

## General Description



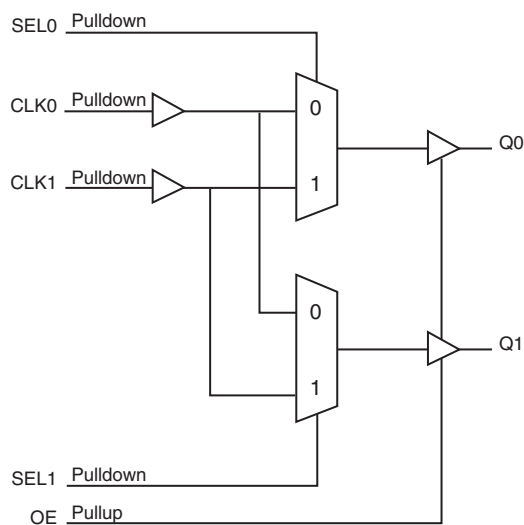
The ICS83052I-01 is a 2-bit, 2:1, Single-ended Multiplexer and a member of the HiPerClockS™ family of High Performance Clock Solutions from IDT. The ICS83052I-01 has two selectable single-ended clock inputs and two single-ended

clock outputs. The output has a  $V_{DDO}$  pin which may be set at 3.3V, 2.5V, or 1.8V, making the device ideal for use in voltage translation applications. An output enable pin places the output in a high impedance state which may be useful for testing or debug. Possible applications include systems with up to two transceivers which need to be independently set for different rates. For example, a board may have two transceivers, each of which need to be independently configured for 1 Gigabit Ethernet or 1 Gigabit Fibre Channel rates. Another possible application may require the ports to be independently set for FEC (Forward Error Correction) or non-FEC rates. The device operates up to 250MHz and is packaged in a 16 TSSOP.

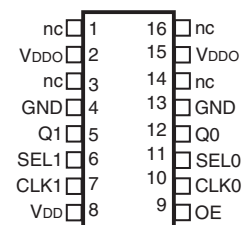
## Features

- 2-bit, 2:1 single-ended multiplexer
- Nominal output impedance:  $15\Omega$  ( $V_{DDO} = 3.3V$ )
- Maximum output frequency: 250MHz
- Propagation delay: 3ns (maximum),  $V_{DD} = V_{DDO} = 3.3V$
- Input skew: 85ps (maximum),  $V_{DD} = V_{DDO} = 3.3V$
- Part-to-part skew: 500ps (maximum),  $V_{DD} = V_{DDO} = 3.3V$
- Output skew: 65ps (maximum),  $V_{DD} = V_{DDO} = 3.3V$
- Additive phase jitter, RMS (12KHz - 20MHz): 0.15ps (typical)
- Operating supply modes:
  - $V_{DD}/V_{DDO}$
  - 3.3V/3.3V
  - 3.3V/2.5V
  - 3.3V/1.8V
  - 2.5V/2.5V
  - 2.5V/1.8V
- -40°C to 85°C ambient operating temperature
- Available in both standard (RoHS5) and lead-free (RoHS 6) packages

## Block Diagram



## Pin Assignment



**ICS83052I-01**  
**16-Lead TSSOP**  
**4.4mm x 5.0mm x 0.925mm**  
**package body**  
**G Package**

**Table 1. Pin Descriptions**

Number	Name	Type		Description
1, 3, 14, 16	nc	Unused		No connect.
2, 15	V <sub>DDO</sub>	Power		Output supply pins.
4, 13	GND	Power		Power supply ground
5, 12	Q1, Q0	Output		Single-ended clock outputs. LVCMOS/LVTTL interface levels.
6, 11	SEL1, SEL0	Input	Pulldown	Clock select inputs. See Table 3, Control Input Function Table. LVCMOS / LVTTL interface levels.
7, 10	CLK1, CLK0	Input	Pulldown	Single-ended clock input. LVCMOS/LVTTL interface levels.
8	V <sub>DD</sub>	Power		Power supply pin.
9	OE	Input	Pullup	Output enable. When LOW, outputs are in HIGH impedance state. When HIGH, outputs are active. LVCMOS / LVTTL interface levels.

NOTE: Pullup and Pulldown refer to internal input resistors. See Table 2, Pin Characteristics, for typical values.

