National Semiconductor

CGS74CT2524
1 to 4 Minimum Skew (450 ps) Clock Driver

General Description

These minimum skew clock drivers are designed for Clock Generation and Support (CGS) applications operating at high frequencies. This device guarantees minimum output skew across the outputs of a given device.

Skew parameters are also provided as a means to measure duty cycle requirements as those found in high speed clocking systems. The '2524 is a minimum skew clock driver with one input driving four outputs, specifically designed for signal generation and clock distribution applications.

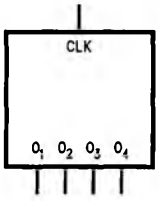
Features

- Guaranteed and tested:
  450 ps pin-to-pin skew
  (t_{OSHL} and t_{OHLH}) M package
- Implemented on National's FACT™ family process
- 1 input to 4 outputs low skew clock distribution
- Symmetric output current drive: 24 mA I_{OH}/I_{OL}
- Industrial temperature of −40°C to +85°C
- 8-pin DIP and SOIC packages
- Low dynamic power consumption above 20 MHz
- Guaranteed 2 kV ESD protection

Ordering Code: See Section 5

Logic Symbol

'2524



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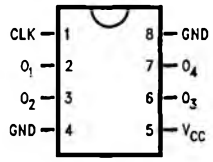
The output pins act as a single entity and will follow the state of the CLK when the clock distribution chip is selected.

Connection Diagrams

Pin Assignment for M and N

'2524



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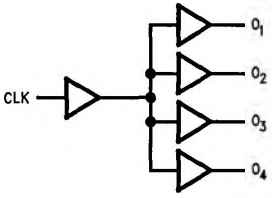

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Pin Description

Pin Names	Descripton
CLK	Clock Input
O_1–O_4	Outputs

Truth Table

'2524

Inputs	Outputs
CLK	O_1–O_4
L	L
H	H

L = Low Logic Level
H = High Logic Level

Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})			−0.5 to 7.0V
DC Input Voltage Diode Current (I_{IK})			
$V = -0.5V$			−20 mA
$V = V_{CC} + 0.5V$			+20 mA
DC Input Voltage (V_I)			$-0.5V$ to $V_{CC} + 0.5V$
DC Output Diode (Current) (I_O)			
$V = -0.5V$			−20 mA
$V = V_{CC} + 0.5V$			+20 mA
DC Output Voltage (V_O)			$-0.5V$ to $V_{CC} + 0.5V$
DC Output Source or Sink Current (I_O)			±50 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})			±50 mA
Storage Temperature (T_{STG})			−65°C to +150°C
Junction Temperature (θ_J)	0	225	500 LFM
	M 167	132	117°C/W
	N 115	79	62°C/W

Recommended Operating Conditions

Supply Voltage (V_{CC})	4.5V to 5.5V
Input Voltage (V_I)	0V to V_{CC}
Output Voltage (V_O)	0 to V_{CC}
Operating Temperature (T_A)	−40°C to +85°C
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

NOTE: *The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the DC and AC Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The Recommended Operating Conditions will define the conditions for actual device operation.*

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	CGS74CT2524			Units	Conditions
			$T_A = +25°C$	$T_A = -40°C$ to $+85°C$			
			Typ	Guaranteed Limits			
V_{IH}	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	1.5	2.0	2.0		
V_{IL}	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	1.5	0.8	0.8		
V_{OH}	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4	V	$V_{IN} = V_{IL}$ or V_{IH} $I_{OUT} = -50\ \mu A$
		5.5	5.49	5.4	5.4		
		4.5		3.86	3.76	V	$V_{IN} = V_{IL}$ or V_{IH} $I_{OH} = -24$ mA
		5.5		4.86	4.76		
V_{OL}	Minimum Low Level Output Voltage	4.5	0.001	0.1	0.1	V	$V_{IN} = V_{IL}$ or V_{IH} $I_{OUT} = 50\ \mu A$
		5.5	0.001	0.1	0.1		
		4.5		0.36	0.44	V	$V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 24$ mA
		5.5		0.36	0.44		
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	mA	$V_I = V_{CC}$, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.5	mA	$V_I = V_{CC} - 2.1V$
I_{OLD}	Minimum Dynamic Output Current	5.5			75	mA	$V_{OLD} = 1.65V$ Max
I_{OHD}		5.5			−75	mA	$V_{OHD} = 3.85V$ Min
I_{CC}	Minimum Quiescent Supply Current	5.5		8.0	80	μA	$V_{IN} = V_{CC}$ or GND

AC Electrical Characteristics

Over recommended operating free air temperature range. All typical values are measured at V_{CC} = 5V, T_A = 25°C.

Symbol	Parameter	CT2524 V_{CC} = 4.5V to 5.5V, T_A = −40°C to +85°C, C_L = 50 pF, R_L = 500Ω			Units
		Min	Typ	Max	
t_{PLH}	Low-to-High Propagation Delay CK to O_n ('2524)	3.5		9.0	ns
t_{PHL}	High-to-Low Propagation Delay CK to O ('2524)	3.5		9.0	ns

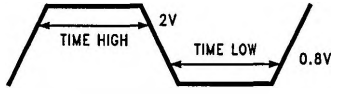
Extended AC Electrical Characteristics

Over recommended operating free air temperature range. All typical values are measured at V_{CC} = 5V, T_A = 25°C.

