

ITU-T G.8262 SYNCHRONOUS ETHERNET JITTER-ATTENUATING CLOCK MULTIPLIER

Features

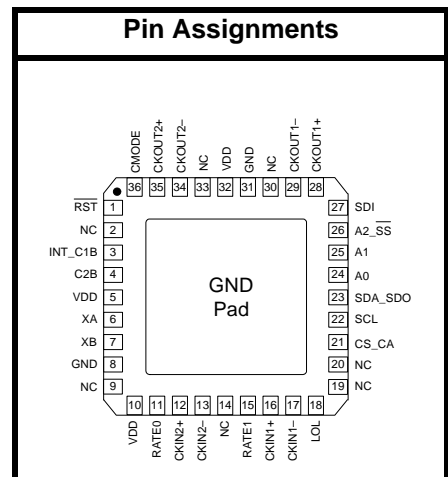
- Fully-compliant with ITU-T G.8262, EEC options 1 and 2.
- Generates any frequency from 8 kHz to 808 MHz.
- Ultra-low jitter clock outputs with jitter generation as low as 0.3 ps rms (12 kHz–20 MHz)
- Integrated loop filter with selectable loop bandwidth (0.1 Hz; 1 to 10 Hz)
- Dual clock inputs with manual or automatically controlled hitless switching
- Dual clock outputs with selectable signal format (LVPECL, LVDS, CML, CMOS)
- LOL, LOS, FOS alarm outputs
- I²C or SPI programmable
- On-chip voltage regulator for 2.5 ±10% or 3.3 V ±10% operation
- Small size: 6 x 6 mm 36-lead QFN
- Pb-free, ROHS compliant

Applications

- G.8262 Synchronous Ethernet, EEC options 1 and 2
- GbE/10GbE/100GbE Synchronous Ethernet
- Carrier Ethernet switches, routers

Description

The Si5328 is a jitter-attenuating precision clock multiplier for Synchronous Ethernet applications requiring sub 1 ps jitter performance and ultra-low loop bandwidth. When combined with a low-wander, low-jitter reference oscillator, the Si5328 meets all of the wander, MTIE, TDEV, and other requirements listed in ITU-T G.8262/Y.1362. The Si5328 accepts two input clocks ranging from 8 kHz to 710 MHz and generates two output clocks ranging from 8 kHz to 808 MHz. The two outputs are divided down separately from a common source. The Si5328 can also use the TCXO as a clock source for frequency synthesis. The device provides virtually any frequency translation combination across this operating range. The Si5328 input clock frequency and clock multiplication ratio are programmable through an I²C or SPI interface. The Si5328 is based on Silicon Laboratories' third-generation DSPLL[®] technology, which provides 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 digitally programmable, providing jitter performance optimization at the application level. Operating from a single 2.5 or 3.3 V supply, the Si5328 is ideal for providing clock multiplication and jitter attenuation in high-performance, Synchronous Ethernet timing applications.



Functional Block Diagram

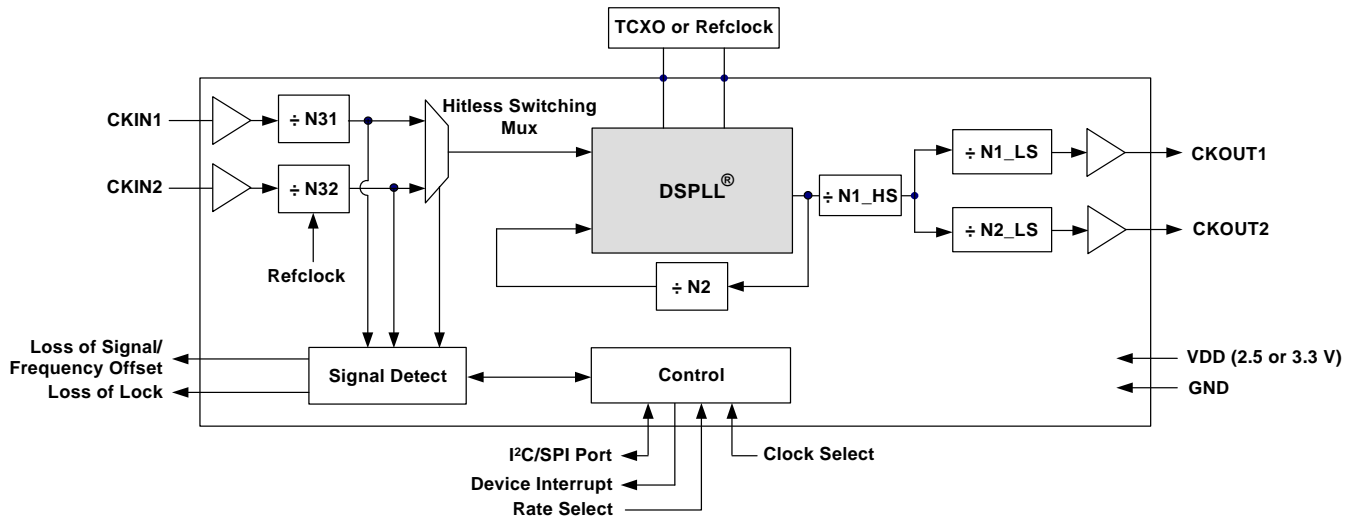


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1. Electrical Specifications

Table 1. Recommended Operating Conditions

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|----------|----------------|------|-----|------|------|
| Ambient Temperature | T_A | | -40 | 25 | 85 | C |
| Supply Voltage during Normal Operation | V_{DD} | 3.3 V Nominal | 2.97 | 3.3 | 3.63 | V |
| | | 2.5 V Nominal | 2.25 | 2.5 | 2.75 | 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 stated.

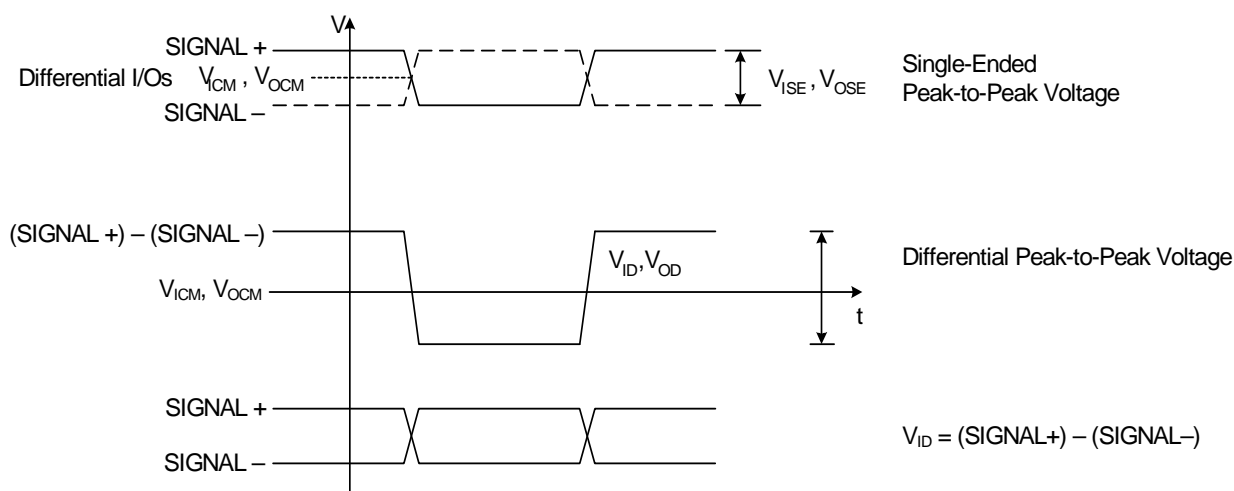


Figure 1. Differential Voltage Characteristics

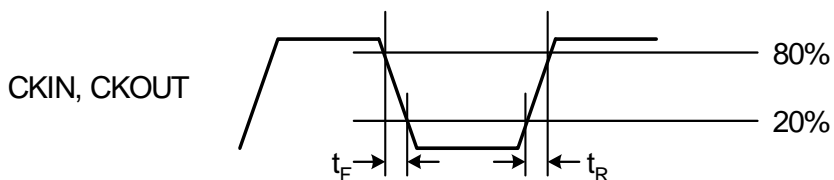


Figure 2. Rise/Fall Time Characteristics

Table 2. DC Characteristics $(V_{DD} = 2.5\text{ V} \pm 10\%$ or $3.3\text{ V} \pm 10\%$, $T_A = -40$ to $85\text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|-------------|---|------|-----|------|------------|
| Supply Current ¹ | I_{DD} | LVPECL Format 808 MHz Out Both CKOUTs Enabled | — | 251 | 279 | mA |
| | | LVPECL Format 808 MHz Out 1 CKOUT Enabled | — | 217 | 243 | mA |
| | | CMOS Format 25 MHz Out Both CKOUTs Enabled | — | 204 | 234 | mA |
| | | CMOS Format 25 MHz Out 1 CKOUT Enabled | — | 194 | 220 | mA |
| | | Disable Mode | — | 165 | — | mA |
| CKINn Input Pins² | | | | | | |
| Input Common Mode Voltage (Input Threshold Voltage) | V_{ICM} | 2.5 V \pm 10% | 1 | — | 1.7 | V |
| | | 3.3 V \pm 10% | 1.1 | — | 1.95 | V |
| Input Resistance | CKN_{RIN} | Single-ended | 20 | 40 | 60 | k Ω |
| Single-Ended Input Voltage Swing (See Absolute Specs) | V_{ISE} | $f_{CKIN} < 212.5\text{ MHz}$ See Figure 1. | 0.2 | — | — | V_{PP} |
| | | $f_{CKIN} > 212.5\text{ MHz}$ See Figure 1. | 0.25 | — | — | V_{PP} |
| Differential Input Voltage Swing (See Absolute Specs) | V_{ID} | $f_{CKIN} < 212.5\text{ MHz}$ See Figure 1. | 0.2 | — | — | V_{PP} |
| | | $f_{CKIN} > 212.5\text{ MHz}$ See Figure 1. | 0.25 | — | — | V_{PP} |
| Notes: | | | | | | |
| 1. Current draw is independent of supply voltage | | | | | | |
| 2. No under- or overshoot is allowed. | | | | | | |
| 3. LVPECL, CML, LVDS and low-swing LVDS measured with $F_o = 312.5\text{ MHz}$. | | | | | | |
| 4. This is the amount of leakage that the 3-Level inputs can tolerate from an external driver. See Si53xx Family Reference Manual for more details. | | | | | | |

Table 2. DC Characteristics (Continued) $(V_{DD} = 2.5\text{ V} \pm 10\% \text{ or } 3.3\text{ V} \pm 10\%, T_A = -40 \text{ to } 85\text{ }^\circ\text{C})$

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---------------|--|---------------------|-----------------|-----------------|-----------|
| Output Clocks (CKOUTn) | | | | | | |
| Common Mode | CKO_{VCM} | LVPECL 100 Ω load line-to-line | $V_{DD} - 1.42$ | — | $V_{DD} - 1.25$ | V |
| Differential Output Swing ³ | CKO_{VD} | LVPECL 100 Ω load line-to-line | 1.1 | — | 1.9 | V_{PP} |
| Single Ended Output Swing ³ | CKO_{VSE} | LVPECL 100 Ω load line-to-line | 0.5 | — | 0.93 | V_{PP} |
| Differential Output Voltage ³ | CKO_{VD} | CML 100 Ω load line-to-line | 350 | 425 | 500 | mV_{PP} |
| Common Mode Output Voltage ³ | CKO_{VCM} | CML 100 Ω load line-to-line | — | $V_{DD} - 0.36$ | — | V |
| Differential Output Voltage ³ | 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 ³ | CKO_{VCM} | LVDS 100 Ω load line-to-line | 1.125 | 1.2 | 1.275 | V |
| Differential Output Resistance | CKO_{RD} | CML, LVPECL, LVDS | — | 200 | — | Ω |
| Output Voltage Low | CKO_{VOLLH} | CMOS | — | — | 0.4 | V |
| Output Voltage High | CKO_{VOHLH} | $V_{DD} = 2.25\text{ V}$ CMOS | $0.8 \times V_{DD}$ | — | — | V |
| Notes: | | | | | | |
| 1. Current draw is independent of supply voltage | | | | | | |
| 2. No under- or overshoot is allowed. | | | | | | |
| 3. LVPECL, CML, LVDS and low-swing LVDS measured with $F_o = 312.5\text{ MHz}$. | | | | | | |
| 4. This is the amount of leakage that the 3-Level inputs can tolerate from an external driver. See Si53xx Family Reference Manual for more details. | | | | | | |

Table 2. DC Characteristics (Continued) $(V_{DD} = 2.5\text{ V} \pm 10\%$ or $3.3\text{ V} \pm 10\%$, $T_A = -40$ to $85\text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|------------|--|-----|-----|-----|------|
| Output Drive Current (CMOS driving into CKO_{VOL} for output low or CKO_{VOH} for output high. $CKOUT+$ and $CKOUT-$ shorted externally) | CKO_{IO} | $ICMOS[1:0] = 11$ $V_{DD} = 2.5\text{ V}$ | — | 20 | — | mA |
| | | $ICMOS[1:0] = 10$ $V_{DD} = 2.5\text{ V}$ | — | 15 | — | mA |
| | | $ICMOS[1:0] = 01$ $V_{DD} = 2.5\text{ V}$ | — | 10 | — | mA |
| | | $ICMOS[1:0] = 00$ $V_{DD} = 2.5\text{ V}$ | — | 5 | — | mA |
| | | $ICMOS[1:0] = 11$ $V_{DD} = 3.3\text{ V}$ | — | 32 | — | mA |
| | | $ICMOS[1:0] = 10$ $V_{DD} = 3.3\text{ V}$ | — | 24 | — | mA |
| | | $ICMOS[1:0] = 01$ $V_{DD} = 3.3\text{ V}$ | — | 16 | — | mA |
| | | $ICMOS[1:0] = 00$ $V_{DD} = 3.3\text{ V}$ | — | 8 | — | mA |
| 2-Level LVCMOS Input Pins | | | | | | |
| Input Voltage Low | V_{IL} | $V_{DD} = 2.25\text{ V}$ | — | — | 0.7 | V |
| | | $V_{DD} = 2.97\text{ V}$ | — | — | 0.8 | V |
| Input Voltage High | V_{IH} | $V_{DD} = 2.25\text{ V}$ | 1.8 | — | — | V |
| | | $V_{DD} = 3.63\text{ V}$ | 2.5 | — | — | V |
| Notes: | | | | | | |
| 1. Current draw is independent of supply voltage | | | | | | |
| 2. No under- or overshoot is allowed. | | | | | | |
| 3. LVPECL, CML, LVDS and low-swing LVDS measured with $F_o = 312.5\text{ MHz}$. | | | | | | |
| 4. This is the amount of leakage that the 3-Level inputs can tolerate from an external driver. See Si53xx Family Reference Manual for more details. | | | | | | |

