

# Si53320-28 Data Sheet

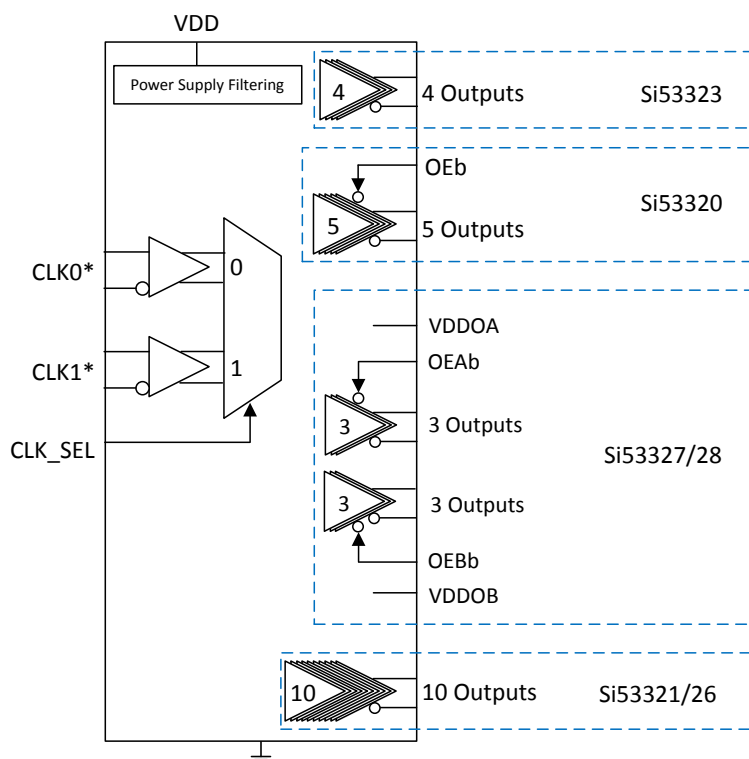
## Low-Jitter LVPECL Fanout Clock Buffers with up to 10 LVPECL Outputs from Any-Format Input and Wide Frequency Range from DC up to 1250 MHz

The Si53320–28 family of LVPECL fanout buffers is ideal for clock/data distribution and redundant clocking applications. These devices feature typical ultra-low jitter characteristics of 50 fs and operate over a wide frequency range from dc to 725/1250 MHz. Built-in LDOs deliver high PSRR performance and reduce the need for external components, simplifying low-jitter clock distribution in noisy environments.

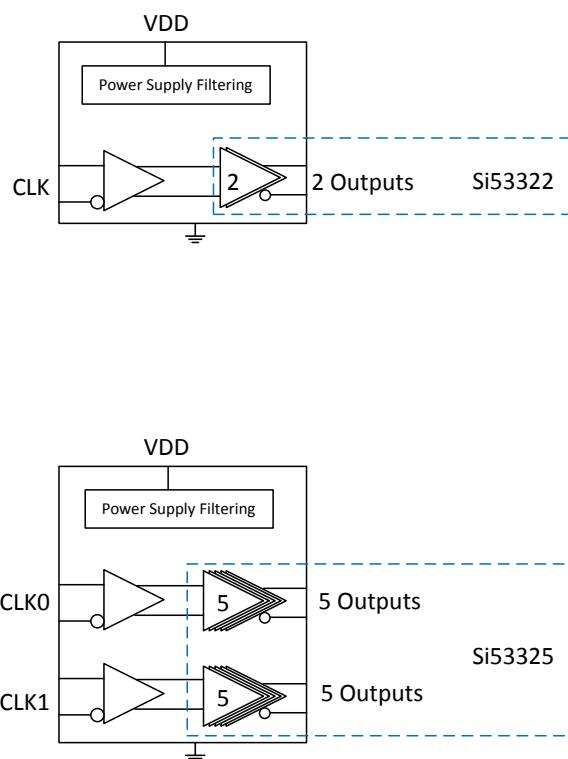
The Si53320–28 family is available in multiple configurations, with some versions offering a selectable input clock using a 2:1 input mux. Other features include independent output enable and built-in format translation. These buffers can be paired with the Si534x clocks and Si5xx oscillators to deliver end-to-end clock tree performance.

### KEY FEATURES

- Ultra-low additive jitter: 50 fs rms
- Built-in LDOs for high PSRR performance
- Up to 10 LVPECL Outputs
- Any-format Inputs (LVPECL, Low-power LVPECL, LVDS, CML, HCSL, LVCMOS)
- Wide frequency range: dc to 1250 MHz
- Output Enable option
- Multiple configuration options
  - Dual Bank option
  - 2:1 Input Mux operation
- RoHS compliant, Pb-free
- Temperature range: –40 to +85 °C



\*Si53326/28 require Single-ended Inputs



## 1. Ordering Guide

**Table 1.1. Si5332x Ordering Guide**

| Part Number  | Input                            | LVPECL Output       | Output Enable | Frequency Range | Package              |
|--------------|----------------------------------|---------------------|---------------|-----------------|----------------------|
| Si53320-B-GT | 2:1 selectable MUX<br>Any-format | 1 bank / 5 Outputs  | Single        | dc to 725 MHz   | 20-TSSOP             |
| Si53321-B-GM | 2:1 selectable MUX<br>Any-format | 1 bank / 10 Outputs | —             | dc to 1250 MHz  | 32-QFN<br>5 x 5 mm   |
| Si53321-B-GQ | 2:1 selectable MUX<br>Any-format | 1 bank / 10 Outputs | —             | dc to 1250 MHz  | 32-eLQFP<br>7 x 7 mm |
| Si53322-B-GM | 1 bank / 1 Input<br>Any-format   | 1 bank / 2 Outputs  | —             | dc to 1250 MHz  | 16-QFN<br>3 x 3 mm   |
| Si53323-B-GM | 2:1 selectable MUX<br>Any-format | 1 bank / 4 Outputs  | —             | dc to 1250 MHz  | 16-QFN<br>3 x 3 mm   |
| Si53325-B-GM | 2 banks / 2 Inputs<br>Any-format | 2 banks / 5 Outputs | —             | dc to 1250 MHz  | 32-QFN<br>5 x 5 mm   |
| Si53325-B-GQ | 2 banks / 2 Inputs<br>Any-format | 2 banks / 5 Outputs | —             | dc to 1250 MHz  | 32-eLQFP<br>7 x 7 mm |
| Si53326-B-GM | 2:1 selectable MUX<br>LVCMOS     | 1 bank / 10 Outputs | —             | dc to 200 MHz   | 32-QFN<br>5 x 5 mm   |
| Si53327-B-GM | 2:1 selectable MUX<br>Any-format | 2 banks / 3 Outputs | 1 per bank    | dc to 1250 MHz  | 24-QFN<br>4 x 4 mm   |
| Si53328-B-GM | 2:1 selectable MUX<br>LVCMOS     | 2 banks / 3 Outputs | 1 per bank    | dc to 200 MHz   | 24-QFN<br>4 x 4 mm   |

## 2. Functional Description

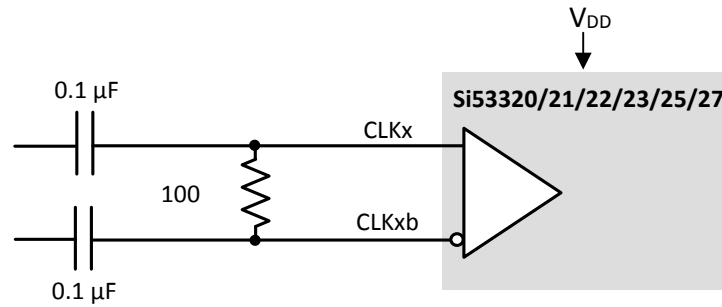
The Si53320-28 are a family of low-jitter, low-skew, fixed-format (LVPECL) buffers. All devices except the Si53326 and Si53328 have a universal input that accepts most common differential or LVCMOS input signals. The Si53326 and Si53328 accept only single-ended LVCMOS inputs. These devices are available in multiple configurations customized for the end application (refer to [1. Ordering Guide](#) for more details on configurations).

### 2.1 Universal, Any-Format Input Termination (Si53320/21/22/23/25/27)

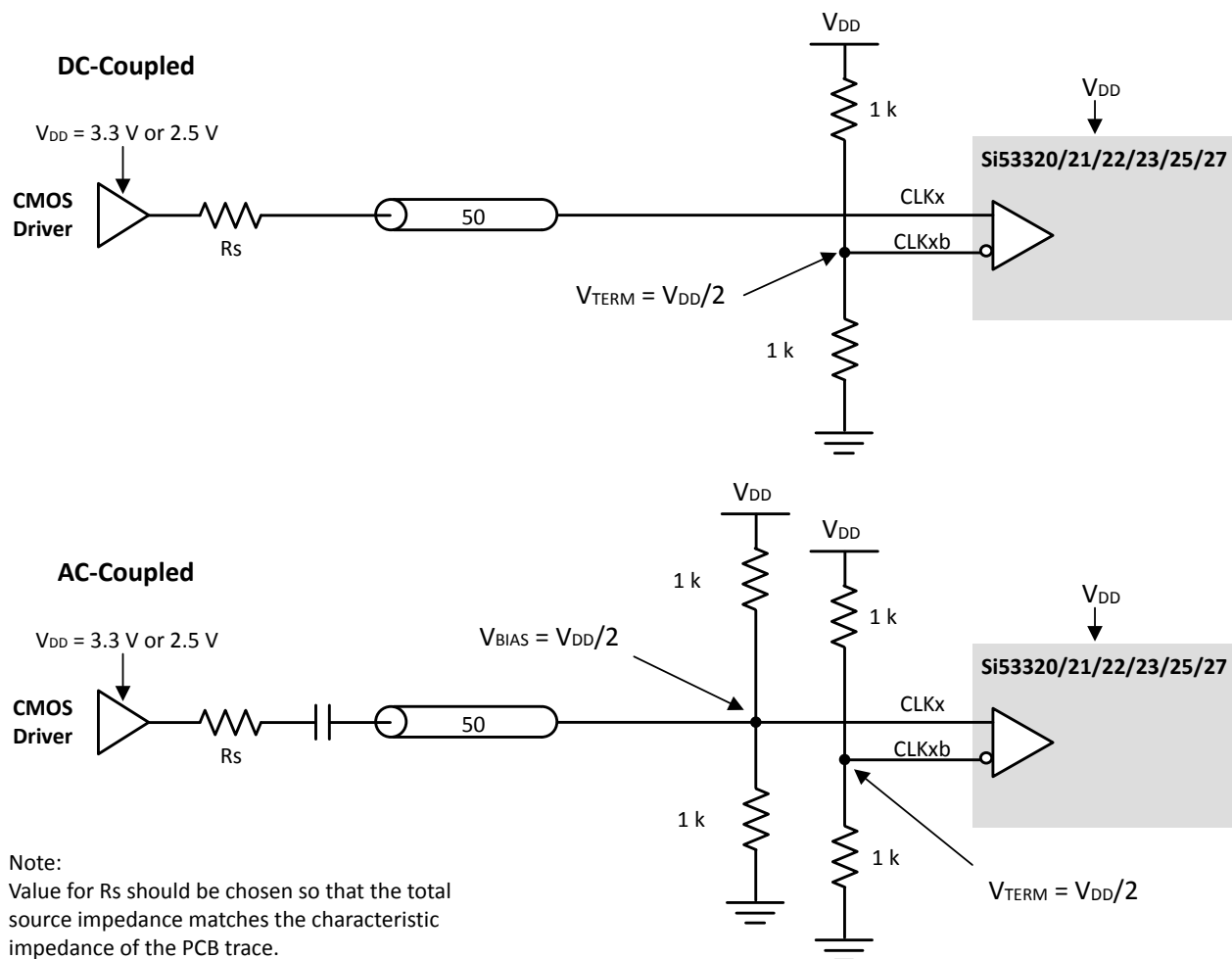
The universal input stage enables simple interfacing to a wide variety of clock formats, including LVPECL, low-power LVPECL, LVCMOS, LVDS, HCSL, and CML. The tables below summarize the various ac- and dc-coupling options supported by the device. For the best high-speed performance, the use of differential formats is recommended. For both single-ended and differential input clocks, the fastest possible slew rate is recommended since low slew rates can increase the noise floor and degrade jitter performance. Though not required, a minimum slew rate of 0.75 V/ns is recommended for differential formats and 1.0 V/ns for single-ended formats. See “[AN766: Understanding and Optimizing Clock Buffer's Additive Jitter Performance](#)” for more information.

**Table 2.1. Clock Input Options**

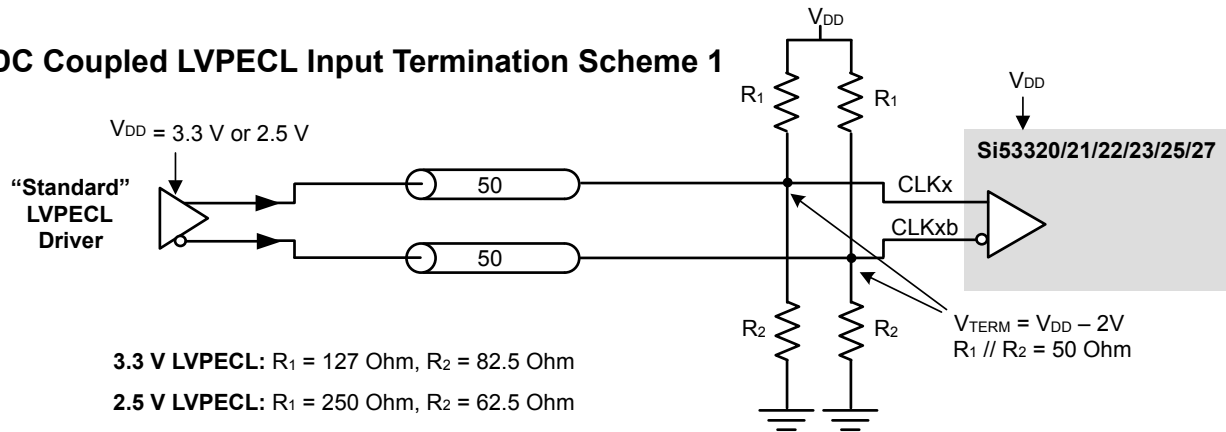
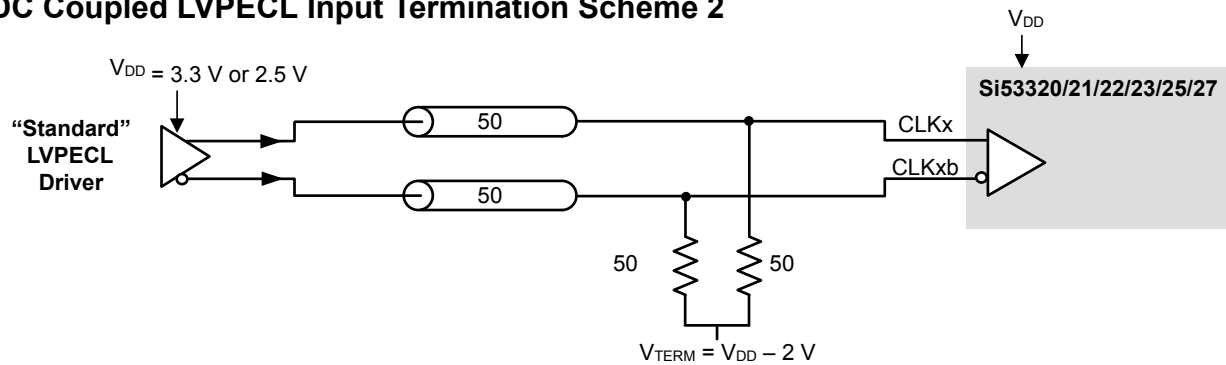
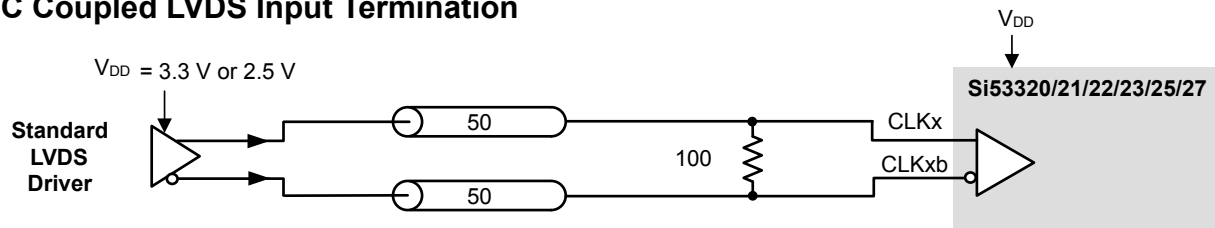
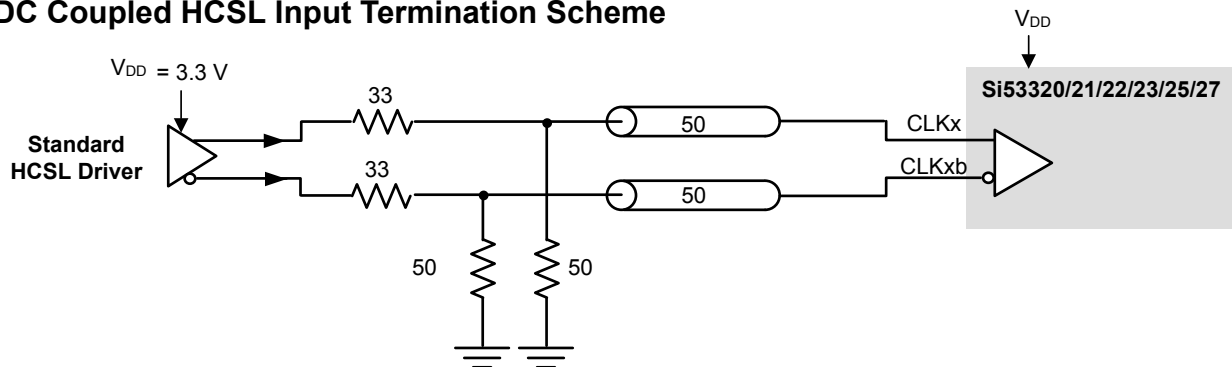
| Clock Format            | 1.8 V | 2.5/3.3 V   |
|-------------------------|-------|-------------|
| <b>AC-Coupled</b>       |       |             |
| LVPECL/Low-power LVPECL | N/A   | Yes         |
| LVCMOS                  | No    | Yes         |
| LVDS                    | Yes   | Yes         |
| HCSL                    | No    | Yes (3.3 V) |
| CML                     | Yes   | Yes         |
| <b>DC-Coupled</b>       |       |             |
| LVPECL/Low-power LVPECL | N/A   | Yes         |
| LVCMOS                  | No    | Yes         |
| LVDS                    | No    | Yes         |
| HCSL                    | No    | Yes (3.3 V) |
| CML                     | No    | No          |



