

LTC3833EUDC High Efficiency Step-Down DC/DC Converter

DESCRIPTION

Demonstration circuit 1640A is a 1.5V/20A synchronous buck converter operating with a switching frequency of 300kHz over an input voltage range of 4.5V to 14V. The demo board comes in two versions. The A version uses inductor DCR current sensing with an iron powder inductor for high efficiency. The B version uses a $2\text{m}\Omega$ /1% sense resistor for accurate current sensing with a low DCR ferrite inductor. The fixed on-time valley current mode topology of the LTC3833 allows for a fast load step response (see Figures 4 and 5). The load step response can be tested with the onboard load step circuit and a bench pulse generator.

Other features of the board include a MODE jumper to program either DCM or CCM with light or no load, a PLLIN input for synchronizing the converter to an external clock, a TRACK/SS pin, a PGOOD pin and an EXTV_{CC} pin.

The demo board uses a high density, two sided drop-in layout. The entire converter, excluding the bulk output and input capacitors, fits within a compact 1.4" × 0.6" area on the board. The package style for the LTC3833EUDC is a 3mm × 4mm 20-lead QFN with an exposed ground pad.

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

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PERFORMANCE SUMMARY (T_A = 0°C to 85°C)

PARAMETER	CONDITION	VALUE
Minimum Input Voltage		4.5V
Maximum Input Voltage		14V
Output Voltage	I _{OUT} = 0A to 20A	1.5V ±2%
Switching Frequency		300kHz
Efficiency DCR Sense Version (A) R _{SENSE} Version (B)	V _{IN} = 12V, V _{OUT} = 1.5V, I _{OUT} = 20A; See Figures 2 and 3	89.4% 88.8%

DEMO MANUAL DC1640A

QUICK START PROCEDURE

Demonstration circuit 1640A is easy to set up to evaluate the performance of the LTC3833EUDC. Please refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

1. With power off, connect the input supply, load and meters as shown in Figure 1. Preset the load to 0A and V_{IN} supply to be 0V. Place jumpers in the following positions:

JP1	JP2
RUN	MODE
ON	CCM

2. Adjust the input voltage to be between 4.5V to 14V. V_{OUT} should be $1.5V \pm 2\%$.
3. Next, apply 20A load and recheck V_{OUT} .
4. Once the DC regulation is confirmed, observe the output voltage ripple, load step response, efficiency and other parameters.

Note 1. To measure the output voltage ripple, use the BNC connector labeled V_{OUT} .

Note 2. Do not apply the load from the VO_SNS+ turret to the VO_SNS- turret. This will damage the converter. These turrets are only intended to monitor V_{OUT} across C_{OUT4} which is the point of regulation.

