

GENERAL DESCRIPTION

The ICS83904-02 is a low skew, high performance 1-to-4 Crystal-to-LVCMOS Fanout Buffer. The ICS83904-02 has selectable single-ended clock or two crystal-oscillator inputs. There is an output enable to disable the outputs by placing them into a high-impedance state.

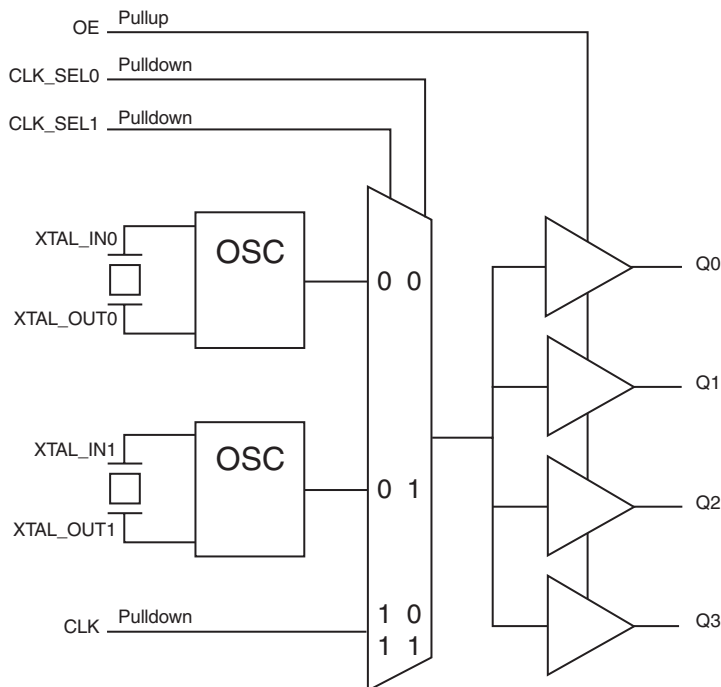
Guaranteed output and part-to-part skew characteristics make the ICS83904-02 ideal for those applications demanding well defined performance and repeatability.

FEATURES

- Four LVCMOS/LVTTTL outputs, 19Ω typical output impedance @ $V_{DD} = V_{DDO} = 3.3V$
- Two Crystal oscillator input pairs
One LVCMOS/LVTTTL clock input
- Crystal input frequency range: 12MHz – 38.88MHz
- Output frequency: 200MHz (maximum)
- Output Skew: 40ps (maximum) @ $V_{DD} = V_{DDO} = 3.3V$
- RMS phase jitter @ 25MHz output, using a 25MHz crystal (100Hz – 1MHz): 0.16ps (typical) @ $V_{DD} = V_{DDO} = 3.3V$
- RMS phase noise at 25MHz:

| Offset | Noise Power |
|--------|---------------|
| 100Hz | -118.4 dBc/Hz |
| 1kHz | -141.5 dBc/Hz |
| 10kHz | -157.2 dBc/Hz |
| 100kHz | -157.2 dBc/Hz |
- Supply Voltage Modes:
(Core/Output)
3.3V/3.3V
3.3V/2.5V
3.3V/1.8V
2.5V/2.5V
2.5V/1.8V
- 0°C to 70°C ambient operating temperature
- Available in both standard (RoHS 5) and lead-free (RoHS 6) packages

BLOCK DIAGRAM



PIN ASSIGNMENT

| | | | |
|-----------|---|----|------|
| CLK_SEL0 | 1 | 16 | VDDO |
| XTAL_OUT0 | 2 | 15 | Q0 |
| XTAL_IN0 | 3 | 14 | Q1 |
| VDD | 4 | 13 | GND |
| XTAL_IN1 | 5 | 12 | Q2 |
| XTAL_OUT1 | 6 | 11 | Q3 |
| CLK_SEL1 | 7 | 10 | VDDO |
| CLK | 8 | 9 | OE |

ICS83904-02
16-Lead TSSOP
 4.4mm x 5.0mm x 0.92mm
 package body
G Package
 Top View

TABLE 1. PIN DESCRIPTIONS

| Number | Name | Type | | Description |
|----------------|------------------------|--------|----------|--|
| 1, 7 | CLK_SEL0, CLK_SEL1 | Input | Pulldown | Clock select inputs. See Table 3, Input Reference Function Table. LVCMOS / LVTTTL interface levels. |
| 2, 3 | XTAL_OUT0, XTAL_IN0 | Input | | Crystal oscillator interface. XTAL_IN0 is the input. XTAL_OUT0 is the output. |
| 4 | V _{DD} | Power | | Positive supply pin. |
| 5, 6 | XTAL_IN1, XTAL_OUT1 | Input | | Crystal oscillator interface. XTAL_IN1 is the input. XTAL_OUT1 is the output. |
| 8 | CLK | Input | Pulldown | Single-ended clock input. LVCMOS/LVTTTL interface levels. |
| 9 | OE | Input | Pullup | Output enable. When LOW, outputs are in HIGH impedance state. When HIGH, outputs are active. LVCMOS / LVTTTL interface levels. |
| 10, 16 | V _{DDO} | Power | | Output supply pins. |
| 11, 12, 14, 15 | Q3, Q2, Q1, Q0 | Output | | Single-ended clock outputs. LVCMOS/LVTTTL interface levels. |
| 13 | GND | Power | | Power supply ground. |

