

### Description

The SiT9551 is a ruggedized ultra-low jitter differential ApexMEMS™ oscillator engineered for military and aerospace applications. It delivers the most stable timing under environmental stressors such as shock, vibration, high heat, rapid thermal transients, and power supply noise.

In addition to standard differential signal types, a unique FlexSwing™ output-driver performs like LVPECL and provides independent control of voltage swing and DC offset to simplify interfacing with chipsets having non-standard input voltage requirements and eliminate all external source-bias resistors. The device also integrates multiple on-chip regulators to filter power supply noise, eliminating the need for an external dedicated LDO.

The SiT9551 is factory programmed for specific combinations of frequency, stability, output signaling, voltage, and output enable functionality. Programmability enables designers to optimize clock configurations while eliminating long lead times and customization costs associated with quartz devices where each combination is custom built.

The wide frequency range and programmability makes this device ideal for communications, enterprise, and military and aerospace applications that require a variety of frequencies and operate in noisy environments.

Refer to [Manufacturing Notes](#) for proper reflow profile, tape and reel dimension, and other manufacturing related information.

### Block Diagram

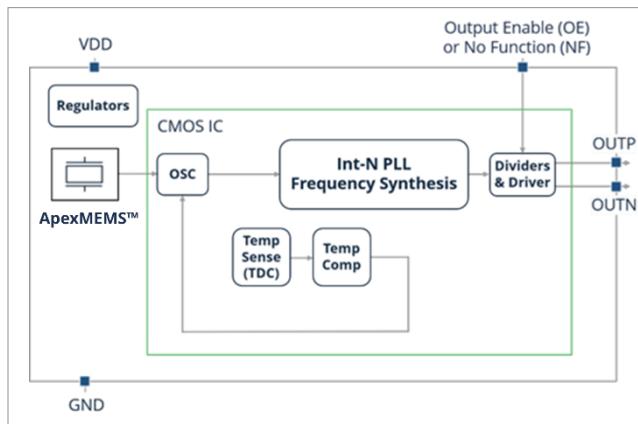


Figure 1. SiT9551 Block Diagram

### Features

- 0.04 or 0.1 ppb/g acceleration sensitivity for harsh environments
- Select frequencies from 25 MHz to 644.53125 MHz. See [Ordering Information](#)
- 70 fs RMS typical phase jitter, 12 kHz to 20 MHz
- 50 fs RMS typical phase jitter for SerDes applications
- 9 fs/mV typical PSNR
- LVPECL, LVDS, HCSL, Low-power HCSL, and FlexSwing signaling options
- ± 20, ±30 and ±50 ppm frequency stabilities
- Wide temperature range (-55°C to 125°C)
- Factory programmable options for low lead time
- 1.8 V, 2.5 V, 3.3 V, and wide continuous power supply voltage range options
- 2 x 1.6, 2.5 x 2, 3.2 x 2.5 mm x mm package

### Applications

- Airborne Communications
- Command and Control
- Field Communications
- Airframe/Engine Management Control
- Radar
- SATCOM

### Package Pinout

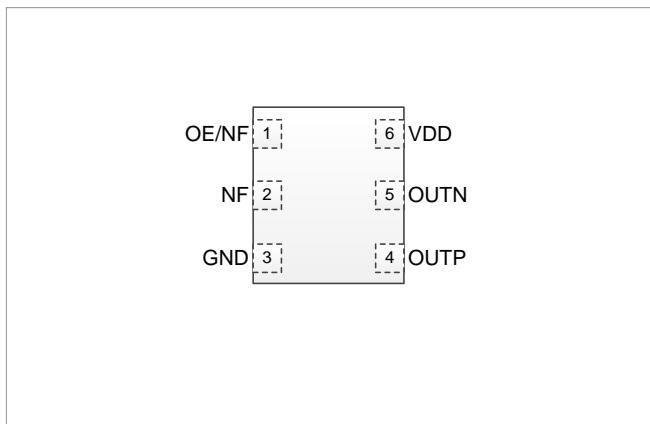


Figure 2. Pin Assignments (Top view)  
(Refer to [Table 16](#) for Pin Descriptions)

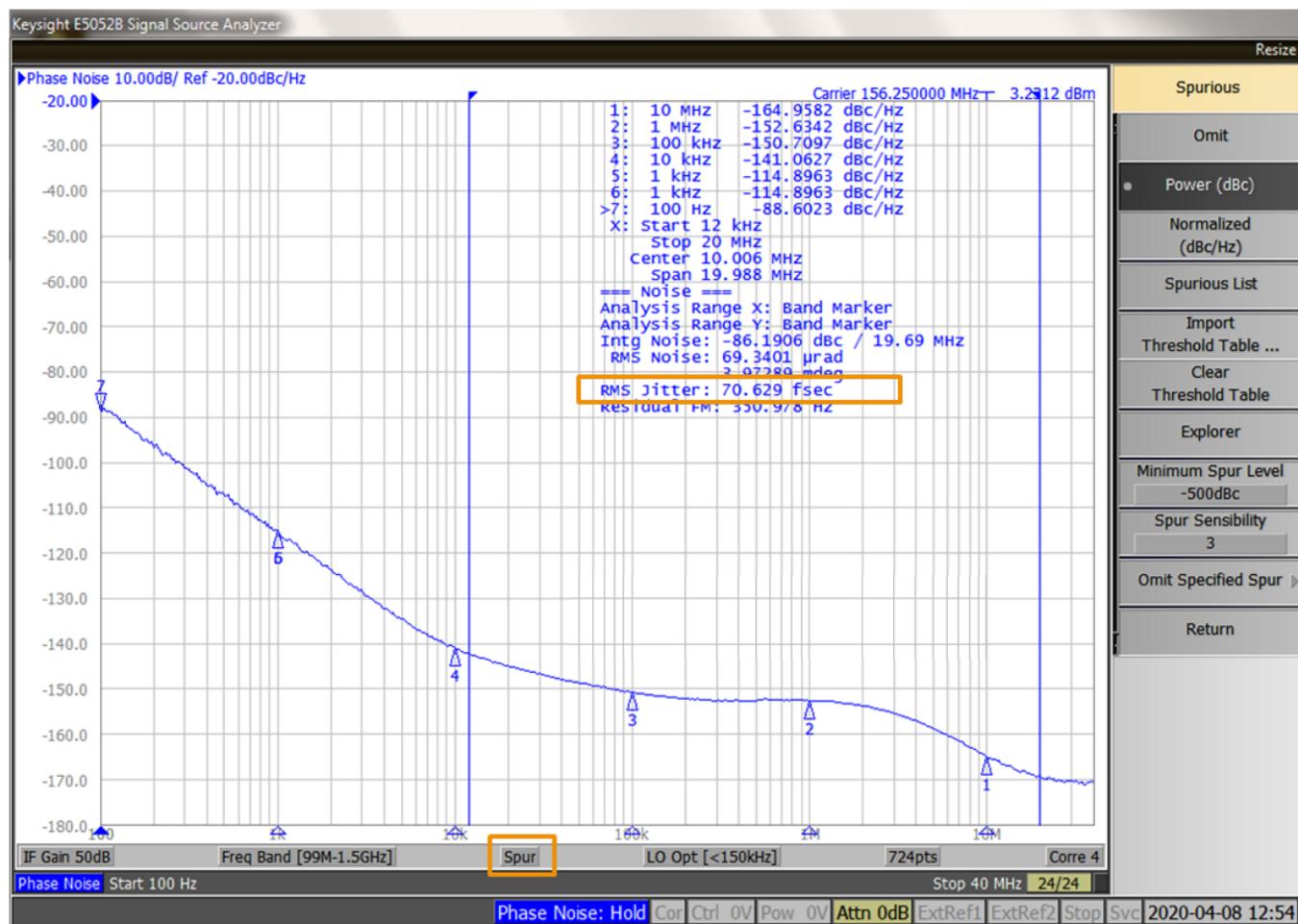


Figure 3. Typical Phase Noise Plot of 3.3 V  
 156.25 MHz LVPECL Device at 25°C, Spur turn on

SiT9551 features 45 fs RMS phase jitter for SerDes applications. Figure 4 shows the phase noise (green curve) observed by the system, after accounting for aliased phase noise when filtering (gray curve) the measured SiT9551 phase noise (blue curve). This “4-16A” phase jitter analysis methodology more accurately estimates reference clock

jitter than the legacy “12 kHz to 20 MHz” brick-wall filter methodology. It can be applied to all modern SerDes applications to optimize system performance. See “4-16A” Phase Jitter Methodology for SerDes Applications for more information.

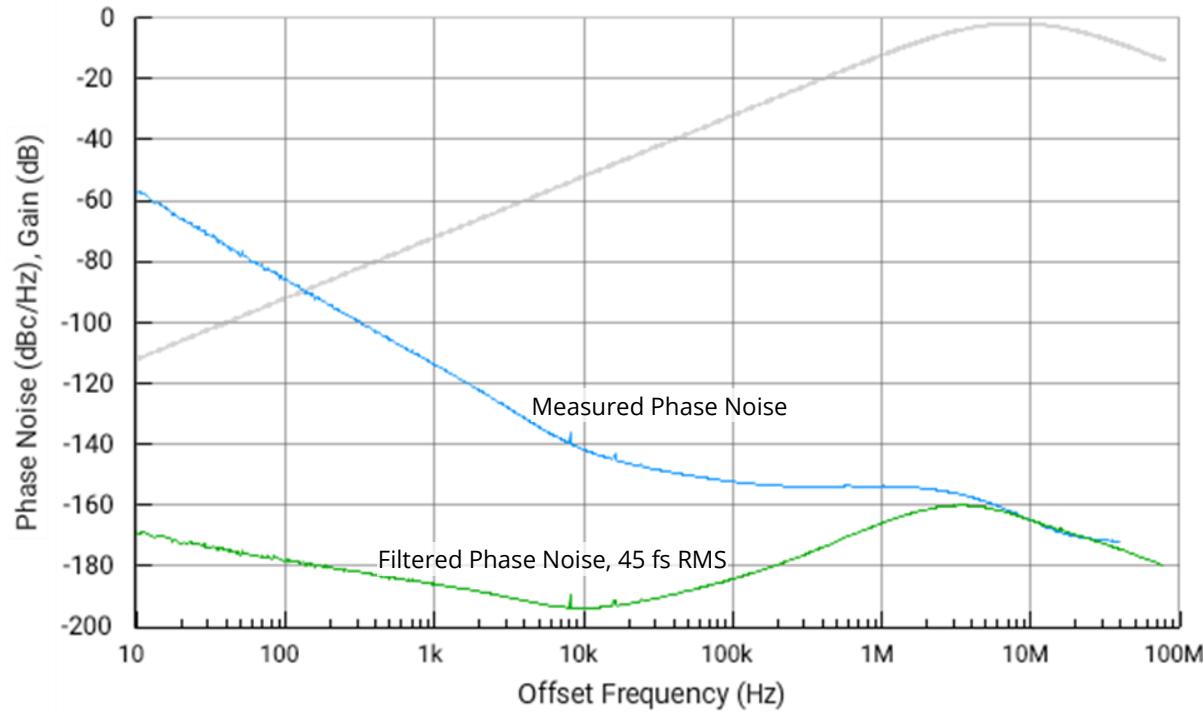
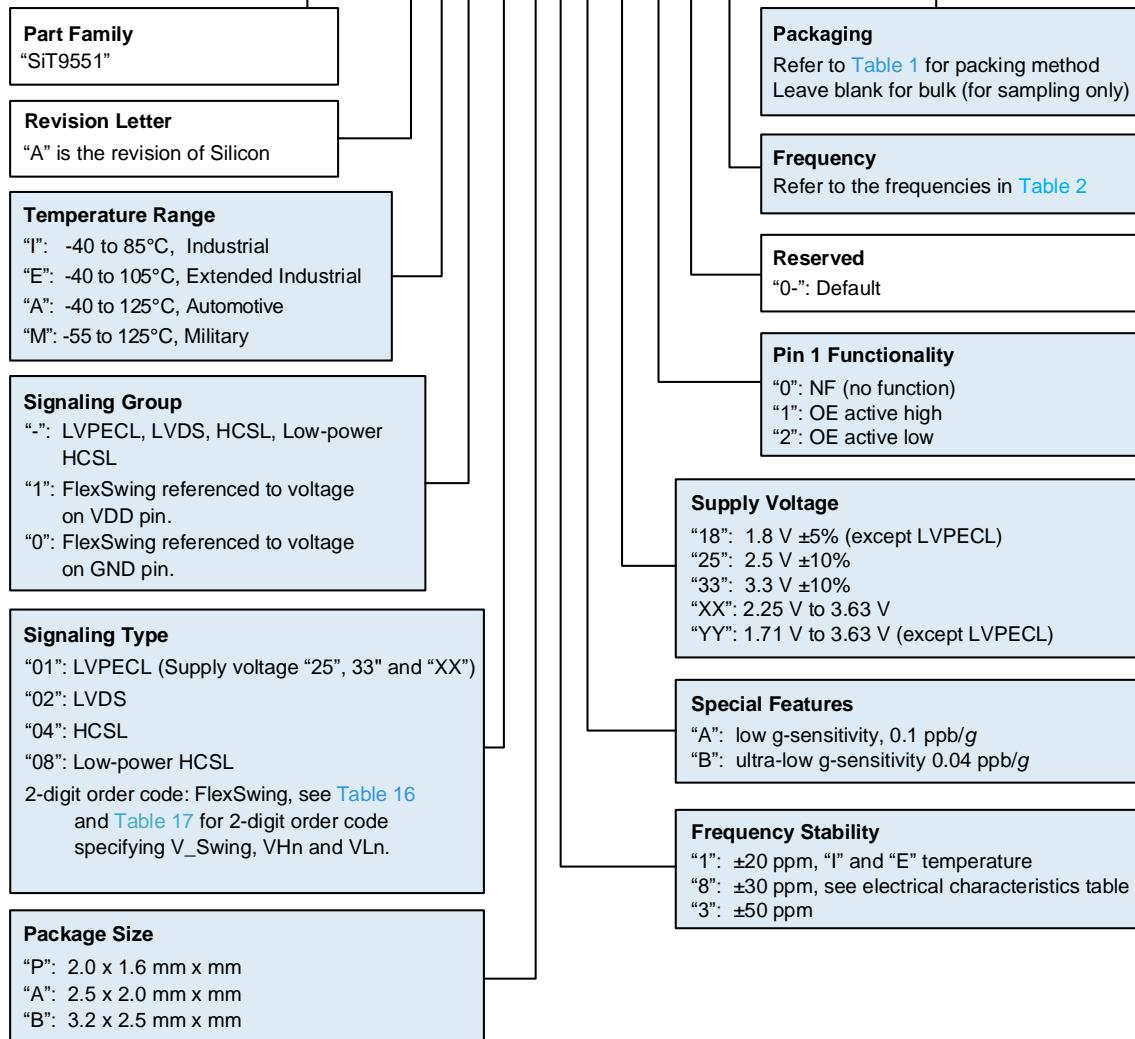


Figure 4. Phase noise before and after filtering for SiT9551 (156.25 MHz, LVPECL, 2.5V, 25°C). The filter is applied to analyze phase noise with aliasing included up to the 3<sup>rd</sup> harmonic and features first-order filter cutoff frequencies of 4 MHz (high pass) and 16 MHz (low pass).

**Ordering Information****SiT9551A M-01B2A3310-125.000000D****Table 1. Ordering Codes for Supported Tape & Reel Packing Method**

| Device Size<br>(mm x mm) | 8 mm T&R<br>(3ku) | 8 mm T&R<br>(1ku) | 8 mm T&R<br>(250u) |
|--------------------------|-------------------|-------------------|--------------------|
| 2.0 x 1.6                | D                 | E                 | G                  |
| 2.5 x 2.0                | D                 | E                 | G                  |
| 3.2 x 2.5                | D                 | E                 | G                  |

**Table 2. Supported Frequencies**

|                |                |                |                |                |                |                |                |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 25.000000 MHz  | 39.062500 MHz  | 50.000000 MHz  | 53.125000 MHz  | 62.500000 MHz  | 78.125000 MHz  | 125.000000 MHz | 156.250000 MHz |
| 161.132813 MHz | 250.000000 MHz | 312.500000 MHz | 322.265625 MHz | 625.000000 MHz | 644.531250 MHz |                |                |

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| Low-power HCSL, Supply Voltage: 1.8 V $\pm$ 5%, 2.5 V $\pm$ 10%, 3.3 V $\pm$ 10%, 2.25 V to 3.63 V, 1.71 V to 3.63 V ..... | 31 |
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## Electrical Characteristics

All Min and Max limits in the Electrical Characteristics tables are specified over operating temperature and rated operating voltage with standard output termination shown in the termination diagrams. Typical values are at 25°C and nominal supply voltage. See [Test Circuit Diagrams](#) for the test setups used with each signaling type.

