LTC3290
High Voltage Boost Charge Pump

DESCRIPTION

Demonstration circuit 2585A contains two circuits featuring the LTC®3290. The top LTC3290 circuit operates as a high voltage boost by using the power from two input supplies to create a higher output voltage. The bottom LTC3290 circuit operates as a V_{IN} tracking supply by using the power from an auxiliary supply input (V_{AUX}) and regulating a voltage above the V_{IN} supply input. The wide V_{IN}/V_{AUX} range allows two voltages to be used together to efficiently create a third voltage, boost from a single supply to boost, or regulate above a variable input voltage like a battery.

The high efficiency boost circuit has three selectable outputs, 15V, 24V, or 42V. If a different output is desired then the top resistor, R2, and/or the bottom resistor, R6, can be changed to provide a different output voltage. Refer to the LTC3290 data sheet and demo board schematic for more information on how to set the output voltage for the LTC3290.

The V_{IN} tracking circuit also has three selectable outputs, V_{IN2} + 5V, V_{IN2} + 10V, and V_{IN2} + 15V. If a different output voltage is desired, then R9 and/or R13 can be changed to set a different output. Refer to the LTC3290 data sheet for more information on how to set the output voltage in V_{IN} tracking mode.

The LTC3290 can use two separate supplies or a single supply connected to both inputs for either circuit. This can be useful to boost or track a battery voltage with a regulated output.

The LTC3290 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.

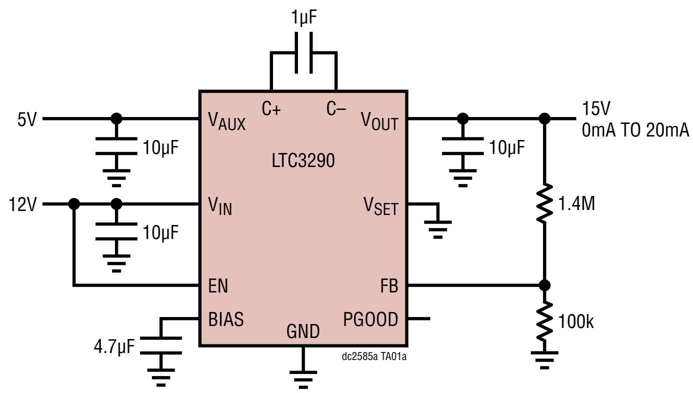
PERFORMANCE SUMMARY Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	V_{IN} Input Voltage Range		4.5		50.5	V
V_{AUX}	V_{AUX} Input Voltage Range		4.5		50.5	V
V_{IN} +V_{AUX}	Sum of Input Voltage Range		9		55	V
V_{OUT1}	V_{OUT} Output Voltage Range (High Efficiency Boost Circuit)*	$V_{IN1} + V_{AUX1} \geq 15V + R_{OL} \bullet I_{OUT}$, JP1 = 15V $V_{IN1} + V_{AUX1} \geq 24V + R_{OL} \bullet I_{OUT}$, JP1 = 24V $V_{IN1} + V_{AUX1} \geq 42V + R_{OL} \bullet I_{OUT}$, JP1 = 42V	14.5 23.3 40.8	15 24 42	15.5 24.7 43.2	V V V
V_{OUT2}	V_{OUT} Output Voltage Range (V_{IN} Tracking Circuit)*	$V_{AUX2} \geq 5V + R_{OL} \bullet I_{OUT}$, JP4 = V_{IN2} + 5V $V_{AUX2} \geq 10V + R_{OL} \bullet I_{OUT}$, JP4 = V_{IN2} + 10V $V_{AUX2} \geq 15V + R_{OL} \bullet I_{OUT}$, JP4 = V_{IN2} + 15V	V_{IN2} + 4.80 V_{IN2} + 9.7 V_{IN2} + 14.55	V_{IN2} + 5 V_{IN2} + 10 V_{IN2} + 15	V_{IN2} + 5.15 V_{IN2} + 10.3 V_{IN2} + 15.45	V V V

