



ZD832EVB Evaluation Board Manual

General Description

The ZD832 is a high voltage, TransformerFree™ AC-DC constant current driver for driving a string of white or RGB LEDs in series. It operates from an universal input voltage of 85VAC to 125VAC, or 180VAC to 240VAC and generates a programmable constant output current. The high operating voltage of ZD832, along with its linear control architecture eliminates the need for an external inductor, transformer and rectifying diode bridge. The output current level is set by a single resistor and can be set as high as 30mA. Dimming control can be accomplished by using pulse-width modulation signal with varying duty cycle on the PWM pin or by applying an analog DC voltage on the ISET pin. Thermal and over-voltage circuitry protects the internal power transistors from excessive power dissipation.

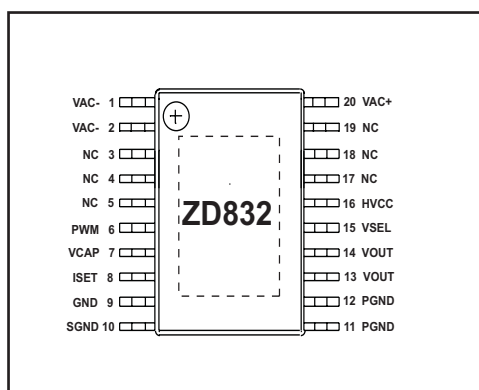
The ZD832 is available in a thermally enhanced 20-pin exposed TSSOP green package.

Factory Default Setting

The ZD832EVB is configured for 27mA application using 87 LEDs (240VAC), 78 LEDs (220VAC), or 35 LEDs (110VAC).

See details in the Typical Applications section

Pin Configuration



20-Pin Exposed TSSOP

WARNING! This is a high voltage application circuit where Galvanic Isolation is not provided. Dangerous voltages are present when connected to the AC line. It is the responsibility of the engineer employing the ZD832EVB to ensure adequate safeguards are put in place to protect the end user from electrical hazardous shock. Do not connect the ZD832 circuit ground with earth grounded devices such as scopes and power supplies.



Typical Application

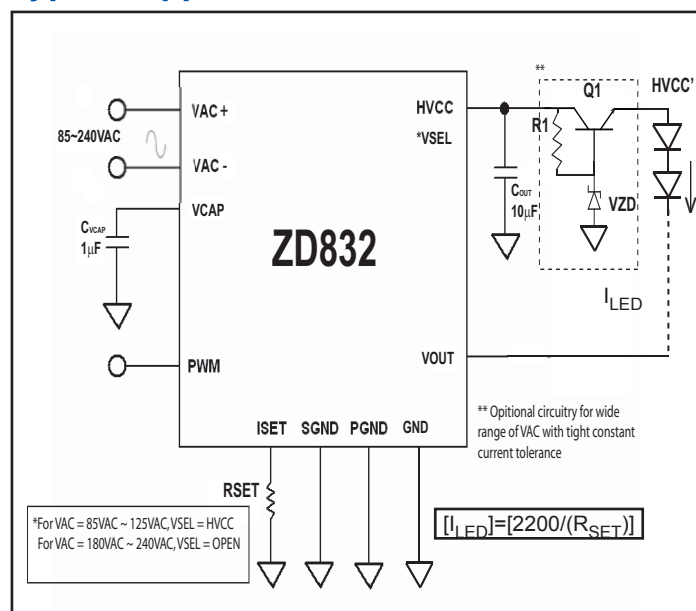


Figure 1. ZD832 driving a string of LEDs in series at a pre-set constant current

Ordering Information

Part Number	Temperature Range	Package Type
ZD832LEY	-40°C to +85°C	20-EP TSSOP
ZD832EVB	n/a	Evaluation Board

Please contact the factory for pricing and availability on Tape-on-Reel option.

Electrical Characteristics

$T_A = +25^\circ\text{C}$, V_{AC+} & $V_{AC-} = 110\text{VAC}$ ($V_{SEL} = \text{HVCC}$) or 220VAC ($V_{SEL} = \text{OPEN}$), $\text{SGND} = \text{PGND} = 0\text{V}$, C_{OUT} to $\text{PGND} = 10\mu\text{F}$ (rated at 350V), C_{VCAP} to $\text{SGND} = 1\mu\text{F}$ (rated at 10V), $\text{PWM} = 5\text{V}$; unless otherwise noted.

Parameter	Condition	Min	Typ	Max	Units
AC Input Voltage, V_{AC+} & V_{AC-}	$V_{SEL} = \text{HVCC}$ $V_{SEL} = \text{OPEN}$	85 180	110 220	125 240	V_{AC} V_{AC}
High Voltage, HVCC DC Input applied to HVCC DC Output from HVCC	$V_{SEL} = \text{HVCC}$ un-connected V_{AC+} & V_{AC-} , $I_{LED} = 5\text{mA}$, $V_{\text{OUT}} = 5\text{V}$ connected V_{AC+} & V_{AC-} , $I_{LED} = 5\text{mA}$, $V_{\text{OUT}} = 5\text{V}$	120 120		175 175	V V
High Voltage, HVCC DC Input applied to HVCC DC Output from HVCC	$V_{SEL} = \text{OPEN}$ un-connected V_{AC+} & V_{AC-} , $I_{LED} = 5\text{mA}$, $V_{\text{OUT}} = 5\text{V}$ connected V_{AC+} & V_{AC-} , $I_{LED} = 5\text{mA}$, $V_{\text{OUT}} = 5\text{V}$	250 250		340 340	V V
LED Driver Output, V_{OUT}	$R_{\text{SET}} = 733\text{k}\Omega$, $I_{LED} = 3\text{mA}$	5		30	V
LED Driver Output, V_{OUT}	$R_{\text{SET}} = 110\text{k}\Omega$, $I_{LED} = 20\text{mA}$	5		25	V
LED Driver Output, V_{OUT}	$R_{\text{SET}} = 73\text{k}\Omega$, $I_{LED} = 30\text{mA}$	7		18	V
Supply Current, I_{VAC} Quiescent Current	$R_{\text{SET}} = 110\text{k}\Omega$, $\text{PWM} = 5\text{V}$, un-connected V_{OUT}		2	5	mA
LED Output Current Range, I_{LED}		3		33	mA
LED Output Current Min.	$R_{\text{SET}} = 733\text{k}\Omega$, $\text{PWM} = 5\text{V}$, $V_{\text{OUT}} = 3\text{VDC}$ to 30VDC	3			mA
LED Output Current Max.	$R_{\text{SET}} = 73\text{k}\Omega$, $\text{PWM} = 5\text{V}$, $V_{\text{OUT}} = 7\text{VDC}$ to 18VDC		30	33	mA
Output Current, I_{LED}	$R_{\text{SET}} = 110\text{k}\Omega$; [I_{LED}] = $[2200 / (R_{\text{SET}})]$ $V_{\text{OUT}} = 5\text{V}$ to 10V $V_{\text{OUT}} = 3\text{V}$ to 25V	18.6 17	20 20	21.4 23	mA mA
Output Leakage Current, $I_{LED-\text{Leakage}}$	$\text{PWM} = 0\text{V}$, $V_{\text{OUT}} = 5\text{V}$		20	100	μA
PWM Signal Pin Input Voltage High Input Voltage Low Input Leakage Current	$\text{PWM} = 0\text{V}$ or 5V	2.0	0.2 1	10	V V μA
ISET Pin Regulated ISET Voltage, V_{ISET}		1.1	1.25	1.3	V

