Zywyn

ZD3203

300mA Regulated Charge Pump for White LEDs

Features

- Input Supply Voltage from 2.9V to 5V
- Low Noise, Constant Frequency Operation
- 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
- Internal Thermal Shutdown
- 1.5MHz Switching Frequency
- No Inductors
- Icc < 1uA in Shutdown
- Available in 10-Pin MSOP Green Packages

General Description

The ZD3203 is a low noise, constant frequency, 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 300mA from a 3.3V to 5V input. Low external parts count make the ZD3203 ideally suited for small, battery-powered applications.

An internal 2-bit DAC allows LED current to be adjusted for LED brightness control. The ZD3203 also has thermal shutdown protection and can survive a continuous short-circuit from Vout to GND. 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 ZD3203 is available in a 10-pin MSOP Green Packages.

Applications

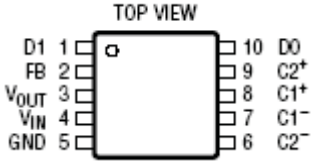
- White LED Flash/Torch for Cellular Phones
- Digital Cameras, Camcorders and GPS Receivers
- General Lighting, Flash, or Strobe Applications
- LCD Module Backlighting
- Programmable DC/DC Boost Converter

Ordering Information

Part Number	Temperature Range	Package Type
ZD3203LEU	–40℃ to +85℃	10-Pin MSOP
ZD3203EVB	n/a	Evaluation Board

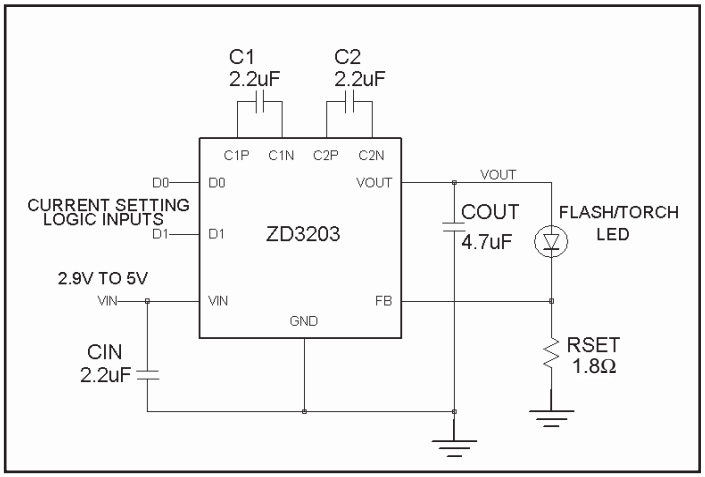
Please contact the factory for pricing and availabiliy on Tape-on-Reel option.

Pin Configuration



10-Pin MSOP

Typical Application



Current Setting Logic Inputs Truth Table

D1	D0	Mode (R_{SET}=1.8Ω)
0	0	Shutdown
0	1	100mA (Torch)
1	0	250mA (Torch+ or Flash-)
1	1	300mA (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℃ to +85℃
Storage Temperature ..... –65℃ to +150℃
Lead Temperature (Soldering, 10 sec.) ..... 260℃

Power Dissipation Per Package
10-pin MSOP Thermal Resistance (θ_{JA})..... 157ºC/W

Note 1: Based on long-term current density limitations

Note 2: The ZD3203 is guaranteed to meet performance specifications from -40℃ to 85℃.

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℃ 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℃ 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℃. V_{IN} = 3.6V; unless otherwise noted.

