



LOW SKEW PLL CLOCK DRIVER TURBOCLOCK™ JR.

QS59920

FEATURES:

- Eight zero delay outputs
- Selectable positive or negative edge synchronization
- Synchronous output enable
- Output frequency: 25MHz to 85MHz
- CMOS outputs
- 3 skew grades:
 - QS59920 -2: $t_{SKEW0} < 250ps$
 - QS59920 -5: $t_{SKEW0} < 500ps$
 - QS59920 -7: $t_{SKEW0} < 750ps$
- 3-level input for PLL range control
- PLL bypass for DC testing
- External feedback, internal loop filter
- 46mA I_{OL} high drive outputs
- Low Jitter: $< 200ps$ peak-to-peak
- Outputs drive 50Ω terminated lines
- Pin compatible with Cypress CY7B9920
- Available in SOIC Package

DESCRIPTION:

The QS59920 is a high fanout phase lock loop clock driver intended for high performance computing and data-communications applications. The QS59920 has CMOS outputs.

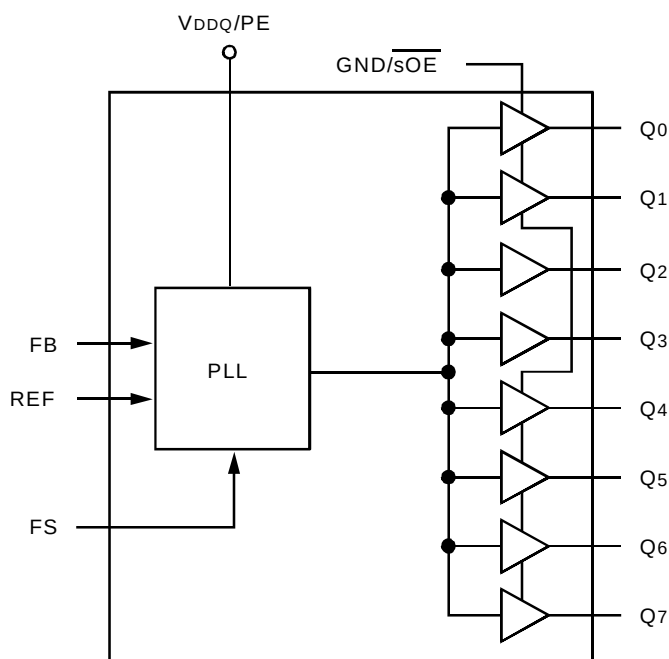
The QS59920 maintains Cypress CY7B9920 compatibility while providing two additional features: Synchronous Output Enable ($GND/\overline{sOE}$), and Positive/Negative Edge Synchronization (V_{DDQ}/PE). When the $GND/\overline{sOE}$ pin is held low, all outputs are synchronously enabled (CY7B9920 compatibility). However, if $GND/\overline{sOE}$ is held high, all outputs except Q2 and Q3 are synchronously disabled.

Furthermore, when the V_{DDQ}/PE is held high, all outputs are synchronized with the positive edge of the REF clock input (CY7B9920 compatibility). When V_{DDQ}/PE is held low, all 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.

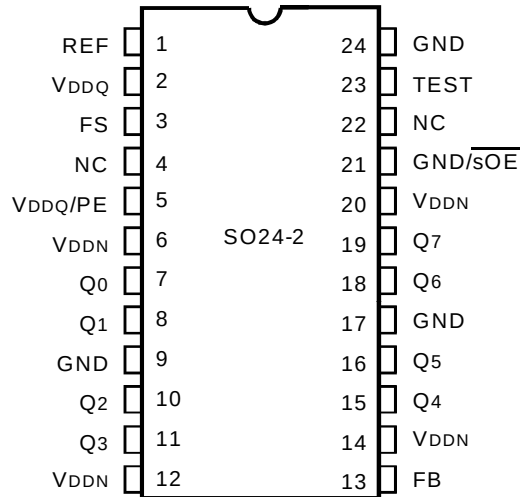
FUNCTIONAL BLOCK DIAGRAM



COMMERCIAL/INDUSTRIAL TEMPERATURE RANGES

MARCH 2000

PIN CONFIGURATION



SOIC
TOP VIEW

ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Rating	Max.	Unit
	Supply Voltage to Ground	-0.5 to +7	V
V_i	DC Input Voltage	-0.5 to +7	V
	Maximum Power Dissipation ($T_A = 85^\circ\text{C}$)	530	mW
T_{STG}	Storage Temperature Range	-65°C to +150°C	°C

NOTE:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating 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 rating conditions for extended periods may affect reliability.

