Low Voltage, High Brightness LED Driver Demo Board

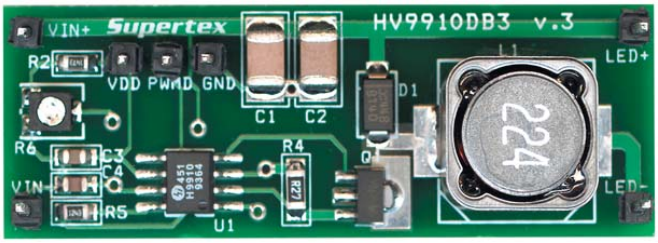
General Description

The Supertex HV9910DB3v.3 demo board is a complete high current, High-Brightness LED power driver to supply a string of LED(s) using the HV9910 IC from a low DC voltage. The demo board can be used to test the performance of the HV9910 as a constant current driver to power LEDs.

The HV9910DB3v.2 (constant frequency HV9910 demoboard) was not capable of driving LED strings whose voltage was greater than one-half the input voltage. The HV9910DB3v.3 rectifies this drawback by operating in a constant off-time mode as compared to a constant frequency mode. The constant off-time mode enables regulation of the LED current even when the LED voltage string is greater than one half the input voltage. (Please refer to the application note AN-H50 on the Supertex website for more information on the constant off-time mode of operation.)

The HV9910DB3v.3 can supply a maximum output current of 900mA to drive LED strings from a 9VDC to 30VDC input. It achieves an overall efficiency above 85%. The HV9910DB3v.3 is ideally suited to drive two 1Watt or 3Watt LEDs from a 12V or 24V input voltage.

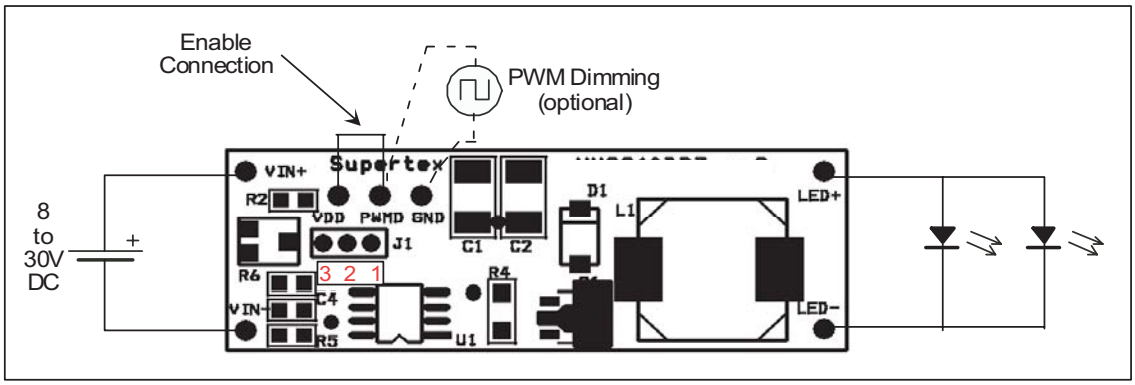
The power conversion stage of the HV9910DB3v.3 consists of a current-controlled buck converter operating at an off-time of about 5.8µs. The nominal output current of the demo board can be adjusted to any value less than 900mA using the on-board trimming potentiometer. PWM dimming can be achieved by applying a pulse-width-modulated square wave signal between the PWMD and GND pins.



(Board Size: 53mm x 18mm)

Specifications	
Input Voltage:	8V – 30V DC
LED string voltage:	See instructions
Load current:	900mA maximum
Switching Frequency:	variable
Efficiency:	>85%
Dimensions:	82mm X 28mm

Board Layout and Connections



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Instructions:

V_{IN}+: Connect the positive terminal of the DC input source to this pin.

V_{IN}-: Connect the negative terminal of the DC input source to this pin.

LED+: Connect the Anode of the LED(s) to this pin.

LED-: Connect the Cathode of the LED(s) to this pin.

V_{DD}: This pin is connected to the V_{DD} pin of the HV9910. The typical voltage on the pin is 7.6V. This voltage can be used to drive any additional circuitry required. Please see the datasheet regarding the output current capability at the V_{DD} pin.

GND: This pin is connected to the Ground connection of the buck converter.

PWMD: This terminal can be used to either enable/disable the converter or to apply a PWM dimming signal.

To just enable the converter, connect the PWMD pin to the V_{DD} pin. Disconnecting the PWMD pin will cause the circuit to stop.

PWM dimming of the LED light can be achieved by turning the converter on and off with a low frequency 50Hz to 1000Hz TTL logic level signal. Changing the Duty Ratio of the signal changes the effective average current via the LEDs, thus changing the light emission.

Note: In the case of PWM dimming, the PWMD pin should not be connected to the V_{DD} pin!

