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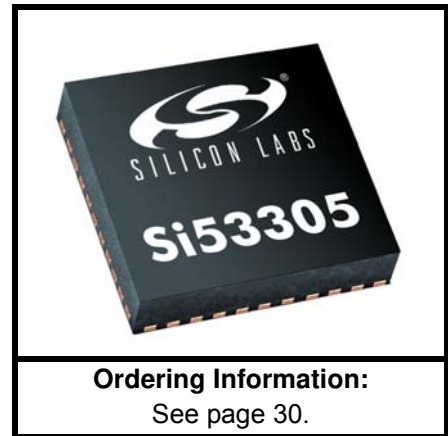
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## 1:10 LOW JITTER UNIVERSAL BUFFER/LEVEL TRANSLATOR WITH 2:1 INPUT MUX AND INDIVIDUAL OE

### Features

- 10 differential or 20 LVCMOS outputs
- Ultra-low additive jitter: 45 fs rms
- Wide frequency range: dc to 725 MHz
- Any-format input with pin selectable output formats: LVPECL, Low Power LVPECL, LVDS, CML, HCSL, LVCMOS
- 2:1 mux with hot-swappable inputs
- Glitchless input clock switching (1 MHz to 725 MHz)
- Individual output enable
- Synchronous output enable
- Low output-output skew: <70 ps
- Low propagation delay variation: <400 ps
- Independent  $V_{DD}$  and  $V_{DDO}$  : 1.8/2.5/3.3 V
- Excellent power supply noise rejection (PSRR)
- Selectable LVCMOS drive strength to tailor jitter and EMI performance
- Small size: 44-QFN (7 mm x 7 mm)
- RoHS compliant, Pb-free
- Industrial temperature range: -40 to +85 °C

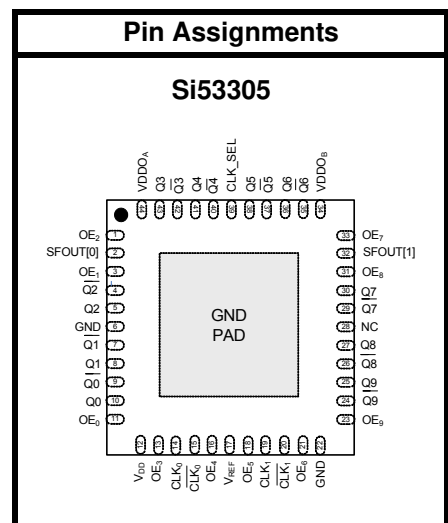


### Applications

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

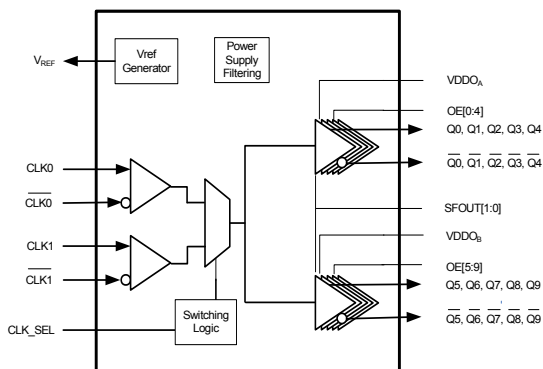
### Description

The Si53305 is an ultra low jitter ten output differential buffer with pin-selectable output clock signal format and individual OE. The Si53305 features a 2:1 mux with glitchless switching, making it ideal for redundant clocking applications. The Si53305 utilizes Silicon Laboratories' advanced CMOS technology to fanout clocks from dc to 725 MHz with guaranteed low additive jitter, low skew, and low propagation delay variability. The Si53305 features minimal cross-talk and provides superior supply noise rejection, simplifying low jitter clock distribution in noisy environments. Independent core and output bank supply pins provide integrated level translation without the need for external circuitry.



Patents pending

### Functional Block Diagram



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## 1. Electrical Specifications

**Table 1. Recommended Operating Conditions**

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Ambient Operating Temperature	$T_A$		-40	—	85	°C
Supply Voltage Range*	$V_{DD}$	LVDS, CML	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, LVC MOS	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, LVC MOS	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  $V_{DDOX}$  are independent. LVC MOS clock input is not supported for  $V_{DD} = 1.8V$  but is supported for LVC MOS clock output for  $V_{DDOX} = 1.8V$ . LVC MOS outputs at 1.5V and 1.2V can be supported via a simple resistor divider network. See "2.9.1. LVC MOS Output Termination To Support 1.5V and 1.2V"

**Table 2. Input Clock Specifications**

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Differential Input Common Mode Voltage	$V_{CM}$	$V_{DD} = 2.5V \pm 5\%$ , $3.3V \pm 10\%$	0.05	—	—	V
Differential Input Swing (peak-to-peak)	$V_{IN}$		0.2	—	2.2	V
LVC MOS Input High Voltage	$V_{IH}$	$V_{DD} = 2.5V \pm 5\%$ , $3.3V \pm 10\%$	$V_{DD} \times 0.7$	—	—	V
LVC MOS Input Low Voltage	$V_{IL}$	$V_{DD} = 2.5V \pm 5\%$ , $3.3V \pm 10\%$	—	—	$V_{DD} \times 0.3$	V
Input Capacitance	$C_{IN}$	CLK0 and CLK1 pins with respect to GND	—	5	—	pF

**Table 3. DC Common Characteristics**

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Current	$I_{DD}$		—	65	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)	—	30	—	mA
		HCSL, 100 MHz, 2 pF load (3.3 V)	—	35	—	mA
		CMOS (1.8 V, SFOUT = Open/0), per output, $C_L = 5\text{ pF}$ , 200 MHz	—	5	—	mA
		CMOS (2.5 V, SFOUT = Open/0), per output, $C_L = 5\text{ pF}$ , 200 MHz	—	8	—	mA
CMOS (3.3 V, SFOUT = 0/1), per output, $C_L = 5\text{ pF}$ , 200 MHz	—	15	—	mA		
Input Clock Voltage Reference	$V_{REF}$	$V_{REF}$ pin $I_{REF} = \pm 500\text{ }\mu\text{A}$	—	$V_{DD}/2$	—	V
Input High Voltage	$V_{IH}$	SFOUT, CLK_SEL, OEx	$0.8 \times V_{DD}$	—	—	V
Input Mid Voltage	$V_{IM}$	SFOUT, 3-level input pins	$0.45 \times V_{DD}$	$0.5 \times V_{DD}$	$0.55 \times V_{DD}$	V
Input Low Voltage	$V_{IL}$	SFOUT, CLK_SEL, OEx	—	—	$0.2 \times V_{DD}$	V
Internal Pull-down Resistor	$R_{DOWN}$	CLK_SEL, SFOUT	—	25	—	k $\Omega$
Internal Pull-up Resistor	$R_{UP}$	OEx, SFOUT	—	25	—	k $\Omega$