CAPACITANCE ($T_A = 25^\circ\text{C}$, $f = 1\text{MHz}$, $V_{IN} = 0\text{V}$)

Parameter	Description	Typ.	Max.	Unit
C_{IN}	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 ⁽¹⁾	IN	When MID or HIGH, disables PLL (except for conditions of Note 1). REF goes to all outputs. Set LOW for normal operation.
GND/ $\overline{\text{sOE}}$ ⁽¹⁾	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/ $\overline{\text{sOE}}$ LOW for normal operation.
VDDQ/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 ⁽²⁾	IN	Frequency range select. 3 level input. FS = GND: 25 to 35MHz. FS = MID (or open): 35 to 60MHz FS = VDD: 60 to 85MHz
Q0 - Q7	OUT	8 clock output
VDDN	PWR	Power supply for output buffers
VDDQ	PWR	Power supply for phase locked loop and other internal circuitry
GND	PWR	Ground

NOTES:

- When TEST = MID and GND/ $\overline{\text{sOE}}$ = HIGH, PLL remains active.
- This input is wired to VDD, 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	QS59920-5, -7 (Industrial)		QS59920-2 (Commercial)		Unit
		Min.	Max.	Min.	Max.	
V _{DD}	Power Supply Voltage	4.5	5.5	4.75	5.25	V
T _A	Ambient Operating Temperature	-40	+85	0	+70	°C

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Conditions	Min.	Max.	Unit
V _{IH}	Input HIGH Voltage	Guaranteed Logic HIGH (REF, FB Inputs Only)	V _{DD} −1.35	—	V
V _{IL}	Input LOW Voltage	Guaranteed Logic LOW (REF, FB Inputs Only)	—	1.35	V
V _{IHH}	Input HIGH Voltage ⁽¹⁾	3-Level Inputs Only	V _{DD} −1	—	V
V _{IMM}	Input MID Voltage ⁽¹⁾	3-Level Inputs Only	V _{DD} /2−0.5	V _{DD} /2+0.5	V
V _{ILL}	Input LOW Voltage ⁽¹⁾	3-Level Inputs Only	—	1	V
I _{IN}	Input Leakage Current (REF, FB Inputs Only)	V _{IN} = V _{DD} or GND V _{DD} = Max.	—	±5	μA
I ₃	3-Level Input DC Current (TEST, FS)	V _{IN} = V _{DD} HIGH Level	—	±200	μA
		V _{IN} = V _{DD} /2 MID Level	—	±50	
		V _{IN} = GND LOW Level	—	±200	
I _{PU}	Input Pull-Up Current (V _{DDQ} /PE)	V _{DD} = Max., V _{IN} = GND	—	±100	μA
I _{PD}	Input Pull-Down Current (GND/sOE)	V _{DD} = Max., V _{IN} = V _{DD}	—	±100	μA
V _{OH}	Output HIGH Voltage	V _{DD} = Min., I _{OH} = −16mA	—	—	V
		V _{DD} = Min., I _{OH} = −40mA	V _{DD} −0.75	—	V
V _{OL}	Output LOW Voltage	V _{DD} = Min., I _{OL} = 46mA	—	0.45	V
I _{OS}	Output Short Circuit Current ⁽²⁾	V _{DD} = Max., V _O = GND	—	N/A	mA

NOTES:

- These inputs are normally wired to V_{DD}, GND, or unconnected. Internal termination resistors bias unconnected inputs to V_{DD}/2. If these inputs are switched, the function and timing of the outputs may be glitched, and the PLL may require an additional t_{LOCK} time before all datasheet limits are achieved.
- QS59920 outputs are not to be shorted.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions	Typ.	Max.	Unit
I _{DDQ}	Quiescent Power Supply Current	V _{DD} = Max., TEST = MID, REF = LOW, GND/sOE = LOW, All outputs unloaded	10	40	mA
ΔI _{DD}	Power Supply Current per Input HIGH	V _{DD} = Max., V _{IN} = 3.4V	0.4	1.5	mA
I _{DDD}	Dynamic Power Supply Current per Output	V _{DD} = Max., C _L = 0pF	100	160	μA/MHz
I _{TOT}	Total Power Supply Current	V _{DD} = 5V, F _{REF} = 25MHz, C _L = 240pF ⁽¹⁾	53	—	mA
		V _{DD} = 5V, F _{REF} = 33MHz, C _L = 240pF ⁽¹⁾	63	—	mA
		V _{DD} = 5V, F _{REF} = 66MHz, C _L = 240pF ⁽¹⁾	117	—	mA

NOTE:

- For eight outputs, each loaded with 30pF.

INPUT TIMING REQUIREMENTS

Symbol	Description ⁽¹⁾	Min.	Max.	Unit
t _R , t _F	Maximum input rise and fall times, 0.8V to 2V	—	10	ns/V
t _{PWC}	Input clock pulse, HIGH or LOW	3	—	ns
DH	Input duty cycle	10	90	%
REF	Reference Clock Input	25	85	MHz

NOTE:

- Where pulse width implied by DH is less than t_{PWC} limit, t_{PWC} limit applies.

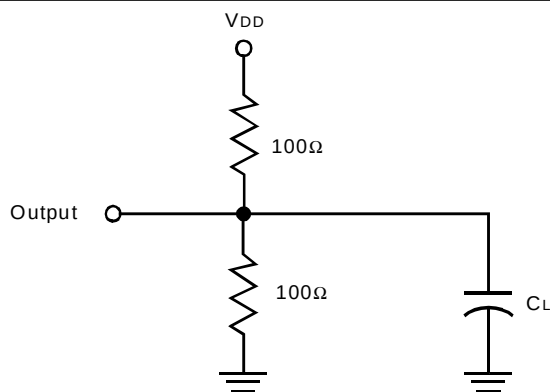
SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter		QS59920-2			QS59920-5			QS59920-7			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
FREF	REF Frequency Range	FS = LOW	25	—	35	25	—	35	25	—	35	MHz
		FS = MID	35	—	60	35	—	60	35	—	60	
		FS = HIGH	60	—	85	60	—	85	60	—	85	
trpwh	REF Pulse Width HIGH ^(1,7)		3	—	—	3	—	—	3	—	—	ns
trpwl	REF Pulse Width LOW ^(1,7)		3	—	—	3	—	—	3	—	—	ns
tskew	Zero Output Skew (All Outputs) ^(1,3)		—	0.1	0.25	—	0.25	0.5	—	0.3	0.75	ns
tdev	Device-to-Device Skew ^(1,2,4)		—	—	0.75	—	—	1.25	—	—	1.65	ns
tpd	REF Input to FB Propagation Delay ^(1,6)		−0.25	0	0.25	−0.5	0	0.5	−0.7	0	0.7	ns
todcv	Output Duty Cycle Variation from 50% ⁽¹⁾		−1.2	0	1.2	−1.2	0	1.2	−1.5	0	1.5	ns
torise	Output Rise Time ⁽¹⁾		0.5	2	2.5	0.5	2	3.5	0.5	3	5	ns
tofall	Output Fall Time ⁽¹⁾		0.5	2	2.5	0.5	2	3.5	0.5	3	5	ns
tlock	PLL Lock Time ⁽¹⁾		—	—	0.5	—	—	0.5	—	—	0.5	ms
tj _R	Cycle-to-Cycle Output Jitter	RMS	—	—	25	—	—	25	—	—	25	ps
		Peak-to-Peak	—	—	200	—	—	200	—	—	200	

NOTES:

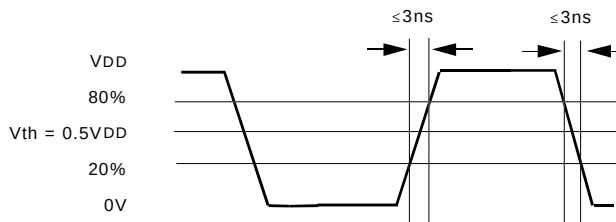
- All timing tolerances apply for F_{NOM} ≥ 25MHz. Guaranteed by design and characterization, not subject to production testing.
- Skew is the time between the earliest and the latest output transition among all outputs with the specified load.
- tskew is the skew between all outputs. See AC Test Loads.
- tdev is the output-to-output skew between any two devices operating under the same conditions (V_{DD}, ambient temperature, air flow, etc.)
- tlock is the time that is required before synchronization is achieved. This specification is valid only after V_{DD} 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_{PD} is within specified limits.
- t_{PD} 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