J1: The three pins in J1 are used to set the current level of the output. The HV9910DB3v.3 has two current levels:

Pin 2 connected to Pin 1: Output Current is 900mA

Pin 2 connected to Pin 3: Output current can be adjusted using the potentiometer

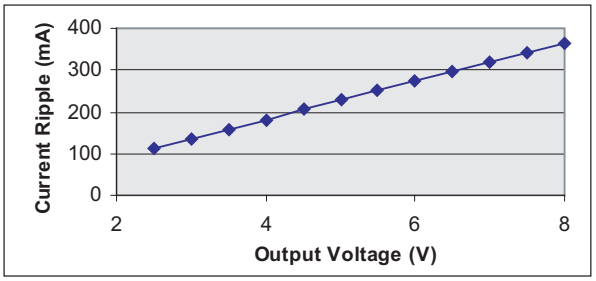
LED STRING VOLTAGE

In a constant-off time buck converter, the relationship between the output current ripple ΔI_0, the LED string voltage V_0 , the inductance value L, and the programmed off time t_{off} is given by:

$$V_0 = L \cdot \frac{\Delta I_o}{t_{off}}$$

From the above equation, it can be seen that for a given value of L and t_{off}, the output current ripple is directly proportional to the output voltage. A plot of the current ripple vs. the output voltage is given below:

In cases where the current ripple is too high (as a percentage of the average LED current), it may be necessary to add a small ceramic capacitor between the output terminals to reduce the LED current ripple.



Testing the HV9910DB3v.3

Connect the LED string to the output terminals. Check the polarity of the LED connection, anode end of the string should be connected to the positive output, cathode should be connected to the negative output. Connect the DC input to the input terminals (check the polarity). Short the PWMD pin to V_{DD}. Apply a DC voltage at the input terminals and the LED string should start to glow.

An ammeter can be connected in series with the LED(s) to measure the output current. The current level can then be changed by adjusting the trimming potentiometer.

Open LED test:

After the initial test of functionality, the demo board can be tested at open LED string. The test is non-destructive and not time restricted. Disconnect one end of the LEDs and power up the demo. There will be no light emission and the AC current withdrawn from the line will be very low. There is no switching at the switching node.

Linear dimming test:

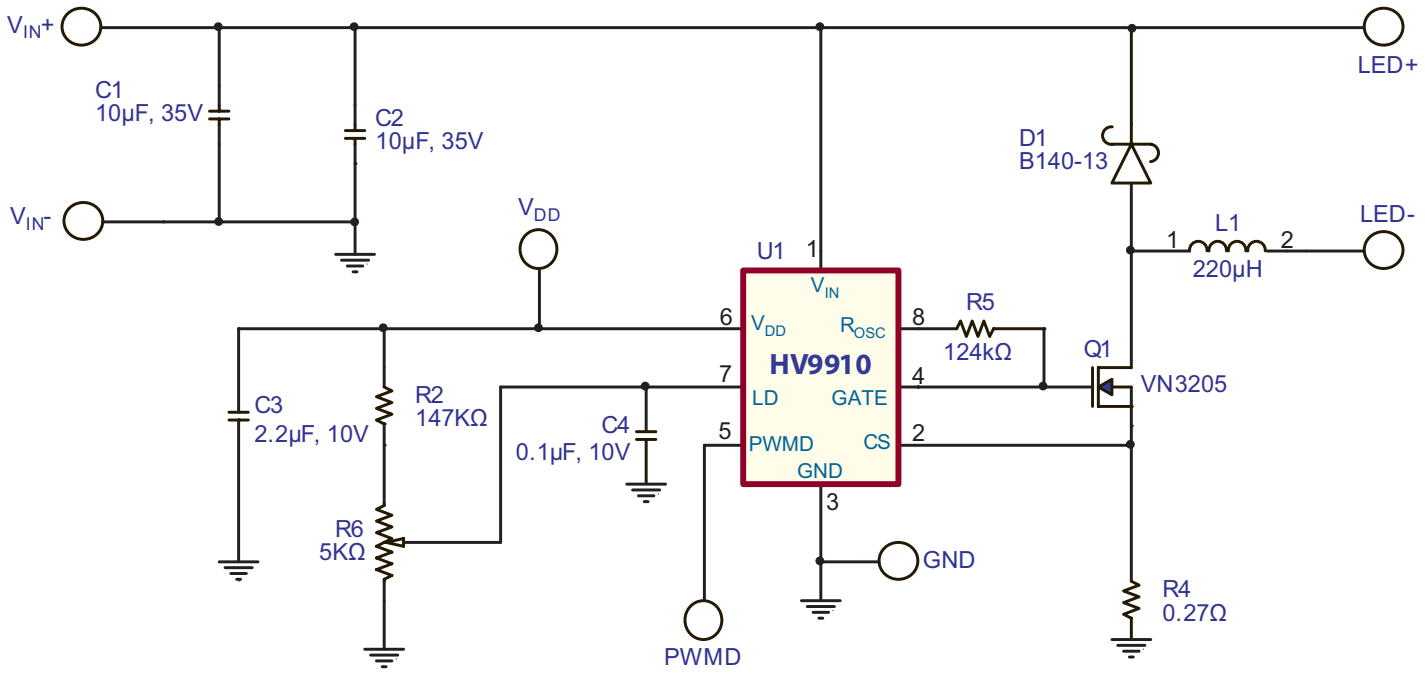
Gradual change of current via LED(s) is possible by using the trimming potentiometer placed on the demo board. The HV9910 has a preset voltage reference level of 250mV when the voltage at the LD pin of the IC is above 250mV. The external resistor divider consisting of R2 and potentiometer R6 can change that level by pulling down the pin LD below 250mV, reducing the LED string current in linear fashion.

