CY29976

3.3 V, 125 MHz, Multi-Output Zero Delay Buffer

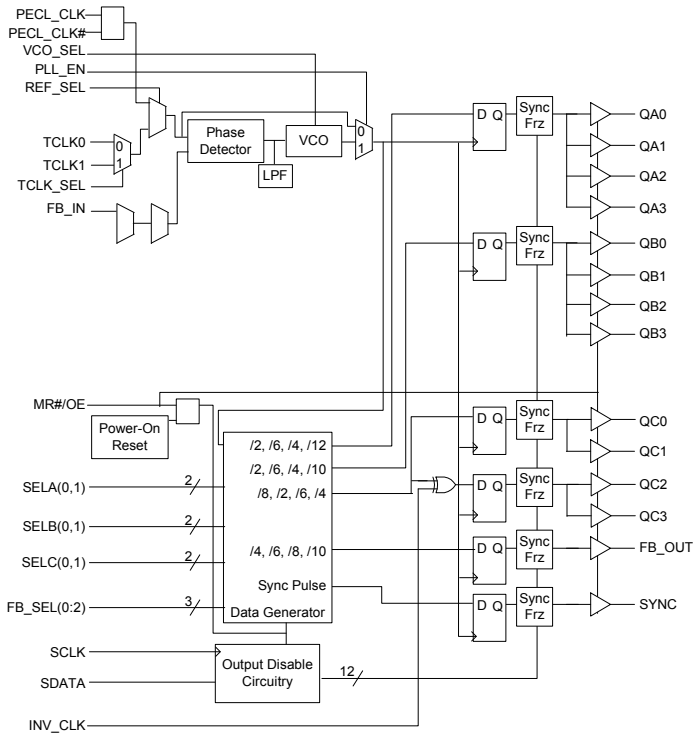
Features

- Output frequency up to 125 MHz
- Supports PowerPC®, and Pentium® processors
- 12 clock outputs: frequency configurable
- Configurable Output Disable
- Two reference clock inputs for dynamic toggling
- Oscillator or PECL reference input
- Spread spectrum compatible
- Glitch-free output clocks transitioning
- 3.3 V power supply
- Pin compatible with SC973X
- Industrial temperature range: –40 °C to +85 °C
- 52-pin TQFP package

Table 1. Frequency Table [1]

VC0_SEL	FB_SEL2	FB_SEL1	FB_SEL0	F_{VCO}
0	0	0	0	8x
0	0	0	1	12x
0	0	1	0	16x
0	0	1	1	20x
0	1	0	0	8x
0	1	0	1	12x
0	1	1	0	16x
0	1	1	1	20x
1	0	0	0	4x
1	0	0	1	6x
1	0	1	0	8x
1	0	1	1	10x
1	1	0	0	4x
1	1	0	1	6x
1	1	1	0	8x
1	1	1	1	10x

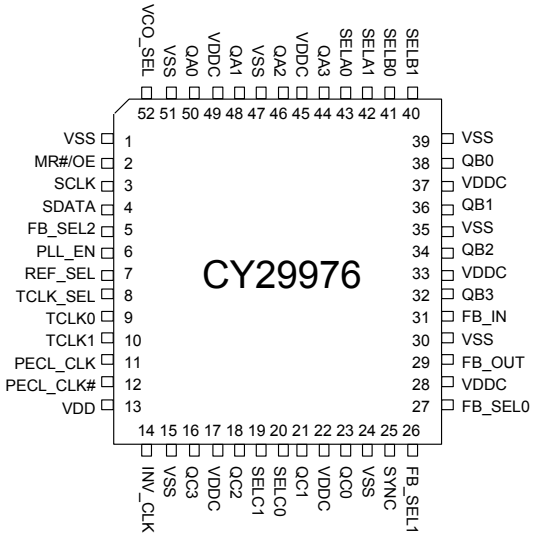
Logic Block Diagram



Note
1. x = the reference input frequency, 200 MHz < F_{VCO} < 480 MHz.

