1:4 Low-Jitter Universal Buffer/Level Translator

Features

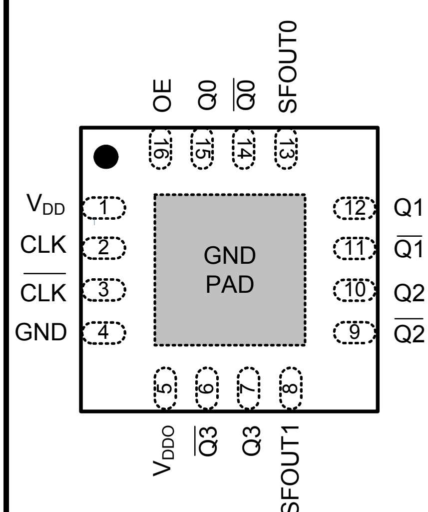
- 4 differential or 8 LVCMOS outputs
- Ultra-low additive jitter: 45 fs rms
- Wide frequency range: 1 to 725 MHz
- Any-format input with pin selectable output formats: LVPECL, low power LVPECL, LVDS, CML, HCSL, LVCMOS
- Synchronous output enable
- Independent V_{DD} and V_{DDO} : 1.8/2.5/3.3 V
- 1.2/1.5 V LVCMOS output support
- Selectable LVCMOS drive strength to tailor jitter and EMI performance
- Small size: 16-QFN (3 mm x 3 mm)
- RoHS compliant, Pb-free
- Industrial temperature range: –40 to +85 °C

Ordering Information:
See page 24.

Applications

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

Pin Assignments

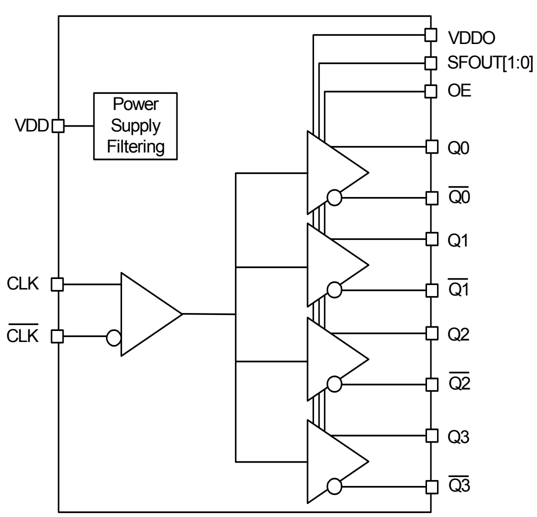


Patents pending

Description

The Si53306 is an ultra low jitter four output differential buffer with pin-selectable output clock signal format. The Si53306 utilizes Silicon Laboratories' advanced CMOS technology to fanout clocks from 1 to 725 MHz with guaranteed low additive jitter, low skew, and low propagation delay variability. The Si53306 features minimal cross-talk and provides superior supply noise rejection, simplifying low jitter clock distribution in noisy environments. Independent core and output bank supply pins provide integrated level translation without the need for external circuitry.

Functional Block Diagram



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1. Electrical Specifications

Table 1. Recommended Operating Conditions

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

***Note:** Core supply V_{DD} and output buffer supplies V_{DDO} are independent. LVCMOS clock input is not supported for V_{DD} = 1.8V but is supported for LVCMOS clock output for V_{DDOX} = 1.8V. LVCMOS outputs at 1.5V and 1.2V can be supported via a simple resistor divider network. See “2.7.1. LVCMOS Output Termination To Support 1.5V and 1.2V”

Table 2. Input Clock Specifications

(V_{DD}=1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A=–40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Differential Input Common Mode Voltage	V_{CM}	V_{DD} = 2.5 V± 5%, 3.3 V± 10%	0.05	—	—	V
Differential Input Swing (peak-to-peak)	V_{IN}		0.2	—	2.2	V
LVCMOS Input High Voltage	V_{IH}	V_{DD} = 2.5 V± 5%, 3.3 V± 10%	V_{DD} x 0.7	—	—	V
LVCMOS Input Low Voltage	V_{IL}	V_{DD} = 2.5 V± 5%, 3.3 V± 10%	—	—	V_{DD} x 0.3	V
Input Capacitance	C_{IN}	CLK pins with respect to GND	—	5	—	pF

Table 3. DC Common Characteristics
(V_{DD} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Current	I_{DD}		—	55	100	mA
Output Buffer Supply Current (Per Clock Output) @100 MHz (diff) @200 MHz (CMOS)	I_{DDOX}	LVPECL (3.3 V)	—	35	—	mA
		Low Power LVPECL (3.3 V)*	—	35	—	mA
		LVDS (3.3 V)	—	20	—	mA
		CML (3.3 V)	—	40	—	mA
		HCSL, 100 MHz, 2 pF load (3.3 V)	—	35	—	mA
		CMOS (1.8 V, SFOUT = Open/0), per output, C_L = 5 pF, 200 MHz	—	5	—	mA
		CMOS (2.5 V, SFOUT = Open/0), per output, C_L = 5 pF, 200 MHz	—	10	—	mA
		CMOS (3.3 V, SFOUT = 0/1), per output, C_L = 5 pF, 200 MHz	—	20	—	mA
Input Clock Voltage Reference	V_{REF}	V_{REF} pin I_{REF} = +/-500 µA	—	VDD/2	—	V
Input High Voltage	V_{IH}	SFOUTx, OE	0.8 x VDD	—	—	V
Input Mid Voltage	V_{IM}	SFOUTx 3-level input pins	0.45 x VDD	0.5 x VDD	0.55 x VDD	V
Input Low Voltage	V_{IL}	SFOUTx, OE	—	—	0.2 x VDD	V
Internal Pull-down Resistor	R_{DOWN}	SFOUTx	—	25	—	kΩ
Internal Pull-up Resistor	R_{UP}	SFOUTx, OE	—	25	—	kΩ

***Note:** Low-power LVPECL mode supports an output termination scheme that will reduce overall system power.

Table 4. Output Characteristics (LVPECL)
(V_{DDOX} = 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output DC Common Mode Voltage	V_{COM}		V_{DDOX} – 1.595	—	V_{DDOX} – 1.245	V
Single-Ended Output Swing*	V_{SE}		0.55	0.80	1.050	V
***Note:** Unused outputs can be left floating. Do not short unused outputs to ground.						