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

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output 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)** $(V_{DDOX} = 2.5\text{ V} \pm 5\%$ , or  $3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

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

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Single-Ended Output Swing	$V_{SE}$	Terminated as shown in Figure 9 (CML termination).	300	400	550	mV

**Table 7. Output Characteristics—LVDS**

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

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

**Table 8. Output Characteristics—LVCMOS**

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Voltage High*	$V_{OH}$		$0.75 \times V_{DDOX}$	—	—	V
Output Voltage Low*	$V_{OL}$		—	—	$0.25 \times V_{DDOX}$	V

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

**Table 9. Output Characteristics—HCSL**

( $V_{DDOX} = 3.3\text{ V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ )

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

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Frequency	F	LVPECL, low power LVPECL, LVDS, CML, HCSL (Glitchless switching to a min of 1 MHz)	dc	—	725	MHz
		LVC MOS (Glitchless switching to a min of 1 MHz)	dc	—	200	MHz
Duty Cycle <b>Note:</b> 50% input duty cycle.	D <sub>C</sub>	200 MHz, 20/80% T <sub>R</sub> /T <sub>F</sub> < 10% of period (LVC MOS) (12 mA drive)	40	50	60	%
		20/80% T <sub>R</sub> /T <sub>F</sub> < 10% of period (Differential)	48	50	52	%
Minimum Input Clock Slew Rate <sup>1</sup>	SR	Required to meet prop delay and additive jitter specifications (20–80%)	0.75	—	—	V/ns
Output Rise/Fall Time	T <sub>R</sub> /T <sub>F</sub>	LVDS, 20/80%	—	—	325	ps
		LVPECL, 20/80%	—	—	350	ps
		HCSL <sup>1</sup> , 20/80%	—	—	280	ps
		CML, 20/80%	—	—	350	ps
		Low-Power LVPECL, 20/80%	—	—	325	ps
		LVC MOS 200 MHz, 20/80%, 2 pF load	—	—	750	ps
Minimum Input Pulse Width	T <sub>W</sub>		500	—	—	ps
Propagation Delay	T <sub>PLH</sub> , T <sub>PHL</sub>	LVC MOS (12mA drive with no load)	1250	2000	2750	ps
		LVPECL	600	800	1000	ps
		LVDS	600	800	1000	ps
Output Enable Time	T <sub>EN</sub>	F = 1 MHz	—	2500	—	ns
		F = 100 MHz	—	30	—	ns
		F = 725 MHz	—	5	—	ns

**Notes:**

1. HCSL measurements were made with receiver termination. See Figure 9 on page 19.
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<sub>DDOX</sub> (3.3 V = 100 mV<sub>PP</sub>) and noise spur amplitude measured. See "AN491: Power Supply Rejection for Low-Jitter Clocks" for further details.



**Table 10. AC Characteristics (Continued)**

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Output Disable Time	$T_{DIS}$	F = 1 MHz	—	2000	—	ns
		F = 100 MHz	—	30	—	ns
		F = 725 MHz	—	5	—	ns
Output to Output Skew <sup>2</sup>	$T_{SK}$	LVCMOS (12 mA drive to no load)	—	50	120	ps
		LVPECL	—	35	70	ps
		LVDS	—	35	70	ps
Part to Part Skew <sup>3</sup>	$T_{PS}$	Differential	—	—	150	ps
Power Supply Noise Rejection <sup>4</sup>	PSRR	10 kHz sinusoidal noise	—	-63	—	dBc
		100 kHz sinusoidal noise	—	-62	—	dBc
		500 kHz sinusoidal noise	—	-58	—	dBc
		1 MHz sinusoidal noise	—	-55	—	dBc

**Notes:**

1. HCSL measurements were made with receiver termination. See Figure 9 on page 19.
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  $V_{DDOX}$  ( $3.3\text{ V} = 100\text{ mV}_{PP}$ ) 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 <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%-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:**

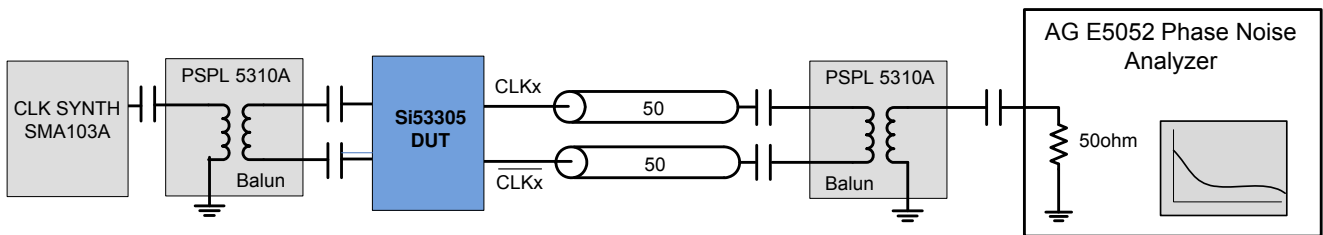
1. For best additive jitter results, use the fastest slew rate possible. See “AN766: Understanding and Optimizing Clock Buffer’s Additive Jitter Performance” for more information.
2. AC-coupled differential inputs.
3. Measured differentially using a balun at the phase noise analyzer input. See Figure 1.