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 | | kΩ |
| R _{PULLDOWN} | Input Pulldown Resistor | | | 51 | | kΩ |
| C _{PD} | Power Dissipation Capacitance (per output) | V _{DDO} = 3.465V | | 8 | | pF |
| | | V _{DDO} = 2.625V | | 7 | | pF |
| | | V _{DDO} = 2.0V | | 7 | | pF |
| R _{OUT} | Output Impedance | V _{DDO} = 3.3V | | 19 | | Ω |
| | | V _{DDO} = 2.5V | | 21 | | Ω |
| | | V _{DDO} = 1.8V | | 32 | | Ω |

TABLE 3. INPUT REFERENCE FUNCTION TABLE

| Control Inputs | | Reference |
|----------------|----------|-----------------|
| CLK_SEL1 | CLK_SEL0 | |
| 0 | 0 | XTAL0 (default) |
| 0 | 1 | XTAL1 |
| 1 | 0 | CLK |
| 1 | 1 | CLK |

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, θ_{JA} | 100.3°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, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, $T_A = 0^\circ\text{C}$ TO 70°C

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|----------------------------------|---------|---------|---------|-------|
| V_{DD} | Power Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| V_{DDO} | Output Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| I_{DD} | Power Supply Current | No Load & XTALx selected @ 12MHz | | | 7 | mA |
| | | No Load & CLK selected | | | 1 | mA |
| I_{DDO} | Output Supply Current | No Load & CLK selected | | | 1 | mA |

TABLE 4B. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$, $V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ\text{C}$ TO 70°C

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|----------------------------------|---------|---------|---------|-------|
| V_{DD} | Power Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| V_{DDO} | Output Supply Voltage | | 2.375 | 2.5 | 2.625 | V |
| I_{DD} | Power Supply Current | No Load & XTALx selected @ 12MHz | | | 7 | mA |
| | | No Load & CLK selected | | | 1 | mA |
| I_{DDO} | Output Supply Current | No Load & CLK selected | | | 1 | mA |

TABLE 4C. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$, $V_{DDO} = 1.8V \pm 0.2V$, $T_A = 0^\circ\text{C}$ TO 70°C

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|----------------------------------|---------|---------|---------|-------|
| V_{DD} | Power Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| V_{DDO} | Output Supply Voltage | | 1.6 | 1.8 | 2.0 | V |
| I_{DD} | Power Supply Current | No Load & XTALx selected @ 12MHz | | | 7 | mA |
| | | No Load & CLK selected | | | 1 | mA |
| I_{DDO} | Output Supply Current | No Load & CLK selected | | | 1 | mA |

TABLE 4D. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ\text{C}$ TO 70°C

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|----------------------------------|---------|---------|---------|-------|
| V_{DD} | Power Supply Voltage | | 2.375 | 2.5 | 2.625 | V |
| V_{DDO} | Output Supply Voltage | | 2.375 | 2.5 | 2.625 | V |
| I_{DD} | Power Supply Current | No Load & XTALx selected @ 12MHz | | | 3 | mA |
| | | No Load & CLK selected | | | 1 | mA |
| I_{DDO} | Output Supply Current | No Load & CLK selected | | | 1 | mA |

TABLE 4E. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = 2.5V \pm 5\%$, $V_{DDO} = 1.8V \pm 0.2V$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|----------------------------------|---------|---------|---------|-------|
| V_{DD} | Power Supply Voltage | | 2.375 | 2.5 | 2.625 | V |
| V_{DDO} | Output Supply Voltage | | 1.6 | 1.8 | 2.0 | V |
| I_{DD} | Power Supply Current | No Load & XTALx selected @ 12MHz | | | 3 | mA |
| | | No Load & CLK selected | | | 1 | mA |
| I_{DDO} | Output Supply Current | No Load & CLK selected | | | 1 | mA |