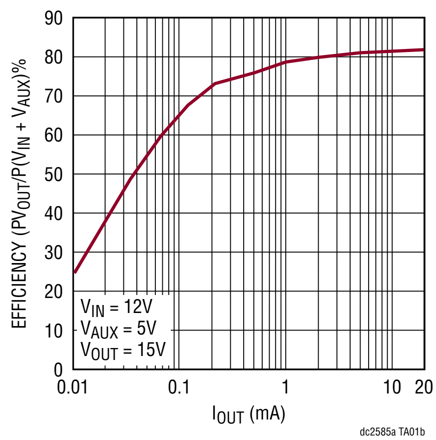
*R_{OL} is the effective open loop resistance and is typically about 65Ω. Refer to the Available Output Current section of the LTC3290 data sheet for more information about this.

TYPICAL APPLICATIONS

15V Output from a 12V Input (with 5V Auxiliary Input) Standard Boost Charge Pump Mode, V_{SET} = 0V

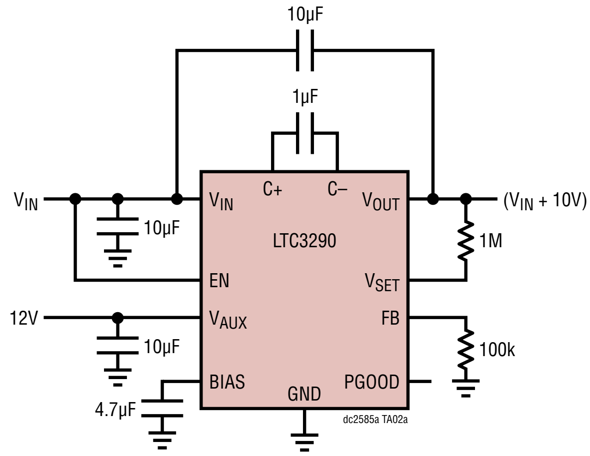


Efficiency vs Output Current

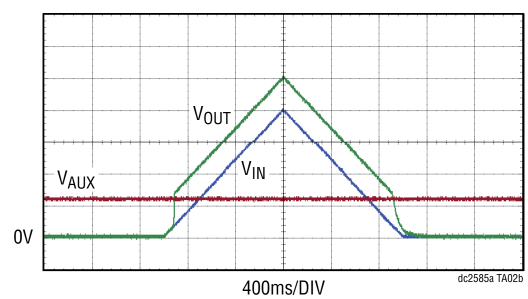


TYPICAL APPLICATIONS

(V_{IN} + 10V) Tracking Power Supply



V_{OUT}, V_{IN} vs Time



V_{AUX} = 12V
V_{IN} RAMP FROM 0V TO 40V
V_{OUT} = V_{IN} + 10V
I_{OUT} = 1mA (FROM V_{OUT} TO V_{IN})
ALL CHANNELS 10V/DIV

QUICK START PROCEDURE

ASSEMBLY TEST 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.