Table 2. DC Characteristics (Continued) $(V_{DD} = 2.5\text{ V} \pm 10\%$ or $3.3\text{ V} \pm 10\%$, $T_A = -40$ to $85\text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|-----------|--|----------------------|-----|----------------------|---------------|
| 3-Level Input Pins⁴ | | | | | | |
| Input Voltage Low | V_{ILL} | | — | — | $0.15 \times V_{DD}$ | V |
| Input Voltage Mid | V_{IMM} | | $0.45 \times V_{DD}$ | — | $0.55 \times V_{DD}$ | V |
| Input Voltage High | V_{IHH} | | $0.85 \times V_{DD}$ | — | — | V |
| Input Low Current | I_{ILL} | See Note 4 | -20 | — | — | μA |
| Input Mid Current | I_{IMM} | See Note 4 | -2 | — | +2 | μA |
| Input High Current | I_{IHH} | See Note 4 | — | — | 20 | μA |
| LVC MOS Output Pins | | | | | | |
| Output Voltage Low | V_{OL} | $I_O = 2\text{ mA}$ $V_{DD} = 2.25\text{ V}$ | — | — | 0.4 | V |
| Output Voltage Low | | $I_O = 2\text{ mA}$ $V_{DD} = 2.97\text{ V}$ | — | — | 0.4 | V |
| Output Voltage High | V_{OH} | $I_O = -2\text{ mA}$ $V_{DD} = 2.25\text{ V}$ | $V_{DD} - 0.4$ | — | — | V |
| Output Voltage High | | $I_O = -2\text{ mA}$ $V_{DD} = 2.97\text{ V}$ | $V_{DD} - 0.4$ | — | — | V |
| Disabled Leakage Current | I_{OZ} | RSTb = 0 | -100 | — | 100 | μA |
| Notes: | | | | | | |
| 1. Current draw is independent of supply voltage | | | | | | |
| 2. No under- or overshoot is allowed. | | | | | | |
| 3. LVPECL, CML, LVDS and low-swing LVDS measured with $F_o = 312.5\text{ MHz}$. | | | | | | |
| 4. This is the amount of leakage that the 3-Level inputs can tolerate from an external driver. See Si53xx Family Reference Manual for more details. | | | | | | |

Table 3. AC Characteristics $(V_{DD} = 2.5 \pm 10\%$ or $3.3 \text{ V} \pm 10\%$, $T_A = -40$ to $85 \text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---------------|---|-------|-----|-------|---------------------|
| Single-Ended Reference Clock Input Pin XA (XB with cap to GND) | | | | | | |
| Input Resistance | XA_{RIN} | RATE[1:0] = LM, ML, MH, ac coupled | — | 12 | — | k Ω |
| Input Voltage Swing | XA_{VPP} | RATE[1:0] = LM, ML, MH, ac coupled | 0.5 | — | 1.2 | V_{PP} |
| Differential Reference Clock Input Pins (XA/XB) | | | | | | |
| Input Voltage Swing | XA/XB_{VPP} | RATE[1:0] = LM, ML, MH | 0.5 | — | 1.2 | V_{PP} , each. |
| CKINn Input Pins | | | | | | |
| Input Frequency | CKN_F | | 0.008 | — | 710 | MHz |
| Input Duty Cycle (Minimum Pulse Width) | CKN_{DC} | Input frequency > 225 MHz | 40 | — | 60 | % |
| | | Input frequency < 225 MHz refers to both high and low widths | 2 | — | — | ns |
| Input Capacitance | CKN_{CIN} | | — | — | 3 | pF |
| Input Rise/Fall Time | CKN_{TRF} | 20–80% See Figure 2 | — | — | 11 | ns |
| CKOUTn Output Pins | | | | | | |
| (See ordering section for speed grade vs frequency limits) | | | | | | |
| Output Frequency (Output not configured for CMOS) | CKO_F | $N1 \geq 6$ | 0.008 | — | 808 | MHz |
| Maximum Output Frequency in CMOS Format | CKO_F | | — | — | 212.5 | MHz |
| Output Rise/Fall (20–80%) @ 212.5 MHz output | CKO_{TRF} | CMOS Output $V_{DD} = 2.25$ $C_{LOAD} = 5 \text{ pF}$ | — | — | 8 | ns |
| Output Rise/Fall (20–80%) @ 212.5 MHz output | CKO_{TRF} | CMOS Output $V_{DD} = 2.97$ $C_{LOAD} = 5 \text{ pF}$ | — | — | 2 | ns |
| Notes: | | | | | | |
| 1. Lock and settle times may change with different f3, loop BW, and VCO frequency values. Contact Silicon Labs for further details. | | | | | | |
| 2. See Section 9 of “AN775: Si5328 Synchronous Ethernet Compliance Test Report” for more details. | | | | | | |

Table 3. AC Characteristics (Continued) $(V_{DD} = 2.5 \pm 10\%$ or $3.3 \text{ V} \pm 10\%$, $T_A = -40$ to $85 \text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|--------------|--|-----|-----|-----------------|---------------|
| Output Rise/Fall (20–80%) @ 312.5 MHz output | CKO_{TRF} | LVPECL, LVDS or CML Output | — | 230 | 350 | ps |
| Output Duty Cycle Uncertainty @ 808 MHz | CKO_{DC} | 100 Ω Load Line-to-Line Measured at 50% Point (Not for CMOS) | 45 | — | 55 | % |
| LVC MOS Input Pins | | | | | | |
| Minimum Reset Pulse Width | t_{RSTMN} | | 1 | | | μs |
| Reset to Microprocessor Access Ready | t_{READY} | | | | 10 | ms |
| Input Capacitance | C_{in} | | — | — | 3 | pF |
| LVC MOS Output Pins | | | | | | |
| Rise/Fall Times | t_{RF} | $C_{LOAD} = 20\text{pf}$ See Figure 2 | — | 25 | — | ns |
| LOS _n Trigger Window | LOS_{TRIG} | From last $CKIN_n \uparrow$ to \downarrow Internal detection of LOS _n $N3 \neq 1$ | — | — | $4.5 \times N3$ | T_{CKIN} |
| Time to Clear LOL after LOS Cleared | t_{CLRLOL} | \downarrow LOS to \downarrow LOL Fold = Fnew Stable Xa/XB reference | — | 10 | — | ms |
| Device Skew | | | | | | |
| Output Clock Skew | t_{SKEW} | \uparrow of $CKOUT_n$ to \uparrow of $CKOUT_m$, $CKOUT_n$ and $CKOUT_m$ at same frequency and signal format <u>PHASEOFFSET = 0</u> <u>CKOUT_ALWAYS_ON = 1</u> <u>SQ_ICAL = 1</u> | — | — | 100 | ps |
| Phase Change due to Temperature Variation | t_{TEMP} | Max phase changes from – 40 to +85 $^\circ\text{C}$, stable XAXB reference | — | 300 | 500 | ps |
| Notes: | | | | | | |
| 1. Lock and settle times may change with different f ₃ , loop BW, and VCO frequency values. Contact Silicon Labs for further details. | | | | | | |
| 2. See Section 9 of “AN775: Si5328 Synchronous Ethernet Compliance Test Report” for more details. | | | | | | |

Table 3. AC Characteristics (Continued) $(V_{DD} = 2.5 \pm 10\%$ or $3.3 V \pm 10\%$, $T_A = -40$ to $85\text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---------------|---|---------|------|-----|----------|
| PLL Performance ($f_{in} = f_{out} = 346\text{ MHz}$; $BW = 0.088\text{ Hz}$; LVPECL) | | | | | | |
| Lock Time ¹ | t_{LOCKMP} | Start of ICAL to LOL low, LOCKT = 4, FASTLOCK enabled | — | 2 | — | s |
| | | Start of ICAL to LOL low, LOCKT = 1, FASTLOCK enabled | — | 12.5 | — | s |
| Settle Time ¹ | t_{SETTLE} | Start of ICAL to output phase within 45 degrees of final value, LOCKT = 4, FASTLOCK enabled | — | 1 | — | s |
| | | Start of ICAL to output phase within 45 degrees of final value, LOCKT = 1, FASTLOCK enabled | — | 1 | — | s |
| Output Clock Phase Change | t_{P_STEP} | After clock switch $f_3 \geq 128\text{ kHz}$ | — | 200 | — | ps |
| Closed Loop Jitter Peaking | J_{PK} | | — | 0.05 | 0.2 | dB |
| Jitter/Wander Tolerance ² | J_{TOL} | Jitter Frequency \geq Loop Bandwidth | 5000/BW | — | — | ns pk-pk |
| Phase Noise $f_{out} = 156.25\text{ MHz}$ | CKO_{PN} | 1 kHz Offset | — | -120 | — | dBc/Hz |
| | | 10 kHz Offset | — | -128 | — | dBc/Hz |
| | | 100 kHz Offset | — | -130 | — | dBc/Hz |
| | | 1 MHz Offset | — | -144 | — | dBc/Hz |
| Subharmonic Noise | SP_{SUBH} | Phase Noise @ 100 kHz Offset | — | -88 | — | dBc |
| Spurious Noise | SP_{SPUR} | Max spur @ $n \times F_3$ ($n \geq 1$, $n \times F_3 < 100\text{ MHz}$) | — | -93 | — | dBc |
| Notes: | | | | | | |
| 1. Lock and settle times may change with different f_3 , loop BW, and VCO frequency values. Contact Silicon Labs for further details. | | | | | | |
| 2. See Section 9 of "AN775: Si5328 Synchronous Ethernet Compliance Test Report" for more details. | | | | | | |

Table 4. Microprocessor Control

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|-----------------|--|----------------------|-----|----------------------|---------------|
| I²C Bus Lines (SDA, SCL) | | | | | | |
| Input Voltage Low | $V_{IL_{I2C}}$ | | — | — | $0.25 \times V_{DD}$ | V |
| Input Voltage High | $V_{IH_{I2C}}$ | | $0.7 \times V_{DD}$ | — | V_{DD} | V |
| Input Current | I_{I2C} | $V_{IN} = 0.1 \times V_{DD}$ to $0.9 \times V_{DD}$ | -10 | — | 10 | μA |
| Hysteresis of Schmitt trigger inputs | $V_{HYS_{I2C}}$ | | $0.05 \times V_{DD}$ | — | — | V |
| Output Voltage Low | $V_{OL_{I2C}}$ | $I_O = 3 \text{ mA}$ | — | — | 0.4 | V |

Table 4. Microprocessor Control (Continued) $(V_{DD} = 2.5 \pm 10\%$ or $3.3 \text{ V} \pm 10\%$, $T_A = -40$ to $85 \text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|-----------|----------------|-----|-----|-----|------|
| SPI Specifications | | | | | | |
| Duty Cycle, SCLK | t_{DC} | SCLK = 10 MHz | 40 | — | 60 | % |
| Cycle Time, SCLK | t_c | | 100 | — | — | ns |
| Rise Time, SCLK | t_r | 20–80% | — | — | 25 | ns |
| Fall Time, SCLK | t_f | 20–80% | — | — | 25 | ns |
| Low Time, SCLK | t_{lsc} | 20–20% | 30 | — | — | ns |
| High Time, SCLK | t_{hsc} | 80–80% | 30 | — | — | ns |
| Delay Time, SCLK Fall to SDO Active | t_{d1} | | — | — | 25 | ns |
| Delay Time, SCLK Fall to SDO Transition | t_{d2} | | — | — | 25 | ns |
| Delay Time, SS Rise to SDO Tri-state | t_{d3} | | — | — | 25 | ns |
| Setup Time, SS to SCLK Fall | t_{su1} | | 25 | — | — | ns |
| Hold Time, SS to SCLK Rise | t_{h1} | | 20 | — | — | ns |
| Setup Time, SDI to SCLK Rise | t_{su2} | | 25 | — | — | ns |
| Hold Time, SDI to SCLK Rise | t_{h2} | | 20 | — | — | ns |
| Delay Time between Slave Selects | t_{cs} | | 25 | — | — | ns |

Table 5. Jitter Generation^{1,2,3,4,5,6}

| Symbol | Filter | Output Frequency | Min | Typ | Max | Unit |
|--------|------------------|------------------|-----|-----|-----|---------|
| JGEN | 12 kHz to 20 MHz | 125 MHz | — | 331 | — | fs, RMS |
| JGEN | 10 kHz to 1 MHz | 125 MHz | — | 287 | — | fs, RMS |
| JGEN | 12 kHz to 20 MHz | 156.25 MHz | — | 308 | — | fs, RMS |
| JGEN | 10 kHz to 1 MHz | 156.25 MHz | — | 263 | — | fs, RMS |

Notes:

1. Input frequency = 25 MHz.
2. XAXB reference = Rakon 40 MHz TCXO model RTX7050A, part number 509768.
3. Vdd = 3.3 V.
4. Clock output = LVPECL.
5. Loop bandwidth = 0.085 Hz.
6. Using Agilent E5052B.

