



## 3.3V LOW SKEW PLL CLOCK DRIVER TURBOCLOCK™ JR.

IDT5V9910A

### FEATURES:

- Eight zero delay outputs
- <250ps of output to output skew
- Selectable positive or negative edge synchronization
- Synchronous output enable
- Output frequency: 15MHz to 85MHz
- 3 skew grades:
  - IDT5V9910A-2:  $t_{SKEW0} < 250ps$
  - IDT5V9910A-5:  $t_{SKEW0} < 500ps$
  - IDT5V9910A-7:  $t_{SKEW0} < 750ps$
- 3-level inputs for PLL range control
- PLL bypass for DC testing
- External feedback, internal loop filter
- 12mA balanced drive outputs
- Low Jitter: <200ps peak-to-peak
- Available in SOIC package

### DESCRIPTION:

The IDT5V9910A is a high fanout phase locked-loop clock driver intended for high performance computing and data-communications applications. It has eight zero delay LVTTTL outputs.

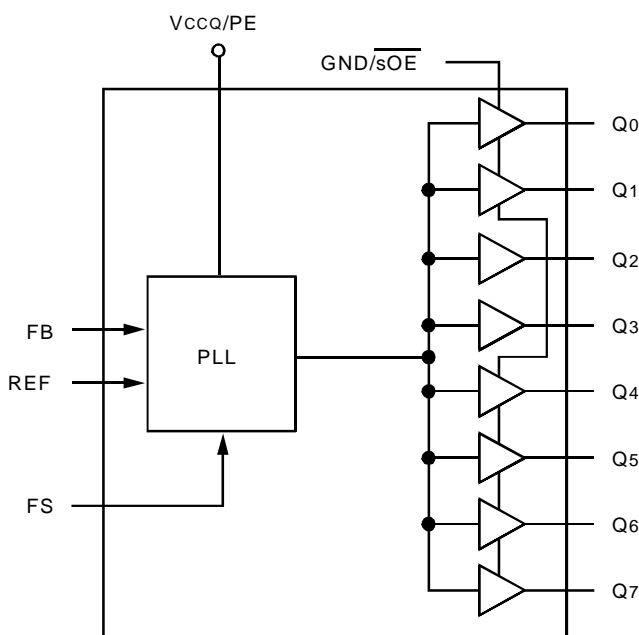
When the  $GND/\overline{SOE}$  pin is held low, all the outputs are synchronously enabled. However, if  $GND/\overline{SOE}$  is held high, all the outputs except Q2 and Q3 are synchronously disabled.

Furthermore, when the  $VCCQ/PE$  is held high, all the outputs are synchronized with the positive edge of the REF clock input. When  $VCCQ/PE$  is held low, all the outputs are synchronized with the negative edge of REF.

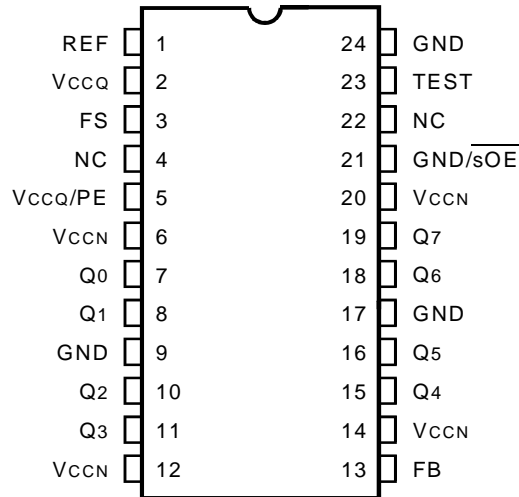
The FB signal is compared with the input REF signal at the phase detector in order to drive the VCO. Phase differences cause the VCO of the PLL to adjust upwards or downwards accordingly.

An internal loop filter moderates the response of the VCO to the phase detector. The loop filter transfer function has been chosen to provide minimal jitter (or frequency variation) while still providing accurate responses to input frequency changes.

### FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



SOIC  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Description	Max	Unit
	Supply Voltage to Ground	-0.5 to +7	V
V <sub>I</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> +0.5	V
	REF Input Voltage	-0.5 to +5.5	V
	Maximum Power Dissipation (T <sub>A</sub> = 85°C)	530	mW
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C

**NOTE:**

- Stresses beyond those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## CAPACITANCE (T<sub>A</sub> = +25°C, f = 1MHz, V<sub>IN</sub> = 0V)

Parameter	Description	Typ.	Max.	Unit
C <sub>IN</sub>	Input Capacitance	5	7	pF

**NOTE:**

- Capacitance applies to all inputs except TEST and FS. It is characterized but not production tested.