Table 5. Output Characteristics (Low Power LVPECL)
(V_{DDOX} = 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output DC Common Mode Voltage	V_{COM}	R_L = 100 Ω across Qn and $\overline{Qn}$	V_{DDOX} – 1.895		V_{DDOX} – 1.275	V
Single-Ended Output Swing	V_{SE}	R_L = 100 Ω across Qn and $\overline{Qn}$	0.25	0.60	0.85	V

Table 6. Output Characteristics—CML
(V_{DDOX} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Single-Ended Output Swing	V_{SE}	Terminated as shown in Figure 7 (CML termination).	300	400	550	mV

Table 7. Output Characteristics—LVDS
(V_{DDOX} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Single-Ended Output Swing	V_{SE}	R_L = 100 Ω across Q_N and $\overline{Q}_N$	247	—	490	mV
Output Common Mode Voltage (V_{DDO} = 2.5 V or 3.3V)	V_{COM1}	V_{DDOX} = 2.38 to 2.63 V, 2.97 to 3.63 V, R_L = 100 Ω across Q_N and $\overline{Q}_N$	1.10	1.25	1.35	V
Output Common Mode Voltage (V_{DDO} = 1.8 V)	V_{COM2}	V_{DDOX} = 1.71 to 1.89 V, R_L = 100 Ω across Q_N and $\overline{Q}_N$	0.85	0.97	1.25	V

Table 8. Output Characteristics—LVCMOS

(V_{DDOX} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Voltage High*	V_{OH}		0.75 x V_{DDOX}	—	—	V
Output Voltage Low*	V_{OL}		—	—	0.25 x V_{DDOX}	V
***Note:** I_{OH} and I_{OL} per the Output Signal Format Table for specific V_{DDOX} and SFOUTX settings.						

Table 9. Output Characteristics—HCSL

(V_{DDOX} = 3.3 V ± 10%, T_A = –40 to 85 °C))

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Voltage High	V_{OH}	R_L = 50 Ω to GND	550	700	900	mV
Output Voltage Low	V_{OL}	R_L = 50 Ω to GND	–150	0	150	mV
Single-Ended Output Swing	V_{SE}	R_L = 50 Ω to GND	550	700	850	mV
Crossing Voltage	V_C	R_L = 50 Ω to GND	250	350	550	mV

Table 10. AC Characteristics

(V_{DD} = V_{DDOX} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Frequency	F	LVPECL, low power LVPECL, LVDS, CML, HCSL	1	—	725	MHz
		LVCMOS	1	—	200	MHz
Duty Cycle **Note:** 50% input duty cycle.	D_C	200 MHz, 20/80% T_R/T_F<10% of period (LVCMOS) (12 mA drive)	40	50	60	%
		20/80% T_R/T_F<10% of period (Differential)	48	50	52	%
Minimum Input Clock Slew Rate	SR	Required to meet prop delay and additive jitter specifications (20–80%)	0.75	—	—	V/ns

Notes:

1. HCSL measurements were made with receiver termination. See Figure 7 on page 16.
2. Output to Output skew specified for outputs with an identical configuration.
3. 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.
4. Measured for 156.25 MHz carrier frequency. Sine-wave noise added to V_{DDOX} (3.3 V = 100 mV_{PP}) and noise spur amplitude measured. See “AN491: Power Supply Rejection for Low-Jitter Clocks” for further details.

Table 10. AC Characteristics (Continued)
(V_{DD} = V_{DDOX} = 1.8 V ± 5%, 2.5 V ± 5%, or 3.3 V ± 10%, T_A = –40 to 85 °C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Rise/Fall Time	T_R/T_F	LVDS, 20/80%	—	—	350	ps
		LVPECL, 20/80%	—	—	350	ps
		HCSL[1], 20/80%	—	—	280	ps
		CML, 20/80%	—	—	350	ps
		Low-Power LVPECL, 20/80%	—	—	350	ps
		LVCMOS 200 MHz, 20/80%, 2 pF load	—	—	750	ps
Minimum Input Pulse Width	T_W		500	—	—	ps
Propagation Delay	T_{PLH}, T_{PHL}	LVCMOS (12mA drive with no load)	1250	2000	2750	ps
		LVPECL	675	875	1075	ps
		LVDS	675	875	1075	ps
Output Enable Time	T_{EN}	F = 1 MHz	—	1570	—	ns
		F = 100 MHz	—	20	—	ns
		F = 725 MHz	—	5	—	ns
Output Disable Time	T_{DIS}	F = 1 MHz	—	2000	—	ns
		F = 100 MHz	—	35	—	ns
		F = 725 MHz	—	5	—	ns
Output to Output Skew[2]	T_{SK}	LVCMOS (12 mA drive to no load)	—	50	120	ps
		LVPECL	—	30	75	ps
		LVDS	—	40	85	ps
Part to Part Skew[3]	T_{PS}	Differential	—	—	150	ps
Power Supply Noise Rejection[4]	PSRR	10 kHz sinusoidal noise	—	–72.5	—	dBc
		100 kHz sinusoidal noise	—	–70	—	dBc
		500 kHz sinusoidal noise	—	–67.5	—	dBc
		1 MHz sinusoidal noise	—	–62.5	—	dBc

Notes:
1. HCSL measurements were made with receiver termination. See Figure 7 on page 16.
2. Output to Output skew specified for outputs with an identical configuration.
3. 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.
4. Measured for 156.25 MHz carrier frequency. Sine-wave noise added to V_{DDOX} (3.3 V = 100 mV_{PP}) and noise spur amplitude measured. See “AN491: Power Supply Rejection for Low-Jitter Clocks” for further details.

Table 11. Additive Jitter, Differential Clock Input

V_{DD}	Input[1,2]				Output	Additive Jitter (fs rms, 12 kHz to 20 MHz)[3]	
	Freq (MHz)	Clock Format	Amplitude V_{IN} (Single-Ended, Peak-to-Peak)	Differential 20%-80% Slew Rate (V/ns)	Clock Format	Typ	Max
3.3	725	Differential	0.15	0.637	LVPECL	45	65
3.3	725	Differential	0.15	0.637	LVDS	50	65
3.3	156.25	Differential	0.5	0.458	LVPECL	160	185
3.3	156.25	Differential	0.5	0.458	LVDS	150	200
2.5	725	Differential	0.15	0.637	LVPECL	45	65
2.5	725	Differential	0.15	0.637	LVDS	50	65
2.5	156.25	Differential	0.5	0.458	LVPECL	145	185
2.5	156.25	Differential	0.5	0.458	LVDS	145	195

Notes:

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 1.

Table 12. Additive Jitter, Single-Ended Clock Input

V_{DD}	Input[1,2]				Output	Additive Jitter (fs rms, 12 kHz to 20 MHz)[3]	
	Freq (MHz)	Clock Format	Amplitude V_{IN} (single-ended, peak to peak)	SE 20%-80% Slew Rate (V/ns)	Clock Format	Typ	Max
3.3	200	Single-ended	1.70	1	LVCMOS[4]	120	160
3.3	156.25	Single-ended	2.18	1	LVPECL	160	185
3.3	156.25	Single-ended	2.18	1	LVDS	150	200
3.3	156.25	Single-ended	2.18	1	LVCMOS[4]	130	180
2.5	200	Single-ended	1.70	1	LVCMOS[5]	120	160
2.5	156.25	Single-ended	2.18	1	LVPECL	145	185
2.5	156.25	Single-ended	2.18	1	LVDS	145	195
2.5	156.25	Single-ended	2.18	1	LVCMOS[5]	140	180

Notes:
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 1.
4. Drive Strength: 12 mA, 3.3 V (SFOUT = 11). LVCMOS jitter is measured single-ended.
5. Drive Strength: 9 mA, 2.5 V (SFOUT = 11). LVCMOS jitter is measured single-ended.