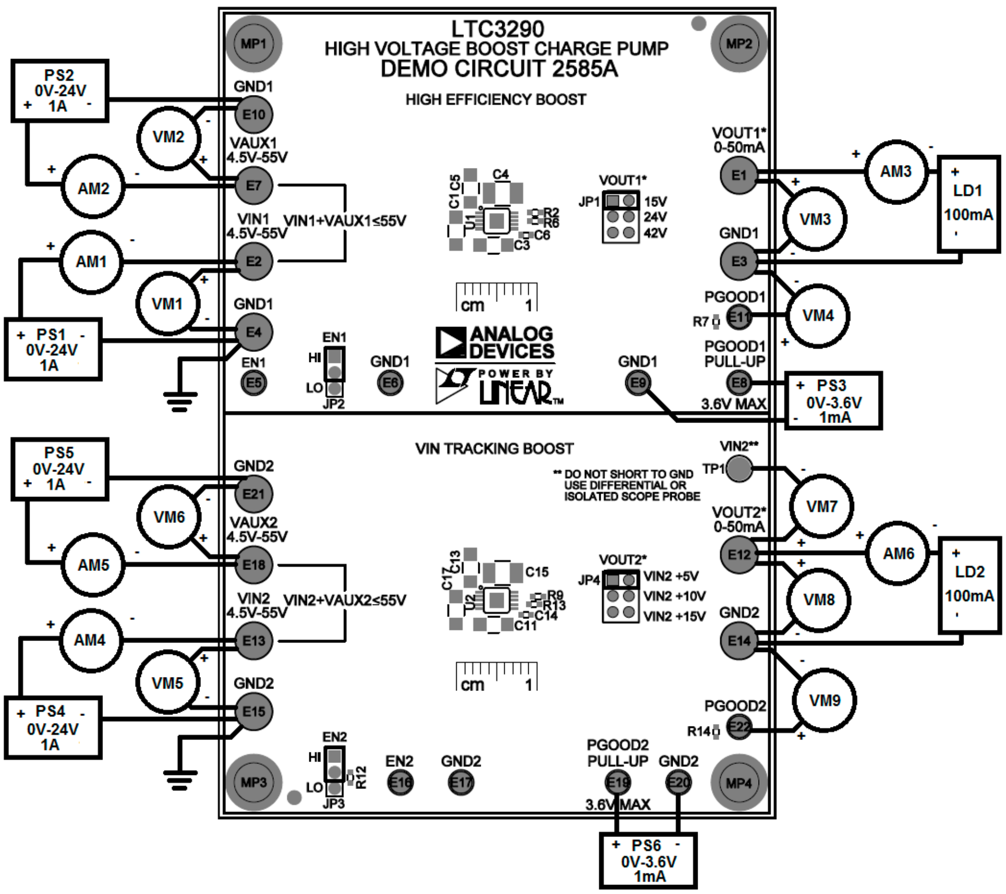


Figure 1. Proper Measurement Equipment Setup for DC2585A

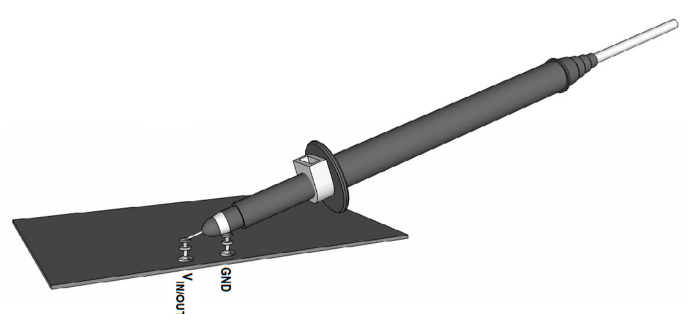


Figure 2. Measuring Input or Output Ripple

Rev. 0

QUICK START PROCEDURE

HIGH EFFICIENCY BOOST CIRCUIT

1. Make sure the jumper settings are as follows:

   JP1: V_{OUT1} is on the 15V position.

   JP2: EN1 is on the HI position.

2. Set PS1 and PS2 to 1V and then turn on. If AM1 and AM2 < 10mA then set both PS1 and PS2 to 10V.

   NOTE: Make sure that the sum of V_{IN1} and V_{AUX1} ≤ 55V.

3. Set LD1 to 5mA and observe the output voltage, I_{IN}, I_{AUX} and the output ripple on an oscilloscope.
4. Increase the load slowly up to 50mA and observe the output voltage, I_{IN}, I_{AUX}, and the output ripple on an oscilloscope.
5. If it is desired to observe PGOOD1, set PS3 to 3.3V as shown in Figure 1 and observe PGOOD1 with a DVM, VM4 in Figure 1.
6. If a different output voltage or input voltage is desired, disable the LTC3290 by moving JP2 to the LO position and then turn off LD1. Then move JP1 to the desired V_{OUT1} selection or replace R2 and/or R6 to obtain the desired output voltage. Then re-enable the LTC3290 by returning JP2 to the HI position.

   NOTE: If R2 and/or R6 are to be replaced, turn off PS1 and PS2 to prevent damage due to soldering a hot circuit.

7. Adjust PS1 and PS2 to the desired voltages and turn on and set LD1 to the desired load.
8. When done, turn off LD1, PS1, PS2 and PS3.