Table 6. Thermal Characteristics $(V_{DD} = 2.5 \pm 10\%$ or $3.3 \text{ V} \pm 10\%$, $T_A = -40$ to $85 \text{ }^\circ\text{C}$)

| Parameter | Symbol | Test Condition | Value | Unit |
|--|---------------|----------------|-------|---------------------------|
| Thermal Resistance Junction to Ambient | θ_{JA} | Still Air | 32 | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance Junction to Case | θ_{JC} | Still Air | 14 | $^\circ\text{C}/\text{W}$ |

Table 7. Absolute Maximum Ratings

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|-------------|----------------|------------------|-----|--------------|------------------|
| DC Supply Voltage | V_{DD} | | -0.5 | — | 3.8 | V |
| LVC MOS Input Voltage | V_{DIG} | | -0.3 | | $V_{DD}+0.3$ | V |
| CKINn Voltage Level Limits | CKN_{VIN} | | 0 | — | V_{DD} | V |
| XA/XB Voltage Level Limits | XA_{VIN} | | 0 | — | 1.2 | V |
| Operating Junction Temperature | T_{JCT} | | -55 | — | 150 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{STG} | | -55 | — | 150 | $^\circ\text{C}$ |
| ESD HBM Tolerance (100 pF, 1.5 k Ω); All pins except CKIN+/CKIN- | | | 2 | — | — | kV |
| ESD MM Tolerance; All pins except CKIN+/CKIN- | | | 150 | — | — | V |
| ESD HBM Tolerance (100 pF, 1.5 k Ω); 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 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 Phase Noise Performance

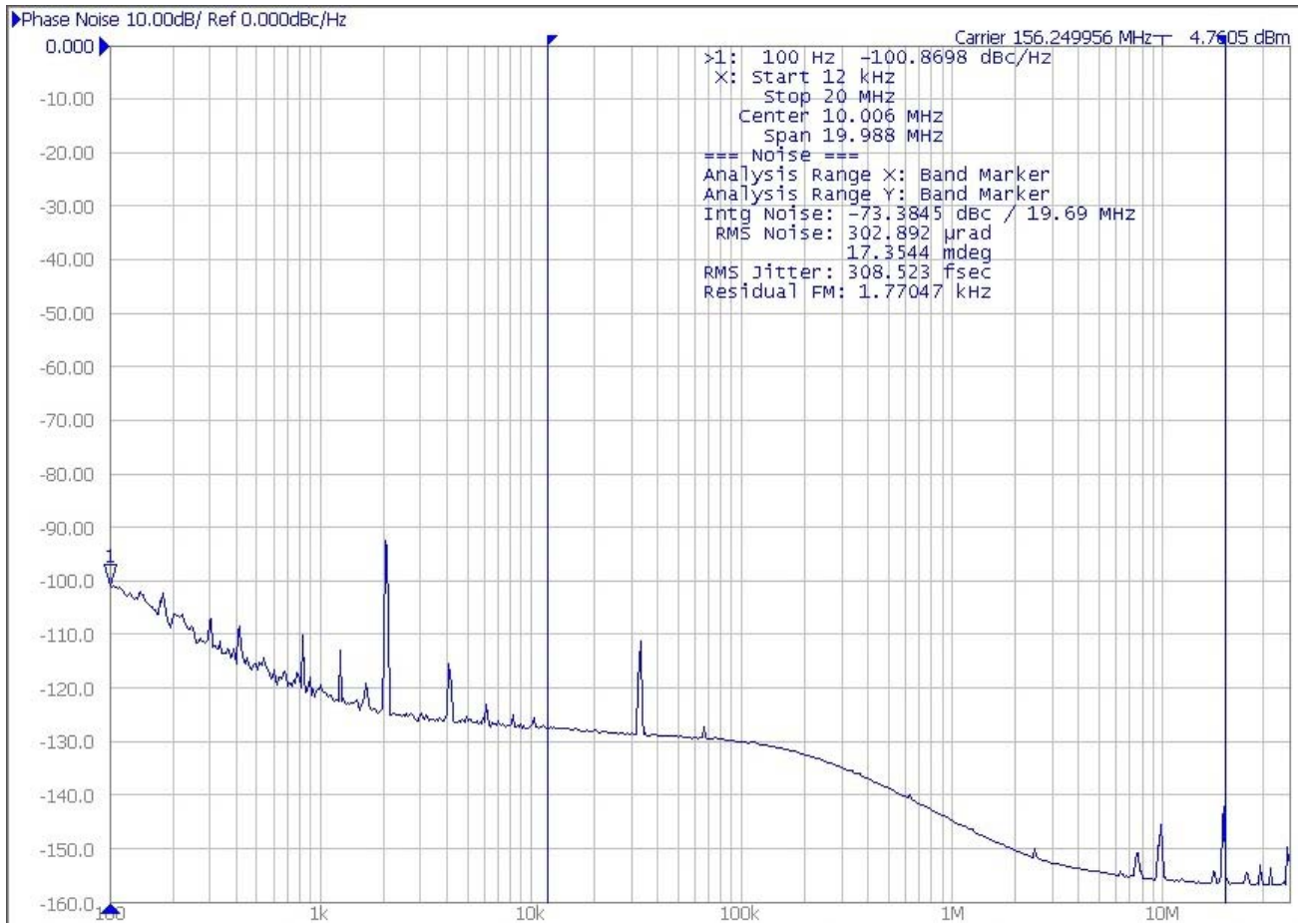


Figure 3. Typical Phase Noise Plot

Table 8. RMS Jitter Values

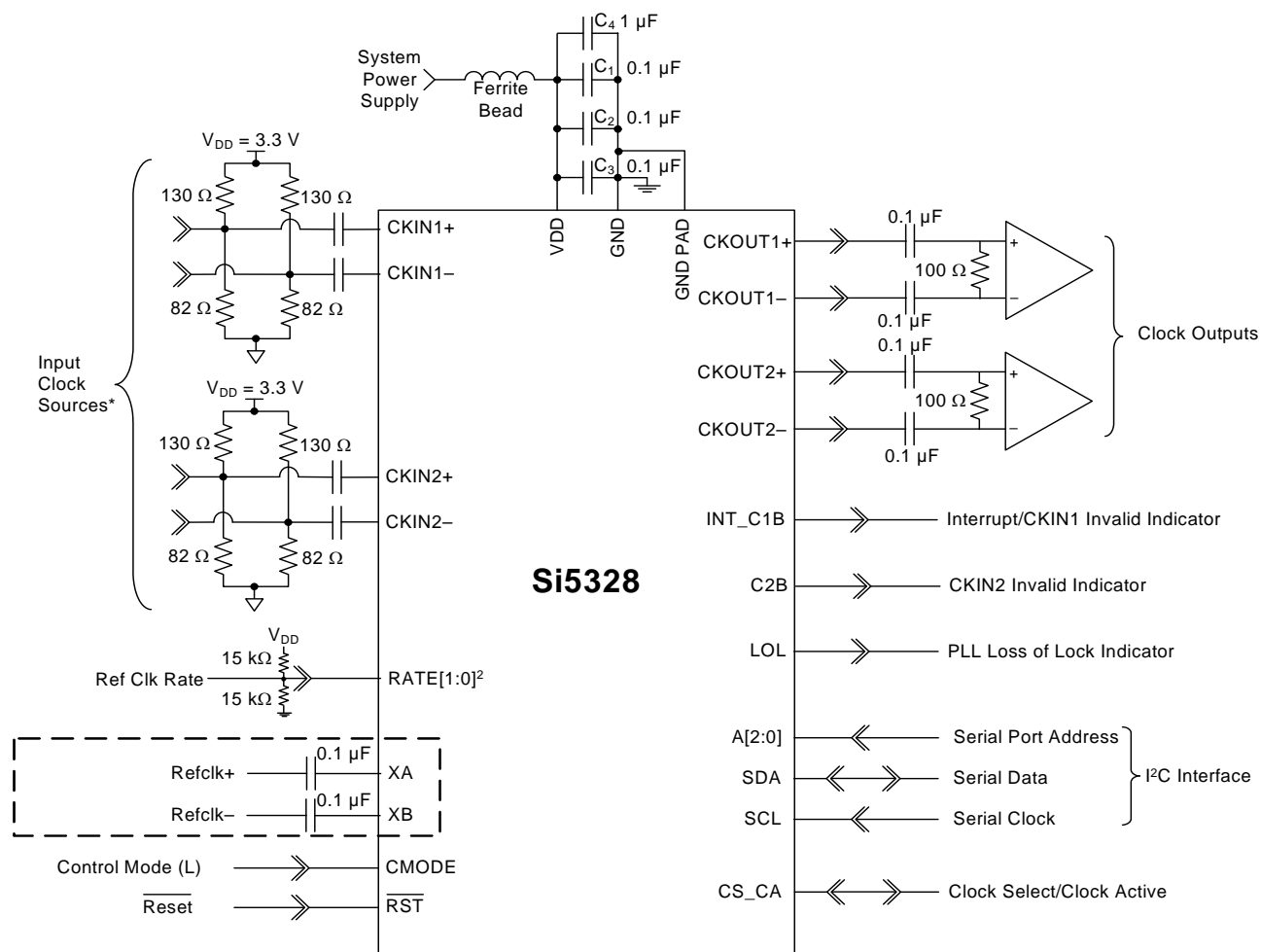
| Jitter Band | Jitter (rms) |
|------------------|--------------|
| 10 kHz to 1 MHz | 263 fs |
| 12 kHz to 20 MHz | 309 fs |

Notes:

1. input frequency = 25 MHz.
2. XAXB reference = Rakon 40 MHz TCXO model RTX7050A, part number 509768.
3. Vdd = 3.3 V.
4. Clock output = LVPECL.
5. Loop bandwidth = 0.085 Hz.
6. Using Agilent E5052B.

3. Typical Application Circuit

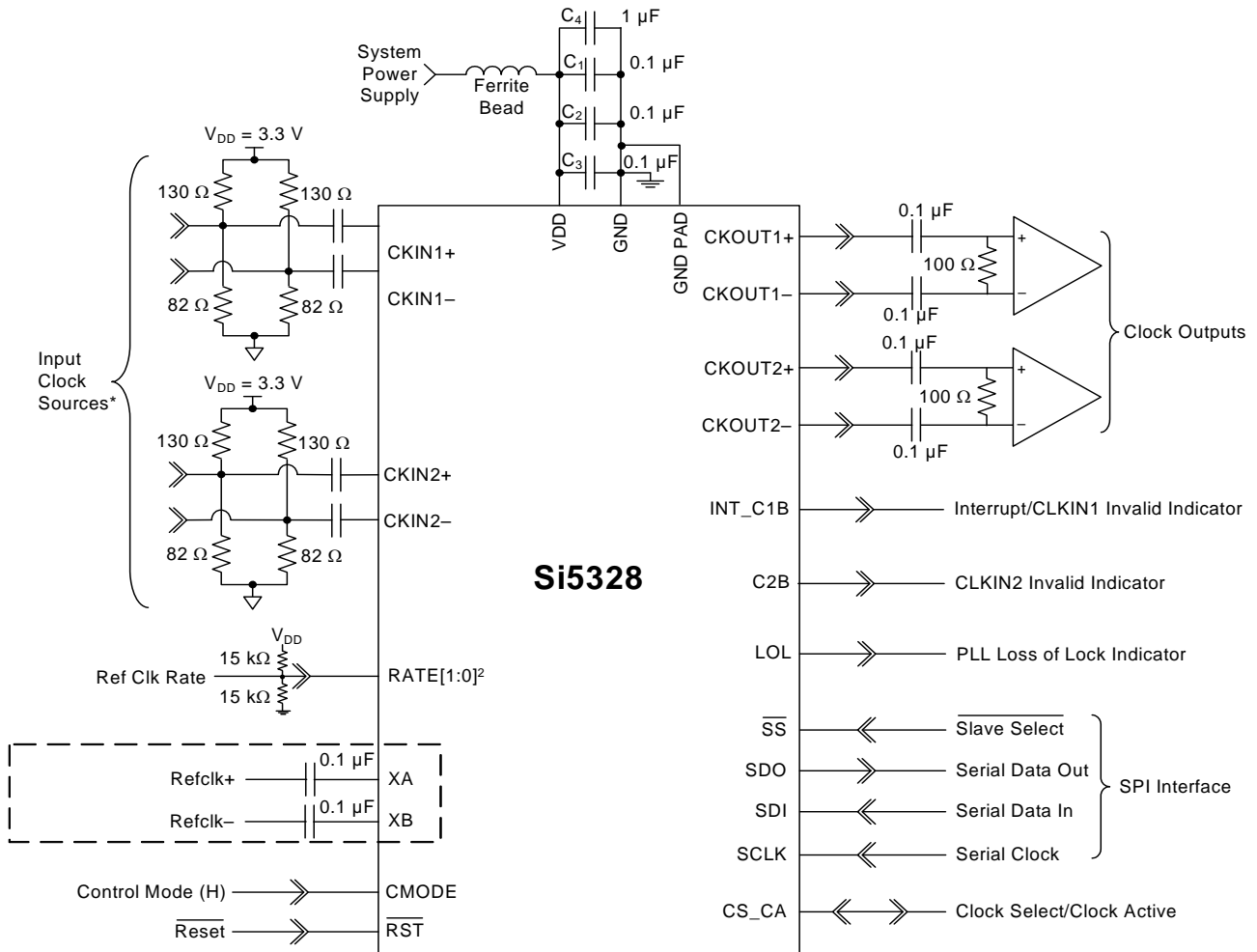
Note: For an example schematic and layout, refer to the Si5328-EVB User's Guide.



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. I²C-required pull-up resistors not shown.

Figure 4. Si5328 Typical Application Circuit (I²C Control Mode)



- 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 (VDD/2), and H (VDD).

