



# 3.3V/2.5V Programmable Skew Clock Buffer

## Features

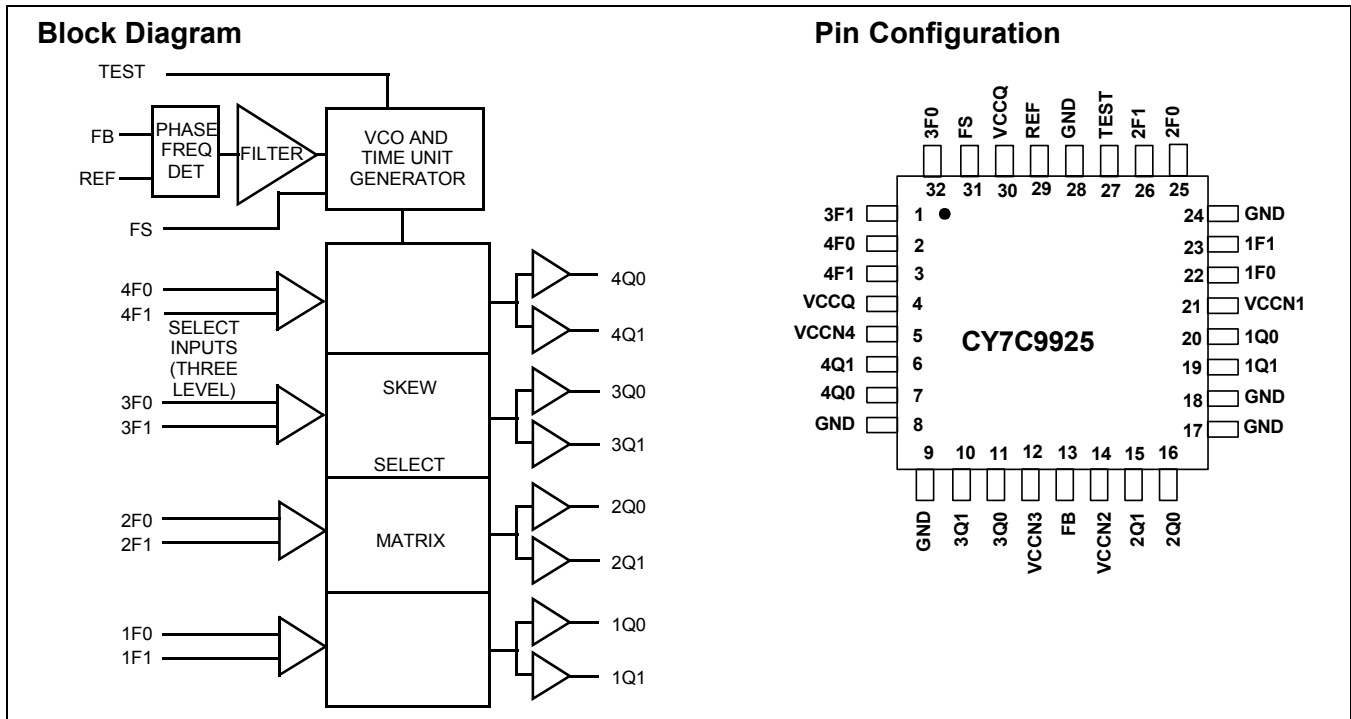
- All output pair skew <100 ps (typical)
- Input Frequency Range: 3.75 MHz to 200 MHz
- Output Frequency Range: 3.75 MHz to 200 MHz
- User-selectable output functions
  - Selectable skew to 18 ns
  - Inverted and non-inverted
  - Operation at  $\frac{1}{2}$  and  $\frac{1}{4}$  input frequency
  - Operation at 2x and 4x input frequency (input as low as 3.75 MHz)
- Zero input-to-output delay
- 3.3V Core power supply
- Split 2.5V or 3.3V Output power supplies
- $\pm 2.5\%$  Output Duty Cycle Distortion for 3.3V Output
- LVTTTL outputs drive 50 $\Omega$  terminated lines
- Low operating current
- 32-pin QFN package
- Jitter < 100ps peak-to-peak (< 15 ps RMS)

## Functional Description

The CY7C9925 RoboClock is 200-MHz Low-voltage Programmable Skew Clock Buffer that offers user-selectable control over system clock functions. This multiple-output clock driver provides the system integrator with functions necessary to optimize the timing of high-performance computer systems. Eight individual drivers, arranged as four pairs of user-controllable outputs, can each drive terminated transmission lines with impedances as low as 50 $\Omega$  while delivering minimal and specified output skews and full-swing logic levels (LVTTTL).

Each output can be hardwired to one of nine delay or function configurations. Delay increments of 0.32 to 1.6 ns are determined by the operating frequency with outputs able to skew up to  $\pm 6$  time units from their nominal "zero" skew position. The completely integrated PLL allows external load and transmission line delay effects to be canceled. When this "zero delay" capability of the LVPSCB is combined with the selectable output skew functions, the user can create output-to-output delays of up to  $\pm 12$  time units.

Divide-by-two and divide-by-four output functions are provided for additional flexibility in designing complex clock systems. When combined with the internal PLL, these divide functions allow distribution of a low-frequency clock that can be multiplied by two or four at the clock destination. This facility minimizes clock distribution difficulty while allowing maximum system clock speed and flexibility.



**Pin Definitions**

Pin No.	Name	I/O	Type	Description
29	Ref	Input	LVTTL/LVCMOS	Reference Clock Input
13	FB	Input	LVTTL	Feedback Clock Input
31	FS	Input	Three-level	Three Level Frequency Range Select
22,23	1F0, 1F1	Input	Three-level	Three level function select for 1Q0,1Q1
25,26	2F0, 2F1	Input	Three-level	Three level function select for 2Q0,2Q1
32,1	3F0, 3F1	Input	Three-level	Three level function select for 3Q0,3Q1
2, 3	4F0, 4F1	Input	Three-level	Three level function select for 4Q0,4Q1
27	Test	Input	Three-level	Three level select for test modes
19,20	1Q0, 1Q1	Output	LVTTL	Output Pair
15,16	2Q0, 2Q1	Output	LVTTL	Output Pair
10,11	3Q0, 3Q1	Output	LVTTL	Output Pair
6,7	4Q0, 4Q1	Output	LVTTL	Output Pair
21	VCCN1	Power	POWER	3.3V or 2.5V Power Supply for output pair 1Q0 and 1Q1.
14	VCCN2	Power	POWER	3.3V or 2.5V Power Supply for output pair 2Q0 and 2Q1.
12	VCCN3	Power	POWER	3.3V or 2.5V Power Supply for output pair 3Q0 and 3Q1.
5	VCCN4	Power	POWER	3.3V or 2.5V Power Supply for output pair 4Q0 and 4Q1.
4,30	VCCQ	Power	POWER	3.3V Core Power
8,9,17,18,24,28	GND	Ground	POWER	Ground

**Block Diagram Description**
**Phase Frequency Detector and Filter**

These two blocks accept inputs from the Reference Frequency (REF) input and the Feedback (FB) input and generate correction information to control the frequency of the Voltage-Controlled Oscillator (VCO). These blocks, along with the VCO, form a Phase-Locked Loop (PLL) that tracks the incoming REF signal.

