Zywyn

# ZD3215

## 800mA Regulated Charge Pump for White LEDs

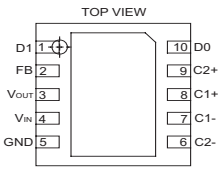
## Features

- Input Supply Voltage from 2.9V to 5V
- 800mA Output Current
- Low Noise, Variable Frequency Operation
- Super Low Quescent current of typical 500µA.
- 3 Levels of Regulated Output
- 2-Bit Control For Torch and Flash Mode Function
- Regulated Output Voltage or Current
- 2 Phase, 2X Charge Pump For High Efficiency
- Automatic Soft-Start limits Inrush Current
- Internal Thermal Shutdown
- 1.5MHz Switching Frequency
- No Inductors
- Icc < 1uA in Shutdown
- Available in 10-Pin 3x3 DFN Green Package

## Applications

- White LED Flash/Torch for Cellular Phones
- Digital Cameras, Camcorders and GPS Receivers
- General Lighting, Flash, or Strobe Applications
- LCD Module Backlighting
- Programmable DC/DC Boost Converter

## Pin Configuration




10-Pin 3x3 DFN

## General Description

The ZD3215 is a low noise, super low quiescent current, regulated charge pump DC/DC converter that uses 2 phase conversion for high power output applications such as flash and torch White LED applications. The part can be used to produce a regulated voltage or current of up to 800mA from a 2.9V to 5V input. Low external parts count make the ZD3215 ideally suited for small, battery-powered applications.

An internal 2-bit DAC allows LED current to be adjusted for LED brightness control. The ZD3215 also has thermal shutdown protection and can survive a continuous short-circuit from Vout to GND. Built-in soft-start circuitry prevents excessive inrush current during start-up. High switching frequency enables the use of small external capacitors. A low current shutdown feature disconnects the load from Vin and reduces quiescent current to less than 1uA.

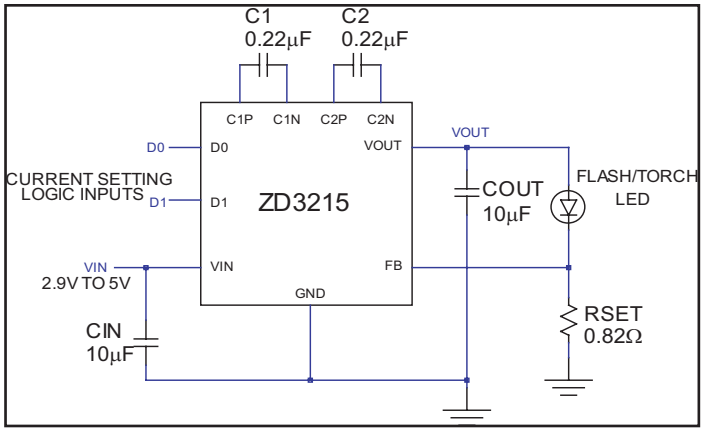
The ZD3215 is available in a 10-pin 3x3 DFN Green Packge.

## Ordering Information

| Part Number | Temperature Range | Package Type |
|---|---|---|
| ZD3215LED | –40°C to +85°C | 10-Pin 3x3 DFN |
| ZD3215EVB | n/a | Evaluation Board |

Please contact the factory for pricing and availabiliy on Tape-on-Reel and Green Package option.

## Typical Application




**Current Setting Logic Inputs Truth Table**

| D1 | D0 | Mode ($R_{SET}$= 0.82Ω) |
|---|---|---|
| 0 | 0 | Shutdown |
| 0 | 1 | 300mA (Torch) |
| 1 | 0 | 600mA (Red-Eye) |
| 1 | 1 | 800mA (Flash) |

## Absolute Maximum Ratings

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

$V_{IN}$, $V_{OUT}$ to GND ..... -0.3V to 6V
D0, D1 ..... -0.3V to $V_{IN}$ + 0.3V
$V_{OUT}$ Short-Circuit Duration ..... Indefinite
Operation Temperature Range ..... –40°C to +85°C
Storage Temperature ..... –65°C to +150°C
Lead Temperature (Soldering, 10 sec.) ..... 300°C

Power Dissipation Per Package
10-pin 3x3 DFN Thermal Resistance ($\theta_{JA}$)..... 50ºC/W

Note 1: Based on long-term current density limitations

Note 2: The ZD3215 is guaranteed to meet performance specifications from -40°C to 85°C.

