

## 100 MHz Differential Buffer for PCI Express and SATA

### Features

- Two differential 0.7V clock output pairs
- OE# input for enabling SRC outputs
- Individual OE controls
- Low CTC jitter (< 50 ps)
- Spread Aware
- 3.3V operation
- Industrial Temperature Grade -40°C to +85°C
- 16-pin TSSOP package

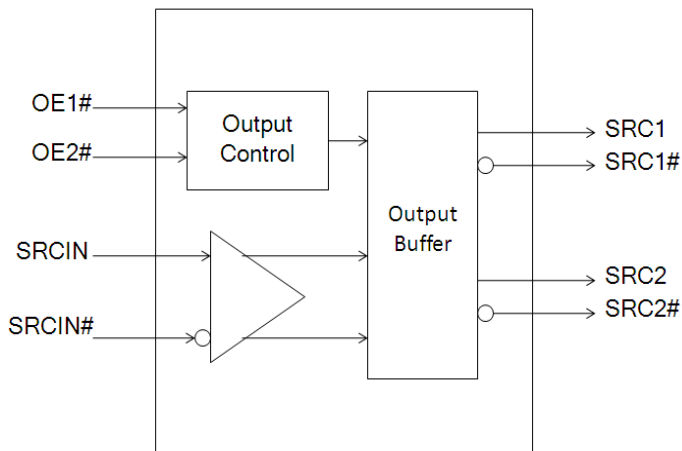
### Functional Description

The SL28DB200 is a differential buffer capable of distributing the Serial Reference Clock (SRC) for PCI Express Gen2 and SATA implementations. The buffer enables the application system to control the distribution of the SRC.

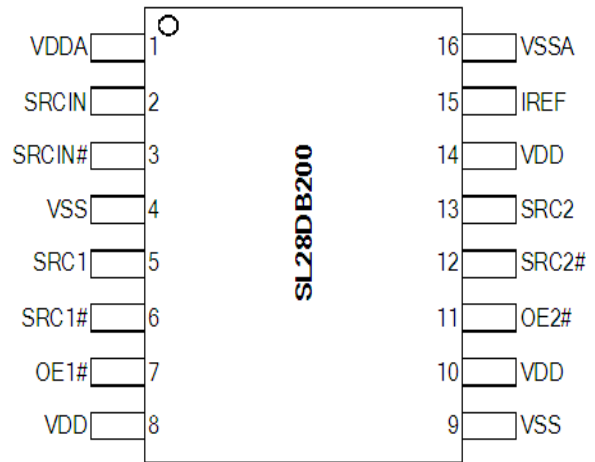
### Applications

- Network/Media Attached Storage
- Routers/IP Gateways
- Multi-function Printers

### Block Diagram



### Pin Configuration



16 TSSOP

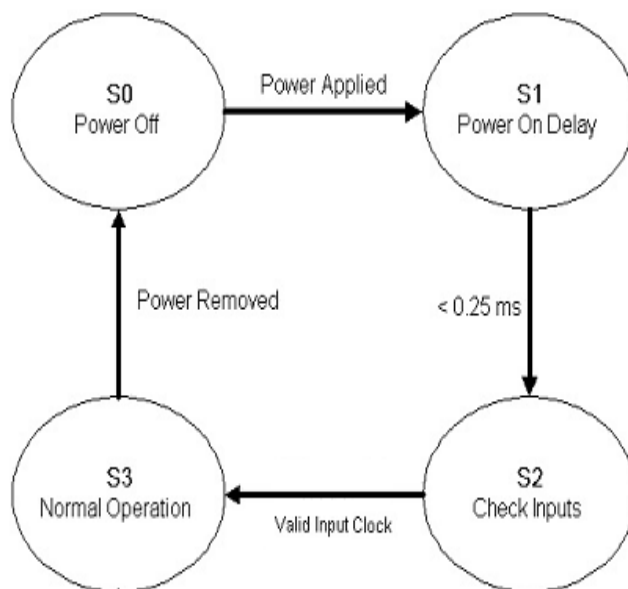
**Pin Description**

Pin	Name	Type	Description
2,3	SRCIN, SRCIN#	I,DIF	<b>0.7V Differential inputs</b>
5,6,13,12	SRC[1:2], SRC[1:2]#	O,DIF	<b>0.7V Differential Clock Outputs</b>
7,11	OE[1:2]#	I,SE	<b>3.3V LVTTTL input for enabling differential outputs</b>
15	IREF	I	<b>A precision resistor 475 ohm is attached to this pin to set the differential output current</b>
1	VDDA	PWR	<b>3.3V Power Supply</b>
16	VSSA	GND	<b>Ground</b>
8,10,14	VDD	PWR	<b>3.3V power supply for outputs</b>
4,9	VSS	GND	<b>Ground for outputs</b>

