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# 1:4 LVCMOS to LVPECL Fanout Buffer with Selectable Clock Input

## Features

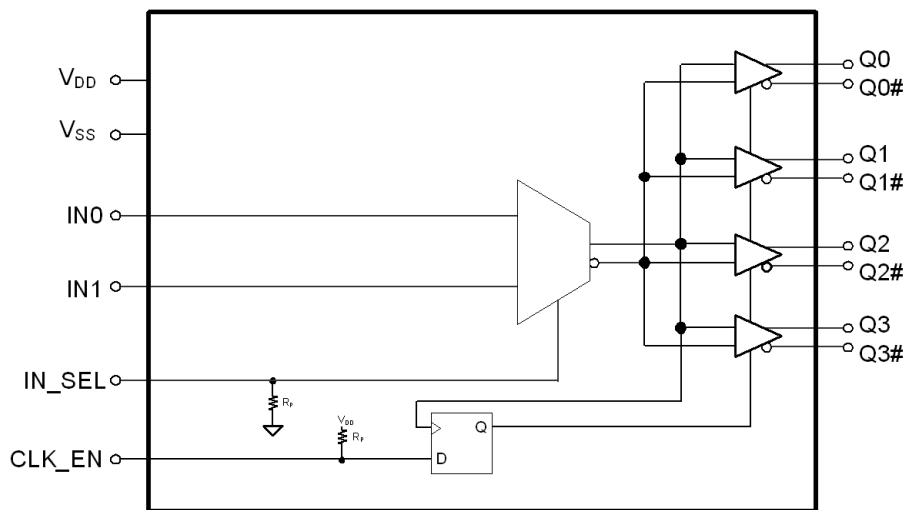
- Select one of two low-voltage complementary metal oxide semiconductor (LVCMOS) inputs to distribute to four low-voltage positive emitter-coupled logic (LVPECL) output pairs
- 30-ps maximum output-to-output skew
- 480-ps maximum propagation delay
- 0.15-ps maximum additive RMS phase jitter at 156.25 MHz (12-kHz to 20-MHz offset)
- Up to 250 MHz operation
- Synchronous clock enable function
- 20-Pin thin shrunk small outline package (TSSOP) package
- 2.5-V or 3.3-V operating voltage <sup>[1]</sup>
- Commercial and industrial operating temperature range

## Functional Description

The CY2CP1504 is an ultra-low noise, low-skew, low-propagation delay 1:4 LVCMOS to LVPECL fanout buffer targeted to meet the requirements of high-speed clock distribution applications. The CY2CP1504 can select between two separate LVCMOS input clocks using the IN\_SEL pin. The synchronous clock enable function ensures glitch-free output transitions during enable and disable periods. The device has a fully differential internal architecture that is optimized to achieve low additive jitter and low skew at operating frequencies of up to 250 MHz.

For a complete list of related documentation, [click here](#).

## Logic Block Diagram



### Note

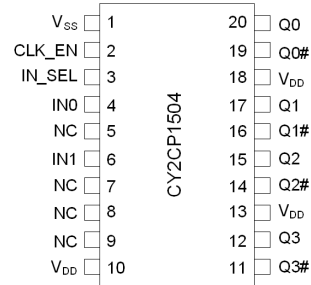
1. Input AC-coupling capacitors are required for voltage-translation applications.

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## Pin Configurations

**Figure 1. 20-pin TSSOP Package pinout**



## Pin Definitions

Pin No.	Pin Name	Pin Type	Description
1	V <sub>SS</sub>	Power	Ground
2	CLK_EN	Input	Synchronous clock enable. LVCMOS/low-voltage transistor-transistor logic (LVTTL). When CLK_EN = Low, Q(0:3) outputs are held low and Q(0:3)# outputs are held high
3	IN_SEL	Input	Input clock select pin. LVCMOS/LVTTL; When IN_SEL = Low, input IN0 is active When IN_SEL = High, input IN1 is active
4	IN0	Input	LVCMOS input clock. Active when IN_SEL = Low
5, 7, 8, 9	NC		No connection
6	IN1	Input	LVCMOS input clock. Active when IN_SEL = High
10, 13, 18	V <sub>DD</sub>	Power	Power supply
11, 14, 16, 19	Q(0:3)#	Output	LVPECL complementary output clocks
12, 15, 17, 20	Q(0:3)	Output	LVPECL output clocks

