



**CYPRESS**

**2.5V/3.3V, 200 MHz Multi-Output Zero Delay Buffer**

**Z9960**

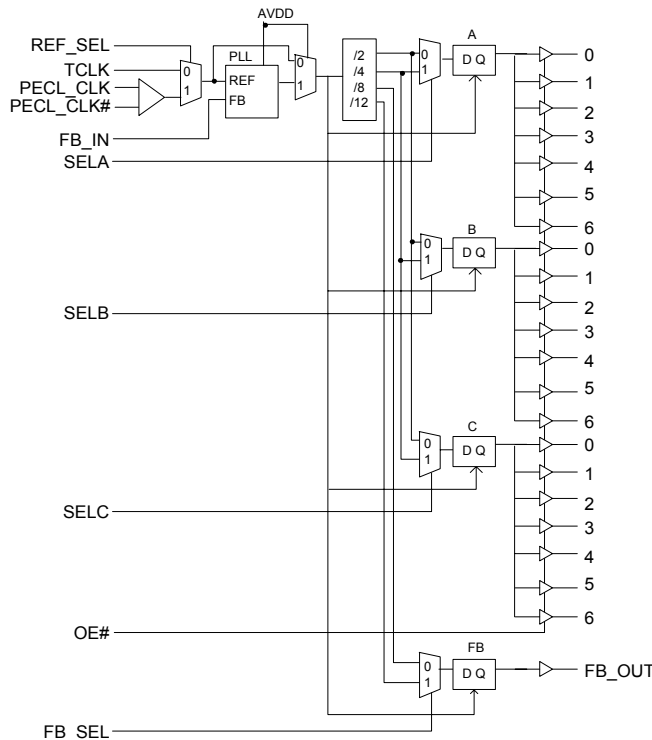
**Features**

- 2.5V or 3.3V operation
- Output frequency up to 200 MHz
- Supports PowerPC™, and Pentium® processors
- 21 clock outputs: drive up to 42 clock lines
- LVPECL or LVCMOS/LVTTL clock input
- Output-to-output skew < 150 ps
- Split 2.5V/3.3V outputs
- Spread spectrum compatible
- Glitch-free output clocks transitioning
- Output disable control
- Pin-compatible with MPC9600
- Industrial temperature range: -40°C to +85°C
- 48-pin LQFP package

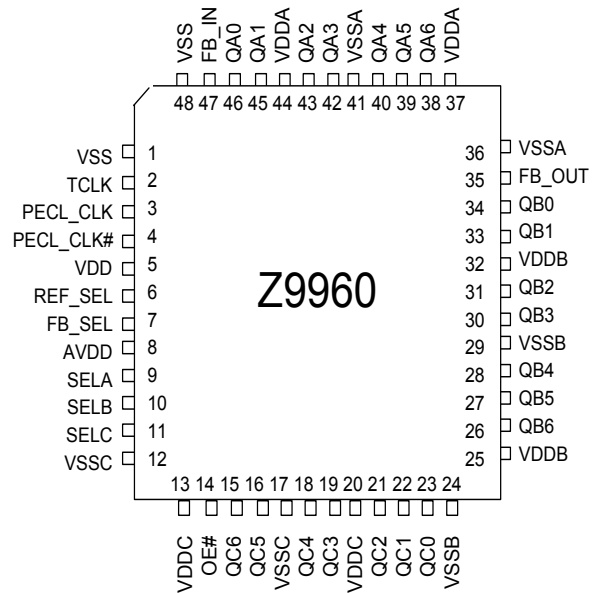
**Table 1. Frequency Table<sup>[1]</sup>**

