Si5315

Synchronous Ethernet/Telecom Jitter Attenuating Clock Multiplier

Features

- Provides jitter attenuation and frequency translation between SONET/PDH and Ethernet
- Supports ITU-T G.8262 Synchronous Ethernet equipment slave clock (EEC option 1 and 2) requirements with optional Stratum 3 compliant timing card clock source
- Two clock inputs/two clock outputs
- Input frequency range: 8 kHz–644 MHz
- Output frequency range: 8 kHz–644 MHz
- Ultra low jitter:
  0.23 ps RMS (1.875–20 MHz)
  0.47 ps RMS (12 kHz–20 MHz)
- Simple pin control interface
- Selectable loop bandwidth for jitter attenuation: 60 to 8.4 kHz
- Automatic/Manual hitless switching and holdover during loss of inputs clock
- Programmable output clock signal format: LVPECL, LVDS, CML or CMOS
- 40 MHz crystal or XO reference
- Single supply: 1.8, 2.5, or 3.3 V
- On-chip voltage regulator with high PSRR
- Loss of lock and loss of signal alarms
- Small size: 6 x 6 mm, 36-QFN
- Wide temperature range: –40 to +85 ºC



Ordering Information:

See page 48.

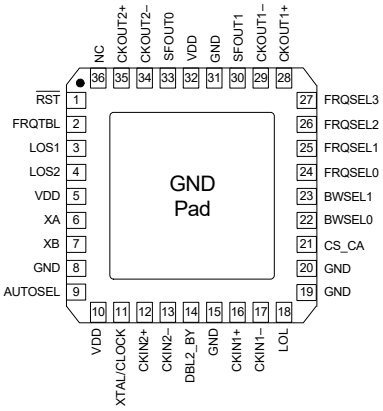
Applications

- Synchronous Ethernet line cards
- SONET OC-3/12/48 line cards
- PON OLT/ONU
- Carrier Ethernet switches routers
- MSAN / DSLAM
- T1/E1/DS3/E3 line cards

Description

The Si5315 is a jitter-attenuating clock multiplier for Gb and 10G Synchronous Ethernet, SONET/SDH, and PDH (T1/E1) applications. The Si5315 supports SyncE EEC options 1 and 2 when paired with a timing card that implements the required wander filter. The Si5315 accepts dual clock inputs ranging from 8 kHz to 644.53 MHz and generates two equal frequency-multiplied clock outputs ranging from 8 kHz to 644.53 MHz. The input clock frequency and clock multiplication ratio are selectable from a table of popular SyncE and T1/E1 rates. The Si5315 is based on Skyworks Solutions' third-generation DSPLL® technology, which provides any-frequency synthesis and jitter attenuation in a highly integrated PLL solution that eliminates the need for external VCXO and loop filter components. The DSPLL loop bandwidth is user programmable, providing jitter performance optimization at the application level.

Pin Assignments



Functional Block Diagram

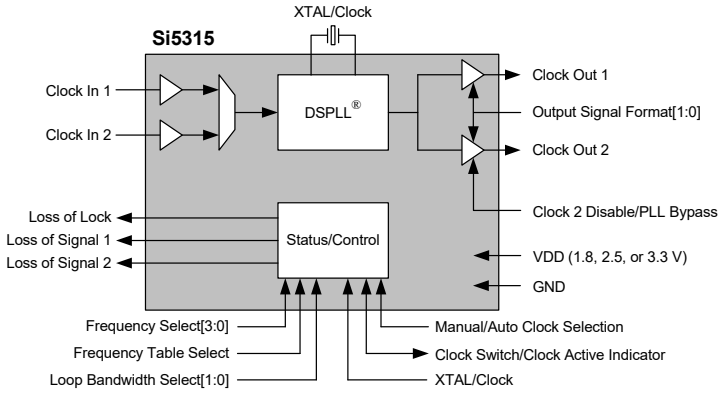


TABLE OF CONTENTS

Section	Page
1. Electrical Specifications	**4**
1.1. Three-Level (3L) Input Pins (No External Resistors)	11
1.2. Three-Level (3L) Input Pins (With External Resistors)	12
2. Typical Application Circuit	**14**
3. System Level Overview	**15**
4. Functional Description	**16**
4.1. Overview	16
4.2. PLL Performance	17
5. Frequency Plan Tables	**19**
5.1. Frequency Multiplication Plan	19
5.2. PLL Self-Calibration	29
5.3. Input Clock Control	30
5.4. Alarms	31
5.5. Holdover Mode	32
5.6. PLL Bypass Mode	32
6. High-Speed I/O	**34**
6.1. Input Clock Buffers	34
6.2. Output Clock Drivers	36
7. Crystal/Reference Clock Input	**38**
7.1. Crystal/Reference Clock Selection	39
8. Power Supply Filtering	**41**
9. Typical Phase Noise Plots	**42**
9.1. 10G LAN SyncE Example	42
10. Pin Descriptions: Si5315	**43**
11. Ordering Guide	**48**
12. Package Outline: 36-Pin QFN	**49**
13. PCB Land Pattern	**50**
14. Top Marking	**52**
14.1. Si5315 Top Marking (QFN)	52
14.2. Top Marking Explanation	52
Document Change List	**53**
Contact Information	**54**

1. Electrical Specifications

Table 1. Recommended Operating Conditions

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Temperature Range	T_A		–40	25	85	ºC
Supply Voltage	V_{DD}	3.3 V nominal	2.97	3.3	3.63	V
		2.5 V nominal	2.25	2.5	2.75	V
		1.8 V nominal	1.71	1.8	1.89	V

Note: All minimum and maximum specifications are guaranteed and apply across the recommended operating conditions. Typical values apply at nominal supply voltages and an operating temperature of 25 °C unless otherwise noted.

Table 2. DC Characteristics

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Supply Current (Supply current is independent of V_{DD})	I_{DD}	LVPECL Format 644.53125 MHz Out All CKOUTs Enabled[1]	—	251	279	mA
		LVPECL Format 644.53125 MHz Out Only 1 CKOUT Enabled[1]	—	217	243	mA
		CMOS Format 25.00 MHz Out All CKOUTs Enabled[2]	—	204	234	mA
		CMOS Format 25.00 MHz Out Only CKOUT1 Enabled[2]	—	194	220	mA
CKINn Input Pins						
Input Common Mode Voltage (Input Threshold Voltage)	V_{ICM}	1.8 V ± 5%	0.9	—	1.4	V
		2.5 V ± 10%	1.0	—	1.7	V
		3.3 V ± 10%	1.1	—	1.95	V
Input Resistance	CKN_{RIN}	Single-ended	20	40	60	kΩ
Input Voltage Level Limits	CKN_{VIN}		0	—	V_{DD}	V

Notes:
1. Refers to Si5315A speed grade.
2. Refers to Si5315B speed grade.
3. This is the amount of leakage that the 3L inputs can tolerate from an external driver. See Figure 3 on page 11.

Table 2. DC Characteristics (Continued)
(V_{DD} = 1.8 ±5%, 2.5 ±10%, or 3.3 V ±10%, T_A = –40 to 85 ºC)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Single-ended Input Voltage Swing	V_{ISE}	$f_{CKIN} \leq$ 212.5 MHz See Figure 2.	0.2	—	—	V_{PP}
		f_{CKIN} > 212.5 MHz See Figure 2.	0.25	—	—	V_{PP}
Differential Input Voltage Swing	V_{ID}	$f_{CKIN} \leq$ 212.5 MHz See Figure 2.	0.2	—	—	V_{PP}
		f_{CKIN} > 212.5 MHz See Figure 2.	0.25	—	—	V_{PP}
CKOUTn Output Clocks						
Common Mode	V_{OCM}	LVPECL 100 Ω load line-to-line	V_{DD} – 1.42	—	V_{DD} – 1.25	V
Differential Output Swing	V_{OD}	LVPECL 100 Ω load line-to-line	1.1	—	1.9	V_{PP}
Single Ended Output Swing	V_{SE}	LVPECL 100 Ω load line-to-line	0.5	—	0.93	V_{PP}
Differential Output Voltage	CKO_{VD}	CML 100 Ω load line-to-line	350	425	500	mV_{PP}
Common Mode Output Voltage	CKO_{VCM}	CML 100 Ω load line-to-line	—	V_{DD} – 0.36	—	V
Differential Output Voltage	CKO_{VD}	LVDS 100 Ω load line-to-line	500	700	900	mV_{PP}
		Low swing LVDS 100 Ω load line-to-line	350	425	500	mV_{PP}
Common Mode Output Voltage	CKO_{VCM}	LVDS 100 Ω load line-to-line	1.125	1.2	1.275	V
Differential Output Resistance	CKO_{RD}	CML, LVPECL, LVDS, Disable	—	200	—	Ω
Output Voltage Low	CKO_{VOLLH}	CMOS	—	—	0.4	V
Output Voltage High	CKO_{VOHLH}	V_{DD} = 1.71 V CMOS	0.8 x V_{DD}	—	—	V

Notes:
1. Refers to Si5315A speed grade.
2. Refers to Si5315B speed grade.
3. This is the amount of leakage that the 3L inputs can tolerate from an external driver. See Figure 3 on page 11.

Table 2. DC Characteristics (Continued)
(V_{DD} = 1.8 ±5%, 2.5 ±10%, or 3.3 V ±10%, T_A = –40 to 85 ºC)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Output Drive Current	CKO_{IO}	CMOS Driving into CKO_{VOL} for output low or CKO_{VOH} for output high. CKOUT+ and CKOUT– shorted externally.				
		V_{DD} = 1.71 V	7.5	—	—	mA
		V_{DD} = 2.97 V	32	—	—	mA
2-Level LVCMOS Input Pins						
Input Voltage Low	V_{IL}	V_{DD} = 1.71 V	—	—	0.5	V
		V_{DD} = 2.25 V	—	—	0.7	V
		V_{DD} = 2.97 V	—	—	0.8	V
Input Voltage High	V_{IH}	V_{DD} = 1.89 V	1.4	—	—	V
		V_{DD} = 2.25 V	1.8	—	—	V
		V_{DD} = 3.63 V	2.5	—	—	V
Input Low Current	I_{IL}		—	—	50	µA
Input High Current	I_{IH}		—	—	50	µA
Weak Internal Input Pull-up Resistor	R_{PUP}		—	75	—	kΩ
Weak Internal Input Pull-down Resistor	R_{PDN}		—	75	—	kΩ
3-Level Input Pins						
Input Voltage Low	V_{ILL}		—	—	0.15 x V_{DD}	V
Input Voltage Mid	V_{IMM}		0.45 x V_{DD}	—	0.55 x V_{DD}	V
Input Voltage High	V_{IHH}		0.85 x V_{DD}	—	—	V
Input Low Current	I_{ILL}	See note 3.	–20	—	—	µA
Input Mid Current	I_{IMM}	See note 3.	–2	—	2	µA
Input High Current	I_{IHH}	See note 3.	—	—	20	µA

Notes:
1. Refers to Si5315A speed grade.
2. Refers to Si5315B speed grade.
3. This is the amount of leakage that the 3L inputs can tolerate from an external driver. See Figure 3 on page 11.

Table 2. DC Characteristics (Continued)
(V_{DD} = 1.8 ±5%, 2.5 ±10%, or 3.3 V ±10%, T_A = –40 to 85 ºC)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
LVCMOS Output Pins						
Output Voltage Low	V_{OL}	I_O = 2 mA V_{DD} = 1.62 V	—	—	0.4	V
		I_O = 2 mA V_{DD} = 2.97 V	—	—	0.4	V
Output Voltage High	V_{OH}	I_O = –2 mA V_{DD} = 1.62 V	V_{DD} – 0.4	—	—	V
		I_O = –2 mA V_{DD} = 2.97 V	V_{DD} – 0.4	—	—	V
Disabled Leakage Current	I_{OZ}	$\overline{RST}$ = 0	–100	—	100	µA
Single-Ended Reference Clock Input Pin XA (XB with Cap to Gnd)						
Input Resistance	XA_{RIN}	XTAL/CLOCK = M	—	12	—	kΩ
Input Voltage Level Limits	XA_{VIN}		0	—	1.2	V
Input Voltage Swing	XA_{VPP}		0.5	—	1.2	V_{PP}
Differential Reference Clock Input Pins (XA/XB)						
Input Resistance	XA/XB_{RIN}	XTAL/CLOCK = M	—	12	—	kΩ
Differential Input Voltage Level Limits	XA/XB_{VIN}		0	—	1.2	V
Input Voltage Swing	XA_{VPP}/XB_{VPP}		0.5	—	2.4	V_{PP}

Notes:
1. Refers to Si5315A speed grade.
2. Refers to Si5315B speed grade.
3. This is the amount of leakage that the 3L inputs can tolerate from an external driver. See Figure 3 on page 11.

Table 3. AC Characteristics

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Input Frequency	CKN_F		0.008	—	644.53	MHz
CKINn Input Pins						
Input Duty Cycle (Minimum Pulse Width)	CKN_{DC}	Whichever is smaller[1]	40	—	60	%
			2	—	—	ns
Input Capacitance	CKN_{CIN}		—	—	3	pF
Input Rise/Fall Time	CKN_{TRF}	20–80% See Figure 2	—	—	11	ns
CKOUTn Output Pins						
Output Frequency (Output not configured for CMOS or disable)	CK_{OF}	Note 2	0.008	—	644.53	MHz
		Note 3	0.008	—	125	MHz
Maximum Output Frequency in CMOS Format	CKO_{FMC}		—	—	161.13	MHz
Output Rise/Fall (20–80%) at 644.5313 MHz	CKO_{TRF}	Output not configured for CMOS or disabled, see Figure 2	—	230	350	ps
Single Ended Output Rise/Fall (20–80%)	CKO_{TRF}	CMOS Output V_{DD} = 1.62 Cload = 5 pF	—	—	8	ns
		CMOS Output V_{DD} = 2.97 Cload = 5 pF	—	—	2	ns
Output Duty Cycle Differential Uncertainty	CKO_{DC}	100 Ω Load Line to Line Measured at 50% Point (not for CMOS)	—	—	±40	ps
LVCMOS Pins						
Input Capacitance	C_{in}		—	—	3	pF

Notes:
1. Assumes N3 does not equal 1. IF N3 = 1, CKN_{DC} = 50 µs.
2. Refers to Si5315A speed grade.
3. Refers to Si5315B speed grade.

Table 3. AC Characteristics (Continued)
(V_{DD} = 1.8 ±5%, 2.5 ±10%, or 3.3 V ±10%, T_A = –40 to 85 ºC)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
LVCMOS Output Pins						
Rise/Fall Times	t_{RF}	CLOAD = 20 pf See Figure 2	—	25	—	ns
LOSn Trigger Window	LOS_{TRIG}	From last CKINn ↑ to internal detection of LOSn	—	—	750	µs
Time to Clear LOL after LOS Cleared	t_{CLRLOL}	↓ LOS to ↓ LOL Assume Fold=Fnew, Stable XA-XB reference	—	10	—	ms
PLL Performance						
Output Clock Skew	t_{SKEW}	↑ of CKOUTn to ↑ CKOUTn	—	—	100	ps
Phase Change Due to Temperature Variation	t_{TEMP}	Maximum phase change from –40 to +85 °C	—	300	500	ps
Lock Time	t_{LOCKHW}	↑ $\overline{RST}$ with valid CKIN to ↓ LOL; BW = 100 Hz	—	1200	—	ms
Closed Loop Jitter Peaking	J_{PK}		—	0.05	0.1	dB
Jitter Tolerance	J_{TOL}		See 4.2.3. "Jitter Tolerance" on page 18.			ns pk-pk
Minimum Reset Pulse Width	t_{RSTMIN}		1	—	—	µs
Output Clock Initial Phase Step	t_{P_STEP}	During clock switch CKIN ≥ 19.44 MHz	—	100	200	ps
Holdover Frequency Historical Averaging Time	$t_{HISTAVG}$		—	6.7	—	sec
Holdover Frequency Historical Delay Time	$t_{HISTDEL}$		—	26.2	—	ms
Spurious Noise	SP_{SPUR}	Max spur @ n x f3 (n ≥ 1, n x f3 < 100 MHz)	—	–75	—	dBc

Notes:
1. Assumes N3 does not equal 1. IF N3 = 1, CKN_{DC} = 50 µs.
2. Refers to Si5315A speed grade.
3. Refers to Si5315B speed grade.

