

Universal Input, Phase Dimmable, Single High Brightness LED Driver

Introduction

The Supertex HV9910DB5 demo board is a high brightness (HB) LED power driver to supply one HB LEDs using the HV9910 IC from either 110V or 220VAC supply. The HV9910DB5 is ideal for incandescent retrofit applications. The features of the HV9910DB5 are:

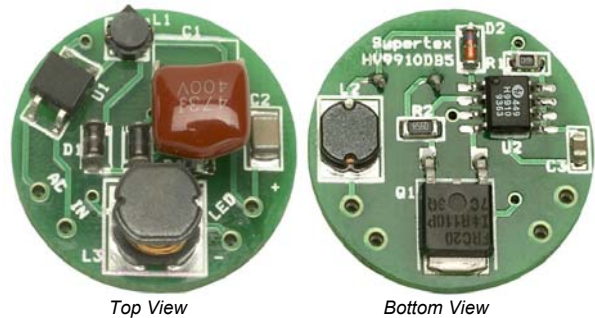
- Small 1" diameter which can be used in an Edison base
- Works with a standard wall dimmer
- Low cost solution

It also avoids the use of electrolytic capacitors, which reduce the lifetime of the circuit in high ambient temperatures (which would be found in the base of a bulb). The demo board can be used to test the performance of the HV9910 as a constant current driver to power LEDs.

The HV9910DB5 uses a unique double buck circuit to achieve the high step down conversion ration required for operating low voltage LEDs from a high input voltage. This circuit allows the converter to operate at a reasonably high switching frequency of 50kHz while still regulating the output current at all times. The HV9910DB5 supplies 350mA to a 4V (max) LED with input voltages ranging from 90VAC – 265VAC 50/60Hz.

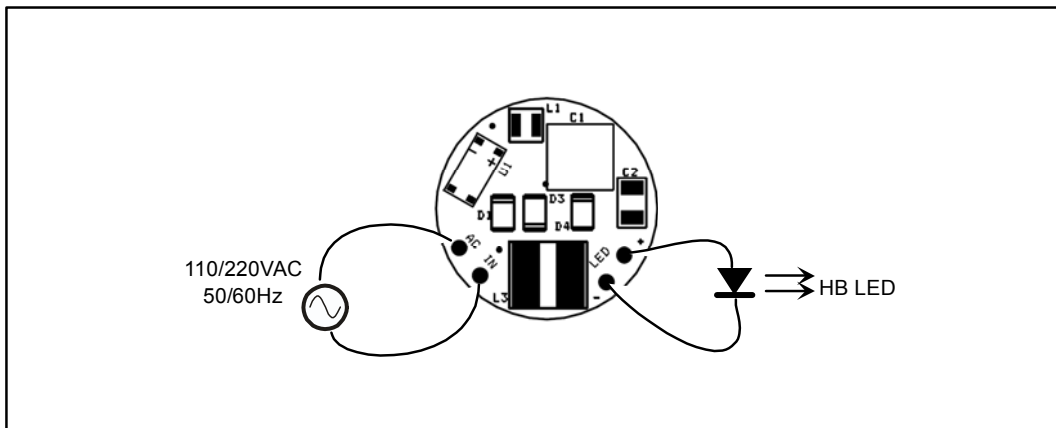
Specifications

Input	90V – 265V AC, 50/60Hz
LED Current	300mA ± 10%
Maximum Output Voltage	4V
Switching Frequency	50kHz
Board Dimensions	25.4mm diameter x 10mm height



Actual Size: 25.4 mm x25.4 mm

Board Layout and Connections



Connections:

Connect the universal input to the AC IN terminals.

Connect the output to the LED terminals – Red wire to Anode of LED and Black wire to cathode of LED.

Testing HV9910DB5:

Turn on the AC power. The LED should glow. Place an ammeter in series with the LED to measure the LED current.