**Table 2. Pin Characteristics**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
C <sub>IN</sub>	Input Capacitance			4		pF
R <sub>PULLUP</sub>	Input Pullup Resistor			51		kΩ
R <sub>PULLDOWN</sub>	Input Pulldown Resistor			51		kΩ
C <sub>PD</sub>	Power Dissipation Capacitance (per output); NOTE 1	V <sub>DDO</sub> = 3.465V		18		pF
		V <sub>DDO</sub> = 2.625V		19		pF
		V <sub>DDO</sub> = 2.0V		19		pF
R <sub>OUT</sub>	Output Impedance	V <sub>DDO</sub> = 3.465V		15		Ω
		V <sub>DDO</sub> = 2.625V		17		Ω
		V <sub>DDO</sub> = 2.0V		25		Ω

## Function Tables

**Table 3. Control Input Function Table**

Control Inputs		Outputs	
SEL1	SEL0	Q0	Q1
0	0	CLK0 (default)	CLK0
0	1	CLK1	CLK0
1	0	CLK0	CLK1
1	1	CLK1	CLK1

## Absolute Maximum Ratings

NOTE: Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

Item	Rating
Supply Voltage, $V_{CC}$	4.6V
Inputs, $V_I$	-0.5V to $V_{DD} + 0.5V$
Outputs, $V_O$	-0.5V to $V_{DDO} + 0.5V$
Package Thermal Impedance, $\theta_{JA}$	100.3°C/W (0 mps)
Storage Temperature, $T_{STG}$	-65°C to 150°C

## DC Electrical Characteristics

**Table 4A. Power Supply DC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$  or  $1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$V_{DD}$	Positive Supply Voltage		3.135	3.3	3.465	V
$V_{DDO}$	Output Supply Voltage		3.135	3.3	3.465	V
			2.375	2.5	2.625	V
			1.6	1.8	2.0	V
$I_{DD}$	Power Supply Current				40	mA
$I_{DDO}$	Output Supply Current	No Load			5	mA

**Table 4B. Power Supply DC Characteristics,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$  or  $1.8V \pm 0.2V$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$V_{DD}$	Positive Supply Voltage		2.375	2.5	2.625	V
$V_{DDO}$	Output Supply Voltage		2.375	2.5	2.625	V
			1.6	1.8	2.0	V
$I_{DD}$	Power Supply Current				40	mA
$I_{DDO}$	Output Supply Current	No Load			5	mA

Table 4C. LVCMOS/LVTTL DC Characteristics,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ 

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$V_{IH}$	Input High Voltage	$V_{DD} = 3.465\text{V}$	2		$V_{DD} + 0.3$	V
		$V_{DD} = 2.625\text{V}$	1.7		$V_{DD} + 0.3$	V
$V_{IL}$	Input Low Voltage	$V_{DD} = 3.465\text{V}$	-0.3		1.3	V
		$V_{DD} = 2.625\text{V}$	-0.3		0.7	V
$I_{IH}$	Input High Current	CLK0, CLK1, SEL0, SEL1 $V_{DD} = V_{IN} = 3.465\text{V}$ or $2.625\text{V}$			150	$\mu\text{A}$
		OE $V_{DD} = V_{IN} = 3.465\text{V}$ or $2.625\text{V}$			5	$\mu\text{A}$
$I_{IL}$	Input Low Current	CLK0, CLK1, SEL0, SEL1 $V_{DD} = 3.465\text{V}$ or $2.625\text{V}$ , $V_{IN} = 0\text{V}$	-5			$\mu\text{A}$
		OE $V_{DD} = 3.465\text{V}$ or $2.625\text{V}$ , $V_{IN} = 0\text{V}$	-150			$\mu\text{A}$
$V_{OH}$	Output High Voltage; NOTE 1	$V_{DDO} = 3.3\text{V} \pm 5\%$	2.6			V
		$V_{DDO} = 2.5\text{V} \pm 5\%$	1.8			V
		$V_{DDO} = 1.8\text{V} \pm 0.2\text{V}$	$V_{DDO} - 0.3$			V
$V_{OL}$	Output Low Voltage; NOTE 1	$V_{DDO} = 3.3\text{V} \pm 5\%$			0.5	V
		$V_{DDO} = 2.5\text{V} \pm 5\%$			0.45	V
		$V_{DDO} = 1.8\text{V} \pm 0.2\text{V}$	-5		0.35	V

NOTE 1: Outputs terminated with  $50\Omega$  to  $V_{DDO}/2$ . See Parameter Measurement Information, *Output Load Test Circuit diagrams*.