Contents

Pin Configuration



Pin Definitions

Pin No. [2]	Pin Name	PWR	IO	Type	Description
11	PECL_CLK		I	PU	**PECL Clock Input**.
12	PECL_CLK#		I	PD	**PECL Clock Input**.
9	TCLK0		I	PU	**External Reference/Test Clock Input**.
10	TCLK1		I	PU	**External Reference/Test Clock Input**.
44, 46, 48, 50	QA(3:0)	V_{DDC}	O		**Clock Outputs**. See Table 2 on page 5 for frequency selections.
32, 34, 36, 38	QB(3:0)	V_{DDC}	O		**Clock Outputs**. See Table 2 on page 5 for frequency selections.
16, 18, 21, 23	QC(3:0)	V_{DDC}	O		**Clock Outputs**. See Table 2 on page 5 for frequency selections.
29	FB_OUT	V_{DDC}	O		**Feedback Clock Output**. Connect to FB_IN for normal operation. The divider ratio for this output is set by FB_SEL(0:2). See Table 1 on page 1. A bypass delay capacitor at this output controls Input Reference/ Output Banks phase relationships.
25	SYNC	V_{DDC}	O		**Synchronous Pulse Output**. This output is used for system synchronization. The rising edge of the output pulse is in sync with both the rising edges of QA (0:3) and QC(0:3) output clocks regardless of the divider ratios selected.
42, 43	SELA(1, 0)	–	I	PU	**Frequency Select Inputs**. These inputs select the divider ratio at QA(0:3) outputs. See Table 2 on page 5.
40, 41	SELB(1, 0)	–	I	PU	**Frequency Select Inputs**. These inputs select the divider ratio at QB(0:3) outputs. See Table 2 on page 5.
19, 20	SELC(1, 0)	–	I	PU	**Frequency Select Inputs**. These inputs select the divider ratio at QC(0:3) outputs. See Table 2 on page 5.
5, 26, 27	FB_SEL(2:0)	–	I	PU	**Feedback Select Inputs**. These inputs select the divide ratio at FB_OUT output. See Table 1 on page 1.
52	VCO_SEL	–	I	PU	**VCO Divider Select Input**. When set LOW, the VCO output is divided by 2. When set HIGH, the divider is bypassed. See Table 1 on page 1.
31	FB_IN	–	I	PU	**Feedback Clock Input**. Connect to FB_OUT for accessing the PLL.
6	PLL_EN	–	I	PU	**PLL Enable Input**. When asserted HIGH, PLL is enabled. When LOW, PLL is bypassed.
7	REF_SEL	–	I	PU	**Reference Select Input**. When HIGH, the PECL clock is selected. When LOW, TCLK (0,1) is the reference clock.
8	TCLK_SEL	–	I	PU	**TCLK Select Input**. When LOW, TCLK0 is selected and when HIGH TCLK1 is selected.
2	MR#/OE	–	I	PU	**Master Reset/Output Enable Input**. When asserted LOW, resets all of the internal flip-flops and also disables all of the outputs. When pulled HIGH, releases the internal flip-flops from reset and enables all of the outputs.
14	INV_CLK	–	I	PU	**Inverted Clock Input**. When set HIGH, QC(2,3) outputs are inverted. When set LOW, the inverter is bypassed.
3	SCLK	–	I	PU	**Serial Clock Input**. Clocks data at SDATA into the internal register.
4	SDATA	–	I	PU	**Serial Data Input**. Input data is clocked to the internal register to enable/disable individual outputs. This provides flexibility in power management.
17, 22, 28, 33, 37, 45, 49	VDDC	–	–	–	**3.3 V Power Supply for Output Clock Buffers**.
13	VDD	–	–	–	**3.3 V Supply for PLL**.
1, 15, 24, 30, 35, 39, 47, 51	VSS	–	–	–	**Common Ground**.