**VCO and Time Unit Generator**

The VCO accepts analog control inputs from the PLL filter block and generates a frequency that is used by the time unit generator to create discrete time units that are selected in the skew select matrix. The operational range of the VCO is determined by the FS control pin. The time unit ( $t_U$ ) is determined by the operating frequency of the device and the level of the FS pin as shown in *Table 1*.

**Notes:**

- For all three-state inputs, HIGH indicates a connection to  $V_{CC}$ , LOW indicates a connection to GND, and MID indicates an open connection. Internal termination circuitry holds an unconnected input to  $V_{CC}/2$ .
- The level to be set on FS is determined by the "normal" operating frequency ( $f_{NOM}$ ) of the VCO and Time Unit Generator (see Logic Block Diagram). Nominal frequency ( $f_{NOM}$ ) always appears at 1Q0 and the other outputs when they are operated in their undivided modes (see *Table 2*). The frequency appearing at the REF and FB inputs will be  $f_{NOM}$  when the output connected to FB is undivided. The frequency of the REF and FB inputs will be  $f_{NOM}/2$  or  $f_{NOM}/4$  when the part is configured for a frequency multiplication by using a divided output as the FB input.

**Table 1. Frequency Range Select and  $t_U$  Calculation<sup>[1]</sup>**

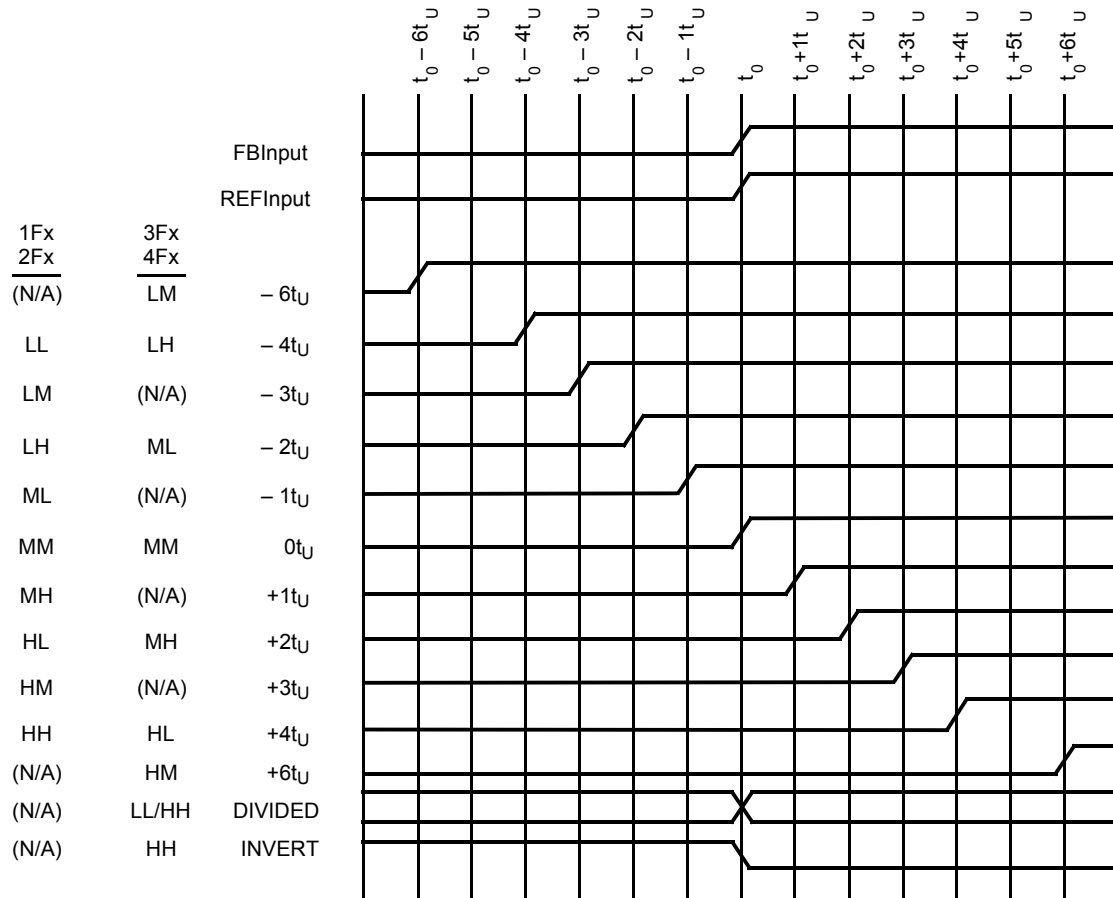
FS <sup>[2]</sup>	$f_{NOM}$ (MHz)		$N = \frac{1}{f_{NOM} \times N}$ where N =	Approximate Frequency (MHz) At Which $t_U = 1.0$ ns
	Min.	Max.		
LOW	15	30	44	22.7
MID	25	50	26	38.5
HIGH	40	200	16	62.5

**Skew Select Matrix**

The skew select matrix is comprised of four independent sections. Each section has two low-skew, high-fanout drivers ( $xQ0$ ,  $xQ1$ ), and two corresponding three-level function select ( $xF0$ ,  $xF1$ ) inputs. *Table 2* below shows the nine possible output functions for each section as determined by the function select inputs. All times are measured with respect to the REF input assuming that the output connected to the FB input has  $0t_U$  selected.