## AC Electrical Characteristics

**Table 5A. AC Characteristics,  $V_{DD} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{pLH}$	Propagation Delay, Low to High; NOTE 1		2.0	2.45	3.0	ns
$t_{pHL}$	Propagation Delay, High to Low; NOTE 1		2.0	2.45	3.0	ns
$t_{sk(i)}$	Input Skew; NOTE 2			20	85	ps
$t_{sk(o)}$	Output Skew; NOTE 2, 3			15	65	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 2, 4				500	ps
$f_{jit}$	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section, NOTE 5	Integration Range: 12kHz - 20MHz		0.15		ps
$t_R / t_F$	Output Rise/Fall Time	20% to 80%	200		600	ps
odc	Output Duty Cycle		40		60	%
$MUX_{ISOL}$	MUX Isolation	Unselected CLK input @100MHz		45		dB

NOTE: Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lfpm. The device will meet specifications after thermal equilibrium has been reached under these conditions

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: This parameter is defined in accordance with JEDEC Standard 65.

NOTE 3: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 4: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 5: Driving only one input clock.

**Table 5B. AC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$**

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{pLH}$	Propagation Delay, Low to High; NOTE 1		2.2	2.55	3.0	ns
$t_{pHL}$	Propagation Delay, High to Low; NOTE 1		2.2	2.55	3.0	ns
$t_{sk(i)}$	Input Skew; NOTE 2			10	50	ps
$t_{sk(o)}$	Output Skew; NOTE 2, 3			20	70	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 2, 4				500	ps
$f_{jit}$	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section, NOTE 5	Integration Range: 12kHz - 20MHz		0.12		ps
$t_R / t_F$	Output Rise/Fall Time	20% to 80%	200		600	ps
odc	Output Duty Cycle		40		60	%
$MUX_{ISOL}$	MUX Isolation	Unselected CLK input @100MHz		45		dB

NOTE: See Notes above.

**Table 5C. AC Characteristics,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ C$  to  $85^\circ C$** 

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{pLH}$	Propagation Delay, Low to High; NOTE 1		2.2	3.1	4.0	ns
$t_{pHL}$	Propagation Delay, High to Low; NOTE 1		2.2	3.1	4.0	ns
$t_{sk(i)}$	Input Skew; NOTE 2			15	60	ps
$t_{sk(o)}$	Output Skew; NOTE 2, 3			30	100	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 2, 4				500	ps
$f_{jit}$	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section, NOTE 5	Integration Range: 12kHz - 20MHz		0.14		ps
$t_R / t_F$	Output Rise/Fall Time	20% to 80%	150		1000	ps
odc	Output Duty Cycle	$f_{OUT} < 200MHz$	40		60	%
$MUX_{ISOL}$	MUX Isolation	Unselected CLK input @100MHz		45		dB

NOTE: Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lfm. The device will meet specifications after thermal equilibrium has been reached under these conditions

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: This parameter is defined in accordance with JEDEC Standard 65.

NOTE 3: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

NOTE 4: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 5: Driving only one input clock.

**Table 5D. AC Characteristics,  $V_{DD} = V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $85^\circ C$** 

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{pLH}$	Propagation Delay, Low to High; NOTE 1		2.0	2.7	3.4	ns
$t_{pHL}$	Propagation Delay, High to Low; NOTE 1		2.0	2.7	3.4	ns
$t_{sk(i)}$	Input Skew; NOTE 2			15	55	ps
$t_{sk(o)}$	Output Skew; NOTE 2, 3			20	75	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 2, 4				500	ps
$f_{jit}$	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section, NOTE 5	Integration Range: 12kHz - 20MHz		0.19		ps
$t_R / t_F$	Output Rise/Fall Time	20% to 80%	200		600	ps
odc	Output Duty Cycle		40		60	%
$MUX_{ISOL}$	MUX Isolation	Unselected CLK input @100MHz		45		dB

NOTE: See Notes above.

**Table 5E. AC Characteristics,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 0.2V$ ,  $T_A = -40^\circ C$  to  $85^\circ C$** 

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
$f_{MAX}$	Output Frequency				250	MHz
$t_{pLH}$	Propagation Delay, Low to High; NOTE 1		2.0	3.1	4.2	ns
$t_{pHL}$	Propagation Delay, High to Low; NOTE 1		2.0	3.1	4.2	ns
$t_{sk(i)}$	Input Skew; NOTE 2			30	135	ps
$t_{sk(o)}$	Output Skew; NOTE 2, 3			30	95	ps
$t_{sk(pp)}$	Part-to-Part Skew; NOTE 2, 4				500	ps
$f_{jit}$	Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section, NOTE 5	Integration Range: 12kHz - 20MHz		0.17		ps
$t_R / t_F$	Output Rise/Fall Time	20% to 80%	150		1000	ps
odc	Output Duty Cycle		40		60	%
$MUX_{ISOL}$	MUX Isolation	Unselected CLK input @100MHz		45		dB

NOTE: Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lfpm. The device will meet specifications after thermal equilibrium has been reached under these conditions

NOTE 1: Measured from the  $V_{DD}/2$  of the input to  $V_{DDO}/2$  of the output.