Pin Description

Pin Number	Pin Name	Pin Function
1, 2	VAC-	High Voltage AC Input, from 85~125V _{AC} (VSEL=HVCC) or 180~240V _{AC} (VSEL=OPEN).
20	VAC+	High Voltage AC Input, from 85~125V _{AC} (VSEL=HVCC) or 180~240V _{AC} (VSEL=OPEN).
6	PWM	LED Control Pin, Pulse-width Modulated or logic high/low Input.
7	VCAP	Internal Regulator Output. Bypass this pin with a 1 μ F capacitor to SGND.
8	ISET	LED Current Setting Pin. Connect RSET from ISET to PGND to set the LED current.
9	GND	Substrate Ground. Must be connected to SGND (Pin #10)
10	SGND	Signal Ground. Connects all small signal components to this ground.
11, 12	PGND	Power Ground. Connects high voltage decoupling capacitor to this ground.
13, 14	VOUT	LED Driver open-drain Output. Constant current sinking outputs rated for 100V.
15	VSEL	VSEL = OPEN when the device is to operate for 220V _{AC} input. VSEL=HVCC (connect to HVCC pin) when the device is to operate for 110V _{AC} input.
16	HVCC	High Voltage Rectified DC Output from VAC+ & VAC-. Bypass HVCC with at least 10 μ F to PGND.
3, 4, 5, 17, 18, 19	NC	No Connect Pins. Must be left open and unconnected.

Input Operation Description

AC Input Voltage (VAC+, VAC-)

An AC voltage power source, with a typical range of 85V_{AC} to 240V_{AC}, can be applied directly to the VAC+ and VAC- pins of the ZD832 to drive a string of LEDs. The input voltage power source should be able to provide a 1.5A load current. The ZD832EVB demo board is capable of providing a constant current for the string of LEDs over this input voltage ranges of 85V_{AC} to 240V_{AC}.

Note: The ZD832EVB evaluation board is not protected from output open/short circuit conditions. Potential damage to the Demo Board may occur if the output load is not properly connected.

High Voltage DC Input (HVCC)

A typical range of 85V_{DC} to 340V_{DC} can be applied to the HVCC pin to drive the LED string directly without connecting the VAC+ and VAC-. A small 1μF decoupling capacitor from the HVCC pin to PGND is used to reduce possible ripples. The power rating (V_{DC}) of the capacitor depends on the input voltage at HVCC, but should typically be rated at 250V.

LED Dimming

PWM Dimming

The output string of series LEDs can be dimmed by applying an input pulse-width modulated signal (50Hz to 5kHz) to the PWM pin. This allows for a wide range of dimming gradient. The dimming is proportional to the PWM duty cycle, which can range from 10% to 90%. The device is in shutdown mode when PWM is at LOGIC LOW "0" state, and is fully-on when PWM is at a LOGIC HIGH "1" state.

Output Operation Description

High Voltage Rectified DC Output (HVCC)

A typical range of 85V_{DC} to 340V_{DC} can be sourced from the HVCC pin and is dependent on the AC input voltage at VAC+ and VAC-. A 10μF decoupling capacitor, C_{OUT}, is connected from the HVCC pin to PGND is used to reduce the rectified ripples at the output. The power rating (V_{DC}) of the capacitor depends on the input VAC voltage, but should typically be rated at 400V. Please refer to the following figures for expected HVCC values using different C_{OUT} at various output current, ILED.

