LT3744
High Current Synchronous Inverting Buck-Boost LED Driver

DESCRIPTION

Demonstration circuit 1930A is a high current synchronous inverting buck-boost LED driver featuring the LT®3744. The unique drive stage used on the LT3744 allows the anodes of three LEDs to be connected together for better heat sinking in both the step-down configuration and the inverting buck-boost configuration. The pros and cons of each configuration can be found in the data sheet. This demonstration circuit 1930A is for customers to test the inverting buck-boost configuration. The step-down configuration is shown in a separate demonstration circuit DC2339A.

The components are optimized for the efficiency, thermal and PWM dimming for a 12V input. Each of the three outputs is up to 5V, 12A with a 6.05V maximum output voltage limit. The PWM1, PWM2 and PWM3 pins are set to low by default. A DC or PWM signal is required to connect to at least one of the PWM pins to enable the circuit. At any giving time, output current only passes through one LED determined by settings of PWM pins.

The CTRL1, CTRL2 and CTRL3 pins can be adjusted to provide accurate analog dimming down to 20:1 ratio.

The input voltage range for the LT3744 to operate is from 3.3V to 36V. However, to maintain the output current regulation in an inverting buck-boost regulator, the actual input voltage range is determined by the load current, voltage, the maximum duty cycle, etc. For a 5V, 12A load, the demo board operating input range should limit to 7V to 30V at room temperature. The load to be used with this demo board is high current LEDs or laser diodes. Smaller LEDs may not be able to handle the high current, even for a short period of time. It is necessary to mount the LED load on a proper heat sink. A fan may become necessary to avoid exceeding LED's maximum temperate rating.

The typical efficiency of the demo board is 89.3% from a 12V input to 4V, 12A load. If an efficiency measurement is needed in an application, the output voltage must be measured at the output capacitors instead of the LED load. This prevents cable loss from being counted as loss of the board.

The demo circuit DC1930A achieves fast current rise time from 0A to 12A in 5µs. To see the real rise time, wires between the LED and the board should be as short as possible to minimize the wire inductance and resistance. It is recommended to measure the voltage across R32 with a short 50Ω coax cable directly into a BNC connector on the oscilloscope. Figure 1 shows the current rise time. The current can be calculated from the measured voltage. A current probe adds more delays to the rise time so using a current probe is not recommended unless rise time is not a concern.

The LT3744 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1930A.

Design files for this circuit board are available at http://www.linear.com/demo/DC1930A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
PV_{IN}*	Input Supply Voltage	LED Voltage = 5V	7		30	V
V_{LED}^+ to V_{LED}^-	Maximum Output Voltage			6.05		V
I_{OUT}	Output Current	CTRL1, CTRL2, CTRL3 = 1.5V	11.4	12	12.6	A
F_{SW}	Switching Frequency		270	300	330	kHz
EFF	Efficiency at DC	V_{IN} = 12V, I_{OUT} = 12A, V_{OUT} = 4V		89.3		%

*The board operating voltage range is narrower than the IC operating range in an inverting buck-boost configuration.