**Table 2. Programmable Skew Configurations<sup>[1]</sup>**

Function Selects		Output Functions		
1F1, 2F1, 3F1, 4F1	1F0, 2F0, 3F0, 4F0	1Q0, 1Q1, 2Q0, 2Q1	3Q0, 3Q1	4Q0, 4Q1
LOW	LOW	$-4t_U$	Divide by 2	Divide by 2
LOW	MID	$-3t_U$	$-6t_U$	$-6t_U$
LOW	HIGH	$-2t_U$	$-4t_U$	$-4t_U$
MID	LOW	$-1t_U$	$-2t_U$	$-2t_U$
MID	MID	$0t_U$	$0t_U$	$0t_U$
MID	HIGH	$+1t_U$	$+2t_U$	$+2t_U$
HIGH	LOW	$+2t_U$	$+4t_U$	$+4t_U$
HIGH	MID	$+3t_U$	$+6t_U$	$+6t_U$
HIGH	HIGH	$+4t_U$	Divide by 4	Inverted


**Figure 1. Typical Outputs with FB Connected to a Zero-Skew Output<sup>[3]</sup>**
**Note:**

3. FB connected to an output selected for "zero" skew (i.e., xF1 = xF0 = MID).

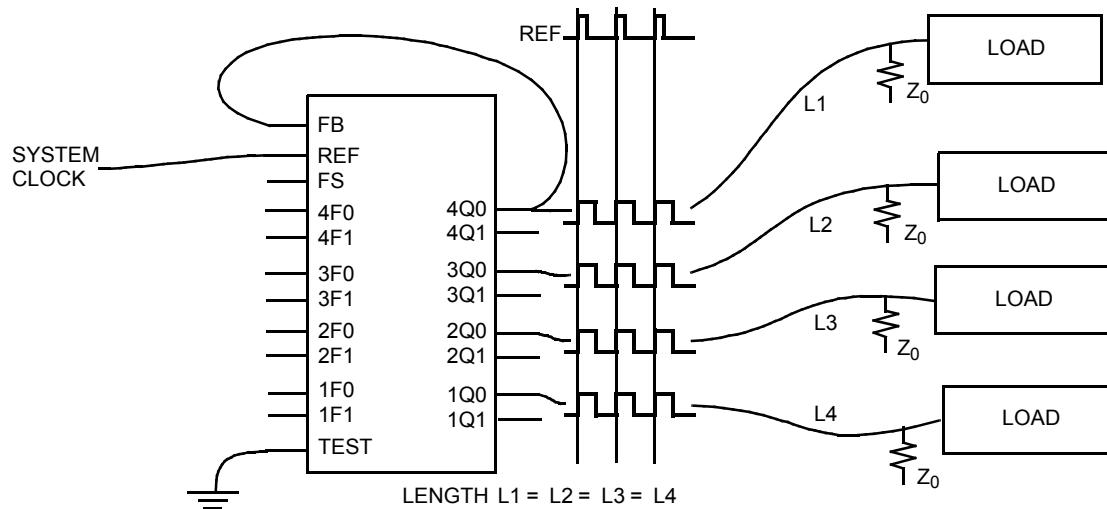
### Test Mode

The TEST input is a three-level input. In normal system operation, this pin is connected to ground, allowing the CY7C9925 to operate as explained briefly above (for testing purposes, any of the three-level inputs can have a removable jumper to ground, or be tied LOW through a 100Ω resistor. This will allow an external tester to change the state of these pins.) If the TEST input is forced to its MID or HIGH state, the

device will operate with its internal phase locked loop disconnected, and input levels supplied to REF will directly control all outputs. Relative output to output functions are the same as in normal mode.

In contrast with normal operation (TEST tied LOW). All outputs will function based only on the connection of their own function select inputs (xF0 and xF1) and the waveform characteristics of the REF input.

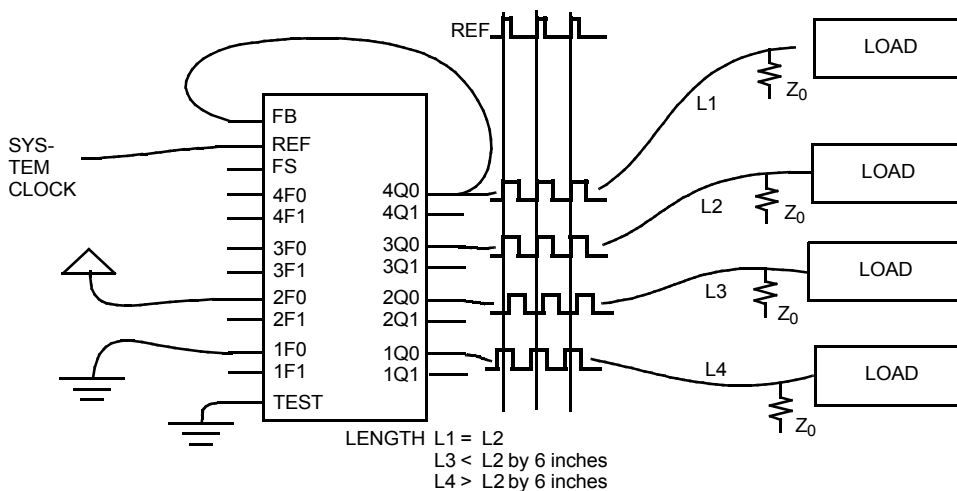
### Operational Mode Descriptions



**Figure 2. Zero-Skew and/or Zero-Delay Clock Driver**

Figure 2 shows the LVPSCB configured as a zero-skew clock buffer. In this mode the CY7C9925 can be used as the basis for a low-skew clock distribution tree. When all of the function select inputs (xF0, xF1) are left open, the outputs are aligned and may each drive a terminated transmission line to an independent load. The FB input can be tied to any output in

this configuration and the operating frequency range is selected with the FS pin. The low-skew specification, coupled with the ability to drive terminated transmission lines (with impedances as low as 50Ω), allows efficient printed circuit board design.



**Figure 3. Programmable-Skew Clock Driver**

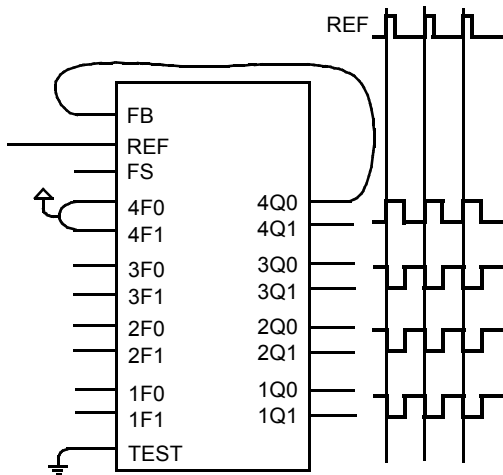
Figure 3 shows a configuration to equalize skew between metal traces of different lengths. In addition to low skew between outputs, the LVPSCB can be programmed to stagger the timing of its outputs. The four groups of output pairs can

each be programmed to different output timing. Skew timing can be adjusted over a wide range in small increments with the appropriate strapping of the function select pins. In this configuration the 4Q0 output is fed back to FB and configured for

zero skew. The other three pairs of outputs are programmed to yield different skews relative to the feedback. By advancing the clock signal on the longer traces or retarding the clock signal on shorter traces, all loads can receive the clock pulse at the same time.

