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## 3.3V SDRAM Buffer for Mobile PCs with 4 SO-DIMMs

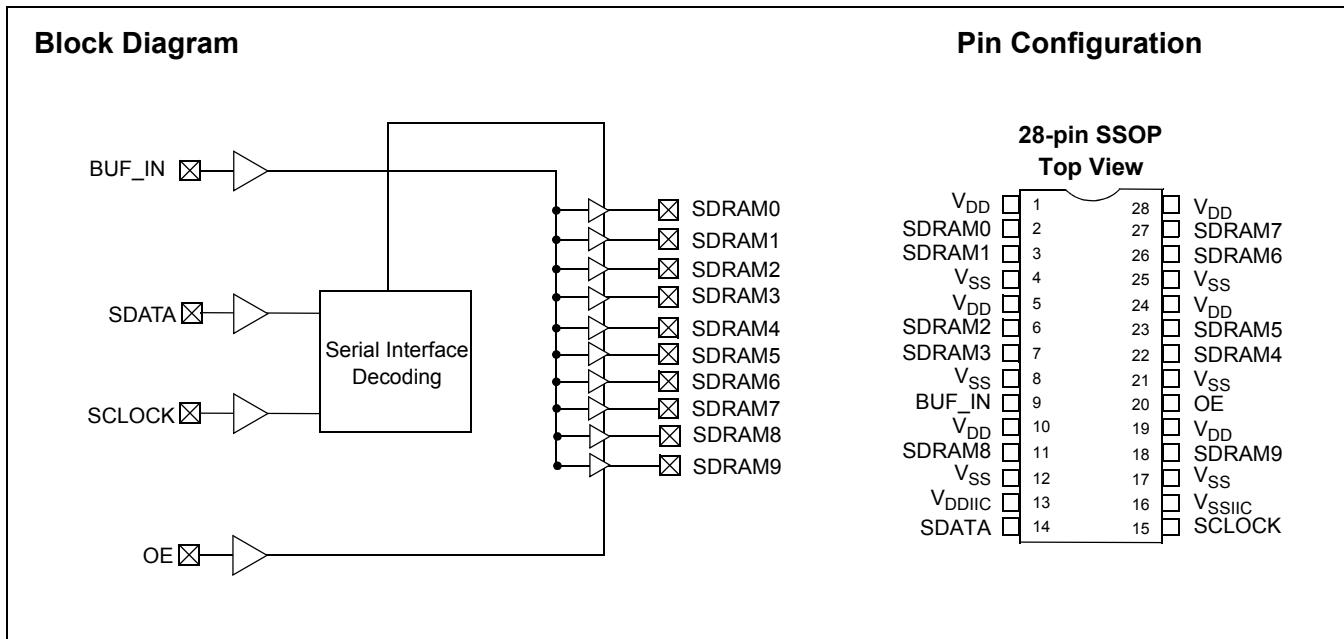
### Features

- One input to 10 output buffer/driver
- Supports up to four SDRAM SO-DIMMs
- Two additional outputs for feedback
- Serial interface for output control
- Low skew outputs
- Up to 100-MHz operation
- Multiple  $V_{DD}$  and  $V_{SS}$  pins for noise reduction
- Dedicated OE pin for testing
- Space-saving 28-pin SSOP package
- 3.3V operation

### Functional Description

The CY2310ANZ is a 3.3V buffer designed to distribute high-speed clocks in mobile PC applications. The part has 10 outputs, 8 of which can be used to drive up to four SDRAM SO-DIMMs, and the remaining can be used for external feedback to a PLL. The device operates at 3.3V and outputs can run up to 100 MHz, thus making it compatible with Pentium II® processors. The CY2310ANZ can be used in conjunction with the CY2281 or similar clock synthesizer for a full Pentium II motherboard solution.

The CY2310ANZ also includes a serial interface which can enable or disable each output clock. On power-up, all output clocks are enabled. A separate Output Enable pin facilitates testing on ATE.