Table 4. Jitter Generation

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

Parameter	Symbol	Test Condition[1,2,3,4]		Min	Typ	Max	GR-253 Spec	Unit
		Measurement Filter (MHz)	DSPLL BW[1]					
Jitter Gen OC-192	J_{GEN}	0.02–80	167 Hz[5]	—	0.483	0.628	N/A	ps_{rms}
		4–80	167 Hz[5]	—	0.302	0.392	N/A	ps_{rms}
		0.05–80	167 Hz[5]	—	0.467	0.607	1.0 ps_{rms} (0.01 UI_{rms}	ps_{rms}
Jitter Gen OC-48	J_{GEN}	0.012–20	167 Hz[5]	—	0.470	0.611	4.02 ps_{rms} (0.01 UI_{rms})	ps_{rms}
			111 Hz[6]	—	0.565	0.734	4.02 ps_{rms} (0.01 UI_{rms})	ps_{rms}
IEEE 802.3 GbE RMS Jitter	J_{GEN}	1.875–20	83 Hz[6]	—	0.232	0.301		ps_{rms}

Notes:
1. BWSEL [1:0] loop bandwidth settings provided in Table 9 on page 20.
2. 40 MHz fundamental mode crystal used as XA/XB input.
3. V_{DD} = 2.5 V
4. T_A = 85 °C
5. Si5315A test condition: f_{IN} = 19.44 MHz, f_{OUT} = 156.25 MHz, LVPECL clock input: 1.19 Vppd with 0.5 ns rise/fall time (20–80%), LVPECL clock output.
6. Si5315B test condition: f_{IN} =19.44 MHz, f_{OUT} = 125 MHz, LVPECL clock input: 1.19 Vppd with 0.5 ns rise/fall time (20-80%), LVPECL clock output.

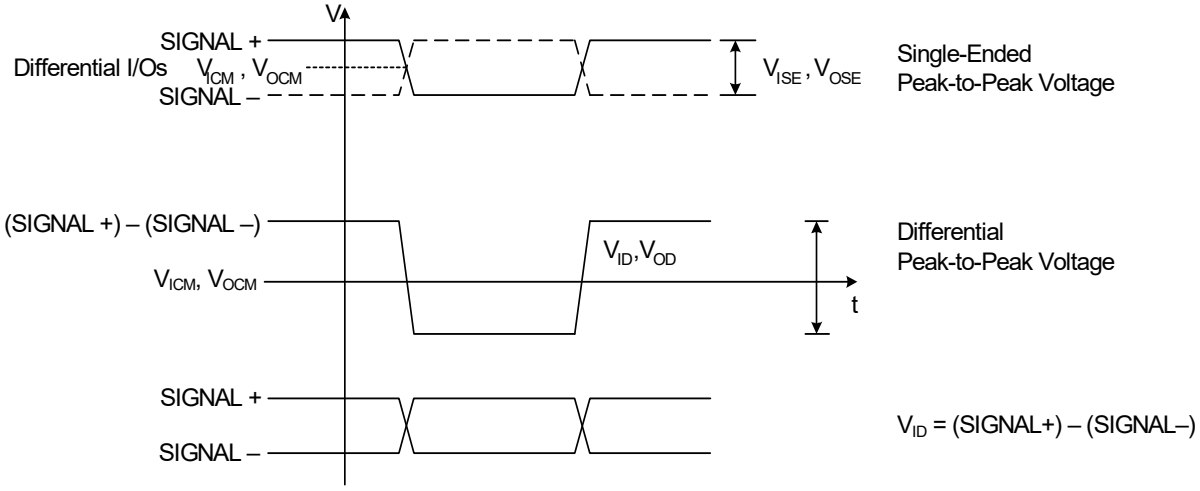


Figure 1. CKIN Voltage Characteristics

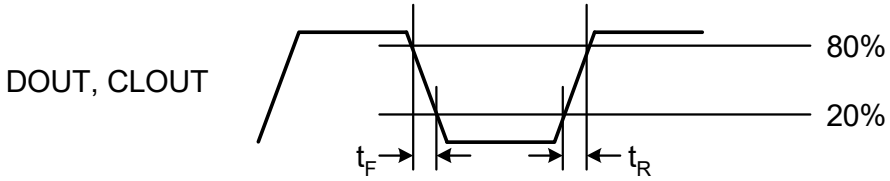


Figure 2. Rise/Fall Time Characteristics

1.1. Three-Level (3L) Input Pins (No External Resistors)

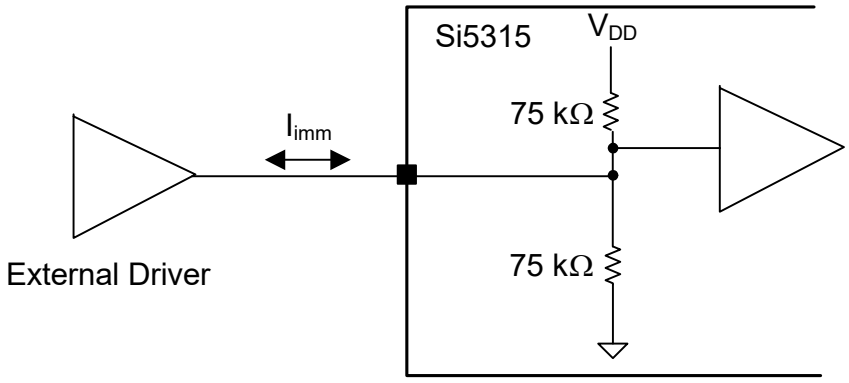
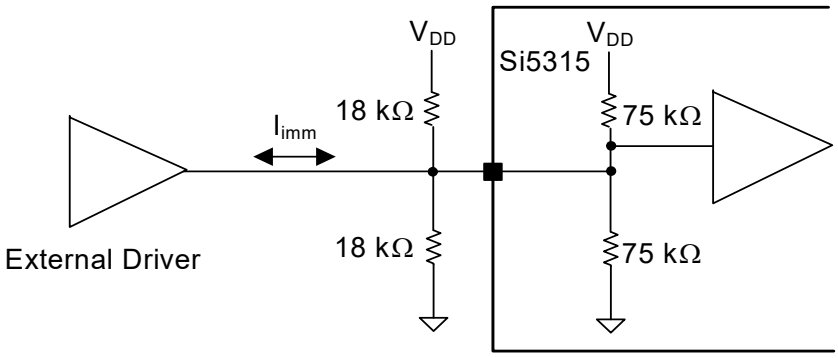


Figure 3. Three-Level Input Pins

Table 5. Three-Level Input Pins (No External Resistors)

Parameter	Symbol	Min	Max
Input Voltage Low	Vill	—	0.15 x V_{DD}
Input Voltage Mid	Vimm	0.45 x V_{DD}	0.55 x V_{DD}
Input Voltage High	Vihh	0.85 x V_{DD}	—
Input Low Current	Iill	–6 µA	—
Input Mid Current	Iimm	–2 µA	2 µA
Input High Current	Iihh	—	6 µA
Note: The above currents are the amount of leakage that the 3L inputs can tolerate from an external driver.			

1.2. Three-Level (3L) Input Pins (With External Resistors)



One of eight resistors from a Panasonic EXB-D10C183J (or similar) resistor pack

Figure 4. Three Level Input Pins

Table 6. Three-Level Input Pins (With External Resistors)

Parameter	Symbol	Min	Max
Input Low Current	Iill	–30 µA	—
Input Mid Current	Iimm	–11 µA	–11 µA
Input High Current	Iihh	—	–30 µA
Note: The above currents are the amount of leakage that the 3L inputs can tolerate from an external driver.			

- Any resistor pack may be used.
  - The Panasonic EXB-D10C183J is an example.
  - PCB layout is not critical.
- Resistor packs are only needed if the leakage current of the external driver exceeds the listed currents.
- If a pin is tied to ground or V_{DD}, no resistors are needed.
- If a pin is left open (no connect), no resistors are needed.

Table 7. Thermal Characteristics

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

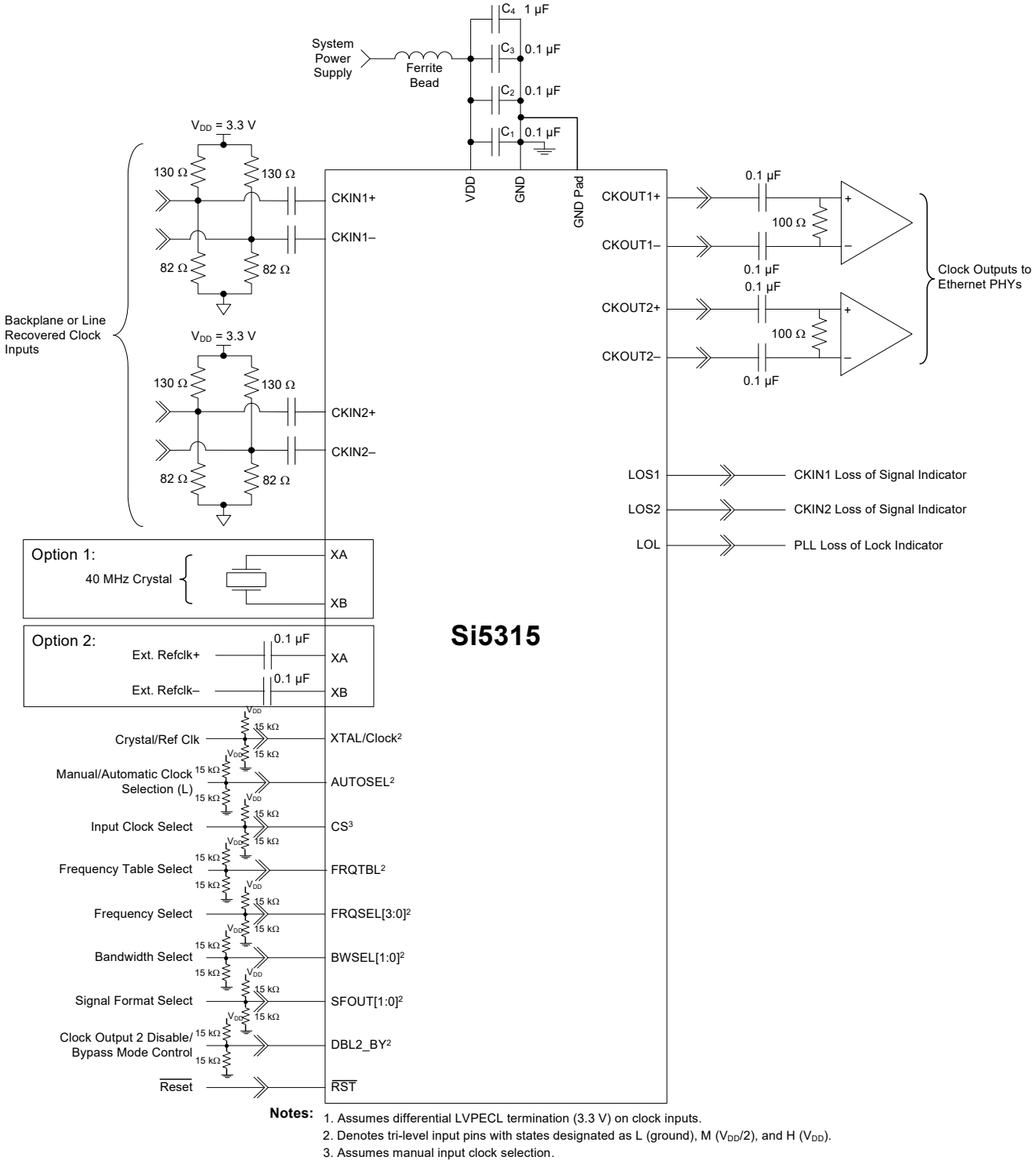
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Thermal Resistance Junction to Ambient	θ_{JA}	Still Air	—	32	—	ºC/W
Thermal Resistance Junction to Case	θ_{JC}	Still Air	—	14	—	ºC/W

Table 8. Absolute Maximum Limits

Parameter	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	–0.5 to 3.8	V
LVCMOS Input Voltage	V_{DIG}	–0.3 to (V_{DD} + 0.3)	V
CKINn Voltage Level Limits	CKN_{VIN}	0 to V_{DD}	V
XA/XB Voltage Level Limits	XA_{VIN}	0 to 1.2	V
Operating Junction Temperature	T_{JCT}	–55 to 150	C
Storage Temperature Range	T_{STG}	–55 to 150	C
ESD HBM Tolerance (100 pF, 1.5 kΩ); All pins except CKIN+/CKIN–		2	kV
ESD MM Tolerance; All pins except CKIN+/CKIN–		150	V
ESD HBM Tolerance (100 pF, 1.5 kΩ); CKIN+/CKIN–		750	V
ESD MM Tolerance; CKIN+/CKIN–		100	V
Latch-Up Tolerance		JESD78 Compliant	

Note: Permanent device damage may occur if the Absolute Maximum Ratings are exceeded. Functional operation should be restricted to the conditions as specified in the operation sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods of time may affect device reliability.

2. Typical Application Circuit



Notes:
1. Assumes differential LVPECL termination (3.3 V) on clock inputs.
2. Denotes tri-level input pins with states designated as L (ground), M (V_{DD}/2), and H (V_{DD}).
3. Assumes manual input clock selection.

Figure 5. Si5315 Typical Application Circuit

3. System Level Overview

The Si5315 provides clock translation, jitter attenuation, and clock distribution for high-performance Synchronous Ethernet* line card timing applications.

***Note:** The Si5315 supports SyncE EEC options 1 and 2 when paired with a timing card that implements the required wander filtering and Stratum 3 compliant reference clock. For detailed information, refer to "AN420: SyncE and IEEE 1588: Sync Distribution for a Unified Network".

The Si5315 provides clock translation, jitter attenuation, and clock distribution for high-performance Synchronous Ethernet line card timing applications. The device accepts two clock inputs ranging from 8 kHz to 644.53 MHz and generates two equal frequency, low jitter clock outputs ranging from 8 kHz to 644.53 MHz. For ease of use, the Si5315 is pin controlled to enable simple device configuration of frequency plans, PLL loop bandwidth, and input clock selection. The DSPLL locks to one of two input reference clocks and provides over 200 frequency translations to synchronize output clocks for Ethernet, SONET/SDH, and PDH line cards. The Si5315 implements internal state machines to control hitless switching between input clocks and holdover. Status alarms, loss of signal (LOS) and loss of lock (LOL) are provided on output pins to indicate a change in device status.

This device is designed for systems with line cards that are synchronized to a redundant, centralized telecom or Ethernet backplane. The Si5315 synchronizes to backplane clocks and generates a multiplied, jitter attenuated Ethernet/SONET/SDH clock or PDH clock. A typical system application is shown in Figure 6. The Si5315 translates a 19.44 MHz clock from the telecom backplane to an Ethernet or SONET/SDH clock frequency to the PHY and filters the jitter to ensure compliance with related ITU-T and Telcordia standards.