**Table 3. Electrical Characteristics – Common to All Output Signaling Types**

| Parameter                                  | Symbol  | Min.                 | Typ.  | Max.               | Unit  | Condition   |
|--|---------|----------------------|-------|--------------------|-------|---|
| <b>Frequency Range</b>                     |         |                      |       |                    |       |   |
| Output Frequency Range                     | f       | Standard frequencies |       |                    | MHz   | Refer to frequencies listed in <a href="#">Ordering Information</a>   |
| <b>Frequency Stability</b>                 |         |                      |       |                    |       |   |
| Frequency Stability                        | F_stab  | –                    | –     | ±20                | ppm   | Frequency ordering code "1"<br>–40°C to +105°C (Temperature Ordering Code "I" and "E")<br>Inclusive of initial tolerance, operating temperature, rated power supply voltage, load variation of 2 pF ± 10%, and 10 years aging at 85°C   |
|  |         | –                    | –     | ±30                | ppm   | Frequency ordering code "8"<br>–40°C to +105°C (Temperature Ordering Code "I" and "E")<br>–40°C to +125°C, ± 50 ppm for +105°C to +125°C (Temperature Ordering Code "A")<br>Inclusive of initial tolerance, operating temperature, rated power supply voltage, load variation of 2 pF ± 10%, and 10 years aging at 85°C |
|  |         | –                    | –     | ±50                | ppm   | Frequency ordering code "2"<br>Inclusive of initial tolerance, operating temperature, rated power supply voltage, load variation of 2 pF ± 10%, and 10 years aging at 85°C  |
| 10 Year Aging                              | F_10y   | –                    | ±0.7  | 2.3                | ppm   | Ambient temperature of 85°C   |
| <b>Rugged Characteristics</b>              |         |                      |       |                    |       |   |
| Acceleration (g) sensitivity, Gamma Vector | F-g     | –                    | 0.025 | 0.04               | ppb/g | Ultra-low sensitivity grade; total gamma over 3 axes; 330 Hz to 1.9kHz, 20g, MIL-PRF-55310, section 4.8.18.3.1.   |
|  |         | –                    | –     | 0.1                | ppb/g | Low sensitivity grade; total gamma over 3 axes; 330 Hz to 1.9kHz, 20g, MIL-PRF-55310, section 4.8.18.3.1.   |
| <b>Temperature Range</b>                   |         |                      |       |                    |       |   |
| Operating Temperature Range                | T_use   | -40                  | –     | +85                | °C    | Industrial, ambient temperature   |
|  |         | -40                  | –     | +105               | °C    | Extended industrial, ambient temperature  |
|  |         | -40                  | –     | +125               | °C    | Automotive, ambient temperature   |
|  |         | -55                  | –     | +125               | °C    | Military, ambient temperature   |
| <b>Supply Voltage</b>                      |         |                      |       |                    |       |   |
| Supply Voltage                             | Vdd     | 1.71                 | –     | 3.63               | V     | Voltage-supply order code "YY"<br>Not supported for LVPECL and FlexSwing  |
|  |         | 2.25                 | –     | 3.63               | V     | Voltage-supply order code "XX"  |
|  |         | 1.71                 | 1.80  | 1.89               | V     | Voltage-supply order code "18".<br>Not supported for LVPECL and FlexSwing   |
|  |         | 2.25                 | 2.50  | 2.75               | V     | Voltage-supply order code "25"  |
|  |         | 2.97                 | 3.30  | 3.63               | V     | Voltage-supply order code "33"  |
| <b>Input Characteristics</b>               |         |                      |       |                    |       |   |
| Input Voltage High                         | VIH     | 70%                  | –     | –                  | Vdd   | Logic High function for Pin 1   |
| Input Voltage Low                          | VIL     | –                    | –     | 30%                | Vdd   | Logic High function for Pin 1   |
| Input Pull-up/Pull-down Impedance          | Z_in    | –                    | 120   | –                  | kΩ    | Pin 1 for OE function   |
| <b>Output Characteristics</b>              |         |                      |       |                    |       |   |
| Duty Cycle                                 | DC      | 48                   | –     | 52                 | %     | See <a href="#">Figure 20</a> for waveform.   |
| <b>Startup, OE and SE Timing</b>           |         |                      |       |                    |       |   |
| Startup Time                               | T_start | –                    | 1.2   | 2                  | ms    | Measured from the time Vdd reaches its rated minimum value  |
| Output Enable Time 1                       | T_oe    | –                    | –     | 100+3 clock cycles | ns    | For all signaling types except Low-Power HCSL. Measured from the time OE pin toggles to enable logic level to the time clock pins reach 90% of final swing. See <a href="#">Figure 26</a> for waveform.   |
| Output Enable Time 2                       | T_oe    | –                    | –     | 500+3 clock cycles | ns    | For Low-Power HCSL signaling type. Measured from the time OE pin toggles to enable logic level to the time clock pins reach 90% of final swing. See <a href="#">Figure 26</a> for waveform.   |
| Output Disable Time                        | T_od    | –                    | –     | 100+3 clock cycles | ns    | Measured from the time OE pin toggles to disable logic level to the last clock edge. See <a href="#">Figure 27</a> for waveform.  |

**Table 3. Electrical Characteristics – Common to All Output Signaling Types (continued)**

| Parameter   | Symbol     | Min. | Typ. | Max.              | Unit   | Condition  |
|---|------------|------|------|-------------------|--------|--|
| <b>Jitter and Phase Noise, measured at f = 156.25 MHz</b> |            |      |      |                   |        |  |
| <b>4-16A Phase Jitter<sup>[1]</sup></b>                   | T_416A     | –    | 50   | 64 <sup>[2]</sup> | fs RMS | Measured with phase noise analyzer, extending (flat) phase noise to 3rd harmonic (i.e., 312.5 MHz offset), folding phase noise below the Nyquist frequency (i.e., 78.125 MHz offset), filtering and integrating from 10 kHz to Nyquist. Uses 4 MHz high pass and 16 MHz low pass filters, each with 20 dB/dec roll off. Includes spurs. See “4-16A” Phase Jitter Methodology for SerDes Applications for additional details. |
| <b>0.012-20 Phase Jitter (legacy)<sup>[1]</sup></b>       | T_phj      | –    | 70   | 100               | fs     | Measured with phase noise analyzer, integrating between 12 kHz and 20 MHz offset frequency. Recommended for SONET OC-48 applications. <a href="#">Contact SiTime</a> for 85 fsec Max phase jitter option.  |
| <b>Spurious Phase Noise</b>                               | T_spn      | –    | –    | -101              | dBc    | 12 kHz to 20 MHz offset frequency range  |
| <b>RMS Period Jitter<sup>[3]</sup></b>                    | T_jitt_per | –    | 0.5  | 0.72              | ps     | Measured based on 10K cycle  |
| <b>Peak Cycle-to-cycle Jitter<sup>[3]</sup></b>           | T_jitt_cc  | –    | 3.5  | 4.4               | ps     | Measured based on 1K cycle   |

**Note:**

1. Recommended for SerDes applications to improve the accuracy of clock jitter analysis, replacing the traditional 12 kHz to 20 MHz brick wall filter when application-specific filter characteristics are not explicitly specified.
2. Max phase jitter for LVPECL.
3. Measured according to JESD65B using Keysight DSAX91604A Oscilloscope.

**Table 4. Electrical Characteristics – LVPECL** | Supply voltage (“order code”): 2.5 V  $\pm$ 10% (“25”), 3.3 V  $\pm$ 10% (“33”), All typical specifications are measured at nominal supply voltage of 2.5 V and nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 9](#) and [Figure 10](#) for test setups.

| Parameter  | Symbol     | Min.      | Typ.     | Max.      | Unit  | Condition  |
|--|------------|-----------|----------|-----------|-------|--|
| <b>Current Consumption, f = 156.25 MHz</b>                     |            |           |          |           |       |  |
| <b>Current Consumption, Output Enabled without Termination</b> | Idd_oe_nt  | –         | 28.5     | 35.5      | mA    | Excluding load termination current.  |
| <b>Current Consumption, Output Enabled with Termination 1</b>  | Idd_oe_wt1 | –         | 39       | 49        | mA    | Including load termination current as shown in <a href="#">Figure 31</a> for Vdd=3.3 V $\pm$ 10%, Vdd=2.25 V to 3.63 V and R3=220 Ohms.  |
|  |            | –         | 39       | 45.5      | mA    | Including load termination current as shown in <a href="#">Figure 31</a> for Vdd=2.5 V $\pm$ 10% and R3=220 Ohms.  |
| <b>Current Consumption, Output Enabled with Termination 2</b>  | Idd_oe_wt2 | –         | 55       | 61        | mA    | Including load termination current. See <a href="#">Figure 32</a> for termination.   |
| <b>Current Consumption Output Disabled with Termination 1</b>  | Idd_od_wt1 | –         | 46.5     | 58        | mA    | Including load termination current as shown in <a href="#">Figure 31</a> for Vdd=3.3 V $\pm$ 10%, Vdd=2.25 V to 3.63 V and R3=220 Ohms. Driver output is at logic-high voltage levels. |
|  |            | –         | 46.5     | 53.5      | mA    | Including load termination current as shown in <a href="#">Figure 31</a> for Vdd=2.5 V $\pm$ 10% and R3=220 Ohms. Driver output is at logic-high voltage levels.                       |
| <b>Current Consumption, Output Disabled with Termination 2</b> | Idd_od_wt2 | –         | 66       | 73        | mA    | Including load termination current. See <a href="#">Figure 32</a> for termination. Driver output is at logic-high voltage levels.  |
| <b>Output Characteristics</b>                                  |            |           |          |           |       |  |
| <b>Output High Voltage</b>                                     | VOH        | Vdd-1.095 | Vdd-0.95 | Vdd-0.855 | V     | See <a href="#">Figure 19</a> for waveform.  |
| <b>Output Low Voltage</b>                                      | VOL        | Vdd-1.845 | Vdd-1.7  | Vdd-1.61  | V     | See <a href="#">Figure 19</a> for waveform.  |
| <b>Output Differential Voltage Swing</b>                       | V_Swing    | 1.4       | 1.5      | 1.65      | V     | See <a href="#">Figure 20</a> for waveform.  |
| <b>Rise/Fall Time</b>  | Tr, Tf     | –         | 170      | 220       | ps    | 20% to 80%. See <a href="#">Figure 20</a> for waveform.  |
| <b>Differential Asymmetry, peak-peak</b>                       | V_da       | –         | 45       | –         | mV    | See <a href="#">Figure 22</a> for waveform.  |
| <b>Differential Skew, peak</b>                                 | V_ds       | –         | $\pm$ 30 | –         | ps    | See <a href="#">Figure 23</a> for waveform.  |
| <b>Overshoot Voltage, peak</b>                                 | V_ov       | –         | 12       | –         | %     | Measured as percent of V_Swing. See <a href="#">Figure 24</a> for waveform.  |
| <b>Power Supply Noise Immunity</b>                             |            |           |          |           |       |  |
| <b>Power Supply-Induced Jitter Sensitivity</b>                 | PSJS       | –         | 9        | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz  |
|  |            | –         | 2.0      | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz. Using RC power supply filter as shown in <a href="#">Figure 9</a> .   |
| <b>Power Supply-Induced Phase Noise</b>                        | PSPN       | –         | -79      | –         | dBc   | 50 mV peak-peak ripple on VDD.   |
|  |            | –         | -92      | –         | dBc   | 50 mV peak-peak ripple on VDD. Using RC power supply filter as shown in <a href="#">Figure 9</a> .   |

**Table 5. Electrical Characteristics – FlexSwing** | Supply voltage (“order code”) referred to VDD only: 2.5 V  $\pm$ 10% (“25”), 3.3 V  $\pm$ 10% (“33”), 2.25 V to 3.63 V (“XX”). All typical specifications are measured at nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 11](#) and [Figure 12](#) for test setups.

| Parameter  | Symbol    | Min.      | Typ.        | Max.      | Unit  | Condition   |
|--|-----------|-----------|-------------|-----------|-------|---|
| <b>Current Consumption</b>                                     |           |           |             |           |       |   |
| <b>Current Consumption, Output Enabled without Termination</b> | Idd_oe_nt | –         | 29.5        | 38        | mA    | Excluding load termination current.   |
| <b>Current Consumption, Output Enabled with Termination</b>    | Idd_oe_wt | –         | 37          | 47.5      | mA    | Including load termination current, for FlexSwing order code “ER”. See <a href="#">Figure 31</a> for Vdd=3.3 V $\pm$ 10%, Vdd=2.25 V to 3.63 V, and R3=220 Ohms.  |
|  |           | –         | 37          | 43.5      | mA    | Including load termination current, for FlexSwing order code “ER”. See <a href="#">Figure 31</a> for Vdd=2.5 V $\pm$ 10%, and R3=220 Ohms.  |
| <b>Current Consumption Output Disabled with Termination</b>    | Idd_od_wt | –         | 42.5        | 53        | mA    | Including load termination current, for FlexSwing order code “ER”. See <a href="#">Figure 31</a> for Vdd=3.3 V $\pm$ 10%, Vdd=2.25 V to 3.63 V, and R3=220 Ohms. Driver output is at logic-high voltage levels. |
|  |           | –         | 42.5        | 49.5      | mA    | Including load termination current, for FlexSwing order code “ER”. See <a href="#">Figure 31</a> for Vdd=2.5 V $\pm$ 10%, and R3=220 Ohms. Driver output is at logic-high voltage levels.                       |
| <b>Output Characteristics</b>                                  |           |           |             |           |       |   |
| <b>Output High Voltage</b>                                     | VOH       | VHn -0.14 | VHn         | VHn +0.1  | V     | See <a href="#">Figure 19</a> for waveform; Refer to <a href="#">Table 17</a> or <a href="#">Table 18</a> order codes for nominal VOH (i.e. VHn) values   |
| <b>Output Low Voltage</b>                                      | VOL       | VLn -0.15 | VLn         | VLn +0.12 | V     | See <a href="#">Figure 19</a> for waveform; Refer to <a href="#">Table 17</a> or <a href="#">Table 18</a> order codes for nominal VOL (i.e. VLn) values   |
| <b>Output Differential Voltage Swing</b>                       | V_Swing   | -15%      | 2*(VHn-VLn) | +15%      | V     | See <a href="#">Figure 20</a> for waveform.   |
| <b>Rise/Fall Time</b>  | Tr, Tf    | –         | 170         | 200       | ps    | 20% to 80%. See <a href="#">Figure 20</a> for waveform.   |
| <b>Differential Asymmetry, peak-peak</b>                       | V_da      | –         | 60          | –         | mV    | See <a href="#">Figure 22</a> for waveform.   |
| <b>Differential Skew, peak</b>                                 | V_ds      | –         | $\pm$ 40    | –         | ps    | See <a href="#">Figure 23</a> for waveform.   |
| <b>Overshoot Voltage, peak</b>                                 | V_ov      | –         | 12          | –         | %     | Measured as percent of V_Swing. see <a href="#">Figure 24</a> for waveform.   |
| <b>Power Supply Noise Immunity</b>                             |           |           |             |           |       |   |
| <b>Power Supply-Induced Jitter Sensitivity</b>                 | PSJS      | –         | 14          | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz. For FlexSwing order code “ER”.   |
|  |           | –         | 2           | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz. For FlexSwing order code “ER”. Using RC power supply filter as shown in <a href="#">Figure 11</a> .  |
| <b>Power Supply-Induced Phase Noise</b>                        | PSPN      | –         | -75         | –         | dBc   | 50 mV peak-peak ripple on VDD. For FlexSwing order code “ER”.   |
|  |           | –         | -93         | –         | dBc   | 50 mV peak-peak ripple on VDD. For FlexSwing order code “ER”. Using R C power supply filter as shown in <a href="#">Figure 11</a> .   |