Figure 5. Si5328 Typical Application Circuit (SPI Control Mode)

4. Functional Description

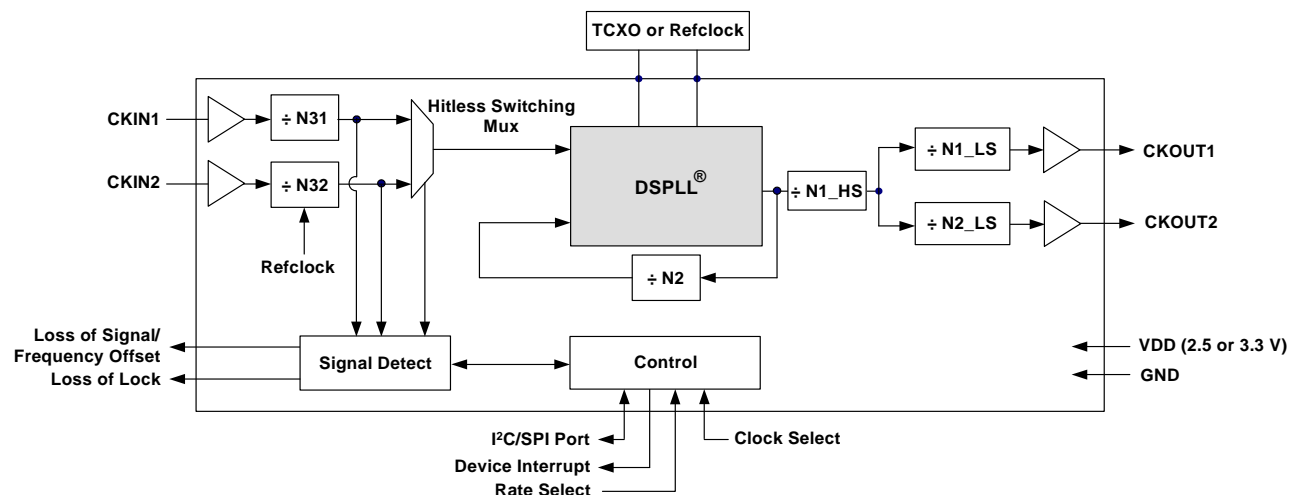


Figure 6. Functional Block Diagram

The Si5328 is a jitter-attenuating precision clock multiplier for Synchronous Ethernet applications requiring sub 1 ps jitter performance and ultra-low loop bandwidth. When combined with a low-wander reference oscillator, the Si5328 meets all of the wander, MTIE, TDEV, and other requirements that are listed in ITU-T G.8262/Y.1362. The Si5328 accepts two input clocks ranging from 8 kHz to 710 MHz and generates two output clocks ranging from 8 kHz to 808 MHz. The Si5328 can also use its TCXO as a clock source for frequency synthesis. The device provides virtually any frequency translation combination across this operating range. Independent dividers are available for each input clock and output clock, so the Si5328 can accept input clocks at different frequencies and it can generate output clocks at different frequencies. The Si5328 input clock frequency and clock multiplication ratio are programmable through an I²C or SPI interface. Silicon Laboratories offers a PC-based software utility, *DSPLLsim*, that can be used to determine the optimum PLL divider settings for a given input frequency/clock multiplication ratio combination that minimizes phase noise and power consumption. This utility can be downloaded from <http://www.silabs.com/timing>.

The Si5328 is based on Silicon Laboratories' 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 Si5328 PLL loop bandwidth is digitally programmable and supports a range from less than 0.1 Hz to 6 Hz. The *DSPLLsim* software utility can be used to calculate valid loop bandwidth settings for a given input clock frequency/clock multiplication ratio.

The Si5328 supports hitless switching between the two synchronous input clocks in compliance with G.8262 that greatly minimizes the propagation of phase transients to the clock outputs during an input clock transition (maximum 200 ps phase transient). Manual and automatic revertive and non-revertive input clock switching options are available. The Si5328 monitors both input clocks for loss-of-signal (LOS) and provides a LOS alarm (INT_C1B and C2B) 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 Si5328 also monitors frequency offset alarms (FOS), which indicate if an input clock is within a specified frequency band relative to the frequency of a reference clock. Both Stratum 3/3E and SONET Minimum Clock (SMC) FOS thresholds are supported. The Si5328 provides a digital hold capability that allows the device to continue generation of a stable output clock when the selected input reference is lost. During digital hold, the DSPLL generates an output frequency based on a historical average frequency that existed for a fixed amount of time before the error event occurred, eliminating the effects of phase and frequency transients that may occur immediately preceding digital hold.

The Si5328 has two differential clock outputs. The electrical format of each clock output is independently programmable to support LVPECL, LVDS, CML, or CMOS loads. If not required, the second clock output can be powered down to minimize power consumption.

The phase of one output clock may be adjusted in relation to the phase of the other output clock with resolution that varies from 800 ps to 2.2 ns, depending on the PLL divider settings. See Table 9 for instructions on ensuring output-to-output alignment. The input to output skew is not specified or controlled. The DSPLLsim software utility determines the phase offset resolution for a given input clock/clock multiplication ratio combination. 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 is powered by a single 2.5 or 3.3 V supply.

4.1. External XAXB Reference

In order to achieve the levels of performance required by G.8262, care must be exercised when selecting an XA/XB reference. To meet the wander specifications in G.8262, a TCXO or OCXO will be needed.

“AN775: Si5328 ITU-T G.8262 SyncE Compliance Test Report” is a G.8262 test report using a 40 MHz Rakon RTX7050A-109 TCXO. See “AN776: Using the Si5328 in a G.8262 Compliant SyncE Application” for a discussion of how to select and best use a TCXO as well as a list of other potential TCXO sources.

4.2. Further Documentation

Consult the Silicon Laboratories Si53xx Any Frequency Precision Clock Family Reference Manual (FRM) for detailed information about the Si5328 functions. Additional design support is available from Silicon Laboratories through your distributor.

Silicon Laboratories has developed a PC-based software utility called DSPLLsim to simplify device configuration, including frequency planning and loop bandwidth selection. The FRM and this utility can be downloaded from <http://www.silabs.com/timing>.

Table 9. CKOUT_ALWAYS_ON and SQ_ICAL Truth Table

| CKOUT_ALWAYS_ON | SQ_ICAL | Results |
|-----------------|---------|---|
| 0 | 0 | CKOUT OFF until after the first ICAL |
| 0 | 1 | CKOUT OFF until after the first successful ICAL (i.e., when LOL is low) |
| 1 | 0 | CKOUT always ON, including during an ICAL |
| 1 | 1 | CKOUT always ON, including during an ICAL. Use these settings to preserve output-to-output skew |

5. Register Map

All register bits that are not defined in this map should always be written with the specified Reset Values. The writing to these bits of values other than the specified Reset Values may result in undefined device behavior. Registers not listed, such as Register 64, should never be written to.

| Register | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|------------------|--------------|-----------------|--------------|----------------|-----------------|---------------|-----------|
| 0 | | FREE_RUN | CKOUT_ALWAYS_ON | | | | BYPASS_REG | |
| 1 | | | | | CK_PRIOR2[1:0] | | CK_PRIOR[1:0] | |
| 2 | BWSEL_REG[3:0] | | | | | | | |
| 3 | CKSEL_REG[1:0] | | DHOLD | SQ_ICAL | | | | |
| 4 | AUTOSEL_REG[1:0] | | | HST_DEL[4:0] | | | | |
| 5 | ICMOS[1:0] | | | | | | | |
| 6 | | SLEEP | SFOUT2_REG[2:0] | | | SFOUT1_REG[2:0] | | |
| 7 | | | | | | FOSREFSEL[2:0] | | |
| 8 | HLOG_2[1:0] | | HLOG_1[1:0] | | | | | |
| 9 | HIST_AVG[4:0] | | | | | | | |
| 10 | | | | | DSBL2_REG | DSBL1_REG | | |
| 11 | | | | | | | PD_CK2 | PD_CK1 |
| 19 | FOS_EN | FOS_THR[1:0] | | VALTIME[1:0] | | LOCK[T2:0] | | |
| 20 | | | | | CK2_BAD_PIN | CK1_BAD_PIN | LOL_PIN | INT_PIN |
| 21 | | | | | | | CK1_ACTV_PIN | CKSEL_PIN |
| 22 | | | | | CK_ACTV_POL | CK_BAD_POL | LOL_POL | INT_POL |
| 23 | | | | | | LOS2_MSK | LOS1_MSK | LOSX_MSK |
| 24 | | | | | | FOS2_MSK | FOS1_MSK | LOL_MSK |
| 25 | N1_HS[2:0] | | | | | | | |
| 31 | | | | | NC1_LS[19:16] | | | |
| 32 | NC1_LS[15:8] | | | | | | | |
| 33 | NC1_LS[7:0] | | | | | | | |
| 34 | | | | | NC2_LS[19:16] | | | |

Si5328

| Register | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|----------|-----------------------|------|--------------|--------------|-----------------|----|---------------|---------------|----------|
| 35 | NC2_LS[15:8] | | | | | | | | |
| 36 | NC2_LS[7:0] | | | | | | | | |
| 40 | N2_HS[2:0] | | | N2_LS[19:16] | | | | | |
| 41 | N2_LS[15:8] | | | | | | | | |
| 42 | N2_LS[7:0] | | | | | | | | |
| 43 | N31[18:16] | | | | | | | | |
| 44 | N31[15:8] | | | | | | | | |
| 45 | N31[7:0] | | | | | | | | |
| 46 | N32[18:16] | | | | | | | | |
| 47 | N32[15:8] | | | | | | | | |
| 48 | N32[7:0] | | | | | | | | |
| 55 | CLKIN2RATE[2:0] | | | | CLKIN1RATE[2:0] | | | | |
| 128 | | | | | | | CK2_ACTV_REG | CK1_ACTV_REG | |
| 129 | | | | | | | LOS2_INT | LOS1_INT | LOSX_INT |
| 130 | DIGHOLDVALID | | | | | | FOS2_INT | FOS1_INT | LOL_INT |
| 131 | | | | | | | LOS2_FLG | LOS1_FLG | LOSX_FLG |
| 132 | | | | | | | FOS2_FLG | FOS1_FLG | LOL_FLG |
| 134 | PARTNUM_RO[11:4] | | | | | | | | |
| 135 | PARTNUM_RO[3:0] | | | | REVID_RO[3:0] | | | | |
| 136 | RST_REG | ICAL | | | | | | GRADE_RO[1:0] | |
| 137 | | | | | | | | FASTLOCK | |
| 138 | | | | | | | LOS2_EN [1:1] | LOS1_EN [1:1] | |
| 139 | | | LOS2_EN[0:0] | LOS1_EN[0:0] | | | | FOS2_EN | FOS1_EN |
| 142 | INDEPENDENTSKEW1[7:0] | | | | | | | | |
| 143 | INDEPENDENTSKEW2[7:0] | | | | | | | | |

6. Register Descriptions

Register 0.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----|----------|-----------------|----|----|----|------------|----|
| Name | | FREE_RUN | CKOUT_ALWAYS_ON | | | | BYPASS_REG | |
| Type | R | R/W | R/W | R | R | R | R/W | R |

Reset value = 0001 0100

| Bit | Name | Function |
|-----|-----------------|---|
| 7 | Reserved | Reserved. |
| 6 | FREE_RUN | Free Run. Internal to the device, route XA/XB to CKIN2. This allows the device to lock to its XA-XB reference. 0: Disable 1: Enable |
| 5 | CKOUT_ALWAYS_ON | CKOUT Always On. This will bypass the SQ_ICAL function. Output will be available even if SQ_ICAL is on and ICAL is not complete or successful. See Table 9 on page 20. 0: Squelch output until part is calibrated (ICAL). 1: Provide an output. Note: The frequency may be significantly off and variable until the part is calibrated. |
| 4:2 | Reserved | Reserved. |
| 1 | BYPASS_REG | Bypass Register. This bit enables or disables the PLL bypass mode. Use only when the device is in digital hold or before the first ICAL. 0: Normal operation 1: Bypass mode. Selected input clock is connected to CKOUT buffers, bypassing the PLL. Bypass mode does not support CMOS clock outputs. |
| 0 | Reserved | Reserved. |

Register 1.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|-----------------|----|-----------------|----|
| Name | Reserved | | | | CK_PRIOR2 [1:0] | | CK_PRIOR1 [1:0] | |
| Type | R | | | | R/W | | R/W | |

Reset value = 1110 0100

| Bit | Name | Function |
|-----|-----------------|--|
| 7:4 | Reserved | Reserved. |
| 3:2 | CK_PRIOR2 [1:0] | CK_PRIOR 2. Selects which of the input clocks will be 2nd priority in the autoselection state machine. 00: CKIN1 is 2nd priority. 01: CKIN2 is 2nd priority. 10: Reserved 11: Reserved |
| 1:0 | CK_PRIOR1 [1:0] | CK_PRIOR 1. Selects which of the input clocks will be 1st priority in the autoselection state machine. 00: CKIN1 is 1st priority. 01: CKIN2 is 1st priority. 10: Reserved 11: Reserved |

Register 2.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-----------------|----|----|----|----------|----|----|----|
| Name | BWSEL_REG [3:0] | | | | Reserved | | | |
| Type | R/W | | | | R | | | |

Reset value = 0100 0010

| Bit | Name | Function |
|-----|-----------------|---|
| 7:4 | BWSEL_REG [3:0] | BWSEL_REG. Selects nominal f3dB bandwidth for PLL. See DSPLLsim for settings. After BWSEL_REG is written with a new value, an ICAL is required for the change to take effect. |
| 3:0 | Reserved | Reserved. |

Register 3.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-----------------|----|-------|---------|----------|----|----|----|
| Name | CKSEL_REG [1:0] | | DHOLD | SQ_ICAL | Reserved | | | |
| Type | R/W | | R/W | R/W | R | | | |

Reset value = 0000 0101

| Bit | Name | Function |
|-----|-----------------|---|
| 7:6 | CKSEL_REG [1:0] | <p>CKSEL_REG.</p> <p>If the device is operating in register-based manual clock selection mode (AUTOSEL_REG = 00), and CKSEL_PIN = 0, then these bits select which input clock will be the active input clock. If CKSEL_PIN = 1 and AUTOSEL_REG = 00, the CS_CA input pin continues to control clock selection and CKSEL_REG is of no consequence.</p> <p>00: CKIN_1 selected. 01: CKIN_2 selected. 10: Reserved 11: Reserved</p> |
| 5 | DHOLD | <p>DHOLD.</p> <p>Forces the part into digital hold. This bit overrides all other manual and automatic clock selection controls.</p> <p>0: Normal operation. 1: Force digital hold mode. Overrides all other settings and ignores the quality of all of the input clocks.</p> |
| 4 | SQ_ICAL | <p>SQ_ICAL.</p> <p>This bit determines if the output clocks will remain enabled or be squelched (disabled) during an internal calibration. See Table 9 on page 20.</p> <p>0: Output clocks enabled during ICAL. 1: Output clocks disabled during ICAL.</p> |
| 3:0 | Reserved | Reserved. |