## Absolute Maximum Ratings

Parameter	Description	Condition	Min	Max	Unit
$V_{DD}$	Supply voltage	Nonfunctional	-0.5	4.6	V
$V_{IN}^{[2]}$	Input voltage, relative to $V_{SS}$	Nonfunctional	-0.5	lesser of 4.0 or $V_{DD} + 0.4$	V
$V_{OUT}^{[2]}$	DC output or I/O voltage, relative to $V_{SS}$	Nonfunctional	-0.5	lesser of 4.0 or $V_{DD} + 0.4$	V
$T_S$	Storage temperature	Nonfunctional	-55	150	°C
$ESD_{HBM}$	Electrostatic discharge (ESD) protection (Human body model)	JEDEC STD 22-A114-B	2000	-	V
$L_U$	Latch up		Meets or exceeds JEDEC Spec JESD78B IC latch up test		
UL-94	Flammability rating	At 1/8 in	V-0		
MSL	Moisture sensitivity level		3		

## Operating Conditions

Parameter	Description	Condition	Min	Max	Unit
$V_{DD}$	Supply voltage	2.5 V supply	2.375	2.625	V
		3.3 V supply	3.135	3.465	V
$T_A$	Ambient operating temperature	Commercial	0	70	°C
		Industrial	-40	85	°C
$t_{PU}$	Power ramp time	Power-up time for $V_{DD}$ to reach minimum specified voltage (power ramp must be monotonic)	0.05	500	ms

**Note**

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



## DC Electrical Specifications

( $V_{DD} = 3.3\text{ V} \pm 5\%$  or  $2.5\text{ V} \pm 5\%$ ;  $T_A = 0\text{ }^\circ\text{C}$  to  $70\text{ }^\circ\text{C}$  (Commercial) or  $-40\text{ }^\circ\text{C}$  to  $85\text{ }^\circ\text{C}$  (Industrial))

Parameter	Description	Condition	Min	Max	Unit
$I_{DD}$	Operating supply current	All LVPECL outputs floating (internal $I_{DD}$ )	–	61	mA
$V_{IH1}$	Input high voltage, All inputs	$V_{DD} = 3.3\text{ V}$	2.0	$V_{DD} + 0.3$	V
$V_{IL1}$	Input low voltage, All inputs	$V_{DD} = 3.3\text{ V}$	–0.3	0.8	V
$V_{IH2}$	Input high voltage, All inputs	$V_{DD} = 2.5\text{ V}$	1.7	$V_{DD} + 0.3$	V
$V_{IL2}$	Input low voltage, All inputs	$V_{DD} = 2.5\text{ V}$	–0.3	0.7	V
$I_{IH}$	Input high current, All inputs	Input = $V_{DD}$ <sup>[3]</sup>	–	150	$\mu\text{A}$
$I_{IL}$	Input low current, All inputs	Input = $V_{SS}$ <sup>[3]</sup>	–150	–	$\mu\text{A}$
$V_{OH}$	LVPECL output high voltage	Terminated with $50\ \Omega$ to $V_{DD} - 2.0$ <sup>[4]</sup>	$V_{DD} - 1.20$	$V_{DD} - 0.70$	V
$V_{OL}$	LVPECL output low voltage	Terminated with $50\ \Omega$ to $V_{DD} - 2.0$ <sup>[4]</sup>	$V_{DD} - 2.0$	$V_{DD} - 1.63$	V
$R_P$	Internal pull-up/pull-down resistance	CLK_EN has pull-up only IN_SEL has pull-down only	60	165	$\text{k}\Omega$
$C_{IN}$	Input capacitance	Measured at 10 MHz; per pin	–	3	pF

## Thermal Resistance

Parameter <sup>[5]</sup>	Description	Test Conditions	20-pin TSSOP	Unit
$\theta_{JA}$	Thermal resistance (junction to ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, in accordance with EIA/JESD51.	80	$^\circ\text{C}/\text{W}$
$\theta_{JC}$	Thermal resistance (junction to case)		16	$^\circ\text{C}/\text{W}$

### Notes

3. Positive current flows into the input pin, negative current flows out of the input pin.
4. Refer to Figure 2 on page 7.
5. These parameters are guaranteed by design and are not tested.