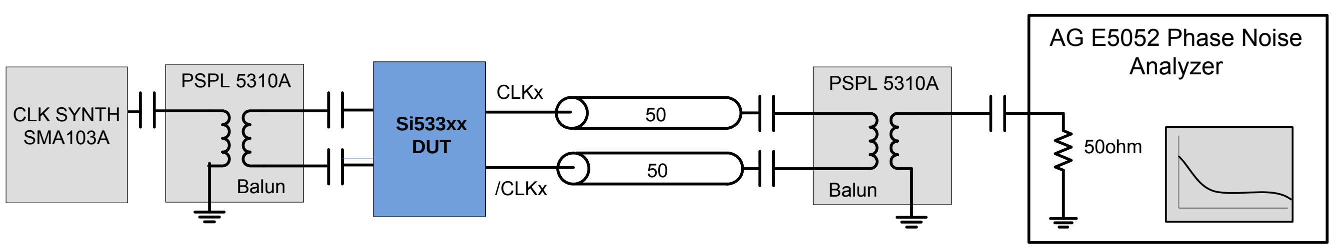


Figure 1. Differential Measurement Method Using a Balun

Table 13. Thermal Conditions

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

Table 14. Absolute Maximum Ratings

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Storage Temperature	T_S		–55	—	150	°C
Supply Voltage	V_{DD}		–0.5	—	3.8	V
Input Voltage	V_{IN}		–0.5	—	V_{DD}+ 0.3	V
Output Voltage	V_{OUT}		—	—	V_{DD}+ 0.3	V
ESD Sensitivity	HBM	HBM, 100 pF, 1.5 kΩ	—	—	2000	V
ESD Sensitivity	CDM		—	—	500	V
Peak Soldering Reflow Temperature	T_{PEAK}	Pb-Free; Solder reflow profile per JEDEC J-STD-020	—	—	260	°C
Maximum Junction Temperature	T_J		—	—	125	°C
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.						

2. Functional Description

The Si53306 is a low jitter, low skew 1:4 differential buffer. The device has a universal input that accepts most common differential or LVCMOS input signals. The Si53306 features control pins for output enable, output signal format selection and LVCMOS drive strength.

2.1. Universal, Any-Format Input

The universal input stage enables simple interfacing to a wide variety of clock formats, including LVPECL, low-power LVPECL, LVCMOS, LVDS, HCSL, and CML. Tables 15 and 16 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 as 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 15. LVPECL, LVCMOS, and LVDS Input Clock Options

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

Table 16. HCSL and CML Input Clock Options

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

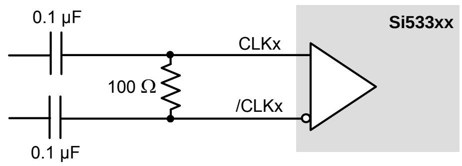


Figure 2. Differential HCSL, LVPECL, Low-Power LVPECL, LVDS, CML AC-Coupled Input Termination

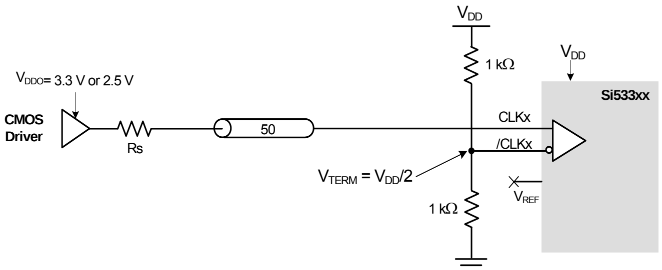
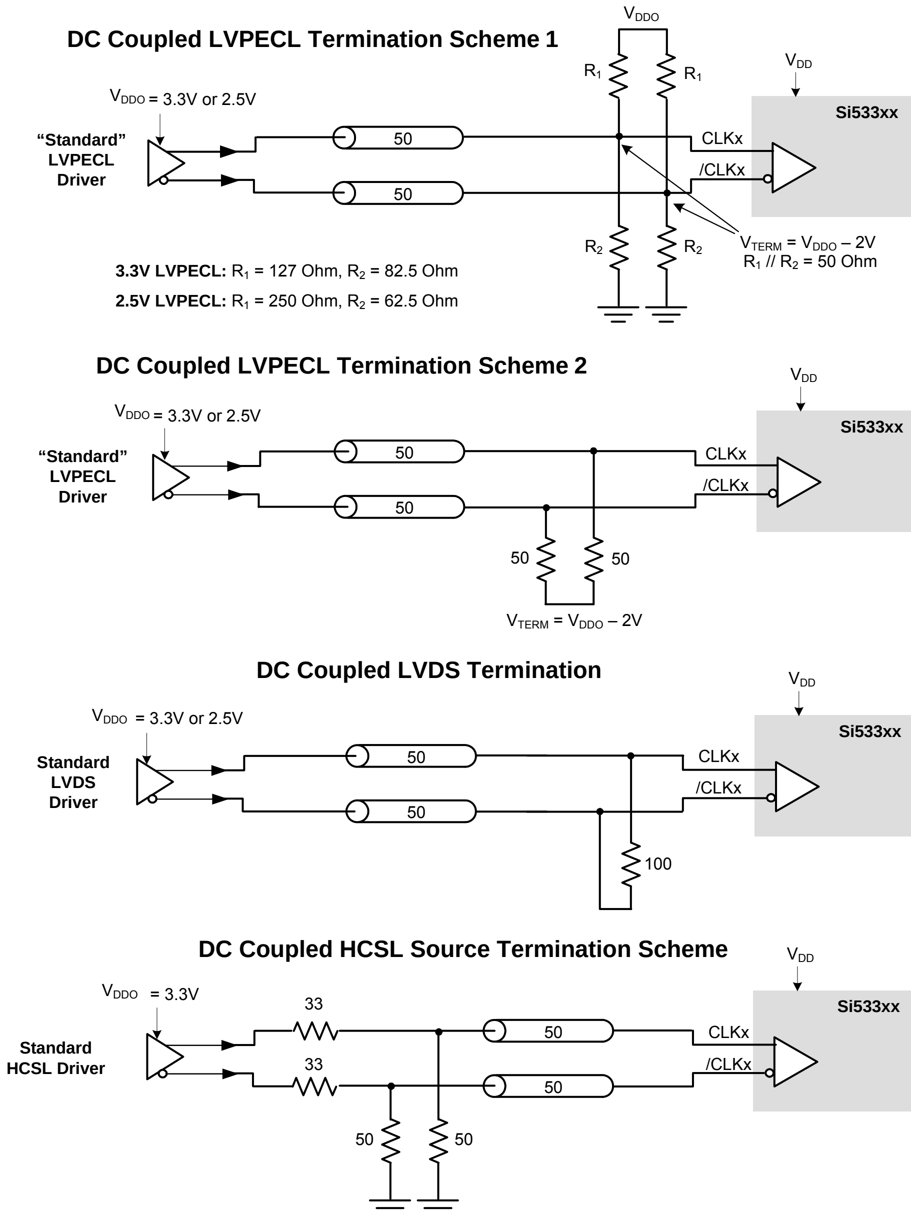


Figure 3. LVCMOS DC-Coupled Input Termination



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

Figure 4. Differential DC-Coupled Input Terminations

2.2. Input Bias Resistors

Internal bias resistors ensure a differential output low condition in the event that the clock inputs are not connected. The non-inverting input is biased with a 18.75 kΩ pull-down to GND and a 75 kΩ pull-up to V_{DD}. The inverting input is biased with a 75 kΩ pull-up to V_{DD}.