Register 4.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------------|----|----------|----------------|----|----|----|----|
| Name | AUTOSEL_REG [1:0] | | Reserved | HIST_DEL [4:0] | | | | |
| Type | R/W | | R | R/W | | | | |

Reset value = 0001 0010

| Bit | Name | Function |
|-----|-------------------|---|
| 7:6 | AUTOSEL_REG [1:0] | AUTOSEL_REG [1:0]. Selects method of input clock selection to be used. 00: Manual (either register or pin controlled, see CKSEL_PIN) 01: Automatic Non-Revertive 10: Automatic Revertive 11: Reserved See the Si53xx Family Reference Manual for a detailed description. |
| 5 | Reserved | Reserved. |
| 4:0 | HIST_DEL [4:0] | HIST_DEL [4:0]. Selects amount of delay to be used in generating the history information used for Digital Hold. See the Si53xx Family Reference Manual for a detailed description. |

Register 5.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------|----|----------|----|----|----|----|----|
| Name | ICMOS [1:0] | | Reserved | | | | | |
| Type | R/W | | R | | | | | |

Reset value = 1110 1101

| Bit | Name | Function |
|-----|-------------|--|
| 7:6 | ICMOS [1:0] | ICMOS [1:0]. When the output buffer is set to CMOS mode, these bits determine the output buffer drive strength. The first number below refers to 3.3 V operation; the second to 2.5 V operation. These values assume CKOUT+ is tied to CKOUT-. 00: 8 mA/5 mA 01: 16 mA/10 mA 10: 24 mA/15 mA 11: 32 mA/20 mA |
| 5:0 | Reserved | Reserved. |

Register 6.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|-------|------------------|----|----|------------------|----|----|
| Name | Reserved | SLEEP | SFOUT2_REG [2:0] | | | SFOUT1_REG [2:0] | | |
| Type | R | R/W | R/W | | | R/W | | |

Reset value = 0010 1101

| Bit | Name | Function |
|-----|------------------|---|
| 7 | Reserved | Reserved. |
| 6 | SLEEP | SLEEP. In sleep mode, all clock outputs are disabled and the maximum amount of internal circuitry is powered down to reduce power dissipation and noise generation. This bit overrides the SFOUTn_REG[2:0] output signal format settings. 0: Normal operation 1: Sleep mode |
| 5:3 | SFOUT2_REG [2:0] | SFOUT2_REG [2:0]. Controls output signal format and disable for CKOUT2 output buffer. 000: Reserved 001: Disable 010: CMOS (Bypass mode not supported) 011: Low swing LVDS 100: Reserved 101: LVPECL 110: CML 111: LVDS |
| 2:0 | SFOUT1_REG [2:0] | SFOUT1_REG [2:0]. Controls output signal format and disable for CKOUT1 output buffer. 000: Reserved 001: Disable 010: CMOS (Bypass mode not supported) 011: Low swing LVDS 100: Reserved 101: LVPECL 111: LVDS |

Register 7.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|----|----|----|----|-----------------|----|----|
| Name | Reserved | | | | | FOSREFSEL [2:0] | | |
| Type | R | | | | | R/W | | |

Reset value = 0010 1010

| Bit | Name | Function |
|-----|-----------------|--|
| 7:3 | Reserved. | Reserved. |
| 2:0 | FOSREFSEL [2:0] | FOSREFSEL [2:0]. Selects which input clock is used as the reference frequency for frequency offset (FOS) alarms. 000: XA/XB (External reference) 001: CKIN1 010: CKIN2 011: Reserved 100: Reserved 101: Reserved 110: Reserved 111: Reserved |

Register 8.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------|----|-------------|----|----------|----|----|----|
| Name | HLOG_2[1:0] | | HLOG_1[1:0] | | Reserved | | | |
| Type | R/W | | R/W | | R | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|--------------|--|
| 7:6 | HLOG_2 [1:0] | HLOG_2 [1:0]. 00: Normal operation 01: Holds CKOUT2 output at static logic 0. Entrance and exit from this state will occur without glitches or runt pulses. 10: Holds CKOUT2 output at static logic 1. Entrance and exit from this state will occur without glitches or runt pulses. 11: Reserved |
| 5:4 | | HLOG_1 [1:0]. 00: Normal operation 01: Holds CKOUT1 output at static logic 0. Entrance and exit from this state will occur without glitches or runt pulses. 10: Holds CKOUT1 output at static logic 1. Entrance and exit from this state will occur without glitches or runt pulses. 11: Reserved |
| 3:0 | Reserved | Reserved. |

Register 9.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------------|----|----|----|----|----------|----|----|
| Name | HIST_AVG [4:0] | | | | | Reserved | | |
| Type | R/W | | | | | R | R | R |

Reset value = 1100 0000

| Bit | Name | Function |
|-----|----------------|--|
| 7:3 | HIST_AVG [4:0] | HIST_AVG [4:0]. Selects amount of averaging time to be used in generating the history information for Digital Hold. See the Si53xx Family Reference Manual for a detailed description |
| 2:0 | Reserved | Reserved. |

Register 10.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|----|----|----|-----------|-----------|----------|----------|
| Name | Reserved | | | | DSBL2_REG | DSBL1_REG | Reserved | Reserved |
| Type | R | | | | R/W | R/W | R | R |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|-----------|--|
| 7:4 | Reserved | Reserved. |
| 3 | DSBL2_REG | DSBL2_REG. This bit controls the powerdown of the CKOUT2 output buffer. If disable mode is selected, the N2_LS output divider is also powered down. 0: CKOUT2 enabled 1: CKOUT2 disabled |
| 2 | DSBL1_REG | DSBL1_REG. This bit controls the powerdown of the CKOUT1 output buffer. If disable mode is selected, the N1_LS output divider is also powered down. 0: CKOUT1 enabled 1: CKOUT1 disabled |
| 1:0 | Reserved | Reserved. |

Register 11.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----|--------|--------|
| Name | Reserved | | | | | | PD_CK2 | PD_CK1 |
| Type | R | | | | | | R/W | R/W |

Reset value = 0100 0000

| Bit | Name | Function |
|-----|----------|---|
| 7:2 | Reserved | Reserved. |
| 1 | PD_CK2 | PD_CK2. This bit controls the powerdown of the CKIN2 input buffer. 0: CKIN2 enabled 1: CKIN2 disabled |
| 0 | PD_CK1 | PD_CK1. This bit controls the powerdown of the CKIN1 input buffer. 0: CKIN1 enabled 1: CKIN1 disabled |

Register 19.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|--------|---------------|----|---------------|----|-------------|----|----|
| Name | FOS_EN | FOS_THR [1:0] | | VALTIME [1:0] | | LOCKT [2:0] | | |
| Type | R/W | R/W | | R/W | | R/W | | |

Reset value = 0010 1100

| Bit | Name | Function |
|-----|---------------|---|
| 7 | FOS_EN | <p>FOS_EN.</p> <p>Frequency Offset Enable globally disables FOS. See the individual FOS enables (FOSX_EN, register 139).</p> <p>0: FOS disable</p> <p>1: FOS enabled by FOSx_EN</p> |
| 6:5 | FOS_THR [1:0] | <p>FOS_THR [1:0].</p> <p>Frequency Offset at which FOS is declared (relative to the selected FOS reference):</p> <p>00: ± 11 to 12 ppm (Stratum 3/3E compliant, with a Stratum 3/3E used for REFCLK)</p> <p>01: ± 48 to 49 ppm (SMC)</p> <p>10: ± 30 ppm (SONET Minimum Clock (SMC), with a Stratum 3/3E used for REFCLK.</p> <p>11: ± 200 ppm</p> |
| 4:3 | VALTIME [1:0] | <p>VALTIME [1:0].</p> <p>Sets amount of time for input clock to be valid before the associated alarm is removed.</p> <p>00: 2 ms</p> <p>01: 100 ms</p> <p>10: 200 ms</p> <p>11: 13 seconds</p> |
| 2:0 | LOCKT [2:0] | <p>LOCKT [2:0].</p> <p>Sets retrigger interval for one shot monitoring phase detector output. One shot is triggered by phase slip in DSPLL. Refer to the Si53xx Family Reference Manual for more details.</p> <p>000: 106 ms</p> <p>001: 53 ms</p> <p>010: 26.5 ms</p> <p>011: 13.3 ms</p> <p>100: 6.6 ms</p> <p>101: 3.3 ms</p> <p>110: 1.66 ms</p> <p>111: .833 ms</p> |

Register 20.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|-------------|-------------|---------|---------|
| Name | Reserved | | | | CK2_BAD_PIN | CK1_BAD_PIN | LOL_PIN | INT_PIN |
| Type | R | | | | R/W | R/W | R/W | R/W |

Reset value = 0011 1110

| Bit | Name | Function |
|-----|-------------|--|
| 7:4 | Reserved | Reserved. |
| 3 | CK2_BAD_PIN | CK2_BAD_PIN. The CK2_BAD status can be reflected on the C2B output pin. 0: C2B output pin tristated 1: C2B status reflected to output pin |
| 2 | CK1_BAD_PIN | CK1_BAD_PIN. Either LOS1 or INT (see INT_PIN) status can be reflected on the INT_C1B output pin. 0: INT_C1B output pin tristated 1: LOS1 or INT (see INT_PIN) status reflected to output pin |
| 1 | LOL_PIN | LOL_PIN. The LOL_INT status bit can be reflected on the LOL output pin. 0: LOL output pin tristated 1: LOL_INT status reflected to output pin |
| 0 | INT_PIN | INT_PIN. Reflects the interrupt status on the INT_C1B output pin. 0: Interrupt status not displayed on INT_C1B output pin. Instead, the INT_C1B pin indicates when CKIN1 is bad. If CK1_BAD_PIN = 0, INT_C1B output pin is tristated. 1: Interrupt status reflected to output pin. |

Register 21.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----------|----|----|----|----|--------------|-----------|
| Name | Reserved | Reserved | | | | | CK1_ACTV_PIN | CKSEL_PIN |
| Type | R | Force 1 | R | R | R | R | R/W | R/W |

Reset value = 1111 1111

| Bit | Name | Function |
|-----|--------------|---|
| 7:2 | Reserved | Reserved. |
| 1 | CK1_ACTV_PIN | <p>CK1_ACTV_PIN.</p> <p>The CK1_ACTV_REG status bit can be reflected to the CS_CA output pin using the CK1_ACTV_PIN enable function. CK1_ACTV_PIN is of consequence only when pin controlled clock selection is not being used. (See CKSEL_PIN)</p> <p>0: CS_CA output pin tristated. 1: Clock Active status reflected to output pin.</p> |
| 0 | CKSEL_PIN | <p>CKSEL_PIN.</p> <p>If manual clock selection is being used, clock selection can be controlled via the CKSEL_REG[1:0] register bits or the CS_CA input pin. This bit is only active when AUTOSEL_REG = Manual.</p> <p>0: CS_CA pin is ignored. CKSEL_REG[1:0] register bits control clock selection. 1: CS_CA input pin controls clock selection.</p> |

Register 22.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|-------------|------------|---------|---------|
| Name | Reserved | | | | CK_ACTV_POL | CK_BAD_POL | LOL_POL | INT_POL |
| Type | R | | | | R/W | R/W | R/W | R/W |

Reset value = 1101 1111

| Bit | Name | Function |
|-----|-------------|---|
| 7:4 | Reserved | Reserved. |
| 3 | CK_ACTV_POL | CK_ACTV_POL. Sets the active polarity for the CS_CA signals when reflected on an output pin. 0: Active low 1: Active high |
| 2 | CK_BAD_POL | CK_BAD_POL. Sets the active polarity for the INT_C1B and C2B signals when reflected on output pins. 0: Active low 1: Active high |
| 1 | LOL_POL | LOL_POL. Sets the active polarity for the LOL status when reflected on an output pin. 0: Active low 1: Active high |
| 0 | INT_POL | INT_POL. Sets the active polarity for the interrupt status when reflected on the INT_C1B output pin. 0: Active low 1: Active high |

Register 23.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----------|----------|----------|
| Name | Reserved | | | | | LOS2_MSK | LOS1_MSK | LOSX_MSK |
| Type | R | | | | | R/W | R/W | R/W |

Reset value = 0001 1111

| Bit | Name | Function |
|-----|----------|--|
| 7:3 | Reserved | Reserved. |
| 2 | LOS2_MSK | <p>LOS2_MSK.</p> <p>Determines if a LOS on CKIN2 (LOS2_FLG) is used in the generation of an interrupt. Writes to this register do not change the value held in the LOS2_FLG register.</p> <p>0: LOS2 alarm triggers active interrupt on INT_C1B output (if INT_PIN=1).</p> <p>1: LOS2_FLG ignored in generating interrupt output.</p> |
| 1 | LOS1_MSK | <p>LOS1_MSK.</p> <p>Determines if a LOS on CKIN1 (LOS1_FLG) is used in the generation of an interrupt. Writes to this register do not change the value held in the LOS1_FLG register.</p> <p>0: LOS1 alarm triggers active interrupt on INT_C1B output (if INT_PIN=1).</p> <p>1: LOS1_FLG ignored in generating interrupt output.</p> |
| 0 | LOSX_MSK | <p>LOSX_MSK.</p> <p>Determines if a LOS on XA/XB(LOSX_FLG) is used in the generation of an interrupt. Writes to this register do not change the value held in the LOSX_FLG register.</p> <p>0: LOSX alarm triggers active interrupt on INT_C1B output (if INT_PIN=1).</p> <p>1: LOSX_FLG ignored in generating interrupt output.</p> |

Register 24.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----------|----------|---------|
| Name | Reserved | | | | | FOS2_MSK | FOS1_MSK | LOL_MSK |
| Type | R | | | | | R/W | R/W | R/W |

