LTC3265EDHC
Low Noise Dual Supply with Boost and Inverting Charge Pumps

DESCRIPTION

Demonstration Circuit 2235A has boost and inverting charge pumps each with a low noise LDO post regulator featuring the LTC®3265EDHC. The LTC3265 operates with an input voltage from 4.5V to 16V for the boost charge pump and from 4.5V to 32V for the inverting charge pump. The demo board provides selectable LDO± output set magnitudes of 5V, 15V, and 24V for each polarity. The demo board also provides the means to select between low power Burst Mode® operation or low noise constant-frequency mode operation, plus select an operating frequency of 500kHz, 200kHz, or 50kHz.

The LTC3265 data sheet gives a complete description of the device, operation and application information. The data sheet must be read in conjunction with this demo manual.

**Design files for this circuit board are available at** http://www.linear.com/demo/DC2235A

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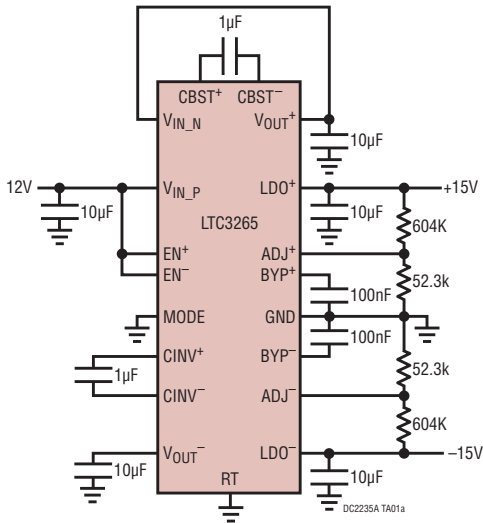
PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN_P}	V_{IN_P} Input Voltage Range		4.5		16	V
V_{IN_N}	V_{IN_N} Input Voltage Range		4.5		32	V
V_{LDO}^+	LDO⁺ Output Voltage	$V_{IN\_P} \cdot 2 \geq$ LDO⁺ Set Point + 0.8V	1.2		32	V
V_{LDO}^-	LDO⁻ Output Voltage	$V_{IN\_N} \leq$ LDO⁻ Set Point − 0.5V	−32		−1.2	V
V_{OUT}^+	V_{OUT}^+ Output Voltage Range	MODE = 0V (Const. Freq.) MODE ≥ 2V (Burst)		$V_{IN\_P} \cdot 2$ $0.94 \cdot V_{IN\_P} \cdot 2$		V V
V_{OUT}^-	V_{OUT}^- Output Voltage Range	MODE = 0V (Const. Freq.) MODE ≥ 2V (Burst)		$-V_{IN\_N}$ $-0.94 \cdot V_{IN\_N}$		V V