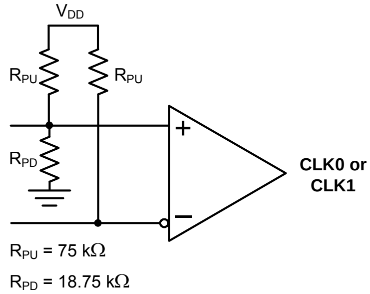


Figure 5. Input Bias Resistors

2.3. Universal, Any-Format Output Buffer

The Si53306 has highly flexible output drivers that support a wide range of clock signal formats, including LVPECL, low power LVPECL, LVDS, CML, HCSL, and LVCMOS. SFOUT1 and SFOUT0 are 3-level inputs that can be pin-strapped to select the output clock signal formats. This feature enables the device to be used for format translation in addition to clock distribution, minimizing the number of unique buffer part numbers required in a typical application and simplifying design reuse. For EMI reduction applications, four LVCMOS drive strength options are available for each V_{DDO} setting.

Table 17. Output Signal Format Selection

SFOUT1	SFOUT0	V_{DDOX} = 3.3 V	V_{DDOX} = 2.5 V	V_{DDOX} = 1.8 V
Open*	Open*	LVPECL	LVPECL	N/A
0	0	LVDS	LVDS	LVDS
0	1	LVCMOS, 24 mA drive	LVCMOS, 18 mA drive	LVCMOS, 12 mA drive
1	0	LVCMOS, 18 mA drive	LVCMOS, 12 mA drive	LVCMOS, 9 mA drive
1	1	LVCMOS, 12 mA drive	LVCMOS, 9 mA drive	LVCMOS, 6 mA drive
Open*	0	LVCMOS, 6 mA drive	LVCMOS, 4 mA drive	LVCMOS, 2 mA drive
Open*	1	LVPECL low power	LVPECL low power	N/A
0	Open*	CML	CML	CML
1	Open*	HCSL	N/A	N/A

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

2.4. Synchronous Output Enable

This buffer features a synchronous output enable (disable) feature. Output enable is sampled and synchronized on the falling edge of the input clock. This feature prevents runt pulses from being generated when the outputs are enabled or disabled.

When OE is low, Q is held low and $\overline{Q}$ is held high for differential output formats. For LVCMOS output format options, both Q and $\overline{Q}$ are held low when OE is set low. The device outputs are enabled when the output enable pin is unconnected. See Table 10, “AC Characteristics,” on page 6 for output enable and output disable times.

2.5. Output Enable Logic

All four outputs are controlled with a single output enable (OE) pin. Table 18 summarizes the input and output clock based upon the state of the input clock and the OE pin.

Table 18. Output Enable Logic

CLK	OE[1]	Q[2]
L	H	L
H	H	H
X	L	L[3]

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

2.6. Power Supply (V_{DD} and V_{DDO})

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

2.7. Output Clock Termination Options

The recommended output clock termination options are shown below.

