



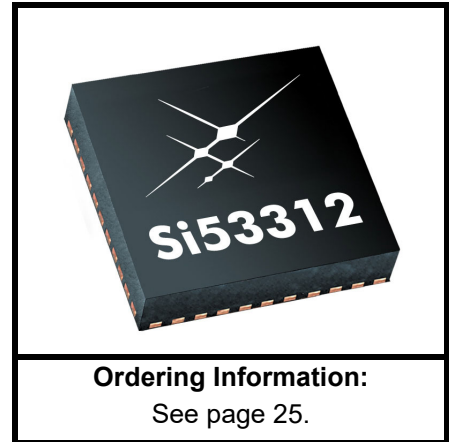
SKYWORKS®

# Si53311

## 1:6 LOW JITTER UNIVERSAL BUFFER/LEVEL TRANSLATOR WITH 2:1 INPUT MUX (<1.25 GHz)

### Features

- 6 differential or 12 LVCMOS outputs
- Ultra-low additive jitter: 100 fs rms
- Wide frequency range: 1 MHz to 1.25 GHz
- Any-format input with pin selectable output formats: LVPECL, Low Power LVPECL, LVDS, CML, HCSL, LVCMOS
- 2:1 mux with hot-swappable inputs
- Asynchronous output enable
- Output clock division: /1, /2, /4
- Low output-output skew: <50 ps
- Low propagation delay variation: <400 ps
- Independent  $V_{DD}$  and  $V_{DDO}$  : 1.8/2.5/3.3 V
- Excellent power supply noise rejection (PSRR)
- Selectable LVCMOS drive strength to tailor jitter and EMI performance
- Small size: 32-QFN (5 mm x 5 mm)
- RoHS compliant, Pb-free
- Industrial temperature range: -40 to +85 °C

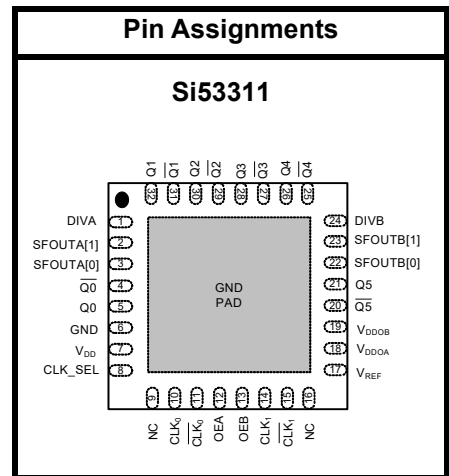


### Applications

- High-speed clock distribution
- Ethernet switch/router
- Optical Transport Network (OTN)
- SONET/SDH
- PCI Express Gen 1/2/3
- Storage
- Telecom
- Industrial
- Servers
- Backplane clock distribution

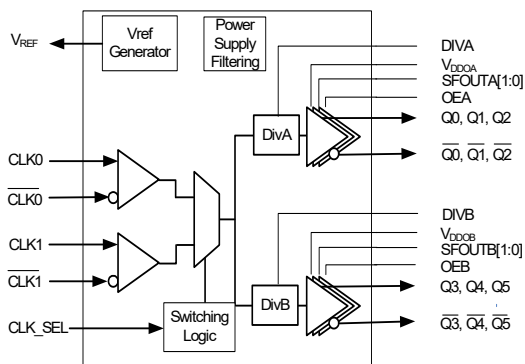
### Description

The Si53311 is an ultra low jitter six output differential buffer with pin-selectable output clock signal format and divider selection. The Si53311 features a 2:1 mux, making it ideal for redundant clocking applications. The Si53311 utilizes Skyworks Solutions' advanced CMOS technology to fanout clocks from 1 MHz to 1.25 GHz with guaranteed low additive jitter, low skew, and low propagation delay variability. The Si53311 features minimal cross-talk and provides superior supply noise rejection, simplifying low jitter clock distribution in noisy environments. Independent core and output bank supply pins provide integrated level translation without the need for external circuitry.



Patents pending

### Functional Block Diagram



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## 1. Electrical Specifications

**Table 1. Recommended Operating Conditions**

| Parameter                     | Symbol    | Test Condition                                     | Min  | Typ | Max  | Unit |
|-------------------------------|-----------|--|------|-----|------|------|
| Ambient Operating Temperature | $T_A$     |  | -40  | —   | 85   | °C   |
| Supply Voltage Range*         | $V_{DD}$  | LVDS, CML, HCSSL, LVCMOS                           | 1.71 | 1.8 | 1.89 | V    |
|                               |           | LVPECL, low power LVPECL, LVDS, CML, HCSSL, LVCMOS | 2.38 | 2.5 | 2.63 | V    |
|                               |           |  | 2.97 | 3.3 | 3.63 | V    |
| Output Buffer Supply Voltage* | $V_{DDO}$ | LVDS, CML, HCSSL, LVCMOS                           | 1.71 | —   | 1.89 | V    |
|                               |           | LVPECL, low power LVPECL, LVDS, CML, HCSSL, LVCMOS | 2.38 | —   | 2.63 | V    |
|                               |           |  | 2.97 | —   | 3.63 | V    |

**\*Note:** Core supply  $V_{DD}$  and output buffer supplies  $V_{DDO}$  are independent.

**Table 2. Input Clock Specifications**

( $V_{DD}=1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A=-40$  to  $85\text{ }^\circ\text{C}$ )

| Parameter                                | Symbol   | Test Condition  | Min                 | Typ | Max                 | Unit |
|--|----------|---|---------------------|-----|---------------------|------|
| Differential Input Common Mode Voltage   | $V_{CM}$ | $V_{DD} = 2.5\text{ V} \pm 5\%$ , $3.3\text{ V} \pm 10\%$ | 0.05                | —   | —                   | V    |
| Input Swing (single-ended, peak-to-peak) | $V_{IN}$ |   | 0.1                 | —   | 1.1                 | V    |
| Input Voltage High                       | $V_{IH}$ |   | $V_{DD} \times 0.7$ | —   | —                   | V    |
| Input Voltage Low                        | $V_{IL}$ |   | —                   | —   | $V_{DD} \times 0.3$ | V    |
| Input Capacitance                        | $C_{IN}$ |   | —                   | 5   | —                   | pF   |

**Table 3. DC Common Characteristics**

( $V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40\text{ to }85\text{ }^\circ\text{C}$ )

| Parameter  | Symbol     | Test Condition  | Min                  | Typ                 | Max                  | Unit          |
|--|------------|---|----------------------|---------------------|----------------------|---------------|
| Supply Current   | $I_{DD}$   |   | —                    | TBD                 | 100                  | mA            |
| Output Buffer Supply Current (Per Clock Output) @100 MHz | $I_{DDOX}$ | LVPECL (3.3 V)  | —                    | 35                  | —                    | mA            |
|  |            | Low Power LVPECL (3.3 V)  | —                    | 30                  | —                    | mA            |
|  |            | LVDS (3.3 V)  | —                    | 20                  | —                    | mA            |
|  |            | CML (3.3 V)   | —                    | 30                  | —                    | mA            |
|  |            | HCSL, 100 MHz, 2 pF load (3.3 V)  | —                    | 35                  | —                    | mA            |
|  |            | CMOS (1.8 V, SFOUT = Open/0), per output, $C_L = 5\text{ pF}$ , 200 MHz | —                    | 5                   | —                    | mA            |
|  |            | CMOS (2.5 V, SFOUT = Open/0), per output, $C_L = 5\text{ pF}$ , 200 MHz | —                    | 8                   | —                    | mA            |
| Leakage Current  | $I_L$      | Input leakage at all inputs except CLKIN, $V_{IN} = 0\text{ V}$         | —                    | —                   | TBD                  | $\mu\text{A}$ |
|  |            | Input leakage at CLKIN $V_{IN} = 0\text{ V}$                            | —                    | —                   | TBD                  | $\mu\text{A}$ |
| Voltage Reference  | $V_{REF}$  | $V_{REF}$ pin   | —                    | $V_{DD}/2$          | —                    | V             |
| Input High Voltage                                       | $V_{IH}$   | SFOUTX, DIVX 3-level input pins   | $0.85 \times V_{DD}$ | —                   | —                    | V             |
| Input Mid Voltage  | $V_{IM}$   | SFOUTX, DIVX 3-level input pins   | $0.45 \times V_{DD}$ | $0.5 \times V_{DD}$ | $0.55 \times V_{DD}$ | V             |
| Input Low Voltage  | $V_{IL}$   | SFOUTX, DIVXpin 3-level input pins                                      | —                    | —                   | $0.15 \times V_{DD}$ | V             |
| Internal Pull-down Resistor                              | $R_{DOWN}$ | CLK_SEL, DIVA, DIVB, SFOUTA[1], SFOUTB[1]                               | —                    | 25                  | —                    | k $\Omega$    |
| Internal Pull-up Resistor                                | $R_{UP}$   | SFOUTA[1], SFOUTB[1], DIVA, DIVB, OEA, OEB                              | —                    | 25                  | —                    | k $\Omega$    |

