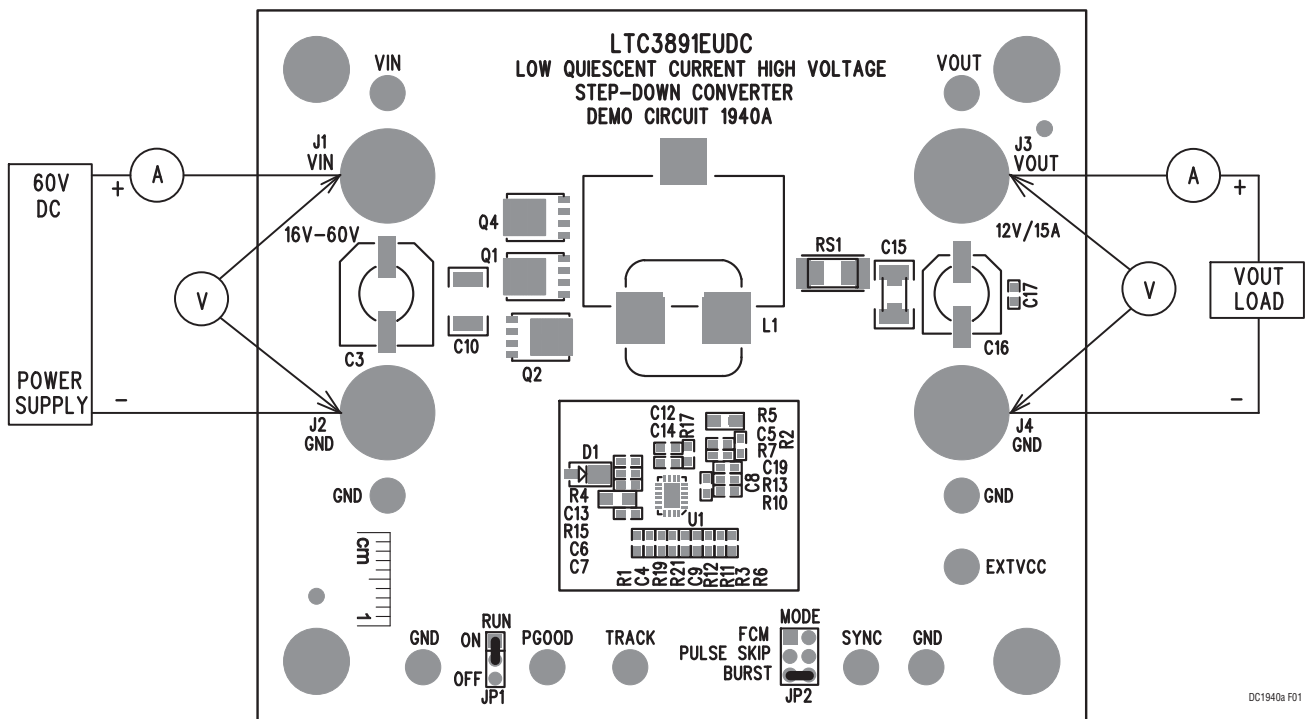
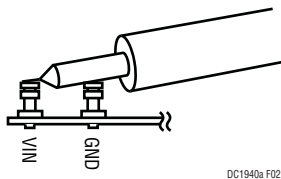


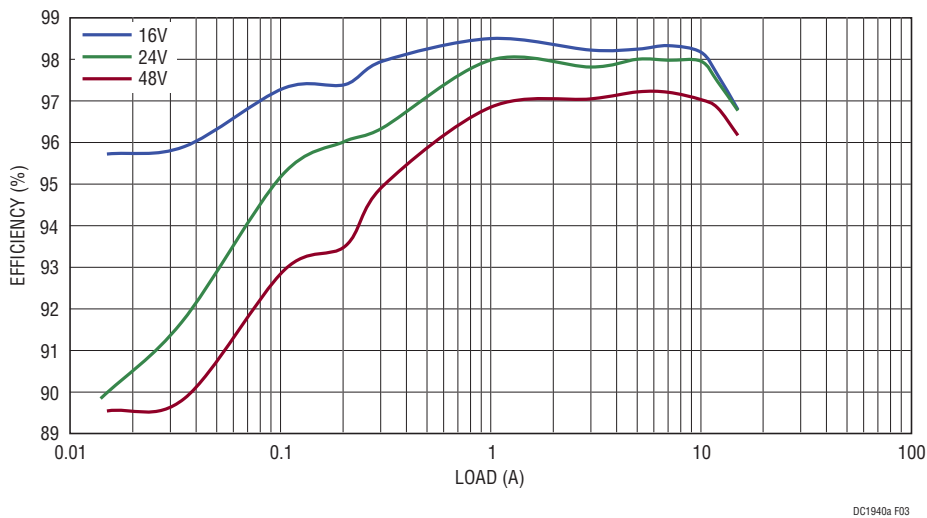
Figure 1. Proper Measurement Equipment Setup

