



ZD3210

## High Current, Low Noise, Regulated Charge-Pump Based DC/DC Converter



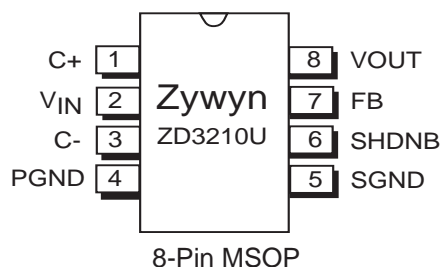
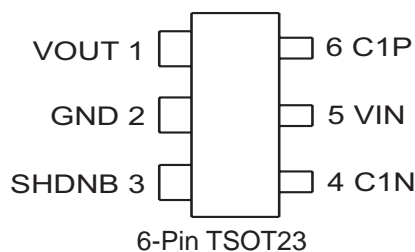
### Features

- Low Noise Constant Frequency Operation
- High Output Current 200mA
- Regulated 5V Output (ZD3210) or Adjustable Output (ZD3210U)
- Super low quiescent current of typical 250 $\mu$ A
- VIN Range +2.7V to +5V
- High Efficiency Output of Over 85%
- 2.5MHz Switching Operation
- Pin And Function Compatible to LTC3200, LTC3200-5, AAT3110 and AAT3110-5 With Enhanced Current Output
- Available in 6-pin ThinSOT-23 (ZD3210LES6) and 8-pin MSOP (ZD3210LEU) Green Packages

### Applications

- Cellular Phones
- PDA's , Handheld Computers
- Digital Cameras and Camera Modules
- Battery-Powered LCD Display Modules Backlighting
- PCMCIA Local 5V Supplies
- Smart Card Readers
- Local 3V to 5V Conversion
- USB Port Power Conversion

### Pin Configuration



### General Description

The ZD3210 and ZD3210U are low noise, fixed frequency, switched capacitor charge pump voltage doublers. They provide a regulated output voltage from a 2.7V to 5V input source with up to 200mA of output current. Low external parts count (one fly capacitor and two small bypass capacitors) make the ZD3210/ZD3210U ideally suited for small and battery-powered applications.

The circuit is internally short-circuit protected. High switching frequency enables the use of small ceramic capacitors.

The ZD3210 is available in a 6-pin ThinSOT-23 Green Package (ZD3210LES6) and the ZD3210U in an 8-pin MSOP Green Package (ZSD3210LEU) for small board space applications.

### Typical Application

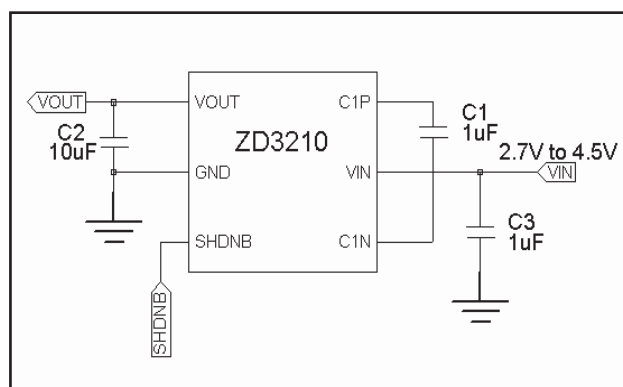


Figure 1. ZD3210 Low Noise Regulated Charge Pump

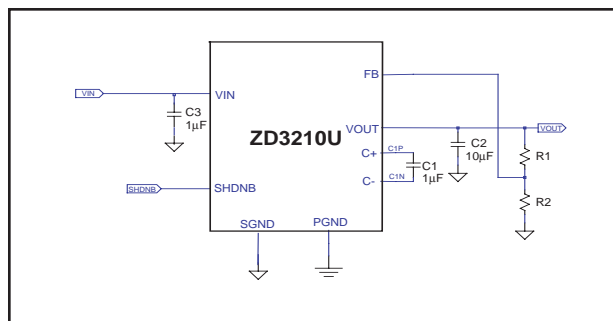


Figure 2. ZD3210U Adjustable Voltage Output

Specifications subject to change without notice



## 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.

Input Voltage, (VIN) .....	+6.0V
VOUT to GND .....	-0.3V to +5.5V
VFB, SHDNB Voltage .....	-0.3V to VIN+0.3V
Extended Commercial	
Operating Temperature .....	-40°C to +85°C
Maximum Junction Temperature .....	+150°C
Storage Temperature .....	-65°C to +150°C
Lead Temperature (Soldering, 10sec.) .....	300°C

### Power Dissipation Per Package

6-pin TSOT-23 Thermal Resistance ( $\theta_{JA}$ ) .....	177°C/W
8-pin MSOP Thermal Resistance ( $\theta_{JA}$ ) .....	155°C/W

## 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

### ZD3210LES6, 6-Pin TSOT23

Specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{IN} = 3.6\text{V}$ ,  $C1=1\mu\text{F}$ ,  $C2=10\mu\text{F}$ ,  $C3=10\mu\text{F}$ ; unless otherwise noted.