**Table 4. DC Characteristics—LVPECL and Low Power LVPECL** $(V_{DD} = 2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

| Parameter                     | Symbol    | Test Condition  | Min                | Typ  | Max                | Unit |
|-------------------------------|-----------|---|--------------------|------|--------------------|------|
| Output Voltage High           | $V_{OH}$  | $R_L = 50\ \Omega$ to $V_{DDOX} - 2\text{ V}$                             | $V_{DDOX} - 1.145$ | —    | $V_{DDOX} - 0.895$ | V    |
| Output Voltage Low            | $V_{OL}$  | $R_L = 50\ \Omega$ to $V_{DDOX} - 2\text{ V}$                             | $V_{DDOX} - 1.945$ | —    | $V_{DDOX} - 1.695$ | V    |
| Output DC Common Mode Voltage | $V_{COM}$ |   | $V_{DDOX} - 1.895$ | —    | $V_{DDOX} - 1.425$ | V    |
| Single-Ended Output Swing     | $V_{SE}$  | Terminate unused outputs to $R_L = 50\ \Omega$ to $V_{DDOX} - 2\text{ V}$ | 0.25               | 0.60 | 0.85               | V    |

**Table 5. DC Characteristics—CML** $(V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

| Parameter                 | Symbol   | Test Condition                                     | Min | Typ | Max | Unit |
|---------------------------|----------|--|-----|-----|-----|------|
| Single-Ended Output Swing | $V_{SE}$ | Terminated as shown in Figure 6 (CML termination). | 300 | 400 | 500 | mV   |

**Table 6. DC Characteristics—LVDS** $(V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

| Parameter   | Symbol     | Test Condition   | Min  | Typ  | Max  | Unit |
|---|------------|--|------|------|------|------|
| Single-Ended Output Swing   | $V_{SE}$   | $R_L = 100\ \Omega$ across $Q_N$ and $\overline{Q}_N$  | 247  | —    | 454  | mV   |
| Output Common Mode Voltage ( $V_{DDO}=2.5\text{V}$ or $3.3\text{V}$ ) | $V_{COM1}$ | $V_{DDOX} = 2.38$ to $2.63\text{ V}$ , $2.97$ to $3.63\text{ V}$ , $R_L = 100\ \Omega$ across $Q_N$ and $\overline{Q}_N$ | 1.10 | 1.25 | 1.35 | V    |
| Output Common Mode Voltage ( $V_{DDO}=1.8\text{V}$ )                  | $V_{COM2}$ | $V_{DDOX} = 1.71$ to $1.89\text{ V}$ , $R_L = 100\ \Omega$ across $Q_N$ and $\overline{Q}_N$                             | 0.85 | 0.97 | 1.10 | V    |

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**Table 7. DC Characteristics—LVCMOS**

( $V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

| Parameter            | Symbol   | Test Condition | Min                    | Typ | Max                    | Unit |
|----------------------|----------|----------------|------------------------|-----|------------------------|------|
| Output Voltage High* | $V_{OH}$ |                | $0.85 \times V_{DDOX}$ | —   | —                      | V    |
| Output Voltage Low*  | $V_{OL}$ |                | —                      | —   | $0.15 \times V_{DDOX}$ | V    |

\*Note:  $I_{OH}$  and  $I_{OL}$  per the Output Signal Format Table for specific  $V_{DDOX}$  and SFOUTX settings.

**Table 8. DC Characteristics—HCSL**

( $V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

| Parameter                 | Symbol   | Test Condition            | Min  | Typ | Max | Unit |
|---------------------------|----------|---------------------------|------|-----|-----|------|
| Output Voltage High       | $V_{OH}$ | $R_L = 50\ \Omega$ to GND | 550  | 700 | 850 | mV   |
| Output Voltage Low        | $V_{OL}$ | $R_L = 50\ \Omega$ to GND | -150 | 0   | 150 | mV   |
| Single-Ended Output Swing | $V_{SE}$ | $R_L = 50\ \Omega$ to GND | —    | 700 | —   | mV   |
| Crossing Voltage          | $V_C$    | $R_L = 50\ \Omega$ to GND | 250  | 350 | 550 | mV   |

**Table 9. AC Characteristics**(V<sub>DD</sub> = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T<sub>A</sub> = -40 to 85 °C)

| Parameter  | Symbol                              | Test Condition  | Min  | Typ | Max  | Unit |
|--|-------------------------------------|---|------|-----|------|------|
| Frequency  | F                                   | LVPECL, low power LVPECL, LVDS, CML, HCSL   | 1    | —   | 1250 | MHz  |
|  |                                     | LVC MOS   | 1    | —   | 200  | MHz  |
| Duty Cycle<br><b>Note:</b> 50% input duty cycle. | D <sub>C</sub>                      | 200 MHz, 50 Ω to V <sub>DD</sub> /2, 20/80% T <sub>R</sub> /T <sub>F</sub> <10% of period (LVC MOS) | TBD  | TBD | TBD  | %    |
|  |                                     | 20/80% T <sub>R</sub> /T <sub>F</sub> <10% of period (Differential)                                 | 48   | 50  | 52   | %    |
| Minimum Input Clock Slew Rate <sup>1</sup>       | SR                                  | Required to meet prop delay and additive jitter specifications (20–80%)                             | 0.75 | —   | —    | V/ns |
| Output Rise/Fall Time                            | T <sub>R</sub> /T <sub>F</sub>      | LVPECL, LVDS, CML, HCSL, 20/80%   |      |     | 350  | ps   |
|  |                                     | 200 MHz, 50 Ω, 20/80%, 2 pF load (LVC MOS)  | TBD  | TBD | 750  | ps   |
| Minimum Input Pulse Width                        | T <sub>W</sub>                      |   | 500  | —   | —    | ps   |
| Additive Jitter (Differential Clock Input)       | J                                   | V <sub>DD</sub> = 2.5/3.3 V, LVPECL/LVDS, F = 725 MHz, 0.75 V/ns input slew rate                    | —    | 60  | 80   | fs   |
| Propagation Delay                                | T <sub>PLH</sub> , T <sub>PHL</sub> | Low to high, high to low Single-ended   | TBD  | —   | TBD  | ns   |
|  |                                     | Low to high, high to low Differential   | TBD  | —   | TBD  | ns   |
| Output Enable Time <sup>2</sup>                  | T <sub>EN</sub>                     | F = 1 MHz   | —    | 2   | —    | μs   |
|  |                                     | F = 100 MHz   | —    | 60  | —    | ns   |
|  |                                     | F = 725 MHz   | —    | 50  | —    | ns   |
| Output Disable Time <sup>2</sup>                 | T <sub>DIS</sub>                    | F = 1 MHz   | —    | 2   | —    | μs   |
|  |                                     | F = 100 MHz   | —    | 25  | —    | ns   |
|  |                                     | F = 725 MHz   | —    | 15  | —    | ns   |

**Notes:**

1. For clock division applications, a minimum input clock slew rate of 30 mV/ns is required.
2. See Figure 4.
3. Defined as skew between outputs on different devices operating at the same supply voltages, temperatures, and equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
4. Measured for 156.25 MHz carrier frequency. Sine-wave noise added to V<sub>DDOX</sub> (1.8V=50mV<sub>PP</sub>, 2.5/3.3V=100mV<sub>PP</sub>) and noise spur amplitude measured. See AN491 for further details.

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**Table 9. AC Characteristics (Continued)**

( $V_{DD} = 1.8\text{ V} \pm 5\%$ ,  $2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40\text{ to }85\text{ }^\circ\text{C}$ )

| Parameter                                 | Symbol   | Test Condition   | Min | Typ | Max | Unit |
|---|----------|--|-----|-----|-----|------|
| Output to Output Skew                     | $T_{SK}$ | Identical Configuration, Single-ended ( $Q_N$ to $Q_M$ ) | —   | —   | 100 | ps   |
|   |          | Identical Configuration, Differential ( $Q_N$ to $Q_M$ ) | —   | —   | 50  | ps   |
| Part to Part Skew <sup>3</sup>            | $T_{PS}$ | Identical configuration                                  | —   | 50  | —   | ps   |
| Power Supply Noise Rejection <sup>4</sup> | PSRR     | 10 kHz sinusoidal noise                                  | —   | -90 | —   | dBc  |
|   |          | 100 kHz sinusoidal noise                                 | —   | -90 | —   | dBc  |
|   |          | 500 kHz sinusoidal noise                                 | —   | -80 | —   | dBc  |
|   |          | 1 MHz sinusoidal noise                                   | —   | -70 | —   | dBc  |

**Notes:**

1. For clock division applications, a minimum input clock slew rate of 30 mV/ns is required.
2. See Figure 4.
3. Defined as skew between outputs on different devices operating at the same supply voltages, temperatures, and equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
4. Measured for 156.25 MHz carrier frequency. Sine-wave noise added to  $V_{DDOX}$  ( $1.8\text{V}=50\text{mV}_{PP}$ ,  $2.5/3.3\text{V}=100\text{mV}_{PP}$ ) and noise spur amplitude measured. See AN491 for further details.