DC1940a F01

**QUICK START PROCEDURE**



**Figure 2. Measuring Input or Output Ripple**



**Figure 3. 12V Output, Efficiency vs Load, Burst Mode Operation,  $V_{IN}$  16V, 24V, 48V**

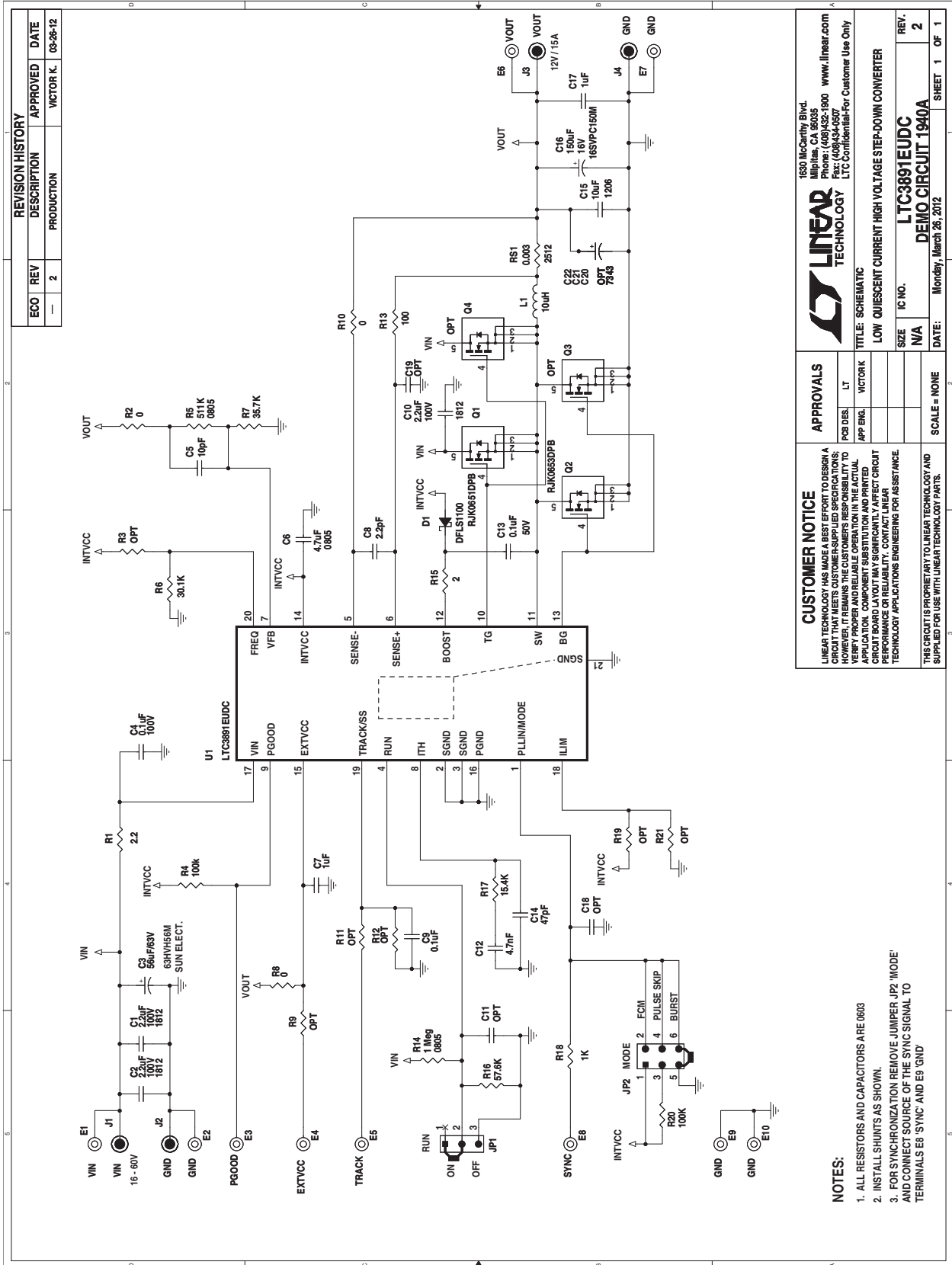
# DEMO MANUAL DC1940A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	3	C1, C2, C10	CAP, X7R, 2.2 $\mu$ F 100V 10%, 1812	TDK, C4532X7R2A225K
2	1	C3	CAP, EL, 56 $\mu$ F/63V, F4	SUN EL, 63HVH56M
3	1	C4	CAP, X7R, 0.1 $\mu$ F 100V 10%, 0603	MURATA, GRM188R72A104KA35D
4	1	C5	CAP, NPO, 10pF, 50V, 5%, 0603	AVX, 06031A100JAT2A
5	2	C9, C13	CAP, X7R, 0.1 $\mu$ F 50V 10%, 0603	TDK, C1608X7R1H104K
6	1	C6	CAP, X5R, 4.7 $\mu$ F, 16V, 10%, 0805	MURATA, GRM219R61C475KE15D
7	2	C7, C17	CAP, X7R, 1 $\mu$ F 16V, 10%, 0603	TDK, C1608X7R1C105K
8	1	C8	CAP, NPO, 2.2pF 50V, $\pm$ 0.25pF, 0603	AVX, 06035A2R2CAT
9	1	C12	CAP, X7R, 4700pF, 10V, 5%, 0603	AVX, 0603ZC472JAT2A
10	1	C14	CAP, NPO, 47pF 50V, 5%, 0603	NIC, NMC0603NPO470J50TRPF
11	1	C15	CAP, X7R, 10 $\mu$ F 16V 10%, 1206	MURATA, GCM31CR71C106KA64L
12	1	C16	CAP, SANYO, 150 $\mu$ F, 16V, 20%	SANYO, 16TSVPC150
13	1	D1	DIODE, POWER DI-123	DIODES/ZETEX, DFLS1100-7
14	1	L1	IND, 10 $\mu$ H, 7443631000	WÜRTH, 7443631000
15	1	Q1	SILICON N CHANNEL POWER MOSFET LPAK	RENESAS, RJK0651DPB
16	1	Q2	SILICON N CHANNEL POWER MOSFET LPAK	RENESAS, RJK0653DPB
17	1	RS1	RES, 0.003 $\Omega$ 1W 1% 2512	PANASONIC ERJM1WSF3MOU
18	1	R1	RES, 2.2 1% 1/10W, 0603	VISHAY, CRCW06032R20FNEA