Notes: I=Input, O=Output, DIF=Differential signal, SE=Single Ended, PWR=Power input, GND=Ground

**Table 1. Buffer Power-up State Machine**

State	Description
S0	3.3V Buffer power off
S1	After 3.3V supply is detected to rise above 1.8V - 2.0V, the buffer enters state 1 and initiates a 0.2-ms–0.3-ms delay
S2	Buffer waits for a valid clock on the SRCIN input
S3	Once a valid input is detected, the buffer enters state 3 and enables outputs for normal operation



**Figure 1. Buffer Power-up State Diagram**

**Output Enable Clarification**

OE# functionality allows for enabling and disabling individual outputs. OE1# and OE2# are Active LOW inputs. Disabling the outputs may be implemented by deasserting the OE# input pin. If the OE# pin is deasserted, the output of interest will be tri-stated. (The assertion and deassertion of this signal is absolutely asynchronous.)

**OE Deassertion**

The impact of deasserting OE# is that each corresponding output will transition from normal operation to tri-state in a glitch-free manner. The maximum latency from the deassertion to tri-stated outputs is between 2–6 DIF clock periods.

**OE Assertion**

All differential outputs that were tri-stated will resume normal operation in a glitch-free manner. The maximum latency from the assertion to active outputs is between 2–6 SRC clock periods. In addition, SRC clocks will be driven high within 15 ns of OE# assertion to a voltage greater than 200 mV

**Table 2. OE Functionality**

OE#	SRC,SRC#
0	Enable
1	Tri-State

**Absolute Maximum Conditions**

Parameter	Description	Condition	Min.	Max.	Unit
VDD	Core Supply Voltage		-0.5	4.6	V
VDDA	Analog Supply Voltage		-0.5	4.6	V
V <sub>IN</sub>	Input Voltage	Relative to V <sub>SS</sub>	-0.5	V <sub>DD</sub> + 0.5	VDC
T <sub>S</sub>	Temperature, Storage	Non-functional	-65	+150	°C
T <sub>A</sub>	Temperature, Operating Ambient (Commercial Grade)	Functional	0	85	°C
T <sub>A</sub>	Temperature, Operating Ambient (Industrial Grade)	Functional	-40	85	°C
T <sub>J</sub>	Temperature, Junction	Functional		150	°C
ESD <sub>HBM</sub>	ESD Protection (Human Body Model)	JEDEC (JESD 22 - A114)	2000	-	V
UL-94	Flammability Rating	UL (Class)	V-0		
MSL	Moisture Sensitivity Level		1		

**DC Electrical Specifications**

Parameter	Description	Condition	Min.	Max.	Unit
VDDA, VDD	3.3V Operating Voltage	3.3 ± 5%	3.135	3.465	V
V <sub>IL</sub>	3.3V Input Low Voltage		V <sub>SS</sub> - 0.5	0.8	V
V <sub>IH</sub>	3.3V Input High Voltage		2.0	V <sub>DD</sub> + 0.5	V
I <sub>IL</sub>	Input Low Leakage Current	except internal pull-up resistors, 0 < V <sub>IN</sub> < V <sub>DD</sub>	-5		µA
I <sub>IH</sub>	Input High Leakage Current	except internal pull-down resistors, 0 < V <sub>IN</sub> < V <sub>DD</sub>		5	µA
C <sub>IN</sub>	Input Pin Capacitance		1.5	5	pF
C <sub>OUT</sub>	Output Pin Capacitance		--	6	pF
L <sub>IN</sub>	Pin Inductance		-	7	nH
I <sub>DD3.3V</sub>	Dynamic Supply Current	At max. load, Full Active, at 100MHz	-	60	mA