NOTE 2: This parameter is defined in accordance with JEDEC Standard 65.

NOTE 3: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

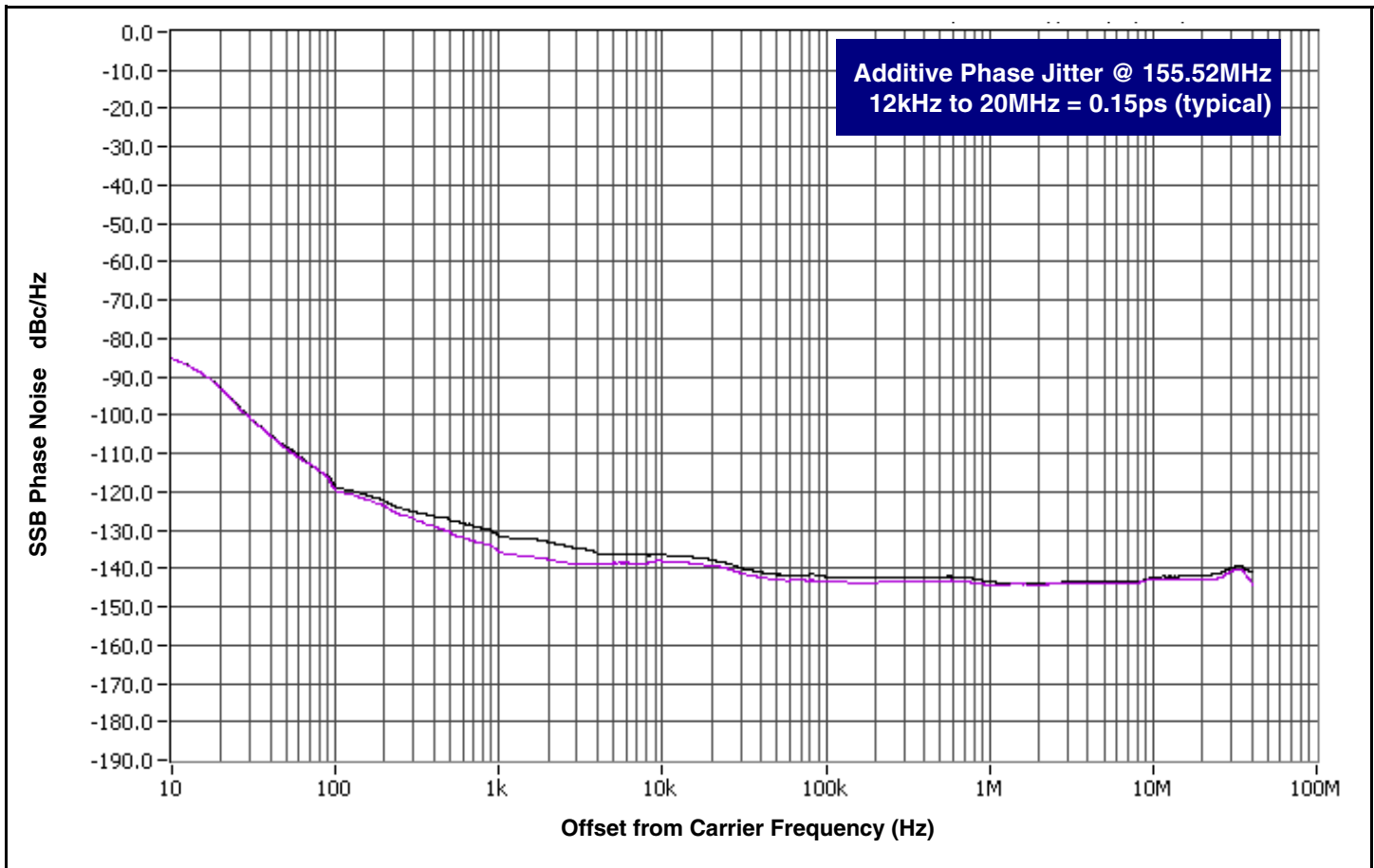
NOTE 4: Defined as skew between outputs on different devices operating at the same supply voltage and with equal load conditions. Using the same input on each device, the output is measured at  $V_{DDO}/2$ .

NOTE 5: Driving only one input clock.

## Additive Phase Jitter

The spectral purity in a band at a specific offset from the fundamental compared to the power of the fundamental is called the ***dBc Phase Noise***. This value is normally expressed using a Phase noise plot and is most often the specified plot in many applications. Phase noise is defined as the ratio of the noise power present in a 1Hz band at a specified offset from the fundamental frequency to the power value of the fundamental. This ratio is expressed in decibels (dBm) or a ratio of the power in the 1Hz band

to the power in the fundamental. When the required offset is specified, the phase noise is called a ***dBc*** value, which simply means dBm at a specified offset from the fundamental. By investigating jitter in the frequency domain, we get a better understanding of its effects on the desired application over the entire time record of the signal. It is mathematically possible to calculate an expected bit error rate given a phase noise plot.