19	3	R2, R8, R10	RES, 0 $\Omega$ 1% 1/16W, 0603	VISHAY, CRCW06030000Z0EA
20	2	R4, R20	RES, 100k 1% 1/16W, 0603	VISHAY, CRCW0603100KFKEA
21	1	R5	RES, 511k 1% 1/16W, 0805	VISHAY, CRCW0805511KFKEA
22	1	R6	RES, 30.1k 1% 1/10W, 0603	VISHAY, CRCW060330K1FKEA
23	1	R7	RES, 35.7k 1% 1/16W, 0603	VISHAY, CRCW060335K7FKEA
24	1	R13	RES, 100 1% 1/10W, 0603	VISHAY, CRCW0603100RFKEA
25	1	R14	RES, 1M 1% 1/10W, 0805	VISHAY, CRCW08051M00FKEA
26	1	R15	RES, 2 $\Omega$ 1% 1/16W, 0603	VISHAY, CRCW06032R00FNEA
27	1	R16	RES, 57.6k 1% 1/16W, 0603	VISHAY, CRCW060357K6FKEA
28	1	R17	RES, 15.4k 1% 1/10W, 0603	VISHAY, CRCW060315K4FKEA
29	1	R18	RES, 1k 1% 1/16W, 0603	VISHAY, CRCW06031K00FKEA
30	1	U1	IC, LTC3891EUDC, QFN20EUDC-3X4	LINEAR TECHNOLOGY, LTC3891EUDC
<b>Additional Demo Board Circuit Components</b>				
1		R3, R9, R11, C11, R12, C18, C19, R19, R21	RES, 0603	OPT
2		C20, C21, C22	CAP, 7343	OPT
3		Q3, Q4 (OPT)	MOSFET, LPAK	OPT
<b>Hardware</b>				
1	10	E1 TO E10	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	J1, J2, J3, J4	CONN, BANANA JACK, KEYSTONE-575-4	KEYSTONE 575-4
3	1	JP1	JMP, 3PIN 1 ROW, 0.079"	SULLINS, NRPN031PAEN-RC
4	1	JP2	JMP, 3PIN 2 ROW, 0.079"	SULLINS, NRPN032PAEN-RC
5	4	MTGS AT 4 CORNERS	STANDOFF, NYLON 0.5 1/2"	KEYSTONE, 8833(SNAP-ON)
6	2	XJP1, XJP2	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G

dc1940af

SCHEMATIC DIAGRAM



# DEMO MANUAL DC1940A

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

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