LED Driver Demo Board

Input 220VAC, Output 210mA, 65..75V, 15W

General Description

The AN9931 LED driver is primarily targeted at low to medium power LED lighting applications where galvanic isolation of the LED string is not an essential requirement. The driver provides near unity power factor and constant current regulation using a two stage topology driven by a single MOSFET and control IC.

Specifications	
Input voltage	190VAC to 265VAC, 50Hz
Output voltage:	65 to 75V
Output current:	210mA +/-7%
Output power:	15W
Power factor	95%
Efficiency	82%
Output 100Hz current ripple	5%
Output overvoltage protection	90V, Non-Latching
Switching frequency	60kHz
Dimensions:	156 x 13 x 16 mm

The AN9931DB8_v3 demo board was designed for a fixed string current of 210mA and a string voltage of 65 to 75V for a load power of about 15W. Input voltage range for the AN9931DB8_v3 is 190..265VAC. Design is perfect for supplying LED lamps T8 format.

The circuits featured are output current soft start and protections from, load overvoltage and open circuit. The driver is inherently short circuit proof by virtue of the peak current regulation method.

AN9931DB8_v3 intended for evaluation and testing purposes only, not for high volume and/or end product usage.

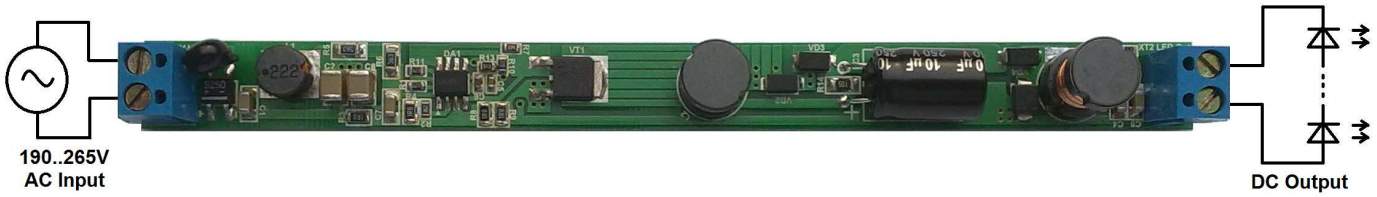
Warning!

Working with this board can cause serious bodily harm or death. Connecting the board to a source of line voltage will result in the presence of hazardous voltage throughout the system including the LED load.

The board should only be handled by persons well aware of the dangers involved with working on live electrical equipment. Extreme care should be taken to protect against electric shock. Disconnect the board before attempting to make any changes to the system configuration. Always work with another person nearby who can offer assistance in case of an emergency. Wear safety glasses for eye protection.