**Pin Summary**

Name	Pins	Description
V <sub>DD</sub>	1, 5, 10, 19, 24, 28	3.3V Digital voltage supply
V <sub>SS</sub>	4, 8, 12, 17, 21, 25	Ground
V <sub>DDIIC</sub>	13	Serial interface voltage supply
V <sub>SSIIC</sub>	16	Ground for serial interface
BUF_IN	9	Input clock
OE	20	Output Enable, three-states outputs when LOW. Internal pull-up to V <sub>DD</sub>
SDATA	14	Serial data input, internal pull-up to V <sub>DD</sub>
SCLK	15	Serial clock input, internal pull-up to V <sub>DD</sub>
SDRAM [0–3]	2, 3, 6, 7	SDRAM byte 0 clock outputs
SDRAM [4–7]	22, 23, 26, 27	SDRAM byte 1 clock outputs
SDRAM [8–9]	11, 18	SDRAM byte 2 clock outputs

**Device Functionality**

OE	SDRAM [0–17]
0	High-Z
1	1 x BUF_IN

**Serial Configuration Map**

- The Serial bits will be read by the clock driver in the following order:

Byte 0 - Bits 7, 6, 5, 4, 3, 2, 1, 0

Byte 1 - Bits 7, 6, 5, 4, 3, 2, 1, 0

Byte N - Bits 7, 6, 5, 4, 3, 2, 1, 0

- Reserved and unused bits should be programmed to “0”.
- Serial interface address for the CY2310ANZ is:

A6	A5	A4	A3	A2	A1	A0	R/W
1	1	0	1	0	0	1	---

**Byte 0:SDRAM Active/Inactive Register  
(1 = Enable, 0 = Disable), Default = Enabled**

Bit	Pin #	Description
Bit 7	--	Initialize to 0
Bit 6	--	Initialize to 0
Bit 5	--	Initialize to 0
Bit 4	--	Initialize to 0
Bit 3	7	SDRAM3 (Active/Inactive)
Bit 2	6	SDRAM2 (Active/Inactive)
Bit 1	3	SDRAM1 (Active/Inactive)
Bit 0	2	SDRAM0 (Active/Inactive)

**Byte 1: SDRAM Active/Inactive Register  
(1 = Active, 0 = Inactive), Default = Active**

Bit	Pin #	Description
Bit 7	27	SDRAM7 (Active/Inactive)
Bit 6	26	SDRAM6 (Active/Inactive)
Bit 5	23	SDRAM5 (Active/Inactive)
Bit 4	22	SDRAM4 (Active/Inactive)
Bit 3	--	Initialize to 0
Bit 2	--	Initialize to 0
Bit 1	--	Initialize to 0
Bit 0	--	Initialize to 0

**Byte 2: SDRAM Active/Inactive Register  
(1 = Active, 0 = Inactive), Default = Active**

Bit	Pin #	Description
Bit 7	18	SDRAM9 (Active/Inactive)
Bit 6	11	SDRAM8 (Active/Inactive)
Bit 5	--	Reserved, drive to 0
Bit 4	--	Reserved, drive to 0
Bit 3	--	Reserved, drive to 0
Bit 2	--	Reserved, drive to 0
Bit 1	--	Reserved, drive to 0
Bit 0	--	Reserved, drive to 0

**Maximum Ratings**

Supply Voltage to Ground Potential .....	-0.5V to +7.0V	Storage Temperature .....	-65°C to +150°C
DC Input Voltage (Except BUF_IN).....	-0.5V to $V_{DD} + 0.5V$	Junction Temperature .....	150°C
DC Input Voltage (BUF_IN).....	-0.5V to +7.0V	Static Discharge Voltage (per MIL-STD-883, Method 3015) .....	>2000V

**Operating Conditions**

Parameter	Description	Min.	Max.	Unit
$V_{DD}$	Supply Voltage	3.135	3.465	V
$T_A$	Operating Temperature (Ambient Temperature)	0	70	°C
$C_L$	Load Capacitance	20	30	pF
$C_{IN}$	Input Capacitance		7	pF
$t_{PU}$	Power-up time for all $V_{DD}$ s to reach minimum specified voltage (power ramps must be monotonic)	0.05	50	ms