## AC Electrical Specifications

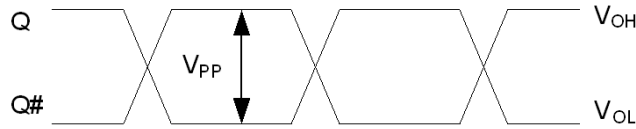
( $V_{DD} = 3.3\text{ V} \pm 5\%$  or  $2.5\text{ V} \pm 5\%$ ;  $T_A = 0\text{ }^\circ\text{C}$  to  $70\text{ }^\circ\text{C}$  (Commercial) or  $-40\text{ }^\circ\text{C}$  to  $85\text{ }^\circ\text{C}$  (Industrial))

Parameter	Description	Condition	Min	Typ	Max	Unit
$F_{IN}$	Input frequency		DC	–	250	MHz
$F_{OUT}$	Output frequency	$F_{OUT} = F_{IN}$	DC	–	250	MHz
$V_{PP}$	LVPECL differential output voltage peak- to-peak, single-ended. Terminated with $50\ \Omega$ to $V_{DD} - 2.0$ [4]	$F_{out} = \text{DC to } 150\text{ MHz}$	600	–	–	mV
		$F_{out} = >150\text{ MHz to } 250\text{ MHz}$	400	–	–	mV
$t_{PD}$ [6]	Propagation delay input to output pair	Input rise/fall time $< 1.5\text{ ns}$ (20% to 80%)	–	–	480	ps
$t_{ODC}$ [7]	Output duty cycle	Rail-to-rail input swing, 50% input DTCY measured at $V_{dd}/2$	45	–	55	%
$t_{SK1}$ [8]	Output-to-output skew	Any output to any output, with same load conditions at DUT	–	–	30	ps
$t_{SK1 D}$ [8]	Device-to-device output skew	Any output to any output between two or more devices. Devices must have the same input and have the same output load.	–	–	150	ps
$PN_{ADD}$	Additive RMS phase noise 156.25-MHz Input Rise/fall time $< 150\text{ ps}$ (20% to 80%) $V_{ID} > 400\text{ mV}$	Offset = 1 kHz	–	–	–120	dBc/Hz
		Offset = 10 kHz	–	–	–130	dBc/Hz
		Offset = 100 kHz	–	–	–135	dBc/Hz
		Offset = 1 MHz	–	–	–150	dBc/Hz
		Offset = 10 MHz	–	–	–150	dBc/Hz
		Offset = 20 MHz	–	–	–150	dBc/Hz
$t_{JIT}$ [9]	Additive RMS phase jitter (Random)	156.25 MHz sinewave, 12 kHz to 20 MHz offset; input swing = $2.2\text{V}$ , $V_{bias} = V_{DD}/2$	–	–	0.15	ps
$t_R, t_F$ [10]	Output rise/fall time	50% duty cycle at input, 20% to 80% of full swing ( $V_{OL}$ to $V_{OH}$ ) Input rise/fall time $< 1.5\text{ ns}$ (20% to 80%)	–	–	300	ps
$t_{SOD}$	Time from clock edge to outputs disabled	Synchronous clock enable (CLK_EN) switched Low	–	–	700	ps
$t_{SOE}$	Time from clock edge to outputs enabled	Synchronous clock enable (CLK_EN) switched high	–	–	700	ps

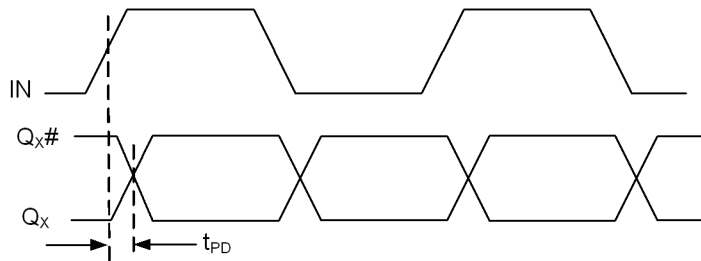
### Notes

6. Refer to Figure 3 on page 7.
7. Refer to Figure 4 on page 7.
8. Refer to Figure 5 on page 7.
9. Refer to Figure 6 on page 8.
10. Refer to Figure 7 on page 8.