Note on Current Measurement: The HV9910DB5 is designed to regulate the output current at 350mA (the recommended current level for most HB LEDs). This can easily be verified by applying a DC voltage greater than 50V at the input of the demo board. However, when the output current is measured with an AC waveform, the measured current is typically around 300mA. This drop in the current is due to the demo board turning off when the instantaneous input voltage is less than 46V. This dropout at low voltages causes the average current to drop by about 50mA. This dropout at low voltages also allows the demo board to function properly with a wall dimmer. The output current can be increased or decreased by replacing the current sense resistor R2.

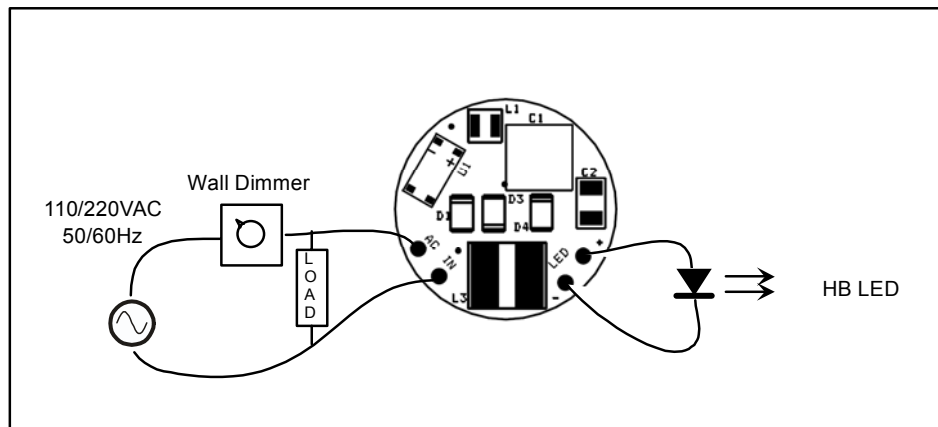
Open LED Protection:

The Hv9910DB5 is not protected against Open LED conditions. Leaving the LED terminals open while applying an input voltage **will damage** the circuit.

The double buck converter is inherently protected against open load conditions. However, to protect the circuit, the middle capacitor (C2 in the schematic diagram) would have to be rated for 400V, although during normal operation a 100V rating would suffice. To minimize the size of the board, a 100V capacitor has been used in the demo board.

Operation with a Wall Dimmer

To operate the Hv9910DB5 with a wall dimmer, connect the circuit as shown in the following figure. Note that wall dimmers typically are rated for about 600W and they require a significant fraction of the load to operate properly (a minimum of load of 5% of the rating is recommended). Since the total load presented by the HV9910Db5 is just about 1W, an external load might be required in parallel to the board for the wall dimmer to function as desired.



The following waveforms shown the input voltage and output current for different input voltage conditions:

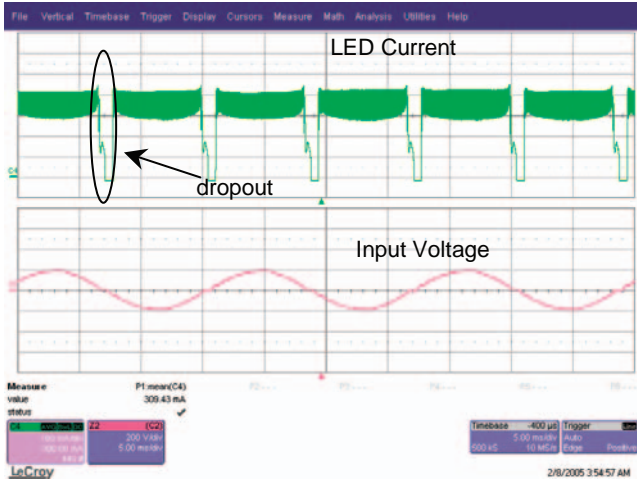


Fig. 1: Output Current at 110V Input Voltage

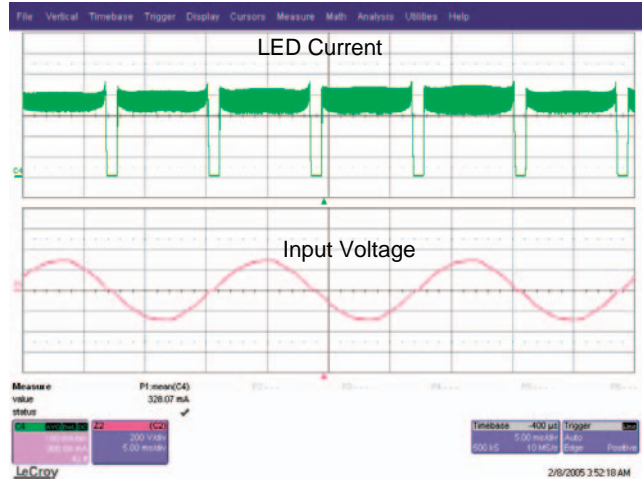
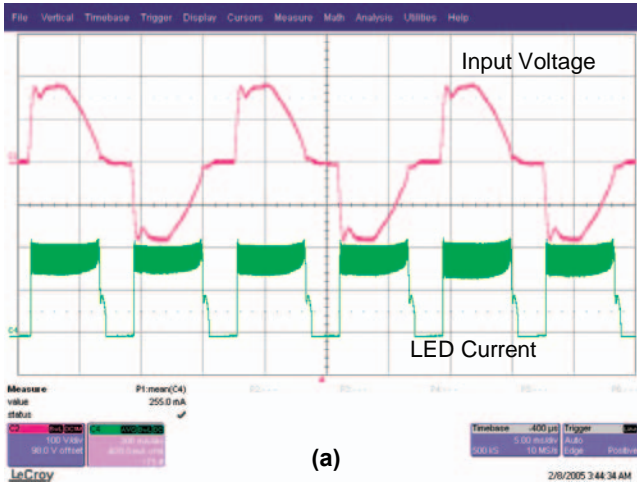
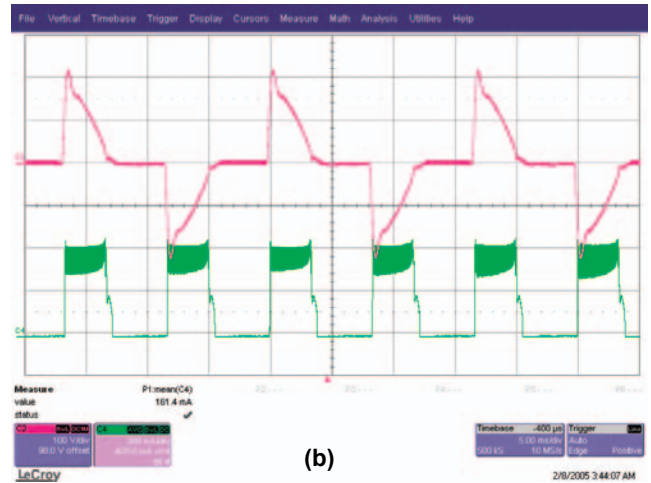


Fig. 2: Output Current at 230V Input Voltage

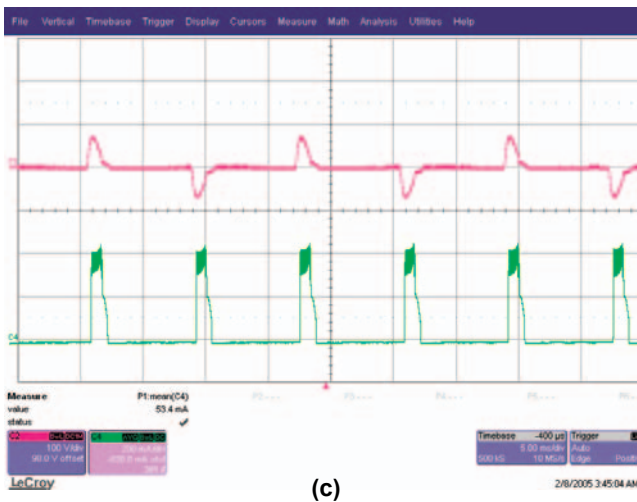
The following waveforms show the operation of the circuit with a wall dimmer with 110V input:



(a)



(b)



(c)

Fig. 3a, b, c: Dimming the HV9910DB5 with a Wall Dimmer.