**Electrical Characteristics**

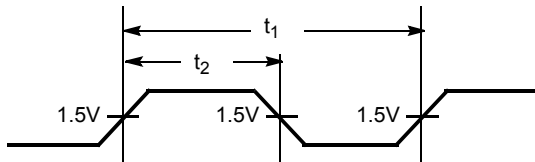
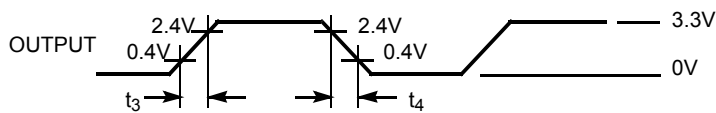
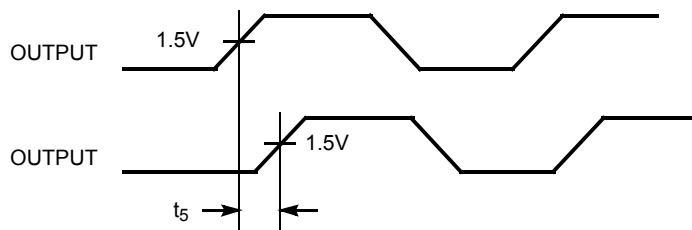
Parameter	Description	Test Conditions	Min.	Max.	Unit
$V_{IL}$	Input LOW Voltage <sup>[1]</sup>	Except serial interface pins		0.8	V
$V_{ILic}$	Input LOW Voltage	For serial interface pins only		0.7	V
$V_{IH}$	Input HIGH Voltage <sup>[1]</sup>		2.0		V
$I_{IL}$	Input LOW Current (BUF_IN input)	$V_{IN} = 0V$	-10	10	μA
$I_{IL}$	Input LOW Current (Except BUF_IN Pin)	$V_{IN} = 0V$		100	μA
$I_{IH}$	Input HIGH Current	$V_{IN} = V_{DD}$	-10	10	μA
$V_{OL}$	Output LOW Voltage <sup>[2]</sup>	$I_{OL} = 25\text{ mA}$		0.4	V
$V_{OH}$	Output HIGH Voltage <sup>[2]</sup>	$I_{OH} = -36\text{ mA}$	2.4		V
$I_{DD}$	Supply Current <sup>[2]</sup>	Unloaded outputs, 100-MHz		200	mA
$I_{DD}$	Supply Current	Loaded outputs, 100-MHz		360	mA
$I_{DD}$	Supply Current <sup>[2]</sup>	Unloaded outputs, 66.67-MHz		150	mA
$I_{DD}$	Supply Current	Loaded outputs, 66.67-MHz		230	mA
$I_{DDs}$	Supply Current	BUF_IN= $V_{DD}$ or $V_{SS}$ All other inputs at $V_{DD}$		500	μA

**Notes:**

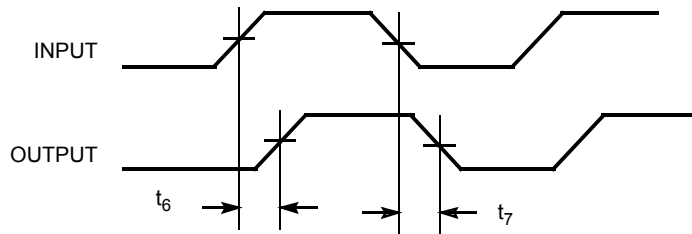
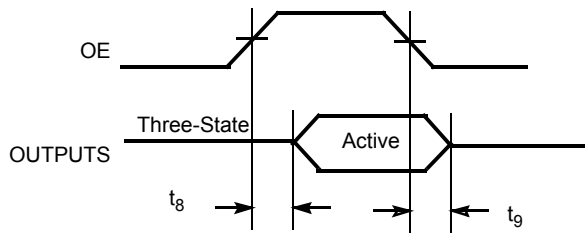
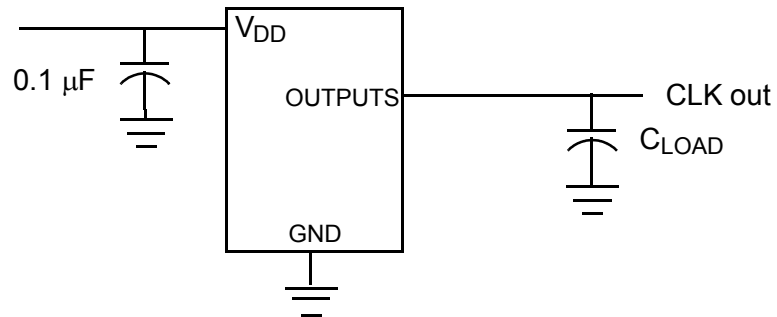
1. BUF\_IN input has a threshold voltage of  $V_{DD}/2$ .
2. Parameter is guaranteed by design and characterization. Not 100% tested in production.