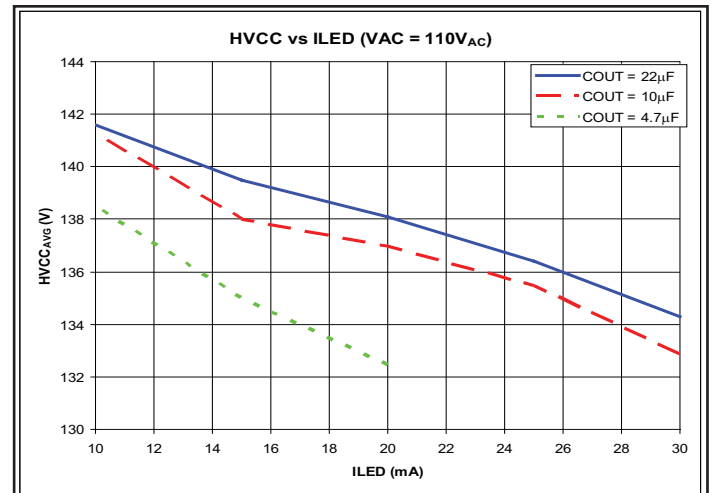


Figure 2. Expected Values of HVCC with VAC = 110V_{AC}

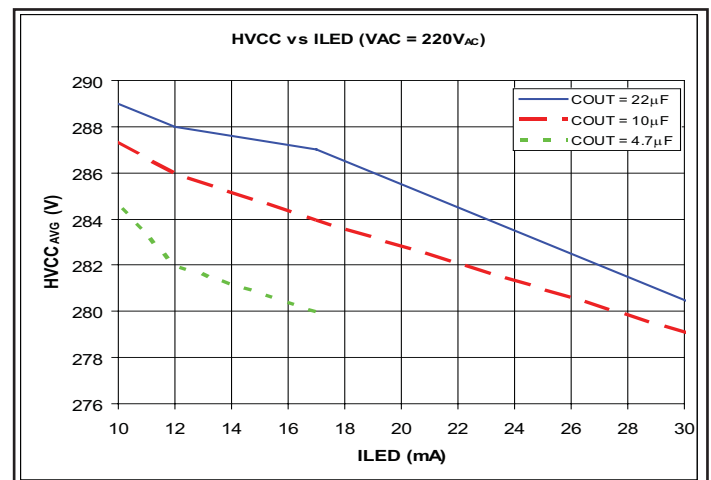


Figure 3. Expected Values of HVCC with VAC = 220V_{AC}

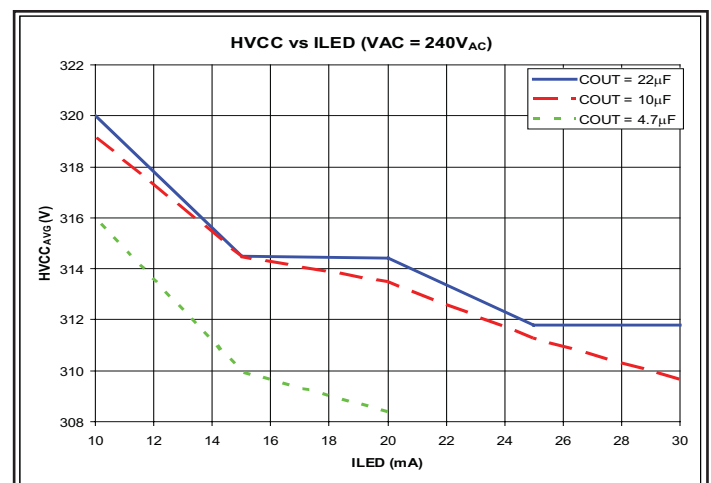


Figure 4. Expected Values of HVCC with VAC = 240V_{AC}

Input Operation Description cont.

Analog Voltage Dimming

To allow for LED current amplitude adjustment as well as linear dimming, ISET can be connected to an analog voltage through a resistor, RSET, where RSET is in the range of $733k\Omega \geq RSET \geq 73k\Omega$. The ISET pin is typically regulated at 1.25V.

As shown in Figure 5, when the DC voltage is set at 0V for example, the I_{LED} current is positioned at its default value which is calculated from the equation,

$$[I_{LED}] = [2200 / (RSET)]$$

Increasing the DC voltage from 0V to 1.25V will dim the LEDs in linear proportion with decreased in the I_{LED} current. Setting the DC voltage at midpoint upon device power-up can control the dimming up and down function.

Voltage Select (VSEL)

The ZD832 can be operated from two banks of AC voltage range inputs; 85VAC~125VAC or 180VAC ~240VAC. To operate for 85VAC~125VAC, the VSEL (pin #15) must be connected to the HVCC (pin #16). To operate for 180VAC~240VAC, VSEL (pin #15) must be left OPEN.

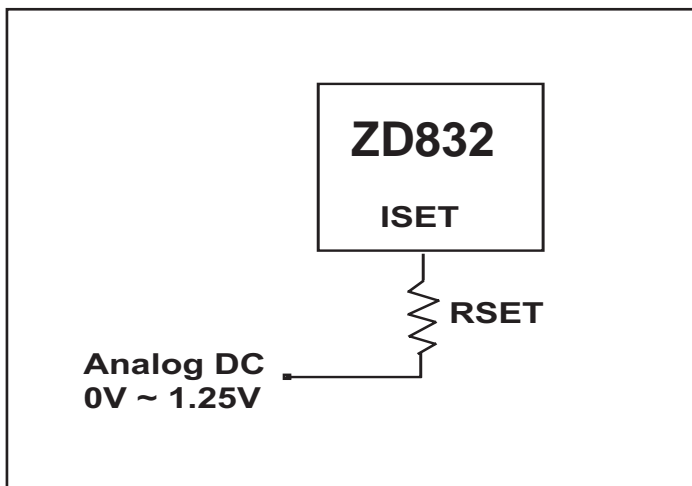


Figure 5. Analog dimming using analog DC voltage.

Note: The ZD832EVB circuit is not isolated from AC mains. Connecting external devices or equipments to the ZD832 input pins without the use of proper isolations, such as opto-isolators, can be hazardous and may cause equipment damages. Do not connect the ZD832 circuit ground with earth grounded devices such as scopes and power supplies.

Circuit Description

The Limiting Resistor R_{EXT}

To protect excessive power dissipation on the internal power transistor, an external resistor R_{EXT} may be required to maintain the V_{OUT} within the range of 3V and 30V. The formula for the limiting resistor R_{EXT} should be used to calculate the resistor value in series with the LEDs as follows,

$$R_{EXT} = (HVCC - n \cdot V_f - V_{OUT})/I_{LED}$$

where,

HVCC = Average High Voltage Rectified DC.
Please refer to Figure 2 and Figure 3 for expected values.

n = Number of LEDs connected in series.

V_f = Forward bias voltage of a single LED at specified I_{LED} level.

V_{OUT} = Average dropout voltage at VOUT pin, recommended to be set at $V_{OUT} \geq 7V$ for calculations.

I_{LED} = Regulated average LED current, ranges from 3mA to 30mA.

Use the following formula to make sure R_{EXT} has adequate power rating tolerance:

$$P_{REXT} = (I_{LED})^2 \cdot R_{EXT}$$

where

P_{REXT} = Power dissipated by R_{EXT}

Several design examples are shown in table below for reference, assuming the V_f of the LED is 3.3V at $I_{LED}=30mA$ and $C_{OUT} = 10\mu F$.

VAC Input Voltage	HVCC _{AVG} (V)	# of LEDs	Calculated V_{OUT}	R_{EXT} (Ω)	Power Rating (W)
110±3% VAC	133	37	10	Not required	N/A
110±3% VAC	133	35	10	270	0.5
220±2% VAC	279	81	12	Not required	N/A
220±2% VAC	279	78	12	270	0.5
240±2% VAC	309	90	12	Not required	N/A
240±2% VAC	309	87	12	270	0.5

Table 1. Design Examples.

Selecting External Component RSET to Set I_{LED} Current

The ZD832 uses an external resistor, RSET, to set the constant LED current, I_{LED} . I_{LED} is determined by the formula:

$$[I_{LED}] = [2200 / (RSET)]$$

with a minimum value of $RSET \geq 73k\Omega$, which sets the I_{LED} to 30mA, and a maximum value of $RSET \leq 733k\Omega$, which sets the minimum I_{LED} to 3mA (Refer to Figure 5). The maximum allowable capacitance at the ISET pin is 50pF.