## Storage Considerations

Storage in a low humidity environment is preferred. Large high density plastic packages are moisture sensitive and should be stored in Dry Vapor Barrier Bags. Prior to usage, the parts should remain bagged and stored below 40°C and 60%RH. If the parts are removed from the bag, they should be used within 168 hours or stored in an environment at or below 20%RH. If the above conditions cannot be followed, the parts should be baked for 12 hours at 125°C in order to remove moisture prior to soldering. Zywyn ships product in Dry Vapor Barrier Bags with a humidity indicator card and desiccant pack. The humidity indicator should be below 30%RH. The MSL of this product is 3.

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## Electrical Characteristics

Specifications are at $T_A$ = 25°C. $V_{IN}$ = 3.6V, $C_1$=$C_2$=0.22μF, $C_{OUT}$=$C_{IN}$=10μF; unless otherwise noted.

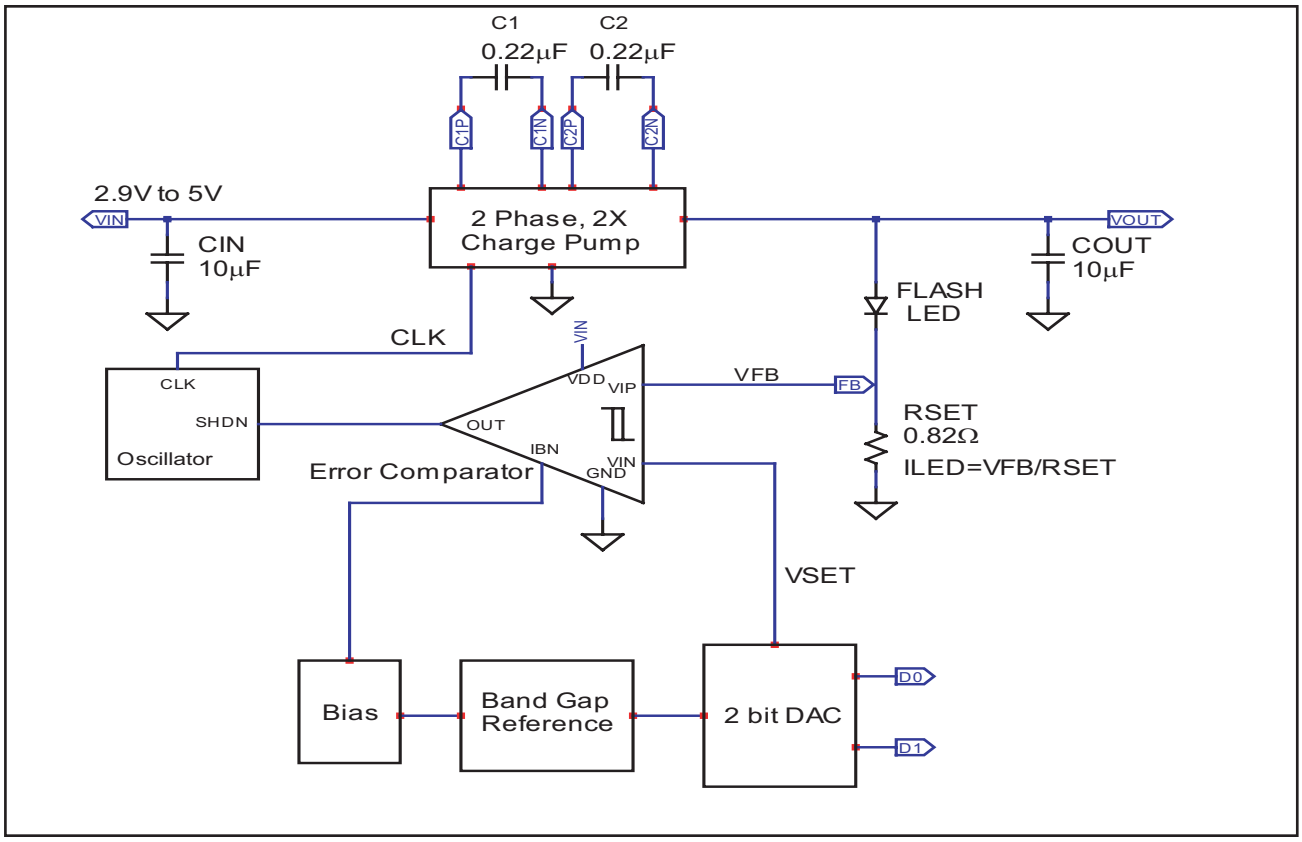
| Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **Input Power Supply** | | | | | |
| $V_{IN}$ Operating Voltage | | 2.9 | | 5.0 | V |
| $I_{CC}$ Operating Current | $I_{OUT}$ = 0mA, $V_{IN}$= D0 = D1 = 3.6V | | 0.5 | 1 | mA |
| $I_{SHDNB}$ Shutdown Current | D1 = D0 = 0V | | | 1 | μA |
| $I_{FB}$ | $V_{FB}$ = 0.8V | | 50 | | nA |
| ***Torch Mode*** | | | | | |