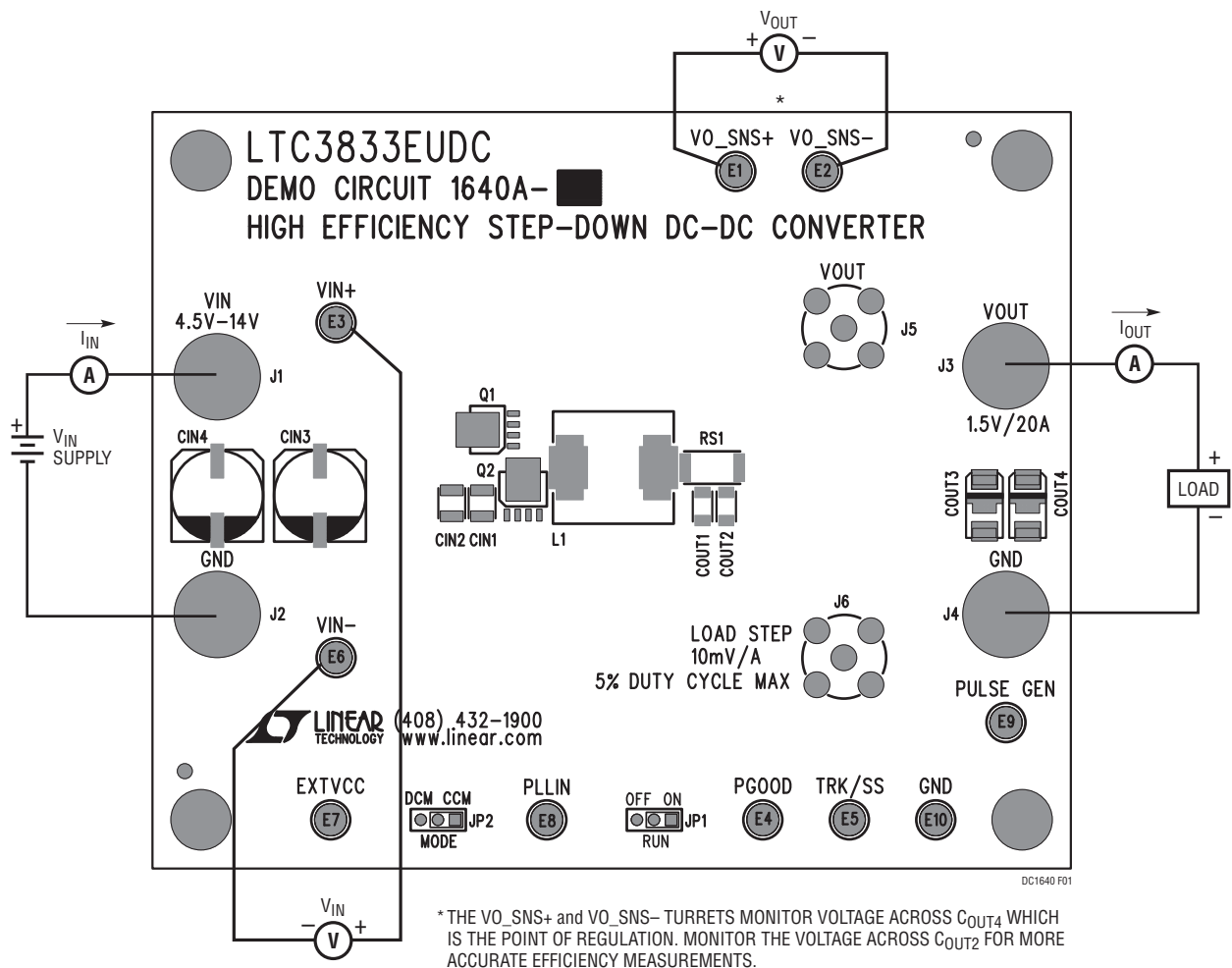


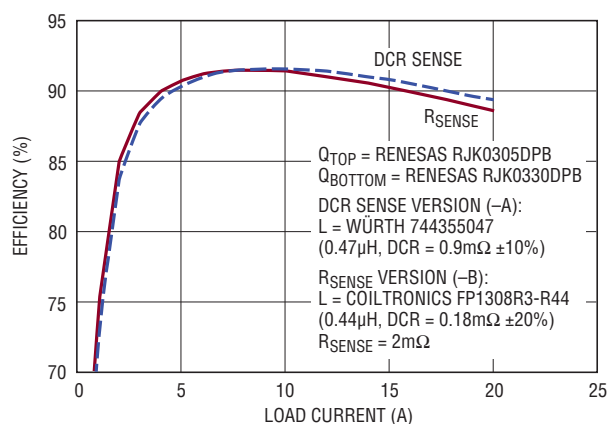
Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Demonstration circuit 1640A has a simple load step circuit consisting of a MOSFET and sense resistor. To apply a load step, follow the steps below.