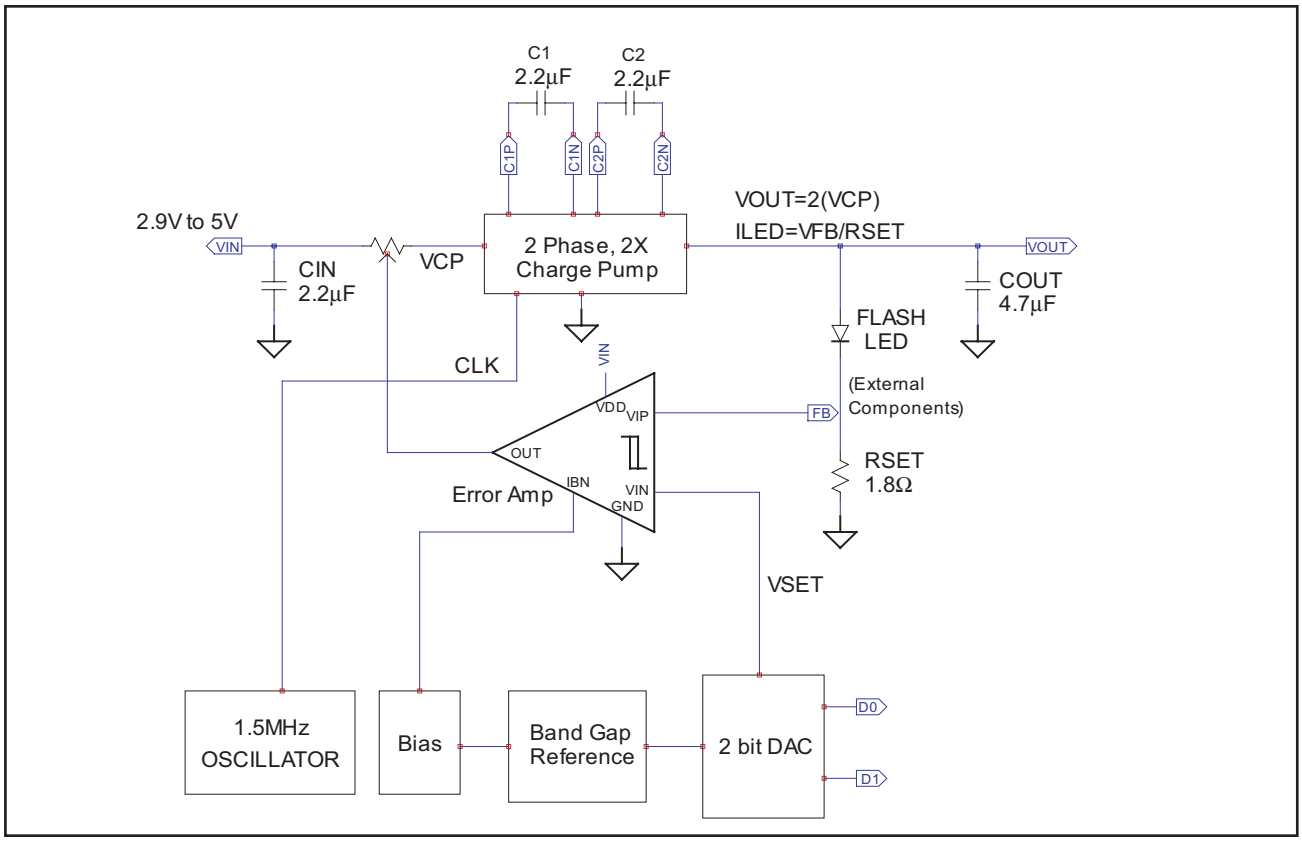
Parameter	Condition	Min	Typ	Max	Units
Input Power Supply					
V_{IN} Operating Voltage		2.9		5.0	V
I_{CC} Operating Current, Quiescent	I_{OUT} = 60μA, V_{IN} = D0 = D1 = 3.6V		2.5	5	mA
I_{SHDNB} Shutdown Current	D1 = D0 = 0V			1	μA
Output					
Torch Mode					
I_{OUT}	D1=0V, D0=V_{IN}; V_{IN}=3.3V; R_{SET}=1.8Ω	100			mA
	D1=V_{IN}, D0=0V; V_{IN}=3.3V; R_{SET}=1.8Ω	200	250		mA
V_{FB}	D1=0V, D0=V_{IN}; I_{OUT}=0mA		200		mV
	D1=V_{IN}, D0=0V; I_{OUT}=0mA		490		mV
Flash Mode					
I_{OUT}	D1=V_{IN}, D0=V_{IN}; VIN=3.3V; RSET=1.8Ω; Pulse Width=50ms~500ms; Duty Cycle=50% of 1Hz max		300		mA
V_{FB}	D1=V_{IN}, D0=V_{IN}; I_{OUT}=0mA		550		mV
I_{FB}	V_{FB} = 0.8V		50		nA
Charge Pump					
Efficiency	D1=D0=V_{IN}; V_{IN}=3.0V; I_{OUT}=150mA		80		%
CLK Frequency			1.5		MHz
Data Input, D0, D1					
High Level Input Voltage (V_{IH})		1.4			V
Low Level Input Voltage (V_{IL})				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	100mA	Torch Function
1	0	250mA	More Torch or Flash Function
1	1	300mA	Flash Function