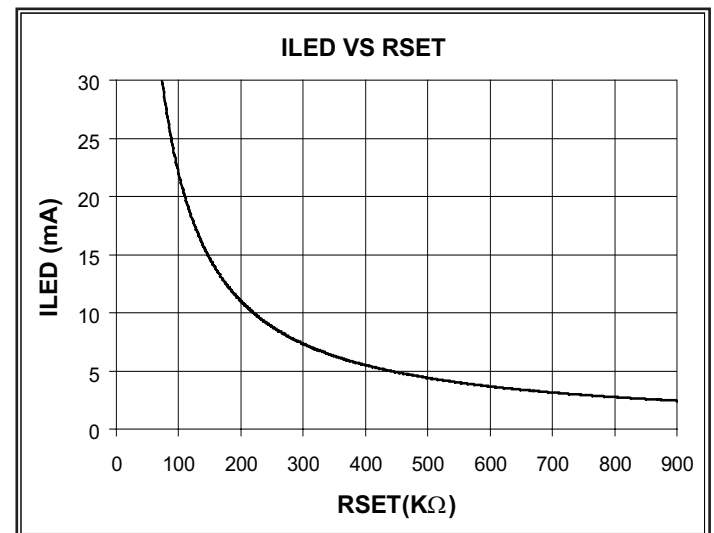


Figure 6. ILED vs RSET

Typical Application

The ZD832EVB Evaluation Board is populated for operations of to 90 LEDs, 80 LEDs and 40 LEDs with their respective VAC inputs. The circuit boards are wired for driving a constant output current of about 30mA using a RSET of 73kΩ as the default value configuration at factory. A jumper is connected at the VCAP pin and can be connected to the PWM to enable the device. If PWM dimming control is required, disconnect the jumper.

Application circuit using 90 LEDs

An input voltage of $240V_{AC} \pm 2\%$ can be applied to VAC+ and VAC- pin. The average output at HVCC will be about 309V (See Table 1), assuming 90 LEDs in series with V_f of 3.3V are being used. Figure 7 shows the typical circuit.

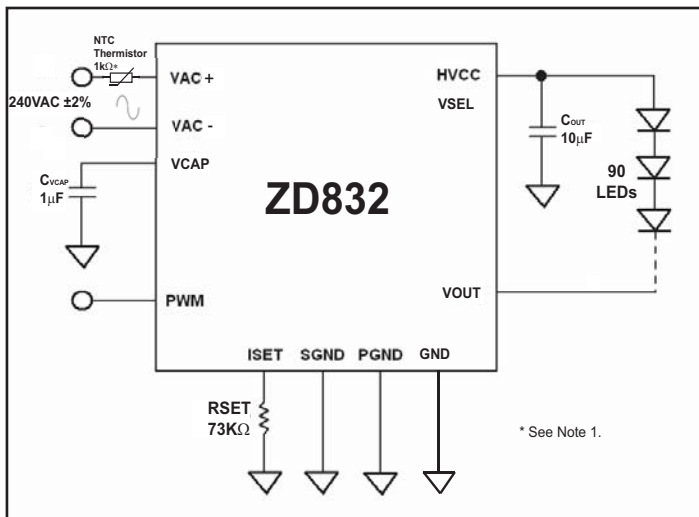


Figure 7. Driving 90 LEDs with the ZD832 from a power source of $220V_{AC} \pm 2\%$ with 30mA output current.



Figure 8. ZD832EVB evaluation board configured for $240V_{AC}$ operation.

Application circuit using 78 LEDs

An input voltage of $220V_{AC} \pm 2\%$ can be applied to VAC+ and VAC- pin. The average output at HVCC will be about 286V and the limiting REXT is set at 270Ω (See Table 1), assuming 78 LEDs in series with V_f of 3.3V are being used. Figure 9 shows the typical circuit.

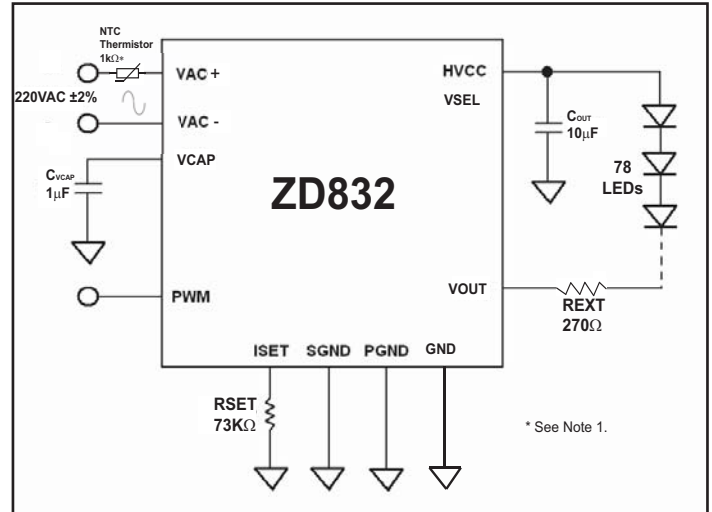


Figure 9. Driving 78 LEDs with the ZD832 from a power source of $220V_{AC} \pm 2\%$ with 30mA output current.

Application circuit using 40 LEDs

An input voltage of $220V_{AC} \pm 2\%$ can be stepped down by using an external RC circuit to about $110V_{AC}$ across VAC+ and VAC-. The average output at HVCC will be about 150V, assuming 40 LEDs in series with V_f of 3.3V are being used. Figure 10 shows the typical circuit

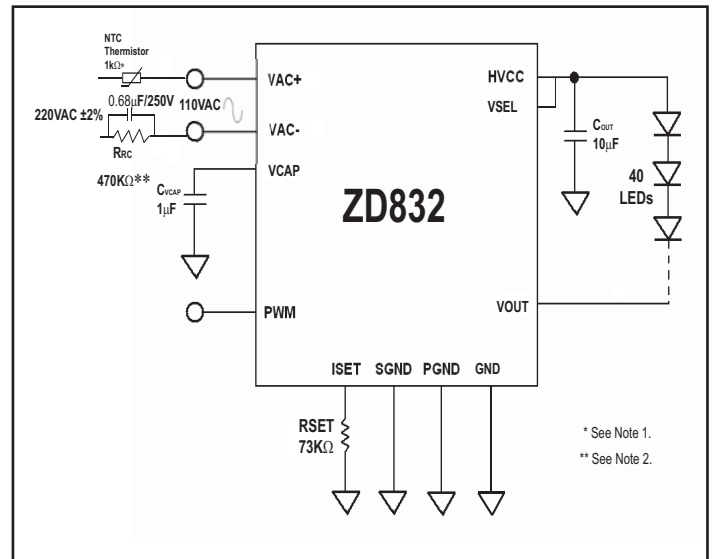


Figure 10. Driving 40 LEDs with the ZD832 from a power source of $220V_{AC} \pm 2\%$ with 30mA output current.