Note
2. A bypass capacitor (0.1µF) must be placed as close as possible to each positive power (<0.2”). If these bypass capacitors are not close to the pins their high frequency filtering characteristics are cancelled by the lead inductance of the traces.

Description

The CY29976 has an integrated PLL that provides low-skew and low-jitter clock outputs for high-performance microprocessors. Three independent banks of four outputs and 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 480 MHz. This allows a wide range of output frequencies up to125 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(0:2) and VCO_SEL select inputs, refer to Frequency Table. The VCO frequency is then divided down to provide the required output frequencies. These dividers are set by SELA(0,1), SELB(0,1), SELC(0,1) select inputs, see Table 2. For situations were the VCO needs to run at relatively low frequencies and hence might not be stable, assert VCO_SEL low to divide the VCO frequency by 2. This maintains the desired output relationships, but provides an enhanced PLL lock range.

The CY29976 is also capable of providing inverted output clocks. When INV_CLK is asserted HIGH, QC2 and QC3 output clocks are inverted. These clocks could be used as feedback outputs to the CY29976 or a second PLL device to generate early or late clocks for a specific design. This inversion does not affect the output to output skew.

Table 2. Divider Table

VCO_SEL	SELA1	SELA0	QA	SELB1	SELB0	QB	SELC1	SELC0	QC
0	0	0	VCO/4	0	0	VCO/4	0	0	VCO/16
0	0	1	VCO/12	0	1	VCO/12	0	1	VCO/4
0	1	0	VCO/8	1	0	VCO/8	1	0	VCO/12
0	1	1	VCO/24	1	1	VCO/20	1	1	VCO/8
1	0	0	VCO/2	0	0	VCO/2	0	0	VCO/8
1	0	1	VCO/6	0	1	VCO/6	0	1	VCO/2
1	1	0	VCO/4	1	0	VCO/4	1	0	VCO/6
1	1	1	VCO/12	1	1	VCO/10	1	1	VCO/4

Zero Delay Buffer

When used as a zero delay buffer the CY29976 is likely be in a nested clock tree application. For these applications the CY29976 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 CY29976 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 CY29976 is a function of the configuration used.

Glitch-Free Output Frequency Transitions

Customarily when output buffers have their internal counter's changed "on the fly," their output clock periods will:

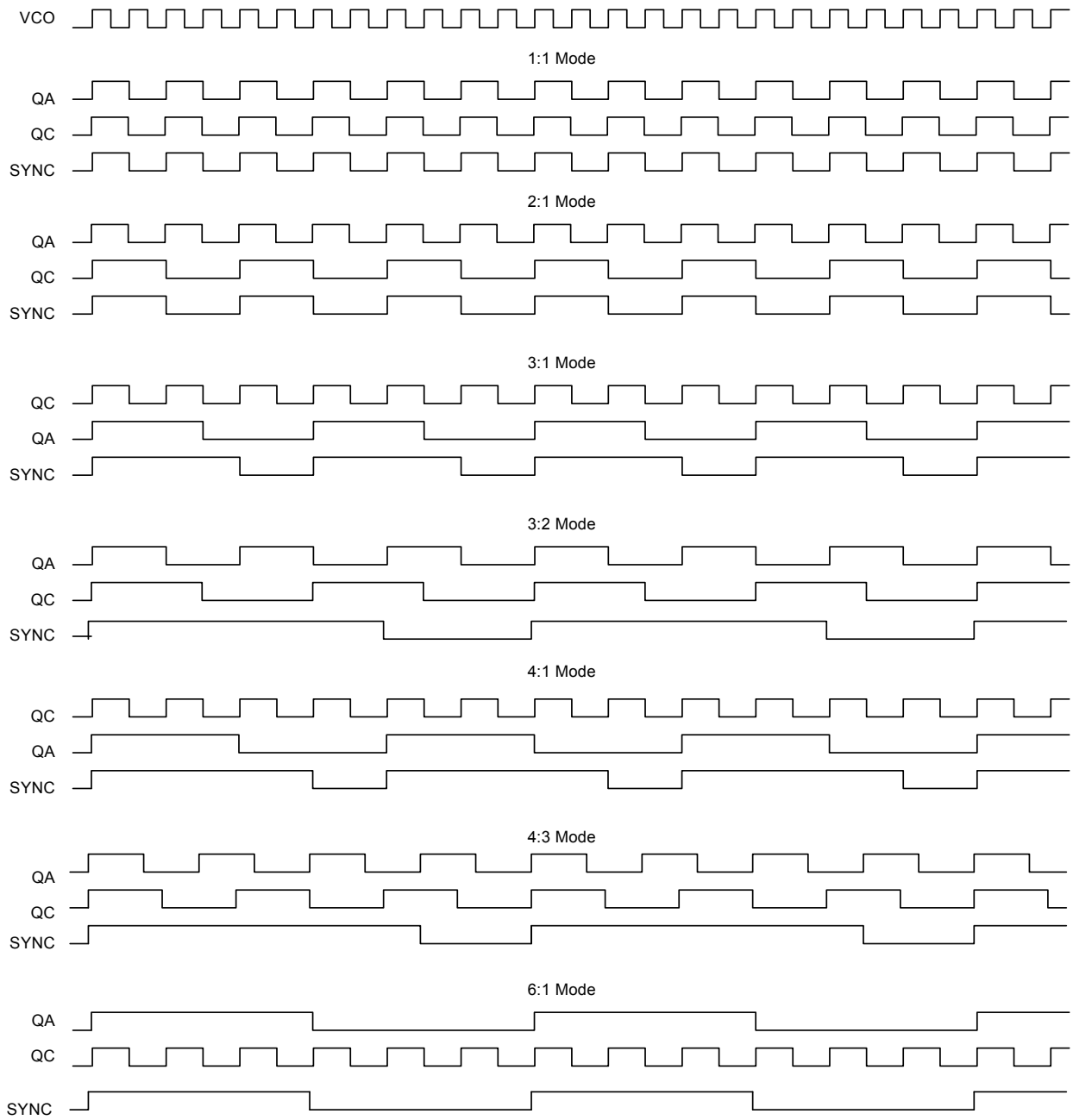
- Contain short or "runt" clock periods. These are clock cycles in which the cycle(s) are shorter in period than either the old or new frequency that is being transitioned to.
- Contain stretched clock periods. These are clock cycles in which the cycle(s) are longer in period than either the old or new frequency that is being transitioned to.

This device specifically includes logic to guarantee that runt and stretched clock pulses do not occur if the device logic levels of any or all of the following pins changed "on the fly" while it is operating: SELA, SELB, SELC, and VCO_SEL.

SYNC Output

In situations were output frequency relationships are not integer multiples of each other the SYNC output provides a signal for system synchronization. The CY29976 monitors the relationship between the QA and the QC output clocks. It provides a low going pulse, one period in duration, one period prior to the coincident rising edges of the QA and QC outputs. The duration and the placement of the pulse depend on the higher of the QA and QC output frequencies. The following timing diagram (Figure 1) illustrates various waveforms for the SYNC output. Note that the SYNC output is defined for all possible combinations of the QA and QC outputs even though under some relationships the lower frequency clock could be used as a synchronizing signal.

Figure 1. SYNC output for different input and output ratio



Power Management

The individual output enable/freeze control of the CY29976 allows the user to implement unique power management schemes into the design. The outputs are stopped in the logic ‘0’ state when the freeze control bits are activated. The serial input register contains one programmable freeze enable bit for 12 of the 14 output clocks. The QC0 and FB_OUT outputs can not be frozen with the serial port, this avoids any potential lock up situation must an error occur in the loading of the serial data. An output is frozen when a logic ‘0’ is programmed and enabled when a logic ‘1’ is written. The enabling and freezing of individual outputs is done in such a manner as to eliminate the possibility of partial “runt” clocks.