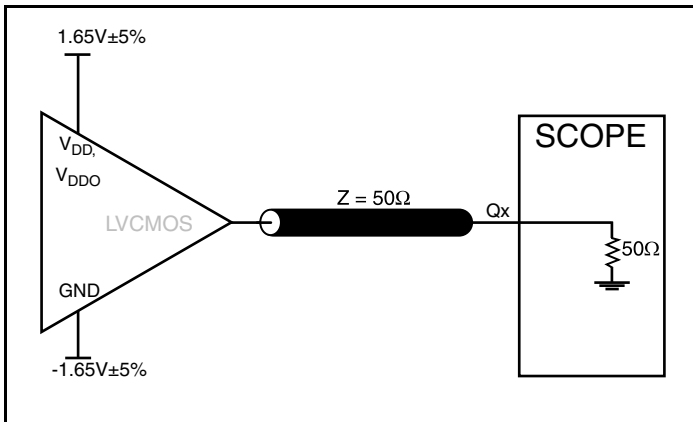


As with most timing specifications, phase noise measurements has issues relating to the limitations of the equipment. Often the noise floor of the equipment is higher than the noise floor of the

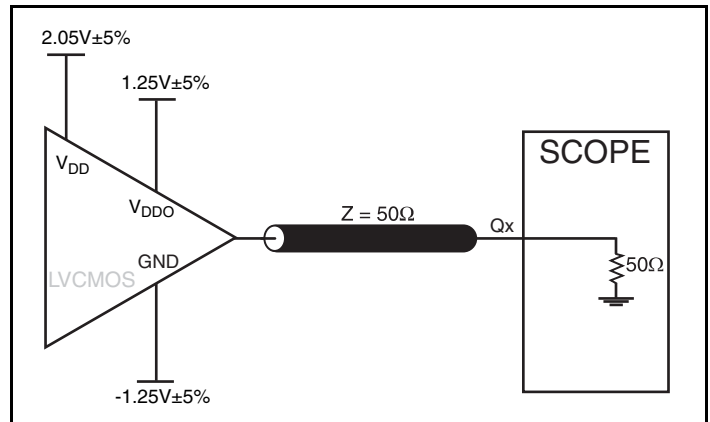
device. This is illustrated above. The device meets the noise floor of what is shown, but can actually be lower. The phase noise is dependent on the input source and measurement equipment.



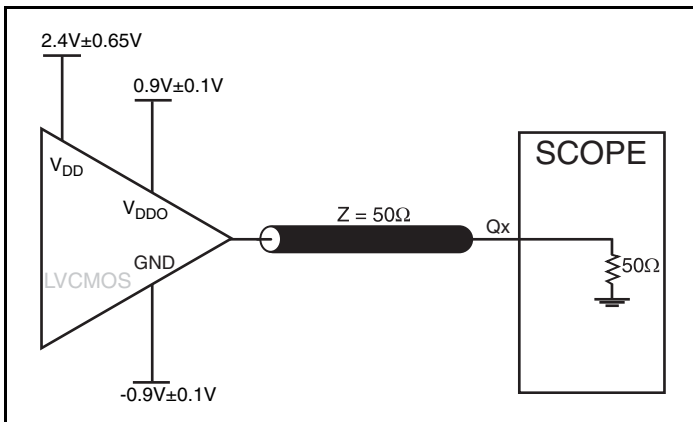
## Parameter Measurement Information



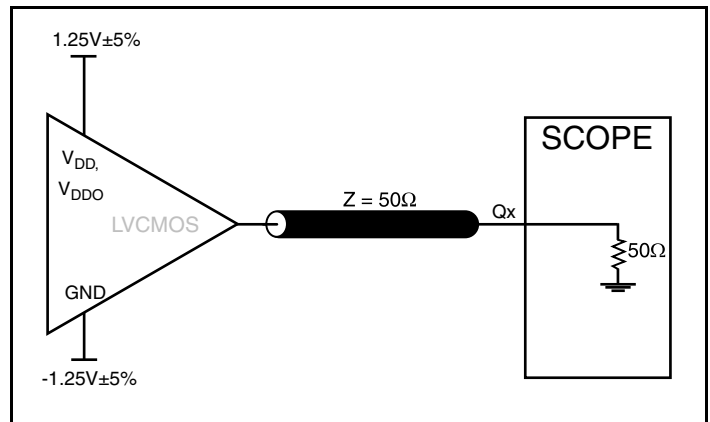
3.3V Core/3.3V LVC MOS Output Load AC Test Circuit