Parameter	Condition	Min	Typ	Max	Units
$V_{IN}$ , Input Operating Voltage		2.7		5	V
$V_{OUT}$ , Output Voltage	$V_{IN}=2.8\text{V to }4.2\text{V}; I_{OUT}<80\text{mA}$	4.8	5.0	5.4	V
	$V_{IN}=3.2\text{V to }4.2\text{V}; I_{OUT}<150\text{mA}$	4.8	5.0	5.4	V
	$V_{IN}=3.5\text{V to }4.5\text{V}; I_{OUT}<200\text{mA}$	4.8	5.0	5.4	V
$I_{CC}$ Current (Quiescent)	$I_{OUT}=0\text{mA}; \text{SHDNB}=V_{IN}$ $\text{SHDNB}=0\text{V}; V_{OUT}=0\text{V}$		250	500	$\mu\text{A}$
$I_{SHDN}$ Current (Shutdown)				1.0	$\mu\text{A}$
Output Ripple Voltage	$V_{IN}=3\text{V}; I_{OUT}=100\text{mA}$		30		mVpp
Efficiency	$V_{IN}=3\text{V}; I_{OUT}=50\text{mA}$		85		%
Switching Frequency			2.5		MHz
$V_{IH}$ SHDNB Input Threshold	$V_{IN}=3.6\text{V}$	1.4			V
$V_{IL}$ SHDNB Input Threshold				0.4	V
SHDNB Input Current	$\text{SHDNB}=0\text{V}$ or $\text{SHDNB}=V_{IN}$	-1		1	$\mu\text{A}$

## Electrical Characteristics

### ZD3200LEU, 8-Pin MSOP

Specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{IN} = 3.6\text{V}$ ,  $C1=1\mu\text{F}$ ,  $C2=10\mu\text{F}$ ,  $C3=10\mu\text{F}$ ; unless otherwise noted.

Parameter	Condition	Min	Typ	Max	Units
$V_{IN}$ , Input Operating Voltage		2.7		5	V
$V_{OUT}$ , Output Voltage	$V_{IN}=2.7\text{V to }4.5\text{V}$ ; $I_{OUT}<80\text{mA}$ ; $R1=32\text{k}\Omega$ , $R2=10\text{k}\Omega$	4.8	5.0	5.4	V
	$V_{IN}=3.1\text{V to }4.5\text{V}$ ; $I_{OUT}<150\text{mA}$ ; $R1=32\text{k}\Omega$ , $R2=10\text{k}\Omega$	4.8	5.0	5.4	V
	$V_{IN}=3.5\text{V to }4.5\text{V}$ ; $I_{OUT}<200\text{mA}$ ; $R1=32\text{k}\Omega$ , $R2=10\text{k}\Omega$	4.8	5.0	5.4	V
$I_{CC}$ Current (Quiescent)	$I_{OUT}=0\text{mA}$ ; $\text{SHDNB}=V_{IN}$ $\text{SHDNB}=0\text{V}$ ; $V_{OUT}=0\text{V}$		250	500	$\mu\text{A}$
$I_{SHDN}$ Current (Shutdown)				1.0	$\mu\text{A}$
$V_{FB}$ Feedback Voltage			1.268		V
Output Ripple Voltage	$V_{IN}=3\text{V}$ ; $I_{OUT}=100\text{mA}$		30		mVpp
Efficiency	$V_{IN}=3\text{V}$ ; $I_{OUT}=50\text{mA}$		85		%
Switching Frequency			2.5		MHz
$V_{IH}$ SHDNB Input Threshold	$V_{IN}=3.6\text{V}$	1.4			V
$V_{IL}$ SHDNB Input Threshold				0.4	V
SHDNB Input Current	$\text{SHDNB}=0\text{V}$	-1		1	$\mu\text{A}$
$I_{FB}$ Feedback Input Current	$V_{FB}=1.4\text{V}$	-50		50	nA
$R_{OL}$ Open-Loop Output Resistance	$V_{IN}=3\text{V}$ ; $I_{OUT}=100\text{mA}$ ; $V_{FB}=0\text{V}$		4.0		$\Omega$