**Table 12. Additive Jitter, Single-Ended Clock Input**

V <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)	SE 20%-80% Slew Rate (V/ns)		Clock Format	Typ
3.3	200	Single-ended	1.70	1	LVC MOS <sup>4</sup>	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	LVC MOS <sup>4</sup>	130	180
2.5	200	Single-ended	1.70	1	LVC MOS <sup>5</sup>	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	LVC MOS <sup>5</sup>	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). LVC MOS jitter is measured single-ended.
5. Drive Strength: 9 mA, 2.5 V (SFOUT = 11). LVC MOS 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	$\theta_{JA}$	Still air	49.6	°C/W
Thermal Resistance, Junction to Case	$\theta_{JC}$	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 k $\Omega$	—	—	2000	V
ESD Sensitivity	CDM		—	—	500	V
Peak Soldering Reflow Temperature	$T_{PEAK}$	Pb-Free; Solder reflow profile per JEDEC J-STD-020	—	—	260	°C
Maximum Junction Temperature	$T_J$		—	—	125	°C

**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 Si53305 is a low jitter, low skew 1:10 differential buffer with an integrated 2:1 input mux and individual OE control. The device has a universal input that accepts most common differential or LVCMOS input signals. A clock select pin is used to select the active input clock. The Si53305 features two control pins to select the signal format and LVCMOS drive strength settings. In addition, each clock output has an independent OE pin for individual clock enable/disable.

### 2.1. Universal, Any-Format Input

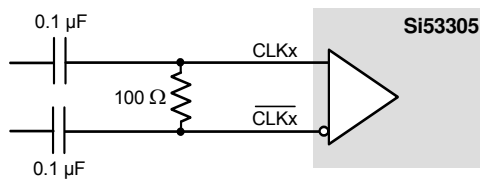
The universal input stage enables simple interfacing to a wide variety of clock formats, including LVPECL, low-power LVPECL, LVCMOS, LVDS, HCSL, and CML. Tables 15 and 16 summarize the various ac- and dc-coupling options supported by the device. For the best high-speed performance, the use of differential 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**

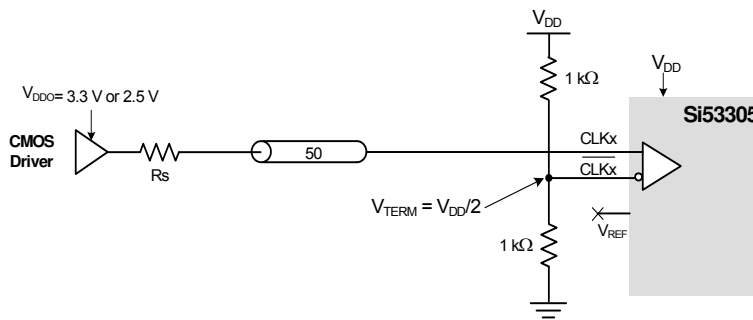
	LVPECL		LVCMOS		LVDS	
	AC-Couple	DC-Couple	AC-Couple	DC-Couple	AC-Couple	DC-Couple
1.8 V	N/A	N/A	No	No	Yes	No
2.5/3.3 V	Yes	Yes	No	Yes	Yes	Yes