**Figure 2.1. Differential (HCSL, LVPECL, Low-Power LVPECL, LVDS, CML) AC-Coupled Input Termination**



**Figure 2.2. Single-Ended (LVCMOS) Input Termination**

**DC Coupled LVPECL Input Termination Scheme 1****DC Coupled LVPECL Input Termination Scheme 2****DC Coupled LVDS Input Termination****DC Coupled HCSL Input Termination Scheme**

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

Figure 2.3. Differential DC-Coupled Input Terminations (Si53320/21/22/23/25/27)

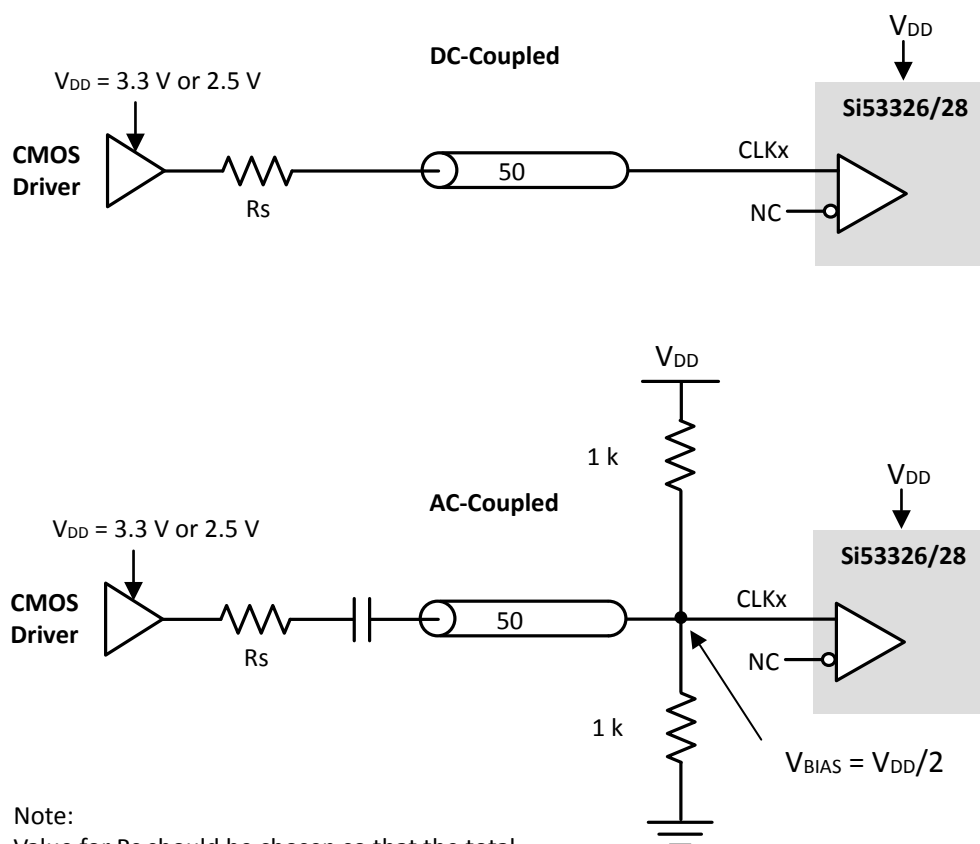
## 2.2 LVCMOS Input Termination (Si53326/28 Only)

The table below summarizes the various ac- and dc-coupling options supported by the LVCMOS device, and the figure shows the recommended input clock termination.

**Note:** 1.8 V LVCMOS inputs are not supported for Si53326/28.

**Table 2.2. LVCMOS Input Clock Options**

|           | LVCMOS     |            |
|-----------|------------|------------|
|           | AC-Coupled | DC-Coupled |
| 1.8 V     | No         | No         |
| 2.5/3.3 V | Yes        | Yes        |

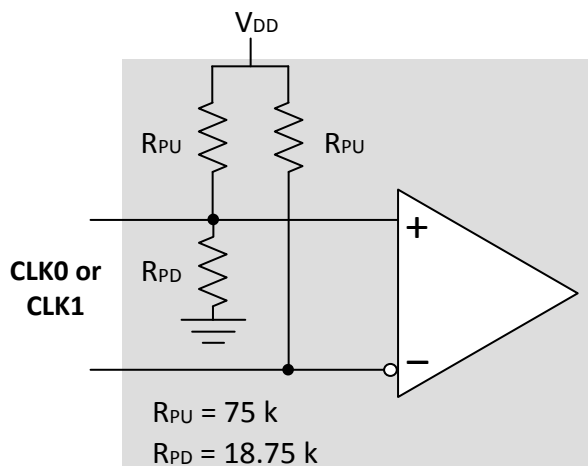


**Note:**  
Value for  $R_s$  should be chosen so that the total source impedance matches the characteristic impedance of the PCB trace.

**Figure 2.4. Recommended Input Clock Termination (Si53326/28)**

## 2.3 Input Bias Resistors

Internal bias resistors ensure a differential output low condition in the event that the clock inputs are not connected. The non-inverting input is biased with a 18.75 k $\Omega$  pull-down to GND and a 75 k $\Omega$  pull-up to V<sub>DD</sub>. The inverting input is biased with a 75 k $\Omega$  pull-up to V<sub>DD</sub>.



**Figure 2.5. Input Bias Resistors**

**Note:** To minimize the possibility of system noise coupling into the Si5332x differential inputs and adversely affecting the buffered output, Silicon Labs recommends 1 PPS clocks and disabled/gapped clocks be dc-coupled and driven “stop-low”.

## 2.4 Input Mux

The Si53320/21/23/26/27/28 provide 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 following table summarizes the input and output clock based on the input mux and output enable pin settings.

**Table 2.3. Input Mux Logic**

| CLK_SEL | CLK0 | CLK1 | Q <sup>1</sup> | Qb |
|---------|------|------|----------------|----|
| L       | L    | X    | L              | H  |
| L       | H    | X    | H              | L  |
| H       | X    | L    | L              | H  |
| H       | X    | H    | H              | L  |

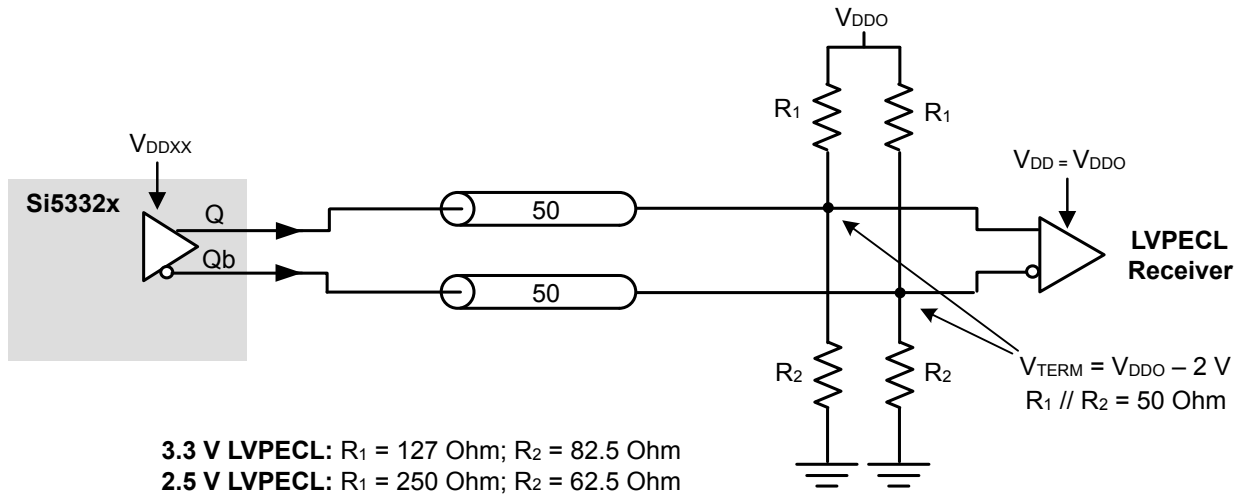
**Note:**

1. On the next negative transition of CLK0 or CLK1.

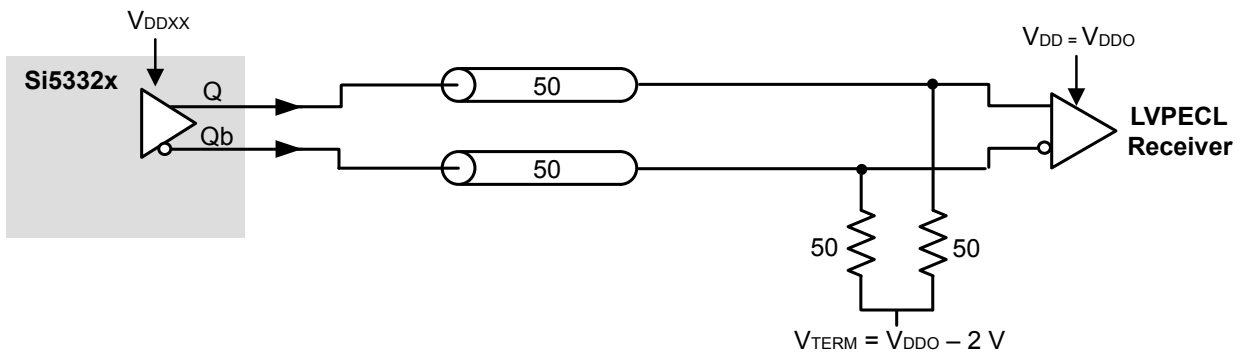
## 2.5 Output Clock Termination Options

The recommended output clock termination options for dc and ac are shown below. Unused outputs should be left unconnected.

### DC Coupled LVPECL Output Termination Scheme 1



### DC Coupled LVPECL Output Termination Scheme 2



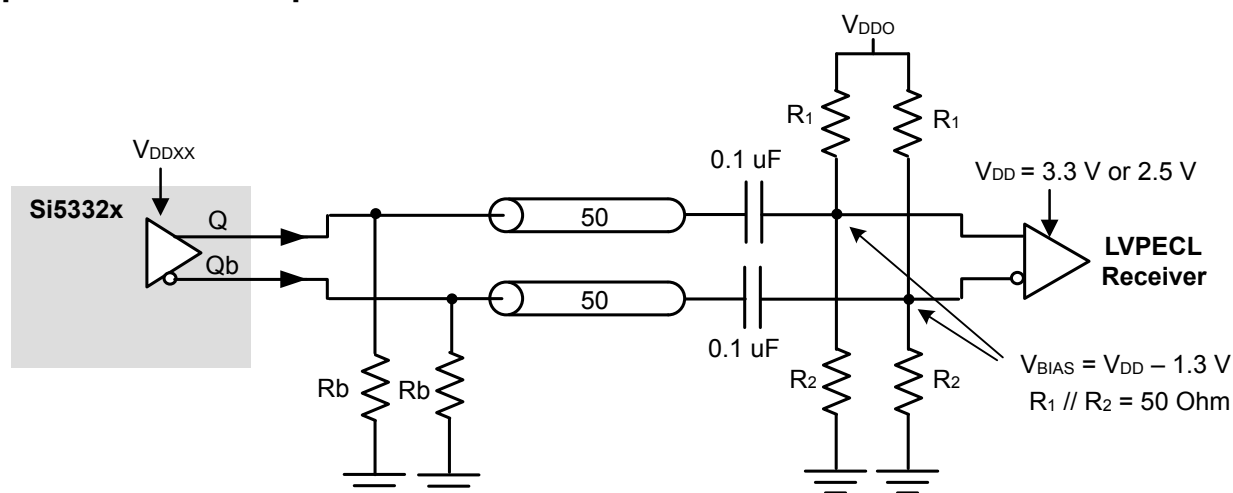
Note:

For Si53320/21/22/23/25/26,  $V_{DDXX} = V_{DD} = 3.3\text{ V}$ ,  $2.5\text{ V}$

For Si53327/28,  $V_{DDXX} = V_{DDOA}$  or  $V_{DDOB} = 3.3\text{ V}$ ,  $2.5\text{ V}$

Figure 2.6. LVPECL DC Output Terminations

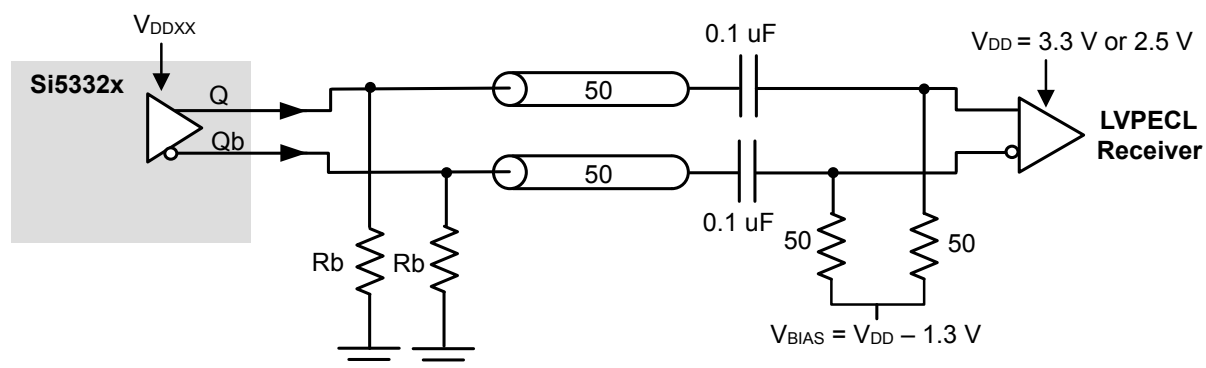
## AC Coupled LVPECL Output Termination Scheme 1



**3.3 V LVPECL:**  $R_1 = 82.5 \text{ Ohm}$ ;  $R_2 = 127 \text{ Ohm}$ ;  $R_b = 120 \text{ Ohm}$

**2.5 V LVPECL:**  $R_1 = 62.5 \text{ Ohm}$ ;  $R_2 = 250 \text{ Ohm}$ ;  $R_b = 90 \text{ Ohm}$

## AC Coupled LVPECL Output Termination Scheme 2



**3.3 V LVPECL:**  $R_b = 120 \text{ Ohm}$

**2.5 V LVPECL:**  $R_b = 90 \text{ Ohm}$

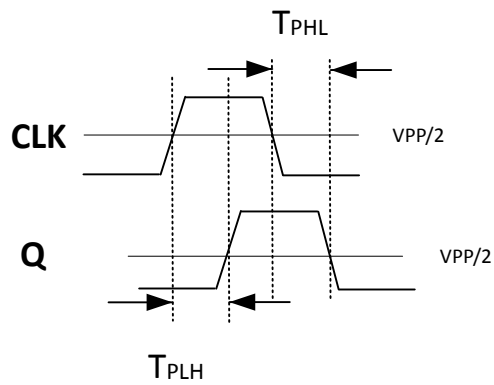
Note:

For Si53320/21/22/23/25/26,  $V_{DDXX} = V_{DD} = 3.3 \text{ V}, 2.5 \text{ V}$

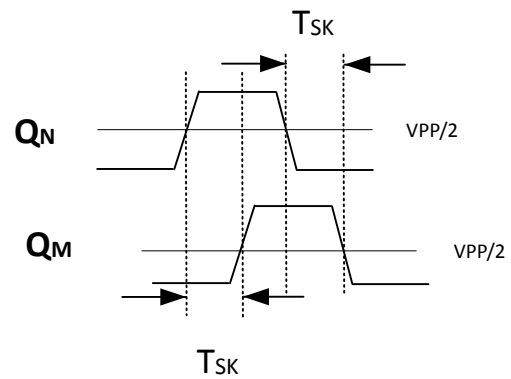
For Si53327/28,  $V_{DDXX} = V_{DDOA} \text{ or } V_{DDOB} = 3.3 \text{ V}, 2.5 \text{ V}$

Figure 2.7. LVPECL AC Output Terminations

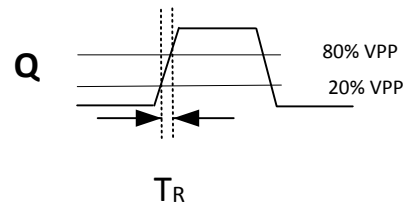
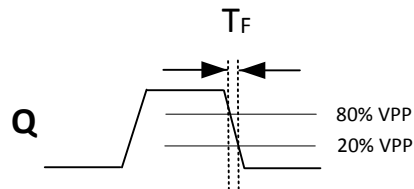
## 2.6 AC Timing Waveforms



Propagation Delay



Output-Output Skew



Rise/Fall Time

Figure 2.8. AC Timing Waveforms

## 2.7 Typical Phase Noise Performance: Differential Input Clock

Each of the phase noise plots superimposes Source Jitter, Total SE Jitter, and Total Diff Jitter on the same diagram.