### Block Diagram

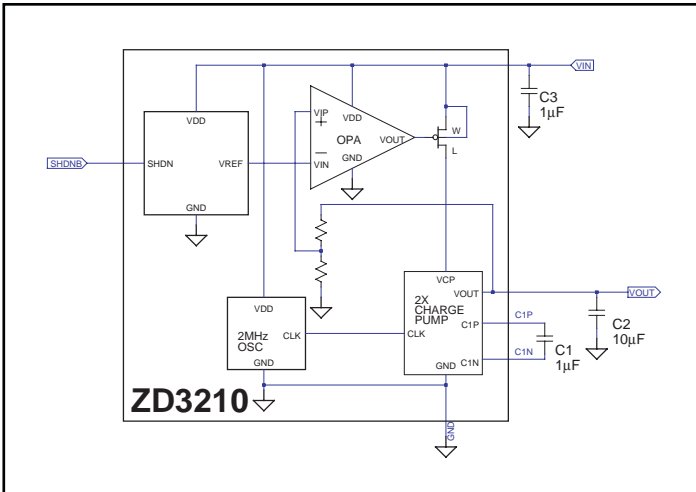


Figure 3. ZD3210 block diagram with regulated voltage output at 5V

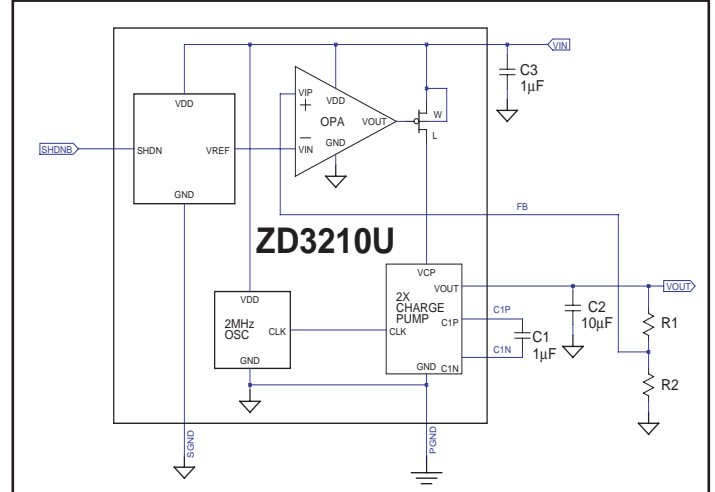


Figure 4. ZD3210U block diagram with adjustable voltage output controlled by external R1 and R2 resistors

### Pin Description

#### ZD3210LES6 (6-pin TSOT-23) Pin Function Table

Pin Name	Pin Number	Pin Function
VOUT	1	5V regulated voltage output. Bypass with 10µF capacitor close to VOUT pin.
GND	2	Ground.
SHDNB	3	Shutdown logic input. Active LOW to shutdown.
C1N	4	C1 fly-cap connection.
VIN	5	Input supply voltage connection. Bypass with 10µF capacitor close to VIN pin.
C1P	6	C1 fly-cap connection. Use 1µF ceramic capacitor.

#### ZD3210LEU (8-pin MSOP) Pin Function Table

Pin Name	Pin Number	Pin Function
C1P	1	C1 fly-cap connection. Use 1µF ceramic capacitor.
SGND	2	Signal Ground. Return feedback resistors to this Ground pin.
C1N	3	C1 fly-cap connection.
PGND	4	Power Ground. High current return path.
VIN	5	Input supply voltage connection. Bypass with 10µF capacitor close to VIN pin.
SHDNB	6	Shutdown logic input. Active LOW to shutdown.
FB	7	Feedback connection to external resistors.
VOUT	8	Regulated output voltage set by feedback resistor ratio, $A_v=1+(R1/R2)$ . Bypass with 10µF capacitor close to VOUT pin.

## Circuit Description

### Operation

Referring to figure 4, the ZD3210 uses a switched-capacitor, voltage doubling charge pump and a voltage regulator to generate a regulated output voltage. The 2X charge pump is connected within the feedback loop of the linear regulator, so that as the supply voltage (VIN) varies, the voltage that is applied to the input of the charge pump is adjusted by the voltage regulator to keep the output voltage constant. A feedback voltage is generated from a resistor divider connected between VOUT and ground (PGND). This feedback voltage is used by the voltage regulator to maintain the proper input voltage to the charge pump. The charge pump uses a 2-phase, constant frequency non-overlapping clock to alternately charge the fly-capacitor, C1, between the voltage regulator output and VOUT. In phase 1, the fly-capacitor is charged to the VCP voltage while the output capacitor, C2 supplies output current to the load. In phase 2, C1 is connected between VCP and VOUT, discharging energy into the load and generating a doubling of VCP to VOUT. This switching of the fly-capacitor continues at a free running frequency of 2.5MHz with a non-overlapping time of approximately 20ns to keep the charge pump power switches from conducting directly from VCP to ground during switch phases.