Based on feedback resistor R_{SET} of 1.8Ω with rating at 0.25W.

Block Diagram



Block diagram of ZD3203 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 determine the Set Point Voltage of the FB pin.
FB	2	Feedback Pin. Input for the regulation control loop. LED current is equal to VFB / RSET
VOUT	3	VOUT is the output of the charge pump. A low ESR, 4.7µF ceramic capacitor is required from VOUT to GND
VIN	4	Input Supply Voltage. VIN should be bypassed with a 1µF to 2.2µF low ESR ceramic capacitor
GND	5	Ground Pin. Connect to local ground plane.
C2-, C1-, C1+, C2+	6. 7. 8. 9	Charge Pump Flying Capacitor Pins. A 2.2µF, low ESR ceramic capacitor should be connected from C1+ to C1- and from C2+ to C2-.

Circuit Description

The ZD3203 uses a state-of-the-art switched capacitor, 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 free running frequency of 1.5MHz (typ).

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 ZD3203 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	Feedback Set Point Voltage	Output (R_{SET}=1.8Ω)
0	0	0V	Shutdown
0	1	0.20V	100mA
1	0	0.49V	250mA
1	1	0.55V	300mA

Table 1. Feedback Control Voltage Settings

Controlled Power-Down

The ZD3203 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 ZD3203 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.

Short-Circuit/Thermal Protection

The ZD3203 has integrated short-circuit current limiting circuitry designed to protect the device. Thermal protection circuitry has also been integrated. These protection circuits allow for robust designs during manufacturing and industrial, as well as consumer environments. The current limit is set to approximatley 350mA and the thermal protection will shut down the charge pump when the die temperature reaches approximately 160℃. The charge pump will be re-started when the die temperature reaches approximately 155℃. The ZD3203 will continue to cycle, without latchup or damage, until the fault is corrected.

Voltage or Current Programming of the ZD3203

The ZD3203 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

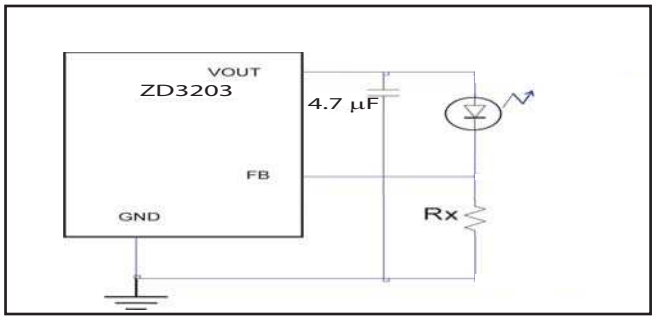


Figure 1 Current Control Mode

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. Typically the total resistance of the voltage divider, R1:R2, will be in the range of several KΩ to 1MΩ.