DESCRIPTION

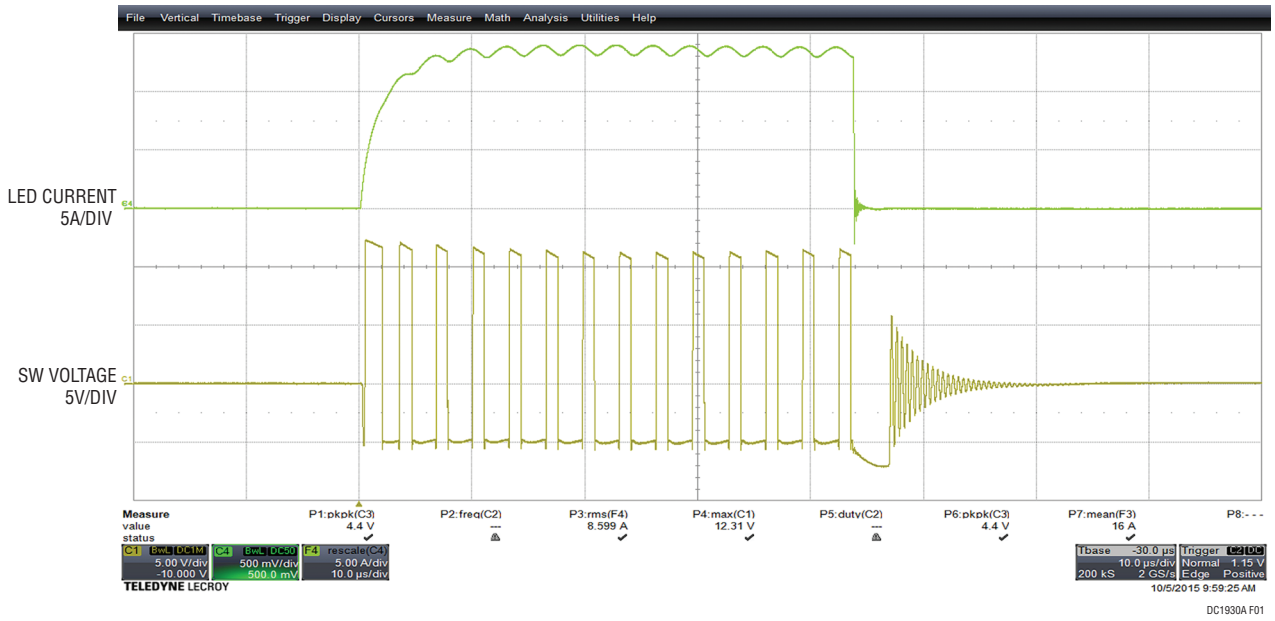


Figure 1: DC1930A Current Rise Time: V_{IN} = 12V, LED Voltage = 4.2V when ON. Total LED Current = 12A

QUICK START PROCEDURE

Demonstration circuit 1930A is easy to set up to evaluate the performance of the LT3744. Refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to PV_{IN} and GND. Note: make sure PV_{IN} is below 30V.
2. With power off, connect the LED load to V_{LED}^+ and proper LED1$^-$, LED2$^-$, LED3$^-$ according to the setting of the PWM pins.
3. Turn on the power at the input.
4. Carefully evaluate other design parameters as needed.