Connecting the SHDNB pin to ground (SGND), the internal circuitry is turned off and the charge pump switches are disconnected from VOUT. In shutdown mode, the IC draws only leakage current from the input supply. The SHDNB input is a high impedance CMOS input and must be connected to either a HIGH or LOW logic level, it must not be allowed to open or left floating.

### Short-Circuit Protection

The ZD3210 has built-in circuitry that contains output current limiting in the event of an output short circuit to limit the maximum current supplied by the charge pump and LDO. The output short circuit current is about 300mA.

### Programming the ZD3210U Output Voltage Via The FB Pin

While the ZD3210 has an internal resistive divider to preset and regulate the output voltage at 5 volts, the programmable ZD3210U can be adjusted to an arbitrary output voltage via an external resistive divider. Since the device employs a 2X charge pump, it is not possible to achieve output voltages greater than twice the available input voltage. Figure 5 shows a typical external resistive divider connection with the voltage divider ration given by the formula:

$$R1/R2 = [VOUT/(1.268V)]-1$$

Typical values of the total voltage resistive divider resistance can be varied from several K $\Omega$  to 1M $\Omega$ .

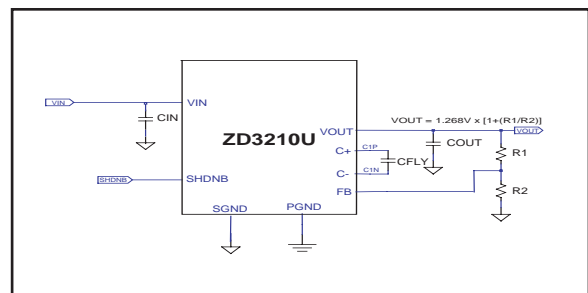
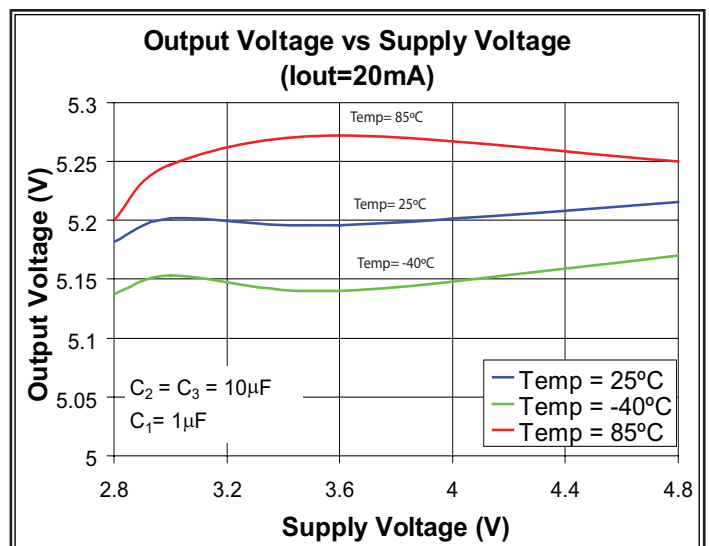
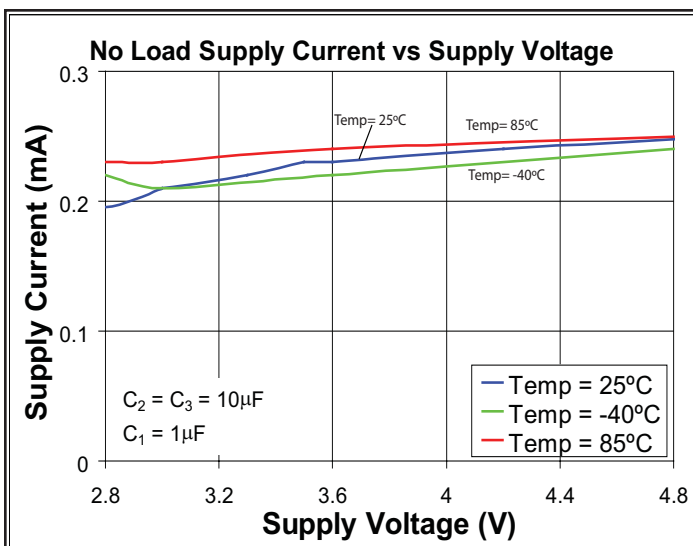
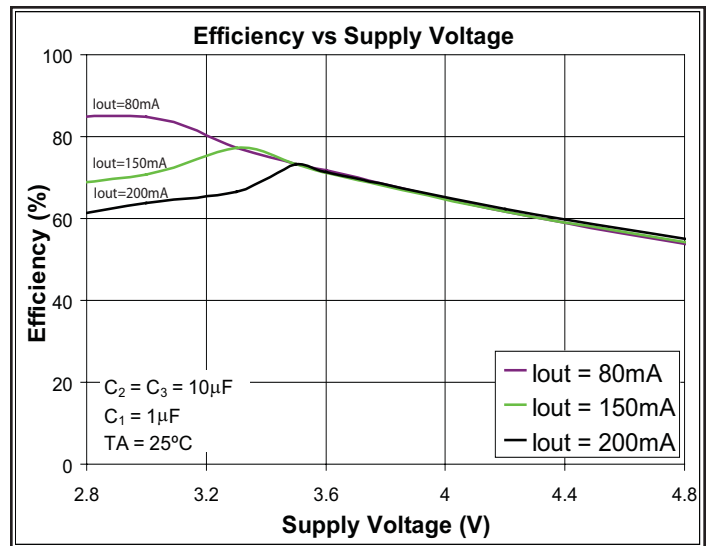
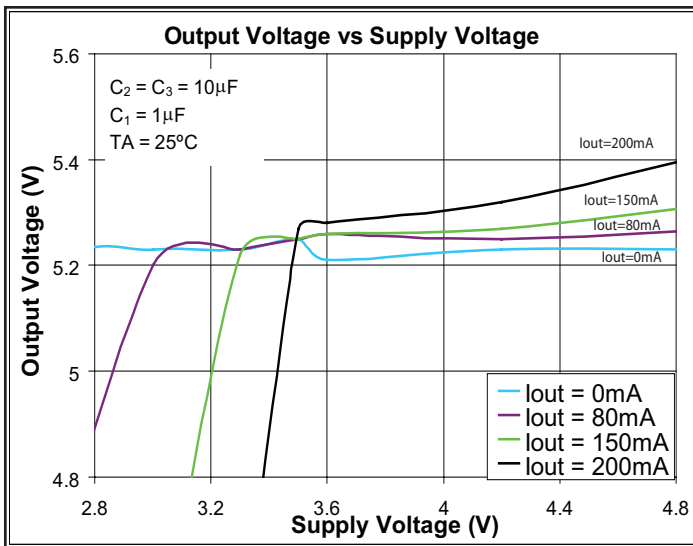
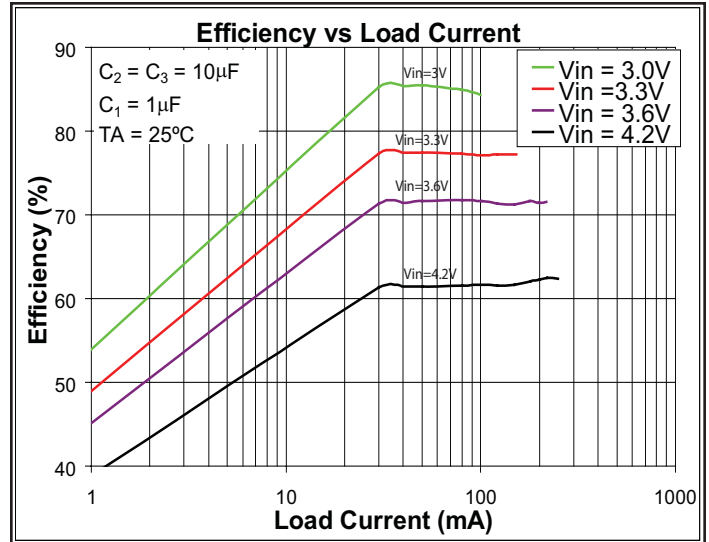
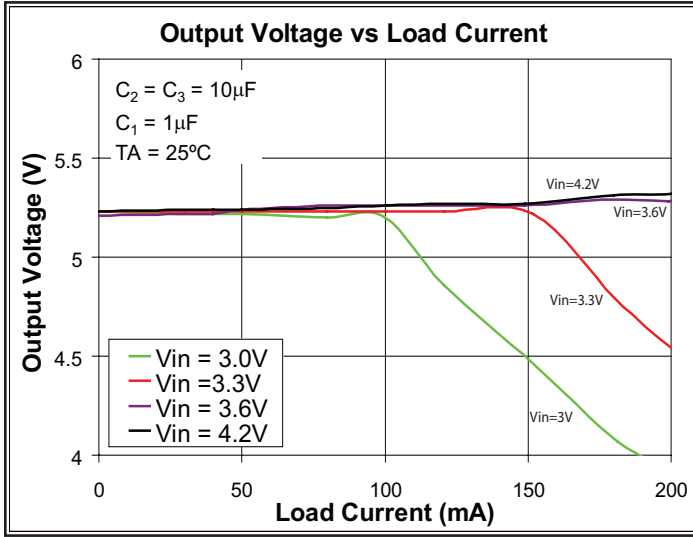