**AC Electrical Specifications**

All measurements at VDD (typical) = 3.3V, T<sub>A</sub> = 25°C unless otherwise stated

Parameter	Description	Condition	Min.	Max.	Unit
<b>SRCIN at 0.7V</b>					
T <sub>PERIOD</sub>	Average Period	Measured at crossing point V <sub>OX</sub>	9.9970	10.0533	ns
T <sub>ABSMIN-IN</sub>	Absolute minimum clock periods	Measured at crossing point V <sub>OX</sub>	9.8720		ns
T <sub>R</sub> / T <sub>F</sub>	SRC and SRC# Rise and Fall Times	Single ended measurement: V <sub>OL</sub> = 0.175 to V <sub>OH</sub> = 0.525V (Averaged)	0.6	4	V/ns
V <sub>IH</sub>	Differential Input High Voltage		150		mV
V <sub>IL</sub>	Differential Input Low Voltage			-150	mV
V <sub>OX</sub>	Crossing Point Voltage at 0.7V Swing	Single-ended measurement	250	550	mV
ΔV <sub>OX</sub>	Vcross Variation over all edges	Single-ended measurement		140	mV
V <sub>RB</sub>	Differential Ringback Voltage		-100	100	mV
T <sub>STABLE</sub>	Time before ringback allowed		500		ps
V <sub>MAX</sub>	Absolute maximum input voltage			1.15	V
V <sub>MIN</sub>	Absolute minimum input voltage		-0.3		V
T <sub>DC</sub>	SRC and SRC# Duty Cycle	Measured at crossing point V <sub>OX</sub>	45	55	%
T <sub>RFM</sub>	Rise/Fall Matching	Determined as a fraction of 2*(T <sub>R</sub> - T <sub>F</sub> )/(T <sub>R</sub> + T <sub>F</sub> )	-	20	%
<b>SRC at 0.7V</b>					
F <sub>IN</sub>	Input Frequency		90	210	MHz
F <sub>ERROR</sub>	Input/Output Frequency Error		-	0	ppm
T <sub>DC</sub>	SRC and SRC# Duty Cycle	Measured at crossing point V <sub>OX</sub>	45	55	%
T <sub>PERIOD</sub>	Average Period	Measured at crossing point V <sub>OX</sub> at 100 MHz	9.9970	10.0533	ns
T <sub>R</sub> / T <sub>F</sub>	SRC[1:2] and SRC[1:2]# Rise and Fall Times	Single-ended measurement: V <sub>OL</sub> = 0.175 to V <sub>OH</sub> = 0.525V (Averaged)	175	700	ps
T <sub>RFM</sub>	Rise/Fall Matching	Determined as a fraction of 2 * (T <sub>R</sub> - T <sub>F</sub> )/(T <sub>R</sub> + T <sub>F</sub> )	-	20	%
ΔT <sub>R</sub> /ΔT <sub>F</sub>	Rise and Fall Time Variation Variation	Single-ended measurement: V <sub>OL</sub> = 0.175 to V <sub>OH</sub> = 0.525V (Real Time)	-	125	ps
V <sub>HIGH</sub>	Voltage High	Single-ended measurement	660	850	mv
V <sub>LOW</sub>	Voltage Low	Single-ended measurement	-150	-	mv
V <sub>OX</sub>	Crossing Point Voltage at 0.7V Swing	Single-ended measurement	250	550	mv
ΔV <sub>OX</sub>	Vcross Variation over all edges	Single-ended measurement	-	140	mV
V <sub>OVS</sub>	Maximum Overshoot Voltage	Single-ended measurement	-	V <sub>HIGH</sub> + 0.3	V
V <sub>UDS</sub>	Minimum Undershoot Voltage	Single-ended measurement	-	-0.3	V
V <sub>RB</sub>	Ring Back Voltage	Single-ended measurement	0.2	N/A	V
T <sub>CCJ</sub>	Cycle to Cycle Jitter	Jitter is additive	-	50	ps
T <sub>SKEW</sub>	Any SRC/SRC# to SRC/SRC# Clock Skew	Measured at crossing point V <sub>OX</sub>	-	50	ps
T <sub>PD</sub>	Input to output skew	Measured at crossing point V <sub>OX</sub>	2.5	4.5	ns