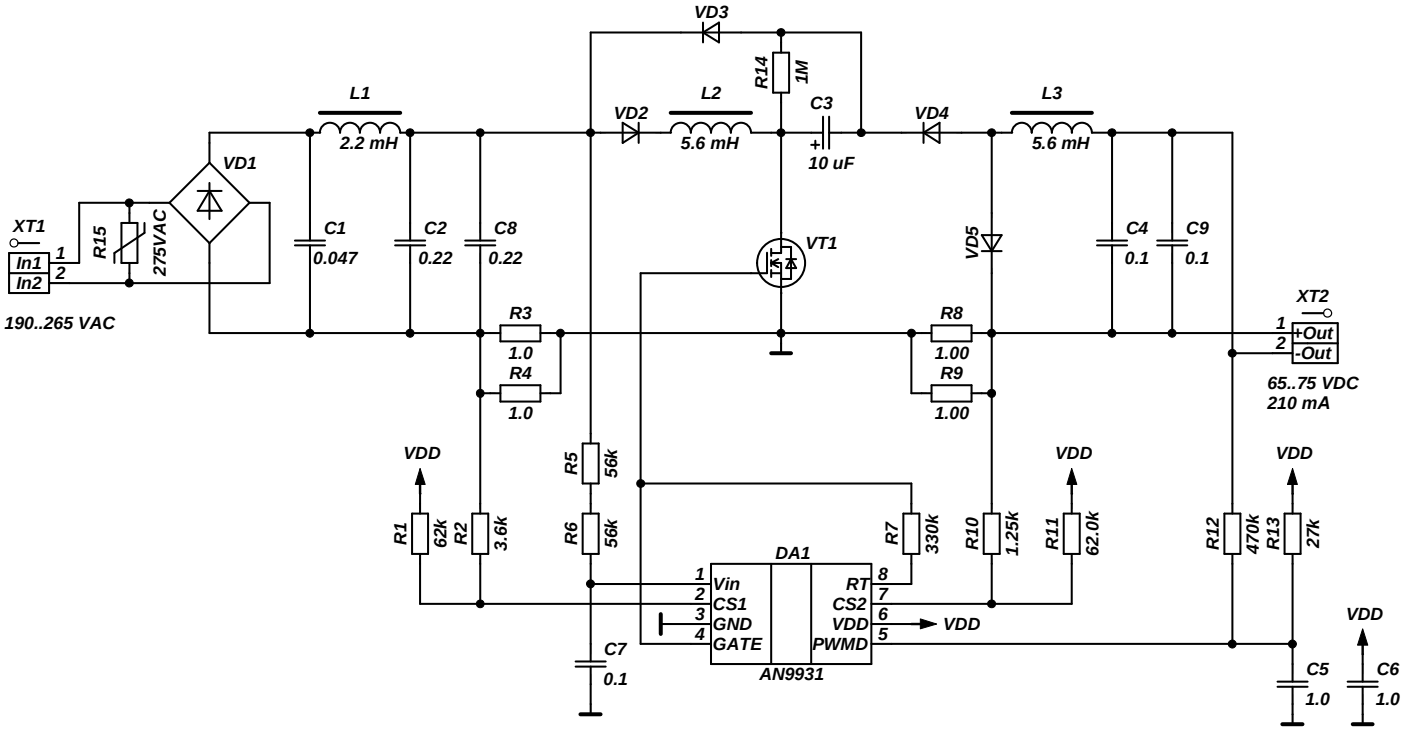
The electrolytic capacitor carries a hazardous voltage for an extended time after the board is disconnected. Check the capacitor voltage before handling the board.

Board Layout and Connections



Proezd № 4806, Bld 4/3, Zelenograd, Moscow, Russia, 124460
Tel: +7(499)731-4906; +7(499)731-3270; Fax: +7(499)731-1508
E-mail: market@angstrem.ru; Web: www.angstrem.ru

Schematic Diagram



Connection Instructions

1. Carefully inspect the board for shipping damage, loose components, etc, before making connections.

2. Attach the board to the line and load as shown in the diagram. Be sure to check for correct polarity when connecting the LED string to avoid damage to the string. The board is short circuit and open circuit proof. The LED string voltage can be anything between 65 and 75V.

3. Energize the mains supply.

Principles of Operation

The AN9931 topology can be viewed as a series connection of two basic power supply topologies, a buck-boost stage as first or input stage, for purpose of converting AC line power into a source of DC power, commonly known as the DC bus, having sufficient capacitive energy storage to maintain the bus voltage more or less constant throughout the AC line cycle, and a buck stage as second or output stage for powering the LED string, stepping down the DC bus voltage to the LED string voltage in order to produce a steady LED string current.

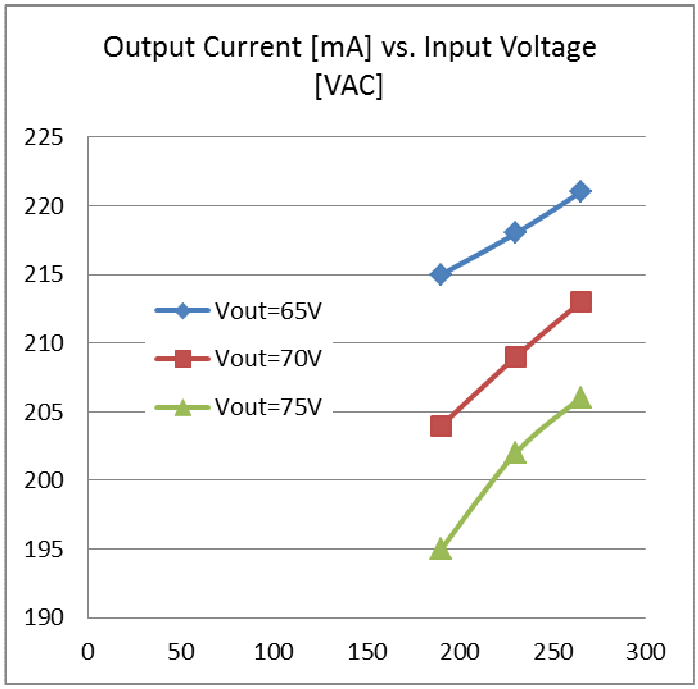
The output or buck stage is designed for operation in continuous conduction mode (CCM), operating with about 30 to 50% inductor current ripple. This amount of ripple serves the needs of the AN9931 peak current controller which relies on a sloping inductor current for setting ON time, and is of an acceptable level to high brightness LEDs. Duty cycle is more or less constant throughout the line cycle as the DC bus voltage and LED string voltage are more or less constant as well. Duty cycle and bus voltage do adjust in response to changes in line or load voltage but are otherwise constant over the course of a line cycle. With the AN9931, OFF time is fixed by design, being programmed by an external resistor, whereas ON time adjusts to a more or less constant value, being under control of the AN9931 peak current regulator. The input or buck-boost stage is designed for operation in discontinuous conduction mode (DCM) throughout the range of line and load voltage anticipated. This can be accomplished by making the input inductor