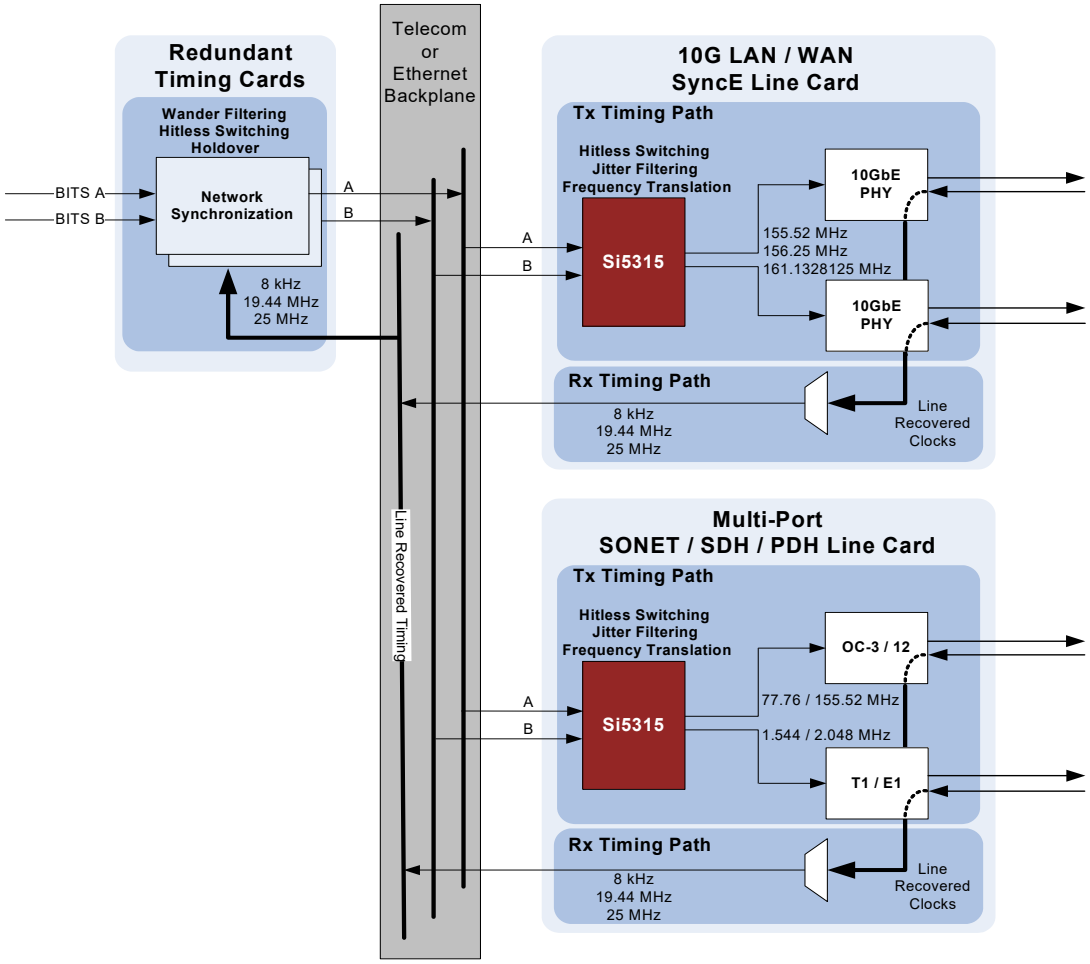


Figure 6. Typical Si5315 Application

4. Functional Description

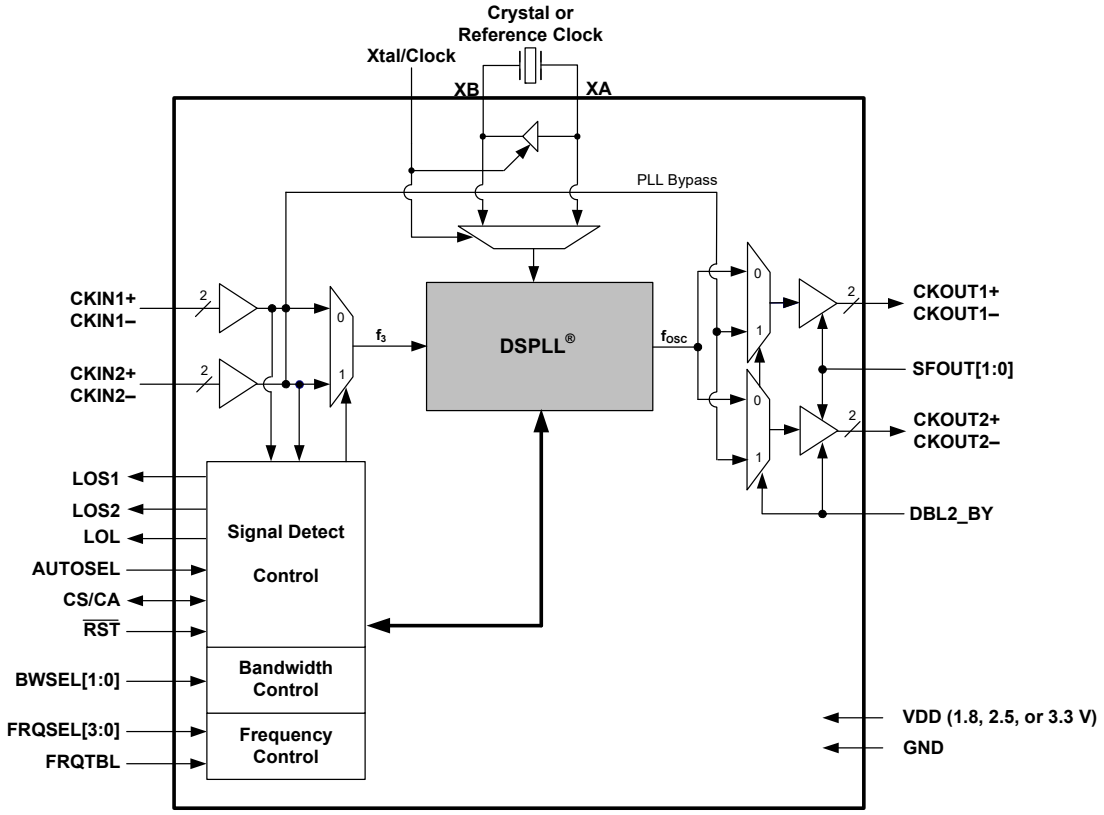


Figure 7. Detailed Block Diagram

4.1. Overview

The Si5315 is a jitter-attenuating precision clock multiplier for Synchronous Ethernet, SONET/SDH, and PDH (T1/E1) applications. The Si5315 accepts dual clock inputs ranging from 8 kHz to 644.53 MHz and generates two frequency-multiplied clock outputs ranging from 8 kHz to 644.53 MHz. The two input clocks are at the same frequency and the two output clocks are at the same frequency. The input clock frequency and clock multiplication ratio are selectable from a look up table of popular SyncE and T1/E1 rates.

The Si5315 is based on Skyworks Solutions' 3rd-generation DSPLL® technology, which provides any-frequency synthesis and jitter attenuation in a highly integrated PLL solution that eliminates the need for external VCXO and loop filter components. The Si5315 PLL loop bandwidth is selectable via the BWSEL[1:0] pins and supports a range from 60 to 8.4 kHz.

The Si5315 supports hitless switching between the two input clocks in compliance with ITU-T G.8262 and Telcordia GR-253-CORE and GR-1244-CORE. This feature greatly minimizes the propagation of phase transients to the clock outputs during an input clock transition (<200 ps typ). Manual and automatic revertive and non-revertive input clock switching options are available via the AUTOSEL input pin. The Si5315 monitors both input clocks for loss-of-signal and provides a LOS alarm when it detects missing pulses on either input clock. The device monitors the lock status of the PLL. The lock detect algorithm works by continuously monitoring the phase of the input clock in relation to the phase of the feedback clock. The Si5315 provides a holdover capability that allows the device to continue generation of a stable output clock when the selected input reference is lost.

The Si5315 has two differential clock outputs. The signal format of the clock outputs is programmable to support LVPECL, LVDS, CML, or CMOS loads. The second clock output can be powered down to minimize power consumption. For system-level debugging, a bypass mode is available which drives the output clock directly from the input clock, bypassing the internal DSPLL. The device operates from a single 1.8, 2.5, or 3.3 V supply.

4.2. PLL Performance

The Si5315 provides extremely low jitter generation, a well-controlled jitter transfer function, and high jitter tolerance due to the high level of integration.

4.2.1. Jitter Generation

Jitter generation is defined as the amount of jitter produced at the output of the device with a jitter free input clock. Generated jitter arises from sources within the VCO and other PLL components. Jitter generation is a function of the PLL bandwidth setting. Higher loop bandwidth settings may result in lower jitter generation, but may result in less attenuation of jitter that might be present on the input clock signal.

4.2.2. Jitter Transfer

Jitter transfer is defined as the ratio of output signal jitter to input signal jitter for a specified jitter frequency. The jitter transfer characteristic determines the amount of input clock jitter that passes to the outputs. The DSPLL technology used in the Si5315 provides tightly controlled jitter transfer curves because the PLL gain parameters are determined largely by digital circuits which do not vary over supply voltage, process, and temperature. In a system application, a well-controlled transfer curve minimizes the output clock jitter variation from board to board and provides more consistent system level jitter performance.

The jitter transfer characteristic is a function of the loop bandwidth setting. Lower bandwidth settings result in more jitter attenuation of the incoming clock, but may result in higher jitter generation. Figure 8 shows the jitter transfer curve mask.

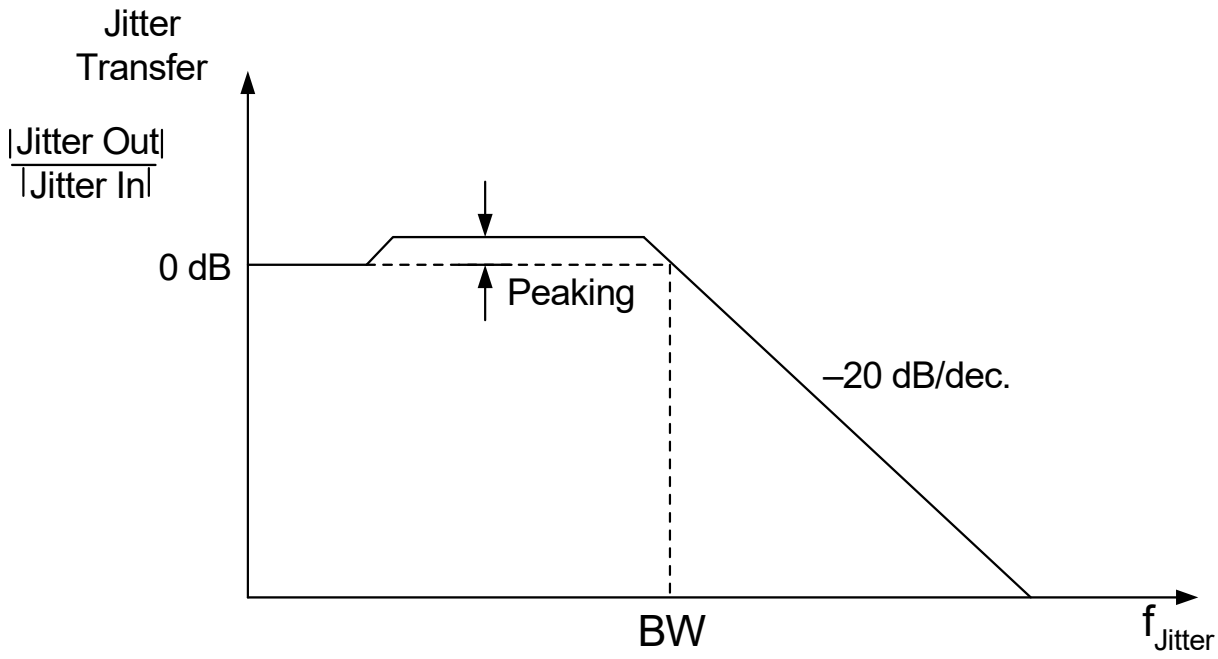


Figure 8. PLL Jitter Transfer Mask/Template

4.2.3. Jitter Tolerance

Jitter tolerance is defined as the maximum peak-to-peak sinusoidal jitter that can be present on the incoming clock before the DSPLL loses lock. The tolerance is a function of the jitter frequency, because tolerance improves for lower input jitter frequency.

The jitter tolerance of the DSPLL is a function of the loop bandwidth setting. Figure 9 shows the general shape of the jitter tolerance curve versus input jitter frequency. For jitter frequencies above the loop bandwidth, the tolerance is a constant value A_{j0}. Beginning at the PLL bandwidth, the tolerance increases at a rate of 20 dB/decade for lower input jitter frequencies.

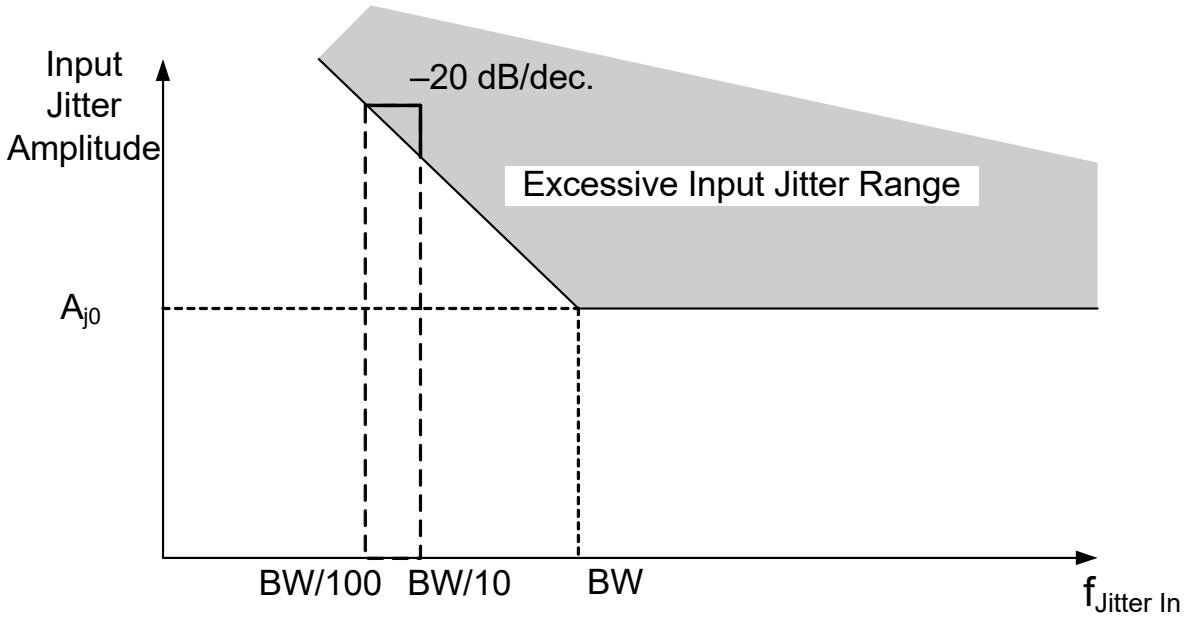


Figure 9. Jitter Tolerance Mask/Template

The equation for the high frequency jitter tolerance can be expressed as a function of the PLL loop bandwidth (i.e., BW):

$$A_{j0} = \frac{5000}{BW} \text{ ns pk-pk}$$

For example, the jitter tolerance when f_{in} = 19.44 MHz, f_{out} = 161.13 MHz and the loop bandwidth (BW) is 113 Hz:

$$A_{j0} = \frac{5000}{113} = 44.24 \text{ ns pk-pk}$$

4.2.4. Jitter Attenuation Performance

The Internal VCO uses the reference clock on the XA/XB pins as its reference for jitter attenuation. The XA/XB pins support either a crystal input or an input buffer single-ended or differential clock input, such that an external oscillator can become the reference source. In either case, the device accepts a wide margin in absolute frequency of the reference input. (See 5.5. "Holdover Mode" on page 32.) In holdover, the Si5315's output clock stability matches the reference supplied on the XA/XB pins. The external crystal or reference clock must be selected based on the stability requirements of the application if holdover is a key requirement.

However, care must be exercised in certain areas for optimum performance. For examples of connections to the XA/XB pins, refer to 7. "Crystal/Reference Clock Input" on page 38.

5. Frequency Plan Tables

For ease of use, the Si5315 is pin controlled to enable simple device configuration of the frequency plan and PLL loop bandwidth via a predefined look up table. The DSPLL has been optimized for each frequency multiplication and PLL loop bandwidth provided in Table 9 on page 20.

Many of the control inputs are three levels: High, Low, and Medium. High and Low are standard voltage levels determined by the supply voltage: V_{DD} and Ground. If the input pin is left floating, it is driven to nominally half of V_{DD}. Effectively, this creates three logic levels for these controls. See 1.2. "Three-Level (3L) Input Pins (With External Resistors)" on page 12 and 8. "Power Supply Filtering" on page 41 for additional information.

5.1. Frequency Multiplication Plan

The input to output clock multiplication is set by the 3-level FRQSEL[3:0] pins. The device provides a wide range of commonly used SyncE, SONET/SDH, and PDH frequency translations. The CKIN1 and CKIN2 inputs must be the same frequency as specified in Table 9. Both CKOUT1 and CKOUT2 outputs are at the same frequency.

