

# LOW SKEW 1 TO 4 CLOCK BUFFER

# ICS524

## Description

The ICS524 is a low skew, single input to four output, clock buffer. Part of IDT's ClockBlocks™ family, this is our lowest skew, small clock buffer.

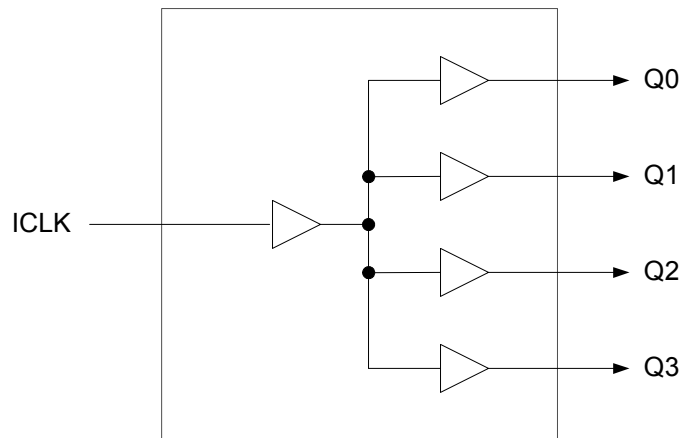
See the ICS552-02 for a 1 to 8 low skew buffer. For more than eight outputs, see the MK74CBxxx Buffalo™ series of clock drivers.

IDT makes many non-PLL and PLL based low skew output devices as well as Zero Delay Buffers to synchronize clocks. Contact us for all of your clocking needs.

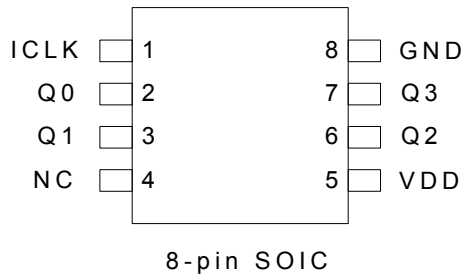
## Features

- Extremely low skew outputs (50 ps maximum)
- Packaged in 8-pin SOIC
- Available in Pb (lead) free package
- Low power CMOS technology
- Operating voltages of 2.5 V to 5 V
- 5 V tolerant input clock
- Industrial temperature range

## Block Diagram



## Pin Assignment



## Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	ICLK	Input	Clock input, 5V tolerant input.
2	Q0	Output	Clock output 0.
3	Q1	Output	Clock output 1.
4	NC	—	Internal no connect.
5	VDD	Power	Connect to +2.5 V, +3.3 V or +5.0 V.
6	Q2	Output	Clock Output 2.
7	Q3	Output	Clock Output 3.
8	GND	Power	Connect to ground.

## External Components

A minimum number of external components are required for proper operation. A decoupling capacitor of 0.01  $\mu\text{F}$  should be connected between VDD on pin 5 and GND on pin 8, as close to the device as possible. A 33  $\Omega$  series terminating resistor may be used on each clock output if the trace is longer than 1 inch.

To achieve the low output skew that the ICS524 is capable of, careful attention must be paid to board layout. Essentially, all four outputs must have identical terminations, identical loads and identical trace geometries. If they do not, the output skew will be degraded. For example, using a 30 $\Omega$  series termination on one output (with 33 $\Omega$  on the others) will cause at least 15 ps of skew.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS524. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	7 V
Outputs	-0.5 V to VDD+0.5 V
ICLK	-0.5 V to 5.5 V
Ambient Operating Temperature	-40 to +85° C
Storage Temperature	-65 to +150° C
Junction Temperature	125° C
Soldering Temperature	260° C

## Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature	-40		+85	°C
Power Supply Voltage (measured in respect to GND)	+2.375		+5.25	V

## DC Electrical Characteristics

VDD=2.5 V ±5%, Ambient temperature -40 to +85° C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		2.375		2.625	V
Input High Voltage, ICLK	V <sub>IH</sub>	Note 1	VDD/2+0.5		5.5	V
Input Low Voltage, ICLK	V <sub>IL</sub>	Note 1			VDD/2-0.5	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -16 mA	2			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 16 mA			0.4	V
Operating Supply Current	IDD	No load, 135 MHz		25		mA
Nominal Output Impedance	Z <sub>O</sub>			20		Ω
Input Capacitance	C <sub>IN</sub>	ICLK		5		pF
Short Circuit Current	I <sub>OS</sub>			±28		mA

## DC Electrical Characteristics (continued)

**VDD=3.3 V ±5%** , Ambient temperature -40 to +85°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.15		3.45	V
Input High Voltage, ICLK	V <sub>IH</sub>	Note 1	VDD/2+0.7		5.5	V
Input Low Voltage, ICLK	V <sub>IL</sub>	Note 1			VDD/2-0.7	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -25 mA	2.4			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 25 mA			0.4	V
Output High Voltage (CMOS Level)	V <sub>OH</sub>	I <sub>OH</sub> = -12 mA	VDD-0.4			V
Operating Supply Current	IDD	No load, 135 MHz		35		mA
Nominal Output Impedance	Z <sub>O</sub>			20		Ω
Input Capacitance	C <sub>IN</sub>	ICLK		5		pF
Short Circuit Current	I <sub>OS</sub>			±50		mA

**VDD=5 V ±5%** , Ambient temperature -40 to +85°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		4.75		5.25	V
Input High Voltage, ICLK	V <sub>IH</sub>	Note 1	VDD/2+1		5.5	V
Input Low Voltage, ICLK	V <sub>IL</sub>	Note 1			VDD/2-1	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -35 mA	2.4			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 35 mA			0.4	V
Output High Voltage (CMOS Level)	V <sub>OH</sub>	I <sub>OH</sub> = -12 mA	VDD-0.4			V
Operating Supply Current	IDD	No load, 135 MHz		45		mA
Nominal Output Impedance	Z <sub>O</sub>			20		Ω
Input Capacitance	C <sub>IN</sub>	ICLK		5		pF
Short Circuit Current	I <sub>OS</sub>			±80		mA