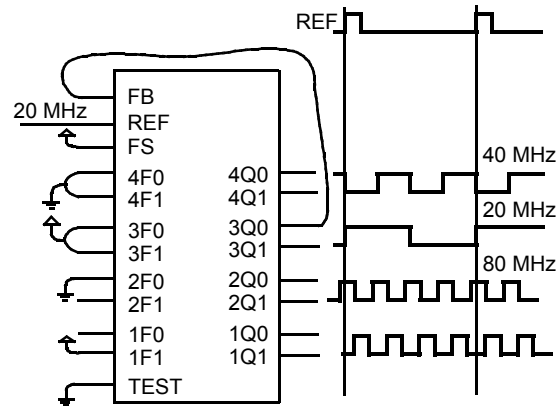
In this illustration the FB input is connected to an output with 0-ns skew ( $x_{F1}$ ,  $x_{F0} = \text{MID}$ ) selected. The internal PLL synchronizes the FB and REF inputs and aligns their rising edges to insure that all outputs have precise phase alignment.

Clock skews can be advanced by  $\pm 6$  time units ( $t_U$ ) when using an output selected for zero skew as the feedback. A wider range of delays is possible if the output connected to FB is also skewed. Since "Zero Skew",  $+t_U$ , and  $-t_U$  are defined relative to output groups, and since the PLL aligns the rising edges of REF and FB, it is possible to create wider output skews by proper selection of the  $x_{Fn}$  inputs. For example a  $+10 t_U$  between REF and  $3Q_x$  can be achieved by connecting  $1Q_0$  to FB and setting  $1F_0 = 1F_1 = \text{GND}$ ,  $3F_0 = \text{MID}$ , and  $3F_1 = \text{High}$ . (Since FB aligns at  $-4 t_U$  and  $3Q_x$  skews to  $+6 t_U$ , a total of  $+10 t_U$  skew is realized.) Many other configurations can be realized by skewing both the output used as the FB input and skewing the other outputs.



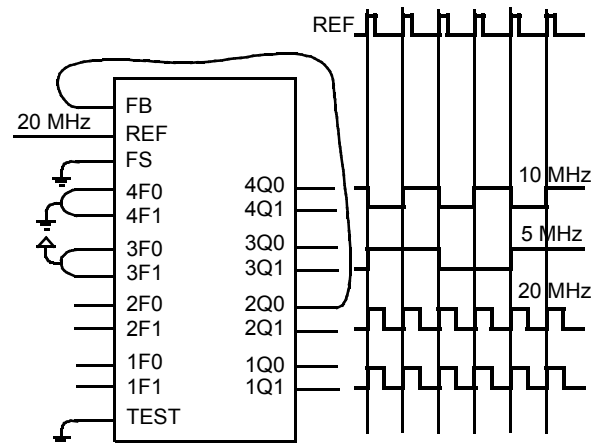
**Figure 4. Inverted Output Connections**

Figure 4 shows an example of the invert function of the LVPSCB. In this example the  $4Q_0$  output used as the FB input is programmed for invert ( $4F_0 = 4F_1 = \text{HIGH}$ ) while the other three pairs of outputs are programmed for zero skew. When  $4F_0$  and  $4F_1$  are tied HIGH,  $4Q_0$  and  $4Q_1$  become inverted zero phase outputs. The PLL aligns the rising edge of the FB input with the rising edge of the REF. This causes the  $1Q$ ,  $2Q$ , and  $3Q$  outputs to become the "inverted" outputs with respect to the REF input. By selecting which output is connect to FB, it is possible to have 2 inverted and 6 non-inverted outputs or 6 inverted and 2 non-inverted outputs. The correct configuration would be determined by the need for more (or fewer) inverted outputs.  $1Q$ ,  $2Q$ , and  $3Q$  outputs can also be skewed to compensate for varying trace delays independent of inversion on  $4Q$ .



**Figure 5. Frequency Multiplier with Skew Connections**

Figure 5 illustrates the LVPSCB configured as a clock multiplier. The  $3Q_0$  output is programmed to divide by four and is fed back to FB. This causes the PLL to increase its frequency until the  $3Q_0$  and  $3Q_1$  outputs are locked at 20 MHz while the  $1Q_x$  and  $2Q_x$  outputs run at 80 MHz. The  $4Q_0$  and  $4Q_1$  outputs are programmed to divide by two, which results in a 40-MHz waveform at these outputs. Note that the 20- and 40-MHz clocks fall simultaneously and are out of phase on their rising edge. This will allow the designer to use the rising edges of the  $1/2$  frequency and  $1/4$  frequency outputs without concern for rising-edge skew. The  $2Q_0$ ,  $2Q_1$ ,  $1Q_0$ , and  $1Q_1$  outputs run at 80 MHz and are skewed by programming their select inputs accordingly. Note that the FS pin is wired for 80-MHz operation because that is the frequency of the fastest output.



**Figure 6. Frequency Divider Connections**

Figure 6 demonstrates the LVPSCB in a clock divider application.  $2Q_0$  is fed back to the FB input and programmed for zero skew.  $3Q_x$  is programmed to divide by four.  $4Q_x$  is programmed to divide by two. Note that the falling edges of the  $4Q_x$  and  $3Q_x$  outputs are aligned. This allows use of the rising edges of the  $1/2$  frequency and  $1/4$  frequency without concern for skew mismatch. The  $1Q_x$  outputs are programmed to zero skew and are aligned with the  $2Q_x$  outputs. In this example, the FS input is grounded to configure the device in the 15- to

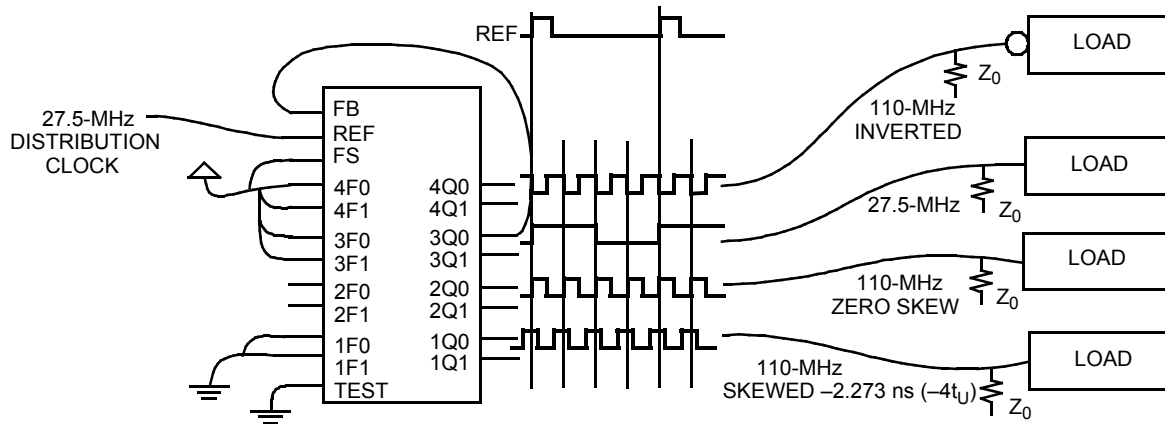
30-MHz range since the highest frequency output is running at 20 MHz.