| $I_{OUT}$ | D1=0V, D0=$V_{IN}$; 2.9V ≤ $V_{IN}$ ≤ 4.2V; $R_{SET}$=0.82Ω | | 300 | | mA |
| $V_{FB}$ | D1=0V, D0=$V_{IN}$; 2.9V ≤ $V_{IN}$ ≤ 4.2V; $I_{OUT}$=10mA | 180 | 230 | 280 | mV |
| ***Red-Eye Mode*** | | | | | |
| $I_{OUT}$ | D1=$V_{IN}$, D0=0V; $V_{IN}$=3.6V; RSET=0.82Ω; Pulse Width=50ms~300ms; 1Hz max | | 600 | | mA |
| $V_{FB}$ | D1=$V_{IN}$, D0=0V; $I_{OUT}$=10mA | 380 | 450 | 530 | mV |
| ***Flash Mode*** | | | | | |
| $I_{OUT}$ | D1=D0=$V_{IN}$; $V_{IN}$=4.2V; RSET=0.82Ω; Pulse Width=50ms~100ms; 1Hz max | | 800 | | mA |
| $V_{FB}$ | D1=D0=$V_{IN}$; $I_{OUT}$=10mA | 500 | 600 | 700 | mV |
| **Charge Pump** | | | | | |
| Efficiency | D1=$V_{IN}$, D0=0V; $V_{IN}$=3.0V; $I_{OUT}$=200mA | | 70 | | % |
| **Data Input, D0, D1** | | | | | |
| High Level Input Voltage ($V_{IH}$) | $V_{IN}$=3.6V; | 1.5 | | | V |
| Low Level Input Voltage ($V_{IL}$) | $V_{IN}$=3.6V; | | | 0.4 | V |
| Input Current ($I_{IH}$) | D1 = D0 = $V_{IN}$ | -1 | | 1 | μA |
| Input Current ($I_{IL}$) | D1 = D0 = 0V | -1 | | 1 | μA |

**Current Setting D1, D0 Truth Table**

| D1 | D0 | Mode | Application |
|---|---|---|---|
| 0 | 0 | Shutdown | Power Down |
| 0 | 1 | 300mA | Torch Function |
| 1 | 0 | 600mA | Red-Eye Function |
| 1 | 1 | 800mA | Flash Function |

Based on feedback resistor $R_{SET}$ of 0.82Ω with rating at 0.5W.