The serial input register is programmed through the SDATA input by writing a logic ‘0’ start bit followed by 12 NRZ freeze enable bits. The period of each SDATA bit equals the period of the free running SCLK signal. The SDATA is sampled on the rising edge of SCLK.

Figure 2. Control Bit Map

D0-D3 are the control bits for QA0-QA3, respectively
D4-D7 are the control bits for QB0-QB3, respectively
D8-D10 are the control bits for QC1-QC3, respectively
D11 is the control bit for SYNC

Maximum Ratings

Exceeding maximum ratings[3] may shorten the useful life of the device. User guidelines are not tested.

Input Voltage Relative to V_{SS} ..... V_{SS} – 0.3 V

Input Voltage Relative to V_{DD} ..... V_{DD} + 0.3 V

Storage Temperature ..... –65 °C to +150 °C

Operating Temperature ..... –40 °C to +85 °C

Maximum Power Supply ..... 5.5 V

This device contains circuitry to protect the inputs against damage due to high static voltages or electric field; however, precautions must 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} must 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}).

Notes
3. Multiple Supplies: The voltage on any input or IO pin cannot exceed the power pin during power up. Power supply sequencing is NOT required.

DC Parameters

$V_{DD} = V_{DDC}$ = 3.3 V ± 10%, T_A = –40 °C to +85 °C

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{IL}	Input Low Voltage		V_{SS}	–	0.8	V
V_{IH}	Input High Voltage		2.0	–	V_{DD}	V
V_{PP}	Peak-to-Peak Input Voltage PECL_CLK	Note 4	300	–	1000	mV
V_{CMR}	Common Mode Range PECL_CLK		V_{DD} – 2.0	–	V_{DD} – 0.6	V
I_{IL}	Input Low Current (at $V_{IL} = V_{SS}$)	Note 5	–	–	–120	µA
I_{IH}	Input High Current (at $V_{IH} = V_{DD}$)	Note 5	–	–	120	µA
V_{OL}	Output Low Voltage	I_{OL} = 20 mA, Note 6	–	–	0.5	V
V_{OH}	Output High Voltage	I_{OH} = –20 mA, Note 6	2.4	–	–	V
I_{DDC}	Quiescent Supply Current	All V_{DDC} and V_{DD}	–	10	15	mA
I_{DD}	PLL Supply Current	V_{DD} only	–	–	15	mA
C_{IN}	Input Pin Capacitance		–	4	–	pF

Notes
4. The V_{CMR} is the difference from the most positive side of the differential input signal. Normal operation is obtained when “High” input is within the V_{CMR} range and the input lies within the V_{PP} specification.
5. Inputs have pull up/pull down resistors that effect input current.
6. Driving series or parallel terminated 50 Ω (or 50 Ω to $V_{DD}/2$) transmission lines.