- **Source Jitter**—Reference clock phase noise (measured Single-ended to PNA).
- **Total Jitter (SE)**—Combined source and clock buffer phase noise measured as a single-ended output to the phase noise analyzer and integrated from 12 kHz to 20 MHz.
- **Total Jitter (Diff)**—Combined source and clock buffer phase noise measured as a differential output to the phase noise analyzer and integrated from 12 kHz to 20 MHz. The differential measurement as shown in each figure is made using a balun. For more information, see [3. Electrical Specifications](#).

**Note:** To calculate the total RMS phase jitter when adding a buffer to your clock tree, use the root-sum-square (RSS).

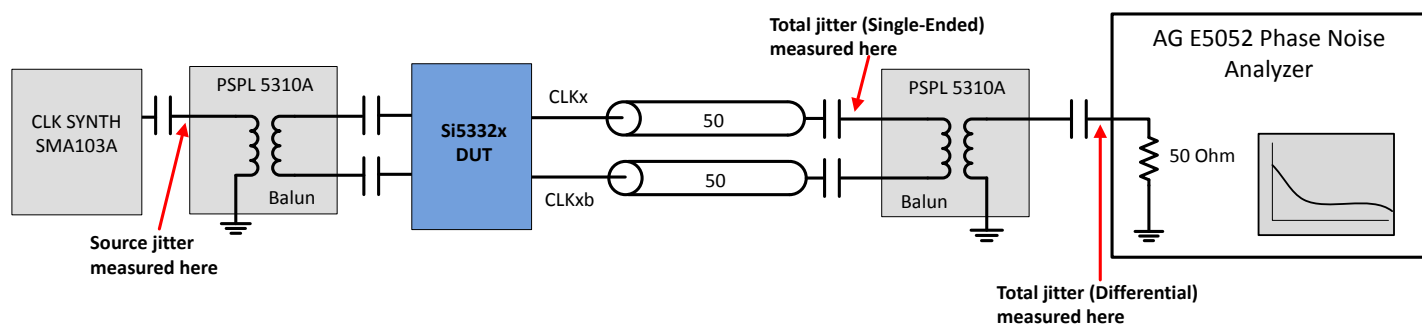
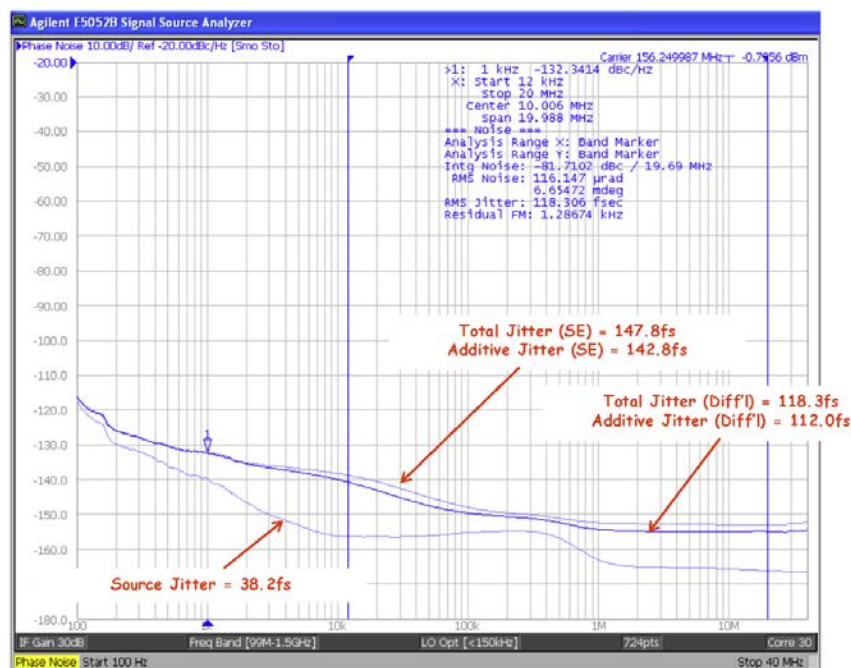


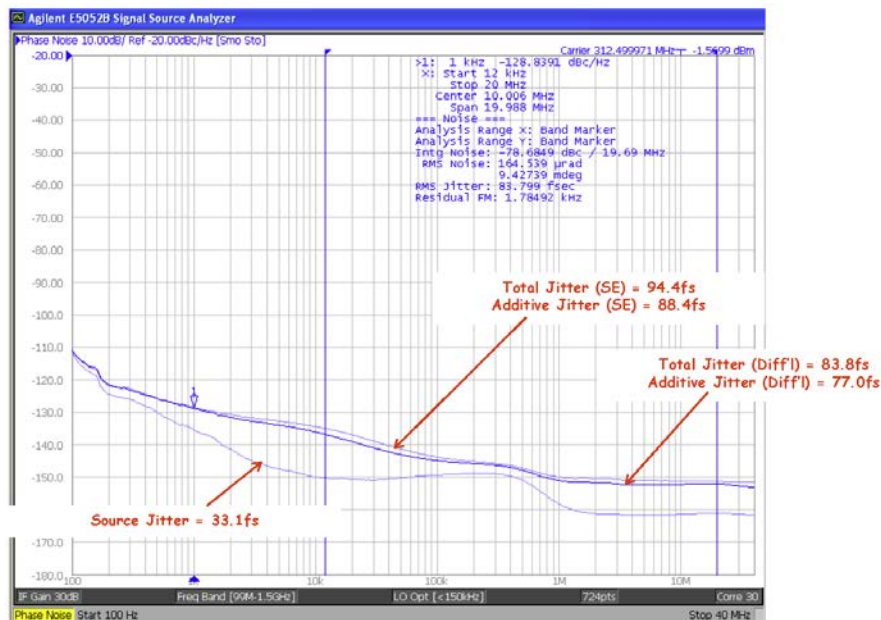
Figure 2.9. Differential Measurement Method Using a Balun

The total jitter is a measure of the source plus the buffer's additive phase jitter. The additive jitter (rms) of the buffer can then be calculated (via root-sum-square addition).



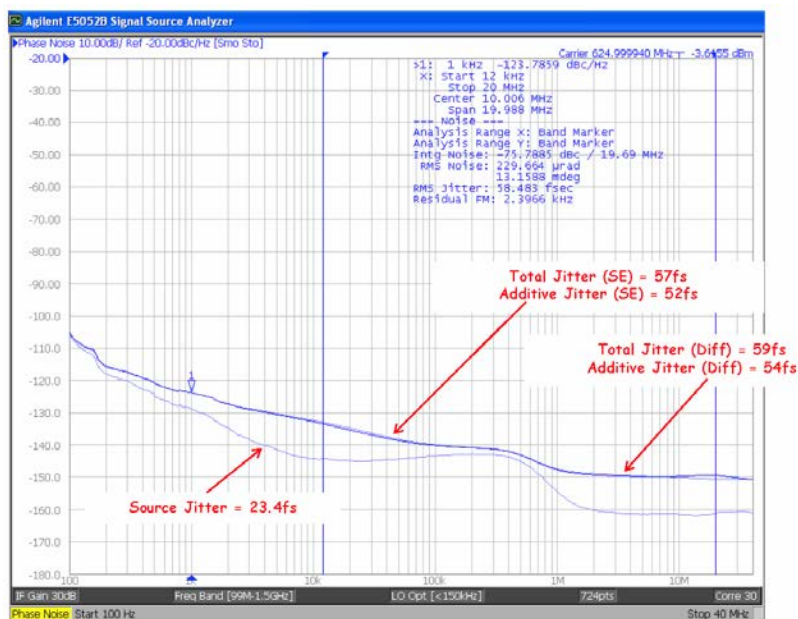
| Frequency (MHz) | Differential Input Slew Rate (V/ns) | Source Jitter (fs) | Total Jitter (SE) (fs) | Additive Jitter (SE) (fs) | Total Jitter (Differential) (fs) | Additive Jitter (Differential) (fs) |
|-----------------|-------------------------------------|--------------------|------------------------|---------------------------|----------------------------------|-------------------------------------|
| 156.25          | 1.0                                 | 38.2               | 147.8                  | 142.8                     | 118.3                            | 112.0                               |

Figure 2.10. Total Jitter Differential Input (156.25 MHz)



| Frequency (MHz) | Differential Input Slew Rate (V/ns) | Source Jitter (fs) | Total Jitter (SE) (fs) | Additive Jitter (SE) (fs) | Total Jitter (Differential) (fs) | Additive Jitter (Differential) (fs) |
|-----------------|-------------------------------------|--------------------|------------------------|---------------------------|----------------------------------|-------------------------------------|
| 312.5           | 1.0                                 | 33.10              | 94.39                  | 88.39                     | 83.80                            | 76.99                               |

Figure 2.11. Total Jitter Differential Input (312.5 MHz)



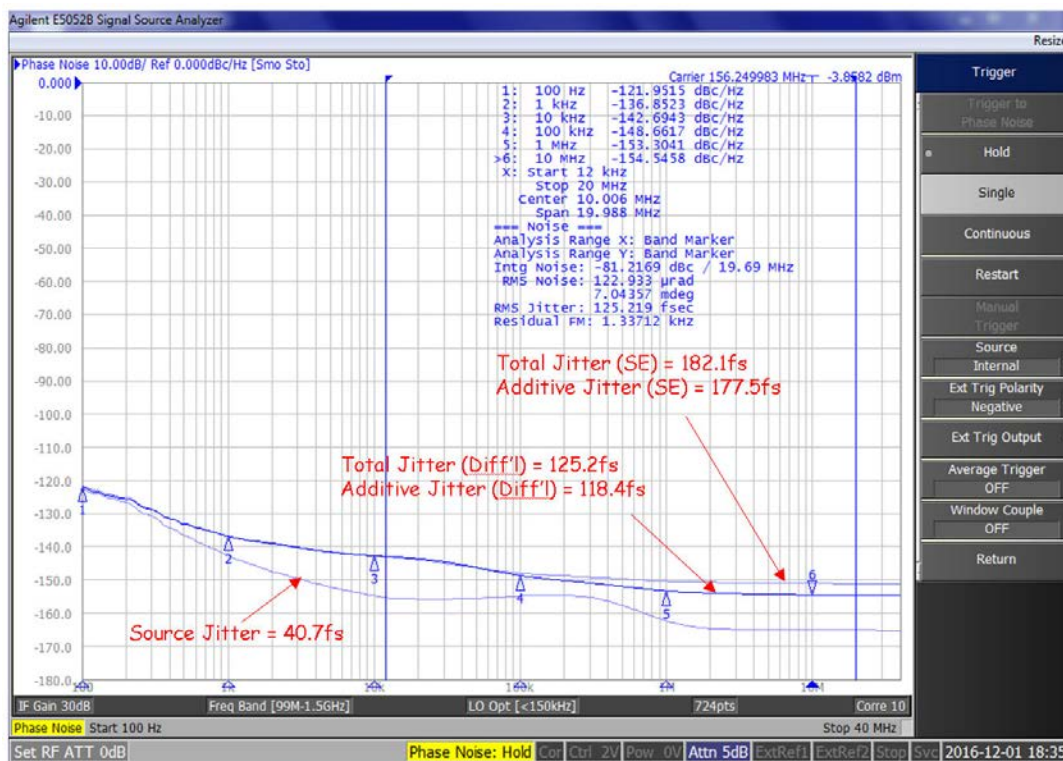
| Frequency (MHz) | Differential Input Slew Rate (V/ns) | Source Jitter (fs) | Total Jitter (SE) (fs) | Additive Jitter (SE) (fs) | Total Jitter (Differential) (fs) | Additive Jitter (Differential) (fs) |
|-----------------|-------------------------------------|--------------------|------------------------|---------------------------|----------------------------------|-------------------------------------|
| 625             | 1.0                                 | 23                 | 57                     | 52                        | 59                               | 54                                  |

Figure 2.12. Total Jitter Differential Input (625 MHz)

## 2.8 Typical Phase Noise Performance: Single-Ended Input Clock

For single-ended input phase noise measurements, the input was connected directly without the use of a balun.

The following figure shows three phase noise plots superimposed on the same diagram.



| Frequency (MHz) | Single-Ended Input Slew Rate (V/ns) | Source Jitter (fs) | Total Jitter (SE) (fs) | Additive Jitter (SE) (fs) | Total Jitter (Differential) (fs) | Additive Jitter (Differential) (fs) |
|-----------------|-------------------------------------|--------------------|------------------------|---------------------------|----------------------------------|-------------------------------------|
| 156.25          | 1.0                                 | 40.74              | 182.12                 | 177.51                    | 125.22                           | 118.41                              |

Figure 2.13. Total Jitter Single-Ended Input (156.25 MHz)

## 2.9 Input Mux Noise Isolation

The input clock mux is designed to minimize crosstalk between the CLK0 and CLK1. This improves phase jitter performance when clocks are present at both the CLK0 and CLK1 inputs. The following figure shows a measurement of the input mux's noise isolation.

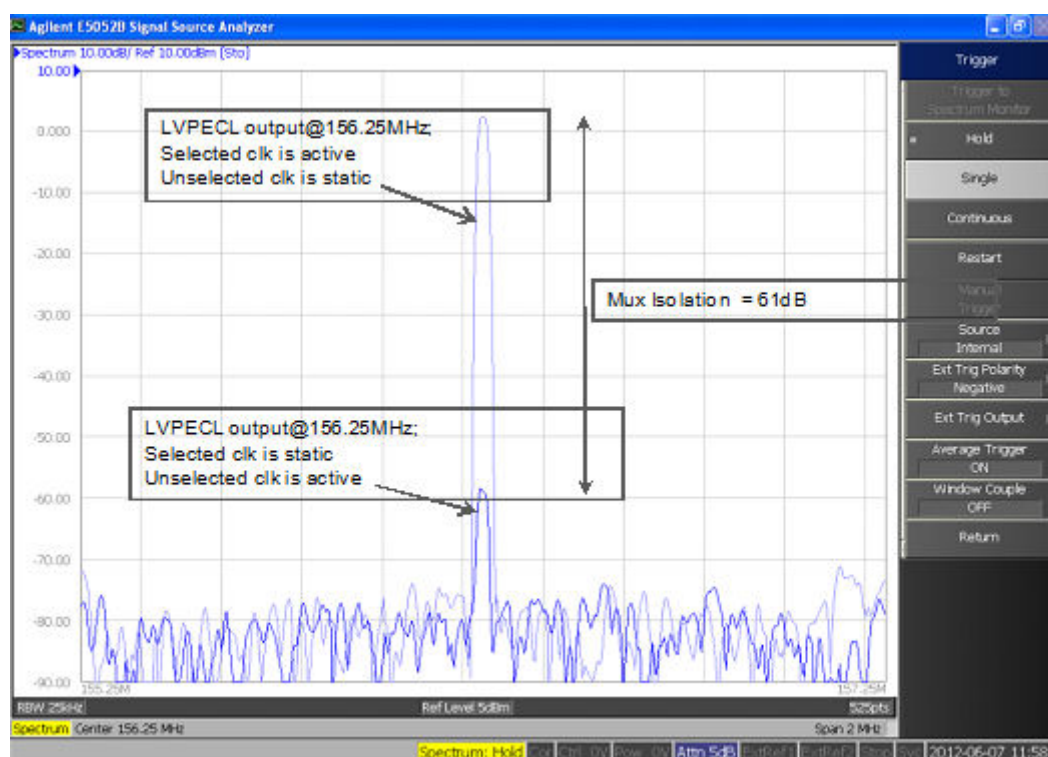


Figure 2.14. Input Mux Noise Isolation (Differential Input Clock, 44-QFN Package)