Reset value = 0011 1111

| Bit | Name | Function |
|-----|----------|--|
| 7:3 | Reserved | Reserved. |
| 2 | FOS2_MSK | FOS2_MSK. Determines if the FOS2_FLG is used in the generation of an interrupt. Writes to this register do not change the value held in the FOS2_FLG register. 0: FOS2 alarm triggers active interrupt on INT_C1B output (if INT_PIN=1). 1: FOS2_FLG ignored in generating interrupt output. |
| 1 | FOS1_MSK | FOS1_MSK. Determines if the FOS1_FLG is used in the generation of an interrupt. Writes to this register do not change the value held in the FOS1_FLG register. 0: FOS1 alarm triggers active interrupt on INT_C1B output (if INT_PIN=1). 1: FOS1_FLG ignored in generating interrupt output. |
| 0 | LOL_MSK | LOL_MSK. Determines if the LOL_FLG is used in the generation of an interrupt. Writes to this register do not change the value held in the LOL_FLG register. 0: LOL alarm triggers active interrupt on INT_C1B output (if INT_PIN=1). 1: LOL_FLG ignored in generating interrupt output. |

Register 25.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------|----|----|----|----------|----|----|----|
| Name | N1_HS [2:0] | | | | Reserved | | | |
| Type | R/W | | | | R | | | |

Reset value = 0010 0000

| Bit | Name | Function |
|-----|-------------|---|
| 7:5 | N1_HS [2:0] | N1_HS [2:0]. Sets value for N1 high speed divider which drives NCn_LS (n = 1 to 2) low-speed divider. 000: N1 = 4 001: N1 = 5 010: N1 = 6 011: N1 = 7 100: N1 = 8 101: N1 = 9 110: N1 = 10 111: N1 = 11 |
| 4:0 | Reserved | Reserved. |

Register 31.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----------------|----|----|----|
| Name | Reserved | | | | NC1_LS [19:16] | | | |
| Type | R | | | | R/W | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|----------------|--|
| 7:4 | Reserved | Reserved. |
| 3:0 | NC1_LS [19:16] | NC1_LS [19:16]. Sets value for NC1 low-speed divider, which drives CKOUT1 output. Must be 0 or odd. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111 = 2^{20} Valid divider values = [1, 2, 4, 6, ..., 2^{20}] |

Register 32.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|---------------|----|----|----|----|----|----|----|
| Name | NC1_LS [15:8] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|---------------|---|
| 7:0 | NC1_LS [15:8] | <p>NC1_LS [15:8]. Sets value for NC1 low-speed divider, which drives CKOUT1 output. Must be 0 or odd. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111=2²⁰ Valid divider values=[1, 2, 4, 6, ..., 2²⁰]</p> |

Register 33.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|--------------|----|----|----|----|----|----|----|
| Name | NC1_LS [7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0011 0001

| Bit | Name | Function |
|-----|---------------|---|
| 7:0 | NC1_LS [19:0] | <p>NC1_LS [7:0]. Sets value for N1 low-speed divider, which drives CKOUT1 output. Must be 0 or odd. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111=2²⁰ Valid divider values=[1, 2, 4, 6, ..., 2²⁰]</p> |

Register 34.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----------------|----|----|----|
| Name | Reserved | | | | NC2_LS [19:16] | | | |
| Type | R | | | | R/W | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|----------------|--|
| 7:4 | Reserved | Reserved. |
| 3:0 | NC2_LS [19:16] | <p>NC2_LS [19:16]. Sets value for NC2 low-speed divider, which drives CKOUT2 output. Must be 0 or odd. 00000000000000000000=1 00000000000000000001=2 00000000000000000011=4 00000000000000000101=6 ... 11111111111111111111=2²⁰ Valid divider values=[1, 2, 4, 6, ..., 2²⁰]</p> |

Register 35.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|---------------|----|----|----|----|----|----|----|
| Name | NC2_LS [15:8] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|---------------|---|
| 7:0 | NC2_LS [15:8] | <p>NC2_LS [15:8]. Sets value for NC2 low-speed divider, which drives CKOUT2 output. Must be 0 or odd. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111=2²⁰ Valid divider values=[1, 2, 4, 6, ..., 2²⁰]</p> |

Register 36.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|--------------|----|----|----|----|----|----|----|
| Name | NC2_LS [7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0011 0001

| Bit | Name | Function |
|-----|--------------|--|
| 7:0 | NC2_LS [7:0] | <p>NC2_LS [7:0].</p> <p>Sets value for NC2 low-speed divider, which drives CKOUT2 output. Must be 0 or odd.</p> <p>00000000000000000000 = 1</p> <p>00000000000000000001 = 2</p> <p>00000000000000000011 = 4</p> <p>00000000000000000101 = 6</p> <p>...</p> <p>11111111111111111111 = 2^{20}</p> <p>Valid divider values = [1, 2, 4, 6, ..., 2^{20}]</p> |

Register 40.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------|----|----|----------|---------------|----|----|----|
| Name | N2_HS [2:0] | | | Reserved | N2_LS [19:16] | | | |
| Type | R/W | | | R | R/W | | | |

Reset value = 1100 0000

| Bit | Name | Function |
|-----|---------------|--|
| 7:5 | N2_HS [2:0] | <p>N2_HS [2:0]. Sets value for N2 high speed divider, which drives N2LS low-speed divider. 000: 4 001: 5 010: 6 011: 7 100: 8 101: 9 110: 10 111: 11</p> |
| 4 | Reserved | Reserved. |
| 3:0 | N2_LS [19:16] | <p>N2_LS [19:16]. Sets value for N2 low-speed divider, which drives phase detector. 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111 = 2^{20} Valid divider values = [2, 4, 6, ..., 2^{20}]</p> |

Register 41.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|--------------|----|----|----|----|----|----|----|
| Name | N2_LS [15:8] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|--------------|---|
| 7:0 | N2_LS [15:8] | <p>N2_LS [15:8]. Sets value for N2 low-speed divider, which drives phase detector. 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111 = 2^{20} Valid divider values = [2, 4, 6, ..., 2^{20}]</p> |

Register 42.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------|----|----|----|----|----|----|----|
| Name | N2_LS [7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 1111 1001

| Bit | Name | Function |
|-----|-------------|--|
| 7:0 | N2_LS [7:0] | <p>N2_LS [7:0]. Sets value for N2 low-speed divider, which drives phase detector. 00000000000000000001 = 2 00000000000000000011 = 4 00000000000000000101 = 6 ... 11111111111111111111 = 2^{20} Valid divider values = [2, 4, 6, ..., 2^{20}]</p> |

Register 43.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|----|----|----|----|-------------|----|----|
| Name | Reserved | | | | | N31 [18:16] | | |
| Type | R | | | | | R/W | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|-------------|--|
| 7:3 | Reserved | Reserved. |
| 2:0 | N31 [18:16] | N31 [18:16]. Sets value for input divider for CKIN1. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000010 = 3 ... 11111111111111111111 = 2^{19} Valid divider values=[1, 2, 3, ..., 2^{19}] |

Register 44.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|------------|----|----|----|----|----|----|----|
| Name | N31_[15:8] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|------------|---|
| 7:0 | N31_[15:8] | N31_[15:8]. Sets value for input divider for CKIN1. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000010 = 3 ... 11111111111111111111 = 2^{19} Valid divider values=[1, 2, 3, ..., 2^{19}] |

Register 45.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-----------|----|----|----|----|----|----|----|
| Name | N31_[7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 1001

| Bit | Name | Function |
|-----|-----------|--|
| 7:0 | N31_[7:0] | N31_[7:0]. Sets value for input divider for CKIN1. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000010 = 3 ... 11111111111111111111 = 2^{19} Valid divider values=[1, 2, 3, ..., 2^{19}] |

Register 46.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|-------------|----|----|
| Name | Reserved | | | | | N32_[18:16] | | |
| Type | R | | | | | R/W | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|-------------|--|
| 7:3 | Reserved | Reserved. |
| 2:0 | N32_[18:16] | N32_[18:16]. Sets value for input divider for CKIN2. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000010 = 3 ... 11111111111111111111 = 2^{19} Valid divider values=[1, 2, 3, ..., 2^{19}] |

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Register 47.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|------------|----|----|----|----|----|----|----|
| Name | N32_[15:8] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|------------|---|
| 7:0 | N32_[15:8] | N32_[15:8]. Sets value for input divider for CKIN2. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000010 = 3 ... 11111111111111111111 = 2^{19} Valid divider values=[1, 2, 3, ..., 2^{19}] |

Register 48.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-----------|----|----|----|----|----|----|----|
| Name | N32_[7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 1001

| Bit | Name | Function |
|-----|-----------|--|
| 7:0 | N32_[7:0] | N32_[7:0]. Sets value for input divider for CKIN1. 00000000000000000000 = 1 00000000000000000001 = 2 00000000000000000010 = 3 ... 11111111111111111111 = 2^{19} Valid divider values=[1, 2, 3, ..., 2^{19}] |

Register 55.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|------------------|----|----|-----------------|----|----|
| Name | Reserved | | CLKIN2RATE_[2:0] | | | CLKIN1RATE[2:0] | | |
| Type | R | | R/W | | | R/W | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|------------------|--|
| 7:6 | Reserved | Reserved. |
| 5:3 | CLKIN2RATE[2:0] | CLKIN2RATE[2:0]. CKINn frequency selection for FOS alarm monitoring. 000: 10–27 MHz 001: 25–54 MHz 010: 50–105 MHz 011: 95–215 MHz 100: 190–435 MHz 101: 375–710 MHz 110: Reserved 111: Reserved |
| 2:0 | CLKIN1RATE [2:0] | CLKIN1RATE[2:0]. CKINn frequency selection for FOS alarm monitoring. 000: 10–27 MHz 001: 25–54 MHz 010: 50–105 MHz 011: 95–215 MHz 100: 190–435 MHz 101: 375–710 MHz 110: Reserved 111: Reserved |

Register 128.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----|--------------|--------------|
| Name | Reserved | | | | | | CK2_ACTV_REG | CK1_ACTV_REG |
| Type | R | | | | | | R | R |

Reset value = 0010 0000

| Bit | Name | Function |
|-----|--------------|--|
| 7:2 | Reserved | Reserved. |
| 1 | CK2_ACTV_REG | <p>CK2_ACTV_REG.</p> <p>Indicates if CKIN2 is currently the active clock for the PLL input. 0: CKIN2 is not the active input clock. Either it is not selected or LOS2_INT is 1. 1: CKIN2 is the active input clock.</p> |
| 0 | CK1_ACTV_REG | <p>CK1_ACTV_REG.</p> <p>Indicates if CKIN1 is currently the active clock for the PLL input. 0: CKIN1 is not the active input clock. Either it is not selected or LOS1_INT is 1. 1: CKIN1 is the active input clock.</p> |

Register 129.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----------|----------|----------|
| Name | Reserved | | | | | LOS2_INT | LOS1_INT | LOSX_INT |
| Type | R | | | | | R | R | R |

Reset value = 0000 0110

| Bit | Name | Function |
|-----|----------|---|
| 7:3 | Reserved | Reserved. |
| 2 | LOS2_INT | LOS2_INT. Indicates the LOS status on CKIN2. 0: Normal operation. 1: Internal loss-of-signal alarm on CKIN2 input. |
| 1 | LOS1_INT | LOS1_INT. Indicates the LOS status on CKIN1. 0: Normal operation. 1: Internal loss-of-signal alarm on CKIN1 input. |
| 0 | LOSX_INT | LOSX_INT. Indicates the LOS status of the external reference on the XA/XB pins. 0: Normal operation. 1: Internal loss-of-signal alarm on XA/XB reference clock input. |

Register 130.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|--------------|----------|----|----|----------|----------|---------|
| Name | Reserved | DIGHOLDVALID | Reserved | | | FOS2_INT | FOS1_INT | LOL_INT |
| Type | R | R | R | | | R | R | R |

Reset value = 0000 0001

| Bit | Name | Function |
|-----|--------------|--|
| 7 | Reserved | Reserved. |
| 6 | DIGHOLDVALID | <p>Digital Hold Valid.</p> <p>Indicates if the digital hold circuit has enough samples of a valid clock to meet digital hold specifications.</p> <p>0: Indicates digital hold history registers have not been filled. The digital hold output frequency may not meet specifications.</p> <p>1: Indicates digital hold history registers have been filled. The digital hold output frequency is valid.</p> |
| 5:3 | Reserved | Reserved. |
| 2 | FOS2_INT | <p>CKIN2 Frequency Offset Status.</p> <p>0: Normal operation.</p> <p>1: Internal frequency offset alarm on CKIN2 input.</p> |
| 1 | FOS1_INT | <p>CKIN1 Frequency Offset Status.</p> <p>0: Normal operation.</p> <p>1: Internal frequency offset alarm on CKIN1 input.</p> |
| 0 | LOL_INT | <p>PLL Loss of Lock Status.</p> <p>0: PLL locked.</p> <p>1: PLL unlocked.</p> |

Register 131.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----------|----------|----------|
| Name | Reserved | | | | | LOS2_FLG | LOS1_FLG | LOSX_FLG |
| Type | R | | | | | R/W | R/W | R/W |

Reset value = 0001 1111

| Bit | Name | Function |
|-----|----------|---|
| 7:3 | Reserved | Reserved. |
| 2 | LOS2_FLG | CKIN2 Loss-of-Signal Flag. 0: Normal operation. 1: Held version of LOS2_INT. Generates active output interrupt if output interrupt pin is enabled (INT_PIN = 1) and if not masked by LOS2_MSK bit. Flag cleared by writing 0 to this bit. |
| 1 | LOS1_FLG | CKIN1 Loss-of-Signal Flag. 0: Normal operation 1: Held version of LOS1_INT. Generates active output interrupt if output interrupt pin is enabled (INT_PIN = 1) and if not masked by LOS1_MSK bit. Flag cleared by writing 0 to this bit. |
| 0 | LOSX_FLG | External Reference (signal on pins XA/XB) Loss-of-Signal Flag. 0: Normal operation 1: Held version of LOSX_INT. Generates active output interrupt if output interrupt pin is enabled (INT_PIN = 1) and if not masked by LOSX_MSK bit. Flag cleared by writing 0 to this bit. |

Register 132.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------|----------|----|----|----|----------|----------|---------|----------|
| Name | Reserved | | | | FOS2_FLG | FOS1_FLG | LOL_FLG | Reserved |
| Type | R | | | | R/W | R/W | R/W | R |