Typical Application cont.

Operation for 110V_{AC} ±3% and 35 LEDs

An input voltage of 110V_{AC} can be applied to VAC+ and VAC-. The output at HVCC is rectified at 134V_{DC} and the limiting REXT is set be 270Ω, assuming 35 LEDs in series with V_f of 3.3V are being used. Figure 11 shows the typical circuit with VSEL connected to HVCC.

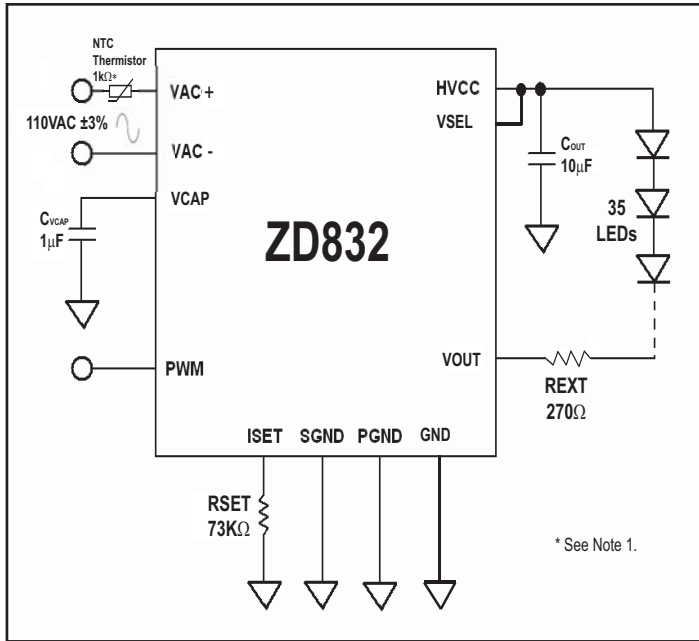


Figure 11. Driving the ZD832 from a power source of 110V_{AC}±3% with 30mA output current.

* Note 1. Using a thermistor (1KΩ/0.5W) in series with the AC+ input of the ZD832 will effectively limit the inrush charging current to the C_{OUT} at the HVCC pin during the start up of the AC supply without reducing the power efficiency.

When the AC supply is turned on, the thermistor is cool and provides about 1KΩ resistance at 25 °C and reduces the instant inrush current. When the inrush current drops to the steady-state current and flows through the thermistor, the thermistor dissipates heat and reduces it's resistance to about 100 Ω.

Due to the thermal characteristics of the thermistor, the duration between switching the AC supply ON and OFF should be more than 2 to 3 seconds to allow the thermistor to cool it's resistance back to 1KΩ to protect any further inrush current.

Application circuit with parallel ZD832

The ZD832 can be used in parallel with another ZD832 to achieve an ILED current of 60mA through and LED string. See Figure 12 for reference.

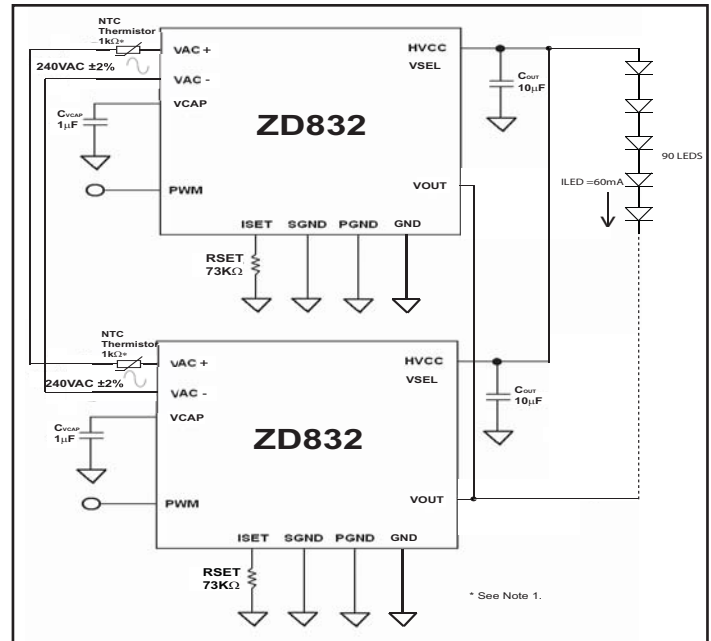


Figure 12. Driving parallel ZD832s from a power source of 240V_{AC}± 2%with 60mA output current.

** Note 2. R_{RC} should be in the range of 390KΩ~680KΩ, 0.25W when used in the external RC circuit.

Note: The ZD832EVB evaluation board is not protected from output open/short circuit conditions. Potential damage to the Demo Board may occur if the output load is not properly connected. The ZD832EVB circuit is not isolated from AC mains. Connecting external devices or equipments to the ZD832 input pins without the use of proper isolations, such as opto-isolators, can be hazardous and may cause equipment damages. Do not connect the ZD832 circuit ground with earth grounded

Typical Application cont.

Operation for VAC from 85VAC to 125VAC with tight constant current tolerance.

By adding 3 external components, the ZD832 can regulate a rectified DC voltage for a wider range of input voltage with a constant ILED current of ±6%.

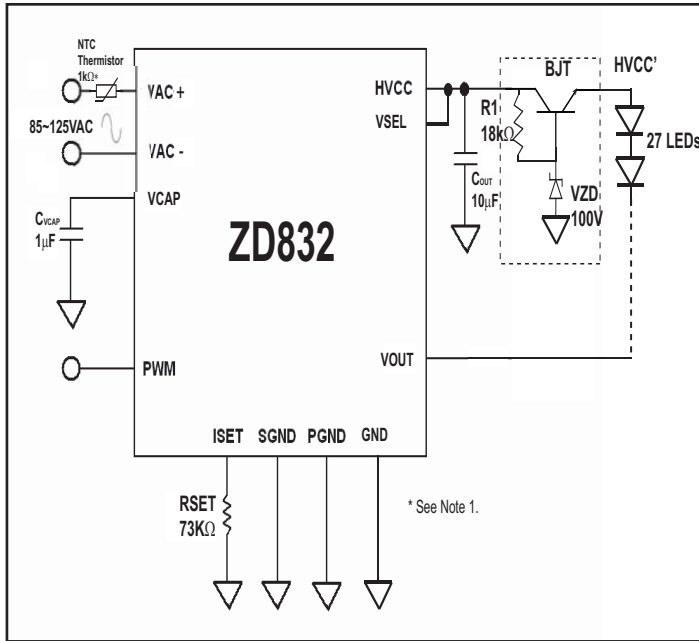


Figure 13. Driving the ZD832 from a power source of 85V_{AC} to 125V_{AC} with 30mA ± 6% output current.