**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

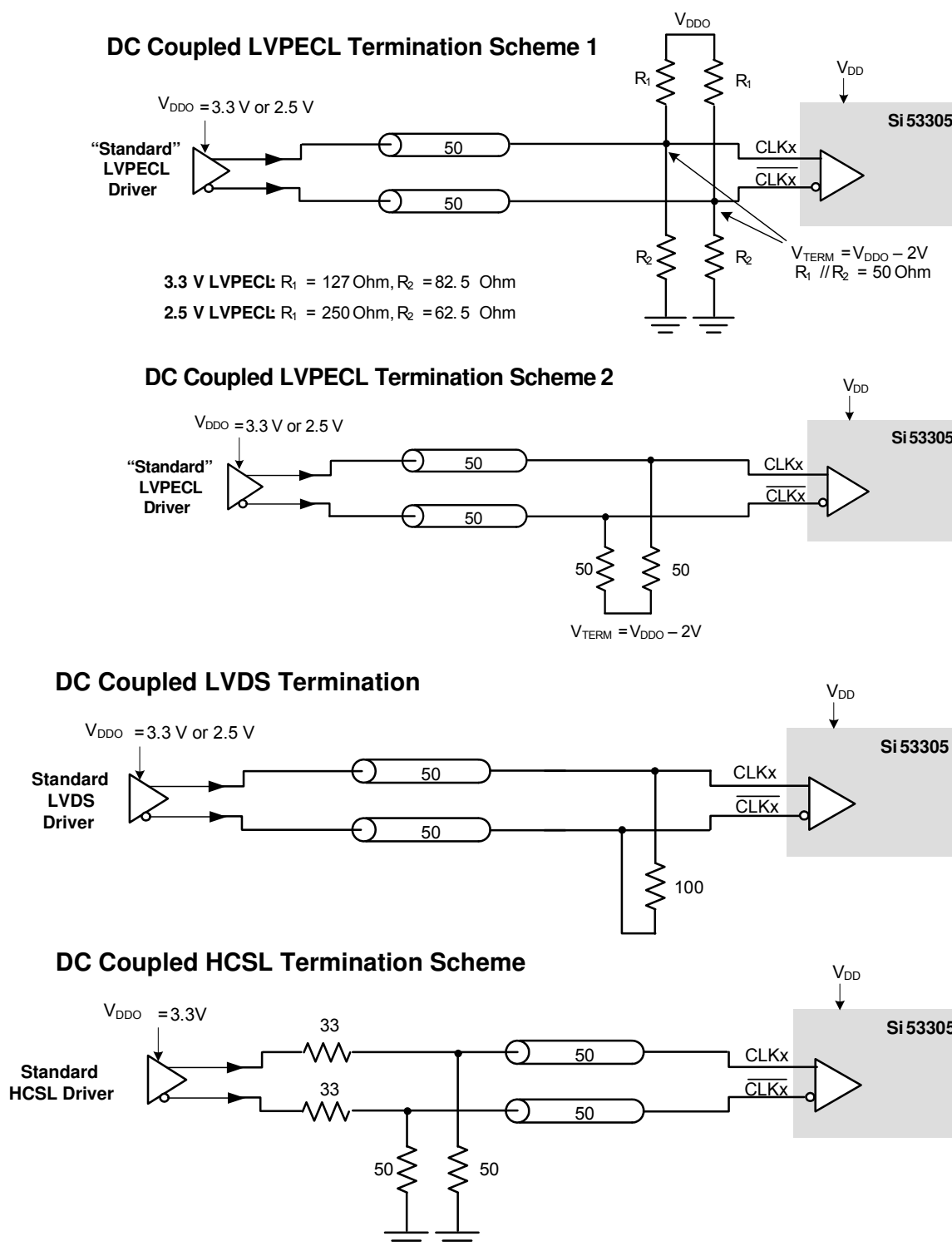


**Figure 2. Differential HCSL, LVPECL, Low-Power LVPECL, LVDS, CML AC-Coupled Input Termination**



**Figure 3. LVCMOS DC-Coupled Input Termination**



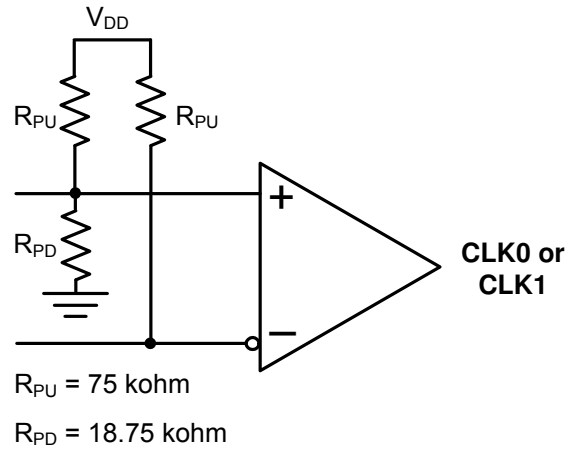


Note: 33 Ohm series termination is optional depending on the location of the receiver.

**Figure 4. Differential DC-Coupled Input Terminations**

## 2.2. Input Bias Resistors

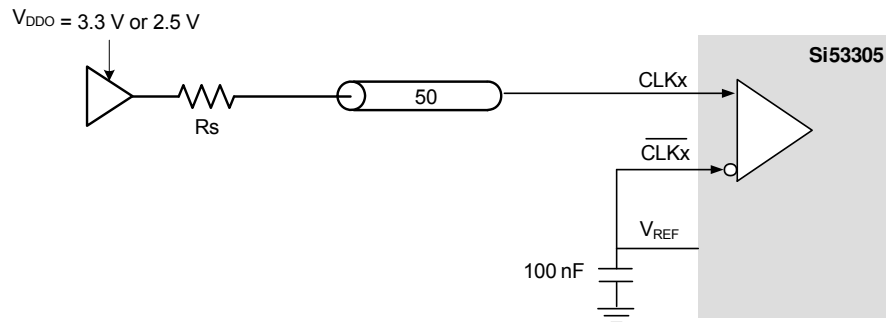
Internal bias resistors ensure a differential output low condition in the event that the clock inputs are not connected. The noninverting input is biased with a 18.75 kΩ pulldown to GND and a 75 kΩ pullup to V<sub>DD</sub>. The inverting input is biased with a 75 kΩ pullup to V<sub>DD</sub>.



**Figure 5. Input Bias Resistors**

## 2.3. Voltage Reference (V<sub>REF</sub>)

The V<sub>REF</sub> pin is used to bias the input receiver as shown in Figure 6 when a single-ended input clock (such as LVCMOS) is used. Note that V<sub>REF</sub>=V<sub>DD</sub>/2 and should be compatible with the VCM rating of the single-ended input clock driving the CLK0 or CLK1 inputs. To optimize jitter and duty cycle performance, use the circuit in Figure 3. V<sub>REF</sub> pin should be left floating when differential clocks are used.



**Figure 6. Using Voltage Reference with Single-Ended Input Clock**

## 2.4. Universal, Any-Format Output Buffer

The highly flexible output drivers support a wide range of clock signal formats, including LVPECL, low power LVPECL, LVDS, CML, HCSL, and LVCMOS. SFOUT[1] and SFOUT[0] are 3-level inputs that can be pin-strapped to select the Bank A and Bank B 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.

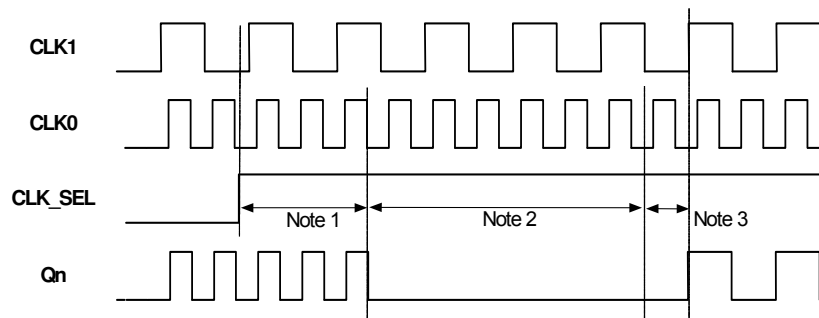
**Table 17. Output Signal Format Selection**

SFOUT[1]	SFOUT[0]	$V_{DDOX} = 3.3\text{ V}$	$V_{DDOX} = 2.5\text{ V}$	$V_{DDOX} = 1.8\text{ V}$
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:** SFOUT[1] and SFOUT[0] are 3-level input pins. Tie low for “0” setting. Tie high for “1” setting. When left open, the pin floats to  $V_{DD}/2$ .

## 2.5. Glitchless Clock Input Switching

The input clock mux features glitchless switching between two valid input clocks. Figure 7 illustrates that switching between input clocks does not generate runt pulses or glitches at the output.



Notes:

1.  $Q_n$  continues with CLK0 for 2-3 falling edges of CLK0.
2.  $Q_n$  is disabled low for 2-3 falling edges of CLK1.
3.  $Q_n$  starts on the first rising edge after 1 + 2.

**Figure 7. Glitchless Input Clock Switch**

Glitchless switching between 2 input clocks that are up to 10x different in frequency and between 1 MHz and 725 MHz is supported. When a switchover to a new clock is made, the output will disable low after two or three clock cycles of the previously-selected input clock. The outputs will remain low for up to three clock cycles of the newly-selected clock, after which the outputs will start from the newly-selected input. In the case a switchover to an absent clock is made, the output will glitchlessly stop low and wait for edges of the newly selected clock. A switchover from an absent clock to a live clock will also be glitchless. Note that the CLK\_SEL input should not be toggled faster than 1/250th the frequency of the slower input clock.