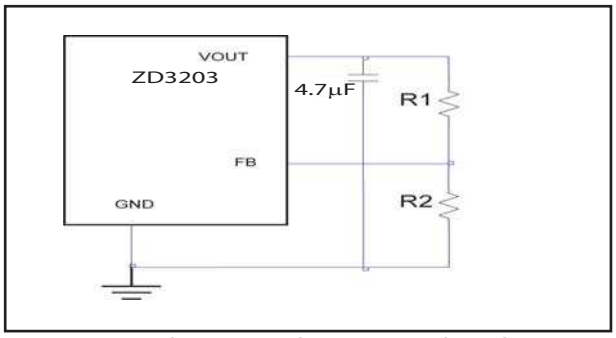
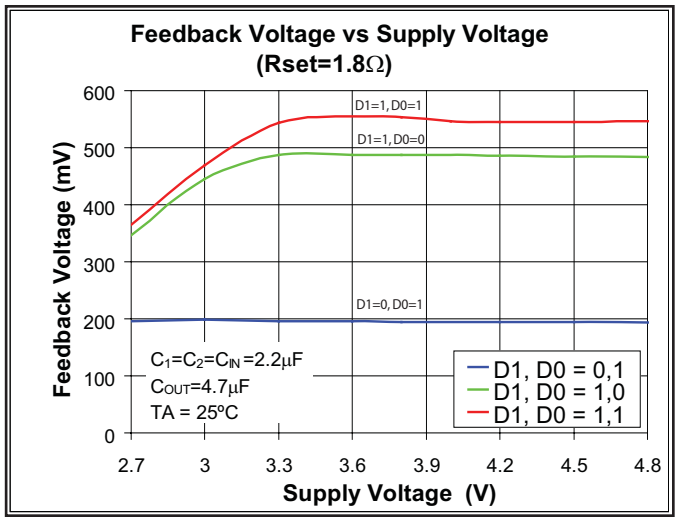
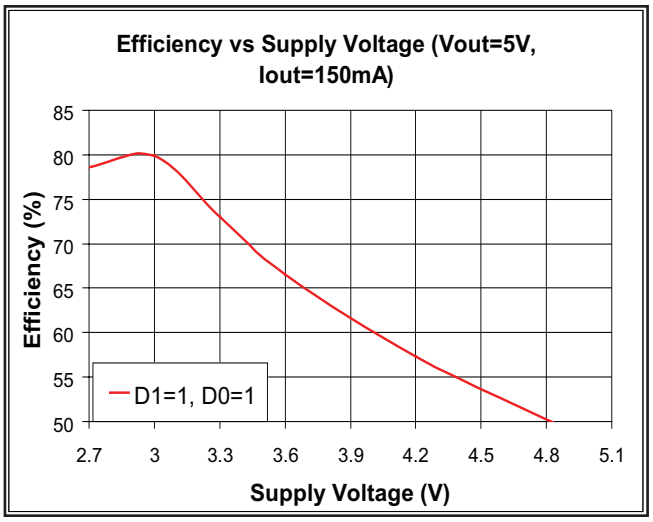
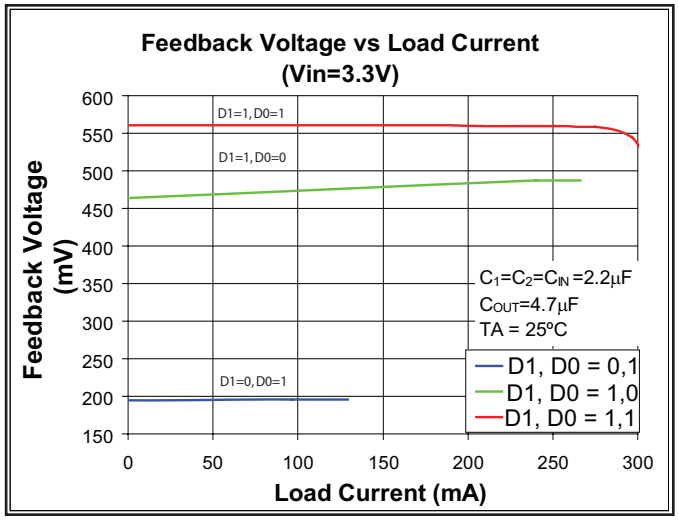