## Block Diagram




Block diagram of ZD3215 high power flash LED driver with external components

## Pin Description

| Pin Name | Pin Number | Pin Function |
|---|---|---|
| D1, D0 | 1, 10 | Control Inputs. D0 and D1 determines either torch, red-eye, or flash setting |
| FB | 2 | Feedback Pin. Input for the regulation contro loop. LED current is equal to VFB / RSET |
| VOUT | 3 | VOUT is the output of the charge pump. A low ESR, 10µF ceramic capacitor is required from VOUT to GND |
| VIN | 4 | Input Supply Voltage. VIN should be bypassed with a 10µF low ESR ceramic capacitor |
| GND | 5 | Ground Pin for the charge pump and control circuitry. This pin should be connected directly to a low impedance local ground plane. |
| C2-, C1-, C1+, C2+ | 6. 7. 8. 9 | Charge Pump Flying Capacitor Pins. A 0.22µF, low ESR ceramic capacitor should be connected from C1+ to C1- and from C2+ to C2-. |

## Circuit Description

The ZD3215 uses a state-of-the-art switched capacitor, fractional conversion, charge pump to boost $V_{OUT}$ by as much as twice the input voltage. The charge pump switches are driven by a two-phase, non-overlapping clock that assures low EMI designs. The two-phase clock alternately charges the flying capacitors and boosts the output voltage at a variable frequency.

### Adjustable, Regulated Output

Regulation is provided by a feedback loop from the FB pin to the charge pump modulator, resulting in stable output voltages over the devices wide operating range. The regulated output can be adjusted with the control pins, D0 and D1. The ZD3215 integrates a digital-to-analog converter to allow dynamic,digital control of the regulated voltage. Table 1 shows the feedback Set Point Voltage as a function of D0 and D1.

| D1 | D0 | Operation Mode | Output ($R_{SET}$=0.82Ω) |
|---|---|---|---|
| 0 | 0 | Shutdown | 0mA |
| 0 | 1 | Torch Application | 300mA |
| 1 | 0 | Red-Eye Application | 600mA |
| 1 | 1 | Flash Application | 800mA |

Table 1. Feedback Control Voltage Settings

### Controlled Power-Down

The ZD3215 has a low-power shutdown mode controlled by the control pins, D0 and D1. When both control pins are held at a low logic level, the ZD3215 enters power down mode and draws only leakage current from the $V_{IN}$ supply. All internal circuitry is disabled and $V_{OUT}$ is disconnected from $V_{IN}$. D0 and D1 control inputs are high impedance CMOS inputs and should not be left floating. Ensure that they are always driven with valid logic levels.

### Shutdown Current

When the ZD3215 is placed in shutdown mode and while the $V_{OUT}$ is still at a positive voltage, regulators feedback circuit will draw 5μA of current. To minimize the current draw, a bleed resistor of 10kΩ to 100kΩ can be used to draw down $V_{OUT}$ during shutdown.

### Voltage or Current Programming of the ZD3215

The ZD3215 is configurable to regulate either voltage or current. In white LED applications, the ratio of the feedback set point and a sense resistor controls the current through the white LED, as shown in Figure 1

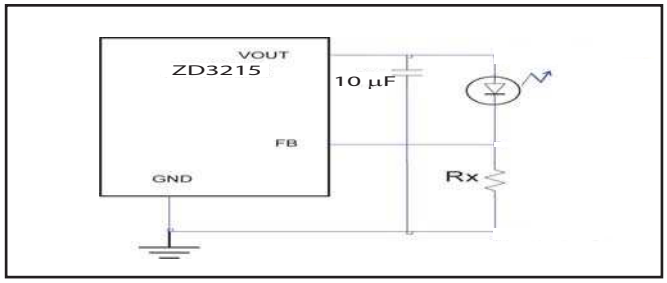



Figure 1 Current Control Mode

This configuration requires the largest amount of output capacitance to maintain stability, due to the high loop gain caused by relativity low impedance of the white LED as compared to the sense resistor.