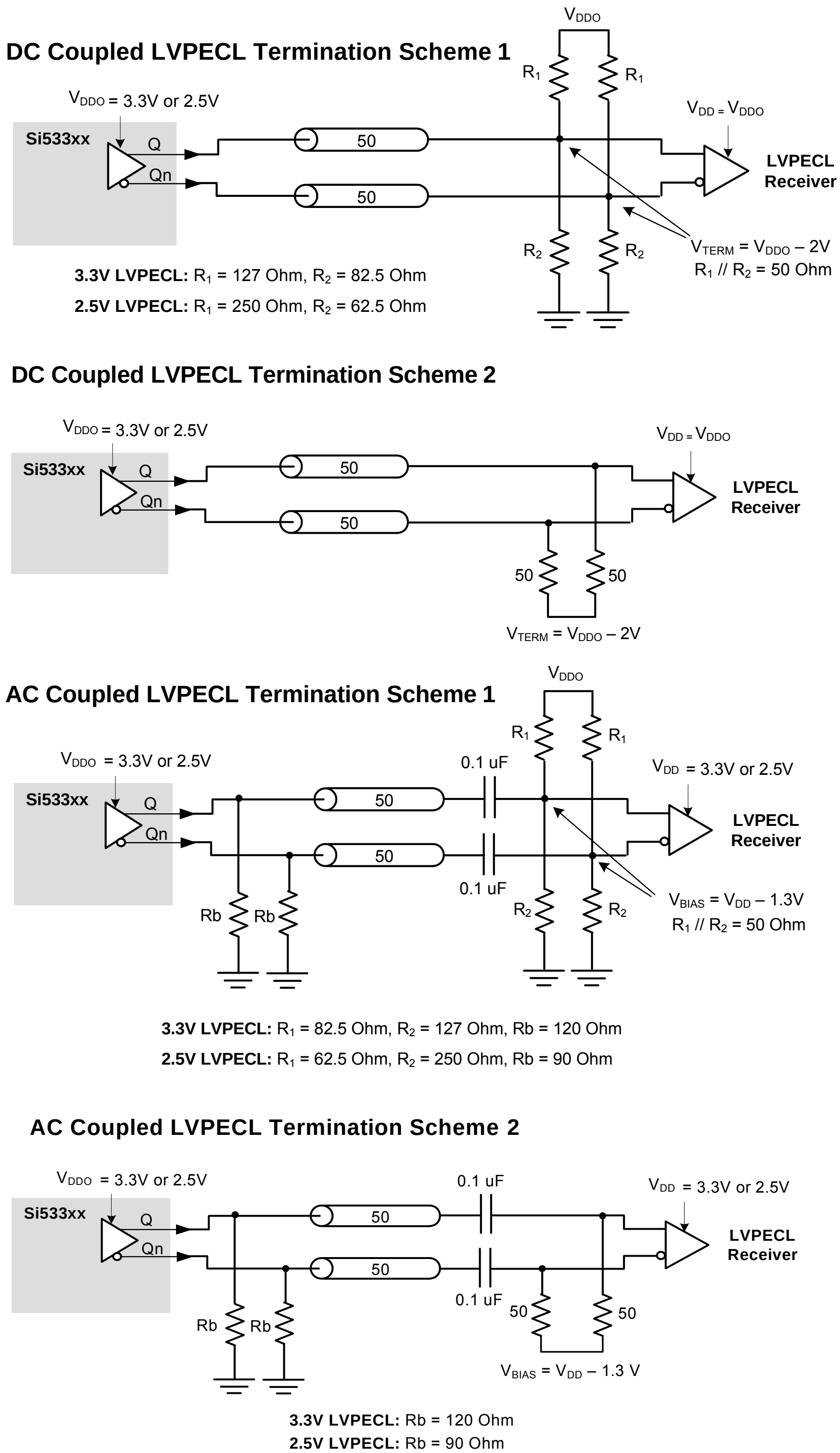


Figure 6. LVPECL Output Termination

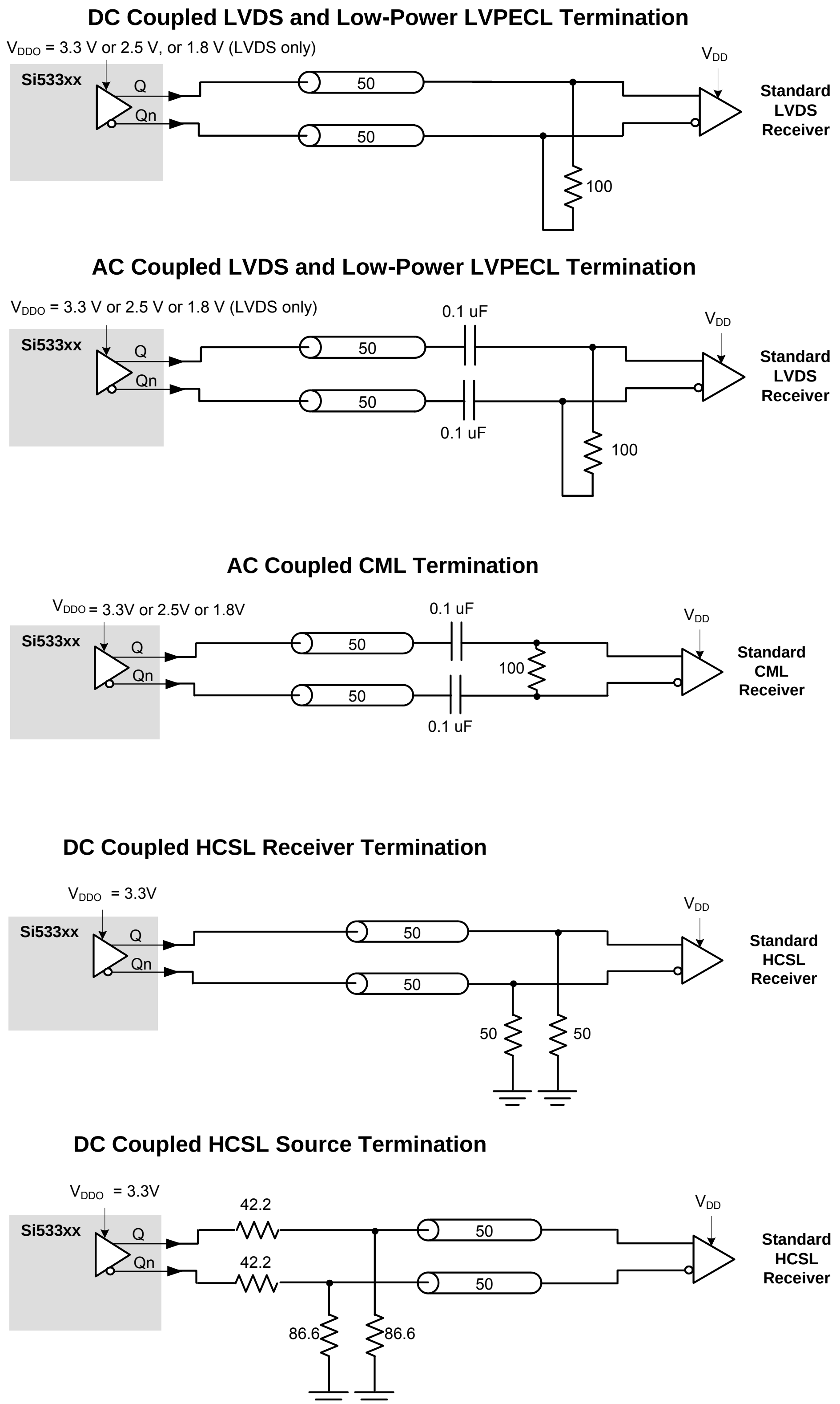


Figure 7. LVDS, CML, HCSL, and Low-Power LVPECL Output Termination

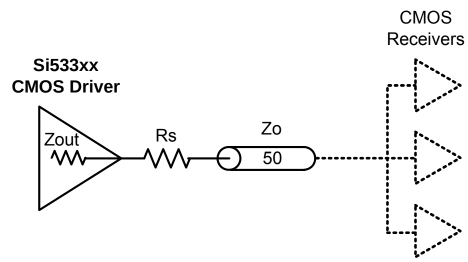


Figure 8. LVCMOS Output Termination

Table 19. Recommended LVCMOS R_S Series Termination

SFOUT1	SFOUT0	R_S (ohms)		
		3.3 V	2.5 V	1.8 V
0	1	33	33	33
1	0	33	33	33
1	1	33	33	0
Open	0	0	0	0

2.7.1. LVCMOS Output Termination To Support 1.5V and 1.2V

LVCMOS clock outputs are natively supported at 1.8, 2.5, and 3.3V. However, 1.2V and 1.5V LVCMOS clock outputs can be supported via a simple resistor divider network that will translate the buffer's 1.8V output to a lower voltage as shown in Figure 9 below.