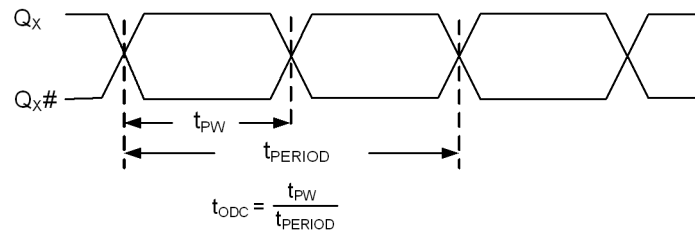
**Figure 2. Output Differential Voltage**



**Figure 3. Input to Any Output Pair Propagation Delay**



**Figure 4. Output Duty Cycle**



**Figure 5. Output-to-Output and Device-to-Device Skew**

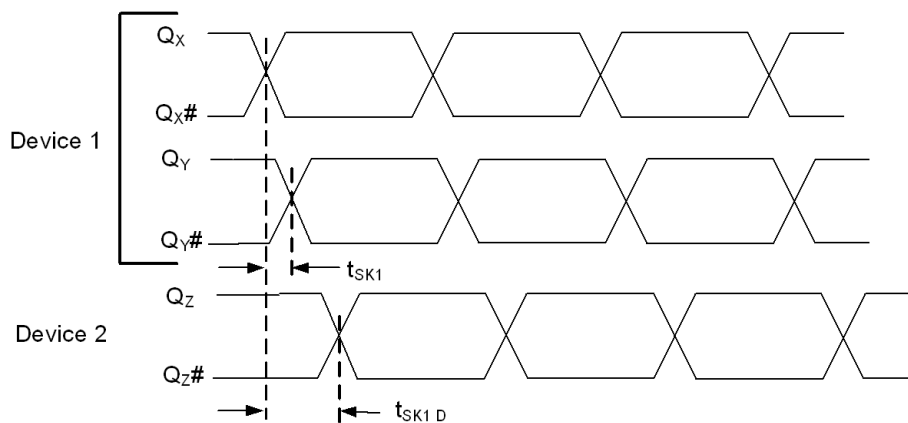




Figure 6. RMS Phase Jitter

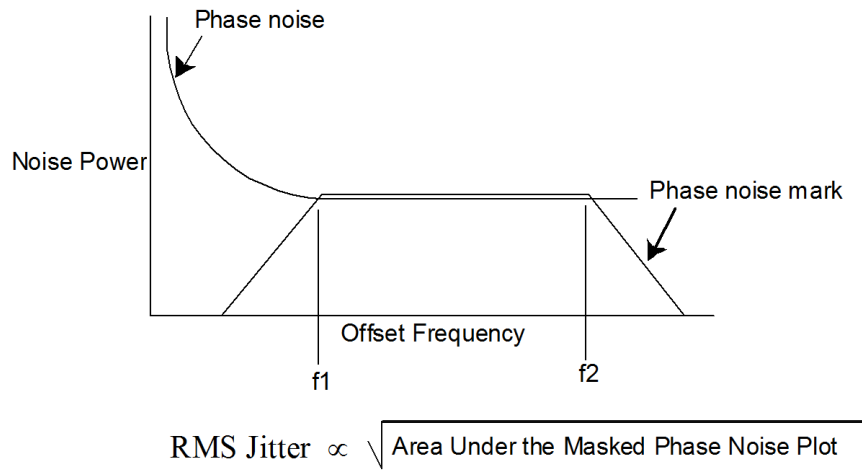


Figure 7. Output Rise/Fall Time

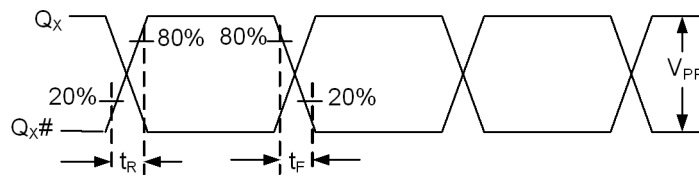