Symbol	Parameter	CT2524 V_{CC} = 4.5V to 5.5V, T_A = −40°C to +85°C, C_L = 50 pF, R_L = 500Ω					Units
		Package	V_{CC} (V)	Min	Typ	Max	
t_{OSHL}	Maximum Skew Common Edge Output-to-Output Variation*	M	5.0			450	ps
		N				500	
t_{OSLH}	Maximum Skew Common Edge Output-to-Output Variation*	M	5.0			450	ps
		N				500	
t_{PS}	Maximum Skew Pin (Signal) Transition Variation**	ALL	5.0			1.0	ns
t_{rise} t_{fall}	Rise Time/Fall Time (from 0.8V to 2.0V/2.0V to 0.8V)	ALL	5.0			1.5	ns
F_{max}	Maximum Operating Frequency	ALL			100		MHz

Extended Electrical Characteristics: (66.67 MHz)

CGS74CT2524	T_A = −40 to +85°C, C_L = 50 pF, R_L = 500Ω	Units
Time High	4	ns
Time Low	4	ns



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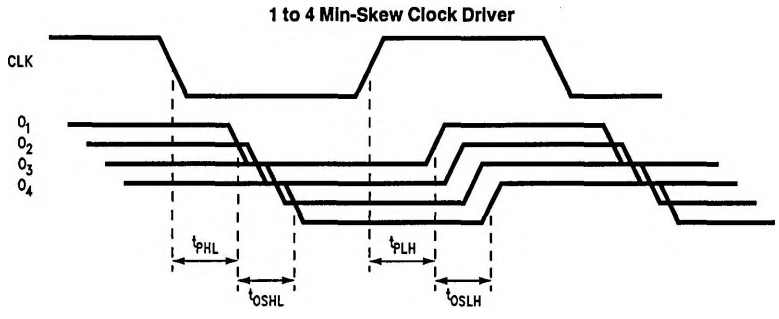
Time high is measured with outputs at above 2V.
Time low is measured with outputs at below 0.8V.

t_{OSHL} and t_{OSLH} parameters for M package are being guaranteed by design at 66.67 MHz until Oct. 1993. Thereafter will be guaranteed by production test.

* Output-to-Output Skew is defined as the absolute value of the difference between the actual propagation delay from any outputs within the same packaged device. The specifications apply to any outputs switching in the same direction either HIGH or LOW (t_{OSHL}) or LOW to HIGH (t_{OSLH}) or in opposite directions both HL and LH (t_{OST}).

** Pin transition skews is the absolute difference between High-to-Low and Low-to-High propagation delay measure at a given output pin.

Timing Diagrams



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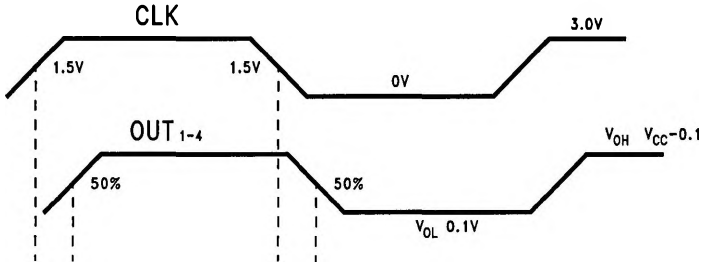

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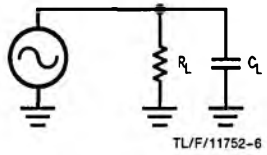
Test Circuit



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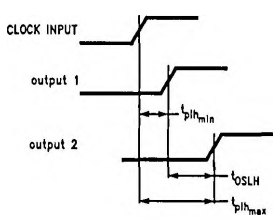
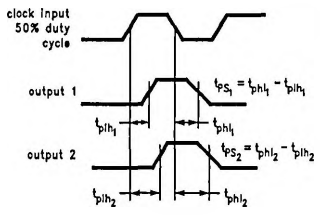
R_L is 500Ω
C_L is 50 pF for all prop delays and skew measurements.

Notes:

- Refer to Minimum Skew Parameters Measurement Information Chart for definitions of each skew specification.
- Load capacitance includes the test jig.

Minimum Skew Parameters

Parameter Measurement Information (Preliminary)

Definition	Example	Significance
t_{OSHL}, t_{OSLH} **Common Edge Skew:** Output Skew for HIGH-to-LOW Transitions: $t_{OSHL} = \lvert t_{PHL_{max}} - t_{PHL_{min}} \rvert$ Output Skew for LOW-to-HIGH Transitions: $t_{OSLH} = \lvert t_{PLH_{max}} - t_{PLH_{min}} \rvert$ Propagation delays are measured across the outputs of any given device.	 **FIGURE A**	• t_{OS}, Output Skew or Common Edge Skew • Skew parameter to observe propagation delay differences in applications requiring synchronous data/clock operations.
t_{PS} **Pin Skew or Transition Skew:** $t_{PS} = \lvert t_{PHL_i} - t_{PLH_i} \rvert$ Both HIGH-to-LOW and LOW-to-HIGH propagation delays are measured at each output pin across the given device. T_{PS} is the maximum difference for outputs i = 1 to 8 within a device package.	 **FIGURE B**	• t_{PS}, Pin Skew or Transition Skew • Skew parameter to observe duty cycle degradation of any output signal (pin).