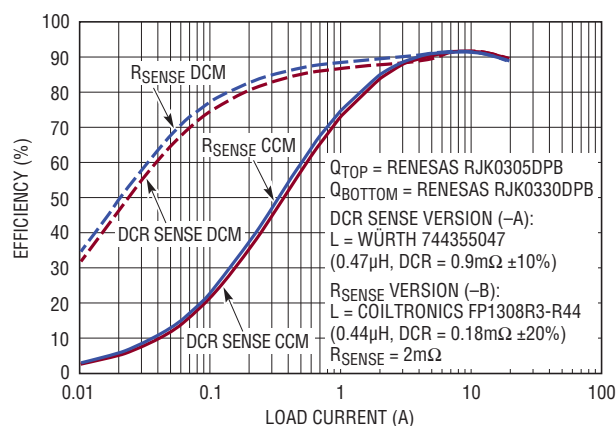
1. Preset the amplitude of a pulse generator to 0.0V and the duty cycle to 5% or less.
2. Connect the V_{OUT} and LOAD STEP BNC connectors to the oscilloscope. Use a short cable to minimize noise pickup.

3. Connect the output of the pulse generator to the PULSE GEN turret and connect the return to the GND turret.
4. With the converter running, slowly increase the amplitude of the pulse generator output to provide the desired load step pulse height. The scaling for the LOAD STEP signal is 10mV/Amp.



DC1640 F02

Figure 2. Efficiency Curves for the DC1640A in CCM.



DC1640 F03

Figure 3. Efficiency Curves for the DC1640A in CCM and DCM.

QUICK START PROCEDURE

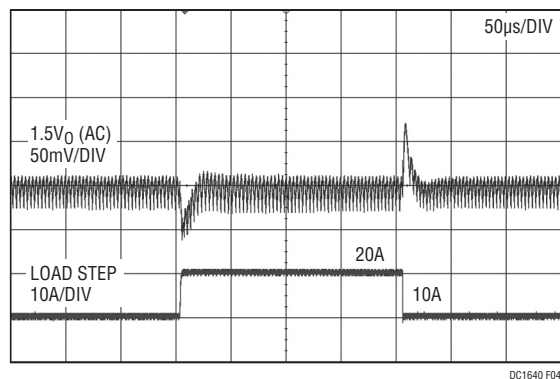


Figure 4. 10A to 20A to 10A Load Step Response of the DC1640A-A (DCR Sense) at $V_{IN} = 12V$. $C_{OUT} = 2 \times$ Sanyo 2R5TPE330M9 || 2x 100µF, X5R, 6.3V, 1206; $L = 0.47\mu H$; $F_{SW} = 300kHz$

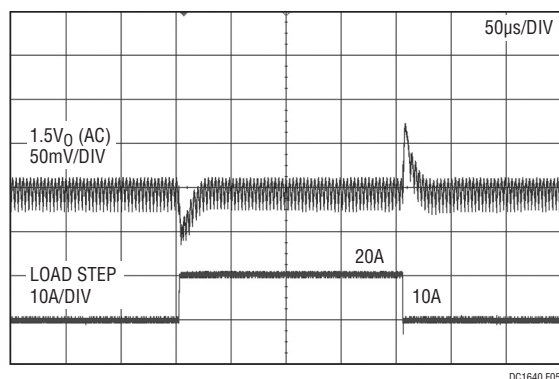


Figure 5. 10A to 20A to 10A Load Step Response of the DC1640A-B (R_{SENSE}) at $V_{IN} = 12V$. $C_{OUT} = 2 \times$ Sanyo 2R5TPE330M9 || 2x 100µF, X5R, 6.3V, 1206; $F_{SW} = 300kHz$; $L = 0.44\mu H$

PARTS LIST

DEMO CIRCUIT 1640A-A (DCR SENSE)