Reset value = 0000 0010

| Bit | Name | Function |
|-----|----------|--|
| 7:4 | Reserved | Reserved. |
| 3 | FOS2_FLG | CLKIN_2 Frequency Offset Flag. 0: Normal operation. 1: Held version of FOS2_INT. Generates active output interrupt if output interrupt pin is enabled (INT_PIN = 1) and if not masked by FOS2_MSK bit. Flag cleared by writing 0 to this bit. |
| 2 | FOS1_FLG | CLKIN_1 Frequency Offset Flag. 0: Normal operation 1: Held version of FOS1_INT. Generates active output interrupt if output interrupt pin is enabled (INT_PIN = 1) and if not masked by FOS1_MSK bit. Flag cleared by writing 0 to this bit. |
| 1 | LOL_FLG | PLL Loss of Lock Flag. 0: PLL locked 1: Held version of LOL_INT. Generates active output interrupt if output interrupt pin is enabled (INT_PIN = 1) and if not masked by LOL_MSK bit. Flag cleared by writing 0 to this bit. |
| 0 | Reserved | Reserved. |

Register 134.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|-------------------|----|----|----|----|----|----|----|
| Name | PARTNUM_RO [11:4] | | | | | | | |
| Type | R | | | | | | | |

Reset value = 0000 0001

| Bit | Name | Function |
|-----|-------------------|--|
| 7:0 | PARTNUM_RO [11:0] | Device ID (1 of 2). 0000 0001 1100: Si5328 |

Register 135.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|------------------|----|----|----|----------------|----|----|----|
| Name | PARTNUM_RO [3:0] | | | | REVID_RO [3:0] | | | |
| Type | R | | | | R | | | |

Reset value = 1100 0010

| Bit | Name | Function |
|-----|-------------------|---|
| 7:4 | PARTNUM_RO [11:0] | Device ID (2 of 2). 0000 0001 1100: Si5328 |
| 3:0 | REVID_RO [3:0] | Device Revision. 0010: Revision C Others: Reserved |

Register 136.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|---------|------|----------|----|----|----|----|----|
| Name | RST_REG | ICAL | Reserved | | | | | |
| Type | R/W | R/W | R | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|----------|---|
| 7 | RST_REG | <p>Internal Reset (Same as Pin Reset).</p> <p>Note: The I²C (or SPI) port may not be accessed until 10 ms after RST_REG is asserted.</p> <p>0: Normal operation. 1: Reset of all internal logic. Outputs disabled or tristated during reset.</p> |
| 6 | ICAL | <p>Start an Internal Calibration Sequence.</p> <p>For proper operation, the device must go through an internal calibration sequence. ICAL is a self-clearing bit. Writing a “1” to this location initiates an ICAL. The calibration is complete once the LOL alarm goes low.</p> <p>0: Normal operation. 1: Writing a “1” initiates internal self-calibration. Upon completion of internal self-calibration, LOL will go low.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. A valid stable clock (within 100 ppm) must be present to begin ICAL. 2. If the input changes by more than 500 ppm, the part may do an autonomous ICAL. 3. See Table 10, “Register Locations Requiring ICAL,” on page 62 for register changes that require an ICAL. |
| 5:0 | Reserved | Reserved. |

Register 137.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----|----|----|----|----|----|----|----------|
| Name | | | | | | | | FASTLOCK |
| Type | R | R | R | R | R | R | R | R/W |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|----------|---|
| 7:1 | Reserved | Do not modify. |
| 0 | FASTLOCK | This bit must be set to 1 to enable FASTLOCK. This improves initial lock time by dynamically changing the loop bandwidth. |

Register 138.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|----|----|----|----|--------------|---------------|
| Name | Reserved | | | | | | LOS2_EN[1:1] | LOS1_EN [1:1] |
| Type | R | | | | | | R/W | R/W |

Reset value = 0000 1111

| Bit | Name | Function |
|-----|---------------|--|
| 7:2 | Reserved | Reserved. |
| 1 | LOS2_EN [1:0] | <p>Enable CKIN2 LOS Monitoring on the Specified Input (2 of 2).</p> <p>Note: LOS2_EN is split between two registers. 00: Disable LOS monitoring 01: Reserved 10: Enable LOSA monitoring 11: Enable LOS monitoring LOSA is a slower and less sensitive version of LOS. SEe the Si53xx Family Reference Manual for details.</p> |
| 0 | LOS1_EN [1:0] | <p>Enable CKIN1 LOS Monitoring on the Specified Input (1 of 2).</p> <p>Note: LOS1_EN is split between two registers. 00: Disable LOS monitoring 01: Reserved 10: Enable LOSA monitoring 11: Enable LOS monitoring LOSA is a slower and less sensitive version of LOS. See the Si53xx Family Reference Manual for details.</p> |

Register 139.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|----------|----|---------------|---------------|----------|----|---------|---------|
| Name | Reserved | | LOS2_EN [0:0] | LOS1_EN [0:0] | Reserved | | FOS2_EN | FOS1_EN |
| Type | R | | R/W | R/W | R | | R/W | R/W |

Reset value = 1111 1111

| Bit | Name | Function |
|-----|---------------|--|
| 7:6 | Reserved | Reserved. |
| 5 | LOS2_EN [1:0] | <p>Enable CKIN2 LOS Monitoring on the Specified Input (2 of 2).</p> <p>Note: LOS2_EN is split between two registers. 00: Disable LOS monitoring 01: Reserved 10: Enable LOSA monitoring 11: Enable LOS monitoring LOSA is a slower and less sensitive version of LOS. See the Si53xx Family Reference Manual for details</p> |
| 4 | LOS1_EN [1:0] | <p>Enable CKIN1 LOS Monitoring on the Specified Input (1 of 2).</p> <p>Note: LOS1_EN is split between two registers. 00: Disable LOS monitoring 01: Reserved 10: Enable LOSA monitoring 11: Enable LOS monitoring LOSA is a slower and less sensitive version of LOS. See the Si53xx Family Reference Manual for details.</p> |
| 3:2 | Reserved | Reserved. |
| 1 | FOS2_EN | <p>Enables FOS on a Per Channel Basis.</p> <p>0: Disable FOS monitoring 1: Enable FOS monitoring</p> |
| 0 | FOS1_EN | <p>Enables FOS on a Per Channel Basis.</p> <p>0: Disable FOS monitoring 1: Enable FOS monitoring</p> |

Register 142.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|------------------------|----|----|----|----|----|----|----|
| Name | INDEPENDENTSKEW1 [7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|-------------------------|---|
| 7:0 | INDEPEND-ENTSKEW1 [7:0] | INDEPENDENTSKEW1. Eight-bit field that represents a 2's complement of the phase offset in terms of clocks from the high speed output divider. |

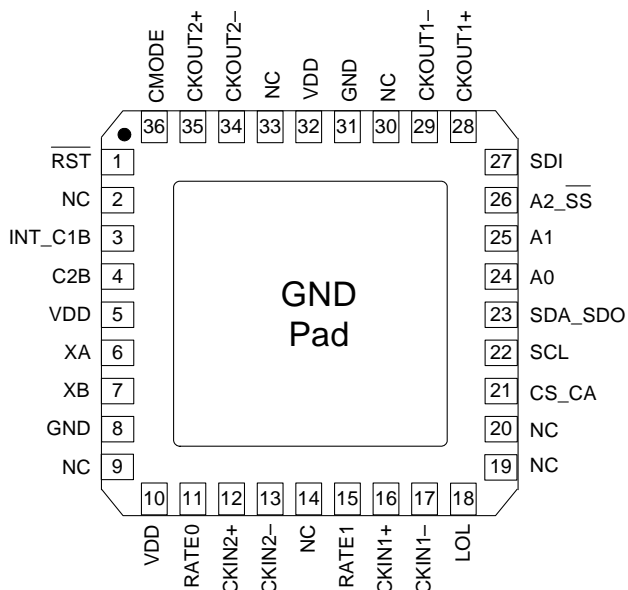
Register 143.

| Bit | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|------------------------|----|----|----|----|----|----|----|
| Name | INDEPENDENTSKEW2 [7:0] | | | | | | | |
| Type | R/W | | | | | | | |

Reset value = 0000 0000

| Bit | Name | Function |
|-----|-------------------------|---|
| 7:0 | INDEPEND-ENTSKEW2 [7:0] | INDEPENDENTSKEW2. Eight-bit field that represents a 2's complement of the phase offset in terms of clocks from the high speed output divider. |

7. Pin Descriptions: Si5328



| Pin # | Pin Name | I/O | Signal Level | Description |
|---|-------------------------|-----|--------------|---|
| 1 | $\overline{\text{RST}}$ | I | LVC MOS | External Reset. Active low input that performs external hardware reset of device. Resets all internal logic to a known state and forces the device registers to their default value. Clock outputs are tristated during reset. The part must be programmed after a reset or power on to get a clock output. See the Si53xx Family Reference Manual for details. This pin has a weak pull-up. |
| 2, 9, 14, 19, 20, 30, 33 | NC | — | — | No Connection. Leave floating. Make no external connections to this pin for normal operation. |
| 3 | INT_C1B | O | LVC MOS | Interrupt/CKIN1 Invalid Indicator. This pin functions as a device interrupt output or an alarm output for CKIN1. If used as an interrupt output, <i>INT_PIN</i> must be set to 1. The pin functions as a maskable interrupt output with active polarity controlled by the <i>INT_POL</i> register bit. If used as an alarm output, the pin functions as a LOS (and optionally FOS) alarm indicator for CKIN1. Set <i>CK1_BAD_PIN</i> = 1 and <i>INT_PIN</i> = 0. 0 = CKIN1 present 1 = LOS (FOS) on CKIN1 The active polarity is controlled by <i>CK_BAD_POL</i> . If no function is selected, the pin tristates. |
| Note: Internal register names are indicated by underlined italics, e.g., <i>INT_PIN</i> . See Section "5. Register Map". | | | | |

| Pin # | Pin Name | I/O | Signal Level | Description |
|--|------------------|-----------------|--------------|---|
| 4 | C2B | O | LVC MOS | <p>CKIN2 Invalid Indicator.</p> <p>This pin functions as a LOS (and optionally FOS) alarm indicator for CKIN2 if $CK2_BAD_PIN = 1$.</p> <p>0 = CKIN2 present 1 = LOS (FOS) on CKIN2</p> <p>The active polarity can be changed by CK_BAD_POL. If $CK2_BAD_PIN = 0$, the pin tristates.</p> |
| 5, 10, 32 | V _{DD} | V _{DD} | Supply | <p>Supply.</p> <p>The device operates from a 2.5 or 3.3 V supply. Bypass capacitors should be associated with the following V_{DD} pins:</p> <p>5 0.1 μF 10 0.1 μF 32 0.1 μF</p> <p>A 1.0 μF should also be placed as close to the device as is practical.</p> |
| 7 6 | XB XA | I | Analog | <p>Reference Clock.</p> <p>A TCXO or OCXO should be connected to these pins. Refer to the Si53xx Family Reference Manual for interfacing to the external reference. External reference must be from a high-quality clock source (TCXO, OCXO). Frequency of crystal or external clock is set by RATE[1:0] pins.</p> |
| 8, 31 | GND | GND | Supply | <p>Ground.</p> <p>Must be connected to system ground. Minimize the ground path impedance for optimal performance of this device. Grounding these pins does not eliminate the requirement to ground the GND PAD on the bottom of the package.</p> |
| 11 15 | RATE0 RATE1 | I | 3-Level | <p>Reference Clock Rate.</p> <p>Three level inputs that select the type and rate of external crystal or reference clock to be applied to the XA/XB port. Refer to the Si53xx Family Reference Manual for settings. These pins have both a weak pull-up and a weak pull-down; they default to M.</p> <p>L setting corresponds to ground. M setting corresponds to V_{DD}/2. H setting corresponds to V_{DD}.</p> <p>Some designs may require an external resistor voltage divider when driven by an active device that will tristate.</p> |
| 16 17 | CKIN1+ CKIN1– | I | Multi | <p>Clock Input 1.</p> <p>Differential input clock. This input can also be driven with a single-ended signal.</p> |
| 12 13 | CKIN2+ CKIN2– | I | Multi | <p>Clock Input 2.</p> <p>Differential input clock. This input can also be driven with a single-ended signal.</p> |
| <p>Note: Internal register names are indicated by underlined italics, e.g., <i>INT_PIN</i>. See Section “5.Register Map”.</p> | | | | |

| Pin # | Pin Name | I/O | Signal Level | Description |
|--|----------|-----|--------------|---|
| 18 | LOL | O | LVC MOS | <p>PLL Loss of Lock Indicator.</p> <p>This pin functions as the active high PLL loss of lock indicator if the <i>LOL_PIN</i> register bit is set to 1.</p> <p>0 = PLL locked 1 = PLL unlocked</p> <p>If <i>LOL_PIN</i> = 0, this pin will tristate. Active polarity is controlled by the <i>LOL_POL</i> bit. The PLL lock status will always be reflected in the <i>LOL_INT</i> read only register bit.</p> |
| 21 | CS_CA | I/O | LVC MOS | <p>Input Clock Select/Active Clock Indicator.</p> <p>Input: In manual clock selection mode, this pin functions as the manual input clock selector if the <i>CKSEL_PIN</i> is set to 1.</p> <p>0 = Select CKIN1 1 = Select CKIN2</p> <p>If <i>CKSEL_PIN</i> = 0, the <i>CKSEL_REG</i> register bit controls this function and this input tristates. If configured for input, must be tied high or low.</p> <p>Output: In automatic clock selection mode, this pin indicates which of the two input clocks is currently the active clock. If alarms exist on both clocks, <i>CK_ACTV</i> will indicate the last active clock that was used before entering the digital hold state. The <i>CK_ACTV_PIN</i> register bit must be set to 1 to reflect the active clock status to the <i>CK_ACTV</i> output pin.</p> <p>0 = CKIN1 active input clock 1 = CKIN2 active input clock</p> <p>If <i>CK_ACTV_PIN</i> = 0, this pin will tristate. The <i>CK_ACTV</i> status will always be reflected in the <i>CK_ACTV_REG</i> read only register bit.</p> |
| 22 | SCL | I | LVC MOS | <p>Serial Clock.</p> <p>This pin functions as the serial clock input for both SPI and I²C modes.</p> <p>This pin has a weak pull-down.</p> |
| 23 | SDA_SDO | I/O | LVC MOS | <p>Serial Data.</p> <p>In I²C control mode (CMODE = 0), this pin functions as the bidirectional serial data port.</p> <p>In SPI control mode (CMODE = 1), this pin functions as the serial data output.</p> |
| 25 24 | A1 A0 | I | LVC MOS | <p>Serial Port Address.</p> <p>In I²C control mode (CMODE = 0), these pins function as hardware controlled address bits. The I²C address is 1101 [A2] [A1] [A0].</p> <p>In SPI control mode (CMODE = 1), these pins are ignored.</p> <p>These pins have a weak pull-down.</p> |
| <p>Note: Internal register names are indicated by underlined italics, e.g., <i>INT_PIN</i>. See Section “5.Register Map”.</p> | | | | |