Figure 7 shows some of the functions that are selectable on the 3Qx and 4Qx outputs. These include inverted outputs and outputs that offer divide-by-2 and divide-by-4 timing. An inverted output allows the system designer to clock different subsystems on opposite edges, without suffering from the pulse asymmetry typical of non-ideal loading. This function allows the two subsystems to each be clocked 180 degrees out of phase, but still to be aligned within the skew spec.

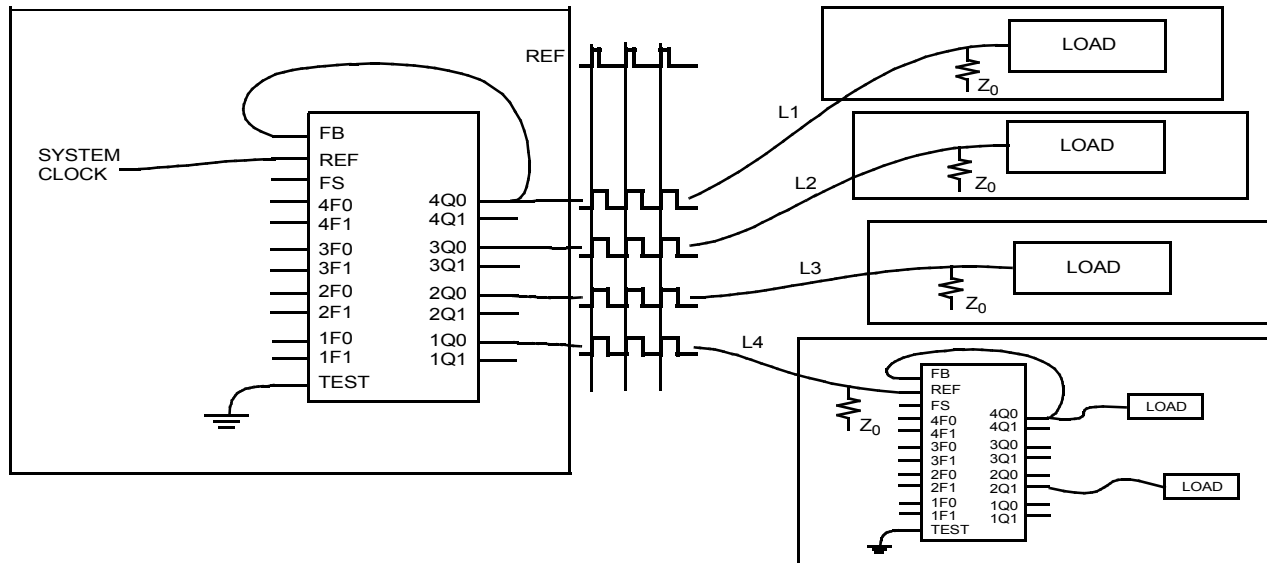
The divided outputs offer a zero-delay divider for portions of the system that need the clock to be divided by either two or four, and still remain within a narrow skew of the "1X" clock.

Without this feature, an external divider would need to be added, and the propagation delay of the divider would add to the skew between the different clock signals.

These divided outputs, coupled with the Phase Locked Loop, allow the LVPSCB to multiply the clock rate at the REF input by either two or four. This mode will enable the designer to distribute a low-frequency clock between various portions of the system, and then locally multiply the clock rate to a more suitable frequency, while still maintaining the low-skew characteristics of the clock driver. The LVPSCB can perform all of the functions described above at the same time. It can multiply by two and four or divide by two (and four) at the same time that it is shifting its outputs over a wide range or maintaining zero skew between selected outputs.



**Figure 7. Multi-Function Clock Driver**



**Figure 8. Board-to-Board Clock Distribution**

Figure 8 shows the CY7C9925 connected in series to construct a zero-skew clock distribution tree between boards. Delays of the downstream clock buffers can be programmed to compensate for the wire length (i.e., select negative skew equal to the wire delay) necessary to connect them to the

master clock source, approximating a zero-delay clock tree. Cascaded clock buffers will accumulate low-frequency jitter because of the non-ideal filtering characteristics of the PLL filter. It is recommended that not more than two clock buffers be connected in series.

**Absolute Maximum Conditions**

Parameter	Description	Condition	Min.	Max.	Unit
V <sub>DD</sub>	Supply Voltage	Nonfunctional	-0.5	4.6	VDC
V <sub>IN</sub>	Input Voltage REF	Relative to V <sub>CC</sub>	-0.5	4.6	VDC
V <sub>IN</sub>	Input Voltage Except REF	Relative to V <sub>CC</sub>	-0.5	V <sub>DD</sub> + 0.5	VDC
LU <sub>I</sub>	Latch-up Immunity	Functional	300		mA
T <sub>S</sub>	Temperature, Storage	Nonfunctional	-65	+125	°C
T <sub>A</sub>	Temperature, Operating Ambient	Commercial Temperature	0	+70	°C
T <sub>A</sub>	Temperature, Operating Ambient	Industrial Temperature	-40	+85	°C
T <sub>J</sub>	Junction Temperature	Industrial Temperature		125	°C
Ø <sub>Jc</sub>	Dissipation, Junction to Case	Functional	TBD		°C/W
Ø <sub>Ja</sub>	Dissipation, Junction to Ambient	Functional	TBD		°C/W
ESD <sub>h</sub>	ESD Protection (Human Body Model)		2000		V
MSL	Moisture Sensitivity Level		MSL - 1		Class
G <sub>ATES</sub>	Total Functional Gate Count	Assembled Die	TBD		Each
UL-94	Flammability Rating	@ 1/8 in.	V-0		class
FIT	Failure in Time	Manufacturing test	10		ppm
T <sub>PU</sub>	Power-up time for all V <sub>DD</sub> s to reach minimum specified voltage (power ramps must be monotonic)		0.05	500	ms
C <sub>IN</sub>	Input Capacitance <sup>[4]</sup>	T <sub>A</sub> = 25°C, f = 1 MHz, V <sub>CC</sub> = 3.3V	-	10	pF
Z <sub>OUT</sub>	Output Impedance	Low to High (Rising edge)	27		Ω
		High to Low (Falling edge)	7		Ω