BOARD PHOTO

dc2235af
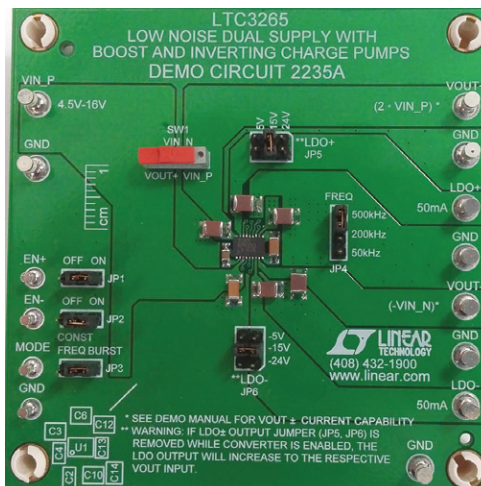
TYPICAL APPLICATIONS

Low Noise ±15V Outputs from a Single 12V Input

DC2235A TA01a

LDO Rejection of V_{OUT}± Ripple

DC2235A TA01b

$V_{IN\_P} = 12V$, $V_{IN\_N} = V_{OUT}^-$
$V_{LDO}^+ = 15V$
$V_{LDO}^- = -15V$
$f_{OSC} = 500kHz$
$I_{LDO}^+ = 20mA$
$I_{LDO}^- = -20mA$
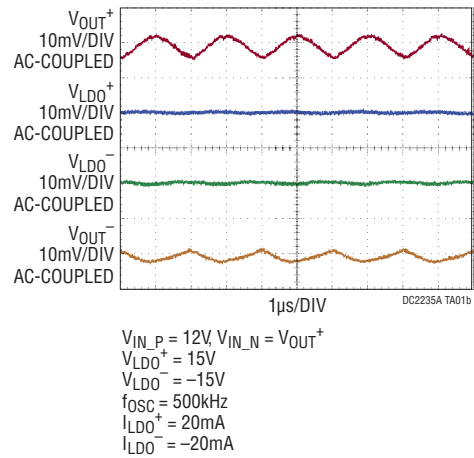
QUICK START PROCEDURE

Refer to Figure 1 for the proper measurement equipment setup and jumper settings 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. Make sure the jumper settings are as follows:

   JP1: EN$^+$ is on the ON position
   JP2: EN$^-$ is on the ON position
   JP3: MODE is in the Burst position
   JP4: FREQ is on the 500kHz position
   JP5: LDO$^+$ is set to 15V setting
   JP6: LDO$^-$ is set to –15V setting

2. Set SW1 to the V_{OUT}^+ position.

3. Set PS1 to 12V.

4. Slowly increase load on LDO$^-$ to –50mA and observe how output ripple on V_{OUT}^- changes and how burst frequency increases. When the load is large enough, the charge pump will run constant-frequency.

5. Slowly increase the load on LDO$^+$ to 50mA and observe the output ripple and the output voltage on LDO$^+$.

6. Set the LDO$^+$ load and the LDO$^-$ load to 0mA and turn off PS1.

7. Set SW1 to the V_{IN_P} position.

8. Set JP5 LDO$^+$ jumper to 5V position and JP6 LDO$^-$ to the –5V position.

   Note: It is recommended to remove power or disable the respective regulators prior to changing the positions of the LDO$^\pm$ output jumpers (JP5, JP6).

9. Repeat steps 3 through 6.

10. Set JP5 LDO$^+$ jumper to 24V position and JP6 LDO$^-$ to the –24V position.

11. Set SW1 to the V_{OUT}^+ position

12. Turn on and set PS1 to 15V.

13. Repeat steps 4 through 6.

14. Return JP5 LDO$^+$ jumper to 15V position and JP5 LDO$^-$ to the –15V position.

15. Turn on and set PS1 to 12V.

QUICK START PROCEDURE

16. Slowly increase the load on V_{OUT}^+ to 100mA and observe the output ripple and output voltage on V_{OUT}^+.

17. Set the load on V_{OUT}^+ to 0mA.

18. Slowly increase the load on V_{OUT}^- to –100mA and observe the output ripple and output voltage on V_{OUT}^-.

19. Set the load on V_{OUT}^- to 0mA.

20. Change JP3 MODE jumper from Burst Mode operation to the constant-frequency mode and repeat steps 16 to 19.

21. Change JP4 FREQ jumper from 500kHz to 200kHz then slowly increase the load on V_{OUT}^+ from 0mA to 50mA and observe the output ripple and output voltage on V_{OUT}^+.

22. Set the load on V_{OUT}^+ to 0mA.

23. Slowly increase the load on V_{OUT}^- to –50mA and observe the output ripple and output voltage on V_{OUT}^-.

24. Set the load on V_{OUT}^- to 0mA.

25. Change JP4 FREQ jumper from 200kHz to 50kHz. Slowly increase the load on V_{OUT}^+ from 0mA to 10mA and observe the output ripple and output voltage on V_{OUT}^+.