V_{IN} TRACKING BOOST CIRCUIT

9. Make sure the jumper settings are as follows:

   JP3: EN2 is on the HI position.

   JP4: V_{OUT2} is on the V_{IN2} +5V position.

10. Set PS4 and PS5 to 1V and then turn on. If AM4 and AM5 < 10mA then set both PS4 and PS5 to 10V.

    NOTE: Make sure that the sum of V_{IN2} and V_{AUX2} ≤ 55V.

11. Set LD2 to 5mA and observe the output voltage, I_{IN}, I_{AUX}, and the output ripple on an oscilloscope.
12. Increase the load slowly up to 50mA and observe the output voltage, I_{IN}, I_{AUX}, and the output ripple on an oscilloscope.

    NOTE: When the LTC3290 is disabled, V_{OUT} is high impedance and can be 0V. If an electronic load is placed from V_{OUT2} to V_{IN2}, V_{OUT2} can have a negative potential with respect to V_{IN2}. Care must be used with loads that are high impedance when disabled when connecting a load between V_{OUT2} and V_{IN2}.

13. If it is desired to observe PGOOD2, set PS6 to 3.3V as shown in Figure 1 and observe PGOOD2 with a DVM, VM9 in Figure 1.
14. Slowly decrease PS4 to 5V and observe the output voltage, I_{IN}, I_{AUX}, and the output ripple on an oscilloscope.
15. Slowly increase PS4 to 24V and observe the output voltage, I_{IN}, I_{AUX}, and the output ripple on an oscilloscope.
16. To observe V_{OUT2} with respect to V_{IN2}, place a DVM from V_{OUT2} to TP1, V_{IN2}. A differential oscilloscope or isolated scope probe can be used to view V_{OUT2} with respect to V_{IN2}.

    NOTE: Do not short TP1 to GND.

17. If a different output voltage or input voltage is desired, disable the LTC3290 by moving JP3 to the LO position and then turn off LD2. Then move JP4 to the desired V_{OUT} selection or replace R9 and/or R13. Then re-enable the LTC3290 by returning JP2 to the HI position.

    NOTE: If R9 and/or R13 are to be replaced, turn off PS4 and PS5 to prevent damage due to soldering a hot circuit.

18. Adjust PS4 and PS5 to the desired voltages and turn on and set LD2 to the desired load.
19. When done, turn off LD2, PS4, PS5 and PS6.

QUICK START PROCEDURE

BOOST CHARGE PUMP WITH V_{OUT} REGULATION

The LTC3290 can be set up as a high voltage boost charge pump by utilizing two supply inputs to boost to a higher regulated voltage. To operate in this mode the V_{SET} pin is tied to GND and V_{OUT} is set by a voltage divider from V_{OUT} to GND. The output is regulated to a 1V reference compared to the voltage sensed on the FB pin.

The V_{OUT} output voltage is given by:

$$V_{OUT} = 1V \bullet \left(\frac{R2}{R1} + 1\right)$$

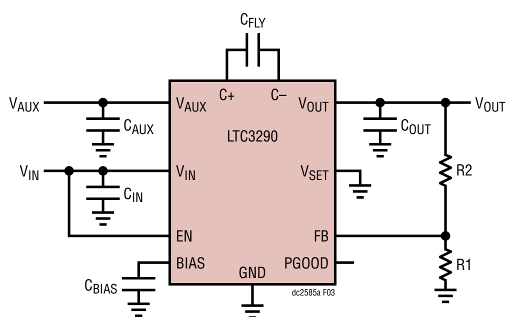


Figure 3. Boost Charge Pump with V_{OUT} Regulation

V_{IN} TRACKING MODE BOOST CHARGE PUMP

The LTC3290 can also be set to regulate a fixed voltage above an input voltage. With this circuit a resistor on the FB pin is used to set up a current using a 1V reference. A second resistor is connected between the V_{OUT} and V_{SET} pins to set a voltage above the V_{IN} supply.