**Electrical Characteristics** Over the Operating Range <sup>[5]</sup>

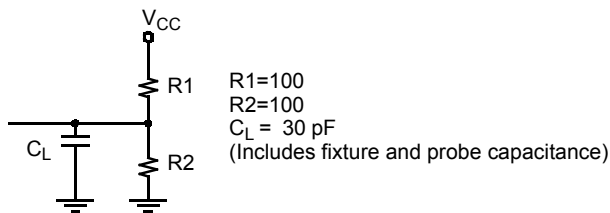
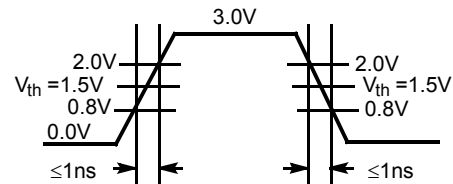
Parameter	Description	Test Conditions	Min.	Max.	Unit
V <sub>CCQ</sub>	Core Power Supply	@3.3V ± 10%	2.97	3.63	V
V <sub>CCN[1:4]</sub>	Output Buffer Power Supply	@3.3V ± 10%	2.97	3.63	V
		@2.5V ± 5%	2.375	2.625	V
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = Min., I <sub>OH</sub> = -20 mA (3.3V)	2.4	-	V
		V <sub>CC</sub> = Min., I <sub>OH</sub> = -15 mA (2.5V)	1.8	-	
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = Min., I <sub>OL</sub> = 36 mA (3.3V)	-	0.45	V
		V <sub>CC</sub> = Min., I <sub>OL</sub> = 20 mA (2.5V)	-	0.4	
V <sub>IH</sub>	Input HIGH Voltage (REF and FB inputs only) <sup>[6]</sup>		2.0	V <sub>CC</sub>	V
V <sub>IL</sub>	Input LOW Voltage (REF and FB inputs only) <sup>[6]</sup>		-0.5	0.8	V
V <sub>IHH</sub>	Three-Level Input HIGH Voltage (Test, FS, xFn) <sup>[7]</sup>	Min. ≤ V <sub>CC</sub> ≤ Max.	0.87 * V <sub>CC</sub>	V <sub>CC</sub>	V
V <sub>IMM</sub>	Three-Level Input MID Voltage (Test, FS, xFn) <sup>[7]</sup>	Min. ≤ V <sub>CC</sub> ≤ Max.	0.47 * V <sub>CC</sub>	0.53 * V <sub>CC</sub>	V
V <sub>ILL</sub>	Three-Level Input LOW Voltage (Test, FS, xFn) <sup>[7]</sup>	Min. ≤ V <sub>CC</sub> ≤ Max.	0.0	0.13 * V <sub>CC</sub>	V
I <sub>IH</sub>	Input HIGH Leakage Current (REF and FB inputs only)	V <sub>CC</sub> = Max., V <sub>IN</sub> = Max.	-	10	μA

**Notes:**

- Applies to REF and FB inputs only. Tested initially and after any design or process changes that may affect these parameters.
- See the last page of this specification for Group A subgroup testing information.
- V<sub>IH</sub> and V<sub>IL</sub> for FB inputs guaranteed by statistical correlation. Tested initially and after any design or process changes that may affect this parameters.

**Electrical Characteristics** Over the Operating Range (continued)<sup>[5]</sup>

Parameter	Description	Test Conditions	Min.	Max.	
$I_{IL}$	Input LOW Leakage Current (REF and FB inputs only)	$V_{CC} = \text{Max.}, V_{IN} = 0.4V$	-10	-	$\mu A$
$I_{IHH}$	Input HIGH Current (Test, FS, xFn)	$V_{IN} = V_{CC}$	-	200	$\mu A$
$I_{IMM}$	Input MID Current (Test, FS, xFn)	$V_{IN} = V_{CC}/2$	-50	50	$\mu A$
$I_{ILL}$	Input LOW Current (Test, FS, xFn)	$V_{IN} = \text{GND}$	-	-200	$\mu A$
$I_{OS}$	Short Circuit Current <sup>[8]</sup>	$V_{CC} = \text{MAX}, V_{OUT} = \text{GND} (25^\circ \text{ only})$	-	-200	mA
$I_{CCQ}$	Operating Current Used by Internal Circuitry	$V_{CCN} = V_{CCQ} = \text{Max.}, \text{All Input Selects Open}$	-	90	mA
			-	100	
$I_{CCN}$	Output Buffer Current per Output Pair <sup>[9]</sup>	$V_{CCN} = V_{CCQ} = \text{Max.}, I_{OUT} = 0 \text{ mA}$ Input Selects Open, $f_{MAX}$	-	14	mA
PD	Power Dissipation per Output Pair <sup>[10]</sup>	$V_{CCN} = V_{CCQ} = \text{Max.}, I_{OUT} = 0 \text{ mA}$ Input Selects Open, $f_{MAX}$	-	78	mW

**AC Test Loads and Waveforms**

**TTL AC Test Load**

**TTL Input Test Waveform**
**AC Input Specifications**

Parameter	Description	Condition	Min.	Max.	Unit
$T_{R,T_F}$	Input Rise/Fall Edge Rate	0.8V – 2.0V	-	10	ns/V
$T_{PWC}$	Input Clock Pulse	HIGH or LOW	2	-	ns
$T_{DCIN}$	Input Duty Cycle	PLL	10	90	%
		Test Mode	30	70	
$F_{REF}$	Reference Input Frequency	FS=LOW	3.75	30	MHz
		FS=MID	6.25	50	
		FS=HIGH	10	200 <sup>[11]</sup>	

**Notes:**

- These inputs are normally wired to  $V_{CC}$ , GND, or left unconnected (actual threshold voltages vary as a percentage of  $V_{CC}$ ). Internal termination resistors hold unconnected inputs at  $V_{CC}/2$ . If these inputs are switched, the function and timing of the outputs may glitch and the PLL may require an additional  $t_{LOCK}$  time before all data sheet limits are achieved.
- CY7C9925 should be tested one output at a time, output shorted for less than one second, less than 10% duty cycle. Room temperature only.
- Total output current per output pair can be approximated by the following expression that includes device current plus load current:  
 $CY7C9925: I_{CCN} = [(4 + 0.11F) + \{[(835 - 3F)/Z] + (.0022FC)\}N] \times 1.1$   
 Where  
 $F$  = frequency in MHz  
 $C$  = capacitive load in pF  
 $Z$  = line impedance in ohms  
 $N$  = number of loaded outputs; 0, 1, or 2  
 $FC = F * C$
- Total power dissipation per output pair can be approximated by the following expression that includes device power dissipation plus power dissipation due to the load circuit:  
 $PD = [(22 + 0.61F) + \{[(1550 + 2.7F)/Z] + (.0125FC)\}N] \times 1.1$   
 See note 9 for variable definition.
- In test mode, Max REF input frequency is 133MHz.