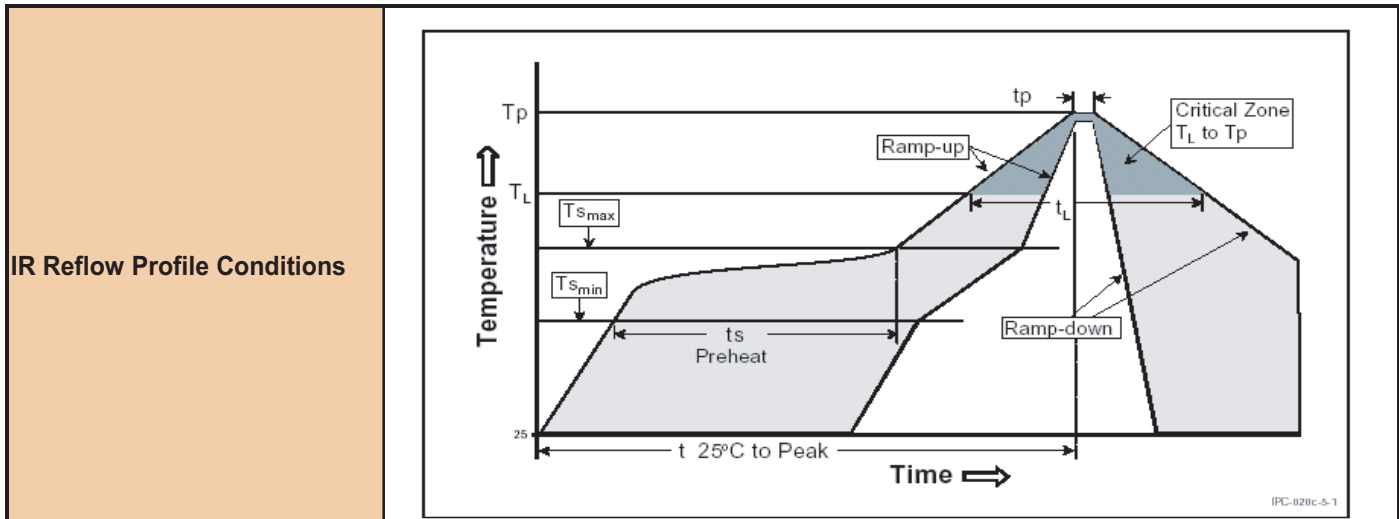
Figure 5. Programming the adjustable ZD3210U voltage output

# Typical Performance Characteristics

(Based on ZD3210LES6, 6-Pin TSOT23)