Test and Measurement Setup

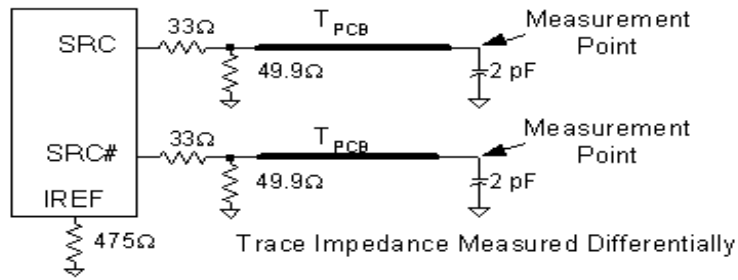


Figure 1. Differential Clock Termination

Switching Waveforms

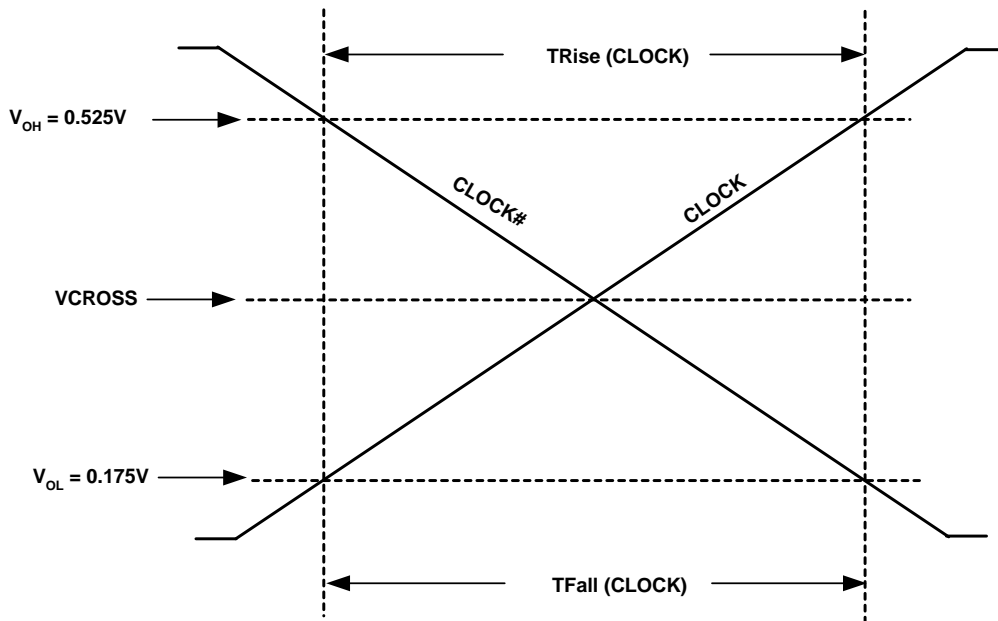


Figure 2. Single-Ended Measurement Points for TRise and TFall

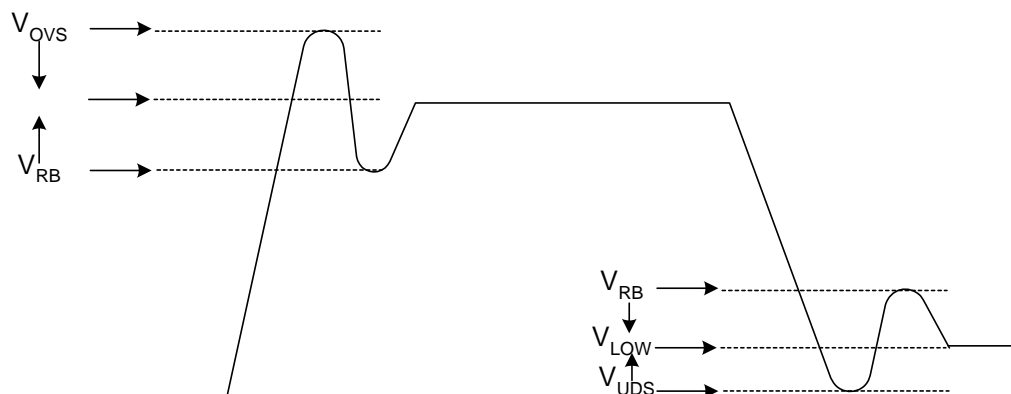


Figure 3. Single-ended Measurement Points for  $V_{OVS}$ ,  $V_{UBS}$  and  $V_{RB}$