26. Set the load on V_{OUT}^+ to 0mA.

27. Slowly increase the load on V_{OUT}^- to -10mA and observe the output ripple and output voltage on V_{OUT}^-.

28. Set the load on V_{OUT}^- to 0mA.
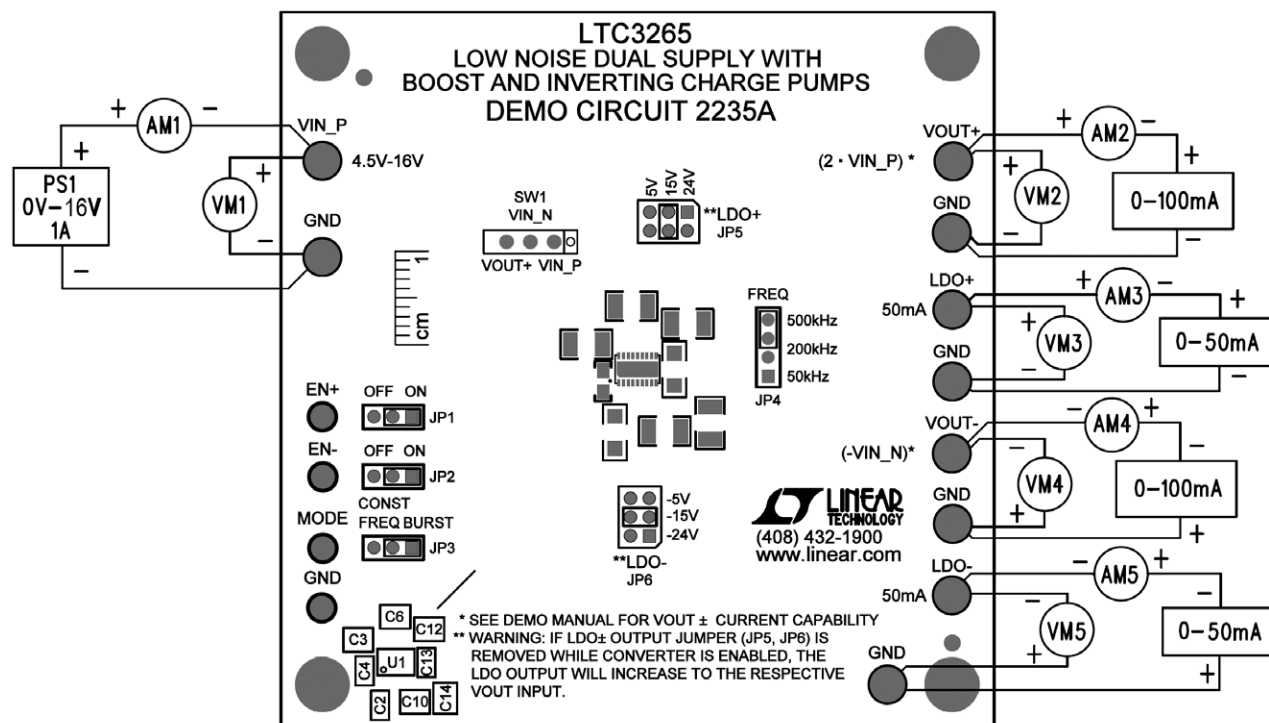
29. Turn off the loads and supply when done.

Figure 1. Proper Measurement Equipment Setup for DC2235A
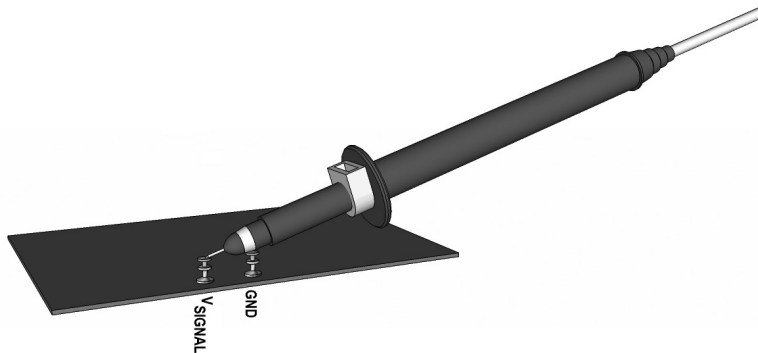
QUICK START PROCEDURE

