



**TABLE 1. PIN DESCRIPTIONS**

| Number | Name       | Type           | Description                                                                                                                   |
|--------|------------|----------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1      | $V_{DDO}$  | Power          | Output supply pin.                                                                                                            |
| 2      | GND        | Power          | Power supply ground.                                                                                                          |
| 3, 6   | CLK1, CLK0 | Input Pulldown | Single-ended clock inputs. LVCMOS/LVTTL interface levels.                                                                     |
| 4      | $V_{DD}$   | Power          | Core supply pin.                                                                                                              |
| 5      | OE         | Input Pullup   | Output enable. When LOW, outputs are in HIGH impedance state. When HIGH, outputs are active. LVCMOS / LVTTL interface levels. |
| 7      | SEL0       | Input Pulldown | Clock select input. See Control Input Function Table. LVCMOS / LVTTL interface levels.                                        |
| 8      | Q          | Output         | Single-ended clock output. 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      |
|----------------|--------------------------------------------|--------------------|---------|---------|---------|------------|
| $C_{IN}$       | Input Capacitance                          |                    |         | 4       |         | pF         |
| $R_{PULLUP}$   | Input Pullup Resistor                      |                    |         | 51      |         | k $\Omega$ |
| $R_{PULLDOWN}$ | Input Pulldown Resistor                    |                    |         | 51      |         | k $\Omega$ |
| $C_{PD}$       | Power Dissipation Capacitance (per output) | $V_{DDO} = 3.465V$ |         | 18      |         | pF         |
|                |                                            | $V_{DDO} = 2.625V$ |         | 19      |         | pF         |
|                |                                            | $V_{DDO} = 1.89V$  |         | 19      |         | pF         |
| $R_{OUT}$      | Output Impedance                           |                    |         | 15      |         | $\Omega$   |

**TABLE 3. CONTROL INPUT FUNCTION TABLE**

| Control Inputs | Input Selected to Q |
|----------------|---------------------|
| SEL0           |                     |
| 0              | CLK0                |
| 1              | CLK1                |



### ABSOLUTE MAXIMUM RATINGS

|                                          |                           |
|------------------------------------------|---------------------------|
| Supply Voltage, $V_{DD}$                 | 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, $\theta_{JA}$ | 101.7°C/W (0 mps)         |
| Storage Temperature, $T_{STG}$           | -65°C to 150°C            |

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.

**TABLE 4A. POWER SUPPLY DC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 3.3V \pm 5\%$ ,  $2.5V \pm 5\%$  OR  $1.8V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  TO  $85^\circ\text{C}$**

| Symbol    | Parameter             | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|-----------------|---------|---------|---------|-------|
| $V_{DD}$  | Core 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 |                 |         |         | 5       | mA    |

**TABLE 4B. POWER SUPPLY DC CHARACTERISTICS,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$  OR  $1.8V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  TO  $85^\circ\text{C}$**

| Symbol    | Parameter             | Test Conditions | Minimum | Typical | Maximum | Units         |
|-----------|-----------------------|-----------------|---------|---------|---------|---------------|
| $V_{DD}$  | Core 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  |                 |         |         | 36      | $\mu\text{A}$ |
| $I_{DDO}$ | Output Supply Current |                 |         |         | 5       | $\mu\text{A}$ |