SEL A	QA	SEL B	QB	SEL C	QC	FB SEL	FB_OUT
0	VCO/2	0	VCO/2	0	VCO/2	0	VCO/8
1	VCO/4	1	VCO/4	1	VCO/4	1	VCO/12

**Block Diagram**



**Pin Configuration**



**Note:**

1. Input frequency range: 16 MHz to 33 MHz (FB\_SEL = 1), or 25 MHz to 50 MHz (FB\_SEL = 0).



## Pin Definition

Pin Name	No.	Type	Pin Description
PECL_CLK	3	I, PD	<b>PECL Clock Input.</b>
PECL_CLK#	4	I, PU	<b>PECL Clock Input.</b>
TCLK	2	I, PD	<b>External Reference/Test Clock Input.</b>
QA(6:0)	38, 39, 40, 42, 43, 45, 46	O V <sub>DDA</sub>	<b>Clock Outputs.</b> See <i>Table 1</i> for frequency selections.
QB(6:0)	26, 27, 28, 30, 31, 33, 34	O V <sub>DDB</sub>	<b>Clock Outputs.</b> See <i>Table 1</i> for frequency selections.
QC(6:0)	15, 16, 18, 19, 21, 22, 23	O V <sub>DDC</sub>	<b>Clock Outputs.</b> See <i>Table 1</i> for frequency selections.
FB_OUT	35	O V <sub>DD</sub>	<b>Feedback Clock Output.</b> Connect to FB_IN for normal operation. The divider ratio for this output is set by FB_SEL; see <i>Table 1</i> . A bypass delay capacitor at this output will control Input Reference/ Output Banks phase relationships.
SELA	9	I, PU	<b>Frequency Select Inputs.</b> These inputs select the divider ratio at QA(0:6) outputs. See <i>Table 1</i> .
SELB	10	I, PU	<b>Frequency Select Inputs.</b> These inputs select the divider ratio at QB(0:6) outputs. See <i>Table 1</i> .
SELC	11	I, PU	<b>Frequency Select Inputs.</b> These inputs select the divider ratio at QC(0:6) outputs. See <i>Table 1</i> .
FB_SEL	7	I, PU	<b>Feedback Select Inputs.</b> These inputs select the divide ratio at FB_OUT output. See <i>Table 1</i> .
FB_IN	47	I, PD	<b>Feedback Clock Input.</b> Connect to FB_OUT for accessing the PLL.
REF_SEL	6	I, PU	<b>Reference Select Input.</b> When high, the PECL clock is selected. And when low, TCLK is the reference clock.
OE#	14	I, PD	<b>Output Enable Input.</b> When asserted low, enables all of the outputs. When pulled high, disables to high impedance all of the outputs except FB_OUT.
V <sub>DDA</sub>	37, 44		Power Supply for Bank A Clock Buffers.
V <sub>DDB</sub>	25, 32		Power Supply for Bank B Clock Buffers.
V <sub>DDC</sub>	13, 20		Power Supply for Bank C Clock Buffers.
V <sub>DD</sub>	5		Power Supply for Core
AV <sub>DD</sub>	8		<b>Power Supply for PLL.</b> When AV <sub>DD</sub> is set low, PLL is bypassed.
V <sub>SSA</sub>	36, 41		Common Ground for Bank A.
V <sub>SSB</sub>	24, 29		Common Ground for Bank B.
V <sub>SSC</sub>	12, 17		Common Ground for Bank C.
V <sub>SS</sub>	1, 48		Common Ground.

A bypass capacitor (0.1 $\mu$ F) should be placed as close as possible to each positive power pin (< 0.2"). If these bypass capacitors are not close to the pins, their high-frequency filtering characteristic will be cancelled by the lead inductance of the traces.



## Function Table

Control Pin	0	1
REF_SEL	TCLK	PECL_CLK
AVDD	PLL Bypass, Outputs Controlled by OE#	PLL Power
OE#	Outputs Enabled	Outputs Disabled (except FB_OUT)
SELA	Output Bank A at VCO/2	Output Bank A at VCO/4
SELB	Output Bank B at VCO/2	Output Bank B at VCO/4
SELC	Output Bank C at VCO/2	Output Bank C at VCO/4
FB_SEL	Feedback Output at VCO/8	Feedback Output at VCO/12

## Overview

The Z9960 has an integrated PLL that provides low skew and low jitter clock outputs for high-performance microprocessors. Three independent banks of seven outputs as well as an independent PLL feedback output, FB\_OUT, provide exceptional flexibility for possible output configurations. The PLL is ensured stable operation given that the VCO is configured to run between 200 MHz to 400 MHz. This allows a wide range of output frequencies up to 200 MHz.

The phase detector compares the input reference clock to the external feedback input. For normal operation, the external feedback input, FB\_IN, is connected to the feedback output, FB\_OUT. The internal VCO is running at multiples of the input reference clock set by FB\_SEL select inputs; refer to *Table 1*. The VCO frequency is then divided down to provide the required output frequencies.