## 2.6. 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  $\bar{Q}$  is held high for differential output formats. For LVCMOS output format options, both Q and  $\bar{Q}$  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 7 for output enable and output disable times.

## 2.7. Input Mux and Output Enable Logic

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

Table 18. Input Mux and Output Enable Logic

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

**Notes:**

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

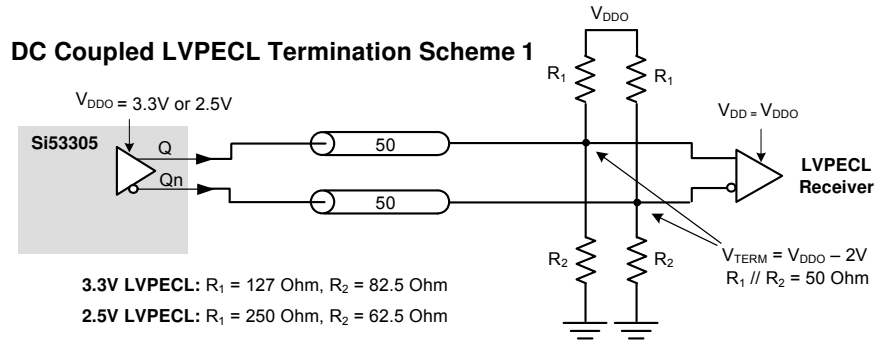
## 2.8. Power Supply ( $V_{DD}$ and $V_{DDOX}$ )

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

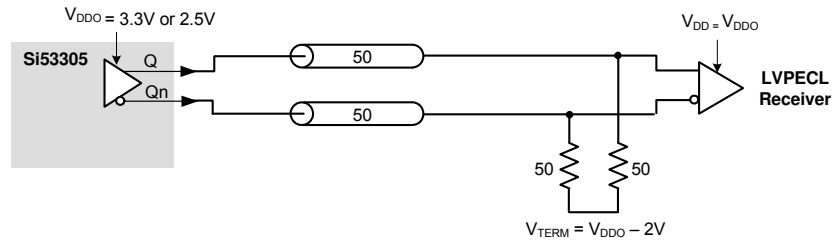


## 2.9. Output Clock Termination Options

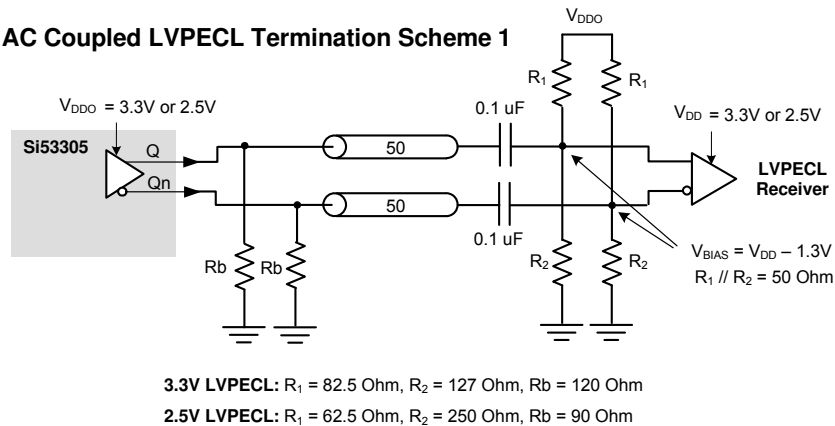
The recommended output clock termination options are shown below.



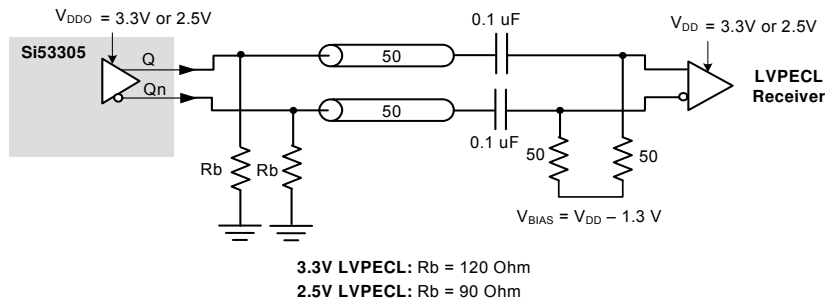
### DC Coupled LVPECL Termination Scheme 2