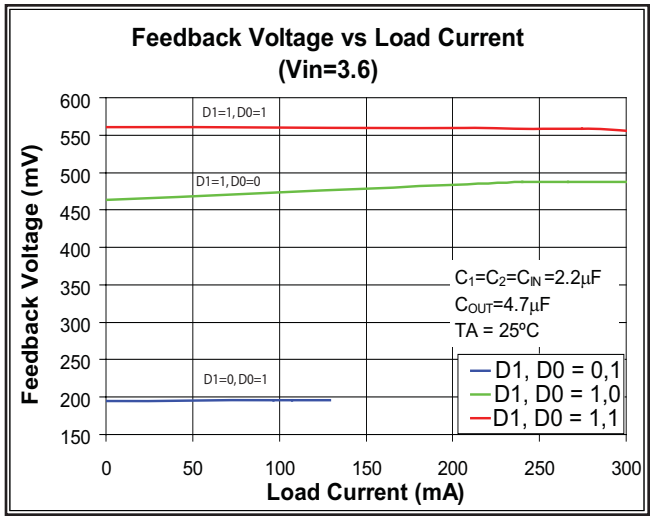
Figure 2. Voltage Control Mode

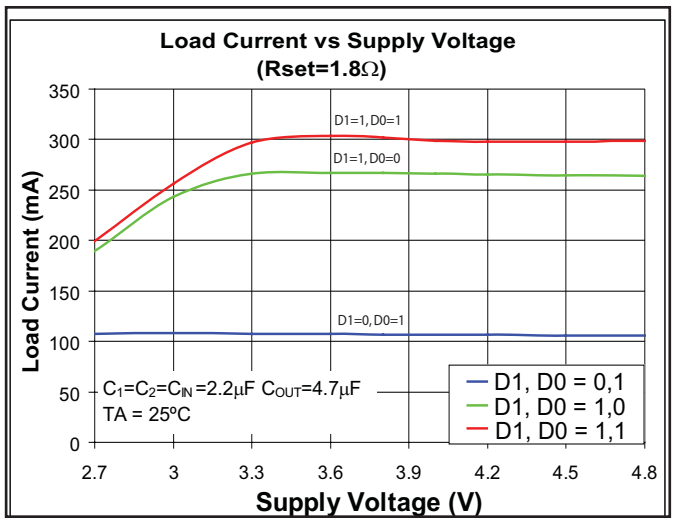
Typical Performance Characteristics

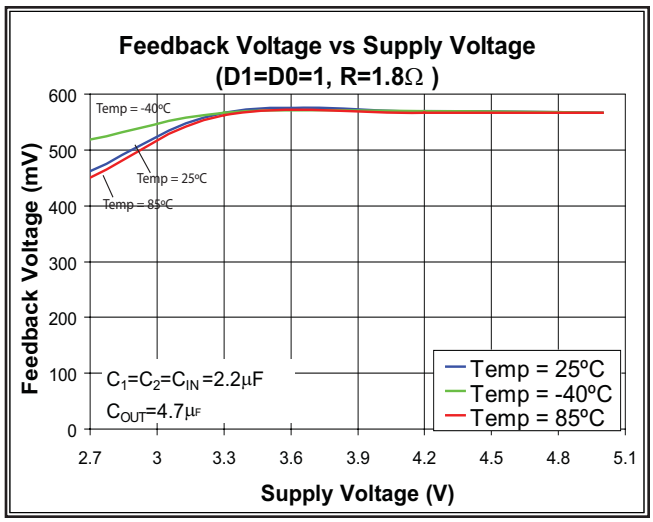




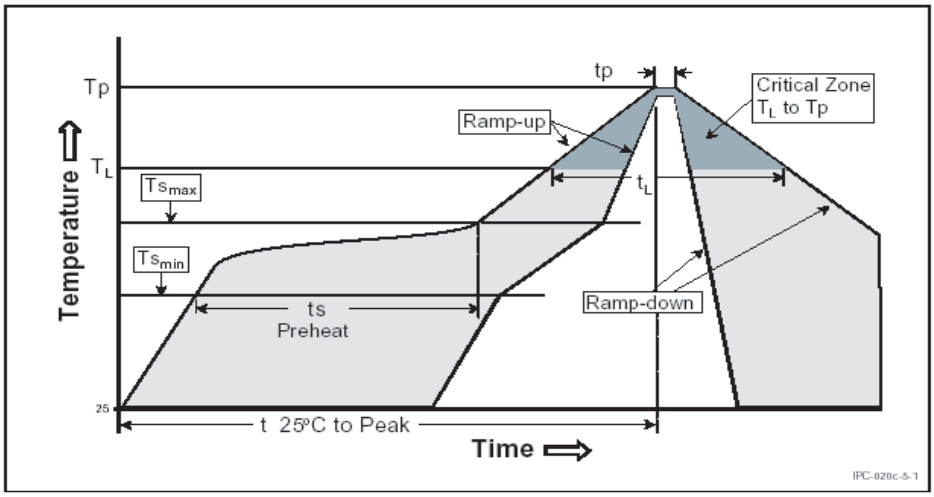






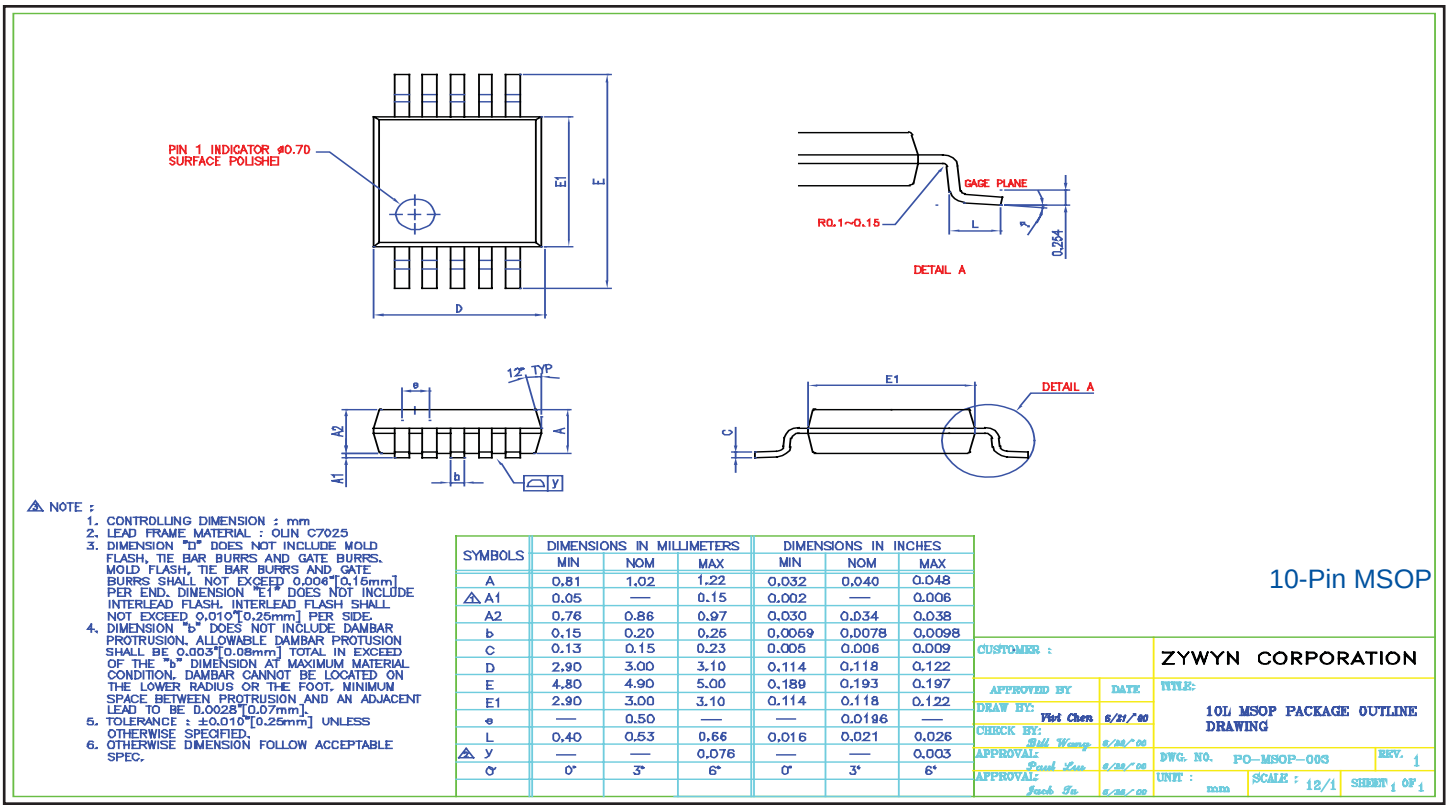


Green Package SMD IR Reflow Profile Information

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 **- Temperature Min (T_{Smin})** **- Temperature Max (T_{Smax})** **- Time (T_{Smin} to t_{Smax})**	 100°C 150°C 60~120 seconds	 **150°C** **200°C** **60~180 seconds**
Time maintained above: **- Temperature (T_L)** **- Time (t_L)**	 183°C 60~150 seconds	 **217°C** **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