QUICK START PROCEDURE

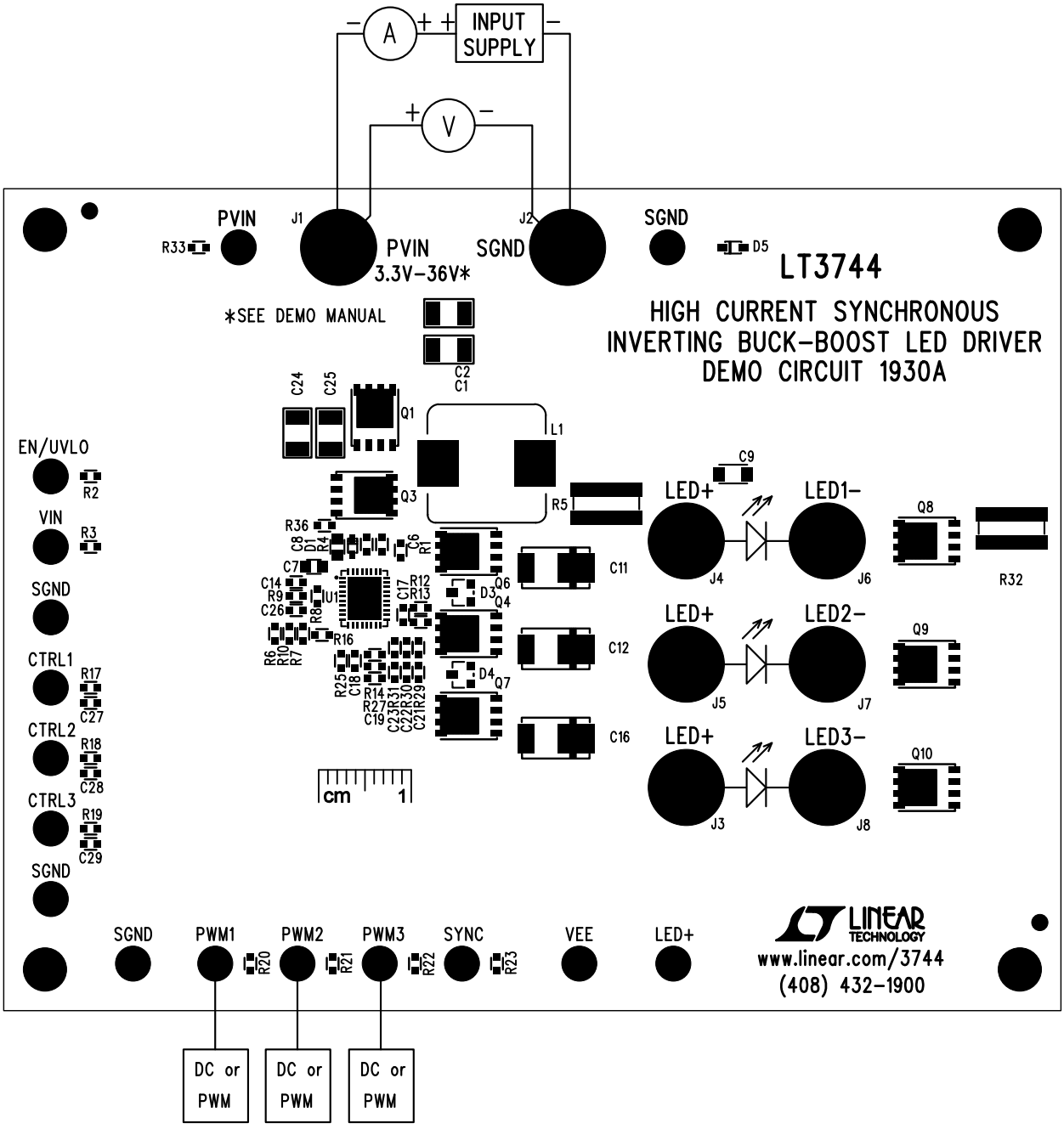
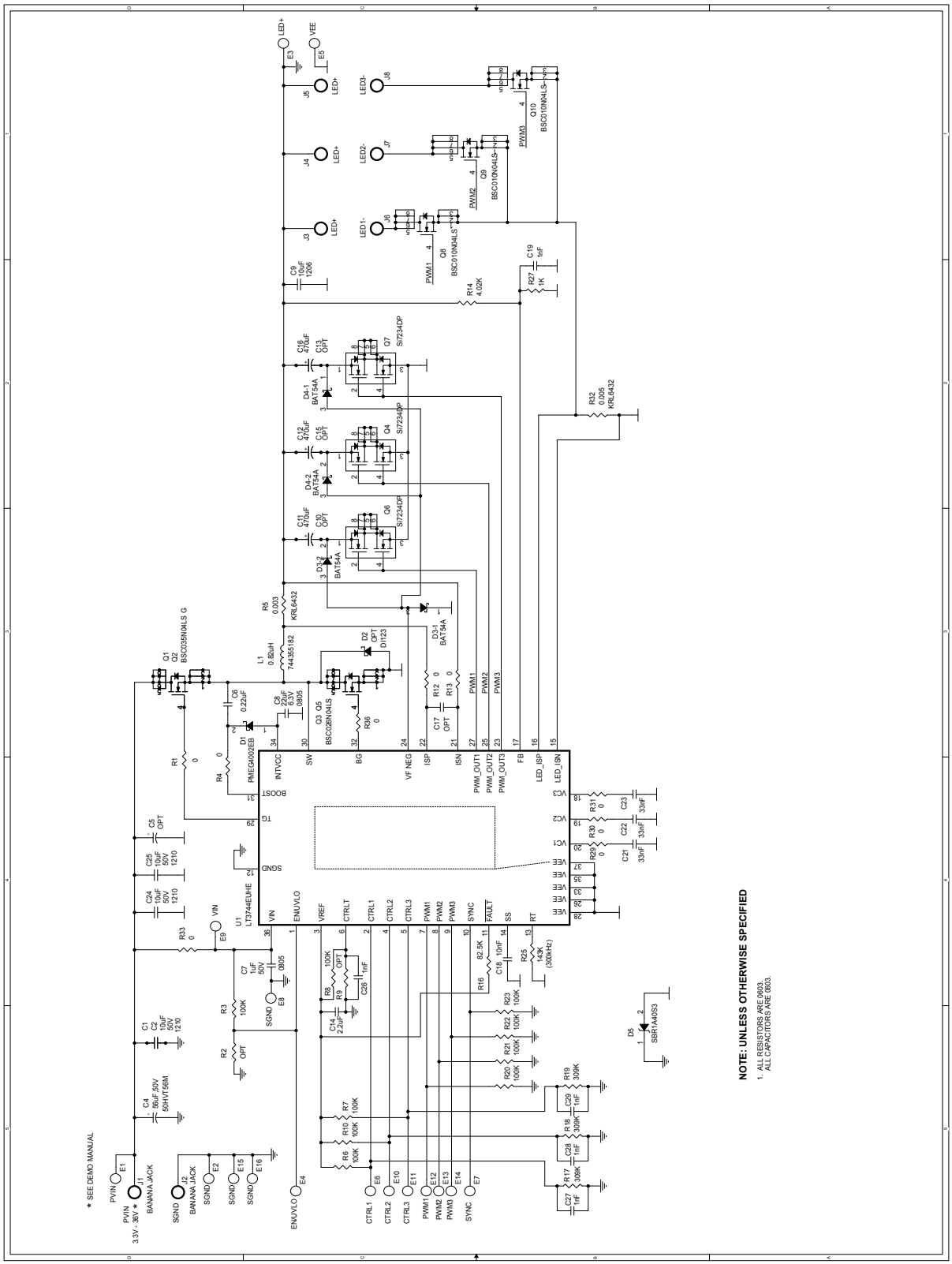


