

21-Watt, Universal, AC LED Driver Demoboard with Accurate Average-Mode, Constant Current Control

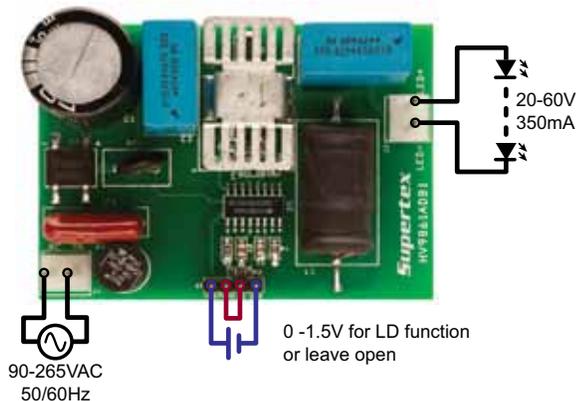
General Description

The HV9861ADB1 demoboard is a high-brightness LED driver employing the patented average-mode, constant current control scheme by Supertex Inc. The power conversion stage of the HV9861ADB1 consists of a diode bridge rectifier followed by a buck converter operating with fixed off-time of 20 μ s.

The HV9861ADB1 LED driver features tight regulation of the LED current within a few milliamps over the entire range of the input AC line and the output LED string voltage. The LED current accuracy is almost insensitive to the passive component tolerances, such as the output filter inductance or the timing resistor. The accuracy of the LED current is mainly determined by the internal 270mV \pm 3% reference voltage of the HV9861A control IC and by the external current sense resistor tolerance.

(Note, that the linear dimming input of the HV9861A disables switching, when its voltage falls below a 200mV threshold. Expect the LED driver to shut off when the LED current falls below 50 ~ 55mA.)

Connection Diagram



WARNING!!!

Do not connect earth-grounded test instruments. Doing so will short the AC line, resulting in damage to the instrument and/or the HV9861ADB1. Use floating high voltage differential probes or isolate the demoboard by using an isolating transformer.

Connections

1. Connect the input AC voltage between the AC IN terminals as shown in the connection diagram.
2. Connect the LED string between LED+ (anode of LED string) and LED- (cathode of LED string).
3. Connect the PWMD terminal to the VDD terminal using the jumper provided to enable the LED driver.
4. The current level can be adjusted by applying 0 - 1.5V between LD and GND. Leave LD floating to use the internal current setting.

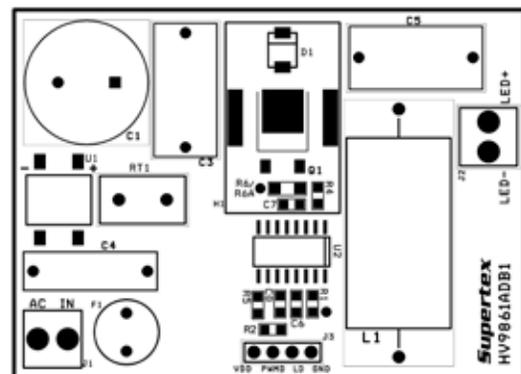
PWM dimming can be achieved by applying a pulse-width-modulated square wave signal between the PWMD and GND pins.

The HV9861ADB1 features protection from an output short circuit condition. Open LED protection is inherent, since the output filter capacitor can accept the full rated rectified AC line voltage.

Please, note that the demoboard is not CISPR15 compliant. An additional input EMI filter circuit is required to make the board meet conducted electro-magnetic emission limits. Also, note that:

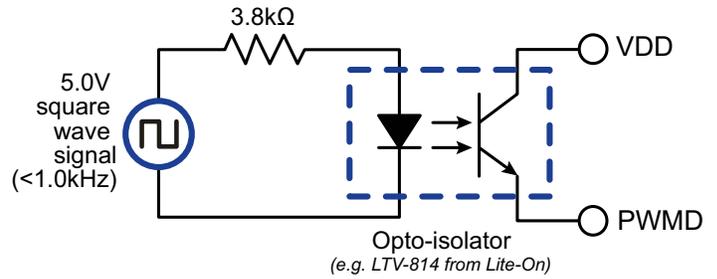
NO SAFETY ISOLATION OF THE LED LOAD FROM THE AC MAINS VOLTAGE IS PROVIDED!