**Table 6. Electrical Characteristics – FlexSwing** | Supply voltage (“order code”) referred to GND, only: 1.8 V  $\pm$ 5% (“18”), 1.71 V to 3.63 V (“YY”). All typical specifications are measured at nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 11](#) and [Figure 12](#) for test setups.

| Parameter   | Symbol    | Min.     | Typ.        | Max.      | Unit  | Condition   |
|---|-----------|----------|-------------|-----------|-------|---|
| <b>Current Consumption</b>                              |           |          |             |           |       |   |
| Current Consumption, Output Enabled without Termination | Idd_oe_nt | –        | 31          | 37.5      | mA    | Excluding load termination current.   |
| Current Consumption, Output Enabled with Termination    | Idd_oe_wt | –        | 38.5        | 44        | mA    | Including load termination current, for FlexSwing order code “3E”. See <a href="#">Figure 31</a> for Vdd=1.8 V $\pm$ 5% and R3=220 Ohms.  |
|   |           | –        | 38.5        | 45.5      | mA    | Including load termination current, for FlexSwing order code “3E”. See <a href="#">Figure 31</a> for Vdd=1.71 V to 3.63 V and R3=220 Ohms.  |
| Current Consumption Output Disabled with Termination    | Idd_od_wt | –        | 44.5        | 50        | mA    | Including load termination current, for FlexSwing order code “3E”. See <a href="#">Figure 31</a> for Vdd=1.8 V $\pm$ 5% and R3=220 Ohms. Driver output is at logic-high voltage levels.   |
|   |           | –        | 44.5        | 51.5      | mA    | Including load termination current, for FlexSwing order code “3E”. See <a href="#">Figure 31</a> for Vdd=1.71 V to 3.63 V and R3=220 Ohms. Driver output is at logic-high voltage levels. |
| <b>Output Characteristics</b>                           |           |          |             |           |       |   |
| Output High Voltage                                     | VOH       | VHn -0.1 | VHn         | VHn +0.12 | V     | See <a href="#">Figure 19</a> for waveform; Refer to <a href="#">Table 17</a> or <a href="#">Table 18</a> order codes for nominal VOH (i.e. VHn) values                                   |
| Output Low Voltage                                      | VOL       | VLn -0.1 | VLn         | VLn +0.12 | V     | See <a href="#">Figure 19</a> for waveform; Refer to <a href="#">Table 17</a> or <a href="#">Table 18</a> order codes for nominal VOL (i.e. VLn) values                                   |
| Output Differential Voltage Swing                       | V_Swing   | -15%     | 2*(VHn-VLn) | +15%      | V     | See <a href="#">Figure 20</a> for waveform.   |
| Rise/Fall Time  | Tr, Tf    | –        | 170         | 215       | ps    | 20% to 80%. See <a href="#">Figure 20</a> for waveform.   |
| Differential Asymmetry, peak-peak                       | V_da      | –        | 60          | –         | mV    | See <a href="#">Figure 22</a> for waveform.   |
| Differential Skew, peak                                 | V_ds      | –        | $\pm$ 40    | –         | ps    | See <a href="#">Figure 23</a> for waveform.   |
| Overshoot Voltage, peak                                 | V_ov      | –        | 12          | –         | %     | Measured as percent of V_Swing. See <a href="#">Figure 24</a> for waveform.   |
| <b>Power Supply Noise Immunity</b>                      |           |          |             |           |       |   |
| Power Supply-Induced Jitter Sensitivity                 | PSJS      | –        | 12          | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz. For FlexSwing order code “3E”.   |
|   |           | –        | 2           | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz. For FlexSwing order code “3E”. Using RC power supply filter as shown in <a href="#">Figure 11</a> .  |
| Power Supply-Induced Phase Noise                        | PSPN      | –        | -76         | –         | dBc   | 50 mV peak-peak ripple on VDD. For FlexSwing order code “3E”.   |
|   |           | –        | -95         | –         | dBc   | 50 mV peak-peak ripple on VDD. For FlexSwing order code “3E”. Using RC power supply filter as shown in <a href="#">Figure 11</a> .  |

**Table 7. Electrical Characteristics – FlexSwing** | Supply voltage (“order code”) referred to GND, only:  
 2.5 V  $\pm$ 10% (“25”), 3.3 V  $\pm$ 10% (“33”), 2.25 V to 3.63 V (“XX”). All typical specifications are measured at nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 11](#) and [Figure 12](#) for test setups.

| Parameter   | Symbol    | Min.        | Typ.            | Max.      | Unit  | Condition   |
|---|-----------|-------------|-----------------|-----------|-------|---|
| <b>Current Consumption</b>                              |           |             |                 |           |       |   |
| Current Consumption, Output Enabled without Termination | Idd_oe_nt | –           | 30              | 36        | mA    | Excluding load termination current.   |
| Current Consumption, Output Enabled with Termination    | Idd_oe_wt | –           | 37.5            | 44        | mA    | Including load termination current, for FlexSwing order code “VP”. See <a href="#">Figure 31</a> for Vdd=3.3 V $\pm$ 10%, Vdd=2.25 V to 3.63 V, and R3=220 Ohms.  |
| Current Consumption Output Disabled with Termination    | Idd_od_wt | –           | 46              | 53        | mA    | Including load termination current, for FlexSwing order code “VP”. See <a href="#">Figure 31</a> for Vdd=3.3 V $\pm$ 10%, Vdd=2.25 V to 3.63 V, and R3=220 Ohms. Driver output is at logic-high voltage levels. |
| <b>Output Characteristics</b>                           |           |             |                 |           |       |   |
| Output High Voltage                                     | VOH       | VHn - 0.115 | VHn             | VHn + 0.1 | V     | See <a href="#">Figure 19</a> for waveform; Refer to <a href="#">Table 17</a> or <a href="#">Table 18</a> order codes for nominal VOH (i.e. VHn) values   |
| Output Low Voltage                                      | VOL       | VLn - 0.1   | VLn             | VLn + 0.1 | V     | See <a href="#">Figure 19</a> for waveform; Refer to <a href="#">Table 17</a> or <a href="#">Table 18</a> order codes for nominal VOL (i.e. VLn) values   |
| Output Differential Voltage Swing                       | V_Swing   | -15%        | 2*( VHn - VLn ) | +15%      | V     | See <a href="#">Figure 20</a> for waveform.   |
| Rise/Fall Time  | Tr, Tf    | –           | 170             | 210       | ps    | 20% to 80%. See <a href="#">Figure 20</a> for waveform.   |
| Differential Asymmetry, peak-peak                       | V_da      | –           | 60              | –         | mV    | See <a href="#">Figure 22</a> for waveform.   |
| Differential Skew, peak                                 | V_ds      | –           | $\pm$ 40        | –         | ps    | See <a href="#">Figure 23</a> for waveform.   |
| Overshoot Voltage, peak                                 | V_ov      | –           | 12              | –         | %     | Measured as percent of V_Swing.<br>See <a href="#">Figure 24</a> for waveform.  |
| <b>Power Supply Noise Immunity</b>                      |           |             |                 |           |       |   |
| Power Supply-Induced Jitter Sensitivity                 | PSJS      | –           | 14              | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz.<br>For FlexSwing order code “VP”   |
|   |           | –           | 2               | –         | fs/mV | Power supply ripple from 10 kHz to 20 MHz.<br>For FlexSwing order code “VP”. Using RC power supply filter as shown in <a href="#">Figure 11</a> .   |
| Power Supply-Induced Phase Noise                        | PSPN      | –           | -75             | –         | dBc   | 50 mV peak-peak ripple on VDD.<br>For FlexSwing order code “VP”.  |
|   |           | –           | -93             | –         | dBc   | 50 mV peak-peak ripple on VDD.<br>For FlexSwing order code “VP”. Using RC power supply filter as shown in <a href="#">Figure 11</a> .   |

**Table 8. Electrical Characteristics – LVDS** | Supply voltage (“order code”): 2.5 V  $\pm$ 10% (“25”), 3.3 V  $\pm$ 10% (“33”), 2.25 V to 3.63 V (“XX”). All typical specifications are measured at nominal supply of 2.5 V and nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 13](#) and [Figure 14](#) for test setups.

| Parameter   | Symbol       | Min.  | Typ.     | Max.  | Unit  | Condition   |
|---|--------------|-------|----------|-------|-------|---|
| <b>Current Consumption</b>                              |              |       |          |       |       |   |
| Current Consumption, Output Enabled without Termination | Idd_oe_nt    | –     | 25.5     | 32    | mA    | Excluding load termination current.   |
| Current Consumption, Output Enabled with Termination    | Idd_oe_wt    | –     | 29       | 35    | mA    | Including load termination current. See <a href="#">Figure 35</a> for termination.  |
| Current Consumption Output Disabled with Termination    | Idd_od_wt    | –     | 34.5     | 41    | mA    | Including load termination current. See <a href="#">Figure 35</a> for termination. Driver output is at logic-high voltage levels. |
| <b>Output Characteristics</b>                           |              |       |          |       |       |   |
| Differential Output Voltage                             | VOD          | 250   | 360      | 450   | mV    | See <a href="#">Figure 21</a> for waveform.   |
| Delta VOD   | $\Delta$ VOD | –     | –        | 50    | mV    | See <a href="#">Figure 21</a> for waveform.   |
| Offset Voltage  | VOS          | 1.125 | 1.25     | 1.375 | V     | See <a href="#">Figure 21</a> for waveform.   |
| Delta VOS   | $\Delta$ VOS | –     | –        | 50    | mV    | See <a href="#">Figure 21</a> for waveform.   |
| Rise/Fall Time  | Tr, Tf       | –     | 290      | 340   | ps    | Measured 20% to 80% using <a href="#">Figure 35</a> for termination. See <a href="#">Figure 20</a> for waveform.                  |
| Differential Asymmetry, peak-peak                       | V_da         | –     | 25       | –     | mV    | See <a href="#">Figure 22</a> for waveform.   |
| Differential Skew, peak                                 | V_ds         | –     | $\pm$ 40 | –     | ps    | See <a href="#">Figure 23</a> for waveform.   |
| Overshoot Voltage, peak                                 | V_ov         | –     | 8        | –     | %     | Measured as percent of VOD. See <a href="#">Figure 25</a> for waveform.   |
| <b>Power Supply Noise Immunity</b>                      |              |       |          |       |       |   |
| Power Supply-Induced Jitter Sensitivity                 | PSJS         | –     | 18       | –     | fs/mV | Power supply ripple from 10 kHz to 20 MHz   |
|   | PSJS         | –     | 3.5      | –     | fs/mV | Power supply ripple from 10 kHz to 20 MHz. Using RC power supply filter as shown in <a href="#">Figure 13</a> .                   |
| Power Supply-Induced Phase Noise                        | PSPN         | –     | -73      | –     | dBc   | 50 mV peak-peak ripple on VDD.  |
|   | PSPN         | –     | -88      | –     | dBc   | 50 mV peak-peak ripple on VDD. Using RC power supply filter as shown in <a href="#">Figure 13</a> .                               |

**Table 9. Electrical Characteristics – LVDS** | Supply voltage (“order code”): 1.8 V  $\pm$ 5% (“18”), 1.71 V to 3.63 V (“YY”). All typical specifications are measured at nominal supply of 2.5V and nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 13](#) and [Figure 14](#) for test setups.

| Parameter   | Symbol       | Min.  | Typ.     | Max.  | Unit  | Condition   |
|---|--------------|-------|----------|-------|-------|---|
| <b>Current Consumption</b>                              |              |       |          |       |       |   |
| Current Consumption, Output Enabled without Termination | Idd_oe_nt    | –     | 25.5     | 32    | mA    | Excluding load termination current.   |
| Current Consumption, Output Enabled with Termination    | Idd_oe_wt    | –     | 29       | 35    | mA    | Including load termination current. See <a href="#">Figure 34</a> and <a href="#">Figure 35</a> for termination.  |
| Current Consumption Output Disabled with Termination    | Idd_od_wt    | –     | 34.5     | 41    | mA    | Including load termination current. See <a href="#">Figure 34</a> and <a href="#">Figure 35</a> for termination. Driver output is at logic-high voltage levels. |
| <b>Output Characteristics</b>                           |              |       |          |       |       |   |
| Differential Output Voltage                             | VOD          | 250   | 330      | 450   | mV    | See <a href="#">Figure 21</a> for waveform.   |
| Delta VOD   | $\Delta$ VOD | –     | –        | 50    | mV    | See <a href="#">Figure 21</a> for waveform.   |
| Offset Voltage  | VOS          | 1.125 | 1.25     | 1.375 | V     | See <a href="#">Figure 21</a> for waveform.   |
| Delta VOS   | $\Delta$ VOS | –     | –        | 50    | mV    | See <a href="#">Figure 21</a> for waveform.   |
| Rise/Fall Time  | Tr, Tf       | –     | 290      | 340   | ps    | Measured 20% to 80% using <a href="#">Figure 35</a> for termination. See <a href="#">Figure 20</a> for waveform.  |
| Differential Asymmetry, peak-peak                       | V_da         | –     | 25       | –     | mV    | See <a href="#">Figure 22</a> for waveform.   |
| Differential Skew, peak                                 | V_ds         | –     | $\pm$ 40 | –     | ps    | See <a href="#">Figure 23</a> for waveform.   |
| Overshoot Voltage, peak                                 | V_ov         | –     | 8        | –     | %     | Measured as percent of VOD. See <a href="#">Figure 25</a> for waveform.   |
| <b>Power Supply Noise Immunity</b>                      |              |       |          |       |       |   |
| Power Supply-Induced Jitter Sensitivity                 | PSJS         | –     | 22.5     | –     | fs/mV | Power supply ripple from 10 kHz to 20 MHz   |
|   |              | –     | 3.5      | –     | fs/mV | Power supply ripple from 10 kHz to 20 MHz. Using RC power supply filter as shown in <a href="#">Figure 13</a> .   |
| Power Supply-Induced Phase Noise                        | PSPN         | –     | -71      | –     | dBc   | 50 mV peak-peak ripple on VDD.  |
|   |              | –     | -88      | –     | dBc   | 50 mV peak-peak ripple on VDD. Using RC power supply filter as shown in <a href="#">Figure 13</a> .   |

**Table 10. Electrical Characteristics – HCSL** | Supply voltage (“order code”): 2.5 V  $\pm$ 10% (“25”), 3.3 V  $\pm$ 10% (“33”), 2.25 V to 3.63 V (“XX”), 1.8 V  $\pm$ 5% (“18”), 1.71 V to 3.63 V (“YY”). All typical specifications are measured at nominal supply of 2.5V and nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 15](#) and [Figure 16](#) for test setups.

| Parameter   | Symbol    | Min. | Typ.     | Max. | Unit  | Condition   |
|---|-----------|------|----------|------|-------|---|
| <b>Current Consumption</b>                              |           |      |          |      |       |   |
| Current Consumption, Output Enabled without Termination | Idd_oe_nt | –    | 25       | 31   | mA    | Excluding load termination current.   |
| Current Consumption, Output Enabled with Termination    | Idd_oe_wt | –    | 39.5     | 45.5 | mA    | Including load termination current. See <a href="#">Figure 36</a> for termination.  |
| Current Consumption, Output Disabled with Termination   | Idd_od_wt | –    | 45       | 52   | mA    | Including load termination current. See <a href="#">Figure 36</a> for termination. Driver output is at logic-high voltage levels. |
| <b>Output Characteristics</b>                           |           |      |          |      |       |   |
| Output High Voltage                                     | VOH       | 0.60 | 0.7      | 0.95 | V     | See <a href="#">Figure 19</a> for waveform.   |
| Output Low Voltage                                      | VOL       | -0.1 | 0        | 0.1  | V     | See <a href="#">Figure 19</a> for waveform.   |
| Output Differential Voltage Swing                       | V_Swing   | 1.1  | 1.4      | 1.6  | V     | See <a href="#">Figure 20</a> for waveform.   |
| Rise/Fall Time  | Tr, Tf    | –    | 340      | 385  | ps    | Measured 20% to 80%.<br>See <a href="#">Figure 20</a> for waveform.   |
| Differential Asymmetry, peak-peak                       | V_da      | –    | 65       | –    | mV    | See <a href="#">Figure 22</a> for waveform.   |
| Differential Skew, peak                                 | V_ds      | –    | $\pm$ 70 | –    | ps    | See <a href="#">Figure 23</a> for waveform.   |
| Overshoot Voltage, peak                                 | V_ov      | –    | 0        | –    | %     | Measured as percent of V_Swing.<br>See <a href="#">Figure 24</a> for waveform.  |
| <b>Power Supply Noise Immunity</b>                      |           |      |          |      |       |   |
| Power Supply-Induced Jitter Sensitivity                 | PSJS      | –    | 27       | –    | fs/mV | Power supply ripple from 10 kHz to 20 MHz   |
|   |           | –    | 3.5      | –    | fs/mV | Power supply ripple from 10 kHz to 20 MHz. Using RC power supply filter as shown in <a href="#">Figure 15</a> .                   |
| Power Supply-Induced Phase Noise                        | PSPN      | –    | -70      | –    | dBc   | 50 mV peak-peak ripple on VDD   |
|   |           | –    | -88      | –    | dBc   | 50 mV peak-peak ripple on VDD. Using RC power supply filter as shown in <a href="#">Figure 15</a> .                               |