ITEM	QUANTITY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	Cap X7R 0.22 μ F 16V 10% 0603	AVX 0603YC224KAT2A
2	2	C3, C9	Cap X7R 0.1 μ F 16V 10% 0603	AVX 0603YC104KAT2A
3	1	C4	Cap X7R 0.01 μ F 16V 10% 0603	AVX 0603YC103KAT2A
4	1	C5	Cap C0G 100pF 50V 5% 0603	AVX 06035A101JAT2A
5	1	C6	Cap C0G 470pF 50V 10% 0603	AVX 06035A471KAT2A
6	1	C7	Cap X5R 4.7 μ F 16V 10% 0805	AVX 0805YD475KAT2A
7	3	CIN1, CIN2, CIN6	Cap X5R 22 μ F16V 10% 1210	Murata GRM32ER61C226KE20L
8	1	CIN4	Cap SVP 180 μ F 16V 30m Ω ESR	Sanyo 16SVP180MX
9	2	COUT1, COUT2	Cap X5R 100 μ F 6.3V 20% 1206	Murata GRM31CR60J107ME39L
10	2	COUT3, COUT4	Cap POSCAP 330 μ F 2.5V 20% 7343	Sanyo 2R5TPE330M9
11	1	D1	Diode Schottky 30V SOD323	Central Semi CMDSH-3TR
12	1	L1	Inductor 0.47 μ H	Würth Elektronik 744355047
13	1	Q1	MOSFET Power N-CH LFPK	Renesas RJK0305DPB
14	1	Q2	MOSFET Power N-CH LFPK	Renesas RJK0330DPB
15	1	R1	Res 100k 1/16W 5% 0603	Yageo RC0603JR-07100KL
16	2	R10, R11	Res 10 1/16W 5% 0603	Yageo RC0603JR-0710RL
17	2	R13, R17	Res 0 1/16W 0603	Yageo RC0603FR-070RL
18	1	R15	Res 13k 1/16W 1% 0603	Yageo RC0603FR-0713KL
19	1	R18	Res 137k 1/16W 1% 0603	Yageo RC0603FR-07137KL
20	1	R20	Res 2.2 1/16W 5% 0603	Yageo RC0603JR-072R2L
21	2	R21, R8	Res 10k 1/16W 1% 0603	Yageo RC0603FR-0710KL
22	2	R4, R9	Res 0 1/16W 0603	Yageo RC0603FR-070RL
23	1	R6	Res 15k 1/10W 1% 0603	Yageo RC0603FR-0715KL
24	1	R7	Res 2.15k 1/16W 1% 0603	Yageo RC0603FR-072K15L
25	1	RS1	Res 0.000 2512	Tepro RN5326
26	1	U1	IC LTC3833EUDC	Linear Technology LTC3833EUDC#PBF

Additional Circuit Components

1	0	C2, C8, C10	Cap 0603	OPT
2	0	CIN3	Cap SVP-F8	OPT
3	0	CIN5	Cap 1210	OPT
4	0	COUT5, COUT6	Cap 1206	OPT
5	0	Q3, Q4	MOSFET Power N-CH LFPK	OPT
6	1	Q5	MOSFET N-CH 30-V (D-S) DPAK-TO252AA	Vishay SUD50N03-12P-E3
7	1	R22	Res Chip 10k 1/16W 1% 0603	Yageo RC0603FR-0710KL
8	1	R23	Res 0.01 2% 2010	IRC LRC-LRF2010LF-01-R010-G
9	0	R2, R3, R12, R14, R5, R16, R19	Res 0603	OPT

Hardware for Demo Board Only

1	10	E1 to E10	Testpoint Turret .094"	Mill-Max 2501-2-00-80-00-00-07-0
2	4	J1, J2, J3, J4	Jack Banana	Keystone 575-4
3	2	J5, J6	Conn BNC 5 Pins	Connex 112404
4	2	JP1, JP2	Shunt 2MM Center	Samtec 2SN-BK-G
5	2	JP1, JP2	Header 2MM Single Row 3 Pin	Samtec TMM-103-02-L-S
6	4		Stand-Off Nylon 0.50"	Keystone 8833 (Snap-On)