Silk Screen



PWM Dimming

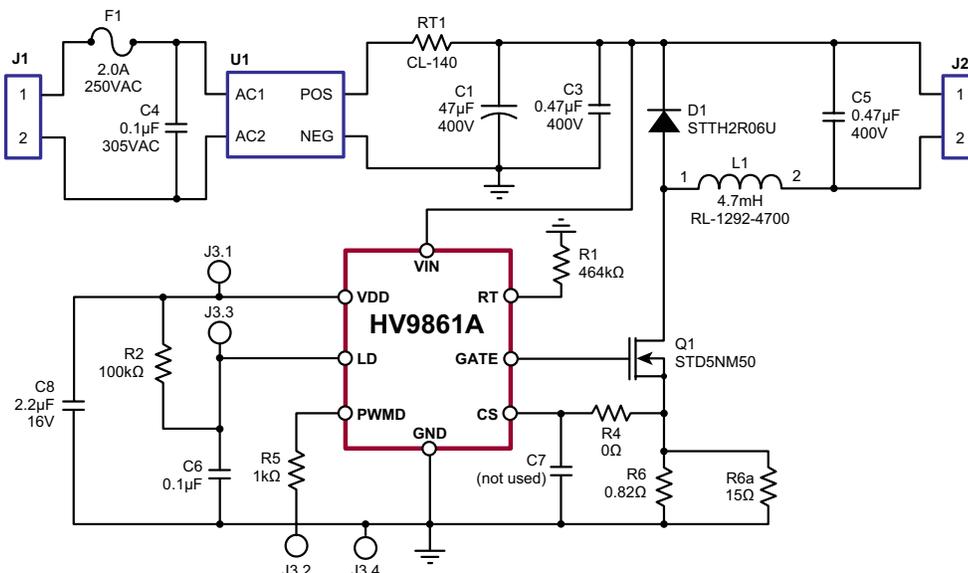
The HV9861ADB1 is capable of being PWM dimmed by applying a square wave TTL compatible signal between PWMD and GND terminals. However, since there is no galvanic isolation on the board, care must be taken to prevent damage to the PWM dimming source and/or the HV9861ADB1. One simple way is to isolate the LED driver from the AC line using an isolation transformer. Another approach is to use an opto-isolator to drive the PWMD pin as shown in the following figure.



Specifications

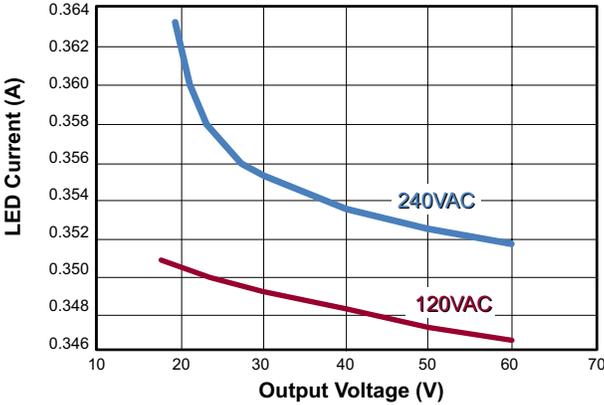
| Parameter | Value | Condition |
|--|---|-------------------|
| Input voltage | 90~265VAC, 50/60Hz | --- |
| Output voltage | 20~60V | --- |
| Nominal output current | 350mA±4% | --- |
| Output current ripple | ±15% (typical, depending on the type of LED) | 120VAC, 60V/350mA |
| Full load efficiency | 92% | 120VAC, 60V/350mA |
| | 91% | 240VAC, 60V/350mA |
| Power factor | 0.56 | 120VAC, 60V/350mA |
| | 0.50 | 240VAC, 60V/350mA |
| Maximum input current | 0.27A (RMS) | 90VAC, 60V/350mA |
| Switching frequency (variable, T _{OFF} = 20μs) | 29kHz | 120VAC, 60V/350mA |
| | 38kHz | 240VAC, 60V/350mA |
| | 40kHz | 120VAC, 20V/350mA |
| | 43kHz | 240VAC, 20V/350mA |
| Open LED protection | YES | --- |
| Output short circuit protection | YES | --- |
| Dimensions | 68.6mm X 49.6mm | --- |