**Table 11. Electrical Characteristics – Low-Power HCSL** | Supply voltage (“order code”): 2.5 V  $\pm$ 10% (“25”), 3.3 V  $\pm$ 10% (“33”), 2.25 V to 3.63 V (“XX”), 1.8 V  $\pm$ 5% (“18”), 1.71 V to 3.63 V (“YY”). All typical specifications are measured at nominal supply of 2.5V and nominal frequency of 156.25 MHz unless otherwise stated. See [Figure 17](#) and [Figure 18](#) for test setups.

| Parameter   | Symbol    | Min. | Typ.     | Max. | Unit  | Condition   |
|---|-----------|------|----------|------|-------|---|
| <b>Current Consumption</b>                              |           |      |          |      |       |   |
| Current Consumption, Output Enabled without Termination | Idd_oe_nt | –    | 26       | 31.5 | mA    | Excluding load termination current.   |
| Current Consumption, Output Enabled with Termination    | Idd_oe_wt | –    | 26.5     | 32   | mA    | Including load termination current. See <a href="#">Figure 37</a> for termination.  |
| Current Consumption, Output Disabled with Termination   | Idd_od_wt | –    | 28.5     | 35   | mA    | Including load termination current. See <a href="#">Figure 37</a> for termination. Driver output is at logic-high voltage levels. |
| <b>Output Characteristics</b>                           |           |      |          |      |       |   |
| Output High Voltage                                     | VOH       | 0.8  | 0.92     | 1.15 | V     | See <a href="#">Figure 19</a> for waveform.   |
| Output Low Voltage                                      | VOL       | -0.1 | 0        | 0.1  | V     | See <a href="#">Figure 19</a> for waveform.   |
| Output Differential Voltage Swing                       | V_Swing   | 1.6  | 1.83     | 2.0  | V     | See <a href="#">Figure 20</a> for waveform.   |
| Rise/Fall Time  | Tr, Tf    | –    | 330      | 365  | ps    | Measured 20% to 80%. See <a href="#">Figure 20</a> for waveform.  |
| Differential Asymmetry, peak-peak                       | V_da      | –    | 55       | –    | mV    | See <a href="#">Figure 22</a> for waveform.   |
| Differential Skew, peak                                 | V_ds      | –    | $\pm$ 30 | –    | ps    | See <a href="#">Figure 23</a> for waveform.   |
| Overshoot Voltage, peak                                 | V_ov      | –    | 1        | –    | %     | Measured as percent of V_Swing. See <a href="#">Figure 24</a> for waveform.   |
| <b>Power Supply Noise Immunity</b>                      |           |      |          |      |       |   |
| Power Supply-Induced Jitter Sensitivity                 | PSJS      | –    | 18       | –    | fs/mV | Power supply ripple from 10 kHz to 20 MHz   |
|   |           | –    | 6.5      | –    | fs/mV | Power supply ripple from 10 kHz to 20 MHz. Using RC power supply filter as shown in <a href="#">Figure 17</a> .                   |
| Power Supply-Induced Phase Noise                        | PSPN      | –    | -73      | –    | dBc   | 50 mV peak-peak ripple on VDD.  |
|   |           | –    | -82      | –    | dBc   | 50 mV peak-peak ripple on VDD. Using RC power supply filter as shown in <a href="#">Figure 17</a> .                               |

**Table 12. Absolute Maximum Ratings**

Operation outside the absolute maximum ratings may cause permanent damage to the part.

Performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

| Parameter  | Test Conditions | Min. | Max.      | Unit |
|--|-----------------|------|-----------|------|
| <b>Continuous Power Supply Voltage Range (Vdd)</b> |                 | -0.5 | 4.0       | V    |
| <b>Input Voltage, Maximum</b>                      | Any input pin   | —    | Vdd + 0.3 | V    |
| <b>Input Voltage, Minimum</b>                      | Any input pin   | -0.3 | —         | V    |
| <b>Storage Temperature</b>                         |                 | -65  | 150       | °C   |
| <b>Maximum Junction Temperature</b>                |                 | —    | 135       | °C   |

**Table 13. Thermal Considerations<sup>[4]</sup>**

| Package     | $\theta_{JA}$ (°C/W) | $\Psi_{JT}$ (°C/W) | $\theta_{JB}$ (°C/W) | $\theta_{JC,Top}$ (°C/W) |
|-------------|----------------------|--------------------|----------------------|--------------------------|
| 3225, 6-pin | 111                  | 5.1                | 34                   | 86                       |
| 2520, 6-pin | 126                  | 4.8                | 39                   | 118                      |
| 2016, 6-pin | 149                  | 3.9                | 40                   | 163                      |

**Notes:**

4.  $\theta_{JA}$ ,  $\Psi_{JT}$ ,  $\theta_{JB}$  and  $\theta_{JC}$  are provided according to JEDEC standards 51-2A, 51-7, 51-8, and 51-12.01 with a 25C ambient and 250 mW power consumption (typical of 1 GHz  $f_{out}$ ). The conduction thermal resistances  $\theta_{JB}$  and  $\theta_{JC}$  are obtained with the assumption that all heat flows from the junction to a heat sink through either the solder pads ( $\theta_{JB}$ ) or the top of the package ( $\theta_{JC,Top}$ ). These may be used in a two-resistor compact model. The values of  $\theta_{JA}$  and  $\Psi_{JT}$  are strongly application dependent, and we report values based on the JEDEC thermal environment.  $\theta_{JA}$  is the thermal resistance to ambient on a JEDEC PCB - it is a highly conservative estimate, since the JEDEC board does not have vias to PCB planes in the vicinity of the package.  $\Psi_{JT}$  can be used to estimate the junction temperature from measurements of the temperature at the top of the package if the thermal environment is similar to the JEDEC environment.

**Table 14. Maximum Operating Junction Temperature<sup>[5]</sup>**

| Max Operating Temperature (ambient) | Maximum Operating Junction Temperature |
|-------------------------------------|--|
| 85°C                                | 95°C                                   |
| 105°C                               | 115°C                                  |
| 125°C                               | TBD                                    |

**Notes:**

5. Datasheet specifications are not guaranteed if junction temperature exceeds the maximum operating junction temperature.

**Table 15. Environmental Compliance**

| Parameter   | Test Conditions                      | Value  | Unit |
|---|--------------------------------------|--------|------|
| <b>Mechanical Shock Resistance</b>  | MIL-STD-883F, Method 2002            | 30,000 | g    |
| <b>Mechanical Vibration Resistance</b>  | MIL-STD-883F, Method 2007            | 70     | g    |
| <b>Altitude</b>   | MIL-STD-202, Method 105, Condition C | 70,000 | ft   |
| <b>Soldering Temperature (follow standard Pb free soldering guidelines)<sup>[6]</sup></b> | MIL-STD-883F, Method 2003            | 260    | °C   |
| <b>Moisture Sensitivity Level</b>   | MSL1 @ 260°C                         |        |      |
| <b>Electrostatic Discharge (HBM)</b>  | HBM, JESD22-A114                     | 2,000  | V    |
| <b>Charge-Device Model ESD Protection</b>   | JESD220C101                          | 750    | V    |
| <b>Latch-up Tolerance</b>   | JESD78 Compliant                     |        |      |

**Notes:**

6. Please refer to [SiTime Manufacturing Notes](#).

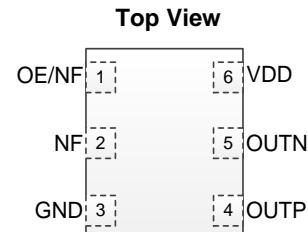
## Pin Description

**Table 16. Pin Description**

| Pin | Map   | Functionality      |   |
|-----|-------|--------------------|---|
| 1   | OE/NF | Output Enable (OE) | H <sup>[7]</sup> : Specified frequency output<br>L <sup>[8]</sup> : OUT: Logic HIGH,    |
|     |       | No Function (NF)   | Open, 120 kΩ internal pull-down resistor to GND   |
| 2   | NF    | No Function        | H or L or Open: No effect on output frequency or other device functions. <sup>[9]</sup> |
| 3   | GND   | Power              | Power Supply Ground   |
| 4   | OUTP  | Output             | Oscillator output   |
| 5   | OUTN  | Output             | Complementary oscillator output   |
| 6   | VDD   | Power              | Power supply voltage <sup>[10]</sup>  |

**Notes:**

7. OE pin includes a 120 kΩ internal pull-up resistor to VDD when active high, and a 120 kΩ internal pull-down resistor to GND when active low. In noisy environments, the OE pin is recommended to include an external 10 kΩ resistor (Use 10kΩ pull-up if active high OE; use 10kΩ pull-down if active low OE) when the pin is not externally driven.
8. Differential Logic high means OUTP=VOH, OUTN=VOL
9. Can be left open. SiTime recommends grounding it for better thermal performance.
10. A capacitor of value 0.1 µF or higher between VDD and GND pins is required.

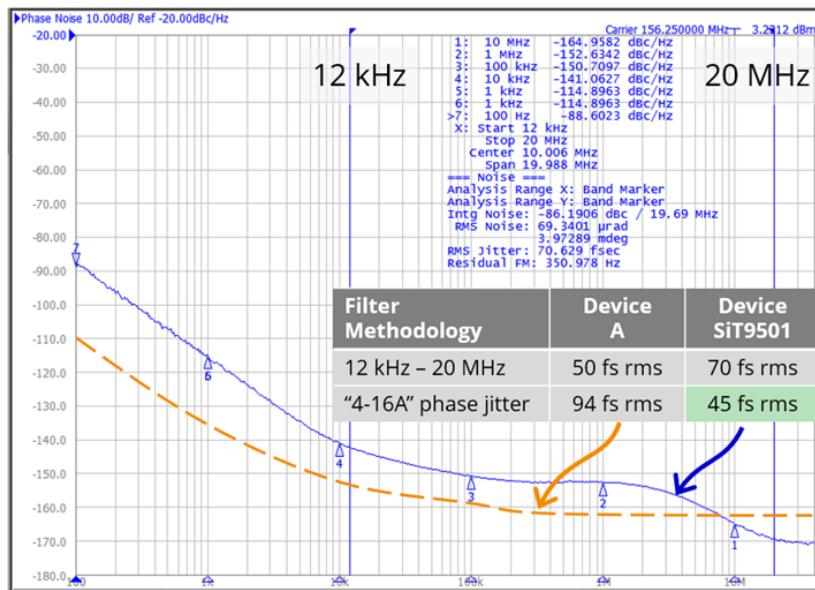


**Figure 5. Pin Assignments**

## “4-16A” Phase Jitter Methodology for SerDes Applications

Proper evaluation of reference clock (refclk) jitter is critical to optimize system performance in high-speed serial links.

Figure 6 shows how the traditional 12 kHz to 20 MHz analysis of filtering refclk jitter can mislead designers to select components that degrade rather than improve link performance. Using a more accurate filter analysis predicts a 50% reduction (45 vs 94 fs RMS) in jitter. Therefore, this datasheet replaces the legacy 12 kHz to 20 MHz filter analysis with a more accurate and established methodology adopted by several industry standards (e.g. PCI Express, CXL, UCIe) and implemented here as “4-16A” phase jitter. A brief overview follows.



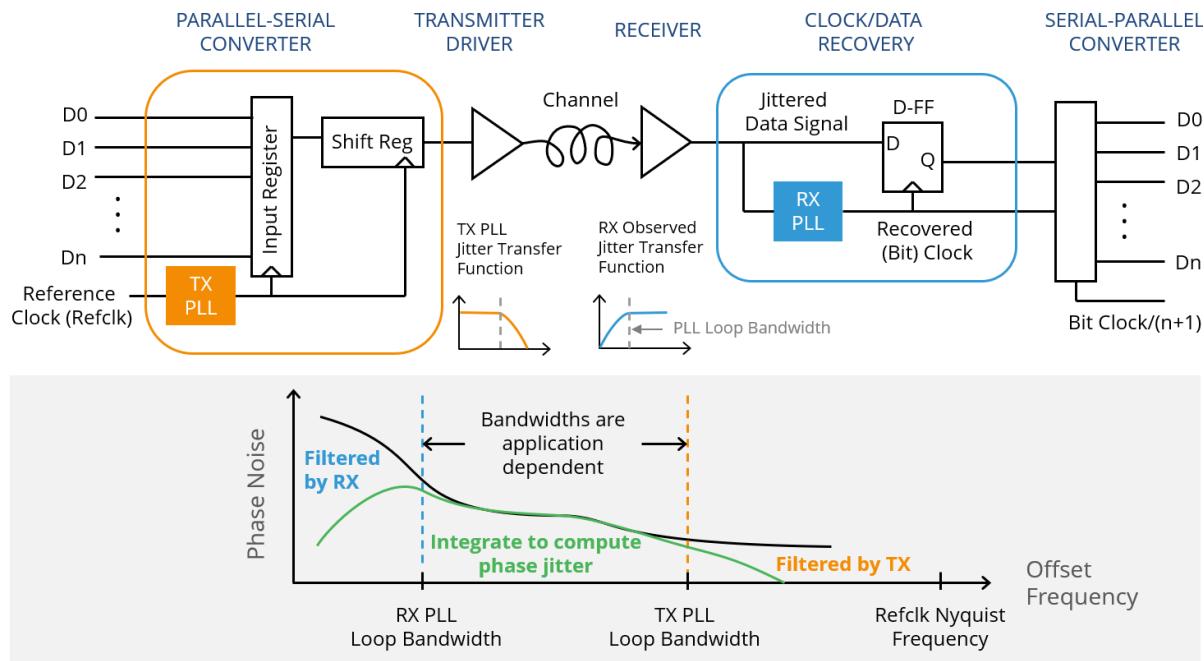
**Figure 6. Two products analyzed with 2 different methodologies lead to opposite conclusions. The “4-16A” phase jitter methodology more accurately predicts in-system performance for modern SerDes applications.**

Established in 1991 for SONET OC-48 line rates, the traditional 12 kHz to 20 MHz jitter filter served as a golden reference to evaluate refclk jitter for over 30 years. The filter is used in nearly all clock and timing datasheets today. However, the results it provides no longer correlate with system performance and can create suboptimum link performance. Sources of filter error include incorrect corner frequencies, unrealistic brick-wall roll offs and a lack of accounting for aliased phase noise. Errors of tens of femtoseconds are significant today and will become more significant as data rates increase. For these reasons, we recommend customers adopt the more accurate “4-16A” phase jitter methodology for SerDes applications.

The conventional refclk jitter analysis uses a band-pass filter, as shown in Figure 7, to extract the refclk contribution to jitter observed at the receiver. Historically the refclk jitter filter was arbitrarily applied to phase noise up to an offset equal to the refclk Nyquist frequency. However, this ignores higher-offset phase noise that aliases when the refclk is sampled by a PLL's digital phase detector. Studies have shown that extending the measured phase noise data flat to the third harmonic (or, twice the fundamental frequency in the offset-frequency axis) accurately estimates worst-case phase jitter<sup>[11]</sup>. Above the third harmonic, phase noise rolls off quickly and can be ignored.