## Zero Delay Buffer

When used as a zero delay buffer the Z9960 will likely be in a nested clock tree application. For these applications the Z9960 offers a low-voltage PECL clock input as a PLL reference. This allows the user to use LVPECL as the primary clock distribution device to take advantage of its far-superior skew performance. The Z9960 then can lock onto the LVPECL reference and translate with near zero delay to low skew outputs.

By using one of the outputs as a feedback to the PLL, the propagation delay through the device is eliminated. The PLL

works to align the output edge, with the input reference edge thus producing a near-zero delay. The reference frequency affects the static phase offset of the PLL and thus the relative delay between the inputs and outputs. Because the static phase offset is a function of the reference clock, the Tpd of the Z9960 is a function of the configuration used.



### Absolute Maximum Ratings<sup>[2]</sup>

Input Voltage Relative to $V_{SS}$ :	$V_{SS} - 0.3V$
Input Voltage Relative to $V_{DD}$ :	$V_{DD} + 0.3V$
Storage Temperature:	$-65^{\circ}C$ to $+150^{\circ}C$
Operating Temperature:	$-40^{\circ}C$ to $+85^{\circ}C$
Maximum ESD Protection:	2kV
Maximum Power Supply:	5.5V
Maximum Input Current:	$\pm 20mA$

#### Note:

2. The voltage on any input or I/O or pin cannot exceed the power pin during power-up. Power supply sequencing is NOT required.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, precautions should be taken to avoid application of any voltage higher than the maximum rated voltages to this circuit. For proper operation,  $V_{IN}$  and  $V_{OUT}$  should be constrained to the range

$$V_{SS} < (V_{IN} \text{ or } V_{OUT}) < V_{DD}$$

Unused inputs must always be tied to an appropriate logic voltage level (either  $V_{SS}$  or  $V_{DD}$ ).

### DC Electrical Characteristics $V_{DD} = 2.5V \pm 5\%$ , $T_A = -40^{\circ}C$ to $+85^{\circ}C$

Parameter	Description	Test Condition	Min.	Typ.	Max.	Unit
$V_{IL}^{[3]}$	Input Low Voltage		$V_{SS}$	–	0.7	V
$V_{IH}^{[3]}$	Input High Voltage		1.7	–	$V_{DD}$	V
$V_{PP}$	Peak-to-Peak Input Voltage PECL_CLK		500	–	1000	mV
VCMR <sup>[4]</sup>	Common Mode Range PECL_CLK		$V_{DD} - 1.4$	–	$V_{DD} - 0.6$	V
$I_{IL}^{[5]}$	Input Low Current (@ $V_{IL} = V_{SS}$ )		–	–	–120	$\mu A$
$I_{IH}^{[5]}$	Input High Current (@ $V_{IH} = V_{DD}$ )		–	–	120	$\mu A$
$V_{OL}^{[6]}$	Output Low Voltage	$I_{OL} = 15 \text{ mA}$	–	–	0.6	V
$V_{OH}^{[6]}$	Output High Voltage	$I_{OH} = -15 \text{ mA}$	1.8	–	–	V
$I_{DD}$	Quiescent Supply Current	$V_{DD}$ and $AV_{DD}$	–	10	13	mA
$C_{IN}$	Input Pin Capacitance		–	4	–	pF

### DC Electrical Characteristics $V_{DD} = 3.3V \pm 5\%$ , $T_A = -40^{\circ}C$ to $+85^{\circ}C$

Parameter	Description	Test Condition	Min.	Typ.	Max.	Unit
$V_{IL}^{[3]}$	Input Low Voltage		$V_{SS}$	–	0.8	V
$V_{IH}^{[3]}$	Input High Voltage		2.0	–	$V_{DD}$	V
$V_{PP}$	Peak-to-Peak Input Voltage PECL_CLK		500	–	1000	mV
VCMR <sup>[4]</sup>	Common Mode Range PECL_CLK		$V_{DD} - 1.4$	–	$V_{DD} - 0.6$	V
$I_{IL}^{[5]}$	Input Low Current (@ $V_{IL} = V_{SS}$ )		–	–	–120	$\mu A$
$I_{IH}^{[5]}$	Input High Current (@ $V_{IH} = V_{DD}$ )		–	–	120	$\mu A$
$V_{OL}^{[6]}$	Output Low Voltage	$I_{OL} = 24 \text{ mA}$	–	–	0.55	V
$V_{OH}^{[6]}$	Output High Voltage	$I_{OH} = -24 \text{ mA}$	2.4	–	–	V
$I_{DD}$	Quiescent Supply Current	$V_{DD}$ and $AV_{DD}$	–	15	20	mA
$C_{IN}$	Input Pin Capacitance		–	4	–	pF