Table 10. Thermal Conditions

| Parameter                               | Symbol        | Test Condition | Value | Unit |
|---|---------------|----------------|-------|------|
| Thermal Resistance, Junction to Ambient | $\theta_{JA}$ | Still air      | 49.6  | °C/W |
| Thermal Resistance, Junction to Case    | $\theta_{JC}$ | Still air      | 32.3  | °C/W |

Table 11. Absolute Maximum Ratings

| Parameter   | Symbol     | Test Condition                                     | Min  | Typ | Max            | Unit |
|---|------------|--|------|-----|----------------|------|
| Storage Temperature   | $T_S$      |  | -55  | —   | 150            | °C   |
| Supply Voltage  | $V_{DD}$   |  | -0.5 | —   | 3.8            | V    |
| Input Voltage   | $V_{IN}$   |  | -0.5 | —   | $V_{DD} + 0.3$ | V    |
| Output Voltage  | $V_{OUT}$  |  | —    | —   | $V_{DD} + 0.3$ | V    |
| ESD Sensitivity   | HBM        | HBM, 100 pF, 1.5 k $\Omega$                        | 2000 | —   | —              | V    |
| ESD Sensitivity   | CDM        |  | 500  | —   | —              | V    |
| Peak Soldering Reflow Temperature   | $T_{PEAK}$ | Pb-Free; Solder reflow profile per JEDEC J-STD-020 | —    | —   | 260            | °C   |
| Maximum Junction Temperature  | $T_J$      |  | —    | —   | 125            | °C   |
| <b>Note:</b> Stresses beyond those listed in this table may cause permanent damage to the device. Functional operation specification compliance is not implied at these conditions. Exposure to maximum rating conditions for extended periods may affect device reliability. |            |  |      |     |                |      |

## 2. Functional Description

The Si53311 is a low jitter, low skew 1:6 differential buffer with an integrated 2:1 input mux. The device has a universal input that accepts most common differential or LVCMOS input signals. A clock select pin is used to select the active input clock. The selected clock input is routed to two independent banks of outputs. Each output bank features control pins to select signal format, output enable, output divider setting and LVCMOS drive strength.

### 2.1. Universal, Any-Format Input

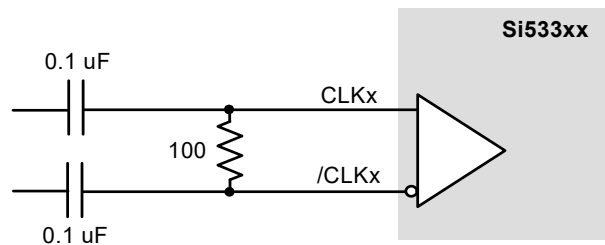
The Si53311 has a universal input stage that enables simple interfacing to a wide variety of clock formats, including LVPECL, LVCMOS, LVDS, HCSL, and CML. Tables 12 and 13 summarize the various input ac- and dc-coupling options supported by the device. Figures 3 and 4 show the recommended input clock termination options.

**Table 12. LVPECL, LVCMOS, and LVDS**

|           | LVPECL    |           | LVCMOS    |           | LVDS      |           |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|           | AC-Couple | DC-Couple | AC-Couple | DC-Couple | AC-Couple | DC-Couple |
| 1.8 V     | N/A       | N/A       | No        | Yes       | Yes       | No        |
| 2.5/3.3 V | Yes       | Yes       | No        | Yes       | Yes       | Yes       |

**Table 13. HCSL and CML**

|           | HCSL      |             | CML       |           |
|-----------|-----------|-------------|-----------|-----------|
|           | AC-Couple | DC-Couple   | AC-Couple | DC-Couple |
| 1.8 V     | No        | No          | Yes       | No        |
| 2.5/3.3 V | No        | Yes (3.3 V) | Yes       | No        |



**Figure 1. Differential LVPECL, LVDS, CML AC-Coupled Input Termination**

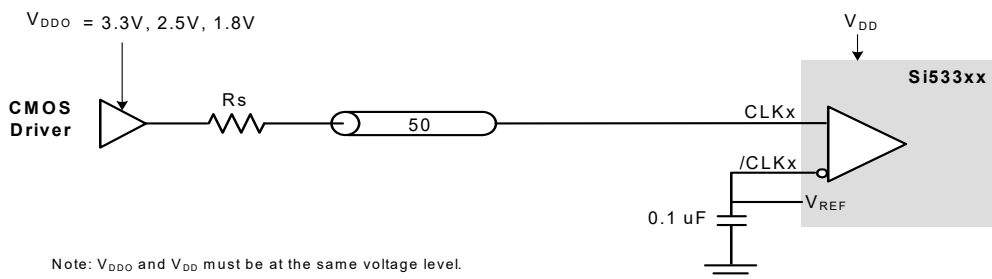
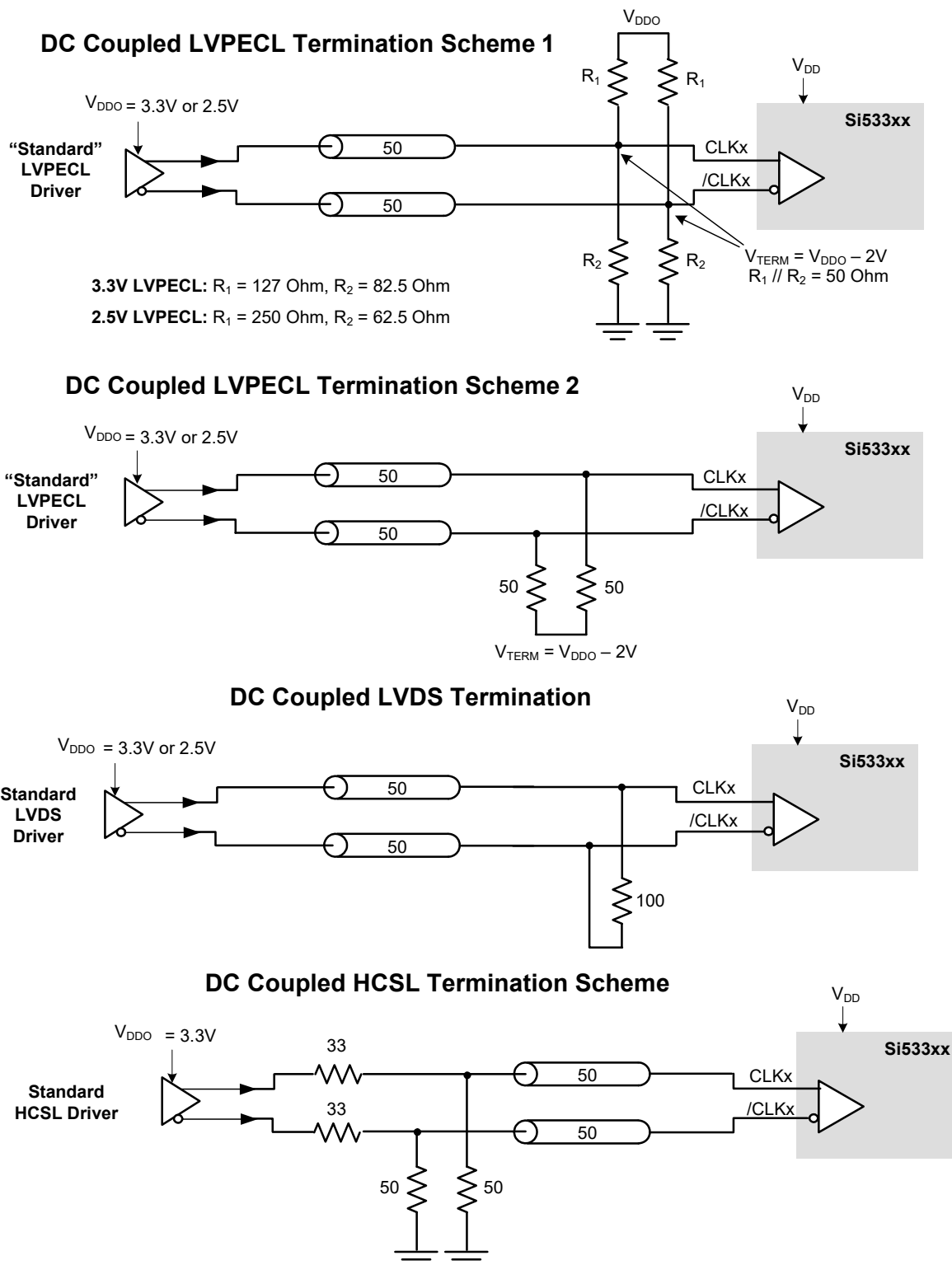