**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  | $V_{DD} = 3.3\text{V} \pm 5\%$                                      | 2              |         | $V_{DD} + 0.3$ | V             |
|          |                     | $V_{DD} = 2.5\text{V} \pm 5\%$                                      | 1.7            |         | $V_{DD} + 0.3$ | V             |
| $V_{IL}$ | Input Low Voltage   | $V_{DD} = 3.3\text{V} \pm 5\%$                                      | -0.3           |         | 0.8            | V             |
|          |                     | $V_{DD} = 2.5\text{V} \pm 5\%$                                      | -0.3           |         | 0.7            | V             |
| $I_{IH}$ | Input High Current  | CLK0, CLK1, SELO<br>$V_{DD} = 3.3\text{V}$ or $2.5\text{V} \pm 5\%$ |                |         | 150            | $\mu\text{A}$ |
|          |                     | OE<br>$V_{DD} = 3.3\text{V}$ or $2.5\text{V} \pm 5\%$               |                |         | 5              | $\mu\text{A}$ |
| $I_{IL}$ | Input Low Current   | CLK0, CLK1, SELO<br>$V_{DD} = 3.3\text{V}$ or $2.5\text{V} \pm 5\%$ | -5             |         |                | $\mu\text{A}$ |
|          |                     | OE<br>$V_{DD} = 3.3\text{V}$ or $2.5\text{V} \pm 5\%$               | -150           |         |                | $\mu\text{A}$ |
| $V_{OH}$ | Output High Voltage | $V_{DDO} = 3.3\text{V} \pm 5\%$ ; NOTE 1                            | 2.6            |         |                | V             |
|          |                     | $V_{DDO} = 2.5\text{V} \pm 5\%$ ; NOTE 1                            | 1.8            |         |                | V             |
|          |                     | $V_{DDO} = 1.8\text{V} \pm 5\%$ ; NOTE 1                            | $V_{DD} - 0.3$ |         |                | V             |
| $V_{OL}$ | Output Low Voltage  | $V_{DDO} = 3.3\text{V} \pm 5\%$ ; NOTE 1                            |                |         | 0.5            | V             |
|          |                     | $V_{DDO} = 2.5\text{V} \pm 5\%$ ; NOTE 1                            |                |         | 0.45           | V             |
|          |                     | $V_{DDO} = 1.8\text{V} \pm 5\%$ ; NOTE 1                            |                |         | 0.35           | V             |

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

**TABLE 5A. AC CHARACTERISTICS,  $V_{DD} = V_{DDO} = 3.3\text{V} \pm 5\%$ ,  $T_A = -40^{\circ}\text{C}$  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;<br>NOTE 1                                               |                                                   | 2.0     | 2.4     | 2.7     | ns    |
| $t_{pHL}$         | Propagation Delay, High to Low;<br>NOTE 1                                               |                                                   | 2.0     | 2.5     | 2.9     | ns    |
| $t_{sk(i)}$       | Input Skew; NOTE 4                                                                      |                                                   |         | 36      | 160     | ps    |
| $t_{sk(pp)}$      | Part-to-Part Skew; NOTE 2, 4                                                            |                                                   |         |         | 490     | ps    |
| $t_{jit}$         | Buffer Additive Phase Jitter, RMS;<br>refer to Additive Phase Jitter section,<br>NOTE 3 | 155.52MHz,<br>Integration Range:<br>12kHz - 20MHz |         | 0.18    |         | ps    |
| $t_R / t_F$       | Output Rise/Fall Time                                                                   | 20% to 80%                                        | 200     |         | 700     | ps    |
| odc               | Output Duty Cycle                                                                       |                                                   | 45      |         | 55      | %     |
| $MUX_{ISOLATION}$ | MUX Isolation                                                                           |                                                   |         | 45      |         | dB    |

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

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

NOTE 3: Driving only one input clock.

NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.



**TABLE 5B. AC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Symbol            | Parameter                                                                               | Test Conditions                                   | Minimum | Typical | Maximum | Units |
|-------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$         | Output Frequency                                                                        |                                                   |         |         | 250     | MHz   |
| $tp_{LH}$         | Propagation Delay, Low to High;<br>NOTE 1                                               |                                                   | 2.3     | 2.6     | 2.9     | ns    |
| $tp_{HL}$         | Propagation Delay, High to Low;<br>NOTE 1                                               |                                                   | 2.3     | 2.6     | 2.9     | ns    |
| $tsk(i)$          | Input Skew; NOTE 4                                                                      |                                                   |         | 23      | 106     | ps    |
| $tsk(pp)$         | Part-to-Part Skew; NOTE 2, 4                                                            |                                                   |         |         | 350     | ps    |
| $t_{jit}$         | Buffer Additive Phase Jitter, RMS;<br>refer to Additive Phase Jitter section,<br>NOTE 3 | 155.52MHz,<br>Integration Range:<br>12kHz - 20MHz |         | 0.14    |         | ps    |
| $t_R / t_F$       | Output Rise/Fall Time                                                                   | 20% to 80%                                        | 300     |         | 700     | ps    |
| odc               | Output Duty Cycle                                                                       |                                                   | 46      |         | 54      | %     |
| $MUX_{ISOLATION}$ | MUX Isolation                                                                           |                                                   |         | 45      |         | dB    |

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

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

NOTE 3: Driving only one input clock.

NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.

**TABLE 5C. AC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Symbol            | Parameter                                                                               | Test Conditions                                   | Minimum | Typical | Maximum | Units |
|-------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$         | Output Frequency                                                                        |                                                   |         |         | 250     | MHz   |
| $tp_{LH}$         | Propagation Delay, Low to High;<br>NOTE 1                                               |                                                   | 2.3     | 3.1     | 3.9     | ns    |
| $tp_{HL}$         | Propagation Delay, High to Low;<br>NOTE 1                                               |                                                   | 2.3     | 3.1     | 3.9     | ns    |
| $tsk(i)$          | Input Skew; NOTE 4                                                                      |                                                   |         | 19      | 66      | ps    |
| $tsk(pp)$         | Part-to-Part Skew; NOTE 2, 4                                                            |                                                   |         |         | 350     | ps    |
| $t_{jit}$         | Buffer Additive Phase Jitter, RMS;<br>refer to Additive Phase Jitter section,<br>NOTE 3 | 155.52MHz,<br>Integration Range:<br>12kHz - 20MHz |         | 0.16    |         | ps    |
| $t_R / t_F$       | Output Rise/Fall Time                                                                   | 20% to 80%                                        | 350     |         | 850     | ps    |
| odc               | Output Duty Cycle                                                                       |                                                   | 46      |         | 54      | %     |
| $MUX_{ISOLATION}$ | MUX Isolation                                                                           |                                                   |         | 45      |         | dB    |

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

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

NOTE 3: Driving only one input clock.

NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.



**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   |
| $tp_{LH}$         | Propagation Delay, Low to High;<br>NOTE 1                                               |                                                   | 2.2     | 2.7     | 3.2     | ns    |
| $tp_{HL}$         | Propagation Delay, High to Low;<br>NOTE 1                                               |                                                   | 2.2     | 2.7     | 3.2     | ns    |
| $tsk(i)$          | Input Skew; NOTE 4                                                                      |                                                   |         | 28      | 123     | ps    |
| $tsk(pp)$         | Part-to-Part Skew; NOTE 2, 4                                                            |                                                   |         |         | 400     | ps    |
| $t_{jit}$         | Buffer Additive Phase Jitter, RMS;<br>refer to Additive Phase Jitter section,<br>NOTE 3 | 155.52MHz,<br>Integration Range:<br>12kHz - 20MHz |         | 0.22    |         | ps    |
| $t_R / t_F$       | Output Rise/Fall Time                                                                   | 20% to 80%                                        | 300     |         | 700     | ps    |
| odc               | Output Duty Cycle                                                                       |                                                   | 45      |         | 55      | %     |
| $MUX_{ISOLATION}$ | MUX Isolation                                                                           |                                                   |         | 45      |         | dB    |

NOTE 1: Measured from VDD/2 of the input to VDDO/2 of the output.

NOTE 2: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of input on each device, the output is measured at VDDO/2.

NOTE 3: Driving only one input clock.

NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.