#### Notes:

- The LVCMOS inputs threshold is at 30% of  $V_{DD}$ .
- The VCMR is the difference from the most positive side of the differential input signal. Normal operation is obtained when HIGH input is within the VCMR range and the input lies within the  $V_{PP}$  specification.
- Inputs have pull-up/pull-down resistors that affect input current.
- Driving series or parallel terminated 50 $\Omega$  (or 50 $\Omega$  to  $V_{DD}/2$ ) transmission lines.


**AC Electrical Characteristics**  $V_{DD} = 2.5V \pm 5\%$  or  $3.3V \pm 5\%$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ <sup>[7]</sup>

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit	
Fref	Reference Input Frequency	FB_SEL = 1	16	–	33	MHz	
		FB_SEL = 0	25	–	50		
FrefDC	Reference Input Duty Cycle		25	–	75	%	
Fvco	PLL VCO Lock Range		200	–	400	MHz	
Tlock	Maximum PLL lock Time		–	–	10	ms	
Tr / Tf	Output Clocks Rise / Fall Time <sup>[8],[9]</sup>	0.55V to 2.0V, $V_{DD} = 3.3V$	0.1	–	1.0	ns	
		0.5V to 1.8V, $V_{DD} = 2.5V$	–	–	–		
Fout	Maximum Output Frequency	Q ( $\pm 2$ )	100	–	200	MHz	
		Q ( $\pm 4$ )	50	–	100		
FoutDC	Output Duty Cycle <sup>[8],[9]</sup>		45	50	55	%	
tpZL, tpZH	Output Enable Time <sup>[8]</sup> (all outputs)		2	–	10	ns	
tpLZ, tpHZ	Output Disable Time <sup>[8]</sup> (all outputs)		2	–	8	ns	
TCCJ	Cycle to Cycle Jitter <sup>[8],[9]</sup>		–	$\pm 100$	–	ps	
Tskew	Any Output to Any Output Skew <sup>[8],[9]</sup>	Same frequency	–	–	150	ps	
		Different frequency	–	–	300		
Tskew	Bank to Bank Skew	Banks at different voltages	–	–	400	ps	
Tskew(pp)	Part to Part Skew <sup>[10]</sup>		–	–	450	ps	
Tpd	Phase Error <sup>[8],[9]</sup>	TCLK or PECL_CLK to FB_IN	$V_{DD} = 3.3V$	0	100	200	ps
			$V_{DD} = 2.5V$	25	125	225	

**Note:**

7. Parameters are guaranteed by design and characterization. Not 100% tested in production.

8. Outputs loaded with 30pF each.

9. 50 $\Omega$  transmission line terminated into  $V_{DD}/2$ .

10. Part to Part skew at a given temperature and voltage



## Ordering Information

Ordering Code	Package Name	Package Type
IMIZ9960AL	48 LQFP	Industrial, -40°C to +85°C
IMIZ9960ALT	48 LQFP - Tape and Reel	Industrial, -40°C to +85°C

## Package Drawing and Dimension

### 48-Lead Thin Plastic Quad Flat Pack (7x7x1.4 mm) A48

51-85135-\*\*

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**Document History**

<b>Document Title: Z9960 2.5V/3.3V, 200 MHz Multi-Output Zero Delay Buffer</b> <b>Document #: 38-07087 Rev. *C</b>				
<b>Rev.</b>	<b>ECN No.</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
**	107123	06/06/01	IKA	Convert from IMI to Cypress
*A	108715	11/07/01	NDP	Updated AVDD Pin Functionality.
*B	122772	12/21/02	RBI	Add power up requirements to maximum ratings information
*C	223804	See ECN	RGL	Corrected the Ordering information entry