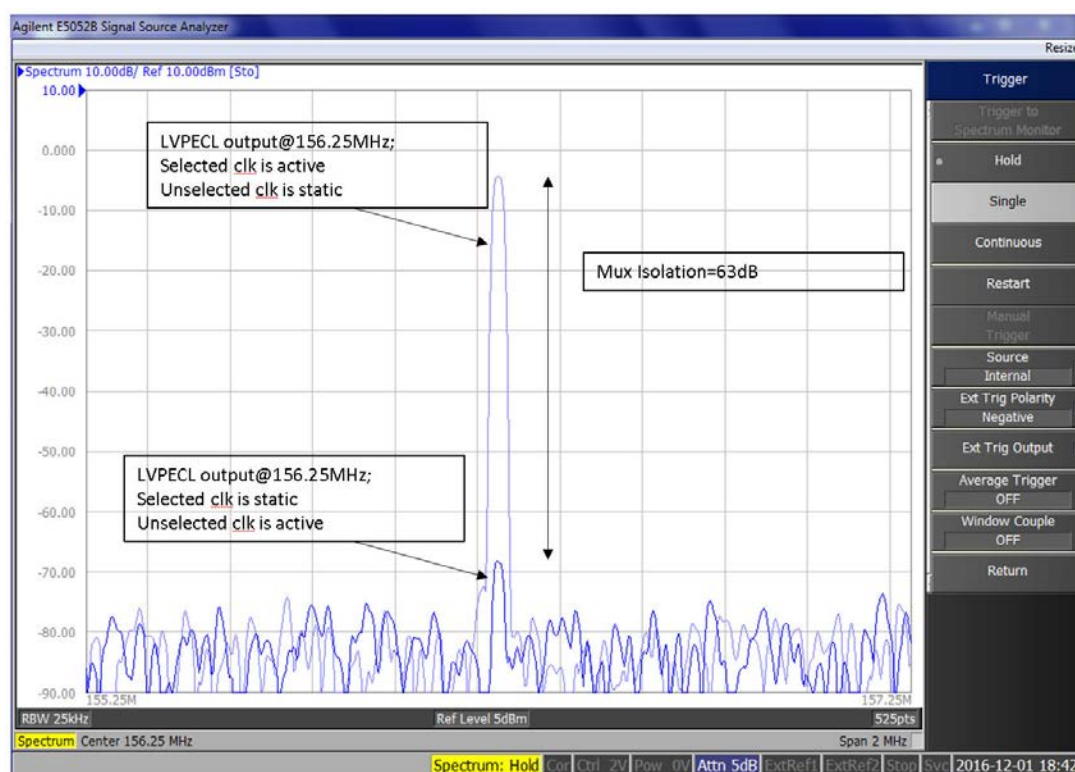


Figure 2.15. Input Mux Noise Isolation (Single-Ended Input Clock, 24-QFN Package)

## 2.10 Power Supply Noise Rejection

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

### 3. Electrical Specifications

**Table 3.1. Recommended Operating Conditions**

| Parameter                     | Symbol   | Test Condition | Min  | Typ | Max  | Unit |
|-------------------------------|----------|----------------|------|-----|------|------|
| Ambient Operating Temperature | $T_A$    |                | −40  | —   | 85   | °C   |
| Supply Voltage Range          | $V_{DD}$ | LVPECL         | 2.38 | 2.5 | 2.63 | V    |
|                               |          |                | 2.97 | 3.3 | 3.63 | V    |

**Table 3.2. Input Clock Specifications**

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

| Parameter                               | Symbol   | Test Condition                         | Min                 | Typ | Max                 | Unit |
|-----------------------------------------|----------|----------------------------------------|---------------------|-----|---------------------|------|
| Differential Input Common Mode Voltage  | $V_{CM}$ |                                        | 0.05                | —   | —                   | V    |
| Differential Input Swing (peak-to-peak) | $V_{IN}$ |                                        | 0.2                 | —   | 2.2                 | V    |
| LVC MOS Input High Voltage              | $V_{IH}$ |                                        | $V_{DD} \times 0.7$ | —   | —                   | V    |
| LVC MOS Input Low Voltage               | $V_{IL}$ |                                        | —                   | —   | $V_{DD} \times 0.3$ | V    |
| Input Capacitance                       | $C_{IN}$ | CLK0 and CLK1 pins with respect to GND | —                   | 5   | —                   | pF   |

**Table 3.3. DC Common Characteristics**

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

| Parameter                                | Symbol       | Test Condition | Min                 | Typ | Max                 | Unit       |
|------------------------------------------|--------------|----------------|---------------------|-----|---------------------|------------|
| Core Supply Current                      | $I_{DD}^1$   | Si53320        | —                   | 260 | —                   | mA         |
|                                          |              | Si53321/25/26  | —                   | 440 | —                   | mA         |
|                                          |              | Si53322        | —                   | 130 | —                   | mA         |
|                                          |              | Si53323        | —                   | 210 | —                   | mA         |
|                                          |              | Si53327/28     | —                   | 80  | —                   | mA         |
| Output Supply Current (Per Clock Output) | $I_{DDOX}^1$ | Si53327/28     | —                   | 35  | —                   | mA         |
| Input High Voltage                       | $V_{IH}$     | CLK_SEL, OExb  | $V_{DD} \times 0.8$ | —   | —                   | V          |
| Input Low Voltage                        | $V_{IL}$     | CLK_SEL, OExb  | —                   | —   | $V_{DD} \times 0.2$ | V          |
| Internal Pull-down Resistor              | $R_{DOWN}$   | CLK_SEL, OExb  | —                   | 25  | —                   | k $\Omega$ |

**Note:**

1. Measured using ac-coupled termination at  $V_{DD}/V_{DDOX} = 3.3\text{ V}$ .

**Table 3.4. Output Characteristics (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 |
|----------------------------------------|-----------|----------------|------------------|------|------------------|------|
| Single-Ended Output Swing <sup>1</sup> | $V_{SE}$  |                | 0.55             | 0.80 | 1.05             | V    |
| Output Common Mode Voltage             | $V_{COM}$ |                | $V_{DD} - 1.595$ | —    | $V_{DD} - 1.245$ | V    |

**Note:**

1. Unused outputs can be left floating. Do not short unused outputs to ground.

**Table 3.5. AC Characteristics** $V_{DD} = 2.5\text{ V} \pm 5\%$  or  $3.3\text{ V} \pm 10\%$ ;  $T_A = -40$  to  $85\text{ }^{\circ}\text{C}$ 

| Parameter                                 | Symbol             | Test Condition                                                                | Min  | Typ   | Max  | Unit |
|-------------------------------------------|--------------------|-------------------------------------------------------------------------------|------|-------|------|------|
| Frequency                                 | F                  | Si53326/28                                                                    | dc   | —     | 200  | MHz  |
|                                           |                    | Si53320                                                                       | dc   | —     | 725  | MHz  |
|                                           |                    | Si53321/22/23/25/27                                                           | dc   | —     | 1250 | MHz  |
| Duty Cycle<br>(50% input duty cycle)      | $D_C$              | 20/80% $T_R/T_F < 10\%$ of period<br>(Differential input clock)               | 47   | 50    | 53   | %    |
|                                           |                    | 20/80% $T_R/T_F < 10\%$ of period<br>(Single-Ended input clock)               | 45   | 50    | 55   | %    |
| Minimum Input Clock Slew Rate             | $SR_{diff}$        | Required to meet prop delay<br>and additive jitter specifications<br>(20–80%) | 0.75 | —     | —    | V/ns |
|                                           | $SR_{se}$          |                                                                               | 1.00 | —     | —    | V/ns |
| Output Rise/Fall Time                     | $T_R/T_F$          | 20–80%                                                                        | —    | —     | 350  | ps   |
| Minimum Input Pulse Width                 | $T_W$              |                                                                               | 360  | —     | —    | ps   |
| Propagation Delay                         | $T_{PLH}, T_{PHL}$ |                                                                               | 600  | 800   | 1000 | ps   |
| Output-to-Output Skew <sup>1</sup>        | $T_{SK}$           |                                                                               | —    | 25    | 60   | ps   |
| Part-to-Part Skew <sup>2</sup>            | $T_{PS}$           |                                                                               | —    | —     | 150  | ps   |
| Power Supply Noise Rejection <sup>3</sup> | PSRR               | 10 kHz sinusoidal noise                                                       | —    | –65   | —    | dBc  |
|                                           |                    | 100 kHz sinusoidal noise                                                      | —    | –62.5 | —    | dBc  |
|                                           |                    | 500 kHz sinusoidal noise                                                      | —    | –60   | —    | dBc  |
|                                           |                    | 1 MHz sinusoidal noise                                                        | —    | –55   | —    | dBc  |

**Note:**

1. Output-to-output skew specified for outputs with identical configuration.
2. Defined as skew between any output on different devices operating at the same supply voltage, temperature, and equal load condition. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
3. Measured for 156.25 MHz carrier frequency. Sine-wave noise added to  $V_{DD}$  ( $3.3\text{ V} = 100\text{ mV}_{PP}$ ) and noise spur amplitude measured. See “AN491: Power Supply Rejection for Low-Jitter Clocks” for more information.

Table 3.6. Additive Jitter, Differential Clock Input

| V <sub>DD</sub> | Input <sup>1, 2</sup> |              |                                                        |                                          | Output       | Additive Jitter (fs rms, 12 kHz to 20 MHz) <sup>3</sup> |     |
|-----------------|-----------------------|--------------|--------------------------------------------------------|------------------------------------------|--------------|---------------------------------------------------------|-----|
|                 | Freq (MHz)            | Clock Format | Amplitude V <sub>IN</sub> (Single-Ended, Peak-to-Peak) | Differential 20% to 80% Slew Rate (V/ns) | Clock Format | Typ                                                     | Max |
| 3.3             | 725                   | Differential | 0.15                                                   | 0.637                                    | LVPECL       | 45                                                      | 95  |
| 3.3             | 156.25                | Differential | 0.5                                                    | 0.458                                    | LVPECL       | 160                                                     | 185 |
| 2.5             | 725                   | Differential | 0.15                                                   | 0.637                                    | LVPECL       | 45                                                      | 95  |
| 2.5             | 156.25                | Differential | 0.5                                                    | 0.458                                    | LVPECL       | 145                                                     | 185 |

**Note:**

1. For best additive jitter results, use the fastest slew rate possible. See [“AN766: Understanding and Optimizing Clock Buffer’s Additive Jitter Performance”](#) for more information.
2. AC-coupled differential inputs.
3. Measured differentially using a balun at the phase noise analyzer input. See [Figure 2.9 Differential Measurement Method Using a Balun on page 10](#).

Table 3.7. Additive Jitter, Single-Ended Clock Input

| V <sub>DD</sub> | Input <sup>1, 2</sup> |              |                                                        |                                          | Output       | Additive Jitter (fs rms, 12 kHz to 20 MHz) <sup>3</sup> |     |
|-----------------|-----------------------|--------------|--------------------------------------------------------|------------------------------------------|--------------|---------------------------------------------------------|-----|
|                 | Freq (MHz)            | Clock Format | Amplitude V <sub>IN</sub> (Single-Ended, Peak-to-Peak) | Single-Ended 20% to 80% Slew Rate (V/ns) | Clock Format | Typ                                                     | Max |
| 3.3             | 156.25                | Single-ended | 2.18                                                   | 1                                        | LVPECL       | 160                                                     | 185 |
| 2.5             | 156.25                | Single-ended | 2.18                                                   | 1                                        | LVPECL       | 145                                                     | 185 |

**Note:**

1. For best additive jitter results, use the fastest slew rate possible. See [“AN766: Understanding and Optimizing Clock Buffer’s Additive Jitter Performance”](#) for more information.
2. DC-coupled single-ended inputs.
3. Measured differentially using a balun at the phase noise analyzer input. See [Figure 2.9 Differential Measurement Method Using a Balun on page 10](#).

Table 3.8. Thermal Conditions

| Parameter                                        | Symbol        | Test Condition | Value | Unit |
|--------------------------------------------------|---------------|----------------|-------|------|
| 16-QFN Thermal Resistance, Junction to Ambient   | $\theta_{JA}$ | Still air      | 57.6  | °C/W |
| 16-QFN Thermal Resistance, Junction to Case      | $\theta_{JC}$ | Still air      | 41.5  | °C/W |
| 20-TSSOP Thermal Resistance, Junction to Ambient | $\theta_{JA}$ | Still air      | 93.88 | °C/W |
| 24-QFN Thermal Resistance, Junction to Ambient   | $\theta_{JA}$ | Still air      | 37    | °C/W |
| 24-QFN Thermal Resistance, Junction to Case      | $\theta_{JC}$ | Still air      | 25    | °C/W |
| 32-eLQFP Thermal Resistance, Junction to Ambient | $\theta_{JA}$ | Still air      | 54.9  | °C/W |
| 32-eLQFP Thermal Resistance, Junction to Case    | $\theta_{JC}$ | Still air      | 10.0  | °C/W |
| 32-QFN Thermal Resistance, Junction to Ambient   | $\theta_{JA}$ | Still air      | 99.6  | °C/W |
| 32-QFN Thermal Resistance, Junction to Case      | $\theta_{JC}$ | Still air      | 10.3  | °C/W |

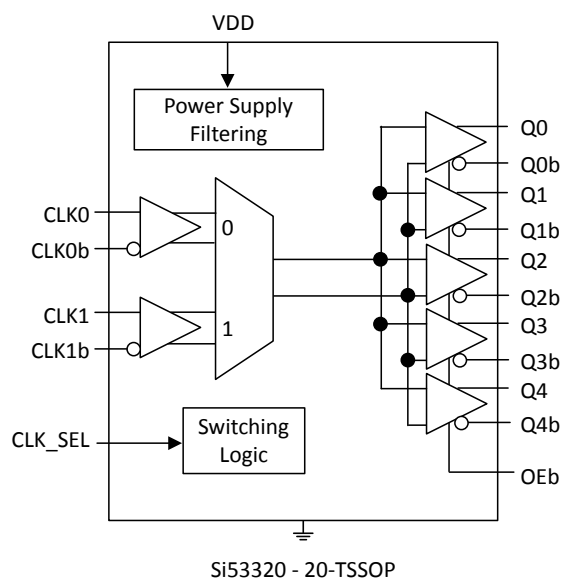
Table 3.9. Absolute Maximum Ratings<sup>1</sup>

| 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    |
|                                   | 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   |

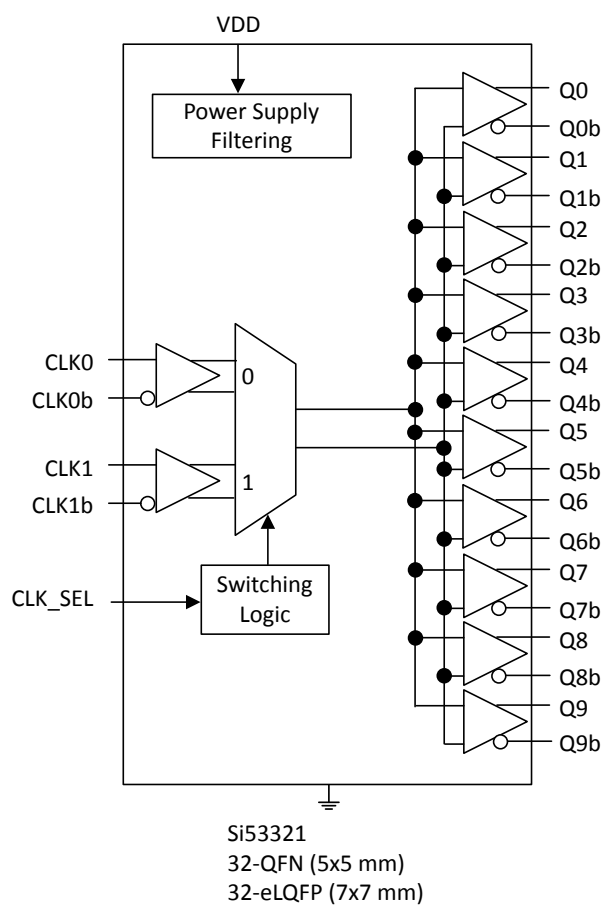
**Note:**

- 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.