### AC Coupled LVPECL Termination Scheme 1



### AC Coupled LVPECL Termination Scheme 2



**Figure 8. LVPECL Output Termination**

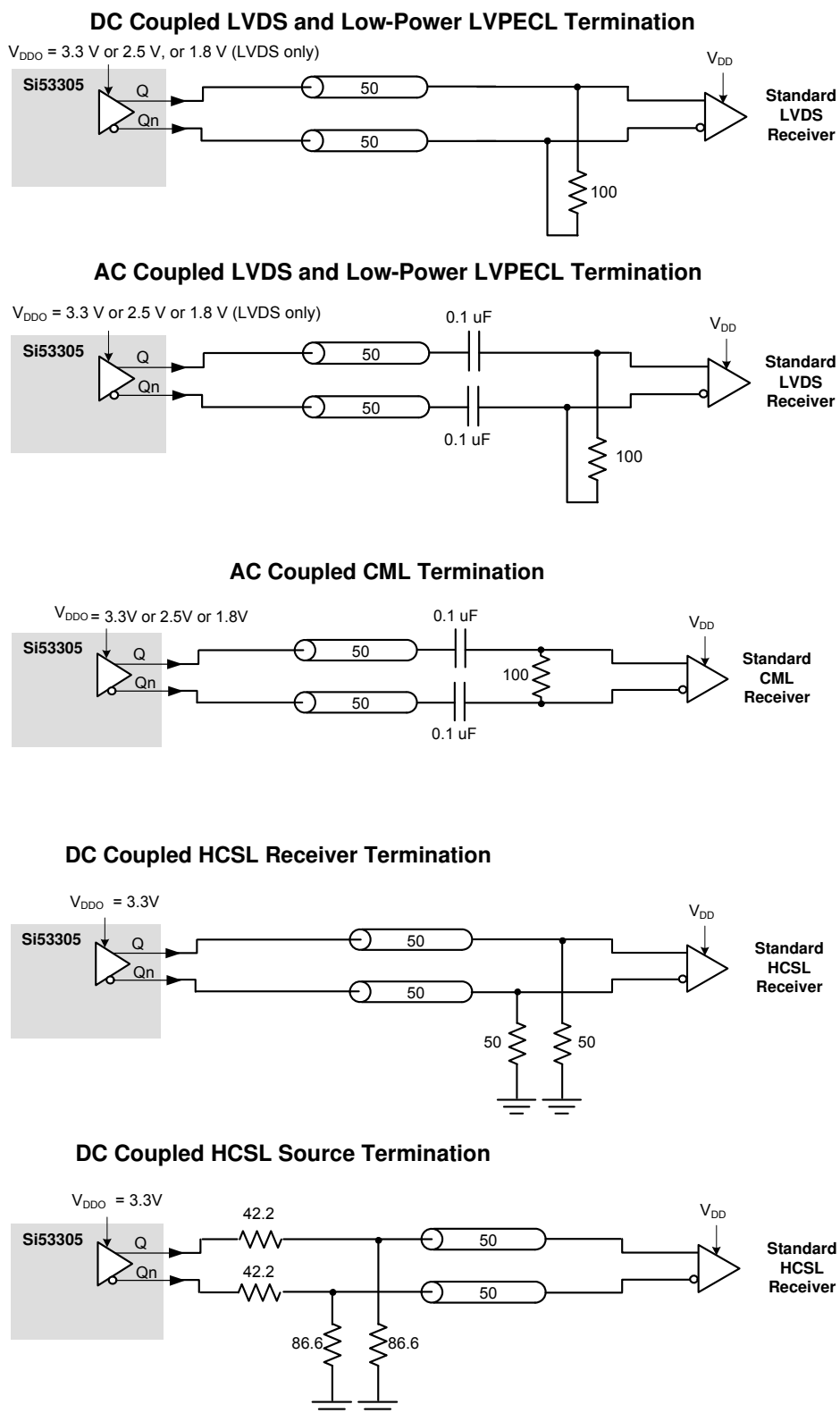
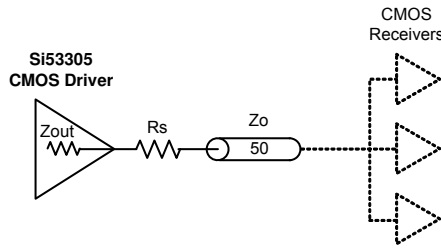


Figure 9. LVDS, CML, HCSL, and Low-Power LVPECL Output Termination



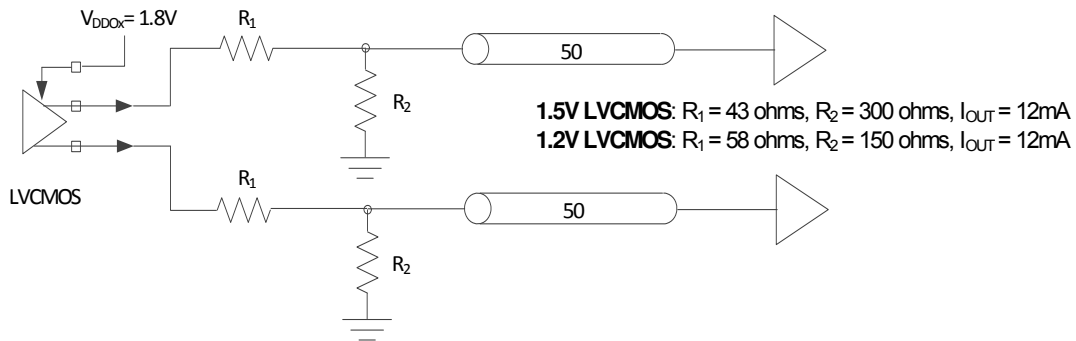
**Figure 10. LVC MOS Output Termination**

**Table 19. Recommended LVC MOS  $R_S$  Series Termination**

SFOUT[1]	SFOUT[0]	$R_S$ (ohms)		
		3.3 V	2.5 V	1.8 V
0	1	33	33	33
1	0	33	33	33
1	1	33	33	0
Open	0	0	0	0

### 2.9.1. LVC MOS Output Termination To Support 1.5V and 1.2V

LVC MOS clock outputs are natively supported at 1.8V, 2.5V, and 3.3V. However, 1.2V and 1.5V LVC MOS 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 11 below.