**TABLE 5E. AC CHARACTERISTICS,  $V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 1.8V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Symbol            | Parameter                                                                               | Test Conditions                                   | Minimum | Typical | Maximum | Units |
|-------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------|---------|---------|---------|-------|
| $f_{MAX}$         | Output Frequency                                                                        |                                                   |         |         | 250     | MHz   |
| $tp_{LH}$         | Propagation Delay, Low to High;<br>NOTE 1                                               |                                                   | 2.1     | 3.1     | 4.1     | ns    |
| $tp_{HL}$         | Propagation Delay, High to Low;<br>NOTE 1                                               |                                                   | 2.1     | 3.1     | 4.2     | ns    |
| $tsk(i)$          | Input Skew; NOTE 4                                                                      |                                                   |         | 19      | 73      | ps    |
| $tsk(pp)$         | Part-to-Part Skew; NOTE 2, 4                                                            |                                                   |         |         | 350     | ps    |
| $t_{jit}$         | Buffer Additive Phase Jitter, RMS;<br>refer to Additive Phase Jitter section,<br>NOTE 3 | 155.52MHz,<br>Integration Range:<br>12kHz - 20MHz |         | 0.19    |         | ps    |
| $t_R / t_F$       | Output Rise/Fall Time                                                                   | 20% to 80%                                        | 350     |         | 850     | ps    |
| odc               | Output Duty Cycle                                                                       |                                                   | 45      |         | 55      | %     |
| $MUX_{ISOLATION}$ | MUX Isolation                                                                           |                                                   |         | 45      |         | dB    |

NOTE 1: Measured from VDD/2 of the input to VDDO/2 of the output.

NOTE 2: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of input on each device, the output is measured at VDDO/2.

NOTE 3: Driving only one input clock.

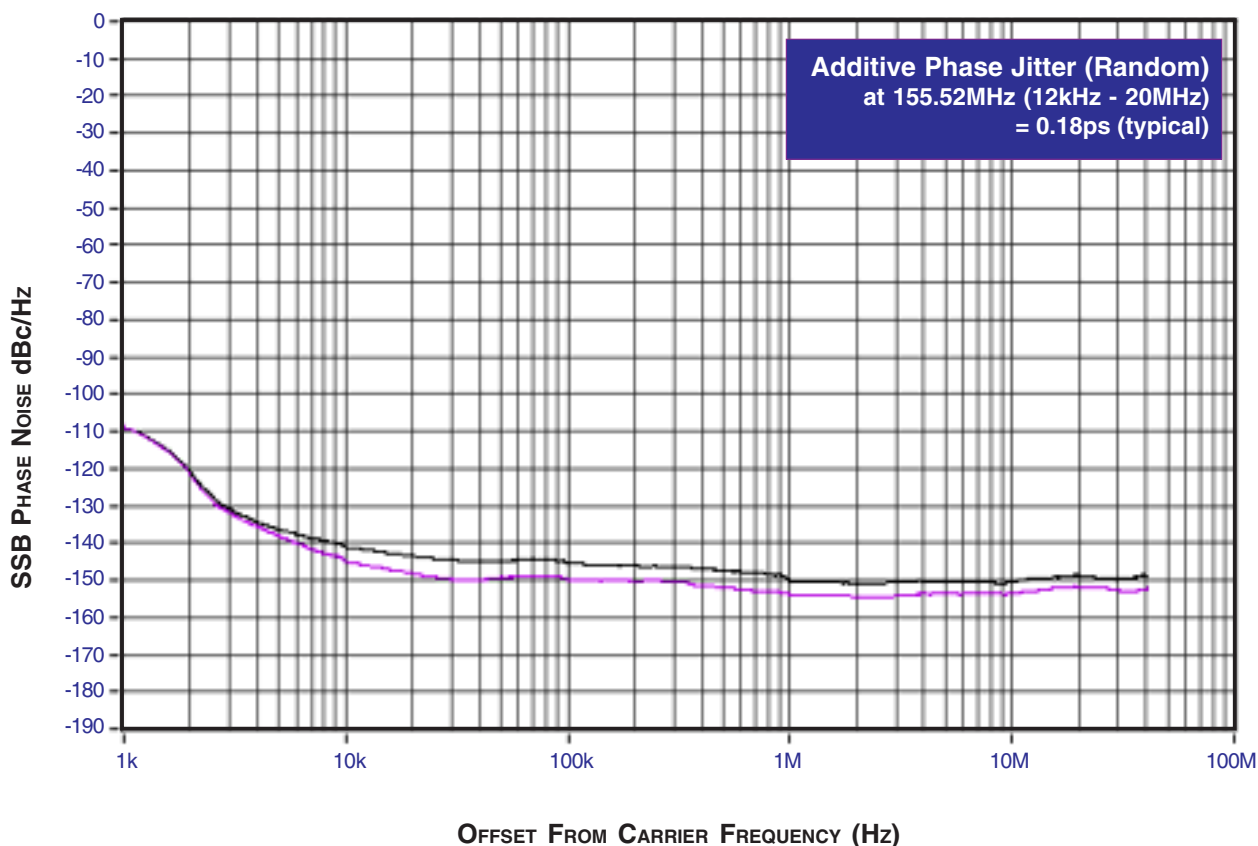
NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.