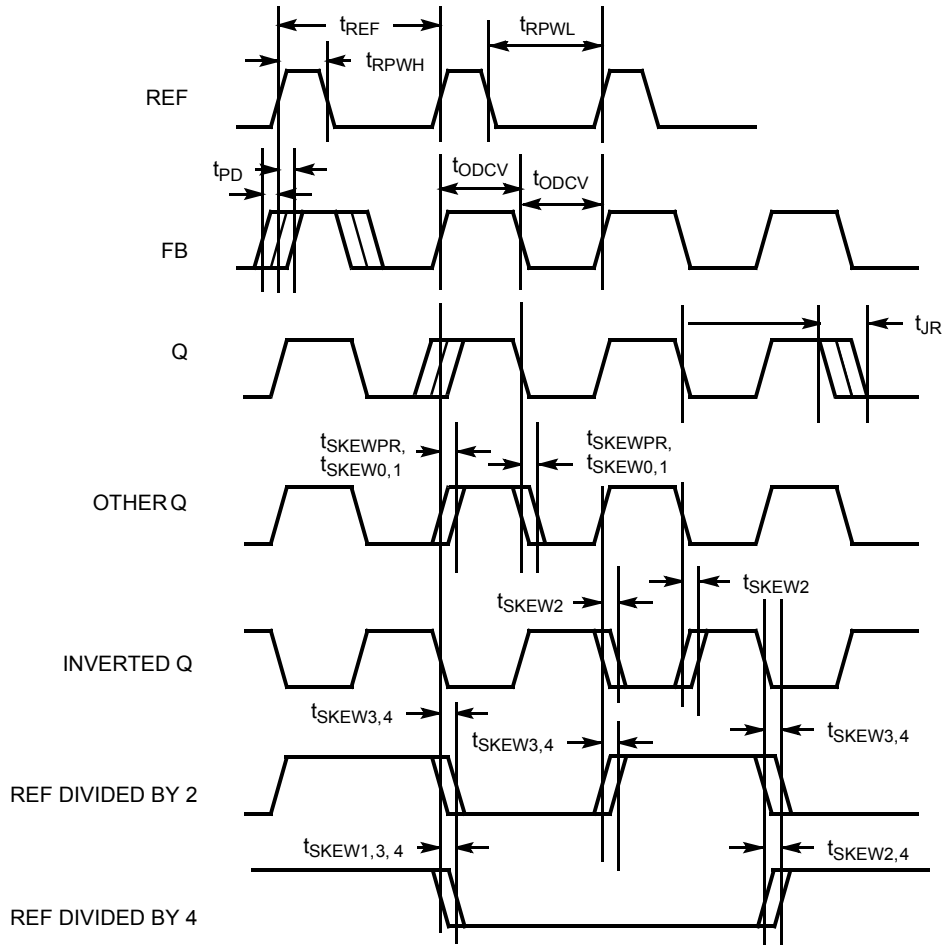


**Switching Characteristics** Over the Operating Range [2, 12]

Parameter	Description	Min.	Typ.	Max.	Unit	
f <sub>NOM</sub>	Operating Clock Frequency in MHz	FS = LOW <sup>[1, 2]</sup>	15	–	30	MHz
		FS = MID <sup>[1, 2]</sup>	25	–	50	
		FS = HIGH <sup>[1, 2]</sup>	40	–	200	
F <sub>OUT</sub>	Output Frequency	FS=LOW	3.75	–	30	MHz
		FS=MID	6.25	–	50	
		FS=HIGH	10	–	200	
F <sub>VCO</sub>	VCO Frequency	160	–	800	MHz	
F <sub>BW</sub>	Loop Bandwidth	–	1	–	MHz	
t <sub>U</sub>	Programmable Skew Unit	See Table 1				
t <sub>SKIEWPR</sub>	Zero Output Matched-Pair Skew (XQ0, XQ1) <sup>[13, 15]</sup>	–	0.05	0.1	ns	
t <sub>SKIEW0</sub>	Zero Output Skew (All Outputs) <sup>[13, 16, 17]</sup>	–	0.1	0.2	ns	
t <sub>SKIEW1</sub>	Output Skew (Rise-Rise, Fall-Fall, Same Class Outputs) <sup>[13, 18]</sup>	–	0.25	0.3	ns	
t <sub>SKIEW2</sub>	Output Skew (Rise-Fall, Nominal-Inverted, Divided-Divided) <sup>[13, 18]</sup>	–	0.3	0.5	ns	
t <sub>SKIEW3</sub>	Output Skew (Rise-Rise, Fall-Fall, Different Class Outputs) <sup>[13, 18]</sup>	–	0.25	0.5	ns	
t <sub>SKIEW4</sub>	Output Skew (Rise-Fall, Nominal-Divided, Divided-Inverted) <sup>[13, 18]</sup>	–	0.5	0.9	ns	
t <sub>DEV</sub>	Device-to-Device Skew <sup>[14, 19]</sup>	–	–	0.75	ns	
t <sub>PD</sub>	Propagation Delay, REF Rise to FB Rise	–0.15	–	+0.15	ns	
t <sub>ODCV3.3</sub>	Output Duty Cycle Variation at 3.3V <sup>[20]</sup>	47.5	50	52.5	%	
t <sub>ODCV2.5</sub>	Output Duty Cycle Variation at 2.5V <sup>[20]</sup>	45	50	55	%	
t <sub>PWH3.3</sub>	Output HIGH Time Variation at 3.3V <sup>[21]</sup>	47.5	50	52.5	%	
t <sub>PWH2.5</sub>	Output HIGH Time Variation at 2.5V <sup>[21]</sup>	45	50	55	%	
t <sub>PWL3.3</sub>	Output LOW Time Variation at 3.3V <sup>[21]</sup>	47.5	50	52.5	%	
t <sub>PWL2.5</sub>	Output LOW Time Variation at 2.5V <sup>[21]</sup>	45	50	55	%	
t <sub>ORISE</sub>	Output Rise Time <sup>[21, 22]</sup>	0.15	1.0	1.5	ns	
t <sub>OFALL</sub>	Output Fall Time <sup>[21, 22]</sup>	0.15	1.0	1.5	ns	
t <sub>LOCK</sub>	PLL Lock Time <sup>[23]</sup>	–	–	0.5	ms	
t <sub>JR</sub>	Cycle-to-Cycle Output Jitter	RMS <sup>[14]</sup>	–	–	15	ps
		Peak-to-Peak <sup>[14]</sup>	–	–	100	ps
t <sub>PJ</sub>	Period Jitter	RMS <sup>[14]</sup>	–	–	25	ps
		Peak-to-Peak <sup>[14]</sup>	–	–	150	ps
t <sub>PHJ</sub>	Phase Jitter	–	–	100	ps	

