## FEATURES

- Constant LED Current for Varying Input Voltage
- Adjusted Current Operation
- Low Quiescent Current
- Simplifies Circuit and System Designs
- Compact Component Count
- Provided Higher Current by Parallel
- Temperature Compensated Constant Current
- Over Current Protection
- Over Temperature Protection
- LED Current Programmable Thermal Foldback for thermal Protection
- SOP-8L Package or DFN-8L Package or TO252-5L Package

## APPLICATIONS

- LED Driver
- Lighting Applications
- Lamp Indicators
- Candle Light
- Low Cost solution
- Constant Current Source

## GENERAL DESCRIPTION

The EC4211 is a constant current linear LED driver for replace discrete solutions in AC/DC power application (up to 265V). The device is to drive a constant current of ±5% variation by an external resistor for different LED strings. The solution eliminates the need of individual components by combining them into a single package, which results in a significant reduction of both system cost and board space. For higher current application, multiple EC4211s can also be used in parallel such as 40mA, 80mA or 160mA. The EC4211 is self-protected against over temperature and over current. Internal thermal foldback function regulates LED driver current automatically to limit die temperature during high power operation or high ambient temperature conditions. These features provide maximum system protection for the demanding lighting applications. The EC4211 is available in a space saving SOP-8L package, DFN-8L package or TO252-5L package, and the operating temperature is from –40°C to +125°C.

## TYPICAL APPLICATION CIRCUIT

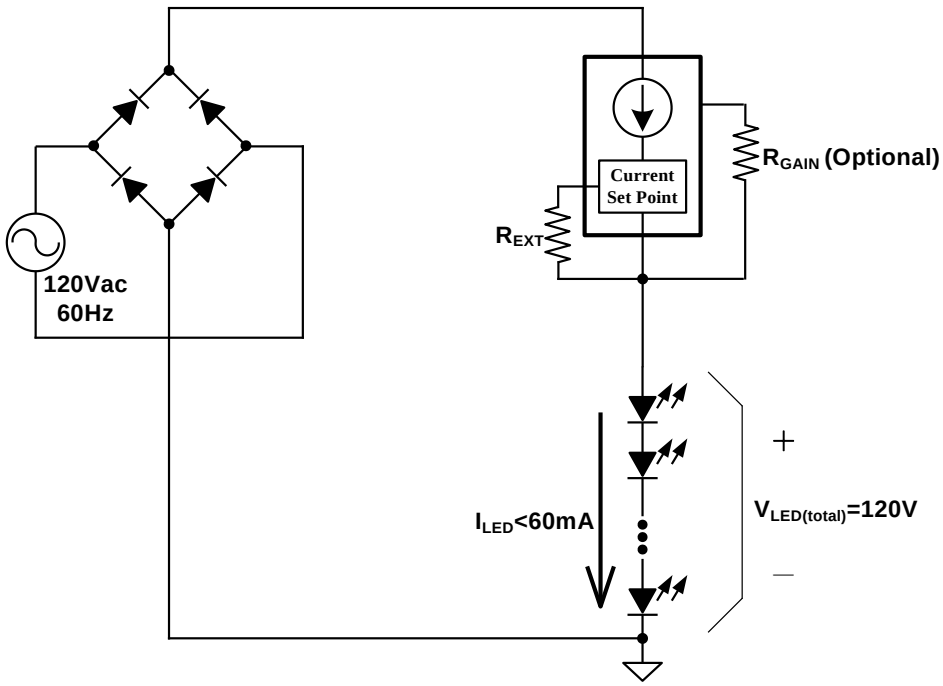
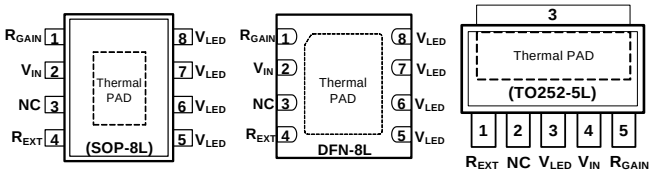



**Fig. 1 Simplified Application Circuit**

## ABSOLUTE MAXIMUM RATINGS

$V_{IN}$ Supply Voltage..... 500V
$R_{EXT}$, $R_{GAIN}$ Operation Voltages..... 6V
Operating Temperature..... -40°C to +125°C
Storage Temperature..... -55°C to +150°C
Maximum Die Temperature..... +150°C
Lead Temperature..... +260°C
ESD HBM Voltage..... 2.5kV
ESD MM Voltage..... 300V

## PIN CONFIGURATION




**Note:**
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. Continuous operation of the device at the absolute rating level may affect device reliability.