TABLE 4F. DC CHARACTERISTICS, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|---------------------|--|---------|---------|----------------|---------|
| V_{IH} | Input High Voltage | $V_{DD} = 3.3V \pm 5\%$ | 2.2 | | $V_{DD} + 0.3$ | V |
| | | $V_{DD} = 2.5V \pm 5\%$ | 1.6 | | $V_{DD} + 0.3$ | V |
| V_{IL} | Input Low Voltage | $V_{DD} = 3.3V \pm 5\%$ | -0.3 | | 1.3 | V |
| | | $V_{DD} = 2.5V \pm 5\%$ | -0.3 | | 0.9 | V |
| I_{IH} | Input High Current | CLK, CLK_SEL0:1 $V_{DD} = 3.3V$ or $2.5V \pm 5\%$ | | | 150 | μA |
| | | OE $V_{DD} = 3.3V$ or $2.5V \pm 5\%$ | | | 5 | μA |
| I_{IL} | Input Low Current | CLK, CLK_SEL0:1 $V_{DD} = 3.3V$ or $2.5V \pm 5\%$ | -5 | | | μA |
| | | OE $V_{DD} = 3.3V$ or $2.5V \pm 5\%$ | -150 | | | μA |
| V_{OH} | Output High Voltage | $V_{DDO} = 3.3V \pm 5\%$; NOTE 1 | 2.6 | | | V |
| | | $V_{DDO} = 2.5V \pm 5\%$; NOTE 1 | 1.8 | | | V |
| | | $V_{DDO} = 1.8V \pm 0.2V$; NOTE 1 | 1.2 | | | V |
| V_{OL} | Output Low Voltage | $V_{DDO} = 3.3V \pm 5\%$; NOTE 1 | | | 0.6 | V |
| | | $V_{DDO} = 2.5V \pm 5\%$; NOTE 1 | | | 0.5 | V |
| | | $V_{DDO} = 1.8V \pm 0.2V$; NOTE 1 | | | 0.4 | V |

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

TABLE 5. CRYSTAL CHARACTERISTICS

| Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|------------------------------------|-----------------|-------------|---------|---------|----------|
| Mode of Oscillation | | Fundamental | | | |
| Frequency | | 12 | | 38.88 | MHz |
| Equivalent Series Resistance (ESR) | | | | 50 | Ω |
| Shunt Capacitance | | | | 7 | pF |
| Drive Level | | | | 1 | mW |

TABLE 6A. AC CHARACTERISTICS, $V_{DD} = V_{DDO} = 3.3V \pm 5\%$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------------|---|---|--------------|---------|---------|-------|
| f_{MAX} | Output Frequency | w/external XTAL | 12 | | 38.88 | MHz |
| | | w/external CLK | | | 200 | MHz |
| t_{pLH} | Propagation Delay, Low-to-High; NOTE 1 | | 1.4 | 1.9 | 2.4 | ns |
| $t_{sk(o)}$ | Output Skew; NOTE 2 | | | | 40 | ps |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 2, 3 | | | | 700 | ps |
| $f_{jit}(\emptyset)$ | RMS Phase Jitter, Random; NOTE 2, 4 | 25MHz, Integration Range: 100Hz – 1MHz | | 0.16 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 800 | ps |
| odc | Output Duty Cycle | w/external XTAL | 45 | | 55 | % |
| | | w/external CLK | $f < 150MHz$ | 46 | 54 | % |
| t_{EN} | Output Enable Time; NOTE 5 | | | | 10 | ns |
| t_{DIS} | Output Disable Time; NOTE 5 | | | | 10 | ns |

NOTE 1: Measured from $V_{DD}/2$ 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 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 4: Phase jitter is dependent on the input source used.

NOTE 5: These parameters are guaranteed by characterization. Not tested in production.

TABLE 6B. AC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$, $V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------------|---|---|--------------|---------|---------|-------|
| f_{MAX} | Output Frequency | w/external XTAL | 12 | | 38.88 | MHz |
| | | w/external CLK | | | 200 | MHz |
| t_{pLH} | Propagation Delay, Low-to-High; NOTE 1 | | 1.5 | 2.0 | 2.5 | ns |
| $t_{sk(o)}$ | Output Skew; NOTE 2 | | | | 40 | ps |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 2, 3 | | | | 700 | ps |
| $f_{jit}(\emptyset)$ | RMS Phase Jitter, Random; NOTE 2, 4 | 25MHz, Integration Range: 100Hz - 1MHz | | 0.16 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 800 | ps |
| odc | Output Duty Cycle | w/external XTAL | 45 | | 55 | % |
| | | w/external CLK | $f < 150MHz$ | 46 | 54 | % |
| t_{EN} | Output Enable Time; NOTE 5 | | | | 10 | ns |
| t_{DIS} | Output Disable Time; NOTE 5 | | | | 10 | ns |

NOTE 1: Measured from $V_{DD}/2$ 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 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 4: Phase jitter is dependent on the input source used.

NOTE 5: These parameters are guaranteed by characterization. Not tested in production.