**Switching Characteristics<sup>[3]</sup>**

Parameter	Name	Test Conditions	Min.	Typ.	Max.	Unit
	Maximum Operating Frequency				100	MHz
	Duty Cycle <sup>[2, 4]</sup> = $t_2 \div t_1$	Measured at 1.5V	45.0	50.0	55.0	%
$t_3$	Rising Edge Rate <sup>[2]</sup>	Measured between 0.4V and 2.4V	0.9	1.5	4.0	V/ns
$t_4$	Falling Edge Rate <sup>[2]</sup>	Measured between 2.4V and 0.4V	0.9	1.5	4.0	V/ns
$t_5$	Output to Output Skew <sup>[2]</sup>	All outputs equally loaded		150	250	ps
$t_6$	SDRAM Buffer LH Prop. Delay <sup>[2]</sup>	Input edge greater than 1 V/ns	1.0	3.5	5.0	ns
$t_7$	SDRAM Buffer HL Prop. Delay <sup>[2]</sup>	Input edge greater than 1 V/ns	1.0	3.5	5.0	ns
$t_8$	SDRAM Buffer Enable Delay <sup>[2]</sup>	Input edge greater than 1 V/ns	1.0	5	12	ns
$t_9$	SDRAM Buffer Disable Delay <sup>[2]</sup>	Input edge greater than 1 V/ns	1.0	20	30	ns

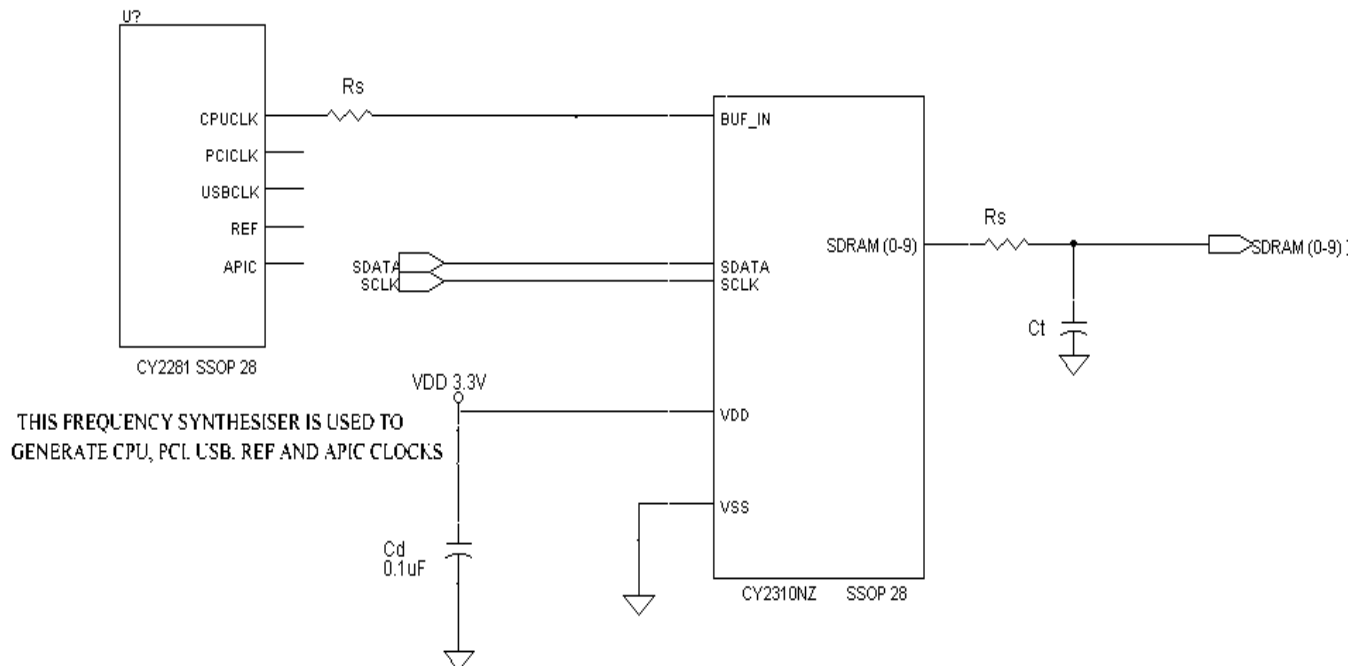
**Switching Waveforms**
**Duty Cycle Timing**

**All Outputs Rise/Fall Time**

**Output-Output Skew**

**Notes:**

3. All parameters specified with loaded outputs.
4. Duty cycle of input clock is 50%. Rising and falling edge rate is greater than 1V/ns

**Switching Waveforms (continued)**
**SDRAM Buffer LH and HL Propagation Delay**

**SDRAM Buffer Enable and Disable Times**

**Test Circuit**


## Application Information

Clock traces must be terminated with either series or parallel termination, as is normally done.