## Ordering Information

| Part No. | Package Type | Marking Information | Remark |
|---|---|---|---|
| EC4211NNMHR | SOP-8L | EC4211<br>YYWW<br>LLLLLT | YYWW ：Date Code<br>LLLLL：Lot No<br>T：internal tracking code |
| EC4211NNF2R | DFN-8L | EC4211<br>LLLLL<br>YYWWT | |
| EC4211NNA5R | TO252-5L | EC4211<br>YYWW<br>LLLLLT | |

## ELECTRICAL CHARACTERISTICS

**$T_A$ = 25°C unless otherwise specified**

| PARAMETER | | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **Electrical Characteristic** | | | | | | |
| $V_{IN}$ | Operation Voltage | | 15 | | 265 | V |
| $I_{LED}$ | Current Regulation (Note 1) | $V_{IN}$=120Vdc, $R_{EXT}$=15Ω, $V_{LED}$=100V | 38.16 | 40.17 | 42.18 | mA |
| | | $V_{IN}$=220Vdc, $R_{EXT}$=30Ω, $V_{LED}$=200V | 19.16 | 20.17 | 21.18 | mA |
| $I_{LED(MAX)}$ | Maximum Current Regulation | $V_{DROP}$≦16V (Note 2) | | | 60 | mA |
| $I_Q$ | Quiescent Current | $V_{IN}$=20Vdc, $R_{EXT}$=Open | | 170 | | μA |
| $V_{REF}$ | Reference Voltage (Note 3) | | | 0.6 | | V |
| $V_{DROP(MAX)}$ | Maximum Dropout Voltage (Note 4) | $V_{IN}$= 265Vac, $R_{EXT}$=30Ω, $V_{LED}$=220V | | | 170 | V |
| **Thermal Characteristic** | | | | | | |
| △$V_{REF}$(T) | $V_{REF}$ Temperature Coefficient | $T_A$=-40°C ~125°C | | 0.01 | | %/℃ |
| $T_A$ | Operating Temperature | | -40 | | 125 | ℃ |
| $P_D$ | Total Power Dissipation (Operation) | | | | 1 | W |
| $R_{\Theta JA}$ | Thermal Resistance | SOP-8L Package | | 75 | | ℃/W |
| | | DFN-8L Package | | 33.2 | | ℃/W |
| | | TO252-5L Package | | 68 | | ℃/W |
| **Protection** | | | | | | |
| OCP | Over Current Protection | | | 150 | | mA |
| OTP | Over Temperature Protection | | | 150 | | ℃ |
| TFP | Thermal Foldback Protection (Note 5) | | | 90 | | ℃ |

**Note:**
1. $I_{LED}$=0.6/$R_{EXT}$+$I_Q$
2. $V_{DROP}$=$V_{IN}$－$V_{LED}$－0.6, $P_D$＜1W (No heat sink)
3. $V_{REF}$=V($R_{EXT}$)－$V_{LED}$
4. The current regulation is for a instantaneous AC line input current only, not to exceed thermal characteristics of package.
5. $I_{LED(TFP)}$=$I_{LED}$－V($R_{GAIN}$)/$R_{GAIN}$