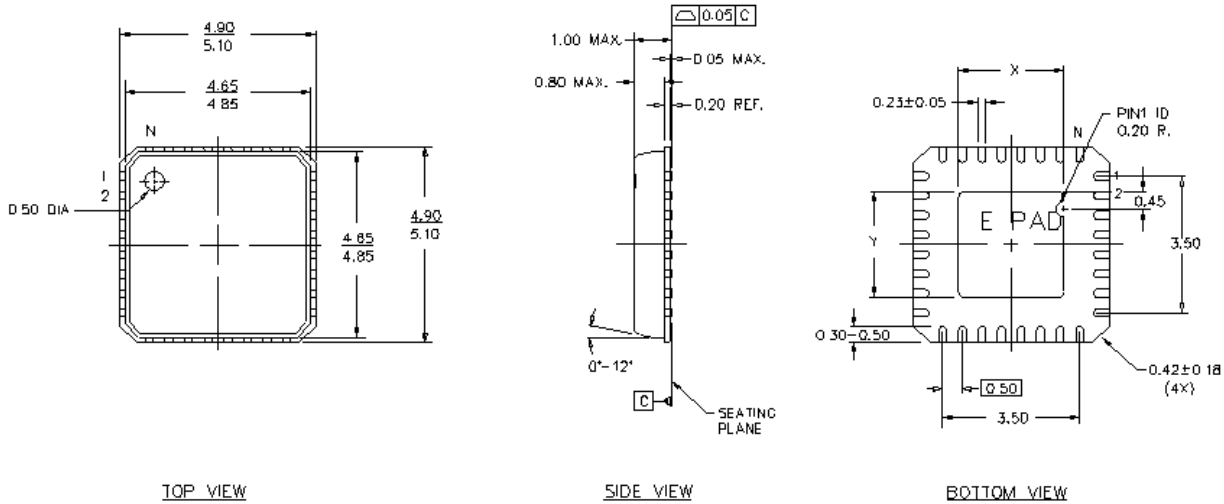
**Notes:**

12. Test measurement levels for the CY7C9925 are TTL levels (1.5V to 1.5V). Test conditions assume signal transition times of 2 ns or less and output loading as shown in the AC Test Loads and Waveforms unless otherwise specified.
13. SKEW is defined as the time between the earliest and the latest output transition among all outputs for which the same t<sub>U</sub> delay has been selected when all are loaded with 30 pF and terminated with TTLAC Test Load.
14. Guaranteed by statistical correlation. Tested initially and after any design or process changes that may affect these parameters.
15. t<sub>SKIEWPR</sub> is defined as the skew between a pair of outputs (XQ0 and XQ1) when all eight outputs are selected for 0t<sub>U</sub>.
16. t<sub>SKIEW0</sub> is defined as the skew between outputs when they are selected for 0t<sub>U</sub>. Other outputs are divided or inverted but not shifted.
17. C<sub>L</sub>=0 pF. For C<sub>L</sub>=30 pF, t<sub>SKIEW0</sub>=0.35 ns.
18. There are three classes of outputs: Nominal (multiple of t<sub>U</sub> delay), Inverted (4Q0 and 4Q1 only with 4F0 = 4F1 = HIGH), and Divided (3Qx and 4Qx only in Divide-by-2 or Divide-by-4 mode).
19. t<sub>DEV</sub> is the output-to-output skew between any two devices operating under the same conditions (V<sub>CC</sub> ambient temperature, air flow, etc.)
20. t<sub>ODCV</sub> is measure at V<sub>CCN</sub>/2.
21. Specified with outputs loaded with 30 pF for the CY7C9925 devices. Devices are terminated through 50Ω to V<sub>CC</sub>/2. t<sub>PWH</sub> is measured at 2.0V. t<sub>PWL</sub> is measured at 0.8V for 3.3V power supply. t<sub>PWH</sub> is measured at 1.7V. t<sub>PWL</sub> is measured at 0.7V for 2.5V power supply.
22. t<sub>ORISE</sub> and t<sub>OFALL</sub> measured between 0.8V and 2.0V for 3.3V power supply. t<sub>ORISE</sub> and t<sub>OFALL</sub> measured between 0.7V and 1.7V for 2.5V power supply
23. t<sub>LOCK</sub> is the time that is required before synchronization is achieved. This specification is valid only after V<sub>CC</sub> is stable and within normal operating limits. This parameter is measured from the application of a new signal or frequency at REF or FB until t<sub>PD</sub> is within specified limits.

**AC Timing Diagrams**

**Ordering Information**

Ordering Code	Package Type	Operating Range
CY7C9925LFXC	32-QFN package	Commercial, 0°C to 70°C
CY7C9925LFXT	32-QFN package - Tape and Reel	Commercial, 0°C to 70°C
CY7C9925LFXI	32-QFN package	Industrial, -40°C to 85°C
CY7C9925LFXIT	32-QFN package - Tape and Reel	Industrial, -40°C to 85°C

**Package Drawing and Dimensions**
**32-Lead QFN (5 x 5 mm) LF32A**

 DIMENSIONS IN mm MIN. MAX.


51-85188-\*\*

NOTE: E-PAD X, Y DIMENSION VARIES BY PRODUCT DUE TO DIE SIZE VARIABLE.

JEDEC # MO-220

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**Document History Page**

Document Title: CY7C9925 3.3V/2.5V Programmable Skew Clock Buffer  
Document Number: 38-07688

REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	236309	See ECN	RGL	New Data Sheet