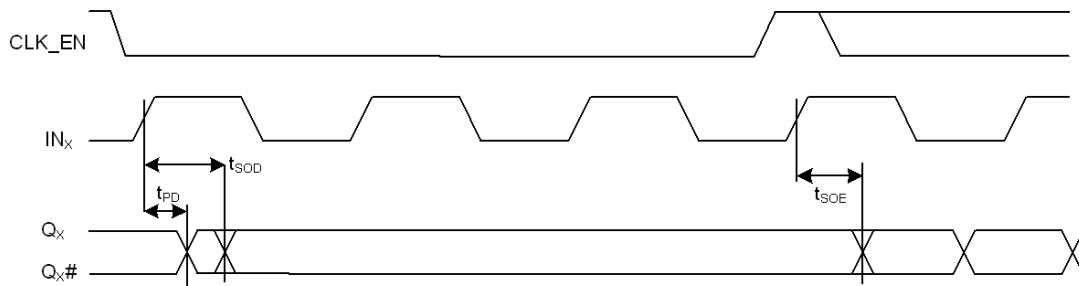


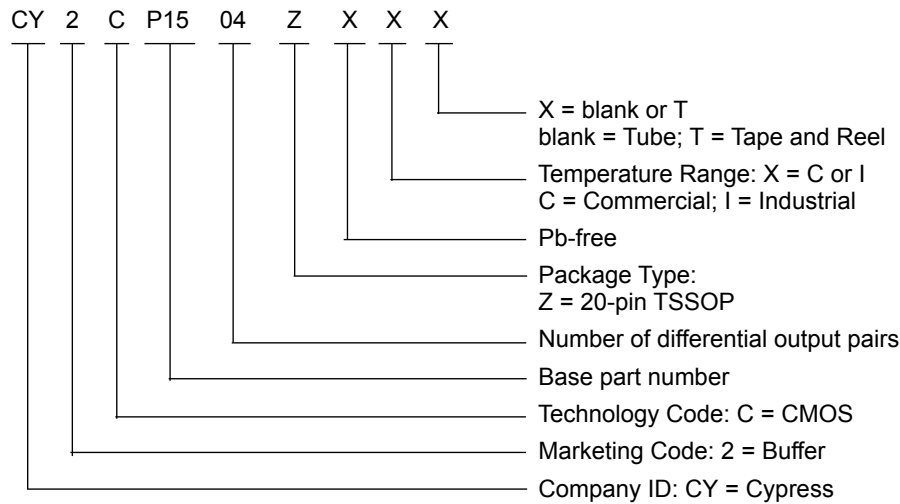
Figure 8. Synchronous Clock Enable Timing



**Ordering Information**

Part Number	Type	Production Flow
<b>Pb-free</b>		
CY2CP1504ZXC	20-pin TSSOP	Commercial, 0 °C to 70 °C
CY2CP1504ZXCT	20-pin TSSOP – Tape and Reel	Commercial, 0 °C to 70 °C
CY2CP1504ZXI	20-pin TSSOP	Industrial, –40 °C to 85 °C
CY2CP1504ZXIT	20-pin TSSOP – Tape and Reel	Industrial, –40 °C to 85 °C