**Note:**

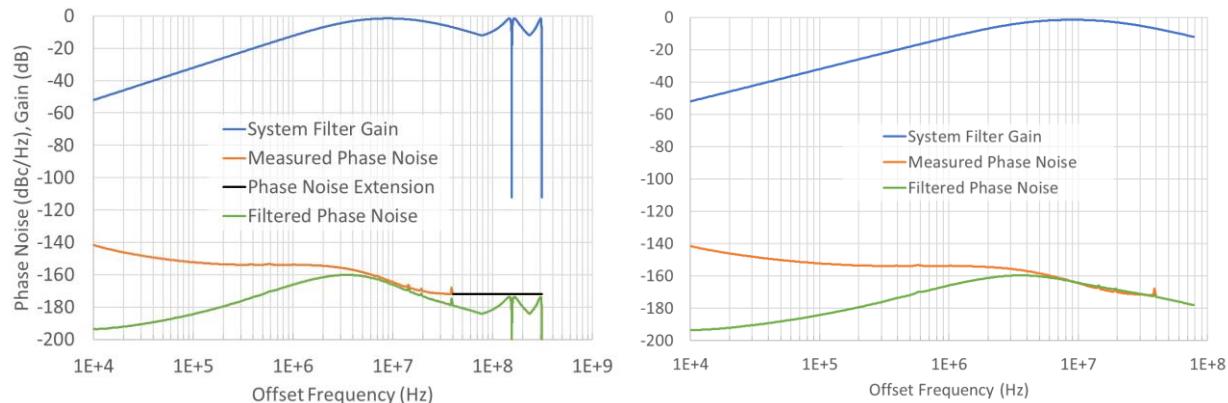
11. “How to evaluate reference-clock phase noise in high-speed serial links”, Signal Integrity Journal (May 3, 2019).



**Figure 7.** A generic serial link (top) uses a transmit PLL and receive CDR to low and high pass filter, respectively, refclk phase noise. This forms a band-pass system filter (bottom) for computing phase jitter.

The left Figure 8 chart illustrates this methodology of filtering aliased phase noise for a 156.25 MHz clock. Direct phase noise analyzer instruments (e.g., E5052B or FSWP) include an anti-aliasing filter. Thus, to account for aliasing, the phase noise is extended flat to the 3<sup>rd</sup> harmonic (468.75 MHz in the signal spectrum, or 312.5 MHz in offset frequency spectrum) and the jitter filter is folded across

Nyquist-zone boundaries (at 156.25/2, 156.25 and 156.25×3/2 MHz). Then the phase noise data is filtered and integrated to derive phase jitter. The right chart in Figure 8 illustrates a mathematically equivalent process that aliases the extended phase noise below an offset equal to the Nyquist frequency before filtering in the first Nyquist zone<sup>[11]</sup>.



**Figure 8.** Illustration of two equivalent processes to filter aliased phase noise. The left chart extends (black) the measured phase noise (orange) to the 3<sup>rd</sup> harmonic, mirrors the filter (blue) across higher Nyquist zones before deriving the filtered phase noise (green). Alternatively, the right chart aliases the extended phase noise (not shown) below the Nyquist frequency before filtering (green). Integrating either green curve produces the same phase jitter.

A shorthand label for this methodology is “#-#A” phase jitter where the first and second numbers “#” are replaced with RX CDR and TX PLL bandwidths, respectively, and assuming 20 dB/dec roll offs (unless specified otherwise), and “A” indicates that aliasing is included. For example, “4-16A” phase jitter uses 4 MHz RX and 16 MHz TX bandwidths with aliasing. Here, 4 MHz represents the most common serial standard, Ethernet, which typically specifies a CDR bandwidth of 4 MHz for 10 Gbps and higher link

rates, and 16 MHz represents a worst-case estimate for TX PLL bandwidth (the PLL becomes unstable at higher bandwidths). This shorthand terminology makes it easy to describe variations. For example, “2-10A” phase jitter describes the same methodology but for 2 MHz RX CDR and 10 MHz TX PLL bandwidths. In practice, the exact bandwidths are application dependent, and “4-16A” is simply chosen here to represent the most common application (Ethernet).

## FlexSwing Configurations

A FlexSwing output-driver performs like LVPECL and additionally provides independent control of voltage swing and DC offset voltage levels. This simplifies interfacing with chipsets having non-standard input voltage requirements

and can eliminate all external source-bias resistors. FlexSwing supports power supply voltages from 1.71 V to 3.63 V, and the programmable VOH and VOL levels may be referenced to the voltage on either VDD or GND pins.

**Table 17. FlexSwing 2-digit Order Codes specifying VHn and VLn referenced to voltage on VDD pin**

| Order Code<br>V_Swing (V) |   | VLn       |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |      |
|---------------------------|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
|                           |   | Vdd-2.31V | Vdd-2.26V | Vdd-2.21V | Vdd-2.16V | Vdd-2.11V | Vdd-2.06V | Vdd-2.01V | Vdd-1.96V | Vdd-1.91V | Vdd-1.86V | Vdd-1.82V | Vdd-1.77V | Vdd-1.72V | Vdd-1.67V | Vdd-1.62V | Vdd-1.57V | Vdd-1.52V | Vdd-1.47V | Vdd-1.42V | Vdd-1.37V | Vdd-1.32V | Vdd-1.28V |      |
| VHn                       | A |           |           |           |           |           |           |           |           | AJ        | AK        | AL        | AM        | AN        | AP        | AQ        | AR        | AS        | AT        | AU        | AV        | AW        | AX        |      |
|                           | B |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76      |      |
|                           | C |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | D |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | E |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | F |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | G |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | H |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | J |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | K |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | L |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | M |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | N |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | P |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | Q |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | R |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | S |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | T |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | U |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | V |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |
|                           | W |           |           |           |           |           |           |           |           | 1.94      | 1.86      | 1.77      | 1.69      | 1.61      | 1.52      | 1.44      | 1.35      | 1.27      | 1.18      | 1.10      | 1.01      | 0.93      | 0.85      | 0.76 |

| Supply Voltage | Available Colors |
|----------------|------------------|
| 1.8V±5%        | Not Supported    |
| 1.71V to 3.63V | Not Supported    |
| 2.5V±10%       | Blue             |
| 3.3V±10%       | Blue Red         |
| 2.25V to 3.63V | Blue             |
| Note 12        | Gray             |

**Note:**

12. Please contact SiTime.

The above table identifies supported combinations of nominal VOH (i.e. VHn) and nominal VOL (i.e. VLn) in colored boxes. The two-character code in each box corresponds to the VHn and VLn codes specified in the 2<sup>nd</sup> column and 2<sup>nd</sup> row in the table, respectively. The number in each box indicates the nominal differential swing (i.e. VHn – VLn).

For example, order code "FS" selects VHn code "F" (i.e. Vdd-1.144 V) and VLn code "S" (i.e. Vdd-1.530 V) corresponding to a V\_Swing of 0.845 V peak-peak, which may be used for supply voltages of 2.5 V ±10%, 3.3 V ±10% or (2.25 V to 3.63 V). Alternatively, an order code of "GS" corresponds to a VHn code "G" (i.e. Vdd-1.193 V) and a VLn order code "S" (e.g. Vdd-1.530 V) corresponding to a V\_Swing of 0.760 V peak-peak, which may be used for a supply voltage of 3.3 V ±10%.

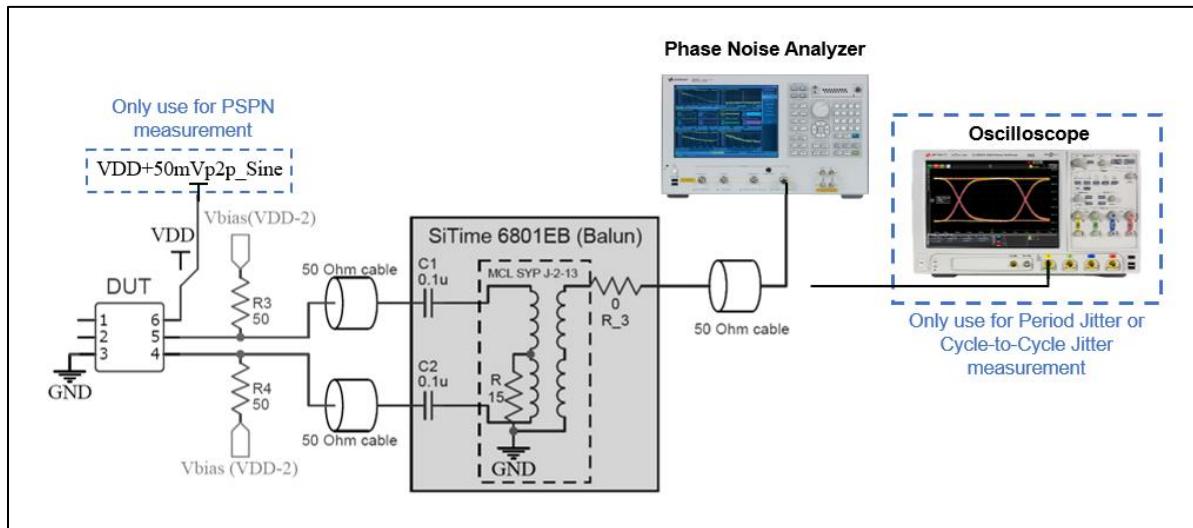
Table 18. FlexSwing 2-digit Order Codes specifying VHn and VLn referenced to voltage on GND pin

| Order Code<br>V_Swing (V) |       | Order Codes |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       |       |       |      |    |    |    |    |    |
|---------------------------|-------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|------|----|----|----|----|----|
|                           |       | C           | D     | E     | F     | G     | H     | J     | K     | L     | M     | N     | P     | Q     | R     | S    | T     | U     | V     | W    | X  | Y  |    |    |    |
| 0.45V                     | 0.49V | 0.54V       | 0.59V | 0.64V | 0.69V | 0.74V | 0.79V | 0.84V | 0.89V | 0.94V | 0.99V | 1.03V | 1.08V | 1.16V | 1.23V | 1.3V | 1.38V | 1.45V | 1.53V | 1.6V |    |    |    |    |    |
| A                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | AV    | AW    | AX   | AY |    |    |    |    |
| B                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | BV    | BW    | BX   | BY |    |    |    |    |
| C                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | CU    | CV    | CW   | CX | CY |    |    |    |
| D                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | DT    | DU    | DV   | DW | DX | DY |    |    |
| E                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | ET    | EU    | EV   | EW | EX | EY |    |    |
| F                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | FS    | FT    | FU   | FV | FW | FX | FY |    |
| G                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | GS    | GT    | GU   | GV | GW | GX | GY |    |
| H                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | HS    | HT    | HU   | HV | HW | HX | HY |    |
| J                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | JS    | JT    | JU   | JV | JW | JX | JY |    |
| K                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | KS    | KT    | KU   | KV | KW | KX | KY |    |
| L                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | LS    | LT    | LU   | LV | LW | LX | LY |    |
| M                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | MR    | MS    | MT   | MU | MV | MW | MX |    |
| N                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | NQ    | NR    | NS   | NT | NU | NV | NW |    |
| P                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | NR    | NS    | NT   | NU | NV | NW | NX | NY |
| Q                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | PP    | PQ    | PR   | PS | PT | PU | PV |    |
| R                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | QQ    | QR    | QS   | QT | QU | QV | QW | QX |
| S                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | RM    | RN    | RP   | RQ | RR | RS | RT |    |
| T                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | SL    | SM    | SN   | SP | SQ | SR | SS |    |
| U                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | TK    | TL    | TM   | TN | TP | TQ | TR |    |
| V                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | UJ    | UK    | UL   | UM | UN | UP | UR |    |
| W                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | VH    | VJ    | VL   | VM | VN | VP | VR |    |
| X                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | WG    | WH    | WJ   | WK | WL | WM | WN |    |
| Y                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | XH    | XJ    | XK   | XL | XM | XN | XP |    |
| Z                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | XF    | XG    | XH   | XJ | XK | XN | XQ |    |
| 1                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | YE    | YF    | YG   | YH | YJ | YL | YM |    |
| 2                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1C    | 1D    | 1E   | 1F | 1G | 1H | 1I |    |
| 3                         |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1D    | 1E    | 1F   | 1G | 1H | 1I | 1K |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1E    | 1F    | 1G   | 1H | 1I | 1K | 1L |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1F    | 1G    | 1H   | 1I | 1K | 1L | 1M |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1G    | 1H    | 1I   | 1K | 1L | 1M | 1N |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1H    | 1I    | 1K   | 1L | 1M | 1N | 1P |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1I    | 1K    | 1L   | 1M | 1N | 1P | 1Q |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1K    | 1L    | 1M   | 1N | 1P | 1Q | 1R |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1L    | 1M    | 1N   | 1P | 1Q | 1R | 1S |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1M    | 1N    | 1P   | 1Q | 1R | 1S | 1T |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1N    | 1P    | 1Q   | 1R | 1S | 1T | 1U |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1P    | 1Q    | 1R   | 1S | 1T | 1U | 1V |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1Q    | 1R    | 1S   | 1T | 1U | 1V | 1W |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1R    | 1S    | 1T   | 1U | 1V | 1W | 1X |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1S    | 1T    | 1U   | 1V | 1W | 1X | 1Y |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1T    | 1U    | 1V   | 1W | 1X | 1Y | 1Z |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1U    | 1V    | 1W   | 1X | 1Y | 1Z | 1A |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1V    | 1W    | 1X   | 1Y | 1Z | 1A | 1B |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1W    | 1X    | 1Y   | 1Z | 1A | 1B | 1C |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1X    | 1Y    | 1Z   | 1A | 1B | 1C | 1D |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1Y    | 1Z    | 1A   | 1B | 1C | 1D | 1E |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1Z    | 1A    | 1B   | 1C | 1D | 1E | 1F |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1A    | 1B    | 1C   | 1D | 1E | 1F | 1G |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1B    | 1C    | 1D   | 1E | 1F | 1G | 1H |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1C    | 1D    | 1E   | 1F | 1G | 1H | 1I |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1D    | 1E    | 1F   | 1G | 1H | 1I | 1J |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1E    | 1F    | 1G   | 1H | 1I | 1J | 1K |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1F    | 1G    | 1H   | 1I | 1J | 1K | 1L |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1G    | 1H    | 1I   | 1J | 1K | 1L | 1M |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1H    | 1I    | 1J   | 1K | 1L | 1M | 1N |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1I    | 1J    | 1K   | 1L | 1M | 1N | 1O |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1J    | 1K    | 1L   | 1M | 1N | 1O | 1P |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1K    | 1L    | 1M   | 1N | 1O | 1P | 1Q |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1L    | 1M    | 1N   | 1O | 1P | 1Q | 1R |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1M    | 1N    | 1O   | 1P | 1Q | 1R | 1S |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1N    | 1O    | 1P   | 1Q | 1R | 1S | 1T |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1O    | 1P    | 1Q   | 1R | 1S | 1T | 1U |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1P    | 1Q    | 1R   | 1S | 1T | 1U | 1V |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1Q    | 1R    | 1S   | 1T | 1U | 1V | 1W |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1R    | 1S    | 1T   | 1U | 1V | 1W | 1X |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1S    | 1T    | 1U   | 1V | 1W | 1X | 1Y |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1T    | 1U    | 1V   | 1W | 1X | 1Y | 1Z |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1U    | 1V    | 1W   | 1X | 1Y | 1Z | 1A |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1V    | 1W    | 1X   | 1Y | 1Z | 1A | 1B |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1W    | 1X    | 1Y   | 1Z | 1A | 1B | 1C |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1X    | 1Y    | 1Z   | 1A | 1B | 1C | 1D |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1Y    | 1Z    | 1A   | 1B | 1C | 1D | 1E |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1Z    | 1A    | 1B   | 1C | 1D | 1E | 1F |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1A    | 1B    | 1C   | 1D | 1E | 1F | 1G |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1B    | 1C    | 1D   | 1E | 1F | 1G | 1H |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1C    | 1D    | 1E   | 1F | 1G | 1H | 1I |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1D    | 1E    | 1F   | 1G | 1H | 1I | 1J |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1E    | 1F    | 1G   | 1H | 1I | 1J | 1K |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1F    | 1G    | 1H   | 1I | 1J | 1K | 1L |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1G    | 1H    | 1I   | 1J | 1K | 1L | 1M |    |
|                           |       |             |       |       |       |       |       |       |       |       |       |       |       |       |       |      |       | 1H    | 1I    | 1J   | 1K | 1L | 1M | 1N |    |

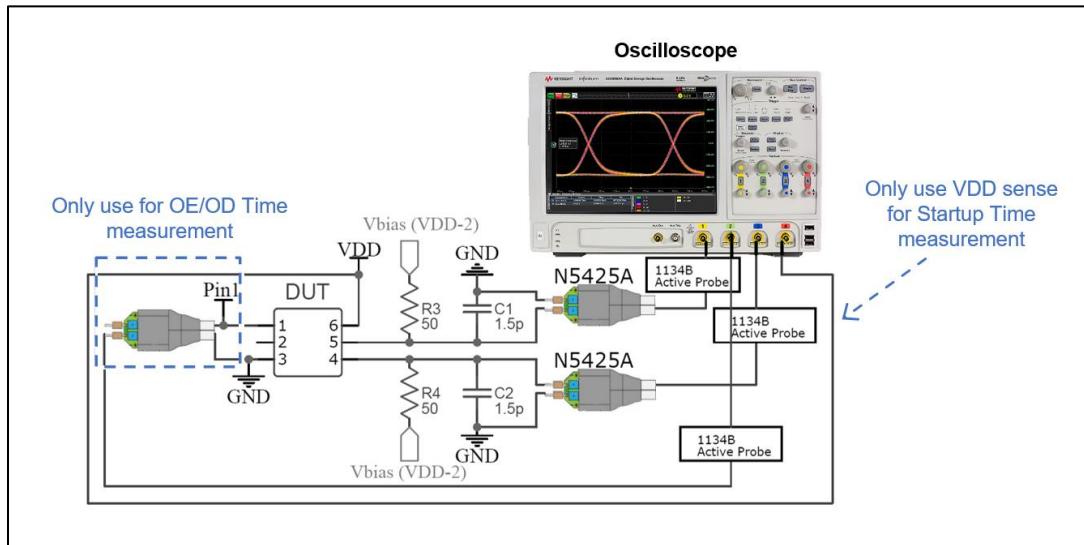
## Test Circuit Diagrams

A 1.5 pF capacitive load is used at each differential output. Because of the additive input capacitance of the active probe used with the oscilloscope, the output characteristics for all signal types are measured with a total of 2 pF capacitive load.