5.1.1. PLL Loop Bandwidth Plan

The Si5315's loop bandwidth ranges from 60 Hz to 8.4 kHz. For each frequency multiplication, its corresponding loop bandwidth is provided in a simple look up table. (See Table 9 on page 20.) The loop bandwidth (BW) is digitally programmable using the 3-level BWSEL [1:0] and FRQTBL input pins.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
1	0.008	0.008	L	LLLL	257	60	—	—	—	—	—
2	0.008	1.544	L	LLLM	257	60	—	—	—	—	—
3	0.008	2.048	L	LLLH	257	60	—	—	—	—	—
4	0.008	8.192	L	LLML	257	60	—	—	—	—	—
5	0.008	19.44	L	LLMM	257	60	—	—	—	—	—
6	0.008	25	L	LLMH	257	60	—	—	—	—	—
7	0.008	32.768	L	LLHL	257	60	—	—	—	—	—
8	0.008	34.368	M	LLLL	257	60	—	—	—	—	—
9	0.008	38.88	M	LLLM	257	60	—	—	—	—	—
10	0.008	44.736	M	LLLH	257	60	—	—	—	—	—
11	0.008	51.84	M	LLML	257	60	—	—	—	—	—
12	0.008	65.536	M	LLMM	257	—	—	—	—	—	—
13	0.008	77.76	M	LLMH	257	60	—	—	—	—	—
14	0.008	125	M	LLHL	257	60	—	—	—	—	—
15	0.008	155.52	H	LLLL	257	60	—	—	—	—	—
16	0.008	156.25	H	LLLM	257	60	—	—	—	—	—
17	0.008	311.04	H	LLLH	257	60	—	—	—	—	—
18	0.008	312.5	H	LLML	257	60	—	—	—	—	—
19	0.008	622.08	H	LLMM	257	60	—	—	—	—	—
20	1.544	0.008	L	LLHM	257	60	—	—	—	—	—
21	1.544	1.544	L	LLHH	—	—	6047	1451	359	179	89
22	1.544	2.048	L	LMLL	257	60	—	—	—	—	—
23	1.544	8.192	L	LMLM	257	60	—	—	—	—	—
24	1.544	19.44	L	LMLH	257	60	—	—	—	—	—

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
25	1.544	25	L	LMML	257	60	—	—	—	—	—
26	1.544	32.768	L	LMMM	257	60	—	—	—	—	—
27	1.544	34.368	M	LLHM	257	60	—	—	—	—	—
28	1.544	38.88	M	LLHH	257	60	—	—	—	—	—
29	1.544	44.736	M	LMLL	257	60	—	—	—	—	—
30	1.544	51.84	M	LMLM	257	60	—	—	—	—	—
31	1.544	65.536	M	LMLH	257	—	—	—	—	—	—
32	1.544	77.76	M	LMML	257	60	—	—	—	—	—
33	1.544	125	M	LMMM	257	60	—	—	—	—	—
34	1.544	155.52	H	LLMH	257	60	—	—	—	—	—
35	1.544	156.25	H	LLHL	257	60	—	—	—	—	—
36	1.544	311.04	H	LLHM	257	60	—	—	—	—	—
37	1.544	312.5	H	LLHH	257	60	—	—	—	—	—
38	1.544	622.08	H	LMLL	257	60	—	—	—	—	—
39	2.048	0.008	L	LMMH	2089	485	240	59	—	—	—
40	2.048	1.544	L	LMHL	1037	242	119	—	—	—	—
41	2.048	2.048	L	LMHM	—	—	3949	959	238	118	59
42	2.048	8.192	L	LMHH	—	—	3949	959	238	118	59
43	2.048	19.44	L	LHLL	—	—	3946	958	238	118	59
44	2.048	25	L	LHLM	2087	485	240	—	—	—	—
45	2.048	32.768	L	LHLH	—	—	3947	959	238	118	59
46	2.048	34.368	M	LMMH	—	8163	3935	958	238	118	—
47	2.048	38.88	M	LMHL	—	—	3946	958	238	118	59
48	2.048	44.736	M	LMHM	—	3983	1944	477	118	59	—
49	2.048	51.84	M	LMHH	—	—	3946	958	238	118	59

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
50	2.048	65.536	M	LHLL	—	8185	3940	958	238	118	—
51	2.048	77.76	M	LHLM	—	—	3946	958	238	118	59
52	2.048	125	M	LHLH	1037	242	119	—	—	—	—
53	2.048	155.52	H	LMLM	—	—	3946	958	238	118	59
54	2.048	156.25	H	LMLH	1037	242	119	—	—	—	—
55	2.048	311.04	H	LMML	—	—	3946	958	238	118	59
56	2.048	312.5	H	LMMM	1037	242	119	—	—	—	—
57	2.048	622.08	H	LMMH	—	—	3946	958	238	118	59
58	8.192	0.008	L	LHML	2089	485	240	59	—	—	—
59	8.192	1.544	L	LHMM	1037	242	119	—	—	—	—
60	8.192	2.048	L	LHMH	—	—	6434	1541	381	190	95
61	8.192	8.192	L	LHHL	—	—	6434	1541	381	190	95
62	8.192	19.44	L	LHHM	—	—	3946	958	238	118	59
63	8.192	25	L	LHHH	2087	485	240	—	—	—	—
64	8.192	32.768	L	MLLL	—	—	6431	1541	381	190	95
65	8.192	34.368	M	LHML	—	8163	3935	958	238	118	—
66	8.192	38.88	M	LHMM	—	—	3946	958	238	118	59
67	8.192	44.736	M	LHMH	—	3983	1944	477	118	59	—
68	8.192	51.84	M	LHHL	—	—	3946	958	238	118	59
69	8.192	65.536	M	LHHM	—	—	6411	1539	381	190	95
70	8.192	77.76	M	LHHH	—	—	3946	958	238	118	59
71	8.192	125	M	MLLL	1037	242	119	—	—	—	—
72	19.44	0.008	L	MLLM	1759	409	202	—	—	—	—
73	19.44	1.544	L	MLLH	—	2779	1362	335	83	—	—
74	19.44	2.048	L	MLML	—	3348	1638	402	100	—	—

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Skyworks Solutions, Inc. • Phone [781] 376-3000 • Fax [781] 376-3100 • sales@skyworksinc.com • www.skyworksinc.com
Rev. 1.0 • Skyworks Proprietary Information • Products and Product Information are Subject to Change Without Notice • August 23, 2021

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
75	19.44	8.192	L	MLMM	—	3348	1638	402	100	—	—
76	19.44	19.44	L	MLMH	—	—	7706	1832	452	225	112
77	19.44	25	L	MLHL	—	2778	1362	335	83	—	—
78	19.44	32.768	L	MLHM	—	—	5022	1215	301	150	75
79	19.44	34.368	M	MLLM	—	5662	2749	672	167	83	—
80	19.44	38.88	M	MLLH	—	—	7703	1832	452	225	112
81	19.44	44.736	M	MLML	—	5653	2747	672	167	83	—
82	19.44	51.84	M	MLMM	—	—	7696	1832	452	225	112
83	19.44	65.536	M	MLMH	2618	607	300	74	—	—	—
84	19.44	77.76	M	MLHL	—	—	7696	1832	452	225	112
85	19.44	125	M	MLHM	3960	913	450	111	—	—	—
86	19.44	155.52	H	LMHL	—	—	7696	1832	452	225	112
87	19.44	156.25	H	LMHM	6003	1373	677	167	—	—	—
88	19.44	161.1328	H	LMHH	484	113	—	—	—	—	—
89	19.44	311.04	H	LHLL	—	—	7696	1832	452	225	112
90	19.44	312.5	H	LHLM	6003	1373	677	167	—	—	—
91	19.44	622.08	H	LHLH	—	—	7696	1832	452	225	112
92	19.44	644.5313	H	LHML	103	—	—	—	—	—	—
93	25	0.008	L	MLHH	—	—	7045	1681	415	207	103
94	25	1.544	L	MMLL	6741	1529	753	186	—	—	—
95	25	2.048	L	MMLM	1299	303	150	—	—	—	—
96	25	8.192	L	MMLH	6737	1529	753	186	—	—	—
97	25	19.44	L	MMML	—	—	6551	1568	387	193	96
98	25	25	L	MMMM	—	—	7615	1812	447	223	111
99	25	32.768	L	MMMH	6737	1529	753	186	—	—	—

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
100	25	34.368	M	MLHH	6722	1528	753	186	—	—	—
101	25	38.88	M	MMLL	6729	1529	753	186	—	—	—
102	25	44.736	M	MMLM	1298	303	150	—	—	—	—
103	25	50	H	HMLH	—	—	7880	1880	470	230	120
104	25	51.84	M	MMLH	—	7988	3846	936	232	116	—
105	25	65.536	M	MMML	1298	303	150	—	—	—	—
106	25	77.76	M	MMMM	6706	1528	753	186	—	—	—
107	25	125	M	MMMH	—	—	7606	1811	447	223	111
108	25	155.52	H	LHMM	1298	303	150	—	—	—	—
109	25	156.25	H	LHMH	—	—	7606	1811	447	223	111
110	25	161.1328	H	LHHL	—	—	6106	1468	363	181	90
111	25	311.04	H	LHHM	1298	303	150	—	—	—	—
112	25	312.5	H	LHHH	—	—	7606	1811	447	223	111
113	25	622.08	H	MLLL	1298	303	150	—	—	—	—
114	25	644.5313	H	MLLM	—	—	6106	1468	363	181	90
115	32.768	0.008	L	MMHL	2089	485	240	59	—	—	—
116	32.768	1.544	L	MMHM	1037	242	119	—	—	—	—
117	32.768	2.048	L	MMHH	—	—	7187	1714	423	211	105
118	32.768	8.192	L	MHLL	—	—	7632	1816	448	223	111
119	32.768	19.44	L	MHLM	—	—	3946	958	238	118	59
120	32.768	25	L	MHLH	2087	485	240	—	—	—	—
121	32.768	32.768	L	MHML	—	—	7632	1816	448	223	111
122	32.768	34.368	M	MMHL	—	8163	3935	958	238	118	—
123	32.768	38.88	M	MMHM	—	—	—	958	238	118	59
124	32.768	44.736	M	MMHH	—	3983	1944	477	118	59	—

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
125	32.768	51.84	M	MHLL	—	—	3946	958	238	118	59
126	32.768	65.536	M	MHLM	—	—	7604	1815	448	223	111
127	32.768	77.76	M	MHLH	—	—	3946	958	238	118	59
128	32.768	125	M	MHML	1037	242	119	—	—	—	—
129	50	25	L	HHHH	—	—	7880	1880	470	230	120
130	50	50	M	HMLH	—	—	7770	1850	466	230	110
131	77.76	0.008	L	MHMM	2089	485	240	59	—	—	—
132	77.76	1.544	L	MHMH	—	2779	1362	335	83	—	—
133	77.76	2.048	L	MHHL	—	—	6804	1626	402	200	100
134	77.76	19.44	L	MHHM	—	—	7905	1879	464	231	115
135	77.76	25	L	MHHH	—	2778	1362	335	83	—	—
136	77.76	34.368	M	MHMM	—	—	6798	1626	402	200	100
137	77.76	38.88	M	MHMH	—	—	7905	1879	464	231	115
138	77.76	44.736	M	MHHL	—	—	6756	1623	402	200	100
139	77.76	51.84	M	MHHM	—	—	7905	1879	464	231	115
140	77.76	65.536	M	MHHH	—	2461	1208	298	74	—	—
141	77.76	77.76	M	HLLL	—	—	7905	1879	464	231	115
142	77.76	125	M	HLLM	5336	1220	602	148	—	—	—
143	77.76	155.52	H	MLLH	—	—	7905	1879	464	231	115
144	77.76	156.25	H	MLML	6003	1373	677	167	—	—	—
145	77.76	161.1328	H	MLMM	484	113	—	—	—	—	—
146	77.76	311.04	H	MLMH	—	—	7905	1879	464	231	115
147	77.76	312.5	H	MLHL	6003	1373	677	167	—	—	—
148	77.76	622.08	H	MLHM	—	—	7905	1879	464	231	115
149	77.76	644.5313	H	MLHH	484	113	—	—	—	—	—

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
150	125	0.008	L	HLLL	—	—	7045	1681	415	207	103
151	125	1.544	L	HLLM	6741	1529	753	186	—	—	—
152	125	2.048	L	HLLH	1299	303	150	—	—	—	—
153	125	19.44	L	HLML	—	—	6551	1568	387	193	96
154	125	25	L	HLMM	—	—	7862	1870	462	230	115
155	125	34.368	M	HLLH	6722	1528	753	186	—	—	—
156	125	38.88	M	HLML	6729	1529	753	186	—	—	—
157	125	44.736	M	HLMM	1298	303	150	—	—	—	—
158	125	51.84	M	HLMH	—	7988	3846	936	232	116	—
159	125	65.536	M	HLHL	1298	303	150	—	—	—	—
160	125	77.76	M	HLHM	6706	1528	753	186	—	—	—
161	125	125	M	HLHH	—	—	7862	1870	462	230	115
162	125	155.52	H	MMLL	1298	303	150	—	—	—	—
163	125	156.25	H	MMLM	—	—	7862	1870	462	230	115
164	125	161.1328	H	MMLH	—	—	7718	1839	454	226	113
165	125	311.04	H	MMML	1298	303	150	—	—	—	—
166	125	312.5	H	MMMM	—	—	7862	1870	462	230	115
167	125	622.08	H	MMMH	1298	303	150	—	—	—	—
168	125	644.5313	H	MMHL	—	—	7718	1839	454	226	113
169	155.52	0.008	L	HLMH	2089	485	240	59	—	—	—
170	155.52	1.544	L	HLHL	—	2779	1362	335	83	—	—
171	155.52	2.048	L	HLHM	—	—	7606	1809	447	223	111
172	155.52	19.44	L	HLHH	—	—	7905	1879	464	231	115
173	155.52	25	L	HMLL	—	2778	1362	335	83	—	—
174	155.52	77.76	H	MMHM	—	—	7905	1879	464	231	115

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
175	155.52	125	H	MMHH	5336	1220	602	148	—	—	—
176	155.52	155.52	H	MHLL	—	—	7905	1879	464	231	115
177	155.52	156.25	H	MHLM	6003	1373	677	167	—	—	—
178	155.52	161.1328	H	MHLH	484	113	—	—	—	—	—
179	155.52	311.04	H	MHML	—	—	7905	1879	464	231	115
180	155.52	312.5	H	MHMM	6003	1373	677	167	—	—	—
181	155.52	622.08	H	MHMH	—	—	7905	1879	464	231	115
182	155.52	644.5313	H	MHHL	828	193	95	—	—	—	—
183	156.25	0.008	L	HMLM	—	—	6123	1469	363	181	90
184	156.25	1.544	L	HMLH	1627	379	187	—	—	—	—
185	156.25	2.048	L	HMML	322	75	—	—	—	—	—
186	156.25	19.44	L	HMMM	—	—	4852	1172	290	145	72
187	156.25	25	L	HMMH	—	—	7835	1864	460	229	114
188	156.25	77.76	H	MHHM	1625	379	187	—	—	—	—
189	156.25	125	H	MHHH	—	—	7835	1864	460	229	114
190	156.25	155.52	H	HLLL	322	75	—	—	—	—	—
191	156.25	156.25	H	HLLM	—	—	7835	1864	460	229	114
192	156.25	161.1328	H	HLLH	—	—	7718	1839	454	226	113
193	156.25	311.04	H	HLML	322	75	—	—	—	—	—
194	156.25	312.5	H	HLMM	—	—	7835	1864	460	229	114
195	156.25	622.08	H	HLMH	322	75	—	—	—	—	—
196	156.25	644.5313	H	HLHL	—	—	7718	1839	454	226	113
197	161.1328	0.008	L	HMHL	225	—	—	—	—	—	—
198	161.1328	1.544	L	HMHM	151	—	—	—	—	—	—
199	161.1328	2.048	L	HMHH	225	—	—	—	—	—	—

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

Table 9. Look Up Tables for Clock Multiplication and Loop Bandwidth Settings (Continued)

Plan #	f_{IN} (MHz)	f_{OUT} (MHz)	FRQTBL	FRQSEL [3:0]	Loop Bandwidth Selection (Hz), BWSEL[1:0]						
					LM	LH	ML	MM	MH	HL	HH
200	161.1328	19.44	L	HHLL	679	159	78	—	—	—	—
201	161.1328	25	L	HHLM	678	159	78	—	—	—	—
202	161.1328	77.76	H	HLHM	678	159	78	—	—	—	—
203	161.1328	125	H	HLHH	—	—	7179	1721	426	212	106
204	161.1328	156.25	H	HMLL	—	—	7019	1683	416	207	103
205	161.1328	161.1328	H	HMLM	332	78	—	—	—	—	—
206	161.1328	312.5	H	HMML	3873	892	440	109	—	—	—
207	161.1328	644.5313	H	HMMM	151	—	—	—	—	—	—
208	644.5313	0.008	L	HHLH	880	206	101	—	—	—	—
209	644.5313	1.544	L	HHML	413	96	—	—	—	—	—
210	644.5313	2.048	L	HHMM	—	3373	1650	405	101	—	—
211	644.5313	19.44	L	HHMH	—	3641	1779	437	108	—	—
212	644.5313	25	L	HHHL	—	—	7886	1875	463	231	115
213	644.5313	77.76	H	HMMH	828	193	95	—	—	—	—
214	644.5313	125	H	HMHL	—	—	7732	1840	454	226	113
215	644.5313	155.52	H	HMHM	828	193	95	—	—	—	—
216	644.5313	156.25	H	HMHH	—	—	7732	1840	454	226	113
217	644.5313	161.1328	H	HHLL	—	—	7895	1880	464	231	115
218	644.5313	311.04	H	HHLM	828	193	95	—	—	—	—
219	644.5313	312.5	H	HHLH	206	—	—	—	—	—	—
220	644.5313	622.08	H	HHML	120	—	—	—	—	—	—
221	644.5313	644.5313	H	HHMM	—	—	7895	1880	464	231	115

Notes:

1. F_{IN} and F_{OUT} frequency values may be rounded off. For exact multiplication ratios, please contact Skyworks Solutions.
2. Si5315A supports all frequency plans.
3. Si5315B supports output frequency plans up to 125 MHz.