Notes: 1. Nominal switching threshold is VDD/2

## AC Electrical Characteristics

**VDD = 2.5 V ±5%**, Ambient Temperature -40 to +85° C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency			0		200	MHz
Output Rise Time	t <sub>OR</sub>	0.8 to 2.0 V, C <sub>L</sub> =15 pF		1.0	1.5	ns
Output Fall Time	t <sub>OF</sub>	2.0 to 0.8 V, C <sub>L</sub> =15 pF		1.0	1.5	ns
Propagation Delay	Note 1		2.2	3	5	ns
Output to Output Skew	Note 2	Rising edges at VDD/2		0	50	ps
Device to Device Skew		Rising edges at VDD/2			500	ps

**VDD = 3.3 V ±5%**, Ambient Temperature -40 to +85° C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency			0		200	MHz
Output Rise Time	t <sub>OR</sub>	0.8 to 2.0 V, C <sub>L</sub> =15 pF		0.6	1.0	ns
Output Fall Time	t <sub>OF</sub>	2.0 to 0.8 V, C <sub>L</sub> =15 pF		0.6	1.0	ns
Propagation Delay	Note 1		2.0	2.4	4	ns
Output to Output Skew	Note 2	Rising edges at VDD/2		0	50	ps
Device to Device Skew		Rising edges at VDD/2			500	ps

**VDD = 5 V ±5%**, Ambient Temperature -40 to +85° C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency			0		200	MHz
Output Rise Time	t <sub>OR</sub>	0.8 to 2.0 V, C <sub>L</sub> =15 pF		0.3	0.7	ns
Output Fall Time	t <sub>OF</sub>	2.0 to 0.8 V, C <sub>L</sub> =15 pF		0.3	0.7	ns
Propagation Delay	Note 1		1.8	2.5	4	ns
Output to Output Skew	Note 2	Rising edges at VDD/2		0	50	ps
Device to Device Skew		Rising edges at VDD/2			500	ps

Notes: 1. With rail to rail input clock

2. Between any 2 outputs with equal loading.

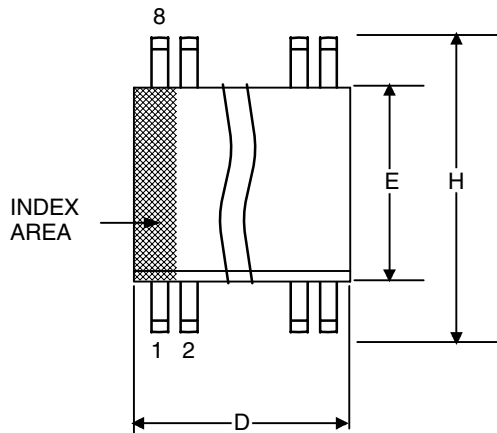
3. Duty cycle on outputs will match incoming clock duty cycle. Consult IDT for tight duty cycle clock generators.

## Thermal Characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Thermal Resistance Junction to Ambient	θ <sub>JA</sub>	Still air		150		°C/W
	θ <sub>JA</sub>	1 m/s air flow		140		°C/W
	θ <sub>JA</sub>	3 m/s air flow		120		°C/W
Thermal Resistance Junction to Case	θ <sub>JC</sub>			40		°C/W

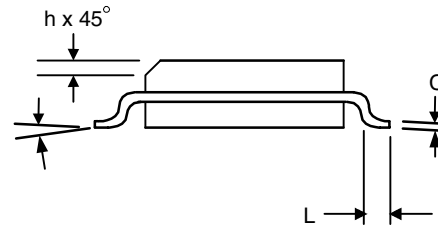
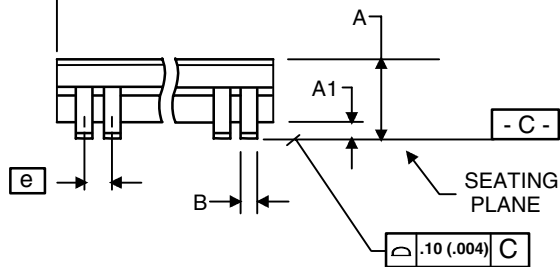
## Package Outline and Package Dimensions (8-pin SOIC, 150 Mil. Narrow Body)

Package dimensions are kept current with JEDEC Publication No. 95



Symbol	Millimeters		Inches*	
	Min	Max	Min	Max
A	1.35	1.75	.0532	.0688
A1	0.10	0.25	.0040	.0098
B	0.33	0.51	.013	.020
C	0.19	0.25	.0075	.0098
D	4.80	5.00	.1890	.1968
E	3.80	4.00	.1497	.1574
e	1.27 BASIC		0.050 BASIC	
H	5.80	6.20	.2284	.2440
h	0.25	0.50	.010	.020
L	0.40	1.27	.016	.050
$\alpha$	0°	8°	0°	8°

\*For reference only. Controlling dimensions in mm.



## Ordering Information

Part / Order Number	Marking	Shipping Packaging	Package	Temperature
524MILF	524MILF	Tubes	8-pin SOIC	-40 to +85 °C
524MILFT	524MILF	Tape and Reel	8-pin SOIC	-40 to +85 °C

Parts that are ordered with a "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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**Corporate Headquarters**

Integrated Device Technology, Inc.  
6024 Silver Creek Valley Road  
San Jose, CA 95138  
[www.idt.com](http://www.idt.com)



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**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.