## Test Setups for LVPECL Measurements



**Figure 9. Test setup to measure LVPECL Phase Noise, Period Jitter, Cycle-to-Cycle Jitter, and Power Supply-Induced Phase Noise (PSPN) without filter added<sup>[14]</sup>**



**Figure 10. Test setup to measure LVPECL Waveform Characteristics, Current Consumption (with Termination 2)<sup>[15]</sup>, Output Enable/Disable Time, and Startup Time**

### Notes:

14. See [Figure 11](#) for the test setup to measure LVPECL Power Supply-Induced Phase Noise (PSPN) with filter added.
15. See [Figure 12](#) for the test setup to measure LVPECL Current Consumption with Termination 1 or without Termination.

## Test Circuit Diagrams (continued)

### Test Setups for FlexSwing Measurements<sup>[16]</sup>

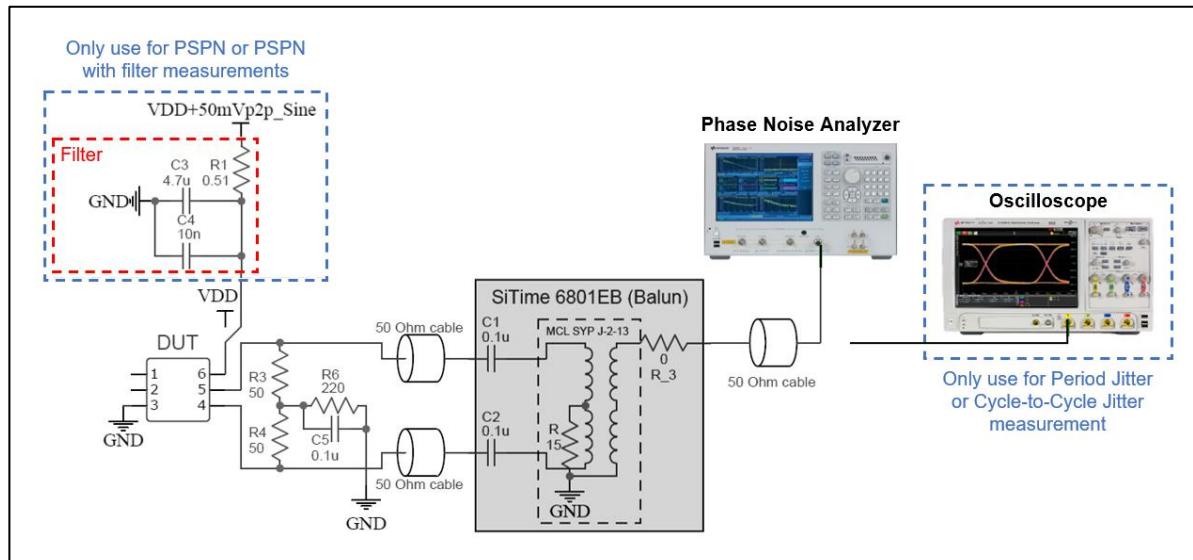


Figure 11. Test setup to measure FlexSwing Phase Noise, Period Jitter, Cycle-to-Cycle Jitter, and Power Supply-Induced Phase Noise (PSPN) with and without filter added<sup>[17]</sup>

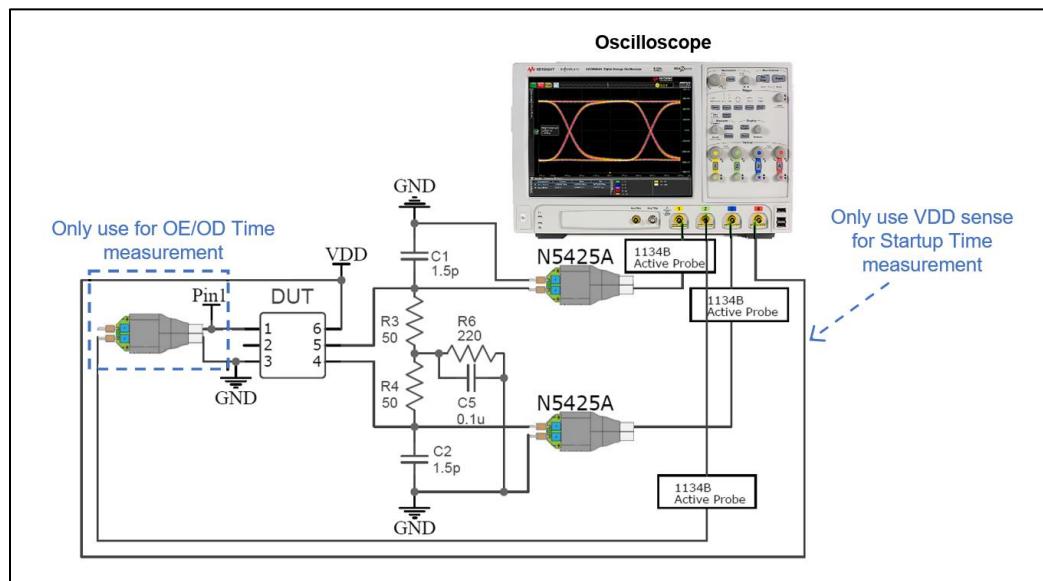


Figure 12. Test setup to measure FlexSwing Waveform Characteristics, Current Consumption<sup>[18]</sup>, Output Enable/Disable Time, and Startup Time

#### Note:

16. The same test circuits are used for FlexSwing referenced to VDD and FlexSwing referenced to GND.
17. Test setup is also used to measure LVPECL Power Supply-Induced Phase Noise (PSPN) with filter added.
18. Test setup is also used to measure LVPECL Current Consumption with Termination 1 or without Termination.

## Test Circuit Diagrams (continued)

### Test Setups for LVDS Measurements

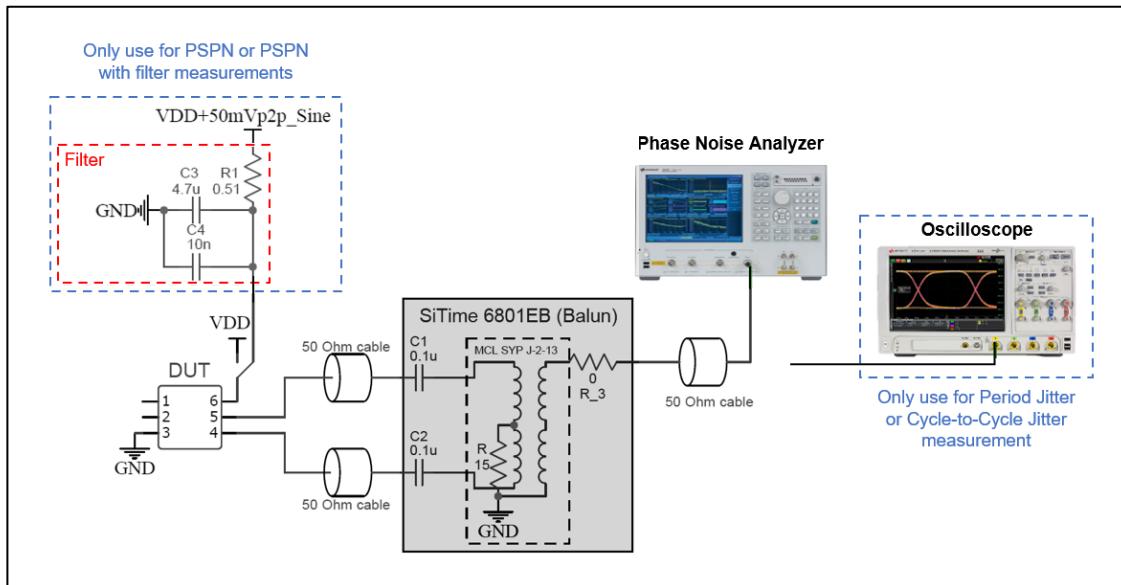


Figure 13. Test setup to measure LVDS Phase Noise, Period Jitter, Cycle-to-Cycle Jitter, and Power Supply-Induced Phase Noise (PSPN) with and without filter added

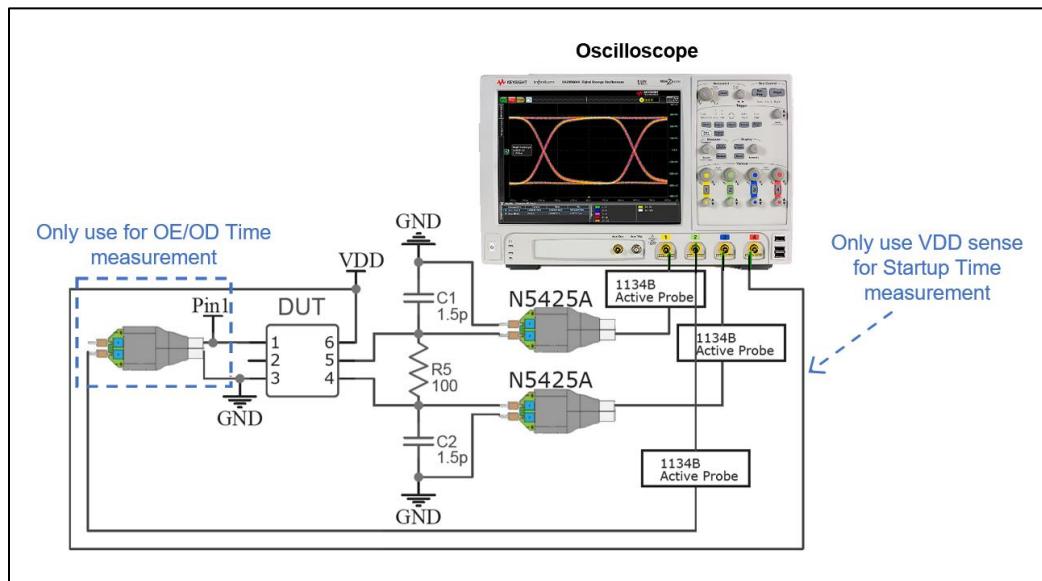
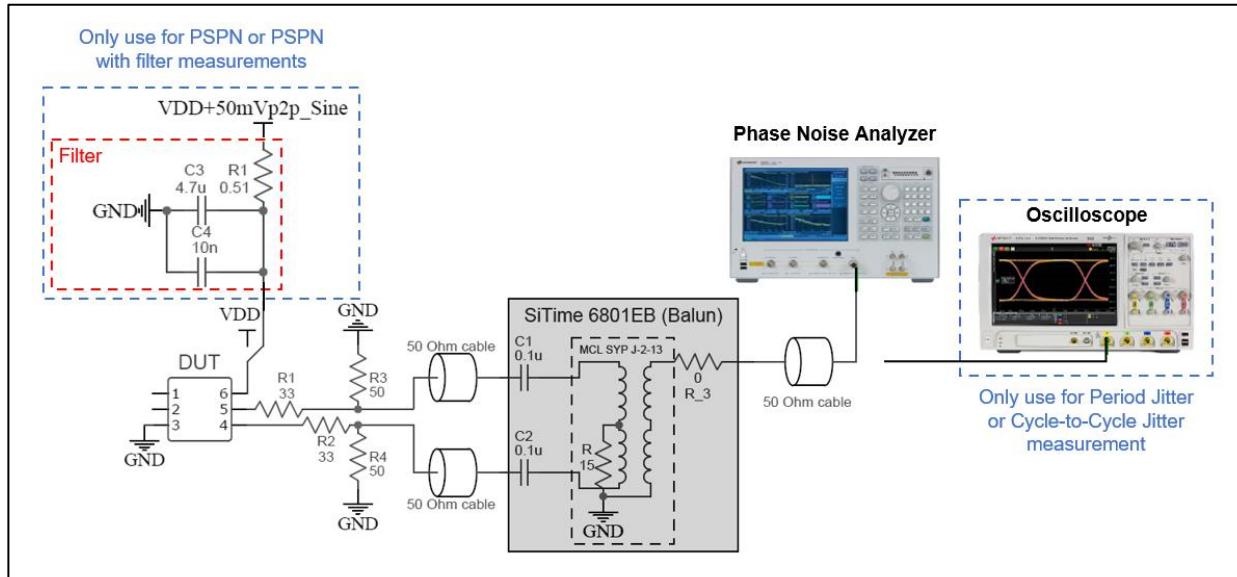


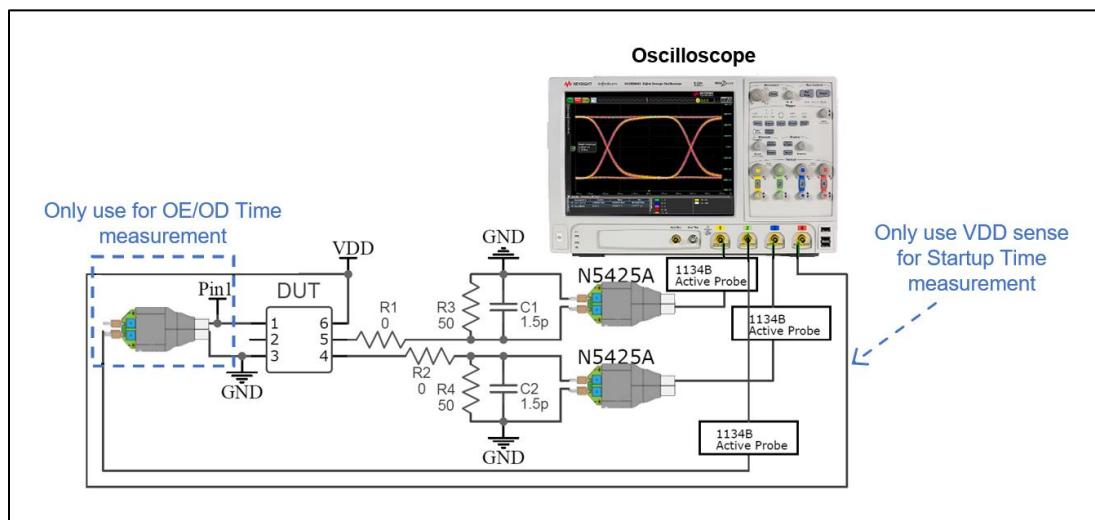
Figure 14. Test setup to measure LVDS Waveform Characteristics, Current Consumption, Output Enable/Disable Time, and Startup Time