In constant voltage applications. The output voltage is set by the ratio of two resistors and the feedback set point, as shown in Figure 2. $V_{OUT}$ = set point voltage * (1 + R1/R2). The closed-loop output resistance is impacted by the resistor ratio R1:R2, the higher the ratio, the higher the output resistance. The output resistance is 0.35Ω with a nominal gain of 1. Typically the total resistance of the voltage divider, R1:R2, will be in the range of several KΩ to 1MΩ.

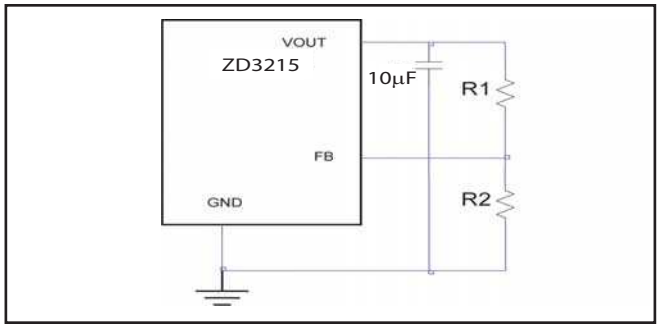
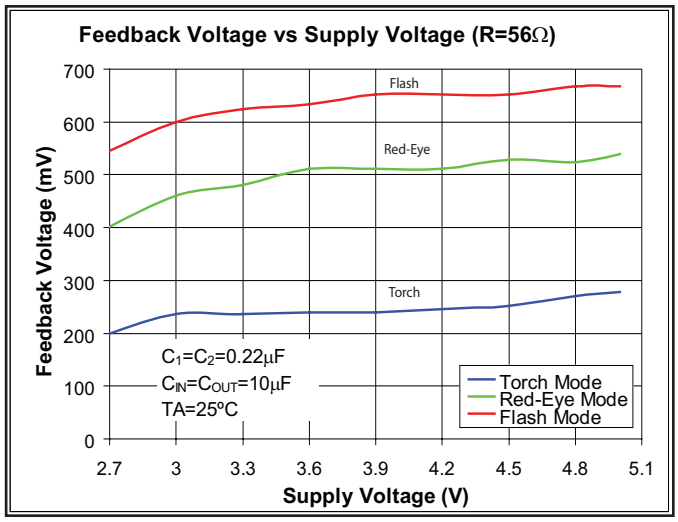
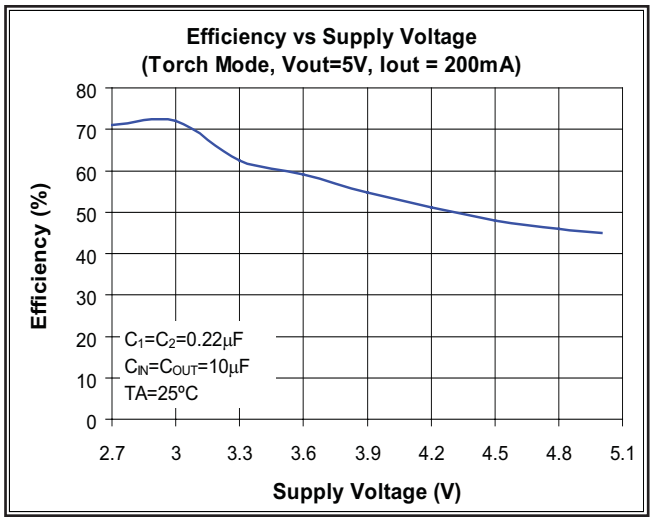
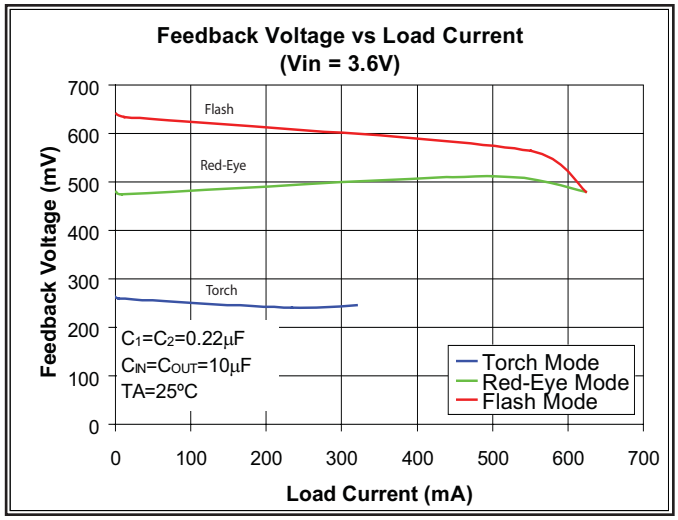