The V_{OUT} voltage in this configuration is given by:

$$V_{OUT} = V_{IN} + 1V \bullet \left(\frac{R2}{R1}\right)$$

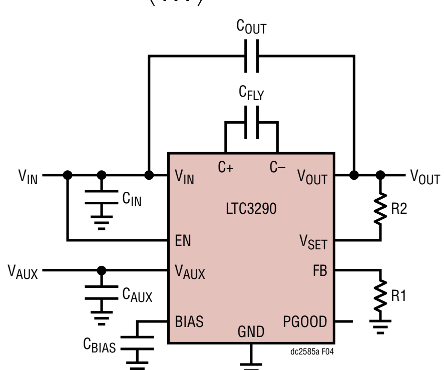


Figure 4. Boost Charge Pump with V_{IN} Tracking

AVAILABLE OUTPUT CURRENT

The available output current can be limited by the effective open-loop resistance (R_{OL}). The R_{OL} is affected by the oscillator frequency, value of the flying cap, nonoverlap time, internal switch resistance, and ESR of the external capacitors. The typical ROL is 65Ω and can increase with temperature.

The available output current is given by:

$$I_{OUT} = \frac{(V_{IN} + V_{AUX}) - V_{OUT}}{R_{OL}}$$

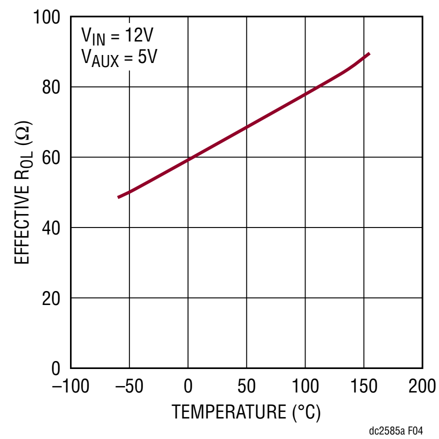


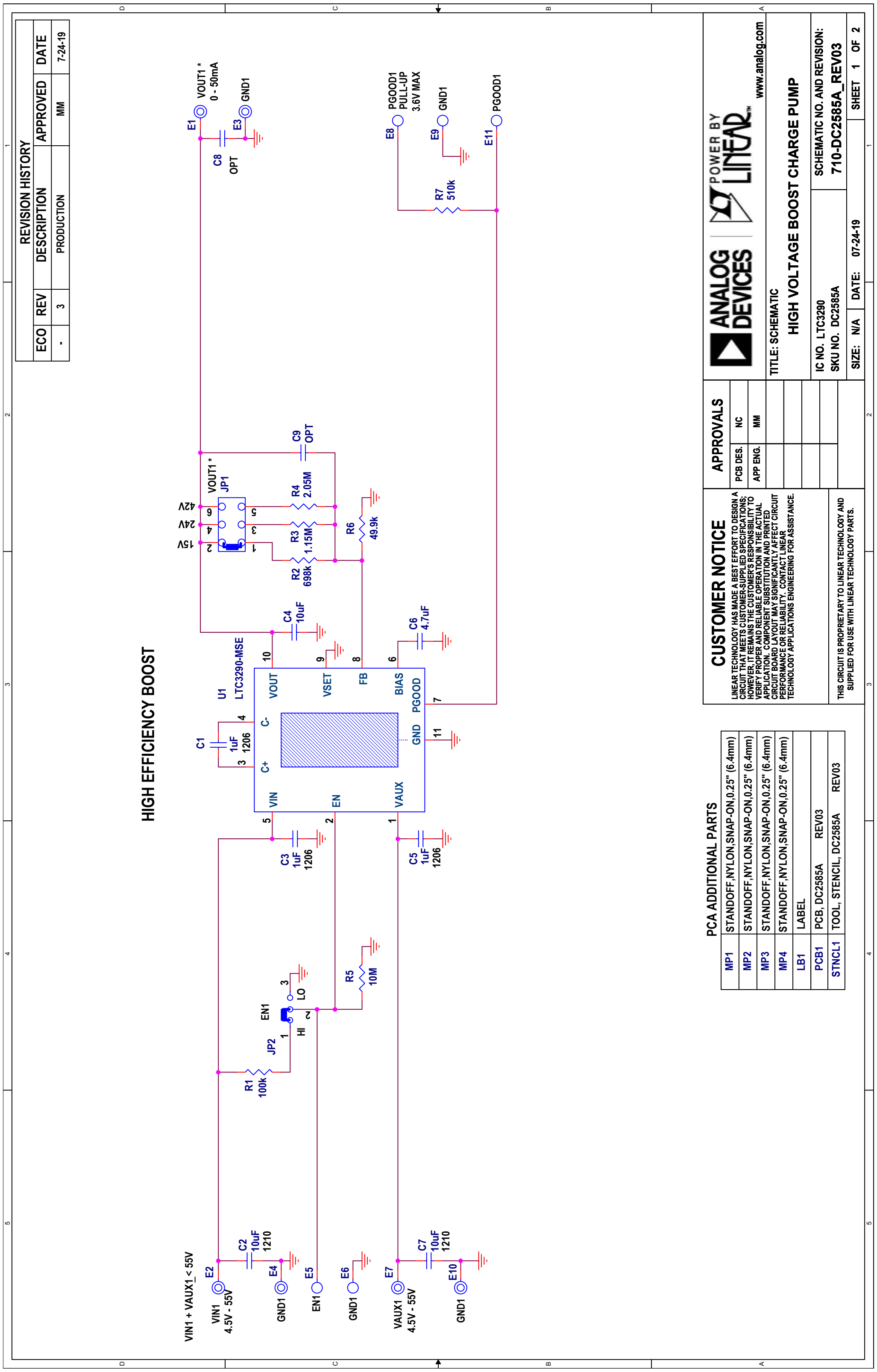
Figure 5. Typical R_{OL} vs Temperature

Rev. 0

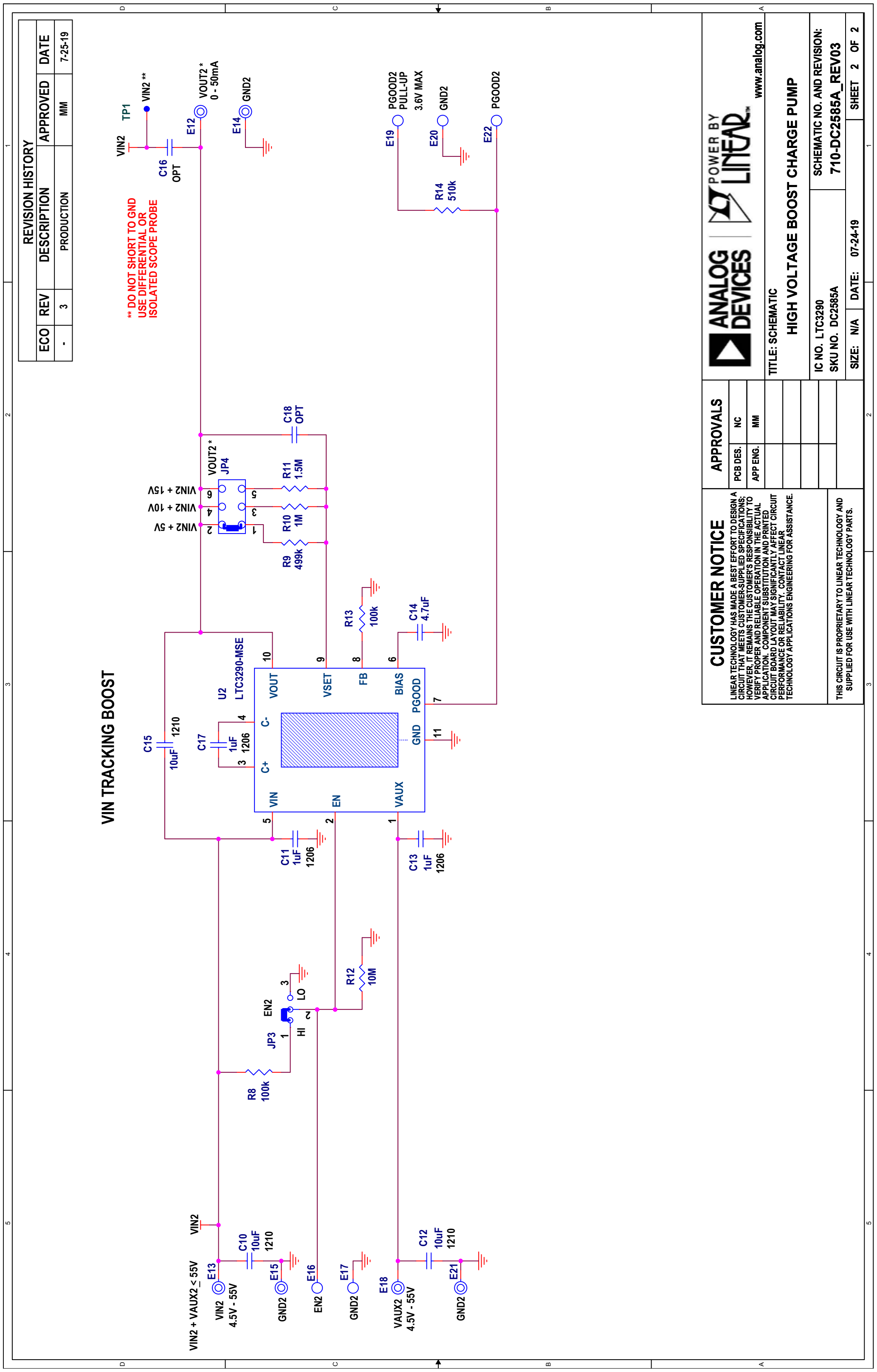
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	6	C1, C3, C5, C11, C13, C17	CAP., 1µF, X7R, 100V, 10%, 1206	AVX, 12061C105KAT2A