## Test Circuit Diagrams (continued)

## Test Setups for HCSL Measurements



**Figure 15. Test setup to measure HCSL Phase Noise, Period Jitter, Cycle-to-Cycle Jitter, and Power Supply-Induced Phase Noise (PSPN) with and without filter added**



**Figure 16. Test setup to measure HCSL Waveform Characteristics, Current Consumption, Output Enable/Disable Time, and Startup Time**

## Test Circuit Diagrams (continued)

### Test Setups for Low-Power HCSL Measurements

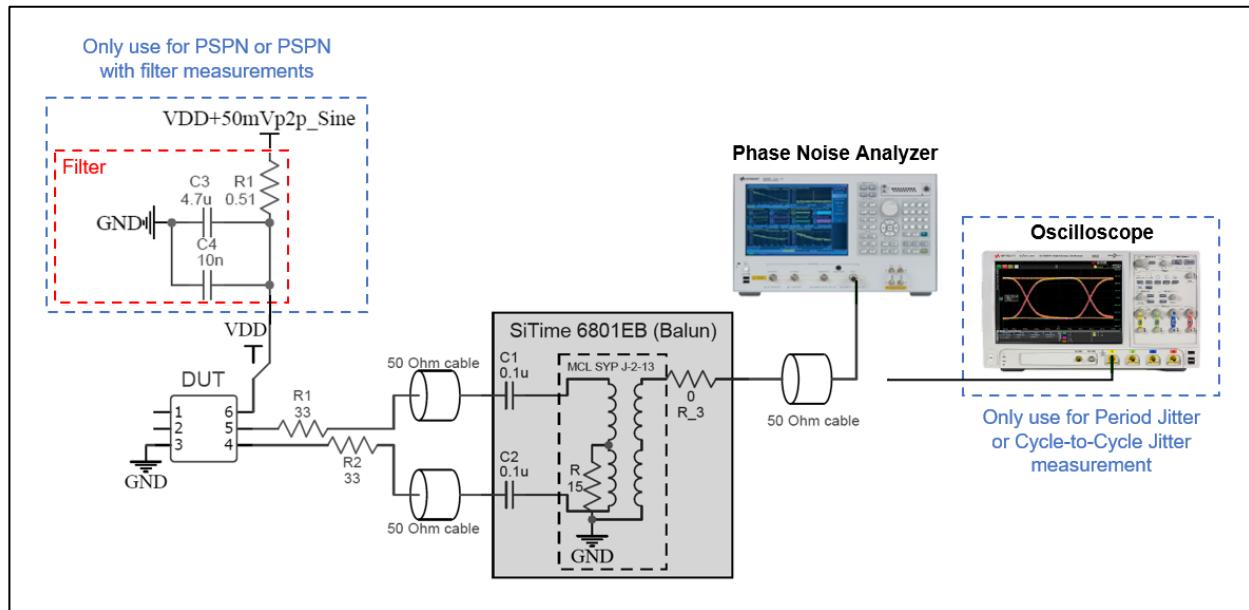


Figure 17. Test setup to measure Low-Power HCSL Phase Noise, Period Jitter, Cycle-to-Cycle Jitter, and Power Supply-Induced Phase Noise (PSPN) with and without filter added

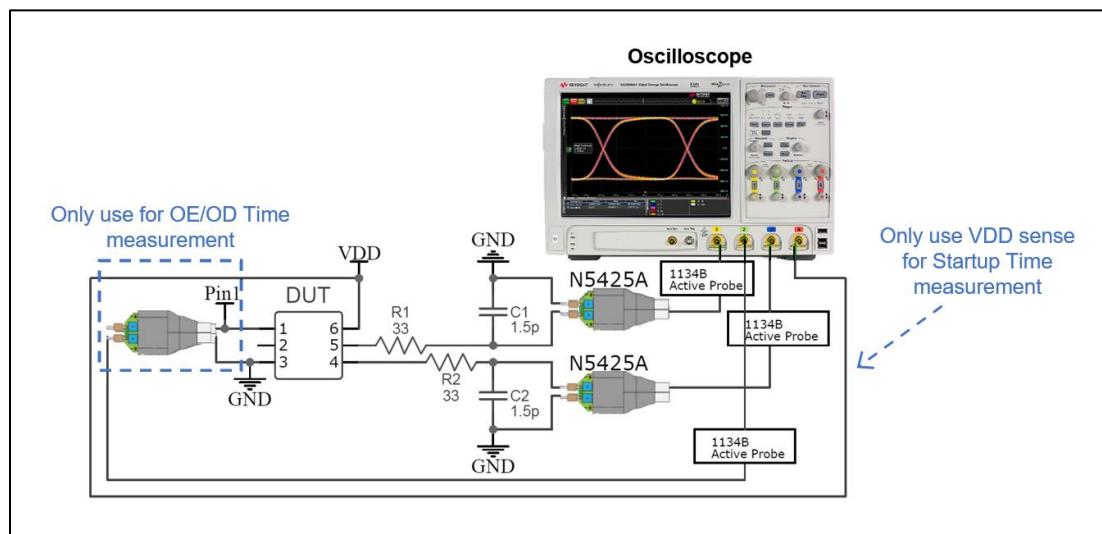


Figure 18. Test setup to measure Low-Power HCSL Waveform Characteristics, Current Consumption, Output Enable/Disable Time, and Startup Time

## Waveform Diagrams

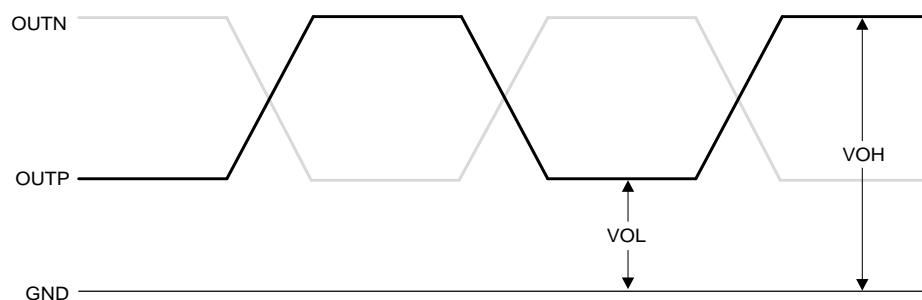


Figure 19. LVPECL, HCSL, Low-Power HCSL, and FlexSwing Voltage Levels per Differential Pin

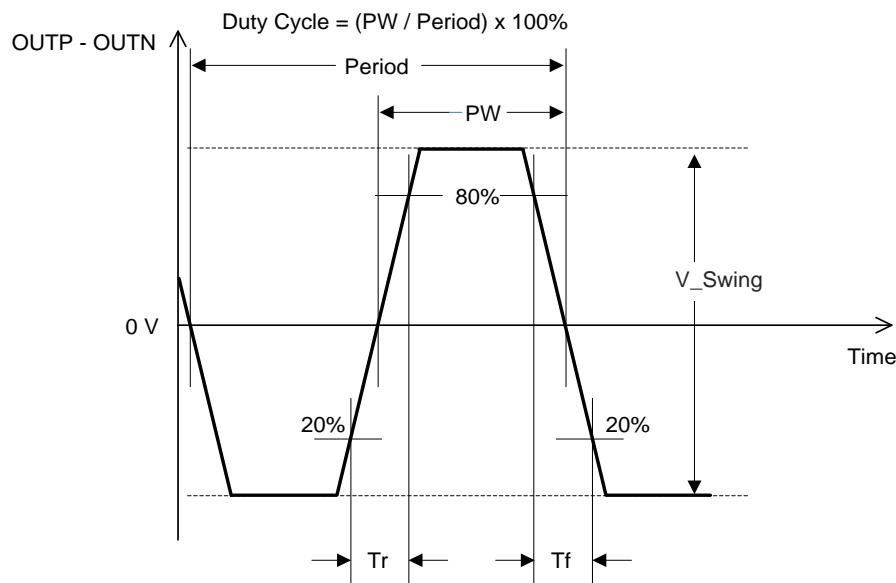


Figure 20. LVPECL, LVDS, HCSL, Low-Power HCSL, and FlexSwing Voltage Levels Across Differential Pair

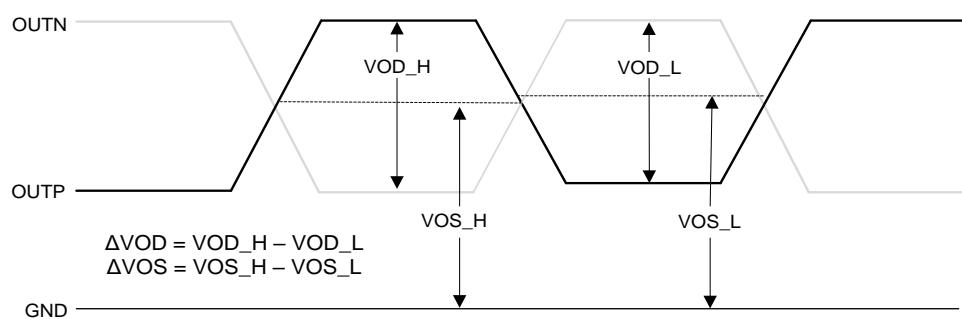
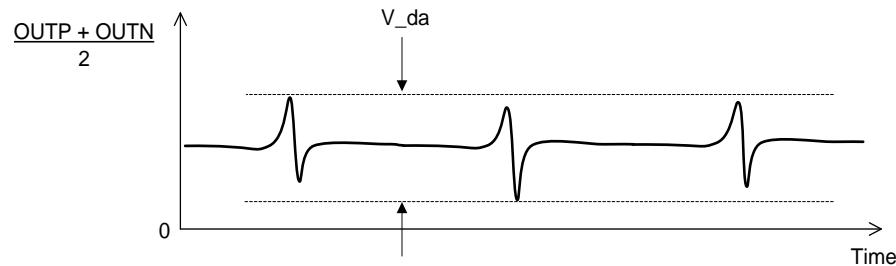
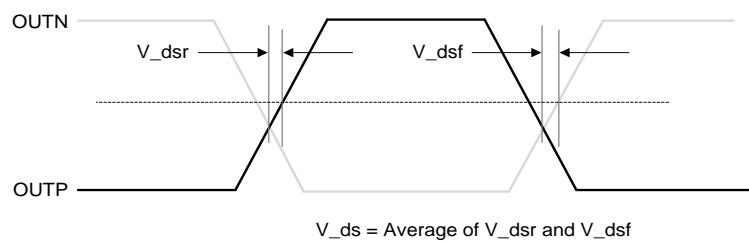
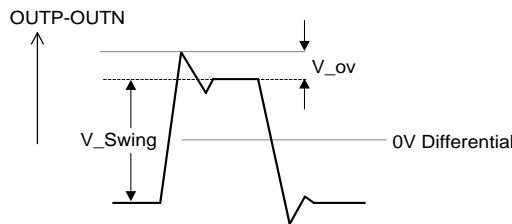
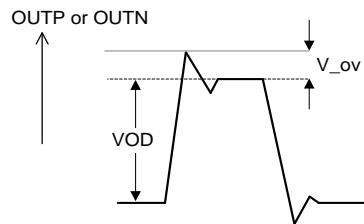
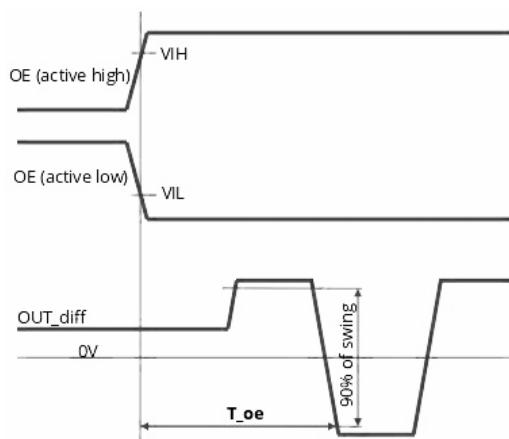
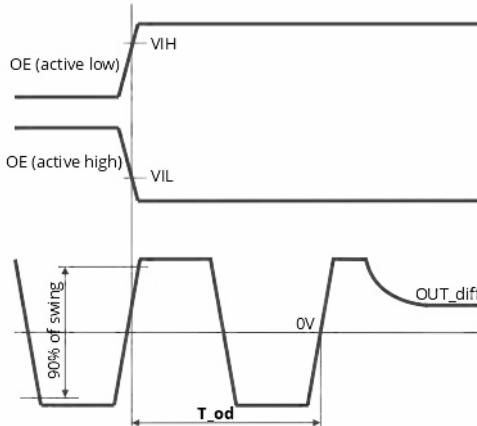


Figure 21. LVDS Voltage Levels per Differential Pin

## Waveform Diagrams (continued)

Figure 22. Differential Asymmetry ( $V_{da}$ )Figure 23. Differential Skew ( $V_{ds}$ ) is measured as the Time between the Average Voltage Level and Crossing VoltageFigure 24. Overshoot Voltage ( $V_{ov}$ ) for LVPECL, FlexSwing, HCSL, Low-power HCSLFigure 25. Overshoot Voltage ( $V_{ov}$ ) for LVDS OutputFigure 26. OE Pin Enable Timing ( $T_{oe}$ )Figure 27. OE Pin Disable Timing ( $T_{od}$ )

## Termination Diagrams

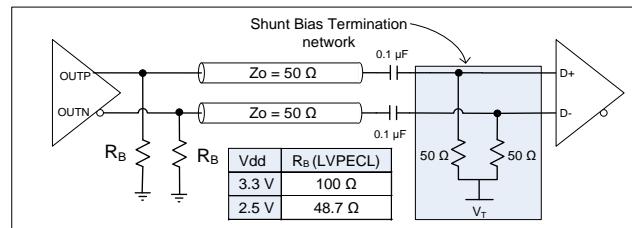
### LVPECL and FlexSwing Termination

The SiT9551 FlexSwing output drivers support low power without sacrificing signal integrity via simple terminations as shown in [Figure 29](#) and [Figure 31](#), compared to traditional LVPECL drivers. The FlexSwing and LVPECL outputs are

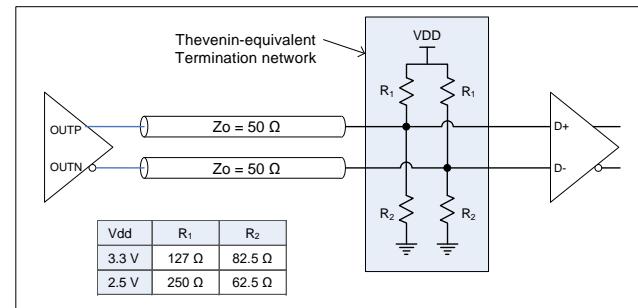
voltage-mode drivers. Use the table and figures below to select a termination circuit for the desired supply voltage. The table also provides LVPECL current consumption ( $I_{load}$ ) into the load termination.