DEMO MANUAL DC1640A

PARTS LIST

DEMO CIRCUIT 1640A-B (R_{SENSE})

ITEM	QUANTITY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	Cap X7R 1000pF 50V 5% 0603	AVX 06035C102JAT2A
2	2	C3, C9	Cap X7R 0.1µF 16V 10% 0603	AVX 0603YC104KAT2A
3	1	C4	Cap X7R 0.01µF 16V 10% 0603	AVX 0603YC103KAT2A
4	1	C5	Cap C0G 100pF 50V 5% 0603	AVX 06035A101JAT2A
5	1	C6	Cap C0G 470pF 50V 10% 0603	AVX 06035A471KAT2A
6	1	C7	Cap X5R 4.7µF 16V 10% 0805	AVX 0805YD475KAT2A
7	3	CIN1, CIN2, CIN6	Cap X5R 22µF16V 10% 1210	Murata GRM32ER61C226KE20L
8	1	CIN4	Cap SVP 180µF 16V 30mΩ ESR	Sanyo 16SVP180MX
9	2	COUT1, COUT2	Cap X5R 100µF 6.3V 20% 1206	Murata GRM31CR60J107ME39L
10	2	COUT3, COUT4	Cap Poscap 330µF 2.5V 20% 7343	Sanyo 2R5TPE330M9
11	1	D1	Diode Schottky 30V SOD323	Central Semi CMDSH-3TR
12	1	L1	Inductor 0.44µH	Cooper Bussmann FP1308R3-R44-R
13	1	Q1	MOSFET Power N-CH LPAK	Renesas RJK0305DPB
14	1	Q2	MOSFET Power N-CH LPAK	Renesas RJK0330DPB
15	1	R1	Res Chip 100k 1/16W 5% 0603	Yageo RC0603JR-07100KL
16	2	R10, R11	Res Chip 10 1/16W 5% 0603	Yageo RC0603JR-0710RL
17	1	R14	Res Chip 0 1/16W 0603	Yageo RC0603FR-070RL
18	1	R15	Res Chip 16.5k 1/16W 1% 0603	Yageo RC0603FR-0716K5L
19	1	R18	Res Chip 137k 1/16W 1% 0603	Yageo RC0603FR-07137KL
20	2	R2, R3	Res Chip 10 1/10W 1% 0603	Yageo RC0603FR-0710RL
21	1	R20	Res Chip 2.2 1/16W 5% 0603	Yageo RC0603JR-072R2L
22	2	R21, R8	Res Chip 10k 1/16W 1% 0603	Yageo RC0603FR-0710KL
23	2	R4, R9	Res Chip 0 1/16W 0603	Yageo RC0603FR-070RL
24	1	R6	Res Chip 15k 1/10W 1% 0603	Yageo RC0603FR-0715KL
25	1	RS1	Res Chip 0.002Ω 1W 1% 2512	Vishay WSL25122L000FEA
26	1	U1	IC LTC3833EUDC	Linear Technology LTC3833EUDC#PBF
Additional Circuit Components				
1	0	C2, C8, C10	Cap 0603	OPT
2	0	CIN3	Cap SVP-F8	OPT
3	0	CIN5	Cap 1210	OPT
4	0	COUT5, COUT6	Cap 1206	OPT
5	0	Q3, Q4	MOSFET Power N-CH LPAK	OPT
6	1	Q5	MOSFET N-CH 30-V (D-S) DPAK-T0252AA	Vishay SUD50N03-12P-E3
7	1	R22	Res Chip 10k 1/16W 1% 0603	Yageo RC0603FR-0710KL
8	1	R23	Res 0.01 2% 2010	IRC LRC-LRF2010LF-01-R010-G
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5	2	JP1, JP2	Header 2MM Single Row 3 Pin	Samtec TMM-103-02-L-S
6	4		Stand-Off Nylon 0.50"	Keystone 8833 (Snap-On)

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DEMO MANUAL DC1640A

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dc1640af

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