2	2	C4, C15	CAP., 10µF, X7S, 100V, 10%, 1210	MURATA, GRM32EC72A106KE05L
3	2	C6, C14	CAP., 4.7µF, X5R, 6.3V, 20%, 0402	MURATA, GRM155R60J475ME87D
4	1	R2	RES., 698k, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW0402698KFKED
5	1	R5	RES., 10MΩ, 5%, 1/16W, 0402	VISHAY, CRCW040210M0JNED
6	1	R6	RES., 49.9k, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW040249K9FKED
7	1	R9	RES., 499k, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW0402499KFKED
8	1	R13	RES., 100k, 1%, 1/10W, 0402, AEC-Q200	PANASONIC, ERJ2RKF1003X
9	2	U1, U2	IC, HIGH VOLTAGE BOOST CHARGE PUMP	ANALOG DEVICES, LTC3290EMSE#PBF
Additional Demo Board Circuit Components				
1	4	C2, C7, C10, C12	CAP., 10µF, X7S, 100V, 10%, 1210	MURATA, GRM32EC72A106KE05L
2	2	R1, R8	RES., 100k, 5%, 1/16W, 0402	YAGEO, RC0402JR-07100KL
3	1	R3	RES., 1.15MΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW04021M15FKED
4	1	R4	RES., 2.05MΩ, 1%, 1/16W, 0402	VISHAY, CRCW04022M05FKED
5	2	R7, R14	RES., 510k, 5%, 1/16W, 0402	VISHAY, CRCW0402510KJNED
6	1	R10	RES., 1MΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW04021M00FKED
7	1	R11	RES., 1.5MΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW04021M50FKED
8	1	R12	RES., 10MΩ, 5%, 1/16W, 0402	VISHAY, CRCW040210M0JNED
Hardware				
1	12	E1-E4, E7, E10, E12-E15, E18, E21	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	10	E5, E6, E8, E9, E11, E16, E17, E19, E20, E22	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2308-2-00-80-00-00-07-0
3	2	JP1, JP4	CONN., HDR., MALE, 2×3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
4	2	JP2, JP3	CONN., HDR, MALE, 1×3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000311121
5	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 0.25" (6.4mm)	KEYSTONE, 8831
6	4	XJP1, XJP2, XJP4, XJP5	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



Rev. 0

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Rev. 0

11/19

ANALOG DEVICES

www.analog.com