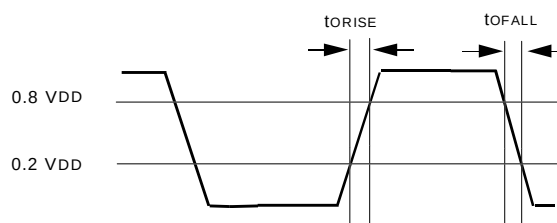


$C_L = 50\text{pF}$ ($C_L = 30\text{pF}$ for -2 and -5 devices)

TESTLOAD

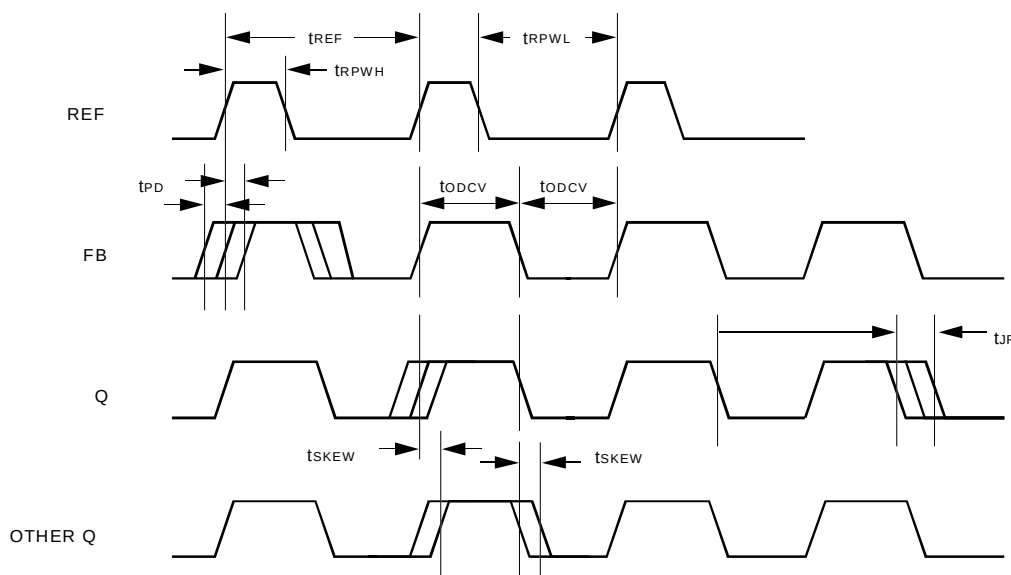


CMOS INPUT TEST WAVEFORM



CMOS 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 50pF (30pF for -2 and -5) and terminated with $V_{DD}/2$.
- t_{SKEW} : The skew between all outputs.
- t_{DEV} : The output-to-output skew between any two devices operating under the same conditions (V_{DD} , ambient temperature, air flow, etc.)
- t_{ODCV} : The deviation of the output from a 50% duty cycle.
- t_{ORISE} and t_{OFALL} are measured between $0.2V_{DD}$ and $0.8V_{DD}$.
- t_{LOCK} : The time that is required before synchronization is achieved. This specification is valid only after V_{DD} 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_{PD} is within specified limits.

ORDERING INFORMATION

QS	XXXXX	XX	X		
	Device Type	Package	Process		
			C		Commercial (0°C to +70°C)
			I		Industrial (-40°C to +85°C)
			SO		Small Outline IC (300-mil) (SO24-2)
			59920-2		Low Skew PLL Clock Driver TurboClock Jr.
			59920-5		
			59920-7		



CORPORATE HEADQUARTERS
2975 Stender Way
Santa Clara, CA 95054

for SALES:
800-345-7015 or 408-727-6116
fax: 408-492-8674
www.idt.com*

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