## 4. Detailed Block Diagrams



**Figure 4.1. Si53320 Block Diagram**



**Figure 4.2. Si53321 Block Diagram**

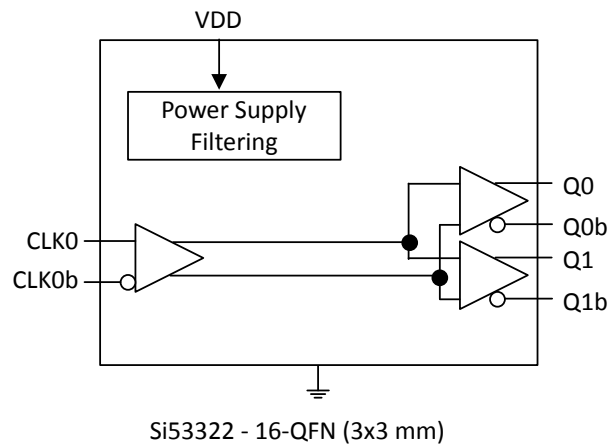


Figure 4.3. Si53322 Block Diagram

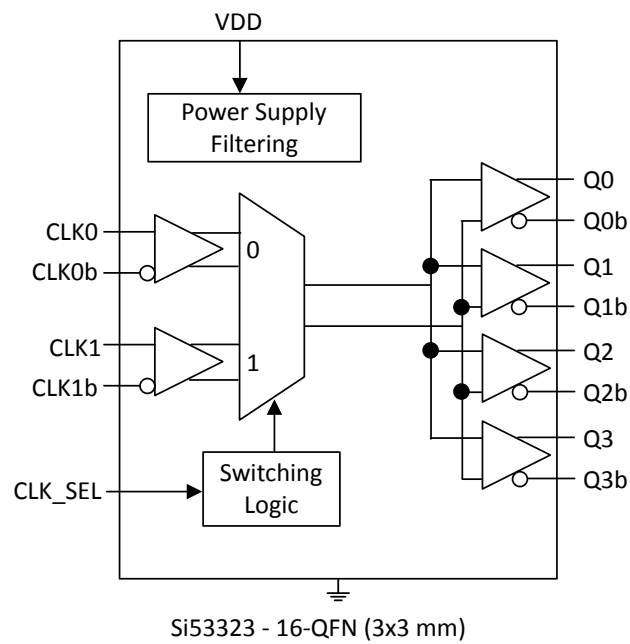
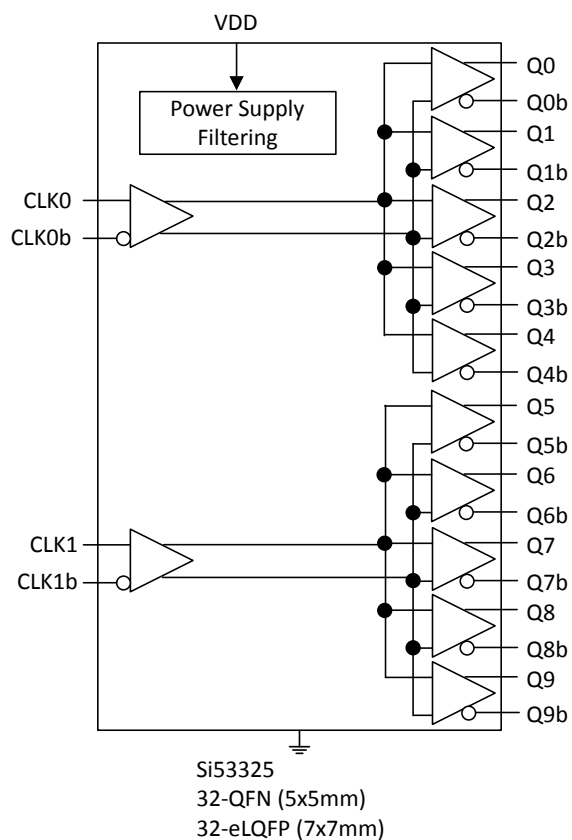
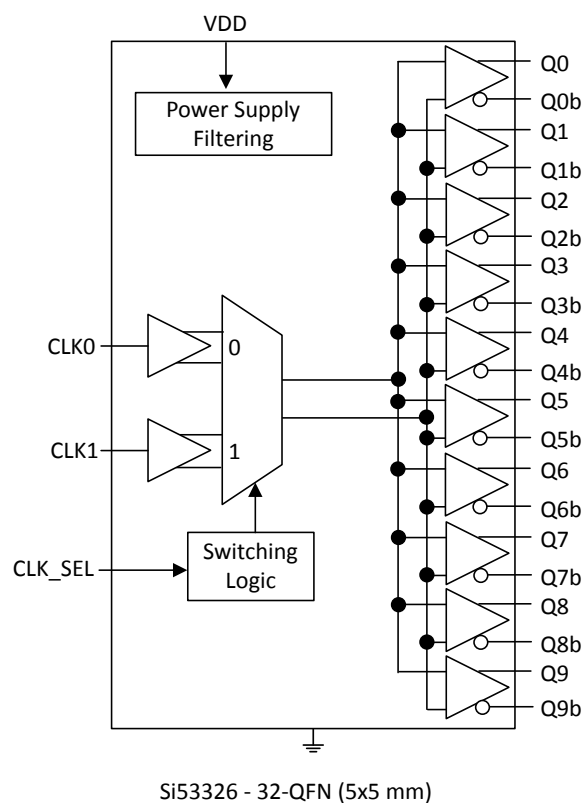


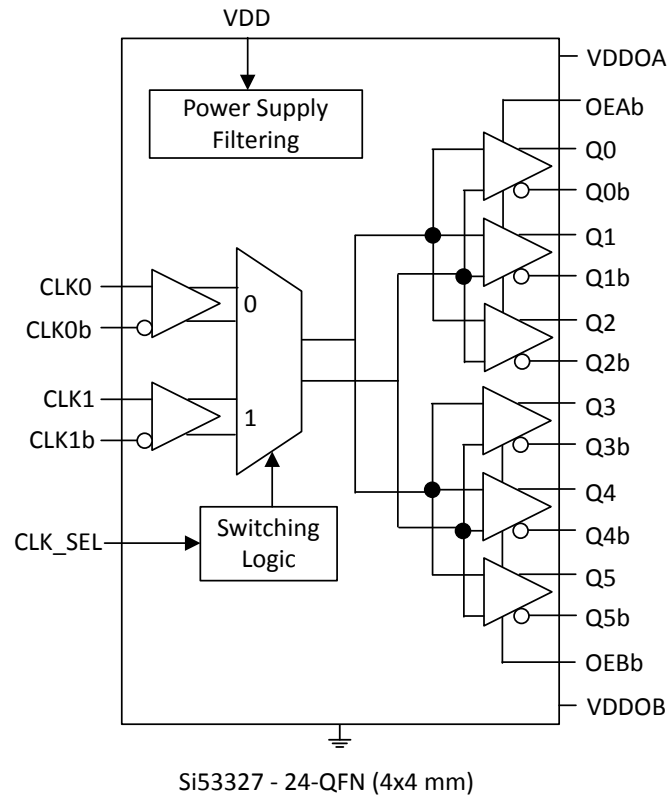
Figure 4.4. Si53323 Block Diagram



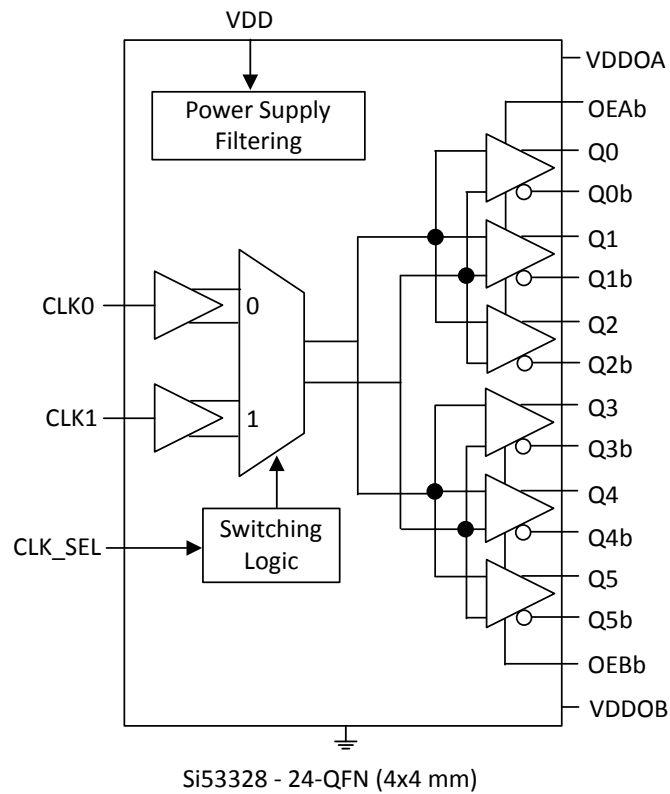
**Figure 4.5. Si53325 Block Diagram**



**Figure 4.6. Si53326 Block Diagram**



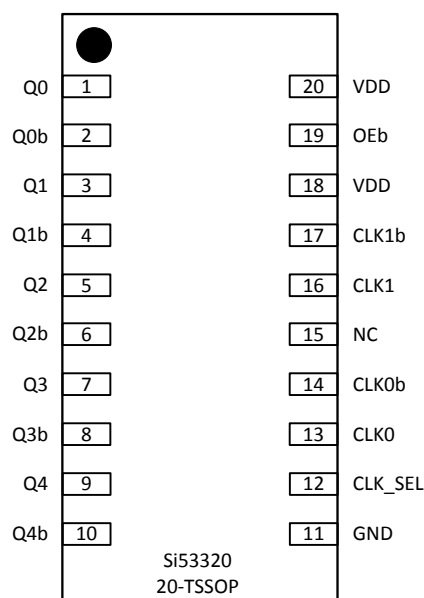
**Figure 4.7. Si53327 Block Diagram**



**Figure 4.8. Si53328 Block Diagram**

## 5. Pin Descriptions

### 5.1 Si53320 Pin Descriptions

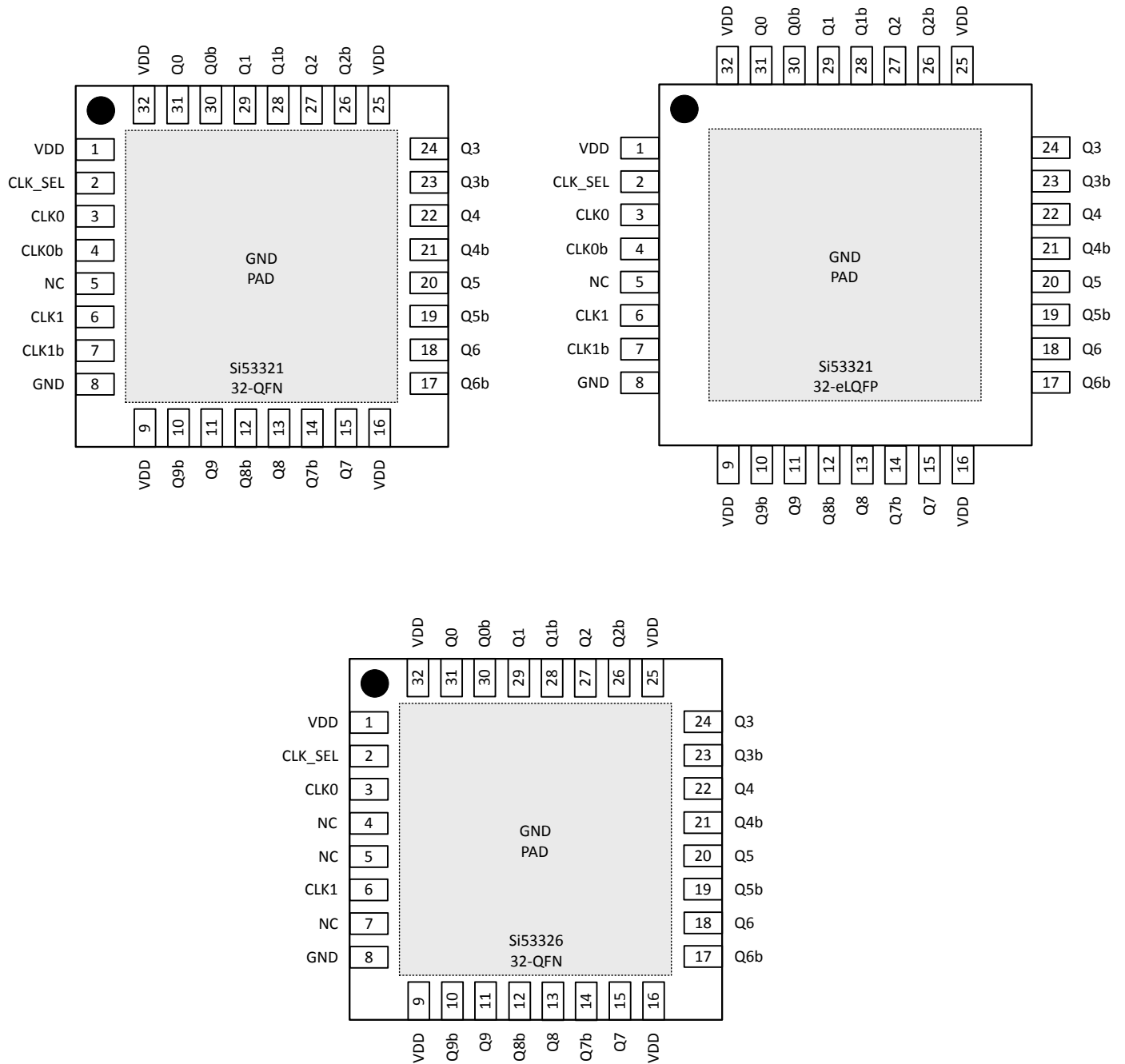


**Table 5.1. Si53320 20-Pin TSSOP Descriptions**

| Pin # | Name    | Type <sup>1</sup> | Description                                                                                                                                                       |
|-------|---------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Q0      | O                 | Output clock 0.                                                                                                                                                   |
| 2     | Q0b     | O                 | Output clock 0 (complement).                                                                                                                                      |
| 3     | Q1      | O                 | Output clock 1.                                                                                                                                                   |
| 4     | Q1b     | O                 | Output clock 1 (complement).                                                                                                                                      |
| 5     | Q2      | O                 | Output clock 2.                                                                                                                                                   |
| 6     | Q2b     | O                 | Output clock 2 (complement).                                                                                                                                      |
| 7     | Q3      | O                 | Output clock 3.                                                                                                                                                   |
| 8     | Q3b     | O                 | Output clock 3 (complement).                                                                                                                                      |
| 9     | Q4      | O                 | Output clock 4.                                                                                                                                                   |
| 10    | Q4b     | O                 | Output clock 4 (complement).                                                                                                                                      |
| 11    | GND     | GND               | Ground.                                                                                                                                                           |
| 12    | CLK_SEL | I                 | Mux input select pin (LVCMOS). When CLK_SEL is high, CLK1 is selected. When CLK_SEL is low, CLK0 is selected. CLK_SEL contains an internal pull-down resistor.    |
| 13    | CLK0    | I                 | Input clock 0.                                                                                                                                                    |
| 14    | CLK0b   | I                 | Input clock 0 (complement). When CLK0 is driven by a single-ended input, connect CLK0b to an appropriate bias voltage (e.g., for a CMOS input apply $V_{DD}/2$ ). |
| 15    | NC      | —                 | No connect. Leave this pin unconnected.                                                                                                                           |
| 16    | CLK1    | I                 | Input clock 1.                                                                                                                                                    |

| Pin #                                                              | Name  | Type <sup>1</sup> | Description                                                                                                                                                                                  |
|--------------------------------------------------------------------|-------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17                                                                 | CLK1b | I                 | Input clock 1 (complement). When CLK1 is driven by a single-ended input, connect CLK1b to an appropriate bias voltage (e.g., for a CMOS input apply $V_{DD}/2$ ).                            |
| 18                                                                 | VDD   | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                             |
| 19                                                                 | OEB   | I                 | Output enable. When OEB = low, the clock outputs are enabled. When OEB = high, Qx is held low and Qxb is held high. OEB features an internal pull-down resistor and may be left unconnected. |
| 20                                                                 | VDD   | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                             |
| <b>Note:</b><br>1. I = Input; O = Output; P = Power; GND = Ground. |       |                   |                                                                                                                                                                                              |

## 5.2 Si53321 and Si53326 Pin Descriptions



**Table 5.2. Si53321 32-QFN/32-eLQFP and Si53326 32-QFN Pin Descriptions**

| Pin # | Name                    | Type <sup>1</sup> | Description                                                                                                                                                    |
|-------|-------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | VDD                     | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                               |
| 2     | CLK_SEL                 | I                 | Mux input select pin (LVCMOS). When CLK_SEL is high, CLK1 is selected. When CLK_SEL is low, CLK0 is selected. CLK_SEL contains an internal pull-down resistor. |
| 3     | CLK0                    | I                 | Input clock 0.                                                                                                                                                 |
| 4     | CLK0b<br>(Si53321 only) | I                 | Input clock 0 (complement). When CLK0 is driven by a single-ended LVCMOS input, connect CLK0b to an appropriate bias voltage (e.g. $V_{DD}/2$ ).               |
|       | NC<br>(Si53326 only)    | —                 | No connect. Leave this pin unconnected.                                                                                                                        |
| 5     | NC                      |                   | No connect. Leave this pin unconnected.                                                                                                                        |
| 6     | CLK1                    | I                 | Input clock 1.                                                                                                                                                 |
| 7     | CLK1b<br>(Si53321 only) | I                 | Input clock 1 (complement). When CLK1 is driven by a single-ended input, connect CLK1b to $V_{DD}/2$ .                                                         |
|       | NC<br>(Si53326 only)    | —                 | No connect. Leave this pin unconnected.                                                                                                                        |
| 8     | GND                     | GND               | Ground.                                                                                                                                                        |
| 9     | VDD                     | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                               |
| 10    | Q9b                     | O                 | Output clock 9 (complement).                                                                                                                                   |
| 11    | Q9                      | O                 | Output clock 9.                                                                                                                                                |
| 12    | Q8b                     | O                 | Output clock 8 (complement).                                                                                                                                   |
| 13    | Q8                      | O                 | Output clock 8.                                                                                                                                                |
| 14    | Q7b                     | O                 | Output clock 7 (complement).                                                                                                                                   |
| 15    | Q7                      | O                 | Output clock 7.                                                                                                                                                |
| 16    | VDD                     | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                               |
| 17    | Q6b                     | O                 | Output clock 6 (complement).                                                                                                                                   |
| 18    | Q6                      | O                 | Output clock 6.                                                                                                                                                |
| 19    | Q5b                     | O                 | Output clock 5 (complement).                                                                                                                                   |
| 20    | Q5                      | O                 | Output clock 5.                                                                                                                                                |
| 21    | Q4b                     | O                 | Output clock 4 (complement).                                                                                                                                   |
| 22    | Q4                      | O                 | Output clock 4.                                                                                                                                                |
| 23    | Q3b                     | O                 | Output clock 3 (complement).                                                                                                                                   |
| 24    | Q3                      | O                 | Output clock 3.                                                                                                                                                |
| 25    | VDD                     | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                               |
| 26    | Q2b                     | O                 | Output clock 2 (complement).                                                                                                                                   |

| Pin #   | Name               | Type <sup>1</sup> | Description                                                                                                                                                                                                                        |
|---------|--------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 27      | Q2                 | O                 | Output clock 2.                                                                                                                                                                                                                    |
| 28      | Q1b                | O                 | Output clock 1 (complement).                                                                                                                                                                                                       |
| 29      | Q1                 | O                 | Output clock 1.                                                                                                                                                                                                                    |
| 30      | Q0b                | O                 | Output clock 0 (complement).                                                                                                                                                                                                       |
| 31      | Q0                 | O                 | Output clock 0.                                                                                                                                                                                                                    |
| 32      | VDD                | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                                                                   |
| GND Pad | Exposed ground pad | GND               | Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met. |