## PIN DESCRIPTION

Pin Name	Type	Description
REF	IN	Reference Clock Input
FB	IN	Feedback Input
TEST <sup>(1)</sup>	IN	When MID or HIGH, disables PLL (except for conditions of Note 1). REF goes to all outputs. Set LOW for normal operation.
GND/ $\overline{sOE}$ <sup>(1)</sup>	IN	Synchronous Output Enable. When HIGH, it stops clock outputs (except Q2 and Q3) in a LOW state - Q2 and Q3 may be used as the feedback signal to maintain phase lock. Set GND/ $\overline{sOE}$ LOW for normal operation.
VccQ/PE	IN	Selectable positive or negative edge control. When LOW/HIGH the outputs are synchronized with the negative/positive edge of the reference clock.
FS <sup>(2)</sup>	IN	Frequency range select: FS = GND: 15 to 35MHz FS = MID (or open): 25 to 60MHz FS = Vcc: 40 to 85MHz
Q0 - Q7	OUT	Eight clock output
VCCN	PWR	Power supply for output buffers
VccQ	PWR	Power supply for phase locked loop and other internal circuitry
GND	PWR	Ground

**NOTES:**

- When TEST = MID and GND/ $\overline{sOE}$  = HIGH, PLL remains active.
- This input is wired to Vcc, GND, or unconnected. Default is MID level. If it is switched in the real time mode, the outputs may glitch, and the PLL may require an additional lock time before all data sheet limits are achieved.

**RECOMMENDED OPERATING RANGE**

Symbol	Description	IDT5V9910A-5,-7 (Industrial)		IDT5V9910A-2 (Commercial)		Unit
		Min.	Max.	Min.	Max.	
V <sub>CC</sub>	Power Supply Voltage	3	3.6	3	3.6	V
T <sub>A</sub>	Ambient Operating Temperature	-40	+85	0	+70	°C

**DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE**

Symbol	Parameter	Conditions	Min.	Max.	Unit
V <sub>IH</sub>	Input HIGH Voltage	Guaranteed Logic HIGH (REF, FB Inputs Only)	2	—	V
V <sub>IL</sub>	Input LOW Voltage	Guaranteed Logic LOW (REF, FB Inputs Only)	—	0.8	V
V <sub>IHH</sub>	Input HIGH Voltage <sup>(1)</sup>	3-Level Inputs Only	V <sub>CC</sub> -0.6	—	V
V <sub>IMM</sub>	Input MID Voltage <sup>(1)</sup>	3-Level Inputs Only	V <sub>CC</sub> /2-0.3	V <sub>CC</sub> /2+0.3	V
V <sub>ILL</sub>	Input LOW Voltage <sup>(1)</sup>	3-Level Inputs Only	—	0.6	V
I <sub>IN</sub>	Input Leakage Current (REF, FB Inputs Only)	V <sub>IN</sub> = V <sub>CC</sub> or GND V <sub>CC</sub> = Max.	—	±5	μA
I <sub>3</sub>	3-Level Input DC Current (TEST, FS)	V <sub>IN</sub> = V <sub>CC</sub> HIGH Level	—	±200	μA
		V <sub>IN</sub> = V <sub>CC</sub> /2 MID Level	—	±50	
		V <sub>IN</sub> = GND LOW Level	—	±200	
I <sub>PU</sub>	Input Pull-Up Current (V <sub>CC0</sub> /PE)	V <sub>CC</sub> = Max., V <sub>IN</sub> = GND	—	±100	μA
I <sub>PD</sub>	Input Pull-Down Current (GND/sOE)	V <sub>CC</sub> = Max., V <sub>IN</sub> = V <sub>CC</sub>	—	±100	μA
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = Min., I <sub>OH</sub> = -12mA	2.4	—	V
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = Min., I <sub>OL</sub> = 12mA	—	0.55	V

**NOTE:**

- These inputs are normally wired to V<sub>CC</sub>, GND, or unconnected. Internal termination resistors bias unconnected inputs to V<sub>CC</sub>/2. If these inputs are switched, the function and timing of the outputs may be glitched, and the PLL may require an additional lock time before all datasheet limits are achieved.