**Table 19. Termination Options for LVPECL and FlexSwing Signaling**

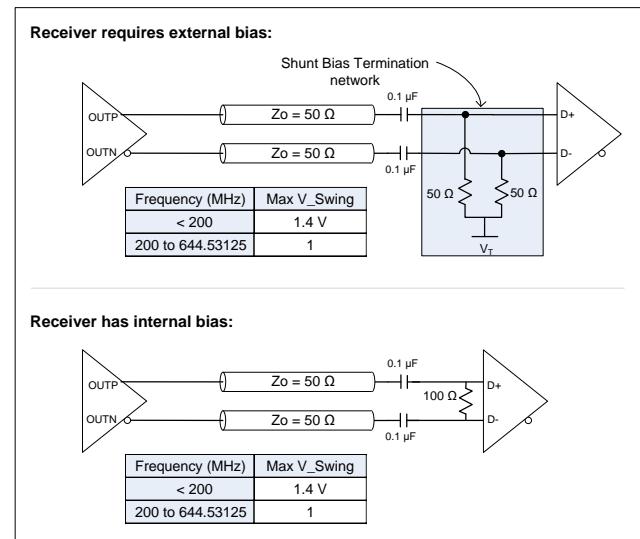
| Signaling                   | Supply Voltage Order Codes     | Termination Options  |                           |                                 |            |                                 |            |  |
|-----------------------------|--------------------------------|--|---------------------------|---------------------------------|------------|---------------------------------|------------|--|
|                             |                                | Figure 28  | Figure 29                 | Figure 30                       | Figure 31  | Figure 32                       | Figure 33  |  |
| LVPECL referenced to Vdd    | "25", "33", "XX"               | OK to use<br>$I_{load} = 40$ mA with 100 $\Omega$ near-end bias resistor                             | Do Not Use                | OK to use<br>$I_{load} = 28$ mA | OK to use  | OK to use<br>$I_{load} = 28$ mA | Do Not Use |  |
| FlexSwing referenced to Vdd |                                | OK to use <sup>[19]</sup><br>(see <a href="#">Figure 29</a> for frequency ranges and voltage swings) | OK to use <sup>[20]</sup> | OK to use                       | OK to use  | OK to use                       | Do Not Use |  |
| FlexSwing referenced to Gnd | "25", "33", "XX", "YY"<br>"18" |  | Do Not Use                | OK to use                       | Do Not Use | Do Not Use                      | Do Not Use |  |
|                             |                                |  | Do Not Use                | OK to use                       | Do Not Use | Do Not Use                      | OK to use  |  |



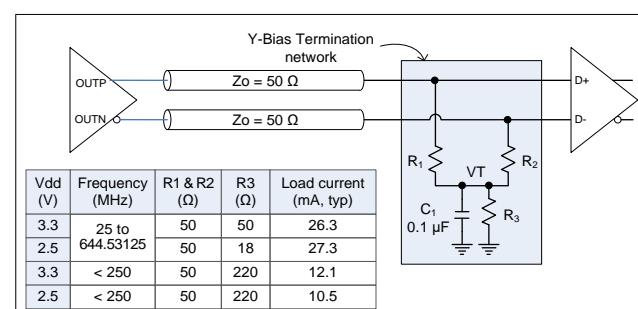
**Figure 28. Recommended LVPECL and FlexSwing<sup>[19]</sup> Termination when AC-coupled**



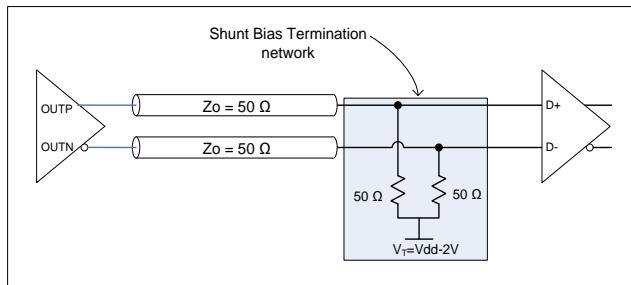
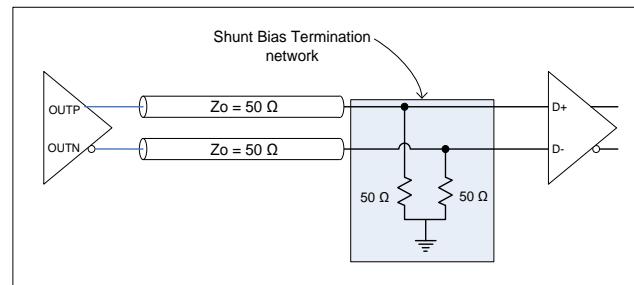
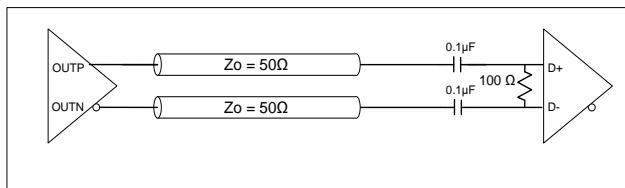
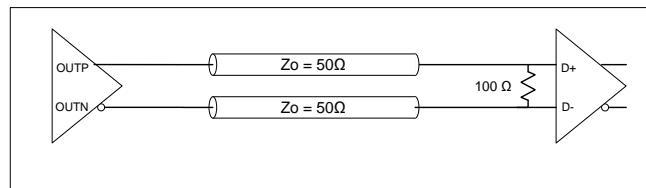
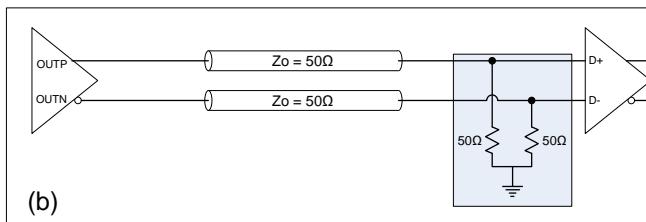
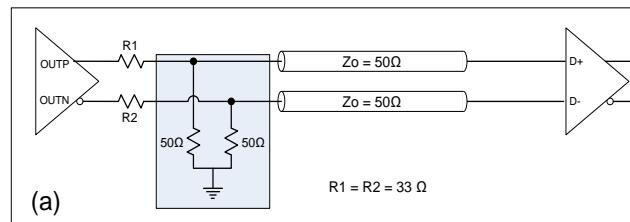
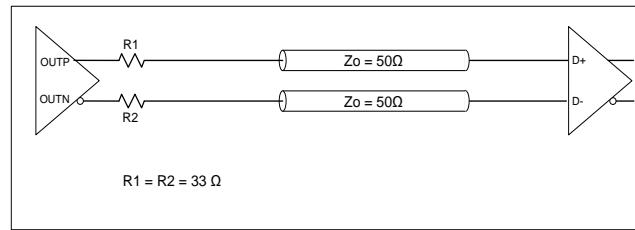
**Figure 30. LVPECL and FlexSwing DC-coupled Load Termination with Thevenin Equivalent Network<sup>[20]</sup>**



**Figure 29. Recommended FlexSwing Termination when AC-coupled**



**Figure 31. LVPECL and FlexSwing with Y-Bias Termination**

**Termination Diagrams (continued)****Figure 32. LVPECL and FlexSwing with DC-coupled Parallel Shunt Load Termination****Figure 33. FlexSwing Termination – Only for use with Supply Voltage Order Code ‘18’****LVDS, Supply Voltage: 1.8 V ±5%, 2.5 V ±10%, 3.3 V ±10%, 2.25 V to 3.63 V, 1.71 V to 3.63 V****Figure 34. LVDS AC Termination****Figure 35. LVDS DC Termination at the Load****HCSL, Supply Voltage: 1.8 V ±5%, 2.5 V ±10%, 3.3 V ±10%, 2.25 V to 3.63 V, 1.71 V to 3.63 V****Figure 36. (a) HCSL Source Termination and (b) HCSL Load Termination****Low-power HCSL, Supply Voltage: 1.8 V ±5%, 2.5 V ±10%, 3.3 V ±10%, 2.25 V to 3.63 V, 1.71 V to 3.63 V****Figure 37. Low-power HCSL Termination****Notes:**

19. Contact SiTime for optimum  $R_B$  values for FlexSwing options.
20. Contact SiTime for optimum  $R1$  and  $R2$  values for FlexSwing options.

## Dimensions and Patterns — 2.0 x 1.6 mm x mm

Package Size – Dimensions (Unit: mm)<sup>[21]</sup>

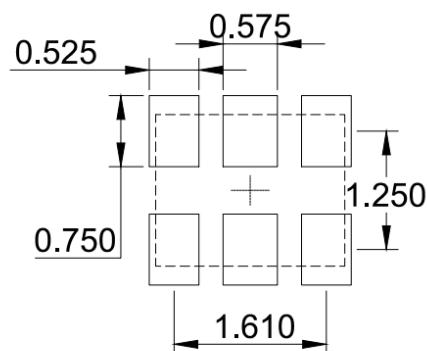
(TOP VIEW) (BOTTOM VIEW) (SIDE VIEW)

|                        | SYMBOL | MIN       | NOM   | MAX   |
|------------------------|--------|-----------|-------|-------|
| TOTAL THICKNESS        | A      | 0.700     | 0.750 | 0.800 |
| STAND OFF              | A1     | 0.000     | 0.035 | 0.050 |
| BODY SIZE              | X      | 2.000 BSC |       |       |
|                        | Y      | 1.600 BSC |       |       |
| LEAD WIDTH             | b      | 0.225     | 0.275 | 0.325 |
| LEAD LENGTH            | L      | 0.300     | 0.400 | 0.500 |
| LEAD PITCH             | e      | 0.730 BSC |       |       |
| PACKAGE TOLERANCE      | aaa    | 0.100     |       |       |
| MOLD FLATNESS          | bbb    | 0.100     |       |       |
| COPLANARITY            | ccc    | 0.080     |       |       |
| NOTE                   |        |           |       |       |
| 1. ALL DIMENSION IN MM |        |           |       |       |

**SiTime**

| PKG INFO             |             | DRAWING NO.             |       |
|----------------------|-------------|-------------------------|-------|
| 6L PQFN              |             | POD-077-PQFN-006-C02016 |       |
| 2.000x1.600x0.750 mm |             | REV                     | SHEET |
| DATE                 | 11-AUG-2024 | B03                     | 01    |

### Recommended Land Pattern (Unit: mm)<sup>[22]</sup>



Note : All units in mm.

| SiTime     | PKG INFO                 | SPL DRAWING NO. |       |
|------------|--------------------------|-----------------|-------|
|            | 6L QFN<br>2.000x1.600 mm | REV             | SHEET |
| DATE       | SPL-077-QFN-006-C02016   |                 |       |
| 2020/04/20 |                          | B00             | 01    |

### Notes:-

- 21. Top Marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
- 22. A capacitor of value 0.1  $\mu$ F or higher between VDD and GND is required. An additional 10  $\mu$ F capacitor between VDD and GND is required for the best phase jitter performance.

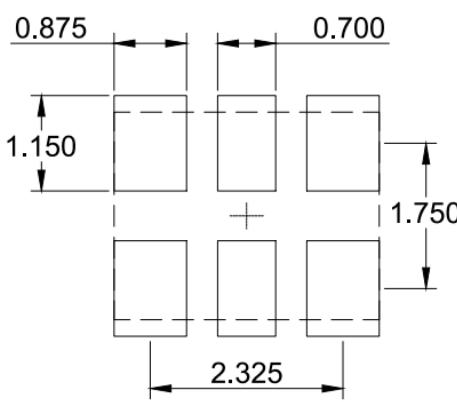
**Dimensions and Patterns — 2.5 x 2.0 mm x mm**

| Package Size – Dimensions (Unit: mm) <sup>[21]</sup> |             |                         |           |       |
|--|-------------|-------------------------|-----------|-------|
|  |             | SYMBOL                  | MIN       | NOM   |
| TOTAL THICKNESS                                      | A           | 0.800                   | 0.850     | 0.900 |
| STAND OFF  | A1          | 0.000                   | 0.035     | 0.050 |
| BODY SIZE  | X           | D                       | 2.500 BSC |       |
|  | Y           | E                       | 2.000 BSC |       |
| LEAD WIDTH   | b           | 0.330                   | 0.380     | 0.430 |
| LEAD LENGTH  | L           | 0.550                   | 0.650     | 0.750 |
| LEAD PITCH   | e           | 0.900 BSC               |           |       |
| PACKAGE TOLERANCE                                    | aaa         |                         | 0.100     |       |
| MOLD FLATNESS  | bbb         |                         | 0.100     |       |
| COPLANARITY  | ccc         |                         | 0.080     |       |
| NOTE   |             |                         |           |       |
| 1. ALL DIMENSION IN MM                               |             |                         |           |       |
|  |             |                         |           |       |
| <b>SiTime</b>  |             |                         |           |       |
| PKG INFO   |             | DRAWING NO.             |           |       |
| 6L PQFN  |             | POD-092-PQFN-006-C02520 |           |       |
| 2.500x2.000x0.850 mm                                 |             | REV                     | SHEET     |       |
| DATE   | 11-AUG-2024 | A02                     | 01        |       |

| Recommended Land Pattern (Unit: mm) <sup>[22]</sup> |                |  |                        |       |
|---|----------------|--|------------------------|-------|
|   |                |  |                        |       |
| Note : All units in mm.                             |                |  |                        |       |
| <b>SiTime</b>                                       | PKG INFO       |  | SPL DRAWING NO.        |       |
|   | 6L PQFW        |  | SPL-078-QFN-006-C02520 |       |
|   | 2.500x2.000 mm |  | REV                    | SHEET |
|   | B00            |  | 01                     |       |

## Dimensions and Patterns — 3.2 x 2.5 mm x mm

| Package Size – Dimensions (Unit: mm) <sup>[21]</sup> |             |                         |       |       |  |  |  |
|--|-------------|-------------------------|-------|-------|--|--|--|
|  |             | SYMBOL                  | MIN   | NOM   |  |  |  |
| TOTAL THICKNESS                                      | A           | 0.800                   | 0.850 | 0.900 |  |  |  |
| STAND OFF  | A1          | 0.000                   | 0.035 | 0.050 |  |  |  |
| BODY SIZE  | X           | D                       | 3.200 | BSC   |  |  |  |
|  | Y           | E                       | 2.500 | BSC   |  |  |  |
| LEAD WIDTH   | b           | 0.550                   | 0.600 | 0.650 |  |  |  |
| LEAD LENGTH  | L           | 0.650                   | 0.700 | 0.750 |  |  |  |
|  | L1          | 0.800 REF               |       |       |  |  |  |
| LEAD PITCH   | e           | 1.100 BSC               |       |       |  |  |  |
| PACKAGE TOLERANCE                                    | aaa         | 0.100                   |       |       |  |  |  |
| MOLD FLATNESS  | bbb         | 0.100                   |       |       |  |  |  |
| COPLANARITY  | ccc         | 0.080                   |       |       |  |  |  |
| DIMPLE WIDTH   | T           | 0.150 REF               |       |       |  |  |  |
| DIMPLE LENGTH  | P           | 0.150 REF               |       |       |  |  |  |
| DIMPLE DEPTH   | A2          | 0.100 REF               |       |       |  |  |  |
| NOTE   |             |                         |       |       |  |  |  |
| 1. ALL DIMENSION IN MM                               |             |                         |       |       |  |  |  |
| <b>SiTime</b>  |             |                         |       |       |  |  |  |
| PKG INFO   |             | DRAWING NO.             |       |       |  |  |  |
| 6L PQFD  |             | POD-076-PQFD-006-C03225 |       |       |  |  |  |
| 3.200x2.500x0.850 mm                                 |             | REV                     | SHEET |       |  |  |  |
| DATE   | 11-AUG-2024 | B02                     | 01    |       |  |  |  |

| Recommended Land Pattern (Unit: mm) <sup>[22]</sup>                                  |  |                |                        |       |
|--|--|----------------|------------------------|-------|
|  |  |                |                        |       |
| Note : All units in mm.  |  |                |                        |       |
| <b>SiTime</b>  |  | PKG INFO       | SPL DRAWING NO.        |       |
| DATE   |  | 6L QFN         | SPL-076-QFN-006-C03225 |       |
| 2020/04/20   |  | 3.200x2.500 mm | REV                    | SHEET |
|  |  |                | B00                    | 01    |

## Additional Information

**Table 20. Additional Information**

| Document  | Description  | Download Link   |
|---|--|---|
| <b>ECCN #:</b> EAR99                            | Five character designation used on the commerce Control List (CCL) to identify dual use items for export control purposes.           | —   |
| <b>HTS Classification Code:</b><br>8542.39.0000 | A Harmonized Tariff Schedule (HTS) code developed by the World Customs Organization to classify/define internationally traded goods. | —   |
| <b>Manufacturing Notes</b>                      | Tape & Reel dimension, reflow profile and other manufacturing related info   | <a href="https://www.sitime.com/support/resource-library/manufacturing-notes-sitime-products">https://www.sitime.com/support/resource-library/manufacturing-notes-sitime-products</a>                                 |
| <b>Termination Techniques</b>                   | Termination design recommendations   | <a href="http://www.sitime.com/support/application-notes">http://www.sitime.com/support/application-notes</a>   |
| <b>Layout Techniques</b>                        | Layout recommendations   | <a href="http://www.sitime.com/support/application-notes">http://www.sitime.com/support/application-notes</a>   |
| <b>Evaluation Boards</b>                        | SiT6760EB  | <a href="https://www.sitime.com/support/resource-library/user-manuals/sit6760eb-evaluation-board-user-manual">https://www.sitime.com/support/resource-library/user-manuals/sit6760eb-evaluation-board-user-manual</a> |

## Revision History

**Table 21. Revision History**

| Revision | Release Date | Change Summary                   |
|----------|--------------|----------------------------------|
| 1.2      | 27-Aug-2024  | Datasheet for production release |

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