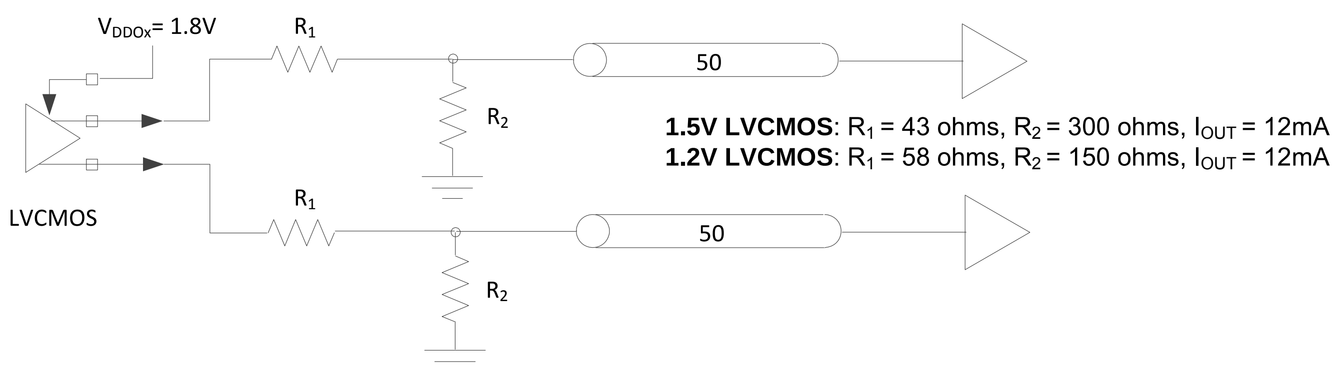


Figure 9. 1.5V and 1.2V LVCMOS Low-Voltage Output Termination

2.8. AC Timing Waveforms

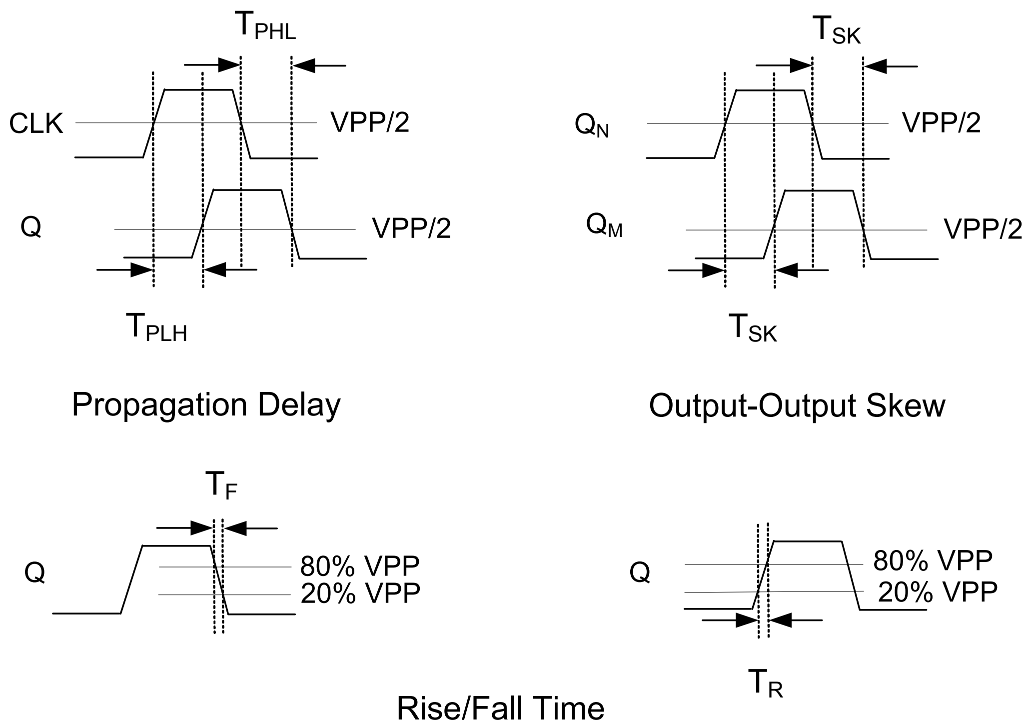


Figure 10. AC Waveforms

2.9. Typical Phase Noise Performance

Each of the following three figures shows three phase noise plots superimposed on the same diagram.

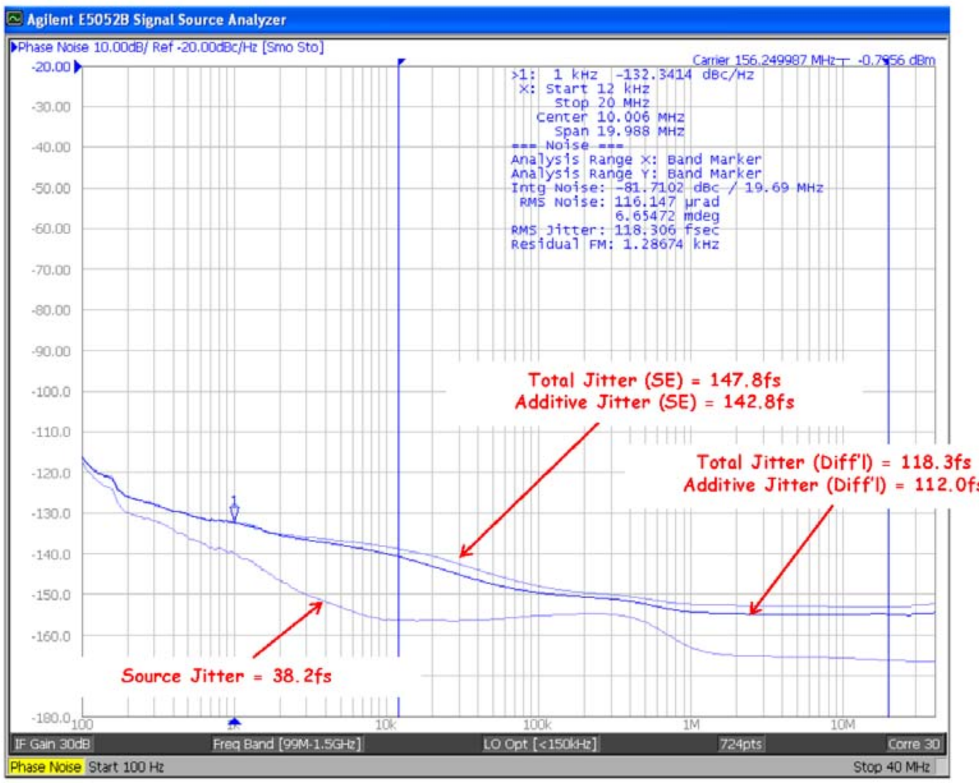
Source Jitter: Reference clock phase noise.

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. See Figure 1 on page 9.

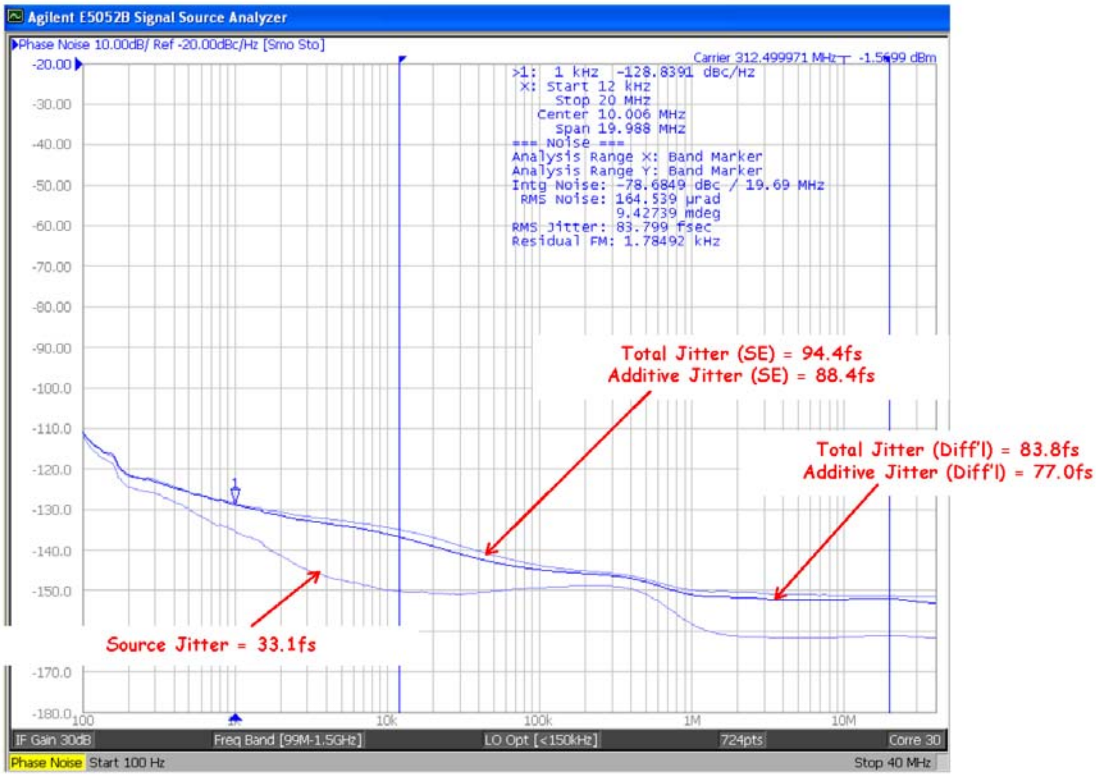
Note: To calculate the total RMS phase jitter when adding a buffer to your clock tree, use the root-sum-square (RSS).