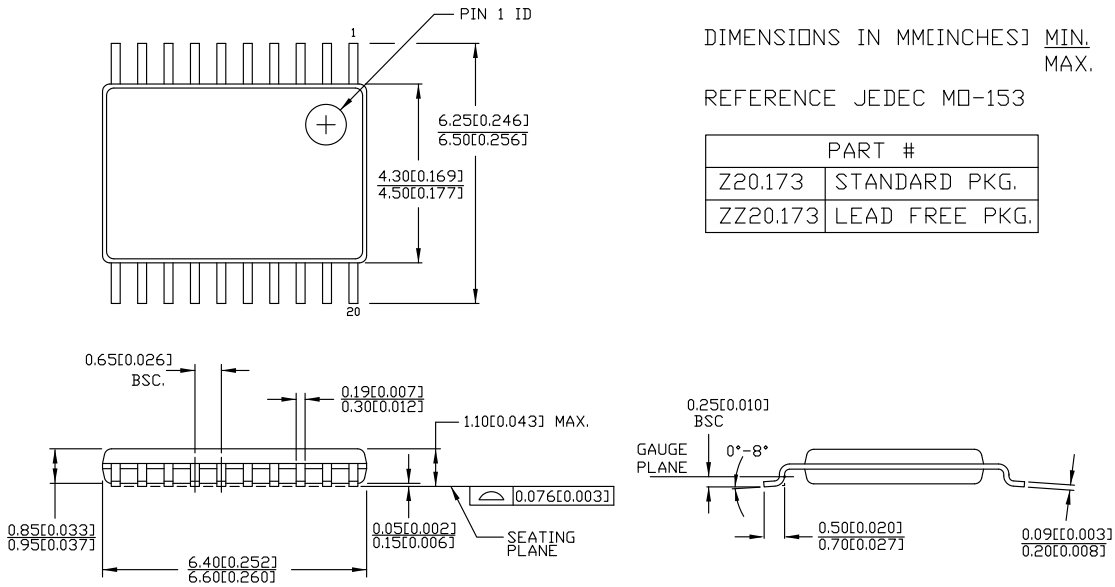
**Ordering Code Definitions**



**Package Diagram**

**Figure 9. 20-pin TSSOP (4.40 mm Body) Z20.173/ZZ20.173 Package Outline, 51-85118**

20 Lead TSSOP 4.40 MM BODY



51-85118 \*E

## Acronyms

**Table 1. Acronyms Used in this Document**

Acronym	Description
ESD	electrostatic discharge
HBM	human body model
JEDEC	joint electron devices engineering council
LVDS	low-voltage differential signal
LVC MOS	low-voltage complementary metal oxide semiconductor
LVPECL	low-voltage positive emitter-coupled logic
LVTTTL	low-voltage transistor-transistor logic
RMS	root mean square
TSSOP	thin shrunk small outline package

## Document Conventions

### Units of Measure

**Table 2. Units of Measure**

Symbol	Unit of Measure
°C	degree Celsius
dBc	decibels relative to the carrier
GHz	gigahertz
Hz	hertz
kΩ	kilohm
μA	microampere
μF	microfarad
μs	microsecond
mA	milliampere
ms	millisecond
mV	millivolt
MHz	megahertz
ns	nanosecond
Ω	ohm
pF	picofarad
ps	picosecond
V	volt
W	watt