Figure 2. Proper Measurement Equipment Setup

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C1, C2, C24, C25	CAP., X7R, 10µF, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
2	1	C4	CAP., ALUM., ELECT., 56µF, 50V	SUN ELECTRONIC INDUSTRIES CORP., 50HVT56M
3	1	C6	CAP., X7R, 0.22µF, 25V, 10% 0603	MURATA, GRM188R71E224KA88D
4	1	C7	CAP., X7R, 1µF, 50V, 10% 0805	AVX, 08055C105KAT2A
5	1	C8	CAP., X7R, 22µF, 6.3V, 20% 0805	AVX, 08056D226MAT2A
6	1	C9	CAP., X5R, 10µF, 25V, 20% 1206	AVX, 12063D106MAT2A
7	3	C11, C12, C16	CAP., POSCAP, 470µF, 6.3V, D4D	PANASONIC, 6TPF470MAH
8	1	C14	CAP., X5R, 2.2µF, 25V, 10% 0603	MURATA, GRM188R61E225KA12D
9	1	C18	CAP., X7R, 10nF, 25V, 10% 0603	AVX, 06033C103KAT2A
10	5	C19, C26-C29	CAP., X7R, 1nF, 25V, 10% 0603	AVX, 06033C102KAT2A
11	3	C21, C22, C23	CAP., X7R, 33nF, 25V, 10% 0603	MURATA, GRM188R71E333KA01D
12	1	D1	SCHOTTKY RECTIFIER, 40V, SOD523	NXP, PMEG4002EB
13	2	D3, D4	DIODE, BAT54A SOT23	DIODES INC., BAT54A-7-F
14	1	D5	DIODE, SBR1A40S3 SOD-323	DIODES INC., SBR1A40S3-7
15	1	L1	INDUCTOR, 0.82µH	WURTH ELEKTRONIK, 744355182
16	2	Q1, Q2	N-CH., 40-V, PG-TDSON-8	INFINEON, BSC035N04LS G
17	2	Q3, Q5	N-CH., 40-V, PG-TDSON-8	INFINEON, BSC026N04LS
18	3	Q4, Q6, Q7	N-CH., 12-V, POWERPAK SO-8	VISHAY, Si7234DP-T1-GE3
19	3	Q8-Q10	N-CH., 40-V, PG-TDSON-8 FL	INFINEON, BSC010N04LS
20	9	R3, R6, R7, R8, R10, R20, R21, R22, R23	RES., CHIP., 100k, 1/10W, 1%0603	VISHAY, CRCW0603100KFKEA
21	9	R1, R4, R12, R13, R29-R31, R33, R36	RES., CHIP., 0Ω, 1/10W, 0603	VISHAY, CRC06030000Z0EA
22	1	R5	RES., CHIP., 0.003Ω, 3W, 1%, KRL6432	SUSUMU, KRL6432E-M-R003-F
23	1	R14	RES., CHIP., 4.02k, 1/10W, 1% 0603	VISHAY, CRCW06034K02FKEA
24	1	R16	RES., CHIP., 82.5k, 1/10W, 1% 0603	VISHAY, CRCW060382K5FKEA
25	3	R17, R18, R19	RES., CHIP., 309k, 1/10W, 1% 0603	VISHAY, CRCW0603309KFKEA
26	1	R25	RES., CHIP., 143k, 1/10W, 1% 0603	VISHAY, CRCW0603143KFKEA
27	1	R27	RES., CHIP., 1k, 1/10W, 1% 0603	VISHAY, CRCW06031K00FKEA
28	1	R32	RES., CHIP., 0.005Ω, 3W, 1%, KRL6432	SUSUMU, KRL6432D-M-R005-F
29	1	U1	I.C. LT3744EUHE 36-PIN, UHE	LINEAR TECH., LT3744EUHE#PBF
Additional Demo Board Circuit Components				
1	0	C5 (OPT)	CAP., ALUM., ELECT.	
2	0	C10, C13, C15 (OPT)	CAP., D4D	
3	0	C17 (OPT)	CAP., 0603	
4	0	D2 (OPT)	DIODE, DI123	
5	0	R2, R9 (OPT)	RES., CHIP., 0603	
Hardware For Demo Board Only				
1	16	E1-E16	TESTPOINT, TURRET, 0.094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
2	8	J1-J8	JACK BANANA	KEYSTONE, 575-4
3	4	(STAND-OFF)	STAND-OFF, NYLON 0.50" (SNAP ON)	WURTH ELEKTRONIK, 702935000

SCHEMATIC DIAGRAM



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