The input voltage and input current waveforms for the HV9910DB5 are shown in Fig. 4:

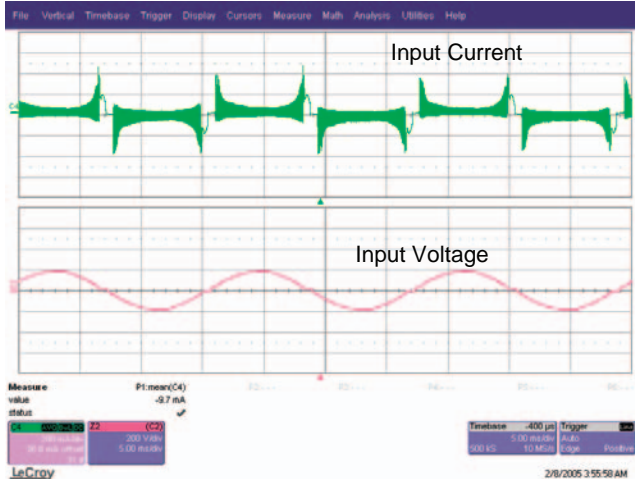


Fig. 4a: Input Voltage and Current Waveforms at 110VAC Input

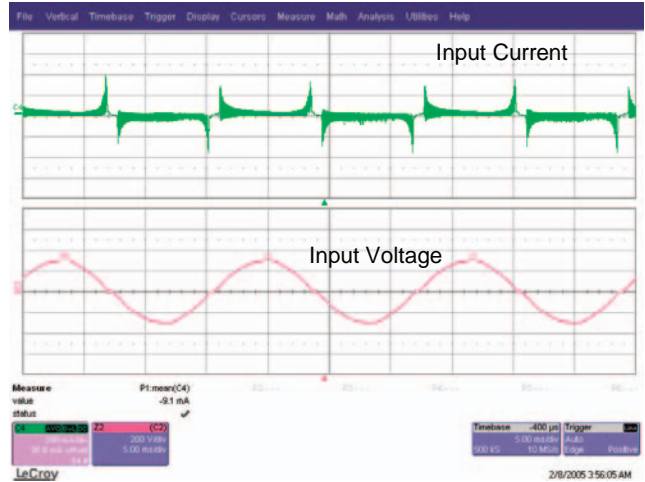
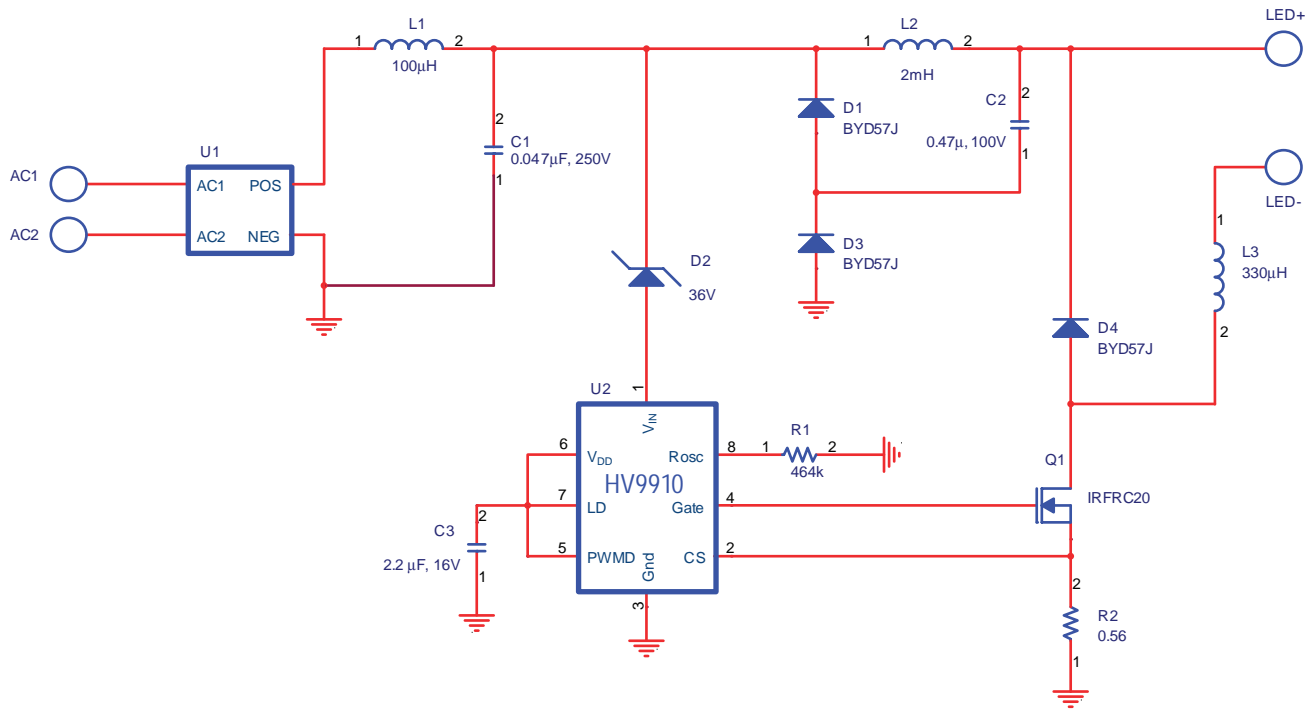