Figure 2. LVCMOS DC-Coupled Input Termination

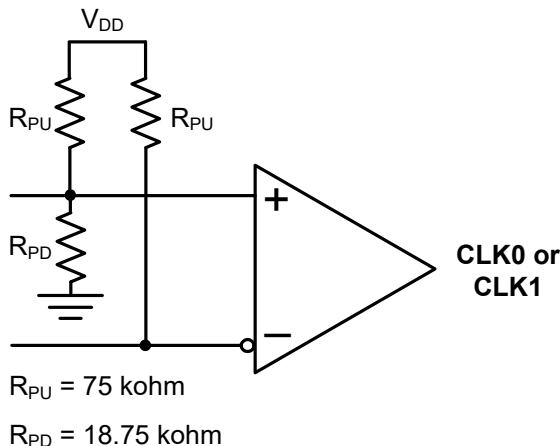


Note: 33 Ohm series termination is optional depending on the location of the receiver.

Figure 3. Differential DC-Coupled Input Terminations

## 2.2. Input Bias Resistors

Internal bias resistors ensure a differential output low condition in the event that the clock inputs are not connected. The noninverting input is biased with a 18.75 kΩ pulldown to GND and a 75 kΩ pullup to V<sub>DD</sub>. The inverting input is biased with a 75 kΩ pullup to V<sub>DD</sub>.



**Figure 4. Input Bias Resistors**

## 2.3. Universal, Any-Format Output Buffer

The Si53311 has highly flexible output drivers that support a wide range of clock signal formats, including LVPECL, low power LVPECL, LVDS, CML, HCSL, and LVCMOS. SFOUTX[1] and SFOUTX[0] are 3-level inputs that can be pin-strapped to select the Bank A and Bank B clock signal formats, respectively. This feature enables the device to be used for format/level translation in addition to clock distribution, minimizing the number of unique buffer part numbers required in a typical application and simplifying design reuse. For EMI reduction applications, four LVCMOS drive strength options are available for each V<sub>DDO</sub> setting.

**Table 14. Output Signal Format Selection**

| SFOUTX[1] | SFOUTX[0] | V <sub>DDOX</sub> = 3.3 V | V <sub>DDOX</sub> = 2.5 V | V <sub>DDOX</sub> = 1.8 V |
|-----------|-----------|---------------------------|---------------------------|---------------------------|
| Open*     | Open*     | LVPECL                    | LVPECL                    | N/A                       |
| 0         | 0         | LVDS                      | LVDS                      | LVDS                      |
| 0         | 1         | LVCMOS, 24 mA drive       | LVCMOS, 18 mA drive       | LVCMOS, 12 mA drive       |
| 1         | 0         | LVCMOS, 18 mA drive       | LVCMOS, 12 mA drive       | LVCMOS, 9 mA drive        |
| 1         | 1         | LVCMOS, 12 mA drive       | LVCMOS, 9 mA drive        | LVCMOS, 6 mA drive        |
| Open*     | 0         | LVCMOS, 6 mA drive        | LVCMOS, 4 mA drive        | LVCMOS, 2 mA drive        |
| Open*     | 1         | LVPECL Low power          | LVPECL Low power          | N/A                       |
| 0         | Open*     | CML                       | CML                       | CML                       |
| 1         | Open*     | HCSL                      | HCSL                      | HCSL                      |

**\*Note:** SFOUTX[1:0] are 3-level input pins. Tie low for “0” setting. Tie high for “1” setting. When left open, the pin floats to V<sub>DD</sub>/2.

## 2.4. Input Mux and Output Enable Logic

The Si53311 provides two clock inputs for applications that need to select between one of two clock sources. The CLK\_SEL pin selects the active clock input. The table below summarizes the input and output clock based on the input mux and output enable pin settings.

**Table 15. Input Mux and Output Enable Logic**

| CLK_SEL | CLK0 | CLK1 | OE <sup>1</sup> | Q <sup>2</sup> |
|---------|------|------|-----------------|----------------|
| L       | L    | X    | H               | L              |
| L       | H    | X    | H               | H              |
| H       | X    | L    | H               | L              |
| H       | X    | H    | H               | H              |
| X       | X    | X    | L               | L <sup>3</sup> |

**Notes:**

1. Output enable active high
2. On the next negative transition of CLK0 or CLK1.
3. Single-end: Q=low,  $\overline{Q}$ =high  
Differential: Q=low,  $\overline{Q}$ =high

## 2.5. Flexible Output Divider

The Si53311 provides optional clock division in addition to clock distribution. The divider setting for each bank of output clocks is selected via 3-level control pins as shown in the table below. Leaving the DIVX pins open will force a divider value of 1 which is the default mode of operation.

**Table 16. Divider Selection**

| DIVX  | Divider Value |
|-------|---------------|
| Open* | ÷1 (default)  |
| 0     | ÷2            |
| 1     | ÷4            |

**\*Note:** DIVX are 3-level input pins. Tie low for “0” setting. Tie high for “1” setting. When left open, the pin floats to  $V_{DD}/2$ .

## 2.6. Input Mux and Output Enable Logic

The Si53311 provides two clock inputs for applications that need to select between one of two clock sources. The CLK\_SEL pin selects the active clock input. The table below summarizes the input and output clock based on the input mux and output enable pin settings.

**Table 17. Input Mux and Output Enable Logic**

| CLK_SEL | CLK0 | CLK1 | OE <sup>1</sup> | Q <sup>2</sup> |
|---------|------|------|-----------------|----------------|
| L       | L    | X    | H               | L              |
| L       | H    | X    | H               | H              |
| H       | X    | L    | H               | L              |
| H       | X    | H    | H               | H              |
| X       | X    | X    | L               | L <sup>3</sup> |

**Notes:**

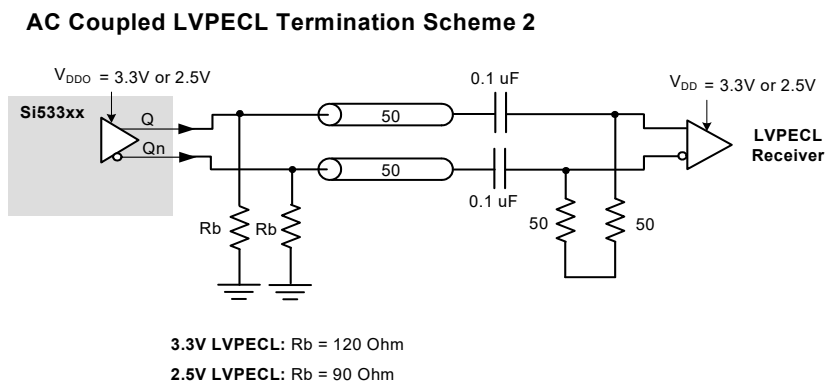
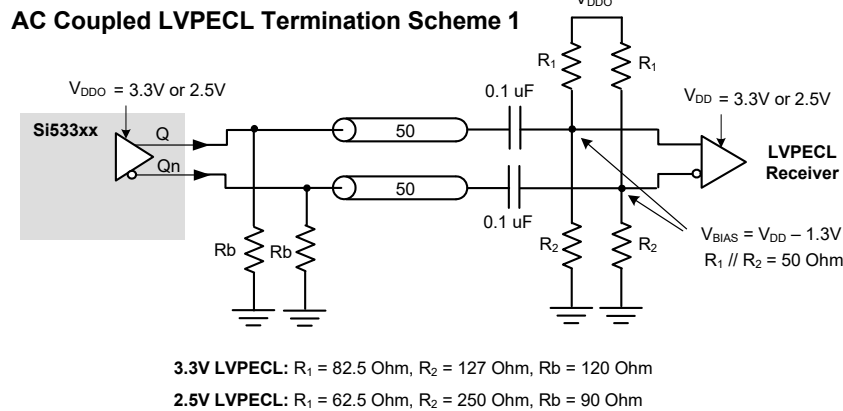
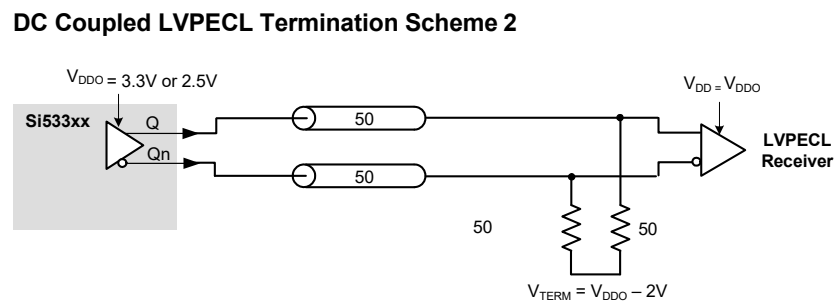
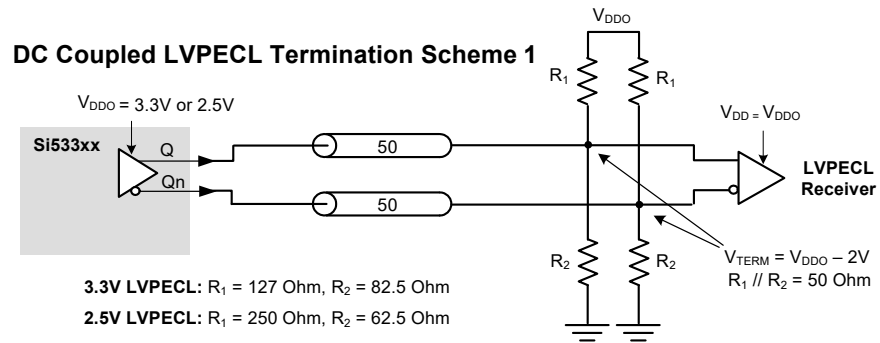
1. Output enable active high
2. On the next negative transition of CLK0 or CLK1.
3. Single-end: Q=low,  $\overline{Q}$ =high  
Differential: Q=low,  $\overline{Q}$ =high