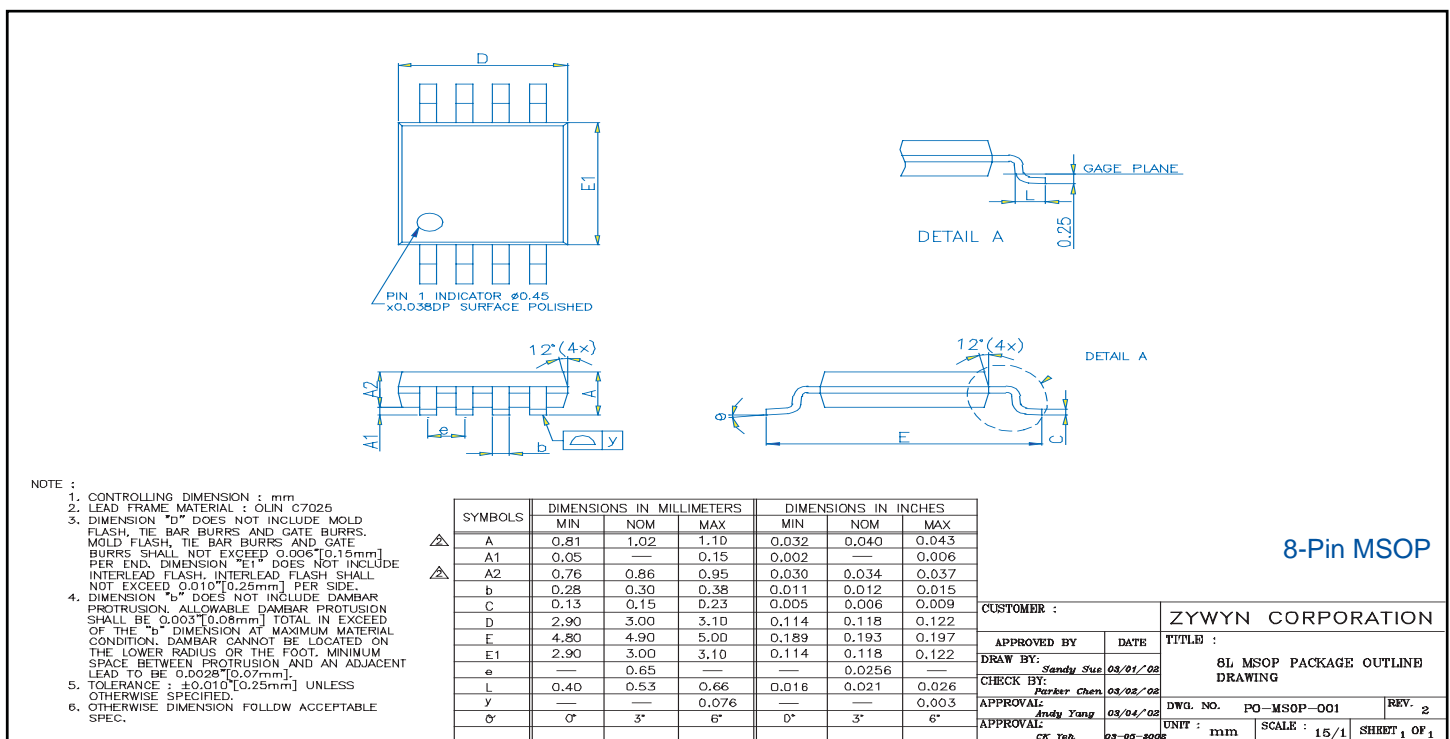
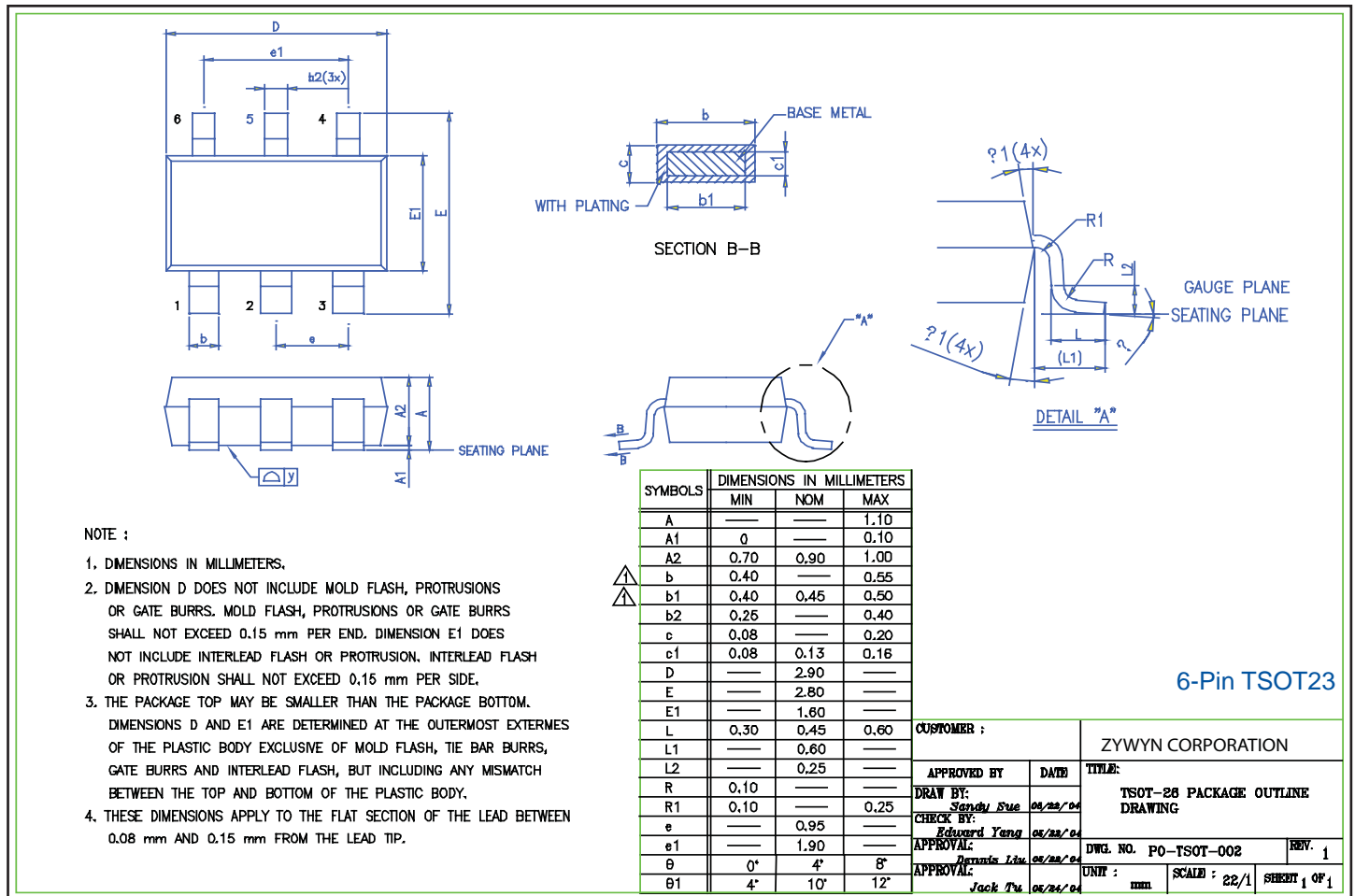
Green Package SMD IR Reflow Profile Information