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).



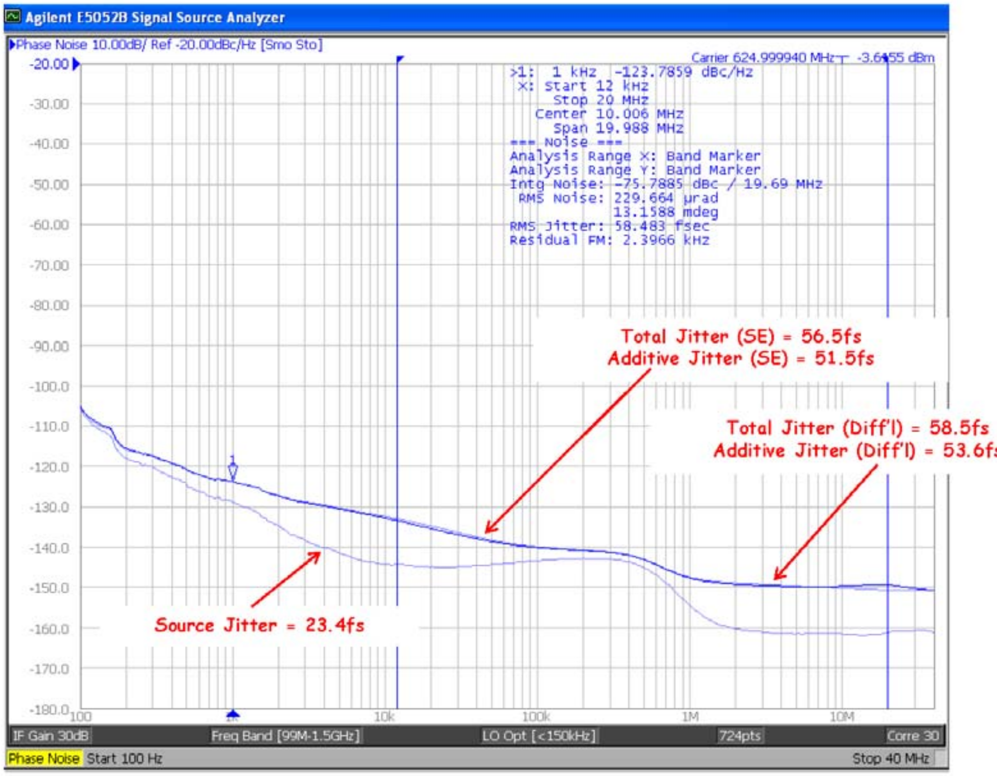
Frequency (MHz)	Diff'l Input Slew Rate (V/ns)	Source Jitter (fs)	Total Jitter (SE) (fs)	Additive Jitter (SE) (fs)	Total Jitter (Diff'l) (fs)	Additive Jitter (Diff'l) (fs)
156.25	1.0	38.2	147.8	142.8	118.3	112.0

Figure 11. Source Jitter (156.25 MHz)



Frequency (MHz)	Diff'l Input Slew Rate (V/ns)	Source Jitter (fs)	Total Jitter (SE) (fs)	Additive Jitter (SE) (fs)	Total Jitter (Diff'l) (fs)	Additive Jitter (Diff'l) (fs)
312.5	1.0	33.10	94.39	88.39	83.80	76.99

Figure 12. Single-Ended Total Jitter (312.5 MHz)



Frequency (MHz)	Diff'l Input Slew Rate (V/ns)	Source Jitter (fs)	Total Jitter (SE) (fs)	Additive Jitter (SE) (fs)	Total Jitter (Diff'l) (fs)	Additive Jitter (Diff'l) (fs)
625	1.0	23.4	56.5	51.5	58.5	53.6

Figure 13. Differential Total Jitter (625 MHz)

2.10. Power Supply Noise Rejection

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

3. Pin Description: 16-Pin QFN

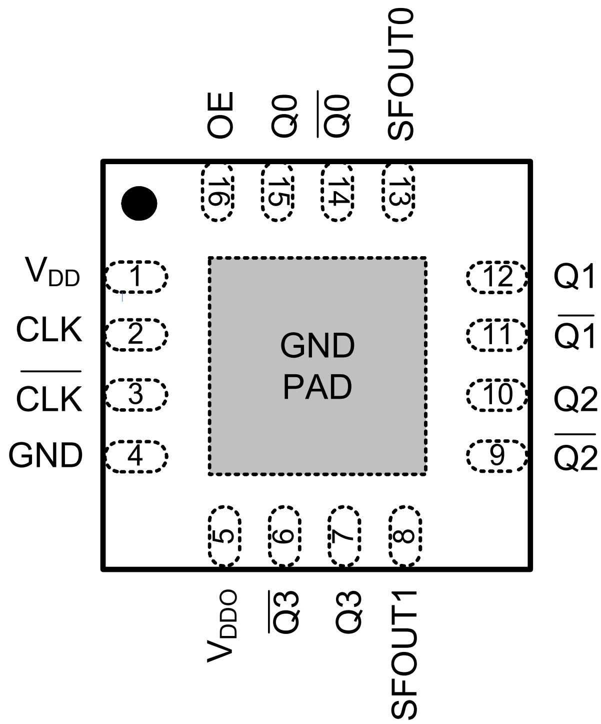


Table 20. Pin Description

Pin	Name	Type*	Description
1	VDD	P	Core voltage supply. Bypass with 1.0 µF capacitor and place as close to the VDD pin as possible.
2	CLK	I	Input clock.
3	$\overline{CLK}$	I	Input clock (complement). When the CLK is driven by a single-ended input, connect $\overline{CLK}$ to VDD/2. See Figure 1, "Differential Measurement Method Using a Balun," on page 9.
4	GND	GND	Ground.
5	VDDO	P	Output voltage supply— All outputs (Q0 to Q3). Bypass with 1.0 µF capacitor and place as close to the VDDO pin as possible.
6	$\overline{Q3}$	O	Output clock 3 (complement).
7	Q3	O	Output clock 3.
8	SFOUT1	I	Output signal format control pin 1. Three-level input control. Internally biased at VDD/2. Can be left floating or tied to ground or VDD.