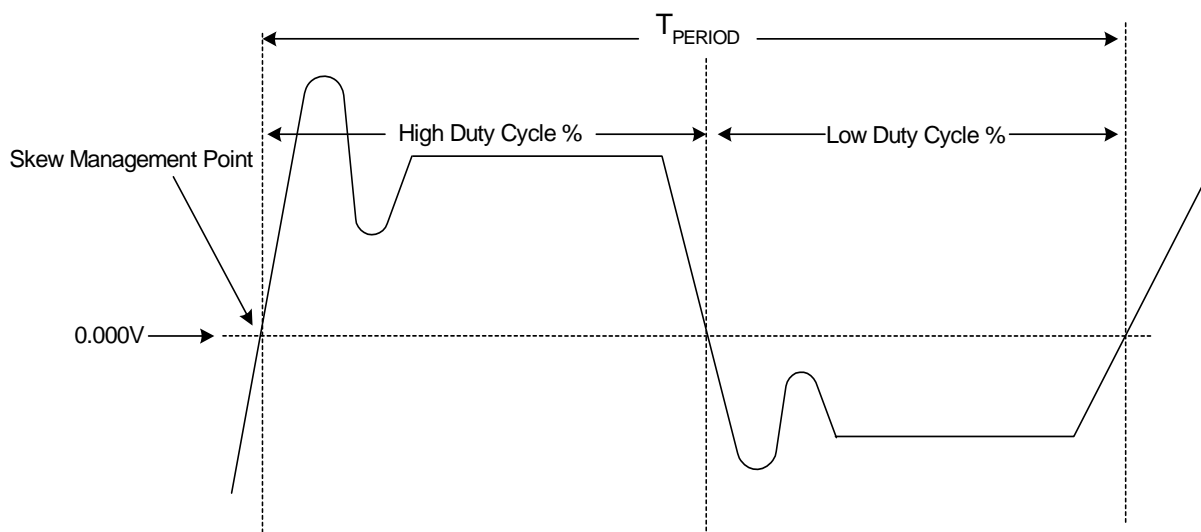


Figure 4. Differential (Clock-Clock#) Measurement Points ( $T_{period}$ , Duty Cycle and Jitter)