## FUNCTION DIAGRAM

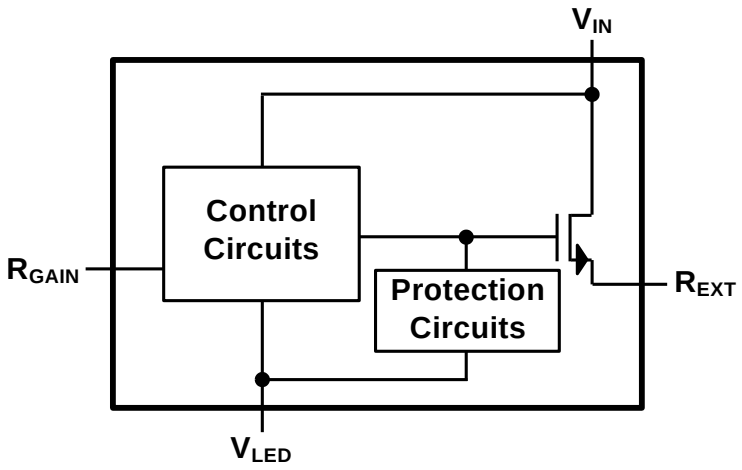



**Fig. 2 Detailed Block Diagram**

## PIN DESCRIPTIONS

**TO252-5L Package**

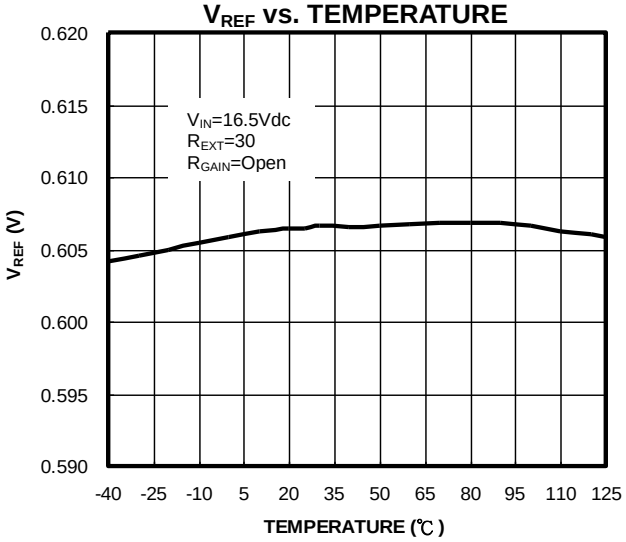
| PIN | Symbol | Description |
|---|---|---|
| 1 | $R_{EXT}$ | An external resistor between $R_{EXT}$ and $V_{LED}$ pin sets different current regulation for LED strings. |
| 2 | NC | No internal mechanically connection. Leave this pin open. |
| 3 | $V_{LED}$ | The LED strings are connected from this pin to ground. |
| 4 | $V_{IN}$ | Input supply voltage. |
| 5 | $R_{GAIN}$ | Programmable thermal foldback protection for current regulation to limit die temperature during high power operation or high ambient temperature conditions. |

**DFN-8L / SOP-8L Package**

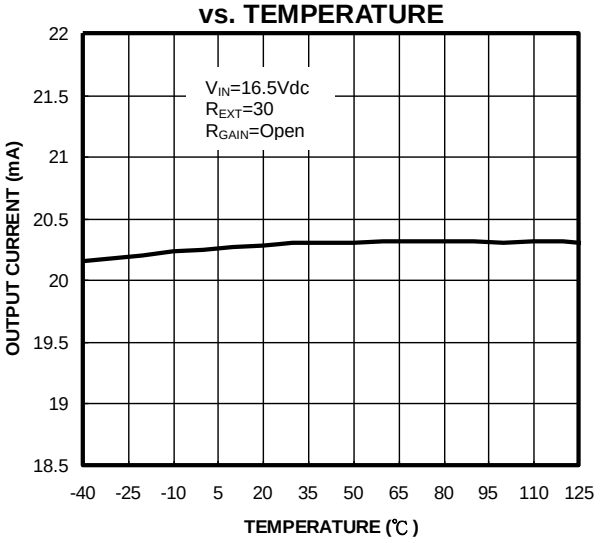
| PIN | Symbol | Description |
|---|---|---|
| 1 | $R_{GAIN}$ | Programmable thermal foldback protection for current regulation to limit die temperature during high power operation or high ambient temperature conditions. |
| 2 | $V_{IN}$ | Input supply voltage. |
| 3 | NC | No internal mechanically connection. Leave this pin open. |
| 4 | $R_{EXT}$ | An external resistor between $R_{EXT}$ and $V_{LED}$ pin sets different current regulation for LED strings. |
| 5, 6, 7, 8 | $V_{LED}$ | The LED strings are connected from these pins to ground. |

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C, unless otherwise specified)