**Note:**

1. I = Input; O = Output; P = Power; GND = Ground.

## 5.3 Si53322 Pin Descriptions

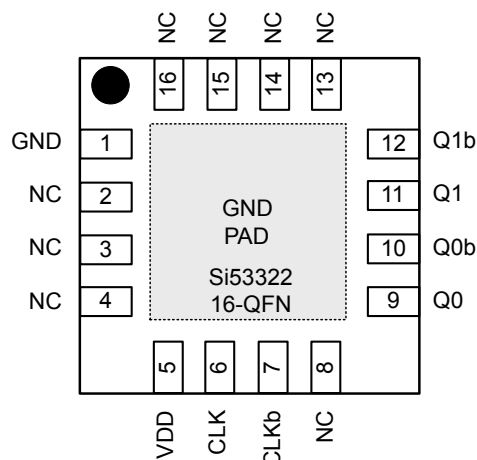


Table 5.3. Si53322 16-QFN Pin Descriptions

| Pin     | Name               | Type <sup>1</sup> | Description                                                                                                                                                                                                                        |
|---------|--------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | GND                | GND               | Ground.                                                                                                                                                                                                                            |
| 2       | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 3       | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 4       | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 5       | VDD                | P                 | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                                                                   |
| 6       | CLK                | I                 | Input Clock                                                                                                                                                                                                                        |
| 7       | CLKb               | I                 | Input clock (complement). When CLK is driven by a single-ended LVCMOS input, connect CLKb to an appropriate bias voltage (e.g. $V_{DD}/2$ ).                                                                                       |
| 8       | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 9       | Q0                 | O                 | Output Clock 0.                                                                                                                                                                                                                    |
| 10      | Q0b                | O                 | Output Clock 0 (complement).                                                                                                                                                                                                       |
| 11      | Q1                 | O                 | Output Clock 1.                                                                                                                                                                                                                    |
| 12      | Q1b                | O                 | Output Clock 1 (complement).                                                                                                                                                                                                       |
| 13      | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 14      | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 15      | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 16      | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| GND Pad | Exposed ground pad | GND               | Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met. |

**Note:**

1. I = Input; O = Output; P = Power; GND = Ground.

## 5.4 Si53323 Pin Descriptions

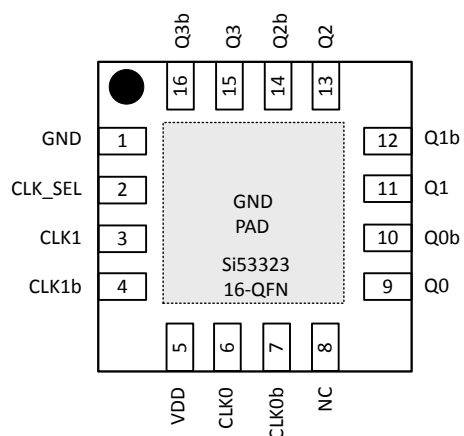


Table 5.4. Si53323 16-QFN Pin Descriptions

| Pin     | Name               | Type <sup>1</sup> | Description                                                                                                                                                                                                                        |
|---------|--------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | GND                | GND               | Ground.                                                                                                                                                                                                                            |
| 2       | CLK_SEL            | I                 | Mux input select pin (LVCMOS). When CLK_SEL is high, CLK1 is selected. When CLK_SEL is low, CLK0 is selected. CLK_SEL contains an internal pull-down resistor.                                                                     |
| 3       | CLK1               | I                 | Input clock 1.                                                                                                                                                                                                                     |
| 4       | CLK1b              | I                 | Input clock 1 (complement). When CLK1 is driven by a single-ended input, connect CLK1b to an appropriate bias voltage (e.g., for a CMOS input apply $V_{DD}/2$ ).                                                                  |
| 5       | VDD                | P                 | Core and Output Voltage Supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                                                                   |
| 6       | CLK0               | I                 | Input Clock 0.                                                                                                                                                                                                                     |
| 7       | CLK0b              | I                 | Input Clock 0 (complement). When CLK0 is driven by a single-ended input, connect CLK0b to an appropriate bias voltage (e.g., for a CMOS input apply $V_{DD}/2$ ).                                                                  |
| 8       | NC                 | —                 | No connect. Leave this pin unconnected.                                                                                                                                                                                            |
| 9       | Q0                 | O                 | Output Clock 0.                                                                                                                                                                                                                    |
| 10      | Q0b                | O                 | Output Clock 0 (complement).                                                                                                                                                                                                       |
| 11      | Q1                 | O                 | Output Clock 1.                                                                                                                                                                                                                    |
| 12      | Q1b                | O                 | Output Clock 1 (complement).                                                                                                                                                                                                       |
| 13      | Q2                 | O                 | Output Clock 2.                                                                                                                                                                                                                    |
| 14      | Q2b                | O                 | Output Clock 2 (complement).                                                                                                                                                                                                       |
| 15      | Q3                 | O                 | Output Clock 3.                                                                                                                                                                                                                    |
| 16      | Q3b                | O                 | Output Clock 3 (complement).                                                                                                                                                                                                       |
| GND Pad | Exposed ground pad | GND               | Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met. |

**Note:**

1. I = Input; O = Output; P = Power; GND = Ground.

## 5.5 Si53325 Pin Descriptions

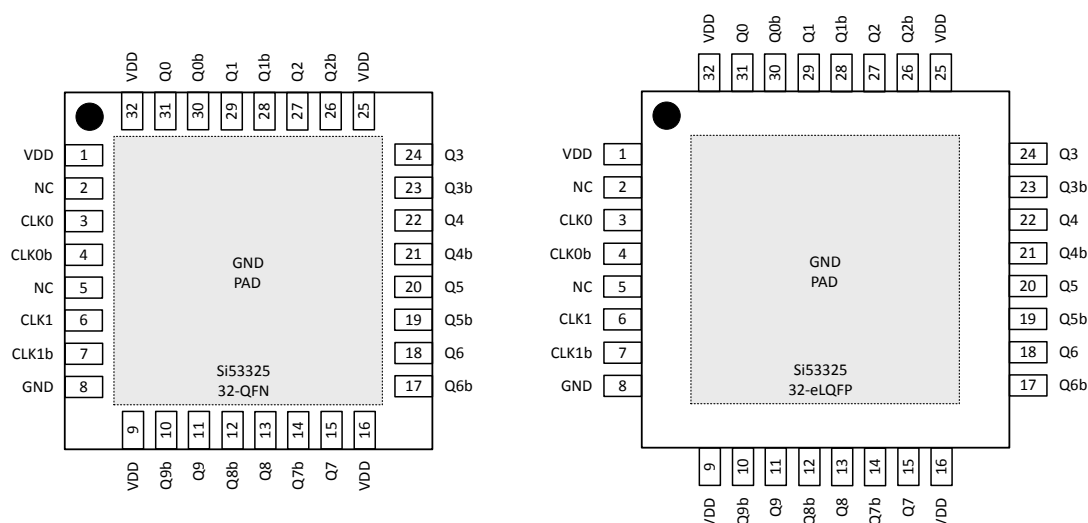


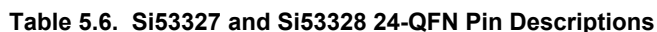
Table 5.5. Si53325 32-QFN and 32-eLQFP Pin Descriptions

| Pin # | Name <sup>1</sup> | Type | Description                                                                                                         |
|-------|-------------------|------|---------------------------------------------------------------------------------------------------------------------|
| 1     | VDD               | P    | Core and Output voltage supply.<br>Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible. |
| 2     | NC                | —    | No connect. Leave this pin unconnected.                                                                             |
| 3     | CLK0              | I    | Input clock 0.                                                                                                      |
| 4     | CLK0b             | I    | Input clock 0 (complement).                                                                                         |
| 5     | NC                | —    | No connect. Leave this pin unconnected.                                                                             |
| 6     | CLK1              | I    | Input clock 1.                                                                                                      |
| 7     | CLK1b             | I    | Input clock 1 (complement).                                                                                         |
| 8     | GND               | GND  | Ground.                                                                                                             |
| 9     | VDD               | P    | Core voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.               |
| 10    | Q9b               | O    | Output clock 9 (complement).                                                                                        |
| 11    | Q9                | O    | Output clock 9.                                                                                                     |
| 12    | Q8b               | O    | Output clock 8 (complement).                                                                                        |
| 13    | Q8                | O    | Output clock 8.                                                                                                     |
| 14    | Q7b               | O    | Output clock 7 (complement).                                                                                        |
| 15    | Q7                | O    | Output clock 7.                                                                                                     |
| 16    | VDD               | P    | Core voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.               |
| 17    | Q6b               | O    | Output clock 6 (complement).                                                                                        |
| 18    | Q6                | O    | Output clock 6.                                                                                                     |
| 19    | Q5b               | O    | Output clock 5 (complement).                                                                                        |
| 20    | Q5                | O    | Output clock 5.                                                                                                     |

| Pin #   | Name <sup>1</sup>  | Type | Description                                                                                                                                                                                                                        |
|---------|--------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21      | Q4b                | O    | Output clock 4 (complement).                                                                                                                                                                                                       |
| 22      | Q4                 | O    | Output clock 4.                                                                                                                                                                                                                    |
| 23      | Q3b                | O    | Output clock 3 (complement).                                                                                                                                                                                                       |
| 24      | Q3                 | O    | Output clock 3.                                                                                                                                                                                                                    |
| 25      | VDD                | P    | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                                                                   |
| 26      | Q2b                | O    | Output clock 2 (complement).                                                                                                                                                                                                       |
| 27      | Q2                 | O    | Output clock 2.                                                                                                                                                                                                                    |
| 28      | Q1b                | O    | Output clock 1 (complement).                                                                                                                                                                                                       |
| 29      | Q1                 | O    | Output clock 1.                                                                                                                                                                                                                    |
| 30      | Q0b                | O    | Output clock 0 (complement).                                                                                                                                                                                                       |
| 31      | Q0                 | O    | Output clock 0.                                                                                                                                                                                                                    |
| 32      | VDD                | P    | Core and Output voltage supply. Bypass with 1.0 $\mu$ F capacitor and place as close to the VDD pin as possible.                                                                                                                   |
| GND Pad | Exposed ground pad | GND  | Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met. |

**Note:**

1. I = Input; O = Output; P = Power; GND = Ground.

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| Pin     | Name               | Type <sup>1</sup> | Description                                                                                                                                                                                                                                      |
|---------|--------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16      | Q4b                | O                 | Output clock 4 (complement).                                                                                                                                                                                                                     |
| 17      | Q4                 | O                 | Output clock 4.                                                                                                                                                                                                                                  |
| 18      | OEBb               | I                 | Output Enable for Bank B (Q3, Q4, Q5). When OEBb = LOW, outputs Q3, Q4, and Q5 are enabled. This pin contains an active pull-down resistor, and leaving the pin disconnected enables the outputs. When OEBb = HIGH, Q3, Q4, and Q5 are disabled. |
| 19      | VDDOB              | P                 | Output voltage supply—Bank B (Outputs: Q3 to Q5). Bypass with 1.0 $\mu$ F capacitor and place as close to the VDDOB pin as possible.                                                                                                             |
| 20      | Q3b                | O                 | Output clock 3 (complement).                                                                                                                                                                                                                     |
| 21      | Q3                 | O                 | Output clock 3.                                                                                                                                                                                                                                  |
| 22      | Q2b                | O                 | Output clock 2 (complement).                                                                                                                                                                                                                     |
| 23      | Q2                 | O                 | Output clock 2.                                                                                                                                                                                                                                  |
| 24      | VDDOA              | P                 | Output voltage supply—Bank A (Outputs: Q0 to Q2). Bypass with 1.0 $\mu$ F capacitor and place as close to the VDDOA pin as possible.                                                                                                             |
| GND Pad | Exposed ground pad | GND               | Ground Pad—Power supply ground and thermal relief. The exposed ground pad is thermally connected to the die to improve the heat transfer out of the package. The ground pad must be connected to GND to ensure device specifications are met.    |

**Note:**

1. I = Input; O = Output; P = Power; GND = Ground.

## 6. Package Outlines

### 6.1 16-Pin QFN Package

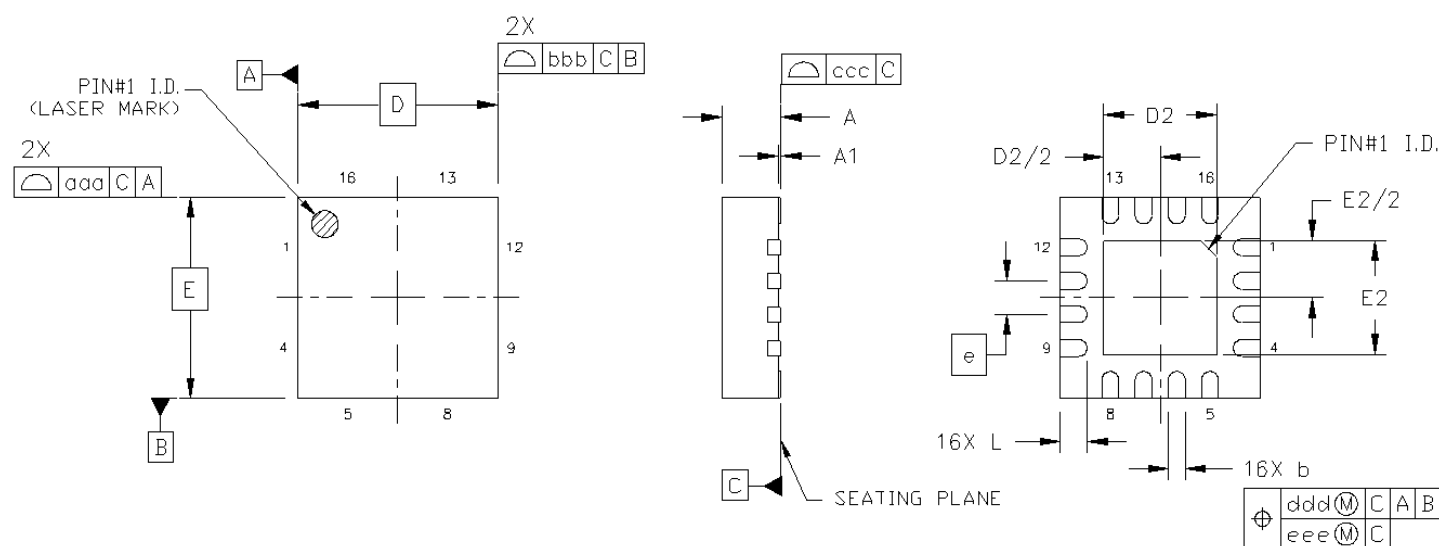


Figure 6.1. 16-Pin QFN Package

Table 6.1. 16-QFN Package Dimensions

| Dimension | Min       | Nom  | Max  |
|-----------|-----------|------|------|
| A         | 0.80      | 0.85 | 0.90 |
| A1        | 0.00      | 0.02 | 0.05 |
| b         | 0.18      | 0.25 | 0.30 |
| D         | 3.00 BSC. |      |      |
| D2        | 1.65      | 1.70 | 1.75 |
| e         | 0.50 BSC. |      |      |
| E         | 3.00 BSC. |      |      |
| E2        | 1.65      | 1.70 | 1.75 |
| L         | 0.30      | 0.40 | 0.50 |
| aaa       | —         | —    | 0.10 |
| bbb       | —         | —    | 0.10 |
| ccc       | —         | —    | 0.08 |
| ddd       | —         | —    | 0.10 |
| eee       | —         | —    | 0.05 |