Schematic

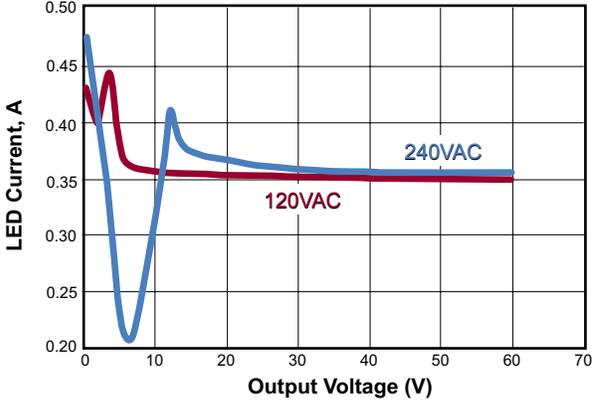


Typical Characteristics

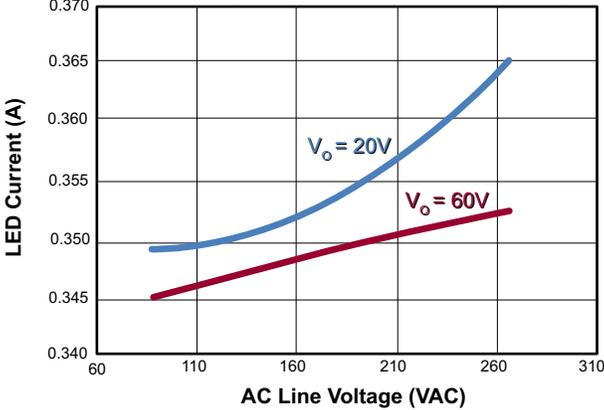
Current Regulation vs. LED String Voltage