Cd = DECOUPLING CAPACITOR

Ct = OPTIONAL EMI-REDUCING CAPACITORS

Rs = SERIES TERMINATING RESISTORS

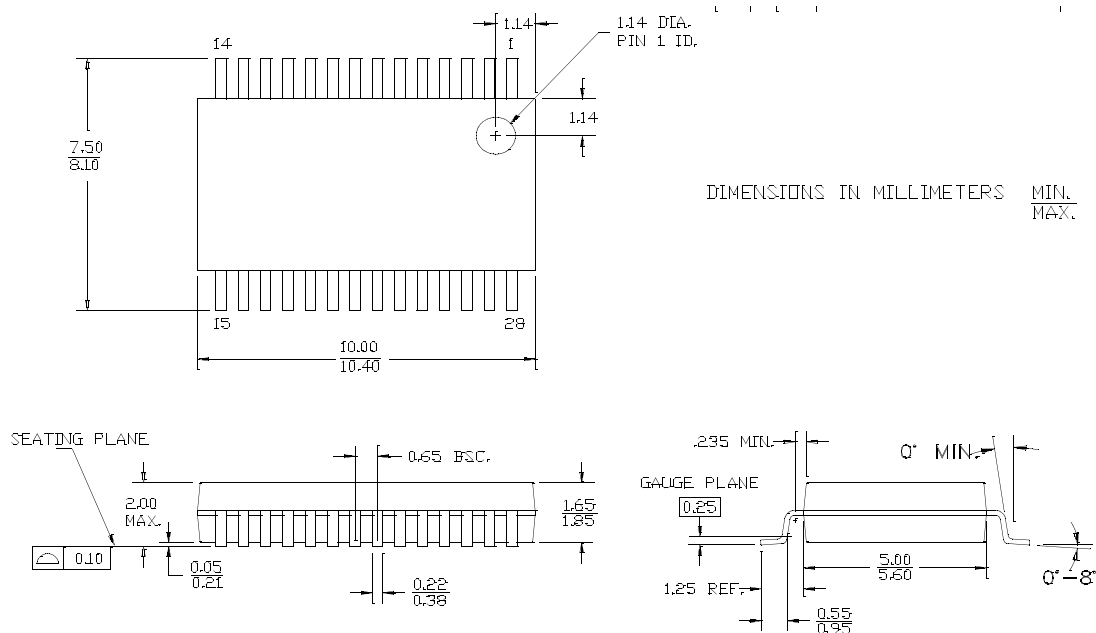
## Summary

- Surface mount, low-ESR, ceramic capacitors should be used for filtering. Typically, these capacitors have a value of 0.1  $\mu$ F. In some cases, smaller value capacitors may be required.
- The value of the series terminating resistor satisfies the following equation, where  $R_{trace}$  is the loaded characteristic impedance of the trace,  $R_{out}$  is the output impedance of the buffer (typically 25 $\Omega$ ), and  $R_{series}$  is the series terminating resistor.  

$$R_{series} > R_{trace} - R_{out}$$
- Footprints must be laid out for optional EMI-reducing capacitors, which should be placed as close to the terminating resistor as is physically possible. Typical values of these capacitors range from 4.7 pF to 22 pF.
- A Ferrite Bead **may** be used to isolate the Board  $V_{DD}$  from the clock generator  $V_{DD}$  island. Ensure that the Ferrite Bead offers greater than 50 $\Omega$  impedance at the clock frequency, under loaded DC conditions. Please refer to the application note "Layout and Termination Techniques for Cypress Clock Generators" for more details.
- If a Ferrite Bead is used, a 10  $\mu$ F–22  $\mu$ F tantalum bypass capacitor should be placed close to the Ferrite Bead. This capacitor prevents power supply droop during current surges.

**Ordering Information**

Ordering Code	Package Type	Operating Range
<b>Standard</b>		
CY2310ANZPVC-1	28-pin SSOP	Commercial
CY2310ANZPVC-1T	28-pin SSOP - Tape and Reel	Commercial
<b>Lead-free</b>		
CY2310ANZPVXC-1	28-pin SSOP	Commercial
CY2310ANZPVXC-1T	28-pin SSOP - Tape and Reel	Commercial

**Package Diagram**
**28-Lead (5.3 mm) Shrunken Small Outline Package O28**


51-85079-°C

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**Document History Page**

<b>Document Title: CY2310ANZ 3.3V SDRAM Buffer for Mobile PCs with 4 SO-DIMMs</b>				
<b>Document Number: 38-07142</b>				
<b>REV.</b>	<b>ECN NO.</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
**	110251	11/18/01	DSG	Change from Spec number: 38-00659 to 38-07142
*A	121829	12/14/02	RBI	Power up requirements added to Operating Conditions Information
*B	310555	See ECN	RGL	Added Lead-free Devices