## 2.7. Power Supply ( $V_{DD}$ and $V_{DDOX}$ )

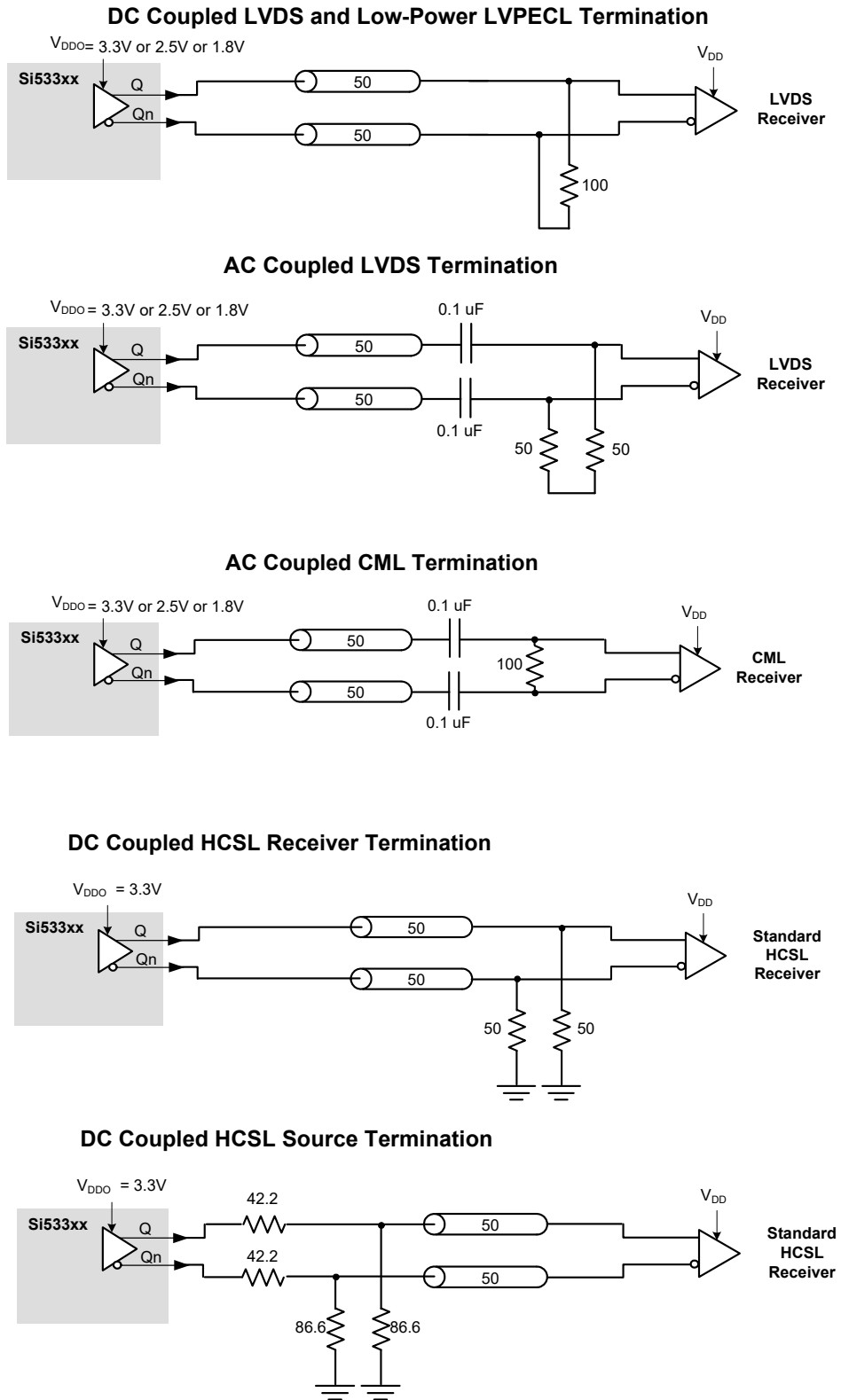
The device includes separate core ( $V_{DD}$ ) and output driver supplies ( $V_{DDOX}$ ). This feature allows the core to operate at a lower voltage than  $V_{DDO}$ , reducing current consumption in mixed supply applications. The core  $V_{DD}$  supports 3.3, 2.5, or 1.8 V. Each output bank has its own  $V_{DDOX}$  supply, supporting 3.3, 2.5, or 1.8 V.

## 2.8. Output Clock Termination Options

The recommended output clock termination options are shown below. Unused output clocks should be left floating.



**Figure 5. LVPECL Output Termination**



**Figure 6. LVDS, CML, and HCSSL Output Termination**



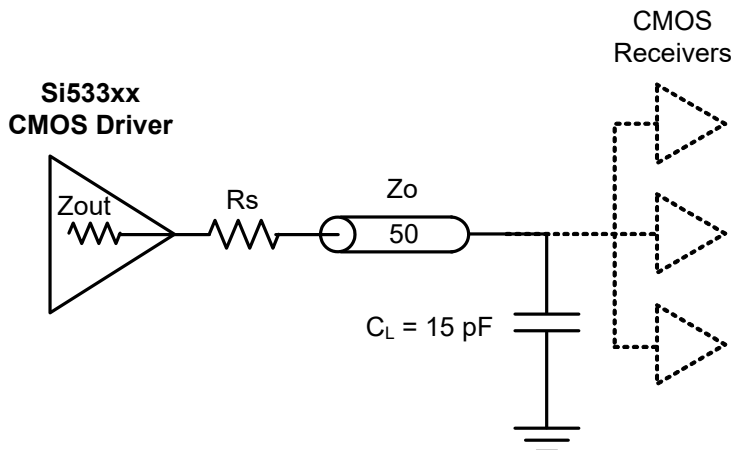


Figure 7. LVC MOS Output Termination

Table 18. Recommended LVC MOS  $R_S$  Series Termination

| SFOUTX[1] | SFOUTX[0] | $R_S$ (ohms) |       |       |
|-----------|-----------|--------------|-------|-------|
|           |           | 3.3 V        | 2.5 V | 1.8 V |
| 0         | 1         | 33           | 33    | 33    |
| 1         | 0         | 33           | 33    | 33    |
| 1         | 1         | 0            | 0     | 0     |
| Open      | 0         | 0            | 0     | 0     |