Fig. 4a: Input Voltage and Current Waveforms at 230VAC Input

Schematic Diagram:



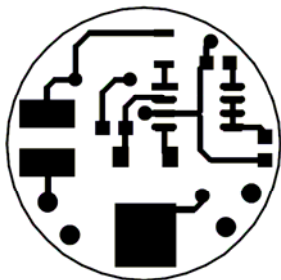
Bill of Materials

Quantity	RefDes	Description	Package	Manufacturer	Manufacturer's Part Number
1	C1	0.047uF, 400V Film capacitor	Thru-hole	BC Components	2222 370 51473
1	C2	0.47uF, 100V X7R ceramic chip capacitor	SMD 1210	Panasonic	ECJ-4YB2A474K
1	C3	2.2uF, 16V X7R ceramic chip capacitor	SMD 0805	TDK Corporation	C2012X7R1C225K
3	D1,D3,D4	600V, 1A Ultra-fast soft-recovery diode	SOD87	Philips	BYD57J
1	D2	36V, 500mW zener diode	MINIMELF	Diodes, Inc.	ZMM5258B-7
1	L1	100uH, 0.3A sat, 0.3A rms inductor	SMT	Coilcraft	1008PS-104KB
1	L2	2mH, 140mA peak drum core inductor	SMT	Coiltronics	CTX01-16611
1	L3	330uH, 0.83A sat, 0.64A rms	SMT	Coiltronics	LD2-331
1	Q1	600V, 2A Hexfet	DPAK	IR	IRFRC20
1	R1	464k, 1/10W, 1% chip resistor	SMD 0805	Panasonic	ERJ-6ENF4643V
1	R2	0.56 ohm, 1/4W, 1% chip resistor	SMD 1206	Panasonic	ERJ-8RQFR56V
1	U1	400V, 0.5A Single phase diode bridge	MINIDIP	Diodes, Inc.	RH04-T
1	U2	Universal LED driver	SOIC-8	Supertex	HV9910LG

HV9910DB5 –Top Layer



HV9910DB5 - Bottom Layer



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