5.2. PLL Self-Calibration

An internal self-calibration (ICAL) is performed before operation to optimize loop parameters and jitter performance. While the self-calibration is being performed, the DSPLL is being internally controlled by the self-calibration state machine. The LOL alarm will be active during ICAL. The self-calibration time t_{LOCKHW} is given in Table 3, “AC Characteristics”.

Any of the following events will trigger a self-calibration:

- Power-on-reset (POR)
- Release of the external reset pin $\overline{RST}$ (transition of $\overline{RST}$ from 0 to 1)
- Change in FRQSEL, FRQTBL, BWSEL, or XTAL/CLOCK pins
- Internal DSPLL registers out-of-range, indicating the need to relock the DSPLL

In any of the above cases, an internal self-calibration will be initiated if a valid input clock exists (no input alarm) and is selected as the active clock at that time. The external crystal or reference clock must also be present for the self-calibration to begin. If valid clocks are not present, the self-calibration state machine will wait until they appear, at which time the calibration will start. An output clock will be active while waiting for a valid input clock. The output clock frequency is based on the VCO range determine by FRQSEL and FRQTBL settings. This output clock will vary by ±20%. If no output clock is desired prior to an ICAL, then the SFOUT pins should be kept at LM for 1.2 seconds until the output clock is stable.

After a successful self-calibration has been performed with a valid input clock, no subsequent self calibrations are performed unless one of the above conditions are met. If the input clock is lost following self-calibration, the device enters holdover mode. When the input clock returns, the device relocks to the input clock without performing a self-calibration.

5.2.1. Input Clock Stability during Internal Self-Calibration

An exit from reset must occur when the selected CKINn clock is stable in frequency with a frequency value that is within the device operating range. The other CKINs must also either be stable in frequency or squelched during a reset.

5.2.2. Self-Calibration caused by Changes in Input Frequency

If the selected CKINn varies by 500 ppm or more in frequency since the last calibration, the device may initiate a self-calibration.

5.2.3. Device Reset

Upon powerup, the device internally executes a power-on-reset (POR) which resets the internal device logic. The pin $\overline{RST}$ can also be used to initiate a reset. The device stays in this state until a valid CKINn is present, when it then performs a PLL Self-Calibration (See 5.2. "PLL Self-Calibration”).

5.2.4. Recommended Reset Guidelines

Follow the recommended RESET guidelines in Table 10 when reset should be applied to a device.

Table 10. Si5315 Pins and Reset

Pin #	Si5315 Pin Name	Must Reset after Changing
2	FRQTBL	Yes
11	XTAL/CLOCK	Yes
22	BWSEL0	Yes
23	BWSEL1	Yes
24	FRQSEL0	Yes
25	FRQSEL1	Yes
26	FRQSEL2	Yes
27	FRQSEL3	Yes

5.2.5. Hitless Switching with Phase Build-Out

Skyworks Solutions switching technology performs "phase build-out" to minimize the propagation of phase transients to the clock outputs during input clock switching. All switching between input clocks occurs within the input multiplexor and phase detector circuitry. The phase detector circuitry continually monitors the phase difference between each input clock and the DSPLL output clock, f_{OSC}. The phase detector circuitry can lock to a clock signal at a specified phase offset relative to f_{OSC} so that the phase offset is maintained by the PLL circuitry.

At the time a clock switch occurs, the phase detector circuitry knows both the input-to-output phase relationship for the original input clock and for the new input clock. The phase detector circuitry locks to the new input clock at the new clock's phase offset so that the phase of the output clock is not disturbed. The phase difference between the two input clocks is absorbed in the phase detector's offset value, rather than being propagated to the clock output.

The switching technology virtually eliminates the output clock phase transients traditionally associated with clock rearrangement (input clock switching). The Maximum Time Interval Error (MTIE) and maximum slope for clock output phase transients during clock switching are given in (Table 3, “AC Characteristics”). These values fall significantly below the limits specified in the ITU-T G.8262, Telcordia GR-1244-CORE, and GR-253-CORE requirements.

5.3. Input Clock Control

This section describes the clock selection capabilities (manual input selection, automatic input selection, hitless switching, and revertive switching). When switching between two clocks, LOL may temporarily go high if the two clocks differ in frequency by more than 100 ppm.

5.3.1. Manual Clock Selection

Manual control of input clock selection is chosen via the CS_CA pin according to Table 11 and Table 12.

Table 11. Automatic/Manual Clock Selection

AUTOSEL	Clock Selection Mode
L	Manual
M	Automatic non-revertive
H	Automatic revertive

Table 12. Manual Input Clock Selection, AUTOSEL = L

CS_CA	Si5315 AUTOSEL = L
0	CKIN1
1	CKIN2

5.3.2. Automatic Clock Selection

The AUTOSEL input pin sets the input clock selection mode as shown in Table 11. Automatic switching is either revertive or non-revertive. Setting AUTOSEL to M or H, changes the CS_CA pin to an output pin that indicates the state of the automatic clock selection.

Table 13. Clock Active Indicators, AUTOSEL = M or H

CS_CA	Active Clock
0	CKIN1
1	CKIN2

The prioritization of clock inputs for automatic switching is shown in Table 14. This priority is hardwired in the devices.

Table 14. Input Clock Priority for Auto Switching

Priority	Input Clocks
1	CKIN1
2	CKIN2
3	Holdover

At power-on or reset, the valid CKINn with the highest priority (1 being the highest priority) is automatically selected. If no valid CKINn is available, the device suppresses the output clocks and waits for a valid CKINn signal.

If the currently selected CKINn goes into an alarm state, the next valid CKINn in priority order is selected. If no valid CKINn is available, the device enters holdover.

Operation in revertive and non- revertive is different when a signal becomes valid:

Revertive (AUTOSEL = H): The device constantly monitors all CKINn. If a CKINn with a higher priority than the current active CKINn becomes valid, the active CKINn is changed to the CKINn with the highest priority.

Non-revertive (AUTOSEL = M): The active clock does not change until there is an alarm on the active clock. The device will then select the highest priority CKINn that is valid. Once in holdover, the device will switch to the first CKINn that becomes valid.

5.4. Alarms

Summary alarms are available to indicate the overall status of the input signals. Alarm outputs stay high until all the alarm conditions for that alarm output are cleared.

5.4.1. Loss-of-Signal

The device has loss-of-signal circuitry that continuously monitors CKINn for missing pulses. The LOS circuitry generates an internal LOSn_INT output signal that is processed with other alarms to generate LOS1 and LOS2.

An LOS condition on CKIN1 causes the internal LOS1_INT alarm to become active. Similarly, an LOS condition on CKINn causes the LOSn_INT alarm to become active. Once a LOSn_INT alarm is asserted on one of the input clocks, it remains asserted until that input clock is validated over a designated time period. The time to clear LOSn_INT after a valid input clock appears is listed in Table 3, “AC Characteristics”. If another error condition on the same input clock is detected during the validation time then the alarm remains asserted and the validation time starts over.

5.4.1.1. LOS Algorithm

The LOS circuitry divides down each input clock to produce an 8 kHz to 2 MHz signal. The LOS circuitry over samples this divided down input clock using a 40 MHz clock to search for extended periods of time without input clock transitions. If the LOS monitor detects twice the normal number of samples without a clock edge, a LOSn_INT alarm is declared. Table 3, “AC Characteristics” gives the minimum and maximum amount of time for the LOS monitor to trigger.

5.4.1.2. Lock Detect

The PLL lock detection algorithm indicates the lock status on the LOL output pin. The algorithm works by continuously monitoring the phase of the input clock in relation to the phase of the feedback clock. If the time between two consecutive phase cycle slips is greater than the retrigger time, the PLL is in lock. The LOL output has a guaranteed minimum pulse width as shown in (Table 3, “AC Characteristics”). The LOL pin is also held in the active state during an internal PLL calibration. The retrigger time is automatically set based on the PLL closed loop bandwidth (See Table 15).

Table 15. Lock Detect Retrigger Time

PLL Bandwidth Setting (BW)	Retrigger Time (ms)
60–120 Hz	53
120–240 Hz	26.5
240–480 Hz	13.3
480–960 Hz	6.6
960–1920 Hz	3.3
1920–3840 Hz	1.66
3840–7680 Hz	0.833

5.5. Holdover Mode

If an LOS condition exists on the selected input clock, the device enters holdover. In this mode, the device provides a stable output frequency until the input clock returns and is validated. When the device enters holdover, the internal oscillator is initially held to its last frequency value. Next, the internal oscillator slowly transitions to a historical average frequency value that was taken over a time window of 6,711 ms in size that ended 26 ms before the device entered holdover. This frequency value is taken from an internal memory location that keeps a record of previous DSPLL frequency values. By using a historical average frequency, input clock phase and frequency transients that may occur immediately preceding loss of clock or any event causing holdover do not affect the holdover frequency. Also, noise related to input clock jitter or internal PLL jitter is minimized.

If a highly stable reference, such as an oven-controlled crystal oscillator, is supplied at XA/XB, an extremely stable holdover can be achieved. If a crystal is supplied at the XA/XB port, the holdover stability will be limited by the stability of the crystal; Table 3, “AC Characteristics” gives the specifications related to the holdover function.

5.5.1. Recovery from Holdover

When the input clock signal returns, the device transitions from holdover to the selected input clock. The device performs hitless recovery from holdover. The clock transition from holdover to the returned input clock includes "phase buildout" to absorb the phase difference between the holdover clock phase and the input clock phase. See Table 3, “AC Characteristics” for specifications.

5.6. PLL Bypass Mode

The Si5315 supports a PLL bypass mode in which the selected input clock is fed directly to both enabled output buffers, bypassing the DSPLL. Internally, the bypass path is implemented with high-speed differential signaling; however, this path is not a low jitter path and will see significantly higher jitter on CKOUT. In PLL bypass mode, the input and output clocks will be at the same frequency. PLL bypass mode is useful in a laboratory environment to measure system performance with and without the jitter attenuation provided by the DSPLL. The DSBL2_BY pin is used to select the PLL Bypass Mode according to Table 16. Bypass mode is not supported for CMOS clock outputs (SFOUT = LH).

Table 16. DSBL2/BYPASS Pin Settings

DSBL2/BYPASS	Function
L	CKOUT2 Enabled
M	CKOUT2 Disabled
H	PLL Bypass Mode w/ CKOUT2 Enabled

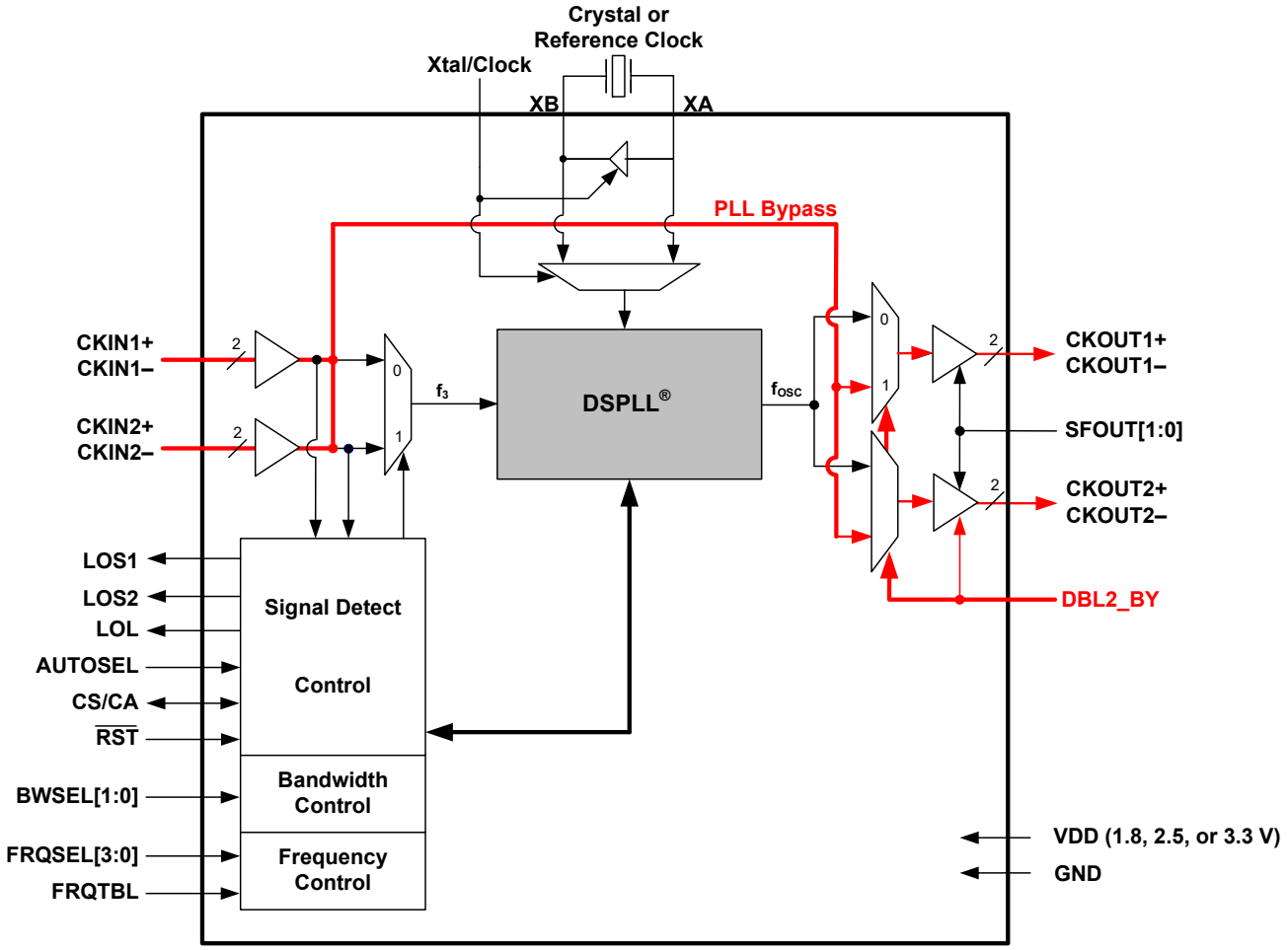


Figure 10. Bypass Signal

6. High-Speed I/O

6.1. Input Clock Buffers

The Si5315 provides differential inputs for the CKINn clock inputs. These inputs are internally biased to a common mode voltage [see Table 2, “DC Characteristics”] and can be driven by either a single-ended or differential source. Figure 11 through Figure 14 show typical interface circuits for LVPECL, CML, LVDS, or CMOS input clocks. Note that the jitter generation improves for higher levels on CKINn (within the limits in Table 3, “AC Characteristics”).

AC coupling the input clocks is recommended because it removes any issue with common mode input voltages. However, either ac or dc coupling is acceptable. Figures 11 and 12 show various examples of different input termination arrangements. Unused inputs can be left unconnected.