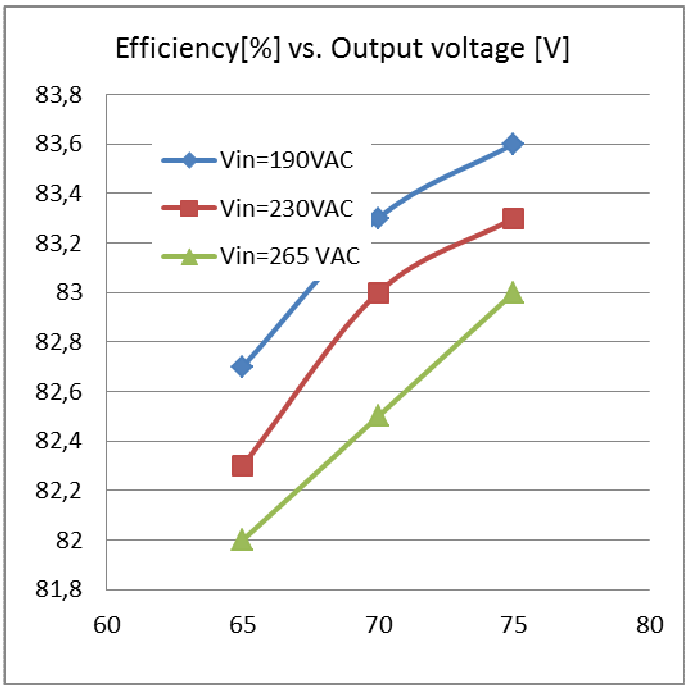
Proezd № 4806, Bld 4/3, Zelenograd, Moscow, Russia, 124460
Tel: +7(499)731-4906; +7(499)731-3270; Fax: +7(499)731-1508
E-mail: market@angstrem.ru; Web: www.angstrem.ru

sufficiently small. A well known property of the DCM buck-boost stage, when operated with constant ON time and constant OFF time, is that input current is proportional to input voltage, whether in peak value or average value. This results in sinusoidal input current when the input voltage is sinusoidal, thereby giving unity power factor operation when operating from the rectified AC line voltage.

When operated in the anticipated range of line and load voltage, the MOSFET ON time will be under control of the output stage current controller, which turns the MOSFET off when sensing that the output inductor current has reached the desired peak current level as programmed by a resistive divider at the CS2 pin. Under certain abnormal circumstances such as initial run-up and line undervoltage, which both could lead to the draw of abnormally high line current, ON time is further curtailed by the action of the CS1 comparator, which monitors the input stage inductor current against a threshold. This threshold can be a simple DC level or be shaped in time as is performed on the demo board. In particular, when shaping the CS1 threshold with the shape of the rectified AC line input voltage waveform, the line current will be bounded by a more or less sinusoidal line current envelope which results in sinusoidal input current for low line and other abnormal conditions.