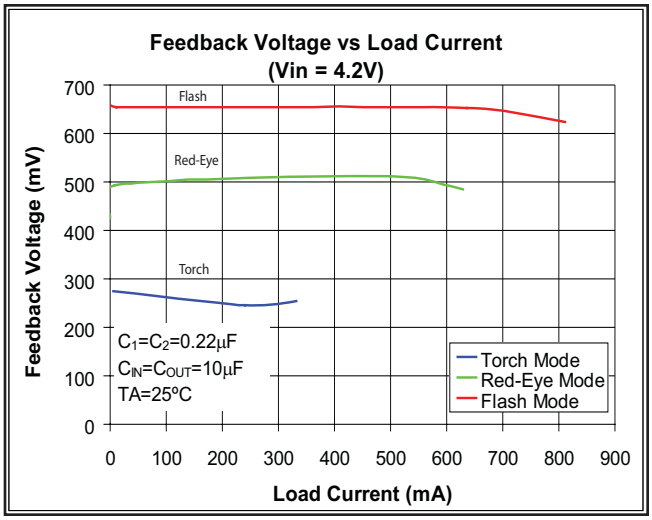

Figure 2. Voltage Control Mode

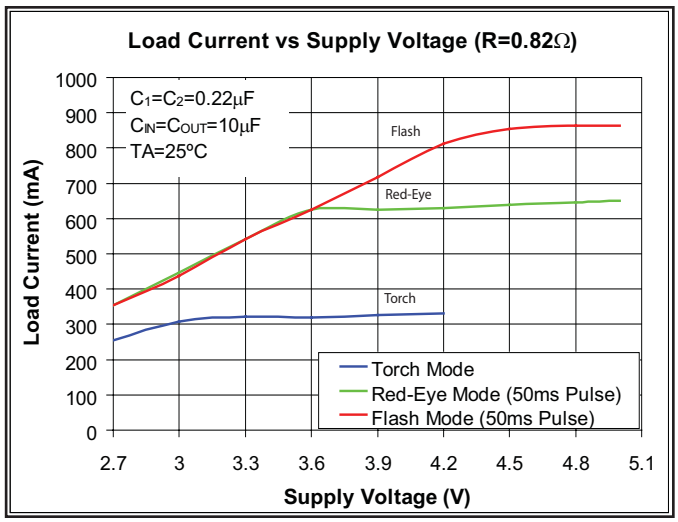
## Typical Performance Characteristics

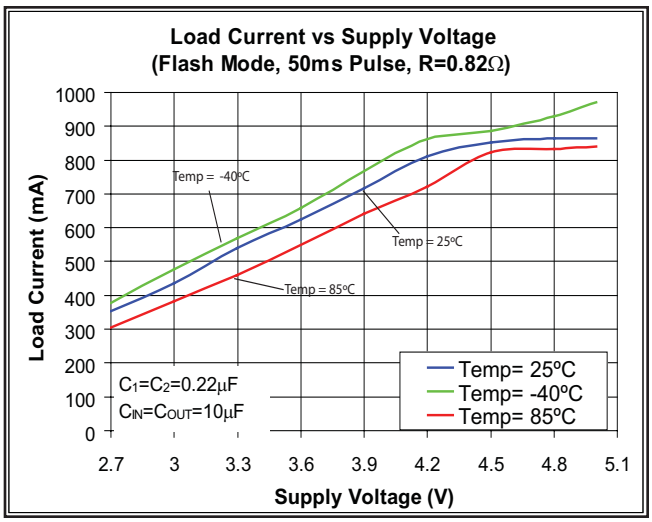


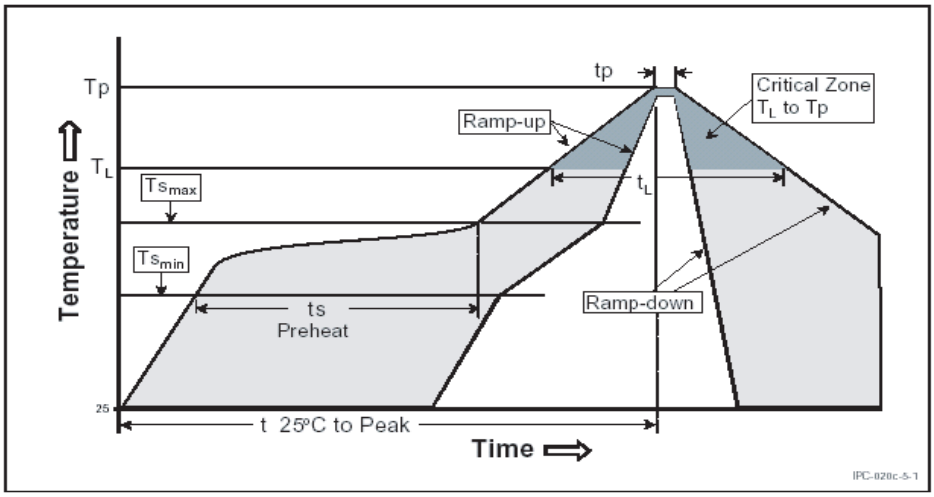



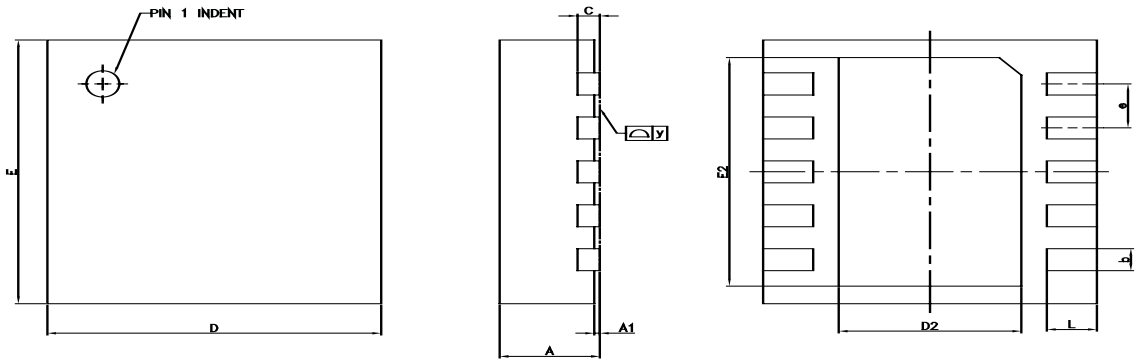



## Green Package SMD IR Reflow Profile Information

| IR Reflow Profile Conditions |  | |
|---|---|---|
| **Profile Feature** | JESD Sn-Pb Eutectic Assembly | **JESD Pb-free Assembly** |
| **Average Ramp-Up Rate ($T_{Smax}$ to $T_P$)** | 3°C/seconds max. | **3°C/seconds max.** |
| **Pre-heat**<br>**- Temperature Min ($T_{Smin}$)**<br>**- Temperature Max ($T_{Smax}$)**<br>**- Time ($T_{Smin}$ to $t_{Smax}$)** | <br>100°C<br>150°C<br>60~120 seconds | <br>**150°C**<br>**200°C**<br>**60~180 seconds** |
| **Time maintained above:**<br>**- Temperature ($T_L$)**<br>**- Time ($t_L$)** | <br>183°C<br>60~150 seconds | <br>**217°C**<br>**60~150 seconds** |
| **Peak/Classification Temperature ($T_P$)** | 235°C+5/-0°C | **255°C+5/-0°C** |