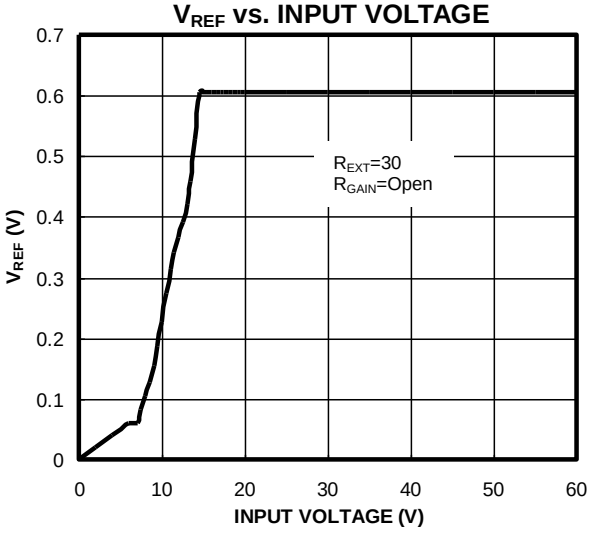
### $V_{REF}$ vs. TEMPERATURE



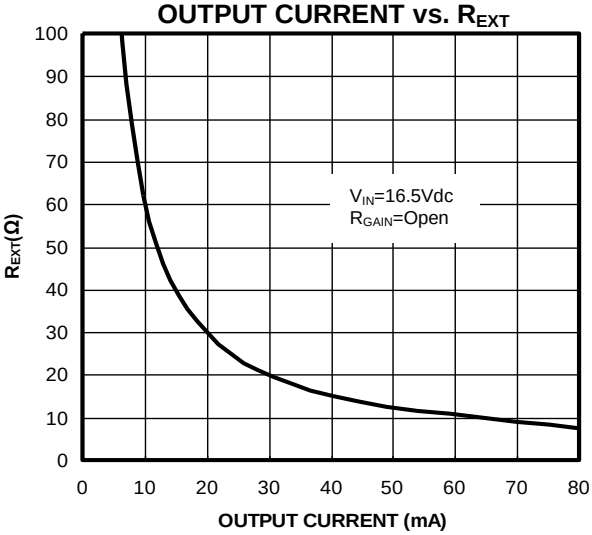

### OUTPUT CURRENT vs. TEMPERATURE



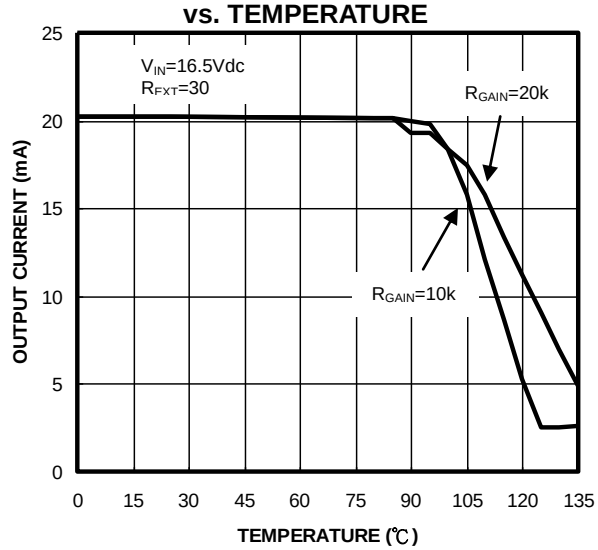

### $V_{REF}$ vs. INPUT VOLTAGE



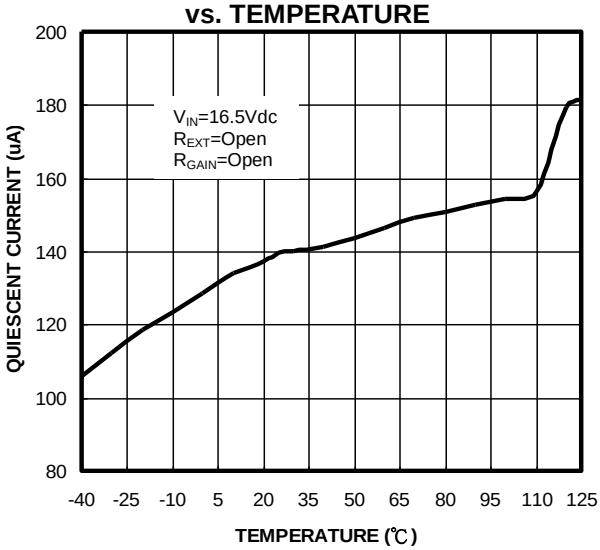

### OUTPUT CURRENT vs. $R_{EXT}$




### THERMAL FOLDBACK vs. TEMPERATURE

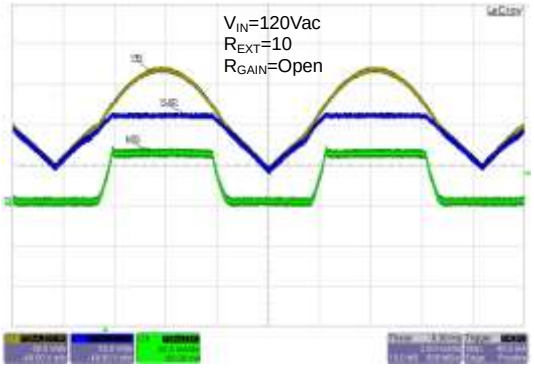



### QUIESCENT CURRENT vs. TEMPERATURE

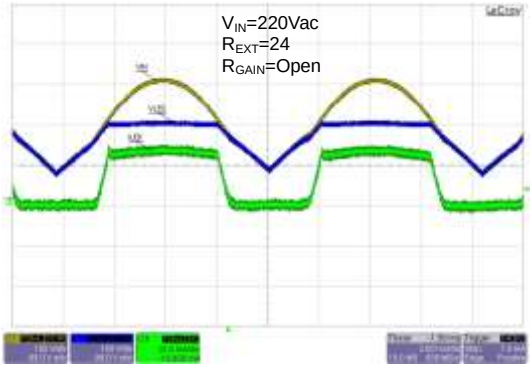


## ELECTRICAL CHARACTERISTICS (Continued)

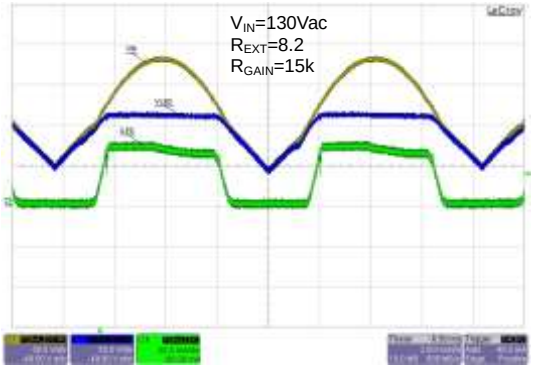