Document History Page

Document Title: CY2CP1504, 1:4 LVCMOS to LVPECL Fanout Buffer with Selectable Clock Input				
Document Number: 001-56313				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	2782891	CXQ	10/09/09	New data sheet
*A	2838916	CXQ	05/01/2010	<p>Changed status from "ADVANCE" to "PRELIMINARY".</p> <p>Changed from 0.34 ps to 0.25 ps maximum additive jitter in "Features" on page 1 and in <math>t_{JIT}</math> in the AC Electrical Specs table on page 5.</p> <p>Added <math>t_{PU}</math> spec to the Operating Conditions table on page 3.</p> <p>Changed max <math>I_{DD}</math> spec in the DC Electrical Specs table on page 4 from 60 mA to 61 mA.</p> <p>Changed <math>V_{OH}</math> in the DC Electrical Specs table on page 4: minimum from <math>V_{DD} - 1.15V</math> to <math>V_{DD} - 1.20V</math>; maximum from <math>V_{DD} - 0.75V</math> to <math>V_{DD} - 0.70V</math>.</p> <p>Removed <math>V_{OD}</math> spec from the DC Electrical Specs table on page 4.</p> <p>Added <math>R_P</math> spec in the DC Electrical Specs table on page 4. Min = 60 k<math>\Omega</math>, Max = 140 k<math>\Omega</math>.</p> <p>Added a measurement definition for <math>C_{IN}</math> in the DC Electrical Specs table on page 4.</p> <p>Added <math>V_{PP}</math> spec to the AC Electrical Specs table on page 5. <math>V_{PP}</math> min = 600 mV for DC - 150 MHz and min = 400 mV for 150 MHz to 250 MHz.</p> <p>Changed letter case and some names of all the timing parameters in the AC Electrical Specs table on page 5 to be consistent with EROS.</p> <p>Lowered all additive phase noise mask specs by 3 dB in the AC Electrical Specs table on page 5.</p> <p>Added condition to <math>t_R</math> and <math>t_F</math> specs in the AC Electrical specs table on page 5 that input rise/fall time must be less than 1.5 ns (20% to 80%).</p> <p>Changed letter case and some names of all the timing parameters in Figures 2, 3, 4, 5 and 7, to be consistent with EROS.</p>
*B	3011766	CXQ	08/20/2010	<p>Changed from 0.25 ps to 0.15 ps maximum additive jitter in "Features" on page 1 and in <math>t_{JIT}</math> in the AC Electrical Specs table on page 6.</p> <p>Added note 2 to describe <math>I_{IH}</math> and <math>I_{IL}</math> specs.</p> <p>Removed reference to data distribution from "Functional Description".</p> <p>Updated phase noise specs for 1 k/10 k/100 k/1 M/10 M/20 MHz offset to -120/-130/-135/-150/-150/-150dBc/Hz, respectively, in the AC Electrical Specs table.</p> <p>Updated package diagram.</p> <p>Added Acronyms and Ordering Code Definition.</p>
*C	3017258	CXQ	08/27/2010	Corrected Output Rise/Fall time diagram.
*D	3100234	CXQ	11/18/2010	<p>Changed <math>V_{IN}</math> and <math>V_{OUT}</math> specs from 4.0V to "lesser of 4.0 or <math>V_{DD} + 0.4</math>".</p> <p>Removed 200mA min LU spec, replaced with "Meets or exceeds JEDEC Spec JESD78B IC Latchup Test"</p> <p>Changed <math>C_{IN}</math> condition to "Measured at 10 MHz".</p> <p>Removed <math>t_R</math> and <math>t_F</math> input specs from AC specs table.</p> <p>Changed <math>t_{ODC}</math> from 48/52% to 45/55%, changed condition to "Rail-to-rail input swing, 50% input duty cycle measured at <math>V_{DD}/2</math>".</p> <p>Changed phase jitter condition to "156.25 MHz sinewave, 12 kHz to 20 MHz offset; input swing = 2.2V, <math>V_{bias} = V_{DD}/2</math>".</p> <p>Removed <math>t_S</math> and <math>t_H</math> specs from AC specs table.</p>
*E	3137726	CXQ	01/13/2011	<p>Removed "Preliminary" status heading.</p> <p>Removed resistors from IN0/IN1 in <a href="#">Logic Block Diagram</a>.</p> <p>Added <a href="#">Figure 8</a> to describe <math>T_{SOE}</math> and <math>T_{SOD}</math>.</p>
*F	3182321	CXQ	02/25/11	Post to external web.
*G	3208968	CXQ	03/29/2011	Changed $R_P$ max from 140 k $\Omega$ to 165 k $\Omega$ and updated $R_P$ in <a href="#">Logic Block Diagram</a> .

**Document History Page** (continued)

Document Title: CY2CP1504, 1:4 LVCMOS to LVPECL Fanout Buffer with Selectable Clock Input Document Number: 001-56313				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
*H	3878020	PURU	01/21/2013	Updated <a href="#">Package Diagram</a> : spec 51-85118 – Changed revision from *C to *D. Updated to new template.
*I	4587249	PURU	12/03/2014	Updated <a href="#">Functional Description</a> : Added “For a complete list of related documentation, <a href="#">click here.</a> ” at the end. Updated <a href="#">Package Diagram</a> : spec 51-85118 – Changed revision from *D to *E.
*J	5267558	PSR	05/13/2016	Added <a href="#">Thermal Resistance</a> . Updated to new template.



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