| **Time within 5°C of actual Peak Temperature ($t_P$)** | 10~30 seconds | **20~40 seconds** |
| **Ramp-Down Rate** | 6°C/second max. | **6°C/second max.** |
| **Time 25°C to Peak Temperature** | 6 minutes max. | **8 minutes max.** |

Zywyn Green Packages are Pb-free and RoHS compliance.

## Package Information



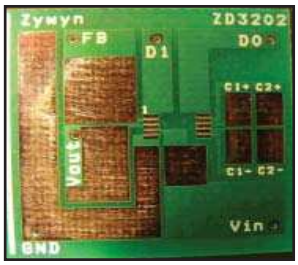

NOTE:
1. THE PACKAGE OUTLINE DRAWING IS COMPATIBLE WITH JEDEC MO-229C ; VARIATIONS : VEED-5
2. THE TERMINAL #1 IDENTIFIER IS A LASER MARKED FEATURE

| SYMBOLS | DIMENSIONS IN MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 0.80 | 0.90 | 1.00 |
| A1 | 0.00 | 0.02 | 0.05 |
| b | 0.18 | 0.25 | 0.30 |
| C | —— | 0.20 REF. | —— |
| D | 2.90 | 3.00 | 3.10 |
| D2 | 1.40 | 1.64 | 1.75 |
| E | 2.90 | 3.00 | 3.10 |
| E2 | 2.20 | 2.60 | 2.70 |
| e | —— | 0.50 | —— |
| L | 0.30 | 0.45 | 0.50 |
| y | 0.00 | —— | 0.076 |

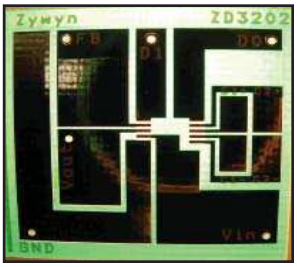
10-Pin 3x3 DFN

| | | |
|---|---|---|