**Figure 11. 1.5V and 1.2V LVC MOS Low-Voltage Output Termination**

## 2.10. AC Timing Waveforms

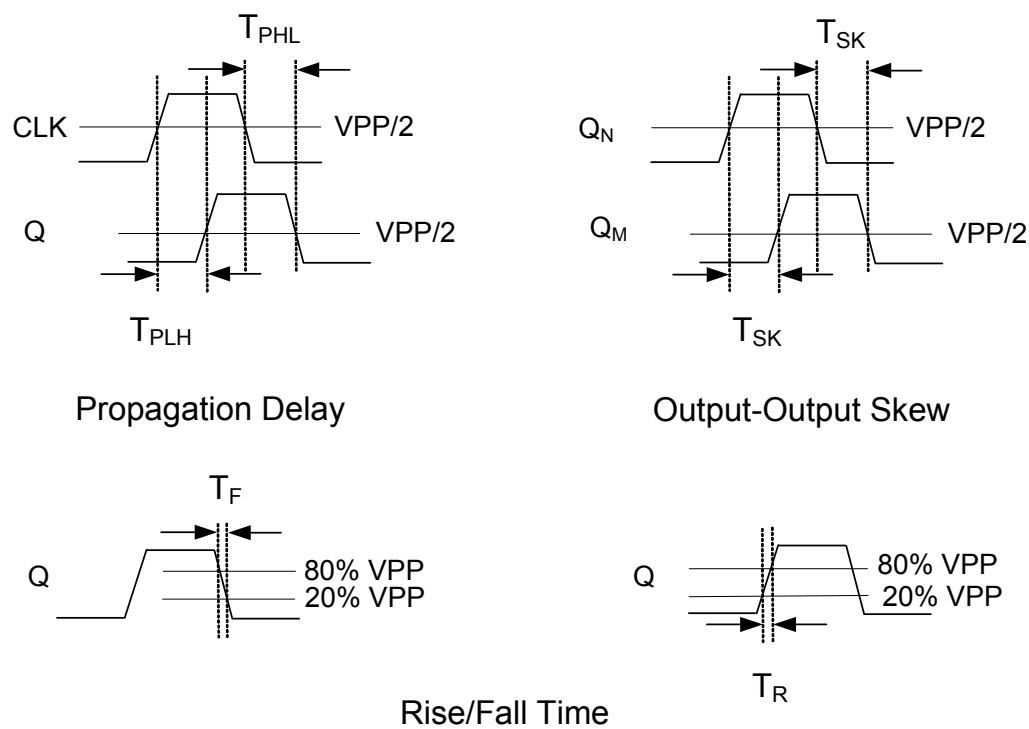


Figure 12. AC Waveforms

## 2.11. 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 10.

**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).

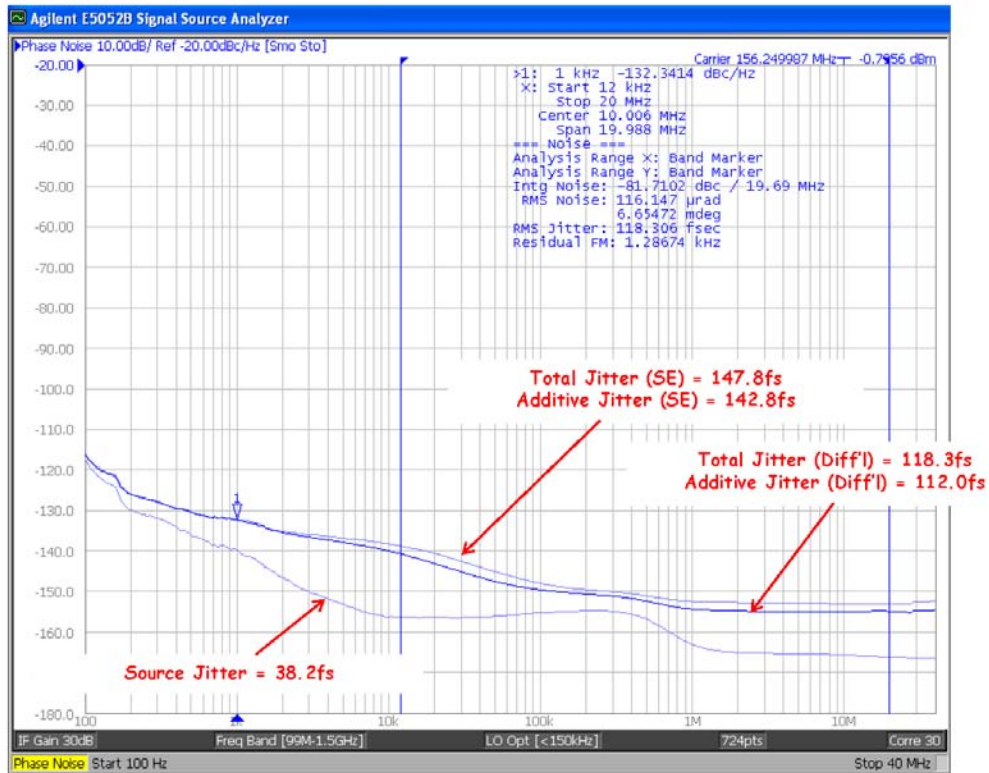


Figure 13. Source, Additive, and Total Jitter (156.25 MHz)

Table 20. Source, Additive, and Total 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)
156.25	1.0	38.2	147.8	142.8	118.3	112.0



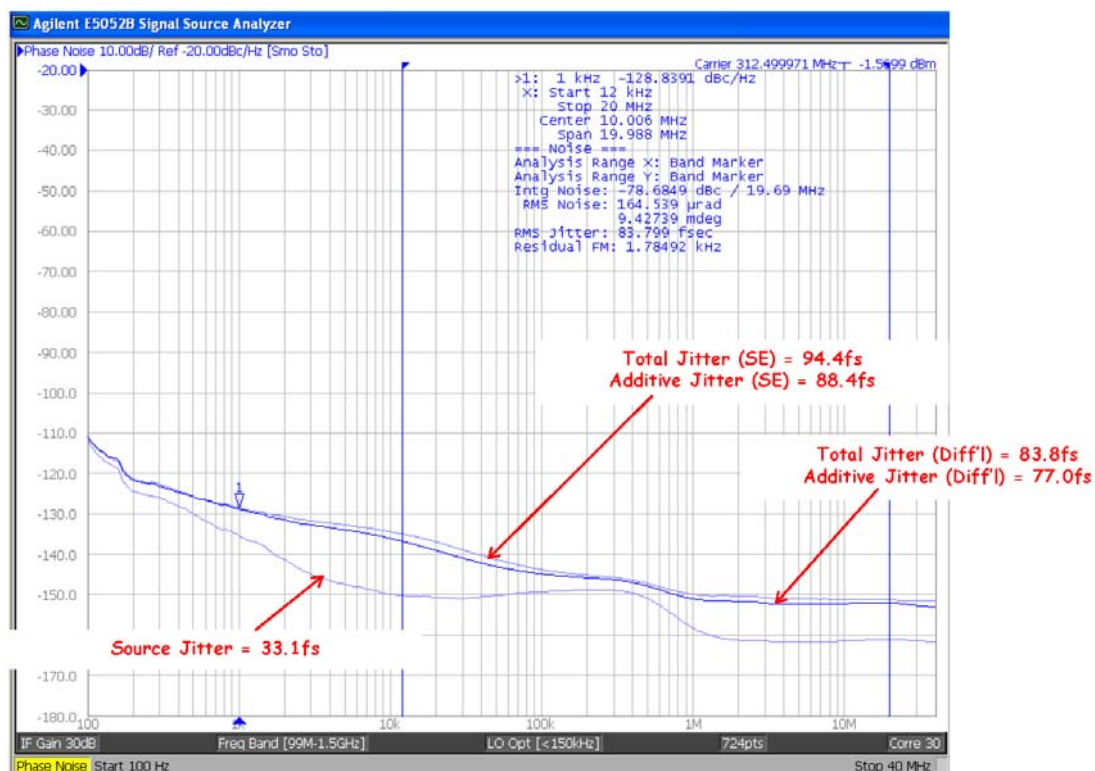


Figure 14. Source, Additive, and Total Jitter (312.5 MHz)