## 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.

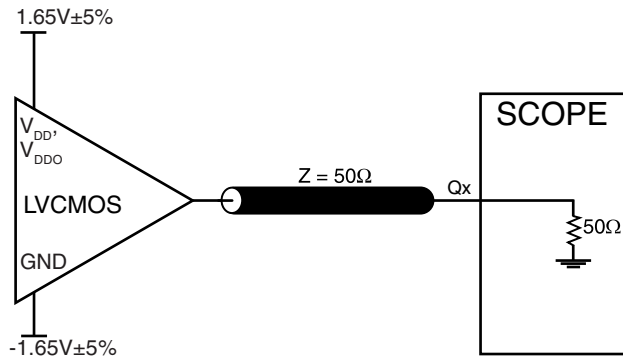


As with most timing specifications, phase noise measurements have issues. The primary issue relates to the limitations of the equipment. Often the noise floor of the equipment is higher than the noise floor of the device. This is illustrated

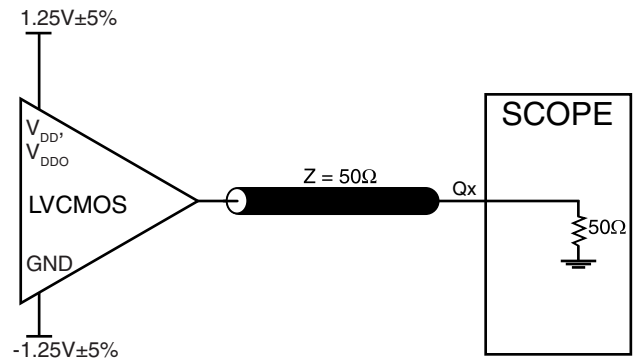
above. The device meets the noise floor of what is shown, but can actually be lower. The phase noise is dependant on the input source and measurement equipment.



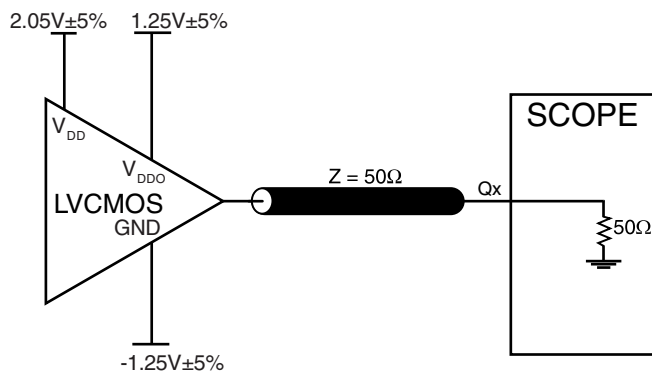
## PARAMETER MEASUREMENT INFORMATION



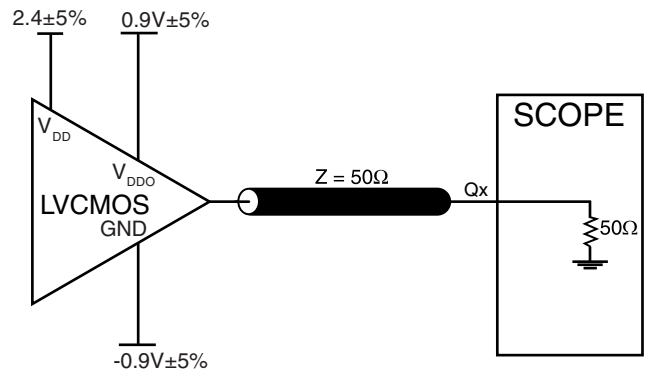
**3.3V CORE/3.3V OUTPUT LOAD AC TEST CIRCUIT**