Figure 2. Measuring Input or Output Ripple

APPLICATIONS INFORMATION

Figure 3 illustrates the voltage loss from the ideal boost charge pump output voltage of $2 \cdot V_{IN\_P}$ to the measured V_{OUT}^+ voltage. Figure 4 illustrates the voltage loss from the ideal inverting charge pump output voltage of $-V_{IN\_N}$ to the measured V_{OUT}^- voltage.
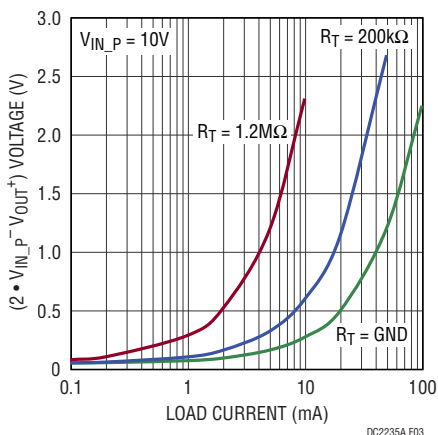

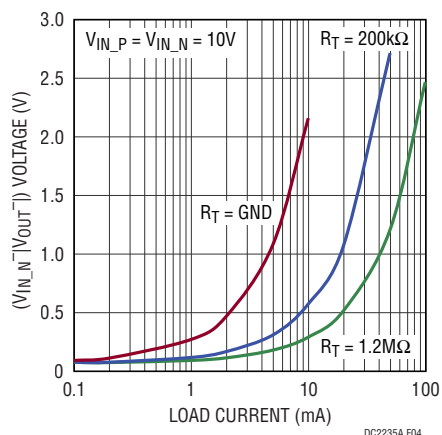**Figure 3. V_{OUT}^+ Voltage Loss vs Output Current (Constant-Frequency Mode)**

Figure 4. V_{OUT}^- Voltage Loss vs Output Current (Constant-Frequency Mode)

APPLICATIONS INFORMATION

Figures 5 and 6 are CISPR radiated and conducted emissions respectively. The data were collected in a GTEM chamber and using a CISPR25 LISN for conducted emissions. The EMI tests were conducted using a 12V input on V_{IN_P}, V_{OUT}^+ connected to V_{IN_N} via SW1 of the demo board, and a 600Ω resistor load between LDO$^+$ and

LDO$^-$ in constant-frequency mode with a 500kHz oscillator frequency. Linear Technology has made every effort to provide useful and accurate EMI data, but it remains the responsibility of the customer to ensure product compliance with applicable rules and regulations.
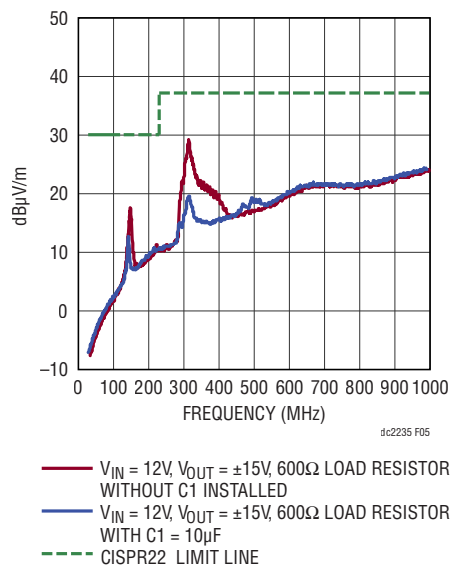

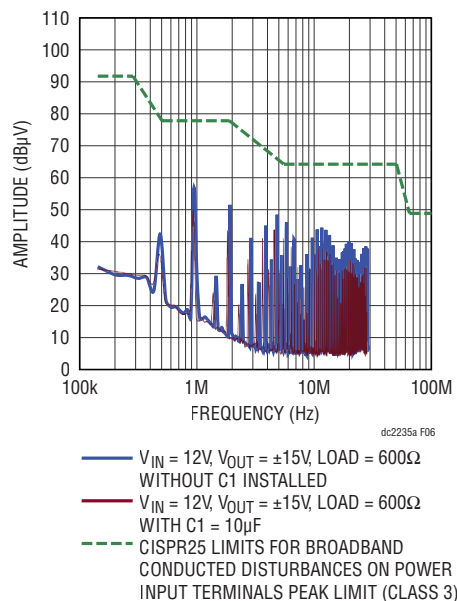—— V_{IN} = 12V, V_{OUT} = ±15V, 600Ω LOAD RESISTOR WITHOUT C1 INSTALLED
—— V_{IN} = 12V, V_{OUT} = ±15V, 600Ω LOAD RESISTOR WITH C1 = 10µF
----- CISPR22 LIMIT LINE