TABLE 6C. AC CHARACTERISTICS, $V_{DD} = 3.3V \pm 5\%$, $V_{DDO} = 1.8V \pm 0.2V$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------------|---|---|--------------|---------|---------|-------|
| f_{MAX} | Output Frequency | w/external XTAL | 12 | | 38.88 | MHz |
| | | w/external CLK | | | 200 | MHz |
| t_{pLH} | Propagation Delay, Low-to-High; NOTE 1 | | 1.7 | 2.2 | 2.7 | ns |
| $t_{sk(o)}$ | Output Skew; NOTE 2 | | | | 40 | ps |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 2, 3 | | | | 700 | ps |
| $f_{jit}(\emptyset)$ | RMS Phase Jitter, Random; NOTE 2, 4 | 25MHz, Integration Range: 100Hz - 1MHz | | 0.16 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 1000 | ps |
| odc | Output Duty Cycle | w/external XTAL | 45 | | 55 | % |
| | | w/external CLK | $f < 150MHz$ | 46 | | 54 |
| t_{EN} | Output Enable Time; NOTE 5 | | | | 10 | ns |
| t_{DIS} | Output Disable Time; NOTE 5 | | | | 10 | ns |

NOTE 1: Measured from $V_{DD}/2$ 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 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 4: Phase jitter is dependent on the input source used.

NOTE 5: These parameters are guaranteed by characterization. Not tested in production.

TABLE 6D. AC CHARACTERISTICS, $V_{DD} = V_{DDO} = 2.5V \pm 5\%$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------------|---|---|--------------|---------|---------|-------|
| f_{MAX} | Output Frequency | w/external XTAL | 12 | | 38.88 | MHz |
| | | w/external CLK | | | 200 | MHz |
| t_{pLH} | Propagation Delay, Low-to-High; NOTE 1 | | 1.5 | 2.2 | 3.0 | ns |
| $t_{sk(o)}$ | Output Skew; NOTE 2 | | | | 40 | ps |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 2, 3 | | | | 700 | ps |
| $f_{jit}(\emptyset)$ | RMS Phase Jitter, Random; NOTE 2, 4 | 25MHz, Integration Range: 100Hz - 1MHz | | 0.20 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 800 | ps |
| odc | Output Duty Cycle | w/external XTAL | 45 | | 55 | % |
| | | w/external CLK | $f < 150MHz$ | 48 | | 52 |
| t_{EN} | Output Enable Time; NOTE 5 | | | | 10 | ns |
| t_{DIS} | Output Disable Time; NOTE 5 | | | | 10 | ns |

NOTE 1: Measured from $V_{DD}/2$ 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 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 4: Phase jitter is dependent on the input source used.

NOTE 5: These parameters are guaranteed by characterization. Not tested in production.

TABLE 6E. AC CHARACTERISTICS, $V_{DD} = 2.5V \pm 5\%$, $V_{DDO} = 1.8V \pm 0.2V$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------------|---|---|--------------|---------|---------|-------|
| f_{MAX} | Output Frequency | w/external XTAL | 12 | | 38.88 | MHz |
| | | w/external CLK | | | 200 | MHz |
| t_{pLH} | Propagation Delay, Low-to-High; NOTE 1 | | 1.7 | 2.5 | 3.3 | ns |
| $t_{sk(o)}$ | Output Skew; NOTE 2 | | | | 40 | ps |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 2, 3 | | | | 700 | ps |
| $f_{jit}(\emptyset)$ | RMS Phase Jitter, Random; NOTE 2, 4 | 25MHz, Integration Range: 100Hz - 1MHz | | 0.19 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 1000 | ps |
| odc | Output Duty Cycle | w/external XTAL | 45 | | 55 | % |
| | | w/external CLK | $f < 150MHz$ | 46 | | 54 |
| t_{EN} | Output Enable Time; NOTE 5 | | | | 10 | ns |
| t_{DIS} | Output Disable Time; NOTE 5 | | | | 10 | ns |