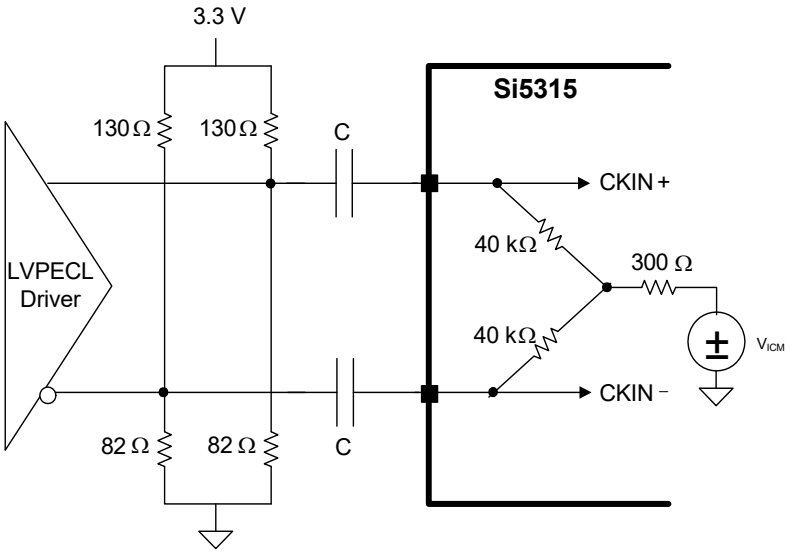


Figure 11. Differential LVPECL Termination

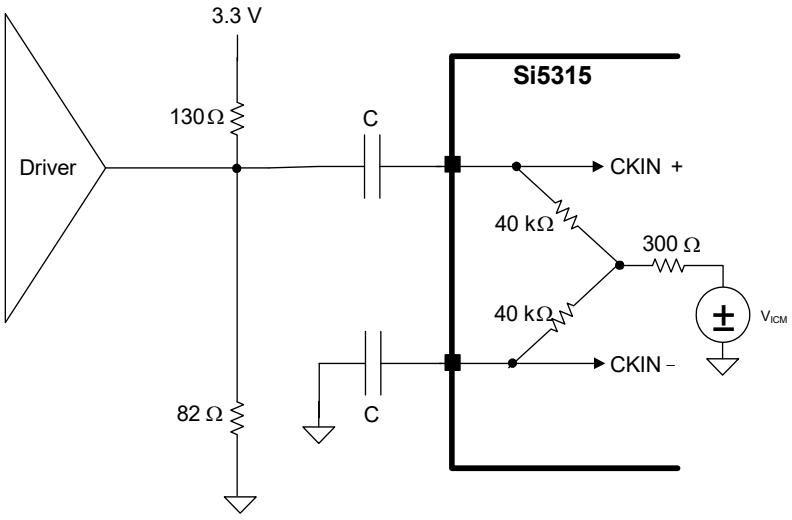


Figure 12. Single-ended LVPECL Termination

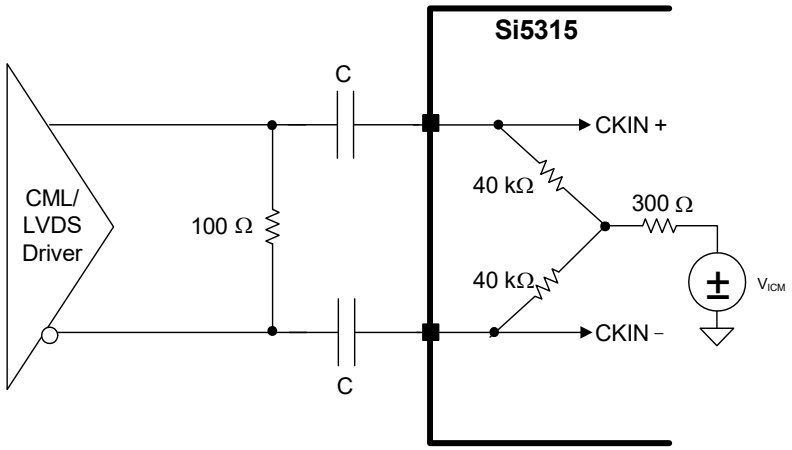
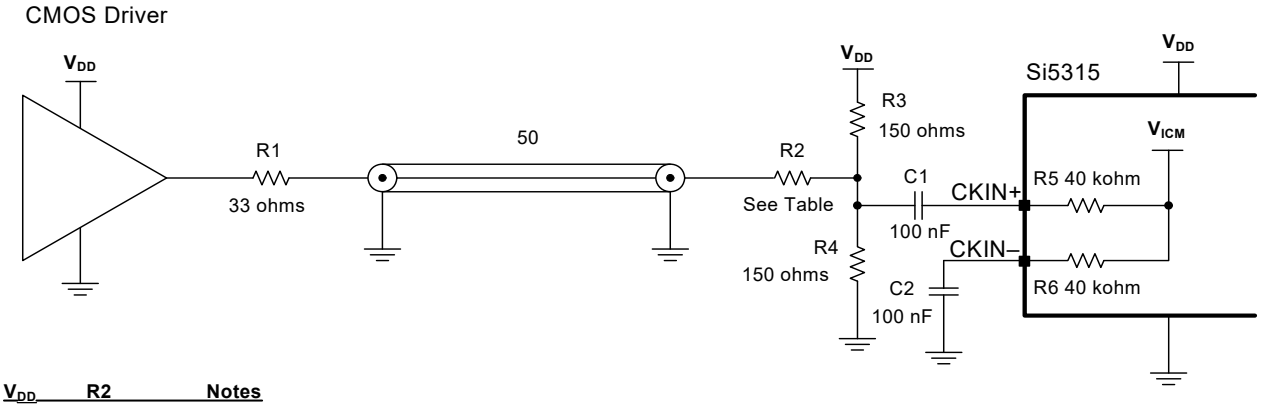


Figure 13. CML/LVDS Termination (1.8, 2.5, 3.3 V)



V_{DD}	R2	Notes
3.3 V	100 ohm	Locate R1 near CMOS driver
2.5 V	49.9 ohm	Locate other components near Si5317
1.8 V	14.7 ohm	Recalculate resistor values for other drive strengths

Additional Notes:
1. Attenuation circuit limits overshoot and undershoot.
2. Not to be used with non-square wave input clocks.

Figure 14. CMOS Termination (1.8, 2.5, 3.3 V)

6.2. Output Clock Drivers

The Si5315 has a flexible output driver structure that can drive a variety of loads, including LVPECL, LVDS, CML, and CMOS formats. The signal format is selected for both CKOUT1 and CKOUT2 outputs using the SFOUT [1:0] pins. This modifies the output common mode and differential signal swing. See Table 2, “DC Characteristics” for output driver specifications. The SFOUT [1:0] pins are three-level input pins, with the states designated as L (ground), M (V_{DD}/2), and H (V_{DD}). Table 17 shows the signal formats based on the supply voltage and the type of load being driven.

Table 17. Output Signal Format Selection (SFOUT)

SFOUT[1:0]	Signal Format
HL	CML
HM	LVDS
LH	CMOS
LM	Disabled
MH	LVPECL
ML	Low-swing LVDS
All Others	Reserved

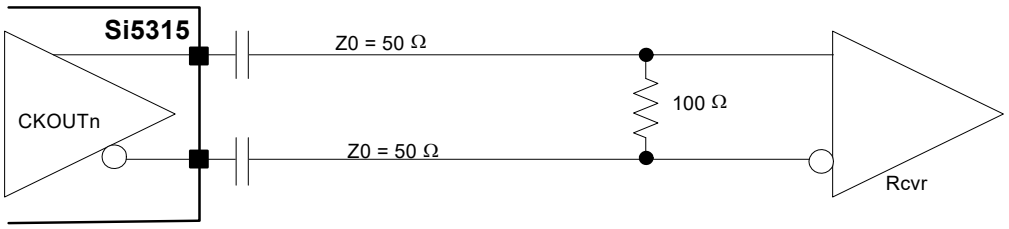


Figure 15. Typical Differential Output Circuit

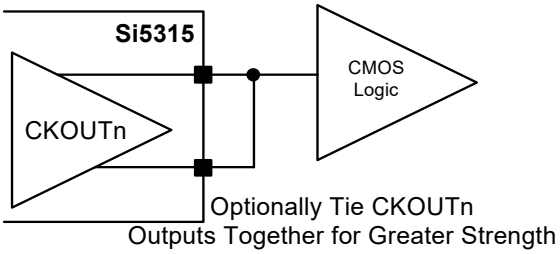


Figure 16. Typical CMOS Output Circuit (Tie CKOUTn+ and CKOUTn– Together)

For the CMOS setting (SFOUT = LH), both output pins drive single-ended in-phase signals. The CKOUT+/- can be externally shorted together for greater drive strength specified in Table 2, “DC Characteristics”.

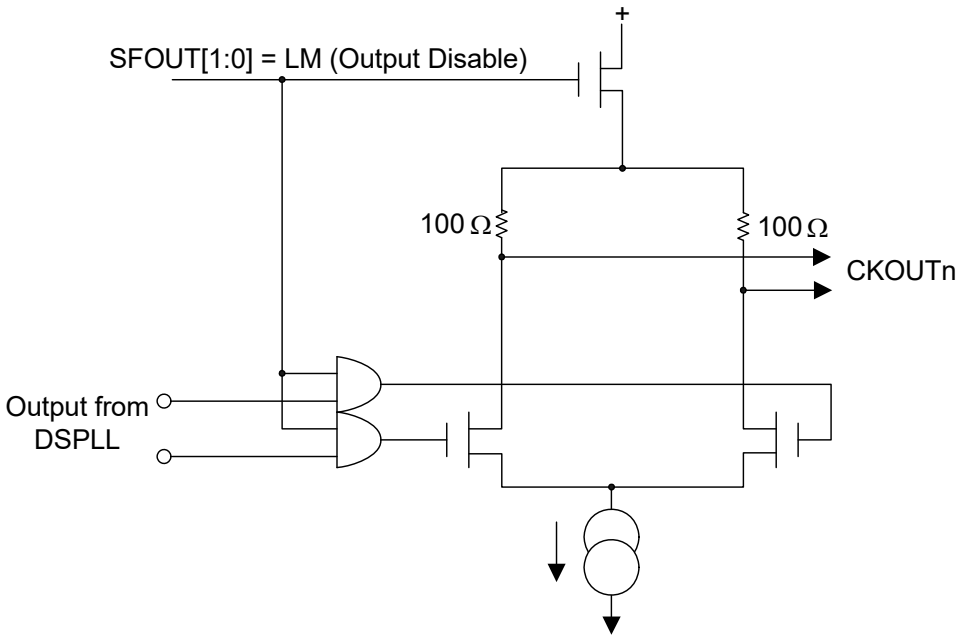
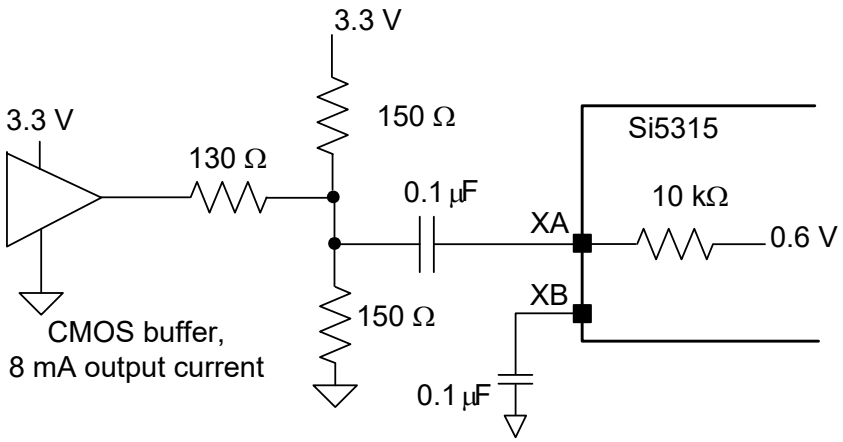


Figure 17. Disable CKOUTn Structure

The SFOUT [1:0] pins can also be used to disable both outputs. Disabling the output puts the CKOUTn+ and CKOUTn– pins in a high-impedance state relative to V_{DD} (common mode tri-state) while the two outputs remain connected to each other through a 200 Ω on-chip resistance (differential impedance of 200 Ω). The maximum amount of internal circuitry is powered down, minimizing power consumption and noise generation. Recovery from the disable mode requires additional time as specified in Table 3, “AC Characteristics”.

7. Crystal/Reference Clock Input

The device can use an external crystal or external clock as a reference. If an external clock is used, it must be ac coupled. With appropriate buffers, the same external reference clock can be applied to CKINn. Although the reference clock input can be driven single ended (See Figure 18), the best performance is with a crystal or low jitter, differential clock source. No external loading capacitors are required for normal crystal operation.



For 2.5 V operation, change 130 Ω to 82 Ω.

Figure 18. CMOS External Reference Circuit

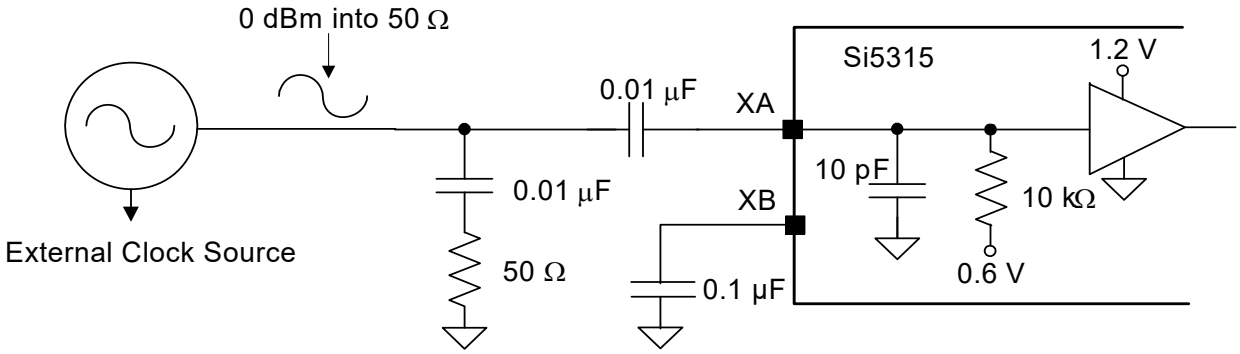


Figure 19. Sinewave External Reference Clock Input Example

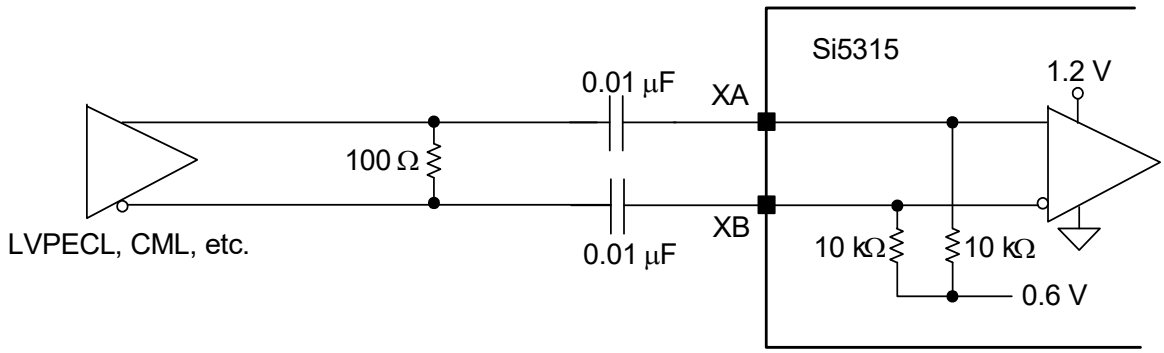


Figure 20. Differential External Reference Clock Input Example

7.1. Crystal/Reference Clock Selection

The Si5315 requires either a low-jitter external oscillator or a low-cost fundamental mode crystal to be connected to its XA/XB pins. This serves both as a jitter reference for jitter attenuation and as a reference oscillator for stability during holdover. The frequency the reference is not directly related to either the input or the output clock frequencies. The range of the reference frequency is from 37 to 41 MHz. For recommendations on the selection of the reference frequency and a list of approved crystals, see the application note AN591 which can be downloaded from https://www.skyworksinc.com/en/Products/Timing.

In holdover, the DSPLL remains locked to this external reference. Any changes in the frequency of this reference when the DSPLL is in holdover will be tracked by the output of the device. Note that crystals can have temperature sensitivities. Table 18 shows how the XTAL/CLOCK pin is used to select between a crystal and an external oscillator.

Table 18. XA/XB Reference Sources

XTAL/CLOCK	Type
M	37–41 MHz external clock
L	40 MHz crystal

Because the crystal is used as a jitter reference, rapid changes of the crystal temperature can temporarily disturb the output phase and frequency. For example, it is recommended that the crystal not be placed close to a fan that is being turned off and on. If a situation such as this is unavoidable, the crystal should be thermally isolated with an insulating cover.

7.1.1. Reference Drift

During holdover, long-term and temperature related drift of the reference input result in a one-to-one drift of the output frequency. That is, the stability of the any-frequency output is identical to the drift of the reference frequency. This means that for the most demanding applications where the drift of a crystal is not acceptable, an external temperature compensated or ovenized oscillator will be required. Drift is not an issue unless the part is in holdover. Also, the initial accuracy of the reference oscillator (or crystal) is not relevant.

7.1.2. Reference Jitter

Jitter on the reference input has a roughly one-to-one transfer function to the output jitter over the bandwidth ranging from 100 Hz up to 30 kHz. If a crystal is used on the XA/XB pins, the reference will have low jitter if a suitable crystal is in use. If the XA/XB pins are connected to an external reference oscillator, the jitter of the external reference oscillator may contribute significantly to the output jitter.

A typical reference input-to-output jitter transfer function is shown in Figure 21.