Figure 5. CISPR22 Radiated Emissions

—— V_{IN} = 12V, V_{OUT} = ±15V, LOAD = 600Ω WITHOUT C1 INSTALLED
—— V_{IN} = 12V, V_{OUT} = ±15V, LOAD = 600Ω WITH C1 = 10µF
----- CISPR25 LIMITS FOR BROADBAND CONDUCTED DISTURBANCES ON POWER INPUT TERMINALS PEAK LIMIT (CLASS 3)

Figure 6. CISPR25 Conducted Emissions

dc2235af

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C2	CAP, CHIP, X7R,10µF, ±10%, 25V, 1206	WURTH ELEKTRONIK, 885012208069
2	5	C3, C6, C10, C12, C14	CAP, CHIP, X7S, 10µF, ±10%, 50V, 1210	TDK, C3225X7S1H106K250AB
3	1	C4	CAP, CHIP, X7R, 1µF, ±10%, 25V, 0805	TDK, C2012X7R1E105K125AB
4	1	C13	CAP, CHIP, X7R, 1µF, ±10%, 50V, 1206	TDK, C3216X7R1H105K160AB
5	2	R3, R9	RES 604kΩ 1/16W 1% 0402 SMD	VISHAY, CRCW0402604KFKED
6	2	R11, R12	RES 52.3kΩ 1/16W 1% 0402 SMD	VISHAY, CRCW040252K3FKED
7	1	U1	LOW NOISE DUAL SUPPLY WITH BOOST AND INVERTING CHARGE PUMPS	LINEAR TECH., LTC3265EDHC#PBF
Additional Demo Board Circuit Components				
8	1	C1	CAP, CHIP, X7R,10µF, ±10%, 25V, 1206	WURTH, 885012208069
9	0	C5, C7, C9 (OPT)	CAP, CHIP, 25V, 0603	
10	2	C8, C11	CAP, CHIP, X7R, .1µF, ±10%, 16V, 0402	MURATA, GRM155R71C104KA88D
11	2	C15, C16	CAP, CHIP, NPO, 10pF, ±5%, 50V, 0402	AVX, 04025A100JAT2A
12	3	R1, R6, R13	RES 1.0MΩ 1/16W 5% 0402 SMD	VISHAY, CRCW04021M00JNED
13	2	R2, R8	RES 1.0MΩ 1/16W 1% 0402 SMD	VISHAY, CRCW04021M00FKED
14	2	R4, R10	RES 165kΩ 1/16W 1% 0402 SMD	VISHAY, CRCW0402165KFKED
15	3	R5, R7, R14	RES 4.7kΩ 1/16W 5% 0402 SMD	VISHAY, CRCW04024K70JNED
16	1	R15	RES 909kΩ 1/16W 1% 0402 SMD	VISHAY, CRCW0402909KFKED
17	1	R16	RES 200kΩ 1/16W 1% 0402 SMD	VISHAY, CRCW0402200KFKED
Hardware				
18	3	JP1, JP2, JP3	HEADER, 3-PIN 1 ROW 0.079CC	SULLIN, NRPN031PAEN-RC
19	1	JP4	HEADER, 4-PIN 1 ROW 0.079CC	SULLIN, NRPN041PAEN-RC
20	2	JP5, JP6	HEADER, 2 × 3 PINS, 2mm	SULLIN, NRPN032PAEN-RC
21	6	JP1-JP6	SHUNT, 2mm	SAMTEC, 2SN-BK-G
22	10	E1, E2, E7-E14	TP, TURRET, 0.094", PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
23	4	E3-E6	TURRET, 0.061" DIA	MILL-MAX, 2308-2-00-80-00-00-07-0
24	4	MH1-MH4	STAND-OFF, NYLON 0.375" TALL	KEYSTONE, 8832 (SNAP ON)
25	1	SW1	10mm × 2.5mm, SLIDE SWITCH, THT	WURTH ELEKTRONIK, 450301014042