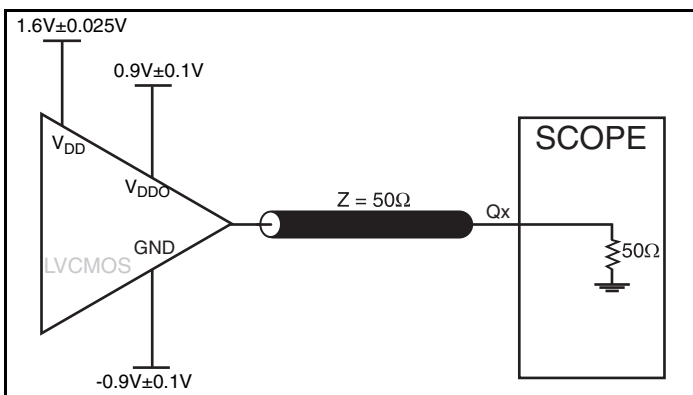
3.3V Core/2.5V LVC MOS Output Load AC Test Circuit



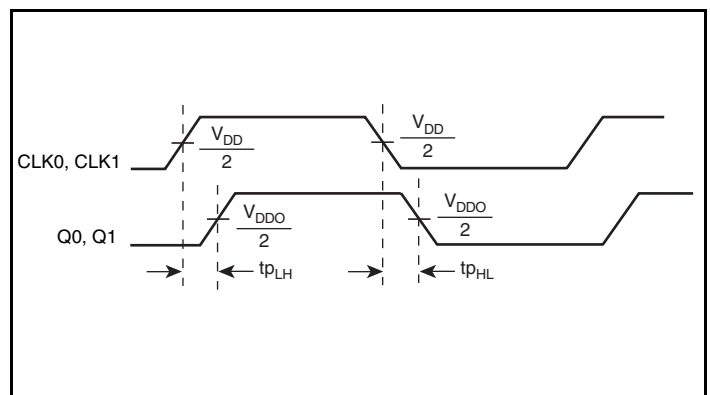
3.3V Core/ 1.8V LVC MOS Output Load AC Test Circuit