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

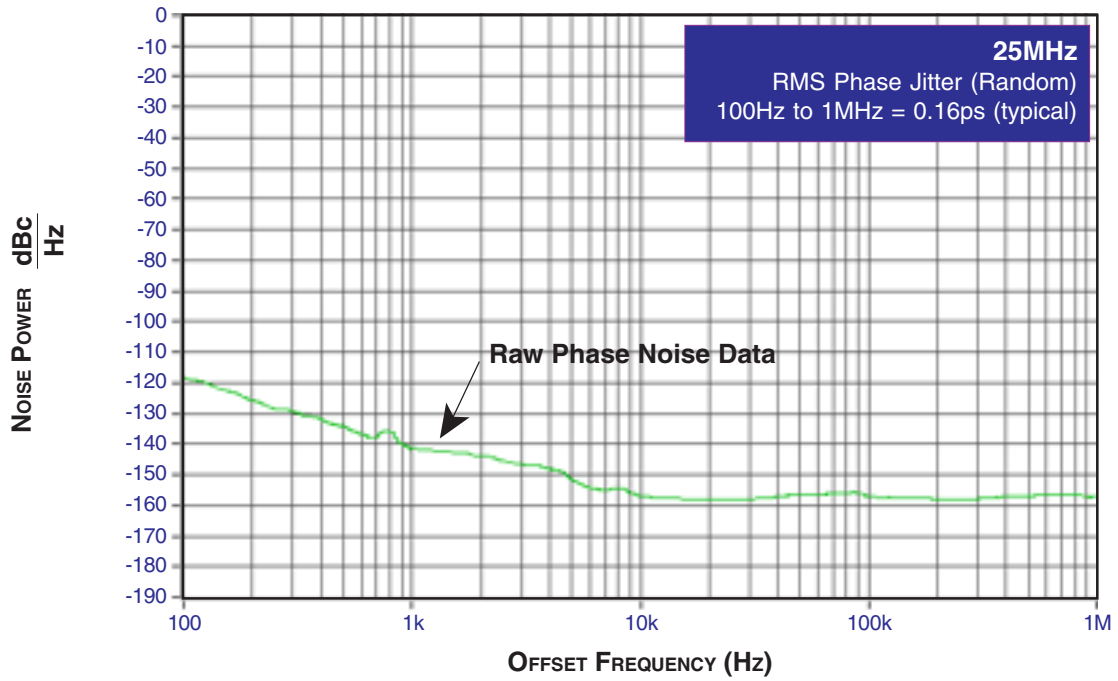
NOTE 2: This parameter is defined in accordance with JEDEC Standard 65.

NOTE 3: Defined as skew between outputs 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 $V_{DDO}/2$.

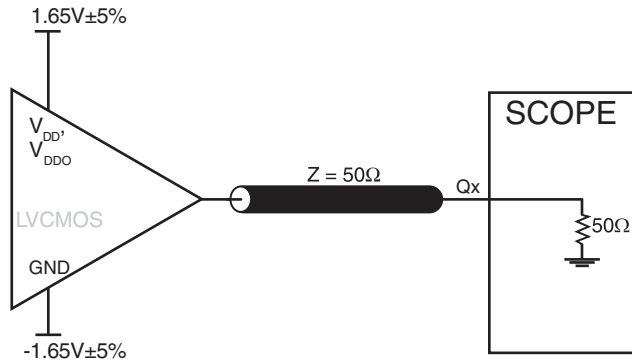
NOTE 4: Phase jitter is dependent on the input source used.

NOTE 5: These parameters are guaranteed by characterization. Not tested in production.

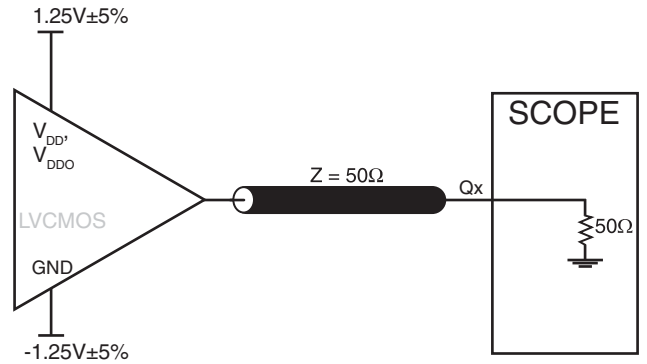
TYPICAL PHASE NOISE AT 25MHz



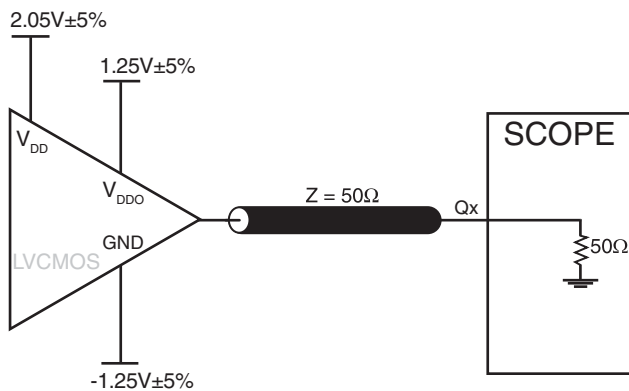
PARAMETER MEASUREMENT INFORMATION



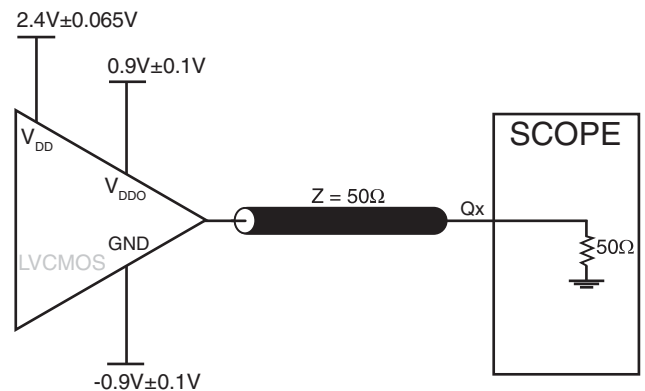
3.3V CORE/3.3V OUTPUT LOAD AC TEST CIRCUIT