Table 20. Pin Description (Continued)

Pin	Name	Type*	Description
9	$\overline{Q2}$	O	Output clock 2 (complement).
10	Q2	O	Output clock 2.
11	$\overline{Q1}$	O	Output clock 1 (complement).
12	Q1	O	Output clock 1.
13	SFOUT0	I	Output signal format control pin 0. Three-level input control. Internally biased at $V_{DD}/2$. Can be left floating or tied to ground or V_{DD}.
14	$\overline{Q0}$	O	Output clock 0 (complement).
15	Q0	O	Output clock 0.
16	OE	I	Output enable. When OE = high, all outputs are enabled. When OE = low, Q is held low, and $\overline{Q}$ is held high for differential formats. For LVCMOS, both Q and $\overline{Q}$ are held low when OE is set low. OE contains an internal pull-up resistor.
GND Pad	GND	GND	Ground.
*Pin types are: I = input, O = output, P = power, GND = ground.			

4. Ordering Guide

Part Number	Package	Pb-Free, ROHS-6	Temperature
Si53306-B-GM	16-QFN	Yes	–40 to 85 °C
Si53301/4-EVB	Evaluation Board	Yes	—

Notes:

1. To buy, go to http://www.supplier-direct.com/silabs/Cart.aspx?supplierUVID=63410000&partnumber=Si53306-B-GM&quantity=1&issample=0.
2. To sample, go to http://www.supplier-direct.com/silabs/Cart.aspx?supplierUVID=63410000&partnumber=Si53306-B-GM&quantity=1&issample=1.

5. Package Outline

Figure 14 shows the package dimensions for the 3x3 mm 16-pin QFN package. Table 21 lists the values for the dimensions shown in the illustration.

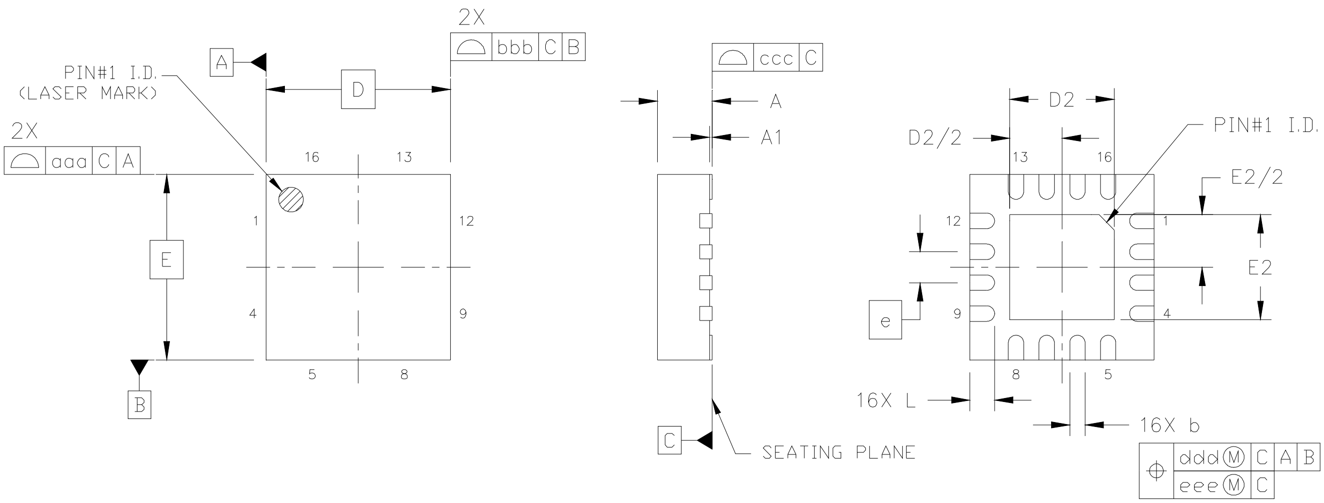


Figure 14. Si53306 3x3 mm 16-QFN Package Diagram

Table 21. Package Diagram 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

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

6. PCB Land Pattern

Figure 15 shows the PCB land pattern dimensions for the 3x3 mm 16-pin QFN package. Table 22 lists the values for the dimensions shown in the illustration.

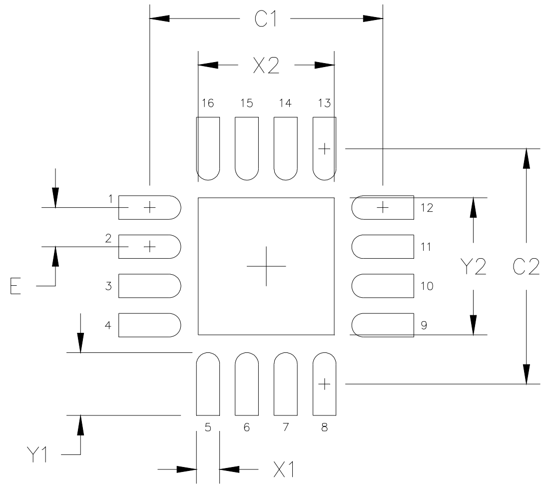


Figure 15. Si53306 3x3 mm 16-QFN Package Land Pattern

Table 22. PCB 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.

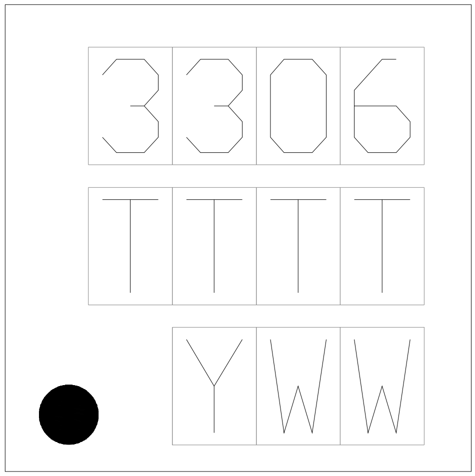
Solder Mask Design
4. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60 µm minimum, all the way around the pad.

Stencil Design
5. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
6. The stencil thickness should be 0.125 mm (5 mils).
7. The ratio of stencil aperture to land pad size should be 1:1 for all perimeter pads.
8. A 2x2 array of 0.65 mm square openings on a 0.90 mm pitch should be used for the center ground pad.

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

7. Top Marking

7.1. Si53306 Top Marking



7.2. Top Marking Explanation

Mark Method:	Laser	
Font Size:	0.635 mm (25 mils) Right-Justified	
Line 1 Marking:	Product ID	**3306**
Line 2 Marking:	TTTT = Mfg Code	Manufacturing Code from the Assembly Purchase Order form.
Line 3 Marking	Circle = 0.5 mm Diameter (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.

Document Change List

Revision 0.9 to Revision 1.0

- Corrected front-page block diagram.
- Improved performance specifications with more detail.
- Added additional information to clarify the use of the voltage reference feature.
- Added pin type description to Table 20, “Pin Description,” on page 22.
- Added low-voltage termination options for 1.2 V and 1.5 V LVCMOS support.

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