Profile Feature	JESD Sn-Pb Eutectic Assembly	JESD Pb-free Assembly
Average Ramp-Up Rate (T <sub>Smax</sub> to T <sub>P</sub> )	3°C/seconds max.	3°C/seconds max.
Pre-heat		
- Temperature Min (T <sub>Smin</sub> )	100°C	150°C
- Temperature Max (T <sub>Smax</sub> )	150°C	200°C
- Time (T <sub>Smin</sub> to t <sub>Smax</sub> )	60~120 seconds	60~180 seconds
Time maintained above:		
- Temperature (T <sub>L</sub> )	183°C	217°C
- Time (t <sub>L</sub> )	60~150 seconds	60~150 seconds
Peak/Classification Temperature (T <sub>P</sub> )	235°C+5/-0°C	255°C+5/-0°C
Time within 5°C of actual Peak Temperature (t <sub>p</sub> )	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



## Ordering Information

Part Number	Temperature Range	Package Type
ZD3210LES6	-40°C to +85°C	6-Pin TSOT23 Green Package 
ZD3210LEU	-40°C to +85°C	8-Pin MSOP Green Package 
ZD3210EVB	n/a	Evaluation Board for 6-Pin TSOT23 Package
ZD3210UEVB	n/a	Evaluation Board for 8-Pin MSOP Package

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

## Evaluation Board Information



Figure 5. ZD3210EVB Evaluation Board Component Side Layout

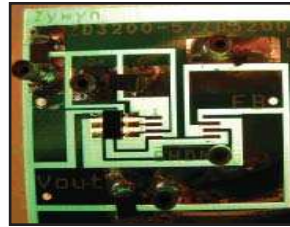
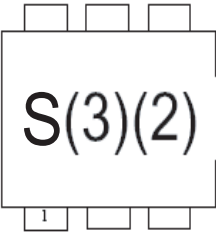


Figure 6. ZD3210EVB Evaluation Board Solder Side Layout


## Part Marking Information

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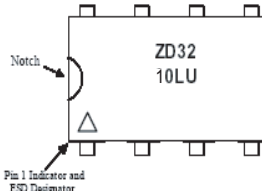
Line 1: Zywyn Part Identification Code "S(3)(2)"  
 where (3) is a 2-character Lot # code  
 (2) is a 1-character date-code  
Refer to Zywyn's WLED Part Marking Table for details.

**BOTTOMSIDE MARK INSTRUCTIONS:**



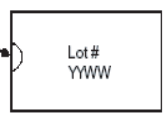
No bottom-side marking.  
 6-pin TSOT23

**TOPSIDE MARK INSTRUCTIONS:**



Line 1: Zywyn Part Name "ZD32"  
 Line 2: Zywyn Part Number "10LU"  
 Note: Pin #1 "Δ" Indicator Required

**BOTTOMSIDE MARK INSTRUCTIONS:**



Line 1: Lot Number  
 Line 2: Date Code: (Last 2 digits of Prod. Year & Prod. Work Week)

8-pin MSOP

## Zywyn Corporation

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