AC Parameters

$V_{DD} = V_{DDC}$ = 3.3 V ± 10%, T_A = –40 °C to +85 °C

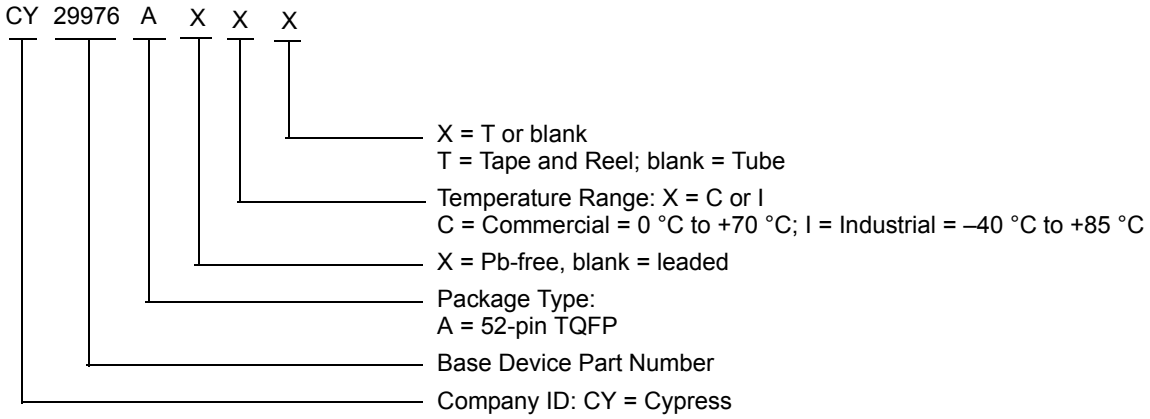
Parameter [7]	Description		Conditions	Min	Typ	Max	Unit
T_R / T_F	TCLK Input Rise / Fall			–	–	3.0	ns
F_{REF}	Reference Input Frequency			Note 8	–	Note 8	MHz
F_{REFDC}	Reference Input Duty Cycle			25	–	75	%
F_{VCO}	PLL VCO Lock Range			200	–	480	MHz
T_{LOCK}	Maximum PLL lock Time			–	–	10	ms
t_R / t_F	Output Clocks Rise/Fall Time [9]		0.8 V to 2.0 V	0.15	–	1.2	ns
F_{OUT}	Maximum Output Frequency		Q (÷2)	–	–	125	MHz
			Q (÷4)	–	–	120	
			Q (÷6)	–	–	80	
			Q (÷8)	–	–	60	
F_{OUTDC}	Output Duty Cycle [9]			45	–	55	%
t_{pZL}, t_{pZH}	Output Enable Time [9] (all outputs)			2	–	10	ns
t_{PLZ}, t_{PHZ}	Output Disable Time [9] (all outputs)			2	–	8	ns
T_{CCJ}	Cycle to Cycle Jitter[9](peak to peak)			–	±100	–	ps
T_{SKEW}	Any Output to Any Output Skew [9, 10]		All outputs at same frequency	–	–	350	ps
			Outputs at different frequencies	–	–	550	ps
T_{PD}	Propagation Delay [10, 11]	PECL_CLK [12]	QFB =(÷8)	–225	–25	175	ps
		TCLK0/1		–130	–	270	

Notes
7. Parameters are guaranteed by design and characterization. Not 100% tested in production.
8. Maximum and minimum input reference is limited by VC0 lock range.
9. Outputs loaded with 30 pF each.
10. 50Ω transmission line terminated into $V_{DD}/2$.
11. Tpd is specified for a 50 MHz input reference. Tpd is the static phase error of the device and does not include jitter.
12. V_{CMR} = 2.0 V and V_{PP} = 650 µV. Tpd window varies with different V_{CMR} and V_{PP} values.