The maximum output current of the HV9910DB3v.3 is about 900mA.

PWM dimming test:

During normal demo board operation, by applying a PWM TTL level signal to pin PWMD, the output current through the LEDs can be changed in PWM fashion in a 0 to 100% range. In this dimming mode, the output current has normally two levels – zero and nominal current, except at very low duty ratios where inductor current cannot ramp up to the nominal value within the short time.

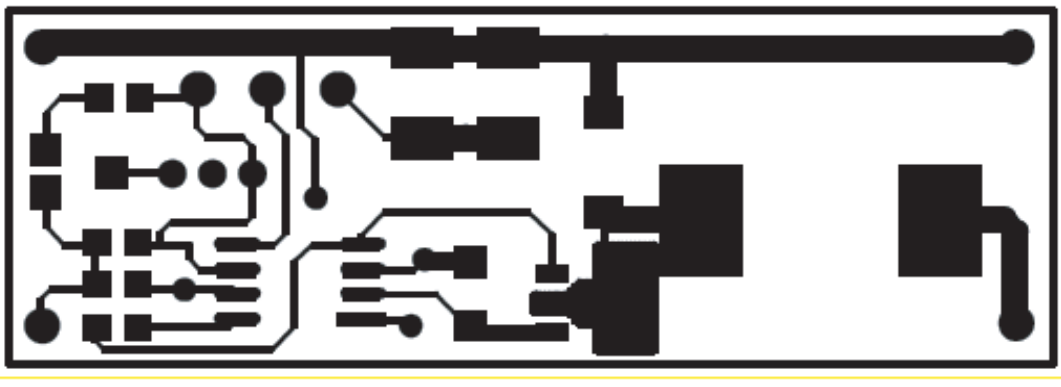
Schematic Diagram



Bill of Materials

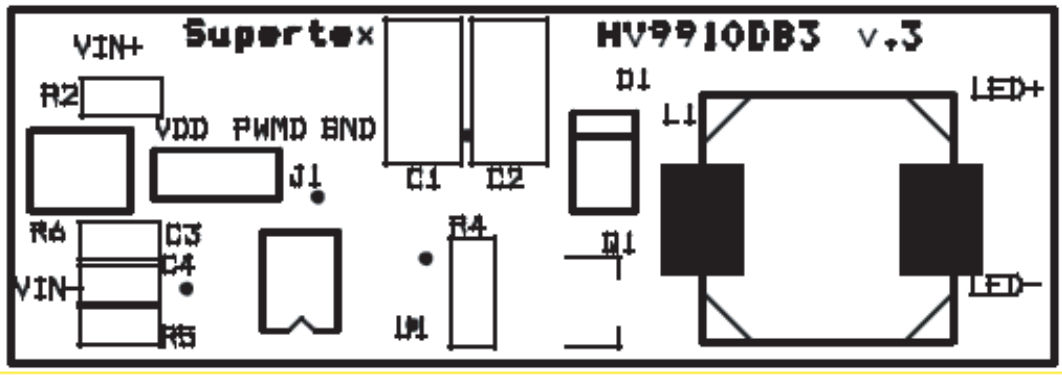
Quantity	RefDes	Description	Manufacturer	Manufacturer's Part Number
2	C1,C2	10µF, 35V SMD 1812 Multilayer Ceramic Chip Capacitors	Panasonic	ECJ-5YF1V106Z
1	C3	2.2uF, 16V X7R Ceramic Capacitor	TDK Corp.	C2012X7R1C225K
1	C4	0.1uF, 16V X5R Ceramic Chip Capacitor	Panasonic	ECJ-2VB1C104K
1	D1	40V, 1A SMA Schottky Diode	Diodes, Inc.	B140-13
1	L1	220µH, 1A Shielded Power Inductor	Coilcraft	MSS1278-224KXB
1	Q1	50V, 1.5A SOT-89 Power MOSFET	Supertex	VN3205N8
1	R2	147KΩ, 1/10W, 1% SMD 0805 Chip Resistor	Panasonic	ERJ-6ENF1473V
1	R4	0.27Ω, 1/4W, 1% SMD 1206 Chip Resistor	Panasonic	ERJ-8RQFR27V
1	R5	124K, 1/10W, 1% SMD 0805 Chip Resistor	Panasonic	ERJ-6ENF1243V
1	R6	5KΩ Surface Mount Trim Pot	Murata	PVG3A502A01R00
1	U1	Universal LED Driver	Supertex	HV9910LG

Top Layer



Bottom Layer

Silk Screen



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