## 2.9. AC Timing Waveforms

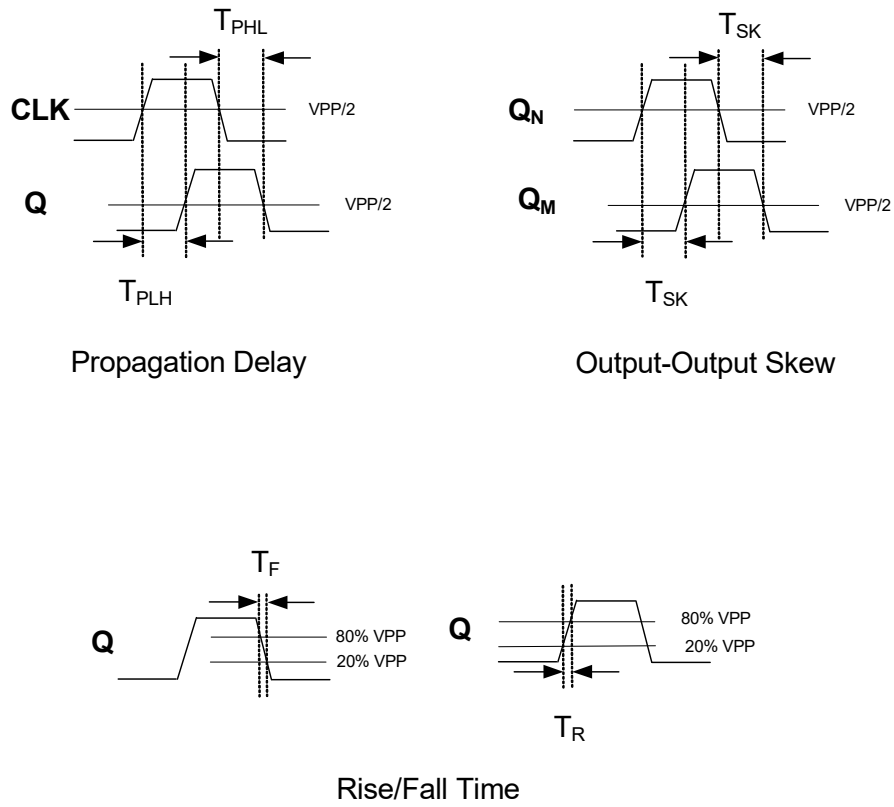
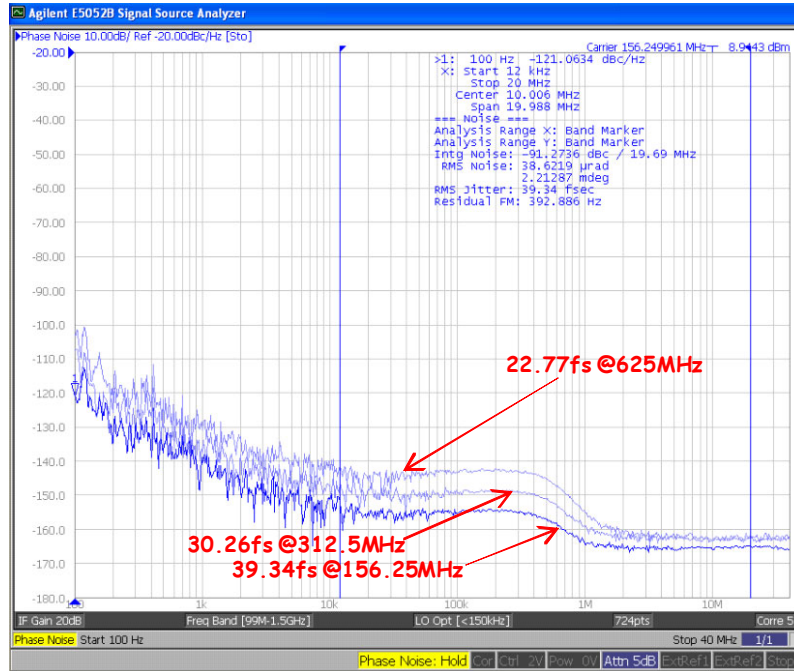
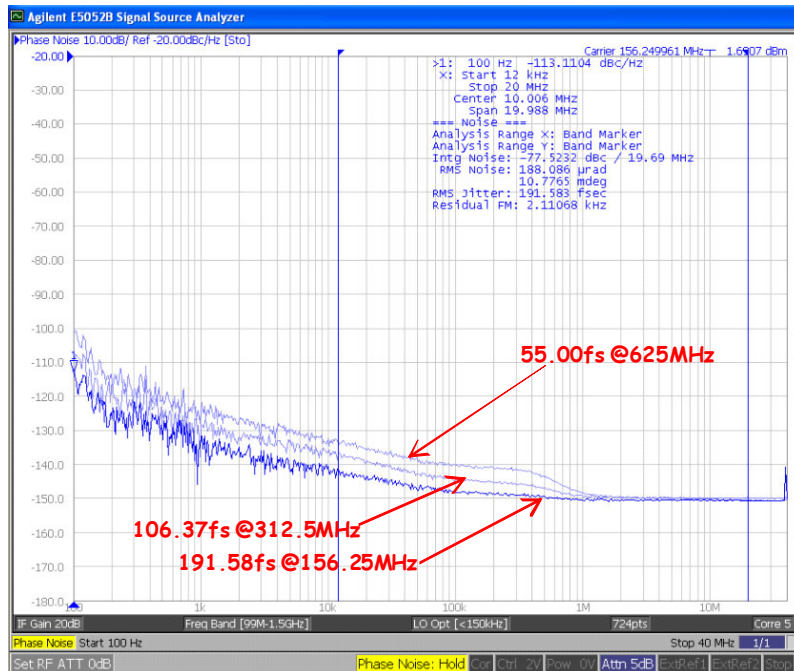


Figure 8. AC Waveforms

2.10. Typical Phase Noise Performance



Source Jitter



Total Jitter

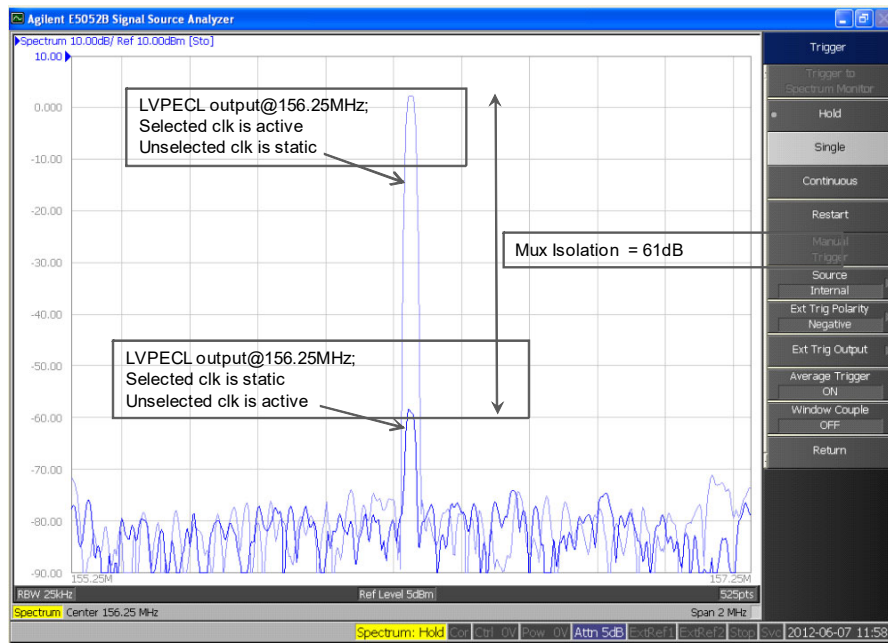
Figure 9. Si53311 Phase Noise

Note: Measured single-endedly.

**Table 19. Si53311 Additive Jitter**

| Frequency (MHz) | Source Jitter (fs) | Total Jitter (fs) | Additive Jitter (fs) |
|-----------------|--------------------|-------------------|----------------------|
| 156.25          | 39.34              | 191.58            | 187.50               |
| 312.5           | 30.26              | 106.37            | 101.98               |
| 625             | 22.77              | 55.00             | 50.07                |

## 2.11. Input Mux Noise Isolation



**Figure 10. Input Mux Noise Isolation**

## 2.12. Power Supply Noise Rejection

The device supports on-chip supply voltage regulation to reject noise present on the power supply, simplifying low jitter operation in real-world environments. This feature enables robust operation alongside FPGAs, ASICs and SoCs and may reduce board-level filtering requirements. For more information, see “AN491: Power Supply Rejection for Low Jitter Clocks.”