An input voltage of 85~120V_{AC} can be applied to VAC+ and VAC-. The output at HVCC is rectified at 100~156V_{DC} and the external circuitry will start to regulate the HVCC' voltage to 93~105V_{DC} when the HVCC minimum voltage is 100V_{DC} because of the 100V Zener diode and the NPN BJT. The number of LEDs depend on the application and the forward voltage of the LEDs and can be determined by the equation:

$$HVCC' - (n \times V_{Forward}) = VOUT \geq 7V \text{ (At } 85V_{AC}\text{)}$$

The BJT will help to keep the ZD832 from thermal shut-down by putting the extra voltage on the VCE of the BJT, keeping the VOUT ≤ 18V

The example in Figure 13 above uses 27 LEDs in series with V_f of 3.3V @30mA.

Operation for VAC from 180VAC to 240VAC with tight constant current tolerance.

By adding 3 external components, the ZD832 can regulate a rectified DC voltage for a wider range of input voltage with a constant ILED current of ±6%.

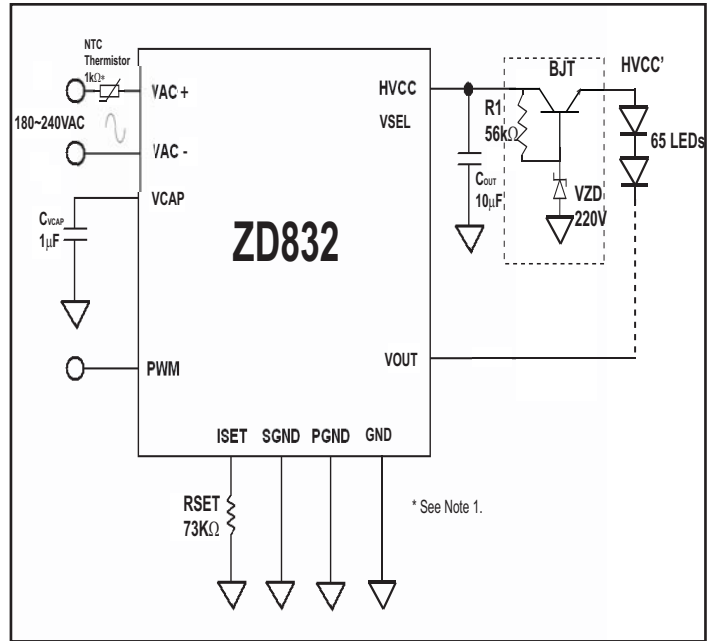


Figure 14. Driving the ZD832 from a power source of 180V_{AC} to 240V_{AC} with 30mA ± 6% output current.

An input voltage of 180~240V_{AC} can be applied to VAC+ and VAC-. The output at HVCC is rectified at 227~310V_{DC} and the external circuitry will start to regulate the HVCC' voltage to 219~230V_{DC} when the HVCC minimum voltage is 220V_{DC} because of the 220V Zener diode and the NPN BJT. The number of LEDs depend on the application and the forward voltage of the LEDs and can be determined by the equation:

$$HVCC' - (n \times V_{Forward}) = VOUT \geq 7V \text{ (At } 180V_{AC}\text{)}$$

The BJT will help to keep the ZD832 from thermal shut-down by putting the extra voltage on the VCE of the BJT, keeping the VOUT ≤ 18V

The example in Figure 14 above uses 65 LEDs in series with V_f of 3.3V @30mA.

Typical Application cont.

Operation for VAC from 180VAC to 240VAC with 90 LEDs and tight constant current tolerance.

By adding 5 external components, the ZD832 can regulate a rectified DC voltage and ILED current for a wider range of input voltage, driving two strings of 45 LEDs in series at 15mA per string.

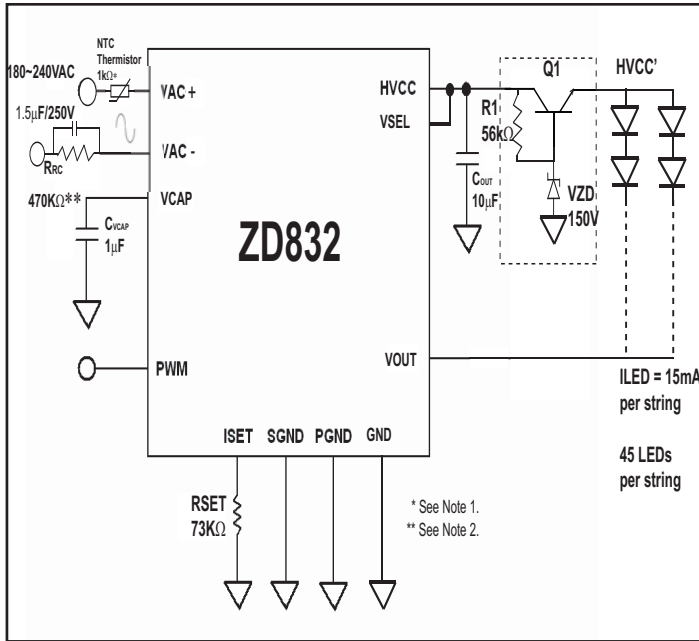


Figure 15 Driving the ZD832 from a power source of 180V_{AC} to 240V_{AC} with 90 LEDs and 30mA ± 6% output current.

An input voltage of 180~240V_{AC} can be applied to VAC+ and VAC- through a RC dropper circuit with 1.5μF in parallel with a 470kΩ. The output at HVCC is rectified at 160~220V_{DC} and the external circuitry will start to regulate the HVCC' voltage to 150~160V_{DC} when the HVCC minimum voltage is 150V_{DC} because of the 150V Zener diode and the NPN BJT. The number of LEDs depend on the application and the forward voltage of the LEDs and can be determined by the equation:

$$HVCC' - (n \times V_{Forward}) = VOUT \geq 7V \text{ (At } 180V_{AC})$$

The BJT will help to keep the ZD832 from thermal shut-down by putting the extra voltage on the VCE of the BJT, keeping the VOUT ≤ 18V

The example in Figure 15 above uses two strings of 45 LEDs in series with V_f of 3.15V @15mA per string.