2.5V Core/ 2.5V LVC MOS Output Load AC Test Circuit

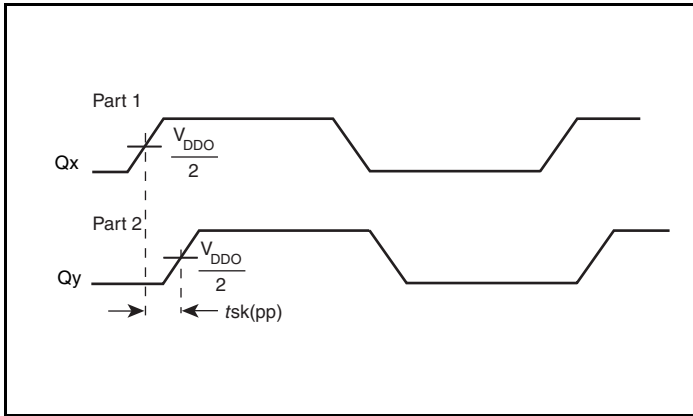


2.5V Core/ 1.8V LVC MOS Output Load AC Test Circuit

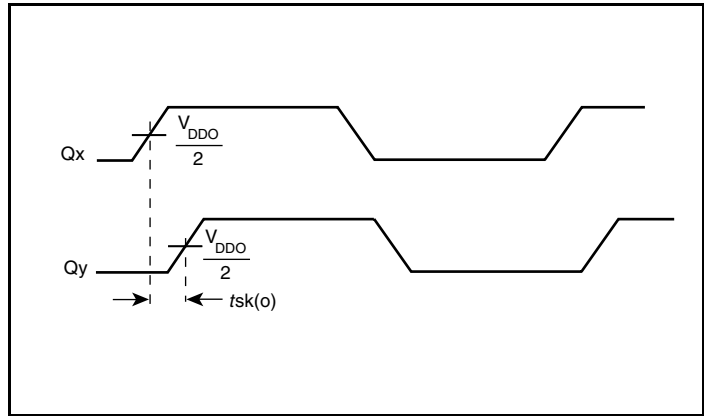


Propagation Delay

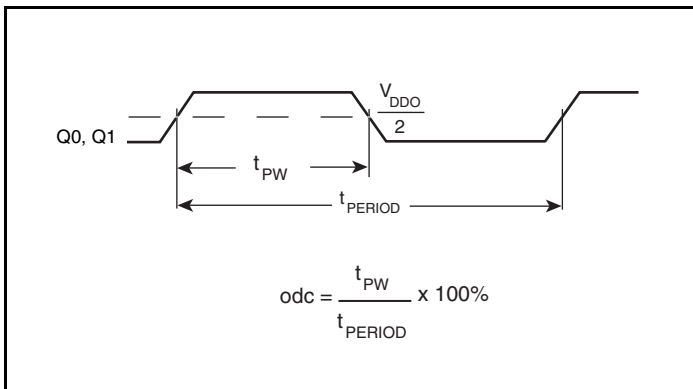
### Parameter Measurement Information, continued



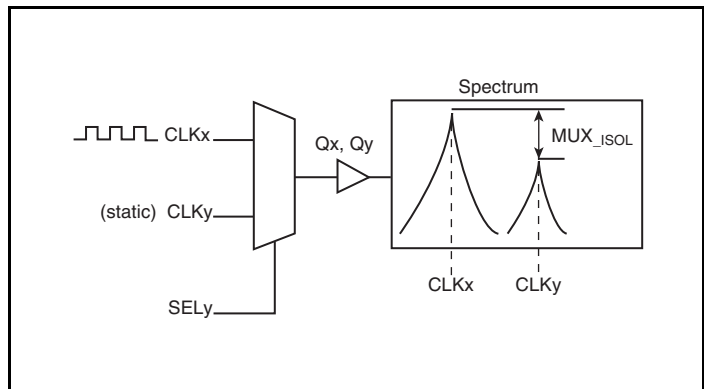
**Part-to-Part Skew**



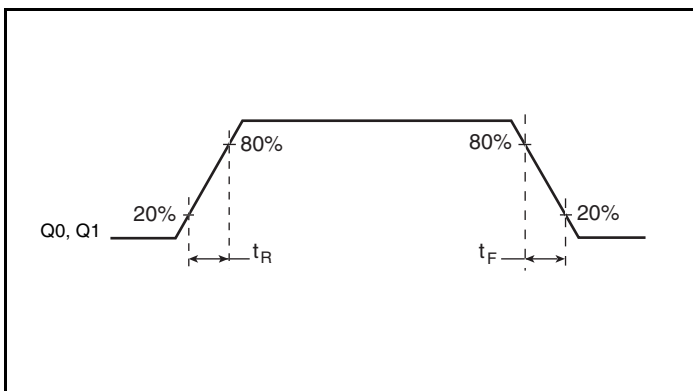
**Output Skew**



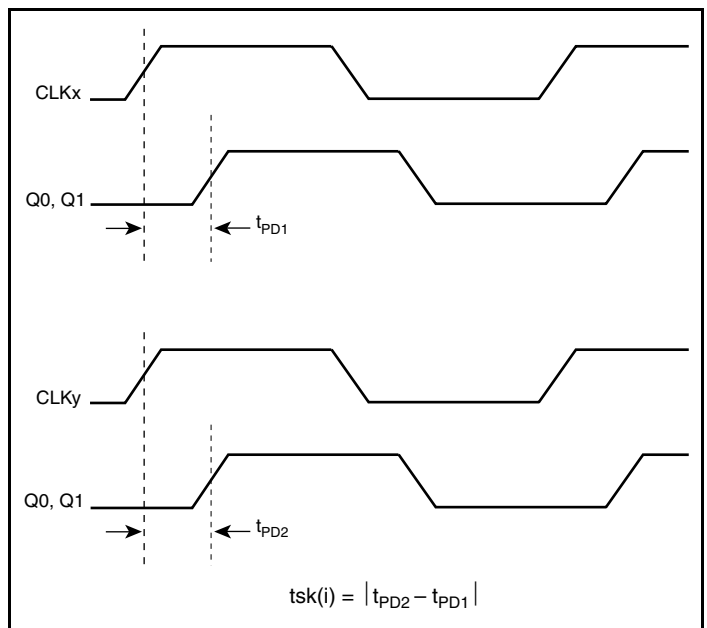
**Output Duty Cycle/Pulse Width/Period**



**MUX Isolation**



**Output Rise/Fall Time**



**Input Skew**

## Application Information

### Recommendations for Unused Input and Output Pins

#### Inputs:

##### LVC MOS Control Pins

All control pins have internal pull-ups or pull-downs; additional resistance is not required but can be added for additional protection. A 1k $\Omega$  resistor can be used.

##### CLK Inputs

For applications not requiring the use of a clock input, it can be left floating. Though not required, but for additional protection, a 1k $\Omega$  resistor can be tied from the CLK input to ground.