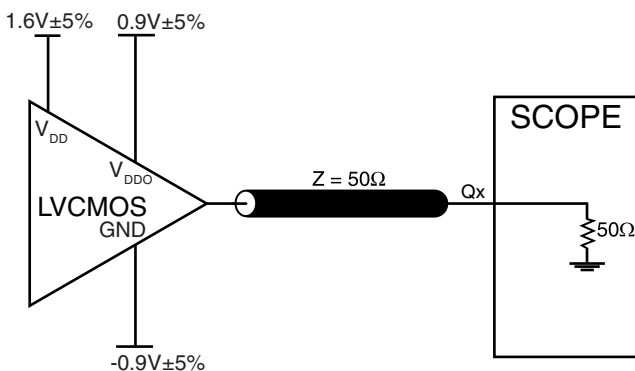
**2.5V CORE/2.5V OUTPUT LOAD AC TEST CIRCUIT**



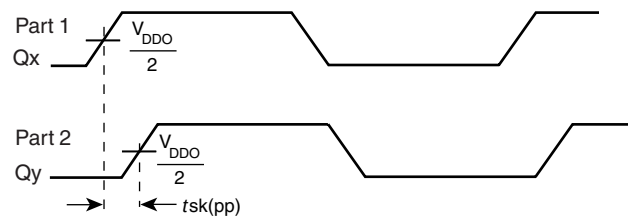
**3.3V CORE/2.5V OUTPUT LOAD AC TEST CIRCUIT**



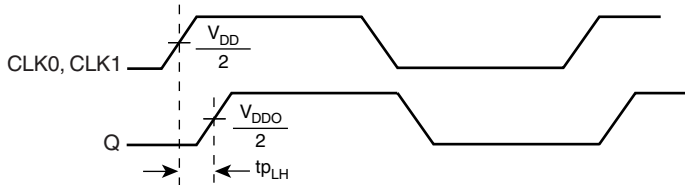
**3.3V CORE/1.8V OUTPUT LOAD AC TEST CIRCUIT**



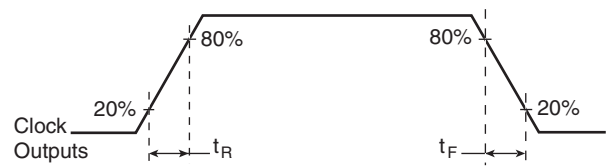
**2.5V CORE/1.8V OUTPUT LOAD AC TEST CIRCUIT**



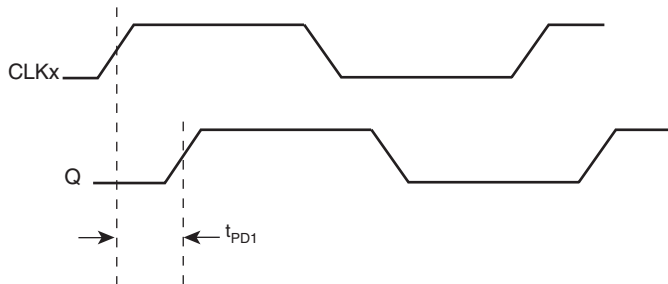
**PART-TO-PART SKEW**



**PROPAGATION DELAY**

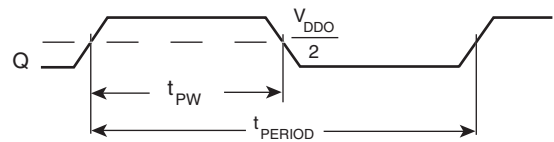


**OUTPUT RISE/FALL TIME**



**INPUT SKEW**

$$tsk(i) = |t_{PD1} - t_{PD2}|$$



$$odc = \frac{t_{PW}}{t_{PERIOD}} \times 100\%$$

**OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD**





## APPLICATION INFORMATION

### RECOMMENDATIONS FOR UNUSED INPUT AND OUTPUT PINS

#### INPUTS:

##### CLK INPUT:

For applications not requiring the use of the test clock, 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.

##### 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.

#### OUTPUTS:

##### LVC MOS OUTPUT:

All unused LVC MOS output can be left floating. We recommend that there is no trace attached.