Ordering Information

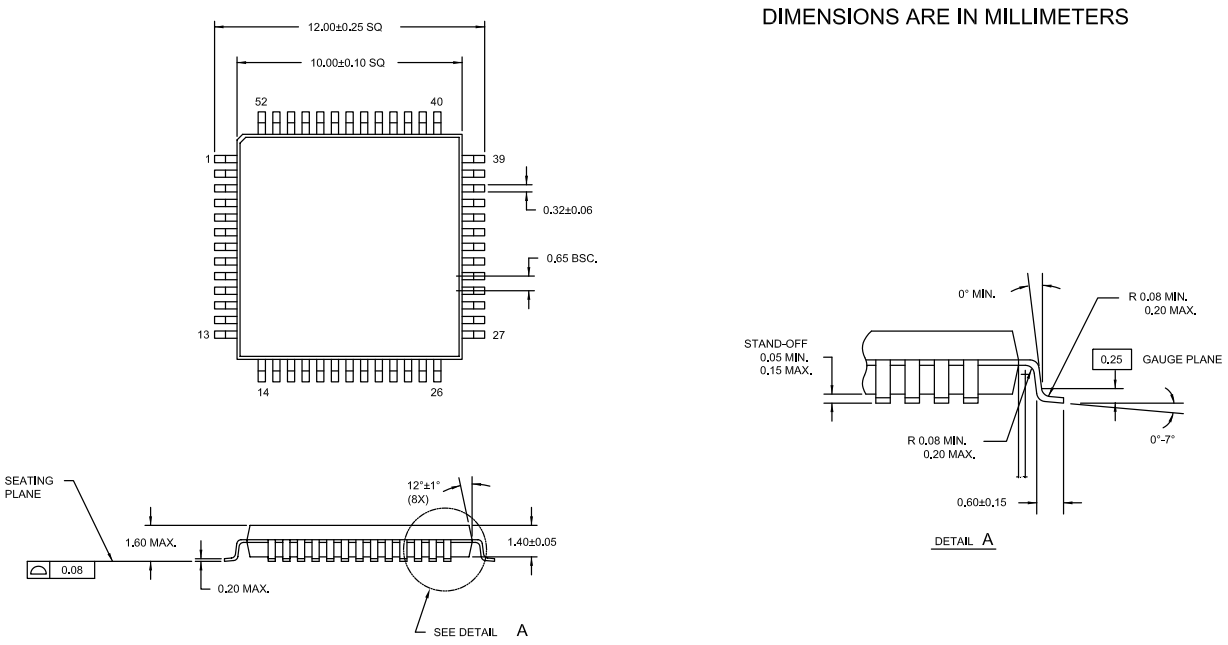
Part Number	Package Name	Package Type	Production Flow
Pb-free			
CY29976AXI	A52	52-pin TQFP	Industrial, –40 °C to +85 °C
CY29976AXIT	A52	52-pin TQFP – Tape and Reel	Industrial, –40 °C to +85 °C

Ordering Code Definitions



Package Drawing and Dimensions

Figure 3. 52-pin TQFP (10 × 10 × 1.4 mm) A52SA Package Outline, 51-85131



51-85131 *B

Acronyms

Acronym	Description
I/O	input/output
LVPECL	low voltage pseudo (positive) emitter coupled logic
PECL	pseudo (positive) emitter coupled logic
PLL	phase locked loop
TQFP	thin quad flat pack

Document Conventions

Units of Measure

Symbol	Units of Measure
°C	degree Celsius
MHz	megahertz
µA	microampere
mA	milliampere
ms	millisecond
mV	millivolt
ns	nanosecond
%	percent
pF	picofarad
ps	picosecond
V	volt

Document History Page

Document Title: CY29976, 3.3 V, 125 MHz, Multi-Output Zero Delay Buffer Document Number: 38-07413				
Rev.	**ECN**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	114663	HWT	05/14/02	New data sheet.
*A	122922	RBI	12/27/02	Updated Maximum Ratings (Added Note 3).
*B	2562606	AESA	09/09/08	Updated Ordering Information (Added a Note “Not recommended for new designs.” and referred the same note in the part number CY29976AI, added part numbers CY29976AXI and CY29976AXIT). Updated in new template.
*C	3052284	CXQ	10/08/2010	Updated Ordering Information (Removed the part number CY29976AI and also removed associated note “Not recommended for new designs.”). Updated Package Drawing and Dimensions. Updated Sales, Solutions, and Legal Information.
*D	3187933	CXQ	03/04/2011	No technical updates (sunset review).
*E	3533576	PURU	02/23/2012	Added Ordering Code Definitions. Updated Package Drawing and Dimensions. Added Acronyms and Units of Measure. Updated in new template.

Sales, Solutions, and Legal Information

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