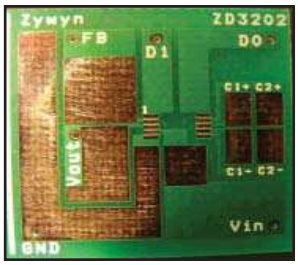
⚠ NOTE :
1. CONTROLLING DIMENSION : mm
2. LEAD FRAME MATERIAL : OLIN C7025
3. DIMENSION "D" DOES NOT INCLUDE MOLD FLASH, TIE BAR BURRS AND GATE BURRS. MOLD FLASH, TIE BAR BURRS AND GATE BURRS SHALL NOT EXCEED 0.006"[0.15mm] PER END. DIMENSION "E1" DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010"[0.25mm] PER SIDE.
4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTUSION SHALL BE 0.003"[0.08mm] TOTAL IN EXCEED OF THE "b" DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUN SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD TO BE 0.0028"[0.07mm].
5. TOLERANCE : ±0.010"[0.25mm] UNLESS OTHERWISE SPECIFIED.
6. OTHERWISE DIMENSION FOLLOW ACCEPTABLE SPEC.

SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.81	1.02	1.22	0.032	0.040	0.048
⚠ A1	0.05	—	0.15	0.002	—	0.006
A2	0.76	0.86	0.97	0.030	0.034	0.038
b	0.15	0.20	0.26	0.0059	0.0078	0.0098
C	0.13	0.15	0.23	0.005	0.006	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	4.80	4.90	5.00	0.189	0.193	0.197
E1	2.90	3.00	3.10	0.114	0.118	0.122
e	—	0.50	—	—	0.0196	—
L	0.40	0.53	0.66	0.016	0.021	0.026
⚠ y	—	—	0.076	—	—	0.003
θ	0°	3°	6°	0°	3°	6°

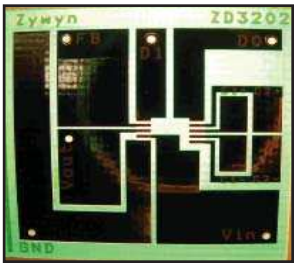
10-Pin MSOP

CUSTOMER :		ZYWYN CORPORATION
APPROVED BY	DATE	TITLE: 10L MSOP PACKAGE OUTLINE DRAWING
DRAW BY: Vist Chen	6/21/'00	
CHECK BY: Bill Wang	6/28/'00	
APPROVAL: Frank Liao	6/28/'00	DWG. NO. PO-MSOP-003 REV. 1
APPROVAL: Jack Fu	6/28/'00	UNIT : mm SCALE : 12/1 SHEET 1 OF 1

Evaluation Board Information



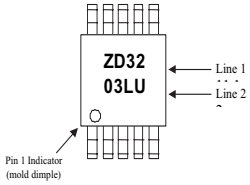
ZD3203EVB Evaluation Board Component Side Layout



ZD3203EVB Evaluation Board Solder Side Layout

Part Marking Information

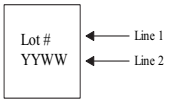
TOPSIDE MARK INSTRUCTIONS:



Line 1: Zywyn Part Number "ZD32"
Line 2: Zywyn Part Number "03LU"

Note: Pin # 1 "△" Indicator Required if no Mold Dimple

BOTTOMSIDE MARK INSTRUCTIONS:



Line 1: Lot Number: XXXXX.XX (Mark only the 4 characters underlined)
Line 2: Date Code: (Last 2 digits of Prod. Year & Prod. Work Week)

10-pin MSOP

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