### Ordering Information

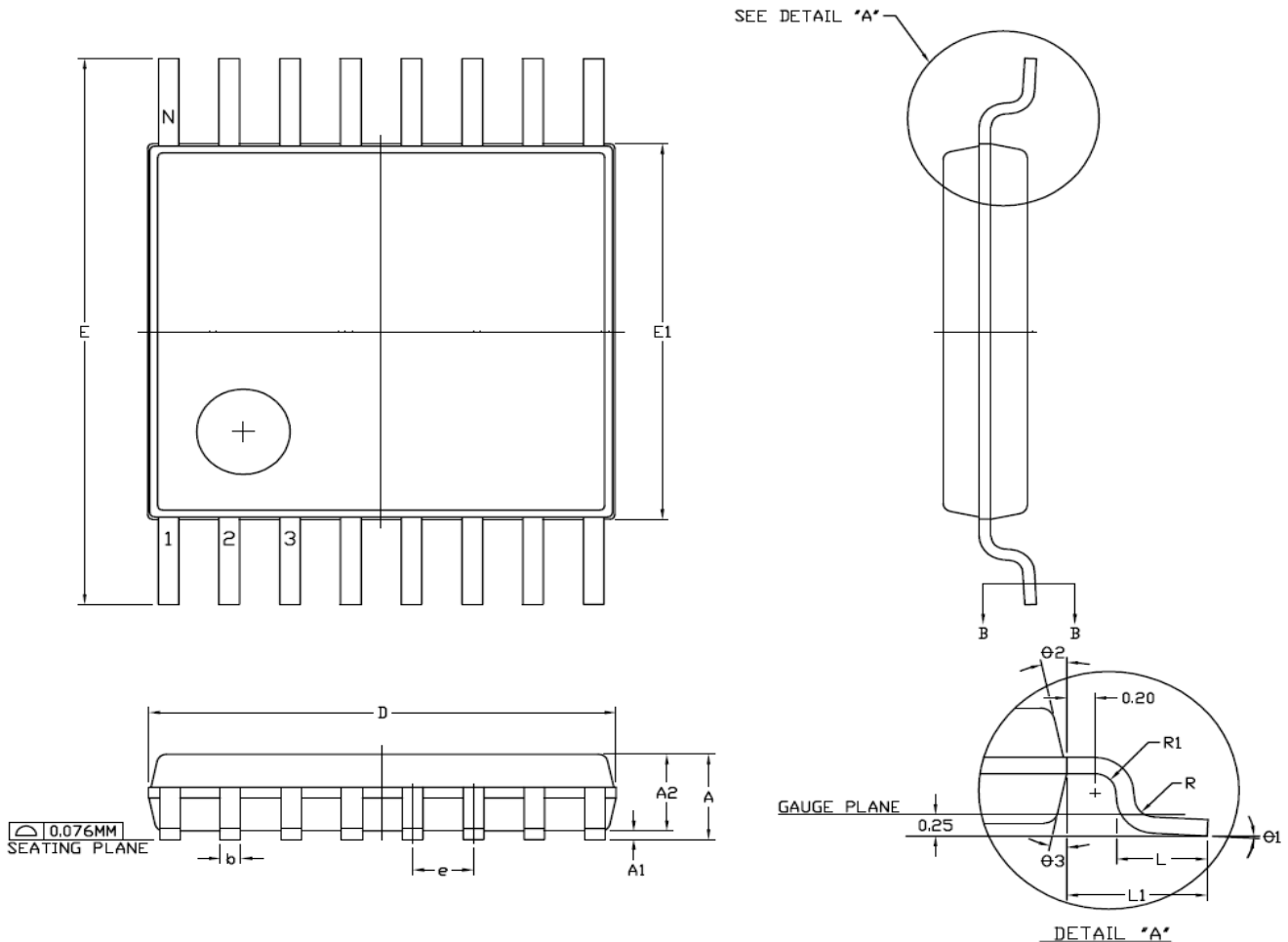
Ordering Code	Package Type	Operating Range
<b>Lead-free</b>		
SL28DB200AZC	16-pin TSSOP	Commercial, 0°C to 85°C
SL28DB200AZCT	16-pin TSSOP—(Tape and Reel)	Commercial, 0°C to 85°C
SL28DB200AZI	16-pin TSSOP	Industrial, -40°C to 85°C
SL28DB200AZIT	16-pin TSSOP—(Tape and Reel)	Industrial, -40°C to 85°C

Note: All orderables are Lead-free and RoHS compliant



Package Drawing and Dimensions

16-Lead Thin Shrunken Small Outline Package



SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A			1.20			.047
A1	0.05		0.15	.002		.006
A2	0.80	0.90	1.05	.031	.035	.041
b	0.19		0.30	.007		.012
b1	0.19	0.22	0.25	.007	.009	.010
c	0.09		0.20	.004		.008
c1	0.09		0.16	.004		.006
D	4.90	5.00	5.10	.193	.197	.200
e	0.65 BSC.			.026 BSC.		
E	6.40 BSC.			.252 BSC.		
E1	4.30	4.40	4.50	.169	.173	.177
L	0.50	0.60	0.75	.020	.024	.030
L1	1.00 REF.			.039 REF.		
R	0.09			.004		
R1	0.09			.004		
theta1	0		8	0		8
theta2	12 REF.			12 REF.		
theta3	12 REF.			12 REF.		

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSION 'D' DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
3. DIMENSION 'E1' DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
4. 'N' IS THE NUMBER OF TERMINAL POSITIONS.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. REFERENCE DRAWING JEDEC MO-153, VARIATION AB.



Document History Page

<b>Document Title: SL28DB200 PCI Express Gen2 and SATA Differential Buffer</b>				
<b>Document #: 38-07722 Rev *C</b>				
<b>REV.</b>	<b>ECR#</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
1.0		06/17/10	TRP	Initial Release
AA		09/27/10	TRP	Updated Dynamic Supply Current

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