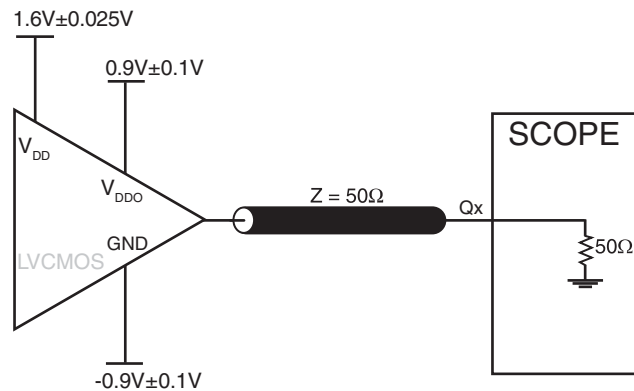
2.5V CORE/2.5V OUTPUT LOAD AC TEST CIRCUIT



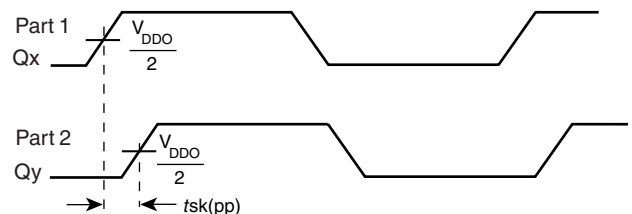
3.3V CORE/2.5V OUTPUT LOAD AC TEST CIRCUIT



3.3V CORE/1.8V OUTPUT LOAD AC TEST CIRCUIT

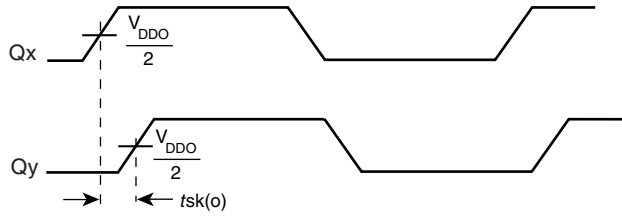


2.5V CORE/1.8V OUTPUT LOAD AC TEST CIRCUIT

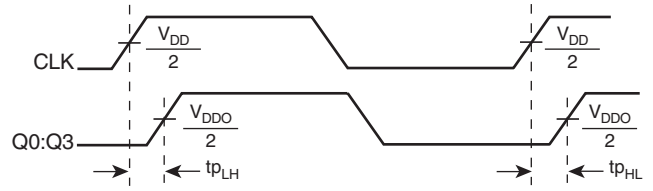


PART-TO-PART SKEW

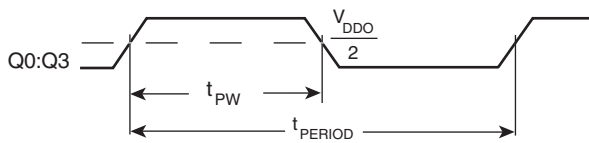
PARAMETER MEASUREMENT INFORMATION, CONTINUED



OUTPUT SKEW

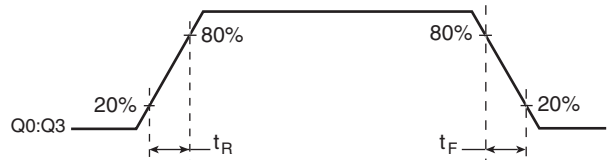


PROPAGATION DELAY



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

OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD



OUTPUT RISE/FALL TIME

APPLICATION INFORMATION

RECOMMENDATIONS FOR UNUSED INPUT AND OUTPUT PINS

INPUTS:

CRYSTAL INPUTS

For applications not requiring the use of the crystal oscillator input, both XTAL_IN and XTAL_OUT can be left floating. Though not required, but for additional protection, a 1k Ω resistor can be tied from XTAL_IN to ground.

CLK INPUT

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

SELECT PINS

All select pins have internal pull-ups and pull-downs; additional resistance is not required but can be added for additional protection. A 1k Ω resistor can be used.