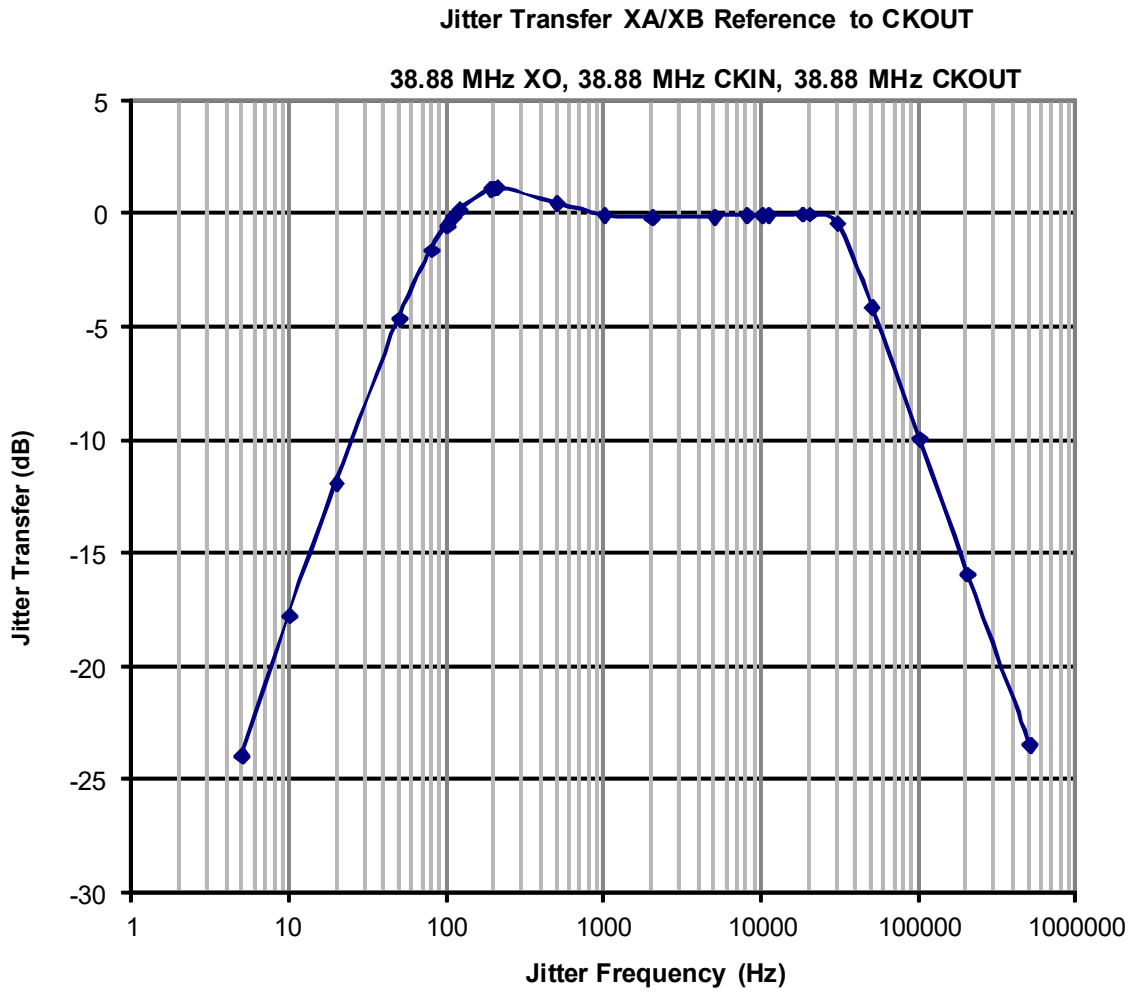


Figure 21. Typical XA/XB Reference Jitter Transfer Function

8. Power Supply Filtering

This device incorporates an on-chip voltage regulator with excellent PSRR to power the device from a supply voltage of 1.8, 2.5, or 3.3 V. The device requires minimal supply decoupling and no stringent layout or ground plane islands. Internal core circuitry is driven from the output of this regulator while I/O circuitry uses the external supply voltage directly. Table 3, “AC Characteristics” gives the sensitivity of the on-chip oscillator to changes in the supply voltage. Refer to the Si5315 evaluation board for an example.

The center ground pad under the device must be electrically and thermally connected to the ground plane. See Figure 26, “Ground Pad Recommended Layout,” on page 50.

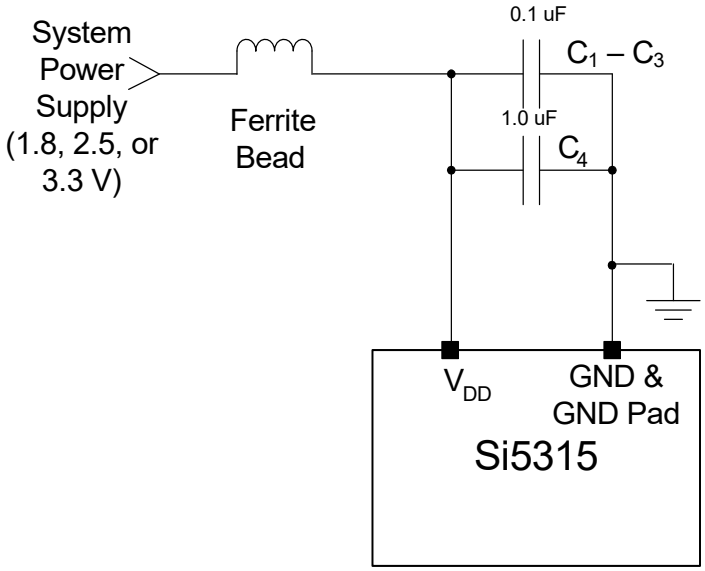


Figure 22. Typical Power Supply Bypass Network

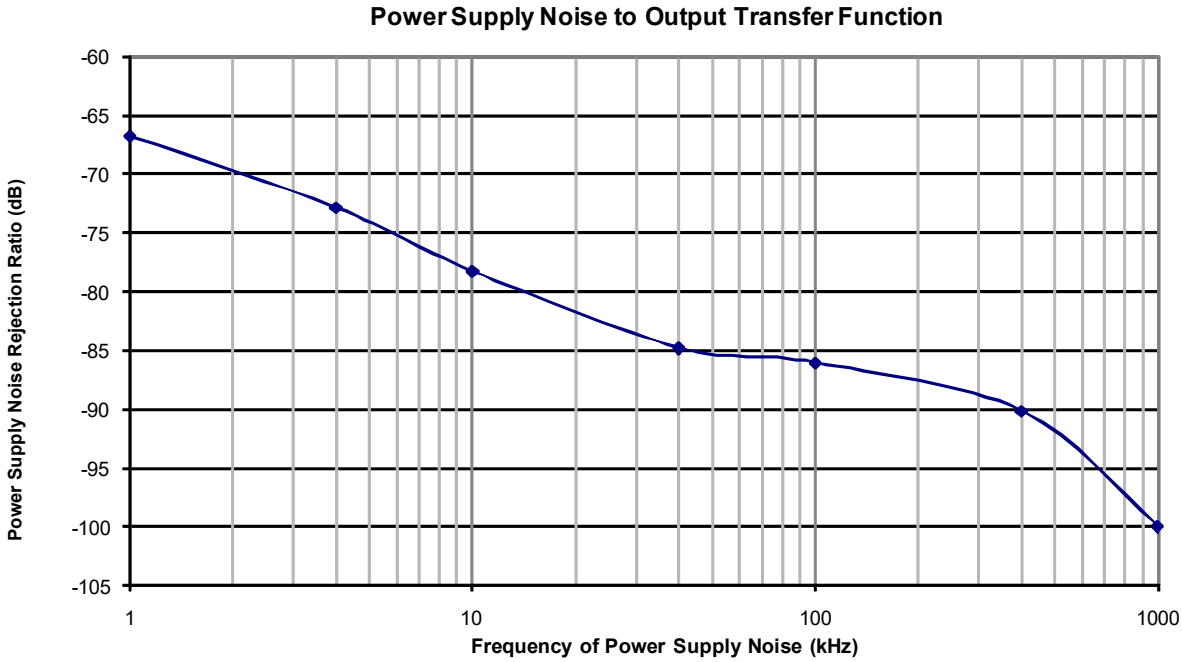
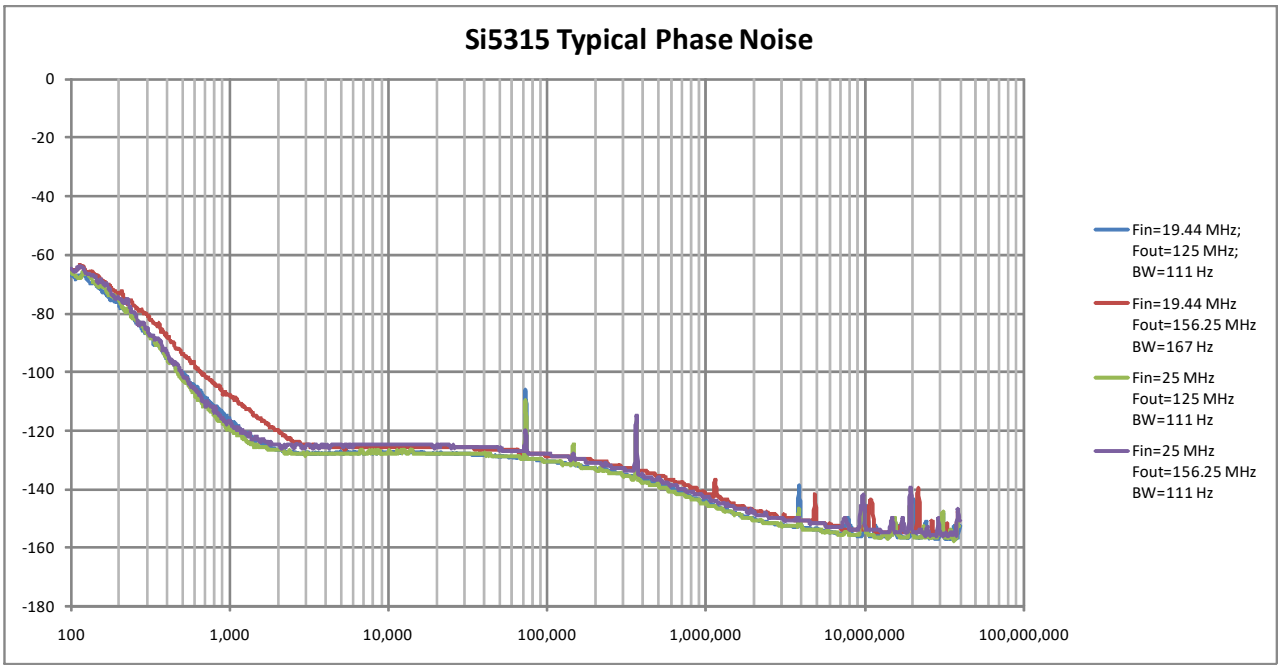


Figure 23. Fout = 155 MHz with 112 Hz Loop Bandwidth, 100 mVp-p Supply Noise

9. Typical Phase Noise Plots

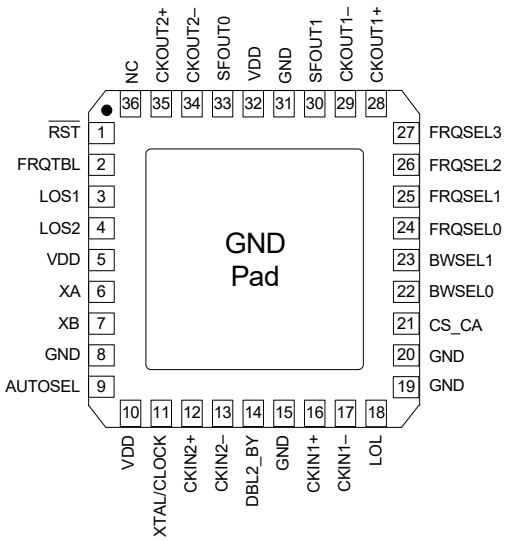
The following is a typical phase noise plot. The clock input source was a Rohde and Schwarz model SML03 RF Generator. The spectrum analyzer was either an Agilent model E5052B, model E4400A or model JS-500. The Si5315 operates at 3.3 V with an ac coupled differential PECL output and an ac coupled differential sine wave input from the RF generator at 0 dBm. Note that, as with any PLL, the output jitter that is below the loop BW is caused by the jitter at the input clock, not the Si5315. Except as noted, loop BWs of 60 to 240 Hz were in use.

9.1. 10G LAN SyncE Example



	Frequency Plan			
	Fin=19.44 MHz Fout=156.25 MHz BW=167 Hz	**Fin=19.44 MHz Fout=125 MHz BW=111 Hz**	**Fin=25 MHz Fout=156.25 MHz BW=111 Hz**	**Fin=25 MHz Fout=125 MHz BW=111 Hz**
Jitter Integration Filter Band	RMS Jitter (fs)			
IEEE802.3 (1.875 to 20 MHz)	232	240	251	240
SONET OC-192 (20 kHz to 80 MHz)	483	575	525	550
SONET OC-192 (4 to 80 MHz)	302	303	300	294
SONET OC-192 (50 kHz to 80 MHz)	467	564	510	537
SONET OC-48 (12 kHz to 20 MHz)	470	565	517	541
SONET OC-3 (12 kHz to 5 MHz)	422	524	471	503
BroadBand (800 Hz to 80 MHz)	511	584	533	557

10. Pin Descriptions: Si5315



Pin assignments are preliminary and subject to change.

Table 19. Si5315 Pin Descriptions

Pin #	Pin Name	I/O	Signal Level	Description
1	$\overline{\text{RST}}$	I	LVCMOS	**External Reset.** Active low input that performs external hardware reset of device. Resets all internal logic to a known state. Clock outputs are tristated during reset. After rising edge of $\overline{\text{RST}}$ signal, the Si5315 will perform an internal self-calibration when a valid input signal is present. This pin has a weak pull-up.
2	FRQTBL	I	3-Level	**Frequency Table Select.** Selects frequency table. (Table 9 on page 20.) This pin has a weak pull-up and weak pull-down and defaults to M. Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.
3	LOS1	O	LVCMOS	**CKIN1 Loss of Signal.** Active high loss-of-signal indicator for CKIN1. Once triggered, the alarm will remain active until CKIN1 is validated. 0 = CKIN1 present 1 = LOS on CKIN1
4	LOS2	O	LVCMOS	**CKIN2 Loss of Signal.** Active high loss-of-signal indicator for CKIN2. Once triggered, the alarm will remain active until CKIN2 is validated. 0 = CKIN2 present 1 = LOS on CKIN2

Table 19. Si5315 Pin Descriptions (Continued)

Pin #	Pin Name	I/O	Signal Level	Description
5, 10, 32	V_{DD}	V_{DD}	Supply	**Supply.** The device operates from a 1.8, 2.5, or 3.3 V supply. Bypass capacitors should be associated with the following V_{DD} pins: 5 0.1 µF 10 0.1 µF 32 0.1 µF A 1.0 µF should also be placed as close to device as is practical.
7 6	XB XA	I	Analog	**External Crystal or Reference Clock.** External crystal should be connected to these pins to use internal oscillator based reference. Crystal or reference clock selection is set by the XTAL/CLOCK pin.
8, 15,19, 20,31	GND	GND	Supply	**Ground.** Must be connected to system ground. Minimize the ground path impedance for optimal performance of this device.
9	AUTOSEL	I	3-Level	**Manual/Automatic Clock Selection.** Three level input that selects the method of input clock selection to be used. L = Manual M = Automatic non-revertive H = Automatic revertive This pin has a weak pull-up and weak pull-down and defaults to M. Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.
11	XTAL/CLOCK	I	3-Level	**External Crystal or Reference Clock Rate.** Three level input that selects the type and rate of external crystal or reference clock to be applied to the XA/XB port. This pin has both a weak pull-up and a weak pull-down and defaults to M. L = Crystal M = Clock (Default) H = Reserved Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.
12 13	CKIN2+ CKIN2–	I		**Clock Input 2.** Differential input clock. This input can also be driven with a single-ended signal. Input frequency selected from a table of values. The same frequency must be applied to CKIN1 and CKIN2.

Table 19. Si5315 Pin Descriptions (Continued)

Pin #	Pin Name	I/O	Signal Level	Description
14	DBL2_BY	I	3-Level	**Output 2 Disable/Bypass Mode Control.** Controls enable of CKOUT2 divider/output buffer path and PLL bypass mode. L = CKOUT2 enabled M = CKOUT2 disabled H = Bypass mode with CKOUT2 enabled. Bypass mode is not supported with CMOS clock outputs (SFOUT = LH). This pin has a weak pull-up and weak pull-down and defaults to M. Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.
16 17	CKIN1+ CKIN1–	I	Multi	**Clock Input 1.** Differential input clock. This input can also be driven with a single-ended signal. Input frequency selected from a table of values. The same frequency must be applied to CKIN1 and CKIN2.
18	LOL	O	LVCMOS	**PLL Loss of Lock Indicator.** This pin functions as the active high PLL loss of lock indicator. 0 = PLL locked 1 = PLL unlocked
21	CS_CA	I/O	LVCMOS	**Input Clock Select/Active Clock Indicator.** **Input**: If manual clock selection mode is chosen (AUTOSEL = L), this pin functions as the manual input clock selector. This input is internally deglitched to prevent inadvertent clock switching during changes in the CS input state. 0 = Select CKIN1 1 = Select CKIN2 If configured as input, must be set high or low. **Output**: If automatic clock selection mode is chosen (AUTOSEL = M or H), this pin indicates which of the two input clocks is currently the active clock. If alarms exist on both CKIN1 and CKIN2, indicating that the holdover state has been entered, CA will indicate the last active clock that was used before entering the hold state. 0 = CKIN1 active input clock 1 = CKIN2 active input clock
23 22	BWSEL1 BWSEL0	I	3-Level	**Loop Bandwidth Select.** Three level inputs that select the DSPLL closed loop bandwidth. See Table 9 on page 20 for available settings. These pins have both weak pull-ups and weak pull-downs and default to M. Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.