**POWER SUPPLY CHARACTERISTICS**

Symbol	Parameter	Test Conditions <sup>(1)</sup>	Typ. <sup>(2)</sup>	Max.	Unit
I <sub>CCQ</sub>	Quiescent Power Supply Current	V <sub>CC</sub> = Max., TEST = MID, REF = LOW, GND/sOE = LOW, All outputs unloaded	8	25	mA
ΔI <sub>CC</sub>	Power Supply Current per Input HIGH	V <sub>CC</sub> = Max., V <sub>IN</sub> = 3V	1	30	μA
I <sub>CCD</sub>	Dynamic Power Supply Current per Output	V <sub>CC</sub> = Max., C <sub>L</sub> = 0pF	55	90	μA/MHz
I <sub>TOT</sub>	Total Power Supply Current	V <sub>CC</sub> = 3.3V, F <sub>REF</sub> = 25MHz, C <sub>L</sub> = 160pF <sup>(1)</sup>	34	—	mA
		V <sub>CC</sub> = 3.3V, F <sub>REF</sub> = 33MHz, C <sub>L</sub> = 160pF <sup>(1)</sup>	42	—	
		V <sub>CC</sub> = 3.3V, F <sub>REF</sub> = 66MHz, C <sub>L</sub> = 160pF <sup>(1)</sup>	76	—	

**NOTE:**

- For eight outputs, each loaded with 20pF.

## INPUT TIMING REQUIREMENTS

Symbol	Description <sup>(1)</sup>	Min.	Max.	Unit
t <sub>R</sub> , t <sub>F</sub>	Maximum input rise and fall times, 0.8V to 2V	—	10	ns/V
t <sub>PWC</sub>	Input clock pulse, HIGH or LOW	3	—	ns
D <sub>H</sub>	Input duty cycle	10	90	%
REF	Reference clock input	15	85	MHz

**NOTE:**

- Where pulse width implied by D<sub>H</sub> is less than t<sub>PWC</sub> limit, t<sub>PWC</sub> limit applies.

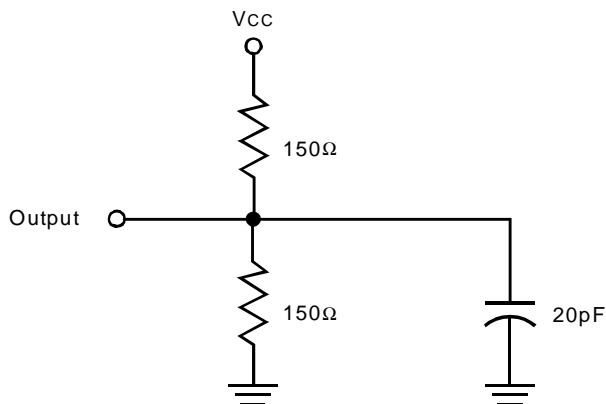
## SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	IDT5V9910A-2			IDT5V9910A-5			IDT5V9910A-7			Unit	
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
F <sub>REF</sub>	REF Frequency Range	FS = LOW	15	—	35	15	—	35	15	—	35	MHz
		FS = MED	25	—	60	25	—	60	25	—	60	
		FS = HIGH	40	—	85	40	—	85	40	—	85	
t <sub>RPWH</sub>	REF Pulse Width HIGH <sup>(6)</sup>	3	—	—	3	—	—	3	—	—	ns	
t <sub>RPWL</sub>	REF Pulse Width LOW <sup>(6)</sup>	3	—	—	3	—	—	3	—	—	ns	
t <sub>SKEW0</sub>	Zero Output Skew (All Outputs) <sup>(1,3,4)</sup>	—	0.1	0.25	—	0.25	0.5	—	0.3	0.75	ns	
t <sub>DEV</sub>	Device-to-Device Skew <sup>(1,2,5)</sup>	—	—	0.75	—	—	1.25	—	—	1.65	ns	
t <sub>PD</sub>	REF Input to FB Propagation Delay <sup>(1,7)</sup>	−0.25	0	0.25	−0.5	0	0.5	−0.7	0	0.7	ns	
t <sub>ODCV</sub>	Output Duty Cycle Variation from 50% <sup>(1)</sup>	−1.2	0	1.2	−1.2	0	1.2	−1.2	0	1.2	ns	
t <sub>ORISE</sub>	Output Rise Time <sup>(1)</sup>	0.15	1	1.2	0.15	1	1.5	0.15	1.5	2.5	ns	
t <sub>OFALL</sub>	Output Fall Time <sup>(1)</sup>	0.15	1	1.2	0.15	1	1.5	0.15	1.5	2.5	ns	
t <sub>LOCK</sub>	PLL Lock Time <sup>(1,6)</sup>	—	—	0.5	—	—	0.5	—	—	0.5	ms	
t <sub>JR</sub>	Cycle-to-Cycle Output Jitter <sup>(1)</sup>	RMS	—	—	25	—	—	25	—	—	25	ps
		Peak-to-Peak	—	—	200	—	—	200	—	—	200	