OUTPUTS:

LVCMOS OUTPUTS

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

CRYSTAL INPUT INTERFACE

Figure 1 shows an example of ICS83904-02 crystal interface with a parallel resonant crystal. The frequency accuracy can be fine tuned by adjusting the C1 and C2 values. For a parallel crystal with loading capacitance $C_L = 18\text{pF}$, we suggest $C_1 = 15\text{pF}$ and $C_2 = 15\text{pF}$ to start with. These values may be slightly fine tuned further to optimize the frequency accuracy for different board layouts. Slightly increasing the C1 and C2 values will slightly reduce the frequency. Slightly decreasing the C1 and C2 values will slightly increase the frequency. For the oscillator circuit below, R1 can be used, but is not required. For new designs, it is recommended that R1 not be used.

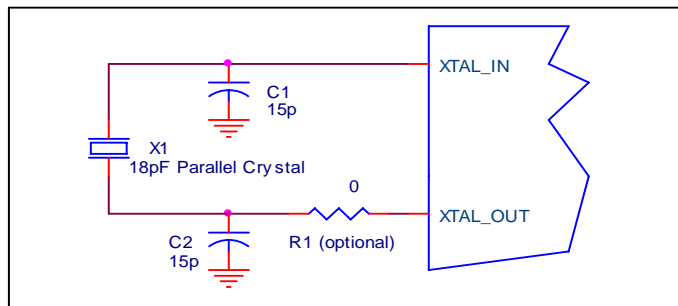


FIGURE 1. CRYSTAL INPUT INTERFACE

OVERDRIVING THE CRYSTAL INTERFACE

The XTAL_IN input can accept a single-ended LVCMOS signal through an AC coupling capacitor. A general interface diagram is shown in Figure 2A. The XTAL_OUT pin can be left floating. The maximum amplitude of the input signal should not exceed 2V and the input edge rate can be as slow as 10ns. This configuration requires that the output impedance of the driver (R_o) plus the series resistance (R_s) equals the transmission line impedance. In addition, matched termination at the crystal input will attenuate

the signal in half. This can be done in one of two ways. First, R1 and R2 in parallel should equal the transmission line impedance. For most 50Ω applications, R1 and R2 can be 100Ω. This can also be accomplished by removing R1 and making R2 50Ω. By overdriving the crystal oscillator, the device will be functional, but note, the device performance is guaranteed by using a quartz crystal.

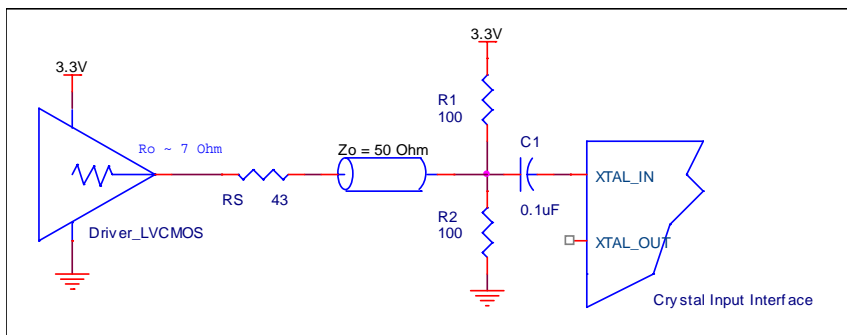


FIGURE 2A. GENERAL DIAGRAM FOR LVCMOS DRIVER TO XTAL INPUT INTERFACE

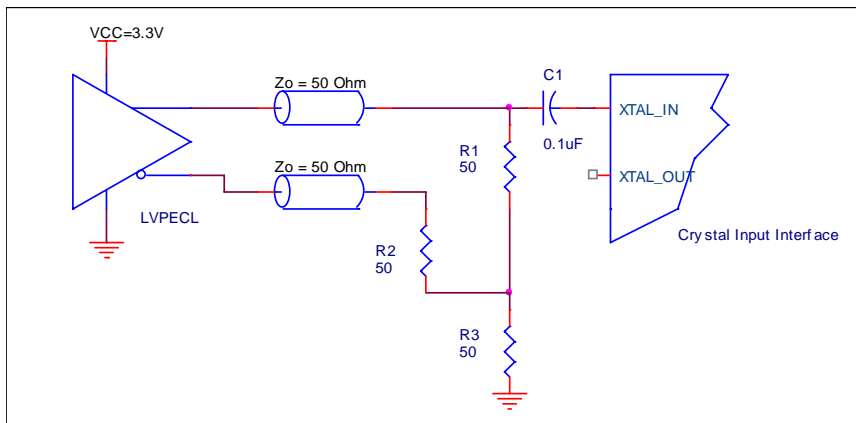


FIGURE 2A. GENERAL DIAGRAM FOR LVPECL DRIVER TO XTAL INPUT INTERFACE

RELIABILITY INFORMATION

TABLE 7. θ_{JA} VS. AIR FLOW TABLE FOR 16 LEAD TSSOP

| θ_{JA} by Velocity (Linear Feet per Minute) | | | |
|--|-----------|----------|----------|
| | 0 | 1 | 2.5 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 100.3°C/W | 96.0°C/W | 93.9°C/W |