| Pin # | Pin Name | I/O | Signal Level | Description |
|--|--------------------|-----|--------------|---|
| 26 | A2_SS | I | LVC MOS | Serial Port Address/Slave Select. In I ² C control mode (CMODE = 0), this pin functions as a hardware controlled address bit [A2]. In SPI control mode (CMODE = 1), this pin functions as the slave select input. This pin has a weak pull-down. |
| 27 | SDI | I | LVC MOS | Serial Data In. In I ² C control mode (CMODE = 0), this pin is ignored. In SPI control mode (CMODE = 1), this pin functions as the serial data input. This pin has a weak pull-down. |
| 29 28 | CKOUT1– CKOUT1+ | O | Multi | Output Clock 1. Differential output clock with a frequency range of 8 kHz to 808 MHz. Output signal format is selected by <i>SFOUT1_REG</i> register bits. Output is differential for LVPECL, LVDS, and CML compatible modes. For CMOS format, both output pins drive identical single-ended clock outputs. |
| 34 35 | CKOUT2– CKOUT2+ | O | Multi | Output Clock 2. Differential output clock with a frequency range of 8 kHz to 808 MHz. Output signal format is selected by <i>SFOUT2_REG</i> register bits. Output is differential for LVPECL, LVDS, and CML compatible modes. For CMOS format, both output pins drive identical single-ended clock outputs. |
| 36 | CMODE | I | LVC MOS | Control Mode. Selects I ² C or SPI control mode. 0 = I ² C Control Mode 1 = SPI Control Mode This pin must not be NC. Tie either high or low. See the Si53xx Family Reference Manual for details on I ² C or SPI operation. |
| GND PAD | GND | GND | Supply | Ground Pad. The ground pad must provide a low thermal and electrical impedance to a ground plane. |
| Note: Internal register names are indicated by underlined italics, e.g., <i>INT_PIN</i> . See Section "5.Register Map". | | | | |

Table 10 lists all of the register locations that should be followed by an ICAL after their contents are changed.

Table 10. Register Locations Requiring ICAL

| Addr | Register |
|------|-----------------|
| 0 | BYPASS_REG |
| 0 | CKOUT_ALWAYS_ON |
| 1 | CK_PRIOR2 |
| 1 | CK_PRIOR1 |
| 2 | BWSEL_REG |
| 4 | HIST_DEL |
| 5 | ICMOS |
| 7 | FOSREFSEL |
| 9 | HIST_AVG |
| 10 | DSBL2_REG |
| 10 | DSBL1_REG |
| 11 | PD_CK2 |
| 11 | PD_CK1 |
| 19 | FOS_EN |
| 19 | FOS_THR |
| 19 | VALTIME |
| 19 | LOCKT |
| 25 | N1_HS |
| 31 | NC1_LS |
| 34 | NC2_LS |
| 40 | N2_HS |
| 40 | N2_LS |
| 43 | N31 |
| 46 | N32 |
| 55 | CLKIN2RATE |
| 55 | CLKIN1RATE |

Table 11. Si5328 Pull up/Pull down

| Pin # | Si5328 | Pull up/Pull down |
|-------|--------|-------------------|
| 1 | RST | U |
| 11 | RATE0 | U, D |
| 15 | RATE1 | U, D |
| 21 | CS_CA | U, D |
| 22 | SCL | D |
| 24 | A0 | D |
| 25 | A1 | D |
| 26 | A2_SS | D |
| 27 | SDI | D |
| 36 | CMODE | U, D |

8. Ordering Guide

| Ordering Part Number | Output Clock Frequency Range | Package | ROHS6, Pb-Free | Temperature Range |
|----------------------|------------------------------|----------------------|----------------|-------------------|
| Si5328B-C-GM | 8 kHz–808 MHz | 36-Lead 6 x 6 mm QFN | Yes | –40 to 85 °C |
| Si5328C-C-GM | 8 kHz–346 MHz | 36-Lead 6 x 6 mm QFN | Yes | –40 to 85 °C |
| Si5328-EVB | 8 kHz–808 MHz | Evaluation Board | — | –40 to 85 °C |

Note: Add an R at the end of the device to denote tape and reel options.

9. Package Outline: 36-Pin QFN

Figure 7 illustrates the package details for the Si5328. Table 12 lists the values for the dimensions shown in the illustration.

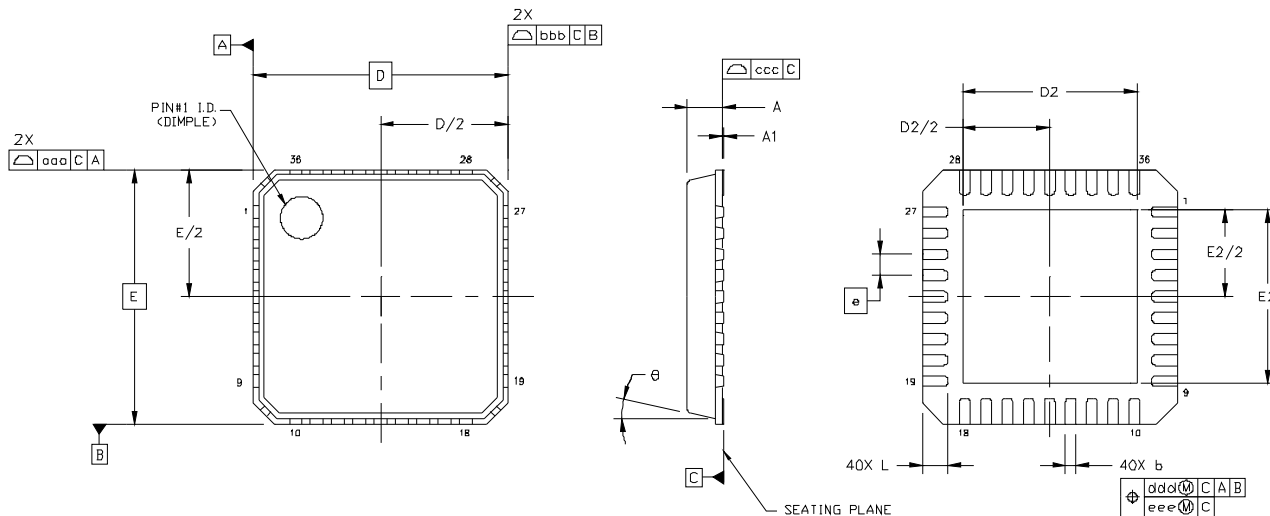


Figure 7. 36-Pin Quad Flat No-lead (QFN)

Table 12. Package Dimensions

| Symbol | Millimeters | | | Symbol | Millimeters | | |
|--------|-------------|------|------|----------|-------------|------|------|
| | Min | Nom | Max | | Min | Nom | Max |
| A | 0.80 | 0.85 | 0.90 | L | 0.50 | 0.60 | 0.70 |
| A1 | 0.00 | 0.02 | 0.05 | θ | — | — | 12° |
| b | 0.18 | 0.25 | 0.30 | aaa | — | — | 0.10 |
| D | 6.00 BSC | | | bbb | — | — | 0.10 |
| D2 | 3.95 | 4.10 | 4.25 | ccc | — | — | 0.08 |
| e | 0.50 BSC | | | ddd | — | — | 0.10 |
| E | 6.00 BSC | | | eee | — | — | 0.05 |
| E2 | 3.95 | 4.10 | 4.25 | | | | |

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-020C specification for Small Body Components.

10. Recommended PCB Layout

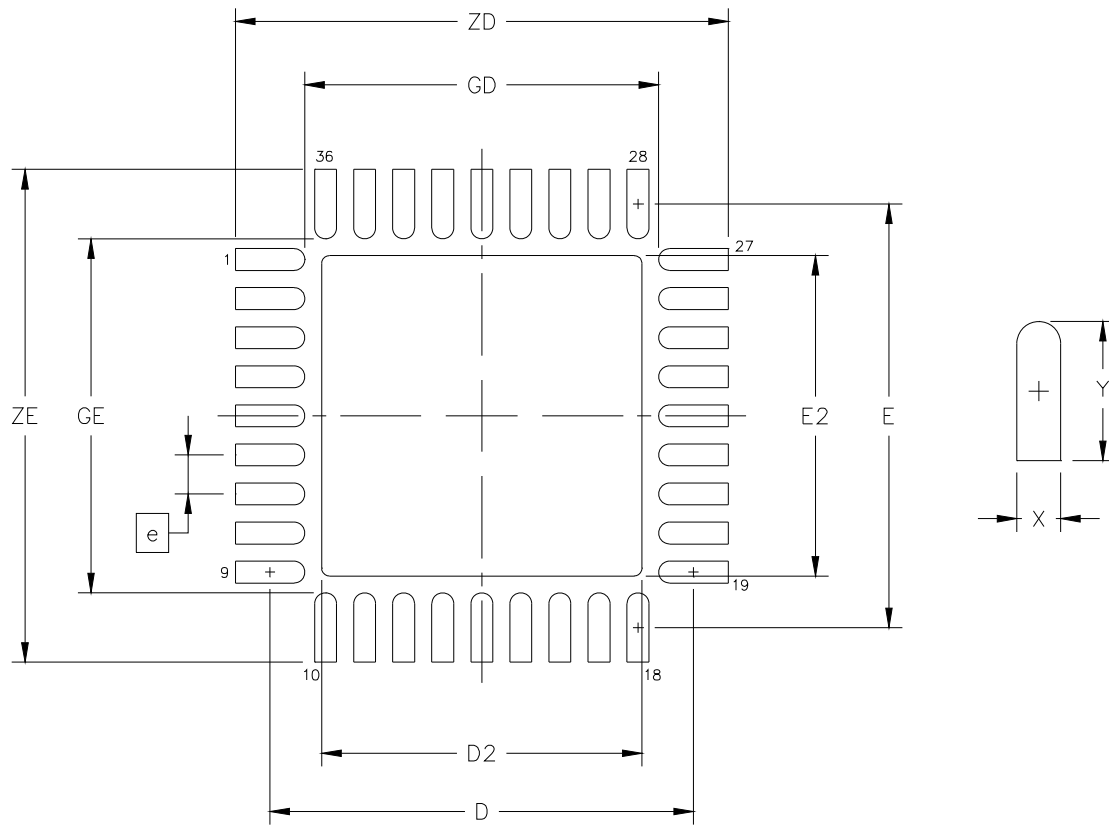


Figure 8. PCB Land Pattern Diagram

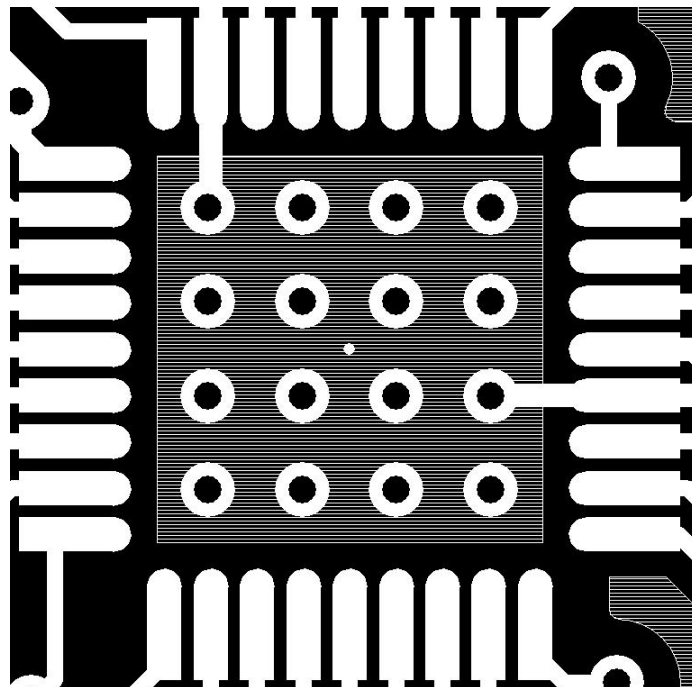


Figure 9. Ground Pad Recommended Layout

Table 13. 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.

Solder Mask Design

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

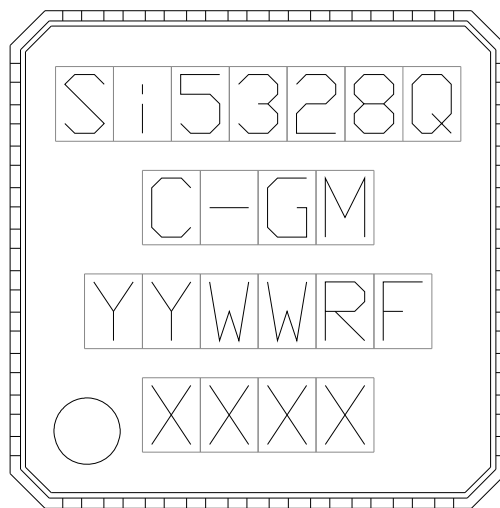
Stencil Design

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

Card Assembly

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

11. Si5328 Device Top Mark



| | | |
|------------------------|----------------------------|---|
| Mark Method: | Laser | |
| Font Size: | 0.80 mm Right-Justified | |
| Line 1 Marking: | Si5328Q | Customer Part Number Q = Speed Code: C See "8.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 0.9 to Revision 1.0

- Removed Vdd of 1.8 V.
- Updated lock and settling time specs.
- Added B speed grade with 808 MHz output frequency.

NOTES:

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