Application using ZD832 in 220VAC Operation for 8W Applications

A) Driving 42 LEDs at 60mA Constant Current

An input voltage of 200~240V_{AC} can be stepped down by using an external RC circuit to about 120V_{AC} across VAC+ and VAC- on both ZD832 in parallel. The BJT will keep the HVCC at 150V, assuming 42 LEDs in series with V_f of 3.16V (custom LEDs) are being used. The ILED current will be 60mA, which is set by the RSET of 73kΩ. Figure 17A shows the typical circuit.

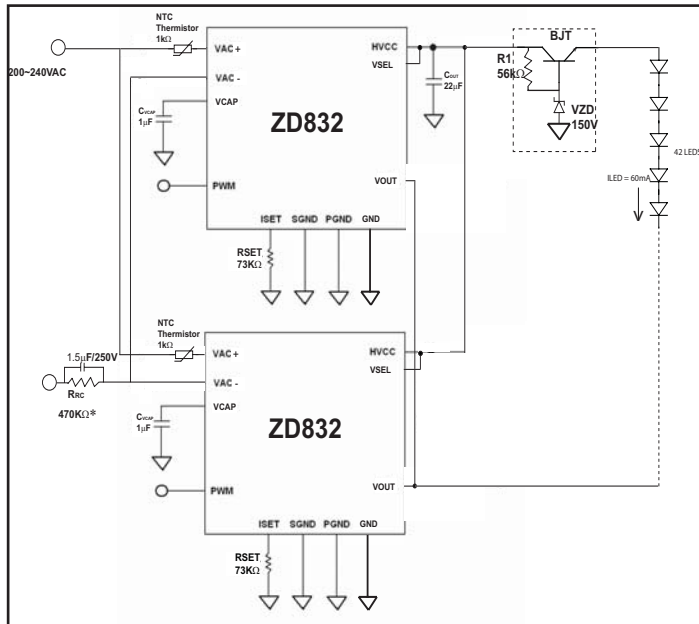


Figure 17A. ZD832 driving 42 LEDs for 8W output.

B) Driving 66 LEDs at 40mA Constant Current

To maximize the number of LEDs in the application, the RC circuit is removed and an input voltage of 200~240V_{AC} can be applied directly across VAC+ and VAC- on both ZD832 in parallel. The BJT will keep the HVCC at 220V, assuming 66 LEDs in series with V_f of 3.16V (custom LEDs) are being used. The ILED current will be 40mA, which is set by the RSET of 110kΩ. Figure 17B shows the typical circuit.

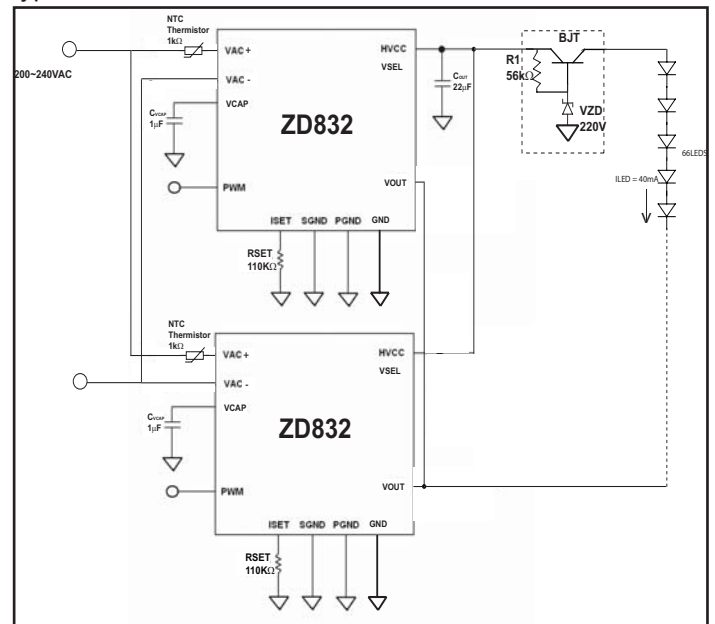


Figure 17B. ZD832 driving 66 LEDs for 8W output.

ZD832EVB Bill of Material (BOM) Listing

Item	Quantity	Location	Part
1	2	VCAP	1µF/16VDC
2	1	COUT	22µF/400VDC
3	2	RSET	73kΩ
4	0	R _{EXT}	Variable
5	2	U1	ZD832LEY
6	42	HVCC	Custom LEDs
7	2	TH	1kΩ/0.5W NTC Thermistor
8	1	VAC	1.5µF/250VDC
9	1	VAC	470kΩ*/0.25W
10	1	Q1	NPN BJT
11	1	R1	56kΩ
12	1	VZD	150V Zener

ZD832EVB Bill of Material (BOM) Listing

Item	Quantity	Location	Part
1	2	VCAP	1µF/16VDC
2	1	COUT	22µF/400VDC
3	2	RSET	110kΩ
4	0	R _{EXT}	Variable
5	2	U1	ZD832LEY
6	66	HVCC	Custom LEDs
7	2	TH	1kΩ/0.5W NTC Thermistor
8	1	Q1	NPN BJT
9	1	R1	56kΩ
10	1	VZD	220V Zener

* R_{RC} should be in the range of 390kΩ~680kΩ, 0.25W when used in the external RC circuit.

Components Selection

Capacitor Selection

The small size of ceramic capacitors makes them ideal- for ZD832 applications. X5R and X7R types retain their capacitance over wider voltage and temperature ranges and are recommended over Y5V or Z5U types. A 10 μ F filtering output capacitor and a 1 μ F input capacitor are sufficient for the most ZD832 applications.

AVX	www.avxcorp.com
Kemet	www.kemet.com
Murata	www.murata.com
Taiyo Yuden	www.t-yuden.com

Table 2. Recommended Ceramic Capacitor Manufacturers

BJT Selection

The VCE of the BJT should be more than 80V to tolerate the potential difference between the HVCC maximum and the HVCC minimum of about 60V. Due to the voltage drop in VCE the BJT should be able to dissipate more than 4Watt of power.

Part #	VCBO (max)	VCEO (max)	IC (max)	Power Dissipation (max)
2N3439	450V	350V	1A	5W
NTE157	325V	300V	1A	20W
NTE396	350V	350V	1A	5W

Table 3. Recommended NPN BJTs

Zener Diode Selection

The typical VZD of the Zener Diode is 220VDC for VAC min. of 180VAC and 100VDC for VAC min. of 85VAC. It can be one Zener Diode or a series of Zener Diodes to come up with the required VZD.