**Note:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.

## 6.2 20-Pin TSSOP Package

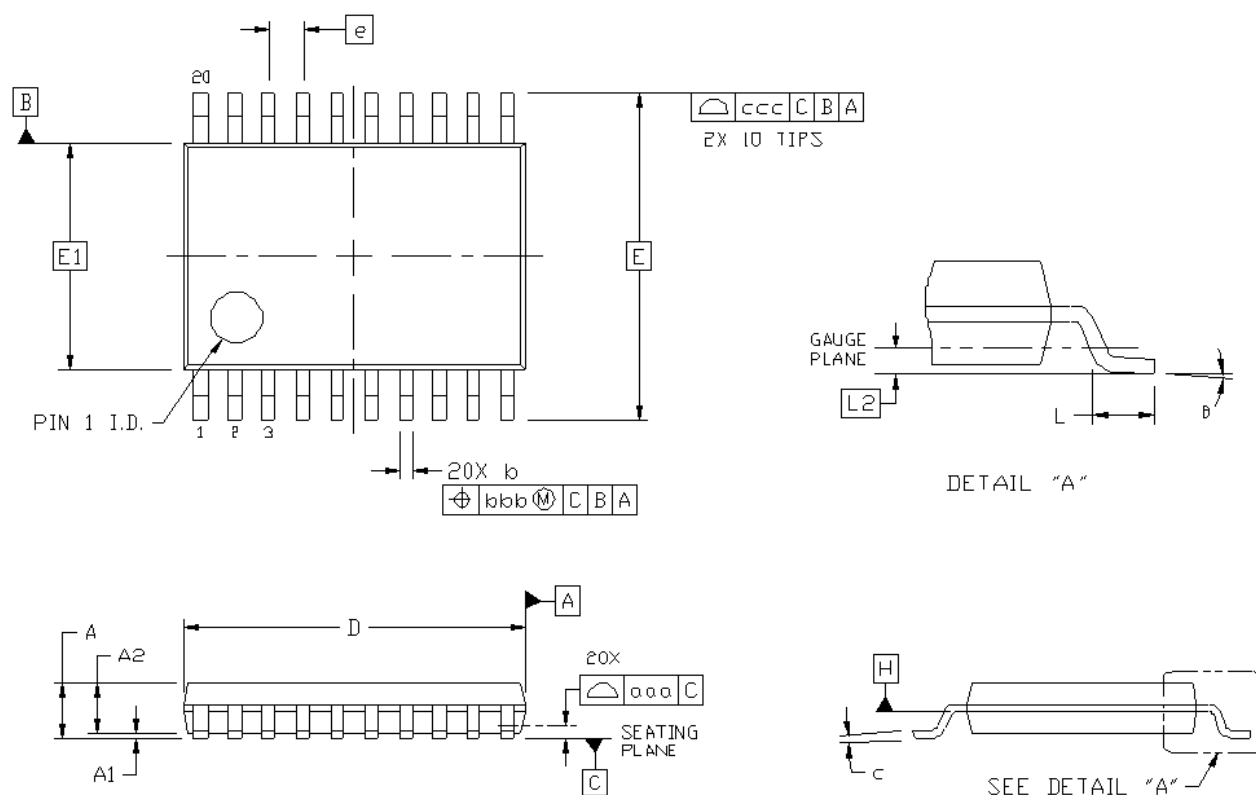


Figure 6.2. 20-Pin TSSOP Package

Table 6.2. 20-TSSOP Package Dimensions

| Dimension | Min      | Nom  | Max  | Dimension | Min      | Nom  | Max  |
|-----------|----------|------|------|-----------|----------|------|------|
| A         | —        | —    | 1.20 | e         | 0.65 BSC |      |      |
| A1        | 0.05     | —    | 0.15 | L         | 0.45     | 0.60 | 0.75 |
| A2        | 0.80     | 1.00 | 1.05 | L2        | 0.25 BSC |      |      |
| b         | 0.19     | —    | 0.30 | q         | 0°       | —    | 8°   |
| c         | 0.09     | —    | 0.20 | aaa       | 0.10     |      |      |
| D         | 6.40     | 6.50 | 6.60 | bbb       | 0.10     |      |      |
| E         | 6.40 BSC |      |      | ccc       | 0.20     |      |      |
| E1        | 4.30     | 4.40 | 4.50 |           |          |      |      |

**Note:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to the JEDEC Solid State Outline MO-153, Variation AC.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

## 6.3 24-Pin QFN Package

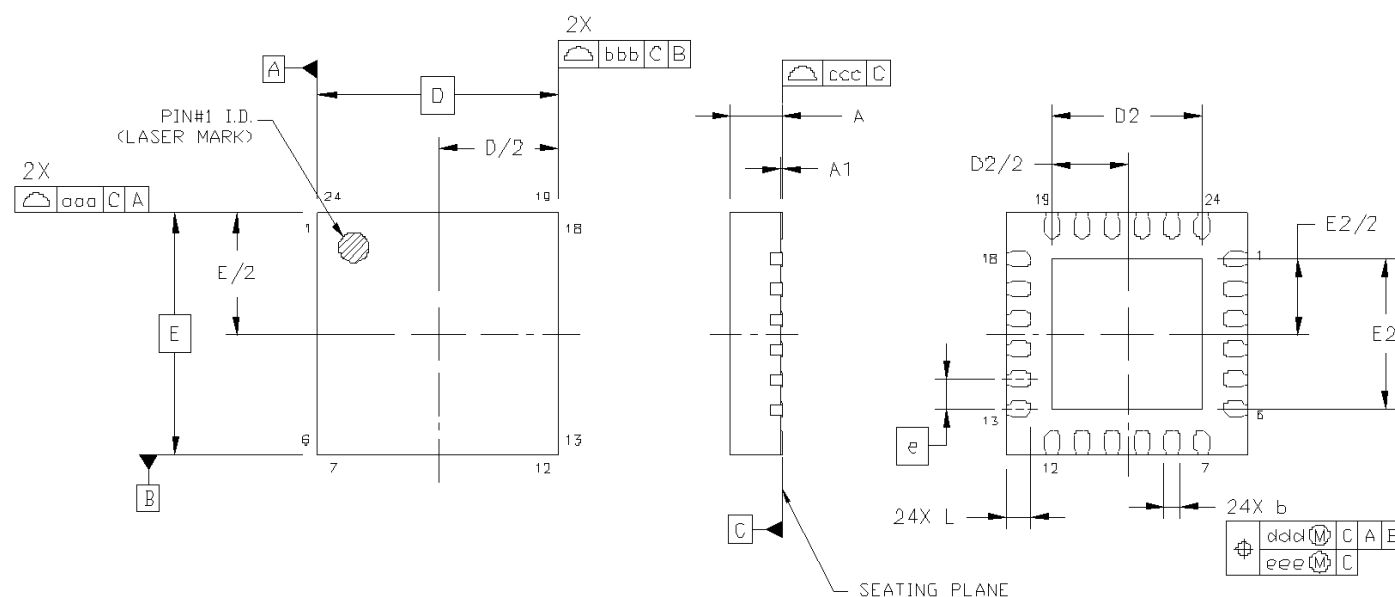


Figure 6.3. 24-Pin QFN Package

Table 6.3. 24-QFN Package Dimensions

| Dimension | Min       | Nom  | Max  |
|-----------|-----------|------|------|
| A         | 0.80      | 0.85 | 0.90 |
| A1        | 0.00      | 0.02 | 0.05 |
| b         | 0.18      | 0.25 | 0.30 |
| D         | 4.00 BSC. |      |      |
| D2        | 2.35      | 2.50 | 2.65 |
| e         | 0.50 BSC. |      |      |
| E         | 4.00 BSC. |      |      |
| E2        | 2.35      | 2.50 | 2.65 |
| L         | 0.30      | 0.40 | 0.50 |
| aaa       | 0.10      |      |      |
| bbb       | 0.10      |      |      |
| ccc       | 0.08      |      |      |
| ddd       | 0.10      |      |      |
| eee       | 0.05      |      |      |

**Note:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to JEDEC outline MO-220, variation VGGD-8.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020C specification for Small Body Components.

## 6.4 32-Pin QFN Package

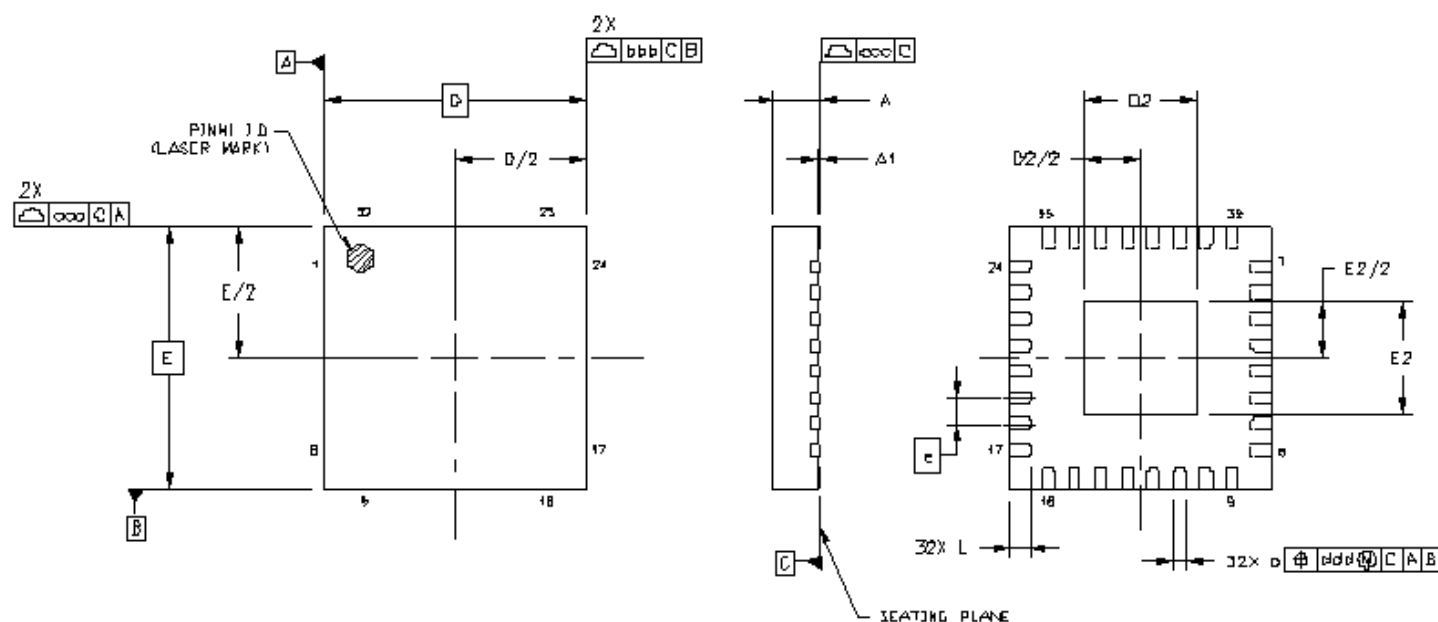


Figure 6.4. 32-Pin QFN Package

Table 6.4. 32-QFN 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     |      |      |

**Note:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to the JEDEC Solid State Outline MO-220.

## 6.5 32-Pin eLQFP Package

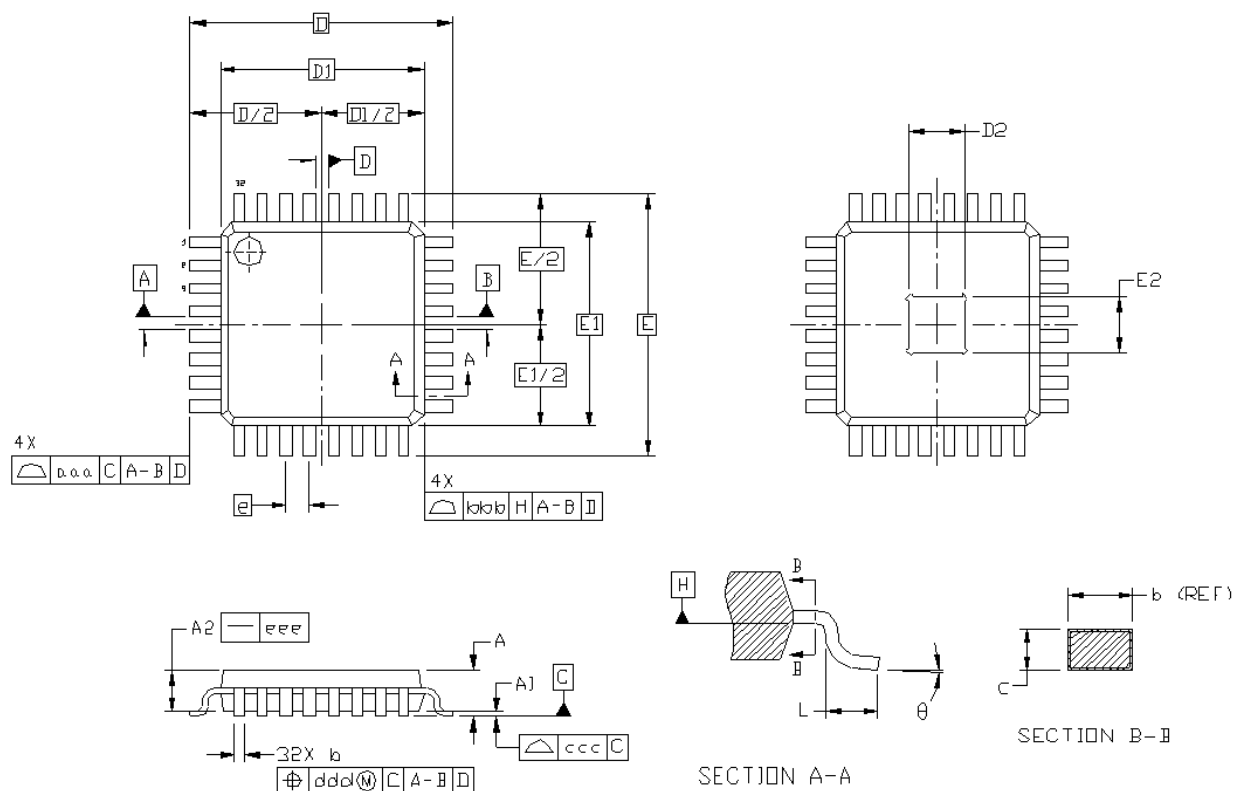


Figure 6.5. 32-Pin eLQFP Package

Table 6.5. 32-eLQFP Package Dimensions

| Dimension | Min      | Nom  | Max  |  | Dimension | Min      | Nom  | Max  |
|-----------|----------|------|------|--|-----------|----------|------|------|
| A         | —        | —    | 1.60 |  | E1        | 7.00 BSC |      |      |
| A1        | 0.05     | —    | 0.15 |  | E2        | 1.87     | 1.92 | 1.97 |
| A2        | 1.35     | 1.40 | 1.45 |  | L         | 0.45     | 0.60 | 0.75 |
| b         | 0.30     | 0.37 | 0.45 |  | θ         | 0°       | 3.5° | 7°   |
| c         | 0.09     | —    | 0.20 |  | aaa       | 0.20     |      |      |
| D         | 9.00 BSC |      |      |  | bb        | 0.20     | 0.20 |      |
| D1        | 7.00 BSC |      |      |  | ccc       | 0.10     |      |      |
| D2        | 1.87     | 1.92 | 1.97 |  | dddd      | 0.20     |      |      |
| e         | 0.80 BSC |      |      |  | eee       | 0.05     |      |      |
| E         | 9.00 BSC |      |      |  |           |          |      |      |

**Note:**

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to the JEDEC MS-026.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

## 7. Land Patterns

### 7.1 16-Pin QFN Land Pattern

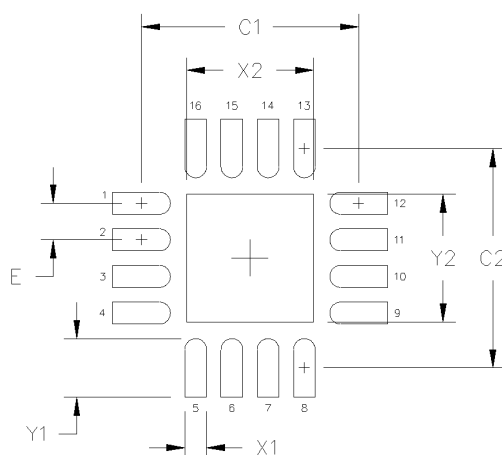


Figure 7.1. 16-Pin QFN Land Pattern

Table 7.1. 16-QFN Land Pattern Dimensions

| Dimension | mm   |
|-----------|------|
| C1        | 3.00 |
| C2        | 3.00 |
| E         | 0.50 |
| X1        | 0.30 |
| Y1        | 0.80 |
| X2        | 1.75 |
| Y2        | 1.75 |

#### Notes:

##### General

1. All dimensions shown are in millimeters (mm).
2. This Land Pattern Design is based on the IPC-7351 guidelines.
3. All dimensions shown are at Maximum Material Condition (MMC). Least Material Condition (LMC) is calculated based on a Fabrication Allowance of 0.05 mm.

##### 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  $\mu$ 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 2 x 2 array of 0.65 mm square openings on a 0.90 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.