## RELIABILITY INFORMATION

TABLE 6.  $\theta_{JA}$  VS. AIR FLOW TABLE FOR 8 LEAD TSSOP

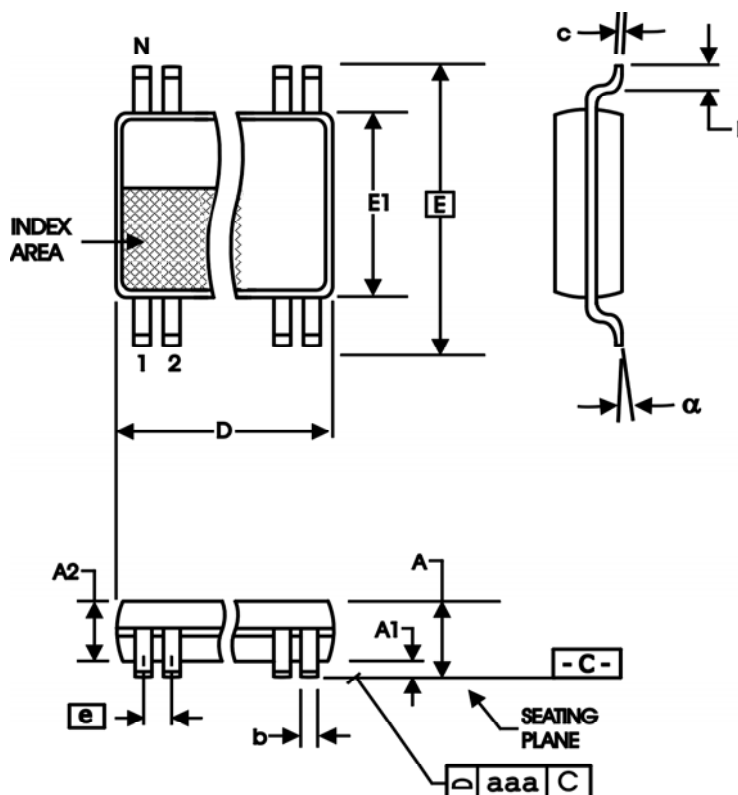
| $\theta_{JA}$ by Velocity (Meters per Second) |           |          |          |
|-----------------------------------------------|-----------|----------|----------|
|                                               | 0         | 1        | 2.5      |
| Multi-Layer PCB, JEDEC Standard Test Boards   | 101.7°C/W | 90.5°C/W | 89.8°C/W |

#### TRANSISTOR COUNT

The transistor count for ICS83052I is: 967



**PACKAGE OUTLINE - G SUFFIX FOR 8 LEAD TSSOP**



**TABLE 7. PACKAGE DIMENSIONS**

| SYMBOL   | Millimeters |         |
|----------|-------------|---------|
|          | Minimum     | Maximum |
| N        | 8           |         |
| A        | --          | 1.20    |
| A1       | 0.05        | 0.15    |
| A2       | 0.80        | 1.05    |
| b        | 0.19        | 0.30    |
| c        | 0.09        | 0.20    |
| D        | 2.90        | 3.10    |
| E        | 6.40 BASIC  |         |
| E1       | 4.30        | 4.50    |
| e        | 0.65 BASIC  |         |
| L        | 0.45        | 0.75    |
| $\alpha$ | 0°          | 8°      |
| aaa      | --          | 0.10    |

Reference Document: JEDEC Publication 95, MO-153



**TABLE 8. ORDERING INFORMATION**

| Part/Order Number | Marking | Package                  | Shipping Packaging | Temperature   |
|-------------------|---------|--------------------------|--------------------|---------------|
| ICS83052AGI       | 052AI   | 8 lead TSSOP             | tube               | -40°C to 85°C |
| ICS83052AGIT      | 052AI   | 8 lead TSSOP             | 2500 tape & reel   | -40°C to 85°C |
| ICS83052AGILF     | TBD     | 8 lead "Lead-Free" TSSOP | tube               | -40°C to 85°C |
| ICS83052AGILFT    | TBD     | 8 lead "Lead-Free" 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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