Table 19. Si5315 Pin Descriptions (Continued)

<table>
<tr><th>Pin #</th><th>Pin Name</th><th>I/O</th><th>Signal Level</th><th>Description</th></tr>
<tr><td>27
26
25
24</td><td>FRQSEL3
FRQSEL2
FRQSEL1
FRQSEL0</td><td>I</td><td>3-Level</td><td>Frequency Select.
Three level inputs that select the input clock and clock multiplication ratio, depending on the FRQTBL setting.
These pins have both weak pull-ups and weak pull-downs and default to M.
Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.</td></tr>
<tr><td>29
28</td><td>CKOUT1–
CKOUT1+</td><td>O</td><td>Multi</td><td>Clock Output 1.
Differential output clock with a frequency selected from a table of values. Output signal format is selected by SFOUT pins. Output is differential for LVPECL, LVDS, and CML compatible modes. For CMOS format, both output pins drive identical single-ended clock outputs.</td></tr>
<tr><td>33
30</td><td>SFOUT0
SFOUT1</td><td>I</td><td>3-Level</td><td>Signal Format Select.
Three level inputs that select the output signal format (common mode voltage and differential swing) for both CKOUT1 and CKOUT2.
<table>
<tr><th>SFOUT[1:0]</th><th>Signal Format</th></tr>
<tr><td>HH</td><td>Reserved</td></tr>
<tr><td>HM</td><td>LVDS</td></tr>
<tr><td>HL</td><td>CML</td></tr>
<tr><td>MH</td><td>LVPECL</td></tr>
<tr><td>MM</td><td>Reserved</td></tr>
<tr><td>ML</td><td>LVDS—Low Swing</td></tr>
<tr><td>LH</td><td>CMOS</td></tr>
<tr><td>LM</td><td>Disable</td></tr>
<tr><td>LL</td><td>Reserved</td></tr>
</table>
These pins have both weak pull-ups and weak pull-downs and default to M.
Some designs may require an external resistor voltage divider when driven by an active device that will tri-state.</td></tr>
<tr><td>34
35</td><td>CKOUT2–
CKOUT2+</td><td>O</td><td>Multi</td><td>Clock Output 2.
Differential output clock with a frequency selected from a table of values. Output signal format is selected by SFOUT pins. Output is differential for LVPECL, LVDS, and CML compatible modes. For CMOS format, both output pins drive identical single-ended clock outputs.</td></tr>
<tr><td>36</td><td>NC</td><td>—</td><td>—</td><td>No Connect.
Leave floating. Make no external connections to this pin for normal operation.</td></tr>
<tr><td>GND
PAD</td><td>GND</td><td>GND</td><td>Supply</td><td>Ground Pad.
The ground pad must provide a low thermal and electrical impedance to a ground plane.</td></tr>
</table>

Table 20. Si5315 Pull-Up/Pull-Down

Pin #	Si5315	Pull
1	$\overline{\text{RST}}$	U
2	FRQTBL	U, D
9	AUTOSEL	U, D
11	XTAL/ CLOCK	U, D
14	DBL2_BY	U, D
21	CS_CA	U, D
22	BWSEL0	U, D
23	BWSEL1	U, D
24	FRQSEL0	U, D
25	FRQSEL1	U, D
26	FRQSEL2	U, D
27	FRQSEL3	U, D
30	SFOUT1	U, D
33	SFOUT0	U, D

11. Ordering Guide

Ordering Part Number	Output Clock Freq Range	Pkg	ROHS6, Pb-Free	Temp Range
Si5315A-C-GM	8 kHz–644.53 MHz	36-Lead 6x6 mm QFN	Yes	–40 to 85 °C
Si5315B-C-GM	8 kHz–125 MHz	36-Lead 6x6 mm QFN	Yes	–40 to 85 °C
Si5315-EVB	8 kHz–644.53 MHz	Evaluation Board		
Note: Add an “R” at the end of the device to denote tape and reel options (i.e., Si5315A-C-GMR).				

12. Package Outline: 36-Pin QFN

Figure 24 illustrates the package details for the Si5315. Table 21 lists the values for the dimensions shown in the illustration.

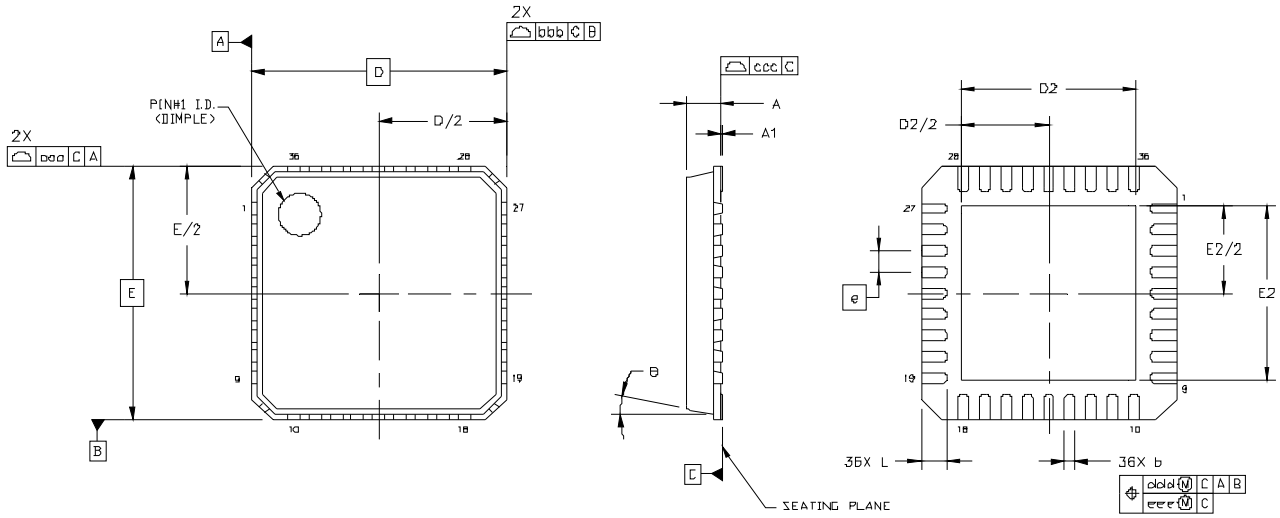


Figure 24. 36-Pin Quad Flat No-Lead (QFN)

Table 21. Package Dimensions

Symbol	Millimeters		
	Min	Nom	Max
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
D		6.00 BSC	
D2	3.95	4.10	4.25
e		0.50 BSC	
E		6.00 BSC	
E2	3.95	4.10	4.25

Symbol	Millimeters		
	Min	Nom	Max
L	0.50	0.60	0.70
θ	—	—	12º
aaa	—	—	0.10
bbb	—	—	0.10
ccc	—	—	0.08
ddd	—	—	0.10
eee	—	—	0.05

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

13. PCB Land Pattern

Figure 25 illustrates the PCB land pattern for the Si5315. Figure 26 illustrates the recommended ground pad layout. Table 22 lists the land pattern dimensions.

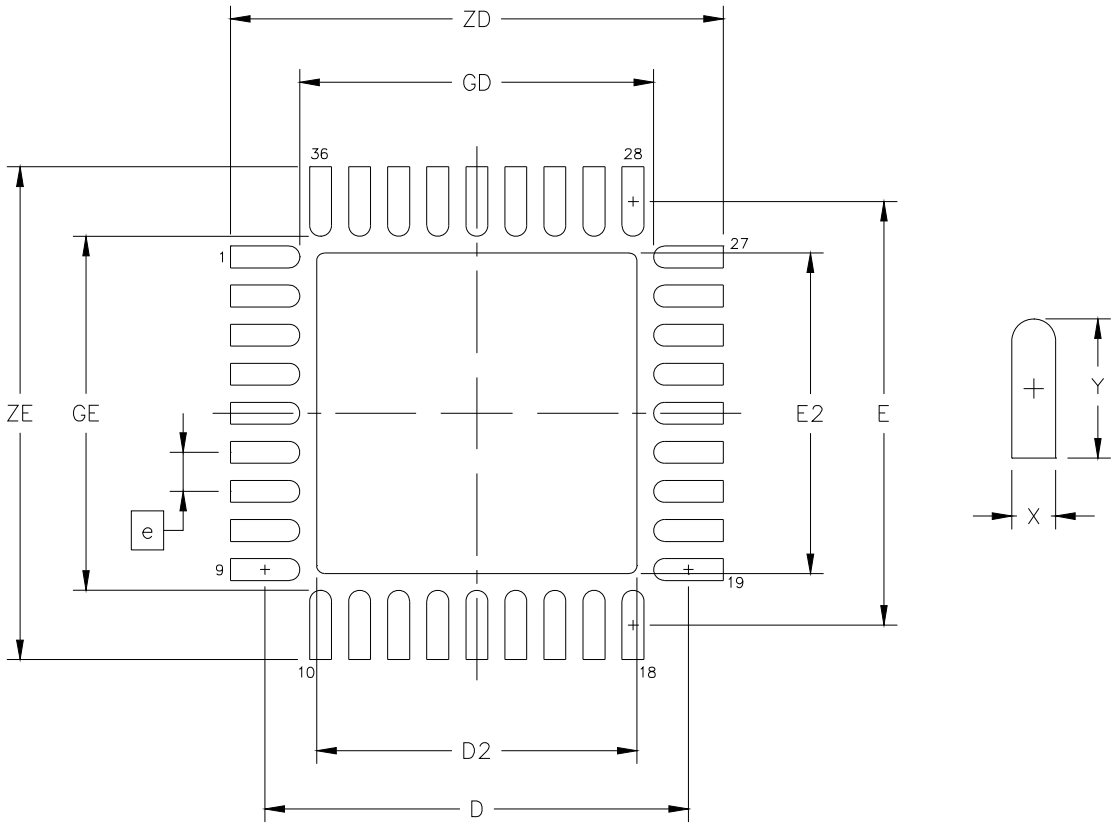


Figure 25. PCB Land Pattern

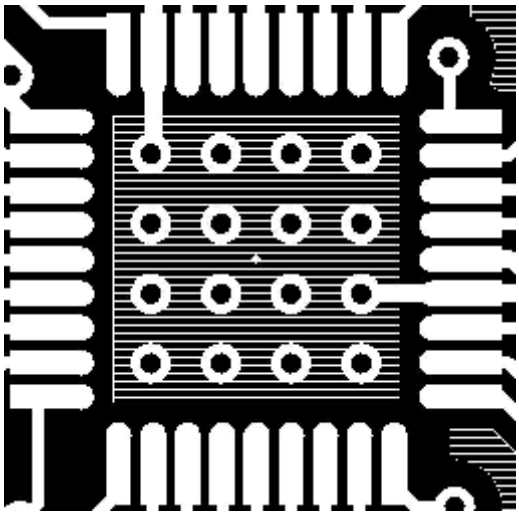


Figure 26. Ground Pad Recommended Layout

Table 22. PCB Land Pattern Dimensions

Dimension	Min	Max
e	0.50 BSC.	
E	5.42 REF.	
D	5.42 REF.	
E2	4.00	4.20
D2	4.00	4.20
GE	4.53	—
GD	4.53	—
X	—	0.28
Y	0.89 REF.	
ZE	—	6.31
ZD	—	6.31

Notes (General):

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing is per the ANSI Y14.5M-1994 specification.
3. This Land Pattern Design is based on IPC-SM-782 guidelines.
4. All dimensions shown are at Maximum Material Condition (MMC). Least Material Condition (LMC) is calculated based on a Fabrication Allowance of 0.05 mm.

Notes (Solder Mask Design):

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

Notes (Stencil Design):

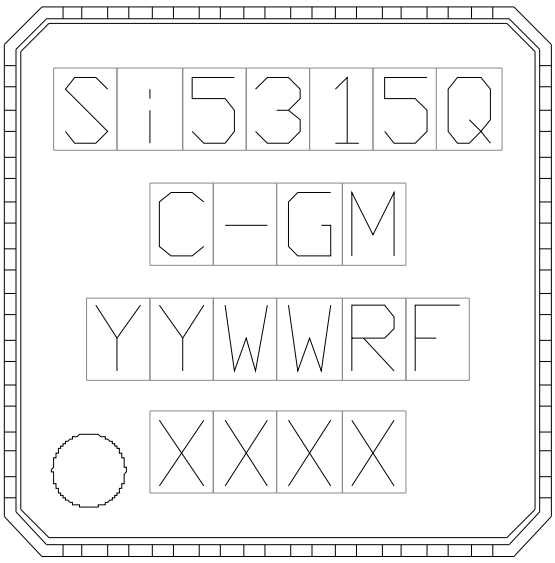
1. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
2. The stencil thickness should be 0.125 mm (5 mils).
3. The ratio of stencil aperture to land pad size should be 1:1 for the perimeter pads.
4. A 4 x 4 array of 0.80 mm square openings on 1.05 mm pitch should be used for the center ground pad.

Notes (Card Assembly):

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

14. Top Marking

14.1. Si5315 Top Marking (QFN)



14.2. Top Marking Explanation

Mark Method:	Laser	
Font Size:	0.80 mm Right-Justified	
Line 1 Marking:	Si5315Q	Customer Part Number Q = Speed Code: A, B See Ordering Guide for options.
Line 2 Marking:	C-GM	C = Product Revision G = Temperature Range –40 to 85 °C (RoHS6) M = QFN Package
Line 3 Marking:	YYWWRF	YY = Year WW = Work Week R = Die Revision F = Internal code Assigned by the Assembly House. Corresponds to the year and work week of the mold date.
Line 4 Marking:	Pin 1 Identifier	Circle = 0.75 mm Diameter Lower-Left Justified
	XXXX	Internal Code

Document Change List

Revision 0.1 to Revision 0.2

- Expanded/added numerous operating sections to initial data sheet

Revision 0.2 to Revision 0.25

- Updated features and application list
- Updated Section 1. "Electrical Specifications”
- Added voltage regulator block to Figure 7
- Revised footnotes in Table 9
- Removed plan #203 from Table 9
- Removed Figure 17. Crystal Oscillator with Feedback Resistor diagram from Section 7. "Crystal/Reference Clock Input”
- Added XA/XB jitter transfer plot to Section 7. "Crystal/Reference Clock Input”
- Added PSRR transfer function plot to Section 8. "Power Supply Filtering”
- Updated Typical phase noise plot and RMS jitter table in Section 9. "Typical Phase Noise Plots”

Revision 0.25 to Revision 0.26

- Corrected Section 11. "Ordering Guide” Output Clock Frequency Range for Si5315B-C-GM to 8 kHz–125 MHz.

Revision 0.26 to Revision 1.0

- Updated Table 2 on page 4.
- Updated Table 3 on page 8.
- Updated Table 7 on page 13.
- Moved “Typical Application Circuit” to page 14.
- Added reference to AN591.
- Bypass mode not supported with CMOS outputs.
- Changed G.8262 compliance language.
- Added frequency plans 103, 129, and 130.

SKYWORKS®

ClockBuilder Pro

Customize Skyworks clock generators, jitter attenuators and network synchronizers with a single tool. With CBPro you can control evaluation boards, access documentation, request a custom part number, export for in-system programming and more!

www.skyworksinc.com/CBPro



Portfolio
www.skyworksinc.com/ia/timing

SW/HW
www.skyworksinc.com/CBPro

Quality
www.skyworksinc.com/quality

Support & Resources
www.skyworksinc.com/support

Copyright © 2021 Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks' Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of Skyworks' published specifications or parameters.

Skyworks, the Skyworks symbol, Sky5®, SkyOne®, SkyBlue™, Skyworks Green™, Clockbuilder®, DSPLL®, ISOmodem®, ProSLIC®, and SiPHY® are trademarks or registered trademarks of Skyworks Solutions, Inc. or its subsidiaries in the United States and other countries. Third-party brands and names are for identification purposes only and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.

Skyworks Solutions, Inc. | Nasdaq: SWKS | sales@skyworksinc.com | www.skyworksinc.com
USA: 781-376-3000 | Asia: 886-2-2735 0399 | Europe: 33 (0)1 43548540 |