#### Outputs:

##### LVC MOS Outputs

All unused LVC MOS output can be left floating. There should be no trace attached.

## Reliability Information

**Table 6.  $\theta_{JA}$  vs. Air Flow Table for a 16 Lead TSSOP**

$\theta_{JA}$ vs. Air Flow			
Meters per Second	0	1	2.5
Multi-Layer PCB, JEDEC Standard Test Boards	100.3°C/W	96.0°C/W	93.9°C/W

NOTE: Most modern PCB design use multi-layered boards. The data in the second row pertains to most designs.

### Transistor Count

The transistor count for ICS83052I-01 is: 967

## Package Outline and Package Dimensions

### Package Outline - G Suffix for 16 Lead TSSOP

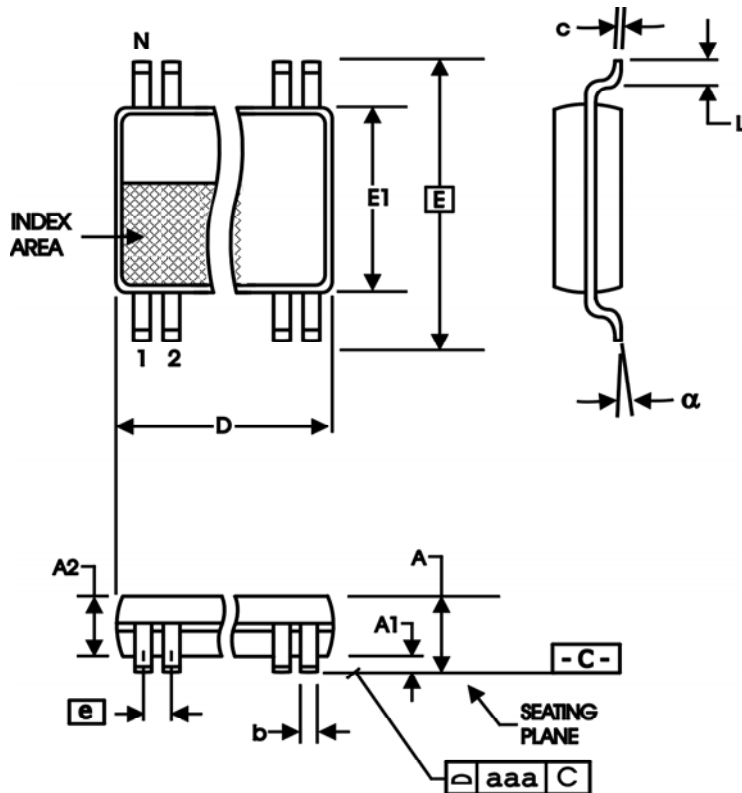


Table 7. Package Dimensions for 16 Lead TSSOP

All Dimensions in Millimeters		
Symbol	Minimum	Maximum
N	16	
A		1.20
A1	0.5	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E	6.40 Basic	
E1	4.30	4.50
e	0.65 Basic	
L	0.45	0.75
α	0°	8°
aaa		0.10

Reference Document: JEDEC Publication 95, MO-153

## Ordering Information

Table 8. Ordering Information

Part/Order Number	Marking	Package	Shipping Packaging	Temperature
83052AGI-01	3052AI01	16 Lead TSSOP	Tube	-40°C to 85°C
83052AGI-01T	3052AI01	16 Lead TSSOP	2500 Tape & Reel	-40°C to 85°C
83052AGI-01LF	052AI01L	"Lead-Free" 16 Lead TSSOP	Tube	-40°C to 85°C
83052AGI-01LFT	052AI01L	"Lead-Free" 16 Lead TSSOP	2500 Tape & Reel	-40°C to 85°C

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

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## Revision History Sheet

Rev	Table	Page	Description of Change	Date
A	T3	2	Corrected <i>Control Input Function Table</i> .	7/25/08
A	T8	13	Ordering Information Table - deleted "ICS" prefix from Part/Order Number column.	3/9/09

ICS83052I-01

2-BIT, 2:1, SINGLE-ENDED MULTIPLEXER

## Contact Information:

**www.IDT.com**

### Sales

800-345-7015 (inside USA)  
+408-284-8200 (outside USA)  
Fax: 408-284-2775  
[www.IDT.com/go/contactIDT](http://www.IDT.com/go/contactIDT)

### Technical Support

[netcom@idt.com](mailto:netcom@idt.com)  
+480-763-2056

### Corporate Headquarters

Integrated Device Technology, Inc.  
6024 Silver Creek Valley Road  
San Jose, CA 95138  
United States  
800-345-7015 (inside USA)  
+408-284-8200 (outside USA)



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