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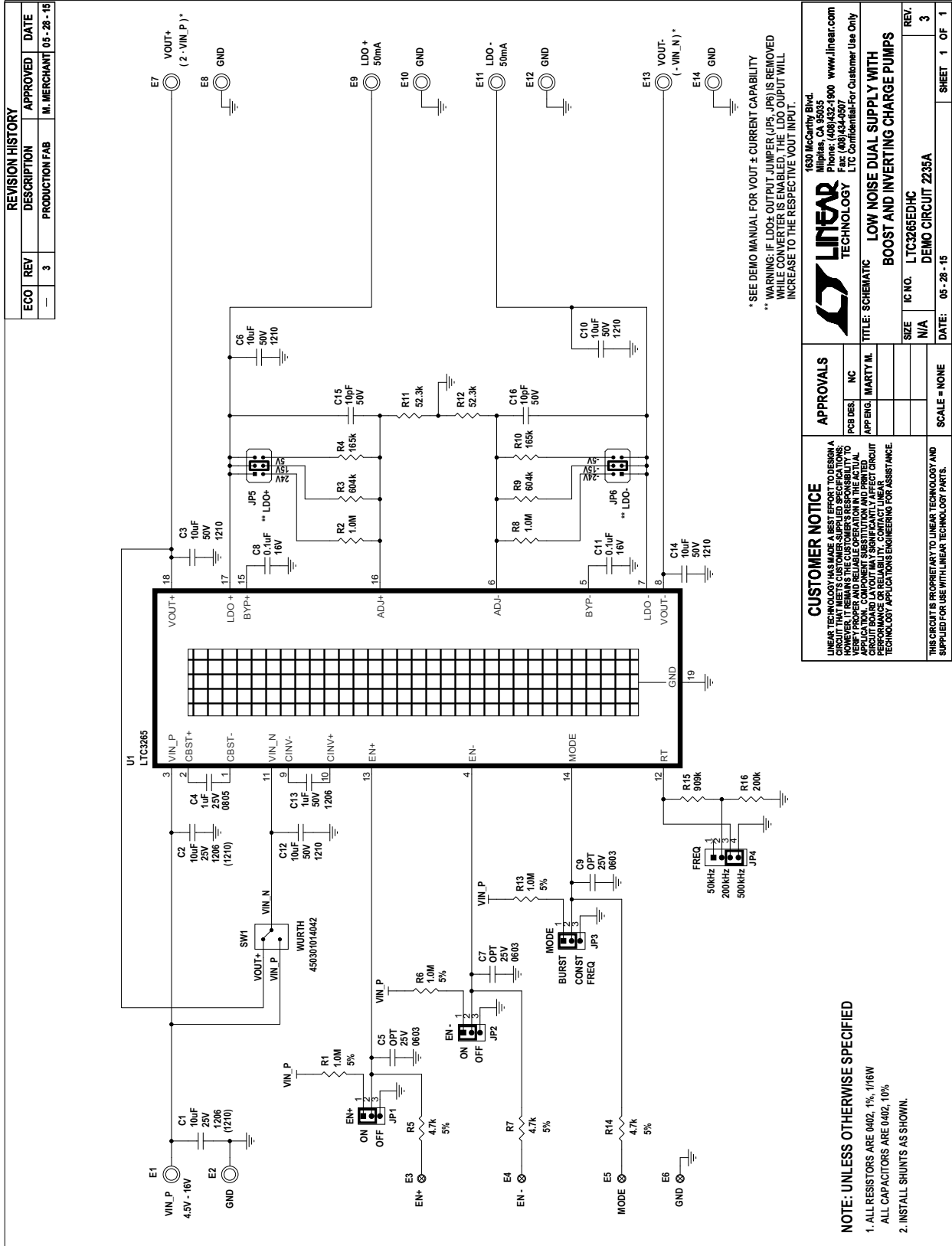
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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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