### TRANSIENT RESPONSE



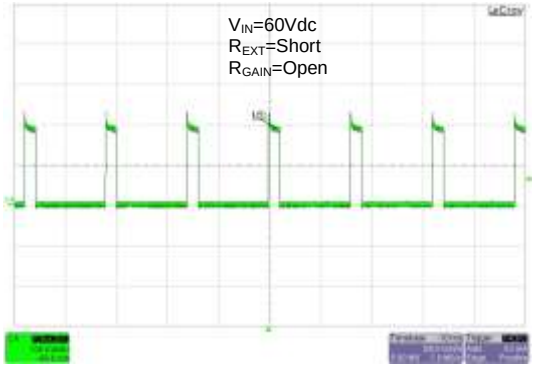

### TRANSIENT RESPONSE



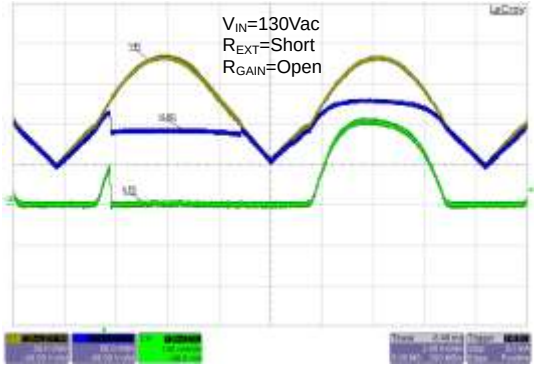

### TRANSIENT RESPONSE vs. THERMAL FOLDBACK




### OVER CURRENT PROTECTION




### OVER TEMPERATURE PROTECTION



## LED Lighting EC4211 Application Circuit Schematic

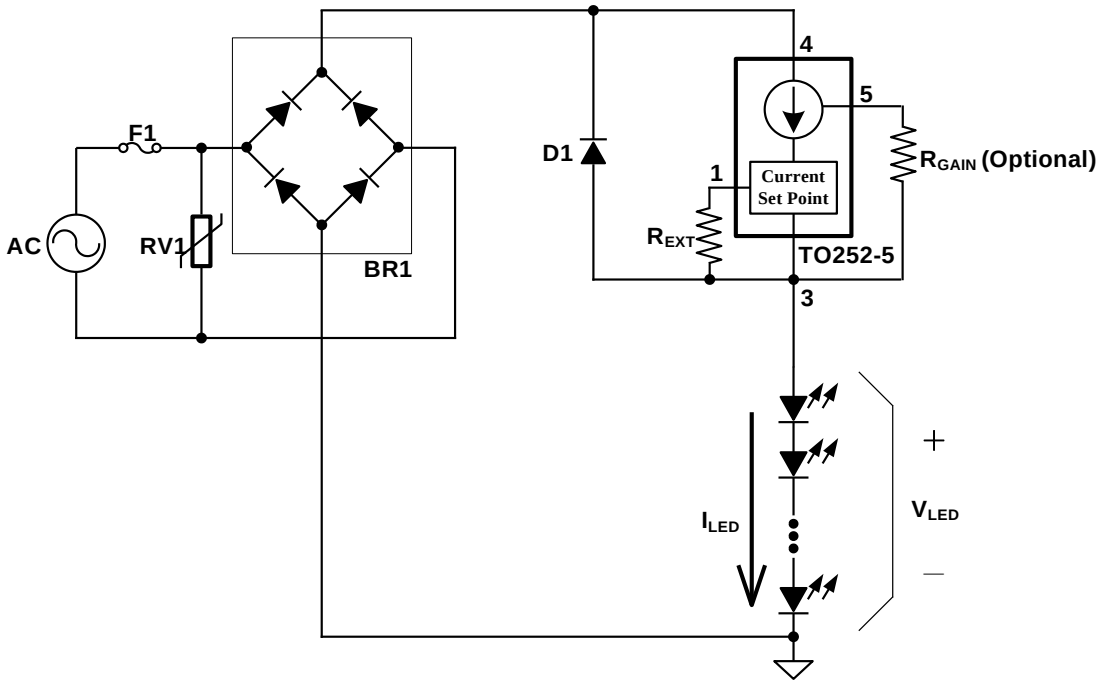



**Fig. 3 Typical Application Circuit**

## 110VAC 4W LED Lighting Demo Board Part List

| COMPONENT | VALUE | PACKAGE |
|---|---|---|
| U1 | EC4211 | TO252-5L |