7.2 20-Pin TSSOP Land Pattern

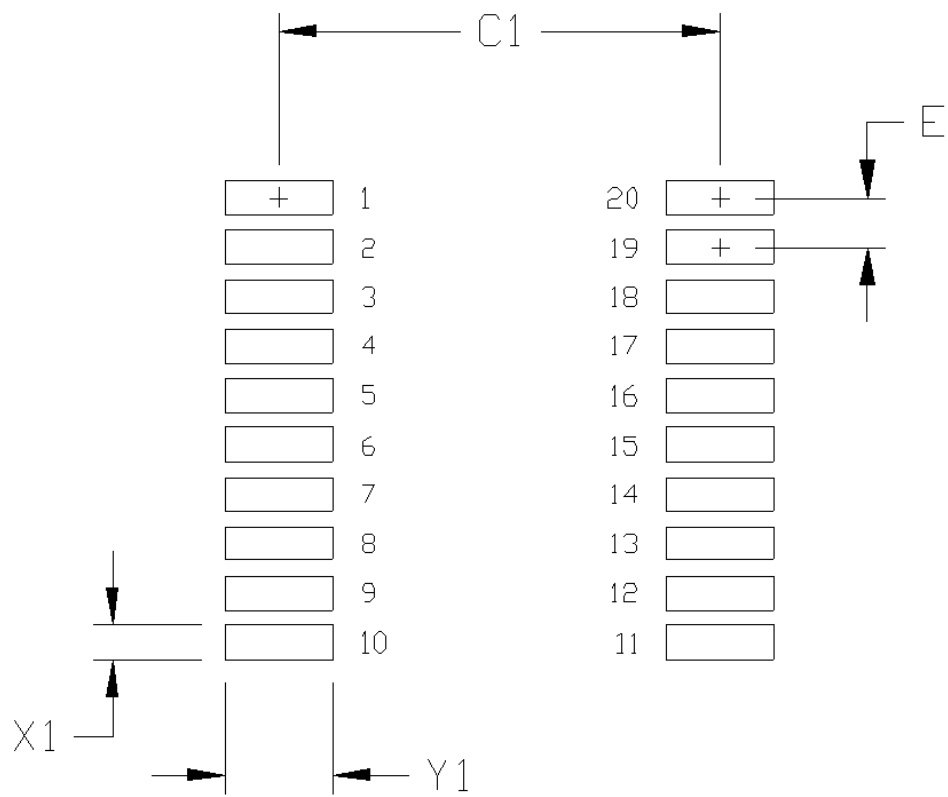


Figure 7.2. 20-Pin TSSOP Land Pattern

Table 7.2. 20-TSSOP Land Pattern Dimensions

| Dimensions | Feature            | (mm) |
|------------|--------------------|------|
| C1         | Pad Column Spacing | 5.80 |
| E          | Pad Row Pitch      | 0.65 |
| X1         | Pad Width          | 0.45 |
| Y1         | Pad Length         | 1.40 |

**Note:**

- 1. This Land Pattern Design is based on IPC-7351 specifications for Density Level B (Median Land Protrusion).
- 2. All feature sizes shown are at Maximum Material Condition (MMC) and a card fabrication tolerance of 0.05 mm is assumed.

### 7.3 24-Pin QFN Land Pattern

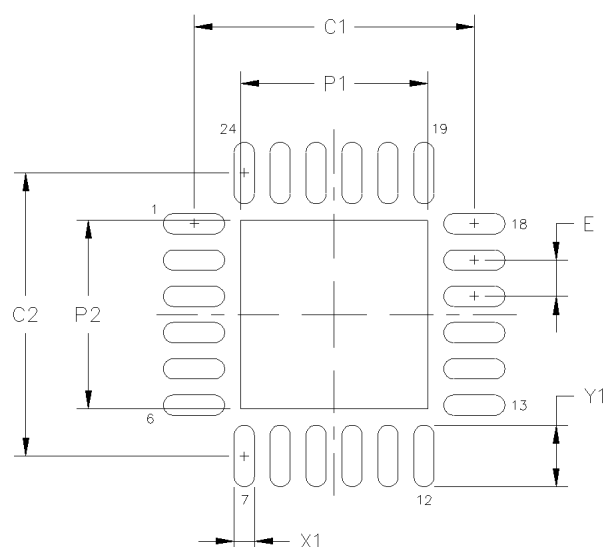


Figure 7.3. 24-Pin QFN Land Pattern

Table 7.3. 24-QFN Land Pattern Dimensions

| Dimension | mm   |
|-----------|------|
| P1        | 2.55 |
| P2        | 2.55 |
| X1        | 0.25 |
| Y1        | 0.80 |
| C1        | 3.90 |
| C2        | 3.90 |
| E         | 0.50 |

#### Notes:

##### General

1. All dimensions shown are in millimeters (mm).
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  $\mu$ 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 2 x 2 array of 1.10 mm x 1.10 mm openings on 1.30 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.

## 7.4 32-Pin QFN Land Pattern

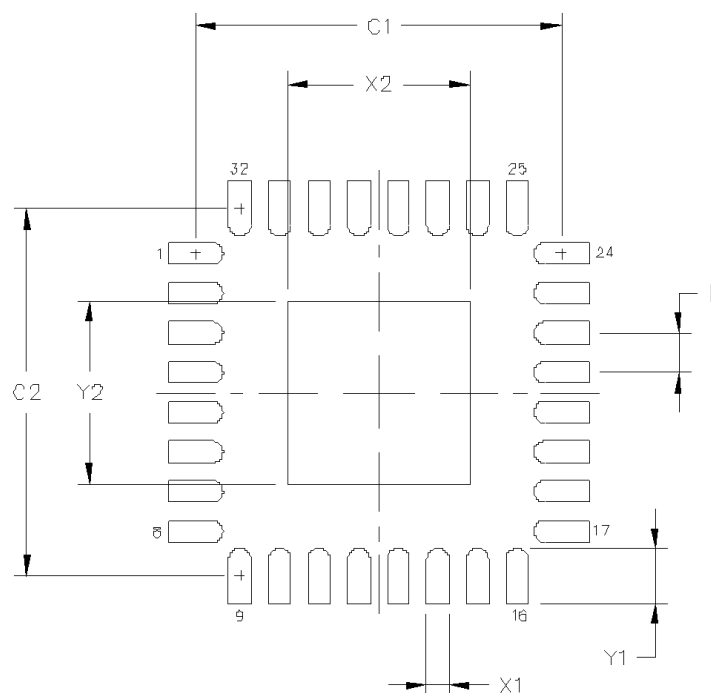


Figure 7.4. 32-Pin QFN Land Pattern

Table 7.4. 32-QFN Land Pattern Dimensions

| 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  $\mu$ 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 2 x 2 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.

## 7.5 32-Pin eLQFP Land Pattern

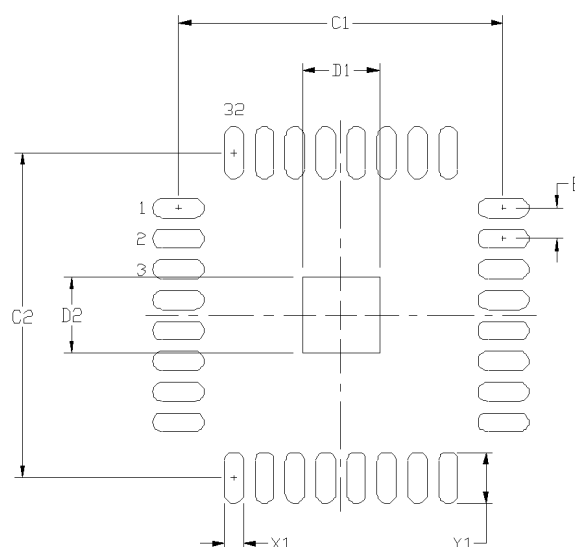


Figure 7.5. 32-Pin eLQFP Land Pattern

Table 7.5. 32-eLQFP Land Pattern Dimensions

| Dimension | Min      | Max  |
|-----------|----------|------|
| C1        | 8.40     | 8.50 |
| C2        | 8.40     | 8.50 |
| D1        | 1.84     | 2.00 |
| D2        | 1.84     | 2.00 |
| E         | 0.80 BSC |      |
| X1        | 0.40     | 0.50 |
| Y1        | 1.25     | 1.35 |

**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 mm 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 single 1.5 x 1.5 mm stencil aperture should be used for the center ground pad to achieve between 50-60% solder coverage.

**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.

8. Top Markings

8.1 Si53320 Top Marking

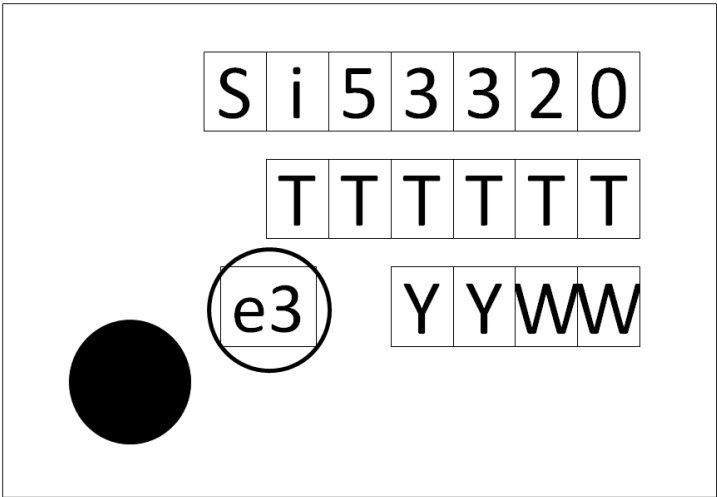


Figure 8.1. Si53320 Top Marking

Table 8.1. Si53320 Top Marking Explanation

|                 |                                        |                                                                                      |
|-----------------|----------------------------------------|--------------------------------------------------------------------------------------|
| Mark Method:    | Laser                                  |                                                                                      |
| Font Size:      | 2.0 Point (0.71 mm)<br>Right-Justified |                                                                                      |
| Line 1 Marking: | Customer Part Number                   | Si53320                                                                              |
| Line 2 Marking: | TTTTTT = Mfg Code                      | Manufacturing Code from Assembly Purchase Order form.                                |
| Line 3 Marking: | Circle = 1.2 mm Diameter               | “e3” Pb-Free Symbol                                                                  |
|                 | YY = Year<br>WW = Work Week            | Assigned by the Assembly House. Corresponds to year and work week of the build date. |

8.2 Si53321/25/26 Top Markings

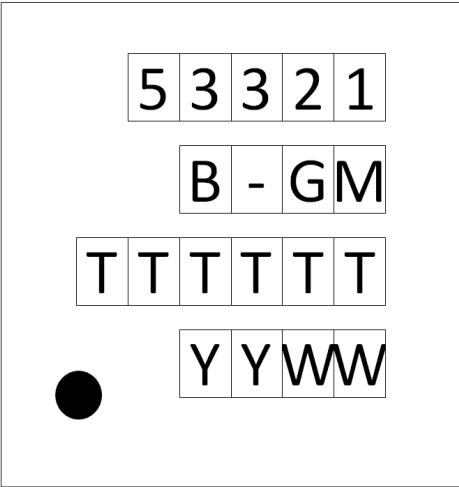


Figure 8.2. Si53321 Top Marking

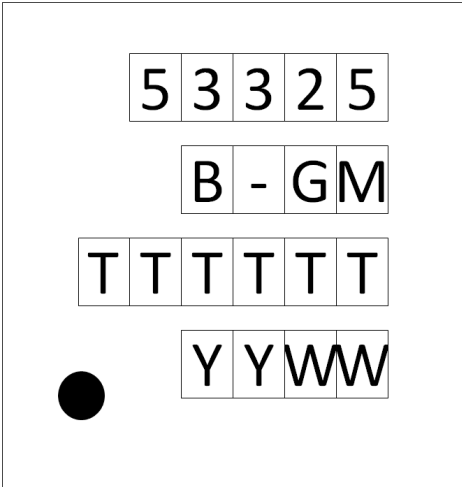


Figure 8.3. Si53325 Top Marking

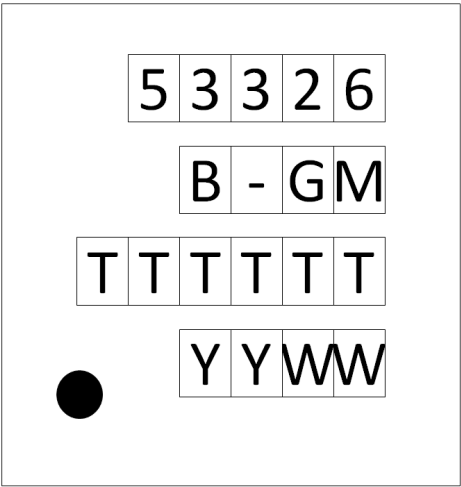


Figure 8.4. Si53326 Top Marking

Table 8.2. Si53321/25/26 Top Marking Explanation

|                 |                                                   |                                                             |
|-----------------|---------------------------------------------------|-------------------------------------------------------------|
| Mark Method:    | Laser                                             |                                                             |
| Font Size:      | 2.0 Point (28 mils)<br>Center-Justified           |                                                             |
| Line 1 Marking: | Device Part Number                                | 53321 for Si53321<br>53325 for Si53325<br>53326 for Si53326 |
| Line 2 Marking: | Device Revision/Type                              | B-GM for Si53321 and Si53325. Blank for Si53326.            |
| Line 3 Marking: | TTTTTT = Mfg Code                                 | Manufacturing Code from the Assembly Purchase Order form.   |
| Line 4 Marking  | Circle = 0.50 mm Diameter<br>Lower-Left Justified | Pin 1 Identifier                                            |
|                 | YY = Year<br>WW = Work Week                       | Corresponds to the year and work week of the mold date.     |

8.3 Si53322/23 Top Markings

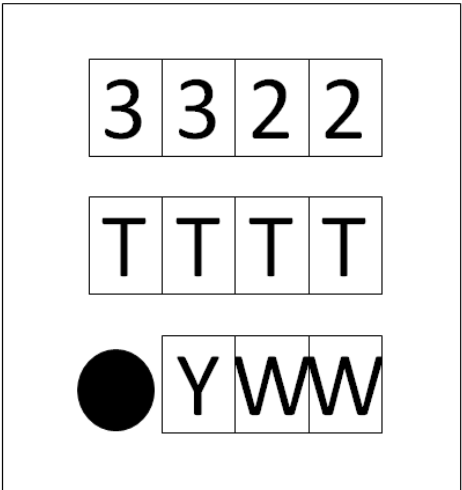


Figure 8.5. Si53322 Top Marking

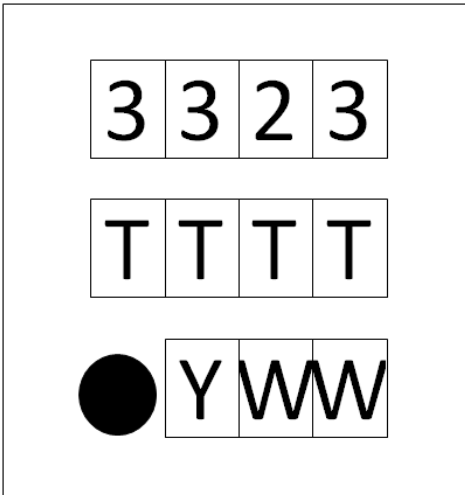


Figure 8.6. Si53323 Top Marking

Table 8.3. Si53322/23 Top Marking Explanation

|                 |                                                   |                                                                                               |
|-----------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Mark Method:    | Laser                                             |                                                                                               |
| Font Size:      | 0.635 mm (25 mils)<br>Right-Justified             |                                                                                               |
| Line 1 Marking: | Product ID                                        | 3322 for Si53322<br>3323 for Si53323                                                          |
| Line 2 Marking: | TTTT = Mfg Code                                   | Manufacturing Code                                                                            |
| Line 3 Marking  | Circle = 0.5 mm Diameter<br>Bottom-Left Justified | Pin 1 Identifier                                                                              |
|                 | YWW = Date Code                                   | Corresponds to the last digit of the current year (Y) and the workweek (WW) of the mold date. |

8.4 Si53327/28 Top Markings

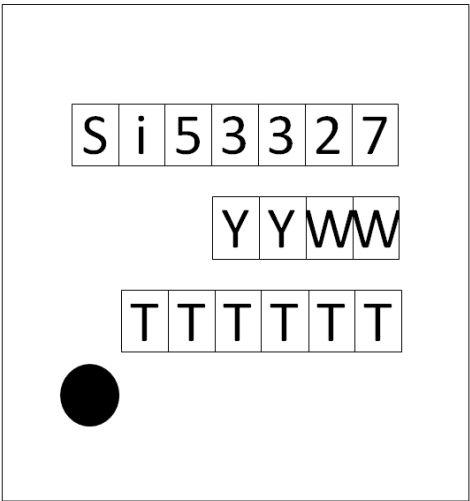


Figure 8.7. Si53327 Top Marking

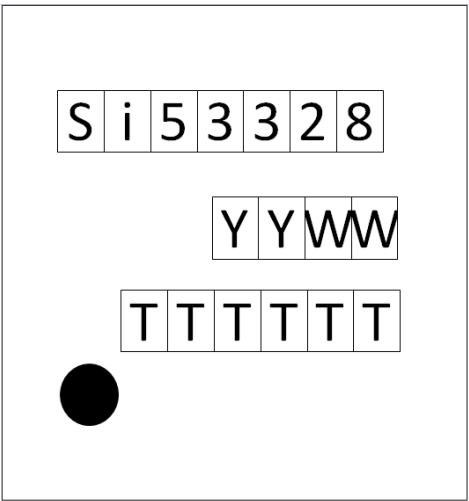


Figure 8.8. Si53328 Top Marking

Table 8.4. Si53327/28 Top Marking Explanation

|                 |                                                  |                                                                                         |
|-----------------|--------------------------------------------------|-----------------------------------------------------------------------------------------|
| Mark Method:    | Laser                                            |                                                                                         |
| Font Size:      | 2.0 Point (28 mils)<br>Center-Justified          |                                                                                         |
| Line 1 Marking: | Device Part Number                               | 53327 for Si53327<br>53328 for Si53328                                                  |
| Line 2 Marking: | Device Revision/Type                             | B-GM                                                                                    |
| Line 3 Marking: | TTTTTT = Mfg Code                                | Manufacturing Code from the Assembly Purchase Order form.                               |
| Line 4 Marking: | Circle = 0.5 mm Diameter<br>Lower-Left Justified | Pin 1 Identifier                                                                        |
|                 | YY = year<br>WW = Work Week                      | Assigned by the Assembly House. Corresponds to the year and work week of the mold date. |

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