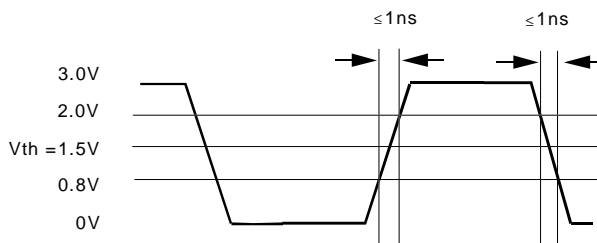
**NOTES:**

- All timing and jitter tolerances apply for F<sub>NOM</sub> ≥ 25MHz.
- Skew is the time between the earliest and the latest output transition among all outputs with the specified load.
- t<sub>SKEW</sub> is the skew between all outlets. See AC TEST LOADS.
- For IDT5V9910A-2 t<sub>SKEW0</sub> is measured with C<sub>L</sub> = 0pF; for C<sub>L</sub> = 20pF, t<sub>SKEW0</sub> = 0.35ns Max.
- 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.)
- 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.
- t<sub>PD</sub> is measured with REF input rise and fall times (from 0.8V to 2V) of 1ns.
- Refer to INPUT TIMING REQUIREMENTS for more detail.

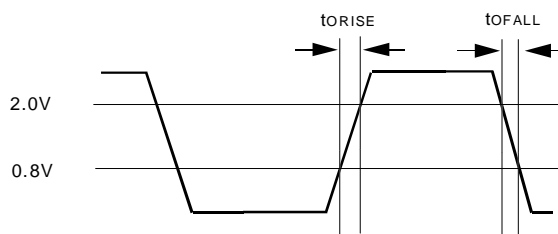
## AC TEST LOADS AND WAVEFORMS



Test Load

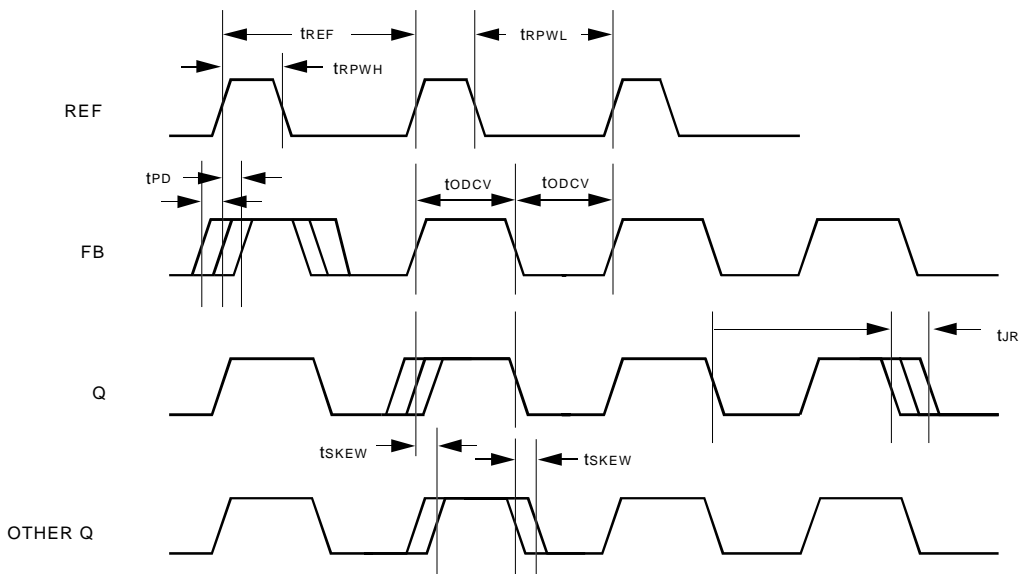


LVTTL Input Test Waveform



LVTTL Output Waveform

## AC TIMING DIAGRAM



### NOTES:

Skew: The time between the earliest and the latest output transition among all outputs when all are loaded with 20pF and terminated with 75Ω to  $V_{cc}/2$ .

tsKEW: The skew between all outputs.

tDEV: The output-to-output skew between any two devices operating under the same conditions ( $V_{cc}$ , ambient temperature, air flow, etc.)

tODCV: The deviation of the output from a 50% duty cycle.

tORISE and tOFALL are measured between 0.8V and 2V.

tLOCK: The time that is required before synchronization is achieved. This specification is valid only after  $V_{cc}$  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 tPD is within specified limits.

## ORDERING INFORMATION

IDT	XXXXX	XX	X		
	Device Type	Package	Process		
				Blank	Commercial (0°C to +70°C) Industrial (-40°C to +85°C)
				I	
				SO	Small Outline IC (300-mil)
				5V9910A-2 5V9910A-5 5V9910A-7	3.3V Low Skew PLL Clock Driver TurboClock Jr.



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