| BR1 | B10S | SMD |
| F1 | 1A | DIP |
| RV1 | 221KD14 (140VAC) | DIP |
| D1 | 1N4003 | DIP |
| $R_{EXT}$ | 8.5 | 0603 |
| $R_{GAIN}$ | 7.5k | 0603 |
| $V_{LED}$ | 120V | NA |

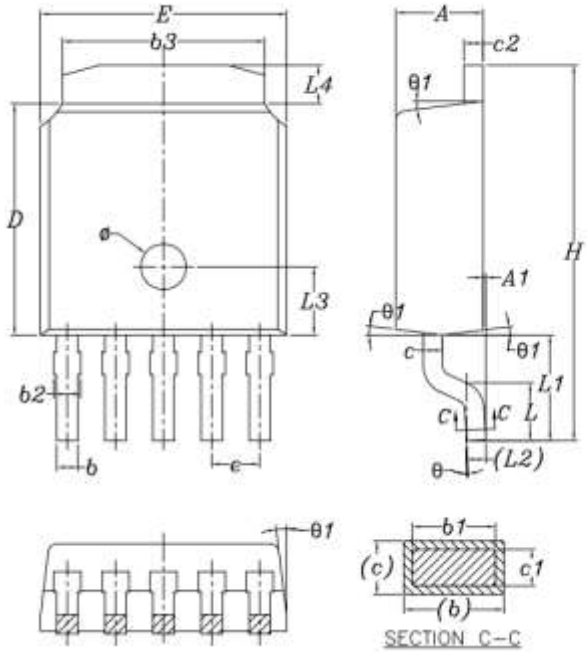
## 220VAC 4W LED Lighting Demo Board Part List

| COMPONENT | VALUE | PACKAGE |
|---|---|---|
| U1 | EC4211 | TO252-5L |
| BR1 | B10S | SMD |
| F1 | 1A | DIP |
| RV1 | 431KD14 (275VAC) | DIP |
| D1 | 1N4003 | DIP |
| $R_{EXT}$ | 24 | 0603 |
| $R_{GAIN}$ | 7.5k | 0603 |
| $V_{LED}$ | 240V | NA |