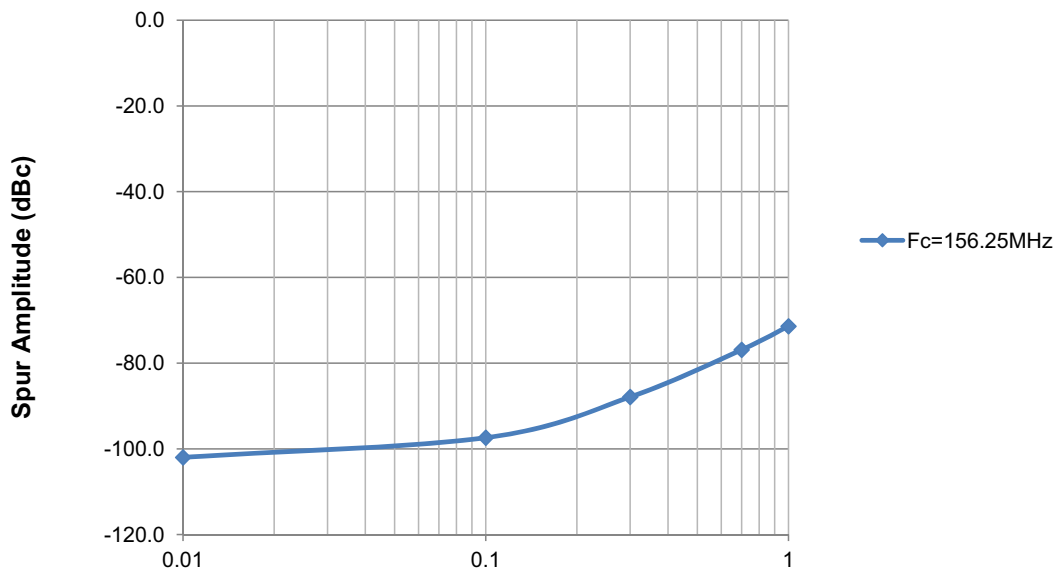
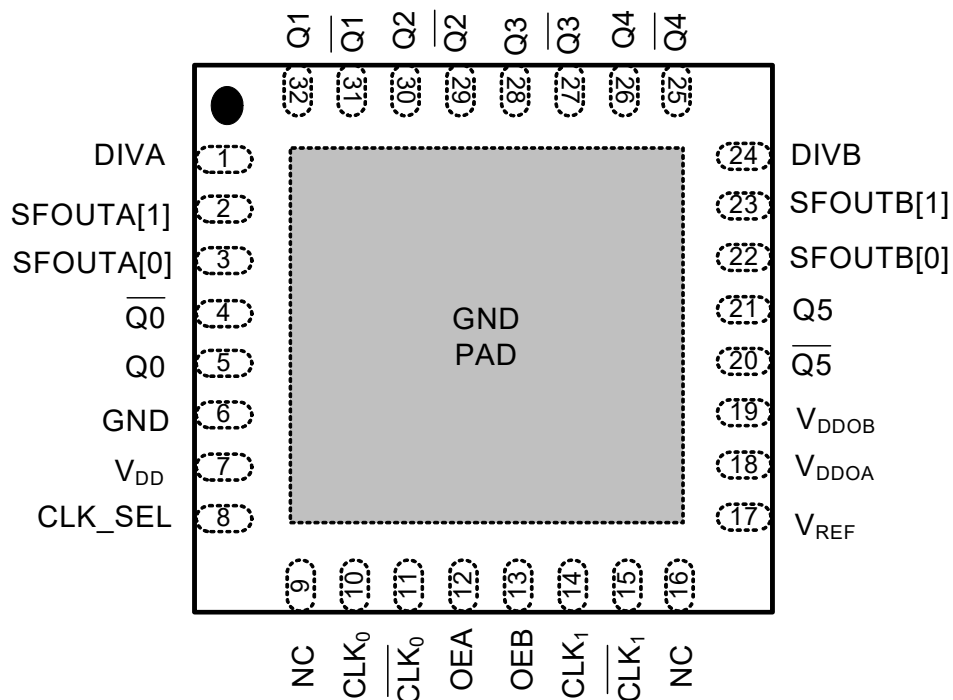


Figure 11. Power Supply Noise Rejection (100mVpp Sinusoidal Power Supply Noise Applied)

## 3. Pin Description: 32-Pin QFN



**Table 20. Pin Description**

| Pin | Name            | Description  |
|-----|-----------------|--|
| 1   | DIVA            | Output divider control pin for Bank A<br>Three-level input control. Internally biased at $V_{DD}/2$ . Can be left floating or tied to ground or $V_{DD}$ .       |
| 2   | SFOUTA[1]       | Output signal format control pin for Bank A<br>Three-level input control. Internally biased at $V_{DD}/2$ . Can be left floating or tied to ground or $V_{DD}$ . |
| 3   | SFOUTA[0]       | Output signal format control pin for Bank A<br>Three-level input control. Internally biased at $V_{DD}/2$ . Can be left floating or tied to ground or $V_{DD}$ . |
| 4   | $\overline{Q0}$ | Output clock 0 (complement)  |
| 5   | Q0              | Output clock 0   |
| 6   | GND             | Ground   |
| 7   | $V_{DD}$        | Core voltage supply.<br>Bypass with 1.0 $\mu$ F capacitor and place as close to the $V_{DD}$ pin as possible.  |

Table 20. Pin Description (Continued)

| Pin | Name                     | Description  |
|-----|--------------------------|--|
| 8   | CLK_SEL                  | Mux input select pin (LVCMOS)<br>Clock inputs are switched without the introduction of glitches.<br>When CLK_SEL is high, CLK1 is selected.<br>When CLK_SEL is low, CLK0 is selected.<br>CLK_SEL contains an internal pull-down resistor.  |
| 9   | NC                       | No connect.  |
| 10  | CLK0                     | Input clock 0  |
| 11  | $\overline{\text{CLK0}}$ | Input clock 0 (complement)<br>When the CLK0 is driven by a single-end input, connect $V_{\text{REF}}$ to $\overline{\text{CLK0}}$ .<br>$\overline{\text{CLK0}}$ contains an internal pull-up resistor.   |
| 12  | OEA                      | Output enable—Bank A<br>When OE=high, the Bank A outputs are enabled.<br>When OE=low, Q is held low, and $\overline{Q}$ is held high for differential formats.<br>For LVCMOS, both Q and $\overline{Q}$ are held low when OE is set low.<br>OEA contains an internal pull-up resistor. |
| 13  | OEB                      | Output enable—Bank B<br>When OE=high, the Bank B outputs are enabled.<br>When OE=low, Q is held low, and $\overline{Q}$ is held high for differential formats.<br>For LVCMOS, both Q and $\overline{Q}$ are held low when OE is set low.<br>OEB contains an internal pull-up resistor. |
| 14  | CLK1                     | Input clock 1  |
| 15  | $\overline{\text{CLK1}}$ | Input clock 1 (complement)<br>When the CLK1 is driven by a single-end input, connect $V_{\text{REF}}$ to $\overline{\text{CLK1}}$ .<br>$\overline{\text{CLK1}}$ contains an internal pull-up resistor.   |
| 16  | NC                       | No connect.  |
| 17  | $V_{\text{REF}}$         | Input reference voltage<br>When driven by a LVCMOS clock input, connect the unused clock input to $V_{\text{REF}}$ and a 0.1 $\mu\text{F}$ cap to ground. When driven by a differential clock, do not connect the $V_{\text{REF}}$ pin.  |
| 18  | $V_{\text{DDOA}}$        | Output voltage supply—Bank A (Outputs: Q0 to Q2)<br>Bypass with 1.0 $\mu\text{F}$ capacitor and place as close to the $V_{\text{DDOA}}$ pin as possible.   |
| 19  | $V_{\text{DDOB}}$        | Output voltage supply—Bank B (Outputs: Q3 to Q5)<br>Bypass with 1.0 $\mu\text{F}$ capacitor and place as close to the $V_{\text{DDOB}}$ pin as possible.   |
| 20  | $\overline{\text{Q5}}$   | Output clock 5 (complement)  |
| 21  | Q5                       | Output clock 5   |

**Table 20. Pin Description (Continued)**

| Pin     | Name            | Description   |
|---------|-----------------|---|
| 22      | SFOUTB[0]       | Output signal format control pin for Bank B.<br>Three-level input control. Internally biased at $V_{DD}/2$ . Can be left floating or tied to ground or $V_{DD}$ . |
| 23      | SFOUTB[1]       | Output signal format control pin for Bank B.<br>Three-level input control. Internally biased at $V_{DD}/2$ . Can be left floating or tied to ground or $V_{DD}$ . |
| 24      | DIVB            | Output divider configuration bit for Bank B.<br>Three-level input control. Internally biased at $V_{DD}/2$ . Can be left floating or tied to ground or $V_{DD}$ . |
| 25      | $\overline{Q4}$ | Output clock 4 (complement)   |
| 26      | Q4              | Output clock 4  |
| 27      | $\overline{Q3}$ | Output clock 3 (complement)   |
| 28      | Q3              | Output clock 3  |
| 29      | $\overline{Q2}$ | Output clock 2 (complement)   |
| 30      | Q2              | Output clock 2  |
| 31      | $\overline{Q1}$ | Output clock 1 (complement)   |
| 32      | Q1              | Output clock 1  |
| GND Pad | GND             | Ground Pad.<br>Power supply ground and thermal relief.  |