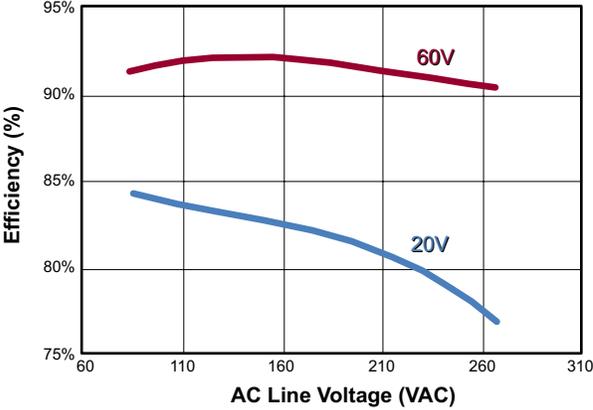
Output Short Circuit Response



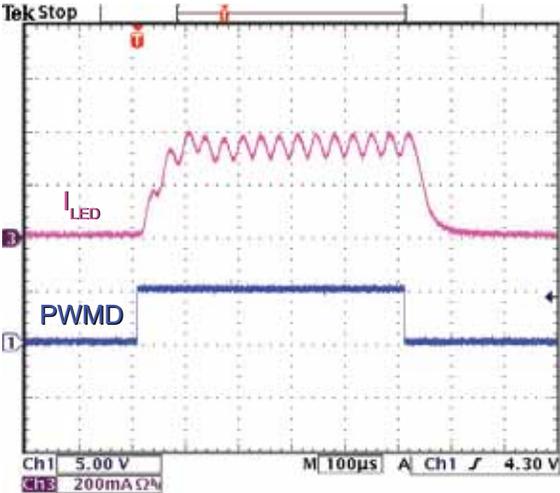
Current Regulation vs. AC Line Voltage



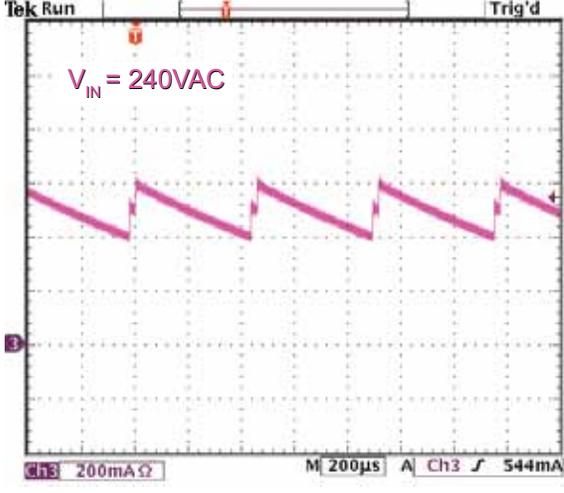
Efficiency



PWM Dimming Response



Short Circuit Current



Bill of Materials

| Item # | Quan | RefDes | Description | Package | Manufacturer | Manufacturer's Part Number |
|--------|------|--------|---|-----------|----------------|----------------------------|
| 1 | 1 | C1 | 47 μ F, 400V electrolytic capacitor | Radial | Panasonic | EEU-ED2G470 |
| 2 | 2 | C3, C5 | 0.47 μ F, 400V metal film capacitor | Radial | EPCOS Inc | B32522C6474K |
| 3 | 1 | C4 | 0.1 μ F, 305VAC EMI suppression capacitor | Radial | EPCOS Inc | B32922C3104M |
| 4 | 1 | C6 | 0.1 μ F, 16V X7R ceramic chip capacitor | SMD0805 | Panasonic | ECJ-2VB1C104K |
| 5 | 1 | C8 | 2.2 μ F, 16V X7R ceramic chip capacitor | SMD0805 | TDK Corp | C2012X7R1C225K |
| 6 | 1 | D1 | 600V, 2A ultrafast diode | SMB | ST Micro | STTH2R06U |
| 7 | 1 | F1 | 2.0A, 250VAC time lag fuse | Radial | Cooper Bussman | SR-5-2A-BK |
| 8 | 1 | H1 | 15C/W DPAK heat sink | SMT | Aavid | 7106PD |
| 9 | 2 | J1, J2 | 2 position, 0.156" pitch, vertical header | Thru-Hole | Molex | 26-48-1021 |
| 10 | 1 | J3 | 4 position, 0.100" pitch, vertical header | Thru-Hole | Molex | 22-03-2041 |
| 11 | 1 | L1 | 4.7mH, 400mA rms, 470mA SAT inductor | Axial | Renco USA | RL-1252-4700 |
| 12 | 1 | Q1 | 550V, 0.7 Ω N-channel FET | DPAK | ST Micro | STD5NM50 |
| 13 | 1 | RT1 | 50 Ω NTC inrush limiter | Thru-Hole | GE Sensing | CL-140 |
| 14 | 1 | R1 | 464k Ω , 1/8W, 1% chip resistor | SMD0805 | --- | --- |
| 15 | 1 | R2 | 100k Ω , 1/8W, 1% chip resistor | SMD0805 | --- | --- |
| 16 | 1 | R5 | 1k Ω , 1/8W, 1% chip resistor | SMD0805 | --- | --- |
| 17 | 1 | R6 | 0.82 Ω , 1/4W, 1% chip resistor | SMD1206 | --- | --- |
| 18 | 1 | R6a | 15 Ω , 1/4W, 1% chip resistor | SMD1206 | --- | --- |
| 19 | 1 | U1 | 400V, 1A single phase diode bridge | DF-S | Diodes Inc | DF04S |
| 20 | 1 | U2 | Universal LED Driver | SO-16 | Supertex | HV9861ANG-G |

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