Table 21. Source, Additive, and 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)
312.5	1.0	33.10	94.39	88.39	83.80	76.99

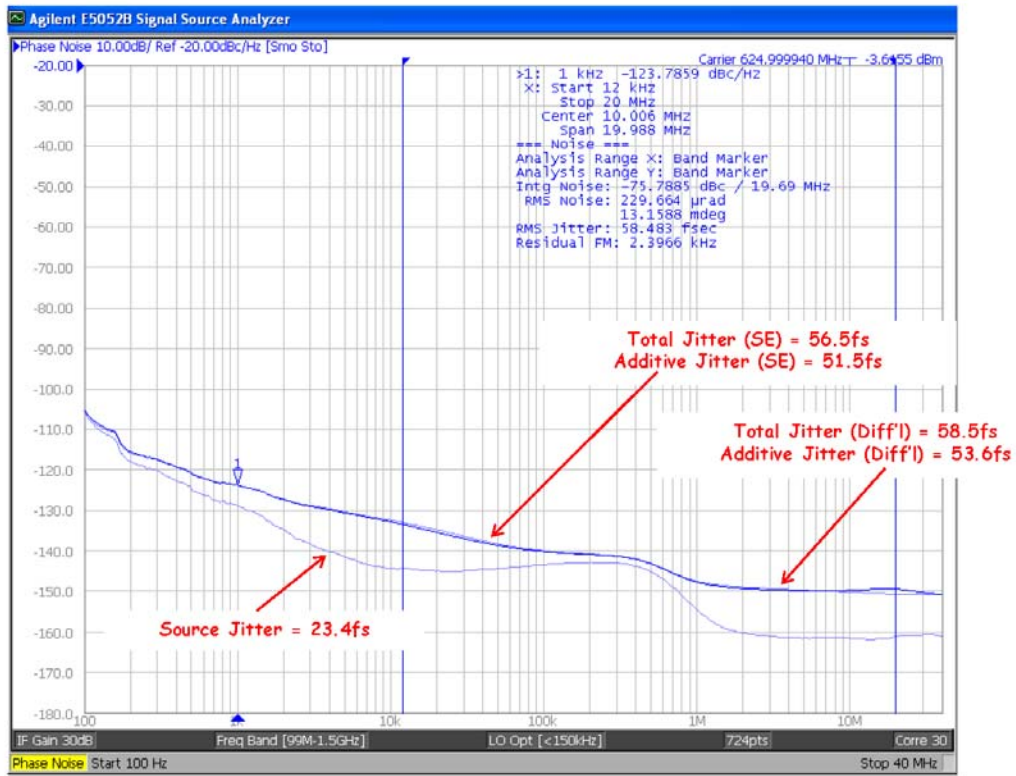


Figure 15. Source, Additive, and Total Jitter (625 MHz)

Table 22. Source, Additive, and Total Jitter (625 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

## 2.12. Input Mux Noise Isolation

The buffer's 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. Figure 16 below is a measurement of the input mux's noise isolation.

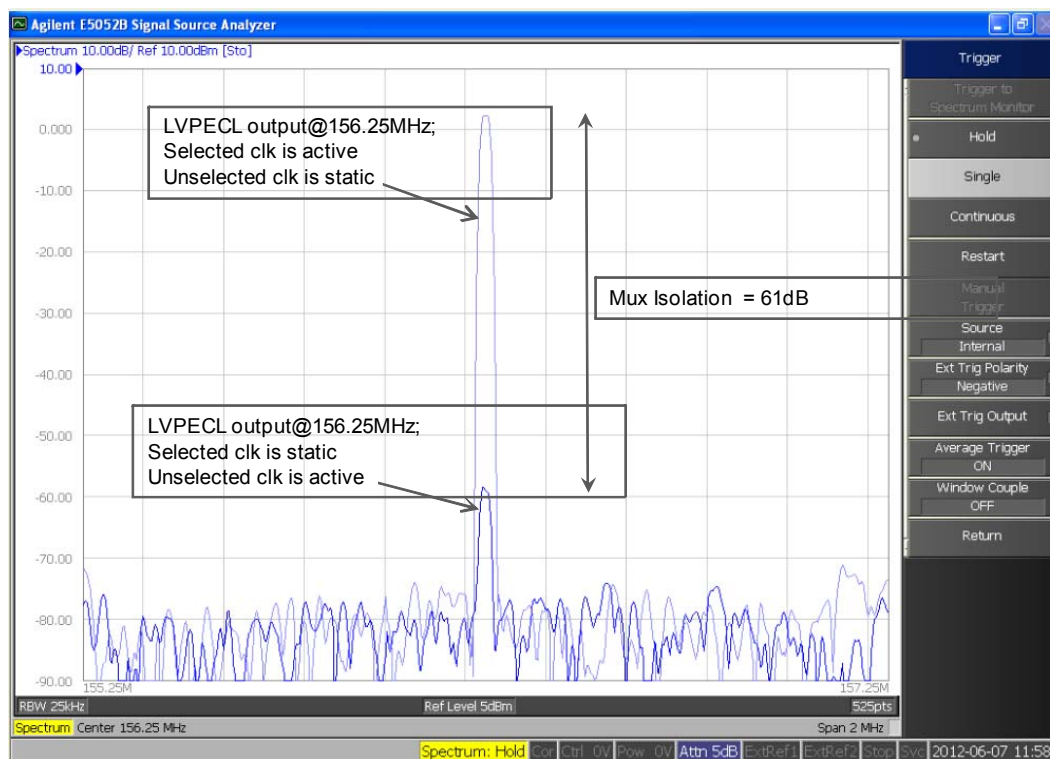


Figure 16. Input Mux Noise Isolation

## 2.13. 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”.