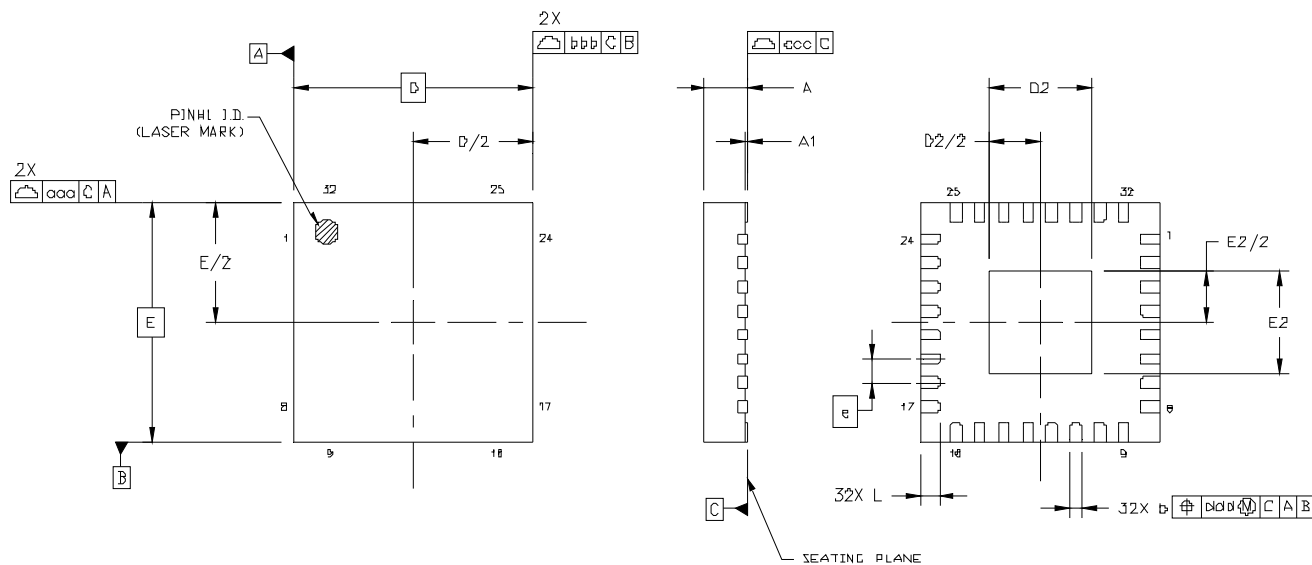


## 4. Ordering Guide

| Part Number  | Package | PB-Free, RoHS-6 | Temperature  |
|--------------|---------|-----------------|--------------|
| Si53311-B-GM | 32-QFN  | Yes             | -40 to 85 °C |

## 5. Package Outline

### 5.1. 5x5 mm 32-QFN Package Diagram



**Figure 12. Si53311 5x5 mm 32-QFN Package Diagram**

**Table 21. Package Dimensions**

| Dimension     | Min  | Nom  | Max  |
|---------------|--|------|------|
| A             | 0.80   | 0.85 | 1.00 |
| A1            | 0.00   | 0.02 | 0.05 |
| b             | 0.18   | 0.25 | 0.30 |
| c             | 0.20   | 0.25 | 0.30 |
| D             | 5.00 BSC   |      |      |
| D2            | 2.00   | 2.15 | 2.30 |
| e             | 0.50 BSC   |      |      |
| E             | 5.00 BSC   |      |      |
| E2            | 2.00   | 2.15 | 2.30 |
| L             | 0.30   | 0.40 | 0.50 |
| aaa           | 0.10   |      |      |
| bbb           | 0.10   |      |      |
| ccc           | 0.08   |      |      |
| ddd           | 0.10   |      |      |
| <b>Notes:</b> | <ol style="list-style-type: none"> <li>All dimensions shown are in millimeters (mm) unless otherwise noted.</li> <li>Dimensioning and Tolerancing per ANSI Y14.5M-1994.</li> <li>This drawing conforms to the JEDEC Solid State Outline MO-220.</li> </ol> |      |      |

## 6. PCB Land Pattern

### 6.1. 5x5 mm 32-QFN Package Land Pattern

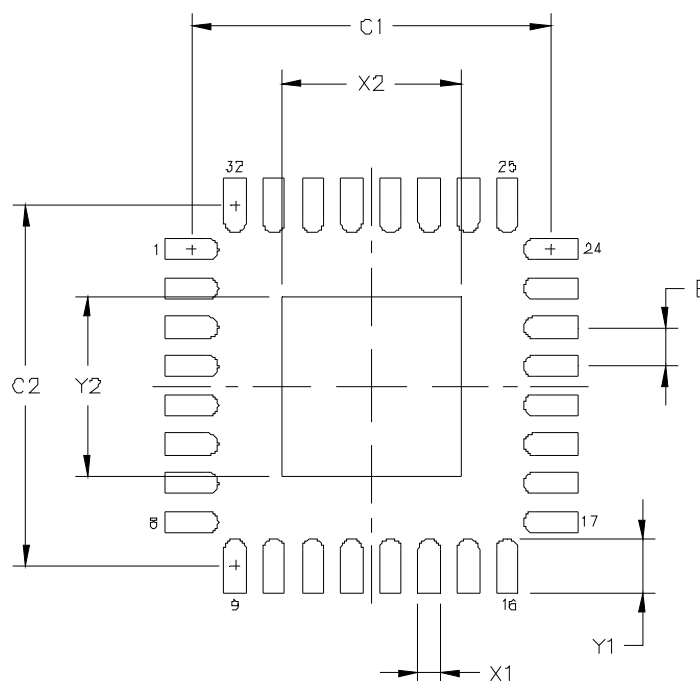


Figure 13. Si53311 5x5 mm 32-QFN Package Land Pattern

Table 22. PCB Land Pattern

| Dimension | Min      | Max  | Dimension | Min  | Max  |
|-----------|----------|------|-----------|------|------|
| C1        | 4.52     | 4.62 | X2        | 2.20 | 2.30 |
| C2        | 4.52     | 4.62 | Y1        | 0.59 | 0.69 |
| E         | 0.50 BSC |      | Y2        | 2.20 | 2.30 |
| X1        | 0.20     | 0.30 |           |      |      |

#### Notes:

##### General

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. This Land Pattern Design is based on the IPC-7351 guidelines.

##### Solder Mask Design

1. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60  $\mu\text{m}$  minimum, all the way around the pad.

##### Stencil Design

1. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
2. The stencil thickness should be 0.125 mm (5 mils).
3. The ratio of stencil aperture to land pad size should be 1:1 for all perimeter pads.
4. A 2x2 array of 0.75 mm square openings on 1.15 mm pitch should be used for the center ground pad.

##### Card Assembly

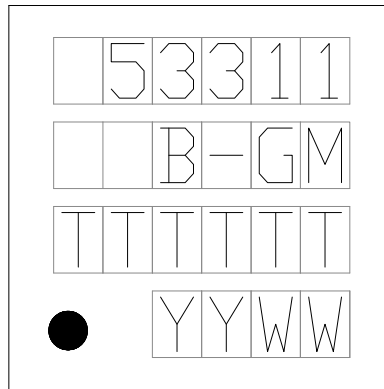
1. A No-Clean, Type-3 solder paste is recommended.
2. The recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

# Si53311

---

## 7. Top Marking

### 7.1. Si53311 Top Marking



### 7.2. Top Marking Explanation

|                        |  |  |
|------------------------|--|--|
| <b>Mark Method:</b>    | Laser  |  |
| <b>Font Size:</b>      | 2.0 Point (28 mils)<br>Center-Justified                    |  |
| <b>Line 1 Marking:</b> | Device Part Number   | <b>53311</b>   |
| <b>Line 2 Marking:</b> | Device Revision/Type                                       | <b>B-GM</b>  |
| <b>Line 3 Marking:</b> | YY=Year<br>WW=Work Week                                    | Assigned by the Assembly House.<br>Corresponds to the year and work week of the mold date. |
|                        | R=Die Rev<br>F=Wafer Fab                                   | First two characters of the Manufacturing Code from the Assembly Purchase Order form.      |
| <b>Line 4 Marking</b>  | Circle=0.5 mm Diameter<br>Lower-Left Justified             | Pin 1 Identifier   |
|                        | A=Assembly Site<br>I=Internal Code<br>XX=Serial Lot Number | Last four characters of the Manufacturing Code from the Assembly Purchase Order form.      |

**NOTES:**



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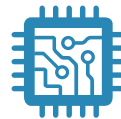
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[ADCLK905BCPZ-R2](#)