TRANSISTOR COUNT

The transistor count for ICS83904-02 is: 205

PACKAGE OUTLINE - G SUFFIX FOR 16 LEAD TSSOP

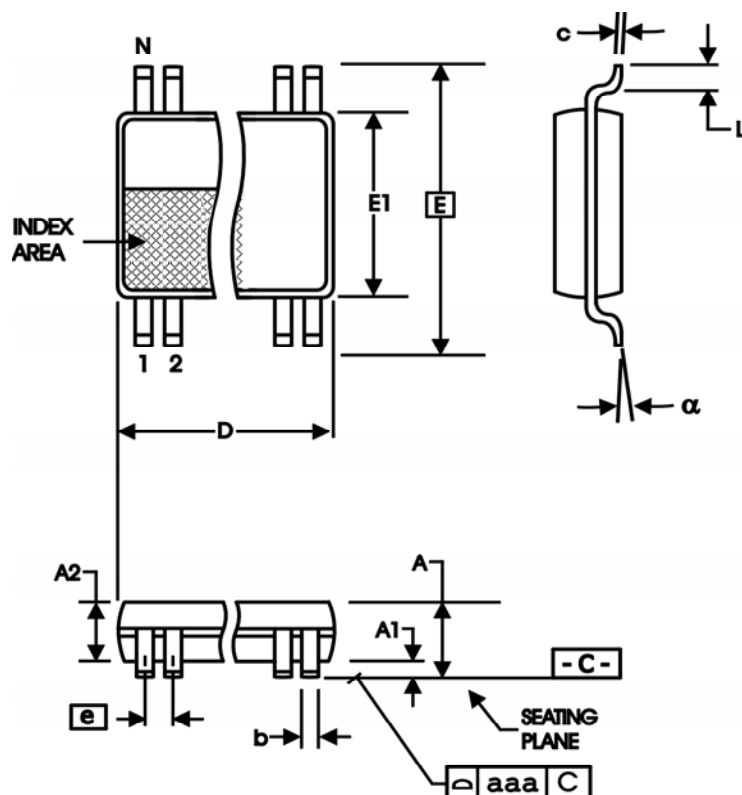


TABLE 8. PACKAGE DIMENSIONS

| SYMBOL | Millimeters | |
|--------|-------------|---------|
| | Minimum | Maximum |
| N | 16 | |
| A | -- | 1.20 |
| A1 | 0.05 | 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 |
| alpha | 0° | 8° |
| aaa | -- | 0.10 |

Reference Document: JEDEC Publication 95, MO-153

TABLE 9. ORDERING INFORMATION

| Part/Order Number | Marking | Package | Shipping Packaging | Temperature |
|-------------------|----------|---------------------------|--------------------|-------------|
| 83904AG-02 | 83904A02 | 16 Lead TSSOP | tube | 0°C to 70°C |
| 83904AG-02T | 83904A02 | 16 Lead TSSOP | 2500 tape & reel | 0°C to 70°C |
| 83904AG-02LF | 3904A02L | 16 Lead "Lead-Free" TSSOP | tube | 0°C to 70°C |
| 83904AG-02LFT | 3904A02L | 16 Lead "Lead-Free" TSSOP | 2500 tape & reel | 0°C to 70°C |

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

While the information presented herein has been checked for both accuracy and reliability, Integrated Device Technology, Incorporated (IDT) assumes no responsibility for either its use or for infringement of any patents or other rights of third parties, which would result from its use. No other circuits, patents, or licenses are implied. This product is intended for use in normal commercial applications. Any other applications such as those requiring extended temperature ranges high reliability or other extraordinary environmental requirements are not recommended without additional processing by IDT. IDT reserves the right to change any circuitry or specifications without notice. IDT does not authorize or warrant any IDT product for use in life support devices or critical medical instruments.

| REVISION HISTORY SHEET | | | | |
|-------------------------------|--------------|-------------|---|-------------|
| Rev | Table | Page | Description of Change | Date |
| A | T9 | 12 14 | Updated Overdriving the Crystal Interface section. Ordering Information Table - deleted the "ICS" prefix in the Part/Order Number column and corrected the Temperature column. Updated header/footer. | 9/3/10 |
| | | | | |

We've Got Your Timing Solution.



www.IDT.com

6024 Silver Creek Valley Road
San Jose, CA 95138

Sales

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

Tech Support

netcom@idt.com
+480-763-2056