| CUSTOMER : | | ZYWYN CORPORATION |
| APPROVED BY | DATE | TITLE: 10L VERY THIN SMALL OUTLINE NO-LEAD PACKAGE OUTLINE DRAWING (3x3 mm) |
| DRAW BY: Sandy Sun | 10/21/'03 | |
| CHECK BY: Andrew Yang | 01/09/'04 | |
| APPROVAL: Kevin Liao | 01/09/'04 | DWG. NO. PO-VSON-008 REV. 0 |
| APPROVAL: Jack Tu | 01/09/'04 | UNIT : mm SCALE : 30/1 SHEET 1 OF 1 |

## Evaluation Board Information



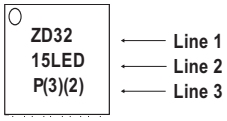

ZD3215EVB Evaluation Board Component Side Layout




ZD3215EVB Evaluation Board Solder Side Layout

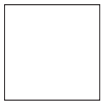
## Part Marking Information

***TOPSIDE MARK INSTRUCTIONS:***




Line 1: Zywyn Part Number "ZD32"
Line 2: Zywyn Part Number "15LED"
Line 3: Zywyn's Part Identification Code "P(3)(2)"
where (3) is a 2-character Lot # code
(2) is a 1-character date-code
**Refer to Zywyn's WLED Part Marking Table for details.**

***BOTTOMSIDE MARK INSTRUCTIONS:***



No Backside marking.

10-pin 3x3 DFN

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