Part #	Zener Voltage (V)	Power Dissipation (W)
SML4764A	100	1
BZG03-C220-TR	220	3
BZG03-C150-TR	150	3

Table 4. Recommended Zener Diodes

ZD832EVB Bill of Material (BOM) Listing

For 90 LEDs Application (refer to Figure 7)

Item	Quantity	Location	Part
1	1	VCAP	1 μ F/16VDC
2	1	HVCC	10 μ F/400VDC
3	1	RSET	Variable
4	1	R _{EXT}	Variable
5	1	U1	ZD832LEY
6	87-90	HVCC	LEDs
7	1	VAC	1k Ω /0.5W NTC Thermistor

For 80 LEDs Application (refer to Figure 9)

Item	Quantity	Location	Part
1	1	VCAP	1 μ F/16VDC
2	1	HVCC	10 μ F/400VDC
3	1	RSET	Variable
4	1	R _{EXT}	Variable
5	1	U1	ZD832LEY
6	81-78	HVCC	LEDs
7	1	VAC	1k Ω /0.5W NTC Thermistor

For 40 LEDs Application (refer to Figure 10)

Item	Quantity	Location	Part
1	1	VCAP	1 μ F/16VDC
2	1	HVCC	10 μ F/400VDC
3	1	RSET	Variable
4	1	R _{EXT}	Variable
5	1	U1	ZD832LEY
6	40	HVCC	LEDs
7	1	VAC	1k Ω /0.5W NTC Thermistor
8	1	VAC	0.68 μ F/250VDC
9	1	VAC	470k Ω **/0.25W

ZD832EVB Bill of Material (BOM) Listing cont.

**For 85VAC to 125VAC with 27 LEDs Application
(refer to Figure 13)**

Item	Quantity	Location	Part
1	1	VCAP	1 μ F/16VDC
2	1	HVCC	10 μ F/400VDC
3	1	RSET	Variable
4	1	R _{EXT}	Variable
5	1	U1	ZD832LEY
6	27	HVCC	LEDs
7	1	VAC	1k Ω /0.5W NTC Thermistor
8	1	Q1	NPN BJT
9	1	R1	18k Ω
10	1	VZD	100V Zener

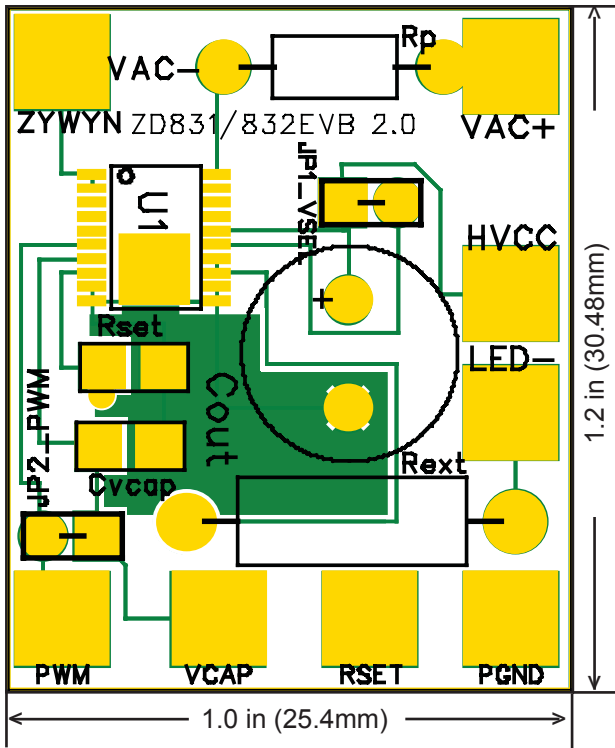
**For 180VAC to 240VAC with 65 LEDs Application
(refer to Figure 14)**

Item	Quantity	Location	Part
1	1	VCAP	1 μ F/16VDC
2	1	HVCC	10 μ F/400VDC
3	1	RSET	Variable
4	1	R _{EXT}	Variable
5	1	U1	ZD832LEY
6	65	HVCC	LEDs
7	1	VAC	1k Ω /0.5W NTC Thermistor
8	1	Q1	NPN BJT
9	1	R1	56k Ω
10	1	VZD	220V Zener

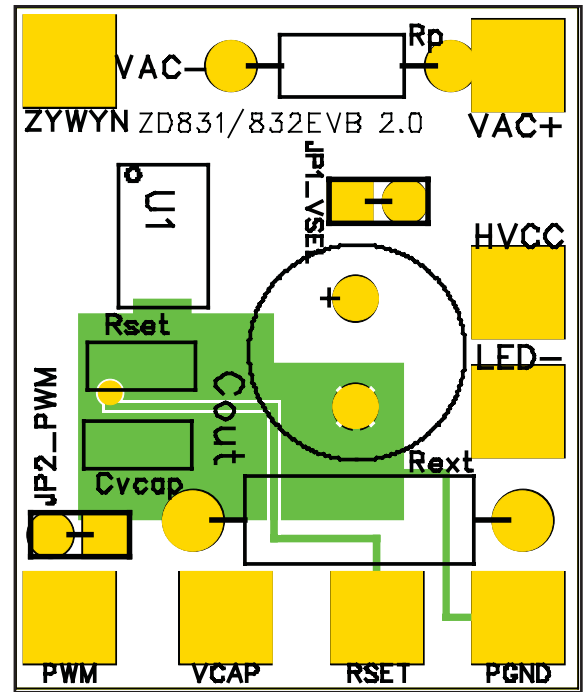
**For 180VAC to 240VAC with 90 LEDs Application
(refer to Figure 15)**

Item	Quantity	Location	Part
1	1	VCAP	1 μ F/16VDC
2	1	HVCC	10 μ F/400VDC
3	1	RSET	Variable
4	1	R _{EXT}	Variable
5	1	U1	ZD832LEY
6	90	HVCC	LEDs
7	1	VAC	1k Ω /0.5W NTC Thermistor
8	1	VAC	1.5 μ F/250VDC
9	1	VAC	470k Ω **/0.25W
10	1	Q1	NPN BJT
11	1	R1	56k Ω
12	1	VZD	150V Zener

Evaluation Board Information



ZD832EVB Double-Layer Evaluation Board
Front Side Layout



ZD832EVB Double-Layer Evaluation Board Back Side Top
View Layout

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