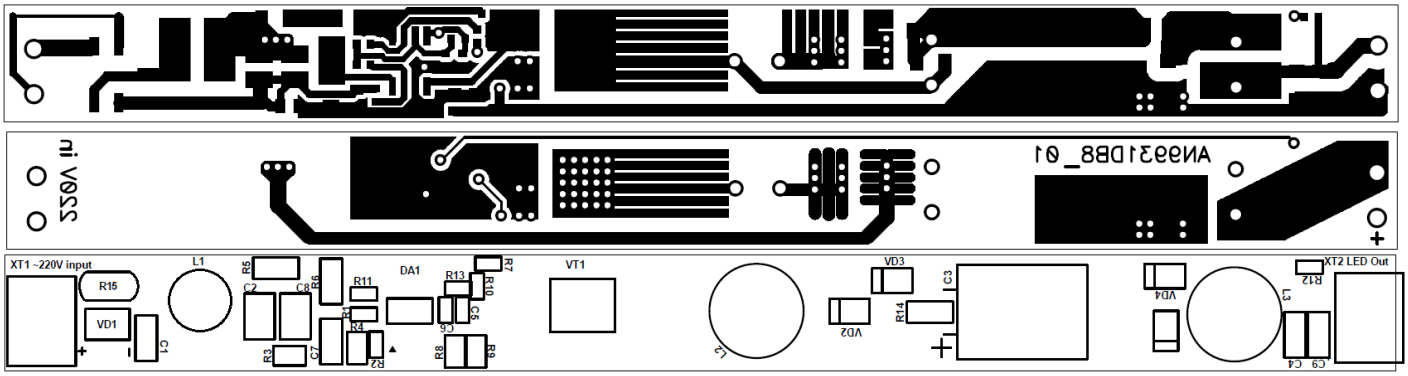
Typical Characteristics





Proezd № 4806, Bld 4/3, Zelenograd, Moscow, Russia, 124460
Tel: +7(499)731-4906; +7(499)731-3270; Fax: +7(499)731-1508
E-mail: market@angstrem.ru; Web: www.angstrem.ru

PCB Layout



Bill of Materials

Qty	REF	Description	Manufacturer	Product Number
1	C1	Cap Cer X7R 1210 0.047uF 630V	Murata	GRM43DR72J473K
2	C2, C8	Cap Cer X7T 1812 0.22uF 630V	TDK	C4532X7T2J224K
1	C3	Cap Alel ED Rad 10uF 250V	Panasonic ECG	EEU-ED2E100
3	C4, C7, C9	Cap Cer X7R 1206 0.1uF 250V	Murata	GRM31CR72E104K
2	C5, C6	Cap Cer X7R 0603 1uF 16V	Kermet	C0603C105K1RACTU
1	DA1	IC LED Driver SO-8	Angstrem	AN9931
1	L1	Inductor 2.2 mH 0. 2A	Bourns	SDR0805-222KL
2	L2, L3	Inductor 5.6 mH 0.21A	Sumida	RCH114NP-562KB
1	VD1	Rect Bridge MiniDIL 600V 0.5A	Diotec	S250
3	VD2, VD3, VD4	Diode Ultra-Fast 600V 1A 35 ns SMA	Fairchild	ES1J
1	VD5	Diode Ultra-Fast 600V 1A 25ns SMA	ST Microelectronics	STTH1R06A
1	VT1	Transistor N-MOS 650V 1.4Ohm 12nC	Infineon	SPD03N60C3
2	R1, R11	Res 0603 1% 62kOhm	-	-
1	R2	Res 0603 5% 3.6kOhm	-	-
4	R3, R4, R8, R9	Res 0805 1% 1Ohm	-	-
1	R5, R6	Res 1206 5% 56kOhm	-	-
1	R7	Res 0603 5% 330kOhm	-	-
1	R10	Res 0805 1% 1.25kOhm	-	-
1	R12	Res 0805 5% 470kOhm	-	-
1	R13	Res 0805 5% 27kOhm	-	-
1	R14	Res 1206 5% 1MOhm	-	-
1	R15	Sur Absorber 5mm 430V 600A ZNR	Panasonic	ERZV05D431
2	XT1, XT2	Terminal Block 250VAC 1A	Ningbo Xinya M&E	300-021-12

Proezd № 4806, Bld 4/3, Zelenograd, Moscow, Russia, 124460
Tel: +7(499)731-4906; +7(499)731-3270; Fax: +7(499)731-1508
E-mail: market@angstrem.ru; Web: www.angstrem.ru