**Note:**
1. RV1 is for Surge Protection.
2. D1 is for Hi-POT protection.

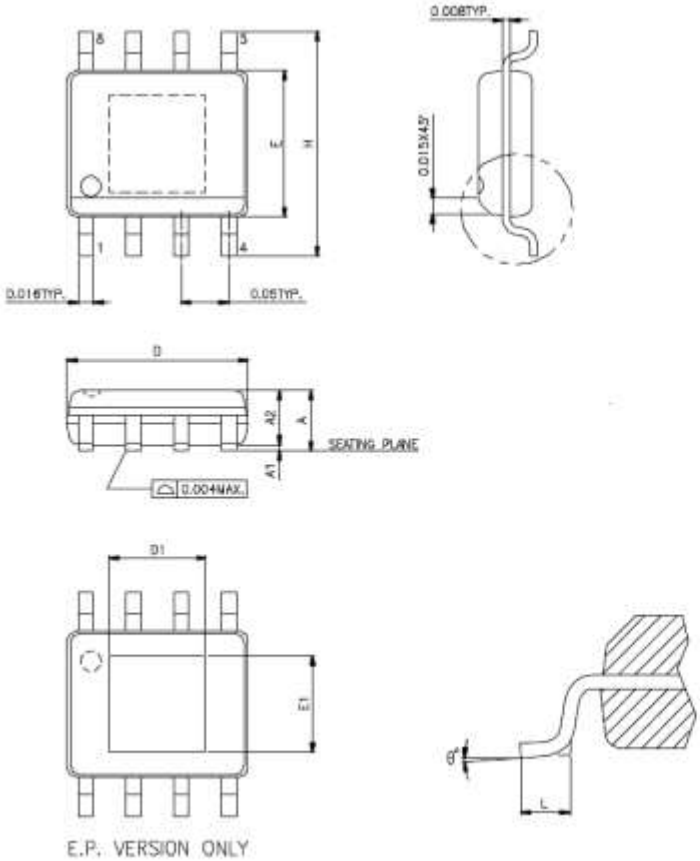
## OUTLINE DIMENSIONS (Dimensions shown in millimeters)

### TO252-5L Package




| SYMBOL | DIMENSIONS | | | |
|---|---|---|---|---|
| | MM | | INCH | |
| | MIN | MAX | MIN | MAX |
| A | 2.184 | 2.387 | 0.0860 | 0.0940 |
| A1 | 0.000 | 0.127 | 0.000 | 0.0050 |
| b | 0.508 | 0.711 | 0.0200 | 0.0280 |
| b1 | 0.508 | 0.660 | 0.0200 | 0.0260 |
| b2 | 0.610 | 0.787 | 0.0240 | 0.0310 |
| b3 | 5.184 | 5.461 | 0.2041 | 0.2150 |
| c | 0.460 | 0.610 | 0.0181 | 0.0240 |
| c1 | 0.406 | 0.559 | 0.0160 | 0.0220 |
| c2 | 0.460 | 0.610 | 0.0181 | 0.0240 |
| D | 6.000 | 6.223 | 0.2362 | 0.2450 |
| D1 | 5.050 | / | 0.1988 | / |
| E | 6.350 | 6.731 | 0.2500 | 0.2650 |
| E1 | 4.318 | / | 0.1700 | / |
| e | 1.170 | 1.370 | 0.0461 | 0.0539 |
| H | 9.500 | 10.300 | 0.3740 | 0.4055 |
| L | 1.397 | 1.778 | 0.0550 | 0.0700 |
| L1 | 2.400 | 3.000 | 0.0945 | 0.1181 |
| L2 | 0.508 REF | | 0.020 REF | |
| L3 | 1.600 | 2.000 | 0.0630 | 0.0787 |
| L4 | 0.889 | 1.270 | 0.0350 | 0.0500 |
| θ | 0° | 10° | 0° | 10° |
| θ1 | 0° | 15° | 0° | 15° |
| ø | 1.05 | 1.35 | 0.0413 | 0.0531 |

### SOP-8L Package




| SYMBOLS | MIN. | MAX. |
|---|---|---|
| A | 1.35 | 1.75 |
| A1 | 0.05 | 0.15 |
| A2 | – | 1.5 |
| D | 4.8 | 4.98 |
| E | 3.8 | 4.0 |
| H | 5.8 | 6.2 |
| L | 0.4 | 1.27 |
| θ° | 0 | 8 |

UNIT:mm

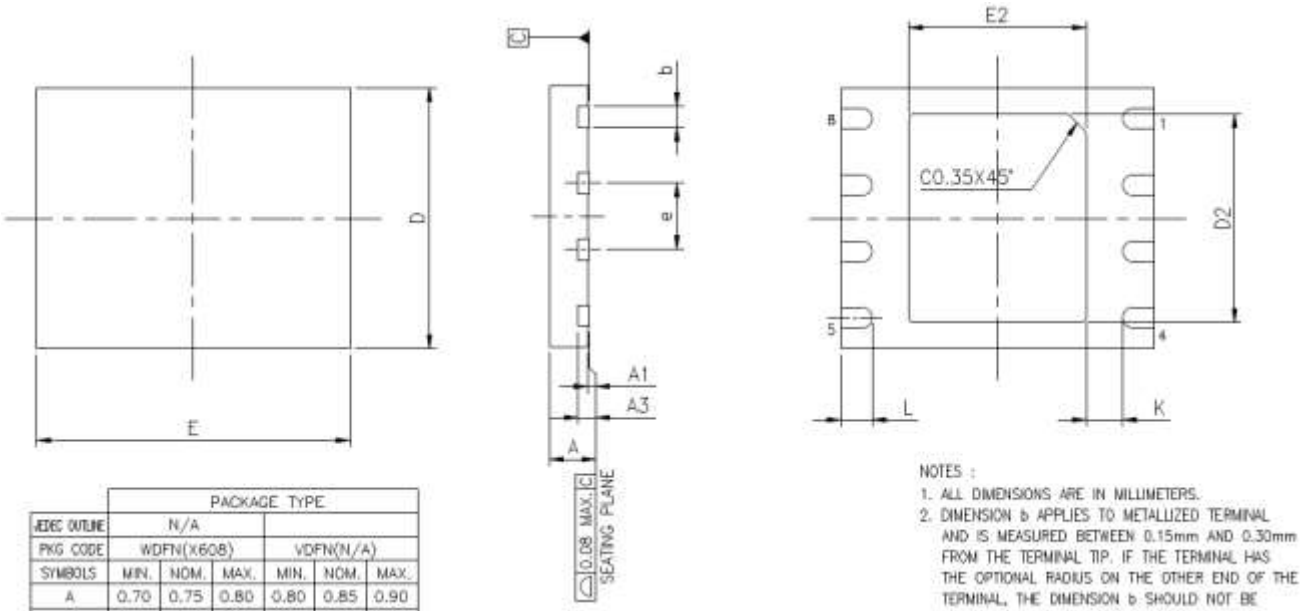
THERMALLY ENHACED DIMENSIONS

| E1 | D1 |
|---|---|
| 2.2 REF | 3.0 REF |

UNIT:mm

NOTES:
1.JEDEC OUTLINE : N/A
2.DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .15mm (.006in) PER SIDE.
3.DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.01Gin) PER SIDE.

## DFN-8L Package




| | PACKAGE TYPE | | | | | |
|---|---|---|---|---|---|---|
| JEDEC OUTLINE | N/A | | | | | |
| PKG CODE | WDFN(X608) | | | VDFN(N/A) | | |
| SYMBOLS | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 | 0.80 | 0.85 | 0.90 |
| A1 | 0.00 | 0.02 | 0.05 | 0.00 | 0.02 | 0.05 |
| A3 | 0.20 REF. | | | 0.20 REF. | | |
| b | 0.35 | — | 0.48 | 0.35 | — | 0.48 |
| D | 5.00 BSC | | | 5.00 BSC | | |
| E | 6.00 BSC | | | 6.00 BSC | | |
| e | 1.27 BSC | | | 1.27 BSC | | |
| L | 0.50 | — | 0.70 | 0.50 | — | 0.70 |
| K | 0.20 | — | — | 0.20 | — | — |

| PAD SIZE | E2 | | | D2 | | | LEAD FINISH | | JEDEC CODE |
|---|---|---|---|---|---|---|---|---|---|
| E2XD2 | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | Pure Tin | PPF | |
| 142X165 MIL | 3.30 | 3.40 | 3.45 | 3.90 | 4.00 | 4.05 | V | V | N/A |

UNIT:mm

NOTES :
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
3. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.